HABITAT USE BY SELECTED SMALL MAMMALS OCCURRING IN SURFACE MINE CATTAIL MARSHES[1]

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Abstract.--Little information is available regarding the wildlife value of cattail marshes on surface mines. Small mammals may increase the value of reclaimed surface mines because they serve as major prey items for terrestrial and avian predators. Small mammals were sampled in 12 cattail marshes and on 12 nearby grassy comparison sites on surface mines. Six trap samples were conducted between October 1985 and April-May 1987 in Monongalia County, WV and Greene County, PA. A total of 157 _Peromyscus_ were captured during the study period. _Significantly_ ($p<.05$) greater numbers of _Peromyscus_ were taken in cattail marshes (111) than _on camparison_ sites (46). Breeding adults accounted for 30% of the marsh captures, compared to 26% of the _Peromyscus_ captured on nearby comparison sites. A _total of 76_ meadow voles were captured during the study period. Equal numbers of meadow voles were captured in cattail marshes and on comparison sites. However, breeding adults accounted for 32% of the marsh captures, compared to 15% of those meadow voles captured on comparison sites. This sampling demonstrated that cattail marshes provide additional small mammal habitat on surface mines, and that _Peromyscus_ prefer surface mine cattail marshes over _grassy comparison_ sites.

INTRODUCTION

McConnell and Samuel (1985) documented the use of surface mine cattail marshes by a variety of birds and small mammals. As a major prey item in the diets of many avian and terrestrial predators (Linduska 1950, Craighead and Craighead 1956, Dexter 1978, Hockman and Chapman 1983), small mammals increase the habitat value of reclaimed surface mines for such predators (Yearsley 1976, Mindell 1978, Forren 1981). They may therefore provide an index to the wildlife value of cattail marshes on reclaimed surface mines. The objective of this study was to determine the relative use of cattail drainages and grasslands by small mammals on reclaimed surface mines and lands affected by surface mining.

Acid mine drainage affects about 17,600 km of streams in the United States. A majority of those streams impacted by iron- and manganese-containing acid runoff occur in the Appalachian coal mining regions (National Research Council 1979). Such water can be chemically neutralized but recently circulation of acid drainage through natural and manmade wetland has been suggested (Kleinmann et al. 1983, Burris et al. 1984, Wieder and Lang 1984, Holm and Jones 1985, Girts and Kleinmann 1986).

Cattails have value in treating acid mine drainage (Snyder and Aharrah 1984, McConnell and Samuel 1985, Kleinmann 1987). Although there is also substantial evidence that Appalachian wetlands, including cattail marshes, have significant wildlife value

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(Evans and Wilson 1982, Udevitz and Michael 1982, Rewa 1984), little is known about the value of cattail marshes on surface mines. Cattail marshes are a naturally occurring by-product of surface coal-mining activities (Klimstra and Nawrot 1985). The opportunity now exists to incorporate cattail marsh construction into surface mine reclamation as a passive mine drainage treatment. The added value of enhancement to wildlife would encourage such a consideration.

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STUDY AREAS

Twelve cattail sites were located on mined lands or lands affected by surface mining in Monongalia County, WV and Greene County, PA. Twelve grassy sites (hereafter called comparison sites) were trapped for comparison purposes. Comparison sites were the same size and shape as the cattail sites to which they were compared and were selected to represent as closely as possible the environmental characteristics affecting each cattail site. Each comparison site was located at least 100 m from the cattail site to which it was compared.

There were six cattail sites and six comparison sites on King Knob Mine (Monongalia County, WV). They varied in size from .024-.10 hectaces and were mined prior to the Federal Surface Mining Control and Reclamation Act of 1977. There were two sites (.008 hectaces and .104 hectaces, respectively) located on the active Dippel and Dippel Mine in Monongalia County, WV. Two additional Monongalia County sites were .012 hectaces receiving runoff from a reclaimed mine upslope and a .068-hactare site located in an old sediment pond for a depp mine. In Greene County, two additional 0.1-hectare sites were selected from a 1.6-hectare rectangular cattail marsh. This area had never been mined, but received drainage from an unreclaimed surface mine.

Eight cattail sites and their respective comparison sites were bordered by deciduous woods on at least one side. Open areas of standing or running water were present in nine of the cattail sites at least part of the year. Ten of the cattail sites had cattail densities greater than 10 stems/m^2 and nine had densities greater than 13 stems/m^2. Vegetative cover was greater than 50% on nine of the comparison sites. Of these, three were mowed regularly.

METHODS

Small Mammal Census

Small mammals were sampled by the snap-trap removal method (Brower and Zar 1977) during October 1985, May, July, and October 1986, and April-May 1987 on all cattail and comparison sites. Additional sampling was conducted only in Greene County, PA during February 1987. A peanut butter and oatmeal mxiture was used as bait (Beer 1964). Initially, trapping stations were 10 m apart. This was changed to a 5-m^2 grid in July 1986 to increase capture probabilities. Three traps per station were monitored for three successive nights during each trapping period. The total number of traps set in the cattail marshes each trapping period varied with grid size and wetland water levels (i.e., fewer trap stations were available during flooded conditions). The number of traps set in comparison areas were adjusted accordingly.

Vegetative Cover

Cattail densities were calculated as the simple average of 10 randomly placed 1-m^2 plots in each cattail site. Herbaceous cover on the comparison sites was measured by ocular estimate.

Statistics

The small mammals captured in the present study do not represent a random sample, but rather a convenient sample taken within budgetary, time, and effort constraints. Captures from all sites in each treatment group were pooled by species to achieve a sufficient sample size for statistical application. The small sample sizes available and the inequality of numbers of animals captured at different sites create ambiguity as to the applicability of statistical testing. It may be hypothesized, however, that if a truly random sample were taken similar results would be achieved.

Wilcoxon's signed rank test for non-normal samples (Hollander and Wolfe 1973) was used to describe small mammal preferences for cattail drainages on surface mines. Insufficient sample size precluded the use of statistics to describe seasonal differences in habitat preferences. Only significant ($p < .10$) results are reported. Considering the assumption violations inherent in this sample, statistical inference is inappropriate. Significance is reported for descriptive purposes only, and trends will be discussed.

RESULTS AND DISCUSSION

General

A total of 76 meadow voles and 157 *Peromyscus* were captured during 6 trapping periods between October 1985 and April-May 1987 (table 1). Smaller numbers of short-tailed shrews (*Blarina brevicauda*), meadow jumping mice (*Zapus hudsonius*), and and house mice (*Mus musculus*) were also caught throughout the study period (table 2). Total small mammal captures over the study period were significantly ($p < .05$)

Table 1.--Number of meadow voles and *Peromyscus* caught during six trapping periods between October 1985 and April-May 1987.

	Number of Meadow Voles		Number of *Peromyscus*	
	Cattails	Comparison Sites	Cattails	Comparison Sites
Oct 1985	19	18	11	16
May 1986	1	2	6	6
Jul 1986	8	6	31	12
Oct 1986	6	5	46	11
Feb 1986	0	0	11	0
Apr-May 1987	4	7	6	1
TOTAL	38	38	111	46

Table 2.--Total numbers of short-tailed shrews, meadow jumping mice, and house mice captured during six trapping periods between October 1985 and April-May 1987.

	Cattail Sites	Comparison Sites
Short-tailed shrew	20	33
Meadow jumping mouse	5	5
House mouse	9	0
TOTALS	34	38

greater on cattail marshes than on comparison sites.

The number of meadow vole and *Peromyscus* captures in each period reflected a generally decreasing trend in trap success rates throughout the study period (table 3). This decreasing trend in trap success during the study period may reflect the cyclic nature of many small mammal populations (Krebs and Meyers 1974, Gunderson 1976, Wolff 1985a). Seasonal weather extremes may exacerbate cyclic trends. Environmental stresses may also participate in reducing small mammal populations. In a concurrent study (Amrani 1987) it was found that iron levels in the tissues of some small mammals are correlated with iron levels in soil samples taken from capture sites. Iron absorption, retention, and toxicity are age-related (Gruden 1986, Klassen et al. 1986), increasing with decreasing age. Increased susceptibility of subadults to metal toxicity could have serious impacts on population structure.

Peromyscus

Peromyscus captures in cattail marshes totalled 111, compared with 46 captures on comparison sites (table 1). Significant differences ($p < .05$) between habitat types occurred during all trapping periods except October 1985, a period of peak *Peromyscus* densities during this study. In *all cases* preference was shown for cattail sites.

Mindell (1978) reported that small mammal densities on reclaimed surface mines were positively correlated with percent of vegetative cover. Less than 50% vegetative cover on three of the twelve comparison sites may have decreased use of comparison sites. Mowing practices reduced vegetative cover on three additional comparison sites. *Peromyscus* using habitat with little vegetative cover would be easy targets for predators occupying reclaimed surface mines (Yearsley 1976, Mindell 1978, Forren 1981). This was a good possibility on the Greene County sites where there was an active fox den throughout the study

Table 3.--Trap success rates (no./100 trap nights) for meadow voles and *Peromyscus* caught during the six trapping periods between October 1985 and April-May 1987.

	Meadow Voles		Peromyscus	
	Cattails	Comparison Sites	Cattails	Comparison Sites
Oct 1985	.051	.048	.030	.0430
May 1986	.003	.006	.019	.0170
Jul 1986	.005	.003	.018	.0070
Oct 1986	.003	.003	.025	.0060
Feb 1986	--	--	.025	.0000
Apr-May 1987	.002	.004	.003	.0005

period.

Eight of the cattail marshes and their comparison sites were adjacent to wooded areas. All of these were within home range estimates reported for *Peromyscus* (Blair 1940, Wolff 1985b). There were no observable differences between amount of woodland perimeter around cattail and comparison sites. McConnell and Samuel (1985) suggested that deer mice moved into cattail marshes from adjacent woodlands. They reported no similar movement into grass-legume fields. White-footed mice occupying adjacent woodlands may be attracted to the vertical structure of cattail sites (Sheppe 1966, Barry et al. 1984).

Cattail marshes may also provide small mammals a protective microclimate. The thermoneutral zones of *Peromyscus* are very narrow. A milder, moister habitat may mitigate thermo-regulatory and water regulation requirements of *Peromyscus* (Hill 1983, MacMillen 1983).

Subadults accounted for only 8% of all *Peromyscus* captured in cattails from May 1986 to April-May 1987 compared to 20% on comparison sites during the same period (table 4). Linduska (1950) reported 95% of all *Peromyscus* examined in October-November were subadults. During October 1986, 10% of all *Peromyscus* captured in cattail marshes were subadults, compared to 66% on comparison sites. Burt (1940) reported that 51 of 154 young white-footed mice moved between 100 and 900 yds from the place of first capture. Considering the small size of many of the cattail sites in this study, it is possible that subadults dispersed from cattail marshes into adjacent grasslands thereby inflating the number of subadults on comparison sites.

Breeding adults accounted for 30% of all captures on cattail sites compared to 26% on the comparison sites during this period (table 5). However, only one breeding adult from the comparison sample was female, compared with ten from the cattail sample. Linduska (1950) reported 40% of adult female *Peromyscus* examined in October-November to be in breeding condition. It is therefore apparent that *Peromyscus* were using cattail marshes as breeding habitat.

Meadow Voles

Total numbers of meadow voles captured on cattail sites equaled total numbers captured on comparison sites (table 1). No significant differences were found between habitat types during any trapping period. This is not surprising since meadow voles are reported to inhabit lush grassy fields, as well as marshes, swamps, and woodland glades (Whitaker 1980).

McConnell and Samuel (1985) found no differences in meadow vole captures on cattail and grass-legume sites during July 1984. However, they reported increased meadow vole densities in cattail marshes on surface mines during the spring and autumn of that year. Their study was conducted during a period of low annual rainfall (D.E. Samuel, personal communication). Udevitz and Michael (1982) found significantly ($p < .05$) more meadow voles on cattails sites than in the uplands during the summer, but no difference the previous summer. Weather conditions were not reported.

The advantages of protective microhabitat discussed above apply equally well to meadow voles. It is possible that an ameliorating microclimate may increase meadow vole densities in marshes during weather extremes (McConnell and Samuel 1985). Cattail marshes may provide little microclimate advantage during extremely dry summer months when water sources dissipate.

Table 4.--Demographic characteristics of Peromyscus caught in cattail marshes and on comparison sites during five trapping periods from May 1986 to April-May 1987.

	Subadult		Adult		Undetermined
	Male	Female	Male	Female	
			CATTAILS		
May 1986	1	2	2	3	0
Jul 1986	0	0	15	9	7
Oct 1986	1	3	20	19	4
Feb 1986	0	0	5	6	0
April-May 1987	1	0	1	0	0
TOTALS	3	5	43	38	11
			COMPARISON SITES		
May 1986	1	0	1	2	0
Jul 1986	1	0	6	5	0
Oct 1986	2	2	3	3	0
Feb 1986	0	0	0	0	0
April-May 1987	0	0	3	1	0
TOTALS	4	2	13	11	0

Table 5.--Number of breeding adult *Peromyscus* caught in cattail marshes and on comparison sites during five trapping periods from May 1986 to Apirl-May 1987.

	Cattails		Comparison Sites	
	Male	Female	Male	Female
May 1986	0	0	0	0
Jul 1986	15	0	6	1
Oct 1986	3	7	0	0
Feb 1987[a]	0	0	-	-
April-May 1987	2	3	1	0
TOTALS	20	10	7	1

[a] No *Peromyscus* were caught on grasslands during this period.

Table 6.--Demographic characteristics of meadow voles caught in cattail marshes and on comparison sites during five trapping periods from May 1986 to April-May 1987.

	Subadult		Adult		Undetermined
	Male	Female	Male	Female	
			CATTAILS		
May 1986	0	0	1	0	0
Jul 1986	0	0	3	3	0
Oct 1986	0	2	2	2	2
Feb 1987	0	0	0	0	0
April-May 1987	0	1	0	3	0
TOTALS	0	3	6	8	2
			COMPARISON SITES		
May 1986	1	0	1	0	0
Jul 1986	0	2	2	4	0
Oct 1986	0	2	1	1	0
Feb 1987	0	0	0	0	0
April-May 1987	1	0	3	1	0
TOTALS	2	4	7	6	0

Table 7.--Number of breeding adult meadow voles caught in cattail marshes and on comparison sites during five trapping periods from May 1986 to April-May 1987.

	Cattails		Comparison Sites	
	Male	Female	Male	Female
May 1986	1	0	0	0
Jul 1986	2	2	0	1
Oct 1986	0	1	0	0
Feb 1987[a]	-	-	-	-
April-May 1987	0	0	0	2
TOTALS	3	3	0	3

[a]No meadow voles were caught during this period.

This may explain inconsistencies in summer meadow vole densities in cattails during different years.

Subadult meadow voles on cattail sites accounted for 16% of marsh captures, compared with 10% on comparison sites (table 6). Breeding adult voles accounted for 32% of the marsh captures and 15% of the captures on comparison sites (table 7). All breeding adults from comparison sites were female. Sexes were equally divided among breeding adults in cattail marshes.

Cattail marshes green up earlier in the spring, often remain moist and productive during dry summer months, and are not subject to regular mowing schedules. The additional food available in highly productive marsh habitat may favorably influence the demographic characteristics of meadow vole populations. Desy and Thompson (1983) reported greater numbers of breeding adults on sites artificially supplemented with additional food (high proteinPurina mouse chow) than on controls. They also reported larger numbers of juvenile voles during autumn on food-supplemented sites.

CONCLUSIONS

Cattail marshes on surface mines provide additional habitat for meadow voles. Reproductive parameters are higher for meadow voles caught in cattail marshes than for those from grassy comparison sites. *Peromyscus* prefer cattail habitats on surface mines over grassy areas. Marshes adjacent to woodlands provide additional vertical structure and overhead cover. *Peromyscus* use cattails as breeding habitat. Additional investigations may conclude that cattails are used preferrentially for breeding.

Marshes provide a moist, moderate microclimate which enhances productivity. High food availability, good vegetative cover, and a protective microhabitat create a suitable environment for small mammal populations.

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