California’s Central Valley

Hydrology, the key to understanding ecosystem service delivery
Background

• USDA-NRCS (CEAP) funded research

• Ecosystem services of California’s Central Valley and Oregon’s Upper Klamath River Basin wetlands

• Partners: Point Blue, USGS-Water Research Center, NRCS (Davis), Sonoma State University, USFWS-NWR
Hydrology – changes in time

1 = Sacramento River
2 = Bay/ Delta
3 = San Joaquin River
4 = Tulare Lake
5 = Buena Vista Lake
6 = Kern Lake

1 = Sacramento River – channelized/dammed
2 = Bay/ Delta – drained/channelized
3 = San Joaquin River - channelized
4 = Tulare Lake
5 = Buena Vista Lake
6 = Kern Lake
Wetland Restoration

• USDA programs
• Restored 24,000 hectares since inception

• Ecosystems services
  • **Provisioning** e.g., biodiversity, habitat
  • **Regulating** e.g., carbon storage, water quality, groundwater recharge
  • Cultural
  • Supporting

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easement component, NRCS helps American Indian tribes, state and local governments and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands.

USDA Seeks Partner Proposals to Protect and Restore Critical Wetlands

NRCS is making $15 million in financial and technical assistance available to help eligible conservation partners leverage local resources to voluntarily protect, restore and enhance critical wetlands on private and tribal agricultural land nationwide. The funding is provided through the Wetland Reserve Enhancement Partnership, a special enrollment option under the Agricultural Conservation Easement Program. Proposals are due to NRCS State Offices by May 10, 2016.

Benefits
Agricultural Land Easements protect the long-term viability of the nation’s food supply by preventing conversion of productive working lands to non-agricultural uses. Land protected by agricultural land easements can also be used for growing food, fiber and renewable energy feedstocks. The Wetlands Reserve Program protects the nation’s wetlands through voluntary agreements with landowners who agree to protect or restore these important resources.
Climate and Management linked

Unmanaged

- No active management following restoration or less than 50% of time since restoration

Intermediate

- Flooded annually for more than 50% of time since restoration

Intensive

- Flooded, Drawn-down, Mowed, disked, burned, grazed, chemical weed control, moist soil management, emergent cover management
Managed Central Valley wetland hydrology

Solid lines = hydrologic flows - Yellow = outflow - Green = in/outflow - Blue = inflow
Dashed line = driver

**Ephemeral wetlands same as historic**

As in Intensively managed sites, but unmanaged ~50% of time since restoration
<table>
<thead>
<tr>
<th>Assessment summary: climate and management</th>
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<tbody>
<tr>
<td><strong>Unmanaged, Low management</strong></td>
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<tr>
<td><img src="image1.png" alt="Unmanaged Landscape" /></td>
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<td><strong>Upland plants</strong> (biodiversity/carbon)</td>
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<td><strong>Upland birds</strong> (biodiversity/recreation)</td>
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<td><strong>Pollinators</strong></td>
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Hydrology and management – Carbon

Very low management, coupled with moist, but not saturated/flooded soils favorable to carbon sequestration

Hydrology (Depth, Duration)

Management Intensity
None

Intermediate

High

Permanent

Semi-permanent

Irrigated seasonal

Non-irrigated seasonal

**Ephemeral wetlands same as historic**

Solid lines = hydrologic flows
-Yellow = outflow
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Regulation

State legislation

Water rights

Technical/financial support

Management goal

Irrigation

Evapotranspiration

Managed Central Valley wetland hydrology

As in Intensively managed sites, but unmanaged ~50% of time since restoration
Drought impacts

• InVEST models 2007-2015

• Waterfowl and shorebird habitats declined in northern Central Valley

• But increased substantially in southern Central Valley

  • Similar trends on WRE
  • (~1-2% of waterfowl/shorebird habitat in CCV)

  • Despite worsening drought
Groundwater extraction increased 2-3 fold from 2012-2015.
Conclusions and recommendations

• Intensive management linked to climate and legislation favors some key functions, but not all.

• Hydrology key, but need to parameterize links between natural and socio-political components in model.

• Recommend that agencies and institutions collect management related information and integrate into analyses.

• Groundwater supplements surface water shortfalls, but unsustainable and negatively impacts infrastructure.

• Investigate degree to which various ecosystem services are dependent on surface vs. groundwater.
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