Bird Damage Management Conference

Blackbirds, Starlings, Corvids, Vultures

February 10-13, 2020

Hilton Salt Lake City Center
Salt Lake City, Utah

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Welcome to Utah and the first ever Bird Damage Management Conference!

In January of 2008, Dr. George Linz, then Field Station Leader of the USDA-WS National Wildlife Research Center in Bismarck, North Dakota, organized a symposium on "*Managing Blackbirds, Starlings, and Corvids*" in Nashville, TN. The main objective of the meeting was to gather stakeholders and determine sound management methods to meet their challenges in protecting agriculture, urban, and natural resources. The result was a working document that outlined priorities in research and management to alleviate economic and ecological losses to blackbird species. Fast forward twelve years, and the damage to agriculture, urban areas, airports, threatened and endangered species, ecosystems, and personal property continues to be a challenge for scientists and managers dedicated to mitigating this issue. This year, the idea of gathering essential expertise blackbirds, starlings, and corvids, as well as vultures was resurrected by a committee of leaders from across the nation and once again spearheaded by Dr. Linz along with his successor, Dr. Page Klug.

We welcome you to Salt Lake City for an enlightening and informative two days dedicated to developing successful (cost effective and environmentally sound) strategies and tools for bird damage mitigation. This conference will bring together a core group of researchers, managers, administrators, and stakeholders that are interested in the biology and management of these birds with an objective to involve key stakeholders in the development of a plan that will focus on a coordinated path forward to effectively manage these species.

This conference has a unique format! Day one opens with a slate of Plenary speakers who will lay the foundation of the greatest issues: economics, producer losses, climate change, and airport safety. The conference will then have coordinated sessions on blackbirds, starlings, corvids, and black vultures, followed by moderated panels on management and mitigation of damage in which attendees are encouraged to participate. The last day will be devoted to break-out sessions to aid in the development of road-maps for future research and methods development. As you can see, we have a full agenda and many opportunities for contribution as well as networking.

We invite you to enjoy the fantastic educational and professional resources from the many presenters and sponsors at the conference. Explore downtown Salt Lake City and all that the Capital city has to offer! If at any time you have a need or special request, one of the organizing committee members will be glad to assist you.

2020 Bird Damage Management Conference Organizing Committee:

Dr. George Linz, USDA-APHIS-Wildlife Services (National Wildlife Research Center, Retired)
Dr. Page Klug, USDA-APHIS-WS (NWRC Project Leader, North Dakota Field Station)
Mr. Jason Suckow, USDA-APHIS-Wildlife Services (Western Regional Director)
Dr. Peter Coates, US Geological Survey (Western Ecological Research Center)
Mr. Michael Begier, USDA-APHIS-Wildlife Services (Coordinator, Airport Wildlife Hazards Program)
Mr. Brett Dunlap, USDA-APHIS-Wildlife Services (State Director, Tennessee and Kentucky)
Dr. Terry Messmer, Berryman Institute, Utah State University
Dr. Jessica Tegt, Berryman Institute, Utah State University
Mrs. Rae Ann Hart, Berryman Institute, Utah State University

2020 Bird Damage Management Conference

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Agenda at a Glance

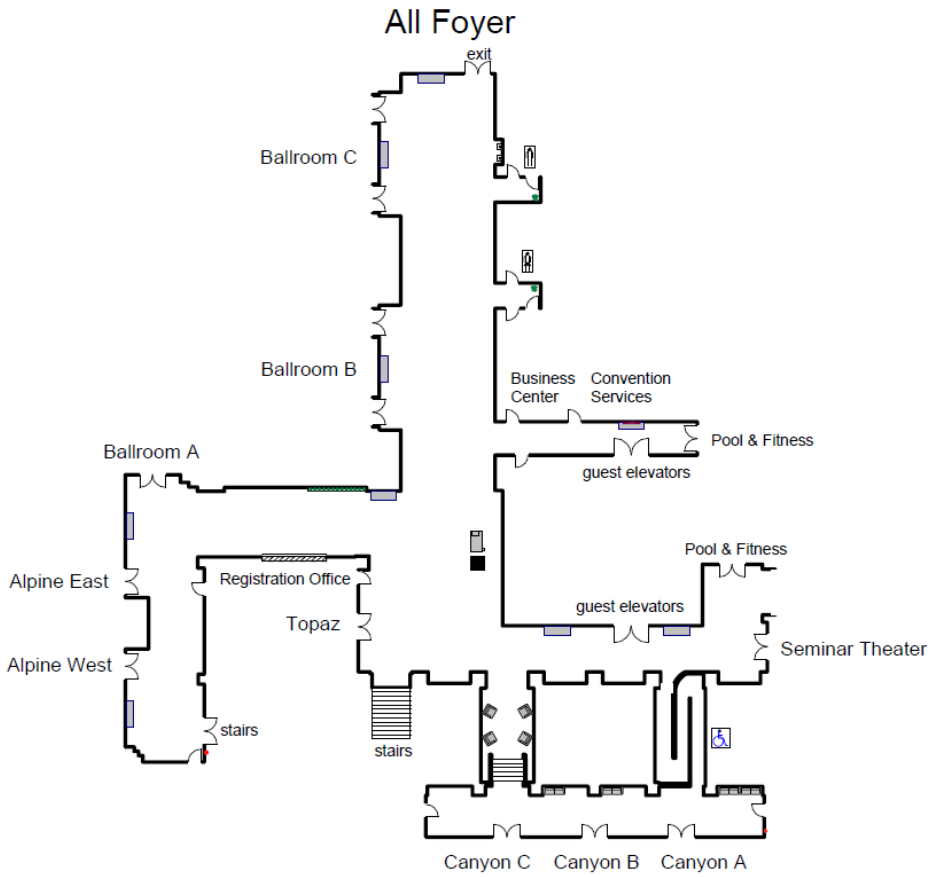
MONDAY, FEBRUARY 10th	
6:00 – 8:00pm	Welcome Reception – *Cash Bar and Hors d'oeuvres*

TUESDAY, FEBRUARY 11th	
7:00 - 5:30pm	Registration- Main Ballroom Lobby
7:00 - 8:15	Breakfast provided- Main Ballroom Lobby
8:15 - 8:30	**Conference Welcome**
8:30 - 10:00	**Plenary Session**
10:00 - 10:15	Break
10:15 - 12:15	**Session 1: Contributed Presentations- Corvids**
12:15 – 1:30	Lunch on your own
1:30 – 2:50	**Session 2: Contributed Presentations- Corvids**
2:50 – 3:15	Break
3:15 – 4:15	**Session 3: Contributed Presentations- Corvids**
4:15 - 5:00	**Corvid Panel Discussion**
	Dinner on your own

WEDNESDAY, FEBRUARY 12th	
7:00 - 8:00	Breakfast provided- Visit our Vendors!
8:00 – 10:00	**Session 4: Contributed Presentations- Blackbirds/Starlings**
10:00 – 10:15	Break
10:15 – 11:35	**Session 5: Contributed Presentations- Blackbirds/Starlings**
11:35 – 12:30	**Blackbirds/Starlings Panel Discussion**
12:30 – 2:00	Lunch on your own
2:00 – 3:20	**Session 6: Contributed Presentations- Vultures**
3:20 – 3:40	Break
3:40 - 4:30	**Vultures Panel Discussion**
4:30 – 6:00	Poster Session
	Dinner on your own

THURSDAY, FEBRUARY 13th	
7:00 – 8:30	Breakfast provided
8:00 - 8:30	Vendor Visits
8:30 - 10:15	**Breakout A:** *Corvids* **Breakout B:** *Blackbirds/Starlings* **Breakout C:** *Vultures*
10:15 – 10:30	Break
10:30- 11:45	**Breakout A:** *Corvids* **Breakout B:** *Blackbirds/Starlings* **Breakout C:** *Vultures*
11:45 – 12:30	Breakout Presentations and Closing Remarks
1:00-	Lunch on your own

Hilton Salt Lake City Center Layout



Bird Damage Conference Activities will take place in the Ballroom Lobby and Main Ballrooms. Breakout rooms for Thursday are Canyon A, B, C.

Visit our Vendors

Bird Control Group
The Berryman Institute
Wildlife Dominion
USDA/APHIS/ WS National Wildlife Research Center
Utah Community-based Conservation Programs
BirdGard
Bird Buffer
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Conference Welcome

Dr. George Linz
USDA-APHIS-Wildlife Services
National Wildlife Research Center (retired)

George M. Linz was a Research Wildlife Biologist for the National Wildlife Research Center from 1987 until his retirement in 2015 and was stationed in Bismarck, North Dakota for much of his career. George was hired primarily as the Leader for the blackbird-sunflower research project, however, his group also conducted research on European Starlings in urban and feedlot environments. George and his wife Linda spend winters in Phoenix and during the remainder of the year work on their hobby farms in Pennsylvania and North Dakota where they monitor nearly 100 bird houses, and plant food plots and trees to enhance habitat for wildlife.

Dr. Terry Messmer
Professor and Wildlife Extension Specialist
Director, Jack H. Berryman Institute
Utah State University

Terry A. Messmer is a professor and extension wildlife specialist in the Department of Wildland Resources at Utah State University (USU). He holds the Quinney Professorship of Wildlife Conflict Management in USU's Quinney College of Natural Resources and is the director of USU's Utah Community-Based Conservation Program (CBCP) and the Jack H. Berryman Institute for Wildlife Damage Management. His research, teaching, and extension activities include identification, implementation, and evaluation of conservation strategies, technologies, and partnerships that can benefit communities, wildlife, and natural resources stakeholders by reducing human-wildlife conflicts. He is the past Editor-in-chief of The Wildlife Society Bulletin (WSB), and a currently an Associate Editor (AE) for the Journal of Wildlife Management and the WSB, and the Editor-in-Chief of Human-Wildlife Interactions. He recently retired as a Colonel in the U.S. Army Reserve where he served as the commander of multiple units during their combat deployments. His civilian and military awards include the 2018 Utah Governor's Science Medal, the Bronze Star, and the Medical Order of Merit.

Plenary Speakers

Dr. Stephanie Shwiff- USDA-APHIS-Wildlife Services
Project Leader NWRC Economic Research and Human-wildlife Conflicts Project

Understanding the Economics of Bird Impacts

Mr. Michael Begier- USDA-APHIS-Wildlife Services
National Coordinator Airport Wildlife Hazards Program

60 Years Later- Remembering Eastern Airlines Flight 375

Dr. Richard Dolbeer- USDA-APHIS-Wildlife Services
Science Adviser, Airport Wildlife Hazards Program

Vultures, starlings, and blackbirds pose unique challenges for aviation safety in North America

Dr. Greg Forcey, Normandeau Associates
Wildlife Science Principal Scientist

A review of potential climate change impacts on blackbird distribution in North America

Mr. Clark Coleman, National Sunflower Association
Board President

Sunflower losses to blackbirds: an economic burden

Full Agenda and Schedule of Oral Presentations

Tuesday, February 11, 2020	
7:00 am – 8:15 am	**Main Ballroom Lobby** Conference Breakfast – Vendor Displays
7:00 am – 5:30 pm	**Main Ballroom Lobby** Conference Registration
8:15 am – 8:30 am	**Main Ballroom** Welcoming Remarks- **Dr. George Linz, USDA, Wildlife Services, (National Wildlife Research Center Retired Field Station Leader)** **Dr. Terry Messmer, Berryman Institute, Utah State University**
8:30 am - 10:00 am **PLENARY**	**Main Ballroom** Plenary **Dr. Stephanie Shwiff, USDA-APHIS-Wildlife Services** *Understanding the economics of bird impacts* **Mr. Michael Begier, USDA- APHIS-Wildlife Services** *60 Years Later- Remembering Eastern Airlines Flight 375* **Dr. Richard Dolbeer, USDA-APHIS-Wildlife Services** *Vultures, starlings, and blackbirds pose unique challenges for aviation safety in North America* **Dr. Greg Forcey, Normandeau Associates, Inc.** *A review of potential climate change impacts on blackbird distributions in North America* **Mr. Clark Coleman, National Sunflower Association** *Sunflower losses to blackbirds: an economic burden*
10:00 am- 10:15 am	**Main Ballroom Lobby** Break
10:15 am – 5:00 pm	**MAIN BALL ROOM- CORVIDS Dr. Peter Coates, US Geological Survey, Moderator**
10:15 am – 12:15 pm **10:15** **10:35** **CORVIDS** **10:55**	**Session 1: Contributed Papers** **Dr. Seth Dettenmaier, US Geological Survey** *Inhabiting the West: Range expansion and population growth of common ravens* **Dr. Jonathan Dinkins, Oregon State University** *Expanding abundance of a native predator, Common raven, within the habitat of a sensitive native prey species, greater and Gunnison sage-grouse* **Dr. Shawn O'Neil, US Geological Survey** *Factors influencing common raven occurrence and density across cold-desert sagebrush ecosystems of the southwestern U.S.*
10:15 am – 12:15 pm **11:15** **CORVIDS** **11:35** **11:55**	**Seth Harju, Heron Ecological, LLC** *Common raven movement and space use: influence of nearby anthropogenic subsidies within greater sage-grouse nesting habitat* **Lindsey Perry, Oregon State University** *Raven nest site selection in the sagebrush-steppe* **Julia Brockman, University of Nevada, Reno** *Common raven nest attraction and juvenile dispersal*
12:15 pm - 1:30 pm	**Lunch on your own**

1:30 pm – 2:50 pm **1:30** **1:50** **CORVIDS** **2:10** **2:30**	**Session 2: Contributed Papers** **Dr. Peter Coates, US Geological Survey** *Effects of common ravens on greater sage-grouse in the Great Basin region, USA* **Seth Harju, Heron Ecological, LLC** *Spatial patterns in raven nestling diets and responses of breeding ravens and greater sage-grouse nest success following raven nest removal* **Brianne Brussee, US Geological Survey** *Reproductive success of common ravens influences their prey: Implications for egg-oiling techniques* **Dr. Brenda Hanley, Cornell University** *Novel management tools for subsidized avian predators and a case study in the conservation of a threatened species*
2:50 pm- 3:15 pm	**Main Ballroom Lobby** Break
3:15 pm – 4:15 pm **3:15** **CORVIDS 3:35** **3:55**	**Session 3: Contributed Papers** **Dr. Jonathan Dinkins, Oregon State University** *Effects of common raven removal and weather on greater sage-grouse nesting success and lek counts* **Kerry Holcomb, US Fish and Wildlife Service** *Reducing common raven depredation pressure on the Mojave desert tortoise* **Dr. Seth Dettenmaier, US Geological Survey** *A tiered management approach to reduce raven impacts on sensitive species*
4:15 pm – 5:00 pm	**PANEL DISCUSSION- CORVIDS** **Moderator, Dr. Peter Coates**
5:00 pm - until	**Dinner on your own**

Wednesday, February 12, 2020	
7:00 am – 8:15 am	**Main Ballroom Lobby** Conference Breakfast – Vendor Visits
8:00 am – 11:35 am	**MAIN BALL ROOM – BLACKBIRD** **Dr. Page Klug, USDA-APHIS-Wildlife Services Moderator**
8:00 am – 10:00 am **8:00** **BLACKBIRDS** **8:20** **8:40** **9:00** **9:20** **9:40**	**Session 4: Contributed Papers** **Emily Blizzard, USDA-APHIS-Wildlife Services** *Imperfect data: offering the best available objective data for NEPA compliance* **Julie Elser, USDA-APHIS-Wildlife Services (NWRC)** *Measuring bird damage to three fruit crops: A comparison of grower and field estimates* **Dr. George Linz, USDA-APHIS-Wildlife Services (NWRC, retired)** *Blackbird research in North America: A Review* **Nathan Bornsen, USDA-APHIS-Wildlife Services** *Operational blackbird damage management assistance in North Dakota* **Shelagh DeLiberto, USDA-APHIS-Wildlife Services (NWRC)** *Repellent development for blackbird damage management* **Dr. Esteban Fernandez-Juricic, Purdue University** *Are avian laser-deterrents safe? A study on how visual foraging is affected by laser exposure*
10:00 am – 10:15 am	**Main Ballroom Lobby** Break

10:15 am – 11:35 am **10:15** **10:35** **BLACKBIRDS** **10:55** **11:15**	**Session 5: Contributed Papers** **James Thiele, USDA-APHIS-Wildlife Services** *Can trapping be a feasible alternative to DRC-1339 for starling control?* **Dr. Brian Peer, Western Illinois University** *Management of the brown-headed cowbird: Implications for endangered species and agricultural damage mitigation* **Dr. H. Jeffrey Homan, USDA-APHIS-Wildlife Services (NWRC retired)** (George Linz, Presenting) *Behavior of European starlings (Sturnus vulgaris) in three landscapes* **Dr. Page E. Klug, USDA-APHIS-Wildlife Services (NWRC)** *Human-blackbird conflict in North America: Current directions in avian damage management research*
11:35 am – 12:30 pm	**PANEL DISCUSSION- BLACKBIRDS** **Moderator, Dr. Page E. Klug**
12:30 pm – 2:00 pm	Lunch on your own
2:00 pm- 3:20 pm	**MAIN BALL ROOM – VULTURES** **Brett Dunlap, USDA-Wildlife Services, Moderator**
2:00 pm – 3:20 pm **2:00** **2:20** **VULTURES** **2:40** **3:00**	**Session 6: Contributed Papers** **Dr. Richard Dolbeer, USDA-APHIS-Wildlife Services (Airport Hazards)** *Vultures, landfills, and airports: an ominous combination* **Dr. Brian Kluever, USDA-APHIS-Wildlife Services (NWRC)** *Black vulture conflict in North America: current and needed research, with an emphasis on damage to agriculture* **Dr. John Sauer, US Geological Survey** *Allowable Take: Modeling and data needs for science-based assessments* **Brett Dunlap, USDA-APHIS-Wildlife Services** *Federal/State/Private cooperation in managing black vulture damages to livestock*
3:20 pm – 3:40 pm	**Main Ballroom Lobby** Break
3:40 pm – 4:30 pm	**PANEL DISCUSSION- VULTURES** **Moderator, Brett Dunlap**
4:30 pm – 6:00 pm	**Main Ballroom Lobby POSTER SESSION (light snacks and drinks)**
6:00 pm - until	**Dinner on your own**

Thursday, February 13, 2020	
7:00 am – 9:00 am	**Main Ballroom Lobby** Conference Breakfast – Vendor Visits
9:00 am – 10:15 am **BREAKOUTS**	**Breakout A:** *Corvids,* Lorien Belton, Berryman Institute, Facilitator **Breakout B:** *Blackbirds/Starlings,* Gail Keirn, USDA/LPA, Facilitator **Breakout C:** *Vultures,* Jessica Tegt Facilitator, Berryman Institute, Facilitator
10:15 am – 10:30 am	**Main Ballroom Lobby** Break
10:30 am – 11:45 am **BREAKOUTS**	**Breakout A:** *Corvids,* Lorien Belton, Berryman Institute, Facilitator **Breakout B:** *Blackbirds/Starlings,* Gail Keirn, USDA/LPA, Facilitator **Breakout C:** *Vultures,* Jessica Tegt Facilitator, Berryman Institute, Facilitator
11:45 am – 12:30 pm	**Breakout Presentations and Closing Remarks, Dr. George Linz**

Breakout Facilitators:

Ms. Gail Keirn
USDA-APHIS-Wildlife Services

Gail Keirn is the Public Affairs Specialist for the USDA-APHIS Wildlife Services' National Wildlife Research Center. She has more than 15 years of experience as a natural resource professional with a focus on public relations and environmental education. Her main role is to increase and improve communications within NWRC and between the Center and its various stakeholders, collaborators, and the public. Gail holds M.S. and B.S. degrees in wildlife biology from Colorado State University and Texas A&M University, respectively.

Ms. Lorien Belton
Jack H. Berryman Institute, Utah State University

Lorien Belton is the Program Coordinator and Facilitator for Utah's Community-Based Conservation Program, Utah State University Extension. She is responsible for LWG facilitation, coordination, and reporting. She received her M.S from Utah State University.

Dr. Jessica Tegt
Jack H. Berryman Institute, Utah State University

Jessica Tegt is the Outreach and Engagement Coordinator for the Jack H. Berryman Institute at Utah State University. She has 20 years of experience in human dimensions and conservation education. Jessica has a B.S. from the University of Wisconsin, an M.S from Utah State University, and a Ph.D. from Mississippi State University.

ABSTRACTS
Contributed Session 1: Corvids

Inhabiting the west: range expansion and population growth of common ravens

Seth Dettenmaier[1], Pete Coates[2], and Jonathan Dinkins[3]
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Common raven (Corvus corax) populations in the western United States have dramatically increased over the last 4 decades. As an opportunistic omnivore that relies on resources heavily subsidized by humans, ravens have expanded their range into areas where they were historically absent. We conducted a longitudinal quantitative assessment using Breeding Bird Survey data collected over 40 years to quantify and illustrate range expansion and estimate rate of population change across multiple temporal and spatial scales within the western United States and Canada. We identify specific areas that have experienced the greatest increase in numbers as well as identify newly inhabited areas. Lastly, we provide insight into environmental and anthropogenic factors that influence variation in raven numbers and occupancy at relatively large spatial scales.

Expanding abundance of native predator, common raven, within the habitat of a sensitive native prey species, greater and Gunnison sage-grouse

Jonathan Dinkins[1], Pete Coates[2], and Jeffrey Beck[3]
[1]Department of Animal and Rangeland Sciences, Oregon State University, Corvallis, Oregon, 97331, jonathoan.dinkins@orgonstate.edu, [2]US Geological Survey, 800 Business Park Drive, Dixon, California 95620, pcoates@usgs.gov, [3] Department of Ecosystem Science and Management, University of Wyoming, Laramie, Wyoming, 82071, jlbeck@uwyo.edu.

Common raven (Corvus corax; hereafter, raven) abundance has increased throughout western North America throughout the last century. This has resulted in ravens conflicting with numerous sensitive species, including greater sage-grouse (Centrocercus urophasianus; hereafter, sage-grouse), in areas that were previously poorer raven habitat. Human subsidies have allowed ravens to maintain higher annual survival and reproduction than with natural resources alone. Using Breeding Bird Survey (BBS) data from 1995–2014, we evaluated raven abundance to quantitatively describe expansion into sagebrush ecosystems, specifically sage-grouse habitat. We focused our analyses on the seven sage-grouse Management Zones (MZ) delineated across 11 western U.S. states and 2 Canadian provinces. We assessed the effects of burned, forested, and cropland habitat; human population, road, oil and gas well, and power line densities; and distance to landfill on instantaneous growth rate (r) and carrying capacity (K) of ravens. Abundance of ravens in western and southeastern MZs was greater than northeastern MZs within the sage-grouse range. Higher abundance in MZ VII in the southeast indicated Gunnison sage-grouse (Centrocercus minimus) have been exposed to higher raven abundance. Areas with higher power line density had greater r; proportion of urban landcover within 25 km was positively related to higher K; and proportion of forest landcover within 15 km was negatively related to K. Our findings suggest ravens have capitalized on human subsidies to expand into sagebrush ecosystems. This has put them at odds with sensitive species that inhabit sagebrush ecosystems that did not historically house as many ravens.

Factors influencing common raven occurrence and density across cold-desert sagebrush ecosystems of the southwestern US

Shawn O'Neil[1], Peter Coates[1], Brianne Brussee[1], Pat Jackson[2], and David Delehanty[3]
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Common ravens (Corvus corax) are a predator of eggs and chicks of numerous species including greater sage-grouse (Centrocercus urophasianus). Raven abundance and distribution are increasing within sagebrush ecosystems as a result of anthropogenic resource subsidies. Despite concerns about subsequent predation pressure on sage-grouse,

broad-scale spatial information about raven populations remains lacking. We used hierarchical occupancy and distance sampling models to map raven density and distribution in response to natural and anthropogenic landscape covariates using >20,000 point count surveys occurring within the Great Basin region since 2007. Anthropogenic factors contributing to greater raven occurrence included increased road density, presence of transmission lines, agricultural activity, and presence of roadside rest areas. Natural landscape characteristics included lower elevations with greener vegetation (NDVI), greater stream and habitat edge densities, and lower percentages of big sagebrush (A. tridentate spp.). Many of these same environmental factors influenced spatial variation in raven density, although the effects varied by field site. Both raven occurrence and density tended to increase in valleys with networks of agricultural fields, ranches, roads, and distribution lines. These features likely subsidize local raven populations, which then move into more remote shrubland environments with negative consequences for sage-grouse populations. We used the relationships identified in our models to make predictions of raven density and distribution across the Great Basin landscape. We show how these model outputs can be used to guide management decisions at multiple spatial scales, where raven distributions overlap with breeding sage-grouse concentration areas and evidently suppress sage-grouse nest success. Findings are preliminary and provided for timely best science.

Common raven movement and space use: influence of nearby anthropogenic subsidies within greater sage-grouse nesting habitat

Seth Harju[1], Chad Olsen[2], Jennifer Hess[2], Bryan Bedrosian[3]
[1]Heron Ecological LLC P.O. Box 235 Kingston, ID, 83839, seth@heronecological.com, [2]HWA Wildlife Consultants, LLC, 2308 S. 8th St., Laramie, WY 82071, chad@hwa-wildlife.com, jenn@hwa-wildlife.com, [3]Teton Raptor Center, P.O. Box 1805, Wilson, WY 83014, bryan@tetonraptorcenter.org.

Common raven (Corvus corax; hereafter 'raven') populations have increased dramatically in the western United States in recent years. Ravens benefit from human resources and are known predators of other avian species. We developed a raven study to determine how primary (large-scale, high food density, and temporally consistent) anthropogenic subsidies influenced raven movement and space use during the raven and greater sage-grouse (Centrocercus urophasianus) breeding season. We also examined how movement, space use, and anthropogenic subsidization differed among breeding, post-successful breeding, post-failed breeding, and non-breeding ravens in different breeding statuses. Twenty ravens were captured and GPS-tagged between 2012 and 2014. We found that breeding ravens overwhelmingly built nests on anthropogenic structures (81-94%) and subsequently used small portions of the landscape intensively. Movement of non-breeding ravens (distance average = 2783 m/hr) and ravens who had failed nests (distance average = 1357 m/hr) ranged widely. Breeding ravens visited highways and railroads inversely proportional to the distance between the nest and the nearest highway/railroad. Non-breeding ravens regularly visited landfills and transfer stations, but breeding ravens did not (<0.1% of locations). We found that non-breeding ravens travel widely to utilize primary point source subsides, breeding ravens focus on areas near the nest, and ravens with failed nests switch to movement behaviors and space use similar to wide-ranging non-breeding ravens. These findings have implications for management of ravens and anthropogenic subsidies in sagebrush landscapes to potentially reduce depredation of greater sage-grouse nests

Raven nest site selection in the sagebrush-steppe

Lindsey Perry[1], Terrah Owens[1], Jonathan Dinkins[1], Lee Foster[2], Jacqueline Cupples[3], Jimmy Taylor[4]
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Common Ravens (Corvus corax; hereafter ravens) inhabit multiple ecosystems throughout most of North America, and populations throughout their range have been increasing over the past fifty years. Although not typically found in urban areas, they frequently utilize anthropogenic subsidies such as power lines and irrigation equipment for perching, nesting, and/or roosting. Anthropogenic nesting structures have allowed more breeding ravens to access ecosystems relatively devoid of nesting structure, such as sagebrush-steppe. Relatively smaller home ranges during the nesting period concentrates raven foraging, elevating predation pressure on nearby prey. Ravens are documented predators of several sensitive species including Greater Sage-Grouse (Centrocercus urophasianus; hereafter sage-

grouse) which has undergone multiple listing petitions through the Endangered Species Act. A sharp decline in sage-grouse numbers within the Baker Priority Area of Conservation (PAC) in eastern Oregon, and anecdotally high raven abundance, have prompted evaluation of raven ecology relative to sage-grouse habitat. Throughout the 2017, 2018 and 2019 nesting seasons, we found 2 nest locations from GPS-marked ravens and 110 nest locations from systematic searches of unmarked raven breeding pairs throughout the study area. Using a resource selection function, we evaluated habitat features at multiple spatial scales associated with nest site selection and created a predictive map of raven nest site use throughout the Baker sage-grouse PAC. We found 35 nests on anthropogenic structures and 77 nests on natural substrates. High use areas and anthropogenic substrates will be targeted for population manipulation efforts, to reduce raven nesting in sage-grouse habitat.

Common raven nest attraction and juvenile dispersal

Julia Brockman[1], Peter Coates[2], Pat Jackson[3], Perry Williams[1]
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Anthropogenic modifications to sagebrush ecosystems have contributed to increasing Common raven (Corvus corax) numbers throughout the Great Basin. Population increases have substantial negative impacts on prey species including species of conservation concern such as greater sage-grouse (Centrocercus urophasianus). Understanding intraspecific variation in raven space and resource use is crucial to raven population management and conservation of sensitive prey. We used GPS location data to estimate home range of ravens captured at multiple sites across Nevada from 2015-2019. Specifically, we investigated differences between breeding adults, juveniles, and individuals of unknown age-class. Additionally, we estimated points of attraction within individual home ranges using discrete-time animal movement models. We quantified breeding adult attraction to nests and investigated the probability and location of adults with an unknown breeding status having a nest. These techniques can also be used to model movement in relation to anthropogenic features. Finally, we examined juvenile dispersal. Juveniles dispersed from natal home ranges by fall each year and post-dispersal home ranges were larger than those of adults. Our results provide a foundation for investigating variation in resource use by outlining a method to (1) obtain more information about individuals of unknown age class and (2) estimate attraction to anthropogenic features. They also illustrate differences in space use between age-classes and highlight the importance of a multi-pronged approach to management of the species. This information is preliminary and provided as timely best science.

Contributed Session 2: Corvids (cont.)

Effects of common ravens on greater sage-grouse in the Great Basin region, USA

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Anthropogenic modification to ecosystems can result in the redistribution of species at higher trophic levels. Humans have re-organized predator-prey dynamics, namely by removing top predators and subsidizing more generalist mesocarnivore species. As a result, some mid-level predator species have increased in abundance and distribution, often to the detriment of lower-level species that are not adapted to increased predation rates. One example of a native avian predator that has experienced population increase following increased anthropogenic subsidization is the common raven (Corvus corax; hereafter, raven). The raven is a ubiquitous predator within sagebrush ecosystems in the western U.S., and may contribute to suppressed population growth in greater sage-grouse (Centrocercus urophasianus) through disruptions to lekking behavior and top-down influences on nest success and recruitment. Ravens have expanded in distribution and abundance, in large part due to increased resource subsidies from human infrastructure and land use activities. Concurrently, some sage-grouse populations appear to be in decline where habitat conditions should be promoting species persistence. Using long-term monitoring data on sage-grouse and ravens in the northern Great Basin region, we observed that 1) ravens disrupt

sage-grouse lekking behavior, 2) increased raven density is strongly associated with reduced sage-grouse nest success, and 3) that negative trends in lek counts may be associated with variation in raven occurrence and density. Taken together, these results suggest urgency to address a growing problem, as ravens continue to expand their distribution, facilitated by anthropogenic subsidies. These findings are preliminary and provided to meet the need for timely best science.

Spatial patterns in raven nestling diets and responses of breeding ravens and greater sage-grouse nest success following raven nest removal

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Common ravens (Corvus corax) are a generalist avian predator responsible for a wide variety of human-wildlife conflicts, including impacts on greater sage-grouse (Centrocercus urophasianus) populations via depredation of sage-grouse nests. We conducted two studies, one to assess spatial relationships between raven nest location and raven nestling diet and a second to assess both breeding raven space use and greater sage-grouse nest success in response to raven nest removal. We found that the proportion of raven nestling diet derived from herbivore carrion decreased from 70.2% to 47.7% with increasing distance from highways/railroads. The proportion of nestling diets comprised of avian chicks/eggs declined by a factor of 0.869 for every kilometer that the raven nest was from an active sage-grouse lek. In the nest removal experiment we found that breeding ravens and breeding sage-grouse showed high overlap in crepuscular movement patterns whereas nonbreeding ravens showed minimal diurnal variation in movement rates. Following removal of active raven nests, we found that breeding ravens dramatically switched to high and variable movement rates whereas untreated breeding ravens showed regular movement until fledging over the same time period. We also found that sage-grouse nest success was 2-5 times higher in portions of the landscape where raven nests were removed than in the same landscape where raven nests were untreated, but only in our study area with previously-documented high rates of raven predation on sage-grouse nests. In our study area with previously-documented high rates of both coyote and raven depredation, we found no impact of raven nest removal. These results suggest that where ravens are primary sage-grouse nest predators, raven nest removal may improve sage-grouse nest success via switching how ravens use space and forage on the landscape.

Reproductive success of common ravens influences their prey: implications for egg-oiling techniques

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A contemporary and prominent increase in Common Raven (Corvus corax) numbers across western North America is characteristic of subsidized predator populations of the Anthropocene, and effective management actions are needed to alleviate increased predation impacts on sensitive prey species. Despite the need for non-lethal management strategies, findings from well-designed studies are lacking. Oiling of raven eggs (hereafter; egg-oiling), a technique designed to prevent hatching, offers two major advantages: (1) limits recruitment of juvenile ravens into populations, and (2) reduces predation of sensitive species by eliminating the need of breeding adults to acquire food for their young. Here, we present three independent studies underway to investigate the impacts of egg-oiling in three unique ecosystems, including coastal California, the Mojave Desert, and sagebrush ecosystems within the Great Basin. Our two general objectives across these studies were to: 1) estimate effects of egg-oiling on raven reproductive success, using a mixture of ground, pole, and drone applications; and 2) estimate subsequent impacts of this management action on the survival of targeted prey species. First, we present results from a 6-year study using remote videography on nests of ravens and their prey, black-crowned night-herons, Nycticorax nycticorax), on Alcatraz Island. Results revealed that predation rates on night-heron nests and chicks decreased during years with raven egg-oiling. Within the Mojave Desert, initial findings indicate hatchability of ravens, as well as predation rates

on desert tortoise (Gopherus agassizii), were substantially reduced within areas of egg-oiling. Finally, within sagebrush ecosystems, initial findings indicate greater sage-grouse (Centrocercus urophasianus) nest survival increased by approximately 20% following egg-oiling relative to control sites. These published and preliminary results from three independent studies reveal that egg-oiling can be a viable localized method to reduce raven recruitment and may aid in the conservation of sensitive species. Findings are preliminary and provided for timely best science.

Novel management tools for subsidized avian predators and a case study in the conservation of a threatened species

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Wildlife managers face complex problems in attempting to achieve contemporary conservation goals while maintaining ecosystem function. As human development expands across the US, subsequent alteration of wildlife habitats can subsidize certain species, causing overabundance of those species better adapted to coexist with human infrastructures. Our team has been meshing practical field technologies with theoretical modeling to provide a complementary toolset aimed at ecological rebalancing despite anthropogenic expansion. Our field tool (Remote Fluid Application System; RFAS) is a novel technology that is used for the oiling of bird eggs, remotely from the ground, to reduce population growth of, and predation pressure by, anthropogenically subsidized and problematic pest bird species. To scale this application, we developed a theoretical tool (StallPOPd) which is an interactive software program used to prescribe the level of survival reduction necessary to counterbalance pest bird population expansion. Together, this toolset provides a novel and increasingly preferable alternative to managers seeking to combat bird damage in critical wildlife or human development areas. We demonstrate the use of this toolset in the case study of the common raven (Corvus corax) in Desert Tortoise Critical Habitat Units of the southwestern US. We highlight that the RFAS achieved the goal of reduced reproductive output on either artificial or natural nest substrates. We discuss the pragmatic scalability of these tools to remote egg oiling in larger geographic areas, plus the transferability of these tools to aid in avian pest management in other critical wildlife systems, or to minimize bird damage at other human-wildlife interfaces. We conclude that the combination of our RFAS technology and StallPOPd software are rapidly becoming an alternative of great interest for managers faced with increasing level of undesirable bird damage.

Contributed Session 3: Corvids (cont.)

Effects of common raven removal and weather on greater sage-grouse nesting success and lek counts

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Common raven (Corvus corax; hereafter, raven) abundance has increased throughout western North America throughout the last century. This has resulted in ravens conflicting with numerous sensitive species, including greater sage-grouse (Centrocercus urophasianus; hereafter, sage-grouse), in areas that were previously poorer raven habitat. Meanwhile, predator removal has been simultaneously proposed and criticized as a mitigation measure for low reproductive rates of prey species, such as sage-grouse. In Wyoming, lethal removal of ravens was conducted by USDA/APHIS/Wildlife Services (WS) for the protection of livestock. During 2008–2017, we evaluated sage-grouse nest success and lek counts in study sites where (1) WS initiated a raven removal program and (2) WS did not manipulate ravens. Precipitation and temperature were analyzed as sources of annual variation in nest success and lek counts. Over the course of our study, raven densities decreased at study sites with WS raven removal, while sage-grouse nest success and lek counts in those study sites were higher during years with reduced raven density. Temperature effects on nest success were dependent on timing with successful nests having cooler temperatures prior to the nesting season (conditions promoting water retention and grass growth) and warmer temperatures the week before nest fate (conducive to degradation of sage-grouse odorants used by mammalian predators). Cooler temperatures and more precipitation were associated with more adult males on leks. Cooler temperatures and more

precipitation probably increased the survival of sage? Grouse chicks indirectly by increasing their forage. Raven removal may have a place in sage-grouse management as an interim mitigation measure when sage-grouse populations are subjected to high densities of ravens. However, long-term solutions are necessary, such as reducing supplemental food sources and perch structures used by ravens.

Reducing common raven depredation pressure on the Mojave Desert tortoise

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Common Raven (Corvus corax) populations have grown exponentially across much of western North America. This population explosion has been fueled by the ever increasing availability of anthropogenic subsidies. Between 1970 and 2010, Breeding Bird Surveys recorded a 700 percent increase in the number of Common Ravens inhabiting California's deserts. Consequently, Common Raven depredation has contributed to the decline of avian and reptilian species abundance and local diversity. Common Raven depredation of the Mojave desert tortoise (Gopherus agassizii) has caused the number of 3 to 9 year-old (i.e., 60 to 120-mm mid-line carapace length) tortoises to decline precipitously, thus shifting the demography of these populations in favor of larger, older adult animals. In 2008, the Fish and Wildlife Service in partnership with the Raven Subgroup of the Desert Managers Group published an Environmental Assessment (EA) to enable implementation of a phased Raven Management Program, designed to reduce Common Raven depredation pressure on the Mojave desert tortoise in California's Deserts by at least 75 percent. A phased approach ensured that all nonlethal Common Raven management options were exhausted before broad-scale Common Raven removal is considered. As part of phases I & II the Raven Subgroup is implementing an environmental education program, wildlife-proof trash-receptacles installation program, road kill removal program, landfill soil-capping program, low power green lasers hazing program, Common Raven egg oiling program, and Common Raven Removal program for all ravens associated with a tortoise depredation. We are also in the process of analyzing all raven management data collected between 2013 and 2018, which will provide us with a comprehensive database of identified Common Raven nests and a better understanding of the spatial dynamics of Common Raven depredation. My presentation will expand on each of the above Common Raven Management programs and provide a glimpse of our future management and monitoring efforts.

A tiered management approach to reduce raven impacts on sensitive species

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Common raven (Corvus corax) populations have increased drastically in recent decades within the Great Basin, primarily as a result of landscape alterations and anthropogenic resource subsidies, including alternative food, perching, and nesting substrates. Despite growing evidence of ravens adversely impacting numerous sensitive prey species, detailed raven assessments within ecosystems, as well as multi-pronged management approaches are deficient. Although lethal removal of ravens can provide short-term positive responses of their prey, a multi-faceted approach that encompasses habitat improvements and reduces anthropogenic subsidies will likely be most effective as a long-term management strategy. Thus, we provide an applied example of a multi-tier management approach that employs a rapid survey and ecological predator-prey thresholds to help guide management actions that ameliorate predicted impacts of ravens on sensitive prey species. We focus our example on greater sage-grouse (Centrocercus urophasianus), as this species is often considered an indicator for the health of sagebrush ecosystems and has recently become central to state and federal land management actions. Our framework is objective-based and engages three tiers of management actions, namely: (1) improvement to sensitive prey habitat that reduces probability of predation by ravens; (2) reduction of access to anthropogenic resource subsidies that provide alternative food sources (e.g., roadkill, landfills) and perching and nesting substrates (e.g., power lines); and (3)

lethal techniques at various life stages (e.g., egg-oiling techniques and application of DRC-1339). We demonstrate the use of multiple quantitative tools that guide the assignment of tiers and facilitates movement among tiers based on post-management raven assessments, which the ultimate goal of reducing impacts of ravens on greater sage-grouse populations at broad spatial scales. This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science and should not be cited as conclusive.

Contributed Plenary: Blackbirds

A review of potential climate change impacts on blackbird distributions in North America

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Climate change is occurring at rate faster than what has been observed in recorded history. Consequences of climate change include rising global temperatures, extreme precipitation events which could affect land use, and ocean acidification. While it is uncertain how these changes will affect blackbirds, understanding how blackbirds respond to changes in these variables is important for making predictions about future population dynamics. We reviewed and synthesized existing literature on the influences of weather and land use variables on blackbird life history and population dynamics. Weather variables such as temperature can affect food supplies and precipitation can affect the amount of wetland habitat in the landscape which is important for multiple blackbird species. Blackbirds, especially yellow-headed blackbirds, are likely adapted to highly unstable interannual precipitation leading to inconsistent wetland conditions. Lethal levels of temperature are likely to become more common in the southern portion of the U.S. as the century progresses, pushing breeding season distribution northward. However, this northward movement can only be possible if suitable habitat conditions exist. Long-term precipitation forecasts are mixed, but most suggest increased precipitation in the central U.S., which should be a boon to blackbirds and the habitats they require. Despite this research, it is still unclear to what extent the synergistic effects of a changing climate and land use will have on blackbird populations as anthropogenic land change will ultimately be a large influence on the amount of suitable habitat for blackbirds.

Sunflower losses to blackbirds: an economic burden

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Sunflower emerged as an important crop in the Upper Midwest in the late seventies. Sunflower is produced for its high oil content; the kernel or nut is used as an ingredient in many foods and the whole seed is a primary ingredient in bird food. However, blackbird damage to maturing sunflower is a serious threat to the future of the crop. Farmers have very few effective tools to control damage. In most cases weeds can be efficiently controlled by a 'one pass' application of an herbicide. No such tool exists in protecting sunflower fields from blackbirds. An integrated approach of harassment utilizing propane cannons, pyrotechnics and shotguns continues to be the most common method. But this type of harassment simply moves the problem to a nearby field, perhaps owned by the same farmer. Most farmers do not have the time or patience to harass blackbirds twice a day for six weeks. Their alternative is to accept a level of damage or to plant alternate crops. Many farmers have chosen the latter. Sunflower acreage in the Dakotas and western Minnesota has declined precipitously in the last five years resulting in a loss of markets and income.

Contributed Session 4: Blackbirds

Imperfect data: offering the best available objective data for NEPA compliance
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The National Environmental Policy Act (NEPA) requires federal agencies to examine the direct, indirect, and cumulative impact of their proposed actions on the human environment. Typically, Chapter 3 of Environmental Assessments provides a comparative analysis of these actions and discusses information pertinent to making an informed selection among the identified alternatives. When analyzing bird species population estimates, WS-Colorado used the best data available and compared the data quality for each source. Bird populations were evaluated using trend data derived from Breeding Bird Survey, Christmas Bird Count, Partners in Flight Landbird Population Estimates Database (version 2.0), the Bird Conservancy of the Rockies (Rocky Mountain Avian Data Center), and scientific publications. In the analysis, we clearly explain the inherent problems associated with each dataset to the reader while allowing them to examine all available data. Other factors are also objectively explained including: natural factors that limit bird population, the decline of North American aviafauna, additive and compensatory mortality, logistical growth of bird populations, and individual bird species life tables. Through a more thorough and detailed analysis, all agencies, cooperators, stakeholders, and individuals can use the best available data to generate an informed decision on proposed management actions.

Measuring bird damage to three fruit crops: a comparison of grower and field estimates
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Birds are common pests in fruit orchards. They frequently consume and damage fruit resulting in decreased yields for growers. The true extent of damage is difficult to measure. Producer surveys are often implemented to estimate damage, but the accuracy of these estimates is uncertain. We compared damage estimates obtained through field studies with estimates from a producer survey for three fruit crops: wine grapes, sweet cherries, and 'Honeycrisp' apples. We also analyzed relationships between use of various damage management methods and levels of bird damage. We found wine grape and sweet cherry growers accurately assessed bird damage, while 'Honeycrisp' apple growers may overestimate damage. Growing region appears to be an important damage predictor for wine grape and sweet cherry crops. Significant relationships between management methods and damage were positive, suggesting growers only use these methods when bird damage is substantial.

Blackbird research in North America: a review
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We briefly recount the history of applied blackbird research and management in North America. Since the 1950s, scientists and managers have collaborated to develop methods to reduce blackbird (Icteridae) damage to crops and to manage large winter roosts that create a nuisance and public health problems. This is a testament to the challenging nature of dealing with abundant and highly mobile birds. All federal actions developed to mitigate bird damage must be acceptable within the legal framework of The Migratory Bird Treaty Bird Act of 1918. Blackbirds may be legally killed in the USA under the Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43). Canada has similar regulations. Further, proposed federal actions must be analyzed for environmental impacts as required by the National Environmental Policy Act. Within these limitations, investigators have tested chemical frightening agents and repellents; mechanical scare devices; bird-resistant crops; habitat management; and population management of blackbirds. Cultural modifications or changes in the agricultural practices, including alternative feeding sites (i.e., wildlife conservation food plots [WCFP], decoy crops) and desiccants to advance harvest have also been explored. Of these, we believe that harvest advancement through desiccation, WCFP, and

habitat management should form the foundation of any blackbird management scheme that might also include a suite of harassment techniques. These methods help reduce damage by manipulating the environment within and surrounding crop fields to alter bird distribution or behavior. Strategies and methods developed to date provide a foundation for new and improved management techniques to meet the challenges of consumers seeking organically grown foods, public environmental concerns in light of bird population declines, climate change, and human population growth. Details can be found in "Linz GM, Avery ML, Dolbeer RA. 2017. Ecology and management of blackbirds in North America. Boca Raton (FL) CRC Press."

Operational blackbird damage management assistance in North Dakota

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Annually, migrating blackbirds threaten heavy economic losses on North Dakota's sunflower yield, worth an estimated $127 million. In previous years, direct economic losses to North Dakota's some 7000 sunflower producers from blackbirds have reached as high as $10.7 million annually. To mitigate this annual blackbird damage, USDA, Wildlife Services works in cooperation with producers to employ an integrated management approach, using multiple methods, such as a variety of pyrotechnics, propane cannon's, shotguns and drones to haze and disrupt persistent blackbirds. A variety of drones are being tested operationally to assist in hazing efforts. Wildlife Services personnel have fabricated a new propane canon base plate to enable the cannons to be elevated off the ground to provide more effective sound projection and to protect the cannons from field mice damage. This challenging conflict, like many, doesn't have a "silver bullet" resolve, but Wildlife Services Operations continue to develop new techniques and modify existing tools to enhance efforts to reduce damage from migrating blackbirds.

Repellent development for blackbird damage management

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Non-lethal alternatives are needed to alleviate agricultural damage caused by wild birds, particularly blackbird species. In recent decades few novel alternatives have been developed. The discovery phase of our non-lethal repellents research has been on-going since 1950. In the last decade, the progress of our research project includes the development of repellent formulations for wild birds. Although repellents can provide a non-lethal option for managing agricultural depredation, the effectiveness of avian repellents is dependent upon their efficacy under field conditions, cost relative to expected damages of unmanaged crops, environmental impacts, and food and feed safety. There is a need for optimized repellent formulations and application strategies for the protection of newly-planted and ripening crops in the context of these economic, environmental, and safety considerations. Our research regarding avian repellents and visual cues has resulted in new formulations currently under development that are based upon repellent efficacy data and species-specific visual ecology. We will summarize the results of studies conducted with red-winged blackbirds that illustrate the development of these new formulations, which provide increased repellency at lower concentrations of the active ingredient plus specific combinations of visual cues.

Are avian laser-deterrents safe? A study on how visual foraging is affected by laser exposure

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Lasers are used to deter birds from crops, airports, etc. Laser exposure can cause eye injury in humans, but little is known about the effects on birds. We conducted a controlled study with house sparrows facing a foraging task with two backgrounds before and after being exposed to a laser with different energy output. After laser exposure, individuals reduced the amount of time using their binocular vision and the rate of high-acuity vision fixations compared to before exposure. Considering only the after exposure period, individuals exposed to more powerful lasers

increased their use of high-acuity vision while searching for food likely as a compensatory mechanism. Additionally, when food was more difficult to detect, individuals reduced their scan time and increased the time using a combo of binocular + high acuity vision to search for food, but this effect was not apparent when the food was easy to detect. These findings suggest that laser exposure to high-energy output laser units could constrain visual function in birds due to potential retinal injury. Further research is necessary to regulate the use of lasers for bird control and minimize potential injuries to native species.

Contributed Session 5: Blackbirds (cont.)

Can trapping be a feasible alternative to DRC-1339 for starling control?
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European starlings (Sturnus vulgaris) are an invasive species in the United States that cause a significant amount of damage to property and threaten human health and safety. The USDA-APHIS-Wildlife Services (WS) Program is often requested to assist in reducing starling numbers at Concentrated Animal Feeding Operation (CAFO), landfills, utilities, and urban areas. WS uses DRC-1339 to cost-effectively remove starlings and reduce damage. There may be a need for an alternative to DRC-1339 in situations where supplies run short or a cooperator requests non-chemical options. Trapping can be an effective tool in reducing starling numbers but historically required more time and cost than DRC-1339. This research takes another look at several starling traps in an attempt to develop an effective trap that could be a feasible option to DRC-1339.

Management of the brown-headed cowbird: implications for endangered species and agricultural damage mitigation
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The Brown-headed Cowbird (Molothrus ater) is unique among North American blackbirds because it is managed for both its negative effects on endangered songbird species in addition to the losses it causes from crop depredation. The cowbird is one of over 100 species of obligate avian brood parasites that lay their eggs in the nests of other birds and rely on these hosts to care for their young. Most hosts of the cowbird raise fewer of their own young when parasitized and in some cases, they raise only the cowbird and none of their own offspring. Brood parasitism is one of many factors that can limit a population and only becomes a management concern when it affects threatened or endangered species. The typical response in these cases has been to cull cowbirds with relatively little success in restoring populations or addressing the ultimate cause of the population declines. Similar to other North American blackbirds, cowbirds depredate agricultural crops albeit at a significantly lower rate than the other blackbird species. Little information exists on the amount of damage caused by cowbirds, but despite this, cowbirds are killed to reduce losses. Management of cowbirds for endangered species and agricultural damage mitigation have often been based on misinformation. In this paper, we address these myths, offer alternative solutions and directions for future research.

Behavior of European starlings (Stumus vulgaris) in three landscapes
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We tracked movements and use of habitats by radio tagged European starlings (Sturnus vulgaris) in six individual studies conducted during fall and winter. Four studies involved confined animal feeding operations (CAFO), two in rural landscapes (beef feedlots) and two in exurban landscapes (localized aggregate of small dairies, game bird farm). Two involved roosts in urban landscapes. We used fixed- and mobile receiving systems. Typically, daily activity centers (DAC) were small-sized (<50 km2) and located near anthropogenic sources of food (landfills,

granaries, abattoirs, and CAFOs). Site fidelity to DACs was strong, with mid-morning arrivals and late-afternoon departures. Urban roosts often had DACs in industrial zones and suburban areas <15 km from the roosting sites. Roosts in downtown areas exchanged members with nearby major roosts (>100,000 birds) underneath transportation overpasses, in secluded tree stands within industrial zones, and on international airport grounds. Exurban DACs had a greater diversity of habitats, including small towns, hobby farms and fairgrounds, and expansive grassy areas of residential estates, local airports, and recreational parks. Major roosts were found in wetlands in industrial zones 20 to 40 km from exurban DACs. Small roosts, closer to exurban DACs, were found in stands of conifers, lowland drainage areas, barns and other outbuildings, and towns. Rural DACs were often near open-trough CAFOs. Major roosts were found at wildlife refuges, reservoirs, and oil refineries 20 to 40 km away. No rural CAFOs were used as major roosts. Visits and switched affiliations occurred with nearby (<20 km) rural CAFOs. Starlings baited with DRC-1339 in rural and exurban landscapes may travel over small towns, suburbs, and urban areas while returning to outlying major roosts. Wildlife managers and government officials administering the toxicant should prior to baiting alert the public of possible encounters with large numbers of affected or deceased birds.

Human-blackbird conflict in North America: current directions in avian damage management research
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Avian species able to adapt to agricultural landscapes often reach pest levels resulting in producers seeking tools or methods to reduce damage. For example, blackbirds (Icteridae) cause significant damage to sunflower (*Helianthus annuus*) with damage estimates of $US3.5 million annually in the Prairie Pothole Region of North Dakota. Additional crops impacted by large blackbird flocks include corn located near post-breeding roosts and along fall migration routes and rice at overwintering locations and along spring migrations routes. Many tactics have been tested and used to reduce blackbird damage to crops, including physical frightening devices (cannons, pyrotechnics, drones), non-lethal chemical repellents (methyl anthranilate), decoy crops (alternative food), habitat modification (cattail reduction), cultural modification (timing and siting of sunflower crops), and lethal removal (shooting and toxicants). In this talk we will discuss research directions exploring new tools along with the innovative technologies and approaches for tool deployment. We will also address how understanding the spatial and temporal behavior of red-winged blackbirds across the annual cycle and distribution of crop damage on the landscape can further inform tool deployment and efficacy. Continued progress in acquisition of baseline biological knowledge and the impacts of methods and tools on blackbird populations are needed at local, regional, and national scales.

Contributed Plenary: Vultures

Vultures, starlings, and blackbirds pose unique challenges for aviation safety in North America
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There is a strong correlation between bird size (mass) and the likelihood of aircraft damage during a bird-aircraft collision (strike). Thus, the U.S. Federal Aviation Administration has established airworthiness standards for engines, airframes, and windshields by aircraft and engine type related to bird mass. With the exception of the empennage and certain large turbofan engines used on transport aircraft, a bird mass of 1.8 kg (4 lbs) is the maximum size evaluated for certification. Failure of components after striking a bird mass >1.8 kg is acceptable. Of the 42 bird species in North America with mean body masses >1.8 kg and at least 1 bird strike reported for civil aircraft, 1990-2018, turkey and black vultures (*Cathartes aura*, *Coragyps atratus*) rank 2 and 3 (behind Canada geese, *Branta canadensis*) with the most damaging strikes. This high damage ranking is related not only to the body masses of these species but also to the dramatic increase in their populations in North America. From 1990-2008, the turkey vulture population increased an estimated 2.2 fold from 4.8 million to 10.5 million; black vultures increased 4.5-fold from 0.6 million to 2.8 million. In contrast to vultures, European starlings (*Sturnus vulgaris*) and blackbirds (Icteridae) typically have body masses from 0.05 kg to 0.12 kg. In addition, starlings and most species of blackbirds have shown significant population declines since the 1970s. However, unlike vultures in which <5% of strikes involve 2 (and rarely more) birds, strikes with starlings/blackbirds sometimes involve large, dense flocks of

>100 birds which greatly exceeds the 1.8-kg standard. In fact, the 2 bird strike events worldwide that have caused the greatest loss of human life in civil and military aircraft were caused by European starlings. Progress is being made to mitigate the threat from vultures, starlings, and blackbirds by aggressive management programs to keep these birds away from airport properties. However, these actions do little to mitigate the threat during climb, approach, and enroute phases of flight when most vulture strikes occur. Likewise, strikes involving starlings/blackbirds sometimes involve flight lines of birds moving across arrival and departure airspace. Because wildlife management options to mitigate these off-airport strikes are limited, enhanced airworthiness standards for aircraft engines and airframes, bird-detecting radar to provide real-time warnings of bird activity, and aircraft lighting schemes to enhance visibility of aircraft to birds should be key components of an integrated safety management system for birds and aviation.

Contributed Session 6: Vultures

Vultures, landfills, and airports: an ominous combination

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The Federal Aviation Administration recommends at least a 5-mile separation distance between airports and municipal solid waste landfills if such facilities attract birds into arrival/departure airspace. Any land-use near airports that attracts black and turkey vultures is of particular concern because these species exceed the body mass limits (4 lbs) required for certification of most aircraft components. Furthermore, strikes with vultures are more likely to cause damage relative to other birds of comparable body masses because vultures are typically struck at greater heights above ground level where aircraft are traveling at greater velocities. Of additional concern is that black and turkey vulture populations have exhibited 3- to 4-fold population increases in North America during the past 50 years. In 2004, we conducted a study to assess the potential for vulture – aircraft interactions at a proposed landfill site 4 miles from the Villahermosa International Airport (VIA) in Mexico. We did bird surveys at the existing landfill (scheduled for closure) located 13 miles from VIA and estimated the height of soaring vultures over the landfill using photography. We found that during midday, several thousand vultures soared at heights of 1,000-2,000 feet AGL above the landfill. At a distance of 4 miles from VIA, this would put thousands of vultures in the same height zone as arriving and departing aircraft. Based on these data, we strongly recommended against relocating the landfill from its existing site to any distance closer to the airport. We also recommended that the existing landfill be managed to reduce exposure of garbage to vultures. These recommendations were accepted.

Black vulture conflict in North America: current and needed research, with an emphasis on damage to agriculture

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Black vultures (*Coragyps atratus*) provide an important ecological services as scavengers, clearing the environment of carrion and potentially reducing disease transmission rates. Unlike the majority of vulture species worldwide, black vultures are increasing in both abundance and distribution. For example, while previously endemic to the southeastern US, black vulture populations have expanded their range over the last several decades into many Midwestern States. Black vultures can cause property damage, risks to human health and safety, and livestock predation. Advancements toward increasing our understanding of black vulture ecology and management have been achieved, and include recommendations to abate collision risk at/near airfields, development of means to disperse vultures from roost sights, determining behavioral and ecological differences between black and turkey vultures, and development of allowable take models to help inform the decisions of migratory bird management agencies. However, information is still lacking in greater ecological context on how to manage populations across varying landscapes, climatic seasons, and agricultural practices. Here, we provide a brief overview of the state of knowledge regarding black vulture ecology management, with an emphasis on the black vulture-livestock conflict. Continued progress in acquisition of baseline biological knowledge and the development and rigorous

testing of tools are needed at local, regional, and national scales. We conclude by briefly describing the objectives of a new collaboration that is just beginning in Indiana and discuss how this work will address some of the critical gaps regarding the greater ecological context for black vultures.

Allowable take: modeling and data needs for science-based assessments

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Abundant bird species can conflict with agriculture and other human activities. When nonlethal methods to reduce conflict are exhausted, lethal methods are sometimes employed, provided the take is consistent with conservation principles under various statutes. We used discrete logistic population models in combination with population-specific estimates of maximum annual growth rate (r_{max}) and population size to estimate annual allowable take for regional populations of Black Vultures (*Coragyps atratus*) and Red-winged Blackbirds (*Agelaius phoeniceus*). This framework for assessment of allowable take draws on harvest theory, with which managers can use predictive models to sustainably manage populations below their carrying capacity. We describe the models used in these analyses, the population and demographic data that can be employed to parametrize the models, and the complications associated with scale and heterogeneity in widely-distributed bird populations. Our analyses rely on synthesis of demographic data from the literature and survival estimates from banding data to estimate r_{max}, but direct estimation of the parameter may be possible for populations that experience fluctuations or range expansions that leave them far below carrying capacity. Large-scale population monitoring programs such as the North American Breeding Bird Survey (BBS) provide a reasonable source of information on population change of species, but not of absolute population size, because detectability of birds is not estimated as part of this survey. BBS data can be used to estimate population size by either adjusting the data for factors influencing detection or by calibrating it with actual population estimates from a more intensive local study. We discuss the prospects for using derived estimates of population size from BBS and other surveys in allowable take modeling, and discuss complexities associated with geographic scale and demography in implementing allowable take programs.

Federal/State/Private Cooperation in Managing Black Vulture Damages to Livestock

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USDA-APHIS-Wildlife Services (WS) in Tennessee and Kentucky continues to provide assistance in managing black vulture damages to livestock in cooperation with the USFWS, Tennessee Farm Bureau, and Kentucky Farm Bureau. The project also collaborates with the Tennessee Wildlife Resources Agency and the Kentucky Department of Fish and Wildlife Resources. The collaborative project in both states allow livestock producers to receive sub-permits for lethal control under the Farm Bureau's USFWS Depredation permit. The majority of permit requests are granted on the same day they are received. WS provides technical assistance and serves as the liaison between Farm Bureau and the USFWS and continues to provide operational control on larger, more complex black vulture issues when the sub-permit system fails to provide adequate resolution to the predation. The majority of sub-permittees are issued authority to take less than 5 birds each. Additionally, most producers utilize birds taken under their sub-permit as effigy components of an integrated management program. The combination of harassment, lethal shooting and effigy use have been effective deterrents in many cases. The true value of the program is that it provides livestock producers the legal ability to protect their livestock in an expedited manner.

Benign acoustic bird deterrence in a marine environment

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This case study presents the scope and results of using SonicNets in a marine environment at a joint commercial and military-use airfield at Iwakuni, Japan (IWK). SonicNets is a benign acoustic deterrent developed at the College of William and Mary that interferes with avian communication. The 54 acre north retention pond at IWK is adjacent to the northern edge of the runway, and is a foraging area for a large number of high-risk bird species including ospreys, cormorants, herons, egrets and ducks. Bird strikes on aircraft are a common problem, including a recent strike on an F-35 jet fighter causing $2 million in damage. IWK has had an extensive BASH-team effort to reduce the potential for bird strikes that includes multi-year surveys of bird populations making IWK ideal for a study of the effectiveness of new deterrent technology. SonicNets was deployed to deter birds from the north retention pond using shore and raft-based solar powered units starting in July 2019, with bird population results tallied through January 2020. The data indicate that SonicNets reduced the bird presence in and around the pond by over 95% as compared to previous years' numbers.

Contributed Posters

Corvids:

Reducing the impact of common ravens on greater sage-grouse through egg oiling

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Common raven (Corvus corax) populations have increased across western North America in recent decades concomitantly with increases in the availability of anthropogenic resources which provide them with nesting and food substrates. Concurrently, Greater sage-grouse (Centrocercus urophasianus, sage-grouse) populations have experienced substantial declines in distribution and abundance. Ravens have been linked to population declines for several species of conservation concern and are now an important nest-predator of sage-grouse. Managed reduction of raven nest success could ameliorate raven effects on nesting grouse if raven foraging is suppressed as a result of nest failure relative to breeding ravens that are provisioning chicks. We hypothesize that reducing raven reproductive success through egg-oiling treatments, which causes eggs to become inviable, will improve sage-grouse nest survival. In 2019, we oiled raven eggs at two treatment sites using ground-based and drone application methods and did not oil eggs at four control sites as part of a before-after-control-impact experimental design. Sage-grouse nest survival was estimated during the treatment year at all sites as well as three years before initiation of treatments. Additionally, we measured incubation patterns of ravens to identify impacts of egg-oiling on incubation recesses, constancy (% time incubating eggs), and duration. Preliminary results indicate an average increase in sage-grouse nest survival by approximately 21% at treatment sites while control sites either declined in survival or did not change. Results will be used to develop management actions for reducing the impact of ravens on sage-grouse and other sensitive prey and potentially provide novel insights into raven breeding biology. Findings are preliminary and provided to meet the need for timely best science.

Blackbirds:

The economic impacts of blackbird (Icteridae) damage to sunflower in the USA

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BACKGROUND: Blackbird (Icteridae) damage to ripening sunflower (Helianthus annuus L.) has been a persistent economic issue in the USA for the last five decades. To quantify losses, we surveyed blackbird damage from 2001 to 2013 (excluding 2004) to physiologically mature sunflower in eight states: North Dakota, South Dakota, Texas, Nebraska, Minnesota, Colorado, Kansas, and Vermont. RESULTS:We pooled data gathered during the most recent 5 years (2009 to 2013) of the survey and found losses averaged $US2.5 million and $US11.3 million for confectionery and oilseed hybrids, respectively. Three states, North Dakota, South Dakota, and Nebraska, had sufficient acreage and bird damage to warrant economic analyses using a regional economic model. The average annual total (direct plus indirect) economic impact of bird damage to sunflower production for North Dakota, South Dakota, and Nebraska was $US18.7million, $US7.3 million, and $US2.6million, respectively. CONCLUSION: This study provides a better understanding of the broader economic implications of bird damage to sunflower by estimating the macroeconomic impacts of lost sunflower production in the region. Additionally, the findings of this study may be used to inform decisions regarding bird management policy by providing policymakers with information to determine the downstream value of bird management and the possible benefits of improved methods that further mitigate losses.

Economic and livestock health impacts of birds on dairies: evidence from a survey of Washington dairy operators

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The survey described in this research paper aimed to investigate the economic and health impacts of birds on dairies. Birds are common pests on dairies, consuming and contaminating feed intended for cattle. As a result, dairy operators experience increased feed costs and increased pathogen and disease risk. We surveyed dairy operators attending the 2017 Washington Dairy Conference to examine the impact of birds on dairies in Washington State. Dairy operators reported feed losses valued at $55 per cow resulting in annual losses totaling $5.5 million in the Western region of the state and $9.2 million in the Eastern region of the state. Shooting was the most commonly used bird management method and European starlings (Sternus vulgaris) were the most frequently implicated species statewide. Bird abundance greater than 10,000 birds per day was associated with larger herd size and with self-reported presence of Johne's disease and Salmonella.

Typha (cattail) invasion in North America

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Typha (cattail) is an iconic wetland plant found worldwide. An abundance of wind-dispersed seeds allows Typha to colonize wetlands across great distances, and its rapid growth rate, large stature, and aggressive clonal propagation can result in dense monotypic stands. These stands have considerable impact on local fauna and flora, biogeochemical cycling, and wetland hydrology, which correspondingly impact wetland functions. Over recent decades, the distribution and abundance of Typha in North America has increased due to anthropogenic disturbances to wetland hydrology and nutrient loads. In addition, vigorous non-native and hybrid taxa have exacerbated the rapid spread of Typha. The invasion and expansion of Typha have required widespread management, albeit control is often short-lived or ineffective. Despite the negative impacts, Typha can provide beneficial ecosystem services including bioremediation to reduce pollution and providing biofuel feedstocks. Many of the underlying concepts about Typha are relevant to invasive species in other wetland ecosystems.

Factors influencing individual variation in production of fledgling red-winged blackbirds: does overwinter location influence reproduction in red-winged blackbirds?

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Red-winged blackbirds (Agelaius phoeniceus), and other blackbird species, cause $3.5 million of damage to sunflower crop and $1.3 million of damage to corn annually in North Dakota. While breeding populations of red-winged blackbirds are declining in many regions, populations in the Prairie Pothole Region of North Dakota, a location with high sunflower production, are remaining stable. Although many do not survive their first annual migration, young of year blackbirds represent a significant portion of the local late season population that depredates crops. Therefore, it is important to better understand the factors that influence reproductive success and the production of young birds in this species. To avoid harsh conditions at their breeding grounds, many birds, including blackbirds in North Dakota, migrate south during the winter. The environment on the overwintering grounds and/or migration distance may influence timing of breeding and reproductive success. Our research addresses the potential impact of overwinter location and migration on timing of arrival to the breeding grounds, pre-breeding reproductive hormones, timing of clutch initiation and reproductive success. We collected blood and claw samples from male and female red-winged blackbirds before breeding in the Alice Waterfowl Production Area in North Dakota. We measured estradiol and testosterone in females and testosterone levels in males. We estimated the migration distance of an individual using geolocators, hydrogen stable isotopes from distal claw tissue, and GPS data loggers. We found that males with shorter migration distances have higher baseline testosterone levels upon arrival. However, migration distance was not correlated with larger harems or the number of fledglings produced. Based on our sampling, female migration distance was not correlated with baseline estradiol and testosterone levels, number of eggs laid, timing of reproduction, or fledglings produced. Additional data are needed to better understand factors outside of the nesting period influencing production of this species.

Analysis of a blackbird roost using weather surveillance radar

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Weather surveillance radar (WSR) is increasingly used to monitor biological phenomena. The network of these radars in the United States is known as the next generation radar (NEXRAD) system. These radars have been used to study many airborne animals including bats, insects, and birds. Blackbirds are one of the most abundant and studied species of North American bird. While, surveillance radars were accessed to evaluate blackbird flocks over 60 years ago (Harper, 1958), little research has focused on detecting blackbird roosts using the NEXRAD system. Typically, NEXRAD does not detect blackbirds because they tend to fly below elevations scanned by NEXRAD radars (~500m). Near Bismarck, North Dakota, however, blackbird roost at sites within 20km of the NEXRAD (KBIS) site. This proximity makes it plausible to detect blackbirds at moderate elevations. To determine whether these roosts can be monitored by KBIS we compared biological scatter on radar to ground-truthed observations to confirm the identity of blackbirds. Our study evaluated to what extent flocks of blackbirds observed in the field appeared on radar. At one roost, we were able to routinely observe a morning exodus of blackbirds on radar as it coincided with field observations. Other roosts in the area were not detectable on radar. We have determined that being able to monitor blackbirds on radar in North Dakota is limited to their low flight heights and distance from the radar where they will literally be flying under the radar.

Evaluating the response of blackbird flocks to a precision agriculture spraying drone: future directions for avian repellent applications

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North Dakota sunflower producers face a unique dilemma when it comes to blackbird damage and depredation to their crops. The overall damage is generally at the accepted industry threshold of 5%, however an individual producer can experience total field losses due to bird damage. Dynamic and humane crop protection tools are needed to reduce large-scale blackbird damage, while considering the protected status of blackbirds. Recently, unmanned aircraft systems (hereafter referred to as drones) have been evaluated as a hazing tool for mitigating human-wildlife conflicts. In regard to the conflict between blackbirds and sunflower producers, an increased negative stimulus needs to be associated with the drone, given a single drone is not threatening to flocks exceeding 200 birds. The application of an avian repellent, via a large precision agriculture spraying drone (DJI Agras MG-1P; hereafter referred to as Agras), could be an increased negative stimulus, however the flock response to the platform needs to be evaluated so that an effective repellent application protocol can be developed. The objective of this study was to evaluate the flock response towards the approaching Agras during the damage window to sunflowers (September-October). Commercial sunflower fields were selected in the Prairie Pothole Region of North Dakota, and independent mixed blackbird flocks were evaluated on their response to the Agras approaching at a standard height above ground level (5 m AGL) and speed (4 m/s). The flight initiation distance was recorded from an eye-in-the-sky Phantom drone that was flying 50 m above the Agras. We recorded flock size, field size, time of day, temperature, and wind speed as explanatory variables influencing flight initiation distance. Understanding flight initiation distance and other behavioral responses to the Agras will be fundamental in developing a protocol to effectively administer secondary tools to reduce agricultural damages.

Take a closer look! Are any of those blackbirds rusty?

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The Rusty Blackbird is a declining songbird that breeds across northern North America from Alaska to northern New England and the Maritime Provinces and winters in the southeastern United States, especially the lower Mississippi Alluvial Valley and the southern Atlantic Coastal Plain. This species forages primarily in wet areas, but sometimes frequents pecan orchards and occurs in agricultural fields with other blackbirds during the migration and wintering periods. This poster provides information on the Rusty Blackbird's distribution, status and decline, and foraging habits, and tips for distinguishing it from other blackbird species, and discusses current research into migration routes and wintering locations.

Efficacy of an avian repellent applied using drop nozzle-equipped ground rigs in reducing blackbird damage to sunflower

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In North Dakota large flocks of blackbirds feed on ripening crops, after breeding and prior to migration, resulting in an annual damage estimate averaging US$3.5 million for sunflower. Since the repellent needs to be ingested to be effective, one obstacle is applying sufficient repellent directly to the sunflower face. Thus, we tested efficacy of an anthraquinone-based repellent when applied via drop-nozzle to sunflower using enclosed blackbirds in a semi-natural field setting. We used a ground-rig equipped with 360 Undercover® drop nozzle sprayers to apply 20 gal/ac of solution to sunflower plots with a product application rate of 1.0 gal/ac (13% AQ). To test efficacy, we installed bird enclosures (12 x 13 x 10 ft) to house 10 captive, male red-winged blackbirds (*Agelaius phoeniceus*) for 23 days on 10 treated and 10 untreated plots. The repellent did not cause birds to consume more alternative diet (i.e., red milo). Sunflower yield did not differ between treated and untreated enclosures as a result of blackbird damage. Variation in the amount of repellent reaching the face of the sunflower and subsequent residues was a limitation of the application method. Efficacy may be improved by increasing the application rate or repellent in the tank mixture, but sprayer technology and economic limitations related to repellent costs need to be considered. Future studies

should aim to optimize the amount of product in tank mixtures and the repellent formulation as designed for specific pests and crops.

Assessing avian repellent residue, coverage, and efficacy when applied to intact sunflower

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Blackbirds (*Icteridae*) cause significant damage to sunflower (*Helianthus annuus*) with damage estimates of $US3.5 million annually in the Prairie Pothole Region of North Dakota, the largest sunflower producing state. Chemical repellents may be a tool for reducing bird damage if application strategies can be optimized for sunflowers. Anthraquinone-based repellents have been shown to reduce feeding on loose sunflower achenes by more than 80% in lab studies, but field results are inconclusive due to application issues where floral components of sunflower result in low repellent contact with achenes. We evaluated AV-5055 (a.i. 13% 9,10 anthraquinone) as a red-winged blackbird (*Agelaius phoeniceus*) repellent applied directly to mature sunflowers in both a concentration-response (no choice) and preference (two choice) feeding experiment. We tested four tank mixtures (2.5%, 5%, 10%, and 20% repellent) applied at 126.3 L/ha using a spraying system for uniform distribution of repellent across the sunflower face. We analyzed residues on florets (40-294 ppm) and achenes (0.4-2.8 ppm) and identified the role of florets as a barrier to repellent reaching the achenes. In both feeding experiments, we found no significant difference in consumption between repellent concentrations. Results from our concentration response showed no significant differences in consumption after one day of repellent treatment. We found no significant difference between treatments in the preference experiment ($F_{3,34} = 0.37$, $p < 0.77$, $\eta G2 = 0.02$), but did observe a significant influence of day ($F_{1.9,65.7} = 28.76$, $p < 0.0001$, $\eta G2 = 0.21$. Although total consumption decreased (31-46%) after the second test day for all treatments, we found no significant difference in consumption of treated ($\tilde{x} = 17.41$, SD = 10.84) versus untreated ($\tilde{x} = 13.28$, SD = 11.71) sunflowers; $t_{37} = -1.78$, $p = 0.08$. Thus, birds interact with repellent applied directly to sunflowers differently than loose achenes for which the repellent was formulated.

Evaluating blackbird behavior response to unmanned aircraft systems (UAS) as hazing devices

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Animals respond to nonlethal forms of human disturbance using behaviors adapted to avoid predators. Wildlife managers can potentially exploit these behaviors when using disturbance stimuli to increase perceived predation risk and possibly encourage animals to abandon a resource patch. A promising tool in the field of wildlife damage management is the unmanned aircraft system (UAS), able to overcome the mobility limitations of other hazing strategies. In particular, multirotor UAS are ideal in that they are a multi-functional tool in precision agriculture and relatively easy to fly. Thus, multirotor UAS have been proposed as a hazing tool to minimize blackbird damage to agriculture crops and bird strikes in the aviation industry. Our specific objectives were to 1) evaluate the antipredator response of captive red-winged blackbirds (*Agelaius phoeniceus*) to three UAS platforms (i.e., multirotor, fixed-wing, and predator model) approaching at direct and overhead trajectories; and 2) conduct a field evaluation of UAS effectiveness as a hazing tool. We did not observe an effect of trajectory on alert response, however, blackbirds alerted to the predator model (mean ± SD seconds before the UAS reached the bird; 15.50 ± 7.98) approximately 8 seconds earlier than the fixed-wing (7.51 ± 6.97), and approximately 13 seconds earlier than the multirotor (2.49 ± 2.11). Additionally, blackbirds returned to foraging earlier and alarm-called and took flight

less frequently in response to multirotor approaches compared to the predator model. Overhead approaches failed to elicit flight, suggesting UAS hazing may be most effective at low altitude, direct approaches. In direct approaches, only the multirotor failed to elicit an escape response. In the field blackbird flocks responded to all three platforms by taking flight. Compared to a simulated predator approach, a multirotor may be a suboptimal hazing tool as evaluated through the antipredator responses of individual blackbirds in semi-natural settings.

Vultures:

Turkey vulture responses to approach by two unmanned aerial systems in a landfill: a preliminary study
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Unmanned aerial system (UAS) technology has been applied for wildlife management to disperse animals from select areas. Some new UAS have been developed to look and fly like a predatory bird (ornithopters), but little is known about their efficacy relative to other UAS (e.g. fixed wing). We conducted a preliminary study recording turkey vulture (Cathartes aura) responses to an ornithopter and a fixed-wing UAS performing targeted and overhead flights. Turkey vultures are considered a hazard to aviation safety and can congregate in large numbers, which warrants a need for deterring them around airports. In lieu of using an airport, our experimental site was a municipal landfill. We recorded the reduction in vulture numbers (i.e. number of vultures present after a flight/number of vultures present before a flight; with lower values indicating a higher proportion of vultures dispersed). We ran 14 total trials over a 5-day period, of which turkey vultures were present for 12 trials. Fixed-wing UAS flights led to more vultures dispersed (mean = 0.74) compared to ornithopter flights (mean = 1.87). Overhead approaches led to more vultures dispersed (mean = 1.17) compared to targeted approaches (mean = 1.44). The effect size of UAS type (Cohen's d = 1.54) was higher than direction of approach (Cohen's d = 0.28). Given these preliminary results, we predict that a fixed-wing UAS would disperse more vultures than an ornithopter possibly because of the fixed-wing's larger size and higher speed might increase the perceived risk to turkey vultures and subsequent dispersal behavior. We plan on testing this prediction empirically in the near future.

Black vulture (*Coragyps atratus*) damage in Tennessee
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Although black vultures (Coragyps atratus) play an important role in the ecosystem by scavenging on carrion, they also create various damage issues. Occasionally black vultures attack and seriously injure or kill livestock and pets, they damage vehicles, buildings, cell phone towers, and other property, and can pose a threat to people. In Tennessee, reports of black vulture damage have increased over the last 10 years. The USDA's Wildlife Services responds to requests for assistance from landowners and cooperators related to agriculture (typically predation on livestock), property (residential and non-residential buildings, vehicles, landfills, utilities, etc.) damage, and human health and safety (related to air traffic safety, fecal material, etc.). We will attempt to identify patterns and areas of high risk for vulture damage in Tennessee. To accomplish this, we will overlay locations where black vulture damage has been reported with various spatial factors (e.g., distance to water, roads, cell phone towers).

Serum chemistries values in Black Vultures (*Coragyps atratus*) in Mississippi

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Blood serum from 30 female and 14 male wild, healthy Black Vultures (Coragyps atratus) was analyzed to provide serum chemistry values for use in clinical pathology. Chemical analytes measured included sodium, chloride, potassium, carbon dioxide, anion gap, glucose, creatinine, calcium, phosphorus, total protein, albumin, globulin, and aspartate aminotransferase. In general, blood chemistry values of Black Vultures were similar to those found in new and old world vultures and raptor species. Serum chemistry values that can be important indicators of avian health were described by gender for the American Black Vulture. Chemistry values for males were lower than females for sodium, chloride, creatinine, calcium, total protein, albumin, and globulin. This study provides important blood chemistry values that may be used for comparison with free-ranging birds that may come into veterinary clinics or wildlife rehabilitation centers. Furthermore, the use of such parameters in assessing population health may enable conservationists to further explore environmental conditions affecting species reproduction and survival.