



Aquatic biosecurity standard operating procedures (SOPs) for hatcheries



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1. Definition of biosecurity

Biosecurity refers to the establishment and implementation of procedures to prevent the introduction of pathogens into a fish hatchery from a source outside the facility or into a section of the hatchery from another section within the same hatchery.

Biosecurity is a basic method of prevention to avoid contact between animals and pathogens and, in so doing, to avoid the introduction and spread of pathogens. It is a beneficial practice in any hatchery and does not require significant costs. Where biosecurity measures are not followed, however, more time and money are spent trying to cure diseases that result from the introduction and spread of pathogens. With respect to fish hatcheries, biosecurity entails measures that are straightforward, often cost-free, and can keep both pathogens away from fish and fish away from pathogens.

2. Definition of pathogen

Pathogens (bacteria; parasites; fungi; viruses) are infectious agents that can cause disease.

3. Benefits of aquatic biosecurity standard operating procedures (SOPs)

Biosecurity allows hatchery owners to minimise the risk of the following:

- occurrence of a disease outbreak;
- high fish mortality;
- high financial losses from the loss of fish;
- a setback caused by the disruption of production;
- high operation costs required to clean the premises after an outbreak;
- project failure;
- loss of clients who will no longer trust the quality of the juveniles/fry/fingerlings; and
- negative public perception.

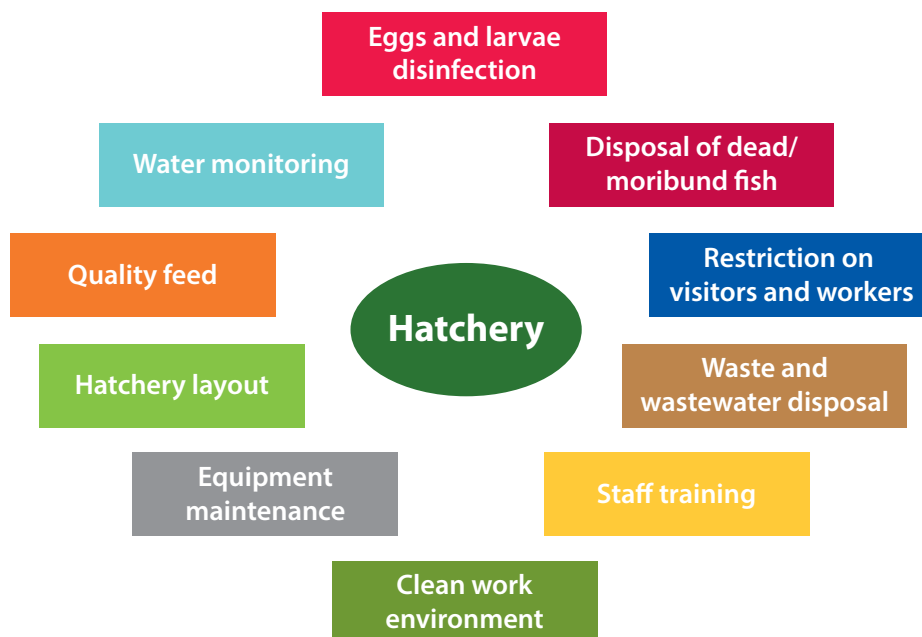


Figure 1. Basic biosecurity measures for hatcheries

4. Disease introduction and spread pathways

A list of the most common disease introduction pathways is provided below.

- **New fish:** The introduction of live fish (of any life stage, including eggs, larvae, juveniles, adults and brooders) from the outside (i.e. other countries; other aquaculture facilities; the wild) can introduce and spread pathogens resulting in an outbreak among fish already present in a hatchery. Fish that are carrying pathogens may not show clinical signs of disease.
- **Contaminated water:** Bringing contaminated water from outside can introduce pathogens into a hatchery.
- **Feeds:** Feeds (especially fresh or live feeds, and pelleted feeds) can be a source of aquatic pathogens that enter into a hatchery.
- **Contaminated equipment:** Pathogens may be carried on contaminated equipment used in fish hatchery.
- **Vehicles:** Uncontrolled visitors may carry pathogens into hatchery.
- **Hatchery staff:** Hatchery staff may introduce pathogens into a hatchery unintentionally.
- **Uncontrolled visitors:** Uncontrolled visitors entering into a hatchery can introduce and spread pathogens into a hatchery.
- **Vectors:** Vectors (i.e. any agent that carries and transmits an infectious pathogen into another living organism) can introduce and spread pathogens into a hatchery.

To overcome the introduction of new diseases/pathogens into a hatchery, operators must follow the protocols outlined below.

- Avoid introducing live fish into a hatchery from other countries or other facilities outside your facility, where possible.
- Avoid introducing wild live fish into a hatchery, where possible.
- Seek advice from the fisheries/biosecurity competent authorities first if fish must be introduced from the outside in order to identify reliable sources of fish.
- Ensure that a health certificate, certifying that fish are free of harmful pathogens, accompanies all consignments of fish.
- Keep new fish separate (quarantined whereby the quarantine period will depend on the specific species, life stage and health status of the facility/country of origin and destination) to ensure they are free of pathogens and disease before mixing them with existing fish in the hatchery. Remember that diseases introduced by new fish mixed with local hatchery fish can cause severe mortality (mortality rate higher than 10 per cent).
- Seek advice from biosecurity competent authorities on the level of risk (high; medium; low) and period of quarantine that should be implemented, depending on the type of fish being introduced (aquatic species; life stage; origin).

In a hatchery, equipment and items (e.g. buckets; nets; siphon hoses; clothing; footwear; etc.) are moved around during daily operations and can accidentally encounter sick fish or pathogens and transmit diseases.

Transmission can also occur through people, or vectors (e.g. rats; mice; squirrels; cockroaches; other stray animals).

To avoid the spread of disease, the protocols outlined below should be respected.

- Limit the movement of items within the premises and bar the entry of animals into the premises.
- Clean, disinfect and discard water used to bring new fish into the hatchery.
- Disinfect items (e.g. beakers; anything introduced into a fish tank).
- Clean and disinfect all items used at a fish hatchery, at a minimum, after each production cycle, as described in section 5.18.

5. Standard operating procedures (SOPs)

5.1 Basic requirements

Before establishing a new hatchery, proper planning is necessary to ensure the facility can be used successfully. The measures outlined below should be ensured when establishing a new fish hatchery.

- Position the hatchery far from other hatcheries or aquaculture farms, if possible, to help lower the risk of infection from neighbouring aquaculture facilities.
- Ensure the hatchery is free from flood-prone areas.
- Ensure that there is a facility on the hatchery that is capable of properly discharging effluent.
- Ensure the hatchery is accessible by road to facilitate the transport of fish, equipment, materials, and other necessities.
- Provide the hatchery with access to electricity.
- Ensure that the hatchery has access to a clean/high-quality water supply and that water availability is commensurate with the expected production volume.

5.2 Hatchery design

The success or failure of fish production depends on the design of the hatchery. Hatcheries should be designed to ensure effective biosecurity in order to prevent the introduction of pathogens while allowing efficient and cost-effective operation of the hatchery.

To achieve reliable production of high-quality larvae, production facilities must ensure the parameters outlined below are respected.

- Construct buildings using inexpensive and locally available materials, if available.
- Seal buildings to prevent the entry of animals/vectors (e.g. rats; birds), which can carry and spread pathogens, while also helping reduce high fluctuations in temperature, which can stress the fish.
- Install durable fencing to prevent the entry of both animals and unauthorised persons.
- Ensure constant aeration (24 hours per day) of the fish.
- Provide sufficient lighting.
- Ensure there are different compartments for different operations in the hatchery (e.g. broodstock; maturation; spawning; larvae rearing; nursery), with a separate footbath, equipment, and handwashing facility for each compartment as well as a separate compartment to quarantine new fish when necessary, and avoid entering the hatching area from the quarantine room.
- Include a separate compartment/production area for the laboratory.
- Include separate compartments for the storage of equipment, feeds and chemicals.
- Install separate entries for other sections in the hatchery (storage rooms for feed and equipment) to ensure that staff do not pass through the live fish section, in order to avoid cross-contamination.
- Ensure each tank has its own water inlet and outlet that do not flow from one tank to another in order to prevent cross-contamination.
- Install a drive-thru dip at the entrance to the hatchery to sanitise vehicles.
- Provide footbaths and handwashing stations at the entrance to the hatchery.
- Ensure the packing area is located near the main entrance of the hatchery.
- Isolate aerators and water pumps to avoid disturbances from noises and vibrations.

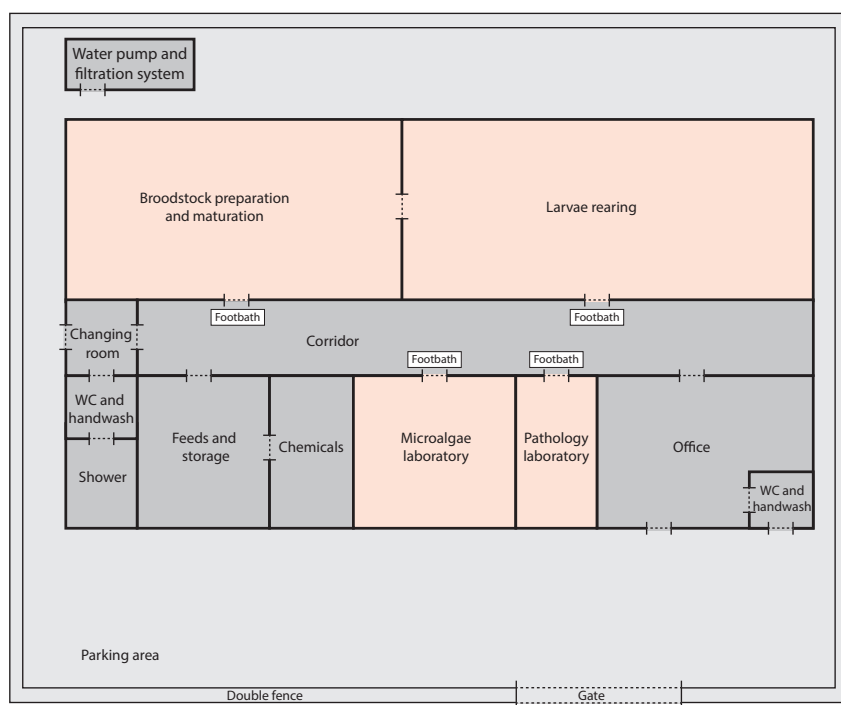


Figure 2. Design of a hatchery

5.3 Water supply and water quality

Clean water is essential to maintain optimum fish health. Poor water quality will result in low larval survival and affect overall hatchery production. Therefore, the water supply of a hatchery should be pathogen-free or treated appropriately.

Water quality is the most important factor affecting fish health and performance in aquaculture production systems. Thus, having good water quality is critical for any fish hatchery.

- Prioritise water drawn from bore wells and filtered (using sand filters, cartridge/bag filters, and other models to filter the water supply to the hatchery before use).
- Treat water that has been obtained from an open source before use, using a sand filter, UV light or ozone.
- Avoid splashes and aerosols between tanks, as these can spread pathogens.
- Treat all water that is contaminated with chemicals or heavy metals before use.
- Ensure that the physical and chemical conditions of the water remain within the optimum ranges for fish under culture, using reliable instruments to measure the water quality (e.g. temperature; dissolved oxygen levels; pH and ammonia and nitrite levels).
- Calibrate instruments to ensure reliable readings.
- Take appropriate measures, if the readings are not within the acceptable ranges, to correct the situation as changes to water quality can stress the fish.



pH test kit

5.4 Fish introductions

When new fish are introduced into a hatchery, they can contain pathogens that can spread disease throughout the facility. Although newly purchased fish may appear healthy, they can carry pathogens while showing no signs of disease. If proper precautions are not taken, the pathogens will spread and contaminate the hatchery. Once pathogens are introduced into a hatchery, it is difficult to eliminate them.

To minimise fish deaths from disease, hatcheries must implement the protocols outlined below.

- Purchase healthy fish from reliable suppliers that are regularly monitored by fish health experts and certified free of disease.
- Ensure fish sellers have a certificate or laboratory test results proving that the fish are free of specific pathogens, when there is a threat of a new pathogen.
- Seek a second opinion by sending the fish to an independent, reliable laboratory for testing, when there is cause for concern of a new pathogen.
- Maintain fish at the optimum stocking density, ensuring that tanks are not overcrowded as this can stress the fish and render them more susceptible to disease.
- Examine newly purchased fish eggs for pathogens, as described above, for new fish consignments. Disinfect fish eggs to remove pathogens from the surface, where necessary.
- Remove sick fish and isolate them in quarantine away from the healthy fish population to avoid transmitting diseases from sick to healthy fish, keeping in mind that the type and duration of the quarantine period will depend on the type of fish introduced (aquatic species; life stage; origin).



Packing broodstock

- Fisheries/biosecurity competent authorities will advise on the specific type and duration of the quarantine necessary, based on the factors outlined above.
- Maintain cleanliness in the hatchery and the surrounding areas at all times.

5.5 Fish handling and routine hatchery procedures

Stress can weaken fish, making them easily susceptible to any pathogens in the water. To lower the risk of infection, hatcheries must minimise the handling of fish and implement proper day-to-day procedures.

Hatchery protocols for handling fish

- Do not transfer fish more often than necessary.
- Remove live fish from water only when necessary.
- Use a smooth tray or plate to scoop fish.
- Do not hold live fish by the gills or tail.
- Avoid rough handling to minimise damages.

Routine hatchery procedures

- Monitor fish frequently and check their behaviour. Any abnormal behaviour is an indication of stress or disease.
- Maintain appropriate water quality parameters.
- Stock appropriate densities of fish to avoid stress.
- Provide proper nutrition/feed.
- Remove any excess feed by siphoning it from the tank.
- Ensure an appropriate stocking density (number of fish) in each tank. Do not allow overcrowding (understanding that specific stocking densities will vary depending on the species, water quality and farming strategy).
- Avoid the potential risk of introducing diseases, as described in previous sections.
- Remove dead or dying fish regularly/daily. Disease can spread through water or when healthy fish consume dead or dying fish infected with pathogens. It is, thus, important to remove and quarantine (isolate) all sick fish.
- Examine dead fish to determine the cause of death.
- Clean and disinfect tanks and accessory equipment (e.g. pumps; filters; pipes; trays) in the hatchery following each harvest and before introducing any new fish.
- Clean and disinfect hatchery items and the surrounding premises (to break the cycle).
- Maintain accurate records of growth rates, feed conversion ratios, survival rates and diseases.

5.6 Feeds and feeding

Proper nutrition during larval stages is crucial to meet the production plans of a hatchery. If fish larvae are provided with quality feed, they will grow quicker and be more resistant to stress and disease. However, live and fresh feed from unknown origin pose a higher risk of transmitting disease than commercial pelleted feeds. Care must be taken to provide proper feed for a balanced diet that is free of pathogens.

The protocols outlined below should be adopted for feed procurement and storage.

- Obtain good quality feed from reliable sources, as poor quality feed can also cause disease.
- Use feed before the expiry date to retain the nutritional contents and to avoid contamination of old feed with pathogens.
- Keep feed away from rats and other animals, and store it in a cool, dry, secure place to retain its nutritional contents.
- Avoid using fresh or live feed.
- Do not use fresh feed (trash fish; bivalves; etc.) that could contain pathogens, as fresh feed should only be used if it can be treated to remove pathogens.
- Keep in mind that commercial pellet feeds are generally safe and present a low risk of disease transmission.



Pelleted feeds distribution

5.7 Hatchery equipment: cleaning and disinfection

To prevent disease transmission, effective cleaning and disinfection procedures should be carried out to avoid introducing and spreading diseases.

Hatcheries must adopt the protocols outlined below in order to minimise the risk of contamination.

- Clean and disinfect all tanks and equipment thoroughly after each use and before starting a new production cycle. (Note that UV radiation can be used as a means for disinfection.)
- Wash and disinfect filters at regular intervals.
- Avoid taking any hatchery items outside the facility.
- Use reliable instruments to make measurements and calibrate them frequently.
- Clean, disinfect and dry all hatchery equipment (nets; buckets; boots; etc.) after each use.
- Flush and remove sand from sand filters and, then, dry the filters in the sun.
- Wash and disinfect tanks at the end of every production cycle.
- Limit the movement of equipment. Ensure that each tank has its own small items (beakers; scoop nets; buckets; etc.), and refrain from using these items in other tanks.
- Disinfect items after each use if sharing items between tanks is absolutely necessary.
- Maintain a clean work environment.



Disinfection of cartridge filters

A necessary component of disease prevention and control in a hatchery is disinfection. Diseases affecting one larval tank can spread easily to other tanks through contamination.

The sanitation and disinfection protocols outlined below should be practised.

- Apply appropriate disinfectants at suitable concentration levels and for appropriate durations.
- Disinfect all hatchery equipment (trays; nets; etc.) regularly and dry them thoroughly.
- Wash items thoroughly, if necessary, after disinfection to remove any toxic residues.
- Flush and remove sand from sand filters and, then, dry the filters in the sun.
- Soak airbag/cartridge filters in disinfectant and dry them in the sun.
- Wash and disinfect tanks at the end of every production cycle.
- Store nets and other equipment off the floor.
- Do not use hatchery equipment in other places due to the risk of cross-contamination.
- Disinfect hatchery equipment properly after use, if it is absolutely necessary to use it in other locations.
- Use antimicrobial agents to disinfect non-living objects or surfaces in order to destroy or inactivate pathogens.

5.8 Cleaning and disinfection protocol

Proper cleaning and disinfection procedures must be practised to ensure items treated with chemicals are disinfected thoroughly.

For proper disinfection, the steps listed below must be undertaken in the order that follows.

1. Remove dirt and organic matter manually from the item to ensure the disinfectant is effective.
2. Wash the item with soap and water.
3. Rinse the item with water.
4. Apply an appropriate disinfectant at suitable concentration levels and for appropriate durations.
5. Rinse the item again to remove the disinfectant.
6. Dry the item (under the sun, if possible).



Disinfection of cartridge filters

5.9 Transport and vehicles

Hatcheries must adopt the protocols outlined below to minimise the risk of vehicles introducing and spreading disease both within and outside the hatchery.

- Do not permit unauthorised vehicles inside hatchery premises.
- Disinfect the wheels and undercarriage of all vehicles allowed to enter a hatchery by passing them through a bath at the gate entrance.
- Replace the disinfectant regularly, adhering to the instructions on the label.
- Position the packing/storage area near the main entrance of the hatchery to prevent vehicles from entering the hatchery area to download.



Fish in the tank

5.10 Visitors

It is important to minimise the risk of staff and visitors transferring diseases on, within and off the hatchery. If procedures are not followed, someone who has visited another site may be carrying pathogens that can contaminate the hatchery. Similarly, frequent movement of staff between different sections within the hatchery can also transmit pathogens.

To avoid contamination from people, hatcheries must implement the procedures outlined below.

- Restrict the movement of people and staff between different compartments/production areas, with special emphasis between the production areas with different “health status” (e.g. quarantine area and production area).
- Use the hand wash and foot bath at the entrance of the hatchery.
- Do not allow unauthorised people inside the hatchery.
- Maintain a visitors’ logbook.
- Ensure that hatchery personnel escort all visitors into the facility.
- Restrict visitors from fish tank areas.
- Replace the disinfectant regularly, adhering to the instructions on the label.

5.11 Wastewater management and solid waste disposal

Wastewater management

Hatcheries must ensure that water discharged from the facility is as clean as possible and free of pathogens. Proper treatment and discharge will reduce the risk of disease within the hatchery and to others in the vicinity.

Treat wastewater at an acceptable level before discharge to avoid the spread of any disease by following the procedures outlined below.

- Release wastewater from the hatchery into a sedimentation tank/s.
- Chlorinate and de-chlorinate wastewater from sedimentation tanks before discharging them in treatment tanks.
- Do not discharge water close to the intake point.

Solid waste disposal

Waste products (e.g. dead animals; wastewater; processing waste) can be vectors for transmitting disease into a hatchery.

To reduce the risk of spreading disease, ensure proper disposal, as outlined below.

- Dispose of solid waste properly, with strict respect to local regulations and laws.
- Bury or burn dead fish to prevent the spread of disease.

5.12 Staff capacity building

To ensure the effectiveness of a hatchery's biosecurity plan, staff members must have a clear understanding of their responsibilities to maintain biosecurity. All staff should be trained on the protocols to ensure they understand biosecurity principles well and to ensure effective implementation of measures to prevent the spread of disease in the hatchery.

Hatchery owners/managers must take specific measures, outlined below, to ensure staff members have the knowledge, resources and tools necessary to maintain biosecurity.

- Allow staff access to the hatchery biosecurity standard operating procedures (SOPs).
- Review the hatchery biosecurity programme periodically and update it when necessary.
- Keep hatchery staff up to date on biosecurity measures by undergoing regular refresher trainings.
- Promote exchanges with other hatchery technicians and managers to be updated on biosecurity protocols.
- Promote continuous training of hatchery staff.

5.13 Sampling

As with other animals, fish will show symptoms when they are sick. For this reason, it is important to observe the fish carefully and often in order to identify any changes in behaviour. The two most obvious symptoms are a lack of appetite (or none at all) and slower movement. Other symptoms include: blood spots; extra mucus; a swollen abdomen; and cloudy and/or swollen eyes.

Depending on the disease, fish may die daily or they may die in large numbers within a few days. Stress renders fish more susceptible to disease. Thus, to decrease overall stress on the fish, it is important to reduce overcrowding, maintain a constant temperature, maintain good water quality, and provide adequate feed. These measures will help reduce mortality among the fish.

To minimise losses, hatcheries must implement the protocols outlined below.

- Report any outbreak to the nearest authorities to ensure that quick action can be taken to control the spread of the disease.
- Remove sick fish and place them in a separate tank in another section of the hatchery to prevent them from infecting healthy fish.
- Seek support from an expert to examine the sick fish and advise whether they should be treated or killed.
- Treat all remaining fish in the tank if the disease can be cured.
- Bury all of the sick fish to avoid spreading the disease and then disinfect the entire hatchery, including the equipment, if the disease cannot be cured.
- Take action immediately by following the previous steps within 2–5 days, depending on the disease.

Transportation of sick fish to a laboratory

In such cases, sick fish can be sent to a laboratory for further examination in one of three ways, as outlined below.

a) Packed in oxygenated bags

- Pack live sick fish in oxygenated bags and send them to a laboratory.
- Avoid overcrowding fish in a small bag, as this can kill the fish.
- Provide the laboratory with a sufficient number of samples to determine the cause of the disease. If the fish are small, 10–20 fish should suffice.
- Include a bag of healthy fish to enable the laboratory expert to compare them to the sick fish and determine the disease.
- Label the bags (or boxes) properly, including the owner's name (or the hatchery name) and the tank number where the fish were collected.
- Include details (e.g. when the fish started showing symptoms; how many fish are infected; when they started dying, if applicable; the number of tanks involved; the percentage of mortality) on a separate sheet.

b) Preserved in formalin

- If the laboratory is located far from the hatchery, preserve the fish in formalin (referred to as 10 per cent buffered formalin), which is specially treated. Buffered formalin filled bottles are usually available in fish health laboratories.
- If the fish are very small (fry), slit the fish vertically from anus to gills and fix them in a buffered formalin vial.

- If the fish are large (fingerlings; juveniles), kill and dissect the fish, as outlined below.
 - Cut the spinal cord behind operculum (pithing).
 - Slit the fish ventrally from anus to gills.
 - Remove viscera away from the kidney and puncture the swim bladder for proper fixation of the kidney.
 - Slit muscles lengthwise on either side of the body (for fish larger than 5 cm in length).
 - Place fish in fixative at a ratio of 1:10 (fish to fixative).
 - Open the intestinal tract and make several slits in the liver, spleen and kidney for better fixation (for fish larger than 10 cm in length).
 - Divide the head lengthwise along the midline to allow fixation of the brain.

c) Packed in an icebox

- In certain cases, fish can be sent to a laboratory in an insulated box filled with ice. If an insulated box is used, ensure that the fish have been freshly collected from the tank.

Precautions to take for the transportation of fish to a laboratory

- Always check first with the laboratory before sending fish for examination (e.g. number of fish to be sent; required method of preservation for the fish – live in plastic bags with oxygen, frozen, preserved in formalin/ethanol/other preservatives, etc.).
- Do not send decomposing fish to the laboratory for examination.
- Notify the laboratory when the fish have been sent.
- Inform the laboratory of the date the fish will arrive.

5.14 Record keeping

Good record keeping is essential in a hatchery operation. All activities must be recorded to make it easier to trace or investigate an event that could help determine the cause of a disease outbreak. Record keeping must be accurate and reliable. All records must include: the date of the event; a signature of the person who made the entry; and any additional remarks or comments.

Hatcheries should keep records of the following activities:

- visitors to the hatchery;
- movement of fish from outside or within the hatchery;
- purchase and introduction of new fish;
- changes in fish behaviour;
- fish mortality along with any symptoms;
- reports on disease investigations received from laboratories or reports from experts visiting the hatchery;
- handling or treatment of fish;
- water quality parameters;
- number of each fry consignment produced and to which hatchery these consignments were sold;
- training offered to staff members; and
- changes in hatchery operations (e.g. new feed; change in water supply; new disinfectant and new dosage).



Refractometer used to record water parameters

5.15 Quarantine

Quarantine is defined as the maintenance of a group of aquatic organisms in isolation with no direct or indirect contact with other aquatic animals, in order to undergo observation for a specified length of time and, if appropriate, testing and treatment, including proper treatment of the effluent waters.

- Quarantine is commonly applied to aquatic animals that are sick or new to a certain hatchery (fish coming from the wild, from another hatchery, from another country, or from a different section within the same hatchery).
- There are three types of quarantine: high; medium; and low.
- Each type of quarantine has its own requirements regarding duration, treatment of water inlet, treatment of water effluents and biosecurity measures applied during the quarantine period.
- The type of quarantine to be applied depends on: the type of fish introduction/movement; aquatic species; life stage; and origin (sick animals from the same hatchery, wild; different hatchery; different country; etc.).
- The type of quarantine is based on the risks associated with the introduction/movement and the comparison of health status between the hatchery of origin and the hatchery of destination.



Water filtration system in a quarantine area

- The hatchery should have a separate production area/compartments devoted to the quarantine of sick or new organisms.
- The quarantine area should be physically isolated, when possible.
- The quarantine area should have its own water inlet and water outlet.
- Water effluents from the quarantine area should be disinfected (treated) before being discharged into the environment.
- The quarantine area should have its own set of equipment and materials.
- Staff operating in the quarantine area should clean and disinfect their hands and feet before entering another production area.
- Visitors should not be authorised into the quarantine area.
- Daily records should be collected regarding water quality parameters, water exchange, fish behaviour, fish morbidity, fish mortality and feeding.
- Deceased fish should be collected and preserved in the fridge for further analysis.
- The hatchery manager and the biosecurity competent authorities will determine the duration of the quarantine.

5.16 Emergency planning

The hatchery should have a basic plan on how to react in case of a serious disease outbreak and/or emergency.

- The emergency plan should be developed as a way to minimise economic and environmental impacts in case of a disease outbreak and/or emergency.
- The emergency plan requires prompt action.
- The plan should be designed to reduce the spread of the pathogen.

The plan should respond to the following question: What will we do in the event of a disease outbreak and/or emergency?

- Who will respond? A biosecurity/quarantine competent authority and hatchery manager should respond.
- Who will assist? Collaborative partners should be engaged to assist.
- What will the chain of command be? Who will lead the action? Who will take action? A reliable person should be identified for each of these roles.
- What steps will be followed? Strategies and procedures should be respected.
- How will the outbreak be communicated in and outside the country, to avoid further damage? Communication approaches should be in place and carefully followed.

The emergency plan should define specific actions related to the following:

- the collection of samples (from the affected hatchery, neighbouring hatchery and the wild);
- submission of samples to the laboratory;
- definition of laboratories of reference (national or international centres);
- establishment of a quarantine area;
- slaughter and disposal of animals;
- cleaning and disinfection of equipment, premises and water; and
- treatment of water effluents.

5.17 Contact with competent authorities and laboratory

The hatchery manager should have transparent communication with the national competent authorities in charge of aquaculture and aquatic biosecurity. Competent authorities should be contacted in case of:

- reliable suspicion of disease;
- a disease outbreak (high mortalities); and
- introduction of fish from another country.

5.18 Common disinfectants

A disinfectant is an agent that destroys infection-producing organisms. Concentration and duration are important factors that are dependent on the conditions and procedures undertaken.

Hatchery owners/managers must ensure the following measures are carefully respected.

- Wear protective gear when handling disinfectants, and follow instructions carefully.
- Ensure that expired disinfectants are not used and instead discarded properly.

Table 1. Common disinfectants used in aquaculture

Disinfectant	Concentration	Duration	Comments
Benzalkonium chloride	250–500 ppm	10–30 min	Plastics, floors, footbaths, walls, equipment and furnishings
Didecyl dimethyl ammonium chloride	400 ppm	5 min	Plastics, floors
Phenols	2–5% active ingredients	10–30 min	General disinfection
Chlorine	200–500 ppm	10–60 min	All surfaces except plastic When cleaning tanks, disinfect for 24 hours, neutralise, rinse and dry.
Ethyl alcohol	70–80%	10–30 min	Hands, tools, work surfaces
Isopropyl alcohol	60–80%	10–30 min	Hands, tools, work surfaces
Iodine	100–250 ppm	20–30 min	Antiseptic on tissues. Follow product label instructions if using antiseptics for egg surface disinfection.
Hydrogen peroxide	3–30% (weight percentage)	5–30 min	General disinfection
	3–5%	5–15 min	Follow label instructions to treat fish or disinfect eggs.
Virkon® Aquatic	0.5–1% or 50–100 g per 10 L of water	10–15 min	General disinfection Commonly used for footbaths
Chlorhexidine (most solutions contain 2% active chlorhexidine)	Add 100 ml to 1 L of water for disinfection	5–10 min (general disinfection)	Commonly used for footbaths

6. Further reading

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Pacific
Community

Communauté
du Pacifique

BP D5 • 98848 NOUMEA CEDEX
NEW CALEDONIA

Telephone: +687 26 20 00
Facsimile: +687 26 38 18
Email: cfpinfo@spc.int

BP D5 • 98848 NOUMÉA CEDEX
NOUVELLE-CALÉDONIE

Téléphone : +687 26 20 00
Télécopieur : +687 26 38 18
Courriel : cfpinfo@spc.int