Analyzing Plant Tissue Chemistry of *Salicornia pacifica* in Restored and Established Wetlands

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Introduction

Coastal wetlands play a valuable role in sequestering carbon, but many have been degraded by human activities. Wetland restoration can help re-establish ecosystem function, including long term carbon storage, but the extent is unknown. Many factors determine how long carbon is stored in wetlands, but slower decomposition rates usually result in longer carbon storage[1].

Decomposition rate is also dependent on many factors, and the chemical makeup, especially percent carbon and nitrogen, of plant litter is an important one. For example, the stoichiometric ratio of carbon to nitrogen (C:N) can help predict decomposition rate: a high C:N corresponds with slow decomposition, and vice versa[2]. Thus C:N of restored wetland vegetation is important, since its decomposition rate can be an indicator of how much carbon it will store long term.

Taking C:N as an indicator of decomposition rate, this study examines variation of C:N, carbon, and nitrogen in *Salicornia pacifica* (pickleweed), a common coastal wetland plant, between restored and established wetlands, as well as across elevations.

Methods

- Site Description:
  The Devereux Slough, a coastal estuary in Goleta, CA, is split into the recently *restored* North Campus Open Space (NCOS) and the *established* Coal Oil Point Reserve (COPR) (Fig. 1). Restoration on NCOS began 7 years ago, while COPR has been a protected wetland reserve for 54 years.
- Pickleweed biomass samples were collected from NCOS and COPR over summer 2023
  - 29 total locations (18 in NCOS and 11 in COPR)
  - 29 locations distributed across three elevations: 7 ft (ten locations), 7.5 ft (ten locations), and 8 ft (nine locations)
  - Sampled all aboveground biomass in a 0.5 x 0.5 m quadrat
- Separated biomass samples into “vegetative” (leafy) and “woody” tissue categories
  - Total of 58 samples (29 vegetative & 29 woody)
- Oven dried, milled, and foil balled samples for analysis
- Samples were analyzed for carbon and nitrogen content using a Flash 2000 CN Elemental Analyzer and acetanilide standards

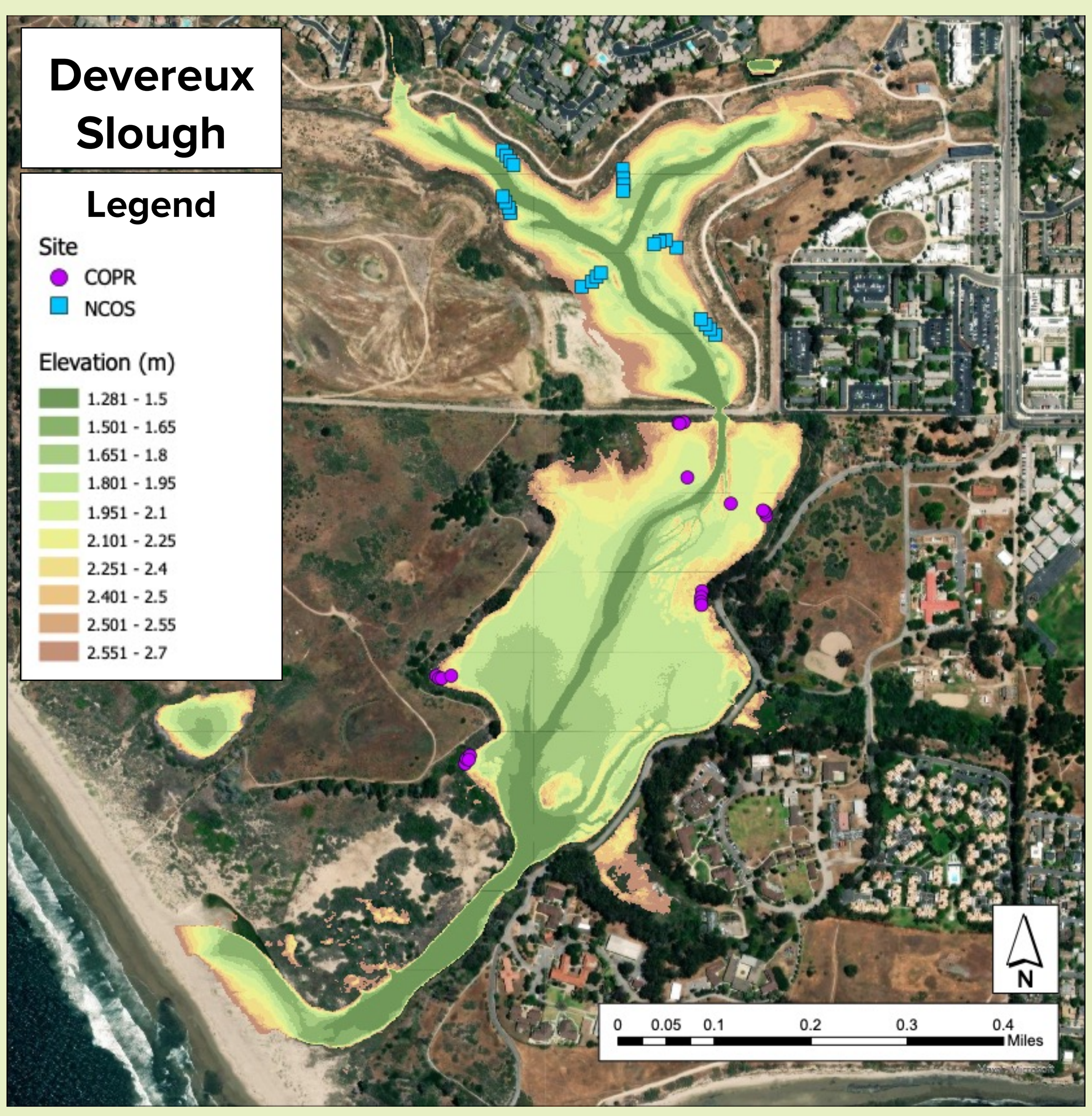

Figure 1. Map of pickleweed biomass sampling locations at Devereux Slough. NCOS locations are denoted as blue squares and COPR locations as purple circles. Elevation gradient goes from lowest in green to highest in orange.

Acknowledgements

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Results

I compared carbon (C), nitrogen (N) and C:N of vegetative and woody samples separately, between NCOS and COPR, as well as between 7, 7.5 and 8 feet of elevation. Vegetative samples have lower C and higher N content, resulting in a lower C:N, while woody samples have higher C and lower N content, resulting in high C:N (Table 1).

Across elevations, I found no significant differences in C, N, or C:N. Between NCOS and COPR, I found no significant difference in N or C:N.

Both vegetative and woody pickleweed C content is higher at COPR than NCOS. There is a medium (Cohen’s d = 0.76) difference in vegetative C (two-tailed t-test, $t(27) = 1.98$, $p = 0.057$, $\alpha = 0.05$), and large (Cohen’s d = 1.17) difference in woody C (two-tailed Welch’s t-test, $t(26.8) = 3.50$, $p = 0.002$, $\alpha = 0.05$). Mean vegetative C at COPR is 2.3% higher than at NCOS and mean woody C at COPR is 2.7% higher than at NCOS.

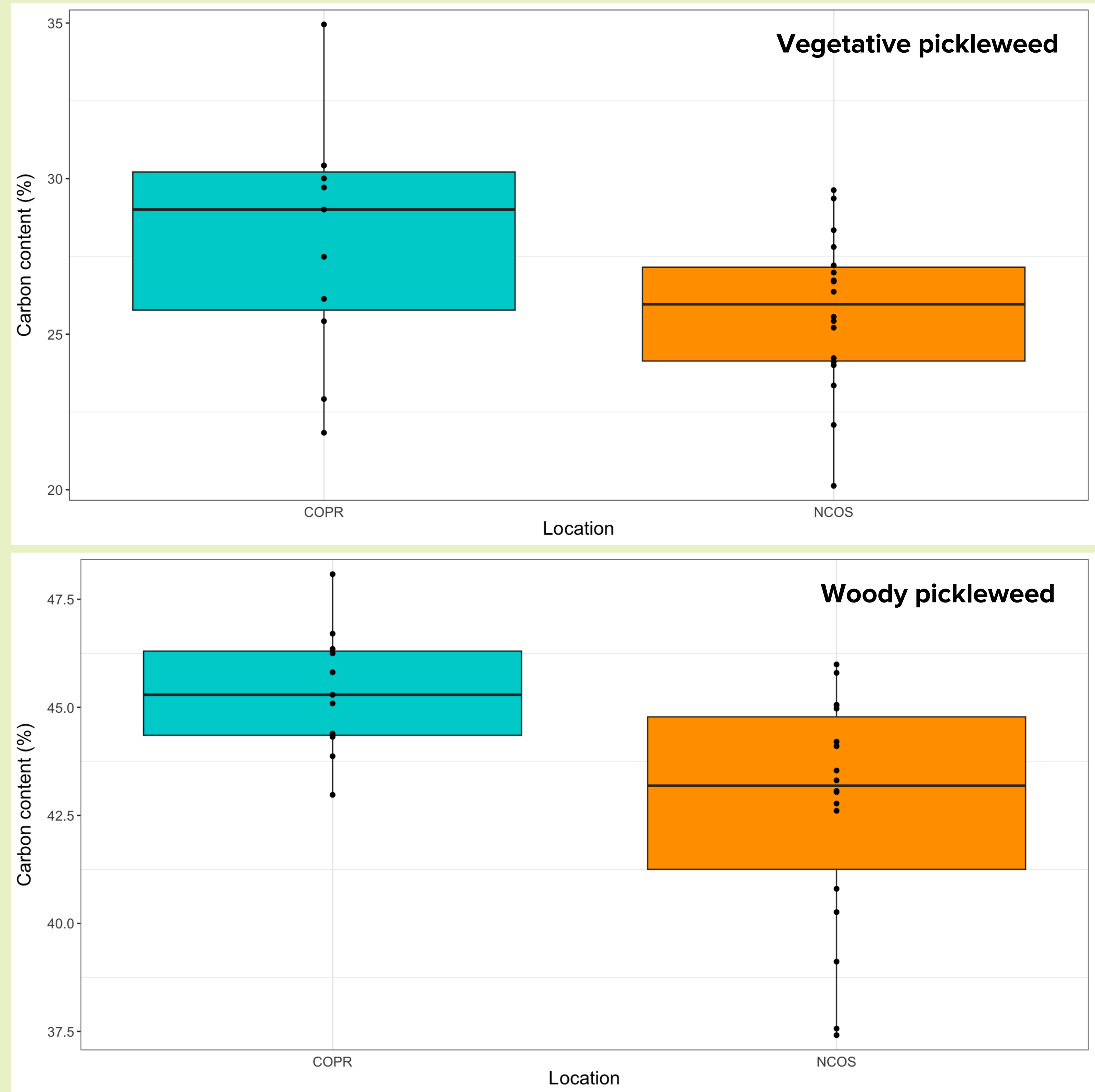

Figure 2. Pickleweed carbon content at COPR vs. NCOS. Upper plot represents vegetative pickleweed C, lower plot represents woody pickleweed C. Data are across elevations, as elevation showed no significant variation. Note the difference in scale between the two plots, due to natural variation in C between plant parts.

Table 1. Pickleweed C:N, carbon and nitrogen contents by plant part and location. Note the difference in all three measurements between vegetative and woody plant parts.

Part of plant (location)	**Vegetative (NCOS)**	**Woody (NCOS)**	**Vegetative (COPR)**	**Woody (COPR)**
C:N	29.20	64.89	32.07	65.25
Carbon	25.73 %	42.70 %	28.03 %	45.38 %
Nitrogen	0.94 %	0.68 %	1.00 %	0.77 %

Discussion

My findings suggest that pickleweed C content varies between restored (NCOS) and established (COPR) wetlands, with higher C content at COPR. Because COPR is an established wetland, its plants are likely more mature. Plant maturity affects C: younger plants have lower C as they allocate resources to growth, and older plants have higher C as they have more established structural systems[3]. COPR also has higher salinity than NCOS due to proximity to the ocean. Salinity also affects plant C: increased salinity is associated with higher C content[4]. These two variables could explain higher C at COPR than at NCOS.

N and C:N do not vary significantly between NCOS and COPR, possibly because soil N availability does not vary significantly between the two. While NCOS is considerably younger as a protected wetland than COPR, it was vegetated as a golf course before restoration. Its soil N was likely maintained by golf course fertilization and vegetation, thus it may have enough N to meet pickleweed’s N needs.

While C:N is a common predictor of decomposition rate and can help estimate long term C storage, plant C can also help predict long term ecosystem C storage. Higher plant C content translates to more C sequestered in living biomass, and consequently in soil as well once biomass decomposes[5]. COPR’s higher C pickleweed suggests that established wetlands’ vegetation store more C than restored wetlands’ vegetation. Therefore, in the short term until NCOS becomes an established wetland, I expect its vegetation will store less C than its established counterpart, until it eventually catches up to COPR.