Science Proposal

Monitoring long-term wetland and rangeland trends; decision support for Oregon's Natural Resources Conservation Service

J. Patrick Donnelly – Intermountain West Joint Venture, 32 Campus Drive, FOR302, University of Montana, Missoula, MT 59812, USA.

Victoria J. Dreitz - Director of Avian Science Center and Professor of Conservation Biology, 32 Campus Drive, FOR312A, University of Montana, Missoula, MT 59812, USA.

Funded by:

Overview

In Oregon the Intermountain West Joint Venture (IWJV) seeks to collaborate with the Natural Resources Conservation Service (NRCS) to expand long-term wetland and rangeland monitoring. Wetland monitoring models documenting seasonal wetland hydrology and agricultural flood irrigation history completed by the IWJV and NRCS in Lake, Harney, and Klamath Counties (Donnelly 2017) will expand to the remainder of the state (Fig. 1a). Rangeland drought sensitivity modeling provided by the Sage Grouse Initiative (Donnelly et al. 2016) will expand to additional areas in eastern Oregon (Fig. 1b). Principal investigators associated with original monitoring efforts will be acting as research leads for project expansion. Analyses will follow methods similar to those used previously and provide deliverables compatible with existing data.

Methods

Project footprint

Wetland monitoring will encompass emergent palustrine wetlands, major riparian areas and irrigated agriculture (hereafter 'wetlands'). Analysis will be concentrated along riparian corridors and valley bottoms containing a majority of wetland resources, but may also include isolated wetland sites. Monitoring will be comprehensive to all land ownership and land-use practices linked to wetland resources with the exception of small isolated high elevation sites. These wetlands were omitted due to their relatively minor influence on water use management and environmental metrics that make site monitoring difficult. Rangeland drought sensitivity monitoring will occur on all public and privately owned shrub and grasslands, including irrigated pasture and riparian areas (hereafter 'rangelands') east of the Cascade Mountain range (Fig. 1b).

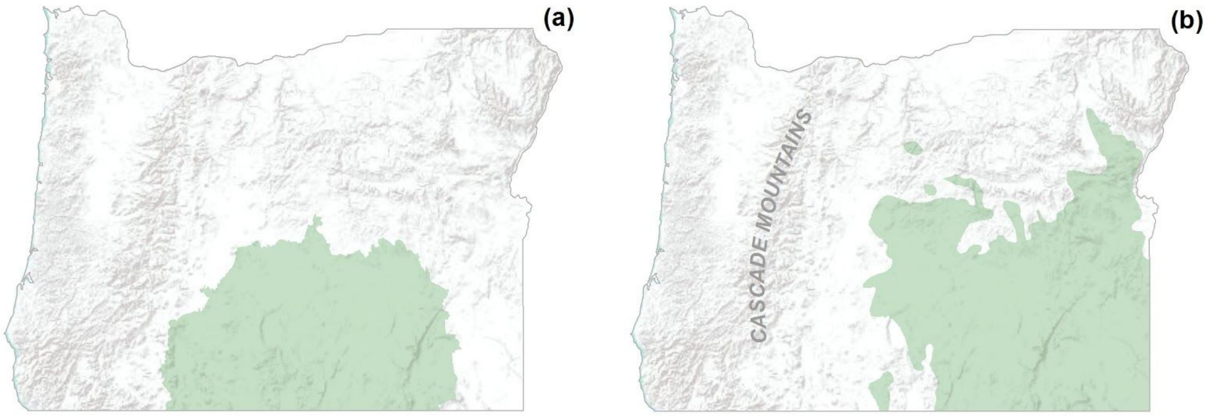

Figure 1. Area of existing wetlands monitoring (a) shown in green. Area of existing rangeland drought sensitivity monitoring (b) shown in green.

Modeling wetland hydrology

Spatiotemporal dynamics of wetland hydrology (i.e. flooding) will be modeled from 1984 to present using remote sensing and satellite imagery. Surface water extent will be measured using constrained spectral mixture analysis (Adams and Gillespie 2006) and sub-pixel water fraction that allows a proportional estimation of water contained within a 30x30 meter monitoring grid. This approach provides a more accurate account of flood extent when only a proportion of surface water is visible due to interspersion of emergent vegetation; a characteristic common to shallow seasonal wetlands and flood irrigated agriculture in Oregon.

Spectral mixture models will be partitioned by multiyear oscillations in above and below average precipitation trends characteristic of long-term climatic patterns. Trends will be derived from the Gridded Surface Meteorological Dataset (Abatzoglou 2013). Wetland hydrology will be averaged within these periods and divided into approximately 30 day intervals correlated to calendar months. Applying this approach makes it possible to isolate climate driven ecological means influencing wetland response (i.e. drought) and simultaneously reduced the potential of monitoring gaps resulting from poor quality satellite data. Final analysis will result in a monthly estimation of wetland flooding within five to six distinct climatic periods over a continuous 35 year span.

Modeling rangeland drought sensitivity

Rangeland monitoring will identify trends in drought sensitivity (1984-present) following methods outlined by Donnelly et al. (2016). Measurements will based on normalized difference vegetation indices (NDVI) which quantify photosynthetic activity and correlate closely to fluctuations in net primary production. Monitoring will be conducted annually using remote sensing and satellite imagery to account for climate driven variation in landscape condition. Results will be provided as a single value for each year representative of mean productivity occurring from late July to September. Adhering to original methods, monitoring will be constrained to drought resilient rangelands defined by sites that have remained productive (NDVI ≥ 0.3) during late summer for one or more years of the past 35. Areas that do not meet this condition will be excluded because they are considered to have near zero probability of seasonal drought resiliency and are continuously unproductive and dry during late summer months. (*see* Sage Grouse Initiative interactive mesic map as example of anticipated rangeland monitoring results.)

Project objectives

1. Monitor and inventory long-term trends (1984-present) of seasonal surface water hydrology and flood irrigation occurring in important wetland and agricultural landscapes of Oregon.
2. Monitor and inventory long-term trends (1984-present) of drought limited rangeland productivity in eastern Oregon.

Deliverables and timeline

Project results will be provided in a GIS and accompanied by a metadata report outlining data structure and methods used in analysis. Interactive maps linking public-private wetland hydrology and rangeland production 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 and evaluation. To accelerate incorporation of project result into ongoing conservation planning, a webinar will be provided to present data and demonstrate mapping tools.

List of deliverables

1. Metadata report outlining data structure and methods used in analysis
2. GIS data layers depicting wetland and rangeland trends (1984-present)
3. Google Earth mapping tools supporting habitat conservation needs
4. Webinar outlining results and demonstrating mapping tool use

Wetland and rangeland monitoring will be conducted by a biotech located at the University of Montana (UM), Missoula. Principal investigators Patrick Donnelly (IWJV) and Victoria Dreitz (UM) will provide project oversight and supervision. Principal investigators maintain offices on the UM campus and will have direct contact with the biotech throughout the project. Project implementation will commence when funding is made available. GIS data, report, and map products will be provided to NRCS 18 months post implantation date. The webinar date will be coordinated with NRCS once other products are reviewed and approved.

Literature Cited

Abatzoglou, J. T. 2013. Development of gridded surface meteorological data for ecological applications and modelling. International Journal of Climatology 33:121–131.

Adams, J. B., and A. R. Gillespie. 2006. Spectral-mixture analysis. Pages 126–165 Remote Sensing of Landscapes with Spectral Images: A Physical Modeling Approach. Cambridge University Press.

Donnelly, J. P. 2017. Managing risk and maximizing return; decision support for conservation of dynamic wetland landscapes in southern Oregon and northeast California. Intermountain West Joint Venture.

Donnelly, J. P., D. E. Naugle, C. A. Hagen, and J. D. Maestas. 2016. Public lands and private waters: scarce mesic resources structure land tenure and sage-grouse distributions. Ecosphere 7:1–15.