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Non-native Animals on Public Lands

by
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Non-native plants and animals have become part of our surroundings, in cities, agricultural areas, and wildlands. While there are many beneficial purposes for non-native animals, such as for food and sport hunting and as agricultural animals, the introduction of some has had major negative economic consequences (Palmer 1899), and adverse effects on native wildlife, plants, and habitats. The British ecologist Charles Elton, in a major review of introduced species, described the increasing number of invasions as constituting "one of the great historical convulsions in the world's flora and fauna" (Elton 1958, p. 31).

Non-native species are significant problems on large areas of state and federal public lands, and areas set aside to protect native plant and animal communities are not immune to such harm. Science and conservation journals have devoted entire issues to the threats posed by non-native plants and animals in nature reserves (e.g., Usher et al. 1988). In a compilation of threats to U.S. national parks, non-native plants and animals were the most often reported threat, and were reported by the most areas; feral cats (*Felis catus*), feral dogs (*Canis familiaris*), and wild pigs (*Sus scrofa*) were the non-native animals cited most often (NPCA 1977). Non-native species present serious threats, but at the same time, coordinated efforts on public lands offer the best possibility for controlling some harmful non-native species, and protecting both native plant and animal communities and human interests and needs.

We compiled information on non-native animals on public and private land-management areas by conducting a mail survey to assess their occurrence and management status in land-management areas. Survey results represent contributions from 937 national parks, national forests, national wildlife refuges, Bureau of Land Management field areas, and state and private land-management areas. The results reflect those species that land managers considered of greatest concern, and their general distribution on public lands. Non-native invertebrate animals, particularly forest insects and agricultural pests, cause severe economic and environmental damage as well (OTA 1993), but were not the focus of this survey.

Distribution and Effects

The forests, parks, refuges, and other areas that responded to the surveys identified 205 non-native animal species as species of management concern. As a group, non-native mammals were most often reported by land managers as problem species, accounting for 60% (823 of 1,370) of the reports received (Table 1). Twenty-eight non-native mammal species were listed for the areas surveyed, with feral cats and dogs and wild pigs reported most often (Table 2). Feral cats and dogs are nearly ubiquitous (Figure) and are of concern because they prey on native birds and mammals (Van't Woudt

Table 1. Non-native species reported from U.S. national forests, parks, refuges, and other land-management areas. "Species introduced" is the total number of non-native species of each group that are known to have been brought into the United States (fish from Courtenay and Stauffer 1984; amphibians and reptiles from Smith and Kohler 1977; birds from Long 1981; mammals from Lever 1985). "Established" is the number of species that have established successful long-term populations. "Species reported" is the number of species noted in mail surveys sent to U.S. land-management areas, and "Number of reports" is the number of areas reporting each species.

	Fish	Amphibians	Reptiles	Birds	Mammals
Species introduced	104	27	67	119	40
Established	41	14	35	56	35
Species reported in this survey	40	3	4	19	28
Number of reports	272	24	6	245	823

Table 2. Non-native animal species most commonly reported in national forests, parks, and other U.S. land-management areas.

Common	Name		No. of areas
	Common	Scientific	
Cat (feral)		<i>Felis catus</i>	180
Dog (feral)		<i>Canis familiaris</i>	123
Pig		<i>Sus scrofa</i>	100
European starling		<i>Sturnus vulgaris</i>	93
Carp		<i>Cyprinus carpio</i>	56
Cow		<i>Bos taurus</i>	35
Horse		<i>Equus caballus</i>	31
Nutria		<i>Myocastor coypus</i>	29
Rainbow trout		<i>Oncorhynchus mykiss</i>	28
Burro		<i>Equus asinus</i>	25
Goat		<i>Capra hircus</i>	25
Brown trout		<i>Salmo trutta</i>	23
Brook trout		<i>Salvelinus fontinalis</i>	21
Red fox		<i>Vulpes vulpes</i>	11
Rock dove		<i>Columba livia</i>	28

1990). Wild pigs were reported primarily in the southeastern United States, California, and Hawaii; despite their status as game in most areas, they pose serious threats to native plant communities and rare plant species by their foraging and digging (Singer 1981; Stone and Loope 1987). Wild horses (*Equus caballus*) are primarily present in the western United States and on the barrier islands of the east coast. Although they may damage native vegetation, wild horses are generally protected as part of the historic scene.

After mammals, non-native fish were listed most often as problem non-native species. For all areas combined, we received 272 reports representing a total of 40 non-native fish species. Non-native trout (introduced to augment local fisheries) and common carp (*Cyprinus carpio*) were reported most. Introduced trout include species from other parts of the United States (e.g., eastern brook trout, *Salvelinus fontinalis*, introduced in many areas of the West) and species from other areas of the world (primarily European brown trout, *Salmo trutta*). Introduced trout may decimate susceptible native fish populations, lead to the loss of native varieties through interbreeding, and deplete amphibians and aquatic invertebrates in waters originally without fish (Taylor et al. 1984; Larson and Moore 1985). Most areas reporting problems or threats from non-native trout are in the western United States (Figure). Carp have been introduced in waters throughout much of the United States, but most areas reporting them as serious pests were wetland-management districts and wildlife refuges along the Mississippi, Missouri, and Columbia river systems.

We received 245 reports of non-native birds from survey respondents. Although many bird species have been introduced into the United States (Table 1), many failed to become established or remained restricted to areas where introduced. Only 19 species were reported as causing significant damage. European starling (*Sturnus vulgaris*) and rock dove (common pigeon, *Columba livia*) were reported most often, primarily in developed areas.

Only three non-native amphibian species and four non-native reptiles were reported. These species (e.g., marine toad, *Bufo marinus*) are primarily a problem in tropical and subtropical areas of southern Florida and Hawaii and some U.S. territories.

Seventy-three of the species identified in the surveys had been targeted for control or eradication. Feral cats were the subject of the greatest number of management projects (138 areas). Seventy-eight areas were conducting or had completed projects to control wild pigs, while 60 areas listed management for feral dogs, 41

for wild horses, 35 for cows (*Bos taurus*), and 35 for feral burros (*Equus asinus*).

Non-mammalian species were less often targets for control. Thirty-four areas, primarily U.S. Fish and Wildlife Service areas, listed control or eradication programs for carp. Other fish subject to control were introduced rainbow trout (*Oncorhynchus mykiss*; 22 areas) and brook trout (20 areas) in streams in western North America. Fewer projects were listed for birds. European starlings were the target of most controls (15 areas). A few areas listed control projects for non-native invertebrates. Most common were fire ants (*Solenopsis* spp., 14 areas) and gypsy moths (*Lymantria dispar*; 9 areas).

This survey highlights widespread and serious concerns about the effects of introduced species on native plant and animal communities. Geographically, this was true for areas across most of the United States except Alaska, where survey respondents generally reported few problems with non-native species, possibly because of the extreme climate of that area. Even there, however, non-native species can be a serious threat in local areas; some nesting waterfowl and seabirds on island wildlife refuges are severely affected by predation from introduced Arctic foxes (*Alopex lagopus*).

Some of the greatest adverse impacts of non-native species have been in freshwater communities and on islands. Introduced fish have caused calamitous changes in the Great Lakes, decimating both the natural community of the lakes and the commercial fishery that depends on these inland seas (Lawrie 1970; Eck and Wells 1987). Adverse effects of introduced fish, especially predaceous species, on native fish, amphibians, and invertebrates are a recurrent pattern (Taylor et al. 1984; Moyle 1986). Introduced brown trout, in particular, are serious predators on native salmonids in the United States. In spite of their small size, introduced western mosquitofish (*Gambusia affinis*) may eliminate other small, native fishes through competition or predation; they may also prey heavily on the young of food and game fish and also on aquatic amphibian larvae (Meffe et al. 1983).

Non-native species introduced to islands have caused the greatest harm to terrestrial plant and animal communities. Areas specifically responding to our surveys included the national seashores on the barrier islands of the east coast and Gulf of Mexico, the National Park Service on the California Channel Islands, and national parks and wildlife refuges on the Hawaiian Islands. It is generally considered that long-isolated island plants and animals are poorly adapted to cope with introduced predators, competitors, and disease organisms, and all of these island areas have suffered serious damage from

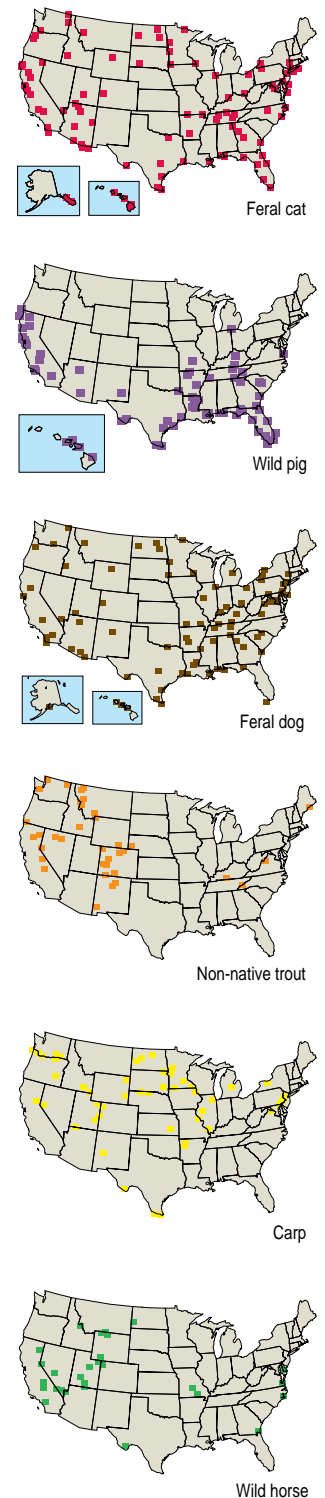


Figure. Distribution of several non-native animal species on public lands as reported by land managers responding to mail surveys: feral cat, wild pig, feral dog, non-native trout, carp, and wild horse.

introduced herbivores such as goats (*Capra hircus*), pigs, and Old World rabbits (*Oryctolagus cuniculus*), and introduced predators such as feral cats, rats, and mongooses (*Herpestes auropunctatus*; Stone 1985; Brockie et al. 1988). At the same time, these island areas have had some of the greatest success at controlling and managing non-native species. Feral goats, pigs, rabbits, and cats have been eliminated from some of the Channel Islands, allowing native plant and animal communities to begin to recover, and Hawaiian parks and refuges have successfully protected parts of their unique flora and fauna through aggressive and innovative control and exclusion measures against non-natives (Stone and Loope 1987).

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Exotic Species in the Great Lakes

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Global transfer of exotic organisms is one of the most pervasive and perhaps least recognized effects of humans on aquatic ecosystems of the world. Such transfers to new environments may lead to loss of species diversity and the extensive alteration of the native community. These changes, in turn, may have broad economic and social effects on the human communities that rely on the system for food, water, or recreation. Here we describe the exotic aquatic species that have become established in the Great Lakes and discuss their entry mechanisms or routes, the timeline of introduction, their geographic origins or sources, and their effects on the ecosystem of the Great Lakes. A recent review (Mills et al. 1993) provides the basis for much of this report.

Introductions of Species

Since the early 1800's, at least 139 new aquatic organisms have become established in the Great Lakes (Fig. 1); most are aquatic or wetland plants (42%), fishes (18%), and algae (17%). Introduced species of mollusks, oligochaetes, crustaceans, flatworms, bryozoans, cnidarians, and disease pathogens combined represent 22% of the total. All entered the Great Lakes basin by major mechanisms or routes (Fig. 2) including shipping (41 exotic species); unintentional releases (40 new species); ship or barge canals, along railroads or highways, or deliberate releases (17 species); unknown entry vectors (14 species); and multiple entry mechanisms (27 species).