Restoring Riparian Landscapes to Achieve Multiple Ecosystem Services in the Sacramento Valley

Insights after 25 years at Kachituli Oxbow

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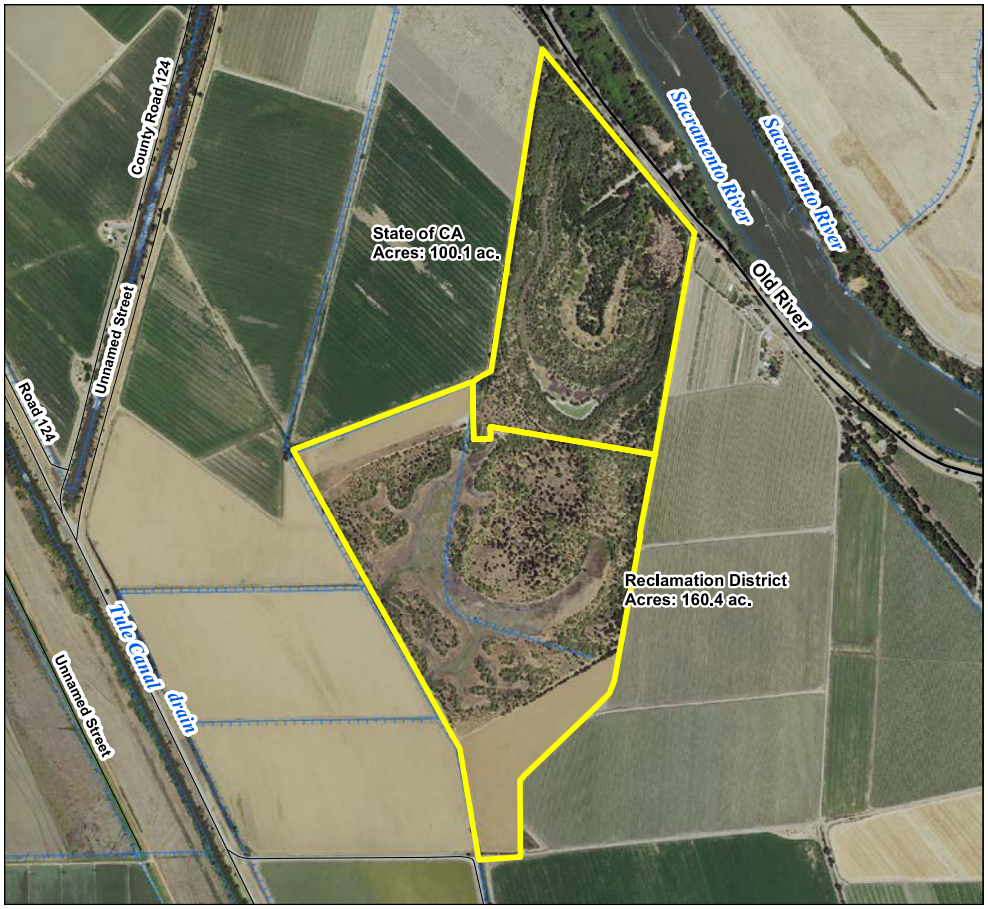
KACHITULI WILDLIFE RESERVE · MASTERPLAN
YOLO COUNTY · CALIFORNIA
KEY:
OAK WOODLAND
ELDERBERRY SAVANNAH
COTTONWOOD / OAK RIPARIAN FOREST
VEGETATED OXBOW: BANKS OF WILLOWS / DOG ELDER / ASH & OTHER ASSOCIATED VEGETATION
EMERGENTS AND LOW FLOW CHANNEL
DEEPWATER POOL
MUDFLAT
UPLAND SHRUB / LIVING FENCE AT PROJECT BOUNDARY
AREAS OF RESTORATION WITHIN EXISTING RIPARIAN FOREST
PERMANENT (NON-PAVED) MAINTENANCE ROAD OR TRAIL


CATERPILLAR

Kachituli Plantings 1997



USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

MAP:
USDA Farm Service Agency
2014 Aerial Photography
1:14,000

Riparian **Carbon** Sequestration

The Soil Component

Soil carbon stocks under woodland vs. grassland restoration on alluvial floodplain of the Sacramento River

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Riparian **Carbon** Sequestration

The Soil Component

Soil C stocks to 70 cm depth were 29% higher under oak woodland (64.7 t ha^{-1}) compared to native grassland (50.2 t ha^{-1}), and both were significantly higher relative to adjacent agricultural land use.

Significant contribution of subsurface depths (>25 cm) to total soil C stocks; this highlights the need to conduct deeper assessments of soil C storage in riparian and other ecosystems with deep-rooted species.

Soil Carbon Sequestration

- Rationale
  - Grassland and woodland have different primary productivity, with differences in soil C accrual
  - Restoration aimed at maximizing soil C sequestration should consider land cover
- Objective: Quantify soil C stock in restored grassland and restored woodland
- Hypothesis: restored woodland will have greater soil C stocks than restored grassland
- Approach: soil profiles and C quantification to depth (< 50 cm) at Kachituli Oxbow restoration under grassland and woodland

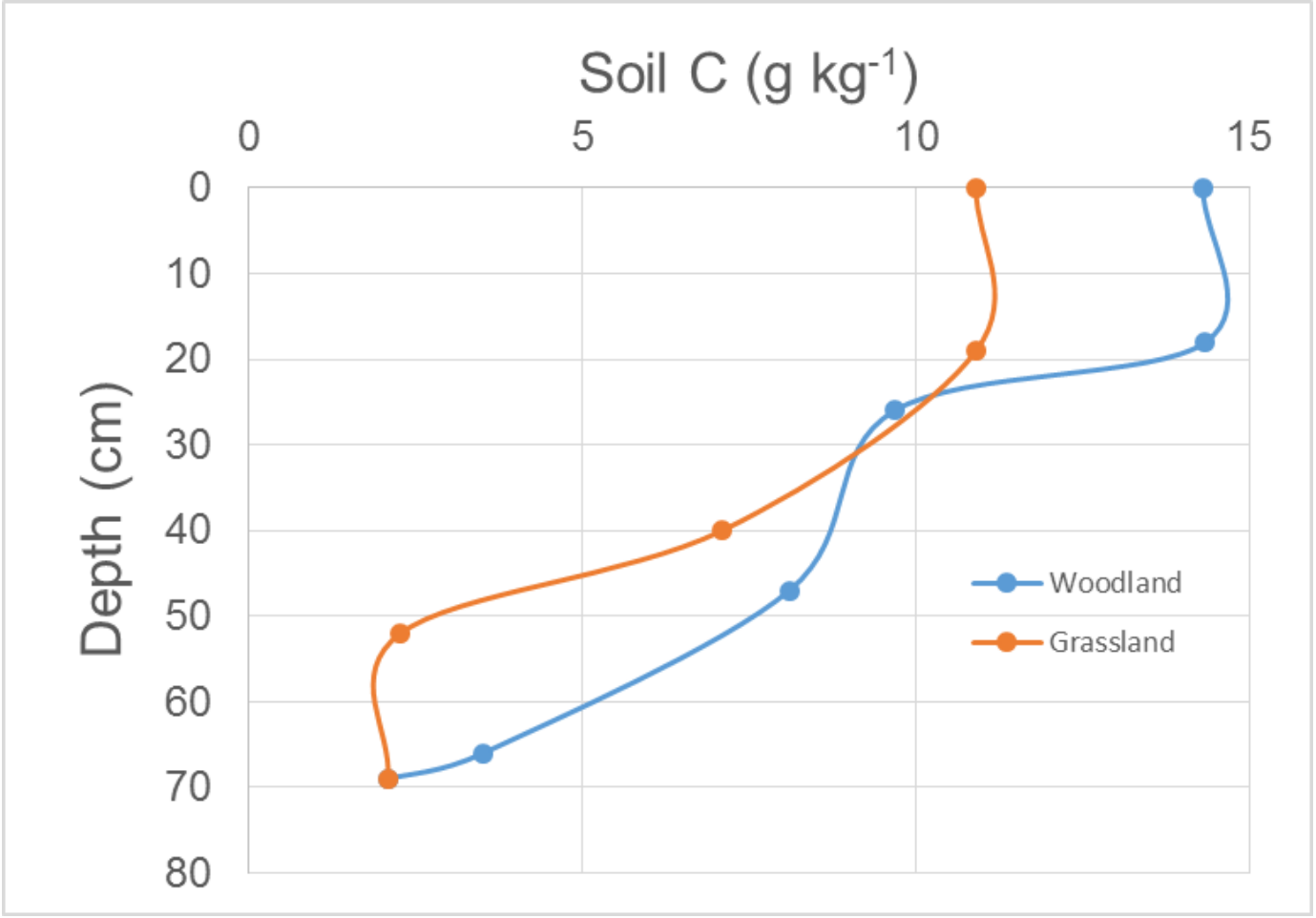

Vc
247
W
Sv
Ss

Woodland (W)

Grassland (G)

- Same scale (to 29 cm depth)
- Similar depth of A horizons

- O horizon in W but not G
- G thicker (+1 cm) A horizon
- Presence of more and thicker roots in W, and to greater depth
- Greater compaction in G-- Anthropogenic activity?
  - Fewer roots to de-compact?



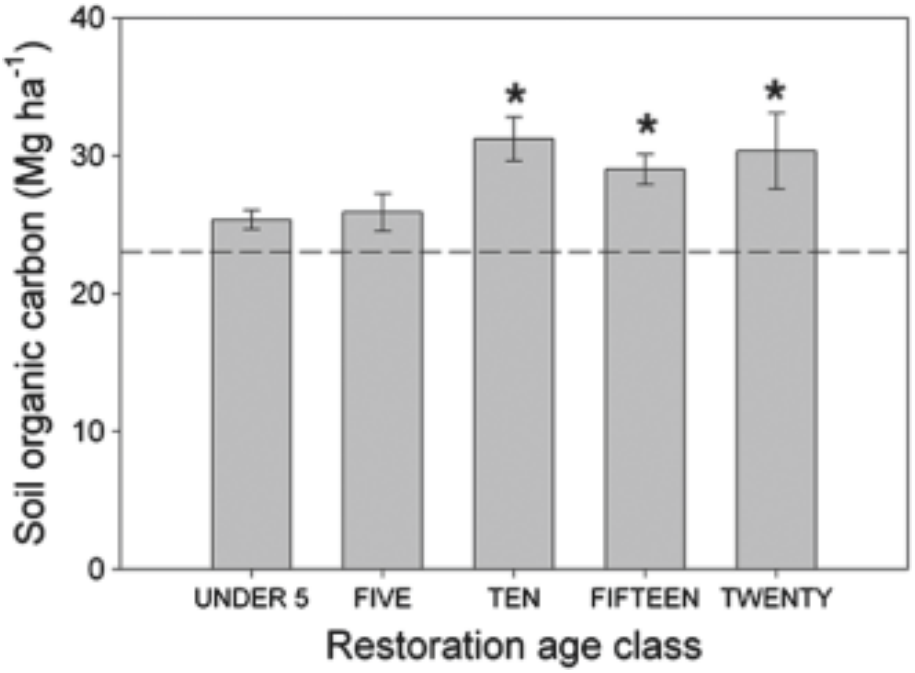
- Convergence of soil C concentrations at ~66 cm
- Higher soil C for greater depth in W
- More rapid fall-off in soil C in G tracks more sudden emergence of sand texture

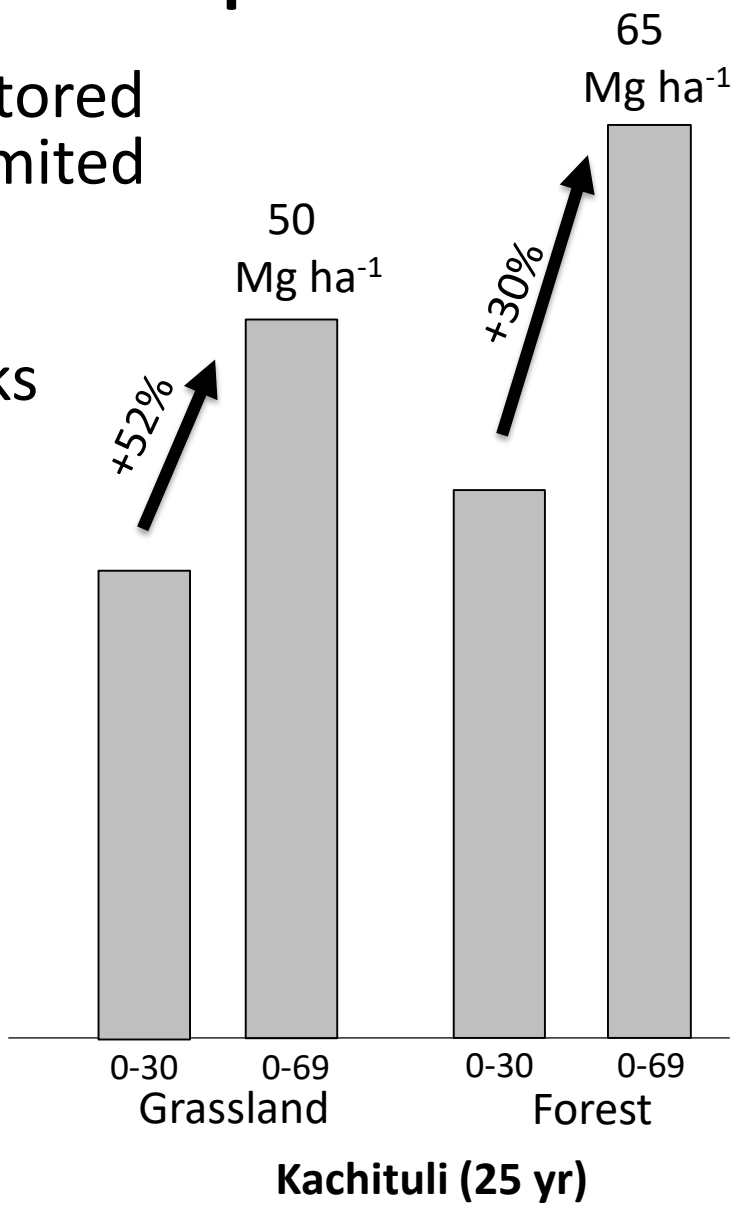
Calculating soil C *stocks*

- Initial data provide soil C as a concentration
  - Grams of C per kilogram of soil (g kg^{-1})
  - Bulk density changes how much soil is present (kg)
  - Concentration × mass = total
- Soil C stock estimates must take into account bulk densities of each sampled layer

Need to go deep!

- Previous studies of soil C in restored riparian of Sacramento River limited to 30 cm depth
- Subsurface C can contribute significantly to total soil C stocks





Matzek et al. 2015

Summary

- 29% greater C stock to depth of 69 cm under woodland vs. grassland
  - Similar C concentration and stock in similarly thick A horizons
  - Difference is in greater soil C concentration in woodland to ~65 cm
  - Below 70 cm, similar sandy texture and low (0.2%) soil C
- Greater OM input (e.g., litter, roots) under woodland likely accounts for greater soil C stocks

Riparian **Carbon** Sequestration

The Vegetation Component

Carbon in Woodlands and Grasslands

Michelle Stevens
CSU Sacramento


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Figure 1: Oak Woodland Area, by Zachary Frese

Area Output

15323.871 m²
0.015 km²
3.787 Acres
1.532 Hectares
164944.776 Feet²

Perimeter Output

1078.827 m
1.079 km

Figure 2: Grassland Area, by Zachary Frese

Riparian **Carbon** Sequestration

The Vegetation Component

Evaluation of Carbon Sequestration

Total carbon sequestered within the woodland:

183.33 ± 351.43 Mg/ha

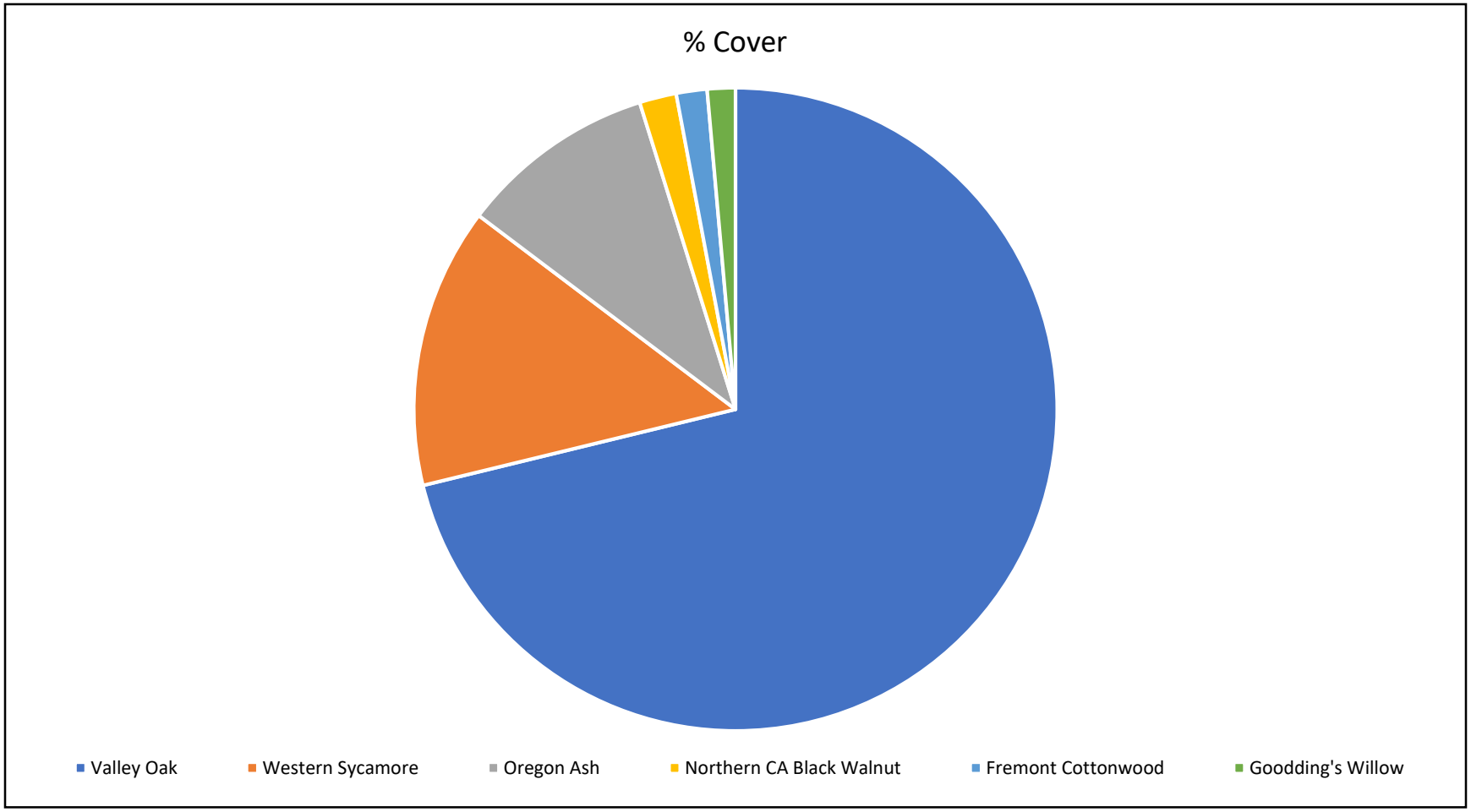
Oak: 1103.13 Mg/ha Sycamore: 165.05 Mg/ha

Ash: 143.67 Mg/ha Walnut: 45.28 Mg/ha

Cottonwood: 8.61 Mg/ha

Buckeye/Elderberry: >1Mg/ha

Relative Cover of Riparian Species in Oak Woodland



The WETLANDS Component

Wetlands in Riparian Systems

Michelle Stevens
CSU Sacramento

CRAM

California Rapid Assessment Method (CRAM)

Assessments/Evaluation of Biodiversity

Scores for depressional wetlands averaged around 75.00 (about average compared to other depressional wetlands in the state).