



Aquatic Invasive Species HACCP in Baitfish and Aquaculture Operations

Introduction

The potential exists for aquatic invasive species (AIS) to spread to uninfested waters through the day-to-day operations of businesses dealing in wild harvested baitfish and aquacultured fish. Baitfish and aquaculture industries are diverse and complex, as are their risks of spreading AIS. These industries, however, strive to avoid spreading AIS since it is clearly not in their best interest. While most industry segments pose very low risk of spreading AIS, risk tolerance is also very low and additional risk reduction measures may be warranted. To deal effectively and fairly with this potential vector, it is important to characterize the industry according to the risks of spreading AIS. Without adequate risk assessment of individual operations, regulations could be imposed which would have unnecessarily negative impacts on the economy of these industries while still resulting in no measurable reduction of the risks of spreading AIS.

One approach to this problem is to apply the Hazard Analysis and Critical Control Point (HACCP) concept, similar to that used by the seafood industry to minimize seafood consumption health risks. The advantages of this system are that it can effectively deal with a diverse industry, it has proven to be a good partnership between industry and government regulators, and when properly applied it is effective at reducing the risk of identified hazards. The HACCP approach concentrates on the points in the process that are critical to the safety of the product, minimizes risks, and stresses communication between regulators and the industry.



The AIS Problem and Minimizing its Risk

Wild-harvested baitfish and aquaculture have been identified as vectors for the spread of AIS. In fact, some management agencies have closed AIS infested areas to harvest and culture. Some states have banned the importation of live bait and others only allow certified AIS-free bait to cross their borders. Other regulations restricting the economic viability of the baitfish/aquaculture industries have been proposed. The baitfish and aquaculture industries are extremely diverse in the species produced, the market forms of these species, the production systems used, and the water sources used. The HACCP concept, similar to that used by the seafood industry to minimize the human health risks of seafood consumption, is well-adapted to such a diverse industry.



In December 1995 the United States Food and Drug Administration (FDA) issued seafood regulations based on the principles of HACCP. The FDA issued these regulations to ensure safe processing and importing of fish and fishery products. These regulations specify that someone trained in HACCP perform certain critical jobs in seafood processing. Just as HACCP is used to ensure safe seafood, it can be applied to other business processes to ensure product safety. The Seafood HACCP approach was modified to address the risk that wild harvested baitfish and private and public cultured fish could spread AIS. This methodology is now referred to as AIS-HACCP.

The goal of the AIS-HACCP approach is to prevent the spread of AIS while maintaining viable baitfish and aquaculture industries. The AIS-HACCP approach can also be used to verify or certify AIS-free products for those businesses that choose to seek this level of oversight. Because industry pioneered the HACCP approach and it stresses communication between industry and resource managers, the approach attempts to strike a balance between over-regulation and ignoring the potential for spreading AIS. For the AIS-HACCP concept to be adopted as a tool, it must be accepted by both the industry and resource management agencies.

The AIS-HACCP Approach

Baitfish harvesting and aquaculture activities can be categorized into four general areas that include field operations, production facility operations, transportation, and sales. The principle risk to the environment associated with the baitfish harvesting and aquaculture sectors is the movement and introduction of AIS through these activities. Broad risk categories to address within these four general

areas of activity include use of contaminated surface waters, collection of contaminated stocks, and using water or equipment from contaminated facilities. These can be broken down further into specific risk factors designated as potentially significant hazards, which include parasites, pathogens, plants, invertebrates, fish, and other aquatic vertebrates.

The AIS-HACCP concept, if adopted by industry and resource management agencies, can be used to focus attention on the segments of the baitfish and aquaculture processes that are most likely to pose a risk of spreading AIS. The HACCP approach allows regulators to assess what happens in various baitfish or aquaculture operations and to evaluate how potential hazards are being handled. With HACCP, the emphasis is to understand the entire process. This requires the regulator and industry to communicate and work with one another. HACCP is most effective when regulators take the opportunity to review the HACCP plan and evaluate if critical hazards have been properly identified and ensure that individual businesses are consistently controlling these hazards. It is, therefore, a shared responsibility of the baitfish harvesting and aquaculture businesses and the resource management agencies to develop and implement AIS-HACCP plans.

The AIS-HACCP approach has been designed for three primary purposes. The first is to restrict the spread of AIS via the culture or transfer of live fish while maintaining the economic viability of baitfish harvesting and aquaculture industries. Many organizations and resource management agencies have recommended that baitfish harvesting and aquaculture operations be eliminated if they use AIS infested waters or are actually raising AIS. This is certainly the most effective approach to prevent the spread of AIS through this pathway, but it is also unnecessarily restrictive to important segments of the baitfish harvesting and aquaculture industry.

Of course, if the risk and economic damage caused by the baitfish harvesting and aquaculture industry is significant, then shutting down segments of the industry or preventing the culture of AIS is appropriate. The risk, however, is often small and depends on the particular AIS and the control strategies used. In comparison to other potential AIS pathways (e.g. recreational boating, shipping, aquarium trade) baitfish harvesting and aquaculture are frequently



held to a higher standard of zero risk. The rationale for variability in regulatory standards is unclear, but the comparably small size and fragmented nature of the baitfish harvesting and aquaculture industries likely plays a role.

However, the fact that the baitfish harvesting and aquaculture industries are rather small is advantageous because less effort is needed to encourage them to change their behavior to reduce the risk of spreading AIS compared to that needed to change the behavior of recreational boaters or commercial shippers, for example. The AIS-HACCP approach is one way in which resource management agencies can work with the baitfish and aquaculture industries to change, monitor, record, and verify their efforts to reduce the risk of spreading AIS.

The second purpose of the AIS-HACCP approach is to provide state, federal, and tribal hatcheries with a means to satisfy public concerns regarding their role in the spread of AIS. State, federal, and tribal hatcheries must also change their practices when raising and stocking fish to ensure they are not responsible for the spread of unwanted species when the waters they use become AIS infested. Public hatcheries have been implicated in the unintentional spread of fish. An example is the U.S. Fish and Wildlife Service Inks Dam hatchery in Texas, which was identified as the source of a gizzard shad introduction to Morgan Lake in New Mexico via a shipment of largemouth bass. Gizzard shad have subsequently appeared to move downstream into the San Juan arm of Lake Powell in Utah. Gizzard shad are not native to this region.

State, federal, and tribal hatcheries have a responsibility to instill confidence in the public that they are addressing AIS risks when they raise and stock fish. The AIS-HACCP

approach provides a mechanism by which state, federal, and tribal hatcheries can assure the public that they are conducting their fish stocking efforts in an environmentally responsible manner.

The third purpose for developing the AIS-HACCP approach is to provide a mechanism by which private baitfish harvesting and aquaculture operations can certify their product as AIS-free. Some states and watersheds require certified AIS-free bait. In addition, some organizations, agencies, and private buyers would prefer to purchase certified AIS-free fish for stocking. Currently, there is no certification program available in the North Central Region of the U.S. The AIS-HACCP approach could serve this purpose.

AIS-HACCP Implementation

AIS-HACCP is a voluntary training program based on the principles of the FDA's Seafood HACCP. Seeing a need to comparatively address AIS risks in baitfish and aquaculture sectors, Sea Grant personnel from Minnesota and Michigan developed a voluntary AIS-HACCP program. Objectives of the AIS-HACCP program were to:

1. Identify and concentrate on critical process control points to ensure environmental safety
2. Minimize risks associated with baitfish and aquaculture activities
3. Stress communication between regulators and industry

Since its inception the Great Lakes Sea Grant Network has conducted numerous AIS-HACCP training workshops for regional units of the U.S. Fish and Wildlife Service, U.S. Geological Survey, tribal governments, state agency personnel, and private industry.

The U.S. Fish and Wildlife Service later developed their own AIS-HACCP training programs, along with the HACCP Natural Resource Management website that provides resource information, examples of AIS-HACCP plans, and a web tool for [developing AIS-HACCP plans](http://www.haccp-nrm.org) (www.haccp-nrm.org). According to that website, as of October 2018 there have been 181 AIS-HACCP plans developed across 30 states. In 2009, AIS-HACCP was added to Active Standard ASTM E2590 International Standard Guide for Conducting Hazard Analysis-Critical Control Point Evaluations.





Preliminary steps for implementing an AIS-HACCP program include a management commitment, formal AIS-HACCP training for personnel, and the formation of a HACCP team after the training. The team must identify all the activities involved with the specific baitfish harvesting or aquaculture operation with the intended use of the final product. This will involve the development of a detailed flow diagram of all the activities in the operation.

AIS-HACCP consists of identifying AIS hazards, determining where they occur, establishing critical limits to deal with the hazards, monitoring these points, and recording the results. AIS-HACCP involves day-to-day monitoring of critical control points by baitfish harvesters and aquaculture production employees. AIS-HACCP is based on the belief that baitfish harvesting and aquaculture production employees can understand the AIS hazards associated with their products and take reasonable steps to control them. These can include practices such as treating hauling water, inspecting and cleaning equipment, using quarantine procedures, and other appropriate measures. This should all be documented in a record keeping system.

The seven HACCP principles include:

1. Conduct a hazard analysis and identify preventive measures

The significance of each hazard is assessed by considering the risk and severity. The focus should only be on the truly relevant hazards. The hazard must be controlled if it is reasonably likely to occur and if not controlled will likely cause AIS to spread.

2. Identify critical control points

This is a step at which control can be applied and is essential to prevent or eliminate the hazard or reduce it to an acceptable level. One critical control point can control more than one hazard, or more than one critical control point may be needed to control a specific hazard.

3. Establish control measures

A control limit represents the boundaries that are used to ensure that AIS are removed or destroyed. When a process deviates from a control limit, a corrective action must be taken. Control limits may be difficult to develop and selection should be driven by practicality and experience.

4. Monitor each critical control point

Monitoring involves a planned sequence of observations or measurements to assess whether a critical control point is under control and to produce an accurate record for future use in verification. The purpose of monitoring is to identify trends that may require adjustments to ensure continued control over the hazard. Monitoring helps identify when there is a loss of control and provides written documentation of the hazard control system.

5. Establish corrective action to be taken when a critical limit deviation occurs

Corrective actions are the procedures followed when deviations from critical limits occur at critical control points. When possible these procedures should be predetermined. It is important to rapidly identify deviations from a control point to prevent the spread of AIS.

6. Establish verification procedures

Verification is the use of methods, procedures, or tests, in addition to those used in monitoring, that determine if the HACCP system is in compliance with the HACCP plan or whether the plan needs modification.

7. Establish a record keeping system

Records provide documentation that the critical limits have been met or that appropriate corrective actions were taken when the limits were exceeded. The four categories of records as part of the HACCP system will include the HACCP plan and supporting documentation, critical control point monitoring, corrective actions, and verification activities.



Steps to implement an AIS-HACCP program include:

- Facility personnel need to identify all operational practices (control points) that may pose risk of AIS movement or introduction
- Responsible oversight operators need to be identified for each activity
- Risk factors should be defined predominantly by specific site, water body (watershed), or region
- Potentially new AIS must be considered
- Training must be provided for operators in risk factors associated with the activities being conducted
- Knowledge of risk analysis methodology is necessary
- A framework for risk analysis needs to be established that takes into account the activities being conducted, associated risks, operator skill sets, efficiency of operations, and control measures
- Operators will require training for implementing risk management measures
- Record keeping, reporting, and communication protocols must be identified, described, and implemented
- Operators need to be trained in monitoring, record keeping, reporting, and communications
- Operators must be aware of the regulations (e.g. health certification requirements) pertaining to each activity
- Operators will require training in inspection and disinfection

Conclusions and Recommendations

The AIS-HACCP approach has many advantages. It can effectively deal with a diverse industry and diverse risk factors associated with a variety of plant, invertebrate, vertebrate, and pathogen AIS. As it develops, as it has in the seafood industry, it should prove to be a good partnership between industry and government regulators. It can help avoid overly restrictive regulations, and, if properly applied, can be effective at reducing the risk of spreading AIS via baitfish and fish stocking.

The AIS-HACCP approach concentrates on the points in the process that are critical to the environmental safety of the product, minimizes risks, and stresses communication between regulators and the industry. With proper cooperation between industry representatives, resource management agencies, and other AIS experts, the AIS-HACCP approach will reduce the risk that AIS will be established in new locations while maintaining the economic viability of the baitfish harvesting and aquaculture industries. It can provide a mechanism for AIS-free certification, and instill confidence in the public that state, federal, and tribal fish stocking programs are conducting their activities in an environmentally responsible manner.

Author Contact Information and Affiliation

Ronald E. Kinnunen
Michigan Sea Grant
Michigan State University
710 Chippewa Square – Suite 202
Marquette, MI 49855
Phone: 906-226-3687
Email: kinnune1@msu.edu

Nicholas B. D. Phelps
Minnesota Aquatic Invasive Species Research Center
University of Minnesota
135 Skok Hall, 2003 Upper Buford Circle
St. Paul, MN 55108
Phone: 612-624-7450
Email: phelp083@umn.edu

All photos courtesy of Ronald E. Kinnunen





Suggested Readings and Information Resources

Gunderson, J.L. and R.E. Kinnunen. 2001. Aquatic invasive species: Hazard analysis and critical control point training curriculum. Minnesota Sea Grant Publications Number: MNSG-F11. Michigan Sea Grant Publications Number: MSG-00-400. 78 pp.

Gunderson, J.L. and R.E. Kinnunen. 2004. Aquatic invasive species: Hazard analysis and critical control point training curriculum. Second Edition. Minnesota Sea Grant Publications Number: MNSG-F11. Michigan Sea Grant Publications Number: MSG-00-400. 83 pp.



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