Pacific Flyway integrated landscape conservation; meeting the needs of waterbirds in a new errea of water scarcity

Principal Investigators

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Supporting Partners:

U.S. Fish & Wildlife Service — Department of the Interior

Intermountain West Joint Venture

Central Valley Joint Venture — Conserving Bird Habitat

Ducks Unlimited

NRCS — Natural Resources Conservation Service

Avian Science Center — University of Montana

Wildlife Biology — The University of Montana

Point Blue Conservation Science

INTRODUCTION

Water is a fundamental element of wetland ecosystem function. Sustainability of this resource is vital to continental wetland networks supporting migratory waterbird populations. Waterbirds utilize wetland networks through a complex synchronization of migration and seasonal landscape change where movements are timed to intercept windows of habitat availability important to breeding, over wintering and migratory success. Conservation of these networks has often overlooked water security as a limiting factor, instead focusing on land based protection strategies (e.g. USFWS National Wildlife Refuge System) that have assumed water resources to be inexhaustible. Increasing water scarcity due to changing climate and water use demands now raises concerns of functional wetland loss (i.e. drying) and the emergence of new and powerful bottlenecks to continental waterbird migration (Donnelly et al. 2020). Offsetting potential impacts to waterbird populations will require novel conservation strategies considerate of wetland network sustainability in a new era of limited water resources.

In the Pacific Flyway, water use has long been tied to ecologically important riparian and wetland resources. Water developed through these systems act as drivers to irrigation and urban development supporting metropolitan centers and agricultural economies. While most wetlands in the Pacific Flyway have been significantly altered, they remain essential to biological processes supporting fish and wildlife populations. Rising temperatures and more frequent and severe droughts coupled with growing urban and agricultural demands for water have triggered cascading ecological effects. To offset impacts, shrinking water supplies are now triaged to maintain the most threatened and endangered wildlife species. Such scenarios are spurring new conflict among migratory waterbird interest and other wildlife conservation groups over limited water allocations. Long-term sustainability of Pacific Flyway waterbird networks will require a more holistic perspective of human and climate impacts to inform policy and conservation measures that balance diverse economic and ecosystem demands.

To understand wetland ecosystem change in the Pacific Flyway, Ducks Unlimited and the University of Montana have partnered with the Intermountain West and Central Valley Joint Ventures to monitor the effects of climate and human development on long-term wetland resilience. The study will focus on monthly changes and drivers of wetland availability from 1984 to 2020 in SONEC (Southern Oregon - Northeast California) and the Central Valley of California, two of the most important waterbird landscapes in Western North America. Analyses will examine spatiotemporal wetland trends and ecological relationships between these landscapes to identify changing alignment of seasonal habitat resources and their influence on waterbird breeding, wintering and migration cycles. Climate and human drivers identified as important predictors of wetland trends will be used to forecast future landscape conditions. Work will be inclusive of all ownerships and important agricultural water uses linked to wetland resources; e.g. rice cultivation and flood irrigated hay meadows. Outcomes will provide natural resource managers a first ever Pacific Flyway perspective of integrated SONEC and Central Valley wetland ecology. Results will support new cross landscape collaboration intended to offsets impacts of water scarcity at a flyway scale through coordinated wetland management and conservation benefiting waterbirds and other wetland dependent wildlife.

While this work emphasizes landscape connectivity in migratory waterbirds, the detailed spatiotemporal wetland monitoring it provides are applicable to conservation of any wetland associate taxa - from sage-grouse to garter snakes. Products may also be used in outcome based monitoring as tools to measure success of wetland restoration and protections. We encourage natural resource practitioners to consider the biologic returns from this project broadly.

METHODS AND OUTCOMES

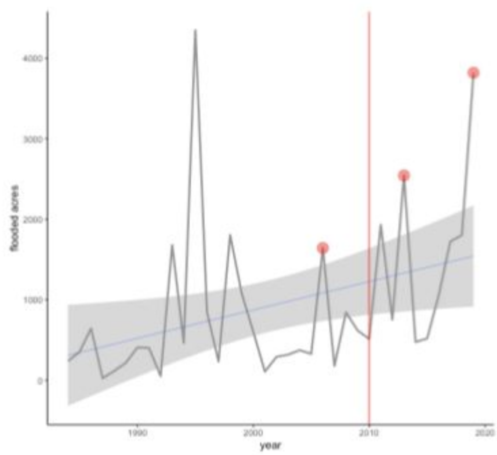
Project Area

The project footprint will encompass important waterbird habitats in the Central Valley Joint Venture and the SONEC region (Figure 1). Analyses will be inclusive of all public and private lands.

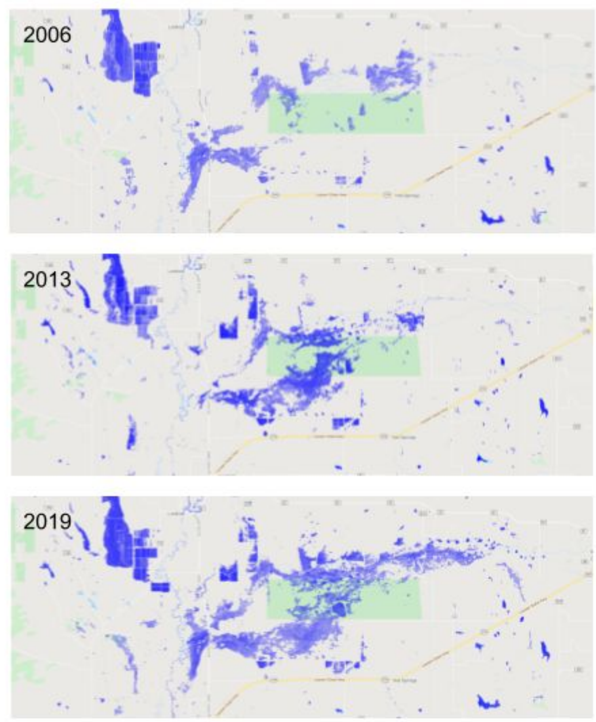
Figure 1. Project study area defined by Central Valley Joint Venture boundary and SONEC region.

Monitoring long-term wetland trends

Following methods outlined by Donnelly et al. (2019), spatiotemporal dynamics of seasonal wetland inundation will be monitored from 1984-2020 using Landsat satellite imagery. Surface water extent will be measured using constrained spectral mixture models to provide proportional estimations of water contained within $30\ m^2$ Landsat pixels (Halabisky et al. 2016, Jin et al. 2017)). This approach provides an accurate account of inundation when only a portion of surface water is visible due to interspersion of water and emergent vegetation, a common characteristic among shallow seasonal wetlands. To depict timing and extent of surface water inundation, wetland dynamics will be summarized monthly as a five-year rolling mean and annually within waterbird breeding, migration and overwintering periods (Figure 2). Because hydrologic regimes are an important predictor of waterbird habitat values, modeling will be used to quantify annual abundance by different wetland types defined as ‘temporary’ (flooded < 2 months), ‘seasonal’ (flooded > 2 and < 8 months), and ‘semi-permanent’ (flooded > 8 months) (sensu Cowardin et al. 1979).



Monitoring example; wetland restoration and climate influences on spring surface water trends - Ash Creek Wildlife Area 1984-2019. Red line marks pre-post restoration. Red points correlate to model outputs shown - 2006, 2013, and 2019. Blue line is least squares regression with the 0.95% confidence interval of the slope shown in gray fill.



Cross landscape relationships

To assess landscape synchrony we will compare monthly patterns of inundation by wetland type (i.e. temporary, seasonal, semi-permanent) between SONEC and the Central Valley from 1984 to 2020. Relationships will focus on timing and abundance of wetland flooding linked to important waterbird lifecycle events (e.g. breeding, migration, and overwintering) developed through analysis of eBird data. Analyses will identify divergence in cross-landscape patterns associated with wetland drying that may lead to emergence of bottlenecks in species habitat needs. Results will be isolated by land ownership, resource agency, wildlife area/refuge, and land use practice (e.g. rice cultivation) that isolate ecological effects to inform collaborative conservation planning.

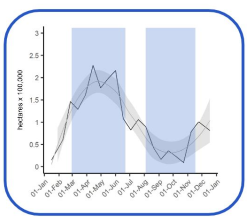
Landscape limiting factors

We will attribute the importance of climate and human water use to the prediction of wetland surface water trends using randomForestSRC regression tree analysis (Ishwaran and Kogalur 2019), as a nonparametric measure of variable importance. This approach is applicable to dynamic ecological systems with typically non-normal statistical distributions. Variables identified as important predictors of wetland change will be combined with climate projection models to forecast future wetland availability. Outcomes will identify important landscape limiting factors that may be used to inform meaningful wetland conservation. For example if drought is identified as the major driver of wetland declines, investments in climate resilient strategies may be prioritized to best offset ecological impacts.

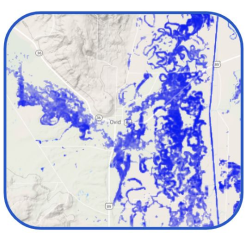
Data integration into web-based viewing platform

Wetland data will be made available through a web-based data viewer being funded and developed independently of efforts outlined in this proposal.

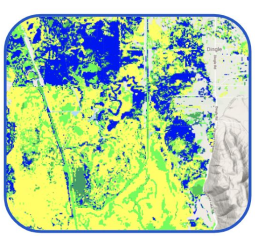
Available wetland data layers will include the following:



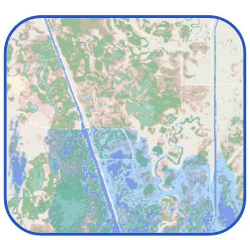
1. Annual mean spring and fall wetland flooding - layers depict mean surface water extent over annual three-month maximum (spring) and minimum (fall) periods.



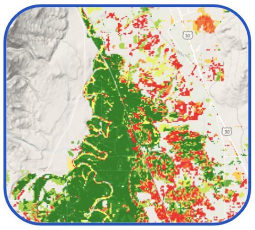
2. Rolling 5-year monthly wetland flooding mean - layers depict surface water extent as a monthly rolling five year mean.



3. The 36-year trend in seasonal surface water resiliency - layer identifies linear trend in surface water occurrence to determine if wetland hydrology is unchanged, drying, or increasing periods of flooding.



4. Wetland hydroperiod classification - classifies period of seasonal flooding by summarizing the length of time an area is wet annually.



5. Probability of monthly wetland flooding - layers depict probability an area will be flooded within specific months of the year.

Technical transfer

To accelerate the integration project outcomes into flyway and local scale biological planning, the IWJV will host webinars outlining data interpretation for conservation practitioners. Presentations will include separate technical sessions for science support staff that wish to apply model outputs to agency-specific projects.

Project Objectives

Proposal funders seek to provide natural resource managers a first ever Pacific Flyway perspective of joint SONEC and Central Valley wetland ecology. Science objectives include support for new cross landscape collaboration intended to offset impacts of water scarcity at a flyway scale through coordinated wetland management and conservation benefiting waterbirds and other wetland dependent wildlife. Associated objectives include:

1. Provide partner wetland data access through a web-based viewing platform,

2. Promote incorporation of wetland science outcomes into agency and NGO conservation planning using interactive webinar-workshop training.

TIMEFRAMES AND DELIVERABLES

Modeling and data development will commence fall 2020. Project completion will occur in fall 2021. All associated spatial and tabular data will be made available to funding partners. Summary results will be provided initially as a technical report followed by a peer-reviewed scientific publication Deliverables include:

1. Access to wetland monitoring data through a web-based viewer.
2. Technical report summarizing study outcomes.
3. Two webinar based workshops to support data use and incorporation into existing planning efforts for Pacific flyway NGO, state, and federal partners.

References

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