Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Vysazení a zavlečení nepůvodních druhů živočichů (psů, koček, krys, prasat, koz atd. a jejich parazitů i nemocí) bylo a je příčinou vyhubení mnohých ostrovních endemitů.

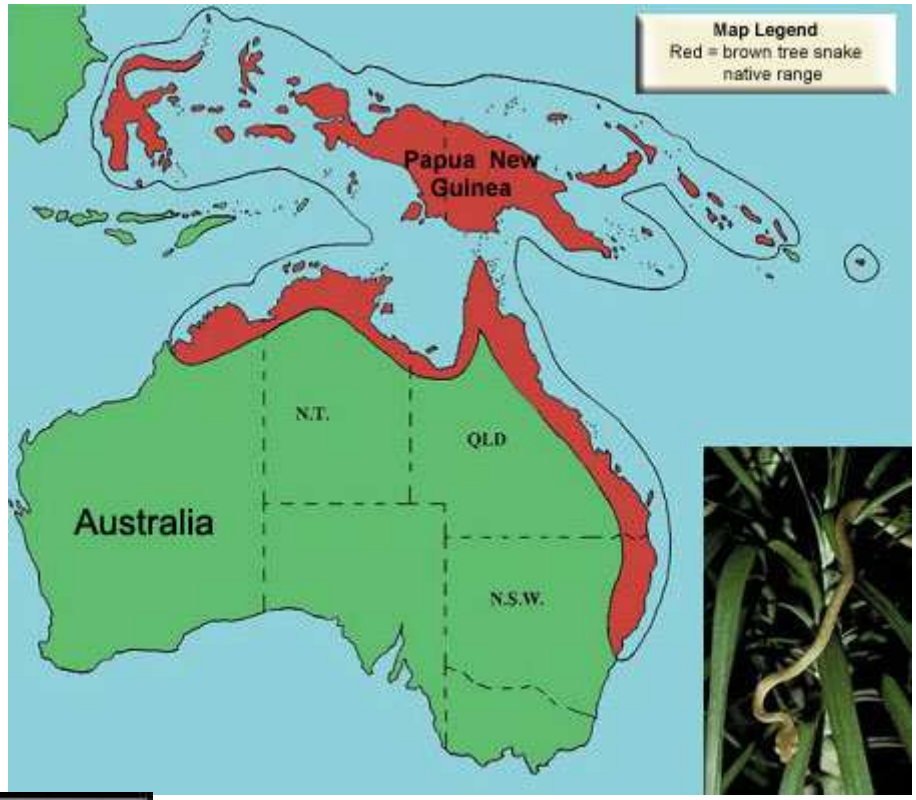
The intentional or accidental introduction of non-indigenous animal species (dogs, cats, rats, pigs, goats, etc., and their parasites and diseases) has been the cause of extinction of many island endemics.

Kočka ulovila leguána na Galapágách
A cat has caught an iguana on the Galapagos islands

Na Hawaii bylo kromě jiných druhů vyhubena řada šatovníků (Drepanidini), typického příkladu adaptivní radiace. / On Hawai a number of Hawaian finches (Drepanidini) a typical example of adaptive radiation, have been driven to extinction (as many other species).

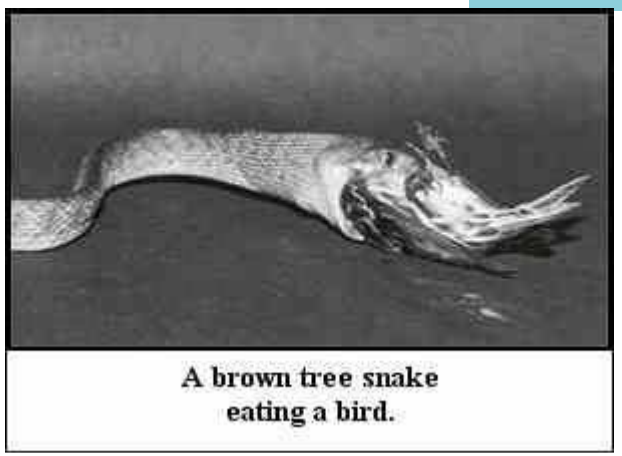
Vysazená divoká a zdivočelá domácí prasata mění prostředí a hubí původní druhy./ Introduced wild boars and ferralized pigs are changing the environment and killing indigenous species.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones



Zavlečená stromová užovka *Boiga irregularis* ohrožuje endemické ptáky na pacifických ostrovech, např. Guamu.

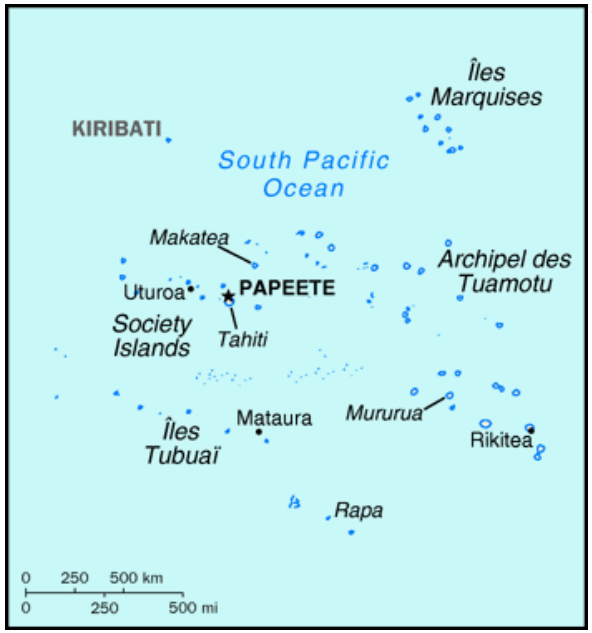
The brown tree snake (*Boiga irregularis*) threatens endemic birds on Pacific islands, e. g. Guam.


A brown tree snake eating a bird.

Původní areál / Native range

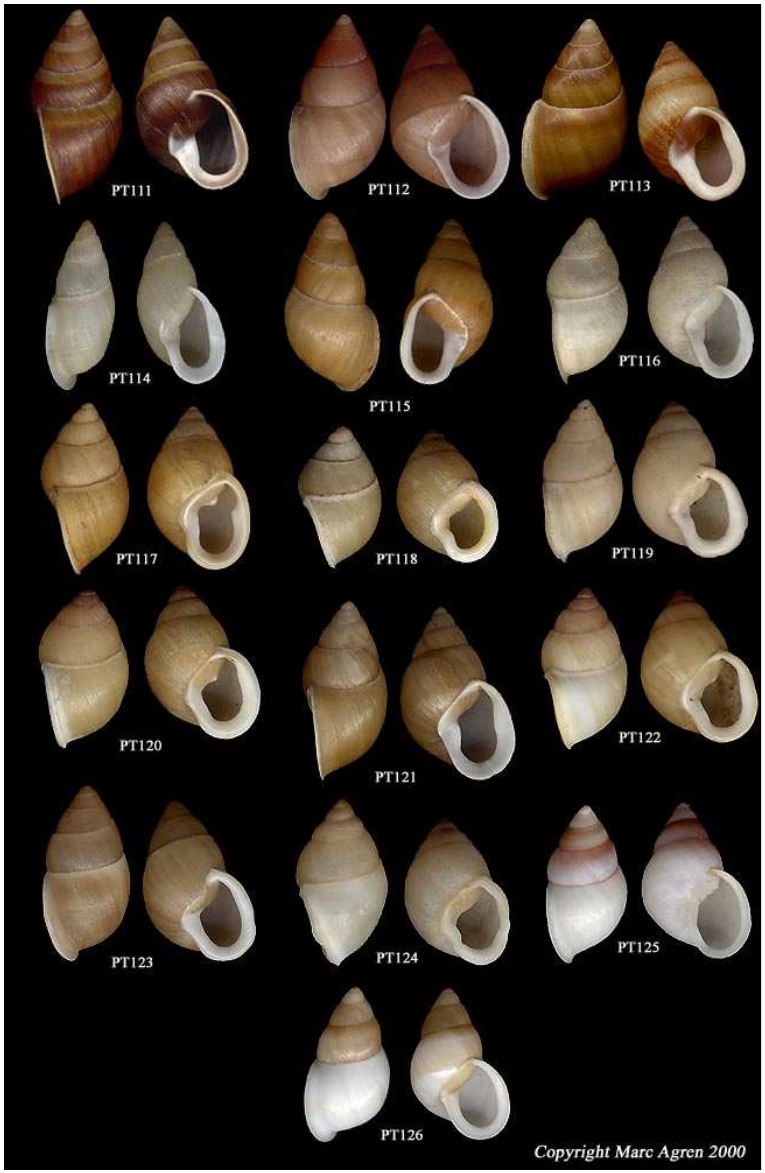
Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Ostrov Moorea (Společenské ostrovy)
Moorea Island (Society islands)



Vysazení nepůvodních plžů vedlo k zániku velkého počtu druhů endemických druhů plžů (*Partula* spp.) Francouzské Polynésie.
The introduction of exotic snails led to the extinction of a large number of snail species (*Partula* spp.) endemic to French Polynesia

Francouzská Polynésie / French Polynesia



Ulity druhů rodu *Partula*
Shells of the genus *Partula*

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

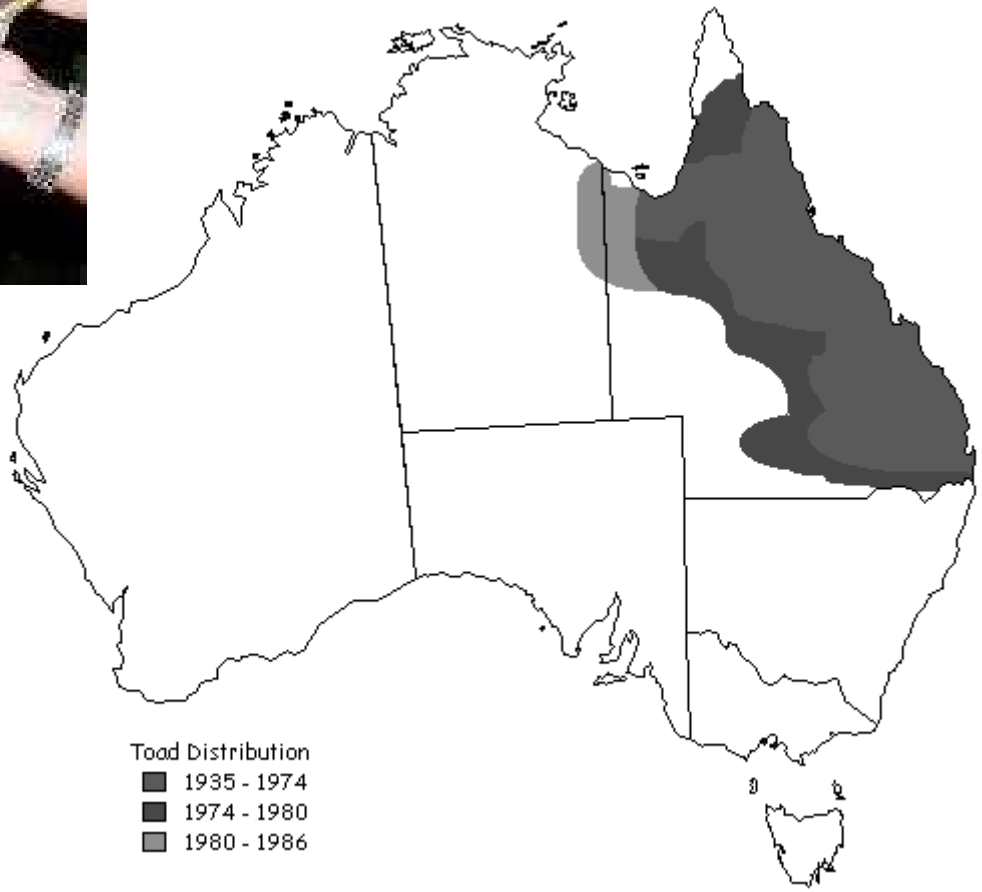
Původní, endemický druh *Partula* sp. / Native, endemic *Partula* species

Oblovka *Achatina fulica* z Afriky, introdukce na ostrov Moorea v 60. letech 20. století. The Giant African Land Snail (*Achatina fulica*) from Africa was introduced to the island of Moorea in the 1960s.

***Euglandina rosea* z Floridy a střední Ameriky; introdukce na ostrov Moorea v r. 1977 za účelem hubení plžů *Achatina fulica*. / *Euglandina rosea* from Florida and Central America; introduced to Moorea Island in 1977 to reduce the population of *Achatina fulica*.**

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones



Jihoamerická ropucha *Bufo marinus* byla vysazena na severu Queenslandu aby redukovala hmyzího škůdce (brouka) na cukrové třtině. Místo toho hubí mnohé původní živočichy vč. ptáků a malých vačnatců.

The Marine or Cane Toad (*Bufo marinus*) from South America was introduced to northern Queensland to reduce an insect pest (beetle) on sugar cane. Instead it has been preying on many native species including birds and small marsupials.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Kapradinka nepukalka (*Salvinia molesta*) z jihovýchodní Brazílie / The aquatic fern *Salvinia molesta* from south-eastern Brasil

Lake Moon Dara (sev. Queensland, Austrálie) před a po vysazení nosatce *Cyrtobagous salviniae* (1981) / Lake Moon Dara (N.Queensland, Australia) before and after the introduction of the Black Long-snouted Weevil (*Cyrtobagous salviniae*) in 1981.

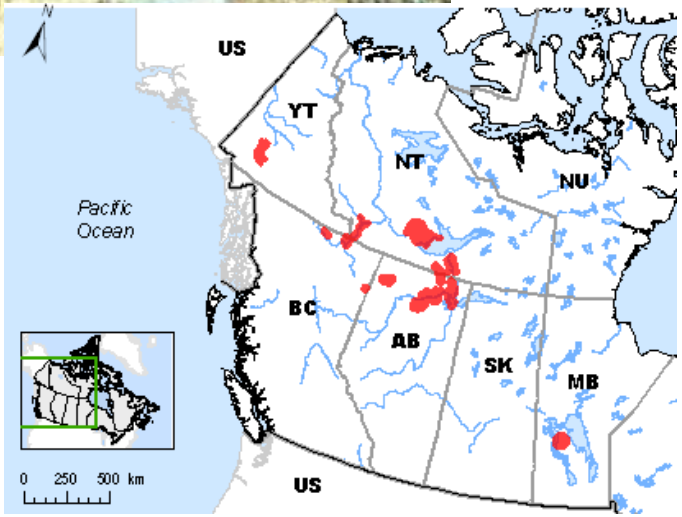
Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Mol *Castoblastis cactorum* z již. Ameriky zredukoval populace amerických kaktusů opuncií (*Opuntia inermis, O. stricta*) v Austrálii. Jeho šíření do sev. Ameriky (vč. Mexika) však ohrožuje existenci velkého počtu zde domácích druhů opuncií. / The Prickly Pear Moth (*Cactoblastis cactorum*) from S. America reduced populations of Prickly Pear cacti (*Opuntia inermis, O. stricta*) in Australia. Its spreading to N. America (incl. Mexico) threatens the existence of many native species of Prickly Pear.

Ohrožení druhů introdukcí nepůvodních druhů

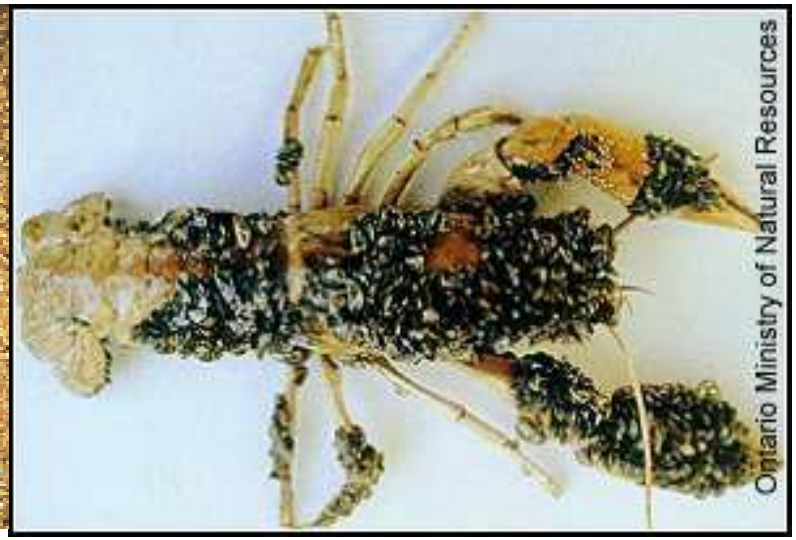
Threat to species by the introduction of exotic ones



Tuberkulóza skotu ohrožuje lesní poddruh bizona v Kanadě, populace buvola kaferského i lva v Krügerově národ. parku v jižní Africe.

Bovine tubercolosis threatens the Wood Bufallo subspecies of the American bison as well as the populations of African Bufallo and Lion in the Krüger Nat. Park of South Africa.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones



Pontokaspický mlž slávička mnohotvárná (*Dreissena polymorpha*) se rozšířil od r. 1890 z Hamburku Labem po střední Evropě. Od konce 80. let 20. století, kdy se dostal s balastní vodou do severoamerických Velkých jezer, se lavinovitě šíří vodní sítí severní Ameriky, kde vytlačuje původní druhy benthosu a způsobuje velké ekonomické (technické) škody.

The Ponto-caspian Zebra Mussel (*Dreissena polymorpha*) spread in Central Europe vie the Elbe river, starting in 1890 in Hamburg. In the end of the 1980s it was introduced with balast water to the N. American Great Lakes and has been expanding in the N. American water ways ever since with tremendous speed, out-competing native benthic species and causing large economic (technical) damage.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Introduced species / Zavlečené, vysazené, nepůvodní druhy

species that were only able to surmount a barrier to dispersal with the (intentional or unintentional) assistance of man and thus to colonize a given locality

druhy, které byly schopny překonat překážku svého šíření pouze s pomocí (úmyslnou či neúmyslnou) člověka, a tak osídlit danou lokalitu

Classification of species introduced to Europe / Klasifikace druhů zavlečených do Evropy:

- archeophytes / (archeozoa) – introduced before 1492
  archeofyty / (archeozoa) – zavlečené či vysazené před r. 1492
- neophytes / (neozoa) – introduced from 1492 onwards
  neofyty / (neozoa) – zavlečené či vysazené od r. 1492

Invasive species / invazní druhy

- a subset of introduced (non-indigenous, exotic) species
  podmnožina nepůvodních (exotických) druhů
- introduced species expanding their range and representation in habitats by outcompeting native species
  nepůvodní druhy, které rozšiřují svůj areál a zastoupení v biotopech vytlačováním původních druhů

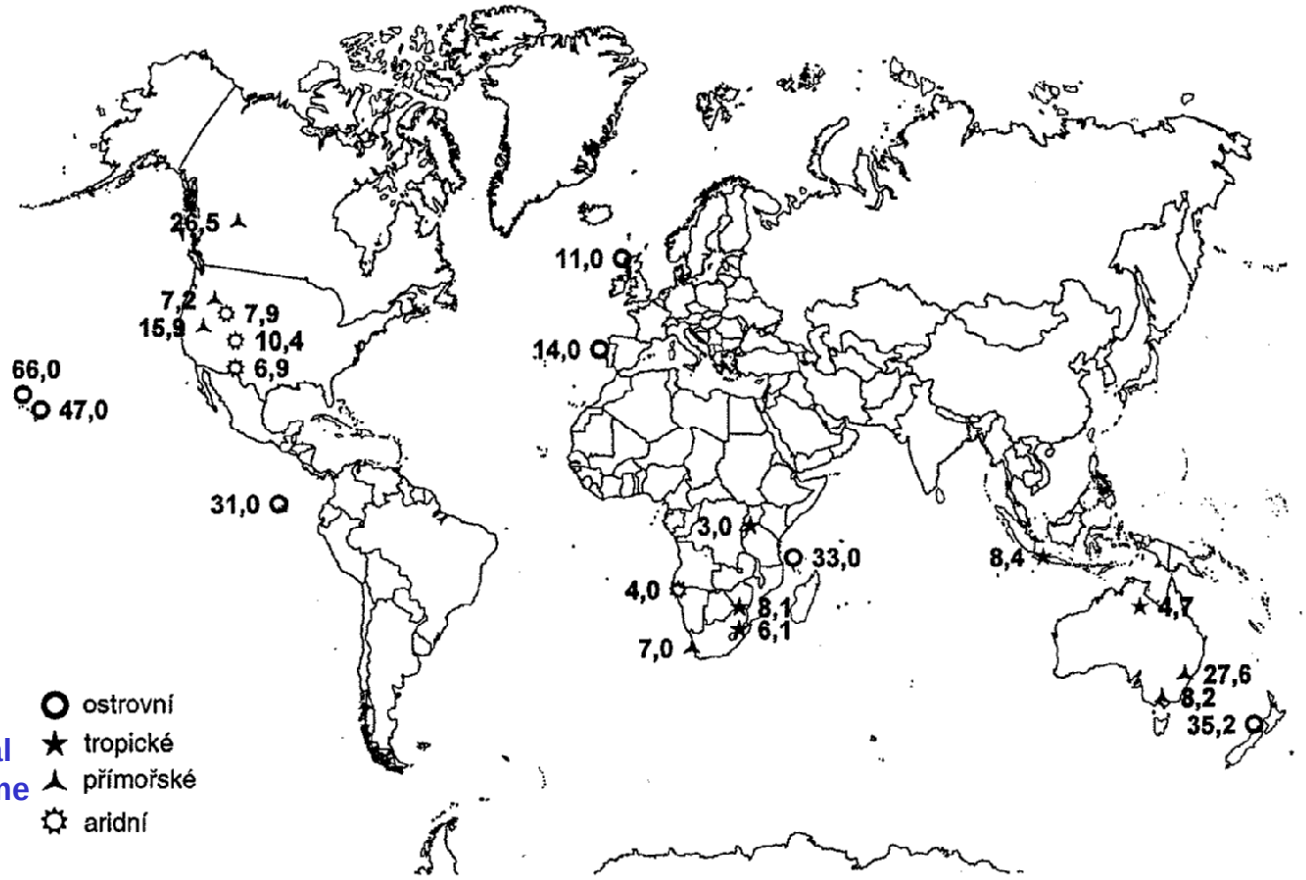
Expansive species / expanzivní druhy

- species native to a given area that have started to substantially expand their range and the number of colonised localities, often because of habitat disturbance by man
  druhy původní, které začaly výrazně rozšiřovat svůj areál a počet lokalit výskytu, často v důsledku narušení prostředí člověkem

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

The proportion of introduced plant species in large reserves (National Parks, Biosphere Reserves) world-wide. For the character of the reserves see explanation of symbols below. For name of reserve see Czech legend below the map.



Podíl zavlečených druhů rostlin ve světových rezervacích. Charakter jednotlivých rezervací je rozlišen symboly.

A. Ostrovní rezervace: Rhum (Skotsko) – 11 %; Selvagem Grande (Portugalsko) – 14 %; Campbell (Nový Zéland) – 35,2 %; Galapagos – 31 %; Aldabra (Seychely) – 33 %. Z Havajských ostrovů pocházejí údaje z rezervací Maui – 47 %, Hawaii Volcanoes – 66 % a Kamakou – 38 %.

B. Travinné a lesostepní formace tropických oblastí: Ngorongoro (Tanzanie) – 3 %; Kruger National Park (Jižní Afrika) – 8,1 %; Hluhluwe (Jižní Afrika) – 6,1 %; Baluran (Jáva) – 8,4 %; Kakadu (Austrálie) – 4,7 %.

C. Oblasti s přímořským typem klimatu: kalifornské rezervace Hastings Reserve – 15 %, Sequoia, Mt. Whitney a Kings Canyon – 7,2 % a Pinnacles National Monument – 15,9 %; Jasper Ridge (Britská Kolumbie) – 26,5 %; australské rezervace Myall Lakes (Austrálie) – 8,2 % a Kings Park – 27,6 %; mys Dobré naděje (Jižní Afrika) – 7 %.

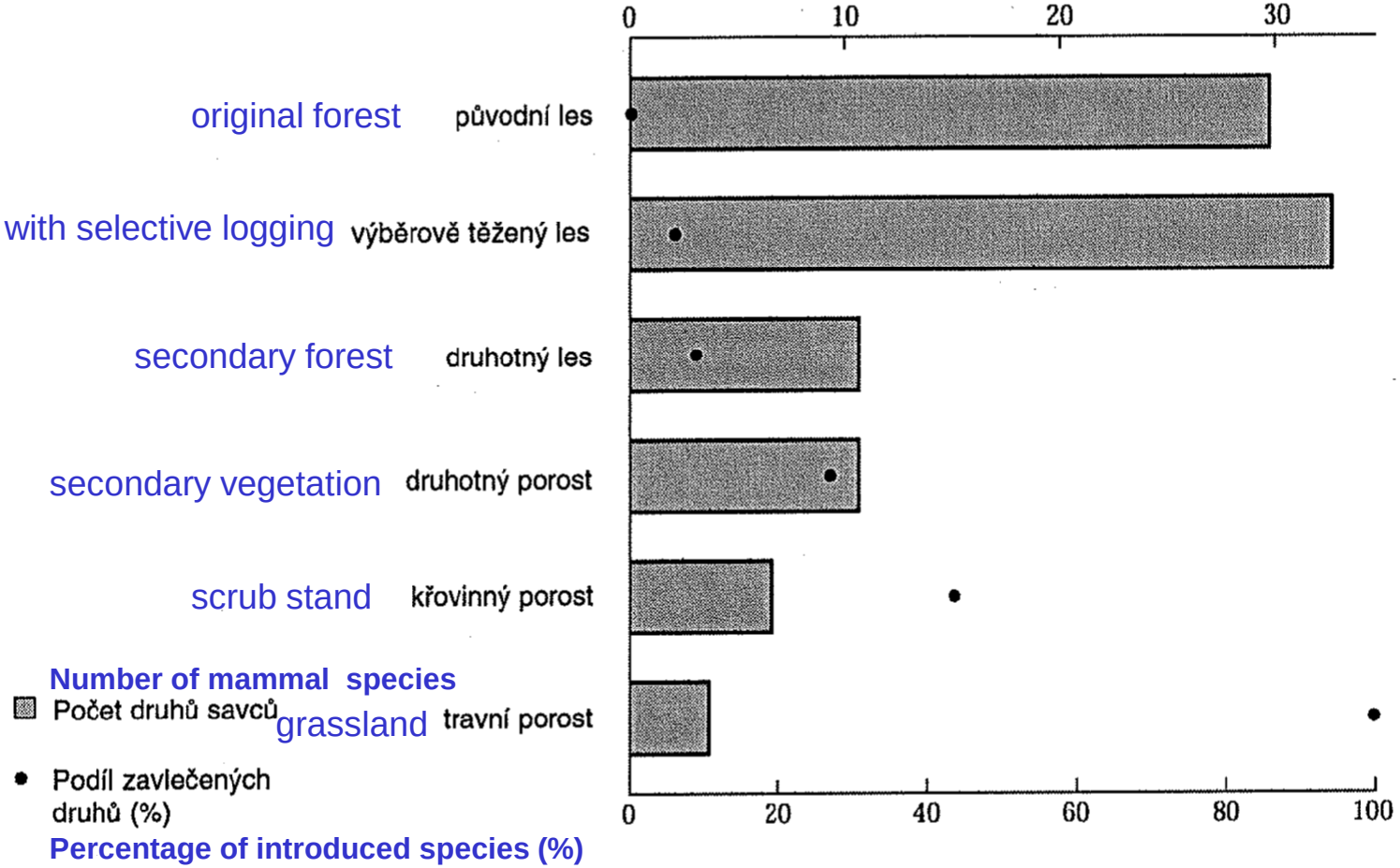
D. Pouštní oblasti: Skeleton Coast (Namibie) – 4 %; Organ Pipe Cactus (Arizona) – 6,9 %; Death Valley (Kalifornie) – 7,9 %; Canyonlands and Arches (Utah) – 10,4 %. (Kučera & Pyšek, 1997)

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

The gradual degradation of forests in south-east Asia by logging and agricultural practices does not only reduce the number of native mammal species but also increases the percentage of introduced species. In the last stage of this succession, the savannah, only introduced rat species are present.

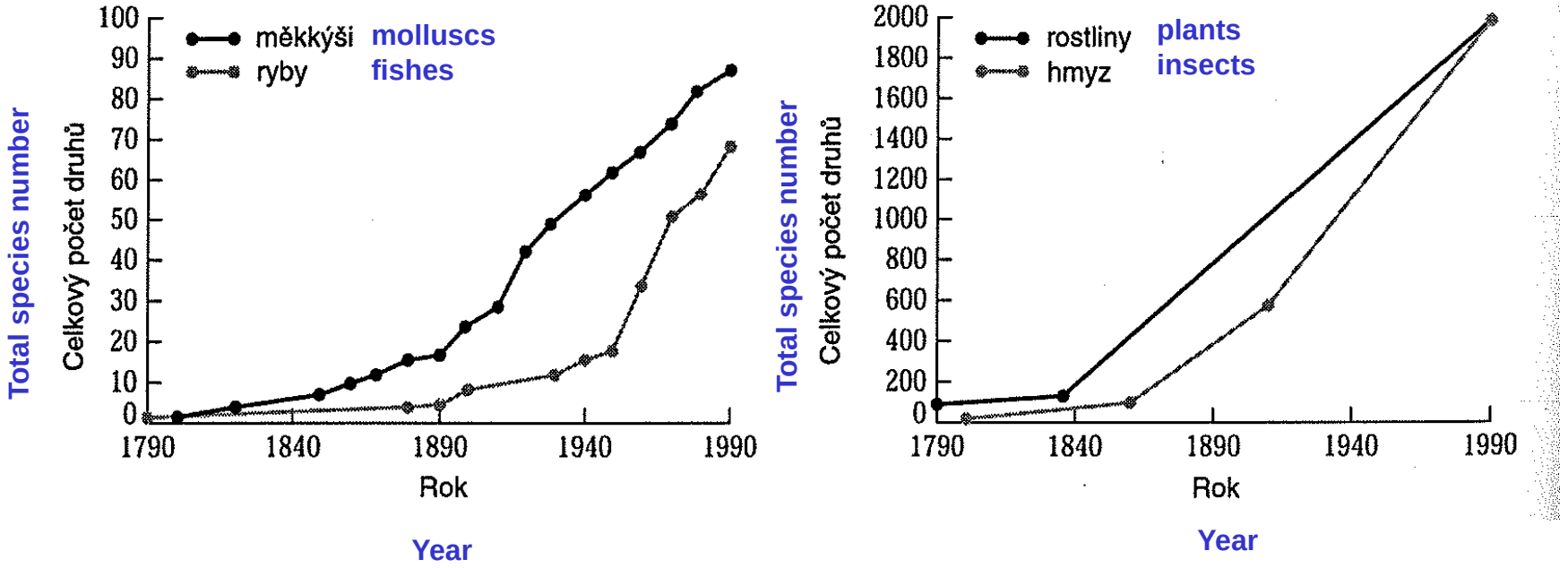
Obr. 2.21 Postupná degradace lesů v jihovýchodní Asii kácením a zemědělskou výrobou nejen snižuje počet původních druhů savců, ale také zvyšuje procento zavlečených druhů. Ve finální fázi této sukcese – v savaně – jsou přítomny jen introdukované krysy. (Harrison, 1968)



Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

The number of species of exotic molluscs, fishes, plants and insects in the USA has been increasing constantlv over time

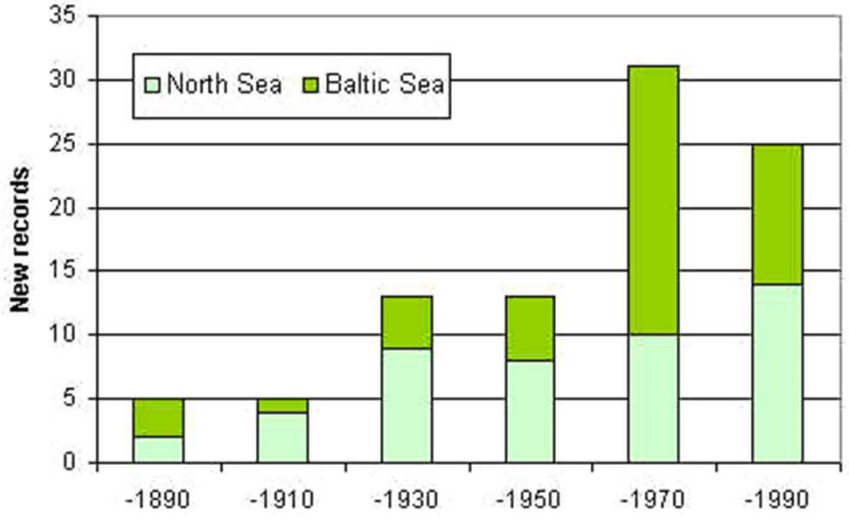
Obr. 2.20 Počet druhů cizokrajných měkkýšů, ryb, rostlin a hmyzu v USA v průběhu času konstantně roste. (OTA, 1993)



J. Schlaghamerský: Ochrana přírody – introdukce nepůvodních druhů

Threat to species by the introduction of exotic ones

Vodní mor kanadský (*Elodea canadensis*) je dnes rozšířen po celé Evropě / Canadian pondweed (*Elodea canadensis*) is today present all over Europe



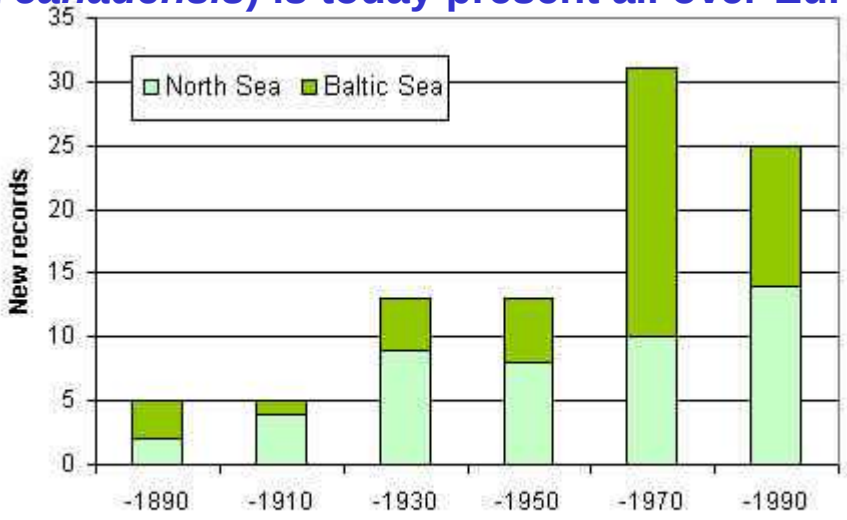
Numbers of first records of nonindigenous species in North and Baltic Seas within 20 year intervals (n = 92 species)

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Vodní mor kanadský (*Elodea canadensis*) je dnes rozšířen po celé Evropě / Canadian pondweed (*Elodea canadensis*) is today present all over Europe

Zelená řasa *Caulerpa taxifolia* z teplých vod Pacifiku se šíří ve Středozemním moři; zkouší se biol. boj pomocí plže *Elysia subornata*. / The green alga *Caulerpa taxifolia* from warm Pacific waters has been spreading in the Mediterranean Sea; biological control by the snail *Elysia subornata* is being tested.



Numbers of first records of nonindigenous species in North and Baltic Seas within 20 year intervals (n = 92 species)

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Zelená řasa *Caulerpa taxifolia* z teplých vod Pacifiku se šíří ve Středozemním moři; zkouší se biologický boj pomocí plže *Elysia subornata*. / The green alga *Caulerpa taxifolia* from warm Pacific waters has been spreading in the Mediterranean Sea; biological control by the snail *Elysia subornata* is being tested.

Oblasti s nepůvodním výskytem řasy *Caulerpa taxifolia* / Areas with introduced populations of *Caulerpa taxifolia*

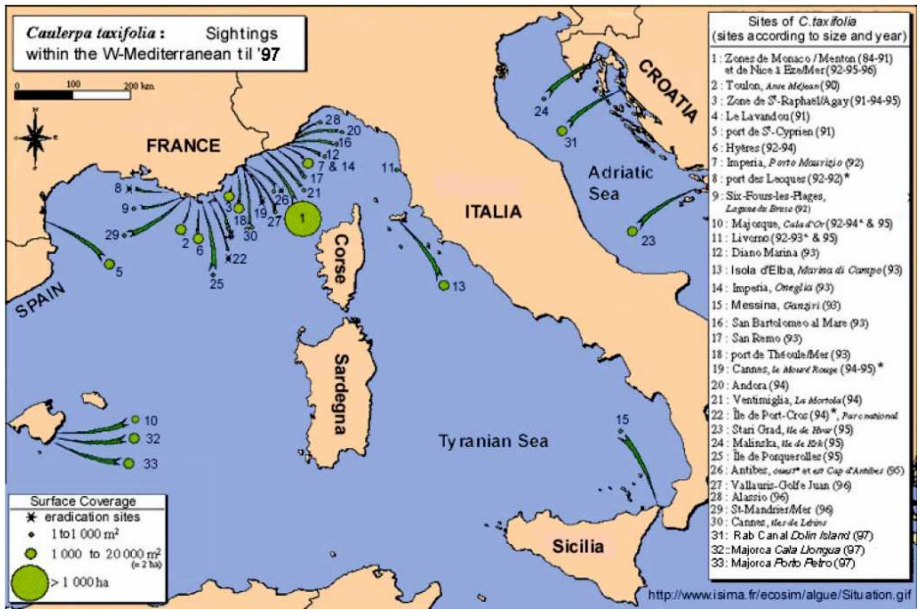
1982: kultivace řasy v akváriích monackého oceánografického muzea / cultivation of the alga in the aquarium of the Oceanographic Museum of Monaco

1984: řasa objevena v monackém zálivu přímo pod okny muzea (porost na 1 m^2 mořského dna) / discovered in the Bay of Monaco just below the museum's windows (patch covering 1 m^2 of sea bed)

1992: řása dosáhla břehů Itálie a Španělska / reached the coasts of Italy and Spain

1995: řasa dosáhla břehů Chorvatska / reached the coast of Croatia

1997: známo 99 lokalit o celkové rozloze 6600 ha / 99 sites of occurrence covering in total 6600 ha known from the Mediterranean Sea



Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Norek evropský (*Mustela nutreola*) byl dříve intenzivně loven
European Mink was formerly intensively hunted

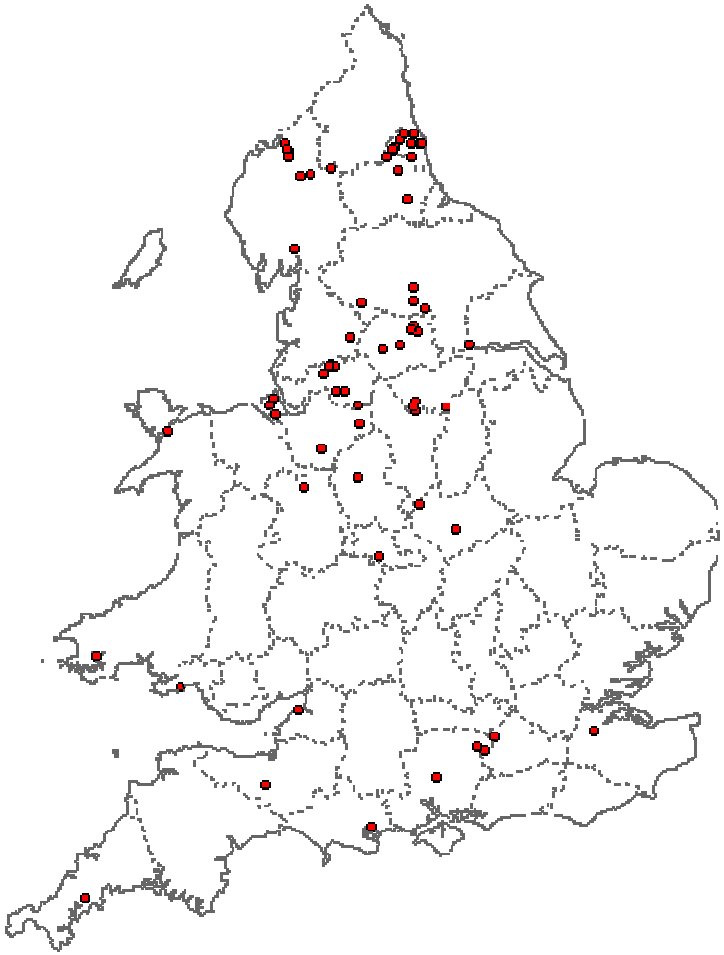
Rozšíření norka dříve (bíle) a dnes (červeně) / Former (white) and present (red) range of European Mink

Dnes je vytlačován norkem americkým - minkem (*Mustela vison*) ze Sev. Ameriky.
At present it is being out-competed by the American Mink

Např. v Estonsku je volně žijící populace norka posilována vysazováním jedinců z chovu. / For instance in Estonia its wild populations are being reinforced by individuals bred in captivity.

Ohrožení druhů introdukcí nepůvodních druhů

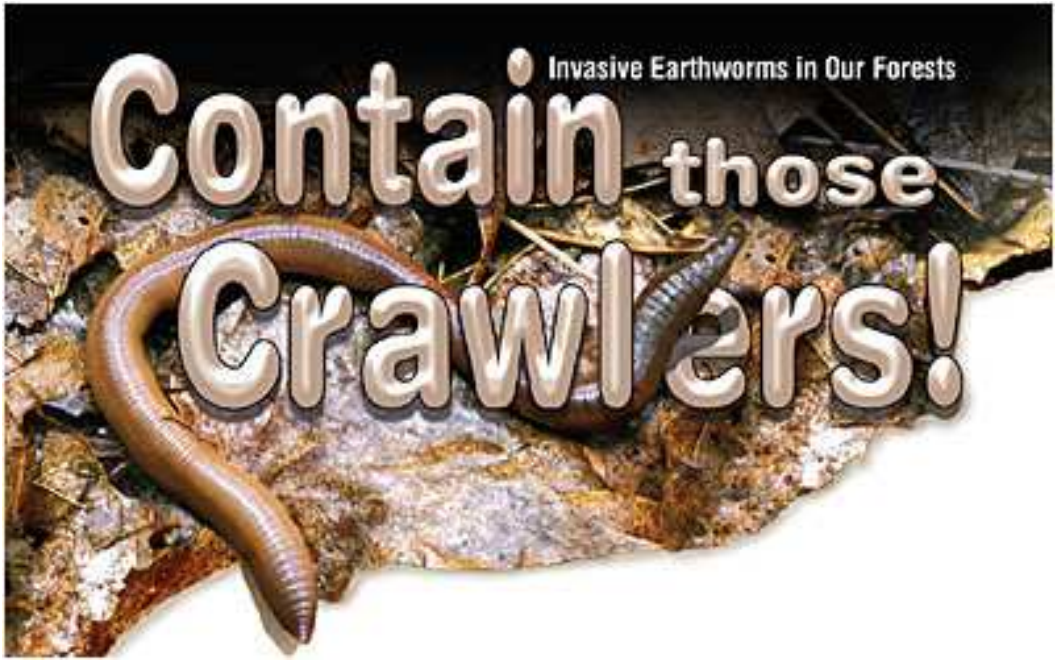
Threat to species by the introduction of exotic ones



Nálezy půdního ploštěnce *Artioposthia triangulata* (= *Arthurdendyus triangulatus*) z Nového Zélandu v Anglii a Walesu (první nálezy v Evropě 1963 v sev. Irsku, 1965 v sev.-záp. Skotsku). Jako predátor významně redukuje populace žížal. / Records of the soil-dwelling flatworm *Artioposthia triangulata* (= *Arthurdendyus triangulatus*) from New Zealand in England and Wales (first records in Europe from Northern Ireland in 1963 and north-western Scotland in 1965). A predator of earthworms substantially reducing their populations.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Invaze evropských žížal do Severní Ameriky
Invasion of European earthworms to North America



Evropské druhy žížal se šíří severní Amerikou (vč. velkých oblastí prostých severoamerických žížal) a mění charakter lesních ekosystémů / European earthworm species have been spreading across North America (including large areas lacking Northamerican earthworm species) profoundly changing the character of forest ecosystems

Oblast zalednění (modře) během poslední doby ledové / Glaciated Area during the last ice age

V Sev. Americe se žížaly v době příchodu Evropanů vyskytovaly hlavně na jiho-východě; tyto druhy v konkurenci podléhají evropským druhům / Upon arrival of the Europeans, native earthworms occurred mainly in the south-east; these species are often outcompeted by the European ones.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Půdní povrch (vlevo)
a přirozená obnova javoru
Acer saccharum (vpravo)
v lese bez žížal / soil surface (left) and natural rejuvenation of sugar maple (right) in a forest without earthworms

Lesní podrost (vlevo) a přirozená obnova javoru (vpravo) v lese s žížalami / soil surface and undergrowth (left) and lacking natural rejuvenation of sugar maple (right) in a forest with exotic earthworms

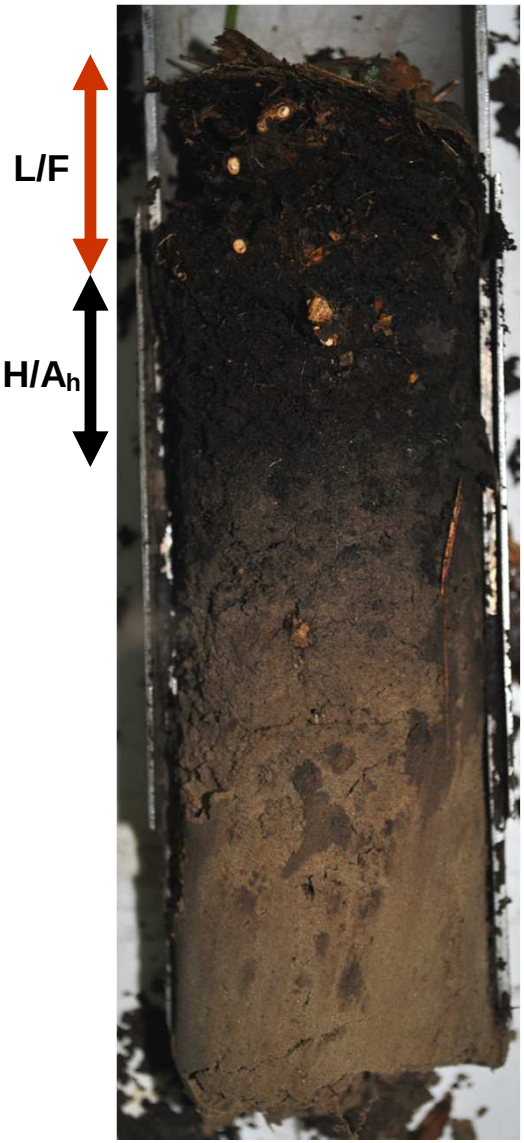
Kapradina *Botrychium mormo* mizí z lesů osídlených žížalami / The fern *Botrychium mormo* is disappearing from forests invaded by earthworms

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Půda a podrost v lese bez žížal (vlevo) a s nimi (vpravo)
/ Soil and undergrowth in a forest without (left) and with earthworms (right)

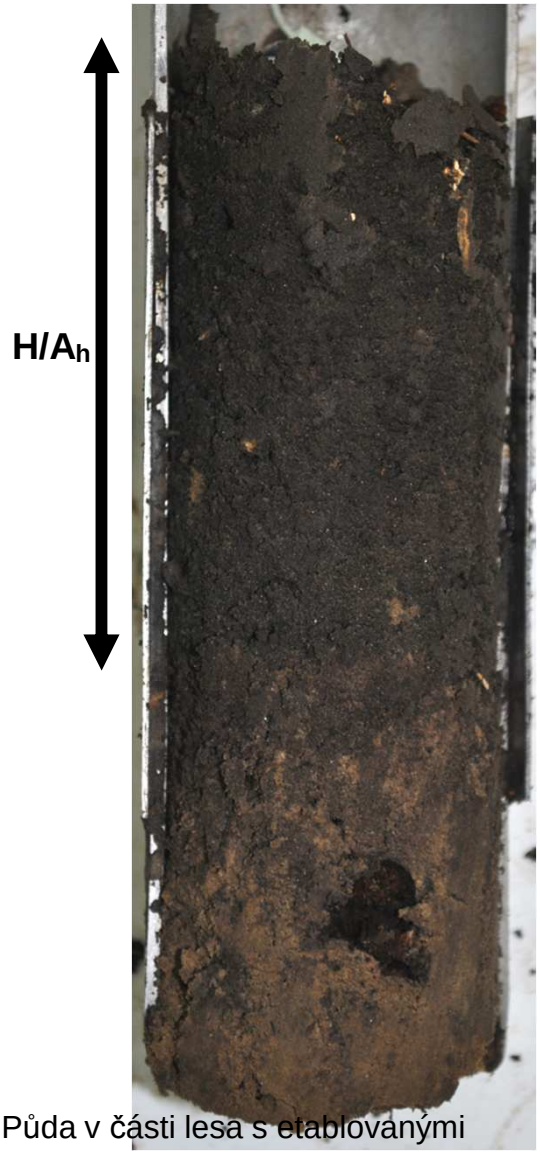
Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones



Půda v části lesa bez žížal
Soil in an earthworm-free forest area

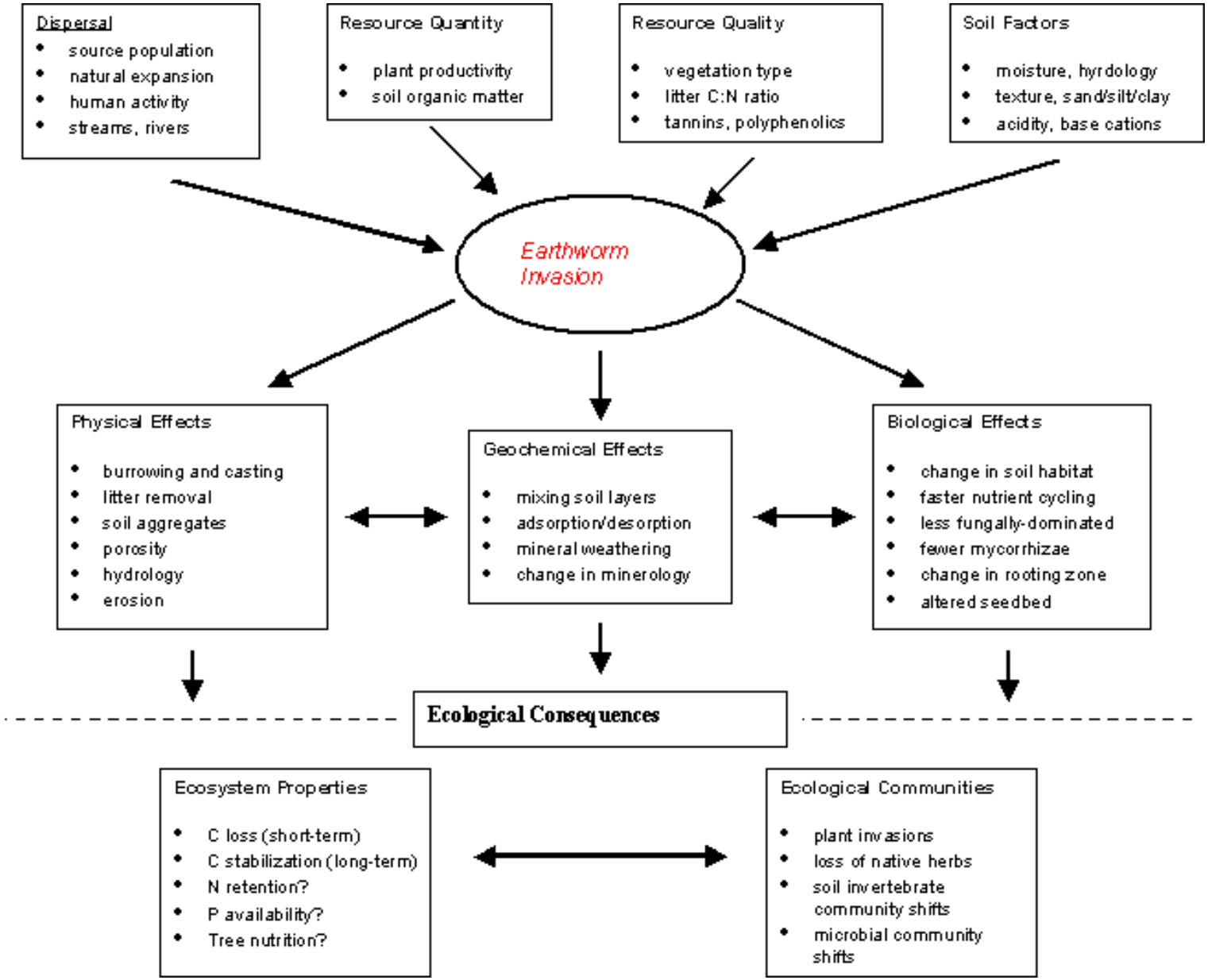
Půda v části lesa na invazní frontě
Forest soil at the leading edge of invasion



Půda v části lesa s etablovanými populacemi žížal (vč. anektického druhu *Lumbricus terrestris*) / Soil in forest with established earthworm populations incl. the anectic *Lumbricus terrestris*

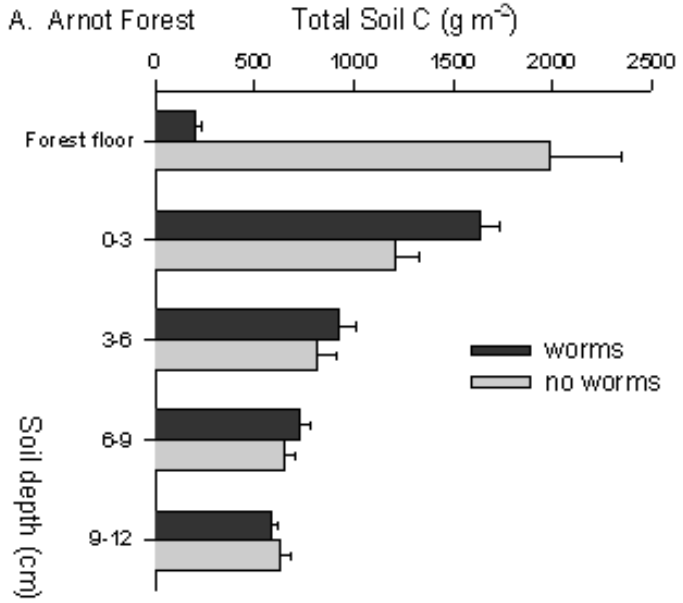
Ohrožení druhů introdukcí nepůvodních druhů

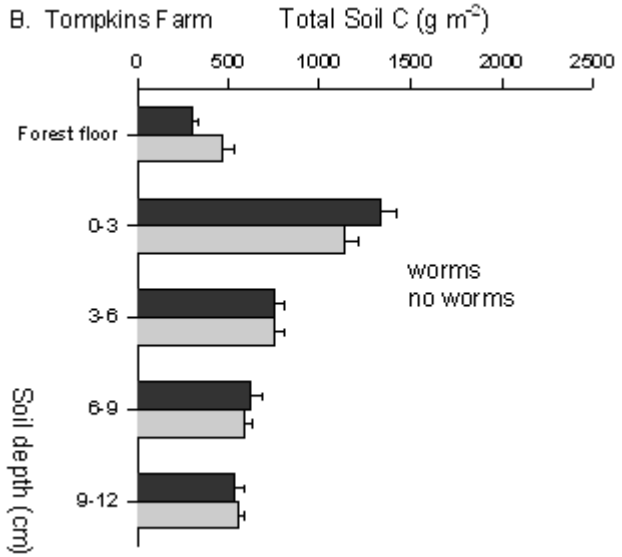
Threat to species by the introduction of exotic ones

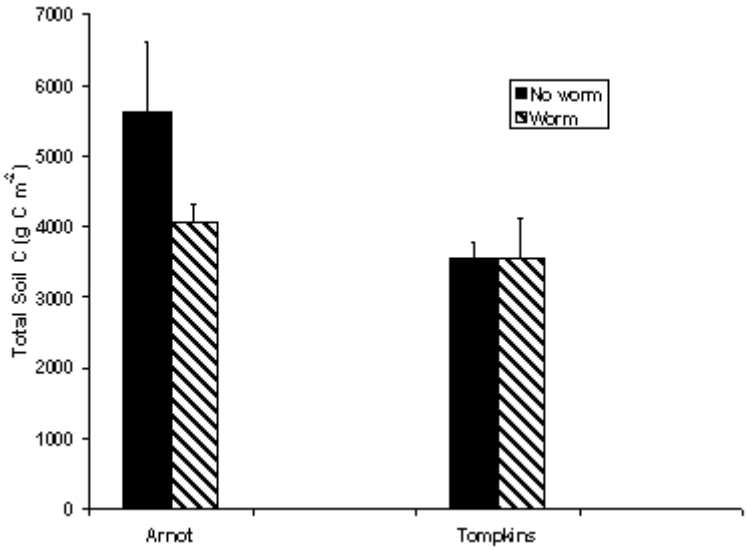


Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones





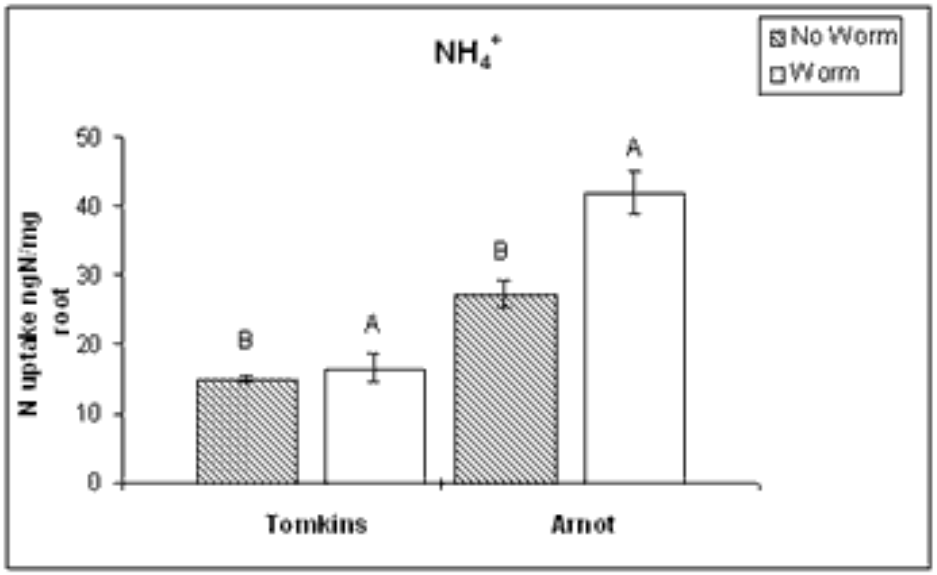


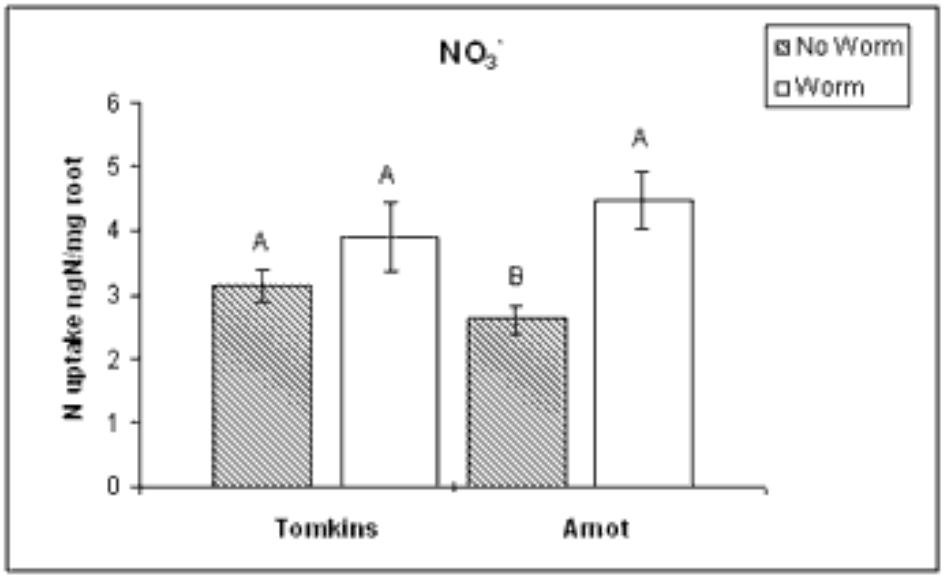
Srovnání obsahu celkového uhlíku v horních vrstvách půdy (nahoře podle vrstev, dole celkem) v lesích s (nepůvodními) žížalami a bez nich ve dvou oblastech (Arnot Forest a Tomkins Farm) v USA

Comparison of total carbon contents in the upper soil layers (above broken down to layers, below in total) in forests with (exotic) earthworms and without them studied at two sites (Arnot Forest and Tomkins Farm) in the USA

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones



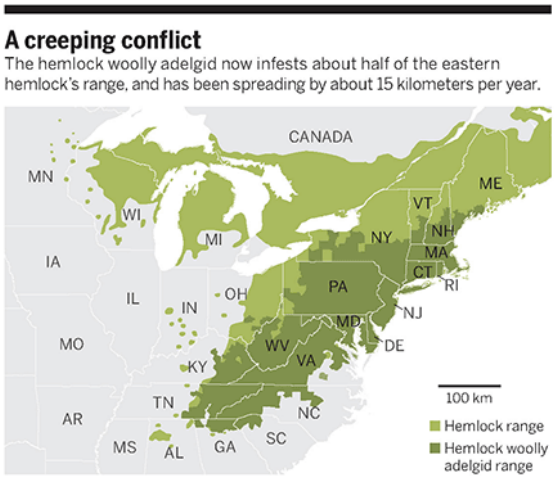


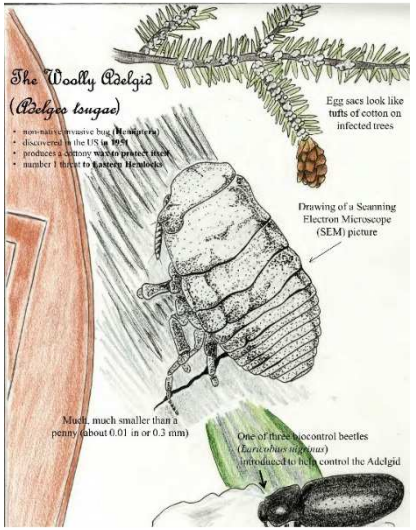
Srovnání příjmu dusíku ve formě amoniového iontu a dusičnanového iontu rostlinami (vztaženo na jeden mg kořenů) v lesích s (nepůvodními) žížalami a bez nich ve dvou oblastech (Arnot Forest a Tomkins Farm) v USA

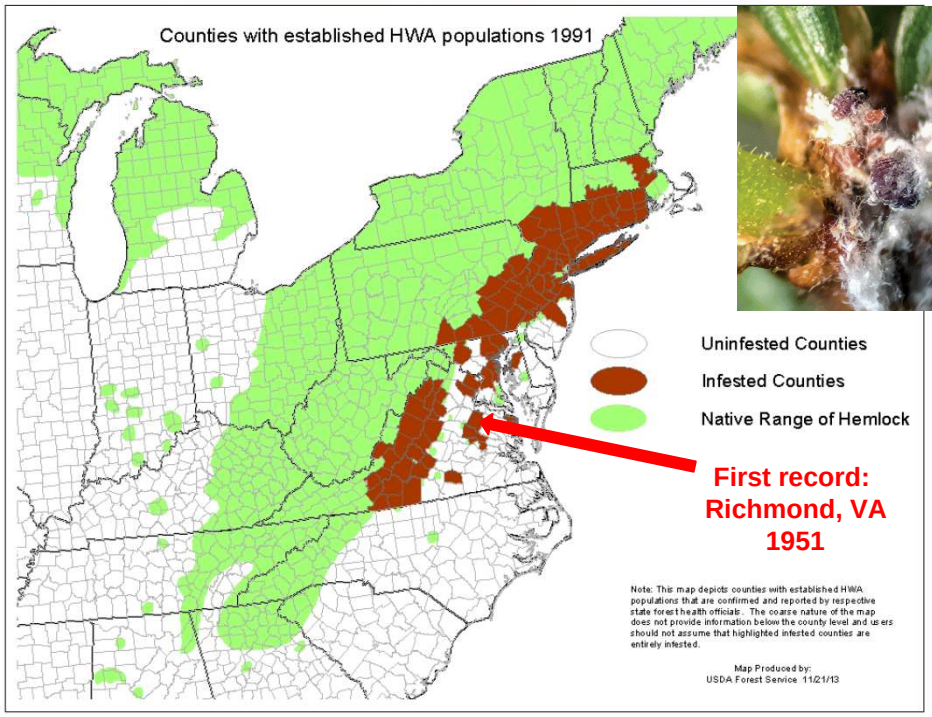
Comparison of nitrogen up-take in the form of the ammonium ion and the nitrate ion by plants (per mg roots) in forests with (exotic) earthworms and without them (Arnot Forest and Tomkins Farm) in the USA

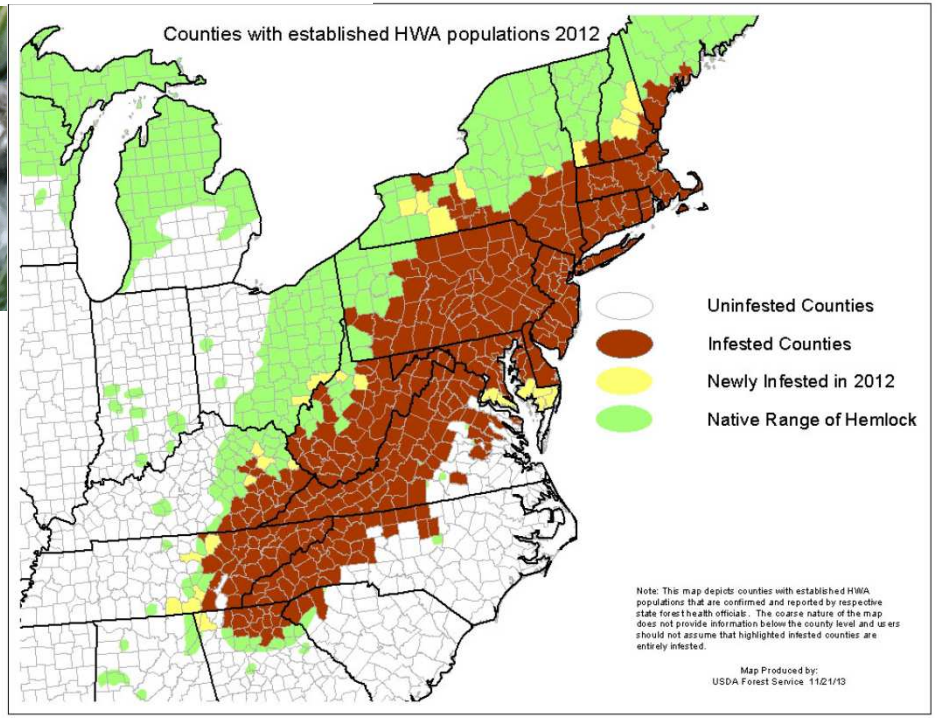
Threat to species by the introduction of exotic ones

Hemlock woolly adelgid (*Adelges tsugae*)– accidentally imported from Japan to eastern North America





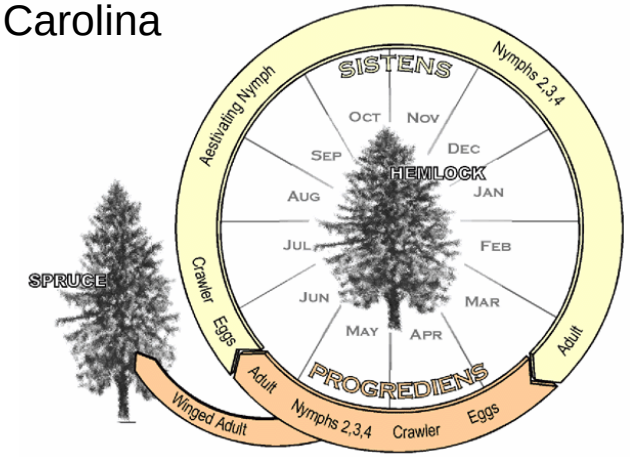




Threat to species by the introduction of exotic ones

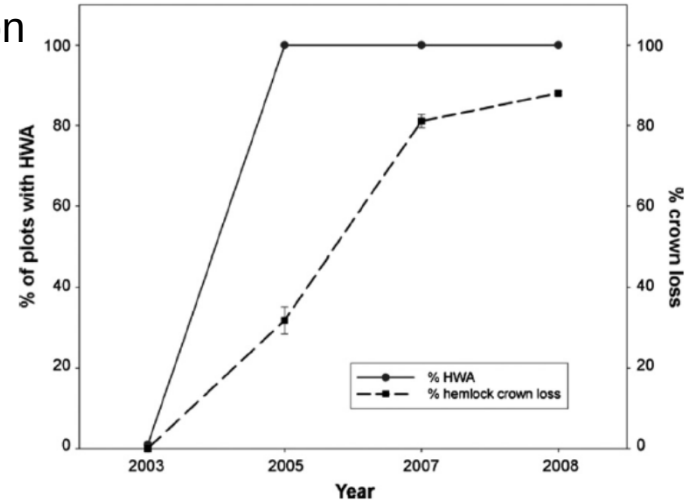
Hemlock woolly adelgid (*Adelges tsugae*) on Eastern and Carolina Hemlock (*Tsuga canadensis* and *T. carolinensis*)

Decline and mortality in infested hemlock in North Carolina



Hemlock woolly adelgid annual life cycle on hemlock in North America (partheno-genetic, specific spruce host is lacking)

Damage to needles and branches after 2-3 years of infestation

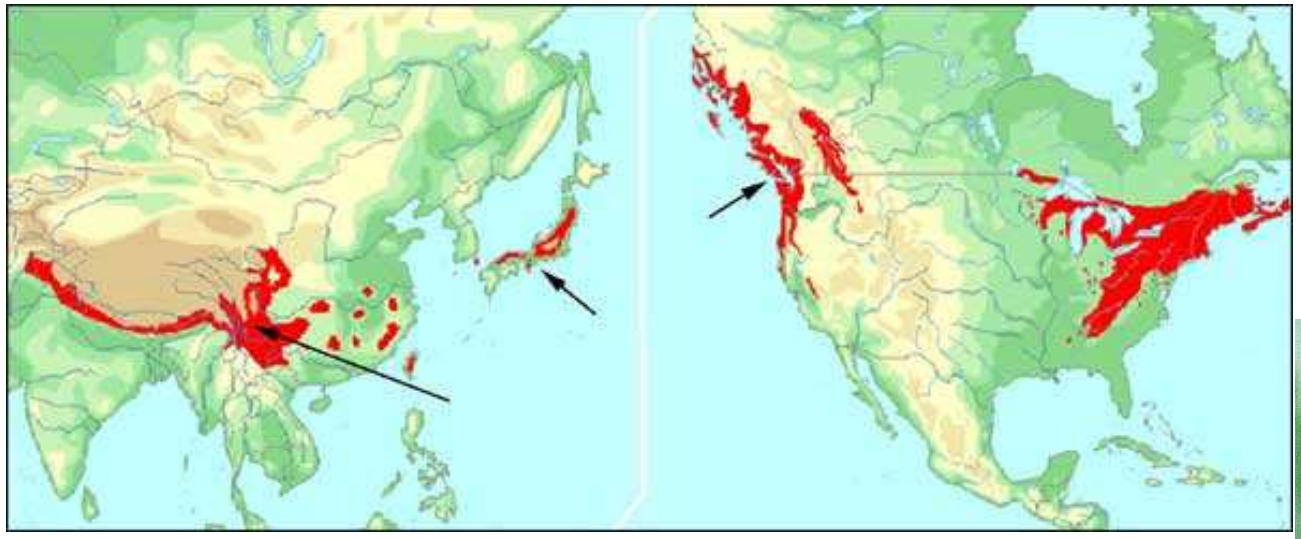


Progression of hemlock infestation and crown loss within a 1600 ha watershed in the southern Appalachians

(Vose et al. (2013), Forest Ecology and Management 291: 209–219)

Threat to species by the introduction of exotic ones

Hemlock woolly adelgid (*Adelges tsugae*)



Worldwide occurrence of Hemlock (red) with arrows showing where biological control agents were collected for importation to the USA. HWA seems to be native on the west coast of North America, where native hemlock species are little affected.

Sasajiscymnus tsugae adult feeding on HWA eggs

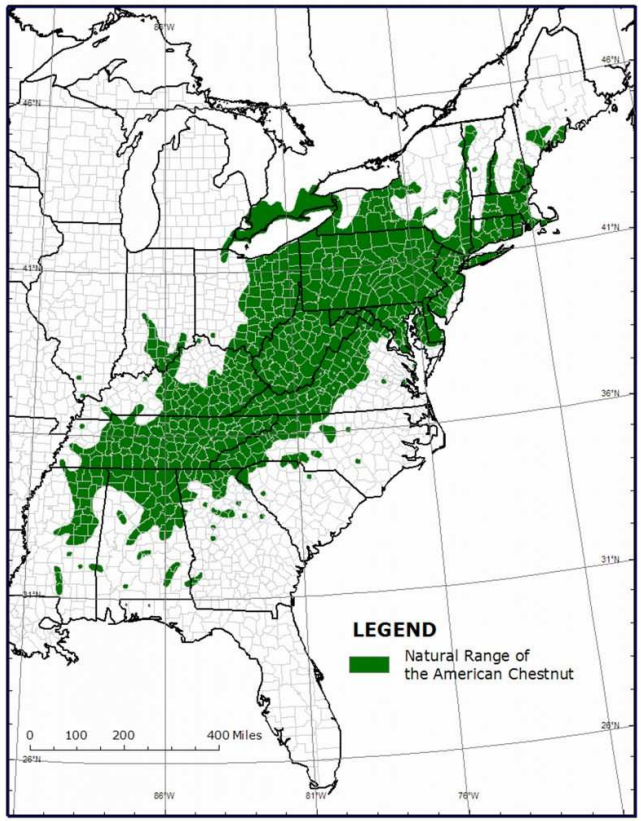
The tooth-necked fungus beetle (*Laricobius nigrinus*), a natural predator of HWA

Scymnus sinuanodulus adults, a biological control agent under consideration

Threat to species by the introduction of exotic ones

Chestnut blight is a fungal disease of plants caused by the fungus *Cryphonectria parasitica* from Asia, which has almost extermined the American chestnut *(Castanea dentata)*

- American chestnut made up for 25% of timber in the eastern USA
- Origin of fungus: Eastern Asia
- Disease first observed in the USA in 1904 (New York City)
- Apparently introduced after 1870 with seedlings of *Castanea crenata* from Japon
- 1926 in all the range of American chestnut

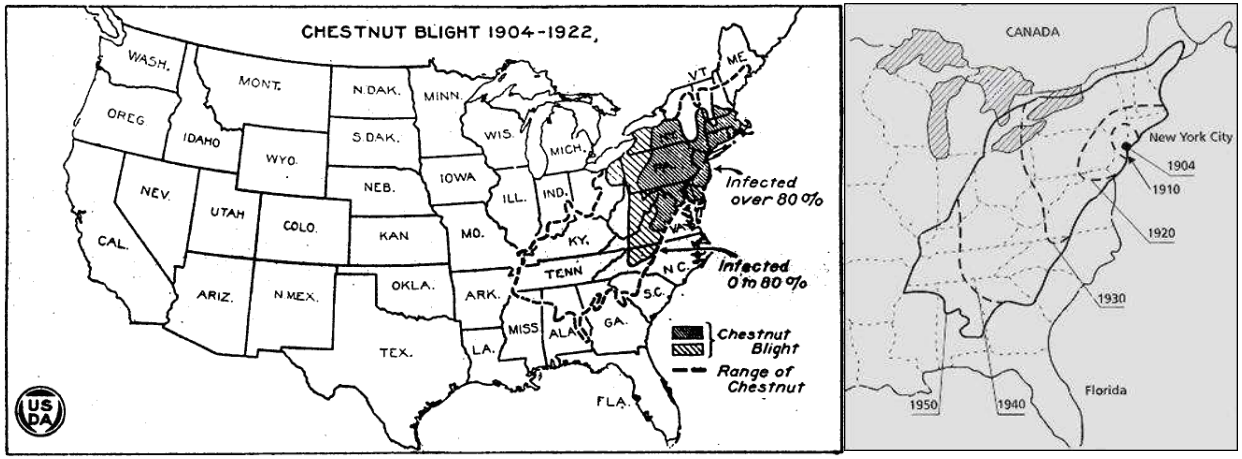


Natural Range of the American chestnut

Lumberjacks stand beside old-growth chestnut trees in North Carolina around 1910 (Forest History Society, Durham, N.C.)

Threat to species by the introduction of exotic ones

Chestnut blight
(*Cryphonectria parasitica*)



Spread of Chestnut Blight in the USA

A stand of blight-infected chestnuts in New York, 1915. (source: national-geographic.com, courtesy of William Powell)

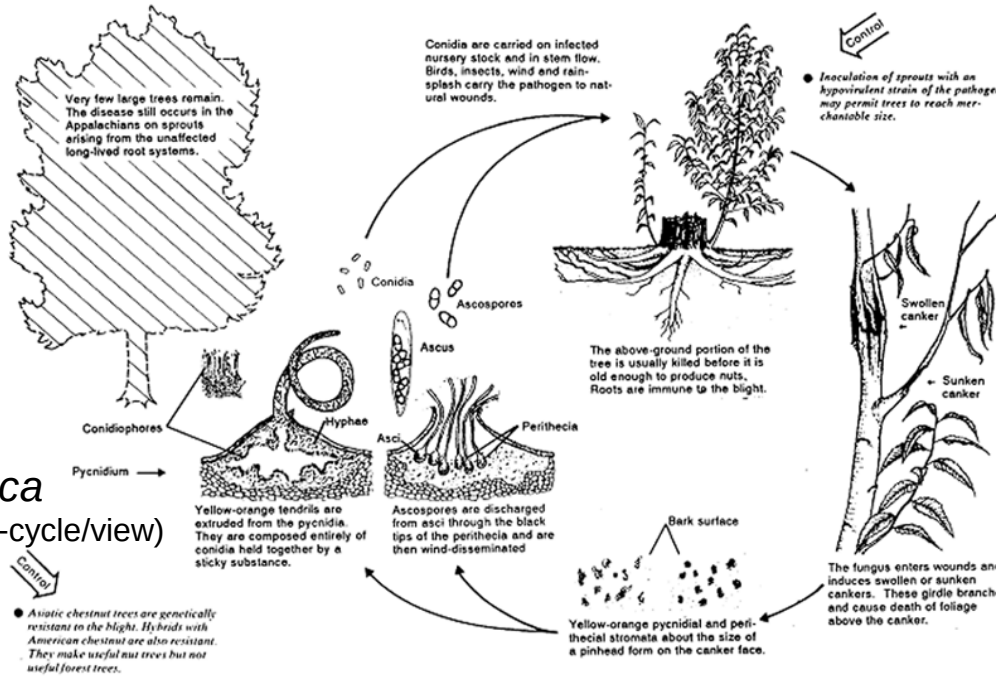
Dead American chestnuts, 1943 (USDA Forest Service)

Resprouting American chestnut stump

Threat to species by the introduction of exotic ones

Chestnut blight

(*Cryphonectria parasitica*)



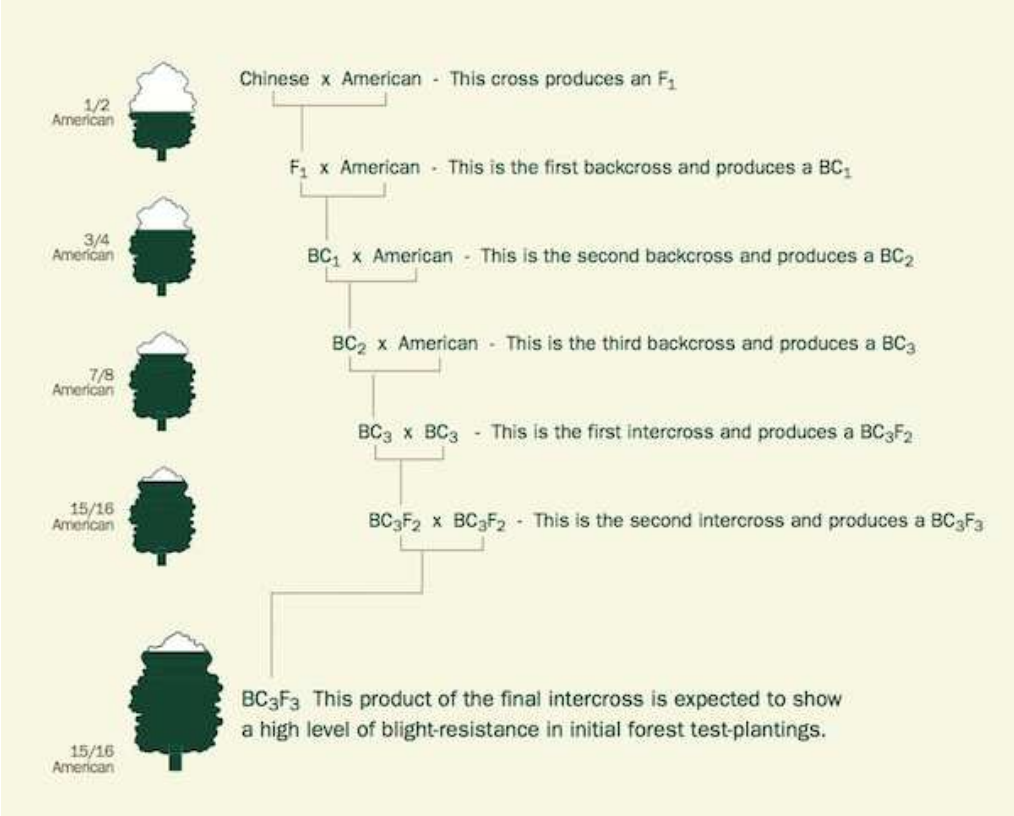
Disease cycle of *Cryphonectria parasitica*
(http://sfr.psu.edu/public/chestnut/breeding/blight/life-cycle/view)

Photographs Claudette Hoffman

Threat to species by the introduction of exotic ones

Chestnut blight (*Cryphonectria parasitica*)

Since the 1980s, backcrossing experiments have been conducted with the objective to obtain blight-resistant “American” chestnuts by backcrossing of resistant hybrids of American and Chinese chestnut (*Castanea mollissima*). In the last years there have been new attempts to obtain trees with as pure *C. dentata* genome as possible by means of genetic engineering (first taking a blight-resistance gene from wheat, now screening for such genes in the genome of *C. mollissima*)



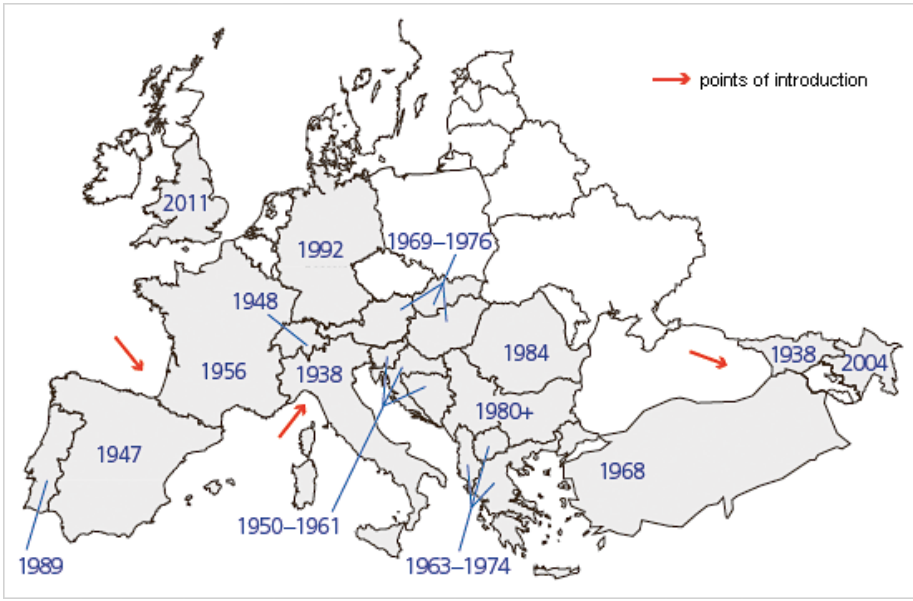
A diagram of backcrossing experiments. American Chestnut Foundation (source: nationalgeographic.com)

Chestnut hybrids, grown at the Hashawa Environmental Center,Carroll County, MD. (Photo: Melissa Boyle; source: http://www.americanforests.org /magazine/article/revival-of-the-american-chestnut/)

Threat to species by the introduction of exotic ones

Chestnut blight (*Cryphonectria parasitica*)

Chestnut trees infected with chestnut blight near Collonges (Valais). After a long-standing infection, a large portion of the crown has died off. (Photo: Phytopathology WSL)



Occurrence of chestnut blight (*Cryphonectria parasitica*) within the distribution range of the European chestnut (*Castanea sativa*). Years indicate when the disease was first observed, while arrows suggest probable points of introduction.

Threat to species by the introduction of exotic ones

Dutch Elm Disease (caused by the fungi *Ophiostoma ulmi* and *O. novo-ulmi*)

- First wave of elm dieback in Europe from ca 1910
- The cause was a fungal disease leading do clotting of tracheae (tracheomykosis) caused by *Ophiostoma ulmi* (= *Ceratocystis*; first observed in the Netherlands).
- Two bark beetles were the vectors, the larger (*Scolytus scolytus*) and smaller European elm bark beetle (*S. multristriatus*).
- In the process, the fungus *O. ulmi* outcompeted the less harmful, related *O. quercus*, with which these bark beetles had lived in symbiosis.
- Around 1920, *S. multristriatus* and the fungus *O. ulmi* were accidentally introduced to North America, where a pandemy affected all elms present (the even more sensitive native species as well as planted European ones).
- Here, another bark beetle introduced from Asia (*Scolytus schevyrewi*) and a native species associated with elm (*Hylurgopinus rufipes*) also became vectors.

Longitudinal section of an elm vessel with enlarged tyloses. (Courtesy D.M. Elgersma)

Symptom of the Dutch Elm Disease: wilt of branches and later the whole tree crown

Scolytus multistriatus (above)
a *Hylurgopinus rufipes* (below)
(photos: J. R. Baker and S. B. Bambara, North Carolina State University, Bugwood.org)

Threat to species by the introduction of exotic ones

Dutch Elm Disease (caused by the fungi *Ophiostoma ulmi* and *O. novo-ulmi*)

- The first epidemy in Europe ceased in the 1940s.

- From the 1950s there was a second epidemy, caused by the even more virulent species *O. novo-ulmi,* in which two subspecies are distinguished, traditionally called Euro-Asian Race (EAN) and North American Race (NAN), which hybridise. This pandemy still continues.

- In Great Britain alone, some 25 million elms died; for instance in the floodplain forests of South Moravia (Czechia) the representation of elms dropped from about 30% to single, interspersed trees (mainly the more resistant young ones).

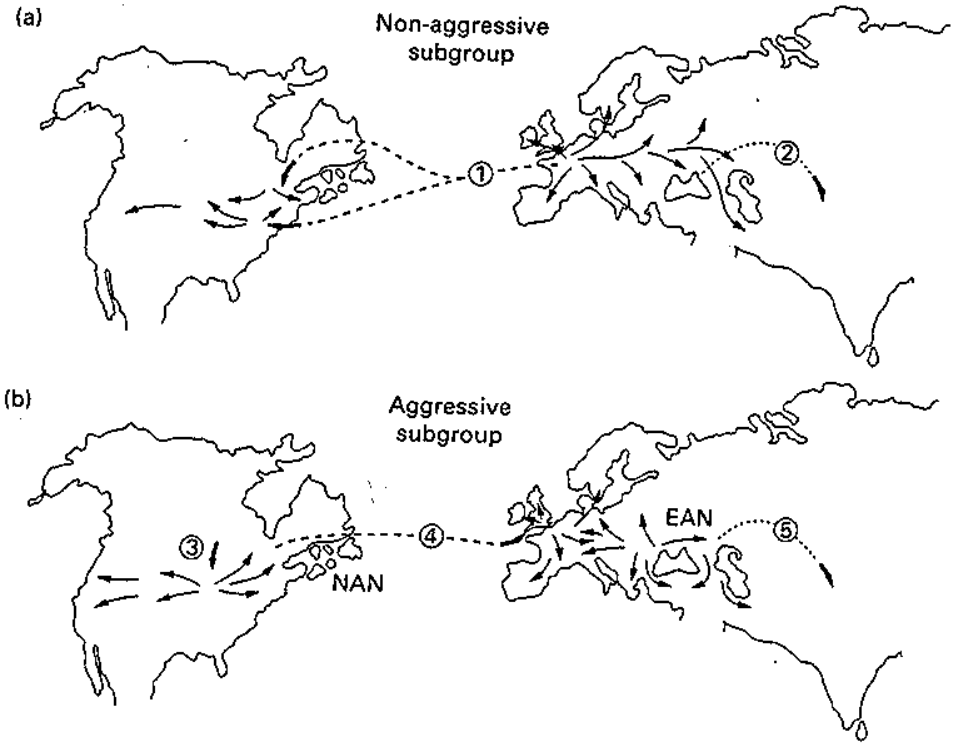
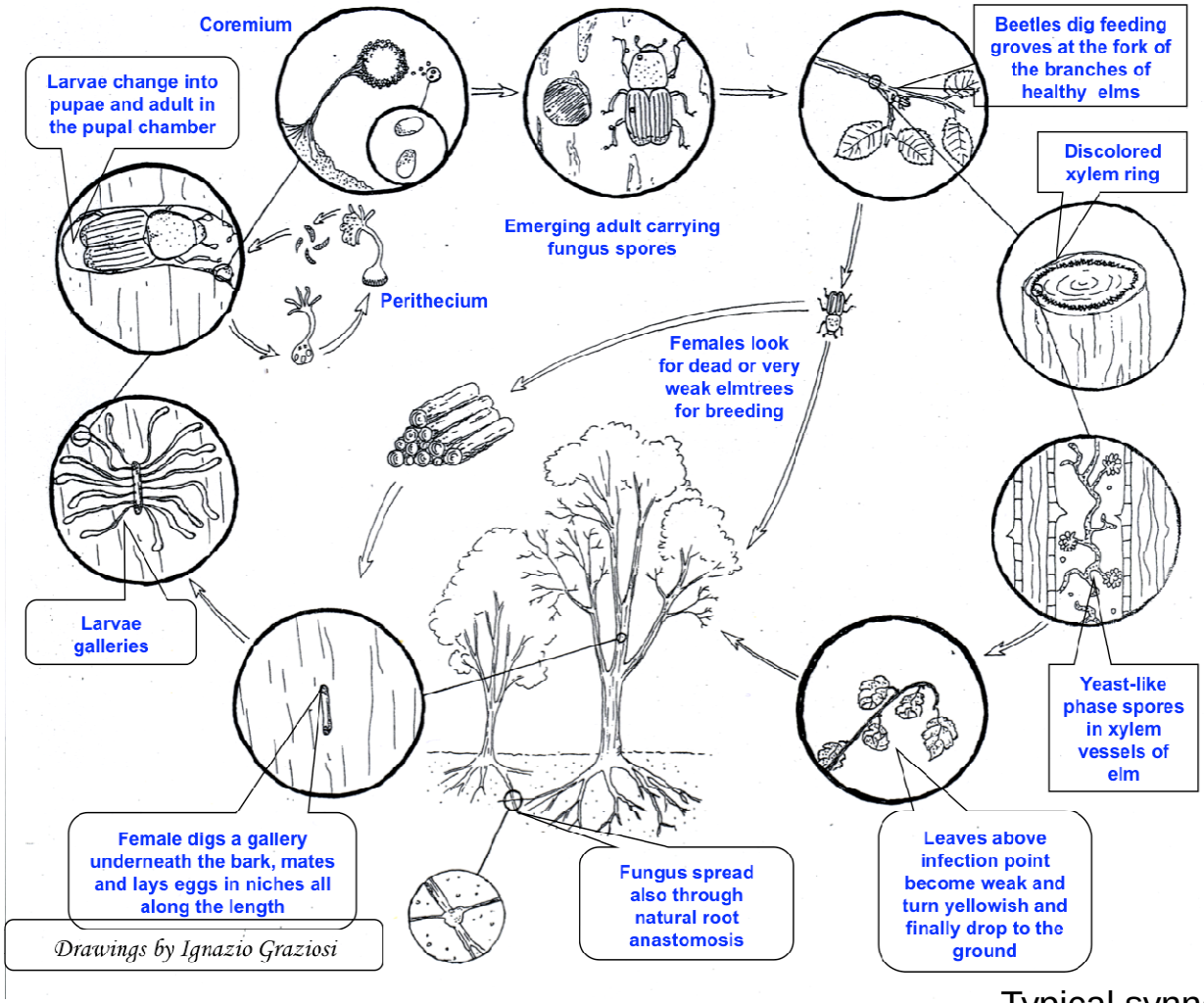


Fig. 9.9 Proposed pattern of spread of (a) the non-aggressive, and (b) the EAN and NAN aggressive subgroups of *O. ulmi* during the first and second epidemics of Dutch elm disease. Small arrows, overland spread; large arrows, major introductory events as follows. (1) Introduction of the non-aggressive subgroup from NW Europe to North America, *c.* 1920s. (2) Introduction of the non-aggressive subgroup from Krasnodor to Tashkent, *c.* late 1930s. (3) Introduction of a form close to the EAN aggressive subgroup into North America (Illinois area), *c.* 1940s, and its subsequent evolution into the NAN subgroup. (4) Introduction of the NAN subgroup from the Toronto area into the UK, *c.* 1960. (5) Introduction of the EAN subgroup into the Tashkent area, *c.* mid-1970s. (From Brasier 1990.)

Galleries of an elm bark beetle (*Scolytus* spp.) under elm bark

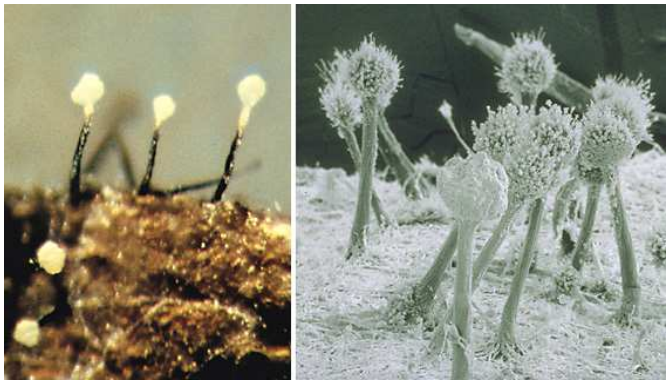
Threat to species by the introduction of exotic ones

Dutch Elm Disease (caused by the fungi *Ophiostoma ulmi* and *O. novo-ulmi*)



The life cycle of elm bark beetles and how the fungi *Ophiostoma ulmi* and *O. novo-ulmi*, causing Dutch Elm Disease, are transmitted.

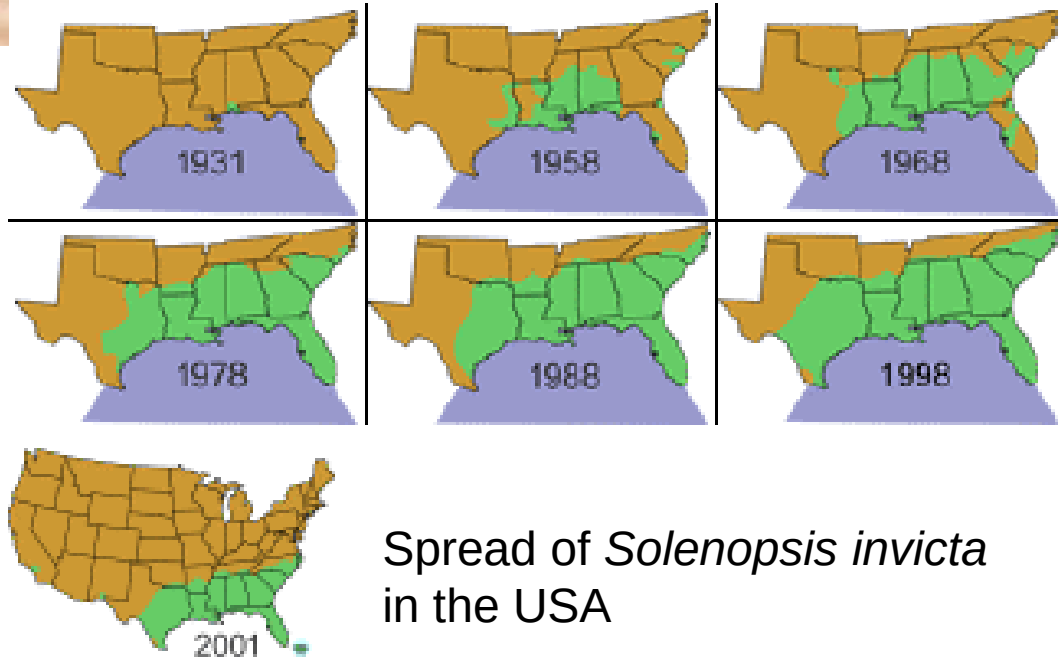
The European elm bark beetle (*S. multistriatus*) feeding in the twig crotch of an elm (Courtesy P. Svihra)



Typical synnemata (bundles of konidiophores) of the fungi *Ophiostoma ulmi* and *O. novo-ulmi.* Left: view under a light microscope (photo: L. F. Grand), right: micrograph from a scanning electron microscope (photo: M. F. Brown a H. G. Brotzman)

Threat to species by the introduction of exotic ones

Invasion of the Argentine fire ant (*Solenopsis invicta*) to North America



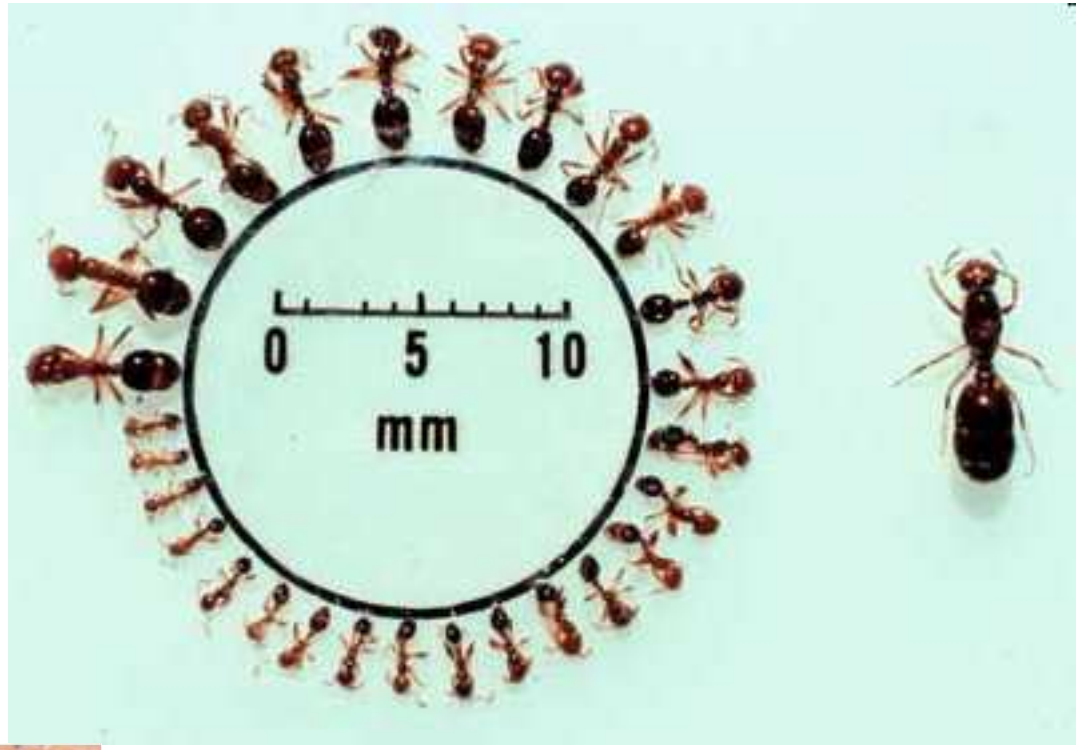
Spread of *Solenopsis invicta* in the USA

The result of direct contact of man with *S. invicta*

Threat to species by the introduction of exotic ones

Solenopsis invicta

The workers show a high degree of polymorphism.
Under favourable conditions, *S. invicta* creates supercolonies extending over large areas (interconnected nests of related colonies).



Threat to species by the introduction of exotic ones

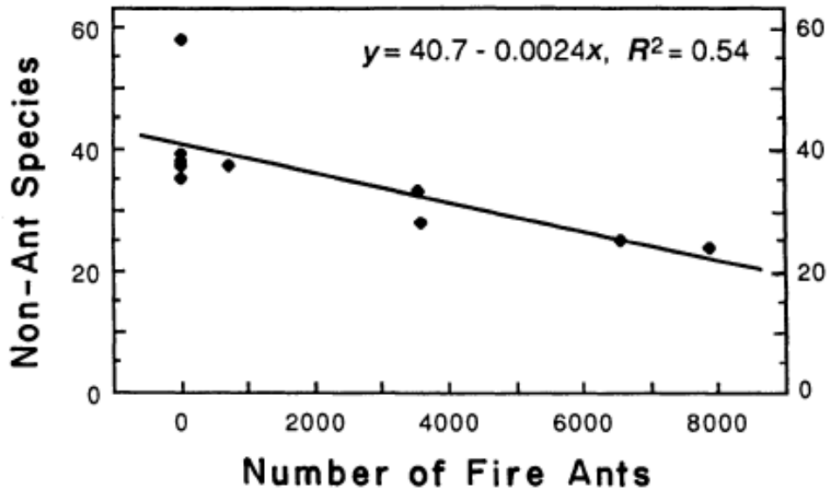
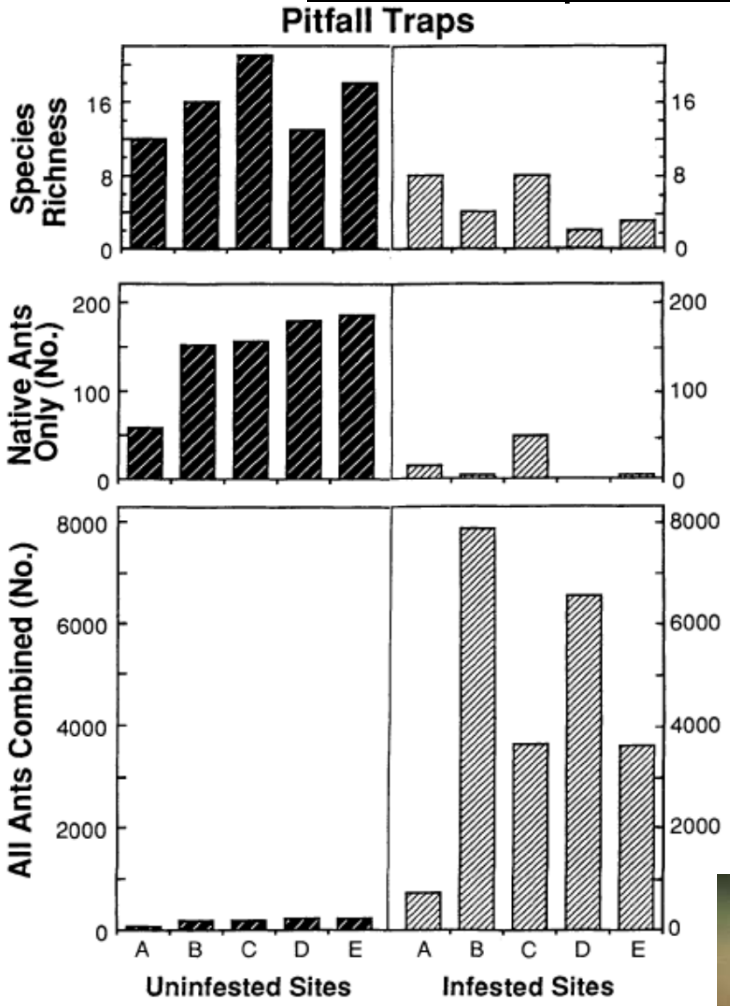


FIG. 6. Relationship between the number of fire ants (*Solenopsis invicta*) and the number of non-ant species collected in pitfall traps at 10 sample sites ($P = .015$).

According to a study conducted in the late 1980s in central Texas (Porter and Savignano, 1990), *S. invicta* supercolonies had the following effects on assemblages of ants and other arthropods:

- drop of ant species richness by 70%
- drop of ant abundance of native species by 90%
- where *S. invicta* occurred, it made up for over 99% of all ants, the total abundance of ant workers increased by 10-30%
- decrease of the species richness of other arthropods by 30% and of their abundance by 75% (some groups were severely reduced, others beneffited from that and increased)

Threat to species by the introduction of exotic ones



Effect of *S. invicta* on species richness and abundance of ants (workers) – based on pitfall trapping (Texas, USA, 1987) - from Porter and Savignano (1990).

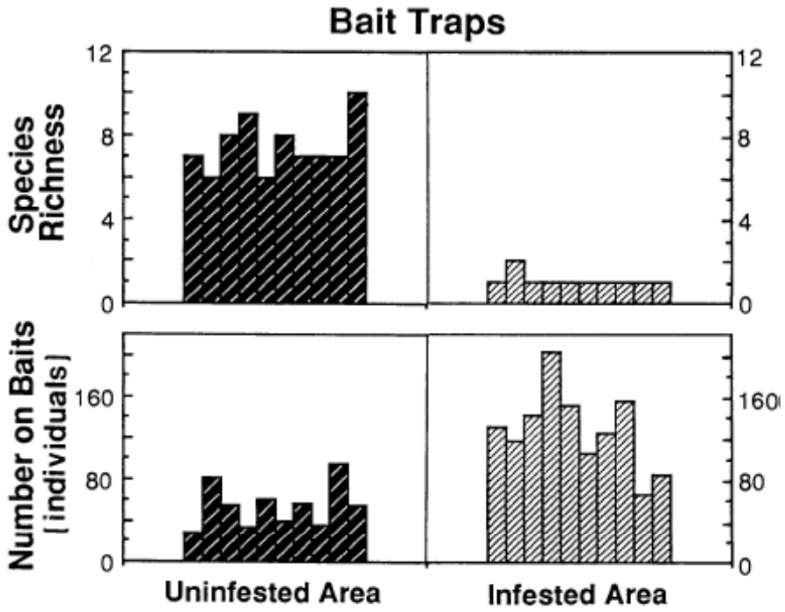


FIG. 4. Ant species richness and numbers of workers attracted to bait traps at 10 uninfested sites and 10 sites infested with the fire ant, *Solenopsis invicta*. Data are from site totals summed across date.

Porter and Savignano (1990)

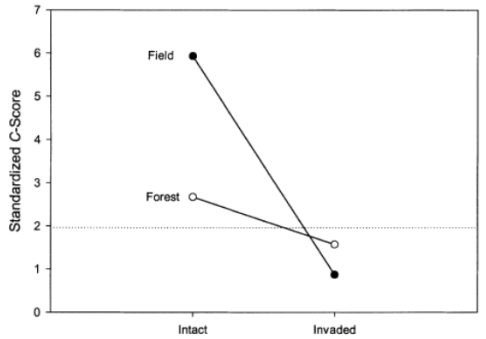
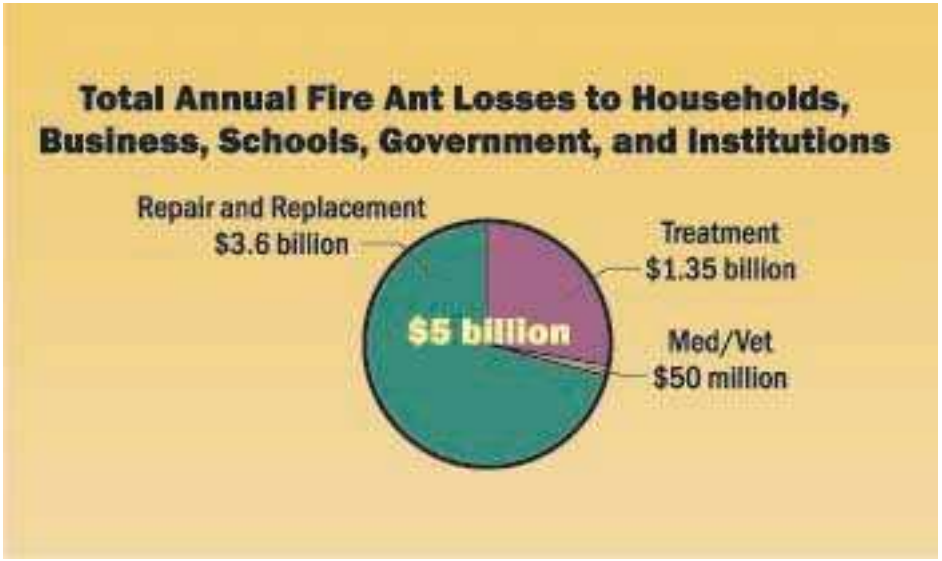


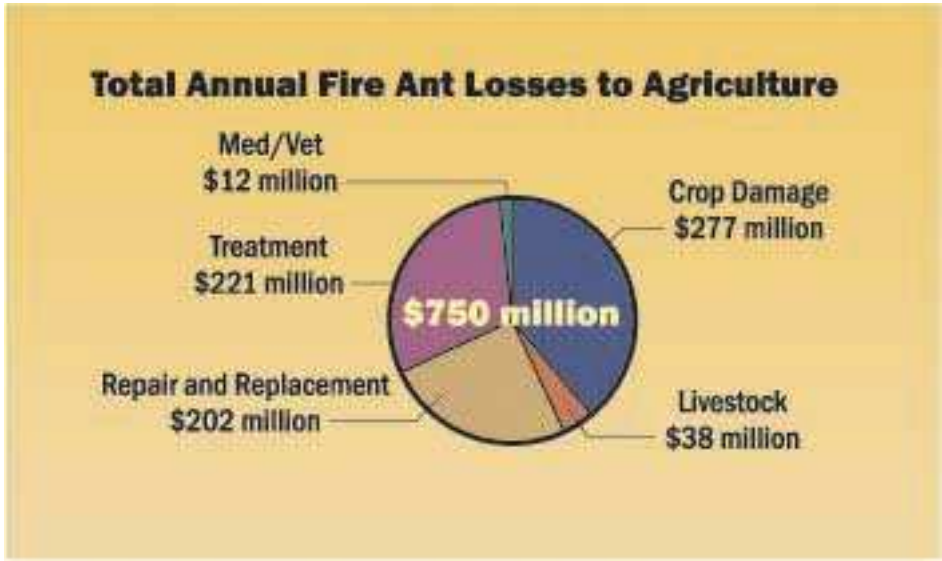
Figure 2 Effects of *S. invicta* on community structure. The standardized *C*-score measures the extent to which species co-occur less frequently than expected by chance. The larger the standardized *C*-score, the less co-occurrence compared with a randomly assembled community. The dotted line indicates 1.96 standard deviations, the approximate level of statistical significance ($P<0.05$). ○, Forest ant assemblages; ●, open-field ant assemblages. In the presence of *S. invicta*, ant community structure converges to a random pattern.

N.J. Gotelli and A.E. Arnett
Ecology Letters, (2000) **3**:257–261

Threat to species by the introduction of exotic ones

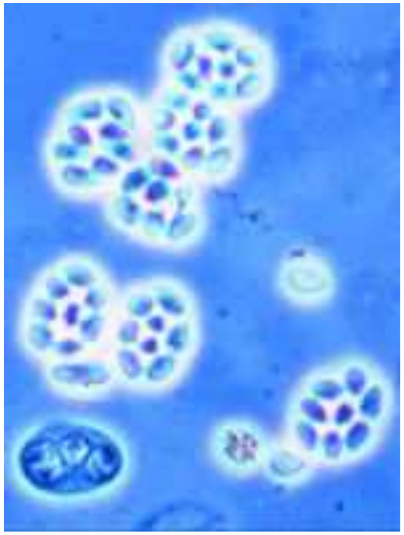
Solenopsis invicta



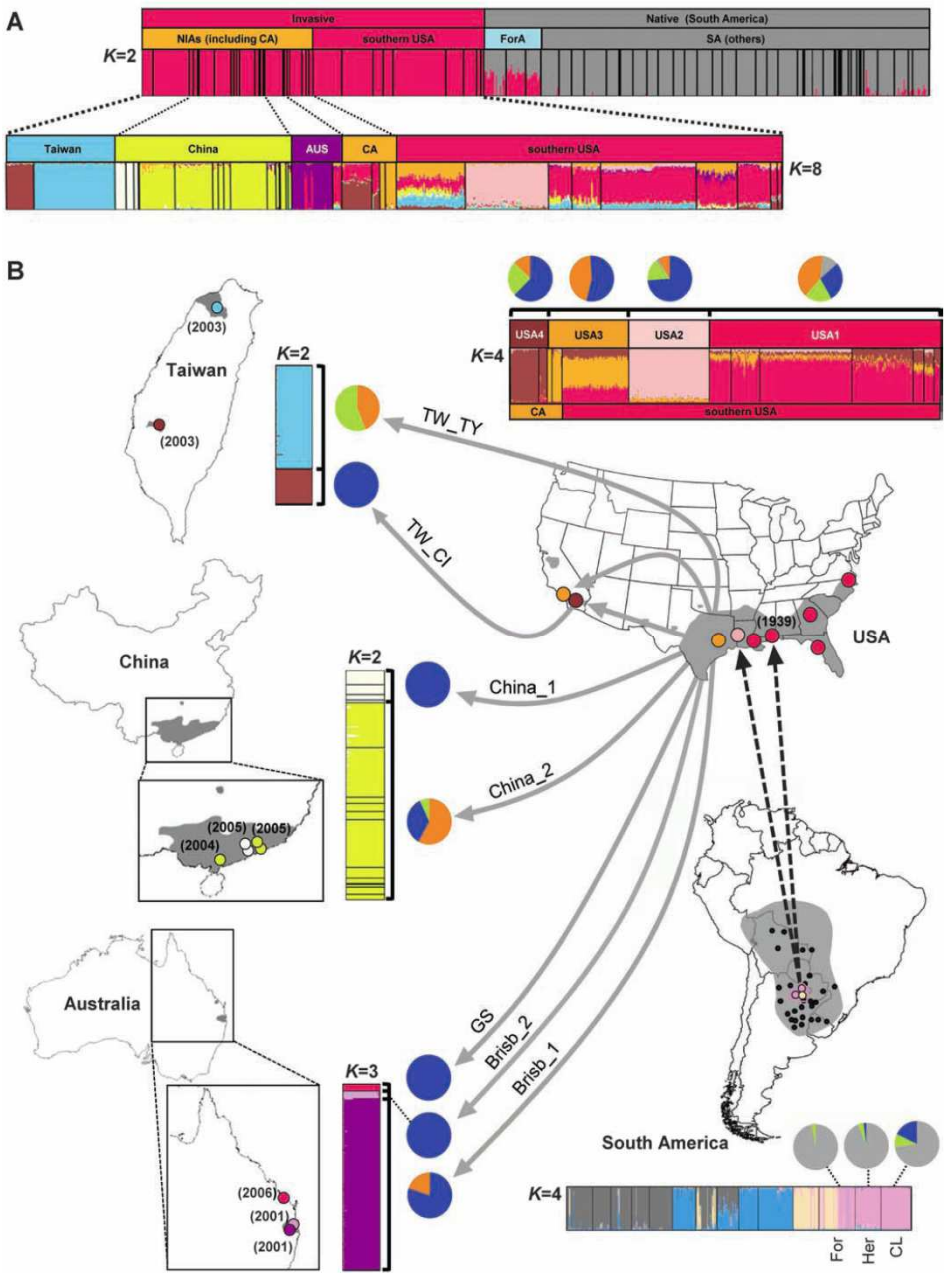


Assessment of annual damage inflicted by *S. invicta* in the USA

There have been attempts of biological control of *S. invicta* using parasitoid flies of the genus *Pseudacteon* and the pathogenous protozoan *Thelohania solenopsae*.



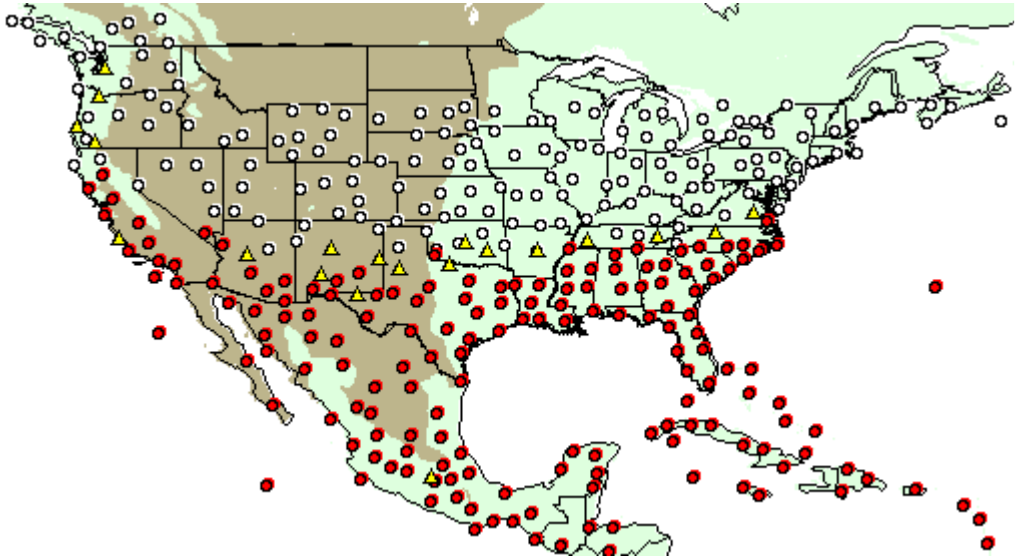
Threat to species by the introduction of exotic ones

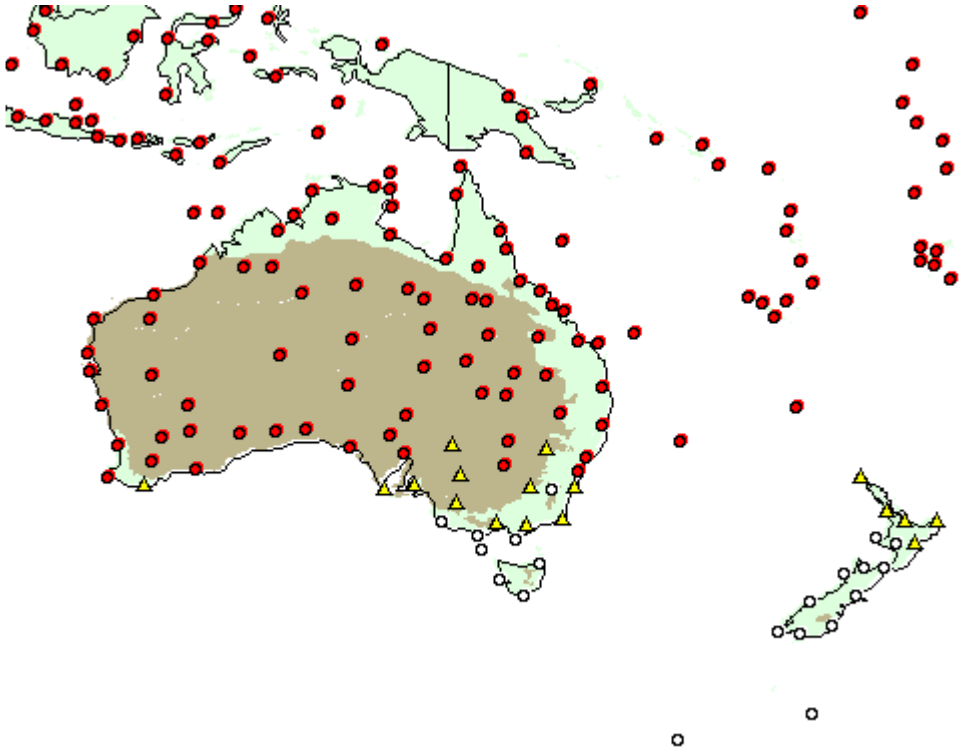


A molecular-genetic study has shown that first colonies of *Solenopsis invicta* found on Taiwan, mainland China and in Australia were of North American origin (Ascunce et al. 2011)

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Solenopsis invicta





Potenciální rozšíření (červené body) mravence *S. invicta* v severní Americe, Austrálii a na okolních souostrovích na základě vyhodnocení klimatických dat.

Potential range (red points) of *S. invicta* in N. America, Australia and neighbouring archipelagos based on the analysis of climatic data.

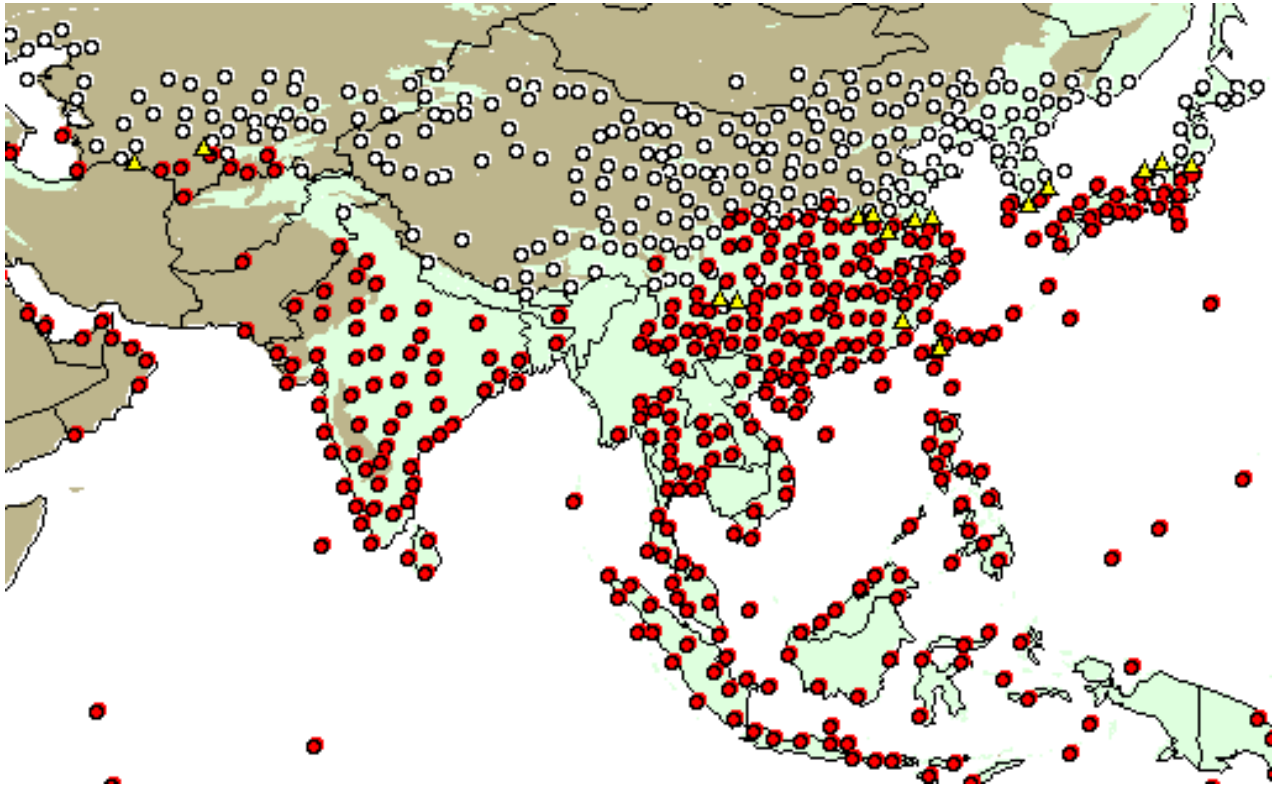
První, maloplošný výskyt v Austrálii byl již zaznamenán!

A first small-scale occurrence in Australia has already been recorded.

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Solenopsis invicta



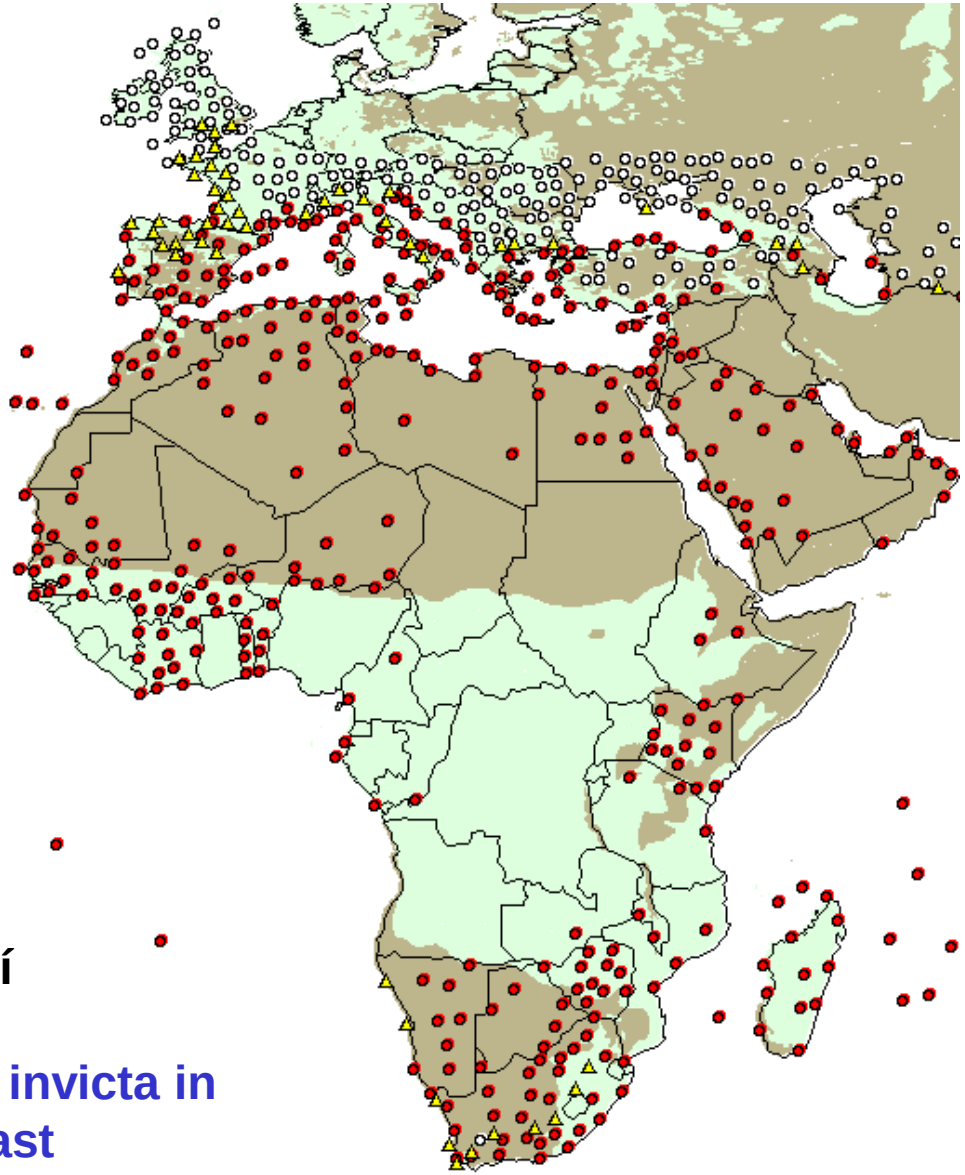
Potenciální rozšíření (červené body) mravence *S. invicta* v Asii na základě vyhodnocení klimatických dat.

Potential range (red points) of *S. invicta* in Asia based on the analysis of climatic data.

Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Solenopsis invicta



Potenciální rozšíření (červené body) mravence *S. invicta* v Evropě, Africe a na Blízkém východě na základě vyhodnocení klimatických dat (červené body).

Potential range (red points) of S. invicta in Europe, Africa and in the Near East based on the analysis of climatic data.

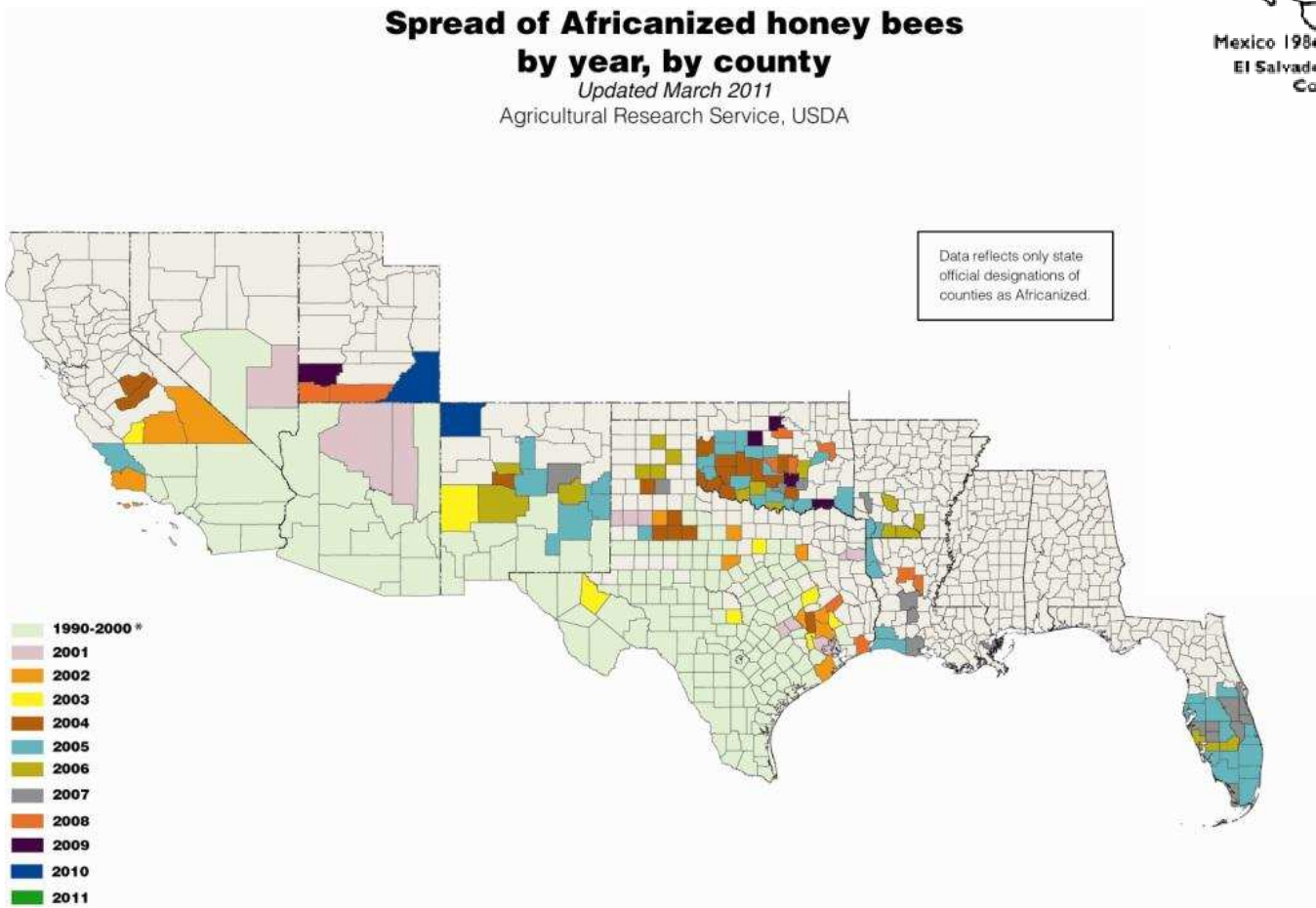
Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Africký poddruh včely medonosné - *Apis mellifera scutellata*, resp. jeho hybridi s jinými poddruhy se šíří jižní a střední Amerikou. Svou vysokou agresivitou představují nebezpečí pro původní včelstva, zvířata i člověka.

The African subspecies of the honeybee – *Apis mellifera scutellata* – or its hybrids with other subspecies are expanding their range in South and Central America. By their high agressivity the present a threat to native bee colonies, animals and humans.

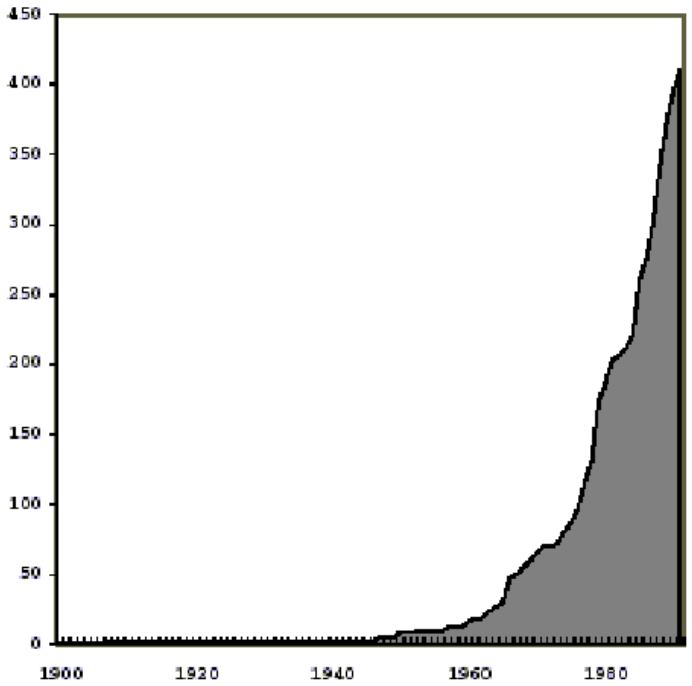
Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones



Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

Invasive hogweeds (*Heracleum* spp.) in Europe



Bolševník velkolepý *(Heracleum mantegazzianum)* v ČR

The Giant Hogweed *(Heracleum mantegazzianum)* in the Czech Republic.

Ohrožení druhů introdukcí nepůvodních druhů
Threat to species by the introduction of exotic ones

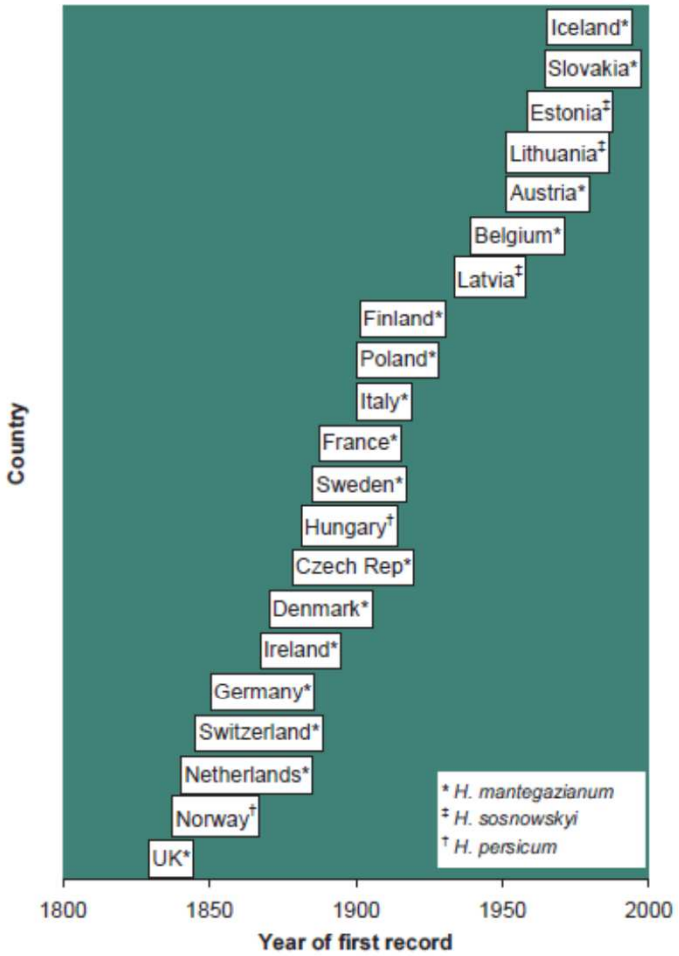
Invasive hogweeds (*Heracleum* spp.) in Europe

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

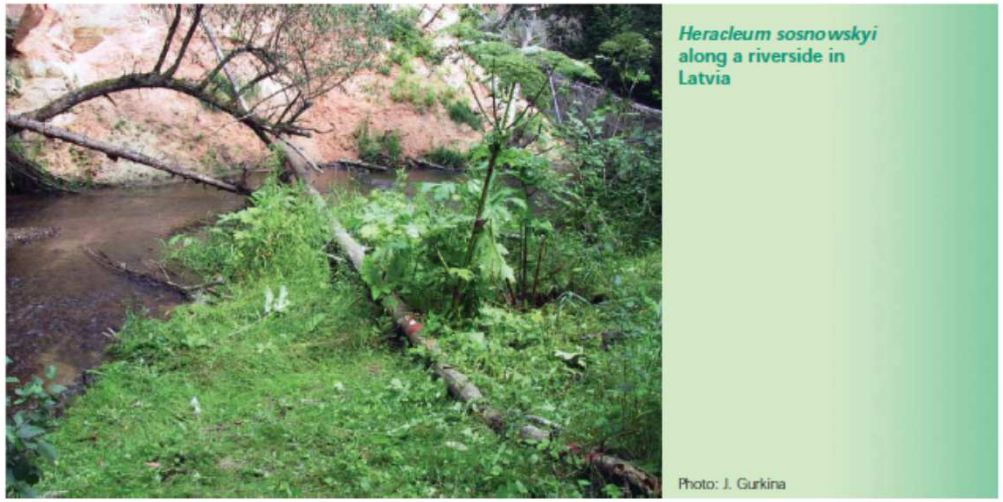
Ohrožení druhů introdukcí nepůvodních druhů

Threat to species by the introduction of exotic ones

Invasive hogweeds (*Heracleum* spp.) in Europe



*First records in the wild of tall invasive Heracleum species (*H. mantegazzianum, H. sosnowskyi *and* H. persicum*) throughout Europe*



Additional to Giant hogweed (originally from the Caucasus and areas south of it) some related exotic species are spreading in Europe:

- Persian hogweed (*H. persicum*) in Fennoscandia
- Sosnowsky's hogweed (*H. sosnowskyi*) in the Baltic states

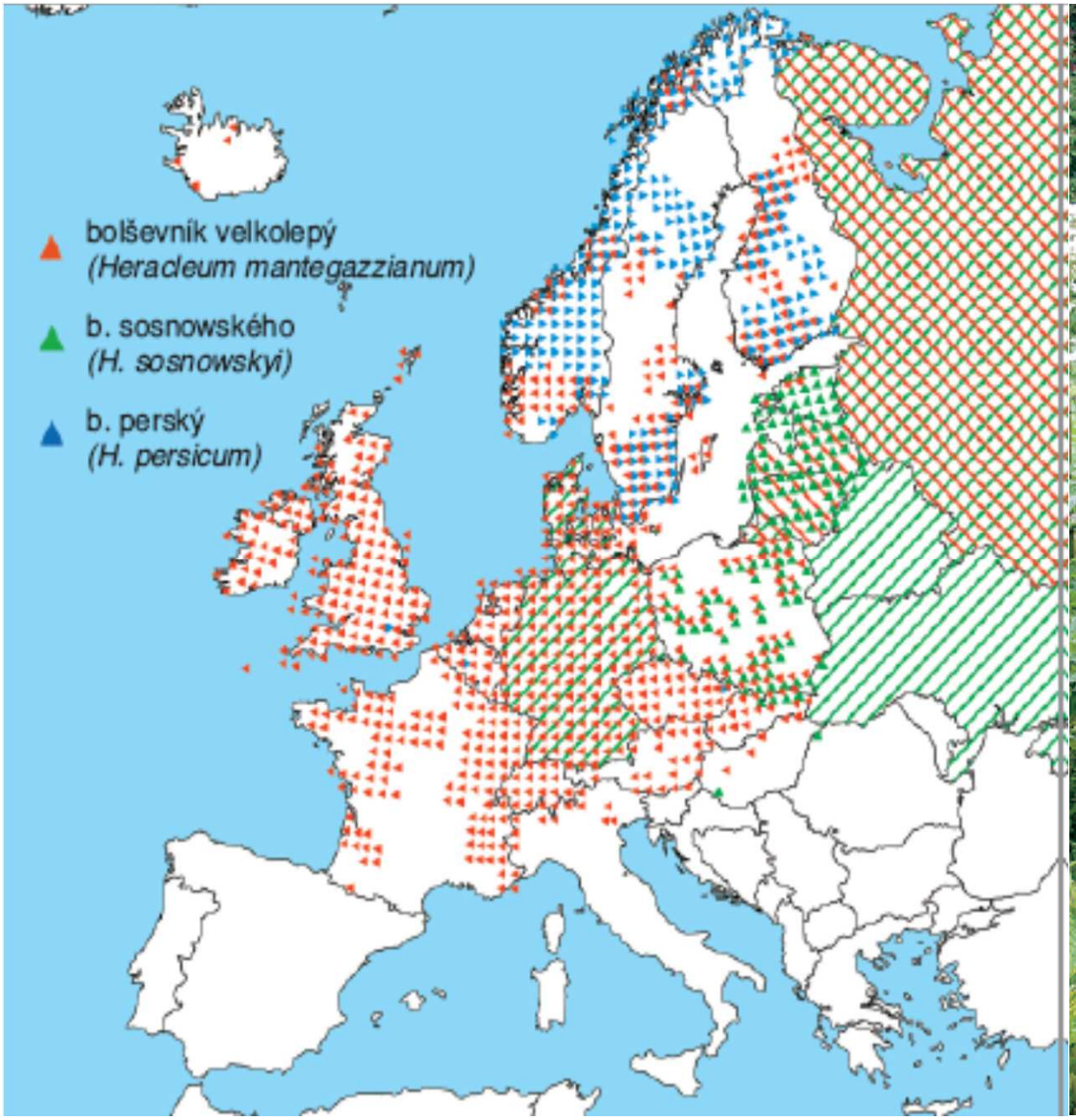
The Giant hogweed is also invasive in North America.

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Threat to species by the introduction of threatened ones

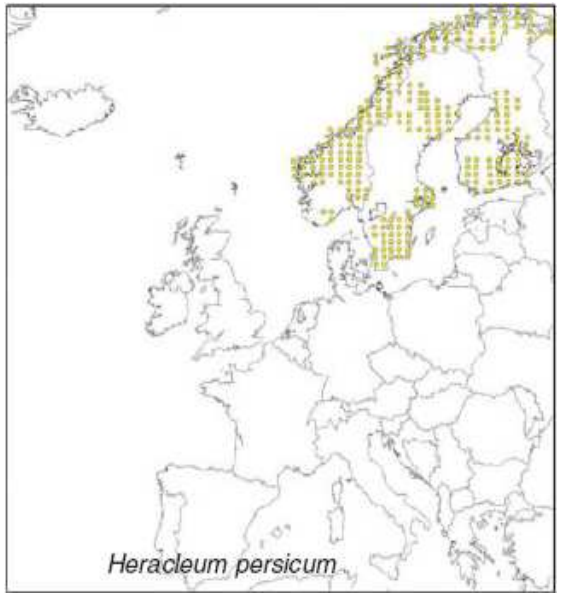
Invasive hogweeds (*Heracleum* spp.) in Europe



Distribution of invasive hogweeds (*Heracleum* spp.) in Europe

Threat to species by the introduction of threatened ones

Invasive hogweeds (*Heracleum* spp.) in Europe



Distribution of invasive hogweed species (*Heracleum* spp.) in Europe

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Threat to species by the introduction of threatened ones

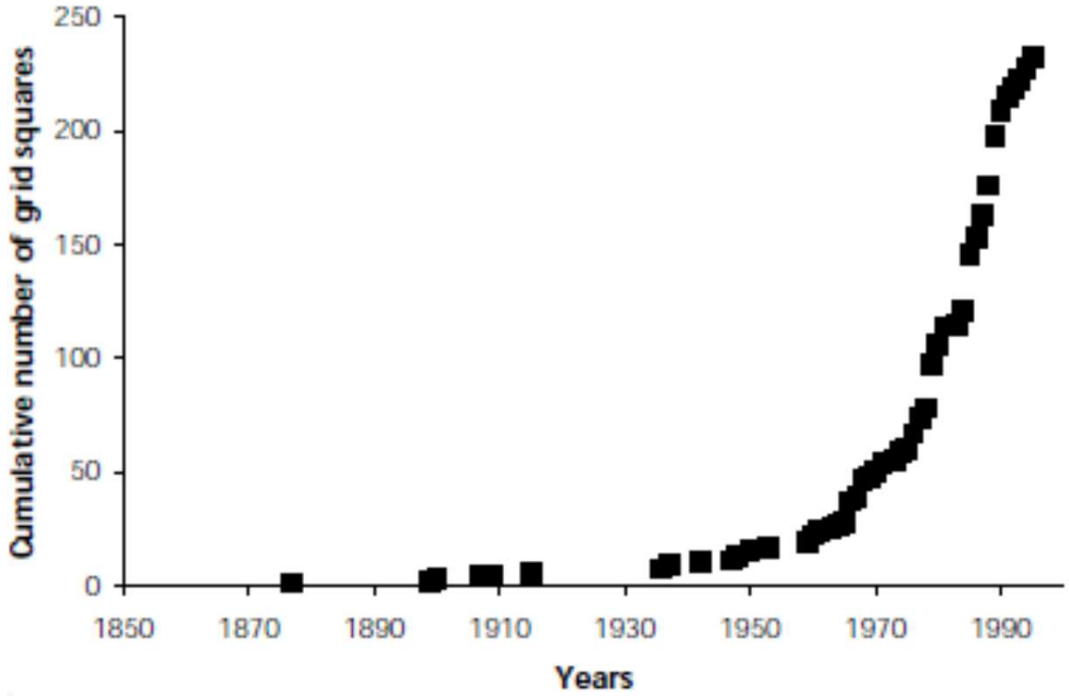
Invasive hogweeds (*Heracleum* spp.) in Europe

Table 1. Features of tall invasive hogweed species

Plant species	Height (cm)	Stem	Leaf	Flower	Fruit	Distribution
Giant Hogweed *Heracleum mantegazzianum*	200-400 (-500)	Shaggy (villous) upper stem; lower stem coarsely ridged and more or less hairy. Stem up to 10 cm thick at base with purple blotches				Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Liechtenstein, Luxemburg, Netherlands, Norway, Poland, Russia, Slovakia, Sweden, Switzerland, UK incl. Northern Ireland Possible occurrence in: Belarus, Estonia, Latvia, Lithuania, Ukraine
Heracleum sosnowskyi	100-300	Ridged, sparsely hairy stem with purple blotches very simular to Giant Hogweed		White flowers. Outer petals radiate, 9-10 mm long. Slightly convex compound umbels, 30-50 cm across. 30-75 rays with only short hairs		Belarus, Estonia, Germany, Hungary, Latvia, Lithuania, Poland, Russia, Ukraine
Heracleum persicum	(-100) 150-300	Stem purple, 1.5-2 cm thick at the base. Whole plant has anise odour				Denmark, Finland, Norway, Sweden, Possible occurrence in: Hungary, Latvia, UK
						Drawings; J. C. Schou

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

The Giant hogweed (*Heracleum mantegazzianum*) in Europe



Dynamics of the Giant hogweed invasion in Czechia
(grid size: 11 km x 12 km)

As in other countries, Giant hogweed was originally planted in Czechia as an ornamental plant – for the first time in 1862 – possibly even earlier – in the gardens of Kynžvart castle in western Bohemia.

Wild-growing plants were observed here from 1877, by 1907 already in north-eastern Moravia. In 1950 there were 9 known localities in the open countryside, today ca 600.

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Threat to species by the introduction of threatened ones

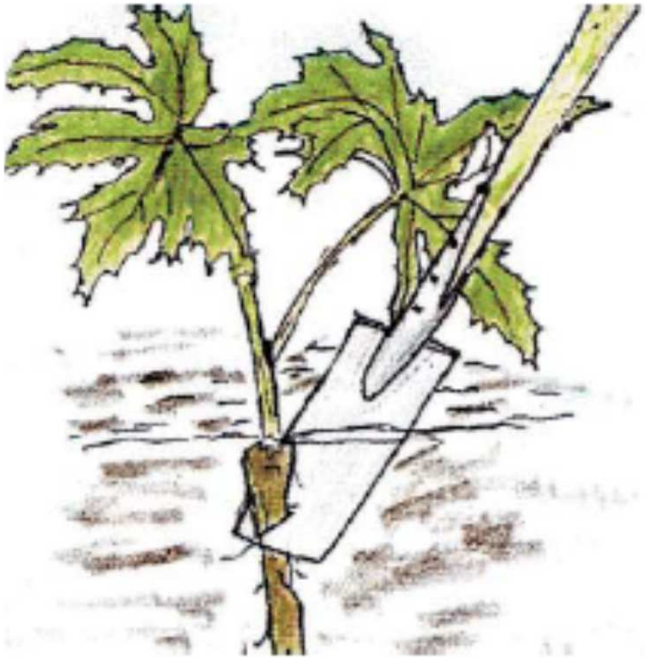
The Giant hogweed (*Heracleum mantegazzianum*) in Europe

Traits that make the species such an successful invader:

- High fecundity and ability of self-pollination (a single plant can found a population and thus cause an invasion)
- Flowering sufficiently early in the vegetation period to complete the development of seeds
- High density of seeds in the soil seed bank, with some seeds surviving for at least two years
- Very high germination rate
- Germination in early spring before the resident vegetation appears
- Fast growth of rosettes allowing rapid development of populations and the ability to form dense cover and place leaves above the resident vegetation
- Low mortality of plants once they become established
- Stable proportion of plants that flower and produce seeds
- Ability of plants under stressful conditions to postpone flowering until a time when sufficient reserves are stored (success at suboptimal sites)

Threat to species by the introduction of threatened ones

Invasive hogweeds
(*Heracleum* spp.) in Europe



The root must be cut at least 10 cm below soil level. Plants in pastures have deeper roots and they should be cut 10 cm below the top of the root

Drawing: Peter Leth, County of Vestsjælland, Denmark

Tall invasive species of hogweeds have a high regeneration potential and cutting treatment must be conducted 2-3 times during the gro-wing season in order to stop plants from setting seed

Photo: C. Nielsen

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Threat to species by the introduction of threatened ones

Invasive hogweeds (*Heracleum* spp.) in Europe

Sheep and cattle prefer young and fresh plants, and the most efficient control is obtained by beginning the grazing early in the season when the plants are small.

Photo: C. Nielsen

Treatment effects of glyphosate when applied once early in the growing season (late April). The photograph was taken one month after the treatment

Photo: C. Nielsen

Source: Nielsen, C., H. P. Ravn, W. Nentwig, M. Wade (editors), 2005: The Giant Hogweed Best Practise Manual. *Forest & Landscape Denmark*, Hoersholm, 43 pp.

Threat to species by the introduction of threatened ones

Japanese or Asian knotweed (*Reynoutria japonica),* Nakai giant knotweed (*R. sachalinensis)* and in Czechia in particular their local hybrid Bohemian knotweed (*R. x bohemica*) are among the most successful invasive plants.

Origin: The Far East (Japan, Korea, China and the Sachalin island, respectively). Introduced in the 19. century as ornamental plants.

Spreads along water courses and to disturbed (ruderal) sites.

Strong competitors with high ability of regeneration.

Outcompete native species.

Threat to species by the introduction of threatened ones

Impatiens glandulifera
(many English names, e.g. Himalayan Balsam, Policeman's helmet)

Origin: The Himayas

Introduced to Europe as an ornamental Plant in the first half of the 19th century.

First planted within Czechia in the Červený Hrádek castle park near Jirkov (NW Bohemia), first record "in the wild" near Litoměřice (ca 50 km to the east of Jirkov) in 1896 .

Became invasive in the 1930s, spreading mostly along water courses, building up homogenous, permanent stands in the river floodplains, replacing native vegetation.

Threat to species by the introduction of threatened ones

***Impatiens parviflora* (Small balsam, Small-flowered touch-me-not)**

Origin: south-western Siberia, western Mongolia, western Himalayas.

Introduced to further areas of Asia, Europe, North Africa, and North America in the first half of the 19th century.

In Czechia spreading since the end of the 19th century from castle parks and botanical gardens.

Requires shady, nutrient-rich habitats. Under these conditions it creates contiguous stands and supresses native species of the herb layer including the native touch-me-not balsam.

Small balsam (*Impatiens parviflora*)

Touch-me-not balsam (*Impatiens noli-tangere*)