Fish Health Management Plan

HSWRI

January 2009

1 INTRODUCTION

1.1 Objective

The objective of this Fish Health Management Plan is to provide good and uniform health conditions for cultured and wild fish owned by HSWRI.

1.2 Definitions

This document includes the following definition:

- HSWRI – Hubbs-SeaWorld Research Institute
- Institute – Refers to Hubbs-SeaWorld Research Institute
- FHS – Fish Health Specialist
- Fish Health Specialist – Veterinarian licensed in the state who maintains a client-patient relationship with the institute
- SOP – Standard Operating Procedure
- FHMT – Fish Health Management Team

1.3 Target audience

This document is intended for use as a Fish Health Management Plan. The plans are used by each facility's site staff in training and day-to-day contact with the fish, by fish health staff who are responsible for keeping good health status of the fish, and by management who have to make decisions about fish health.

1.4 Document structure

This document includes sections for Net Pen sites, Broodstock, and Hatchery sites. Sections requiring a site-specific Standard Operating Procedure (SOP) are noted in the document.

In development of Fish Health Management plans, hatchery managers will have SOP's referencing Appendix 1 and Appendix 2 of this document. In some instances an SOP may apply to more than one section; in these cases the same SOP can be used to address multiple requirements (e.g., the same feed storage SOP may be used for net pen and hatchery sites if applicable). Managers may also combine related SOP's, e.g. Isolation/Quarantine and Infectious Disease Emergency procedures.

1.5 Annual review

This document will be subject to annual review by the Fish Health Management Team to make sure it is up to date and that all SOPs are updated regularly.

1.6 Living document

Changes will be made to this document as required.

1.7 Personnel duties and responsibilities

1.7.1 Veterinarian

The veterinarian or fish health specialist (FHS), in conjunction with fish health staff, is responsible for overall fish health management for the facilities. The veterinarian is licensed in the state and retains a veterinarian-client-patient relationship with the institute. The veterinarian is also responsible for disease diagnoses and writing prescriptions and he/she is expected to exercise good professional judgment in fish health matters.

The institute will report outbreaks of significant disease to the proper authorities as required by law.

1.7.2 Fish Hatchery Manager/Technicians

Job descriptions for Fish Hatchery Managers, Fish Health Technicians and other positions are detailed by the institute.

The Fish Health Management Team (FHMT) refers to those personnel, including the veterinarian(s), who have responsibility for major fish health decisions. The FHMT is responsible for identifying and managing risk factors in order to minimize their effect on fish health.

1.7.3 On Site Staff

Hatchery staff may be assigned fish health duties from time to time. Site staff are expected to follow good hygienic measures and fish health procedures.

1.7.4 Contact names and numbers

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

1.8 Communication to enhance disease prevention and control

Over and above regulatory reporting requirements to the state or federal government, HSWRI will communicate incidents of disease that are significant[1] to their industry associations so that clinically unaffected sites in the geographic vicinity can be alerted to the concern. Hatcheries within the institute are also encouraged to contact each other directly.

[1] Refer to California State Statutes Section 245, Title 14 for a list of diseases.

2 NET PEN SITES

2.1 Biosecurity

Maintaining a clean, safe work environment will reduce the possibility for spread and exposure of fish to infectious or parasitic disease. Pathogens may be spread by sick fish and wild fish through the water, on shared equipment, or by inadvertent contact by personnel, visitors, or their gear. Entrance of potential pathogens will be prevented or minimized by an effective biosecurity "barrier" at each facility. Biosecurity applies to all personnel (staff, divers, management), to all visitors and all equipment.

Biosecurity includes three components:

- Keeping fish healthy
- Keeping pathogens out
- Keeping disease from spreading within the site

2.2 Keeping Fish Healthy

Keeping fish as healthy as possible is critical to preventing disease from coming on site and/or spreading within a site.

2.2.1 Single age class sites

Where possible, sites will contain single age classes of stock to prevent transmission of disease between age classes.

2.2.2 Suitable rearing environment

HSWRI management is responsible for ensuring a suitable rearing environment for the fish, so they can stay healthy. Facility requirements including nets are detailed in regulation; materials used in the construction and maintenance of holding areas are chosen to minimize potential harm to the fish. Facilities will be monitored to minimize the occurrence of vandalism.

2.2.3 Normal fish behavior

Fish will be routinely monitored for signs of health and disease. All staff will be familiar with normal fish behavior. Key behaviors that indicate healthy fish include but are not limited to:

- Physical – changes from normal i.e. scale loss, parasites, external injury
- Behavioral - swimming and schooling behavior, increased respiration
- Feeding – normally aggressive feed response when feed is presented

Fish will be kept at reasonable densities. Any changes in behavior and physical condition will be reported to the net pen operator. Early detection is the key to good disease management.

2.2.4 Predators

Predators will be excluded from the site. Predators include birds, other fish, and marine mammals. HSWRI maintains SOPs for predator exclusion.

Standard Operating Procedures (SOP)[2]

Predator exclusion

2.2.5 Feed and Nutrition

The objective of good nutrition is to keep fish healthy; fish receive sufficient quantity and quality of feed. HSWRI has procedures in place for healthy feeding of fish, including type of feed and different feed delivery methods. Proper storage of these diets is essential to maintaining their nutritional value. Feed will be stored in secure buildings where wildlife can be excluded and spillage prevented; feed is protected from extremes of heat, light and humidity.

SOP

Feed storage

2.3 Fish Handling Techniques

2.3.1 Common Fish Handling Techniques

The operator will maintain SOPs for handling fish (e.g. grading or seining, including minimizing the risk of escape while the fish are being handled). Handling - including types of equipment used and equipment maintenance – will be designed to minimize injury to the fish and/or predispose to disease. Fish will be monitored while being handled as well as for a period after handling to ensure any negative effects are noted and mitigative steps are taken to minimize impact. Staff will minimize the time fish are exposed to stressful events such as crowding and out-of-water events (i.e. handling, counting, weighing, grading, tagging, injecting).

SOPs

Fish Handling techniques

2.3.2 Harvesting[3]

Fish being moved via live haul to be harvested will be handled in as stress free a manner as possible. Where fish are stunned and bled on site, they will be seined, pumped, and/or stunned in as stress free a manner as possible. All bloodwater shall be managed as per

[2] See Appendix 1 – List of Standard Operating Procedures (SOP's)
[3] Not applicable to all facilities

state and local regulations require. Special SOPs may be required for specific diseases of concern.

2.4 Monitoring water quality

Maintaining good water quality is vital to good fish health. HSWRI maintains a regular program for monitoring and recording water quality at net pen sites. Monitoring will vary between sites depending on location and specifics of the aquatic environment.

SOP

Water quality monitoring

2.4.1 Contingency Plans

HSWRI maintains a contingency plan in the event of acute deterioration of water quality (e.g. fuel spill, algae bloom). Depending on cause, the state fish pathologist may recommend direct release of the fish. Water quality monitoring may be increased to determine the cause and to estimate how long the problem may persist. If fish are not released, they will be monitored more closely for the duration of the event and will not be further handled until water quality is acceptable. Records will be kept.

Attachment

HSWRI Net Pen Water Quality Contingency Plan

2.5 Keeping Pathogens Out

All necessary precautions will be taken to ensure disease is kept out of a facility.

2.5.1 Personnel movement

Staff will adhere to biosecurity procedures for the site. Where possible, personnel will not travel between sites. If such travel is unavoidable, personnel will adhere to all biosecurity procedures at each facility.

SOP

Site and staff disinfection and biosecurity procedures

2.5.2 Visitors

Each site shall have procedures for all visitors, and visitors are expected to follow these procedures.

SOP

Visitor procedures

2.5.3 Equipment

Equipment will be kept clean at all times. This is to prevent possible spread of pathogens by fish, personnel or water borne route. Equipment will be properly disinfected after each use and put away in its proper place.

2.5.4 Equipment movement

Where possible, equipment will not be shared between sites and/or areas. This includes fish handling equipment, vessels, feeding, monitoring and other equipment. Vessels and equipment, which must be used at multiple sites, will be subject to strict biosecurity and disinfection measures between uses.

SOP

Equipment disinfection

2.5.5 Diver disinfection and movement

Divers will adhere to disinfection and biosecurity procedures at each facility. All efforts will be made for additional disinfection of divers, equipment and vessels to occur in transit between sites.

SOPs

Diver disinfection per site *Diver procedures if diving multiple sites*

2.5.6 Suppliers

Suppliers will be advised of HSWRI and site specific procedures in advance. Suppliers who visit multiple sites shall be subject to strict biosecurity measures and may be requested not to come on site. HSWRI will notify suppliers of any significant disease concerns, as per 2.9.2.4 (below).

SOP

Supplier procedures (general)

2.5.7 Moving fish between sites

Fish movement between sites will be minimized, however, when this is necessary, a disease risk assessment will be performed by the state fish pathologist prior to moving the fish. If there is a disease of concern, fish cannot be moved without written authorization from the Director of Operations, and in such a case, could only be moved back to the hatchery. Under no circumstance can fish be moved between net pet sites without the authorization of the state fish pathologist. Particular care will be paid to handling of the fish to avoid undue stress, transmission of disease or possibility of escape. Where there is a potential fish health problem the risk will be assessed by the state fish pathologist in advance of the fish being moved. Where well boats are used, water quality will be closely monitored and maintained to reduce stress during transport.

SOP

Fish transport procedure

2.6 Minimizing disease within the site

All efforts will be made to minimize disease on a site. Adequate hygiene, disinfection, and mortality collection help to keep fish healthy and exposed to as few pathogens as possible.

2.6.1 Hygiene and disinfection - personnel

All personnel will adhere to the facility hygiene and disinfection procedures as per 2.5.1 (above).

2.6.2 Hygiene and disinfection – equipment

Equipment will be kept clean, in good working order and disinfected as per 2.5.4 (above).

2.6.3 Mort collection

Mortalities will be collected on a routine and frequent basis to minimize the potential spread of disease and to minimize attractiveness to predators. Disinfection procedures will be adhered to after each mort dive.

Management of unusually high mortalities will be as per 2.9.2.5 (below).

SOP

Mortality collection and disposal

2.7 Monitoring Fish Health

Ideally, fish will be monitored at least once daily for any unusual behavior, visible lesions or other signs of disease. Changes in behavior and physical condition will be reported to the net pen operator. Water quality may also be routinely monitored (as per 2.4 (above)).

2.7.1 Mort dives

Morts collected on routine mort dives (as per 2.6.3 (above)) may be examined for signs of disease. Suspected causes of mortality must be recorded and the state fish pathologist will be notified of any unusual numbers or types of mortalities.

Routine sampling may be done by the state fish pathologist or the FHS.

SOP

Mortality classification

SOPs

Fish health sampling procedures, e.g., proper collection and shipping of samples

2.7.2 Common fish health procedures

2.7.2.1 Anesthetizing fish

A variety of fish health procedures require that fish be anesthetized. Anesthetics are obtained through the institute's veterinarian. Netting or seining of fish prior to anesthesia will be done in as stress-free a manner as possible. Exposure to anesthetic will be minimized while ensuring the anesthetic level is adequate for the procedure. Anesthetized fish will be monitored carefully at all times. Water quality of the anesthetic bath – in particular, oxygen level – will be monitored.

SOP

Anesthesia

2.7.2.2 Euthanasia

In the uncommon situation where fish will be euthanized (e.g., certain fish health sampling), euthanasia is performed in as humane a manner as possible. The method used results in rapid and irreversible loss of consciousness.

SOP

Euthanasia

2.8 Fish Health Records

Fish health records include but are not limited to:

- Inventory records
    - Includes source, number, location and spawn ID of fish at the site
- Fish movement records
- Daily feed consumption, growth rate and feeding behavior
- Mortality records including mortality cause if known
- Signs of increased morbidity
- Lab work
- Diagnostic sampling records
- Water quality records
- Medicated feed records
- Therapeutant treatment records (see also 2.12 (below))
- Records of mitigative actions (other than therapeutants) taken to prevent or mitigate disease, e.g. taking fish off feed due to an algal bloom
- Records of reporting to State or Federal authorities, in accordance with existing regulation

Many of these records are computerized. HSWRI 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 easily accessible and protected from damage, e.g. kept in binders in the site office.

Records will be kept for the duration of time the fish are on site. HSWRI will keep archived records at a suitable location at the hatchery office or securely stored off site.

Aquaculture facility records will be available for inspection upon request by state or federal regulations.

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

2.9 Fish Disease Outbreaks

A fish health emergency is any situation where the health of a fish population is suddenly at risk. This may be due to significant pathogens such as viruses or to water quality changes such as algal blooms or fuel spills. Vigilant monitoring and early detection is key to good management of emergencies. Basic guidelines for the steps to be followed in outbreak investigation are found in the Manual of Fish Health Practices.

SOP

Fish Health Emergency Procedures

2.9.1 First steps

The state fish pathologist and the FHS and/or the Fish Health Management Team will be *immediately* notified if a serious problem is suspected. If the problem is due to water quality the site will activate the Operator's Water Quality Contingency Plan (see 2.4.1 (above)).

2.9.2 Infectious Disease Emergencies

An outbreak is defined as an unexpected occurrence of mortality or disease. Not all outbreaks are fish health emergencies. Infectious diseases may differ in how contagious they are and therefore how easy or difficult they are to control. Rapid response is essential but will be determined on a case-by-case basis in conjunction with the state fish pathologist, FHS, and/or Fish Health Management Team. Once an emergency has been recognized certain steps will be followed. The objective is to keep the pathogen "load" as low as possible and to prevent spread of the problem on or off the site.

2.9.2.1 Isolation/Quarantine[4]

At the state fish pathologist's or FHS's recommendation the site may be officially isolated/quarantined. Isolation/Quarantine remains in effect until such time as the problem has been diagnosed and/or managed.

SOP's

Isolation/Quarantine

2.9.2.2 Stop fish movement and/or handling

The movement of all fish on/off and within the site will cease. Fish will not be further handled. Equipment and personnel will *not* move on or off site unless special arrangements are made, e.g., for staff going on or off shift for the site. No visitors or non-essential staff will be allowed on site unless previously authorized by the Director of Operations.

2.9.2.3 Disinfection and Hygiene

Hygiene and disinfection on site, including procedure for personnel and equipment will be strictly enforced.

2.9.2.4 Suppliers

Suppliers will be instructed to visit the site last or to make special arrangements (e.g., designated vessel) to pick up and deliver only to the affected site.

2.9.2.5 Mortality Dives

The frequency of mortality dives/netting will be increased. The affected site will be dived last and divers will adhere to disinfection procedures between sites. Separate gear and vessels will be designated for the affected site whenever possible. All equipment, surfaces and clothing that come in contact with infected fish or infected material will be thoroughly disinfected after use. Mortality collection and disposal procedures will be strictly adhered to, and provisions made for increased mortality pick-ups and disposal.

2.9.2.6 Determining the cause of the outbreak (outbreak investigations)

The DFG pathologist and/or institute veterinarian may require records and appropriate sampling to determine cause of the outbreak and best course of action. The DFG fish pathologist and/or institute veterinarian may give instructions for proper sampling or may take samples directly on site. Water and feed samples may be requested. Samples will be properly handled, properly stored and promptly shipped as per the Veterinarian's or DFG pathologist's instructions.

Continued monitoring will be required after the initial workup to determine the course of the outbreak and to assess whether treatment and/or management measures are being effective. Frequent observations of the fish are essential. Feeding response and water

[4] "Quarantine" is the enforced physical separation of a healthy population from a (potentially) infected population, their products or items they may have contaminated (Martin et. al., eds. Veterinary Epidemiology: Principles and Methods)

quality will be monitored. All treatments and management changes will be noted as they occur. The DFG pathologist, institute veterinarian, and/or the Fish Health Management Team and site management will work together to review fish health records and make further management decisions. Any repeat sampling – including results - will be duly noted.

2.9.2.7 Dealing with Large Scale Mortality Events

If it has been agreed to depopulate the site, the procedures will conducted in a manner consistent with principles of hygiene and biosecurity (see 2.9.3 (below)).

2.9.2.8 Reporting to authorities

Where appropriate and/or in accordance with existent regulation, institute's management will report the outbreak to State or Federal authorities.

2.9.2.9 Communicating with other operators

As per 1.8 (above) the institute's head office will notify other operators in the geographic area of the outbreak.

2.10 Fish escape

Fish escapes are covered by Aquaculture regulation. In the unlikely event that fish escape, the institute's Fish Escape Response Plan goes into immediate effect. As part of the Response Plan, fish health records - including relevant diagnoses and treatments - will be made available to the appropriate regulatory authorities upon request.

2.11 Releases

The health and treatment status of fish will be considered when planning intentional fish releases. If there is a health or treatment concern fish shall not be released until risk assessment recommendations are in place. All fish must be examined and cleared for release by the DFG Fish Pathologist prior to release.

SOP

Risk assessment for fish releases

2.12 Handling drugs and chemicals

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. As per 1.7.1 (above) the Veterinarian retains a veterinarian-client-patient relationship with the institute that is the basis for disease diagnoses and prescribing treatments.

2.12.1 Medicated feed storage and inventory

Medicated feed is stored in clearly marked bags separately from non-medicated feed. The storage area shall be clean, dry and free of predators. The label on the medicated feedbag states details about the feed, medication included, feed rate, name of the veterinarian, and date it was prepared.

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 there is excess medicated feed after completion of the treatment the FHS will be contacted to determine proper handling and disposal.

SOP

Medicated feed

2.12.2 Handling and administering medicated feed

Medication mixed into feed has a Material Safety Data Sheet (MSDS), which specifies handling and safety precautions. An MSDS for all medications used must be on site in a readily accessible binder. All chemicals must be handled safely by trained staff e.g., by wearing appropriate protective gear and taking suitable precautions.

Medicated feedbags, including bulk bags will be handled carefully in transit from storage to automated feeding equipment or in preparation for hand feeding. All inadvertent spillage will be cleaned up immediately, and feed will be protected from bird predation.

Medicated feed will be fed out in accordance with the Veterinarian's instructions. The appropriate pen(s) must receive the prescribed amount medicated feed for the duration of treatment.

SOP

Medicated feed

2.12.3 Treatment records

State regulations require that treatment records for therapeutants include:

- Location of aquaculture facility
- Species of fin fish, number, and fish identification numbers
- Name of the prescribing Veterinarian
- A log naming the drugs (therapeutants), including
    - Name of the Drug
    - Dose and method of administration
    - 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 will be kept during the entire time of medication. Medicated feed records will be kept for the entire time the fish are on site. In combination with inventory records, the groups that were treated will be readily identifiable through treatment and withdrawal times.

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

2.12.4 Chemicals and Biologicals

2.12.4.1 Disinfectants

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

2.12.4.2 Chemicals

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

2.12.4.3 Biologicals

Biologicals include vaccines. Where applicable, these products will be kept refrigerated and handled as per manufacturer's instructions. A product insert for each vaccine that is on site will be kept in a safe, readily accessible place. Trained staff must handle all biologicals safely e.g., by wearing appropriate protective gear and taking suitable precautions.

3 HATCHERY SITES

3.1 Biosecurity

Maintaining a clean, safe work environment will reduce the possibility for spread and exposure of fish to infectious or parasitic disease. Pathogens may be spread by sick fish and wild fish through the water, on shared equipment, or by inadvertent contact by personnel, visitors or their gear. Entrance of potential pathogens will be prevented or minimized by an effective biosecurity "barrier" at each facility. Biosecurity applies to all personnel (staff, divers, management), to all visitors and all equipment.

Biosecurity includes three components:

Keeping fish healthy

Keeping pathogens out

Keeping disease from spreading within the site

3.2 Keeping Fish Healthy

Keeping fish as healthy as possible is critical to keeping disease from coming on site and/or spreading within a site.

3.2.1 Separation of year classes

Hatchery operations commonly have overlapping age classes on site, e.g., larvae, juveniles, and broodstock. Rearing units will be kept separate to prevent transmission of disease between age classes.

3.2.2 Suitable rearing environment

HSWRI is responsible for ensuring a suitable rearing environment for the fish, so they can stay healthy. Facility requirements for physical assets are specified elsewhere; materials used in the construction and maintenance of holding areas are chosen to minimize potential harm to the fish. Facilities will be monitored to minimize the occurrence of vandalism. Redundant and/or back up systems are necessary in the event of catastrophic failures in the water supply.

3.2.3 Normal fish behavior

Fish will be routinely monitored for signs of health and disease. All staff shall be familiar with normal fish behavior. Key behaviors that indicate healthy fish include but are not limited to:

- Physical – changes from normal i.e. scale loss, parasites, external injury
- Behavioral - swimming and schooling behavior, increased respiration
- Feeding – normally aggressive feed response when feed is presented

Fish will be kept at reasonable densities. Changes in behavior and physical condition will be reported to hatchery management and/or the FHS. Early detection is key to good disease management.

3.2.4 Predators

Predators will be excluded from the site. Predators include birds, other fish and marine mammals. The operator maintains Best Management Practices (BMP's) for predator exclusion.

Standard Operating Procedures (SOPs)[5]*:*

Predator exclusion

3.2.5 Feed and Nutrition

The objective of good nutrition is to keep fish healthy; fish receive sufficient quantity and quality of feed. The operator has procedures in place for healthy feeding of fish, including type of feed and different feed delivery methods. Proper storage of these diets is essential to maintaining their nutritional value. Feed will be stored in secure buildings where wildlife can be excluded and spillage prevented; feed is protected from extremes of heat, light and humidity.

SOP:

Feed storage

3.3 Fish Handling techniques

3.3.1 Common Fish Handling Techniques

The operator maintains BMP's for handling fish, e.g. grading, including minimizing the risk of escape while the fish are being handled. Handling – including equipment maintenance - will be done so as to minimize injury to the fish and/or predispose to disease. Fish will be monitored while being handled as well as for a period after handling to ensure any negative effects are noted and mitigative steps are taken to minimize impact. Staff will minimize the time fish are exposed to stressful events such as crowding and out-of-water events (i.e. handling, counting, weighing, grading, tagging, injecting).

SOPs:

Fish Handling techniques

[5] See Appendix 1 – List of Standard Operating Procedures (SOP's) for a Fish Health Management Plan

3.3.2 Tagging fish

Tagging fish will be done in a manner to cause minimal injury and stress to the fish. The resulting open wound can lead to secondary infections. Appropriate anesthesia (see 3.7.2.4 (below)) and monitoring will be done for adverse effects after the procedure.

SOP

Tagging Fish

3.3.3 Fish transports

All 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 disease. Vehicles and vessels used to transport mortalities are not used to transport live fish unless absolutely necessary. Proper hygiene and disinfection will be adhered to. Appropriate permits will be obtained from DFO.

SOP

Fish transport

3.4 Monitoring water quality

Maintaining good water quality is vital to good fish health. The institute 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. In-line monitoring may be applicable. The frequency of monitoring will depend on available equipment and type of facility, e.g., flow through or recirculation.

SOP

Water quality monitoring - temperature, DO, chemistries equipment calibration and maintenance, (others as applicable)

3.4.1 Contingency plans

The institute maintains a contingency plan in the event of acute deterioration of water quality. Systems are suitably alarmed to indicate changes in water quality below predetermined set points, e.g. precipitous fall in dissolved oxygen levels. In the event of life threatening water quality fish are immediately taken off feed to reduce oxygen demand and stress.

Failure of pumps and/or oxygen delivery is an immediate emergency. The site has back up system(s) for keeping dissolved oxygen levels compatible with short-term life support for the fish while the system failure is being addressed.

Enhancement fish will be released with the prior approval of the DFG pathologist.

Attachment:

Operator's Water Quality Contingency Plan (hatchery)
Emergency Fish Release

3.5 Keeping Pathogens Out

All necessary precautions will be taken to ensure disease is kept out of a facility. Potential pathogens will be prevented or minimized by an effective biosecurity "barrier" at the perimeter of each facility and, where possible, between rearing units on the facility. Biosecurity applies to all personnel (staff, management), to all visitors and all equipment.

3.5.1 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 adhere to all biosecurity procedures at each facility.

SOP

Site and staff disinfection procedures

3.5.2 Visitors

Each site shall have procedures for all visitors, and visitors are expected to follow these procedures.

SOP

Visitor procedure

3.5.3 Equipment

Equipment will be kept clean at all times. This is to prevent possible spread of pathogens by fish, personnel or water borne route. Equipment will be properly disinfected after each use and put away in its proper place.

3.5.4 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.

SOP

Equipment disinfection

3.5.5 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. Particular attention will be paid to biosecurity measures for mort pick-ups. Farms will notify suppliers of any significant disease concerns, as per 3.9.2.4 (below).

SOP

Supplier procedures (general)

3.5.6 Moving fish between sites

Fish movement between sites will be minimized, however wherever this is necessary there will be a disease risk assessment done by a fish health professional prior to moving the fish. If there is a disease of concern fish cannot be moved without prior authorization of the DFG fish pathologist. Particular care will be paid to handling of the fish to avoid undue stress, transmission of disease or possibility of escape. Where there is a potential fish health problem the risk will be reduced in conjunction with the Fish Health Management Team in advance of the fish being moved.

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

SOP

Moving fish between sites

3.6 Minimizing disease within the site

All efforts will be made to minimize disease on a site. Adequate hygiene, disinfection, mortality collection and tank cleaning help to keep fish healthy and exposed to as few pathogens as possible.

3.6.1 Hygiene and disinfection - personnel

All personnel will adhere to the facility hygiene and disinfection procedures as per 3.5.1, (above).

3.6.2 Hygiene and disinfection – equipment

Equipment must be kept clean, in good working order and disinfected as per 3.5.4 (above).

3.6.3 Mort collection

Mortalities will be collected on a routine and frequent basis to minimize the potential spread of disease and to minimize attractiveness to predators. The operator has BMP's for mortality collection. The mort storage area will be an appropriate distance away from any rearing units to minimize inadvertent spread of disease. Proper disinfection procedures will be adhered to after each mort collection.

Management of unusually high mortalities will be as per 3.9.2.5 (below).

SOP

Mortality collection and disposal

3.7 Monitoring Fish Health

Fish will be monitored at least once daily for any unusual behavior, visible lesions or other signs of disease. Changes in behavior and physical condition will be reported to site management. Water quality will also be routinely monitored (as per 4.4 (above)).

3.7.1 Mortality classification

Morts collected daily (as per 3.6.3 (above)) will be examined for signs of disease. As per the operator procedure suspect morts 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.

Routine sampling may be done as per the operator procedure and/or on the instructions of the institute's Veterinarian and/or DFG Fish pathologist.

SOPs

Mortality classifications

Fish health sampling procedures e.g., proper collection and shipping of samples, lab work (on-site, in house or referred)

3.7.2 Common fish health procedures

3.7.2.1 Egg disinfection

Eggs can be safely disinfected following fertilization. This is done at the broodstock facility and/or when the eggs enter the hatchery.

SOP

Egg disinfection

3.7.2.2 Egg treatments

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

SOP

Egg treatment

3.7.2.3 Anesthetizing fish

A variety of fish health procedures require that fish be anesthetized. Anesthetics will be obtained from the institute's veterinarian. Netting of fish prior to anesthesia will be done in as stress-free a manner as possible. Exposure to anesthetic will be minimized while ensuring the anesthetic level is adequate for the procedure. Anesthetized fish will be monitored carefully at all times. Water quality of the anesthetic bath – in particular, oxygen level – will be monitored.

SOP

Anesthesia

3.7.2.4 Vaccinating fish

Vaccines are used to boost immunity to certain infectious diseases (e.g. Furunculosis) and are part of an integrated fish health management program. Vaccines are biologic substances that will be stored (refrigerated) and handled as per manufacturer's instructions so as to maintain their effectiveness. Staff will be appropriately trained prior to undertaking the vaccination procedure. At this time, there are no vaccines recommend for use in marine fish. However, vaccines may become available. At that time, the Fish Health Management Team will decide whether vaccination should become a regular part and develop appropriate SOPs.

3.7.2.5 Euthanasia

In the uncommon situation where fish will be euthanized (e.g., certain fish health sampling), euthanasia is performed in as humane a manner as possible. The method used will result in rapid and irreversible loss of consciousness.

SOP

Euthanasia

3.8 Fish Health Records

Fish health records include but are not limited to:

- Inventory records
    - Includes source, number, location and spawn ID of fish at the site
- Fish movement records
- Daily feed consumption, growth rate and feeding behavior
- Mortality records including mortality cause if know and any deformations
- Signs of increased morbidity
- Lab work
- Diagnostic sampling records
- Water quality records
- Medicated feed records
- Therapeutant treatment records (see also 3.12, below)
- Records of mitigative actions (other than therapeutants) taken to prevent or mitigate disease, e.g. changed filters, sterilized system
- Records of reporting to State and/or Federal authorities, in accordance with existing regulation

Many of these records are computerized. The institute 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 easily accessible and protected from damage, e.g. kept in binders in the hatchery office. 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.

Aquaculture facility records will be available for inspection upon request by state or Federal authorities as per regulation.

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

3.9 Fish Disease Outbreaks

A fish health emergency is any situation where the health of the fish population is suddenly at risk. This may be due to significant pathogens such as VNN virus or sudden, severe decreases in dissolved oxygen levels. Vigilant monitoring and early detection is key to good management of emergencies.

SOP

Fish Health Emergency Procedures

3.9.1 First steps

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 Institute's Water Quality Contingency Plan (see 3.4.1(above)).

If a serious infectious disease problem is suspected the operator's Veterinarian and/or Fish Health Management Team will be *immediately* notified. If the problem is not easily discerned, diagnosis and management need to be done hand in hand.

3.9.2 Infectious Disease Emergencies

An outbreak is defined as an unexpected occurrence of mortality or disease. Not all outbreaks are fish health emergencies. Diseases may differ in how infectious they are and therefore how easy or difficult they are to control. 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 will be followed. The objective is to keep the pathogen "load" as low as possible and to prevent spread of the problem on or off the site.

3.9.2.1 Isolation/Quarantine

At the DFG pathologist or FHS recommendation the site may be officially isolated/quarantined. Isolation/Quarantine remains in effect until such time as the problem has been diagnosed and/or managed.

SOP

SOP Isolation/Quarantine

3.9.2.2 Stop fish movement and/or handling

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

3.9.2.3 Disinfection and Hygiene

Hygiene and disinfection on site, including procedure for personnel and equipment will be strictly enforced.

3.9.2.4 Suppliers

Suppliers (e.g., feed or oxygen delivery) will be instructed to visit the site last or to make special arrangements.

3.9.2.5 Mortality Collection

The frequency of mortality collection will be increased. Affected tanks/net pens will be mort picked last and staff will adhere to disinfection procedures between tanks and rearing units. Where possible separate gear will be designated for the affected unit. All equipment, surfaces and clothing that come in contact with infected fish or infected material will be thoroughly disinfected after use. Mortality collection and disposal procedures will be strictly adhered to, and provisions made for increased mortality pick-ups and disposal.

3.9.2.6 Determining the cause of an outbreak (outbreak investigations)

The DFG Pathologist or FHS may require records and appropriate sampling to determine cause of the outbreak and best course of action. The DFG Pathologist or FHS will give instructions for proper sampling. Water and feed samples may be requested. Samples will be properly handled, properly stored and promptly shipped as per the DFG Pathologist or FHS's instructions.

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

3.9.2.7 Dealing with large-scale mortality events

If it has been agreed to depopulate the site, the procedures will conducted in a manner consistent with principles of hygiene and biosecurity (see 3.9.3 (below)).

3.9.2.8 Reporting to authorities

Where appropriate and/or in accordance with existent regulation, institute management will report the outbreak to state and/or Federal authorities.

3.9.2.9 Communicating with other operators

As per 1.8 (above) the institute's head office will notify other hatchery operators in the geographic area of the outbreak.

3.10 Fish escape

In the unlikely event that fish escape into open water, the operator Fish Escape Response Plan goes into immediate effect. As part of the Response Plan, fish health records - including relevant diagnoses and treatments - will be made available to state and/or Federal authorities and required by law.

3.11 Releases

The health and treatment status of fish will be considered when planning intentional fish releases from enhancement facilities. If there is a health or treatment concern fish shall not be released until risk assessment recommendations are in place.

SOP

Risk assessment for fish releases

3.12 Handling drugs and chemicals

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. As per 1.7.1 (above) the Veterinarian retains a veterinarian-client-patient relationship with the institute that is the basis for disease diagnoses and prescribing treatments.

3.12.1 Medicated feed storage and inventory

Medicated feed will be stored in clearly marked containers separately from non-medicated feed. The storage area will be clean, dry and free of predators. The label on the medicated feed container states details about the feed, medication included, feed rate, name of the veterinarian, and date it was milled or mixed.

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 there is excess medicated feed after completion of the treatment the Veterinarian will be contacted to determine proper handling and disposal.

SOP

Medicated feed

3.12.2 Handling and administering medicated feed

Medication mixed into feed has a Material Safety Data 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 chemicals must be handled safely by trained staff e.g., by wearing appropriate protective gear and taking suitable precautions.

Medicated feed will be fed out in accordance with the Veterinarian's instructions. The appropriate tanks or net pens must receive the prescribed amount medicated feed for the duration of treatment.

SOP

Medicated feed

3.12.3 Treatment records

State regulations require that treatment records for therapeutants include:

- Name, signature, address, and telephone number of the prescribing veterinarian
- The veterinarian's license number and his or her federal registry if a controlled substance is prescribed
- The name and address of the facility
- Species of fish, number of fish, and identifying information for the fish
- A log naming the drugs (therapeutants), including
    - The name, strength, and quantity of the drug(s)
    - Directions for use including withdrawl times, if applicable
    - Date of issue
    - Number of refills

Detailed records of medicated feed administration will be kept during the entire time of medication. Medicated feed records will be kept for the entire time the fish are on site. In combination with inventory records, the groups that were treated will be readily identifiable through treatment and withdrawal times.

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

3.12.4 Chemicals and Biologicals

3.12.4.1 Disinfectants

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

SOP

Use of disinfectants

3.12.4.2 Chemicals

Chemicals include but are not limited to fixatives, such as formalin or Bouin's solution used for preserving fish tissues. These chemicals will be stored in clearly marked

containers. An MSDS for each chemical that is on site will be kept in a safe, readily accessible place, e.g. binder in the site office. All chemicals must be handled safely trained staff e.g., by wearing appropriate protective gear and taking suitable precautions.

3.12.4.3 Biologicals

Biologicals include vaccines. Where applicable, these products will be kept refrigerated and handled as per manufacturer's instructions. A product insert for each vaccine that is on site will be kept in a safe, readily accessible place. Trained staff must handle all biologicals safely e.g., by wearing appropriate protective gear and taking suitable precautions.

4 BROODSTOCK – SPECIAL CONSIDERATIONS

Broodstock may be held at net pen sites or may be held in inland facilities. All fish health considerations in the previous sections apply (e.g., biosecurity, routine monitoring, treatments, emergencies, records)[6] though they will differ between net pen and inland facilities. For example, water quality monitoring and contingency planning will differ between sites.

4.1 Suitable rearing environment

HSWRI is responsible for providing a suitable, secure rearing environment. Escape prevention is essential.

4.2 Feed and Nutrition

The objective of good nutrition is to keep fish healthy; fish receive sufficient quantity and quality of feed. Broodstock require specially formulated diets to meet their nutritional requirements. Broodstock feeding strategies differ from those of production fish, particularly as they begin to spawn. Proper storage of these diets is essential to maintaining their nutritional value; feed is protected from extremes of heat, light, and humidity.

4.3 Biosecurity

Mature broodstock are kept for a longer period of time than production fish. They may have been exposed to more pathogens or, upon approaching maturation, may have become more susceptible to infection due to the stress of physiological changes they are undergoing.

Where possible separate staff and equipment will be designated for broodstock. Strict disinfection and hygiene procedures need to be in place. Biosecurity is particularly important to stop the transfer of pathogens from the mature fish to susceptible larvae.

As per 2.1 and 3.1 (above) pathogens may be spread by sick fish, through the water, on shared equipment or by inadvertent contact by personnel, visitors or their gear. To minimize two-way transmission of disease, mature broodstock may be kept at a designated site or at a portion of a site or system removed from production fish.

SOP

[6] See Appendix 1 – List of Standard Operating Procedures (SOP's) for a Fish Health Management Plan

Broodstock biosecurity

4.4 Selection and handling

Broodstock will be handled individually at least once. Aquaculture sites will select broodstock for specific traits. Handling individual fish will be done with care and with minimal stress so as to prevent any problems with gametes (eggs and milt). As per 2.7.2.1 and 3.7.2.4 (above) anesthesia will be done so as to minimize time under anesthetic and to provide as gentle a recovery as possible.

SOPs

Broodstock anesthesia
-Handling, recovery

SOP

Broodstock handling

4.5 Treatments

Broodstock will be treated preventatively for infectious diseases during their initial quarantine.

The type and timing of therapeutant treatments required is decided by the FHS. As per 2.12 and 3.12 (above) medications will be handled safely with appropriate gear. Treatments will be recorded and withdrawal times and all instructions adhered to. Broodstock should be treated as food fish.

SOP

Broodstock treatments

4.6 Egg collection

Egg collection will be done in as hygienic a manner as possible to prevent horizontal transmission of pathogens to progeny.

SOP

Egg Collection

4.7 Disease screening

The FHS will develop specific disease screening procedures to minimize the risk of vertical transmission. Samples for disease screening will be collected using proper disinfection procedures

For enhancement 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

Disease screening procedures

4.8 Egg disinfection

Eggs can be safely disinfected following fertilization. This is done prior to being placed in the incubators. (see 3.7.2.1 (above)).

SOP

Egg disinfection

4.9 Identifying larvae

Larval crops will be clearly labeled by date and by broodstock tank.

5 APPENDICES

5.1 APPENDIX 1: List of Standard Operating Procedures (SOP's) for Fish Health Management Plan

SOP	Net pen sites	Broodstock	Hatchery
Predator Exclusion	X	X	X
Feed storage	X	X	X
Fish handling techniques	X	X[7]	X
Marking fish			X
Water quality monitoring and equipment calibration and maintenance	X	X	X
Company water quality contingency plan	X	X	X
Site and staff disinfection protocols	X	X	X
Visitor protocol	X	X	X
Equipment disinfection	X	X	X
Diver disinfection per site	X	X	X
Diver protocols if diving multiple sites	X	X	X
Supplier protocols (general)	X	X	X
Fish transport	X	X	X
Mortality collection and disposal	X	X	X
Mortality classifications	X	X	X
Fish health sampling protocols o Proper collection and shipping of samples o Lab work (on site, in house, referral)	X	X	X
Anesthesia	X	X	X
Euthanasia	X	X	X
Infectious disease emergency protocols	X	X	X
Quarantine	X	X	X
Risk assessment for fish releases	X		X
Medicated feed	X	X	X
Use and disposal of	X	X	X

[7] See Broodstock handling (next page)

disinfectants			
Broodstock biosecurity		X	
Broodstock anesthesia o Handling o Recovery		X	
Broodstock handling		X	
Broodstock treatments		X	
Disease screening protocols		X	
Egg disinfection		X	X

5.2 APPENDIX 2: Elements of a Standard Operating Procedure (SOP)

1. Descriptive Title

2. Rationale: An indication of what aspects of the Fish Health Management Plan this SOP addresses (Reference to specific section(s) of this document would be preferred)

3. Definitions: Any technical terms, jargon or abbreviations used in the SOP are defined

4. Authority: Who in the organization is the contact person for any required information on details of the SOP and who is responsible for managing the implementation of the SOP

5. Details of the Operating Procedure:
    a. Goals, targets, legal requirements and/or standards the SOP is striving for
    b. Methods, equipment and procedures use
    c. Frequency of the actions, measures and/or assessment required by the procedure
    d. Who in the organizational structure will be responsible for conducting the SOP
    e. What actions will be taken if the goals, targets or standards are not achieved (response, mitigation, reporting)

6. Records:
    a. What information is recorded to document that the SOP is followed
    b. Where the records are stored
    c. How long the records are stored

The preceding outlines the features of an SOP thought to be necessary to evaluate how the procedure will address the goals and objectives of the Fish Health Management Plan. It is anticipated that the specifics of the SOP will vary with situation, species and rearing objectives. Not all aspects of the above will be required for each SOP.

APPENDIX 3:Regulations/Policies Directly Related to Fish Health Management

5.2.1 Federal

5.2.2 State