Indiana Aquatic Nuisance Species (ANS) Management Plan

Aruana caught by angler in Lake George, Lake County, Indiana Photo credit: Brian Breidert, IDNR

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EXECUTIVE SUMMARY

What are aquatic nuisance species?

An "invasive species" is defined as a species that is nonnative (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112; http://www.invasivespecies.gov). Invasive species can be plants, animals, and other organisms, such as bacteria and viruses. This plan addresses invasive species that can live in the aquatic habitats of Indiana, such as lakes, rivers, and wetlands.

Why should we be concerned?

Invasive species problems are both a consequence of and an impact on the economic welfare of our nation (Evans, 2003). Most introductions of invasive species can be linked to the intended or unintended consequences of economic activities, such as trade and shipping (Perrings, et al., 2002). Six types of economic impacts can be identified: (a) production; (b) price and market effects; (c) trade; (d) food security and nutrition; (e) human health and the environment; and (f) financial costs impacts (Food and Agricultural Organization, 2001). Over the past 200 years or so, more than 50,000 foreign plant and animal species have become established in the United States. About one in seven has become invasive, with damage and control costs estimated at more than $137 billon each year (Pimental et al., 2000).

New invasions of nuisance aquatic species could decimate fisheries and other aquatic resources, requiring funds for prevention, control, and mitigation that could have been used for other purposes. Nuisance aquatic plant and animal invaders, such as zebra mussels, bighead carp, purple loosestrife, gizzard shad, and sea lamprey, cost Hoosiers millions of dollars each year in control measures and lost natural resource value. For instance, University of Notre Dame researchers determined that it would be cost effective to spend $324,000 per year to prevent zebra mussel infestation of each lake associated with a power plant due to the high costs of managing their negative impacts on water withdrawals (Leung et al., 2002). The Department of Natural Resources estimated that lake residents in northern Indiana spend at least $800,000 per year to remove Eurasian watermilfoil, an invasive aquatic plant that mats across the water surface, degrades habitat for fish and wildlife, and interferes with recreational uses (White, 1998). An initial estimate created during the process of developing this document indicates that state agencies and others are spending at least $3 million annually on prevention and control of invasive species in Indiana and much more could be done.

What can we do to minimize our risks?

The development of a state management plan, as called for in Section 1204 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646) (NANPCA) provides an opportunity for federal cost-share support for implementation of the plan. The Indiana Aquatic Nuisance Species (ANS) Management Plan identifies feasible, cost-effective management practices and measures to be taken on by state and local programs to prevent and control ANS infestations in a manner that is environmentally sound.

Universities, industries, non-governmental organizations, and citizens interested in aquatic nuisance species control have contributed ideas toward development of a statewide long-term Indiana ANS Management Plan. The completed plan will be used as a road map for guiding nuisance control efforts over the next five years. Approval of the management plan by the national ANS Task Force is also required for a state to be eligible for federal cost-share support. In recent years, adjacent Midwestern states have received up to $100,000 annually in federal funds for implementation of ANS plans. The plan will also provide a foundation for prioritizing and coordinating actions in other state and federal programs. For instance, the Indiana state legislature approved an increase in the Lake and River Enhancement (LARE) boater fee to generate about $1.1 million annually, starting in 2004, for sediment removal and control of exotic plants and animals in Indiana waters.

The goals of this state management plan are designed to address different stages of ANS invasion:

1. preventing the introduction of new nonindigenous species transported from water bodies in other parts of the continent or world;
2. limiting the spread of established, reproducing ANS populations to other water bodies in Indiana and other states; and
3. mitigating the harmful ecological, economic, social, and public health impacts of established ANS populations.

The draft Indiana ANS Plan includes an introduction to aquatic exotic species issues, regulations, and a strategic implementation section with goals, actions, tasks, and subtasks. The Implementation Table contains a list of strategies and actions to carry out these goals. Over 170 strategies and actions are listed under each of 32 objectives. The regulatory sections were developed in close coordination with Dr. Robert Waltz, who is leading a DNR effort to review and propose modifications for state authority over all types of invasive species, both aquatic and terrestrial.

Public input and approval process

Information for plan development was derived from a number of agency meetings, interviews with over 40 stakeholders, and public meetings on April 15, July 29, and September 18, 2003. The list of project reviewers, including work group members, totaled over 120 individuals who represent industries, agencies, and organizations with an interest in impacts and management of aquatic nuisance species. Drafts of the management plan were available for public review and

comment over the summer. All meetings were announced in IDNR Division of Fish and Wildlife *Wild Bulletin* email news service and on the DNR website. A professional facilitation team from D.J. Case & Associates, Mishawaka, Indiana, guided all meetings and plan development under contract to the IDNR Division of Fish and Wildlife.

The agency approval process included presentation of the project to the DNR Advisory Council on August 27, 2003, approval of the completed plan by the Natural Resources Commission as a nonrule policy document on September 16, 2003, acquisition of the Governor's signature, and publication in the Indiana Register on November 1. State eligibility for federal funding was contingent upon final approval by the national ANS Task Force. The Indiana ANS Management Plan and minutes from the public meetings are on the DNR website at: www.invasivespecies.in.gov.

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INTRODUCTION

Why should we be concerned?

The introduction of nonindigenous aquatic nuisance species into the Great Lakes, Mississippi River, and inland state waters is a source of biological pollution that threatens not only the ecology of the region and states' water resources, but also the economic, societal and public health conditions of the region and states. The Great Lakes and connecting channels and rivers form the largest surface freshwater system in the world. The aquatic resources of the Great Lakes region are an integral part of activities such as recreation and tourism valued at $15 billion annually with $6.89 billion related to the fishing industry. Approximately 75,000 jobs are supported by sport fisheries; and commercial fisheries provide an additional 9,000 jobs (U.S. Fish and Wildlife Service, 1995). Introduction of over 150 exotic species has irreversibly altered the Great Lakes ecosystem, causing dramatic changes in biological relationships and natural resource availability. Nationally, about 42% (400 of 958) of species that are listed as threatened or endangered under the Endangered Species Act are considered to be at risk primarily because of predation by or competition with non-indigenous species (Nature Conservancy, 1996; Wilcove et al., 1998).

Hoosiers support recreational, commercial, and protective uses of aquatic habitats in Indiana, which range widely from the Lake Michigan shoreline to the banks of the Ohio River. Records of the Indiana Department of Natural Resources show that over 874,000 recreational anglers, 19,000 waterfowl hunters, and 9,000 trappers depend on intact aquatic wildlife and ecosystems in Indiana. An additional 1.7 million wildlife watchers enjoy the benefits of wildlife diversity in the seven major natural regions covering the state. Over 60 rare and endangered species rely on wetland and shallow aquatic habitats in the state. According to the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, anglers, hunters and wildlife watchers spend $1.5 billion annually to participate in these activities in Indiana. The Indiana Chapter of The Nature Conservancy (2003) indicates that up to 72,000 Hoosiers purchase the environmental license plate over the past nine years, generating over $1.8 million per year for acquisition of parks, recreational areas, nature preserves, and similar open space uses. Ad additional 31,000 state residents contributed almost $400,000 to the funds available for protection of nongame and endangered wildlife. Over 16,000 citizens are members of land conservation trusts, raising over $3.5 million in 2001 for land preservation efforts.

These valuable resources and associated Hoosier investments are at risk if nuisance exotic species invade and degrade these ecosystems. An initial estimate created during the process of developing this document indicates that state agencies and others are spending at least $3 million annually on prevention and control of invasive species in Indiana and significantly more could be done.

Why are we hearing about more nuisance exotics?

Increasing global trade, airline travel, and internet sales have brought hundreds of exotic species literally to our doorsteps in a period of hours or days. As use of the Great Lakes intensified as a transportation route for commerce, the rate of introduction of aquatic nuisance species also

increased. More than one-third of the new organisms have been introduced in the past 30 years, a surge coinciding with the opening of the St. Lawrence Seaway. Other human activities contributing to the transport and dispersal of aquatic nuisance species into the Great Lakes and inland state waters include release of organisms from the ballast water of ships, transport and release from the bottom of ships, movement or intentional release of aquaculture and fishery species along with their associated (free-living and parasitic) organisms, release of organisms associated with pet industries or pest management practices, recreational boating, bait handling, water transport, and ornamental and landscape practices.

Are all exotic species causing problems?

No. Since recorded time began, humans have traveled across the earth, bringing plants and animals with them for food and other uses. Introduced species of plants and animals, such as varieties of corn, wheat, rice, and other food crops, and cattle, poultry, and other livestock, now provide more than 98% of the U.S. food system at a value of approximately $800 billion per year (Pimental, 2002). Modern society reaps the benefits of many cultivated species that were not originally found in Indiana. Some species that were originally introduced with beneficial intent have in the end caused more problems than they were worth. For instance, common carp were transported across the country on railcars in the late 1800s and stocked by the government in waterbodies in nearly every state and several other countries in the Western hemisphere as a source of angling enjoyment and food. More recently, it has become clear that carp can interfere with native fish populations by rooting around in polluted sediments, tearing out beneficial aquatic plants, disturbing nests of native fish, and muddying the water. Despite these negative characteristics, there remain anglers who appreciate the recreation and food provided by this species.

Why do some of these species become nuisances?

Species that are useful to humans are those that can tolerate a broad range of conditions, reproduce easily, can accommodate disturbance associated with human activities, and are resistant to diseases. Unfortunately these characteristics can also mean a new introduction may quickly dominate the native plants and animals in an area that may be more specialized or sensitive to environmental degradation.

Additionally, both humans and domesticated plants and animals can unintentionally carry pests and pathogens. In recent years, scientists have become increasingly concerned with zoonotic diseases that are transmitted from animals to humans. Monkey pox, ebola virus, and HIV are thought to have originated in animals and either mutated or jumped to human populations. While diseases are most commonly spread between closely related species, there are a number of serious pests and pathogens of humans and domestic animals that live in water or have waterborne vectors, such as mosquitoes or fish.

A newly introduced species, if it becomes established through reproduction, can disrupt the natural ecosystem balance by altering the composition, density and interactions of native species. This disruption can cause significant changes to the ecosystem, such as alterations to the foodwebs, nutrient dynamics and biodiversity. New introductions also can cause costly socio-

economic impacts even if effective prevention and control mechanisms are established. Eventually, each newly introduced species will become integrated into an ecosystem that is in a constant state of flux; or the population will not survive and become extinct (New York State Department of Environmental Conservation, 1993). The following examples portray the extensive ecological and economic impacts caused by aquatic nuisance species that have been introduced into the Great Lakes and Ohio River basins.

What principles should guide invasive species management in Indiana?

The guiding principles describe the precepts by which the *Indiana ANS Management Plan* has been developed and will be implemented. The *Indiana ANS Management Plan* process will:

- Ensure strong leadership, resources, staff support, and commitment to follow, implement, and evaluate the plan as an integrated and coordinated long-term process.
- Show the economic impact of ANS to the people of Indiana by producing effective educational outreach materials and programs.
- Create a visionary plan with elements that can be readily implemented within the short-term and that have adequate money and support.
- Create a usable plan for all levels of government and grassroots organizations.
- Prioritize issues that need to be immediately addressed. Allow for flexibility, recognizing that priorities will vary across agencies and organizations and that all ideas should be retained. Use public input to assure that prioritization recognizes differing viewpoints.
- Use frequent and effective communication tools.
- Use education efforts to develop leadership support from the local to state level.
- Involve the public in education and implementation. Create a plan that is clear, uncluttered, accessible, and avoids unnecessary complexity in messages to the general public as an introduction to ANS issues.
- Assign resources where they will be most effective. Make sure the plan is not driven by politics but by the best available science-based risk assessment and management strategies.

Which species are top priorities for management in Indiana?

The Great Lakes region has been subject to the invasion of aquatic nuisance species since the settlement of the region by Europeans. Since the 1800s, at least 139 nonindigenous aquatic organisms have colonized habitats of the Great Lakes ecosystem (Mills et al., 1993). The bulk of these species include aquatic or wetland plants (42%), fishes (18%), and algae (17%). Introduced species of mollusks, oligochaetes, crustaceans, flatworms, bryozoans, cnidarians, and disease pathogens combined represent 22% of the total. All entered the Great Lakes basin by major mechanisms or routes including shipping (41 exotic species); unintentional releases (40 new species); ship or barge canals, along railroads or highways, or deliberate releases (17 species); unknown entry vectors (14 species); and multiple entry mechanisms (27 species). About 55 percent of these species are native to Eurasia; 13 percent are native to the Atlantic Coast. Approximately 10 percent of the Great Lakes' nonindigenous aquatic species have resulted in significant negative ecological and economic impacts. The NOAA online Great Lakes Aquatic Nondigenous Species List currently provides 162 species known from these ecosystems.

Although the obvious impacts of some of the most abundant species are being determined, most of the aquatic nuisance species and their direct and indirect impacts are not known.

No comprehensive survey of invasive species has been conducted for the state of Indiana. However, a number of researchers, district biologists, and aquatic plant management companies have contributed to lists provided in the appendices of this document. Ecological information on several of the species is given in the following sections by taxon (i.e., fish, insects and crustaceans, mussels and snails, and plants). A compilation on information on aquarium species found over the past few years in state waters is also provided. A list of high priority ANS species for Indiana are provided in Table 1. Several of the fish species on the Indiana watch list are from a set of 56 fish species predicted as being potential invaders that could be transported in the ballast water of ships from the Ponto-Caspian region of Eurasia (Kolar and Lodge, 2002). A similar analysis has not been conducted for other groups of plants or animals.

Table 1. Aquatic nuisance species on the watch list (not yet detected in Indiana waters) and ANS species detected in parts of the state but not distributed statewide. The common and scientific names are given, along with the primary paths of introduction. For watch list species, the standard abbreviation for the nearest state, province or region known to have the species is provided. (ONT = Lake Ontario; EA = Eurasia).

Watch list (not yet detected in Indiana waters)

Common name(s)	Scientific name or taxon	Pathway(s) and nearest infestation
Black carp	*Mylopharyngodon piceus*	aquaculture (IL, AR)
Black sea silverside	*Atherina boyeri*	ballast water (EA)
Eurasian minnow	*Phoxinus phoxinus*	ballast water (EA)
European perch	*Perca fluviatilis*	ballast water, aquaculture (EA)
Eurasian ruffe	*Gymnocephalus cernuus*	ballast, fish transfer (MI, WI)
European frogbit	*Hydrocharis morsus-ranae*	bait bucket, trailer (MI)
Fourspine Stickleback	*Apeltes quadracus*	bait bucket, fish transfer (PA)
Heterosporis parasite	*Heterosporis sp.*	fish transfer, bait bucket (WI)
Hydrilla	*Hydrilla verticillata*	aquarium, bait bucket (PA, TN)
Giant cladoceran	*Daphnia lumholtzi*	ballast water, bait bucket (IL)
Giant salvinia	*Salvinia auriculata complex*	aquarium, bait bucket (TX, GA)
Monkey goby, Sand goby	*Neogobius fluviatilis*	ballast water (EA)
New Zealand mudsnail	*Potamopyrgus antipodarum*	bait bucket, trailer (ONT, ID, UT)
Roach	*Rutilus rutilus*	ballast water (EA)
Snakehead fish	Channidae	fish transfer, food (FL, NC)
Spring viremia of carp	*Rhabdovirus carpio*	fish transfer, bait bucket (WI)
Tyulka, Kilka shad	*Clupeonella cultriventris*	ballast water (EA)
Walking catfish	*Clarias batrachus*	fish transfer (CT, FL, GA, MA)
Whirling disease in salmon	*Myxobolus cerebralis*	mud on waders, fish transfer (MI)
Zander	*Stizostedion lucioperca*	ballast water, aquaculture (NY)

Detected species (found in the State of Indiana)

Common name(s)	Scientific name or taxon	Pathway(s)
Alewife	*Alosa pseudoharengus*	ballast water, fish transfer
Asian tiger mosquito	*Aedes albopictus*	containers holding water, tires
Asiatic clam	*Corbicula fluminea*	bait bucket, trailer
Bighead carp	*Hypophthalmichthys nobilis*	fish transfer
Bluegreen algae	*Cylindrospermopsis spp.*	bait bucket, trailer
Fishhook water flea	*Cercopagis pengoi*	ballast water, bait bucket, trailer
Flowering rush	*Butomus umbellatus*	wetland plant transfer
Brazilian elodea	*Egeria densa*	aquarium, bait bucket, trailer
Cabomba	*Cabomba caroliniana*	aquarium, bait bucket, trailer
Chinese mystery snail	*Cipangopaludina spp.*	aquarium, bait bucket
Common carp	*Cyprinus carpio*	fish transfer, bait bucket
Common waterweed	*Egeria densa*	aquarium, bait bucket, trailer
Eurasian watermilfoil	*Myriophyllum spicatum*	trailer, bait bucket
Gizzard shad	*Dorosoma cepedianum*	fish transfer, bait bucket
Grass carp	*Ctenopharyngodon idella*	fish transfer from private pond
Largemouth bass virus	virus	fish transfer, bait bucket, live well
Common reed, Giant reed	*Phragmites australis*	wetland plant transfer
Purple loosestrife	*Lythrum salicaria*	wetland plant transfer
Reed canary grass	*Phalaris arundinace*a	wetland plant transfer
Round goby	*Neogobius melanostomus*	ballast water, bait bucket
Rudd	*Scardinius erythrophthalmus*	fish transfer, bait bucket
Rusty crayfish	*Orconectes rusticus*	bait, native in southern Indiana
Sea lamprey	*Petromyzon marinus*	ballast water
Silver carp	*Hypophthalmichthys molitrix*	fish transfer
Spiny water flea	*Bythotrephes cederstroemi*	ballast water, bait bucket
Tench	*Tinca tinca*	fish transfer, bait
Threespine Stickleback	*Gasterosteus aculeatus*	bait, fish transfer
Water hyacinth	*Eichhornea azuria*	trailer, private ponds
West Nile virus	Flaviviridae	containers holding water, birds
White perch	*Morone Americana*	fish transfer, bait bucket
Zebra mussels	*Dreissena polymorpha*	bait bucket, trailer, ballast

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Much of the information for the descriptions in this section was derived from Indiana DNR publications, the USGS Nonindigenous Aquatic Species website (http://nas.er.usgs.gov/), and publications from Illinois-Indiana Sea Grant.

Nuisance fish

Fisheries in Indiana support both leisure activities and commercial enterprises. The 1991 National Hunting and Fishing Survey reported that anglers made over 1,846,300 fishing trips to Indiana streams at an annual economic value of $57 million. An average of 502 inland commercial fishing licenses and 1,782 net tags were sold annually in the state of Indiana from 1977 to 1994 (Carnahan 1995). The average inland commercial fishing harvest was 165,360

pounds annually. By 2003, the rapidly growing number of charter boat companies, that take people fishing for hire, had reached over 75 businesses in Indiana. Canoe liveries, campgrounds, and other support services for recreational users also rely on high quality aquatic systems. As an example, the Department of Natural Resources has a multi-million dollar investment in the waters of the St. Joseph River as a salmonid stream. Public attention to the St. Joseph River in South Bend and Mishawaka has resulted in long-term development of a unique salmon fishery in a $15 million joint effort with the state of Michigan that annually generates about $6 million in income to local communities. These investments in quality of life along rivers in urban areas and other parts of the state may be jeopardized by lack of sufficient control on invasive species.

Recreational and commercial users of state waters recognize the critical importance of protecting these resources. Eighty-one percent of anglers polled in 1994 felt that the Division of Fish and Wildlife should increase the emphasis on protecting Indiana streams and rivers from pollution. Introduction of exotic species can have a longer-term and more irreversible impact on important fish communities than other kinds of pollution. At least 45 invasive fish species are known from the Great Lakes. A few examples of nuisance fish are described below. A complete list of all known exotic fish and crayfish is provided in Appendix A.

Sea lamprey: The invasion of the sea lamprey in the 1940s has resulted in substantial economic losses to recreational and commercial fisheries, and has required annual expenditures of millions of dollars to finance control programs. During the 1940s and 1950s, the sea lamprey, a top predator which kills fish by attaching to its prey and feeding on body fluids, devastated populations of whitefish and lake trout. Their aggressive feeding behavior contributed significantly to the collapse of fish species that were the economic mainstay of a vibrant Great Lakes fishery (Great Lakes Fishery Commission, undated). For example, before sea lampreys entered the Great Lakes, Canada and the United States harvested about 15 million pounds of lake trout in lakes Huron and Superior annually. By the early 1960s, the catch was only about 300,000 pounds. In 1992, annual sea lamprey control costs and research to reduce its predation were approximated at $10 million annually. Ongoing control efforts have resulted in a 90% reduction of sea lamprey populations in most areas, creating a more amenable environment for fish survival and spawning. The total value of the lost fishing opportunities plus indirect economic impacts in the Great Lakes could exceed $500 million annually (Office of Technology Assessment, 1993).

Silver and bighead carp: Similar to the closely-related silver carp, the bighead carp is a filter feeder that prefers large river habitats. These so-called Asian carps have been used in many parts of the world as a food fish and sometimes introduced in combination with silver carp into sewage lagoons and aquaculture ponds (Jennings 1988). Approximately 176,400 pounds per month of live food fish, mostly Asian carp species, are sold in Toronto markets (Dennis Wright, Fisheries and Oceans Canada, pers. comm., July 22, 2003). Many of these fish may be transported live through Indiana from fish farms in the southern states, especially Arkansas. The impact of these two species in the United States is not adequately known. The largest bighead carp reported from Indiana waters was 53.5 pounds, but they are known to reach 90 pounds elsewhere in the United States. Silver carp reach lengths of three feet and weights of 60 pounds. Because bighead carp and silver carp are planktivorous and can attain a large size, Laird and Page (1996) suggested these carp have the potential to deplete zooplankton populations. As Laird and Page pointed out,

a decline in the availability of plankton can lead to reductions in populations of native species that rely on plankton for food, including all larval fishes, some adult fishes, and native mussels. In some of the big pools along the Mississippi River, Asian carps have multiplied so quickly that in less than a decade they make up 90 percent or more of the fish life. Several species of fish with high recreational and commercial value are most at risk from such competition in large rivers and Lake Michigan including paddlefish, bigmouth buffalo, salmon, walleye, and perch. To date, populations of bighead carp have been reported in every large river system up to the first dam that blocks upstream movement, including lower portions of the Wabash River and some tributaries up to Huntington Dam, on the Tippecanoe River up to Oakdale dam (forms Lake Freeman), lower portions of the White River to Williams Dam on the East Fork of White River and up to dams at Martinsville or higher along the West Fork of White River, and in embayments along the Ohio River. Silver carp are likely to be distributed similarly to bighead carp. Silver carp have been taken from the lower portions of the Wabash River at least to Lafayette, along portions of the Ohio River, and the West Fork of White River in Greene County.

Black carp: The black carp is a bottom-dwelling molluscivore that has been used by U.S. fish farmers to prey on and control disease-carrying snails in their production ponds. Black carp are superficially very similar in appearance to the grass carp. The grass carp is legal to use for aquatic plant control in private ponds in Indiana as a genetically modified fish that cannot reproduce. As such, Nico and Williams (1996) expressed concern that if black carp become more common in U.S. aquaculture, there will be an increased risk that the species be misidentified and unintentionally introduced to some areas. It is highly probable that black carp would feed on and reduce populations of native mussels and snails (Nico and Williams 1996). There are 26 species of mussels listed as endangered or threatened in Indiana, including 10 federally endangered species, which would likely be further affected by black carp introductions. Sterilization of black carp for aquaculture use does not eliminate the ecological risk posed by these fish (USFWS 2002). A sterile adult black carp is capable of eating 3 to 4 pounds of mollusks a day and can live up to 15 years. The methods used to produce sterile fish do not guarantee 100 percent sterility, meaning that a small percentage of fertile fish may be found among groups of sterile fish. To date, there have been no reports of black carp found in Indiana waters.

White perch: White perch are naturally found in brackish waters of the Atlantic coast, but invaded the lower Great Lakes during the late 1980s. The fish is a food fish and provides angling opportunities, but tends to stunt and become undesirable when over-population occurs in freshwater lakes (Scott and Crossman 1990). Through competition with native species, predation on fish eggs, preying on young fish, and hybridization with white bass, white perch can quickly become the dominant species in freshwater lakes. White perch are thought to cause declines in walleye (Schaeffer and Margraf 1987), yellow perch (Parrish and Margraf 1990), and white bass (Todd 1986) in the Great Lakes region. White perch have been collected in Indiana from Lake Michigan and more recently from Wolf Lake and Cedar Lake in Lake County and Koontz Lake in Marshall County. Although white perch may have migrated from Lake Michigan to Wolf Lake, this fish was probably illegally stocked in Cedar Lake and Koontz Lake within the past five years. The invasion by white perch can degrade fishing quality. A 2001 fisheries survey showed that white perch had rapidly overwhelmed the fish community in Cedar Lake, constituting eighty-eight percent (88%) by number and 67% by weight of the fish caught. Similar

to Cedar Lake, white perch was the most abundant fish by number (49%) and weight (25%) in a 1999 survey of Wolf Lake. White perch in these Indiana lakes grow to a maximum size of 11.5 inches and average weight of 7-13 ounces. This species must not be confused with the native freshwater drum, which may commonly be referred to as a "white perch" in parts of southern Indiana.

Nuisance insects and crustaceans

Asian tiger mosquito: Public health threats can result from the introduction of insects and other animals that serve as vectors for the parasites and diseases of humans and domesticated or native animals. For example, the Asian tiger mosquito is a tropical insect from Asia and Africa that was most likely brought into the country through the worldwide transport of used tires. It is now established in most states east of the Mississippi River (Dr. Robert Novak, Associate Professional Scientist for the Illinois Natural History Survey and Associate Professor, University of Illinois, Champaign/Urbana). It is solely a container breeder, with the larval stage living in discarded tires, pails, flower pots, and any pool of water that lasts longer than a few days, and does not breed in naturally-occurring water bodies. It can serve as the intermediate host for many mosquito-borne diseases, including dengue hemorrhagic fever, dog heartworm, and possibly West Nile virus. According to state medical entomologist Dr. Michael J. Sinsko, the Asian tiger mosquito was first discovered in Indiana in Vanderburgh County on September 15, 1986. Since that time, they have been documented in the following counties: Vanderburgh, Marion, Dearborn, Shelby, Daviess, Gibson, Dubois, Perry, Warrick, Posey, Jackson, Spencer, Lawrence, Greene, Knox, Clark, Martin, Bartholomew, Washington, Crawford, Pike, Floyd, Orange, Ohio, Harrison, Sullivan, Scott, Owen, and Jefferson.

Giant cladoceran: An exotic zooplankton species, *Daphnia lumholtzi*, is native to Africa, Asia, and Australia and was most likely brought to North America with African fish imported for the aquarium trade or to stock reservoirs. Since 1995, it has been found in the Illinois River and a connecting channel to Lake Michigan through Chicago and now appears close to invading Lake Michigan. Cladocerans, also known as water fleas, are small zooplankton that are an important food source for larval and early juvenile stages of nearly every species of North American fish. *Daphnia lumholtzi* is much larger and has more numerous spines than similar native species. The large spines make it difficult for young fish to eat this exotic. Protection from predation could give it a competitive advantage over the more edible native species. This could result in reduction of food available in lakes, streams, and fish hatcheries where this zooplankter invades. Sportfish susceptible to impacts would be late-spawning species such as bass and other sunfish.

Rusty crayfish: Rusty crayfish are invasive crustaceans that are native to southern Indiana within the Ohio River drainage, but have been spreading to lakes, rivers, and streams in other parts of North America and Ontario. They are more aggressive than other native crayfish, better able to avoid fish predation, and can harm native fish populations by eating their eggs and young. They can displace native crayfish, hybridize with them, and graze on and eliminate beneficial aquatic plants. They have likely spread by bait buckets and aquariums, activities of commercial bait harvesters, and live study of specimens purchased from biological supply houses. Females can carry fertilized eggs or a male's sperm, so even the release of a single female could establish a new population. Eradicating established infestations is currently impossible.

Spiny water flea and fishhook water flea: The spiny water flea, a likely ballast water introduction, is a tiny crustacean (related to shrimp and crabs) with a sharply barbed tail spine. The northern European native was first found in Lake Huron in 1984. The spiny water flea is now found throughout the Great Lakes, including Lake Michigan, and in some inland lakes in nearby states. Another invasive zooplankton, called the fishhook water flea, was first found in Lake Ontario in 1998. It has since been reported from the southern waters of Lake Michigan and was most likely transported in the ballast water of ships. Many other predatory fish avoid them as prey and most smaller fish cannot effectively consume them because they cannot ingest the long hooked tail spine. These large zooplankton are nearly a half inch long and may compete for food with young fish, such as yellow perch, that also eat small zooplankton. The long tail spine of these two water fleas is irritating to anglers whose lines become entangled with "globs" of the fishhook flea. Anglers and other recreational water users can avoid transferring these species by emptying water from live wells, bait buckets, and other equipment before using them in inland waters of the state.

Nuisance mussels and snails

Zebra mussel: The zebra mussel, another ballast water introduction, is one of the best known invaders of the Great Lakes region and other areas of the country where it has spread. This aquatic nuisance species has caused serious economic and ecosystem impacts. The zebra mussel, a highly opportunistic mollusk, reproduces rapidly and consumes microscopic aquatic plants and animals from the water column in large quantities. The potential impact on the fishery can be profound due to changes in food availability and spawning areas, to name a few. Economic impacts are as pervasive as the ecosystem impacts. Due to the infestation of zebra mussel in their intake and discharge pipes, Great Lakes municipalities, utilities, and industries have significant costs associated with monitoring, cleaning, and controlling infestations. According to a recent economic impact study, each of 84 Great Lakes water users reported average total expenditures of $513,600 over the five-year period from 1989 to 1994 (Hushak et al., 1995). By the end of this century, water users across the country are expected to spend between $2 billion and $3 billion cleaning clogged water intakes (Ruiz et al., 1995). Commercial and recreational vessels and beach areas also are vulnerable to the negative impacts of the zebra mussel.

Oriental mystery snails: The Chinese (or Japanese) mystery snail is native to Burma, Thailand, South Vietnam, China, Korea, and Asiatic Russia in the Amur region, Japan, the Philippines, and Java. These snails have been collected from Fall Creek and West Fork of White River, Marion County, Indiana; and five drainages in Illinois. The closely related Japanese trap door snail has been found on the west coast of North America but has not been collected from Indiana. Chinese mystery snails live partially buried in the mud or silt of lakes, ponds, rice paddies, irrigation canals, roadside ditches or slower portions of streams. They prefer quiet water where there is some vegetation and a mud substrate. This species was probably introduced through accidental or intentional releases from the aquarium industry. It can serve as a vector for various parasites and diseases, some of which may infect humans. Shells of large exotic snails have been clogging intake screens at the IPALCO Stout and Perry K power generating plants in Marion County (Terry Hogan, pers. comm. Cinergy Corporation, 2 October 2000). The snails have not been found at the Pritchard power plant in Morgan County. The large conically shaped shell creates a

troublesome problem for the plant maintenance, as the shells clog the cooling water condenser tubes. The snails are an operculated species, having a "trap door" over their entrance and thus, can simply close up and wait for an intermittent biocide to pass by without controlling the snails.

New Zealand mudsnail: The New Zealand mudsnail is a small aquatic snail, about one-eighth of an inch long. As its name states, this species is native to freshwater lakes and streams of New Zealand. Like many organisms today, it is being incidentally carried to many locations around the world such as Europe, Asia, and North America. In the U.S., this snail was first detected in the mid-1980s in the Snake River region of Idaho. Since then, it has spread to waters of Montana, Wyoming, California, Arizona, Oregon, and Utah. The only known population in the eastern U.S. is in Lake Ontario where a population was discovered in the early 1990s. Mudsnail densities of over one-half million per meter square in western streams are a cause for concern. Because the West is known for abundant trout and productive fishing spots, there is concern that the mudsnails will impact the food chain for native trout and the physical characteristics of the streams themselves. Research is needed to determine the impacts of large populations of mudsnails on the native fauna, such as aquatic insects and native snails, and on any changes in the physical environment.

Diseases, pathogens, and parasites

Although not many diseases of coldblooded aquatic animals are zoonotic (transferable to humans), there are some diseases transmitted by mosquitoes (e.g., West Nile virus) or other waterborne vectors (e.g., cholera). To date, the greatest threat of disease has been affects on domestic, commercial, and recreational fish stocks. Since the 1980s, all trout and salmon brought into Indiana under aquaculture or importation permits must be inspected for a number of diseases. Infected fish or fish showing signs of disease cannot be stocked into state or private waters. Diseases of trout and salmon that are unknown from the Great Lakes basin and strictly regulated include viral hemorrhagic septicemia, infectious hematopoietic necrosis virus, ceratomyxosis, and proliferative kidney disease. Other salmonid diseases known from the Great Lakes but not found in Indiana waters are infectious pancreatic necrosis virus, bacterial kidney disease, furunculosis, enteric redmouth disease, and EED virus. Anglers are advised to remove all mud and water from waders and other fishing equipment, if they have been fishing in lakes or streams in other states, and not to transfer live fish or fish parts between waters. Aquarium fish must not be released to state waters, as they may be carrying diseases or parasites. The Indiana DNR contracts with the Animal Disease Diagnostic Lab (ADDL) at Purdue University to examine fish suspected of disease. Large fish kills and strange behaviors in populations of fish should be reported to the DNR for investigation.

Heterosporis: The fish parasite, *Heterosporis sp.*, was found in fish muscle tissue from yellow perch in Wisconsin, Minnesota and Ontario in 2000 (Wisconsin DNR, 2002a; Wisonsin DNR, 2002b). Previously, this genus of parasites was unknown from North America and had only been reported from aquarium species such as angelfish, bettas and cichlids, and the Japanese eel. This infection does not seem to cause direct mortality, but when an infected fish dies, other fish may eat infected muscle or the infected muscle may break down, releasing spores into the water, which are then acquired by other fish. In severely infected fish, almost 90% or more of the fillet is actually made up of the parasite's spores, rather than muscle tissue. There is no evidence that

Heterosporis can infect people. However many people discard infected fish because changes in texture and quality of the flesh make the fish appear to be freezer burned even as a fresh fillet. The disease has been seen in walleye, yellow perch, sculpin, and northern pike. In the laboratory, rainbow trout, channel catfish, walleye and fat head minnows also readily hosted the parasite. Largemouth bass and bluegills could be infected, but the degree of infection was less severe. Fisheries biologists in Indiana are interested in any similar reports in fish from state waters.

Largemouth bass virus (LMBV): Largemouth bass virus (LMBV) ceased being a "southern phenomenon" when it caused a kill at 565-acre Lake George, along the border between Indiana and Michigan, in August 2000. Previously, LMBV had only been documented from kills during the heat of the summer at southern U.S. reservoirs. To date, LMBV has been detected in bass from five northeast Indiana natural lakes and Dogwood Lake in Daviess County. LMBV first gained attention in 1995, when it was implicated in a fish kill on Santee-Cooper Reservoir in South Carolina. Scientists do not know how the virus is transmitted between fish or how it is activated into a fatal disease. Along with hot weather, stress factors might include poor water quality caused by pollution and frequent handling by anglers. Most bass infected with LMBV appear completely normal. The LMBV appears to attack the swim bladder, so diseased fish will be near the surface, have trouble swimming in an upright position, and may appear bloated. Adult bass of two pounds and more seem to be the most susceptible to disease, or at least the most visible. Although largemouth bass die-offs have received considerable attention, LMBV-related kills have been minor in comparison to kills prompted by other causes, such as pollution. Fisheries biologists in Indiana continue to monitor populations where largemouth bass die-offs occur. Scientists know of no cure, as is commonly the case with viruses. Transmission may be prevented by avoiding transfer of water or fish between waters and reducing stress on fish where possible.

West Nile virus: Since West Nile virus (WNV) was first isolated in 1937, it has been known to cause asymptomatic infection and fevers in humans in Africa, West Asia, and the Middle East. Human and animal infections were not documented in the Western Hemisphere until 1999. In 1999 and 2000, outbreaks of WNV encephalitis (inflammation of the brain) were reported in persons living in the New York City metropolitan area, New Jersey, and Connecticut. The Centers for Disease Control reported that the disease grew rapidly from an initial U.S. outbreak of 62 disease cases in 1999 to 44 states reporting 4,156 cases, including 284 deaths, in 2002 (CDC, 2003). The USGS database reports 312 cases from Indiana in 2002 and predominantly in the northeastern quadrant of the state (USGS, undated). West Nile virus may be transmitted when an infected mosquito bites a human to take in blood. Mosquitoes become infected when they feed on infected birds, which may circulate the virus in their blood for a few days. In addition, recent investigations confirmed WNV transmission through transplanted organs and transfused blood. The recent introduction of routine WNV screening of blood donations should greatly reduce the risk of spread of WNV through transfused blood. Only about two persons of every 10 who are bitten by an infected mosquito will experience any illness. Although illness from WNV is usually mild, serious illness and death are possible, particularly for persons over the age of 50. West Nile virus is spread by a "filth mosquito," referred to as such because it prefers to reproduce in stagnant standing water. A survey in Indiana showed that two-thirds of the breeding sites for the mosquito consisted of discarded tires that held small pools of water (NRCS, 2003). Three simple actions can help prevent infection: avoiding mosquito bites by

using insect repellants with DEET and wearing light, long-sleeved clothing, mosquito-proofing properties by emptying standing water and installing screens, and reporting dead birds to local health authorities.

Whirling disease (WD): Whirling disease is caused by *Myxobolus cerebralis*, which is a native myxosporidean fish parasite in salmonids from Europe. The parasite penetrates the head and spinal cartilage of fingerling trout, where it reproduces rapidly, causing the fish to swim erratically, negatively affecting feeding ability and predator avoidance behavior. Severe infections can result in high rates of mortality and skeletal deformities that persist in adult fish. Spores released when the fish dies are nearly indestructible and can survive in sediments for 20 to 30 years. It was unintentionally introduced to the eastern United States in the late 1950s in shipments of frozen trout that harbored spores of this fish parasite (Markiw 1992). The parasite devastated rainbow trout populations in Colorado, Montana, and other western states in the 1990s. The life cycle of the parasite can only be completed in earthen-bottomed rearing ponds inhabited by *Tubifex* worms, the second host of the parasite. Fish transfers probably spread the disease to other states. Whirling disease has not been detected in Indiana, although it is known from several rivers and private hatcheries in Michigan and has occurred in adjacent states of Ohio, Pennsylvania, and New York (Whirling Disease Foundation, undated).

Spring viremia of carp (SVC): An exotic fish virus, spring viremia of carp, was suspected of killing more than 10 tons of carp in a lake in northwestern Wisconsin (Wisconsin DNR, 2002c). The diagnosis was the first documented occurrence in wild fish in the United States. Spring viremia of carp (SVC) was previously diagnosed in a North Carolina fish farm that raises an ornamental carp variety called koi. The virus, which is widespread in Europe and found in Russia, Asia and the Middle East, cannot infect humans. The disease is an international animal health concern, however, and covered under an international treaty that requires confirmation of the virus by a designated laboratory, reporting to international animal health authorities, and other measures. Only members of the minnow family, which include carp, are naturally susceptible to the virus, but northern pike fry also have been infected in laboratory studies. Effects on other species can create problems for fisheries and aquaculture production, potentially affecting large areas, if the virus has passed to downstream waters in the Mississippi River basin. Spring viremia in carp strikes primarily in the spring or fall, when fish immune systems are suppressed due to very cold water temperatures. Signs of the fish disease include a fluid buildup in the body cavity, small hemorrhages on the skin, the belly, and hemorrhages on the swim bladder. Infected fish become diseased and can die within 10 to 17 days. Fisheries management agencies and the USDA APHIS program are monitoring wild carp and aquaculture facilities to determine any distribution of the disease in other areas.

Aquarium pets caught from Indiana waters

Keeping pets in home aquaria and backyard ponds is a relatively recent venture. It is also posing unforeseen risks when aquarists and aquaculture farms do not properly manage these pets. The earliest known keepers of captive fish were the Sumerians, who kept fish in artificial ponds at least 4,500 years ago. Although the English kept goldfish in glass containers during the 1700s, keeping a thriving aquarium was not common until the relationships between oxygen, animals, and plants were understood a century later and technology was developed to maintain adequate

water quality conditions in small tanks. The circus entrepreneur P.T. Barnum opened the first display aquarium on this continent in 1856 at the American Museum in New York City.

Species that make good aquarium fish are tough survivors. Trying to keep fish alive in a tank can be difficult unless those species are adaptable to a wide range of water quality, variable temperatures, and possess fairly general feeding habits. Aquarium fish must tolerate being shipped in containers having low dissolved oxygen or which are exposed to fluctuating temperatures. They have fairly general food habits, eating prepared artificial diets rather than requiring a particular form of prey or plant. Aquarium fish may reproduce rapidly under fairly general conditions, allowing them to be economically raised on fish farms.

Several decades ago, the only fish available were the few species carried by the local dime store, usually goldfish or guppies. With the advent of global commerce and the internet, it is now possible for a home aquarist to order one of hundreds of species of fish and have it shipped from nearly anywhere in the world. Fish shipped for aquarium purposes are generally exempt from state importation laws, so the state has no way of tracking which species are coming into Indiana and which ones might be problematic if released into the wild.

Many of the tropical fish and other species sold in pet stores will not survive an Indiana winter. Even if a single individual survives, it would need others of its kind to reproduce. Many tropical species like Tilapia (cichlids) die in water temperatures below 50 degrees. However, evidence suggests that as generations of fish and plants are kept in aquaria, some of them can become more adapted to the conditions of northern waters. Strains of various tropical species are under development for aquaculture so that they will survive lower temperatures or saltier water. These species that normally would not survive in colder waters may have become domesticated and now have a better chance of survival in new environments. Some species may be tropical distributions, not because they could not survive in cold water, but because they never had the opportunity to move to cold areas. Threats associated with the parasites and diseases that the pets may be carrying could be even greater than direct problems related to the animal itself.

A number of Indiana residents overwinter or visit in Florida or other southern states. When Hoosiers are south for the winter, they should keep in mind that problems with releases of aquarium fish are extreme in warmer states. While Indiana currently hosts over 40 species of introduced fish, established exotic fish in Florida number over 120 species. Nationwide, about 1 in 4 new species originates from the aquarium trade. In Florida, about 75 percent were introduced from aquaria or farms raising aquarium fish.

Moving fish from one waterbody to another is stocking fish. This includes fish from an aquarium, backyard pond, and live fish from a bait bucket. It is illegal to stock fish without a permit. Most native fish do not need a boost from stocking. Fish like bass, bluegill, and catfish will generally reproduce and thrive in areas where the water quality and habitat are available to sustain them. The DNR fisheries biologists carefully survey lakes and rivers before determining where stocking might help establish a new fishery without damaging the existing fish community.

Moving fish around can cause serious problems for the resident fish. The difficulty with detecting and tracking fish diseases makes it hard to predict the impacts of transferring sick fish. Fish may be carrying diseases or parasites without looking or acting sick. Bacteria, viruses, parasites, and the microscopic young of other species may be contained in the water dumped along with the fish. Largemouth bass virus, previously thought to be only in southern lakes and rivers, was recently discovered in Lake George along the Indiana-Michigan border and may be in other lakes or rivers. The impacts of this new disease are not completely understood but it has been implicated in fish kills in southern states. Zebra mussels are easily transported to previously clean waters without even being aware of it. The baby mussels, called veligers, are microscopic and nearly colorless.

The most cost-effective, and often the only, defense against introduced species is prevention. While laws can be passed that affect ownership or release of species, they can be difficult to enforce. Indiana relies mostly on the ethics of aquarium owners in properly caring for their pets to keep our native fish and wildlife populations safe and healthy. It is up to the aquarium owner and dealers to be the first line of defense.

If anglers do catch an unusual fish, the IDNR asks that they measure its length, take a close-up photograph, save it by freezing, and report the find to a district fisheries biologist. By tracking exotic fish, state natural resource managers may be able to identify potential problems before they develop. The following aquarium fish and other aquatic pets were caught from Indiana waters within the last few years. Nearly all were identified by professional biologists with the exception of some of the "piranha," that were probably actually pacu.

- Three live alligators several feet in length were recovered from the Wabash River, Huntington County in July 2001 and one from a creek in Parke County on August 30, 2003.

- A 48-inch caiman was found in a private pond in Marion County on June 30, 2002.

- Two specimens of the Oriental weatherfish, family Cobitadae (loaches) *Misgurnus anguillicaudatus*, were caught near the Hammond WTTP outfall on the West Branch of the Grand Calumet River, Indiana, on 11/4/02. The native range of this popular aquarium fish is eastern Asia, including Russia, North Korea, Japan, China, Myanmar/Burma, and North Vietnam.

- A 20-inch long Aruana was caught in Lake George, Lake County, on October 15, 2000 and another Aruana from Deep River, Lake County, September 2003.

- Dead shells of Oriental Mystery Snails clogging intake screens at two power plants along the West Fork of the White River. The snails are used in aquaria and backyard ponds.

- A 10-inch dead tiger oscar was found in Blue Lake, Whitley County on January 27, 2003.

- A 5.9-inch bala shark was captured in a gill net by DNR biologists from Diamond Lake in July 1995.

- Piranha or pacu were caught by anglers as follows:
  - 14-inch pacu from Praxair dam on the East Branch of the Little Calumet River, Porter County, August 2003;
  - piranha from Cedar Lake, Lake County, August 2002;
  - 15-inch pacu from Lake Shafer, White County, August 2002;
  - 2.7-pound pacu from St Joseph River, St Joseph County, July 2002;
  - two 10-inch piranhas White River, Delaware County, August 2002;
  - 8.75-inch pacu private pond, Delaware County, August 2000;
  - several unconfirmed piranha were reportedly caught from ponds in Clay County;
  - seven piranha city park pond, Boone County, July 2002;
  - 14-inch pacu Griffy Lake, Monroe County, July 2001; and
  - 15-inch pacu gravel pit, Johnson County.

- A 9.9-inch tinfoil barb (*Barbus schwanefeldi* or *Barbodes schwanenfeldii*) was caught in a District 6 Fisheries survey in West Brazil Pond, Clay County, in 2001.

Many large tropical fish can be kept, as long as the owner complies with the law and is prepared to care properly for the pet. Oversized, unwanted aquarium pets should be traded with someone or dispose of properly. Release of large aquarium fish may be mostly related to buying species that grow to unmanageable sizes. Most of these fish are very small–the size of a quarter–in the pet store, but can get as big as a dinner plate within a year or two. The 20-inch long Aruana caught in Lake George near Hobart last year was probably only two inches long when the aquarist bought it. Most people do not own an aquarium that can handle a two-foot long fish and would not be able to keep it fed properly.

Some of them have feeding habits that are difficult to accommodate unless the pet owner has a steady supply of minnows or goldfish for the pet to devour. Most of these pets will chase and kill other fish in the tank until only one big fish is left. Finding a way to dispose of a big dead fish may not be pleasant.

Pacu, piranha, arowana, and some tropical catfish are among the species require extra care and grow to large sizes. While the scientific names of fish don't change, the common names that a fish is sold by may vary. There are at least 15 species of piranha sold in aquarium stores. Pet owners must conduct some research on the species they are thinking of buying or get fish from a store where the sales people will tell the pet owner how large it will get and what it will need to eat. Responsible pet owners are the first and possibly only line of defense to prevent problems associated with release of these species. Further investigation of the educational and regulatory needs surrounding this issue are most likely necessary.

Nuisance plants

Nonindigenous aquatic plants also have been introduced to the Great Lakes region and inland waters. These plants can be unintentionally transported, as fragments hanging on boat trailers or floating in live wells and bait buckets. They may be dumped intentionally from aquaria or drift due to flooding of backyard ponds. Sales in the aquatic gardening industry are now reaching

approximately $1 billion per year (Kay and Hoyle, 2001). The IDNR Division of Entomology and Plant Pathology licenses over 5,000 nurseries and other facilities that sell terrestrial and aquatic plants. In an investigation of aquatic plant sales from vendors across the United States, supported by the Minnesota Sea Grant and Minnesota DNR, 90 percent of the shipments contained a mixture of species that were not part of the order. Additionally, out of 14 attempts to order prohibited or noxious weeds, they were received 13 times (93 percent), including plants that were illegal to ship across state lines (K. Maki and S. Galatowitsch, unpublished manuscript). A more extensive list of nuisance aquatic plants that may be problematic for Indiana is provided in Appendix B.

Bluegreen algae: There are more than 50 major types of freshwater blue-green algae, and about one-third of them can produce some form of toxin. Blue-green algae are generally a harmless, natural part of the water system in small numbers. But when they dominate the plant community, the algae can interfere with the ecological health and human use of the water by producing offensive taste and odor compounds and sometimes forming a thick scum on the surface. One of the bluegreen algae species, *Cylindrospermopsis*, originally found in Australia, Brazil, and more recently in Florida and North Carolina, was thought to be a subtropical organism. However, the species was found blooming and producing toxin in Ball Lake, Steuben County, Indiana, in August of 2001. The organism has since been identified in several other large reservoirs around the state. Along with many other exotic and nuisance organisms, *Cylindrospermopsis* could potentially be spread by human or natural influences. People exposed to blue-green algal blooms by swimming in affected lakes or rivers have experienced skin irritations, allergic reactions, gastrointestinal symptoms, and respiratory problems. Several other bluegreen algae species release compounds into the water that can cause taste and odor to be so objectionable that the water is deemed unfit for consumption. Standard methods of treating drinking water are thought to remove these toxins. Filtration of taste and odor problems at high levels can require more expensive or cost-prohibitive treatment methods. In 1989 and for several years since 2000, all major surface sources of drinking water for the city of Indianapolis have been chemically treated to reduce populations of bluegreen algae, at a high cost to the utility and its customers, as well as incurring the risks to the ecosystem associated with use of herbicides.

Brazilian elodea: Brazilian elodea has been found in Indiana waters, including a thriving population in Griffy Lake in Bloomington, Indiana. The plant looks very much like a larger, more robust version of its commonly-found native relative, *Elodea canadensis* (waterweed). Stems are erect, cylindrical, simple or branched and grow until they reach the surface of the water where they form dense mats. In Griffy Lake, the Brazilian elodea appears to be overtaking established populations of another nuisance exotic, Eurasian watermilfoil.

Common reed: Common reed (*Phragmites*) is a widely distributed wetland plant found on five continents. It can grow up to 20 feet high in dense stands in wetlands and is long-lived. This plant is capable of reproduction by seeds, but primarily does so asexually by means of rhizomes. Research has shown that native and introduced varieties of this species currently exist in North America. The species is invasive in eastern states along the Atlantic Coast and increasingly across much of the Midwest and in parts of the Pacific Northwest. The plant has been common along roadside ditches in northwest Indiana, but appears to be spreading throughout the state. Where it occurs in abundance, it can change a diverse wetland community to a monoculture,

decreasing the wildlife habitat value of the area.

Hydrilla: Hydrilla is a European species that is thought to have been introduced to Florida sometime during the 1950's. It is an aggressive, invasive species and has spread throughout Florida and most southern states, as well as California, Delaware, and the District of Columbia. Hydrilla has been categorized as one of the world's worst weeds and is certainly among the most notorious of submerged aquatic plant species. It may be found in all types of water bodies. Hydrilla is a submersed plant that can grow to the surface and form dense mats. The plant stems are slender, branched and up to 25 feet long. Infestations of Hydrilla are extremely severe and can completely choke entire lakes and public water supplies. There are no effective control measures against Hydrilla once it has become established in a region. The plant is not known from Indiana waters.

Eurasian watermilfoil: Eurasian watermilfoil is an exotic aquatic plant that rapidly invades shoreline areas by forming dense mats across the surface of the water and can grow into fairly deep water. The plant is suspected to have been an accidental release from an aquarium and was first detected in Washington, D.C. in 1942. By 1950, it was found in Arizona, California, and Ohio. There are about 616 lakes in northern Indiana. Eurasian watermilfoil is currently reported from 175 Indiana lakes and reservoirs in this natural lakes region (compared to 75 in Minnesota and 190 in Wisconsin). This plant affects recreational and source water use in at least 58,981 acres in northern Indiana and 67,438 acres in southern Indiana. This nonnative milfoil crowds out desirable native vegetation, provides no desirable food for waterfowl or wildlife, and makes waterways unsuitable for boating, fishing, and swimming.

Traditional control methods may be less effective than biological control for this particular plant. Mechanical harvesting actually spreads milfoil, because the plant reproduces through fragmentation. Herbicides that are effective against milfoil are also very expensive and may have secondary effects on other plants or animals in the water. During 1998, 160 permits were issued for herbicide treatment of nuisance aquatic plants, the vast majority of which targeted milfoil (84 percent of the treatment area). Nuisance filamentous algae was a common target statewide. The average permit in northern Indiana was for treatment of 11 percent of the surface area, while 52 percent of the surface of southern Indiana lakes was treated.

Lakes treated for nuisance plant growth were three times larger than average for the region, averaged 310 acres in size, had more shallow areas, a greater number of lakefront homes, and tended not to be dominated by bluegreen algae. A report on the St. Joseph River basin indicated that “lakes with public access sites have a greater tendency to have problem densities of weeds, because species are transferred by boats and trailers” (Wesley and Duffy, 1998). This pattern was also indicated in the statewide survey in 1998. Eurasian watermilfoil and curly-leafed pondweed were prevalent in lakes in northern tier of counties and all northeastern counties in natural glacial lakes. Eurasian watermilfoil occurred in reservoirs across the central portion of the state that were generally located in state parks with high recreational use and near large metropolitan areas. Exotic aquatic plants were not reported from reservoirs in the upper Wabash River watershed in north central Indiana or from southern counties in the Ohio River and lower Wabash River watersheds. Control by any method is usually temporary due to repeated introduction of the plant via fragments transported by boat trailers from infested lakes.

Lake associations and water utilities in Indiana spend an estimated $803,041 each year for aquatic plant control in Indiana lakes. Reward and 2,4-D constituted over 60 percent of the cost of chemicals with over 60,000 pounds of 2,4-D indicated on permit applications. Based on the surface area of lakes where presence of Eurasian watermilfoil was reported and current application rates, the annual demand for nuisance plant control in Indiana lakes could be over $1,224,000. This number may be a very conservative estimate of the actual cost of controlling exotic plants that interfere with recreation and drinking water supplies and does not include state resources spent on treating plants on state-owned properties or treatment of private lakes where no permit is required.

Biological control of weeds can provide long-term control that only affects target plants without harming beneficial plants. Once established, biological controls can be self-maintaining, reducing the need for repeated treatments. Applications to lakes in Minnesota, Vermont, Illinois, and Ohio show that a native weevil (*Euhrychiopsis lecontei*) actually prefers the exotic species of milfoil over the native milfoil and has provided a successful means of milfoil control. The weevil lays its eggs on the tips of the milfoil plant. When the young hatch, they burrow down the stem, eating their way through the plant and slowing plant growth or shearing the top of the plant below the water surface. The weevil occurs in Minnesota, Wisconsin, and Illinois, and was discovered in northern Indiana at Saugany Lake, Laporte County, in 1997. Several lakes in Indiana have hired the application of weevils, but results have not been reported.

Purple loosestrife: Purple loosestrife, known for its beautiful purple flowers and landscape value, is a wetland plant from Europe and Asia that was introduced to the east coast of North America in the 1800s. It has become a serious pest to native wetland communities where it out-competes native plants. Purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. This nonindigenous plant is unsuitable to meet habitat needs such as cover, food or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads and turtles. Each year, more than a million acres of wetlands in the U.S. are taken over by this plant. To control the spread of purple loosestrife, a state law was enacted on July 1, 1996, that prohibits the sale of all forms of purple loosestrife (any variety, species, horticultural variety, cultivar), or other members of the genus *Lythrum*, whether reportedly sterile or not. The Department of Natural Resources has also been releasing insects to control purple loosestrife where it has invaded wetlands. Releasing the insects that control loosestrife in Europe can bring it under control. At a typical site, the amount of purple loosestrife around the boat ramp at Pleasant Lake in St. Joseph County decreased dramatically only one year after releasing the insects in July 1998.

Reed canary grass: Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America (Wisconsin DNR, undated). The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. Over time, it forms

large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites. Once established, reed canary grass is difficult to eradicate without removing other beneficial plants.

Which programs are engaged in management of invasive species?

Numerous aquatic nuisance species have been introduced and dispersed in the Great Lakes, Mississippi River basin, and associated inland waters of the state by various pathways. The environmental and socio-economic costs resulting from ANS infestations will only continue to rise with further ANS introductions. Although an awareness of the problems caused by aquatic nuisance species is emerging, the solutions are not readily apparent. This comprehensive state management plan for nonindigenous aquatic nuisance species provides guidance for management actions to address the prevention, control and impacts of aquatic nuisance species that have invaded or may invade the Great Lakes region and inland state waters. State programs are described here and other related regional or federal programs are described in Appendix C.

INDR Division of Entomology and Plant Pathology (DEP)

The Division of Entomology and Plant Pathology manages plant and apiary pests for the preservation and protection of cultivated and natural resources, to facilitate trade, and to enhance the quality and appreciation of the environment. The division inspects and certifies 4,000 licensed dealers and 500 plant nursery facilities in Indiana to protect state resources from pests and pathogens (Robert Waltz, DEP, pers. comm., July 29, 2003). They work with federal agencies such as the U.S. Department of Agriculture's Animal and Plant Health Inspection System (APHIS), the North American Plant Protection Organizations's Phytosanitary Alert System, and other organizations to identify and track diseases, conduct surveys, inspect shipments and nursery stock, and eradicate or control species on the list of federal noxious weeds. Some aquatic plants on this list include hydrilla (*Hydrilla verticillata*), Chinese waterspinach (*Ipomoea aquatica*), giant salvinia (*Salvinia auriculata*), and anchored water hyacinth (*Eichhornia azurea*). Alerted by the public and a district fisheries biologist, the division has taken action to eradicate a population of water hyacinth found in a southern Indiana pond.

IDNR Division of Fish and Wildlife

The Division of Fish and Wildlife is charged with the management and protection of fish, game, and nongame animals in the state of Indiana. The Fisheries Section spends a total of about $1.5 million per year on projects or programs related to exotic species. Regulatory programs address the use of fish and wildlife through permitting by imposing disease-monitoring requirements on imported fish and controlling use of high-risk exotic species that are not legal for possession without a permit. Most of the $750,000 Lake Michigan program is oriented to exotic species management (Randy Lang, DFW, pers. comm., August 12, 2003). The division additionally supports a one-quarter million dollar monitoring project on yellow perch, a species that may be in peril partially due to interactions with exotics such as zebra mussels and round gobies in Lake Michigan. Additionally, division biologists conduct surveys of fish and wildlife including the identification and control of exotic species in certain circumstances. Exotic species management on inland lakes could conservatively cost another $250,000 per year. Surveying and controlling exotic species on streams can amount to an additional $100,000 to $200,000 annually. In more

extreme cases, the district fisheries biologists periodically use chemicals to eradicate fish where the fishery is irreversibly damaged by invasive species, such as gizzard shad or carp, and then restock the water with game and occasionally nongame fish species. Most of the predatory fish stockings are aimed at making the best use of ANS forage bases or to replace native species lost because of ANS. The hatchery and fish management annual grant agreements run about two million dollars each for a total of four million. Approximately half of that, or $2 million, is a direct result of managing against or around the impacts of ANS on recreational and commercial fisheries in Indiana (Tom Flatt, DFW, pers. comm., August 12, 2003). Fish and wildlife biologists, working with private land owners, have enrolled 2,500 acres in the wildlife habitat improvement program, 78,000 acres in the classified wildlife habitat program, and 1,500 acres in the wildlife habitat cost-share program. Much of the stability of these areas depends upon active management and resistance to invasion by nuisance species.

IDNR Division of Law Enforcement

Conservation officers are trained in the detection and identification of exotic species that are illegal for possession, as well as inspection of facilities that are permitted for use of certain controlled fish or other aquatic wildlife, and investigation of fish and wildlife damages caused by pollution. Information on preventing the spread of zebra mussels and other invasive species is included in Boater Education courses administered by the division.

IDNR Lake and River Enhancement program (LARE)

The Division of Soil Conservation's Lake and River Enhancement Program (LARE) was developed to ensure the continued viability of public-access lakes and streams. The program's goal is to utilize a watershed approach to reduce nonpoint source sediment and nutrient pollution of Indiana's and adjacent states' surface waters to a level that meets or surpasses state water quality standards. The program funds aquatic plant management plans for lakes. In 1999, the State Soil Conservation Board (SSCB) approved grants of up to $92,816 in supplemental funding as a 25 percent cost-share to fund nuisance plant control at 17 lakes in northern Indiana and provided up to $43,650 to fund a demonstration project using milfoil weevils in two lakes in northern Indiana and a reservoir in southern Indiana. In the same year, staff from the Purdue University Pesticide Programs and the Division co-authored a 19-page brochure to inform lake associations and others about treatment methods and land use management to prevent overabundant aquatic plant growth. Continued interest in state funding for nuisance aquatic plant control resulted in the state legislature approving doubling of LARE fees associated with boat registration for additional funding of these activities, raising about $700,000 per year for control of exotic species in state waters (Jim Ray, LARE, pers. comm., July 29, 2003).

IDNR Division of Nature Preserves (DNP)

Indiana's system of Nature Preserves was established by a 1967 act of the General Assembly. The system's purpose is to provide permanent protection for significant natural areas within the state. A natural area is an area of land and/or water that has retained or re-established its natural character, or has unusual flora or fauna, or has biotic, geological, scenic or paleontological features of scientific or educational value. Nature Preserves are actually living museums, natural resources that contain a record of Indiana's original natural character. Like other museums, they serve as a valuable record for scientific study and increase understanding of the natural and historical heritage of the state. Natural areas can become dedicated nature preserves only with

the agreement of the landowner, the Department of Natural Resources, the Natural Resources Commission, and the Governor. Once a preserve is dedicated, it is protected in perpetuity from development that would harm its natural character. Unfortunately, it may continue to be difficult and costly to protect dedicated nature preserves from invasion by exotic species. The Division is charged with insuring that the natural qualities of preserves are protected. This may include prescribed burning, removing non-native plants, or other management provided for in the Master Plan, and maintaining boundaries and trails. The IDNR Division of Nature Preserves provides technical support costing $27,438 for the volunteer biocontrol project for distribution of purple loosestrife beetles, has spent $51,787 on contract work and $20,000 on seasonal labor per year for control of invasive species (e.g., *Rhamnus, Phragmites, Lythrum)* in nature preserves, and assists with publication and distribution of brochures on encouraging the use of native species in landscapes rather than exotics in both private and public lands (John Bacone, DNP, pers. comm., August 6, 2003). The Division is also actively involved in inventorying the state for previously unknown natural areas and has information on the distribution of a number of exotic species.

Indiana Department of Transportation (InDOT)

Permits associated with road construction require the InDOT to monitor and maintain mitigation wetlands for five years after construction. They spend approximately $2,500 to $5,000 per acre to control invasive species in these wetlands (Rick Phillabaum, InDOT, pers. comm., July 29, 2003). The agency expends staff resources to explore more effective tools for invasive species control in wetlands and disturbed sites, especially for control of purple loosestrife, common reed, and aggressive native species such as cattails, until adequate native diversity is establish in the mitigation wetland.

Indiana State Office, Natural Resources Conservation Service (NRCS)

The NRCS provides technical information and financial assistance regarding impacts and control of exotic species on agricultural lands. The office produced a publication on wetlands and West Nile Virus (NRCS, 2003). The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed. The WHIP program provides funds for control of exotic species on land and waters dedicated to management for wildlife habitat. The NRCS spends an estimated $3,000 to $5,000 per year on control of reed canary grass along wetlands, drainage ways, and riparian areas (Dave Stratman, NRCS, pers. comm., July 29, 2003).

State Health and Environment Officials (ISDH, IDEM, OISC, BOAH, ADDL)

Several state health agencies become involved in situations where parasites or pathogens of humans or domestic livestock are introduced into the state. Epidemiologists at the Indiana State Department of Health (ISDH) assist with diagnosis, tracking, and public information on diseases. They have most recently been involved in the introduction of exotic diseases such as monkey pox, West Nile Virus, Chronic Wasting Disease (CWD), and health warnings associated with the discovery of toxin-producing bluegreen algae. Drinking water utilities are regulated by the Indiana Department of Environmental Management (IDEM) which issues permits that may monitoring and filtration of toxins produced by introduced algae in public source water. The

Office of the Indiana State Chemist (OISC) reviews and registers pesticide products that might be needed for control efforts in Indiana, and incorporates specific invasive pest species materials into their pesticide applicator training materials and certification exams. The State Board of Animal Health (BOAH) promotes and encourages the prevention, suppression, control and eradication of infectious, contagious and communicable diseases affecting the health of domestic or wild animals within Indiana and trade in animals and animal products in and from Indiana. Animals suspected of infection are examined and tested by specialized veterinarians at the Animal Disease Diagnostic Laboratory (ADDL) at Purdue University. Introduced diseases for which the ADDL has tested have included largemouth bass virus, spring viremia of carp, and several diseases of trout and salmon. Researchers at the Southern Indiana-Purdue Agricultural Center (SIPAC) in Dubois County have a history of intense research in production and utilization of forages and agronomic crops, management of beef and dairy cattle, and catfish production. The Southern Indiana Disease Diagnostic Laboratory serves the agricultural industry in this part of the state.

Aquatic management and plant control companies

The DNR Division of Fish and Wildlife provides a complementary list of 18 companies in Indiana that provide lake management and plant control services. There are 34 companies listed as commercial fish suppliers, which sell to private property owners. Invasive plant control and renovation of fisheries on private waters due to ANS infestation can amount to 50 to 80 percent of company income (Scott Shuler, Aquatic Control, pers. comm., July 29, 2003). Estimates for the statewide industry are unknown.

Invasive Plant Species Assessment Working Group (IPSAWG)

Many Indiana agencies and organizations have joined together to form the Invasive Plant Species Assessment Working Group (IPSAWG). The goal of the group is to assess which terrestrial and aquatic plant species may threaten natural areas in Indiana. Through the assessment, recommendations will be developed for specific plant species concerning their recommendation, sale, and planting within the state. While the focus of the effort so far has been terrestrial, aquatic plants will also be evaluated as appropriate. The IPSAWG's goal is that all partner agencies and organizations would utilize the species assessment when recommending or selling plants.

University of Notre Dame

Researchers at the University of Notre Dame are developing risk assessments for freshwater taxa that will allow the prediction of likely invasive species in the Great Lakes region. Once these species are identified, efforts can be made to keep them out of Indiana. A risk assessment protocol for fishes in the Great Lakes has been completed, and similar analyses for molluscs and aquatic plants are underway. With these tools, it is possible for regulators to assess species before they arrive and determine whether it is in the best interests of the state for them to be allowed. Risk assessments can be applied to organisms that may be introduced intentionally (e.g. aquarium and watergarden trades) or unintentionally (e.g. ballast). In future work, risk assessments already formulated will be refined, and risk assessments will be developed for additional taxa.

The Nature Conservancy, Indiana Chapter

Together with our members and conservation partners, the Indiana Chapter of The Nature Conservancy has protected over 43,000 acres of irreplaceable forest, wetland and prairie habitats in the state. The chapter works with the IDNR Division of Nature Preserves to prevent and control the invasion of exotic species in these areas, spending an estimated $30,000 annually in salary and material costs along with an additional $5,000 annually to develop site conservation plans (Ellen Jacquart, pers. comm., August 27, 2003). They also support a statewide biocontrol project using beetles that feed on purple loosestrife. The chapter assisted with development of the brochure *Landscaping with Plants Native to Indiana: Recommended Plants and Their Sources*, which encourages individuals and landscapers to use native species rather than invasive species in both terrestrial and aquatic settings.

Indiana Lakes Management Society (ILMS)

The ILMS promotes and encourages the understanding and comprehensive management of lakes and reservoirs and their watershed ecosystems. Indiana is blessed with over 500 natural (glacial) lakes greater than 5 acres in area. These are located primarily in the three northernmost tiers of counties. Besides the natural lakes, there are 25 public reservoirs larger than 300 acres. In addition, the state contains at least 10,000 artificial ponds of various sizes. Total area of lake habitat in Indiana is estimated to be almost 300,000 acres. The southern tip of Lake Michigan makes up about half this amount. All together, a little more than 1% of Indiana's total area is composed of "lake water." Approximately 120 lake associations provide information on issues of concern to residents around private and public lakes in Indiana. For instance, the 15 lake associations working within the Tippecanoe Environmental Lake and Watershed Foundation (TELWF) and over 120 lake associations involved with the ILMS have raised private funds for aquatic plant herbicide control and biocontrol demonstration projects, as well as distributing 5,000 newsletters each quarter and answering about 100 visits and calls each week with information on permits and other ANS issues (Lynn Stevens, TELWF and ILMS, pers. comm., July 29, 2003). The cost of these services, if provided by a private sector contractor, would amount to approximately $30,550 annually.

Indiana Native Plant and Wildlflower Society (INPAWS)

The INPAWS promotes the appreciation, preservation, conservation, utilization and scientific study of the flora native to Indiana and to educate the public about the values, beauty, diversity and environmental importance of indigenous vegetation. Together with the Indiana Chapter of The Nature Conservancy and IDNR Division of Nature Preserves, they sponsored development of brochures on exotic and native plant species for landscape use. They also organize and host volunteer control efforts to remove invasive species from nature preserves. Other statewide aquatic gardening societies also provide information to property owners and retailers that address invasive species concerns.

Indiana-Illinois Sea Grant

The Indiana-Illinois Sea Grant offices are located on the campuses of the University of Illinois and Purdue University. Sea Grant produces a number of outreach materials on exotic species, including a CD-ROM with a compendium of brochures and other information, exotic species advisory signs that are posted at public access sites and boat ramps throughout Indiana, “Don’t Dump Bait” stickers and informative signs for bait shops, zebra mussel citizen monitoring kits, videos, and posters.

Indiana Lake Michigan Coastal Zone Management

The purpose of the Indiana Lake Michigan Coastal Program is to enhance the State's role in planning for
and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies and organizations. The Indiana Lake Michigan Coastal Program relies upon existing laws and programs as the basis for achieving its purpose. Indiana's most challenging coastal issues include public access to the shore, beach closures, water quality, brownfields dredging, shoreline erosion, and preservation of natural areas. Coastal industries are significant to Indiana's economy. The Lake Michigan shore is home to the fifth largest oil refinery in the world, 25% of the nation's steel production, and the busiest port in the Great Lakes (Port of Indiana, 1994). Tourism and recreation are also important, especially in the extensive Indiana Dunes State and National Lakeshore. In 2003, Indiana received $1.171 million as the state's share of the federal Coastal Zone Management Program funds for projects to protect and restore natural resources in Indiana's Lake Michigan coastal region. Approximately $975,000 of this funding is being used as for the Indiana Coastal Grants program and is available to local entities for projects meeting the program criteria. The program can provide funds for exotic species management in this region.

Circle City Aquarium Club, Indianapolis, Indiana

Established in Indianapolis in 1991, the Circle City Aquarium Club promotes a higher educational level of the aquarium hobby to the membership and public at large; stimulates an interest in the hobby; increases knowledge of environmental concerns related to the hobby and means of affecting those concerns; and develops social friendships of the members. They have monthly meetings, host a chat room, feature speakers, and produce a newsletter for members that could include information on the risks of releasing fish to public waters or on other ANS issues. An officer of the aquarium club participated in development of the state ANS management plan.

Other programs

A number of other programs include an invasive species outreach or funding component. The Indiana Commissioner of Agriculture's office supports control of disease and weeds that affect agriculture. Purdue University is initiating a new curriculum on invasive species, based on the efforts of Dr. Carol Lembi on aquatic plants and Dr. Steve Yaninek on aquatic insects. The Illinois-Indiana regional chapter of the North American Native Fishes Association (NANFA) supports appreciation for and use of native fishes rather than exotics in the aquarium and pet trade. The Indiana Karst Conservancy is exploring the impact of ANS on dedicated nature preserves and other karst areas with ground water sources (Kriste Lindberg, IKC, pers. comm., July 29, 2003). The Sierra Club in Indiana is increasingly involved in outreach to members on these issues (John Ulmer, Sierra Club, pers. comm., July 29, 2003). The City of Bloomington parks department has participated in state cost-share biocontrol projects using weevils on Eurasian watermilfoil, funded plant control, and contracted for plant surveys to detect problematic invaders (Steve Cotter, City of Bloomington, pers. comm., July 29, 2003). In 2003, the International Association of Fish and Wildlife Agencies (IAFWA) funded a multiyear project to facilitate communication on ANS issues between state fish and wildlife agencies in each region of the nation and supporting a pilot state communication project that will provide the agencies with model plans for public outreach on ANS issues.

What regulatory authorities control management of exotic species?

The prevention and control of aquatic nuisance species have global implications that require policies and programs at various levels of government. The federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646, also known as NANPCA) delineates the basic role of federal, regional and state government in the implementation of the act. The NANPCA provides a foundation for the implementation of state plans.

Federal Role

The NANPCA is the federal legislation which calls upon each state to develop and implement a comprehensive state management plan for the prevention and control of aquatic nuisance species. The act, established for the prevention and control of the unintentional introduction of nonindigenous aquatic nuisance species, is based on the following five objectives as listed in Section 1002 of NANPCA:

- to prevent further unintentional introductions of nonindigenous aquatic nuisance species;
- to coordinate federally funded research, control efforts and information dissemination;
- to develop and carry out environmentally sound control methods to prevent, monitor and control unintentional introductions;
- to understand and minimize economic and ecological damage; and to establish a program of research and technology development to assist state governments.

The NANPCA was primarily created in response to the zebra mussel invasion of the Great Lakes, where this ballast water introduction has caused serious ecological and socio-economic impacts. Although the zebra mussel invasion of the Great Lakes has played a central role in prompting passage of the federal legislation, NANPCA has been established to prevent the occurrence of new ANS introductions and to limit the dispersal of aquatic nuisance species already in U.S. waters.

The national Aquatic Nuisance Species (ANS) Task Force, co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, was established under Section 1201 of NANPCA to coordinate governmental efforts related to nonindigenous aquatic nuisance species in the United States with those of the private sector and other North American interests. An important role of this federal group in the implementation of NANPCA is to facilitate national policy direction in support of the act. The ANS Task Force (consisting of seven federal agency representatives and eight ex officio members representing nonfederal governmental entities) has adopted the Aquatic Nuisance Species Program under Section 1202 of the act which recommends the following essential elements:

> Prevention: Establish a systematic risk identification, assessment and management process to identify and modify pathways by which nonindigenous aquatic nuisance species spread.
>
> Detection and Monitoring: Create a National Nonindigenous Aquatic Nuisance Species Information Center to coordinate efforts to detect the presence and

monitor the distributional changes of all nonindigenous aquatic nuisance species, to identify and monitor native species and other effects, and to serve as a repository for that information.

Control: The Task Force or any other potentially affected entity may recommend initiation of a nonindigenous aquatic nuisance species control program. If the Task Force determines, using a decision process outlined in the control program, that the species is a nuisance and control is feasible, cost effective and environmentally sound, a control program may be approved.

The ANS Task Force recommends research, education and technical assistance, and rapid response planning as strategies to support the elements listed above.

The ANS Task Force also provides national policy direction as a result of protocols and guidance that have been developed through the efforts of the following working committees: Research Protocol/Coordination Committee, Intentional Introduction Policy Review Committee, Great Lakes Panel on Aquatic Nuisance Species, Ruffe Control Committee, Risk Assessment and Management Committee, Detection and Monitoring Committee, Zebra Mussel Coordination Committee and the Brown Tree Snake Control Committee.

One role of the federal government in the prevention of unintentional introductions of aquatic nuisance species is defined under Section 1101 of NANPCA, which mandates the establishment of regulations for ballast water management aimed at limiting introductions through transoceanic shipping. U.S. regulations control the discharge of ballast from all vessels entering Great Lakes waters, thus far the only region in the United States to be regulated. The regulations have been enforced by the U.S. Coast Guard since May 1993, with active assistance from the Canadian Coast Guard and Seaway authorities. (The Canadian federal government has yet to enact federal ballast water management regulations; voluntary guidelines are in place.) The need has been identified for a federal research program to develop innovative technology for ballast water management.

The U.S. Fish and Wildlife Service administers the Lacy Act, which prohibits importation and interstate delivery of listed species. The list of injurious live or dead fish, mollusks, crustaceans, or their eggs (50 CFR 16.13) include the following aquatic nuisance species:

- walking catfish, family Clariidae
- mitten crabs, genus *Eriocheir*
- zebra mussels, *Dreissena polymorpha*
- live or dead uneviscerated salmonid fish, live fertilized eggs, or gametes of salmonids are prohibited unless accompanied by a certification that the ensures they are free of *Oncorhynchus masou* virus and the viruses causing viral hemorrhagic septicemia and infectious hematopoietic necrosis, and meet the conditions in 50 CFR 16.13
- Any live fish or viable eggs of snakehead fishes of the genera *Channa* and *Parachanna* (or their generic synonyms of *Bostrychoides*, *Ophicephalus*, *Ophiocephalus*, and *Parophiocephalus*) of the Family Channidae.

The U.S. Department of Agriculture also regulates the importation and interstate transport of aquatic pests and pathogens that can have a negative impact on crop production, horticulture, silviculture, and aquaculture. The federal noxious weed list has authority through the Plant Protection Act (Title IV) of the P.L. 106-224 (2000). Included in the list are 19 aquatic or wetland species as of September 8, 2000. These species include mosquito fern (*Azolla pinnata*), anchored water hyacinth (*Eichhornia azurea*), and hydrilla (*Hydrilla verticillata*).

Application of pesticides for control of exotic species must be conducted under FIFRA, the Federal Insecticide, Fungicide, and Rodenticide Act. In response to the Talent Decision in the 9th Circuit Court and ensuing actions, G. Tracy Mehan, III, Assistant Administrator for Water, and Stephen Johnson, Assistant Administrator for Prevention, Pesticides and Toxic Substances, signed a memorandum on July 11, 2003, that provides interim guidance on whether certain pesticide uses may legally occur without issuance of a permit under the National Pollution Discharge Elimination System (NPDES) of the Clean Water Act. The Interim Guidance states that the application of a pesticide to waters of the United States consistent with relevant requirements of Federal Insecticide, Fungicide, and Rotencide Act (FIFRA) does not constitute the discharge of a pollutant that requires a NPDES permit in the following circumstances: (1) the application of pesticides is directly to waters of the United States in order to control pests (for example mosquito larvae or aquatic weeds that are present in the water) and (2) the application of pesticides is to control pests that are present over waters of the United States that result in a portion of the pesticide being deposited to water bodies (for example when insecticides are aerially applied to a forest canopy where water may be present below the canopy or when insecticides are applied for control of adult mosquitoes). EPA will solicit comments on this interim statement and guidance through the Federal Register prior to determining a final Agency position.

On July 11, 2003, G. Tracy Mehan, III, Assistant Administrator for Water, and Stephen Johnson, Assistant Administrator for Prevention, Pesticides and Toxic Substances, also signed a "Charge to the NPDES/Pesticides Work Group" that directed an EPA workgroup to compare the risk management/risk mitigation measures that have been adopted as a result of the Federal Insecticide, Fungicide, and Rotendicide Act (FIFRA) label relative to actions that would be required as a result of an NPDES permit. The workgroup was also directed to identify any recommendations that could be made under either FIFRA/FQPA (Food Quality Protection Act) or Clean Water Act (CWA) that would assist in better coordination, integration and increased efficiencies between the programs and continued protection of the aquatic environment. For example, these could include modifications that could be made in the pesticide registration process or changes in the approach to risk management under the CWA and/or FIFRA.

Regional Role

Two major basins incorporate waters of the state of Indiana—the Mississippi River, including the Ohio and Wabash River drainages, and the Great Lakes, including the St. Joseph and other rivers draining to Lake Michigan in the northwest and with a smaller portion of the northeastern part of the state draining to Lake Erie. Fisheries related activities in the Ohio and Mississippi River basins have been regionally coordinated by two organizations—the Mississippi Interstate Cooperative Resource Association (MICRA), established in 1991, and Ohio River Valley Water

Sanitation Commission (ORSANCO), established in 1948. The Ohio River Fish Management Team (ORFMT) is a multi-state effort to collaborate on research and regulations along the length of the Ohio River system. The Great Lakes ANS Panel provided early leadership for developing state ANS management plans, including model guidance on invasive species regulations. Although none of these organizations has direct regulatory authority within Indiana, they all have been instrumental in generating discussion between states in the respective regions regarding common regulatory interests and concerns. Indiana has had one or more state agency representatives participating in activities of these two groups over the past decade.

State Role

The comprehensive state management plans for aquatic nuisance species are addressed in Section 1204 of NANPCA. Section 1204 requires that the management plan "identifies those areas or activities within the state, other than those related to public facilities, for which technical and financial assistance is needed to eliminate or reduce the environmental, public health and safety risks associated with aquatic nuisance species." The content of each state plan is to focus on the identification of feasible, cost-effective management practices and measures to be pursued by state and local programs to prevent and control aquatic nuisance species infestations in a manner that is environmentally sound. As part of the plan, federal activities are to be identified for prevention and control measures, including direction on how these activities should be coordinated with state and local efforts. Section 1204 also states that in the development and implementation of the management plan, the state needs to involve appropriate local, state and regional entities, as well as public and private organizations that have expertise in ANS prevention and control.

The state management plans are to be submitted to the national ANS Task Force for approval. If the plan meets the requirements of the ANS Task Force, the plan becomes eligible for federal cost-share support. If not, the plan is returned to the state with recommended modifications. Plans may be implemented with other funds supplied by state and cooperative agencies. Further details on the state management plans can be found in Section 1204 of the act.

Regulations in many states were initially designed to address particularly high risk species and activities for which species are imported and sold. Other nuisance or exotic species are addressed within the context of pests or pathogens that affect agricultural crops or aquaculture production. An annotated listing of all Indiana regulations pertaining to prevention and control of aquatic nuisance species is provided in the Appendix E.

Designing an integrated, comprehensive regulatory approach: Issues for further examination

As invasive exotic species and global trade introduce more pervasive problems, a more integrated and comprehensive approach to state, regional, and federal authority will be needed to avert the economic and aesthetic changes that could occur. Invasive species and exotic pests and pathogens may be transported together, indicating a need for consistent and coordinated jurisdiction across all nuisance species. A comprehensive approach may consist of either: (1)

modification of a number of existing definitions and authorities in state statutes and administrative rules to include additional invasive species; or (2) development of a state statute to specifically provide for addition and modification of sections of code addressing all invasive species, similar to Minnesota Chapter 84D on Harmful Exotic Species and based on the Great Lakes ANS Panel model statute recommendations.

Some of issue areas that may require additional examination are described below. Significant contributions to this analysis were derived from *Analysis of Laws & Policies Concerning Exotic Invasions of the Great Lakes: A Report Commissioned by the Office of the Great Lakes, Michigan Department of Environmental Quality* by Eric Reeves, March 15, 1999.

Definition and classification of invasive exotics: Adequate regulatory authority is based on clear and defensible definitions that classify the characteristics of plants and animals considered by an invasive species program. Regulatory authority could address species that are both invasive and exotic (nonnative). They may need to distinguish between exotic and naturalized nonnative species (i.e., species that have been present in Indiana for so long or are so widely distributed that control measures would be ineffective). Certain invasive species may be regulated as a pest in a particular area, even if the species is widespread in other parts of the state. Exotic species may not be invasive or harmful. Regulation of benign exotics would be an inefficient use of authority. In contrast, there are also native species that are invasive nuisances in situations where the area has been disturbed or is being managed for a particular purpose. Therefore, most regulatory authorities are often built on the concept of "harmful exotics".

Examples of terms that may require definition are: nuisance, invasive, harmful exotic, incapable of perpetuation, confined for research, indigenous, and naturalized species are not specifically defined in state law or administrative code. Worms (i.e., annelids, oligochaetes, trematodes, cestodes, planarians), lower invertebrates and microorganisms that can be pests or pathogens of fish and wildlife are not included in either the plant pest lists, licensing of bait dealers or wild animal importation permits. A specific statute regulates the control of nuisance aquatic plants, including exotic and native species in public waters. Exotic species that have a negative impact on other types of commercial facilities or animals that affect recreational uses of water, such as clogging of intake pipes by zebra mussels, are not directly defined or regulated as pests in state law. Release of organic or inorganic matter that pollutes aquatic communities and limits uses of water is prohibited under state water pollution control laws in IC 13-18-4. Effluents from certain fish hatchery systems are required to have a National Pollution Discharge Elimination System (NPDES) permit. However, exotic species in these effluents are not generally monitored or prosecuted. In comparison, the Pennsylvania law specifies that discharges be "rendered incapable of containing self-perpetuating living organisms…." (Pennsylvania Consolidated Statutes, 3PCS Sect 4219.c). Several states, including Minnesota, Wisconsin, and New York have specifically included "biological materials" as a form of pollution under state pollution control laws. However, it is not clear whether release of exotic plants, animals, microorganisms, or viable genetic material falls within the jurisdiction of state pollution control laws in Indiana, as indicated by a recent inquiry about regulation of "bacterial remediation" in public lakes. A procedure for classifying exotic species by using a designated criteria or a risk assessment method could institute consistency, predictability, and responsibility for justifying risk management decisions and authorities.

Jurisdiction: As with other exotic species issues, consistency between states where trade occurs regularly or where watersheds overlap jurisdictions is essential for effective control. Ability to enter into cooperative agreements and powers of quarantine to manage pests and pathogens, as currently defined in state law, may need to be extended to address other aquatic nuisance species and terrestrial invasive species. The department would need the ability to respond to an introduction by protecting a particular uninfested area or waters that are particularly sensitive to exotics. For instance, specific policies may need to be developed to address management and release of invasive species on state properties. The impacts of invasive species may be different for sensitive properties that are maintained by the state for particular reasons (e.g., nature preserves, recreational fisheries), requiring more specific regulations than the rules that cover general use statewide. Agencies may need to review their policies through an intradepartmental oversight mechanism to ensure that different division policies and actions regarding invasive species are not contrary to each other within the same agency.

Interjurisdictional issues and interstate commerce laws: Prevention and control of invasive aquatic species may require careful evaluation and effective use of interjurisdictional authorities. Although management of invasive species by waterway or watershed makes sense ecologically, watersheds are not a legal entity. However, regulations within a state may overlay the counties on the watershed and designate a portion of the county that nearly matches watershed boundaries. State laws are constrained by federal interstate commerce laws. Regulations may need to clarify or extend control of interstate shipments by stating that animals must not be unloaded or leave the control of a common carrier. A mechanism for interstate agreements to regulate fish and game management on boundary waters is available in IC 14-22-10-9. Extension of this authority to include agreements regarding invasive species that move along waterways that cross state lines may be beneficial. Authority in IC 14-24-2-2 to enter into agreements with the federal government or other states for the purpose of controlling pests and pathogens of plants and bees should possibly be extended to cover management of invasive species**.**

Under IC 14-22-34-14, the department may enter into agreements with federal agencies, political subdivisions or private individuals for the purpose of managing an area used by endangered species, possibly including removal of invasive species that threaten habitat used by the protected species. The ability to prohibit the importation of an animal from an area with an epidemic disease under IC 15-2.1-18 could be extended to importation of aquatic animals from waters known to contain particularly harmful invasive species. Relationships between state agencies, such as the Department of Commerce, Board of Animal Health, Office of the State Chemist, Office of the Commissioner of Agriculture, Department of Health, Department of Environmental Management, and Department of Natural Resources may need to be better integrated to effectively and efficiently address invasive species and their impacts on wild and domestic aquatic organisms.

Invasive species council: The Department of Natural Resources is working with other state agencies and representatives to explore the needs and development of a state invasive species council to coordinate a number of programs that address management of aquatic and terrestrial invasive species. The Division of Fish and Wildlife is funding a facilitator to develop an Indiana State Aquatic Nuisance Species (ANS) Management Plan for approval by the ANS Task Force.

However, there is no legislatively created council or program to guide and coordinate overall management of aquatic or terrestrial invasive species. Continuation of the ANS Advisory Council, as an outgrowth of the ANS Plan Work Group, would facilitate further implementation of the plan and provide a pilot process for the larger council.

Enforcement: Additional funding for patrols and training of law enforcement officers in detection of nuisance species may be essential to ensure that well-designed regulatory authority can be implemented. Due to the extreme cost associated with the remediation of damage caused by exotic species, if remediation is even possible, fines must be commensurate with potential damages. Civil penalties associated with misdemeanors are low (up to $500 for unlicensed possession of a prohibited species) indicating that the fines are not intended as a major deterrent for major commercial ventures such as aquaculture, the pet trade or commercial shipping. No criminal penalties exist for the violations. Existing authorities to assess and recover costs related to civil liability resulting in wildlife damage assessments under IC 14-22-10-6 may be construed or extended to cover death of fish or game resulting from negligent or intentional release of nuisance exotic species. Clarity may be needed to ensure that definitions of jurisdictional (e.g., "public" or "private") waters adequately address risks to public and commercial resources.

Approved and illegal species lists: Regulations also include several sets of species that are prohibited for importation, possession or sale for any use, as well as a list of approved fish species for sale for release under permits. These lists were developed as the department becomes aware of individual species that are known to pose a serious risk to natural and commercial resources in Indiana. The department has not undertaken a comprehensive risk assessment to proactively identify species for these lists.

Risk assessments that describe the level of threat associated with the life history characteristics, probability of introduction and establishment, and use or containment of the species could be a standard science-based procedure for permitting authorities. Risk assessments must be driven by the best available data and refereed science, not just expert opinion, anecdotal data, or unpublished scientific data without adequate peer review. Use of a published decision support tool creates a process that can be replicated, periodically evaluated and updated, and defended both legally and publicly.

Determining the level of risk for particular species may be very complex. Risk posed by some species may be difficult to assess due to a lack of scientific information on the life history, invasive character or adaptability of the species. Some states use the concept of a "clean list" that identifies allowable species and places the burden of proof on the applicant for species posing unknown levels of risk. Some states, such as Pennsylvania, broadly exempt tropical or saltwater fish under the assumption that these species will not survive winters in the fresh waters of the northern United States. Importers of colder water fish that may survive could be required to submit information on the ecological and economic risk of the species prior to approval for implementation under statutes addressing the sale of fish in Indiana. It is possible for an introduced species to be benign until it reaches a threshold level and then suddenly creates a nuisance for reasons that may or may not be understood. A significant lag time may exist from the time the invasive is recognized to the time when it attains critical mass and becomes problematic.

The effectiveness of illegal species lists in states that are joined by common waters or shared introduction pathways may be seriously compromised if they differ in which species they address. At a regional level, the Reeves' (1999) analysis suggests that it would be more effective to develop such lists for use in all Great Lakes basin states under the auspices of the Great Lakes Fishery Commission and the Great Lakes ANS Panel. Regional and national structures are in place for dealing with agricultural pests between state and federal jurisdictions. It may be necessary to develop or improve similar infrastructure for adequate enforcement regarding invasive species that have impacts on other natural and cultural resources.

Genetic modified organisms: Genetic engineering has become a tool for developing species with enhanced characteristics, such as faster growth or higher quality. State regulations have gradually incorporated references to use of genetically altered (or genetically modified) species, including biological control by release of sterile individuals. Some regulations have been extended to address importation of eggs, gametes or other genetically viable material. A risk analysis could be developed and implemented to determine acceptable use of biotechnology and genetic engineering in aquatic systems.

Pests and pathogens: Taxa that are controlled in the entomology and plant pathology code include arthropods, nematodes, microorganisms, fungus, parasitic plants, mollusks, plant diseases, or exotic weeds that are injurious to plants or bees. Pests or pathogens of fish or other wildlife are addressed in importation requirements of the fish and wildlife code. Most of the focus has been on diseases of fish. In cooperation with regional guidelines developed by the Great Lakes Fishery Commission in their *Great Lakes Fish Disease Control Policy and Model Program* (Hnath, 1993), the Division of Fish and Wildlife places conditions on permits for verifying and controlling the health status of all lots of stocked fish or fish sold for release with special emphasis on diseases of trout and salmon. Some states also provide for fish health certification requirements in administrative code or statute. Because discovery or introduction of new diseases can change quickly, regulations must be flexible enough to incorporate additional coverage.

Diseases of aquatic animals and water-borne pests and pathogens are addressed by several agencies in Indiana. Most of the legal structure regulating aquaculture facilities reside with the Department of Natural Resources. Aquaculture production is not represented on the state Board of Animal Health under IC 15-2.1-3-2. However, the state Animal Disease Diagnostic Laboratory (ADDL) at Purdue University has retained the services of aquatic veterinarians who provide assistance to state and private fish hatcheries. The ADDL has investigated diseases introduced into the state such as Largemouth Bass Virus (LMBv) and regularly conducts fish health inspections on shipments of trout and salmon. The state department of health has been involved in the epidemiology of diseases transmitted by nuisance aquatic species, such as West Nile virus, water-borne diseases or toxin-producing organisms, such as cholera or the bluegree alga *Cylindrospermopsis*, and in diseases spread by terrestrial exotic pets, such as monkey pox. The commissioner of agriculture's office primarily provides assistance in markets and financing of aquaculture facilities. The Indiana Aquaculture Association has been somewhat variable in its strength as an organization for bridging agency policies and private aquaculture issues. As other species become increasingly common in aquaculture and production of aquatic organisms

increases in Indiana, state capacity to assist aquatic production facilities and address additional invasive species and disease risks may need to be examined. The state of Michigan and several other states maintain aquaculture advisory committees that coordinate information transfer and policy recommendations. A similar body may be useful in Indiana.

Aquaculture and bait dealers: State regulations may not adequately address ANS risks associated with industries that are not specifically related to use of exotic fish in aquaculture production and sale for release. Because the regulations were developed within the fish and wildlife code, the primary concern was for reducing risks posed to natural resources by fish and other aquatic animals directly introduced into public waters. For this reason, most of the regulations cover only fish that are released or sold for release such as aquaculture, stocking, and use of bait in public waters. Property regulations may need to specifically address release of invasive species or vectors of disease on public property. Bait dealers licenses cover relatively few taxa (i.e.. "minnows" and crayfish) and do not address earthworms or other species that may be sold as bait. Approximately 500 bait dealers are licensed in the state by the DNR. No specific public education programs or requirements exist for record-keeping on sources and species or inspection of bait dealers to ensure that prohibited species or other harmful exotics are not introduced. Several species of fish on the "clean" list are exotic species that may have invasive tendencies (e.g., mosquitofish) and may merit reexamination and removal from that list. Some states have implemented policies and training in HACCP procedures to ensure that bait is checked for ANS. Although wild animal possession permits (312 IAC 9-11-2(e)) anticipate the possibility and require a plan for the quick and safe recovery of an escaped animal, aquaculture permits do not. At a regional level, the Reeves (1999) analysis suggests that it would be more effective to develop interagency agreements for inspection and certification of bait fish production ponds as a primary control point in the potential spread of ANS by that pathway.

Private aquaria, ornamental fish ponds, aquascapes, food fish, and pet trade: Under the assumption that fish purchased as pets or for food will not be released into outdoor waters, most of the regulations exempt food markets and the aquarium and pet trade. Public exhibits, such as zoos and aquariums, are also exempt from most permit requirements. Nurseries that sell aquatic plants and snails for backyard ponds are regulated to the extent that some species, such as purple loosestrife, are described or prohibited as plant pests or federal noxious weeds. Stocking of private ponds is only indirectly regulated by controlling the species which may be sold under a Haulers and Suppliers Permit or Aquaculture Permit. Most regulations exempt the aquarium and pet trade, sale of live fish for food, and other activities that may directly or indirectly spread nuisance exotics. Rules describing containment may need to be extended from aquaculture facilities and fish to other situations and species, especially for organisms held in backyard ponds, outdoor pens, having an external effluent, or in flood plains. Ironically, classifying certain pets as illegal without a permit, such as crocodilians over five feet in length or snakehead fish, may result in release of these specimens by pet owners who do not recognize an alternative means of dispossession. In response to heightened concern about introduction of Asian carp into Lake Michigan, the Chicago City Council passed a municipal ordinance banning any possession of these fishes without a permit and requiring retail food establishments to kill any live Asian carp before the fish is sold or provided to the customer (Title 7, Chapter 12 of the Municipal Code of Chicago, City Council Journal, April 9, 2003).

Education plays a key role in enforcement affecting private activities. There should be a link between the regulatory authorities, outreach organizations, and the public that encourages citizens to become a part of monitoring compliance and to take ownership in the impacts and control of invasive species.

Other pathways: Some states have regulations regarding additional pathways, such as recreational boating and transportation of aquatic recreation devices between waters. Existing authority over activities that aid in the spread of exotics (e.g., fragmentation by boat harvesters, habitat disturbance caused by shoreline construction) could include review and action to address impacts of the activity on risks related to exotic species. Ballast water regulations have not been proposed at the state level, but the department of natural resources has voiced political support for use of coordinated regional or federal regulations through comments on proposed federal legislation and participation in the Great Lakes ANS Panel.

Early detection and rapid response activities: Other activities related to aquatic nuisance species may be added to existing mandates for state agencies. These new program activities may include screening and monitoring for early detection of ANS introductions. State or regional authorities must be adequate to develop and implement rapid response activities. Recent incidents involving discovery of exotic toxin-producing cyanobacteria (blue-green algae) in public waters used for drinking and recreation suggest that better communication and prior establishment of roles and relationships between state agencies regulating animal and human health may be warranted. The IDEM works with DNR and other agencies to respond to emergency spills of toxic substances. Several of these staff are already trained in the identification of some aquatic nuisance species, particularly fish. Additional resources for training of the same team or implementation of a similar model could be acquired to react to emergency releases of invasive organisms. These regulations may include authority for preapproved methods of eradication, cooperative functions between agencies, entry onto private property, quarantines or other required verification and control activities.

Emergency rule-making authority can be a critical tool for rapid response. For example, when state authorities attempted to address pesticide applicator competency issues related to the potential spread of West Nile Virus during 2002 to 2003, they discovered too late that the agency did not have emergency rule-making authority (Dave Scott, Office of the Indiana State Chemist, pers. comm., August 15, 2003). As a result, the state may have missed out on an entire, and possible critical, mosquito pesticide application season. Emergency rule authority by signature of director of DNR can be used in the event of introduction of an invasive or to prevent an impending introduction, rather going through the normal rule process which usually takes nine months. Emergency rules must be followed by permanent rules to stay in effect beyond the initial period of not more than a year. This authority may need to be extended to other agencies with regulatory jurisdiction over invasive species introductions.

What can Hoosiers do to prevent and control the impacts of ANS?

The goals of this state management plan are designed to address different stages of ANS invasion:

1. preventing the introduction of new nonindigenous species transported from water bodies in other parts of the continent or world;
2. limiting the spread of established, reproducing ANS populations to other water bodies in Indiana and other states; and
3. mitigating the harmful ecological, economic, social, and public health impacts of colonization of ANS populations within water bodies, including the harmful impacts resulting from colonization.

The plan includes the following goals and actions. Approximately 180 strategies and actions are listed under each of 32 objectives. The information for this section was derived from a number of agency meetings, a public meeting on April 15, 2003, and interviews with 43 stakeholders. The list of project reviewers totals over 120 individuals who represent industries, agencies, and organizations with an interest in aquatic nuisance species management. The management actions were made available for public review and comment to determine which tasks should be modified, eliminated or added, and which tasks should be highest priority for the next five-year planning cycle. The group voted at the meeting, and project reviewers not present were allowed an absentee ballot by email, to identify their individual top five priority objectives. Objectives that received at least 50% of the highest number of votes are indicated by a diamond in the *Index to the Strategic Management Plan*. Comments were submitted by attending the second public meeting on July 29, 2003, at The Garrison Conference Center in Indianapolis, Indiana, or by sending comments to the project facilitators prior to August 15, 2003.

The Strategic Management Plan for the Indiana ANS plan outlines all strategies and actions that have been deemed useful for prevention and control of ANS in the state. However, recognizing the limitations of budgets and resources, the state has selected a subset of higher priority actions to focus on initially. The Implementation Table gives the primary and cooperating entities, as well as actual costs for each of the past two fiscal years (FY01-02) and costs for proposed highest priority management actions for the first five years of the program (Appendix F). The Implementation Schedule provides a sequence for high priority actions to be completed within the first two years of project management (Appendix G).

Index to the Strategic Management Plan: Goals, Strategic Actions, Tasks, and Subtasks

Goals and objectives are indicated in bold type. Strategies that received at least 50% of the highest number of votes for priority rating during the public review are indicated by a diamond (◆).

II.B.2.b. Enact comprehensive and protective legislation
II.B.2.c. Permitting system that allows controlled use
II.B.2.d. Effects of fragmented or degraded habitat
II.B.2.e. Consider boat trailer laws

II.C. Implement compliance tools

II.C.1. Provide the public with alternatives
II.C.1.a. Identify native species that can be substitutes
II.C.1.b. Encourage pet suppliers to develop policies
II.C.1.c. Dispossession of unwanted pets
II.C.2.100th Meridian and other national programs
II.C.2.a. Travelers taking species to other states
II.C.2.b. Track the contribution of Indiana travelers
II.C.2.c. Support international efforts
II.C.3. Use HACCP prevention plans and training materials
II.C.3.a. Update Indiana DNR containment policies
II.C.3.b. Plans for monitoring programs
II.C.3.c. Plans for earth-moving construction programs
II.C.3.d. Private aquaculture, bait, and live food fish

II.D. Enforce prevention measures

II.D.1. Formalize and train county lake patrols in ANS issues
II.D.2. Enforcement actions and fines

◆**II.E. Educate the public on prevention**

II.E.1. Unintentional introduction
II.E.1.a. Notify incoming travelers of current distributions
II.E.1.b. Notify Indiana of problems in other areas
II.E.1.c. Use common entry points for education
II.E.1.d. Notify anglers of illegal species

Goal III. Early detection

III.A. Maximize the efforts of monitoring programs

III.A.1. Survey high priority species in at-risk locations
III.A.1.a. Identify high priority species and locations
III.A.1.b. Create an accessible statewide database
III.A.1.c. Current list of exotic and native nuisance species
III.A.1.d. Information on distribution, abundance, and ecology
III.A.1.e. Develop capacity to verify identification of exotics
III.A.1.f. Develop a system to voucher specimens
III.A.2. Develop official coordination between monitoring programs
III.A.2.a. Agency and volunteer water quality monitoring efforts

III.B. Use monitoring for enforcement and control

III.B.1. Validate the presence and urgency of ANS discoveries
III.B.2. Measure the effectiveness of enforcement and education

III.C. Inform and educate on early detection

III.C.1. Progression of species invasions and identify control points
III.C.2. Avoid confusing the public by sending mixed messages

Goal IV. Rapid response

◆**IV.A. Plan for rapid response activities**

IV.A.1. Coordinate programs
IV.A.1.a. Inventory programs and authority
IV.A.1.b. Identify a lead agency and cooperators
IV.A.2. Develop institutional capacity
IV.A.2.a. Response plans from other states and regions
IV.A.2.b. Regulatory and administrative authorities
IV.A.3. Develop, implement, and evaluate rapid response plans
IV.A.3.a. Identify, classify, and prioritize species
IV.A.3.b. Inventory all available control options
IV.A.3.c. Select the most appropriate methods
IV.A.3.d. Act on species and populations
IV.A.3.e. Use monitoring to evaluate the success
IV.A.3.f. Do not rely on initial project success

IV.B. Inform and educate on rapid response

IV.B.1. Prior to the need for actions, explain to the public
IV.B.2. Use state agency education programs
IV.B.3. Use fishing and hunting program materials

Goal V. Control

◆**V.A. Research and develop control methods for priority species**

V.A.1. Identify and prioritize species
V.A.1.a. Use risk analysis tools and public input
V.A.1.b. Prioritize control efforts in publicly funded areas
V.A.2. Develop plans to depress populations
V.A.2.a. Fully study management options for milfoil
V.A.2.b. Control of nuisance Cyanobacteria
V.A.2.c. Control of toxin producing nonindigenous algae
V.A.2.d. Control of plants that limit flow in canals
V.A.2.e. Fisheries techniques for renovation and restocking

V.B. Evaluate effectiveness of control measures

V.B.1. Explore impacts on target and nontarget species
V.B.1.a. Conduct surveys on native communities
V.B.1.b. Support development of taxonomists
V.B.2. Capacity for preventing impacts to nontarget species
V.B.2.a. Aquatic plant control and native species
V.B.2.b. Rare aquatic plants competing with milfoil
V.B.2.c. Treatment for whole-lake milfoil infestations

◆**V.C. Coordinate control programs**
V.C.1. Control efforts into all land use management plans
V.C.1.a. Develop watershed level criteria
V.C.1.b. ANS control in cleanup of contaminated sites
V.C.1.c. Habitat restoration plans
V.C.2. State permitting programs for control methods
V.C.2.a. Aquatic plant control permits
V.C.2.b. Piscicide permits
V.C.2.c. Drinking water supply permits
V.C.2.d. Ensure proper use of pesticides
V.C.2.e. Research on restricted species and tools

◆**V.D. Regulate the spread of exotics**
V.D.1. State permitting programs to restrict spread of exotics
V.D.1.a. Private stocking permits in public waters
V.D.1.b. Fish health conditions
V.D.1.c. Limits on use of controlled species
V.D.1.d. Periodic review of illegal species possession list
V.D.1.e. Assess role of live food fish trade

◆**V.E. Inform and educate on control programs**
V.E.1. Incorporate the public directly in control programs
V.E.1.a. Expand capacity for volunteer biocontrol programs
V.E.2. Inform the public on legal and effective control methods
V.E.2.a. Nuisance pest control companies
V.E.2.b. Educate public on ecological effects on nontarget species
V.E.3. Implement educational programs to reduce the transfer
V.E.3.a. Communicate a sense of urgency
V.E.3.b. Communicate economic costs, especially to legislators
V.E.3.c. Improve awareness among boaters and anglers
V.E.3.d. Negative impacts of misguided and illegal stocking
V.E.3.e. Communicate why the agency stocks certain exotic fish
V.E.3.f. Message received by invasives in the record fish program
V.E.3.g. Eradicating an exotic that provides the only habitat
V.E.3.h. Participate in national education campaigns
V.E.3.i. Avoid mixed messages in fish kill damage assessments

Goal VI. Mitigation

VI.A. Identify naturalized species with no effective control methods
VI.A.1. Determine the distribution, rate and mechanism of spread
VI.A.2. Explore eradication or control of naturalized aquatic species
VI.A.3. Identify invasive species having recreational or other uses.

VI.B. Encourage use of existing invasive species
VI.B.1. Develop markets for commercial and recreational fisheries
VI.B.1.a. Eliminate size and bag limits
VI.B.1.b. Use existing exotic species, not introducing new ones

VI.C. Develop technology to allow use of contaminated waters
VI.C.1. Treatments to remove offending species or their byproducts
VI.C.1.a. Develop drinking water treatment processes
VI.C.1.b. Treatments of source water for hatcheries
VI.C.1.c. Develop methods of treating fish diseases
VI.C.2. Develop a technology transfer system

Goal VII. Plan evaluation

VII.A. Provide an annual evaluation of the plan
VII.A.1. The ANS program coordinator will prepare an annual report
VII.A.1.a. Facilitate documentation and track actions
VII.A.1.b. Distribute the annual report

VII.B. Conduct a cost-benefit analysis
VII.B.1. The coordinator will track costs of implementing the plan
7.B.1.a. Track use of state general, dedicated, and federal funds
VII.B.2. The coordinator will track benefits of implementing the plan
7.B.2.a. Abatement and control costs estimate the fiscal benefits
VII.B.3. Annual and five-year fiscal analyses of the cost-benefit ratio

VII.C. Use analyses to make mid-course adjustments
VII.C.1. The ANS coordinator will facilitate review of the actions
VII.C.2. These groups will provide recommendations on changes

VII.D. Produce an update to the plan every five years
VII.D.1. Use annual updates and public input

Description of the Strategic Management Plan: Goals, Actions, Tasks, and Subtasks

Goal I. Coordinate all efforts among agencies and organizations both within Indiana and with other states and nations to manage aquatic nuisance species.

Problem description: Because aquatic nuisance species issues cross the gamut of nearly all natural resource, commercial, recreational, and human health programs, it can be difficult to coordinate efforts. Fragmentation of programs can result in duplication of effort and lack of efficiencies or even conflicting policies in controlling invasive species. Pathways of entry cross state and other jurisdictional lines. Many problem species are located in boundary waters. Coordination of efforts among state agencies and across the region is essential to effectively prevent and control problems associated with invasive species. Actions that control species in Indiana also prevent the export of problems to other states in the region.

Objective I.A. Develop an integrated state aquatic nuisance species management plan to inform and direct efforts among all entities in the state of Indiana.

Strategy I.A.1. Develop a statewide internet web site for invasive species and post information on plan implementation.

Strategy I.A.2. Prioritize activities and adhere to timelines for implementation.

Strategy 1I.A.3. Prioritize enforcement actions to have maximum impact.

Objective I.B. Integrate the state plan with regional initiatives in the Great Lakes and Mississippi River basins by supporting federal and interjurisdictional regulatory and educational approaches that prevent ANS from entering Indiana.

Strategy I.B.1. Influence regional and national policies by informing decision-makers of ways in which Indiana's ability to prevent and control ANS are affected by regional, federal, and international jurisdiction, policies, and regulations.

Strategy I.B.2. Participate in meetings and activities of the Great Lakes Aquatic Nuisance Species (ANS) Panel, International Joint Commission, Council of Great Lakes Governors, Great Lakes Fishery Commission by attending annual meetings and working with subcommittees, such as the Lake Michigan Committee and Fish Health Committee, and other similar organizations by attending meetings and contributing to policy-making discussions.

Strategy I.B.3. Participate in meetings and activities of the Mississippi Interstate Cooperative Resource Association (MICRA) and especially the Mississippi River Basin Panel (MRBP) on ANS issues, Ohio River Valley Water Sanitation Commission (ORSANCO) and their Ohio River Fish Management Team (ORFMT), and similar organizations by attending meetings and contributing to policy-making discussions.

Objective I.C. Develop a baseline understanding of ANS issues by the public.

Strategy I.C.1. Understand and influence public perception of ANS issues.

Action I.C.1.a. Survey public opinion on the perception of the threat posed by invasive aquatic species.

Action I.C.1.b. Inform the public about the risks and responsibilities associated with invasive species on a similar level with the public perceptions of other forms of water pollution and human health threats.

Action I.C.1.c. Develop a common language for use in all sectors of public education and media. Use photographs, descriptions, and explanations to inform the public about the impacts of invasive species. Create an adequate distribution system for news releases and other public information on the web site and in handouts.

Action I.C.1.d. Establish relationship with and create specific messages for various sectors with special emphasis on the media and less regulated industries such as the pet trade.

Strategy I.C.2. Provide the public with current information on the definition, distribution, and risks of invasive species.

Action I.C.2.a. Explain the criteria used by public agencies to distinguish between and define beneficial and harmful exotic species.

Action I.C.2.b. Develop a publicly-accessible ANS "alert system" with a list of nuisance species existing in and not known from each region. Include public education, not just about which invasive species exist in Indiana, but also about what species are problematic in other parts of the country. Increase public awareness of which species they should avoid transporting across state lines.

Action I.C.2.c. Address invasive species as part of statewide conservation initiatives, such as the natural region assessments in the Indiana Biodiversity Initiative.

Action I.C.2.d. Make better use of primary contact points for educating water users, such as boater registration procedures through the Bureau of Motor Vehicles and Boater Education programs, to distribute information on ANS.

Objective I.D. Build institutional capacity to implement the plan. Although a number of organizations and agency programs address invasive species, these organizations need a central point of contact to focus and coordinate their efforts.

Strategy I.D.1. Institute a state program on ANS management.

Action I.D.1.a. Hire a full time coordinator and staff for implementation of the ANS plan.

Action I.D.1.b. Create a central clearinghouse for ANS information, including updates to the statewide invasive species web page.

Action I.D.1.c. Support the development of a statewide interagency task force on invasive species. Use the plan to guide efforts on aquatic species and as a model for efforts to address terrestrial species.

Strategy I.D.2. Build capacity within professional and citizen organizations to represent and address constituents information needs (e.g., ILMS, lake associations).

Action I.D.2.a. Hold public meetings, conferences, or workshops at least annually to get updates from state agencies and ensure that all stakeholders understand the issues, participate in prioritization, and know where they can get information. Provide training for local level citizen leaders, including grassroots technical information and communication training. Develop and provide handouts that assist with the transfer of key information.

Action I.D.2.b. Involve citizens in education, prevention, reporting, and control processes by distributing educational kits that are like a little tackle box, having a CD or video in it and collection vials so people could preserve samples, as well as phone numbers and contact information to get samples identified. Currently, the 15 lake associations served by the TELF and ILMS design, print, and distribute 5,000 newsletters each quarter and respond to 100 visits or calls each week, many of which address nuisance plant management and other invasive species issues.

Objective I.E. Generate baseline funding to implement the plan.

Strategy I.E.1. Determine cost-effective principles and state priorities for funding.

I.E.1.a. Develop tools to assess economic impact of invasive species, including species that are not yet known from the state, introduced but not established, and established populations. Use this information to develop funding support for ANS programs.
I.E.1.b. Recognize and communicate to the public that only areas with a budget and commitment to ongoing maintenance will continue to have intact natural communities.
I.E.1.c. Convince the public and implementing agencies that proactive early response to initial infestations will be more cost effective than waiting for severe infestation.
I.E.1.d. Ensure that agencies are provided with adequate supplementary funding and other necessary resources to conduct rapid response actions rather than expecting the agency to absorb unanticipated emergency actions into existing budgets.

Strategy I.E.2. Consistently fund the plan and programs statewide for long-term benefit of the state's economic, ecological, and public health. Target funding and use resources in ways that are the most philosophically or ecologically appropriate from a management standpoint. Adequately fund all necessary aspects of prevention, control, monitoring, early detection, rapid response, and evaluation practices.

Action I.E.2.a. Apply existing funding and strategies to the state plan, including efforts by state agencies and nongovernmental organizations.

Action I.E.2.b. Support and develop dedicated sources of funding for implementation of invasive species activities, such as the LARE boating fees and federal funding through the national Strategy Force.

Action I.E.2.c. Develop and support private funding for implementation. Cultivate corporate sponsors to fund prevention messages.

Action I.E.2.d. Use increases in funding for law enforcement patrols to include more focused efforts on ANS issues and prevention awareness.

Goal II. Prevent new introductions of nuisance aquatic species into the Lake Michigan and Mississippi River basins of Indiana.

Problem description: Aquatic nuisance species may be difficult or impossible to eradicate after they have become established. Therefore, prevention is the most cost-effective, and sometime the only means to avoid damaging results. Often the costs associated with managing a new species are not known, making it difficult to raise support for prevention actions, especially if they limit commercial or recreational activities. A delayed "crisis-response" approach may limit the vision and opportunity for avoiding problems that could be economically costly, technically challenging, and frequently irreversible. Although the state may have to accept some impacts of existing species, the state should make every attempt to hold the line on the introduction of new invasive species.

Objective II.A. Conduct effective risk assessments to assist in classifying new organisms according to the potential for damage and possibility of controlling the species.

Strategy II.A.1 Examine the pathways by which ANS are introduced into Indiana and identify control points that can be addressed by education or regulation. The risk assessment would determine the potential of various pathways to introduce species and identify major control points where intervention could limit transmission or establishment of invasive species.

Action II.A.1.a. Determine the risk associated with ballast water in Lake Michigan and explore the transport of materials in bilge water on the Ohio River.

Action II.A.1.b. Determine the risk associated with commercial sales of exotic species. Some of the risks to be examined would include the use of Asian carps and other exotic fish in aquaculture, nurseries that promote the use of non-native vegetation to pond owners in the increasing backyard pond industry, and importation of species by aquarium dealers.

Action II.A.1.c. Examine the effect of global trade and internet sales.

Action II.A.1.d. Examine risks associated with removal and replacement of recreational structures (e.g., boat lifts; piers; buoys; diving equipment).

Action II.A.1.e. Identify native species that could spread invasive species. For instance, waterfowl may carry exotic algae or plant fragments between water bodies.

Strategy II.A.2 Prioritize species to address invasive organisms with the greatest invasive potential, potential cost, and difficulty of control. Develop or adapt existing standardized risk assessment tools with criteria for rating the invasiveness, cost, and control complications associated with particular species not yet known to be established in Indiana. Predictive factors in the tool would include characteristics of the species such as:

Action II.A.2.a. Origin of the species, including natives introduced outside their range, transfer of natives with altered genomes, and native species that become undesirable species due to changes in conditions.

Action II.A.2.b. Invasiveness of the species, based on other areas in the nation or world that have been colonized.

Action II.A.2.c. Identify trigger points or control points of invasive species introduction, release, and establishment related to the physiology, ecology or use of the species.

Strategy II.A.3. The tool must analyze impacts on natural resources and water use, including:

Action II.A.3.a. Threats to natural resources, including biodiversity, state and federal T&E species, habitat degradation including native plant communities. For instance, wetland communities are impaired by buckthorn, hybrid cattails, phragmites, and other invasive plants.

Action II.A.3.b. Influence of the presence of exotic species on calibration and use of analytical tools used to assess the integrity of water and ecological communities.

Action II.A.3.c. Threats to commercial use of water, including reduced operating efficiencies and control costs, impairment of water conveyance, withdrawal, and drinking water treatment processes. For

instance, live zebra mussels and dead shells of oriental mystery snails increase the cost of maintaining intakes for cooling water at power plants and source water piping for other utilities. Eurasian watermilfoil and curly-leafed pondweed interferes with the flow of water in conveyance canals (e.g., drinking water supply, drainage and stormwater management). Bluegreen algae (cyanobacteria) can compromise drinking water quality due to taste and odor or toxin production.

Action II.A.3.d. Threats to human health through direct or indirect introduction. Conduct a risk analysis regarding the human health impacts of nonindigenous algae species (e.g., *Cylindrospermopsis*) that can produce toxins in drinking water and recreational use waters. Animal vectors may transmit zoonotic pathogens and parasites to humans (e.g., mosquitoes carrying West Nile virus; infective parasites consumed in uncooked fish flesh).

Action II.A.3.e. Threats to domestic animals and plants used in aquaculture and nurseries. Exotic animals may spread parasites and pathogens through the source water for state or private fish hatcheries. Costs to the producer can include costs of disinfection or limits on the sale of infested animals or plants.

Action II.A.3.f. Threats to recreational use of water. Examine impairment of lakes and reservoirs by Eurasian watermilfoil and impacts of zebra mussels on use of swimming beaches.

Strategy II.A.4. The tool must prioritizing threatened locations, such as:

Action II.A.4.a. Conducting an inventory of uninfested waters and prioritizing them for protection with particular attention to source waters for human consumption and aquaculture production.

Action II.A.4.b. Predicting vulnerability of certain waters to new ANS, including an analysis of the progression of new species in Lake Michigan.

Action II.A.4.c. Establishing an appropriate balance of attention to effects on various habitat types, including lakes, wetlands, and streams, possibly with a need to increase attention to river and stream communities.

Action II.A.4.d. Analyzing association between public access and spread of exotics (e.g., boat launches, boating activities fragmenting milfoil). The analysis should address ill feelings among lake residents toward state government where Indiana's public accesses have resulted in destructive exotic introductions, but the state has provided little assistance in controlling the resulting problems.

Objective II.B. Regulate the introduction of exotics, including education, regulation, compliance tools, and enforcement.

Strategy II.B.1. Examine effectiveness of regulation versus education in the following areas:

Action II.B.1.a. Determine an effective strategy for reducing the release of species acquired through pet stores, global trade, and internet sales, and determine the risk of these species transmitting associated pathogens and parasites to humans.

Action II.B.1.b. Determine an effective strategy for controlling release of unwanted aquarium pets (e.g., reducing the "dump and flush" mentality).

Strategy II.B.II. Develop effective state regulations to prevent introductions of invasive species.

Action II.B.II.a. Acquire participation of state and congressional legislators in implementation of the ANS plan.

Action II.B.2.b. Enact comprehensive and protective legislation, using state regulation to prevent movement from Lake Michigan to inland waters and regional or national regulations for movement within the Great Lakes. Legislation must include appropriate definitions for ANS in statutes and administrative rules.

Action II.B.2.c. Institute a permitting system that allows controlled use of fish in production facilities for aquaculture, food, research on warmwater and coldwater fish for aquaculture use, and stocking of beneficial exotic species in public waters for recreational and commercial use.

Action II.B.2.d. Address the effects of fragmented or degraded habitat resulting from aquatic and riparian habitat modification as a precursor to invasion by exotics in all state and local permitting programs, including aquatic plant control, lake shoreline construction, maintenance of drainage ditches, and construction in and around wetlands.

Action II.B.2.e. Consider the use of boat trailer laws to avoid spreading Eurasian watermilfoil, zebra mussels, and other species that cling to hard surfaces and propellers. Preventive regulations should focus on discouraging interstate travelers from bringing invasive species into the state.

Objective II.C. Develop and implement compliance tools that enable better adherence to regulations and minimize practices that could introduce invasive species.

Strategy II.C.1. Provide the public with alternatives to using or releasing invasive exotic species.

Action II.C.1.a. Identify native species that can be substitutes for invasive species in aquaculture, the pet trade, and landscaping.

Action II.C.1.b. Encourage dealers and educational institutions to develop policies on selling risky species as pets or for educational use.

Action II.C.1.c. Create a safe and accessible means for the dispossession of unwanted pets.

Strategy II.C.II. Participate as a state in the 100th Meridian Initiative, Protect Our Waters, and other targeted regional, national, and international programs.

Action II.C.2.a. Institute policies and educational programs that discourage Indiana travelers from taking nuisance species to other states, either intentionally or accidentally.

Action II.C.2.b. Participate in tracking activities to determine the contribution of Indiana travelers to distribution of invasive species. Available data shows that people from Lake and Cass Counties in Indiana have crossed the 100^{th} Meridian with boats. There is a risk that they and others from those from those counties could transport zebra mussels from Indiana to waters west of the 100^{th} Meridian.

Action II.C.2.c. Support international efforts to control movement of new species by participating in national and international education, law enforcement, and regulatory activities at the Indianapolis international airport and other venues.

Strategy II.C.3. Use HACCP prevention plans and training materials for each introduction pathway used by private entities, public agencies, and land use programs.

Action II.C.3.a. Update Indiana DNR containment policies on zebra mussels to include other invasive species that could be spread by activities such as fish hatchery, survey, and stocking practices.

Action II.C.3.b. Develop prevention plans for monitoring and survey practices of the Indiana Department of Environmental Management, local health or resource management agencies, and volunteer monitoring programs.

Action II.C.3.c. Develop policies for the Indiana Department of Transportation, IDNR property management, and other agencies that use earth-moving construction practices that may introduce ANS into new development sites or create amenable environments for invasion of nuisance species.

Action II.C.3.d. Develop and institute training for prevention plans in the private aquaculture, bait, and live food fish industry.

Objective II.D. Enforce prevention measures.

Strategy II.D.1. Formalize county lake patrols funded by local property owners with better training, better reporting, and agency-directed focus on critical issues such as ANS education and training.

Strategy II.D.II. Determine appropriate use of enforcement Objectives for "bad actors" who refuse education and voluntary compliance with fines that would be a deterrent.

Objective II.E. Educate the public on the benefits of preventing introductions of invasive species.

Strategy II.E.1. Provide the public with information that reduces the chance of unintentionally introducing new species into or from Indiana.

Action II.E.1.a. Use the invasive species "alert system" to identify the current distribution of species and notify incoming travelers of species that could pose a problem for Indiana.

Action II.E.1.b. Use the invasive species "alert system" to notify travelers leaving Indiana of species present in this state that could pose a problem for other states or regions.

Action II.E.1.c. Use common entry points, such as kiosks at airports and in welcome stations and information on state highway maps, to inform travelers of high-risk invasive species.

Action II.E.1.d. Notify anglers of species that are illegal to possess live through information in the annual fishing regulation guidebook (*Fishing Guide*).

Goal III. Conduct monitoring programs to enhance early detection of introductions or invasions.

Problem description: Monitoring programs often get short shrift in prioritization of agency or organizational activities due to the delay in realizing the benefits of the program. However, early cost-effective control or eradication of an invasive species or associated pathogen cannot be achieved without early detection of the offending organism. Various agencies and organizations are monitoring water bodies for their own purposes. Coordination between these efforts would maximize the use of limited resources. Because costly or controversial eradication or enforcement Objectives may result, training is essential to verify that the species was properly identified in the monitoring effort.

Objective III.A. Maximize the efforts of monitoring programs to ensure that detections of invasive species are properly detected, verified, and reported.

Strategy III.A.1. Survey and catalogue high priority species in at-risk locations.

Action III.A.1.a. Use the risk assessment to identify high priority species and locations thought to be particularly at risk of introduction or invasion.

Action III.A.1.b. Create an accessible statewide database for monitoring information.

Action III.A.1.c. Maintain a current list of exotic and native nuisance species that occur in Indiana.

Action III.A.1.d. Compile basic information on the distribution, abundance, and ecology of priority and established invasive species.

Action III.A.1.e. Develop institutional capacity or access to individuals who can verify identification of critical invasive species.

Action III.A.1.f. Develop a system to verify the identification of exotic species and ensure vouchering of specimens in appropriate scientific institutions.

Strategy III.A.2. Develop official coordination mechanisms to reduce duplication of effort or gaps in coverage.

Action III.A.2.a. Coordinate existing agency and volunteer water quality monitoring efforts to ensure maximum coverage of high priority waters in Indiana where ANS could potentially invade. Efforts may include extension of the annual DNR-sponsored fish sampling coordination meeting to include other aquatic sampling efforts, review of applications for Scientific Purposes Permits (previously called "Collectors Permits") to identify efforts in or near high priority at-risk areas, periodic hosting of training workshops to enable identification of new ANS, and other mechanisms.

Objective III.B. Use monitoring information to enhance and evaluate the effectiveness of enforcement and control efforts.

Strategy III.B.1. Use monitoring information as a mechanism to validate the presence and urgency of ANS discoveries before acting to conduct further investigations, inform the public, control the populations, or take enforcement Objectives.

Strategy III.B.2. Use monitoring information as a tool to measure the effectiveness of enforcement and education programs, after distinguishing between species that are distributed by human activities rather than moving naturally through waterways.

Objective III.C. Inform and educate the public on the benefits and reasons for early detection programs.

Strategy III.C.1. Use monitoring information to show the public the progression of species invasions and identify control points for reducing the introduction of new species.

Strategy III.C.2. Avoid confusing the public by sending mixed messages on the severity of problems associated with newly introduced species.

Goal IV. Institute rapid response Objectives to limit the cost of controlling new introductions.

Problem description: Many techniques for eradicating or controlling invasive species are either very labor intensive (e.g., removing individual plants by hand) or nonselective (e.g., use of piscicides to kill invasive fish; destruction of an entire lot of infected fish and disinfection of the hatchery). Therefore, it is much more cost-effective and acceptable to apply these techniques when the infested area is small. However, the nature of the treatment methods may require use of techniques that would normally involve significant education of the public to obtain their approval, may involve intrusion on private property, and intensive coordination between agencies with differing authorities. If the plans are not developed and approved prior to emergency use, the conflicts that result could severely hamper the implementation and effectiveness of the early control or eradication.

Objective IV.A. Plan for rapid response activities.

Strategy IV.A.1. Coordinate programs available to conduct rapid response activities.

Action IV.A.1.a. Inventory programs and authority available for rapid response in each region of the state.

Action IV.A.1.b. Identify a lead agency and responsibility of other cooperating agencies.

Strategy IV.A.2. Develop institutional capacity for rapid response activities.

Action IV.A.2.a. Review response plans from other states and coordinate the plans with efforts of other regional organizations.

Action IV.A.2.b. Establish all regulatory and administrative authorities needed for effective and timely response to aquatic invasive species on public and private property.

Strategy IV.A.3. Develop, implement, evaluate, and adjust rapid response plans for particular species to effectively control new invasions when necessary and feasible.

Action IV.A.3.a. Identify, classify, and prioritize species that under certain conditions may be amenable to eradication through rapid response Objectives.

Action IV.A.3.b. Inventory all available chemical, physical and biological control options for each high priority species that could invade an area.

Action IV.A.3.c. Select the most appropriate methods given physical, institutional, and social constraints. Ensure that the impacts of the treatment on nontarget organisms are commensurate with the overall likelihood of negative effects if the target invasive species becomes established.

Action IV.A.3.d. Act on species and populations requiring rapid response.

Action IV.A.3.e. Use monitoring to evaluate the success of control measures and make adjustments to response plans.

Action IV.A.3.f. Do not rely on initial project success to solve a problem that will likely require diligence for over a long period of time.

Objective IV.B. Inform and educate the public on the need for rapid response Objectives.

Strategy IV.B.1. Prior to the need for Objectives, explain to the public the reasons for conducting rapid response measures, which may include impacts on nontarget organisms.

Strategy.IV.B.2. Use state agency education programs to encourage volunteer monitoring and reporting, such as Riverwatch, Lake Volunteer Monitoring, Project WILD, Project WET, conservation and recreational sporting clubs, and Adopt-a-Wetland programs.

Strategy IV.B.3. Use fishing and hunting program materials to encourage volunteer monitoring and reporting.

Goal V. Limit the spread of established populations of aquatic nuisance species into uninfested waters of the state.

Problem description: Any aquatic nuisance species that has successfully become established in a large ecosystem is unlikely to be eradicated by currently available control methods. Limiting the spread of established species into uninfested waters must receive top priority in research, education, and enforcement programs. Often a species is unnecessarily spread simply by routine activities of uninformed water resource users. The public must understand how species are spread, why it is important to limit their spread, what methods are available for control, and how those control measures can have unintended adverse consequences.

Objective V.A. Research and develop control methods for priority species.

Strategy V.A.1. Identify and prioritize species requiring control Objectives.

> Action V.A.1.a. Use risk analysis tools and public input to identify high priority species for control. Priority species that have been identified by the project reviewers include:
>
> -- zebra mussels affecting cooling water plants;
> -- toxin-producing algae (*Cylindrospermopsis*) in water used for drinking and recreation;
> -- purple loosestrife;
> -- Asian carps; and
> -- giant cane grass (*Phragmites*).
>
> Action V.A.1.b. Prioritize control efforts that target invasive species that reduce the value of resources that are maintained by public funds (e.g., sport fisheries, threatened and endangered species, public properties) and accessible to the public.

Strategy V.A.2. Develop plans to either depress populations of established species or to slow the rate of range expansion of established species.

> Action V.A.2.a. Fully study management options for milfoil (e.g., harvesting, weevil biocontrol techniques).
>
> Action V.A.2.b. Analyze and implement control of nuisance Cyanobacteria (e.g., *Pseudoanabaena*) blooms creating taste and odor problems in drinking water supplies (e.g., Geist, Morse and Eagle Creek reservoirs). Control can include nutrient management in watersheds, herbicide treatment, and filtration or other chemical treatments in the water supply facility.

Action V.A.2.c. Develop effective control methods for nonindigenous algae species (e.g., *Cylindrospermopsis*) that can produce toxins in drinking water and recreational use waters.

Action V.A.2.d. Develop effective control methods for plants (e.g., Eurasian watermilfoil) that limit flow in canals to large drinking water treatment plants and in drainage ditches.

Action V.A.2.e. Continue the use of fisheries techniques (e.g., exclusionary devices, renovation and restocking, habitat protection and restoration) that control the spread of harmful exotic fish in public access waters.

Objective V.B. Evaluate the effectiveness of control measures in preventing or reducing the spread of established invasive species.

Strategy V.B.1. Explore impacts on target and nontarget species. Examine the short- and long-term effects to ensure that the cure will not be worse than the disease.

Action V.B.1.a. Conduct surveys on native communities adequate to predict and track the impacts of control measures on nontarget species.

Action V.B.1.b. Support development of taxonomists who can identify native and exotic species.

Strategy V.B.2. Develop capacity for preventing impacts to nontarget species.

Action V.B.2.a. Conduct research on impacts of aquatic plant control in lakes on native species composition in order to avoid effects on rare, threatened or endangered species.

Action V.B.2.b. Explore methods of conservation for rare aquatic plant species succomb to competition with milfoil.

Action V.B.2.c. Support research and development of treatment and eradication options for severe whole-lake milfoil infestations. Existing tools are becoming limited because whole lake herbicide treatments may have unacceptable adverse impacts.

Objective V.C. Coordinate control efforts to maximize effectiveness of programs.

Strategy V.C.1. Incorporate exotic species control efforts into all land use management plans.

Action V.C.1.a. Develop watershed level criteria for use of control methods to reduce the possibility the species will be eradicated from one part of the watershed and be reintroduced from another area upstream or downstream.

Action V.C.1.b. Include exotic species control in plans for cleaning up sites that were contaminated by other pollutants.

Action V.C.1.c. Address invasive species as part of habitat restoration plans, including the USFWS Partners for Fish and Wildlife program, NRCS wetland reserve program, and IDNR certified wildlife habitat or forestry projects.

Strategy V.C.2. Establish effective and responsive state permitting programs for control of ANS.

Action V.C.2.a. Include effective means of controlling invasive plants in review criteria for permits for use of herbicides in public waters.

Action V.C.2.b. Include effective means of controlling invasive fish in review criteria for permits for use of piscicides in public waters.

Action V.C.2.c. Ensure that drinking water supply permits provided by the Department of Environmental Management account for an effective means of controlling invasive aquatic plants and animals, while protecting safe water supplies.

Action V.C.2.d. Ensure that pesticides used are registered with the Office of the State Chemist, used according to label directions, and applied by competent and licensed handlers.

Action V.C.2.e. Implement a permitting system that allows research to be conducted on restricted species, biocontrol methods, and innovative tools for limiting the spread of invasive exotics.

Objective V.D. Implement and enforce regulations to control the spread of invasive species within Indiana.

Strategy V.D.1. Establish effective and responsive state permitting programs that prevent the spread of ANS.

Action V.D.1.a. Ensure that review criteria for private stocking permits assess risks associated with use of potentially invasive game species.

Action V.D.1.b. Ensure that conditions on private stocking permits prevent the spread of pests and pathogens associated with stocked fish.

Action.V.D.1.c. Implement regulations for the use of controlled species, such as grass carp, that are adequate to ensure that fish will not be released into public waters or damage private resources.

Action V.D.1.d. Conduct periodic evaluations of the rules listing species that are illegal to possess live to ensure that any high risk species are included to limit distributions in Indiana.

Action V.D.1.e. Assess volume of trade in the live food fish industry to identify invasive species sold, risks of introduction, and need for regulation including containment, disposition, and treatment of holding tank water.

Strategy V.D.2. Provide adequate resources for the enforcement of all regulations that control the spread of invasive species in Indiana.

Objective V.E. Inform and educate the public on control programs.

Strategy V.E.1. Incorporate the public directly into implementation and management of invasive species control projects whenever feasible to develop a sense of ownership.

Action V.E.1.a. Expand existing capacity to add educational institutions, lake associations, and other organizations in volunteer biocontrol projects using purple loosestrife beetles.

Strategy V.E.2. Inform the public on legal and effective means of controlling invasive species.

Action V.E.2.a. Provide information and training to companies involved in nuisance pest control that includes brochures and other materials to use in educating the public on invasive species issues.

Action V.E.2.b. Educate public on ecological effects on nontarget species when nonselective tools are used to eradicate ANS.

Strategy V.E.3. Implement educational programs to reduce the transfer of invasive species.

Action V.E.3.a. Communicate a sense of urgency and concern about introduction of aquatic aquaculture (e.g., fish) and human (e.g., West Nile virus) diseases using models from other terrestrial diseases (e.g., CWD, monkey pox).

Action V.E.3.b. Communicate economic costs associated with bringing in ANS for commercial use, especially to legislators, possibly through workshops.

Action V.E.3.c. Provide information to improve awareness among boaters and anglers that move from one water to the next.

Action V.E.3.d. Provide information regarding the negative impacts of misguided and illegal stocking of known nuisance species by anglers (e.g., gizzard shad as a forage base for sport fish) and divers (e.g., zebra mussels in anticipation of clearer water).

Action V.E.3.e. Clearly communicate to the public why the agency stocks certain exotic fish but limits private stocking of other exotics.

Action V.E.3.f. Evaluate the message received by the public when state agencies recognize invasive exotic species in the record fish program.

Action V.E.3.g. Provide public forum for discussion of costs of eradicating an exotic that is providing the only available habitat (e.g., milfoil monocultures in lakes).

Action V.E.3.h. Participate in or adapt materials from national education campaigns, including the International Association for Fish and Wildlife Agencies (IAFWA) ANS communication project, "Stop Aquatic Hitchikers" program for recreational boaters and anglers, and a similar forthcoming Sea Grant educational campaign for aquarium and pet owners.

V.E.3.i. Avoid sending mixed messages in natural resource damage assessments by communicating with the public that liability for fish kills in a pollution event includes impacts on ecosystems that contain or even primarily consist of invasive species. These Objectives do not imply that those species or communities are preferred conditions.

Goal VI. Mitigate harmful ecological, economic, social, and public health impacts resulting from infestations of aquatic nuisance species.

Problem description: A number of harmful exotic species have become established in public waters and have few if any cost-effective or technologically viable means of controlling or eradicating the species. In recognition of the irreversible changes in these systems, the most rational approach to dealing with these species may be to develop recreational or commercial uses. Where the species are interfering with water uses, technology must be implemented or developed to allow continued use of the water.

Objective VI.A. Conduct an analysis to identify species that are naturalized and for which no means of eradication or control is feasible.

Strategy VI.A.1. Determine the distribution, rate of spread, and mechanism of spread for species that are widely distributed and naturalized in the state.

Strategy VI.A.2. Explore all means of eradicating or eliminating naturalized aquatic species.

Strategy VI.A.3. Identify invasive species that may have recreational or other uses.

Objective VI.B. Encourage recreational use of naturalized aquatic nuisance species.

Strategy VI.B.1. Develop markets for recreational fisheries for naturalized species having no viable control methods, such as common carp. Fisheries development must be used only as a means of eradicating or controlling invasive species, not an incentive to propagate or reintroduce these species.

> Action VI.B.1.a. Eliminate size and bag limits on all invasive exotic species, but require all such species to be killed immediately upon capture.
>
> Action VI.B.1.b. Encourage use of existing species of carp as food fish rather than introduction of new species or varieties of carp.

Objective VI.C. Develop and implement technology to allow continued use of irreversibly contaminated waters.

Strategy VI.B.1. Conduct research and development on cost-effective treatments to remove offending species or their byproducts that spoil the quality of water for particular uses.

> Action VI.B.1.a. Develop drinking water treatment processes to remove toxic or repugnant substances produced by nonnative algae.
>
> Action VI.B.1.b. Develop chemical or physical treatments of source water for hatcheries that removes zebra mussel veligers without affecting fish eggs and fry.
>
> Action VI.B.1.c. Develop methods of treating diseases of trout and salmon, such as whirling disease and bacterial kidney disease.

Strategy VI.B.2. Develop a technology transfer system through cooperative efforts of universities, agencies, and trade organizations to encourage the use of mitigating techniques.

Goal VII. Evaluate the effectiveness of the plan and use adaptive management strategies to update the plan during initial implementation and after the five-year period of use.

Problem description: Adequate evaluation processes are necessary to ensure that the management plan remains up to date and accommodates changes in the rapidly shifting field of aquatic nuisance species. Funding and implementation of the plan depend upon being able to demonstrate results and fiscal responsibility.

Objective VII.A. Provide an annual evaluation on the implementation and effectiveness of the plan.

Strategy VII.A.1. The ANS program coordinator will prepare an annual report on the effectiveness of the plan and.

Action VII.A.1.a. The coordinator will facilitate documentation and track Objectives by the agencies and organizations that implement activities under the plan.

Action VII.A.1.b. The coordinator will distribute the annual report to the agencies and public.

Objective VII.B. Conduct a cost-benefit analysis for the ANS program.

Strategy VII.B.1. The coordinator will track costs of implementing the plan.

Action VII.B.1.a. The coordinator will track the use of state general funds, dedicated funds, and return of federal funds to Indiana as they were used to implement the plan.

Strategy VII.B.2. The coordinator will track benefits of implementing the plan.

Action VII.B.2.a. The coordinator will use published literature and actual costs of abatement and control to estimate the fiscal benefits of the plan in conducting activities that resulted in avoiding costs associated with damages incurred from invasive species.

Strategy VII.B.3. The coordinator will prepare annual and five-year fiscal analyses indicating the cost-benefit ratio for implementing the plan.

Objective VII.C. Use information from the evaluation to make mid-course adjustments to the plan.

Strategy VII.C.1. The ANS coordinator will facilitate review of the Objectives by the state invasive species Strategy force and other constituencies.

Strategy VII.C.2. These groups will provide recommendations on any changes that should be made to improve implementation of the plan.

Objective VII.D. Produce an update to the plan every five years.

Strategy VII.D.1. The coordinator will use information from annual updates and input from implementing agencies, organizations, and the general public to produce an update to the long-term plan every five years.

How will we know if we succeeded?

The evaluation process of Indiana's State ANS Management Plan allows monitoring of progress toward prevention, limitation and abatement of ANS. Recognizing the volatile and unpredictable nature of ANS introductions, it is reasonable to believe that the plan will require periodic mid-course changes. The process will involve three components : 1) oversight, 2) evaluation, and 3) dissemination of information. The following will briefly discuss each of these components.

<u>Oversight</u>

An ANS Advisory Council will be composed of external publics (identified as interested parties during the review process), other state and federal agencies (e.g., IDEM, ISDH, Commissioner of Agriculture's Office, APHIS, USFWS), a representative from the Governor's office, and members from the original task force who authored this document. The role of this interagency council will be to examine progress on management

actions focused on three goals of the state management plan. The committee can evaluate the success of each strategic action by examining the level of achievement of the tasks clearly defined within each action. The committee will also function in relation to the proposed state Invasive Species Council.

Evaluation

The evaluation effort should not only examine progress, but also place a special emphasis on identifying funding needs to successfully accomplish goals and associated tasks. Performance measures will be used to assess the effectiveness of management objectives. For instance, on an annual basis this might include:

- whether or not objectives are achieved;
- rate of spread along a river reach or coastline;
- change in total acreage of habitat occupied by the ANS or the displaced native species;
- changes in abundance of an invader and directly or indirectly impacted species; or
- changes to Federal and State T&E and extinct species lists due to ANS.

It is recognized that unforeseen factors may impact the progress of remedying a problem and this would be evident through program monitoring and evaluation. This information will prove useful in future program planning processes. Evaluation should also incorporate information from those groups affected by plan implementation. These include organizations (or individuals) involved with the responsibility of implementing management actions and resource user groups.

Dissemination

An annual report will be prepared and distributed, highlighting the progress of strategic management actions. This report will include information on the successes in achieving the seven goals (i.e., coordination, prevention, early detection, rapid response, control, mitigation, and plan evaluation) of the ANS plan as well as future plans and directions. Successes, failures, and new directions within Indiana will be evaluated in comparison with other regional plans in the Great Lakes and Mississippi River / Ohio River basins. The annual report will be available to the members of the general public and local, state, and federal decision makers.

Literature Cited

Aquatic Nuisance Species Task Force (D. James Baker, Under Secretary of Commerce for Oceans and Atmosphere and Mollie Beattie, Director of U.S. Fish and Wildlife Service). 1994. Report to Congress: Findings, Conclusions, and Recommendations of the Intentional Introductions Policy Review.

CDC. 2003. CDC Confirms Nation's First Human Case of West Nile in 2003. Centers for Disease Control, Office of Communication, News Release, July 8, 2003.

USGS. Undated. West Nile Virus – Indiana cumulative human map. (http://cindi.usgs.gov/hazard/event/west_nile/indiana/in_human_apr_22.html)

Evans, E.A. 2003. Economic dimensions of invasive species. Choices, the Magazine of Food, Farm, and Resource Issues June 2003. (http://www.choicesmagazine.org/current/2003-2-02.htm)

Food and Agricultural Organization. (2001). *The state of food and agriculture 2001*. Rome, Italy. (http://www.fao.org/docrep/003/x9800e/x9800e14.htm)

Great Lakes Fishery Commission. Undated. Sea lampreys: a Great Lakes invader. Webpage. (http://www.glfc.org/lampcon.asp)

Hnath, J.G., ed. 1993. Great Lakes fish disease control policy and model program. Great Lakes Fishery Commission Special Publication 93-1:1-38.

Kay, S.H., and S.T. Hoyle. 2001. Mail order, the internet and invasive aquatic weeds. Journal of Aquatic Plant Management 39:88-91.

Kolar, C., and D. Lodge. 2002. Ecological predictions and risk assessment for alien fishes in North America. Science 298:1233-1236.

Leung, B, D.M. Lodge, D. Finnoff, J.F. Shogren, M.A. Lewis, and G. Lamberti. 2002. An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species. Proceedings of The Royal Society of London 02PB0566.1-02PB0566.7 (http://www.nd.edu/~dlodge/Prospective%20Grad%20Student%20Info/NSF%20IRCEB%20project/Leung%20et%20al%20Proc%20R%20Soc%20B%2011-02.pdf)

Maki, K., and S. Galatowitsch. Undated. Mail-order sales of aquatic plants: a pathway for ANS introduction. Unpublished manuscript.

Markiw, M.E., 1992. Salmonid whirling disease. US Fish and Wildlife Service, Fish and Wildlife Leaflet 17, Washington, DC.

Mills, E.L., J.H. Leach, J.T. Carlton, and C.L. Secor. 1993. Exotic species in the Great Lakes: a history of biotic crises and anthropogenic introductions. Journal of Great Lakes Research 19:1-54. (http://biology.usgs.gov/s+t/noframe/x185.htm)

Minnesota Chapter 84D on Harmful Exotic Species (http://www.revisor.leg.state.mn.us/stats/84D/)

Nature Conservancy. 1996. *America's Least Wanted*: *Alien Species Invasions of U.S. Ecosystems*. Arlington, Va: The Nature Conservancy.

NRCS. 2003. Wetlands, mosquitoes, and West Nile virus. Indiana Technical Note Number 4, June, 2003. (http://www.in.nrcs.usda.gov/intranet/TechnicalNotes/Indiana_Tech_note_4.pdf)

Pimental, D., R. H. Groves, D. Canyon, and C. L. White. 2002. Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species. CRC Press, Cornell University, Ithaca, NY.

Pimental, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. Bioscience 50(1):53-65. (Earlier document available at http://www.news.cornell.edu/releases/Jan99/species_costs.html)

Reeves, E. 1999. *Analysis of Laws & Policies Concerning Exotic Invasions of the Great Lakes: A Report Commissioned by the Office of the Great Lakes, Michigan Department of Environmental Quality*. (http://www.deq.state.mi.us/documents/deq-water-great-lakes-aquatics-exotic2.pdf)

The Nature Conservancy, Indiana Chapter (2003). Community and economic development: quality of life and the environment. Briefing paper. March 10, 2003. Indianapolis, Indiana.

Title 7, Chapter 12 of the Municipal Code of Chicago, City Council Journal, April 9, 2003 (http://www.chicityclerk.com/citycouncil/journals/040903meeting/07Energy/pgs106440-106442.pdf)

U.S. Congress, Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, Public Law 101-646.

U.S. Congress, Office of Technology Assessment. 1993. Harmful Nonindigenous Species in the United States. OTA-F565.

USDA APHIS. (2001). *APHIS strategic plan 2000-2005*. Available on the World Wide Web: http://www.aphis.usda.gov/oa/aphissp/spextfaclhtml.

Wesley, J.K., and J.E. Duffy. 1998. St. Joseph River Assessment. Draft. Michigan Department of Natural Resources, Fisheries Division.

Whirling Disease Foundation, undated. Interactive state-by-state map. Webpage (http://www.whirling-disease.org/)

White, G.M. 1998. Exotic Plant Species in Indiana Lakes. Report prepared for the Nonindigenous Aquatic Species Database, USGS, Gainesville, Florida. Indiana Department of Natural Resources, Division of Soil Conservation.

Wilcove DS, Rothstein D, Bubow J, Phillips A, Losos E. 1998. Quantifying threats to imperiled species in the United States. *BioScience* 48(8): 607-615.

Wisconsin DNR. 2002a. Heterosporis: Yellow Perch Parasite. (http://www.dnr.state.wi.us/org/water/fhp/fish/health/disease.htm)

Wisconsin DNR. 2002b. Study reveals more game fish species at risk from new parasite. News Release March 26, 2002. (http://www.dnr.state.wi.us/org/caer/ce/news/on/2002/ON020326.htm#art3)

Wisconsin DNR. 2002b. Exotic fish virus suspected of killing carp. Wisconsin DNR News Release, September 10, 2002.

Wisconsin DNR. Undated. Reed canary grass (*Phalaris arundinace*a). Fact sheet. (http://www.dnr.state.wi.us/org/land/er/invasive/factsheets/reed.htm)

Glossary of Terms

aquatic nuisance species (ANS): An aquatic species that threatens the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, aquaculture or recreational activities dependent on such waters. For purposes of state ANS management plans, reference to an aquatic nuisance species will imply that the species is nonindigenous.

ballast water: any water and associated sediments used to manipulate the trim and stability of a vessel.

environmentally sound: methods, efforts, actions or programs to prevent introductions or control infestations of aquatic nuisance species that minimize adverse impacts to the structure and function of an ecosystem and adverse effects on nontarget organisms and ecosystems and emphasize integrated pest management techniques and nonchemical measures.

exotic species: any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country to another. Equivalent to “nonindigenous” species.

federal consistency (*): a requirement under the Coastal Zone Management Act that stipulates that federal actions that are reasonably likely to affect land or water use or natural resources of the coastal zone be consistent with the enforceable policies of a coastal state's federally approved coastal management program. A coastal state reviews the federal action to determine if the proposed action will be consistent with the program.

Great Lakes: Lake Ontario, Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Superior, and the connecting channels (Saint Mary's River, Saint Clair River, Detroit River, Niagara River, and Saint Lawrence River to the Canadian Border), and includes all other bodies of water within the drainage basin of such lakes and connecting channels.

nonindigenous species: any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country to another. Equivalent to “exotic” species.

waters of the United States: the navigable waters and the territorial sea of the United States.

unintentional introduction: an introduction of nonindigenous aquatic species that occurs as the result of activities other than the purposeful or intentional introduction of the species involved, such as the transport of nonindigenous species in ballast or in water used to transport fish, mollusks or crustaceans for aquaculture or other purposes.

watershed: an entire drainage basin, including all its living and nonliving components.

List of agency and organization acronyms

319: IDEM Watershed Management program providing grants under Section 319 of the Clean Water Act
AC: ANS Advisory Committee (all stakeholders)
APHIS: Animal and Plant Health Inspection Service
BASS: Bass Anglers Society Indiana
BOAH: Board of Animal Health
CLP: IU-SPEA and IDEM Clean Lakes Program
Coop Ext: cooperative extension service
CZM: Coastal Zone Management
DEP: Division of Entomology and Plant Pathology
DFW: Division of Fish and Wildlife
DNP: Division of Nature Preserves
DNR: Department of Natural Resources
DSC: Division of Soil Conservation
FWS : US Fish and Wildlife Service
GLC: Great Lakes Commission
IAA: Indiana Aquaculture Association
IAFS: Indiana Chapter of the American Fisheries Society
IBI: Indiana Biodiversity Initiative
IDEM: Indiana Department of Environmental Management
ILMS: Indiana Lakes Management Society
InDOT: Indiana State Department of Transportation
ISDH: Indiana State Department of Health
ISL: Indiana State Legislature
IUPUI: Indiana University - Purdue University
IUPUI-CEES: IUPUI Center for Earth and Environmental Science
IU-SPEA: Indiana University School of Public and Environmental Affairs
LARE: Lake and River Enhancement program
LE: Division of Law Enforcement
MICRA: Mississippi Interstate Cooperative Resource Association
MRBP: Mississippi River Basin Panel (on ANS)
NANPCA: Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646)
NRCS : Natural Resources Conservation Service
NRDA : Natural Resource Damage Assessments
OCA: Office of the Commissioner of Agriculture
ORFMT: Ohio River Fish Management Team
ORSANCO: Ohio River Valley Water Sanitation Commission
OISC: Office of the Indiana State Chemist
TELWF : Tippecanoe Environmental Lake and Watershed Foundation
TNC: The Nature Conservancy
TWS: The Wildlife Society

Appendix A. List of introduced fish and crayfish

List of Non-indigenous and exotic fish and crayfish species occurring in Indiana waters. *Range:* Statewide (I), north (N), south (S), west (W), east (E), and various combinations of these regions. *Relative abundance :* R = rare; C = common; O = occasional. *Conservation status:* NI = nonindigenous, E = exotic. Source: Tom Simon, U.S. Fish and Wildlife Service.

COMMON AND SCIENTIFIC NAME	RANGE	RELATIVE ABUNDANCE	STATUS
CLASS OSTEICHTHYES			
Order Petromyzontiformes (lampreys)			
Family Petromyzontidae (lamprey)			
Petromyzon marinus Linnaeus, sea lamprey	NW	O	NI
Order Clupeiformes (herring, shad)			
Family Clupeidae (herrings)			
Alosa psuedoharengus(Wilson), alewife	NW	A	NI
Dorosoma petenense (Gunther), threadfin shad	S	C	NI
Order Cypriniformes (carps and minnows)			
Family Cyprinidae (carps and minnows)			
Carassius auratus (Linnaeus), goldfish	I	C	E
Ctenopharyngodon idella (Valenciennes), grass carp	NW, C	O	E
Cyprinella lutrensis(Baird & Girard), red shiner	NW	O	NI
Cyprinus carpio Linnaeus, common carp	I	A	E
Hypopthalmichthys molitrix (Valenciennes), silver carp	SE, SW	R	E
Hypopthalmichthys nobilis (Richardson), bighead carp	SW	O	E
Scardinius erythrophhthalmus (Linnaeus), rudd	NW	O	E
Order Siluriformes (bullhead and catfish)			
Family Ictaluridae (bullhead and catfish)			
Ameiurus catus (Linnaeus), white catfish	C, S	O	NI
Order Salmoniformes (trout, salmon, whitefish)			
Family Osmeridae (smelt)			
Osmerus mordax (Mitchill), rainbow smelt	NW	C	NI
Family Salmonidae (salmon and whitefish)			
Oncorhynchus kisutch (Walbaum), coho salmon	NW	C	NI
Oncorhynchus mykiss (Walbaum), rainbow trout	N	C	NI
Oncorhynchus tshawytscha (Walbaum), chinook salmon	NW	C	NI
Salmo salar Linnaeus, Atlantic salmon	NW	O	NI
Salmo trutta Linnaeus, brown trout	N	C	E
Order Cyprinodontiformes (topminnows)			
Family Poeciliidae (live-bearing fishes)			
Gambusia affinis (Baird & Girard), mosquitofish	W	O	NI
Order Atheriniformes (silversides)			
Family Atherinidae (silversides)			
Menidia beryllina (Cope), inland silverside	S	R	NI
Order Mugiliformes			
Family Mugilidae (mullets)			

Mugil cephalus Linnaeus, striped mullet	S	R	NI
Order Gasterosteiformes (sticklebacks)			
Family Gasterosteidae (sticklebacks)			
Gasterosteus aculeatus Linnaeus, threespine stickleback	NW	O	NI
Order Perciformes (basses, sunfish, perch, darters, gobies)			
Family Moronidae (temperate basses)			
Morone americana (Gmelin), white perch	NW	R	NI
Morone saxatilis (Walbaum), striped bass	S	O	NI
Family Gobiidae (gobies)			
Neogobius melanostomus (Pallas), round goby	NW	A	E
Order Decapoda			
Family Cambaridae (crayfish)			
Genus *Procambarus*			
Subgenus *Scapulicambarus*			
Procambarus clarkii (Girard), red swamp crayfish	NW, SW	R	NI

NOTE: *P. clarkii* is native to SW Indiana, but NI to NW portions of the state.

Genus *Orconectes*			
Subgenus *Procericambarus*			
Orconectes rusticus (Girard), rusty crayfish	I	C	NI

NOTE: *O. rusticus* is native to the Whitewater and Maumee River basins, but NI elsewhere

APPENDIX B: List of invasive aquatic plants

Below is a list of common and scientific names for nonindigenous aquatic plant species that are confirmed from Indiana by the U.S. Geological Survey (USGS). The information was provided by Scott Shuler, Aquatic Control, Seymour, Indiana.

Brazilian waterweed or Brazilian elodea (*Egeria densa*)

brittle naiad (*Najas minor*)

curlyleaf pondweed (*Potamogeton crispus*)

Eurasian watermilfoil (*Myriophyllum spicatum*)

European waterclover (*Marsilea quadrifolia*)

flowering rush (*Butomus umbellatus*)

purple loosestrife (*Lythrum salicaria*)

watercress (*Nasturtium officinale*)

yellow floatingheart (*Nymphoides peltata*)

yellow iris (*Iris pseudacorus*)

These are additional exotic species found within the state by staff of aquatic plant control companies:

Asian lotus (*Nelumbo nucifera*) - the exact species has not been confirmed. However, this is the likely species and it is present in Oswego Lake per my survey last summer. There is a patch about 50 feet by 20 feet.

common reed (*Phragmites australis*) – originally most common in the northwest part of Indiana, now occurring statewide.

fanwort (*Cabomba carolinian*) - Not confirmed but most likely in two locations in northern Indiana according to Weed Patrol.

giant reed (*Arundo donax*) - The Center for Aquatic Plants lists this exotic for Indiana.

hydrilla (*Hydrilla verticillata*) - This plant will survive in Indiana, spreads easily and quickly and will typically out-compete Eurasian watermilfoil and take over a lake. This plant is not known from Indiana but represents a significant concern.

parrotfeather (*Myriophyllum aquaticum*) - This plant is established in several private lakes in northern Indiana. It can cause nuisance conditions. The plant is native to South American and is common in water gardens. This plant has a high potential for spread.

waterchestnut (*Trapa natans*) - Ball State may have a confirmed specimen in the herbarium collection from Tri-county Fish and Wildlife Area. This species has not caused any known problems in Indiana to date. However, this species has become a nuisance problem in some areas of the country, particularly in the northeast.

APPENDIX C: List of High Priority ANS in the Great Lakes basin.

The following list of high priority ANS was compiled by the Research Committee of the Great Lakes ANS Panel, based on the Great Lakes Aquatic Nonindigenous Species List compiled by the NOAA National Center for Research on Aquatic Invasive Species (NCRAIS) Great Lakes Environmental Research Laboratory with the assistance of the University of Michigan's Cooperative Institute for Limnology and Ecosystems Research, both in Ann Arbor, Michigan. (http://www.glerl.noaa.gov/res/Programs/invasive/). The list was presented in the document *ANS Research Priorities for the Great Lakes, Draft, July 2003*.

Grouping	Common Name	Taxon	Species	Origin	Date	Location	Mechanism
Fish	silver carp (Asian carp)	Cyprinidae	*Hypophthalmichthys molotrix*	Asia	???	???	Release (Aquaculture, Accidental)
	bighead carp (Asian carp)	Cyprinidae	*Hypophthalmichthys nobilis*	Asia	???	???	Release (Aquaculture, Accidental)
	black carp (Asian carp)	Cyprinidae	*Mylopharyngodon piceus*	Asia	???	???	???
	grass carp (Asian carp)	Cyprinidae	*Ctenopharyngodon idella*	Asia	???	???	Release (Deliberate)
	alewife	Clupeidae	*Alosa pseudoharengus*	Atlantic	1873	Lake Ontario	Canals, Release (Fishing)
	blueback herring	Clupeidae	*Alosa aestivalis*	Atlantic N. Amer.	1995	Unknown	Unknown
	chinook salmon	Salmonidae	*Oncorhynchus tshawytscha*	Pacific	1873	All Lakes but S	Release (Deliberate)
	coho salmon	Salmonidae	*Oncorhynchus kisutch*	Pacific	1933	Lake Erie	Release (Deliberate)
	common carp	Cyprinidae	*Cyprinus carpio*	Asia	1879	Widespread	Release (Deliberate)
	Eurasian ruffe	Percidae	*Gymnocephalus cernuus*	Eurasia	1986	St. Louis River (S)	Shipping (Ballast Water)
	fourspine stickleback	Gasterosteidae	*Apeltes quadracus*	Atlantic	1986	Thunder Bay (S)	Shipping (Ballast Water)
	rainbow trout	Salmonidae	*Oncorhynchus mykiss*	Pacific	1876	Lake Huron (T)	Release (Deliberate)
	round goby	Gobiidae	*Neogobius melanostomus*	Eurasia	1990	St. Clair River (StC)	Shipping (Ballast Water)
	rudd	Cyprinidae	*Scardinius erythrophthalmus*	Eurasia	1989	Lake Ontario	Release (Fishing)
	sea lamprey	Petromyzontidae	*Petromyzon marinus*	Atlantic	1830s	Lake Ontario	Canals, Shipping (Fouling)
	tubenose goby	Gobiidae	*Proterorhinus marmoratus*	Eurasia	1990	St. Clair River (StC)	Shipping (Ballast Water)
	white perch	Perichthyidae	*Morone americana*	Atlantic	1950	Cross Lake (O)	Canals
Zooplankton	amphipod	Amphipoda	*Echinogammarus ischnus*	Black Sea	1995	Unknown	Unknown
	cladoceran	Clodocera	*Bosmina maritima*	Eurasia	<1980	Unknown	Unknown
	cyclopoid copepod	Copepoda	*Megacyclops viridis*	Europe	1994	Unknown	Unknown
	fish-hook waterflea	Clodocera	*Cercopagis pengoi*	Black Sea	1998	Unknown	Unknown
	harpacticoid copepod	Copepoda	*Nitocra hibernica*	Eurasia	1973	Unknown	Unknown
	harpacticoid copepod	Copepoda	*Nitocra incerta*	Black Sea	1998	Unknown	Unknown
	harpacticoid copepod	Copepoda	*Heteropsyllus cf. nunni.*	Black Sea	1999	Unknown	Unknown
	harpacticoid copepod	Copepoda	*Schizopera borutzkyi*	Unknown	1990s	Unknown	Unknown
	spiny water flea	Cloderca	*Bythotrephes cederstroemi*	Eurasia	1984	Lake Huron	Shipping (Ballast Water)
Plants	curly pondweed	Potamogetonaceae	*Potamogeton crispus*	Eurasia	1879	Keuka Lake (O)	Release (Deliberate, Fishing)
	Eurasian watermilfoil	Haloragaceae	*Myriophyllum spicatum*	Eurasia	1952	Lake Erie	Release (Aquarium, Accidental)
	European frog-bit	Hydrocharitaceae	*Hydrocharis morsus-ranae*	Eurasia	1972	Lake Ontario	Release (Aquarium, Deliberate), Shipping (fouling)
	purple loostrife	Lythraceae	*Lythrum salicaria*	Eurasia	1869	Ithaca, NY (O)	Canals, Shipping (Solid Ballast)

	water chestnut	Trapaceae	*Trapa natans*	Eurasia	<1959	Lake Ontario (T)	Release (Accidental, Aquarium)
Macroinvert.	digenean fluke	Digenea	*Neascus brevicaudatus*	Unknown	1992	Unknown	Unknown
	digenean fluke	Digenea	*Acanthostomum sp.*	Black Sea	1994	Unknown	Unknown
	digenean fluke	Digenea	*Ichthyocotylurus pileatus*	Eurasia	1980s	Unknown	Unknown
	mudsnail	Gastropoda	*Potamopyrgus antipodarum*	New Zealand	1991	Unknown	Unknown
	quagga mussel*	Dreissenidae	*Dreissena bugensis*	Eurasia	1991	Lake Ontario	Shipping (Ballast Water)
	zebra mussel	Dreissenidae	*Dreissena polymorpha*	Eurasia	1988	Lake St. Clair	Shipping (Ballast Water)
Other	parasite		*Heterosporus sp.*		???	???	???
	furunculosis	Bacteria	*Aeromonas salmonicida*	Unknown	<1902	Unknown	Release (Fish)
	mixosporidian	Myxozoa	*Sphaeromyxa sevastopoli*	Black Sea	1994	Unknown	Unknown
	salmonid whirling disease	Protozoa	*Myxobolus cerebralis*	Unknown	1968	Ohio (E)	Release (Fishing)
Nonindigenous	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Appendix D. Regional and federal programs involved in ANS management.

Great Lakes Commission (GLC) and Great Lakes ANS Panel

Great Lakes regional coordination is addressed under Section 1203 of NANPCA, which first called upon the Great Lakes Commission to convene the Great Lakes Panel on Aquatic Nuisance Species in 1991. Panel membership is drawn from a wide range of federal, state, provincial and regional agencies, private sector user groups, Sea Grant programs and environmental organizations, to ensure that the positions of the Panel provide a balanced and regional perspective on Great Lakes issues. The Panel's responsibilities for the Great Lakes region are fivefold: 1) identify Great Lakes priorities; 2) make recommendations to the national ANS Task Force; 3) assist the ANS Task Force in coordinating federal programs within the region; 4) advise public and private individuals on control efforts; and 5) submit annually a report to the ANS Task Force describing prevention, research, and control activities in the Great Lakes Basin.

The Great Lakes ANS Panel provided early leadership for developing state ANS management plans, including model guidance on plans and regulations. Six of the eight Great Lakes states (New York, Michigan, Ohio, Illinois, Wisconsin, and Minnesota) have or participate in federally approved plans. Indiana has had a state agency representative on the Great Lakes ANS Panel since its inception and is completing the process of developing a plan. In addition, Indiana state agencies have benefited from frequent communication and collaboration with the Illinois-Indiana Sea Grant offices in Illinois and at Purdue University.

Mississippi Interstate Cooperative Resource Association (MICRA)

The MICRA was established in 1991 to improve the conservation, development, management and utilization of interjurisdictional fishery resources (both recreational and commercial) in the Mississippi River Basin through improved coordination and communication among the responsible management entities. The Mississippi River Basin is the largest watershed in the nation, covering 1.25 million square miles, and draining 41% of the continental United States. Ninety-three of the Basin's rivers have been identified by the states as interjurisdictional waters, including the Ohio River and parts of the Wabash River in Indiana. The organization has recently decided to form a regional aquatic nuisance species panel (Mississippi River Basin Panel or MRBP) under the auspices of the federal task force and began meeting in July 2003. Twenty-eight states are located in the Mississippi River drainage, spanning from New York in the northeast to Montana in the northwest and Louisiana in the south. Members states include AL, AR, CO, GA, IL, IN, IA, KS, KY, LA, MN, MS, MO, MT, NE, NY, NC, ND, PA, OH, OK, SD, TN, TX, VA, WV, WI, and WY. Seven of these states (Illinois, Iowa, Minnesota, Montana, New York, Ohio, and Wisconsin) either have state or interjurisdictional plans approved by the ANS Task Force.

Ohio River Valley Water Sanitation Commission (ORSANCO)

The Ohio River Valley Water Sanitation Commission (ORSANCO) was established in 1948. Member states have cooperated to improve water quality in the Ohio River Basin so that the river and its tributaries can be used from drinking water, industrial supplies, recreational purposes, and can support a healthy and diverse aquatic community. ORSANCO operates monitoring programs to check for pollutants and toxins that may interfere with specific uses of the river, and conducts special studies to address emerging water quality issues. Exotic species have not been a primary focus of ORSANCO, but a representative will participate on the MRBP on ANS. Member states in ORSANCO include: Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia. Three of these eight states have federally approved ANS plans.

Fish Health Committee, Great Lakes Fishery Commission (GLFC)

Established in 1973 under Article VI of the Great Lakes Fishery Commission Convention between the United States and Canada (1955), the Great Lakes Fish Health Committee serves as the instrument of the Commission in coordinating regional efforts in the Great Lakes basin to prevent introduction and dissemination of

communicable fish diseases. The Committee consists of two representatives appointed by each agency formally cooperating with the Great Lakes Fishery Commission. Generally, the Indiana representatives include the state fish hatchery supervisor for IDNR and a state hatchery manager knowledgeable in technical management of fish health.

U.S. EPA Great Lakes National Program Office (GLNPO)

The U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) provided $2.9 million in Fiscal Year 2002 funding, including $300,000 earmarked for invasive species issues. GLNPO provided assistance to address invasive (non-indigenous) aquatic and terrestrial species in the Great Lakes Basin with an emphasis on prevention. The highest priority was given to proposals in three topic areas: 1) development and demonstration of strong and innovative programs (education and outreach, new technology, or biological) to prevent the introduction of new invasive species (aquatic or terrestrial) into the Great Lakes Basin; 2) development and demonstration of strong and innovative programs to control the spread of invasive species within and from the Great Lakes Basin; and 3) projects that allow for the prediction of new invaders into the Great Lakes Basin and the development of contingency plans to address these potential invaders. The program also funded development of an early detection and rapid response model program through actions of the Great Lakes ANS Panel.

Stop Aquatic Hitchhikers Campaign and Protect Your Waters Website

The "Stop Aquatic Hitchhikers!" campaign and www.protectyourwaters.net web site empower recreational users to become part of the solution in stopping the transport and spread of these harmful hitchhikers. The national Aquatic Nuisance Species (ANS) Task Force, the U.S. Fish and Wildlife Service and the U.S. Coast Guard are the primary sponsors of this campaign. The website has links to news updates, provides an email notification service for emerging issues and news, and contact information for ANS publications and brochures. Campaign sponsors will use a variety of means, such as public service announcements, stickers, posters, magazine and newspaper articles, television and radio programs to make the public aware of this issue. Most material and announcements will include this web site address to direct individuals to visit and learn about how they can become part of the solution. Individuals and clubs/organizations are being called upon to spread the message. Support materials will be available to help those who want to get involved. News is disseminated to the press and available to the public and press through the web site. Media interested in running public service ads can contact the webmaster, and the campaign sponsors will provide appropriate formats.

Department of Homeland Security

On November 25, 2002, Public Law 107-296 was passed to create a new US Department of Homeland Security. DHS is responsible for assessing the vulnerabilities of the nation's critical infrastructure and cyber security threats and will take the lead in evaluating these vulnerabilities and coordinating with other federal, state, local, and private entities to ensure the most effective response. These threats may include the introduction of invasive species as a means of bioterrorism. According to the DSH, more than 500 million people are admitted into the United States annually, of which 330 million are non-citizens. On land, 11.2 million trucks and 2.2 million rail cars cross into the United States, while 7,500 foreign-flag ships make 51,000 calls in U.S. ports annually. In 2003, the Bush Administration proposed an increase of $2.2 billion from the previous year’s budget for border security. This additional funding would allow border agencies to begin implementing a seamless air, land, and sea border that protects the United States against foreign threats while moving legitimate goods and people into and out of the country. Border patrols for invasive species of plants, animals, and diseases include the USDA's Animal and Plant Health Inspection Service (APHIS) and the Department of Transportation's Coast Guard, which prevent and control some of the most harmful invasive species through monitoring of pests in shipments and invasive species in ballast water of oceangoing vessels. These programs, among others, were transferred to the new DHS.

Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW)

The FICMNEW was established through a memorandum of understanding between 16 federal agencies with invasive plant management and regulatory responsibilities. During monthly meetings, also attended by staff of the National Invasive Species Council, the committee coordinates information on the identification and extent of invasive plants and coordinates federal agency management of the species. The committee shares scientifica and technical information, fosters collaborative efforts among federal agencies, and sponsors technical and education conferences and workshops regarding invasive plants.

USDA Agricultural Research Service (ARS)

Projects related to ANS include: development and testing of user-friendly data entry systems for importation of foreign invertebrates and microbial biological control agents of invertebrate, weed, and microbial pests; development of cost-effective information management systems to compile connections to the Federal Departments and agencies responsible for the exclusion, early detection and eradication, and long-term management of invasive species and rehabilitation of affected areas; testing of behavior-modifying chemicals and biocontrol agents to disrupt reproduction and spread of invasive species;

USFWS Branch of Invasive Species

The Service's Fisheries Program, through its Division of Environmental Quality, supports the implementation of these Acts and the Executive Order through its Invasive Species Program. This program provides national leadership preventing, eradicating, and controlling invasive species. The program provides funding for ANS Task Force personnel and numerous Task Force activities. It also funds seven FWS regional coordinators and their respective invasive species activities. These coordinators work closely with the public and private sector to develop and implement invasive species activities. Many of the Service's fishery resources offices also provide support for invasive species activities. The National Invasive Species Act (NISA) was passed in 1996 amending the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The 1990 Act established the Aquatic Nuisance Species (ANS) Task Force to direct ANS activities annually. The Task Force is co-chaired by the U.S. Fish and Wildlife Service (Service) and the National Oceanic and Atmospheric Administration. Other members include the National Marine Fisheries Service, Environmental Protection Agency, Department of Agriculture, the U.S. Coast Guard, the U.S. State Department, and the Army Corps of Engineers. NISA furthered ANS activities by calling for ballast water regulations, the development of State management plans and regional panels to combat the spread of ANS, and additional ANS research. The Lacey Act was passed in 1900 and has since been amended to restrict import, export, and interstate transport of injurious fish and wildlife. Wildlife are considered injurious if importing them could impact negatively on agriculture, horticulture, forestry, the health and welfare of humans, and the welfare and survival of wildlife and wildlife resources in the nation. The USFWS also provides assistance for controlling ANS on federal lands, including 93 million acres of wildlife refuges and 25 million acres controlled by the Department of Defense.

USFWS Habitat Conservation Programs

The North American Waterfowl Management Plan (NAWMP) and other habitat improvement programs provide funds for invasive species control on lands managed for wildlife habitat in Indiana. By 1985, approximately 3.2 million people were spending nearly $1 billion annually to hunt waterfowl. By 1985, interest in waterfowl and other migratory birds had grown in other arenas as well. About 18.6 million people observed, photographed, and otherwise appreciated waterfowl and spent $2 billion for the pleasure of doing it. As of the end of 2001, Plan partners have invested more than $1.7 billion to protect, restore, and/or enhance more than 5 million acres of habitat. These wetland habitats and associated recreational uses may be threatened by invasion of exotics such as purple loosestrife, reed canary grass, and common reed.

Aquatic Ecosystem Restoration Foundation (AERF)

The Aquatic Ecosystem Restoration Foundation (AERF) in Lansing, Michigan, is a nonprofit, tax-exempt corporation created to conduct and support applied research in the management of aquatic pest species, with a focus on nuisance vegetation. The AERF supports research for the control of aquatic weed species and exotic

plants such as Eurasian watermilfoil, hydrilla, water hyacinth, purple loosestrife, and other aquatic weeds found in lakes, ponds, reservoirs, rivers and streams.

Center for Aquatic Plant Research and Technology, US Army Corps of Engineers (CAPRT)
The CAPRT was established on 9 August 1993 (Permanent Order 8-1) and is assigned to the Environmental Laboratory located at the Waterways Experiment Station, Vicksburg, Mississippi. The CAPRT provides a single point of contact for coordination and facilitation for all aquatic plant research and resulting technology transfer to federal and state agencies, universities, and other users. Activities include: technical assistance, direct allotted R&D, technology transfer, workshops and seminars, work for others technical, guidance documents, general information requests, and coordination with special interest groups and organizations.

Invasive Species Program, U.S. Geological Survey (USGS)
The USGS plays an important role in Federal efforts to combat invasive species in natural and semi-natural areas through early detection and assessment of newly established invaders, monitoring of invading populations, improving understanding of the ecology of invaders and factors in the resistance of habitats to invasion, and development and testing of prevention, management and control methods. USGS research on invasive species includes all significant groups of invasive organisms in terrestrial and aquatic ecosystems. The Nonindigenous Plants and Animals Program tracks the status and distribution of introduced aquatic organisms and provides this information in a timely manner for research, management and education. There are two programs at the Gainesville Center that compliment each other. The nonindigenous fishes program conducts field and laboratory studies. The Nonindigenous Aquatic Species program is developing a database on all nonindigenous aquatic species and maintains one of the most comprehensive websites on invasive species distributions and descriptions.

Appendix E. Annotated listing of Indiana ANS regulations

General powers of the department (IC 14-11-1-1)

Generally authorizes the department to conduct surveys, investgate, compile, and make recommendations concerning the natural resources of Indiana.

Administration: Indiana Department of Natural Resources

Enforcement powers (IC 14-11-1-6)

The department shall recommend and secure the enforcement of laws for the conservation and development of natural resources in Indiana.

Administration: Indiana Department of Natural Resources

Definitions of private waters (IC 14-22-9-5(b))

As used in the fish and wildlife code regarding the capture and transport of baitfish outside of Indiana, "private waters" means water wholly on the land of an individual that is not connected with public waters and will not allow the ingress of fish.

Administration: IDNR Division of Fish and Wildlife

Definitions of pests, pathogens, and weeds

For the purposes of IC 14-24, pest or pathogen organisms of listed taxa that may be injurious to nursery stock, agricultural crops, other vegetation, or bees are defined in IC 14-8-2-203. An exotic weed is defined in IC 14-8-2-87.5 as a weed that is not native to Indiana. Weeds are defined in IC 14-8-2-316 as any plant that is competitive, persistent, pernicious, and interferes with human activity, and as a result is undesirable.

Taxa: pests or pathogens include the arthropods, nematodes, microorganisms, fungus, parasitic plants, mollusks, plant diseases, or exotic weeds that are injurious to plants or bees
Uses: control of pests, pathogens, and weeds
Administration: IDNR Division of Entomology and Plant Pathology

Powers regarding pests or pathogens (IC 14-24-2-1)

The division director may cooperate with a person in Indiana to locate, check, or eradicate a pest or pathogen.

Administration: IDNR Division of Entomology and Plant Pathology

Cooperation with federal government or other states (IC 14-24-2-2)

The division director may, on behalf of the department, enter into a cooperative agreement with the United States government, an Agency of the United States, or a state government or state agency.

Administration: IDNR Division of Entomology and Plant Pathology

Emergency action (IC 14-24-2-5)

The division director has authority to order treatment of a pest or pathogen, or prevent the movement or require the destruction of pest or pathogen that may pose an environmental, health, or economic hazard to Indiana.

Administration: IDNR Division of Entomology and Plant Pathology

Rule-making authority (IC 14-24-3)

The natural resources commission has authority to adopt rules to control pests or pathogens establish fees, declare species or subspecies to be pests or pathogens, and to establish quarantines.

Administration: Natural Resources Commission

Control of pests or pathogens (IC 14-24-4)

The division may inspect any site in Indiana where agricultural, horticultural, or sylvan products are grown, shipped, sold, or stored to determine if a pest or pathogen is present. The division may declare all or part of a township infested. All farms and premises located in an infested area must conform to standards of operation approved by the commission, including the destruction or treatment of infested material. The department may add costs incurred for non-compliance to the owner's tax bill.

Administration: IDNR Division of Entomology and Plant Pathology

Duties regarding imported nursery stock (IC 14-24-5-5)

A person receiving nursery stock from a foreign origin must hold the material unopened until it i s inspected or released.

Administration: IDNR Division of Entomology and Plant Pathology

Control of pests or pathogens (312 IAC 18-3)

Provides specific regulatory authority over a pest or pathogen even if not associated with a plant. Includes survey and eradication activities, permits for movement, containment criteria, post entry requirements, honeybee issues, and various pests or pathogens.

Administration: IDNR Division of Entomology and Plant Pathology

Trade secrets (312 IAC 18-6)

Provides for the protection of trade secrets within the permitting system, particularly in reference to culture and use of genetically modified organisms or biocontrols.

administration: IDNR Division of Entomology and Plant Pathology

Beneficial organism defined (312 IAC 18-1)

administration: IDNR Division of Entomology and Plant Pathology

Infested areas and quarantines (312 IAC 18-2)

Includes procedures for declaring and managing infested areas and quarantine principles.

administration: IDNR Division of Entomology and Plant Pathology

Interstate agreements on boundary waters (IC 14-22-10-9)

Provides for the state of Indiana to enter into an interstate agreement on boundary waters for the purpose of better protection of wild animals in the water.

Taxa: wild animals in boundary waters
Uses: interstate agreements for better protection
Administration: IDNR Division of Fish and Wildlife

Entry onto property (IC 14-22-2-1; IC 14-22-2-5)

Allows the director of the division of fish and wildlife or representative to enter into or upon private or public property for the purpose of killing or removing a wild animal that is considered a nuisance or detrimental to overall populations. The definition of "public or private property" does not include "barns, dwellings, or other buildings."

administration: IDNR Division of Fish and Wildlife

Search of effects; entry onto property (IC 14-22-39-3)

The director and conservation officers may:
(1) search a boat, a conveyance, a vehicle, an automobile, a fish box, a fish basket, a game bag, a game coat, or other receptacle in which game may be carried; and
(2) enter into or upon private or public property for the purposes of patrolling or investigating;
if the director or conservation officer has good reason to believe evidence of a violation of a law for the propagation or protection of fish, frogs, mussels, game, furbearing mammals, or birds will be obtained. Dwellings are not subject to this search authority and require a warrant to investigate gear or illegal possession of wild animals.

taxa: fish, frogs, mussels, game, forbearing mammals, birds
uses: determination of violations of fish and game laws
exempts: dwellings
administration: IDNR Division of Law Enforcement

Liability for destruction of wild animals by pollutant (IC 14-22-10-6)

Any person either accidentally or intentionally releases waste materials, chemicals, or other substances that result in death of fish or wildlife is liable for the damages. The department and attorney general shall recover damages by reaching a settlement with the person.

taxa: fish and wildlife
uses: recovery of damages associated with release of a fatally toxic substance
Administration: IDNR Division of Fish and Wildlife

Sale of fish (IC 14-22-9-7 and 312 IAC 9-10-2)

Approval from the department is required for importation and sale of any live species of fish. It is not legal to offer or actually sell, barter or exchange, or purchase any fish protected by law, whether taken in Indiana, the boundary waters of Indian, or taken in some other state and brought into Indiana, except as otherwise provided. Restaurants, hotels and similar facilities may prepare and serve fish to patrons and their families if the fish was lawfully taken in open season. The provisions do not apply to the sale of fish produced in private ponds, providing that the owner has an applicable permit from the department. The sale of packaged fish and parts must be prepared subject to regulations of the department of natural resources and health agencies and be accompanied by a tag or label indicating that the fish was legally acquired and a dated bill of lading.

taxa: fish
uses: sale of live or processed fish
exempts: properly labeled hatchery reared fish or fish legally acquired from other states
administration: IDNR Division of Fish and Wildlife

Transportation of fish and game outside the state (IC 14-22-10-3)

A person can only legally transport a wild animal protected by state law outside of the state if the animal is legally possessed under an Indiana breeder's permit, license to fish, trap or hunt, or commercial fishing license. The wild animal shipment must be enclosed in a package on which there is clearly, legibly, and conspicuously marked information regarding the ownership, number, and kind of animals contained. Both the license and animal must be made openly available for inspection.

taxa: all fish and game
uses: transport of fish and game outside the state of Indiana
administration: IDNR Division of Fish and Wildlife

Transportation of wild minnows, crayfish or gamefish beyond limits of state (IC 14-22-9-5)

Unless the animals have been commercially raised in private waters, an individual may not transport more than one hundred (100) minnows or one hundred (100) crayfish to other states from Indiana in a twenty-four (24) hour period.

taxa: minnows, crayfish, sport fish
uses: transport outside of state of Indiana
exempts: production of fish or crayfish in private waters
administration: IDNR Division of Fish and Wildlife

Importation statute (IC 14-22-25)

Requires an importation permit to bring into Indiana, for the purpose of release or selling for release in Indiana, live fish, the fry of live fish, or any other living wild animal. Permits are granted for importation only upon satisfactory proof that the specific animals intended to be imported meet the following conditions: animals are free of a communicable disease at time of importation; that the animals will not become a nuisance; the animals will not cause damage to a native wild or domestic species. Import permits not needed for animals being imported into Indiana for the purpose of being confined and exhibited in a zoo or other public display of animals.

taxa: live fish, fry of live fish or any other wild animal
uses: for release or sale for release

exempts : animals confined and exhibited in a zoo or other public display of animals.
other animals that the department designates.
administration: IDNR Division of Fish and Wildlife

Wild animal importation permit (312 IAC 9-10-20)

Requires a wild animal importation permit before importing a mammal, reptile, amphibian, mollusk, or crustacean for release or sale for release in Indiana. Application must be made not less than 10 days in advanced of proposed importation and be accompanied by the appropriate fee for each species or release site. Have to be able to show that species will not become a nuisance, and will not damage a native wild animal, domesticated species, or animal or a species of plant. A permit is not needed to ship through Indiana, or for a zoo, carnival, menagerie, animal dealer, pet shop, circus, or nature center licensed under 9 CFR, Chapter 1, Subchapter A, Parts I through IV or following import into Indiana for confinement and exhibit in a zoo or other public display.

taxa: mammal, bird, reptile, amphibian, mollusk, crustacean
uses: for release or sale for release
exempts: during interstate shipment through Indiana.
zoo, carnival, menagerie, animal dealer, pet shop, circus, or nature center licensed under 9 CFR, Chapter 1, Subchapter A, Parts I through IV.
confinement and exhibit in a zoo or other public display.
administration: IDNR Division of Fish and Wildlife

Fish importation permit (312 IAC 9-10-15)

Assists in administration of the requirements relative to fish importation. Section 15(e) provides a "clean list" of fish species allowed without restriction. Genetically altered fish are not allowed under the clean list. Imported fish must be free of communicable diseases, not become a nuisance, and not damage a native wild species or domestic species of animal or plant.

taxa: fish
uses: importation of live fish for sale or release
exempts: confinement and exhibit in a zoo or public display
aquarium pet trade
conditions: free of communicable disease
not become a nuisance
not damage a native wild species or domestic species of animal or plant
administration: IDNR Division of Fish and Wildlife

Fish haulers and suppliers permit (312 IAC 9-10-17)
A Haulers and Suppliers Permit or an Aquaculture Permit is required to transport fish for release or sale for release. A list of automatically approved species is provided in the Haulers and Suppliers rule. The Aquaculture Permit is used for controlled species that carry a higher risk and require special conditions for use.

taxa: includes the "clean list" in Sect 15(e) and adds five species
uses: imports live fish from another state or country for sale
produces live fish for sale
exempts: aquarium pet trade
holders of a bait dealers license
conditions: fish health certification is required as a condition of the permit for trout and salmon

administration: IDNR Division of Fish and Wildlife

Aquaculture permit (312 IAC 9-10-17)

The Aquaculture Permit controls fish species not explicitly allowed under the Haulers and Suppliers Permit as listed in 312 IAC 9-10-14(d) and 312 IAC 9-10-15(e). The permit is primarily used for regulation of grass carp and for research use of fish species that would otherwise be illegal for live possession under 312 IAC 9-6-7. The department may require a description or investigation of the production facility prior to approval of an aquaculture permit (312 IAC 9-10-17). A definition for a closed aquaculture system in 312 IAC 9-6-1(25) as a rearing facility designed to prevent the escape of cultured organisms to the wild. All diploid grass carp must be held in a closed aquaculture system according to 312 IAC 9-10-17(e)(4). The requirement may be applied as needed to other cultured species. Detailed quarterly reports of the number sold and stocking location of triploid grass carp are required for use of this fish in private ponds. Similar information or a prohibition against release in public or private waters may be required for sales of other controlled fish species under an Aquaculture Permit.

taxa: any species not included on the “clean list” in Sect 15(e)
uses: imports, raises, sells or transports fish
exempts: confinement and exhibit in a zoo or public display
aquarium pet trade
conditions: fish health certification is required for trout and salmon
quarterly sales reports required for grass carp
genetic certification required for triploid grass carp through USFWS
permit holder must deliver and stock grass carp
administration: IDNR Division of Fish and Wildlife

Bait dealers statute (IC 14-22-16 and IC 14-8-2-167)

Live minnows and crayfish may be sold as live bait under a Bait Dealers License. Minnows are defined in IC 14-8-2-167 as including all of the fish of the minnow family (Cyprinidae) and the young of all species of fish that are not protected by law.

taxa: possession of over 500 live minnows or crayfish
uses: taking, catching, selling, or bartering species for bait
exempts: minnows, crayfish, or gamefish commercially raised in private waters for sale
administration: IDNR Division of Fish and Wildlife

Fish stocking permit (IC 14-22-9-8 and 312 IAC 9-10-8)

Live fish cannot be transferred between or released live into state waters without a stocking permit. The department may issue to a person a permit to stock fish in waters containing state-owned fish, waters of the state or boundary waters of the state. In instances where stocking of grass carp has been allowed in public waters, all fish were required to be reproductively sterile (i.e., triploid). Fish stocking by the department of natural resources and review of private permits for stocking have been guided by a nonrule policy adopted in 1999.

taxa: fish
uses: release in public water
exempts: stocking by the department
administration: IDNR Division of Fish and Wildlife

Disposal of fish parts and wanton waste (IC 14-22-9-6 and 312 IAC 9-6-3)

Dead fish and associated diseases or parasites cannot be returned to the water in whole or part for any reason other than legal use as bait.

taxa: fish
uses: disposal of carcasses in public water
administration: IDNR Division of Fish and Wildlife

Threatened and endangered species (IC 14-22-34 and 312 IAC 9-5-4)

A person cannot take, possess, transport, export, process, sell, or offer for sale or shipment nongame species on the state endangered species list under IC 14-22-34-9. The department may enter into agreements with federal agencies, political subdivisions or private individuals for the purpose of managing an area used by endangered species under IC 14-22-34-14.

Taxa: threatened and endangered nongame species of mammals, reptiles and amphibians, fish
Uses: possession of endangered species; agreements to manage habitat
Administration: IDNR Division of Fish and Wildlife

Wild animal possession permits (312 IAC 9-11)

Provides for a permit to possess animals protected under fish and wildlife codes but not legally acquired under other permits. The animal must be free of disease, confined in a proper enclosure, and have a plan for the safe recapture or destruction of an escaped animal. Requirements for confining potential aquatic nuisance species (i.e., venomous reptiles and crocodilians over five feet in length) are listed in 312 IAC 9-11-13.5.

Taxa: wildlife not covered by other permits
Uses: possession
Exempt: zoos, carnivals, menageries, circuses, pet shops, animal dealers, nature centers
Administration: IDNR Division of Fish and Wildlife

Possession, sale and transport of dangerous reptiles (312 IAC 9-5-8)

Prohibits possession, sale, and transport of dangerous reptiles, including crocodilians over five feet in length unless otherwise exempted.

taxa: dangerous reptiles
uses: possession, sale, transport
exempt: specimens transported through Indiana for interstate commerce to out-of-state destinations
possession under a Class III Wild Animal Permit (312 IAC 9-11) or by a zoo
adminstration: IDNR Division of Fish and Wildlife

Mussels permit (IC 14-22-17)

Commercial and personal harvest of mussels has been closed since 1993. No license under IC 14-22-17-3(1) or IC 14-22-17-3(3) shall be issued to take, ship, sell, buy, or export mussels or mussel shells for personal or commercial use.

taxa: mussels or mussel shells

uses: take, ship, sell or offer to sell, buy or offer to buy, or export mussels or mussel shells taken from the water of the state
administration: IDNR Division of Fish and Wildlife

Illegal fish possession (312 IAC 9-6-7)

Prohibits importation, possession, or release into public or private waters of specified live fish. As of December 1, 2002, an emergency rule was enacted to prohibit use of exotic catfish (Clariidae), bighead carp (*Hypophthalmichthys nobilis*), black carp (*Mylopharyngodon piceus*), silver carp (*Hypophthalmichtys molitrix*), white perch (*Morone americana*), snakehead fish (Channidae), rudd (*Scardinius erythrophthalmus*), ruffe (*Gymnocephalus cernuus*), round goby (*Neogobius melanostomus*) or tubenose goby (*Proterorhinus marmoratus*). An aquaculture permit may be provided for medical, educational or scientific research purposes. The Natural Resources Commission adopted a permanent rule to cover these species in 2003.

taxa: live walking catfish, round goby, rudd, tubnose goby, ruffe, bighead carp, black carp, silver carp, white perch, snakehead fish or hybrids thereof.
uses: import, possess, propagate, buy, sell, barter, trade, transfer, loan or release into public or private waters
exempts: holders of an aquaculture permit for medical, educational, or scientific research
properly accredited zoological park as defined in 312 IAC 9-6-8(i)
during interstate shipment
conditions: must comply with federally listed injurious species in Lacey Act (18 USC 42) and 50 CFR 16
administration: IDNR Division of Fish and Wildlife

Mussel possession and illegal species (IC 14-22-17-3 and 312 IAC 9-9-3)

Prohibits importation, possession, or release into public or private waters, a live zebra mussel, quagga mussel (*Dreissena* sp.), or Asiatic clam (*Corbicula* sp.).

taxa: listed exotic mussel species
uses: import, possess, or release into public or private waters
exempts: holder of a permit issued under 312 IAC 9-10-6.
administration: IDNR Division of Fish and Wildlife

Illegal uses of exotic fish (312 IAC 9-6-8)

Goldfish (*Carassius auratus*) can be used as live bait. Carp (*Cyprinus carpio*) and gizzard shad (*Dorosoma cepedianum*) cannot be used as live bait in most waters. Gizzard shad are allowed as live bait in one lake. Minnows 'should not' be released into the water after fishing.

taxa: carp, gizzard shad
uses: not permitted as live bait
exempts: use of live gizzard shad at Brookville Reservoir
administration: IDNR Division of Fish and Wildlife

Scientific purposes license (IC 14-22-22 and 312 IAC 9-10-6)

A Scientific Purposes license is required to collect fish or wildlife from public waters for purposes of medical, educational or scientific research. Annual reports of the collection methods, location, species, number, and disposition of specimens are required of license holders.

taxa: wild birds, nests or eggs of wild birds, other wild animals
uses: taken from public waters for scientific purposes
conditions: annual report of the collection by species, number, and location
administration: IDNR Division of Fish and Wildlife

Nuisance wild animal control permit (312 IAC 9-10-11)

A Nuisance Wildlife Permit is required for use of any methods that would otherwise be illegal under fish and game laws to remove wildlife that are causing damage or threatening property, or health and safety of humans or domestic animals. Handling and disposition of animals is proscribed, along with annual reports. An examination is required prior to licensing.

taxa: nuisance wildlife
uses: control of wildlife damaging property or health and safety of humans or domestic animals
conditions: proper handling, disposal or release
administration: IDNR Division of Fish and Wildlife

Aquatic plant control permit (IC 14-22-9-10; 312 IAC 9-10-3)

An Aquatic Plant Control Permit is required for use of chemical, physical, biological or mechanical methods to control plants in public waters, including nuisance exotic species. Most aquatic plant control permits are issued for chemical control of the exotic invasive plants Eurasian watermilfoil and Curly leafed pondweed. Permits have been issued at a few lakes for use of the watermilfoil biocontrol weevil (*Euhrychiopsis lecontei*). *Administrative rule amendments are in process for 2004.*

taxa: aquatic plants in specified state waters
uses: control of plants, including exotics, by use of physical, mechanical, chemical, or biological means
exempts: privately owned lake, farm pond, public or private drainage ditch, riparian owners treating less than 625 square feet
conditions: *provide information on the application to accommodate the additional regulation of physical, mechanical, and biological methods*
requires information on dominant plants in proposed treatment area
requires reporting of date, location, and method of treatment
administration: IDNR Division of Fish and Wildlife

Water pollution control (IC 13-18-4)

State water quality standards prohibit activities that impair aquatic communities and uses of waters. Destruction of protected qualities and properties of water is prohibited, including effects on public health, lawful uses of water, agricultural, floricultural or horticultural uses, watering of livestock or other domestic animals, and production or life of fish or beneficial animals or plants in the water. It is unlawful to discharge any organic or inorganic matter that causes a polluted condition of state waters.

Taxa: negative effects on physical, biological, or chemical quality of water
Uses: pollution control and prevention of loss of beneficial water uses
Administration: Indiana Department of Environmental Management

Pesticide control (I.C. 15-3-3.5 and I.C. 15-3-3.6)

Pesticides used to control invasive species must be registered with the office of the Indiana state chemist, used according to label directions, and legally applied by a competent and/or certified applicator.

Taxa: all organisms
Uses: pest control
Administration: Office of the Indiana State Chemist

Control of diseases (IC 15-2.1-1-1)

Promotes and encourages the prevention, suppression, control and eradication of infectious, contagious and communicable diseases affecting the health of domestic or wild animals within Indiana and trade in animals and animal products in and from Indiana. Domestic animals include "an aquatic animal that may be the subject of aquaculture (as defined in IC 4-4-3.8-1)." Aquatic animals are specifically excluded from the definition of "livestock" in IC 15-2.1-2-27.

taxa: animals and animal products
uses: commercial trade
administration: Board of Animal Health

Proclamation against importation of certain animals (IC 15-2.1-18-13)

Whenever the governor has good reason to believe that any disease has become epidemic in another state and that the importation of animals or products derived from animals from that state would be injurious to the health of the citizens or the animals of this state, the governor may, on the recommendation of the board, designate such locality by proclamation and prohibit the entry or stipulate the conditions under which animals and products derived from animals of the type diseased or animals exposed to the disease may enter the state.

taxa: animals and animal products
uses: importation from areas with epidemic diseases
administration: Board of Animal Health

Aquaculture (IC 4-4-3.8)

Defines aquaculture as the "controlled cultivation and harvest of aquatic plants and animals" and requires the commissioner of agriculture to: (1) organize and develop an information and market research center for aquaculture; (2) instigate the formation of a market and development plan for the aquaculture industry; and (3) encourage the development and growth of aquaculture.

taxa: aquatic plants and animals
uses: controlled cultivation and harvest
administration: Commissioner of Agriculture

Protection and improvement of public health (IC 16-19-3-4)

The state department of health is responsible for detection, reporting, prevention, and control of diseases that affect public health, regulation of the pollution of any water supply other than where jurisdiction is in the water pollution control board and department of environmental management, and the production, distribution and sale of human food, including consumption of fish.

taxa: human pathogens
uses: diseases that affect public health; water supplies not regulated by other agencies
administration: Indiana State Department of Health

APPENDIX F. IMPLEMENTATION TABLE

Based upon strategic actions prioritized through public review and oversight from the Indiana Department of Natural Resources, the implementation table lists all top priority goals, tasks, and subtasks with information identifying the primary and cooperating agencies, expenditures over the past two years, and funding or staffing needs over the next five years.

The implementation table summarizes the plan's funding from all sources. Existing funds that are dedicated to ANS related tasks total $3.121 million per year. Total program costs for FY03 are estimated to be $4,134,400. Of this amount, funding of $589,100 annually must come from new sources for the first phase of ANS program implementation (actions: I.A.1; I.B.1; I.B.2; I.B.3; I.C.1.a; I.D.1.a; I.D.1.c; I.D.2; I.D.2.a; I.D.2.b; I.E.1.a; I.E.1.c; I.E.1.d; II.B.1; II.E.1.d; V.A.1.a; V.A.2.a; V.C.1; V.C.1.b; V.C.1.c; V.C.2.e). For these activities, the state of Indiana requests $441,825 from the Federal ANS Task Force as a 75 percent federal cost-share. State programs will contribute $147,275 annually for the next five years as a 25 percent cost-share from eligible state government sources. The residual of the program costs will be covered by other federal monies and funds that cannot be used as state cost share.

Plan #	**Strategic Actions / Tasks**				**Recent Efforts ($)**		**Planned efforts ($)**				
	Descriptive Title	Funding Source	Impl. Entity	Coop. Entity	FY01	FY02	FY03	FY04	FY05	FY06	FY07
I.	**COORDINATION**										
I.A.	**Develop an integrated management plan**										
I.A.1.	Develop content and maintain a statewide internet web site	DNR	DNR	TNC, AC		$5,000	$10,000	$7,000	$7,000	$7,000	$7,000
I.A.2.	Prioritize activities and adhere to timelines	DNR	DNR	AC		see 1.D.1.a.					
I.A.3.	Prioritize enforcement actions	DNR	LE	DFW		see 2.B.1.a.					
I.B.	**Integrate the state plan with regional initiatives**										
I.B.1.	Influence regional and national policies	DNR	DFW	GLC	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
I.B.2.	Participate in regional activities of the Great Lakes basin (semi-annual meetings)	DNR	DFW	GLC, TNC	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500
I.B.3.	Participate in regional activities of the Mississippi River basin (semi-annual meetings)	DNR	DFW	MICRA, MRBP, GLC	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000

I.C.	**Develop a baseline understanding of ANS issues by the public**										
I.C.1.	Understand and influence public perception	DNR	DFW, DEP, DNP	AC			see 1.C.1.b-d				
I.C.1.a	Survey public opinion	DNR	DFW	AC			$45,000				
I.C.1.b	Inform the public about risks and responsibilities (outreach program development)	DNR	DNR	IDEM				$55,000	$5,000	$5,000	$5,000
I.C.1.c	Develop a common language	DNR	DNR	AC				see 1.C.1.b.			
I.C.1.d	Establish relationships with various sectors (targeted outreach effort)	DNR	DFW, DEP, DNP	IAA, AC				$4,000	$4,000	$4,000	$4,000
I.C.2.	Provide the public with current information	DNR	DFW, DEP, DNP	AC, ILMS, IAA, BASS				see 1.C.1.c.			
I.C.2.a.	Explain the criteria that define harmful exotics	DNR	DNR	IAA, AC				see 1.C.1.c.			
I.C.2.b.	Develop and maintain a publicly-accessible ANS “alert system”	DNR	DFW	AC					$5,000	$500	$500
I.C.2.c.	Invasive species in statewide conservation initiatives	IBI, DFW	IBI, DFW	private lands	see 5.C.2.						
I.C.2.d.	Use primary contact points for educating water users	DNR	DNR	InDOT				see 1.C.1.c.			
I.D.	**Build institutional capacity to implement the plan**										
I.D.1.	Institute a state program on ANS management (0.5 FTE)	DFW, SFR	DFW	AC	$18,223	$43,223	$20,000	$20,000	$20,000	$20,000	$20,000
I.D.1.a.	Hire a full time coordinator and staff (2 FTEs)	DFW, SFR, FWS	DFW				$100,000	$100,000	$100,000	$100,000	$100,000
I.D.1.b.	Create a central clearinghouse						see 1.D.2.				
I.D.1.c.	Support a statewide interagency task force (monthly meetings)	DNR	DEP	AC			$50,000	$50,000	$50,000	$50,000	$50,000

I.D.2.	Build capacity within organizations	DNR, FWS, LARE	DFW	AC, ILMS			$4,000	$4,000	$4,000	$4,000	$4,000
I.D.2.a.	Provide public information forum (annual meeting, workshop or conference)	DNR, FWS, SFR, LARE	DFW	AC, ILMS			$10,000	$10,000	$10,000	$10,000	$10,000
I.D.2.b.	Involve citizens in education and management processes (newsletters)	TELWF, ILMS, CLP	TELWF, ILMS, CLP	lake associations	$30,550	$30,550	$35,000	$35,000	$35,000	$35,000	$35,000
I.E.	**Generate baseline funding to implement the plan**										
I.E.1.	Determine cost-effective principles and priorities for funding	DFW, SFR, FWS	DFW	DNP, DEP				$10,000			
I.E.1.a.	Develop tools to assess economic impact	DFW, SFR, FWS	DFW	DNP, DEP			$45,000				
I.E.1.b.	Recognize that areas with a budget have intact natural communities (TNC: $5,000 annually for habitat plans)	DNP, DFW, SFR, private funds	DNP	DSPR, TNC, private waters	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
I.E.1.c.	Early response to initial infestations (semi-annual meetings)	DFW, SFR, FWS	DFW	private waters, contractors			$7,000	$7,000	$7,000	$7,000	$7,000
I.E.1.d.	Funding for emergency actions (10 days annually)	DFW, SFR, FWS	DFW	private waters, contractors			$6,000	$6,000	$6,000	$6,000	$6,000
I.E.2.	Consistently fund the plan and programs for long-term benefit	DFW, SFR, FWS	DFW	AC	as oulined in table						
I.E.2.a.	Apply existing funding and strategies	LARE, DFW, SFR, FWS	DFW	DEP, LARE, DNP, TNC, AC	as oulined in table						

I.E.2.b.	Support and develop dedicated sources of funding (10 days annually)							$6,000	$6,000	$6,000	$6,000
I.E.2.c.	Develop and support private and corporate funding (10 days annually)							$6,000	$6,000	$6,000	$6,000
I.E.2.d.	Fund law enforcement for increased focus on ANS	DNR, LARE	LE	DFW							
II.	**PREVENTION**										
II.B.	**Regulate introduction of exotics**										
II.B.1.	Examine effectiveness of regulation versus education						$15,000				
II.B.1.a.	Species acquired through global trade and internet sales							see 2.B.1.b.			
II.B.1.b.	Release of unwanted aquarium pets (brochure and distribution)							$20,000	$1,000	$1,000	$1,000
II.B.2.	Develop effective state regulations to prevent introductions (policy development process)							$25,000			
II.B.2.a	Acquire participation of state and congressional legislators							see 2.B.2.	$6,000	$6,000	$6,000
II.B.2.b.	Enact comprehensive and protective legislation	ISL	ISL	DNR				see 2.B.2.			
II.B.2.c.	Institute Aquaculture permitting system that allows controlled use	DFW, SFR	DFW	IAA		see 5.C.2.b					
II.B.2.d.	Address the effects of fragmented or degraded habitat				see 5.C.2.						
II.B.2.e.	Consider boat trailer laws	DFW	DFW	LE, BASS			see 2.B.2.				
II.E.	**Educate the public on prevention**										
II.E.1.	Unintentional introduction	DFW, SFR, FWS	DFW	LE, InDOT, BASS					see 2.E.1.a.		

II.E.1.a.	Notify incoming travelers of current distributions (brochure and distribution)	DFW, SFR, FWS	DFW	LE, InDOT, BASS					$20,000	$500	$500
II.E.1.b.	Notify travelers leaving Indiana of problems in other areas (brochure and distribution)	DFW, SFR, FWS	DFW	LE, InDOT, BASS						$20,000	$500
II.E.1.c.	Use common entry points for education	DFW, SFR, FWS	DFW	LE, InDOT, BASS						see 2.E.1.c.	
II.E.1.d.	Provide information to anglers about illegal species (one page in annual *Fishing Guide*)	DFW, SFR, FWS	DFW	LE, BASS	$2,188	$2,188	$3,000	$3,000	$3,000	$3,000	$3,000

V.	**CONTROL**										
V.A.	**Research and develop control methods for priority species**										
V.A.1.	Identify and prioritize species	DNR	DFW	AC			$15,000				
V.A.1.a.	Use risk analysis tools and public input	DFW, FWS	Univ Notre Dame	DEP, LARE, DNP, TNC, AC				$60,000			
V.A.1.b.	Prioritize control efforts in publicly funded areas	DFW, SFR, DNP, DEP, LARE	DFW	DEP, DNP					$10,000		
V.A.2.	Develop plans to depress populations	DFW, SFR, DNP, DEP, LARE	DFW	DEP, DNP, LARE, lake associatin os, private waters						$55,000	

V.A.2.a.	Fully study and implement management options for milfoil ($800,000 annually estimated cost of milfoil control by lake associations; $92,816 in FY01 supplemental LARE funds for plant control; $43,650 in FY02 for milfoil weevil demonstration study; $700,000 in FY03-07 in new LARE funds)	LARE, water and power utilities	Lake associations, water and power utilities	IDNR, IDEM, ISDH, IUPUI-CEES, Purdue Botany, plant control firms	$892,816	$843,650	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000
V.A.2.b.	Control of nuisance Cyanobacteria (cost estimates based on permits for water utilities in Indianapolis, Kokomo, and Richmond)	Water utilities	Water utilities	IDNR, IDEM, ISDH, IUPUI-CEES, IU-SPEA, Purdue Botany, plant control firms	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000
V.A.2.c.	Control of toxin producing nonindigenous algae (cost estimates based on permits for water utilities in Indianapolis, Kokomo, and Richmond)	Lake associations, water utilities	Lake associations, water utilities	IDNR, ISDH, IUPUI-CEES, Purdue Botany, plant control contractors	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000

V.A.2.d.	Control methods for plants that limit flow in canals (cost estimates based on permits for water utilities in Indianapolis)	Lake associations, water utilities, LARE	Lake associations, water utilities	IDNR, ISDH, IUPUI-CEES, Purdue Botany, plant control contractors	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000	$65,000
V.A.2.e.	Fisheries techniques for renovation and restocking	SFR, DFW	SFR, DFW	SFR, DFW, fisheries contractors	$1,470,558	$1,445,558	$1,468,000	$1,468,000	$1,468,000	$1,468,000	$1,468,000
V.C.	**Coordinate control programs**										
V.C.1.	Incorporate control efforts into all land use management plans (e.g., reed canary grass)	NRCS, IDNR, InDOT	IDNR	NRCS, InDOT	$5,000	$5,000	$10,000	$10,000	$10,000	$10,000	$10,000
V.C.1.a.	Develop and distribute watershed level criteria (workshop)	IDNR, IDEM 319	IDNR	IDEM, Coop Ext					$11,200	$3,600	$3,600
V.C.1.b.	Cleanup of contaminated sites	IDEM, NRDA	IDEM	DFW			$10,000	$10,000	$10,000	$10,000	$10,000
V.C.1.c.	Habitat restoration plans (ANS on nature preserves managed by DNP: $75,000+ and TNC: $30,000 annually)	DNP, DFW, SFR, private funds	DNP	TNC, DFW	$129,225	$129,225	$105,000	$105,000	$105,000	$105,000	$105,000
V.C.2.	State permitting programs for control methods	IDNR, SFR	IDNR	IDEM, Coop Ext	see 5.C.2.b-e						
V.C.2.a.	Aquatic plant control permits (200 permits annually)	IDNR, SFR	IDNR	IDEM	$11,219	$11,219	$12,000	$12,000	$12,000	$12,000	$12,000
V.C.2.b.	Piscicide permits (2 permits annually)	IDNR, SFR	IDNR	IDEM	$300	$300	$300	$300	$300	$300	$300
V.C.2.c.	Drinking water supply permits (10 permits annually)	IDEM	IDEM	IDNR, ISDH	$3,000	$3,000	$2,000	$2,000	$2,000	$2,000	$2,000

V.C.2.d.	Ensure proper use of pesticides	ISCO	ISCO	IDEM, IDNR	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
V.C.2.e.	Research on restricted species and innovative tools	state, federal, private grants	Purdue Univ of Notre Dame	IAA, IDNR, InDOT, IDEM			$60,000	$75,000	$100,000	$100,000	$100,000
	TOTAL EXPENDITURES =				**$3,165,179**	**$3,121,013**	**$4,134,400**	**$4,125,600**	**$4,125,600**	**$4,159,000**	**$4,084,500**

KEY

AC = ANS Advisory Committee (all stakeholders)
CLP = IU-SPEA and IDEM Clean Lakes Program
Coop Ext = cooperative extension service
DEP = DNR Division of Entomology and Plant Pathology
DFW = DNR Division of Fish and Wildlife
DNP = DNR Division of Nature Preserves
DNR = Department of Natural Resources
FWS = US Fish and Wildlife Service, NISA funds
GLC = Great Lakes ANS Panel
IAA = Indiana Aquaculture Association
IBI = Indiana Biodiversity Initiative
IDEM = Indiana Department of Environmental Management
ILMS = Indiana Lakes Management Society
InDOT = Indiana State Department of Transportation
ISDH = Indiana State Department of Health
ISL = Indiana State Legislature
IUPUI-CEES = IUPUI Center for Earth and Environmental Science
IU-SPEA = Indiana University School of Public and Environmental Affairs
LE = DNR Division of Law Enforcement
MICRA = Mississippi Interstate Cooperative Resource Association
MRBP = Mississippi River Basin Panel (on ANS)
NRCS = Natural Resources Conservation Service
NRDA = Natural Resource Damage Assessments
OISC = Office of the Indiana State Chemist
TELWF = Tippecanoe Environmental Lake and Watershed Foundation
TNC = The Nature Conservancy, Indiana

Appendix G. Implementation Schedule: Two-year short term action plan

Section 1204(a)(2)(C) requires that a state management plan include a schedule for implementing the plan, including a schedule of annual objectives. It is difficult to develop a highly detailed implementation schedule because of funding ambiguities in the program. Full implementation of the plan is dependent upon federal aid. If Indiana implements the program without federal assistance, the program would be considerably smaller in scope and would take much longer to implement.

Year One Action Plan (October 1, 2003-Sept 31, 2004)

Year one tasks that can be implemented with existing state funding:
I.A.2. Prioritize activities and adhere to timelines in the ANS Management Plan under guidance of the Advisory Council.
I.A.3. Prioritize enforcement actions in the ANS Management Plan under guidance of the Advisory Council.
I.C.1. Understand and influence public perception
I.D.1. Institute a state program on ANS management, based on the plan developed in FY02.
I.D.1.b. Create a central clearinghouse.
I.E.2. Consistently fund the plan and programs for long-term benefit
I.E.2.a. Apply existing funding and strategies
II.B.2.c. Permitting system that allows controlled use
V.A.2.a. Fully study management options for milfoil
V.A.2.b. Control of nuisance Cyanobacteria
V.A.2.c. Control of toxin producing nonindigenous algae
V.A.2.d. Control of plants that limit flow in canals
V.A.2.e. Fisheries techniques for renovation and restocking
V.C.2.a. Aquatic plant control permits
V.C.2.b. Piscicide permits
V.C.2.c. Drinking water supply permits
V.C.2.d. Ensure proper use of pesticides

Year one tasks dependent upon new funding:
I.A.I. Develop complete content for a statewide internet web site (limited content was created in FY01-FY02).
I.B.1. Influence regional and national policies by drafting responses to national policy issues.
I.B.2. Participate in regional activities of the Great Lakes basin (send Indiana representative to two meetings per year)
I.B.3. Participate in regional activities of the Mississippi River basin (send Indiana representative to two meetings per year)
I.C.1.a. Survey public opinion regarding ANS issues and priorities.
I.D.1.a. Hire a full time coordinator and staff (2 FTEs) to implement the ANS plan.
I.D.1.c. Support a statewide interagency task force that meets monthly.
I.D.2. Build capacity within professional and citizen organizations.
I.D.2.a. Hold public meetings, workshops, or conferences at least annually to update citizens on ANS issues and available outreach products.
I.D.2.b. Involve citizens in education and management processes.
I.E.1.a. Develop tools to assess economic impact
I.E.1.c. Early response to initial infestations
I.E.1.d. Supplementary funding for emergency actions
II.E.1.d. Notify anglers of illegal species through page in the annual Fishing Guide.
V.A.1. Identify and prioritize species
V.C.1. Control efforts into all land use management plans

V.C.1.b. ANS control in cleanup of contaminated sites
V.C.1.c. Habitat restoration plans
V.C.2.e. Research on restricted species and tools
VII.A.1. The ANS program coordinator will prepare an annual report, based on program evaluation.

Year Two Action Plan (October 1, 2004-Sept 31, 2005)

Year two tasks that can be implemented with existing state funding:
I.A.2. Prioritize activities and adhere to timelines in the ANS Management Plan under guidance of the Advisory Council.
I.A.3. Prioritize enforcement actions in the ANS Management Plan under guidance of the Advisory Council.
I.D.1. Institute a state program on ANS management, based on the plan developed in FY02.
I.D.1.b. Create a central clearinghouse.
I.E.2. Consistently fund the plan and programs for long-term benefit
I.E.2.a. Apply existing funding and strategies
I.E.2.d. Fund law enforcement for increased focus on ANS
V.A.2.b. Control of nuisance Cyanobacteria
V.A.2.c. Control of toxin producing nonindigenous algae
V.A.2.d. Control of plants that limit flow in canals
V.A.2.e. Fisheries techniques for renovation and restocking

Year two tasks dependent upon new funding:
I.A.1. Develop complete content for a statewide internet web site (limited content was created in FY01-FY02).
I.C.1.b. Develop an outreach program to inform the public about risks and responsibilities.
I.C.1.c. Develop a common language within the context of the outreach program.
I.C.1.d. Establish relationships with various sectors targeted to affect particular ANS distribution pathways.
I.C.2. Provide the public with current information about ANS.
I.C.2.a. Explain the criteria that distinguish harmful exotics from benign exotics, especially in regard to aquaculture use.
I.C.2.d. Use primary contact points for educating water users
I.D.1.a. Hire a full time coordinator and staff (2 FTEs) to implement the ANS plan.
I.D.1.c. Support a statewide interagency task force that meets monthly.
I.D.2. Build capacity within professional and citizen organizations.
I.D.2.a. Hold public meetings, workshops, or conferences at least annually to update citizens on ANS issues and available outreach products.
I.D.2.b. Involve citizens in education and management processes.
I.E.1. Determine cost-effective principles and priorities for funding
I.E.1.c. Early response to initial infestations
I.E.1.d. Supplementary funding for emergency actions
I.E.2.b. Support and develop dedicated sources of funding
I.E.2.c. Develop and support private and corporate funding
II.B.1. Examine effectiveness of regulation versus education
II.B.1.a. Global trade and internet sales
II.B.1.b. Release of unwanted aquarium pets (develop brochure).
II.B.2. Effective state regulations to prevent introductions (facilitated policy development process).
II.B.2.a. Participation of state and congressional legislators
II.B.2.b. Enact comprehensive and protective legislation
II.B.2.e. Consider boat trailer laws
V.A.1.a. Use risk analysis tools and public input
V.A.2.a. Fully study management options for milfoil
VII.A.1. The ANS program coordinator will prepare an annual report, based on program evaluation.

APPENDIX H. Indiana ANS Plan - Work Group

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APPENDIX J. Section 1204 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646)

SEC. 1204. STATE AQUATIC NUISANCE SPECIES MANAGEMENT PLANS.

(a) STATE OR INTERSTATE INVASIVE SPECIES MANAGEMENT PLANS.--

(1) IN GENERAL.--After providing notice and opportunity for public comment, the Governor of each State may prepare and submit, or the Governors of the States and the governments of Indian Tribes involved in an interstate organization, may jointly prepare and submit--

(A) a comprehensive management plan to the Task Force for approval which identifies those areas or activities within the State or within the interstate region involved, other than those related to public facilities, for which technical, enforcement, or financial assistance (or any combination thereof) is needed to eliminate or reduce the environmental, public health, and safety risks associated with aquatic nuisance species, particularly the zebra mussel; and

(B) a public facility management plan to the Assistant Secretary for approval which is limited solely to identifying those public facilities within the State or within the interstate region involved for which technical and financial assistance is needed to reduce infestations of zebra mussels.

(2) CONTENT.--Each plan shall, to the extent possible, identify the management practices and measures that will be undertaken to reduce infestations of aquatic nuisance species. Each plan shall--

(A) identify and describe State and local programs for environmentally sound prevention and control of the target aquatic nuisance species;

(B) identify Federal activities that may be needed for environmentally sound prevention and control of aquatic nuisance species and a description of the manner in which those activities should be coordinated with State and local government activities;

(C) identify any authority that the State (or any State or Indian Tribe involved in the interstate organization) does not have at the time of the development of the plan that may be necessary for the State (or any State or Indian Tribe involved in the interstate organization) to protect public health, property, and the environment from harm by aquatic nuisance species; and

(D) a schedule of implementing the plan, including a schedule of annual objectives, and enabling legislation.

(3) CONSULTATION.--

(A) In developing and implementing a management plan, the State or interstate organization should, to the maximum extent practicable, involve local governments and regional entities, Indian Tribes, and public and private organizations that have expertise in the control of aquatic nuisance species.

(B) Upon the request of a State or the appropriate official of an interstate organization, the Task Force or the Assistant Secretary, as appropriate under paragraph (1), may provide technical assistance in developing and implementing a management plan.

(4) PLAN APPROVAL.--Within 90 days after the submission of a management plan, the Task Force or the Assistant Secretary in consultation with the Task Force, as appropriate under paragraph (1), shall review the proposed plan and approve it if it meets the requirements of this subsection or return the plan to the Governor or the interstate organization with recommended modifications.

(b) GRANT PROGRAM.--

(1) STATE GRANTS.--The Director may, at the recommendation of the Task Force, make grants to States with management plans approved under subsection (a) for the implementation of those plans.

(2) APPLICATION.--An application for a grant under this subsection shall include an identification and description of the best management practices and measures which the State proposes to utilize in implementing an approved management plan with any Federal assistance to be provided under the grant.

(3) FEDERAL SHARE.--

(A) The Federal share of the cost of each comprehensive management plan implemented with Federal assistance under this section in any fiscal year shall not exceed 75 percent of the cost incurred by the State in implementing such management program and the non-Federal share of such costs shall be provided from non-Federal sources.

(B) The Federal share of the cost of each public facility management plan implemented with Federal assistance under this section in any fiscal year shall not exceed 50 percent of the cost incurred by the State in implementing such management program and the non-Federal share of such costs shall be provided from non-Federal sources.

(4) ADMINISTRATIVE COSTS.--For the purposes of this section, administrative costs for activities and programs carried out with a grant in any fiscal year shall not exceed 5 percent of the amount of the grant in that year.

(5) IN-KIND CONTRIBUTIONS.--In addition to cash outlays and payments, in-kind contributions of property or personnel services by non-Federal interests for activities under this section may be used for the non-Federal share of the cost of those activities.

(a) ENFORCEMENT ASSISTANCE.--Upon request of a State or Indian tribe, the Director or the Under Secretary, to the extent allowable by law and in a manner consistent with section 141 of title 14, United States Code, may provide assistance to a State or Indian tribe in enforcing an approved State or interstate invasive species management plan.