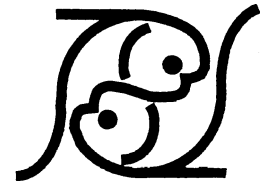


North Central Regional Aquaculture Center



In cooperation with USDA

Biosecurity for Aquaculture Facilities in the North Central Region

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Fish diseases are not new to aquaculture; they continue to be one of the greatest causes of economic loss for the industry. Each year in the U.S., millions of dollars in losses to fish producers are attributed to infectious diseases. The impact from disease may occur as direct losses due to illness or mortalities as well the indirect effects such as decreased production (e.g., reduced growth rates, feed conversion efficiency, or product quality) or loss of business or reputation.

One of the best ways to protect your fish, farm and business is by prevention through the use of biosecurity measures. This fact sheet will overview how fish diseases are spread, help you identify risk factors for disease introduction on your farm, and provide some basic biosecurity practices to minimize these risks.



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What is Biosecurity?

Biosecurity involves the practices, procedures and policies used to prevent the introduction. Also, the spread of disease causing organisms (e.g., bacteria, viruses, fungi, parasites) as well as many aquatic invasive species (e.g., zebra mussels, rusty crayfish) should be considered.

While some fish pathogens are well known problems, other diseases are emerging or spreading to previously unaffected areas. Outbreaks can happen rapidly and spread quickly, often resulting in high mortalities. It is difficult to predict when disease might occur; however, the routine use of biosecurity measures can reduce the risk of introduction and economic impact of these diseases.

Biosecurity Principles for Aquaculture Facilities

Disease threats for an aquaculture facility vary with the type of production operation, its purpose (e.g., stocking, food fish) as well as the species or life stage being reared. Many different biosecurity solutions may exist; there is no "one-size-fits-all" solution.

Determining the biosecurity measures needed for your facility will involve identifying risk areas and determining the necessary preventive measures to obtain the greatest cost-benefit. Most

preventive measures are inexpensive when compared to the potential loss that can occur from fish deaths, decreased production or the need for depopulation following a disease outbreak. Many also are quickly implemented procedures (e.g., foot dips, disinfection); while others may involve variable levels of economic investment or effort (e.g., dedicated quarantine equipment or facilities).

Work with your veterinarian or fish health specialist to identify risk factors and develop an effective biosecurity plan for your operation. Once determined, make sure these measures are communicated to others involved with your farm (e.g., employees, delivery personnel, visitors).

Disease Transmission to Fish

Understanding how fish diseases are spread helps to identify necessary biosecurity measures. Fish diseases can be spread by direct contact, water sources, fomites, ingestion (oral), and vectors. Not all pathogens are transmitted by all routes; some may be spread by multiple routes.



Direct contact is one of the most common routes of disease transmission in aquaculture.

This involves the transfer of disease causing agents through direct contact with infected fish. Entry may occur through the skin, open wounds, mucous membranes, or gills.

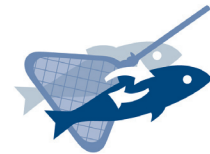


water sources

Water sources can serve to transfer disease causing organisms.

Contamination occurs from the urine, feces, reproductive fluids, and mucus of diseased fish. The movement of contaminated water during the transport of fish can spread pathogens to new locations. A few fish pathogens (e.g., *Ichthyophthirius multifiliis*, Ich) have been found to spread via aerosols, sprays or splashes between tanks, although less common and typically requiring close proximity of sources.

Fomites are inanimate objects that can transfer pathogens between



fomites

rearing areas or production sites. These items become contaminated following contact

with infected fish or contaminated water sources. Examples include equipment such as nets, buckets, siphon hoses, footwear, clothing, or contaminated vehicles (including tires).

Vectors are living creatures, such as fish-preying birds, that can spread pathogens.



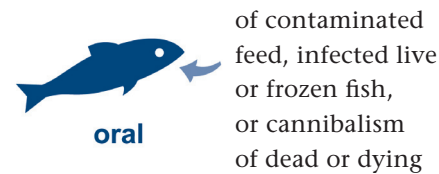
vector

These animals may transfer fish diseases between locations by carrying the

pathogen on their body or feet, or by dropping fish or fish parts at other locations. Rodents and birds may carry some fish pathogens in their feces or urine, contaminating the

environment or fish feeds. People may serve as vectors, transferring pathogens to fish during handling (e.g., hands).

Disease organisms can be transmitted orally by consumption

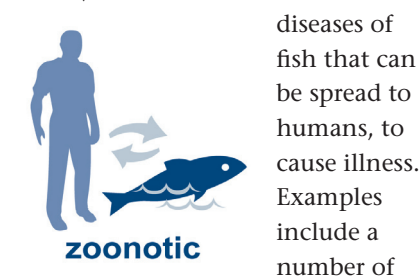


oral

of contaminated feed, infected live or frozen fish, or cannibalism of dead or dying

fish from the same unit. Ingestion of water contaminated with waste products from infected fish also may serve as a transmission route.

While not a route of transmission to fish, zoonotic diseases are those



zoonotic

diseases of fish that can be spread to humans, to cause illness. Examples include a number of

bacterial organisms – *Mycobacterium*, *Erysipelothrix*, *Klebsiella*, *Edwardsiella*. Biosecurity measures should also address any zoonotic risks to you or your employees as well as the risk to your fish stocks.

Biosecurity Measures for Aquaculture Facilities

The potential for the introduction of fish pathogens can be categorized into five risk factor areas: Fish movement, water sources, fish health, equipment and vehicles, and vectors. Prevention recommendations for each of these risk areas are provided as a starting point and should be applicable to most aquaculture facilities.

Fish Movement

The movement of fish onto, within or off the farm is the greatest risk factor for disease introduction and

spread in aquaculture. This includes new fish brought to the farm for breeding, grow out, or restocking or those returned to the farm. Also, contact between wild and farmed fish can be a potential source of disease introduction. These “new” additions can introduce pathogens to resident fish, and for some diseases, these fish may be infected without showing signs of illness, serving as “carriers” to other fish.

Purchase healthy fish. To prevent disease introduction onto your farm, purchase fish from known and trusted suppliers. These fish should be inspected and found free of important diseases. Limit the number of sources fish are purchased from and the frequency and number of new introductions onto your farm. When possible, purchase eggs or fish from certified disease-free broodstock. Eggs should be disinfected upon arrival. When appropriate, vaccinate newly acquired fish for diseases.

Quarantine new arrivals. Once fish are brought to your farm, minimize the transfer of disease to resident fish by isolating new arrivals before adding them to your current stock. This includes fish recently purchased as well as fish returned to the farm. The length of quarantine is variable and depends on the disease of concern; 4-6 weeks is commonly suggested.

The quarantine area should be at a location away from resident fish and should have a separate water source or flow circuit. Any water effluent on or off the farm from the quarantine area should be managed to avoid contaminating water sources or fish production areas. Dedicated equipment for the quarantine area should be used to avoid fomite transfer to resident fish. Fish in the

quarantine area should be cared for or worked with after resident fish, or an employee should be assigned solely to the care and handling of the quarantined fish.

Water Sources

Use pathogen-free water sources, such as well water, springs, or other groundwater sources, when possible. Surface water sources should be avoided as they have a greater potential for carrying fish pathogens. If this is not possible, disinfection of the water supply by ozonation or ultraviolet radiation may be needed. Filtration of water sources can help exclude the introduction of unwanted aquatic species.

Fish Health

Optimum health is essential for disease prevention in fish and greatly improves the ability of your fish to fight off infection. This is achieved by minimizing stress, maintaining appropriate water quality parameters and proper nutrition, removing potential infectious disease sources, and monitoring and maintaining fish production and health records.

Minimize stress. The susceptibility of fish to disease is greatly influenced by stress. A number of parameters in aquaculture can increase stress in fish, including high stocking densities, improper water quality parameters and poor nutrition.

Minimize stress in your fish by keeping stocking densities within acceptable parameters. Limit transfers of fish between units or locations when possible. When moving fish, use gentle crowding and fish handling methods.

Maintain optimum water quality.

Fluctuations or improper maintenance of parameters such as dissolved oxygen, ammonia, nitrite and pH can cause increased stress for fish, and, in some cases, cause tissue damage;

accordance with local and state laws and in a manner that predators or wild birds cannot access carcasses and further spread the disease.

Ill fish should be removed and placed in an isolated area away from current fish stocks. This area, similar to quarantine, should have dedicated equipment and water sources. Care or treatment of these fish should occur after healthy resident fish or by an employee solely dedicated to this area.

Risk Factors for Disease Introduction and Spread in Aquaculture Facilities

Fish Movement
Water Sources
Fish Health
Equipment/Vehicles
Vectors (human and animal)

this can make fish more susceptible to diseases. Water temperature is also important to monitor, as many fish pathogens have an optimum temperature range for infectivity, and fish immune systems are influenced by water temperature.

Provide proper nutrition. Store feed in a cool, dry place and use within 3-6 months. This serves to maintain vitamin and mineral stability in the feed as well as reduce the potential for moldy feed. Keep feed in areas secured from vectors (e.g., rodents, birds). Clean up any spilled feed to avoid attraction of birds or rodents. If live fish are used as feed, be sure to obtain healthy fish from reliable sources.

Remove dead or dying fish. Monitor fish frequently for disease. Employees should know the major signs of illness in fish and who to contact when these are noted. Early identification of fish diseases can help minimize its spread and impact on your farm.

Ill or dead fish should be removed immediately as they can serve as potential disease sources to the remaining stock. Dying fish should be promptly and humanely euthanized. Disposal should be in

When signs of illness are noticed, contact your aquatic veterinarian or fish health specialist immediately. Necropsy and testing of ill fish can help identify a potentially infectious disease before it becomes widespread on your farm.

Keep accurate records. Maintenance and monitoring of fish production and health records can help to detect disease problems and highlight their severity (e.g., sudden versus gradual increases in death rate) and often provides clues for disease diagnoses. Maintain accurate records of fish illnesses or deaths. Keep records on fish production parameters, such as growth and feed conversion ratio to aid in detecting subclinical disease problems. Record all new introductions or returning fish, their sources, and movements on or off the farm. This can help identify potential disease entry points in the event of a disease outbreak.

Equipment and Vehicles

Many disease causing agents can survive in the environment for variable amounts of time. For this reason, any equipment (e.g., nets, buckets, scales, boots, waders) or even vehicles used to work with or move fish can serve as a potential source

of disease transfer between facilities or units. Any equipment used at aquaculture facilities should be cleaned and thoroughly dried (preferably in direct sunlight) or chemically disinfected before being used in another location.

Fish production tanks, raceways and ponds should be disinfected between each lot of fish. Construction materials should be nonporous and easy to clean and disinfect. Avoid the use of wood, as it is hard to disinfect completely; if used, it should be limited to temporary structures and should never be transferred to another site. Minimize aerosols with tank covers or by placing barriers between tanks.

Vehicles and equipment should not be shared between sites; if possible, dedicated equipment or vehicles should be used. If this is not possible, these items should be cleaned and

disinfected between fish lots or farms. Any residual water or debris should be removed; bilge water

Proper Cleaning Protocol

1. Remove visible debris
2. Wash with soap and water, rinse
3. Apply selected disinfectant for appropriate contact time
4. Rinse or Neutralize
5. Allow to dry

from boats should be removed and disinfected. Vehicle cleaning should include the wheel wells, tires and undercarriage. Wash stations should be provided onsite away from animal production areas.

Foot dips should be placed near the entrance to animal areas. Boots and waders should be cleaned and submersed for an appropriate period of time (see product label) prior to

and after leaving the area. Foot dip solutions should be changed daily or when visibly soiled with debris.

Cleaning and disinfection of equipment and vehicles are important disease prevention measures for aquaculture facilities. One of the most overlooked and most important steps is the removal of visible debris (e.g., mucus, waste products, aquatic plants and algae, uneaten feed). This is important because many disinfectants are less effective and often inactivated in the presence of organic matter and debris.

Washing items with soap and water can greatly reduce the number of pathogens on most items; rinse well to remove any residual soap (which also can inactivate some disinfectants).

Apply an *appropriate disinfectant* (see Table 1), using the *proper concentration, application method*

Table 1. Select chemical disinfectant used in aquaculture.*

Product	Concentration*	Uses and Precautions
Virkon® Aquatic	1:100 - 1:200 (1% - 0.5%) for 1 minute	Equipment, pumps, protective clothing, foot dips, bilges, bins, buckets, harvesting equipment, vehicles
Sodium hypochlorite (bleach)	200-500 ppm	Nets, boots, clothing. Surfaces must be clean; easily inactivated by organic debris. May be corrosive. Highly toxic for aquatic animals; allow to inactivate for several days or neutralize with sodium thiosulfate after 3 hours. Note: Bleach is 5.25% sodium hypochlorite solution.
Iodine(iodophors)	200 ppm for a few seconds	Nets, boots, clothing. Surfaces must be clean; product is easily inactivated by organic debris. Highly toxic for aquatic animals
Benzalkonium chloride (e.g., Roccal)	250 ppm	Plastic surfaces *can be toxic to fish, so use with caution
Alcohol (ethanol)	70%	Hand sanitizing

*** Always consult the product label for appropriate concentrations, uses, and safety precautions.**

Disclaimer: The use of product names does not constitute endorsement.

References: World Organization for Animal Health (OIE). 2006. Methods for disinfection of aquaculture establishments. Chapter 1.1.5. *in* Manual of diagnostic tests for aquatic animals.

and contact time (according to the product label). Allowing the necessary contact time is essential for optimum killing of the disease agent.

Many disinfectants can be lethal to fish, so thorough **rinsing** (away from production areas) and/ or **neutralization** (e.g., sodium thiosulfate for chlorine products) are necessary to remove any toxic residues. If possible, allow the items to **thoroughly** dry before re-using them with fish or at different locations. Drying, especially in direct sunlight, also can effectively destroy a number of fish pathogens.

Vectors

Wild fish and animals. Limit contact between your fish and other animals that may present a risk of disease introduction. This includes wild fish stock, predators, domestic animals (e.g., dogs and cats), and wildlife traveling between farms.

Pathogen transfer between farm and wild fish populations is an equally important consideration. Biosecurity measures must protect cultured fish from contact with wild species, as well as prevent the escape of infected cultured fish or run-off of contaminated water sources or effluents.

Implement predator management and rodent control programs. Contact USDA-APHIS or your local extension office for legal control measures.

People. Employees should wear clean clothing/coveralls and footwear when working with fish and wash or sanitize their hands when moving between areas. Foot dips for disinfecting

footwear also should be used between these areas. Employees should perform tasks in areas from lowest risk to highest risk (e.g, inside tanks to outside tanks), from most susceptible to least susceptible populations (e.g., fry or fingerlings to adult). Personnel should save quarantine/isolation work for last. Access to egg incubation and fry facilities should be restricted to a minimum number of well-trained individuals.

Visitors to the farm, especially those coming from areas where they may have been exposed to fish diseases (e.g. other farms or areas with known disease outbreaks), may serve as vectors for the introduction of disease. These individuals should take measures to minimize the potential risk of disease transfer. This includes wearing clean coveralls and disposable or disinfected rubber boots while on the farm. Maintain a log of visitors to your farm. All visitors on your farm should be accompanied by farm personnel during their visit. When possible, these individuals should avoid animal areas and be restricted from contacting and handling your fish (unless absolutely necessary).

Conclusion

As the aquaculture industry continues to grow, the threat of infectious diseases to fish production facilities will continue. New diseases are being discovered or are emerging in new locations. While the risk of disease in production settings cannot be completely eliminated, the use of biosecurity measures on the farm can help you to prevent

disease introductions and spread and protect your fish, your farm and your investment.

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