Department of Fisheries and Oceans Salmon Enhancement Program

Seymour River Salmon Hatchery

Fish Health Management Plan

Prepared by:
Paige Ackerman, Brian Smith, James Weger,
Christine MacWilliams and Don MacKinlay

June 11, 2007

1 Introduction 6
1.1 Objective 6
1.2 Target Audience 7
1.3 Document Structure 7
1.4 Annual Review of Living Document 7
1.5 Fish Health Management Team: Personnel duties and responsibilities 7
1.5.1 Hatchery Manager 7
1.5.2 Fish Culture Staff 8
1.5.3 Support Biologists/Community Advisors 8
1.5.4 Veterinarian 8
1.5.5 Contact names and numbers 8
2 General Principles of Fish Health Management 9
2.1 Keeping Fish Healthy 9
2.1.1 Maintaining an Optimum Environment 9
2.1.2 Feed and Nutrition 10
2.1.3 Common Fish Culture Procedures 10
2.2 Keeping Pathogens Out 11
2.2.1 Site Physical Barriers 12
2.2.2 Personnel Movement 12
2.2.3 Visitors 12
2.2.4 Predator Exclusion 12
2.2.5 Suppliers 12
2.2.6 Equipment Movement 12
2.2.7 Equipment Maintenance 12
2.2.8 Moving Fish Between Sites 13
2.2.9 Broodstock Management 13
2.3 Keeping disease from spreading 13
2.3.1 Separation of Fish Groups 13
2.3.2 Minimizing Disease Within the Site 13
2.3.3 Monitoring Fish Health 14
2.3.4 Fish Health Emergencies 15
2.3.5 Handling Drugs and Chemicals Properly 17
2.4 Keeping Good Records 18
2.4.1 Fish Health Records 18
2.4.2 Reporting to BC Fish Health Database 18
2.4.3 Egg Take Records 18
2.5 Impacts on Non-Enhanced Stocks 19
2.5.1 Fish Escape 19
2.5.2 Releases 19
3 A Brief Overview of this Facility 20
4 Standard Operating Procedures for the Seymour River Hatchery 21
Broodstock 22
4.1 Broodstock Selection 23
4.2 Broodstock Collection & Handling 25
4.2.1 Steelhead collection and holding 25
4.2.2 Collection and holding of pink, coho, chum and Chinook salmon 25
4.2.3 Ripeness Checks 26
4.2.4 Handling at Spawning 26
4.3 Broodstock Biosecurity 27
4.4 Adult Carcass Disposal 28

4.5 Gamete Collection (Egg Take and Milt Collection) 29
4.5.1 Coho, Chinook, pink, & chum 29
4.5.2 Air Spawning of Adult Steelhead 30
4.6 Egg and Milt Transport 33
Incubation 35
4.7 Egg Disinfection 36
4.7.1 Heath Trays: 36
4.7.2 Pallant incubators (bulk incubators)(chum and pink) 37
4.8 Egg Fungal Treatments 38
4.9 Egg Shocking & Egg Picking 39
4.9.1 Egg Shocking: 40
4.9.2 Egg Picking: 40
4.9.3 Live Egg Enumeration: 40
4.9.4 Dead Egg Enumeration: 41
4.9.5 Post picking 41
4.10 Ponding 42
4.10.1 Ponding determination for Heath trays 42
Rearing 44
4.11 Feed, Feed Storage, & Feeding Practices 44
4.11.1 Feed Storage 44
4.11.2 Feed 44
4.11.3 Feeding Practices 44
4.12 Individual Length/Weight and Bulk Weight Sampling Protocols 47
4.12.1 Bulk Sampling: 48
4.12.2 Length/Weight sampling: 49
4.13 Fish Handling Procedures 51
4.13.1 Seining from the ponds 51
4.13.2 Marking 52
4.13.3 Injections 52
4.14 Marking Fish 53
4.14.1 Adipose Clipping 53
4.14.2 Coho mark and recapture program (escapement estimation) 54
4.15 Juveniles-Health Observations 55
Release 56
4.16 Pre-Release or Transfer Disease Risk Assessment 56
4.17 Transporting Fish 57
4.17.1 Prior to transport 57
4.17.2 During Transport 59
4.17.3 After transport 59
4.18 Juvenile Release 60
Mortalities and Responses 62
4.19 Mortality Collection and Disposal 62
4.20 Mortality Classification 64
4.21 Outbreak Response 65
4.21.1 Securing the Site 65
4.21.2 Assessment 65
4.21.3 Outbreak – Disinfection Protocols 66
4.22 Quarantine/Isolation Procedures 68
4.22.1 Securing the Site 68
4.22.2 Isolation of Infected Group 68
4.22.3 Mortality Removal 68
4.23 Juvenile Treatments 69
4.23.1 Chloramine-T 69
4.23.2 Parasite-S™ (Formalin) 70
4.24 Broodstock Treatments 72

4.24.1 Fungal infections 72
4.24.2 Bacterial infections 72
4.24.3 Spawning synchronization 72
4.24.4 Ovaprim™ 73
4.24.5 Erythromycin Injections 73
4.25 Top-Coating Medicated Feed 75
4.26 Medicated Feed: Storage, Handling, and Feeding 77
4.27 Diagnostic Sampling protocols 79
4.28 Sample Shipment to a Diagnostic Laboratory 80
4.28.1 Before shipping: 80
4.28.2 Selecting the samples: 81
4.28.3 Shipping live fish: 81
4.28.4 Shipping fresh dead fish: 81
4.28.5 Following Transport: 81
Chemicals & Disinfectants 83
4.29 Anaesthesia 83
4.29.1 Clove Oil 84
4.30 Euthanasia 87
4.31 Chemicals: Supplies and Storage 88
4.31.1 Compressed Gas Cylinders Storage 88
4.31.2 Parasite-S 89
4.31.3 Sodium chloride 89
4.31.4 Oxyvet (Oxytetracycline) 90
4.32 Disinfectant: Supplies and Storage 91
4.32.1 Parasite-S 91
4.32.2 Chloramine-T 92
4.32.3 Ovadine™ 92
4.32.4 Virkon 93
4.32.5 Purell hand sanitizer 93
4.32.6 Ethanol 93
4.33 Equipment disinfection 95
4.33.1 Between sites: 95
4.33.2 Within the site: 95
4.33.3 General Disinfectant Protocols: 95
4.33.4 Equipment Disinfection Protocol: 96
4.33.5 Tank Disinfection Protocol: 96
4.33.6 Foot Bath Disinfection Protocols: 96
4.33.7 Ovadine™ 97
4.33.8 Virkon™ 97
4.34 Vaccine handling, storage and administration. 98
4.34.1 Vaccine Storage: 98
4.34.2 Before Vaccination: 98
4.34.3 During Vaccination: 98
General Practices and Procedures 100
4.35 Predator exclusion 100
4.35.1 Infrastructure 100
4.35.2 Procedures 100
4.35.3 Contingency plan 100
4.36 Site and staff disinfection and biosecurity 102
4.36.1 Personnel Movements: 102
4.36.2 Visitors 102
4.36.3 Facility Maintenance: 103
4.36.4 Disinfectant protocols: 103
4.37 Supplier Procedures 104
4.38 Visitor Protocols 105
4.39 Water quality contingency plan 106
4.40 Water quality monitoring 108

4.40.1 Temperature 108
4.40.2 Dissolved oxygen 108
4.40.3 Other Parameters 108

5 Appendices 110

5.1 BKD sampling procedure (revised 2006) 111
5.2 Sample submission form 113
5.3 Ovadine™ Emergency Drug Release (EDR) – Hatchery Reporting Requirements 114
5.4 Ovadine™ Six Month Usage Record 115
5.5 Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment 116

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).

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.

With the NAAHP requirements in place, this Fish Health Management Plan provides best management practice guidelines for maintaining optimal health conditions for cultured fish. 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.

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 spawning populations.

Section 3 provides a brief overview of this 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 will be included in the Section 4 SOPs where appropriate. Where indicated, Appendixes will be included containing ancillary documents pertinent to the operation of the specific facility.

1.4 Annual Review of Living Document

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

1.5 Fish Health Management Team: Personnel duties and responsibilities

1.5.1 Hatchery Manager

The hatchery manager is responsible for identifying and managing disease-related risk factors to minimize their impacts on fish health. The hatchery manager consults 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.

1.5.2 Fish Culture Staff

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

1.5.3 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.

1.5.4 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.

1.5.5 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.

EMERGENCY PHONE NUMBERS

Emergency Police, Fire Department and Ambulance	911
Non Emergency Police (North Vancouver R.C.M.P.)	604-985-1311
Non Emergency Fire (District of North Van. Fire Dept.)	604-980-7575
Ambulance Service	604-872-5151
G.V.R.D. Lake City	604-444-8401
Rice Lake Security Gate	604-987-5354

HATCHERY STAFF PHONE NUMBERS

Brian Smith	604-466-4493 (Home) 604-761-5335 (Cell)
Marc Guimond	604-733-9278 (Home)
James Weger	604-931-8440 (Home)

D.F.O. CONTACT PHONE NUMBERS

D.F.O. Community Advisor (Sandie Hollick-Kenyon)	604-666-0743 (Office) 604-290-3156 (Cell) 604-984-2527 (Home)
Fisheries Officer (Ann Bussell)	604-644-9288 (Office) 604-880-3889 (Cell)
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

If a water flow related emergency occurs call G.V.R.D. Lake City 604-444-8401 and the Rice Lake operations office 604-990-0483 and inform them of the problem. They will contact the G.V.R.D. representatives that will most likely be able to help. The hatchery manager should then be contacted.

Should a fish related emergency occur (dead and or dying fish) the hatchery manager should be notified followed by anyone you feel may be able to help solve the problem (Community Advisor 604-290-3156, G.V.R.D. 604-444-8401 or 604-990-0483, Fisheries Officer 604-644-9288, Pacific Biological Station 1-250-756-7057). Remember; never put your personal safety in jeopardy.

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 behaviour. Observations which may indicate a problem with the population include (but are not limited to):

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

Fish will 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 will be reported to site management. 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 maintains 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. 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 maintains a contingency plan in the event of acute deterioration of water quality. Failure of pumps and/or oxygen delivery is an emergency, requiring an immediate response. Systems are suitably alarmed to indicate changes in water quality below predetermined set points; i.e., precipitous fall in

dissolved oxygen levels or flow. The site has backup system(s) for keeping dissolved oxygen levels compatible with short-term life support for the fish while the system failure is being addressed.

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 is stored in secure buildings, wildlife is excluded and spillage is prevented.

SOP: Feed, Feeding & Feed Storage

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 will be done in as stress-free a manner as possible. Exposure to anaesthetic will be minimized while ensuring the anaesthetic level is adequate for the procedure. Anaesthetized fish will be carefully monitored at all times and the water quality of the anaesthetic bath – in particular, oxygen level – must 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 will be reviewed annually during this facility's production planning meetings. Marking will 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 will be handled in as stress-free a manner as possible in preparation for transport. Equipment will 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 will 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 will be handled in as stress-free a manner as possible.

SOP: Vaccine Handling, Storage and Administration

2.1.3.5 Euthanasia

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

SOP: Euthanasia

2.1.3.6 Gamete Collection (Egg Take and Milt Collection)

At the Veterinarian's discretion, broodstock may be treated preventatively for specific infectious diseases prior to maturation to reduce the risk of vertical transmission of disease. Egg take and milt collection will be performed in as hygienic a manner as possible to prevent transmission of diseases to other broodstock and/or progeny. Adult fish will be anaesthetized and surface disinfected prior to gamete harvest and spawned adults will be euthanized as humanely as practicable. Carcasses are disposed of in a manner to prevent spread of disease. Males, if used multiple times, will 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 water hardening. This is done at the Broodstock facility and/or when the eggs enter the hatchery.

SOP: Egg Disinfection

2.1.3.8 Egg Treatments

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

SOP's: Egg Shocking & Egg Picking
Egg Disinfection

2.1.3.9 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.

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: Visitor protocols

2.2.4 Predator Exclusion

Predators will 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 will 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: Supplier Procedures

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 will be subject to strict biosecurity and disinfection measures between uses as per 2.2.5.

2.2.7 Equipment Maintenance

To reduce the possible spread of pathogens by fish, personnel or via a waterborne route, equipment will be kept clean at all times. Equipment will 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 will be performed in conjunction with the Fish Health Management Team prior to moving fish and necessary transfer permits will be obtained. Clinically ill fish will not be moved between sites. The move will be planned in advance to be as stress-free and short as possible. Fish will be transported as per 2.1.3.3 Particular care will be paid to the fish during transportation to avoid undue stress or possibility of escape. Water quality will be maintained and frequently monitored during transport. All attempts will be made to minimize the amount of transport water delivered to the receiving site to reduce the risk of waterborne pathogen introduction.

The receiving sites will make arrangements for isolating the newly arriving fish. Once on site, measures will 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

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 will 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 Biosecurity*
Broodstock Selection
Broodstock Handling
Broodstock Treatments
Adult Carcass Disposal

2.3 Keeping disease from spreading

2.3.1 Separation of Fish Groups

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

2.3.2 Minimizing Disease Within the Site

All efforts will 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 will be monitored at least once daily for any unusual behaviour, visible lesions or other sign of disease. Changes in behaviour and physical condition will 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*
Length/Weight Sampling Protocol

2.3.3.1 Mortality Classification

Mortalities will 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 will be notified of any unusual numbers or types of mortalities.

SOP: *Mortality Classification*

2.3.3.2 Mortality Collection and Disposal

Mortalities will 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 will be an appropriate distance away from any rearing units and outside usual travel corridors to minimize inadvertent spread of disease. Proper disinfection procedures will 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 will 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 will be inventoried separately from regular feed. Daily inventory records will 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 will be contacted to determine proper handling and disposal.

SOP: *Medicated Feed Storage and Handling*

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 will 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 will be entered into and a hard copy will 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 will 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 will 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 will 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 will 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 Protocols 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

If site depopulation has been agreed upon, the procedure will 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: *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: 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. Backups will be maintained.

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

Records will 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 will be available for inspection upon request by BC MAFF.

Records will 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 will 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, will be made available to the appropriate regulatory authorities as required.

2.5.2 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. The health and treatment status of fish is considered when planning intentional fish releases. Fish shall not be released until risk assessment recommendations are in place.

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

3 A Brief Overview of this Facility

The Seymour River Hatchery was first built in 1977 as a small salmonid enhancement facility. Between 1977 and 1987, The British Columbia Institute of Technology was contracted by the Federal government to develop and operate the hatchery, where students could gain practical field experience in fish culture activities. The facility is situated in the Lower Seymour Conservation Reserve in North Vancouver B.C. and plays a vital role in sustaining fish stocks and creating fish habitat which have both been in decline since the construction of the Seymour Falls Dam. The construction of the Seymour River dam removed 32 kilometres of fish habitat; a loss of habitat representing approximately 60% of the river and 90% of the original spawning grounds. In 1987, the lower Seymour River watershed was opened to the public and the operation of the hatchery was taken over by a community-based group known as the Seymour Salmonid Society which now, in addition to operating the Seymour River Hatchery, also runs an educational program.

Because of the extreme habitat loss the Seymour Salmonid Society is creating as much new habitat as possible by way of spawning channels and wintering water.

The Seymour River Hatchery employs only three permanent staff and therefore relies heavily on volunteer assistance to carry out its day to day procedures. With the help of Fisheries and Oceans Canada the Seymour River Hatchery has developed a primarily elementary school education program which blends hands-on experience with class room research to teach students about stream ecology, fish and fish habitat.

The Seymour Hatchery is supported in part by the Department of Fisheries and Oceans Canada, (Community Economic Development Program) and the Greater Vancouver Regional District.

Employee Handbook (double click icon to access)

Employee Handbook 2007 (draft)

Habitat and Enhancement: Facts and Figures, Third Edition, 2001 (double click icon to access)

Facts & Figures

4 Standard Operating Procedures for the Seymour River 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 as needed 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

Broodstock represent an important and sensitive life stage. Fish are channelling 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.

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: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

Adult collection numbers are based on the annual contract between DFO and the Seymour Salmonid Society. The number of broodstock required is determined according to the contract such that the run is represented each day. The daily number of fish required will reflect the annual contract. This currently excludes cutthroat trout and steelhead as these are regulated by the Province.

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

- Jacks are currently not utilized as broodstock at the Seymour River Hatchery (2007)
- Fish that are deformed, heavily covered with fungus, moribund, haemorrhaging, bleeding from the gills, displaying open sores or lesions, or have been wounded due to angling or predation are not taken for brood.
- Only wild coho are collected. Any clipped fish are sorted and returned to the river. Clips may include adipose, maxillary and ventral fin.
- Chinook are only collected from the Seymour River on an opportunistic basis and are not actively sought.
- Over a five year period, 50% of the collected and spawned steelhead may be of hatchery origin.

Choice of broodstock reflects the current DFO contract and reflects early, mid and late runs to ensure equal representation of all runs. All attempts will be made to ensure the selected broodstock population contains individuals collected across the time course (early, middle and late) of the run.

- Coho broodstock are divided into three runs, early, mid and late.
- Steelhead are divided into summer and winter runs.
- There is no division in timing of any other species.

All salmon broodstock collection and allocation is performed by river seining or by adult trapping. However, some steelhead are angled by designated broodstock anglers and transported to the hatchery. These fish serve as steelhead broodstock. All transportation of steelhead is performed by staff only.

Gametes from pink and chum salmon are collected from the Indian River and the Chilliwack River. No adult broodfish of these species are transported to this site, only gametes are transported. At the current time (2007), 100% of the chum eggs collected are from the Indian River, 40% of the pink eggs are from the Indian River and 60% of the pink eggs are from the Chilliwack River. The Indian River proportion of pink salmon is anticipated to be dramatically reduced in future years based on a superior apparent fitness of the Chilliwack River stock and the anticipated potential for better returns up the Seymour River.

Fish that are selected as broodstock are moved from location of capture to the hatchery holding facilities via an ATV and transport trailer.

DNA and scale samples are collected when requested by Provincial Authorities. DNA samples are acquired via a tissue punch from the caudal fin at the time of broodstock selection.

Forms & Records:

Broodstock records are kept in annual binders in the office and on computer file
Species specific daily broodstock collection forms (includes collection, location of capture, location of holding)
Stud records
Annual reports based on daily records


Capture Record


Coho Broodstock Form


Release and Carcass Records

References:

Salmonid Enhancement: Facts and Figures (PIP manual)
Community Advisor (Currently Sandie Hollick-Kenyon) is available for consultation
Fish Facts Binder – Research Papers, Journal Articles, Etc. (materials supplied by the Ministry of Environment and DFO and located in the office)

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.2 Broodstock Collection & 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. The goal of this SOP is to ensure that fish are handled with care and subjected to minimal stress and it addresses section 2.2.9 of the General Principles of Fish Health Management.

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

Authority: Site management is responsible for the information contained in the SOP and fish culturists are responsible for ensuring that the SOP is carried out properly.

Details of the Operating Procedure:

When possible do not collect broodstock alone. The G.V.R.D. radio should be carried at all times when collecting broodstock. Remember to set a check in time with either the hatchery or Rice Lake security gate.

4.2.1 Steelhead collection and holding

Adult steelhead are captured by volunteer anglers. Site staff transport them back to the hatchery site. As soon as steelhead are brought to the facility they are tagged with a kurl-lock tag for identification. On release, all tags are removed.

4.2.2 Collection and holding of pink, coho, chum and Chinook salmon

Pink, coho, chum and Chinook are captured by seine net or through the use of fish traps.

- Traps are checked on a daily basis. Outside of regular collection season, the fence is dismantled and the trap is left in an open position.

Fish are crowded in the seine nets during collection to make dip netting easier. The duration of crowding and the density will be kept to the minimum amount of time possible. Nets used for crowding and netting will be knotless and every attempt will be made to ensure the volume of fish in the net will be such that fish on the bottom of the load are not being crushed.

Adult fish are dip netted out of the seine net or the trap and assessed for suitability (See Broodstock Selection SOP). Any fish that are not suitable for broodstock (other than coho) are released unmarked. Coho that are not selected for broodstock are marked by opercular punch and released for the mark recapture program.

Fish that are selected for the broodstock program are placed into a floating holding pen. When seining is complete and the fish have been sorted, fish in the pen are transferred to the transport tank on the ATV trailer for transport to the holding enclosures at the main facility.

Fish are netted out of the transport tank, sorted by sex, and placed into the appropriate holding container. Fish are not anaesthetized for sorting.

- Coho and Chinook are held in raceways.
- Steelhead are maintained in dedicated adult earthen holding ponds.
- Four holding pens are also maintained in Hurry Creek for use if required. These are strictly used for coho broodstock.

Fish are handled without the use of gloves at any point other than at terminal spawning.

4.2.3 Ripeness Checks

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

Fish are handled with care to minimize scale and mucus loss and are not held solely by the tail if expected to survive post-handling.

4.2.3.1 Steelhead

Adult steelhead are crowded using a seine net and checked for ripeness on a weekly to biweekly basis. Fish are dipnetted from the seine net and passed up to a full time staff member for ripeness check (see above for ripeness check)

If fish are ripe, they are separated and placed into individual holding compartments (fish condos) to await live air spawning.

4.2.3.2 All other species

Coho and Chinook are dipnetted from raceways and checked for ripeness (see above) on a weekly to biweekly basis without the use of anaesthetics.

If fish are being held in the Hurry Creek holding pens, they will be checked for ripeness on a weekly or biweekly basis. If deemed ready for spawning they are placed into a plastic transport garbage pail with water and transported to the main hatchery where they are placed into the fish condos until spawning commences.

4.2.4 Handling at Spawning

For all species other than steelhead, once all spawning equipment is prepared, fish are netted from the condos and are killed by a blow to the head.

Only steelhead are anaesthetized for spawning. These fish are transferred into an anaesthetic bath (see Anaesthesia SOP) and monitored until they are ready to be handled. The anaesthetic bath may contain mucus protectants (e.g. Vidalife™), if available, to protect the fish cuticle from subsequent opportunistic infection.

After anaesthesia and all handling events, steelhead are monitored closely for signs of injury, morbidity and mortality.

Forms & Records:


Capture Record


Coho Broodstock Form


Release and Carcass Records

References:
Fish Handling SOP
Broodstock Treatment SOP
Anaesthesia SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.3 Broodstock Biosecurity

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

Definitions:
Broodstock: a male or female breeding animal

Authority: Site management is responsible for information contained in the SOP. Site staff is responsible for ensuring that the SOP is carried out properly.

Details of the Operating Procedure:

Broodstock are maintained in a separate holding area from other fish (i.e. juveniles).

Enclosures used for broodstock are cleaned between uses to ensure pathogen transfer potential is minimized. Earthen ponds are drained and baked by sunlight (for a minimum of one month) and when dry are either raked or power washed. Raceways used for broodstock are pressure washed, scrubbed and disinfected with bleach, Virkon, or other suitable disinfectant, prior to being used for other life stages.

Spray bottles of Virkon are available for surface disinfection of hands and rain gear.

Purell hand stations are located outside of the incubation room and in the rearing shed. A disinfectant foot mat is located at the entrance to the incubation room.

Staff must adhere closely to site and staff biosecurity procedures (see staff and site biosecurity procedures SOP).

Forms & Records:
Inventory and location records
Daily mortality records
Daily fish movement data sheets

References:
Staff and Site Biosecurity Procedures SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.4 Adult Carcass Disposal

Rationale: Carcasses are 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: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

Carcasses at this facility are 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 and is not suitable for all facilities

Because of drug clearance times, and the length of holding, fish previously treated with any chemical anaesthetic (e.g. 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) are considered safe for placement. If in doubt, contact the Fish Pathology Program at PBS.

Forms & Records:
Records of numbers and species of carcasses placed in streams are kept as per the collection records


Release and Carcass Records

References:
DFO Carcass Placement Guidelines

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.5 Gamete Collection (Egg Take and Milt Collection)

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

Authority: Fish health management and the Veterinarian are responsible for information contained in this SOP. All fish culturists taking part in egg takes are responsible for ensuring that it is carried out properly.

Details of the Operating Procedure:

Prior to gamete collection

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

Equipment List

- ☐ Fish bonker
- ☐ Nets
- ☐ Paper towels
- ☐ Basins and/or spawning buckets
- ☐ Spawning knives
- ☐ Cooler (if required)
- ☐ Field tent (if required)
- ☐ Bleeding tubes
- ☐ J-cloths
- ☐ Milt bags (Whirl-paks)
- ☐ Wool glove
- ☐ Ovadine bath
- ☐ Ice or ice packs (if required)

All necessary transport/transfer permits are in place.

4.5.1 Coho, Chinook, pink, & chum

4.5.1.1 Female fish:

1. Euthanize ripe females by a sharp blow to the head.
2. Cut the gill arches and place the fish head first into a bleeding tube to bleed for 5 – 10 minutes.
3. Handle the fish in an inverted position until it is ready to be incised for egg removal.
4. The person holding the fish will use a wool glove to ensure an adequate grip and avoid dropping fish and potentially damaging eggs.
5. After bleeding, remove the fish from the bleeding tube and wipe the ventral surface with paper towel to minimize blood, water or mucus dropping into the eggs.
6. Insert a clean paper towel into the opercular cavity to keep any blood from contaminating the gametes when they are stripped.
7. Disinfect the spawning knife with Ovadine between each female (see Equipment Disinfection SOP).
8. The person holding the fish turns the fish into a head up position and the person cutting the fish cuts from the vent towards the head, cutting to the side of the pelvic girdle.
9. Collect the eggs from each female into individual, clean, disinfected and dried basins.
10. Any eggs with abnormal appearance, cloudy ovarian fluid or from a female with obvious signs of disease should be immediately discarded.

11. Once eggs have been checked for suitability, eggs from several females may be combined into larger buckets (these buckets are dedicated and labeled for spawning purposes only. Buckets are replaced annually).
12. Place eggs into a cool environment (e.g. on gel packs covered with paper towel or newspaper) until fertilization or transport. The eggs should not sit directly on the ice or gel packs, a thick layer of newspaper should be placed in between. Buckets of eggs may be placed into shallow stream water to keep them cool until ready for transport back to the facility.
13. The person responsible for stripping the eggs from the female washes his/her hands and cleans the spawning knife prior to handling another female.

4.5.1.2 Male Fish:

1. Male fish are netted from the fish condos and carried into the rearing shed for milt stripping. If working in the field (pink, chum) a field tent is erected for spawning purposes.
2. Wipe the ventral body wall with a clean paper towel to minimize water or mucus dripping into the milt being collected.
3. Collect milt from the male fish by cradling the fish, extending the tail while applying firm but gentle pressure on both sides of the body wall at the level of the testes. Collect milt into a sterile Whirl-pak™ bag.
4. Any milt with abnormal appearance, or containing blood or feces, should be discarded.
5. Following successful milt collection, kill the male fish by a blow to the head.
6. The surface area of milt exposed to oxygen should be maximized by ensuring that there is lots of air in the bag.
7. Place the bags of milt into a container onto ice packs that are covered with a thick layer newspaper or paper towel to maintain a cool temperature. Bags of gametes should never be placed directly on exposed ice or ice packs.

Adult carcasses are disposed of as outlined in the Adult Carcass Disposal SOP

4.5.2 Air Spawning of Adult Steelhead

Note: Ripeness checks are performed without the use of anaesthetics

Equipment:

- ☐ 2-3 people (preferably 3)
- ☐ Paper towels
- ☐ Forceps
- ☐ Regulator
- ☐ Oxygen cylinder
- ☐ 18 gauge needle
- ☐ J-cloths
- ☐ Milt bags (Whirl-paks)
- ☐ Hole punch and scissors
- ☐ Scale booklet
- ☐ An umbrella during inclement weather
- ☐ Basins and/or spawning buckets
- ☐ River-water filled "recovery" containers, (garbage buckets)

Procedure:

4.5.2.1 Air Spawning – Female Steelhead

1. When fish are ripe (see Broodstock Handling SOP), move them from the holding pond to the fish condos.

2. Set-up the oxygen tank nearby, being careful to brace it and protect the main valve from all the spawning activity.
3. Attach to this tank a compressed gas regulator, oxygen flow meter and 4 feet of tygon tubing (1/4" ID).
4. At the other end of the tygon tubing insert a needle attachment and then a G18 one inch long needle.
5. Anaesthetize fish using clove oil (see Anaesthesia SOP). Steelhead generally succumb to anaesthesia in 5 minutes, and will turn onto their side.
6. For the safety of the fish and the staff, the fish should be under full anaesthesia prior to the needle being inserted.
7. Dry off the fish as well as possible (using a disposable shop towel) to prevent any possibility of water being added to the unfertilized eggs.
8. One person holds the fish with the head up and the vent down over a disinfected, clean, dry basin
9. Another person inserts the needle into the fish at the base of the pelvic fins. The needle is placed straight in and then angled towards the tail region where the chance of hitting any organs is minimal.
10. Turn on the oxygen by opening the main valve, and adjusting the flow meter to approximately 1-1.5 L/min flow

    It is very important that the needle NOT be inserted into the tissue. and that the oxygen flow is turned off while the needle is being inserted.

    NOTE: It is also important that the needle tip is inserted under scales and not through them. While this doesn't appear to be as much of a problem for Steelhead, punctured scales have resulted in higher mortalities after air spawning of Cutthroat.
11. The eggs should start to slide out. In addition to the air, they may need a gentle, but firm and steady pressure on the main part of the belly to help eject them.
12. When approximately 50% of the eggs are assumed to have been ejected, turn off the oxygen and remove the needle
13. Continue manual stripping to remove as many eggs as possible without damaging the fish
14. Transfer fish to recovery container and gently stroke out remaining air. Hold the fish head down in the recovery tank as this forces any trapped air to the vent area where it is most easily expelled.
15. Remove the kurl-lock tag
16. Return spawned steelhead to condos for recuperation and release at the end of the day or early the following day. Fish are usually released at the hatchery pool on the Seymour River. On occasion, kelted fish may be released at spur 4 or Twin bridges
17. Rinse the needle in alcohol (95% ethanol or isopropyl alcohol) between uses to avoid introducing any potential pathogens between adult fish.

4.5.2.2 Spawning – Male Steelhead

1. Males are anaesthetized with clove oil (see Anaesthesia SOP) for the spawning process
2. When suitably anaesthetized, gently remove fish from the anaesthetic bath
3. Wipe down the ventral body wall with a disposable shop towel to minimize water or mucus dripping into the milt being collected.
4. Collect 1-5 ml of milt from each male if possible. Milt is expressed into a sterile Whirl-pak™ bag.
5. Milt is collected from the male fish by cradling the fish, extending the tail while applying firm but gentle pressure on both sides of the body wall at the level of the testes.

6. Any milt with abnormal appearance, or containing blood or feces, may be discarded.
7. The bags of milt are kept at a cool temperature
8. Record kurl-lock tag numbers in the stud records and remove after final stripping
9. If males have been used for milt once, return them to the adult holding ponds. If they have been used twice, place them into the fish condos for recuperation and release them to the river either late in the day or the next morning.

4.5.2.3 Fertilization

Assuming an equal proportion of males to females, an equal number of males and females will be killed and spawnings will be on a 1:1 basis.

1. Eggs and milt are taken into the incubation room.
2. One males milt is added to one female bucket
3. The eggs and milt are mixed gently by hand
4. 2L of water will be added to the bucket and the mixture will be stirred by hand
5. Allow to sit for one minute
6. After one minute additional water is added and the water is decanted to wash the eggs.
7. Repeat step 6 until the water is completely clear and all broken eggs and blood and any other contaminants are removed.
8. Excess water is removed by placing a screen over the top of the bucket and inverting it.
9. Eggs destined for the recirculation system will be disinfected directly in the fertilization buckets, those destined for incubation in the flow through stacks will be disinfected in the stacks directly in the Heath trays. See Egg Disinfection SOP.

Forms & Records:

Stud records

Egg Take Summary Sheet

References:

Disinfection SOP
Broodstock Handling SOP
Anaesthesia SOP
Egg and Milt Transport SOP
Sampling Protocols SOP
Adult Carcass Disposal SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.6 Egg and Milt Transport

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

Definitions:
ITC: Introduction and Transfers Committee – an intergovernmental committee that regulates the movement of live aquatic animals throughout British Columbia
Gametes: Male or female reproductive cells - the sperm or the egg.

Authority: Fish Health Management is responsible for the information contained in this SOP. Staff transporting eggs and milt is responsible for ensuring that the SOP will be carried out.

Details of the Operating Procedure:

Chum, pink and coho eggs are transported both onto and off of the facility.

- Chum and pink are collected offsite and transported to the site.
- Coho and chum eggs may be transported offsite for educational purposes for the Salmonids in the Classroom Program.

Milt is only transferred offsite if requested by Fisheries Officials. Pink and chum milt is transported onto this site from offsite locations.

All necessary transfer permits must be place at the time of gamete transport and the appropriate paperwork is to be carried with the shipment during transit. If eyed eggs are being transferred under ITC permit to complete incubation at a new site, the eggs and transport water will 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)

Eggs are contained in clean egg buckets which are dedicated to spawning purposes only. The buckets containing the gametes are disinfected prior to use and are handled in a hygienic manner.

Milt is contained in sterile Whirl-pak™ bags. Air space is maximised in the Whirl-pak™ bags: the amount of air 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 air.

Gametes are placed into insulated containers and their temperature is maintained as close to the originating temperature as possible. The containers must be clean, labeled and have secure lids.

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

References:
Egg Disinfection SOP
Gamete Collection SOP
Equipment Disinfection SOP
Federal-Provincial Introductions and Transfers Committee web page

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

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.

4.7 Egg Disinfection

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

Definitions:
Ovadine™: a buffered, iodine-based disinfectant that is safe for the disinfection of eggs.

Authority: Fish health staff and the Veterinarian are responsible for the information contained in this SOP. All fish culturists that perform surface disinfection of eggs are responsible for carrying out this SOP.

General Principles:

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

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

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

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

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

Details of the Operating Procedure:

4.7.1 Heath Trays:

An average heath stack tray will hold 7 – 10 litres of Ovadine™ solution; the actual volume will be predetermined before starting.

1. Eggs are dry fertilized. (See Gamete Collection and Fertilization SOP)

2. Water is added to the egg/milt mixture to cover the eggs (approximately 1 L) and activate the sperm.

3. After 1-3 minutes, the water is then drained out of the egg containers and the eggs are either gently transferred to a heath tray preloaded with 100 ppm Ovadine™ solution, and let sit without disturbance or transferred to a second basin and disinfected with a premeasured volume of Ovadine to achieve a 100 ppm solution.

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

5. After 10 minutes, the flow is restored or the tray is gently pushed all the way back in the stack to start fresh water flowing over the eggs, or the eggs are transferred into a heath tray which is pushed all the way into the stack to ensure water flow.

6. Fresh disinfectant solution is used for each batch of eggs.

7. Ovadine solutions are disposed of to ground

4.7.2 Pallant incubators (bulk incubators)(chum and pink)

1. Eggs are dry fertilized. (See Gamete Collection and Fertilization SOP)

2. Water is added to the egg/milt mixture to cover (approximately 1 L) to activate the sperm.

3. After 1-3 minutes, the water is then drained out of the egg containers and the eggs transferred to a Heath tray basket in a tray containing Ovadine solution (100ppm) and let sit for 10 minutes.

4. Eggs are then drained and placed into the bulk incubator.

5. Ovadine solutions are disposed of to ground

Forms & Records:
Ovadine™ Usage Form

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.8 Egg Fungal Treatments

Rationale: Dead eggs serve as growth media for saprophytic fungal infections. Once a fungal infection has started, it rapidly spreads to adjacent eggs and can result in poor survival to hatch. Egg disinfection and picking (see Egg Disinfection SOP and Egg Shocking & Picking SOP) 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.

Definitions:

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

Authority: Fish health staff and the Veterinarian are responsible for the information contained in this SOP. All fish culturists that perform fungal treatments of eggs are responsible for carrying out this SOP.

General Principles:

A site-specific fungal treatment program will vary according to historical egg fungus infection rates and egg survival data.

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

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

Details of the Operating Procedure:

Egg fungal treatments using Parasite-S are new to this facility (as of 2007) and are only performed in the Heath tray stacks.

1. Newly incubated eggs are normally run at a water flow rate of 11 L/min. When using Parasite-S the water flow is reduced to 8 L/min
2. Parasite-S is purchased from Syndel in a 200L barrel that is kept in the incubation room. A pump is inserted into the top of the barrel for dispensing volumes into 1L IV bags.
3. Parasite–S is delivered at a concentration of 167 ppm over a 15 minute period every other day.
4. At 8 L/min, 200 L will flow through the stack in 15 minutes.
5. The flow rate of Parasite-S from the IV bag into the stack is 13.33 ml/min. The flow for each IV bag has been measured and set with the stopcock.
6. After delivery of Parasite-S, flow is turned back up to 11 L/min

Forms & Records:

Use records are kept in an Excel spreadsheet

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.9 Egg Shocking & Egg Picking

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.

Definitions:

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

Authority: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it 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 should only be attempted if mortalities are very high. Extra care is 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 SOP).

Details of the Operating Procedure:

Incubation trays are started at a flow rate of 11 L/min. Once all the trays in the stack have reached the eyed stage, switch the flow back to 17L/min

Eggs will not be picked or handled until they have reached the eyed stage (see ATU guide for approximation of when eggs will reach this stage)

ATU Approximations	Eyed	Biorings	First Hatch	Pond
Coho	~180-220	~350-400	~450-480	~680-740
Chum	~280-360	~325	~400	~850
Chinook	~240-270	~450	~490-525	~870
Pink	~300	~425	~500+	~900
Steelhead	~205-220	~290	~320-340	~585-655
Cutthroat	~230	~300	~330	~555

When the appropriate developmental ATU (as per the guide above) has been reached for the species in question eggs will be checked for development.

If the eyes are easily seen in the eggs they may be shocked

4.9.1 Egg Shocking:

1. Carefully pour the eggs from the Heath tray into a basin
2. Fill a second basin with water (to a sufficient depth so that when the eggs are shocked they are not hitting the bottom of the basin – approximately ¾ full)
3. Lift the basin containing the eggs to approximately knee height and pour the eggs into the second basin containing water
4. Clean the Heath tray to remove any debris, egg shells etc
5. Pour the eggs back into the tray
6. Place the tray back into the appropriate slot in the Heath stack and push it all the way in such that water is flowing through it
7. Leave the eggs to rest for 24 hours prior to picking

4.9.2 Egg Picking:

Eggs may be picked by hand or aided by the use of an automatic egg picker. If a small number of eggs (<500) are to be picked, pick by hand using modified tweezers. If greater than 500 eggs are to be picked, use the egg picker

4.9.2.1 Use of the Automatic Egg Picker

1. Select the appropriate sized wheel for the Jensorter according to the size of the eggs
2. Ensure the water that is ejecting the live eggs is of a pressure that is not too high when ejecting. It is undesirable to have them hit the sidewall of the ejecter ramp as this will further shock them
3. Put 1 – 2 trays of eggs into the hopper
4. Turn on the egg picker
5. Make sure that there is enough water in the live egg catch basin so that the eggs are not dropping into a dry basin
6. A dead egg sieve should also be in place
7. Monitor both exits to ensure selection of live and dead eggs is correct (i.e. that eggs going into the dead egg sieve are not actually live eggs) Fine tune effectiveness of the photo-eye so live and dead eggs are being differentiated properly.
8. Check the hopper occasionally to make sure all the eggs have gone through
9. After the eggs have been picked they should be enumerated

4.9.3 Live Egg Enumeration:

Because one to two trays are being picked simultaneously and there will be some egg size variation, random samples should be taken over the entire lot (multiple trays) to determine average eggs per gram.

1. Tare a sieve
2. Pour the eggs from the live basin into the sieve and drain it briefly to remove excess water
3. Place the drained sieve onto the scale and weigh the eggs
4. Place the eggs back into the Heath tray
5. Tare an egg counting paddle
6. Remove 100 eggs with the paddle and drain as much water as possible
7. Weigh the paddle and eggs on the scale and record this number
8. Return the eggs to the heath tray
9. Repeat steps 5-8 two more times
10. Calculate the number of eggs based on weight

4.9.4 Dead Egg Enumeration:

All dead eggs will be collected for the entire lot of picked eggs. The dead egg calculations will be based on the entire lot rather than a per tray basis.

11. Tare a small sieve
12. Pour dead eggs into this sieve and drain any excess water
13. Place the drained sieve on the scale and weigh the eggs
14. If there are few dead eggs, all the eggs may be counted manually
15. If there are >500 eggs, eggs are placed back into a basin of water to facilitate effective use of the counting paddle
16. Tare the counting paddle
17. Using the tared egg counting paddle, take a sample of 100 eggs
18. Weigh the paddle and eggs on the scale and record this number
19. Repeat steps 16-18 two more times
20. Calculate the number of dead eggs per gram weight

4.9.5 Post picking

Post picking begins roughly two days following initial picking and will be performed on a weekly basis. This is done using modified tweezers. If large clumps are present they may be removed by hand.

The previously calculated numbers of eggs per gram calculation from the initial enumeration will be used if there are relatively few eggs. If there are many eggs to be picked, eggs may be counted and weighed as above.

As the hatch is occurring, on a regular basis, egg shells will be removed using a small piece of vexar to avoid clogging the upper screen on the tray.

When the eggs have started to hatch, biorings will be added to the trays. Egg shells are removed first. Depending on species (ex chum and Chinook) biorings may not be added until almost complete hatch has been achieved. Egg shells from other species seem to dissolve faster and egg shell removal does not seem to be a major problem.

Biorings are added to slow the water flow and make it more indirect, to keep the alevin from swimming and overexerting, and to provide cover

Forms & Records:
Cumulative mortalities for each incubation container are recorded in the incubation binder in the office


Egg Picking Summary Sheet


Egg Incubation Record

References:

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.

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.10 Ponding

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

Authority: Site management and fish health management are responsible for the information contained in the SOP. Trained staff conducting the procedure is responsible for ensuring that it is carried out properly.

Details of the Operating Procedure:

4.10.1 Ponding determination for Heath trays

1. Determine the degree of buttoning
    a. At least 50% should be fully buttoned up (~0.5 mm yolk remaining).
    b. If there is approximately 1-1.5 mm yolk remaining before full buttoning up, wait a few more days
2. Once the majority of the fry have reached the emergent stage (as above), the fry will be moved to a Capilano trough
3. The Capilano troughs are started with aerated surface (reservoir) water at 125 L/min
4. Clean and scrub troughs well prior to ponding
5. Depending on the number of fry being ponded, a divider may be added to the trough.
    a. A minimum of 10,000 fry are needed to pond an entire trough without dividers.
6. Remove the Heath trays to be ponded from the stack, pour approximately half of the water off (keep the screen in place).
7. Carry the tray out to the rearing shed and place it in a convenient position beside the trough
8. The basket within the tray is lifted (with the screen in place) and placed directly into the water in the trough
9. Remove the screen from the basket and tip the tray to dump the fry gently out into the trough
10. The biorings will float and can be removed from the trough
11. If a trough is ponded in a divided fashion, first ponded fry are placed at the lower end of the trough.
    a. Newly ponded fry will be placed above older fry
12. If a very small number of fry are ready for ponding, they may be placed into a floating ponding bucket which is placed in the Capilano trough.
13. Once fry in the entire trough are feeding regularly and at least 10,000 have been ponded, remove the dividers
14. Clean the troughs on a daily basis
15. First feeding will usually be the day following ponding

Note: Chinook (if being reared) do not go to ponds. They are reared in the Cap troughs until they are released at ~5g

Forms & Records:
Daily record sheets

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

---

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

Rearing

4.11 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. This SOP addresses section 2.1.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that feed is stored in a manner that ensures its nutritional value is maintained.

Definitions:
CFIA – Canadian Food Inspection Agency

Authority: The site manager is responsible for information regarding this SOP. Site staff is required to ensure it is carried out properly.

Details of the Operating Procedure:

4.11.1 Feed Storage

Dry feeds should be stored at temperatures <20^{o}C and humidity <75%.

Feed is stored in a dedicated space in the back half of the workshop/feed room building next to the rearing shed. The building is secured such that wildlife is excluded and feed is kept protected from extremes of heat, light and humidity.

Windows and doors to the feed storage building are kept closed to exclude pests.

Feed for rearing ponds is measured out each morning, placed into sealed buckets and placed out for daily feeding. This ensures that feed is protected from humidity and light.

Feed in feeders is similarly protected and is replaced frequently with feed from storage.

4.11.2 Feed

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

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

Feed buckets are cleaned and put away after each use and are disinfected on a weekly basis.

Medicated feed, when in use, is clearly identified and used immediately. (See SOP for Medicated Feed Storage and Handling)

4.11.3 Feeding Practices

General Practices

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

Fish should be observed regularly during feeding to determine if they are responding as expected and if the volume of ration is sufficient or if overfeeding is occurring.

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

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

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

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

Practices at Seymour Hatchery

First feeding is usually the day following ponding. Small amounts will be fed approximately every 30 minutes over a period of eight to ten hours during the day and will be delivered by a combination of automatic feeders and hand feeding. Automatic feeders are filled once daily in the morning after the troughs have been cleaned. Automatic feeders are used for the duration of the time the fry are held in the rearing shed

- Fry are started on EWOS #0 micro-crumble. If fry are not starting to feed, freeze dried krill powder may be added to the #0 micro-crumble.

- Newly ponded fry will remain on the #0 micro-crumble for approximately one week. Then feed will be increased to #1 micro-crumble until they have reached 1.5g.

- Weights will be determined by weekly to biweekly bulk sampling (See Length Weight and Bulk Sampling SOP). Further feed size adjustments will be made according to bulk sample weights and manufacturers feed charts.

- When changing feed sizes, old and new feeds will be blended gradually over the course of a one to two week period. The starting will be 25% new, then 50%, 75% and finally to a 100% change to the new feed size.

- When fry reach 3-5 grams they are moved to the earthen rearing ponds

Feeding in the ponds (coho and steelhead)

Feed is measured into buckets with lids and distributed to each pond on a daily basis according to the growth model (see attached file below).

Feed is placed in out by each pond. Attempt to feed the entire volume out to each pond at a single feeding to ensure all fish have had an opportunity to feed. If not, feed may be fed out up to four to five times per day to deliver the entire daily ration.

Feed size and delivery schedules are determined by biweekly (steelhead) or monthly (coho) bulk sampling.

Forms & Records:

Feed Schedule Sheets

References:

SOP for medicated feed storage and handling

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.12 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. This monitoring allows optimum target release dates and sizes to be accurately met, in an attempt to mimic the natural life stages of juvenile wild salmonids. Juvenile growth as well as environmental conditions will determine the ration and rate at which the juveniles will be fed during a rearing program.

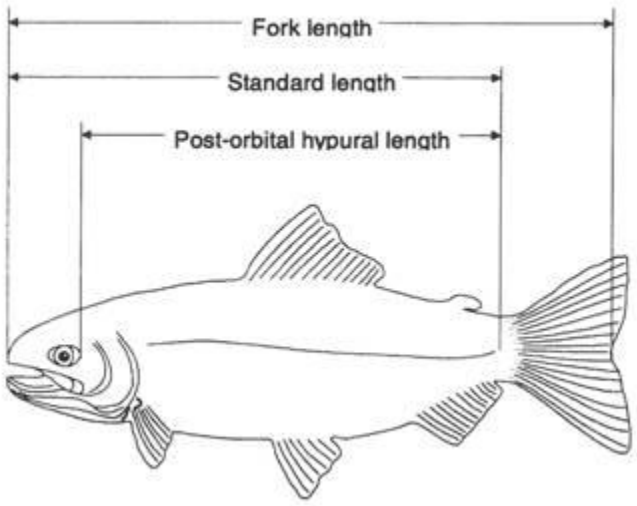
Definitions:

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

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

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

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.



Authority: Fish health staff and the Veterinarian are responsible for the information contained in this SOP. All fish culturists that will be performing fungal treatments of eggs are responsible for carrying out this SOP.

General Principles:

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

Anaesthesia and Fish Handling SOP guidelines will be followed.

Anaesthetic baths will 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 will be disposed of in accordance with local waste management regulations.

4.12.1 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.

If sampling from troughs, fish will be taken from the thickest group of fish rather than crowding them.

If sampling fish in the ponds, they will be crowded by seine net at the outflow of the rearing pond. Dipnet samples will 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.

Equipment list:

- □ Person to sample fish
- □ Large sample dipnet to remove fish from trough
- □ Smaller sub-sample net or sampling sieve for sampling basins
- □ Balance
- □ One 12 litre bucket
- □ sample basin (5L)
- □ Notepad with waterproof paper and pencil

4.12.1.1 Fry in rearing troughs

Husbandry records will be reviewed to ensure no sign of disease within the population to be sampled. Time held off-feed will be confirmed.

1. A sample of fry will be netted out of the area of thickest concentration of fish. The target is approximately 150 fish
2. The net of fish is drained of excess water for several seconds (approximately 5seconds)
3. These are placed in a tared bucket of water, approximately 5-6 L
4. The weight is recorded
5. Using a tallywhacker (a hand counter) fish are counted back into the trough
6. This procedure is repeated two more times
7. Average weight of the fish is then calculated

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

4.12.1.2 Bulk sampling from ponds:

1. Turn the flow in the ponds down to half the normal flow rate
2. Using a juvenile seine net, crowd the fish into the outflow region of the rearing pond
3. Place an 80 L garbage bucket on a digital scale and fill it with approximately 40 L of water
4. Tare the bucket
5. Take random dip net samples to total approximately 150 fish. Place these into the tared bucket
6. Record the weight
7. Net the fish out of the bucket and count (using a tallywhacker) them back into the rearing pond.
8. Repeat the above two more times
9. Average weight is calculated as above

Forms & Records:
Stressful events recorded in the husbandry records
Weights entered into the bulk sampling field book
Weights are then entered into the feed schedule for feed ration calculation

References:
Fish Handling Procedures SOP
Equipment Disinfection SOP

4.12.2 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.

Equipment list:

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

Details of the Operating Procedure:

Individual length weight sampling is only done prior to release. It may be done up to a week before release. Clip assessment and smolting assessment will be performed along with this procedure.

1. Crowd fish using a seine net (see above)
2. Dipnet out a sufficient number to ensure that at least 150 fish are placed into a large bucket and take the bucket to the rearing shed
3. Place a hose with running water into the bucket and deliver oxygen via an airstone
4. Monitored the oxygen levels using a DO meter
5. Set up a recovery bucket up next to the sample collection bucket and deliver water and oxygen to both buckets as needed
6. Fill two sampling basins to ¾ volume (~11 L)
7. Add clove oil to one basin (see Anaesthesia SOP)
8. Use the other basin as a semi recovery container to move fish to once they are anaesthetized and ready to be sampled
9. Place an airstone in the anaesthetic basin
10. Set up the digital scale with a moistened J-cloth on top
11. Tared the scale between each sample
12. Place the smolt board (length measuring) out in an easy to use location
13. One person will sample and one person will enter data into the computer
14. The sampler will monitor the welfare of the fish during the procedure
15. Net a small number of fish out of the large bucket and place them into the anaesthetic bath
16. Place the dipnet on the hooks in the basins
17. After 3-4 minutes the fish should be sufficiently anaesthetized for handling

18. One at a time, remove fish from the anaesthetic bath
19. Measure the length on the smolt board and call the data out to the data entry person
20. Place the fish on the scale call out the weight to the data entry person
21. Check the adipose fin for clip and assess the degree of clip (A=fully clipped, B= partial clip, C=no clip)
22. Perform a visual assessment of smoltification. Look for some scale loss, obscuring of the parr marks, examine the shape of the fish, should be long and slender looking, silver colouration.
23. Place fish into the recovery bucket
24. When 150 fish have been assessed, return the fish to the rearing pond
25. Clean and put away equipment

Forms & Records:

All measurements will be recorded in the computer and included in the annual report

Individual Weights Data Sheet

References:

Anaesthetic SOP
Fish Handling Procedures SOP
Equipment disinfection SOP
Growth prediction tables will be available for comparison

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.13 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: Site management is responsible for the information contained in the SOP and site staff is responsible for carrying it out.

General Principles:

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

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

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

The amount of time out of water should be minimized. Fish must be adequately supported when out of water and must not be handled solely by the tail if they are expected to survive as this 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, marking and sampling (see Anaesthesia SOP).

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) is monitored before handling fish. Depending on the procedure, water quality may be measured throughout the handling procedure.

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

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

Details of the Operating Procedure:

4.13.1 Seining from the ponds

1. Drop the level of the water in the pond by removing one or more stop logs if necessary
2. Two people will enter the water
3. Walk the seine net up towards the inflow end of the rearing pond and make sure the lead line is pushed to the bottom of the pond.
4. Each person places one foot into the loop at the bottom of the end of the seine net
5. The two people will walk the net simultaneously at each side of the pond towards the outflow end of the pond

6. The ends of the net are pulled in and piled onto the weir/walkway maintaining a good seal against the screen to avoid escapes from the net
7. A line with a hook hangs from the top of some of the enclosures, the back end of the net is hooked onto this to keep the net from collapsing in on the fish. In ponds with no hook, ensure that the net does not collapse inwards on the fish contained within it
8. Both people exit the water. If there are enough people, one person may stay in the pond to ensure the net does not crush fish when being removed
9. Fish are netted from the seine net using dip nets
10. When sampling has been completed, one person grabs each end of the cork line and it is pulled up quickly so the lead line is pulled out from underneath the fish
11. Creases and pockets in the net are checked for any fish that may have been caught, these are removed and placed back into the pond.

4.13.2 Marking

1. Only coho and steelhead are marked for identification. Currently (2007) only the adipose fin is clipped for marking but a maxilla clip may be added at a future date to identify early and late release.
2. Fish are marked when they are moved from the Capilano troughs to the ponds.
3. Fish are generally crowded down to the bottom of the trough using a divider, dipnetted out of the trough (approximately 100 at a time).
4. Fish are placed into a clove oil bath and anaesthetized for ease of handling (See Anaesthesia SOP).
5. When adequately anaesthetized, fish are removed from the bath individually and the adipose fin is removed using a sharp pair of scissors.
6. Clipped fish are placed into a recovery container with oxygenated flowing water prior to being transported to holding ponds for the duration of the rearing.

4.13.3 Injections

Currently (2007) no injection treatments other than spawning synchronization for steelhead males is carried out on this facility. Ovaprim is used to initiate sperm production in male steelhead. When it is anticipated that female steelhead will ripen before males, a select few males will be treated with Ovaprim.

1. Male steelhead are seined from the holding pond and placed into a large bucket containing water.
2. The bucket is carried to the hatchery building and the fish is placed into a fish condo
3. When all the fish have been checked, males for injection are placed into a bucket containing an anaesthetic bath (see Anaesthesia SOP).
4. When fish are sufficiently anaesthetized, they are weighed in a tared bucket containing water on a digital scale
5. A volume of Ovaprim (Syndel) equal to 0.5 ml/kg fish is injected using a 20 G needle and syringe. The injection is made between the pelvic fins into the intraperitoneal cavity.
6. Fish are then placed into a condo for recovery prior to being placed back into the adult holding pond.

Forms & Records:

Stressful events should be recorded in the husbandry records.
Record the Kurl-lock tag number of the fish injected

References:

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.14 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 tagged properly with minimal stress or injury. Methods of tagging should not negatively affect productivity or survival unless they are part of an institutional approved research protocol.

Definitions:

Coded wire tag: a wire tag imprinted with a binary code

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.

Rostral: the nasal/snout region

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

Authority: Site management and fish health management are responsible for the information contained in the SOP. Trained staff conducting the procedure is responsible for ensuring that it is carried out properly.

General Principles:

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

Fish are collected in dip nets with soft knotless mesh. 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 net.

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

Fish are anaesthetized with clove oil for the marking procedure (see Anaesthesia SOP).

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

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

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

Details of the Operating Procedure:

4.14.1 Adipose Clipping

1. Crowd fish in Capilano troughs using dividers.
2. Dip-net fish out of the troughs and quickly carry them, using the net, to the tagging anaesthetic bath.
3. Place the net of fish into a basin containing anaesthetic (~ 200 fish in one batch). Fish are anaesthetized with clove oil according to the Anaesthesia SOP. Fish will be taken to a level of anaesthesia such that they may be handled easily (approx 3-4 min)

4. Net fish out of the anaesthesia bath and manually divide them between the staff performing adipose clipping. Place them into small basins containing water with a very low level of clove oil (approx ¼ capful). There is a net in the basin to hold the fish in water but allow easy accessibility
5. Lift each fish from the basin and remove the adipose fin using sharp scissors.
6. Gently place the fish into the running water trough allowing it to flow back into a recovery bucket containing flowing water.
7. When approximately 500 fish have been clipped and returned to each recovery bucket, the fish are moved into the appropriate rearing pond.

4.14.2 Coho mark and recapture program (escapement estimation)

On a yearly basis, every two weeks between mid July and Nov, coho are seined from the hatchery pool or the old dam pool.

Captured fish are placed in a cradle, assessed for species, sex, marked or unmarked status, determine by measurement if they are jacks or not. Information is recorded. The operculum is hole punched and fish are released

If marking is occurring during broodstock collection periods, some unclipped fish may be kept for broodstock, excess is marked and released, all fish that are clipped will be marked and released.

Carcass recovery ensues between Oct and Jan. This data is recorded and forwarded to DFO Stock Assessment

Forms & Records:
Rearing records – for each trough, how many clipped and put into each pond etc
Information is transferred over to the feed schedule

References:
Anaesthesia SOP
Fish Handling Procedures SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.15 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: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

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

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

Groups of fish are tracked from their incubation containers to their rearing containers using rearing mortality sheets.

Daily mortality summaries are calculated on a weekly to biweekly basis and transferred to rearing mortality records.

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

Changes in the daily mortalities will result in sample collection and submission to the Pathology Lab at PBS. Groups of fish suspected of having a disease are sampled according to the Veterinarian's instructions for lab analysis.

Forms & Records:
Growth models using EXCEL

References:
Diagnostic Sampling Protocols SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

Release

4.16 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.

Definitions:
Biosecurity: Biosecurity refers to an integrated strategy to assess and manage the risks that threaten animal health, human health, food safety, and the environment.
Prevalence: the total number of cases of a specific disease in existence in a given population at a certain time
ITC: Introductions and Transplant Committee

Authority: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure: (Please refer to the Juvenile Release SOP and the Juvenile Health Observation SOP and Mortality Classification SOP)

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

- species, life stage, disease and treatment records
- location of receiving facility or watershed
- disease history of the current rearing facility
- history of pathogen surveillance within the population being moved

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

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

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

References:
Juvenile Release SOP
Juvenile Health Observation SOP
Mortality Classification SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.17 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: It should be clearly defined in the SOP which site is responsible for fish transport, the donor or the receiving site.

General Principles:

4.17.1 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 Transport Disease Risk Assessment SOP). This includes mortality, diagnostic and treatment records and examination of a representative sample of dead fish and moribund fish within 10 days of transportation. Consideration should be given to any differences in the pattern of disease recipient area and the location which fish are being transferred.

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

All required transport permits are in place

- The annual DFO permit allows this facility to catch and retain adults and to release juvenile fish into this watershed.
- A steelhead broodstock collection permit is acquired from the Ministry of the Environment.
- Other permits, when required, are obtained for the purposes of scientific purposes

Fish are crowded for the minimum time (not to exceed 1 hour) possible to allow collection into transport vessels via nets. Fish transfer into the vehicles/vessels must be conducted in the least stressful manner possible. Fish should be handled in a manner that minimizes skin damage or other trauma and leaves fish out of the water for as little time as possible. When fish are handled out of water, the equipment used to handle them must be kept wet to minimize trauma.

Dip nets should not contain too many fish to avoid crushing fish at the bottom of the net.

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™).

If fish are to be moved from fresh to salt water then the degree of smoltification is visually assessed to ensure that fish are ready to be transferred.

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

Ensure all required equipment is available and functioning.

- □ Truck
- □ Oxygen cylinders (2)
- □ Airstones
- □ Buckets
- □ Oxygen meter
- □ Release hoses, couplers, adapters
- □ Lengths of bio-weave for water circulation
- □ Tank
- □ Oxygen Regulator
- □ Tubing
- □ Pump for bio-weave
- □ Nets
- □ Volunteers
- □ Notify Fisheries Officer of planned transport

1. All equipment (tanks, pumps, hoses, aerator, air stones) is pre-checked to ensure good working order.
   - □ The vehicles are ensured to have been serviced and are determined to be in good working order.
   - □ The oxygen must be on board the truck prior to loading fish.
   - □ All required equipment should be on board.
2. The transport tanks have been disinfected following the prior transport and may be given a rinse and a scrub prior to filling
3. The transport tanks are filled with reservoir water from the aeration tower
4. Airstones are checked for proper functioning (small bubbles, no breaks, hoses intact)
5. Regulators and all flow and oxygen meters should be functioning properly (see manual)
6. The tank is filled with fresh water and overcharged with oxygen (~ 15-25 ppm)
7. Mucus protectants such as Vidalife may be added to the transport tank, antifoam may also be added
8. The truck is located as closely as possible to the rearing channel to reduce the amount of time the fish are out of the water.

4.17.1.1 Smolt transport from Channels

1. A seine net is placed into the head of the earthen rearing pond, (at the opposite end as that at which the truck is positioned).
2. Water level is manipulated as required through the use of drop logs (stop logs).
3. Fish are crowded towards the outflow of the pond to a degree that easily enables netting but minimizes stress. Fish are dipped out of the channel using knotless nets.
4. One person will be atop the tanks monitoring displacement and general fish condition.
5. One person will be immediately adjacent to the tank being loaded (on a step ladder if necessary). This person will assist with lifting the net to the person at the top of the tank.
6. Two people will be dipping fish from the channel and passing the nets to the person on the ladder.
7. Another person (or persons) will either dip fish out or manage water levels, repositioning the crowder etc. as needed
8. The tank lid is securely closed and fish are transported to the release site. Use care when fitting the lid to not damage the oxygen probe cord. All transport tanks are monitored continuously for oxygen levels during transport.
9. Biomass in the transport tanks is targeted at 100 g/L

4.17.2 During Transport

Water quality must be maintained at all times during transportation. Transport vessels are be equipped with supplemental oxygen tanks and air stones. Oxygen levels are checked with a portable oxygen meter that is inside the cab of the truck to ensure adequate oxygen throughout the transport. If the oxygen levels fall below 10 ppm (10-12 ppm is preferred), the transport will be paused, the fish will be visually checked and the oxygen delivery adjusted.

The Seymour River Hatchery is located on a private road and delays in transport have not been encountered to date. Most transfers are within the confines of the Seymour watershed along this road. The GVRD are notified in advance of transports which are always given high priority and allowed passage even if road delays were to be expected.

The water that is used at the hatchery is the same water that feeds the river system therefore it is presumed that water temperatures and quality will not differ significantly. If fish have been reared on ground water for any period of time, they are switched back onto reservoir water at least one week prior to transport to ensure the rearing conditions and the release conditions are the same.

Juvenile coho are transported outside off this facility to two community maintained net pen sites (Terasen gas refinery and near the Ioco marina). Fish are transported by truck and trailer to the Terasen refinery netpen. Fish being transported to the Ioco netpen are moved by land to the boat launch before being transferred by boat to the net pens.

Fish are released into the receiving waters in a careful manner (see Juvenile Release SOP). Locations of all groups are noted in the records.

4.17.3 After transport

Vehicles, vessels and equipment used in transport are cleaned and disinfected with Ovadine after use.

When adults are transported onto the site they are isolated from fish already on site. For example, adult steelhead ponds are only used for steelhead. All adult fish transported onto this site are isolated from juvenile rearing and water flows do not mix between enclosures. Fish are visually monitored closely after transportation for signs of illness or trauma. Mortality rates are calculated daily and all fresh mortalities are examined.

Forms & Records

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

References:

Juvenile Release SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.18 Juvenile Release

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

Authority: Management personnel are responsible for information contained in this SOP. Site staff is responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

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

Stocking rates are determined according to the DFO contract.

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

Release date windows are a component of the DFO contract.

The GVRD is made aware of the time and date of the fish release.

Coho designated for the watershed are checked for health condition prior to volitional release, which is by removing screens and allowing them to leave at will. Fish are not fed on the release day, and may be sampled within the week prior to the release day. Fish that have not left within 2 weeks of screen removal are forced to leave by crowding them out with a seine net.

Two marine net pen sites are stocked for short holding prior to release. One pen site is located at the Westridge Terminal in Burrard Inlet attached to the dock at Kinder-Morgan (formerly Terasen gas). The second net pen site (The Ioco Seapen) is located in the Port Moody Arm at a floating facility off of the Ioco boat club. Fish being released at the Westridge Terminal are transported and released directly by trailer transport tank. Fish being moved to the Ioco Seapen are transported by transport trailer and then moved to the net pen by boat.

4.18.1.1 Direct truck/trailer release

1. On reaching the release location, the truck is positioned as close as practical to the release site.
2. Release method options depend on size of fish. Where release hoses are employed, they are connected and laid out. Adapters are attached at the outlets if required.
3. The outflow of the hose is moved into the receiving stream or netpen and directed in a slight upward angle
4. The gate is lifted and the fish are released through the hose
5. The person directing the outflow ensures an upward angle of dispersal to ensure proper release and break up the water surface to soften the landing.
6. When all of the fish have been visibly removed, several buckets of water will be flushed through the hose to ensure the fish have been moved from the tank into the hose
7. The hose will be walked out to the end to ensure all fish and water have been expelled

8. Fish are observed for behaviour at release
9. Equipment is collected and packed up, disinfected on return to site and put away in its appropriate location.

95% of the fish raised at the Seymour River Hatchery in earthen ponds are released via transport tank/trailer as above. Any remaining fish that have escaped seine capture are released volitionally by pulling the screen at the pond outlet.

4.18.1.2 Boat release

1. On reaching the release location, the truck is positioned as close as practical to the water using a boat ramp
2. A boat is positioned as close as possible to the transport trailer
3. Transport totes are placed onto the boat and filled halfway with seawater (using buckets or a pump)
4. Place airstones into the totes and turn on oxygen
5. Fish are netted from the transport tank using a knotless net. Nets will not contain too many fish to ensure that fish at the bottom are not crushed
6. Load approximately 1000 fish per tote (several trips will be required)
7. Place lids securely on totes and transport fish to the net pen by boat
8. When the boat is securely tied to the net pen float, the lids are removed and fish are dipnetted from the tote and placed into the net pens
9. When all the fish have been removed from the totes, oxygen is turned off and the water is drained for the return trip. Fresh sea water is added for each transport to the net pen
10. When all of the fish have been netted from the transport trailer, a net is held under the outflow and the hose is removed. Any fish that are caught in the net are placed into a tote during the final transport to the net pen
11. Fish are observed for behaviour at release
12. A predator net is installed tightly over the net pen and cable ties are securely fastened to minimize possibility for predator entry
13. Equipment is collected and returned to the truck and trailer where it is rinsed, scrubbed and disinfected prior to being returned to its appropriate location.

Forms & Records:
Fish transport and release information is recorded according to DFO requirements in the juvenile release form

References:
Pre-release or Transfer Disease Risk Assessment SOP
Transporting Fish SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

Mortalities and Responses

4.19 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.

Definitions:
Mort: dead fish
Moribund: fish in a dying state

Authority: Site manager and Fish Health Management is responsible for information contained in this SOP and site staff is responsible for ensuring it is carried out properly.

General Principles:

Staff must take hygienic precautions to protect their own health; this includes and washing hands after mort picking and using Purell hand sanitizer stations.

The rearing shed is checked and troughs are cleaned first thing each day. Other life stages are fed and checked for mortalities at a later time in the day. Ponds are generally fed and checked second and any egg/incubation work is performed later in the day.

Troughs have their own cleaning brushes. Nets and buckets are communally used but are disinfected with Ovadine between each container in which they are used.

All dead and moribund fish are to be removed from holding units on a daily basis. Moribund fish are removed from the population and placed in the mort bucket. They are euthanized by suffocation.

Mortalities are counted and classified (if unusual levels of mortalities or unusual circumstances have occurred). (Mortality classification SOP)

In the event of unexpectedly high morbidity or mortality rates, the frequency of mort collection may be increased to no more than twice daily. If daily mortalities are unusually high or are increasing in numbers or frequency, the veterinarian is notified and samples are sent to the Pathology lab at PBS. (see Outbreak Response and Outbreak – Disinfection Protocols SOPs)

Buckets used to collect mortalities are cleaned and ideally, should be disinfected before being returned to the fish rearing area. The mort bucket is dedicated for this purpose. Any bucket in which dead fish have been contained is used for no other purpose.

After mortalities have been collected they are placed into an earthen pit and buried just off site. This is generally done on a daily basis.

Forms & Records

Daily Summary Sheet

References:

Euthanasia SOP
Equipment Disinfection SOP
Mortality Collection and Disposal SOP
Site and Staff Disinfection and Biosecurity SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.20 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 Veterinarian is responsible for information contained in the SOP. All staff are responsible for carrying out the details of the SOP.

General Principles and Details of the Operating Procedure:

All mortalities are recorded in the husbandry logs and any unexpectedly high mortalities are classified.

A certain degree of historical mortality is presumed but staff should record data. If levels are seen to be above normal expected background levels then investigation is initiated.

Standard mortality classifications:

Background Mortality (expected background losses)
Systems related (systems or equipment failure)
Environmental (water quality ie total suspended solids are checked daily and water flow)
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 i.e. pinheads)

Forms & Records:

Daily mortality records

Daily Summary Sheet

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.21 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 will be managed as though an infectious agent is present.** Steps must be taken to keep the pathogen load as low as possible and to prevent spread of the pathogen both within and from the site. This SOP addresses sections 2.3.4.3 and 2.3.4.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that the pathogen load is maintained as low as possible and spread of pathogens on or off the site is prevented.

Definitions:
Outbreak: an unexpected occurrence of mortality or disease
Isolation:
Quarantine: the segregation of animals from all others to prevent the spread of disease

Authority: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

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

4.21.1 Securing the Site

At the Veterinarian's recommendation the site may be officially quarantined and this quarantine will remain in effect until such time as the problem has been diagnosed and/or managed. No visitors or non-essential staff are to be allowed on site during an outbreak unless previously authorized by Management.

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

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

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

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

Mortality collection and disposal procedures must be strictly adhered to.

4.21.2 Assessment

The Veterinarian is to 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.

Fish are to 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 are to be monitored and water and feed samples are to be taken if requested.

Healthy fish are to be cared for first and personnel should disinfect themselves between handling groups to avoid inadvertent transfer. Disinfection procedures (below) are to be followed for movements into and out of the affected areas of the facility.

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 behaviour in the weeks previous to the outbreak.

On site post mortems and sampling are done at the discretion of the fish health Veterinarian and may be conducted by fish health personnel after securing the site. (See guidelines under Diagnostic Sampling Protocols SOP). Samples must be properly handled, properly stored and promptly shipped as per the Veterinarian's instructions to ensure that they will supply relevant information. Temporal distribution of disease is 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.

Forms & Records
All treatments and management changes are noted as they occur.

References:
Quarantine/Isolation Procedures for Suspected Disease Outbreaks SOP
Diagnostic Sampling Protocols SOP

4.21.3 Outbreak – Disinfection Protocols

4.21.3.1 Personnel and Equipment

Foot baths are to be used by all personnel before entering and leaving the facility. In the case of viral outbreaks a 2% solution of Virkon™ is to be used in the foot bath. Footbaths must be monitored and changed regularly or as necessary to ensure efficacy.

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

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

A 250 ppm Ovadine solution is to be used for dip net disinfection.

4.21.3.2 Mortalities

Mort collection equipment is to be disinfected with Ovadine (250 ppm) after use.

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

References:

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.22 Quarantine/Isolation Procedures

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 with in and between facilities This SOP addresses section 2.3.4.3.1 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that disease transmission within and between facilities is prevented during a quarantine.

Definitions:

Isolation: Separation and observation of potentially infected animals for a reasonable period to allow expression of signs of disease if present; desire is to prevent or limit the transmission of an infectious agent to naive animals

Quarantine: Strict separation of infected or potentially infected from healthy populations, including their products or items they might have contaminated, their effluent, feed and handling equipment, 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.

Authority: Management personnel are responsible for information contained in this SOP. Site staff is responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

4.22.1 Securing the Site

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

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

4.22.2 Isolation of Infected Group

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

Disinfection procedures are followed for movements into and out of the facility. If possible, effluent is trapped and treated prior to discharge to the environment.

4.22.3 Mortality Removal

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

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

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

4.23 Juvenile Treatments

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

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

Authority: Management personnel and the Fish Health Management Team are responsible for the information contained in this SOP. Site staff is responsible for ensuring that it is carried out correctly.

General Principles:

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

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

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

4.23.1 Chloramine-T

Chloramine-T has been used on this site once in ten years and is not a standard treatment. The following is for informational purposes.

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

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

The standard flush, bath or dip treatment with Chloramine-T is 8.5 – 12 ppm for one hour daily on three treatments on consecutive or alternating days.

4.23.2 Parasite-S™ (Formalin)

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

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.

Formalin should be stored in the dark above 10^{o}C to reduce the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish.

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

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

Cautions:

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

Formalin should not be used if :

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

Details of the Operating Procedure:

Parasite-S has been used at the Seymour River Hatchery to treat *Costia* and saddleback (*Columnaris*). In all cases, treatments have been static and fish are treated for a one hour bath.

1. Prepare airstones and oxygen supply
2. Set up DO meters to monitor oxygen levels
3. Determine the volume of the rearing trough
4. Dilute the Parasite-S in a volume of water according to the veterinarians instructions
5. Ensure the solution is mixed well
6. Stop the flow in the rearing trough
7. Pour the solution across the entire length of the trough and mix well using a net paddle
8. Time for one hour

9. Monitor the oxygen regularly during the treatment and watch for any behavioural changes that may indicate toxicities
10. After one hour, turn the flow back on in the trough
11. Feed may be withheld from fish during the treatment and restarted the following day.

In all cases, the Veterinarian's recommendations will be adhered to.

Forms and Records:

Parasite-S Treatment frequency

References:

Egg Fungal Treatment SOP
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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.24 Broodstock Treatments

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

Definitions:
Gametes: Male (sperm or milt) or female (eggs) reproductive cells
Vertical transmission: spread of a pathogen from the parent to the offspring

Authority: The Veterinarian and fish health management are responsible for information contained in this SOP. Fish health staff and fish culture staff is responsible for carrying out the SOP under the direct or indirect supervision of the Veterinarian.

General Principles:

4.24.1 Fungal infections

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

4.24.2 Bacterial infections

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

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

4.24.3 Spawning synchronization

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

Details of the Operating Procedure:

4.24.4 Ovaprim™

General Principles

Ovaprim™ is a potent ovulating/spermiating agent to promote and facilitate reproduction of fish. Using Ovaprim™, time to ovulation following injection is highly predictable, with high egg fertility and viability.

A general dose of Ovaprim™ is 0.5 ml per kilogram of body weight. This dose may vary among species and locations.

Ensure that all equipment is clean and, if possible, sterilized. Always clean the needle with a cotton swab soaked in rubbing alcohol before and after each injection. Wear gloves.

From the bottle of Ovaprim™ withdraw only enough solution as will be required for the weight of the fish. With the needle pointed upward, squeeze the syringe gently to expel any trapped air.

Hold the fish firmly and insert the needle into the belly behind the pelvic fin or in the muscle on either side of the dorsal fin. Inject Ovaprim™ carefully, and quickly remove the needle. Gently place the fish into a container of fresh, aerated water.

After the fish has recovered from sedation (5 to 10 minutes), return it to the breeding tank. More than one fish may be induced at the same time.

Use at the Seymour River Hatchery

Ovaprim™ is used to initiate sperm production in male steelhead. When it is anticipated that female steelhead will ripen before males, a select few males will be treated with Ovaprim™.

1. Male steelhead are seined from the holding pond (See Broodstock Handling SOP) and are anaesthetized with clove oil (see Anaesthesia SOP).

2. When fish are sufficiently anaesthetized, they are weighed and a volume of Ovaprim™ equal to 0.5 ml/kg fish is injected using a 20 G needle and syringe. The injection is made between the pelvic fins into the intraperitoneal cavity.

3. Fish are then placed into a condo for recovery prior to being placed back into the adult holding pond.

4.24.5 Erythromycin Injections

Injections have been given only to steelhead on one occasion.

The dosage is 0.2 mL/kg-body weight erythromycin.

Details of the Procedure:

1. Fish are anaesthetized according to the Anaesthesia SOP
2. Remove individual fish from the anaesthetic bath and weigh them
3. Calculate the required amount of drug to be injected
4. Tail the fish and place its head in water
5. The antibiotic will be administered with a 1 cc syringe with 0.01 ml graduations (1cc tuberculin) and a needle between 22 and 27 gauge
6. A second person will insert the needle into the dorsal sinus, which is located just anterior to the dorsal fin, and inject the proper amount of antibiotic

7. Wait briefly after the injection, and then withdraw the needle slowly.
8. If it is difficult to inject the drug then you are not into the sinus; adjust the depth of the needle until you can easily inject the drug.
9. Fish are either placed into a condo or back into the holding container

Notes:

- Fish are handled carefully (see Broodstock Handling SOP), If needed, fish are sedated or anaesthetized prior to handling (see Anaesthesia SOP).
- Injections are given according to veterinary prescription at the prescribed dosage.
- Fish are monitored for recovery
- Treated fish carcasses must not enter the human food chain; they should be composted at an approved facility

References:

Fish Handling SOP
Anaesthesia SOP
Egg Fungal Treatment SOP
Syndel Information sheets

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.25 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 Veterinarian is responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

General Principles:

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

Details of Procedure:

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

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

Equipment:

- ☐ Oxytetracycline (Terramycin Aqua)
- ☐ Scale for weighing
- ☐ Large sanitized pail or garbage can to mix feed with Oxytetracycline.
- ☐ Fish oil or canola oil for binding to feed.
- ☐ Rubber/latex gloves, eye protection, respirator, protective clothing.
- ☐ Optional: krill powder to improve palatability

WARNINGS: Always wear a respirator, eye protection, latex gloves, and protective clothing when handling this drug to avoid exposure, inhalation and potential allergic reactions. A manual or sequential cleaning of mixing equipment and medicated feed containers is essential following this RX.

Procedure:

1. All disease treatments must be recorded in the daily record sheets
2. Should the diagnosis from PBS recommend an Oxytetracycline treatment, use the following steps.
3. Put on all safety equipment while preparing medicating feed. Respirator, eyeglasses, latex gloves
4. Carefully follow the dosage amounts given by the veterinarian and/or PBS. Weigh out the amount of drug specified and mix it with the amount of food required. Oxytetracycline is usually administered daily for a ten day period. Feed is mixed on a daily basis. Never touch the antibiotic/food mixture with your bare hands. Use a large paddle or food scoop to mix ingredients.
5. The days ration is placed in a bucket and the medication is added gradually and mixed thoroughly using a feed scoop before adding vegetable oil to coat and ensure that the medication adheres to the feed rather than the basin. The oil is poured in a little at a time and stirred well between additions and is added until all the pellets appear evenly coated.
6. Some feeds may contain enough oil that extra addition is not needed, especially the micro-diets
7. You may add krill powder as well to improve palatability.

8. Feed as usual, reminding other staff members and volunteers not to use their bare hands when feeding medicated food.
9. Like all antibiotics, treatment should not be stopped prior to finishing off the full amount of drug. The medicated food is to be fed as the sole ration for the period of treatment. Ensure thorough saturation of feed to be certain that all fish have an equal chance to eat. If fish are feeding/being fed properly, mortality should be reduced by the fifth day of treatment; otherwise the diagnosis should be re-evaluated.
10. At the end of the treatment, thoroughly wash all feed buckets with dish soap and water to remove antibiotic residue and oil, disinfect, rinse, and store to dry.

Notes:

- Clean troughs and pick mortalities first thing in the morning prior to feeding with medicated feed. Feeding should be a slow, thorough process, observe the feeding behaviour and note any abnormalities
- In fish feed has a high ash content, ions of Ca, Fe, Cu and Zn may bind with the Oxytetracycline retarding its absorption from the gut.
- Do not use in feeds containing the pellet-binding agent bentonite.
- If the Oxytetracycline treatment does not work within five days make sure the veterinarian is contacted. A different treatment many be recommended in conjunction with Oxytetracycline (such as Chloramine T).
- Feed is not stored for any longer than one day.
- Buckets may be labeled and designated to a particular pond.
- Medication is to be stored in the fridge
- Fish may be taken off feed for a day or two prior to starting treatment with medicated feed.
- All equipment (Food scoop, mort net and brush) involved with sick fish is isolated for use only with that container

Forms & Records

Feed inventory records.
Feed lot number to be noted in inventory records.
Medicated feed inventory,
Fish health records,
Veterinary prescription,

References:

Medicated Feed: Storage, Handling, and Feeding SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.26 Medicated Feed: Storage, Handling, and Feeding

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

Authority: Site management and fish health management are responsible for the information contained in the SOP. Trained staff conducting the procedure is responsible for ensuring that it is carried out properly.

General Principles:

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

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

Persons dispensing medicated feed should wear protective latex gloves.

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

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

Adverse reactions to medicated feed will result in immediate cessation of the treatment and consultation with the prescribing Veterinarian.

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

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

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

Staff may help encourage eating by holding fish off food for 24 - 48 hours before starting medicated feed or by initially mixing decreasing amounts of non-medicated food for the first couple of feedings. Palatability can also be increased by the addition of freeze dried krill. 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.

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.

Mort picking and tank cleaning occurs prior to feeding with medicated feed.

Notes:

- In fish feed having high ash content, ions of Ca, Fe, Cu and Zn may bind with the Oxytetracycline retarding its absorption from the gut.
- Do not use in feeds containing the pellet-binding agent bentonite.
- If the Oxytetracycline treatment does not work within five days make sure the veterinarian is contacted. A different treatment many be recommended in conjunction with Oxytetracycline (such as Chloramine T).
- Buckets are labeled and designated to a particular pond.
- Medication is to be stored in the freezer
- Coho may be taken off feed for a day or two prior to starting treatment with medicated feed.
- All equipment (Food scoop, mort net and brush) involved with sick fish is isolated for use only with that container

Forms & Records:

Prescription file
Daily feed records (on the daily record sheets)

References:

MSDS sheets
Syndel product information sheets
Veterinarian advice

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.27 Diagnostic Sampling protocols

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

Definitions:
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.

Authority: Fish Health Management and the Veterinarian are responsible for the information contained in this SOP. Fish health staff is responsible for ensuring samples are collected properly.

Details of the Operating Procedure:

This facility only sends fish (moribund or live) in to the pathology lab at PBS for sampling.

Tissue sampling is not performed by staff or volunteers.

Forms:
Fish health records, results of diagnostic testing

References:
Euthanasia SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.28 Sample Shipment to a Diagnostic Laboratory

Rationale: In order for accurate diagnoses to be obtained, fish samples must arrive at the laboratory be 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.

Definitions:
Moribund: in a state of dying

Authority: Fish Health Management is responsible for the information contained in the SOP. Staff members shipping fish to a diagnostic facility (in house or referral) are responsible for ensuring it is carried out properly.

General Principles:

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

4.28.1 Before shipping:

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

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

or

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

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

Evaluate fish condition. Fish found dead must have red gills and firm flesh in order to be of any value for diagnostics.

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

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.

Call PBS one day in advance as they may not be able to receive samples the next day based on their work load.

Send samples via Harbour Air (604-274-1277 Call ahead).

4.28.2 Selecting the samples:

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

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

4.28.3 Shipping live fish:

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

Double bag fish and tank water in heavy duty plastic bags. Use separate, labeled bags for moribund and apparently healthy fish.

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

Seal the bags tightly and label clearly.

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

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

4.28.4 Shipping fresh dead fish:

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

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

4.28.5 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
Pathology Lab Submission form (see Appendix)

References:
Diagnostic Sample Collection SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

Chemicals & Disinfectants

4.29 Anaesthesia

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

Definitions:

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

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.

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.

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.

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

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.

Authority: The company/contract Veterinarian is responsible for information contained in the SOP. Fish Health Management and fish culturists will carry out the SOP under direct or indirect supervision of the Veterinarian.

General Principles:

Prior to Anaesthesia:

All staff handling anaesthetics must be aware of WHMIS and MSDS information.

Juveniles are anaesthetized prior to clipping and individual length weight sampling. Individual length, weight, smolt assessment and clip assessment sampling is performed one week prior to release. Fish are taken off feed for 24 hrs prior to being anaesthetized.

Anaesthetic baths are prepared according to manufacturer's directions and are made up using the same water source as that in which the fish are being reared to minimize stress.

During Anaesthesia:

Staff should wear personal protective equipment to minimize exposure to anaesthetic agents. Because the health risks associated with some agents are currently unknown, it is advisable to be pro-active in preventing personal risk. Recommended gear includes safety/splash glasses, latex or nitrile gloves and rubber boots.

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

Mucus protectants (e.g. Vidalife™) may be employed to minimize damage to the fish mucus-skin barrier (see the Fish Handling SOPs).

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

The action of anaesthetics is affected by water quality. Water temperature is known as it is measured daily and the anaesthetic water is the same as rearing water. Dissolved oxygen is monitored during the procedure.

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

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

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

More fish may be transferred to the anaesthetic bath as required but any degradation in water quality or change in the time to anaesthesia should be monitored and addressed. When induction time increases to > 2 minutes or water quality deteriorates (D.O. < 5 mg/L and/or temperature changes > 2 degrees) the anaesthetic bath will be renewed.

Following Anaesthesia:

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

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

Fish populations are monitored closely after all handling events. Mortality and morbidity are assessed daily.

Details of the Operating Procedure:

4.29.1 Clove Oil

Note: This is not a veterinary approved anaesthetic drug.

Clove oil is obtained from Dynamic Aqua (800-355-8551 and Catalogue #C10242)

4.29.1.1 Juvenile Anaesthesia

Equipment List :

- Clove oil
- Nets
- 2 basins
- 2 garbage buckets/transport buckets
- Oxygen cylinder
- Oxygen meter
- Oxygen regulator
- Airstones
- Tubing

1. One designated individual is in charge of the anaesthesia procedure for the duration of the procedure
2. The stock solution of clove oil is prepared as a 10:1 ratio (10 parts ethanol to 1 part clove oil)
3. The clove oil stock solution is stored in the refrigerator
4. The basins are filled ¾ full (approximately 11L) to the bottom of the net hooks with water
5. Airstones are placed in the basins
6. One capful of the clove oil stock solution is added to one of the basins
7. The other basin is used if the procedure backs up and partial recovery is required to ensure fish are not accidentally euthanized
8. When fish are sufficiently anaesthetized, the procedure is carried out
9. Following the handling procedure, fish are placed into a recovery bucket with either flowing water or oxygen
10. Following recovery fish are placed back into their rearing container
11. After procedures are completed, the anaesthetic bath is disposed of to ground.
12. If fin clipping is being performed, the procedure will require constant replenishing of the anaesthetic bath throughout the day. Spent baths will always be disposed of to ground.

4.29.1.2 Adult Anaesthesia

1. One large transport garbage bucket is filled to approximately 20-30 L with water
2. Two capfuls of the clove oil stock solution is added to the bucket
3. Fish is removed from the condo and placed head first into the anaesthetic bath
4. Place a lid on the bath
5. The fish is checked for level of anaesthesia. If the fish resists being lifted from the bath, it is deemed to be not ready for handling and replaced in the bath
6. When the fish is suitably anaesthetized, the spawning procedure is started.

References:

G.K. Cho, D.D. Heath. 2000. Comparison of tricaine methanesulphonate (MS222) and clove oil anaesthesia effects on the physiology of juvenile Chinook salmon *Oncorhynchus tshawytscha* (Walbaum). Aquaculture Research 31 (6), 537–546.

Wagner, E., R Arndt, and B Hilton. 2002. Physiological stress responses, egg survival and sperm motility for rainbow trout broodstock anesthetized with clove oil, tricaine methanesulfonate or carbon dioxide. Aquaculture. 211:353-366

4.29.1.3 MSDS Information:

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

Forms & Records:

Stressful events are recorded in the fish health 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

Fish Handling SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.30 Euthanasia

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

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

Authority: The Veterinarian is the contact person for information on euthanasia. Site management is responsible for ensuring that euthanasia occurs in a humane manner.

General Principles:

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

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

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

- The current method of euthanizing fish is by a sharp blow to the head for larger fish held out of the water.
- Moribund juveniles are killed by a sharp flick to the head or by suffocation in the mort bucket

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

Forms & Records:
Daily mortality records

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.31 Chemicals: Supplies and Storage

Rationale: Chemicals must be handled, stored and administered/used properly to be efficacious. 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 are used in a manner that is efficacious and safe. All staff handling chemicals must be aware of WHMIS requirements.

Authority: Management personnel are responsible for information contained in this SOP. All staff members are responsible for ensuring that it is carried out correctly.

General Principles:

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

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

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

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

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

Details of the Operating Procedure:

4.31.1 Compressed Gas Cylinders Storage

Compressed gas cylinders must be stored in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs. "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 in the wet lab when not in use.

The area is well ventilated and cylinders are on a fireproof surface. The enclosure is tamper-proof and cylinders are protected from contact with ground, ice, snow, water, salt, corrosion, and high temperatures.

Oxygen and fuel gases are stored separately.

Indoors, oxygen must be stored at a distance from fuel gas cylinders of at least 6 metres (20 feet), by a wall at least 1.5 m (5 feet) high, or in cylinders rated for 1.5 hour fire resistance

There is always an extra full cylinder of oxygen on hand

Cylinders are moved by dolly to the appropriate transport tank. The tanks are strapped securely using strong bungee cords to the transport tank when in use. There is a secure strap on the dolly as well.

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

4.31.1.1 *MSDS Information:*

Contents of cylinders are under pressure. Liquid and cold vapour may cause tissue freezing.

4.31.2 Parasite-S

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

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 incubation room in 45 gallon drum.

When Parasite-S is dispensed gloves, safety glasses and a respirator are worn.

Cautions:

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

Formalin should not be used if :

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

4.31.2.1 *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.

Formalin should be stored in the dark above 10^{o}C to reduce the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish.

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

4.31.3 Sodium chloride

Sodium chloride has been used for salt treatments of Steelhead in the past and stock remains on site.

Sodium chloride is stored in the wet lab in 3 x 20kg bags.

4.31.4 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.

Oxytet is only on site during a prescribed treatment. When it is on site it is labeled and stored in the wet lab in a locked cabinet.

References:
WHMIS
Material Safety Data Sheets

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.32 Disinfectant: Supplies and Storage

Rationale: Disinfectants must be handled, stored and administered 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 disinfectants are safely stored and stock solutions are properly made.

Definitions:

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

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

Authority: Management personnel and the Veterinarian are responsible for information contained in this SOP. All site staff are responsible for ensuring that it 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

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

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

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

Details of the Operating Procedure:

4.32.1 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 Treatment SOP).

Cautions:

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

Formalin should not be used if :

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

Parasite-S is stored in the incubation room in 45 gallon drum.

When Parasite-S is dispensed gloves, safety glasses and a respirator are worn.

4.32.1.1 *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.

Formalin should be stored in the dark above 10^{o}C to reduce the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish.

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

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.

4.32.2 Chloramine-T

Chloramine-T is a disinfectant used for surface bacterial infections including bacterial gill rot.

Chloramine T is used only on prescription from the veterinarian and is not stored on site when not in use.

Chloramine-T is stored in the fridge when in use on site.

When handling Chloramine-T a respirator and rubber gloves are worn and the MSDS sheet information is followed.

4.32.2.1 *MSDS information*

Chloramine-T powder can cause burns or sensitization on skin contact and sensitivities upon inhalation; it is injurious to eyes and is harmful if swallowed. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

4.32.3 Ovadine™

Ovadine is a specially buffered, non-corrosive, aqueous iodine solution used by fish culturists as a general disinfectant on equipment, tanks, nets, hands and clothing in hatcheries and at farm sites. It is also used to disinfect eggs. It is a fast acting disinfectant that has been shown to be effective against many gram-positive and gram-negative bacteria and fungi.

Ovadine is stored in the incubation room and in the wet lab. Ovadine is purchased in 20 L pails. The 20 L pails are stored in the wet lab and dispensed into 4L bottles for use.

4.32.3.1 MSDS Information

Synonym- 10% Povidone iodine solution

There is no evidence of any hazard associated with inhalation of Ovadine solution. There is no evidence of any adverse effects of ingestion or skin contact with Ovadine. Ovadine solution is classified as practically non-toxic. Even so, eye and skin protection is advised .

Storage in high temperatures results in a loss of available iodine in solution.

4.32.4 Virkon

Virkon is the trade name of a disinfectant chemical containing peroxygen compounds, a surfactant, organic acids and an inorganic buffer system.

Virkon is stored in the wet lab (powder) and 1 L solutions are mixed and aliquoted into spray bottles (1%). Virkon solution (4L of 1 % solution) is used in a foot mat outside the incubation room.

Safety equipment as per the MSDS sheets are worn (rubber gloves, mask and eye protection)

4.32.4.1 MSDS Information

Rubber gloves, a dust mask (stored in the cupboard above the counter) and protective eyewear are worn when measuring out Virkon powder as per manufacturers requirements. Good ventilation should be used. Care should be used when measuring out Virkon powder to avoid the generation of airborne dust which can be irritating.

Virkon may be very irritating to the skin, eyes and mucus membranes and should be handled with a degree of caution. If contact is made with skin, rinse well. If eye contact is made, rinse eyes well with water for at least 165 minutes and obtain medical attention. Ingestion may result in severe irritation tot eh throat, digestive tract and stomach. Do not induce vomiting, drink plenty of water (or milk) and seek immediate medical attention.

4.32.5 Purell hand sanitizer

Purell hand sanitizers are located outside the incubation room and in the rearing shed. Refills are kept in a cupboard in the wet lab.

4.32.6 Ethanol

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

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

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

Ethanol is used for DNA sample storage and for clove oil dilution

Ethanol is stored in the wet lab in a cupboard away from flammables.

4.32.6.1 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, vomitting and inebriation; chronic use can cause serious liver damage. Note that "absolute" alcohol, which is close to 100% ethanol, may nevertheless contain traces of 2-propanol, together with methanol or benzene. The latter two are very toxic, while "denatured" alcohol has substances added to it which make it unpleasant and possibly hazardous to consume.

Extreme caution should be exercised if working with ethanol near flame sources as it is highly flammable and the flame may be invisible in well lit areas.

Forms & Records:
Ovadine use records
MSDS sheets

References:
Virkon™ data sheet: http://www.antecint.co.uk/MAIN/vkuse.htm
Ovadine™ data sheet: http://www.syndel.com/d_p_f_s/Ovadine_info_sheet.html

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.33 Equipment disinfection

Rationale: Equipment is to be kept clean at all times to limit pathogen spread. Movement of equipment between sites provides easy access for pathogens to migrate to facilities in different geographical regions. This should be avoided to reduce the risks associated with pathogen transfer. This SOP addresses section 2.2.7 of the General Principles of Fish Health Management.

Authority: Site and fish health management staff is responsible for information contained in the SOP. All site staff are responsible for ensuring the SOP is carried out correctly.

General Principles:

4.33.1 Between sites:

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

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

Each site has designated raingear and it is not to be transferred between sites.

4.33.2 Within the site:

Each rearing unit has designated cleaning brushes that are not be used in other rearing units.

After use, equipment such as dip nets, buckets and feeding equipment will be cleaned, disinfected in an Ovadine bath (1.25 L Ovadine are added to 50 L = 250 ppm) for ten minutes, dried and put away in the proper location.

When equipment must be shared between rearing units that have known health problems, it will 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 are cleaned, disinfected and dried between groups of fish housed in the facility. Tanks are cleaned whenever organic matter has accumulated or algal growth becomes problematic. High pressure water is often insufficient to remove biological matter and surfaces may require manual scrubbing.

At all sites holding units should be cleaned and disinfected prior to housing different groups of fish. Acceptable methods of disinfection include fallowing, drying, and chemical disinfection.

4.33.3 General Disinfectant Protocols:

Disinfectants are chosen based on the anticipated degree of microbial killing required, the nature of the surfaces involved (i.e. rubber versus stainless steel versus concrete), and the cost, safety and ease of use of the chemical. Selection of appropriate disinfectants is made by the site management in consultation with the Veterinarian.

Products should be used according to manufacturer's directions.

Disinfectant concentrations are maintained by regular renewal of the product (e.g. Ovadine™ dips replaced when indicated by a colour change or as required).

Disinfectants are disposed according to manufacturer directions in such a manner that meets the requirements of waste management regulations. Disinfectant baths are disposed of to ground.

Details of Operating Procedures:

4.33.4 Equipment Disinfection Protocol:

Equipment is rinsed with water and then scrubbed with during disinfection to remove all visible organic matter. Transport tanks are power washed when necessary rpior to disinfection.

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.

Brushes, small dipnets etc are dipped in an Ovadine bath for ten minutes and then hung to dry between uses.

Tranpsort tanks, buckets and basins that are used to move fish are rinsed and may be dried (depending on use e.g egg containers) following a ten minute Ovadine treatment.

Inadequate attention to rinsing can leave residual disinfectant behind that can be harmful to fish.

4.33.5 Tank Disinfection Protocol:

Rearing troughs, circ tubs, and raceways are scrubbed with Ovadine, then power washed prior to use, and allowed to dry after the removal of fish and prior to the introduction of new fish.

All tanks are scrubbed without use of chemicals on a daily basis while in use.

Adequate contact time for the disinfectant is allowed (please review this for the disinfectant concentration being used – a minimum contact time of 10 minutes is standard).

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

4.33.6 Foot Bath Disinfection Protocols:

Spent footbaths are drained and rinsed of residual solutions and then recharged.

Dispose of excess solution is disposed of to ground.

Add an appropriate volume of fresh pre-mixed disinfectant solution. (4 L or 1% Virkon)

Monitor footbath concentration by daily visual inspection and change when the volume has dropped to an inadequate level (below the rubber fingers such that footwear is not in contact with the solution) or when it appears heavily soiled.

4.33.7 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^{o}C) for periods greater than two years if containers are kept tightly sealed and away from direct sunlight.

4.33.8 Virkon™

To create a 1:100 solution (1%) of Virkon™ add 100 mg of disinfectant to 10 litres of fresh water. The pink colour is an indicator of efficacy; concentration test strips are also available.

Footbaths are replenished as needed depending on traffic, when heavily soiled or when the colour changes.

Virkon™ should be stored at room temperature. For the powder, a 2.3% loss in activity will be seen following 36 months in storage. For a 1% working solution, a 10% loss of activity will be seen after 7 days in 350 ppm hard water.

Forms & Records:
Ovadine use records
Ovadine 6 month use forms
References:
Virkon™ data sheet: http://www.antecint.co.uk/MAIN/vkuse.htm
Ovadine™ data sheet: http://www.syndel.com/d_p_f_s/Ovadine_info_sheet.html

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.34 Vaccine handling, storage and administration.

Vaccination is not currently a standard practice at this facility and is only carried out on the prescription of the DFO Veterinarian. The following SOP is for informational purposes only.

Rationale: Vaccines must be handled, stored and administered properly to be efficacious. This SOP addresses sections 2.1.3.4 and 2.3.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that vaccination is carried out in a manner that is efficacious.

Authority: Fish Health management and the staff/contract Veterinarian are responsible for the information contained in this SOP. Trained staff is responsible for ensuring that the SOP is carried out properly.

Details of the Operating Procedure:

Fish showing signs of illness are not vaccinated and fish are not vaccinated at water temperatures of less than 1°C. Vaccination will also be avoided during smoltification and the four weeks prior to seawater entry

4.34.1 Vaccine Storage:

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

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

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

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

4.34.2 Before Vaccination:

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

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

Vaccination should not occur if water quality is questionable.

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

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

4.34.3 During Vaccination:

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

In general:

Each litre of vaccine is diluted with 9 litres of clean water.
Fish are handled gently to minimize stress (see common Fish Handling Procedures SOP).

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

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

The fish are immersed in the vaccine solution for 30 seconds.

The fish are removed from the dilution, drained and returned to the holding unit.

Repeat this procedure until 100kg of fish per litre of diluted vaccine have passed through the bath.

Fish are transferred to their rearing unit and monitored closely for signs of injury from handling.

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

All equipment used is cleaned, disinfected and put away in its proper place (see Equipment Disinfection SOP)

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

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

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: Site management is responsible for ensuring this SOP is carried out.

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.

This facility uses full net enclosures over all rearing ponds. The first 1 metre above ground is protected with hardwared cloth (steel fencing) to prevent predators from chewing through the protective netting.

The rearing shed is enclosed fully behind chain link fencing and all troughs are protected with aluminum lids.

All other tanks (circ tubs, raceways) are fully enclosed with lids.

4.35.2 Procedures

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

Feed is stored and distributed in a manner that does not increase attraction to scavengers and predators. (See Feed Storage SOP) Spilled feed is cleaned up immediately.

Household refuse is properly contained prior to removal from the site.

Mortalities are examined regularly for signs of predator attack (See Mortality Classification SOP)

4.35.3 Contingency plan

When exclusion methods have failed and all other options have been exhausted, a professional trapper or 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 as per responsibility of the professional trapper of CO. The predator population must not be put at undue risk.

Forms & Records
Any signs of predation are recorded in the daily log

References:
Feed Storage SOP

Mortality Classification SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

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.

Definitions:

Isolation: Separation for the period of communicability of infected animals in a manner that prevents or limits the transmission of an infectious agent to susceptible individuals.

Authority: Fish Health Management and the Veterinarian are responsible for information contained in the SOP. All staff is responsible for ensuring that the SOP is carried out.

Details of the Operating Procedure:

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

4.36.2 Visitors

No visitors are allowed on site without staff presence.

Footbaths and hand wash stations are placed at critical locations (outside the incubation room and in the rearing shed) and visitors are expected to use them. Visitors will be informed not to handle feed, fish or equipment.

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

If staff are arriving from another site to pick up fish, fish for transport will have been moved to an easy access location for pick up and visitors will be expected to remove the fish and transport them without delay.

Tours will 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

See also Supplier Procedures SOP

4.36.3 Facility Maintenance:

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

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

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

4.36.4 Disinfectant protocols:

Disinfectants include chemical products determined by the site management in consultation with their Veterinarian.

Products should be used according to manufacturer's directions.

Organic matter must be removed from boots and equipment prior to disinfection to ensure efficacy.

Disinfectant concentrations are maintained either by visual inspection and regular renewal of the product as needed.

Disinfectants are disposed of according to manufacturer directions and following the requirements of waste management regulations. Disposal is to ground.

References:

Disinfectant: Supplies and Storage SOP
Egg Disinfection SOP
Equipment disinfection SOP
Outbreak – Disinfection Protocols SOP
Quarantine/Isolation Procedures SOP
Visitor Protocols SOP

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.37 Supplier Procedures

Suppliers do not deliver to this facility. All supplies are transported onto this site by staff.

Rationale: Suppliers can transport pathogens from one site to another as they make deliveries and pick ups at farm sites. 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.

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

Authority: Site management is responsible for information contained in this SOP. All staff members that will be taking deliveries or arranging pick-ups are responsible for ensuring that the requirements of the SOP are met.

Details of the Operating Procedure:

All suppliers will be informed of site procedures and biosecurity protocols prior to delivering anything to the site or removing anything from the site. (Refer to the Site and Staff Biosecurity Procedures SOP)

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.

Forms & Records
Daily Log

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.38 Visitor Protocols

Rationale: 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.

The goal of this SOP is to ensure that pathogens are not transported to or from the site by visitors, and that visitor threats to the site are minimized through either restricted access and/or supervision.

Authority: Management personnel are responsible for information contained in this SOP. All site staff are responsible for ensuring that it is carried out correctly.

Details of the Operating Procedure:

Visitors are welcome on our sites during posted business hours.

Group tours are common at this facility and are scheduled and conducted by site staff.
Self guided walking tours are available with interpretive stations.

All staff and site biosecurity protocols will be followed. (See site and staff disinfection SOP)

Feed buckets that are placed out have lids to discourage visitors from handling feed.

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

Supervised group tours will 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. Only supervised visitors may be allowed to view the incubation facilities.

An education program 'Gently Down the Seymour' is carried out at this facility. 1500 elementary students over the course a three month period (April, May and June) are involved in this program and are accompanied by instructors that have been trained by staff at the beginning of the program. Instructors have been trained over a three day period and instructed in the different procedures and hazards associated with the site. These instructors are instructed in site biosecurity to ensure fish are safe from unintended harm.

Forms & Records
Numbers of visitors are tracked in the daily records sheets

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.39 Water quality contingency plan

Rationale: Acute deteriorations in water quality can result in mass mortality of fish populations. A plan needs to be in place to protect fish from declining water quality. This SOP addresses section 2.1.1.3 of the General Principles of Fish Health Management.

The goal of this SOP is to have a system in place that will protect fish from catastrophic poor water quality events. Examples of catastrophic water quality failures include issues both within (pump failure, pipe burst, filter clogging, etc.) and upstream of the hatchery (turbidity events from landslides, chemical spills during transport, etc.).

Definitions:
Turbidity: A cloudy condition in water due to suspended silt or organic matter.

Authority: Site management is responsible for information contained in this SOP. Site staff is responsible for ensuring it is carried out properly.

Details of the Operating Procedure:

A water quality monitoring program must be in place (see Water Quality Monitoring SOP).

A site may have access to a variety of water supply options. This redundancy in supply has multiple advantages. It allows the cleanest possible water to be directed to sensitive lifestages (i.e. well water during egg incubation), allows mixing of different water sources (i.e. well water and surface water) for cost-effective temperature manipulations, and allows immunocompetent juvenile fish to be reared in the same water they will eventually be released into, allowing imprinting to their native streams and controlled exposure to endemic pathogens. The main value of redundant water sources however, is that in the event that one water supply is compromised, alternate sources may be available till normal supply is restored.
There are two water sources at this facility.

Reservoir and ground water are available. Reservoir water is fed by gravity from above the dam. The intake is approximately half way down the dam.

The ground water supply is seepage water that is collected into underground cathedrals and then gravity fed to the settling pond at the head of the rearing channel. The ground water may be pumped from this location for incubation purposes.
Earthen ponds may be supplied with either ground water or reservoir water depending on quality and temperature.

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.
Backup generators are on site to ensure power is available in the event of a power failure. Because the water on this facility is gravity fed to the hatchery, these generators are not dedicated for water pumping. In the event of a power failure, water will continue to flow or water that is being pumped from the ground supply may be switched over to reservoir water. .

A disadvantage of flow through water supplies is that in the event of water flow shortage or water quality failure, large numbers of fish in tanks and raceways will quickly exhaust the dissolved oxygen levels in stagnate water. Each hatchery has the capacity to provide supplemental oxygen to critical life stages via air stones in an emergency.

In the event of a pipe rupture to the aeration tower, and depending on production levels in the facility, the most critical life stages will be addressed first. Where possible pumps will be utilize to move water from the earthen ponds to critical life stage enclosures.

Where water flows and/or supplemental oxygen capacity is limited, our sites have a last ditch option to do an emergency, early release. This option will only be exercised if the fish in question 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 SOP).

If mitigation efforts are not successful and losses are high, the premises will be quarantined until it is determined that a disease outbreak is not occurring (see Outbreak Response SOP). The Community Advisor would be notified immediately and DFO would advise as to whether the site should be quarantined.

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.40 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: Site management is responsible for information contained in the SOP. Trained site staff is responsible for carrying out the SOP.

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:

4.40.1 Temperature

Temperature is measured daily in the morning. Measurements are taken at representative locations throughout the facility (i.e. in header tanks, effluent flow). Temperatures are taken at the groundwater source, the reservoir source and in the incubation facility. Temperatures are measured using thermometers that are fixed in each of these locations. These are placed in incubation, adult holding and juvenile rearing.

4.40.2 Dissolved oxygen

Dissolved oxygen (D.O.) is measured once a week during feeding periods. D.O. is measured differently in different containers. In Heath trays, the DO is measured at both the top and bottom of a representative stack. Rearing troughs and raceways are measured at the outflow. Circ tubs are measured within the enclosure. All information is recorded in the daily records. Measurements are taken at representative locations throughout the freshwater facility e.g. in each tank influent and effluent, in header tanks etc….

The D.O probe is calibrated according to manufacturer's directions when required. Specifics of probe calibration are to found in the manufacturer's instructions which are located with the DO meter..

4.40.3 Other Parameters

Ground water flow is measured by GVRD and on request the information is available to the hatchery.

pH, ammonia, nitrite, nitrate, total dissolved gasses may be monitored when it is deemed necessary. Equipment is available from DFO and other facilities when required.

Turbidity is assessed by visual inspection.

Form & Records:
Daily records

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

5 Appendices

5.1 BKD sampling procedure (revised 2006)

Only females are to be sampled

1. Label Whirl-pak™ bags with a waterproof felt pen.

2. Put the scalpel and tweezers into a beaker of alcohol. Burn off the alcohol by passing the blade of the scalpel and the tweezers through a propane torch flame (called "flaming"). Tools may be laid across the top of the beaker until used.

3. Do an external examination. Record any abnormalities.

4. Pull away swim bladder and other internal organs using the scalpel handle. Start at the anterior (head) end of the swim bladder and pull down and towards the tail end. DO NOT TOUCH the middle or posterior (tail end) kidney with the scalpel handle!

5. Dip the scalpel blade in alcohol and "flame" the blade. Cool for a few seconds.

6. Cut a chunk of kidney (about 1cm wide x 1cm deep x 2 cm long, or roughly the distance between the tip of your thumb and the knuckle) from the posterior portion of the kidney. Use the tweezers to put these into the labeled Whirl-pak bag and seal. DO NOT TOUCH THE KIDNEY SAMPLE WITH ANYTHING BUT THE TWEEZERS!!! Put the Whirl-pak™ bag on ice in either a garbage bag or cooler to keep the samples cool. Wipe the scalpel blade and tweezers with Kleenex and return them to the alcohol beaker. Frequently change the scalpel blade as it becomes dull easily and scrub tweezers with a wire brush to keep them clean.

7. Examine the internal organs and record any abnormalities.

8. Discard any eggs from fish with obvious pustules in the kidney or if the ovarian fluid is cloudy.

9. Phone us 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 labeling
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

FISHER SCIENTIFIC 1-800-234-7437

Disposable-Blade Dissecting Knives Size 4 Stainless steel
Cat. No. 08-917-5 Approx. $13.00 each or 10/$120.00

#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 $55.00 for box of 500

5.2 Sample submission form

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

DATE: _____ HATCHERY OR SAMPLE SITE:_____

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

SAMPLE INFORMATION

BROODSTOCK CODE: _____ LAB CASE NUMBER:_____

SPECIES:_____ SAMPLE SIZE: _____

SAMPLE TYPE (√):	RANDOM		MORTS		SICK		NORMAL	

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

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

DIET:_____

WATER SOURCE: (√)	SALT		RIVER		LAKE		WELL		SPRING		MIXED		CITY	

TEMPERATURE:_____ºC OXYGEN (AVERAGE):_____ PPM

NUMBER OF FISH IN REARING CONTAINER: _____

LOSS RECORDS (PLEASE INCLUDE DATE):

TODAY:_____PAST 10 DAYS:_____

REASON FOR SUBMISSION:_____

_____

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

_____

_____

5.3 Ovadine™ Emergency Drug Release (EDR) – Hatchery Reporting Requirements

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

Ovadine is currently (January 2007) under review by the Veterinary Drug Directorate for approval as a fish egg disinfectant. Until approval is received, it is available only by prescription from a licensed veterinarian, through Health Canada's Emergency Drug Release (EDR) program.

The EDR process:

The Veterinarian applies for approval for Site X to use X litres of Ovadine to disinfect X Pacific salmon eggs.

For example: PBS Hatchery - 20 L of Ovadine to disinfect 4 million eggs.

If approved, the site is issued an EDR#, which can be used to order Ovadine from an approved supplier (currently Syndel is the only approved supplier). Along with the EDR#, you will be supplied an Ovadine Usage Record Form (see next page). This form must be filled out when using Ovadine on eggs and must be returned to your Veterinarian within 6 months, to be included in a report to Health Canada. If you see any problems with your eggs or hatch that you think might be related to Ovadine egg disinfection, this form is where you record your concerns. This is an important part of the approval process.

If you need Ovadine only for equipment disinfection, you may order and use it without keeping any records.

If you already have sufficient Ovadine on site for both equipment disinfection and egg disinfection needs, you must still inform the Veterinarian to receive approval for its use on eggs and you are still required to keep records of the amount used on eggs.

If you require Ovadine, you must contact Syndel Laboratories and order the total volume desired for all disinfection needs. To complete the order, you must quote the EDR # for the volume (in litres) for which you have been approved of for egg disinfection.

For example: Order 56 L of Ovadine with 20 L to be used for egg disinfection under EDR # 2006-17xxx.

Use Ovadine as directed for egg disinfection. At the end of each spawning day, record the total volume of Ovadine used on eggs on the following form.

After incubation is complete, or when requested to do so, please return the Ovadine Use Record Form to your Veterinarian.

5.4 Ovadine™ Six Month Usage Record

(To be returned to the Veterinarian at the end of the spawning season)

EDR#: _____

DFO Facility Name: _____

Ovadine supply company: _____

Lot number and expiration: _____

Veterinarian: _____

Each date used on eggs	Volume used on eggs only (L)	User initials	Comments (include species, number of eggs treated and any adverse effects noted)

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

Introduction

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

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

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

Planning, Review, And Awareness

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

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

Carcass Management and Condition

The placement of salmon carcasses in streams may pose a risk of disease transmission if carcasses of infected fish are used, if carcasses are moved to areas within the watershed that are normally not accessible to salmon, or if carcasses are moved to streams outside the watershed. Streams that receive carcasses are referred to as “treatment” streams and those that provide carcasses are referred to as “donor” streams. In general, no carcasses may be moved outside their natal stream because of concerns regarding disease transmission. However, in specific circumstances, movement of carcasses from the watershed to nearby streams may be considered if all of the following conditions are met: donor and treatment streams are geographically proximate and, treatment stream is within the zone of influence of the donor

stock (i.e. adults may be straying from donor to treatment stream), and current disease history is available. If sufficient information is not available, health testing of fish in the donor stream and treatment stream may need to be undertaken. Historical information can be obtained by searching the Pacific Biological Station (PBS) Fish Health Database; the Fish Pathology Program may be contacted at (250) 756-7057. Please note that wild fish surveys have not been conducted in many locations in recent years so that information contained in the database does not include current disease status for many salmon stocks.

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

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

Carcass Loading Density

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

Suggested Average Weights for B.C. salmon *
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

Ashley, K.I. and P.A. Slaney. 1997. Accelerating recovery of stream, river and pond productivity by low-level nutrient replacement (Chapter 13). In: Fish Habitat Rehabilitation Procedures.

Slaney and D. Zaldokas (eds.). Province of B.C., Ministry of Environment, Lands and Parks, and Ministry of Forests. Watershed Restoration Technical Circular No. 9: 341 p.

B.C. Ministry of Fisheries. Feb. 2000. Proposal re International conference on the role of marine derived nutrients and salmonids in the Pacific Northwest.

Bilby, R.E., B.R. Fransen, P.A. Bisson and J.K. Walter. 1998. Response of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*) to the addition of salmon carcasses to two streams in southwestern Washington, U.S.A. Can. J. Fish. Aquat. Sci. 55: 1909-1919.

Bilby, R.E., B.R. Fransen, J.K. Walter, C.J Cederholm and W.J. Scarlett. 2001. Preliminary evaluation of the use of nitrogen stable isotope ratios to establish escapement levels for Pacific Salmon. Fisheries. 26(1): 6-14.

Cederholm, C.J., M.D. Kunze, T. Murota and A Sibatani. 1999. Pacific salmon carcasses: essential contributions of nutrient and energy for aquatic and terrestrial ecosystems. Fisheries 24 (10): 6-15.

Gresh, T., J. Lichatowich and P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the northeast Pacific ecosystem: Evidence of a nutrient deficit in the freshwater systems of the Pacific Northwest. Fisheries 25(1): 15-21.

Groot and Margolis.(eds),1991. Pacific Salmon Life Histories. UBC Press, 564 p.

Johnston N.T. E.A. MacIsaac, P.J. Tschaplinski, and K.J. Hall 2004. Effects of the abundance of spawning sockeye salmon (*Oncorhynchus nerka*) on nutrients and algal biomass in forested streams. Can. J. Fish. Aquat. Sci. 61:384-403

Reimchen, T.E., D.D. Mathewson, M.D. Hocking and J. Moran. 2003. Isotopic Evidence for Enrichment of Salmon-Derived Nutrients in Vegetation, Soil, and Insects in Riparian Zones in Coastal British Columbia. In: J.Stockner (ed.) Nutrients in Salmonid Ecosystems: Sustaining Production and Biodiversity, Am. Fish. Soc. Symposium 34, Bethesda. Pp. 59-69.

Oregon Department of Fish and Wildlife. Nov 2000. ODFW fish health guidelines for use of salmon and steelhead carcasses for nutrient enrichment. 2 p.

Shively, D. 2001. The role and benefits of salmon carcass supplementation – selected research findings and quotes. Nov. 2001. 6 p.

Washington Department of Fish and Wildlife (WDFW). Protocols and guidelines for distributing salmonid carcasses, salmon carcass analogs, and delayed release fertilizers to enhance stream productivity in Washington State. 11 p.

Wipfli, M.S., J.P. Hudson, D.T. Chaloner and J.P. Caouette. 1999. Influence of salmon spawner densities on stream productivity in Southeast Alaska. Can. J. Aquat. Sci. 56: 1600-1611.

Wipfli, M. S., J. P. Hudson, J. P. Caouette, ad D. T. Chaloner. 2003. Marine subsidies in freshwater ecosystems: salmon carcasses increase growth rates of stream-resident salmonids. Trans. Am. Fish. Soc. 132:371-381.