Analysis of the Effect of Grazing by Cattle on the Floral Communities of Grasslands in California

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ABSTRACT

In this study I examined the prevalence of plant functional groups in grazed and ungrazed fields and tested hypotheses about floral communities' response to grazing by cattle. Data was collected for four groups - grasses, forbs, legumes, and rosettes - over 60 meters in both grazed and ungrazed pastures. Comparing differences in the groups of plants between the fields showed clearly that the amount of grazing present on the field did not significantly alter the Shannon-Weiner diversity of its floral community. Cattle reduce legumes ($p=0.17$) and increase rosette plants ($p=0.06$) where they are grazing. Spatial analysis showed that the disturbance from cattle grazing did not affect the floral community more than factors like soil type and seed distribution. Analysis showed that grazing may make grasslands more spatially homogenous, which has positive implications for management, though other studies have found that it may reduce diversity. These results are promising for the continuation of cattle grazing to reduce aboveground biomass. The grazed pasture had significantly less aboveground biomass than the ungrazed pasture, and without any negative effects on the diversity of the flora present. The cattle effectively reduced aboveground biomass without significantly impacting the diversity of the floral community at the pasture scale.

KEYWORDS

Intermediate Disturbance Hypothesis (IDH), field heterogeneity, grassland management, NMDS, paired study

INTRODUCTION

Biodiversity has been an important focus for ecological research as it has been shown to have positive impacts on many aspects of ecosystems all over the world, and preserving biodiversity has been a goal of many conservationists recently (Ballare et al. 2019, Soliveres et al. 2016). Biodiversity can significantly influence how various ecosystems function, impacting forage production and ecosystem resilience (Stokely et al. 2022). Rangeland ecosystems cover much of the earth and provide many ecosystem services to wildlife and society, so we have grown to rely on them and manage them to maximize their services (Sala et al. 2017). Studies have shown that grazing impacts biodiversity like other disturbances, reducing some species and increasing others (Perevolotsky and Seligman 1998, Bartolome and Bush 2006). One of the most prevalent disturbances on rangeland ecosystems is grazing, so quantifying its effects on the floral communities of specific rangelands is very important for maintaining these vital parts of our society (Wessels et al. 2007).

Natural and anthropogenic disturbances have greatly impacted all ecosystems in diverse ways throughout history. In the context of ecosystem ecology, a disturbance can range from insect activity to wildfires, but many disturbances are much more intermediate than either of those examples, such as grazing. Many studies have been conducted that analyze diversity-disturbance relationships (DDRs) across diverse ecosystems which find varying results (Carreño-Rocabado et al. 2012, Hall et al. 2012). A major theory in the field of DDRs is the intermediate disturbance hypothesis (IDH) which states that at an intermediate level of disturbance maximizes diversity (Connell 1978). Not all experimental studies observe this relationship, but it is still widely viewed as a good baseline for many hypotheses as the logic behind it has held up to scrutiny (Fox 2013, Sheil and Burslem 2013). Grazing as a disturbance impacts fields by reducing plant biomass, trampling plants, compressing soil, and depositing nutrients. All these modes of disturbance may favor or harm specific species and will affect the overall diversity of a field, and it can be hard to create management protocols due to this. Different plant communities may respond in varying ways, so studying their relationship with these disturbances is important to do throughout different ecosystems, as it will help us predict how any field may respond to similar disturbances (Hoffmann et al. 2016).

Biodiversity and functional diversity impact the services that ecosystems provide (Schuldt et al. 2018, Felipe-Lucia et al. 2020). This correlation between biodiversity and ecosystem services, as well as the relationship between diversity and disturbances, indicates that we need to quantify the effects of various disturbances if we want a clear understanding of how our management strategies will affect any given ecosystem. A common practice in modern studies is to measure functional diversity; the differences in specific traits throughout all members of an ecosystem (Laureto et al. 2015). Functional diversity is a better predictor of various ecosystem functions than biodiversity is, although it can be inaccessible and hard to measure as it requires more advanced equipment and time (Cadotte W. et al. 2011). A simpler way to measure functional diversity is to classify various species into specific functional groups that possess similar traits and fill a common role in an ecosystem. More research is being produced that demonstrates the value of biodiversity and functional diversity in various ecosystems through many pathways (Ferris and Tuomisto 2015, Oliver et al. 2015). As climate change continues to threaten the stability of our rangelands it becomes more important to understand how our management of these ecosystems affects their diversity.

In this study I use a field that is divided into grazed and ungrazed pastures by a fence to evaluate how grazing might affect the diversity of the floral communities of grasslands. The study looked at 40 plots over a 60-meter transect of California grassland, with half of the plots grazed by cattle and the other half ungrazed. In each plot I recorded the coverage of four functional groups of plants, along with bare ground, and used this data to examine the relationship between the diversity of plots. To assess the relationship between grazing and the floral communities of rangelands I aimed to answer the following questions: 1) Does grazing change the evenness of the functional groups present on this grassland?, 2) Does grazing affect any specific functional groups more than others?, And 3) does each functional group and the evenness of functional groups change in similar ways across both grazed and ungrazed fields?

METHODS

Study site

All study plots were located within Briones Regional Park (37.927438, -122.160768) on grazed and ungrazed fields separated by a fence. The park is in the East Bay of the San Francisco Bay Area in Northern California, a region which experiences a Mediterranean climate typical of this area. The park receives an average of 26.7 inches (678 mm) of rain each year, with an annual average max temperature of 68 F and min temperature of 48 F. Due to time restraints for this study, I took the measurements between winter and early spring after rain and some growth has occurred. The area sampled is a hilly grassland with sparse oak tree cover. The study area is a portion of a larger two pasture grazing rotation where a total of 210-280 AUM of cattle are grazed for seven months out of the year. The ungrazed area has not been grazed by cattle in at least the past decade, and has not been mowed or otherwise largely disturbed by humans in the same time. The area where plots were set up was on top of a hill, which may have decreased the grazing disturbance from cattle. There was still clear visual evidence that the flora on the grazed side of the fence was regularly disturbed by the cattle, as the aboveground biomass on the grazed portion of the field was visibly significantly lower than that of the ungrazed portion.

The study had 40 0.5m x 0.5m plots in the grazed and ungrazed fields. I determined the location of each plot by beginning along the fence that separates the grazed and ungrazed areas and then moving 5m directly away from the fence; I found subsequent plot locations by moving 3m parallel to the fence (Figure 1). GPS coordinates for each site were recorded from Google Maps and the sites were marked with wooden markers. Having the grazed and ungrazed sites separated by a fence but still close to their paired plot allowed me to potentially reduce many confounding spatial variables. For example, the proximity of the sites makes it less likely a difference in soil quality would change the flora on one field without mirroring it on both sides of the fence in the weeks of the study. Before taking measurements there had been several large storms, which likely increased plant cover on these fields and sped the development of seedlings. At the time of taking measurements some flowers had begun to bloom, and grasses had grown high but had not begun to produce seeds yet.

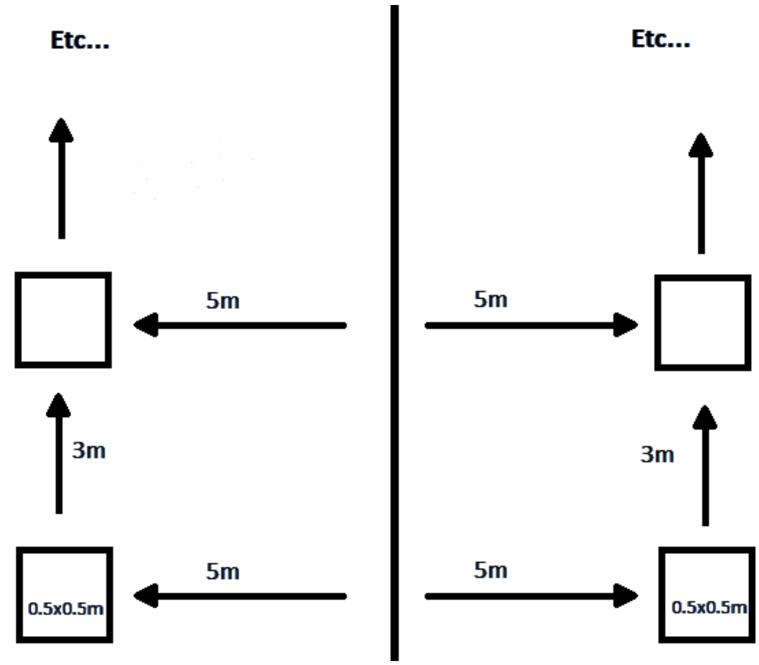

Figure 1. Diagram of plot layout on the fields. A diagram depicting how plots on either side of the fence were positioned relative to the fence separating the grazed and ungrazed field, as well as other plots.

Data Collection

I focused the data collection on classifying individuals within predetermined functional groups of flora within each plot. The time of year in which this study was conducted did not allow for accurate species identification of all florae with the material available to me, but accurate identification of functional groups was possible. Grasses were unable to be fully identified, but many forbs and legumes were able to be accurately assigned to a species. The goal of identifying functional groups is to differentiate species by the ecological niches they occupy, and in order to do that I decided on using 4 functional groups. Those groups were: grasses, forbs, rosettes, and legumes (Table 1) (Lavorel et al. 1999). These groups were chosen so that plants could be easily placed into one of these categories, and each category represents a different niche to be filled in a typical grassland.

Table 1. Description of functional groups. This table lists the functional groups used in this study along with the niches they fill in the ecosystem and examples of commonly encountered species in this study.

Functional group	Niche filled	Description	Commonly encountered species
Grasses	Grow rapidly and are resilient to grazing and many other disturbances.	thin bladed monocots, either annual or perennial.	*Bromus sp., Elymus sp., Hordeum sp.*
Rosettes	Very defended against grazing and mowing. Can grow below other taller plants.	Grow low to the ground in a circular rosette pattern with broad leaves.	*Cirsium vulgare, Agoseris grandiflora, Centaurea solstitalis*
Forbs	Provides a lot of functional diversity. They are generally subordinate to graminoids.	Small, herbaceous leafy plants, no flowers present at the time of the study.	*Geranium dissectum, Geranium molle, Lupinus bicolor*
Legumes	Nitrogen fixing bacteria in their roots facilitate the nitrogen cycle.	Herbaceous plants that incorporate nitrogen-fixing bacteria into their roots.	*Trifolium sp., Vicia sp.*

After a plot was identified the quadrat was placed in a predetermined orientation and the plants within it were classified into the previously specified functional groups. Markers were placed next to individuals that represented key species in the plots so that they could be properly identified and recorded. After this, visual estimations of percent coverage were taken for each functional group as a measure of the prevalence of each group. After these measurements of each functional group were taken, a soil sample was collected, and I moved on to the next plot.

Analysis

Functional evenness across fields

After collecting percent coverage data for each plot I calculated their evenness by using the Shannon-Wiener equitability index $H = -\Sigma[p_i * ln(p_i)]$ and $E_H = \frac{H}{ln(S)}$ where S is the number of functional groups in each plot and p_i is the percent coverage of functional group i (Nolan and Callahan 2006). I will refer to this as functional evenness throughout this study, as it is a measure of an evenness index calculated with functional group data. Using this index 1 represents a completely even distribution of coverage between functional groups in a plot, and 0 would be completely uneven. This measure of evenness of the plots is the metric that I used to compare the floral communities between each field. For all analyses I used Excel and R studio (R Core Team 2023, RStudio Team 2023).

After calculating these indices for each plot, I performed analyses on the average functional evennesses to find differences. To find if there was any significant difference between the grazed and ungrazed fields' functional evenness I used a two-tailed T-test with the functional evenness values for each plot. Performing this T-test determines if the grazed field has a difference in the evenness of its floral community across all plots compared to the ungrazed field by returning a p-value. If the p-value is over 0.05 then the null hypothesis will be accepted, and there is no statistically significant difference between the functional evenness of the fields. In addition to the T-tests, I also calculated the standard deviation of functional evennesses on each field.

Specific functional groups across fields

To assess if there is any statistically significant relationship between specific functional groups in each field I conducted T-tests with the percent coverage data. The analysis for this subquestion started with conducting two-tailed T-tests on the percent coverage values of a functional group from all grazed and ungrazed plots and interpreting the p-value. In addition to T-tests for each group I also determined the standard deviation for each functional group in the grazed and ungrazed fields and compared them by taking the difference of the standard deviations (ungrazed SD – grazed SD). The p-values from the T-tests were then used to determine what functional groups were the most affected by grazing, and the standard deviations were looked at to determine which field varied less in each functional group.

Functional group coverage and functional evenness over distance

This analysis was conducted to see if the fields changed in distinct ways over the distance of the study site (60m). First the percent coverage of each functional group was put in a line graph using data from both the grazed and ungrazed fields. A similar graph was also created with functional evenness data. These graphs allow me to compare the trends for when each functional group is increasing or decreasing as you move through the study site to see if those trends are shared between fields. In addition to the line graphs, I also conducted NMDS (Non-metric

Multidimensional Scaling) analysis on the data from each plot. The NMDS was done using the Vegan package in R Studio (Oksanen 2022). NMDS compares each plot by the percent coverage of each functional group and bare ground, and it uses each functional group as well as distance from plot 1 and days since the first day of collection as vectors (Manly and Alberto 2016). This analysis was done to determine if the fields changed in distinct ways, which would have various implications on the results of the study.

RESULTS

Functional evenness and grazing

A comparison of the functional evenness between the grazed and ungrazed fields shows that the functional diversity of any given plot didn't differ significantly due to the presence of grazing. After the functional evenness of each plot was calculated, the means of the grazed and ungrazed field were very similar, only different by 0.02. The distribution of the functional evennesses was similar throughout both fields, however the ungrazed field had a slightly higher standard deviation (Table 2). The ungrazed fields had a range of 0.56, which is greater than the range of functional evenness in the grazed field being 0.37. The T-test performed on these data showed that there was no significant difference between these groups. The test resulted in a p-value of 0.88 which is much greater than the alpha value of 0.05 (Figure 2). There was not a major difference in the functional evenness of both groups.

Table 2. Result of functional evenness analysis across fields. The quartile values calculated from the functional evenness values for the grazed and ungrazed plots.

	Minimum	**Q1**	**Mean**	**Q3**	**Maximum**	**SD**	**n**
Grazed	0.55	0.65	0.74	0.88	0.92	0.12	20
Ungrazed	0.42	0.68	0.72	0.88	0.98	0.15	20

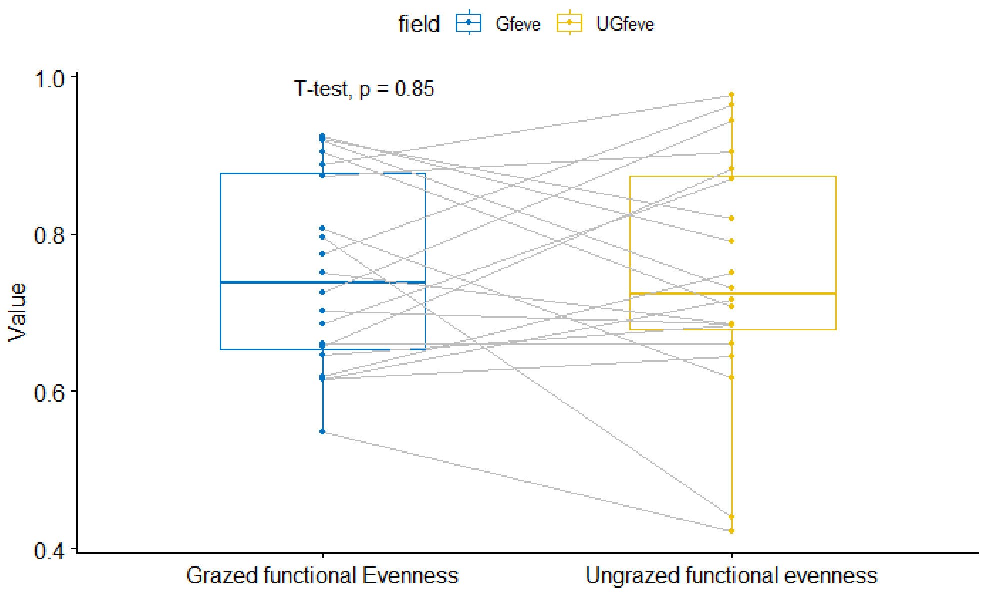

Figure 2. Box plot for functional evenness of grazed and ungrazed fields. Box plot representing the distribution of the functional evennesses of all plots in both the grazed and ungrazed levels. Each point representing a plot on one field is connected to its paired plot on the other field.

Specific functional groups and grazing

Most functional groups had a similar coverage of plots in both fields. Comparing the percent coverage from each functional group, including bare ground, between the grazed and ungrazed fields revealed that most pairs were very similar to each other. Though no T-tests showed significant differences between the fields, the legume ($p = 0.17$) and rosette (0.06) had p-values much lower than any other group (Table 3). Rosettes appeared to increase on the grazed fields and legumes increased on the ungrazed fields. The variation in these coverages seemed to be different between the fields, and rosettes were the only functional group that had a higher standard deviation on the grazed fields (3.61 percent coverage). Most of the functional groups measured were very similar across the grazed and ungrazed fields across 60m and 20 plots, but rosettes and legumes had the closest p-values to indicate significant relationships.

Table 3. Result of analysis of each functional group's percent coverage. Means, standard deviation, and p-value from 2-sided T-test of the percent coverage data collected on each functional group (including bare ground).

	Mean		**SD**			
Field	**Grazed**	**Ungrazed**	**Grazed**	**Ungrazed**	**Difference**	***P***
Bare ground	18.25	18.5	10.17	15.9	5.73	0.95
Grass	49.25	50.0	12.28	19.12	6.68	0.88
Forbs	12	12.25	5.94	12.08	6.14	0.93
Rosettes	11.5	6.25	10.27	6.66	-3.61	0.06
Legumes	9	13	6.41	10.93	4.52	0.17

An analysis of the standard deviations within the functional groups across all plots in the grazed and ungrazed field revealed a nonsignificant difference as well. After conducting a two-sided T-test on the standard deviations it resulted in a p-value of 0.16. This probably is a result of the small number of functional groups in the study, and rosettes being so different from each other group. On the box plots it is noticeable that the ungrazed fields typically have a higher range and more outliers (Figure 3).

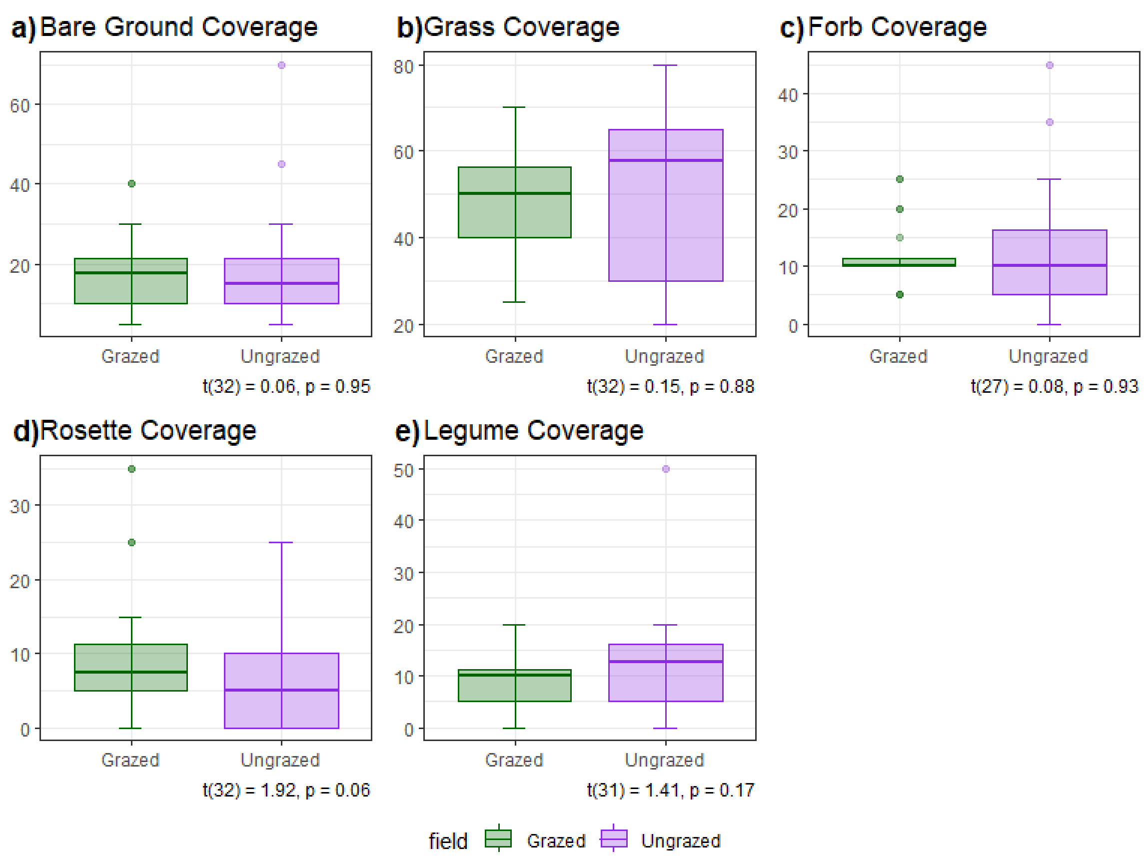

Figure 3. Box plots of all functional group percent coverages on the grazed and ungrazed fields. These are box plots showing the percent coverage of each functional group measured: a) bare ground, b) grass, c) forbs, d) rosettes, e) legumes. Data for each graph is from 20 plots in both the grazed and ungrazed fields, with the results of two-sided T-test analysis under each graph.

Functional groups and evenness over distance

Along the transect, functional groups change over each plot shows that the coverage of each group tends to follow similar trends (Figure 4). The graphs show that within around five plots (15m) any functional group is either increasing or decreasing in both fields in a similar way. When comparing the functional evenness of both fields they can be seen to follow similar trends (Figure 5). Both fields are shown here to have very similar trends in the functional groups present over the transect of the study site.

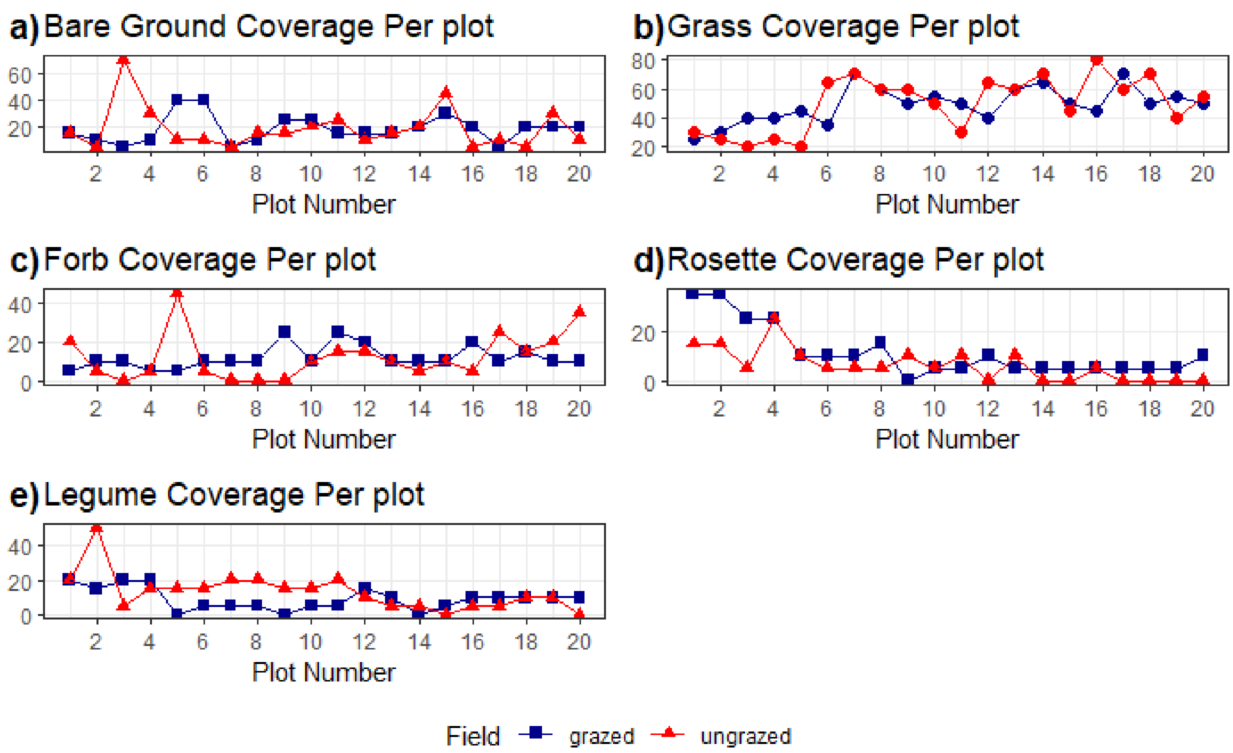

Figure 4. Line graphs of percent coverage for each functional group. Percent coverage of each functional group in each plot from plot 1 to 20: a) bare ground, b) grass, c) forbs, d) rosettes, c) legumes. The similarities between the lines in each plot show how functional groups follow the same trends in grazed and ungrazed fields.

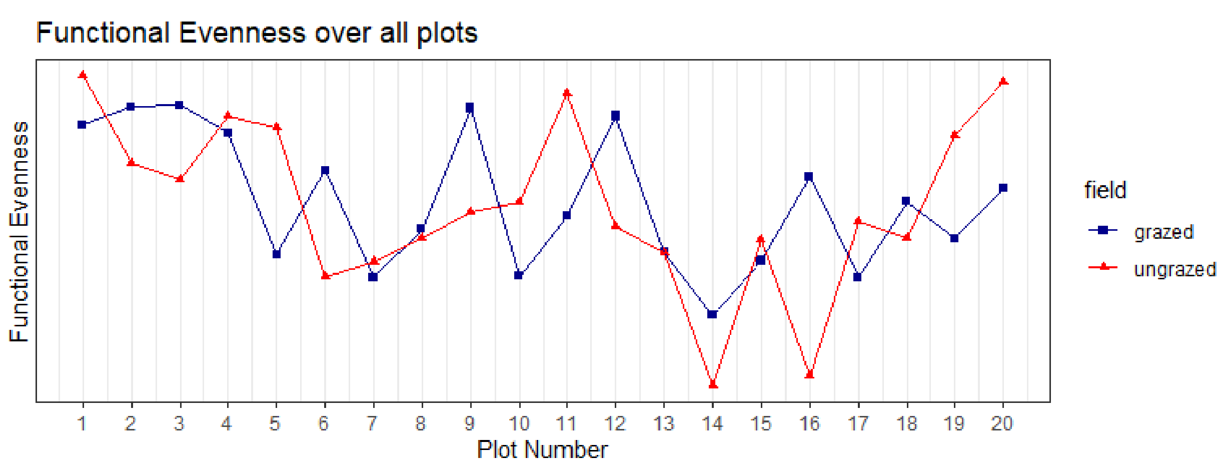

Figure 5. Line graph of the functional evenness of the grazed and ungrazed fields. This graph represents how functional evenness changed over the transect of the study site.

When NMDS analysis was done on the percent coverage data it showed that there was no significant clumping of specific sites, neither grazed nor ungrazed (Figure 6). There may be some slight clumping of ungrazed plots in the upper half of the graph, but there is no very strong relationship as there is too much overlap between the grazed and ungrazed fields. There are strong vectors for each functional group except forbs, but none of them point to a specific group of plots, indicating that there are areas in the study that favored these groups, but those areas don't correspond to specifically grazed or ungrazed sites.

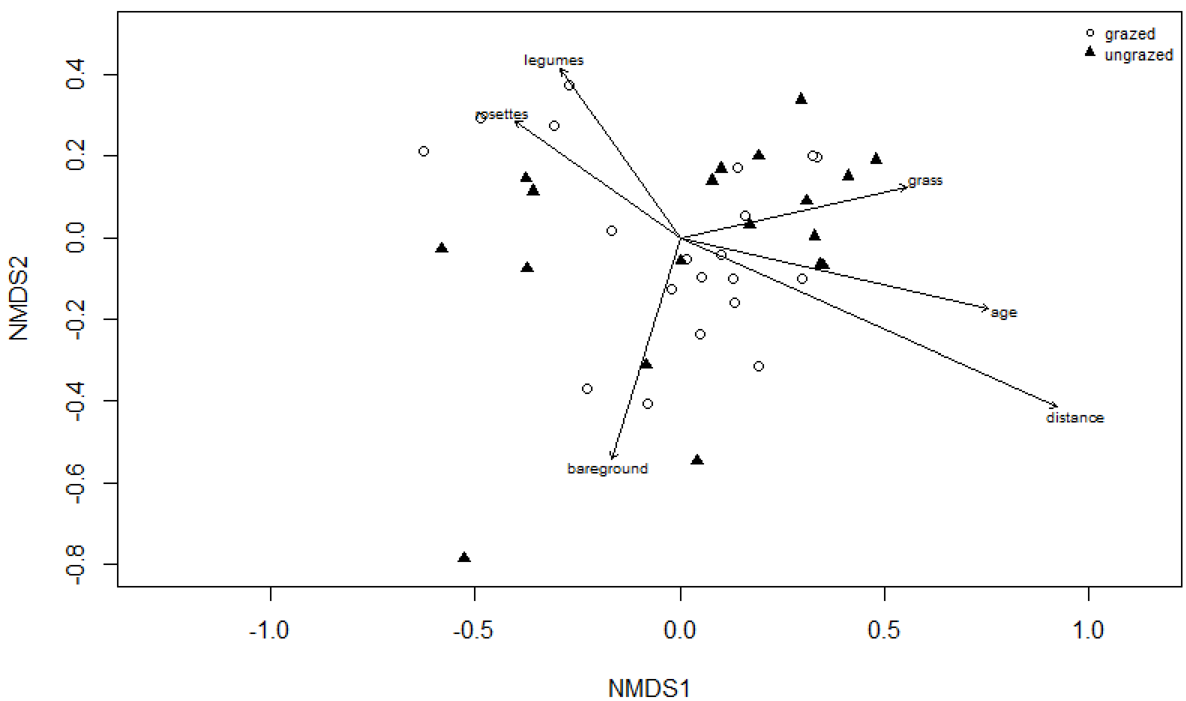

Figure 6. NMDS analysis of the plots on the grazed and ungrazed fields. On the graph grazed plots are represented by circles and ungrazed plots are represented by triangles. There is a vector for each functional group as well as the age of the plot from the start of the study, and the distance from the first plot. There is no noticeable clumping of the grazed or ungrazed plots.

DISCUSSION

The results derived from this study provide understanding on how disturbance from a specific intensity of cattle grazing affected various functional groups and the overall level of diversity on a grassland using a small-scale field experiment with linked plots on a grazed and ungrazed field. I did not detect a significant effect on the overall level of functional evenness across both fields was detected when comparing all the measurements taking over a 60m section of the field, however one marginally significant difference was noticed when comparing the levels of specific functional groups present in each field. Additionally, I found a strong correlation in the presence of each functional group, and overall functional evenness between the paired plots in each field over the length of the study. This section discusses the ecological significance of these results and their implications for future research and management of these ecosystems.

Functional evenness and grazing

Grazing did not have a strong impact on the functional diversity of flowering plants on these fields. Because functional diversity of many natural systems has been linked to their resilience and the services they perform, determining if grazing affects functional evenness would be valuable to those creating management plans in similar grazing landscapes. Disturbances like grazing have been linked to a change in the level of diversity, and a review of many similar studies in Australia found significant negative impacts on many aspects of floral communities (Eldridge et al. 2016). In this study in Northern California, there was a lack of significant difference in the level of functional evenness between the grazed and the ungrazed fields. The similarities between the field's functional evenness implies that the level of grazing on these fields did not have a major impact on their floral communities. Because functional evenness here is a measure of the diversity in a plot, and with respect to this variable both fields were similar, grazing by cattle should continue to be used as it significantly reduced the biomass present on the field without harming the floral communities. Functional evenness is an important indicator of the production and resilience of ecosystems (Ali et al. 2018, Aslan et al. 2019), so demonstrating that this level of grazing does not influence it is useful when creating management protocols.

Many studies have found that increasing heterogeneity of fields benefits their diversity, but studies have also found conflicting results on how grazing impacts the spatial heterogeneity of rangeland ecosystems, with the type of grazing and the specific ecosystem contributing to its effects (Adler et al. 2001). Results from this study showed that there may be a slight decrease in heterogeneity on grazed fields as the grazed field had a lower standard deviation in its functional evenness. Because this study also indicates that grazing did not have a very negative effect on diversity, it can be argued that this indicates that grazed fields are easier to control as there is less variation within the field. In addition to the reduction of variance in the level of diversity, there was also a substantial reduction in the amount of aboveground biomass and thatch on the grazed field. This reduction of aboveground biomass is generally the purpose of implementing cattle grazing as a management strategy for grasslands, so these results show that grazing can reduce aboveground biomass on a field while keeping the level of functional evenness at a similar level to an undisturbed field. This is a major benefit for grazing as it accomplishes its management objective without significantly impacting composition of floral communities (Tälle et al. 2016).

Functional group cover and grazing

Despite the similarities between the fields' overall functional evennesses, they still displayed a difference in some functional groups which should be considered when evaluating the impacts of cattle grazing. Some functional groups of plants are typically more affected by grazing than others (De Bruijn and Bork 2006, Horadagoda et al. 2009). At Briones Regional Park similar trends were found as some of the measured functional groups had more differences between the grazed and ungrazed fields than others. Across the grazed and ungrazed fields rosettes had a close to significant correlation ($p = 0.06$). Legumes had a less significant correlation than rosettes, but a much lower p-value than any other functional group ($p = 0.17$). These p-values indicate that rosettes are more affected than the other groups measured in this study. The grazed fields had a higher level of rosette coverage and a lower level of legume coverage compared to the ungrazed fields. It is probable that cattle prefer to eat legumes as they grow fairly high and are rich in nutrients, whereas they are less likely to eat rosette plants which are harder to access due to growing very close to the ground (Fujita and Koda 2015). It is possible that rosette plants were on average able to propagate more on the fields where legume presence had been reduced, due to there being more space and nutrients available in the soil. When creating a management protocol for a field, it is important to consider the current level of rosettes and legumes present and determine if grazing would influence them in the way that is desirable. It seems like cattle would not be a good choice to reduce rosette plants on fields at this level of stocking.

Research on the impact of grazing on the heterogeneity of fields has also shown mixed results from the impacts of grazing (McIntyre and Lavorel 1994). Here the ungrazed plots had a larger range of values than the grazed fields did on average, which indicates that grazing decreased heterogeneity of the field. For all functional groups including bare ground, except for rosettes, the grazed fields were more homogenous. Despite the mean level of coverage for bare ground, grass, and forbs being incredibly consistent across fields, the standard deviation in the percent coverage of each of them per plot was significantly higher in the ungrazed fields. The increase in the rosette's variance on the grazed field may also be explained by their lack of control by cattle. It is also possible that significant changes in field heterogeneity may be difficult to detect because of the scale of this study. Other studies have found that when grazing increased heterogeneity in fields, it also significantly increased the diversity of those fields (Marion et al. 2010). It appears that in these fields a decrease in small scale heterogeneity did not significantly affect the diversity of the fields. As long as diversity remains unaffected, I think that the increased homogeneity of the grazed field would lead to easier implementation of management protocols on these fields, as there would be a broader area that is more similar to itself, compared to a heterogeneous field.

Functional evenness and percent cover over distance

The layout of each plot in this study was designed so that confounding variables that could have affected the results would be eliminated by the proximity between the paired plots. When looking at how the coverage of each functional group varies over the 60m of the study a tight correlation occurs. If the coverage of one group changes in one field most of the time that change is mirrored in the other field within the distance of 1 plot (3m). Throughout the length of the study the percent coverage of each plot was always followed the same trends, increasing or decreasing, over 5 plots (15m). These similarities indicate that environmental variables (slope, seed dispersal, soil type, etc…) which governed where specific plants were more important to consider than any impact from grazing. It also shows how the distribution of the plots controlled for many possibly confounding variables. Looking at functional evenness over each plot reveals a similar, but less stark similarity. The broad trends of functional evenness are mirrored in both fields, but there are more sudden shifts in one field that are not mirrored in the other. This is more evidence that functional evenness wasn't affected by many confounding variables, and the results from the previous analyses are trustworthy.

NMDS has been used in similar studies to this many times to determine how multiple communities may differ from each other, and how different aspects of the study are emphasized in specific groups (Hernández et al. 2021). NMDS has been shown to be a useful tool for examining the differences in pasture composition over a gradient of grazing disturbance (Fensham et al. 1999). The NMDS analysis of the plots in this study revealed that there was a very weak distinction between the grazed and ungrazed fields in terms of community differences. As expected from the previous analyses, the ungrazed plots appeared to be less clustered than the grazed ones. This analysis did show that there was some clustering in each of the groups in a specific area, but it was not very distinct when compared to previous similar studies (Pykälä 2003). It also indicated that no specific functional group was more apparent in either grazed or ungrazed field. This spatial analysis shows that, even in the presence of grazing by cattle, the floral community of these fields were much more impacted by other state factors than any disturbance from the grazing. This further adds to the point that if this grazing accomplishes the level of biomass reduction necessary, then it is a good management tool because it doesn't affect the field significantly in other ways.

Limitations and Future Directions

This study illuminated some relationships between the floral communities in grazed and ungrazed fields, but it also provides many guidelines for similar research in this area to use when designing studies. Firstly, it would be useful to time this study so that identification of grasses and other species is easier, so that more comparisons can be made between functional groups and species present. Another study with more precise functional groups would also be helpful in order to find more precise relationships by resolving the groups to a smaller level, as a similar study which measured abundance of specific species did notice trends over a gradient of grazing intensity (Fensham et al. 1999). If possible, similar studies that use functional traits instead of groups would also be helpful, as functional traits are more representative of ecosystem function that groups are (Wood et al. 2015). Additionally, having multiple fields where the intensity of grazing can be modified and controlled would provide valuable information on how different intensities of grazing could fit into various management protocols better. Making any or all these changes would lead to a future study that may provide more precise results which would be helpful in making judgements on the effects of grazing disturbances on these fields.

Conclusion

The results from this study showed that grazing did not have a significant impact on the floral community of these fields. Some relationships, like the reduction of legumes and increase of rosettes, were indicated when comparing them to other functional groups, but the data collected did not find a statistically significant association. It is possible that a stronger relationship may be present if the functional groups are more specific, or if the intensity of grazing is increased. All other functional groups measured in this study did not indicate any variation between the grazed and ungrazed fields. All of this indicates that this level of grazing does not have statistically significant impacts on the functional evenness of a field when examining these functional groups. The results from this study indicated that the diversity between grazed and ungrazed fields remained fairly constant. Because of this, we can conclude that grazing may be helpful for management of fields, as aboveground biomass was significantly reduced on the grazed field, and it tends to make the floral communities more consistent and predictable. Grazing should continue to be used as a valuable tool for grassland management, but more studies may be necessary to fully determine the extent of its impact on floral communities.

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