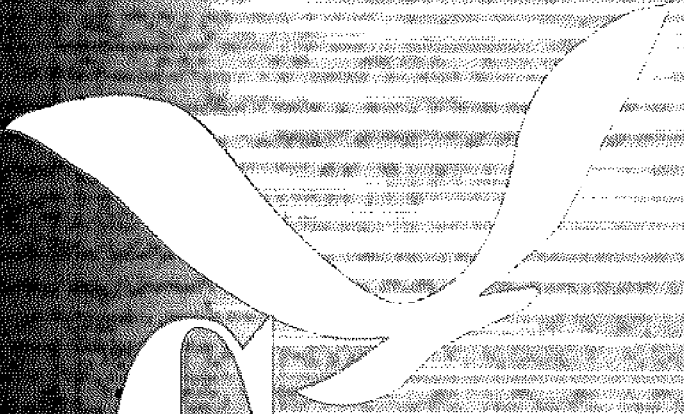


ANS-HACCP

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Sea Grant

***Aquatic Nuisance Species-
Hazard Analysis and
Critical Control Point
Training Curriculum***



Illinois-Indiana Sea Grant
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Introduction

This course manual was adapted from the “*HACCP: Hazard Analysis and Critical Control Point Training Curriculum*,” which was developed by the National Seafood HACCP Alliance for Training and Education. It is written especially for wild baitfish harvesters and fish farmers (both private and public) who raise baitfish or fish for stocking into public and private waters. The HACCP approach also may be used for fish farmers culturing aquatic nuisance species for food or other purposes. The manual identifies critical pathways through which aquatic nuisance species and/or non-target aquatic species could enter aquaculture and baitfish operations. It also identifies methods to prevent the inadvertent transfer of these species to new areas.

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Chapter 1: Introduction to Course and HACCP

Objectives:

- ◆ Provide an overview of this course
- ◆ Provide an introduction to HACCP
- ◆ Present the seven HACCP Principles
- ◆ Define terms used in this manual

Introduction

The potential exists for aquatic nuisance species (ANS) to spread to uninfested waters through the transport of wild harvested baitfish and cultured fish. Baitfish and aquaculture operations are diverse and complex, as are the risks of spreading ANS. Most segments pose no or very low risk for spreading ANS. To deal effectively and fairly with this potential vector, it is important to characterize operations according to their risks of spreading ANS. Without adequate risk assessment of individual operations, regulations could be imposed that would unnecessarily negatively impact the economy of these industries and still not effectively reduce the risk of spreading ANS.

One approach to this problem is to adapt the Hazard Analysis and Critical Control Point (HACCP – pronounced “has-sip”) concept used by the seafood industry to minimize seafood consumption health risks. The advantage of this system is that it effectively manages a diverse industry, it fosters partnership between industry and government regulators, and it is effective if properly applied. 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 U.S. Food and Drug Administration (FDA) issued seafood regulations based on the principles of HACCP in 1995 to ensure safe processing and importing of fish and fishery products. These regulations specify that certain critical jobs in seafood processing be performed by someone trained in HACCP. Just as HACCP has applicability in the fish processing industry, it can also be applied to other business processes to help ensure product safety. Because the baitfish/aquaculture trade has been suggested as a potential pathway for the movement of ANS, the HACCP approach can be used by these operations to reduce the risk of wild baitfish/aquaculture products containing these unwanted aquatic species.

This manual serves as the basis for a 1- to 1-1/2 day course. While it could be used as a stand-alone document for baitfish harvesters, fish farmers, or public hatcheries to develop ANS-HACCP plans, we believe that it is best used to support the course and as a reference for course attendees.

Course Objective

This course is designed to train fish farmers, bait harvesters, and management agencies in the use of HACCP fundamentals to control the spread of ANS via baitfish and aquaculture operations. The goal of the HACCP approach is to prevent the spread of ANS while maintaining viable baitfish and aquaculture industries. Some management agencies have closed ANS-infested areas to harvest and culture, some states have banned the importation of live bait, and others only allow ANS-free bait into their state or specific watersheds. HACCP is an approach that brings together management agencies and industry representatives to establish a plan to prevent the spread of ANS. The HACCP approach can also be used to certify ANS-free products for those businesses that choose to seek this certification. This course contains the information necessary for those involved in baitfish/aquaculture operations or in managing natural resources to learn how to apply HACCP principles.

The HACCP approach stresses communication between industry and resource managers. It attempts to strike a balance between over-regulation and ignoring the potential for moving ANS. For the HACCP concept to be adopted, it must be accepted by both the industry and resource management agencies.

Course Format

This ANS-HACCP course is divided into two segments:

- 1) HACCP fundamentals
- 2) A work session to develop a baitfish/aquaculture ANS-HACCP plan

The first segment defines the seven fundamental principles of HACCP. As each principle is discussed, participants will develop an ANS-HACCP plan for baitfish harvest using the fictional ABC Baitfish Company as a model. This segment also presents information about baitfish/aquaculture-specific hazards. This will help you understand HACCP principles and how they interrelate.

The second segment demonstrates how to develop an ANS-HACCP plan. During this part of the course, participants will be divided into teams to write a plan based on their experiences.

What is Expected of the Participant

HACCP is a common-sense technique used to control ANS hazards in wild baitfish and aquaculture products. It is an important environmental safety management system and can be integrated into any operation. However, HACCP can seem complicated and demanding until its concepts are understood. Therefore, you are encouraged to ask questions and to contribute first-hand experiences to discussions. This manual includes exercises that require class participation throughout the training. Keep in mind that the more you contribute to these exercises, the less complicated the HACCP system will seem and the easier it will be to implement an ANS-HACCP plan later at your baitfish/aquaculture operation.

How to Use This Manual

This manual is yours. Become familiar with it. Learn where the definitions are, where the forms are that will help you develop an ANS-HACCP plan, and where to find other basic information. Make as many notes and marks in the text as needed for assisting in creating and understanding an ANS-HACCP plan. Use the manual as a reference. This manual does not have a copyright. Make as many copies of its forms as necessary or copy the whole manual to share with others.

Meaning and Importance of HACCP

Many people may not have heard the term “HACCP” until recently. However, it is neither a new term nor a new concept. HACCP is merely an acronym that stands for Hazard Analysis and Critical Control Point. But the concept behind this term is important. HACCP is a preventive system of hazard control rather than a reactive one. Baitfish/aquaculture operations can use it to reduce the risk that products will be contaminated by ANS and so will prevent the spread of these unwanted species into new water bodies. To ensure uncontaminated fish, the HACCP system is designed to identify ANS hazards, establish controls, and monitor these controls. Hazards can be aquatic nuisance fish or other aquatic vertebrates, invertebrates, and plants.

The Pillsbury Co. pioneered the application of the HACCP concept to food production during its efforts to supply food for the U.S. space program in the early 1960s. Pillsbury decided that their existing quality control techniques did not provide adequate assurance against contamination during food production. The company found that end-product testing necessary to provide such assurance would be so extensive that little food would be available for space flights.

The only way to ensure safety, Pillsbury concluded, would be to develop a preventive system that kept hazards from occurring during production. Since then, Pillsbury’s system has been recognized worldwide as the state-of-the-art measure for hazard control. It is not a zero risk system, but it is designed to minimize the risk of hazards.

Seven HACCP principles have been developed:

- 1) Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe preventive measures.
- 2) Identify the critical control points (CCP) in the process.
- 3) Establish controls for each CCP identified.
- 4) Establish CCP monitoring requirements. Establish procedures for using monitoring results to adjust the process and maintain control.
- 5) Establish corrective actions to be taken when monitoring indicates that there is a deviation from an established critical limit.
- 6) Establish procedures to verify that the HACCP system is working correctly.
- 7) Establish effective record-keeping procedures that document the HACCP system.

These principles will be explained in more detail in the following chapters. The HACCP regulation and other domestic and international HACCP control systems are based on these principles. ANS-HACCP is a preventive system to help ensure that marketed fish are free of ANS.

The ANS-HACCP concept, if adopted by the industry and resource management agencies, can focus attention on the parts of the baitfish and aquaculture harvest/handling process that are most likely to risk spreading ANS. The ANS-HACCP approach allows regulators to look at what happens in various baitfish/aquaculture operations and evaluate how potential hazards are being handled.

With ANS-HACCP, the emphasis is to understand the entire process. This requires the regulator and industry to communicate and work with one another. Regulators will have the opportunity to review the ANS-HACCP plan and evaluate if critical hazards have been properly identified and if individual businesses are consistently controlling these hazards. It is a shared responsibility of baitfish/aquaculture operations and the resource management agencies to develop and implement ANS-HACCP plans.

As you learn more about HACCP, there will be many new terms you will need to understand. To assist you, the most common definitions are found below. Refer back to these pages as needed and add other terms that will help you to develop and implement your own ANS-HACCP plan.

Definitions and Acronyms

ANS: Aquatic Nuisance Species

BMP: Best Management Practice

Control: (a) (verb) To manage the conditions of an operation to maintain compliance with established criteria. (b) (noun) The state in which correct procedures are being followed and criteria are being met.

Control Limit (CL): A criterion that must be met for each control measure associated with a critical control point.

Control Measure: Factors that can be used to control an identified aquatic nuisance species hazard (sometimes referred to as a preventive measure).

Control Point: Any point, step or procedure at which aquatic nuisance fish or other aquatic vertebrates, invertebrates, and plants can be controlled.

Corrective Action: Procedures followed when a deviation from a critical limit occurs at a critical control point.

Critical Control Point (CCP): A point, step or procedure at which control can be applied to prevent or eliminate an aquatic nuisance species hazard.

CCP Decision Tree: A sequence of questions asked to determine whether a control point is a CCP.

Deviation: Failure to meet a critical limit.

HACCP: Hazard Analysis and Critical Control Point.

HACCP Plan: The written document based upon principles of HACCP that delineates the procedures to be followed to ensure the control of a specific process or procedure.

HACCP System: The result of the implementation of the HACCP plan.

HACCP Team: The group of people responsible for developing a HACCP plan.

HACCP Plan Validation: The initial review by the HACCP team to ensure that all elements of the HACCP plan are accurate.

Hazard: An aquatic nuisance plant, invertebrate, or fish or other aquatic vertebrate that is reasonably likely to be transported by aquaculture or baitfish harvest and establish reproducing populations that could negatively impact existing species, recreation, or other existing use of water resources in the absence of its control.

Monitor: To conduct a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification.

Operating Limits: Criteria more stringent than critical limits that are used by an operator to reduce the risk of ANS contamination. For example, if a certain chemical concentration is required to control an ANS hazard, the operating limit is generally set above the minimum concentration needed to ensure effective treatment.

Risk: An estimate of the likely occurrence of a hazard.

Severity: The seriousness of a hazard (if not properly controlled).

Validation: The element of verification focused on collecting and evaluating scientific and technical information to determine if the ANS-HACCP plan, when properly implemented, will effectively control the ANS hazards.

Verification: 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 and/or whether the plan needs modification.



Chapter 2: Hazards – Aquatic Nuisance Plants, Invertebrates, and Fish/Other Vertebrates

Objectives:

- ◆ Awareness of:
 - Aquatic nuisance plant hazards
 - Aquatic nuisance invertebrate hazards
 - Aquatic nuisance fish and other aquatic vertebrate hazards
- ◆ Characteristics of certain ANS species

To perform a hazard analysis for the development of an ANS-HACCP plan, baitfish harvesters and fish farmers must gain a working knowledge of potential hazards. The HACCP plan is designed to control all reasonable aquatic nuisance species (ANS) hazards. Such hazards are categorized into three classes: plants, invertebrates, and fish and other aquatic vertebrates.

Definition:

Hazard: An aquatic nuisance plant, invertebrate, or fish or other aquatic vertebrate that is reasonably likely to be transported by aquaculture or baitfish harvest and establish reproducing populations that could negatively impact existing species, recreation, or other existing use of water resources in the absence of its control.

Species considered ANS vary from state to state. Consult with resource management agencies to determine which species are considered ANS hazards. Aquatic nuisance plant hazards may include: Eurasian watermilfoil (*Myriophyllum spicatum*), water chestnut (*Trapa natans*), hydrilla (*Hydrilla verticillata*), curly-leaf pondweed (*Potamogeton crispus*), and purple loosestrife (*Lythrum salicaria*).

Aquatic nuisance invertebrate hazards may include: zebra mussel (*Dreissena polymorpha*); quagga mussel (*D. bugensis*); Asiatic clam (*Corbicula fluminea*); spiny (*Bythotrephes cederstroemi*), fishhook (*Cercopagis pengoi*), and lumholtzi (*Daphnia lumholtzi*) waterfleas; rusty crayfish (*Orconectes rusticus*); Chinese mitten (*Eriocheir sinensis*) and green (*Carcinus maenas*) crabs.

Aquatic nuisance fish hazards may include: ruffe (*Gymnocephalus cernuus*), round goby (*Neogobius melanostomus*), white perch (*Morone americana*), rudd (*Scardinius erythrophthalmus*), threespine (*Gasterosteus aculeatus*) and fourspine (*Apeltes quadracus*) sticklebacks, smelt (*Osmerus mordax*), and Asian carps — black (*Mylopharyngodon piceus*), grass (*Ctenopharyngodon idella*), silver (*Hypophthalmichthys molitrix*), and bighead (*Hypophthalmichthys nobilis*). Other aquatic vertebrates could include amphibians or reptiles that may be identified as nuisance species.

Aquatic Nuisance Hazards

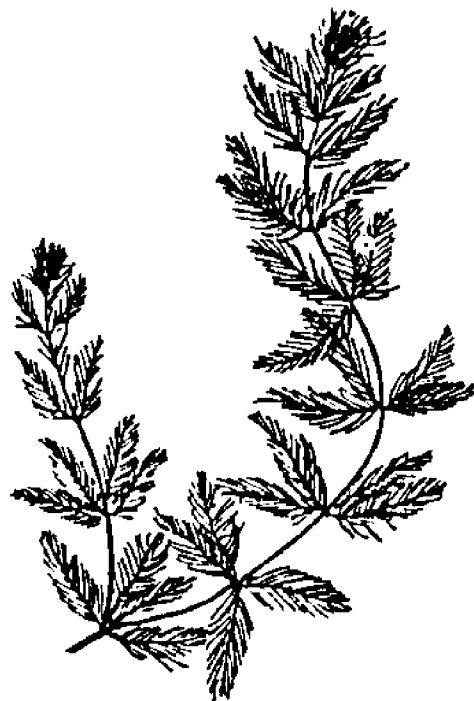
What follows are descriptions of selected ANS. The purpose is to describe their unique life histories and characteristics that cause them to be of environmental and economic concern. These sections describe how they can be spread via baitfish and fish raised for stocking. Not all ANS are covered in this section. You will need more information on each of the hazards to develop effective control strategies. For information on other species see Chapter 12 or the Web sites listed at the end of this chapter.

Aquatic Nuisance Plant Hazards

When live fish are harvested from infested waters, there is a risk that plant ANS can be moved to uninfested waters. These hazards can come with the fish, the water, or be clinging to equipment used in infested waters. Many aquatic nuisance plant species reproduce by plant fragmentation. Small pieces of the plant can settle to the bottom, take root, and grow even after being out of water for many days or even weeks in some moist, cool conditions. Care must be taken to prevent the transport of viable plant fragments to uninfested waters. In addition, many plants can produce seeds or tubers that can survive long periods before germinating.

Eurasian Watermilfoil

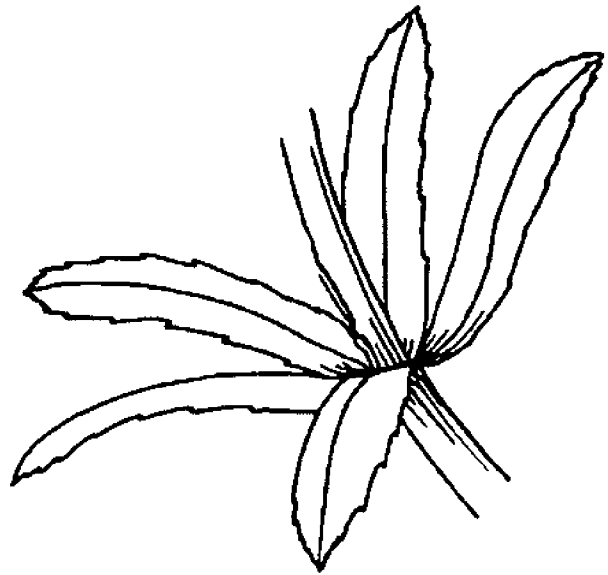
Eurasian watermilfoil is a submersed aquatic plant that has long stems with feathery leaves attached in whorls of four. Each leaf typically has 12 or more pairs of leaflets, one of the key characteristics used to differentiate between Eurasian and northern watermilfoil. Eurasian watermilfoil is an exotic species that came to North America from Europe. It was discovered in the eastern U.S. sometime before 1950 and has since spread to at least 47 states and three Canadian provinces. Eurasian watermilfoil can interfere with recreational and other uses of the lakes and rivers by producing dense mats at the water surface. These mats are similar to, but can be more extensive than those produced by native vegetation. Matted milfoil can displace native aquatic plants and alter environmental conditions, which in turn may harm fish and wildlife. Milfoil is spread from one body of water to another primarily by the introduction of plant fragments. Fragmentation is the principal means of reproduction in this species. A milfoil fragment only a few inches long can form roots and grow into a



new plant. Milfoil fragments are most abundant from mid to late summer but can be transported from a lake year-round. Zebra mussels can colonize Eurasian watermilfoil and be moved to new locations along with the plant fragments.

Hydrilla

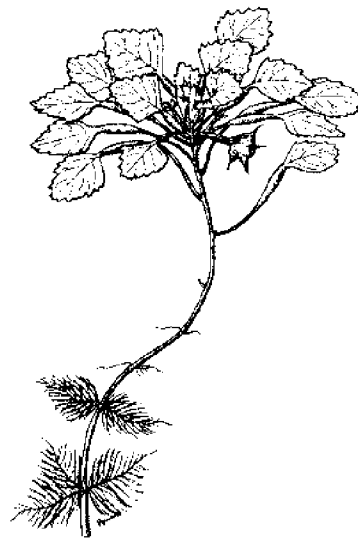
Hydrilla is an extremely prolific aquatic plant that has already infested millions of acres of lakes, rivers, and irrigation systems throughout the United States. Hydrilla resembles a number of plants. The leaves are spear shaped with saw-tooth edges. They have small spines on the underside of the leaf center vein, and the leaf margins are serrated. It was first found in a Florida river and drainage canal in 1960. It is believed to have been imported originally for aquarium use. When hydrilla invades, important native submersed plants are shaded out and eliminated. Near the water surface it branches profusely and produces greater stem density than any other submersed aquatic plant. As a result, recreational and commercial boating becomes difficult, seining or trapping fish is nearly impossible and swimming becomes unpleasant and even dangerous. Like Eurasian watermilfoil, hydrilla can form new plants from fragments containing one or more whorls of leaves. Hydrilla usually doesn't form seeds, but it is so efficient in using low light levels and available nutrients that the fragments can produce large stands of plants in a few months. In the late summer to early winter hydrilla also



produces structures called tubers from fragments that grow down into the bottom mud. Studies have shown that a single fragment of hydrilla can form thousands of tubers in one growing season. The tubers can last for several years before sprouting, although many sprout the first spring after they form. These long-lived reproductive structures make hydrilla very difficult to eradicate because even the removal of plant material will not harm tubers. The presence of tubers also requires safe and proper disposal of dredge spoils.

Water Chestnut

European water chestnut is an aquatic plant native to Eurasia. It usually is rooted in the mud of quiet streams, ponds, freshwater regions of estuaries, and on exposed mud flats. Water chestnut bears a rosette of floating leaves (similar to small birch leaves) on a submersed stem usually three feet long but it may reach 15 feet in length. An inconspicuous flower with four white petals is located at the center of the leafy rosette. Water chestnut has become an ANS in North America because of its ability to



reproduce rapidly and form extensive floating mats. It impedes navigation, interferes with recreation, and can impact aquatic ecosystems by eliminating other aquatic plant species in the shade of the floating canopy and because it has low food value for wildlife. Fish farming and baitfish

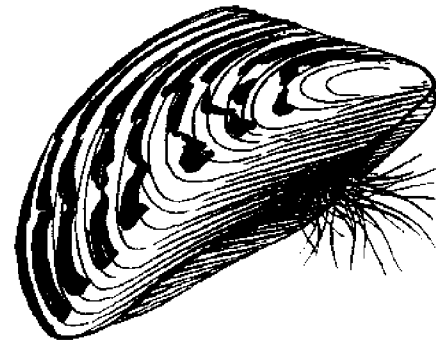
harvest would be severely restricted by an infestation of water chestnut. In addition, it produces large, hard, nut-like fruits with sharp spines that can be hazardous to swimmers and people walking on beaches. These seeds can remain viable for up to 12 years.

Aquatic Nuisance Invertebrate Hazards

When live fish are harvested from infested waters, there is a risk that ANS invertebrates can be moved to uninfested waters. These hazards can come with the fish, the water, or be clinging to equipment used in infested waters. Some aquatic invertebrates can produce resting eggs that are resistant to freezing and drying, and they can produce eggs and larvae that are too small to see without aid of a microscope. Other invertebrates, like zebra mussels, can attach to boats, equipment, and vegetation, and survive out of the water long enough to be moved to other waters. As a result of these characteristics, aquatic nuisance invertebrates present different challenges for preventing their spread.

Zebra Mussels

Zebra mussels were first discovered in Lake St. Clair and Erie in 1988. Since then, they have infested all the Great Lakes except Lake Superior (although some tributaries and bays are infested) and have spread to a number of inland lakes and to many large river systems in the U.S. A closely-related species called the quagga mussel (*Dreissena bugensis*) has also been introduced into North America and is spreading. The rapid spread and abundance of both mussels can be partly attributed to their reproductive cycles. A fully mature female mussel may produce up to one million eggs per season. Eggs are fertilized outside the mussel's body and within a few days develop into free-swimming microscopic larvae called veligers that soon develop small clam-like shells. Veligers swim, feed, and drift with the current for three to four weeks before they settle on firm objects such as rocks, clams, docks, and boats. They attach to hard surfaces with sticky, secreted fibers called byssal threads. Zebra and quagga mussels can also colonize soft muddy bottoms when hard objects deposited on the mud serve as a



substrate. As a few mussels begin to grow, they in turn serve as substrate for additional colonization, forming mats of zebra mussels over soft sediment.

Mussel colonies can reach densities of up to 100,000 mussels per square meter. Mussels filter phytoplankton from the water and so can reduce the food for zooplankton, which in turn are food for larval and juvenile fish as well as forage fish that support sport and commercial fisheries. The competition for phytoplankton, the base of the food web, could have long-term negative environmental impacts. Zebra mussels have contributed to increased water clarity in areas they have infested. As a result, rooted aquatic plants have become a problem in

some of these areas, because turbidity no longer shades them out. Filtering of the water by mussels has also resulted in noxious blue green algae blooms in some areas. Zebra and quagga mussels also rapidly accumulate persistent contaminants and pass them up the food chain, which increases the risk of exposure to humans. The mussel's affinity for hard surfaces causes clogging of pipes used to draw water from infested areas.

Power and municipal water treatment plants, industrial water users, irrigation systems, and even cooling water inlets of boat

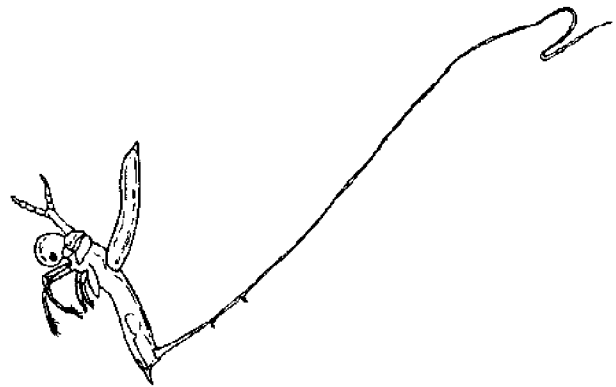
Spiny and Fishhook Waterflea

The spiny and fishhook waterfleas are easily recognized by their unique shapes. The tail spine is their distinguishing feature and separates them from all other free-swimming lake invertebrates, or zooplankton. The spine often comprises 70 to 80 percent of the animal's total length, and has from one to four pairs of thorn-like barbs. Fishhook waterfleas can be distinguished from spiny waterfleas by the unique loop at the end of their tails and by a brood pouch that is more pointed than in spiny waterfleas.

Spiny and fishhook waterfleas belong to the class Crustacea, a group of animals including crabs and shrimp that possesses a hard exoskeleton (outer shell). Like all other Crustacea, they molt their exoskeleton in order to grow. These waterfleas have a remarkable influence on the biological communities of the lakes they invade, largely because of their rapid reproduction. Reproductive females carry their offspring on their backs in a balloon-

engines can be colonized and clogged. Native mussels (many of which were threatened or endangered already) have been completely eliminated when zebra mussels invade because the mussels so heavily colonize their shells. Zebra mussels also affect beaches. The sharp edge of mussel shells found in windrows along swimming beaches can be a hazard to unprotected feet. Because zebra mussels and quagga mussels can cause such dramatic problems for the environment and water users, including fish farmers and baitfish producers, it is important not to move this species to uninfested waters.

like brood pouch, which can be filled either with developing embryos or resting eggs. Most of the time, females exhibit a rapid and unusual method of reproduction known as parthenogenesis, or asexual reproduction. By this method, females produce from one to ten eggs that are able to develop into new females without mating or fertilization. Female offspring are genetic replicas of the mother. The generation time of this parthenogenic life cycle (embryo to adult female) varies with water temperature, because, as with all Crustacea, rates of metabolism rise and fall with temperature.



Fishhook Waterflea

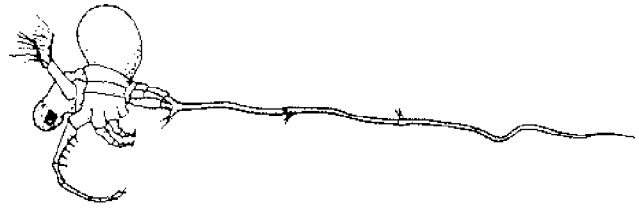
During the summer when the surface water of the lake is warm, spiny and fishhook waterfleas can produce a new generation without fertilization (parthenogenesis) in less than two weeks. Because males are not needed for parthenogenesis, they are rarely found when food is plentiful, or when environmental conditions favor rapid population growth. Sex of offspring is not determined genetically, but rather by environmental factors. So, when food becomes limited or when the lake cools in the fall, males begin to be produced. Declining environmental quality can be sensed by adult females, who respond by producing male rather than female offspring. These males are able to mate with surviving females, producing resting eggs. The resting eggs are first carried as orange-brown spheres in the female brood pouch. They are later released and sink to the lake bottom where they can survive the cold winter. In spring or early summer, these eggs hatch into juvenile females that begin parthenogenic reproduction again.

Resting eggs can remain dormant for long periods of time, and offer an explanation for the arrival of these waterfleas in North America from northern Europe. It also allows them to be easily spread to new waters if fishing lines, nets, or equipment are fouled with females carrying resting eggs. Spiny and fishhook waterfleas eat smaller zooplankton like *Daphnia*.

Rusty Crayfish

Rusty crayfish (*Orconectes rusticus*) have invaded portions of Illinois, Iowa, Massachusetts, Michigan, Missouri, Minnesota, New Mexico, New York, New Jersey, Pennsylvania, Wisconsin, all New England states except Rhode Island, and many areas in Ontario, Canada. Although

Daphnia, however, is also an important food item for small, juvenile fish. These waterfleas thus compete directly with young fish for food.



Spiny Waterflea

Their rapid population growth enables them to monopolize the food supply at times, to the detriment of some fish. Although fish eat spiny and fishhook waterfleas, their barbed spine seems to frustrate most small fish, which have difficulty swallowing them. Growth rates and survival of these young fish may be adversely affected by the presence of spiny and fishhook waterfleas in the ecosystem, because of competition for food. Fishhook waterfleas have also become a significant nuisance to anglers. They catch on fishing lines while trolling, and accumulate in such high numbers and with such density at the tip of fishing rods that the line cannot be reeled in. At times, they become such a problem that charter and recreational anglers have stopped fishing during periods of peak abundance. Fishhook waterfleas also foul commercial fishing nets.

native to parts of some Great Lakes states, rusty crayfish have caused a variety of ecological problems in areas where they have spread. Rusty crayfish were probably spread by anglers who brought them north to use as fishing bait. As rusty crayfish populations increased, they were harvested for the regional bait market and for biological supply companies. Such activities probably helped spread the species further.

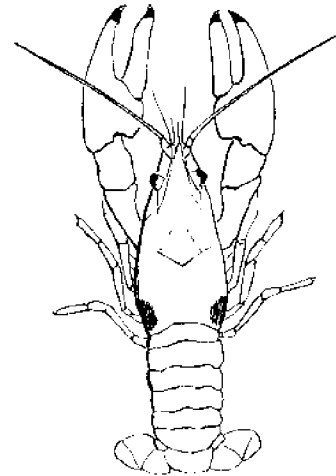
Invading rusty crayfish frequently displace native crayfish, reduce the amount and kinds of aquatic plants and invertebrates, and reduce some fish populations. Environmentally-sound ways to eradicate or control introduced populations of rusty crayfish have not been developed, and none are likely in the near future. The best way to prevent further ecological problems is to prevent or slow their spread into new waters.

Mature rusty crayfish mate in late summer, early fall, or early spring. The male transfers sperm to the female, which she then stores until her eggs are ready to fertilize, typically in the spring (late April or May) as water temperatures begin to increase. The stored sperm are released as eggs are expelled and external fertilization occurs. Because of this unique reproductive strategy, if a female has previously mated, it is theoretically possible for one female crayfish to start a new population.

They are an aggressive species that often displaces native or existing crayfish species. Perhaps the most serious impact is the destruction of aquatic plant beds. Rusty crayfish have been shown to reduce aquatic plant abundance and species diversity. This can be especially damaging in lakes where beds of aquatic plants are not abundant. Although other crayfish eat aquatic plants, rusty crayfish eat even more because they have a higher metabolic rate and appetite. They also grow larger, hide less from predators — and therefore feed longer — and attain high population densities.

Rusty crayfish, especially juveniles, feed heavily on benthic invertebrates like mayflies, stoneflies, midges, and side-swimmers. It has been estimated that rusty crayfish might consume twice as much food as similar-sized native species because of their higher metabolic rate. So, rusty crayfish are more likely to compete with juvenile game fish and forage species for

benthic invertebrates than are native crayfish. Fish eat rusty crayfish, but because of their thick exoskeleton, their food quality is not as high as many of the invertebrates they replace. Less food or lower food quality means slower growth, which can reduce fish survival.



Finally, it has been suggested that rusty crayfish harm fish populations by eating fish eggs. While rusty crayfish do consume fish eggs under various circumstances, there is no scientific study directly linking fishery declines with egg predation. Observations and circumstantial evidence suggest that bluegill, bass, and northern pike populations frequently decline following introduction of rusty crayfish. The declines are probably a result of reduced abundance and diversity of aquatic plants, but reduced food (such as mayflies, midges, and side-swimmers) and egg predation may also play a role. Because impacts and population abundance of rusty crayfish vary in lakes that appear similar, it is not possible to predict what will happen when they invade a new lake. Nevertheless, it is clear that rusty crayfish are an aggressive, unwanted ANS. Cabin owners on heavily-infested northern Wisconsin and Minnesota lakes have even stopped swimming because large numbers of rusty crayfish occupy their favorite swimming area throughout the day. They fear stepping on them and getting pinched by the large-clawed crayfish

Aquatic Nuisance Fish Hazards and Other Vertebrates

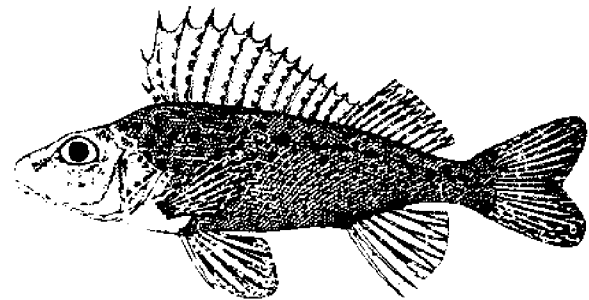
When live fish are harvested from infested waters, there is a risk that aquatic nuisance fish or other vertebrates like amphibians or reptiles can be moved to uninfested waters. These hazards can come with the fish or the water used to haul the fish. Separating fish or other vertebrate ANS after harvest is difficult and is best accomplished by preventing an infestation in your ponds or facility or by harvesting during times of the year or times of the day when fish are spatially segregated.

Eurasian Ruffe

Eurasian ruffe are small (typically four to six inches), aggressive fish native to Eurasia. They were introduced into the St. Louis River, a tributary of western Lake Superior, in the mid-1980s from the release of freshwater ballast from ocean-going vessels. Because ruffe mature quickly, have a high reproductive capacity, adapt to a wide variety of environments, and compete with native fishes, they are considered a serious threat to the delicate predator-prey balance vital to sustaining healthy commercial and sport fisheries across North America. They have a faster first-year growth rate than most of their competitors.

Due in part to a high reproductive rate, ruffe populations can rapidly increase. For example, ruffe became the most abundant fish in the St. Louis River in less than ten years. Ruffe prefer darkness and spend their days in deeper water, moving into the shallows to feed at night. They have a well-developed system of subsurface canals on their head and lateral line that contain sensory organs called neuromasts. Neuromasts give ruffe the ability to detect extremely small vibrations given off by both predators and prey. This allows them to avoid predators

and to find prey in nearly complete darkness, giving them a competitive advantage over native fishes.



Ruffe have spread about 190 miles east of Duluth along the south shore of Lake Superior. They were also moved via ballast water to Thunder Bay, Ontario, on Lake Superior and to Alpena, Michigan, on Lake Huron. There is great concern that ruffe may negatively impact yellow perch populations in the Great Lakes. Yellow perch are an extremely valuable recreational and commercial species already experiencing recruitment problems in a number of the Great Lakes. Ruffe reportedly consume fish eggs, which could harm native fish populations in areas where ruffe become extremely abundant.

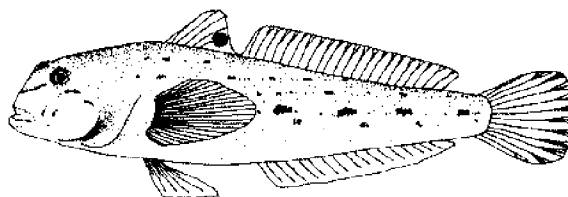
Round Goby

Round gobies were first discovered in the St. Clair River, the channel connecting Lakes Huron and St. Clair, in 1990. This species comes from around the Black and Caspian seas, the same area of the world as the zebra mussel. They most likely arrived in ballast water discharged by transoceanic vessels. When they reach a new area gobies are capable of rapid population growth. Densities of round gobies in rocky areas have exceeded 300 per square meter.

Round gobies are bottom-dwelling fish that sit on rocks and other substrate. They are typically 0.5 to 5.5 inches, but can grow to ten inches. Gobies have large heads, soft bodies, and dorsal fins lacking spines; they slightly resemble large tadpoles. Their unique feature is a fused pelvic fin, which forms a suction cup-like disk. In flowing water habitats, this suction cup-like disk aids in holding the fish to the substrate. Round gobies look similar to sculpins, a native, bottom-dwelling fish occasionally caught by anglers. Round gobies possess four characteristics that make them effective invaders.

First, round gobies are aggressive fish. They feed voraciously and may eat the eggs and fry of native fish such as sculpins, darters, and log perch. They will aggressively defend spawning sites in rocky habitats. Second, they have a well-

developed sensory system that enhances their ability to detect movement. This allows them to feed in complete darkness and gives them a competitive advantage over native fish. Third, they are robust and are able to survive under degraded water quality conditions. Fourth, round gobies spawn over a long period during the summer months so they can take advantage of optimal temperature and food conditions.



The diet of round gobies consists mainly of clams, zebra mussels and large invertebrates, but they also eat fish eggs, small fish, and insect larvae. Round gobies have already reduced local populations of sculpins. Predation on eggs and fry of lake trout and lake sturgeon may limit recruitment of these species in the Great Lakes. Because zebra mussels concentrate contaminants and gobies feed heavily on them, gobies can increase contaminants in other fish that feed on them. Gobies have also proven to be a severe nuisance to anglers because they aggressively take live bait and interfere with fishing for other species.

Rudd

The rudd, a member of the minnow family, is widely distributed throughout western Europe and Asia. Rudd were intentionally stocked in North America beginning in the 1920s. Escape from waters where rudd were introduced, extensive propagation as a bait species by southern states, subsequent

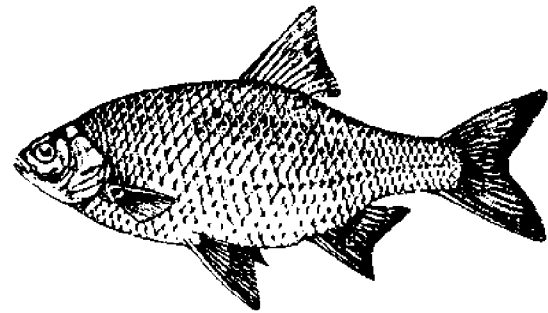
importation by other states, and release from bait buckets have resulted in numerous inland introductions of rudd in at least 11 states.

In North America, the extent of successful natural reproduction is unknown because rudd have been found at low densities at most locations. Rudd closely resemble a

common baitfish, the golden shiner, and show similarities to goldfish. In Europe, rudd frequently hybridize with other closely-related minnow species. As adults, rudd primarily feed on submersed aquatic vegetation. They can consume up to 40 percent of their body weight in aquatic vegetation per day. Rudd inhabit quiet surface waters and shallow areas along the shorelines of lakes, river backwaters, and canals. They seldom move into open water.

Rudd reportedly do not compete effectively with other minnow species in Europe, but may compete with trout and the plankton-eating fry stages of perch and pike. They are frequent prey of European northern pike, perch, and brown trout. Rudd may have several potential impacts in North America. First, they consume large amounts of aquatic vegetation, promoting the release of nutrients into the water either from rudd waste or from broken plant fragments. Phosphorus and other nutrients released by rudd feeding can increase algal blooms, reduce water clarity, and accelerate the natural aging process of a lake. Second, depletion of aquatic vegetation by rudd may

reduce the reproductive success of native fish species that use near shore areas for spawning sites or nursery habitats for their young. Third, rudd may hybridize with native golden shiners. Although the rudd-shiner hybrids were found to be sterile, long-term reproductive success of golden shiners and other native species could be reduced through hybridization. Fourth, rudd may compete with young native fish for food and habitat.



While rudd may not appear as invasive or as much of a nuisance as some other aquatic nuisance fish, their long-term impacts cannot be predicted. Efforts to prevent their spread to new locations should be taken.

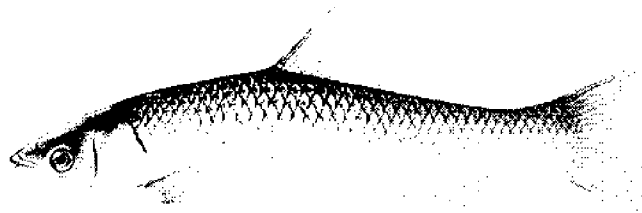
Asian Carp

Black, grass, silver, and bighead carp have been intentionally brought into North America from Asia for a variety of reasons. Grass carp have been used effectively for aquatic vegetation control. Black carp have been used to control snail populations that serve as an intermediate host for a parasitic trematode, the yellow grub, which infects cultured catfish. Bighead carp were introduced into private fish farms to control phytoplankton and improve water quality. Silver carp were also imported for phytoplankton control and as a food fish.

The native range of all these carps includes a number of Pacific drainages, centered primarily in China. All of these carps have escaped or have been released into natural waters of the U.S. The grass carp has the widest reported distribution and the black carp has the most restricted distribution. All except the black carp have developed reproducing populations. Approximately 30 black carp escaped into the Osage River, Missouri when high water flooded hatchery ponds in 1994.

Potential environmental impacts of the four Asian carps differ by species. Black carp could negatively impact native aquatic communities by feeding on, and reducing,

populations of native mussels and snails, many of which are considered endangered or threatened. Because bighead carp are planktivorous and attain a large size, they can deplete zooplankton populations. A decline in the availability of plankton can reduce populations of native species that rely on plankton for food, including all larval fishes, some adult fishes, and native mussels. Adult fishes most at risk from such competition in the Mississippi and Missouri rivers are paddlefish, bigmouth buffalo, and gizzard shad. Like bighead carp, silver carp could cause enormous damage to native species because they feed on plankton required by larval fish and native mussels. This species would also be a potential competitor with adults of some native fishes, such as gizzard shad that also rely on plankton for food. The effects of grass carp introduction on a water body are complex and apparently depend on the stocking rate, macrophyte abundance, and community structure of the ecosystem.



Grass Carp

Negative effects involving grass carp include competition for food with invertebrates (e.g., crayfish) and other fishes, significant changes in the composition of macrophyte, phytoplankton, and invertebrate communities, interference with the reproduction of other fishes, and decreases in nursery areas and habitat for other fishes. In addition, grass carp may carry several parasites and diseases known to be transmissible or potentially transmissible to native fishes. For instance, it is believed that grass carp imported from China were the source of the Asian tapeworm (*Bothriocephalus opsarichthydis*) in North America.

For More Information on Aquatic Nuisance Species Visit these Web Sites:

<http://nas.er.usgs.gov>

<http://www.sgnis.org>

<http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html>

<http://www.glc.org/ans/anspanel.html>

<http://www.nbio.gov/invasive/spp.html>

<http://www.entryway.com/seagrant/>

<http://www.ucc.uconn.edu/~wwwsgo/aen.html>

<http://www.seagrant.umn.edu/exotics/index.html>

<http://www.engin.umich.edu/seagrant/>

<http://www.iisgcp.org>

Objectives:

- ◆ Describe the preliminary steps needed before developing an ANS-HACCP plan

ANS-HACCP systems are designed to prevent and control ANS hazards associated with wild baitfish harvest/aquaculture operations from harvest to distribution. ANS-HACCP systems must be built upon a firm foundation of compliance with current Best Management Practices (BMPs). BMPs affect every aspect of baitfish and aquaculture operations and should be considered a prerequisite to ANS-HACCP. BMPs are activities routinely conducted to ensure healthy, lively, good quality bait that is as free of other aquatic organisms as possible. Specific BMPs for this industry are being developed.

Preliminary Steps in Developing an ANS-HACCP Plan

HACCP is often thought of in terms of its seven basic principles. However, it also includes five preliminary steps. Failure to properly address the preliminary steps may lead to ineffective design, implementation, and management of the ANS-HACCP plan.

1) *Management Commitment*

For an ANS-HACCP plan to work, it is extremely important to have the support of everyone in the company, from the owner to the seasonal help. Without it, the plan will not become a company priority or be effectively implemented.

2) *ANS-HACCP Training*

Education and training are important elements in developing and implementing an ANS-HACCP program. Employees who will be responsible for the ANS-HACCP program must be adequately trained in its principles. This course is designed to meet that need.

3) *ANS-HACCP Team Assembly*

Assembling a team is an important step in building an ANS-HACCP program. Although one person may be able to analyze hazards and develop a plan successfully, many businesses find it helpful to build a team. When only one person develops the ANS-HACCP plan, some key points can be missed or misunderstood in the process. The team approach minimizes this risk. It also encourages ownership of the plan, builds company involvement, and brings in different areas of expertise. Teams can also include people from Sea Grant, resource management agencies, Cooperative Extension, universities or community colleges, or other local experts. Generic ANS-HACCP examples (see appendices 1-4), and published information on ANS can provide additional assistance.

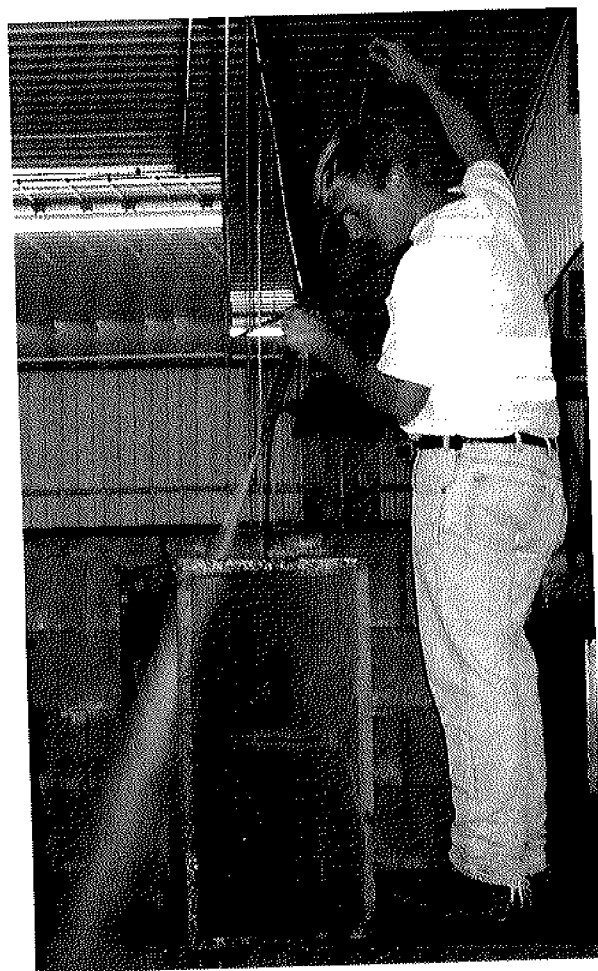
4) *Description and Intended Use of Product*

Once a HACCP team is established, the members first describe the product, the method of distribution, the intended customer (e.g., wholesale bait dealers, bait retailers, sport anglers, private pond/lake owners) and consumer use of the product (e.g., bait for sportfishing, forage

fish, stocking in sportfish ponds or aquaculture operations, fish for fee operations, food). See the ABC Baitfish Company Description on page 19.

5) *Development and Verification of the Product's Flow Diagram*

A flow diagram (see page 21) shows in simple block or symbol form the steps required to harvest/handle and distribute a baitfish/aquaculture product. This step provides an important visual tool that the ANS-HACCP team can use to complete the remaining steps of the plan. Only a clear, simple, but complete, description of the process is needed. It is important to include all the steps within the baitfish/aquaculture operation control, including harvesting, transporting, handling, storage steps, and distributing methods used. The flow diagram should be clear and complete enough so that people unfamiliar with the process can quickly comprehend your operational procedures. Since the accuracy of the flow diagram is critical to conduct a hazard analysis, the steps outlined in the diagram must be verified for the baitfish/aquaculture operation. If a step is missed, a significant hazard may not be addressed. The ANS-HACCP team should evaluate the entire aquaculture or baitfish harvest/handling operation and make any changes required in the flow chart. The evaluation allows each team member to gain an overall picture of how fish are harvested, handled, held, and distributed.



Objectives:

- ◆ Present the ABC Baitfish Co., which will be used as an example throughout the manual
- ◆ Describe the use of a process narrative and flow diagram

Meet the ABC Baitfish Co. Using this fictitious company as an example, we will discuss and illustrate the evolution of an ANS-HACCP plan for emerald shiners (*Notropis atherinoides*) harvested from waters infested with Eurasian watermilfoil. Keep in mind that the ANS-HACCP plan developed for ABC Baitfish Co. is primarily intended to demonstrate the procedures used in plan development. Since HACCP plans are product-, species-, and facility-specific and will vary with state regulations, ABC Baitfish Company’s plan may not be suitable for baitfish harvesters collecting shiners from infested waters.

ABC Baitfish Co. Description:

Firm Name:	ABC Baitfish Company
Firm Address:	RR 1, Box 111 Baitville, MI 48999
Species of fish:	Emerald shiners (<i>Notropis atherinoides</i>)
Cultured or wild harvested:	Wild harvested
Harvest method:	Seined
Method of distribution and storage:	Held in tanks at baitfish facility, then delivered to retail stores or wholesalers.
Intended use and consumer:	To be sold live in retail bait shops and to wholesale bait dealers for fishing bait.

Narrative descriptions of the steps needed to produce a product covered by a particular ANS-HACCP plan can be helpful. They offer a historical, working reference for the fish farmer or baitfish harvester and facilitate communication with the staff and state resource management agencies. For these reasons, a written description should accompany a HACCP plan.

The next step after describing the process of producing fish from start to end in a written narrative is to summarize the narrative description in a flow diagram. The flow diagram will be important in the next step of ANS-HACCP plan development, which is conducting the hazard analysis. The flow diagram for the ABC Baitfish Company (Figure 1) is described below.

ABC Baitfish Company Narrative Description

Harvest

Emerald shiners are seined late in the fall when they concentrate in shallow areas of Lake XXX. Large seines are deployed around schools of shiners in relatively vegetation-free areas. The ends of the seine are pulled together and the shiners are loosely bagged in the seine. They are then dip-netted into 5-gallon buckets filled with about 1.5 gallons of lake water. Buckets with shiners and some lake water are then dumped into the hauling truck, which contains salted (0.5%

solution), aerated, well water from the culture/holding facility. An estimate of the volume of shiners is obtained by recording the number of gallons of shiners taken in each seine haul. When leaving the harvest site visible plant material is removed from the seine, dip-nets, waders, and any other equipment used in the harvest process. The nets used in harvesting shiners from Lake XXX are only used in Lake XXX at this time of year. They will be frozen during the winter months before they are used on another waterbody.

Transporting to Facilities

Emerald shiners from a number of seine hauls are placed in the hauling truck and taken to the holding facility. The shiners and water on the truck are drained directly into holding tanks at the culture/holding facility.

Holding

Emerald shiners are held in flow-through concrete tanks. Well water is sprayed in at one end of the tank and a screened standpipe at the other end of the tank drains the overflow. Agitation aerators are placed in the tank to ensure proper oxygen levels are maintained. Tanks are cleaned daily to remove dead fish, debris, and any plant material. Shiners from subsequent harvests are added to the tank until the tank's holding capacity is reached.

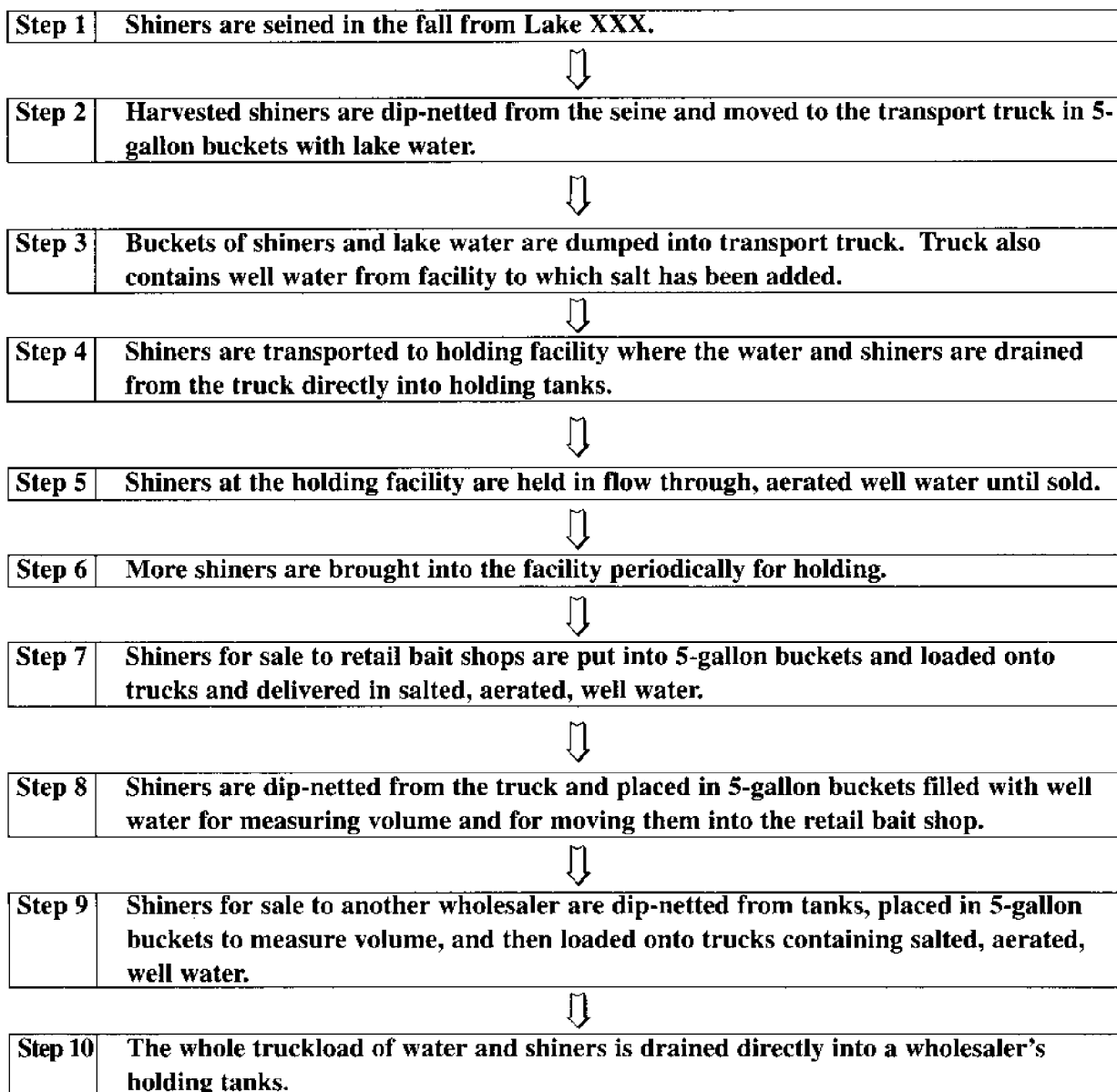
Transporting to Wholesalers/Retailers

When shiners are sold to retail bait shops, the shiners are dip-netted into 5-gallon buckets and then loaded onto a truck filled with salted (0.5 % solution), aerated, well water. Aeration is accomplished using bottled pure oxygen released into the tanks via air stones. Upon arrival at the retail bait shop, shiners are dip-netted from the truck and placed in 5-gallon buckets with a known amount of well water to measure the volume sold and to transport the shiners into the retail bait shop.

When shiners are sold to another wholesaler, they are dip-netted from the holding tanks into 5 gallon buckets, their volume is measured, and they are loaded onto a truck carrying salted, aerated, well water. Aeration is accomplished using bottled pure oxygen released into the tanks via air stones. When the truck arrives at the wholesale facility, the shiners and water are drained directly into the wholesaler's holding tanks.



Figure 1. Flow Diagram for ABC Baitfish Company – Emerald Shiner Wild Harvest



Chapter 5: Principle 1: Hazard Analysis

Objectives:

- ◆ Describe Hazard Analysis
- ◆ Demonstrate the use of a Hazard Analysis Worksheet
- ◆ Present the concept of Control Measures to control ANS hazards

Introduction

The hazard-analysis step is fundamental to the ANS-HACCP system. To establish a plan that effectively prevents the movement of ANS, it is crucial to identify significant ANS hazards and measures to control them. As previously stated, a hazard is an ANS fish or other aquatic vertebrate, invertebrate, or plant that may cause the final retail baitfish/wild fish or aquaculture product to be contaminated and so further spread these unwanted species to new water bodies.

Considerations for the HACCP Team

During the hazard analysis, the significance of each potential hazard should be assessed by considering risk (likelihood of occurrence) and severity. The estimate of risk is usually based upon a combination of experience, ANS infestation data, and information in the technical literature. Severity is the seriousness of a hazard. This will require close communication with resource management agencies and university experts.

For some baitfish/wild fish harvesters and aquaculturists, the expertise necessary to properly assess the risk of occurrence and severity of the ANS hazards is available within the company. However, others will likely need outside assistance to address this issue correctly.

The HACCP team has the initial responsibility to decide which ANS hazards are significant and must be addressed by the HACCP plan. Keep in mind that there may be differences of opinion, even among experts, as to the significance of a hazard. The HACCP team may rely on available guidance materials and the opinions of experts who assist in the development of HACCP plans.

Hazard Analysis

One approach to hazard analysis divides it into two activities: brainstorming and risk assessment. Brainstorming should result in a list of potential hazards at each operational step (see Figure 1) in the process from the collection/harvest step to the release of the final product.

All potentially significant hazards must be considered. To assist in this, the following ANS hazards should be addressed:

- Plants (e.g., Eurasian watermilfoil)
- Invertebrates (e.g., spiny and fishhook waterflea, zebra mussels)
- Fish (e.g., round goby, ruffe) and other aquatic vertebrates (nuisance amphibians or reptiles)

After hazard identification, the team conducts an analysis of the risks and severity of each of the ANS hazards to determine the significance of potentially moving these to new waterbodies. However, ANS-HACCP focuses solely on significant hazards that are reasonably likely to occur. Without this focus, it would be tempting to try to control too much and lose sight of truly relevant hazards.

Hazard-Analysis Worksheet

A hazard-analysis worksheet (see appendices 1-4) can be used to organize and document the considerations in identifying ANS hazards. Each step in the process flow diagram should be first listed in column 1. The results of the hazards brainstorming is recorded in column 2. The results of the risk assessment should be recorded in column 3, with the justification for accepting or rejecting the listed potential hazards stated in column 4.

Control Measures

Definition:

Control Measures: Factors that can be used to control an identified aquatic nuisance species hazard (sometimes referred to as a preventive measure).

Control measures are actions and strategies that can be used to prevent or eliminate an ANS hazard or reduce it to an acceptable level. In practice, control measures encompass a wide array of actions.

On the hazard-analysis worksheet, please note the significant hazards that are identified for ABC Baitfish Company in column 5 (Appendix 2). At the harvest and holding steps, Eurasian watermilfoil has been identified as the significant hazard when harvesting emerald shiners. Eurasian watermilfoil is known to be present in the waterbody where the emerald shiners will be harvested, and so it must be identified as a significant hazard.

As ABC Baitfish Co. analyzed its process, it identified the harvest and holding steps as times to remove any plant material that may have been collected with the emerald shiners (column 6 in Appendix 2).

First-time HACCP writers, more often than not, identify too many hazards! This is a problem because it can dilute your ability to focus efforts and control the truly significant hazards. Accordingly, it is essential that only significant ANS hazards be identified and controlled with the HACCP system. The dilemma is deciding what is significant. A hazard must be controlled if it is: 1) reasonably likely to occur, AND 2) if not properly controlled, it is likely to result in an unacceptable risk of spreading ANS to new water bodies.

Examples of Control Measures

An important difference between the seafood HACCP program and this one is that there is a lack of science-based controls currently available. As a result, control measures are best determined with the help of resource management agencies, Sea Grant, university, college, or other local

experts. The following are examples of possible control measures (not proven controls) that could be examined for use on the three types of hazards.

1) *Aquatic Nuisance Fish Hazards Example - Ruffe:*

In ruffe-infested waters, harvest baitfish during the day in the shallow water where the ruffe are unlikely to occur. If there is a chance that ruffe have been harvested with baitfish, grading steps at the holding facility may be used to separate ruffe from the baitfish if there is an appropriate size difference.

2) *Aquatic Nuisance Invertebrate Hazards Example - Waterfleas:*

In spiny waterflea- and fishhook waterflea-infested waters, harvest baitfish in spring or early summer when females are not present or not carrying resting eggs. Females carrying resting eggs quickly die when removed from the water on nets and other gear, but resting eggs can survive. Because waterfleas are not strong swimmers they can be separated from fish in holding facilities using proper flow control.

3) *Aquatic Nuisance Plant Hazards Example – Eurasian Watermilfoil:*

Remove all plant fragments during the harvest and holding steps.



Robert Lindsey with the U.S. Fish and Wildlife Service, rinses a mesh “sock” that filters reservoir water entering the Inks Dam National Fish Hatchery in Texas. The sock keeps debris, fish eggs and fry from contaminating the hatchery’s water supply. Rinsing the sock before it clogs is an example of a critical control point.

Chapter 6: Principle 2: Determine the Critical Control Points

Objectives:

In this module you will learn:

- ◆ The definition of a critical control point (CCP)
- ◆ The relationship between a significant hazard and a CCP
- ◆ That a CCP may change for different species raised/harvested and for different ANS
- ◆ The use of a decision tree to select a CCP
- ◆ About examples of CCP's

For every significant hazard identified during the hazard analysis (Principle 1) there must be one or more critical control points (CCPs) where the hazard is controlled. The CCPs are the points in the process where the HACCP control activities will occur.

Definition:

Critical Control Point: Any point, step or procedure at which aquatic nuisance fish or other aquatic vertebrates, invertebrates, and plants can be controlled.

Points may be identified as CCP's when hazards can be prevented.

In some cases the following may be true:

- Avoiding infested waters can eliminate ANS hazards.
- ANS hazards can be eliminated during the harvest by choosing when, where, and how to harvest.
- ANS hazards can be separated from baitfish or fish for stocking during holding through grading, chemical treatment, or other control measures.
- ANS hazards can be separated manually from baitfish or other live fish.
- ANS hazards can be eliminated by selling the contaminated baitfish or other for purposes other than release into public waters (e.g., sell fish for growout in recirculation aquaculture).
- Sterile ANS can be cultured.

It may not be possible to fully eliminate or prevent a hazard. In some cases and with some ANS hazards, minimization may be the only reasonable goal of the ANS-HACCP plan. Although hazard minimization is acceptable in some instances, it is important that all ANS hazards be addressed. Any limitations of the ANS-HACCP plan to control those hazards also should be understood by resource management agencies and the fish farmer or baitfish harvester. When ANS-HACCP plans cannot satisfactorily control ANS hazards, other approaches to prevent the spread will be required.

Definition:

Control Point: Any step at which ANS can be controlled.

CCPs vs. Control Points

Many points in the flow diagram not identified as CCPs may be considered control points. A HACCP plan can lose focus if points are unnecessarily identified as CCPs. Only points at which significant ANS hazards can be controlled are considered CCPs. A tendency exists to control too much and to designate too many CCPs. A CCP should be limited to that point or those points at which control of the significant hazards can best be achieved. For example, an ANS plant fragment hazard can be controlled by attempting to avoid infested areas of the lake, by trying to pick each fragment off of a net before leaving the lake, and by freezing the net for 48 hours before going to uninfested waters. However, trying to avoid infested areas or trying to pick off plant fragments would not necessarily be considered CCPs if freezing the net for 48 hours best controlled the hazard. Differentiating between CCPs and control points will vary from business to business and depend on their unique operation. When designating CCPs you must also consider any applicable state statutes or rules that may dictate the identification of a CCP. For example, if it is illegal to transport ANS overland, then CCPs that comply must be developed.

Multiple CCPs and Hazards

A CCP can be used to control more than one hazard. For example, holding fish in flowing water for 12 hours might be a CCP to separate baitfish from ANS plant fragments and *Daphnia lumholtzi* because neither can swim against the current and will be flushed from the system. Likewise, more than one CCP may be needed to control a hazard. In controlling plant fragments, both the flow rate and the length of time fish are held in the tank could both be identified as CCPs if holding time to ensure elimination of ANS plant fragments is based on a minimum flow rate.

CCPs are Product- and Process-Specific

CCPs identified for baitfish or fish for stocking grown or harvested in one manner may be different for the same product grown or produced in a different manner. For example, the hazards of dip-netting shiners at night may be quite different than seining shiners during the day from the same infested water body. The reasons that CCPs can differ for the same product is because the hazards and the best points for controlling them may change with differences in:

- Harvest methods
- Facility layout
- Holding tank design
- Transportation techniques
- Type and use of equipment
- Source of water

Although HACCP models and generic HACCP plans can be useful in considering CCPs, each baitfish species or fish sold for stocking into public waters must be considered separately. Three

CCPs were identified for the harvest of emerald shiners from Eurasian watermilfoil-infested waters by the ABC Baitfish Co. (Appendix 2).

CCP Decision Tree

In Principle 1, you learned how to determine where hazards enter a process. Often the best place to control a hazard is at the point of entry. But this is not always true. The CCP can be several steps away from the point where the significant hazard is introduced. A series of four questions can help to identify CCPs for a process (see questions below and Figure 2). The questions are referred to as the CCP Decision Tree and are asked at each process step identified in Principle 1 with a significant hazard. Properly used, the CCP decision tree can be a helpful tool in identifying CCPs, but it is not a perfect one.

Question 1. Does a control measure(s) exist at this step or subsequent steps for the identified hazard?

If your answer is “yes,” ask question 2.

If you cannot identify a control measure and answer “no” at this step, then ask, “Is control at this step necessary to prevent or minimize the hazard?” If this answer is “no” too, the step is not a CCP for that hazard. If the answer is “yes,” then you have identified a significant hazard that is not being controlled. In this case, the step, process or product must be redesigned to include a control measure. Sometimes there is no reasonable control measure available. In such cases, HACCP does not provide assurance that baitfish or fish for stocking are ANS-free.

Question 2. Does this step eliminate or reduce the likely occurrence of a significant hazard to an acceptable level?

Consider if this is the best step at which to control the hazard. If the answer is “yes,” then the step is a CCP; move to the next significant hazard. If the answer is “no,” ask question 3.

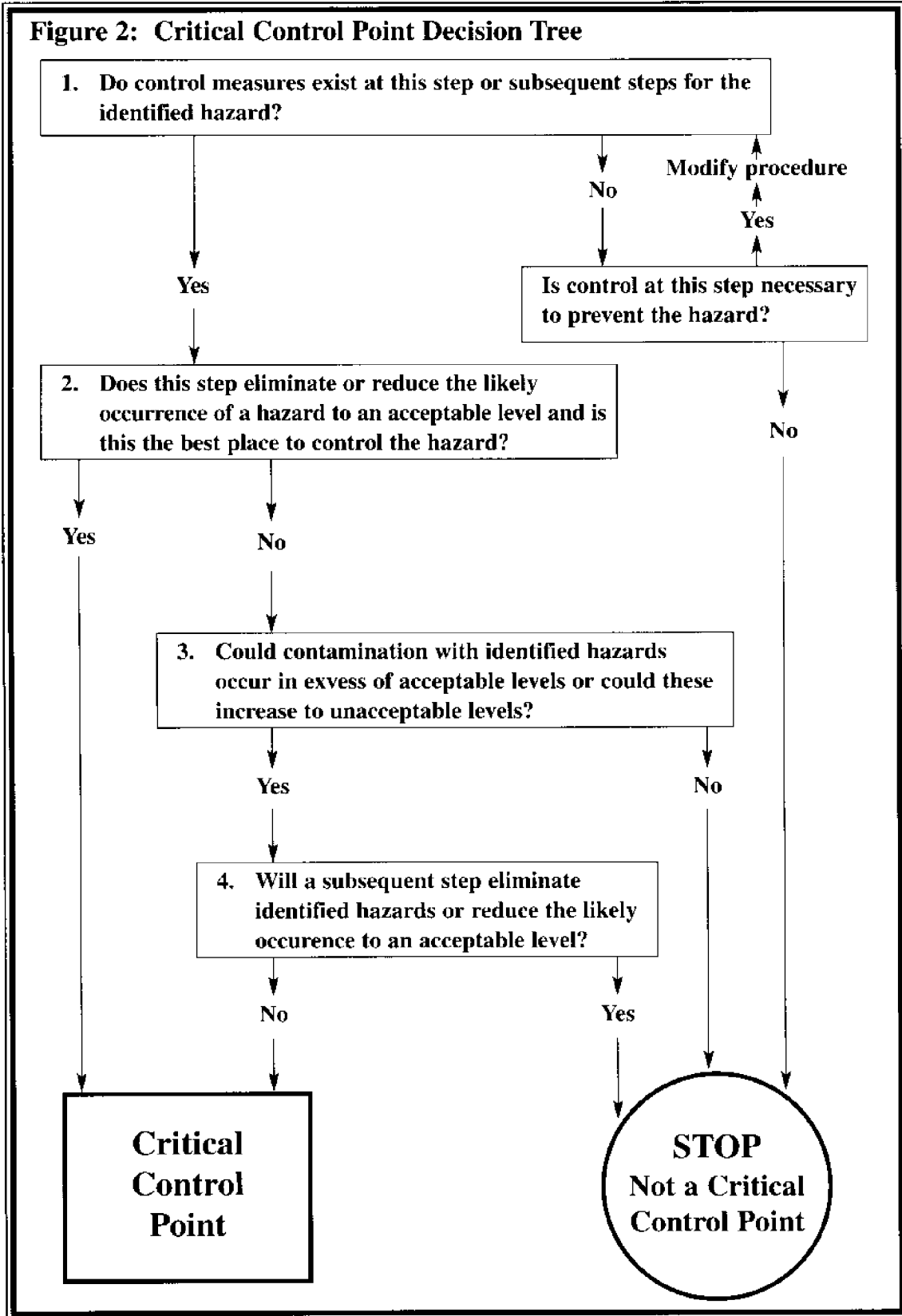
Question 3. Could contamination with an identified hazard or hazards occur, or increase at this step?

For example, if you continue to add fish harvested from infested waters to holding tanks, you may be adding an ANS that had already been removed from the system. If the answer is “no,” then the step is not a CCP for that hazard. If the answer is “yes,” then ask the fourth question.

Question 4. Will a subsequent step eliminate the identified hazard or hazards or reduce the likely occurrence to an acceptable level?

If you answer “no,” then this step is a CCP. If you answer “yes,” then this step is not a CCP for this hazard. In this case, be sure the hazard is controlled by a subsequent processing step.

Figure 2: Critical Control Point Decision Tree



Chapter 7: Principle 3: Establish Controls

Objectives:

- ◆ Define Controls used at each Critical Control Point
- ◆ Describe how to establish Controls
- ◆ Describe Operating Limits

Controls must be established for each CCP identified in the hazard analysis. A control represents the boundaries that are used to ensure that a baitfish or aquaculture operation produces ANS-free products or if ANS are intentionally cultured, they are not allowed to become established in the wild. Each CCP must have one or more controls for each significant ANS hazard. When the process deviates from the control limits, corrective action must be taken to ensure an ANS-free product. Examples of controls might be a minimum flow rate and time that baitfish are held in the holding tank to ensure that aquatic nuisance plant fragments are trapped in the outlet filters. In this case, adhering to a minimum flow rate and time controls the aquatic plant hazard.

Definition:

Control: (a) (verb) To manage the conditions of an operation to maintain compliance with established criteria. (b) (noun) The state in which correct procedures are being followed and criteria are being met.

Establishing Controls

In many cases, the appropriate control may not be readily apparent or available. Tests may need to be conducted or information gathered from sources such as scientific publications, regulatory guidelines, experts, or experimental studies. If the information needed to define controls is not available, a conservative value should be selected. The rationale and reference material used to establish controls should become part of the support documentation for the HACCP plan.

Definition:

Control Limit: A criterion that must be met for each control measure associated with a critical control point.

Often a variety of options exist for controlling a particular hazard. The selection of the best control option and the best control limit is often driven by practicality and experience.

In many cases, it is not practical to continually monitor the harvested wild baitfish, wild fish, or cultured fish to ensure that there are no ANS. As an alternative, controls may be set to assure that the harvest/holding/grading practices achieve the necessary elimination or containment of ANS.

Establishing Operating Limits

If monitoring shows a trend toward lack of control at a CCP, operators should take action before the control limit is exceeded. The point where operators take such an action is called the operating limit. Operating limits should not be confused with control limits. Operating limits are established at a level that would be reached before the control limit is violated.

Definition:

Operating Limit: Criteria that are more stringent than critical limits and that are used by an operator to reduce the risk of ANS contamination. For example, if a certain chemical concentration is required to control an ANS hazard, the operating limit is generally set above the minimum concentration needed to ensure effective treatment.

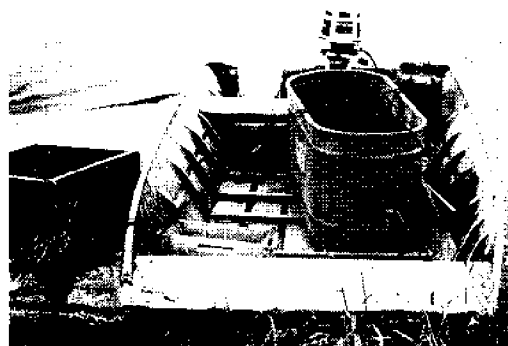
The process should be adjusted when the operating limit is exceeded to avoid violating critical limits. These actions are called process adjustments. A processor may use these adjustments to avoid loss of control and the need to take corrective action. Spotting a trend toward loss of control early and acting on it can save added stress on fish caused by procedures to separate ANS, or worse yet, product destruction. Corrective action is only required when the control limit is exceeded.

Operating limits may be selected for various reasons:

- For quality (e.g., separating fish by species and size)
- To avoid exceeding a control limit (e.g., a flow rate in holding tanks could be higher than the control limit to ensure that any aquatic plant fragments are trapped in the outlet filter or a disinfectant solution could be stronger than needed to ensure control)

When a corrective action is necessary, operators must be able to identify and segregate the affected lots of fish. If lot sizes are big, large quantities of the product may require segregation and corrective action even if only a small amount of the product was produced when control limits were exceeded. Segregating fish into smaller holding tanks means far less product may be involved when a violation of a control limit occurs. Consequently, wise operators should keep fish harvested from certain locations segregated from other fish already in the holding facility.

Sample controls and control limits for the harvest of emerald shiners from Eurasian watermilfoil-infested water by the ABC Baitfish Co. is found in Appendix 2.



Chapter 8: Principle 4: Critical Control Point Monitoring

Objectives:

In this module you will learn:

- ◆ How monitoring is defined
- ◆ Why monitoring is needed
- ◆ How to design a monitoring system
- ◆ What methods and equipment are used for monitoring controls
- ◆ How often monitoring should be performed
- ◆ Who should monitor

Monitoring is important to ensure that the controls designed to eliminate or minimize ANS hazards are consistently met.

Definition:

Monitor: To conduct a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification.

Purpose for monitoring

- To identify trends that may require adjustments to ensure continued control over the hazards
- To identify when there is a loss of control (a deviation occurs at a CCP)
- To provide written documentation of the hazard control system

Monitoring is the process that the operator relies upon to maintain control at a CCP. Accurate monitoring indicates when there is a loss of control at a CCP and a deviation from a control limit. When a control limit is compromised, a corrective action is needed. Reviewing the monitoring records and finding the last recorded value that meets the control limit can determine the extent of the problem needing correction. Monitoring also provides a record that products were produced in compliance with the ANS-HACCP plan. This information is useful in the verification of the ANS-HACCP plan as discussed in Principle 7.

Design of a Monitoring System

The preventive measures discussed in Principle 1 and the control limits discussed in Principle 3 are intended to control the hazards at each CCP. Monitoring procedures are used to determine if the preventive measures are being enacted and the control limits are being met.

Monitoring procedures must identify:

- What will be monitored (column 4)
- How the control limits and preventive measures will be monitored (column 5)
- How frequently monitoring will be performed (column 6)
- Who will perform the monitoring (column 7)

ANS-HACCP Plan Form Monitoring									
			Monitoring						
(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Limits for each Control Measure	(4) What	(5) How	(6) Frequency	(7) Who	(8) Corrective Action(s)	(9) Records	(10) Verifi- cation
Specify the monitoring procedure for each CCP									

<p>Monitoring</p> <ul style="list-style-type: none"> • What: usually a measurement or observation to assess if the CCP is operating within the control limit. • How: Usually physical or chemical measurements or observations. • When (frequency): can be continuous or intermittent. • Who: someone trained to perform the monitoring task.
--

What will be Monitored

Monitoring may mean measuring a characteristic of the product or of the process to determine compliance with a control limit. Examples include:

- Measurement of water flow rate or tank water exchange rate
- Measurement of freezer temperature when freezing nets to kill ANS
- Observations of the presence/absence of ANS
- Measurements of any chemical concentrations for treatments used to kill ANS
- Determination of the sex or ploidy of cultured ANS

Monitoring may also involve observing if a preventive measure at a CCP is being performed.

Examples include:

- Checking with management agencies for lists of infested waters
- Checking to see that fish purchased from other wholesalers did not come from ANS infested waters

How Control Limits and Preventive Measures will be Monitored

Monitoring must be designed to provide rapid (real-time) results. There is no time for lengthy analytical testing because control limit failures must be detected quickly and an appropriate corrective action instituted before distribution occurs.

Physical and chemical measurements are preferred monitoring methods because testing can be done rapidly. Physical measurements (e.g., time, temperature, and direct observation) can often be related to ANS control. Physical measurements include:

- **Time and temperature.** This combination of measurements is often used to monitor the effectiveness for destroying or controlling ANS contamination of traps, nets, and other equipment. For example, nets used in Eurasian watermilfoil-infested waters in Minnesota must be frozen for 48 hours or dried for 10 days before using in other waters.
- **Water flow rate.** Since plant fragments, eggs, and many invertebrates cannot swim against the current, holding fish in flowing water to separate them from ANS is one way to control the hazard. Measuring flow rate and the time it takes for one complete water exchange are examples of physical measurements that may need to be monitored.
- **Visual examination.** Observations for the presence of ANS contamination in baitfish or fish for stocking or regular surveys for ANS in waters considered to be uninfested is one way to monitor ANS hazards.

The selection of monitoring equipment is a major consideration during development of an ANS-HACCP plan. Equipment used for monitoring CCPs varies with the condition being monitored. Examples of monitoring equipment include:

- Thermometers
- Clocks
- Scales
- Flow meters
- Chemical analytical equipment

The equipment chosen for monitoring at the CCP must be accurate to assure control of the hazard. The reliability of the monitoring equipment should be considered when setting the control limit. Periodic calibration or standardization is necessary to ensure accuracy. This is further discussed in Chapter 10.

Monitoring Frequency

Monitoring can be continuous or intermittent. Where possible, monitor continuously. Continuous monitoring is possible for many types of physical and chemical parameters.

A monitoring instrument that produces a continuous record will not control the hazard on its own. The continuous record needs to be observed periodically and action taken when needed. This too, is a component of monitoring. The length of time between checks will directly affect the amount of rework or product loss when a critical limit deviation is found. In all cases, the checks must be performed in time to ensure that the irregular product is isolated before shipment. When it is not possible to monitor a CCP on a continuous basis, it is necessary for the monitoring interval to be short enough to detect possible deviations from control limits or operating limits. The frequency of intermittent monitoring should be partially determined from historical knowledge of the product and process.

Who Will Monitor?

Assignment of the responsibility for monitoring is an important consideration when developing an ANS-HACCP plan. Individuals assigned to CCP monitoring can be:

- Owner/operator
- Employees/helpers

Including all personnel in ANS-HACCP activities has the advantage of building a broad base of understanding and commitment to the program. Those responsible for monitoring a CCP should:

- Be trained in the CCP monitoring techniques
- Fully understand the importance of CCP monitoring
- Have ready access to the monitoring activity
- Accurately report each monitoring activity
- Immediately report control limit infractions so that immediate corrective actions (Principle 5) can be taken

The monitor's duties should require that all unusual occurrences and deviations from controls be reported immediately to make sure adjustments and corrective actions are made in a timely manner. All records and documents associated with CCP monitoring must be signed or initialed by the person doing the monitoring.

Who will perform the monitoring is recorded in column 7 of the HACCP plan form (see appendices 1-4). An example of monitoring for Eurasian watermilfoil by the ABC Baitfish Company is located in Appendix 2.

Chapter 9: Principle 5: Corrective Actions

Objectives:

- ◆ Describe corrective actions
- ◆ Provide examples and components of corrective actions

Corrective actions must be taken when controls at a CCP have been compromised. When possible, these actions must be determined while developing the HACCP plan.

Definition:

Corrective Action: Procedures followed when a deviation from a critical limit occurs at a critical control point.

When controls are violated at a CCP, the predetermined, documented corrective actions should be instituted. These corrective actions should state procedures to restore process control and determine the environmentally-safe disposition of the affected product. It may be possible, and is always desirable, to correct the problem immediately.

Corrective action options include:

- Isolating and holding fish for safety evaluation
- Diverting the affected fish to another use where ANS contamination would not be considered critical
- Using some method to separate ANS from the fish
- Rejecting fish
- Destroying fish

Corrective actions are implemented when monitoring results indicate a deviation from control limits. Effective corrective actions depend heavily on an adequate monitoring program.

The primary objective is to establish an ANS-HACCP program that permits rapid identification of deviations from a control limit. The sooner the deviation is identified, the more easily corrective actions can be taken and the greater the potential for minimizing the amount of noncompliant product. An individual who has a thorough understanding of the process, product, and ANS-HACCP plan and who has the authority to make decisions needs to be assigned the responsibility of making corrective actions.

Effective corrective action plans must:

- Correct and eliminate the cause of the noncompliance to assure that the CCP is brought back under control.
- Segregate, assess, and determine the disposition of the noncompliant product.

All corrective actions taken should be documented. Documentation will assist the firm in identifying recurring problems so that the ANS-HACCP plan can be modified. Additionally, corrective action records provide proof of product disposition.

Components of Corrective Actions

There are two components of corrective actions:

- To correct and eliminate the cause of the deviation and restore control of the ANS hazard
- To identify the product that was possibly contaminated with ANS and determine its disposition

1) Correct and Eliminate the Cause of the Deviation and Control

Corrective actions must bring the CCP back under control. A corrective action should take care of the immediate (short-term) problem as well as provide long-term solutions. The objective is to implement a short-term fix so that control can be re-established as soon as possible without further deviations. An unanticipated or reoccurrent control limit failure necessitates a re-evaluation of the ANS-HACCP plan. A permanent solution to eliminating or minimizing the initial cause or causes for the deviation should be implemented if necessary. Specific instructions for corrective actions must be available to all workers in the operation and should be part of the documented ANS-HACCP plan.

2) Identify the Product that was Produced During the Deviation and Determine the Disposition

When a deviation occurs, identify the nonconforming product. As previously discussed, there are several steps that may be used for determining product disposition and developing a corrective action plan. If a product is to be tested and released, the sampling method is highly important. The use of a faulty sampling protocol can result in accepting, rather than rejecting, an undesirable product. The limits of sampling plans must be understood. It may be prudent to consult an expert.

Corrective actions are usually written in an “if/then” format. The “if” part of the corrective action describes the condition and the “then” part describes the action taken.

Corrective Action Records

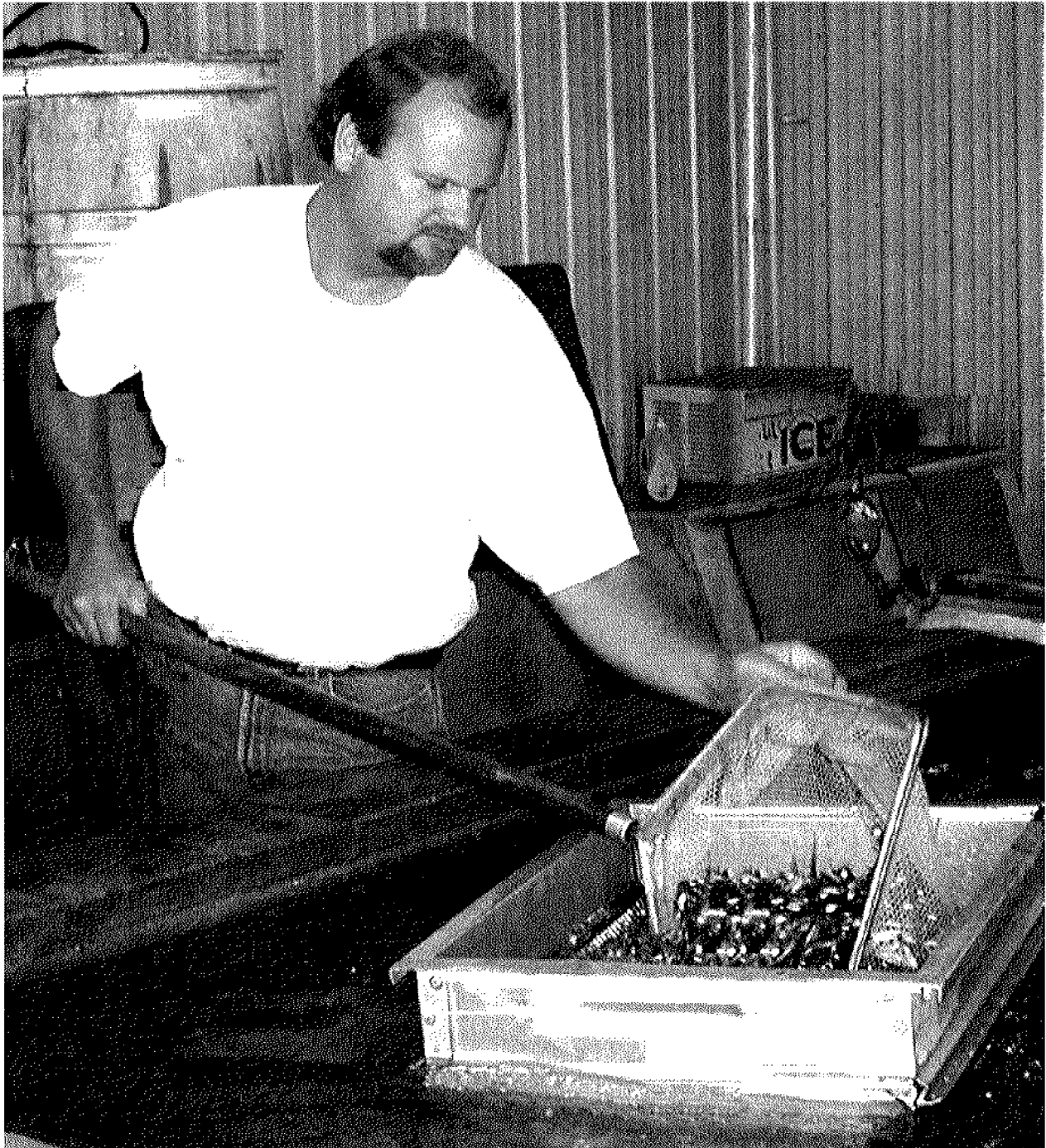
Predetermined corrective actions are written into the ANS-HACCP plan. When control limits are exceeded and a corrective action occurs, it is recorded. A corrective-action report form is helpful.

The corrective-action report should contain the following:

- Product identification (e.g., product description, amount of product on hold)
- Description of the deviation
- Corrective action taken including final disposition of the affected product
- Name of the individual responsible for taking the corrective action
- Results of any evaluations

ANS-HACCP plan records should contain a separate file in which all deviations and corresponding corrective actions are maintained in an organized fashion. Corrective actions are recorded in column 8 of the ANS-HACCP plan form (see appendices 2-5).

Corrective actions identified by the ABC Baitfish Co. are found in appendices 2 and 3.



Chapter 10: Principle 6: Verification Procedures

Objectives:

In this chapter you will learn:

- ◆ How to define verification
- ◆ What functions are part of ANS-HACCP plan verification
- ◆ What functions are part of verification that the plan is being followed

Definition:

Verification: 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 and/or whether the plan needs modification.

Verification

One of the more complex principles of HACCP is verification. Although it is complex, the proper development and implementation of the verification principle is fundamental to the successful execution of the ANS-HACCP plan. HACCP has spawned a new adage – “trust what you can verify,” which speaks to the heart of the verification principle. The purpose of verification is to provide a level of confidence that the plan is based on solid scientific principles, is adequate to control the hazards associated with producing and selling live fish, and is being followed.

There are several elements associated with this principle including validation and reviews. Confusion sometime arises because the HACCP plan must include verification procedures for individual CCPs **and** for the overall plan.

Elements of Verification:

- Validation
- CCP verification activities
 - Calibration of monitoring devices
 - Calibration record review
 - Targeted sampling and testing
 - CCP record review
- ANS-HACCP system verification
 - Observation and reviews
- Regulatory agencies

Validation

Validation is an essential component of verification and requires substantiation that the ANS-HACCP plan, if implemented effectively, is sufficient to control the ANS hazards that are likely to occur. Validation of the plan occurs before the plan is actually implemented. The purpose of validation is to provide objective evidence that all essential elements of the plan have a scientific basis and represent a valid approach to controlling the ANS hazards associated with baitfish harvest and production of fish for stocking. There are several approaches to validating the ANS-HACCP plan, among them are incorporation of fundamental scientific principles, use of scientific data, reliance on expert opinion, or conducting specific observations or tests.

Definition:

Validation: The element of verification focused on collecting and evaluating scientific and technical information to determine if the ANS-HACCP plan, when properly implemented, will effectively control the ANS hazards.

Validation can be performed by the ANS-HACCP team or by an individual qualified by training or experience. Validation activities may be similar in scope and time commitment to the original ANS-HACCP plan development. Actual components of the plan should be validated before relying on the HACCP plan and when factors warrant. These factors could include: harvesting fish from a new lake; changing the harvest gear or techniques; new scientific information about potential hazards or their control; or new ANS infestations. Validation involves a scientific and technical review of the rationale behind each part of the ANS-HACCP plan from hazard analysis through each CCP verification strategy.

Verification of CCPs

Verification activities developed for CCPs are essential to ensure that the control procedures used are properly functioning and that they are operating and calibrated within appropriate ranges for ANS control. Additionally, CCP verification includes supervisory review of CCP calibration, monitoring, and corrective action records to confirm compliance with the ANS-HACCP plan. CCP verification may also include targeted sampling and testing.

Calibration of Monitoring Devices

Verification includes calibration of monitoring devices or review of calibration records to assure the accuracy of measurements. Regular calibration of CCP monitoring equipment is important. If the equipment is out-of-calibration, then monitoring results will not be accurate. Significant deviations could render monitoring results completely unreliable. If this happens, the CCP could be considered out of control since the last documented acceptable calibration. This condition should be considered when establishing the frequency of calibration.

Calibration Record Review

Reviewing the equipment calibration records involves checking the dates and methods of calibration, and the test results (e.g., equipment passing or failing). Calibration records are kept and reviewed.

Targeted Sampling and Testing

Verification may also include targeted sampling, testing, and other periodic activities. If you are relying on others to verify through compliance records that the fish they sell to you are ANS-free, then you may want to check targeted samples to verify their claims. Typically, when a monitoring procedure is not as stringent as desired, it should be coupled with a strong verification strategy.

CCP Record Review

At least two types of records are generated at each CCP: monitoring and corrective action. These records are valuable management tools, providing documentation that CCPs are operating within established safety parameters and that deviations are handled in an appropriate manner. However, records alone are meaningless unless someone in a supervisory capacity reviews them on a periodic basis to verify that the ANS-HACCP plan is being followed.

ANS-HACCP System Verification

In addition to the verification activities for CCPs, strategies should be developed for scheduled verification of the complete ANS-HACCP system. The frequency of the system-wide verification should be yearly or whenever there is a system failure or a significant change in the product or process. The ANS-HACCP team is responsible for ensuring that this verification is performed.

System Verification Activities

Systematic verification activities include on-site observations and record reviews. An unbiased person who is not responsible for performing the monitoring activities usually performs reviews.

System verification should occur at a frequency that ensures the HACCP plan is being routinely followed. This frequency depends on a number of conditions, such as the variability of the process and product.

Role of the Regulatory Agencies in ANS-HACCP Plan Verification

Until the ANS-HACCP approach is jointly accepted and used by industry and resource management agencies there is no official role of the resource management agencies in reviewing ANS-HACCP plans. The major role of resource management agencies in a HACCP system could be to verify that HACCP plans are effective and are being followed. Verification normally will occur at the facility or at the water body that is being harvested.

ANS-HACCP plans are unique documents prepared by the fish producer to ensure the control of ANS hazards. ANS-HACCP plan reviewers must have access to records that pertain to CCPs, deviations, corrective actions, and other information pertinent to the plan that may be needed for verification. The plans may, however, contain proprietary information and must be appropriately protected by the regulatory agency or other plan reviewers.

Objectives:

- ◆ Describe the purpose and importance of record keeping
- ◆ Identify the types of records needed
- ◆ Describe records review process

Accurate record keeping is an essential part of a successful ANS-HACCP program. Records provide documentation that the control limits have been met or that appropriate corrective actions were taken when the limits were exceeded. Likewise, they provide a means of monitoring so that adjustments can be made to prevent ANS contamination.

Types of Records Needed

1) *ANS-HACCP Plan and Support Documents*

It is advisable to maintain ANS-HACCP plan supporting documentation described in this chapter. ANS-HACCP support documents include the information and data used to develop the plan. This includes the written hazard-analysis worksheet (Chapter 5) and records of any information used in performing the hazard analysis and establishing the controls.

Support documents may include: current geographic range of ANS infestations and sufficient data used to establish the adequacy of any barriers to ANS contamination of product. In addition to data, support documents may also include correspondence with consultants or other experts.

Support documents should also include a list of the ANS-HACCP team and their responsibilities and a summary of the preliminary steps taken in the development of the HACCP plan.

2) *Monitoring Records*

ANS-HACCP monitoring records are primarily kept to demonstrate control at CCPs. These records provide a useful way to determine if control limits have been violated. Timely record review by a management representative ensures that the CCPs are being controlled in accordance with the plan. Monitoring records also provide a means by which regulators (if involved) can determine whether a firm is in compliance with its ANS-HACCP plan.

By tracking the values recorded on monitoring records, an operator or manager can determine if a process is approaching its control limit. Trends can be identified through record review to make necessary adjustments. If timely adjustments are made before the control limit is violated, operators can reduce or eliminate the labor and material costs associated with corrective actions.

Examples of CCP monitoring records may include:

- Presence/absence of Eurasian watermilfoil fragments in harvested bait
- Number of water exchanges in holding tanks with baitfish taken from Eurasian watermilfoil-infested waters

3) *Corrective Action Records*

Corrective action records were discussed in Chapter 9.

4) *Verification Records*

Verification records (Chapter 10) should include:

- Modifications to the ANS-HACCP plan (e.g., changes in handling and distribution)
- Operator audit records verifying supplier compliance with guarantees or certifications
- Verification of the accuracy and calibration of all monitoring equipment
- Results of in-house, on-site inspections
- Results of equipment evaluation tests

Record Monitoring Information

Monitoring information should be recorded at the time the observation is made. False or inaccurate records filled out before the operation takes place or ones that are completed later are inappropriate for a HACCP system.

Computerized Records

Computerized records are an option to record keeping. When using computerized records, include controls to ensure that records are authentic, accurate and protected from unauthorized changes. Regular back-up of computer files is necessary to prevent loss of records from a computer malfunction.

Record Review

Monitoring records for CCPs and control deviations should be reviewed in a timely manner by a representative of operations management. All records should be signed or initialed and dated by the reviewer.

Monitoring Records

Using the ABC Baitfish Co. as an example (see appendices 2-3), monitoring records should be included for each of the activities identified in columns 4 to 7 of the ANS-HACCP plan. The names of these records should be entered in column 9 of the form. These records should include the presence or absence of Eurasian watermilfoil detected in harvested emerald shiners and actions taken to remove it from bait and equipment. It also should include confirmation that clean water was brought to the site to transport the harvested emerald shiners. At the holding facility, records should confirm that the baitfish were held in holding tanks for a minimum time at a certain flow rate to ensure that any plant fragments are trapped in the filter system.

Any corrective actions taken should be included in column 8. For instance, if the minimum water flow and holding time were not attained before bait was to be transported, employees should take the documented corrective action. In this case, the baitfish should be held in the holding tanks for a minimum time at the prescribed flow rate to ensure that plant fragments are trapped in the filter system before baitfish are transported from the facility.

Chapter 12: Sources of Information on Preparing ANS-HACCP Plans

Objectives:

- ◆ Identify other sources of information that will help with ANS-HACCP plan development

Chapter 2 introduced the hazards that could occur in harvesting fish and aquaculture products. Appendix 2 outlines an example of harvesting wild baitfish from waters which are infested with an aquatic nuisance plant. Appendices 3 and 4 give examples of baitfish aquaculture in waters with an aquatic nuisance plant species infestation and without any type of ANS infestation. Appendix 5 has the forms needed to conduct a hazard analysis and complete a HACCP Plan. You will need to perform a hazard analysis to decide whether these or other hazards are reasonably likely to occur in your products. Also, control measures need to be devised that make sense for your operations. To do this, gather information from a variety of sources and choose the information that best applies to your situation. Some of the most useful sources follow.

- *The Baitfish/Wild Fish Harvester and Aquaculturist*

You and your employees know your operation better than anyone. Experience is an excellent source of information. You may already know about hazards that can affect your product, and you may have already implemented suitable controls, perhaps for purposes other than ANS control.

- *State, Federal, Tribal Natural Resource Managers*

Federal, state and tribal natural resource managers can be good sources of information. They may point out potential hazards based on their field assessments, but it will usually be your responsibility to implement effective control measures.

- *Trade Associations*

Trade associations can also provide useful information. Trade journals are now beginning to cover ANS topics and often provide general information on potential hazards and controls. Articles on specific processes or products can be useful. Some trade organizations provide services such as consulting, educational programs, and publications that can help identify hazards and control measures.

- *Suppliers and Buyers*

Suppliers of cleaning materials and fish handling equipment can provide information on potential hazards and control measures. A buyer's specification may point to a hazard in one of your products and request only baitfish which are certified free from ANS. Note, however, that not all buyer's specifications relate to ANS.

- *Sea Grant/Cooperative Extension*

Many universities have Sea Grant or Cooperative Extension programs. These programs provide continuing education and technical assistance to industry. Extension specialists and agents can assist in identifying potential hazards and control measures. Also a wealth of publications on ANS are available through Sea Grant.

- *Publications*

Textbooks, government publications and scientific literature provide general and specific ANS information. These publications usually include a list of references that can be used to get further information.

Scientific journals are available in most libraries, especially university libraries. Summaries of information from scientific journals are also available from the FDA, Sea Grant, Cooperative Extension, and in other publications. Following is a listing of organizations that produce publications.

- *HACCP: Hazard Analysis and Critical Control Point Training Curriculum*

This curriculum was developed to help seafood processors learn about the HACCP process and serves as the main resource when teaching HACCP. The material contained in this curriculum is based on it.

Computer-Accessible Information Sources

- *AquaNIC* (Aquaculture Network Information Center)

This is a gateway to electronic resources on aquaculture. AquaNIC is maintained at Purdue University, West Lafayette, Indiana. Many fact sheets, technical bulletins, and other publications are available on this site. Information on AquaNIC can be viewed on your computer monitor, or downloaded. AquaNIC also contains an image directory that holds hundreds of pictures, short videos and slides in a variety of common image formats. AquaNIC is linked to other aquaculture databases on the Internet.

Web Address: <http://aquanic.org>

- *sgnis*

Sea Grant Nonindigenous Species Site is an electronic resource on ANS. The site is a peer-reviewed national information center that contains a comprehensive, searchable collection of research publications and educational materials produced by the National Sea Grant College Program. This site includes research findings, training and educational materials, newsletters, distribution maps, a Sea Grant Graphics Library of slides, illustrations, and videos, with links to local Sea Grant personnel and related Web sites.

Web Address: <http://www.sgnis.org>

- *National Aquatic Nuisance Species Clearinghouse*

Sea Grant's National Aquatic Nuisance Species Clearinghouse is the home of North America's most extensive technical library of publications related to the spread, biology, impacts and control of zebra mussels and other important aquatic nuisance, nonindigenous and invasive species.

Web Address: <http://www.entryway.com/seagrant/>

- *United States Geological Survey*

The nonindigenous aquatic species site of the U.S. Geological Survey is a repository for a large database of nonindigenous aquatic species information. Scientific reports, U.S. distribution maps, regional contact lists and general information are available on this site.

Web Address: <http://nas.er.usgs.gov>



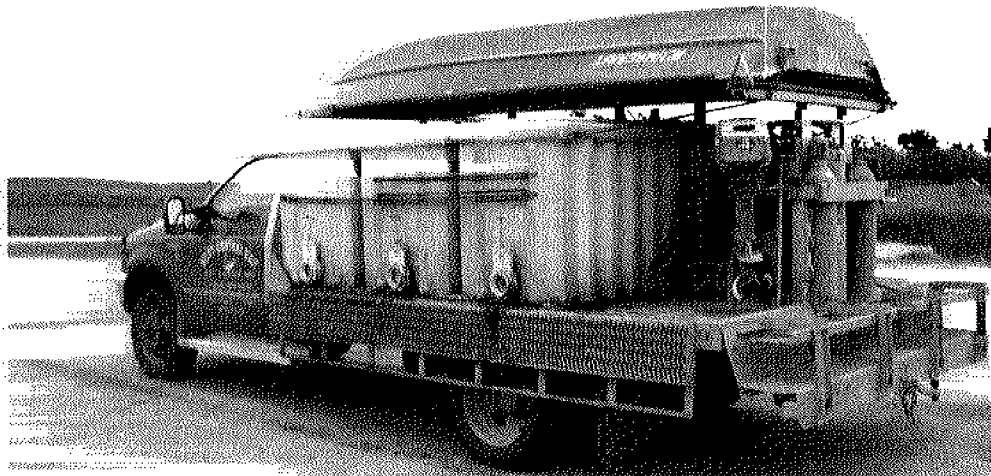
Reducing the Risk of Spreading ANS and Certifying ANS-Free Fish through the HACCP Approach

OVERVIEW

HACCP is a preventative system of hazard control rather than a reactive one. Baitfish/aquaculture operators can use it to reduce the risk that products will be contaminated by ANS and so will prevent the spread of these unwanted species into new water bodies. To ensure uncontaminated fish, the HACCP system is designed to identify ANS hazards, establish controls, and monitor these controls. Hazards can be ANS fish or other aquatic vertebrates, invertebrates, and plants. The advantage of this system is that it applies to a diverse industry, it provides partnership opportunities between industry and government regulators, and, if properly applied, it is effective. The HACCP approach concentrates on points in the process that are critical to the safety of the product, minimizes the risks, and stresses communication between regulators and industry.

This overview is designed to walk you through a series of 9 steps that will yield a completed ANS-HACCP plan. A blank ANS-HACCP Plan Form is contained in Appendix 5. The HACCP approach to preventing the spread of ANS suggests that you prepare an ANS-HACCP plan for fish that will be stocked live into other waters and for baitfish (where significant ANS hazards exist). The HACCP approach to ANS does not require that you use the form included in Appendix 5. However, using this standardized form will likely help you develop an acceptable plan and will expedite review.

In order to complete the ANS-HACCP Plan Form you will need to perform a process called "hazard analysis." We have found that the use of a standardized Hazard Analysis Worksheet assists in this process. A blank Hazard Analysis Worksheet is contained in Appendix 5. A written hazard analysis will be very useful when you perform ANS-HACCP plan reassessments and when you are asked to justify why certain hazards were or were not included in your ANS-HACCP plan.



The steps

A list of steps to use in ANS-HACCP plan development:

Preliminary Steps
General information
Describe the cultured or wild harvested fish
Describe the method of collection, storage, and distribution
Identify the intended use and consumer
Develop a flow diagram

Hazard Analysis Worksheet
Set up the Hazard Analysis Worksheet
Identify the potential ANS-related hazards
Complete the Hazard Analysis Worksheet
Understand the potential hazard
Determine if the potential hazard is significant
Identify the critical control points (CCP)

ANS-HACCP Plan Form
Complete the ANS-HACCP Plan Form
Set the critical limits (CL)
Establish monitoring procedures
What
How
Frequency
Who
Establish corrective action procedures
Establish verification procedures
Establish a record-keeping system

PRELIMINARY STEPS

STEP 1: General information.

Record the name and address of your processing facility in the spaces provided on the first page of the Hazard Analysis Worksheet and the ANS-HACCP Plan Form (Appendix 5).

STEP 2: Describe the cultured or wild harvested fish.

Identify the market name or Latin name (species) of the fish.

examples:

Fathead minnows (*Pimephales promelas*)

Golden shiners (*Notemigonus crysoleucas*)

White sucker (*Catostomus commersoni*)

Walleye (*Stizostedion vitreum*)

Fully describe the product.

examples:

Fathead minnows graded on 16 grader

Golden shiners graded on 21 grader

Shiners — multiple species and sizes

White suckers ungraded
Rosy red minnows from Arkansas, held in my ponds until distribution
Fathead minnows from Minnesota held in tanks until distribution to retail outlets
White suckers graded on a 23 grader
Walleye fingerlings 5 - 8 inches
Yellow perch fingerlings 2.5 - 3 inches

Record this information in the spaces provided on the first page of the Hazard Analysis Worksheet and the ANS-HACCP Plan Form.

STEP 3: Describe the method of collection, storage, and distribution.

Identify how the product is collected, stored prior to distribution, and how it is distributed to the customer. Identify whether any special shipping methods, such as mail order, are used.

examples:

Wild harvested with seines, held in tanks, graded, then trucked to retail stores
Pond-raised, seined, then held in different ponds over the winter, trucked to retail stores
Pond-raised, trapped from ponds, then transferred directly to lakes for stocking

Record this information in the spaces provided on the first page of the Hazard Analysis Worksheet and the ANS-HACCP Plan Form.

STEP 4: Identify the intended use and customer.

Identify how the product will be used.

examples:

Live fishing bait
Feeder fish (feeding pond or aquarium fish)
Stocking into public waters
Stocking into private waters
Stocking into aquaculture production facility (indoor or outdoor)

Identify your intended customer or user of the product.

examples:

General public
A wholesaler
A retail store
Fish farmer
State agency

Record this information in the spaces provided on the first page of the Hazard Analysis Worksheet and the ANS-HACCP Plan Form.

STEP 5: Develop a flow diagram.

The purpose of the diagram is to provide a clear, simple description of the steps involved in producing your fishery products as they “flow” from receipt or collection, to storage/holding, to distribution. The flow diagram should cover all of the steps in the process that your firm performs, including distribution if it is on company-owned trucks. The flow diagram should be verified on-site for accuracy. Examples of flow diagrams can be found in appendices 2-4.

HAZARD ANALYSIS WORKSHEET

STEP 6: Set up the Hazard Analysis Worksheet.

Record each of the steps from the flow diagram in column 1 of the Hazard Analysis Worksheet.

STEP 7: Identify the potential ANS-related hazards.

You should use your own expertise and that of outside experts, as necessary, to identify any ANS hazards that may be related to your fish production practices. Check with management agencies to determine if the waters that you harvest or grow fish in are infested with exotic species.

You may already have effective controls in place for a number of these hazards as part of your routine or traditional handling practices. The presence of such controls does not mean that the hazard is not significant. The likelihood of a hazard should be judged in the absence of controls. For example, the fact that ANS plant material has not been found in your product, may be the result of: 1) absence of ANS plants in the area of harvest; or 2) the existence of controls that are already in place to prevent plant contamination (e.g. holding fish in flowing water). In the first case the hazard is not reasonably likely to occur. In the second case the controls should be included in the ANS-HACCP plan.

STEP 8: Complete the Hazard Analysis Worksheet.

These steps involve: understanding the potential hazard; determining if the potential hazard is significant; and identifying the critical control points. When you have finished these steps for all of the potential hazards that relate to your product, you will have completed the Hazard Analysis Worksheet. Proceed to step 9.

ANS-HACCP PLAN FORM

STEP 9: Complete the ANS-HACCP Plan Form.

Find the steps that you have identified as CCPs in column 6 of the Hazard Analysis Worksheet. If you do not have any significant hazards and Critical Control Points, you do not need to complete the ANS-HACCP Plan. If you do have Critical Control Points identified from your Hazard Analysis Worksheet, then record these steps in column 1 of the ANS-HACCP Plan Form. Enter the hazard(s) for which these steps were identified as CCPs in column 2 of the ANS-HACCP Plan Form. This information can be found in column 2 of the Hazard Analysis Worksheet.

Complete the ANS-HACCP Plan Form by designing techniques, methods, and treatments to deal with each of the significant hazards that you entered in column 2 of the HACCP Plan Form.

Complete the following steps for each of the significant hazards: set the critical limits; establish monitoring procedures; establish corrective action procedures; establish a record keeping system; and establish verification procedures. When you have finished these steps for all of the significant hazards that relate to your product, you will have completed the ANS-HACCP Plan Form.

You should then sign and date the first page of the ANS-HACCP Plan Form. The signature must be that of the most responsible individual on-site at your processing facility or a higher level official. It signifies that the ANS-HACCP plan has been accepted for implementation by your firm.

Appendix 2

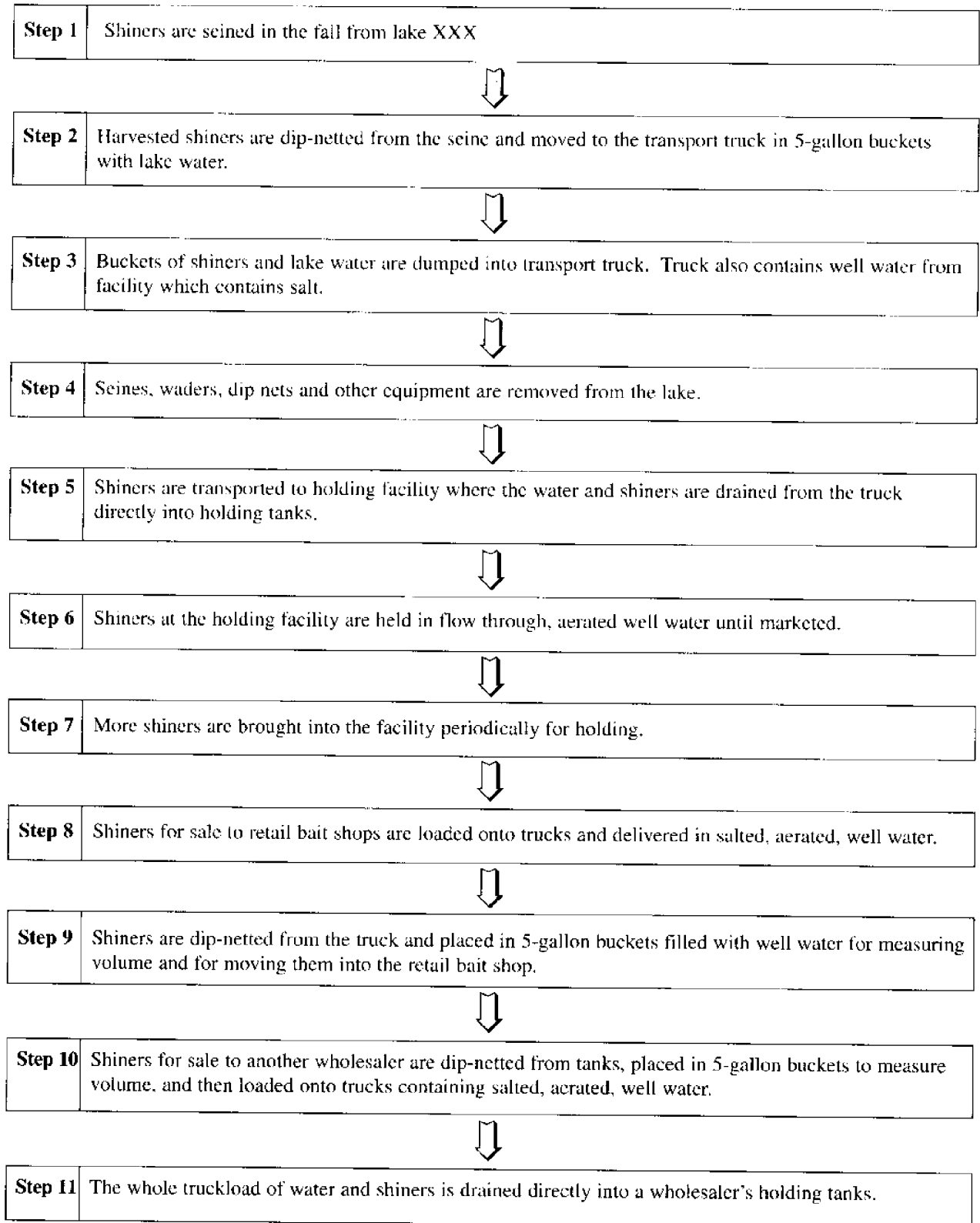
ANS-HACCP Plan — Emerald Shiners Harvested from Eurasian Watermilfoil-Infested Waters

- 1) Product Description
 - 2) Flow Diagram
 - 3) Potential Hazards
 - 4) Hazard Analysis Worksheet
 - 5) HACCP Plan Form
-

1) Product Description

Firm Name:	ABC Baitfish Company
Firm Address:	RR 1, Box 111 Baitville, MI 48999
Species of fish:	Emerald Shiners (<i>Notropis atherinoides</i>)
Cultured or wild harvested:	Wild harvested
Harvest method:	Seined
Method of distribution and storage	Held in tanks at baitfish facility, then delivered to retail stores or wholesalers.
Intended use and consumer:	To be sold live in retail bait shops and to wholesaler bait dealers for live fishing bait.

2) Flow Diagram



3) Potential Hazards (List relevant species)

1. **ANS Fish and Other Vertebrates.** Examples: Eurasian ruffe, round goby, Asian carps, non-native amphibians, etc.

2. **ANS Invertebrates.** Examples: zebra mussels, Asiatic clams, spiny waterfleas, rusty crayfish, etc.

3. **ANS Plants.** Examples: Eurasian watermilfoil, hydrilla, giant salvinia, water chestnut, etc.

Eurasian Watermilfoil found in Lake XXX

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step <i>(from flow diagram)</i>	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
Shiners are seined.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM	Hazard controlled at subsequent step	No
Harvested shiners are dip-netted from the seine and moved to the truck in 5 gal buckets with lake water.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM	Hazard controlled at subsequent step	No
Buckets of shiners and lake water are dumped into transport truck.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM	Hazard controlled at subsequent step	No
Seines, waders, dip nets and other equipment are removed from the lake.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM and could be moved on equipment.	Remove plant fragments, freeze nets.	Yes
Shiners are transported to holding facility where the water and shiners are drained from the truck directly into holding tanks.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM	Hazard controlled at subsequent step	No
Shiners at the holding facility are held in flow through, aerated well water until marketed.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	EWM could be present in tanks	Time, flow rate and cleaning tanks	Yes

4) Hazard Analysis Worksheet

More shiners are brought into the facility periodically for holding.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Lake XXX is infested with EWM	Time, flow rate and cleaning tanks	Yes
Shiners for sale are loaded onto trucks and delivered in salted, aerated, well water.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	Yes	Control of ANS hazard completed		No
Shiners are dip-netted from the truck and placed in 5 gal buckets filled with well water for measuring volume and for moving them into the retail bait shop.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	No	Control of ANS hazard completed		No
The whole truckload of water and shiners is drained directly into a wholesaler's tanks.	Fish/Other Vertebrates	No	ANS not present		
	Invertebrates	No	ANS not present		
	Plants Eurasian Watermilfoil	No	Control of ANS hazard completed		No
Firm Name: ABC Baitfish Company			Species of Fish: Emerald Shiners (<i>Notropis atherinoides</i>)		
Firm Address: RR 1, Box 111, Baitville, MI 48999			Cultured, wild harvested, or both: Wild harvested		
Signature:			Intended Use and Consumer: To be sold as live bait to anglers		
Date:					

5) HACCP Plan Form

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Limits for each Control Measure	Monitoring				(8) Corrective Actions(s)	(9) Verification	(10) Records
			(4) What	(5) How	(6) Frequency	(7) Who			
Seines, waders, dip nets and other equipment are removed from the lake.	Eurasian watermilfoil could be moved to uninfested lakes	Plant fragments are removed from waders, buckets, other equipment. Nets are frozen for 48 hours before use in uninfested waters	Presence of plant fragments and time and temp. for nets	Visual inspection, clock and thermometer	Each time equipment leaves lake	Manager	If time and temperature not obtained, refreeze for entire time. If plant fragments found on other equipment, remove before going to uninfested waters.	Records Review	Record time in freezer and time out. Record temperature. Record time of visual inspection of equipment leaving the lake.
Shiners at the holding facility are held in flow through, aerated well water until marketed.	Eurasian watermilfoil could be moved with baitfish to retail outlets	Shiners are held in flowing water for at least 18 hours. Tank bottoms and sides are swept before loading shiners to ensure plant fragments are no longer present. Flow rate maintained at 50 gal/min.	Time, flow rate, and presence of plant fragments	Clock, timer and known volume container, and visual inspection	Each lot of shiners	Manager	If plant fragments are found, hold for another 18 hours. If flow rate drops, increase flow and hold for 18 hours.	Records Review	Record time shiners were brought in, and time loaded out. Record flow rate, and time of visual inspections

5) HACCP Plan Format, cont.

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Limits for each Control Measure	Monitoring				(8) Corrective Actions(s)	(9) Verification	(10) Records
			(4) What	(5) How	(6) Frequency	(7) Who			
More shiners are brought into the facility for holding.	Eurasian watermilfoil could be moved with baitfish to retail outlets	Shiners are added at drain end of tank, separated by screen from other shiners. Shiners are held in flowing water for at least 18 hours. Tank bottoms and sides are swept before loading shiners to ensure plant fragments are no longer present. Flow rate maintained at 50 gal/min.	Time, flow rate, and presence of plant fragments	Clock, timer and known volume container, and visual inspection,	Each lot of shiners	Manager	If plant fragments are found, hold for another 18 hours. If flow rate drops, increase flow and hold for 18 hours.	Records Review	Record time shiners were brought in, and time loaded out. Record flow rate, and time of visual inspections
Firm Name: ABC Baitfish Company									
Firm Address: RR1, Box 111 Baitville, MI 48999									
Signature:									
Date: 1/1/01									
Species of Fish: Emerald shiners (<i>Notropis atherinoides</i>)									
Method of Storage and Distribution: Wild harvest, stored in indoor tanks, trucked to distribution outlets.									
Intended Use and Consumer: Used as live bait for angling. Sold to retail bait shops and other wholesalers									

Appendix 3

ANS-HACCP Plan — White Suckers Cultured for Sale as Baitfish

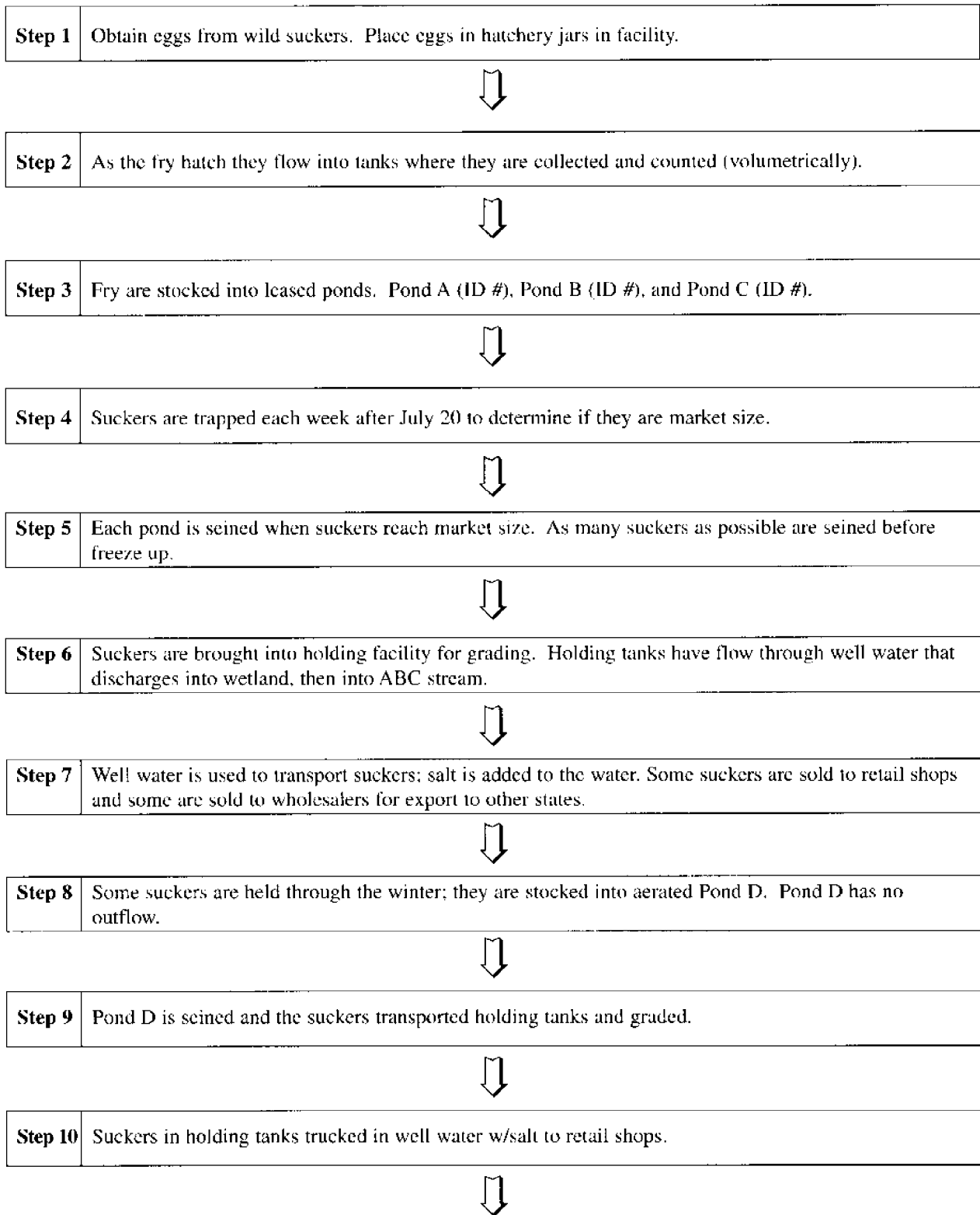
Eurasian Watermilfoil Infestation Example

- 1) Product Description
 - 2) Flow Diagram
 - 3) Potential Hazards
 - 4) Hazard Analysis Worksheet
 - 5) HACCP Plan Form
-

1) Product Description

Firm Name:	ABC Baitfish Company
Firm Address:	RR 1, Box 111 Baitville, MI 48999
Species of fish:	White suckers (<i>Catostomus commersoni</i>)
Cultured or wild harvested:	Cultured
Harvest method:	Seined and trapped from grow out ponds
Method of distribution and storage	Held in tanks on-site, then delivered to retail stores or wholesalers. Some held in aerated ponds over winter for sale in the spring.
Intended use and consumer:	To be sold in retail bait shops for fishing bait

2) Flow Diagram



3) Potential ANS Hazards (List relevant species)

- 1) **ANS Fish/Other vertebrates.** Examples include round goby, ruffe, white perch, threespine stickleback, etc.

- 2) **ANS Invertebrates.** Examples include zebra mussels, spiny and fishhook waterflea, green crab, rusty crayfish, etc,

- 3) **ANS Plants.** Examples include Eurasian watermilfoil, hydrilla, water chestnut, and purple loosestrife.

Eurasian Watermilfoil

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
Obtaining eggs, hatching them, and collecting fry.	ANS Fish/Other Vertebrates	No	ANS fish have not been found in river where sucker eggs were collected		No
	ANS Invertebrates	No	ANS invertebrates have not been found in river where sucker eggs were collected		No
	ANS Plants	No	ANS plants have not been found in river where sucker eggs were collected		No
Fry are stocked into ponds	ANS Fish/Other Vertebrates	No	ANS fish not present in hatchery		No
	ANS Invertebrates	No	ANS invertebrates not present in hatchery		No
	ANS Plants	No	ANS plants not present in hatchery		No
Suckers are harvested from ponds.	ANS Fish/Other Vertebrates	No	ANS fish not present in ponds		No
	ANS Invertebrates	No	ANS invertebrates not present in ponds		No
	ANS Plants Eurasian Watermilfoil	Yes	EWM present in ponds and could be transported to holding facility with suckers	Hazard controlled at a subsequent step	No
Suckers are held and graded in tanks at the facility.	ANS Fish/Other Vertebrates	No	ANS fish are not present in holding facility		No
	ANS Invertebrates	No	ANS invertebrates are not present in holding facility		No

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
	ANS Plants Eurasian Watermilfoil	Yes	Since one pond has EWM, it is possible it could be brought into the facility with suckers	Suckers held in holding facility for several water exchanges to trap any EWM in outflow filters. Suckers from the pond with EWM are kept in separate tanks or are screened in the downstream end of the holding tank.	Yes
Suckers are trucked to retail stores or to wholesalers' facilities.	ANS Fish/Other Vertebrates	No	ANS fish are not present in holding facility		No
	ANS Invertebrates	No	ANS invertebrates are not present in holding facility		No
	ANS Plants Eurasian Watermilfoil	No	Control of ANS hazard completed		No
Suckers are moved to aerated ponds for the winter	ANS Fish/Other Vertebrates	No	ANS fish are not present in holding facility		No
	ANS Invertebrates	No	ANS invertebrates are not present in holding facility		No
	ANS Plants	No	Since suckers have been held in holding facility for extended time period there is minimal risk of EWM contamination		No
Suckers are harvested from over-winter ponds and brought to holding facility.	ANS Fish/Other Vertebrates	No	ANS fish not present in ponds		No
	ANS Invertebrates	No	ANS invertebrates not present in ponds		No
	ANS Plants Eurasian Watermilfoil	Yes	EWM present in one pond and could be transported to holding facility with suckers	Hazard controlled at a subsequent step	No

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
Suckers are held and graded in tanks at the facility.	ANS Fish/Other Vertebrates	No	ANS fish are not present in holding facility		No
	ANS Invertebrates	No	ANS invertebrates are not present in holding facility		No
	ANS Plants Eurasian Watermilfoil	Yes	Since one pond has EWM, it is possible it could be brought into the facility with suckers	Suckers held in holding facility for several water exchanges to trap any EWM in outflow filters. Suckers from the pond with EWM are kept in separate tanks or are screened in the downstream end of the holding tank.	Yes
Suckers are trucked to retail stores.	ANS Fish/Other Vertebrates	No	ANS fish are not present in holding facility		No
	ANS Invertebrates	No	ANS invertebrates are not present in holding facility		No
	ANS Plants Eurasian Watermilfoil	No	Control of ANS hazard completed		No
Firm Name: ABC Baitfish Company			Species of Fish: White suckers (<i>Catostomus commersoni</i>)		
Firm Address: RR 1, Box 111 Baitville, MI 48999			Cultured, wild harvested, or both: Cultured		
Signature:			Intended Use and Consumer: To be sold in retail bait shops for fishing bait. Also sold to other wholesalers.		
Date:					

5) HACCP Plan Form

White Suckers Cultured for Sale as Baitfish – EWM Infested

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Critical Limits for each Preventive Measure	Monitoring			(8) Corrective Action(s)	(9) Records	(10) Verification	
			(4) What	(5) How	(6) Frequency				(7) Who
Suckers from EWM infested waters brought into holding facility.	EWM could be transported to hatchery receiving waters.	Suckers held in holding facility for several water exchanges to trap any EWM in outflow filters.	Duration suckers held in holding tanks and number of water exchanges. In-tank, inch screens maintained. Sand filter functioning.	Measure time of holding and water exchanges. Visual inspection of screens and filter. Plant fragments on screens are properly disposed.	Holding times/water exchanges measured with each lot of fish. Check for plant fragments twice daily	Owner or operator	All fish must be held for 12 hours or two complete water exchanges. If water is found bypassing the sand filter, water flow is shut down until filter is functioning.	Record holding time/water exchanges and proper functioning of water filters. Record presence of EWM and its removal.	Owner or manager will review records once per week during holding period
Firm Name: ABC Baitfish Company									
Firm Address: RR 1, Box 111 Baitville, MI 48999									
Signature:									
Date:									
Intended Use and Consumer: To be sold in retail bait shops for fishing bait.									

Appendix 4

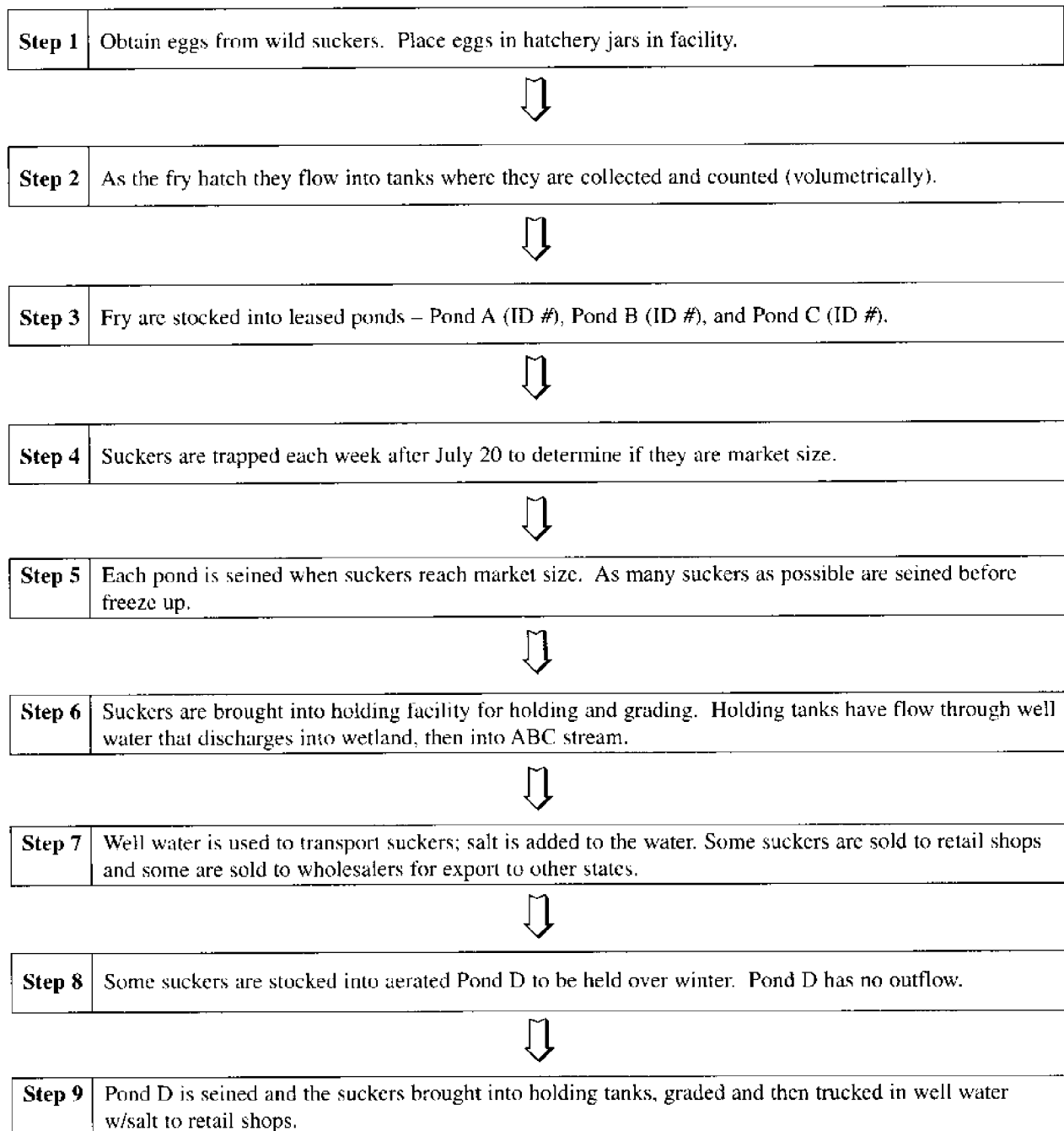
ANS-HACCP Plan — White Suckers Cultured for Sale as Baitfish with no ANS Infestation

-
- 1) Product Description
 - 2) Flow Diagram
 - 3) Potential Hazards
 - 4) Hazard Analysis Worksheet
 - 5) HACCP Plan Form
-

1) Product Description

Firm Name:	ABC Baitfish Company
Firm Address:	RR 2, Box 555 Fishtown, MI 48999
Species of fish:	White suckers (<i>Catostomus commersoni</i>)
Cultured or wild harvested:	Cultured
Harvest method:	Seined and trapped from grow out ponds
Method of distribution and storage	Held in tanks on-site, then delivered to retail stores or wholesalers. Some held in aerated ponds over winter for sale in the spring.
Intended use and consumer:	To be sold in retail bait shops for fishing bait

2) Flow Diagram



3) Potential ANS Hazards (List relevant species)

- 1) **ANS Fish/Other vertebrates.** Examples include round goby, ruffe, white perch, threespine stickleback, etc.

- 2) **ANS Invertebrates.** Examples include zebra mussels, spiny and fishhook waterflea, green crab, rusty crayfish, etc,

- 3) **ANS Plants.** Examples include Eurasian watermilfoil, hydrilla, water chestnut, and purple loosestrife.

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step	(2) Identify potential ANS hazards introduced or controlled at this step	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
Obtaining eggs, hatching them, and collecting fry.	ANS Fish/Other Vertebrates	No	ANS fish species have not been found in river where sucker eggs were collected.		No
	ANS Invertebrates	No	ANS invertebrates have not been found in river where sucker eggs were collected.		No
	ANS Plants	No	ANS plants have not been found in river where sucker eggs were collected.		No
Fry are stocked.	ANS Fish/Other Vertebrates	No	No ANS fish have been found in hatchery source water or in hatchery.		No
	ANS Invertebrates	No	No ANS invertebrates have been found in hatchery source water or in hatchery.		No
	ANS Plants	No	No ANS plants have been found in hatchery source water or in hatchery.		No
Suckers are harvested from ponds.	ANS Fish/Other Vertebrates	No	Ponds have not been contaminated with ANS fish and most of the transport water is well water.		No
	ANS Invertebrates	No	Ponds have not been contaminated with ANS invertebrates and most of the transport water is well water.		No
	ANS Plants	No	Ponds have not been contaminated with ANS plants and most of the transport water is well water.		No

Suckers are held and graded in tanks at the facility.	ANS Fish/Other Vertebrates	No	Well water is used and all nets and other equipment are only used in the facility.		No
	ANS Invertebrates	No	Well water is used and all nets and other equipment are only used in the facility.		No
	ANS Plants	No	Well water is used and all nets and other equipment are only used in the facility.		No
Suckers are trucked to retail stores or to wholesalers' facilities.	ANS Fish/Other Vertebrates	No	Well water is used and all nets and other equipment are only used in the facility.		No
	ANS Invertebrates	No	Well water is used and all nets and other equipment are only used in the facility.		No
	ANS Plants	No	Well water is used and all nets and other equipment are only used in the facility.		No
Suckers are moved to aerated ponds for the winter.	ANS Fish/Other Vertebrates	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No
	ANS Invertebrates	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No
	ANS Plants	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No

Suckers are harvested from over-winter ponds and brought to holding facility.	ANS Fish/Other Vertebrates	No	Ponds have not been contaminated with ANS fish and most of the transport water is well water.		No
	ANS Invertebrates	No	Ponds have not been contaminated with ANS invertebrates and most of the transport water is well water.		No
	ANS Plants	No	Ponds have not been contaminated with ANS plants and most of the transport water is well water.		No
Suckers are trucked to retail stores and wholesalers' facilities.	ANS Fish/Other Vertebrates	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No
	ANS Invertebrates	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No
	ANS Plants	No	Holding facility is not infested and if hauling trucks have been used to haul contaminated fish/water, they are drained and thoroughly rinsed before loading.		No
Firm Name: ABC Baitfish Company			Species of Fish: White suckers (<i>Catostomous commersoni</i>)		
Firm Address: RR2, Box 555 Fishtown, MI 48999			Cultured, wild harvested, or both: Cultured		
Signature:			Intended Use and Consumer: To be sold in retail bait shops for fishing bait.		
Date:					

5) ANS-HACCP Plan Form

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Critical Limits for each Preventive Measure	Monitoring				(8) Corrective Actions(s)	(9) Records	(10) Verification
			(4) What	(5) How	(6) Frequency	(7) Who			
No significant hazards identified. No critical control points. No HACCP Plan required.									
Firm Name: ABC Baitfish Company					Species of Fish: White suckers (<i>Catostomous commersoni</i>)				
Firm Address: RR2, Box 555 Fishtown, MI 48999					Method of Storage and Distribution: Held in tanks on-site, then delivered to retail stores or to wholesalers. Some held in aerated ponds over winter for sale in the spring.				
Signature:					Intended Use and Consumer: To be sold in retail bait shops for fishing bait.				
Date:									

Appendix 5

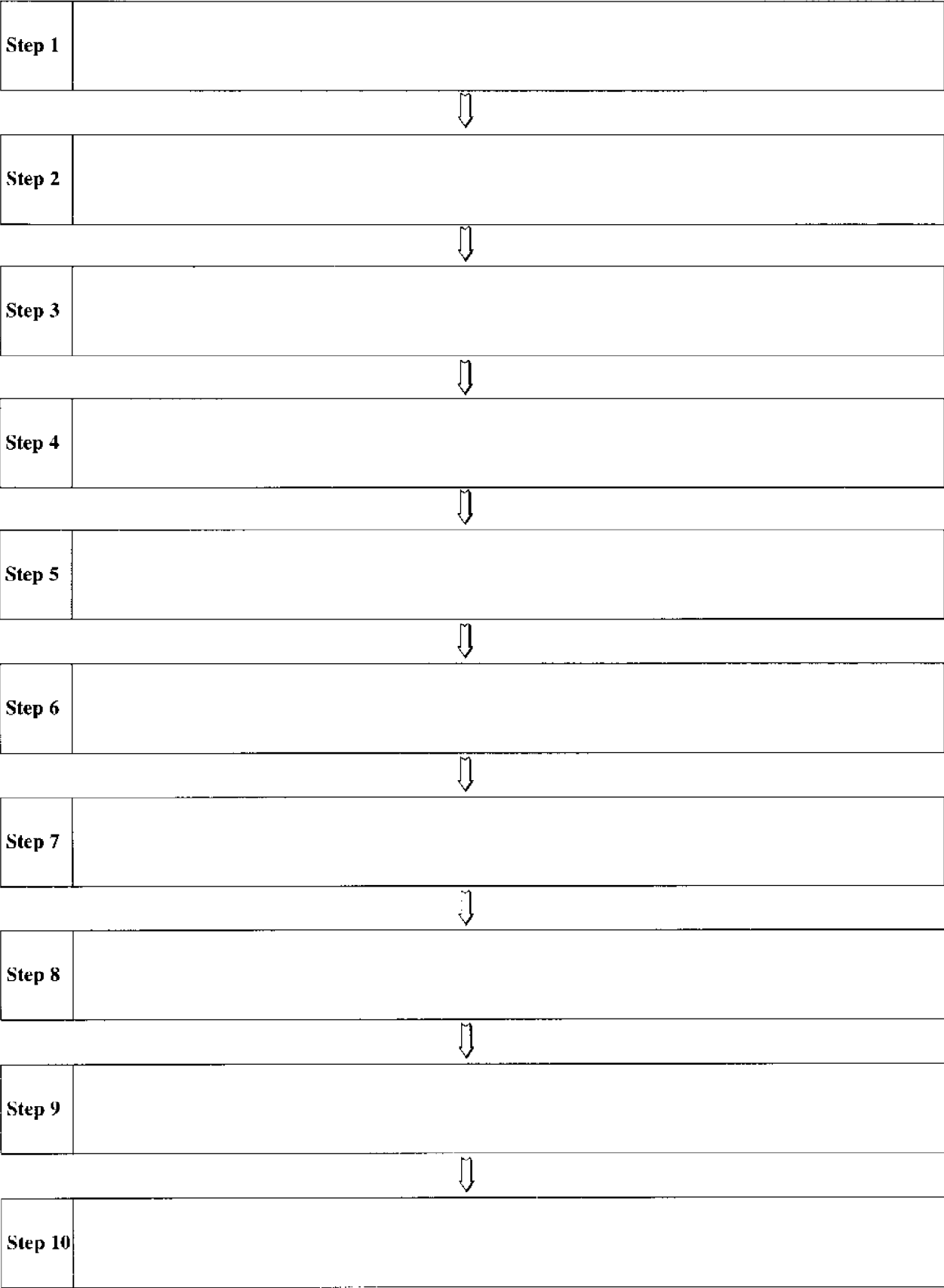
This appendix contains a blank model ANS-HACCP Plan Form and Hazard Analysis Worksheet and Product Flow Diagram.

-
- 1) Product Description
 - 2) Flow Diagram
 - 3) Potential Hazards
 - 4) Hazard Analysis Worksheet
 - 5) HACCP Plan Form
-

1) Product Description

Firm Name:	
Firm Address:	
Species of fish:	
Cultured or wild harvested:	
Harvest method:	
Method of distribution and storage	
Intended use and consumer:	

2) Flow Diagram



3) Potential ANS Hazards (List relevant species)

- 1) **ANS Fish and Other Vertebrates.** Examples: Eurasian ruffe, round goby, Asian carps, non-native amphibians, etc.

- 2) **ANS Invertebrates.** Examples: zebra mussels, Asian clams, spiny water fleas, rusty crayfish, etc.

- 3) **ANS Plants.** Examples: Eurasian watermilfoil, hydrilla, giant salvinia, water chestnut, etc.

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step <small>(from flow diagram)</small>	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
	Fish/Other Vert.				
	Invertebrate				
	Plant				
	Fish/Other Vert.				
	Invertebrate				
	Plant				
	Fish/Other Vert.				
	Invertebrate				
	Plant				

(1) Harvest or Aquaculture Step <small>(from flow diagram)</small>	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
	Fish/Other Vert.				
	Invertebrate				
	Plant				
	Fish/Other Vert.				
	Invertebrate				
	Plant				
	Fish/Other Vert.				
	Invertebrate				
	Plant				

(1) Harvest or Aquaculture Step <small>(from flow diagram)</small>	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
	Fish/Other Vert.				
	Invertebrate				
	Plant				
Firm Name:			Species of Fish:		
Firm Address:			Cultured, wild harvested, or both:		
Signature:			Intended Use and Consumer:		
Date:					

5) ANS-HACCP Plan Form

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Limits for each Control Measure	Monitoring				(8) Corrective Actions(s)	(9) Verification	(10) Records
			(4) What	(5) How	(6) Frequency	(7) Who			

5) ANS-HACCP Plan Form, cont

(1) Critical Control Point (CCP)	(2) Significant Hazard(s)	(3) Limits for each Control Measure	Monitoring				(8) Corrective Actions(s)	(9) Verification	(10) Records
			(4) What	(5) How	(6) Frequency	(7) Who			
Firm Name:			Species of Fish:						
Firm Address:			Method of Storage and Distribution:						
Signature:			Intended Use and Consumer:						
Date:									

