

Invasive Species

T E X A S



What Is an “Invasive Species”?

As legally defined, an invasive species is “An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health... ‘Alien species’ means, with respect to a particular ecosystem, any species... that is not native to that ecosystem.”¹ Alien species are also known as exotic, non-native, introduced, or non-indigenous species, and the term noxious or nuisance is sometimes used instead of “invasive” when these organisms cause harm. Although they are “natural” and because at times they can spread very slowly, over years or even decades, invasive species cause a range of problems. They can:

- threaten the survival of native plants and animals
- interfere with ecosystem functions
- hybridize with native species, resulting in negative genetic impacts
- spread easily in today’s era of global commerce
- be difficult and costly to control
- impede industries and threaten agriculture
- be a significant drain on the economy
- endanger human health

How Severe Is the Invasive Species Problem in the United States?

- Invasive species are a significant threat to nearly half of the native US species currently listed under the federal Endangered Species Act.²
- Costs of preventing, monitoring, and controlling invasive species in the United States—not to mention the costs of damage to crops, fisheries, forests, and other resources—are huge. The economic impact of invasive plants is \$13 billion per year.³ Costs or losses due to our most expensive invasive species can top \$100 million annually per species.⁴

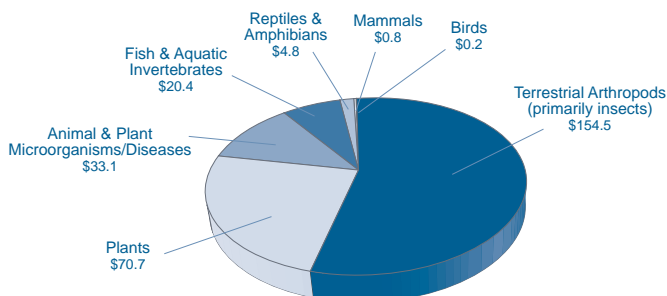
What Is an “Introduction”?

When an animal, plant, fungus, bacterium, or virus ends up in a new ecosystem, it is said that the organism has been “introduced” to that new ecosystem. Humans are responsible for introducing the vast majority of non-native species. We deliberately transport some organisms; others end up in a new ecosystem unintentionally.

Examples of deliberate introductions are plants that we import for gardens, fish that we keep as pets or put in pens for aquaculture, animals for hunting, fish we stock in lakes, and animals and insects introduced into new ecosystems to control other organisms.

Federal Funding for Categories of Invasive Species

(Fiscal Year 1999, in Millions of Dollars)



Source: General Accounting Office

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Various Ways that Unintentionally Introduced Species Arrive

On imported nursery stock or soil
(e.g., balsam wooly adelgid, chestnut blight, mealybug)

On imported fruits and vegetables
(e.g., Mediterranean fruit fly)

In untreated, discharged ballast water of ships
(e.g., zebra mussel, Chinese mitten crab)

In or on vehicles like boats, airplanes, trucks, ships, etc.
(e.g., Asian cockroach, poverty grass)

In bilge water, live wells, bait buckets, and on fishing gear
(e.g., European shore crab)

In packing material and shipping containers
(e.g., Asian long-horned beetle, wood-boring wasp)

Mixed in with seed packets or shipments
(e.g., serrated tussock, corn brome)

From people traveling for tourism, recreation, or commerce
(e.g., rust fungus)

Through canals and other humanly produced paths
(e.g., sea lamprey)

Some Means of Deliberate Introductions

Sport fishing (e.g., largemouth bass, flathead catfish)

Aquaculture (e.g., Pacific oyster, Atlantic salmon, Pacific white shrimp)

Home aquaria (e.g., Asian swamp eel, hydrilla, zebra danio)

Biological control (e.g., grass carp, rosy wolfsnail)

Research facilities (e.g., giant tiger shrimp)

Seeds/Gardens/Landscaping (e.g., purple loosestrife, kudzu)

Erosion control (e.g., tamarisk [also known as saltcedar])

Fur/silk production (e.g., nutria, European gypsy moth)

Examples of unintentional introductions are insects that cling to or burrow into wooden packing material used to protect imported goods, or insects and their eggs “hitchhiking” on imported plants, in soil, or on fresh produce. We accidentally take in huge numbers of small and microscopic organisms in ships’ ballast water, and we transport them to new ports of call.

When Introduction Becomes Harmful

The vast majority of species transported to a place other than their native ecosystem—whether intentionally or accidentally—do not survive. Of those that do survive, scien-

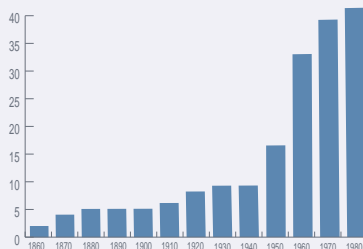
tists estimate that approximately 15% go on to become very harmful.⁵ Plants and animals may “escape” from confined areas. Sometimes an introduced plant or animal finding itself in this situation will be aggressive or voracious, or will carry parasites or disease, any of which can devastate an ecosystem. People may dump no-longer-wanted fish or aquarium plants into a nearby pond or river, or discard yard waste or garden clippings in a nearby park. The species that become invasive do succeed, in part, because the new ecosystems in which they find themselves offer favorable environmental conditions and lack the natural predators, competitors, and diseases that would normally keep their populations in check.

How Do We Transport Invasive Species Between Ecosystems?

Invasive species have moved around the globe in many ways, depending on their taxonomic group, geographic

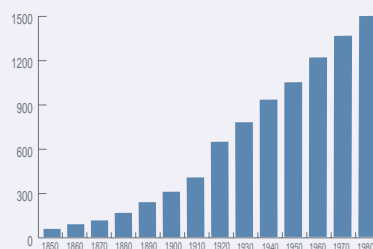
Cumulative Numbers of Non-Native Species

US Fish



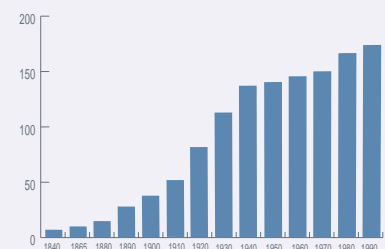
Source: J. L. Ruesink, W. Courtenay, Jr., and others.

North American Insects



Source: J. L. Ruesink, R.I. Sailer, and others.

US Plant Diseases



Source: C.L. Schouties

region, and other factors. With increased global commerce and human exploration, rates of introduction and numbers of invasive species continue to rise. Transport in ships' ballast water and ballast sediments is the leading means of unintentionally moving a broad range of aquatic species throughout the world⁶ and from state to state.

What's Happening in Texas - A Problem on the Upswing

How Many Invasive Species Are There in Texas?

Various agencies have jurisdiction over different types of invasive species. Consequently, there has never been a comprehensive statewide tally and the total number of invasive species is still unknown. There are at minimum the following number of invasive species: 67 terrestrial plants, 12 aquatic/wetland plants, 10 mammals, 4 birds, 7 fishes, 11 insects, and 11 mollusks and crustaceans.¹

Indicators of the Scope of the Problem:

- The Texas Parks and Wildlife Department restricts the importation and possession of approximately 600 species of fishes, shellfishes, and aquatic plants, many of which are already problematic in the state.²
- The US Department of Agriculture's Agricultural Research Service lists 45 "noxious weeds" present in Texas.³
- The Gulf of Mexico Regional Panel of the federal Aquatic Nuisance Species Task Force lists 31 aquatic invasive species that constitute current and potential future management priorities in Texas.⁴

Invasion Trends over Time

Invasive species are capable of spreading rapidly under the right conditions. Because existing invasions are difficult to eradicate and the number of new introduced species continues to grow, the number, size, and impacts of invasions are likely growing as well.

- Since 1970, woodlands containing monocultures of the highly invasive Chinese tallow have increased in area from 5 to 30,000 acres in Galveston County.⁶
- Hydrilla was first discovered spreading in Florida canals in 1960. Today it is found in nearly 100 bodies of water and covers 75,000-100,000 acres in Texas.⁷
- In the 1920s, the red imported fire ant arrived in Alabama from South America. Since then the invader has infested over 56 million acres in Texas.⁸
- Africanized "killer bees" first arrived in Texas in October of 1990. Since then the invader has spread across the southeastern United States and the eastern two-thirds of Texas. By July 10, 2002, Texas had 143 counties with Africanized honeybee quarantines in effect.⁹
- Giant salvinia, currently the top aquatic invasive plant management priority of the Texas Parks and Wildlife Department, is capable of doubling its population in as little as two to eight days under the right conditions.¹⁰

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Giant salvinia can form mats more than two feet thick on water surfaces.

Invasive species as a percentage of total state species in four major categories ⁵

Category	Total Approximate Number of Species in State	Approximate Number of Suspected Invasive Species	Approximate Percent Invasive Species
Vascular Plants	4834	80	1.7%
Mammals	160	10	6.3%
Freshwater Fishes	247	7	2.8%
Birds	620	4	0.6%

An Ounce of Prevention

Some invasive species not yet established in Texas

Snakehead fish (Family Channidae)

A number of snakehead fish are aggressive predators able to wriggle across moist land for short distances. One species was recently found in a Maryland pond. In 2001, Texas Parks and Wildlife law enforcement personnel raided several Houston-area stores found selling snakeheads. Unfortunately, many snakeheads had already been sold to the public even though their possession is illegal in the state. If any were ever released in Texas waters, they would pose a serious ecological threat...

Brown tree snake (*Boiga irregularis*)

Best known for its devastating impacts on Guam's biodiversity—having wiped out 12 species of birds, for example, some found nowhere else—the brown tree snake has twice been found on ships that arrived in the Corpus Christi area. Luckily, these snakes were discovered, but there is no guarantee that others may not have already arrived or that future snakes will always be detected upon arrival...

Asian lake mussel (*Limnoperna fortunei*)

This mussel is similar to the dreaded zebra mussel that is wreaking havoc in the Great Lakes and beyond. Unlike the zebra mussel, which has limited tolerance to Texas' warm waters, the Asian lake mussel thrives in such conditions. It has recently invaded Argentina and is only a boat ride away from Texas...



G.H. Rodda for the US Geological Survey

The brown tree snake—which has decimated 12 species of birds on Guam—has twice been detected on ships arriving in Corpus Christi.

species that are intentionally introduced, for example, can be screened for invasiveness before being permitted to enter. For inadvertent introductions (like those in ballast water), addressing the general route, or pathway, of introductions is more feasible.

In today's era of international trade, travel, and communication, many foreign organisms from around the globe commonly end up in Texas. The growing number of imports and inadvertent introductions increases the likelihood that Texas' invasive species problems will escalate. A number of routes of entry are known:

Shipping: When foreign ships empty their ballast water in the Gulf of Mexico, they are potentially introducing thousands of alien organisms into the marine ecosystem. The total estimated volume of ballast water exchanged at the Port of Houston was 3.7 million metric tons in 1996. The Port of Houston is the leading national port in foreign waterborne commerce. In total tonnage, it is ranked second in the country and eighth in the world.¹

Agriculture: Texas has 36.8 million acres of prime farmland, the most found in any state.² The vast majority of non-native plants used in Texas agriculture are harmless. Unfortunately, some have escaped cultivation and have become a major problem. For example, Chinese tallow, a small tree, was once planted by the US Department of Agriculture in the Gulf States to encourage the development

How Do We Bring Invasive Species to Texas?

Preventing or slowing the entry of invasive species depends on knowing the route by which they reach the state. Single

of a soap industry. It “escaped” from cultivation and is today overrunning much of the southeastern United States.³

Ranching and Seeding: Some of Texas’ invasive species were introduced as forage for cattle. Others were seeded along highways to stabilize soils. Traditionally, researchers promoted non-native species because they are generally cheaper and easier to establish—and, on rangeland— increase forage production. Grasses like buffelgrass, Kleingrass, and Lehman’s lovegrass now dominate thousands of acres in Texas.⁴

Horticulture and Aquaculture: The horticulture and aquaculture industries have been well-documented introduction pathways for invasions around the world. The Texas floral and nursery crop industry is the third largest in the nation and the state’s fastest growing segment of agriculture.⁵ Unfortunately, nurseries still sell invasives like Chinese tallow trees as ornamentals, despite their known

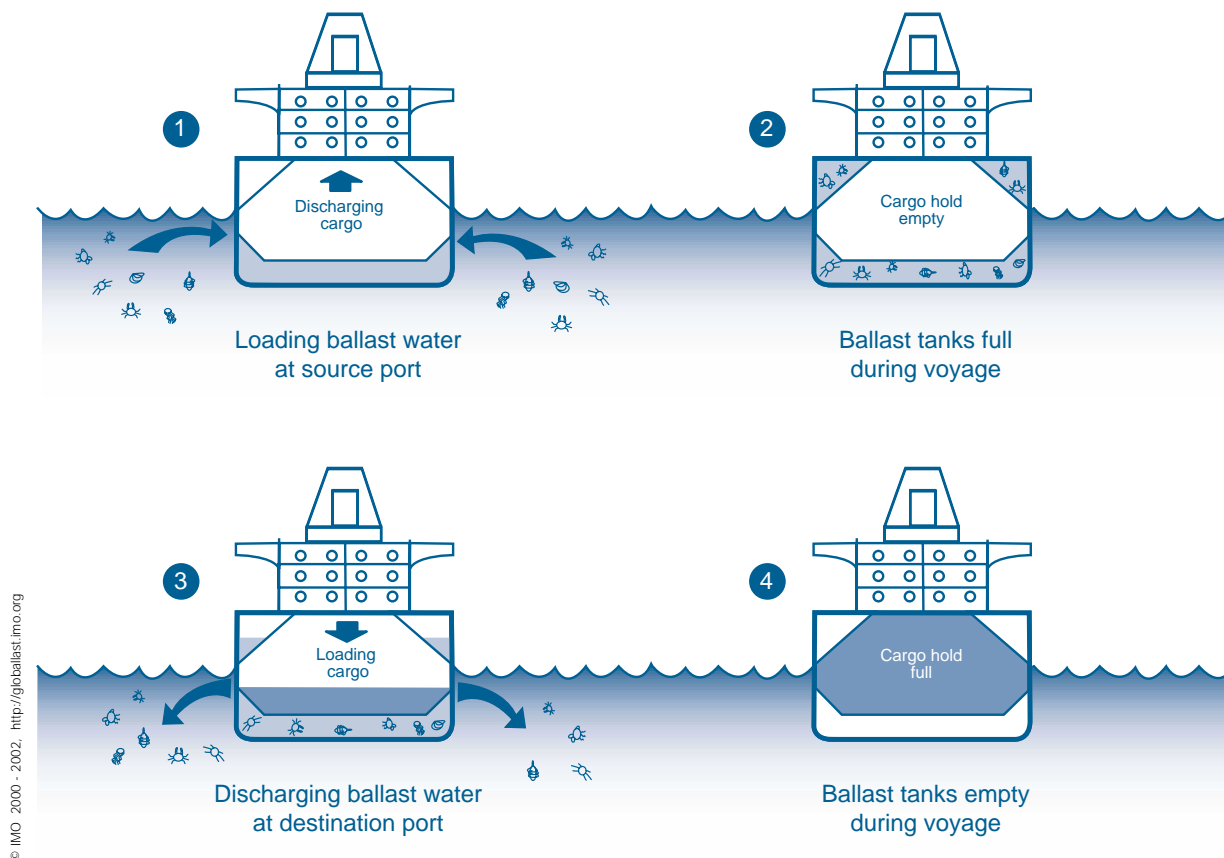
Biological control—introducing an organism to keep another organism’s population in check—can be risky. Grass carp—introduced in Texas to control aquatic vegetation—has become invasive.



US Geological Survey

devastating effects.⁶ Two major invasives in rangelands, lantana and castor bean, are escaped ornamentals and are toxic to livestock.⁷ Blue tilapia, non-native fish found in many Texas reservoirs, most likely came from fish farms and perhaps bait buckets.⁸

Aquarium and Pet Trades: The aquarium and pet trades are also responsible for the introduction of some plants, reptiles, birds, and other pests. People have been



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The number one way that we unintentionally move thousands of aquatic species is by transport in ships’ ballast water and ballast sediments.

known to release no-longer-wanted pets into the wild, where they can sometimes establish breeding populations. Aquarium owners who are cleaning a tank or can no longer keep their fish sometimes dump plants or plant fragments, as well as fish, into nearby waters, unwittingly affecting ecosystems.

Recreation: Recreational boating spreads aquatic invasives within a body of water and from one body of water to another. Pieces of aquatic vegetation and organisms caught in boat propeller blades or between boat and trailer can multiply once transported. Invasive mussels and other small organisms travel in boat live wells, bilges, and bait buckets. State and federal agencies' stocking of fish in lakes has also resulted in many documented invasions. For example, stocking common carp proved to be destructive to some Texas native freshwater ecosystems.⁹ Some animals introduced into Texas for game hunting have escaped and established populations. Feed for pack horses can contain seeds of invasive plants.

Biological Control: Some exotic organisms were deliberately released by public agencies and organizations to manage nuisance populations: the Western mosquitofish to control mosquitoes, grass carp to control aquatic vegetation, giant rams-horn snails to control other unwanted snails, and bighead and silver carps to control large volumes of phytoplankton and zooplankton.¹⁰ Floating waterhyacinth was introduced into canals of Cameron County to remove contaminants from the water.¹¹



The bluebonnet—a native lupine that the Texas legislature declared the official state flower in 1901—is being crowded out in some areas by invasive plants.

Natural Phenomena: In Texas, where extreme weather events are common, some biological invaders that already have been introduced to the state can expand their distribution through these natural phenomena. Red imported fire ants disperse naturally by floating to new locations on floodwater.¹² Scientists are still waiting to see if the invasive channeled applesnail, a potentially serious pest in Texas rice fields, was distributed by floodwater from Tropical Storm Allison in June 2001.¹³

Once in Texas, what factors determine if a new species becomes invasive?

Once a species is moved to a new ecosystem, it must find a suitable niche in order to become invasive. Texas offers plentiful and varied aquatic and terrestrial habitats. Additionally, certain factors—urban sprawl, already-stressed ecosystems, and the overuse of chemicals—increase an invasive species' chance to succeed. All three of these factors are present in varying degrees throughout the state.

How Much Do Invasives Cost Texans?

In addition to jeopardizing native populations, human health, and the functioning of ecosystems, invasive species cause serious economic damage. In Texas, the costs of invasive species to the economy are significant.

Between 1906 and 1991, 79 invasive species caused documented losses of \$97 billion across the United States. These 79 species represented only 12% of the total number of documented harmful invasives.¹ It is difficult to estimate the total costs of invasive species to Texas but indicators like those below illustrate that it is high.

Missing from these figures, though, are the intangible and incalculable losses to biodiversity, ecosystem services, and aesthetics caused by biological invasions. What is the value of a field of native bluebonnets, the Texas state flower? If bluebonnets were to become extinct as a result of invasive species, it would be impossible to assign a dollar amount to the loss. In fact, there are several invasive species

currently impacting native wildflower populations, including the Texas bluebonnet.

FACT: Texas' economy is heavily dependent on industries that are highly affected by invasive species.

Agriculture

In 2001, the value of Texas' crop production was \$3.35 billion.² Texas farmers invest a considerable amount of time and money preventing infestations by weeds and pests. Agricultural invasives, both plant and animal, also cost farmers by diminishing crop quality and limiting their choices of crop rotation cycles and other management practices. The channeled applesnail, a recent arrival in Texas, decimated rice farms in the Philippines soon after its introduction. The applesnail has been found in the middle of the Texas rice belt, a region that generates over one billion dollars annually.³ Additional losses sometimes result when agricultural pollinators hybridize with invasive ones. For example, the honeybee population of Texas is responsible for an estimated \$480 million worth of crop pollination. If the current population hybridizes with Africanized honeybees, farmers will be less able to manage valuable pollination activities.⁴

Ranching

In 2001, the total value of Texas livestock (cattle, sheep, goats, and pigs) was \$8.59 billion.⁵ Spiny and poisonous invasive plants can spell disaster for pastures and rangelands. They inflict physical injuries on grazing animals and restrict their access to forage and water. Certain animal invasives, such as red imported fire ants, Africanized honeybees, and feral dogs, attack young livestock, resulting in severe losses to the ranching industry. It costs Texas ranchers \$10 to \$15 per acre per year to control fire ant populations in their pastureland.⁶

Fishing

In 2000, commercial fishing landings in Texas were valued at \$293 million dollars.⁷ Recreational fishing along the



Red imported fire ants, an invasive species in Texas and much of the southeastern United States, can attack young livestock, resulting in severe losses to the ranching industry.

Walter Ebeling from the book Urban Entomology

state's 1,400 miles of coastline and in its many inland lakes and waterways is also a significant source of economic activity. In 1996, sport fishers spent \$2.87 billion in Texas, creating a total impact of \$6.37 billion for the state's economy. Sport fishing supports thousands of jobs and generates economic activity by encouraging related spending on food, lodging, transportation, guides, boat use, and equipment rental.⁸ Disruption of the fishing industry by invasive species could be devastating to the many Texas communities that rely on healthy aquatic ecosystems for their livelihoods. For instance, invasive blue tilapia can reach densities of 2,000 pounds per acre in some Texas reservoirs and can suppress reproduction in sportfishes like largemouth bass and channel catfish.⁹

Mariculture

Texas leads the country in production acreage of shrimp, with five times more than the second ranked state. In 1998, an exotic shrimp virus known as "White Spot Syndrome" was discovered in a native shrimp. It had been previously discovered in 1995 at an exotic shrimp farm and in 1997 at a research facility. Individuals involved in the Texas shrimp industry are worried about the potential costs if White Spot spreads. The industry accounts for \$600 million of economic activity per year and provides jobs for 15,000 Texans.¹⁰

Tourism

Coastal tourism is the state's second-largest industry.¹¹ Invasive species can have a direct impact on the recreational

value of certain tourist destinations. In lakes and bodies of water clogged with invasive aquatic vegetation, people are not able to fish, boat, or swim.

Real Estate

Invasive species have the power to lower property values. One common culprit in this scenario is hydrilla, which forms dense mats along lakeside shorelines. Others are the giant salvinia and saltcedar. Owners of lakeside and riverside properties can see their properties' values dramatically decrease once an intransigent hydrilla, giant salvinia, or saltcedar invasion has set in.

What's At Stake? - The Special Landscapes, Habitats, and Species of Texas

Texas Biodiversity

Texas is a vast state that overlaps several major ecological regions—the Great Plains, Southwestern deserts, the humid Gulf Coast, and Mexican subtropics. Texas is the second-most biologically diverse state in the United States and is ranked third in the number of endemic, or unique, species, with 340 species found nowhere else in the world. More than 10% of the state's 6,273 species are considered "rare or at risk of extinction."¹ Ninety-six Texas species are federally listed as threatened or endangered.²

Invasive species play a large role in the loss of biodiversity. In the United States, they are now considered to be the sec-



Prairie ecosystems in Texas—like this one of native Texas wildflowers—are under threat by invasive grasses.

Lady Bird Johnson Wildflower Center

ond greatest threat to species listed under the Endangered Species Act, preceded only by loss of habitat.³ The same is likely true in Texas, where invasive species compete with native flora and fauna for valuable resources and ever-shrinking habitat. Since it is hard to translate these impacts into dollar amounts, they are usually estimated by impacts on individual species or ecosystems.

FACT: Invasive species threaten unique habitats.

- Wetlands are extraordinary habitats that host vast numbers of organisms. In Texas' wetlands, invasive plants such as giant salvinia and waterhyacinth crowd out native plants and animals and interfere with natural processes such as water flow and nutrient cycling.
- Big Bend National Park boasts one of the most biologically diverse habitats in Texas and the United States. It is situated at the relatively rare convergence of mountains, river, and desert. Unfortunately, several invasive species—saltcedar, giant river cane, feral pigs, nutria, and aoudad (also known as Barbary sheep)—are some of the worst culprits in the destruction of Big Bend's unique ecosystems.⁴
- In the ecologically unique headwaters of the San Marcos and Comal Rivers, the giant rams-horn snail has been introduced and is damaging aquatic vegetation, including an endangered wild rice that only grows here.⁵

FACT: Invasive species can damage ecosystems and interfere with the services they provide humans.

- Rivers are a vital source of water for farmers and others in dry regions of Texas. Invasive river-side and aquatic plants like saltcedar, hydrilla, giant reed, and waterhyacinth reduce the flow of rivers. Watersheds in West Texas and the Rio Grande Valley are already experiencing dramatically reduced flows. Some plants also greatly diminish the quality of water. Saltcedar, for example, oozes salt, which fosters the growth of algae that can ultimately kill fish.

- Several woody shrubs, including two species of juniper, have invaded the prairies and savannas of central, northern, southern, and western regions of Texas, significantly affecting fire risk and water quality.⁶
- Feral pigs—found throughout Texas but especially in the south and east—root up the earth, causing erosion and damage to native vegetation and private property; displace native wildlife; and can carry disease.⁷

FACT: Invasive species can cause the extinction of native plants and animals.

- It is believed that a population of rainbow trout introduced and established in a stream in the Guadalupe Mountains drove native Rio Grande cutthroat trout to extinction.⁸
- In Big Bend National Park the rare Big Bend mosquitofish is threatened by the introduction of invasive species. Nutria, a large rodent, and another species of mosquitofish have on occasion invaded the few springs that comprise the Big Bend mosquitofish's native habitat. Since the Big Bend mosquitofish has one of the smallest known geographic ranges of any vertebrate species, if left unmanaged, the invasives have the potential to wipe it out.⁹



National Park Service

The Big Bend mosquitofish (above) has a very limited native habitat consisting of a few springs. Nutria—large rodents originally introduced for their fur—have invaded those springs, threatening this fish's very existence.

- Invasive fire ants have not been officially culpable for any extinctions, but they are known to attack several threatened species.¹⁰ They are probably responsible for serious declines in some native wildlife populations,

such as deer fawns, quail, ground-nesting waterfowl chicks, and reptiles.



Bastiaan M. Drees

Cows grazing among red imported fire ant mounds.

Some invasive species that affect native species and ecosystems also endanger human health.

- Red imported fire ants occasionally cause human deaths, usually those of small children who crawl into mounds and receive multiple ant stings. Red imported fire ants have also been problematic to humans during the harvesting of certain crops like pecans.
- Popularly known as “killer bees” because of their aggressive nature, Africanized honeybees will attack humans if sufficiently provoked. The invading bees look like traditional Texas honeybees, but they are more likely to sense danger, are easier to upset, and defend their homes in greater numbers.¹¹
- The channeled applesnail, a recent arrival in the state, has been known to carry a rat lungworm that can also infect humans. However, the disease-causing parasite has not yet been found in Texas' channeled applesnail populations.¹²
- West Nile virus is often transmitted to humans through the Asian tiger mosquito. In the United States, the Asian tiger mosquito was first found in Texas.¹³ As of September 7, 67 Texas residents had contracted West Nile virus so far in 2002 and one died as a result of it.¹⁴

The Worst of the Worst

Saltcedar (*Tamarix spp.*)

Saltcedar is an evergreen shrub that invades desert stream-side communities, including those along the Pecos and Colorado rivers in West Texas. Called saltcedar because it oozes salt from its leaves, the plant changes soil salinity, reduces the flow of adjacent water bodies, and displaces other valuable plant communities. Over the past five decades, once-perennial small rivers and streams in west Texas have experienced significant reductions in flow because of the dense brush monoculture characteristic of a saltcedar invasion. Recent technologies have aided in managing biological invasions in Texas. The NASA-sponsored Texas Synergy Project is using remote-sensing and global information systems to identify and monitor saltcedar invasions in western Texas. The project identified 12,500 acres of likely saltcedar stands. The Texas Department of Agriculture is using the information to prioritize eradication efforts.¹



Hydrilla (*Hydrilla verticillata*)

Hydrilla is one of the state's worst aquatic invaders, covering 75,000-100,000 surface acres of water and found in nearly 100 of Texas' reservoirs.² It is rapidly spreading in these invaded ecosystems; in one Texas lake it covered 23 acres in 1999, but over 200 acres in 2000.³ Biological impacts are severe. Hydrilla depletes water of oxygen and blocks sunlight, causing serious harm to native plant and animal populations. Additionally, many human uses of lakes and reservoirs are adversely affected by hydrilla, including recreation, drinking water treatment, angling, and hydropower generation.



Giant Salvinia (*Salvinia molesta*)

Giant salvinia, a free-floating aquatic fern native to South Africa, is currently the top aquatic invasive plant management priority for the Texas Parks and Wildlife Department. Its range in the state has expanded from one small pond in 1998 to ten public water bodies in 2002, including Texas' largest reservoir, Toledo Bend. Giant salvinia can double its population size in two to eight days if conditions are favorable. It forms dense mats on the surface of water—sometimes more than two feet thick—that block sunlight and oxygen exchange, threatening the survival of many aquatic organisms. In addition to destroying ecosystems, giant salvinia impedes the use of impacted bodies of water and serves as a breeding ground for mosquitoes.⁴ The salvinia weevil, a biological control agent for giant salvinia, has been successfully used in 13 countries and is currently being used in the fight against Texas' populations of the invasive.⁵



Close runners-up for “Worst of the Worst” plant species are waterhyacinth and giant reed.

Red Imported Fire Ant (*Solenopsis invicta*)

Red imported fire ants infest two-thirds of eastern Texas counties.⁶ They damage agricultural crops, displace native ants, eliminate food sources for some wildlife, and kill newborn livestock and ground-dwelling wildlife. They are a nuisance to humans. Small children have occasionally died from multiple invasive ant stings. Red imported fire ant damage in the Dallas-Fort Worth metropolitan area alone totaled \$525.88 million in 1998.⁷ Currently, many types of biological control methods are being studied, including repopulating native fire ants where they have been depleted.



Nutria (*Myocaster coypus*)

Nutria are large beaver-like rodents that were introduced in the United States for the fur trade. Nutria live in freshwater or brackish environments. Their habit of burrowing and digging large underground tunnels increases cave-ins and erosion in some locations, which can disrupt catfish farming, destroy rice and sugar fields, and contribute to flooding. Nutria populations jeopardize native wetland ecosystems by feeding on marsh grasses, which in turn affects wading birds, mollusks, fish, crustaceans, and other organisms. After discovering that nutria were impacting endangered Big Bend mosquitofish, the national park installed a nutria fence around the few freshwater springs in which the mosquitofish live, which so far has proven successful.⁸ These rodents carry many diseases, parasites, and nematodes that can harm humans.



Channeled Applesnail (*Pomacea canaliculata*)

The channeled applesnail, first found in Galveston and Brazoria counties in July 2000, represents a significant threat to Texas' rice industry. The Philippines, a country that once exported rice to the world, must now import most of the crop as a result of a channeled applesnail invasion. Probably introduced through the aquarium trade, the channeled applesnail was added to the Texas Parks and Wildlife Department's list of prohibited species in April 2001. Unfortunately, snails can be difficult to identify, and restricted species, such as the channeled applesnail, often slip under the radar of aquarists, snail collectors, and officials. This snail has also been known to host a rat lungworm that can infect humans, but no one has yet found the parasite in Texas' channeled applesnails.⁹



Finding Solutions: Who Deals With Invasive Species in Texas?

Texas has no single authority that addresses invasive species policy.

Most government agencies only have jurisdiction over those invasive species relevant to their functions (e.g., the Texas Department of Agriculture manages agricultural weeds). Some invasives, especially those that overrun natural areas, often are overlooked altogether. At times agencies can find themselves at cross-purposes. For example, if a federally listed endangered bird nests in an invasive shrub, the agency charged with protecting the bird and the agency responsible for controlling the invasive shrub may disagree on appropriate management strategies. Weaving the various management priorities into a comprehensive statewide invasive species policy would prove invaluable to the health of the state's ecosystems and economy.

State Authorities

The Texas Parks and Wildlife Department (TPWD) and Texas Department of Agriculture (TDA) are the primary state agencies working with invasive species. TPWD is responsible for restricting importation and possession of potentially harmful fish, shellfish, and aquatic plants. This Department also regulates certain aspects of exotic game, performs research related to invasive species, and ensures that exotic fish and shellfish in aquaculture facilities are free of disease. TDA regulates the movement of agricultural seed and plant material and enforces quarantine regulations to control the spread of the worst agricultural invaders. TDA formed an Invasive Riparian Plants and Texas Water Task Force in 2002.

State Legislation

Texas statutes cover some aspects of the invasive species problem. According to Parks and Wildlife Code §57.111, "It is an offense to release into public waters, import, sell, purchase, transport, propagate, or possess any species, hybrid of a species, subspecies, eggs, seeds, or any part of any species defined as harmful or potentially harmful exotic fish, shellfish, or aquatic plant" except with the permission of TPWD.¹ The 76th Texas Legislature addressed the growing problem of aquatic invasive species in state waterways. It mandated that TPWD develop a statewide aquatic vegetation management plan and obligated individuals or organizations performing aquatic vegetation treatment to file a proposal with TPWD. State laws regulating the movement of terrestrial invasive plants and animals fall under the Agriculture Code, which also outlines acceptable control methods for some of the most problematic invaders.

However, for terrestrial invasive species that do not impact agriculture, ranching, or hunting, there are no apparent restrictions. State legislation does not cover terrestrial invasives that are damaging state natural areas unless they happen to also affect an industry. In a more general sense, Texas has some legal language that could apply to the problem of invasive species. According to the state constitution, the preservation and conservation of natural resources is a public right and duty.² This could serve as a building block for future policies that target invasive species in natural areas.



Generally, Texas law is most complete in giving state agencies general authority to manage invasive species. It fails to authorize or address other key measures, such as emergency powers to deal with outbreaks, use of biological control agents, and post-release monitoring of introduced species.³

Federal Authorities

Several federal agencies address the issue of invasive species in Texas. The US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) works to prevent the introduction and establishment of foreign weeds on private lands. The US Department of Agriculture's Agricultural Research Service investigates agricultural weeds and maintains a list of those weeds thought to be most problematic in the state. Other federal agencies, including the US Forest Service, US Fish and Wildlife Service, National Park Service, US Geological Survey, the National Aeronautics and Space Administration, and the Environmental Protection Agency, are also actively involved in invasive species research or management in Texas.

Other Key Players

In addition to state and federal agencies, a number of academic institutions, regional/international organizations, not-for-profit groups, municipal governments, and watershed authorities are involved in the fight against Texas' invasive species.

Public awareness of the problem in Texas is low. This is probably because the issue is relatively young and because biological invasions are less dramatic forms of environmen-

tal destruction than, say, oil spills. But, organizations are making headway. The Texas Fire Ant Project sponsors an annual Fire Ant Awareness Week and hosts a website with large amounts of information for public consumption. The Texas Department of Agriculture is currently assembling a saltcedar slide show it will take to towns across western Texas that depend on the upper Colorado River, towns where the invasive plant threatens the future sustainability of their water sources.⁴

Examples of Organizations Involved with Invasive Species

Academic Collaborations:

Texas Fire Ant Project

Regional / International:

(Federal) Aquatic Nuisance Species Task Force:

Gulf of Mexico & Western Regional Panels
US Environmental Protection Agency's Gulf of Mexico Program

Gulf States Marine Fisheries Commission
Río Grande/Río Bravo Basin Coalition

Not-for-profit:

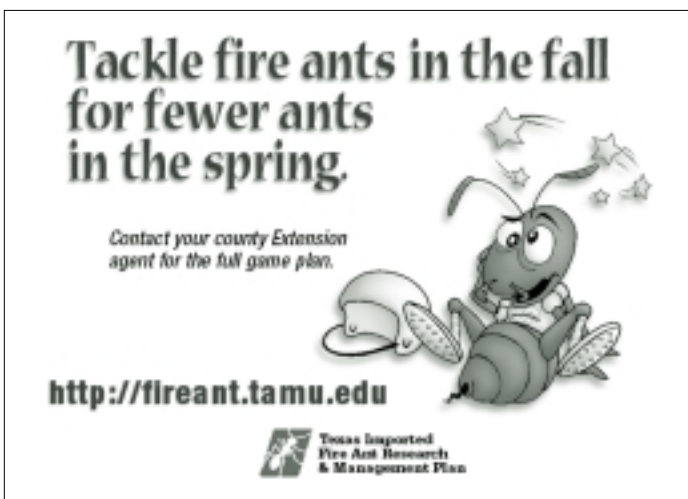
Lady Bird Johnson Wildflower Center
Native Plant Project
The Nature Conservancy
South Texas Native Plant Restoration Project
Texas Aquatic Plant Management Society
Texas Riparian Association
Texas Society for Ecological Restoration

Interagency Collaboration:

Texas Invasive Riparian Plants and Water Task Force
Texas Noxious Weed Working Group

Watershed Authorities:

Galveston Bay Estuary Program
Lower Colorado River Authority
Coastal Bend Estuary Program



Invasive Species in Texas*

* This is a partial list of species considered to be invasive in Texas. The emphasis is on species affecting native plants and ecosystems rather than those with impacts almost exclusively on human health, like the Human Immuno-deficiency Virus (HIV). Some of these species are so long-established that they are an accepted part of the environment. A few are the subject of considerable controversy. So while this list offers one snapshot of Texas's natural resources, it does not provide a blueprint for which species could or should be controlled.

MAMMALS (10)		Source	TERRESTRIAL PLANTS (67)		Source
aoudad, Barbary sheep	<i>Ammotragus lervia</i>	4	jointed goatgrass	<i>Aegilops cylindrica</i>	3,12
feral dog	<i>Canis familiaris</i>	4	corncockle	<i>Agrostemma githago</i>	3
axis deer	<i>Cervus axis</i>	4	tree-of-heaven	<i>Ailanthus altissima</i>	2
sika deer	<i>Cervus nippon</i>	4	camelthorn	<i>Alhagi camelorum</i>	10,12,13
feral cat	<i>Felis catus</i>	4	garlic mustard	<i>Alliaria petiolata</i>	2
house mouse	<i>Mus musculus</i>	4	feral oat	<i>Avena fatua</i>	3
nutria	<i>Myocastor coypus</i>	1,4	King Ranch bluestem	<i>Bothriochola ischaemum</i>	11
Norway rat	<i>Rattus norvegicus</i>	4	var. <i>songarica</i>		
black rat	<i>Rattus rattus</i>	4	hairy chess	<i>Bromus commutatus</i>	3
feral pig	<i>Sus scrofa</i>	4	cheat	<i>Bromus secalinus</i>	3
			downy brome	<i>Bromus tectorum</i>	2
BIRDS (4)		Source	balloonvine	<i>Cardiospermum halicacabum</i>	3,12
rock dove, pigeon	<i>Columba livia</i>	4	musk thistle	<i>Carduus nutans</i>	2,12
monk parakeet	<i>Myiopsitta monachus</i>	4	Buffelgrass	<i>Cenchrus ciliaris</i>	11
common sparrow	<i>Passer domesticus</i>	4	spotted knapweed	<i>Centaurea maculosa</i>	2
European starling	<i>Sturnus vulgaris</i>	4	Russian knapweed	<i>Centaurea repens</i>	3
			yellow star thistle	<i>Centaurea solstitialis</i>	2
INSECTS (11)		Source	Canada thistle	<i>Cirsium arvense</i>	3
red imported fire ant	<i>Solenopsis invicta</i>	4,8,9	blessed thistle	<i>Cnicus benedictus</i>	3
Asian tiger mosquito	<i>Aedes albopictus</i>	4,5,8	field bindweed	<i>Convolvulus arvensis</i>	3,12
Africanized honeybee	<i>Apis mellifera scutellata</i>	4,8,9	bermudagrass	<i>Cynodon dactylon</i>	3,11
formosan subterranean termite	<i>Coptotermes formosanus</i>	4,8	purple nutsedge	<i>Cyperus rotundus</i>	3,12
Mexican fruit fly	<i>Anastrepha ludens</i>	4	scotch broom	<i>Cytisus scoparius</i>	2
cabbage white butterfly, cabbage worm	<i>Pieris rapae</i>	4	wild carrot	<i>Daucus carota</i>	3
pink bollworm	<i>Pectinophora gossypiella</i>	4	Russian olive	<i>Elaeagnus angustifolia</i>	2
boll weevil	<i>Anthonomus grandis grandis</i>	5,8,9	quackgrass	<i>Elytrigia repens</i>	3
Asian ambrosia beetle	<i>Xylosandrus crassiusculus</i>	8	leafy spurge	<i>Euphorbia esula</i>	2
German cockroach	<i>Blattella germanica</i>	8	hogweed	<i>Heracleum mantegazzianum</i>	2
Russian wheat aphid	<i>Diuraphis noxia</i>	9	ivy leaf morningglory	<i>Ipomoea hederacea</i>	3,12
			tall morningglory	<i>Ipomoea purpurea</i>	3,12
MOLLUSKS AND CRUSTACEANS (11)		Source	lantana	<i>Lantana camara</i>	4
Asian trampoline	<i>Bradybaena similaris</i>	4	leucaena	<i>Leucaena leucocephala</i>	4
Asian clam	<i>Corbicula fluminea</i>	1,6	Japanese ligustrum, Japanese privet	<i>Ligustrum japonicum</i>	2
brown garden snail	<i>Cryptomphalus aspersus</i> (formerly <i>Helix aspersa</i>)	4	Chinese privet	<i>Ligustrum sinense</i>	12
			Persian dandelion	<i>Lolium persicum</i>	3
chocolate-band snail	<i>Eobania vermiculata</i>	4	poison ryegrass	<i>Lolium temulentum</i>	3
giant rams-horn snail	<i>Marisa cornuarietis</i>	6	Japanese honeysuckle	<i>Lonicera japonica</i>	2,4
red-rim melania	<i>Melanoides tuberculatus</i>	6	motojo-bobo, childa, alien weed	<i>Lycianthes asarifolia</i>	2
milk snail	<i>Otala lactea</i>	4	common horehound	<i>Marrubium vulgare</i>	4,12
brown mussel	<i>Perna perna</i>	1	Chinaberry	<i>Melia azedarach</i>	4
channeled apple snail	<i>Pomacea canaliculata</i>	1,6	serrated tussock	<i>Nassella trichotoma</i>	3
decollate snail	<i>Rumina decollata</i>	4	branched broomrape	<i>Orobanche ramosa</i>	2
quilted melania	<i>Tarebia granifera</i>	6	red rice	<i>Oryza sativa</i>	3
			Guineagrass	<i>Panicum maximum</i>	11
FISHES (7)		Source	African rue	<i>Peganum harmala</i>	10,12,13
grass carp	<i>Ctenopharyngodon idella</i>	1,6	buckthorn plantain	<i>Plantago lanceolata</i>	12
common carp	<i>Cyprinus carpio</i>	6	broadleaf plantain	<i>Plantago major</i>	3,12
suckermouth catfish	<i>Hypostomus spp.</i>	6	annual bluegrass	<i>Poa annua</i>	3
redbreast sunfish	<i>Lepomis auritus</i>	6	Japanese knotweed	<i>Polygonum cuspidatum</i>	2
smallmouth bass	<i>Micropterus dolomieu</i>	6	mile-a-minute weed	<i>Polygonum perfoliatum</i>	2
blue tilapia	<i>Oreochromis aureus</i>	1,6	kudzu	<i>Pueraria lobata</i>	1,12
snow pleco, sailfin catfish	<i>Pterygoplichthys anisitsi</i>	6	annual bastardcabbage	<i>Rapistrum rugosum</i>	3,11
			castorbean	<i>Ricinus communis</i>	3
AQUATIC / WETLAND PLANTS (12)		Source	Macartney rose	<i>Rosa bracteata</i>	2,11
alligatorweed	<i>Alternanthera philoxeroides</i>	1,2,12	multiflora rose	<i>Rosa multiflora</i>	2
giant reed, giant cane	<i>Arundo donax</i>	4,11,12	itchgrass	<i>Rottboellia cochinchinensis</i>	3
elephant ear	<i>Colocasia esculenta</i>	4	curly dock	<i>Rumex crispus</i>	3,12
waterhyacinth	<i>Eichhornia crassipes</i>	1,2,12	Russian thistle	<i>Salsola kali</i>	4,12
hydrilla	<i>Hydrilla verticillata</i>	1,2,11	Chinese tallow tree	<i>Sapium sebiferum</i>	1,2,4,11
water spinach	<i>Ipomoea aquatica</i>	7	giant foxtail	<i>Setaria faberi</i>	3
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>	2	blessed milkthistle	<i>Silybum marianum</i>	3
torpedograss	<i>Panicum repens</i>	7	silverleaf nightshade	<i>Solanum elaeagnifolium</i>	3,12
common salvinia	<i>Salvinia minima</i>	1	tropical soda apple	<i>Solanum viarum</i>	3
giant salvinia	<i>Salvinia molesta</i>	1,2	Carolina horsenettle	<i>Solanum carolinense</i>	3
giant duckweed	<i>Spirodela oligorhiza</i>	7	Johnsongrass	<i>Sorghum halepense</i>	3
water chestnut	<i>Trapa natans</i>	2	saltcedar	<i>Tamarix spp.</i>	2,11,12
			puncturevine	<i>Tribulus terrestris</i>	3,12
			common cocklebur	<i>Xanthium strumarium</i>	3,12

OTHER (5)

		Source
ich (fish parasite)	Ichthyophthirius multifiliis	4
oak wilt	Ceratocystis fagacearum	4
Taura Syndrome Virus (TSV)		1
West Nile Virus (WNV)		4
White Spot Syndrome Virus (WSSV)		1

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