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WILDLIFE SERVICES PROGRAM

Information on Activities to Manage Wildlife Damage

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Subcommittee on Agriculture, Rural Development,
and Related Agencies
Committee on Appropriations
United States Senate

The Honorable Henry Bonilla, Chairman
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Wildlife are greatly valued by the American public. Activities such as birdwatching, hunting, and wildlife photography provide important recreational, aesthetic, and income-generating benefits. In addition, wildlife have important roles in maintaining ecosystems, and the mere knowledge that wildlife exist is viewed as beneficial by many people. At the same time, however, some wildlife destroy crops, kill livestock, damage property, and pose risks to public health and safety. For example, collisions between aircraft and birds put people's lives at risk and cause considerable damage to aircraft. Further, as the U.S. population has grown and impinged upon wildlife habitats, conflicts between wildlife and humans and their property have become increasingly common, making modern wildlife management more challenging. The use of some methods of controlling wildlife, especially lethal methods, has been a subject of considerable and continuing controversy.

Wildlife Services (formerly known as Animal Damage Control), a program within the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service, is tasked with controlling damage by wildlife, primarily mammals and birds. To do this, Wildlife Services conducts a variety of operational and research activities in cooperation with its clients—federal, state, and local agencies; agricultural producers and ranchers; private homeowners; and others. For example, on request from individuals or agencies, it provides advice about managing wildlife damage. In carrying out its activities, Wildlife Services considers and applies what it believes to be the most appropriate methods—whether lethal or nonlethal—of prevention and control.

The Conference Committee on USDA's fiscal year 2001 appropriations directed us to conduct a study of the Wildlife Services program. Specifically, we agreed to determine (1) the nature and severity of threats posed by wildlife, (2) the actions the program has taken to reduce such threats, (3) the studies Wildlife Services and others have done to assess the specific costs and benefits of program activities; and (4) the opportunities that exist for developing effective nonlethal methods of predator control on farms and ranches.

Among the steps taken in our review, we visited Wildlife Services' two regional offices (western and eastern) as well as program offices in four states; we also visited Wildlife Services' National Wildlife Research Center in Colorado and field research stations in Ohio and Utah. In each state visited, we met with program clients, including farmers, ranchers, and federal and state wildlife management officials. To obtain information on costs and benefits, we interviewed Animal and Plant Health Inspection Service economists and discussed costs and benefits with Wildlife Services researchers and operations personnel, program clients, and academicians. As agreed with your offices, we did not conduct an independent cost-benefit analysis of the Wildlife Services program. Instead, we reviewed studies of program costs and benefits that were done by or in collaboration with Wildlife Services personnel. Based on our interviews with federal and state wildlife officials and representatives of wildlife advocacy organizations—including the Humane Society of the United States and Defenders of Wildlife—and on an extensive literature search, these are the only cost and benefit studies that have been done on the Wildlife Services program. See appendix I for a more detailed discussion of our scope and methodology.

Results in Brief

Although no estimates are available of the total cost of damages attributable to them, some wildlife can pose significant threats to Americans and their property and can cause costly damage and loss. Mammals and birds damage crops, forestry seedlings, and aquaculture products each year, at a cost of hundreds of millions of dollars. Livestock is vulnerable as well. In fiscal year 2000, predators (primarily coyotes) killed nearly half a million livestock—mostly lambs and calves—valued at about $70 million. Some predators also prey on big game animals, game birds, and other wildlife, including endangered species. Beavers, woodchucks, and other species cause millions of dollars in damage each year to property such as roads, bridges, dams, water drainage systems, and electrical utilities. Seemingly benign wildlife, such as deer and birds, can also sometimes be injurious. For example, accidents involving

automobiles and deer result in over $1 billion in damage annually, and deer consume a wide variety of landscape, garden, and forestry shrubs, plants, and trees. There were about 6,000 collisions between aircraft and wildlife—especially birds—in calendar year 2000. Such collisions result in not only human injuries and deaths, but also significant aircraft damage, and cost U.S. civil aviation nearly $400 million a year. Wildlife can attack and injure people, sometimes fatally, and can harbor diseases, such as rabies and West Nile virus, that threaten human health.

Wildlife Services conducts both operational and research activities to curb damage by wildlife. Generally, the program's agricultural clients (e.g., farmers and ranchers) already have several nonlethal controls in place, such as fences, guard dogs, and chemical repellents, to deter wildlife. When these controls prove insufficient, clients seek assistance from Wildlife Services. In these instances, Wildlife Services personnel determine the type of assistance warranted, depending on the severity and extent of the damage and the type of wildlife involved. Assistance may involve suggesting additional techniques for controlling wildlife damage, recommending habitat modifications, or capturing and/or killing animals that are preying on livestock or causing other damage. The Wildlife Services program spent nearly $60 million on such damage control activities in fiscal year 2000; the program provided about $23.3 million of these funds, and its clients provided the remaining $36.4 million. The program also conducts research, such as studying the biology and behavior of injurious animals or conducting experiments on reproductive intervention—interference with a species' normal reproductive cycle or whelping ability. In fiscal year 2000, expenditures for research totaled about $12 million. About 85 percent of the research funding was provided by Wildlife Services funds; the remainder, by clients.

We identified no independent assessments of the costs and benefits associated with Wildlife Services' program. The only available studies were conducted by the program or with the involvement of program staff. However, the studies were peer reviewed prior to publication in professional journals. The most comprehensive study, issued in 1994, concluded that Wildlife Services' current program, which uses all practical methods (both lethal and nonlethal) of control and prevention, was the most cost effective of the program alternatives evaluated. Other studies, focused on specific program activities, have shown that program benefits exceed costs by ratios ranging from 3:1 to 27:1. Nevertheless, there are a number of difficulties inherent in analyses that attempt to assess relative costs and benefits. Of most significance, estimates of the economic benefits (savings) associated with program activities are based largely on

predictions of the damage that would have occurred had the program's control methods been absent. Such predictions are difficult to make with certainty and can vary considerably depending on the circumstances.

Considerable opportunity exists for developing effective nonlethal means of controlling damage by wildlife on farms and ranches—for example, through wildlife contraceptives or through the use of scare devices triggered by motion sensors. In view of the growing controversy surrounding the use of lethal controls, Wildlife Services scientists are focusing most of their research on developing improved nonlethal control techniques. In fiscal year 2000, about $9 million, or about 75 percent of the program's total research funding (federal and nonfederal), was directed toward such efforts. However, developing effective, practical, and economical nonlethal control measures has been a challenge, largely for two reasons. First, some methods that appeared to be promising early on proved to be less effective when tested further. For example, initial research indicated that lamb carcasses laced with lithium chloride, a chemical that sickens coyotes, might be an effective means of conditioning coyotes not to kill lambs. However, while the coyotes learned not to eat lambs, they still killed them. Second, animals often adapt to nonlethal measures, such as scare devices (e.g., bursts of sound or light).

Background

Wildlife are valuable to society in many ways, providing a wide range of social, ecological, and economic benefits. For example, hunting and birdwatching are important as both recreational and income-generating activities. In 1996, according to the latest national survey by the Department of the Interior's Fish and Wildlife Service,[1] 40 million U.S. adults (16 years old and older) went fishing and/or hunting and spent over $71.9 billion on related items. Their expenditures included fishing and hunting equipment, trips, licenses and fees, and books and magazines. In the same year, nearly 63 million adults enjoyed "nonconsumptive" activities such as observing, feeding, or photographing wildlife. These wildlife-watching participants spent over $29.2 billion on related items such as equipment, trips, and books and magazines. The total $101.2 billion spent by anglers, hunters, and wildlife-watchers does not include related economic multiplier effects, or ripple effects, on the American

[1] "1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation," U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census, November 1997.

economy. Nor does it include the household income (salaries and wages) of jobs supported by wildlife-related activities or the state or federal tax revenues generated by such activities. For example, expenditures related to hunting, fishing, and wildlife-watching activities generated about $5.2 billion in state income and sales tax revenues in 1996, according to reports based on the 1996 Fish and Wildlife Service survey.[2]

During the last decade, wildlife seem to have become an almost universal object for concern, a symbol for environmental issues, and a focus for resource management, according to a Cornell University extension publication.[3] However, the publication also notes that actual encounters with wildlife are frequently viewed as a nuisance or are associated with damage and unwanted costs. For example, the coyote is one the most successful and ubiquitous predators in the United States, and coyote predation on livestock is a serious problem for U.S. producers.

In the United States, wildlife are a publicly owned resource held in trust and managed by federal and state agencies. In general, the federal government manages threatened and endangered species and migratory birds, while the states manage big game and other mammals and birds. Wildlife Services is authorized by Congress to conduct activities relating to most wildlife damage situations. The primary statutory authority for the program is the Act of March 2, 1931, as amended (7 U.S.C. 426-426c; 46 Stat. 1468), which authorized the Secretary of Agriculture to conduct activities to control injurious animals. In addition, the program operates under the provisions of numerous other laws, including the 1918 Migratory Bird Treaty Act, as amended; the 1947 Federal Insecticide, Fungicide, and Rodenticide Act, as amended; the National Environmental Policy Act of 1969, as amended; and the Endangered Species Act of 1973, as amended.

The practice of managing wildlife is not new, nor is the control of predators. For centuries, control of mammalian predators has been practiced worldwide as a means of protecting livestock and enhancing

[2]See "1996 National and State Economic Impacts of Wildlife Watching," U.S. Fish and Wildlife Service, Division of Economics, April 1998; "The Economic Importance of Hunting: Economic data on hunting throughout the entire United States," Southwick Associates, Arlington, Virginia, 1998; and "The Economic Importance of Sport Fishing: Economic data on sport fishing throughout the entire United States," American Sportfishing Association, Alexandria, Virginia, 1998.

[3]*Wildlife Damage News*, Cornell Cooperative Extension Wildlife Damage Management Program, Vol. 1, Spring 2001.

game populations. The first recorded federal involvement in wildlife damage control in the United States occurred in 1885, when a federal agency sent questionnaires to farmers about crop damage caused by birds. By 1915, the Congress was appropriating funds for federal predator control operations directed at wolves and coyotes. In 1931, the Congress passed the Act of March 2, 1931, authorizing the control of injurious animals. Since then, federal wildlife control activities have evolved along with demographic and societal changes. In the program's early years, for example, the emphasis was on conducting general eradication campaigns that might be directed at the entire statewide population of a particular species of predator. This operating philosophy, as we reported in 1990,[4] contributed to decimating gray wolf populations in the continental United States. As public attitudes changed, the program's focus changed as well, and it now emphasizes killing only problem animals when necessary. Appendix II summarizes key events in the program's evolution.

Today the Wildlife Services program conducts operational and research activities. The operational activities are headed by the program's eastern and western regional offices (located in Raleigh, North Carolina, and in Lakewood, Colorado), which in turn oversee 37 state offices, some of which are responsible for program activities in more than one state. Operational activities consist of technical assistance (e.g., providing advice or loaning equipment to individuals who are encountering problems with wildlife) and direct assistance (e.g., diverting, removing, or killing injurious wildlife). Generally, Wildlife Services conducts its operational activities in response to requests for assistance. The program coordinates its operational activities with other entities, such as state departments of wildlife, local agricultural extension services, and private animal removal services.

The program's research activities are headed by the National Wildlife Research Center, located in Fort Collins, Colorado. The center has three research programs: product development research, bird research, and mammal research. Whereas most of the product development research is done at the center, most of the bird and mammal research is done at field stations across the country. To augment their staff of scientists and technicians, the research programs rely on undergraduate and graduate students, post-doctoral appointments, and volunteers.

[4] *Wildlife Management: Effects of Animal Damage Control Program on Predators* (GAO/RCED-90-149, Aug. 9, 1990).

Program funds for both operations and research are provided through congressional appropriations and through cooperative agreements with clients—organizations and individuals—that seek the program's assistance. Wildlife Services' clients include other federal agencies (e.g., the Department of the Interior's Fish and Wildlife Service and Bureau of Land Management, USDA's Forest Service, and the Department of Defense); state agencies (e.g., state wildlife divisions and departments of transportation); county agencies and city organizations (e.g., parks and recreation departments, zoos, and airports); Indian tribes; associations (e.g., the Farm Bureau, livestock associations, and wool growers' associations); animal advocacy and conservation groups; private businesses (e.g., hotels and stadiums); and individuals. Some Wildlife Services activities are completely funded by clients.

In fiscal year 2000, the program spent about $80.6 million in funds: about $42.3 million in congressional appropriations and about $38.3 million in funds from clients. Of the total funding, research spent about $12.2 million, or 15 percent; operations spent about $59 million, or 73 percent; and program administration spent about $9.5 million, or 12 percent. See appendix III for information on operational expenditures by state, by funding source, and by type of work.

Damage Caused by Wildlife Can Be Significant and Costly

People exist as only one element in the natural world. Increasingly, as wildlife habitat shrinks due to human population growth and activities, clashes occur between people and wildlife. These clashes take many forms. For example, mammals and birds can damage crops and forestry resources, deplete aquaculture stock, destroy livestock, and despoil property. Further, they pose threats to human health and safety through the spread of disease (e.g., rabies and West Nile virus); through direct attacks on humans; and through collisions with passenger cars, trucks, trains, and aircraft. The effects of injurious wildlife are not limited to rural populations; suburbanites are grappling with how to best deal with growing deer, geese, and beaver populations that damage property and pose threats to human health.

Wildlife Damage Agricultural and Natural Resources and Property

Although they generate substantial economic activity, wildlife of all kinds can cause damage, and that damage can be costly. Wildlife damage to U.S. agriculture alone (including crops and livestock) has been estimated at between $600 million and $1.6 billion annually, with over half of all farmers and ranchers experiencing some type of wildlife-related damage each year. Following are examples of how wildlife can affect agricultural

resources, other wildlife, and property. Appendix IV provides, by state, examples of injurious wildlife, the kinds of resources they damage, and emerging concerns.

- Birds, rodents, deer, and other mammals cause significant damage to a variety of crops such as corn, rice, sunflowers, and lettuce, as well as berries and other fruits and nuts. The estimated annual losses of corn attributed to wildlife exceed $90 million, and those of apples, blueberries, and grapes exceed, in aggregate, $40 million. Deer and bears also eat forestry seedlings and a wide variety of landscape and garden plants.

- Fish-eating birds (e.g., cormorants, herons, egrets, and pelicans) can cause severe damage at aquaculture farms, eating catfish, crawfish, salmon, bass, trout, and ornamental fish. According to a USDA National Agricultural Statistics Service (NASS) survey of catfish producers from 15 states, 69 percent reported some wildlife-caused losses, with a financial loss of $12.5 million to wildlife predation in 1996.

- In aggregate, coyotes, mountain lions, bears, and wolves kill thousands of lambs and calves each year. Livestock losses attributed to predators—predominantly coyotes—are about $71 million a year, according to the most recent NASS surveys. According to a Defenders of Wildlife representative, these livestock loss estimates are inflated because they are self-reported by livestock producers. The available evidence, however, suggests otherwise, according to a Wildlife Services study.[5] This study noted that surveys of livestock producers tend to underreport losses, because reports emphasize confirmed kills. The study also noted that NASS survey data typically report lower losses than other national estimates. Table 1 shows the losses reported by NASS.

[5]M.J. Bodenchuk, J.R. Mason, and W.C. Pitt, "Economics of predation management in relation to agriculture, wildlife, and human health and safety." In: L. Clark (ed.) Proceedings of the 1st International Symposium on the Economics of Wildlife Damage. Colorado State University Press, Fort Collins, Colorado. In press, 2001. Peer reviewed.

Table 1: Annual Livestock Losses Attributed to Predators

Livestock	Number lost to predators	Value of loss (in millions of dollars)
Cattle and calves	147,000	$51.6
Sheep and lambs	273,000	16.5
Goats and kids[a]	61,000	3.4
Total	**481,000**	**$71.5**

[a]Losses of goats and kids were reported only for the three major goat-producing states: Arizona, New Mexico, and Texas.

Source: "Cattle Predator Loss," NASS, May 2001 (data for 2000); "Sheep and Goats Predator Loss," NASS, May 2000 (data for 1999).

Various forms of damage compensation programs are in effect, at the state or private level, for selected areas and selected wildlife species. For example, several states provide some payment to individuals for damage done (e.g., to property or crops) or livestock killed by certain species (e.g., elk, wolves, eagles, grizzly bears, and mountain lions). Additionally, the Defenders of Wildlife has a compensation fund for damage caused by certain species (e.g., wolves and grizzly bears) in certain areas of the country. Generally, the programs require confirmation by state or federal officials that the damage or loss was inflicted by one of the species covered by the program. According to Wildlife Services officials, for example, before an individual can receive compensation from Defenders of Wildlife for damage caused by wolves, a Wildlife Services official must verify that a wolf caused the damage.

Coyotes are the major predator responsible for livestock losses. Of lamb losses to predators in 1999, for example, 64.3 percent were attributed to coyotes. Wildlife Services personnel showed us how, by examining the damage to a lamb carcass (e.g., a broken or missing trachea, the pattern of blood clotting, and other indicators), they can often identify the species that killed the lamb. Figure 1 illustrates the damage that coyotes can do.

Figure 1: Coyotes Are Responsible for Most Lamb Losses to Predators

Two coyotes attacking a lamb.

Wildlife Services officials can tell that this lamb was killed by a coyote.

Sources: Coyotes attacking lamb, USDA; lamb carcass, GAO.

- Threatened and endangered species are sometimes at risk as well. Ravens kill desert tortoises; feral hogs prey on several species of endangered plants, tree snails, and forest birds; and Arctic fox prey on protected Aleutian Canada geese. In Guam, the brown tree snake (a non-native species accidently introduced to the island by humans) has eliminated 9 of the island's 12 species of forest birds and most of the terrestrial vertebrates, killed many pets, and bitten many children.

- Beavers gnaw down trees, build dams, and plug up culverts, causing flood damage to timber, roads, bridges, and other property. The monetary value of beaver-related damage is also significant. In North Carolina alone, the beaver damage management program prevented the loss of, or damage to, $8.5 million in property during fiscal year 2000, according to a program report.

Wildlife Also Pose Threats to Human Health and Safety

In addition to their physical and economic impacts, wildlife can also threaten human health and safety. Wildlife can harbor diseases that can spread to livestock, pets, and people. Wildlife can also directly attack people, causing injuries or death. Further, wildlife—particularly deer—are sometimes the cause of automobile accidents. Collisions between aircraft and birds are of particular concern, because such accidents can result in serious and costly damage and, in some cases, injuries or death to pilots or passengers.

Birds and mammals sometimes harbor diseases—such as rabies, bubonic plague, Lyme disease, bovine tuberculosis, and West Nile virus—that can

be passed along to people through direct or indirect contact. (Such diseases are referred to as zoonotic diseases.) For rabies, the areas at greatest risk are southern Texas (coyote and dog rabies), central Texas (gray fox rabies), and the northeastern United States and Ohio (raccoon rabies). West Nile virus, first documented in the United States in 1999, is now present in the District of Columbia and more than 20 states (primarily in the East and the South) and has been responsible for the deaths of at least 10 people. Birds serve as a host for the virus, which is transmitted to humans and animals through mosquito bites. Excrement poses health risks as well. The excrement of gulls or other birds that nest on rooftops can enter ventilation systems, posing the risk of histoplasmosis (a respiratory disease) to workers who breathe the contaminated air. Similarly, especially in the western states, exposure to rodent excrement poses the risk of hantavirus (a potentially deadly lung disease). The costs associated with these diseases can be substantial. For example, the increased incidence of coyote, raccoon, and fox rabies has resulted in estimated costs of over $450 million annually for additional health care, education, vaccination, and animal control.

Safety concerns are also an issue. With their populations expanding and habitats shrinking, wildlife are more likely to come into contact with humans. An attack by wildlife can result in a person's injury or even death. In August 2001, for example, a black bear broke into a home in a mountain village in New Mexico and killed a 93-year-old woman; in 1997, a mountain lion attacked and killed a 10-year-old child in Colorado's Rocky Mountain National Park. Bites or attacks from wildlife cause few fatalities, but many injuries. While the number of fatalities from rodent (e.g., mice and rats) bites is unknown, rodents cause about 27,000 injuries each year. Table 2 shows the estimated number of human injuries and fatalities that result each year in the United States from wildlife bites or attacks.

Table 2: Estimates of Annual Human Injuries and Fatalities in the United States From Wildlife Bites or Attacks

Species	Injuries	Fatalities
Rodents	27,000	Unknown
Venomous snakes	8,000	15
Skunks	750	0
Foxes	500	0
Bears	30	1
Sharks	28	2
Alligators	18	.5[a]
Coyotes	2	0
Cougars	2	.4[a]

Note: These data are extrapolated from various studies done in various geographic regions over various time periods. They are probably understated because they exclude non-reported bites, which could be quite high in number.

[a]Fewer than one human fatality a year. Alligators, for example, cause an average of one fatality every 2 years.

Source: Michael R. Conover, William C. Pitt, K.K. Kessler, T.J. DuBow, and W.A. Sanborn, "Review of human injuries, illnesses, and economic losses caused by wildlife in the United States," *Wildlife Society Bulletin*, Vol. 23, No. 3, pp. 407-414, Fall 1995.

In other instances, wildlife have collided with automobiles, trains, and planes. Each year more than a million deer-automobile collisions occur in the United States, resulting in over $1 billion in damage to vehicles, 29,000 human injuries, and 200 human fatalities.

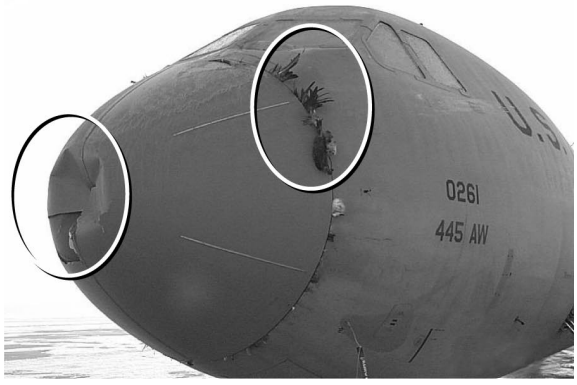
Aircraft collisions with wildlife are of particular concern, given their safety and economic consequences. In calendar year 2000, about 6,000 aircraft collisions involving wildlife, primarily birds, were reported in the United States. From 1990 through 2000, wildlife-aircraft strikes resulted in the deaths of about 140 people and the destruction of about 115 aircraft worldwide. The economic toll has been heavy as well. Wildlife-aircraft strikes cost the aviation industry more than $1 billion a year worldwide, with costs to U.S. civil aviation (commercial and private aircraft) estimated at nearly $400 million a year. For U.S. civil aviation, wildlife strikes have also resulted in nearly 500,000 hours of aircraft downtime each year. Effects on military operations are estimated at $30 million a year.

A single large bird, such as a goose, can cause serious damage to an aircraft. The average aircraft is designed to withstand a direct hit from a bird weighing up to 4 pounds, whereas a Canada goose typically weighs 8 to 15 pounds. In September 1995, the U.S. Air Force lost 24 airmen and a

$190 million AWACS aircraft in a strike involving Canada geese. Although most strikes take place during takeoff or landing, some occur en route. Pilots have reported strikes occurring as high as 30,000 feet. Gulls (which weigh about 2 pounds) are a particular hazard, making up nearly one-third of the reported strikes that identified the type of wildlife struck. In the Great Lakes region alone, the ring-billed gull population has increased about 20-fold over the past 40 years, according to a Wildlife Services bird research official. In an August 2000 incident, a Boeing 747 airplane engine ingested at least one Western gull just after takeoff from the Los Angeles International Airport. The pilot had to dump 83 tons of fuel over the ocean before making an emergency landing. The plane was out of service for 72 hours; the repair cost was $400,000. Figure 2 illustrates the kind of damage a single bird can cause.

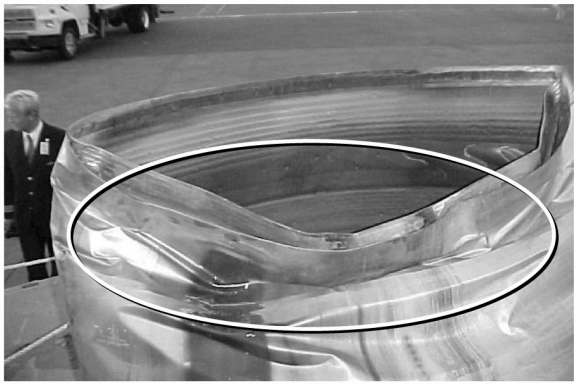
Figure 2: A Single Bird Can Cause Considerable Damage to a Large Aircraft

Gulls are involved in nearly one-third of all reported collisions.



Cargo 141 damage and bird remains from collision with a Canada goose.

Boeing 747 fan blade damage from collision with a Western gull.



Boeing 747 exhaust nozzle damage from collision with a Western gull.

Source: USDA.

Even small birds can be damaging. Starlings, for example, which weigh only about 3 ounces, are referred to as "feathered bullets" because their mass is so great for their size, according to a Wildlife Services official. Starlings are especially dangerous, the official said, because they often travel in dense flocks of many thousands.

All wildlife-aircraft strike reports are entered into the Federal Aviation Administration's (FAA) National Wildlife Strike Database, which is managed by Wildlife Services. As of March 2001, the database contained about 34,000 strike reports for the period 1990 through 2000. However, the actual number of such strikes is probably considerably higher because only FAA-certified airports are required to report wildlife-aircraft strikes.[6] While non-certified airports sometimes report such strikes, Wildlife Services estimates that the total number reported represents only about 20 percent of those that have occurred.

Certain unauthorized uses of airport land can increase the risk of birdstrikes. In a 1999 report,[7] for example, we cited two instances of landfills that had been established on airport land without FAA's authorization. Landfills attract wildlife and thereby increase the risk of birdstrikes. In both of the examples we cited, the unauthorized land use had continued undetected or uncorrected for years. Citing weakneses in FAA's compliance monitoring program, we recommended that FAA revise its compliance policy guidance to require regularly scheduled monitoring, including periodic on-site visits.

Although 97 percent of wildlife-aircraft strikes over a 10-year period involved birds, four-legged animals were also involved in some: 418 reported strikes were with deer; 71 were with coyotes; and another 73 strikes involved turtles, alligators, foxes, or woodchucks. See appendix V for excerpts from reports of wildlife-aircraft strikes.

[6]Certified airports are those that serve air carrier operations with aircraft seating more than 30 passengers.

[7]*General Aviation Airports: Unauthorized Land Use Highlights Need for Improved Oversight and Enforcement* (GAO/RCED-99-109, May 7, 1999).

Wildlife Services Conducts Operational and Research Activities to Manage Wildlife Damage

To curb the damage done by wildlife, Wildlife Services conducts operational and research activities for the benefit of various public and private clients. Program operations and research activities are focused, in large part, on (1) protecting livestock; (2) protecting game animals, game birds, and threatened or endangered species; (3) protecting property and crops; (4) protecting the flying public; and (5) reducing and monitoring the spread of wildlife diseases.

Wildlife Services Manages Wildlife Damage in Various Ways

Wildlife Services' operational activities consist of technical assistance (e.g., providing information, advice, or equipment to property owners and others who are confronted with wildlife problems) and direct assistance (e.g., diverting, relocating, or killing wildlife). Wildlife Services responds to telephone inquiries from the public and has published booklets and pamphlets to help people deal with wildlife problems such as a bat in the attic, a skunk under a porch, or a bear in a hot tub. The program's research activities include both laboratory research and field experiments. Some research investigates particular species' behavior and biology; other research is aimed at improving controls, both lethal and nonlethal.

The type of assistance Wildlife Services provides to a client varies, depending on the situation, the location, and the species involved. In response to a request for assistance from a farmer or a rancher, for example, Wildlife Services officials will provide advice over the phone, mail information, or visit the site and assess the situation. As appropriate, officials will coordinate with other stakeholders, such as state wildlife departments, other federal agencies, or adjoining neighbors. After assessing the situation, officials may suggest the use of one or more controls, including fences, guard dogs, harassment, traps, or shooting.

Once a course of action has been agreed upon, it is documented in a cooperative agreement between Wildlife Services and the client. The cooperative agreement specifies the work that will be done, the methods that will be used, and the way costs will be shared. Cost-sharing arrangements vary by state, depending largely on the demand for program services and the availability and amount of cooperative funding. Cooperative funding is a critical component affecting program availability and delivery and is a key factor determining variability among Wildlife Services' state programs. For example, in some cases, a client pays half the cost of services received; in others, counties pay for part of a Wildlife Services employee's salary, and that employee serves those counties. In still other instances, an organization, such as a wool growers' association, collects fees from its members, who are then eligible to receive services

for no additional charge. And in the case of threatened or endangered species, a government agency (e.g., the Fish and Wildlife Service) enters into an interagency agreement to fund control efforts to protect a certain species.

The type of action Wildlife Services takes varies. In some cases, harassment devices (such as noisemakers or bright lights) are effective in deterring the presence of injurious animals. Repellents are sometimes effective, as are devices such as gridwire (to discourage perching or nesting) and fencing. In other cases, relocation is the best option, particularly when a threatened or endangered species is causing damage. But even when suitable habitat is available, relocation is not always in an animal's best interest, as relocated animals are vulnerable in unfamiliar locations. They may fall prey to predators; they may be seen as interlopers and killed by other members of their own species; or their unfamiliarity with the new habitat and its food and water sources may result in severe stress or even death. In many cases, such as with bears, a relocated animal will immediately return to the area from which it was removed. And moving a bear is no simple task, officials explained. Not only is a bear large and heavy, it is also double-jointed and thus quite floppy. If harassment or relocation is not considered appropriate to the situation, depending on the species involved and the type and extent of damage, lethal means may be needed to halt the depredation or damage. In such cases, Wildlife Services officials strive to select the method that will kill the bird or mammal quickly, effectively, and humanely. Shooting is sometimes considered the best method.

Program Operations and Research Activities Benefit Resources and People

Working with state and local agencies, associations, and individuals, Wildlife Services conducts many wildlife control activities. Some of the program's major efforts include (1) protecting livestock from predation by coyotes and other species; (2) protecting game animals, game birds, and threatened or endangered species from predation by other wildlife; (3) protecting property and crops from damage by mammals and birds; (4) reducing the risk of aircraft striking wildlife around airport runways; and (5) reducing and monitoring the spread of wildlife diseases to livestock, pets, or humans. Both operations and research activities play a part in all of these efforts.

Protecting Livestock

This is a major area of program emphasis. The program's control activities are directed at selected animals or local populations in areas where damage has occurred. When livestock producers find that the controls

they have in place to deter predators have proven insufficient, they turn to Wildlife Services for assistance.

Livestock producers generally use several nonlethal control methods, such as guard animals, exclusion fences, and scare devices. In 1999, for example, according to a recent survey by NASS, most sheep producers had in place one or more nonlethal control methods. The number and type of control methods in use varied from state to state, but certain methods were more widely used than others. For example, half or more of the producers surveyed in numerous states used fencing, "shed lambing" (confining pregnant ewes to a shed during birthing and for several days afterward), and/or night penning to protect their sheep. In three states, half or more of the producers reported using guard dogs, and in two states, a high percentage of producers (61 percent and 70 percent, respectively) reported using guard llamas.

Although nonlethal methods sometimes suffice, in other instances they do not effectively deter predators or may only postpone predation. For example, shed lambing is often thought to be an effective way to keep predators (especially coyotes) from killing newborn lambs. This solution, while effective, is only temporary. Eventually, the young lambs must come out of the shed and when they do, they are at risk of predation. In the four states in which we reviewed Wildlife Services' operations in 1995 (California, Nevada, Texas, and Wyoming),[8] program personnel said they used lethal methods in essentially all instances to control livestock predators because livestock operators were already using nonlethal control methods but were still losing livestock.

Further, nonlethal methods also pose problems. Guard dogs, for example, are helpful in protecting flocks, but they are expensive—not only to buy, but also to train and maintain, according to ranchers we interviewed. And scare devices, such as sirens or spotlights, are generally effective in deterring predators only for a limited time. Most predators—whether birds or mammals—will habituate to any scare device that follows a discernable pattern. Thus, although nonlethal methods have helped reduce losses, they have not brought them to levels that most clients believe are economically viable. For livestock producers who are already operating on a small profit margin, the addition of even a low percentage of losses could drive a

[8] *Animal Damage Control Program: Efforts to Protect Livestock From Predators* (GAO/RCED-96-3, Oct. 30, 1995).

business into deficit. Livestock producers we interviewed said they expect and can tolerate predation losses of 2 to 3 percent but could not continue to operate with sustained losses higher than that.

For coyotes, Wildlife Services officials have found aerial shooting to be a most efficient and effective means of control. It is, though, one of the program's most controversial activities. Funded through cooperative agreements with individual ranchers or livestock associations, Wildlife Services personnel carry out aerial shooting in the winter to kill coyotes in areas of several western states considered most vulnerable to livestock predation. Groups opposing this practice, such as Defenders of Wildlife and the Humane Society of the United States, view it as a reckless, indiscriminate killing campaign. According to representatives of these two groups, the aerial shooting program kills coyotes indiscriminately; it does not distinguish between coyotes that are known predators and those that have never preyed on livestock and might never do so. These representatives noted that they have no quarrel with the practice of killing coyotes or other predators that are known to have preyed on livestock, as long as killing is a last resort and is done in the most humane way possible. Wildlife Services officials, however, defend the aerial shooting program as a proven preventive method that is necessary to protect lambs. According to Wildlife Services officials, the program is conducted in areas in which predation routinely occurs and is timed to remove coyotes before or during their mating season. The intent is to reduce the number of coyotes that have pups to feed just as lambing season begins. The officials pointed out that the aerial shooting activities have been shown to be both effective and cost-efficient in preventing livestock losses, according to a 3-year study by Utah State University researchers.[9]

Although Wildlife Services officials and farmers and ranchers we interviewed believe that the aerial shooting campaign is instrumental in preventing intolerable levels of livestock loss, representatives of Defenders of Wildlife and the Humane Society maintain that lethal control should never be a first resort; it should be used only after all nonlethal controls have been tried and found unsuccessful. Representatives of both groups expressed concern that Wildlife Services personnel in the field tend to rely on lethal methods as the first and primary means of control,

[9]M.R. Conover and K.K. Wagner, "Effect of preventive coyote hunting on sheep losses to coyote predation," *Journal of Wildlife Management* 63(2), pages 606-612, April 1999. Peer reviewed.

without considering whether nonlethal controls might be effective in preventing or curbing damage. A major concern of both Defenders of Wildlife and the Humane Society, according to their representatives, is that livestock producers are not required to have nonlethal controls in place before requesting assistance from Wildlife Services. If livestock producers are unwilling to take reasonable nonlethal steps to prevent or control further damage, the representatives said, then those producers should not be allowed to avail themselves of Wildlife Services' assistance.

Program research has contributed much to the knowledge base about coyote ecology and behavior, adding to the effort to develop more effective nonlethal controls. For example, two recent studies sought to determine whether coyote packs containing a sterile alpha pair[10] would kill fewer lambs than packs with a fertile alpha pair and whether sterile pairs in the wild would maintain pair-bonds and defend their territories, thereby excluding other coyotes.[11] Study results showed that surgically sterilized coyotes were significantly less likely to prey on lambs than were coyotes with pups to feed and that they maintained their pair-bonds and territories. During a 2-year period, 9 sterile packs killed 4 lambs, while 14 packs with pups killed 33 lambs. Future research efforts will seek practical methods, other than surgery, to sterilize animals in the field.

Other research efforts include developing (1) new capture devices and restraint methods that minimize injury to captured animals; (2) new scare devices; and (3) advanced designs for live-capture cages, rather than gripping devices, to restrain predators. In addition, Wildlife Services researchers are looking at ways of using radio-activated conditioning collars (much like those used to train dogs) to modify predators' attack behavior. Researchers have developed a prototype animal-activated electronic device and system, currently being field-tested, that repels predators from livestock areas.

In addition to developing new control methods, researchers also evaluate the effectiveness of nonlethal controls. For example, a study published in

[10]An alpha pair (male and female), as the leaders of a coyote pack, defend the pack's territory from intruders (including other coyotes).

[11]C. Bromley and E.M. Gese, "Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes," *Canadian Journal of Zoology*, 79, pp. 386-392, 2001; and "Surgical sterilization as a method of reducing coyote predation on domestic sheep," *Journal of Wildlife Management*, 65, pp. 381-390, 2001.

the fall 2000 *Wildlife Society Bulletin* evaluated the effectiveness of guard llamas in reducing coyote predation on domestic sheep.[12] The study found that the llamas reduced coyote depredation on lambs during the first year of the study, but not during the second year. The authors concluded that predation may have to reach a threshold before guard llamas have a noticeable effect on losses. The study also found that producers with llamas strongly supported their use as guard animals for sheep. Based on sheep producers' assessments, llamas appear to provide depredation protection similar to that provided by guard dogs. For example, llamas will chase coyotes and will "gather" the sheep and place themselves between the sheep and a coyote. Unlike dogs, however, llamas require little or no training or socialization period. Also, llamas pose little threat to humans, are relatively easy to handle (even without training), and may have a guarding tenure longer than 10 years, compared to an average of 2 years for guard dogs.

Protecting Game Animals, Game Birds, and Threatened or Endangered Species

Various game species and threatened and endangered species have also benefited from the program's operations and research efforts. In rural areas, hunting-related revenue is sometimes critical to the local economy. Accordingly, a growing part of Wildlife Services' activities involves the protection of game populations from predation by other wildlife. The protection of threatened and endangered species is important to ecosystems as well as individual animals and is often essential to the recovery of a species. As with game species, threatened and endangered species can benefit not only from program activities conducted specifically for their protection, but also from activities conducted for another species' protection.

Killing predators is often crucial to the survival of game species. According to a 2001 study,[13] for example, culling of coyotes in various areas in Utah protected local populations of mule deer and pronghorn antelope fawns. When coyote predation management was implemented in one mule deer area, for example, fawn survival increased from 9 percent to 42 percent. As another example, in one population of sage grouse in

[12]Laurie E. Meadows and Frederick F. Knowlton, "Efficacy of guard llamas to reduce canine predation on domestic sheep," *Wildlife Society Bulletin*, Vol. 28, No. 3, pp. 614-622, Fall 2000. Peer-refereed.

[13]M.J. Bodenchuk, J.R. Mason, and W.C. Pitt, "Economics of predation management in relation to agriculture, wildlife, and human health and safety." In: L. Clark (ed.) Proceedings of the 1st International Symposium on the Economics of Wildlife Damage. Colorado State University Press, Fort Collins, Colorado. In press, 2001. Peer reviewed.

Utah, annual adult mortality due to predation (primarily by non-native red fox) was 82 percent without fox control in place, but only 33 percent with fox control.

Many threatened and endangered species have benefited from Wildlife Services' operations and research. For example, for nearly a decade Wildlife Services has conducted a major effort to reduce the brown tree snake's population on the Island of Guam and to prevent the snake's introduction to other Pacific islands. Since it was accidently introduced to Guam 50 years ago, the snake—which has no natural predators on the island—has eliminated 9 of the 12 species of the island's forest birds and most of its terrestrial vertebrates. Program personnel conduct brown tree snake interdiction at Guam's commercial and military exit ports. Since the program's inception in 1993, Wildlife Services personnel have captured about 30,000 snakes near high-risk ports and have trained Jack Russell terriers to detect snakes in outgoing cargo shipments.

Research has played a major role in the snake control effort. After experimenting with various controls, program researchers devised an effective trap, added an alluring bait (mice), and found an effective poison—acetaminophen, which is deadly to the snake. Field tests indicated a zero-percent survival rate for snakes that ate the treated bait. Acetaminophen bait is currently used on a limited scale, under an Environmental Protection Agency (EPA) emergency use permit. Wildlife Services is pursuing a Section 3 EPA registration[14] that would allow larger scale use of this technique on the island. Wildlife Services has also evaluated and registered methyl bromide as a cargo fumigant for use against snakes, has conducted field tests on two alternative fumigants, and is developing a delivery device for dermal toxicants that it found effective against snakes.

Other threatened and endangered species have also benefited from program operations and research. In fiscal year 2000, the program actively protected 142 federal- and state-listed endangered and threatened species. For example, the program's mongoose control in Puerto Rico has helped conserve the entire population of Puerto Rican parrots. In New Hampshire, killing ground hogs that forage on the wild lupine has helped

[14]All pesticides must be used in accordance with the provisions of Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act, and must generally be evaluated and registered with EPA.

protect the endangered Karner blue butterfly, whose reproductive cycle depends on the wild lupine.

Various research efforts are related to threatened and endangered species. For example, researchers are working to develop more humane, nonlethal techniques for removing endangered wolves that are preying on livestock. These techniques include tranquilizer tab traps to reduce stress to captured animals and electronic collars to deter wolves from killing livestock.

Protecting Property and Crops

Wildlife Services conducts many activities to protect property and crops from mammals and birds. For example, a key program emphasis is eliminating beaver and their dams from areas in which they are causing damage. Particularly in the Southeast, but increasingly in other areas, beavers are responsible for millions of dollars in damage annually; in fact, the resulting dollar loss from beaver damage may be greater than that of any other wildlife species in the United States. Along with eliminating the dams, Wildlife Services personnel usually trap and eliminate the beavers as well. If the beavers are left in place, they will quickly build another dam, according to Wildlife Services biologists. And for beavers, as for other species whose populations are increasing rapidly, relocation is not often a viable option because there are not enough suitable habitats available.

To control birds, Wildlife Services personnel often use harassment techniques, such as devices that emit bursts of light or loud noise, to scare birds away and discourage their roosting near fields or aquaculture farms or in urban areas. Wildlife Services research has shown that after several days of harassment birds are likely to seek an alternate roost. According to researchers at Wildlife Services' bird research station in Ohio, recent experiments using lasers as harassment devices have shown encouraging results with certain species. Similarly, Wildlife Services' use of low-level laser lights, in conjunction with pyrotechnic harassment techniques, has been very effective in controlling gulls and other birds that were interfering with the work of law enforcement personnel searching for evidence in the debris from the recent terrorist attack on the World Trade Center. The debris is being hauled to the Staten Island landfill, where it is being examined by personnel from the Federal Bureau of Investigation and the New York City Police Department.

In some cases, such as to protect crops or livestock feed from consumption by birds or contamination by bird feces, Wildlife Services personnel poison birds. Program researchers have developed several effective poisons and have maintained their registrations with EPA or the

Food and Drug Administration (FDA). And in still other cases, such as with Canada geese, which are protected by the Migratory Bird Treaty Act, program personnel oil or addle (shake) bird eggs to interfere with their hatching and thus discourage birds from nesting at that location. After several unsuccessful attempts at breeding in a particular location, birds will leave that location and seek another. A representative of the Humane Society said that, while the Society has no objection to egg oiling or addling, it strongly objects to Wildlife Services' practice of rounding up and killing geese.

Protecting the Flying Public

Another key effort has been to reduce the risk of aircraft striking wildlife at airports. In 2000, Wildlife Services worked at over 418 airports—a 15-percent increase over the previous year. The airport operator (a city, county, or private company) pays 100 percent of the cost of Wildlife Services' airport work. According to FAA regulations, a certified airport must conduct a a wildlife hazard assessment if (1) an aircraft has experienced a multiple birdstrike or engine ingestion, (2) an aircraft has experienced a damaging collision with wildlife other than birds, or (3) wildlife of a size or in numbers capable of causing a strike have access to aircraft flight or movement areas. Usually, an airport hires a Wildlife Services biologist to do a wildlife hazard assessment, which is based on periodic observations of the numbers and types of wildlife on or near airport grounds and the challenges posed by the surrounding habitat. Working from the biologist's report, an airport operator develops a wildlife hazard management plan. For example, a plan might call for using truck-mounted sirens to harass birds or for installing exclusion fences to deter coyotes or deer from wandering onto runways. In collaboration with FAA, Wildlife Services prepared a manual to aid airport personnel in developing, implementing, and evaluating wildlife hazard management plans. The manual, which FAA distributed to all certified airports in the country, includes information on the nature of wildlife strikes, wildlife management techniques, and sources of help and information.

Research contributing to wildlife control at airports includes studies to determine whether birds and small mammals are more attracted to mowed or unmowed areas of vegetation. These studies found that birds were more numerous in unmowed plots. Also, the variety and abundance of small mammals was greater in unmowed plots and increased over time, while remaining constant in mowed plots. This finding is important because small mammals are a primary source of food for raptors, which pose a threat of aircraft collisions because of their large size and their habit of soaring. Other research contributing to wildlife control at airports includes research on the use of mesh bags of coyote hair as a repellent for white-

tailed deer, the use of amplified distress calls as a harassment technique for birds, and the use of wires installed at various heights to discourage birds from perching on top of signs and other structures near airport runways.

Protecting People, Pets, and Livestock From Wildlife-Borne Diseases

This is a large and growing area of emphasis. For several years Wildlife Services has worked in various parts of the country to control rabies. For example, in 1995 it began an oral vaccination campaign in south Texas to control a variant of rabies that had crossed over from domestic dogs to coyotes; in 1994, 166 cases were reported in south Texas. From 1995 to 2000, rabies campaigns—involving the delivery of an oral vaccination enclosed in a bait attractive to coyotes—resulted in the vaccination of between 75 and 90 percent of the coyotes in the area. In 2000, there were no reported cases of the canine variant in south Texas. The rabies program is continuing in 2001, but at reduced levels.

In Ohio and the northeastern United States, another rabies control effort has been ongoing for several years. Raccoon rabies entered northeast Ohio in 1996; by the end of 1997, 62 cases had been reported. To halt the westward spread of raccoon rabies, Wildlife Services worked with federal and state agencies to create a vaccination immune barrier from Lake Erie to the Ohio River. Wildlife Services researchers assisted by developing the vaccine and its delivery packet. (The vaccine, encased in a small plastic pouch about the size of a fast-food ketchup pouch, is in turn encased in a bait cube made of fish meal.) Twice a year, in the spring and in the fall, Wildlife Services personnel drop the baits from a small plane equipped with a conveyer-belt-like mechanism that flings out baits at a rate of about 75 per square kilometer. In fiscal year 2000, the program baited an area in eastern Ohio covering about 2,500 square miles. For several weeks following the bait drops, Wildlife Services biologists trap raccoons for examination and subsequent release. The biologists examine each raccoon, take a blood sample to test for rabies antibodies, and pull a tooth (the first pre-molar) for tests to determine how much vaccine the raccoon ingested and when. The Ohio Wildlife Services office maintains a database on the number and health of raccoons trapped and examined. In fiscal year 2000, for example, the Ohio program trapped and examined over 450 raccoons. In addition to their rabies vaccination-related activities, Wildlife Services employees provide technical assistance. In 2000, for example, Wildlife Services biologists in Ohio responded to questions about raccoons from more than 700 people and assisted with educational and training seminars for local health departments. Figure 3 shows raccoons undergoing procedures in the rabies vaccine program.

Figure 3: After Capture, Raccoons Undergo Various Procedures to Ascertain the Effectiveness of the Oral Rabies Vaccination Project

A raccoon is trapped for testing as part of the program's rabies control work in Ohio.

Blood is drawn and tested for rabies antibodies.

The first pre-molar is pulled and tested for tetracycline (indicating consumption of rabies vaccine bait).

Source: USDA.

Other wildlife-borne diseases are also of concern. For example, surveillance programs for West Nile virus are active on the East Coast, and the virus appears to be spreading southward and westward. In 2000, Delaware reported that four horses had tested positive for West Nile virus. In 2001 (through October 15), Florida reported that 139 horses had tested

positive for the virus. Wildlife Services personnel also assist in surveillance and control activities for wildlife-borne diseases such as hantavirus, bubonic plague, histoplasmosis, and salmonella.

Studies Done by, or in Collaboration With, Wildlife Services Staff Have Found That Program Benefits Exceed Costs

We found no independent studies of Wildlife Services' costs and benefits. The relatively few studies that have analyzed these issues were done by, or in collaboration with, Wildlife Services personnel. However, these studies were peer reviewed and adhered to standards governing their design and conduct. The most comprehensive assessment of costs and benefits, conducted as part of Wildlife Services' 1994 program-wide final environmental impact statement, concluded that the existing program of lethal and nonlethal controls was preferable to the other four alternatives that were studied in detail because it was the most cost-effective, among other advantages. Other, more narrowly focused studies found that program benefits exceed costs, sometimes by large margins. However, there are several inherent difficulties associated with studies of this nature. For example, estimates of the economic benefits (savings) associated with program activities are based largely on predictions of the damage that would have occurred had the program's control methods been absent. Such predictions are difficult to make with certainty and can vary considerably depending on the circumstances.

The Only Rigorous Studies of the Program's Costs and Benefits Were Done by or With Wildlife Services Employees

A variety of organizations, including environmental and animal rights groups, have written about Wildlife Services' activities and policies. However, we found no independent studies that rigorously assessed the costs and benefits of the Wildlife Services program; the only studies that we found were conducted by or in collaboration with Wildlife Services scientists and researchers. Nevertheless, these studies were peer reviewed and met other research standards required for publication in a professional journal. For example, to be eligible for publication in the *Wildlife Society Bulletin*, which has published several of the studies that assessed the costs and benefits of specific Wildlife Services activities, a study must be either peer refereed or peer reviewed.[15] The referees and reviewers assess, among other things, whether a study has design or logic

[15]The *Wildlife Society Bulletin's* peer referee process entails review by an associate editor and two qualified referees, selected by the editor. The peer review process entails review by an editorial panel member who is selected by the editor. In selecting referees and editorial panel reviewers, the editor considers their areas of expertise, affiliation, and performance on previous reviews.

flaws that render its results invalid, biased, or questionable. Referees and reviewers recommend acceptance or rejection of a manuscript submitted for publication. Manuscripts requiring revision are returned to the author for revision and then reviewed again; sometimes a manuscript requires several iterations before a decision is made about its acceptance. Wildlife Services scientists and biologists publish their study results in other professional journals as well.[16]

In addition to following requirements that are prerequisites for publication, all Wildlife Services studies adhere to standards governing the design and conduct of the research studies themselves. Wildlife Services researchers follow the standards published by FDA and EPA. The degree to which research must adhere to the standards depends on its purpose. If research were related to the development of a new chemical product, for example, the full standards would apply. On the other hand, if the research were a field ecological study, not all of the standards' requirements would apply. The standards include requirements governing, among other things, the protocol for and conduct of a study, the reporting of study results, the storage and retention of records, and the humane treatment of any animals used in the study.

Wildlife Services' Environmental Impact Statement Concluded That Its Existing Approach Was the Most Cost-Effective

Of the Wildlife Services' studies of program costs and benefits, the most comprehensive is its program-wide environmental impact statement (EIS), which was peer reviewed and issued for public comment prior to publication. An EIS assesses the biological, sociocultural, physical, and economic impacts of a federal action and alternatives to that action. The 1994 EIS concluded that, of the alternatives evaluated, the existing program was the most cost-effective, resulting in a favorable ratio of benefits to costs, and offered advantages such as economies of scale and nationwide accountability. The EIS was conducted to comply with requirements of the National Environmental Policy Act (NEPA), which created the Council on Environmental Quality. NEPA requires that federal agencies prepare an EIS for every major federal action that may significantly affect the quality of the human environment. The Council on Environmental Quality's regulations implementing NEPA do not require a formal benefit-cost analysis to be conducted. However, they require that

[16]Wildlife Services' study results appear in publications such as the *Canadian Journal of Zoology*, the *Journal of Applied Behavioral Science*, the *Journal of Chemical Ecology*, the *Journal of Mammalogy*, the *Journal of Wildlife Management*, and the *Journal of Wildlife Research*.

considerations important to a decision among alternatives be identified and analyzed so that the merits and drawbacks of the alternatives can be compared.

Wildlife Services' EIS, prepared by the Department of Agriculture's Animal and Plant Health Inspection Service, addressed its ongoing program of wildlife damage management.[17] Its intent was to analyze the impacts associated with the full range of wildlife damage control activities that comprise its program. In addition, the final EIS analyzed the impacts associated with several alternatives to the program. Originally, the potential impacts of three program alternatives were analyzed in detail; as a result of public comments, two additional alternatives were analyzed.[18]

The total cost of the 1994 EIS was about $3.5 million, according to a Wildlife Services official. Scoping for that EIS began in 1987, when a notice in the Federal Register sought public input on the issues and alternatives to be addressed. The final EIS, which contained summaries of and responses to the public comments received, was issued in April 1994 and revised in October 1997; it quantified benefit-cost analyses where reliable data existed.

According to the EIS, the total economic effects of wildlife damage control are composed of direct and indirect effects—on individuals who sustain damage and on the public. Direct economic effects are those effects that are caused by the action and that occur at the same time and place as the action. For the current damage control program, for example, a direct economic effect on individual farmers or ranchers would be the savings realized from a reduction in livestock losses. For the public, the current program could result in direct effects such as the savings realized and the potential losses of life avoided by improving airport safety through the removal of wildlife from airport runways or flight paths. Indirect effects, on the other hand, are those effects caused by actions occurring later in time or removed in distance from the original action, but still reasonably foreseeable. For example, wildlife damage control on one farm could

[17]The 1994 EIS, for what was then called the Animal Damage Control program, was preceded in 1979 by an EIS that analyzed mammalian predator damage control activities that occurred in 1977 in 16 states. The age of that analysis and the lack of a programwide analysis contributed to the decision to prepare an updated, programmatic EIS.

[18]The draft EIS was issued in July 1990 for public comments, and a supplemental EIS—which incorporated public comments on the draft—was issued in January 1993, again for comment. In both cases, about 90 days were allowed for comments.

result in decreased livestock losses on a neighboring farm or ranch, thus benefiting additional farmers and ranchers. Further, by reducing livestock losses, controlling wildlife damage could benefit the public because it could result in lower market prices for agricultural products.

The EIS evaluated five alternatives for controlling wildlife damage: (1) a no-action alternative, in which the current federal control program would not exist; (2) the existing program alternative, consisting of technical assistance, nonlethal controls, and lethal controls; (3) a nonlethal controls alternative, in which the program would employ only nonlethal methods; (4) a nonlethal-before-lethal controls alternative, in which the program would use lethal controls only as a last resort, after nonlethal controls had proven unsuccessful; and (5) a damage compensation program alternative, in which the program would compensate property owners monetarily for the losses they incur.

The EIS assessed the cost-effectiveness of each of the program alternatives and analyzed the various economic impacts that each alternative would likely produce. Specifically, the EIS analyzed, for each of the alternatives, its direct and indirect economic impacts on affected parties and its direct and indirect economic impacts on the public.

- **Direct impacts on affected parties.** This analysis considered the impact, in terms of losses, of wildlife damage on affected parties (e.g., farmers and ranchers). The EIS concluded that the no-action alternative would offer parties at risk the least protection from direct losses, assuming that the current program would not be replaced by other federal, state, or local programs. Under this alternative, where wildlife threatens human health and safety, the affected parties would bear all potential losses, including property damages and insurance and health care costs. The existing control program, offering the widest range of choices in the application of technical assistance and direct assistance methods, could be expected to most efficiently minimize losses and risks. Two other alternatives (a nonlethal control program and a nonlethal-before-lethal control program), restricted by the methods permitted and their order of application, would likely result in higher losses. And finally, the damage compensation program alternative would partially offset agricultural losses, but unverified losses would still be borne by the affected parties and could become significant without a damage control program. Moreover, this alternative would provide monetary compensation only for agricultural damage; in regard to other threats posed by wildlife, such as risks to human health and safety, the damage compensation alternative would be the same as a no-action alternative. The EIS also considered the

direct economic effects of damage control expenditures, and concluded that the alternatives compared similarly.

- **Indirect impacts on affected parties.** This analysis considered the losses and risks that would be borne by third parties. For example, program activities that prevent the spread of disease by rodents and other wildlife could have a positive effect on the costs of health insurance, even though the individuals paying the lower insurance premiums may never suffer direct losses. The EIS concluded that such indirect impacts could be positive or negative, depending on the alternative considered. For example, a lethal predator damage control program (one option under the current program) on one rancher's property could reduce the likelihood of losses by neighbors, whereas a nonlethal control program might increase that likelihood. For many agricultural producers, the analysis noted, assistance with wildlife damage control can mean the difference between remaining in or going out of business. Producers might not be able to absorb either increased losses from wildlife damage or added costs of control to prevent those losses. Either or both of these outcomes could result under a no-action alternative, a nonlethal program alternative, or a nonlethal-before-lethal alternative. The continued operation of such producers contributes to the economies of their local communities. Local businesses, therefore, are indirect beneficiaries of damage control activities. For the damage compensation alternative, the affected parties would be on their own in controlling animal damage; the federal role would be one of compensation rather than control.

- **Direct public impacts.** These impacts mainly take the form of program expenditures. The EIS concluded that the current program alternative was likely to be the least costly to the public (with the possible exception of the no-action alternative), whereas the nonlethal and the nonlethal-before-lethal alternatives would be more costly, because their damage control activities would likely take longer and have lower success rates. At the other extreme, the damage compensation alternative was judged to be "prohibitively expensive," with budgeted funds, in effect, determining expenditure levels. In addition to funds for compensation, the administrative costs of verifying losses and processing claims would be considerable. The no-action alternative would not have an impact at the national level unless damage control were undertaken through other federal programs. If state and local governmental entities were to assume animal damage control responsibilities in the absence of a federal program, though, the costs to the public could be collectively comparable to or even greater than the costs of the current program.

- **Indirect public impacts.** These impacts were considered in terms of each alternative's effects on other governmental costs. If, for example, a public airport were held liable by passengers for injuries resulting from an aircraft collision with birds, the cost of compensation would be an indirect effect. Such incidents could be expected to occur most frequently if no governmental wildlife controls were undertaken (i.e., under the no-action alternative or the damage compensation alternative) and least frequently under the current program alternative. For the other two alternatives, nonlethal only and nonlethal-before-lethal, clients' satisfaction would determine the ultimate impact. That is, if farmers and ranchers were dissatisfied with the approaches used under a federal program, they might demand more appropriate approaches by state, local, or other federal agencies, thus increasing the costs of other government entities.

The EIS concluded that, in terms of both avoided losses (benefits) and damage control expenditures (costs), the existing damage control program was the most cost-efficient of the alternatives. The existing program offers several benefits, such as standardizing approaches to wildlife damage management and conducting and disseminating research leading to improvements in wildlife damage management. Many of these advantages could be lost through a no-action alternative. A damage compensation alternative would provide some financial relief to producers for losses due to wildlife predation, but would neglect nonmarket considerations such as the health and safety of airline passengers. A nonlethal-only alternative could result in clients going out of business, as many types of damage could not be successfully addressed, and this would increase the costs to clients who would need to assume their own lethal control activities. A nonlethal-before-lethal program would be more time-consuming and costly to both the program and its clients. Based on its analyses, the EIS concluded that the existing program alternative offered a favorable ratio of benefits to costs, even though the benefits and costs could not be rigorously quantified.

Other, More Narrowly Focused Wildlife Services Studies Show Program Benefits Exceeding Costs

Wildlife Services studies other than the EIS have also shown that the benefits of wildlife damage control exceed its costs. These studies primarily address specific aspects of the program, often in specific areas of the country. For example, several studies concluded that the estimated benefit-to-cost ratios for livestock protection from predators (predominantly coyotes) range from 3:1 to 27:1, depending primarily on the types of costs considered. Comparing the market value of all livestock saved in 1998 with the cost of all livestock protection programs in place yielded a benefit:cost ratio of 3 to 1, according to a 2001 Wildlife Services

study.[19] In contrast, comparing total savings (including a measure that shows the potential ripple effect of predator losses on rural economies) with federal program expenditures alone would yield a benefit:cost ratio of 27:1.

Studies use several measures of program costs and benefits. Estimates of the cost of livestock losses to predators, for example, vary widely, depending on whether one considers only the value of confirmed losses (market value of dead animals found, with predation confirmed by forensic examination) or also the additional costs incurred by livestock producers to reduce predation risk (e.g., the purchase, training, and maintenance of guard animals; fencing; herders; repellent devices; and contributions to private or public predation management programs such as aerial shooting campaigns). These additional costs are significant, and can equal or exceed the cost of predation.

The studies discuss various benefits of managing predation. In addition to preventing agricultural losses, predation management activities can provide other substantial benefits. For example, predation management is important for the protection of game animals when their populations are reduced in relation to available habitat. Also, predation management is essential for the successful restoration of threatened and endangered species.

Some benefits of the program's operations and research activities accrue to society at large, such as activities undertaken to reduce risks to public health and safety, and are cost effective as well, according to a recent economic study.[20] For example, the benefits of controlling the spread of raccoon rabies greatly outweigh the costs. This study analyzed the benefits and costs associated with a hypothetical rabies barrier that would stretch from Lake Erie to the Gulf of Mexico. The barrier would be a combination of natural geographic features (the Appalachian Mountains) and oral

[19]M.J. Bodenchuk, J.R. Mason, and W.C. Pitt, "Economics of predation management in relation to agriculture, wildlife, and human health and safety." In: L. Clark (ed.) Proceedings of the 1st International Symposium on the Economics of Wildlife Damage. Colorado State University Press, Fort Collins, Colorado. In press, 2001. Peer reviewed.

[20]Philip Kemere, Michael K. Liddel, Phylo Evangelou, Dennis Slate, and Steven Osmek, "Economic Analysis of a Large Scale Oral Vaccination Program to Control Raccoon Rabies." (Paper delivered at a Wildlife Services' symposium, "Human Conflicts with Wildlife: Economic Considerations," in Fort Collins, Colorado, Aug. 1-3, 2000.) Peer reviewed.

vaccination zones. The goal of the barrier would be to prevent the raccoon rabies variant from moving west into broader geographic regions of the United States. The study compared the costs of establishing and maintaining this hypothetical barrier with the benefits (avoided costs) of not having to live with raccoon rabies west of its current distribution. The costs of establishing and maintaining an immune barrier include expenditures for baits, distribution of baits, and program evaluation. Benefits are viewed as all costs, including direct medical and nonmedical costs, that would be avoided as a result of the proposed oral rabies vaccination program. Such costs include the costs of public education regarding raccoon rabies, pre-exposure vaccinations and post-exposure treatments, increased compliance rates for dog and cat vaccinations, increased local animal control and surveillance activities, and increased laboratory staff and supplies.

The study, based on four variations of an economic model, concluded that a large-scale oral rabies vaccination program should be economically feasible, given the program costs and the avoided costs. The total discounted program cost, over a 20-year period, would be about $95.7 million, and the net benefits (avoided costs minus program costs) of the four model variations would range from $109 million to $496 million, depending on the assumptions employed (i.e., the assumed rate at which the rabies variant would travel and whether animal vaccinations were included or excluded). To test the robustness of the model (i.e., how stable its estimates were in reaction to changes in the range of data used), the study's economists used a sampling technique known as Monte Carlo, in which they generated a random data set based on specific probability distributions for the data (e.g., barrier area, bait density, bait cost, and aerial distribution cost). The data set was then used in the model, and the resulting variation in the model's estimates was low, indicating that the model was stable, or robust. Accordingly, the study concluded that the net economic benefits, in terms of avoided costs due to the oral rabies vaccination program, would be substantial.

The type of resource, or animal, protected affects the costs and benefits of damage control. Values for threatened or endangered species have been declared "incalculable."[21] Nevertheless, according to the 2001 study by

[21]See Tennessee Valley Authority v. Hill, 437 U.S. 153, 187 (1978)(stating "the plain language of the [Endangered Species] Act, buttressed by its legislative history, shows clearly that Congress viewed the value of endangered species as 'incalculable'").

Bodenchuk et al., such species' minimum values can be estimated from the funds expended for their restoration. For example, black-footed ferret populations are severely affected by coyote predation, especially following restoration efforts. In studies of restoration success in South Dakota, 30-day survival rates for ferrets averaged 31 percent in the absence of predation management, but 67 percent with predation management in place. Based on an introduction of 50 ferrets, about 18 ferrets would be saved with predation management in place, resulting in a financial benefit of about $524,000. This benefit was calculated using an average individual value of $29,000 per ferret. The individual value was, in turn, calculated by dividing the total reintroduction expenditures in one year ($2,913,220) by the estimated number of individual ferrets in the wild (100).

Several Caveats Are Associated With Wildlife Services' Cost and Benefit Studies

Because of the nature of cost-benefit studies in general, their results should be viewed with some caution. Inherent difficulties bedevil any attempt to quantify the costs and benefits of a program designed to prevent damage. Key among these difficulties are (1) projecting the degree of losses that would have occurred absent the program, (2) valuing those losses, and (3) valuing the program benefits. Moreover, in some instances, the relevancy of data available for quantifying the costs and benefits associated with Wildlife Services activities may be limited by the data's age.

Predicting the Degree of Losses

Predictions of the degree of loss that would have occurred had Wildlife Services' control methods not been in place are difficult to make with any certainty and vary considerably depending on the circumstances. For example, few data exist on livestock losses in the absence of controls. Livestock producers generally have not one control, but a combination of several, in place, such as guard animals, fences, herders, and repellent devices. Yet livestock are taken by predators despite these controls. So the degree of loss that producers would have suffered had they not had controls in place can only be estimated.

Predictions about the degree of loss are further complicated by the difficulty in distinguishing between the relative contributions of program activities versus other factors such as weather, disease, or natural fluctuations in predator and prey populations. For example, according to a

September 1999 study on coyote depredation control,[22] various interrelated factors influence coyote depredation rates on sheep, including coyote density (e.g., pack size, territory size, and number of coyotes per territory) and the abundance of alternative prey. According to the study, research has shown that coyote predation rates on sheep are closely related to the abundance of natural prey, such as rodents and jackrabbits. A 6-year study in Idaho,[23] for example, showed that predation rates on sheep increased in proportion to changes in the abundance of jackrabbits. When the hare population collapsed, and the coyotes had no alternative food source, their depredation on sheep escalated dramatically.

The uneven distribution of damage poses a particular difficulty in predicting losses. That is, although average losses to predators are small compared to overall losses from other causes, such as weather and disease, the damages are not evenly distributed over time or over area. A small proportion of producers absorb high losses, whereas the vast majority of producers sustain less serious economic damage. Thus, using a single average statistic to infer overall program effectiveness would not accurately reflect the distributional variations. For ranchers who are already operating on a small profit margin, additional losses of even a few percentage points could drive their businesses into deficit.

Valuing Losses

The value of losses is difficult to estimate for several reasons. For example, the value of livestock changes with the daily fluctuations in market values. Further, the loss of a pregnant ewe is not simply the loss of that animal, but also the loss of the unborn lamb, as well as any future offspring.

Inherent difficulties also exist in the valuation of wildlife. As species, wildlife have positive value for society, but the specific individuals that cause damage and thus, economic losses, have negative value for livestock producers and others who sustain damage. Although the intrinsic value of wildlife is difficult to quantify, the economic value of wildlife can be estimated from the dollar values that wildlife management agencies place

[22]Frederick F. Knowlton, Eric M. Gese, and Michael M. Jaeger, "Coyote depredation control: An interface between biology and management," *Journal of Range Management* 52(5), pp. 398-412, September 1999.

[23]L. Charles Stoddart, Richard E. Griffiths, and Frederick F. Knowlton, "Coyote responses to changing jackrabbit abundance affect sheep predation," *Journal of Range Management* 54(1), pp. 15-20, January 2001.

on them, according to a 2001 Wildlife Services study.[24] For many common game species, for example, state departments of fisheries and wildlife have established economic values based on estimates of the species' contributions to the economy. These economic values serve as the basis for civil financial penalties assessed as mitigation for illegal poaching or wildlife kills that result from environmental contamination. For example, according to the study, the weighted average civil penalties assessed for illegally killing wildlife ranged from $26 for an upland game bird to $1,312 for a bighorn sheep. The penalty for taking a mule deer was $350; a pronghorn, $400.

Valuing Program Benefits

Estimates of the value of benefits (avoided costs) also cannot be made with certainty. Estimating the value of controlling wildlife at airports, for example, entails making assumptions about not only the number and severity of wildlife-aircraft collisions that would occur without the program in place, but also about the cost associated with repairs, medical treatment, and loss of human life.

Some groups that take issue with Wildlife Services activities suggest that its programs are not cost-effective because the money spent on livestock protection exceeds the value of the losses to ranchers and others. However, Wildlife Services officials believe that it is misleading to focus only on the value of losses that occur with a control program in place and to disregard the value of the damage that is prevented by the program. They compared this type of analysis to having a fire department that costs $10 million a year to operate and keeps fire damage in a community down to $2 million a year in losses. Rather than saying that the department is not worth its cost because losses due to fire damage were only a fraction of the cost of operating the fire department, consideration should be given to what the losses would have been without a fire department.

Relevance of Data

The age of the various cost-benefit studies, and the data upon which they were based, may pose yet another limitation, in terms of both relevance and scope. The environmental impact statement, for example, was based on data that are now over a decade old and may not reflect current conditions. For example, the EIS did not include analyses of the white-tailed deer and the resident Canada goose, both of which have become

[24]M.J. Bodenchuk, J.R. Mason, and W.C. Pitt, "Economics of predation management in relation to agriculture, wildlife, and human health and safety." In: L. Clark (ed.) Proceedings of the 1st International Symposium on the Economics of Wildlife Damage. Colorado State University Press, Fort Collins, Colorado. In press, 2001. Peer reviewed.

increasingly problematic. Some of the other, more narrow, studies we reviewed were also based on old data.

Wildlife Services has requested funding to update the EIS. The EIS primarily used fiscal year 1988 data to provide a comparable baseline against which to evaluate each alternative. If funded, work on the supplemental EIS would likely start next year and would be expected to take about 3 years to complete. The supplemental EIS would incorporate information on new wildlife management techniques that have been introduced since the early 1990s. Program officials also plan to study and incorporate into the supplemental EIS information on aquaculture depredation issues and on overabundant animals such as white-tailed deer, resident Canada geese, and blackbirds.

Wildlife Services Research Efforts Focus on Developing More Effective Nonlethal Controls

Wildlife Services researchers believe that considerable potential exists for developing more effective nonlethal controls of wildlife damage through the use of new and improved technologies. In light of the controversy surrounding lethal controls, Wildlife Services devotes most of its research efforts toward this end. Past efforts to develop effective and economical nonlethal controls, however, have met with limited success. Although Wildlife Services research has developed several nonlethal controls that are used on many farms and ranches, these controls have not limited livestock losses to the point where lethal controls are no longer needed.

Opportunities Exist for Developing More Effective Nonlethal Control Measures

The National Wildlife Research Center conducts research and provides information on a range of methods for managing wildlife damage. Considerable opportunity exists for developing more effective nonlethal means of controlling predators on farms and ranches—for example, through wildlife contraceptives or through the use of scare devices triggered by motion sensors. In fiscal year 2000, about $9 million (75 percent) of the program's total research funding was spent on efforts related to developing or improving nonlethal controls. A National Wildlife Research Center program manager noted that scientists feel considerable pressure to research and quickly develop nonlethal control methods. The manager noted that the pressure comes not only from animal advocacy groups and personal preferences, but also from a changing environment where experts in the field see the loss or diminishing acceptance of traditional control tools like guns, traps, and poisons. Nevertheless, funding levels have remained static for the past several years, hampering the center's ability to conduct additional research projects.

The center generally has about 19 projects underway in such areas as wildlife contraceptives, wildlife repellents, rodent control methods, and analytical chemistry methodology. Most of the projects are multi-year efforts of 3 to 5 years' duration.[25] According to the center's product development manager, research projects dealing with reproductive controls are particularly promising. A goal of these projects is to develop and field-test economical and effective agents to control fertility in populations of mammals and birds involved in human-wildlife conflicts. Researchers are also seeking ways to improve the delivery of contraceptives to wildlife, through, for example, darts or bio-bullets. Some species, however, such as deer, live for a dozen or more years. Using contraceptives to address the problem now that the deer population has surged will mean a long delay before relief can be obtained. Consequently, a researcher stated that such species' populations should probably first be "culled" and then treated with a reproductive inhibitor.

Following are some examples of reproductive control projects recently completed or underway that may lead to the development of more effective nonlethal means of controlling predators on farms and ranches, as well as problem wildlife in urban areas:

- Researchers recently completed a 5-year study on reproductive intervention strategies for managing coyote predation. The goals of the study were to (1) determine whether sheep losses could be reduced by sterilizing coyotes in territories where sheep and other livestock are pastured and (2) develop and transfer information critical to the registration and/or practical application of sterilant technologies and pharmaceutical products. In addition to determining whether sterilized coyotes kill fewer sheep than do coyotes with pups to feed, researchers evaluated whether surgical sterilization changed the coyotes' territorial or affiliate behaviors. After extensive field tests, researchers concluded that sterilization reduced, but did not eliminate, coyote predation on sheep.

- Center scientists are working to tailor an oral contraceptive, Nicarbazin, so that it can be given to geese. They are focusing on developing a more

[25]Wildlife Services considers research aimed at improving traps and snares—such as pan-tension devices to preclude capture of smaller nontarget animals in foothold traps—to be nonlethal efforts. However, the Humane Society contends that the end result of using such traps is that the predator is killed and that, therefore, categorizing such research as nonlethal is misleading.

palatable bait to deliver the contraceptive, delaying release of the contraceptive into the bird's body, and determining effective dose levels.

- Center scientists are working with a rodent immunocontraceptive, GnRH, which is a hormone vaccine. Officials in a California city have asked for help in controlling ground squirrels that are creating a problem on area beaches. Local laws prohibit poisoning or relocating nuisance animals such as the ground squirrels; consequently, officials are using the rodent immunocontraceptive to resolve the problem.

- Wildlife Services researchers received FDA approval to assist in a study trial of a single-shot delivery of PZP (porcine zona pellucida), an injection-delivered contraceptive, for use on deer. A large urban area in Ohio has requested assistance in controlling its deer population in city parks and has agreed to be the host site for the proposed PZP study trial.

The research program also provides data pertaining to pesticide and drug registrations to EPA and FDA. For example, an application for new registration has been submitted to EPA for methiocarb, a bird repellent. To support the application, researchers submitted data required by EPA for future product registrations. In addition, other program specialists are engaged in projects involving the development of global information system (GIS) applications, statistical and monitoring methods, and electronics designs for use in wildlife damage management.

Past Efforts to Develop Nonlethal Controls Have Met With Limited Success

Developing nonlethal control methods is a challenge that involves further research on such tools as chemical repellents and contraceptives. This challenge also involves biological and behavioral science research focusing on the differences both among species and within a single species. However, the nature of scientific research is such that while many research projects are undertaken, relatively few yield effective, marketable results. Moreover, research that looks promising at the outset often encounters problems that cannot be overcome easily. Such has been the case with nonlethal control research. Many nonlethal controls work well, but only in certain situations or locations, and some work only temporarily.

According to researchers, certain chemicals show promise as nonlethal repellents. For example, the center developed methyl anthranilate—a chemical that smells like grape soda—which is repugnant to geese and is applied to ponds and grassy areas to repel geese from golf courses, airstrips, and public parks. Although the use of this chemical appears promising, it must be reapplied frequently to be effective. In other cases,

chemical research that looked promising has not come to fruition. For example, in one research project, researchers laced lamb carcasses with lithium chloride, a chemical that causes coyotes to vomit. Researchers thought that this chemical showed promise in early laboratory and field tests as a means of conditioning coyotes not to kill lambs. However, while the coyotes in the field tests learned not to eat lambs, they continued to kill them. Another chemical that causes a predator to feel sick is Mesurol. This chemical has proven to be an effective deterrent on ravens, predators of bird eggs such as those of the endangered least tern. The center is working on other nonlethal chemical products such as alpha-chloralose. This chemical is an FDA-approved immobilizing agent that researchers are using to capture waterfowl so that identification bands or radio collars can be attached to the birds as part of research studies. Alpha-chloralose is also used to facilitate removal of nuisance animals such as ducks and geese that have found their way into swimming pools or city reservoirs. The presence of geese in these areas is a serious potential health hazard because of bacteria found in goose fecal matter.

In other instances, deterrence devices that appeared to be promising in the lab and during initial testing, such as the Electronic Guard predator scare device, have not received widespread acceptance for use on farms and ranches. The research center's product development program manager stated her belief that the Electronic Guard, which emits both a bright light and a loud noise to scare coyotes, could be highly effective if used correctly. She said purchasers need to use several of them at random intervals to be effective. Unfortunately, each one is fairly expensive. However, an operations official in Utah told us the Electronic Guard is not particularly useful in his state. He pointed out that the Electronic Guard technology is outdated—utilizing a bulky 12-volt battery—and consequently the device is not very easily transported to Utah's remote grazing locations, because it does not fit into a saddlebag. The official expressed his belief that the Electronic Guard has potential for other uses, such as deterring deer and other wildlife.

Other nonlethal control methods that employ traditional "scare" devices such as pop-up scarecrows, flashing lights, pyrotechnics, and noisemakers are also useful in managing birds. Mylar tape works well, too, because light reflecting off the tape apparently frightens the birds. With most such techniques, however, the birds adapt within a relatively short period of time and the measure is no longer effective. Consequently, adjunct techniques must be used.

Lasers are one of the newest scare techniques to show great promise in bird control. According to center researchers in Sandusky, Ohio, the use of lasers has proven effective in dispersing certain species of birds. For example, lasers have worked quite well in low light conditions (after sunset) with geese, double-crested cormorants, and Hawaiian stilts, which shy away from the beam of light emitted by the laser. In a test in Ohio, for instance, lasers were effective in scaring away—within 15 minutes—approximately 18,000 geese at a municipal lake. Because the laser is silent and can be selectively directed at a particular species of bird, the laser is preferable to loud devices where disturbance of people and other wildlife is a concern. Wildlife Services has developed a helium neon gas laser that costs less than $1,000. The beam can extend for a quarter of a mile. The French are marketing a similar laser for animal control for about $7,700. Bird necropsies have shown no damage from lasers, even at 1 meter. Nevertheless, some animal rights groups are protesting their use.

Other nonlethal control approaches can be directed at disrupting the animals' behavior without scaring them. One such nonlethal bird control is "pond gridding," which involves the placement of gridwire over ponds to prevent landings by geese and other birds. Wildlife Services staff also provide advice to homeowners and commercial building owners on how to alter the structure of buildings to discourage birds from roosting on them. For example, ledges can be boxed in, and spiky steel "porcupine wire" can be placed on ledges to dissuade landings. However, birds sometimes figure out how to build nests right on top of the spiky wire, so other devices may be needed in conjunction with the wire.

Supplemental feeding is another nonlethal control directed at changing an animal's damage-causing behavior without frightening the animal. According to researchers, this approach looks promising for bears that are coming out of hibernation when little food is available. In the Pacific Northwest, bears resort to stripping the bark from trees to eat its sweet inner surface, which kills large sections of forest. Experiments have shown that providing bears with sugar cane deters them from damaging the trees and may discourage their livestock predation as well. A successful bear feeding program for the protection of timber has existed for several years in Washington State. Unfortunately, the problem of bears' predation on livestock is often more difficult to resolve. According to a Wildlife Services researcher, even when bears have ample alternate food supplies, they simply seem to prefer lambs and ewes. However, in Utah this past summer, the Wildlife Services state director coordinated with various federal and state organizations and with the permittee to try a bear feeder on a remote grazing allotment. The state director hopes that the use

of the bear feeder, which contains molasses-sweetened dry pellets, will help deter both livestock and wildlife kills by bears.

Wildlife Services has had limited success working to develop effective nonlethal controls for beavers. In addition to landowners' concerns about beavers flooding timber and croplands, Wildlife Services receives numerous requests to help cities deal with beaver problems at their sewage treatment plants. For beavers, the main nonlethal device currently in use is a water control device, developed at Clemson University, called a Clemson Beaver Pond Leveler. The pond leveler design is intended to suppress the problem of flooding by allowing water to drain through a beaver dam or plugged road culvert, even if beavers build a dam at the mouth of the culvert. The pond leveler is a simple, low-cost device that is made largely from PVC pipe. Pond levelers work better in some geographic locations than others. In North Carolina, Wildlife Services installed seven pond levelers in 2000, with mixed results. The pond levelers' effectiveness was temporary at best: most failed within 12 months. The beavers either thwart the pond levelers by building their dams 30 feet downstream, thereby backing up water and defeating the purpose of the devices, or they dam up the pond leveler itself. According to Wildlife Services officials, pond levelers seem to work better in locations with hillier, steeper topography than North Carolina's.

Relocation, a nonlethal control method, is rarely a viable option, for several reasons. First, some animals such as beavers, white-tailed deer, and resident Canada geese are considered to be overabundant, so finding a suitable relocation habitat is difficult. Second, relocation is not always effective or in the animal's best interest. Some animals (e.g., bears) will just return to their original habitat; relocated animals may die in their new habitat because they are unfamiliar with the terrain and food sources or because they are killed by competitors whose territories they have invaded. Third, the risk of wildlife-borne disease sometimes makes people reluctant to accept the relocation of wildlife to areas near their residences. In fact, to help prevent the spread of disease, many states have laws against relocating wildlife.

Most nonlethal control methods such as fencing, guard animals, and animal husbandry practices are most appropriately implemented by the livestock producers themselves, with technical assistance from Wildlife Services. According to Wildlife Services officials, by the time producers request assistance from the Wildlife Services program, they have typically already been employing a variety of nonlethal control measures and are experiencing predation on their livestock in spite of these measures.

Wildlife Services must use lethal control methods in situations where nonlethal controls are ineffective, impractical, or unavailable.

Agency Comments and Our Evaluation

We provided the Department of Agriculture with a draft of our report for its review and comment. We received comments from officials of the Wildlife Services program, including the Deputy Administrator and the Associate Deputy Administrator. The officials agreed with the information presented in the report. They said that the report was thorough and unbiased, and that it competently communicated the need for and complexities associated with wildlife management. The officials acknowledged that there are many emerging wildlife damage concerns, as presented in appendix IV of this report, that exceed the program's current ability to address, within current resources. In an effort to respond to these emerging needs, Wildlife Services officials said they have at times compromised the program's infrastructure by providing services rather than upgrading equipment and facilities. The officials said they are committed to fixing the infrastructure problems while concurrently taking steps to target current and future resources toward the most critical emerging issues. The officials also provided a number of technical corrections and clarifications to the draft report, which we incorporated as appropriate.

We conducted our review from March 2001 through October 2001 in accordance with generally accepted government auditing standards. Details of our scope and methodology are discussed in appendix I.

We are sending a copy of this report to the Secretary of Agriculture and appropriate congressional committees. We will make copies available to others on request.

If you or your staff have any questions about this report, please call me at (202) 512-3841. Key contributors to this report are listed in appendix VI.

Lawrence J. Dyckman
Director, Natural Resources and
the Environment

Appendix I: Objectives, Scope, and Methodology

In October 2000, the Conference Committee on the Department of Agriculture's fiscal year 2001 appropriations directed us to conduct a study of the Department's Wildlife Services program.[1] Specifically, we agreed to determine (1) the nature and severity of threats posed by wildlife, (2) the actions the program has taken to reduce such threats, (3) the studies Wildlife Services and others have done to assess the specific costs and benefits of program activities, and (4) the opportunities that exist for developing effective nonlethal methods of predator control on farms and ranches.

To obtain information about the damage caused by injurious wildlife and the actions Wildlife Services takes to control such damage, we reviewed program documents, research studies, and surveys such as the livestock loss surveys conducted by the U.S. Department of Agriculture's National Agricultural Statistics Service. We gathered information on both the operations and research arms of Wildlife Services. For the operations arm, we visited Wildlife Services' western and eastern regional offices and offices in four states (two western and two eastern). For the research arm, we visited Wildlife Services' National Wildlife Research Center, in Fort Collins, Colorado, and two of its field research stations (one western, near Logan, Utah, and one eastern, in Sandusky, Ohio). The field research station in Utah conducts mammal research; the station in Ohio, bird research. At each of the regional and state offices we interviewed officials and reviewed records such as cooperative agreements, program evaluations, and budget and accounting documents. In selecting states to visit, we strove for geographic diversity as well as a cross-section of the program's various operational emphases (e.g., protection of agriculture, human health and safety, natural resources, and property). In each state visited, we met with program clients (e.g., farmers, ranchers, representatives of associations such as the Farm Bureau, and federal and state wildlife management officials), and we accompanied Wildlife Services personnel in the field to observe various activities such as removing beaver dams and vaccinating raccoons. We also visited and interviewed officials of the program's Management Information System Support Center, located in Fort Collins, Colorado, which tracks the number and types of operational activities conducted.

To obtain information on the program's costs and benefits, we conducted literature searches; reviewed economic studies conducted by program

[1]The Committee's direction was contained in Conference Report H.R. 106-948, p. 117.

researchers, academicians, and others; and interviewed Animal and Plant Health Inspection Service economists who were involved in assessing costs and benefits for the programmatic environmental impact statement. We also discussed the costs and benefits of the Wildlife Services program with program researchers, operations personnel, and cooperators.

To obtain information on nonlethal methods of controlling livestock predators, we reviewed research studies and interviewed program researchers and field operations personnel. At the program's predation ecology and behavioral applications field station, we attended a review of current research on reproductive intervention strategies for managing coyote depredation. We also discussed nonlethal control methods with various livestock operators who were program clients, as well as with representatives of industry associations (e.g., the Farm Bureau and wool growers' associations). Finally, we discussed nonlethal control methods and general Wildlife Services operations with representatives of the Humane Society of the United States and the Defenders of Wildlife.

We conducted our review from March 2001 through October 2001 in accordance with generally accepted government auditing standards.

Appendix II: Evolution of the Wildlife Services Program

The Wildlife Services program, including its predecessor programs, has evolved over the past century to meet the changing needs and desires of society. This appendix, drawing from the history contained in the program's final environmental impact statement (EIS), addresses some of the key events that have shaped the program over the years.

The first federal government involvement in wildlife damage control efforts occurred in 1885, when the Department of Agriculture's Branch of Economic Ornithology sent questionnaires to farmers about damage caused by birds. The following year the branch was elevated to division status and renamed the Division of Economic Ornithology and Mammalogy. The Commissioner of Agriculture stated that the new division would be responsible for educating farmers about birds and mammals affecting their interests so that the destruction of useful species might be prevented. Efforts to educate farmers included conducting studies and demonstrations of wildlife damage control techniques in the western United States and testing poisons for control of the house sparrow.

Between 1905 and 1907, the program, by then named the Bureau of Biological Survey, investigated and published methods for coyote and wolf control in conjunction with the Forest Service. At the same time, western livestock interests began voicing opposition to fees levied by the federal government for livestock grazing on federal lands in areas with high populations of coyotes and wolves.

As agricultural interests began to speak out, more attention was focused on problems with wildlife. In 1913 direct assistance work began under a small administrative allotment of funds to control plague-bearing rodents in California national forests. During the following year, the first cooperative agreement was signed by the president of the New Mexico College of Agriculture and Mechanical Arts and the Secretary of Agriculture. In 1914 the Congress responded to the concerns of farmers and ranchers by appropriating funds for experiments and demonstrations on predator control. The first congressional appropriation for federal predator control operations came in 1915, when the Congress appropriated $125,000 to the Bureau of Biological Survey to control wolves and coyotes.

The 1916 Convention between the United States and Great Britain for the Protection of Migratory Birds and its enabling legislation, the 1918 Migratory Bird Treaty Act, authorized the issuance of permits for the taking of migratory birds that were injurious to agriculture and other interests.

The need for improved methods and techniques for the control of predators and rodents led to the establishment of a laboratory in Albuquerque, New Mexico, for experimentation with poisons. In 1921 this laboratory, called the Eradication Methods Laboratory, was moved to Denver. Years later, this facility would become known as the National Wildlife Research Center, located today in Fort Collins, Colorado.

Although the need for wildlife damage control efforts was acknowledged by the Congress, some felt the federal program was unnecessary. In 1930 the American Society of Mammalogists issued a strong statement of opposition to the federal predator control program. This nearly caused the cancellation of the $1 million congressional appropriation for predator and rodent control. But in 1931, after full congressional hearings, a bill was passed by the Congress and signed by President Hoover giving the federal government authority to conduct wildlife damage control activities. This bill became the Act of March 2, 1931, and remains the primary statutory authority under which the current Wildlife Services program operates.

In 1934, the Congress appropriated funds to buy property in Pocatello, Idaho, for a facility to produce baits for the predator and rodent control programs. The facility opened in 1936 as the Pocatello Supply Depot, which remains an integral part of the current program.

In 1939, under President Franklin Roosevelt's government reorganization plan, Agriculture's Bureau of Biological Survey and Commerce's Bureau of Fisheries were transferred to the Department of the Interior, forming the U.S. Fish and Wildlife Service. All wildlife damage control functions were transferred to Interior's new Branch of Predator and Rodent Control. The reorganization was part of President Roosevelt's attempt to consolidate within the Interior Department all federal activities dealing primarily with wildlife. This presented the Fish and Wildlife Service with the dual objectives of both controlling and enhancing certain wildlife species, depending on the circumstances.

In 1946, the Fish and Wildlife Coordination Act of 1934 was amended to authorize the Secretary of the Interior to cooperate with other federal, state, and public or private agencies in minimizing damage caused by "overabundant" species. In 1948 the Lea Act was passed, authorizing the program to purchase or rent up to 20,000 acres in California for the management and control of migratory waterfowl. That same year, a worldwide shortage of cereal foods prompted the Congress to appropriate funds for Agriculture and Interior to become involved with rat control. The Predator and Rodent Control program conducted extensive rodent control

activities that further established wildlife damage control efforts in the eastern United States.

The federal animal damage control program operated in relative obscurity, with little public opposition, during the 1940s and 1950s. By then the program comprised several components, including research, technical assistance, and both lethal and nonlethal direct assistance activities. The type of assistance provided depended on the location, the local institutions, and the resource being protected.

In the 1960s, however, growing environmental awareness brought the program under closer scrutiny. The use of poisons to kill predators increasingly came under criticism, even from traditionally conservative interests such as editors of national hunting and fishing magazines.

In 1963, Secretary of the Interior Stewart Udall appointed a group called the Advisory Board on Wildlife Management to investigate federal wildlife damage control efforts. The Board published a report in 1964 officially entitled "Predator and Rodent Control in the United States" (Leopold et al. 1964), but the report is more commonly referred to as the Leopold report, named after A. Starker Leopold, Chairman of the Advisory Board. The report was critical of the animal damage control program in many ways, charging it with indiscriminate, nonselective, and excessive predator control. For example, the report stated that the leghold trap was nonselective, meaning it was apt to capture non-target species, resulting in unnecessary loss of wildlife.

Recommendations of the Leopold report were incorporated in the 1969 Animal Damage Control program's policy manual. For example, professionally trained personnel were added to the program, in-service training for long-time employees was instituted, nearly all predator control practices were reduced, and regulation and supervision of toxicants were tightened.

Predator control continued to be the focus of public attention. In 1971, spurred by lawsuits from animal welfare groups over the program's use of toxicants, the Secretary of the Interior and the President's Council on Environmental Quality appointed a seven-person Advisory Committee on Predator Control. The report of that committee, like the Leopold report,

took on the name of its chairman, Stanley Cain.[1] The Cain report stated that the use of chemicals is likely to be inhumane and nonselective, and it recommended that landowners be trained in the use of leghold traps as a major method of predator damage control. The report was generally critical of federal predator control efforts, and outlined 15 recommendations for changes in the federal program. Among the recommendations was that immediate congressional action be sought to remove all toxic chemicals from registration and use for direct predator control.

In February 1972, as a result of the Cain report's recommendations, President Richard Nixon signed Executive Order 11643, restricting the use of toxicants for predator control by federal agencies or for use on federal lands. In compliance with the order, the Environmental Protection Agency cancelled the registrations of several chemicals: Compound 1080, strychnine, sodium cyanide, and thallium sulfate. In 1974, the program was titled the Office of Animal Damage Control.

In 1975, President Nixon's Executive Order 11643 was amended by President Gerald Ford's Executive Order 11870, to allow the experimental use, for up to 1 year, of sodium cyanide to control coyote and other predatory mammal or bird damage to livestock on federal lands or in federal programs. Order 11643 was again amended in 1976 by Executive Order 11917 to allow the operational use of sodium cyanide for predator control on certain federal lands or in federal programs.[2]

In 1978, the Secretary of the Interior appointed an Animal Damage Control Policy Study Committee to review the federal Animal Damage Control program. This committee, too, was very critical of the program, saying it found insufficient documentation to justify the program's existence. As a result of this report, and related public hearings, the Department of the Interior prepared a December 1978 report "Predator Damage in the West:

[1]S.A. Cain, J.A. Kadlec, D.L. Allen, R.A. Cooley, M.C. Hornocker, A.S. Leopold, and F.H. Wagner, "Predator Control—1971," Council on Environmental Quality and U.S. Department of the Interior, Washington, D.C., 1972.

[2]Use of sodium cyanide was still prohibited in: (1) areas where endangered or threatened animal species might be adversely affected; (2) areas of the National Park System; (3) areas of the National Wildlife Refuge System; (4) areas of the National Wilderness Preservation System; (5) areas within National Forests or other federal lands specifically set aside for recreational use; (6) prairie dog towns; (7) National Monument areas; and (8) any areas where exposure to the public and family pets is probable.

A Study of Coyote Management Alternatives." This report summarized all pertinent information and was developed to serve as a source document for consideration by the Secretary in making decisions about the program. The Committee's report led to a policy statement issued by Secretary of the Interior Cecil Andrus in November 1979, which stopped the practice of denning (i.e., finding and killing coyote pups at their dens) and research on the use of the chemical Compound 1080. The policy was an attempt to emphasize the use of nonlethal control methods.

Adverse reactions to Secretary Andrus' policy were expressed in a January 1980 memo by the Western Regional Coordinating Committee, composed of 28 university research and extension personnel and various Agriculture and Interior employees. The committee members were concerned that the policy showed minimal understanding of livestock industry problems and minimal knowledge of the realities of predator losses and control. The Committee's concerns reflected a growing opinion that the Animal Damage Control function would be better served if it were administered by the Department of Agriculture.

In 1981, the Environmental Protection Agency held hearings on the predator control issues. At the same time, Secretary of the Interior James Watt rescinded former Secretary Andrus' policy statement that banned denning. In January 1982, President Reagan signed Executive Order 12342, which revoked President Nixon's Executive Order 11643 (banning the use of toxicants), as amended.

In an amendment to the 1986 continuing federal budget resolution, the Congress transferred all Animal Damage Control program personnel, equipment, and funding from the Fish and Wildlife Service to the Department of Agriculture. By April 1986, transfer of all personnel and resources had been completed. Specifically, the Animal Damage Control program was placed in the Department's Animal and Plant Health Inspection Service (APHIS).

Also in 1986, the National Animal Damage Control Advisory Committee, comprised of agricultural producers, environmental and animal welfare organizations, and academic institutions, was appointed by the Secretary of Agriculture to provide advice on policies and issues of concern to the Animal Damage Control program. At the end of 1987, the Congress, in Public Law 100-202, authorized the program to conduct control activities of nuisance mammals and birds and those that are reservoirs for zoonotic diseases (i.e., diseases that can be passed to people). In 1991, the Congress authorized the Animal and Plant Health Inspection Service to undertake a

pilot program to control the brown tree snake on Guam. Since 1993 Wildlife Services has conducted a brown tree snake damage management program on Guam, in cooperation with the Department of Defense, the Department of the Interior, and the governments of Guam and Hawaii.

In June 1990, the draft environmental impact statement (EIS) for the Animal Damage Control program was released for public comment. The supplement to the draft EIS, which contained revisions, additional information, and analyses developed in response to comments received, was released for public comment in January 1993. Based on comments received, two additional alternatives and more information were included in the April 1994 final EIS, which provided the basis for future direction of the program.

In 1997, the program's name was changed to Wildlife Services. That same year, the program relocated its laboratory headquarters and established the National Wildlife Research Center in Fort Collins, Colorado. In 2000, the Congress amended Wildlife Services' authority under the Act of March 2, 1931 (7 U.S.C. 426). The amendment removed specific language that, according to Wildlife Services officials, reflected outdated program goals and philosophy, such as to ". . . promulgate the best methods of eradication . . . of mountain lions, wolves, coyotes, . . ." and to ". . . conduct campaigns for the destruction . . . of such animals." The revised section of the act now authorizes the Secretary of Agriculture to ". . . conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program. The Secretary shall administer the program in a manner consistent with all of the wildlife services authorities in effect on the day before October 28, 2000."

According to the EIS, the close scrutiny the program has received over the years, together with internal reviews and strategic planning, has resulted in the program's continual evolution. Increasing emphasis has been placed on the development and implementation of a variety of damage control methods, including multiple forms of technical assistance and direct assistance services. Also, the program has sought to increase its staff's professionalism and training, to improve its data systems and its relationships with other wildlife management agencies, and to emphasize research and development of new control methods. In consideration of contemporary societal values, the program seeks an acceptable balance between human interests and wildlife needs.

Appendix III: Program Expenditures, by Source, State, and Activity

This appendix contains details of Wildlife Services' fiscal year 2000 expenditures for its administrative costs, operational activities, and research activities. Wildlife Services' total fiscal year 2000 expenditures were $80.6 million. Of these expenditures, about $42.3 million (including just over half a million specifically earmarked for aquaculture) was funded by Wildlife Services' appropriation; the other $38.3 million was funded by clients (i.e, by cooperative dollars).

Administrative Expenditures

Administrative expenditures totaled about $9.5 million and included a variety of activities such as administrative support, employee development, and Management Information System (MIS) support. Table 3 shows the breakout of administrative expenditures, funded solely with federal dollars.

Table 3: Wildlife Services' Administrative Expenditures, Fiscal Year 2000

Administrative category	Millions of dollars
Department (United States Department of Agriculture) charges	$1.5
Agency (Animal and Plant Health Inspection Service) overhead	3.4
Headquarters support and program investment (e.g., MIS support and employee development)	3.2
Eastern and Western Regional Offices	1.4

Source: Wildlife Services.

Operational Expenditures

In fiscal year 2000, the Wildlife Services program spent almost $60 million on operational activities. Of that amount, about $23 million was from Wildlife Services appropriations; the other $36 million was contributed by cooperators (program clients). Table 4 shows the program's fiscal year 2000 operational expenditures, by state and by source (i.e., Wildlife Services or cooperators).

Table 4: Wildlife Services' Operational Expenditures, by State and Funding Source, Fiscal Year 2000

State	Federal (Wildlife Services) funding	Cooperative funding	Total
Alabama	$204,859	$292,671	$497,530
Alaska	129,796	730,573	860369
Arkansas	252,084	266,441	518,525
Arizona	423,222	434,826	858,048
California	1,458,860	3,389,125	4,847,985
Colorado	746,133	470,306	1,216,439
Connecticut	37,000	5,407	42,407
Delaware	1,684	0	1,684
District of Columbia	102	0	102
Florida/Puerto Rico	205,394	383,355	588,749
Georgia	112,000	149,718	261,718
Hawaii	155,000	1,283,322	1,438,322
Idaho	713,796	613,148	1,326,944
Iowa	23,721	59,593	83,314
Illinois	104,236	536,000	640,236
Indiana	94,158	41,179	135,337
Kansas	49,518	85,793	135,311
Kentucky	158,910	442,310	601,220
Louisiana	352,095	327,535	679,630
Maine	132,133	246,147	378,280
Massachusetts	47,175	93,082	140,257
Maryland	101,233	158,197	259,430
Michigan	95,229	90,374	185,603
Minnesota	201,427	47,554	248,981
Mississippi	845,264	790,859	1,636,123
Missouri	158,753	195,160	353,913
Montana	1,139,067	1,705,032	2,844,099
Nebraska	333,797	315,425	649,222
Nevada	772,618	824,929	1,597,547
New Hampshire	284,672	230,672	515,344
New Jersey	120,653	228,598	349,251
Pennsylvania	61,915	95,646	157,561
New York	383,858	342,521	726,379
New Mexico	1,226,520	1,027,238	2,253,758
North Carolina	180,965	1,124,000	1,304,965
North Dakota	730,996	518,012	1,249,008
Ohio	581,456	7,835	589,291
Oklahoma	746,621	1,679,374	2,425,995
Oregon	918,791	1,197,022	2,115,813
Rhode Island	8,328	17,495	25,823

State	Federal (Wildlife Services) funding	Cooperative funding	Total
South Carolina	173,916	493,577	667,493
South Dakota	325,222	1,135,074	1,460,296
Tennessee	158,910	486,563	645,473
Texas	2,645,488	6,828,214	9,473,702
Utah	948,371	1,115,755	2,064,126
Virginia	166,684	631,478	798,162
Vermont	176,803	47,444	224,247
Washington	531,887	1,340,674	1,872,561
Wisconsin	511,687	1,291,189	1,802,876
West Virginia	281,320	220,658	501,978
Wyoming	946,182	645,977	1,592,159
Guam	115,364	1,751,622	1,866,986
Total	$21,275,873	$36,434,698	$57,710,571

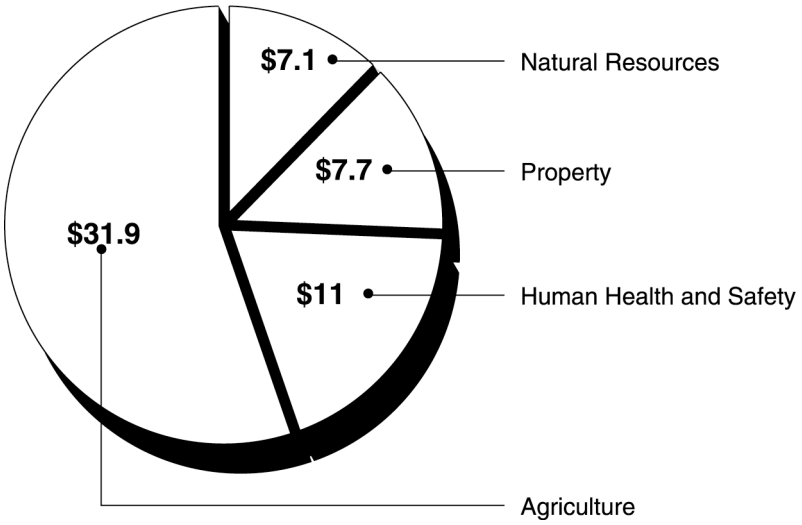
Source: Wildlife Services.

In addition to the $21,275,873 of federal funding allocated specifically for state operations, approximately $2 million of funding managed at the regional level was available for state operations use. According to a Wildlife Services official, the additional amount is managed at the regional office level.

The program spends the majority of its operational funds on activities to protect agriculture; in fiscal year 2000, cooperators contributed about 60 percent of these funds. Figure 4 shows Wildlife Services' fiscal year 2000 operational expenditures, by category (the program's various operational emphases).

Figure 4: Wildlife Services' Operational Expenditures, by Program Category, Fiscal Year 2000

Dollars in millions



Source: Wildlife Services data.

Wildlife Services also tracks subcategories of operational expenditures. Within each program category are several subcategories of expenses. For example, the agriculture category includes expenditures for the protection of livestock, crops, forest/range, and aquaculture. Cooperators provide the majority—over 60 percent in fiscal year 2000—of the funds spent on livestock protection. Table 5 shows the program's fiscal year 2000 agriculture expenditures, by subcategory.

Table 5: Wildlife Services' Operational Expenditures for Agriculture, by Subcategory, Fiscal Year 2000

Agriculture subcategory	Federal and cooperative funding
Livestock	$23,369,093
Crops	4,632,556
Forest/Range	2,887,121
Aquaculture	1,053,743
Total	**$31,942,513**

Source: Wildlife Services.

Research Expenditures

Wildlife Services' expenditures for its research activities totaled $12,226,694 in fiscal year 2000. Wildlife Services covered the majority of these expenditures with $10,357,000; cooperator funding accounted for the remaining $1,869,694.

Appendix IV: Examples of Injurious Wildlife, the Resources They Damage, and Emerging Concerns, by State

Table 6 provides examples, by state, of the wildlife that pose challenges, the resources they damage, and emerging concerns about wildlife damage. For each state, only a few examples are given (of injurious wildlife and the damage they do); many more problems than these exist in each state. The examples do not include the risk to human health and safety posed by birds at airports. This risk is excluded because it exists in every state, and Wildlife Services performs control activities in every state. In some states, though, particularly coastal ones, the risk to human health and safety posed by migratory birds and the risk of their colliding with aircraft is already significant and is growing.

Table 6: Examples of Resources Damaged by Injurious Wildlife, and Related Emerging Concerns, by State

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Alabama	Fish-eating birds (e.g., cormorants, pelicans, herons, egrets)	Catfish ($4 million)	Wildlife diseases pose greater threats to humans, livestock, and pets; populations of fish-eating birds continue to increase; and diminished sport trapping is adding to the increase in beaver populations.
	Beavers	Timber ($19 million), transportation infrastructure	
Alaska	Arctic foxes	Aleutian Canada goose (threatened), nesting seabirds	Increased air travel throughout the state, coupled with immense populations of migratory birds and other wildlife, has created an urgent need for state and federal management of wildlife threats. Also, farmers and ranchers need assistance with damage from birds and predators.
Arizona	Coyotes, black bears, mountain lions	Livestock	Increased human populations and increased recreational use of public lands emphasize the need to deal with risks of wildlife disease transmission.
	Blackbirds	Dairy cattle, feedlot cattle (disease risk from contaminated feed and water)	
Arkansas	Blackbirds	Rice crops ($3.5 million)	The growing rice and aquaculture industries require additional protection from the increasing populations of fish-eating birds.
	Fish-eating birds	Catfish ($2.3 million)	
California	Coyotes, black bears, mountain lions	Livestock (nearly $2 million)	Increased airline traffic and population growth of many bird species has created a greater need for wildlife control at airports; the recent surge in the number of direct attacks on humans creates an increased need to protect humans from large predators such as coyotes, black bears, and mountain lions.
	Birds, rodents	Row crops, fruit and nut crops, vineyards	
	Feral cats, red foxes, raccoons, coyotes, striped skunks, raptors	Threatened or endangered species (e.g., California red-legged frog, salt marsh harvest mouse, Sierra Nevada big horn sheep, Monterey Bay western snowy plover)	

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Colorado	Coyotes	Sheep and lambs ($1.5 million), black-footed ferrets (endangered)	Human population growth, especially in rural and semi-rural areas, creates an increased potential for human-wildlife conflicts.
Connecticut	Starlings, blackbirds	Dairy cattle (salmonella risk from contaminated feed and water)	Preventing wildlife-borne diseases from affecting humans and livestock has become a growing concern with the recent outbreaks of rabies, West Nile virus, salmonella, and E. coli; increased air travel and growing bird populations also call for increased wildlife control at airports.
	Canada geese, blackbirds, mute swans	Vegetable crops, cranberries	
	Birds, bats, squirrels, monk parakeets, ospreys	Buildings, landscaping, utilities	
Delaware	Snow geese	Coastal salt marsh habitat	West Nile virus is a major health concern. In fiscal year 2000, Delaware reported that four horses tested positive for the virus. Growth in air travel, coupled with growth in deer and bird populations, has created a greater need for wildlife control at airports.
	Canada geese	Grain crops, golf courses ($75,000)	
Florida	Raccoons, red foxes, coyotes, feral hogs, ghost crabs, armadillos	Threatened or endangered sea turtles (e.g., leatherback, hawksbill, loggerhead turtles)	Wildlife continue to threaten the safety of air travelers at many airports, but resource constraints have prevented Wildlife Services from resolving the hazards; livestock producers suffer losses from coyote and vulture predation, and direct assistance from Wildlife Services, rather than advice, would help reduce these losses.
	Foxes, coyotes, black rats, skunks, raccoons, snakes, armadillos, dogs	Endangered beach mice (e.g., Perdido Key, Anastasia Island, Choctawhatchee beach mice)	
	Red foxes, rats, coyotes, raccoons, feral cats	Threatened or endangered birds (e.g., roseate tern, least tern, Puerto Rican parrot)	
	Beavers	Flooded timber lands, croplands, roadways ($620,000)	
Georgia	Armadillos, raccoons, coyotes	Ground-nesting birds (e.g., bobwhite quail)	Increased habitat loss, human population growth, and the adaptability of many wildlife species to human environments increase the need for professional resolution of wildlife problems. Of concern are deer, geese, beavers, vultures, cormorants, pigeons, feral hogs, and raccoons.
	Beavers	Landscapes, pastures, timber, sanitation lines, culverts, highways, wells ($152,000)	
	Resident Canada geese, white-tailed deer	Crops, property, neighborhood landscapes and gardens	
Hawaii	Feral goats, sheep, pigs, deer	Endangered waterbirds, plants	The state is concerned about the time and expense involved in complying with the National Environmental Policy Act (conducting environmental analyses of Wildlife Services' actions performed for nonfederal cooperators), and the associated administrative requirements.
	Tree frogs	Horticulture, parrots, Axis deer	
	Rats	Agricultural products, native plants, seabirds, turtles	

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Idaho	Coyotes, black bears, mountain lions, wolves, red foxes	Sheep, lambs ($1.5 million)	Efforts to control crop damage by the sandhill crane have been limited by the lack of resources. Populations of ravens and red foxes have increased, to the detriment of the sage grouse.
	Ravens, coyotes, badgers, red foxes	Sage grouse, endangered northern Idaho ground squirrels	
Illinois	Canada geese, white-tailed deer	Private and municipal property	Bird predation at fish production facilities—an emerging agricultural industry in Illinois—is a concern, as is the transmission of wildlife-borne diseases such as West Nile virus.
	European starlings	Private and industrial property, risk of disease (histoplasmosis)	
Indiana	Canada geese	Private and industrial property ($169,000 in property damage reported in fiscal year 2000)	Over 12,000 people used Indiana's toll-free wildlife conflicts hotline during its first 2 years of service, preventing an estimated $100,000 in wildlife damage; now an additional person is needed to respond to calls.
	Starlings	Property damage (e.g., buildings and equipment), risk of disease (histoplasmosis)	
Iowa	Coyotes	Sheep, cattle, hogs ($20,000 in confirmed losses to coyotes)	Requests for assistance continue to increase, especially in regard to livestock predators (especially coyotes) and beavers.
	Beavers	Roads, crops, bridges	
Kansas	Blackbirds (grackles, starlings, cowbirds)	Livestock feed (more than $660,000 in damage at three feedlots during a recent winter)	Wildlife Services' success in addressing blackbird problems at feedlots has fueled demand for similar services statewide.
Kentucky	Starlings, Canada geese	Agriculture, residential and industrial property, aquaculture, golf courses, parks, utility structures	Increased urbanization and expansion into formerly rural areas, coupled with escalating wildlife populations, have led to a rise in wildlife-human conflicts.
Louisiana	Blackbirds, cowbirds, egrets, cormorants, white pelicans, herons	Sprouting rice ($5 million to $10 million a year in damage), strawberries, pecans, crawfish, catfish	Increased damage by birds is becoming more difficult to control, despite the more than $17 million spent annually by aquaculture facilities throughout the state. Beavers are another source of increasing wildlife damage in the state.
	Beavers	Threatened Louisiana pearlshell (a mussel), timber, roadways, bridges, public utilities. Nearly $5 million in beaver-caused losses was reported between 1998 and 2000.	
Maine	Birds, deer, moose, raccoons, skunks, black bears	Blueberries, strawberries, vegetable crops, beehives, campsites, summer homes, fences	Increasing predation from a rising cormorant population is harming the commercial, pen-raised Atlantic salmon industry and is thought to be the primary cause of the dwindling wild Atlantic salmon population.
	Beavers	Commercial timberlands, municipal roads, highways	
Maryland	Canada geese, vultures	Crops, waterfront properties	The state has an increased need to protect humans, their pets, and livestock from wildlife-borne diseases. Rabies and West Nile virus are two major health concerns on the East Coast.

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Massachusetts	Canada geese, blackbirds	Cranberries, vegetables, dairy feed	Preventing the spread of wildlife-borne diseases to humans and livestock is a growing concern, given the recent outbreaks of rabies, West Nile virus, salmonella, Giardia, and E. coli.
	Eider ducks, swans, cormorants, gulls	Trout hatcheries, shellfish	
Michigan	Starlings	Dairies, feedlots	Wolf populations will likely increase and expand from the Upper to the Lower Peninsula, causing increased demand for prompt and professional response in wolf management services. Also, demand for help in reducing damage by congregating starlings has grown significantly.
	Gray wolves (endangered)	Livestock	
	Deer	Bovine tuberculosis in cattle (projected impact to the state's producers is $121 million over 10 years)	
Minnesota	Gray wolves	Cattle, horses, sheep, poultry, dogs	As the wolf population continues to expand, the need for Wildlife Services' professional assistance is expected to increase. Nuisance bear complaints are also increasing.
	Beavers	Private property, roads, timber, fish habitat	
Mississippi	Double-crested cormorants, American white pelicans	Aquaculture (about $5 million)	Feral hogs are causing more crop damage and posing a disease threat (pseudorabies) for the domestic hog industry. Canada geese and black bears are becoming a growing concern for property owners.
	Beavers	Roads, bridges, drainage structures, agricultural fields, private property, timber (several million dollars a year in damage)	
	Black bears	Beehives, crops, private property	
Missouri	Beavers, muskrats	Crops, roads, levees	The state's resident Canada goose population has quadrupled since 1993, causing increased damage; the feral hog population is also increasing, and the state needs Wildlife Services' help with this problem.
	Blackbirds, herons	Rice crops, aquaculture	
	Canada geese	Crops, lawns, golf courses (more than $122,000 in turf and crop damage in fiscal year 2000)	
Montana	Grizzly bears, Rocky Mountain gray wolves (threatened or endangered)	Livestock (predators caused a $1.1 million loss to state's sheep industry in 2000)	With the successful reintroduction and recovery of Rocky Mountain gray wolves in nearby states, Montana Wildlife Services expects a growing demand for its expertise in handling wolf-related livestock predation issues.
Nebraska	Coyotes, foxes, mountain lions, bobcats	Livestock	Areas requiring increased attention include wildlife management at airports, livestock predation, and public protection from wildlife-borne diseases. Increased public awareness of Wildlife Services' professional role in these issues has increased the demand for its services.
	Prairie dogs	Rangeland	
	Blackbirds	Feedlots	

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Nevada	Rodents	Public health risk of sylvatic plague (wild form of bubonic plague)	Aviation safety is a growing concern. Population growth and city development around Nevada's major airports has created an ideal habitat for migratory birds such as Canada geese, mallard ducks, and American coots.
	Coyotes, mountain lions	Livestock; humans and pets in urban areas	
New Hampshire	Black bears	Apiaries, row crops, livestock	Controlling the spread of West Nile virus is an emerging concern, along with rabies, Lyme disease, salmonella, and chronic wasting disease. Also, the 10-year trend of increasing conflicts associated with bears and bird feeding activities needs to be addressed.
	Deer	Apples, fruit crops, ornamental shrubbery	
	Woodchucks	Earthen dams and levees, wild lupine (essential to the endangered Karner blue butterfly)	
	Gulls	Roseate and common tern recolonization efforts	
New Jersey	Canada geese	Human health effects of goose feces, human safety threats from aggressive geese, crops, turf	The state's large population of resident Canada geese will pose increasing challenges for the protection of human health and safety, as well as property, at schools, hospitals, airports, and urban and suburban areas. The spread of West Nile virus is another concern.
	Deer, blackbirds	Crops, fruit trees, vegetables	
	Red foxes, raccoons, opossums	Threatened and endangered shorebirds (e.g., piping plovers, least terns, black skimmers)	
New Mexico	Coyotes, cougars, bobcats, black bears	Livestock (losses in excess of $1.6 million in 1999)	Coyotes are becoming an increasing problem in urban and suburban areas, killing pets and other domestic animals and posing safety risks to humans. Wildlife Services' assistance will be needed to resolve conflicts between humans and the black-tailed prairie dog, a candidate threatened species.
	Prairie dogs, pocket gophers, ground squirrels	Agricultural crops, pasture land, turf, human health and safety (nearly $500,000 in rodent damage in fiscal year 2000)	
	Sandhill cranes, snow geese	Crops (e.g., alfalfa, chile, wheat)	
New York	Cormorants, gulls	Catfish, bait fish, crawfish, sport fish	Bat and raccoon rabies remain a health concern, and urban winter crow roosts are emerging as a unique problem to city residents, resulting in conflicts over droppings, noise, odor, and fear associated with zoonotic disease.
	Canada geese	Property, crops	
North Carolina	Beavers	Timber, crops, roads, drainage systems, landscapes. In fiscal year 2000, Wildlife Services prevented about $8.5 million in damage to such resources: nearly $9 saved for every $1 spent.	Threats to public safety, not only by wildlife at airports, but also by the rapidly growing beaver population, must be addressed. A rabid beaver's recent attack on a human has increased public awareness of this issue.

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
North Dakota/ South Dakota	Coyotes, foxes	Cattle, sheep, poultry	More work at airports is needed, and concerns over the threat of rabies transferring from skunks to humans or domestic animals continues to be a concern.
	Blackbirds	Sunflowers and other grain crops (over $5 million in losses annually in the upper Great Plains), feedlots	
	Canada geese and other waterfowl	Grain crops (damage increased by 80 percent in 2000, resulting in $162,000 in losses)	
Ohio	Coyotes, vultures	Cattle, sheep, poultry	Increasing populations of gulls, vultures, and starlings are causing significant human health and safety issues and crop and property damage.
	Raccoons	Human health and safety	
	Rooftop nesting gulls	Property	
	Blackbirds, Canada geese	Crops, property	
Oklahoma	Beavers	Dams, timber, crops, roads, private property	Feral hogs cause many problems (livestock predation, crop destruction); Canada geese are growing in number and are damaging crops.
	Coyotes	Cattle, sheep, goats, poultry	
	Canada geese	Crops (especially winter wheat)	
Oregon	Canada geese	Turf grass seed, other crops	Successful wolf reintroduction in Idaho means future wolf conflicts with livestock in Oregon. Wolves will hamper present predator control efforts because control tools and methods will be restricted around wolves.
	Cougars	Human safety (Wildlife Services addressed 386 cougar complaints in 2000; 118 involved threats to humans)	
	Black bears, beavers	Timber	
Pennsylvania	Deer	Human safety (automobile collisions)	The state's large population of resident Canada geese will pose increasing challenges over time, as will increasing populations of deer, vultures, and gulls. Emerging public health issues (e.g., West Nile virus) will also be a challenge.
	Canada geese	Landscape, crops (program annually assists over 300 residents with goose-related problems)	
	Starlings	Livestock facilities	
Rhode Island	Canada geese, gulls, crows, turkey vultures	Property, turf, vegetable crops	The needs of some citizens are currently unmet. Increasingly, the program is able to respond to requests for assistance only from entities that can fully fund it. Preventing wildlife-borne diseases is a growing concern.
	Mute swans	Pond water quality	
	Monk parakeets, ospreys	Landscaping, utilities	
South Carolina	Beavers	Timber, crops, roads, levees, dams	The demand for beaver management has overwhelmed the program, yet some counties cannot afford to share the costs. At the same time, the vulture population and related complaints have increased.
	White-tailed deer	Landscaping, human safety (automobile collisions), human health (tick-borne diseases)	

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
Tennessee	Canada geese	Turf (at golf courses, parks, etc.)	The growing number and variety of wildlife-human conflicts pose a challenge to the program, especially in terms of wildlife control at airports and urban damage by large birds.
	Beavers	Roads, bridges, timber, wildlife management areas	
	Vultures	Municipal utility structures, residential property	
Texas	Coyotes, foxes	Human health (rabies)	The feral hog population in the state exceeds 1 million. Hogs damage many crops (e.g., corn, rice, peanuts, hay), and they prey on lambs, kids, fawns, and ground nesting birds. Also, damage by migratory birds (e.g., cattle egrets, vultures, cormorants) has increased, taxing the program's response abilities.
	Coyotes	Sheep and goats	
	Beavers	Dams, dikes, railroad track beds, timber, roads, pastures, crops	
	Blackbirds	Citrus crops, rice, feedlot operations	
	Feral hogs	Agricultural crops, livestock	
Utah	Coyotes, mountain lions, black bears	Sheep and lambs (nearly $2 million in losses in 1999, even with controls in place), endangered black-footed ferrets, sage grouse, mule deer fawns	Demands for wildlife damage management are increasing, yet the program already has more requests than it can address. Protection of native wildlife continues to be of importance.
	Skunks, raccoons, feral and urban waterfowl, pigeons	Human health and safety (threat of rabies, raccoon roundworm, salmonella, plague)	
Vermont	Raccoons	Human health (rabies), threatened Eastern spiney softshell turtle	Wildlife diseases like West Nile virus, Lyme disease, salmonella, and chronic wasting syndrome continue to emerge and need to be addressed.
	Starlings	Cattle feed at dairies	
Virginia	Coyotes, black vultures	Livestock	Challenges include finding a way to provide damage management services to low- and middle-income people and protecting Virginia's rare natural resources (e.g., the threatened piping plover and Wilson's plover).
	Beavers	Roads, railroads	
	Canada geese, crows, vultures, starlings, muskrats	Urban and suburban property, water quality, human health and safety. (Canada geese are involved in 26 percent of all requests for program assistance in Virginia.)	
Washington	Northern pikeminnows, gulls	Threatened and endangered salmon and steelhead	Increasing problems are caused by urban Canada geese and by predators (damage to livestock, agriculture, and forestry resources), but program resources are already strained.
	Starlings, feral pigeons, Canada geese, gulls	Bridges, buildings (bird feces are corrosive to paint and metal), fruit crops, public and private property, human health (over $6 million a year in damage to the fruit industry)	
	Coyotes	Livestock, endangered Columbian white-tailed deer, pygmy rabbits	

State	Injurious wildlife	Resource damaged (annual damage estimate, if available)	Emerging concerns
West Virginia	Coyotes, vultures	Sheep, cattle, goats	With its limited resources, the program concentrates on the highest priorities (human health and safety). As a result, though, program staff cannot make much-needed on-site evaluations of wildlife damage to property; rather, they make recommendations based on telephone interviews. Also, problems caused by starlings and roosting birds need attention.
	Raccoons	Human health (rabies)	
	Muskrats, beavers	Levees and dams	
Wisconsin	Deer	Crops (over $1 million a year in damage)	The endangered gray wolf population has grown from 34 wolves in 1990 to about 250 in 2000, and the wolf's recovery is considered a success. But problems, such as depredation on livestock and pets, have come with the wolf's recovery. Also problematic is the damage done by the burgeoning population of resident Canada geese, which now numbers over 70,000.
	Black bears	Crops, property, human safety	
	Beavers	Trout streams	
	Gray wolves	Livestock, pets	
	Canada geese	Municipal and private property	
Wyoming	Coyotes, black bears, red foxes, mountain lions, grizzly bears, wolves	Livestock (losses of over $5.6 million to predators in 2000)	As wolf and grizzly bear populations expand, new or different control methods will be needed to prevent unnecessary conflicts with them. Also, skunk rabies seems to be spreading westward across the state, and a program is needed to contain it.
	Skunks	Human health (rabies risk)	
	Coyotes	Black-footed ferrets	
Guam	Brown tree snakes	Power transmission lines, poultry and small animals, endangered species (e.g., Vanikoro swiftlets, Mariana crows, Guam fruit bats, Guam rails, Micronesian kingfishers), human health and safety	The magnitude and complexity of the work to control the brown tree snake pose significant challenges, and the administrative burden is increasing.
U.S. Virgin Islands	Black rats	Endangered sea turtles, migratory birds, native vegetation	Invasive species' impacts on native plants and animals is a major and growing problem.
	Roosting birds	Human health concerns	

Source: Wildlife Services.

Appendix V: Examples of Wildlife-Aircraft Strikes

Through an interagency agreement with the Federal Aviation Administration (FAA), Wildlife Services maintains a database of all reported wildlife strikes to U.S. civil aircraft and to foreign carriers that experience strikes within the United States. The database contains about 34,000 strike reports from 1,100 airports for the period 1990 through 2000. In 2000 alone, about 6,000 strikes were reported. Wildlife Services estimates, however, that the number of strikes reported represents only about 20 percent of those that have occurred.

The following examples from the database show the serious effects that strikes by birds or other wildlife can have on aircraft. The examples are not intended to highlight or criticize individual airports; strikes have occurred at or near almost every airport in the United States. For more information on wildlife strikes, visit www.birdstrike.org.

- In January 1990, a Hawker Siddeley aircraft struck several white-tailed deer during takeoff from John Tune Airport in Tennessee. One deer was completely ingested by the left engine. The impact tore the engine loose, and the aircraft had to be replaced at a cost of $1.4 million.

- In November 1990, a Bae-3200 ingested doves in both engines during takeoff from Michiana Regional Airport in Indiana. The engines were destroyed, and the aircraft was out of service for 60 hours. The repair cost was about $1 million.

- In November 1991, a DC-10's number 1 engine ingested one or more American crows during takeoff from Chicago O'Hare International Airport. Parts of the engine came out the side and damaged the number 2 engine. The aircraft made a precautionary landing.

- In December 1991, a Citation 550's number 1 engine ingested one or two turkey vultures during takeoff from Angelina County Airport in Texas. The engine experienced an uncontained failure, a fire, and vibrations that caused a 100-percent loss of thrust, causing the takeoff to be aborted. The wing and fuselage received damage from engine shrapnel. The aircraft was out of service for 2 weeks, at a repair cost of $552,500.

- In February 1992, a Piper 28 was just about to touch down on the runway at Sandstone Airport in Minnesota when a deer ran toward the aircraft and collided with it. The pilot added power and aborted the landing, but lost power during the climb and crashed into trees and then into the ground about a quarter-mile from the airport. The pilot was seriously injured; the aircraft was destroyed.

- In October 1992, a Boeing 747 struck numerous herring gulls during takeoff from John F. Kennedy International Airport in New York. A gull was ingested by an engine, bending four fan blades and causing the aircraft to make a precautionary landing. The passengers departed on another aircraft the next day. The reported cost—of hotel, lost revenue, and repairs—was $750,000.

- In October 1993, a Boeing 757 struck about 35 cattle egrets on takeoff from Orlando International Airport. Takeoff was aborted. Three tires on the right side blew out, and the aircraft was towed to the gate. The ingestion of 10 to 12 birds damaged engine fan blades and the engine cowl.

- In December 1993, a Cessna 550 struck a flock of geese on its climbout from DuPage Airport in Illinois. A loud bang occurred, followed by unstable flight. The number 2 engine lost power, and the aircraft experienced a substantial fuel leak on the left side. The pilot made a safe emergency landing at Midway Airport. Both engines had to be replaced. The aircraft was out of service for 90 days; the cost of repairs was $800,000.

- In May 1994, a Bell BHT-47 helicopter crashed into the backyard of a residence in Oklahoma, resulting in two fatalities. The pilot of another helicopter, which had been traveling ahead of the one that crashed, said he had warned the other pilot about a flock of birds which he himself had avoided by banking sharply. The probable cause of the crash, according to the National Transportation Safety Board, was the pilot's loss of control when he maneuvered abruptly to avoid colliding with the flock of birds.

- In July 1994, a Cessna 172 was seen flying about 200 feet above the water along a beach in Florida. A pelican collided with the windshield; the aircraft rolled upside down and hit the water. The pilot was fatally injured.

- In June 1995, a Concorde ingested a Canada goose into the number 3 engine upon landing at John F. Kennedy International Airport. The engine suffered an uncontained failure, causing parts to go into the number 4 engine. Both engines were destroyed. The aircraft was out of service for 5 days; repair costs were over $9 million. In an out-of-court settlement 3 years later, the Port Authority of New York and New Jersey paid Air France $5.3 million in compensation for losses.

- In December 1995, on approach to John F. Kennedy International Airport, a Boeing 747 broke through a cloudbank and struck a flock of snow geese,

which sounded like sandbags hitting the aircraft. The impact destroyed one engine, damaged several fan blades on another, and extensively damaged the airframe. The repairs cost about $6 million.

- In July 1996, a Boeing 737 ingested an American kestrel into the left engine upon takeoff from Nashville International Airport, resulting in a compressor stall and an aborted takeoff. The aircraft overran the runway, and the passengers were evacuated. One passenger was seriously injured; four others received minor injuries.

- In October 1996, a Boeing 727 struck a flock of gulls just after takeoff from Washington National Airport. An engine ingested at least one bird, began to vibrate, and was shut down. A burning smell entered the cockpit, and an emergency was declared. The aircraft, carrying Housing and Urban Development Secretary Henry Cisneros and 52 other passengers, returned to the airport and made a safe precautionary landing. Engine blades were damaged.

- In January 1997, a McDonnell Douglas 80 struck over 400 blackbirds just after takeoff from Dallas-Fort Worth Airport. Nearly every part of the plane was hit. The pilot declared an emergency and returned to land uneventfully. The number 1 engine had to be replaced, and damage to the plane was substantial. The cost of repairs was about $219,000.

- In August 1997, a Boeing 737 struck 12 to 15 mallards after takeoff from Portland International Airport in Oregon. The pilot returned to the airport and landed safely. The radome and all engine fan blades had to be replaced, at a cost of over $100,000.

- In May 1998, a Boeing 727 struck several Canada geese after takeoff from Colorado Springs Metro Airport. The crew felt moderate to severe vibration after the aircraft ingested one or more birds. The aircraft lost essential electrical power, which was restored by a generator. The number 3 engine suffered an uncontained failure. Shrapnel was ejected through the engine case, severing electrical wires and puncturing the anti-ice bleed air duct. The radome, upper engine cowling, and thrust reverser were also damaged. The aircraft was out of service for 98 hours; the repair cost was $1.4 million.

- In November 1998, a Boeing 737 struck a buck deer on the runway when taking off from Western Nebraska Regional Airport. The pilot proceeded with the takeoff, but then returned to land. An engine suffered major damage. The flight was canceled; the passengers and crew were rerouted

the next day. Total cost was $430,000 for repairs, lost revenue, meals and hotel rooms, and other transportation for passengers.

- In February 1999, a Boeing 757 encountered a flock of European starlings upon takeoff from Cincinnati/Northern Kentucky International Airport. The first officer tried to climb over the birds but struck several hundred of them. Both engines ingested birds and were damaged; the repair cost was about $500,000. More than 400 dead starlings were picked up from the runway area following the strike.

- In December 1999, a Boeing 747 encountered a red-tailed hawk upon takeoff from Toledo Express Airport in Ohio. The hawk struck the nose bullet, which shattered and entered the engine. A witness called the sheriff and reported hearing a large boom and seeing one of the engines on fire as the aircraft took off. The pilot dumped fuel and returned to the airport to land. Pieces of fan blades tore large holes in the nose cowling. Time out of service was 84 hours; cost of repairs was $1.3 million.

- In March 2000, a Boeing 767 ingested a flock of Bonaparte's gulls after takeoff from Dulles International Airport. The pilot returned to the airport and made a precautionary landing. Fan blades were damaged; the repair cost was $65,000.

- In August 2000, a Boeing 747 flew through a flock of about 30 Canada geese and ingested 1 or 2 in the number 1 engine after taking off from Philadelphia International Airport. The high-speed aborted takeoff resulted in nine flat tires; the aircraft was towed to the ramp. The engine was a total loss, and the aircraft was out of service for 72 hours. The cost was $3 million.

Appendix VI: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

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