Overview of USDA Animal Damage Control efforts to manage overabundant deer

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Because wildlife is a valuable, publicly owned resource, federal and state governments are responsible for maintaining healthy, stable wildlife populations. When wildlife causes damage, government agencies have an obligation to control that damage on behalf of the public. Responsibility for wildlife damage management at the federal level has been legislatively delegated to the Animal Damage Control (ADC) program. Our paper discusses the role of the ADC program in deer (*Odocoileus* spp.) management and highlights recent projects that have reduced deer damage to crops and deer-related human health concerns. We also describe past and ongoing research and development activities conducted to improve deer management techniques.

The ADC program

The ADC program works to alleviate wildlife damage to natural resources in agricultural, urban, and natural environments, and to reduce wildlife-related threats to public health and safety. As a part of the Animal and Plant Health Inspection Service (APHIS), of the U.S. Department of Agriculture (USDA), ADC receives federal funds to conduct its work; however, cost-sharing is an integral part of its program. When other federal or state agencies, counties, or private organizations request assistance from ADC, they frequently contribute funds as cooperators. In some states, specific ADC activities are completely funded by cooperators.

Most ADC work is conducted on private lands, but ADC also manages wildlife damage problems on public lands, particularly those under the responsibility of USDA's Forest Service and the U.S. Department of the Interior's (USDI) Bureau of Land Management. Wildlife damage management also is conducted on lands managed by USDI's Fish and Wildlife Service; the Departments of Defense and Energy; Native American tribal lands; and parklands managed by local, state, or federal agencies. The ADC works on public lands only when asked and authorized by the responsible land-management agency. During these projects, personnel adhere to guidelines and laws such as the National Environmental Policy Act (NEPA) to ensure that management efforts pose no significant risks to the environment, overall wildlife populations, or public safety.

The ADC role in deer management

White-tailed deer (*O. virginianus*) populations in the United States have increased tremendously during this century, rising from between 350,000 and 500,000 in the early 1900s (McCabe and McCabe 1994) to about 24 million today (Wright 1996). Deer are an important wildlife resource and are highly valued by the public. State wildlife agencies attribute millions of dollars in revenues per year to deer through both consumptive and nonconsumptive uses. However, deer also can cause extensive economic damage and pose serious threats to public health and safety.

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The ability of ADC to provide assistance with deer conflicts is limited—states have regulatory authority over resident game species. However, ADC provides assistance upon request by state wildlife agencies. To address requests for assistance with deer damage problems, ADC cooperates with state wildlife agencies through cooperative agreements and memoranda of understanding.

Protection of public health and safety

As deer populations have increased, public safety concerns also have grown. In a review of wildlife damage, Conover et al. (1995) estimated that >1 million deer–vehicle collisions occurred annually in the United States, causing >$1.1 billion in damage. The authors also estimated that an average of 29,000 human injuries and 200 human fatalities occurred annually as a result of these collisions.

Collisions between aircraft and wildlife threaten human safety and cause about $153 million in damage each year to civilian aircraft in the United States (Cleary et al. 1996). Aircraft "down-time" is estimated at 374,000 hours per year. Airports in the eastern and southeastern United States experience the greatest number of wildlife–aircraft collisions, but the problem exists nationwide. Most of these problems involve birds, but an increasing number involve deer. Reports to the Federal Aviation Administration (FAA) indicate that between 1983 and 1996 there were 245 deer–aircraft strikes, resulting in estimated damage to aircraft of >$16.4 million (Wright 1996). Only 12% of the deer strikes reported provided estimates of the costs of repairs; therefore, actual costs could be much higher.

When airports experience wildlife conflicts, the FAA encourages airport officials to contact ADC for assistance. Wildlife biologists from ADC offer technical and direct operational assistance to airport managers on techniques to keep runways clear of deer, thereby reducing potential collisions between deer and aircraft. Biologists are available to conduct on-site evaluations of wildlife problems at the airport and may recommend the use of noise-making devices, such as cracker shells and propane cannons. In addition, guidance is provided on how to modify habitat to make the airport unattractive to deer, such as installing deer-resistant fences, modifying or removing overgrown vegetation and trees, and trapping and relocating deer. If these techniques fail, ADC personnel may request that the state wildlife agency issue a permit to remove a limited number of deer from the airport.

There are numerous examples of how ADC cooperates with other agencies to manage deer at airports. In California, officials at both the Monterey Peninsula Airport and Arcata Airport requested assistance from ADC on resolution of black-tailed deer (*O. hemionus columbianus*) problems. At the Monterey Peninsula airport, deer had been loitering on the runways, resulting in a potential threat to aircraft, and at the Arcata Airport, a deer had been struck by a single-engine airplane as the plane was landing. In both situations, ADC provided technical assistance on exclusion of deer from the property, and also removed 9 deer from the airports by shooting, under permits from the California Department of Fish and Game.

In Oklahoma, after a near miss and several sightings involving white-tailed deer near runways, officials at the Will Rogers World Airport requested assistance from ADC to remove deer on airport property after completion of a deer-proof perimeter fence. Personnel from ADC removed 21 deer by shooting, and at the request of the Oklahoma Department of Conservation, the deer were donated to the Sportsman Against Hunger project.

At the Minot International Airport in North Dakota, airport officials requested assistance after noise-making devices used by airport personnel failed to keep deer off the runway. Because of the immediate threat to public safety, the North Dakota Game and Fish Department gave the airport permission to remove deer by shooting, but only on the condition that ADC conduct the removal. Between April and July 1996, 11 white-tailed deer were removed. Recommendations were then provided for construction of a deer-proof fence now underway at the airport as a long-term solution to the problem.

An intensive deer control project was recently completed at O'Hare International Airport. The project began in November 1995 and was the result of a deer–aircraft strike that occurred in 1994. Deer have historically been found on airport property, and Illinois Department of Natural Resources personnel have assisted ADC with periodic removal of deer. However, a minimum number of deer were always maintained on the property. After the deer–aircraft strike and several other near misses, ADC personnel were requested to remove all deer from airport property. Prior to initiating a population eradication program, ADC recommended that the perimeter fence around the 3,520-ha airport be raised from 1.8 m to 3.7 m high. While the perimeter fencing was being raised, 97 deer were removed from the airport property, thus eliminating the deer threat to aircraft and human safety.

Dulles International Airport had 3 deer-aircraft strikes in 1993, after which Dulles was required to compensate the airlines for $6 million in repairs. Additionally, the FAA required Dulles to conduct an ecological study of wildlife hazards. In 1994, Dulles contracted with the ADC program to conduct the ecological study. A deer management program was developed that included ongoing health checks of the deer herd; spotlight surveys to measure deer abundance and identify areas frequently used by deer; deer-control programs; and use of fencing, exclusion devices, and cattle-guards. Only 1 deer strike has occurred in the 3 years since the program began, deer health has improved, and deer density has decreased on the airport.

Protection of agricultural crops, nurseries, landscaping plants, and forestry products

Deer feed on crops, vegetables, fruit trees, nursery stock, stacked hay, ornamental plants and trees, and forestry seedlings. According to a 1989 survey conducted by USDA's National Agricultural Statistics Service (NASS), nearly half of all field crop producers suffered losses to wildlife (Wywialowski 1994); damage was estimated at $237 million. Deer caused more damage than any other wildlife species in the northeastern and northcentral United States, with >41% of producers citing losses; deer also were rated the number one wildlife problem species by farm bureaus, state agencies, and extension agents (Conover and Decker 1991). A follow-up 1994 survey conducted by NASS showed that estimated losses had increased to about $316 million, with deer again cited as the primary species responsible for the damage (U.S. Dep. Agric. 1994). In the 10 largest corn-producing states in 1993, deer caused >$30 million damage to corn alone (U.S. Dep. Agric. 1993, Wywialowski 1996). A 1990 Cornell University report found that 32% of homeowners in southeastern New York and 17% in the western part of the state experienced deer damage to ornamental plants (Sayre and Decker 1990).

Landowners and agencies frequently require advice on techniques for dealing with deer problems, such as removal of supplemental food sources, use of scare devices and repellents, and construction of fences. The following are typical examples of ADC program involvement in deer management. In Wisconsin, ADC personnel are involved in a deer removal program on a farm that has received severe agricultural damage during the past several years. The Wisconsin Wildlife Damage Abatement and Claims Program provides fencing materials at no cost to farmers in areas where wildlife damage is excessive if the farmers agree to construct and maintain the fence. Although the farmer in this case constructed a 1.8-m high, 9-strand electric fence, he still suffered >$5,000 crop damage annually from deer. Personnel from ADC, at the request of the Wisconsin Department of Natural Resources, removed 21 white-tailed deer from inside the fenced area over a period of 11 nights, thereby resolving the problem.

In Maine, ADC works cooperatively with the Maine Department of Inland Fisheries and Wildlife to provide electric fencing to producers experiencing deer damage to vegetable crops. Fencing is provided on a trial loan basis for 1 year to give the producers an opportunity to evaluate its effectiveness. After the first year, the fencing is made available through a rental agreement that pays normal repairs and replacement costs. After 5 years of paid rental, the producers own the fencing.

Xerox Corporation owns about 850 ha in Virginia where hunting has been prohibited since the 1970s. As deer populations have grown, they have consumed ornamental vegetation; caused deer-vehicle collisions; and altered natural vegetation by removing most saplings, forbs, and shrubbery. The ADC program has developed a deer management plan and environmental assessment, and has conducted a herd health check in cooperation with the Virginia Department of Game and Inland Fisheries.

For several years, ADC has cooperated with the U.S. Fish and Wildlife Service and The Nature Conservancy to protect the habitat of the endangered Karner blue butterfly (*Plebejus melissa samuelis*) from woodchuck (*Marmota monax*) and deer feeding. The Karner blue butterfly is dependent on wild lupine (*Lupinus perennis*), which only grows on a small, isolated site in New Hampshire. Past efforts have centered on controlling woodchucks to prevent browsing on lupine, but current efforts also focus on installation of fencing to prevent deer damage.

NWRC research projects

There is growing support for developing additional nonlethal methods for resolving problems caused by deer in the United States. The National Wildlife Research Center (NWRC), as the research arm of the ADC program, is conducting research to develop exclusion devices, repellents, contraceptive agents, and other methods for preventing deer damage to vehicles, aircraft, ornamentals, agricultural crops, and forest seedlings.

Researchers at NWRC have studied a number of nonlethal methods for reducing damage to seedlings inflicted by deer in the western United States. Past studies have shown that exclusion techniques such as plastic mesh tubes (e.g., Vexar®, DuPont Canada, Whitby, Ontario, Can.), placed around seedlings at planting, provide substantial protection while allowing good seedling growth (Campbell et al. 1988). Researchers also have recommended habitat manipulation to provide alternate forage for deer (Campbell 1987).

Repellents have been tested widely on deer to prevent browsing. Deer Away® big game repellent (Int-Agra, Inc., Minneapolis, Minn.) and other sulfur-containing materials have been shown to repel white-tailed deer (Milunas et al. 1994). However, Deer Away may soon be unavailable, if registrations with the Environmental Protection Agency are canceled. Recently tested, promising, alternatives to deter deer browsing on pine seedlings include Deer Stopper (Messina, Long Valley, N.J.) and Plantskydd™ (Tree World, Sechett, British Columbia, Can.; Nolte 1997). Lime also may have potential as a feeding repellent in agricultural situations (Belant et al. 1997).

The effectiveness of exclusion and frightening devices also have been tested by NWRC researchers. Cattle guards at fence openings can reduce deer crossings by 88% (J. L. Belant, NWRC, Sandusky, Oh., pers. commun.). Electronic frightening devices are generally ineffective, although motion-activated propane exploders, which detonate only when deer approach the area to be protected, may repel deer for ≤6 weeks from feeding areas or airport runways (Belant et al. 1996).

The NWRC began research in 1991 to develop immunocontraceptive vaccine technology to inhibit reproduction in deer. Immunocontraceptive vaccines control fertility by stimulating the production of antibodies against gamete proteins, reproductive hormones, and other proteins essential for reproduction. The antibodies interfere with the normal physiological activity of these reproductive agents (Muller et al. 1997). The NWRC is using 2 approaches in conducting research on deer. The first is a gonadotropin-releasing hormone (GnRH) vaccine. The hormone GnRH is produced in the brain by the hypothalamus and controls the release of follicle stimulating hormone (FSH) and luteinizing hormone (LH), which in turn control the functions of the ovaries and testes. Antibodies to GnRH reduce the levels of FSH and LH, thus causing atrophy of the gonads and infertility of both sexes. The NWRC has conducted 2 years of pen research on the effects of GnRH vaccines on the reproduction of male and female white-tailed deer. The NWRC recently received an Investigational New Animal Drug exemption from the Food and Drug Administration for testing of GnRH and is cooperating with the Cornell Cooperative Extension Service and the New York State Department of Environmental Conservation to field test GnRH on white-tailed deer at a fenced location.

The second approach being pursued by the NWRC involves a zona pellucida (ZP) vaccine. The ZP is an acellular glycoprotein layer located between the oocyte and the granulosa cells on the outer surface of the ovum. The ZP vaccine produces antibodies to this glycoprotein layer, thus causing infertility either by blocking sperm from penetrating the ZP layer or by interference with oocyte maturation (Dunbar and Schwoebel 1988). The NWRC has finished 4 years of ZP research on white-tailed deer. Deer vaccinated with ZP of porcine origin remained sterile for 1–3 years, and fawning data showed an 88% reduction in fawns in the ZP-treated group. Research is continuing on the development of a synthetic form of porcine ZP that will allow more economical production of the vaccine.

Injections are the traditional forms of vaccine delivery for deer. Currently it is necessary to deliver immunocontraceptives in free-roaming animals by a dart or biobullet (Turner et al. 1992, Muller et al. 1997). While this may be effective where deer are confined to small sites, it is impractical for populations in larger areas. Therefore, the NWRC is researching oral vaccine delivery systems.

The increasing role of ADC

As deer populations continue to expand in many areas of the United States, the problems associated with those populations are becoming increasingly difficult to manage. Many people who suffer damage caused by deer do not have the knowledge, ability, or authority to deal with the problem. Placing the responsibility for managing the damage caused by deer on the ADC program, in cooperation with the managing agencies, ensures that responses to damage will be biologically sound and as economically efficient as possible.

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