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MARSH COMMUNITY DEVELOPMENT IN A CENTRAL FLORIDA PHOSPHATE SURFACE-MINED RECLAIMED WETLAND

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Abstract. As the nation's acreage of productive freshwater marsh/wetlands continues to decrease the need for successful marsh restoration/reclamation increases. A variety of land uses including surface mining, residential development and agriculture create direct impacts on wetlands often resulting in a net loss of habitat if appropriate restoration or reclamation of the ecosystem is not obtained within a reasonable period of time. The 30 hectare freshwater marsh reclaimed from a phosphate mined area is part of a 148 hectare upland, 61 hectare wetland ecosystem (Agrico Swamp) reclaimed in 1981/82. Topsoil additions have been a successful means of establishing a marsh system within the site. This technique shows distinct advantages over natural revegetation of overburden. At the end of two full growing seasons the topsoiled area has higher species richness and cover values than the overburden areas. During this period a slight decline in the species richness in the topsoiled area was evident due in part to the aggressive nature of *Pontederia cordata*. Conversely, the species richness of the overburden areas increased significantly. Topsoiling appears to encourage the accelerated establishment of late successional plants in sufficient quantities to compete with aggressive weedy species such as *Typha latifolia*.

INTRODUCTION

Freshwater marsh reclamation has been pursued in the central Florida phosphate mining area for several years especially through construction of wetlands (Clewell, 1981; Dunn and Best, 1983; Gilbert, 1979; Rushton, 1983; Best et al 1983; Best and Erwin, 1984; and Erwin et al, 1984). In most of these areas vegetation has been allowed to invade the wetland areas naturally which generally resulted in a *Typha* dominated ecosystem in a state of arrested succession (Dunn and Best 1983).

The purpose of monitoring the reclaimed marsh was to characterize vegetation found in two wetland areas (topsoiled and overburden) immediately and for several years after reclamation. Percent cover values and species richness were monitored since fall 1982. To determine if topsoiling with mulch can meet the reclamation goals of establishing late successional perennials as well as controlling aggressive weedy species (Dunn and Best, 1983). The overall goal of this study is to determine the optimal method of establishing high diversity, late successional marsh ecosystems immediately after mining and recontouring.

MATERIALS AND METHODS

The freshwater marsh created at Agrico Swamp used two restoration techniques which resulted in the establishment of two wetland habitats. The reclamation site was originally pine flatwoods and rangeland before it was mined in 1978 and 1979. Construction of the marsh was completed in May 1982. The area was surface mined in typical fashion and recontoured. One habitat was created by topsoiling with a 2 to 10 cm layers of mulch obtained from a wetlands borrow site. The mulch contained seed and root material from the native wetlands. The other habitat was created with overburden soils. This area was recontoured and allowed to revegetate naturally.

The project site, Agrico Swamp, is located adjacent to the flood plain of Payne Creek at Agrico's Fort Green Mine in southwest Polk County, Florida (Figure 1). The surface mined land was contoured so that all drainage in the project is from west to east. A levee constructed along the eastern boundary of the project impounds drainage from the 148 ha watershed to form wetlands at the design elevation. Two swale outlets were constructed in the levee to allow overflow discharge of water from Agrico Swamp into the Payne Creek flood plain. The elevation in Agrico Swamp along the base of the levee is 35.97 m MSL. The elevation rises gradually to 36.88 m MSL along the western boundary of the wetland and less gradually on westward across the upland portion of the project to 40.84 m MSL. A water budget for the project was developed to evaluate the disposition of storage, inflow, and outflow of water within the project area during a typical year (Erwin, 1984).

Ponds were constructed within the wetlands with bottom elevations of approximately 32.92 m MSL to maintain open water areas all year round. Small, shallow

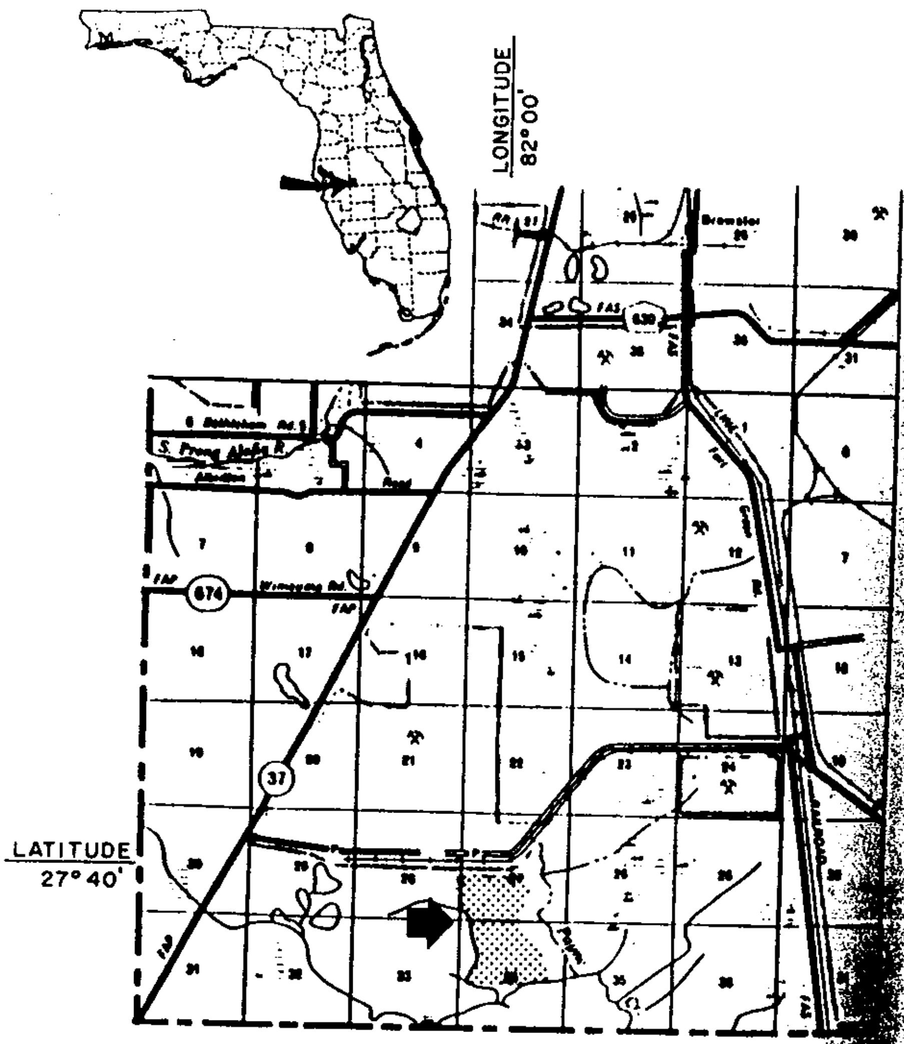

FIGURE 1 Location of study site in Florida. Insert shows location of site within the state.

depressions were constructed randomly throughout the fluctuating water zone to retain water and harbor fish populations during periods of low water. Two lakes were also constructed in the uplands which overflow via swales eastward into the wetlands.

Line intercept transects (Phillips 1959, Smith 1980) were used to compare vegetative cover of mulch topsoiled areas vs. overburden soil. The method consisted of observations on transects in the study area. Plant species touching, overlying, or underlying the line were recorded along with the distance that each species intercepted the line. In this way the line can be thought of as a two dimensional plane extending above and below the actual transect line. Individual intervals were totalled by species and by transect to yield estimates of percent cover. This method is adapted for measuring changes in vegetation across transitional zones, and transects can be randomly placed and replicated to obtain the desired precision (Smith 1980).

Six permanent line intercept transects were monitored in the Spring, Summer and Fall. Three transects were randomly located in mulch topsoiled areas and three transects are randomly located in areas of overburden soil. All transects started in the deep end of the littoral zone and run upslope to the wetland-upland interface. The three transects in the mulch topsoiled area total 391.7 m and the three transects in overburden areas total 275.5 m. The difference in total length of the two groups was due to slope differences in the random locations and wider littoral zone found in the mulch topsoiled area. The emergent zones averaged 210.3 m for the mulch topsoiled area and 91.4 m for the overburden area.

RESULTS AND DISCUSSION

The mulch topsoiled area contained higher species richness than the overburden area (Table 1). However, during fall 1983 and summer 1984 percent cover was higher for the overburden area than for the mulch area (Table 1). These differences are attributed to the invasion of the submerged aquatic *Najas quadalenpsis* in the shallow overburden area. *Najas* is one of the primary water fowl foods in Florida with all plant parts consumed, (Tarver et al, 1979).

TABLE 1. NUMBER OF MARSH SPECIES AND PERCENT COVER FOR MULCH (M) AND OVERBURDEN (O.B.) AREAS.

	NUMBER OF SPECIES		PERCENT COVER	
	M	O.B.	M	O.B.
FALL 1982	37	16	91	33
SPRING 1983	36	14	84	72
SUMMER 1983	34	24	105	83
FALL 1983	34	30	84	110
SPRING 1984	40	26	90	62
SUMMER 1984	48	26	72	76

Species richness and cover values generally increased during the study (Table 1) for the emergent zones. Percent cover trends for five wetland indicator species (Typha, Hydrocotyle, Panicum, Pontederia, and Polygonum) are depicted in Figures 2 and 3. The change in total linear feet occupied by these five species is shown in Figures 4 and 5.

For all six sampling periods the emergent zone of the mulch area has higher species richness and cover values than the overburden area. These results are similar to those reported by Shuey and Swanson (1979) and Clewell (1981).

During the first year of sampling the species richness declined in the mulched area from 37 to 34 species and increased in the overburden area from 16 to 30 species. Reporting this information as a rate indicates the mulch area changed -3 species per year while the overburden area changed +14 species per year. The negative rate of species change in the mulched area can be at least partially explained by the aggressive nature of Pontederia cordata. During the first year P. cordata increased in percent cover and total linear feet thereby increasing the area occupied along the transects during every sampling period, resulting in an increased domination in the mulched marsh.

Typha latifolia is also very aggressive but had to rely on natural dispersal mechanisms to arrive at the Agrico Swamp marsh. T latifolia was not a component of the wetlands borrow site. As a result T. latifolia lagged behind P. cordata (which was inoculated via mulch and planted in a few areas far outside the transects) in dominating its respective area (Figures 2 and 3). Hydrocotyle was first to invade the overburden site, followed by a mixture of annual and perennial herbs.

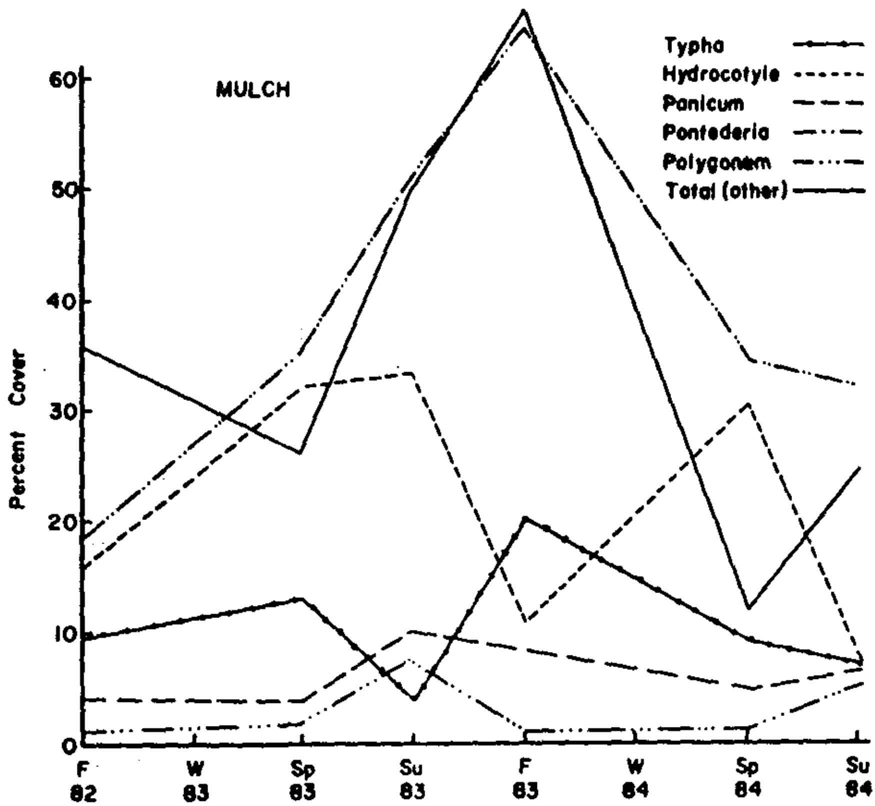

FIGURE 2 Seasonal change in percent cover of select herbaceous plants in mulch areas of Agrico Swamp.

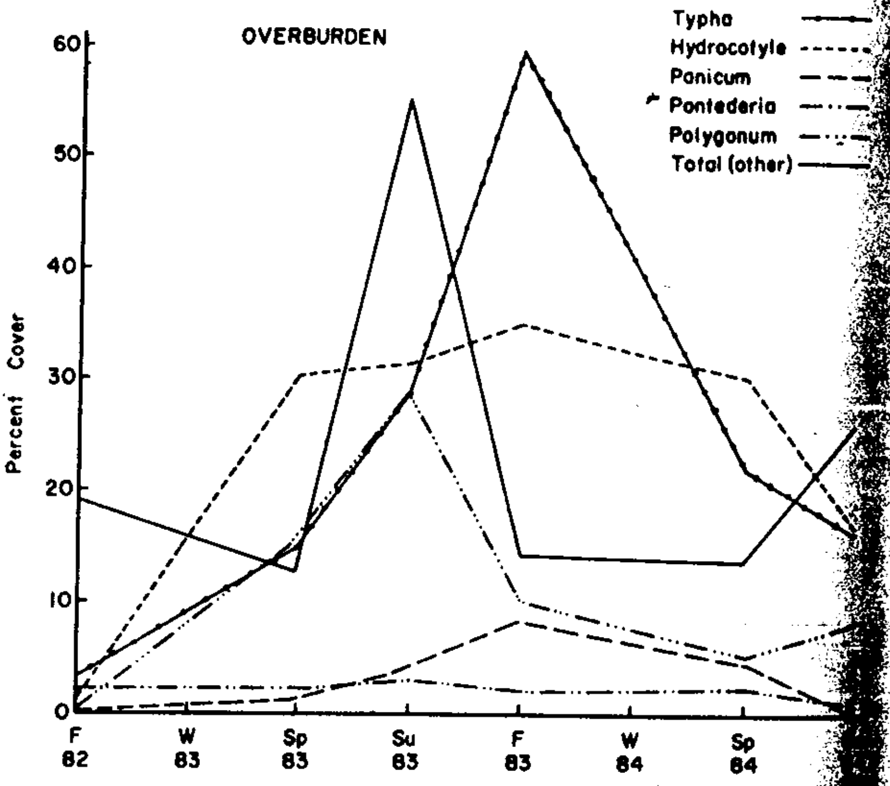

FIGURE 3 Seasonal change in percent cover of select herbaceous plants in non-mulched (overburden) areas of Agrico Swamp.

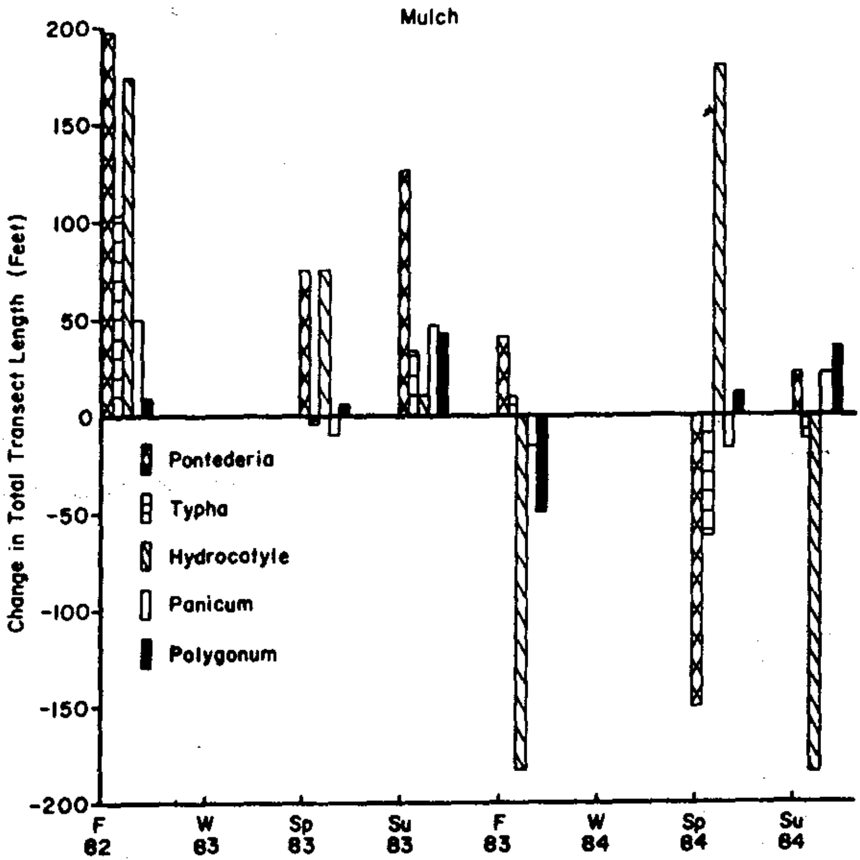

FIGURE 4 Cumulative seasonal change in total length along transect lines occupied by select herbaceous plants in mulched areas of Agrico Swamp.

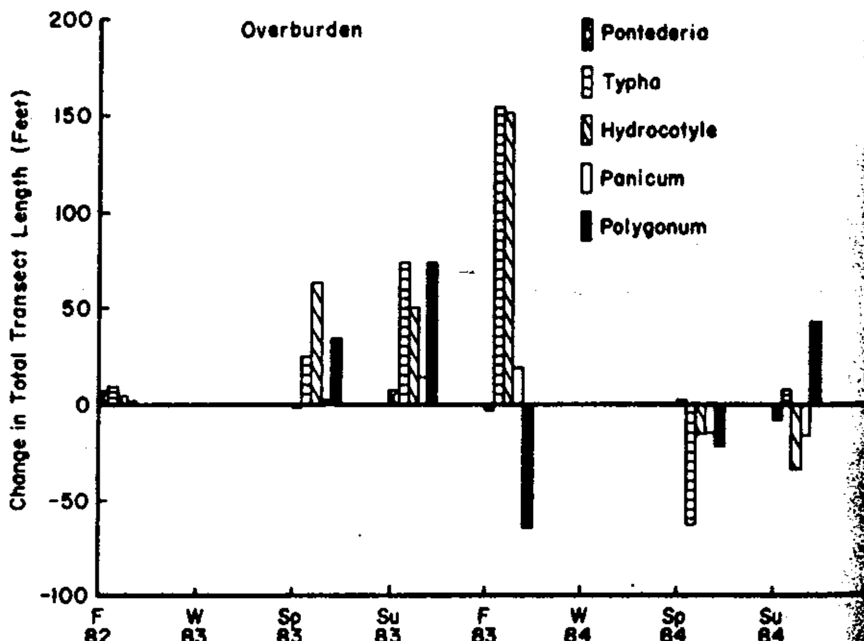

FIGURE 5 Cumulative seasonal change in total length along transect lines by select herbaceous plants in non-mucked (overburden) areas of Agrico Swamp.

before T. latifolia was present in sufficient quantities to exert a dominating influence in some of the overburden area (Figure 3). T. latifolia is apparently in a state of decline in the mulched areas. By the summer of the 1983 season the number of species in the mulch area decreased to 34 and the number of species in the overburden area increased to 24 (Table 1) (Erwin et al, 1984). Again, expressing this information as a rate, the mulched area decreased 3 species during the 1983 season whereas the overburden area increased 8 species during the same period. This corresponded with a decrease in cover values for each dominant species in the different wetland habitats (Figures 2 and 3). The severe winter of 1983-84 may be responsible for a decline in cover values. Species richness in the mulched areas from the summer of 1983 to the summer of the 1984 season increased to 48 species and in the overburden areas decreased to 26 species.

The key to marsh reclamation is to create wetlands that are well buffered against disturbances (Dunn and Best, 1983 and Erwin, et al, 1984). In a succession model presented by Connell and Slayter (1979), early successional species are just as resistant to invasion by competitors as late successional species, so the "climax" species of herbaceous wetlands may be those most resistant to being displaced or eliminated by disturbances. Further monitoring should determine if planting propagules is a successful mechanism for establishing P. cordata in marsh reclamation, and if a severe winter freeze is sufficient disturbance to cause a shift in species composition in portions of a marsh dominated by T. latifolia to a more diversified perennial ecosystem.

Additional study is needed to determine if direct seeding, sowing of propagules, and/or direct planting are sufficient to establish late successional plants in sufficient quantities to compete with agressive weedy species such as T. latifolia. Present data from this study suggests that supplemental planting of such species as P. cordata, assuming resources are available in sufficient quantities, at least partially meets the marsh reclamation goals, as suggested by (Dunn and Best, 1983), of achieving diverse, self-maintained wetlands. Another scenario currently being evaluated in the Agrico Swamp wetland is the apparent displacement of Typha by Scirpus sp., where the Scirpus has been planted within areas dominated by Typha. Cattails are apparently in a state of decline in the mulched areas.

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