Improving Co-Benefits of the Conservation Reserve Program for Biodiversity

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Introduction

Decades of agricultural intensification in the United States have resulted in the loss of species and habitats as well as the degradation of ecosystem services supporting human communities. The Conservation Reserve Program (CRP), the largest federal private lands conservation program that is funded by the Farm Bill, pays farmers to take land out of rotation and establish perennial vegetation for contract periods of 10-15 years in order to improve environmental pollution and also to restore wildlife habitat. Since its inception, the program has spent over $50 billion dollars to restore around 30 million acres of farmland each year.

However, while the demand for enrollment has always exceeded availability, the overall enrollment cap set by the federal agency has been declining over the past decade. As such, there is an opportunity to be more strategic with investments to achieve greater benefits. Currently, decisions about which lands to enroll are informed by the Environmental Benefits Index, which guides the spatial allocation of resources based on benefits to soil, air, water, wildlife, and cost quality. The time is right to reconsider and refine the decision framework in ways that optimize these and other co-benefits.

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This research seeks to rigorously evaluate CRP outcomes related to biodiversity through the conservation of grassland bird populations in the U.S. Our rationale for focusing on the specific benefit is based on the reality that, aside from being useful indicators of grassland and farmland conditions, grassland birds stand out as one of the most imperiled taxa in North America. Since 1970, grassland birds have lost over half of their global populations, with three-quarters of species in decline (Rosenberg et al. 2019).

We construct a spatially explicit database describing grasslands bird communities and the distribution of CRP lands in the last two decades. Leveraging variation in the amount of agricultural land enrolled in CRP across space and time, we compare various biodiversity outcomes for grassland birds in counties with more enrolled CRP lands to counties with no or fewer enrollments. We further identify areas of highest grasslands bird diversity and most benefited from CRP to help improve the efficiency of the program and to reach better cost-effectiveness.

We contribute to the growing literature on agriculture and biodiversity. Noack et al. (2021) and Strobl (2021) find that large-scale, specialized agricultural production leads to lower biodiversity. In addition, Li et al. (2020) find that bird biodiversity decreases from intensified pesticide application and the expansion of cropland. Although a few regional studies have described the socioecological benefits flowing from conservation policies, (e.g., CRP), our understanding of benefits at national scales remains under-explored due to limited data at the spatial resolution and geographic scale necessary. We extend the literature by examining the effectiveness of CRP that seek to address the adverse impacts of agricultural activities on biodiversity using data at fine spatial and temporal scales. As CRP is one of the most funded

federal programs by the Farm Bill, our study could also add to the discussion of the 2023 Farm Bill reauthorization process.

Data

CRP contracts. Our confidential CRP contract data come from the USDA Farm Service Agency and was further processed by our collaborating partners at the Economic Research Service that aggregate the information to county-level. We have information of the total accumulated acreage enrolled in CRP, average rental payments, and the environmental benefits index, a scoring metric that quantifies the expected environmental benefit associated with CRP practices, for each county by the end of a fiscal year. For example, the CRP enrollment in fiscal year 2009 refers to the accumulated enrollment from October 2008 to September 2009. Our CRP data also allow us to differentiate the enrollment acreage by different practice types (e.g., grassland practices, tree practices, and wetlands).

Grasslands birds. The bird database comes from the eBird Basic Dataset, a citizen science dataset maintained by the Cornell Lab of Ornithology that comprises birding observations, where each observation is referred to as a checklist, uploaded by birders recording comprehensive characteristics of the birding trips, such as the number of various species of birds observed, the location and date of observation, the amount of time spent and distance traveled from observing, and other information regarding each birding trip. We focus on 45 grasslands bird species, and only include checklists reported during the breeding season of these bird species. We take several steps following Strimas-Mackey et al. (2020) to reduce the biases of the citizen science dataset as a result of voluntary contributions of the observations and the variation of birding efforts. We limit our sample to checklists with no more than 10 observers, a duration of less than 5 hours, and a traveling distance during observations of less than 5 km. We further restrict the

checklists to only include complete observations. After filtering the dataset, we calculate the average number of grasslands birds observed per checklist by county.

Control variables. We also collect data on weather and land covers as control variables. The daily weather data from PRISM and annual land cover data from NASA MODIS, both of which account for the association with CRP enrollment, as well as the effect on bird outcomes. For both variables, we aggregate them to county-year level to be consistent with our CRP variable.

Empirical Strategy

We use our fine-scale panel database to identify the effect of CRP on the biodiversity of grassland birds. Leveraging variation in the amount of enrolled CRP lands across space and time, our empirical strategy relies on two-way fixed effects regressions that compare various bird biodiversity outcomes in counties with more enrolled CRP lands to counties with no or fewer enrollments. We estimate the following regression model:

$$\#\text{Birds}_{cy} = \beta_1 \text{CRP Share}_{cy} + \gamma \text{X}_{cy} + \eta_c + \eta_y + \eta_{sy} + \varepsilon_{cy}, \quad (1)$$

where *c* and *y* index county and year, respectively. #Birds is average number of grasslands birds observed per checklist; CRP share is CRP enrollment size as the share of county size; and X includes a vector of effort variables associated with the birding efforts, different county land cover shares, and county average temperature and precipitation. We include county, year, and state-by-year fixed effects to flexible control for any other time-invariant and time-varying unobservables. Our identifying assumption is that, conditional on our spatial and temporal control variables and fixed effects, the CRP enrollment across counties is as good as random. We will primarily explore the effect of grass-practice CRP enrollments on abundance of grassland bird species in our dataset, as grass-practice CRP accounts for most CRP practices. We will also study the effect on grassland bird biodiversity measures such as species richness and species

evenness by estimating regressions similar to (1). Taking advantage of the amount of grasslands and croplands coverages in each county over time, we will then explore whether any observed benefits are through the increase in more grasslands that were converted from croplands to CRP grasslands, or through better practice management. As we expect CRP benefits might be different for various grassland bird species, we further explore treatment heterogeneity to identify areas of highest grassland bird diversity and most benefited from CRP to help improve the efficiency of the program and to reach better cost-effectiveness.

Preliminary results

We obtain some preliminary results at this stage and choose not to report here. Please contact the corresponding author if interested in these findings. Our preliminary descriptive results show that the decline in enrolled CRP land in a county is associated with the reduction of grasslands birds observed.

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