

Bird Abundance and Diversity in Managed Wetland and Tidal Restored Habitats in the Suisun Marsh

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Introduction



Figure 1. A map of the Hill Slough Wildlife Area (tan, top middle) and other wildlife areas (tan) in the Grizzly Bay/Suisun Bay area. CDFW (2019).

The Suisun Marsh of the San Francisco Bay Estuary is a brackish marsh system composed of managed wetlands, permanent water sheds, and tidal restored marshes (Casazza et al., 2020). Marsh ecosystems are under threat globally and are a subject of restoration and management programs (Goals Project 2015). Research on bird species should be conducted to help guide and inform these practices.

Objectives

- To study how bird abundance is affected by managed and tidal-restored habitats and native and non-native plants.
- To study how bird diversity is affected by vegetation diversity in a managed wetland habitat.

Methodology

- Point count surveys were conducted at twelve predetermined stations within the Hill Slough Wildlife Area (Figure 2). Habitat characteristics at each station were taken. Birds visually and auditorily detected during the ten-minute surveys were recorded.
- California Wildlife Habitat Relationships (CWHR) vegetation types for each point were used to create vegetation categories. Data of CWHR vegetation types were sourced from a 2015 California Department of Fish & Wildlife GIS vegetation map using ArcGIS Pro.
- Statistical analysis conducted include a two-sample t-test, one-way analysis of variance (ANOVA), linear regression, and a Spearman correlation. These analyses were used to determine if different factors influence bird abundance and diversity.



Figure 2. A satellite image (Google Maps) of the Hill Slough Wildlife Area. The yellow dots represent the point count areas. All ponds are managed except for Pond 5 which is tidal restored.

Results

Bird Abundance in Managed and Mixed Points

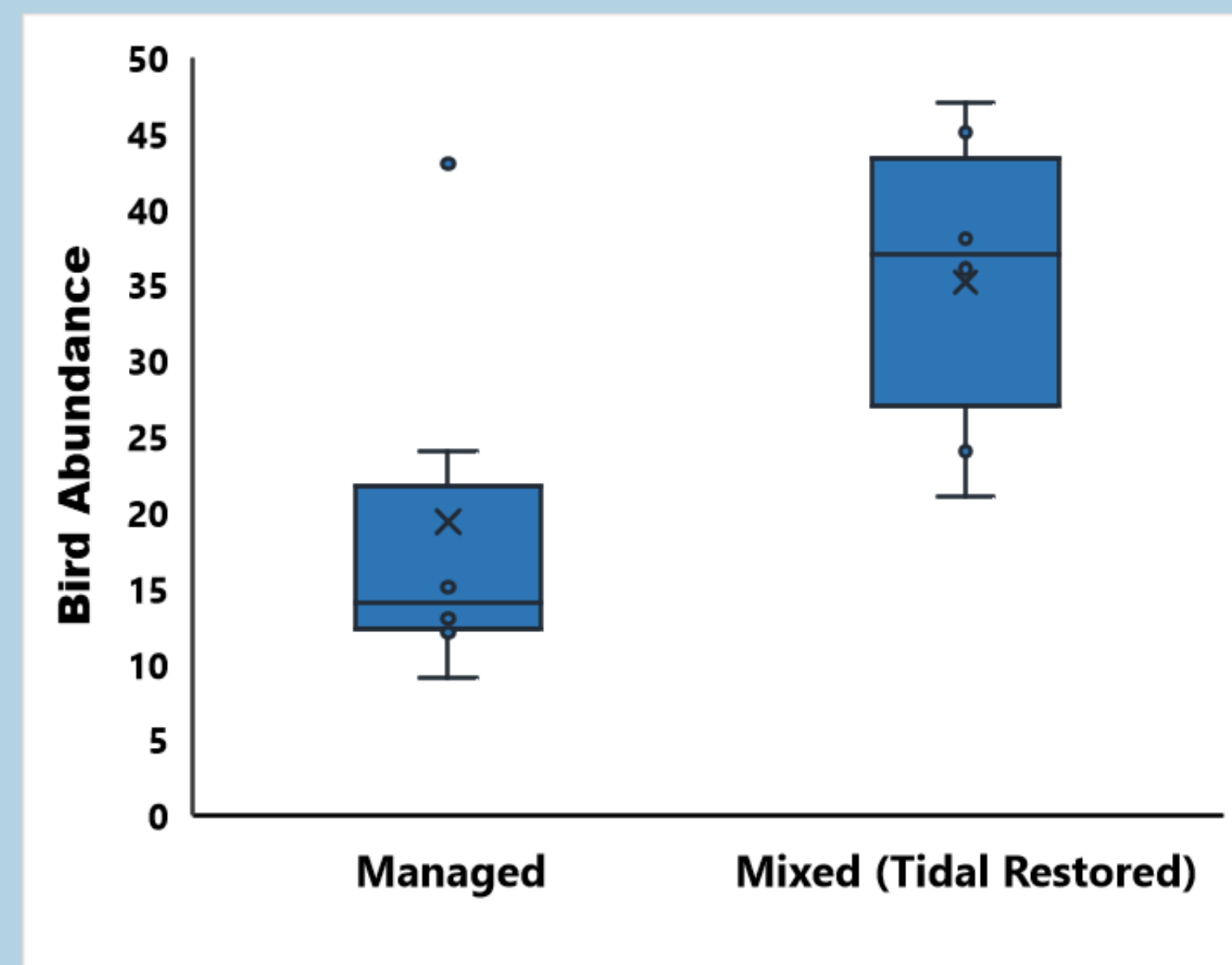


Figure 3. Bird abundance in managed and mixed points.

- A two-sample t-test assuming unequal variances testing for differences between managed and mixed (tidal restored and managed) wetlands indicated significantly higher abundances in the mixed wetland points ($t = -2.34$, $P = 0.0412$).

Bird Abundance and Dominant CWHR Vegetation Type

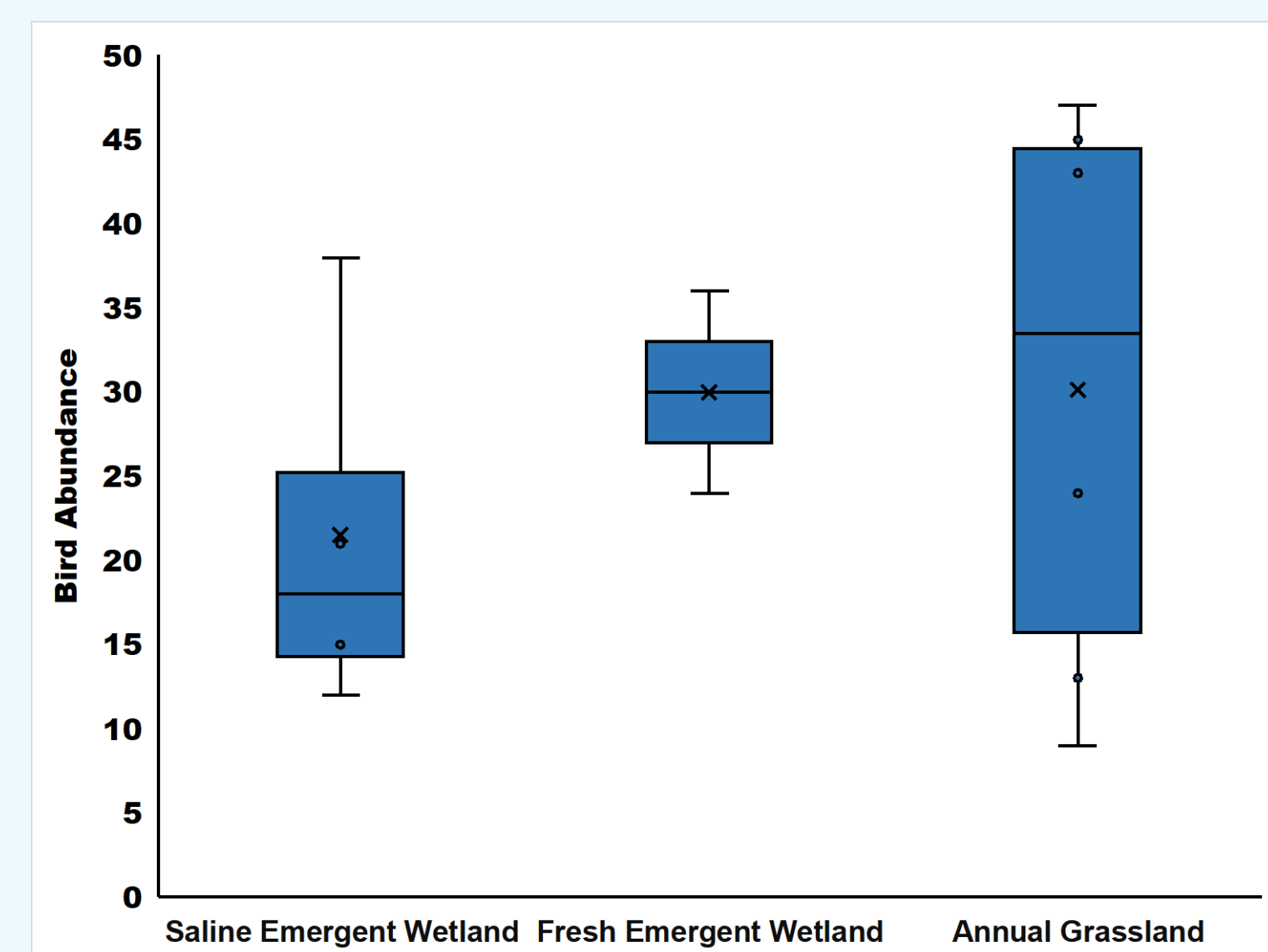


Figure 5. Bird abundance for each dominant CWHR vegetation type.

- Results of an ANOVA showed that bird abundance does not significantly differ among dominant CWHR vegetation types ($F_{2, 4.09} = 0.581$, $P = 0.600$).



Bird Abundance in Relation to Native and Non-Native Plants

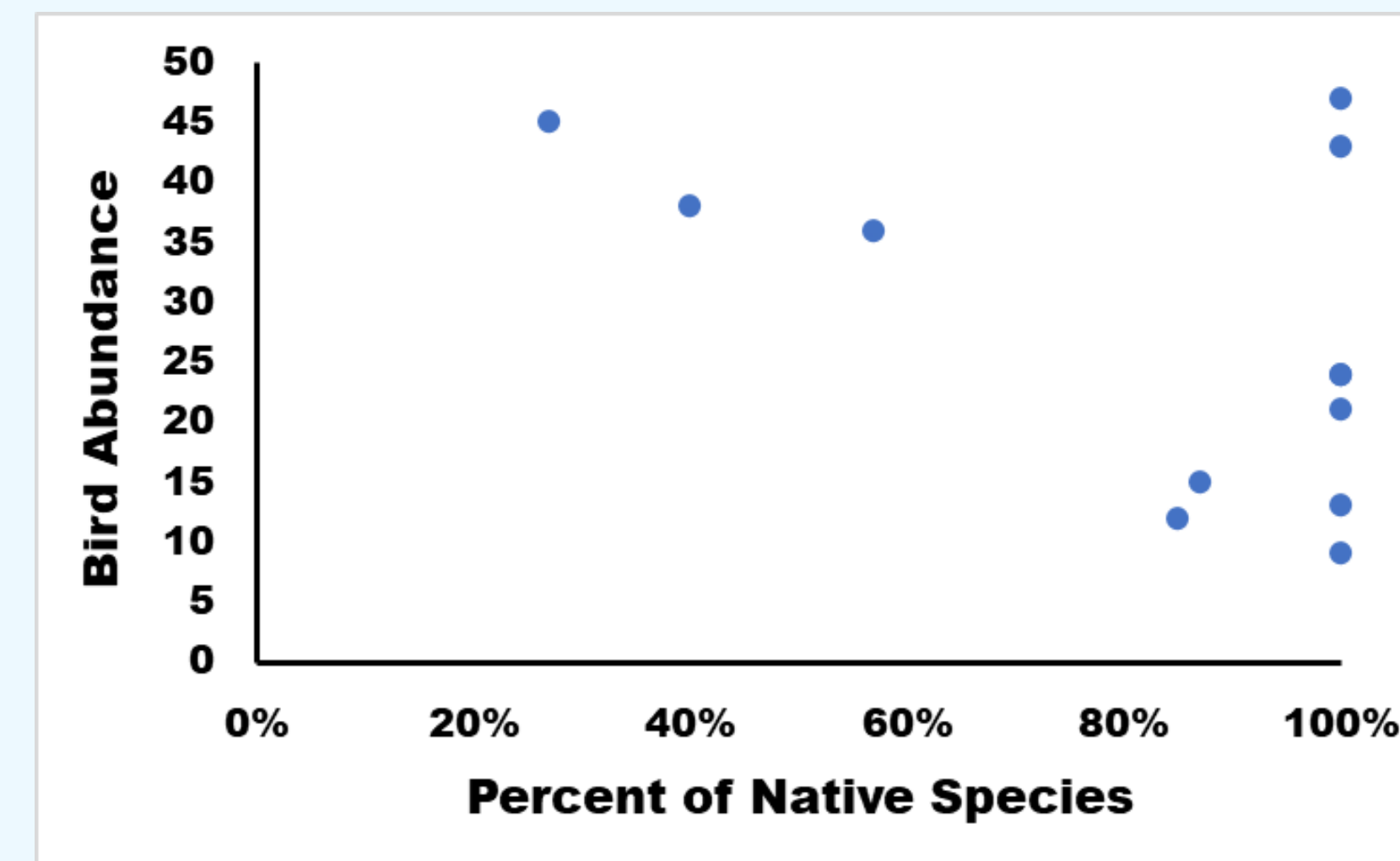
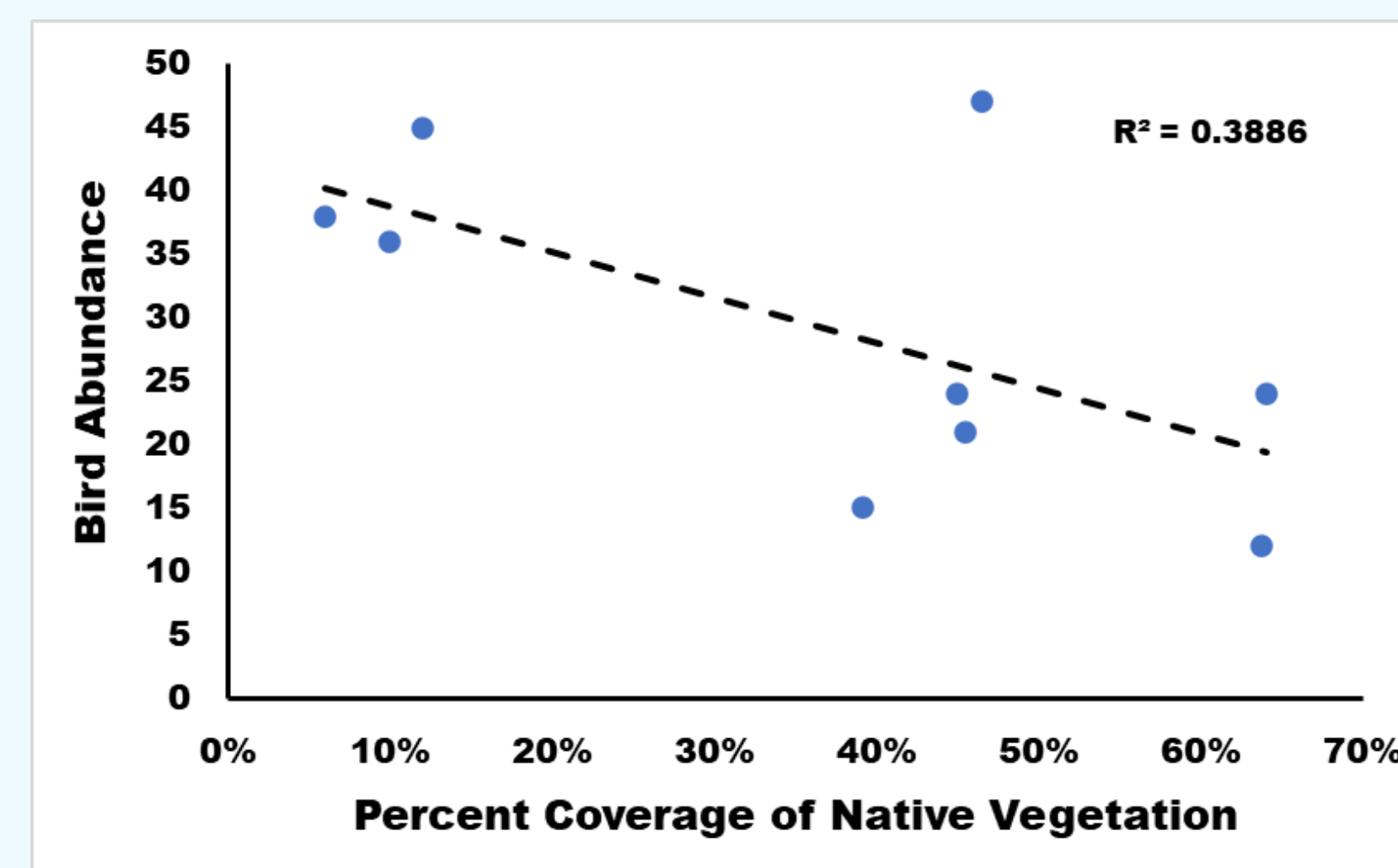


Figure 4. (Top) The relationship between bird abundance and the percent coverage of native species at each point and (Bottom) the relationship between bird abundance and the percent of native species present.

- A linear regression analysis for percent coverage of native vegetation showed a marginally non-significant negative relationship ($P = 0.073$).
- Spearman correlation showed no significant correlation between abundance and the percentage of native species present.

The Relationship Between Bird Diversity and Vegetation Diversity

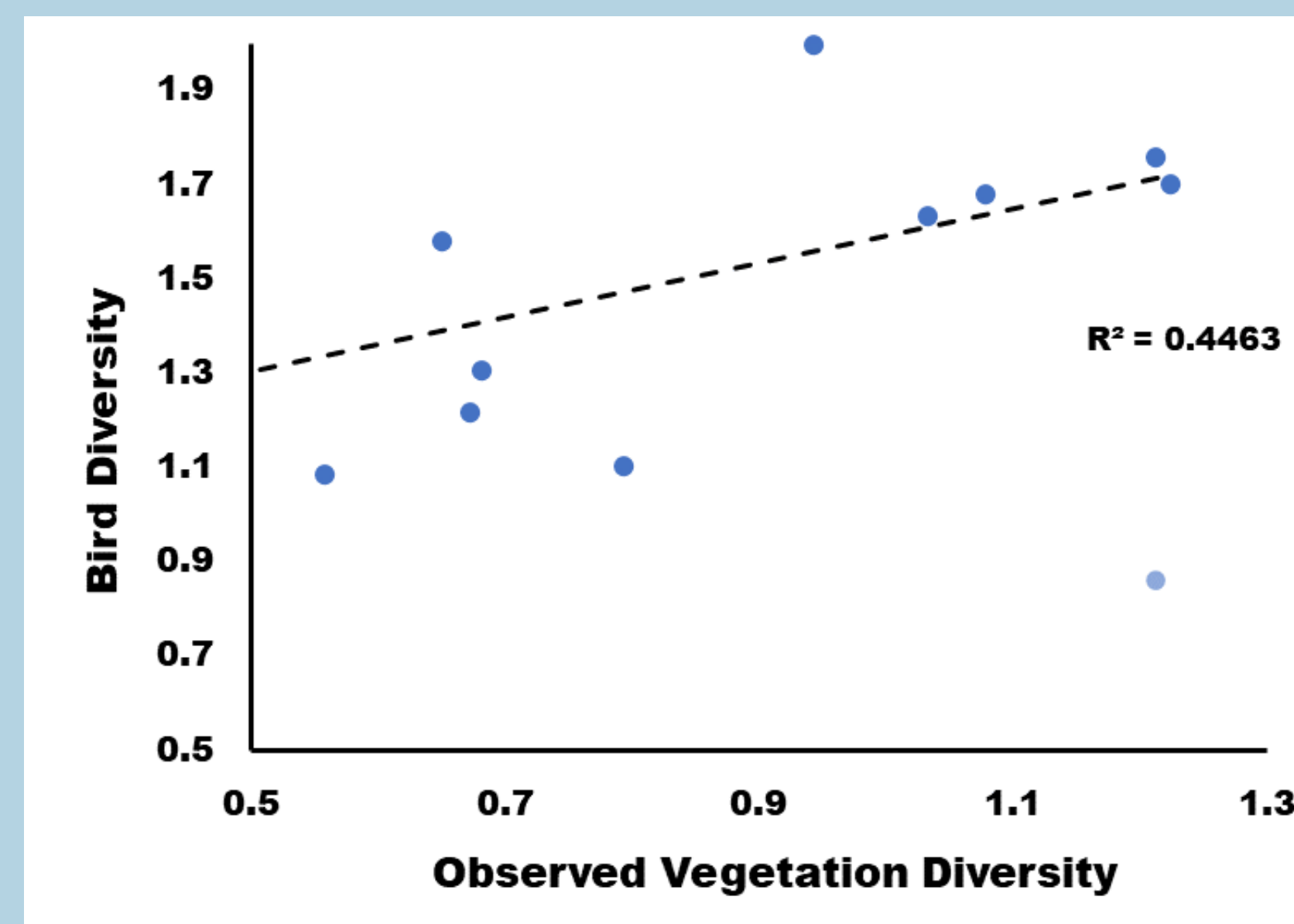


Figure 6. Bird diversity compared to vegetation diversity at each point location in the Hill Slough Wildlife Area of the Suisun Marsh. The light blue point represents an outlier omitted from the analysis.

- The diversity of birds showed a significant positive correlation with the vegetation diversity (linear regression analysis, $P = 0.025$).

Discussion

- The mixed (managed + tidal restored) points of Hill Slough Wildlife Area had higher bird abundances (Figure 3), which partially contradicts prior research suggesting wetland birds prefer managed wetlands (Casazza et al., 2020). However, the mix of managed and tidal restored habitats may constitute an ecotone combining abundances from each type of habitat. It would be beneficial for future research to repeat this study with points that are exclusively tidal restored.
- Results showed a significant positive correlation between vegetation diversity and bird diversity (Figure 6). A habitat composed of high vegetation diversity can support a greater number of animal species, explaining the positive trend.
- The native percent coverage had a slight, but non-significant, negative relationship with bird abundance. This could be attributed to a greater diversity in points that have both native and non-native vegetation.
- There was no difference in bird abundance among the CWHR vegetation types. However, the data were gathered from a 2015 vegetative map prior to the tidal restoration projects in the Hill Slough Wildlife Area. Therefore, it would be interesting to compare the bird abundance in this area from records predating the restoration projects with current abundance or current CWHR vegetation types.



References

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- Casazza ML, McDuffie F, Jones S, Lorenz AA, Overton CT, Yee J, Feldheim CL, Ackerman JT, & Thorne KM. Waterfowl use of wetland habitats informs wetland restoration designs for multi-species benefits. *J Appl Ecol.* 2020;58:1910-1020.
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