Live Aquatic Bait Pathway Analysis

State of the live bait industry and its laws, regulations and policies in the Mississippi River Basin

Report

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Executive Summary

This project had two primary objectives: 1. To describe the live aquatic bait industry in the 28 states of the Mississippi River Basin (MRB) and 2. Summarize the state and federal laws, regulations, policies and procedures that pertain to the production, harvest, transport, sale and use of live aquatic bait.

Live aquatic bait was, for this survey, defined as fish, amphibians, and aquatic invertebrates. Preserved bait (both aquatic and non-aquatic) and live non-aquatic bait, while not a focus of this effort, were identified and recorded (APPENDIX H). Through telephone surveys with industry representatives, the live aquatic bait used in each MRB state was identified (APPENDIX G) and provided in a complete listing of the 42 species used (Figure 3). There were 28 species of fish, 12 invertebrates and two other vertebrates identified. Two species of fish had separate market names for different color variations (fathead minnows/rosy reds and goldfish/black salties) which brought the total to 44 live aquatic baits. For each of the 44 live aquatic baits identified, their scientific name, common names, where they are used in the basin, sizes used and where they are produced in the MRB was described (APPENDIX F). The five most commonly mentioned baitfish include golden shiners, fathead minnows, white suckers, goldfish, and emerald shiners. The most commonly mentioned invertebrates in the MRB were leeches and crayfish.

Of the 28 states in the MRB, half (14) get the majority of their bait minnows from Arkansas. Some of those 14 states may import aquatic invertebrates from another state or have one or two in-state baitfish producers (Missouri and Tennessee), but by far, their baitfish needs are supplied by Arkansas baitfish producers (Appendix G). This is important to know because Arkansas baitfish producers participate in

the Arkansas Commercial Bait and Ornamental Fish Certification program. That program certifies that the baitfish are free of 17 different pathogens and aquatic invasive species (AIS). Upon request they may also certify baitfish for other pathogens of concern not currently part of the program. That doesn't mean those baitfish are risk free. There may be Asian tapeworm, golden shiner ovarian parasite, golden shiner virus (GSV), western mosquitofish, crayfish, tadpoles, and unknown viruses associated with baitfish shipments from Arkansas. These pose very different risks to different areas of the MRB. Some may be native to some areas but considered invasive in others.

The other 14 states receive live aquatic bait from more than one of the known aquatic bait exporting states which include Arkansas, North Dakota South Dakota, Minnesota and Wisconsin (Figure 4) and/or they are supplied by wild harvested aquatic bait from their own state.

While 27 of the 28 states reported that wild aquatic bait could be commercially harvested in their states, wild harvested bait found for retail sale was produced in only nine states. Those states were Minnesota, Montana, New York, North Dakota, Ohio, Pennsylvania, South Dakota, Wisconsin and Wyoming. At least four of those states (Minnesota, Wisconsin, North Dakota and South Dakota) export wild caught aquatic bait to other states in the MRB (Figure 4). Three of the nine states (Ohio, Pennsylvania and New York) harvest wild baitfish from the Great Lakes and primarily use that wild bait in the Great Lakes. Other states that harvest wild bait are Montana and Wyoming, where wild-harvested bait is used solely within their states. Wild harvested aquatic bait is of concern because AIS and pathogens that may be transported with the bait.

The states of North Dakota, South Dakota and Minnesota export large qualities of fathead minnows that may be reported as farm-raised or wild-harvested. Primarily, they come from lakes known as winterkill lakes. For the purpose of aquatic bait production discussions, winterkill lakes are typically shallow, productive lakes that experience periodic low dissolved oxygen levels during winter that result in total or partial fish kills. Some fish such as fathead minnows can prosper in these environments because competition or predation from other fish is greatly reduced. There are usually no sport fish or rough fish (although brook sticklebacks may be present) found in these lakes. Because these lakes don't attract sport fishermen and often don't have public access, the likelihood of their becoming infested with AIS and pathogens of concern is substantially less than for aquatic bait harvested out of public waters with more development, fishing and boating. However, tiling of farm fields for water drainage can allow fish from public waters to occasionally access some of these winterkill waterbodies which can increase the risk of spreading non-target fish, AIS or fish pathogens.

Similarly, several states (Minnesota, South Dakota, Wisconsin) raise and may export white suckers. White suckers are also grown in ponds/lakes that frequently winterkill and have a much-reduced risk of being infested with AIS and pathogens of concern.

Fathead minnows and white suckers that are exported are tested for pathogens of concern as requested by receiving states and most (but not all) receiving states have some pathogen testing requirements. That is not to say that fathead minnows and white suckers raised in these winterkill ponds/lakes are without risk. There is a risk that tiling for farm field drainage could allow winterkill pond connections to public waters; rough fish, AIS or fish pathogens could be introduced through these connections. In a

study by McCann (2012), baitfish from Arkansas, Minnesota and South Dakota were tested for the presence of GSV and other viruses. In combined lots from the three states, thirty-six of the 82 lots (44%) of fish tested positive for one or more viruses. McCann (2012) found that 32% of fathead minnow lots and 5% of white sucker lots tested positive for golden shiner virus. Unfortunately, the source states were not identified.

Wild-harvested bait from public waters with development, fishing, and boating has a greater risk of transporting AIS and pathogens of concern. Most states with substantial wild harvest of aquatic bait in these public waters regulate the practice. Links to each states' regulations are provided in APPENDIX D. Regulations vary considerably; here are some examples that are in place in one or more states: 1. Lakes where aquatic bait is harvested must be tested annually for VHSV and must be negative for the virus. 2. Baitfish harvested from VHSV infested waters may only be used in those waters. 3. Baitfish harvested from VHSV infested waters must be held and tested free of the virus before they can be sold. 4. Baitfish harvested from zebra mussel-infested waters cannot be harvested when larval zebra mussels are likely to be present. 5. When harvesting aquatic bait from waters infested with certain plants and invertebrates, all gear must have tags securely locked onto the gear identifying its use in infested waters and only be used in the infested waters.

As with fathead minnows and white suckers, wild-harvested bait from public waters that is exported usually has pathogen testing requirements in the receiving state. This doesn't eliminate the risk of moving AIS or pathogens of concern but reduces risks to levels accepted by resource management agencies. It is important, however, to watch for new AIS and pathogen arrivals in wild-harvested waters.

Estimation of the volume and value of aquatic bait in the MRB is not possible. Not all MRB states require producers (wild harvesters or fish farmers) to keep production information and of those that do, only a small percentage have the information submitted and then only a few states compile the data on a regular basis. The other problem, applicable to both the USDA Aquaculture Census (USDA 2013) and to state agencies, is that a substantial amount of baitfish produced is sold for feeder fish as well as baitfish. There is no way to separate out the two uses for the baitfish. As much as 85-90% of goldfish sales in the MRB may be for feeder fish while as much as 10-20% or more of fathead minnow sales may be as feeder fish. Therefore, trying to estimate the economic importance of live aquatic bait sales for the sportfishing industry is not possible.

Results of a survey of aquatic bait regulations and policies in MRB states (APPENDIX B) found that they vary widely, but generally demonstrate that all states recognize the risk posed by the live aquatic bait pathway. Survey responses show unanimity among states on some issues but that they are quite split on others.

Several potential AIS and pathogen risks were identified for at least parts of the MRB. Those were the Asian tapeworm, the golden shiner ovarian parasite, the golden shiner virus, western mosquitofish, non-native crayfish, fathead minnow nidovirus, viral hemorrhagic septicemia virus (VHSV) and other unknown viruses. While these species and pathogens may pose a risk, there is little evidence that suggests any have caused impacts to wild populations as a result of being moved with live aquatic bait. This may be because they pose no risk or that impacts have not been adequately examined. Some of

these species may be able to expand their range as the climate changes, so continued vigilance is needed.

Two unknowns that this project could not address relative to the movement of AIS and pathogens with the live aquatic bait industry are the extent of illegal commercial movement of live aquatic bait and how well people harvesting or transporting their own bait follow regulations.

Generally, industry representatives interviewed appeared professional and dedicated to following regulations as best they could. There was concern among some in the industry that regulations change frequently and it is difficult to keep up with changes that happen in all the states where they ship. It is not known however, how many unscrupulous bait dealers are active in the MRB. In my interviews across the MRB there was an occasional comment about some in the industry not following the regulations. This suggests that enforcement needs to be vigilant.

There is little information available regarding whether anglers harvesting their own bait follow the regulations. It was suggested several times that, as regulations restrict the legal sale of aquatic bait, it creates incentives for people to collect their own bait, potentially in violations of regulations or in ways that are unsafe but unregulated for recreational fishers that do not sell bait. Overall industry interviews did not uncover much personal harvest of bait. In fact, most thought it was negligible. Still, the personal harvest and subsequent transportation of aquatic bait by individuals remains unknown and worth a closer look.

Industry representatives identified several trends related to the live aquatic bait industry. First, there are fewer youth entering the sport of fishing. Second, there are fewer traditional bait shops and more bait being sold in convenience stores. Third, there are fewer distributors still in business. And fourth, the sale of live bait is declining as anglers use more artificial baits.

Introduction

The purpose of this Live Aquatic Bait Pathway Analysis is to determine the state of the live bait industry in the Mississippi River Basin and identify the laws, regulations, policies, and procedures that guide it. This report was undertaken to examine the risk of introducing nonindigenous animals, plants and pathogens via live aquatic bait movement. The ultimate goal is to take information provided from this Live Bait Pathway Analysis to develop more consistent industry and regulation standards within the Mississippi River Basin, thereby reducing the risk of introducing nonindigenous species and making regulation compliance easier for industry partners and users.

Background

The introduction of nonindigenous species, parasites and pathogens into lakes and rivers is often attributed to the release of baitfish and other live aquatic organisms from anglers' bait buckets (Nathan et al. 2014; Ludwig and Leitch 1996; Drake and Mandrak 2014). Although regulations are in place in most states to prevent the release of unwanted aquatic bait, anglers don’t always comply (Litvak and Mandrak 1993; Killian et al. 2012). Bait related introductions can result in established populations of aquatic species or pathogens which can alter chemical and physical processes and trophic structure of

aquatic ecosystems. The introduction of rusty crayfish, likely through bait bucket introductions, into lakes outside its normal range is an example. As a result of rusty crayfish environmental effects, the sale of all crayfish as live bait has been outlawed in many states and provinces. Controlling invasive species once established is usually unsuccessful. Preventing introductions is a much better approach.

The Mississippi River Basin Panel (MRBP) is interested in identifying methods to prevent future introductions of harmful species through the live bait pathway. The challenge is defining metrics and quantifying trends in an industry that is loosely structured, inconsistently regulated and very diverse. Aquatic bait is grown commercially on farms, wild harvested in ponds, lakes, streams and rivers and harvested by anglers for personal use. The aquatic bait may be used in the waterbody where it was harvested or it can be shipped nearly anywhere in the country. Live aquatic bait production, distribution and sales in the MRB is an important component of the economy of the states' recreational fishing industry, yet it is extremely diverse in market demand, types of production, and species sold. Current and accurate estimates of production and value of baitfish and an understanding of the diversity of regulations in the MRB are not readily available.

Scope and Objectives

This report has two primary objectives.

Objective 1.

Describe the state of the live bait industry in the 28 states of the Mississippi River Basin. To examine the state of the live bait industry, five sub-objectives were addressed.

a. Describe the live aquatic bait producers, harvesters, wholesalers, distributers, retailers, and consumers.
b. Describe live aquatic bait species, product lines, uses and where the bait comes from for each of the Mississippi River Basin (MRB) states. Wild-caught (both commercially and privately) and farm-raised bait will be described.
c. Compile available information on the volume, value, market demand and seasonality of live aquatic bait produced and sold in each of the MRB states.
d. Describe and characterize how live aquatic bait is delivered in MRB states.
e. Describe expected trends in the live aquatic bait industry in the MRB especially how they may influence the movement of invasive animals, plants and pathogens.

Objective 2.
Summarize the state and federal laws, regulations, policies and procedures that pertain to the production, harvest, transport, sale and use of live aquatic bait.

Methods

Methods for Objective 1. Describe the state of the live bait industry in the 28 states of the Mississippi River Basin.

To accomplish this objective and the five sub-objectives (listed above), expert opinions from knowledgeable people in each of the MRB states were collected and summarized. Experts were sought

out through phone conversations with state management agencies, Regional Aquaculture Center Extension Technical Committee members, Regional Aquaculture Center Industry Advisory Committee members and aquatic bait industry representatives (including farmers, wild trappers, wholesalers, internet sellers and retail shop owners). Each expert was asked to suggest other experts. I continued to seek other experts until I was satisfied with the information for each state. Published information, US Aquaculture Statistics, state baitfish production information and information available on-line was used to supplement expert opinion. Information collected from the experts is summarized for each state in this report. In total, 335 phone calls were made and 154 individuals were surveyed for an average of almost 12 calls per state and 5.5 industry representatives interviewed per state.

Methods for Objective 2. Summarize the state and federal laws, regulations, policies and procedures that pertain to the production, harvest, transport, sale and use of live aquatic bait.

Management agencies in all 28 states were sent a survey by email to characterize the regulations and policies related to aquatic bait farming, wild harvesting, importing/exporting, reporting, sales volume and transportation. Because regulation authority in many states was split between those pertaining to farming/disease testing and those for wild harvest/bait use in the state, several agencies in some states were required to complete the survey. The survey contained 20 primary questions, but depending upon responses, additional questions were asked. In total, there were 43 questions on the survey (APPENDIX A). All 28 states of the MRB responded to the survey. A summary of responses to the state surveys is found in APPENDIX B. The agency contact people for aquatic bait questions in each MRB state are found in APPENDIX C.

Sport fishing regulation pamphlets for each of the 28 states were collected online and reviewed for regulations related to live aquatic bait regulations. In addition, state statutes, laws, and regulations were examined online. Web links to each states' regulations and policies are provided in APPENDIX D.

Federal regulations related to live aquatic bait transportation, use and sale were examined online and through discussions with industry and USFWS representatives.

Results and Discussion

Live Aquatic Bait Pathway Analysis

How Live Bait is Measured, Graded and Marketed

To fully understand the live bait industry in the MRB, it is helpful to understand how aquatic bait is handled, measured, graded and marketed. This varies within the region and by species of aquatic bait. The following description focuses only on baitfish commonly found in the market. Typically, the market demands baitfish of a certain size, so baitfish, whether wild-harvested or farm-raised, are graded for size before being sent to retail outlets.

Baitfish are graded into several size categories by moving vertical drag graders through holding tanks (vats) or using floating box graders. Graders have bars in increments of 1/64 inch that separate fish by body width. For example, a #27 grader has a spacing between the parallel bars of 27/64 inch. Fish with a body width greater than that will be retained by the grader and smaller fish will escape through the bars

of the grader. Graders for baitfish can be found from 12/64 inch to 32/64 inch. Alternatively, baitfish are frequently described by the weight of 1000 individual fish. In that case, the size number refers to the weight of 1000 fish (The following is an example to show how golden shiners are frequently sold comparing the different ways to measure size.

Golden shiners can be sold in up to six different sizes.

Size	Lbs./1000 fish	Length	Grader Sizes (64ths of an inch)
#4	4lbs/1000 fish	1.5 in	Below 21 grader
#6	6lbs/1000 fish	2.25 in	21 to 27 grader
#8	8lbs/1000 fish	2.5 in	
#12	12lbs/1000 fish	3 in	27 to 29 grader
#20	20lbs/1000 fish	3.5 in	
Brooders	38lbs/1000	Over 4 in	Above a 29 grader

FIGURE 1. GRADING MINNOWS

FIGURE 2 MINNOW GRADERS

Grading is important in the live aquatic bait pathway because it not only sorts bait into market sizes, but it provides for a way to separate out unwanted fish, invertebrates and plant material. Fish larger than market size or smaller than market size can be removed by grading. When fish are crowded into a confined space during grading, their struggling movements may help force out invertebrates or plant material. It may not be the only way to control an AIS hazard, but it can help minimize the risk of moving unwanted organisms.

Baitfish and some invertebrates are often sold by the gallon, because this is an easy method to get the weight of the product with minimal injury to the bait. Often a five-gallon bucket is marked in one-gallon increments. Baitfish are dip netted and the excess water allowed to drain from the net and then they are added to the bucket to a desired gallon mark. It is assumed that baitfish weigh the same as water so one gallon of baitfish is assumed to weigh eight pounds. This method is often used whether the baitfish is farm-raised or wild-caught. Baitfish will frequently be added to a hauling truck in this manner and off-loaded at a bait shop using five-gallon buckets to measure volume.

How Live Aquatic Bait is Transported in the MRB

Most aquatic bait is moved around the basin in large fish hauling trucks. These trucks have many separate compartments. Some trucks may have up to 44 different compartments, each capable of holding 100 to 125 pounds of baitfish for a total hauling capacity of 4,400 to 5,500 pounds of baitfish. There are many other configurations of large semi-trailer and straight trucks used to haul baitfish. Each

have several holds that are insulated but not refrigerated. Compartments are aerated and supplied with oxygen. Ice is often added to cool the water for longer hauls. Occasionally ice may be added during the haul if needed. These trucks are used to haul baitfish out of five states in the MRB – Arkansas, Minnesota, South Dakota, North Dakota, and Wisconsin. They deliver the baitfish all over the nation.

In Arkansas, farms may have their own trucks or independent truckers may come to the farm to load baitfish. In states like Minnesota, North and South Dakota, and Wisconsin, aquatic bait may be harvested from several locations and sold to a distributor that holds them in a facility until loading a truck for delivery within the state or out of state.

In some cases, trucks drive directly from exporting state to a destination state, where they deliver to a regional distributor. Exporters may also have a route in which they are delivering baitfish at several stops along the way in several different states. Sometimes the deliveries are to retail outlets and sometimes to other distributors. Some retailers may even meet the truck at a location to collect a baitfish order directly from the truck and take it back to their shop. The minnow hauling trucks also frequently carry other non-aquatic bait or other fishing supplies.

Regional bait distributors, after receiving deliveries from an exporter at their facilities, often have extensive routes where they deliver baitfish and other non-aquatic bait to bait shops within one state or in multiple states.

In some cases, wild trappers or fish farmers sell directly to bait shops. They may deliver to the bait shop or the bait shop owner may go to the fish farm or trapper's facility to pick up bait.

Some aquatic bait including leeches, fathead minnows, goldfish, tiger salamanders, mayfly nymphs, dragonfly nymphs, freshwater shrimp, and crayfish are often shipped by air using carriers like FedEx, Spee Dee, UPS and others. These aquatic baits can be delivered overnight almost anywhere in the US.

How and Where Aquatic Live Bait is Grown on Farms in the MRB

Golden Shiners Grown on Farms in Arkansas

Golden shiners (*Notemigonus chrysoleucus*) were the most important baitfish produced nationally. In the 2013 USDA Aquaculture Census, production of golden shiners was estimated at 6 million pounds and was worth $14.3 million in sales (USDA 2013). Most golden shiners raised on farms in Arkansas go into the bait market, but a small percentage may be sold as feeder fish or for pond management purposes.

Golden shiners are the most valuable component of U.S. baitfish aquaculture because they are a favored bait among anglers and they have several characteristics which make them a good aquaculture species. They have an expansive native range in North America. They are a warm water species but have a broad temperature tolerance. They are a schooling fish that consume a wide variety of foods from phytoplankton and zooplankton to formulated fish feeds. Golden shiners are broadcast spawners with adhesive eggs. This spawning behavior has been used to advantage in pond culture and their growth rate allows them to reach market size quickly.

The following is a summary of the production cycle as described by Stone et al. (2016).

The production cycle begins in the spring as water temperatures increase and spawning begins. Peak spawning is typically at water temperatures of 68-75°F (20-24°C) and during the month of May, however, it can be as early as April or as late as June. Spawning mats are placed in grow-out ponds near the shore. Golden shiners are fractional spawners, releasing 200–500-eggs at numerous times throughout the spawning season. Golden shiner eggs are adhesive and stick to the mats. Spawning mats are collected and transported to indoor hatcheries where they are placed in tanks and suspended above the bottom. The 65°F (18°C) well water is heated 8 to 10F (5 to 6°C) for egg incubation (Stone et al. 2008). Eggs are usually treated with formalin until they get to the eyed stage to prevent fungus. Sometimes eggs are removed from the mats with a 1.5% solution of sodium sulfite. The loose eggs are poured into jars and incubated until just before hatching and are then poured into tanks with mats prior to hatching. Eggs typically hatch in 3 days. Water and fry are drained into shallow tubs. Fry numbers are estimated and then placed in plastic bags with water and oxygen for transfer to nursery ponds.

Prior to spawning, nursery ponds are drained to ensure no unwanted species are in the ponds and to minimize the presence of predacious insects and copepods. Nursery ponds are partially filled with ground water and then filled with water from established golden shiner ponds (that have previously been filled with ground water). Nursery ponds are only partially filled at the time of stocking. They are usually 5-10 acres (2-4 ha) and 3-6 ft (1-2m) deep. Typically, fry stocking rates are 1 to 3 million fry/acre (2.5 to 7.5 million fry/ha). Nursery ponds may be fertilized and the fry are fed a finely ground feed twice per day for several weeks. Feed is changed to crumbled extruded pellets as fish grow. Fry are raised in nursery ponds for 6-8 weeks and then moved to grow-out ponds where they are stocked at lower densities.

Grow-out ponds are generally stocked at a rate of 101,000 to 202,000 fish/acre (250,000 to 500,000 fish/ha). Stocking density is adjusted for the size of bait the farmer wants to market. Lower stocking densities result in larger fish. Golden shiners in grow-out ponds are fed a floating catfish feed 5-7 days/week. Trying to match size, volume, and timing of market demand is challenging for farmers. Some of the golden shiners are sold in the fall once they reach market size, but the vast majority are sold the following spring as one-year-old fish. The golden shiners that are in demand for ice fishing in northern states are held until the following fall/winter. The shiners that are marketed at 4 to 6 inches (10 -15 cm) are therefore, approximately 1.5 years old. Average yield may be around 450 lbs./acre (500 kg/ha) but yields up to 665 lbs./acre (745 kg/ha) in ponds fed a fish meal diet have been found (Stone et al. 2016).

Once fish reach market size, ponds are partially harvested each week. Sinking pellets are fed to attract fish to areas that are then seined. Fish are dip netted out of seines into buckets and loaded onto a truck filled with well water. Fish not needed for market are released back into the pond. Harvested fish are hauled to vats in an on-site holding shed for acclimating to fresh well water, clearing their intestinal tracts, grading, and transporting to market. Salt is typically added at 5 ppt to help reduce osmoregulatory stress. This is often called a “hardening” process.

Golden shiners are then graded into several size categories by moving vertical drag graders through the vats. Graded fish are moved to vats with similar sized fish. By the time fish are ready to be loaded onto trucks, they are being held in 100% groundwater. Fish are dip netted from the vats into buckets or larger transfer containers for loading onto trucks. Liquid oxygen is used to maintain oxygen levels in hauling

tanks and 2 ppt salt (sodium chloride) is often added as an osmoregulatory stress reliever. Golden shiners are then hauled to market (as described above). Vats are completely drained and cleaned before any other fish are brought in from the ponds.

Fathead Minnows Grown on Farms in Arkansas

Fathead Minnows (*Pimephales promelas*), including the pinkish, orange "rosy red" variety are the second most valuable baitfish sold nationally ($9.9 million in total sales) and Arkansas contributed the most of any state with $5.1 million in sales (USDA 2013). There is a substantial sale of fathead minnows (including the rosy red variety) as feeder fish, possibly 15 to 20% of production (Dr. Eric Park, personal communication 4/4/19). However, some fathead minnow producers in Arkansas may sell a higher percentage of their fathead minnows for feeder fish than for bait (Landon Pool, personal communication, 4/6/19).

Fathead minnows have several characteristics which make them a good aquaculture species. Fatheads are considered a warm water species with a broad temperature, turbidity and oxygen tolerance. They are a schooling fish that consume a wide variety of foods including detritus, phytoplankton, and zooplankton and readily accept formulated fish feeds. Fathead minnows are considered fecund and their spawning behavior and adhesive eggs adapt well to pond culture.

Fathead minnows are fractional spawners, meaning they begin spawning when water temperatures approach 64°F (18°C) and continue spawning in Arkansas ponds until early July. Fractional spawning can result in one to two dozen spawning events per female and an annual fecundity of 6,800 to 10,600 eggs per female. Fathead minnows spawn differently than golden shiners. Fathead minnow males defend a territory on the underside of submerged objects placed in ponds for spawning purposes. Typically, farmers use a flexible irrigation pipe called poly pipe. The "pipe," made from polyethylene, is used in its collapsed state which is flat and about 18 inches (46 cm) wide. Different configurations of this flat material are arranged in ponds for fathead spawning substrate.

The eggs are laid on the under surface of the submerged poly pipe or other material and hatch in the pond. Fry are typically raised with brood stock until they reach market size. They may, however, be moved to larger grow out ponds when they get large enough to be moved.

In general, fathead minnows are grown in ponds, fed a supplemental diet, harvested, held in vats, hardened, graded and transported to market similarly to golden shiners (described above).

Goldfish Grown on Farms in Arkansas

Goldfish (*Carassius auratus*), including the black salty variety, are not native to North America. They are a member of the minnow family (*Cyprinidae*) and were imported from East Asia where they are native. They are closely related to other carps found in Europe and Asia. Because they are not native and considered by some to be invasive, they are not legal bait in 9 of the 28 states of the MRB.

Goldfish rank third behind golden shiners and fathead minnows in farm sales value nationally. Arkansas appears to be the leading state in goldfish production ($2.6 million) (USDA 2013). However, because of the USDA Census effort to protect grower's privacy, the sales value in most other states is not reported

(Appendix E). And, as with the fathead minnows, there is a significant market for feeder goldfish. In fact, most of the reported production goes to that market, possibly 85 to 90% (Dr. Eric Park, personal communication, 4/4/19).

Raising goldfish in Arkansas is similar to raising golden shiners. Breeding usually happens after a significant temperature change at temperatures around 68 degrees F (20°C). Males chase gravid females and prompt them to release their eggs by bumping and nudging them. Spawning of goldfish occurs in the spring on mats either placed in ponds or more commonly in outdoor vats or tanks supplied with pond water. Spawning goldfish are typically left in vats with the spawning mats overnight and then removed from the vats the next day. Mats with fertilized eggs are treated to prevent fungus growth and placed in ponds for hatching. Hatching usually occurs in 3 to 5 days. Typical ponds for goldfish rearing are smaller than those where golden shiners are raised (2 to 5 acres rather than 10 to 20 acres) (1 to 2 ha rather than 4 to 8 ha). Generally, goldfish are stocked at 500,000 to 2 million per acre (1.2 to 4.8 million per ha).

In general, goldfish are grown in ponds, fed a supplemental diet, harvested, held in vats, hardened, graded and transported to market similarly to golden shiners (described above). Goldfish may be shipped out by the semitrailer load or placed in plastic bags with water and oxygen, boxed and shipped via air freight. Most goldfish for the feeder market are now being shipped by air freight (Dr. Eric Park, personal communication 4/4/19).

Hybrid Bluegills Grown in Arkansas for Bait

Hybrid bluegills are a cross between a male bluegill (*Lepomis macrochirus*) and a female green sunfish (*L. cyanellus*). The cross results in hybrids that are usually at least 90% male. They are used extensively for pond stocking and bait. Production of hybrid bluegills occurs in many locations throughout the MRB, but mostly they are raised for pond stocking. Arkansas has farms raising them specifically for bait markets. There is no information available on the amount of hybrid bluegills raised and sold as bait.

Broodstock are normally stocked in ponds that have been fertilized to produce a plankton bloom. Spawning usually occurs on sandy bottoms at 78-80°F (26-27°C). Fry are observable soon after hatching. Broodfish may be selectively removed at this time. A starter diet is fed around the edges of the pond. Feed particle sizes are increased as fish grow. Fingerlings can reach a bait market size by fall of their first year, but more typically they reach a market size of 3-4.5 inches (7.6-10 cm) the following year (Landon Pool, personal communication, 4/6/19). Hybrid bluegills are then shipped to bait outlets around the region. Hybrid bluegills produced in Arkansas for the baitfish market are part of the Arkansas Commercial Bait and Ornamental Fish Certification Program.

Arkansas Commercial Bait and Ornamental Fish Certification Program

The Arkansas Commercial Bait and Ornamental Fish Certification Program was officially started in 2007. The program was developed proactively to address growing concerns that live aquatic bait could move AIS and fish pathogens to new waterbodies. All baitfish farms that export bait from Arkansas participate in the program.

The program provides for third-party verification of farm-level fish disease inspections, biosecurity plans, and farm inspections for AIS. The Arkansas Plant Board oversees the program and do the pond inspections for aquatic invasive species. They ensure that only well water is used for filling ponds and loading trucks and that all fish are hatched on the farm. They charge $1/ acre of water and inspect half the ponds each year.

The University of Arkansas at Pine Bluff Fish Health Inspection Laboratory does the testing for pathogens and parasites. Located in Lonoke, Arkansas, the lab is one of eleven facilities nationwide approved by the Animal and Plant Health Inspection Service (APHIS) to conduct diagnostic testing that enables producers to obtain health certification for the export of aquaculture species.

The following describes the program from the legal document (Circular 21).

Purpose

The purpose of the Certification of Commercial Bait and Ornamental Fish in Arkansas is:
To provide high quality, farm-raised bait and ornamental fish, free of certain diseases, undesirable plants, undesirable animals, and other contaminants deemed injurious to fish or fisheries.

Authority

The Arkansas State Plant Board, a division of the Arkansas Agriculture Department, under act 1449 of 2005, is the official certifying agent.

Certified Pathogens and Aquatic Nuisance Species

As stated within the Final Rule (Circular 21 2010), "Within the detection limits of the appropriate official testing protocol, commercial bait and ornamental fish meeting these standards are certified free of the pathogens, plants, animals and other contaminants listed here:"

a. Spring Viremia of Carp (SVCV)
b. Infectious Pancreatic Necrosis (IPNV)
c. Viral Hemorrhagic Septicemia (VHSV)
d. Infectious Hematopoietec Necrosis (IHNV)
e. Eurasian watermilfoil (*Myriophyllum spicatum*)
f. Giant Salvinia (*Salvinia molesta*)
g. Hydrilla (*Hydrilla verticillata*)
h. Zebra mussel (*Dreissena polymorpha*)
i. New Zealand mud snails (*Potamopyrgus antipodarum*)
j. Red-rimmed melania (*Melanoides tuberculata*)
k. Sticklebacks (Family Gasterosteidae)
l. Rudd (*Scardinius erythrophthalmus*)
m. Ide (*Leuciscus idus*) – (known as "Orfe" in the ornamental trade)
n. Silver carp (*Hypophthalmichthys molitrix*)
o. Bighead carp (*Hypophthalmichthys nobilis*)
p. Snakehead fish (Family Channidae)
q. Quagga Mussel (*Dreissena rostriformis bugensis*)

Farms that test positive for listed certified pathogens may not label or represent their fish as certified. If one fish from one pond on an entire farm are found to have one of the certified pathogens, then fish from the whole farm cannot be certified until they are pathogen-free for two years.

Additional pathogens may be certified if requested. Some of the additional pathogens include:

- Fathead minnow nidovirus
- *Heterosporis*
- Golden shiner virus
- Asian tapeworm
- Koi herpes virus
- *Edwardsiella tard*a
- Largemouth bass virus

Fathead Minnows Grown on Farms in Minnesota, Wisconsin and South Dakota

Fathead Minnows are a popular baitfish throughout the MRB. In the U.S., there are $9.9 million in sales of farm-raised fathead minnows reported. Of that total, Arkansas accounts for $5.1 million, Minnesota accounts for $1.1 million and Wisconsin accounts for $0.6 million. These numbers don't accurately represent the importance of fathead minnows as bait for a couple reasons. First a large part of farm-raised fathead minnow sales may be as feeder fish rather than baitfish and second, there is a fine distinction between farm raised and wild caught fatheads in northern states. The USDA Aquaculture Census does not account for the significant wild caught fathead (both as feeder fish and live bait) sales in these northern states and the difference between what is classified as farm-raised and wild caught is minor.

Minnesota, Wisconsin, North and South Dakota have many shallow lakes that produce the bulk of the fathead minnows from northern states.

Fathead minnows are primarily a product of winterkill lakes. For the purpose of aquatic bait production discussions, winterkill lakes are typically shallow, productive lakes that experience periodic low dissolved oxygen levels during winter that result in total or partial fish kills. Some fish such as fathead minnows can prosper in these environments because competition or predation from other fish species is greatly reduced. There are usually no sport fish or other rough fish found in these lakes, except for possibly brook sticklebacks (*Culaea inconstans*). However, tiling of farm fields for water drainage can allow fish from public waters to occasionally access some of these winterkill waterbodies. Bullheads or other predators can become so abundant that baitfish culture or harvest from these ponds/lakes is no longer possible. In addition, AIS or fish pathogens could be introduced through these connections to public waters.

Many winterkill lakes are simply harvested and are not managed in a way that formally constitutes culture. If producers own or lease waterbodies, fathead minnow production may be considered culture and reported that way to states' management agencies and the USDA Aquaculture Census. Fathead minnows harvested from isolated ponds and lakes in North Dakota are not reported as farm-raised. Most fathead minnows produced in South Dakota are not reported as farm-raised. While most fathead

minnows produced in these winterkill lakes/ponds in Minnesota and Wisconsin may be reported as wild-caught, there is also substantial production reported as farm-raised.

Fathead minnow culture in Minnesota, Wisconsin and South Dakota generally involves managing them through selective harvest, occasionally aerating the ponds, predator control and preventing competing species from becoming established.

Spawning begins in May when temperatures reach 60 to 65°F (15 to 18°C) and continues throughout the summer until temperatures exceed 85°F (29°C). The eggs are attached to the underside of rocks, boards, and plant leaves and the male guards them. Spawning substrate may be added to the pond if there are insufficient spawning sites. Several females may use the same nest site. The eggs hatch in 4–6 days.

Fathead minnows hatched in the spring will reach salable size by August or September. The larger minnows can be removed and marketed during the summer. Because many of the young-of-the-year will not reach market size by fall, they must be held over winter, in some cases with the use of aeration, and reared to salable size the following year. Fathead minnows in northern states are not typically fed formulated feeds, but some producers fertilize ponds to increase production or simply use ponds that receive added fertilization via agriculture runoff. Producers may also attempt some form of predator control.

Ponds are trapped or seined multiple times each year and salable size minnows removed. Fatheads have a short two-year life span. The harvest of yearlings, therefore, is as complete as possible to prevent losses. Removing yearlings also increases the growth of the remaining small fathead minnows of the current year's hatch.

White Suckers Grown on Farms in Minnesota, Wisconsin and South Dakota.

White suckers (*Catostomus commersoni*) are an important baitfish in at least 14 states in the MRB. White suckers inhabit the upper Midwest and Northeast in North America, but they are also found as far south as Georgia and New Mexico in the south and west.

White suckers have the fourth highest sales value of farm-raised baitfish in the U.S. ($1.6 million). Of that total, most are raised in two states – Minnesota ($1.0 million) and Wisconsin ($0.5 million) (USDA 2013).

There is less care provided during raising of suckers than that provided for baitfish grown in Arkansas. Typically sucker fry are stocked into winterkill ponds that are free of competitors and predator fish. Sucker fry are obtained by stripping wild-caught ripe fish during the spring spawning runs that occur between mid-April and the end of June. The stripping of eggs and milt from suckers is fairly simple (Dobie 1972) and follows standard procedures. The fertilized eggs are adhesive and must be placed into a slurry of bentonite clay to prevent them from sticking together and clumping.

Eggs are incubated in jars receiving a flow of water that gently agitates the eggs. When the water flow is properly regulated, dead eggs will flow to the surface and be carried out of the jar while live eggs remain in the lower portion of the jar. The entire mass of eggs is kept in motion by a slow, gentle rolling action produced by water coming in at the bottom of the jar. Ponds can be used as a source of water, which

can be piped to the hatching unit. Eggs will hatch in 10–15 days at water temperatures of 50–60°F (10–16°C). When fry hatch, they swim up and flow out of the hatching jar. They collect in tanks where they can be scooped out with a fine meshed screen and their volume measured. There are approximately 85,000 fry/qt (80,440 fry/L).

Sucker fry are placed in plastic bags with water and oxygen and transported to ponds for stocking. Stocking is typically into winterkill ponds as described above for fathead minnows. Between 40,000 and 100,000 fry are stocked per acre (16,188–40,470/ha). Fry growth and survival depend on the fertility of the pond, availability of suitable food, absence of competing fish, and maintenance of suitable oxygen levels throughout the summer. Depending on the rate of stocking and fertility of the pond, suckers may reach market size by July or August. Suckers can be trapped or seined.

Suckers that don't reach market size during their first growing season are usually held over winter for additional growth in the spring so that they can be sold in June and early July. Because suckers are typically raised in ponds and lakes that winterkill, they must be removed and marketed before winter, the pond/lake must be aerated, or they must be moved to an aerated over-wintering pond.

Golden Shiners Grown on Farms in Minnesota and Wisconsin

Golden shiners are a popular bait in Minnesota and Wisconsin. Neither state can raise enough golden shiners to satisfy their market demand. In Minnesota, no baitfish can be imported into the state, so all golden shiners sold there are grown or wild harvested there. Wisconsin can import golden shiners from Arkansas, but there are still golden shiners that are farm raised and wild caught in Wisconsin. Because of the market demand in those two states, golden shiners that are raised or harvested there are primarily sold there and not exported.

This discussion focuses on what is considered farm raising of golden shiners in Minnesota and Wisconsin. Growth of golden shiners to market size in the northern part of the MRB nearly always takes more than one growing season. Culture of golden shiners in these two states primarily entails managing ponds that may be either leased or owned.

Spawning usually begins in May when water temperatures reach 68–70°F (20–21°C) and continues into August. The slightly adhesive eggs are attached to filamentous algae or other aquatic plants. Spawning mats of some sort may be submerged along shorelines to provide usable spawning sites in ponds without suitable vegetation. After eggs hatch, fry feed on naturally occurring zooplankton. Formulated feeds are typically not provided to golden shiners, although some producers have experimented with feeding and fertilizing ponds. Management consists primarily of making sure that no competing fish enter the pond and selectively harvesting the golden shiners as they reach market size. Ponds may be treated with oil to kill predatory insects (Dobie 1972) and aeration may be used to prevent losses during summer and/or winter. Attempts to control avian predation are often an integral aspect of pond management. If ponds winterkill, golden shiners will be stocked to reestablish harvestable populations.

Golden shiners are trapped or seined from ponds and typically brought back to a holding facility where they are held in well water, graded and loaded onto trucks for delivery. Truck loading is usually by transfer in five-gallon buckets to estimate gallons or pounds. Golden shiners are delivered to regional

distributors or directly to bait shops. Golden shiners are usually taken off the truck in five-gallon buckets when delivered to retail outlets.

How and Where Aquatic Live Bait is Wild Harvested in the MRB

There are nine states in the MRB where aquatic bait is wild harvested and sold live. Those states are Ohio, Minnesota, Montana, New York, North Dakota, Pennsylvania, South Dakota, Wisconsin and Wyoming. The following is a brief, generalized description of wild aquatic bait harvest in each of those states. This should not be considered a complete summary of wild aquatic bait harvest in these states but rather a summary of discussions with a limited number of industry representatives in each state.

Ohio

The only wild aquatic bait harvest in Ohio is for emerald shiners out of Lake Erie. Boats will run to areas where they can operate a beach seine. Emerald shiner populations are apparently at historic lows and some commercial operators may be leaving the business. Emerald shiners harvested out of Lake Erie must be used above US 90 which runs along Lake Erie from the Indiana border with Ohio to the Pennsylvania border. All emerald shiners harvested in Ohio are used in Ohio.

Minnesota

There are at least 18 species of aquatic bait wild-harvested in Minnesota. This includes at least 15 fish species and three invertebrates. Fish wild-harvested in Minnesota include: golden shiners, fathead minnows, white suckers, hornyhead chubs (*Nocomis biguttatus*), emerald shiners (*Notropis atherinoides*), spottail shiners (*Notropis hudsonius*), northern redbelly dace (*Phoxinus eos*), finescale dace (*Phoxinus neogaeus*), pearl dace (*Margariscus margarita*), creek chubs (*Semotilus atromaculatus*) , common shiners (*Luxilus cornutis*), tadpole madtoms (Noturus gyrinus), bullheads (*Ameiurus* sp.), central mud minnows (*Umbra limi*) and bluntnose minnows (*Pimephales notatus*). Invertebrates wild-harvested include leeches (both the ribbon leech (Nephelopsis obscura) and the horse leech (*Haemopsis sangaisago*)) and freshwater shrimp (*Gamerus lacustris*). Except for fathead minnows, leeches and some freshwater shrimp, bait wild caught in Minnesota is primarily used in Minnesota. All white suckers exported from Minnesota are considered farm raised. Wild-harvested suckers are primarily used within the state.

Leeches, freshwater shrimp and several minnow species are captured in small ponds and lakes that have few predator fish except perhaps some other minnow species. These lakes do not provide sport angling opportunities. As a result, these lakes are less likely to have AIS than public waters where fishing and boating are common, however, some ponds where leeches are harvested have been infested with faucet snails. Leeches are sold extensively throughout Minnesota and shipped to at least 19 states within the MRB.

Wild-caught fathead minnows along with farm-raised fathead minnows are the number one exported aquatic bait from Minnesota. They are exported both as bait and as feeder fish. As described above, fathead minnows are harvested from isolated winterkill ponds.

Several fish species, including emerald and spottail shiners, creek chubs, hornyhead chubs, common shiners, madtoms, bullheads, and white suckers (except farm-raised white suckers) are harvested from public lakes, streams and rivers that support sportfish populations. Regulations are in place to help prevent any aquatic invasive species or pathogen from being moved with the wild caught bait. For example, baitfish harvested from these waters must be tested at least annually for viral hemorrhagic septicemia virus (VHSV). In addition, baitfish cannot be harvested from zebra mussel (*Dreissena polymorha*) infested waters from May 23 to October 15 to reduce the risk of transporting zebra mussel veligers with baitfish. Because spiny waterflea (*Bythotrephes longimanus*) resting eggs can survive passage through the gut of baitfish, when baitfish like emerald shiners are harvested from May 10 until October 31, they must be kept in tanks for 48 hours before retail sale to allow them to purge any resting eggs and they may not be transported out of the region. There are additional regulations in place to deal with several other plant and invertebrate AIS.

Montana

There are no farm-raised baitfish in Montana. All baitfish sold in the state are wild-harvested by seines and traps in rivers, streams, backwaters and ponds. However, leeches can be imported from dealers approved by Montana Fish Wildlife and Parks. Ten species of fish can be harvested and used for bait, but only in the Eastern and Central Districts of the state. Approved species include fathead minnows, flathead chubs (*Platygobio gracilis*), western silvery minnows (*Hybognathus argyritis*), plains minnows (*Hybognathus placitus*), emerald shiners, longnose dace (*Rhinichthys cataractae*), lake chubs (*Couesius plumbeus*), creek chubs, longnose suckers (*Catostomus catostomus*), and white suckers. Of the baitfish most commonly found for sale, flathead chubs and lake chubs are in highest demand, followed by creek chubs, white suckers and longnose suckers. Preferences and availability may vary across the state.

New York

In New York there are 21 fish species that may be sold for bait. Fifteen of those species are on a "Green List" which means they may be used on all waters where it is legal to use baitfish. Discussions with industry representatives revealed that wild harvest in New York was primarily for emerald shiners from Niagara River and for eastern silvery minnow (known locally as hunts) (*Hybognathus regius*) and banded killifish (*Fundulus diaphanus*) from Lake Ontario/St. Lawrence River tributaries. New York Department of Environmental Conservation officials suggest that bluntnose minnows and spottail shiners may also enter the bait trade and be sold as "hunts." These wild caught minnows are often brought back to holding facilities, either tanks or ponds, and tested for diseases. If they pass, they can then be sold as certified bait anywhere in the state. Crayfish (most likely *Orconectes immunis*) are frequently wild harvested from local ponds, although they may also be farm-raised. They are sold as softshells and hardshells.

North Dakota

In North Dakota, legal live baitfish are fathead minnows, creek chubs and sticklebacks. White sucker are also legal live baitfish, but only for use in the Red and Bois de Sioux rivers. White suckers used there are imported from Minnesota. There are no fish farms in North Dakota so the baitfish sold throughout most

of the state is wild-harvested in North Dakota. Fatheads and sticklebacks are trapped out of ponds. While sticklebacks are not a preferred bait, they may be harvested along with fatheads. North Dakota exports a large quantity of fathead minnows for bait and feeder fish. Creek chubs are not often found for sale, but could be harvested from North Dakota streams. There may be some harvest and sale of tiger salamanders (*Ambystoma tigrinum*) and frogs (*Lithobates sp.*) in North Dakota, but it appears very limited. There is also a small wild harvest of leeches.

Pennsylvania

The only wild harvest of aquatic bait found in Pennsylvania was for emerald shiners harvested out of Lake Erie and sold for use on Lake Erie. Emerald shiner populations have declined considerably and the number of commercial seiners has declined. If the emerald shiners are tested and negative for VHSV, they can be sold anywhere in the state but that is usually not done.

South Dakota

Fathead minnows are trapped extensively in ponds and small lakes throughout South Dakota. They are used for bait in the state and substantial quantities are exported for bait and feeder fish. While a similar harvest of fathead minnows in winterkill ponds in Minnesota is defined as farm-raised, in South Dakota it is defined as wild harvest. Even though ponds may be leased to the producers in South Dakota, little management other than harvest is provided. There may be a small wild harvest in western South Dakota in the Cheyenne River basin for western silvery minnows, white suckers and creek chubs.

Wisconsin

There are at least 10 fish species and four invertebrate groups harvested for the live aquatic bait market in Wisconsin. Fish species wild-harvested include: emerald shiners, creek chubs, common shiners, pearl dace, northern redbelly dace, southern redbelly dace (*Chrosomus erythrogaster*), finescale dace, hornyhead chubs, golden shiners, and white suckers. Invertebrates wild-harvested include dragonfly nymphs (locally known as thunder bugs, and sometimes mistakenly called hellgrammites) (*Tetragoneuria spinigera*), mayfly nymphs (wigglers) (*Ephemera simulons or Hexagenia limbate*), leeches, and rusty crayfish (*Orconectes rusticus*).

Dragonfly nymphs are harvested out of small lakes in northern Wisconsin and are used from spring to fall. Mayfly nymphs are typically dredged from the bottom of streams through the ice and used primarily in winter. Dragonfly and mayfly nymphs are shipped by air freight to many states in the MRB. Leeches are trapped in small quantities in Wisconsin and primarily used to supplement the wild caught leeches imported from Minnesota. Rusty crayfish harvest for bait in Wisconsin has declined due to rusty crayfish population and export market declines (personal communication Gene Check, 3/6/2019).

Emerald shiners are harvested from large rivers like the Wisconsin River for use in Wisconsin and often for export to states like Ohio, Pennsylvania and New York. The harvest of emerald shiners has been restricted to areas above the first dam on Mississippi River tributaries because of the possible non-target harvest of Asian carp and above the first dam on tributaries to Lake Michigan because of VHSV virus (personal communication, Ben Gollon, 3/6/2019). The other fish species wild harvested in

Wisconsin are typically harvested from rivers and streams or ponds/lakes and primarily sold in Wisconsin.

Wyoming

Prior to a recent regulation change, all baitfish used in Wyoming were wild-caught in the state. The state now allows commercially raised fathead minnows to be imported from two fish farms. As of 2018, one was in South Dakota and the other was in Arkansas. Use of imported fathead minnows is permitted statewide, whereas wild-caught baitfish use is restricted by geographic areas. Where still sold, wild-caught bait includes white suckers, fathead minnows, creek chubs and possibly other native species like spottail and emerald shiners. These species are seined or trapped in streams, rivers and ponds.

Aquatic Bait Used in the Mississippi River Basin States

There were 42 species of live aquatic bait identified that were sold in the MRB. Twenty-eight were fish, 12 were invertebrates and two others were non-fish vertebrates (Figure 3). Some of the species reported were mentioned infrequently. APPENDIX F is an attempt to identify the scientific and common names of each species in the region, describe where the species is primarily used, identify the size or sizes at which the species is marketed in the region and identify where the species is primarily produced in the region.

The most common baitfish species in the MRB are golden shiners, fathead minnows (including the rosy red variety), white suckers, goldfish (including the black salty variety), emerald shiners and sunfish (bluegills, green sunfish or their hybrids). The most common invertebrate baits in the MRB were leeches and crayfish. Leeches were reported sold in at least 19 MRB states. Most leeches sold in the MRB are wild caught in Minnesota, but some are harvested in Wisconsin and North Dakota. Crayfish sales were reported in at least 10 states in the MRB. Five species of crayfish were reportedly sold as bait.

The species descriptions (APPENDIX F) are listed somewhat in order of their popularity and use in the MRB. There are no production or sales information to support this, so the list order is somewhat arbitrary and reflects my discussions with industry representatives. Fish species are presented first, followed by invertebrates and then by other vertebrates.

Of the 28 states in the MRB, half (14) get most their baitfish from Arkansas. Some of those 14 states may import some aquatic invertebrates or have one or two in-state baitfish producers (such as Missouri and Tennessee), but by far, their baitfish needs are supplied by Arkansas (APPENDIX G). Those states are

Figure 3. Live Aquatic Bait Sold in the MRB

Golden Shiners (*Notemigonus crysoleucas*)
Fathead Minnows (*Pimephales promelas*)
Rosy Reds (*Pimephales promelas*)
Goldfish (*Carassius auratus*)
Black Salty (*Carassius auratus*)
White Suckers (*Catostomus commersonii*)
Emerald Shiners (*Notropis atherinoides*)
Spottail Shiners (*Notropis hudsonius*)
Bluegills (*Lepomis macrochirus*)
Green Sunfish (*Lepomis cyanellus*)
Hybrid Bluegills (Blusegill/Greensunfish cross)
Northern Redbelly Dace (*Chrosomus eos*)
Southern Redbelly Dace (*Chrosomus erythrogaster*)
Finescale Dace (*Chrosomus neogaeus*)
Creek Chubs (*Semotilus atromaculatus*)
Common Shiners (*Notemigonus crysoleucas*)
Hornyhead Chubs (*Nocomis biguttatus*)
Longnose Suckers (*Catostomus catostomus*)
Eastern Silvery Minnows (*Hybognathus regius*)
Western Silvery Minnow (*Hybognathus argyritis*)
Flathead Chubs (*Platygobio gracilis*)
Lake Chub (*Couesious plumbeus*)
Banded Killifish (*Fundulus diaphanous*)
Central Mudminnow (*Umbra limi*)
Pearl Dace (*Margariscus nachtriebi*)
Bullheads (*Ameiurus melas*)
Tadpole Madtoms (*Noturus gyrinus*)
Common Carp (*Cyprinus carpio*)
Israeli Carp (*Cyprinus carpio carpio*)
American Eels (*Anguilla rostrata*)
Ribbon Leeches (*Nephelopsis obscura*)
Red Swamp Crayfish (*Procambarus clarkii*)
White River Crayfish (*Procambarus acutus*)
Papershell Crayfish (*Orconectes immunis*)
Rusty Crayfish (*Orconectes rusticus*)
Northern Crayfish (*Orconectes virilis*)
Horse Leeches (*Haemopis sangaisaga*)
Freshwater Shrimp (*Gammarus lacustris*)
Mayfly Nymphs (*Ephemera simulons or Hexagenia limbate*)
Dragonfly Nymphs – various species including (*Tetragoneuria spinigera*)
Grass Shrimp (*Palaemonetes kadiakensis*)
Dobsonfly Nymphs also called Hellgrammites (*Corydalus cornutus)*
Tiger Salamanders (*Ambystoma tigrinum*)
Frogs (*Lithobates sp.*)

Alabama, Arkansas, Georgia, Kansas, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, Tennessee, Texas, Virginia, and West Virginia. There are only five states that export live aquatic bait to other states in the MRB (Figure 4). Those states are Arkansas, Minnesota, North Dakota, South Dakota and Wisconsin. (Ohio may export a small quantity of papershell crayfish.) The type and quantity of aquatic bait exported by the five states varies noticeably (Figure 4). Arkansas exports farm raised golden shiners, fathead minnows (including the rosy red variety), goldfish (including the black salty variety) and sunfish. Minnesota exports farm raised and wild caught fathead minnows, wild caught leeches and farm raised white suckers. Minnesota may also export some bullheads for bait, but they did not show up on the state's export report. A small amount of freshwater shrimp may also be exported. North Dakota exports wild-caught fathead minnows. South Dakota exports farm-raised and wild-caught fathead minnows and farm-raised white suckers. Wisconsin exports wild-caught emerald shiners, mayfly nymphs, dragonfly nymphs and a few rusty crayfish.

Nine of the 28 MRB states have a significant wild harvest of aquatic bait (Minnesota, Montana, New York, North Dakota, Ohio, Pennsylvania, South Dakota, Wisconsin and Wyoming). At least four of those states (Minnesota, Wisconsin, North Dakota and South Dakota) export wild-

caught aquatic bait to other states in the MRB (Figure 4). Three of the nine states (Ohio, Pennsylvania and New York) harvest wild baitfish from the Great Lakes and primarily use that wild bait in the Great Lakes. Other states that harvest wild bait are Montana and Wyoming. They use the wild-harvested bait solely within their states. APPENDIX G describes the aquatic bait used in each of the 28 MRB states and where it comes from.

Figure 4. Live Aquatic Bait Exported from Five MRB States.

Arkansas	Minnesota	North Dakota	South Dakota	Wisconsin
Golden Shiners	Fathead Minnows	Fathead Minnows	Fathead Minnows	Emerald Shiners
Fathead Minnows	White Suckers		White Suckers	Dragonfly Nymphs
Goldfish	Leeches			Mayfly Nymphs
Sunfish				

When considering risk of moving AIS and pathogens, the focus should be on the five states that export live aquatic bait and on the nine states where aquatic bait is wild harvested. While there are state regulations in place to address most of the current concerns associated with the live bait pathway, it is important to watch for new threats connected with either farm-raised or wild-caught bait. Regulations in place to reduce the risk of spreading AIS and pathogens are discussed later in this report.

Live Aquatic Bait Production Estimates for the Mississippi River Basin States

One objective for this report was to estimate the sales volume and value of the live aquatic bait industry in the MRB states. That has proven impossible. There are several reasons for this. Only 57% of MRB states reported that wild harvest production data was required to be collected and only 28% of MRB states required producers to report farm raised production data (APPENDIX B, questions 11 and 12). Even if states require the collection of wild harvest and farm raised bait production figures, they either don't compile the data or they don't collect the information (unless there is a problem). Two states provided detailed production figures (Minnesota and North Dakota). But even when information is provided regarding wild harvest and farm raised production, not all of the production is sold for use as baitfish. Goldfish and fathead minnows are frequently sold as feeder fish as well as baitfish.

Feeder fish are fish sold to feed other fish. This could be fish in private ponds, aquarium fish, or predator fish like walleyes or muskellunge being raised by state/federal/tribal management agencies or commercial private producers. Many times, baitfish producers don't even know how much of their product is sold for feeder fish versus baitfish. This is because baitfish are frequently sold to secondary distributors in their own state or in other states and they are not aware of the final use of their product.

Goldfish, raised in Arkansas, are primarily sold as feeder fish. One estimate was that 85-90% of goldfish are sold as feeder fish (personal communication Dr. Eric Park, 4/4/19). There is also a substantial sale of fathead minnows and the rosy red variety as feeder fish, possibly 15 to 20% of Arkansas' production (Dr. Eric Park, personal communication 4/4/19). However, some fathead minnow producers in Arkansas may sell a higher percentage of their fathead minnows for feeder fish than for bait (Landon Pool, personal communication, 4/6/19). I was not able to obtain any estimates of fathead minnow production for

feeder fish in northern states. This makes it impossible to estimate the sales value and volume of baitfish in the MRB.

The USDA Aquaculture Census collects detailed information relating to production volume and methods, surface water acres and sources, sales, point of first sale outlets, and aquaculture distributed for restoration, conservation, enhancement, or recreational purposes (USDA 2013). The census is only for farm-raised fish and does not include fish, crustaceans, mollusks, and other aquatic products which are caught or harvested by the public from non-controlled waters. Aquaculture is defined as the farming of aquatic organisms, including baitfish that involves some form of intervention in the rearing process, such as seeding, stocking, feeding or protection from predators. As a result, the Aquaculture Census does not capture any wild-harvested aquatic bait production. In addition, as described above, it does not distinguish between goldfish or fathead minnow production sold for feeder fish versus baitfish. The census also withholds information to avoid disclosing data for individual farms. This makes it difficult to compile accurate baitfish production efforts. Several knowledgeable industry representatives suggested that the Aquaculture Census in not accurate because not all farms participate.

Nevertheless, the data presented by the census depicts an industry that is economically quite valuable to the MRB. Results of the most recent survey (2018) were not available for this report. The last census was conducted in 2013. Results for baitfish production are found in APPENDIX E. The number of baitfish farms in the MRB states was 145 and they generated almost $26 million in sales. Arkansas was by far the largest producer in the MRB. Arkansas had baitfish sales worth $18.4 million, followed next by Minnesota with $2.4 million, Ohio with $1.7 million and Wisconsin with $1.5 million in sales.

Golden shiners were by far the most valuable baitfish raised in the U.S. with sales of $14.3 million in 2013. Fathead minnows were the next most valuable with $9.9 in sales, followed by white suckers with $1.6 million in sales. The majority of those sales were from farms in the MRB.

While not a part of this study, types of preserved bait and species of non-aquatic bait that were identified during discussions with industry representatives are reported in APPENDIX H. There were 23 different types of frozen/preserved baits (aquatic and non-aquatic). The most commonly encountered preserved baits were different forms of shad (*Dorosoma cepedianum*) and skipjack herring (*Alosa chrysochloris*). Twelve species of live non-aquatic bait were identified. The most common were night crawlers (*Lumbricus terrestris*) and crickets (*Acheta domestica*).

State and Federal Regulations

State Regulation of the Live Aquatic Bait industry

Management agencies in all 28 states were sent a survey by email to characterize the regulations related to aquatic bait farming, wild harvesting, importing/exporting, reporting, transportation and species allowed/prohibited. Because regulation authority in many states was split between those pertaining to farming and disease testing and those for wild harvest and bait use in the state, several agencies in some states were required to complete the surveys. The survey contained 20 primary questions, but depending upon responses, additional questions were asked. In total, there were 43 questions on the survey (APPENDIX A). All 28 states of the MRB responded to the survey. A summary of

responses to the state surveys is found in APPENDIX B. States also supplied web sites where aquatic bait regulation information could be found. Those are summarized in APPENDIX D. The following is a brief summary of how the states responded to survey questions.

Survey of State Regulations

State Regulations Summary

1. Is aquatic bait commercially wild harvested in your state?

Yes 27 No 1 (IN**)**

1a. If yes, are commercial harvesters required to be licensed?

Yes 26 No 0 N/A 1 (IN)

Comment: Nearly all the states in the MRB allow commercial wild harvest of aquatic bait and they all require commercial harvesters to be licensed. The only state where commercial wild harvest is not allowed is in Indiana. In my telephone survey of industry representatives, I only found nine states where live aquatic bait was harvested and entered the live bait market. Licensed commercial bait harvesters in many states in the MRB may be commercially harvesting fish that are used for bait but not as live bait. They may be harvesting shad, skipjack herring, several carp species, mooneyes, smelt, cisco or other fish that are sold frozen or preserved.

2. Is aquatic bait commercially raised in your state?

Yes 26 No 2 (MT and ND)

2a. If yes, are aquatic bait farmers required to be licensed?

Yes 22 No 3 N/A 2 (MT and ND)

Comment: Aquatic bait can be commercially raised in nearly all the states in the MRB and require commercial fish farms to be licensed. The only states where commercial aquatic bait is not farmed is in Montana and North Dakota. Through telephone interviews with industry representatives in the MRB, I found that only eight states (Arkansas, Minnesota, Missouri, Ohio, New York, South Dakota, Tennessee, Wisconsin) had farm raised bait that contributed to the live bait market in the MRB. Some of these eight states did not produce significant quantities of live bait. For example, Ohio and New York produced a relatively small amount of papershell crayfish and Missouri and Tennessee had only a couple farms producing baitfish. The vast majority of states that answered yes to this question have fish farms that may produce baitfish species, but primarily sell them for feeder fish, pond stocking or bait for an on-site fee fishing operation.

3. Are there regulations governing the species of aquatic bait that can be commercially wild harvested in your state?

Yes 25 No 2 (CO and MS) N/A 1 (IN)

Comment: Nearly all the states in the MRB have regulations governing the species of aquatic bait that can be commercially wild harvested in their states. Only two states (Colorado and Mississippi) reported that they did not have regulations governing the species that can be wild harvested. Lists of aquatic bait allowed to be wild harvested is widely diverse in the MRB states.

4. Are there regulations governing the species of aquatic bait that can be commercially raised in your state?

Yes 27 No 0 N/A 1 (ND)

Comment: All states where aquatic bait is commercially raised have regulations governing the species of aquatic bait that can be raised in their states. North Dakota has no aquatic bait farming so their response was listed as not applicable. Species allowed to be cultured vary considerably throughout the

MRB. Many states allow culture of species that are illegal to raise or use as live bait in other states in the MRB. Goldfish, common carp and red swamp crayfish are examples.

5. Does your state require pathogen testing of aquatic bait commercially wild harvested or commercially raised within your state?

Yes 11 No 17

Comment: Less than half the states in the MRB require wild-harvested or farm-raised baitfish to be tested for any pathogens. It is difficult to assess what this means because many states don't produce substantial quantities of live bait. There is less concern for the spread of pathogens (except for VHSV) with the use of dead bait like shad and skipjack herring. However, there is concern over dead bait that is harvested from VHSV infested waters. Freezing alone is not effective in inactivating the virus (Phelps et al. 2013). Also, for the 12 states in the MRB that get the vast majority of their live aquatic bait from Arkansas, all baitfish exported are certified free of four different pathogens. Therefore, the need to require pathogen testing for bait from their own state may be less compelling.

6. Does your state require commercially wild harvested or commercially raised aquatic bait from your state to be tested or certified free of non-native or non-target species?

Yes 5 No 23

Comment: Only five states reported that they require aquatic bait to be tested or certified free of non-native species. This is also difficult to assess because the Arkansas Baitfish Certification program certifies their bait free of 13 different AIS. It is possible states rely on that program. Wyoming for example allows baitfish to be imported into their state from just two fish farms (one in Arkansas and one in South Dakota). Montana does not allow any baitfish to be imported into the state but they do allow leeches to be imported only from dealers that they have certified. Other states that answered yes to this question may not require baitfish to be certified free of non-natives but require baitfish to not contain certain non-native species and enforce that with periodic spot checks to observe compliance, which is quite different than requiring a health certificate.

7. Are there restrictions regarding where aquatic bait can be commercially wild harvested in your state because of the presence of non-native species and/or pathogens?

Yes 15 No 13

Comment: Fifteen of the 28 MRB states have restrictions regarding where aquatic bait can be harvested because of the presence of non-native species or pathogens. The rationale for such regulations varies widely for each of these states, but VHSV and Asian carp are two important motivations for these regulations.

8. Are there restrictions regarding where (specific waterbodies) commercial aquatic bait can be used by anglers in your state because of concerns related to non-native species and pathogens?

Yes 14 No 14

Comment: Fourteen of the 28 MRB states have restrictions regarding where commercial aquatic bait can be used because of the presence of non-native species or pathogens.

9. Are there seasonal restrictions for the commercial wild harvest of aquatic bait in your state?

Yes 3 No 25

Comment: The follow-up question was -- If yes, please briefly describe the seasonal restrictions and indicate if they are influenced by or the result of non-native species or pathogens. While three states reported that they had seasonal restrictions for the wild harvest of aquatic bait, only one state indicated it was the result of the presence of non-native species or pathogens. Minnesota has specific seasonal restrictions on the harvest of baitfish on zebra mussel and spiny waterflea infested waters. On zebra mussel-infested waters, baitfish cannot be harvested from May 23 until October 15 to reduce the risk of

moving zebra mussel veligers with the live baitfish. Because spiny waterflea eggs can survive passing through the gut of baitfish, baitfish harvested from spiny waterflea infested waters must be held in tanks for 48 hours before being sold and not moved out of the region from May 10 to October 31.

10. Are there harvest limits or quotas for the commercial wild harvest of aquatic bait in your state?

Yes 3 No 24 N/A 1 (IN)

Comment: Three states mentioned harvest limits for the commercial harvest of aquatic bait. In Iowa, wild harvest is limited to the amount sufficient to supply licensees' customers for hook and line fishing and they may not carry, transport or ship minnows for sale beyond boundaries of the state. In North Carolina, the regulation focuses on sport harvest rather than commercial harvest. In Tennessee, there is a creel and possession limit on the number of skipjack herring that a bait dealer can harvest and possess. These, however, would not be sold live.

11. Are there reporting requirements (such as harvest or sales volume or value, harvest effort, or harvest locations) for commercially wild harvested aquatic bait in your state?

Yes 16 No 12

Comment: Only 57% of MRB states reported that wild harvest production data was required to be collected. Comments related to this question are described in detail under the section titled "Live Aquatic Bait Production Estimates for the Mississippi River Basin States."

12. Are there reporting requirements (such as harvest or sales volume or value, surface area of production water, surface water or ground water usage) for commercially raised aquatic bait in your state?

Yes 8 No 16

Comment: Only 28% of MRB states required producers to report farm raised production data. Comments related to this question are described in detail under the section titled "Live Aquatic Bait Production Estimates for the Mississippi River Basin States."

13. Can live aquatic bait be exported from your state?

Yes 27 No 1 (MT)

Comment: Live aquatic bait can be exported from every state in the MRB except Montana. There is no farm raised aquatic bait in Montana. It is all wild caught and not allowed to be exported from the state. Even though live aquatic bait can be exported from 27 states, I only found five states that exported live aquatic bait in large enough quantities to show up in retail outlets in MRB states.

14. Can live aquatic bait be imported into your state?

Yes 27 No 1 (MN)

14a. If yes to question 14, are there species restrictions regarding live aquatic bait importation into your state?

Yes 26 No 1 (GA) N/A 1 (MN)

14b. If yes to question 14, is imported live aquatic bait required to be tested for specific pathogens?

Yes 13 No 14 N/A 1 (MN)

14c. If yes to question 14, is live aquatic bait imported into your state required to be tested or certified free of non-native or non-target species?

Yes 6 No 21 N/A 1 (MN)

14d. If yes to question 14, are there reporting requirements for importing live aquatic bait into your state?

Yes 15 No 11 N/A 1 (MN) Blank 1 (SD)

Comment: Minnesota is the only state in the MRB where it is illegal to import live aquatic bait. All states except Georgia reported that there are species restrictions for importing live aquatic bait into their

states. The states were nearly evenly split between those that required live aquatic bait to be tested for specific pathogens and those that didn't. The split was nearly identical to that in question five where states were asked if farm-raised or wild-caught bait in their state required pathogen testing. All states where VHSV has been detected require pathogen testing. Response to question 14c was similar to question 6 except that Colorado and Illinois required non-native species testing for imports but not for in-state bait production, and Pennsylvania does not require non-native species testing for imports but does for in-state production. Montana, North Dakota, Wisconsin and Wyoming responded yes to both question 6 and 14c. Comments associated with question six (above) also apply here. Fifteen states said they have reporting requirements for imported aquatic bait but it is not known if reports are actually submitted or just required to be kept by the importers in case of problems or questions.

15. Are there restrictions on the commercial transportation of live aquatic bait in your state?
    Yes 16 No 12

Comment: Sixteen states reported that they have restrictions on the transportation of live aquatic bait in their states.

16. Does your state allow the wild harvest of aquatic bait for personal use?
    Yes 28 No 0

Comment: Every state in the MRB allows wild harvest of aquatic bait for personal use.

17. Are there any restrictions regarding the release of unwanted aquatic bait into state waters?
    Yes 23 No 5

Comment: Six states reported that there are no restrictions regarding the release of unwanted live aquatic bait. I did find regulations in Arkansas that state – "It is illegal to release any fish, baitfish or crayfish into public waters without written permission from the AGFC, unless releasing said species into waters where they were originally taken" so I changed the response for Arkansas to Yes. In the five other states that responded with No, I reviewed their regulation pamphlets. In the Alabama sportfishing regulation pamphlet they recommend disposal of unwanted bait in the trash, NOT in lakes and rivers. In Indiana's sport fishing regulations pamphlet, they include the Stop Aquatic Hitchhiker message which says to dump bait in the trash. In the Louisiana sportfishing regulations pamphlet there was no mention of what to do with leftover bait. In the Oklahoma sportfishing regulations pamphlet there was the Stop Aquatic Hitchhiker's message of Clean, Drain, Dry but no mention of what to do with leftover bait. There was nothing mentioned in the Texas sportfishing pamphlet regarding dumping bait. Texas does require a receipt for bait and does not allow bait or water to be transferred away from a waterbody, but there was no prohibition against releasing unwanted bait into a waterbody found in the sportfishing pamphlet.

18. Are there any restrictions regarding aquatic bait that has been used on waters infested with aquatic invasive species?
    Yes 10 No 18

Comment: While 18 states reported that there are no restrictions regarding aquatic bait that has been used on infested waters, this is not an accurate representation because many states prevent the movement of water from any waterbody (regardless of infestation with AIS), so they don't need specific regulations for infested waters.

Survey of Sportfishing Brochures

The sportfishing regulation pamphlets of the MRB states were reviewed (see APPENDIX D for weblinks to regulations). Regulations related to baitfish were reviewed for legal baitfish species, messages

regarding disposal of unwanted bait and other regulations that may be of interest to other MRB states. One tool that ten of the 28 MRB states are using to ensure that legal aquatic bait is being used in their states is to require anglers to have a receipt for their bait to show that it has been purchased from legal sources and used in appropriate places. The following is a description of how these states are using receipts with web links to their sportfishing regulations pamphlets.

- **CO** All live aquatic organisms from a commercial source and transported by anglers must be accompanied by a receipt.
- **MN** You must have a valid sales receipt from the vendor for suckers longer than 12 inches.
- **MO** Any number of live bait, when obtained from a source other than the waters of the state or a licensed commercial fisherman; the angler must carry a dated receipt for the bait.
- **MT** Anglers who import and fish with leeches must have a receipt from the approved out-of-state leech dealer.
- **NE** Sport fish may be used for bait if they are purchased from a bait dealer. The angler must keep a legible receipt.
- **NY** Certified bait needs a receipt to be used statewide. Baitfish without a receipt or with a receipt that is older than 10 days shall be considered uncertified bait. Uncertified baitfish outside of an overland transportation corridor must have a receipt.
- **TN** A licensed sport angler may possess rainbow trout 8 inches or less in length without limit for use as bait if purchased from a licensed bait dealer and accompanied by an invoice that was issued by the licensed bait dealer.
- **TX** Transport and use of commercially purchased live bait in water while fishing from a vessel is allowed, provided persons in possession of the bait have a receipt that identifies the source of the bait.
- **VA** Legally purchased fish bait – the angler must have a receipt specifying # and species.
- **WY** Persons with live baitfish in possession shall produce either a receipt from a licensed live baitfish dealer or a valid, unexpired seining license.

Another common component of sportfishing regulation pamphlets was a description of the legal aquatic bait. Descriptions varied widely across MRB states (see APPENDIX I). Some states provide detailed descriptions of legal aquatic bait listing several categories of aquatic bait and how and where they can be used in the state (MN, NE, NY, TN as examples), while other states provide very little information (AL, GA, LA, MS, TX as examples). A great many more species are identified as legal bait in the MRB than occur in retail bait shops. The sportfishing regulations also provide guidance for the personal harvest of aquatic live bait (APPENDIX I).

Federal Regulation of the Live Aquatic Bait Industry

The effect of regulations on aquaculture has been described -- both as it relates to competitiveness of U.S. aquaculture and the costs to producers (Van Senten and Engle 2017; Engle and Stone 2013). Van Senten and Engle (2017) found that for U.S. baitfish and sportfish producers 90% of the regulation burden was from state regulations and 10% were from federal regulations. However, many of the federal regulations related more to commercial trucking, worker safety and bird depredation. They also found that across the country the average was only one federal permit required per farm, although large farms in Arkansas averaged two permits per farm. Descriptions of specific regulations impacting fish farms and more specifically baitfish farms were not presented.

While not specifically focused on the movement of AIS and pathogens with baitfish, three federal regulations will be briefly described here: 1. reportable aquatic pathogens, 2. regulations related to injurious species under the Lacey Act and 3. bird depredation permits.

OIE reportable aquatic animal pathogen. The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) follows standards and rules in concert with the World Organization for Animal Health (Office International des Epizooties or "OIE"). As a member country, the United States monitors animal diseases from a list of "Notifiable diseases" that is generated by OIE. Any "notifiable animal diseases" that are detected in the U.S are reported to OIE. The most relevant of these reportable diseases to the aquatic bait industry are koi herpesvirus disease, spring viremia of carp and viral hemorrhagic septicemia.

Injurious Species under Lacey Act. Under the Lacey Act**,** it is unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants that are taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law. The Lacey Act authorizes the Secretary of the Interior to prohibit the importation and shipment of injurious species between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any possession in the United States of species, including offspring and eggs, designated through regulation to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the United States. Probably the most relevant injurious species to baitfish wild harvest and cultivation are the Asian carps and zebra and quagga mussels.

In a recent ruling the Court of Appeals for the District of Columbia upheld a ruling in 2017 that the U.S. Fish and Wildlife Service does not have the jurisdiction to prohibit the interstate transport of injurious species listed under the Lacey Act within the continental U.S. (with the exception of the District of Columbia), however, the U.S. Fish and Wildlife Service maintains authority to prohibit interstate commerce of state-banned species. Many states in the MRB ban Asian carps and zebra and quagga mussels.

Bird Depredation. The Migratory Bird Treaty Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. The migratory bird species protected by the Act are listed in 50 CFR 10.13. Several migratory birds like cormorants and pelicans can be very destructive to baitfish farms. A federal depredation permit (50 CFR 21.41) authorizes farmers to kill birds to reduce damage caused by birds or to protect other interests such as human health and safety or personal property. Depredation permits are authorized annually but may not be sufficient to protect fish crops. Therefore, bird scaring is frequently used to help minimize the impact of migratory birds. No permit is required for bird scaring.

Trends

When interviewing industry representatives in the MRB they were asked if they have noticed any trends in the last 10-15 years that are noteworthy. Four trends were mentioned all across the MRB with surprising frequency.

The first trend mentioned most often across the MRB was that fewer youth are getting into fishing. Reasons varied little. Industry representatives suggested it was either a preoccupation with phones (social media) and video games or it was expanding commitments to organized sports or other school activities.

A second trend mentioned less often but still pervasive across the MRB was that there are fewer traditional bait shops and more bait being sold at convenience stores. Concerns with this included less knowledgeable employees to both keep bait alive and to assist customers.

A third trend was the loss of distributors, especially in northern states, because it is a difficult business and fewer young people want to put in the work needed to be economically viable and because regulations associated with the discovery of VHSV and other AIS have made it increasingly expensive to test bait for pathogens and comply with additional regulations and paperwork. As one distributor put it, they now have a bigger piece of the pie, but the pie is shrinking and the distribution area is expanding.

The fourth trend frequently heard across the MRB was that the sale of live aquatic bait is declining as more and more anglers switch to using artificial baits.

Risks of Spreading AIS and Pathogens Via the Live Aquatic Bait Pathway

Gunderson (2018) identified several potential AIS and pathogen risks associated with golden shiners raised in Arkansas. These risks and others are described below. While these species and pathogens may pose a risk, there is no evidence available that indicates they have affected wild populations as a result of being moved with live aquatic bait. This may be because they pose no risk or that impacts have not been adequately examined. Some of these species may be able to expand their range as the climate changes, so continued vigilance is needed.

Asian Tapeworm (*Schyzocotyle acheilognathi*)

The Asian tapeworm is a fish parasite that originated from eastern Asia. It is a generalized parasite that affects cyprinids but over 200 fish of different families have been found to serve as hosts (Scholz 2012). Asian tapeworm has been introduced nearly worldwide, mainly with shipments of live grass carp. Asian tapeworms can have pronounced detrimental effects on fish, including severe damage to the intestinal tract, physiological disturbance, reduced growth, condition loss and death.

The life cycle of the Asian tapeworm involves an intermediate host and the definitive host. Eggs are passed in the feces of the fish host and coracidia hatch in 1–5 d depending on water temperature. Free-swimming coracidia are ingested by cyclopoid copepods, the intermediate host. Hexacanths develop into infective procercoids in 11–12 d. The life cycle is completed when a fish eats an infected copepod and the procercoids develop into adult tapeworms. Transmission of adult tapeworms can also occur when a fish consumes an infected fish (Muzzal et al. 2016). Therefore, Asian tapeworms can be moved to new waterbodies with the movement of fish or water with infected copepods or free-swimming coracidia. Asian tapeworms are likely moved from one waterbody to another with baitfish. Boonthai et al. (2018) surveyed 78 retail bait shops in Michigan. They detected Asian tapeworm throughout

Michigan in 48 of 90 (53.3%) lots examined. The tapeworm was found in emerald shiners, golden shiners and sand shiners.

Asian tapeworms are fairly common in AR and have been found in farm-raised golden shiners. While some farms are free from Asian tapeworms and are certified by the AR certification program as Asian tapeworm-free, other farms have the tapeworm.

Little information is available on impacts of Asian tapeworm on wild fish populations, but there is some concern in Michigan regarding how the spread of Asian tapeworms may impact wild forage fish populations (Muzzal et al. 2016).

Ovarian Parasite (*Ovipleistophora ovariae*)

O. ovariae is a microsporidian parasite primarily of golden shiners, but has also been found in fathead minnows. It is a parasite that infects the ovaries and can reduce fecundity and cause sterility of farm-raised golden shiners. While *O. ovariae* will cause egg mortality, there is no evidence that it causes mortality in other life stages. Ovarian parasite is widespread in farmed golden shiners throughout the country. It was found in 45 golden shiner farms in 12 states in 1970 (Summerfelt and Warner 1970b). It was also recently found in 56% of golden shiners collected from Minnesota bait shops (Dr. Nicholas Phelps, personal communication, 12/04/17).

Transmission of ovarian parasite is both horizontal and vertical. Horizontal transmission begins when a fish ingests viable spores that were discharged from spawning of infected fish. Fish could become infected by feeding on cladocera or copepod nauplii that consumed spores. Phelps and Goodwin (2008) provided evidence for vertical transmission with positive PCR for *O. ovariae* in fertilized eggs and in fry produced from infected broodfish. Therefore, the parasite can be transferred with infected fish, infected eggs and in water.

Ovarian parasite was selected as a potential risk because it is likely to be transferred with farm-raised golden shiners, it could have significant impacts on golden shiner reproduction and it is likely to become established in waters with golden shiners. The widespread distribution of infected golden shiners for decades suggest that if it were going to cause problems for wild golden shiners, the impacts would already be evident. There is, however, little known about the effects or occurrence of this parasite in the wild.

Golden Shiner Virus (GSV)

Golden shiner virus is the Chinese grass carp reovirus (McCann 2012). It causes substantial mortality in grass carp. In the U.S., GSV has been found in golden shiners, fathead minnows, creek chubs, white suckers, emerald shiners, muskellunge, silver carp, and smallmouth buffalo (McCann 2012). The pathogenicity of GSV doesn't seem to be well understood because expert opinions vary. According to Dr. Nicholas Phelps (personal communication, 12/04/17) pathogenicity of GSV is very low and GSV rarely causes mortality. However, in a study where fathead minnows were experimentally infected with GSV, there was a clear association between mortality, clinical disease and GSV (McCann 2012).

There is also concern over the risk GSV poses for Muskellunge. GSV was shown to be pathogenic to muskellunge in hatcheries in Michigan (Dr. Mohamed Faisal, personal communication, 12/22/2017). It is not clear if GSV causes mortalities in wild muskellunge but GSV has been found in a wild muskellunge.

In a study by McCann (2012), baitfish from AR, MN and SD were tested for the presence of GSV and other viruses. In combined lots from the three states, thirty-six of the 82 lots (44%) of fish tested positive for one or more viruses. McCann (2012) found that 41% of golden shiner lots, 32% of fathead minnow lots, and 5% of white sucker lots tested positive for GSV. Of the lots that tested positive for GSV, about half contained fish that displayed clinical signs: gill lesions and hemorrhages of the fin bases, vents, gill opercula, eyes, and skin. Clinical signs of GSV were seen in fathead minnows, golden shiners, and white suckers.

Western Mosquitofish (*Gambusia affinis*)

The western mosquitofish is a freshwater fish in the family *Poeciliidae*, native to the Mississippi River and its tributary waters from southern Indiana and Illinois to the Gulf Coast and parts of northeastern Mexico. They are not native to many northern states of the MRB. They are hardy to a variety of temperatures, salinities and oxygen levels and have been spread through many parts of the world through introductions attempting to control mosquito populations. They are most common in vegetated ponds and lakes, backwaters and quiet pools of streams. They feed on zooplankton, small insects, detritus, fish eggs, and small fish (Nico and Fuller 2005; USFWS 2017b). Mosquitofish are voracious, aggressive predators that have extirpated or caused declines in many native fish and amphibians (USFWS 2017b). Mosquitofish are small; females reach an overall length of 7 cm (2.8 in) and males at a length of 4 cm (1.6 in).

Mosquitofish are not thought to be cold tolerant and unlikely to become established in northern states (Nico et al. 2019), however, the western mosquitofish ecological screening summary (USFWS 2017b) concludes that the climate match for western mosquitofish was high for almost the entire continental U.S. With high certainty, they believe there is no climate barrier to this species invading the rest of the U.S.

Baitfish farmers under the Commercial Bait and Ornamental Fish Certification Program in Arkansas apply BMPs to prevent western mosquitofish from invading their ponds (Circular 21 2010), but it can happen. If western mosquitofish are found on fish farms, fish farmers will drain ponds and sterilize any remaining water. If there are market-size golden shiners in that pond, they are shipped to states like Texas that don't have restrictions on mosquitofish (Gunderson 2018).

The risk of establishing western mosquitofish in waters of northern states through importation of baitfish from Arkansas may be rather low, otherwise states like Michigan and Wisconsin, where Arkansas baitfish have been imported for decades, would see established populations of mosquitofish. The only locations in those states where mosquitofish have been found (GLANSIS, April 2019) are the result of intentional stocking for biocontrol.

Non-Native Crayfish - Red Swamp Crayfish, White River Crayfish and Rusty Crayfish

Two crayfish species may be found in baitfish production ponds in Arkansas. The most common crayfish found is the white river crayfish (*Procambarus acutus*) but it is possible red swamp crayfish (*P. clarkii*) may also be found. While these two crayfish are native to some states in the MRB, they are not native to the majority of states in the MRB. Crayfish have frequently been reported in shipments of baitfish from Arkansas (Gunderson 2018). Crayfish are most likely to be seen in shipments from Arkansas from March to July. Crayfish are not seen during the winter months.

Red swamp crayfish are native to the Gulf Coast and Mississippi River drainage to Illinois. They have spread to other U.S. waters probably through the release of live study specimens by teachers and students, by aquarists as pets, by consumers who purchased them from live food markets and by anglers using them as bait.

Both species live in a variety of freshwater habitats, including rivers, lakes, ponds, streams, canals, seasonally flooded swamps and marshes, and ditches. Generally thought to be species of the southern U.S., they both may be able to colonize every state in the contiguous U.S. according to the White River Crayfish Ecological Screening Summary (USFWS 2015b) and the Red Swamp Crayfish Ecological Risk Screening Summary (USFWS 2015a).

Red swamp crayfish have established populations in Lakes Erie and Michigan (USGS NAS December 2017), and more recently inland waters of OH and MI. A reproducing population of red swamp crayfish was also reported in a small pond in WI.

Both species feed heavily on snails, fish, amphibians, and plants. They compete with native crayfish for food and habitat. They could reduce amphibian breeding success. They are known to consume fish eggs. Burrowing behavior can cause problems for banks and levees. They are known to reduce commercial rice production. The effect on wild rice production in northern states could be significant if they became established where wild rice grows naturally or is cultivated.

Eradicating white river and red swamp crayfish is nearly impossible because they often dig deep burrows into banks of lakes and rivers. The overall risk for white river crayfish is listed as unknown (USFWS 2015b). The risk posed by red swamp crayfish is considered high (USFWS 2015a). While native to much of the MRB, red swamp crayfish are a prohibited species in several northern states. There are, however, few prohibitions for the white river crayfish. Even though white river crayfish are the most common crayfish seen in baitfish production ponds and are not considered as invasive as red swamp crayfish (USFWS 2015b), their presence in baitfish shipments is still considered a risk for areas where they are not native.

Rusty crayfish (*Orconectes rusticus*) are native to the Ohio River basin in tributaries in Western Ohio, Indiana, Kentucky, and Northern Tennessee (USFWS 2015 c), but have become widespread in Minnesota, Wisconsin, Michigan, Illinois, Ontario, and portions of 16 other states. No MRB industry representatives reported rusty crayfish being transported along with other live aquatic bait. Rusty crayfish are more likely moved by recreational fishermen intentionally for use as bait (Hobbs et at. 1989; Kerr et al. 2005; Lodge et al. 1986; Lodge et al. 1994). There are online sales of rusty crayfish in

Wisconsin for food or bait that can ship them throughout the MRB where no regulations prevent it. According to the Rusty Crayfish Ecological Screening Summary (USFWS 2015c) the climate match was high for the Northeast, Mid-Atlantic, and Midwest regions, as well as for parts of the Intermountain West. The climate match was low for the West Coast, Gulf Coast, and Desert Southwest. They ranked the overall risk for rusty crayfish as high and suggested their climate assessment may underestimate climate suitability. Several states have banned the sale of live crayfish as bait because of the threat posed by rusty crayfish (MN and PA are examples).

Fathead Minnow Nidovirus (FHMNV) and Unknown Viruses

FHMNV is an emerging disease and causes mortality in fathead minnows and muskellunge in hatcheries (Baird 2015; Faisel et al. 2016). The virus causes hemorrhages in the eyes, skin and muscle as well as hemorrhages in musculature. Infected minnows also have lesions in the spleen, kidney and liver (Iwanowicz & Goodwin, 2001).

McCann (2012) found that over 8% of fathead minnow lots from bait shops from AR, SD, and MN tested positive for FHMNV. McCann (2012) also found that 59% of the lots of fish from AR, 44% from MN and 38% from SD were positive for one or more viruses. McCann (2012) also found that 47% of cultured baitfish and 31% of wild baitfish were positive for one or more viruses. She did not describe which baitfish she examined came from which of the three states and she lumped together GSV, FHMNV and unknown viruses in this analysis. What this suggests, however, is that the baitfish supply is likely infected with FHMNV and other unknown viruses.

State specific information was not presented, but this research suggests fathead minnows and golden shiners being distributed throughout the MRB could be infected with viruses of concern. FHMNV has not been found in farmed fish in Arkansas (since the original case) and the Arkansas baitfish certification program will test for it if requested. More surveillance for FHMNV and other unknown viruses is needed and a better understanding of any impacts this virus could have on wild musky populations is critical.

Viral Hemorrhagic Septicemia (VHSV)

Over 50 species of fish are known to be susceptible to VHSV. Since first discovered in the Great Lakes region, VHSV has caused several largescale fish kills. However, with possibly one exception, it appears that VHSV has not caused population level impacts in the Great Lakes and other inland lakes. However, muskies in the St. Lawrence River have experienced significant mortality and may not have rebounded (Casselman 2011). For this reason, movement of VHSV to new waterbodies is a concern.

VHSV has never been found in Arkansas and is part of the Certification of Commercial Bait and Ornamental Fish Program there. Therefore, the risk of the virus being moved with fish raised in Arkansas is low. In states where VHSV has been detected, there are regulations in place to minimize the risk of spreading the virus with baitfish harvested in those states. Still, several baitfish species are susceptible to the virus and could move the virus to new waterbodies if regulations are not followed or if the virus shows up unexpectedly in new locations. VHSV can even be spread in dead frozen bait if not properly treated (Phelps et al. 2013)

Illegal Activities

Two unknowns that this project could not address relative to the movement of AIS and pathogens with live aquatic bait are: 1. the extent of illegal commercial movement of live aquatic bait and 2. how well people harvesting or transporting their own bait follow regulations.

Generally, industry representatives interviewed appeared professional and dedicated to following regulations as best they could. There was concern among some in the industry that regulations change frequently and it is difficult to keep up with changes that happen in all the states where they ship. There was also some concern expressed about the expanse of regulations, the paperwork required and the amount of money spent on pathogen testing. It is not known however, how many unscrupulous bait dealers are active in the MRB. In my interviews across the MRB there was an occasional comment about some in the industry not following the regulations. Violations occasionally appear in the media. This suggests that enforcement must be vigilant. There was also an allegation that baitfish trappers harvest baitfish and deliver directly to bait shops without grading or transferring to well water.

There is little information available on harvest of aquatic bait by individuals and whether regulations are followed, and such information would be difficult to collect. Several commercial suppliers suggested that, because regulations restrict the legal sale of aquatic bait, it creates incentives for people to collect their own bait, potentially in violations of regulations. Overall industry interviews did not uncover much personal harvest of bait. In fact, most thought it was insignificant. Still, the personal harvest and subsequent transportation of aquatic bait by individuals remains unknown and worth a closer look. There was more concern expressed about anglers transporting bait into states, like Minnesota, North Dakota, Montana and Wyoming, where it is not legal to bring live minnows into the state.

Conclusion

The live aquatic bait industry and regulations in the MRB are extremely complex and pose a risk for moving AIS or pathogens quickly. At the same time, regulations are in place to minimize the risk to levels most management agencies appear to accept. There is a need to further investigate the risks identified in this report and be vigilant for new risks that may arise.

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Appendices

Appendix A -- Survey of Aquatic Bait Regulations for Mississippi River Basin States

Definition: Live aquatic bait for the purpose of this survey has been identified as fish, amphibians, and aquatic invertebrates.

The following questions are related to the commercial wild harvest and commercial raising of live aquatic bait (Questions 1 -15).

1. Is aquatic bait commercially wild harvested in your state? **Yes____ No____**
    a. If yes, are commercial harvesters required to be licensed? **Yes ___ No ___**
2. Is aquatic bait commercially raised in your state? **Yes____ No____**
    a. If yes, are aquatic bait farmers required to be licensed? **Yes ___ No ___**
3. Are there regulations governing the species of aquatic bait that can be commercially wild harvested in your state? **Yes____ No____**
    a. If yes, please briefly explain the species restrictions for both aquatic vertebrates and invertebrates (include species specifically allowed and/or species specifically not allowed in regulations) and provide a web link if available.

4. Are there regulations governing the species of aquatic bait that can be commercially raised in your state? **Yes____ No____**
    a. If yes, please briefly explain the species restrictions for both aquatic vertebrates and invertebrates (include species specifically allowed and/or species specifically not allowed in regulations) and provide a web link if available.

5. Does your state require pathogen testing of aquatic bait commercially wild harvested or commercially raised within your state? **Yes____ No____**
    a. If yes, please briefly describe the pathogen testing or certification program for aquatic bait wild harvested or raised in your state and provide a web link if available.

6. Does your state require commercially wild harvested or commercially raised aquatic bait from your state to be tested or certified free of non-native or non-target species? **Yes____ No____**
    a. If yes, please briefly describe the required testing or certification program and provide a web link if available.

7. Are there restrictions regarding where aquatic bait can be commercially wild harvested in your state because of the presence of non-native species and/or pathogens? **Yes____ No____**
    a. If yes, please briefly describe the restrictions for commercial harvest and provide web links if available.

8. Are there restrictions regarding where (specific waterbodies) commercial aquatic bait can be used by anglers in your state because of concerns related to non-native species and pathogens? **Yes____ No____**
    a. If yes, please briefly describe these restrictions and provide a web link if available.

9. Are there seasonal restrictions for the commercial wild harvest of aquatic bait in your state? **Yes____ No____**
    a. If yes, please briefly describe the seasonal restrictions and indicate if they are influenced by or the result of non-native species or pathogens. Please provide a web link if available.

10. Are there harvest limits or quotas for the commercial wild harvest of aquatic bait in your state? **Yes____ No____**
    a. If yes, please describe the harvest limits or quotas in your state and provide a web link if available.

11. Are there reporting requirements (such as harvest or sales volume or value, harvest effort, or harvest locations) for commercially wild harvested aquatic bait in your state? **Yes____ No____**
    a. If yes, please describe reporting requirements for commercially wild harvesting aquatic bait and provide web links if available.

12. Are there reporting requirements (such as harvest or sales volume or value, surface area of production water, surface water or ground water usage) for commercially raised aquatic bait in your state? **Yes____ No____**
    a. If yes, please describe reporting requirements for raising aquatic bait and provide web links if available.

13. Can live aquatic bait be exported from your state? **Yes____ No____**
    a. Please describe any limitations or restrictions on the export of aquatic bait from your state especially as it may relate to non-native species and pathogens and which species of aquatic bait (both vertebrates and invertebrates) can be exported and indicate if there is any difference between wild caught or farm raised bait. Please provide web links if available.

14. Can live aquatic bait be imported into your state? **Yes____ No____**

a. If yes to question 14, are there species restrictions regarding live aquatic bait importation into your state? **Yes____ No____**
    i. If yes, please describe the species restrictions regarding live aquatic bait imported into your state (include species specifically allowed and/or species specifically not allowed in regulations) and provide a web link if available.

b. If yes to question 14, is imported live aquatic bait required to be tested for specific pathogens? **Yes____ No____**
    i. If yes, please list which pathogens must tested before live aquatic bait can be imported into your state and provide a web link if available.

c. If yes to question 14, is live aquatic bait imported into your state required to be tested or certified free of non-native or non-target species? **Yes____ No____**
    i. If yes, please list which species of non-native or non-target species are part of this testing/certification requirement and provide a web link if available.

d. If yes to question 14, are there reporting requirements for importing live aquatic bait into your state? **Yes____ No____**
    i. If yes, please describe the reporting requirements for importing live aquatic bait into your state and provide a web link if available.

15. Are there restrictions on the commercial transportation of live aquatic bait in your state? **Yes____ No____**
    a. If yes, please briefly describe any transportation restrictions for commercial aquatic bait haulers (not previously described) and provide a web link if available.

The following questions are related to private wild harvest and private raising of live aquatic bait and use of aquatic bait by anglers (Questions 16 - 18).

16. Does your state allow the wild harvest of aquatic bait for personal use? **Yes ____ No ____**
    a. If yes to question 16, please describe any restrictions to the harvest of aquatic bait for personal use by anglers especially as it relates to non-native or non-target species or pathogens and provide web links if available.

    b. If yes to question 16, please describe any transportation restrictions for aquatic bait that was personally wild harvested or raised.

17. Are there any restrictions regarding the release of unwanted aquatic bait into state waters? **Yes ___ No ___**
    a. If yes, please describe any restrictions to the release of unwanted live aquatic bait by anglers in your state and provide a web link if available.

18. Are there any restrictions regarding aquatic bait that has been used on waters infested with aquatic invasive species? **Yes ___ No ___**
    a. If yes, please describe any restrictions regarding aquatic bait that has been used on aquatic invasive species infested waters.

19. Are there other regulations related to aquatic live bait production, sale, transportation and use in your state that other Mississippi River Basin states should be aware of? **Yes____ No____**
    a. If yes, please describe these regulations and provide web links if available.

20. Please provide contact information for a knowledgeable aquatic bait industry representative that I could contact regarding aquatic bait use in your state.

Thank you for your time and effort

Appendix B -- State Regulation Survey Summary

1. Is aquatic bait commercially wild harvested in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

1a. If yes to 1, are commercial harvesters required to be licensed?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

2. Is aquatic bait commercially raised in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

2a. If yes to 2, are they required to be licensed?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

3. Are there regulations governing the species of aquatic bait that can be commercially wild harvested in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

4. Are there regulations governing the species of aquatic bait that can be commercially raised in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

5. Does your state require pathogen testing of aquatic bait commercially wild harvested or commercially raised within your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

6. Does your state require commercially wild harvested or commercially raised aquatic bait from your state to be tested or certified free of non-native or non-target species?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

7. Are there restrictions regarding where aquatic bait can be commercially wild harvested in your state because of the presence of non-native species and/or pathogens?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

8. Are there restrictions regarding where (specific waterbodies) commercial aquatic bait can be used by anglers in your state because of concerns related to non-native species and pathogens?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

9. Are there seasonal restrictions for the commercial wild harvest of aquatic bait in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

10. Are there harvest limits or quotas for the commercial wild harvest of aquatic bait in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

11. Are there reporting requirements (such as harvest or sales volume or value, harvest effort, or harvest locations) for commercially wild harvested aquatic bait in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

12. Are there reporting requirements (such as harvest or sales volume or value, surface area of production water, surface water or ground water usage) for commercially raised aquatic bait in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

13. Can live aquatic bait be exported from your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

14. Can live aquatic bait be imported into your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

14a. If yes to question 14, are there species restrictions regarding live aquatic bait importation into your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

14b. If yes to question 14, is imported live aquatic bait required to be tested for specific pathogens?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

14c. If yes to question 14, is live aquatic bait imported into your state required to be tested or certified free of non-native or non-target species?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

14d. If yes to question 14, are there reporting requirements for importing live aquatic bait into your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

15. Are there restrictions on the commercial transportation of live aquatic bait in your state?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

16. Does your state allow the wild harvest of aquatic bait for personal use?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

17. Are there any restrictions regarding the release of unwanted aquatic bait into state waters?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

18. Are there any restrictions regarding aquatic bait that has been used on waters infested with aquatic invasive species?

Alabama	Kansas	Nebraska	South Dakota
Arkansas	Kentucky	New York	Tennessee
Colorado	Louisiana	North Carolina	Texas
Georgia	Minnesota	North Dakota	Virginia
Illinois	Mississippi	Ohio	West Virginia
Indiana	Missouri	Oklahoma	Wisconsin
Iowa	Montana	Pennsylvania	Wyoming

Yes	No	N/A	No Response

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Appendix D – Web Links to State Regulations related to Live Aquatic Bait

Alabama
Sport Fishing Pamphlet
http://www.eregulations.com/wp-content/uploads/2018/07/18ALAB.pdf

Fishing Regulations
https://www.outdooralabama.com/fishing

Arkansas
Sport Fishing Pamphlet
https://s3.amazonaws.com/agfc-static/guidebooks/fishingguidebook.pdf

Certification of Commercial Bait and Ornamental Fish
http://170.94.37.152/REGS/209.02.08-005F-9995.pdf

Safe Bait
http://safebaitfish.org/

Colorado
Sport Fishing Pamphlet
https://cpw.state.co.us/Documents/RulesRegs/Brochure/fishing.pdf

State Hunting and Fishing Regulations
https://cpw.state.co.us/Documents/RulesRegs/Regulations/Ch00.pdf

Georgia
Sport Fishing Pamphlet
http://www.eregulations.com/wp-content/uploads/2017/12/18GAFW_LR9.pdf

Commercial Fishing Guide
https://georgiawildlife.com/sites/default/files/wrd/pdf/regulations/2018_CommercialFishingGuide.pdf

Georgia Hunting, Fishing and Boating
https://georgiawildlife.com/

Illinois
Sport Fishing Pamphlet
https://www.ifishillinois.org/regulations/2018FishingGuide.pdf

Commercial Fishing
http://www.ilga.gov/commission/jcar/admincode/017/017008300000600R.html

Aquatic Life Approved Species List
https://www.ifishillinois.org/programs/aquaculture/aquatic_approved_species.pdf

Injurious Species
http://www.ilga.gov/commission/jcar/admincode/017/017008050000200R.html

Commercial Harvest of VHSV-Susceptible Fish
http://www.ilga.gov/commission/jcar/admincode/017/017008300000110R.html

Waters Open to Commercial Harvest of Crayfish
http://www.ilga.gov/commission/jcar/admincode/017/017008300000150R.html

Record Keeping and Reporting
http://www.ilga.gov/commission/jcar/admincode/017/017008700000400R.html

VHSV and Fish Health Inspections
https://testbed.ifishillinois.org/programs/aquaculture/sec17-875_admin_rule.pdf

Fish and Aquatic Life Code
http://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=1728&ChapterID=42

Indiana

Sport Fishing Pamphlet
http://www.eregulations.com/wp-content/uploads/2018/02/18INFW_LR.pdf

Online Indiana Admin Code
http://www.in.gov/legislative/iac/title312.html

AIS Prohibited Species (Rules)
https://www.in.gov/dnr/fishwild/files/fw-AIS_PossessionRules.pdf

IDNR Permit and License Page
https://www.in.gov/dnr/fishwild/2371.htm

Board of Animal Health Fish Importation
https://www.in.gov/boah/2388.htm

Aquatic Invasive Species Possession Rules
https://www.in.gov/dnr/fishwild/files/fw-AIS_PossessionRules.pdf

Iowa

Sport Fishing Pamphlet
https://www.iowadnr.gov/Portals/idnr/uploads/fish/regs_fish.pdf

Taking and Selling of Minnows and Other Bait – Regulations.
https://www.legis.iowa.gov/docs/code/481A.pdf

Endangered Plants and Wildlife
https://www.legis.iowa.gov/publications/search/document?fq=id:996423&pdid=972611&q=481b.1#481B.3

Aquatic Invasive Species

https://www.legis.iowa.gov/docs/code/456a.pdf and
https://www.legis.iowa.gov/law/administrativeRules/rules?agency=571&chapter=90&pubDate=01-02-2019

Approved Aquaculture Species
https://www.legis.iowa.gov/docs/iac/agency/571.pdf

Endangered Plants and Wildlife and Those Species May Not be Cultured.
https://www.legis.iowa.gov/publications/search/document?fq=id:996423&pdid=972611&q=481b.1#481B.3

Wildlife Code
https://www.legis.iowa.gov/docs/code/481A.pdf

Kansas
Sport Fishing Pamphlet
http://ksoutdoors.com/content/download/905/4565/file/KS%20Fishing%20Regulations%2016%20WEB.pdf

Regulations and Statutes
https://ksoutdoors.com/Services/Law-Enforcement/Regulations

Kentucky
Sport Fishing Pamphlet
https://fw.ky.gov/Fish/Documents/18-19_Ky_fishing_guide.pdf

Propagation of Aquatic Organisms
https://apps.legislature.ky.gov/law/kar/301/001/115.pdf

Transportation of Fish
https://apps.legislature.ky.gov/law/kar/301/001/125.pdf

Commercial Fishing Regulations
https://apps.legislature.ky.gov/law/kar/301/001/155.pdf

Louisiana
Sport Fishing Pamphlet
http://www.wlf.louisiana.gov/sites/default/files/pdf/page/41407-regulations/lafishingregs2018.pdf

Legislative and Administrative Code
http://www.wlf.louisiana.gov/regulations

Minnesota
Sport Fishing Pamphlet
https://files.dnr.state.mn.us/rlp/regulations/fishing/fishing_regs.pdf

Minnow Harvest in Infested Waters
https://www.dnr.state.mn.us/fishing/commercial/minnowdealer/iwp.html

Minnow Rules
https://www.revisor.mn.gov/rules/6254/

Private Fish Hatcheries
https://www.revisor.mn.gov/statutes/cite/97C.211

Commercial Fishing, Aquaculture and Minnow Harvest
https://www.dnr.state.mn.us/fishing/commercial/index.html

Minnesota Invasive Species Laws
https://www.dnr.state.mn.us/invasives/laws.html

Mississippi

Sport Fishing Pamphlet
http://www.eregulations.com/wp-content/uploads/2018/07/18MSAB.pdf

Sport Fishing Regulations
http://www.mdwfp.com/media/255419/f-rule-13-sportfishing-regulations-final.pdf

Weblink to aquaculture regulations
http://www.mdac.ms.gov/wp-content/uploads/11-Guidelines-for-Aquaculture-Activities.pdf

Commercial Fishing Regulations
http://www.mdwfp.com/media/254121/f-rule-31commercial-fishing-regulations.pdf

Prohibited Invasive Species
http://www.mdwfp.com/media/253718/f-rule-11-prohibited-species-final.pdf

Missouri

Sport Fishing Pamphlet
https://huntfish.mdc.mo.gov/sites/default/files/downloads/2016_FishRegs.pdf

Endangered Species
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-4.pdf

Commercial fish
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-20.pdf

Commercial Fishing Regulations
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-10.pdf

Live Bait Regulations
https://huntfish.mdc.mo.gov/fishing/regulations/live-bait-regulations

Confined Wildlife

https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-9.pdf

Sportfish
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-6.pdf

Wildlife Codes
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-4.pdf
https://www.sos.mo.gov/cmsimages/adrules/csr/current/3csr/3c10-11.pdf

Montana

Sport Fishing Pamphlet
http://fwp.mt.gov/fwpDoc.html?id=84724

Commercial Bait Seining License
http://fwp.mt.gov/fwpDoc.html?id=8211

Fishing Regulations
http://fwp.mt.gov/fish/regulations/default.html?id=fishing#fishing

Commercial Bait Seining Report Form
http://fwp.mt.gov/fwpDoc.html?id=62313

Leech Shipment Inspections
http://www.mtrules.org/gateway/RuleNo.asp?RN=12%2E7%2E542

Nebraska

Sport Fishing Pamphlet
http://digital.outdoornebraska.gov/i/921860-fishing-guide-2018-web-2/5

Nebraska Fishing Regulations
http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Game_and_Parks_Commission/Title-163/Chapter-2.pdf

Fishing Regulations
http://www.sos.ne.gov/rules-and-regs/regsearch/Rules/Game_and_Parks_Commission/Title-163/Chapter-2.pdf

New York

Sport Fishing Pamphlet
http://www.dec.ny.gov/docs/fish_marine_pdf/fishguide.pdf

Baitfish Regulations
http://www.eregulations.com/newyork/fishing/baitfish-regulations/

Commercial Inland Fisheries

Sale of bait fish from waters outside the State of New York

Prohibited and Regulated Invasive Species

North Carolina

Sport Fishing Pamphlet
http://www.eregulations.com/northcarolina/hunting-fishing/pdf/

http://www.eregulations.com/wp-content/uploads/2018/07/18NCAB_LR3.pdf

Nongame Fishing Regulations
http://www.eregulations.com/northcarolina/hunting-fishing/nongame-fish-regulations/

Approved Aquaculture Species
http://www.ncagr.gov/markets/aquaculture/documents/ExplanationoftheAquacultureLicense.pdf

North Dakota

Sport Fishing Pamphlet
https://gf.nd.gov/gnf/fishing/docs/fishing-guide-2018.pdf

Retail and Wholesale Vendor License
https://gf.nd.gov/gnf/licensing/docs/bait-vendor-app.pdf

Aquatic Nuisance Species
https://gf.nd.gov/ans

Ohio

Sport Fishing Pamphlet
http://wildlife.ohiodnr.gov/portals/wildlife/pdfs/publications/laws%20&%20regs/2018-19%20Fishing%20Regs.pdf

Bait and Bait Dealer Regulations
http://codes.ohio.gov/oac/1501:31-13-04

Regulation of Aquaculture
http://codes.ohio.gov/orc/1533.632 and species defined in
http://codes.ohio.gov/oac/1501:31-1-02

Fish Importation
http://codes.ohio.gov/oac/901:1-17-13 and http://codes.ohio.gov/oac/901:1-17-14

Sport Fishing
http://codes.ohio.gov/oac/1501:31-13-01

Oklahoma

Sport Fishing Pamphlet
https://www.wildlifedepartment.com/sites/default/files/18OKAB-Fishing-PP4_RE.pdf

Commercial Minnow Dealers License
http://www.wildlifedepartment.com/license/minnowdealer.pdf

Aquaculture Program
http://www.oda.state.ok.us/ais/aquaculture.htm

Import Export Permit
http://www.wildlifedepartment.com/license/importexportpermit.pdf

Pennsylvania

Sport Fishing Pamphlet
https://pfbc.pa.gov/fishpub/summaryad/2019summaryComplete.pdf

Fishing in Lake Erie And Boundary Lakes
https://www.pacode.com/secure/data/058/chapter69/chap69toc.html

Bait Dealers License
https://www.agriculture.pa.gov/Animals/AHDServices/licenses-certificates/Aquaculture%20Licensing/Documents/Aquaculture%20Dealer%20%20Packet%202018.pdf

Artificial Propagation Application
https://www.agriculture.pa.gov/Animals/AHDServices/licenses-certificates/Aquaculture%20Licensing/Documents/Aquaculture%20Propagation%20Packet%202018.pdf

Sale of VHS-susceptible species of fish
https://www.pacode.com/secure/data/058/chapter69/s69.3.html

Prohibited Species
https://www.pacode.com/secure/data/058/chapter71/s71.6.html

Propagation of Fish
https://www.pacode.com/secure/data/058/chapter71/chap71toc.html

Transportation of Fish
https://www.pacode.com/secure/data/058/chapter73/chap73toc.html

South Dakota

Sport Fishing Pamphlet
https://www.flipsnack.com/SDGamefishparks/2018-fishing-handbook.html

Importation of Fish
https://sdlegislature.gov/Rules/DisplayRule.aspx?Rule=41:09:08

Aquatic Invasive Species
http://sdleastwanted.com/laws/default.aspx

Tennessee

Sport Fishing Pamphlet
https://www.tn.gov/content/dam/tn/twra/documents/Tennessee-fishing-guide.pdf

Bait Proclamation
https://publications.tnsosfiles.com/pub/proclamations/10-04-18.pdf

Aquatic Invasive Species
https://www.tn.gov/twra/fishing/twra-fish-species.html

Texas

Sport Fishing Pamphlet
https://tpwd.texas.gov/publications/pwdpubs/media/cs_bk_l2000_820.pdfCommercial Fishing Guide
https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_v3400_0074.pdf

Commercial Fish Species
http://texreg.sos.state.tx.us/fids/201302067-1.html

Harvest and Sales Reports

Transportation of Harmful or Potentially Harmful Exotic Species

Collection, Possession and Sale of Shad

Permits to Collect and Sell Nongame Fish

Virginia

Sport Fishing Pamphlet
https://www.dgif.virginia.gov/wp-content/uploads/2018-fishing-regulations.pdf

Freshwater Fishing Regulations
https://www.dgif.virginia.gov/fishing/

West Virginia

Sport Fishing Pamphlet
http://www.wvdnr.gov/Fishing/Regs18/2018_fishingRegs.pdf

Commercial Fishing License
http://www.wvlegislature.gov/wvcode/ChapterEntire.cfm?chap=20&art=2&section=59

Commercial Bait Dealers
https://law.justia.com/codes/west-virginia/2005/20/wvc20-2-55.html

License for Pond Raising Aquatic Life Commercially
http://www.wvlegislature.gov/WVCODE/ChapterEntire.cfm?chap=20&art=2&section=48

Regulating the Release of Fish and Water
http://www.wvlegislature.gov/WVCODE/ChapterEntire.cfm?chap=20&art=2&section=64

Importation of Wildlife
http://www.wvlegislature.gov/WVCODE/ChapterEntire.cfm?chap=20&art=2&section=13

Wisconsin
Sport Fishing Pamphlet
https://dnr.wi.gov/topic/fishing/documents/regulations/FishRegs1819Web.pdf

Fish Farm Registration
https://datcp.wi.gov/Pages/Programs_Services/FishFarmRegistration.aspx

Baitfish Health Certification
http://docs.legis.wisconsin.gov/code/admin_code/atcp/010/10/VIII/645

Bait Dealer Records
https://dnr.wi.gov/topic/fishing/documents/vhs/BaitRecordsForm.pdf

Fish Importation
http://docs.legis.wisconsin.gov/code/admin_code/atcp/010/10/VIII/62

Wyoming
Sport Fishing Pamphlet
https://wgfd.wyo.gov/Regulations/Regulation-PDFs/WYFISHINGREGS_BROCHURE

Fishing Regulations
https://wgfd.wyo.gov/Fishing-and-Boating/Fishing-Regulations

Watercraft Inspections and AIS
https://wgfd.wyo.gov/Fishing-and-Boating/Aquatic-Invasive-Species-Prevention

Appendix E -- Aquaculture Census - Baitfish

United States Department of Agriculture, National Agriculture Statistics Service.
2013 Census of Aquaculture. The aquaculture Census collects detailed information relating to production volume and methods, surface water acres and sources, sales, point of first sale outlets, and aquaculture distributed for restoration, conservation, enhancement, or recreational purposes. Presented below is information related to baitfish production.

Geographic area	Baitfish			
	2013		2005	
	Farms	Sales ($1,000)	Farms	Sales ($1,000)
United States	166	29,375	257	38,018
Alabama	5	18	7	41
Arkansas	23	18,360	51	20,302
Colorado	2	(D)	1	(D)
Georgia	3	147	5	6
Illinois	2	(D)	4	(D)
Indiana	1	(D)		
Iowa	3	(D)		
Kansas	3	47	7	(D)
Kentucky			3	(D)
Louisiana	6	(D)	8	(D)
Minnesota	22	2,398	51	4,951
Mississippi	6	172	7	557
Missouri	6	950	4	(D)
Montana				
Nebraska	2	(D)	8	78
New York	7	83	18	171
North Carolina	2	(D)	4	(D)
North Dakota				
Ohio	16	1,674	12	827
Oklahoma	1	(D)	4	24
Pennsylvania	6	270	8	283
South Dakota	2	(D)	1	(D)
Tennessee	1	(D)	5	434
Texas	9	(D)	3	(D)
Virginia		(D)	2	(D)
West Virginia	3	68	2	(D)
Wisconsin	11	1,546	14	3,892
Wyoming	3	4	2	(D)

Table 4. Baitfish Production and Sales by Species - United States: 2013

Species	Farms	Number sold (1,000)	Live weight (1,000 pounds)	Number per pound	Sales	
					Total ($1,000)	Average price per pound (dollars)
Baitfish, total	166	(X)	(X)	(X)	29,375	(X)
Crawfish (bait)	28	2,062	53	38.9	193	3.64
Fathead minnows	100	621,621	3,002	207.1	9,880	3.29
Goldfish (feeder and bait)	20	(D)	(D)	(D)	(D)	(D)
Golden shiners	53	523,428	6,110	85.7	14,286	2.34
Other shiners	13	5,093	53	96.7	(D)	(D)
Suckers	29	14,179	572	24.8	1,624	2.84
Other baitfish	26	(X)	(X)	(X)	426	(X)

Table 16. Baitfish Sales by Species - United States and States: 2013 and 2005

[For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Total					
	2013			2005		
	Farms	Sales ($1,000)	Water surface acres used to produce baitfish	Farms	Sales ($1,000)	Water surface acres used to produce baitfish
United States	166	29,375	33,104	257	38,018	58,306
Alabama	5	18	152	7	41	58
Alaska	-	-	-	-	-	-
Arizona	-	-	-	-	-	-
Arkansas	23	18,360	12,891	51	20,302	21,965
California	2	(D)	(D)	4	(D)	(D)
Colorado	2	(D)	(D)	1	(D)	(D)
Connecticut	-	-	-	-	-	-
Delaware	-	-	-	1	(D)	(D)
Florida	12	41	14	2	(D)	(D)
Georgia	3	147	11	5	6	8
Hawaii	-	-	-	-	-	-
Idaho	-	-	-	-	-	-
Illinois	2	(D)	(D)	4	(D)	7
Indiana	1	(D)	(D)	-	-	-
Iowa	3	(D)	9	-	-	-
Kansas	3	47	(D)	7	(D)	123
Kentucky	-	-	-	3	(D)	22
Louisiana	6	(D)	(D)	8	(D)	1,012
Maine	1	(D)	(D)	2	(D)	(D)
Maryland	-	-	-	1	(D)	(D)
Massachusetts	1	(D)	(D)	1	(D)	(D)
Michigan	1	(D)	(D)	3	5	(D)
Minnesota	22	2,398	15,667	51	4,951	30,674
Mississippi	6	172	(D)	7	557	645
Missouri	6	950	276	4	(D)	(D)
Montana	-	-	-	-	-	-
Nebraska	2	(D)	(D)	8	78	38
Nevada	-	-	-	-	-	-
New Hampshire	1	(D)	(D)	1	(D)	(D)
New Jersey	1	(D)	(D)	4	16	9
New Mexico	-	-	-	-	-	-
New York	7	83	74	18	171	212
North Carolina	2	(D)	(D)	4	(D)	3
North Dakota	-	-	-	-	-	-
Ohio	16	1,674	34	12	827	98
Oklahoma	1	(D)	(D)	4	24	(D)
Oregon	-	-	-	1	(D)	(D)
Pennsylvania	6	270	(D)	8	283	152
Rhode Island	-	-	-	-	-	-
South Carolina	1	(D)	(D)	4	(D)	(D)
South Dakota	2	(D)	(D)	1	(D)	(D)
Tennessee	1	(D)	(D)	5	434	49
Texas	9	(D)	48	3	(D)	(D)
Utah	-	-	-	-	-	-
Vermont	-	-	-	1	(D)	(D)
Virginia	1	(D)	(D)	2	(D)	(D)
Washington	-	-	-	1	(D)	(D)
West Virginia	3	68	2	2	(D)	(D)
Wisconsin	11	1,546	502	14	3,892	1,057
Wyoming	3	4	3	2	(D)	(D)

Table 16. **Baitfish Sales by Species - United States and States: 2013 and 2005** (continued)

Geographic area	Fathead minnows				Goldfish (feeder and bait)				Golden shiners			
	2013		2005		2013		2005		2013		2005	
	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)
United States	100	9,880	160	9,853	20	(D)	40	6,341	53	14,286	76	17,100
Alabama	-	-	3	(D)	-	-	-	-	-	-	2	(D)
Alaska	-	-	-	-	-	-	-	-	-	-	-	-
Arizona	-	-	-	-	-	-	-	-	-	-	-	-
Arkansas	19	5,148	29	4,766	8	2,568	18	3,492	13	10,634	22	11,974
California	1	(D)	3	(D)	-	-	2	(D)	1	(D)	-	-
Colorado	2	(D)	1	(D)	-	-	-	-	-	-	-	-
Connecticut	-	-	-	-	-	-	-	-	-	-	-	-
Delaware	-	-	1	(D)	-	-	-	-	-	-	-	-
Florida	1	(D)	-	-	-	-	-	-	1	(D)	1	(D)
Georgia	-	-	1	(D)	-	-	3	4	-	-	1	(D)
Hawaii	-	-	-	-	-	-	-	-	-	-	-	-
Idaho	-	-	-	-	-	-	-	-	-	-	-	-
Illinois	1	(D)	2	(D)	1	(D)	-	-	-	-	-	-
Indiana	1	(D)	-	-	-	-	-	-	-	-	-	-
Iowa	3	(D)	-	-	-	-	-	-	-	-	-	-
Kansas	3	(D)	7	47	1	(D)	-	-	-	-	-	-
Kentucky	-	-	2	(D)	-	-	1	(D)	-	-	-	-
Louisiana	1	7	2	(D)	-	-	1	(D)	1	1,200	2	(D)
Maine	1	(D)	1	(D)	-	-	-	-	1	(D)	2	(D)
Maryland	-	-	-	-	-	-	-	-	-	-	-	-
Massachusetts	-	-	-	-	-	-	-	-	-	-	1	(D)
Michigan	1	(D)	3	(D)	-	-	-	-	-	-	1	(D)
Minnesota	14	1,137	36	2,019	-	-	-	-	12	175	14	471
Mississippi	3	15	3	(D)	1	(D)	3	39	1	(D)	5	(D)
Missouri	5	(D)	3	21	-	-	1	(D)	3	867	1	(D)
Montana	-	-	-	-	-	-	-	-	-	-	-	-
Nebraska	2	(D)	6	53	-	-	2	(D)	-	-	2	(D)
Nevada	-	-	-	-	-	-	-	-	-	-	-	-
New Hampshire	1	(D)	-	-	-	-	-	-	-	-	-	-
New Jersey	-	-	2	(D)	-	-	-	-	1	(D)	1	(D)
New Mexico	-	-	-	-	-	-	-	-	-	-	-	-
New York	2	(D)	17	45	1	(D)	-	-	-	-	4	(D)
North Carolina	1	(D)	-	-	-	-	1	(D)	1	(D)	-	-
North Dakota	-	-	-	-	-	-	-	-	-	-	-	-
Ohio	12	(D)	9	460	4	25	1	(D)	3	(D)	3	(D)
Oklahoma	-	-	2	(D)	-	-	1	(D)	-	-	-	-
Oregon	-	-	-	-	-	-	-	-	-	-	-	-
Pennsylvania	6	(D)	5	(D)	2	(D)	2	(D)	5	4	3	7
Rhode Island	-	-	-	-	-	-	-	-	-	-	-	-
South Carolina	-	-	-	-	-	-	-	-	-	-	1	(D)
South Dakota	2	(D)	1	(D)	-	-	-	-	1	(D)	-	-
Tennessee	1	(D)	4	258	1	(D)	2	(D)	1	(D)	2	(D)
Texas	5	275	2	(D)	1	(D)	-	-	5	266	1	(D)
Utah	-	-	-	-	-	-	-	-	-	-	-	-
Vermont	-	-	-	-	-	-	-	-	-	-	-	-
Virginia	-	-	-	-	-	-	-	-	-	-	1	(D)
Washington	-	-	-	-	-	-	-	-	-	-	-	-
West Virginia	3	68	2	(D)	-	-	1	(D)	-	-	-	-
Wisconsin	6	633	11	1,617	-	-	1	(D)	3	(D)	6	993
Wyoming	3	(D)	2	(D)	-	-	-	-	-	-	-	-

[For meaning of abbreviations and symbols, see introductory text.]

--continued

Table 16. **Baitfish Sales by Species - United States and States: 2013 and 2005** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Other shiners				Suckers				Other baitfish			
	2013		2005		2013		2005		2013		2005	
	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)	Farms	Sales ($1,000)
United States	13	(D)	18	623	29	1,624	53	2,727	26	426	39	1,124
Alabama									4	(D)	5	(D)
Alaska												
Arizona												
Arkansas				(D)						(D)	2	(D)
California												
Colorado										(D)		
Connecticut												
Delaware												
Florida	2	(D)							3	(D)		
Georgia				(D)					3	147		(D)
Hawaii												
Idaho												
Illinois												
Indiana												
Iowa						(D)						
Kansas												(D)
Kentucky												
Louisiana												(D)
Maine		(D)		(D)		(D)		(D)				
Maryland												(D)
Massachusetts										(D)		
Michigan							1	(D)				
Minnesota	5	32	5	(D)	15	1,044	39	1,924	3	9	9	455
Mississippi	1	(D)			1	(D)						
Missouri												(D)
Montana												
Nebraska											2	(D)
Nevada												
New Hampshire				(D)								
New Jersey										(D)		(D)
New Mexico												
New York				(D)			2	(D)				
North Carolina											2	(D)
North Dakota												
Ohio	3	(D)				(D)				(D)		(D)
Oklahoma										(D)		
Oregon												(D)
Pennsylvania				(D)		(D)	2	(D)				
Rhode Island												
South Carolina											3	(D)
South Dakota						(D)		(D)				
Tennessee												(D)
Texas									2	(D)		(D)
Utah												
Vermont												
Virginia										(D)		(D)
Washington												(D)
West Virginia			1	(D)								
Wisconsin		(D)	6	(D)	6	554	6	725	4	(D)	4	37
Wyoming					2	(D)	1	(D)				

Appendix F – Description of Live Aquatic Bait used in the Mississippi River Basin

Golden shiners (*Notemigonus crysoleucas*)
Common names: golden shiners, silver shiners, shiners, crappie minnows, bass minnows, walleye minnows, pike minnows, brooders, golden roaches.
Where used in MRB: Every state except Montana, North Dakota, and Wyoming.
Typical sizes sold: Bait shops typically carry from 2 to 4 sizes of golden shiners but wholesalers may list up to six sizes of golden shiners.

#4	4lbs/1000 fish	1.5 in	Below 21 grader
#6	6lbs/1000 fish	2.25 in	21 to 27 grader
#8	8lbs/1000 fish	2.5 in	
#12	12lbs/1000 fish	3 in	27 to 29 grader
#20	20lbs/1000 fish	3.5 in	
Brooders	38lbs/1000	Over 4 in	Above a 29 grader

Where they're produced: The primary source of golden shiners in the Basin is from farms in Arkansas. Other states that produce golden shiners from managed lakes or the wild include MN, and WI. There is at least one golden shiner farm in MO and in TN. AR is the only state to export significant quantities.

Fathead minnows (*Pimephales promelas*)
Common names: fathead minnows, tuffy minnows, tuffies, fatheads, blacks, blackhead minnows, chubs, crappie minnows.
Where used in MRB: Every state in the basin except possibly LA.
Typical sizes sold: Bait shops typically carry one or two sizes but wholesalers may carry up to four sizes.

Small	3.5lbs/1000 fish	1 to 1.5 in	Below 17 grader
Medium	5.5lbs/1000 fish	1.5 to 2 in	17 to 19 grader
Large	10lbs/1000 fish	2 to 2.75 in	19 to 21 grader
X-Large	14lbs/1000 fish	2.75 to 3.5 in	Above 21 grader

Where they're produced: The primary source of fathead minnows in the basin is from farms in Arkansas and managed lakes and wild harvest in ND, SD and MN. Some fatheads are also wild caught in WI, WY and MT but are not exported.

Rosy Reds (*Pimephales promelas*)
Common names: rosy reds, rosies, pinks, rosie reds, ruby reds.
Where used in MRB: Nearly every state with possibly a few exceptions.
Typical sizes sold: Bait shops typically sell one size of rosy reds but wholesalers may sell a couple different sizes.

Small	1 to 2 in	Below 18 grader
Large	2 to 3.5 in	Above 18 grader

Where they're produced: The primary source of rosy reds is from farms in Arkansas. There are also some rosy reds raised for bait in other states like MN and WI.

Goldfish (*Carassius auratus*)
Common names: goldfish, goldies, trot line bait.
Where used in the MRB: In many states in the basin goldfish are an illegal baitfish. They are not legal in CO, MN, MT, NY, PA, ND, SD, WI, WY. They are legal in AL, AR, GA, KS, IL, IN, IA, LA, OH, OK, MS, MO, NC, TN, NE, KY, VA, WV, TX.
Typical sizes sold: Goldfish are typically sold for fishing catfish with trotlines or rod and reel at sizes from 2 to 4.5 inches.
Where they're produced: The primary source of goldfish for fishing bait in the basin is from farms in Arkansas. Goldfish are raised in several other states for ornamental purposes and some (typically culls) may be sold for bait.

Black Salty (*Carassius auratus*)
Common Names: black salties, salties, blacks.
Where used in the MRB: Black salties are goldfish without the distinctive gold color. They are only sold where goldfish are legal (AL, AR, GA, KS, IL, IN, IA, LA, OH, OK, MS, MO, NC, TN, NE, KY, VA, WV, TX) but are less commonly found in bait shops than goldfish.
Typical sizes sold: Similar to goldfish, they may be sold for trotline or rod and reel fishing bait for catfish or striped bass and are typically sold as small (2 to 3.5 in) or large (3.5 to 5 in).
Where they're produced: The primary source of black salties is one farm in Arkansas.

White Suckers (*Catostomus commersonii*)
Common names: white suckers, suckers, sucker minnows, chubs, pike or light pike bait, musky bait, decoys, odds, creek chubs.
Where used in the MRB: Primarily in the northern states within the Basin. CO, IL, IN, IA, MN, MT, NE, NY, ND, OH, PA, SD, WI, WY. While legal in a limited area of ND white suckers are not allowed for sale in most of ND.
Typical sizes sold:

Small/Medium	2 to 4 in
Large	4 to 7 in
Small Musky	8 to 10 in
Medium Musky	11 to 13 in
Large Musky	14 to 16 in
X-Large Muskie	Over 16 in

Where they're produced: The primary source for white suckers is farms (see description of farm raised suckers) in MN, SD and WI. Suckers are also wild harvested in a few states such as WI, MN, WY, and MT.

Emerald Shiners (*Notropis atherinoides*)
Common names: emerald shiners, shiners, lake shiners, emeralds, buckeyes.
Where used in the MRB: Emerald shiners are primarily used in the Great Lakes states such as MN, WI, OH, PA, and NY. Some may be wild harvested and used in MT.
Typical sizes sold:

Small	1 to 2 in	below 15 grader

Medium	2 to 2.5 in	15 to 17 grader
Large	2.5 to 4 in	above 17 grader

Where they're produced: Most emerald shiners are wild harvested from lakes and rivers in MN, WI, OH, PA, and NY. Some emerald shiners may also be wild harvested in MT. The only state that exports a significant quantity of emerald shiners is WI.

Spottail Shiners (*Notropis hudsonius*)
Common names: spottail shiners, spottails, shiners.
Where used in the MRB: They are primarily used in MN and WI. They may also be used in NY.
Typical sizes sold: Sizes are similar to emerald shiners.
Where they're produced: They are wild harvested from lakes/tributaries and rivers in MN and WI. The NY bait industry wild harvests what they call "hunts" which could be spottail shiners (personal comm. Gregory Kozlowski, NY DEC).

Bluegills (*Lepomis macrochirus*), **Green Sunfish** (*Lepomis cyanellus*) and **Hybrid Bluegills** (Blusegill/Greensunfish cross)
Common names: bluegills, perch, bream, brim, green sunfish, sunfish, sunnies, rice slicks, warmouth, goggle eye, hybrid bluegill.
Where used in the MRB: These baitfish are used primarily for catfish bait within the Basin and are used in areas where catfishing is popular. Can either be used live or as cut bait. States where commercial retail sales were noted are AR, IA, KS, KY, MO, NE, OK, TN, TX, WV.
Typical sizes sold: Sizes are often 3 to 5 inches.
Where they're produced: They are produced on farms primarily in AR and MO. Hybrid bluegills produced in Arkansas for the baitfish market are part of the Commercial Bait and Ornamental Fish Certification Program. Farms in many states raise them but primarily for pond stocking rather than bait. Anglers will frequently catch their own for use as live or cut bait.

Dace
Northern Redbelly Dace (*Chrosomus eos*)
Southern Redbelly Dace (*Chrosomus erythrogaster*)
Finescale Dace (*Chrosomus neogaeus*)
Pearl Dace (*Margariscus nachtriebi*)
Common names: northern redbelly dace, southern redbelly dace, finescale dace, pearl dace, rainbow chubs, rainbows, jumpers.
Where used in the MRB: The only mention of their use was in MN and WI.
Typical sizes sold: The northern and southern redbelly dace are typically 2 to 2.5 inches and the finescale dace can be up to 4 inches.
Where they're produced: They are wild harvested in MN and WI.

Creek Chubs (*Semotilus atromaculatus*)
Common names: creek chubs, black tail chub, chubs.
Where used in the MRB: The only mention of their use was in MN, ND, SD and WI.

Typical sizes sold: They are typically 3 to 5 inches.
Where they're produced: Creek chubs are wild harvested in MN, ND, SD and WI streams/rivers. Some creek chubs are farm raised in WI.

Hornyhead Chubs (*Nocomis biguttatus*)
Common names: hornyhead chubs, redtail chubs, hornyheads, chubs.
Where used in the MRB: The only mention of their use was in MN and WI.
Typical sizes sold: They are typically 3 to 5 inches.
Where they're produced: Hornyhead chubs are wild harvested in MN and WI streams/rivers. Some hornyhead chubs are farm raised in MN.

Common Shiners (*Notemigonus crysoleucas*)
Common names: common shiner, shiners, river shiner.
Where used in the MRB: The only mention of their use was in MN and WI.
Typical sizes sold: They are typically 3 to 5 inches.
Where they're produced: Common shiners are wild harvested in MN and WI streams/rivers.

Longnose Suckers (*Catostomus catostomus*)
Common names: longnose suckers, sucker, sucker minnows, chubs.
Where used in the MRB: Montana is the only state where these fish were mentioned as part of baitfish wild harvest.
Typical sizes sold: Sizes used for bait may be 2.5 to 5 inches.
Where they're produced: MT

Eastern Silvery Minnows (*Hybognathus regius*)
Common names: silvery minnow, shiners, hunts.
Where used in the MRB: NY
Typical sizes sold: Typical sizes may be 2 to 3.5 inches.
Where they're produced: Tributaries to NY waters of Lake Ontario and St. Lawrence River.

Western Silvery Minnow (*Hybognathus argyritis*)
Common names: silvery minnow, shiners.
Where used in the MRB: The only states where their use as bait was mentioned was MT and SD.
Typical sizes sold: Typically, 2 to 3.5 inches.
Where they're produced: They are wild harvested in MT and SD.

Flathead Chubs (*Platygobio gracilis*)
Common names: flathead chubs, chubs.
Where used in the MRB: The only state where their use as bait was mentioned was MT.
Typical sizes sold: Typical sizes may be 3 to 5 inches.
Where they're produced: They are wild harvested in MT.

Lake Chub (*Couesious plumbeus*)
Common names: lake chub, chub
Where used in the MRB: The only state where their use as bait was mentioned was MT.
Typical sizes sold: Typically, 2.5 to 5 inches.
Where they're produced: They are wild harvested in MT.

Banded Killifish (*Fundulus diaphanous*)
Common names: banded killifish, killifish, killies.
Where used in the MRB: The only mention of their use as bait was in NY.
Typical sizes sold: Typically, 2 to 3 inches.
Where they're produced: Tributaries to NY waters of Lake Ontario and St. Lawrence River.

Central Mudminnow (*Umbra limi*)
Common names: mudminnow.
Where used in the MRB: The only states to mention their use were MN and WI.
Typical sizes sold: Sizes were not reported but likely 2 to 4 inches.
Where they're produced: Wild harvested from MN and WI waters.

Bullheads (*Ameiurus melas or Ameiurus natalis*)
Common names: bullheads, yellow bellies, bullhead catfish.
Where used in the MRB: The only states to mention their use were OH, KS, and MN.
Typical sizes sold: Sizes for catfish bait are 5 to 8 inches, however, smaller ones may be used for walleye bait in the Mississippi River.
Where they're produced: Bullheads are wild harvested in MN and used there or exported. Anglers likely harvest their own for use as bait in many states as well.

Tadpole Madtoms (*Noturus gyrinus*)
Common names: tadpole madtoms, madtoms, willow cats.
Where used in the MRB: The only state where their use was mentioned was in MN. They are primarily used in the Mississippi River.
Typical sizes sold: Usually 2 to 3 inches.
Where they're produced: They are wild harvested in MN but are difficult to get and not widely available.

Carp
Common Carp (*Cyprinus carpio*)
Israeli Carp (*Cyprinus carpio carpio*)
Common names: common carp, Israeli carp, carp, mirror carp.
Where used in the MRB: OH, WV, and KY suggested that Israeli carp had been used as bait in previous years, however, they were unavailable last year.
Typical sizes sold: Not reported.
Where they're produced: The source has not been found but they came from an AR farm.

American eels (*Anguilla rostrata*)
Common names: eels.
Where used in the MRB: Their use was noted in North Carolina and Virginia.
Typical sizes sold: unknown
Where they're produced: They were wild harvested from unnamed east coast states.

Leeches
Ribbon Leeches (*Nephelopsis obscura*)
Horse Leeches (*Haemopis sangaisaga*)
Common names: N. obscura is called ribbon leech, water leech, leech. H. sagaisaga is called the horse leech or mud leech.
Where used in the MRB: The ribbon leech was mentioned as bait in CO, IL, IN, IA, KS, KY, MN, MO, MT, NE, NY, ND, OH, PA, SD, TN, WV, WI, WY. The horse leech was mentioned as bait in IL and MO.
Typical sizes sold: Bait shop typically carry 2 or more sizes of leeches (medium and large most often) and wholesalers sell four to five different sizes of ribbon leeches.

Small	225 to 300 per pound
Medium	170 to 225 per pound
Large	125 to 160 per pound
Jumbo	85 to 120 per pound
Super Jumbo	50 to 80 per pound

Where they're produced: Leeches are primarily wild harvested in MN but some are also wild harvested in WI, ND, SD and MI.

Crayfish
Red Swamp Crayfish (*Procambarus clarkii*)
White River Crayfish (*Procambarus acutus*)
Papershell Crayfish (*Orconectes immunis*)
Rusty Crayfish (*Orconectes rusticus*)
Northern Crayfish (*Orconectes virilis*)
Common names: crayfish, crawfish, crawdads, mudbugs, soft craws, craws, softshells, hardshells.
Where used in the MRB: The states where crayfish were found in bait shops include AL, AR (probably white river crayfish), IN, IA, KS, KY (at least one bait shop sold red swamp crayfish), MO (only northern crayfish are legal), NY (probably papershell crayfish), OH (probably only papershell crayfish), and WV.
Typical sizes sold: Crayfish used for bait are usually 1.5 to 3 inches (tail to nose).
Where they're produced: Rusty crayfish are wild harvested in WI. Papershell crayfish are farm raised in OH (probably only one producer) and wild caught in NY. Northern crayfish are the only legal crayfish in MO and are raised there. White river crayfish are an unwanted invader in AR baitfish ponds and are occasionally sold as bait in AR and other states. Red swamp crayfish are grown in LA and have been shipped by air to other states (like KY) for bait.

Freshwater Shrimp (*Gammarus Lacustris*)
Common names: freshwater shrimp, scuds, sideswimmers, Gammarus.

Where used in the MRB: Primarily used in Minnesota, but some may be used in South Dakota or other neighboring states as a result of internet sales.
Typical Sizes: Less than one inch.
Where they're produced: Freshwater shrimp are harvested from select wetlands in Minnesota that usually contain few fish.

Mayfly Nymphs (*Ephemera simulons or Hexagenia limbate*)
Common names: mayflies, wigglers.
Where used in the MRB: Found in WI bait shops, especially in winter and spring.
Typical sizes sold: About one inch to 1.5 inches.
Where they're produced: They are dredged from the muddy areas of streams or lakes in WI.

Dragonfly Nymphs – various species including (*Tetragoneuria spinigera*)
Common names: thunderbugs, rock flies, dragonfly nymphs, hellgrammites (term used incorrectly in WI).
Where used in the MRB: Found in WI bait shops, especially spring to fall. They are shipped to bait shops and directly to fishermen in many states in the Basin including IL, IN, OH, IA, KY, AL, AR, TX and probably others.
Typical sizes sold: About one inch.
Where they're produced: They are harvested from small lakes in northern WI.

Grass Shrimp (*Palaemonetes kadiakensis*)
Common names: grass shrimp, freshwater shrimp.
Where used in the MRB: They were mentioned as bait in LA, but mostly harvested for personal use.
Typical sizes sold: Typically, 1.5 to 2 inches.
Where they're produced: May be found in many habitats but were described as being captured in backwater areas of the Mississippi River.

Hellgrammites or Dobson Fly Nymphs (*Corydalus cornutus)*
Common names: hellgrammites, dobsonfly larvae, clippers, hellgies.
Where used in the MRB: These have been mentioned in several states like PA, NY, WV, but there was no current record of them being sold in bait shops. The bait labelled as hellgrammites in WI are dragonfly nymphs.
Typical sizes sold: Up to 3 inches in length.
Where they're produced: They are harvested from streams and rivers, mostly for personal use, but there was some mention of them being sold as bait in a few MRB states.

Tiger Salamanders - Larval stage (*Ambystoma tigrinum*)
Common names: tiger salamander, waterdogs, mud puppies.
Where used in the MRB: The only states that mentioned the use of waterdogs in 2018 were CO and ND, however, bait shops in several other states indicated that they had sold them in the past but were now

hard to get. Tiger salamanders are harvested in ND for use there. The only other source found was an online vendor in TX that sells directly to anglers and others in many different states.
Typical sizes sold: Four to seven inches.
Where they're produced: The tiger salamanders are harvested in NE for the online retailer in TX and in ND for use there.

Frogs (*Lithobates sp.*)
Common names: frogs.
Where used in the MRB: Frogs were not mentioned as a live bait sold by any industry contacts during 2018, however, they were occasionally mentioned as being sold in years past.
Typical sizes sold: N/A
Where they're produced: N/A

Appendix G -- Live Aquatic Bait Used in each Mississippi River Basin State

Alabama
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds, black salties from AR. There are some locally caught crayfish that enter the bait market in Alabama.

Arkansas
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds, crawfish, green sunfish, black salty from AR

Colorado
Bait reported used: Fathead minnows, golden shiners from AR. White suckers (likely from MN). Leeches from MN. Waterdogs from a Kansas distributor (not sure where they are harvested).

Georgia
Bait reported used: Fathead minnows, golden shiners, some rosy reds, some goldfish from AR.

Illinois
Bait reported used: Fathead minnows, golden shiners, goldfish from AR. White suckers from WI. Ribbon and horse leeches from MN.

Indiana
Bait reported used: Fathead minnows, golden shiners, some rosy reds, some goldfish from AR. White suckers and leeches from MN or WI. Fathead minnows from SD and MN. Some crayfish (source/species uncertain).

Iowa
Bait reported used: Fathead minnows, golden shiners, some rosy reds, some goldfish and some green sunfish from AR. Green sunfish and crayfish from MO. Fathead minnows, suckers and leeches from SD and MN. Leeches from WI. A few local crayfish are sold at retail. Some horse leeches (from MN) – but hard to get now. Some local harvest of creek chubs, suckers, common shiners and spottail shiners.

Kansas
Bait reported used: Leeches from MN. Hybrid bluegills, bullheads, rosy reds, fathead minnows, goldfish, golden shiners, crayfish from AR. Some crayfish may come from MO.

Kentucky
Bait reported used: Crayfish from LA. Golden shiners, fathead minnows, black salties, hybrid bluegills, goldfish from AR. Leeches from MN. Israeli carp mentioned but can't get them anymore. Israeli carp probably came from AR.

Louisiana
Bait reported used: Golden shiners from AR. Grass shrimp caught locally and sold commercially. Crayfish are harvested for personal live bait use but not sold commercially.

Minnesota
Bait reported used: Golden shiners, fathead minnows, white suckers, hornyhead chubs, emerald shiners, spottail shiners, northern redbelly dace, finescale dace, pearl dace, creek chubs, common shiners, tadpole madtoms, bullheads, mud minnows, bluntnose minnows, leeches, freshwater shrimp (Gammarus) all from MN waters. Most of the white sucker and some of the golden shiners, fathead minnows, and a few hornyhead chubs are farm raised. The rest are wild harvested.

Mississippi
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds from AR.

Missouri
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds from AR. One golden shiner farm in MO. Hybrid bluegill – may come from AR or MO farms. Only one species of crayfish legal (*Orconectes virilis*) and that is produced in MO. Leeches and horse leeches from MN.

Montana
Bait reported used: Western silvery minnows, fathead minnows, lake chubs, creek chubs, longnose suckers, white suckers, plains minnows, emerald shiners, longnose dace, flathead chubs all wild harvested in MT. Leeches from certified dealers in MN and ND.

Nebraska
Bait reported used: Golden shiners, fathead minnows, goldfish, hybrid bluegill from AR. Some fathead minnows from SD. Leeches from MN. Some suckers from MN. Crayfish are mostly locally harvested. There is a limited wild harvest of baitfish out of the Platte River (possible one or more of these species -- the western silvery minnow, plains minnow, flathead chub, and speckled chub).

New York
Bait reported used: Golden Shiners, fathead minnows, rosy reds from AR. Crayfish (*Orconectes immunis*) mostly grown or harvested locally. Emerald shiners from Niagara River, eastern silvery minnow (hunts) (these could also be bluntnose minnows or emerald shiners), banded killifish from Lake Ontario/St. Lawrence River tributaries. Suckers from MN. Some emerald shiners from WI. Leeches from MN.

North Carolina
Bait reported used: Golden shiners, goldfish, black salties, fathead minnows from AR. Eels from east coast.

North Dakota
Bait reported used: Fathead minnows harvested from ND are used statewide (sticklebacks are a legal nontarget component of fathead minnow distribution). White suckers (probably from MN) can only be used in Red River and Bois de Sioux Rivers. Leeches from MN. There was some mention of leeches, tiger salamanders and frogs being harvested and used as bait in ND. There are some creek chubs wild harvested.

Ohio
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds from AR. Emerald shiners from Lake Erie but numbers are way down. Emerald shiners from WI. Crayfish locally grown. Bullheads, leeches and white suckers from MN/WI. Brought in Israeli carp from AR in the past but couldn't get any last year (2018).

Oklahoma
Bait reported used: Golden shiners, goldfish, fathead minnows, rosy reds and hybrid bluegill from AR.

Pennsylvania
Bait reported used: Some golden shiners and fathead minnows raised in PA but the majority comes from AR. Golden shiners, fathead minnows, rosy reds from AR. Emerald shiners from Lake Erie and from WI. White suckers from MN/WI. Leeches from MN.

South Dakota
Bait reported used: Fathead minnows are the predominant aquatic bait in the state and are harvested in SD. Some white suckers are raised and used in SD. Some golden shiners may be brought in from AR. There may be some creek chubs and western silvery minnows wild harvested and sold in SD, but is very small part of the market. Leeches from MN.

Tennessee

Bait reported used: Golden shiners, fathead minnows, rosy reds, goldfish. Black salties, hybrid bluegill from AR. One small farm in TN raises golden shiners and fathead minnows. Leeches from MN.

Texas

Bait reported used: Golden shiners, goldfish, fathead minnows, black salties, rosy reds, hybrid bluegill from AR.

Virginia

Bait reported used: Golden shiners, fathead minnows, rosy reds, goldfish, black salties from AR. Eels from the east coast.

West Virginia

Bait reported used: Golden shiners, fathead minnows, rosy reds, goldfish, sunfish sp. from AR. Used to buy Israeli carp but unavailable last year. Leeches from MN. Some crayfish and hellgrammites that are locally harvested are sold for bait.

Wisconsin

Bait reported used: Golden shiners, fathead minnows and rosy reds from AR. White suckers raised in WI and MN and some wild harvested in WI. Emerald shiners, creek chubs, common shiners, pearl dace, northern redbelly dace, southern redbelly dace, finescale dace, hornyhead chubs, golden shiners that are wild harvested in WI. Golden shiners and creek chubs that are farm raised in WI. Leeches are mostly from MN but some harvested in WI. Mayfly and dragonfly nymphs are harvested and sold for fishing bait in the state and exported to other MRB states. Rusty crayfish are harvested for instate bait use and for export (very small amount).

Wyoming

Bait reported used: Fathead minnows imported from a certified dealer (one in AR and one in SD in 2018) can be used statewide. Wild caught bait that could include white suckers, fathead minnows, creek chubs or other native species are sold for bait but have area restrictions. Leeches from MN.

Appendix H – Preserved and Live Non-Aquatic Bait Sold in the Mississippi River Basin

Frozen and Preserved Baits (Aquatic and Non-Aquatic)

Shad (*Dorosoma cepedianum*)
- Whole
- Sides
- Guts

Skipjack Herring (*Alosa chrysochloris*)
Menhaden (*Brevoortia patronus*) -- Oklahoma
Cisco (*Coregonus artedii*)
Smelt (*Osmerus mordax*)
Emerald Shiners (*Notropis atherinoides*)
Alewives (*Alosa pseudoharengus*) -- Virginia
Bighead Carp Fillets (*Hypophthalmichthys nobilis*)
Mooneye (*Hiodon tergisus*)
Clam snouts (*Spisula solidissima*) -- Virginia
Shrimp (Saltwater)
Finger mullet (*Mugil cephalus*) -- Oklahoma
American Eels (*Anguilla rostrata*)
Sardines (*Clupea harengus*) -- Oklahoma
Chicken livers
Chicken Hearts
Rooster Livers
Turkey Livers
Spawn bags
Salmon Eggs
Brown Trout Eggs
Leeches
Wax Worms (*Galleria mellonella*)
Crayfish
Mayflies

Non-Aquatic Bait

Canadian Night Crawlers, Canadian Green Crawlers, Dillies or Baby Night Crawlers (*Lumbricus terrestris*)
Red Wigglers or Red Worms (*Eisenia fetida*)
European or Belgium Night Crawler (*Eisenia hortensis*)
Jumpers or Panfish/Trout Worms (*Eisenia veneta*)
Asian Jumpers or Snake Worms (*Amynthus agrestis*)
Meal Worms or Giant Meal Worms (*Tenebrio molitor*)
Mousees (*Eristallis tenax*)
Wax Worms or Bee Moth Larvae (*Galleria mellonella*)

Spikes, Maggots or Euro Larvae (*Calliphora Vicina*)
Butter Worms (*Chilecomadia moorei*)
Crickets (*Acheta domestica*)

Appendix I -- Bait Definitions Found in Regulation Pamphlets for each Mississippi River Basin State

See Appendix D for web links to fishing regulation pamphlets.

AL
Baitfish includes minnows, shad, and certain, suckers, sunfish, and Asian clams.

AR
Baitfish include bluntnose minnows, bullhead catfish, bullhead minnows, chubs, crayfish, dace, fatheads, common carp under 6 inches (common carp may not be used as bait in certain waters; see pages 58-79), goldfish, shiners, stonerollers, logperch (also called sand pike or zebra minnows), gizzard and threadfin shad, gar (other than alligator gar), drum, bowfin under 6 inches, skipjack herring, silversides (brook and inland), buffalo (bigmouth, smallmouth and black), river carpsucker, sculpin (banded and Ozark) and bream under 4 inches long. Bream longer than 4 inches may be used as bait only if first taken by hook and line and are subject to daily limit restrictions.

CO
The only species allowed to be taken and used for personal use as bait (either alive or dead) by fishing, seining, netting, trapping or dipping are minnows, bluegill, hybrid bluegill, carp, sunfish, gizzard shad, sculpin, white and longnose suckers, yellow perch and rainbow smelt. Statewide bag limits apply to sunfish, bluegill, hybrid bluegills and yellow perch. Goldfish are no longer legal.
The only fish allowed to be taken for commercial use are minnows, gizzard shad, white and longnose suckers and carp.

Bullfrogs and the aquatic gilled form of the tiger salamander for private and commercial use are permitted. Statewide bag limits apply.

Traditional organic baits, including but not limited to worms, grubs, crickets, leeches, dough baits or stink baits, insects, crayfish, human food, fish, fish parts or fish eggs.

GA
Game fish may be used as live bait (where live bait is legal) if they are taken legally and you do not exceed daily creel and possession limits. Only nongame fish less than 5 inches in length may be taken using a minnow seine and are not to be sold or used for commercial purposes. Dip nets and cast nets may be used to take threadfin shad, gizzard shad, and blueback herring for bait.

IL
The following crayfish species shall be allowed for use as LIVE bait in Illinois using legal sized cast nets, shad scoops, and minnow seines, provided that they are not sold or bartered: White River Crayfish, Papershell Crayfish, Northern Crayfish, Devil Crayfish *Cambarus diogenes*. There is nothing in the Illinois Fish Code which prohibits the use of legally taken sunfish as bait for another species of fish, but sunfish can only be used in the body of water from which they were taken. A minnow is statutorily defined as any fish in the minnow family (Cyprinidae) except carp and goldfish.

IN
“Minnow” is defined as a species of the minnow family *Cyprinidae*, except for exotic species identified in 312 IAC 9-6-7 and endangered species identified in 312 IAC 9-6-9, as well as sucker, brook stickleback

(*Culaea inconstans*), gizzard shad, threadfin shad, and alewife. Live gizzard shad, threadfin shad, and alewife may only be collected, used, possessed, and disposed of in accordance with 312 IAC 9-6-8.

IA

"Bait" includes, but is not limited to, minnows, green sunfish, orange-spotted sunfish, live or dead gizzard shad, frogs, crayfish, salamanders and mussels. "Minnows" are chubs, shiners, suckers, dace, stonerollers, mudminnows, redhorse, bluntnose and fathead minnows. You can only take live mussels from the Mississippi River and its connected backwaters. The daily and possession limit is 24 live mussels. You cannot possess live gizzard shad at any lake.

KS

Baitfish: Minnow family (Cyprinidae), sucker family (Catostomidae), top minnows or killifish family (Cyprinodontidae), sunfish family (Centrarchidae), excluding black basses and crappie, which may be used only if legally harvested by hook and line. Baitfish exclude fishes listed in Kansas as threatened or endangered species.

KY

Live bait fishes are defined as redear sunfish less than 6 inches long and rough fish except blackside dace, palezone shiner, cumberland darter, relict darter and tuxedo darter. Bluegills are not sport fish and may be taken for bait.

No live fish, live bait fish or live bait organisms that are not native or established in Kentucky waters shall be bought, sold, possessed, imported, or in any way used or released into waters of this Commonwealth. Blueback herring are not native to Kentucky and may not be imported or possessed in this state. Holders of sport fishing licenses may take live bait from public waters and may possess up to 500 live bait fishes which include shad (except on lakes where possession or use of live shad is prohibited) and herring, 500 crayfish, 25 spring lizards or dusky salamanders, 5 frogs (other than bullfrogs), 5 tadpoles, 100 native lampreys, 500 other aquatic invertebrate organisms other than mussels, and any number of unshelled Asiatic clams. Live wild caught Asian carp, herring and shad may only be used in the waters from which they were collected.

LA

Bait Species: all species of fish and other aquatic life utilized for bait. Bream (*Lepomis spp*.) may not be taken as bait for sportfishing purposes in any form of trap EXCEPT at Toledo Bend Reservoir, where a minnow trap not exceeding 24 inches in length and having a throat no larger than 1 inch by 3 inches may be used to take bream for non-commercial bait purposes. Legal bait species: minnows, crawfish and shrimp (does not include game fish).

MN

Anglers may take cisco or smelt from Lake Superior or its tributaries below the posted boundaries to use as bait on Lake Superior. Bullhead, sucker, mooneye, goldeye and sheepshead may be taken by hook and line from infested rivers or streams for personal use as bait for fishing on the same river or stream where the bait was taken. Suckers 12 inches and shorter are considered minnows and regular bait rules for minnows apply. However, suckers longer than 12 inches may only be transported alive if they are in containers that are not livewells or other parts of a boat and only if bought from a licensed commercial vendor. You must have a valid sales receipt from the vendor on your person.

You can use personally caught crayfish in all waters of the state, with some exceptions, but you can only use them as bait in the water where they were captured.

"Minnows" means: (1) members of the minnow family, Cyprinidae, except carp and goldfish; (2) members of the mudminnow family, Umbridae; (3) members of the sucker family, Catostomidae, not over 12 inches in length; (4) bullheads, ciscoes, lake whitefish, goldeyes, and mooneyes, not over seven inches long; (5) leeches; and (6) tadpole madtoms (willow cats) and stonecats.

MS

Anglers can harvest minnows, non-game gross fish, and non-game fish for personal use as bait without a commercial fishing license. A freshwater commercial fishing license is required to sell those fishes legally taken in minnow seines and minnow traps from public waters.

MO

Live bait includes crayfish, freshwater shrimp, southern leopard frogs, plains leopard frogs, cricket frogs, and nongame fish. Bullfrogs and green frogs taken under season limits and methods also may be used as bait. Bighead carp and silver carp may not be used as live bait but may be used as dead or cut bait. Game fish or their parts may not be used as bait. Other species that may be used as bait include nongame fish of any size, except bowfin, if taken according to the non-game methods and seasons and mussels and clams legally taken by sport fish methods.

MT

There are 10 species of fish that may be used for bait. Non-game bait fish (fathead minnow, flathead chub, western silvery minnow, plains minnow, emerald shiner, longnose dace, lake chub, creek chub, longnose sucker, and white sucker) may be harvested commercially and transported in accordance with Administrative Rules of Montana. Live bait are animals such as meal worms, red worms, night crawlers, leeches, maggots, crayfish, reptiles, amphibians and insects, which may be used as live bait on all waters not restricted to artificial flies and lures.

NE

Baitfish: devil crayfish, goldfish, red shiner, suckermouth minnow, Alewife, emerald shiner, longnose dace, * ringed crayfish, * barred salamander, bigmouth shiner, fathead minnow, * northern crayfish, river shiner, white sucker, brassy minnow, gizzard shad, * papershell crayfish, sand shiner, * creek chub, golden shiner, plains killifish, stoneroller.

Gizzard Shad and Alewife – May be taken for use as bait by legal dip nets from lakes, ponds, reservoirs, and below dams and other artificial obstructions for a distance of 200 yards below such obstructions. Live shad and alewife may be used only in the body of water from which they were captured.
Sport fish may be used for bait if they can be purchased from a bait dealer that acquired them legally from a licensed aquaculturist or a nonresident fish dealer. The angler must keep a legible receipt or invoice from the dealer listing the date, seller's name and address, and number and size of each species sold or if they are captured using hook and line and used at the body of water from which they were captured. Anglers must follow both the length and bag limits for that body of water.

NY

The following baitfish are the only species that can be purchased and used in any water body in New York where it is legal to use fish as bait. These baitfish are commonly used throughout New York and are not considered to be a threat to other native New York fish species (except for trout in waters where

baitfish use is prohibited). Limiting the use of baitfish to the "Green List" will help prevent the accidental introduction of unwanted species. Golden shiner, blacknose dace, emerald shiner, longnose dace, common shiner, white sucker, spottail shiner, northern hogsucker, banded killifish, creek chub, fathead minnow, fallfish, bluntnose minnow, logperch, northern redbelly dace, eastern silvery minnow, stonecat, margined madtom, tadpole madtom, brindled madtom.

In addition to the "Green List," the following baitfish may be purchased and used in specified waters and their tributaries to the first impassable barrier only: Alewife, rainbow smelt, mummichog, blueback herring and Atlantic menhaden, American eel.

Any person who has a fishing license or is entitled to fish without a license may collect minnows (except carp and goldfish), killifish, mudminnows, darters, sticklebacks, stonecats, smelt, alewives and suckers for personal use in hook and line fishing.

NC

Inland game fish may be used as bait if they are legally taken and are in agreement with the size and creel limits. Nongame fishes, crustaceans (crayfish and blue crabs), and mollusks can be taken for bait or personal consumption but may not be sold.

ND

Legal live baitfish are fathead minnows, creek chubs and sticklebacks. White sucker are also legal live baitfish, but only for use in the Red and Bois de Sioux rivers. Other legal live bait includes leeches, native frog, salamander and crayfish species. Rainbow smelt may be taken on the Missouri River System; however, all smelt taken must be dead when transported. All legal live aquatic organisms used by anglers, including legal baitfish (e.g. fathead minnows), native amphibians (e.g. salamanders and frogs), invertebrates (e.g. crayfish and leeches) and insects must have been purchased or trapped in North Dakota.

OH

Popular aquatic baits include: Fathead minnow, common emerald shiner, golden shiner, bluntnose minnow, northern creek, chub, common shiner, spotfin shiner, Ohio stoneroller minnow, common white sucker, bluegill, gizzard shad, crayfish, hellgrammites, leeches, water dogs, tadpoles, frogs.
A fishing license is required to collect minnows and crayfish for bait. Each person may possess up to 100 crayfish or up to 500 in the aggregate of crayfish and bait fish including minnows, suckers no longer than 10 inches, brook silversides, brook sticklebacks, gizzard shad, trout-perch, sculpins, darters, topminnows and mudminnows.

OK

It is unlawful to take or possess more than 25 nongame bait fish in rivers or streams, except for shad, of which 200 may be taken or possessed. No person shall transport shad from the following waters. If shad are collected from these listed waters for use as bait, they may only be used in the water body from which they were collected -- The Red River below Lake Texoma to the Arkansas state line, Grand Lake O' the Cherokees, The Neosho River from Grand Lake to the Kansas state line, The Kiamichi River below Hugo Lake to the Red River.

PA

Baitfish includes all forms of minnows; suckers, chubs, fallfish, lampreys; gizzard shad 8 inches or less; and all forms of darters, killifishes and stonecats (except those listed as threatened or endangered

species). Legally taken gamefish may be used as bait. Fish bait includes crayfish, crabs, and the nymphs, larvae and pupae of all insects spending any part of their life in the water. For all crayfish species, the head must be immediately removed behind the eyes upon capture unless used as bait in the water from which taken.

SD

Species that may be taken as bait by lawful anglers are bullhead, fathead minnow, white sucker, creek chub, flathead chub, Western silvery minnow, plains minnow, golden shiner, emerald shiner, spottail shiner, gizzard shad, tiger salamander (all subspecies), leopard frog (all subspecies), crayfish (all native species), freshwater shrimp and leeches. Live gizzard shad may not be transported from the water in which they were taken. Bullheads may be used as bait by licensed anglers when taken by legal hook and line methods.

The limits for baitfish (all species combined), crayfish (all species combined), freshwater shrimp and leeches are 144 daily and possession each. The limit for tiger salamander (all subspecies combined) and leopard frog (all subspecies combined) are 24 daily and possession each. Bait limits only apply to bait legally taken from waters of the state. Limits do not apply to bait purchased from bait dealers.

TN

CLASS A BAITFISH. The following species may be: 1. harvested by licensed sport anglers for use as live or dead bait; 2. imported into Tennessee or exported from Tennessee as live or dead bait by licensed bait dealers and licensed sport anglers; 3. harvested and sold as live or dead bait in Tennessee by licensed bait dealers.

Skipjack Herring *(live or dead: creel limit of 100 per day; possession limit is 200),* gizzard shad*,* threadfin shad*,* fathead minnow, golden shiner, goldfish (There is no possession limit for gizzard shad, threadfin shad, fathead minnow, golden shiner, and goldfish), rainbow trout, sunfishes***** Lepomis spp., (all species in the genus Lepomis spp. may be bought and/or sold subject to the following conditions: a. Such fish may be bought and/or sold for bait purposes only. b. Such fish bought and/or sold must not be more than four (4) inches in length. c. Such fish must have been lawfully taken from privately owned lakes and/or ponds. d. Nothing contained herein shall be construed as legalizing the sale of sunfishes taken from any stream or public lake). A licensed sport angler may possess rainbow trout 8 inches or less in length without limit for use as bait if purchased from a licensed bait dealer and accompanied by an invoice that was issued by the licensed bait dealer.

CLASS B BAITFISH. The following species may be: 1. harvested by licensed sport anglers for use as live or dead bait; Daily creel limit is 100 fish per species 2. imported into Tennessee or exported from Tennessee by licensed sport anglers for use as live or dead bait. These species shall not be sold. A licensed sport angler shall possess no more than 200 each of the following species: stonerollers, creek chub, bluntnose minnow, bullhead minnow.

CLASS C BAITFISH. In addition, a licensed bait dealer may also harvest these species to be sold as dead specimens: brook silverside, inland silverside. A licensed bait dealer may possess and sell any fish species that is not native to Tennessee and is imported in a preserved state (e.g. frozen, salted, pickled, or dried).

CLASS D BAITFISH. Only northern dusky and spotted dusky salamanders *(Desmognathus fuscus* and *Desmognathus conanti)* and native crayfish species that are not listed by proclamation as endangered,

threatened, or in need of management may be harvested without limit by licensed sport anglers for use as bait.

TX
Nongame fishes collected may be used as live bait on the water bodies where they were collected.

VA
Minnows, chubs, madtoms, crayfish, hellgrammites, salamanders are limited to 50 total for all species combined (aggregate), not 50 of each species at the same time. Only artificially raised trout may be used as bait. Must have an invoice or bill of sale specifying date of purchase, number of trout purchased and business where trout were purchased. The only game fish that can be used as cut bait are bluegill, sunfish, and bream. It is unlawful to remove the head, tail, or change the appearance of any other game fish since it would be impractical to measure original lengths or count the number of fish in possession. Any legally possessed game fish may be used as bait when fished whole. Must comply with creel and length limits.

WV
A person may have in his possession no more than 50 minnows nor more than a total of 100 aquatic animal life.

Salamanders: The season is closed for the following salamanders: eastern hellbender, mudpuppy, Cheat Mountain salamander, Cow Knob salamander, Shenandoah Mountain salamander, smallmouth salamander, streamside salamander, green salamander, cave salamander and West Virginia spring salamander. These salamanders, their eggs, offspring or any parts thereof may not be possessed.
The total possession limit for all other salamanders is 10 in aggregate.

Frogs and Toads. The season is closed for the following frogs and toads: eastern spadefoot toad, northern cricketfrog and northern leopard frog. These frogs and toads, their eggs, offspring or any parts thereof may not be possessed. Residents and non-residents may take or possess green and bull frogs.
All other frogs and toads: The total possession limit for all other frogs and toads is four (4) in aggregate. Only West Virginia residents may take or possess these “other” frogs and toads.

WI
Minnows include: suckers, mud minnow, madtom, stonecat, killifish, topminnow, silverside, sticklebacks, trout perch, darters, sculpins, and all species in the minnow family (except goldfish and carp). Live rusty crayfish and native species of crayfish may be used for bait on the Mississippi River ONLY—not on other Wisconsin-Minnesota boundary waters. Other non-native crayfish may not be possessed live. Live crayfish may not be used as bait within the federal zone of the St. Croix National Scenic Riverway. Live native crayfish may be used for bait on Lake Superior, but not on streams that flow into the lake. Non-native crayfish may only be possessed and used if dead.

WY
Baitfish -- Nongame fish not designated as aquatic invasive species that were collected or purchased for use as bait. Commercially produced live baitfish -- adult fathead minnows that were propagated and reared in a Department approved private fish hatchery.

Other animals as bait. All amphibians and reptiles may be taken throughout the calendar year for personal use without a permit, except the Columbia Spotted Frog, wood frog, western (Boreal) toad, Wyoming toad, northern tree lizard, Great Basin gopher snake, midget faded rattlesnake, Black Hills red-

bellied Snake, northern rubber boa, pale milksnake, smooth greensnake and Plains box turtle may not be taken.