



The Economic Impact of Invasive Species

on

Provisional Services

Ecosystem Services

Cultural Services

Non-native invasive species (NIS) can have serious economic, ecological, health and social effects. Breaking down these effects into specific categories can provide a way to estimate the economic impact of these invasive species. There are 3 **main areas** where invasive species cause economic losses. It is important to remember that these costs include the personnel that manage the habitats that are invaded, materials needed for management of the native and non-native species, and the decrease in habitat use due to the invasives making a habitat less useful or attractive for public enjoyment.



**Non-native invasive species
have economic effects on**

Provisional Services

Ecosystem Services

Human Health and Social

Services

Provisional services include

- Food and Raw Materials
- Water Storage and Supply
- Non-Food Materials

Provisional services include products from ecosystems such as food, fiber, fuel, fresh water and medicine.

➤ Food and raw materials from agriculture, aquaculture, recreation and industry are affected.

European green crabs* out-compete native species for food and habitat and eat huge quantities of native shellfish causing >\$23 million in losses in commercial shellfish industries. It impacts eastern coastal areas from Maine to Virginia and western coastal areas from British Columbia to Baja, California, and is found globally.

European Green Crab



www.cbc.ca

* = found in CT

Asian Citrus Psyllid



USDA, Agricultural Research
Service Photo Library

www.nybg.org

Asian citrus psyllid, a tiny (1/16 inch) winged insect, transmits a disease that is fatal for all types of citrus crops, and some non-citrus plants. The insect is a vector of citrus greening disease that causes misshapen, bitter fruit and ultimately kills the tree. Honeydew excreted by psyllids coats the outside of fruits and leaves, and promotes the growth of sooty mold fungus that inhibits photosynthesis, weakens the plant, and makes fruit unattractive. Estimates are \$3.63 billion in lost revenues and 6,611 jobs for the Florida citrus industry since 2006.

Boll Weevil



ipm.ncsu.edu

The adult **Boll weevil** (1/4 inch) eats all the buds off the cotton plant, and destroys any cotton that the plants manage to produce by eating and laying eggs in the cotton, reducing crop production. While it was eradicated by 2003 in some cotton producing states, it continues to cause \$300 million in damage annually, mostly in Texas and the mid-South

Water Hyacinth



conservationmagazine.org

Water hyacinth* mats reduce sunlight for submerged plants and aquatic organisms, affect water quality reducing recreational fishing and swimming. It grows rapidly and can spread easily over vast expanses of water. It has been known to double its population within two weeks and infest large areas, reducing revenue for local communities.

➤ Water storage and supplies used for human consumption, irrigation, and industry are affected.

Purple loosestrife* invades wetlands, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs and drainage ditches and reduces important buffers against flooding events. It also affects farmlands by clogging irrigation ditches; this overgrowth causes the degradation and loss of pasture land. Indirect economic losses are associated with decreased hunting opportunities for waterfowl. It is found in 48 US states (not FL or HI) and in parts of all the Canadian provinces

Purple Loosestrife



Japanese Knotweed



www.cumberland.com

Japanese knotweed* quickly shades out or crowds out native plants, has a root system that affects stream flow, water storage and flood protection and provides very little protection from erosion on stream banks. It is found in Newfoundland and many parts of the northeastern U.S. ,west to California and the Pacific Northwest. Due to its highly invasive behavior, it has **direct economic impact** on property owners and the real estate industry through increased costs of site preparation, equipment cleaning, and inspection of materials, reduced property values and can decrease demand for properties.

Zebra Mussels



invasivespeciesin pennsylvania.wikispaces.com

Zebra mussels* clog irrigation intakes and other pipes, and contribute to the explosive growth of harmful algal blooms. Many power plants have had to spend millions of dollars cleaning out zebra mussels from the cooling systems of their facilities. Estimated (2014) cost to Canadian nuclear power facilities per year was \$75-\$91 million.

➤ Non-food materials
that provide medicine
are affected.

Loss of diversity due to invasive, disease-causing organisms harms populations of native species. This reduces the availability of those plants that may prove useful in medicine.

Madagascar Periwinkle



www.kew.org

The invasive fungus *Phytophthora nicotianae*, affects the **Madagascar periwinkle**, a plant that provides an extract called vincristine that has increased the survival rate in childhood leukemia. This ornamental plant is sold in CT nurseries as an annual.

The invasive fungus *Phytophthora ramorum* causes shoot dieback in the **Pacific yew**, (*Taxus brevifolia*) which produces a compound used to treat breast cancer.

P. ramorum is also the causative agent for Sudden Oak Death. Because the yew is found in oak tree habitats, the fungus is transferred to yews that are in the understory.

Pacific Yew



www.agritech.tnau.ac.in

Ecosystem Services affected by invasive species include

- **Pollination**
- **Water Purification**
- **Climate Regulation**
- **Coastal Protection**
- **Pest and Disease Control**

➤ Pollination and Crop Production

Oriental Bittersweet vine



www.srs.fs.usda.gov

Invasive, non-native plants such as the **Oriental bittersweet*** don't provide food for caterpillars of native butterflies, which are pollinators. Crop pollination is affected. In addition, Oriental bittersweet infestations can have costly economic impacts on homeowners when the vines become heavy and break tree branches and trunks, especially in combination with heavy snow. In some areas, broken trees caused by the weight of the vines have fallen on houses and caused significant property damage.

Honeybees infected with **varroa mites**



news.nationalgeographic.com

Infection of honey bees by **varroa mites*** eventually kills the bees. This reduces the number of pollinators, which reduces crop production. The mites feed on both brood and adults by puncturing the body and sucking the body fluids of the bee. Many crops are dependent on honeybees as pollinators, including citrus fruits, apples, alfalfa, watermelons, grapes, and nut trees. Each year commercial honeybee pollination adds over \$14 billion in crop value.

➤ Water Purification



Golden Apple Snails in a rice paddy

pbt.padil.gov.au

Golden apple snails alter food webs that affect rice production, cause plant death and decrease water quality. They may be a vector for disease and parasites such as the lungworm. World-wide, annual agricultural economic losses from golden apple snails have been stated as ranging from US \$55 to \$248 billion per year, depending on the rice-producing country.

Impact of **Zebra Mussels** on water quality



nas.er.usgs.gov

Pollution due to the decay of dead **Zebra mussels** in pipes and intake valves adds to the cost of water purification in treatment plants and may be responsible for adding offensive odors and taste to drinking water. They also interfere with piers, boat engines and boats in freshwater areas.

➤ Coastal Protection

Japanese Sedge



www.nps.gov

Seaside Rose



Leslie J. Mehrhoff

Invasive plants such as **Japanese Sedge** and **Beach Rose*** (*Rosa rugosa*) are examples of plants that degrade protective dunes when they

- replace native grasses along shoreline
- destroy the balance of native plants whose structures hold coastal dunes in place and provide storm protection
- increase erosion during storm surges that can lead to destruction of shoreline structures

➤ Pest and Disease Control



White Nose Syndrome*

wdfw.wa.gov

In temperate regions, **bats** are primary consumers of insects. A recent economic analysis (March 2015) on agricultural crop production indicated that insect suppression services (ecosystem services) provided by bats to U.S. agriculture is valued between \$4 to \$50 billion per year. Significant loss of bat populations has a direct economic effect on agricultural services.

Lantana

livinglands.co.za



Lantana (*Lantana camara*), a shrub that has invaded East Africa from Central America, provides a new habitat for the tsetse fly, spreading sleeping sickness. This causes economic loss due to absence from work and costs of medical treatment for infected individuals. The plant is considered an invasive in the US south, but tsetse flies are not present there.

The Asian Tiger Mosquito can transmit WNV



aces.nmsu.edu

West Nile Virus belongs to the *Flaviviridae* family. The virus is transmitted by multiple species of **mosquitoes**,* including the *Culex* genus found in CT. The disease is transmitted when a mosquito is infected by biting a bird that carries the virus. It originated in Africa and was first identified in the US in 1999. Since its arrival in the US, the CDC reports (2012) that hospitalized cases of WNV disease have cost a cumulative \$778 million in health care expenditures and lost productivity. It is found in 48 states (except Alaska and Hawaii).

- Ecosystems are impacted when introduced species alter the frequency, intensity and severity of fires.

Cheatgrass



wiki.bugwood.org

UGA5270025

Cheatgrass* is a good example of an ecosystem change agent because in arid areas it establishes as a monoculture and its life cycle encourages fires that kill other plants. The plant sprouts in early spring, then seeds into bare soil and dies off before other plants fully mature. It produces debris that encourages and promotes increased fire frequency. Economic impacts include fire suppression efforts, lost forage and grazing, lost infrastructure such as fences and other physical structures, and reseeding efforts. In 2002, wildfire suppression cost \$1.4 billion in the United States, according to the U.S. Forest Service

Buffelgrass behaves in ways similar to cheatgrass by spreading easily germinating seeds that grow quickly and promote hot fires. It has invaded and become established in disturbed and intact desert scrub environments in Australia, Hawaii and the southwestern US. Native to Africa, Asia, and arid and semi-arid Europe, the US Soil Conservation Service brought it to American southwest in early 1940s for erosion control.

Table 1. Examples of the economic effects of invasive species.

Industry/Area Affected	Invasive Species	Cost
Agriculture (U.S. cotton industry)	Boll weevil	\$50 billion dollars (total cost since 1890s)
Western U.S. rangelands	Leafy spurge	\$110 million in 1990
Canadian agriculture	Weeds	\$2.2 billion annually
U.S. agriculture	Weeds	\$30.6 billion in control costs and production losses
Western U.S. forests	Asian gypsy moth	\$20 million eradication campaign
U.S. waterways	hydrilla and water hyacinth	\$100 million annually
Aquaculture industry in Washington	Non-native <i>Spartina</i>	\$26 million since 1996
U.S. Infrastructure	Zebra mussels	\$1.12 billion in control costs and damages
Eastern U.S. forests	Gypsy moths	\$764 million in 1981
Canadian rangeland and wetlands	Purple loosestrife	\$20 million in 2008
Canadian rangeland and agriculture	Cheatgrass	\$10 million in 2008

http://www.aquaticnuisance.org/wordpress/wp-content/uploads/2010/06/economicimpacts_pnwer_2012.pdf

Cultural Services affected by
invasive species include
recreation, ecotourism,
aesthetic values and cultural
heritage.



clarklakespirit.com



www.union.edu

Recreation and tourism activities in terrestrial as well as marine and freshwater ecosystems are affected by invasive species. Habitats that support golfing, recreational fishing, sailing, swimming, and sunbathing and SCUBA diving become less useful and enjoyable, affecting local economies.

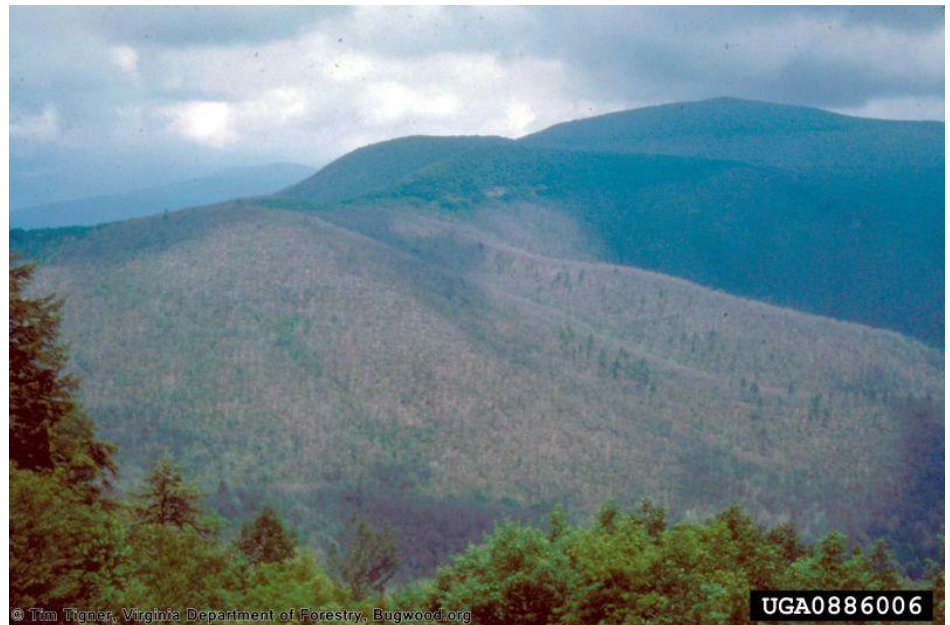


Feral pig damage in native wet forests on the Island of Hawai'i.

www.ctahr.hawaii.edu

Gypsy moth* defoliation of hardwood species

forestry.sfasu.edu



Tourism to tropical forests in Hawaii is affected by damage from bands of wild pigs that overgraze in the rain forest and destroy native trees and plants; they also increase erosion due to their rooting behavior. The low elevation rain forests are being lost at a dramatic rate, and over the past 30 years about 50% or greater were degraded by feral infestations, mostly pigs (Hawaii Ecosystems At Risk, 2003).

Sensory and emotional responses are affected when

- coral habitats (Australia: Crown of thorns Starfish (*Acanthaster Planci*),
- natural coastal areas (US Pacific coast: Japanese mahogany clam)
- and forest areas (Redwood forests: Sudden Oak Death from *Phytophthora ramorum*)

are degraded or destroyed by NIS, leading to decreases in tourism, and loss of income for local and regional communities.

Respect for natural processes and habitats is lost when these are degraded due to habitat loss.

Global Estimates of Economic Costs

Estimated economic losses due to invasive species across the globe

Country	Estimated losses
Globally	€1 trillion/year
US	€90 billion/year
EU	€12 billion/year
China	€11 billion/year
New Zealand	€2 billion/year
UK	€2 billion/year

Data source: European Commission (2013)

2016 ENVIROTHON STUDY GUIDE : SECTION 3.0

Current US dollar to Euro value = \$1 = 0.91€

Addendum:

Slide 10:

Japanese knotweed becomes a problem when it shades out or crowds out native plants. At water's edge, its aggressive aboveground growth slows stream flow and reduces water storage in the water channel. This results in an increased flood hazard. Although it is deep-rooted, the plant has horizontal roots that are easily broken, especially by ice moving with spring floods. Consequently, the abundant plant growth on the edge of the channel offers little protection from erosion on stream banks.

Slide 21:

There is a chain reaction that happens on the sand dune as a result of a loss of native dune-stabilizing plants. **Japanese sedge** and ***Rosa rugosa*** are examples of plants that were once introduced to act as dune stabilizers. However, dunes dominated by Japanese sedge are more vulnerable to wind blowouts and storm erosion. Beach Rose (*R. rugosa*) shades out native grasses and other herbaceous plants whose roots stabilize and hold the sand in place. This makes the dunes more vulnerable to erosion during storm surges. In addition, since both of these plants outcompete stabilizing native plants, they are not only harmful to the dunes themselves but also to the ability of the dunes to provide protection to the coastal land behind the dunes.