

COMMENTARY

The Economic Roots of Species Invasions¹

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Across ecosystems and geographic regions, the rate of newly detected biological invasions is increasing, and, in the case of individual species, this increase is often exponential (Ruiz et al. 2000, Ruiz and Carlson 2003, Fofonoff et al. 2003, Kraus 2003). Invasive alien species have become a real threat to our environment and economy. The economic costs of invading alien species in the United States alone come close to \$120 billion per year (Pimentel et al., in press).

Harmful invasions of alien or non-indigenous species often produce devastating impacts on agriculture, recreation, and natural resources (OTA 1993). They threaten biodiversity, habitat quality, and ecosystem function and are now considered among the greatest threats to native species in the United States (Wilcove et al. 1998). In combination with other economic activities, the rapid expansion of international trade, travel, and transport have contributed significantly to the increasingly high rate of species invasions. Also, unfortunately, “the pressures to increase trade are currently greater than the pressures for pre-

caution in moving biological material across former barriers” (Mooney and Hobbs 2000). The following discussion highlights the links between this exponential increase and the unrestricted trade of a growing global economy.

One of the by-products of international trade and travel is the transportation of species beyond their natural geographic range. A species that is not native to a particular ecosystem is

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The House or Wall Geckos of Florida and other southern states actually represent a sequence of invasions that began with the Mediterranean Gecko (*Hemidactylus turcicus*), which was followed by the Cosmopolitan House Gecko (*H. mabouia*, pictured), and even more recently by the Asian House Gecko (*H. frenatus*). How these species will ultimately partition the available habitats remains to be seen.

referred to as alien, exotic, or non-indigenous. A subset of alien species is considered invasive by virtue of their ability to cause economic or environmental harm, or harm to human health (Executive Order 13112). They generally exhibit characteristics such as rapid growth rate, exceptional dispersal capabilities, large reproductive output, and broad environmental tolerance. Although naturally occurring movement of species has taken place across the surface of the earth for hundreds of millions of



PAMELA MEDINA DIAZ

Introductions of mammalian herbivores, such as these burros on St. Eustatius, alter vegetative communities in ways that cannot be predicted, often with catastrophic effects on native herbivores such as iguanas.

years, human activity has greatly increased the velocity of invasion and, by dissolving temporal and spatial boundaries, has enabled many species to relocate that would not normally have had this opportunity. Most arrive in relation to human economic activities, either intentionally or unintentionally.

Invasive species move along routes referred to as pathways. Their movement is facilitated by vectors, the means by which a species is moved, such as ships, planes, people, and other organisms. Throughout history, cultures and civilizations have relied on trade to improve relations and increase prosperity. Archaeologists have found evidence of human-assisted movement of species by way of seafaring trade connecting continents early in history. Among the first specialized sailors and merchants were the Phoenicians (ca. 3000 B.C.) who traded articles such as Lebanese cedar and processed dyes (Cameron 1997). Greek sailors and merchants traded basic storable foodstuffs, such as grain, grapes, olives, wine, and oil. During Roman times, sea trade existed between India and Egypt; and, as early as the sixth century, the Vikings were exchanging honey, fur, weapons, and slaves for Arabian silver, which has been found as far west as North America (Het Huis van de Aarde Museum 2005).

Between the eighth and fifteenth centuries, Indian Diaspora and Far East trade routes were used not only for economic expansion, but also for the expansion of religion. By the first half of the seventeenth century, the Netherlands had established a fully global trading network (Brummett and Edgar 1999).



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The popularity of Red-eared Sliders (*Trachemys scripta elegans*) in the pet trade and the resultant and maybe inevitable escapes and releases have led to wild populations in many areas where the species is not native, with negative effects on native turtles and yet-to-be evaluated impact on native invertebrates and aquatic vegetation (see also Newsbriefs, p. 216).



JOHN BINNIS

Alien carnivores, such as this Jamaican mongoose (*Herpestes javanicus*), originally imported from India to control rats in the sugar cane fields, were subsequently introduced to many other West Indian islands and to the major Hawaiian islands. Among the unintended consequences were little impact on rat populations and dramatic declines in populations of ground-nesting birds and diurnally active terrestrial reptiles.

Today, transportation of people and cargo via ships and planes has become fast, efficient, and frequent. Increased speed and efficiency of transport enables international trade and feeds aspirations for economic globalization and growth. One shipping company alone can maintain a global network of shipping lines. For example, in 2004, the shipping company Maersk Sealand advertised itself as one of the largest liner shipping companies in the world with over 300 shipping vessels and 950,000 containers traveling around the globe, with feeder vessels, trucks, and dedicated trains available for door-to-door service (www.maersksealand.com).

With increases in total volume of trade and the speed and frequency of transportation and delivery come greater risks of introduction, both intentional and unintentional. For example, larger numbers of products bring greater opportunity for unintentional introductions referred to as “hitchhikers,” organisms that attach themselves to the product itself, such as insects on plants, or that exist within the transportation medium, such as ballast water. As shipping technology continues to improve, ships take less time to traverse greater distances, which means mortality decreases and organisms that might have once died while en route for a few weeks or a month may now have a better chance of survival, given that the journey has been shortened to a number of days. As the rate of non-indigenous, potentially invasive, species introduction accelerates, trade itself begins to look more and more like a sort of “metavector,” comprising numerous, individual, yet associated, vectors.

International trade currently represents a growing share of the U.S. economy. Import volume increased from \$40 billion in 1991 to around \$100 billion in 2001, more than doubling in a 10-year period (Bureau of Transportation Statistics 2002). Some predict that global trade will double again by the year 2020. This international trade facilitates the intentional and unintentional transport of biological organisms around the world.

Approximately 42% of the plants and animals federally listed as threatened or endangered species are at risk because of alien and invasive species (Pimentel et al., in press). The

National Invasive Species Council’s (2003) working group on pathways identifies three major categories of pathways for the introduction of alien and invasive alien species: (1) transportation, (2) living industry, and (3) miscellaneous. Within the category of transportation, pathways include the movement of water (e.g., ballast water, sediments, and dredge spoil materials), items used in transport (e.g., vehicles and ships), and “hitchhikers,” organisms attached to vehicles, ships, or materials attached to them.

Perhaps the most notorious example of a species entering through a transportation pathway is the Zebra Mussel (*Dreissena polymorpha*). This invasive species entered the United States through the St. Lawrence Seaway as planktonic larvae, probably in the ballast water of a bulk cargo vessel coming from a Black Sea port (Holeck et al. 2004). Since their discovery in 1988, Zebra Mussels have spread from the Hudson River in the east to Oklahoma in the west, and from Ontario and Quebec in the north to Louisiana in the south. Zebra Mussels are small bivalves that cluster in colonies of hundreds of thousands per square yard and clog the openings of underwater pipes, often closing them off altogether.

Additionally, invasions are facilitated by the mail, internet, and overnight shipping companies. In particular, the internet is a very difficult pathway to control. Although recognized as a federally-prohibited weed, Giant Salvinia (*Salvinia molesta*) is still available for purchase on the internet.

Within the council working group’s category of “living” industry, pathways include the food industry and non-food industries transporting animals and other organisms, such as the pet trade, research, and public education and enjoyment such as zoos and public aquariums. Through any of the living industry pathways, species can be intentionally released, escape, or hitchhike with people, products, and services. The plant trade is often a vehicle for species introduction through nurseries and pet stores.

Water hyacinth, an example of a highly invasive aquatic species, began charting its course around the globe in 1884. This



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Because of their sensitivity to desiccation and exposure to salt water, amphibians are rarely effective invasives. Nevertheless, some exceptions exist. Cuban Treefrogs (*Osteopilus septentrionalis*) are native to Cuba and may have expanded their range naturally to the Bahamas, Cayman Islands, and possibly to Florida. However, increasing numbers of populations are being established, mostly due to inadvertent “hitch-hiking” with exotic, tropical plants from southern Florida that are destined for resorts to meet tourists’ expectations of what the tropics should be like.

plant originally came from the Amazon Basin in South America and is today a serious pest in North America, tropical Africa, and Southeast Asia. In certain parts of tropical Africa, riverboat transport has become impossible because this aquatic weed has completely blocked entire river systems. The control cost to seven African countries runs about \$20–50 million per year (McNeely et al. 2003).

The council working group's category of miscellaneous pathways includes interconnected waterways for aquatics or interconnected landmasses for terrestrial organisms. One example of introduction by interconnected waterways is the Sea Lamprey (*Petromyzon marinus*), which is native to the Atlantic Ocean. It entered the Great Lakes through the Hudson River and the Welland Canal in 1829 and was later discovered in Lake Erie in 1921 (Mooney and Hobbs 2000). The Sea Lamprey attaches itself to other fish and with its suckorial mouth extracts blood and other body fluids.

In order to address the problem of biological invasions, some important legislation has been passed. In 1990, the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) called for a national program to prevent and respond to problems caused by the unintentional introduction of nonindigenous aquatic species into U.S. waters, and it established the multi-agency Aquatic Nuisance Species Task Force to carry out its mandates. A reauthorization took place in 1996 in the form of the National Invasive Species Act (NISA). Currently a second reauthorization, the National Aquatic Invasive Species Act (NAISA), is under review by Congress. The latter would require a standard for ballast water management and appropriation of funds for the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, and the Smithsonian Institution to establish baselines and invasion rates, as well as improved tools for early detection. It also will focus on rapid response to incipient infestations, establish a separate fund administered by the U.S. Fish and Wildlife Service to assist states to respond to newly detected species. It would allocate funding for establishing a screening mechanism for intentional introductions. It also will encourage the examination of new pathways besides the historical focus on ballast water. Finally, it will mandate more and better research on the topic. Although nearly 30 federal acts and executive orders pertain in some way to invasive species, and some address terrestrial forms (e.g., the Brown Tree Snake Control and Eradication Act of 2004), none, individually or collectively, effectively addresses problems caused by terrestrial invasives in the same fashion as NAISA does for aquatics.

Efforts concerned with prevention, specifically risk identification and assessment, further research on pathways, and continued exploration of avenues available through regulation, must continue. We need to strengthen outreach at all levels and continue to support research specifically in invasion ecology. For management of invasive species at the field level to be successful, we must encourage a greater understanding of early detection/rapid response, control and management, and restoration techniques.

Invasive species have been recognized as one of the most significant drivers of environmental change worldwide — and biological invasions are facilitated by the increasingly expanding network of commercial highways underlying international trade, travel, and transport. We must address these pathways. However, even if urgent measures are taken, the number of species invasions in the United States will probably continue to increase in conjunction with the growth of the economy and the sectors that constitute or represent pathways for invasive species.

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URGENT: Invasive Species Legislation in Highway Bill!¹

March 30, 2005

Action Alert! Action Alert! Action Alert!

If you have “non-native” weeds, grass, trees, or shrubs on your property (and everyone does) you’re in trouble. Under “invasive species” provisions currently sitting in the Senate’s version of the transportation bill, your property could quickly become the target of radical environmentalists and federal bureaucrats. The bill’s name is the “Safe, Accountable, Flexible and Efficient Transportation Equity Act” or SAFETEA 2005 (*please note* that it does not yet have a bill number).

It is vitally important that you call both of your Senators this week, and next week, and tell them to DEMAND that any invasive species provisions be stripped from the SAFETEA bill. SAFETEA could come up for a vote before the full Senate at ANY TIME!

****Call the Senate Switchboard at (202) 224-3121 and simply ask for your Senators by name.****

Currently, the SAFETEA act contains provisions to “minimize invasive species.” This is the foot in the door to federal control of ALL so-called “invasive species” — something that the greens openly covet. Under the Senate version of SAFETEA, the federal government will dictate to the states what types of grasses and plants are allowed to be planted next to roads. This has nothing to do with science or the environment. This is about LAND CONTROL and MONEY FOR RADICAL GREEN GROUPS.

****Call your Senators at (202) 224-3121 and tell them:
NO INVASIVE SPECIES PROVISIONS
in the transportation bill!****

Imagine the Endangered Species Act on steroids. Now multiply its devastating effect on property rights one-hundred fold. That should give you a pretty good idea of what “invasive species” legislation will mean for property owners in every state, county, and city in this nation. “Invasive species” is the radical greens’ key to controlling every square inch of land in the United States. And SAFETEA is the just the beginning.

This nightmare all began when Bill Clinton signed Executive Order 13112 in 1999, creating an “Invasive Species Council” to monitor and control “alien species.” What are alien species? According to Clinton’s Order, “alien species means, with respect to a particular ecosystem, any species, including seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.” Most agricultural crops and ani-

mal species clearly fall within the definition of “alien.” Domesticated pets, many houseplants, and Kentucky bluegrass used in most lawns and golf courses are already defined as alien species. Indeed, this is all the greens and their allies in the federal government need to control all land in the U.S.

Think the invasive species monster can’t get any worse? It already has. In 2001, the Invasive Species Council issued a management plan that states: “Council member agencies will work with the Global Invasive Species Programme (GISP) and other relevant bodies to expand opportunities to share information, technologies, and technical capacity on the control and management of invasive species with other countries, promoting environmentally sound control and management practices.” And just what is the Global Invasive Species Programme? A quick trip to the GISP website reveals it is: The United Nations Environmental Programme (UNEP), The United Nations Environmental, Scientific, and Cultural Organization (UNESCO), The Convention on Biological Diversity, The Nature Conservancy, The International Union for the Protection of Nature, [and] DIVERSITAS: An International Programme of Biodiversity Science (another UNESCO project).

Invasive species legislation opens the door to federal and international control over private property in the United States. And that’s why greens in the Senate are trying to sneak it into the federal transportation bill — without ANY proper debate. We are running out of time. Contact your Senators TODAY, TOMORROW, AND NEXT WEEK. The House version of the transportation bill has already passed and thankfully does NOT include any invasive species language. But the Senate version (SAFETEA 2005) DOES! Once again, the House is on the right track and the Senate is out in left field. ACT NOW!

****Action to Take****

Call both of your Senators and tell them to DEMAND that any and all “invasive species” provisions are REMOVED from the Senate transportation bill (SAFETEA). Call the Senate Switchboard at (202) 224-3121 and ask for your Senators by name.

*****PLEASE SEND THIS URGENT ALERT TO AS
MANY PEOPLE AS POSSIBLE*****

¹ From the American Policy Center (<http://www.americanpolicy.org/sledgehammer/species.htm>); the APC promotes its website as the “Property Rights and Back-to-Basics Education Grassroots Internet Headquarters.”

Invasive Species Legislation¹

Congressman Vernon J. Ehlers²

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For many years, governments and citizens in Michigan and throughout the Great Lakes Basin have been battling a notorious invader – the Zebra Mussel. These small mollusks invaded the Great Lakes in the 1980s, quickly multiplied and spread across the region, clogging water intake pipes and creating problems for boaters who have to spend time and money cleaning hulls. Last summer, a voracious fish known as the Northern Snakehead became a media celebrity and a serious threat to Maryland waterways. This predator wipes out native fish and, once it is done feeding in one pond, it literally gets up and crawls across land to the next one. These are only two examples of “invasive species” – animals and plants that are introduced, take hold and multiply in ecosystems where they don’t have any competition, causing tremendous economic and environmental harm.

If you polled Americans as to what the most pressing economic and environmental issues are, dealing with invasive species probably wouldn’t make the list. But considering the economic and environmental threats they pose to our nation, attention must be paid to invasive species. For example, recent studies have estimated that Zebra Mussels have cost governments and utilities in the Great Lakes region more than \$1 billion since the late 1980s. On an environmental level, invasive species are now recognized as the No. 2 threat to endangered species, as they often compete for food and destroy the habitat of other native plants and animals.

Congress must act to combat this threat. That’s why I, along with Senator Carl Levin and others, have sponsored a comprehensive legislative package (H.R. 1080 & 1081 and S. 525) to do just that. One central theme drives our effort – “an ounce of prevention is worth a pound of cure.” If we spend millions preventing aquatic invasive species from entering our waters, we will avoid spending billions trying to control and manage them once they are here. Our legislation does three overarching things fitting with this theme.

First, this legislation takes major strides forward in managing the shipping industry, which is responsible for (unintentionally) bringing most of the aquatic invasive species into our waters through ships’ ballast tanks. The legislation contains provisions that require shippers to ensure that they are using best management practices, and, most importantly, treat ballast water so that species are killed before ballast water is dumped into our waterways. This is

the most effective way to prevent the next Zebra Mussel from entering our waterways and wreaking economic and environmental havoc.

Second, we will, for the first time, establish a screening program to look at the intentional introduction of new plants and animals into the United States. People have been bringing new species into America since before our nation was created. The rate of these introductions has increased dramatically over the past 50 years because of global trade and efficient and fast transportation systems. Under current law, we take no action until we know that a species is harmful, which is too late. This legislation changes that burden by allowing federal agencies to screen for potential “bad actors” and prevent the next Northern Snakehead from being imported into the United States.

Finally, we establish a comprehensive research program, which was sorely lacking in previous legislative efforts to deal with invasive species. I’m taking the lead on this part of the legislative effort, because when I looked at the underlying law, it became clear that research was simply an afterthought. This explains why so much of the invasive species management program has been stalled for years. Good science must underpin management decisions if these decisions are going to be considered credible to the outside world.

It is time to change our strategy in dealing with aquatic invasive species. It is time for Congress to realize that this threat continues to grow and will not go away unless we act. It is time for Congress to move this legislation forward. Invasive species don’t recognize or respect political boundaries or timelines and they are arriving here even as you read this today.

¹ Adapted from an op-ed piece for *Business Direct Weekly*, March 2003.

² The Honorable Vernon J. Ehlers, United States House of Representatives, serves Michigan’s third district. He serves on the following committees: House Committee on Education and the Workforce, Subcommittee on 21st Century Competitiveness, Subcommittee on Education Reform; House Committee on House Administration; House Committee on Science, Subcommittee on Energy, Subcommittee on Environment Technology and Standards (Chair); House Committee on Transportation and Infrastructure, Subcommittee on Aviation, Subcommittee on Water Resources and Environment; Joint Committee on the Library of Congress.