State Management Plan for Aquatic Invasive Species in South Carolina

An AIS Management Plan

For the State of South Carolina

Draft Management Plan

South Carolina Aquatic Invasive Species Task Force
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November, 2006

South Carolina AIS Management Plan Outline

(Revised based on assessment of available information on 11/06)

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Comment [SKW1]: Nothing in the document about national Park Service.

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Introduction

It is well documented and acknowledged that non-native aquatic invasive species cause serious ecological and economic harm to water resources in many regions of the country. Congress first addressed this concern by passing the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, which targeted the control of zebra mussels in the Great Lakes. Later it passed the National Invasive Species Act of 1996 (P.L. 104-332), which greatly expanded nationwide recognition and coordination of aquatic invasive species. This law established the Aquatic Nuisance Species Task Force and made it responsible for developing voluntary national guidelines for ballast water management. It also charged the ANS Task Force with national coordination of aquatic invasive species through regional panels. Section 1204 of the Act specifically authorized the development of comprehensive state invasive species management plans and authorized federal matching funds for states with comprehensive management plans that were submitted to and approved by the ANS Task Force.

Purpose and Scope

Clearly, one of the purposes for completing a state aquatic invasive species management plan is to help satisfy a requirement of the National Invasive Species Act. The approved plan may even result in the state receiving federal assistance for managing aquatic invasive species. However, the greater value in completing the plan and the primary purpose of the South Carolina Aquatic Invasive Species Management Plan is to provide guidelines for the coordinated management of aquatic invasive species in order to minimize their ecological and economic impacts to the state's marine and freshwater environments. The Plan identifies current and potential aquatic invasive species problems and threats to the state and recommends specific actions that could prevent additional aquatic invasive species introductions and allow for rapid and effective response to problems when they arise. Secondly, the planning process establishes a formal communication network of public and private entities through the creation of the State AIS Task Force. The Task Force is a critical element in ensuring good communication and diverse input to management decisions.

The scope of the plan is limited to the State of South Carolina; however, it is understood and expected that management activities will need to extend beyond these political boundaries. Three out of the state's four major river basins receive inflow from neighboring states. Consequently, state authorities need to work closely with their counterparts in Georgia and North Carolina to minimize possible AIS introductions from those states.

Plan Development Process

A multi-agency task force was assembled to provide guidance in developing the plan. Individual task force members were selected based primarily on their experience with invasive species issues. Most members were selected from the State Aquatic Plant Management Council, the State Aquatic Nuisance Species Communication Plan Advisory Committee, and the State Zebra Mussel Task Force. The Aquatic Invasive Species Task Force included 34 members representing ten state agencies, eight federal agencies, four private entities, and 4 non-profit organizations. A complete list of AIS Task Force members is presented in Appendix A.

The plan was developed over a one-year period starting in July 2006. The AIS Task Force met every other month to review homework assignments and work on specific sections of the plan. A schedule was provided to all members that included proposed meeting dates for the year and anticipated completion dates for sections of the plan. A web site that included detailed information about the planning process and task force activities was established to help facilitate communication among task force members and provide the public with up-to-date information on the plan's development. Communication among task force members between meetings was conducted primarily by email. The final draft was sent out for public review and comment for a 30-day period. Comments were reviewed, discussed among Task Force members, and incorporated as appropriate. The final report was forwarded to the Governor's Office and sent to the Aquatic Nuisance Species Task Force for approval.

Interaction with Other Plans

Development of the Aquatic Invasive Species Management Plan was closely coordinated with recommendations in the 2005 State Comprehensive Wildlife Conservation Strategy (SCWCS). In addition to numerous species-specific recommendations, The SCWCS identifies five general conservation actions pertaining to invasive species. These are:

1. Prevent the spread of existing invasive and non-native species, eliminating them, where possible.
2. Determine the impacts of invasive and non-native species on South Carolina's priority species and habitats used by those species.
3. Strive to prevent the import of additional invasive and non-native species to South Carolina.
4. Develop and conduct an education and outreach campaign to raise awareness of the impacts of introducing non-native species into South Carolina.
5. Develop partnerships with other entities in South Carolina to address impacts associated with invasive and non-native species.

The Aquatic Invasive Species Management Plan addresses each of these action items.

Since 1981, the Department of Natural Resources in conjunction with the State Aquatic Plant Management Council has developed annual Aquatic Plant Management Plans that identify public waters with nuisance aquatic plant problems and prescribe management actions. This planning process is established by law. The AIS Management Plan recognizes this as an effective statewide management effort for the control of invasive aquatic vegetation. It is identified as an action item in the AIS Management Plan that should continue as currently established.

Define "aquatic invasive species"

Many non-native and non-indigenous species can coexist with native species and may be beneficial. These species typically do not reproduce rapidly or develop large populations. For the purposes of this plan the term "aquatic invasive species" refers to nonindigenous species that live most or all of their lives in freshwater or marine/estuarine environments

and threaten the diversity or abundance of native species or the ecological stability and/or uses of infested waters.

Problem Description

Background

Our increasingly global economy has encouraged the rapid movement of plants and animals to areas outside their native ranges. Not all non-native species cause problems; however, those that are able to avoid predation and disease and are able to reproduce rapidly or at least persistently can become very abundant. It is these invasive non-native species that are cause for concern. Aquatic invasive species adversely impact native plant and animal populations, disrupt natural ecosystem functions, and impair beneficial use of our waterways. Specific impacts include:

- Blocked water flow and clogged water withdrawals for municipal, industrial, agricultural purposes and for electric power generation
- Impaired recreational uses (swimming, hunting, fishing, boating)
- Fouled boat hulls and motors
- Reduced waterfront property values
- Degraded water quality
- Declines in fin and shellfish populations
- Reduced diversity of native organisms and desirable wildlife populations
- Flooding due to restricted flow, and
- Expanded breeding habitat for mosquitoes and other pests.

South Carolina has an abundance of freshwater and marine resources. Four major river basins, the Savannah, ACE (Ashley, Combahee, and Edisto), Santee, and Pee Dee include over 11,000 miles of rivers and streams with an average daily flow of about 30 billion gallons. These basins also contain about 1,600 impoundments of ten acres or more in size with a total surface area of over 521,737 acres. In addition, the state's 200 miles of shoreline along the Atlantic Ocean incorporates about 750,000 acres of estuaries. These waters provide important habitat for fish and wildlife populations, support diverse

recreational activities, provide a source of water for industrial, municipal, and agricultural withdrawals, and support commercial and recreational navigation that are important to the economy of the state. The influx of non-native invasive species can severely impact these important water resources.

It is estimated that non-native invasive species cost the U.S. economy $120 billion annually in lost production, control costs, and environmental damage (Pimentel et al., 2005). In addition, about 42 percent of the nation's endangered or threatened species are significantly impacted by non-native invasive species. While the full economic impact from aquatic invasive species is not well documented for South Carolina, a critical incident in 1991 and state records of aquatic plant control costs since 1980 help frame the extent of the problem.

The aquatic weed hydrilla is attributed to causing one of the greatest single impacts from an invasive species in the state. Hydrilla populations in the Santee Cooper Lake System, a large hydroelectric project north of Charleston, had been expanding rapidly since 1982. Following a storm in 1991, large rafts of hydrilla were dislodged and floated into the water intake canal and impinged on the debris screens of the St. Stephen Hydroelectric Facility. The power plant was shut down for weeks while hydrilla was removed from the screens. The economic impact from that incident alone was estimated at $4 million in lost electric power generation and associated costs. In addition, the shutdown prevented water flow downstream, which resulted in oxygen depletion and one of the state's largest fish kill incidents with $526,000 in lost game fish. Hydrilla continued to impair electric power generation at St. Stephens to a lesser extent during subsequent years.

The economic impact of invasive species infestations to the state is also reflected by the cost of preventing water-related problems through ongoing control operations. From 1981 to 2006 a total of $22.6 million has been spent to control hydrilla and other priority invasive plant species in public waterways. These expenditures are a combination of state, federal, and local (public and private) funds. This cost does not include aquatic plant control expenditures by the private sector and federal facilities around the state. It

is also limited to the control of invasive aquatic plants and does not include impacts from the Asiatic clam which invaded the state in the 1970's, certain non-native game fishes stocked over the past 40 years, and a variety of marine organisms released along our coast.

Species Introductions

The U.S. Geological Survey Center for Aquatic Resources Studies maintains an excellent database on introduced aquatic non-indigenous species by state. A review of the data for aquatic animals indicates that the number of non-native species introduced to the state has increased substantially in recent years (Fig. 1). About 87% of all aquatic animal species introduced to the state were introduced after 1950. Most of these were fish (68%) and about 59% came from other regions of North America, eight percent from South America, and eight percent came from Asia (Fig. 2). By far most introduced aquatic animals are freshwater species (82%), followed by marine (15%) and brackish water (3%) species (Fig 3).

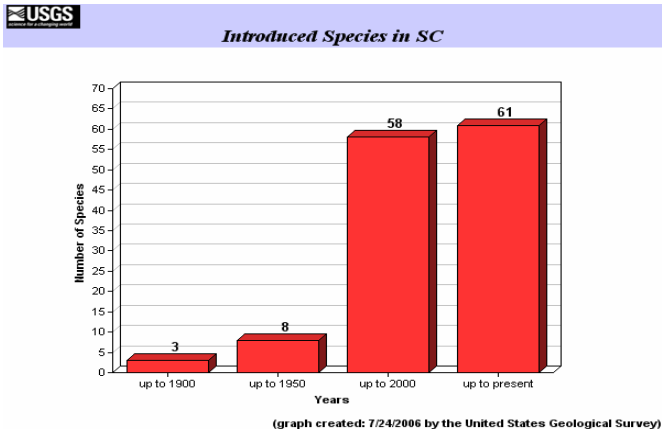

Figure 1

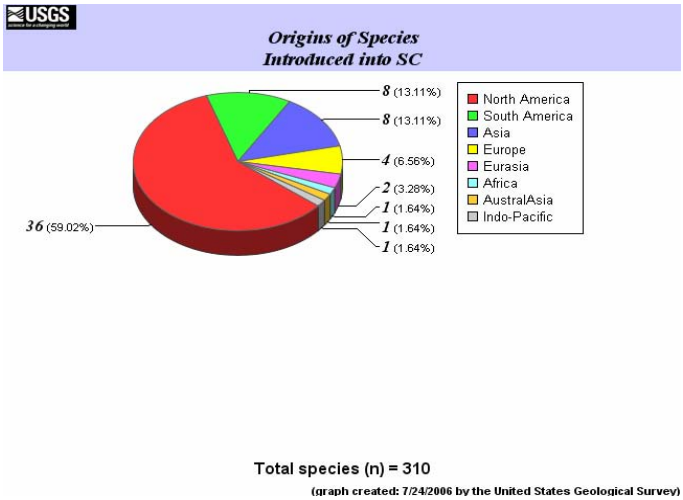

Figure 2

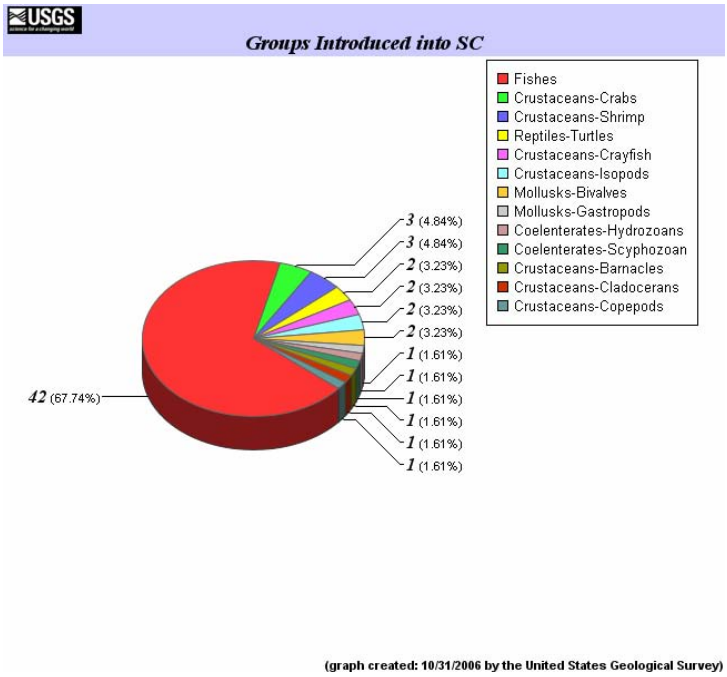

Figure 3

Unfortunately, the USGS database does not include non-native aquatic plants in the state summaries. If it did, the total number of introduced species would be even higher. However, the overall conclusion would be the same. That is, the state is experiencing an

increasing influx of non-native species from locations all over the world. Aquatic invasive species of particular concern to South Carolina are discussed below.

Invasive Species of Concern

This section describes species that are particularly problematic to South Carolina. State management and control are focused primarily on theses specific species. However, there are other species of concern, and South Carolina will focus on preventing the spread of all aquatic invasives and controlling their impacts.

Freshwater Plants

Hydrilla (*Hydrilla verticillata*)

Hydrilla is an introduced submersed perennial originally from Asia. The two biotypes, dioecious and monoecious, that occur in the United States also occur in South Carolina. Dioecious hydrilla was first found in 1982 near a fishing camp in Lake Marion. It has spread to 11 public waterbodies and over 55,000 acres throughout the state. The largest populations have occurred in Lake Marion, Lake Moultrie, Lake Murray, the Cooper River, Goose Creek Reservoir, and Back River Reservoir. Lesser amounts occur in Lake Greenwood, Lake Keowee, and Lake Wateree. Monoecious hydrilla, which was first found in 1995 in the J. Strom Thurmond Reservoir on the South Carolina/Georgia border and more recently in North Carolina reservoirs near Charlotte, threatens to spread to additional South Carolina waters. Both forms were probably introduced inadvertently by boaters or anglers from fragments on recreational boats, their motors and trailers, and in live wells.

Hydrilla reproduces rapidly from plant fragments, tubers and turions, and forms very large populations up to 25 feet in depth. The greatest amount of growth occurs near the water surface where dense surface mats decrease plant diversity by displacing beneficial native species. Hydrilla increases mosquito breeding sites, impairs boating activities (sailing, motor boats and jet skies), clogs municipal and industrial water intakes, as well as cooling water intakes for electric power plants. It decreases oxygen levels and lowers water quality, and decreases lakefront property value. Hydrilla is the most problematic

aquatic plant in the state with over $14.7 million spent since 1982 in controlling over 58,000 acres statewide.

Hydrilla infested 90% of Goose Creek Reservoir in early 1990's.


Hydrilla covered over 10,000 acres in upper Lake Marion.

Water hyacinth (*Eichhornia crassipes*)

Water hyacinth is a showy, free-floating plant from Brazil that reaches up to 3 feet in height. Water hyacinth was most likely introduced to public waters by homeowners discarding water garden plants. Water hyacinths have been in the state prior to 1980 with the largest concentration in water bodies near Charleston such as Back River Reservoir, Cooper River and Goose Creek Reservoir. Water hyacinths have spread south to the Ashepoo River and Savannah River, north to the Waccamaw River and Pee Dee River, and northwest to upper Lake Marion. Infestations have been found in small private ponds in Lexington County near Columbia. By forming new plantlets, a population can completely dominate and obstruct a body of water in a short period of time. Native species are excluded, and large populations may affect water quality. Its floating mats block public access and use of lakes at boat ramps; it also covers coves and shoreline areas, clogs industrial, municipal and electric power plant water intakes. Large infestations inhibit water flow causing upstream flooding during heavy rain events. Water hyacinth is the second most problematic invasive aquatic plant in South Carolina. Since 1985, over 14,000 acres of water hyacinth have been treated in South Carolina's

public waterways at a cost of over $1.3 million. Annual treatments help keep this prolific plant in check in most areas.

Water hyacinth in Indian Lake near the Waccamaw River, Georgetown Co.

Common reed (*Phragmites australis*)

Phragmites is a tall grass that grows up to 10 feet tall and forms dense monotypic stands. While it is native to North America, the variety that occurs in South Carolina originated in Europe. *Phragmites* was first noticed in the 1970s in waters near Georgetown where it is speculated that it arrived on contaminated dredge equipment from northern states. It is still most problematic in this area. The coverage of this plant is not fully known in South Carolina, but estimates are that it exceeds 3,000 acres and it is spreading. *Phragmites* is not a problem in major reservoirs. It is more commonly found in freshwater impoundments along the coast and in estuaries and marsh ecosystems. It is not good waterfowl food and it outcompetes native plants that provide food and habitat for waterfowl. Over $1 million has been spent to control Phragmites in the state since 1985.

Phragmites colonies infesting waterfowl impoundment near the Intracoastal Waterway in Charleston Co.

Water lettuce (*Pistia stratiodes*)

Water lettuce is a free-floating, stoloniferous perennial from the tropical/subtropical regions of the world. Water lettuce was first found in South Carolina on the Waccamaw River near Brookgreen Garden in 1991; however, cold winter temperatures apparently eliminated that population. It currently is present in Goose Creek Reservoir north of Charleston. This infestation came from a private upstream subdivision lake. Water lettuce forms large floating mats that impair water flow, public access and use of waterways, and clog water intakes. Large populations can completely cover the water surface in small lakes and small coves of large lakes and degrade water quality and impact native plants and animals. This species reproduces rapidly from a single plant and is easily spread to other water bodies by man.

Giant salvinia (*Salvinia molesta*)

Giant salvinia is a small, free floating, introduced aquatic fern. Giant salvinia was first found in South Carolina in 1995 in a private pond in Colleton County. The introduction originated from contaminated shipment of water garden plants from California. Close coordination and rapid response between SCDNR, Clemson Extension Service, and USDA resulted in successful eradication in 1995. A new population was found in 2004 in a Jasper County plantation pond. The introduction originated from contaminated water garden plants purchased in Georgia. This population was successfully eradicated by 2006 using repeated herbicide treatments. Populations of giant salvinia in North Carolina and Georgia provide a close source for new infestations in South Carolina. Giant salvinia can be a very problematic plant in South Carolina. Its rapid growth characteristics (can double its biomas every seven days) could make this one of the most problematic plants ever. Giant salvinia can impact irrigation systems, navigable waters, fisheries, electric power production, and municipal and industrial water intakes. Giant mats reduce light penetration and result in oxygen depletion. As light becomes limiting, it affects the growth and survival of phytoplankton and vascular plants. Oxygen depletion may be so severely reduced beneath a mat that it influences fish survival. Extensive mats may exacerbate a situation because they prevent water circulation and mixing.

Giant Salvinia covering a plantation pond in Jasper Co.

Alligatorweed (*Alternanthera philoxeroides*)

Alligatorweed is an aggressive emergent perennial from South America. The original pathway of introduction to South Carolina is unknown, but likely originated from aquarium disposals. Alligatorweed is found throughout South Carolina but is most problematic in waters in the northern Pee Dee Basin. Alligatorweed spreads rapidly by fragmentation. Biological control agents introduced many years ago, such as alligatorweed fleabeetles and stem borer moths, keep populations in most of the state under control. Alligatorweed displaces native vegetation, disrupts navigation, recreation, and water flow by the formation of impenetrable mats. It decreases uptake for agricultural, municipal and industrial purposes and expands human health risks with increases in mosquito breeding habitats.

Alligatorweed on Black Mingo Swamp in Georgetown Co.

Brazilian elodea (*Elodea densa*)

Brazilian elodea was the most problematic submersed aquatic plant in South Carolina

prior to the introduction of hydrilla in 1982. Original pathway of introduction is unknown. The earliest report of Brazilian elodea in the United States was from Millneck, Long Island where the plant was collected in 1893. It was offered for sale in the United States in 1915, where it was recommended as a good "oxygenator" plant. In South Carolina, populations have been identified in the Saluda River below Lake Murray, Savannah River near Augusta, Richard B. Russell Lake, Waccamaw River and small ponds upstate. After Brazilian elodea has been introduced into a lake it grows rapidly and creates dense mats on the waters surface. These mats will choke out native plants that don't grow as quickly. It impedes boating, fishing, swimming, water skiing and other aquatic activities. The mats are unsightly and provide poor habitat for fish. It will form a monotypic stand that can become so dense that water movement is restricted and can cause fluctuations in water quality, and it traps sediment. The fragmented pieces can clog water intake pipes. Because this plant spreads readily through fragmentation, mechanical controls such as cutting, harvesting, and rotovation (underwater rototilling) should be used only when the extent of the infestation is such that all available niches have been filled. Application of herbicide is recommended over mechanical control.

Water primrose (*Ludwigia hexapetala*)

The original introductory pathway of water primrose is unknown. Water primrose is found throughout the state in man-made impoundments but is most problematic from the fall line to the coast. There are problem populations in Back River Reservoir, Goose Creek Reservoir, the Santee Cooper lakes. Water primrose is an emergent perennial that grows to 3 feet tall but stems may be many feet long when floating on the water. This

shoreline plant is very difficult to control due to extensive underground rhizomes. Unlike most shoreline species new shoots can float on the water surface and extend far from shore. Adverse impacts include restricted public access to waterways and use of shoreline areas, impaired navigation in small channels, restricted water flow, formation of free-floating mats, and clogging of water intakes.

Water primrose covers shallow coves in Lake Murray.

Freshwater Animals

Spotted bass (*Micropterus punctulatus*)

Spotted bass populations are found in the Tennessee drainage and were probably illegally introduced to South Carolina by anglers. They are quite prolific where established and may be competitively displacing largemouth populations in upstate Piedmont and mountain lakes, as they are in Lake Lanier in Georgia. Spotted bass seem to dominate the fishery in largemouth bass lakes. Bass anglers are catching them in good numbers

because of their relatively large population size. They seemed to be easier to catch, but the populations are so great that average size is going down compared to largemouth bass. Spotted bass are hybridizing with red-eye bass (*Micropterus coosae*), which is a native Piedmont mountain bass. The red-eye bass does not attain a large size like largemouth bass or support a large fishery, but hybridization may be eliminating this native bass species.

Flathead (*Pylodictis olivaris*) and blue catfish (*Ictalurus furcatus*)

Flathead catfish and blue catfish are native to the Mississippi drainage and were introduced into lake systems in South Carolina during the 1960s. These top predators thrived and became popular in lakes, especially in the Santee Cooper system. Flathead and blue catfish now support a large recreational and commercial fishery. They are now found in the Edisto River and several coastal plain rivers, where they have negatively affected a previously popular fishery for native catfish and redbreast sunfish. These species are able to survive in any water in the state.

White perch (*Morone americana*)

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White perch have become established throughout the state and have compete with white bass. White perch are native to South Carolina's coastal rivers but have been moved to upstate reservoirs and may be competing with the crappie fishery. White perch have displaced white bass, which are not native to the state but were managed as a sport fishery in upstate reservoirs.

Green sunfish (*Lepomis cyanellus*)

Green sunfish are native to the central and eastern United States west of the Appalachian Mountains and east of the Continental Divide, from the Great Lakes region south to the Gulf Coast states and northeastern Mexico. Green sunfish has been introduced in Piedmont rivers and streams where it could be having an effect on native species of warmwater streams. To date, no information is available on how green sunfish have affected native fish fauna in Piedmont rivers and streams.

Mollusks

Viviparid snails

Viviparus georgianus *Viviparus subpurpureus* *Bellamya japonica*

photos courtesy of Rob Dillon, Collage of Charleston

The ecological and economic impacts from non-native snails in South Carolina is not well known. Two species of particular concern include *Viviparus subpurprueus* and *Bellamya japanoica*. Millions of viviparid shells have been identified on beaches at Lake Marion, one of the Santee Cooper lakes. The shells were a mixture of approximately 95 percent *Viviparus subpurpureus* and 5 percent *V. georgianus*. This is the first known report of *V. subpurpureus* in an Atlantic drainage, as well as the first report that this species can be invasive.

Native to Southeast Asia, *Bellamya japonica* (sometimes misidentified as the Chinese mysterysnail, *Cipangopaludina chinensis malleata*) was first introduced to North America in the late 1890s and has now become firmly established in the United States. Healthy populations have become established in South Carolina (Jonesville Reservoir, Lake Greenwood, and Lake Marion). The species is believed to be spread mainly by water garden hobbyists.

Zebra mussels (*Dreissena polymorpha*)

While zebra mussels have not yet been found in South Carolina, they occur nearby (near Knoxville, Tennessee) and threaten to invade the state's waterways. A statewide zebra mussel risk assessment indicated that water quality conditions (soft water) should inhibit the growth and reproduction of zebra mussels in most of the state; however, water quality conditions are more favorable in the middle Piedmont region from York County to

McCormick County, the Intracoastal Waterway near Georgetown, portions of the Cooper and Ashley rivers near Charleston, and the Savannah River near Savannah, Georgia.

The growth of zebra mussel populations can cause significant ecological consequences throughout an aquatic community. They are efficient filter feeders, so can remove large amounts of phytoplankton from the water which serve as the primary energy source in most aquatic ecosystems. Zebra mussels like to attach and colonize on hard surfaces including native clams and mussels. Clams covered with zebra mussels cannot open their valves and as a result are smothered thus reducing the rich diversity of the mussel and clam community. When zebra mussels impact aquatic communities, recreational angling usually suffers. Unprotected docks, breakwalls, boat bottoms and engine outdrives can be rapidly colonized. Economically, industries, including hydropower production facilities and water utilities that take water from inland waters, would incur costs of removing zebra mussels from clogged intake pipes.

Asian clams (*Corbicula fluminea*)

The Asian clam was first reported in the United States in Washington's Columbia River in the 1930s. It was likely introduced intentionally for harvest and consumption purposes (Counts, 1986). *Corbicula fluminea* spread mostly through human activities, such as bait bucket dumping, aquaria releases into streams or canals, and intentional releases by people who bought the clams at food markets. Asian clams may also have been a contaminant in an imported aquaculture species. Another pathway for dispersal is the passive movement of larvae in water currents. Since then it has spread across the country, with the first reports of it in South Carolina were from the Pee Dee River in the late 1960s or early 70s. From there it has spread to the Savannah River, the Santee Rivers, and throughout the state. Ecological impacts of Asian clam infestations include the altering of benthic substrate and increased competition with native species for food and habitat resources. Periodic massive dieoffs of the Asian clam have been linked to mortality of native freshwater mussels (Scheller, 1997), and the clam has been blamed for the decline and local extinctions of several native freshwater mussel species (Williams, 1997). Asian clams also serve as a food source for many species favored by fishermen, including largemouth bass and freshwater drum. But this benefit is outweighed by the economic burden borne by industries and municipalities. Economically, the Asian clam introduction has been related to biofouling of power plant water intakes and other municipal and industrial water intake and supply systems. In some parts of the United States, *C. fluminea* also causes problems in irrigation canals and pipes (Foster et al. 2000).

Insects

Asian tiger mosquito (Aedes albopictus)

Aedes albopictus, the Asian tiger mosquito, has perhaps been the most successful aquatic invasive species to encroach into South Carolina over the past eighteen years. First documented in South Carolina in 1988, the species has spread rapidly and now occurs in all 46 counties. First found in the United States in Texas in 1985, *Ae. albopictus* is thought to have entered the country through the worldwide distribution of used tires. This species is a competent vector of many viruses including dengue fever, Eastern equine encephalitis, potentially St. Louis and LaCrosse encephalitis, as will as dog heartworm. The life cycle of *Ae. Albopictus* is closely associated with human habitat and it breeds in containers of standing water. It is a very aggressive daytime biter with peaks generally occurring during early morning and late afternoon. It feeds on a number of hosts, including man, domestic and wild animals. It generalized feeding behavior contributes to its vector potential. (Dr. Chris Evans, SCDHEC)

Asian mosquito (Ochlerotatus japonicus)

Ochlerotatus japonicus, an Asian species generally found in Japan and Korea, was first documented as occurring in South Carolina in 2003. Initially found in northern Greenville County, the species has spread to nine South Carolina counties, primarily in the upper Piedmont and Central Midlands (Oconee, Pickens, Greenville, Anderson, Laurens, Union, Cherokee, York and Richland). *Oc. japonicus* was first detected in the United States in 1998 in New York and New Jersey. Since its first discovery, the species has rapidly expanded it range. By the end of 2003, the species had been documented as occurring in 19 states, primarily on the eastern seaboard. The species is suspected of being a vector of Japanese encephalitis, West Nile virus and St. Louis encephalitis. The larval habitat for the species is similar to that of *Ae. Albopictus*, with larvae typically being found in small-volume containers such as bird baths, buckets, plastic containers, wheelbarrows, animal watering containers and tires. While not considered an aggressive human biting mosquito, the species is primarily a day and early evening biter. (Dr. Chris Evans, SCDHEC)

Crustaceans

Mammals

Nutria (*Myocastor coypus)*

Photo:USGS

South Carolina's State wildlife officials are concerned that nutria may soon be showing up in the Savannah and Pee Dee river basins. Nutria were introduced from Argentina to the United States in 1938 as a biological agent for controlling aquatic weeds. During the 1950s initial destruction caused by these animals on marshes, rice and sugarcane field was documented, but their valuable fur had already become a target for fur traders.

Harvesting of nutria fur caused them to be listed as protected wildlife in 1965. During the 1980s the international fur market declined and nutria populations started dramatically increasing and the damage to wetland habitats became intense. Ecological impacts from nutria are caused by herbivory damage in emergent marsh grasses where nutria graze. Concerted efforts to regenerate bald cypress forests have largely been unsuccessful due to nutria damage. Burrowing causes significant damage in areas of infestation. Large underground tunnels built by nutria weaken the sides of drainage canals, water impoundments and levees. Nutria overgrazing exacerbates cave-ins and erosion problems in these areas. Economic impacts from nutria have been seen in other states, but not in South Carolina at this time.

Marine/Estuarine Plants

Beach vitex (*Vitex rotundifolia*)

Haven't received permission for us of photo yet; left voicemail with Chuck Gresham
Text coming. D. Knott.
Problems on the South Carolina coast are still being investigated with beach vitex, which is used for sand dune stabilization. Ecological impacts include crowding out beneficial species such as American beach grass and sea oats.
Beach vitex also interferes with nesting of sea turtles, a protected aquatic species.

Marine/Estuarine Animals

Fishes

Red lionfish (*Pterois volitans*)

photo courtesy of Dany Burgess

Text coming. D. Knott.

Mollusks

Asian green mussel (*Perna viridis*)

photos courtesy of the Southeastern Regional Taxonomic Center

Text coming. D. Knott.

Charrua mussel (*Mytella charruana*)

PERMISSION FOR USE OF THIS IMAGE NOT YET RECEIVED

Text coming. D. Knott.

Shellfish

Any to include here?

Crustaceans

Barnacle (*Megabalanus coccopoma*)

photos courtesy of the Southeastern Regional Taxonomic Center

Text coming. D. Knott**.**

Isopod (*Synidotea laticauda*)

photo courtesy of the Southeastern Regional Taxonomic Center

Text coming. D. Knott**.**

Green porcelain crab (*Petrolisthes armatus*)

photo courtesy of the Southeastern Regional Taxonomic Center

Text coming. D. Knott**.**

Spiny hands crab (*Charybdis helleri*)

photo courtesy of the Southeastern Regional Taxonomic Center

Text coming. D. Knott**.**

Pathways of Introductions

The mechanism, or pathway, by which non-native species enter the state is important in order to prevent or minimize additional introductions. An analysis of the USGS Center for Aquatic Resources Studies database (Fig. 4), which only includes aquatic animals, indicates that the major pathways for non-native species to enter South Carolina are stocking (44%), aquarium releases (14%), shipping (11%), and bait releases (10%). These sources are comparable to other states in the southeast. Except for Florida, stocking is the greatest source of introduced non-native species for all other southeastern states. Stocking averages 43% for other southeastern states with ranges from 30% in Louisiana to 56 % in Tennessee (Table 1). These same states site stocking, aquarium releases, bait releases, and aquaculture as the top sources for introduced species.

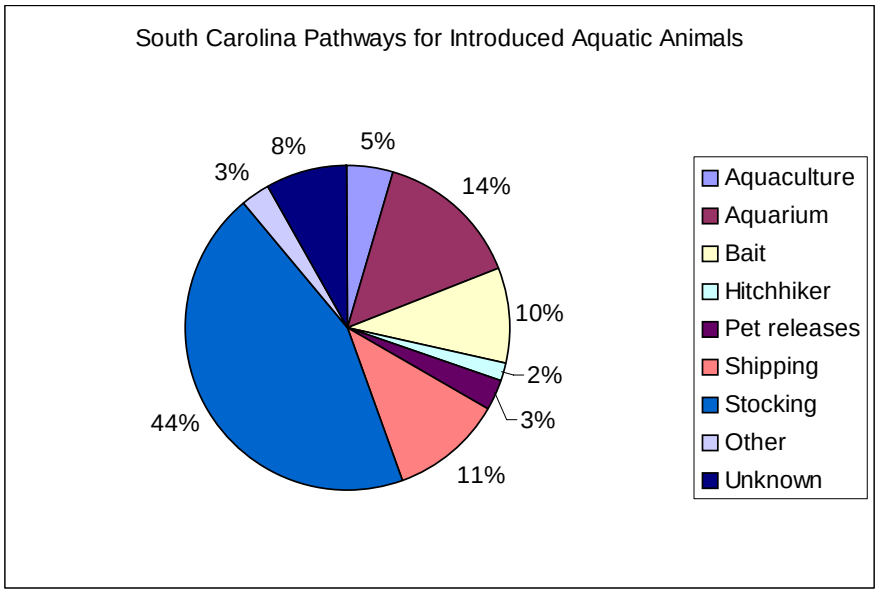

Figure 4.

Table 1. Major Pathways of Introductions for Southeastern States.

State	Stocked	Aquaculture	Bait	Aquarium	Shipping
AL	46	13	17	5	4
FL	13	11	4	36	11
GA	42	7	26	8	3
LA	30	23	8	15	7
MS	40	14	8	10	6
NC	42	3	24	9	6
SC	44	5	9	14	11
TN	56	5	18	4	1
TX	48	4	11	18	4
VA	41	5	21	5	9
Average	40.2	9	14.6	12.4	6.2

When aquatic plants are included in the analysis, the top pathways for introductions for South Carolina are stocking (37%), aquascaping (16%), aquarium releases (12%), and shipping (9%) (Fig. 5).

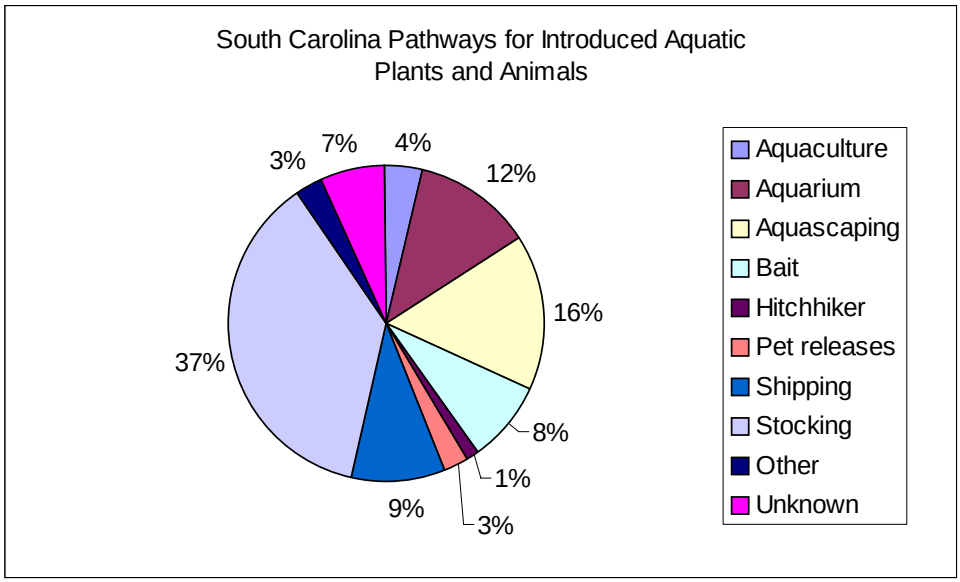

Figure 5.

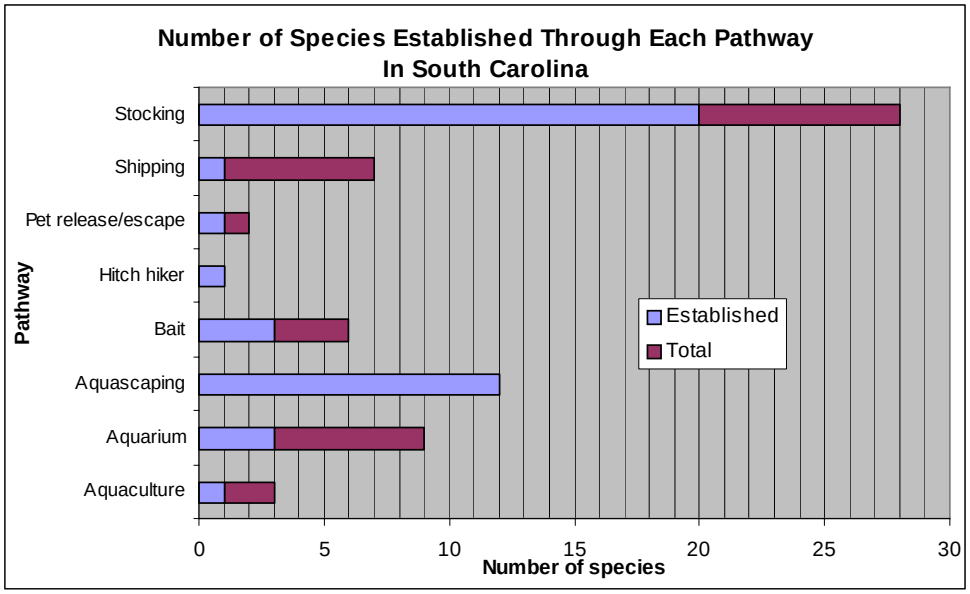

Figure 6.

Stocking

An analysis of how non-native species originally enter the state highlights the fact that the primary pathway has been the intentional stocking of fish (37%). This should not be too much of a surprise since the largest group of non-native species introduced into South Carolina have been fish (68%). Prior to **19??,** stocking of game fish by the S.C. Department of Natural Resources (formally the S.C. Wildlife Department) and by most fish and wildlife agencies nationwide was standard operating procedure. The philosophy at the time was to stock game fish in public waters that provided anglers with an exciting and varied fishing experience. The potential impact of those stockings on native fishes and other aquatic organisms was not weighed as heavily as it is today. Fortunately, most stockings were with species native to North America and usually to the southeast. Because these species were carefully selected to live in South Carolina waterways, this pathway has one of the highest percentages of species establishment after introduction (Fig. 6). Stocking non-native fish in South Carolina is now limited to the introduction of sterile grass carp and Tilapia for aquatic plant control, white bass in major reservoirs, and ….. (What else?)

At the present time, there are no laws against moving fish that are established in the state. One can move fish without a stocking permit into ponds. Fish can escape from their ponds and become established in public waters.

Aquascaping (water gardens, plant nurseries)

This pathway, which is the second largest source of introductions to the state (16%), primarily facilitates the introduction of non-native aquatic plants but may also include the introduction of non-native fishes, such as koi. The water garden industry appears to be increasing as more and more homeowners build backyard ponds and water features. Clemson Department of Plant Industry reports an increase in the number of nurseries that carry aquatic plants for sale. Recent outbreaks of water lettuce, water hyacinth, and

Giant Salvinia have been attributed to homeowner introductions of plants purchased for use in water gardens.

Aquarium/ Pet releases and escapes

Combined, Aquarium and pet releases make up 15% of all non-native introductions to the state (Fig. 5). Department of Natural Resources fishery biologist routinely capture or receive reports from anglers of South American Pacu caught in state waters. This relative to Parana is purchased as an aquarium pet and often released into the wild after they out-grow their aquarium. While it is not well documented, it is possible that introductions of the aquatic weeds hydrilla and Brazilian elodea also came from aquarium releases. These are both popular aquarium "oxygenating" plants. Other examples of introductions from this source are African snails, ….(what else?) Fortunately, only about one-third of all aquarium species identified in South Carolina waters have established populations (Fig. 6). Since many of these species are tropical or subtropical they may survive South Carolina winters by taking refuge in spring-fed waters that do not get as cold in the winter or in thermal effluents of power plants or other industrial facilities. No comprehensive information is available on the distribution of aquarium fish or other pets in South Carolina.

Shipping (Maritime)

Commercial shipping has been identified as the fourth largest pathway for the introduction of non-native aquatic species in the state. Nine percent of all non-indigenous aquatic species have arrived by this pathway. Commercial shipping is big business in South Carolina. The Charleston Customs district ranks as the nation's sixth largest in dollar value of international shipments, with cargo valued at more than $53 billion annually. State ports pump over $23 billion into the state economy and generate $2.5 billion in state and local taxes.

Four major ports provide access to state waterways, Charleston, Georgetown, Port Royal, and Savannah (Georgia). In 2005, the Port of Charleston was the busiest container shipping port along the Southeast and Gulf coasts. In fiscal year 2006, the State Ports Authority alone served 2,167 ships and barges at its terminals in Charleston, Georgetown and Port Royal.

The principal way that aquatic invasive species can enter state waters through shipping is by the discharge of ballast water while ships are in port. Ballast water is pumped in to the hull of a ship to help stabilize the ship and keep it upright while carrying cargo. This water is often discharged at the receiving port after the cargo is unloaded. Each ship may take on and discharge millions of gallons of water. Ballast water taken on in foreign ports may include an abundance of aquatic plants, animals, and pathogens not native to South Carolina. If discharged into state waters these foreign species may become problematic. The U.S. Coast Guard has developed a nationwide Ballast Water Management Program and is responsible for enforcing it in South Carolina.

Ballast water discharges are of particular concern at the ports of Charleston, Georgetown, and Savannah. All three of these areas were identified in a 2002 zebra mussel risk assessment as sites in which water quality was suitable to support zebra mussels. Because of the water quality of these sites they are a possible sources of introduction of marine, estuarine and freshwater organisms.

Bait Releases

Bait releases make up eight percent of all introductions. Bait is imported from many areas outside of the state so has the potential to be contaminated with local plants and animals, associated diseases, and parasites. Specifically, dead or live shrimp used for bait can carry disease that can impact native shrimp populations. South Carolina has not had a problem with other species of bait to date. Baitfish introduction of blue-backed herring occurred in late 1970s to early 1980s. Blueback herring are native to South Carolina, but are causing problems in oligotrophic lakes inland in Georgia. Nonnative fathead minnows are used for bait or forage. Threadfin shad are established and not a big concern; they can be used as bait. Anglers use shad and herring as bait for striped bass and catfish fishery. There is interest in raising rudd for bait, but it is currently illegal. A number of dealers sell fish for private pond stocking and are restricted to use of approved species.

Aquaculture

South Carolina has a diverse aquaculture industry, but it is not a large industry compared with other southeast states. The industry generates $10 to 15 million annually. South Carolina's aquaculture interests range from marine to freshwater species. Native clams (*Mercenaria mercenaria*) are cultivated in coastal areas. There is an aquaculture interest in using non-native clams, shrimp, fish and oysters such as *Crassostrea ariakensis* (introduced in Chesapeake Bay) for bottom culture or cages along coastal and offshore areas. Saltwater aquaculture facilities raise nonnative shrimp, mostly Pacific white shrimp (*Litopenaeus vannamei*) and some freshwater prawn (*Macrobrachium*) for aquaculture. Native shrimp provide an important capture fishery along the coast and may be damaged due to importation of nonnative competitive species, genetic mixing with highly inbred production stocks, and introduction of associated diseases. Nonindigenous Australian (red claw) crayfish is under consideration for aquaculture use in South Carolina.

Freshwater species include grass carp, striped bass, crayfish, prawn and catfish. Use of triploid grass carp in private ponds is permitted, which is the majority use for grass carp. Most grass carp are spawned and reared out-of-state, then sold directly by the dealer or grown out before selling. One business in South Carolina produces them from diploids. There is a small amount of rainbow trout farming in upper regions. (Rainbow trout are not native but not considered invasive.) The first breeding of hybrid striped bass was conducted in South Carolina. As a cross between two species, it is also nonnative but not invasive. Other freshwater species raised include: crayfish *Procambarus clarkii* (not native) and *Procambarus acutus* (native); the freshwater prawn *Macrobrachium rosambergii* (not native) and channel catfish (argument as to whether it is native). South Carolina permits raising nonnative crayfish for food. Most of the crawfish raised in the state for food are native species, such as red crayfish. There is no information on what their effects could be on native fauna or on potential transfer of disease to saltwater shrimp industry.

A few production facilities raise baitfish, some saltwater, but on a small scale. Large baitfish producers in South Carolina have problems maintaining stable markets. The industry also raises golden shiners; these are not considered invasive except in small ponds where they can interfere with pond management. Known high-risk species are rudd, walking catfish, diploid grass carp, freshwater electric eel, and piranha. Many others are available that are known to be a problem from the experiences in other states. For example, silver, bighead and black carp have been a problem in other areas. Use of sturgeon in aquaculture may become a future issue due to South Carolina's endangered short nose sturgeon and Atlantic sturgeon. All proposed introductions have to go through the review system for use in research, education, aquaculture and other uses.

Fish, shellfish and shrimp diseases:

A primary concern for nonindigenous *shrimp* farming is disease amplification and release. Aquaculture producers are very concerned about all other unregulated pathways for introducing *disease*. The main risk of bringing in *disease* relates to saltwater shrimp. Health certification is only required for shrimp and shellfish (clams). There are five

saltwater aquaculture production facilities in the state, which are competing economically with local shrimp boats and imported shrimp. Also, n*onindigenous shrimp* are in the markets for consumption. Consumers buy live shellfish for consumption from out-of-state sources. On occasion, they dispose of live leftover shellfish or shells and heads into the waters. In doing so, they are creating pathways for disease introduction.

There is a large industry of *hard clams* shipped as small seed from hatcheries in Maine and New Jersey, grown out and shipped back. There have been some issues with Virginia and South Carolina producers concerning bringing in *southern clams*, which are more susceptible to disease (QPX or Quahog parasite unknown). *Taura syndrome, yellow head* and *white spot* disease can be transmitted by disposal of body parts, either after human consumption or when used as bait. There is evidence of disease transmission from dead to live shrimp or other native crustaceans. *Largemouth bass virus* (LMBV) is not confirmed in any USACOE reservoirs. The Santee Cooper lakes are the first location where LMBV was found in the U.S.

Hitchhikers (boating)

Recreational boating is one pathway by which invasive species can enter and spread throughout South Carolina's waterways. Lakes, ponds, rivers, and coastal waters provide recreational opportunities for a large population of boaters. The transportation of boats and their trailers between water bodies presents a risk of introduction through hull fouling, entanglements, and water discharge from bilge pumps and bait buckets. By not thoroughly washing or rinsing boats and boat trailers, boaters can easily transport aquatic weeds from one water body to another. The use of recreational boats for fishing poses the additional risk of the release of imported bait species or species that serve as hosts for nonindigenous organisms.

Jurisdictions and Responsibilities

State Entities

South Carolina Department of Natural Resources (SCDNR)

- Land, Water and Conservation Division, Environmental Conservation Section – The division administers the Aquatic Plant Management Program, responsible for statewide management of invasive aquatic plants in public waters. It develops annual statewide aquatic plant management plans, coordinates control activities, implements prevention/public education efforts and identifies research needs.

- Wildlife and Freshwater Fisheries Division, Freshwater Fisheries Section – The division administers programs such as the Sterile Grass Carp Permit program that restrict the importation and aquaculture of certain freshwater fish species.

- Marine Resources Division – The division administers programs that regulate the importation and aquaculture of certain marine organisms. The program is responsible for commercial fisheries in saltwaters of South Carolina, including permitting, scientific collection permits, nonindigenous importation, legislation and policy. Outreach is provided regarding regulatory responsibilities, data collection and survey. The fisheries management program does fishery-dependent data gathering. No formal surveys of satisfaction in the commercial fishing industry have been conducted, but they are considering this possibility.

- Law Enforcement Division – Conservation officers enforce game and fish laws and are authorized to enforce all state laws including those by other state agencies.

- Conservation, Education and Communications Division – The division administers boater and hunter education programs, teacher workshops and agency communications.

Aquatic Plant Management Council

This 10-member board was established by law in 1990 to provide interagency coordination and serve as the principal advisory body to the SCDNR on aquatic plant

management and research. The council establishes management policies, approves all management plans and advises SCDNR on research priorities.

South Carolina Department of Agriculture

The State Department of Agriculture administers the State Noxious Weed Act, including enforcement of the State Noxious Weed List that features several invasive aquatic plant species. It has a limited role in resource management, with more activities focused on agricultural marketing, promotion and regulation. The department has authority to stop movement of materials through commercial channels, including sale of plants by pet stores and water garden distributors. It can place quarantines through the Commissioner of Agriculture. The department can use regulatory power to help resource managers control aquatic nuisance species.

Department of Plant Industry, Clemson University

The Clemson University Department of Plant Industry (DPI) regulates plant pests throughout the state. The Department's regulatory authority is delegated by The State Crop Pest Commission (SCPC). It inspects and regulates nurseries, nursery stock dealers and agricultural producers, and administers the State Crop Pest Act, including the enforcement of state crop pest list. The state crop pest list comprises all illegal state and federal species, including several invasive aquatic plant species. The DPI provides inspection and certification services to agricultural producers to assure they meet pest free requirements for sales, distribution, and exportation of plant products. There is a memorandum of understanding between the DPI and the Department of Natural Resources, which encourages greater focus on the aquatic invasive plant species. The DPI follows up on reports of invasive plant pest and cooperates with SCDNR if eradication or regulatory action is warranted. DPI conducts extensive survey for aquatic invasive plants such as *Salvinia molesta*. Recently DPI assisted SCDNR in the eradication of this invasive aquatic plant from SC. DPI's motto is "Regulation through Education." DPI is proactive in educating the public about invasive species before they are out of control.

The Cooperative Agricultural Pest Survey (CAPS) is a joint effort between states and

USDA APHIS PPQ. The CAPS committee is made up of individuals from several agencies that act as an advisory group for activities to detect or delimit exotic pests in this state. Committee members provide input on upcoming exotic pest surveys, discuss survey results, and share relevant information on pest occurrences. Pest distribution data from surveys is submitted to a national database. CAPS surveys and other monitoring activities strive to protect agricultural and natural resources and prevent economic losses from exotic plants, pests and pathogens. The committee includes a diverse cross section of agencies that work closely with the public and concerned industries to prevent or slow the dispersal of invasive plants.

South Carolina Sea Grant Consortium (SCSGC) and Extension Program (SCSGEP)

The consortium is a university/laboratory-based state agency charged with supporting research, education, training and technical assistance programs to enhance economic opportunities and conserve marine and coastal resources. The agency's primary federal sponsor, the National Oceanic and Atmospheric Administration (NOAA) National Sea Grant College Program, supports aquatic nuisance species research, education and outreach activities around the country with emphasis on marine and Great Lakes environments. The staff includes six extension specialists who focus on aquaculture, fisheries, coastal hazards, ocean observations, coastal communities and coastal economics/business. It has four communications staff in graphic design, technical writing, web design/management and public information. The extension program's aquaculture program helps develop an economically viable and natural resource-friendly aquaculture industry. South Carolina's aquaculture industry has grown dramatically in the last 10 years, and this agency has played a leading role in support of that growth. It also is heavily involved in zebra mussel research and outreach awareness.

Federal Entities

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA APHIS PPQ)

APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests and noxious weeds. The Plant

Protection Act (PPA, 7 U.S.C. 7701 et seq.), enforced by APHIS-PPQ, prohibits the introduction into, or the dissemination of a plant pest or noxious weed within the United States. South Carolina has five regional APHIS-PPQ field offices plus the state office, all of which work to exclude, detect and eradicate newly introduced plant pests or noxious weeds that pose risk to U.S. agriculture or the environment. APHIS-PPQ and the Department of Plant Industry, Clemson University work cooperatively in this safeguarding effort.

APHIS funding assists with aquatic nuisance species surveys in South Carolina. APHIS-PPQ's Smuggling, Interdiction and Trade Compliance (SITC) Program seeks to prevent unlawful entry and distribution of prohibited products that may harbor exotic plant and animal pests, diseases, or invasive species. SITC provides information about illegal imports obtained from various data sources for incoming cargo, which also helps target surveys.

U.S. Department of Agriculture, Forest Service

The USDA Forest Service has the goal nationally, regionally, and locally to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of non-native invasive species across all landscapes and ownerships. Emphasis areas include early detection and rapid response, control and management, rehabilitation and restoration, partnerships and collaboration, research, and information and education. The USDA - Forest Services maintains lists of both terrestrial and aquatic species, which are thought to be invasive (cause economic or ecological damage) on National Forest lands.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)

NRCS provides technical and financial assistance to conserve South Carolina's natural resources. NRCS works in close partnership with the South Carolina Association of Conservation Districts and has field staff available to assist private landowners in every county in South Carolina. NRCS administers several Farm Bill Conservation programs

that provide cost share conservation assistance to agricultural producers to address resource concerns such as soil quality, soil erosion, water quality and wildlife habitat on agricultural lands. Private landowners also have the opportunity to enroll land in conservation programs that encourages the enhancement of wildlife habitat. Conservation easements, through the Wetland Reserve Program, to restore and enhance the functions and values of degraded wetlands in South Carolina, are also a high priority to NRCS. Wetland functions include surface water storage, ground water recharge, nutrient cycling, and protection of characteristic plant communities and wildlife habitat. The NRCS is South Carolina is providing funding and assisting in the administration of a local cost-share program for the control of Phragmites on private property in the Winyah Bay area. On the national level, NRCS manages the National Invasive Species Information Center (www.invasivespeciesinfo.gov), an important invasive species information web site, and sits on the National Invasive Species Council, the Invasive Species Advisory Committee, and Aquatic Nuisance Species Task Force.

U.S. Coast Guard (USCG), Ballast Water Management (BWM) Program

USCG is responsible for enforcing ballast water regulations. In recent years there has been increased international focus on ballast water management due to the ecological, economic, and potential health threats caused by the spread of ANS from ballast water. USCG is responding to these concerns through a comprehensive national BWM program. This program applies to all vessels equipped with ballast water tanks that operate in U.S. waters and are bound for ports or places in the U.S. Highlights of the program are: mandatory ballast water management practices for all vessels that operate in U.S. waters; additional practices for vessels entering U.S. waters after operating beyond the Exclusive Economic Zone, and reporting and recordkeeping of ballasting operations by all vessels.

U.S. Army Corps of Engineers (USACOE), Charleston District

USACOE, Charleston District is involved in dredging and storm damage reduction projects. It also coordinates ecosystem restoration projects, flood control projects, emergency stream bank protection projects and bioengineering projects. The Charleston District's involvement in aquatic invasive species management is limited. It works

closely with SCDNR to provide cost-share funding for aquatic plant control efforts in the state through its Aquatic Plant Control Program. Charleston District does not manage any USACOE reservoirs. Federal APC funding can only be used on public waters with public access, so the District's involvement is limited to public water bodies. USACOE requires that public access sites and boat landings post signs warning of aquatic invasive species and to properly clean boats and trailers to prevent their spread. The Charleston District is also working with the S.C. Department of Natural Resources to control the spread of the aquatic weed Phragmites on dredge spoil areas in the state. They assist by providing the Department with the location of dredge spoil sites for survey purposes and plan to start reimbursing the Department for control expenditures on those sites.

U.S. Army Corps of Engineers, Savannah District

USACOE, Savannah District (located in Georgia) is responsible for maintaining Savannah and Brunswick Harbors, the Intracoastal Waterway along Georgia's coastline and the Savannah River. The Savannah Harbor is a major foreign-trade and general cargo port that has great economic and strategic importance. Savannah District also is a leading producer of hydroelectric power, operating three major multi-purpose dam and lake facilities along the Upper Savannah River along the Georgia/South Carolina border: J. Strom Thurmond, Richard B. Russell and Hartwell. Hydrilla was first discovered in J. Strom Thurmond Lake in 1995. The Savannah District prepared an Aquatic Plant Management Plan in 1998 in response to the presence of hydrilla in Thurmond Lake as well as other aquatic plants of concern in Hartwell Lake, Richard B. Russell Lake, and the New Savannah Bluff Lock and Dam. The plan establishes treatment priorities based on impacts to authorized project purposes, funding, treatments by others and environmental impacts. The Savannah District anticipates the spreading of aquatic invasive species. The Corps of Engineers has matching aquatic plant control program funds for the state of Georgia to treat nonfederal bodies of water in Georgia. However, these funds cannot be used to treat Thurmond Lake, because it is a federal water body.

The Savannah District interacts with the public through numerous boating facilities at all three reservoirs, and through public visitors at District offices. The district also educates

and informs marina employees, boaters and general public about problems associated with improper sewage disposal and encourages the use of pump out stations. It uses displays, publications, workshops, promotional items, education programs and websites to reach target audiences. It helps coordinate the Clean Vessel/Clean Marina Program. The target audience and methods of reaching audiences are similar to aquatic invasive species issues.

U.S. Department of the Interior, National Park Service (NPS)

The National Park Service manages more than 32,000 acres of public land in South Carolina. This acreage is divided into four distinct management units including Congaree National Park (26,434 acres), Cowpens National Battlefield (1,833 acres), Fort Sumter National Monument (226 acres), and Kings Mountain National Military Park (3,945 acres). The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. Congaree National Park is by far the largest NPS site in South Carolina and was established to protect the largest remaining tract of old-growth bottomland hardwood forests in the southeastern U.S.

Exotic, non-native species are a primary management concern at all NPS sites containing significant land resources. In addition to Executive Order # 12112, there are specific NPS management policies directed at the removal of all exotic species. Significant efforts have been made in recent years to conduct baseline biological inventories at all park sites through a centralized Inventory and Monitoring program. Formal inventories of vascular plants, reptiles, amphibians, fish and small mammals have been completed at Congaree. More than 28 non-native plant species have been confirmed at the park including several aquatic nuisance species. Congaree also hosts the Southeast Coast Exotic Plant Management Team and is in the process of completing a draft exotic plant management plan.

U.S. Department of the Interior, Fish and Wildlife Service

The U.S. Fish and Wildlife Service is responsible for enforcing numerous federal laws related to aquatic invasive species.

Clean Vessel/Clean Marina Program

Clean Vessel/Clean Marina Program is funded through a grant from the U.S. Fish and Wildlife Service and the Department of Interior under the Clean Vessel Act of 1992. The program's goal is to provide adequate pump out facilities in the eight-county coastal zone area, with expansion to inland marinas. This program is sponsored through South Carolina Department of Health and Environmental Control's Ocean and Coastal Resource Management (SCDHEC OCRM). OCRM developed the Clean Vessel/Clean Marina Program through close coordination with SCDNR and SCDHEC's Office of Water Pollution Control, as well as the South Carolina Marina Association, a private association of marina owners and operators.

Electric Power and Water Utilities

Several public and private entities are dependent upon public waters for electric power production and some as a source of municipal water. All have a stake in the prevention and control of aquatic invasive species problems in South Carolina and all have some level of management responsibility based on their operating licenses from the Federal Energy Regulatory Commission. The U.S. Army Corps of Engineers manages three lakes on the Savannah River for power production, J. Strom Thurmond Lake, Richard B. Russell Lake, and Hartwell Lake. The operation of these lakes does not fall under FERC jurisdiction but the Corps of Engineers, as discussed above, has initiated invasive species management plans and operations on these lakes. The principal electric utilities in South Carolina are:

- Santee Cooper: Lakes Marion and Moultrie
- South Carolina Electric and Gas: Lake Murray, Lake Monticello
- Duke Power: Cedar Creek (Stumpy Pond), Fishing Creek, Gaston Shoals, Great Falls, Greenwood, Jocassee, Keowee, Ninety-nine Islands, Wateree, Wylie

Santee Cooper

South Carolina Electric and Gas

Duke Power

Direct impacts to power production operations by aquatic invasive species have been limited to the Asiatic clam, *Corbicula fluminea*. Power plant activities in response to *Corbicula* infestations include increased field sampling and reporting of clam population dynamics and increased in-plant maintenance of fire protection and heat exchange systems.

Invasive aquatic plants such as hydrilla (*Hydrilla verticillatta*), parrotfeather (*Myriophyllum brasiliense*), brittle naiad (*Najas minor*), and creeping yellow water primrose (*Ludwigia hexapetala* ((*L. urugayensis*)) have continued to move into mid-Atlantic Piedmont reservoirs during the last two decades. Some 1500 acres of hydrilla in Catawba-Wateree reservoirs beginning in 1994 have been managed using a combination of water level manipulation, herbicides and sterile Asian grass carp.

It is estimated that the 11 reservoirs that comprise the upper reaches of the Catawba-Wateree river basin have 21,000 acres of potential hydrilla habitat that if left unmanaged would impact all multiple use recreational reservoir activities enjoyed by the regional citizenry. In addition, 18 major power production facilities, more than 30 municipal drinking water intake and treatment systems supplying more than 1.5 million residential customers in the Charlotte – Rock Hill metropolitan area alone are in direct jeopardy.

Since 1994, it is estimated that $250,000 has been expended to manage the invasive aquatic plant species listed above by Duke Energy. In addition, approximately $160,000 has been invested in invasive aquatic plant research. It is anticipated that invasive aquatic plants will continue to spread in the Piedmont of the Carolinas. An example of this spread is the recent discovery of approximately 8 acres of hydrilla growing around a public boat access ramp in Progress Energy's Lake Tillery located in the Pee Dee River basin of NC.

State and Federal Legislation

Details are found in Appendix C and Appendix D

(Note: we will start working on this section at the next meeting in January 2007)

Management Goals and Objectives

Proposed Management Actions and Legislative Initiatives

Implementation Table

Monitoring and Evaluation

Literature Cited

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APPENDIX A. MEMBERS OF THE SOUTH CAROLINA AQUATIC INVASIVE SPECIES TASK FORCE

Tom Abrahamsen	US Geological Survey - SC Water Science Center
Wayne Boykin	Congaree National Park
Stephen Compton	Clemson University Department of Plant Industry
Jason Crichton	South Carolina Aquarium
Steve deKozlowski	SC Department of Natural Resources
Rick DeVoe	SC Sea Grant Consortium
Ed DieBold	Riverbanks Zoo and Garden
Jeannie Eidson	SC Dept of Health and Env. Control
Ed EuDaly	US Fish and Wildlife Service
Larry Feller	SC Landscape and Turf Grass Association
Donna Foster	SC Nurseryman's Association
Ken Glenn	US Dept. of Agriculture - APHIS-PPQ
John Hensel	SCDHEC-Office of Coastal Res Mgt
Bill Hulslander	Congaree National Park
Stan Hutto	SC Dept of Parks, Rec, and Tourism
John Inabinet	Santee Cooper
Darryl Jones	SC Forestry Commission
David Knott	SCDNR - Marine Resources Research Institute
Cam Lay	Clemson University Dept. of Pesticide Regulation
Billy Lempesis	SC State Ports Authority
Robin Mackie	US Forest Service - Francis Marion and Sumter National Forest
Ken Manuel	Duke Energy- Lake Services Environmental Ctr.
Keith Nell	State Ports Authority
Matt Nespeca	The Nature Conservancy
Marilyn O'Leary	Southeast Aquatic Resources Partnership
Jennifer Rawlings	Riverbanks Zoo and Garden
Alan Shirey	US Army Corps of Engineers, Charleston District
Brandon Stutts	South Carolina Electric and Gas Co.
Kelly Jo Swygert	SC Department of Transportation
Chris Thomason	SC Dept. of Natural Resources
David Tompkins	SC Dept. of Agriculture
Angela Viney	SC Wildlife Federation
Jack Whetstone	SC Sea Grant Consortium/Clemson University Ext.
Susan Wilde	USC / SCDNR Marine Resources
David Wilkins	South Carolina Aquarium
Dick Yetter	USDA- Natural Res Conservation Service

APPENDIX B. INVASIVE AQUATIC SPECIES IN SOUTH CAROLINA

Comment [dmk2]: is this supposed to be a comprehensive list of species that are INVASIVE or just non-native? it looks like all non-native aquatic plants are listed, but not all fish are. I've added what I think should be included for non-native marine/estuarine taxa, assuming it is supposed to include all, regardless of status as invasive, established, reported, etc. There are good published arguments that any species that becomes established (i.e. reproduces and persists) alters ecological function, as is therefore invasive, regardless of economic or social impacts.

Aquatic Plants

African oxygen weed *	*Lagarosiphon major*
Alligatorweed	*Alternanthera philoxeroides*
Ambulia *	*Limnophila sessiliflora*
Arrowhead *	*Sagittaria sagittifolia*
Arrow-leaved monochoria *	*Monochoria hastata*
Brazilian elodea	*Egeria densa*
Caulerpa *	*Caulerpa taxifolia*
Common reed	*Phragmites australis*
Duck-lettuce *	*Ottelia alismoides*
Eurasian watermilfoil	*Myriophyllum spicatum*
Exotic bur reed *	*Sparganium erectum*
Giant salvinia *	*Salvinia molesta S. biloba, S. herzogii, S. auriculata*
Hydrilla*	*Hydrilla verticallata*
Melaleuca *	*Melaleuca quinquenervia*
Miramar weed *	*Hygrophila polysperma*
Monochoria *	*Monochoria vaginalis*
Mosquito fern *	*Azolla pinnata*
Purple loosestrife	*Lythrum salicaria*
Rooted water hyacinth *	*Eichhornia azurea*
Slender naiad	*Najas minor*
Water chestnut	*Trapa natans*
Water hyacinth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*
Water primrose	*Ludwigia hexapetala*
Water spinach *	*Ipomoea aquatica*
Wetland nightshade *	*Solanum tampicense*

Comment [dmk3]: what does the * mean?

Finfish	
Carnero or candiru catfish	*Vandellia cirrhosa*
Freshwater electric eel	*Electrophorus electricus*
White amur or grass carp	*Ctenopharyngodon idella*
Walking catfish or a member of the clariidae family	Clarias, Heteropneustea, Gymnallabes, Channallabes, or Heterobranchus genera
Piranha	All members of Serrasalmus, Rooseveltiella, and Pygocentrus genera
Stickleback	

Mexican banded tetra	
Sea lamprey	
Rudd	*Scardinius erythrophtalmu-Linneaus*
Red-bellied pacu	*Piaractus brachypomus*
Lionfish	*Pterois volitans*

Cnidarians

hydrozoan	*Blackfordia virginica*
hydrozoan	*Cordylophora caspia*
hydrozoan	*Maeotias marginata*
hydrozoan	*Moerisia lyonsi*
hydrozoan	*Garvia franciscana*
jellyfish	*Drymonema dalmatinum*
anemone	*Nematostella vectensis*
anemone	*Haliplanella lineate*

Annelids

polychaete	*Fabricia sabella*

Mollusks

pulmonate snail	*Microtralia ovula*
pulmonate snail	*Creedonia succinea*
pulmonate snail	*Myosotella myosotis*
Japanese mysterysnail	*Bellamya japonica*
Banded mysterysnai*l*	*Viviparus georgianus*
Olive mysterysnail	*Viviparus subpurpurea*
Asian clam	*Corbicula fluminea*
Atlantic rangia	*Rangia cuneata*
Asian green mussel	*Perna viridis*

Crustaceans

cladoceran	*Daphnia lumhotzi*
barnacle	*Balanus Amphitrite*
barnacle	*Balanus trigonus*
barnacle	*Megabalanus coccopoma*
parasitic barnacle	*Loxothylacus panopaei*
copepod	*Eurytemora affinis*
copepod	*Skistodiaptomus pallidus*
copepod	*Elaphiodella bidens bidens*
tanaid	*Sinelobus stanfordi*
isopod	*Ligia exotica*
isopod	*Synidotea laticauda (S. laevidorsalis?)*
isopod	*Paradella dianae*

isopod	*Sphaeroma terebrans*
amphipod	*Stenothoe gallensis*
amphipod	*Caprella scaura*
crayfish	*Cambarus longirostris*
Red swamp crayfish	*Procambarus clarkii*
Asian tiger shrimp	*Penaeus monodon*
Blue shrimp	*Litopanaeus stylirostris*
Pacific white shrimp	*Litopanaeus vannamei*
Bristled river shrimp	*Macrobrachium olfersii*
Green porcelain crab	*Petrolisthes armatus*
Bocourt swimming crab	*Callinectes bocourti*
rugose swimming crab	*Callinectes exasperatus*
spiny hands crab	*Charybdis hellerii*
blue landcrab	*Cardisoma guanhumi*

Ascidians

rough sea squirt	*Styela canopus* (= *S. partita*)
Lister's encrusting tunicate	*Diplosoma listerianum*
sea grapes	*Molgula manhattensis*

Insects

mosquito	*Aedes albopictus*
mosquito	*Ochlerotatus japonicus*

Mammals

Nutria	*Myocastor coypus*

APPENDIX C. SUMMARY OF SOUTH CAROLINA STATE LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATIC INVASIVE SPECIES

Title 46, Chapter 23 - South Carolina Noxious Weed Act

Provides far reaching powers to seize, quarantine, treat, destroy, apply other remedial measures, to export, return to shipping point, or otherwise dispose of in such a manner as (it) deems appropriate, any noxious weed or any product or article of any character whatsoever or any means of conveyance which (it) has reason to believe contains or is contaminated with any noxious weed, offered for movement, moving, or has moved into or through the state or intrastate. To further deter persons from spreading nuisance aquatic weeds the law includes fines not exceeding $500 and/or imprisonment not exceeding one year.

Title 46, Chapter 9 - State Crop Pest Act

The State Crop Pest Commission is authorized by law (Section 46-9-40) to promulgate and enforce reasonable regulations to eradicate or prevent the introduction, spread or dissemination of plant pests. Plant pests are by definition (Section 46-9-15(5)) any living state of insects, mites, nematodes, slugs, animals, protozoa, snails or other invertebrate animals, bacteria, weeds, fungi, other parasitic plants...which directly or indirectly may injure or cause disease or damage in plants...and which may be a serious agricultural threat to the State, as determined by the Director. The State Crop Pest Commission is responsible for control of plant pests which constitute a threat to production agriculture. In so doing, the Commission is the primary contact point for cooperation with the Animal and Plant Health Inspection Service (APHIS), U. S. Department of Agriculture. The Commission has designated certain organisms as plant pests. These organisms are already designated as noxious weeds by state and/or federal authorities or are under domestic federal quarantine. Once a plant pest has been designated, the Commission has the authority to impose control measures, up to and including, quarantine of the premises. However, the Director, as the Commission's designee, retains the discretion to determine that a plant pest has become so widespread that further control measures are not warranted.

Title 49, Chapter 6 - Aquatic Plant Management Act

SECTION 49-6-10. Purpose; administering agency. There is hereby created the South Carolina Aquatic Plant Management Program for the purpose of preventing, identifying, investigating, managing, and monitoring aquatic plant problems in public waters of South Carolina. The program will coordinate the receipt and distribution of available federal, state, and local funds for aquatic plant management activities and research in public waters. The Department of Natural Resources (department) is designated as the state agency to administer the Aquatic Plant Management Program and to apply for and receive grants and loans from the federal government or such other public and private sources as may be available for the Aquatic Plant Management Program and to coordinate the expenditure of such funds.

SECTION 49-6-20. Aquatic Plant Management Trust Fund.

There is created the South Carolina Aquatic Plant Management Trust Fund which must be kept separate from other funds of the State. The fund must be administered by the department for the purpose of receiving and expending funds for the prevention, management, and research of aquatic plant problems in public waters of South Carolina. Unexpended balances, including interest derived from the fund, must be carried forward each year and used for the purposes specified above. The fund shall be subject to annual audit by the Office of the State Auditor. The fund is eligible to receive appropriations of state general funds, federal funds, local government funds, and funds from private entities including donations, grants, loans, gifts, bond issues, receipts, securities, and other monetary instruments of value. All reimbursements for monies expended from this fund must be deposited in this fund.

SECTION 49-6-30. Aquatic Plant Management Council; membership; duties. There is hereby established the South Carolina Aquatic Plant Management Council, hereinafter referred to as the council, which shall be composed of ten members as follows: The

council shall include one representative from each of the following agencies, to be appointed by the chief executive officer of each agency:

- Water Resources Division of the Department of Natural Resources;
- South Carolina Department of Health and Environmental Control;
- Wildlife and Freshwater Fish Division of the Department of Natural Resources;
- South Carolina Department of Agriculture;
- Coastal Division of the Department of Health and Environmental Control;
- South Carolina Public Service Authority;
- Land Resources and Conservation Districts Division of the Department of Natural Resources;
- South Carolina Department of Parks, Recreation and Tourism;
- Clemson University, Department of Fertilizer and Pesticide Control.
- The council shall include one representative from the Governor's Office, to be appointed by the Governor.

The representative of the Water Resources Division of the Department of Natural Resources shall serve as chairman of the council and shall be a voting member of the council. The council shall provide interagency coordination and serve as the principal advisory body to the department on all aspects of aquatic plant management and research. The council shall establish management policies, approve all management plans, and advise the department on research priorities.

SECTION 49-6-40. Aquatic Plant Management Plan.

The department, with advice and assistance from the council, shall develop an Aquatic Plant Management Plan for the State of South Carolina. The plan shall describe the procedures for problem site identification and analysis, selection of control methods, operational program development, and implementation of operational strategies. The plan shall also identify problem areas, prescribe management practices, and set management priorities. The plan shall be updated and amended at appropriate intervals as necessary; provided, however, problem site identification and allocation of funding shall be conducted annually. In addition, the department shall establish procedures for public input into the plan and its amendments and priorities. The public review procedures shall be an integral part of the plan development process. When deemed appropriate, the department may seek the advice and counsel of persons and organizations from the private, public, or academic sectors. The council shall review and approve all plans and amendments. Approval shall consist of a two-thirds vote of the members present. The department shall have final approval authority over those sections that do not receive two-thirds approval of the council.

SECTION 50-13-1415 -Importation, possession, or placing water hyacinth and hydrilla in waters of the state.

No person shall possess, sell, offer for sale, import, bring, or cause to be brought or imported into this State, or release or place into any waters of this State any of the following plants:

(1) Water Hyacinth

(2) Hydrilla
Provided, however, that the department may issue special import permits to qualified persons for research purposes only.
The department shall prescribe the methods, control, and restrictions which are to be adhered to by any person or his agent to whom a special permit under the provisions of this section is issued. The department is authorized to promulgate such regulations as may be necessary to effectuate the provisions of this section and the department, by regulation, is specifically authorized to prohibit additional species of plants from being imported, possessed, or sold in this State when, in the discretion of the department, such species of plants are potentially dangerous.

SECTION 50-13-1630. Importing, possessing or selling certain fish unlawful; special permits for research; Department shall issue rules and regulations.
No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this State or release into the waters of this State the following fish:

1. carnero or candiru catfish (Vandellia cirrhosa);
2. freshwater electric eel (Electrophorus electricus);
3. white amur or grass carp (Ctenopharyngodon idella);
4. walking catfish or a member of the clariidae family (Clarias, Heteropneustea, Gymnallabes, Channallabes, or Heterobranchus genera);
5. piranha (all members of Serrasalmus, Rooseveltiella, and Pygocentrus genera);
6. stickleback;
7. Mexican banded tetra;
8. sea lamprey;
9. rudd (Scardinius erythrophtalmu-Linneaus).

The department may issue special import permits to qualified persons for research and education only.
The department may issue special permits for the stocking of nonreproducing white amur or grass carp hybrids in the waters of this State.
It is unlawful to take grass carp from waters stocked as permitted by this section. Grass carp caught must be returned to the water from which it was taken immediately.
The department must prescribe the qualifications, methods, controls, and restrictions required of a person or his agent to whom a special permit is issued. The department must condition all permits issued under this section to safeguard public safety and welfare and prevent the introduction into the wild or release of nonnative species of fish or other organisms into the waters of this State. The department may promulgate regulations necessary to effectuate this section and specifically to prohibit additional species of fish from being imported, possessed, or sold in this State when the department determines the species of fish are potentially dangerous.

APPENDIX D. SUMMARY OF FEDERAL LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATICINVASIVE SPECIES

P.L. 104-332 - National Invasive Species Act of 1996
http://uscode.house.gov/download/pls/16C67.txt

P.L. 101-646 - Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
Title 7, Chapter 61- Federal Noxious Weed Act of 1974
http://uscode.house.gov/download/pls/07C61.txt
This US code expressly prohibits the interstate commerce of noxious weeds and allows for the warrant less search and seizure of said weeds. This law also deals with the required management of noxious weeds on Federal lands.
(Note the Federal Noxious Weed Act was superseded by the Plant Protection Act of 2000)
The Plant Protection Act (PPA, 7 U.S.C. 7701 et seq.) authorizes the Secretary of Agriculture to prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary determines that the prohibition or restriction is necessary to prevent the introduction of a plant pest or noxious weed into the United States or the dissemination of a plant pest or noxious weed within the United States. The PPA defines ''noxious weed'' as ''any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.'' The PPA also provides that the Secretary may publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States. Under this authority, the Animal and Plant Health Inspection Service (APHIS) administers the noxious weeds regulations in 7 CFR part 360, which prohibit or restrict the importation and interstate movement of those plants that are designated as noxious weeds in § 360.200.

Title 18, Part 1, Chapter 3, Section 46- Transportation of Water Hyacinths
http://uscode.house.gov/download/pls/18C3.txt
(a) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, alligator grass (*alternanthera philoxeroides*), or water chestnut plants (*trapa natans*) or water hyacinth plants (*eichhornia crassipes*) or the seeds of such grass or plants; or
(b) Whoever knowingly sells, purchases, barters, exchanges, gives, or receives any grass, plant, or seed which has been transported in violation of subsection (a); or
(c) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, an advertisement, to sell, purchase, barter, exchange, give, or receive alligator grass or water chestnut plants or water hyacinth plants or the seeds of such grass or plants
- Shall be fined under this title, or imprisoned not more than six months, or both.

The Lacey Act (P.L. 97-79, 16 U.S.C. 3371-3378)
This law is triggered by interstate transport in conjunction with any violations of state law.
Lacey Act Amendments of 1981 (P.L. 97-79, 95 Stat. 1073, 16 U.S.C. 3371-3378, approved November 16, 1981, and as amended by P.L. 100-653, 102 Stat. 3825, approved November 14, 1988, and P.L. 98-327, 98 Stat. 271, approved June 25, 1984)

These amendments repealed the Black Bass Act and sections 43 and 44 of the Lacey Act of 1900 (18 U.S.C. 43- 44), replacing them with a single comprehensive statute.

Under this law, it is unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

The law covers all fish and wildlife and their parts or products, and plants protected by the Convention on International Trade in Endangered Species and those protected by State law. Commercial guiding and outfitting are considered to be a sale under the provisions of the Act.

Felony criminal sanctions are provided for violations involving imports or exports, or violations of a commercial nature in which the value of the wildlife is in excess of $350. A misdemeanor violation was established, with a fine of up to $10,000 and imprisonment of up to 1 year, or both. Civil penalties up to $10,000 were provided. However, the Criminal Fines Improvement Act of 1987 increased the fines under the Lacey Act for misdemeanors to a maximum of $100,000 for individuals and $200,000 for organizations. Maximum fines for felonies were increased to $250,000 for individuals and $500,000 for organizations.

Rewards are authorized for information leading to arrests, criminal convictions, civil penalties, or the forfeitures of property, and for payment of costs of temporary care for fish, wildlife, or plants regarding a civil or criminal proceeding. Strict liability is established for forfeiture of illegal fish, wildlife or plants, and marking requirements for shipments of fish and wildlife must conform to modern commercial practices.

Those enforcing the Act are authorized to carry firearms, make qualified warrantless arrests for felony and misdemeanor violations of any law of the U.S. when enforcing the Act, search and seize under Attorney General guidelines, issue subpoenas and warrants, inspect vessels, vehicles, aircraft, packages, crates, and containers on arrival in the United States from outside the United States or prior to departure from the United States.

Amendments to the humane shipment provisions of Title 18 required the Secretary of the Interior to issue regulations governing such activity.

As amended May 24, 1949, 18 U.S.C. 42 (63 Stat. 89, September 2, 1960; P.L. 86-702; 74 Stat. 753; and November 29, 1990, P.L. 101-646, 104 Stat. 4772) prohibits importation of wild vertebrates and other animals listed in the Act or declared by the Secretary of the Interior to be injurious to man or agriculture, wildlife resources, or otherwise, except under certain circumstances and pursuant to regulations.

APPENDIX E. SECTION 1204 OF THE NATIONAL INVASIVE SPECIES ACT OF 1996

Section 1204:

State or Interstate Invasive Species Management Plans. Invasive species management plans may be prepared by state, interstate, or Indian tribal governments for technical, enforcement, or financial assistance to reduce the risk of nonindigenous species invasions. The Department of Interior is authorized to receive $4 million/year for 6 years for state management plans.

APPENDIX F. EXECUTIVE ORDER 13112 OF FEBRUARY 3, 1999 12.I

Executive Order 13112

On Feb 3, 1999, Executive Order 13112 was signed establishing the National Invasive Species Council. The Executive Order requires that a Council of Departments dealing with invasive species be created. Currently there are 13 Departments and Agencies on the **Council**.

Executive Order 13112 of February 3, 1999 - Invasive Species (PDF | 67 KB)
Federal Register: Feb 8, 1999 (Volume 64, Number 25)

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq*.), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 *et seq*.), Lacey Act, as amended (18 U.S.C. 42), Federal Plant Pest Act (7 U.S.C. 150aa *et seq*.), Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 *et seq*.), Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.), and other pertinent statutes, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause, it is ordered as follows:

Section 1. Definitions.
(a) "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.
(b) "Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.
(c) "Ecosystem" means the complex of a community of organisms and its environment.

(d) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.
(e) "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
(f) "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
(g) "Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.
(h) "Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.
(i) "Stakeholders" means, but is not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.
(j) "United States" means the 50 States, the District of Columbia, Puerto Rico, Guam, and all possessions, territories, and the territorial sea of the United States.

Section 2. Federal Agency Duties.
(a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,
(1) identify such actions;
(2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and
(3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.
(b) Federal agencies shall pursue the duties set forth in this section in consultation with the Invasive Species Council, consistent with the Invasive Species Management Plan and in cooperation with stakeholders, as appropriate, and, as approved by the Department of State, when Federal agencies are working with international organizations and foreign nations.

Section 3. Invasive Species Council.

(a) An Invasive Species Council (Council) is hereby established whose members shall include the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the Environmental Protection Agency. The Council shall be Co-Chaired by the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Council may invite additional Federal agency representatives to be members, including representatives from subcabinet bureaus or offices with significant responsibilities concerning invasive species, and may prescribe special procedures for their participation. The Secretary of the Interior shall, with concurrence of the Co-Chairs, appoint an Executive Director of the Council and shall provide the staff and administrative support for the Council. (b) The Secretary of the Interior shall establish an advisory committee under the Federal Advisory Committee Act, 5 U.S.C. App., to provide information and advice for consideration by the Council, and shall, after consultation with other members of the Council, appoint members of the advisory committee representing stakeholders. Among other things, the advisory committee shall recommend plans and actions at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order. The advisory committee shall act in cooperation with stakeholders and existing organizations addressing invasive species. The Department of the Interior shall provide the administrative and financial support for the advisory committee.

Section 4. Duties of the Invasive Species Council.
The Invasive Species Council shall provide national leadership regarding invasive species, and shall:
(a) oversee the implementation of this order and see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species, such as the Aquatic Nuisance Species Task Force, the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and the Committee on Environment and Natural Resources;
(b) encourage planning and action at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order, in cooperation with stakeholders and existing organizations addressing invasive species;
(c) develop recommendations for international cooperation in addressing invasive species;
(d) develop, in consultation with the Council on Environmental Quality, guidance to Federal agencies pursuant to the National Environmental Policy Act on prevention and control of invasive species, including the procurement, use, and maintenance of native species as they affect invasive species;
(e) facilitate development of a coordinated network among Federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health;

(f) facilitate establishment of a coordinated, up-to-date information-sharing system that utilizes, to the greatest extent practicable, the Internet; this system shall facilitate access to and exchange of information concerning invasive species, including, but not limited to, information on distribution and abundance of invasive species; life histories of such species and invasive characteristics; economic, environmental, and human health impacts; management techniques, and laws and programs for management, research, and public education; and
(g) prepare and issue a national Invasive Species Management Plan as set forth in section 5 of this order.

Section 5. Invasive Species Management Plan.
(a) Within 18 months after issuance of this order, the Council shall prepare and issue the first edition of a National Invasive Species Management Plan (Management Plan), which shall detail and recommend performance-oriented goals and objectives and specific measures of success for Federal agency efforts concerning invasive species. The Management Plan shall recommend specific objectives and measures for carrying out each of the Federal agency duties established in section 2(a) of this order and shall set forth steps to be taken by the Council to carry out the duties assigned to it under section 4 of this order. The Management Plan shall be developed through a public process and in consultation with Federal agencies and stakeholders.
(b) The first edition of the Management Plan shall include a review of existing and prospective approaches and authorities for preventing the introduction and spread of invasive species, including those for identifying pathways by which invasive species are introduced and for minimizing the risk of introductions via those pathways, and shall identify research needs and recommend measures to minimize the risk that introductions will occur. Such recommended measures shall provide for a science-based process to evaluate risks associated with introduction and spread of invasive species and a coordinated and systematic risk-based process to identify, monitor, and interdict pathways that may be involved in the introduction of invasive species. If recommended measures are not authorized by current law, the Council shall develop and recommend to the President through its Co-Chairs legislative proposals for necessary changes in authority.
(c) The Council shall update the Management Plan biennially and shall concurrently evaluate and report on success in achieving the goals and objectives set forth in the Management Plan. The Management Plan shall identify the personnel, other resources, and additional levels of coordination needed to achieve the Management Plan's identified goals and objectives, and the Council shall provide each edition of the Management Plan and each report on it to the Office of Management and Budget. Within 18 months after measures have been recommended by the Council in any edition of the Management Plan, each Federal agency whose action is required to implement such measures shall either take the action recommended or shall provide the Council with an explanation of why the action is not feasible. The Council shall assess the effectiveness of this order no less than once each 5 years after the order is issued and shall report to the Office of Management and Budget on whether the order should be revised.

Section 6. Judicial Review and Administration.

(a) This order is intended only to improve the internal management of the executive branch and is not intended to create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the United States, its agencies, its officers, or any other person.
(b) Executive Order 11987 of May 24, 1977, is hereby revoked.
(c) The requirements of this order do not affect the obligations of Federal agencies under 16 U.S.C. 4713 with respect to ballast water programs.
(d) The requirements of section 2(a)(3) of this order shall not apply to any action of the Department of State or Department of Defense if the Secretary of State or the Secretary of Defense finds that exemption from such requirements is necessary for foreign policy or national security reasons.

WILLIAM J. CLINTON
THE WHITE HOUSE,
February 3, 1999.

APPENDIX G. SUMMARY OF INTERNATIONAL LAWS AND TREATIES RELEVANT TO AQUATIC INVASIVE SPECIES

International Laws

Codex Alimentarius Commission

The United Nations' Food and Agricultural Organization (FAO) and the World Health Organization
(WHO) created the Codex Alimentarius Commission (Codex) in 1962.1 The purpose of the Codex is to encourage fair international trade in food while promoting the health and economic interests of consumers.2 In the United States, Codex activities are coordinated by the USDA, EPA, and Food and Drug Administration.3 Volume 1A of the Codex empowers the Commission to created specialized committees. One such committee that relates to invasive species is the Committee on Import/Export Inspection and Certification Systems.4 To fulfill its goal of protecting consumer health in the area of food safety. The Codex has formulated standards for specific food commodities, pesticide and drug residues, food contaminants and additives, labeling, and food safety.5 Invasive species are relevant to the
Codex if they threaten food safety or the international food trade.

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) recognizes the importance of "ecological, genetic, social, economic, scientific, educational, cultural, recreational, and aesthetic" values of biological diversity throughout the world.6 Countries have rights over their own biological resources, but also have the responsibility of conserving them and using them in a sustainable manner.7 A fundamental requirement for the conservation of biological

diversity is In-Situ conservation. 8 The CBD recognizes the need to "prevent the introduction of and control or eradicate those alien species which threaten ecosystems, habitats, or species."9 The CDB has a program to target introduction of invasive species.10 The Global Invasive Species Programme works with the CBD to provide expertise through the CBD's Subsidiary Body on Science, Technology, and Technical Assistance.11 The United States has not ratified the agreement.

Convention on International Trade in Endangered Species of Wild Flora and Fauna
The purpose of The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is to foster international cooperation in order to protect certain species of flora and fauna from over-exploitation through international trade.12 CITES divides species of wild flora and fauna into three appendices. Trade of any species in Appendices I, II, or III is prohibited, except in accordance with provisions set forth in CITES.13 Trade of species included in Appendices I, II, and III are regulated through a system of import, export, and re-export permits.14

1 *See* Food Safety and Inspection Service U.S. Codex Office, Codex Alimentarius Commission. Retrieved 17 February 2003 from www.fsis.usda.gov/OA/codex/.
2 *See id*.
3 *See id*.
4 *See* FAO/WHO Food Standards, Codex Alimentarius. Retrieved 17 February 2003 from www.codexalimentarius.net/.
5 *See id*.
6 Convention on Biological Diversity, June 5, 1002, Preamble.
7 *See id*.
8 In-Situ conservation means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties." *Id*. Article 2.
9 *Id*. Article 2(h).
10 *See* Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from www.biodiv.org/programmes/cross-cutting/alien/.
11 *See* Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from www.biodiv.org/programmes/cross-cutting/alien/gisp.asp.
12 *See* Convention on International Trade of Endangered Species of Wild Flora and Fauna, March 3, 1973, Preamble.
13 *See id*. Article II.4.
14 *See id*. Article III.2, III.3, and III.4. See also Article IV.2, IV.3, IV.4, and IV.5 and Article V.2, V.3, and V.4.

Appendix I includes species threatened with extinction that are or may be affected by trade.

Trading members of these species are the most strictly regulated in order not to further endanger their survival.15 For these species, trade is authorized in only "exceptional" circumstances.16 Appendix II includes species that currently are not threatened with extinction, but would become so threatened without strict regulation.17 Appendix II also recognizes that trade in other species also must be regulated in order to effectively protect species included in Appendix II.18
Appendix III includes all species that any Party to CITES declares to be subject to regulation within its jurisdiction to prevent or restrict exploitation, and "as needing cooperation of other parties in the control of trade."19

Office of International Epizootics
The Office of International Epizootics (OIE) is an international organization created by agreement in 1924. Its purposes are to guarantee the transparency of animal diseases worldwide; to collect, analyze, and disseminate veterinary scientific information; to provide expertise and promote international solidarity for the control of animal diseases; and to guarantee the sanitary safety of world trade by developing sanitary rules for international trade in animals and animal products.20 The OIE collects and disseminates information through cooperation between Member Countries. Each Member reports to the OIE animal diseases that it identifies within its territory.21 The OIE thereby disseminates this information to other Members so that each may act upon this information accordingly.22 The OIE provides technical support to Member Countries that request assistance in controlling and eradicating animal diseases.23 The OIE also creates "normative documents relating to rules that Member Countries can use to protect themselves from diseases without setting unjustified sanitary barriers."24 Such normative documents include the International Animal Health Code25 and Manual Standards for Diagnostic Tests and Vaccines.26 While the OIE generally focuses on issues such as livestock diseases and developing standards for diagnostic tests and vaccines, it recently has started to focus on diseases affecting wildlife, including aquatic species, by publishing its International Aquatic Animal Health Code.27

International Plant Protection Convention
The purpose of the International Plant Protection Convention (IPPC) is to prevent the introduction and spread of pests of plants and plant products and to promote appropriate control measures.28 The IPPC was adopted in 1951 and was revised in November 1997. However, the 1997 revision, while adopted, is not yet in force.29 Under the IPPC, each contracting party agrees to cooperate with each other to prevent the introduction of plant pests and diseases and prevent their spread across national boundaries.30 The Food and Agriculture Organization of the United Nations
15 *See id*. Article II.1.
16 *Id*.
17 *See id*. Article II.2(a).
18 *See id*. Article II.2(b).
19 *See id*. Article II.3.
20 *See* Office of International Epizootics, What is the OIE?. Retrieved 17 February 2003 from www.oie.int/eng/OIE/en_oie.htm.
21 *See id*.

22 *See id*.
23 *See id*.
24 *See id*.
25 *See* Office of International Epizootics, Terrestrial Animal Health Code 2003. Retrieved 25 July 2003 from www.oie.int/eng/normes/mcode/A_summry.htm.
26 *See* Office of International Epizootics, Manual Standards for Diagnostic Tests and Vaccines 2000. Retrieved 28 February 2003 from www.oie.int/eng/normes/mmanual/A_summry.htm.
27 *See* Office of International Epizootics, International Aquatic Animal Health Code 2002. Retrieved 28 February 2003 from www.oie.int/eng/normes/fcode/A_summry.htm.
28 *See* International Plant Protection Convention, December 6, 1951, current text adopted in 1979, Article I.1.
29 *See* International Phytosanitary Portal, Documents and Publications. Retrieved 3 March 2003 from www.ippc.int/cds_ippc_prod/IPP/En/publications.htm.
30 *See* International Plant Protection Convention, December 5, 1951, current text adopted in 1979, Preamble. disseminates information on import restrictions, requirements, prohibitions, and regulations to all contracting parties and regional plant protection organizations.
31 Each contracting party is responsible for creating a national plant organization to carry out the provisions of the IPPC, such as inspection of consignments of plants and plant products moving in international traffic that may carry pests and diseases and protecting endangered areas.
32 If necessary for phytosanitary conditions, contracting parties may regulate the entry of plants into their territories by setting requirements of importation; prohibiting importation of specific plants; inspecting and detaining specific plants; and treating, destroying, or refusing entry to specific plants.
33 However, contracting parties shall not take measure more stringent than necessary to accomplish the goals of the IPPC in order to minimize interference with international trade.
34

North American Free Trade Agreement
The main objectives of the North American Free Trade Agreement (NAFTA) are to eliminate trade barriers and to promote fair competition between the Parties to the Agreement.35 NAFTA requires that each Party to the greatest extent practicable, participate in international and North American standardizing organizations, such as the Codex, OIE, IPPC, and North American Plant Protection Organization, to promote the "development and periodic review of international standards, guidelines and recommendations."
36 Chapter 7 relates to invasive species. It allows each Party to adopt sanitary or phytosanitary measures necessary for the protection of human, animal, or plant life or health in its territory.37 Such measures may be more stringent than international standards, guidelines, or recommendations.38 Such measures should be based on research and risk assessment.39 However, measures should not arbitrarily or unjustifiably discriminate against another Party's goods.40 Furthermore, in conducting risk assessments in order to determine appropriate measures of protection, one of the factors

that the Parties must take into account is "the prevalence of relevant diseases or pests, including the existence of pest-free or disease-free areas or areas of low pest or disease prevalence."41

World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures

The Sanitary and Phytosanitary Measures Agreement (SPS Agreement) is a supplement to the World Trade Organization Agreement. It encourages Members to adopt measures necessary to protect human, animal or plant life or health.42 However, such measures should not arbitrarily or unjustifiably discriminate against Members that experience the same conditions in their territories or be disguised as a restriction on international trade.43 The SPS Agreement also encourages Members to use other international guidelines, such as the Codex, OIE, and IPPC44 to promote within these organizations the development and periodic review of standards, guidelines, and recommendations with respect to all aspects of sanitary and phytosanitary measures.45 The SPS Agreement Members should conduct scientific research and collect evidence in order to set appropriate levels of sanitary and phytosanitary protection with the least impact on international

31 *See id*. Article VI.4.
32 *See id*. Article IV.1(a)(i), (ii).
33 *See id*. Article VI.1.
34 *See id*. Article VI.2.
35 *See* North American Free Trade Agreement, 17 December 1992, Article 102.
36 *Id*. Chapter 7, § B, Art. 713(5).
37 *See id*. Chapter 7, § B, Art. 712(1).
38 *See id*.
39 *See id*. Chapter 7, § B, Art. 715(1).
40 *See id*. Chapter 7, § B, Art. 712(4))
41 *Id*. Chapter 7, § B, Art.715(1)(e).
42 *See* Agreement on Sanitary and Phytosanitary Measures, 15 April 1994, Preamble.
43 *See id*. Article 5.5.
44 *See id*. Preamble. *See also* Article 3.4.
45 *See id*. Article 3.4.

trade.46 Such evidence includes the prevalence of specific diseases or pests, existence of pest-free or disease-free areas, relevant ecological and environmental conditions, and quarantine or other treatment.47

APPENDIX H. PUBLIC COMMENTS RECEIVED AND RESPONSES