



University of Maryland, 2113 Animal Science Building
College Park, Maryland 20742-2317
Telephone: 301-405-6085, FAX: 301-314-9412
E-mail: nrac@umd.edu Web: <http://www.nrac.umd.edu>

Biosecurity on the Farm – Guidelines & Resources for Developing a Biosecurity Plan

Michael Pietrak, Maine Aquaculture Association; Dale Leavitt, Roger Williams University; Michele Walsh, Micro Technologies, Inc.

Why Do I Need a Biosecurity Plan?

Aquatic farmers face enormous pressure from native and exotic disease-causing organisms, or pathogens. Infection and disease can invade from multiple sources—water, wild fish or shellfish, newly-introduced farmed fish or shellfish, contaminated equipment, predators, human visitors—and can interfere at all stages of production. Disease resulting from the introduction of new pathogens can have devastating impacts (Figure 1). Potential impacts include: production losses from mortality events; loss of market access if certain pathogens are associated with the facility, aquaculture sector or region; and consequent inability to transport product to other farms or locations. These types of events frequently have crippling economic consequences. Lack of adequate epidemiological information for many aquatic pathogens or lack of access to current, valid information about particular diseases compound the problems in the aquaculture sector.

One highly effective, voluntary way to reduce the risk of infection and disease to a farm is the development of a biosecurity plan. By definition:

“In aquaculture, biosecurity is a collective term that refers to the concept of applying appropriate measures (e.g. proactive disease risk analysis) to reduce the probability of a biological organism or agent spreading to an individual, population, or ecosystem, and to mitigate the adverse impact that may result.” (Subasinghe and Bondad-Rean-
taso 2006.)



Figure 1. A quahog raceway showcasing the impact of QPX, a shellfish pathogen, infecting a farm site.
(Photo by Dale Leavitt)

The purpose of this fact sheet is to acquaint the aquatic farmer with the benefits of developing a biosecurity plan and outline how a plan is developed.

Effective biosecurity plans must be tailored to a specific farm site, be adaptable, address local disease threats, and avoid environmental insult. The biosecurity policies and practices of an aquaculture company are controlled directly by the farmer. The goals of these policies and practices match those of the various levels of government-regulated biosecurity, i.e., to reduce the probability that a pathogen will infect one or more animals under the farmer’s care or negatively impact the surrounding farms

or environment. Unfortunately, there is no “one size fits all” biosecurity program. At the company and farm level, the components of the biosecurity plan developed depend on the characteristics of the facility.

The design of an effective farm biosecurity plan hinges on an understanding of how disease-causing organisms are introduced and spread, and the identification of any pathogens that might be present. The guidelines that follow offer a starting point to facilitate thinking about risks to aquatic animal health and active ways to minimize risk.

Local university extension agents and aquatic animal health professionals can be a valuable resource for additional practical information.

Bear in mind that a good biosecurity plan, consistently implemented, functions as a type of insurance policy against disease. The routine use of biosecurity measures – secure water supply, healthy fish or shellfish stock, good hygiene practices for all entering and exiting the farm, to name a few – can reduce the risk of introduction and economic impact of these diseases on your farm.

Developing a biosecurity plan for aquaculture operations

STEP 1: Establish a Baseline Understanding of Your Aquatic Animal Health & Risks to Health

An important first step is a hazard or risk analysis of the facility. Hazard analysis helps determine the disease risks for the species raised on the farm, for the physical structures of the facility, and for the geographic region. The hazard analysis would result in a list that documents all risks identified after consideration of the factors listed below.

There are three main areas to consider when doing a risk analysis for a farm.

- What are the local and regional disease risks for the species that I am growing?
- How is my operation vulnerable to disease? What factors (e.g. health status of introduced animals, contaminated transport water, contaminated farm water source, etc.) might influence that status?
- What is the current health status of animals on my farm?

What are the local and regional disease risks for the species that I am growing?

Answering the questions below will allow farmers to better understand the diseases of concern in an area. This understanding of disease threats provides a focal point for evaluating disease risk:

- What diseases that could affect my animals are endemic (native) to the area?
- Are there any diseases of concern in neighboring areas that do not occur in my local area?
- What other types of commercial or recreational fishing, aquaculture, and/or resource enhancement activities that may introduce disease, are occurring in the area?

How is my operation vulnerable to disease?

When identifying how a facility is vulnerable to disease, consider how disease may enter and spread on a farm. The four most common means for disease to enter and spread within aquaculture facilities are described below.

- Aquatic animal movement– Imported animals (especially those not regularly screened for pathogens) may bring disease to a healthy farm, or animals can become infected on site (e.g. through an infected water source), then spread disease as they are moved to different areas of a farm. Some animals, known as asymptomatic carriers, can harbor pathogens without showing any symptoms. A farm that imports non-health certified animals or moves animals throughout a facility without knowledge of the potential of each group to spread infection is vulnerable to disease.

- Water source– Every water source has different risks associated with it, and different culture systems–flow through, ponds, re-circulation or open water pens–will impact the way disease may move. Open water sources such as net pens or surface waters are exposed to all local conditions; if pathogens are present in the wild fish/shellfish or waters of the area, the penned animals will be exposed. This type of system is considered high-risk because many factors related to introduction of disease are beyond the farmer’s control. Ground water sources are typically disease-free, though sometimes water quality issues must be addressed. Recirculation systems offer a high degree of control over water quality, but if disease is introduced, pathogens which can survive the filtration and treatment systems can easily spread throughout all areas and can be difficult or impossible to eliminate.

- Aquatic animal husbandry/welfare– An animal’s ability to resist disease is linked to both the health and welfare of the animal. Overcrowding, poor nutrition, and poor water quality can all stress an animal thereby reducing their general health and increasing their chances of becoming sick.

- Farm traffic– equipment, vehicles, predators, people –Just as disease can travel with animals as they move on/off a farm or between areas, disease is able to spread

on people, equipment, vehicles and predators as they move on/off and within a farm.

Fortunately, there are a variety of actions that can be taken to minimize all of these risks, as described in Step 2.

What is the current health status of animals on my farm?

The final step in the risk analysis is to determine the current health status of the farm. An initial aquatic animal health inspection, which screens all populations on site for pathogens of concern, can be useful in determining any pre-existing disease conditions on your farm. Some follow-up testing may be recommended, depending on results of the initial tests and market opportunities for the farm.

Local aquatic animal health professionals and/or extension agents can be helpful in obtaining information on local diseases, fish and shellfish health testing, movement regulations or similar topics. They can also assist in evaluating a risk analysis.

STEP 2: Develop & Implement Strategies to Minimize Identified Risks

Develop and adopt operation and husbandry practices that will minimize the introduction and possible spread of disease on your farm. There are a variety of different steps that can be used to target identified risks. Those practices are organized here based on the same areas of vulnerability mentioned in Step 1. Keep in mind that the utilization of multiple practices is often needed to insure biosecurity; rarely can a single change, like the addition of footbaths, remedy all possible methods of disease spread into and around a facility. Local aquatic animal health professionals, extension agents and the resources listed in the NRAC website can help you find additional strategies that may be most suitable for a facility.

AQUATIC ANIMAL MOVEMENT

- Minimize the movement of animals. This includes practices such as: all in—all out stocking, final density stocking, and separating year classes or lots of animals

- Only bring in animals of known disease status. This includes practices such as: purchasing specific pathogen-free juveniles or animals from certified disease-free sources, limiting animal movement to within the same watershed, and refusing or quarantining animals which are not certified disease-free.

- Utilize pasteurized feeds when possible. If you utilize a non-pasteurized fish meal, moist or live feed, it should meet the same standards established for moving live animals onto the farm.

WATER SOURCE

Implementing steps to address risks can be difficult, as you often do not have the ability to choose or change the type of water source at an existing facility. In an open water situation there are fewer steps that can be taken by individual growers. This situation necessitates participation in community actions to try and protect the water source you operate in.

In situations where surface waters are used as either flow through or to fill a pond or recirculation system, water can be treated primarily with UV light or ozone. The effectiveness and cost of such a system will depend on many factors including the volume of water to be treated, the targeted disease(s), and the contact time of the treatment. You should consult someone with the appropriate technical expertise when considering such a system. If treating your water, consider treating both incoming water and effluent water. In systems where you discharge water into the same system you take your water from, such as a lake, your untreated discharge water may introduce disease into your water source which you may then bring back into your facility.

AQUATIC ANIMAL HEALTH & HUSBANDRY

- Minimize stress. This can be accomplished by following established best husbandry practices, maintaining appropriate stocking densities, and maintaining excellent water quality.

- Utilize preventative vaccinations where available and appropriate.

- Provide proper nutrition. This includes considering how the feed is stored to prevent spoilage, scavenging from rodents, birds and other pests.

- Remove dead or dying animals on a regular basis.

- Keep accurate records: Maintain written records of aquatic animal illnesses or deaths, daily animal maintenance (feeding rates, water quality, cleaning regimen), growth rates, feed conversion ratios and new animal introductions. Accurate records can help maximize production efficiency, detect subclinical disease problems and help identify disease entry points in the event of a disease outbreak or positive tests for pathogens.

FARM TRAFFIC

Farm traffic is a large area where many different practices and combination of practices can be implemented. A variety of practices are listed on the next page, which includes an important section on cleaning and disinfection.

- Maintain separate equipment for each site. This includes dedicated nets, totes, and other gear that is used only at a given location or specific task such as mortality removal, and separate raingear or boots for each location.

- Reduce traffic between farms. This includes designated parking outside of the farm for vehicles that are not required for use in operations. Vehicles required for operations on the farm should remain on a single farm and minimize movement between farms. Similar restrictions should apply to employees. If necessary for employees to visit multiple sites, first try to visit only one farm per day. If it is necessary to visit multiple farms in one day, visit the lowest risk farm first followed by the higher risk farms.

- Maintain visitor logs. This includes requiring employees who do not work on a daily basis at the facility logging in when they visit the site.

- Select appropriate equipment. When building or purchasing equipment, avoid porous and/or organic materials such as wood, which cannot be disinfected.

- Establish limited access points. All traffic onto and off a farm should be at controlled points where appropriate disinfection can occur. Changing of clothing or foot baths can be established. You may also want to establish restricted areas on a farm where sensitive activities occur, such as nursery, grow-out or broodstock rearing areas. These areas can be treated like mini-farms within the farm by utilizing separate equipment, and restricting movement of employees and vehicles.

CLEANING & DISINFECTION

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

The first and most important step to proper disinfection of vehicles or equipment is to thoroughly clean the item. This includes scrubbing with soap and water. Soap and water can kill or remove most of the pathogens on an item. Once the item is clean you can then disinfect it. There are a large variety of disinfectants available. Table 1 lists some common disinfectants used in aquaculture. When selecting a disinfectant to use, you must consider what disease risks you are trying to minimize, as specific disinfectants may work very well against some things but not as well against other diseases. It is also extremely important that you follow the manufacturer's or your aquatic animal health professional's directions on how to use each disinfectant. Changing the concentrations or contact times from recommended procedures may not allow for proper disinfection or may increase a human or animal health risk.

To minimize tracking of pathogens among and around facilities, footbaths should be placed near the entrance to all animal areas. Scrub brushes should be provided to physically remove visible debris from footwear prior to use of footbaths. Boots and protective clothing should be cleaned and submersed or sprayed for an appropriate period of time (according to product label) before entering and exiting an area. Footbath solutions should be maintained to be free of visible debris and ice and should be checked regularly (at least weekly) to ensure that proper concentration of disinfectant is present.

Table 1: Common disinfectants used in aquaculture.
(Modified from Danner and Merrill 2006)

Disinfectant
• Alcohols (e.g. ethanol)
• Alkalis (e.g. sodium hydroxide/lye)
• Biguanides (e.g. chlorhexidine)
• Buffered Potassium Peroxymonosulfate (i.e. Virkon-S®)
• Carboxylic Acids (e.g. citric or acetic acids)
• Iodophors (e.g. Betadine®)
• Oxidizing Agents (e.g. hydrogen peroxide)
• Phenolics (e.g. Lysol®)
• Sodium Hypochlorite (e.g. household bleach)
• Surfactants (e.g. quaternary ammonium compounds)

STEP 3: Coordinate Efforts

Some of these prevention recommendations can be implemented on a farm independent of other activities, while other measures may require outside cooperation or may be more effective with outside cooperation. For example, when growing animals in an open water system such as a lake, river or bay, the effectiveness of your on-farm biosecurity strategies can be rendered less effective if a neighbor has less prudent operating procedures. In situations like this, cooperative agreements among all of the growers in the area or through a trade association, often in the form of industry-wide Best Management Practices (BMPs), can be mutually beneficial.

STEP 4: Write It Down

The formal development and implementation of a biosecurity plan has a number of advantages over just instituting practices which may reduce your risk in a random fashion. First, the creation of a written biosecurity plan should force you to examine, evaluate and record

all of the potential sources of risk that face a given operation. This comprehensive risk list allows you to address each risk that you are exposed to separately, so that an appropriate biosecurity measure can be designed for that risk.

An example would be building a fence that completely surrounds your property so that you know where the possible entry and exit points are, versus constructing a fence that only partially surrounds your property, leaving the farm vulnerable (via gaps in the fence) in all the areas that have not been examined.

A written biosecurity plan is also advantageous because it allows for more consistent implementation, and provides a means to verify that desired procedures actually occurred. It provides a written record documenting the steps that you are taking to ensure the security of the food you produce. When developing your written biosecurity plan, it should address the following aspects:

- identify potential hazards,
- list the steps taken to minimize each risk,
- define who is responsible for each action,
- describe a method for recording that you completed the actions.

Following some type of formal system, such as a Hazard Analysis and Critical Control Point (HACCP) system, helps to ensure that all of the pieces are included in the plan and are thought out. In operations where employees may be performing some of the actions outlined in the biosecurity plan, keeping accurate records will allow the manager or owner to verify that employees are carrying out the tasks they are directed to complete.

The last major advantage of a formalized plan is that it provides one with the opportunity to periodically evaluate the effectiveness of the plan. The plan should specify some interval in which internal audits occur. If the plan is used to document operational procedures, for reasons such as marketing claims or certification, then regular external audits of the plan should occur. Audits verify that the plan is functioning as designed. They also provide the opportunity to reevaluate the risks and threats present and adjust the plan accordingly. In the long run, this adaptive ability will help to ensure that the plan is providing maximum protection, even in the face of emerging or new diseases.

However, creating a biosecurity plan for your operation or participating in a cooperative BMP program with other farmers does not permit anyone to bypass legal requirements pertaining to aquaculture in your area. Many aspects of aquaculture require permission by a special license or permit. Other activities are regulated by local, state or federal authority. Compliance with all applicable

requirements, whether local, state or federal, is a basic requirement of aquatic farming in a sustainable and responsible manner. It is implicit within these recommendations that all participants in the industry take responsibility to determine what regulatory requirements apply and to comply with those requirements.

What happens after the plan is written?

A written biosecurity plan is only as effective as the effort put forth to implement it in the normal operations of the farm. A well written biosecurity plan outlines a specific course of actions that the farmer should take to protect their farm from disease risks. Once written, the farmer needs to follow through and put into operation each of those measures. For example, if the plan calls for footbaths at each entrance and exit to the hatch house, then the farmer needs to install the baths and ensure that the disinfectant in the bath is changed on a regular basis to ensure efficacy.

A biosecurity plan should be a highly flexible document that allows for modifications as new knowledge is gained, conditions change, or farm practices are improved.

It is recommended that the farmer invite an aquatic animal health professional to conduct an external audit of the farm on a regular basis (once every 1-2 years.) An external audit includes a thorough review of the biosecurity plan and common husbandry practices on the farm. The health professional, in addition to reviewing the plan, can perform health checks on a representative sample of animals from the farm to assess the overall health status of the stock and judge the effectiveness of the overall plan. They can make recommendations for improving the plan if needed.

Lastly, in the event that there should be a problem on the farm, the records kept in conjunction with the biosecurity plan could prove to be invaluable in reconstructing potential sources of the problem.

While implementation of the biosecurity measures outlined in this document will not guarantee that a farm will be safe from disease outbreaks, it does provide the farmer with the best defenses available for minimizing the risk of disease on the farm. Furthermore, by following these guidelines and in the event that a disease situation should arise, the farmer is in the best position to assist the health care professional in combating the disease and restoring the productivity of the farm in as short an interval as possible. Therefore, it is in the best interest of the farm to develop and implement a formal biosecurity plan to ensure the production of healthy and healthful products and to sustain the economic integrity of the enterprise.

To assist in the development of your biosecurity plan, a number of references are included in the following section. Many of these documents are available at no cost from the World Wide Web or from your local aquaculture extension agent. In the event that a farmer needs assistance in developing their biosecurity plan, requesting assistance from a local aquaculture extension agent or from an aquatic animal health professional is beneficial.

Recommended reading & references

- Bowser, P.R. 2008. Fish Health Inspections: What They Are. Northeast Regional Aquaculture Center Bulletin No. 106-2008. Univ. Maryland, College Park, MD.
- Bowser, P.R. and J.K. Buttner. 1993. General Fish Health Management. Northeast Regional Aquaculture Center Bulletin No. 111-1993. Univ. Maryland, College Park, MD.
- Donner, G.R. and P. Merrill. 2006. Chapter 8. Disinfectants, disinfection, and biosecurity in aquaculture. In: A.D. Scarfe, C.S. Lee, and P.J. O'Bryen (eds.) 2006. *Aquaculture Biosecurity: Prevention, Control, and Eradication of Aquatic Animal Disease*. World Aquaculture Society/Blackwell Scientific. Hoboken, NJ.
- Dvorak, G. 2009. Biosecurity for Aquaculture Facilities in the North Central Region, NCRAC Fact Sheet #115. Michigan State University, East Lansing, MI.
- Francis-Floyd, R. 2003. Sanitation practices for aquaculture facilities. IFAS Extension Bulletin VM87. University of Florida, Gainesville, FL.
- Goodwin, A. 2002. Biosecurity protection for fish operations. University of Arkansas Cooperative Extension. Pine Bluff, AR.
- Leavitt, D.F., M. Pietrak, and M. Walsh. 2010. Aquaculture Biosecurity 101: Guidelines for developing biosecurity plans for your farm. Northeast Regional Aquaculture Center (NRAC) Publication pending. Univ. Maryland, College Park, MD.
- Scarfe, A.D., C.S. Lee, and P.J. O'Bryen (eds.) 2006. *Aquaculture Biosecurity: prevention, control, and eradication of aquatic animal disease*. World Aquaculture Society/Blackwell Scientific. Hoboken, NJ. 182 pp.
- Subasinghe, R.P. and Bondad-Reantaso, M.G., 2006. Biosecurity in aquaculture: International agreements and instruments, their compliance, prospects and challenges for developing countries. In: A.D. Scarfe, C.S. Lee, and P.J. O'Bryen (eds.) 2006. *Aquaculture Biosecurity: Prevention, Control, and Eradication of*

Aquatic Animal Disease. World Aquaculture Society/Blackwell Scientific. Hoboken, NJ.

World Organization for Animal Health (OIE.) 2006. *Manual of Diagnostic Tests for Aquatic Animals* (2006), Chapter 1.1.5, Methods for Disinfection of Aquaculture Establishments. Paris, France.

Acknowledgments

This work was conducted with the support of the Northeastern Regional Aquaculture Center, through grant number 2006-38500-17065 from the National Institute of Food and Agriculture, U.S. Department of Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

