

100 OF THE WORLD'S WORST INVASIVE ALIEN SPECIES

A SELECTION FROM THE GLOBAL
INVASIVE SPECIES DATABASE



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Cover image: Brown tree snake (*Boiga irregularis*).

Photo: Gordon Rodda

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Biological Invasion

What happens when a species is introduced into an ecosystem where it doesn't occur naturally? Are ecosystems flexible and able to cope with change, or can a new arrival have far-reaching repercussions and do permanent damage? Will something special be lost forever? Does it matter?

In the distant past, the earth's mountains and oceans represented formidable natural barriers to all but the hardiest of species. Ecosystems evolved in relative isolation. Early human migration saw the first intentional introductions of alien species as our ancestors attempted to satisfy physical and social needs, but the magnitude and frequency of those early introductions were minor compared to those associated with today's extensive global trade and passenger movements.

History is rich with tales of the disastrous outcomes of some intentional introductions such as that of the Nile perch, which resulted in the extinction of more than 200 other fish species. We can avoid repeating such mistakes by learning from history. Yet surprisingly, potentially damaging introductions continue. The ongoing release of the mosquito fish that feature in this brochure, is a good example. Another is the questionable behaviour of some participants in the international garden seed and pet trade.

Careless behaviour leads to unintentional introductions. So-called 'accidents' now account for the majority of successful invasions.

The list of "100 of the World's Worst Invasive Alien Species" in this booklet illustrates the incredible variety of species that have the ability, not just to travel in ingenious ways, but also to establish, thrive and dominate in new places. Today, alien invasion is second only to habitat loss as a cause of species endangerment and extinction.

The genes, species and ecosystems that make up the earth's biological diversity are important because their loss and degradation diminishes nature. Species other than our own have a right to exist and to retain their place in the world. We do not know how to estimate which species are essential to ecosystem functioning, which are redundant, and which will be the next to flourish as the world changes. When we introduce a new species into an ecosystem, the full impact is often not immediately apparent. Invasion by species such as *Miconia calvescens* can change entire habitats, making them unsuitable for the original native community.

Safeguarding the earth's diversity is the best way to maintain our life support system. There is evidence to suggest that the biosphere acts as a self-regulating whole and that diverse systems may be more resilient. Island ecosystems, which have evolved in isolation often have relatively fewer plants, herbivores, carnivores and decomposers to maintain essential processes and are more vulnerable to invasion. On islands around the world species extinction is increasing at an un-

precedented rate. A number of the invasive alien species featured in this booklet are contributing to these losses.

Useful initiatives, which contribute to better management practices and a reduced incidence of biological invasion, are being taken by communities all over the world. Invasive alien species are now a major focus of international conservation concern and the subject of cooperative international efforts, such as the Global Invasive Species Programme (GISP). As awareness grows, people and their communities are able to make informed choices that will have lasting effects on their descendants.

The list of "100 of the World's Worst Invasive Alien Species" that is presented here is designed to enhance awareness of the fascinating complexity, and also the terrible consequences, of invasive alien species. Species were selected for the list according to two criteria: their serious impact on biological diversity and/or human activities, and their illustration of important issues surrounding biological invasion. To ensure the inclusion of a wide variety of examples, only one species from each genus was selected. There are many other invasive alien species, in addition to those on this list of examples. Absence from the list does not imply that a species poses a lesser threat. We hope that, by raising general awareness, the risks of further harmful invasions will be reduced in future.

Crazy Ant (*Anoplolepis gracilipes*)

Photo: H. T. Imai and M. Kubota



Crazy ants (so called because of their frenetic movements) have invaded native ecosystems and caused environmental damage from Hawai'i to the Seychelles and Zanzibar. On Christmas Island in the Indian Ocean, they have formed multi-queen supercolonies in at least eight areas of rainforest, foraging in all habitats, including the rainforest canopy. They are also decimating the red land crab (*Gecarcoidea natalis*) populations. In 18 months the crazy ants were able to kill 3 million crabs. The land crabs play an important role in Christmas Island's forest ecosystem

helping in litter breakdown and influencing forest composition by eating leaves and seedlings of rainforest trees. Crazy ants also prey on, or interfere in, the reproduction of a variety of arthropods, reptiles, birds and mammals on the forest floor and canopy. Their ability to farm and protect sap-sucking scale insects, which damage the forest canopy on Christmas Island, is one of their more surprising attributes. Although less than 5% of the rainforest on Christmas Island has been invaded so far, scientists are concerned that endangered birds such as the Abbott's booby (*Sula abbotti*), which nests nowhere else in the world, could eventually be driven to extinction through habitat alteration and direct attack by the ants.

Brown Tree Snake (*Boiga irregularis*)

A native of Australia, Indonesia, Papua New Guinea, and the Solomon Islands, the brown tree snake is thought to have hitchhiked to Guam on military aircraft in the late 1940s or early 1950s. The lack of natural predators and ample prey allowed the snake population to explode. By the 1970s it was found island-wide and had done

extensive economic and ecological damage. It has caused major power outages across the island and sometimes bites people, but is most infamous for its near complete extermination of Guam's native forest birds. The brown tree snake is a serious threat to the biological diversity of other tropical islands. It is able to conceal itself in cargo on boats and aircraft and even in airplane wheel-wells and has reached destinations as far afield as Micronesia, Hawai'i, mainland United States and Spain. Areas most at risk are wet tropical locations that receive large volumes of human and commercial traffic.



Photo: Gordon Rodda

Caulerpa Seaweed (*Caulerpa taxifolia*)

Caulerpa was introduced to the Mediterranean around 1984, possibly as waste from the Monaco Aquarium. There is speculation that the species released into the Mediterranean was a hardier clone of the original tropical seaweed. It adapted well to colder waters and has spread throughout the northern Mediterranean where it is a serious threat to the native marine flora and fauna. New colonies are able to start from small segments of this plant and, being an opportunistic hitchhiker, it is a threat to the whole of the Mediterranean. Wherever it has established itself, it has smothered habitats such as the beds of native sea grass that serve as nurseries for many species. On 12th June 2000, divers in a lagoon near San Diego in the United States discovered a patch of Caulerpa measuring 20 metres by 10 metres. In this case too, it is thought that the infestation occurred after somebody emptied a fish tank into a storm-water drain. Luckily this invasion was discovered at an early stage and measures were taken to eradicate it.



Photo: Alexandre Meinesz

Caulerpa infestation

Avian Malaria (*Plasmodium relictum*)

Avian malaria was introduced to Hawai'i in exotic birds kept by settlers, but it needed a vector to spread. This was made possible following the introduction of the southern house mosquito (*Culex quinquefasciatus*) in the water barrels of a sailing ship in 1826. Hawaii's unique native birds succumbed quickly because, unlike non-native birds, they have no resistance to avian malaria. Unique birds such as the colourful honeycreepers, which evolved into a diverse array of species and subspecies to fill different niches, are threatened by this disease and by habitat loss. Avian malaria, through its mosquito vector has contributed to the extinction of at least 10 native bird species in Hawai'i and threatens many more.



Photo: Jack Jeffrey Photography

Honeycreeper with malaria carrying mosquitos

100 OF THE WORLD'S WORST INVASIVE ALIEN SPECIES

MICRO-ORGANISM

avian malaria (*Plasmodium relictum*)
 banana bunchy top virus (*Banana bunchy top virus*)
 rinderpest virus (*Rinderpest virus*)

MACRO-FUNGI

chestnut blight (*Cryphonectria parasitica*)
 crayfish plague (*Aphanomyces astaci*)
 Dutch elm disease (*Ophiostoma ulmi*)
 frog chytrid fungus (*Batrachochytrium dendrobatidis*)
 phytophthora root rot (*Phytophthora cinnamomi*)

AQUATIC PLANT

caulerpa seaweed (*Caulerpa taxifolia*)
 common cord-grass (*Spartina anglica*)
 wakame seaweed (*Undaria pinnatifida*)
 water hyacinth (*Eichhornia crassipes*)

LAND PLANT

African tulip tree (*Spathodea campanulata*)
 black wattle (*Acacia mearnsii*)
 Brazilian pepper tree (*Schinus terebinthifolius*)
 cogon grass (*Imperata cylindrica*)
 cluster pine (*Pinus pinaster*)
 erect pricklypear (*Opuntia stricta*)
 fire tree (*Myrica faya*)
 giant reed (*Arundo donax*)
 gorse (*Ulex europaeus*)
 hiptage (*Hiptage benghalensis*)
 Japanese knotweed (*Fallopia japonica*)
 Kahili ginger (*Hedychium gardnerianum*)
 Koster's curse (*Clidemia hirta*)
 kudzu (*Pueraria montana var. lobata*)
 lantana (*Lantana camara*)
 leafy spurge (*Euphorbia esula*)
 leucaena (*Leucaena leucocephala*)
 melaleuca (*Melaleuca quinquenervia*)
 mesquite (*Prosopis glandulosa*)
 miconia (*Miconia calvescens*)
 mile-a-minute weed (*Mikania micrantha*)
 mimosa (*Mimosa pigra*)
 privet (*Ligustrum robustum*)
 pumpkin (*Cecropia peltata*)
 purple loosestrife (*Lythrum salicaria*)
 quinine tree (*Cinchona pubescens*)
 shoebutton ardisia (*Ardisia elliptica*)

LAND PLANT (CONTINUED)

Siam weed (*Chromolaena odorata*)
 strawberry guava (*Psidium cattleianum*)
 tamarisk (*Tamarix ramosissima*)
 wedelia (*Sphagneticola trilobata*)
 yellow Himalayan raspberry (*Rubus ellipticus*)

AQUATIC INVERTEBRATE

Chinese mitten crab (*Eriocheir sinensis*)
 comb jelly (*Mnemiopsis leidyi*)
 fish hook flea (*Cercopagis pengoi*)
 golden apple snail (*Pomacea canaliculata*)
 green crab (*Carcinus maenas*)
 marine clam (*Potamocorbula amurensis*)
 Mediterranean mussel (*Mytilus galloprovincialis*)
 Northern Pacific seastar (*Asterias amurensis*)
 zebra mussel (*Dreissena polymorpha*)

LAND INVERTEBRATE

Argentine ant (*Linepithema humile*)
 Asian longhorned beetle (*Anoplophora glabripennis*)
 Asian tiger mosquito (*Aedes albopictus*)
 big-headed ant (*Pheidole megacephala*)
 common malaria mosquito (*Anopheles quadrimaculatus*)
 common wasp (*Vespula vulgaris*)
 crazy ant (*Anoplolepis gracilipes*)
 cypress aphid (*Cinara cupressi*)
 flatworm (*Platydemus manokwari*)
 Formosan subterranean termite (*Coptotermes formosanus shiraki*)
 giant African snail (*Achatina fulica*)
 gypsy moth (*Lymantria dispar*)
 khapra beetle (*Trogoderma granarium*)
 little fire ant (*Wasmannia auropunctata*)
 red imported fire ant (*Solenopsis invicta*)
 rosy wolf snail (*Euglandina rosea*)
 sweet potato whitefly (*Bemisia tabaci*)

AMPHIBIAN

bullfrog (*Rana catesbeiana*)
 cane toad (*Bufo marinus*)
 Caribbean tree frog (*Eleutherodactylus coqui*)

FISH

brown trout (*Salmo trutta*)
 carp (*Cyprinus carpio*)
 large-mouth bass (*Micropterus salmoides*)

FISH (CONTINUED)

Mozambique tilapia (*Oreochromis mossambicus*)
 Nile perch (*Lates niloticus*)
 rainbow trout (*Oncorhynchus mykiss*)
 walking catfish (*Clarias batrachus*)
 Western mosquito fish (*Gambusia affinis*)

BIRD

Indian myna bird (*Acridotheres tristis*)
 red-vented bulbul (*Pycnonotus cafer*)
 starling (*Sturnus vulgaris*)

REPTILE

brown tree snake (*Boiga irregularis*)
 red-eared slider (*Trachemys scripta*)

MAMMAL

brush-tail possum (*Trichosurus vulpecula*)
 domestic cat (*Felis catus*)
 goat (*Capra hircus*)
 grey squirrel (*Sciurus carolinensis*)
 macaque monkey (*Macaca fascicularis*)
 mouse (*Mus musculus*)
 nutria (*Myocastor coypus*)
 pig (*Sus scrofa*)
 rabbit (*Oryctolagus cuniculus*)
 red deer (*Cervus elaphus*)
 red fox (*Vulpes vulpes*)
 ship rat (*Rattus rattus*)
 small Indian mongoose (*Herpestes javanicus*)
 stoat (*Mustela erminea*)

Species were selected for the list using two criteria: their serious impact on biological diversity and/or human activities, and their illustration of important issues of biological invasion. To ensure a wide variety of examples, only one species from each genus was selected. **Absence from the list does not imply that a species poses a lesser threat.**

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For further information on these and other invasive alien species consult The *Global Invasive Species Database*:

www.issg.org/database

Photo: Jim Mitchell



Feral Pig (*Sus scrofa*)

Feral pigs are escaped or released domestic animals. Introduced to many parts of the world, they damage crops, stock and property and transmit many diseases such as Leptospirosis and foot and mouth disease. Rooting pigs dig up large areas of native vegetation and spread weeds, disrupting ecological processes such as succession and species composition. They are omnivorous and their diet can include juvenile land tortoises, sea turtles, sea birds and endemic reptiles. Management of this invasive species is complicated by the fact that complete eradication is often not acceptable to communities that value feral pigs for hunting and food.

Strawberry Guava (*Psidium cattleianum*)

Photo: Wendy Strahm



The strawberry guava is native to Brazil, but has been naturalised in Florida, Hawai'i, tropical Polynesia, Norfolk Island and Mauritius for its edible fruit. It forms thickets and shades out native vegetation in tropical forests and woodlands. It has had a devastating effect on native habitats in Mauritius and is considered the worst plant pest in Hawai'i, where it has invaded a variety of natural

areas. It benefits from feral pigs (*Sus scrofa*) which, by feeding on its fruit, serve as a dispersal agent for its seeds. In turn, the guava provides favourable conditions for feral pigs, facilitating further habitat degradation.

Miconia (*Miconia calvescens*)

A highly ornamental tree from South America, Miconia was introduced to a botanical garden on the island of Tahiti in 1937. Its huge red and purple leaves made it highly desirable for gardeners. It was spread into the wild by fruit-eating birds and today, more than half the island is heavily invaded by this plant. It has a superficial and tentacular rooting system that contributes to landslides and has become the dominant canopy tree over large areas of Tahiti, shading out the entire forest under-story. Scientists estimate that several of the island's endemic species are threatened with extinction as a result of habitat loss due to Miconia. It has been introduced to other Pacific islands, including Hawai'i where it was introduced as an ornamental in the 1960s. The plant has since been found in many locations on the Hawai'ian islands. It is still sold as an ornamental plant in the tropics.



Photo: The Nature Conservancy

Miconia on a mountainside in Tahiti

Western Mosquitofish (*Gambusia affinis*)

The mosquito fish is a small, harmless-looking fish native to the fresh waters of the eastern and southern United States. It has become a pest in many waterways around the world following initial introductions early last century as a biological control of mosquito. In general, it is considered to be no more effective than native predators of mosquitoes. The highly predatory mosquito fish eats the eggs of economically desirable fish and preys on and endangers rare indigenous fish and invertebrate species. Mosquito fish are difficult to eliminate once established, so the best way to reduce their effects is to control their further spread. One of the main avenues of spread is continued, intentional release by mosquito-control agencies.

Mosquitofish; male and female pair



Photo: Bob McDowall

Small Indian Mongoose (*Herpestes javanicus (auropunctatus)*)

Photo: Jack Jeffrey Photography



This voracious and opportunistic predator is native to areas from Iran, through India to Myanmar and the Malay Peninsula. It was introduced to Mauritius and Fiji and to the West Indies and Hawai'i in the late 1800s to control rats. Unfortunately, this early attempt at biological control has had disastrous impacts. Island populations of native fauna, which had evolved without the threat of a fast-moving, mammalian predator, were no match for the mongoose. It has caused the local extinction of several endemic birds, reptiles and amphibians and threatens others including the rare Japanese Amami rabbit (*Pentalagus furnessi*). The small Indian mongoose is also a vector of rabies.

Rosy wolfsnail (*Euglandina rosea*)

Native to the southeastern United States, the predatory rosy wolf snail was introduced to islands in the Pacific and Indian Oceans from the 1950s onwards as a biological control agent for another alien species, the giant African snail (*Achatina fulica*). The giant African snail was intended as a food source for humans but became an agricultural pest. In French Polynesia, the fast moving rosy wolf snail rapidly eliminated local endemic species. One group threatened by the rosy

Photo: Jack Jeffrey Photography



wolf snail is the Partulid tree snails, which evolved separately from each other in isolated valleys and exhibit a variety of unique characteristics. Many Partulid tree snails have been lost already and today the survivors exist in zoos and in the world's first wildlife reserves for snails. This invasion by a biological control agent has caused a significant loss of biodiversity.

Water Hyacinth (*Eichhornia crassipes*)

This South American native is one of the worst aquatic weeds in the world. Its beautiful, large purple and violet flowers make it a popular ornamental plant for ponds. It is now found in more than 50 countries on five continents. Water hyacinth is a very fast growing plant, with populations known to double in as little as 12 days. Infestations of this weed block waterways, limiting boat traffic, swimming and fishing. Water hyacinth also prevents sunlight and oxygen from reaching the water column and submerged plants. Its shading and crowding of native aquatic plants dramatically reduces biological diversity in aquatic ecosystems.



Water hyacinth on Lake Victoria

Photo: Aquarius Systems, North Prairie, Wisconsin, USA

Nile Perch (*Lates niloticus*)

The Nile perch was introduced to Lake Victoria, Africa in 1954 to counteract the drastic drop in native fish stocks caused by over-fishing. It has contributed to the extinction of more than 200 endemic fish species through predation and competition for food. The flesh of Nile perch is oilier than that of the local fish, so more trees were felled to fuel fires to dry the catch. The subsequent erosion and runoff contributed to increased nutrient levels, opening the lake up to invasions by algae and water hyacinth (*Eichhornia crassipes*). These invasions in turn led to oxygen depletion in the lake, which resulted in the death of more fish. Commercial exploitation of the Nile perch has displaced local men and women from their traditional fishing and processing work. The far-reaching impacts of this introduction have been devastating for the environment as well as for communities that depend on the lake.



Photo: Jens Bursell

The Invasive Species Specialist Group (ISSG) is a New Zealand-based specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN). It is chaired by Dr Mick Clout (University of Auckland).

The goals of ISSG are to reduce threats to natural ecosystems and the native species they contain - by increasing awareness of alien invasions and of ways to prevent, control or eradicate them.

The Global Invasive Species Database, developed as part of GISP Phase I, managed by ISSG, is freely available online at www.issg.org/database and mirrored at www.invasivespecies.net/database. Priorities range from a focus on the some of the world's worst invasive species to a focus on areas where information and resources are comparatively scarce, including small-island developing states. The database has images and descriptions for a wide variety of invasive species. Records for these species include information on the ecology, impacts, distribution and pathways of the species, and most importantly, information on management methods as well as contact details of experts that can offer further advice. The database also provides links to numerous other sources of information.

Aliens is the bi-annual newsletter of the Invasive Species Specialist Group (ISSG). Its role is to put researchers, managers and/or practitioners in contact with each other and to publish information and news of alien invasive species and issues.

Aliens-L is a listserver dedicated to invasive species. It allows users to freely seek and share information on alien invasive species and issues, and the threats posed by them to the Earth's biodiversity. To subscribe, look for instructions on the ISSG website.

Cooperative Initiative on Invasive Alien Species on Islands: the aims of the Cooperative Initiative on Invasive Island Alien Species on Islands are: to enhance empowerment, capacity, cooperation and sharing of expertise in key areas of invasive alien species (IAS) management on islands; For more information, contact ISSG.

IUCN Guidelines: The IUCN Guidelines For The Prevention Of Biodiversity Loss Caused By Alien Invasive Species (As approved by 51st Meeting of Council, February 2000) can be obtained from the ISSG office, or <http://iucn.org/themes/ssc/pubs/policy/invasivesEng.htm>

BioNET-INTERNATIONAL, the Global Network for Taxonomy, is an initiative that promotes demand-driven capacity building in taxonomy to address sustainable development needs of developing countries. Comprised of a secretariat and nine, government-endorsed subregional LOOPs with a membership of institutions and individuals, BioNET helps coordinate and engage taxonomists, technology providers and others in the capacity building partnerships needed to address priority issues such as invasive alien species. *Why Taxonomy Matters* is a set of case studies, many of which highlight the contribution of taxonomy to IAS management (see: www.bionet-intl.org/case_studies).

Websites: Invasive Species Specialist Group: www.issg.org
Global Invasive Species Database: www.issg.org/database
IUCN-The World Conservation Union: www.iucn.org
The Global Invasive Species Programme: www.GISP.org
BioNET-INTERNATIONAL: www.bionet-intl.org