BIOAG PROJECT FINAL REPORT

TITLE: Birds and Biosecurity: contact rates and parasite exchange between livestock and songbirds

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ABSTRACT:

Livestock have access to the outdoor environment, which integrates farm animals with soil, vegetation and wildlife that are components of the farm ecosystem. For example, pasture provides cycling of renewable, organic food inputs for livestock and nutrients from manure. These ecosystem services are vital to sustainable organic animal production. However, livestock in the environment also encounter parasites and pathogens found in soil (e.g. Coccidia) and wildlife (e.g. Influenza virus) that affect animal health and potentially contaminate the human food supply (e.g. Campylobacter). Antibiotics and parasiticides that are available for disease control in conventional animal agriculture are tightly restricted in organic production, which puts a premium on preventative measures to lower risks of infection. There have been few comprehensive, systems-level studies of the infectious organisms that livestock encounter in organic production. The lack of tools for disease management impedes the transition to organic animal production. Working on diverse mixed vegetable farms, a subset of which also integrate livestock into their farming systems, we have conducted surveys of wild bird diversity and density. In addition, fecal and blood samples have been collected from poultry and captured birds to determine the frequency of livestock pathogens in the wild bird community. We have found that wild birds have varying levels of contact with livestock, dependent on wild bird species. In addition, we have detected parasites in both poultry and wild birds that indicate the two groups of birds do exchange infectious organisms. These data have been instrumental in grant proposals to acquire funds for further exploration of the impacts of wild birds on infectious disease in animal agriculture.

PROJECT DESCRIPTION:

Forty farms located in California, Oregon and Washington were identified that were exclusive vegetable producers, or had a mixture of vegetable crops and livestock (cattle, poultry, pigs). Each farm was visited twice (once in spring, once in fall). On each

farm the landscape features and habitats were mapped for GIS analysis. Wild bird species were identified by point counts and densities of birds were estimated. In addition, mist nets were deployed to capture wild birds in and around fields and livestock. The captured birds were identified and samples (blood and feces) were collected from each bird. Blood and fecal samples will be analyzed by PCR to identify pathogens known to infect livestock (e.g. Salmonella, E. coli, Campylobacter). In addition, multiple farms focused on organic poultry production were sampled as described above. Poultry on these farms were screened for infection with gut helminth (worm) infections and infection with *Campylobacter sp.* parasites, which are the leading cause of diarrhea in the United States.

OUTPUTS

- **Work Completed and in Progress**:
    1. **Overview**: Data have been collected from three types of farms that provide important information about the relationships between wild birds, the farm landscape, and crops/livestock. These data include quantification of wild bird density and diversity, rates of contact between wild birds and livestock, and identification of parasites that can be shared between wild birds and livestock.
    2. **Methods:** Organic and conventional farms were identified along the west coast from Southern California to Washington State. Point counts (observations) were done on each farm to determine wild bird species and to estimate bird density on each farm. For a point count, the observer used visual and auditory characteristics to identify birds at multiple distances from a fixed point on a farm. In addition to point counts, observational data were collected on contact rates between wild birds and farm elements. The contact surveys included monitoring pastures with outdoor poultry for twenty minutes. During this time, all wild bird species were documented in the area. Wild bird behavior at the pasture is classified into one of seven categories of “contact”, including fly-over (F), contact with a structure (S), contact with a perch (P), contact with the ground (G), contact with an animal (A), contact with a trough (T), and defecation within the pasture (D). Fecal samples pf chickens were collected from pasture, as well as from wild bird nests on farm structures. Those fecal samples were screened for enteric parasites by the Washington Animal Disease Diagnostic Lab (WADDL).
    3. **Results:** Point count data revealed that wild birds are more numerous on farms with livestock compared to farms without livestock. The most common species of birds on farms with livestock are European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*). Flyovers were the most common form of contact (82%), followed by use of structures (6%) and perches (5%). The most common species observed contacting the pasture was the barn swallow (*Hirundo rustica*) (25%), while Brewer’s blackbird (*Euphagus cyanocephalus*), European starling (*Sturnus vulgaris*), and Eurasian collared dove (*Streptopelia decaocto*) were also commonly making contact (18%, 14%, and 12%, respectively). Multiple parasite/pathogen species were detected in feces of pastured poultry and wild birds. These included bacteria (*Campylobacter sp.*), protozoa (*Eimeria*

sp.) and intestinal worms (*Heterakis, Ascaris,* and *Capillaria*). Coccidia parasites were detected in both poultry and European Starlings on the same farm.

4. **Discussion**: Data from these studies have revealed that some wild bird species have more contact with livestock than other species in the community. We have not yet determined if landscape features influence the abundances of these "high-contact" species, or if the bird community itself affects these species. Important enteric pathogens and parasites are found in pastured poultry. Most important, *Campylobacter sp.* bacteria are nearly ubiquitous among pastured poultry (>80% infection rates). These bacteria are the leading cause of food-borne infections and diarrhea in people. These bacteria also occur in wild birds on these farms, which underscores that wild birds may be a source of these pathogens. Our ***ongoing*** work will focus on measuring the contact rates between wild birds and livestock, as well as fully characterizing the parasites and pathogens that livestock may exchange with wild birds.

- **Publications, Handouts, Other Text & Web Products**: An informative web site is being developed to communicate results to farmers and researchers. The design for the site is completed and we are beginning to develop and insert content based on research results.
- **Outreach & Education Activities**: During bird surveys and captures we provided reports to each farm that described the bird species observed on the farm. This is the first step in connecting farmers to the data collection and ultimate analyses that will be accessible through the web resource (see above).

IMPACTS

- **Short-Term**: Farmers have been made aware of the risks that wild birds pose to livestock health. In addition, farmers have been provided with detailed information about the wild bird communities on their respective farms. These data have been used to obtain additional, extramural funding from the USDA-OREA program ($1,625,840) and for a pending proposal to the USDA-ORG program ($110,115).
- **Intermediate-Term**: As parasite and pathogen analyses are completed, farmers will be able to assess infection risks posed to livestock. This information will be essential for farmer's decisions about landscape management and implementation of biosecurity measures (e.g. bird exclusion).
- **Long-Term**: Enhanced biosecurity measures will be developed that provide targeted protection of livestock from parasites and pathogens carried by wild bird species that are commonly interacting with livestock.

ADDITIONAL FUNDING APPLIED FOR / SECURED:

2016 USDA-OREI (**FUNDED** $1,625,840) AVIAN BIODIVERSITY: IMPACTS, RISKS AND DESCRIPTIVE SURVEY (A-BIRDS)

*2017 USDA-ORG (**FUNDED** $458,145) AN ECOLOGICAL APPROACH TO DISEASE RISK MANAGEMENT ON ORGANIC POULTRY FARMS

*THE FUNDING ANNOUNCEMENT FOR THIS PROPOSAL IS STILL UNDER PRESS EMBARGO. PLEASE DO NOT GIVE THIS INFORMATION TO ANYONE UNTIL THE EMBARGO IS LIFTED.

ROLE OF BIOAG FUNDS IN SECURING FUNDING: THE FUNDING PROVIDED BY THE BIOAG PROGRAM HELPED TO SUPPORT TRAVEL COSTS FOR VISITS TO FARMS AND DATA COLLECTION FROM THE FIELD. IN ADDITION, FUNDS WERE USED TO PAY FOR DIAGNOSTIC SCREENING OF FECAL SAMPLES AND REAGENTS TO TEST FOR ANTIBODY RESPONSES IN BIRDS (PENDING). THE DATA COLLECTED FROM THIS PROJECT WAS INSTRUMENTAL IN SECURING FUNDING FOR **TWO** USDA PROJECTS (USDA-OREI $1,625,840; USDA-ORG $458,145), BECAUSE WE COULD PROVIDE PRELIMINARY DATA ON THE RELATIVE ABUNDANCES OF "PEST" BIRD SPECIES ON FARMS WITH AND WITHOUT LIVESTOCK. THOSE DATA MADE THE CRUCIAL POINT THAT WE NEED A BETTER UNDERSTANDING OF THE FACTORS THAT SHAPE BIRD COMMUNITIES AROUND FARMS. THE PARASITE/PATHOGEN DATA HAS BEEN CRITICAL TO THE RECENT USDA-ORG PROPOSAL (IN REVIEW), BECAUSE THEY PROVIDED CLEAR EVIDENCE THAT PARASITES/PATHOGENS ARE COMMON IN PASTURE SETTINGS, AND THAT WILD BIRDS CAN ALSO HARBOR IMPORTANT INFECTIOUS ORGANISMS. WITHOUT THESE VARIOUS DATA, WE WOULD NOT HAVE BEEN ABLE TO ARGUE THAT WILD BIRDS REPRESENT AN IMPORTANT HEALTH CONSIDERATION FOR FARMS.

GRADUATE STUDENTS FUNDED: NO GRADUATE STUDENTS WERE FUNDED BY THIS GRANT.

RECOMMENDATIONS FOR FUTURE RESEARCH:

The U.S. poultry industry is experiencing a rapid expansion of cage-free and pastured poultry production. These production practices put poultry into contact with wild birds that carry multiple parasites and pathogens of poultry (e.g. Salmonella, E. coli, Campylobacter, Avian influenza virus, Newcastle disease virus, ectoparasites, intestinal worms). One avenue for combating infectious diseases in livestock is to breed for immunological and physiological traits that make animals more resistant to infection, or more robust during infection. The domestic chicken is an excellent animal for this approach, because of simplified and well-characterized immunogenetics. Future research should address the potential use of modern immunogenetics as a strategy to combat infections in farm environments with high risk of infectious disease.