

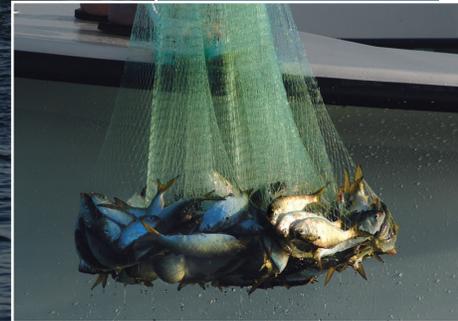
Invasion of the



Aquatic
Exotics

Alien Invaders 101:

War on the Waters



PHOTOS BY MICHAEL FOSTER

Fishermen can prevent the spread of invasive species by disposing of baitfish caught in one body of water before moving on to the next. Tanker ships may harbor exotic invasives in their ballasts.

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In what could be a bad dream or a bad movie, an alien life form descends on the Sampit River, making itself at home and threatening to consume its new neighbors with piranha-like jaws.

This invader isn't from a distant galaxy—it's a South American fish called a red-bellied pacu, and its meals consist of plants, insects and other fish.

At 33-inches long, it probably outgrew its owner's fish tank, and the budding aquarist simply dumped it in a local stream. The pacu adapted its diet and spent its lonely days trolling the river without a mate, sparing the local ecosystem the nightmare of unchecked reproduction that can accompany aquatic invasive species, until it was caught recently by a Georgetown County fisherman.

Aquatic invasive species are defined as non-indigenous organisms that live most or all of their lives in water and have the potential to adversely affect ecological health or economic activity, according to the S.C. Aquatic Invasive Species (AIS) Task Force. The 35-member AIS Task Force was created in 2006 to develop a statewide AIS management plan and enhance interagency communication and coordination regarding aquatic invasive species issues.

While the pacu in the Sampit got local headlines, more pervasive in South Carolina is the problem of aquatic invasive plants, especially hydrilla.

The terminology has evolved over the years, but organisms bearing the label "noxious" or "nuisance"

are likely to fall under the AIS umbrella. It is also important to note that the AIS term applies to a particular ecosystem; for instance, an invasive species in South Carolina may be a stalwart native in the Chesapeake Bay.

Sometimes termed “biological pollution,” AIS intruders can strike freshwater and marine environments alike, leaving South Carolina’s 11,000 miles of rivers and streams, 200 miles of shoreline and 750,000 acres of estuaries vulnerable.

Some exotic species can coexist with local flora and fauna (and may even offer untapped benefits), but most AIS creatures tend to resist natural population controls, according to the S.C. Department of Natural Resources and the S.C. Aquatic Plant Management Council. As a result, invasive plants and animals often reproduce rapidly, edging out native species for limited resources.

“Aquatic invasive species typically develop very large populations that compete with or displace desirable native species,” says Steve de Kozlowski, assistant deputy director for the DNR’s Land, Water and Conservation Division and chairman of the S.C. Aquatic Plant Management Council.

The results of rapid reproduction can be devastating. Non-native invasive species cost the United States an estimated \$120 billion per year, and nearly half of the

nation’s endangered or threatened species owe their classification at least partially to the presence of a non-native species.

In South Carolina, the economic and ecological repercussions include blocked water flow for municipal, industrial, agricultural and power-generation purposes; degraded water quality; boat damage; flooding because of restricted water flow; fish population declines; reduced waterfront property values; expanded mosquito breeding grounds; and impaired recreational outlets for swimming, hunting, fishing and boating.

South Carolina spends about \$450,000 per year managing invasive aquatic vegetation threats alone, and Florida spends more than \$20 million, according to de Kozlowski. In 1991, an invasion of the aquatic weed hydrilla shut down the St. Stephen hydroelectric plant on Lake Moultrie for weeks, costing \$4 million in lost productivity and \$526,000 worth of gamefish deaths.

Another example of an aquatic invader making its presence known by causing equipment malfunctions is the Asian green mussel’s 2006 entry into Charleston Harbor. DNR biologists recently discovered hundreds of dead shells of the green mussel (*Perna viridis*) when they worked to unclog water supply lines to tanks in one of the outdoor saltwater systems at the agency’s Marine



Red-bellied pacu.



Beach vitex overtakes coastal sand dunes, blocking sea turtles from reaching their nesting grounds.

Resources Division in Charleston. The tanks receive water pumped from Charleston Harbor and are regularly inspected. Wallace Jenkins, a senior fisheries biologist with the DNR, suspects that water circulation to some of the tanks was brought to a halt when a pump that had been out of use for nearly two months was brought back online. “A likely scenario,” says Jenkins, “is that larval mussels settled heavily in the six-inch diameter pipeline while water was flowing through it but died when the water became anoxic.”

“The key to minimizing problems caused by aquatic invasive species is to keep them out of the state to begin with,” says de Kozlowski.

Historically, non-native species have been introduced to South Carolina through direct stocking, aquascaping, shipping, aquarium releases and bait releases. Some species also “hitchhike” on boats, motors and trailers.

One invader that likely hitched a ride into our waters on a passing boat is the giant barnacle (*Megabalanus coccopoma*) discovered in Charleston Harbor in 2006. This barnacle likely rode in on the hull of a visiting vessel, possibly even a brand new one. In fact, this discriminating crustacean has great potential for economic damage because of its

preference for attaching to recently submerged surfaces, like new boats and buoys.

With increases in global commerce and interstate travel, pinning down a definitive entryway is often an elusive task. To further complicate the situation, many exotic species were intentionally introduced to the ecosystem to solve a specific problem without fully exploring all the ramifications.

For instance, nutria were originally imported from South America to help control aquatic weeds, but they have become a major pest throughout the Southeast. Meanwhile, carp is such a common South Carolina catch that many fishermen don’t realize it was first ferried in as a

food source from Eastern Europe.

“We’ve gotten used to the carp since they’ve been here so long,” says Chris Thomason, a DNR freshwater fisheries biologist. “But they do compete and add a significant amount of biomass to the system that could have been filled by native fish.”

People are the principal movers of aquatic invasive species, but fighting new AIS introductions is often an uphill battle.

“We’re not dealing with ecoterrorists,” says de Kozlowski. “People think a new species might improve fishing or hunting, or they just don’t have the heart to



PHILLIP JONES

A bass in hydrilla.



TED BORG

Though some fishermen feel a limited amount of it is beneficial, hydrilla is difficult to keep under control and often hitchhikes among bodies of water on boat propellers.



SCDNR FILE



Workers spray chemicals in an effort to eradicate water hyacinth clogging an SCE&G power-plant intake on the Back River Reservoir in Berkeley County.

kill a particular plant or animal.”

Unfortunately, good intentions and minor carelessness can lead to significant ecological and economic ramifications for South Carolina as a whole.

“For freshwater and marine animals, there is legislation that prohibits the import of certain non-native species without a permit,” says David Knott, a DNR marine biologist. “Unfortunately, it’s frequently unenforceable and needs to be revised and consolidated with several other parts of the South Carolina Code.”

Fortunately, the DNR is not alone in this fight. A number of state and federal agencies and private organizations are working together through the S.C. Aquatic Invasive Species Task Force to prevent, manage, monitor and study invasive species. State agencies such as the S.C. Department of Agriculture, Clemson University’s Department of Plant Industry, Clemson Extension Service, S.C. Sea Grant Consortium and federal agencies like the U.S. Fish and Wildlife Service, U.S. Coast Guard, U.S. Geological Survey, U.S. Park Service, U.S. Department of Agriculture and the U.S. Army Corps of Engineers are directed to address invasive species through legislation. Even power companies, including South Carolina Electric and Gas, Duke Energy and Santee Cooper have aquatic

invasive species management responsibilities on their hydroelectric power reservoirs.

Looking forward, DNR experts expect that a small floating plant called salvinia will replace hydrilla as South Carolina’s most problematic invasive plant. Animal concerns include the Asian green mussel, Northern snakehead fish and channeled apple snails.

The department also expects an overall acceleration in AIS infestations because of global trade, faster ships and more ballast discharge. Rising temperatures are also likely to extend the range of non-native species from tropical and subtropical environments to South Carolina. Combined with a growing population, the opportunities for unwelcome Palmetto State invaders are on the rise.

To minimize the threat of invasive species, the DNR emphasizes that fishermen should never throw excess bait back in waterways and always wash their catch at home. Boaters who are moving from one lake to another should also carefully inspect their hulls and propellers for hitchhiking plants and animals.

Finally, water-garden and aquarium enthusiasts should return unwanted specimens, like the red-bellied pacu swimming solo in the Sampit River, to pet stores instead of turning them loose. 🐟

Freshwater Animals:

Invaders on Feet and Fins

Whether it came from the blue lagoon or the Blue Mountains, it's probably coming to South Carolina.

The number of non-native aquatic animal species making their homes in South Carolina has risen dramatically in recent years, with an estimated 88 percent of all non-indigenous animals arriving after 1950. Freshwater species account for 82 percent of these exotic intruders, and 49 percent of them are fish.

"A big problem would be fish that can handle our climate, like some Asian carp species that have thrived in the Mississippi," says Chris Thomason, a freshwater fisheries biologist for the S.C.

Department of Natural Resources. "Species like the big-head carp and silver carp have proliferated in the Mississippi River drainage, competing with native species as a big biomass. We don't want that."

More than 40 percent of this invading army can trace their roots to North America, while South America and Asia each account for about 20 percent of aquatic invasive species (AIS), according to the U.S. Geological Survey Center for Aquatic Resources Studies. Many of these invasive species were brought to the United States decades ago, but some are just now edging their way across state borders.

"Impacts from invasive aquatic animals often go undetected because they occur under water and out of sight," warned Steve de Kozlowski, assistant deputy director for the DNR's Land, Water and Conservation Division and chairman of the S.C. Aquatic Plant Management Council. "But let them clog one power-plant intake or city drinking water withdrawal and they'll get your attention."

These exotic animals can eradicate native competitors, confound local food chains and perpetuate disease.

And many first arrived with the best of intentions. In fact, most invading fish species were purposely introduced during the 1960s and 1970s for aquaculture (usually as a second crop for the catfish industry), sportfishing or to help control local vector-borne afflictions.



MICHAEL FOSTER



PHILLIP JONES

Flathead catfish in the Santee-Cooper lakes are manageable, but in smaller systems, they can wipe out native species. Zebra mussels, below.

"People once thought introducing these species would do some good, either by providing food or solving a problem," says Thomason.

Because environmental impacts are notoriously difficult to project, South Carolina now tries to limit species introduction through an intensive permit process.

"These invasive species may have some qualities that are beneficial, but any benefits are usually far outweighed by the problems they can cause," says Chris Page, program coordinator for the DNR's Aquatic Nuisance Species Program.

Some non-native freshwater fish considered harmful include the spotted bass, white perch, green sunfish, Asian swamp eel and snakehead fish. A poster child for regional environmental differences, the white perch thrives in its native rivers along the Carolina coast, but has caused substantial damage in Upstate reservoirs. The snakehead fish has also demonstrated its versatility, multiplying in both the Potomac River and parts of Florida, where it has shown its ability to become established as a top predator.

The DNR is particularly concerned about the flathead catfish, a predatory, fish-eating catfish. It became popular in the 1960s when it was stocked in Lake Thurmond and the Santee-Cooper lakes along with blue catfish.

"In those days, it was standard procedure to try



NOAA



TOM GUNTER

Northern snakehead fish or nutria (below) may be the next exotic species to invade South Carolina.

to stock different species for food and sport without knowing the long-term effects,” says Thomason. “But the flathead catfish is a top predator in any system.”

The flathead catfish and blue catfish are popular, thriving fish in the vast environment of the Santee-Cooper lakes. However, when they find their way to small, low-fertility river systems like the black waters of the Edisto, they can completely wipe out native species like bullheads and shellcrackers.

Georgia has made several unsuccessful attempts to eradicate the flathead catfish, but the animal’s reproductive prowess and ability to tolerate both warm and cool waters make it extremely versatile. The DNR projects that South Carolina may be able to establish a minimal level of control by applying angling pressure, but the flathead catfish is now a permanent part of the Palmetto State’s ecosystem.

“These catfish are an example of invasive species that some people are happy to see and other people see as a real problem,” says Thomason. “With some other species, everyone is in agreement that we don’t want them.”

Red crayfish top the list of concerns for crustacean invaders, but mollusks may pose the greatest freshwater animal threat for the future.

“I think our next threat may be a small clam or snail that gets into our waterways,” says de Kozlowski. “They can reproduce very, very fast, and that would be a problem.”

Viviparid snails like the olive mystery snail (*Viviparous*

subpurpureus) are not usually considered invasive, but the discovery of millions of their shells along the beaches of Lake Marion has forced scientists to reconsider the evidence. The Lake Marion shells also mark the first known report of this Southeast Asian mollusk in an Atlantic drainage area.

Zebra mussels also have the DNR on its toes.

“If zebra mussels established themselves as an infestation, we would have problems,” says de Kozlowski. “Fortunately, we don’t think the soft water throughout most of the state creates a conducive environment for them.”

As filter feeders, zebra mussels remove phytoplankton—which often serve as the primary energy source for the entire aquatic food chain—from the water. They tend to

colonize on native mollusks, preventing valve function and essentially smothering the competition. Zebra mussels can also attach to unprotected docks, boats, breakwalls, engine outdrives and water-intake pipes.

Another hearty mollusk, the Asian clam, spread through the United States in the 1930s through human activities like bait dumping and aquarium releases. Its larvae can also passively navigate water currents, providing a secondary means of dispersion. The Asian clam serves as a tasty treat for many popular game fish, but this invasive species is also responsible for killing native freshwater mussels and fouling power-plant water intakes.

While not yet here, the most threatening invasive freshwater mammal identified by the S.C. Invasive

Species Task Force is the nutria, a large rodent that was first brought to America from Argentina before World War II to help control aquatic weeds.

The nutria’s tendency to devour marsh grasses and burrow extensive underground tunnels incurred

the wrath of rice and sugarcane farmers by the 1950s, but its valuable pelts boosted the animal’s popularity. In fact, extensive fur harvesting led to a protected wildlife distinction for the animal in 1965. When the fur market declined in the 1980s, the nutria population experienced a resurgence, leaving wetland damage in its wake.

“Nutria are on the list of animals of concern,” Thomason says. “They’ve become a big species in Louisiana and are actually in North Carolina right now. So we can certainly expect to see them here at some point.” 🐾



RUTH ELSEY

Aquatic Invasive Species

SC's Most Wanted

- Hydrilla (Statewide lakes and ponds, coastal plain rivers): While largely under control, it still poses the biggest threat



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to waters statewide. Through rapid spread and growth to 25 feet long, this submersed plant clogs water intakes, blocks boat access and navigation, displaces beneficial native vegetation, and impairs recreational water use activities and water quality. In 1991, it caused the shutdown of a hydroelectric plant, which resulted in a record fish kill. More than \$14 million has been spent since 1982 controlling this “aquatic Kudzu.”

- Giant salvinia (private Lowcountry ponds): Doubling its biomass every week, this free-floating fern can strangle shallow, nutrient-rich lakes while derailing irrigation systems, fisheries, power plants,



BIO-PHOTO SERVICES INC.

transportation routes and municipal and industrial water intakes. DNR officials suspect it might be the next big freshwater AIS threat.

- Water hyacinth (Lowcountry lakes and reservoirs, private ponds): Forming dense, floating mats, these fast-growing plantlets quickly obstruct boat ramps, shorelines and power-plant intakes. This plant kills native submersed plants by obstructing their access to sunlight, resulting in extensive decay and reduced oxygen counts. Water hyacinth has cost South Carolina an estimated \$1.3 million since 1985.



BIO-PHOTO SERVICES INC.

- Flathead catfish (Santee-Cooper lake country, coastal plain rivers): This carnivorous catfish is a top predator in any ecosystem, and it can completely wipe out smaller native catfish, redbreast sunfish and shellcrackers. Once stocked for sport in the Santee-Cooper lakes, the flathead catfish's ability to thrive in all South Carolina water bodies makes it a particularly virulent invader.



PHILLIP JONES



RICHARD MORISON

- Spotted bass (piedmont and mountain lakes): This prolific bass species is quickly displacing or hybridizing with native bass species. It is probably being introduced to state waters by anglers because it is easy to catch.

- Asian green mussel (coastal estuaries): Attaching themselves to any hard surface, these prolific and fast-growing saltwater mussels can clog water intakes, cover buoys, docks and other man-made structures and harm adult and juvenile oysters. Scientists hope cold water temperatures will limit their spread up the coast.



SERTIC

- Beach vitex (coastal shorelines): Sprawling up to 12 feet across beach dunes, this hearty vine can destroy loggerhead turtle nesting sites. Crowding out native plants, its tendency toward rapid expansion led to the creation of the Carolinas Beach Vitex Task Force. Ironically, it is less effective at preserving dunes than the species it was brought in to replace.



BETSY BRABSON

- Giant barnacle (coastal shorelines): Reaching the size of a tennis ball, this giant filter feeder dwarfs native barnacles. Preferring to attach to newly exposed surfaces, it has wide-reaching economic implications. Boaters unlucky enough to discover it on their propellers will quickly discover its strong grip and defensive beak.



SERTIC

Freshwater Plants:

Tenacious Tendrils



PHOTOS FROM DNR FILES

Dense mats of fast-growing water hyacinth choke out native species.



South Carolina's quarter-century battle against freshwater invasive plants has taken place on many fronts and against a variety of foes, ranging from beautiful floating water hyacinth to a ten-foot-tall common reed, particularly along the coastal plain, and in some of the state's big reservoirs.

The S.C. Department of Natural Resources' response to the hydrilla invasion, meanwhile, has received national recognition as an example of using smart science and cooperative action to reverse an ecological disaster.

Unlike the frightening red-bellied pacu, hydrilla is pretty. The long, swaying tendrils of this submersed species make it an ideal aquarium plant, and it was imported from India and Asia to line North American fish tanks. Unfortunately, hydrilla produces dense surface mats that displace native species, especially in freshwater lakes.

"From a wildlife perspective, hydrilla draws fish and waterfowl," says Chris Thomason, a freshwater fisheries biologist at the DNR. "But at certain levels, it impacts everything from boating to industrial power intakes. It quickly escalates, and we have to spend enormous amounts of money to clean it up."

With tendrils that grow as long as 25 feet, each hydrilla plant can span the diameter of an average swimming pool. Its rapid reproduction almost always leads to major municipal and industrial water intake clogs, decreased oxygen levels, impaired boating

activities, degraded water quality and, for good measure, a sizeable increase in mosquito breeding sites.

As a result, hydrilla holds the dubious distinction as South Carolina's most expensive invasive freshwater plant, costing the state \$14.7 million since 1982 to force back a presence that had expanded to cover as much as 58,000 acres statewide, easily enough to cover all of Lake Murray and more.

"Hydrilla is recognized by every state and federal government as one of the most problematic invasive species," says Chris Page, coordinator of the Aquatic Nuisance Species Program at the DNR.

By the time hydrilla appeared on Lake Murray in 1993, the DNR and the Aquatic Plant Management Council had already battled a hydrilla infestation in lakes Marion and Moultrie that covered a large chunk of the massive pair of lakes and temporarily shut down the hydroelectric plant at St. Stephen.

The DNR immediately started treating the Lake Murray invasion with herbicides and later requested a lake drawdown.

"Lake homeowners don't care for drawdowns, so that was not a popular thing," says Page. While herbicides and drawdowns provided good short-term control, hydrilla continued to spread to more than 6,600 acres. At that point the DNR decided to unleash an exotic invader of its own: a large herbivorous minnow called triploid grass carp.



DNR FILE PHOTO



BIO-PHOTO SERVICES INC.

A pond overtaken by giant salvinia.

“We’re fortunate that hydrilla is like shrimp and grits to grass carp,” says Page. “They love it, and it’s what they eat first.”

The DNR first added grass carp to its biological arsenal while controlling hydrilla in the Santee-Cooper lake system in the early 1990s. By stocking only sterile fish, biologists were able to guard against permanent ecological disturbances. Scientific opinion was divided at the time, but the DNR decided to pursue the largest stocking of triploid grass carp in the world.

The gamble worked, and the state stocked 2,620 more grass carp in the Santee-Cooper lakes in 2007 to help keep hydrilla under control. “Small maintenance stockings will ensure that hydrilla doesn’t get out of control yet allow our native plant species to survive,” says Page.

Stocking triploid grass carp in the Santee-Cooper lakes has been very cost-effective, at less than \$10 per acre per year, according to the U.S. Army Corps of Engineers.

An invasive plant that frequently shares the billing

Tiny Enemy Hiding In Hydrilla

One of the less obvious, but perhaps more tragic, consequences of aquatic invasive plants in South Carolina waters is the death of bald eagles.

More than one hundred of the iconic birds have died in recent years across the Southeast, doomed after eating waterfowl like American coots that themselves were afflicted with a disease called avian vacuolar myelinopathy (AVM).

Researchers believe the source of the disease is a neurotoxin produced by a blue-green algae that has found an ideal host, unfortunately, on hydrilla and other invasive water plants.

Susan Wilde, a Charleston-based research scientist for the S.C. Department of Natural Resources and the University of South Carolina, has been exploring the connection for several years.

“We feel like it’s a fairly serious problem in locations where it occurs,” she says. “And our concern is it could spread as invasive plants spread. That’s why we coordinate our work with others, to track the spread of the plants and AVM together and try to learn more about that connection.”

AVM is a nasty condition. Characterized by lesions in the white matter of the central nervous system, it causes birds to appear uncoordinated or intoxicated, flopping about in the water and eventually dying as they slip into paralysis.

“Those vulnerable birds, especially coots, are prime prey for bald eagles,” Dr. Wilde says. Dozens of the big raptors have been killed by AVM in recent years in South Carolina, most around reservoirs with high hydrilla populations. But not always.

“We’re studying why hydrilla in some impoundments but not others apparently has the cyano-bacteria, another name for the blue-green algae, and then the neurotoxin that sometimes but not always follows,” Wilde says.

Researchers have some pretty solid evidence that eliminating invasive plants helps. For instance, since hydrilla was nearly eliminated from Lake Murray, AVM deaths have disappeared.

“We’re not necessarily saying that’s the solution for every location, but we certainly feel that you can break the cycle by getting rid of invasive plants where the disease is prevalent,” Wilde says. 🐾



PHILLIP JONES

Researchers believe hydrilla harbors AVM, a disease that kills eagles.

with hydrilla is water hyacinth, which hails from Brazil. As South Carolina's second most problematic invasive aquatic plant, it has generated a bill of \$1.3 million to treat 16,000 affected acres since 1985. As a result, water hyacinth was specifically named alongside hydrilla in section § 50-13-1415 of the South Carolina Code, which prohibits importation, possession or placement of the plants in state waters. Federal law also specifically forbids the interstate transportation of water hyacinth.

The renegade, free-floating water hyacinth was probably introduced to state waters by homeowners discarding decorative water-garden plants near Charleston in the 1960s and 1970s. Water hyacinth plantlets can double in less than twelve days, completely cloaking entire bodies of water and staking out waterfront real estate.

These dense mats of growth choke out native species and prevent sunlight from penetrating the water, reducing oxygen levels and causing widespread decay. Virulent infestations can even cause flooding by impeding the natural water flow during heavy rains. Water hyacinth is kept in check through low-level herbicide applications early in the season, while the plants are still small.

Another free-floating freeloader is water lettuce, which is known for its cabbage-like appearance. South Carolina was spared its first outbreak in 1991, when cold winter temperatures killed the initial infestation on the Waccamaw River. Water lettuce then reappeared in a private subdivision lake in Berkeley County and migrated to the Goose Creek Reservoir. Its tendency to tag along with humans, coupled with a virulent ability to reproduce from a single plant, have made it a prolific intruder.

A somewhat unexpected invading plant is the common reed, or *Phragmites australis*. While native to North America, the dense clusters invading South Carolina originated from Europe in the 1970s. This giant grass tends to overpower native plants that provide food and habitat for waterfowl and has cost South Carolina \$1 million since 1985.

The most ferociously named freshwater invader is probably alligatorweed, but its bite comes in the form of mosquito breeding grounds. This aggressive

South American perennial spreads rapidly through fragmentation and can be found throughout South Carolina. The S.C. Public Service Authority (Santee Cooper) made initial strides toward controlling alligatorweed in the 1940s, and the U.S. Rivers and Harbors Act of 1958 established a cost-splitting precedent among the state and federal governments to control nuisance aquatic plants.

Prior to the hydrilla invasion, Brazilian elodea was South Carolina's most problematic submersed aquatic plant. Introduced to the United States more than a century ago, it has colonized the Saluda River below

Lake Murray, the Savannah River near Augusta and small ponds in the Upstate, among others. Because it spreads through fragmentation, the elodea defies most mechanical controls like cutting and harvesting.

Looking forward, the DNR is most concerned about a free-floating fern called giant salvinia. Its eight-year tenure in South Carolina began in a private

pond near Colleton County, where it was introduced from a contaminated shipment of water-garden plants from California. Thanks to a concerted effort among the DNR, the Clemson Extension Service and the USDA, giant salvinia was successfully eradicated—only to be reintroduced in the same manner in 2004 in a Jasper County plantation pond.

"I think salvinia is the big one knocking on the door, trying to get in," says de Kozlowski. "It's like a super duckweed, and its reproductive rate is bound to be a problem for us."

Giant salvinia can double its biomass every week, wrecking irrigation systems, fisheries, transportation routes, power production and municipal and industrial water intakes. Smaller lakes and streams can be completely covered over by salvinia infestations.

South Carolina's moderate climate and multitude of shallow, nutrient-rich water bodies make it particularly susceptible to freshwater plant invasions from new threats like giant salvinia. As a result, the DNR is enlisting public cooperation to minimize hitchhikers and cross-contamination among bodies of water. 🐸



MICHAEL FOSTER

Stocking grass carp is a successful hydrilla management tool.

Marine Animals:

Coming in on the Tides



SOUTHEASTERN REGIONAL TAXONOMIC CENTER (SERTC)

Asian green mussels, considered a nuisance even in their native range, were recently discovered in Charleston Harbor.

The oceans teem with fearsome wildlife like powerful sharks, jaw-dropping anglerfish and venomous stonefish.

But the sea-faring species that are most likely to disrupt daily life in South Carolina are diminutive crustaceans and mollusks.

Just two months apart in the fall of 2006, the S.C. Department of Natural Resources announced the discovery of two exotic invasive species in Charleston Harbor, despite predictions that neither the mussel nor the barnacle would be able to survive so far from tropical waters.

The first unlikely pilgrim was the Asian green mussel, which left a trail of dead shells surrounding its handiwork: clogged supply lines at a DNR Marine Resources Division facility in Charleston.

“The Asian green mussel has caused big problems along the Florida coast, and it’s in South Carolina now,” says David Knott, a DNR marine biologist. “It remains to be seen whether it will be able to acclimate to our winter temperatures.”

It’s usually comfortable in temperatures ranging from 79 to 82 degrees, but tests in Florida have shown that the Asian green mussel can function well in water as cool as 54 degrees. Even after two weeks of exposure to 50-degree water, roughly half of the

experimental population survived.

Since DNR temperature records show that Charleston-area water rarely dips below 50 degrees for more than two weeks, the Asian green mussel may prove to be more than just another Lowcountry tourist here for a visit.

Considered a nuisance by power-plant managers even in its native Indo-Pacific waters, the Asian green mussel has a reputation for growing quickly and reaching reproductive maturity at a young age. Because it can spawn at the tender age of two months, moderate mussel populations can produce a progeny of millions.

“These abilities are what make this mussel such a potential threat to coastal structures and enterprises,” says Knott.

Planting themselves on almost any hard surface, Asian green mussels can infest buoys, floating docks, piers and pilings. They also settle on intertidal oyster reefs, displacing adult oysters and killing juveniles.

The second new settler, a gigantic barnacle, arrived at the same Folly River dock where the Asian

green mussel had taken root. With the onomatopoeic scientific name *Megabalanus coccopoma*, this stubborn filter feeder dwarfs native coastal barnacles.

Equipped with a strong grip and defensive beak, the species can grow and release larvae in waters with moderate temperatures and high salinity. Giant



Spiny hands crab.

SERTC

barnacles thrive in the warm currents surrounding the area of Baja California, Ecuador and Brazil, and recent increases in water temperatures on the South Carolina coast could make it a more attractive destination for these tenacious invaders.

The giant barnacle was first spotted in Texas and Louisiana before moving to the Atlantic Coast, where tennis ball-sized broods create significant drag on boat hulls, propellers and drive shafts. It also prefers to attach to new vessels, leading to potentially devastating economic implications.

“Since it reaches a much larger size than native barnacles in South Carolina, significant settlement and growth of the giant barnacle would require greater maintenance efforts in coastal and high-salinity estuarine areas,” Knott says.

Another crustacean nuisance is a tiny isopod, a creature whose strange taxonomy is still the subject of scientific debate. Regardless of whether it hails from the eastern (*Synidotea laticauda*) or western (*S. laevidorsalis*) Pacific, the isopod’s isolated appearances in both South Carolina and New Jersey in 1999 suggest that it was probably introduced by the maritime industry. With seasonal population surges, it can reach densities of more than 30,000 (fitting, thankfully, in the space of a 2’ x 3’ tray) in as little as one week.

Two invasive crabs also have scampered onto the beach scene: the green porcelain crab and the swimming spiny hands crab. The tiny green porcelain crab encompasses a broad territory from Peru in the eastern Pacific to tropical western Africa and the Caribbean. It has gained headway in Florida since the 1970s, but its arrival on St. Catherines Island in Georgia in 1994 served as an ecological wake-up call. In less than a year, the green porcelain crab had become the dominant decapod crustacean in its preferred habitat, reigning from the island’s rocky substrates to its intertidal oyster bars.

Meanwhile, the larger spiny hands crab was probably introduced to the Caribbean Basin from the Indo-Pacific via shipping routes through the Suez Canal. The crab first reached Florida’s Indian River in 1995, but a specimen found at the Southeastern Regional Taxonomic Center (SERTC) dating from 1986 has forced scientists to rethink its pathway into the country. The most documented infestation of spiny hands crabs in South Carolina can be found in Winyah Bay, but their environmental impact remains unknown.

Scientists are also on the trail of an unwelcome relative of the Asian green mussel known as the charrua mussel. Though it has yet to be cataloged in South



Isopod.

SERTC



NATIONAL UNDERSEA RESEARCH CENTER - UNC WILMINGTON

Divers have discovered the beautiful, but dangerous, invasive red lionfish off the South Carolina coast.

Carolina waters, the infestation patterns of similar creatures may foreshadow a northward movement in the near future. The United States was spared a massive outbreak when cold winters eliminated the species from Jacksonville, Florida in 1987, but it has since returned to the Indian River Lagoon and Liberty County, Georgia.

Thanks to a voracious appetite and competition with native shellfish, the charrua mussel could leave a wake of economic damage if it migrates to South Carolina.

As for marine fish, the DNR is most concerned about a venomous scorpionfish called the red lionfish.

It was first reported in 1992 off the Florida coastline, but a juvenile population ranging from estuaries in New York, New Jersey, Rhode Island and Bermuda indicate that the red lionfish is probably spawning off the southeastern coastline, where larvae can hitch a ride on the Gulf Stream. The red lionfish is the first known non-native marine fish to become a fully established species from an aquarium release.

Invasive marine species of all sorts are continuously cataloged by the SERTC (www.dnr.sc.gov/marine/sertc), which is constructing a searchable database of native and invasive species found from Cape Hatteras to Cape Canaveral. Presently these data are being contributed to a global program that records distributional information on ocean life, but eventually the information will be directly available to scientists worldwide and also to the public. “By becoming familiar with native and non-native species, citizens can help scientists monitor infestations and slow their spread,” says Chris Page, the DNR’s Aquatic Nuisance Species Program coordinator. “We’re asking everyone to learn more about these invaders, and then become part of the solution.” 🐟

Marine Plants:

Commanding the Coastline



MARK PALAS-BASF CORP.

Made up of concerned public and private organizations and individuals, the Carolinas Beach Vitex Task Force works to control the spread of the dune-dominating shrub.



BETSY BRAHSON

Beaches bring to mind relaxation and serenity, but salty chlorophyllic invaders may be lurking along the South Carolina shoreline.

“Marine and estuarine invasive species are difficult to control,” says David Knott, a marine biologist with the S.C. Department of Natural Resources, noting that he has never heard of a successful aquatic invasive species (AIS) eradication in U.S. oceans. “Plus, South Carolina has no program to manage or control these species.”

One of the most conspicuous exotic beach-dwellers is beach vitex, a woody shrub from the Pacific Rim that inhabits dunes. It was intentionally imported to minimize erosion in the 1980s, but its tendency to spread rapidly while crowding out native plants began to raise concerns in the mid 1990s.

“The unanticipated characteristic of this fast-growing species is that it is actually less effective at stabilizing sand dunes than the native species it replaces,” says Knott.

Problems like the beach vitex infestation raise questions about introducing new biological organisms to regulate unwanted biological

organisms. It would be impossible to predict every ramification of these biological controls, but scientists minimize threats by following standard practices, conducting new research and using sterile animals like triploid grass carp whenever possible.

“We investigate problems in public waters and provide remedies based on prior experiences, research and currently accepted management techniques,” says Chris Page, program coordinator for the DNR’s Aquatic Nuisance Species Program. “We also do our own research to determine if we can improve our techniques to increase control efficacy.”

The beach vitex’s aquatic classification may be debatable, but its impact on local ecosystems is readily apparent. Sprawling up to 12 feet in diameter and four feet in height, the hearty vitex threatens endangered loggerhead turtle nesting sites.

To combat the vine, state and federal agencies, industries, non-government agencies and concerned private citizens have banded together to form the Carolinas Beach Vitex Task Force. Working together to map the infestation, limit its spread, restore affected areas and assess the overall impact, the task force is

seen as a shining example of conservation partnership.

“A number of federal and state agencies have regulatory and management responsibilities regarding AIS,” says Steve de Kozlowski, assistant deputy director for the DNR’s Land, Water and Conservation Division and chairman of the S.C. Aquatic Plant Management Council.

“We also need the support of the private sector. Good coordination among partners is essential for managing aquatic invasive species throughout the state.”

The newly formed Aquatic Invasive Species Task Force, which consists of 35 representatives from interested agencies and the private sector, is a positive step in that direction.

Individual organizations such as Charleston’s South Carolina Aquarium are also fighting unwanted marine infestations. For instance, the aquarium is helping to protect native marine life through the international Ocean Project, which provides members with consistent, research-based conservation messages, programs and activities.

“In the marine realm, educating the public to refrain from releasing aquarium fish and plants could really reduce aquatic invasive species rates,” says Knott.

“Enlisting citizens to help us monitor non-native plants would also help considerably. Early detection is critical for our rapid response containment methods.”

Knowledge will be crucial to warding off invasive marine plants, especially as a global economy and higher temperatures increase their scope and viability. A major 1999 survey conducted by Northeastern University, the MIT Sea Grant and Williams College-Mystic Seaport showed that most companies and organizations importing live marine plants are at risk of

introducing invasive species into local waters.

The choppy soup of ocean currents makes complete eradication of any unwanted species nearly impossible. Regaining control of key areas overrun by dense plant populations in large marine bodies is a more realistic goal.

“Working in a marine environment places unique social, political and technical constraints on options for pest control,” wrote Ronald E. Thresher and Armand M. Kuris in an article titled “Options for Managing Invasive Marine Species” for the journal

Biological Invasions. Their research suggests that current low-risk efforts to regulate non-native oceanic species have a low probability of success against established invaders.

“Because of the viability of these aquatic invasive species, we need to remind the public that our native populations are here for a reason, and introducing new species can cause problems,” says de Kozlowski. “First of all, it’s against the law. But it’s also a very bad idea if we want to preserve our natural heritage.”

To limit marine plant contamination, the DNR recommends removing any visible mud and plants before transporting equipment among bodies of water, eliminating water from equipment before transportation, cleaning and drying anything that comes into contact with water (including boats, trailers, clothing and even dogs), and never releasing bait or aquarium plants and

animals back into lakes or oceans.

“It’s like eating food,” says de Kozlowski. “When in doubt, throw it out. Dispose of your bait, aquarium plants and animals, or any hitchhiking plants in a dumpster, but don’t put them back into the water.”

The DNR also asks citizens to help report aquatic weed problems in public waters by contacting the Aquatic Nuisance Species Program at (803) 755-2836. 🐟



Beach vitex crowds out native plants.

MARK PALAS-BASF CORP.



PHILLIP JONES

For More Information

For more information about aquatic invasive species on the World Wide Web, visit:

- SCDNR Aquatic Nuisance Species Program: www.dnr.sc.gov/water/envaff/aquatic/index.html
- South Carolina Aquatic Invasive Species Task Force: www.dnr.sc.gov/water/envaff/aquatic/ais.htm
- Stop Aquatic Hitchhikers: www.protectyourwaters.net
- USGS Non-indigenous Aquatic Species: nas.er.usgs.gov/
- University of Florida Center for Aquatic and Invasive Plants: plants.ifas.ufl.edu/
- National Exotic Marine and Estuarine Species Information System: invasions.si.edu/nemesis/index.html
- Smithsonian Institution—Marine Invasions Research Lab: www.serc.si.edu/labs/marine_invasions/

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Cover: Invasive hydrilla forms massive mats in shallow water along Lake Murray's shorelines. Photograph by Steve de Kozlowski