

Evaluation of vegetative response to fire exclusion and prescribed fire rotation on Blackwater National Wildlife Refuge and Fishing Bay Wildlife Management Area

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ABSTRACT:

Prescribed fire has been used to promote the growth of wetland vegetation and to enhance the long-term viability of wetlands. However, relatively little research has been conducted to quantify the effects of fire on marsh vegetation. The objectives of this study are to : 1) determine species composition and compare the species richness of vegetation in marsh habitats; 2) compare the vegetative response of 3 fire rotations and fire exclusion (no burn); and 3) compare vegetation sampling techniques, including ocular estimation, stem densities, and biomass. In 1998, we initiated a fire evaluation study on Blackwater National Wildlife Refuge (NWR) and Fishing Bay Wildlife Management Area (WMA) to compare the vegetative response of 3 fire rotations and fire exclusion at 6 sites. The 6 marsh sites were divided into 3 treatment areas: annual burns, three-five year burns, seven-ten year burns, and a control area (no burn or fire exclusion). Only results from the biomass and stem density in the treatment and control sites for 1998 and 1999 are reported. In 1998, we found no differences in biomass among the treatment and control sites ($F=0.03$, $P=0.8546$) with the average biomass of $656.6 \pm 37.9 \text{ g/m}^2$ at the treatment sites and $665.9 \pm 38.3 \text{ g/m}^2$ at the control sites. However, in 1999, we found a pronounced difference in biomass between the treatment and control sites ($F=4.27$, $P=0.0412$). The control sites (burned in 1998, but not in 1999) had a greater biomass with an average of $993.3 \pm 74.2 \text{ g/m}^2$ than the treatment sites with an average of $837.5 \pm 40.4 \text{ g/m}^2$. For stem densities we also found a difference between treatment and control sites in 1998 ($F=11.87$, $P=0.0008$). The treatment sites had significantly higher average stem densities at $4,832.1 \pm 370.9 \text{ stems/m}^2$ than the control sites at $3,138.7 \pm 365.9 \text{ stems/m}^2$. Similarly, in 1999, the treatment sites had higher average stem densities at $5,369.8 \pm 544.3 \text{ stems/m}^2$ than the control areas at $2,705.2 \pm 363.6 \text{ stems/m}^2$. We will analyze vegetative response by comparing species composition, percent cover, mean vegetative height, biomass, and stem density for 1998-2001 field seasons.

INTRODUCTION:

Vegetation has been recognized as one of the most important determinants of wildlife abundance and distribution (Anderson and Ohmart, 1986). Wildlife managers employ a variety of land management techniques to promote beneficial vegetation for wildlife habitat. One of these techniques is prescribed fire. Prescribed fire has been used in managing the wetlands of Blackwater NWR and nearby Fishing Bay WMA for over 60 years. Fire has been used to facilitate trapping of furbearing animals, to reduce the risk of loss of human life and property due to wildfires, and to stimulate the growth of vegetation. Prescribed fire has been viewed as a technique to promote the growth of wetland vegetation and to enhance the long-term viability of wetlands (Lynch, 1941).

OBJECTIVES:

1. Determine species composition and compare the species richness of marsh habitats.
2. Compare the vegetative response of 3 fire rotations and fire exclusion (no burn).
3. Compare vegetation sampling techniques including ocular estimation, stem densities, and biomass.

STUDY AREA:

Blackwater NWR is managed by the U.S. Fish and Wildlife Service and encompasses over 24,000 acres of tidal marsh, freshwater ponds, mixed conifer, and deciduous forests. Fishing Bay WMA, under the Maryland Department of Natural Resources, includes about 28,500 acres of tidal marsh. The elevation of our study areas was at or near sea level. Overall, we had 6 study areas, including 3 on Blackwater NWR (Areas 1, 2, and 3) and 3 on Fishing Bay WMA (Areas 4, 5, and 6). Areas 1, 5 and 6 were predominantly salt marsh habitats (higher salinities) and Areas 2, 3, and 4 were brackish marsh habitats (lower salinities). Areas 2 and 3 were dominated by *Schoenoplectus americanus* (chairmaker's bulrush or threesquare bulrush) and *Spartina alterniflora* (smooth cordgrass). *Spartina patens* (salt hay) and *Distichlis spicata* (salt grass) dominated areas 5 and 6. Areas 1 and 4 were the only areas with *Juncus roemerianus* (black needlerush). The 6 study areas had a variety of wetland vegetation including *Schoenoplectus americanus*, *Spartina patens*, *Distichlis spicata*, *Juncus roemerianus*, *Iva frutescens* (marsh elder), *Panicum virgatum* (switchgrass), *Spartina cynosuroides* (big cordgrass), and *Schoenoplectus robustus* (saltmarsh bulrush).

Treatment Areas

Each of the six marsh areas were divided into three treatment sites (Fig. 1):

- A - Annual burns
- B - 3-5 year burns
- C - 7-10 year burns
- D - No burn (fire exclusion)- control or reference sites

Prescribed burns were conducted on the annual burn treatment sites from January to March 1999.



Figure 1

METHODS:

Plot Selection Criteria for Percent Cover

- Each treatment site was assigned 10 transects, spaced equidistant from one another.
- All transects are oriented North to South.
- By randomization, 3 plots/transect were assigned to achieve 30-plots/treatment site.
- To prevent clustering, each plot was separated from the next plot by at least 50 meters.
- Each plot was placed at least 20 meters from water.
- Only plots with 50% vegetation cover were selected.
- Each plot was located and recorded using a Global Positioning System (GPS).
- Each plot was marked with a fire resistant fiberglass post.

Ocular Estimation of Cover

Plots were sampled during the growing season from late September to early December 1998 and 1999. At each plot, percent cover was estimated using a m^2 plot (total cover=100%) and average height of each species was recorded (Fig. 2). We sampled 30 plots/treatment site; 120 plots /study area.

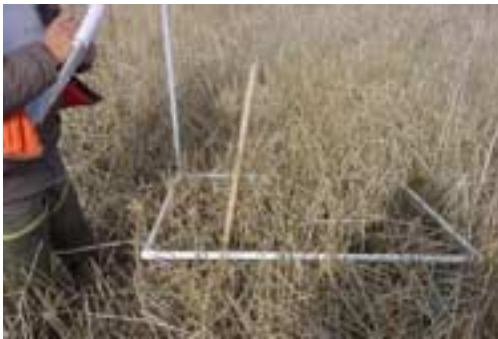


Figure 2



Figure 3

Biomass and Stem Densities

At a sub-sample of the plots (N=10/treatment site; 40 plots/study area), clippings from an area 50 cm x 50 cm ($1/4 m^2$) were taken (Fig. 3).

- Vegetation clippings were taken at a random point along each transect and recorded using GPS.
- Clippings were placed in a large plastic trash bag and labeled.
- Each evening the clippings were sorted by species and individual stems were counted, to calculate stem densities/species.
- The clippings were weighed to determine wet weight and then placed in a drying oven at 55° C.
- Clippings were dried until constant weight was achieved. Dry weights of each species were recorded to compare differences in biomass.

RESULTS:

Although our samples were collected in 0.25 m² plots, we converted our data to 1 m² plots for presentation of results and to facilitate comparison of our findings with similar studies. We found no differences in biomass among the treatment and control sites in 1998 (F=0.03, P=0.8546) with the average biomass of 656.6 ± 37.9 g/m² at the treatment sites and 665.9 ± 38.3 g/m² at the control sites. However, in 1999, we found a pronounced difference in biomass between the treatment and control sites (F=4.27, P=0.0412). The control sites (burned in 1998, but not in 1999) had a greater biomass with an average of 993.3 ± 74.2 g/m² than the treatment sites with an average of 837.5 ± 40.4 g/m². For stem densities we also found a difference between treatment and control sites in 1998 (F=11.87, P=0.0008). The treatment sites had significantly higher average stem densities at 4,832.1 ± 370.9 stems/m² than the control sites at 3,138.7 ± 365.9 stems/m². Similarly, in 1999, the treatment sites had higher average stem densities at 5,369.8 ± 544.3 stems/m² than the control areas at 2,705.2 ± 363.6 stems/m².

For certain wetland plant species there was a difference in biomass between treatment and control in 1999. *Distichlis spicata* (DISP), *Schoenoplectus americanus* (SCAM), and *Spartina patens* (SPPA) had significantly greater biomass in the treatment sites. *Juncus roemerianus* (JURO) and *Spartina alterniflora* (SPAL) showed no difference between treatment and control sites. For stem density the DISP, SCAM, and SPPA there was a difference between the treatment and control sites. Higher stem densities were observed in the treatment sites.

DISCUSSION:

Overall there was an increase in average biomass at our study areas from 1998 to 1999. We found that the control areas, which were not burned in 1999, had greater average biomass than the treatment areas which were burned. One possible explanation for the increase biomass difference in treatment and control areas is that the control sites had greater amounts of litter from the previous year (which did not burn), but were calculated in average biomass.



Other studies have also found that biomass is greater in unburned areas than burned areas. Ford and Grace (1998) found that total biomass was reduced by about one-third after burning in Louisiana. The biomass was significantly greater in unburned control areas than burned treatment areas in Mexico (Cabrera-Perez et al. 1992). Schmalzer et al. (1991) found that biomass was greater before an area was burned than after in Florida. Hackney and de la Cruz (1981) suggested that fire decreased total biomass in marshes in the Gulf Coast.

We found that the treatment sites in both 1998 and 1999 had greater stem densities than the control sites. Other researchers have also found that stem densities increased after burning. Chabreck (1982) found that stem densities of *Schoenoplectus americanus* (*Scirpus olneyi*) and *Spartina patens* increased after burning in Louisiana. Thompson and Shay (1984) found that burning increased total shoot densities in Canada. Vogl (1973) compared burned and unburned areas and found that vegetative production, including stem density, was significantly greater in burned areas in a Florida marsh.

Our results seem to indicate that annual burning increases the number of stems, but does not increase overall biomass. Initially, these results may appear contradictory. However, our findings support those of Thompson and Shay (1984) who also found that burned areas had higher densities of shorter and lighter vegetative shoots than unburned areas, resulting in higher stem densities, but less overall biomass.

For species response, we found that the DISP, SCAM, and SPPA all increased in both biomass and stem densities after burning. Our results support the findings of Chabreck (1982) who found that the stem densities of

SCAM and SPPA also increased after being burned. However, Ford (1996) found that fire had no significant effect on the percent cover of SCAM or SPPA.

We found no increase or decrease in either biomass or stem densities for JURO or SPAL. Turner (1987) found that net above-ground primary production of SPAL decreased after burning in Georgia. Schmalzer et al. (1991) found that JURO biomass was 47% less after burning than before burning.

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