



Update on the environmental and economic costs associated with alien-invasive species in the United States

David Pimentel*, Rodolfo Zuniga, Doug Morrison

College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14850-0901, United States

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Abstract

Invading alien species in the United States cause major environmental damages and losses adding up to almost \$120 billion per year. There are approximately 50,000 foreign species and the number is increasing. About 42% of the species on the Threatened or Endangered species lists are at risk primarily because of alien-invasive species.

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1. Introduction

In the history of the United States, approximately 50,000 alien-invasive (nonnative) species are estimated to have been introduced into the United States. Introduced species, such as corn, wheat, rice, and other food crops, and cattle, poultry, and other livestock, now provide more than 98% of the U.S. food system at a value of approximately \$800 billion per year (USBC, 2001). Other exotic species have been used for landscape restoration, biological pest control, sport, pets, and food processing. Some nonindigenous species, however, have caused major economic losses in agriculture, forestry, and several other segments of the U.S. economy, in addition to

harming the environment. One recent study reported approximately \$97 billion in damages from 79 exotic species during the period from 1906 to 1991 (OTA, 1993).

Estimating the full extent of the environmental damages caused by exotic species and the number of species extinctions they have caused is difficult because little is known about the estimated 750,000 species in the United States of which half have not been described (Raven and Johnson, 1992). Nonetheless, about 400 of the 958 species that are listed as threatened or endangered under the Endangered Species Act are considered to be at risk primarily because of competition with or predation by non-indigenous species (Wilcove et al., 1998). In other regions of the world, as many as 80% of the endangered species are threatened and at risk due to the pressures of nonnative species (Armstrong, 1995). Many other species not listed are also

* Corresponding author. Tel.: +1 607 255 2212; fax: +1 607 255 0939.

E-mail address: dp18@cornell.edu (D. Pimentel).

Table 1
Estimated annual costs associated with some alien species introduction in the United States (see text for details and sources) (×millions of dollars)

Category	Nonindigenous species	Losses and damages	Control costs	Total
<i>Total</i>				
PLANTS	25,000			
Purple loosestrife		–	–	45
Aquatic weeds		10	100	110
Mealeuca tree		NA	3–6	3–6
Crop weeds		24,000	3000	27,000
Weeds in pastures		1000	5000	6000
Weeds in lawns, gardens, golf courses		NA	1500	1500
MAMMALS	20			
Wild horses and burros		5	NA	5
Feral Pigs		800	0.5	800.5
Mongoose		50	NA	50
Rats		19,000	NA	19,000
Cats		17,000	NA	17,000
Dogs		620	NA	620
BIRDS	97			
Pigeons		1100	NA	1100
Starlings		800	NA	800
REPTILES and AMPHIBIANS	53			
Brown tree snake		1	11	12
FISH	138	5400	NA	5400
ARTHROPODS	4500			
Imported fire ant		600	400	1000
Formosan termite		1000	NA	1000
Green crab		44	NA	44
Gypsy moth		NA	11	11
Crop pests		13,900	500	14,400
Pests in lawns, gardens, golf courses		NA	1500	1500
Forest pests		2100	NA	2100
MOLLUSKS	88			
Zebra mussel		–	–	1000
Asian clam		1000	NA	1000
Shipworm		205	NA	205
MICROBES	20,000			
Crop plant pathogens		21,000	500	21,500
Plant pathogens in lawns, gardens, golf courses		NA	2000	2000
Forest plant pathogens		2100	NA	2100
Dutch elm disease		NA	100	100

Table 1 (continued)

Category	Nonindigenous species	Losses and damages	Control costs	Total
LIVESTOCK DISEASES		14,000	NA	14,000
HUMAN DISEASES		NA	7500	7500
TOTAL				\$120,105

negatively affected by alien species and/or ecosystem changes caused by alien species. Estimating the economic impacts associated with nonindigenous species in the United States is also difficult; nevertheless, enough data are available to quantify some of the impacts on agriculture, forestry, and public health. In this article, as much as possible, we assess the magnitude of the environmental impacts and economic costs associated with the diverse alien species that have become established within the United States. Although translocated species can also have significant impacts, this assessment is limited to alien species that did not originate within the United States or its territories.

2. Environmental damages and associated control costs

Most plant and vertebrate animal introductions have been intentional, whereas most invertebrate animal and microbe introductions have been accidental. In the past 40 years, the rate of and risk associated with biotic invaders have increased enormously because of human population growth, rapid movement of people, and alteration of the environment. In addition, more goods and materials are being traded among nations than ever before, thereby creating opportunities for unintentional introductions (Bryan, 1996; USBC, 2001).

Some of the approximately 50,000 species of plants and animals that have invaded the United States cause a wide array of damages to managed and natural ecosystems (Table 1). Some of these damages and control costs are assessed below.

2.1. Plants

Most alien plants now established in the United States were introduced for food, fiber, and/or

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