Annual Report: Vegetation Survey at Wild Basin Wilderness Preserve and Adjacent BCP Vireo Preserve

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ABSTRACT

Resampling fixed plots and/or transects within plant communities represents one of the strongest methods of change detection of ecosystem structure and function. With this in mind, the primary goal of our project was to establish these plots and transects within Wild Basin and adjacent PCP Vireo Preserve, two contiguous tracts that are both part of the Balcones Canyonlands Preserve (BCP). These data serve as a baseline for understanding the dynamics of plant communities and allow for more informed management decisions. Our secondary goal was to establish specific protocols that facilitate easy resampling by students at St. Edwards at future dates. Future resampled data will be added to the database and allow students firsthand experience in exploring questions regarding interannual, short-term and long-term variability in ecosystem structure. We established fixed sampling points (GPS locations) and collected a baseline dataset which quantitatively describes the various plant communities within the Wild Basin/Vireo Preserve between late-May and mid-July 2013. These data were entered into a relational database and the relative cover and abundance of plant species at each site was calculated. Additionally, we collected soil samples (approximately 1 deciliter per site), measure soil moisture in situ and collect other non-destructive data (slope, aspect, etc.) to determine the predominant ecological drivers of vegetation structure. Soil samples were returned to St. Edward's campus and are were analyzed for soil structure, composition and chemistry. Plant cover and abundance data were analyzed using hierarchical cluster analysis and non-metric multidimensional scaling. Results reveal that the plant communities within the Wild Basin/Vireo Preserve consist of five distinct plant communities. These communities ordered together within three axes in an NMS ordination and roughly coincide with prior reports of vegetation structure at these locations. Future work will involve

resampling to decipher interannual, short- and long-term dynamics of the vegetation in this system as well as to determine how these preserves fit within the dynamics of the larger Austin socio-ecological system.

INTRODUCTION

Resampling fixed plots and/or transects within plant communities represents one of the strongest methods of change detection of ecosystem structure and function (e.g. Callaghan et al. 2011). While an informal qualitative understanding of the vegetation structure exists for the Wild Basin/Vireo Preserve specifically (Williams 1977, Respes 1987), formal plots designed to determine quantitatively the vegetation structure of these urban ecosystems are lacking. The predominant view is that the prehistoric physiognomy of the region consisted of fairly large motes of large mature trees in canyon systems such as those found within the Wild Basin/Vireo Preserve (O'Donnell personal communication, Treuer-Kuehn personal communication) embedded within a mixed prairie-savannah system seen at the larger scale of the Edward's Plateau of central Texas (Fowler and Dunlop 1986). However, there is little understanding of how the vegetation of urban preserves, such as the Wild Basin/Vireo Preserve, are structured within larger socio-ecological systems (Cilliers and Siebert 2011) and how these may emerge and may change through time. Thus, because quantitative datasets sampled repeatedly are not available, determinations of both short- and long-term vegetation dynamics and the drivers of such dynamics within these preserves are not possible.

We conducted a study of the plant community composition in the Wild Basin/Vireo Preserve in the early summer 2013. This study consisted of establishing fixed transects (GPS points) and plots near photo-points located throughout the preserve (Figure 1) and three points within the Vireo Preserve (Figure 2). This study augments both the long-term management goals of Wild Basin/Vireo Preserve within BCP (Forest for the trees 1999, BCP Land Management Plan 2005) and allows students from St. Edward's University firsthand experience in conducting vegetation surveys. Beyond this current project, the long-term goal is to understand how plant communities are responding to long-term change as has been seen in other ecosystems (e.g. Villarreal et al. 2012). Between late May and mid-July 2013, we estimated the structure of the vegetation within the fixed transects and plots within the Wild Basin/Vireo Preserve and as well as collected data to determine the primary environmental drivers which control plant community structure. Our primary questions are:

i. What are the primary factors controlling plant community composition?

ii. How does diversity vary among communities and how does diversity relate to controlling factors?

iii. How might regional predictions regarding longer term climate affect current plant community structure?

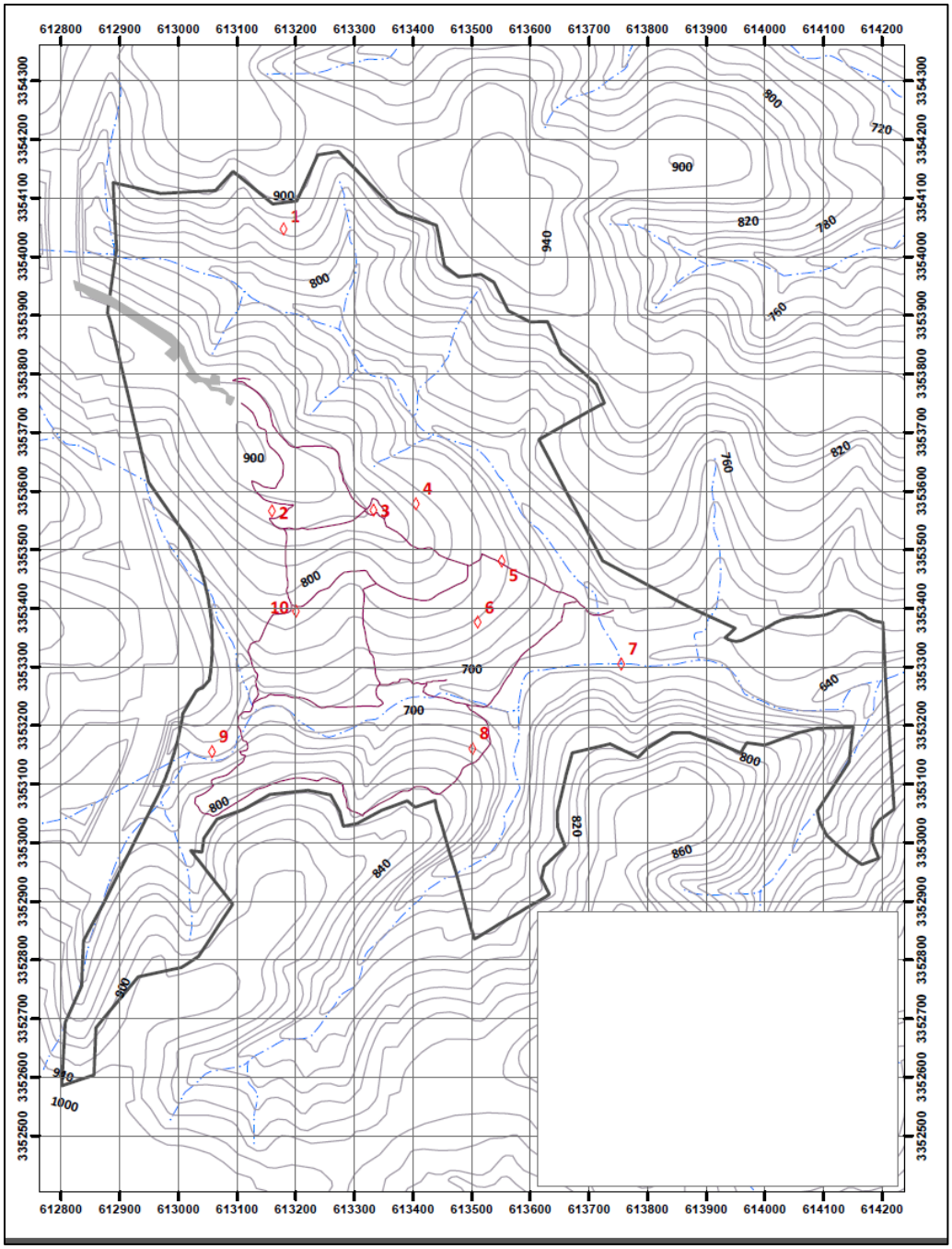

Figure 1. Ten Photopoint locations (red diamonds) within the Wild Basin Wilderness Preserve. Three transects were established at each photopoint, and three plots were established along each transect. Woody cover was estimated along each transect, while ground cover was estimated using 1 x 0.5 m plots.

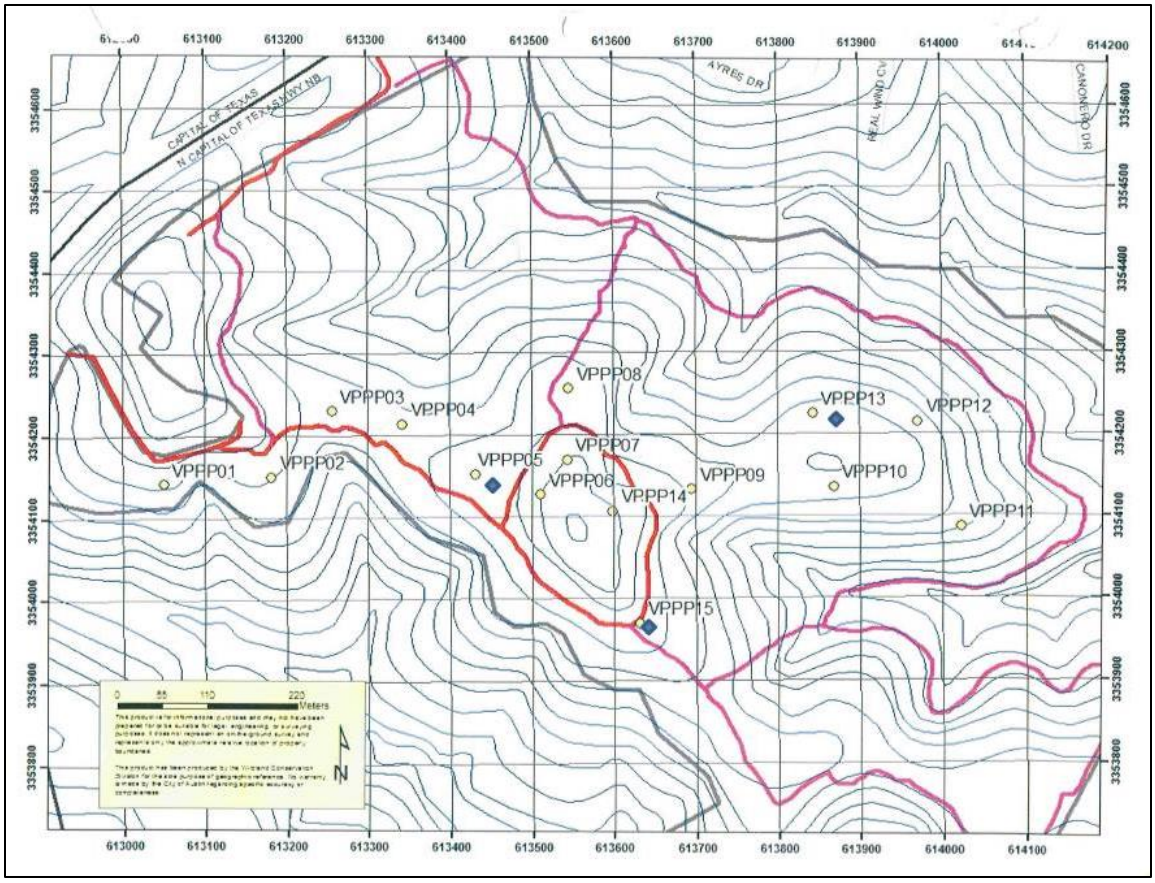

Figure 2. Photopoint locations (yellow diamonds) within the BCP Vireo Preserve. Three points were chosen near photopoings 05, 13 and 15 (blue diamonds) all within the “mechanically cleared” treatment. Three transects were established at each of these sub-locations, and three plots were established along each transect. Woody cover was estimated along each transect, while ground cover was estimated using 1 x 0.5 m plots.

METHODS

Description of study area – We established three transects and nine plots at each photo point at Wild Basin (Figure 1) and at each photopoint within the Vireo Preserve (Figure 2). Each transect consisted of one 30 m tape to determine woody canopy structure (Figure 3). The starting point for each transect was located within 5 meters of each photopoint and preceded in a random direction. The 15 meter mark of each transect was marked with a survey flag and GPS locations for the transect starting and end point was collected. Three plots were located at the 5, 15, and 25 meter marks along each transect. Plots consisted of 100 x 50 cm quadrats to determine understory vegetation (Figure 4).

Procedures - We recorded the species composition of woody canopy species using a line intercept method and ground cover/understory vegetation using a point-frame method modified from Inouye (2002). Data were collected in the field and entered into a relational database for analysis. Additionally we determined the slope and aspect of each transect. We measured soil moisture in situ using a soil moisture probe (Decagon 10HS).



Figure 3. An example of a transect established to estimate woody cover at Wild Basin/Vireo Preserve.

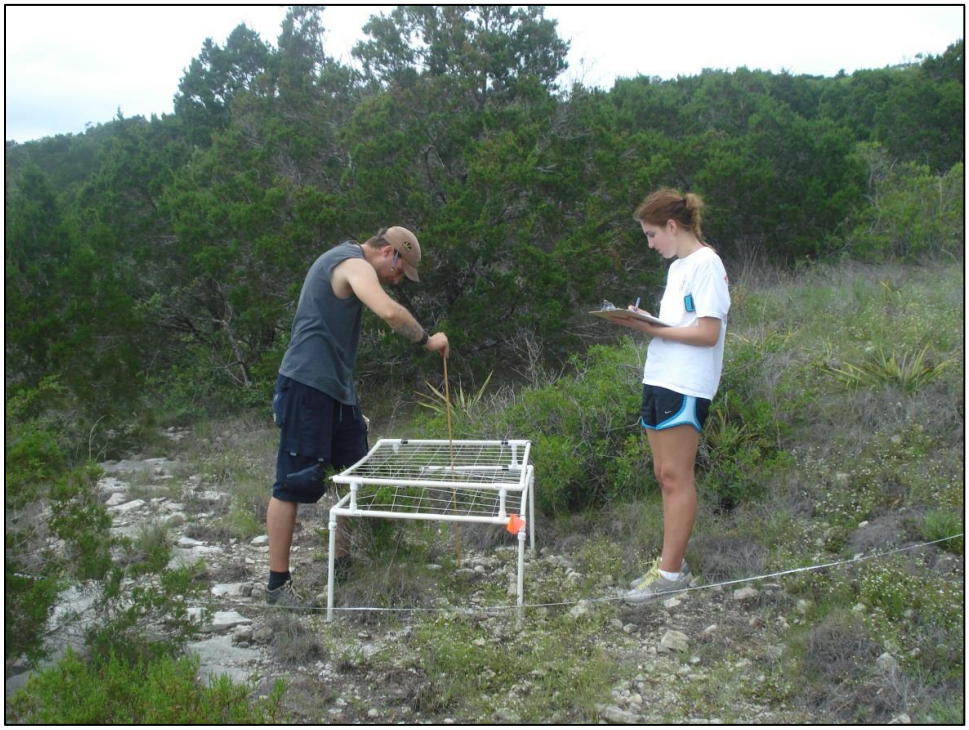

Figure 4. An example of a 0.5 x 1 m plot established to estimate ground cover at Wild Basin/Vireo Preserve.

Collections – We collected one 10 deciliter sample of soil from the 15 meter mark of each transect. Samples were returned to St. Edwards campus for soil characterization, structure and composition in a laboratory environment. This analysis is ongoing. Soils were characterized by determining soil structure, the field capacity, sand/silt/clay, pH, soil carbon and soil nitrogen.

Analysis – Species cover and abundance were summarized for each plot and transect. Because plots were nested within transect, these data were combined to determine the relative cover for each species within each transect. Plant communities were then delineated using hierarchical cluster analysis grouping transects together according to how similar their species composition (McCune and Grace 2002). Ward's Method was used as the group linkage method and Euclidean distance was used as the distance measure. A "50% information remaining" criterion was used as an arbitrary cut-off between groups of transects to delineate community composition, and a second matrix reflecting this arbitrary cut-off was saved to assist with visualization of the clustering and for the non-linear multidimentional scaling ordination (NMS). To determine how communities are structured, plant relative cover and abundance data were then analyzed using NMS with Euclidian distance as the distance measure. This analysis was done using PCOrd software (McCune and Grace, 2002). Once the soil analysis is finalized, axis scores from the ordination for communities will then be used as dependent variables using recursive partitioning with environmental variables, such as soil characterization, slope and aspect, as predictors.

RESULTS

We established a total 13 sites located throughout Wild Basin (n=10) and the Vireo Preserve (n=3). We estimated the cover and abundance of all vascular plant species at these sites. These data comprise 9000+ observations of 127 unique plant species. Analysis reveals that there are approximately five different plant communities within the universe of sites in this study (Figure 5). Because the photopoints may not comprise all plant communities at Wild Basin, and we did not comprehensively sample the Vireo Preserve, we are careful to state that these results suggest that there are approximately five dominant communities in these preserves, as opposed to stating that there are five different communities.

Within our transects, the five communities are distinguishable (Figure 5). The most obvious community that clusters together are the three transects from Wild Basin Photopoint 7 (Figure 5). These are located within the riparian area along Bee Creek (Figure 1), and have high canopy cover. Other communities with high canopy cover include a cluster of transects near photopoints 8 and 5 in Wild Basin (Figure 5, pink labels), and a cluster of transects near Wild Basin photopoints 2 and 6 (Figure 5, light blue labels). Interestingly, 2 transects near photopoint 9 in Wild Basin cluster with the former, and one photopoint 9 transect clusters with the latter. Both of these communities (Figure 5, pink and light blue labels) consist of transects located on shallow slopes (<10°) with high woody cover and very low ground cover.

For the most part, the Vireo Preserve transects cluster together, along with one transect from Wild Basin photopoint 10 (figure 5; green labels), probably because of low Ashe juniper (*Juniperus ashii*) cover on all of these transects. The three transects sampled at the Vireo Preserve coincide with areas actively

manipulated during the winter of 2010/2011 to remove large woody cover effectively resetting succession to a shrub community specifically for the purpose of Black-capped Vireo management (O-Donnell personal communication). Thus, three Vireo Preserve transects associated with different photopoints cluster together with other Wild Basin transects (Figure 5, red labels) within the hierarchical clustering. This final group of transects (Figure 5, red labels) for the most part are found on either steep slopes (Wild Basin photopoints 1, 3 and 4) or on flat limestone terraces (Figure 1, Wild Basin photopoint 10). These all have low to marginal Ashe Juniper cover. The NMS results resulted in a 3-dimensional solution with a final stress of 8.67 (Figure 6). All communities appear to order together according to what might be predicted from hierarchical clustering.

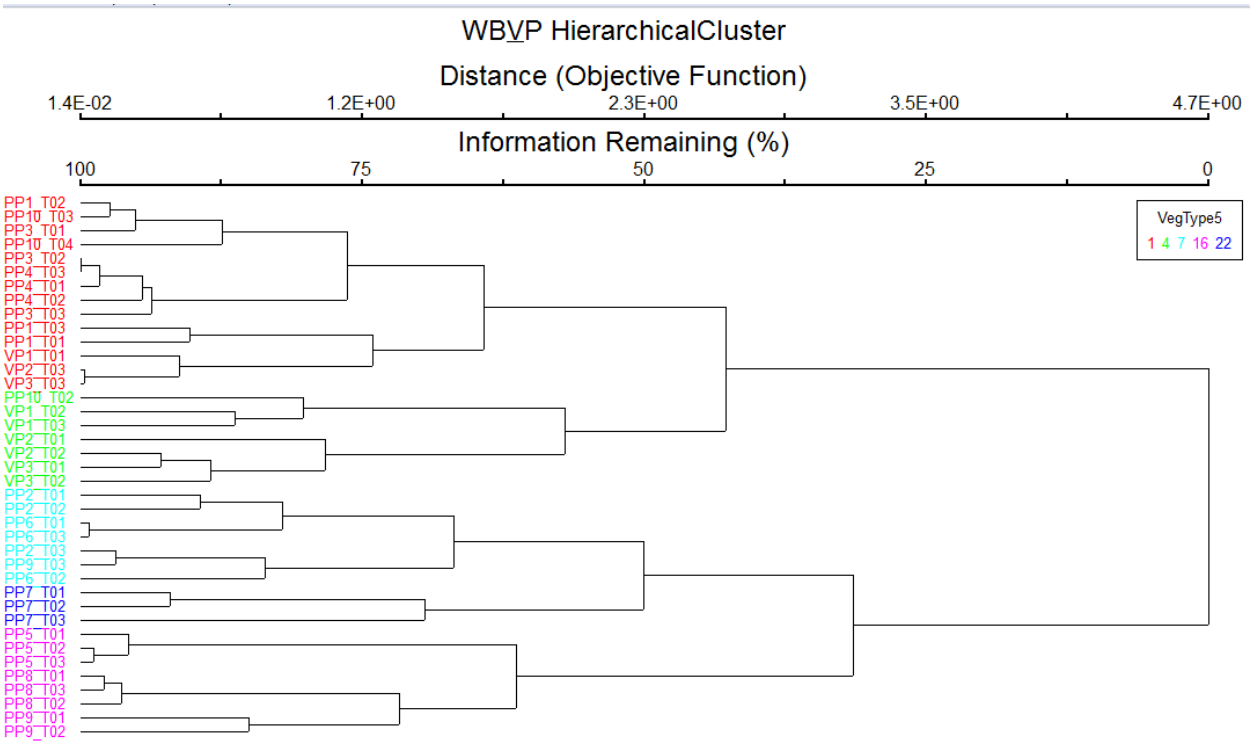

Figure 5. A hierarchical cluster analysis of transects at Wild Basin/Vireo Preserve.

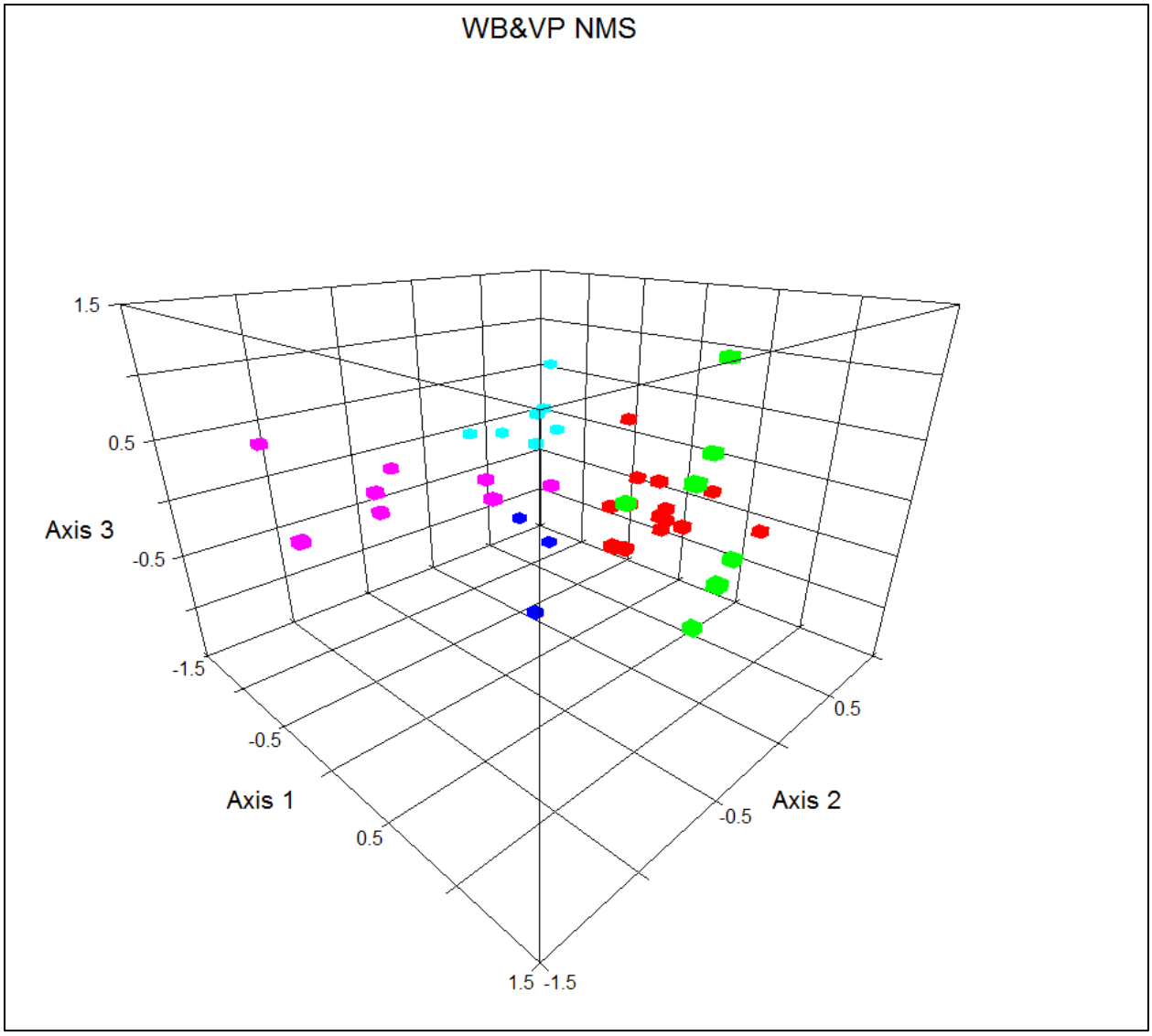

Figure 6. A non-metric multidimensional scaling (NMS) of transects at Wild Basin/Vireo Preserve.

DISCUSSION AND FUTURE PLANS

Our results seem to coincide with those described by Williams (1977), that there are approximately five plant communities at Wild Basin/Vireo Preserve. However, we are careful to note that our results should be viewed in the context that the photopoints may not represent a comprehensive view of the all potential plant communities in Wild Basin. Additionally, we did not comprehensively study all photopoints in the Vireo Preserve due to time constraints associated with student funding. Regardless, our data represent a view of Wild Basin in the summer of 2013. These transect and plots should be resampled in 2014 to determine if, and how, plant community structure varies according to interannual variability (such as precipitation and temperature) as well as identifying any long-term trends.

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