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NATURAL HISTORY
SURVEY



CENTER FOR WILDLIFE ECOLOGY

HABITAT USE BY SMALL MAMMALS IN AN INTENSIVELY
MANAGED GRASSLAND WILDLIFE SANCTUARY

FINAL REPORT FOR FY 97
First two years of 3-5 year project

ILLINOIS WILDLIFE PRESERVATION FUND

Prepared by:

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**HABITAT USE BY SMALL MAMMALS IN AN INTENSIVELY MANAGED GRASSLAND
WILDLIFE SANCTUARY**

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BACKGROUND and JUSTIFICATION

The Short-eared Owl (*Asio flammeus*) and the Northern Harrier (*Circus cyaneus*) are listed as endangered in Illinois (IESPB 1992). Both species of raptor have become regular winter residents at the Prairie Chicken Sanctuary in Jasper Co., and have recently been observed nesting there in the spring. Apparently, management practices implemented to benefit the endangered Greater Prairie Chicken (*Tympanuchus cupido*) have benefitted these endangered raptors and other species of grassland-associated birds as well.

Small mammals constitute the major prey items for Short-eared Owls and Northern Harriers (Colvin and Spaulding 1983, Collopy and Bildstein 1987). Analysis of contents of pellets indicates that this is true at the Prairie Chicken Sanctuary, where voles and bog lemmings constitute the majority of prey items (J. Walk, pers. comm.). An abundant supply of diurnal and crepuscular small mammals, in addition to extensive areas of grassland and wetland habitat suitable for roosting and nest sites, is necessary for successful overwintering or nesting of these raptors. Management practices at the Sanctuary such as the planting and maintenance of blocks of different types of vegetation undoubtedly affect the dispersion, abundance, and productivity of populations of small mammals (e.g., Getz 1985). Further, many species of small mammal exhibit pronounced annual or multiannual fluctuations in abundance (Taitt and Krebs 1985). Some habitat types may be important refuge areas for small mammals during population lows, and provide a ready source of colonists for vacant habitats during population increases.

The purpose of this study is to examine differences in species composition and abundances of small mammals inhabiting four major types of vegetation maintained at the Prairie Chicken Sanctuary:

brome fields (*Bromus inermis*), red top fields (*Agrostis alba*), native prairie restorations, and fields lightly seeded with legumes and left weedy to provide brood cover. Abundance of small mammals in each habitat type will be monitored over 4-5 years to determine how habitat types differ in species composition and productivity of small mammals, and if any habitat type is a critical refuge area for small mammals during annual or multiannual population lows. This information will help managers maintain a mix of habitat types that best assures an adequate supply of small mammals as a prey base for raptors when they manipulate habitat to maximize production and survival of Greater Prairie Chickens.

STUDY AREA

The Prairie Chicken Sanctuary in Jasper Co., Illinois, was established in the early 1960's to preserve and maintain grassland habitat for nesting, brood cover, foraging areas, and roosting sites for the Greater Prairie Chicken. The Sanctuary now includes 2,396 acres of intensively managed grassland, and is the second largest state-managed grassland in Illinois. The Sanctuary also provides habitat for 27 species of vertebrates of special concern (i.e., species recorded so far at the site): 13 State Endangered Species, 5 State Threatened Species, 4 species on the state watch list, and 5 area-sensitive species (S. Simpson and T. Esker, pers. comm.). Management goals for the Sanctuary are expanding from single-species management to grassland-ecosystem management, thus including concern for all endangered and threatened species recorded at the site while maintaining preservation of the Greater Prairie Chicken as the top priority. Annual surveys record numbers of overwintering and nesting Short-eared Owls and Northern Harriers, and recent studies have evaluated habitat use by these species for communal roost and nest sites, for example (J. Walk, pers. comm.).

METHODS

Small mammals will be surveyed in four habitat types: restored native prairie vegetation, brome fields, red top fields, and legume/weed fields. Three replicates of each habitat type will be surveyed, one in each of three separate management tracts (Donnelly, Donsbach/McCormick, and Marshall, Fig. 1), for a total of 12 study fields. Surveys will be conducted in the fall (late Sept./Oct. – just prior to arrival of

overwintering raptors) and spring (March - just prior to nesting season for raptors and chickens). Each study field (ca. 10 acres) will be live-trapped for three nights and days in each survey, using Sherman live traps. Live traps will be spaced 10 m apart in three parallel lines spaced ca. 20 m apart, for a total of 100 traps (300 trap-nights) per study field. Data collected from each small mammal captured will include species, weight, sex, approximate age (adult or juvenile), and reproductive condition. All small mammals will be individually marked by fur-clipping so that an index of abundance for each study plot can be made. Other management activities such as mowing and burning that could affect small mammal populations on each study field will be recorded. As the database develops, it also may be possible to evaluate any short-term effects of these other management practices on small mammal populations.

RESULTS AND DISCUSSION

Four surveys have been conducted to date. Two were conducted using personal funds (21 October - 1 November 1995, 11-17 March 1996), and two were supported by the Illinois Wildlife Preservation Fund (25 October - 1 November 1996, 21-29 March 1997). A total of 1,418 small mammals was captured during these surveys: 964 prairie voles (*Microtus ochrogaster*), 36 meadow voles (*Microtus pennsylvanicus*), 67 southern bog lemmings (*Synaptomys cooperi*), 218 deer mice (*Peromyscus maniculatus*), 102 house mice (*Mus musculus*), 24 least shrews (*Cryptotis parva*), and 1 southern short-tailed shrew (*Blarina carolinensis*). The records of meadow voles are noteworthy because this species has not been reported from as far south as Jasper Co. (Hoffmeister 1989), and these records may be a range extension. Because meadow voles and prairie voles can sometimes be difficult to distinguish, three presumptive meadow voles were collected in spring 1997. These specimens will be prepared as museum specimens and their teeth will be examined to confirm their identification.

Numbers of small mammals captured fluctuated among surveys (Fig. 2). Prairie voles were the most abundant species by far in all surveys. It is premature to draw conclusions about patterns of population dynamics from only two years of data, but voles at the Prairie Chicken Sanctuary may not show the peaks and crashes reported for many populations. Numbers of deer mice were relatively similar among surveys. House mice were common in the first two surveys, but declined considerably by fall 1996.

Shrews were generally uncommon, and also seemed to decline in the second year of the surveys. In general, small mammal abundance was higher in the spring than the fall.

Detailed analyses must wait for additional data (4-5 years of surveys will be conducted). At present, no clear pattern of habitat use emerges when total numbers of small mammals in each study plot are examined (Table 1), but there are some interesting trends among species (Table 2).

Brome fields tend to have fewer small mammals in general than other habitat types. The brome field has become a dense monoculture in the Marshall tract, and this field had few small mammals in most surveys. However, where other vegetation is mixed in with the brome as in the field surveyed in the Donnelly tract, small mammals can be abundant (Table 1). Small mammals in brome fields were predominantly microtine rodents (voles and bog lemmings). Red top fields consistently contained moderately high abundances of small mammals (Table 1). Again, red top fields were dominated by microtine rodents (Table 2).

The prairie fields and weed fields varied considerably among the three study tracts. Numbers and species of small mammals probably reflect differences in the quality of vegetation in each field. Although the study plots were selected to represent distinct types of vegetation, they still differed in many ways. The prairie plot in the Donnelly tract was dominated by tough, mature hummocks of big blue stem, for example, and had few voles. The prairie plot in the Marshall tract was also dominated by big blue stem, but had a diversity of other vegetation and many more small mammals (Table 1). Two of the weed plots had good ground cover in addition to the legumes and weeds (Donnelly, Donsbach/McCormick tracts); these plots regularly had high numbers of small mammals. The third weed plot (Marshall tract) had little ground cover, and this plot had few microtine rodents but more deer mice and house mice (Table 2). In general, deer mice and house mice occurred most frequently in the prairie and weed fields.

Because microtine rodents are the most important diet items for the raptors at the Prairie Chicken Sanctuary, numbers of microtines were examined separately (Figs. 3-5). Microtines were abundant wherever there was both good ground cover and a diversity of vegetation (grass and dicots). In the Donnelly tract, microtines were most abundant in the weed field and brome field; in the Donsbach /McCormick tract, they were most abundant in the weed and red top fields; and in the Marshall tract, they

were most abundant red top and prairie fields. Microtines were least common where brome had become a dense monoculture or stands of big blue stem had become dense, tough, and coarse. If these patterns are maintained over time, then the current mix of habitat types seems to be doing a good job of maintaining a relatively stable vole population. This would be unusual, as voles in other areas of central Illinois show multiannual population cycles where peak years are followed by population crashes and several years of low abundance. It will be interesting to see if vole numbers remain stable over several years.

Three plots were burned just prior to the surveys in spring 1997. Two of these plots (Donnelly red top and Marshall prairie) had been very productive of microtine rodents before the burn, whereas one plot (Donnelly prairie) had few microtines. At the time of the spring 1997 surveys, all three plots were still blackened from the burn, and the remaining charred vegetation was only ca. 10-20 cm tall. Deer mice were captured on all three plots, but voles only occurred on the margins of one plot (Marshall prairie) where roadside ditches still provided dense and rich unburned ground cover. These plots will continue to be monitored over the next few surveys to determine how quickly vole populations return to their former levels. Slow recovery would suggest that burns be scattered around the sanctuary, allowing recolonization of recovering plots by immigration from adjacent unburned areas, rather than concentrated in a local area. The rate of recovery will also suggest a good time interval to delay before between burns of adjacent plots.

As data accumulate, seasonal patterns in habitat use will be examined more closely. If population density declines, the types of habitat that provide critical refuges for populations during years of low numbers (greatest population stability over time, habitats where small mammals are still found during population lows when they may become locally extirpated in many areas) will be identified. These data will be useful to help assure a stable and abundant prey base for overwintering and nesting raptors.

Although the data collected so far suggest that the intensive management practices at the sanctuary are creating a particularly productive environment for small mammals, monitoring will be maintained for 3-5 years (the typical length of a "vole cycle") to better establish the pattern of population dynamics. Further, although there is considerable variation among plots of "similar" habitat that adds noise to the analysis, some plots consistently perform better than others. These results are clearly related to the density and complexity of the vegetative cover on these plots; this relationship will be explored in more detail when

data are rigorously analyzed at the end of the study. A trend seems to be emerging, however, where red-top and legume/weed fields (provided there is ample ground cover) are generally the most productive of voles and bog lemmings. Brome fields can also support high densities of microtines, but only when they also contain a mix of other vegetation. Plots with sparse ground cover (e.g., the Marshall weed plot) support primarily deer mice and house mice, which are not the primary prey for raptors at the sanctuary.

REFERENCES

- Collopy, M.W., and K. L. Bildstein. 1987. Foraging behavior of northern harriers wintering in southeastern salt and freshwater marshes. *Auk* 104:11-16.
- Colvin, B.A., and S. R. Spaulding. 1983. Winter foraging behavior of short-eared owls (*asio flammeus*) in Ohio. *Amer. Midl. Nat.* 110:124-128.
- Illinois Endangered Species Protection Board, (J. Herkert, ed.). 1992. Endangered and threatened species of Illinois: status and distribution. Vol. 2. 142 pp.
- Getz, L.L. 1985. Habitats. Pp. 286-309 in *Biology of New World Microtus* (R. H. Tamarin, ed.). Spec. Publ. 8, Amer. Soc. Mammal., 893 pp.
- Hoffmeister, D.F. 1989. *Mammals of Illinois*. University of Illinois Press, Champaign, IL. 348 pp.
- Taitt, M. J., and C. J. Krebs. 1985. Population dynamics and cycles. Pp. 567-620 in *Biology of New World Microtus* (R. H. Tamarin, ed.). Spec. Publ. 8, Amer. Soc. Mammal., 893 pp.

Survey and habitat type	Donnelly plots	Marshall plots	Donsbach plots	Total for all 3 tracts
Fall 1995				
Brome	15	5	20	40
Red-top	29	18	40	88
Prairie	17	41	12	69
Legume/weed	25	27	37	89 (286 total)
Spring 1996				
Brome	45	26	13	84
Red-top	24	33	44	101
Prairie	21	75	35	131
Legume/weed	71	37	109	217 (533 total)
Fall 1996				
Brome	20	9	8	37
Red-top	25	25	13	63
Prairie	30	24	3	57
Legume/weed	21	25	26	72 (229 total)
Spring 1997				
Brome	65	11	27	103
Red-top	6*	61	35	102
Prairie	8*	20*	39	67
Legume/weed	51	16	31	98 (370 total)

*burned plots

Table 1. Numbers of small mammals captured in different habitat types

Table 2. Numbers of each species captured in different habitat types.

Survey and habitat type	M. ochr.	M. penn.	S. coop.	P. manic.	M. mus.	C. parva	B. brev.
Fall 1995							
Brome	21	0	1	5	9	4	0
Red-top	56	4	1	11	13	2	0
Prairie	20	1	3	24	20	1	0
Legume/weed	39	0	0	21	28	1	0
Spring 1996							
Brome	62	2	10	3	1	6	0
Red-top	84	0	10	3	0	4	0
Prairie	109	3	7	6	2	4	0
Legume/weed	170	2	0	24	20	0	1
Fall 1996							
Brome	16	0	0	4	0	0	0
Red-top	21	1	0	3	0	0	0
Prairie	17	0	0	4	0	0	0
Legume/weed	4	0	10	15	1	0	0
Spring 1997							
Brome	80	6	13	4	0	0	0
Red-top*	84	7	3	7	0	1	0
Prairie**	35	2	3	27	0	0	0
Legume/weed	61	3	5	37	1	0	0

*includes 1 burned plot

**includes 2 burned plots

Species names: M. ochr. *Microtus ochrogaster*, Prairie vole
M. penn. *Microtus pennsylvanicus*, Meadow vole
S. coop. *Synaptomys cooperi*, Southern bog lemming
P. manic. *Peromyscus maniculatus*, Deer mouse
M. mus. *Mus musculus*, House mouse
C. parva *Cryptotis parva*, Least shrew
B. brev. *Blarina brevicauda*, Northern short-tailed shrew

Figure legends



Fig. 1.—Map of the Prairie Chicken Sanctuary, Jasper County, Illinois, showing locations of three study sites: Donnelly tract (9), Donsbach/McCormick tract (16 and 6), Marshall tract (10). Map prepared by staff of Illinois Department of Natural Resources.

Fig. 2.—Numbers of each species of small mammal captured in the four surveys.

Figs. 3-5.—Numbers of microtine rodents (prairie voles, meadow voles, and southern bog lemmings) on each study plot. Fig. 3: Donnelly tract. Fig. 4: Donsbach/McCormick tract. Fig. 5: Marshall tract.

PRAIRIE CHICKEN SANCTUARIES, JASPER COUNTY

Ownership or Lease By:

	Illinois Department of Conservation	767 acres
	The Nature Conservancy	594 acres

TOTAL 1,361 acres

1. Ralph Yeatter, 77 acres
2. Max McGraw, 20 acres
3. Donnelley Brothers, West 60 acres
4. Cyrus H. Mark, 17 acres
5. Jamerson McCormack, 80 acres
6. Mr. and Mrs. Chauncey McCormick, 140 acres

* Grassland Wildlife Ecology Lab.

- STUDY SITES:
7. Cyrus H. Mark, 40 acres
 8. Stuart H. Otis, 58 acres

TRACT 1 9. Donnelley Brothers, East 60 acres

TRACT 2 10. Marshall Field III, 135 acres

11. Fuson Farm, 164 acres
12. Joseph W. Galbreath, 110 acres
13. Walters, 40 acres
14. CIPS, 200 acres
15. Donsbach Lot, 5 acres

TRACT 3 16. Donsbach Farm, 155 acres

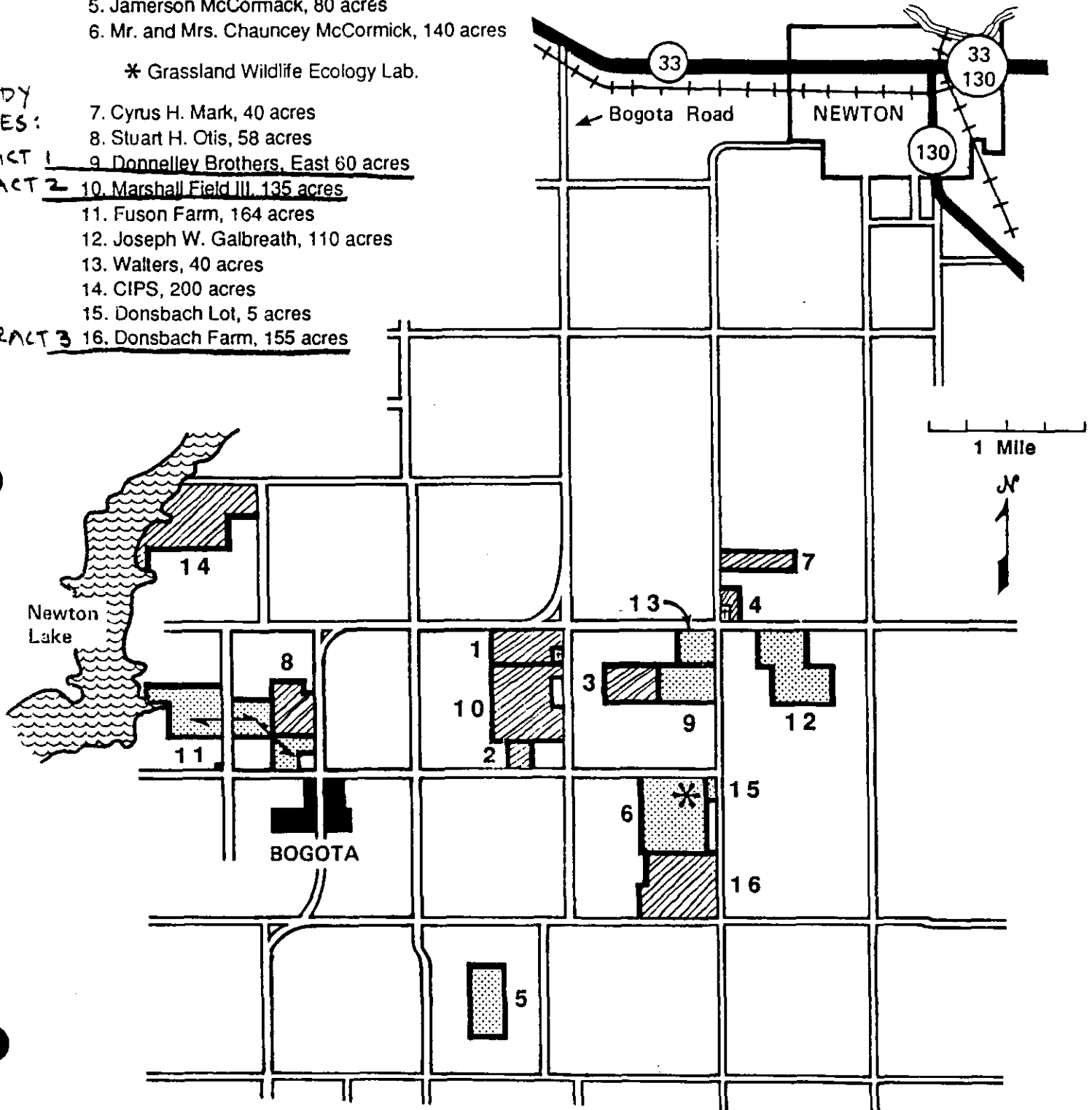


FIGURE 2

Fluctuation in numbers

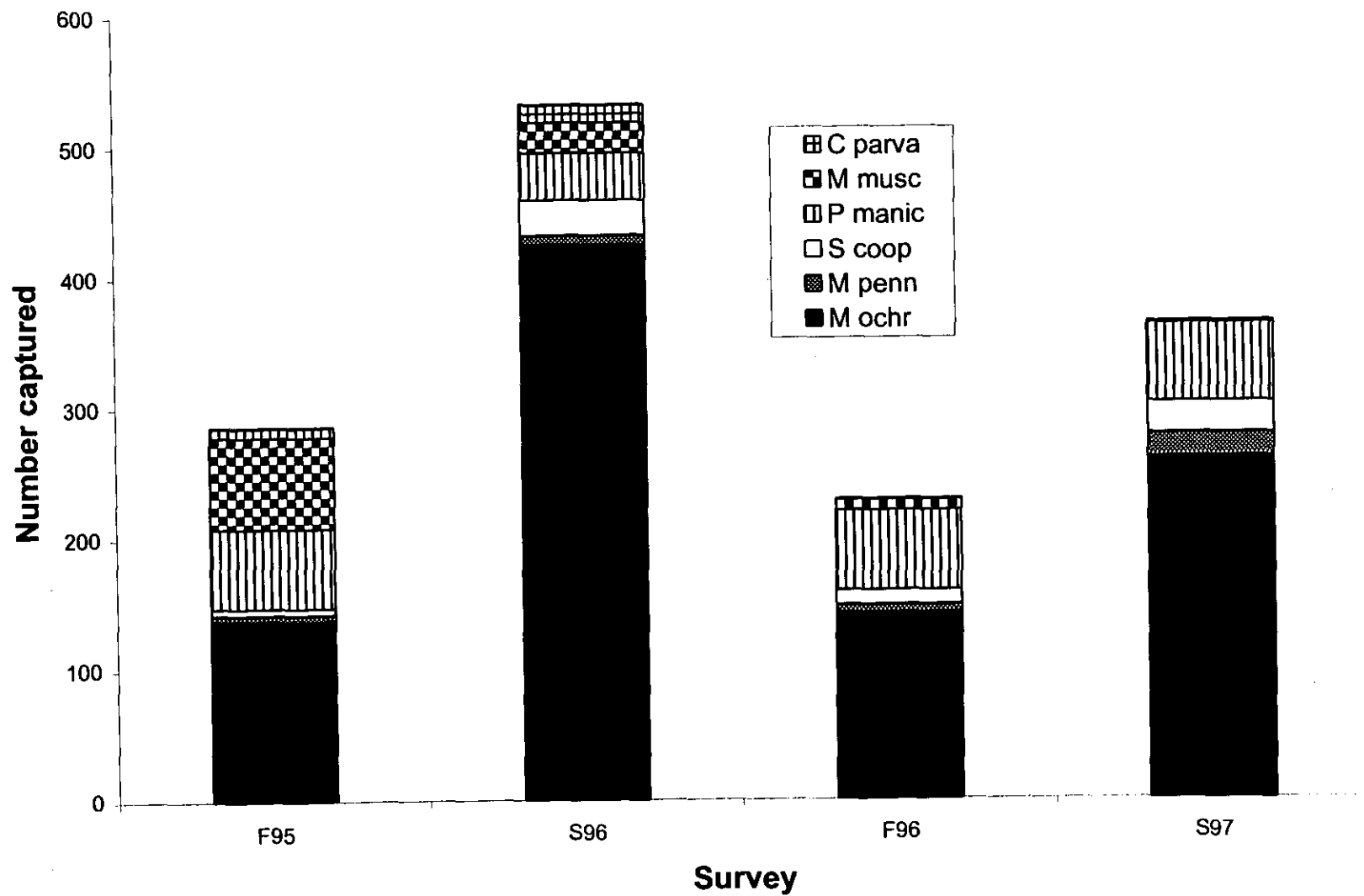


FIGURE 3

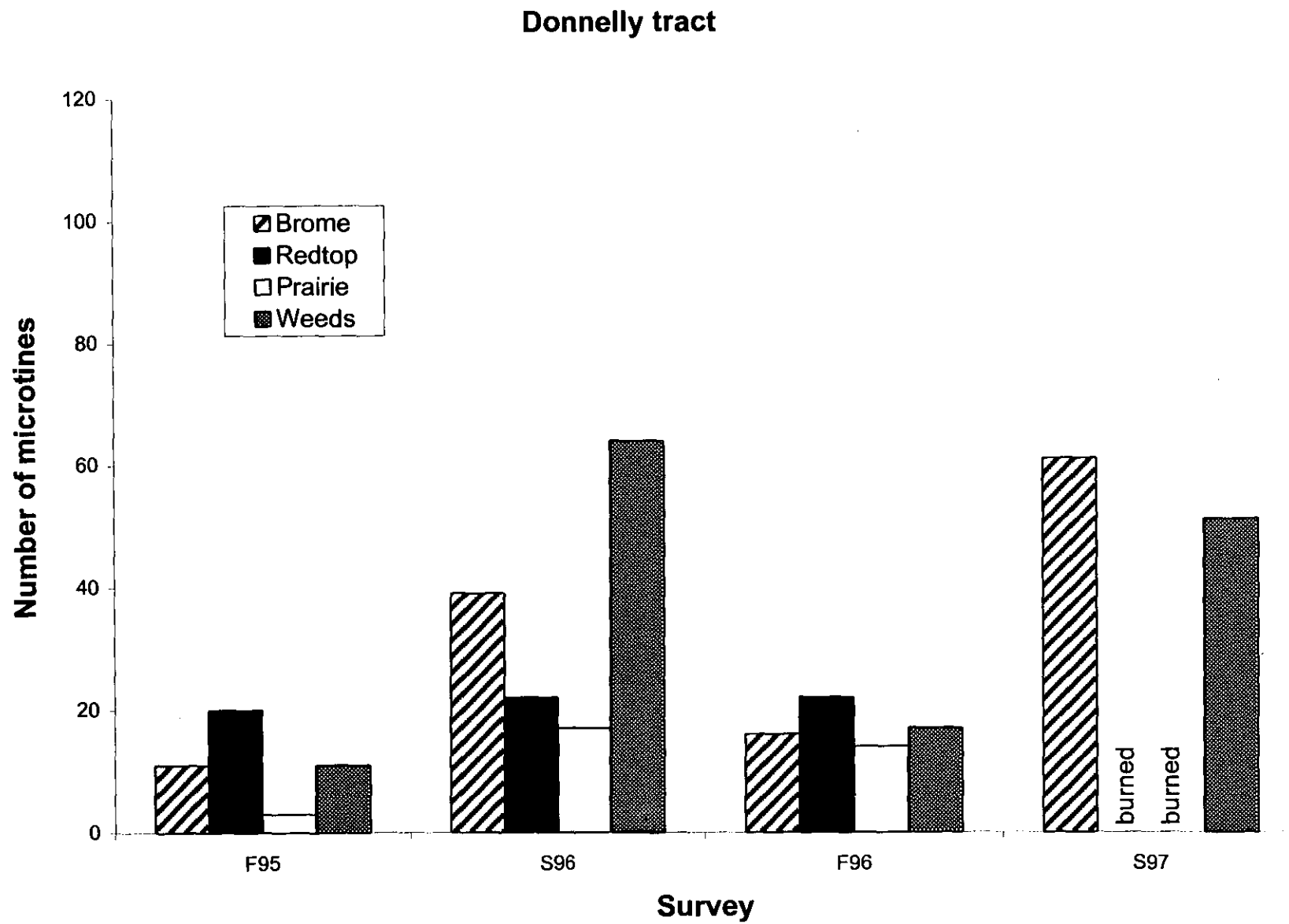


FIGURE 4

Donsbach/McCormick tract

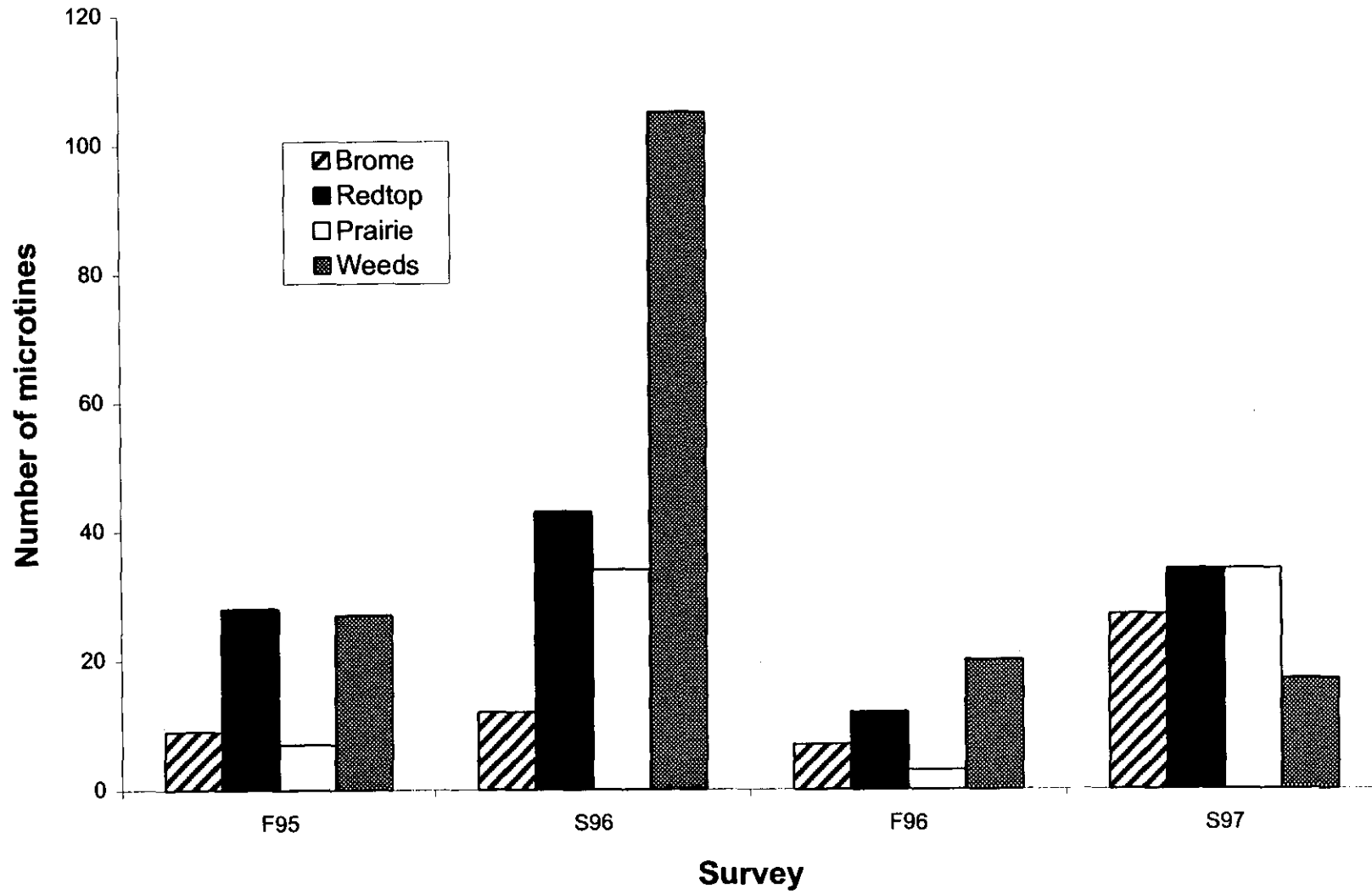
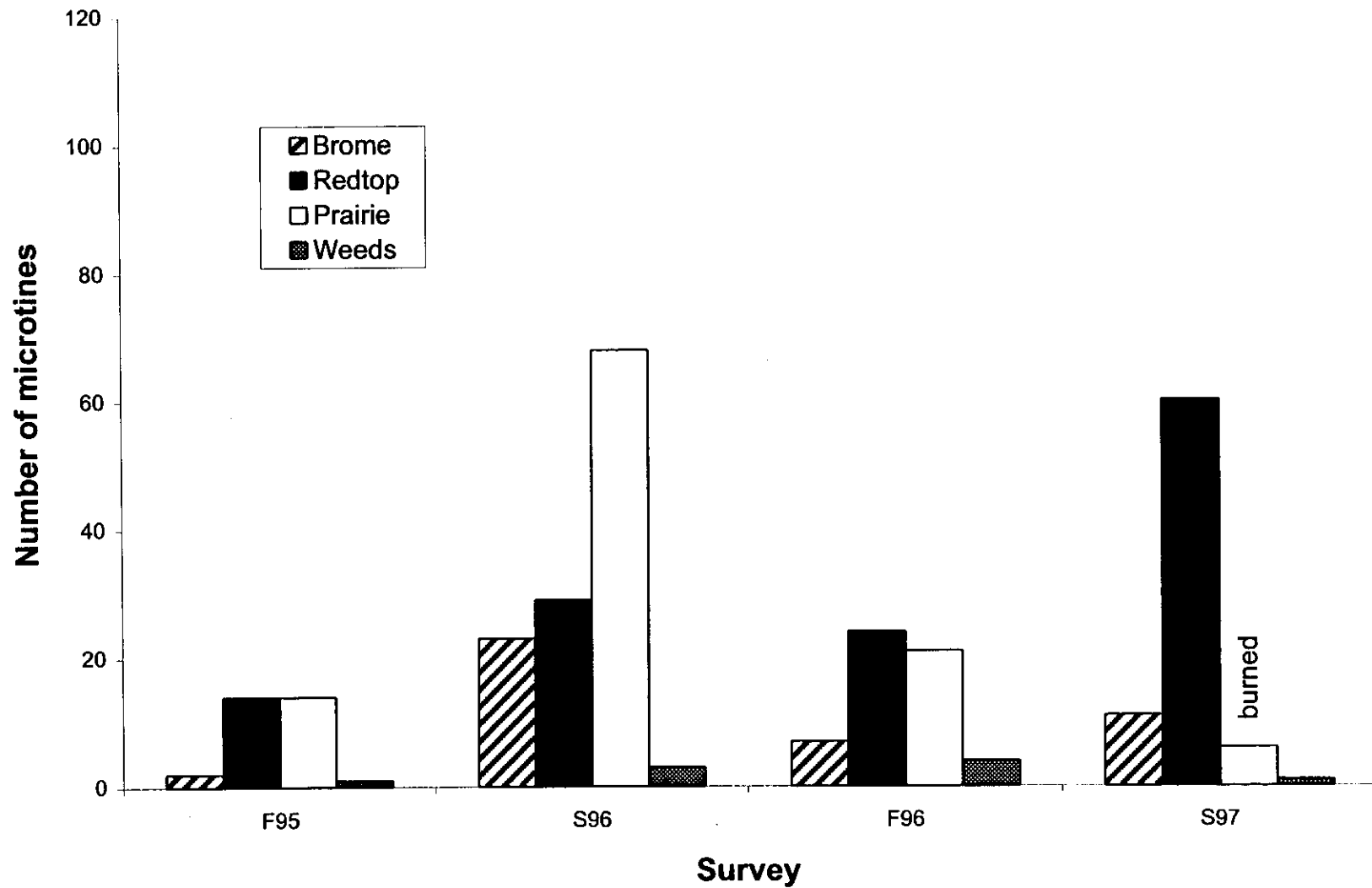


FIGURE 5

Marshall tract



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HABITAT USE BY SMALL MAMMALS IN AN INTENSIVELY
MANAGED GRASSLAND WILDLIFE SANCTUARY
YEAR 3

FINAL REPORT FOR FY 98
First 3 years of 4 year project

Prepared by:

Edward J. Heske
Illinois Natural History Survey

July, 1998

HABITAT USE BY SMALL MAMMALS IN AN INTENSIVELY MANAGED GRASSLAND

WILDLIFE SANCTUARY - YEAR 3

Edward J. Heske, Illinois Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820

BACKGROUND and JUSTIFICATION

The Short-eared Owl (*Asio flammeus*) and the Northern Harrier (*Circus cyaneus*) are listed as endangered in Illinois (IESPB 1992). Both species of raptor have become regular winter residents at Prairie Ridge State Natural Area (PRSNA) in Jasper Co., and have recently been observed nesting there in the spring. Apparently, management practices implemented to benefit the endangered Greater Prairie Chicken (*Tympanuchus cupido*) have benefitted these endangered raptors and other species of grassland-associated birds as well.

Small mammals constitute the major prey items for Short-eared Owls and Northern Harriers (Colvin and Spaulding 1983, Collopy and Bildstein 1987). Analysis of contents of pellets indicates that this is true at PRSNA, where voles and bog lemmings constitute the majority of prey items (J. Walk, pers. comm.). An abundant supply of diurnal and crepuscular small mammals, in addition to extensive areas of grassland and wetland habitat suitable for roosting and nest sites, is necessary for successful overwintering or nesting of these raptors. Management practices at PRSNA such as the planting and maintenance of blocks of different types of vegetation undoubtedly affect the dispersion, abundance, and productivity of populations of small mammals (e.g., Getz 1985). Further, many species of small mammal exhibit pronounced annual or multiannual fluctuations in abundance (Taitt and Krebs 1985). Some habitat types may be important refuge areas for small mammals during population lows, and provide a ready source of colonists for vacant habitats during population increases.

The purpose of this study is to examine differences in species composition and abundances of small mammals inhabiting four major types of vegetation maintained at PRSNA: brome fields (*Bromus*

inermis), red top fields (*Agrostis alba*), native prairie restorations, and fields lightly seeded with legumes and left weedy to provide brood cover. Abundance of small mammals in each habitat type will be monitored over 4 years to determine how habitat types differ in species composition and productivity of small mammals, and if any habitat type is a critical refuge area for small mammals during annual or multiannual population lows. This information will help managers maintain a mix of habitat types that best assures an adequate supply of small mammals as a prey base for raptors when they manipulate habitat to maximize production and survival of Greater Prairie Chickens.

STUDY AREA

Prairie Ridge State Natural Area in Jasper Co., Illinois, was established in the early 1960's to preserve and maintain grassland habitat for nesting, brood cover, foraging areas, and roosting sites for the Greater Prairie Chicken. PRSNA now includes 2,396 acres of intensively managed grassland, and is the second largest state-managed grassland in Illinois. PRSNA also provides habitat for 27 species of vertebrates of special concern (i.e., species recorded so far at the site): 13 State Endangered Species, 5 State Threatened Species, 4 species on the state watch list, and 5 area-sensitive species (S. Simpson and T. Esker, pers. comm.). Management goals for PRSNA are expanding from single-species management to grassland-ecosystem management, thus including concern for all endangered and threatened species recorded at the site while maintaining preservation of the Greater Prairie Chicken as the top priority. Annual surveys record numbers of overwintering and nesting Short-eared Owls and Northern Harriers, and recent studies have evaluated habitat use by these species for communal roost and nest sites, for example (J. Walk, pers. comm.).

METHODS

Small mammals are surveyed in four habitat types: restored native prairie vegetation, brome fields, red top fields, and legume/weed fields. Three replicates of each habitat type are surveyed, one in each of three separate management tracts (Donnelly, Donsbach/McCormick, and Marshall, Fig. 1), for a total of 12 study fields. Surveys are conducted in the fall (late Sept./Oct. – just prior to arrival of

overwintering raptors) and spring (March - just prior to nesting season for raptors and chickens). Each study field (ca. 10 acres) is live-trapped for three nights and days in each survey, using Sherman live traps. Live traps are spaced 10 m apart in three parallel lines spaced ca. 20 m apart, for a total of 100 traps (300 trap-nights) per study field. Data collected from each small mammal captured include species, weight, sex, approximate age (adult or juvenile), and reproductive condition. All small mammals are individually marked by fur-clipping so that an index of abundance for each study plot can be made. Other management activities such as mowing and burning that could affect small mammal populations on each study field are also recorded. As the database develops, it will be possible to evaluate any short-term effects of these other management practices on small mammal populations.

RESULTS AND DISCUSSION

Six surveys have been conducted to date. Two were conducted using personal funds (21 October - 1 November 1995, 11-17 March 1996), and four were supported by the Illinois Wildlife Preservation Fund (25 October - 1 November 1996, 21 - 29 March 1997, 20 October - 2 November 1997, 22 - 29 March 1998). A total of 2,823 small mammals was captured during these surveys: 1,697 prairie voles (*Microtus ochrogaster*), 84 meadow voles (*Microtus pennsylvanicus*), 139 southern bog lemmings (*Synaptomys cooperi*), 570 deer mice (*Peromyscus maniculatus*), 123 house mice (*Mus musculus*), 62 least shrews (*Cryptotis parva*), 7 northern short-tailed shrews (*Blarina brevicauda*), 2 white-footed mice (*Peromyscus leucopus*), and 2 meadow jumping mice (*Zapus hudsonius*). The records of meadow voles are noteworthy because this species has not been reported from as far south as Jasper Co. (Hoffmeister 1989) and these records may be a range extension. Because meadow voles and prairie voles can sometimes be difficult to distinguish, three presumptive meadow voles were collected in spring 1997. These specimens will be prepared as museum specimens and their teeth will be examined to confirm their identification.

Numbers of small mammals captured fluctuated among surveys (Fig. 2). Prairie voles were the most abundant species by far in all surveys. It is premature to draw conclusions about patterns of population dynamics, but voles at PRSNA may not show the peaks and crashes reported for many

populations. Numbers of voles reached their highest in fall 1997, and this year may have been a peak year on some plots. Numbers remained moderately high in spring 1998, and it will require surveys in fall 1998 to determine if a crash finally occurs. This will be a crucial survey, as true habitat refuges can only be determined during population lows. Numbers of deer mice were relatively similar among surveys, but also reached their highest during fall 1997 and spring 1998. House mice were common in the first two surveys, but declined considerably thereafter and have only been captured on a few plots. Shrews were generally uncommon, and also seemed to decline in the second year of the surveys but were abundant on a few plots in fall 1997. In general, small mammal abundance was higher in the spring than the fall during the first two years, but higher in the fall during the third, possibly peak year.

Detailed analyses will not be conducted until additional data are collected (4 years of surveys will be conducted). At present, no clear pattern of habitat use emerges when total numbers of small mammals in each study plot are examined (Table 1), but there are some interesting trends among species (Table 2).

Brome fields tend to have fewer small mammals in general than other habitat types. The brome field in the Marshall tract has become a dense monoculture, and this field had few small mammals in most surveys. However, where other vegetation is mixed in with the brome as in the field surveyed in the Donnelly tract, small mammals can be abundant (Table 1). Small mammals in brome fields were predominantly microtine rodents (voles and bog lemmings). Red top fields consistently contained moderately high numbers of small mammals (Table 1). Again, red top fields were dominated by microtine rodents (Table 2).

The prairie fields and weed fields varied considerably among the three study tracts. Numbers and species of small mammals probably reflect differences in the quality of vegetation in each field. Although the study plots were selected to represent distinct types of vegetation, they still differed in many ways. The prairie plot in the Donnelly tract was dominated by tough, mature hummocks of big blue stem, for example, and had few voles in the first 4 surveys. After this plot was burned, however, numbers of voles increased (Fig. 3). The prairie plot in the Marshall tract was also dominated by big blue stem, but had a diversity of other vegetation and many more small mammals (Table 1). Vole numbers also rebounded quickly after this plot was burned in spring 1997, but declined again in spring 1998 after the plot was

hayed in fall 1997, probably because of reduced vegetative cover during the winter (Fig. 4). Two of the weed plots had good ground cover in addition to the legumes and weeds (Donnelly, Donsbach/McCormick tracts); these plots regularly had high numbers of small mammals, including voles (Figs. 3 and 5). Because of succession, the weed plot on the Donnelly tract has become more and more dominated by brome grass; by the latter three surveys, this plot began to resemble brome plots more strongly than a weed plot. Interestingly, the numbers of microtine rodents on this plot were similar to numbers of microtines on the Donnelly tract brome plot (Fig. 3). The third weed plot (Marshall tract) had little ground cover in all surveys except fall 1997, and this plot had few microtine rodents in most surveys (Fig. 4) but many deer mice and house mice (Table 2). In general, deer mice and house mice occurred most frequently in the prairie and weed fields.

Because microtine rodents are the most important diet items for the raptors at PRSNA, numbers of microtines were examined separately (Figs. 3-5). Microtines were abundant wherever there was both good ground cover and a diversity of vegetation (grass and dicots). In the Donnelly tract, microtines were most abundant in the weed field, red top field (especially after it was burned), and brome field; in the Donsbach/McCormick tract, they were most abundant in the weed and red top fields but also were common in the prairie; and in the Marshall tract, they were most abundant in red top and prairie fields until the prairie was burned and hayed. Microtines were least common where brome had become primarily a monoculture (Marshall, Donsbach), stands of big blue stem had become dense, tough, and coarse (early surveys in Donnelly), or there was little grassy ground cover (Marshall weed plot in all but fall 1997, recently burned plots in spring, Marshall prairie after haying). If these patterns are maintained over time, then the current mix of habitat types seems to be doing a good job of maintaining a relatively stable vole population. This would be unusual, as voles in other areas of central Illinois show multiannual population cycles where peak years are followed by population crashes and several years of low abundance. It will be interesting to see if vole numbers crash after the high numbers of fall 1997 and spring 1998.

Three plots were burned just prior to the surveys in spring 1997. Two of these plots (Donnelly red top and Marshall prairie) had been very productive of microtine rodents before the burn, whereas one plot (Donnelly prairie) had few microtines. At the time of the spring 1997 surveys, all three plots were still

blackened from the burn, and the remaining charred vegetation was only ca. 10-20 cm tall. Deer mice were captured on all three plots, but voles only occurred on the margins of one plot (Marshall prairie) where roadside ditches still provided dense and rich unburned ground cover. Numbers of voles returned to their former levels or higher by the survey in fall 1997. This rapid, potentially positive response to burning suggests that recolonization of recovering plots by immigration from adjacent unburned areas is accomplished within a single season as long as unburned habitat is nearby. Vole populations benefit from burns because older, coarse perennial vegetation is removed (as on the Donnelly prairie plot) and the new, young vegetation may be of better nutritional quality. This is just a hypothesis at this point, but could explain the increases in abundance following burns. The responses of voles on the two plots burned in spring 1998 will be closely observed in fall 1998 and spring 1999.

After the final year of data collection, seasonal patterns in habitat use will be examined more closely. If population density declines in fall 1998, the types of habitat that provide critical refuges for populations during years of low numbers (greatest population stability over time, habitats where small mammals are still found during population lows when they may become locally extirpated in many areas) will be identified. These data will be useful to help assure a stable and abundant prey base for overwintering and nesting raptors. Although the data collected so far suggest that the intensive management practices at the sanctuary are creating a particularly productive environment for small mammals, monitoring will be maintained for 4 years (the typical length of a "vole cycle") to better establish the pattern of population dynamics. Further, although there is considerable variation among plots of "similar" habitat that adds noise to the analysis, some plots consistently perform better than others. These results are clearly related to the density and complexity of the vegetative cover on these plots; this relationship will be explored in more detail when data are rigorously analyzed at the end of the study. A trend seems to be emerging, however, where red-top and legume/weed fields (provided there is ample ground cover) are generally the most productive of voles and bog lemmings. Brome fields can also support high densities of microtines, but only when they also contain a mix of other vegetation. Plots with sparse ground cover (e.g., the Marshall weed plot) support primarily deer mice and house mice, which are not the primary prey for raptors at the sanctuary.

REFERENCES

- Collopy, M.W., and K. L. Bildstein. 1987. Foraging behavior of northern harriers wintering in southeastern salt and freshwater marshes. *Auk* 104:11-16.
- Colvin, B.A., and S. R. Spaulding. 1983. Winter foraging behavior of short-eared owls (*asio flammeus*) in Ohio. *Amer. Midl. Nat.* 110:124-128.
- Illinois Endangered Species Protection Board, (J. Herkert, ed.). 1992. Endangered and threatened species of Illinois: status and distribution. Vol. 2. 142 pp.
- Getz, L.L. 1985. Habitats. Pp. 286-309 in *Biology of New World Microtus* (R. H. Tamarin, ed.). Spec. Publ. 8, Amer. Soc. Mammal., 893 pp.
- Hoffmeister, D.F. 1989. *Mammals of Illinois*. University of Illinois Press, Champaign, IL. 348 pp.
- Taitt, M. J., and C. J. Krebs. 1985. Population dynamics and cycles. Pp. 567-620 in *Biology of New World Microtus* (R. H. Tamarin, ed.). Spec. Publ. 8, Amer. Soc. Mammal., 893 pp.

Survey and habitat type	Donnelly plots	Marshall plots	Donsbach plots	Total for all 3 tracts
Fall 1995				
Brome	15	5	20	40
Red-top	29	18	40	88
Prairie	17	41	12	69
Legume/weed	25	27	37	89 (286 total)
Spring 1996				
Brome	45	26	13	84
Red-top	24	33	44	101
Prairie	21	75	35	131
Legume/weed	71	37	109	217 (533 total)
Fall 1996				
Brome	20	9	8	37
Red-top	25	25	13	63
Prairie	30	24	3	57
Legume/weed	21	25	26	72 (229 total)
Spring 1997				
Brome	65	11	27	103
Red-top	6*	61	35	102
Prairie	8*	20*	39	67
Legume/weed	51	16	31	98 (370 total)
Fall 1997				
Brome	51	47	27	125
Red-top	155	86	40	281
Prairie	103	62	59	219
Legume/weed	69	82	48	199 (824 total)
Spring 1998				
Brome	92	15	30	137
Red-top	83	35	24	142
Prairie	82	21**	18*	121
Legume/weed	85	76	16*	177 (577 total)

*burned plots

**hayed previous fall

Table 1. Numbers of small mammals captured in different habitat types.

Table 2. Numbers of each species captured in different habitat types.

Survey and habitat type	M. ochr.	M. penn.	S. coop.	P. manic.	M. mus.	C. parva	B. brev.
Fall 1995							
Brome	21	0	1	5	9	4	0
Red-top	56	4	1	11	13	2	0
Prairie	20	1	3	24	20	1	0
Legume/weed	39	0	0	21	28	1	0
Spring 1996							
Brome	62	2	10	3	1	6	0
Red-top	84	0	10	3	0	4	0
Prairie	109	3	7	6	2	4	0
Legume/weed	170	2	0	24	20	0	1
Fall 1996							
Brome	16	0	0	4	0	0	0
Red-top	21	1	0	3	0	0	0
Prairie	17	0	0	4	0	0	0
Legume/weed	4	0	10	15	1	0	0
Spring 1997							
Brome	80	6	13	4	0	0	0
Red-top*	84	7	3	7	0	1	0
Prairie**	35	2	3	27	0	0	0
Legume/weed	61	3	5	37	1	0	0
Fall 1997							
Brome	136	0	21	20	0	19	1
Red-top	178	3	12	11	1	9	0
Prairie	86	2	3	73	6	5	0
Legume/weed	107	0	6	91	14	6	5
Spring 1998							
Brome	112	0	11	14	0	0	0
Red-top	77	39	7	19	0	0	0
Prairie*	50	7	9	54	1	0	0
Legume/weed*	72	2	4	91	6	0	0

*includes 1 burned plot

**includes 2 burned plots

Species names: M. ochr. *Microtus ochrogaster*, Prairie vole
M. penn. *Microtus pennsylvanicus*, Meadow vole
S. coop. *Synaptomys cooperi*, Southern bog lemming

P. manic. *Peromyscus maniculatus*, Deer mouse
M. mus. *Mus musculus*, House mouse
C. parva *Cryptotis parva*, Least shrew
B. brev. *Blarina brevicauda*, Northern short-tailed shrew

Not included in table: 2 *Zapus hudsonius*, Meadow jumping mouse, captured in Fall 1997, and 3 *Peromyscus leucopus*, White-footed mouse, captured in Spring 1998.

Figure legends



Fig. 1.—Map of Prairie Ridge State Natural Area (formerly the Prairie Chicken Sanctuary), Jasper County, Illinois, showing locations of three study sites: Donnelly tract (3 and 9), Donsbach/McCormick tract (16 and 6), Marshall tract (10). Map prepared by staff of Illinois Department of Natural Resources.

Fig. 2.—Numbers of each species of small mammal captured in the four surveys.

Figs. 3-5.—Numbers of microtine rodents (prairie voles, meadow voles, and southern bog lemmings) on each study plot. Fig. 3: Donnelly tract. Fig. 4: Marshall tract. Fig. 5: Donsbach/McCormick tract.

PRAIRIE CHICKEN SANCTUARIES, JASPER COUNTY

Ownership or Lease By:

	Illinois Department of Conservation	767 acres
	The Nature Conservancy	594 acres

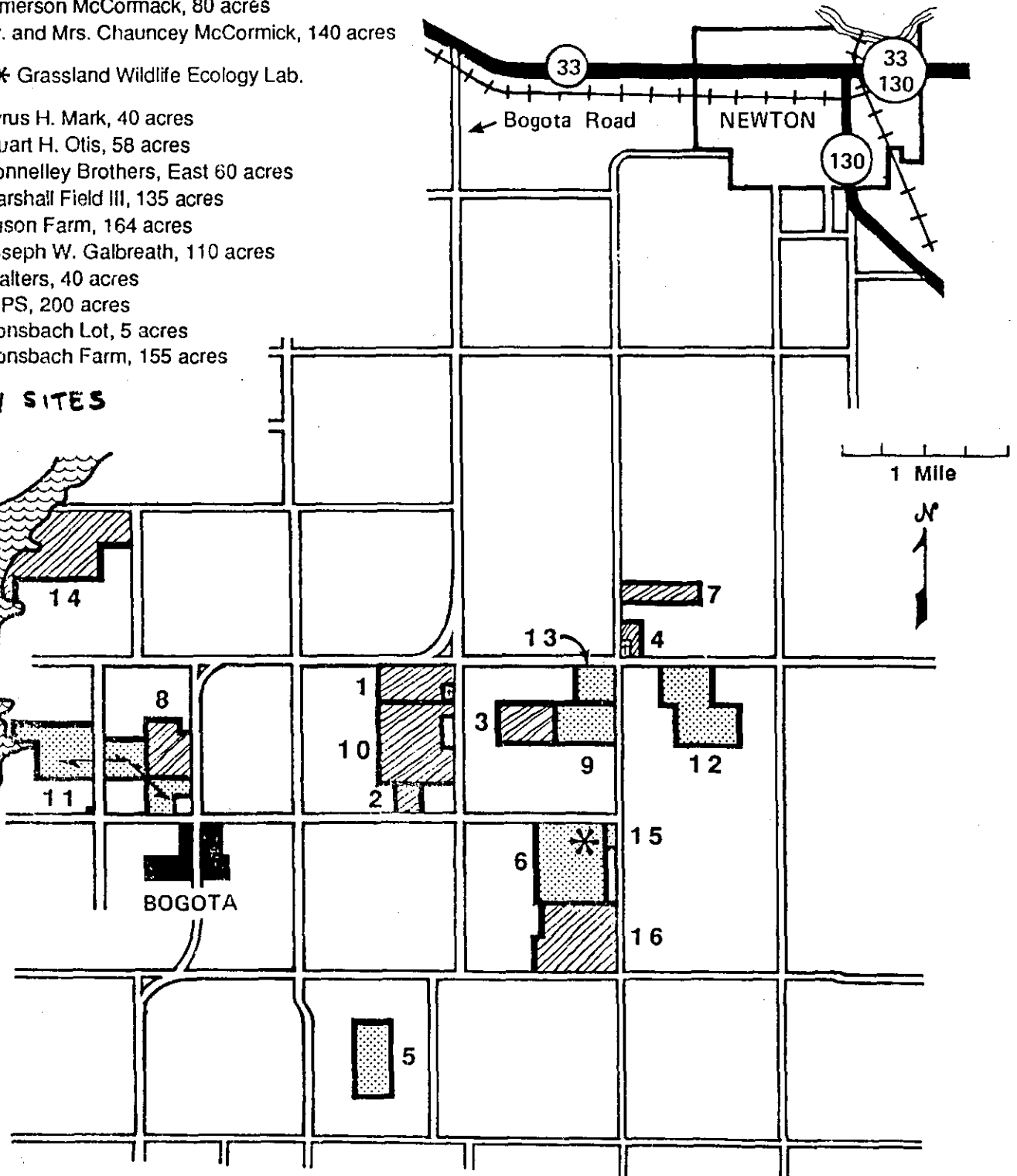
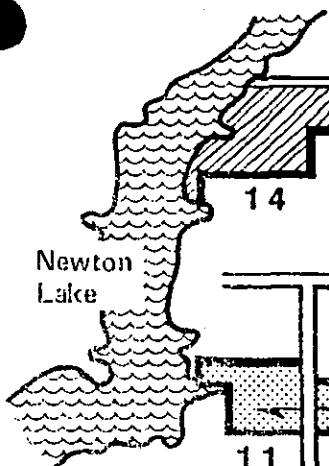
TOTAL 1,361 acres

- 1. Ralph Yeatter, 77 acres
- 2. Max McGraw, 20 acres
- *3. Donnelley Brothers, West 60 acres
- 4. Cyrus H. Mark, 17 acres
- 5. Jamerson McCormack, 80 acres
- *6. Mr. and Mrs. Chauncey McCormick, 140 acres

* Grassland Wildlife Ecology Lab.

- 7. Cyrus H. Mark, 40 acres
- 8. Stuart H. Otis, 58 acres
- *9. Donnelley Brothers, East 60 acres
- *10. Marshall Field III, 135 acres
- 11. Fuson Farm, 164 acres
- 12. Joseph W. Galbreath, 110 acres
- 13. Walters, 40 acres
- 14. CIPS, 200 acres
- 15. Donsbach Lot, 5 acres
- *16. Donsbach Farm, 155 acres

* STUDY SITES



Fluctuation in Numbers

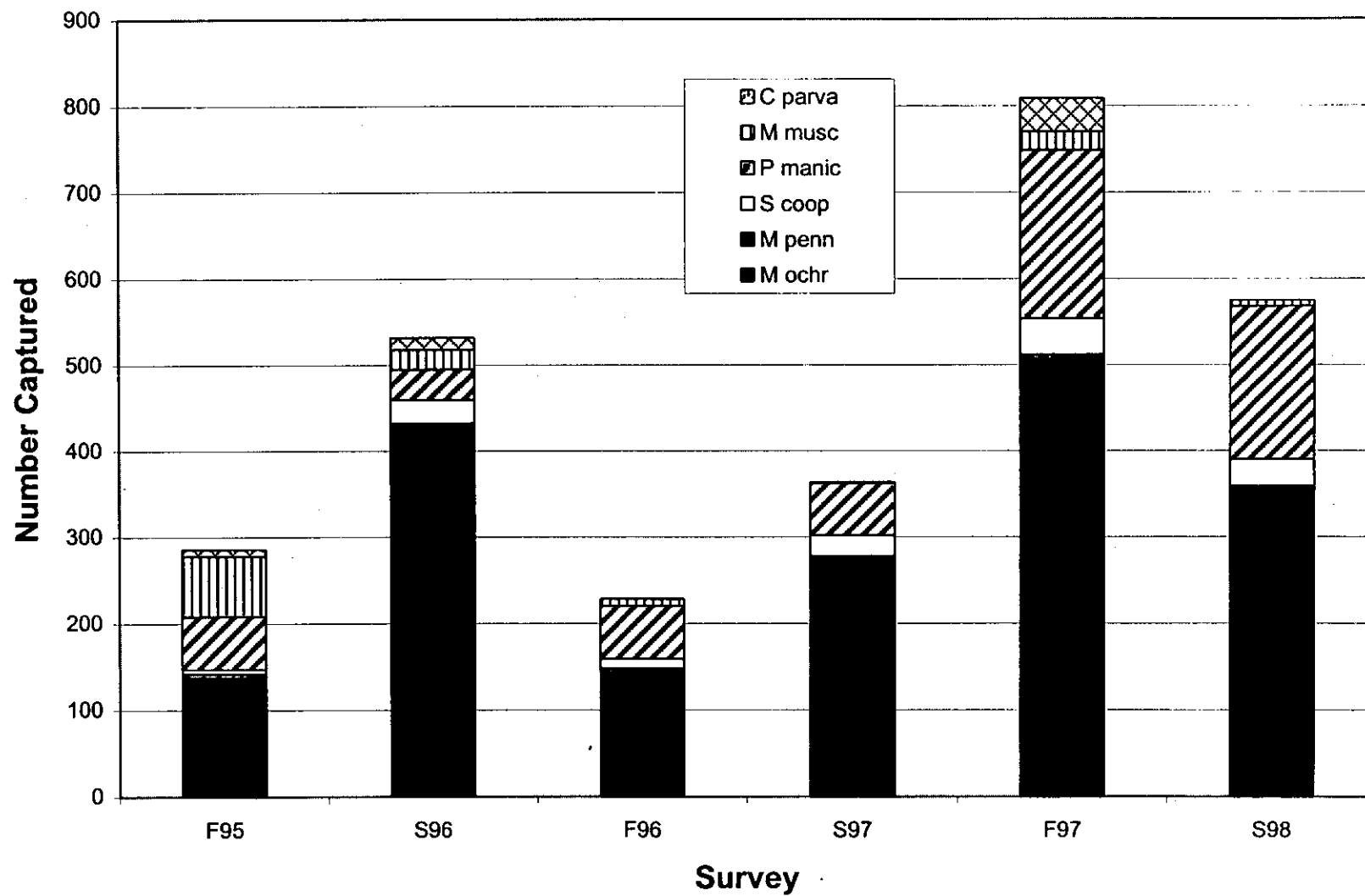
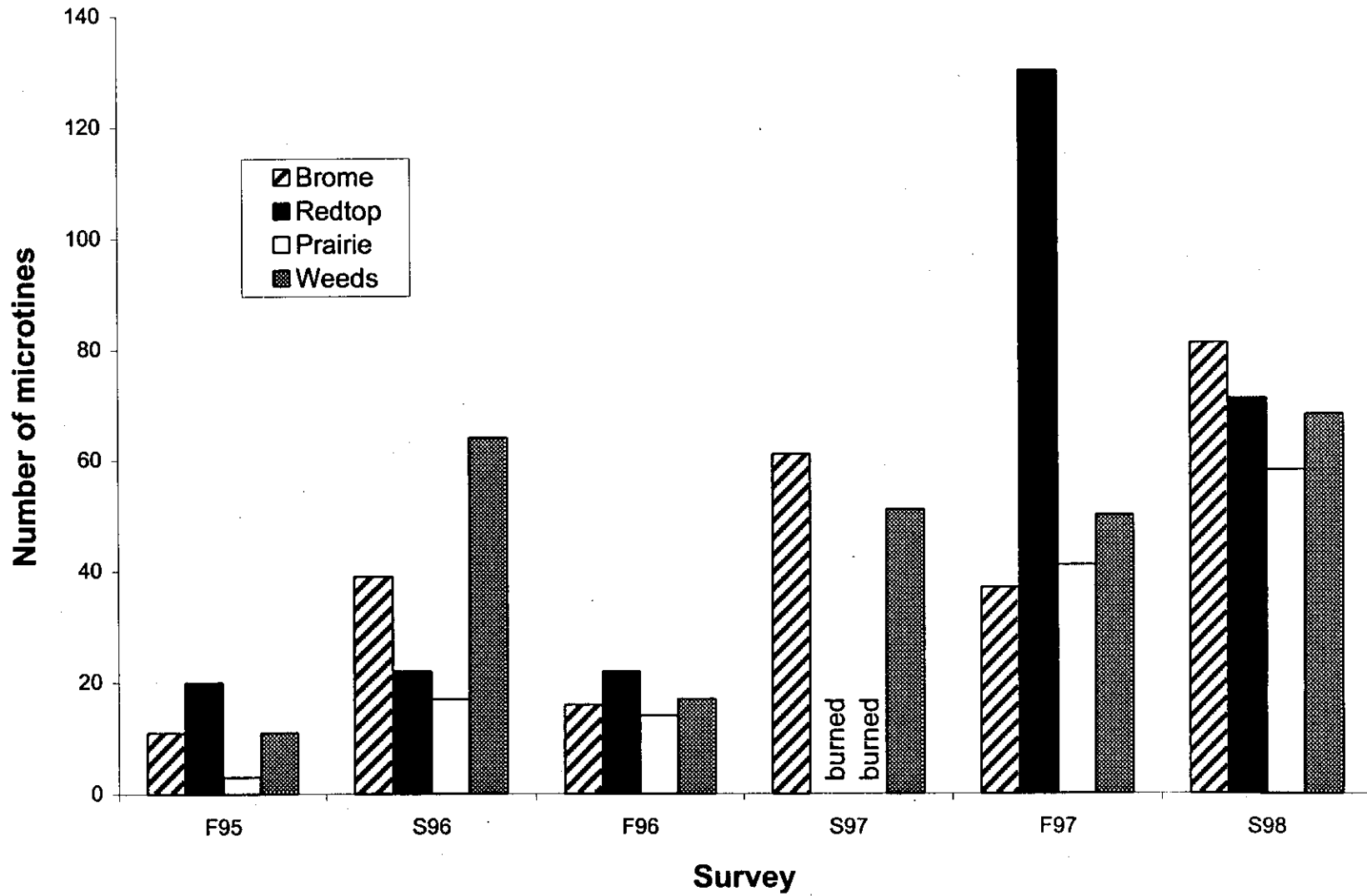
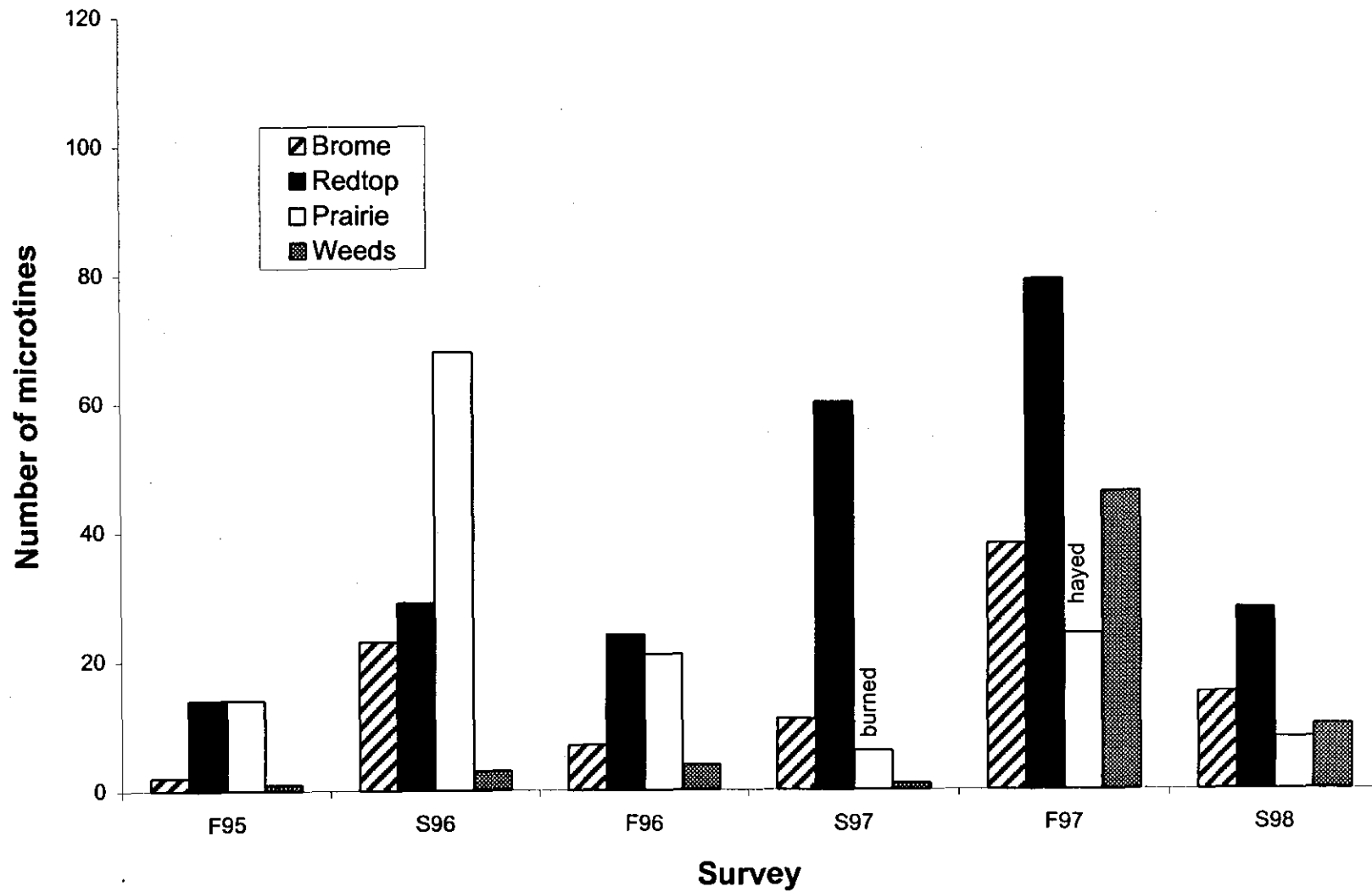


FIG. 2

Donnelly tract



Marshall tract



Donsbach/McCormick tract

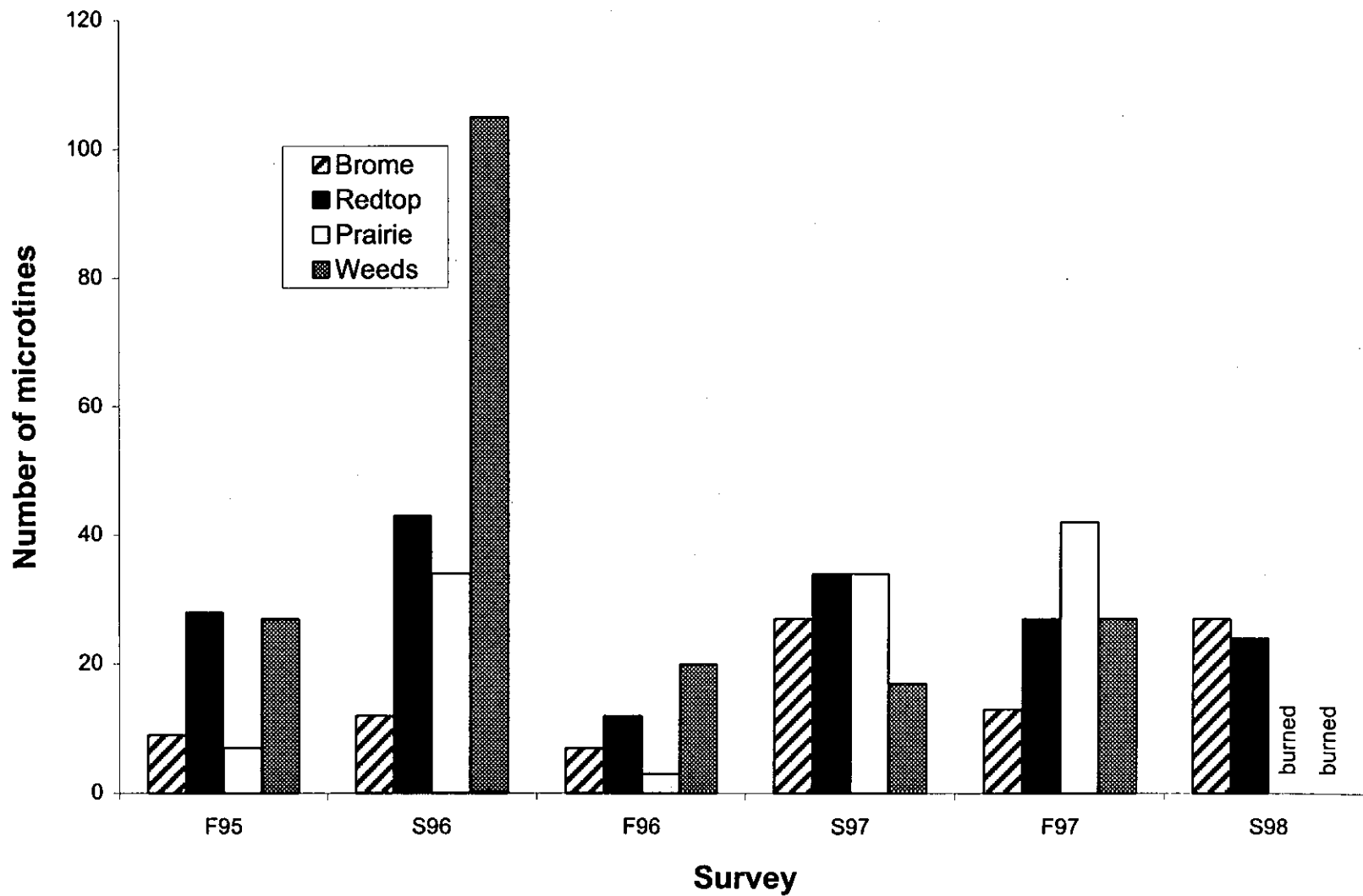


Fig. 5