

Biological invasions as an environmental and economic threat

Alien Invasion



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The hustle-and-bustle of our everyday lives generally prevents us from noticing the fierce, life-and-death battles quietly paying out around us, as incoming "invaders" ruthlessly conquer native species of plants and animals. Can we cope with this problem?

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The biological diversity in all regions of the world naturally undergoes constant change, as a consequence of the territorial shrinking and expanding of species. Such natural processes rarely occur in any sudden fashion, as they are slowed by both abiotic barriers (mountain ranges, climatic

conditions) and biotic barriers, i.e. a kind of "immunity" against the encroachment of new species that is developed by biocenoses (ecological communities) in the course of evolution. This state of affairs, in force for billions of years, was upset only once mankind appeared on Earth.

With a purpose or as "stowaways"

With the advance of civilization, human-related factors have been playing an ever-greater role in shaping the species makeup of particular parts of the Earth. As they colonized new territory, humans brought various plant and animal species with them to serve economic purposes (e.g. cultivated plants and farm animals) as well as to satisfy their aesthetic tastes. Natural barriers therefore ceased to suppress the expansion of species. As the circulation of people and goods grew more intense, in addition to such purposeful introductions of species, mankind began to

Mariusz Lementowicz



Raccoons heading eastward! Poland's first population of the North American raccoon *Procyon lotor*, in the national park at the Warta River estuary, was founded by specimens migrating in from Germany



East News

Fortunately, alien invasions from outer space remain the stuff of science fiction. Nonetheless, the Earth's own invasive alien species do sometimes treat the native species they encounter in their new territory just as ruthlessly as James Cameron's *Aliens*

cause unintentional introductions as well. Contemporary means of rapid transport now make it possible for a given species to be transported out of its natural range to any other point on the globe within just a day or two. Such accidental "stowaways" are currently the most important source of new species invasions.

Aliens among us?

Species which are transported outside of their natural range through either purposeful or accidental human activity are called "alien species." This notion likewise includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. The introduction of alien species into new terrain most often does not exert any negative impact on the existing local ecosystem. Such species "painlessly" blend in as new elements of the biocenoses, and may even have a positive economic impact on regions where they are introduced. Most cultivated plants and domesticated animals, after all, nowadays occur far beyond their original, natural range.

Yet there are some alien species which clearly do have a negative impact on their new environment - these are called "invasive alien species." Their annual cost to the world economy is now estimated at 1.4 trillion USD! Moreover, biological invasions are currently considered to pose one of the two greatest global threats to the natural environment, alongside the destruction of certain types of habitat (e.g. tropical forests).

Such "invaders" can affect native plants and animals in various ways, such as by eating them directly or by bringing in new parasites that can attack indigenous species. Alien species can also compete with native

rivals for food, light, water, or reproductive space within a similar ecological niche. They may also interbreed with related indigenous species. These and many other processes can lead to a drop in native species' numbers or even to their complete disappearance.

Poland no exception

No place on Earth is completely safe from such biological invasions, and Poland is no exception. The PAN Institute of Nature Conservation and the PAN Institute of Botany in Kraków are currently conducting "twin" projects aimed at comprehensively taking stock of the problem in our country. By gathering information about past species introductions and data about the biology of alien species, the present author is working to predict which characteristics are responsible for making a given species a potentially successful "invader" and which ecosystems are most susceptible to such invasion. A database of "Alien Species in Poland" is being developed (www.iop.krakow.pl/ias), currently containing some 760 species, although the real numbers may be several times higher.

Possibly, the problem of alien species invasions now most strongly affects Poland's flora, which according to the latest data encompasses 2,935 species, 445 of them



Michał Grabowski

This invasive gammarid species *Pontogammarus robustoides* wreaks havoc among Poland's native gammarids



Janusz Kupryjanowicz

Sosnowski's hogweed *Heracleum sosnowskyi* was brought to Poland from the Caucasus region in the 1960s for experimental purposes, but its cultivation slipped out of control. Touching the plant causes burns and allergies. Efforts have been made to fight its spread by cutting down large clusters or even by using herbicides, yet the results have been meager

alien. Of the latter, some 290 are considered neophyte species, meaning plants which first appeared in Polish territory after the year 1500. More than half encroach upon semi-natural and natural species communities, while nearly one-quarter are strongly expansive. The ratio of alien species is high among vertebrates as well: one of every three fish species, and one out of every ten bird and mammal species in Poland are alien to our indigenous ecosystem.

Although there is no evidence of an alien species having led to the complete disappearance of any native species in Poland, there are numerous known examples of alien species which have had a very negative impact on Poland's flora and fauna. Particularly invasive alien plant species include Sosnowski's hogweed *Heracleum sosnowskyi* and the Japanese knotweed *Fallopia japonica*. Paradoxically, both of these species have been proposed as potential candidates to be cultivated for producing energy, advertised as offering "clean sources of renewable energy."

European bison under threat

One of the most menacing species of alien fauna in Poland is *Ashworthius sidemi*, a small blood-sucking nematode parasite which infects the abomasum and duodenum of ruminants. It was originally found in the Far East, among Asian members of the deer family, chiefly the sika deer *Cervus nippon* and Asian subspecies of the red deer (e.g. the Siberian maral *Cervus elaphus sibiricus*). This parasite was introduced into many European

countries together with such deer species, colonizing local species of wild ruminants (red deer, roe deer, and elk). The *A. sidemi* parasite was first recorded in Poland in 1997, among European bison shot in the Bieszczady mountains, which had most likely picked up the parasite from deer migrating in from neighboring areas of Ukraine and Slovakia. In 1997-1999, the parasite was recorded in all wild ruminant specimens tested in the Bieszczady region. In 2000, *A. sidemi* was unfortunately likewise recorded in European bison from the Białowieża Forest for the first time ever - with all the bison in the area becoming infected within the next four years! At present, the parasite's impact on European bison health is being intensively studied and methods are being developed for how to resolve the problem. Although the *A. sidemi* invasion remains relatively stable among the parasite's original deer-family hosts, in which it does not evoke any visible pathological changes, among the bison - which are from the family *Bovidae* and came into contact with the parasite only recently - infection proceeds rapidly and causes noticeable pathological changes. The

Jarosław Samsel, <http://wzdny-swiat.org>

Neogobius melanostomus, the round goby fish, has proliferated in the Baltic Sea, posing an ever-greater danger to native fish species

parasite is definitely proving detrimental to the health of the world's largest herd of this endangered species. In order to avoid spreading the parasite further, great caution must be taken when introducing its potential hosts into new regions - in Poland this chiefly means the introduction of sika deer, now increasingly being raised on farms.

Uninvited guests

Another alien species whose invasion of Poland has recently grown more intense is the North American raccoon *Procyon lotor*. Western Poland, including the Ujście Warty National Park (at the estuary of the Warta River), now has a growing population of this species started by specimens migrating in from eastern Germany, where raccoons were introduced prior to WWII. Their pleasant appearance and charm have made these animals fashionable "pets." Individual specimens sometimes observed in other regions of Poland have been abandoned by thoughtless former owners who were unaware that these seemingly cuddly creatures are very difficult to keep. This invasion of omnivorous raccoons could pose a special danger to a number of indigenous vertebrates and could also spread the very dangerous raccoon roundworm *Baylisascaris procyonis*, whose larvae attack the nervous system and sensory organs of birds and mammals, including people.

Another dangerous invasion has likewise been underway in the Polish Baltic for more than a decade and a half now, ever since the round goby fish *Neogobius melanostomus* was first recorded in the Gulf of Gdańsk in 1990. Native to the Black and Caspian Seas, this species most likely reached the Baltic carried in the ballast water of shipping vessels. Quite an unusual species, it fares just as well in rivers as it does in the sea, having been recorded some 100 km up-river from the mouth of the Vistula, in the Danube near Vienna, and in several other rivers in Europe. In Poland, within 10 years of its introduction, the round goby fish has spread throughout the Gulf of Gdańsk, the Vistula Lagoon, and the Pomeranian Bay. Its presence has caused a local drop in the numbers of economically-harnessed native fish species, such as the flounder. Although there is no market for the goby fish in Poland at present, developing commercial catching

of the fish would offer a favorable solution in both economic and environmental terms.

Recognizing the inevitable

Biological invasions are an exceptionally difficult problem to resolve. The most effective form of defense involves trying to prevent both deliberate and accidental species introductions. When such prevention does not work, however, the best tactic to take against such species is to eradicate them promptly and fully, although that goal is usually impossible in view of insufficient methods, excessive costs, or public protests. Sometimes efforts can successfully curb the numbers of an invasive alien species within a specific local area. However, experience to date has shown that once an alien species forms a



The American mink, *Mustela vison*, occurs in Poland as an immigrant from countries further east, where it was introduced into the wild and spread as a breeding farm runaway. Its strong expansion poses a danger to wetland-inhabiting amphibians, lizards, and birds

stable population in a new location, effective control becomes practically impossible and the species must simply be recognized as a permanent addition to the ecosystem.

Despite the enormous impact of invasive alien species on the world economy and the global environment, the extent of our knowledge about them remains very sparse. Perhaps the only chance for coming to grips with the problem in the future is if greater awareness of biological invasions is actively promoted among a broad audience. ■

Further reading:

www.iop.krakow.pl/ias
www.europe-aliens.org
www.gisp.org
www.issg.org