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Groups Affected:

- Consumers and producers of sunflower, rice, corn, fruit, dairy, meat and other products
- Feedlot Owners Association
- National and State Fruit Grower Associations
- National Sunflower Association
- North Dakota Department of Agriculture
- North Dakota Game and Fish Department
- Processors, manufacturers, suppliers, and sellers of sunflower, rice, corn, fruit, dairy and meat
- South Dakota Department of Agriculture
- South Dakota Game, Fish and Parks
- South Dakota Oilseed Council

Major Cooperators:

- Arkion Life Sciences, LLC
- Michigan State University
- National Sunflower Association
- North Dakota State University
- North Dakota Department of Agriculture
- Purdue University
- Red River Zoo
- USDA-APHIS-WS NWRC Ohio Field Station
- USDA-APHIS-WS NWRC Repellents Project

National Wildlife Research Center Scientists Investigate a Variety of Tools to Address Bird Damage

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques. NWRC's field station in Fargo, North Dakota, evaluates and develops methods for managing bird damage to agricultural crops.

European starlings, blackbirds and crows are abundant and widely distributed in the United States, with their winter populations estimated between 750 million and 1 billion birds. The estimated annual damage to grain, fruit and berry crops from these birds exceeds \$150 million in direct costs. Blackbirds annually damage more than \$15 million in sunflower, \$15-25 million in ripening corn, \$20-50 million in seeded corn, \$6 million in sorghum, and more than \$20 million in rice. Thus, the development of bird-damage management methods and acquisition of baseline knowledge on impacts of management actions on ecology and biology of these birds in relation to agriculture is needed at national, regional, and local scales. Current approaches to reduce avian depredation of agricultural crops include 1) chemical repellents, 2) physical frightening devices, 3) decoy crops, 4) habitat management, and 5) altered agricultural practices. NWRC scientists are studying ways to refine current damage abatement methods and develop new methods for reducing damage. As part of their efforts to develop new methods and tools, NWRC scientists conduct multifaceted behavioral and physiological studies involving the use of both captive and free-ranging birds; estimate the economic impacts of bird damage; evaluate and develop application strategies for nonlethal repellents to deter birds; and develop best practices for using unmanned aircraft systems (UAS) as nonlethal scare devices to disperse birds.

Applying Science and Expertise to Wildlife Challenges

Economic Impacts of Birds to Sweet Cherry Production. — The United States is the world's second-largest cherry producer, accounting for 15 percent of the world's total cherry production. Bird damage is a common and costly problem for cherry and other fruit producers. NWRC economists used survey data from producers in five U.S. states to estimate bird damage to sweet cherry (*Prunus avium*) crops with and without the use of bird management. Respondents reported American robins and European starlings as the most damaging bird species. Growers also reported using bird management methods such as repellents, shooting, trapping, exclusion netting, and scare devices, with shooting and exclusion netting being perceived as the most effective methods. Researchers note that the high cost of installation and maintenance of exclusion netting may limit its use by some growers. Producers estimated their average yield loss due to bird damage was 13 percent. They estimated that their own use of bird management methods reduced their losses by 21 percent. However, for those who did not manage bird damage, respondents predicted their yield losses increased by about 26 percent. To better understand the full benefits of bird damage management to cherry crops, the economists applied a partial equilibrium model to the survey data to estimate changes in cherry production costs when bird management is absent. Results showed that a lack of bird damage management increases the cost of cherries to society (i.e., cherry production and associated market outcomes, including price and consumption) by as much as \$238 million in the short-term and \$29 million in the long-term, annually.

Repellent Application Strategies. — Anthraquinone (AQ) is a naturally occurring chemical defense found in animals, plants, and bacteria. AQ is also synthesized for industrial use as an avian repellent. The patent holder, Arkion Life Sciences LLC, holds a national registration (EPA FIFRA Section 3) to use AQ at the seeding stage and is currently working on foliar applications at plant maturity in a variety of crops. Although AQ has shown greater than 80 percent repellency in the lab field studies in ripening sunflower have been inconclusive. Application strategies in the field need to be optimized for the specific crop being protected in order to transfer the efficacy found in the laboratory to the field. As cultivated sunflower matures, the head faces down making the producer-preferred, aerial application of repellent problematic given that blackbirds must ingest the repellent to be effective. Thus, the main obstacle to using AQ in ripening sunflower is applying sufficient repellent directly on the face of the

sunflower to repel birds while minimizing AQ residues on harvested seed. NWRC research is developing application strategies, such as drop-nozzle equipped ground rigs, to apply AQ and other chemicals directly to the sunflower face.

Frightening Devices to Prevent Damage. — One promising new technology in wildlife damage management is unmanned aircraft systems (UAS), which have been deployed by producers to protect agricultural fields from birds and are being evaluated for use in wildlife and agricultural monitoring. A main benefit of UAS is their ability to reduce bird habituation and sensitization through their dynamic flight paths and movements. NWRC research is helping to determine whether UAS can reduce bird damage by evaluating avian physiological and behavioral response and potential habituation to the devices. Researchers also are establishing best practices (i.e., color, size, shape, approach, altitude, and speed) for using UAS to haze blackbirds. Blackbird biology, in particular vision ecology, can inform development of management tools. The potential efficacy of UAS as hazing tools will likely depend upon bird detection and response to the UAS flight dynamics.

Selected Publications:

Eaton, R.A., C.A. Lindell, H.J. Homan, G.M. Linz, and B.A. Maurer. 2016. American Robins (*Turdus migratorius*) and Cedar Waxwings (*Bombycilla cedrorum*) vary in use of cultivated cherry orchards. *The Wilson Journal of Ornithology* 128(1):97-107. doi: 10.1676/wils-128-01-97-107.1.

Forcey, G.M., W.E. Thogmartin, G.M. Linz, P.C. McKann, and S.M. Crimmins. 2015. Spatially explicit modeling of blackbird abundance in the Prairie Pothole Region. *Journal of Wildlife Management* 79(6):1022-1033. doi: 10.1002/jwmg.912.

Lindell, C.A., K.M. Steensma, P.D. Curtis, J.R. Boulanger, J.E. Carroll, C. Burrows, D.P. Lusch, N.L. Rothwell, S.L. Wiefelich, H.M. Henrichs, D.K. Leigh, R.A. Eaton, and G.M. Linz. 2016. Proportions of bird damage in tree fruits are higher in low-fruit-abundance contexts. *Crop Protection* 90:40-48. doi: 10.1016/j.cropro.2016.08.011

Linz, G.M., E.H. Bucher, S.B. Canavelli, E. Rodriguez, and M.L. Avery. 2015. Limitations of population suppression for protecting crops from bird depredation: A review. *Crop Protection* 76:46-52. doi: 10.1016/j.cropro.2015.06.005.

Niner, M.D., Linz, G.M., and M.E. Clark. 2015. Evaluation of 9, 10 anthraquinone application to pre-seed set sunflowers for repelling blackbirds. *Human-Wildlife Interactions*, 9(1):4-13.

Major Research Accomplishments:

- WS economic analyses showed that in the absence of bird damage management, sweet cherry production costs increase as much as \$29 million annually.
- WS research is developing application strategies, such as drop-nozzle equipped ground rigs, to apply an anthraquinone-based repellent and other chemicals directly to the sunflower face.
- WS research is evaluating the use of unmanned aircraft systems (UAS) and developing best management practices to haze blackbirds from agricultural crops.