# Report on Bird Diversity and Food Safety at the Student Farm

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#### **Summary of Our Work**

At the beginning of 2022, Austin Spence, a postdoctoral researcher working with Daniel Karp in the Department of Wildlife, Fish, and Conservation Biology, began working on the Student Farm and adjacent garden with a team of undergraduate students to capture wild birds with mist nets – a specialized net. We collected fecal samples from birds to test for E. coli, Salmonella, and Campylobacter to understand the risk they pose to food safety in integrated agricultural systems. Beyond this project, I am interested in the bird diversity comanaged agricultural systems support. These are some of the results I gathered over the course of two years demonstrating some of the bird life that is being supported by this well-managed agricultural system.



Species pictured all captured on the student farm: Anna's Hummingbird, Lesser Goldfinch, California Scrub-Jay, Nuttall's Woodpecker, Yellowrumped Warbler, California Towhee, Western Bluebird

### **Birds by the Numbers**

<i>123 Species</i> of birds have been recorded on the Student Farm and adjacent garden (Table 1)	Most <i>frequently</i> captured species on the farm
	Yellow-rumped Warbler
<i>26 Species</i> of birds were captured on the Student Farm and adjacent garden during our	White-crowned Sparrow
studies	<b>Golden-crowned Sparrow</b>

# Species of Special Status Detected on the Farm

<u>Swainson's Hawk</u>– State listed as threatened <u>Yellow-billed Magpie</u>– IUCN listed as vulnerable <u>Tricolored Blackbird</u>– State listed as threatened and IUCN listed as endangered

# Golden-crowned Sparrow Case Study

The Golden-crowned Sparrow (*Zonotrichia atricapilla*) is a migratory species that spends its winters in California. A study that captured Golden-crowned Sparrows near the Student Farm and fitted them with GPS tracking devices found that these birds fly 4,300 miles round trip to the shrublands of coastal Alaska during the summer to breed (1).



#### Male Golden-crowned Sparrow

(1) Iverson, A.R., Humple, D.L., Cormier, R.L. et al. Land cover and NDVI are important predictors in habitat selection along migration for the Golden-crowned Sparrow, a temperate-zone migrating songbird. Mov Ecol 11, 2 (2023). https://doi.org/10.1186/s40462-022-00353-2

During our work capturing birds on the Student Farm, we identified and banded more than 70 individual Golden-crowned Sparrows. We also found multiple birds captured during the winter of 2021-22 that returned to the farm for the winter of 2022-23. These birds successfully survived the winter and fueled their journey back to Alaska in the brush piles, compost, and hedgerows of the Student Farm. Then these individuals returned to the same few bushes on the farm for another winter. Golden-crowned Sparrows highlight the importance of well-managed integrated agricultural systems at providing habitat for a species facing declines.

# **Results From Student Farm Study**

Agricultural growers are often concerned about the potential for bird feces to transmit food-borne pathogens to crops. While there are instances of wild birds hosting these pathogens, we have very little data on how much of a risk they pose. Our work on the student farm looked to answer two important questions: (1) which birds are likely to carry pathogens that can be passed along to humans through bird feces (i.e., pathogenic E. coli, Salmonella, or Campylobacter) and (2) how long can these pathogens survive in bird feces on a farm setting?

To understand which birds are likely to carry the pathogens, we combined 274 samples from 32 species collected around Davis with 1,078 samples collected in the Central Coast (1352 total samples) and tested for *E. coli*, *Salmonella*, and *Campylobacter*. We found good news. Positivity rates for all three diseases are low in wild birds: 0.4%, 0.2%, and 1.5% positivity rates for *E. coli*, *Salmonella*, and *Campylobacter*, respectively. Thus, it is unlikely for a bird on a farm to carry one of three common food-borne pathogens.

To test how long pathogens can survive in avian fecal samples we gathered fecal samples from two species of birds that commonly occur in California agriculture (Wild Turkey and Western Bluebird). We took hese samples into a lab and inoculated them with a nonpathogenic *E. coli* (i.e., a safe version of *E. coli* that is incapable of causing disease to anyone on the farm). We then divided these samples into different size classes that match the different sizes of poop that small to large birds typically leave. The samples were placed on three common surfaces found at farms: lettuce, soil, and black plastic mulch. Samples were then re-collected over a period of days and the amount of *E. coli* surviving was measured.



Figure 1. *Experimental plot on the UC Davis Student Farm*. Photo of the experimental plot testing *E. coli* survival in avian fecal samples on lettuce, soil, and plastic mulch.

We found encouraging results, that the probability of *E. coli* surviving declines fairly quickly over time on all surfaces (Fig. 1A), particularly on black plastic mulch. This E. coli also has a much lower probability of survival in small fecal samples consistent with those left by small to medium-sized birds (Fig. 1B). While it can be very difficult to deter and exclude birds from agriculture it is a promising sign that the more abundant small birds – including those that may provide pest control benefits like Western Bluebirds – pose a lower food safety risk than the easier to exclude large birds.



Figure 2. E. coli *survival across substrates and fecal masses*. (A) The probability of *E. coli* survival significantly declined after longer periods in the field across all substrates, but we observed significantly lower *E. coli* survival on soil and plastic mulch. (B) Larger fecal samples had significantly higher *E. coli* survival than smaller fecal samples.

# Conclusion

The student farm served as an important field site for our work. Without your help and cooperation, we could not have collected this important data on the risks birds pose to food safety. Agriculture occupies a significant portion of the planet and finding ways wildlife can coexist with agriculture is of high value to conservation worldwide moving forward.

Beyond our research, the student farm is an important bird habitat. Hundreds of species use it throughout the year for different purposes. Resident Northern Mockingbirds feed in the olive trees and raise their young on the farm during the summer. Migratory Swainson's Thrushes use the cottonwood trees and brushy areas as a critical spot to catch insects. This area will fuel their long annual journey between Central America and the coastal forests of the Pacific Northwest. American Pipits spend the winter picking for insects in the fields of the student farm before returning to the tree-less areas of Canada and Alaska to raise their young in the summer. Thank you for continuing to manage the farm in a way that supports bird diversity and habitat. Attached below is a full list of species detected from the student farm.



Clockwise:

Northern Mockingbird Swainson's Thrush American Pipit

Species	Frequency	Season
Snow Goose	3	Winter
Ross's Goose	3	Winter
Greater White-fronted Goose	3	Winter
Cackling Goose	4	Migration
Canada Goose	2	Year-round
Tundra Swan	4	Migration
Wood Duck	3	Year-round
Mallard	2	Year-round
Canvasback	4	Migration
Ring-necked Duck	4	Migration
Lesser Scaup	4	Migration
Wild Turkey	1	Year-round
Rock Pigeon	1	Year-round
Eurasian Collared-Dove	1	Year-round
Mourning Dove	1	Year-round
Vaux's Swift	4	Migration
White-throated Swift	2	Summer
Black-chinned Hummingbird	2	Summer
Anna's Hummingbird	1	Year-round
Rufous Hummingbird	2	Migration
Killdeer	1	Year-round
Long-billed Curlew	4	Winter
Greater Yellowlegs	4	Winter

Table 1: All species observed on the farm or flying over the farm during research efforts and compiled from independent observations recorded in eBird database

Species	Frequency	Season
Ring-billed Gull	3	Winter
Herring Gull	3	Winter
California Gull	3	Winter
Glaucous-winged Gull	4	Winter
Double-crested Cormorant	2	Year-round
American White Pelican	4	Migration
Black-crowned Night Heron	4	Year-round
Snowy Egret	4	Year-round
Green Heron	4	Year-round
Great Egret	2	Year-round
Great Blue Heron	3	Year-round
Turkey Vulture	1	Year-round
Northern Harrier	2	Year-round
Sharp-shinned Hawk	3	Winter
Cooper's Hawk	1	Year-round
Red-shouldered Hawk	1	Year-round
Swainson's Hawk	1	Summer
Red-tailed Hawk	1	Year-round
Barn Owl	2	Year-round
Northern Saw-whet Owl	4	Migration
Red-breasted Sapsucker	2	Winter
Acorn Woodpecker	3	Year-round
Downy Woodpecker	2	Year-round

Species	Frequency	Season
Nuttall's Woodpecker	1	Year-round
Northern Flicker	1	Winter
American Kestrel	2	Winter
Peregrine Falcon	4	Migration
Western Wood-Pewee	3	Migration
Willow Flycatcher	2	Migration
Hammond's Flycatcher	3	Migration
Western Flycatcher	1	Migration
Black Phoebe	1	Year-round
Say's Phoebe	1	Winter
Ash-throated Flycatcher	4	Summer
Western Kingbird	1	Summer
Cassin's Vireo	3	Migration
Warbling Vireo	2	Migration
California Scrub-Jay	1	Year-round
Yellow-billed Magpie	2	Year-round
American Crow	1	Year-round
Common Raven	2	Year-round
Horned Lark	2	Winter
Tree Swallow	1	Summer
Violet-green Swallow	3	Migration
Purple Martin	4	Migration
Northern Rough-winged Swallow	2	Summer

Species	Frequency	Season
Barn Swallow	1	Summer
Cliff Swallow	1	Summer
Bushtit	1	Year-round
Ruby-crowned Kinglet	1	Winter
White-breasted Nuthatch	1	Year-round
Red-breasted Nuthatch	2	Winter
Blue-gray Gnatcatcher	3	Migration
House Wren	1	Year-round
Bewick's Wren	4	Year-round
European Starling	1	Year-round
Northern Mockingbird	1	Year-round
Western Bluebird	1	Year-round
Varied Thrush	3	Winter
Swainson's Thrush	2	Migration
Hermit Thrush	1	Winter
American Robin	1	Year-round
Cedar Waxwing	1	Winter
House Sparrow	2	Year-round
American Pipit	1	Winter
House Finch	1	Year-round
Purple Finch	2	Winter
Pine Siskin	2	Winter
Lesser Goldfinch	1	Year-round

Species	Frequency	Season
Lawrence's Goldfinch	2	Migration
American Goldfinch	1	Year-round
Chipping Sparrow	3	Winter
Lark Sparrow	3	Year-round
Fox Sparrow	1	Winter
Dark-eyed Junco	1	Winter
White-crowned Sparrow	1	Winter
Golden-crowned Sparrow	1	Winter
White-throated Sparrow	2	Winter
Savannah Sparrow	1	Year-round
Song Sparrow	2	Year-round
California Towhee	1	Year-round
Spotted Towhee	1	Winter
Western Meadowlark	1	Year-round
Hooded Oriole	3	Summer
Red-winged Blackbird	2	Year-round
Tricolored Blackbird	4	Summer
Brown-headed Cowbird	2	Summer
Brewer's Blackbird	2	Year-round
Orange-crowned Warbler	1	Winter
Nashville Warbler	3	Migration
MacGillivray's Warbler	2	Migration
Common Yellowthroat	2	Migration

Species	Frequency	Season
Yellow Warbler	1	Migration
Yellow-rumped Warbler	1	Winter
Black-throated Gray Warbler	2	Migration
Townsend's Warbler	3	Migration
Wilson's Warbler	1	Migration
Western Tanager	1	Migration
Black-headed Grosbeak	2	Migration
Lazuli Bunting	1	Migration