

The Problem of Introduced Species

Invasive species threaten not only Louisiana's economy and environment, but also its unique cultural identity in America—one based on our bayous and backswamps, our rich history and famous cuisine, and our core industries. In recent years, aquatic plants from around the world—hydrilla, water hyacinth and salvinia—have clogged the waterways that make Louisiana a “sportsman's paradise.” Henderson Lake near Lafayette had to be drained to eliminate a mat of hydrilla so thick that marinas, swamp tour operators, and fishermen could no longer use the lake. Muskrat, once trapped for their valuable fur throughout Cajun country, have been crowded out by South American nutria. In New Orleans, Formosan termites have weakened thousands of historical structures and hollowed the city's graceful live oaks. And in the summer of 2000, masses of Australian spotted jellyfish along the Louisiana coast raised the possibility that the gulf shrimp industry may be disrupted by a species from half-a-world away.

From places like China, Brazil, and the South Pacific, these species are “introduced” to Louisiana, having evolved outside our natural ecosystems. Some introduced species (also called *exotic*, *alien*, or *nonindigenous species*) prove to be beneficial, such as sugarcane and cotton, our biggest crops. Others are benign, such as azaleas and crape myrtles, our favorite ornamentals. But other introduced species—called *invasive species*—prove to be astonishingly problematic and costly. Brought here accidentally or intentionally, through trade and transport, they have multiplied rapidly and disrupted local environments and economies. Who are these uninvited guests, how did they arrive and spread, what impact are they having on Louisiana, and how can this problem be addressed? The purpose of this map, created by the Center for Bioenvironmental Research at Tulane and Xavier Universities with support from The Coypu Foundation, is to answer these questions.

North America has already been transformed by the plants, animals and pathogens of faraway continents, at times with devastating consequences. Colonization brought not just people but new domestic animals, crops, weeds and diseases. One could argue that smallpox was the continent's first invasive species, moving into Indian communities in the interior far faster than the Europeans who first brought it. Perhaps the greatest human health crises to afflict our state, the yellow-fever epidemics of the nineteenth century that killed well over 100,000 Louisianians, was caused by an introduced virus carried by the *Aedes aegypti* mosquito brought over from Africa. Today, globalization has increased the opportunities for species to move into new environments: from 1950-1998, exports have increased from \$311 billion to \$5.4 trillion, while international travel has grown from 25 million to 635 million border crossings annually. Introduced species can tag along in packaging, ride in a ship's ballast water, travel in the baggage of returning passengers, or be shipped and sold as products. This map shows how invasive species have entered (“portals”) and moved (“pathways”) through Louisiana, and why the Bayou State is especially vulnerable to species invasions.

The phenomenal diffusion of species in new environments has many ecologists contemplating the possibility of a “global McEcosystem.” Just as franchised fast food has homogenized local cuisines, species introduction may homogenize the world's biodiversity. Invasive species are a major cause of the extinction of native species (second only to habitat loss), and the arrival of a single alien species can alter an entire ecosystem. Cogon grass, which is entering Louisiana along roadways, increases the amount of fuel in forests, so that fires burn hotter and kill native longleaf pines. Southern Louisiana is already losing 25 square miles of coastal lands each year; a crisis

exacerbated by the nutria, a large South American rodent that eats the roots and stems of marsh plants.

An early study of invasive species in the United States estimated that damage and control efforts cost \$137 billion annually. Formosan termites alone cause \$1 billion in damage nationally each year, with \$300 million spent in the New Orleans area alone. One may argue that invasive species are simply one of the costs that accompany the many benefits of a modern, industrialized society. But, as in any endeavor, costs can and must be minimized. The problem of invasive species is especially daunting in Louisiana, but is not beyond the power of Louisianians to solve it. Various solutions are underway and others are planned. With knowledge of the geography of species introduction, we can better design strategies of prevention. On another level, the problem of invasive species in Louisiana calls for recovering a particular kind of environmental knowledge: simply knowing and appreciating the native plants and animals with which we share this place. Even as we develop effective policies and technologies for preventing and slowing the spread of introduced species, we need to learn enough about our local ecosystems to recognize new species that may create problems.

Louisiana: A Hotspot for Species Introduction

Most large rivers host extraordinary communities near their mouths. Human societies tend to be more culturally diverse at these strategic positions; their economies and histories tend to be more far-reaching and tumultuous. The meeting point of vast interior hinterlands with large exterior water bodies—where *rio* joins *mar* at the brink of continents—also creates rich, productive natural ecosystems; in Louisiana, these environments include our inland wetlands and swamps as well as the estuaries where fresh and salt water mix. To scientists, urbanists, poets, and engineers, these port cities and their environs comprise arguably the most fascinating places on Earth. But communities at the mouths of great rivers are also more vulnerable to invasion by species that did not evolve under these specialized conditions. Centuries of shipping merchandise and raw materials from suppliers in one part of the world, through ports and waterways to consumers in other parts of the world, have seen the accidental relocation of thousands of species to new environs.

Louisiana, especially the porous netherlands of the southeast, forms an especially vulnerable site for species introduction. Port activity accounts for much accidental introduction, and Louisiana is home to one of the world's great ports, New Orleans, the gatekeeper of the Mississippi River and entry point to the richest valley of the richest country on Earth. It is neighbored by dozens of smaller ports, perched on nearly every waterway that penetrates the Deep South, as well as larger facilities in nearby Houston, Gulfport, and Mobile. Louisiana's mild, humid subtropical climate allows many incoming species to survive upon arrival; of these, some thrive by exploiting niches in the state's diverse ecosystems (made vulnerable by the large quantity of disturbed land) and then spreading. Railroads, canals, roads, and interstates crisscross the region, performing critical economic functions but also serving as conduits for this diffusion. Even the waters of the Mississippi carry species introduced in northern ports to Louisiana's waterways and estuaries downstream.

As a link between the American heartland and world beyond the Gulf of Mexico, Louisiana is a hotspot for invasive species. Consider these figures:

- Of the world's 100 worst invasive species identified by the *Fondation d'Entreprise*, at least 13 occur in southern Louisiana. Those species are the Asian tiger mosquito,

Formosan termite, zebra mussel, water hyacinth, feral cat, cogon grass, house mouse, nutria, rabbit, kudzu, rat, red imported fire ant, and feral pig.

- According to the US Geological Survey's database of nonindigenous aquatic species, Louisiana has more introduced aquatic plants (32) than any other state save Florida, which has 45. Louisiana has almost 2_ times the average number of introduced aquatic plants per state.
- The Nature Conservancy's "Dirty Dozen" list of most destructive invasive species in the US cites four (33%) occurring in Louisiana, a state that comprises 1.4% of the conterminous US land area. Those species are the zebra mussel, tamarisk, hydrilla, and Chinese tallow.

Louisiana bears a disproportionate share of the ecological and economic burden imparted by invasive species, in a natural and built environment that offers so many unique aspects to the nation and world.

The Geography of Species Introduction in Louisiana

How did these alien species arrive? *Pathways* are the geographical features or patterns that species follow into new areas. Pathways may include shipping lanes, interstate rights-of-way, rivers, ocean currents, or transportation corridors. *Media* are the materials and physical objects on which the species "hitch a ride," and may include ballast water, packing material, water trapped in used tires, or outboard motors. Pathways and media together are sometimes known as *vectors*. *Portal* is a term used here to describe the point of original introduction, which applies to both intentionally and accidentally introduced species. Once introduced, species may perish or persist in their new environment; those that persist may spread by (1) expansion diffusion, in which they expand contiguously into adjacent areas (for example, nutria); (2) by hierarchical diffusion, where they jump from place to place in a non-contiguous manner (for example, Formosan termites relocated by trucks hauling wood to new cities), or (3) by contagious diffusion (such as a virus, spreading from one to many). Considering only those species that have been *accidentally* introduced to our land, there are a number of common pathways of arrival and/or dispersion in Louisiana.

- **Port / Shipping Activity** A premier pathway of species introduction to the Gulf Coast is also one of the region's most important industries. Ships from distant lands have been importing cargo to our shores since 1699; today, 6000 ocean-going vessels carry over 11,000,000 tons of cargo annually through the Port of New Orleans alone. The 2,340-mile-long Mississippi River accesses 14,500 miles of connecting waterways throughout the North American interior, and provides the entire world with access to that million square mile basin once it passes through southeastern Louisiana and joins the Gulf of Mexico. Species accidentally introduced by ocean-going vessels into ports in Louisiana, Texas, Alabama, and Mississippi have subsequently spread to surrounding areas. Among them:
 - Formosan termites originated in Asia and arrived probably first in Houston in the 1940s by means of wooden pallets used to stack freight.
 - Red and black imported fire ants arrived in Mobile from South America during 1910s-1940s by way of soil and shipping dunnage (packing materials).
 - Asian tiger mosquitoes arrived in Houston during the 1980s as larvae residing in water trapped in used tires.
 - Mediterranean geckos arrived to New Orleans as "stowaways."
- **Transportation Corridors** Trucks and trains, like ships, may relocate cargo bearing invasive species. The corridors they use also have been documented as pathways; for example, there is evidence that Formosan termites may spread by infesting consecutive ties along railroad tracks.

- **Waterways** Once introduced to a particular site, the labyrinth of natural and manmade waterways intersecting Louisiana often serve as pathways themselves, allowing aquatic species to proliferate throughout an entire drainage basin. The waters of the Mississippi have brought to Louisiana the zebra mussel, introduced via ballast water dumped in the Great Lakes region, and the rainbow smelt, stocked in northern lakes. Asian clams and Australian spotted jellyfish may spread by water currents, eddies, and phenomena such as the “dead zone” in the Gulf of Mexico.
- **Equipment / Object / Water Relocation** The relocation of equipment, oil rigs, and boats along terrestrial or marine transportation corridors may disperse aquatic plants, crustaceans, and other creatures over long distances to new habitats or into new drainage basins just a few miles from prior infested areas. The transportation of lumber, firewood, and railroad ties (used for landscaping) has spread Formosan termites to new areas. Dumping of water into waterways also accounts for species introduction. On a regional scale, this phenomenon has been observed in ballast water, as previously mentioned; at the local scale, the disposal of aquarium or bait water into the ecosystem has spread hydrilla, goldfish, dotted duckweed, and Asian clams.
- **Animal Routes** Native birds and animals are unlikely to introduce species from afar because of their relatively restricted ranges, but they may assist in spreading introduced species throughout the new habitat. Birds, for example, may have helped spread giant salvinia throughout the wetlands of southern Louisiana. When infected by the introduced viruses that cause encephalitis, crows and other birds do not necessarily die immediately, creating the possibility that infected birds’ flight paths and migrations become pathways.
- **Monocultural Croplands** Vast expanses of a single agricultural or silvicultural species have served as pathways spreading pests into previously uninfested regions. Boll weevils diffused from Central America into Mexico and thence into the American South a century ago by infesting contiguous plantations across the cotton belt, causing billions of dollars in damage.
- **Ecological Niches** If an ecological niche opens up through the eradication of a native species, such as the wolf, that open niche may be viewed as a pathway if it attracts species from neighboring regions. Coyotes arrived to Louisiana from the American West in this manner. Open ecological niches may also help establish introduced species that otherwise would have perished.
- **Disturbed Ecosystems** Expansive areas of overgrazed grasslands, clear-cut forests, or other disturbed ecosystems enable invasive grasses and other plants to spread. Cogon grass spreads along stressed area paralleling interstates and other rights-of-way in southern Alabama and Mississippi, into Louisiana.
- **Pathways of the Future** In the near future, we may see new pathways of species introduction develop in Louisiana. Freshwater-diversion projects designed to reverse salt-water intrusion and to slow wetlands erosion may carry zebra mussels and rainbow smelt into the wetlands. Global climate change may expand regions of subtropical or tropical climatic conditions, allowing exotic species to survive which otherwise would have perished. Deliberate introductions may increase as immigrant communities attempt to grow traditional foods locally. Globalization of economic activity, while not a pathway *per se*, will likely increase the rate at which pathways accidentally deliver new species to our shores, expand the geographical range from which these species come, and speed their spread once they are established.

So What To Do?

Most people agree that invasive species threaten our biodiversity and cost us billions of dollars, but few agree on what we can do. The challenge posed by the continuous stream of alien species entering Louisiana through various portals and spreading via numerous pathways cannot be met through a single “silver bullet” solution. Rather, solutions are as varied as the dimensions of this problem, and they all depend on *people*.

People minimize the spread of certain invasive species in their domestic and recreational activities. This is achieved when:

- **Old wood and railroad ties are inspected carefully for Formosan termite infestation before they are transported, and treated or burned if an infestation is found.**
- **Aquatic plants are removed from hulls and outboard motors before recreational boats are launched in new water bodies.**
- **Exotic fish in aquariums and aquatic plants in ponds are carefully controlled and not released into the environment.**

People make laws more effective. Federal and state laws prohibit known invasive species to be carried in air, rail, and ship cargo. Animals or plants not specifically excluded by law may be quarantined for a period by the USDA Animal and Plant Health Inspection Service (APHIS) to assure that they are free of diseases or pests. These laws are supported when:

- **Gardeners purchase native rather than alien species from nurseries and catalogs.**
- **Pet wholesalers and retailers stock native rather than exotic species.**
- **Returning vacationers leave exotic plants and animals behind.**

People reduce the gamble of biocontrol—that is, the introduction of species to control invasive species, a sometimes-risky venture. Before introduction, scientists try to predict whether the biocontrol species will also become a pest. More wins than losses result when:

- **Farmers and gardeners use only carefully studied biocontrol species that are either native or unlikely to become invasive.**
- **Hunters and anglers allow wildlife agencies the time and resources to study the impacts of stocking new species.**

People minimize risks of introduced food species. Alien species may be introduced as seed to develop a food resource or to improve recreational hunting and fishing, but these species may eventually cost more than they benefit. Risk is reduced when:

- **Gardeners, especially in recently arrived immigrant communities, are discouraged from planting homeland species around their new homes.**
- **Hunting and angling clubs stock private recreational areas with native species.**
- **Seed species are quarantined and studied before use.**
- **Aquaculture entrepreneurs isolate their equipment and processes from the natural environment, with proper disposal and treatment of wastewater.**

People control “late blooming” invasives. Some alien species, like nutria, Chinese tallow, or salvinia, did not become invasive (harmful) until years after introduction. Late bloomers can be controlled when:

- **Hunters and trappers pursue invasive animals such as nutria and wild hogs.**

- **Home and camp owners control invasive water plants through removal or use of approved herbicides.**
- **Property owners remove invasive trees and shrubs and replant with natives.**
- **Fishermen empty bait buckets and bilges before proceeding to another location.**

People enforce controls in industry and commerce. The US Coast Guard depends upon the cooperation of global commercial shippers to prevent accidental species introduction through ballast water. However, ships moving freely between Louisiana, the Caribbean, and Latin America are not covered by this process, nor are invaders riding in a plane's wheel well, a ship's hull, or elsewhere. Gaps can be filled when:

- **Rail, air, and towboat crews clean equipment and transportation corridors that possibly harbor invasive species.**
- **Gulf and Caribbean shippers or ports initiate local ballast water management programs.**
- **Importers and exporters inspect and, if necessary, destroy cargo containers and packing materials that possibly harbor invasive species.**
- **Consumers buy domestic or local products whenever possible.**

Together, every Louisianian, government agencies at all levels, every wildlife, recreation and conservation organization, and all businesses and universities can help control invasive and potentially invasive species through these routine activities. Biodiversity *can be lost* imperceptibly, but invasive species *can be controlled* just as imperceptibly, with a little bit of effort from everyone.

For More Information

General Information

Center for Bioenvironmental Research. <http://www.cbr.tulane.edu>
Louisiana Department of Natural Resources, Office of Coastal Restoration and Management. <http://www.savelawetlands.org>
Louisiana Department of Agriculture and Forestry. <http://www.ldaf.state.la.us>
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