

# A Primer on Federal Policy

# 6

**T**his chapter presents an overview of the Federal Government's activities related to non-indigenous species (NIS). It examines both the prevention and control of harmful NIS and the intentional introduction and use of desirable NIS. The reason for this dual focus is that, in the past, some presumably beneficial NIS introduced or promoted by Federal agencies have subsequently caused great economic or environmental harm.

OTA has drawn from this analysis a number of significant conclusions that cross agency jurisdictions and undergird several policy options presented earlier (ch. 1). The chapter begins with these conclusions, followed by a discussion of existing national policies on NIS. The remainder of chapter 6 presents a detailed reference to Federal programs, broken down along agency lines (box 6-A).

## LESSONS FROM THE PRIMER

### Finding:

The current Federal framework is a largely uncoordinated patchwork of laws, regulations, policies, and programs. Some focus on narrowly drawn problems. Many others peripherally address NIS. In general, present Federal efforts only partially match the problems at hand.

### Keeping Harmful Species Out of the United States

The Federal Government currently plays a much larger role in preventing the entry of agricultural pests than in excluding other potentially harmful NIS. The Animal and Plant Health Inspection Service's (APHIS) fiscal year 1992 budget for agricultural



**Box 6-A–A Locator for Federal Agencies Discussed in Chapter 6**

Agency	Page/s	Agency	Page/s
Department of Agriculture		Department of Commerce	
Animal and Plant Health Inspection Service (APHIS) . . . . .	170-177	National Oceanic and Atmospheric Administration (NOAA) . . . . .	194-195
Agricultural Marketing Service (AMS) . . . . .	177	Department of Defense (DOD) . . . . .	195-196
Foreign Agricultural Service (FAS) . . . . .	177	Environmental Protection Agency (EPA) . . . . .	196-199
Forest Service (USFS) . . . . .	177-179	Department of Health and Human Services	
Agricultural Research Service (ARS) . . . . .	179-181	Public Health Service (PHS) . . . . .	199
Soil Conservation Service (SCS) . . . . .	181-183	<b>Department of the Treasury</b>	
Agricultural Stabilization and Conservation Service (ASCS) . . . . .	183-184	customs service . . . . .	199
<b>Cooperative State Research Service (CSRS) . . . . .</b>	<b>184</b>	Department of Transportation	
Department of the Interior		Coast Guard (USCG) . . . . .	199-200
Fish and Wildlife Service (FWS) . . . . .	184-188	Department of Energy (DOE) . . . . .	200
National Park Service (NPS) . . . . .	188-189	Department of Justice	
Bureau of Land Management (BLM) . . . . .	189-193	Drug Enforcement Agency (DEA) . . . . .	200
Bureau of Indian Affairs (BIA) . . . . .	193		
Bureau of Reclamation (BOR) . . . . .	193		

SOURCE: Office of Technology Assessment, 1993.

quarantine and port inspection was at least \$100 million, compared with the \$3 million for port inspections of fish and wildlife requested by the Fish and Wildlife Service (FWS) (97,100,170). The hundreds of agricultural pests restricted from entry by Federal regulations form the largest category of excluded NIS.<sup>1</sup> Current FWS and Public Health Service (PHS) regulations covering injurious fish and wildlife and potential human disease vectors restrict entry of far fewer NIS (by an order of magnitude). Certain categories of harmful NIS are not restricted from entry at all, such as many potentially affecting only natural areas.

Direct assessment of the effectiveness of Federal efforts to exclude harmful NIS is not possible because both APHIS and FWS lack performance standards for their port inspection activities or

routine evaluations of their programs. The continuing entry of harmful species even in regulated categories (ch. 3) suggests that the agencies are not entirely successful.

Current Federal efforts may fail to exclude a significant number of harmful MS because entry of many is prohibited only after they have become established or caused damage in the United States. Under certain laws, such as the Lacey Act<sup>2</sup> and the Federal Noxious Weed Act,<sup>3</sup> harmful species can continue to be imported legally until added by regulation to a published list. However, adding species to these lists is often difficult and time consuming (40,83,140).

Delays in preventing entry of harmful NIS also sometimes occur when new pathways emerge with no regulatory history. Recent examples include the slow reaction of PHS to the entry of

<sup>1</sup> CFR vols. 7,9.

<sup>2</sup> Lacey Act (1900), as amended (16 U. S.C.A. 667 *et seq.*, 18 U. S.C.A. 42 *et seq.*)

<sup>3</sup> Federal Noxious Weed Act of 1974, as amended (7 U. S.C.A. 2801 *et seq.*)

the Asian tiger mosquito (*Aedes albopictus*) in used tire imports, and of APHIS to the potential entry of forest pests and pathogens with proposed timber imports from Siberia (see also boxes 3-A and 4-B) (22,25), APHIS's efforts to take a more proactive approach for certain categories of agricultural pests have had varying success in part because of erratic support of the databases necessary for worldwide monitoring and anticipation of potential pest threats (54).

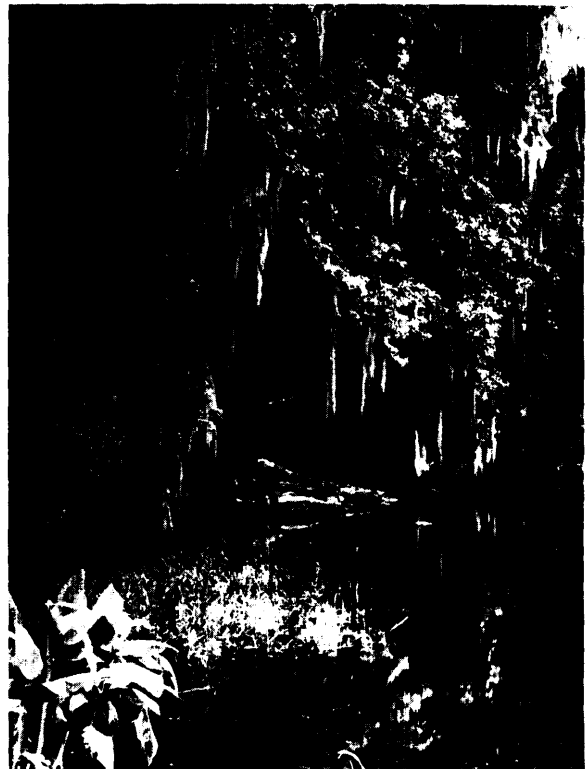
### Dealing With Harmful NIS Already Here

The Federal Government devotes significant resources to managing and preventing interstate movement of many NIS that are agricultural pests. However, insufficient impetus or authority exists for Federal agencies to impose emergency quarantines on other highly damaging species, Noxious weeds, for example, despite explicit authorization under the Federal Noxious Weed Act,<sup>4</sup> receive little attention from APHIS. Interstate transport of injurious fish and wildlife listed under the Lacey Act, such as the zebra mussel (*Dreissena polymorpha*), is not prohibited by Federal law (30).

No coordinated control efforts exist to prevent the spread of large categories of harmful NIS, such as the many that damage only natural areas or are vectors of human diseases. Current Federal efforts to control non-indigenous fish and wildlife developed piecemeal and are noncomprehensive. The Nonindigenous Aquatic Nuisance Prevention and Control Act<sup>5</sup> authorized a coordinated program that might go far toward correcting this shortcoming in the future. Lack of appropriations has impeded implementation of the Act thus far (31).

### Federal Land and Resource Management

Federal agencies manage about 30 percent of the nation's lands and play a major role in



NATIONAL PARK SERVICE

*The National Park Service has strict policies to exclude or eradicate non-indigenous species. Still, control of harmful species is not adequate in Everglades National Park and many others.*

determining the distributions and population sizes of NIS in the United States. Their policies regarding NIS vary from rigorous to nonexistent. The National Park Service (NPS) has the most stringent policies designed to conserve indigenous species and exclude or eradicate NIS. Nevertheless, even this agency does not adequately control harmful NIS,

Most other Federal land management agencies have general policies favoring the use of indigenous species or already established NIS in planned introductions or stocking of fish and wildlife. Few have similar policies regarding plant introductions. Routine planting of NIS for

<sup>4</sup> U. S. C. A. 2804

<sup>5</sup> Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U. S. CA. 4701 *et seq.*, 18 U. S. C. A. 42)

landscaping, soil conservation, and to provide vegetation for wildlife occurs on many Federal lands, including FWS's National Wildlife Refuges and other reserves (4).

Grazing by non-indigenous livestock, feral horses (*Equus caballus*), and burros (*Equus asinus*) is specifically allowed by law on vast areas of Federal land. In some places overgrazing in the past has contributed to rangeland degradation and domination by noxious weeds (134). Many Federal land managers consider the currently widespread and growing distribution of noxious weeds to be a significant management concern (136). Noxious weed control programs generally are small and underfunded, however. Widespread interest exists in the use of biological control agents to control noxious weeds, but few agencies have clearly defined policies for evaluating their safety before release.

Federal policies also affect millions of privately owned acres through the Conservation Reserve Program of the Agricultural Stabilization and Conservation Service. There are no requirements for planting indigenous species or controlling non-indigenous insect pests and noxious weeds on lands enrolled in this program.

### Evaluating NIS Before Introduction

Federal agencies vary in how rigorously they assess potential environmental effects before recommending NIS for technical applications or introducing them through Federal or federally funded activities. Neither the Soil Conservation Service nor the Agricultural Research Service systematically evaluates plant invasiveness before releasing species for use in soil conservation or horticulture. FWS Federal Aid Program makes it the responsibility of State applicants to ensure any proposed introductions comply with the National Environmental Policy Act<sup>6</sup> and Executive Order 119877 (138,139).

### NIS in Commerce

Historically, seed purity laws significantly reduced the entry and spread of non-indigenous weeds by requiring accurate labeling and by setting standards for purity of agricultural seed. Many other categories of MS are commercially distributed today with varying degrees of equivalent coverage. The significance of contamination of transported goods as a potential pathway for harmful introductions is uncertain for these other NIS. Nevertheless, areas with expanding production and markets pose the greatest concern. For example, Federal regulations specifying labeling requirements and standards for product purity are lacking for horticultural seeds (including wildflowers) and certain biological control agents (including insects and nematodes).

### CURRENT NATIONAL POLICY

Finding:

No clear national policy presently exists on NIS. President Carter issued a far-reaching executive order on NIS in 1977; in practice it has been ignored by most Federal agencies. Moreover, the U.S. Fish and Wildlife Service has yet to implement the order in regulations although specifically directed to do so.

### President Carter's Executive Order

President Jimmy Carter issued an executive order in 1977 that could have created a national policy on NIS if it had been broadly implemented (box 6-B). It instructed executive agencies to restrict introductions of "exotic" species into U.S. ecosystems, to encourage State and local governments and private citizens to prevent introductions, and to restrict the export of indigenous species for introduction into ecosystems outside of the United States. While the order's definition of "exotic" is usually interpreted to be those species not yet established in the United

<sup>6</sup> National Environmental Policy Act of 1969 (42 U.S.C.A. 4321 *et seq.*)

<sup>7</sup> Executive Order No. 11987, Exotic Organisms, 42 FR 26949, May 24, 1977

### Box 6-B-Executive Order 11987—May 24, 1977, Exotic Organisms

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the United States of America, in furtherance of the purposes and policies of the Lacey Act (18 U.S.C. 42) and the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.) it is hereby ordered as follows:

Section 1. As used in this Order:

(a) "United States" means all of the several States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the Virgin Islands, Guam, and the Trust Territory of the Pacific Islands.

(b) "Introduction" means the release, escape, or establishment of an exotic species into a natural ecosystem.

(c) "Exotic species" means all species of plants and animals not naturally occurring, either presently or historically, in any ecosystem of the United States.

(d) "Native species" means all species of plants and animals naturally occurring, either presently or historically, in any ecosystem of the United States.

Section 2. (a) Executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystems on lands and waters which they own, lease, or hold for purposes of administration; and, shall encourage the States, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States.

(b) Executive agencies, to the extent they have been authorized by statute to restrict the importation of exotic species, shall restrict the introduction of exotic species into any natural ecosystem of the United States.

(c) Executive agencies shall, to the extent permitted by law, restrict the use of Federal funds, programs, or authorities used to export native species for the purpose of introducing such species into ecosystems outside the United States where they do not naturally occur.

(d) This Order does not apply to the introduction of any exotic species, or the export of any native species, if the Secretary of Agriculture or the Secretary of the Interior finds that such introduction or exportation will not have an adverse effect on natural ecosystems.

Section 3. The Secretary of the Interior, in consultation with the Secretary of Agriculture and the heads of other appropriate agencies, shall develop and implement, by rule or regulation, a system to standardize and simplify the requirements, procedures and other activities appropriate for implementing the provisions of this Order. The Secretary of the Interior shall ensure that such rules or regulations are in accord with the performance by other agencies of those functions vested by law, including this Order, in such agencies.

JIMMY CARTER

SOURCE: Executive Order No. 11987, 42 *Federal Register* 26949 (May 24, 1977).

States, the wording is sufficiently vague to allow a species presently in one U.S. ecosystem to be "exotic" in other U.S. ecosystems (30).

The Secretary of the Interior was instructed to implement the order in regulations. Attempts by FWS to develop regulations in 1978 met with strong opposition from agriculture, the pet trade, and other interest groups (see ch. 4, box 4-A). To date, FWS has not succeeded in issuing regulations under the order, although the earlier draft

regulations continue as internal guidelines for the agency (37).

No direct evidence exists that other executive agencies changed internal guidelines or agency policies in response to the Executive Order. No Federal agency contacted by OTA, other than FWS and NPS, provided any explicit policy statement on NIS, although officials from several were aware of the Carter order. Considerable variation exists among Federal agencies in how

they define and treat NIS. This sometimes makes coordination among them difficult. Given its minor effects, Executive Order 11987 did not generate a consistent national policy on NIS.

Interest in implementing the Carter order continues in some parts of FWS and other agencies. However, executive orders are an inherently weak mechanism for establishing new national policy. Executive Order 11987 has not been fully implemented for 16 years. Consequently, its future significance is questionable.

### Recent Related Efforts

Two acts of Congress in 1990 have recently focused Federal attention on specific groups of harmful MS.

#### AQUATIC NUISANCE SPECIES TASK FORCE

The Nonindigenous Aquatic Nuisance Prevention and Control Act created an interagency task force to deal with harmful aquatic NIS in response to the spread of zebra mussels in the Great Lakes. The Act's goals go beyond control of this single species and include significant anticipatory functions for preventing and controlling future invasions of other harmful aquatic MS.

The Task Force is cochaired by FWS and the National Oceanic and Atmospheric Administration (NOAA) and draws additional members from five other Federal agencies. The Act set out a number of assignments for the Task Force, including many having required completion dates (table 6-1). The delivery of most has been delayed considerably on account of several factors (31).

First, little funding has been appropriated for the program and policy development that is authorized and necessary for fulfilling the Task Force's responsibilities (31). For most staff on working groups, Task Force functions were simply added to their existing responsibilities. A lack of funds has also seriously hampered initia-

tion of the required ballast exchange and biological studies (table 6-1). The related appropriations that have been forthcoming in fiscal years 1991 and 1992 went primarily to zebra mussel control programs and research (91).

In addition, the Task Force has a broad membership with differing missions and goals. It has taken time for member agencies to air their differences, negotiate priorities, and set consensus goals. Had a national policy on NIS already been incorporated into the internal policies of all agencies, this process probably would have been more rapid. Nevertheless, the Task Force's development of common policies and approaches may lay the foundation for future efforts in this area.

Finally, administrative details related to the mandated structure and function of the Task Force have also slowed its progress. Early on, attorneys for several member agencies decided the Task Force needed to be chartered.<sup>8</sup> Further, the charter was deemed a prerequisite for the memorandum of understanding required under the Act and for allowing non-Federal entities to participate in Task Force meetings (31).

A key to future prevention and control efforts will be the development and implementation of an "Aquatic Nuisance Species Program."<sup>9</sup> The Act does not set out details of this program. Instead, it instructs the Task Force to develop the program, describe the responsibilities of individual agencies, and recommend funding levels. A draft of the program was released for public comment in November 1992. Although the draft sets out general areas of potential agency activity, it does not clearly assign agency duties or provide guidance to Congress on future funding. Member agencies have hesitated to take on new responsibilities unmatched by new appropriations.

Should the prevention and control provisions of the Nonindigenous Aquatic Nuisance Prevention and Control Act eventually be funded and implemented, they could have a significant role in

<sup>8</sup> as required by the Federal Advisory Committee Act (1972), as amended (5 Ap 2 U. S.C.A.1 et seq.)

<sup>9</sup> 16 U. S.C.A. 4722

**Table 6-I—Delivery of Requirements Under the Nonindigenous Aquatic Nuisance Prevention and Control Act**

Responsibility assigned to:	Task:	Required by:	Delivered by:
Task Force	Request the Great Lakes Commission convene a coordination meeting	Feb. 29, 1990	Nov. 26, 1991
Task Force	Issue protocols for research on aquatic nuisance species	Feb. 29, 1991	Sept. 24, 1992 (draft)
USCG	Issue voluntary guidelines for ballast exchange	May 29, 1991	Mar. 15, 1991
Task Force	Sign memorandum of understanding on roles of agencies in the task force	May 29, 1991	Apr. 17, 1992
USCG	Issue education and technical assistance programs to assist in compliance with ballast exchange guidelines	Nov. 29, 1991	Dec. 1991
Task Force	Report to Congress on a program to prevent and control aquatic nuisance species ("Aquatic Nuisance Species Program")	Nov. 29, 1991 (annual reports thereafter)	Nov. 18, 1992 (draft)
Task Force	Report to Congress on intentional introductions policy review	Nov. 29, 1991	anticipated mid-1 993
USCG	Report to Congress on needs for controls on vessels other than those entering the great lakes ("Shipping Study")	May 29, 1992	Dec. 1992
Task Force	Report to Congress on effects of aquatic nuisance species on the ecology and economic use of U.S. waters other than the Great Lakes ("Biological Study")	May 29, 1992	anticipated mid-1 995
Task Force	Report to Congress on the environmental effects of ballast exchange ("Ballast Exchange Study")	May 29, 1992	anticipated mid-1 994
USCG	Issue regulations on ballast exchange	Nov. 29, 1992	Apr. 8, 1993

SOURCES: Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 U. S.C.A. 4701-4751; 18 U. S.C.A. 42); G.B. Edwards and D. Nottingham, Coauthors, Aquatic Nuisance Species Task Force, letter to E.A. Chornesky, Office of Technology Assessment, Nov. 25, 1992; 58 Federal Register 18330 (April 8, 1993).

preventing the unintentional entry and dissemination of harmful aquatic species. However, since the draft program requires detailed and time-consuming analyses of requests for funds, this probably will not result in a rapid-response control program for new infestations (91). The absence of any mechanism to disperse funds for emergency control was a significant concern in State reviews of the draft program (17,49). The Act's implementation also will not address the escape of aquatic NIS from aquaculture facilities: the Task Force has interpreted all introductions related to aquaculture as intentional, and therefore not under the general purview of the Act (9 1).

#### UNDESIRABLE PLANT MANAGEMENT ON FEDERAL LANDS

The 1990 Farm Bill contained an amendment to the Federal Noxious Weed Act requiring agencies to control "undesirable plants," including "exotic,"<sup>10</sup> species, on Federal lands. It requires each agency to develop, staff, and support a program for undesirable plant management. Implementation has been patchy thus far. The U.S. Department of Agriculture (USDA) issued a department-wide policy on noxious weeds in 1990 to more fully integrate its existing programs and activities (103). Several agencies, such as the Bureau of Land Management, Forest Service, and Bureau of Indian Affairs, have

<sup>10</sup> The amendment does not define "exotic." Instead it specifies "undesirable" as those plants classified "undesirable, noxious, exotic, injurious, or poisonous, pursuant to State or Federal law," (7 U. S.C.A. 2814)

noxious weed programs in place, although these tend to be a small component of overall land management activities, and the level of effort varies among sites. NPS has a long-standing program for management of non-indigenous plants, some of which are noxious weeds. Several other agencies have not yet developed noxious weed management programs, including FWS and the Department of Energy.

Representatives of several Federal land management agencies met in September 1992 to discuss future efforts to control noxious weeds. There was general consensus that the problems are severe and growing, programs are generally underfunded and understaffed, and needs exist for greater coordination among agencies. Such interest could presage greater efforts in this area.

## **POLICIES AND PROGRAMS OF FEDERAL AGENCIES**

Finding:

Of the 21 Federal agencies engaged in NIS activities, APHIS has the largest role, with a sizable staff performing its responsibilities to prevent the importation and dissemination of agricultural pest species. FWS, although its programs are smaller, also has an important role in regulating the importation of fish and wildlife. Other relevant Federal activities are scattered among agencies and primarily relate to other uses or management of NIS or research.

### **Areas of Federal Activity**

Federal activities related to NIS occur in several areas (table 6-2):

- Movement of species into the United States. This involves restricting entry of harmful NIS by regulation, inspection, and quarantine or enhancing entry by intentional importation of desirable species or by importation of materials that unintentionally harbor harmful NIS.

- Movement of species within the United States across State lines. This involves restricting movement of harmful NIS by regulation, inspection, and quarantine or enhancing movement of desirable NIS by intentional transfers and of harmful NIS by transporting materials that unintentionally harbor NIS.
- Regulating product content or labeling. This involves restricting entry or interstate movement of harmful NIS by regulating contamination or mislabeling of NIS in commerce.
- Controlling or eradicating harmful NIS.
- Introducing desirable NIS.
- Federal land management. This involves preventing, eradicating, or controlling harmful NIS on Federal lands and introducing or maintaining desirable NIS on Federal lands.
- NIS research. This addresses prevention, control, and eradication of harmful NIS and beneficial uses of NIS.

The following section examines the roles and responsibilities of 21 Federal agencies (box 6-A) in each area of activity. Included are several specific topics, such as control of noxious weeds; development or application of aquaculture and biological control (both often are based on the transfer or cultivation of species in areas where they did not formerly occur); and management of livestock, wild horses, and burros—all of which are NIS. These same domestic activities of the various Federal agencies are shown for different groups of organisms in table 6-3.

### **Department of Agriculture**

At least eight separate agencies of the U.S. Department of Agriculture have responsibilities related to NIS. Their roles are diverse and include most categories shown in tables 6-2 and 6-3.

#### **ANIMAL AND PLANT HEALTH INSPECTION SERVICE**

The Animal and Plant Health Inspection Service has broad assignments related to the importa-



Table 6-2—Areas of Federal Agency Activity Related to NIS

Agency <sup>a</sup>	Movement into U.S.		Interstate movement within U.S.		Regulate product content or labeling	Control or eradication programs	Fund or do introductions	Federal land management		Fund or do research		
	Restrict	Enhance	Restrict	Enhance				Prevent eradication or control	Introduce or maintain	Prevention eradication	Uses of species	Aquaculture development
APHIS	✓		✓		✓	✓	✓	✓		✓		✓
AMS				✓	✓							
FAS		<sup>b</sup>										
USFS						✓	✓	✓	✓			
ARS	✓			✓			✓	✓	✓		✓	✓
SCS		✓		✓			✓	✓	✓			
ASCS												
CSRS												
FWS	✓		✓		✓	✓	✓	✓	-2	✓	✓	✓
NPS						✓		✓	-7-7	✓	✓	✓
BLM								✓		✓		✓
BIA						✓						
BOR						✓	✓			✓		
NOAA	✓					✓				✓		
DOD	✓					✓				✓		
EPA	✓			✓	✓				-7	✓		✓
PHS	✓									✓		
Customs	✓											
USCG	✓											
DOE												
DEA	✓											

<sup>a</sup> For acronyms of Federal agencies see DOX b-A.

<sup>b</sup> Monitors animal diseases abroad.

<sup>c</sup> Monitors spread of human disease vectors within the United States.

<sup>d</sup> Regulates experimental releases of microbial pesticides.

<sup>e</sup> DOE lacks policies on NIS.

SOURCE: Office Tech Assessment, 1993.

Table 6-3-Federal Coverage of Different Groups of Organisms<sup>a</sup>

	Movement into U.S.		Interstate movement within U.S.		Regulate product content or labeling	Control or eradication programs	Fund or do introductions	Federal land management		Fund or do research		Assist industry uses
	Restrict	Enhance	Restrict	Enhance				Prevent eradication or control	Introduce or maintain	Prevention control eradication	uses of species	
	APHIS DOD customs DEA	ARS <sup>c</sup> DoD	APHIS Customs	ARS SCS <sup>c</sup> AMS				APHIS DOD <sup>b</sup> AMS BOR NOAA DOD	ARS <sup>c</sup> ASCS <sup>c</sup>	USFS FWS NPS BLM DOD	FWS NPS DOD	
Plants	APHIS DOD customs DEA	ARS <sup>c</sup> DoD	APHIS Customs	ARS SCS <sup>c</sup> AMS	APHIS DOD <sup>b</sup> AMS BOR NOAA DOD	ARS <sup>c</sup> ASCS <sup>c</sup>	USFS FWS NPS BLM DOD	FWS NPS DOD	APHIS ARS SDS CSRS FWS NPS BLM BOR DOD	USFS <sup>c</sup> ARS <sup>c</sup> SCS <sup>c</sup>	ARS <sup>c</sup> SCS <sup>c</sup>	
Terrestrial vertebrates	APHIS FWS DOD PHS Customs	APHIS	APHIS FWS		FWS	APHIS FWS	FWS	FWS NPS	USFS FWS NPS BLM DOD	APHIS FWS NPS		
Insects (and arachnids)	APHIS FAS ARS DOD PHS customs	ARS DOD <sup>b</sup>	APHIS	ARS <sup>d</sup> DOD <sup>b</sup>		APHIS USFS	ARS <sup>d</sup> USFS <sup>d</sup> DOD <sup>d</sup>	USFS NPS BLM	USFS <sup>d</sup> NPS <sup>d</sup> BLM <sup>d</sup>	APHIS USFS ARS CSRS NPS PHS	APHIS <sup>d</sup> ARS <sup>d</sup> ARS NPS <sup>d</sup> DOD <sup>d</sup>	AR & CSRS <sup>d</sup>
Fish	FWS Customs USCG		FWS	FWS	FWS	FWS BOR	FWS BOR <sup>d</sup>	NPS BLM	USFS FWS NPS BLM DOD	USFS NPS NOAA EPA USCG	ARS <sup>d</sup> CSRS <sup>d</sup> FWS <sup>d</sup> NOAA <sup>d</sup>	ARS <sup>d</sup> CSRS <sup>d</sup> FWS <sup>d</sup> NOAA <sup>d</sup>
Invertebrates (non-insect)	APHIS ARS FWS DOD PHS customs USCG		APHIS FWS	APHIS	FWS	APHIS				ARS <sup>c</sup> NOAA EPA USCG	ARS <sup>c</sup> NOAA <sup>d</sup> CSRS <sup>d</sup>	ARS <sup>d</sup> CSRS <sup>d</sup> DOD <sup>d</sup>
Microbes	APHIS FAS ARS FWS NOAA DOD EPA PHS Customs USCG	ARS <sup>d</sup> DOD <sup>b</sup>	APHIS		EPA	APHIS USFS FWS	ARS USFS	USFS NPS	USFS <sup>d</sup> NPS <sup>d</sup>	APHIS USFS ARS CSRS FWS NPS NOAA USCG	ARW CSRS <sup>d</sup> NPS <sup>d</sup>	ARS <sup>d</sup>

a For acronyms of Federal agencies see box 6-A.  
b Pests move unintentionally with equipment or due to construction.  
c Plants for agriculture, horticulture, or soil conservation.  
d Biological control agents.  
<sup>e</sup> Aquiculture.

SOURCE: Office of Technology Assessment, 1993.

tion, interstate movement, and management of NIS under the Federal Plant Pest Act,<sup>11</sup> the Plant Quarantine Act,<sup>12</sup> and several related statutes. The agency's primary concern is species that pose a threat to agriculture, including plant pests and pathogens, animal pests and pathogens, and noxious weeds. APHIS, for the most part, does not deal with species capable of harming natural ecosystems or creating a human nuisance, unless they also affect agriculture or forestry. Exceptions include its responsibilities to control vertebrate pests and to prevent importations of noxious weeds. In addition, APHIS is a member agency of the Aquatic Nuisance Species Task Force.

Movement of Species Into the United States-APHIS restricts the movement of agricultural pests and pathogens into the country by inspecting, prohibiting, or requiring permits for the entry of agricultural products, seeds, live plants and animals, and other articles that might either be or carry pests and pathogens. In fiscal year 1992, actual expenditures for agricultural quarantine and inspection were \$105,787,000, with 1,929 full-time employees (170). APHIS's task of controlling movement of NIS into the country continues to expand because of increased international travel and trade (table 6-4). Pest exclusion activities are projected to double between 1991 and the year 2000 (42).

Most import restrictions relate to the relative risk that an item will be or will carry agricultural pests or pathogens. Past risk assessments were informal and based on review of the scientific literature, previous experience, and expert judgment (ch. 4). Development of more for-r-naked risk assessment procedures is under way.

A shortcoming of current pest exclusion is that potential pests are not always restricted from entry in a timely fashion. In 1990 APHIS did not scrutinize the potential movement of forest pests

and pathogens with proposed imports of timber from Siberia until substantial congressional concern surfaced (25). Delays also occur in excluding noxious weeds from entry, which requires formal listing of species by agency regulation under the Federal Noxious Weed Act.<sup>13</sup> The listing approach is difficult and time consuming, allowing species fulfilling the criteria of a noxious weed to be legally imported until added to the list (40,83).

The overall success of APHIS's efforts to exclude pests is difficult to evaluate. Complete exclusion probably is infeasible. However, it is unclear what level of exclusion APHIS aims for or routinely attains, since the agency lacks performance standards for its port inspection activities or routine evaluation of its programs.

APHIS "pre-clears" some commodities before they are shipped to the United States by inspecting or treating commodities to eliminate pests or by inspecting growing areas, processing facilities, or handling and shipping facilities (55). Approved countries sometimes provide staff for these functions. Pre-cleared materials can enter the United States without further inspection, although they are subject to random examination at the point of entry (55). Thus far, APHIS pre-clearance programs are small, with inspections of fruits, vegetables, and plant material occurring in 24 countries (170).

Most of APHIS's pest exclusion activities occur at ports of entry, where inspection of incoming passenger baggage and cargo and assignment to quarantine take place. Thirty-seven million passengers arrived in fiscal year 1990. That year APHIS found 1,303,000 baggage violations and assessed \$723,345 in penalties for 23,676 of these (42). APHIS forwards certain plants, animals, and commodities from ports of entry to quarantine facilities within the country for detection and treatment of any pests or pathogens they might carry.

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<sup>11</sup>Federal Plant pest Act (1957), as amended (7 U. S.C.A. 147a *et seq.*)

<sup>12</sup>Nursery Stock Quarantine Act (1912), as amended (7 U. S.C.A. 151 *et seq.*; 46 U. S. CA. 103 *et seq.*)

<sup>13</sup>7 U. S.C.A. 2809

Table 6-4-APHIS's Pest and Disease Exclusion Activities

Recent increases in Inspections, Incoming passengers, and commodities (thousands)					
	1977	1984	1989	1980	Percentage increase
Total inspections	— <sup>a</sup>	18,917	— <sup>a</sup>	390,278	2000%
Inspections of animals	— <sup>a</sup>	1,690	— <sup>a</sup>	2,965	75%
Interceptions of prohibited material	— <sup>a</sup>	1,250	— <sup>a</sup>	1,858	49%
Plant importations	155,000	— <sup>a</sup>	318,000	— <sup>a</sup>	105%
Trade in commercial birds	313	— <sup>a</sup>	368	— <sup>a</sup>	18%
Passenger traffic	— <sup>a</sup>	26,000	34,000	— <sup>a</sup>	31%

Numbers of agricultural quarantine Inspections		
	1990	1991
Airplanes inspected	364,000	356,915
Vessels inspected	54,000	52,119
Railroad cars inspected	156,838	151,988
Mail packages inspected	237,024	256,964
Regulated and misc. cargo inspections	1,054,000	1,109,175
Animal/plant import inspections	2,965,000	— <sup>a</sup>
Personally owned pet birds inspected	2,130	1,612
Commercial birds inspected	361,373	180,706
Poultry inspected (chicks and poults)	7,121,000	5,440,976
Seed samples processed	12,923	5,099

Numbers of interceptions of unauthorized material		
	1990	1991
Unauthorized plant material	1,652,000	1,527,922
Unauthorized animal products, by-products	206,000	221,174
Noxious weeds: total interceptions (sent for inspection)	3,219	3,065
Noxious weeds: number of taxa	27	30
Mail containing unauthorized material	8,900	10,785
Baggage containing unauthorized material	1,303,000	1,149,508

<sup>a</sup>Data not obtained.

SOURCES: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, "WADS Information: October 1991/Information Fact Sheet, October 1991"; U.S. Congress, House Committee on Appropriations, Subcommittee on Agriculture, Rural Development and Related Agencies, Hearings on Agriculture, Rural Development and Related Agencies Appropriations for 1992: Part 4, Serial No. 43-171 0, May 2, 1991; D. Barnett, Staff Officer, USDA Animal and Plant Health Inspection Service, FAX letter to E.A. Chornesky, Office of Technology Assessment, Nov. 19, 1992.

Movement of Species Within the United States—APHIS restricts interstate movement of agricultural plant pests or pathogens by imposing domestic quarantines and regulations. Affected States usually adopt parallel measures to restrict intrastate movement (55).

Domestic quarantines exist for 14 non-indigenous plant pests.<sup>14</sup> Such quarantines re-

strict interstate transport of items that might carry a pest, such as firewood and recreational vehicles for the gypsy moth (*Lymantria dispar*). APHIS also regulates the interstate transport of livestock, animal products, hay, manure, and other items that could spread animal pathogens, as well as nursery stock, soil, and soil-moving equipment that could spread plant pathogens listed in domes-

tic quarantines (55). Some domestic quarantines restrict interstate transport of imported commodities. For example, Japanese Unshiu oranges (*Citrus reticulata* var. *unshiu*) can carry citrus canker (*Xanthomonas campestris* pv. *citri*). APHIS allows their importation, but restricts their transport within the country to non-citrus growing areas.

Restricting the movement of non-indigenous pests with high natural rates of spread is difficult. Consequently, APHIS does not attempt eradication, containment, or suppression of pests like the Russian wheat aphid (*Diuraphis noxia*) (55). APHIS also does not regulate some areas where the States are active, unless problems occur requiring a national approach. For example, although regulation of the honey bee (*Apis mellifera*) industry has been a State function, introduction of varroa mites (*Varroa jacobsoni*) prompted APHIS to consider developing regulations on interstate movement of honey bees in 1991 (42).

APHIS's current authority requires a warrant for inspection of first-class mail between States, although this can be an important pathway for pest spread. The shipment of agricultural products and associated pests, such as the Mediterranean fruit fly (*Ceratitis capitata*), between Hawaii and the mainland has been a growing concern. APHIS confiscated 4,228 pounds of prohibited plant material and imposed 85 civil penalties during the first five months of a trial inspection program conducted with the U.S. Postal Service in 1990. Fruit fly larvae occurred in 45 inspected packages; other important agricultural pests were found in 177 packages (42). APHIS supported formalization of first-class mail inspection either in Postal Service regulations or in additional legislation in 1991 (42). By 1992, the agency was no longer seeking an easing of the warrant system, because the interdiction program, coupled with extensive public education, had



*Witchweed* (*Striga asiatica*) is the only noxious weed that USDA's Animal and Plant Health Inspection Service has attempted to quarantine.

reduced attempted quarantine violations by 80 percent (64).

APHIS narrowly interprets its authority under the Federal Noxious Weed Act to restrict interstate transport of noxious weeds. The agency only regulates interstate transport if a quarantine is in place, and imposes a quarantine only if a control or eradication program exists (41). Few control or eradication programs exist for noxious weeds, and the agency has imposed only one domestic quarantine—witchweed (*Striga asiatica*).<sup>15</sup> Consequently, although all 93 designated noxious weeds are prohibited from entry to the United States, 9 of these presently are sold in interstate commerce (55).

Monitoring—APHIS conducts several monitoring programs abroad and in the United States to track non-indigenous pests and pathogens. International pest detection surveys focus on approximately 100 non-indigenous fruit fly species, khapra beetle (*Trogoderma granarium*), citrus canker, and Karnal bunt fungus (*Tilletia indica*)—primarily in Mexico, the Caribbean, or Latin America (42). While monitoring of worldwide animal disease agents is relatively success-

ful, widespread criticism exists of programs for plant pests. Many observers consider current systems to be inadequate for providing predictive information of use to regulators (54). This may, in part, be due to the inherent difficulty of developing plant pest databases (see ch. 4) (12). However, it also reflects erratic support.

The agency has domestic survey programs for at least 23 non-indigenous insect pests (42). APHIS also participates in the National Animal Health Monitoring Program, a cooperative Federal-State-Industry monitoring system that provides information on the geographic scope of infectious pathogens threatening livestock, poultry, and related industries.

**Control and Eradication**—APHIS management plans often combine regulatory actions with monitoring, eradication, or control programs. The choice among these options depends on feasibility and the existence of appropriate technologies. Many management plans are in cooperation with State agencies.

APHIS eradicates or controls certain species that are newly introduced or present in confined areas. Its advanced planning includes “action plans” for eradicating pests not yet in the United States, but which previously have been intercepted at U.S. borders (32). Once a pest is widely established, however, control responsibilities often shift to other Federal, State, and private agencies. For example, APHIS attempted to eradicate early swarms of the African honey bee (*Apis mellifera scutellata*) along the Texas border, but switched its strategy to technology transfer and advice to the States when eradication no longer seemed feasible (42).

APHIS does have some eradication campaigns to eliminate or suppress widespread pests that are under domestic quarantines, such as the boll weevil (*Anthonomus grandis*), the bluetongue virus, several equine pathogens, golden nematode (*Globodera rostochiensis*), and witchweed (55).

More often, however, the goal is to eliminate isolated infestations of pests, like the gypsy moth or imported fire ants (*Solenopsis* spp.).

Suppression of noxious weeds is a minor component of APHIS’s eradication and control efforts. Small control programs exist for only 8 of the 45 listed noxious weeds that are known or thought to occur in the United States (164). APHIS spent an estimated \$725,000 in fiscal year 1992 for control of noxious weeds. As perspective, the agency’s budget for domestic quarantine and control totaled at least \$42 million (98). The budget request for noxious weed control in fiscal year 1993 was even smaller, \$412,000 (98). Among other things, the agency plans to discontinue control efforts for common crupina (*Crupina vulgaris*) (98), even though, according to experts, this harmful weed of rangelands infests about 60,000 acres in the United States and is spreading (87).

APHIS is increasingly involved in biological control (55). Biocontrol programs exist for several pests, including the European corn borer (*Ostrinia nubilalis*), diffuse and spotted knapweed (*Centaurea diffusa* and *C. maculosa*), leafy spurge (*Euphorbia esula*), and Russian wheat aphid (98). In 1990, the National Biological Control Institute was created within APHIS to “promote, facilitate, and provide leadership for biological control” (106). Planned functions include increasing the visibility of biological control within APHIS, developing related regulations, and performing liaison with other Federal and State agencies that use biological control (106).

APHIS’s Animal Damage Control Program (ADC) controls or eradicates both indigenous and non-indigenous wildlife that conflict with agriculture<sup>16</sup> (15). It also is responsible for controlling the brown tree snake (*Boiga irregularis*), under the Nonindigenous Aquatic Nuisance Prevention and Control Act. ADC is working on methods to prevent snake transfers in cargo and toxicants to

<sup>16</sup> 7 U. S.C.A. 426a.

reduce snake populations. It has begun to develop a cooperative program with Guam, with control efforts expected to begin in 1993 (16).

Under the Organic Act of 1944,<sup>17</sup> APHIS conducts eradication programs in countries adjacent to or near the United States. For example, a suppression program exists for the Mexfly (*Anastrepha ludens*), a pest of more than 40 fruits, in the northwestern region of Mexico to prevent its migration into the United States (98).

**Research**—Research at APHIS focuses on methods to support the agency's regulatory activities. Current areas include techniques to detect noxious weeds at ports of entry, treatments to eliminate pests from commodities, pest identification and control methods, and biological control (1,97). APHIS had research under way on control methods for at least nine non-indigenous pests in fiscal year 1992 (98). The agency sometimes works with industry and other government agencies to evaluate promising control agents (97). APHIS also funds some related research by the Agricultural Research Service.

#### AGRICULTURAL MARKETING SERVICE

The Federal Seed Act<sup>18</sup> authorizes USDA to regulate the labeling and content of agricultural and vegetable seed imported to the United States or shipped in interstate commerce. Historically, implementation of this Act significantly reduced the movement of non-indigenous plants into the United States and between the States by setting standards for seed purity and requiring that seed packages accurately identify their contents (60). The Act does not cover seeds of flowers or ornamental plants (104). The Agricultural Marketing Service (AMS) originally was responsible for regulating both seed importations and movement of seeds in interstate commerce. However,

APHIS assumed responsibility for importation in 1982 (75).

AMS works closely with States in regulating interstate seed shipments. About 500 State seed inspectors inspect seed subject to interstate provisions of the Federal Seed Act (98). Regulations require accurate labeling, including specification of all seed in excess of 5 percent, and designation of 'weeds' and 'noxious weeds' conforming to those of the State into which the seed is transported or offered for sale.<sup>19</sup> It is illegal to transport seeds containing weeds or noxious weeds into a State in excess of specified tolerances. When inspectors detect infractions, AMS usually resolves the case administratively, rather than by prosecution (98). In fiscal year 1991, AMS tested 934 seed samples in connection with interstate shipments and collected \$76,075 in penalties under the Act (98). The fiscal year 1991 budget for Federal Seed Act functions was about \$1.1 million (98).

#### FOREIGN AGRICULTURAL SERVICE

The Foreign Agricultural Service (FAS) is the lead agency in all USDA foreign activities (75). It maintains agricultural counselors, attaches, and trade officers in 74 offices, embassies and consulates covering about 110 countries (95). FAS staff periodically report on plant or animal health issues that might affect expected importations, and the agency sometimes alerts U.S. Customs, APHIS, or other agencies of developing problems (75). FAS also facilitates the overseas activities of APHIS staff supervising pre-clearance or monitoring foreign pest and pathogen conditions (75).

#### FOREST SERVICE

Primary responsibilities of the Forest Service (USFS) relate to its management of the National Forest System and research on forest pests and pathogens.

<sup>17</sup>Department of Agriculture Organic Act of 1956, as amended (7 U. S.C.A. 428a et seq.)

<sup>18</sup>Federal Seed Act (1939), as amended (7 U. S.C.A. 1551 et seq.)

<sup>19</sup>7 CFR 201, as amended (Jan. 4, 1940).



*Gypsy moth* (*Lymantria dispar*) research is the U.S. Forest Service's responsibility while the Forest Service and USDA's Animal and Plant Health Inspection Service share obligation for controlling the pest.

**Land and Resource Management**—The 191 million-acre National Forest System is distributed in 43 States (74) and makes up roughly 8 percent of the U.S. land area. Congress has designated 32.5 million of these acres, or 17 percent, as wilderness (92). Policies regarding NIS are more restrictive in wilderness areas; for example, stocking of 'exotic' <sup>20</sup> fish is prohibited, restoration of disturbed vegetation must incorporate only indigenous species, and wildlife may be controlled when they harm indigenous species (75).

In general, however, the National Forest System is managed for multiple uses,<sup>21</sup> including timber production, outdoor recreation, rangeland grazing, watershed preservation, and fish and wildlife habitat (94). Thus, aside from constraints on wilderness areas, the Forest Service manages its lands for purposes that sometimes include the introduction of NIS.

**Grazing**—In 1989, a total of 1,147,916 cattle (*Bos taurus*), horses, and burros and 944,843 sheep (*Ovis aries*) and goats (*Capra hircus*)—all of them non-indigenous—grazed on lands of the National Forest System (163). The Forest Service has inventoried approximately 50 million acres as suitable for grazing (93). According to a recent Forest Service internal survey, 24 percent of the grazing allotments in six Western Regions had problems with vegetation or soil and water resources caused either by improper livestock grazing or by grazing occurring where it conflicts with other valued resources such as wildlife or recreation (92).

**Introductions of Fish and Wildlife**—As a general policy, when stocking or introducing fish or wildlife, the Forest Service favors 'native' <sup>22</sup> or "desirable" non-native species (108). Introductions of new NIS desired by the public may be allowed (108). The Forest Service considers management of fish and wildlife in the National Forests primarily a State responsibility. Releases of NIS at new sites involve joint agreements with State fish and wildlife agencies and coordination with FWS (108,163). In evaluating such introductions, the Forest Service and States consider probable effects on adjoining private and other public lands, as well as compatibility with multiple-use management (108,109). More careful consideration is given to introductions of new NIS than to repeated stocking of species introduced in the past, such as the chukar partridge (*Alectoris chukar*). The latter do not require an environmental analysis unless they are controversial (108).

**Control of Noxious Weeds**—The Forest Service has an active program to control noxious weeds. The current emphasis is on use of integrated management systems, and the Forest

<sup>20</sup> "Exotic" is defined in the FS manual as "Species not originally occurring in the United States and introduced from a foreign country. Exotic species that have become naturalized, such as the ring-neck pheasant [*Phasianus colchicus*], are considered the same as native species' (111).

<sup>21</sup> under the Multiple-Use Sustained Yield Act of 1960, as amended (16 U.S.C.A. 528 et seq.)

<sup>22</sup> According to the Forest Service Manual, "native" refers to species indigenous to the United States (111).



Service has a strong interest in using biological control agents (1 12,168).

A recently issued interim directive on noxious weeds includes several notable components (1 12). Where possible, forage and browse seed for planting and feed, hay, or straw brought onto Forest Service lands must be certified free of noxious weed seed (1 12). The directive further encourages the use of desirable plant species that out-compete noxious weeds and requires where appropriate that equipment brought onto Forest Service lands by contractors or permittees be free of noxious weed seeds (1 12). Forest Supervisors are specifically instructed to assess the risks of introducing noxious weeds in projects that disturb plant communities (1 12).

*Control of Forest Pests and Pathogens—The Forest Service has responsibility for detecting, identifying, surveying, and controlling forest pests affecting forested lands in the United States under the Cooperative Forestry Assistance Act.<sup>23</sup> While the Forest Service directly manages species affecting the National Forest System, management elsewhere is through cooperative agreements with other Federal and State agencies using funds specifically appropriated to the Forest Service for this use (162).*

Most of this program does not deal with NIS, since the majority of significant pests and pathogens affecting the nation's forests are indigenous (1 10). Nevertheless, it does address several well-established non-indigenous pests, including gypsy moth, white pine blister rust (*Cronartium ribicola*), balsam woolly adelgid (*Adelges piceae*), and Port-Orford cedar root disease (*Phytophthora lateralis*) (163). Gypsy moth, considered the most damaging of these, is controlled cooperatively by the Forest Service and APHIS (163). The Forest Service manages larger infested areas, and it shares eradication responsibilities with APHIS for isolated outbreaks (163). The Forest Service expended an average of at least \$10 million annually for gypsy moth suppression and eradica-

tion on Federal, State, and private lands from 1987 to 1991 (163). Non-indigenous insects and pathogens could become an even more significant component of forest pest management if species from Siberia ever become established in the Pacific Northwest—some localized infestations have already occurred (26).

*Research—Forest Service research on timber management includes the selection, testing, and distribution of plant materials to improve forests. The United States is rich in indigenous woody species, and only a few NIS have been developed and distributed for specialized applications, such as windbreaks in treeless areas, urban plantings, and Christmas trees (56).*

Forest Service research on forest insects and pathogens previously had large programs on introduced pathogens such as white pine blister rust, Dutch elm disease (*Ceratocystis ulmi*), and chestnut blight (*Cryphonectria parasitica*) (162). It currently has a large program (funded at \$3,849,000 in fiscal year 1992) on the gypsy moth at the agency's Northeastern Forest Experiment Station (163).

#### AGRICULTURAL RESEARCH SERVICE

The Agricultural Research Service (ARS) is the research branch of USDA. Its functions include the evaluation of agricultural NIS, which later are disseminated throughout the country by the commercial sector. ARS also conducts research on the prevention, control, or eradication of harmful NIS, often in cooperation with APHIS.

*Development of New Varieties—The National Plant Germplasm System (NPGS) is an important repository of seeds and other plant materials (germ plasm) for plant breeding in the United States (53,166). ARS plays a pivotal role in coordinating, funding, and staffing NPGS, although the system is actually a network of cooperating Federal, State, and private institutions (77). ARS's functions in the NPGS include*

<sup>23</sup> Cooperative Forestry Assistance Act of 1978, as amended (7 U.S.C.A. 2651-2654; 16 U.S.C.A. 564 *et seq.*)

foreign exploration to bring back new plant varieties of potential use to breeders and the inspection and quarantine of imported plant materials, which it conducts in cooperation with APHIS (77). In addition, some of the U.S. plant germ plasm collection is stored by ARS (105).

An annual average of 8,503 accessions were incorporated into NPGS between 1985 and 1989 (165). About 90 percent of these were of foreign origin (165). Screening of this plant material for pathogens or contamination by other species is generally successful. Only one introduced pest, the peanut stripe virus has been traced to the National Plant Germplasm Program during the past 25 years (165).

Non-indigenous plant species and varieties are not evaluated for potential invasiveness or other harmful ecological qualities before being placed in NPGS. Many are cultivated plants posing few ecological risks (75). However, the collection does contain some harmful plants that are sources of useful genes for plant breeders (e.g., noxious weeds like wild oats (*Avena fatua*)) (166). Individuals receiving noxious weed seed from the collection must obtain Federal and State permits (166).

ARS's National Arboretum is part of the National Plant Germplasm System. Its functions include overseas plant exploration and importation, although the Arboretum's main focus is on plants for ornamental horticulture (24). The Arboretum imported a total of 2,371 species between 1986 and 1988 (165). In addition, scientists at the Arboretum develop ornamental plants and then release them to researchers or to the commercial sector for multiplication, distribution, and sale. Plants are evaluated for hardiness, pest and disease resistance, and other desirable characteristics before release. The Arboretum does not systematically evaluate plants for invasiveness. Some ARS botanists, however,

may be sensitive to such concerns and incorporate them into plant assessments (27).

ARS presently is developing the National Genetic Resources Program required by the 1990 Farm Bill.<sup>24</sup> This program will eventually subsume work currently in the NPGS (75). Its functions include the collection, classification, preservation, and dissemination of genetic material of importance to U.S. agriculture. Its biological breadth is greater than that of NPGS, encompassing genetic resources of animals, aquatic species, insects, and microbes in addition to those of plants. The National Genetic Resources Program may thus eventually expand ARS's role in foreign exploration and importation to include a greater variety of organisms.

**Aquiculture**-An additional research area involving the use of NIS is aquiculture. ARS projects include culture techniques and disease diagnosis and control (99). Total expenditures in this area were at least \$7 million in fiscal year 1992 (99).

**Biological Control and Other Uses of Beneficial Insects**-ARS considers biological control to be one of the most important pest control tactics and has a sizable program for locating, importing, and evaluating insects and other organisms (5,99). The budget request for this program was about \$9.5 million for fiscal year 1993 (99). The agency operates several laboratories abroad where researchers locate and study new biological control agents and ship them to the United States. The recently closed laboratory in Italy shipped a total of 80,175 individuals of 28 biological control agents to the United States in 1990 (34). (The laboratory's functions shifted to a new facility in Montpellier, France.) Some of ARS research on biological control is in cooperation with other Federal agencies. For example, ARS and the Army Corps of Engineers cooperate extensively on control of aquatic weeds in the

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<sup>24</sup> Food, Agriculture, Conservation, and Trade Act of 1990 (7 U. S.C.A. 5841 *et seq.*)

NOAH PORITZ



The Agricultural Research Service is studying methods to control or eradicate the African honey bee (*Apis mellifera scutellata*), the tracheal mites (*Acarapis woodi*) that infect European honeybees (*A. mellifera*), and other agricultural pests.

southeastern United States, and the Bureau of Reclamation contributes funding to ARS work on biological control of salt cedar (*Tamarix* spp.).

ARS researchers follow protocols for the importation and release of non-indigenous biological control agents, in addition to fulfilling APHIS's requirements for import and interstate transport permits (18). General provisions include adherence to applicable Federal and State laws, quarantine, detailed documentation, and evaluation of potential environmental and safety effects (18). These protocols provide guidance for ARS workers, but are largely voluntary for other researchers in academia and industry (13). Detailed requirements for evaluation of environmental effects before release have not yet been developed by ARS for all categories of biocontrol agents (18).

ARS also imports non-indigenous bees for research on crop pollination (88). APHIS requires permits for importation and release of bees to prevent entry of bee pathogens, parasites, predators, or harmful germ plasm (58).

Prevention, Control, or Eradication Methods—In addition to its biological control program, ARS has research aimed at the control or eradication of several non-indigenous agricultural pests, such as the Russian wheat aphid; sweet potato whitefly (*Bemisia tabaci*); Mediterranean fruit fly; African honey bee; pear thrips (*Taeniothrips inconsequens*); and tracheal mites (*Acarapis woodi*), which infect honey bees (99).

The agency spent almost \$9 million for research on these six NIS in fiscal year 1992 (99). Another relevant research area is plant disease resistance, which aims to prevent infections by non-indigenous plant pathogens. ARS also studies animal pathogens not yet present in the United States at four specialized laboratories in the United States (75).

Some funds for ARS research come from State or local governments. These are for research on the control of NIS of great local concern. For example, in 1991 Florida provided at least \$200,000 to ARS for work on biocontrol of melaleuca (*Melaleuca quinquenervia*) and aquatic weeds (99).

#### SOIL CONSERVATION SERVICE

The Soil Conservation Act of 1935<sup>25</sup> established the Soil Conservation Service (SCS). Its central mission continues to be the protection of land and related resources against soil erosion.<sup>26</sup> SCS gives technical advice to nearly all public agencies and many private entities in the United States on grasses, forages, trees, and shrubs suitable for erosion control (75). The agency devotes a significant part of its efforts to the development and dissemination of new plant materials for conservation.

Some plants released and recommended by the SCS are non-indigenous to the United States (79). Others are species of U.S. origin spread beyond their natural ranges through soil conservation applications. SCS uses NIS at least in part

<sup>25</sup> Soil Conservation and Domestic Allotment Act (1935) (16 U. S.C.A. 590a *et seq.*)

<sup>26</sup> 7 CFR 600, as amended (April 6, 1982).

because indigenous species sometimes may not satisfy all soil conservation needs, especially for plants that grow rapidly in disturbed, contaminated, or polluted habitats (75).

Movement of Species Into and Within the United States-SCS operates 20 plant materials centers throughout the United States, and an additional 6 are operated either jointly with other agencies or by State agencies with SCS assistance (1 16). These centers assemble, test, release, and provide for the commercial production and use of plant materials. Plants evaluated for any given application may come from collections of indigenous vegetation, foreign plant introductions, strains from plant breeders, or commercial seed (114). SCS has a small, informal program to locate new species abroad (69). However, the principal source of foreign plant materials is ARS, which provides an estimated 90 percent of the NIS evaluated by SCS (80).

At any given time, the plant materials centers collectively may be evaluating as many as 20,000 plant types (117). Of these, about 25 percent are non-indigenous to the United States<sup>27</sup> (1 17). From 1981 through 1990, the plant materials centers formally released for public use a total of 75 species or cultivars (varieties); 29 percent had origins outside the United States, including Turkey, China, and Africa (113). Once into commercial production, plants developed by SCS can have wide distribution. For example, in 1989, 200 SCS cultivars were in production, resulting in 24.8 million pounds of seed and 27.1 million plants, with a retail value of \$78.3 million (117).

Within the SCS, no explicit agency-wide policy governs the use of indigenous versus NIS, although SCS officials state that priority is generally given to indigenous<sup>28</sup> species (69,80). The SCS does provide general guidance to the plant materials centers regarding testing for potential weediness. Specifically, it requires de-

termination of whether a plant “has any toxic qualities or has a potential for becoming a pest.” Should the plant have these qualities, “control methods are to be developed and hazards are to be carefully assessed before the plant is considered for release” (114). Annually about 10 percent of species under evaluation are discarded because of their potential to become weeds (80).

Within those general national guidelines, the review process and species choice occurs at the individual plant material centers (69). Procedures for evaluating plants are not standardized and can vary among centers and even among individual researchers (79,80). In the past, SCS has recommended some plants that have become notable pests, such as multiflora rose (*Rosa multiflora*), Russian olive (*Elaeagnus angustifolia*), and salt cedar (75). SCS staff believe that many, if not all, of these harmful species would not pass the plant review process today (75,80).

Nevertheless, present review processes may fail to adequately screen out potential pests, especially those that only become pests in forests and other natural areas. According to one expert, at least 7 of the 22 non-indigenous cultivars released between 1980 and 1990 have the potential to become invasive in natural areas (61). In addition, even U.S. species spread beyond their natural ranges by soil conservation applications might cause problems: the Illinois Department of Conservation recently expressed concern over the release of Elsmo lacebark elm (*Ulmus parvifolia*) by the Missouri plant material center for use in windbreaks and ornamental and conservation areas (76).

Control and Eradication-SCS does not control or eradicate species it has released when they become pests (80). However, SCS is involved in an effort to replace noxious weeds on grazed lands with other palatable plants that outcompete the weeds (80,115). Current and

<sup>27</sup> SCS specifies that 75 percent are “native,” presumably meaning indigenous to the United States (1 17).

<sup>28</sup> SCS staff use the term “native.”

planned work includes grazing management studies, development of methods to encourage re-invasion by long-lived indigenous plants, and the collection and screening of new grassland plants (115). The collection and screening may itself involve new introductions, since SCS is considering “importing plants that have been under centuries of intensive grazing in Inner Mongolia because they have evolved to withstand abusive and intensive grazing” (79).

Providing Indigenous Germ Plasm for Restoration—Since 1990, SCS has collaborated with the National Park Service to propagate indigenous plants for revegetation following park road construction (149). SCS expanded this program to include providing plants for general park maintenance in 1992 and adopted it as an agency plan (81). A unique aspect of this effort is the use of genetic strains that are indigenous<sup>29</sup> to individual parks. The program provides mutual benefits to the participating agencies. SCS obtains plant materials for potential use in soil conservation. Park managers receive indigenous plants that otherwise are difficult to obtain (80).

A SCS draft strategic plan suggested this program and other SCS work could contribute to the development of banks of indigenous<sup>30</sup> species with known ecological zones for future needs (117). The plan recommended an expanded role in the preservation of indigenous germ plasm, including the establishment and operation of an indigenous germ plasm center (117). Whether and how this center would coordinate with the National Genetic Resources Center under development by ARS is unclear. In any case, a repository of indigenous plant material might decrease SCS reliance on potentially harmful NIS for conservation.

#### AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

The Agricultural Stabilization and Conservation Service (ASCS) administers the Conservation Reserve Program (CRP), created under the Food Security Act of 1985.<sup>31</sup> CRP’s primary objective is to help reduce water and wind erosion on highly erodible croplands (19,95). Farmers enroll eligible acreage, and then plant soil-conserving plants for a 10-year contract period (19). In exchange, participants receive annual rental payments and a one-time payment for half of the eligible costs of establishing the plant cover (95). The 1990 Farm Bill broadened the program to include wetland preservation and other conservation practices (75).

CRP is set at a maximum of 44 million acres (95). As of 1990, 33,922,565 acres were enrolled (19), or roughly 8 percent of U.S. cropland and 1 percent of the total U.S. land area. In 1990, 58 percent of CRP lands were planted with grasses non-indigenous to the United States, while only 24 percent were planted with indigenous grasses<sup>32</sup> (19). The difference probably relates to per acre planting costs of \$37.39 for NIS versus \$44.95 for indigenous species (19).

CRP lands may inadvertently provide habitats for non-indigenous weeds, such as tumbleweed (*Salsola iberica*), kochia (*Kochia scoparia*), and leafy spurge (19). Plants on CRP lands can also provide habitats for non-indigenous crop pests during periods when crop hosts are not available; for example, the Russian wheat aphid persists on several grasses recommended for western sites (10,19).

Between 1986 and 1987, CRP acreage jumped by approximately 17 million acres (107). This unanticipated rapid rate of enrollment caused the demand for grass seed to exceed supply and resulted in large legal importations from abroad

<sup>29</sup>Text uses term ‘native’ (149).

<sup>30</sup>Text uses term ‘native,’ referring to species indigenous to the United States (117).

<sup>31</sup>Food Security Act of 1985, Public Law 99-198, Title XII.

<sup>32</sup>Text uses ‘introduced’ and ‘native’ for non-indigenous and indigenous to the United States, respectively (19).

and widespread use of uncertified seed (75). While ASCS is not aware of any resulting weed problems (75), such conditions provide a ripe opportunity for unintentional importation and distribution of non-indigenous weeds.

#### COOPERATIVE STATE RESEARCH SERVICE

The Cooperative State Research Service (CSRS) funds research on agricultural pest control and aquiculture through State agricultural experiment stations, forestry schools, land-grant colleges, the Tuskegee Institute, and veterinary colleges. CSRS awarded grants for research on the management and control, including biological control, of non-indigenous pests totaling at least \$450,000 in 1990 and \$550,000 in 1991 (96). These included leafy spurge, gypsy moth, imported fire ants, Eastern filbert blight (*Anisogramma anomala*), and Russian wheat aphid. CSRS also provides funds for the use of NIS in technical applications such as biological control or aquiculture. In 1990, \$338,900 was awarded to develop facilities for biocontrol of Japanese beetle (*Popillia japonica*) (96). CSRS funds five regional aquiculture centers. At these and other locations, research is under way on the detection and prevention of diseases in aquiculture species and the development of species for aquiculture applications.

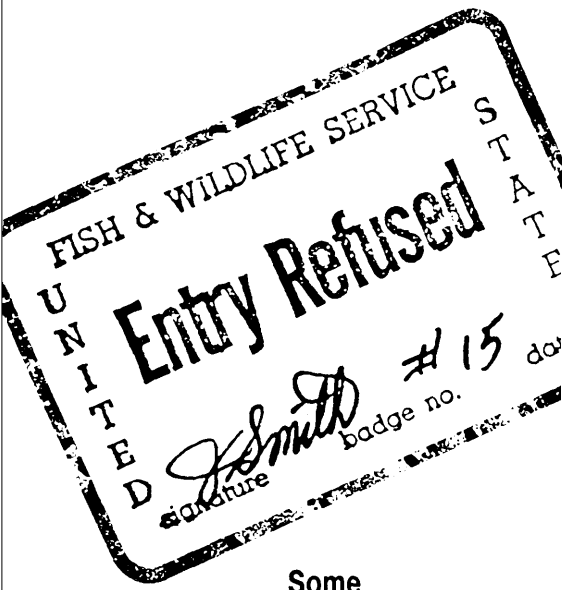
#### Department of the Interior

At least five agencies within the Department of the Interior have responsibilities related to NIS. Of these, the U.S. Fish and Wildlife Service (FWS) has the most diverse role. Collectively, management policies of the department's agencies affect the distributions and impacts of NIS on at least 20 percent of the U.S. land area.

#### FISH AND WILDLIFE SERVICE

FWS simultaneously engages in both controlling and intentionally introducing or stocking NIS. The agency has responsibilities to prevent and control injurious fish and wildlife and to protect threatened and endangered species. At the same time, FWS promotes recreational fisheries,

Buyer Beware!



Some souvenirs you buy overseas could end up costing a lot more than you paid for them.

OTA

*Educational efforts, such as this brochure for travelers, are part of the U.S. Fish and Wildlife Service's work to prevent and control injurious introductions and protect endangered species.*

hunting, and aquiculture that involve NIS. Although FWS uses regulations drafted under Executive Order 11987 as an internal policy to discourage introductions of NIS, the policy has not been uniformly adopted throughout the agency (30). Conflicting goals sometimes occur between different programs, and even between different parts of individual programs.

FWS's participation as co-chair of the Aquatic Nuisance Species Task Force has required some synthesis and internal evaluation of the agency's role in NIS issues. While the ultimate effects of this effort are presently unknown, it potentially will generate increased communication and coordination among the currently disparate programs within FWS.

**Movement of Species Into the United States-** FWS has responsibility for regulating the importation of injurious fish and wildlife under the Lacey Act. Current regulations prohibit or restrict entry to the United States of two families of fishes; 18 genera or species of mammals, birds, reptiles, and shellfish; and two fish pathogens.<sup>33</sup> FWS also restricts the importation of hundreds of threatened and endangered species from abroad under the Convention on International Trade in Endangered Species (CITES).

The FWS port inspection program is relatively small, especially in comparison with agricultural inspection. The budget request for fiscal year 1992 included \$3,294,000 for 65 wildlife inspectors and an additional \$500,000 for an automated import clearance system (100). In 1990, FWS port inspectors inspected 22 percent (a total of 17,562 inspections) of the wildlife shipments at international ports of entry (100).

The potential exists for FWS to play an increased role in regulating fish and wildlife imports, but current shortcomings of the FWS law enforcement division might compromise expanded efforts. A recent advisory commission found the division seriously understaffed and underfunded

and lacking clear priorities, adequate staff supervision, or sufficient technical expertise to identify species (145). Unfunded needs for law enforcement identified by FWS regional offices totaled at least \$7 million for fiscal year 1992 (67).

**Movement of Species Within the United States-** Under the Lacey Act, interstate transport of *federally* listed species is legal. Thus, intentional movements within the country of harmful fish and wildlife such as zebra mussels face no Federal prohibition. In contrast, amendments to the Lacey Act in 1981 made the interstate movement of State-listed injurious fish and wildlife a Federal offense, potentially subject to FWS enforcement (70,90). No interceptions of such interstate shipments were listed among the 1990 accomplishments of FWS enforcement, suggesting this is not a high priority within the agency (100). Future implementation of the Nonindigenous Aquatic Nuisance Prevention and Control Act might increase the FWS role in preventing interstate transfers of harmful aquatic species.

**Federally Funded Introductions-** The FWS Federal Aid Program allows States to recover up to 75 percent of acceptable costs for various projects related to fish and wildlife restoration. Funds come from Federal excise taxes on sales of firearms and hunting and fishing equipment and supplies. The receipts have grown steadily over the past few years (figure 6-1), and payments to States totaled more than \$320 million in fiscal year 1991.

The program frequently is criticized for its historical role in supporting numerous introductions of non-indigenous fish and wildlife species (20,141). Determining the exact number of introductions funded is difficult, however, since few project titles include species names or the words "exotic" or "non-indigenous" (63).

The Federal Aid Program now discourages introductions of MS not yet established in an area. It requires States to assess the environmental

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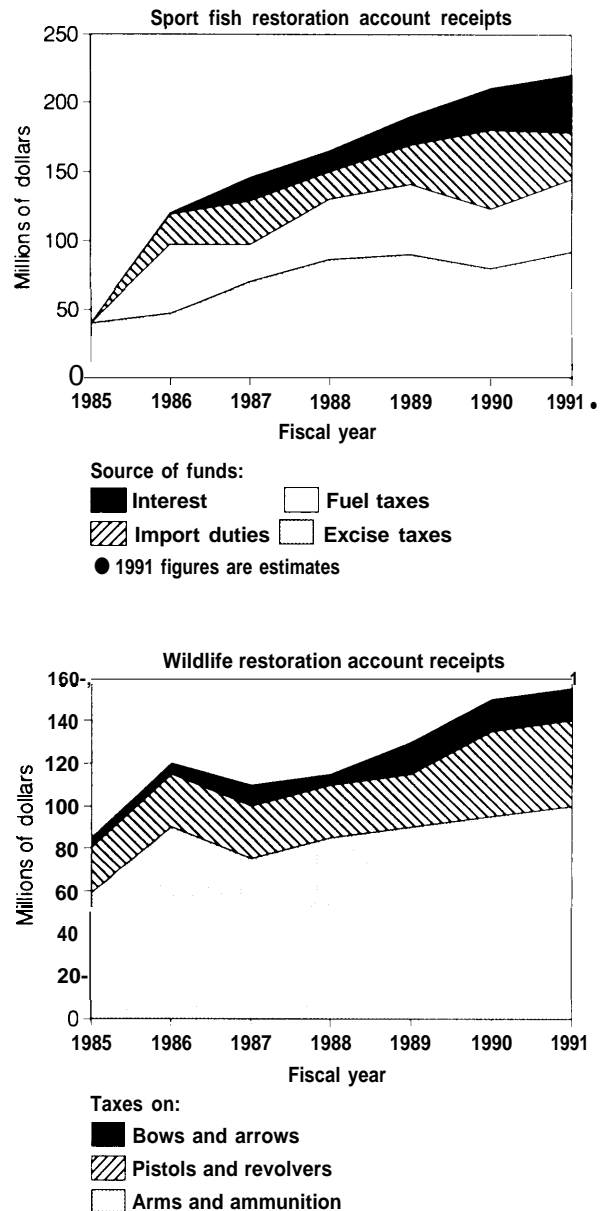
<sup>33</sup>50 CFR 16, as amended (Jan. 4, 1974).

impacts of any introductions they propose (4,138,139). Although proposals for introductions presently are uncommon, they do continue (142). Most involve introductions of U.S. species into areas where they are not indigenous, such as the recent proposal by the New Jersey Division of Fish, Game and Wildlife to introduce chinook salmon (*Oncorhynchus tshawytscha*) from the Pacific coast to the Delaware Bay (159). Such introductions have become controversial only recently (4), and the Federal Aid Program lacks a clear policy regarding their eligibility for funds. Additional concerns are that proposals for introductions are closely scrutinized only when they engender vocal public controversy, and that State agencies sometimes inadequately fulfill requirements for assessing environmental effects of introductions. Further, States can avoid scrutiny by using State funds for the initial introduction of a species; once the species is established, funding can be sought from the Federal Aid Program for stocking without any requirement for environmental assessment.

**Control and Eradication**—FWS has no centralized, comprehensive program for the control and eradication of harmful NIS. Instead, control programs have variable goals, such as control of individual species, recovery of endangered species, and control of fish diseases affecting aquaculture. The most notable control program is for the sea lamprey (*Petromyzon marinus*) in the Great Lakes, conducted by the North Central Regional Office in Minnesota in cooperation with other regional entities. Under the Great Lakes Fish and Wildlife Restoration Act,<sup>34</sup> FWS plans to expand sea lamprey control as part of a Great Lakes initiative (100).

FWS had reported NIS as a factor contributing to the decline of approximately 30 percent of species listed as threatened or endangered as of June 1991 (see table 2-3) (4). Control of NIS is a component of the recovery plans of many listed

**Figure 6-I—Account Receipts of the FWS Federal Aid to States Program**



SOURCE: U.S. Congress, House Committee on Appropriations, Subcommittee on the Department of the Interior and Related Agencies, "Hearings on Department of the Interior and Related Agencies Appropriations for 1992," Serial No. 43-2940, (Washington, DC: U.S. Government Printing Office, 1991), pp. 1091, 1099-1100, 1111, 1117-1118.

<sup>34</sup>Great Lakes Fish and Wildlife Restoration Act of 1990 (16 U. S.C.A. 941 et seq)



species (4). Examples include control of feral animals and non-indigenous vegetation in Hawaii and reduction of non-indigenous fish populations in the upper Colorado Basin (100). Implementation of many recovery plans has been poor, however (4, 152). Endangered species recovery plans consequently contribute little to the control of NIS at this time.

Fisheries Enhancement and Aquaculture—FWS produces fish for stocking waterways at 77 National Fish Hatcheries throughout the country (147). While much of this effort goes to culturing indigenous fishes, it also produces NIS commonly stocked in U.S. waters. Rainbow trout (*Oncorhynchus mykiss*) and striped bass (*Morone saxatilis*), for example, are widely stocked beyond their natural ranges.

FWS created an office to coordinate aquaculture within the agency and with other Federal agencies under the National Aquaculture Act of 1980 (70). The office's primary activity is providing technical assistance related to natural resource issues and fish diseases to State agencies and the private sector. FWS helps control the spread of fish pathogens by promoting a National Fish Health Strategy and by providing voluntary diagnosis and inspection to the private sector through technical centers associated with the National Fish Hatcheries.

Land Management—FWS manages approximately 91 million acres, about 4 percent of the U.S. land area, mostly within the National Wildlife Refuge System. This system includes 500 national wildlife refuges, 166 waterfowl production areas, and 51 wildlife coordination areas (46). General goals include the preservation of natural diversity, although various units were established under different authorities and for varying purposes (4). Sometimes these even include preservation of NIS—for example, management of longhorn cattle (*Bos taurus*) at the Wichita Mountains National Wildlife Refuge.

The National Wildlife Refuge System Administration Act<sup>35</sup> only allows land uses that are compatible with the refuges' original purposes. In practice, this results in inconsistent NIS policies. Some NIS may be purposefully introduced—for example, planting non-indigenous grass mixtures (i.e., wheatgrass (*Agropyron* spp.), alfalfa (*Medicago sativa*), and sweet clover (*Melilotus* spp.)) to enhance waterfowl production and stocking non-indigenous fish to achieve management objectives (4). Other NIS are controlled when they interfere with refuge management goals (72,147). Approximately 12 percent of the wildlife refuges experienced problems with MS in 1991 (72).

Research—FWS has ongoing NIS research in the following areas: the distribution, biology, and control of aquatic nuisance species; the identification and treatment of fish pathogens; control of wildlife diseases; control of the brown tree snake; effects of non-indigenous vegetation on nongame migratory birds; biological control of purple loosestrife (*Lythrum salicaria*); and aquaculture techniques (72,85,100). Much of the work on aquatic species is conducted at the National Fisheries Research Centers in Gainesville, Florida; AM Arbor, Michigan; and LaCrosse, Wisconsin.

The Gainesville center sometimes is referred to as the “Exotic Species Laboratory.” One of its missions is to identify the distribution, status, and impacts of non-indigenous fish (85). The center has a database to monitor the spread of non-indigenous fishes in the United States and is developing a geographic information system (ch. 5) for monitoring non-indigenous aquatic species in general. The center's prominent role in research and information exchange has been due to the intense efforts of a small, experienced staff. However, recent staff turnover coupled with the ambiguous status of NIS among the center's various responsibilities makes its future unclear.

<sup>35</sup>National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C.A. 668dd *et seq.*)

The Federal Aid Program of FWS funds some State research on uses, impacts, and management of non-indigenous fish and wildlife. For example, from 1989 to 1990, \$100,036 went to research on the brown trout (*Salmo trutta*) and \$24,671 to research on feral dogs (*Canis familiaris*) and pigs (*Sus scrofa*) (143,144). Such projects are a small part of the total research funded by this program.

Certification of Sterile Grass Carp—The FWS has operated an inspection service to certify that grass carp (*Ctenopharyngodon idella*) are triploid since 1979 (146). Presently, this is done at the Warm Springs Regional Fisheries Center in Georgia. Grass carp are non-indigenous fish that have wide application as biocontrol agents for aquatic weeds. However, they can also spread and cause environmental harm if reproductive populations become established in the wild. The triploid grass carp are sterile, and can be released without risk of establishing self-sustaining field populations.

#### NATIONAL PARK SERVICE

Although the law that created the National Park Service (NPS) says nothing about NIS, it does set out a general goal to “conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations.”<sup>36</sup> This responsibility is the basis for NPS’s policies promoting the eradication and control of NIS and prohibiting introductions except under very limited circumstances (4). As early as 1933, NPS had explicit policies regarding the need to control ‘exotic’ species on park lands (52).

When the National Park System was created, preservation of U.S. ecosystems could be accomplished largely by leaving things alone. Increasingly, however, intervention has become essential to control the ecological disruption caused by

harmful NIS. This changing need has not been met by an adequate shift in management priorities, funding, and staffing within the NPS.

A rough estimate is that NPS allocates less than 1 percent of its annual budget to research, management, and control of MS. Natural resource issues in general receive low priority within NPS. In fiscal year 1990, only 6 percent of the NPS budget went to management of natural resources (66).

Growing recognition exists that NPS will need to shift its funding priorities if it is to address the degradation of natural resources, including that related to NIS, resulting from human encroachment around park boundaries (86).

Land Management—NPS manages approximately 80 million acres divided into 10 geographic regions, or about 3 percent of the U.S. land area (2). The system is made up of about 364 units having 22 different designations such as parks, monuments, recreation areas, historic sites, and battlefields (2). Reflecting this diversity, NPS lands are divided into natural, cultural, park development, and special use management zones (148). NPS’s strictest policies related to NIS are for natural zones (148).

A survey done in 1986 and 1987 on natural resource conditions in the parks found control of harmful NIS to be a significant management concern throughout NPS (47). Respondents cited non-indigenous plants as the most common threat to park natural resources. Non-indigenous animals were the fourth most commonly reported threat. Parks negatively affected by NIS occur in all 10 NPS regions (47).

Most decisions regarding control and management of NIS are made by individual parks during development of resource management plans. Within any given park, the priority given to NIS projects depends on the park’s goals and present condition. NIS projects have relatively high priority among natural resource concerns within

<sup>36</sup> National Park Service organic Act (1916), as amended (16 U.S.C.A. 1 *et seq.*)

NPS; according to NPS officials, 42 percent of NIS projects were either funded (39 percent) or ranked as highest priority among unfunded projects (3 percent) for the period from 1991 to 1995, compared with only 36 percent for all other resource management projects (51). National Parks with especially pressing problems with NIS include Haleakala and Volcanoes in Hawaii, Everglades in Florida, Great Smoky Mountains in Tennessee, and the Indiana Dunes National Lakeshore. Even smaller parks like Rock Creek Park in the District of Columbia have numerous pressing problems with non-indigenous plants.

NPS generally seeks to perpetuate indigenous plants and animals, and its policy is to manage or eradicate NIS that threaten park resources or public health whenever prudent and feasible. NIS introductions are generally prohibited by agency regulation.<sup>37</sup> To further prevent introductions, some parks, such as Yosemite, have park-specific regulations requiring feed materials transported into the park be certified weed free or requiring use of pelletized feeds in the backcountry (52). Notwithstanding these various bans, intentional introductions are tolerated to varying degrees in NPS's four management zones (box 6-C) (148).

Still, NPS differs from other Federal land management agencies in having strict guidelines for introductions. Plants and animals must be from populations closely related genetically and ecologically to park populations, except when the goal is to correct losses of the gene pool caused by human activities (148). In natural zones, revegetation efforts are to use plant materials not only of indigenous species, but of indigenous gene pools as well (148).

**NPS Control** of Activities Outside the National Parks—NPS officials increasingly see park resources affected by land use practices in surrounding areas (15 1). The potential impact of NIS is clear, since live organisms can move freely

on and off park lands and few other public or private land managers are as restrictive as NPS. However, few parks actually do control NIS on neighboring lands, even though the 1991 NPS Natural Resources Management Guidelines list this as an appropriate approach when surrounding land owners are cooperative (59).

**Research**—NPS conducts research to provide “an accurate scientific basis for planning, development, and management decisions” (148). Research in the national parks is conducted by both NPS staff and researchers from outside institutions. NPS provided about \$2 million for over 200 research projects related to NIS in fiscal year 1990. Research topics included evaluating environmental effects, monitoring, management, eradication methods, and restoration following species removal (150,151). NPS both conducts research on the potential use of biological control to control NIS and participates in related cooperative projects with State agencies (36).

## BUREAU OF LAND MANAGEMENT

The Bureau of Land Management (BLM) manages about 270 million acres, or 11 percent of the total U.S. land area, mostly located west of the Mississippi River (2). The Federal Land Policy and Management Act of 1976 (FLPMA) directs BLM to manage lands under its jurisdiction for a mix of uses including grazing, mining, timber harvest, recreation, and wildlife conservation.<sup>38</sup> FLPMA thus authorizes certain uses that facilitate the spread and establishment of NIS (4).

**Grazing**—Grazing is one of the most common and widespread uses of BLM lands (4). It also has been a factor in the transformation and degradation of rangeland vegetation, including the spread and establishment of many non-indigenous weeds (39,134). The agency annually authorizes grazing by 4.3 million cattle, sheep, goats, and horses on

<sup>37</sup> 36 CFR 2.1 (June 30, 1983).

<sup>38</sup> Federal Land Policy and Management Act Of 1976, as amended (43 U.S.C.A.1701,1702).

### Box 6-C-introduction of Non-Indigenous Species in the National Parks

NPS divides its holdings into four management categories. Natural zones are managed to protect natural resources. Cultural zones are managed to preserve and foster appreciation of cultural resources. Park development zones are managed and maintained for intensive visitor use. And special use zones are managed for uses not appropriate in other zones, such as commercial use, mineral exploration and mining, grazing, forest use, and reservoirs. NPS policies on introductions of NIS differ among the four zones.

In natural zones, non-indigenous plants and animals may be introduced only rarely. Allowed introductions include: nearest relatives of extirpated indigenous species; improved varieties of indigenous species when the local variety cannot survive current environmental conditions; and agents used to control established NIS. Introductions to natural zones are also permitted when there is explicit direction by law or legislative intent; for example, the enabling legislation for Great Basin National Park allows for the perpetuation of free-ranging livestock within the park. The emphasis of natural zone management is on maintaining fundamental ecological processes, rather than individual species per se. Thus, ring-necked pheasants (*Phasianus Colchicus*) and chukars (*Alectoris chukar*), introduced long ago to Haleakala National Park, are tolerated because they may satisfy ecological roles previously filled by now-extinct Hawaiian birds. Also, biological control agents have been introduced into natural zones of several national parks to control harmful NIS.

NIS maybe introduced in cultural zones when they area desirable, and historically authentic, part of the historical landscape. Such introductions are permitted only if the plant or animal is controlled so that it cannot spread. In park development zones, all of the above uses are allowed, as well as introductions to satisfy management needs that cannot be met by indigenous species. Again, such introductions are only permitted if t he NIS will not spread, become a pest, or harm indigenous plants and animals.

Stocking of waterways with non-indigenous fish may occur only in special use zones, either in altered waterways that are inhospitable to indigenous species or in rivers and streams where non-indigenous fish are already established. Similarly, stocking non-indigenous game species may be allowed in national recreation areas and preserves where they are already established. When stocking fish and game, NPS gives precedence to indigenous species wherever possible, and stocking is contingent on evidence that the species cannot spread or do harm to indigenous species.

**SOURCES:** M.J. Bean, "The Role of the U.S. Department of the Interior In Non-Indigenous Species Issues," contractor report prepared for the Office of Technology Assessment, November 1991; D.E. Gardner, U.S. Department of the Interior, National Park Service, "Role of Biological Control as a Management Tool in National Parks and Other Natural Areas," technical report NPS/NRUH/NRTR-90/01; G.H. Johnston, Chief of Wildlife and Vegetation Division, Natural Resources Program Branch, National Park Service, personal communication to E.A. Chornesky, Office of Technology Assessment, July 10, 1991, Mar. 13, 1992; L. Loope, U.S. Department of the Interior, National Park Service, "Public Outreach in Controlling Alien Species in Haleakala National Park," talk presented at the National Park Service Headquarters, Aug. 21, 1991; U.S. Department of the Interior, National Park Service, "Management Policies," Washington, DC, 1958.

about 164 million acres, or 61 percent, of the BLM lands (100).

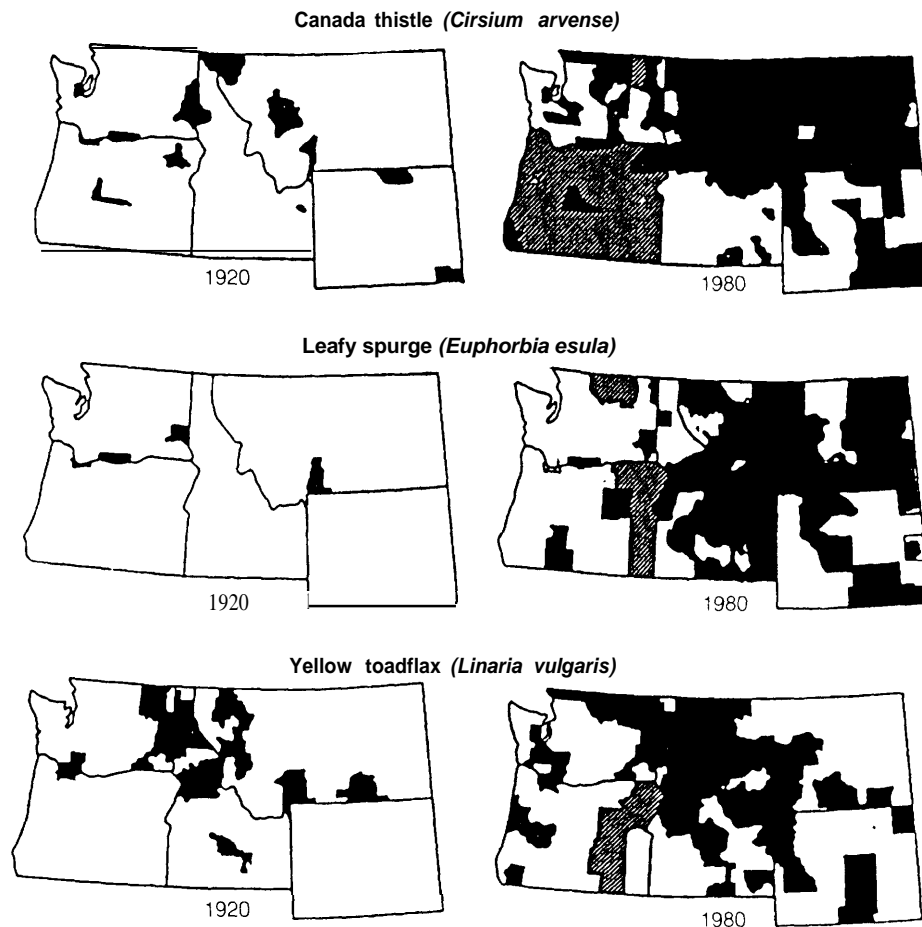
Additional grazing on BLM lands occurs under the Wild Free-Roaming Horses and Burros Act.<sup>39</sup> This law explicitly perpetuates NIS by protecting wild horses and burros and preserving them as a living reminder of the history of the American West. An estimated 50,000 free-roaming horses

and burros occurred on BLM lands at the start of 1991 (100).

Control of Non-Indigenous Weeds---Non-indigenous weeds are widespread on BLM lands within the contiguous 48 States (figure 6-2) (132, 161). They degrade rangelands because many are unsuitable for forage. Although some emphasis is already being placed on weed management in

<sup>39</sup> Wild Free. Roaming Horses and Burros Act (1971) (16 U.S.C.A.1331 *et seq.*).

Figure 6-2—Growing Distributions of Three Noxious Weeds in the Northwest



Many noxious weeds are widespread on BLM lands. These maps show how three species spread in five States over a 60-year period.

SOURCE: U.S. Department of the Interior, Bureau of Land Management, "Northwest Area Noxious Weed Control Program: Final Environmental Impact Statement," December 1985.

BLM, much more is needed (136). Weed management is a small component of rangeland management, receiving only about \$1.2 million annually (100,136). A 1991 internal evaluation concluded that even though noxious weed problems are widespread and growing, their control program is seriously underfunded and lacks adequate staff (136). Moreover, existing staff lack technical training or an awareness of noxious weed problems (136). Documenting the extent and severity

of noxious weed infestations on BLM lands is almost impossible because of inadequate monitoring and inventory (136).

Cooperative weed control efforts exist among BLM and other Federal, State, and county agencies, and BLM's funding provides for control on about 225 sites within 8 States (100). BLM also is involved in the management of noxious weeds in the greater Yellowstone area, in a coordinated effort with several Federal and State agencies

(44). Recent draft policies on weed management include requirements for anticipating and addressing factors that facilitate the spread and establishment of noxious weeds (136), although such long-term strategies have not yet been implemented. Examples include requiring contractors to clean equipment before entering BLM lands and using only seed, hay, mulch, or feed that is free of noxious weed seed.

The 1990 Amendment to the Federal Noxious Weed Act<sup>40</sup> gave Federal land managers explicit authority to develop programs for control of undesirable plants. BLM's internal evaluation cited a need for increased coordination and cooperation with State agencies (136), and the agency has instructed its State Directors to develop cooperative agreements with State agencies and review their programs to ensure full compliance (71).

**Introduction of Biological Control Agents-**BLM encourages introductions of biological control agents as part of an integrated management of weeds (16 1). The agency differs from other Federal land managers in having developed specific guidelines for the release of biological control agents. BLM requires compliance and coordination with State and Federal authorities, including evaluation of an agent's potential environmental effects before its release in an environmental assessment prepared by APHIS (135). BLM contributes funding to the Agricultural Research Service for the development and release of biological control agents. ARS also operates several small, 1-acre laboratories on BLM lands to propagate insects for biological control; in return ARS makes these agents available to BLM (161).

**Introductions and Control of Fish and Wildlife-**BLM manages more fish and wildlife habitat than any other Federal or State agency (100,130). The agency's long-standing policy is to give top priority to protecting, maintaining, and



LEWIS WATERS

*The Bureau of Land Management is beginning a program to manage weeds-like dyer's wood (Isatis tinctoria)-on public lands.*

enhancing indigenous fauna and flora (131). Requirements for introducing fish and wildlife include prior assessment of environmental effects, creation of a buffer zone around the introduction area, and a trial release of at least 2 years (131). In addition, animals must be quarantined to prevent pathogen or parasite introductions. Except under limited circumstances, current policy prohibits introductions into wilderness areas, into areas with threatened and endangered species, or of species that can hybridize with indigenous fauna (131). A unique feature of BLM policy is a provision that "individuals or organizations may be held liable for damages and responsible for expenses incurred in control of unauthorized exotic wildlife introductions" (13 1). However, no related regulation or law specifies such liability (4).

<sup>40</sup> 7 U.S.C.A. 2814

The current BLM manual lacks any statement concerning harmful NIS already established on BLM lands (4). A 1986 draft revision of the fish and wildlife section did promote control of feral species adversely affecting indigenous species, and it would have permitted the persistence of NIS that had become “naturalized” prior to passage of the 1976 Federal Land Policy and Management Act (133). However, this draft was never finalized, and BLM lacks any explicit policy regarding whether and under what circumstances established non-indigenous fish and wildlife should be controlled or eliminated (4).

BLM is indirectly involved in the control of non-indigenous fish through a new joint initiative with the National Fish and Wildlife Foundation. The “Return of the Natives” project was begun in 1991 and is cooperatively funded by public and private sources. Its goal is to restore indigenous fisheries in western streams, primarily through habitat restoration (68).

#### BUREAU OF INDIAN AFFAIRS

The Bureau of Indian Affairs (BIA) is now in the fourth year of a 10-year program for management of noxious weeds, which agency staff estimate infest 726,000-or 12 percent-of the approximately 56 million acres found on Indian reservations (129). The plan’s objective is to eliminate approximately 90 percent of the weed infestation by the end of fiscal year 1999. According to BIA, the most serious problems with noxious weeds occur in North and South Dakota and Montana (65). The management plan provides funds on a 50 percent cost-share basis for control of noxious weeds on reservations to States, counties, and individual farmers. Control programs must last a minimum of three years. BIA requested \$1,974,000 for fiscal year 1993 to fund control on approximately 80,000 acres (101).

#### BUREAU OF RECLAMATION

Congress created the Bureau of Reclamation (BOR) in 1902 to reclaim arid lands in the West

for development. Much of its efforts have been to construct dams and irrigation systems for water management, although the agency’s objectives have expanded to include development of recreational waterways and other goals. Systems built by the Bureau altered wetland habitats, and some agency programs have begun to address resulting changes in the resident plant and animal populations by controlling NIS. These projects are not part of a coordinated program, but instead have arisen according to need through the Bureau’s regional offices (89).

Salt cedar now constitutes, in single or mixed-species stands, 83 percent of riverside vegetation along the Lower Colorado River (137). It provides poor habitat for most wildlife and consumes water more rapidly than indigenous vegetation. BOR currently is developing along-term program for the management and eradication of salt cedar (137). As part of this effort, BOR is funding research by ARS on biological control. BOR presently spends between \$250,000 and \$400,000 annually to remove salt cedar mechanically (89).

In the Columbia River Basin Project, problems occur with Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife-the latter infests about 20,000 wetland acres in the area (89). Non-indigenous aquatic weeds, like hydrilla (*Hydrilla verticillata*) and water hyacinth (*Eichhornia crassipes*), now clog waterways and reservoirs in Texas and California. BOR is working with Federal, State, and private agencies in control programs, which have included introductions of triploid grass carp into irrigation systems as well as the development of chemical control methods for aquatic plants (89).

One by-product of BOR’s water management programs has been the creation of habitats more suitable for non-indigenous rather than for indigenous fish, with indigenous species becoming threatened or endangered in some cases (89). BOR currently has several projects designed to control non-indigenous fishes and protect threatened and indigenous ones.

## Department of Commerce–National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration's (NOAA) involvement with MS originates from its role in the management of the Great Lakes and coastal resources. NOAA has conducted much of the Federal research and funded much of the outside research on the zebra mussel. The agency also co-chairs the Aquatic Nuisance Species Task Force.

### MOVEMENT OF SPECIES INTO THE UNITED STATES

The National Marine Fisheries Service (NMFS) of NOAA inspects imported shellfish to prevent the introduction of non-indigenous parasites and pathogens. NMFS has cooperative inspection agreements with Chile and Australia. Venezuela has requested a similar cooperative agreement, although it is not yet in place because of a lack of funds (167).

### ERADICATION AND CONTROL

NOAA awards annual matching grants to the States for coastal zone management as authorized by the Coastal Zone Management Act.<sup>41</sup> States use some of these funds for the eradication or control of harmful NIS. For example, Pennsylvania received a grant in fiscal year 1991 for eradication of four non-indigenous plants in Presque State Park to aid in restoration of wetland and dune communities (14). Additional funds used for species eradication and control may sometimes be allocated as a component of other general management categories, such as "marsh management" (160).

### LAND AND RESOURCE MANAGEMENT

NOAA cooperates with States in managing the National Estuarine Research Reserve System, also under authority of the Coastal Zone Manage-

ment Act. The agency provides 50 percent in matching funds for States to acquire, develop, and operate estuarine areas as natural field laboratories. As of 1990, there were 18 reserves, or a total of 267,000 acres of estuarine lands and waters, in the system (120). Multiple uses can occur in the reserves as long as they are consistent with the program's goals, including maintenance of a stable environment through protection of estuarine resources, and the uses do not "compromise the representative character and integrity of a reserve. The regulations allow, but do not require, restoration activities to improve the representative character and integrity of a reserve, including removal of NIS."<sup>42</sup>

### RESEARCH

NOAA funds both in-house and outside research on NIS through Sea Grant, the Great Lakes Environmental Research Laboratory, the National Estuarine Research Reserve System, and the National Marine Fisheries Service. Research topics include the ecology and control of harmful species as well as the use of NIS in aquaculture.

Sea Grant's competitive grants program funded 15 projects on the zebra mussel in fiscal year 1991, totaling about \$1.5 million (45). Sea Grant also funds aquaculture research, some of which deals with NIS (1 19,121).

NIS have become a major research priority at NOAA's Great Lakes Environmental Research Laboratory (GLERL) since invasion of the zebra mussel (102). The Laboratory was conducting six projects on zebra mussels and one on the newly introduced spiny water flea (*Bythotrephes cederstroemi*) in fiscal year 1991 (118). Funding included \$1.2 million, with a similar amount provided for fiscal year 1992 (9).

NOAA funds some research projects on MS in its estuarine reserves. Six projects related to NIS were supported from 1985 through 1991 (23).

<sup>41</sup> Coastal Zone Management Act of 1972, as amended (16 U. S.C.A. 1451 *et seq.*)

<sup>42</sup> Reserve regulations refer to "intentional/unintentional species changes-introduced or exotic species" as a factor that may diminish "the representative character and integrity of a site" (15 CFR 921).



Plans for 1995 to 1996 are to increase the focus on restoring habitats in the reserves; in many cases this may be to correct problems caused by NIS (23).

NOAA's National Marine Fisheries Service also conducts research on NIS. The NMFS Laboratory in Oxford, Maryland, studies the detection and diagnosis of non-indigenous pathogens and parasites of aquatic species (167). Much of the \$270,000 (fiscal year 1992) program on oyster research involves studies of non-indigenous parasites and pathogens (91). NMFS also conducts research on aquaculture.

### Department of Defense

The Department of Defense (DOD) has diverse activities related to NIS. These generally relate to its movements of personnel and cargo, management of land holdings, and maintenance of navigable waterways.

#### MOVEMENT OF SPECIES INTO THE UNITED STATES

The Armed Forces move large shipments of equipment, supplies, and personnel into the United States from around the world. These usually are not inspected by APHIS. Instead, each branch of DOD conducts its own inspections using military customs inspectors trained by APHIS and the Public Health Service (124).

Although APHIS officials express confidence in the capability of military customs inspection (33), concerns exist that it lacks sufficient rigor, especially during periods of enhanced military activity. Insect pests were found within material cleared for entry by U.S. Army inspectors during Operation Desert Storm, and shipped equipment sometimes carried excessive dirt or sand (3). While APHIS considered these problems minor (12), subsequent internal review by DOD suggested some Army inspectors may not be adequately trained and that careful inspection suffers under the pressure to move materials rapidly (3). Similar problems may affect other branches of the military.



DON SCHMITZ

*The Army Corps of Engineers helps States control aquatic weeds such as water hyacinth (**Eichornia crassipes**) and also conducts specialized research on control methods.*

The potential spread of NIS through military movements was graphically illustrated by discoveries of the brown tree snake at military airports and in naval cargo on Pacific islands where this noxious pest is not yet established (35). DOD now conducts special pre- and post-flight inspections of military planes flying from Guam to Hawaii to ensure they do not carry brown tree snakes. The program has been commended by experts in Hawaii (84).

#### MOVEMENT OF SPECIES WITHIN THE UNITED STATES

Movement of military equipment within the United States can also spread non-indigenous insect pests, like the European gypsy moth (62), and noxious weed seeds. A specific objective of the Army pest management program is to prevent the spread of economic pests throughout the United States by controlling them at Army installations (127).

The Army Corps of Engineers sometimes is indirectly involved in interstate transfers of species through its efforts to develop aquaculture and build wetlands (1 1). For example, during wetlands construction the Corps will use NIS from nearby areas when indigenous species are not available

(11). In addition, Corps construction of dams, reservoirs, and channels can create new habitats or pathways for the spread of aquatic NIS.

### CONTROL AND ERADICATION

The Aquatic Plant Control Program of COE controls aquatic weeds in cooperation with State and local agencies by providing about 50 percent of the funds for approved projects. The program has supported control efforts in 10 States, the District of Columbia, and Puerto Rico. Appropriations for fiscal year 1992 were \$5 million (91). In addition, the COE is a member of the Aquatic Nuisance Species Task Force.

### LAND AND RESOURCE MANAGEMENT

DOD is the fifth largest land manager in the Federal Government, owning at least 25 million acres and managing another 15 million through agreements with other Federal or State agencies (82). DOD manages natural resources for multiple uses, including hunting, fishing, forestry, grazing, and agriculture (122). NIS are routinely introduced to DOD lands as livestock, agricultural crops, landscaping plants, and vegetation for wildlife. Management plans exist for all DOD lands, and they must include control of noxious weeds<sup>43</sup> (122). Cooperative agreements involving DOD, FWS, and host State agencies are the vehicle for DOD management of fish and wildlife, and new species introductions only occur when consistent with such an agreement (122). Draft Army regulations for resources management further require an environmental assessment to determine the impact of introductions on existing flora and fauna (126). These constraints are not comprehensive, however: the Air Force, like the Forest Service, excludes “certain game birds that have become established, such as pheasants” from its definition of “exotic” species (125).

DOD established the Legacy Resource Management Program in 1991 to “inventory, protect, and manage biological, cultural, and geophysical resources on lands owned or used by DOD” in cooperation with other Federal, State, and non-governmental agencies and organizations (123). The Legacy program funded two projects for control of non-indigenous plants in Ohio and California in fiscal year 1991 (123).

### RESEARCH

The COE conducts research on the biological and chemical control of aquatic weeds at its facility in Vicksburg, Mississippi, an effort related to its Aquatic Weed Control Program. The research presently focuses on hydrilla and Eurasian water-milfoil. Research efforts are coordinated with other Federal and State agencies. The appropriation for fiscal year 1992 was \$4 million (91).

### Environmental Protection Agency

The Environmental Protection Agency (EPA) deals with NIS in two general areas. First, it regulates the entry and dissemination of various microorganisms. Second, it conducts research on aquatic nuisance species.

### MOVEMENT OF SPECIES INTO AND THROUGH THE UNITED STATES

EPA regulates the movement of certain non-indigenous microbes into and through the United States under the Federal Insecticide, Fungicide, and Rodenticide Act<sup>44</sup> (FIFRA) and the Toxic Substances Control Act<sup>45</sup> (TSCA). Since both statutes address the development, distribution, and sale of commercial products, they generally do not apply to the importation or distribution of microbes for research uses before product development. EPA regulates pesticidal microbes, like the bacterium Bt (*Bacillus thuringiensis*), under FIFRA. Microorganisms that are neither agricul-

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<sup>43</sup> DOD defines noxious weeds as including both federally and State-listed species.

<sup>44</sup> Federal Insecticide, Fungicide, and Rodenticide Act (1947), as amended (7 U.S.C.A. 135 *et seq.*)

<sup>45</sup> Toxic Substances Control Act, as amended (15 U.S.C.A. 2601 *et seq.*)

tural pests nor pesticides—for example, nitrogen-fixing fungi—are regulated under TSCA. Any microorganism falling under regulation by FIFRA or TSCA that is also either a potential agricultural pest or a human pathogen would also deregulated by APHIS or the Public Health Service.

**Pesticidal Microbes-FIFRA** authorizes EPA to regulate importation, environmental release, and commercial distribution and sale of pesticides. Living microorganisms used as pesticides include bacteria, fungi, protozoa, and viruses (8). Manufacturers must register such microbial pesticides with EPA before commercial distribution and sale. Reporting requirements for registration are quite extensive and include detailed analyses of effects on organisms other than the target pest and of the eventual fate of the microbe following release to the environment (155). In addition, FIFRA requires explicit labeling of microbial pesticides (155). Violations of this or other provisions of the Act can result in civil or criminal penalties.<sup>46</sup>

Only registered microbial pesticides may be imported into the United States for commercial distribution and sale (43). Unregistered pesticides may be denied entry by U.S. Customs. As of March 1992, 2 of the 23 microbes registered as pesticides in the United States were non-indigenous (table 6-5) (7). Origins of an additional 11 are unknown, since EPA did not require reporting of this information until 1984 (7). Under FIFRA, EPA considers only those microbes from continents other than North America to be non-indigenous to the United States (6).

During pesticide research and development, EPA requires manufacturers to provide notification before small-scale tests of non-indigenous microbial pesticides. EPA may then require additional information, or application for an experimental use permit. Such permits are re-

quired for large-scale tests. Permit applications include information on microbe identity, origin, host range, mode of action, intended application, and potential effects on nontarget organisms and the environment.<sup>47</sup> Similar notification and application for an experimental use permit is not required for small scale tests of indigenous microbes. EPA currently is considering whether it should continue to require notification for small scale tests of NIS, since APHIS and the Public Health Service require permits for tests involving potential agricultural pests or human health threats (6).

**Non-Pest, Non-Pesticidal Microbes-Under TSCA**, EPA could regulate certain non-indigenous microbes that fall outside of other regulatory authorities, such as nitrogen-fixing bacteria and fungi. Thus far EPA has regulated only genetically engineered microbes under TSCA (38). TSCA regulations do not explicitly distinguish between indigenous and non-indigenous microbes, except in the requirement for EPA notification when microbes are imported for commercial purposes or into commerce. TSCA's applicability is further restricted to only those microbes having an identified risk to human health or the environment, since naturally occurring microorganisms are considered to be "in commerce" and therefore implicitly on the TSCA inventory of unregulated substances (38). Nevertheless, should a risk be shown, EPA could potentially ban, limit production of, or remove from sale the non-indigenous microbes that fall under TSCA.<sup>48</sup>

#### MONITORING

The goal of EPA's Environmental Monitoring and Assessment Program (EMAP) is to monitor the condition of the Nation's ecological resources (156). EPA began developing EMAP in 1987, and the program is still in the preliminary phases of

<sup>46</sup> 7 U.S.C.A. 136.

<sup>47</sup> 40 CFR 172.4 (May 11, 1981).

<sup>48</sup> Toxic Substances Control Act, as amended (15 USC 2601).

Table 6-5-Microbial Pesticides Registered by EPA

Microorganism	Year registered	Origin	Pest controlled
<b>Bacteria</b>	1948	•	Japanese beetle larvae ( <i>Popillia japonica</i> )
<i>Bacillus popilliae</i> + <i>B. lentimorbus</i>			
<i>B. thuringiensis</i> "Berliner"	1961	•	Lepidopteran larvae
<i>Agrobacterium radiobacter</i>	1979	•	crown gall disease ( <i>Agrobacterium tumefaciens</i> )
<i>B. thuringiensis istaeliensis</i>	1981	Israel	Dipteran larvae
<i>B. thuringiensis aizawai</i>	1981	•	wax moth larvae ( <i>Galleria mellonella</i> )
<i>Pseuhmonas fluorescent</i>	1988	U.S.	<i>Pythium</i> , <i>Rhizoctonia</i>
<i>B. thuringiensis San Diego</i>	1988	U.S.	Coleopteran larvae
<i>B. thuringiensis tenebrionis</i>	1988	Germany	Coleopteran larvae
<i>B. thuringiensis EG2348</i>	1989	U.S.	Lepidopteran larvae
<i>B. thuringiensis EG2371</i>	1989	U.S.	Lepidopteran larvae
<i>B. thuringiensis EG2424</i>	1990	U.S.	Lepidopteran/Coleopteran larvae
<i>B. sphaericus</i>	1991	U.S.	Dipteran larvae
<b>Viruses</b>			
Heliothis nuclear polyhedrosis virus (NPV)	1975	•	cotton bollworm ( <i>Helicoverpa zea</i> ), budworm ( <i>Choristoneura</i> spp.)
Tussock moth NPV	1976	•	Douglas fir tussock moth larvae ( <i>Orgyia pseudofugata</i> )
Gypsy moth NPV	1978	•	Gypsy moth larvae ( <i>Lymantria dispar</i> )
Pine sawfly NPV	1983	•	Pine sawfly larvae ( <i>Neodiprion</i> spp.)
<b>Fungi</b>			
<i>Phytophthora palmivora</i>	1981	•	citrus stangler vine ( <i>Morrenia odorata</i> )
<i>Colltotrichum gloeosporioides</i>	1982	•	northern joint vetch ( <i>Aeschynomene virginia</i> )
<i>Trichoderma harzianum</i> ATCC20476 + <i>T. polysporum</i> ATCC20475	1990	U.S.	wood rot
<i>Gliocladium virens</i> GL21	1990	U.S.	<i>Pythium</i> , <i>Rhizoctonia</i>
<i>Trichoderma harzianum</i> KRLAG2	1990	U.S.	<i>Pythium</i>
<i>Lagenidium giganteum</i>	1991	U.S.	mosquito larvae
<b>Protozoa</b>			
<i>Nosema locstae</i>	1980	•	grasshoppers

• Reporting of the origin of registered microbes was not required before 1984 so their origins are unknown.

SOURCE: F. Betz, Acting Chief, Science Analysis and Coordination Staff, U.S. Environmental Protection Agency, letter to E.A. Chornesky, Office of Technology Assessment, Apr. 10, 1992.

design and small-scale application. However, EMAP's planners expect the program eventually will involve the accumulation and analysis of information on the plants, animals, and physical environment throughout the country. Although EMAP could conceivably be used to monitor NIS in the United States, that is not one of its goals, and its current design would not provide suitable information for this purpose (50,57).

## RESEARCH

EPA's most direct involvement with NIS is through its Office of Research and Development. Staff from this office represent EPA on the Aquatic Nuisance Species Task Force. EPA's Environmental Research Laboratory in Duluth, Minnesota, conducts in-house research on the environmental effects and control of zebra mussels and the ruffe (*Gymnocephalus cernuus*), and

participates in collaborative projects with NOAA and the Coast Guard on zebra mussel monitoring (48). In 1992, the laboratory also funded related research at several other institutions. EPA appropriations related to harmful aquatic NIS totaled \$1.65 million in fiscal year 1992 (91).

### Department of Health and Human Services—Public Health Service

The Public Health Service (PHS) regulates entry of living organisms that might carry or cause human diseases.<sup>49</sup> Current PHS regulations restrict, require inspection of, or require permits for the importation of all cats, dogs, monkeys, turtles, and bats, as well as certain snails, insects, and microbes.<sup>50</sup> PHS does not perform primary inspection at ports of entry. Instead, it provides training for Customs and USDA inspectors who directly examine people, baggage, and cargo and make referrals to PHS when problems arise (158).

PHS has only small efforts abroad to identify species and commodities that might serve as human disease vectors, and it generally develops regulations only after a potential route of human disease entry has been demonstrated. For example, PHS developed regulations requiring fumigation of used tire imports at least 2 years after evidence demonstrated that the tires were a major pathway by which the Asian tiger mosquito—a vector of several human diseases—entered the country (see box 3-A). For certain human health threats, like the African honey bee, PHS has taken a minimal role. In this case, primary responsibility for devising a response has fallen to APHIS; however, since APHIS is not a public health agency, it has not fully addressed the public health issues (78).

PHS does not impose quarantines or regulations to prevent the interstate spread of human disease vectors once they become established in the country (73). For such organisms, the agency

does, however, monitor spread and conduct research on their potential to transmit indigenous diseases. PHS research also examines general techniques for tracking and controlling organisms that can transmit human diseases (157).

### Department of the Treasury—U.S. Customs Service

The U.S. Customs Service (Customs) has a major operational role in restricting the entry of harmful NIS. Customs personnel inspect passengers, baggage, and cargo at U.S. ports of entry to enforce the regulations of other Federal agencies (154). They inform interested agencies when a possible violation is detected and then usually detain the suspected passenger or commodity for inspection by agency staff. APHIS, FWS, and PHS each has a cooperative agreement with Customs and provides specialized training to Customs inspectors. Customs inspects only some incoming passengers, baggage, and cargo, aiming to examine higher risk categories established by country of origin and other criteria (153). APHIS has established its own high risk categories for agricultural port inspection using different criteria (12).

### Department of Transportation—U.S. Coast Guard

The U.S. Coast Guard (USCG) was given certain responsibilities related to preventing introductions of harmful aquatic species by the Nonindigenous Aquatic Nuisance Prevention and Control Act and is a member of the Aquatic Nuisance Species Task Force. USCG issued voluntary ballast management guidelines for ships entering the Great Lakes in March 1991. Mandatory ballast management regulations went into effect May 10, 1993 to prevent further

<sup>49</sup> -&r the Public Health Service Act (1944), as amended (42 U. S.C.A. 201*et seq.*)

<sup>50</sup> 42 CFR 71.72, as amended (Jan. 11, 1985).

introductions of aquatic species into the Great Lakes.<sup>51</sup> These regulations require ships to exchange ballast water at sea, to retain ballast water on the vessel, or to use an alternative approved method.

USCG is also researching methods of ship design that might prevent the survival and transport of NIS in ballast water (91).

### Department of Energy

Approximately 2.4 million acres, or 0.1 percent of the U.S. land area, fall under the management of the Department of Energy (128). These holdings include research laboratories, electric utilities, and petroleum reserves (29). DOE has no general policies regarding the control of NIS, including noxious weeds, on its lands. The agency plans to issue a programmatic Environmental Impact Statement in 1993 that should help establish consistent land use policies (169).

DOE conducts restoration in some areas. Although the primary goal now is removal or containment of nuclear or toxic wastes, DOE is beginning to restore ecological communities of plants and animals at a few sites (28). DOE lacks a general policy regarding the use of indigenous versus non-indigenous organisms in restoration, presently relying on State policies for guidance.

### Department of Justice-Drug Enforcement Agency

The Drug Enforcement Agency (DEA) restricts importation of a few non-indigenous plants and fungi because they contain narcotic substances. Importation of NIS such as coca (*Erythroxylum coca*), marijuana (*Cannabis sativa*), and opium poppy (*Papaver somniferum*) is only allowed with a permit from DEA.

## CHAPTER REVIEW

This chapter described the large number of Federal agencies and programs responsible for different aspects of managing harmful NIS or introducing desirable ones. Clearly, much is being done. However, OTA's analysis shows that the U.S. system for dealing with harmful NIS falls short in a number of important areas. An overall assessment requires looking beyond the Federal Government, however. For example, when the Asian tiger mosquito became established in the country, control was left to State public health authorities; they simply were unable to respond effectively (21). In the next chapter, OTA looks more closely at such interactions between Federal and State efforts.

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<sup>51</sup> 58 *Federal Register* 18330 (April 8, 1993).