FIRE IN WETLAND HABITATS: A 4-YEAR EVALUATION IN MARYLAND

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1. INTRODUCTION

In many ecosystems fire occurs naturally and is an integral process in habitats (Kozlowski and Ahlgren 1974, Wright and Bailey 1982). Several national wildlife refuges in the southeastern United States have used prescribed fire to effectively manage marsh habitats for wildlife (Givens 1962). Historically, the major objective of marsh burning was to provide more succulent food for waterfowl and fur bearing mammals (Lynch 1941, Lay and O'Neil 1942, Zontek 1966, Chabreck 1976, Hackney and de la Cruz 1981).

As a result of the 1988 Yellowstone fires, the Departments of Interior and Agriculture assembled a Fire Management Policy Review Team to recommend changes to fire management on public lands. These recommendations mandated that all national wildlife refuges with flammable vegetation revise their Fire Management Plans. The U. S. Fish and Wildlife Service (FWS) staff at Blackwater National Wildlife Refuge (NWR), in Dorchester County, Maryland, reviewed their Fire Management Plan in 1995 (Blackwater National Wildlife Refuge 1998). At the same time, the Maryland Department of Natural Resources (DNR), Division of Wildlife also reviewed their fire management program on Fishing Bay Wildlife Management Area (WMA). The two agencies jointly created an external panel to objectively review, evaluate, and revise the fire management plans for Blackwater NWR and Fishing Bay WMA. The panel was formed in 1995 and consisted of an interdisciplinary group of five individuals who developed fire management alternatives and recommendations.

In support of the panel's recommendations, we analyzed fire effects on vegetation above the soil surface. In 1998, we initiated a fire evaluation study on Blackwater NWR and Fishing Bay WMA to compare the vegetative response to two fire rotations and fire exclusion (Flores 2003). Our goal was to compare the effects of fire and fire exclusion on surface vegetation in wetland habitats.

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2. METHODS

Our study areas encompassed 738 ha of brackish marsh habitats. We examined cover, average height, biomass, and stem density at three areas on Blackwater NWR and three on Fishing Bay WMA. Each area had two treatment and two control sites for a total of 24 sites. Treatment 1 was the annual burn, treatment 2 was the 3-year burn, and control 1 and 2 were the no burn (fire exclusion) sites. Historical information on fire histories was not available for our sites; therefore, we burned all the treatment and control sites in 1998 to make them comparable to one another. Each site was divided into about 10 transects and three 1 m^2 plots were placed on each transect for a total of 30 plots per site. We sampled 720 plots each season (September-December) from 1998-2001. Each cover plot was marked with a fire resistant fiberglass post and we visually estimated the percentage of each plant within the plot for a total of 100%. Average height was measured in centimeters at each plot.

In addition, we sampled biomass and stem density data at the 24 sites. On each of the transects, one 0.25 m^2 plot was sampled. We randomly collected biomass samples from 240 plots each season and recorded the locations with a global positioning system. We dried the biomass samples to constant weight, and compared the dry weights among the treatment and control sites. We individually counted all the stems of each species to determine stem densities.

2.1 *Statistical analysis*

We used a split plot design to analyze the biomass and stem density data. However, for cover and average height, we used a split plot design with repeated measures in time (von Ende

2001). The data were not normally distributed and were log transformed. Proc MIXED was used in SAS with LSMeans and the Tukey test (SAS Institute 2000).

3. RESULTS

Overall, we found no differences among the treatment and control sites for percent cover. However, we found that 2000 had less cover than 2001 (Figure 1). We also found no difference among treatment and control sites for vegetation height. However, height was substantially shorter in 1999 than the other three years (Figure 2). Precipitation during the growing season in 1999 was only 18.9 cm compared to precipitation of 34.3 cm in 1998, 31.1 cm in 2000, and 50.6 cm in 2001. The differences we found among years may be related to the drought that occurred during the growing season in 1999.

Live biomass (excluding litter) was substantially greater among annual burn sites and control sites (Flores 2003). There was also greater live biomass in 1998 than in 1999-2001 (Figure 3). Stem density was markedly greater in the annual burn sites than the 3-year and control sites (Flores 2003). There was also greater stem density in 1998 than in 1999-2001 (Figure 4).

4. DISCUSSION

We found no significant difference for cover among treatment and control sites. Similarly, Davison and Bratton (1988) found that burned marsh vegetation cover in a freshwater cordgrass (*Spartina bakeri*) marsh resembled unburned marsh two years after a fire on Cumberland Island, Georgia. In contrast, a study by Mallik and Wein (1986) on *Typha* marshes in New Brunswick, Canada found that cover in drained marshes decreased after spring, summer, and autumn burns over a 3-year period. In the Gulf coast Chenier Plain, in southwestern Louisiana, a winter burn reduced percent cover immediately following the burn, but did not differ between burned and unburned areas the following year (Gabrey et al. 1999). In addition, the percentage of dead vegetation cover in burned plots was lower six months after a burn, but burned and unburned plots did not differ among burn treatments one and a half years later (Gabrey and Afton 2000). One possible reason our results may have differed slightly from other studies may be a factor of the methods we used to collect estimates of cover. Most of the studies used cover classes to categorize the percent cover of vegetation (Davison and Bratton 1988, Gabrey et al. 1999, Gabrey and Afton 2000). We visually estimated cover for all species using a m^2 plot with total cover equal to 100%. Our study may have differed from Mallik and Wein (1986) because their study took place on a drained marsh where the depth of burn may have been deeper which could affect plant cover. The brackish marshes in our study were not drained and often the soils were damp or even wet. Therefore, we may have found no differences in cover because only the vegetation on the surface of the marsh burned.

We found that overall average height was significantly shorter in 1999 than the other years, but there was no difference among treatment and control sites. In contrast, Vogl (1974) reported that in Florida marsh plants in burned areas were taller than plants in unburned areas. Conversely, plant height of *Typha* marshes in Canada decreased significantly following seasonal burns in a drained marsh (Mallik and Wein 1986). Perhaps our study findings differed from Mallik and Wein (1986) because we did not burn on a drained marsh which could result in a deeper burn. The shorter heights we found in 1999 may have resulted from the drought conditions during the summer growing season.

Because all treatment and control sites were initially burned in 1998, we suggest that fire may have promoted new vegetative growth that resulted in greater live biomass. Similarly, in a Florida wetland, Vogl (1974) found a significant increase in biomass on burned areas compared to unburned areas. Likewise, a study on the Texas coast revealed that burning significantly increased live gulf cordgrass (McAtee et al. 1979).

We found that treatment 1 (annual burns) resulted in significantly greater stem densities than the other treatment and control sites. Other researchers have also found that stem densities increased after burning. Thompson and Shay (1985) compared how different burn treatments affected shoot densities of *Phragmites australis*. They found that all burns had greater shoot densities than the control sites (Thompson and Shay 1985). Vogl (1974) compared burned and unburned areas and found that vegetative production was significantly greater in burned areas because of higher stem density in a Florida marsh. We found that 1998 had significantly greater stems than the other years. Our findings suggest that the prescribed burning of all sites in 1998 increased stem densities for all sites.

5. CONCLUSIONS

We found the annual burn and the 3-year burn sites did not differ from the control sites for overall percent cover and average height. Live biomass (excluding litter) was greater in annual burn sites and in 1998 after all sites were burned. Overall stem density was greater in annual burn treatment sites. The temporal effects could be mainly a factor of weather. We found that less precipitation during the growing season in 1999 had significant effects on cover, average height, and biomass. Based on our findings we recommend that burns be conducted approximately every one to two years if managers want to increase stem densities and live biomass.

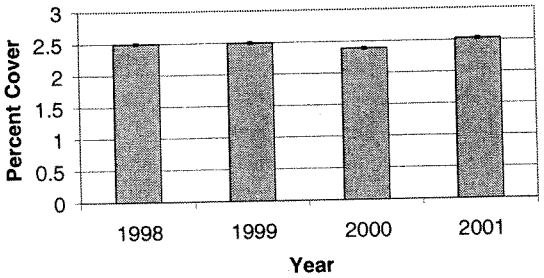

Fig 1. Average percent vegetative cover of all sites (N=24) by year at Blackwater NWR and Fishing Bay WMA, Dorchester County, Maryland 1998-2001.

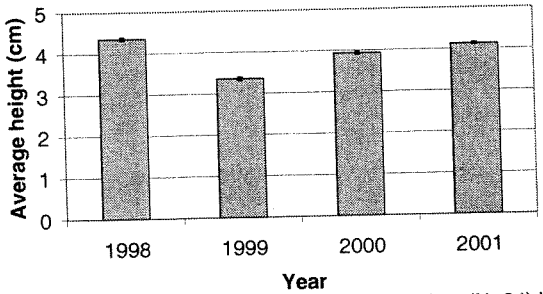

Fig 2. Average vegetative height of all sites (N=24) by year at Blackwater NWR and Fishing Bay WMA, Dorchester County, Maryland 1998-2001.

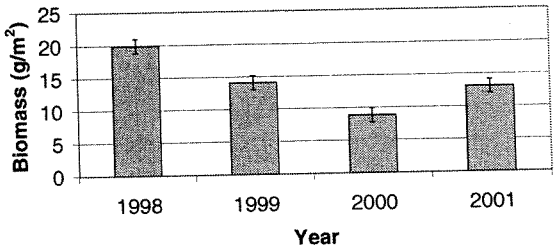

Fig 3. Average live biomass at all sites (N=24) by year at Blackwater NWR and Fishing Bay WMA, Dorchester County, Maryland 1998-2001.

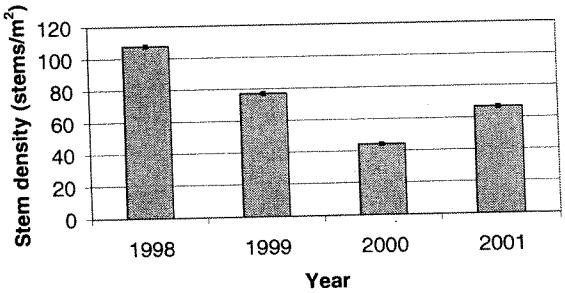

Fig 4. Average stem density of all sites (N=24) by year at Blackwater NWR and Fishing Bay WMA, Dorchester County, Maryland 1998-2001.

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