

Integrating Remote-Sensing and Ecological Forecasting into Decision-Support for Wetland Wildlife Management and Ecosystem Services in the Central Valley of California: Optimizing Across Multiple Benefits (NNX17AG81G)

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NASA Biodiversity and Ecological Forecasting Team Meeting

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Point Blue

Conservation science
for a healthy planet

Black-necked Stilt in Central Valley Rice

Project Team

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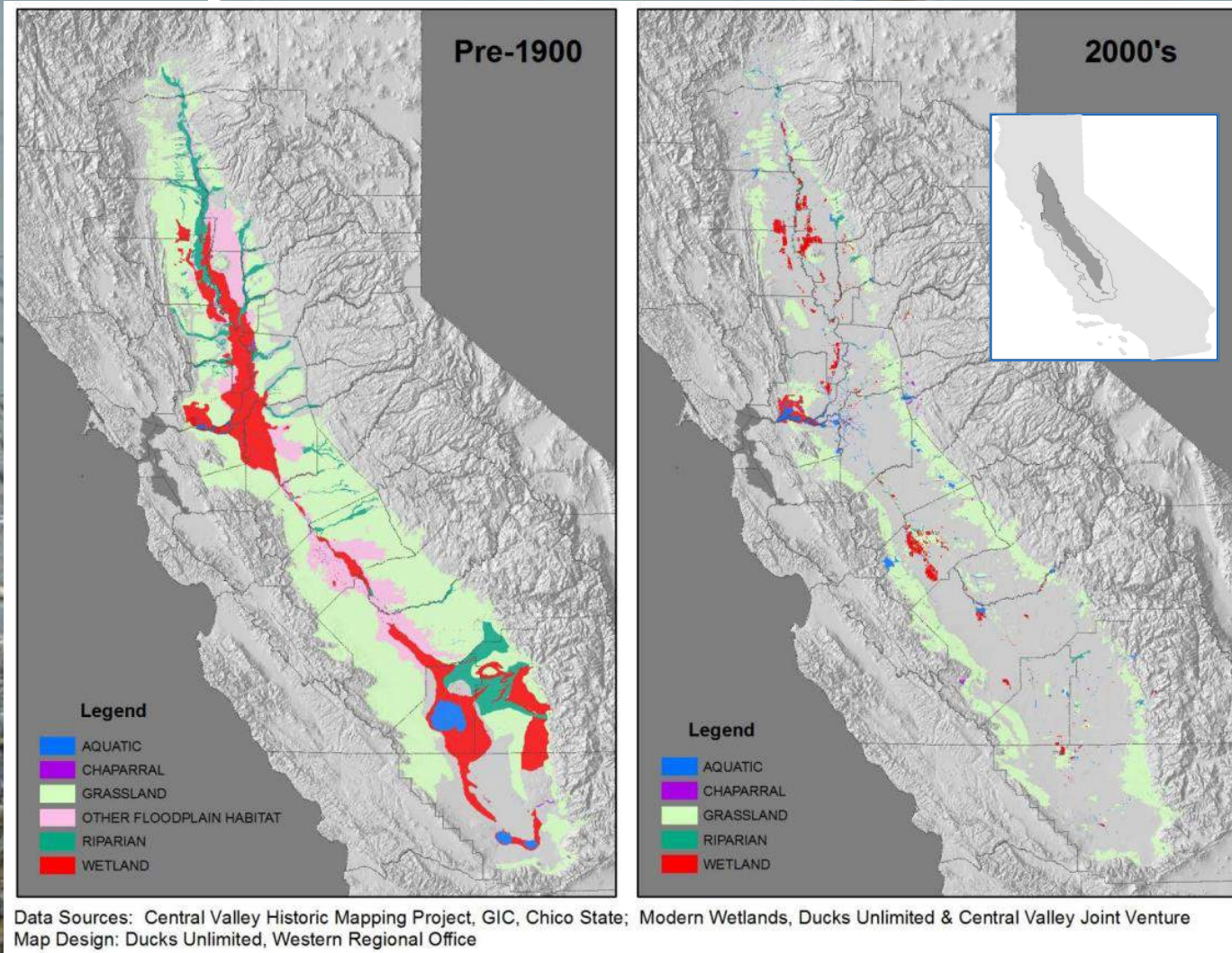
Claudia Mengelt
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NASA

Jay Skiles



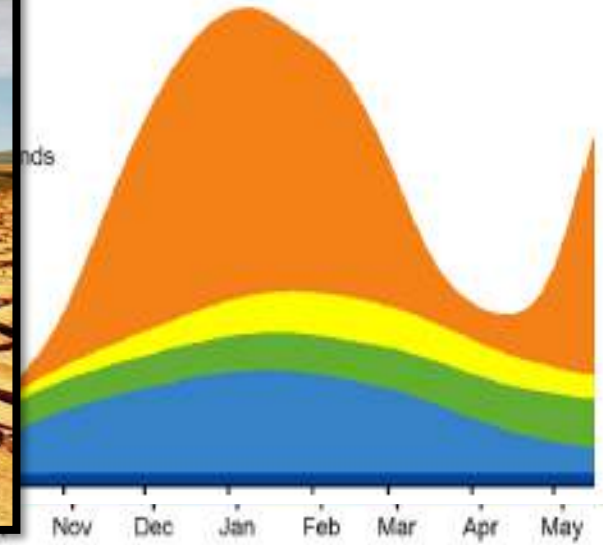
Central Valley has <10% wetlands remaining



Wetland habitat is dynamic – driven by weather and management



Reiter et al. 2015



Dybala et al. 2018

Where to put water and
when to maximize
multiple benefits?

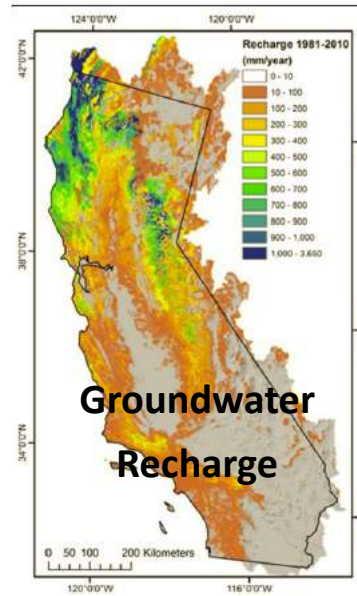


Coordinated Data-Driven Decision Support Optimizes Water
Management to Achieve Multiple-Benefits for today and 100
years from now

Biological Targets
Waterfowl
Shorebirds
Giant Garter Snake

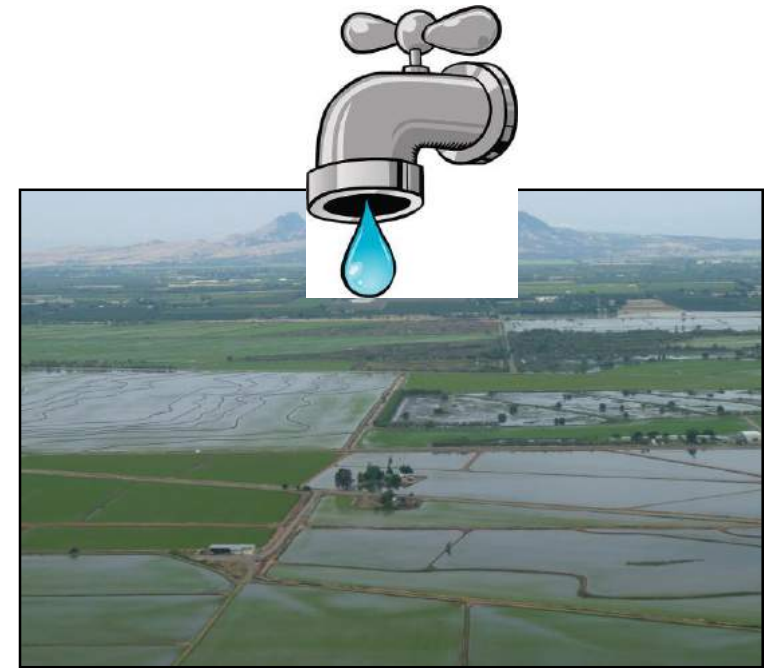


Ecosystem Service
Targets
Groundwater Recharge
Freshwater Biodiversity



+

=



Objectives and Decisions

Within-year forecasts of biological and ecosystem services targets

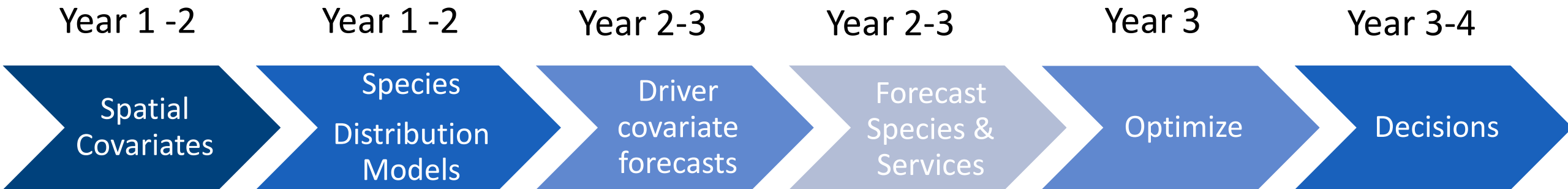
- TNCs dynamic conservation program – BirdReturns
- Annual wetland water management planning (Federal, State, Private)

Long-term forecasts (50-100 years) of biological and ecosystem services targets under multiple scenarios

- Strategic implementation of Central Valley Joint Venture habitat goals
- Habitat restoration potential maps for USFWS

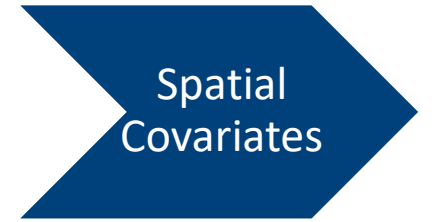
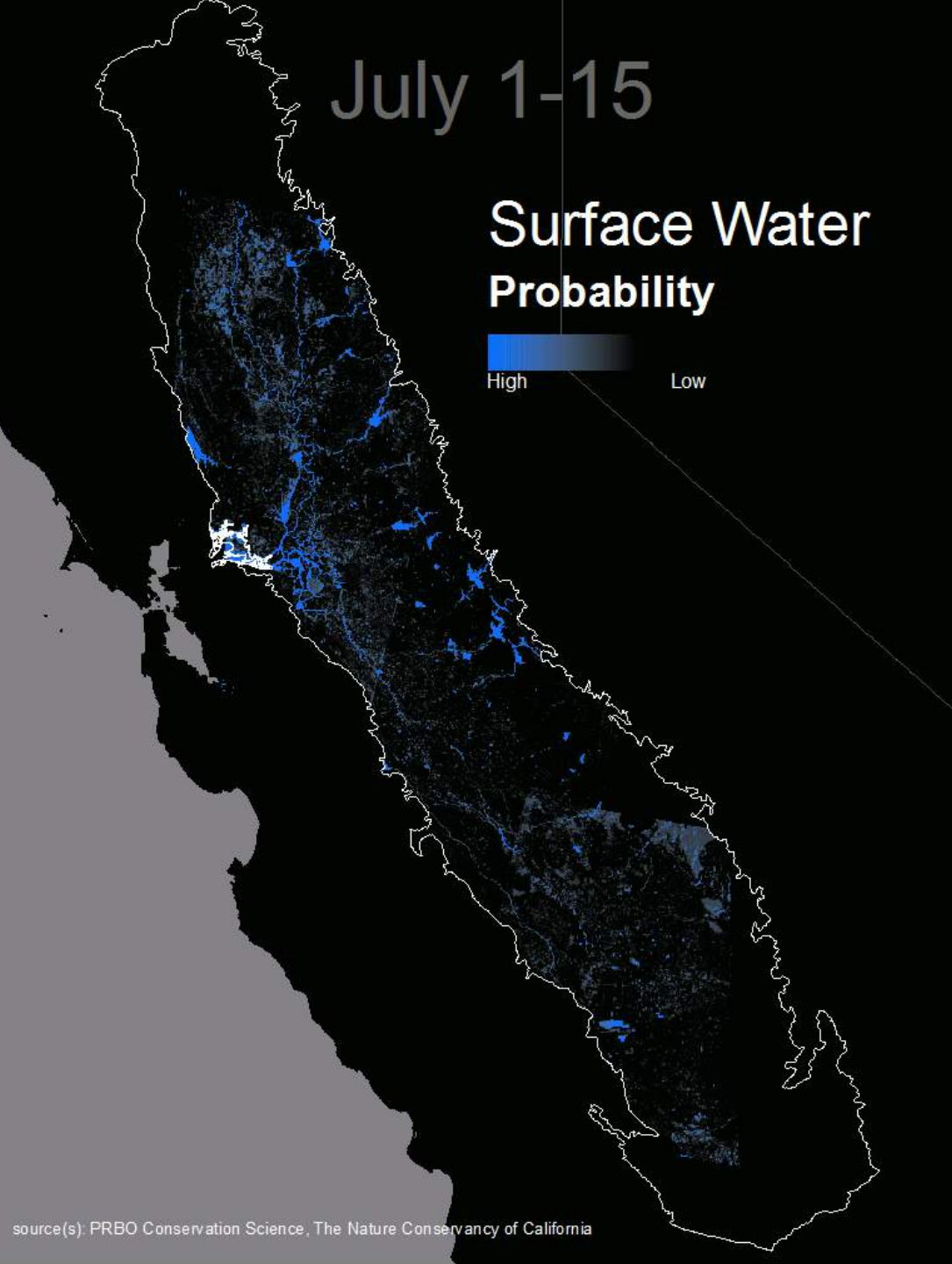


Our Workflow



Water

Open Water Data
2000-2018
(Landsat 5 & 8)

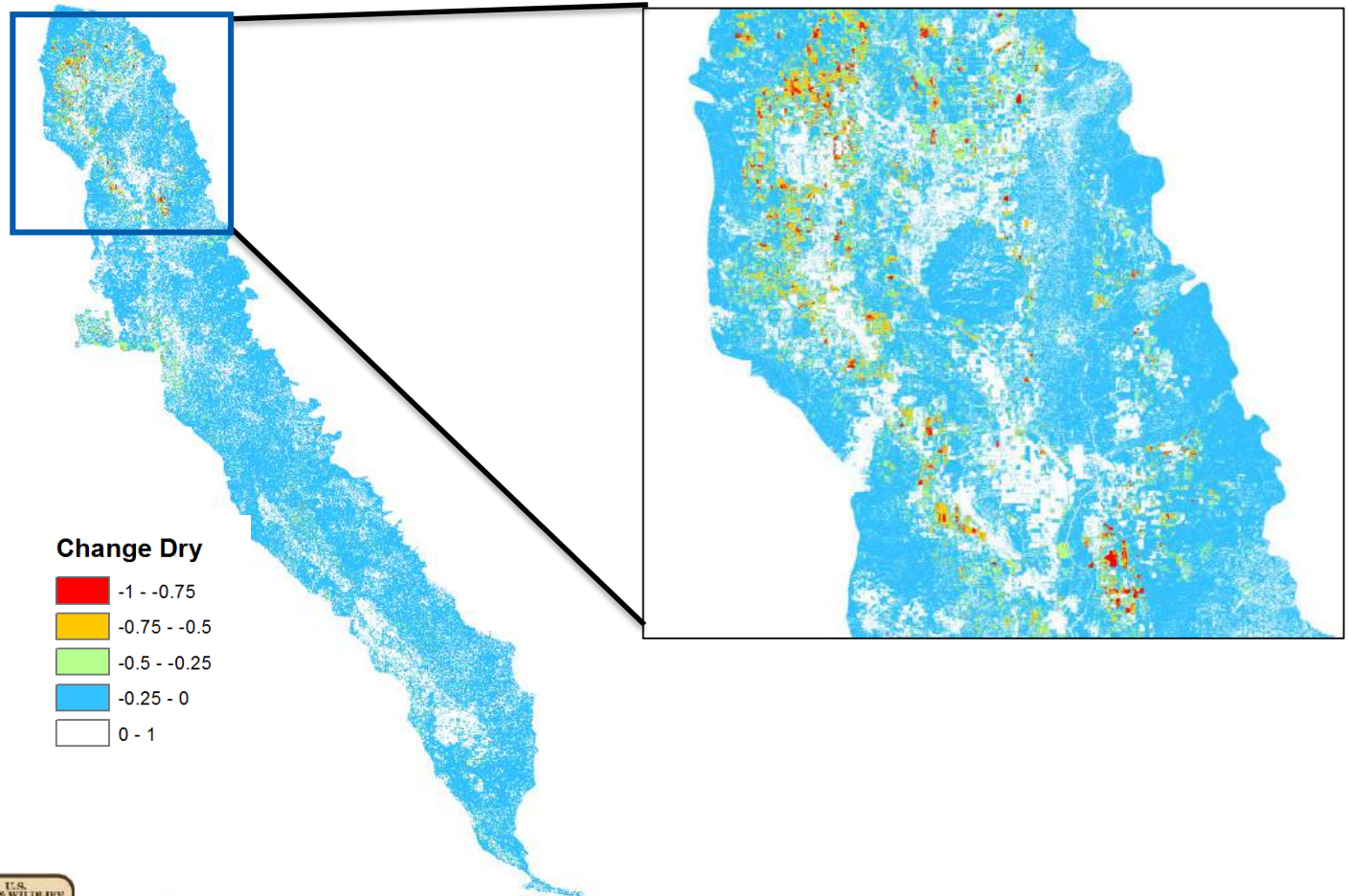
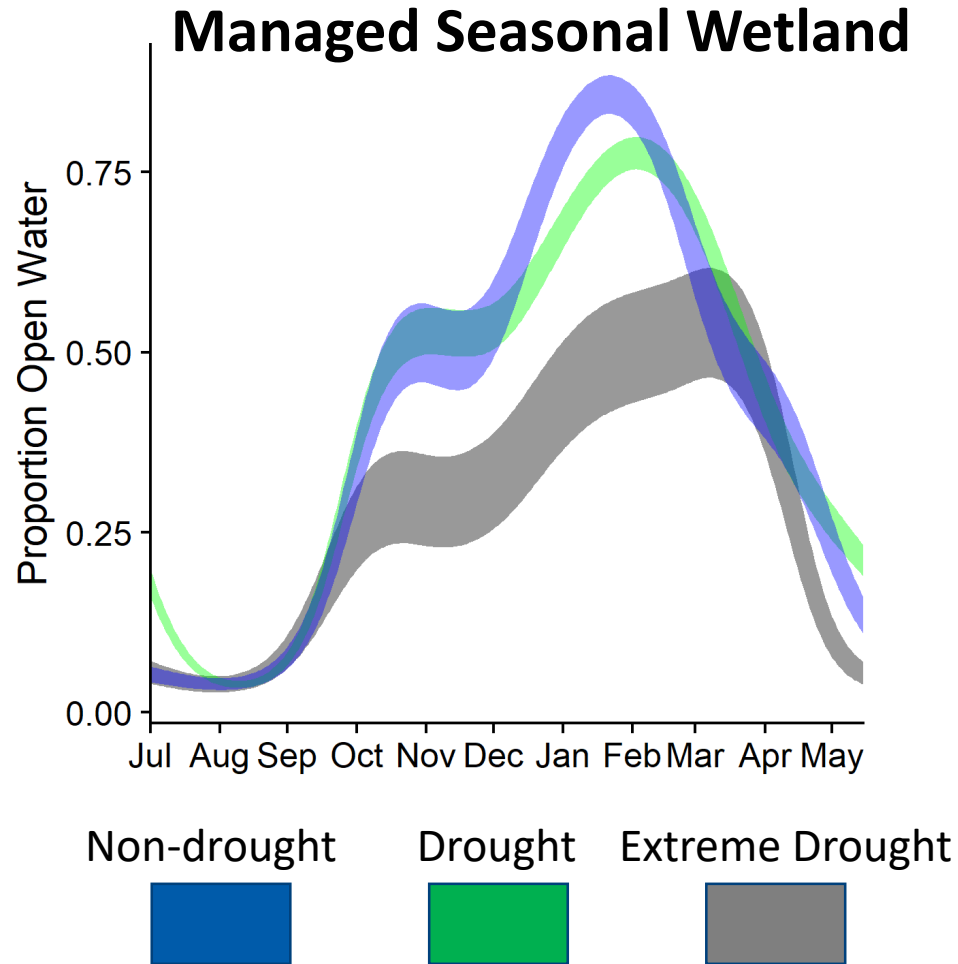


source(s): PRBO Conservation Science, The Nature Conservancy of California

Reiter et al. 2018

Hotspots of Change in Drought

Spatial
Covariates

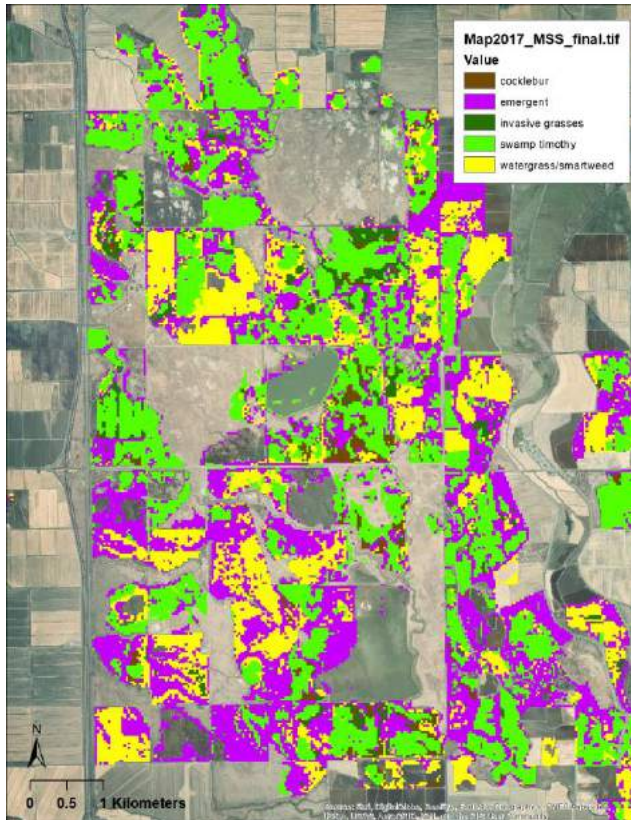


Habitat Quantity / Quality

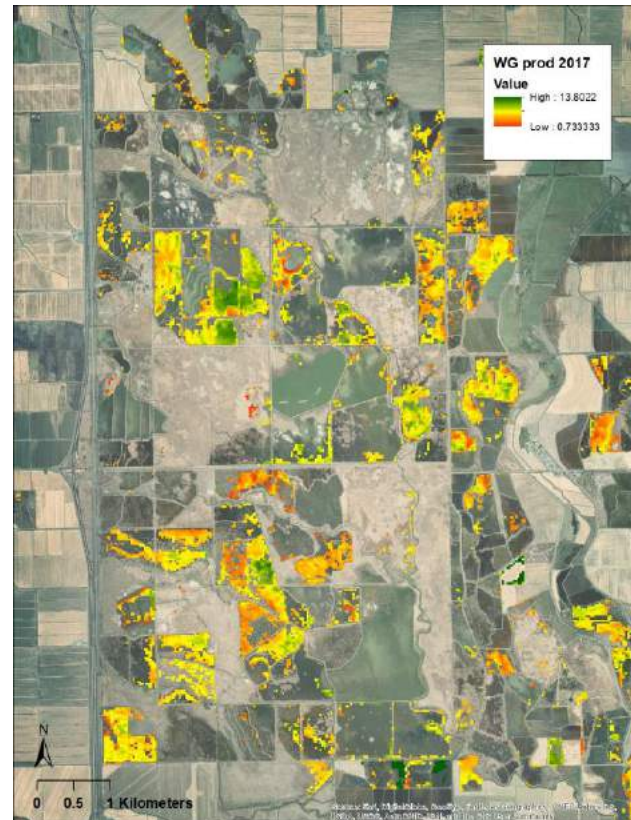
Spatial
Covariates

Landsat 5 & 8
2007-2017

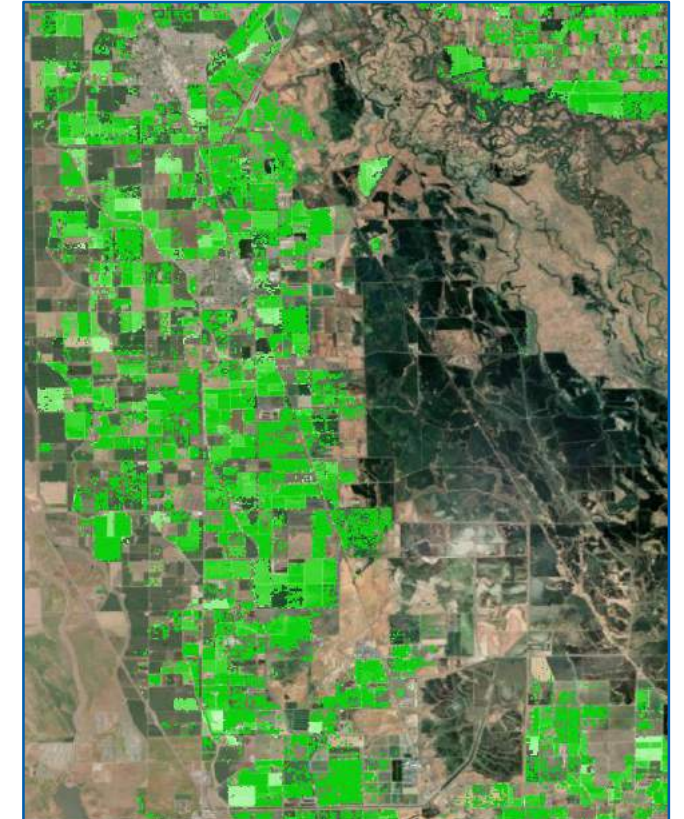
Wetland Vegetation Type



Wetland Productivity

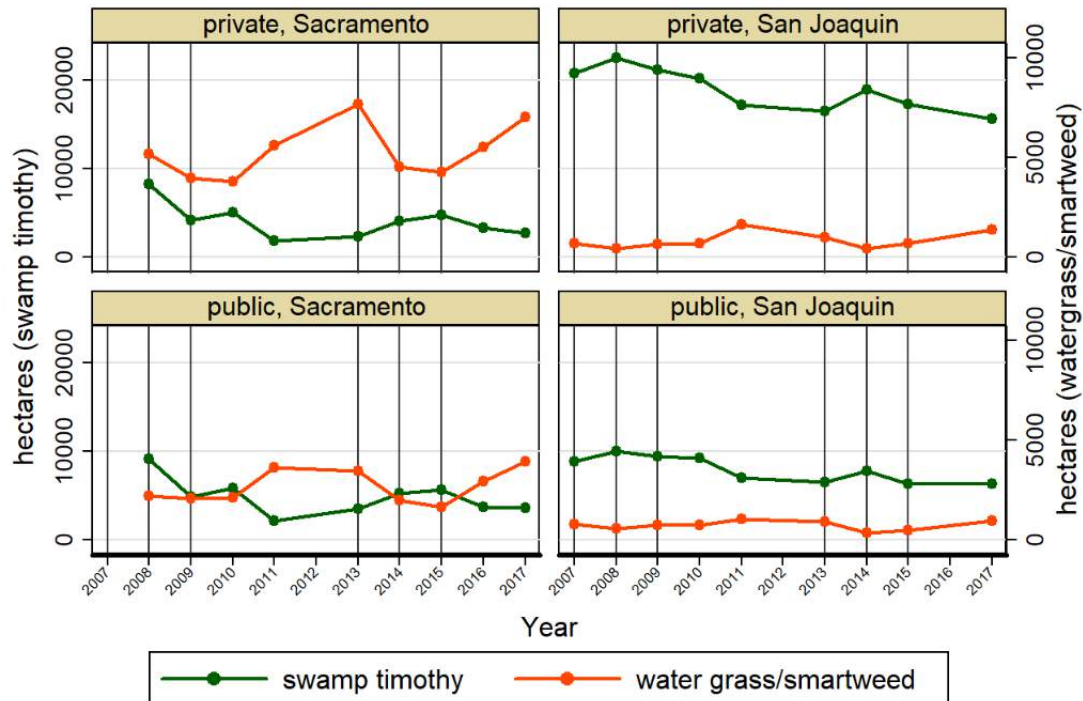


Crop Productivity



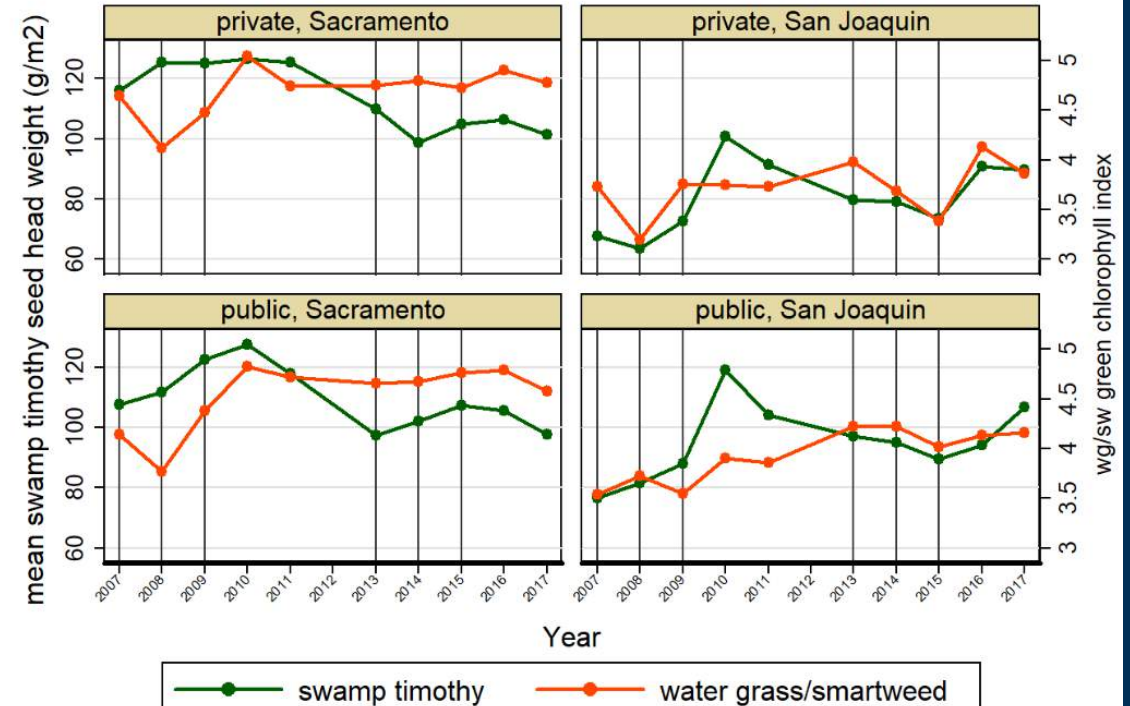
Significantly more swamp timothy and less productivity in critical drought years across the Central Valley, public and private lands

Plant Area



Graphs by protected and valley

Productivity



Graphs by protected and valley

Byrd et al. In prep

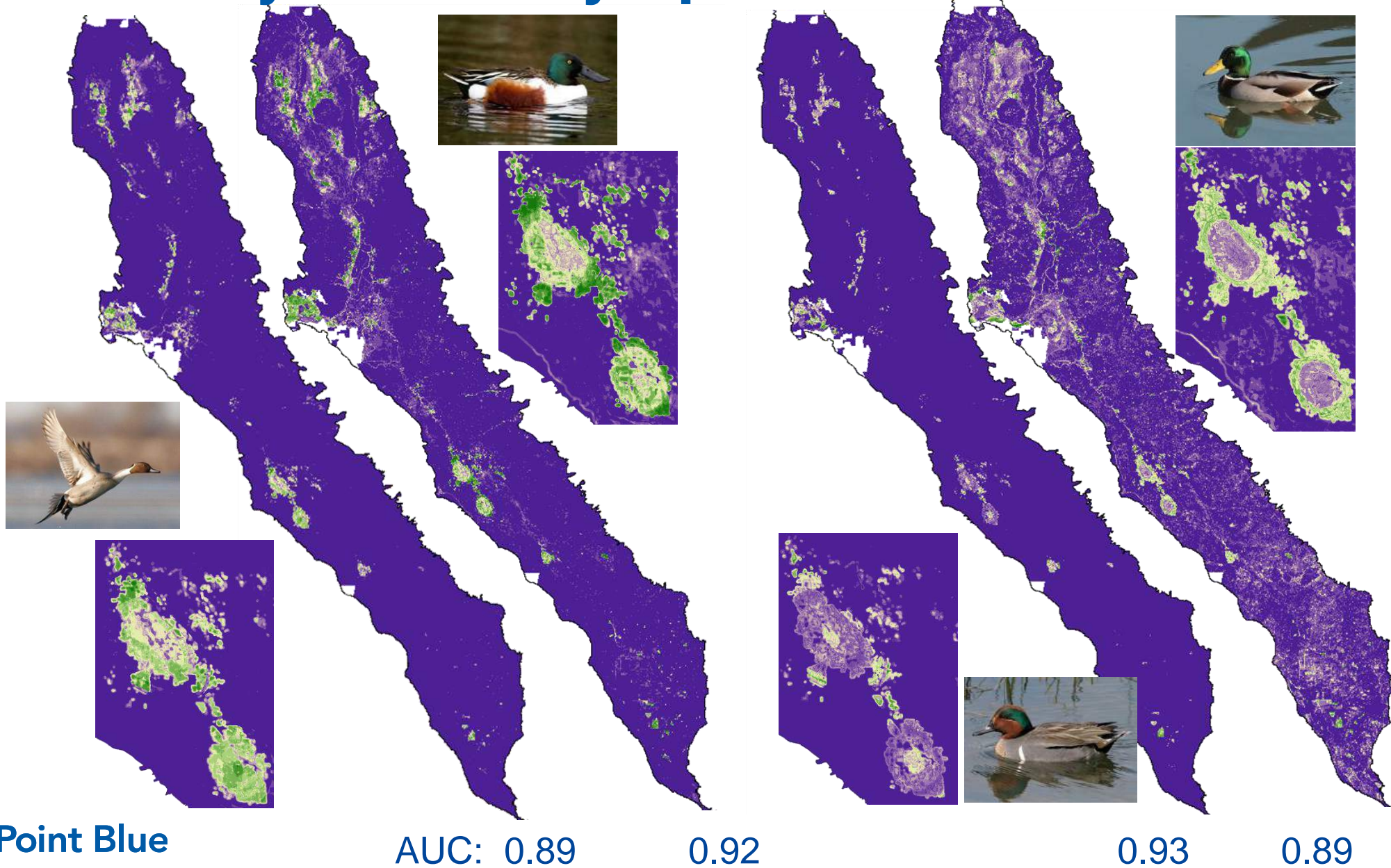
What are the key drivers?

Species
Distribution
Models

- Bird data (Point Blue structured surveys/filtered eBird)
- Snake capture data
- Boosted Regression Trees
- Identify key drivers for forecasting
- Assessed Real-Time versus Long-Term Average
- Drought vs. Non-Drought Years

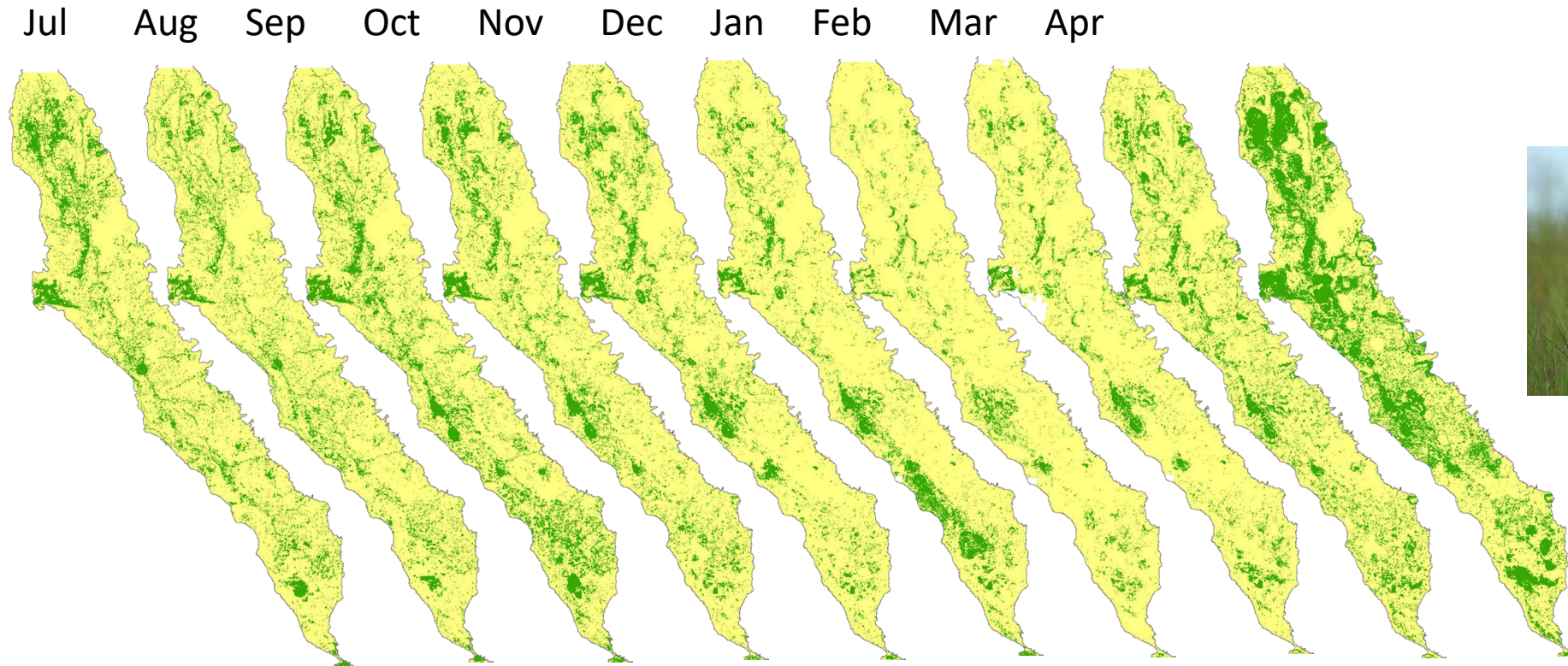


Suitability varies by species



Suitability is seasonally dynamic

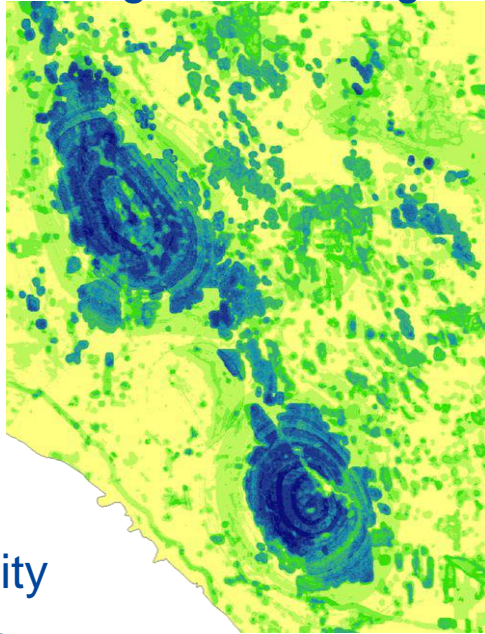
Species
Distribution
Models



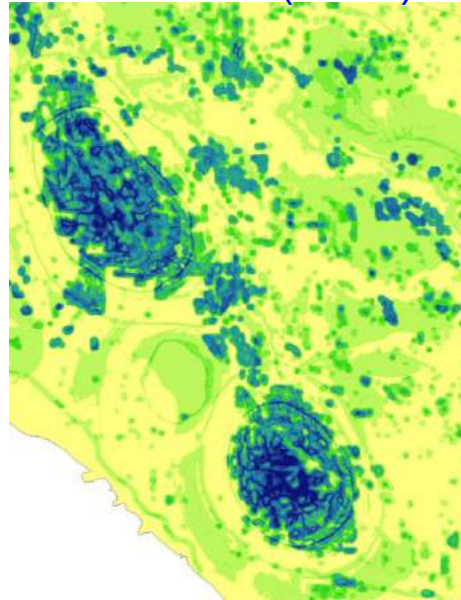
Suitability is dynamic among years

Species
Distribution
Models

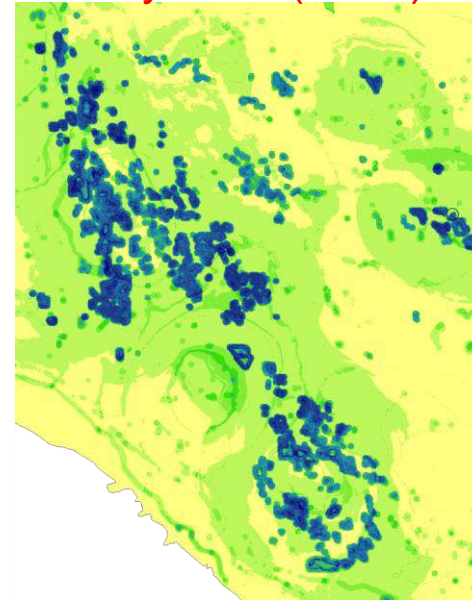
Long-term Average



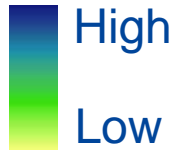
Wet Year (2005)



Dry Year (2014)



Suitability



October



Giant Garter Snake

Covariates

Average (2001-2017) of flooding for two week periods and the period March 1-Oct 15

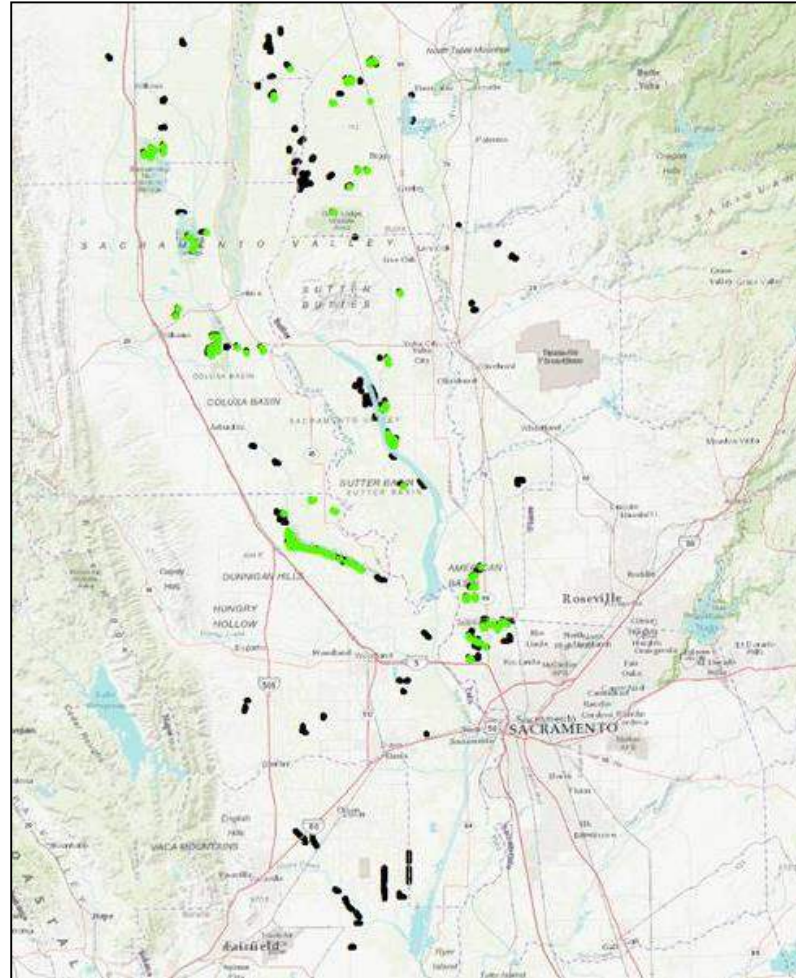
Fraction of landscape that is growing rice, fallow rice and post-harvest flooded rice

Density of canals at 300m, 1000m, and 3000m

Density of streams at 300m, 1000m, and 3000m

Average and standard deviation (across 2001-2016) of day of year of maximum greenness

Average and standard deviation (across 2001-2016) of maximum NDVI

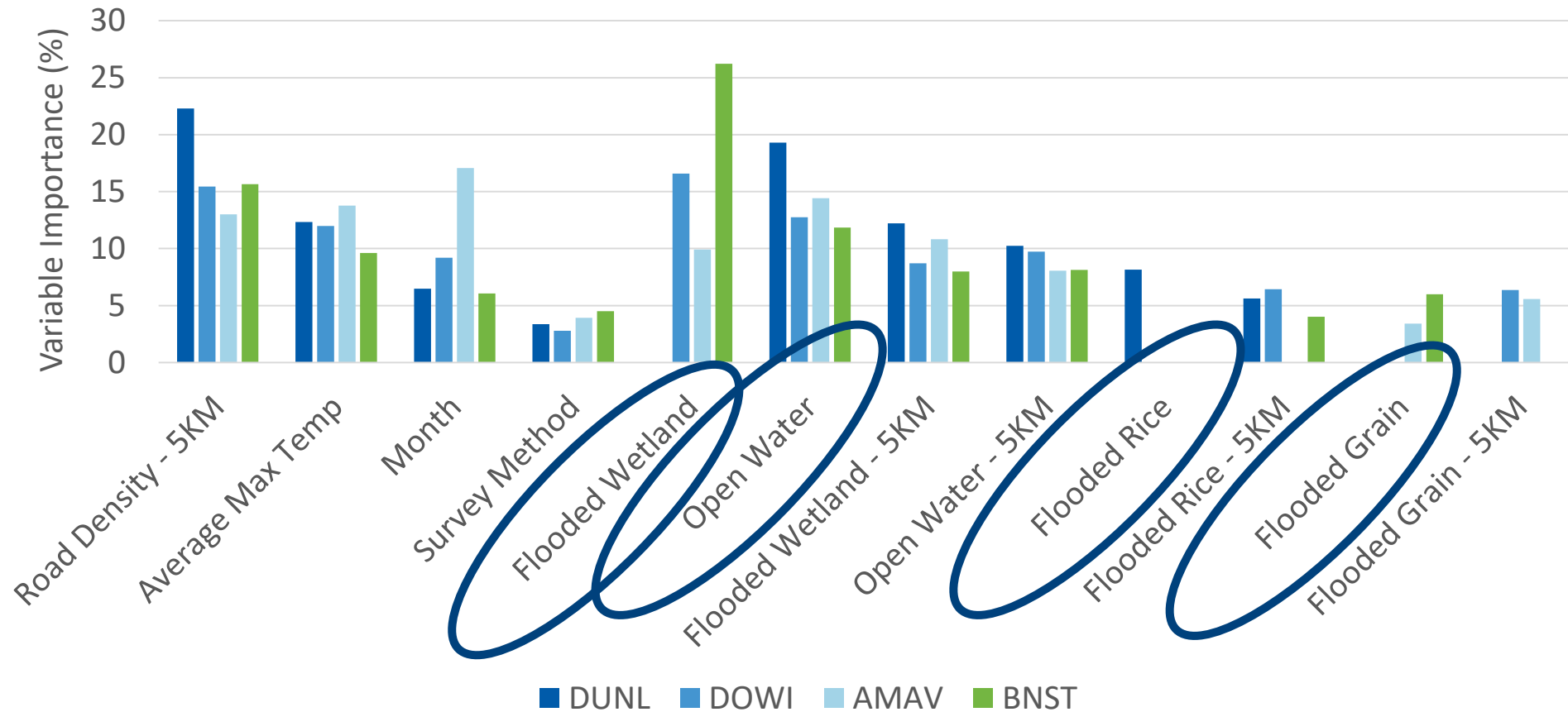


Species
Distribution
Models

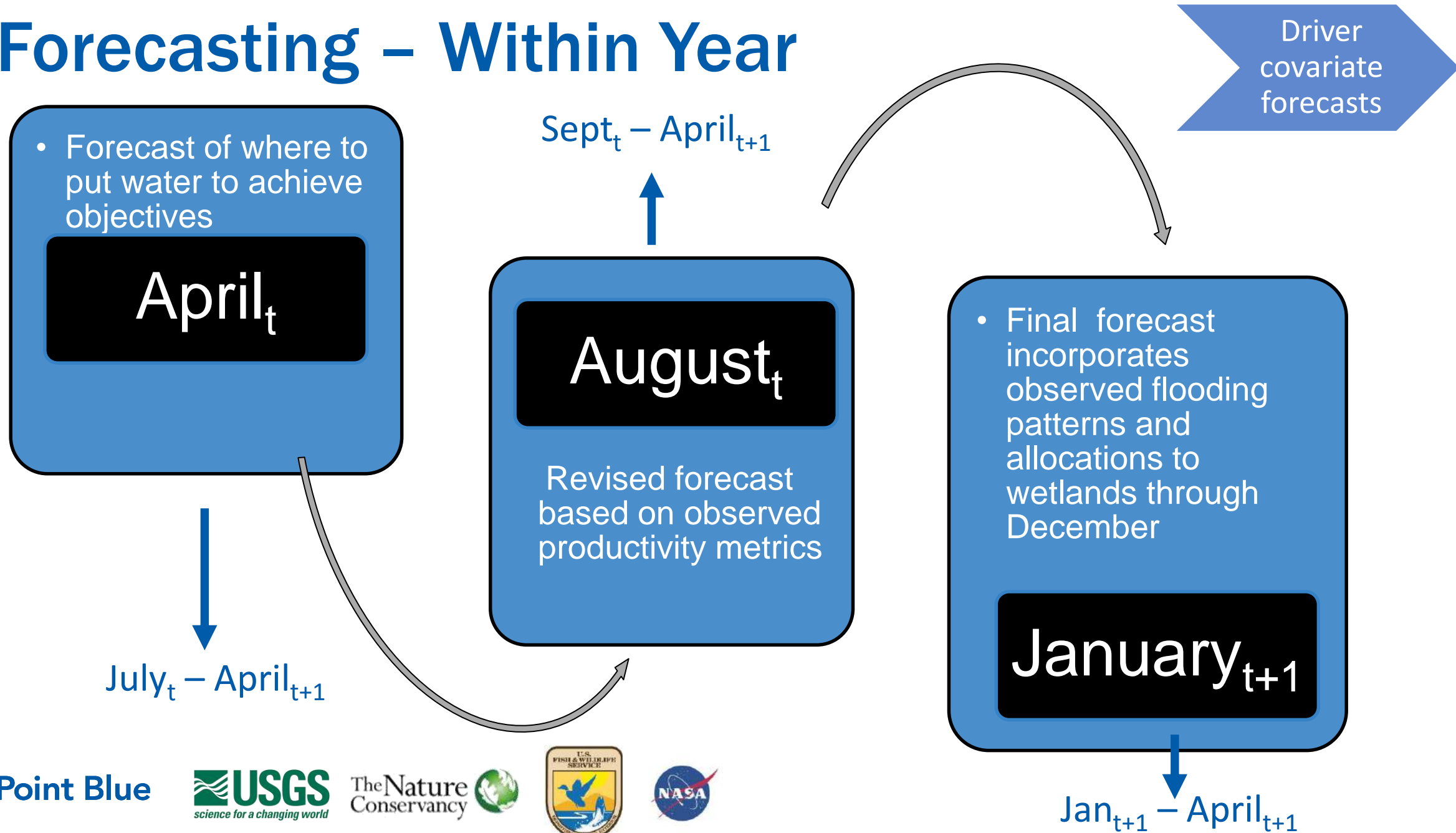


Variable Importance

Species
Distribution
Models



Forecasting – Within Year



Forecasting Water – Within Year

Driver
covariate
forecasts

- Forecast of where to put water to achieve objectives

Apr 1_t

Model forecast accuracy varied by month... wetter months were harder to forecast


Accuracy → 80-90%

July_t – April_{t+1}

Covariate	Time Period	Source	Importance
10-year average water (pixel)	10-year	Landsat 8	66-95%
Basin	NA	CVJV	3-11%
Water Supply Index	WSI forecast monthly	CA DWR	7-16%
Months in the future	NA	calculated	
Month predicted to	NA	calculated	

Scene: Central Valley Mosaic

Date: Apr 17, 2019 to Apr 26, 2019

Draw Polygon: 

Instructions

Select Shapefile: Choose File No file chosen

Download: Select Method

Water Tracker

www.pointblue.org/watertracker

Overlays

- ☒ Labels
- ☒ CVPIA Refuge
- ☒ L8_valley_201904
- ☒ Water (cloud-f
- ☐ Seasonal Wetl
- ☐ NDVI
- ☐ Crop Types - 2
- ☐ National Eleva
- ☐ Dataset

Location Summarized: User-uploaded polygon in California's Central Valley

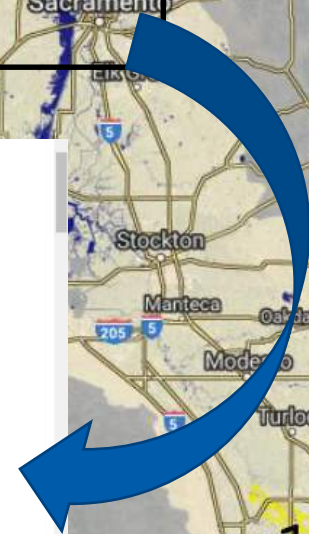
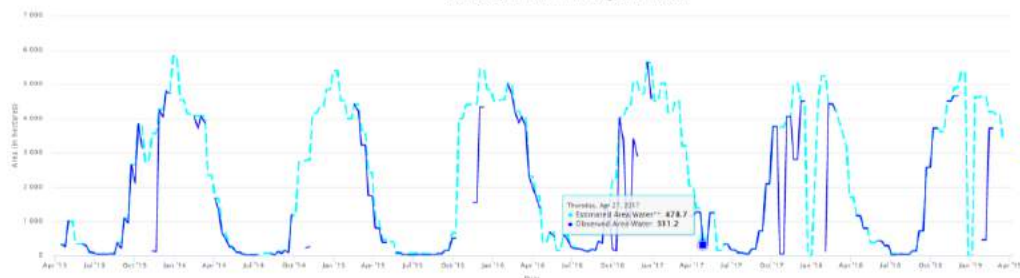
Date(s) Summarized: 2013-04-16 to 2019-03-16

Number of Images: 268

Area Summarized: 7603.2 hectares*

*This was the maximum area observed within the user selection across the dates listed above. A lower-than-expected value here is likely caused by part of the selection falling outside our study area of the CVIIP planning region.

Area of Open Water in the Region of Interest



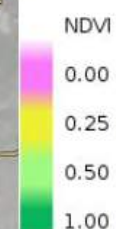
- CROP
- Grass
- Corn
- Field C
- Grains
- Alfalfa
- Rice
- Row C
- Wetlan
- Orchar
- Other

SURFACE WATER

- No Data
- No Water
- Water

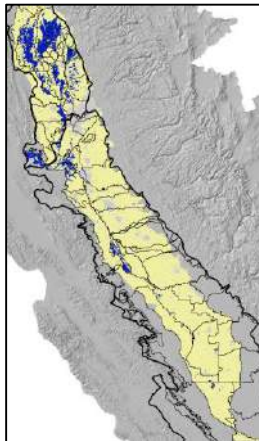
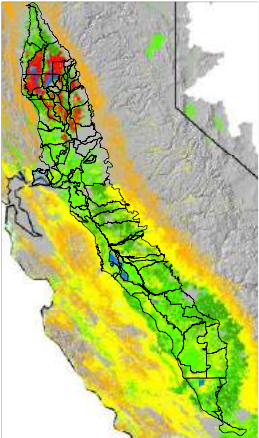
SEASONAL WETLANDS

- Semi-permanent Wetland
- Treated Wetland
- Seasonal Wetland

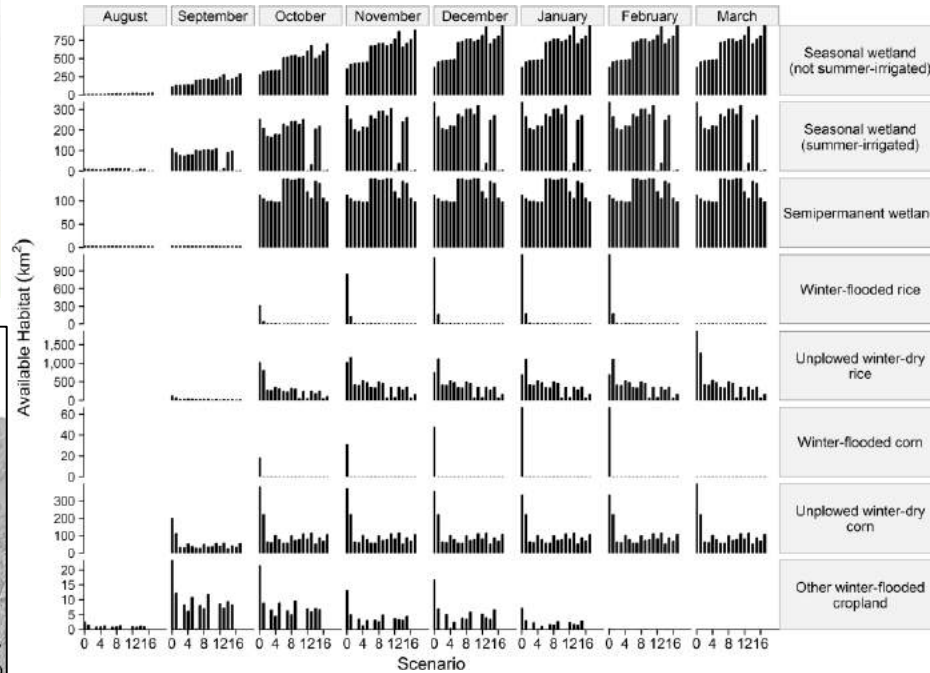


Forecasting – Future

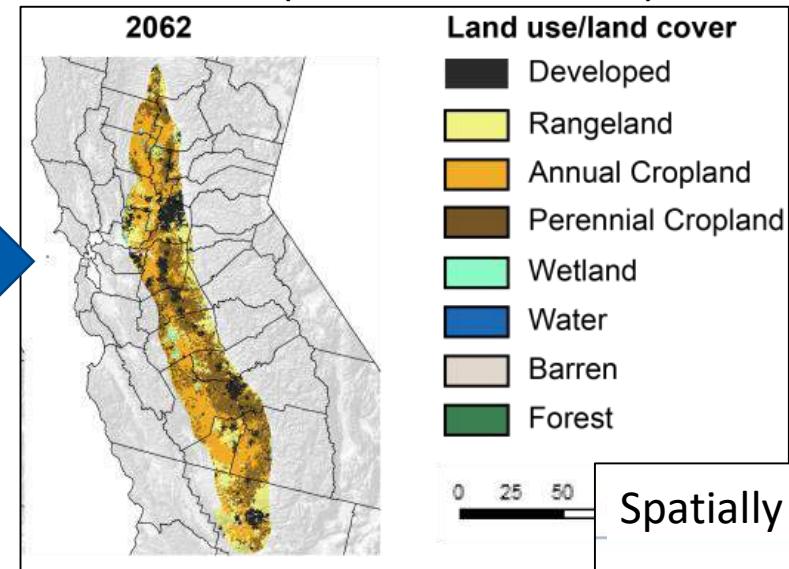
Driver
covariate
forecasts



WEAP-CV (Matchett and Fleskes 2017)



LUCAS (Wilson et al. 2016)



Spatially Explicit Projections



Forecasting Recharge Benefits

Climate

Hot Dry
Hot Variable
Historic

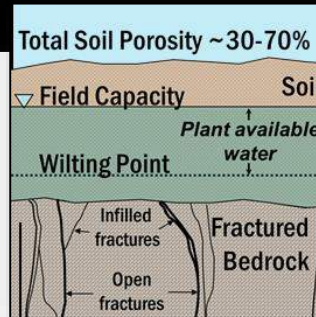
Vegetation

Water Management

Unimpaired
2000-2017 Average
Conservation Flooding

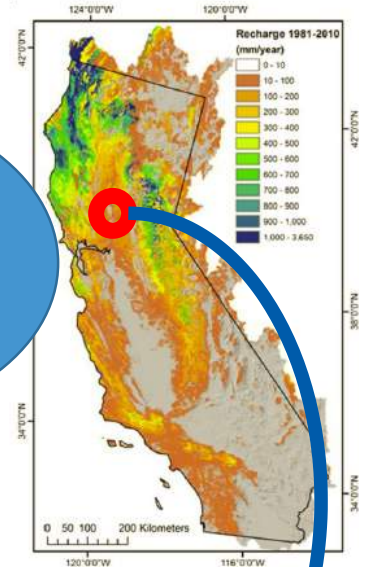
Basin Characterization Model

Spatially Explicit Water Balance Model

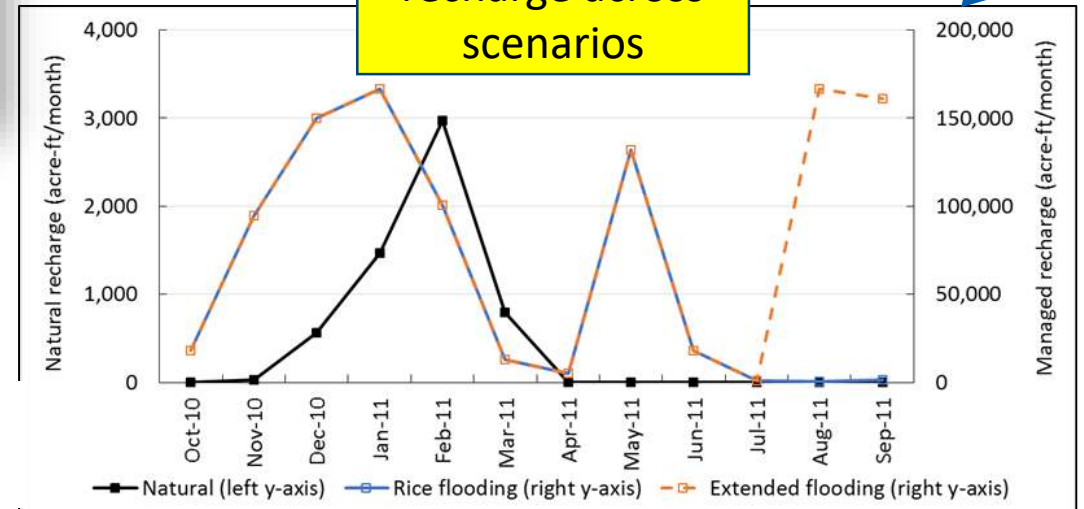


Recharge Maps

2000-2100
by scenario



Site specific
estimates of
recharge across
scenarios



Point Blue



The Nature Conservancy



A scenic landscape featuring a body of water, likely a lake or a wide river, surrounded by dense, tall green reeds. The reeds are in the foreground and middle ground, framing the water. In the background, a large flock of birds, possibly seagulls or terns, is flying across a clear, light blue sky. The birds are scattered throughout the upper half of the image, some in flight and others resting on the water or reeds. The overall atmosphere is peaceful and natural.

Thank You