

**ISSC 2023
Committee Report**

Committee Name : Aquaculture
Chairperson: Chris Schillaci
Date of Meeting: 3/9/2023
Recorder:

Approved
By: *Christopher Schillaci*
Printed Name: Chris Schillaci

Committee Members Present:

- | | | | |
|--|---|---|---|
| <input checked="" type="checkbox"/> Chris Schillaci
(Chairperson) | <input checked="" type="checkbox"/> Portia Sapp | <input type="checkbox"/> Miranda Ries
(FDA Advisor) | <input type="checkbox"/> Joel Hansel
(EPA) |
| <input checked="" type="checkbox"/> Debra Barnes | <input checked="" type="checkbox"/> Curtis Villa | <input type="checkbox"/> Robert Schuster | |
| <input checked="" type="checkbox"/> Andrew Bell | <input checked="" type="checkbox"/> Ned Gaine | <input type="checkbox"/> Bill Dewey | |
| <input type="checkbox"/> Mike Oesterling | <input checked="" type="checkbox"/> Vanessa Zubkousky-
White | <input type="checkbox"/> Chris Brooks
(FDA Delegate) | |
| <input type="checkbox"/> Alissa Dragan | <input checked="" type="checkbox"/> Bob Rheault | <input checked="" type="checkbox"/> Quentin Forrest | |

Charges

Charge 1: Proposal 13-107 Sources of Seed for Aquaculture

- **The committee is charged to review and revise all existing guidance associated with Model Ordinance Chapter VI: Shellfish Aquaculture for the purpose of creating consistency with the Chapter VI revisions adopted in 2017.**

Findings/Conclusions: The Committee found that the current Chapter VI. Guidance Chapter required significant updates to create consistency with the Chapter VI. revisions adopted in 2017. The Committee developed updated guidance based on available data. The Committee discussed the need to revisit the guidance as new information becomes available.

Recommendations: The Aquaculture Committee recommend:

- 1) The adoption of revised Chapter VI. Guidance language as prepared by the Committee (included below).
- 2) Allow the Aquaculture Committee to continue to refine Chapter VI. Guidance on aspects related to managing human health concerns from bird and mammal congregations on aquaculture gear.

Charge 2: Proposal 19-108: Aquaculture Seed Shellstock

Findings/Conclusions: After review of the proposal and supporting information, the Committee finds there is not sufficient information or need to take action on Proposal 19-108.

Recommendations: The Committee recommends Task Force I take no action on proposal 19-108.

Replacement Chapter VI. Shellfish Aquaculture Guidance

Section IV Guidance Documents – Chapter VI. Shellfish Aquaculture or Section III Public Health Reasons and Explanations

NSSP guidance documents provide the public health principles supporting major components of the NSSP and its Model Ordinance, which includes the requirements of the program. For the most up to
Committee Report 2023

date and detailed listing of requirements, the reader should consult the most recent edition of the Model Ordinance.

Introduction

This chapter provides guidance on NSSP standards intended to address human health hazards specifically associated with molluscan shellfish aquaculture activities covered under Chapter VI. of the NSSP Model Ordinance requirements. Additional information concerning the disease-causing potential of molluscan shellfish can be found in the NSSP Model Ordinance Guidance Documents: *Guidance for Developing Marine Biotoxin Contingency Plan, Sanitary Survey and the Classification of Growing Waters, and Shellstock Relay.*

For the purposes of the NSSP Model Ordinance, Aquaculture is defined as the cultivation of bivalve shellfish in controlled conditions for human consumption. This includes cultivation of molluscan shellfish in natural water bodies or man-made systems. Aquaculture can also include the cultivation of molluscan shellfish with non-molluscan species in a common aquaculture system known as polyculture. Bivalve shellfish raised in open water aquaculture operations are generally subject to the same potential for contamination as naturally occurring bivalve shellfish populations. As a result, there is substantial overlap in the sanitary controls within the NSSP Model Ordinance for bivalve shellfish harvested from aquaculture operations and those harvested from naturally occurring populations. There are potential human health concerns specific to land-based or recirculating aquaculture that may require the implementation of operation specific management measures. Activities such as relaying, wet storage, depuration, growing area classification and tagging, are regulated under their respective NSSP Model Ordinance chapters. Aquaculture activities regulated under Chapter VI. of the NSSP Model Ordinance are those unique to aquaculture operations and have the potential to pose a significant public health concern if not properly managed. As outlined in Chapter VI @.01A, these include, but are not limited to:

- (1) Natural seed collection and/or the rearing of larvae and seed shellfish in growing areas and/or hatcheries and nurseries in, or using, waters classified as Prohibited or Unclassified;
- (2) Aquaculture activities that include off-bottom structures that may attract bird and/or mammal congregations to the extent that their waste may present a human health risk; and,
- (3) Land-based aquaculture operations and/or Poly Culture.

Hatcheries and Nurseries- Exemptions and Exceptions to Chapter VI

Chapter VI. makes certain exemptions and exceptions for hatcheries and nurseries rearing larvae and/or seed that are located in, or draw water from, growing areas in the Approved or Conditionally Approved classifications. Hatcheries and nurseries rearing larvae and/or seed that are located in, or draw water from, growing areas in the the Restricted or Conditionally Restricted classification, are also exempt from these requirements if seed does not exceed the maximum seed size established by the Authority under Chapter VI @ .02 (A) or if they adhere to the relay requirements in Chapter V for seed that exceeds the maximum seed size established by the Authority per Chapter VI @ .02 (A).

Requirements for the Authority

To meet the requirements for shellfish aquaculture in Chapter VI, the Authority must have an adequate legal basis, and established procedures, to regulate aquaculture activities outlined in Chapter VI @.01A that occur within their jurisdiction. At a minimum, this includes oversight over

the issuance of permits, the ¹review and approval of operational plans for any operations conducting activities in Chapter VI @.01A., and the ability to inspect such operations at least annually to verify that appropriate permits are up to date and operational plans are being implemented. It may also be necessary, based on the aquaculture operations practiced in a jurisdiction, for the Authority to impose additional control measures or recordkeeping requirements upon aquaculture practitioners in the form of regulation, policies, and/or enforceable permit conditions or operational plans Discussion of additional Authority imposed control measures and associated responsibilities are found under their respective subheading.

Requirements for the Harvester/Dealer (Aquaculture Operator)

It is the responsibility of the operator of an aquaculture facility to verify compliance with NSSP MO requirements, and associated local rules and regulations, and to obtain the permission of the Authority prior to conducting any of the aquaculture activities outlined in Chapter VI. The operator of an aquaculture facility may also be required to conduct record keeping and implement control measures as outlined in regulation, permit conditions, and/or their operational plan as necessary based on individual aquaculture practices and the requirements of the Authority. It is important to note that in many states the Authority does not require formal operational plans, rather the required elements of operational plans listed below are included in permit application materials and as regulations and/or enforceable permit conditions. Discussion of additional harvester control measures and responsibilities are found under their respective subheading.

Seed Production in Water Classified as Prohibited or Unclassified

When adequate controls are implemented, natural seed collection and/or the rearing of larvae and seed shellstock in growing areas and/or hatcheries and nurseries located in, or using, waters classified as prohibited or unclassified, provides aquaculturists the opportunity to access shellstock resources or utilize areas or waters for seed production that would otherwise not be available for the production of shellstock intended for direct human consumption. Often areas that are unclassified or classified as prohibited due to real or potential pollution (such as marinas, boat yards, etc.) are ideal locations for hatchery or nursery operations due to their proximity to physical infrastructure (docks and piers, freshwater, electricity) and other factors (i.e. protection to wave action, ease of access, security, etc.) important to hatchery and nursery production.

The harvesting of shellstock from unclassified areas or areas in the prohibited classification is not allowed for any purpose, except depletion, gathering of seed or hatchery and nursery production. The use of prohibited or unclassified waters for the gathering of natural seed and/or hatchery and nursery production is acceptable because these operations do not produce shellstock for direct consumption; rather, the seed produced/gathered is to Restricted, Conditionally Restricted, or Approved areas in for grow-out prior to harvest for consumption. Research has shown that shellstock has the ability to purge itself of microbial pathogens and certain chemical contaminants over time when moved to clean saline water. In addition, limited exposure during early life stages to lipophilic or other contaminants that cannot be easily purged from shellstock does not constitute a public health hazard if the shellstock are moved to clean waters while these contaminants still represent a small constituent of the total shellstock tissue mass. As a result, seed from prohibited or unclassified areas does not pose a risk to public health provided the Authority ensures they are relocated to suitable waters and provided adequate time for the reduction of contaminants and growth prior to harvest for consumption. *For more information see Section IV Guidance Documents – Chapter II. Growing Areas.*

Maximum Seed Size

Section II Chapter VI @ .02 requires the Authority to sanction (permit) all sources of seed produced or collected in unclassified or prohibited waters, and to establish a maximum seed size for each species of shellfish that are produced in unclassified or prohibited waters. The Authority must set the maximum seed size to ensure a minimum of 120 days of growing to reach market size following movement from unclassified or prohibited waters to waters in other classifications. This period of growth is intended to ensure any potential contaminants accumulated in seed shellstock tissues while being reared in unclassified or prohibited waters will represent a small constituent of the total tissue mass at harvest. 120 days also provides sufficient time for the purging of any bacterial or viral pathogens.

A maximum seed size may be established via regulation, enforceable permit conditions, or within an individual aquaculture operations enforceable operational plan. To determine the appropriate maximum seed size for each species, the Authority may choose to rely on existing locally appropriate data or conduct species specific studies. Growth rates vary across and within regions and can be influenced by a number of environmental factors (i.e. temperature, food availability and quality), genetics (i.e. triploid vs. diploid), and culture practices (i.e. stocking density, on-bottom vs off-bottom). It is also common to see differential growth rates between individual shellfish within a single nursery system. Some hatchery and nursery activities are considered self-limiting with regards to the size of shellstock they can support (i.e. spat on shell, etc.). In such systems, shellstock are likely to be moved to clean waters and remain there for far longer than 120 days prior to harvest. For wild seed collection and other types of nursery activities (upwellers, floating nursery bags, etc.), operators may wait to move shellstock to clean waters until they are close to the maximum seed size. In these cases operators must closely monitor growth rates to ensure shellstock does not exceed the maximum seed size and trigger the need for corrective actions.

The NSSP MO requires the Authority and operator to establish appropriate corrective actions, as required in Chapter VI .03 (B), for when seed that has been produced in waters classified as prohibited or unclassified exceeds the maximum size. With few exceptions, the seed will generally need to be destroyed or moved to a restoration site sanctioned by the Authority. It is critical that the Authority and aquaculture operators work together to ensure the establishment of a maximum seed size that is consistent with production practices and local environmental conditions, and ensures the minimum 120 days prior to harvest to prevent unnecessary loss of shellstock. Corrective actions may be established via regulation, enforceable permit conditions, or within an individual aquaculture operation's enforceable operational plan. If corrective actions are required, it is recommended that the operation and/or Authority adjust practices and/or reevaluate permit conditions and/or the operational plan to prevent further violation of maximum seed size requirements.

An important factor in determining the maximum seed size is if the Authority has established a market or legal harvest size for each species produced in waters classified as prohibited or unclassified. In states where a minimum enforceable market (AKA harvest) size is in place, it may be possible to establish a relatively larger maximum seed size and have sufficient confidence, and a legal basis, to ensure seed shellstock originating from waters classified as prohibited or unclassified will not be harvested prior to the required 120 days, without requiring additional record keeping, segregation, or other measures. In cases where a state does not have an established minimum market size, and are relying on long established market standards to base the determination of an appropriate maximum seed size, it is likely a conservative maximum seed size, and/or additional measures such as record keeping, segregation, or other measures will be required as an enforceable permit condition or enforceable element of an operational plan to provide verifiable compliance

with the 120 day requirement. Alternatively, the Authority may allow an operator to adopt a minimum harvest size as an element of their enforceable operational plan and possibly forgo or reduce the need for record keeping, segregation, or other measures.

Operational Plan

The NSSP MO Section II Chapter VI .03 requires aquaculture operations that collect or culture seed in waters classified as prohibited or unclassified develop a written operational plan and receive approval by the Authority prior to its implementation; such a plan shall at a minimum include:

- (1) A description of the design and activities of the culture facility;
- (2) The specific site and boundaries in which shellfish aquaculture activities will be conducted;
- (3) The types and locations of any structures, including rafts, pens, cages, nets, or floats which will be placed in the waters;
- (4) The species of shellfish to be cultured and harvested;
- (5) Procedures to assure that no poisonous or deleterious substances are introduced from the seed production activities; and,
- (6) Corrective actions for addressing seed exceeding the maximum seed size as defined by the Authority.

If the information for items #1-4 is provided in permit application materials or as a condition on permits, these may be substituted for inclusion in a formal operational plan. Item #5 is often codified in state regulation, and adherence is agreed upon by the operator when signing their permit(s). In other cases, written operational plans containing elements, or the entirety, of the information required in #1-6 may be used to supplement other documentation provided by the permit holder or applicant to satisfy this requirement. In some instances additional information, such as an operator/Authority agreed upon minimum harvest size, segregation and record keeping protocols for shellstock relocated from prohibited areas, or other elements specific to managing human health risks associated with individual operations and as required by the Authority must be submitted. Any form of enforceable written record of the required information in #1-6, and agreed upon by the Authority, is sufficient to meet the intent of Chapter VI @ .03.

Facility Inspection

If an operation plan is determined to be required for an aquaculture site, the authority must inspect the operation at least annually. The inspection is intended to ensure the operation is adhering to the operational plan, and verify that appropriate permits and any reporting, if required, are up to date.

Aquaculture activities that include off-bottom structures that may attract bird and/or mammal congregations to the extent that their waste may present a human health risk

Microbial contamination from nonpoint pollution sources such as wildlife waste in growing areas represents a public health risk. Wildlife such as birds and/or mammals have been documented to host *Campylobacter* spp., *Salmonella* spp., *Listeria*, *E. coli*, *Vibrio cholerae*, *Aeromonas* spp., *Enterococcus* spp., and other zoonotic enteric viruses and bacteria within their digestive tract and feces. A number of these pathogens have a low infectious dose, and have the potential for survival and growth during harvest, processing, transportation and storage (Stelma et al. 1991). A detailed summary of zoonotic pathogens of concern to shellfish sanitation is provided in Stelma et al. 1991. While human enteric pathogens can be isolated in the intestinal tracts of a number of species of birds and/or mammals that inhabit coastal and marine waters, the level of risk to shellfish consumers from wildlife waste is not fully understood; however, it is believed to be less than that related to human sources (Stelma 1991). This largely because for pathogens introduced from wildlife waste to result in human infections they must be a strain that is pathogenic to humans and must be ingested at an infectious dose (Smith et al. 2021). The vast majority of enteric pathogen strains isolated from wildlife waste and growing area waters subject to nonpoint wildlife derived pollution have not been associated with reported human infections, and the majority likely do not have the ability to cause illness in humans (Smith et al. 2021; Stelma, 1991).

The use of floating and off-bottom gear, mainly for oyster culture, has increased in recent years due to the benefits these methods provide aquaculturists to avoid sensitive benthic habitats, and for ease of handling, maintenance, and improved growth rates and survival. However, floating and exposed off-bottom aquaculture gear can provide a roosting platform for various types of birds and/or mammals and become a feeding and defecating site, when these congregations reach sufficient numbers they can present public health concerns.

Increased fecal coliform loading due to congregations of birds and mammals on or around aquaculture structures may result in degradation of water quality to the extent that growing areas no longer meet NSSP criteria outlined in Chapter IV, resulting in growing areas closures, a downgrade in water quality, or potentially a recall of harvested products. Waste associated with congregations of birds and/or mammals on floating and exposed off-bottom aquaculture gear has recently been associated with increased fecal coliform levels in shellfish growing areas and shellfish meats in New York, in some cases requiring growing area closures, and sampling of growing areas and oysters held in floating aquaculture gear prior to reopening of affected areas and farms (NYSDEC). Such actions have had significant adverse impacts on aquaculture operators and highlighted the need to identify potential water quality impacts associated with congregations of birds and mammals on or around aquaculture structures prior to them reaching the level of public health concern.

In addition to concerns associated with water quality degradation, shellstock held in or near structures that serve as a roosting platform for various types of birds and/or mammals may accumulate bird or mammal fecal matter that could serve as a vector for human infections when shellfish are consumed. In the U.S. reports of outbreaks and sporadic infections linked to wildlife contamination of molluscan shellfish are rare, but have been documented. In October, 2021, an investigation indicated that eight people became ill after consuming raw oysters harvested from a small coastal pond in Rhode Island. The illnesses were associated with *Campylobacter jejuni* bacterial contamination linked to the presence of flocks of birds congregating on floating aquaculture gear (RIDOH).

The recent incidence of shellfish derived human infections and water quality issues associated with bird congregations on floating and off bottom gear has prompted management measures focused on mitigating human health concerns related to wildlife congregations on aquaculture sites. Under the growing area classification responsibilities at Chapter VI. *Shellstock Growing Areas* the Authority

is required to consider the presence of wild animals or resident and migrating bird populations for possible adverse effects on growing areas, and to identify and evaluate all actual or potential sources of pollution which may affect the growing area during routine water quality sampling, sanitary surveys, triennial, and annual evaluations. Under aquaculture specific provisions in Chapter VI.@04, the Authority is required to evaluate aquaculture sites to determine if the aquaculture operation and the associated culture gear may attract sufficient numbers of birds and/or mammals to the extent that their waste presents a human health risk. If the Authority determines a human health risk may exist or develop, the Authority must require the operator to submit a written operational plan, including mitigation or deterrent measures to minimize the potential pollution impact of birds and/or mammals, to the Authority for approval prior to its implementation. The two separate, yet interrelated, requirements provide a means for the Authority to evaluate risk associated with proposed aquaculture operations and, if necessary, institute deterrent or mitigation measure before they are approved, and a means to evaluate risk associated with existing aquaculture sites on a routine basis via observations and results from water quality sampling, sanitary surveys, triennial, and annual evaluations.

Risk Determination of Aquaculture Operations

Any aquaculture operation utilizing floating gear or other structures that may serve as a roosting or resting platform for birds or mammals (e.g. work floats, pilings, etc.) has the potential to attract bird and mammal congregations. However, the presence of wildlife, or their waste, on aquaculture gear alone is generally not sufficient to determine if a human health risk may be present. Positioning sampling stations in proximity to aquaculture sites provides a means to evaluate risk associated with existing operations (*See Chapter VI. Shellstock Growing Areas for more information on pollution source sampling*)[1] . Shellstock sampling from existing sites may also provide an indication of potential risk; however, it is important to note fecal coliform counts do not differentiate between human pathogenic and non-pathogenic strains of bacteria, and we currently do not have an estimate of the correlation of human enteric pathogens with coliforms in wildlife waste; although, the risk is considered to be less than that from human derived sources (Stelma, 1991; Smith et al. 2021). Further, there are no bacteriological standards for shellstock meats within the Model Ordinance so an understanding of background levels would likely be necessary to support interpretation of shellfish sampling results.

When evaluating proposed sites the Authority can consider a number of site related factors that may influence whether bird and/or mammal congregations on aquaculture gear may present a risk to human health. These factors include evaluating existing information on the seasonal or year round abundance, type, and behavior of wildlife (e.g. feeding, nesting, migration, etc.), within the growing area where a site is being proposed. An evaluation of site specific hydrodynamic information for the growing area where a site is proposed to be located can also help inform the potential level of risk. Factors such as stratification, tidal magnitude, water depth, current velocity, and wave action can influence the extent to which wildlife waste may become an issue. Areas with minimal currents or flushing may be more susceptible to water quality impacts from smaller congregations of wildlife than those with high current velocities and flushing. Sites proposed within proximity to other facilities that may attract birds and mammals could also increase the risk of gear to serve as roosting platforms for existing populations of birds or mammals in the area. Operation design is also a major consideration for determining if a proposed aquaculture operation may present a risk to human health. The type, extent, and density of exposed gear on the site can impact flushing around gear arrays, and either reduce or increase fecal loading associated with bird and/or mammal waste. Other operation specific practices can be adapted to reduce the potential for a human health concern to develop. For example, floating gear is often used during the nursery and intermediate stages of culture. In areas where the potential risk of human health concerns are high, shellstock may be able

to be moved from floating or exposed gear to submerged gear or planted on bottom for a period of time prior to harvest. In addition, the implementation of proactive deterrent measures may provide the Authority with confidence that issues can be avoided before they reach a level of human health concern.

The approach the Authority employs to meet the requirements of Chapter VI.04 will generally be based on the availability of resources to conduct required water quality sampling at existing aquaculture sites, the availability of resources and existing information needed to evaluate risks associated with proposed sites, and the Authority's confidence that bird and/or mammal congregations on aquaculture gear, and the resulting waste, may or may not present a human health risk based on their evaluation and observations. The information necessary to support an evaluation of risk for new and existing aquaculture operations may be derived from a number of sources such as growing area classification information, external sources, and/or information provided by the aquaculture operator within application materials or other reporting to the Authority. To the extent possible, aquaculture operators should detail to the Authority within their application materials, or other reporting, any site selection criteria or operational design specifics intended to minimize the potential pollution impact of birds and/or mammals they are proposing to proactively employ. This will help the Authority determine which of the following approaches to meet the requirements of Chapter VI.04 they will employ.

1. **Monitoring approach-** If the Authority determines that sufficient evidence does not exist to preemptively require new or existing aquaculture operators to adopt mitigation or deterrent measures, they may choose to continue to monitor the growing area in compliance with growing area classification requirements in Chapter IV. The monitoring should be conducted in a manner that would allow the Authority to identify and address potential human health concerns associated with bird and/or mammal congregations on aquaculture gear, prior to them reaching a level of public health significance. This strategy may require adjusting water quality sampling stations and sampling frequency around aquaculture operations, shellstock meat sampling, microbial source tracking or other forms of directed pathogen sampling, and/or other monitoring or reporting measures as appropriate. In these cases, the Authority and operators should consider the development of procedures to rapidly institute operational plans including deterrent and/or mitigation measures should a concern be identified. The Authority should document any bird and/or mammal congregations on aquaculture sites during aquaculture site inspections, routine water quality monitoring, annual and triennial reviews, and sanitary surveys, and consider adjusting sampling/monitoring frequency around any observed seasonal, or other, trends in wildlife activity.

2. **Preemptive approach-** If the Authority determines that sufficient evidence of a public health concern associated with the use of floating gear exists, or that insufficient resources exist to increase monitoring around new aquaculture operations, they may choose to preemptively require aquaculture operators to provide an operational plan and institute bird and/or mammal mitigation and/or deterrent measures. Alternatively, the Authority may implement industry-wide or operation specific mitigation (e.g. submergence requirements) and/or deterrent measures to minimize impacts from birds and/or mammals via regulation, enforceable permit conditions and/or policies. The Authority should continue to document any bird and/or mammal congregations on aquaculture sites during aquaculture site inspections, routine water quality monitoring, annual and triennial

reviews, and sanitary surveys, and monitor water quality within proximity to aquaculture facilities to evaluate efficacy of measure outlines within operation plans.

Operational Plan

Under Chapter VI.04, if the Authority determines that the aquaculture operation and the associated culture gear may attract sufficient numbers of birds and/or mammals to the extent that their waste presents a human health risk, the operator is required to enact mitigation measures as a component of an operational plan. The plan shall be approved by the Authority prior to its implementation and include:

1. A description of the design and activities of the culture facility;
2. The specific site(s) and boundaries in which the shellfish aquaculture activities will be conducted;
3. The types and locations of any structures, including rafts, pens, cages, nets, or floats which will be placed in the waters;
4. The species of shellfish to be cultured and harvested;
5. Procedures to assure that no poisonous or deleterious substances are introduced from the aquaculture activities;
6. A description of the mitigation or deterrent measures to minimize the potential pollution impact of birds and/or mammals; and
7. Maintenance of the required records.

If the information for items #1-4 & 6-7 is provided in permit application materials or on final permits, these may be substituted for inclusion in a formal operational plan. Likewise, #5 is often codified in state and/or federal regulation, and adherence is agreed upon by the operator when signing their permit(s) or by law. In other cases written operational plans containing elements, or the entirety, of the information required in #1-7 may be submitted. Any form of enforceable written record of these items is sufficient to meet the intent of Chapter VI @ .04. To meet the requirements of #6, if necessary, the written operational plan or application materials should clearly describe any operational, maintenance, handling and/or sanitary practices for the aquaculture gear and shellfish that will be conducted to prevent contamination of the growing area from waste attributed to congregations of birds and/or mammals on aquaculture structures. This may include a written description, sketches and/or photos of deterrents or mitigation measures to be used. Strategies may include a suite of deterrents (i.e. kites, cannons, sprinklers, spikes etc.) or mitigation measures (e.g. submerging gear and shellfish prior to harvest, relocating floating gear to areas with significant flow, seasonal harvest restrictions, configuring farm sites to maximize flushing, etc.) that will address human health concerns related to year-round or seasonal congregations of birds and/or mammals. In addition, plans should address evaluation of the efficacy of deterrent and/or mitigation measures, and potential triggers that would require changing or adapting deterrent or mitigation measures to address new bird or mammal species and/or behavioral changes, and amendments should be made to the plan, as needed, based on changes to the culture operation, gear, and/or reduced efficacy of the approved deterrents and/or mitigation measures employed by the aquaculture operator.

Facility Inspection

If an operation plan is determined to be required for an aquaculture site, the authority must inspect the operation at least annually. The inspection is intended to ensure the operation is adhering to the operational plan, verify that appropriate permits are up to date, and that control measures to prevent possible adverse public health effects from birds or mammals are effective. In addition, the Authority should continue to document any bird and/or mammal congregations on aquaculture sites during, routine water quality monitoring, sanitary surveys, triennial, and annual evaluations, and continue monitor water quality within proximity to aquaculture facilities to evaluate efficacy of mitigation and/or deterrent measure outlined within operation plans. The Authority should consider the development of written protocols associated with evaluating the effectiveness of the deterrents and/or mitigation strategies. If the Authority or Operator documents large congregations of birds and/or mammals on aquaculture gear, and/or an accumulation of fecal matter, an evaluation of the efficacy of current control measures may be necessary to determine if additional control measures are needed.

Polyculture and Land-based Aquaculture Considerations

Polyculture and land-based monoculture operations must be under adequate control to assure the shellstock product harvested will be acceptable for human consumption. The Authority must establish detailed procedures for issuing permits for shellfish aquaculture, approving culturing facilities and boundaries, controlling of harvesting, sampling of shellstock, monitoring environmental parameters, keeping records, imposing quarantine measures, controlling the use of animal drugs to stimulate growth or treat diseases, and developing other control measures as may be necessary.

The Authority should work with FDA in its review of the plans for a land based aquaculture operation. Of particular concern in land-based systems is the use of a closed or recirculating water system. Potential exists for shellstock contamination through the failure of the water treatment system to sufficiently disinfect the water to control levels of human pathogens that might be introduced through the water supply or other means. There is also potential for the increased concentration of poisonous and deleterious substances such as animal drugs or antifouling agents in the water supply and subsequently the shellstock over time.

Prior to the harvest of shellstock from land-based systems for sale in interstate commerce, the aquaculturist must demonstrate that the water in the land-based system meets the NSSP Model Ordinance criteria for direct sale of shellstock to the consumer. If the water supply does not meet those criteria, the aquaculturist must subject the shellstock to relaying or depuration prior to sale. For more information related to Relay or Depuration, see Chapters V and XV, respectively.

The cultivation of shellfish with other species in a common aquaculture system is known as polyculture. There are some additional public health concerns related to polyculture. Greater potential may exist for contamination of oysters, clams, mussels and scallops with human pathogens and animal drugs in polyculture. However, the extent of that potential is not known. The extensive use of tanks, sea enclosures, floating rafts, ponds, etc. in polyculture makes the oysters, clams, mussels or scallops highly vulnerable to pollution from various sources, including their association with the other species present in the polyculture operation. The usage of anti-fouling agents (tributyltin, copper, etc.), hormones, and antibiotics in finfish aquaculture has evoked concern about its environmental effects and potential threat to human health through bioaccumulation in shellfish.

Therefore, a conservative approach to polyculture is provided in the NSSP Model Ordinance requirements.

.05 Land Based Aquaculture

- a. Need for polyculture and land-based monoculture operations to be under sanitary control. Potential increased consumer risk due to land-based operations.
- b. Public health concerns of polyculture elaborated on
 - c. Conservative approach suggested
 - d. Authority must establish procedures for issuing permits, approving culturing sites and boundaries, controlling harvest, sampling of shellstock, monitoring environmental parameters, e. Authority encouraged to work with FDA for review of land-based aquaculture operation plans

.06 Polyculture Systems

A polyculture system shall: A. Meet all requirements in Section .05 Land Based Systems; B. Provide information concerning all sources and species of all organisms to be cultivated, cultured, and harvested; and C. Include in its operational plan requirements to: (1) Monitor for human pathogens, unacceptable levels of animal drugs, and other poisonous or deleterious substances that might be associated with polyculture activities; and (2) Subject all harvested shellstock to relaying or depuration if human pathogens, unacceptable levels of animal drugs, and other poisonous or deleterious substances exist at levels of public health significance.

Facility Inspections

If an operation plan is determined to be required for an aquaculture site, the authority must inspect the operation at least annually. The inspection is intended to ensure the operation is adhering to the operational plan, verify that appropriate permits and any reporting, if required, are up to date.

Citations

Stelma, G.N. and L.J. McCabe. 1990. Non-point pollution from animal sources and shellfish sanitation. *J. of Food Protection*. Vol. 55, No. 8, pp.649 -656.

Smith, O.M., Snyder, W.E. and Owen, J.P. (2020), Are we overestimating risk of enteric pathogen spillover from wild birds to humans?. *Biol Rev*, 95: 652-679. <https://doi.org/10.1111/brv.12581>

The Rhode Island Department of Health (RIDOH) Potters Pond Closed to Shellfish Harvesting. [(accessed on 1 July 2022)]; Available online: <https://www.ri.gov/press/view/42081>