

Developing Methods to Manage Conflicts between Humans and Birds – Three Decades of Change at the USDA National Wildlife Research Center

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Abstract: As the U.S. population has increased and the number and nature of problems caused by wildlife has changed, the focus of research conducted by USDA APHIS National Wildlife Research Center (NWRC) scientists has evolved to meet changing demands for effective solutions. This paper summarizes changes in the focus of NWRC Bird Research Program as reflected in 1) three surveys to determine priority research needs of the Wildlife Services (WS) program, 2) NWRC research literature produced in each of three decades since 1970, and 3) the focus of current research in the NWRC Bird Research Program.

Many research needs of the WS program were consistently expressed in three programmatic research needs assessments (RNAs) conducted in 1989, 1996, and 2001, while others changed as new bird-human conflicts emerged. Blackbirds, starlings, waterfowl, gulls, wading birds, and cormorants were listed in all three RNAs, while pelicans and vultures are more recently expressed as a priority research needs. The major emphasis of NWRC bird research publications over the last three decades has been related to blackbirds, starlings, and grain crops. Songbirds also were a subject of many research publications during each of the last three decades. Waterfowl, gulls, and cormorants, as well as aviation, aquaculture, and endangered species, were subjects of increased research focus at the NWRC during the 1990s.

Key Words: bird damage, National Wildlife Research Center, Research Needs Assessment, Wildlife Services

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INTRODUCTION

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program is the federal organization responsible for protecting American agriculture, human health and safety, natural resources, and property from problems caused by wildlife. As the research arm of WS, the National Wildlife Research Center (NWRC) provides scientific information on the development of effective, socially acceptable methods for managing adverse wildlife impacts on American agriculture, human health and safety, natural resources, and property. Scientists at NWRC conduct research on a broad range of problems and species, including reducing predation on livestock, protecting agricultural crops from depredations by rodents and birds, protecting endangered species, safeguarding human health and safety, and more recently investigating wildlife disease issues.

As the U.S. population has increased and the number and nature of problems caused by wildlife have changed, the focus of research conducted by NWRC scientists has evolved to meet changing demands for effective solutions (Cumow 2001, Bruggers et al. 2002). This paper reviews changes that have occurred in the focus of NWRC Bird Research Program as reflected in 1) three programmatic surveys to determine priority research needs of the WS program, 2) NWRC research literature produced in each of three decades since 1970, and 3) current research projects being conducted by scientists in the NWRC Bird Research Program.

RESEARCH NEEDS ASSESSMENTS

The focus of WS (formerly known as Animal Damage Control) research has always been influenced by numerous economic, political, legislative and biological incentives (Smith 1974), but until recently there has been no systematic process for identifying and prioritizing research needs of the WS program. In 1989, WS initiated a systematic review of wildlife damage control research and methods development needs. The objective was to establish a system for identifying, supporting, and implementing research and methods development priorities of the WS program and its stakeholders that would ensure the availability of a fully adequate range of effective and acceptable methods. A working group was established to survey WS State Directors and NWRC Project Leaders and identify and rank species groups and resource groups with regard to establishing research priority needs. Packham and Connolly (1992) reported on the results of this first survey, or RNA, in 1992 at the 15th Vertebrate Pest Conference. Similar program-wide RNAs were conducted in 1996 and 2001 (Bruggers et al. 1996, 2001) with the intention of reassessing WS research needs about every 5 years. The results of these surveys, together with Congressional and administrative guidance, are the primary means by which NWRC allocates resources to specific research projects to address priority research needs of the WS program.

1989 RNA

In the 1989 RNA, respondents (WS State Directors) were asked to rate the relative severity of each problem

on a scale of 1 to 10, and the various species groups were ranked nationally. Overall, birds comprised 7 of the top 10 groups that posed the most serious problems. Subsequent RNAs also prioritized the various species and problems, although actual scores were not assigned. Nonetheless, results were very similar among all three RNAs (Table 1). Blackbirds (*Agelaius phoeniceus*, *Quiscalus* spp., *Molothrus ater*), starlings (*Sturnus vulgaris*), gulls (*Larus* spp.), wading birds (e.g., *Ardea herodias*, *A. alba*) and cormorants (*Phalacrocorax auritus*) were among the top species priorities during all three surveys.

Table 1. Major bird species groups named by Wildlife Services state directors during each of three programmatic research needs assessments conducted in 1990, 1996, and 2001.

1989	1996	2001
blackbirds/ starlings	blackbirds/ starlings	blackbirds/ starlings
waterfowl	waterfowl	waterfowl
gulls	gulls	gulls
cormorants	cormorants	cormorants
wading birds	wading birds	pelicans
pigeons	vultures	vultures
crows/ravens		crows/ravens

Blackbirds were listed in relation to a number of problems, but mainly feedlots, roost control in urban and suburban environments, and depredations on grains such as seeded and ripening rice and ripening sunflower. Respondents expressed a need for more effective methods, both lethal and non-lethal, to control blackbird problems. Research needs for waterfowl and gulls were associated mainly with nuisance problems, aircraft hazards, fish depredations, and human health and safety in urban and suburban environments. Problems associated with wading birds and cormorants involved aquaculture, commercial and sport fisheries, and transmission of fish diseases. Pelicans (*Pelecanus erythrorhynchos*) appeared on the priority species list in the 2001 RNA, primarily due to increasing populations and their potential to transmit a very significant trematode catfish disease. Vultures were listed in all three RNAs but were a low research priority in the 1989 survey. However, vultures rose to high-priority status in the two subsequent surveys. Problems associated with vultures included predation on newborn calves by black vultures (*Coragyps atratus*) and damage to plastics, vinyl, rubber, vehicles and structures by both black vultures and turkey vultures (*Cathartes aura*). Bird hazards to the aviation industry appeared in all three RNAs. Specific needs related to airports included developing non-lethal methods such as habitat management techniques, developing strategies compatible with on-site endangered species management, and initiating new investigations in non-traditional habitats such as desert environments.

Corvids (*Corvus* spp.) were listed in the 1989 and 2001 RNAs in relation to urban/suburban roost problems, agricultural and livestock depredations, and nuisance problems.

PUBLICATIONS

Species Groups

To evaluate the focus of NWRC research, I used the NWRC annual publication lists (<http://www.aphis.usda.gov/ws/nwrc/is/publications.html>) to tabulate the number of scientific papers published by NWRC scientists in different subject areas during each of three decades. By far, blackbirds and starlings comprised the largest number of publications during all three decades (Table 2). During the 1970s, much of this research focused on evaluating 4-aminopyridine, or Avitrol. During the 1980s, blackbird research shifted to developing methods for controlling nuisance roosts, reducing problems at livestock feedlots, and reducing agricultural depredations on grain crops, particularly corn and rice. During the 1990s, research shifted to developing methods to reduce blackbird depredations to seeded and ripening rice and ripening sunflowers, including evaluating non-lethal repellents, developing an effective bait for delivering DRC-1339, and developing techniques to manage blackbird roosting habitat around sunflower fields.

Table 2. Number of National Wildlife Research Center publications involving selected species groups in each of three decades.

Commodity Groups	1970-79	1980-89	1990-99
Blackbirds/ Starlings	112	172	126
Corvids	2	3	6
Songbirds ¹	22	23	21
Waterfowl	0	10	45
Gulls	2	7	26
Cormorants	0	0	31

¹*Carpodacus mexicanus*, *Turdus migratorius*, *Bombycilla cedrorum*

Next in overall importance were songbirds such as American robins (*Turdus migratorius*), house finches (*Carpodacus mexicanus*), and cedar waxwings (*Bombycilla cedrorum*) and their impacts on fruit crops like grapes, cherries, and blueberries.

Waterfowl, gulls, and double-crested cormorants were the subject of few or no NWRC publications during the 1970s. Research involving these species increased slightly during the 1980s, and even more dramatically during the 1990s. Waterfowl research involved mostly Canada geese (*Branta canadensis*) and repellents such as methyl anthranilate and anthraquinone, egg oiling, and habitat studies. Cormorant research focused on reducing depredations on southern aquaculture farms.

Commodity Groups

Grains, mainly corn, rice, and sunflowers, were the commodity group that was the subject of the most NWRC publications during each decade since 1970 (Table 3). This trend reflects the emphasis of NWRC bird research on blackbirds and starlings. The number of publications that concerned fruits such as cherries, grapes, and blueberries was relatively uniform between 1970 and 1999. These studies involved a broad range of songbirds and starlings. During the 1980s, NWRC researchers conducted studies to evaluate the impact of blackbirds and starlings at feedlots and to evaluate control methods such as spraying feed with methyl anthranilate. Feedlots also were a focus of much research NWRC during the 1980s, when NWRC scientists evaluated surfactants such as CPT and PA-14 for reducing large roosting congregations of blackbirds, grackles, and starlings in the southern U.S. This research all but died out during the early 1990s, mainly because of environmental concerns and registration difficulties.

Table 3. Number of National Wildlife Research Center publications involving selected commodity groups in each of three decades.

Commodity Groups	1970-79	1980-89	1990-99
Grains	50	98	69
Fruits	16	15	18
Feedlots	2	13	2
Roosts	6	19	8
Environment	0	0	10
Aviation	3	11	25
Aquaculture	2	1	42

Aviation, aquaculture, and what I call environmental studies (endangered species protection and contaminant mitigation) emerged as new areas of focus during the 1990s. NWRC scientists first conducted studies involving wildlife aviation hazards in the early 1990s, and today this research has expanded to include ongoing studies across the country, from the Northeast to the northwest and southwest United States. NWRC involvement in aquaculture research began in earnest during the late 1980s when NWRC established a field station in Starkville, Mississippi, to conduct research to assess the impact of fish-eating birds on aquaculture in the mid-South and to develop methods to manage these impacts. Efforts initially focused on double-crested cormorants, but subsequently expanded to include herons, egrets, and pelicans. The environmental category includes a variety of studies, including developing methods to protect endangered species such as the California least tern from predation by ravens, and to reduce hazards associated with environmental contaminants.

Tools/Types of Studies

Each RNA requested that specific tools be researched and/or developed for use by the WS program. A Congressional Directive mandates that at least 50% of NWRC research effort be devoted to developing non-lethal control methods, and all three RNAs expressed a need for more effective non-lethal tools. Currently about 70% of NWRC research involves non-lethal methods development. The NWRC Bird Research Program has devoted a relatively large and increasing proportion of its resources from 1970 to 1999 to developing and evaluating non-lethal bird repellents (Table 4). During the 1970s and 1980s, much of this effort focused on 4-aminopyridine, or Avitrol® (Table 5). Methiocarb (Mesuro®) also was the subject of much research interest throughout the period being considered. Laboratory and field trials were conducted during the 1970s and 1980s to evaluate its effectiveness on ripening fruits and seeded and ripening grains. During the 1990s, research on methiocarb declined due mainly to environmental concerns and registration-related issues. Research conducted during this latter decade led to the registration of methiocarb for use in eggs to reduce predation on endangered species. NWRC research was instrumental in registering methyl anthranilate for repelling birds from turf, standing bodies of water, and feedlots. NWRC scientists currently are evaluating anthraquinone for protecting seeded and ripening rice and other crops.

Table 4. Number of National Wildlife Research Center publications involving selected topics in each of three decades.

Commodity Groups	1970-79	1980-89	1990-99
Repellents	46	62	107
Toxicants	15	22	22
Surfactants	1	11	0
Deterrents	0	14	18
Impact	31	67	44
Environmental Effects	7	12	13
Biology	78	64	74
Overview	24	24	38
Methods	21	15	11

Table 5. Number of National Wildlife Research Center publications involving selected repellents in each of three decades.

Repellent	1970-79	1980-89	1990-99
4-aminopyridine	22	12	0
methiocarb	21	28	12
capsaicin	0	2	5
methyl anthranilate	0	4	46
anthraquinone	0	0	8

Numbers of publications involving avian toxicants were relatively even from 1970 through 1999 (Table 4). These studies included mostly investigation of DRC-1339 and wetting agents like PA-14 and CPT.

NWRC scientists have valued various types of bird deterrents as non-lethal means of reducing bird problems. These include kite-hawk models, balloons, human effigies, and Mylar® reflecting tape. Center scientists have had recent success dispersing roosts of various species of birds with lasers and bird effigies. Determining the impact of birds in various situations has been an ongoing emphasis of Center research (Table 4). This includes determining the percentage of crop or resource damaged, the conditions under which depredations occur, and environmental conditions associated with damage. Environmental studies relate to environmental or wildlife effects associated with use of toxicants or repellents. This may be uptake in the crop itself, persistence in the soil or water, or uptake by non-target species. Biological studies involve anything from food habits, to radio-telemetry, to behavioral studies. Overview publications include summaries, descriptions, or overviews of problem areas or registered pesticides.

CURRENT NWRC BIRD RESEARCH PROJECTS

In 1996, NWRC reorganized all of the Center's existing research into individual multiyear, multidisciplinary projects that address specific areas of research related to research priorities identified in the RNA process. These projects are 3-5 years in duration and have clearly stated goals and objectives, projected milestones, expected outputs, periodic reviews, and annual progress updates. There currently are seven active research projects in the NWRC Bird Research Program (Appendix A). Several of these projects (rice, sunflowers, emerging technologies) are in areas that have long been priorities of the WS program, while other projects (aviation, aquaculture, vulture, waterfowl disease) are more recently identified priorities. All NWRC bird research projects attempt to define the nature and extent of the problem as well as investigate new or improved methods for managing the problem. Specific goals and research objectives of each project are listed in Appendix A.

SUMMARY

As the nature of human-wildlife conflicts has changed, so too has the focus of research conducted by scientists in the NWRC Bird Research Program. This paper reviews these changes as reflected in three

program-wide RNAs, scientific studies published by NWRC scientists since 1970, and the focus of current research in the NWRC Bird Research Program. The largest emphasis of NWRC bird research over the last three decades has been on the impact and management of agricultural bird depredations, especially blackbirds and starlings in grain crops, feedlots, and roosts, and to a lesser degree songbird depredations in fruit crops. The 1990s saw an increased research effort being placed on waterfowl, gulls, wading birds and cormorants, and more recently NWRC initiated multi-year research efforts involving pelicans and vultures. When appropriate, NWRC scientists continue to investigate the safety and efficacy of avicides, but increasing emphasis is being placed on repellents and other non-lethal approaches to resolving conflicts with birds. NWRC research will continue to evolve to meet the changing needs of the WS program as both human and many avian populations expand and new bird-human conflicts emerge.

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Appendix A. Titles, goals, and objectives of current research projects in the National Wildlife Research Center Bird Research Program.

DEFINING AND REDUCING WILDLIFE HAZARDS TO AVIATION

Goal: Provide a scientific foundation for Wildlife Services programs at airports throughout the USA to reduce wildlife hazards to the aviation industry

Research Objectives:

- Develop guidelines for managing wildlife habitat and other land uses at airports
 - Develop and manage the FAA wildlife strike database
 - Develop and evaluate methods to control wildlife damage for airports
 - Develop a wildlife hazard management manual for airport operators
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DEVELOPMENT AND EVALUATION OF MANAGEMENT TECHNIQUES FOR REDUCING BLACKBIRD DAMAGE TO RIPENING SUNFLOWER CROPS AND TO FEEDLOTS

Goal: Develop new and/or improved methods to reduce blackbird damage to ripening sunflower crops and to feedlots

Research Objectives:

- Improve the use of DRC-1339 to reduce blackbird populations responsible for damaging sunflower crops and eating livestock feed
 - Determine the non-target avian risks of using DRC-1339-treated rice for reducing blackbird populations in the Great Plains and develop risk quotients from existing database of LD_{50s} for non-target avian species of interest
 - Improve the cost-effectiveness of glyphosate herbicide applications for managing dense cattail stands used by roosting blackbird populations during late summer
 - Develop population models describing the population distribution, abundance, and dynamics of blackbirds in central North America
 - Quantitatively determine the effects of systematically removing and thus disrupting blackbird pair bonding on reproduction of blackbird and non-target birds
 - Identify, develop, and improve the use of chemical repellents and physical barriers for reducing blackbird damage to ripening sunflower crops
 - Obtain current blackbird population data and levels of crop damage in sunflower growing areas
 - Develop a comprehensive database on the basic ecology of blackbirds in relation to sunflower and livestock feed damage
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WATERFOWL AS DISEASE, PARASITE, AND NOXIOUS WEED RESERVOIRS IN URBAN AND AGRICULTURAL LANDSCAPES

Goal: Understand and develop management recommendation related to the contribution and impact of Canada geese as vectors for disease, parasites, and noxious weeds on human health and safety in urban landscapes and on animal health in agricultural landscapes

Research Objectives:

- Determine the prevalence of *Salmonella* spp., *Campylobacter* spp., and *Escherichia coli* H:0157 from Canada goose feces derived from urban landscapes, and make recommendations for managing associated risks to human health and safety
 - Determine the prevalence of *Salmonella* spp., *Campylobacter* spp., and *Escherichia coli* H:0157 from Canada goose feces derived from agricultural pastures
 - Determine the prevalence of other bacterial pathogens (e.g., *Streptococcus* spp., *Staphylococcus* spp., *Listeria* spp., *Yersinia* spp., *Shigella* spp.) and parasites (e.g., *Girardia* spp.) in Canada goose feces derived from urban landscapes with the aid of collaborative research laboratories
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ECONOMIC IMPACT AND MANAGEMENT OF BIRD PREDATION AT AQUACULTURE FACILITIES IN THE SOUTHEASTERN UNITED STATES

Goal: Determine the magnitude of and develop methodology to reduce damage by cormorants, wading birds and pelicans on southern catfish, baitfish and crawfish farms

Research Objectives:

- Determine population trends of double-crested cormorants, delineate large-scale movements, and construct models that describe population dynamics and predict the effect of various management strategies
 - Determine the biology and impact of various piscivorous birds on catfish, baitfish, and crawfish industries
 - Develop non-lethal methods (fish culturing practices, physical barriers, lasers, and automated frightening devices) for reducing cormorant and other bird damage to aquaculture
 - Determine the potential for piscivorous birds to serve as vectors for fish diseases and parasites
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MANAGEMENT OF BIRD DAMAGE TO RICE

Goal: Develop new or improved management strategies for reducing bird damage to rice

Research Objectives:

- Determine the current population status of blackbirds and waterbirds in rice-growing regions of the U.S., and develop a population management plan for blackbirds for the major rice-growing regions (e.g., Louisiana, Arkansas, Texas) of the U.S.
 - Determine the current economic impact of blackbirds on the rice industry
 - Identify, develop, and evaluate chemical repellents for reducing bird damage to newly planted and ripening rice
 - Determine the efficacy of the Wildlife Services blackbird/DRC-1339 baiting program in Louisiana and Texas; improve DRC-1339 bait formulations and bait application techniques; and determine associated non-target hazards
 - Develop and evaluate new or improved strategies and/or tools for managing wildlife, specifically blackbirds and waterbirds, damage to newly planted and ripening rice
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EMERGING TECHNOLOGIES TO RESOLVE HUMAN-WILDLIFE CONFLICTS: CELL CULTURE, REPELLENTS, ANTI-SWEET AND ANTI-NUTRIENT AGENTS, AND BEHAVIORAL METHODS

Goal: Discover new technologies and adapt existing methods for the development of non-lethal repellents and attractants to resolve conflicts between humans and wildlife. Technologies will focus on identifying new, creative methods to screen repellents and enhancing their efficacy in reducing crop depredation by birds

Research Objectives:

- Refine a cell culture method for neurons that mediate perception of primary repellents, and characterize the differences and similarities between responses of mammalian and avian model systems to neurochemicals
 - Refine collection and culture methods to accommodate the culturing of cells derived from a variety of wildlife species
 - Screen biological and chemical agents for their avian-specific anti-sweet properties
 - Screen chemical agents for their anti-nutrient properties
 - Screen terpenoid compounds for their bird repellent properties
 - Develop and evaluate an automated bird hazing system
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DEVELOPMENT OF METHODS TO MANAGE DEPREDATION AND NUISANCE PROBLEMS CAUSED BY VULTURES

Goal: Understand the relationships between various habitat and land use variables and problems caused by vultures and develop effective management techniques for reducing predation losses and property damage

Research Objectives:

- Evaluate management methods at vulture roosts
 - Determine why vultures damage vinyl, plastic, and other synthetic construction and insulation materials, and evaluate possible deterrents to such behavior
 - Understand broad scale vulture movement patterns and resource use, with particular attention to livestock, landfills, and airports
 - Develop a set of recommended management practices for reducing depredation and nuisance problems caused by vultures
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