SITE PREPARATION METHODS FOR RESTORATION OF NON-NATIVE PASTURELANDS TO NATIVE UPLAND HABITAT

by

KRISANN KOSEL
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ABSTRACT

The flatwoods ecosystem of Florida has been heavily depleted over time but remains one of the most important systems to many threatened and endangered species. Areas that have been converted into non-native pastures may be restored to provide not only this invaluable ecosystem but also restore connectivity of the surrounding ecosystems. The pasture areas on The Disney Wilderness Preserve in central Florida were surveyed, and a conceptual plan for restoration was written in 1996. That same year a pilot study was developed to assess five methods for removing non-native pasture grasses. The treatments studied were single herbicide, single disc, multiple herbicide, multiple disc, and single herbicide with two disc treatments. All plots were monitored once a year for three years along non-permanent transects. Percent cover was estimated for seven variables and a species list was developed for each plot. The triple herbicide treatment had the best overall success in removal of non-natives and establishment of native species characteristic of flatwoods communities. This treatment also had the highest species richness. The results of this study were used to develop the long term restoration plan for the remaining pasture areas of the preserve. This information may also be useful to restore pastures that connect other important ecosystems being purchased and protected throughout Florida and the Southeastern United States.

This Thesis is dedicated to Erv and Gayle Kosel

who never wavered in their support and love.

Erv Kosel 1935-2004

ACKNOWLEDGMENTS

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LIST OF ACRONYMS/ABBREVIATIONS

DWP	Disney Wilderness Preserve
TNC	The Nature Conservancy
NGVD	National Geodetic Vertical Datum
df	Degrees of Freedom
n	Sample size

CHAPTER ONE: INTRODUCTION

Land purchase for long-term preservation is a major focus of conservation efforts worldwide (Primack 2002). While this is a good use of funds, the dichotomy lies in the lack of suitable habitat remaining for purchase. In the United States and generally elsewhere landscapes are heavily impacted by humans leaving few sizable tracts of land available for purchase that may sustain species on a landscape level. Even if land can be purchased, it is often fragmented without connectivity to allow for species preservation in perpetuity (Gilbert and Anderson 1998). Furthermore, few documented cases exist of habitat requirements for a species that specify the number and arrangement of acres needed to insure survival. The value of natural areas to most people exists in our respect for communities that have evolved over time (Gilbert and Anderson 1998).

The pine flatwoods ecosystem of the Southeastern United States is considered a highly endangered habitat (Noss 1989, Stout & Marion 1993, Ware et al. 1993). Estimates of impacted and degraded flatwoods range between 95% to 98% of the original range (Noss 1989, Ware et al. 1993). Kautz (1998) reported a 90% decline between 1936 and 1995 in the total area of forest in Florida formerly dominated by longleaf pine (*Pinus palustris*). Flatwoods are considered to represent one of the most diverse herbaceous floras on Earth and their natural values justify significant efforts to preserve and restore this ecosystem type (Kirkman et al. 2001). This system often provides the connection between wetlands and other upland habitats (Noss, 1989).

Restoration of pine flatwoods is now a major conservation objective in the southeastern U.S. and in Florida in particular (Johnson and Gjerstad 1998). Research into the best strategies for restoration is faced with many challenges. For example, flatwoods have been logged, grazed, mined, used for navel stores, and sustained countless other minor impacts (Ware et al. 1993). Most of these uses have had fairly low long-term impacts, with the exception of mining. Until recently, when areas were mined for phosphate they were reclaimed into non-native pasture (Stout & Marion 1993). Conversion of pine flatwoods into pastures and housing developments has continued as the human population continues to increase.

Restoration can be facilitated through several means including mitigation. Developers in Florida and other states are required to mitigate to compensate for the development of environmentally sensitive areas. Mitigation may involve the preservation and restoration of substitute lands in order to develop. Mitigation has previously focused on wetland systems; however, the importance of flatwoods as habitat and as area for connectivity to other ecosystems has been recognized. Restoration projects need to incorporate several factors including existence of sensitive species, years since conversion, presence of invasive non-native species, impacts of fertilizers, and cost as planning and prioritizing goes forward (Gilbert and Anderson 1998).

Restoration of farmland and pasture has been underway for some time in the prairie states of the mid-western United States. These earlier efforts have developed reliable methods for seed gathering, seed sowing, and measuring success (Shirley 1994, Packard and Mutel 1997). Restoration in Florida has previously been focused on reclamation of mined lands rather than restoring disturbed habitat, e.g., pastures. Several research projects have been conducted over the past 5-7 years focusing more on restoration of pasturelands back into flatwoods, many of which are discussed the Proceedings of the Upland Restoration Workshop (The Nature Conservancy 2000). KBN Engineering in 1988 found that succession in the old field pastures of Central Florida does not follow the predictable stages to a wooded climax community in a classical manner. Instead, succession in agricultural lands may follow one of many paths depending on hydrology and fire frequency (Cattelino et al. 1979). The theoretical basis for observed variation in succession following disturbance or restoration is reviewed by Platt and Connell (2003).

Disney Wilderness Preserve

The Disney Wilderness Preserve (DWP) consists of approximately 11,500 acres (4,654 hectares) and was acquired with mitigation moneys from the Walt Disney Company and the Greater Orlando Aviation Authority. Restoration and management of the DWP served to compensate for wetland losses anticipated by the commercial developments. Once the property was purchased, the initial mitigation efforts were directed at the impacted wetlands on the DWP. These wetlands were restored by the removal of retaining walls, filling ditches, and controlling non-native species. This restoration has been successful as documented in the annual monitoring reports for the preserve, available from The Nature Conservancy. In 1996 a report was compiled describing the pastures on the preserve, their history, and potential restoration options. Over the past 40 years, 1700 acres (688 hectares) of the DWP were converted to non-native pasture for grazing (The Nature Conservancy 1996). A study was developed to determine an efficient and cost effective practice for removing the non-native pasture grasses and restoring the native plants. This pilot study was designed to test five possible treatment methods, in six test plots, in three different pastures. A long-term restoration design for all the pastures was also developed and has since been modified based on the results of this study.

CHAPTER TWO: METHODOLOGY

Site Description

Three pastures designated as Candler, Stump and Stewardship were selected for study. Two sites were selected for study plots within each of the pastures for a total of six plot complexes. Candler pasture contained the Visitor Center complex and the Candler complex; the Stump pasture contained the North Stump complex and South Stump complex; and the Stewardship pasture contained the Work Center complex and the Horse Pasture complex. A range of elevations and locations within the pastures was represented in the study areas. Care was taken to insure that a similar mix of plant species dominated the areas, meaning they were predominantly bahia grass (*Paspalum notatum*). The nature of the original vegetation on the sites was determined from an examination of historic aerial photos and interviews with the previous land owners.

The Candler pasture is currently comprised of two main non-native pasture grasses. One section of approximately 60 acres (24.28 hectares) was planted in pangola grass (*Digitaria decumbens*) as a hay crop. The remaining sections of the Candler pasture, 212 acres (85.8 hectares) are dominated by bahia grass. The Candler pasture was converted from natural range into non-native grasses over a number of years in the 1980s. The soil is Smyrna fine sand (Soil Conservation Service 1990). The pH of the pasture and surrounding flatwoods was tested to estimate the impact of fertilizer application prior to any effort to restore the pasture. The pH of the flatwoods soil was 3.9, which is typical for intact flatwoods. In contrast, the pasture tested at pH of 5.3. The differences are explained by the application of lime fertilizer until fairly recently by the previous owners to encourage the non-native pasture grasses. The differences in pH could influence restoration success by discouraging natives and encouraging non-natives. All of this area is thought to have been mesic to hydric flatwoods prior to conversion to pastures. The elevation ranges from 63 to 67 feet (19.2-20.42 meters) above sea level.

The Stump field was converted to bahia grass in the early 1940s and is one of the oldest pastures on the DWP. Nonetheless, oaks (*Quercus* spp.) and saw palmetto (*Serenoa repens*) are still scattered about the pasture. The pasture is about 280 acres (113.31 hectares) and includes several small wet prairie areas and one cypress dome; the wet areas have been heavily impacted by grazing. One borrow pit was dug to provide fill for a road and a source of deep water for cattle when the pasture was converted. An additional borrow area was created in 2000 to provide fill for a wetland restoration project. This area was designed to be only 1-1.4 feet (0.31-0.43 meters) deep covering approximately 11 acres (4.45 hectares) to minimize potential impacts to the shallow groundwater table. Prior to conversion to pasture, scrubby and mesic flatwoods were the natural communities on the site. In the early 1990s, sod was taken from the north side of the pasture. Smyrna and Myakka sands are mapped on the site. These soils are poorly drained and were derived from sandy marine sediment (Soil Conservation Service 1990). The pH was also tested in this pasture to determine the potential remnant effects of fertilizer. The pH in the surrounding flatwoods measured 4.1 while the pH of the pasture was 4.4 which confirmed that little if any fertilizer had been used on the pasture.

Stewardship pasture was converted to bahia grass in the mid 1950s. The 129 acres (52.2 hectares) of pasture was installed over what used to be oak scrub and mesic flatwoods. The soil is predominantly Immokalee sand and the elevation ranges from 63.7 to 66.2 feet (19.42-20.18

meters) above sea level (Soil Conservation Service 1990). The area of the survey plots is in improved and maintained bahia grass but adjacent to this area is a large improved range where bahia grass was installed within the natural vegetation. Pockets of long leaf pine and saw palmetto still persist in this area.

All pastures were surveyed by Southeastern Surveying and Mapping Company to gain accurate elevation maps. Differences of one to two feet (0.31-0.61 meters) in elevation may contribute to difference in restoration success (Cattelino et al. 1979).

Table 1. Elevations of the pastures at the plot complexes used in this study.

Pasture	Elevation	Plot Complexes
Candler Pasture	20.332 meters	Candler Complex
	20.228 meters	Visitor Center Complex
Stump Field	19.705 meters	North Stump Complex
	19.409 meters	South Stump Complex
Stewardship Pasture	20.314 meters	Work Center Complex
	19.89 meters	Horse Pasture Complex

Treatment and Monitoring

The pilot study was designed to compare five site preparation methods for restoring bahia pasture to native upland habitat. Six plot complexes were established in the three main bahia pastures and were fenced with livestock wire to exclude cattle and wild hogs. Each complex measured approximately 60m x 250m. Five test plots each 30m x 30m were placed within the complex with 15m buffer zones around each plot. Five site preparation treatments were randomly assigned within each plot complex. These site preparation methods were single disking, single herbicide, disk-herbicide, multiple disking, and multiple herbicide.

A contractor applied the herbicides with a tank style sprayer pulled behind a tractor. Disking was accomplished with a six foot wide (1.83 meters), two gang disk pulled by a tractor. The single treatment plots were mowed and then treated as appropriate with a single herbicide application of glyphosate or a single pass with the disk. The disk-herbicide plots were treated with herbicide and disked twice. The multiple disk plots were disked three times over the course of five months. The multiple herbicide plots were treated three times with glyphosate over the course of five months.

Native seed was collected from approximately 300 acres (121.4 hectares) in three different flatwoods that had been burned in May 1996. Seed was collected over a 4 week period from November 15 to December 15 which captured some of the seed variation in maturation. The seed was stored in a building for one month while site preparations were completed. When the preparations were nearly complete, the seed was thoroughly mixed and measured into equal sized portions for dispersal on the plots. The seed was weighted to provide a rate of 20 pounds (9.072 kilograms) per acre. Each plot received roughly 6 pounds (2.722 kilograms) of seed mixture. In addition, to determine if cover encouraged native plant growth, a cover crop of annual rye (*Lolium perenne*) was planted on half of each 30m x 30m plot. These areas were then considered as sub-plots of 15m x 30m.

Prior to seeding, all sites were lightly harrowed to provide small 1 inch (2.54 cm) deep grooves approximately 4 to 6 inches (10 to 15 cm) apart across the entire surface. This treatment encouraged the seed to catch in the grooves, and reduced the chances of its being blown away. After seeding the sites were rolled using a water-weighted roller to ensure good soil-to-seed contact and to further reduce the chance of seed being blown away.

Seeding was performed using a modified leaf blower, which acted as a vacuum, sucking the seed into a tube and allowing the seed to be blown a distance of 15 feet (4.6 meters). As soon as the seed was applied, the plot was rolled.

Vegetation and its response to the treatments on the plots were monitored in two ways. First, a species list was developed for each subplot by walking the area and recording observations. Secondly, cover of vegetation was measured along random transects. Transects had to be a minimum of one meter from the edge of the subplot. A random number between 100 and 700 was generated to determine the first monitoring point along the transect. The next points were every 5 meters from this first point. For example, if the first number was 325 cm, the next points were 825, 1325, 1825, 2325, and 2825. A one meter by one-half meter PVC rectangle was placed at each monitoring point with a short side along the measuring tape. Cover was estimated for seven vegetation categories within the rectangle. Categories measured were bahia, other exotics, all native species, weedy natives, natives characteristic to flatwoods, all litter (standing and fallen), and bare ground. The cover was estimated using a modified Daubenmire classification (Table 2 Daubenmire 1959). The information was recorded into an excel (spreadsheet) program on a palmtop computer. Three transects were done on each subplot for a total of 18 points per subplot and 36 points per plot.

Table 2. Daubenmire classifications used in this study to quantify canopy cover.

Class	Range	Midpoint
0	Not present	
1	1-5	2.5
2	6-25	15
3	26-50	37.5
4	51-75	62.5
5	76-95	85
6	96-100	97.5

Pre-treatment monitoring was done with a point intercept system. For each 30 x 30 meter plot, a non-permanent point intercept transect was randomly located within each of six 5 x 30 meter belts. Measurements were taken at 30 equidistant points along the transect. The initial point was randomly selected within the first meter of the transect. A camera tripod with a level attachment allowed the pin to be dropped vertically at each point. A botanist then identified plants touched by the tip of the pin as it descended. Data were recorded into a palmtop computer. These data cannot be directly compared to post-treatment data but some inferences can be made from the information.

The other variable considered was water table. Ground water wells were installed at each plot complex and water levels were usually measured monthly from April 1996 to November 1999.

Analysis

The cover data were analyzed using SAS (SAS Institute Inc. 1989). The data were converted from the cover classification to the midpoint of the category. These data were then transformed by taking the arcsine of the midpoint divided by 100 to gain normality. An initial analysis of variance showed no influence of the annual rye crop on success so the sub-plots were combined and the data analyzed as whole plots. Therefore the number of data points (n) for each treatment was 216. Further analysis was performed using a repeated measures analysis of variance, MANOVA, a general linear model with a post-hoc Tukey's test at $p = 0.007$. This alpha was reached by adjusting $p = 0.05$ with a Bonferroni correction for repeated data over time. Species richness data were also analyzed using a general linear model on the untransformed data. Tukey's test was also used to determine significant differences between treatments (Zar 1974).

Data from the ground water wells were analyzed with a one-way analysis of variance (ANOVA) using SPSS (SPSS Inc. 1998). The data were combined by plot complex over the four years of the study and the water elevation was subtracted from the ground elevation to determine the difference. The difference in feet represented the true water depth from the surface. The data were determined to be normal, Lavene's statistic = 2.214. These data had differing sample sizes due to sampling error, which required the use of a harmonic mean sample size of 42.155 over the four years of data collection. Tukeys' test was used post-hoc to determine significant differences between the plot complex water wells (Fry 1993).

CHAPTER THREE: RESULTS

The seven categories of cover values taken in 1997, 1998, and 1999 revealed significant treatment effects over time. Characteristic native plants increased in mean cover on multiple herbicide plots by 1999 to be significantly higher than any other treatment method ($p<0.007$, $n=216$, $df=8$) (Figure 1). The disk-herbicide plots and multiple disked plots showed no significant difference by 1999. The single disk treatment seemed to show no increase in cover of characteristic natives after three years and was significantly lower in characteristic native cover than any other treatment ($p<0.007$, $n=216$, $df=8$) (Figure 1).

The mean cover of weedy native plants was greatest on all treatment plots in 1997 and declined in 1998 and 1999 (Figure 2). In 1997, cover of weedy native plants increased significantly from single disk, single herbicide, disk-herbicide, multiple disk, to the greatest value with multiple herbicide ($p< 0.007$, $n=216$, $df=8$). The smallest increases in weedy natives were observed on the single disk and single herbicide plots over the three years. Marked decreases in weedy natives were observed on the disk-herbicide, multiple disk and multiple herbicide over the three years. In 1999, significant differences ($p < 0.007$, $n=216$, $df=8$) in weedy native cover remained between single disk and multiple herbicide; whereas, the other treatments were no longer different (Figure 2).

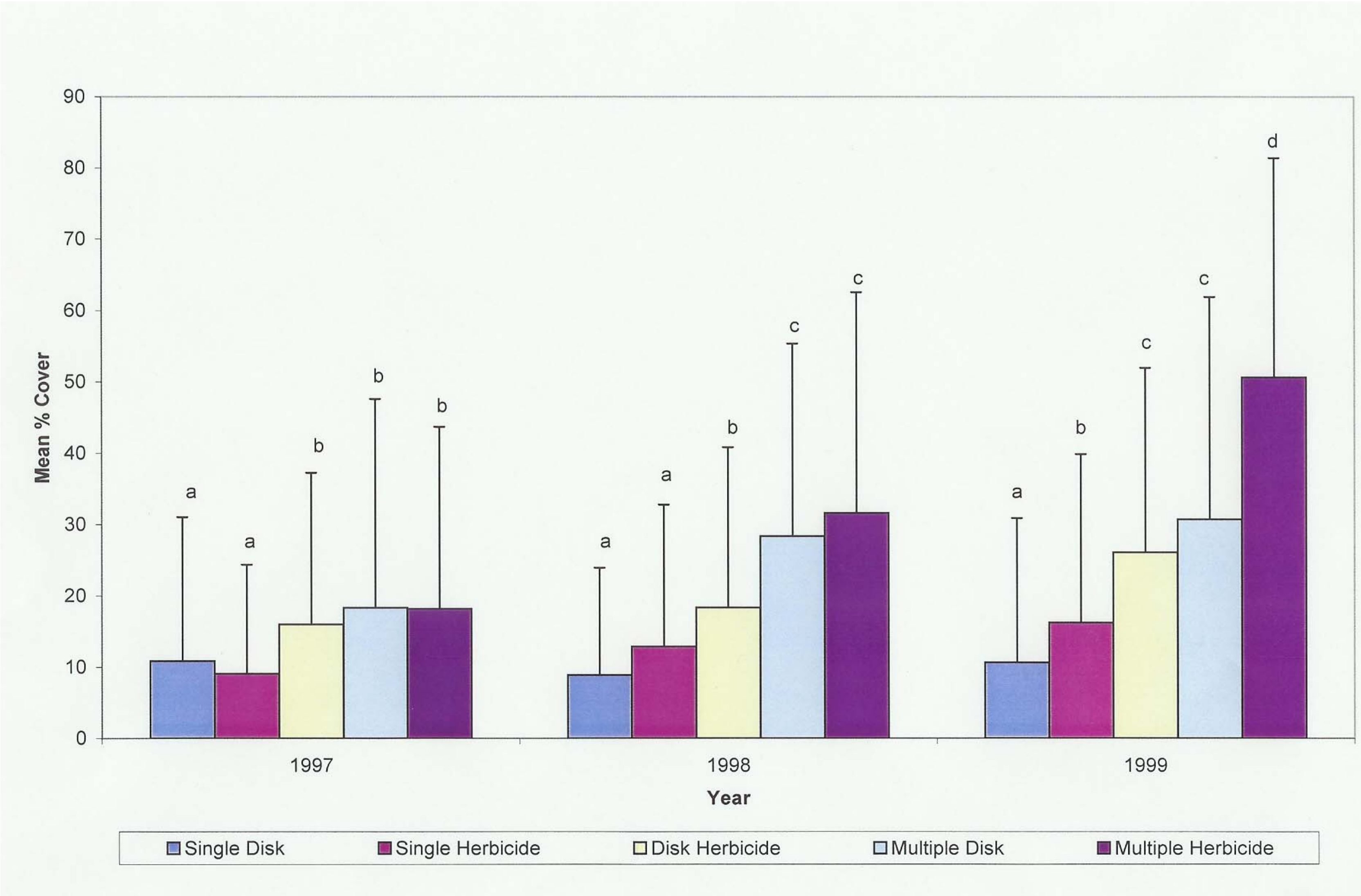

Figure 1: Mean cover of characteristic natives by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$ n=216 for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

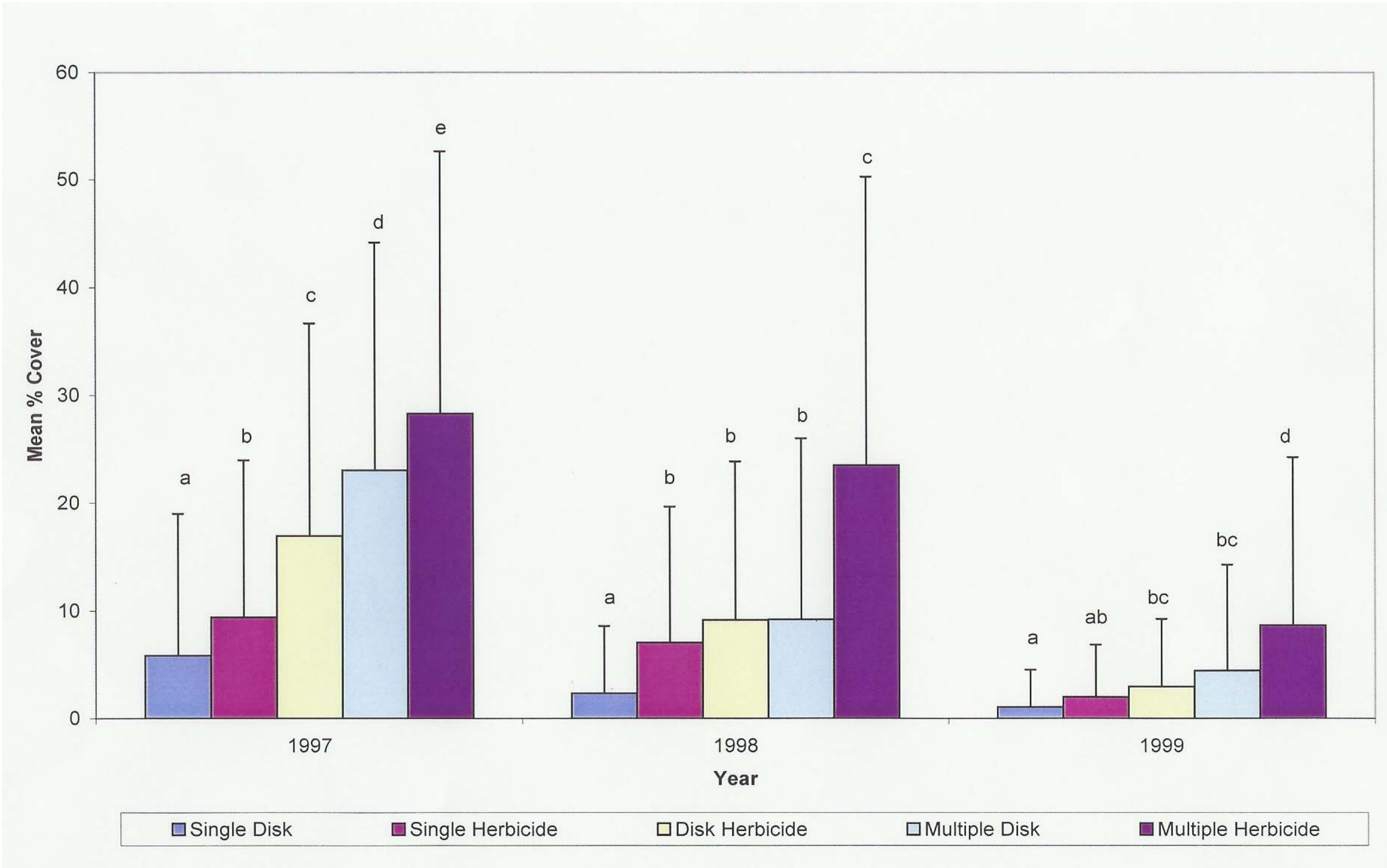

Figure 2: Mean cover of weedy natives by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years. n = 216 for each column

Mean cover of bahia grass increased from the lowest values on all treatment plots in 1997 to the highest values in 1999 (Figure 3). The single disk plots maintained mean cover of bahia > 50% over the three years and reached 70% in 1999. In 1997, the other treatments reduced bahia cover to less than 25%. Cover of bahia increased in parallel in 1998 and 1999 on the single herbicide, disk-herbicide and multiple disk plots. These treatments were between 50 and 60% bahia in 1999. The multiple herbicide plots showed increases in bahia from a low of about 5% in 1997 to 15% in 1999 (Figure 3). Multiple herbicide plots had significantly lower percent cover of bahia through all three years of the study ($p<0.007$, $n=216$, $df=8$) (Figure 3).

An examination of trends in mean cover of all native plants by treatment and years reflected the importance of the response of bahia grass and its cover (Figures 3 and 4). Native plant cover decreased or remained relatively unchanged in 1997, 1998, and 1999 for all the treatment groups with the exception of multiple herbicide, which increased in 1998 ($p < 0.007$, $n=216$, $df=8$) and remained unchanged in 1999 (Figure 4).

The mean cover of exotic plants other than bahia decreased across all treatments from 1997 to 1999 (Figure 5). Cover of exotics varied from 13 to 24% across the treatments in 1997 and increased on the single disk, single herbicide, and disk-herbicide treatments in 1998. In contrast, little change in exotics was observed between 1997 and 1998 on the multiple disk and multiple herbicide treatment groups. Between 1998 and 1999, exotic cover diminished on all the treatments with the multiple disk treatment having the lowest cover value among the treatments ($p<0.007$, $n=216$, $df=8$) (Figure 5).

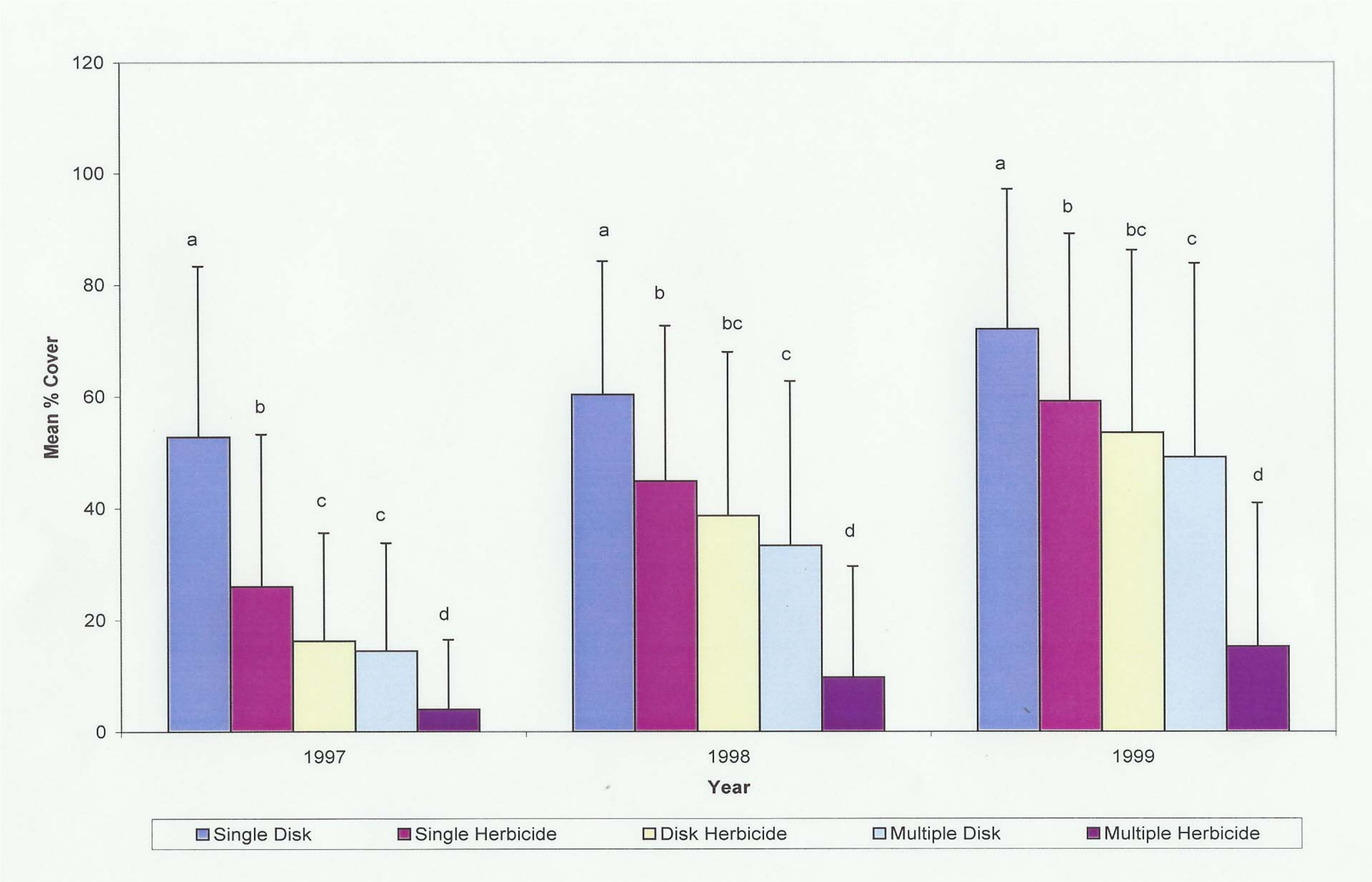

Figure 3: Mean cover of bahia by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$ $n=216$ for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

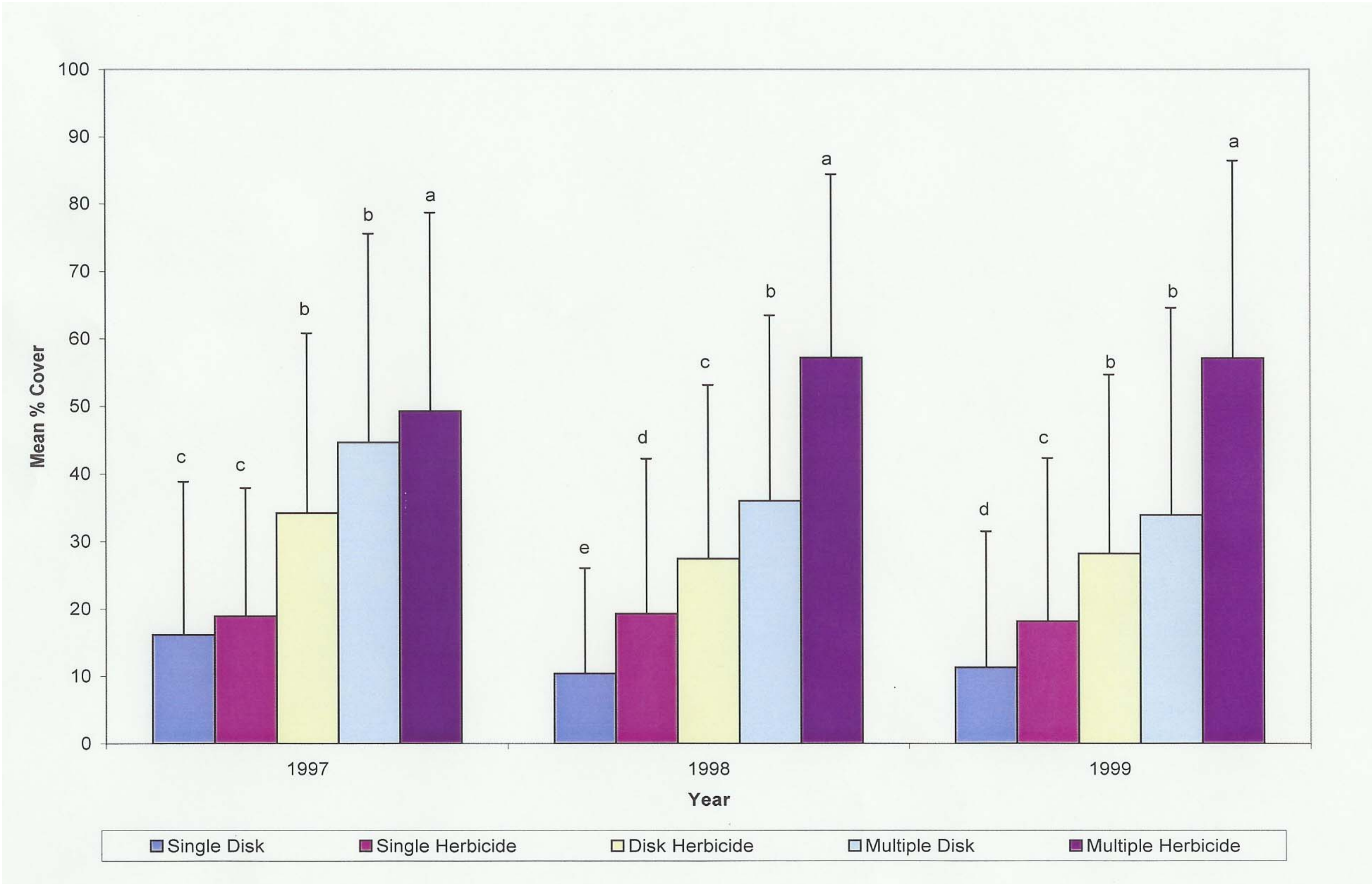

Figure 4: Mean cover of all natives by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$ n=216 for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

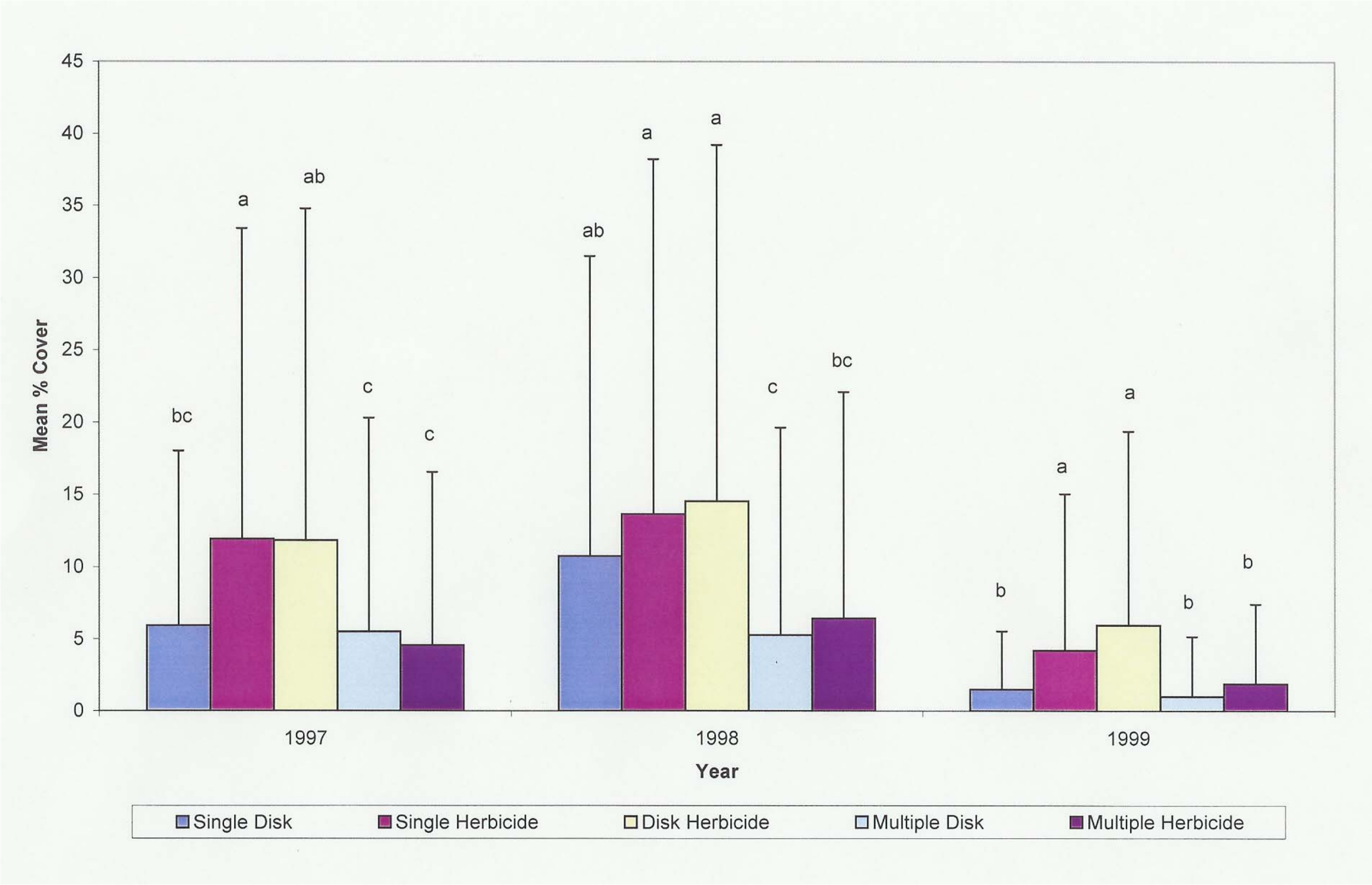

Figure 5: Mean cover of other exotics excluding bahia by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$ n=216 for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

Litter as part of the ground cover was uniformly low in 1997, doubled in value in 1998 relative to 1997, and showed little further change in 1999 (Figure 6). After 1997, the single disk treatment had the greatest amount of litter among the treatments but only in 1998 was it significantly different from all the other treatments ($p < 0.007$, n=216, df=8).

Bare ground was greatest in all years on the multiple herbicide treatments relative to other treatments (Figure 7). The bare ground cover value for the multiple herbicide treatment showed the greatest significance among the comparisons in 1999 ($p < 0.007$, n=216, df=8). Bare ground decreased as bahia cover increased on the single disk treatments from 1997 to 1999 (Figures 3 and 7).

Species richness of plants across all plots in 1997 varied from about 33 on the single disk to 44 on the multiple herbicide treatments (Figure 8). Multiple herbicide was significantly more diverse in 1997 than the other treatments with the exception of disk-herbicide ($p < 0.05$, n=216, df=8). Species richness increased on all treatments in 1998 and declined in 1999. Species richness was consistently higher on the multiple herbicide plots than on the other treatments in all years. These differences were not significant ($p < 0.05$) in 1999 except for the comparison of single disk and multiple herbicide (Figure 8).

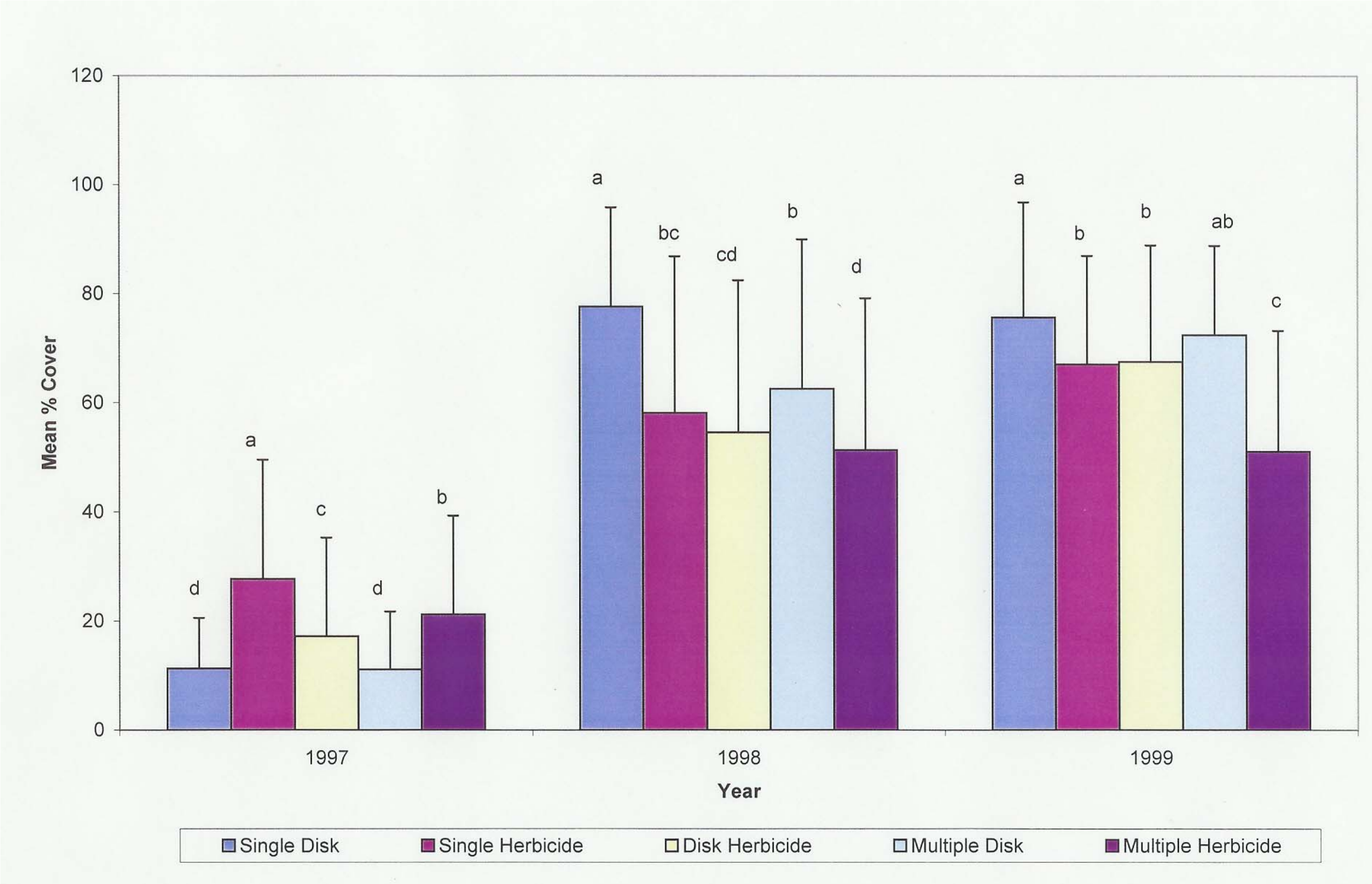

Figure 6: Mean cover of litter by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance $p<0.007$ $n=216$ for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

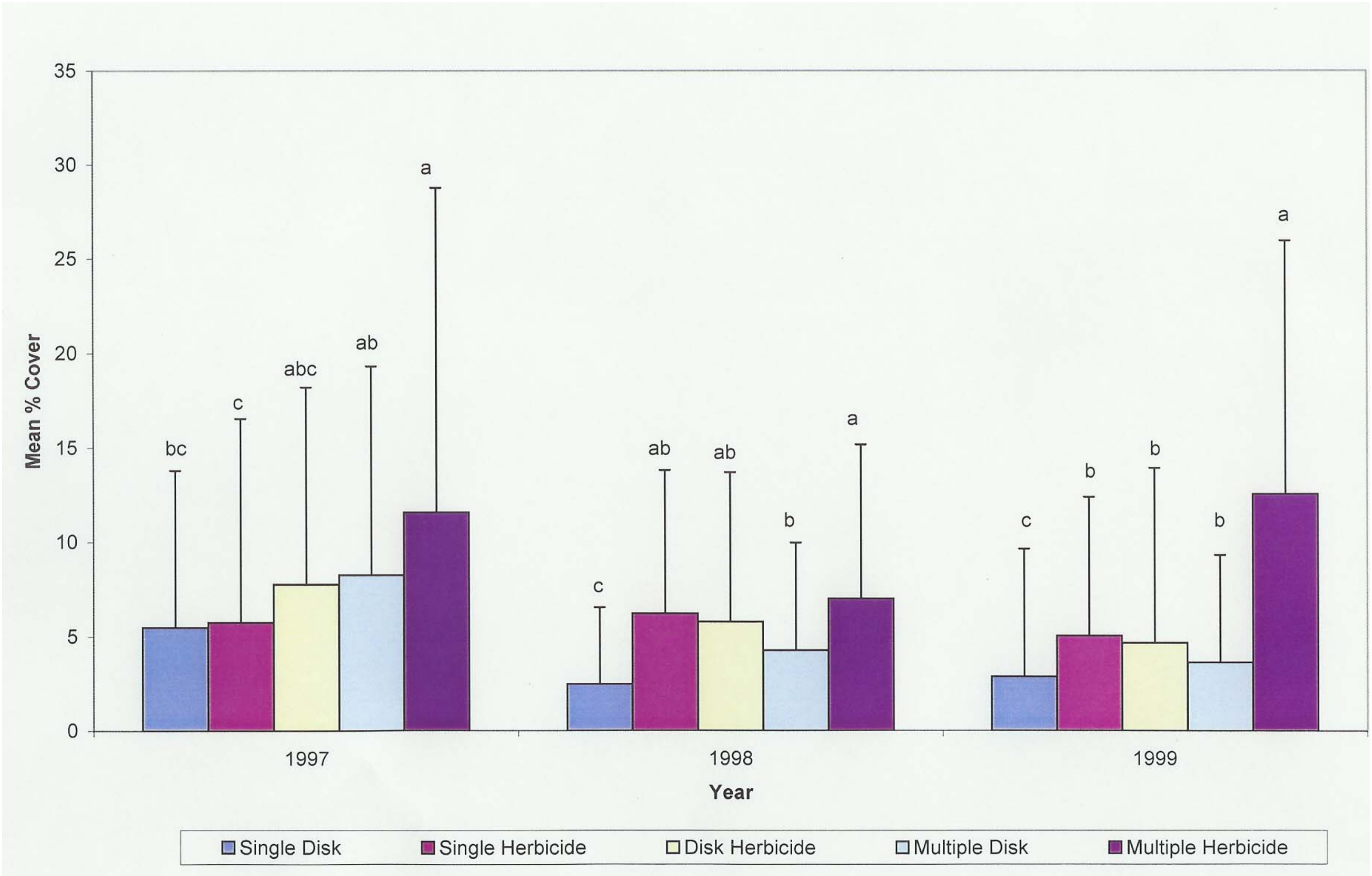

Figure 7: Mean cover of bare ground by treatment on former bahia pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.007$ n=216 for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

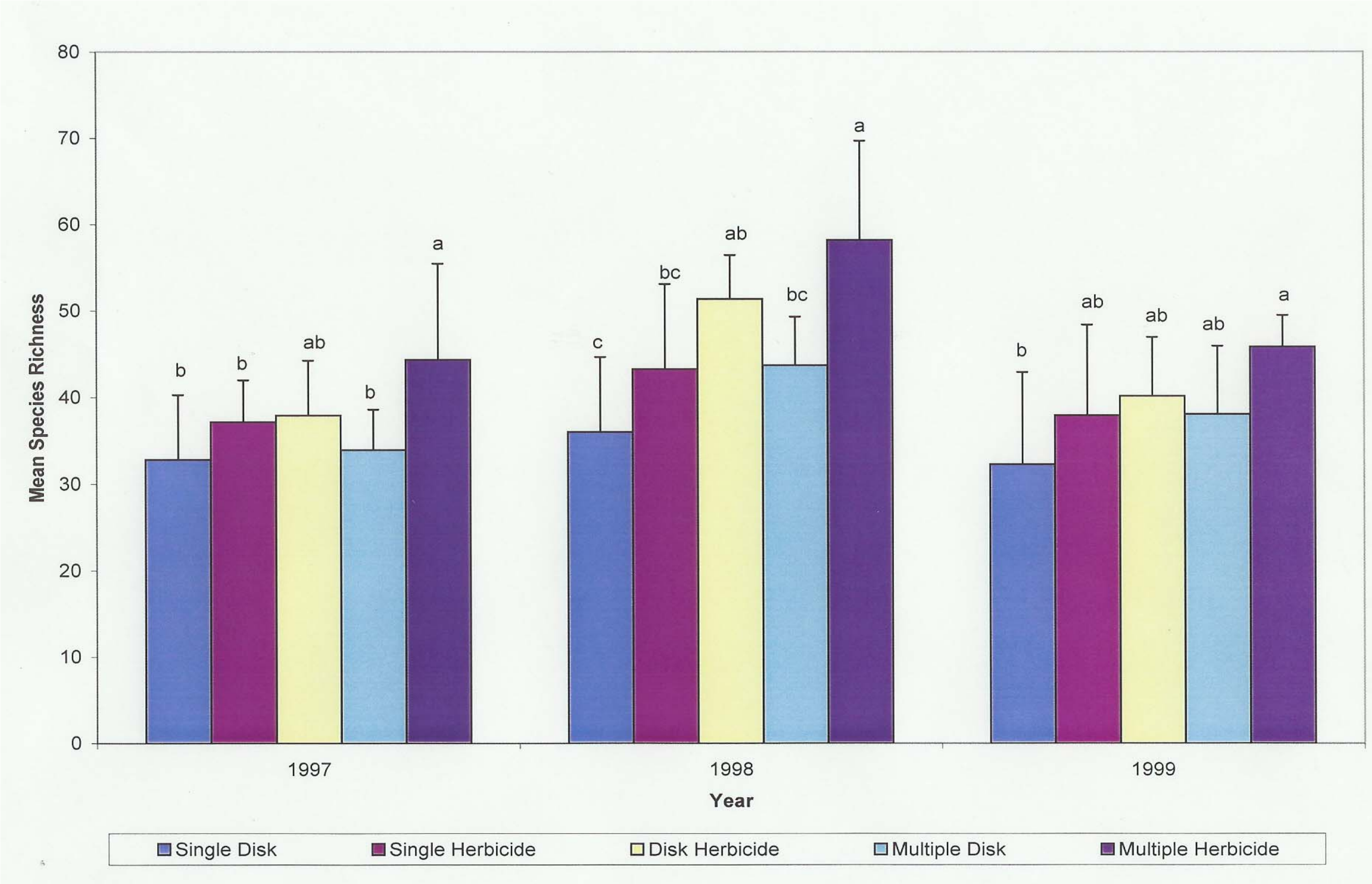

Figure 8: Mean number of species present by treatment on former pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.05$ $n=216$ for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

The ground water well data showed some statistical significant differences when the data were combined over the three years of study. Ground water was significantly lower in the Horse Pasture complex than in the Candler or South Stump complexes ($p<0.05$, harmonic mean sample size = 42.155, df=5) (Figure 9). This does not correspond with any disparity in species richness or over all restoration success among plot complexes.

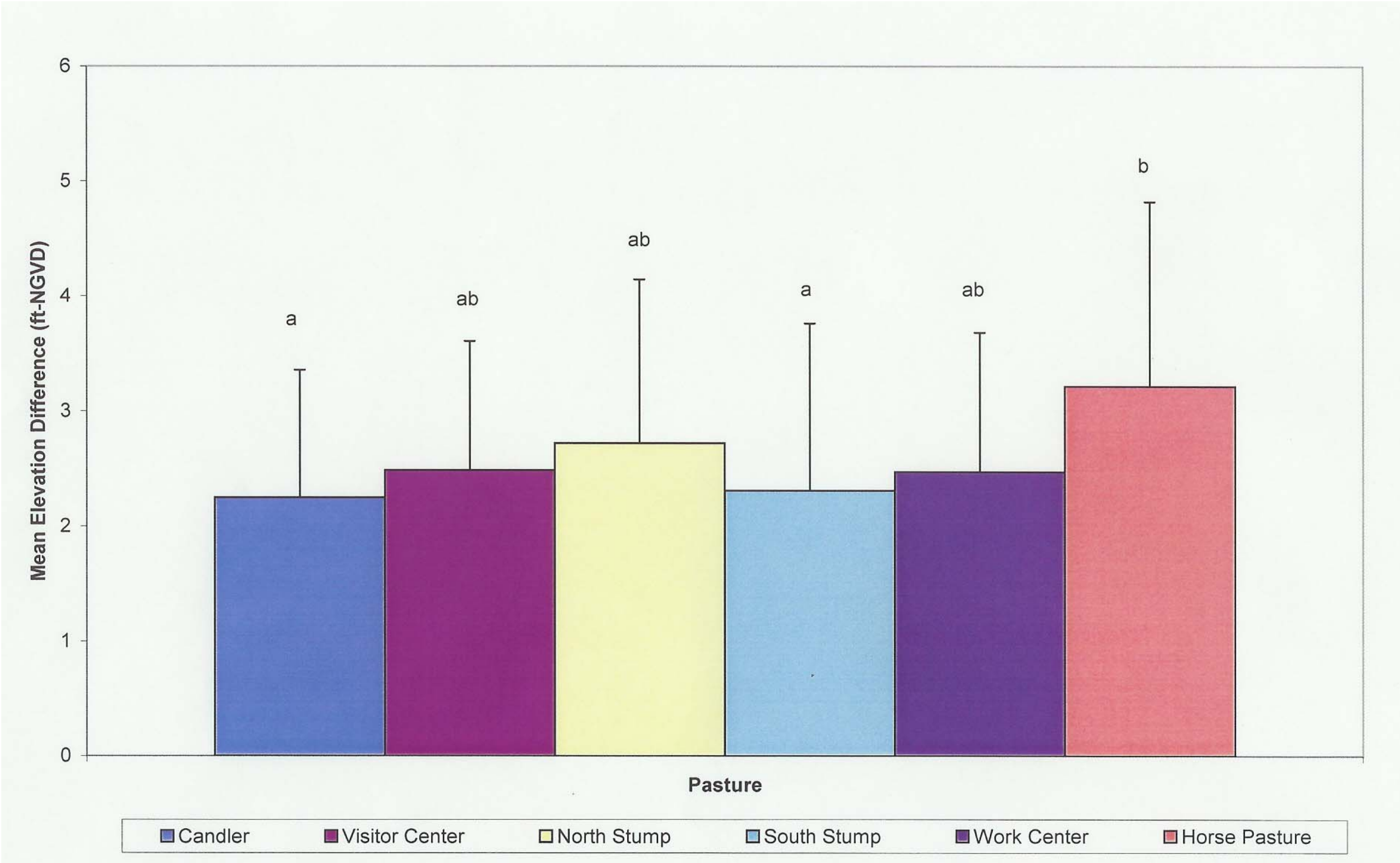

Figure 9: Mean difference in water level elevation from ground elevation on former pastures, Disney Wilderness Preserve.

Letters correspond to statistical significance at $p<0.05$ n=42.155 for each column. Columns (bars) with the same letter are not statistically significant from other columns with the same letters within years.

CHAPTER FOUR: DISCUSSION

The best treatment method for removal of bahia grass in this particular study was multiple herbicide. Relative to other treatments, these plots showed the highest cover of native species, both weedy and characteristic, the least litter and most bare ground. Weedy species cover decreased over the study as I would predict because these are pioneering species and natural succession would result in their replacement with characteristic species. The decline in weedy species also contributed to a decrease in species richness over time. Species richness was highest one year post seeding when weedy natives, characteristic natives and non-native species were present, then, as succession occurred, the richness declined with the loss of weedy natives. The single disc treatment was the least effective in generating a native system.

The consensus of restoration professionals is that the most efficient method of reestablishing native habitat in improved pastures requires a combination of herbicide and disc treatment applied multiple times (The Nature Conservancy, 2000). Further research should be done to determine the effect of these treatments on other non-native grasses like pangola, as well as the potential effect on the soils, in particular the mycorrhizal component. Research and active application of these methods and other innovations continue to be applied on large-scale projects including one at the Disney Wilderness Preserve.

APPENDIX: SPECIES LIST AND DESIGNATOR

The following is a list of species found during this study. The key is as follows:

Short ID = Abbreviated identifier used in data collection

Class = Classification used to distinguish species into native, non-native, weedy or characteristic

Origin = Native or non-native

Type = Weedy, characteristic or aggressive

Nc = Native Characteristic of healthy flatwoods

Wn = Native that usually occurs after disturbance in healthy flatwoods but does not persist

Ew = Exotic, non-native weedy plant that does not usually spread beyond disturbed areas

Ea = Exotic, non-native aggressive plant that may invade healthy systems

Scientific name	Short ID	Class	Origin	Type
Acer rubrum	acerub	nc	n	c
Aletris lutea	alelut	nc	n	c
Amphicarpum muhlenbergianum	ampmuh	nc	n	c
Andropogon brachystachyus	andbra	nc	n	c
Andropogon glomeratus	andglo	nc	n	c
Andropogon glomeratus glaucopsis	andglogla	nc	n	c
Andropogon glomeratus hirsutior	andglohir	nc	n	c
Andropogon virginicus glaucus	andvirgla	nc	n	c
Andropogon virginicus virginicus	andvirvir	nc	n	c
Aristida beyrichiana	aribey	nc	n	c
Aristida purpurascens	aripur	nc	n	c
Aristida spiciformis	arispi	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Asimina reticulata	asiret	nc	n	c
Aster dumosus	astdum	nc	n	c
Aster reticulata	astret	nc	n	c
Aster subulatus	astsub	nc	n	c
Axonopus affinis	axoaff	nc	n	c
Axonopus compressus	axocom	nw	n	w
Axonopus furcatus	axofur	nc	n	c
Bacopa caroliniana	baccar	nc	n	c
Baccharis halimifolia	bachal	nc	n	c
Brachiaria subquadripara	brasub	ew	e	w
Buchnera americana	bucame	nc	n	c
Bulbostylis barbata	bulbar	ew	e	w
Bulbostylis ciliatifolia	bulcil	nc	n	c
Bulbostylis stenophylla	bulste	nc	n	c
Carex albolutescens	caralb	nc	n	c
Carphephorus corymbosus	carcor	nc	n	c
Carphephorus nova	carnov	nc	n	c
Carphephorus paniculatus	carpan	nc	n	c
Cassia obtusifolia	casobt	ew	e	w
Centella asiatica	cenasi	nc	n	c
Chamaecrista nictitans	chanic	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Chenopodium ambrosioides	cheamb	ew	e	w
Cirsium horridulum	cirhor	nw	n	w
Cirsium nuttallii	cirnut	nw	n	w
Commelina diffusa	comdif	nw	n	w
Commelina erecta	comere	nc	n	c
Commelina nigritiana	comnig	ew	e	w
Conyza canadensis	concan	nw	n	w
Crotonopsis linearis	crolin	nc	n	c
Crotalaria mucronata	cromuc	ew	e	w
Crotalaria rotundifolia	crorot	nc	n	c
Ctenium aromaticum	ctearo	nc	n	c
Cuphea carthagenensis	cupcar	ew	e	w
Cynodon dactylon	cyndac	ea	e	a
Cyperus brevifolius	cypbre	nw	n	w
Cyperus compressus	cypcom	nc	n	c
Cyperus globulosus	cypglo	nw	n	w
Cyperus polystachyos	cyppol	nw	n	w
Cyperus pumilus	cyppum	ew	e	w
Cyperus retrorsus	cypret	nw	n	w
Cyperus sesquiflorus	cypses	nw	n	w
Cyperus surinamensis	cypsur	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Desmodium incanum	desinc	nw	n	w
Desmodium triflorum	destri	ew	e	w
Digitaria ciliaris	digcil	ew	e	w
Digitaria decumbens	digdec	ew	e	w
Digitaria longifolia	diglon	ew	e	w
Digitaria serotina	digser	nw	n	w
Diodia virginiana	diovir	nc	n	c
Drymaria cordata	drycor	ew	e	w
Elephantopus elatus	eleela	nc	n	c
Eleusine indica	eleind	ew	e	w
Eleocharis nigrescens	elenig	nc	n	c
Eragrostis atrovirens	eraatr	ew	e	w
Eragrostis elliottii	eraell	nc	n	c
Eragrostis refracta	eraref	nc	n	c
Erechtites hieracifolia	erehie	nw	n	w
Eremochloa ophiuroides	ereoph	ew	e	w
Erigeron quercifolius	erique	nw	n	w
Erigeron vernus	eriver	nc	n	c
Eryngium baldwinii	erybal	nc	n	c
Eulophia alta	eulalt	nc	n	c
Eupatorium capillifolium	eupcap	nw	n	w

Scientific name	Short ID	Class	Origin	Type
Eupatorium rotundifolium	euprot	nc	n	c
Euthamia minor	eutmin	nc	n	c
Fimbristylis autumnalis	fimaut	nw	n	w
Fimbristylis dichotoma	fimdic	ew	e	w
Fimbristylis puberula	fimpub	nc	n	c
Fimbristylis schoenoides	fimsch	ew	e	w
Galactia elliottii	galell	nc	n	c
Galactia volubilis	galvol	nc	n	c
Gnaphalium falcatum	gnafal	nw	n	w
Gnaphalium pensylvanicum	gnapen	nw	n	w
Gratiola hispida	grahis	nc	n	c
Gratiola pilosa	grapil	nc	n	c
Hedyotis corymbosa	hedcor	ew	e	w
Hedyotis uniflora	heduni	nc	n	c
Helianthemum corymbosum	helcor	nc	n	c
Hydrocotyle umbellata	hydumb	nc	n	c
Hypericum cistifolium	hypcis	nc	n	c
Hypericum hypericoides	hyphyp	nc	n	c
Hypoxis juncea	hypjun	nc	n	c
Hypericum mutilum	hypmut	nc	n	c
Hypericum reductum	hypred	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Hypericum tetrapetalum	hyptet	nc	n	c
Ilex cassine	ilecas	nc	n	c
Indigofera hirsuta	indhir	ew	e	w
Iva microcephala	ivamic	nc	n	c
Juncus effusus	juneff	nc	n	c
Juncus marginatus	junmar	nc	n	c
Lachnocaulon anceps	lacanc	nc	n	c
Lactuca canadensis	laccan	nw	n	w
Lachnanthes caroliniana	laccar	nc	n	c
Lechea divaricata	lecdiv	nc	n	c
Lepidium virginicum	lepvir	nw	n	w
Lespedeza striata	lesstr	ew	e	w
Liatris laevigata	lialae	nc	n	c
Liatris spicata	liaspi	nc	n	c
Linaria canadensis	lincan	nw	n	w
Linum floridanum	linflo	nc	n	c
Lindernia grandiflora	lingra	nc	n	c
Lobelia glandulosa	lobgla	nc	n	c
Lolium perenne	lolper	ew	e	w
Ludwigia arcuata	ludarc	nc	n	c
Ludwigia maritima	ludmar	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Ludwigia octovalvis	ludoct	nw	n	w
Ludwigia peruviana	ludper	nw	n	w
Ludwigia repens	ludrep	nc	n	c
Ludwigia suffruticosa	ludsuf	nc	n	c
Ludwigia virgata	ludvir	nc	n	c
Lygodesmia aphylla	lygaph	nc	n	c
Lyonia fruticosa	lyofru	nc	n	c
Macroptilium lathyroides	maclat	ew	e	w
Magnolia virginiana	magvir	nc	n	c
Mollugo verticillata	molver	ew	e	w
Murdannia nudiflora	murnud	ew	e	w
Myrica cerifera	myrcer	nc	n	c
Nyssa sylvatica	nyssyl	nc	n	c
Oenothera laciniata	oenlac	nw	n	w
Oxalis stricta	oxastr	nw	n	w
Panicum anceps	pananc	nc	n	c
Panicum chamaelonche	pancha	nc	n	c
Panicum ciliatum	pancil	nc	n	c
Panicum dichotomiflorum	pandic	nc	n	c
Panicum hemitomon	panhem	nc	n	c
Panicum miliaceum	panmil	ew	e	w

Scientific name	Short ID	Class	Origin	Type
Panicum portoricense	panpor	nc	n	c
Panicum repens	panrep	ea	e	a
Paspalum acuminatum	pasacu	nw	n	w
Paspalum conjugatum	pascon	nw	n	w
Passiflora incarnata	pasinc	nc	n	c
Paspalum laeve	paslae	nc	n	c
Paspalum notatum	pasnot	ea	e	a
Paspalum setaceum	passet	nc	n	c
Phytolacca americana	phyame	nw	n	w
Physalis angulata	phyang	nw	n	w
Physalis arenicola	phyare	nc	n	c
Phyla nodiflora	phynod	nc	n	c
Physalis pubescens	phypub	nc	n	c
Pinus elliottii	pinell	nc	n	c
Pityopsis tracyi	pittra	nc	n	c
Plantago virginica	plavir	nw	n	w
Pluchea odorata	pluodo	nc	n	c
Pluchea rosea	pluros	nc	n	c
Polygonum hirsutum	polhir	nc	n	c
Polygonum hydropiperoides	polhyd	nc	n	c
Polygala lutea	pollut	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Polypremum procumbens	polpro	nc	n	c
Polygonum punctatum	polpun	nc	n	c
Portulaca amilis	porami	ew	e	w
Psilocarya nitens	psinit	nc	n	c
Pterocaulon virgatum	ptevir	nc	n	c
Ptilimnium capillaceum	pticap	nc	n	c
Quercus chapmanii	quecha	nc	n	c
Quercus laevis	quelae	nc	n	c
Quercus laurifolia	quelau	nc	n	c
Quercus minima	quemin	nc	n	c
Quercus myrtifolia	quemyr	nc	n	c
Quercus nigra	quenig	nc	n	c
Quercus pumila	quepum	nc	n	c
Quercus virginiana	quevir	nc	n	c
Rhexia nashii	rhenas	nc	n	c
Rhus copallina	rhucop	nc	n	c
Rhynchospora fascicularis	rhyfas	nc	n	c
Rhynchospora microcephala	rhymic	nc	n	c
Rhynchospora rariflora	rhyrar	nc	n	c
Rhynchelytrum repens	rhyrep	ew	e	w
Richardia brasiliensis	ricbra	ew	e	w

Scientific name	Short ID	Class	Origin	Type
Richardia scabra	ricsca	ew	e	w
Rotala ramosior	rotram	nc	n	c
Rubus cuneifolius	rubcun	nc	n	c
Rumex hastatulus	rumhas	nw	n	w
Sabatia grandiflora	sabgra	nc	n	c
Sabal palmetto	sabpal	nc	n	c
Sacciolepis indica	sacind	ew	e	w
Sacciolepis striata	sacstr	nc	n	c
Sambucus canadensis	samcan	nw	n	w
Schizachyrium scoparium	schsco	nc	n	c
Scleria baldwinii	sclbal	nc	n	c
Scleria ciliata	sclcil	nc	n	c
Scleria reticularis	sclret	nc	n	c
Scleria triglomerata	scltri	nc	n	c
Scoparia dulcis	scodul	nw	n	w
Serenoa repens	serrep	nc	n	c
Sesbania emerus	seseme	nw	n	w
Sesbania vesicaria	sesves	nw	n	w
Setaria geniculata	setgen	nc	n	c
Sida acuta	sidacu	nw	n	w
Sisyrinchium atlanticum	sisatl	nc	n	c

Scientific name	Short ID	Class	Origin	Type
Smilax laurifolia	smilau	nc	n	c
Solanum americanum	solame	nw	n	w
Solidago fistulosa	solfis	nc	n	c
Solidago stricta	solstr	nc	n	c
Solanum viarum	solvia	ew	e	w
Sorghastrum secundum	sorsec	nc	n	c
Sporobolus indicus	spoind	ew	e	w
Stillingia sylvatica	stisyl	nc	n	c
Tephrosia hispidula	tephis	nc	n	c
Trifolium repens	trirep	ew	e	w
Urtica chamaedryoides	urtcha	nw	n	w
Utricularia sp.	utrsp.	nc	n	c
Vaccinium corymbosum	vaccor	nc	n	c
Verbena brasiliensis	verbra	ew	e	w
Vitis aestivalis	vitaes	nc	n	c
Vitis rotundifolia	vitrot	nc	n	c
Woodwardia virginica	woovir	nc	n	c
Xyris jupicai	xyrjup	ew	e	w
Xyris platylepis	xyrpla	nc	n	c
Zea mays	zeamay	ew	e	w

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