Testimony by Professor Daniel Simberloff, University of Tennessee

before the

Subcommittee on National Parks, Forests, and Public Lands
and the
Subcommittee on Insular Affairs, Oceans, and Wildlife
of the House Natural Resources Committee

Oversight hearing on How to Constrict Snakes and Other Invasive Species
March 23, 2010, 10:00 AM

Contact information:
Dr. Daniel Simberloff
Nancy Gore Hunger Professor of Environmental Studies
Department of Ecology and Evolutionary Biology
University of Tennessee
Knoxville, TN 37996
865-974-0849
dsimberloff@utk.edu

Subcommittee members, I am deeply grateful for the opportunity to testify at this hearing on the threats posed by invasive introduced species and how to minimize them.

With my students and colleagues, I have conducted research on many biological invasions over the past 35 years, not only in the United States but in Australia, New Zealand, South America, and Israel. In addition I am the editor-in-chief of the leading scientific journal in the field, "Biological Invasions," and I direct the Institute for Biological Invasions at the University of Tennessee.

My testimony will be in three parts. First, I will address the problems and associated costs generated by introduced species. Second, I will discuss the statutory and regulatory framework that would minimize these problems and costs. Finally, I will very briefly address the means of effectively managing or even eradicating established invasive species.

My main recommendation is that the United States urgently needs to complement its current blacklist approach with a white list procedure whereby every species proposed for introduction is subjected a scientific risk assessment, after which would be either blacklisted or provisionally placed on a white list whose members would be permitted entry.

The Scope of the Problem

The impacts of introduced species are highly varied. Some are extremely obvious, such as the near elimination of forest birds on Guam by the brown tree snake,

the fouling of water systems and smothering of native mussel species by the zebra mussel and quagga mussel in the East, the painful stinging of people, pets, and farm animals by the red imported fire ant in the South and now California, the replacement of native vegetation on more than half a million acres of south Florida by Brazilian pepper and Australian paperbark trees, the tremendous spread in the Southwest of Lehman's lovegrass, replacing native grasses traditionally grazed by livestock with an unpalatable African species, the destruction of homes in Louisiana by the Formosan termite. Not long ago the snakehead burst on the scene in the Washington area. It is now well established and spreading. The potential invasion of the Great Lakes by Asian carp is a potential disaster happening right now. The upper elevations of the Great Smoky Mountains National Park, near my home, are virtually denuded of trees now because an Asian aphid has destroyed virtually all of the dominant firs, and now the hemlock woolly adelgid, another Asian aphid, has reached the park and is devastating the hemlocks, having killed almost all of them previously in the Northeast. The tiny New Zealand mud snail, after just 20 years, is devastating foodwebs in waterbodies around Yellowstone National Park, achieving densities of half a million per square meter.

Other impacts are more subtle but nevertheless extremely important. For instance, not only does the Asian tiger mosquito vector serious human diseases such as yellow fever, dengue, and chikungunya, but painstaking research has show that competition with the Asian tiger mosquito weakens a native mosquito in east Tennessee in such a way that the native mosquito becomes a more efficient vector of the deadly Lacrosse encephalitis virus (Bevins 2008). No one would have suspected such an impact before this research demonstrated it. On the island of Hawaii, the firetree from the eastern Atlantic has changed the nutrient composition of the volcanically derived soil so that many other introduced plants can now spread at the expense of native species (Asner and Vitousek 2005). A tiny introduced European snail, the periwinkle, has changed the New England coast from salt marshes to rocks in about two centuries (Bertness 1984). No one but a biologist, staring at the wave-swept rocky Maine coast today, would have guessed that a snail less than half an inch long could have utterly transformed an entire landscape. In the 1970s, opossum shrimp were introduced to lakes in Montana to try to enhance rainbow trout growth. They drifted to huge Flathead Lake, where they outcompeed sockeye salmon for their food, which is zooplankton. The collapse of the salmon population led to a collapse of the bald eagle population in the Flathead Lake regions (Spencer et al. 1991). Who would have thought that introducing a tiny shrimp would lead to collapse of a bald eagle population?

There are also many cases in which separately introduced species combine to create a greater impact than either would have done alone, a process called invasional meltdown (Simberloff and Von Holle 1999). For instance, filtration of water by the zebra mussel allows one of the most invasive aquatic plants, Eurasian water milfoil, to invade, and the milfoil, in turn, creates a hard surface that allows the mussel larvae to settle and grow.

I could multiply these examples a hundred times, but the key point is that introduced species have many different sorts of impacts, some are very surprising, and

every habitat is at risk – forest, grassland, desert, rivers, lakes, coastal areas. The economic costs are staggering and have been estimated at over $120 billion annually in the United States. Individual states and municipalities spend millions of dollars in attempts to manage harmful introduced species, with only partial success. The majority of invaders are not even managed because resources are inefficient. For instance, the National Park System has an elaborate system of prioritizing which introduced species to manage based on observed and predicted impacts as well as management costs, in an effort to make most efficient use of severely limited resources (Hiebert and Stubbendieck 1993). Most species are at best monitored; many do not receive even that much attention.

How Can We Keep the Problem from Getting Worse?

It is crucial to bear in mind that the opportunity for further mayhem is vast. The United States is estimated to have ca. 200,000 native species, not counting microorganisms. It is also believed now to harbor ca. 7,000 introduced species, of which perhaps 1,000 are invasive. However, there are believed to be ca. 7,000,000 species on earth (of which 1.5 million have been named to date), so there is an enormous pool of species that could potentially reach the United States, far more than are already here. And they keep arriving; several studies and data bases maintained by different government and scientific organizations show that the number of species introduced to the United States is increasing approximately linearly, in spite of the array of laws and regulations that are supposed to keep them out.

What can we do about this? Broadly speaking, there are two sorts of introductions: planned and unplanned. To constrict the flow of planned introductions requires a comprehensive permitting system that is sufficiently stringent that species that pose a substantial economic, environmental, or public health risk cannot be imported. Reducing the flow of unplanned introductions requires the constriction of the pathways by which they arrive. Of course each introduction has its own history, but the great majority of unplanned invaders – hitchhikers – arrive by a few pathways: ballast water, seed contaminants, insects and other pests on ornamental plants or flowers, snails on ceramics and paving stones, etc.

With respect to planned introductions, there is, of course, tremendous pressure to bring in species after species after species. It seems that no one is happy with the species he has, and even with 200,000 native species, Americans for one reason or another are constantly on the lookout for others to import. Current regulations are woefully inadequate and are based primarily on two blacklists, the Lacey Act list for animals and the Federal Noxious Weed list for plants. Both are reactive rather than proactive, and are insufficiently agile to prevent invasions. Consequently, far too few species are blacklisted and it takes far too long – often years – for a species proposed for listing actually to be listed. The result is that the great majority of the world's species can be imported legally into the United States, subject to quarantine regulations to ensure they are not carrying pests or pathogens, and year after year, millions of individuals of many species that pose an obvious risk are brought in. Over 4,000 poisonous snakes are legally imported annually (Dr. C. Romagosa, pers. comm. 2009), among over 6 million reptiles

and amphibians. This number pales compared to the more than 200 million fish introduced each year. Among non-poisonous snakes, the Burmese python that is now established in Florida, including the Everglades National Park, is one of three giant constrictors already established there, and one of the other two, the northern African rock python, is a potential disaster, as it is a far more aggressive species. Yet over the past 30 years, over a million giant constrictors have been imported to the United States (Reed and Rodda 2009).

Blacklists are needed, both for individual species known to be damaging and for some entire groups of them. Examples that are prohibited under the Lacey Act are the small Indian mongoose (which is well established and has already wreaked havoc in Hawaii, Puerto Rico, and the U.S. Virgin Islands) as an individual species and snails that can vector pathogenic trematodes as an entire group.

However, blacklists are an insufficient instrument to constrict the flow of planned introductions. As noted in some of the examples above, even apparently innocuous introductions can have enormous impacts, and some of these are subtle. There should therefore be no blanket permission to import species. What is required in addition to blacklists is a white list approach, whereby every species is subjected to expert scrutiny before it is placed provisionally on a white list, a status that allows its import. White list status should always be provisional and subject to revocation should further information or research indicate greater potential for harm than had previously been recognized. Many introduced species remain innocuous and restricted for a decade or even several decades before exploding across the landscape in a costly invasion. Further, much of the research detailing the impact and mechanisms of impact of invasive species is tedious and time-consuming.

The nation that has best incorporated these features – and particularly a white list approach – into legislation that effectively precludes harmful planned introductions, and has implemented the legislation in a way that ensures adherence to the laws, is New Zealand, though its Biosecurity Act of 1993 and Hazardous Substances and New Organisms (HSNO) Act of 1998. New Zealand, as an island nation, can secure its borders more easily than the United States, but the underlying basis of these acts, and particularly the use of white lists, is absolutely necessary if the United States is to reduce the flow of invaders.

It is important to know that simply the existence of laws or regulations including white lists does not by itself mean that the flow of invaders will be constricted. A good example is Israel, which has a regulatory system for terrestrial vertebrates implemented by the Israel Nature and Parks Authority (INPA) with a risk assessment procedure, after which species are placed in blacklists and provisional white lists. However, in fact, of 64 introduced vertebrate species preliminarily categorized by INPA as potentially high risk, only 13 were subsequently subjected to the risk assessment procedure. Further, 58 species preliminarily classified as low risk were subsequently found by the assessment procedure to be risky, yet their permit status was unchanged (Justo-Hanani et al. 2009). In short, a risk assessment procedure and associated white and black lists is only effective

if permit applications are all subject to the procedure, and if the results of the procedure actually determine permit status.

It is also important to know that, although risk assessment procedures for introduced species are far more complicated than for chemicals introduced to the environment, there have been substantial research advances in such procedures for both plants and animals. The Australians have used such a procedure (the Australian Weed Risk Assessment) for introduced plants with great success, and it has been adapted and used in several other nations and in Florida (Gordon et al. 2008a,b). Keller and Lodge (2007) and Keller et al. (2007) summarize advances in risk assessments for introduced aquatic animals.

Constricting inadvertent introductions is a matter of constricting or closing pathways through which certain groups of invaders repeatedly entire. Ballast water has received the most attention, but many other such pathways exist – untreated wooden products and packing, cut flowers, and the like. Risk assessments for entire pathways are currently far more primitive than those for individual species, but a number of high-risk pathways have been identified and technologies to reduce the invasion potentials associated with them are being developed (see Ruiz and Carlton 2003).

Management and Eradication of Established Invasive Species Populations

It is not uncommon for people to concede that invasive introduced species are a huge economic and ecological problem, but to throw up their hands in desperation and say that nothing can really be done to stop them. Of course the most cost-effective way to deal with introduced species is to keep them out in the first place – an ounce of prevention is worth a pound of cure. However, it is important to know that, in addition to constricting the pipelines by which invasive species enter the United States, it is possible to control many invasive populations at low levels and even to eradicate some. As with risk assessment, the science and technology of introduced species management has advanced rapidly as the gravity of the problem has been increasingly recognized, and there are many success stories (Simberloff 2009). Through chemical, physical, mechanical, and biological means, impacts of many damaging invaders have been minimized. Introduced species, especially vertebrates, have been totally eradicated from islands of increasing size, to the point where large invasive populations of goats and pigs have been totally eliminated from an island in the Galapagos the size of Rhode Island, and an eradication of rats is currently being planned for an island of 80 square miles in New Zealand. There are no hopeless cases, and sufficient effort as well as scientific research would enable many problems to be solved that today appear intractable. Pessimism must not lead to inaction!

Closing Comments

The most urgent and effective immediate need is for an effective white and black list procedure with no species permitted to be imported without being subject to scientific

scrutiny. Without a version of such a system, biological invasions will continue to multiply.

The second most urgent need is a national system of early warning and rapid response that would allow much earlier recognition that an introduced species has passed our borders. Such a system would greatly increase the probability that the population can be eradicated before it establishes and spreads.

In the longer term, the United States suffers from a piecemeal approach to the problem of biological invasions that greatly hinders an effective response, and a lead agency is badly needed to coordinate activities, not unlike a branch of the Ministry of Forestry and Agriculture that serves this purpose in New Zealand. The United States made a major step in this direction with the establishment of the National Invasive Species Council (NISC), as called for in Executive Order 13112 (1999). However, as an interagency council whose constituent members all have larger missions, NISC is hamstrung by a staff and budget not nearly commensurate with the scale and scope of the problem NISC is designed to address. Having served on the first Invasive Species Advisory Committee to NISC, I was able to witness firsthand both the energy and ingenuity brought to bear on the issue and the inadequacy of the structure and size of NISC. What is badly needed is a single entity with the sole mission of dealing with introduced species, rather than the patchwork of programs, jurisidictions, and information sources that currently exist. Such an entity, rather than replacing existing programs, would primarily coordinate them to make them far more efficient. The analogy to the Centers for Disease Control and Prevention (CDC) is obvious (Schmitz and Simberloff 2001). The current approach to dealing with introduced species in the United States is quite analogous to a medical system in which each state and many federal departments and agencies would deal with disease issues quite independently. We can do much better.

I again thank you for the opportunity to discuss the impact of invasions and how we might deal wtih them more effectively. Please enter my entire written and oral testimony into the published record. I will be glad to answer your questions.

References

Asner, G.P., and P.M. Vitousek. 2005. Remote analysis of biological invasion and biogeochemical change. Proceedings of the National Academy of Sciences 102:4383-4386.

Bertness, M.D. 1984.Habitat and community modification by an introduced herbivorous snail. Ecology 65:370–381.

Bevins, S.N. 2008. Invasive mosquitoes, larval competition, and indirect effects on the vector competence of native mosquito species (Diptera: Culicidae). Biological Invasions 10:1109-1117.

Gordon, D.R., D.A. Onderdonk, A.M. Fox, R.K. Stocker, and C. Gantz. 2008. Predicting Invasive Plants in Florida using the Australian Weed Risk Assessment. Invasive Plant Science and Management 1: 178-195.

Gordon, D.R., D.A. Onderdonk, A.M. Fox, and R.K. Stocker. 2008. Accuracy of the Australian Weed Risk Assessment system across varied geographies. Diversity and Distributions 14: 234-242.

Hiebert, R.D., and J. Stubbendieck. 1993. Handbook for Ranking Exotic Plants for Management and Control. Natural Resources Report NPS/NRMWRO/NRR-93/08

Justo-Hanani, R, T. Dayan, and A. Tal. 2009. The role of regulatory decision-making on non-indigenous species introductions. Biological Invasions, in press. On-line Biol Inv DOC 10.1007/s10530-010-9687-x.

Keller, R.P. and D.M. Lodge. 2007. Species invasions from commerce in live aquatic organisms: problems and possible solutions. BioScience 57:428-436.

Keller R.P., D.M. Lodge, and D.C. Finnoff. 2007. Risk assessment for invasive species produces net bioeconomic benefits. Proceedings of the National Academy of Sciences ((USA) 104:203-207.

Reed, R.N., and G.H. Rodda. 2009. Giant constrictors: biological and management profiles and an establishment risk assessment for nine large species of pythons, anacondas, and the boa constrictor: U.S. Geological Survey Open-File Report 2009–1202, 302 p.

Ruiz, G.M., and J.T. Carlton (eds.). 2003. Invasive species. Vectors and management strategies. Washington, DC: Island Press.

Schmitz, D.C, and D. Simberloff. 2001. Needed: A national center for biological invasions. Issues in Science and Technology 17(4):57-62.

Simberloff, D., and M.B. Von Holle. 1999. Positive interactions of nonindigenous species: invasional meltdown? Biological Invasions 1:21-32.

Simberloff, D. 2009. We can eliminate invasions or live with them. Successful management projects. Biological Invasions 11:149-157. 2009.