Science Proposal

Win-win for agricultural and wildlife; developing a wetland conservation model for white-faced ibis in the Intermountain West

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Executive summary

Private lands agriculture and ranching account for up to 90% of wetland resources benefiting wildlife and producers in the semi-arid West. These working wetlands have evolved to support flood irrigated agriculture, but still maintain key ecosystem services that promote drought resiliency and groundwater recharge. Changing policies intended to increase water use efficiencies in some areas now stand to decouple wildlife and wetland benefits attributed to traditional flood irrigation. White-faced ibis (*Plegadis chihi;* hereafter 'ibis') is a species emblematic of the symbiotic relationship existing between wildlife and agricultural water. Recent declines in bird numbers have been attributed to land use practices transitioning from flood to sprinkler irrigation. New proactive strategies are needed to inform holistic water conservation that leverages volunteer incentive-based measures to maintain viability of flood irrigated agriculture and ibis populations. To support this effort we propose development of conservation tools to guide targeted habitat delivery benefiting birds, agriculture, and public lands management. The project will identify long-term trends (1984-present) in ibis breeding habitat availability throughout the Intermountain West and determine population reliance on public and private wetland resources including flood irrigated agriculture. Findings will identify landscape minimums necessary to sustain breeding ibis colonies and put forth conservation solutions mutually beneficial to agricultural water and wildlife.

Introduction

In the semi-arid West private lands agriculture and ranching account for 70 to 90% of wetland resources benefiting wildlife and producers for over a century (Donnelly et al. *in review*). These working wetlands are associated with flood irrigated hay meadows and rangelands occurring in historic river floodplains and lowlands. While many natural wetlands have evolved to support flood irrigated agriculture they still maintain key ecosystem services that promote drought resiliency and groundwater recharge. Urban growth across the West continues to place unprecedented pressure on limited water supplies. Sustainability of flood irrigated agriculture and its associated wetland and riparian habitats are now at risk as demand shifts from agricultural to domestic and industrial uses (MacDonald 2010). Changing policies intended to increase water use efficiencies in some areas now stand to decouple wildlife and wetland benefits attributed to traditional flood irrigation (Goldstein et al. 2011). Predicted shifts in climatic conditions are likely to accelerate these trends and increase pressure on already strained water resources (Elliott et al. 2014).

White-faced ibis (*Plegadis chihi;* hereafter 'ibis') is a species emblematic to the West and the symbiotic benefits existing between wildlife and agricultural water. Prior to western settlement, these birds relied on natural wetland habitats to breed and raise chicks. Ibis nest in colonies numbering from hundreds to thousands of individuals located in permanently flooded marshes adjacent to important foraging habitats made up of shallow seasonally flooded wetlands. Concentrations of these wetland resources make up <2% of western landscapes that today are prime assets of working ranches managed as flood irrigated meadows for livestock forage. Long-term irrigation and grazing practices on these sites mimic natural wetlands and have acted to conserve key habitats benefiting ibis and other wetland dependent wildlife throughout the West.

Across their breeding range ibis are identified as a conservation priority by multiple state (California, Idaho, Montana, Nevada, Utah, and Wyoming) and federal (BLM, Fish and Wildlife Service, Forest Service) natural resource agencies. Recent documentation of colony declines from forage habitat loss have occurred as indirect effects from land use practices transitioning from flood to sprinkler irrigation (Moulton et al. 2013). Volunteer incentive based measures that maintain viability of flood irrigated agriculture and sustain ibis populations provide an economically attainable conservation solution as opposed to costly reactive strategies that would occur if the bird was identified as threatened or endangered. Implementation of proactive strategies will require new tools to improve decision quality and inform holistic water conservation that considers human and wildlife outcomes. To accelerate this process we propose development of a core area strategy for breeding ibis that tracks annual public-private wetland habitat availability to identify conservation needs and prioritize actions of greatest ecological value.

Outlining the science

The project area will encompass ibis breeding habitats in the Intermountain West associated with colonies identified over the past 35 years (Fig. 1). Analyses will monitor trends in annual nesting and foraging habitat availability during the breeding period from 1984 to present using remote sensing and satellite imagery archives. Habitat availability will be determined by measuring the extent of wetland flooding. Measurements will occur by applying constrained spectral mixture analysis (Adams and Gillespie 2006) and sub-pixel water fraction to track surface water extent. This approach provides an accurate account of flooding when only a proportional fraction of surface water is visible due to interspersion of water and emergent vegetation (DeVries et al. 2017); a characteristic common to shallow seasonal wetlands and flood irrigated agriculture.

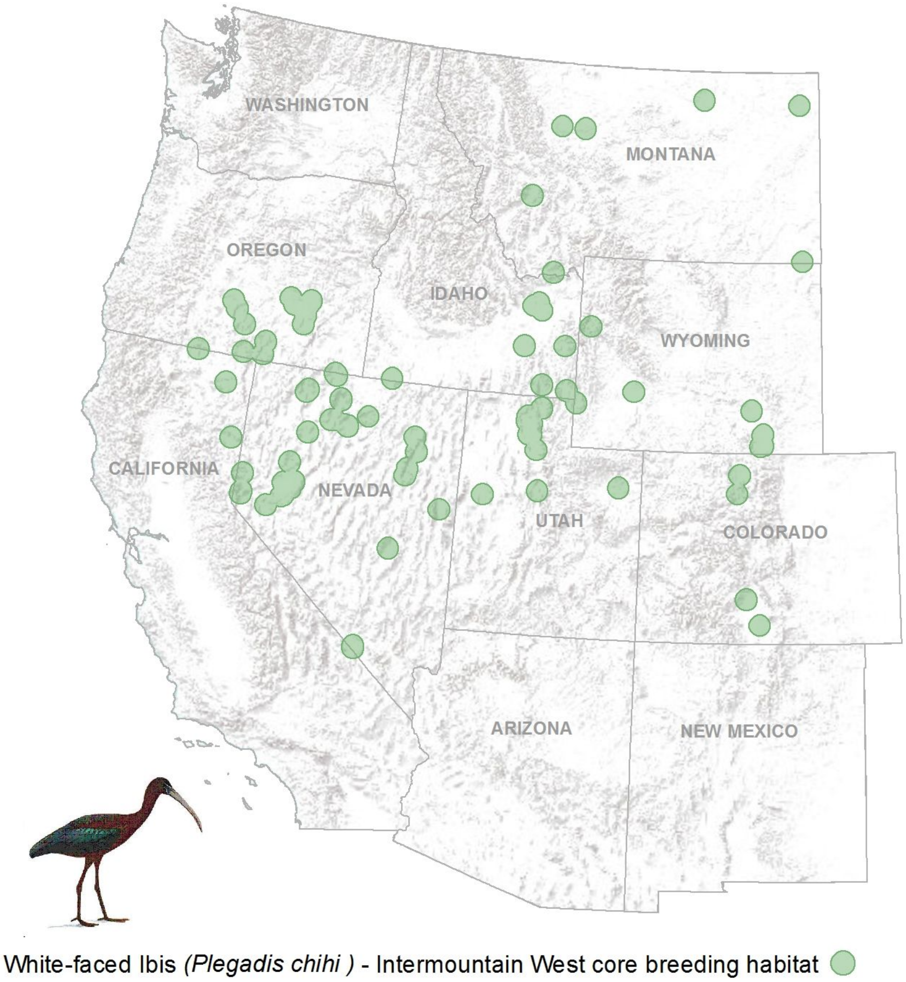

Figure 1. Proposed wetland monitoring footprint for breeding white-faced ibis in the Intermountain West. Green polygons represent 22 km buffers around known colonies identified as active within the past 35 years. Colony locations not considered exhaustive and may change during the course of the project.

Wetland monitoring will occur within a 22 km radius of colony locations. Assessments of habitat dynamics will be conducted across time and space to evaluate changing density and distribution influencing foraging distance of breeding adults (Fig. 2). Annual trends will be linked to suite of climatic and anthropogenic variables and tested to identify landscape drivers influencing wetland flooding (Fig. 3). Known differences in wetland types associated with ibis foraging and nesting habitats will be identified using model results that classify sites by duration of seasonal flooding (i.e. semi-permanent, seasonal, or ephemeral) following criteria outlined by Cowardin et al. (1979). All sites monitored will be identified by ownership (public vs private). Flooded sites associated with agricultural practices or actively managed for wildlife will be labeled as such. Data summaries will assess potential bird reliance on different habitat segments by partitioning wetland availability annually by ownership and land use categories.

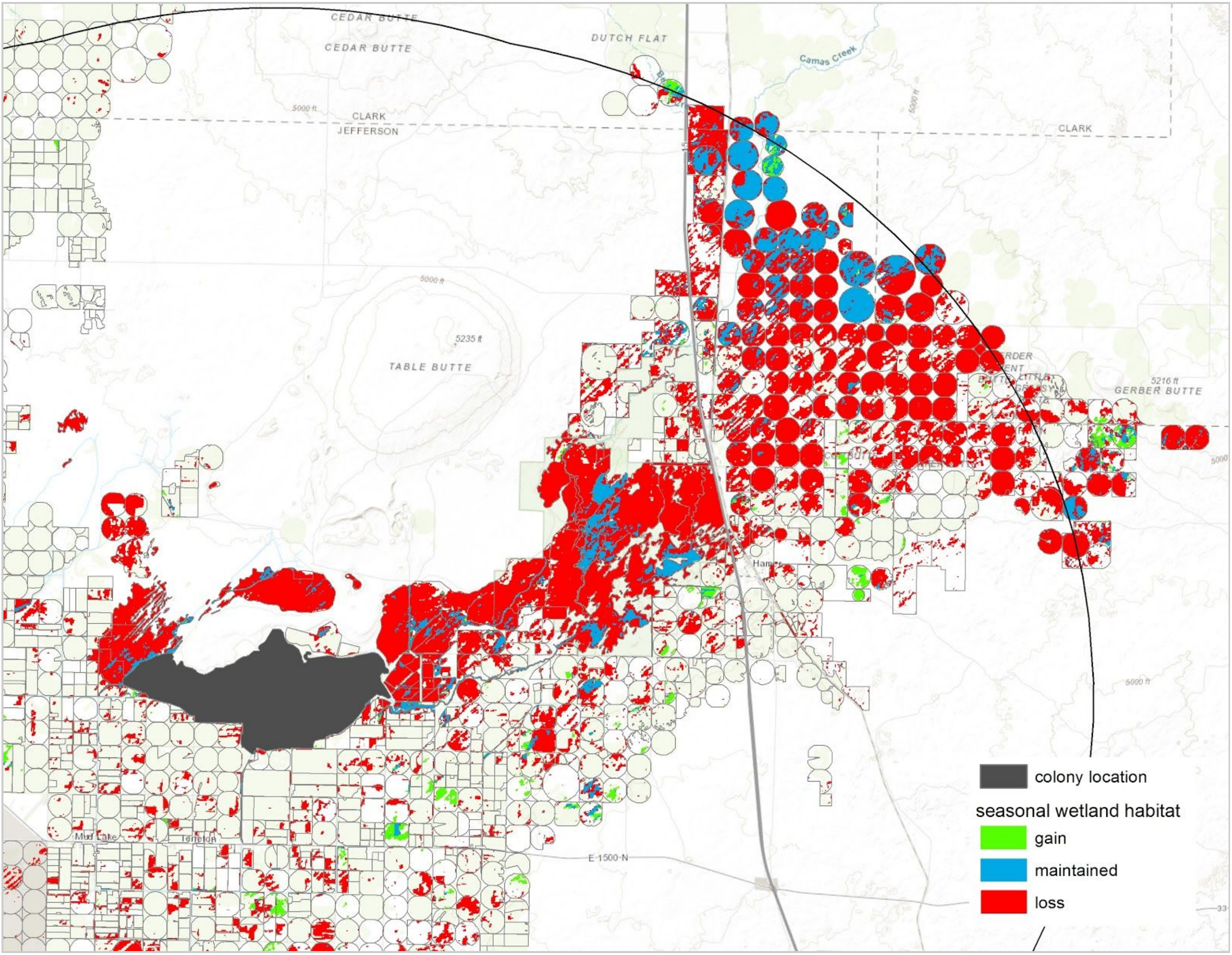

Figure 2. Wetland model example comparing white-faced ibis foraging habitat availability between late-1980's and today at Mud Lake colony near Hamer, Idaho. Dark gray line depicts 22 km distance from colony location.

To assess breeding site suitability, individual ibis colonies (n=95)[1] will act as monitoring points (*see* Fig. 1), each assessed annually from 1984 to present following methods outlined previously. Colony occupancy and bird abundance, when and where available, will be used to develop habitat selection indices (HSI) to inform ecological minimums necessary to maintain landscape viability for breeding birds. Wetland trends will be evaluated using HSI results to identify threats and develop a spatially explicit Intermountain West-wide conservation model for breeding ibis. The model will define core breeding habitat trends, identify important ecological-human drivers of wetland availability, and recommend specific habitat conservation needs for each colony.

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[1] Number of ibis colonies estimated from past observations and are subject to change during the course of the project.

Project objectives

1. Identify long-term trends (1984-present) and threats to ibis breeding habitat availability in the Intermountain West.
2. Determine population reliance on public and private wetland resources including flood irrigated agriculture.
3. Identify landscape minimums necessary to sustain breeding ibis colonies.
4. Provide proactive conservation measures and tools for targeted habitat delivery benefiting birds, agriculture, and public lands management.

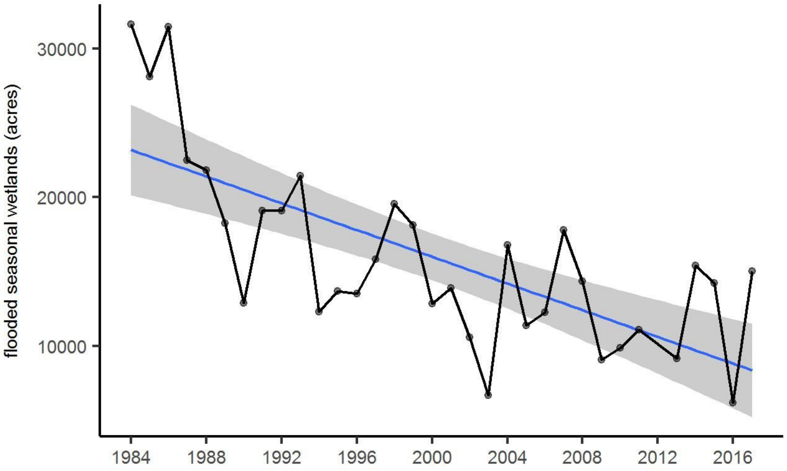

Figure 3. Wetland model example tracking annual trend (1984-2017) in white-faced ibis foraging habitat abundance within 22 km of Mud Lake colony near Hamer, Idaho. Annual variability linked to changes in precipitation (Donnelly et al. *in review*) while long-term decline may be associated with shifting land use practices.

Deliverables and timeline

Project results will be summarized and made available as a technical report and peer reviewed scientific publication. The report will identify conservation measures and practices that may be implemented as solutions to meet irrigator and bird needs. Interactive maps linking public-private irrigation and flooding history (1984-present) to individual agricultural field and wetland boundaries will be provided with associated GIS data. Maps will be viewable digitally using freely available Google Earth software and GPS enabled mobile app to allow users access to data while in the field. Prepackaged mapping products will be designed to streamline delivery of private lands conservation through targeted outreach that can identify irrigators benefiting ibis. Targeted conservation of agricultural practices knowingly aligned with bird benefits will assure outcomes are linked to sustainability of ibis populations. To accelerate incorporation of project result into ongoing conservation planning, a webinar will be provided outlining data and demonstrating mapping tools.

List of deliverables

1. Technical report and peer reviewed publication summarizing project results
2. GIS data layers depicting wetland trends (1984-present; see Fig. 2 as example)
3. Google Earth mapping tools supporting habitat conservation needs
4. Webinar outlining results and demonstrating use of mapping tools

Project implementation will utilize a two year master's student located at the University of Montana, Missoula, MT. Primary investigators Patrick Donnelly and Victoria Dreitz will act as student co-advisors. Co-advisors maintain offices on UM campus and will have direct contact with the student throughout the project. A student search will commence once funding commitments necessary to fully support the project are secured. The expected student start date is August 2018 or January 2019. Final deliverables will be provided spring 2020 or Fall 2021.

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