Impacts of Nutrient Enrichment on Native and Non-Native Plants in Serpentine Soil

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Introduction

Serpentine soil, derived from serpentinite, California's state rock, is characterized by its harsh nature - due to its low levels of essential nutrients and exceptionally high levels of toxic heavy metals.In California, serpentine soils are characterized by high levels of plant endemism and rarity. Plants occurring in serpentine soil exhibit extreme tolerance of harsh soil conditions, and are typically out-competed in 'normal' soils due to the cost associated with physiological specialization. Atmospheric nutrient deposition is contributing to a greater invasion of non-native grass species on serpentine soils, outcompeting the native species and threatening them with local extinction [1, 2, 3]. Our greenhouse study aims to explore the impact of nutrient enrichment on four species of annual grasses and herbs - *Festuca microstachys* and *Plantago erecta* as natives, and *Avena fatua* and *Bromus hordeaceus* as non-natives - growing together under a competitive environment.

H_A : There will be a significant difference in the overall fitness of native and non-native plants under nutrient enrichment.

H_0 : There will be no difference in the fitness of native and non-native plants under nutrient enrichment.

Methods

All plants were germinated in a petri dish and allowed to grow for a few days in individual pots, to reduce the likelihood of mortality due to the shock of transplantation, before being transplanted into the competitive tray. To simulate a competitive environment, all four species were grown together in large trays, with each treatment containing three individuals of each species, for a total of twelve plants per tray, and six replicates of each treatment, for a total of twenty-four trays, all of which were grown within a greenhouse setting to recreate natural climate conditions. Our experiment monitored survival, growth, flowering time, reproductive effort and biomass of each species under the addition of nitrogen, phosphorus, nitrogen + phosphorus, and a control treatment. Once trays were established, plant height was recorded every two weeks, and age at flowering was recorded for every plant that survived to reproduction. At the end of the trials, all plants were harvested and biomass recorded for data analysis.

Figure 1. From left to right: *Avena fatua, Bromus hordeaceus, Festuca microstachys,* and *Plantago erecta*

Figure 2. (Left) An example of a single replicate, consisting of four trays and a total of 48 plants. **(Right)** Over 100 gallons of soil were collected from a local site and used for the study.

Expected Results

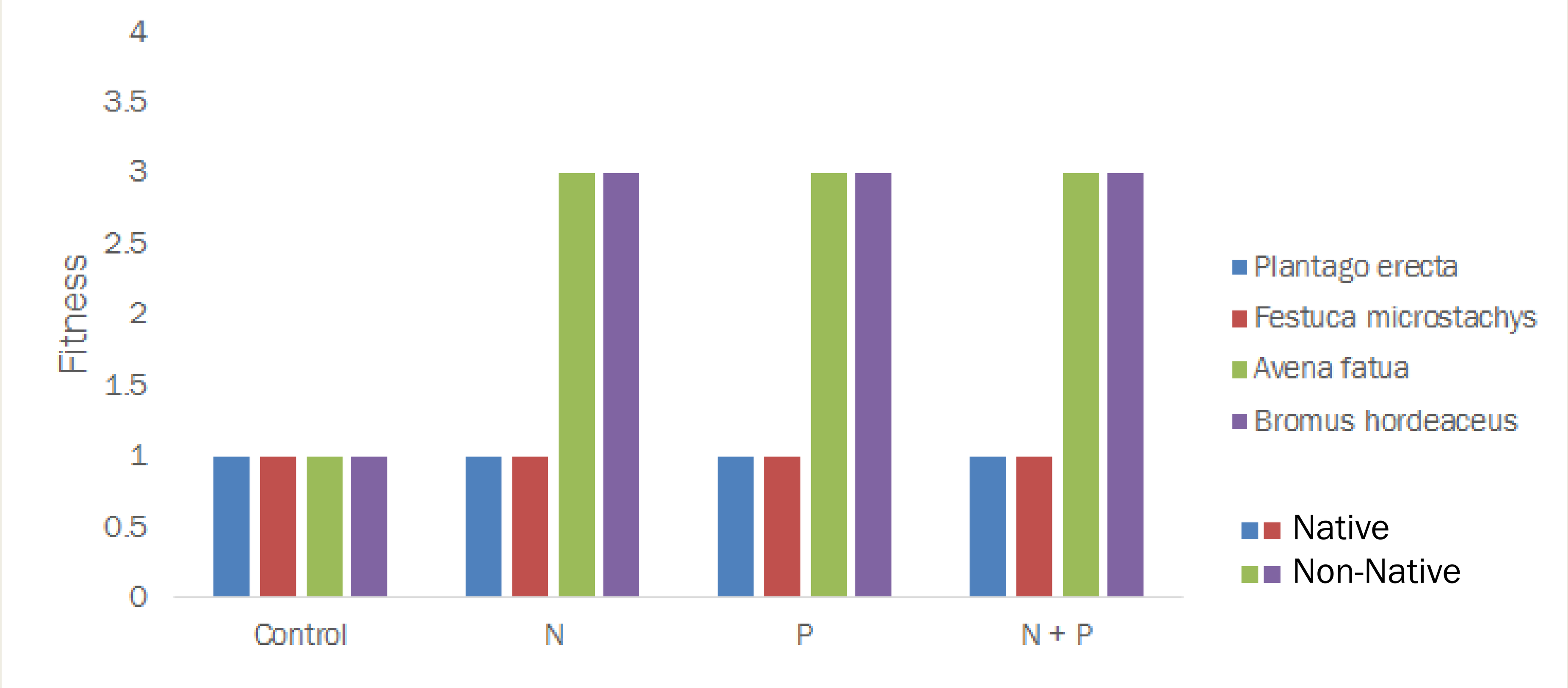

Figure 3. Possible data that would suggest support for our hypothesis.

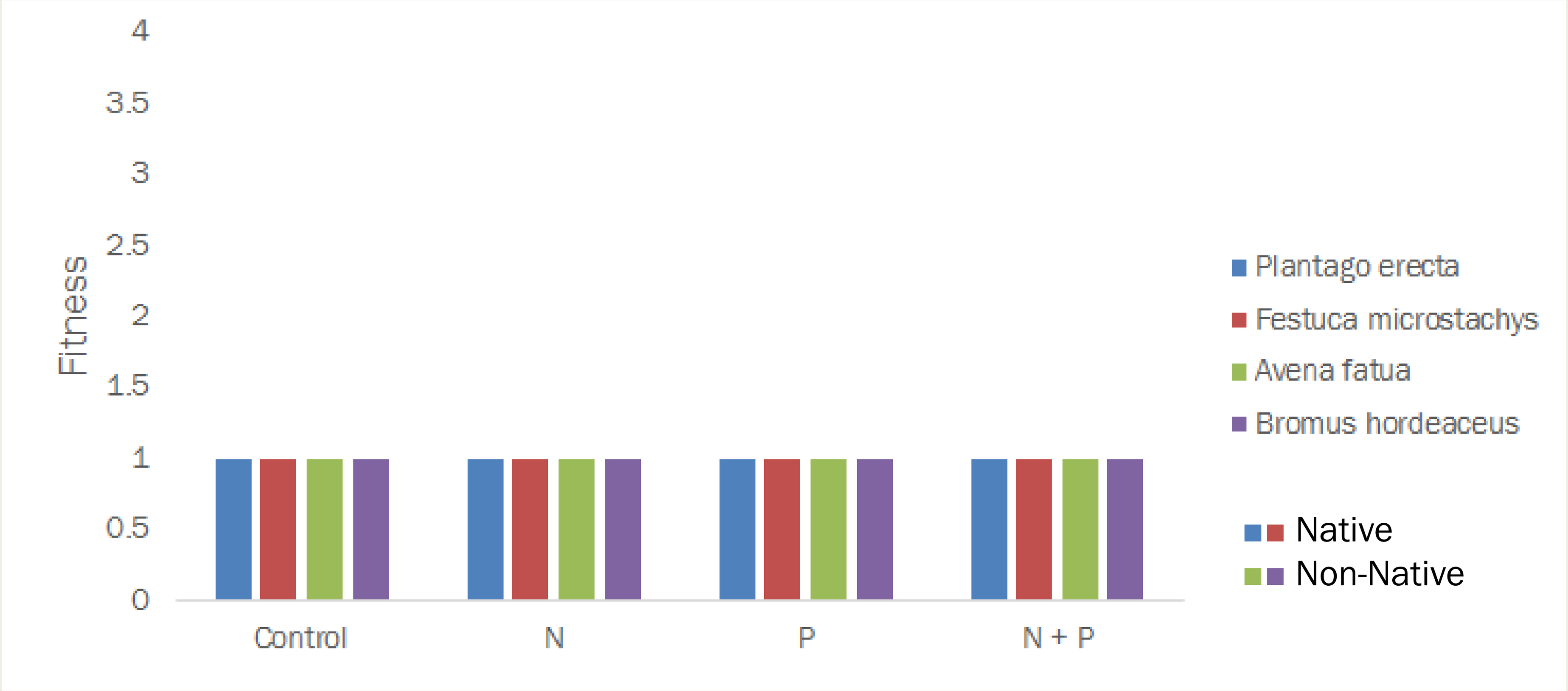

Figure 4. Possible data that would not support for our hypothesis.

Discussion

In an era where climate change and pollution are of serious concern with respect to biodiversity conservation, a study investigating native and non-native plant interactions on serpentine soils would provide useful information on how a prime aspect of climate change, atmospheric deposition of nutrients, can influence the last refuge for many of California's rare and endemic plants. Knowledge gained from this study could be used for better management of biodiverse serpentine habitats in California.

Figure 5. Some of the original seedlings were grown long enough to flower and produce seed, such as this *Plantago erecta* held by Amber Williams, enabling the study to become partially self-sustaining.

References

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