Waterbird response to management practices in rice fields intended to reduce greenhouse gas emissions

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Introduction

There are many benefits of agricultural landscapes for wildlife. In California, some rice agriculture practices are known to benefit both farmers and wildlife. Flooding after harvest, in particular, increases the decomposition of rice straw while providing habitat for over 50 species of waterbirds (Elphick & Oring 1998). Because California has lost over 90% of its historic wetlands (Frayer et al. 1989), flooded rice is now critical wildlife habitat, providing 85% of the total flooded habitat in the Sacramento Valley during winter (CVJV 2006). Rice is also flooded during planting, providing habitat for spring migrants and locally breeding birds (Eadie et al. 2008).

Rice production, however, produces greenhouse gases (GHG) as organic matter decomposes in flooded conditions, and GHG emissions are the primary driver of climate change. Recent modelling efforts have identified several practices that may reduce GHG emissions associated with rice production, including reducing the area of rice that is flooded post-harvest, removal of rice straw via baling, and drill seeding to plant the rice (EDF 2011). Ideally, any practices adopted on a large scale to reduce GHG emissions will not negatively impact bird populations. We studied the response of waterbirds to rice management practices designed to reduce GHG emissions in the Central Valley of California.

Materials and Methods

We compared waterbird density and other indicators of habitat quality (1) among four combinations of post-harvest management practices of flooding and baling during winter; and (2) between drill seeding and flooded aerial seeding during spring.

During the winters (Dec-Jan) of 2011-2013, we examined the effects of reduced flooding and baling of rice straw post-harvest by surveying waterbirds among four combinations of flooding and baling. About 50% of fields are flooded post-harvest to increase decomposition of rice straw and provide waterbird habitat. Non-flooded fields, in general, are incorporated (disk, chisel, etc.), sometimes heavily which reduces availability of waste grain to waterbirds. Baling (3-6% of rice fields) is an alternative means to remove residual rice straw from fields post-harvest and reduces the need to flood.

During spring (Apr-May) of 2012 and 2013, we compared waterbird use between rice fields planted using the drill-seeding method and the more widely-used aerial-seeding method. The aerial-seeded fields were flooded then pre-germinated seed was dropped into the fields via airplane. Drill-seeded fields were not flooded prior to planting, and were flooded with short pulses 2-3 times after seeding to germinate the seed.

Results and Discussion

We surveyed waterbirds on over 25 farms throughout the Sacramento Valley during the winter and spring. In winter, we found significantly higher densities of ducks and shorebirds in flooded fields than in non-flooded fields. We also found significantly more ducks and shorebirds in non-baled and flooded fields than in baled and flooded fields, although the difference in use between these practices was small for ducks. We did not find a difference between the combinations of baled and flooded practices for geese. See Figure 1 for mean densities of waterbirds in all four combinations of baling and flooding.

We found no difference in average density for ducks and shorebirds in drill-seeded versus aerial-seeded fields. See Figure 2 for waterbird densities in each practice. Northbound migrating shorebirds used both seeding methods, and there is little other flooded habitat available during that time of year. The timing of planting of rice coincides with the onset of breeding for some waterbirds, and we recognize that there may be impacts to nesting birds from drill seeding that were not studied.

Figure 1. Average density and 95% Confidence Intervals (CI)

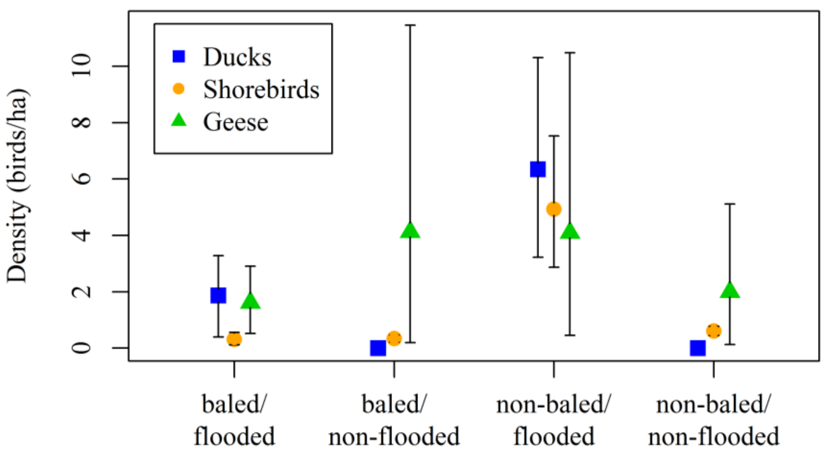
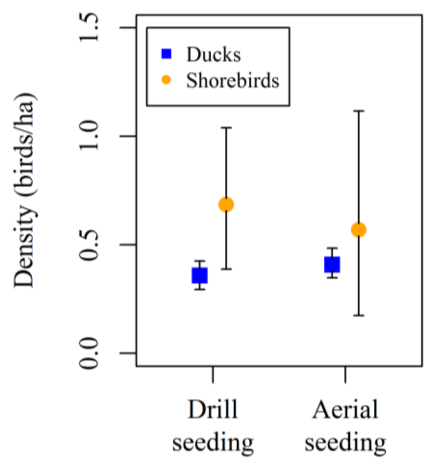


Figure 2. Average density and 95% CI.



Conclusion

Our study provides evidence that some post-harvest practices (reduced winter flooding, baling of rice straw) that reduce GHG emissions from rice agriculture, reduce use by waterbirds. The benefits of the GHG-reducing practices must be evaluated against this trade-off of reduced habitat for waterbirds and other wildlife when considering practices for large-scale implementation (EDF 2011). Additional analyses are needed that focus on the net trade-offs between waterbird populations and total GHG reductions of these practices to help gauge the best approach for potential implementation. An optimization study could identify the combination of rice management strategies that would minimize total GHG emissions while still providing adequate habitat to meet waterbird population objectives. While reducing GHGs is globally necessary to minimizing the impacts of climate change, this study shows that the environmental tradeoffs must to be acknowledged in future decision-making to successfully guide the balancing of multiple competing benefits.

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