AN ABSTRACT OF THE THESIS OF

Crispin H. Dippel for the Master of Science

Biology presented on August 25, 1989

Title: Some Effects on Prairie Vole Populations in Burned and Unburned Prairie

Abstract approved: Dwight L. Spencer

Fire has long been used as a management tool in an effort to maintain tallgrass prairie habitat. This study was designed to determine the effects of prairie fire on populations of prairie voles, Microtus ochrogaster, as well as the effects of live trapping and removal of the voles from the study areas. The study was conducted at Ross Natural History Reservation in Lyon Co. Kansas.

Microtus were live trapped beginning in late fall, 1985, and continuing through early summer, 1986 following a spring burn in 1985. Numbers of individual Microtus captured were found to be significantly higher on the burned plots than on the unburned plots, whereas, there was no significant difference in numbers of animals captured on plots where animals were removed versus plots were they were released back into the plot. A significant interaction was also found to exist between burning and removal as variables.

SOME EFFECTS ON PRAIRIE VOLE POPULATIONS
IN BURNED AND UNBURNED PRAIRIE

A Thesis

Submitted to

the Division of Biological Sciences

Emporia State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Crispin H. Dippel

August, 1989

Thesis
1989
D

Dwight L. Spencer
Approved by Major Advisor

James M Mayo
Approved by Committee Member

Thomas A. Eddy
Approved by Committee Member

Rodney J. Sobieski
Approved for Major Department

James L Wolfe
Approved for Graduate Council

ACKNOWLEDGMENTS

I express my gratitude to my major professor, Dr. Dwight Spencer, for his support, encouragement, advice and patience throughout this study. Thanks to the members of my committee, Dr. James Mayo and Dr. Thomas Eddy, for their helpful suggestions and comments. Thanks to Roger Ferguson for his assistance in the building of the traps used for this study. Thanks to Dr. Dwight Moore for his advice and his patient help with statistical methods and computer usage.

I am particularly thankful to my family for their endless support and encouragement throughout this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Fire is a natural occurrence in grassland areas. It has been estimated that fire occurred naturally every 3-5 years in the tallgrass prairies of Kansas prior to settlement by European man. Plains Indians were known to set fires in order to concentrate game animals (Hyde and Owensby, 1971). Since natural fires are now a rare occurrence, controlled periodic burning has become a major management tool for maintaining and preserving tallgrass prairie. Possible adverse effects of grassland burning include increased soil erosion, increased air pollution and reduced soil moisture. Reduced forage yield results if the burn is before mid-April. There are many positive effects of spring burning. They include the following: encouraging warm season grasses by decreasing competition from cool season grasses and by decreasing the amount of surface litter which allows the sun to warm the soil earlier in the growing season (Hulbert, 1969; Kucera and Ehrenreich, 1962), increasing living shoot biomass and flowering stalk production (Hadley and Kieckhefer, 1963; Kucera and Ehrenreich, 1962), and controlling woody vegetation and insects (Spencer, pers. comm.). Also, weed control and improved forage quality may result (Hyde and Owensby, 1971). Traditionally, burning has also been thought of, by some individuals, as a way to control small mammal (rodent) populations (Spencer, pers. comm.). Hyde and Owensby (1971) also found that big bluestem (_Andropogon gerardi_), indian grass (_Sorghastrum nutans_) and switch grass (_Panicum virgatum_) increased markedly in abundance with late spring burning and that little bluestem (_A. scoparius_), side oats grama (_Bouteloua curtipendula_), blue grama (_B. gracilis_) and buffalo grass (_Buchloe dactyloides_) increased slightly. They also stated that rangeland that has been subjected to late spring burning and light grazing over the last 20 years was in better range condition than land receiving other treatments. General conclusions from these studies were that fire reduces the amount of litter on the soil surface and enhances primary productivity of forbs and grasses in the first growing season following the fire. This leads one to believe that herbivorous small mammals would benefit from such changes.

Quality of available food can exert a strong influence on the density of herbivores. According to Rose and Birney (1985) the ecological niche of _Microtus_ is that of first order consumer; it is one of the principle herbivores in almost all plant communities where it lives. Cole and Batzli (1979) found high forage quality accounted for peak vole population densities. As spring burning has a positive effect on forage quality, burning may indirectly result in increased density of vole populations. However, burning may negatively impact vole populations because of reduced ground litter and, perhaps, loss of some voles to fire.

Numerous studies have examined the effects of prairie fire on small mammal populations (Cook, 1979; Kucera and Ehrenreich, 1962; Schramm and Willcutts, 1982; Hulbert, 1962; Peterson, Kaufman and Kaufman, 1985; Kaufman, Kaufman and Finck, 1983). In most of these studies, prairie vole (Microtus ochrogaster) numbers were found to be too low to obtain sufficient data for drawing conclusions about the fire's effect on their population density, or they were conducted within a short time following the burn. However, the study by Schramm and Willcutts (1982) found that Microtus occurred in both burned and unburned prairie, but the total number of individuals caught was significantly higher in the burned areas.

Taitt and Krebs (1985) summarized, in a review of studies done by Baird and Birney (1982), Krebs et al. (1976), Myers and Krebs (1971), that if resident voles were removed, other voles would colonize the vacant area. Gaines et al. (1979) found that if allowed to remain, immigrant voles would establish a breeding population.

Preferred Habitat and Habits of Prairie Voles

The prairie vole has a wide geographic distribution from the front range of the Rocky Mountains east to southwestern Ohio, northwest into Manitoba, Alberta and Saskatchewan and south into Oklahoma and northern Arkansas

(Schwartz and Schwartz, 1981).

Voles occur in well drained upland habitats in both sparse and dense grass areas. Their diet consists mainly of green grasses and possibly some forbs (Getz, 1985). Prairie voles occupy home ranges with underground burrow systems and extensive surface runways; the runways are used by all voles in the vicinity.

The primary objective of this study was to determine if spring burning had an effect on prairie vole population densities during late fall, winter, spring and early summer following the burn. A second objective was to determine if differential recolonization rates of immigrant voles existed between burned and unburned areas under a regimen of removal trapping. The null hypotheses to be tested were: there is no effect of spring burning on *Microtus* population densities during the year following spring burning and there is no effect of removal of *Microtus* on population densities for the same time period. Sex and relative age data were also recorded in this study but were not tested statistically.

Description of the Study Site

The study was carried out at the Ross Natural History Reservation (R.N.H.R.), 1 of 5 natural areas owned by Emporia State University. It is located in sections 7 and 8, R 10 E, T 18 S, Lyon County, Kansas.

All trapping plots were located in upland, native grassland areas and were relatively similar in vegetation prior to spring burning in April, 1985. The plots had not been burned for at least 2 years prior to 1985. Only limited grazing by cattle had occurred since 1960. The R.N.H.R. is divided into 10 acre grids (Figure 1). Plot 1 was located in grid B47, Plot 2 in B34, Plot 3 in B33, Plot 4 in A43. All areas where the study grids were located have been managed to encourage native, tallgrass prairie vegetation since 1973-74 (Spencer, 1980).

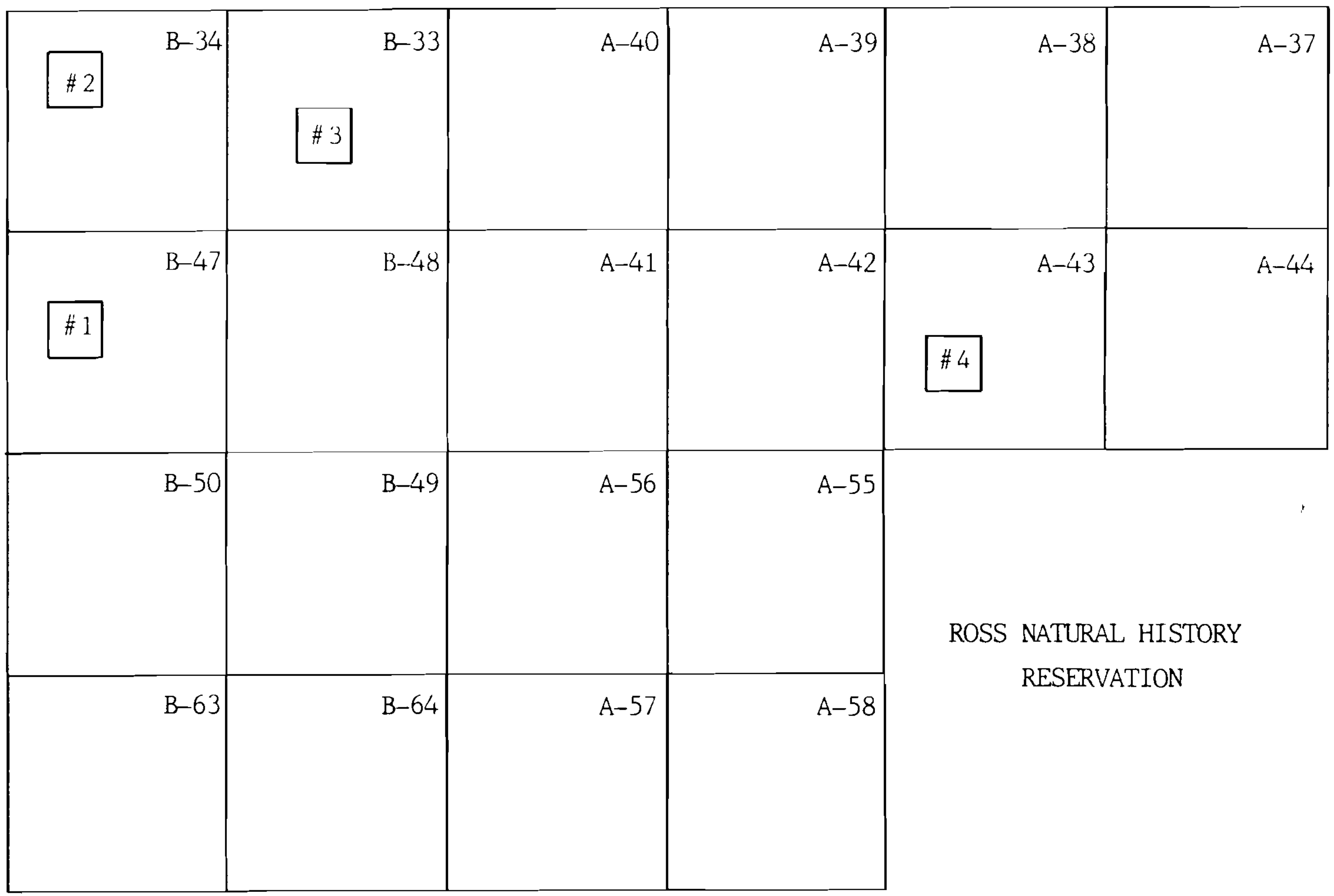
Soil types for each plot are as follows:

Plot 1 - western half is Kenoma silty clay loam with a 1-3% slope; eastern half is a Labette silty clay loam with a 1-3% slope.
Plot 2 - major portion is Kenoma silty clay loam with a 1-3% slope.
Plot 3 - major portion is Clime-Sogn complex with a 5-20% slope.
Plot 4 - Clime-Sogn complex with a 5-20% slope.

Plots 3 and 4 are located in the Clime portion of the Clime-Sogn complex. All these soils are moderately to well drained and have a surface layer 15.2-20.3 cm deep (U.S.D.A., S.C.S., 1981).

By the end of the first growing season after the burn, there was a conspicuous visual difference between the unburned and burned plots. Vegetation on burned plots was taller and more dense with less ground litter than on unburned plots.

Figure 1. Map of Ross Natural History Reservation. Study plots are outlined with the approximate location in the existing 10 acre grids.


B-34
#2
B-33
#3
A-40
A-39
A-38
A-37
B-47
#1
B-48
A-41
A-42
A-43
#4
A-44
B-50
B-49
A-56
A-55
B-63
B-64
A-57
A-58
ROSS NATURAL HISTORY
RESERVATION

MATERIALS AND METHODS

The study was carried out from 2 November 1985 through 12 June 1986 at the Ross Natural History Reservation. Five 60 m x 60 m plots were established for the study.

The experiment was designed as a two factor crossed design. Four plots were established as follows:

Plot 1 - no 1985 spring burn; captured voles were marked and released at site of capture.

Plot 2 - 1985 spring burn; captured voles were marked and released at site of capture.

Plot 3 - no 1985 spring burn; captured voles were removed from the plot.

Plot 4 - 1985 spring burn; captured voles were removed from the plot.

Plots 2 and 4 were burned in mid-April, 1985.

This design allows for the examination of effects, if any, due to burning versus no burning and removal versus non-removal, as well as the interaction between these 2 factors. Analysis of variance was used to test for significant differences in the mean number of individuals captured on the plots and to test for interactions between the variables burning and removal.

Twenty-five, homemade Fitch live traps, each measuring 7.6 cm x 7.6 cm x 30.5 cm, were placed at 15 m intervals in a grid pattern in each plot. Approximately one-half of each trap opposite the door opening was wrapped with heavy brown paper and then aluminum foil and nesting material was placed in the covered portion to reduce trap mortality from precipitation and temperature extremes.

Trapping occurred at 2 week intervals during November 1985, and at 3 to 4 week intervals during January, February and March, 1986. Trapping at 2 week intervals resumed in April and continued through 12 June 1986. Traps were baited with a mixture of rolled oats and peanut butter and were set and run daily for 4 consecutive days during each interval. When overnight temperatures dropped below -4° C, trap mortality increased, therefore trapping was discontinued during these periods.

Trap location, weight, sex and relative age were recorded for each vole before it was either marked and released at the site of capture or removed from the plot. Weights were measured with a Pesola scale. Relative ages were determined by weight as follows: juvenile - up to 22 g; sub-adult - 23-32 g; adult - 33 g and above (Terman, 1978).

Microtus that were captured in plots 3 and 4 were taken approximately 500 m away from the capture site and released. Schwartz and Schwartz (1981) stated that the homing range for *Microtus* is no more than 200 m. Captured *Microtus* from plots 1 and 2 were marked by toe clipping and released at site of capture.

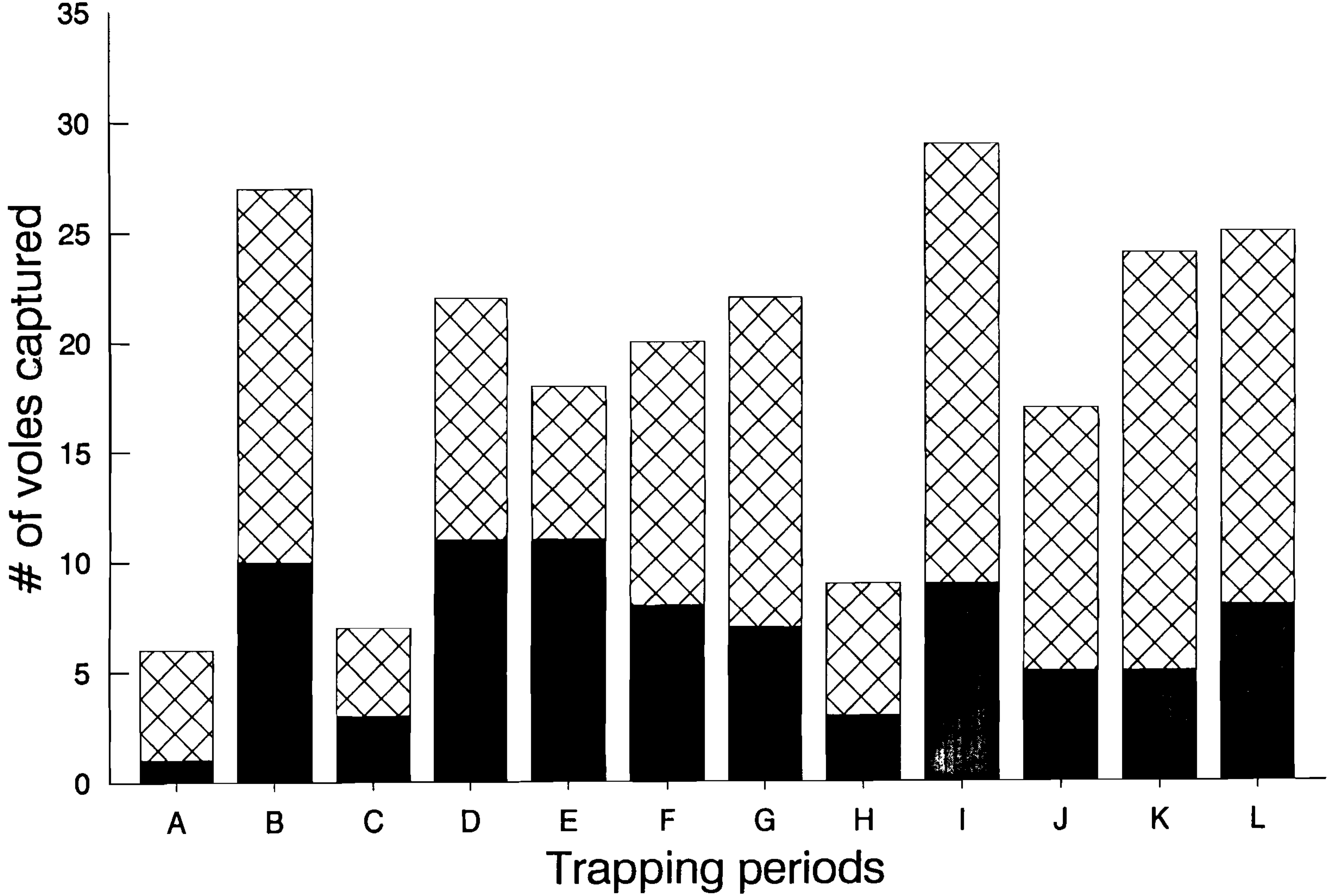
RESULTS

In a total of 4225 trap nights, 225 individual Microtus were captured for a combined trapping success rate of 5.3 voles/100 trap nights (Figure 2).

A basic assumption in this study was that an increase in the number of animals captured implies an increase in the population of that particular area. Overall, there was a significant difference (F = 11.951; d.f. = 1,44; P = 0.000) between the number of individual Microtus (151) captured on burned plots and the number of Microtus (74) captured on unburned plots (Figures 3 and 4). There was no significant difference (F = 3.411; d.f. = 1,44; P = 0.068) between the number of individual Microtus (131) captured on non-removal plots and the number of Microtus (94) captured on removal plots (Figures 5 and 6). There was a significant (F = 4.954; d.f. = 1,44; P = 0.030) interaction between burning-no burning and removal-no removal, this interaction is illustrated, in a graph of cell means, by the non-parallel lines for removal grids and non-removal grids in Figure 7. The significant interaction indicates the response to burning on removal grids is different than the response to burning on non-removal grids. Therefore, the difference between burning and no burning on removal plots and the difference between burning and no burning on non-removal plots were examined. Also, the difference between removal

Figure 2. Number of individual voles caught per trapping period on all plots: females = crosshatched; males = solid.
Designation for trapping periods as follows:

A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



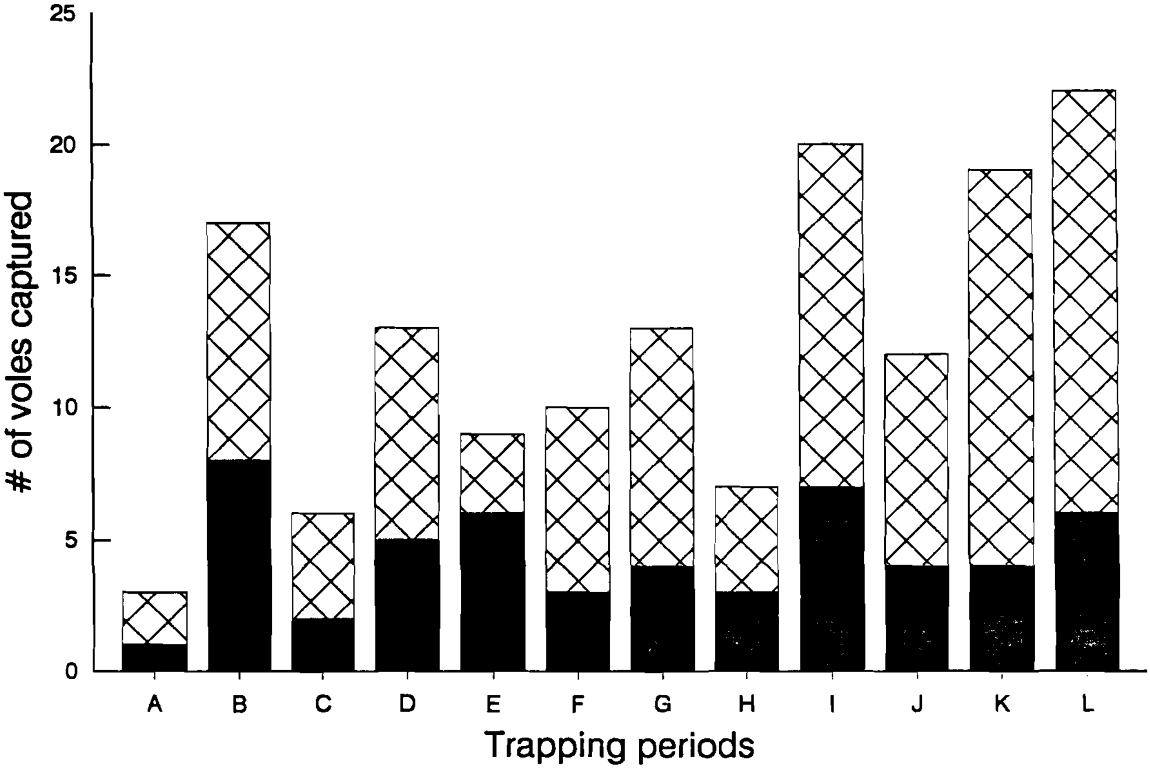
35
30
25
20
15
10
5
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 3. Number of individual voles caught per trapping period on burned plots 2 and 4: females = crosshatched; males = solid.
Designation for trapping periods as follows:

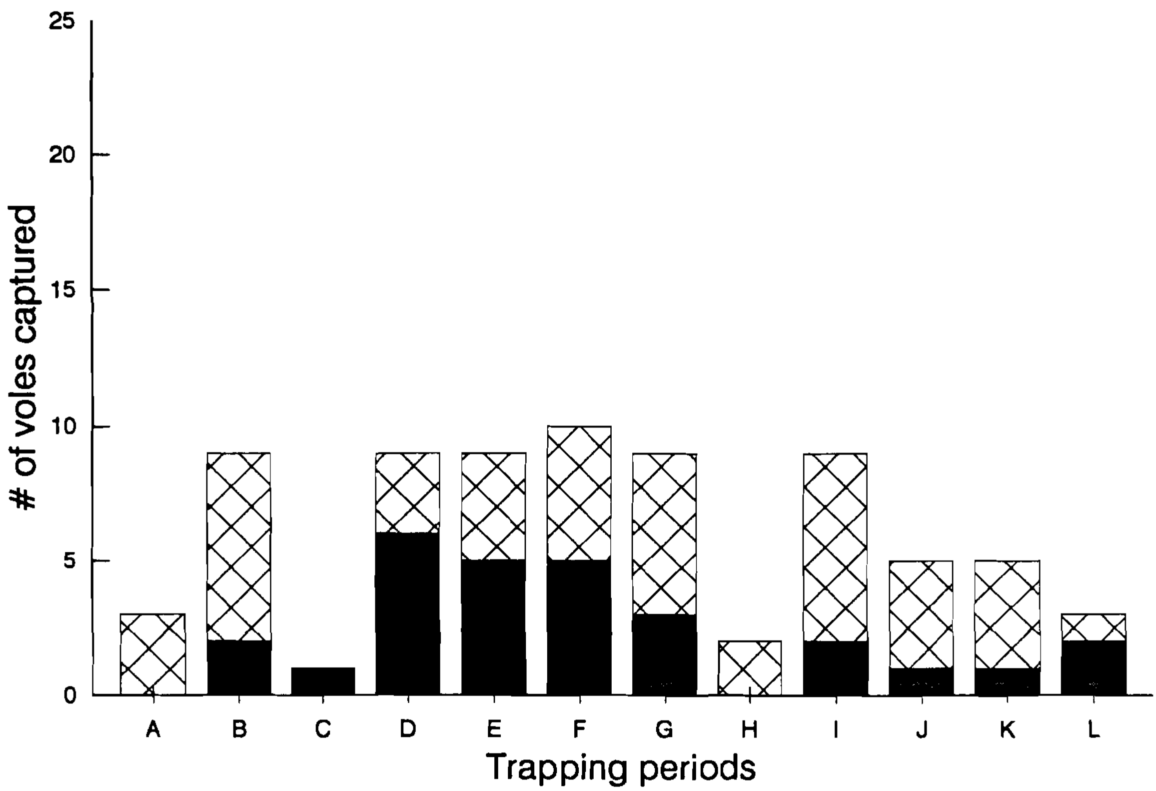
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June

Figure 4. Number of individual voles caught per trapping period on unburned plots 1 and 3: females = crosshatched; males = solid.
Designation for trapping periods as follows:

A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



25
20
15
10
5
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods



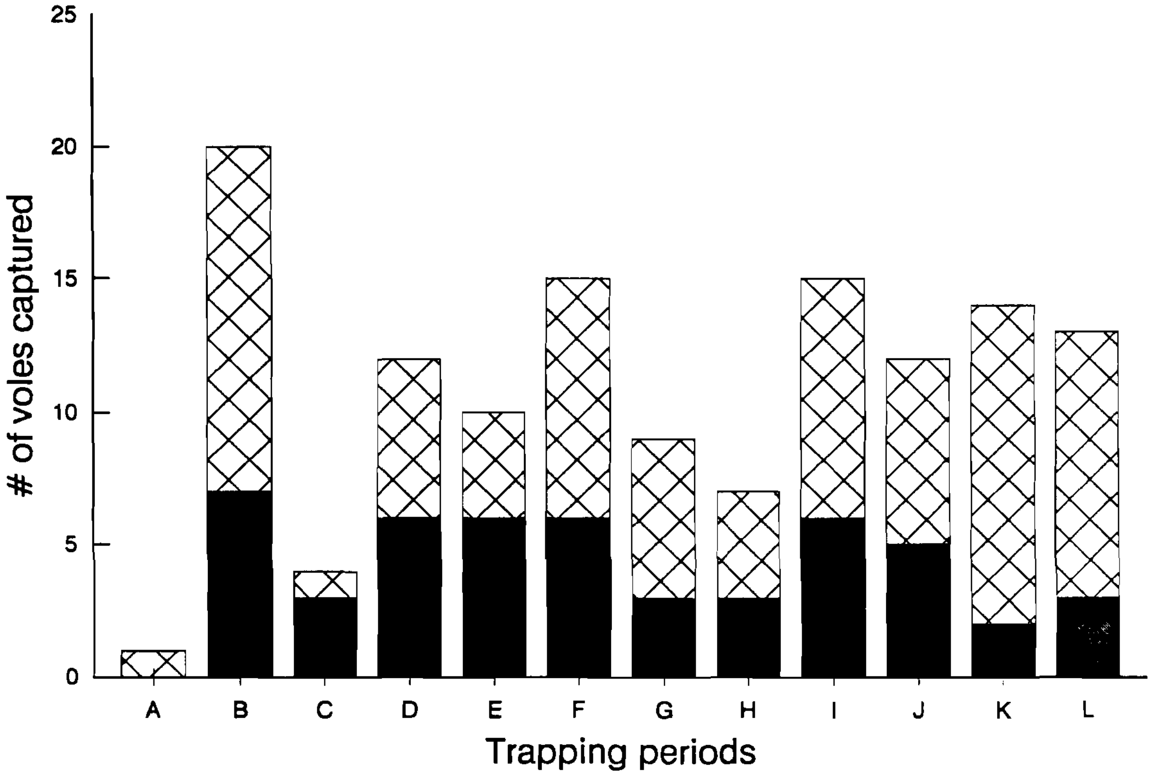
25
20
15
10
5
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 5. Number of individual voles caught per trapping period on non-removal plots 1 and 2: females = crosshatched; males = solid.
Designation for trapping periods as follows:

A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June

Figure 6. Number of individual voles caught per trapping period on removal plots 3 and 4: females = crosshatched; males = solid.
Designation for trapping periods as follows:

A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June


25
20
15
10
5
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

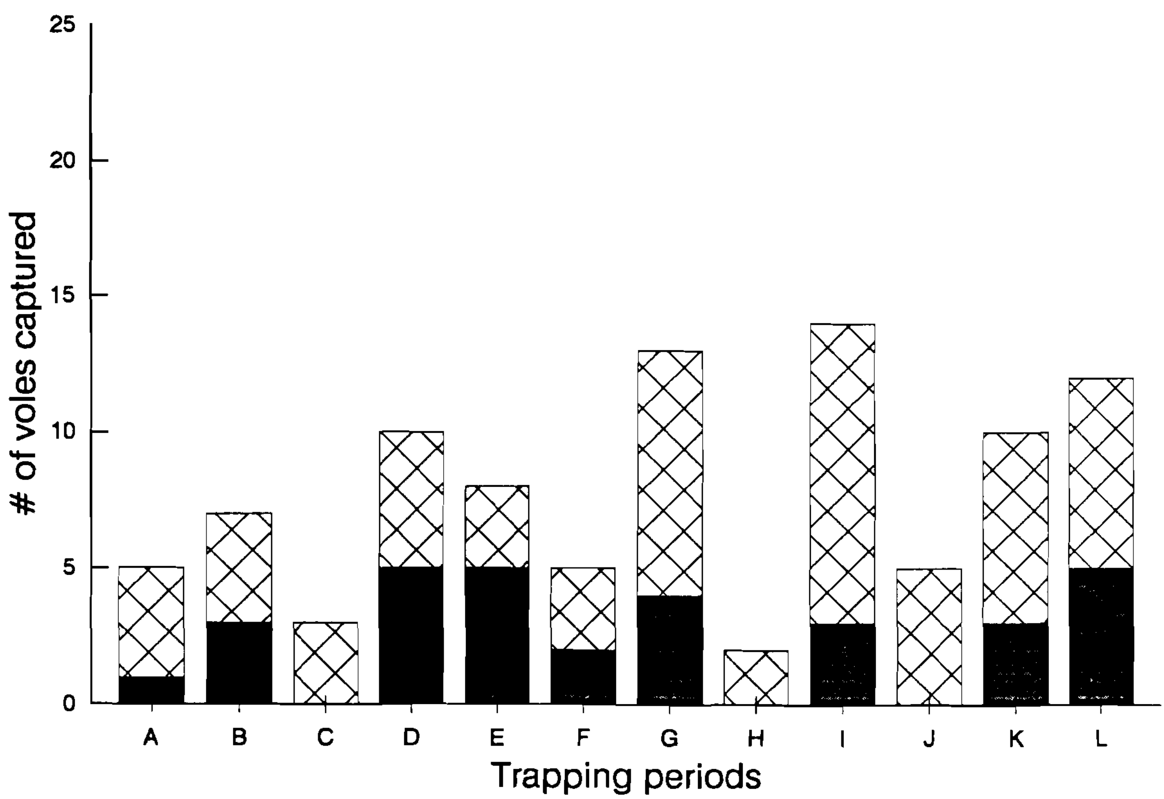
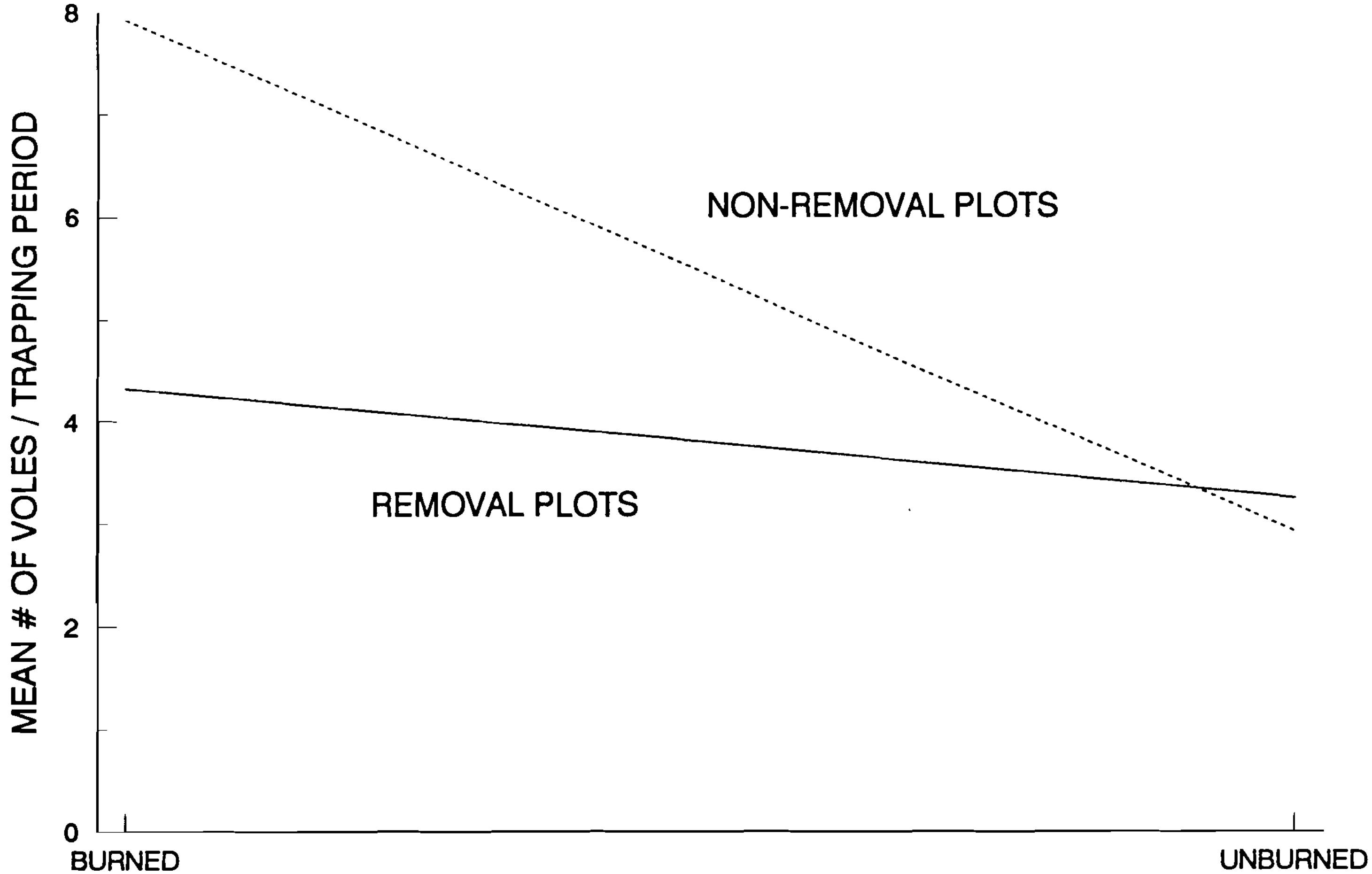

25
20
15
10
5
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 7. Illustration of interaction between burning/no burning and removal/non-removal.


MEAN # OF VOLES / TRAPPING PERIOD
8
6
4
2
0
NON-REMOVAL PLOTS
REMOVAL PLOTS
BURNED
UNBURNED

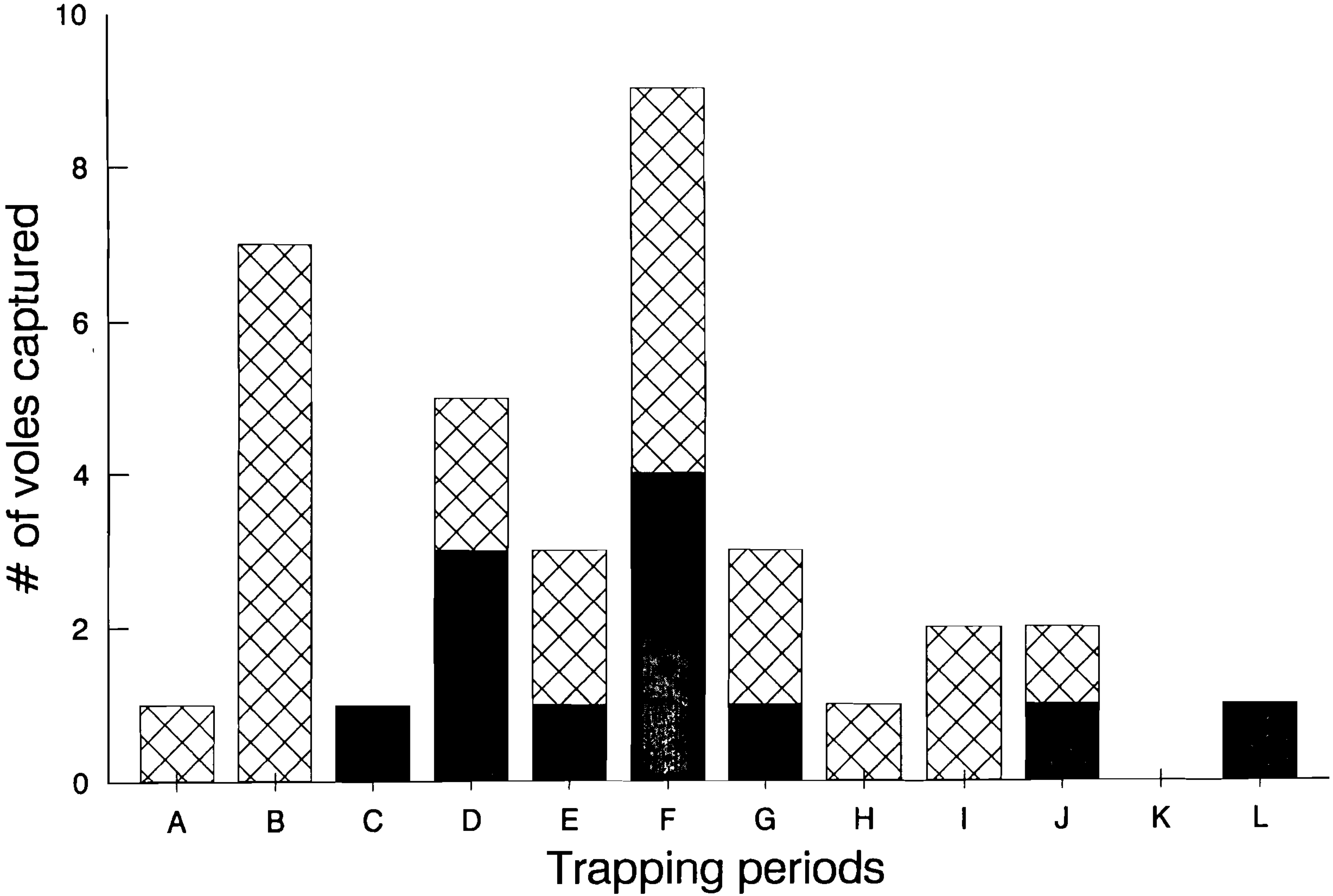
and non-removal on burned plots and the difference between removal and non-removal on unburned plots were examined. There was no significant difference (*F* = 1.166; *d.f.* = 1,22; *P* = 0.292) in numbers of individuals captured between burning versus no burning for the removal grids, however there was a significant difference between burned and no burn for the non-removal grids with more animals caught on the burned grid (*F* = 11.964; *d.f.* = 1,22; *P* = 0.000). There was no difference between removal versus non-removal for unburned grids (*F* = 0.104; *d.f.* = 1,22; *P* = 0.748), however there was a significant difference between removal versus non-removal for burned grids with more animals caught on the non-removal grid (*F* = 6.334; *d.f.* = 1,22; *P* = 0.000). The greatest variation in numbers existed between plots 2 (burn,no removal) and 1 (no burn, no removal). Number of voles captured for each trapping period in each of these plots can be seen in Figures 8, 9, 10 and 11.

Other data included in the study were sex ratios, by months, for all plots combined (Table 1). Relative age classes of individuals caught for each plot during each trapping period are shown in Figures 12, 13, 14, and 15.

Small mammals other than *Microtus* that were captured during the study were the hispid cotton rat (*Sigmodon hispidus*); deer mouse (*Peromyscus maniculatus*); southern bog lemming (*Synaptomys cooperi*); and least shrew (*Cryptotis parva*). An ornate box turtle (*Terrepene ornata*) and a

Figure 8. Number of individual voles caught per trapping period on no burn, non-removal plot 1: females = crosshatched; males = solid.
Designation for trapping periods as follows:

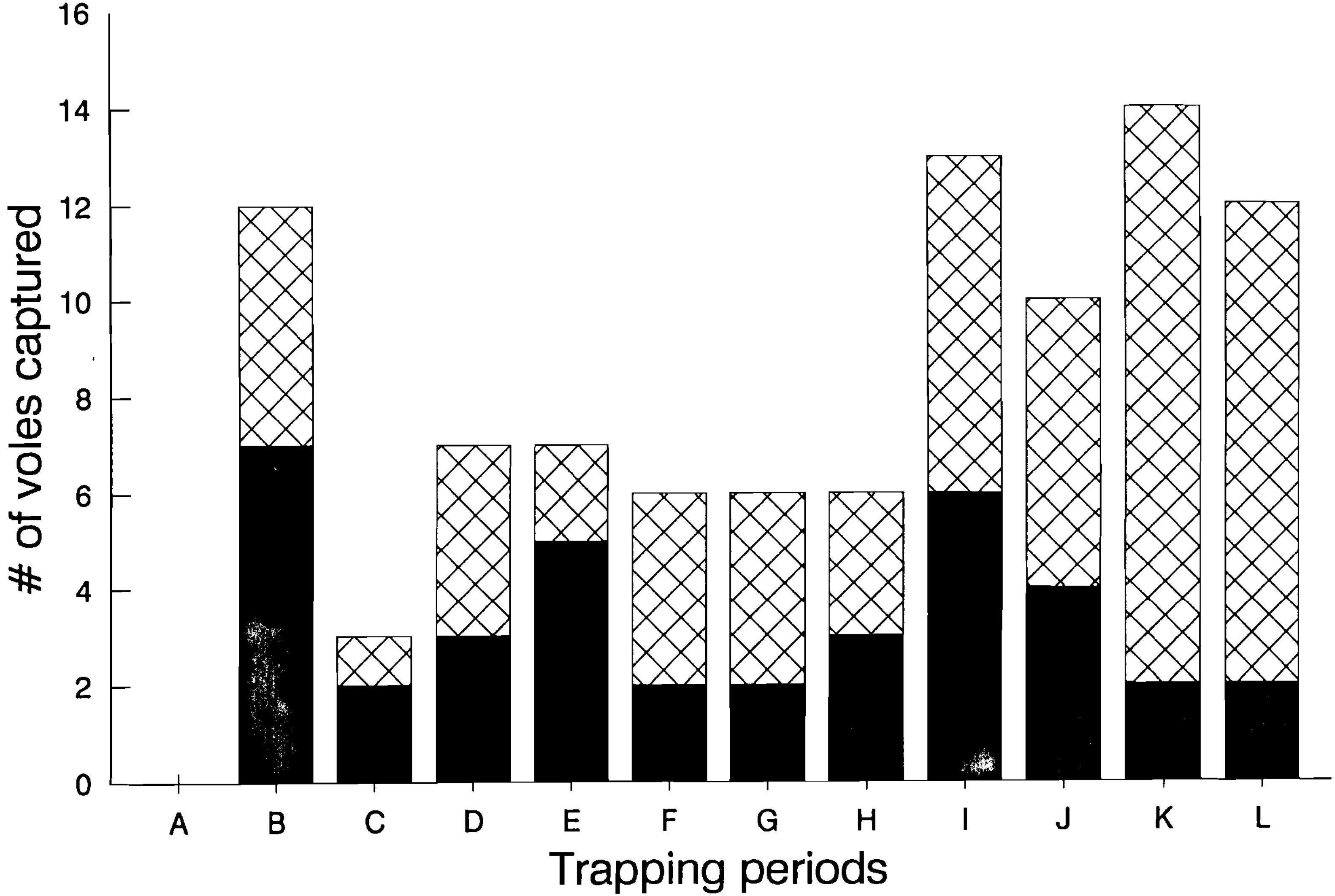
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



10
8
6
4
2
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 9. Number of individual voles caught per trapping period on burn, non-removal plot 2: females = crosshatched; males = solid.
Designation for trapping periods as follows:

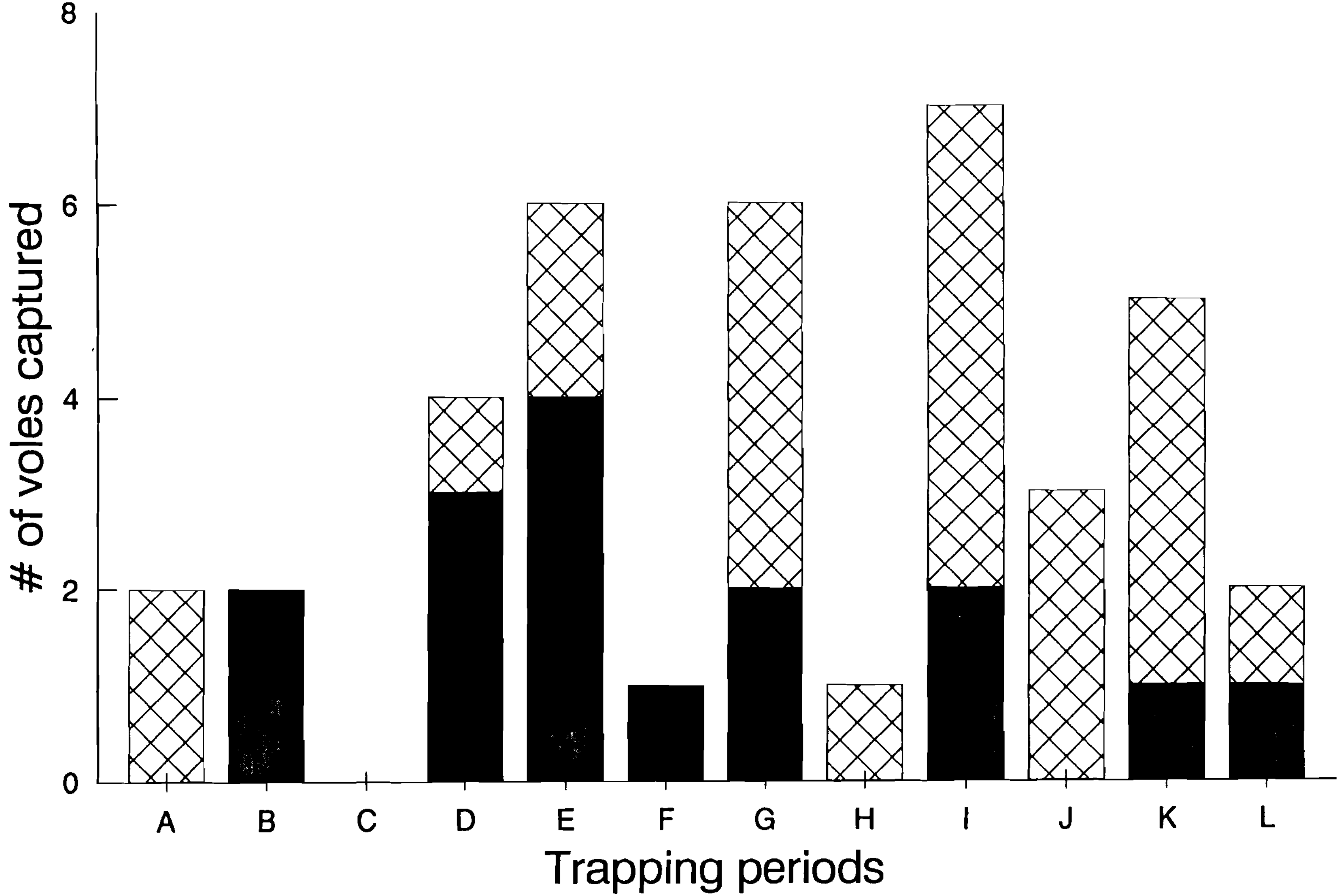
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



16
14
12
10
8
6
4
2
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 10. Number of individual voles caught per trapping period on no burn, removal plot 3: females = crosshatched; males = solid.
Designation for trapping periods as follows:

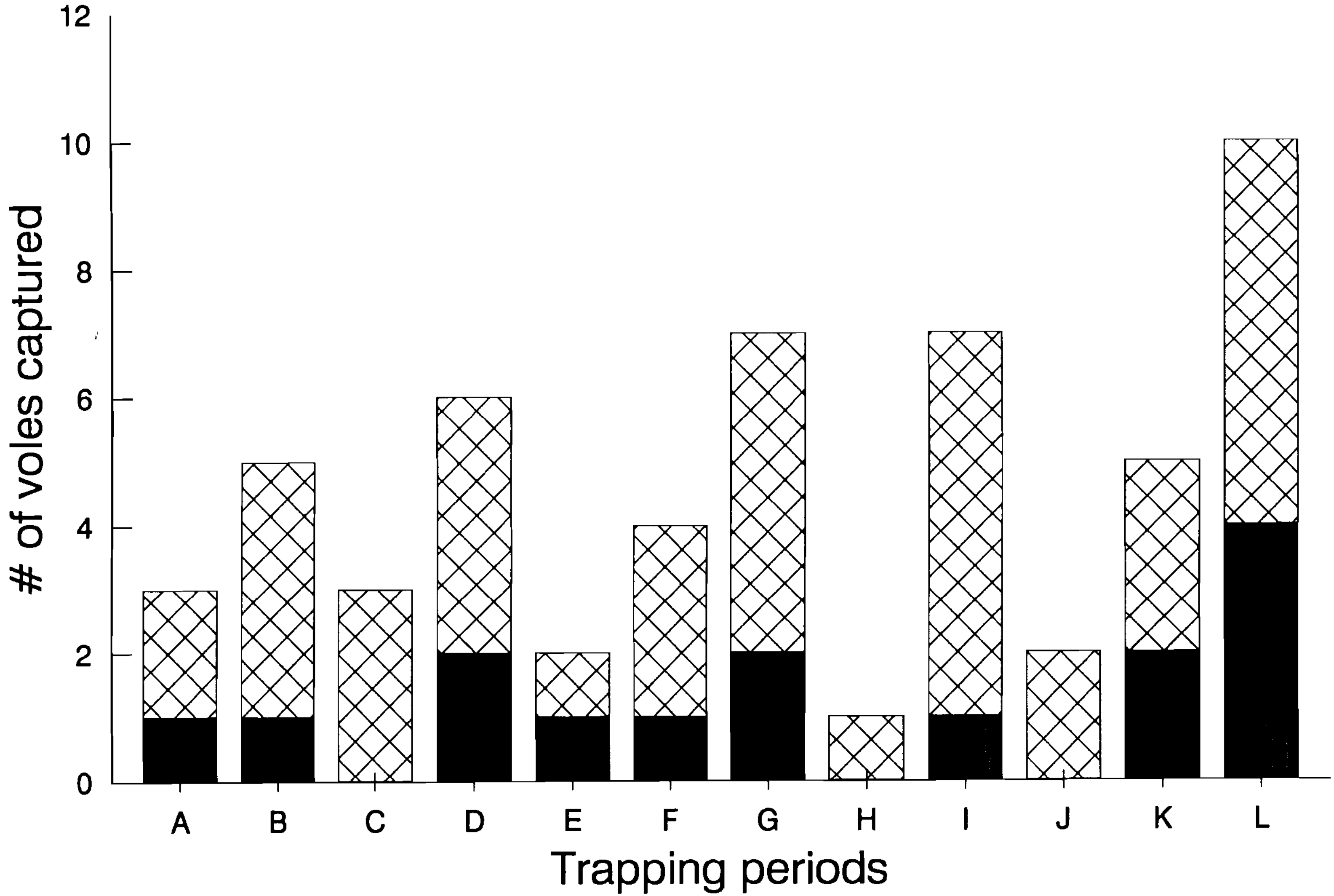
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



8
6
4
2
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 11. Number of individual voles caught per trapping period on burn, removal plot 4: females = crosshatched; males = solid.
Designation for trapping periods as follows:

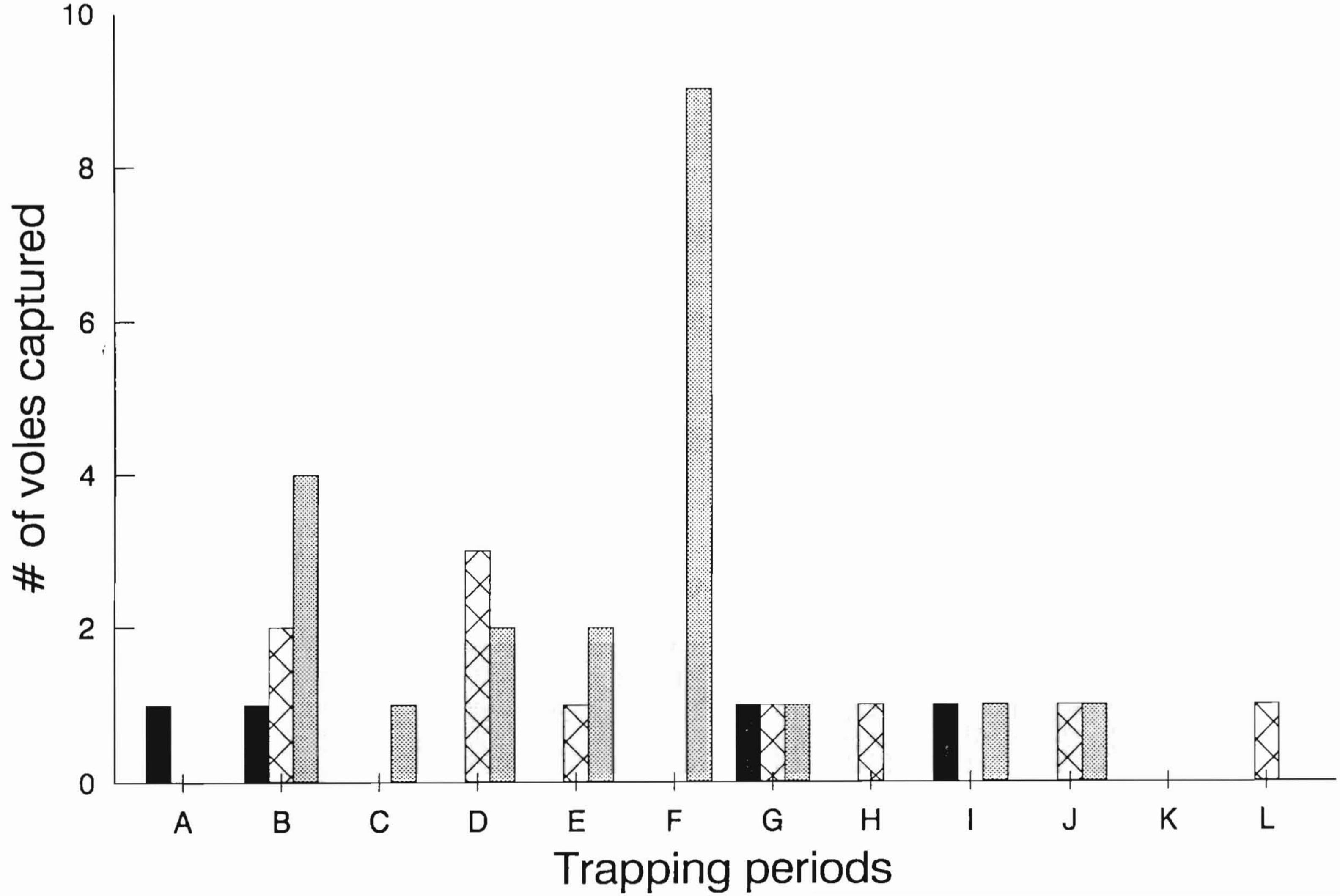
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



# of voles captured
0
2
4
6
8
10
12
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 12. Relative age of individual voles caught per trapping period on plot 1: juveniles = solid; sub-adult = crosshatched; adults = grey. Designation for trapping periods as follows:

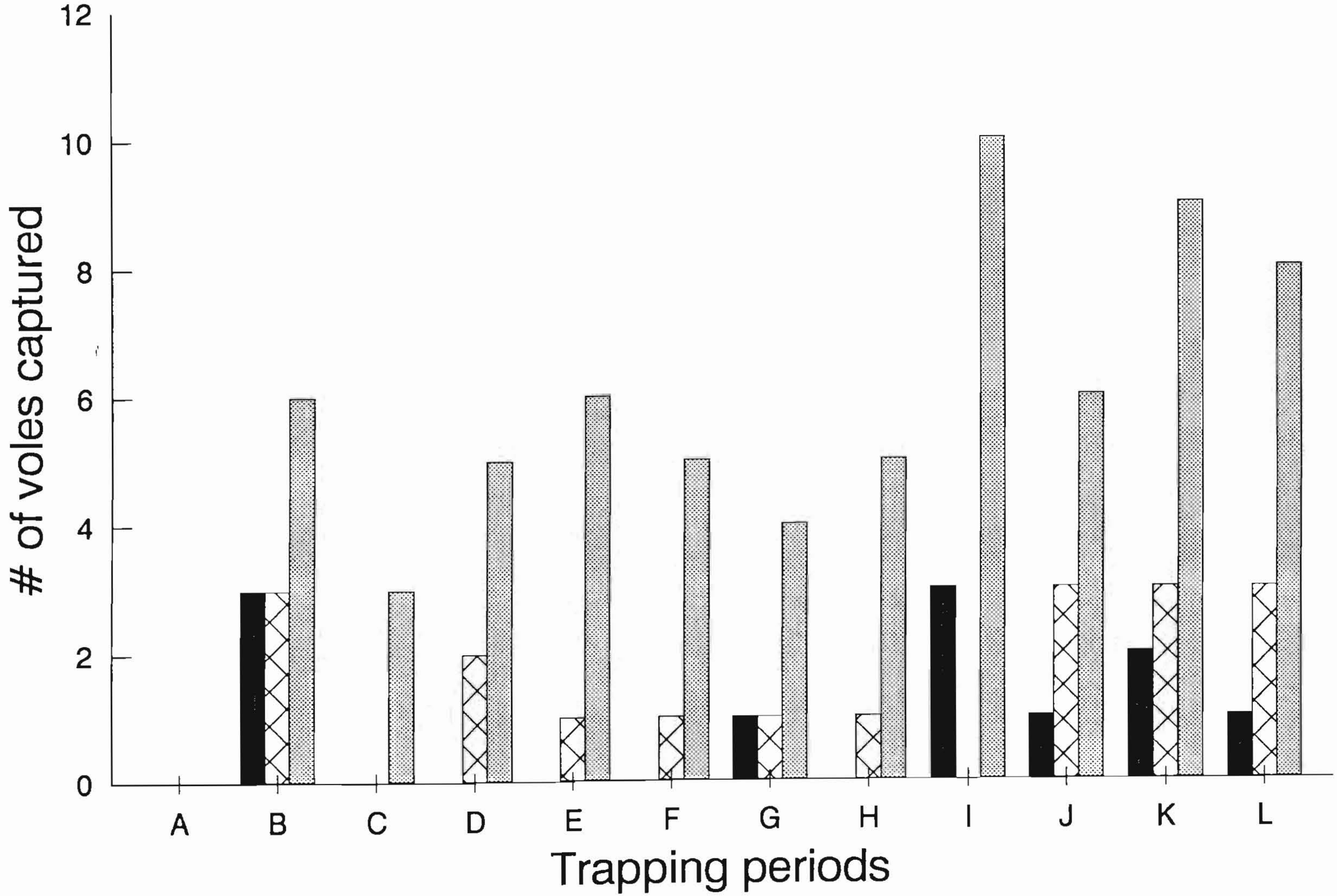
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



10
8
6
4
2
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 13. Relative age of individual voles caught per trapping period on plot 2: juveniles = solid; sub-adults = crosshatched; adults = grey. Designation for trapping periods as follows:

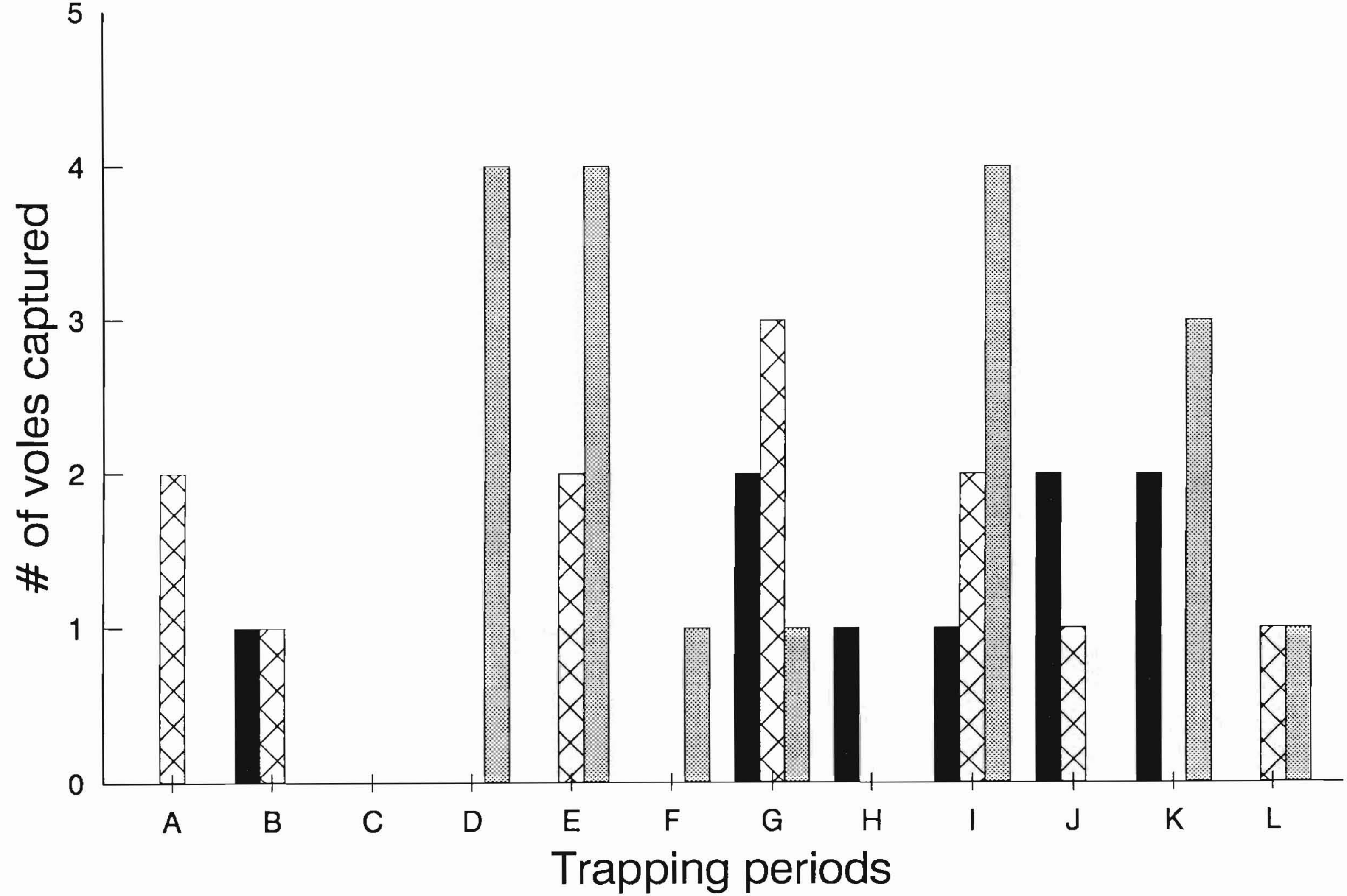
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



12
10
8
6
4
2
0
# of voles captured
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 14. Relative age of individual voles caught per trapping period on plot 3: juveniles = solid; sub-adults = crosshatched; adults = grey. Designation for trapping periods as follows:

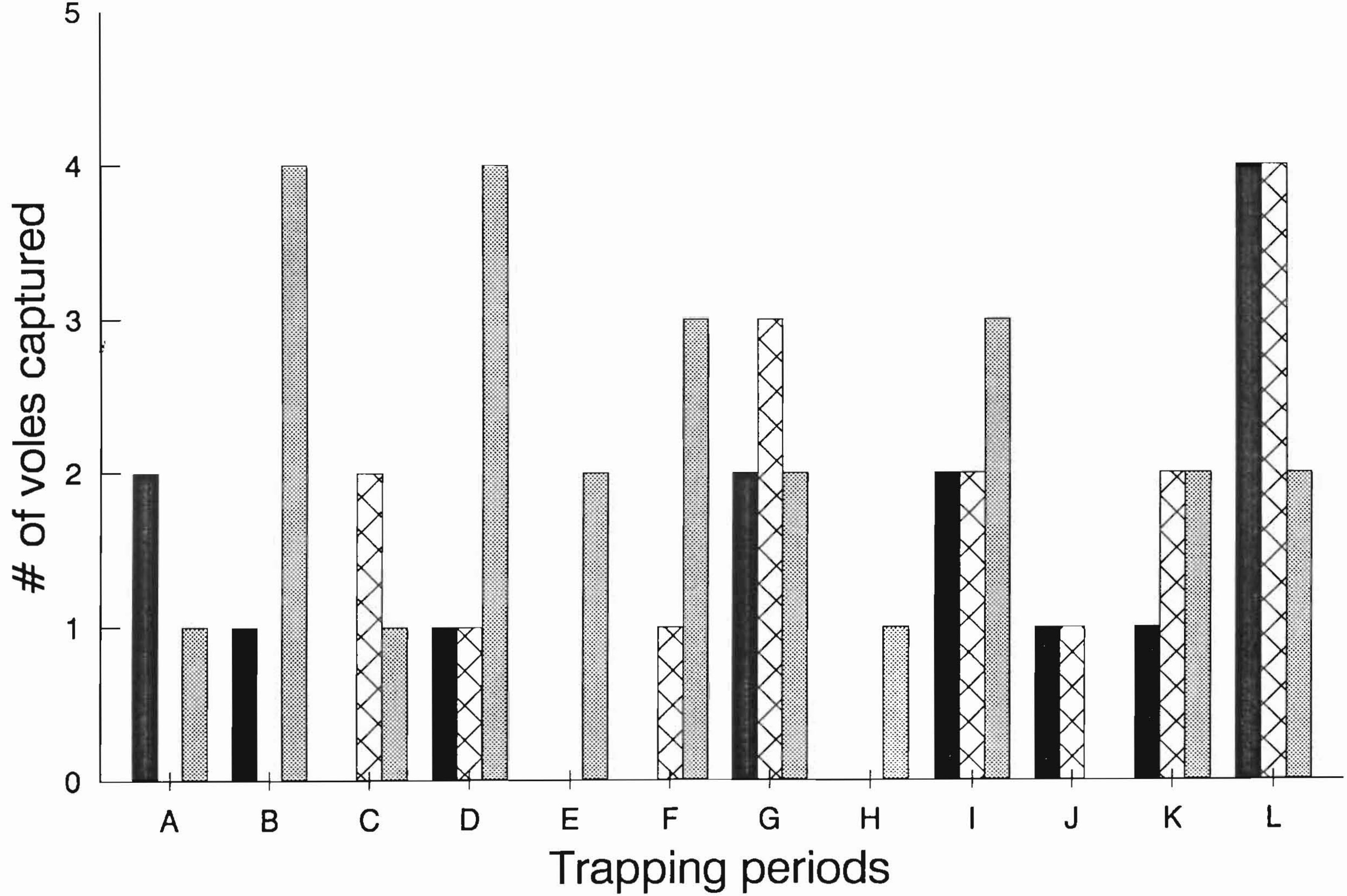
A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



# of voles captured
0
1
2
3
4
5
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

Figure 15. Relative age of individual voles caught per trapping period on plot 4: juveniles = solid; sub-adults = crosshatched; adults = grey. Designation for trapping periods as follows:

A = 2 Nov. - 4 Nov. 1985
B = 17 Nov. - 19 Nov.
C = 29 Nov. - 30 Nov.
D = 10 Jan. - 13 Jan. 1986
E = 24 Jan. - 26 Jan.
F = 28 Feb. - 3 March
G = 28 March - 31 March
H = 12 April - 14 April
I = 25 April - 28 April
J = 10 May - 13 May
K = 24 May - 27 May
L = 9 June - 12 June



# of voles captured
0
1
2
3
4
5
A
B
C
D
E
F
G
H
I
J
K
L
Trapping periods

grasshopper sparrow (*Ammodramus savannarum*) were also captured.

Table 1: Sex ratios, by month, for all plots combined

Month	Males : 100 Females
November	59
January	100
February	67
March	53
April	53
May	40
June	50
mean	59

DISCUSSION

Data from this study on densities of *M. ochrogaster* in burned versus unburned prairie are comparable to those of Schramm and Willcutts (1982) on the differences in *M. ochrogaster* population densities in burned and unburned grids. They found the differences to be significant ($P < .05$) with densities being greater in the burned plots. They also found densities to be lowest in areas that had not been burned for 2-3 years. As mentioned in the RESULTS section, the difference in densities in this study between burned and unburned were significant ($P < .05$).

Vacanti and Geluso (1985) studied recolonization of burned prairie by *M. pennsylvanicus* in Nebraska. They found the density of animals in burned areas finally surpassing that of unburned areas in the second fall following the burn. Some reasons they gave for the higher densities in the burned areas were increased protection from predators, increased food availability and a more favorable microhabitat - *M. pennsylvanicus* preferred more ground litter than *M. ochrogaster* (Vacanti and Geluso, 1985).

Lemen and Clausen (1984) stated that *Microtus* are absent from a burn area for at least 60-90 days after a burn and only begin to recolonize the burned area after vegetation cover has reached approximately 700 g/m2. Presumably, since burning in my study occurred in April and trapping did not begin until late fall following the burn, and the 1985 growing season was favorable for warm season grasses, the 700 g/m2 density had been surpassed and would have had no negative effect on fall trapping results. Grant et al. (1977) demonstrated the ability of *Microtus* to colonize productive habitat. Only one prairie vole was trapped during 15,000 trap nights in a grazed pasture and none were present on experimental grids prior to application of irrigation water and nitrogen fertilizer. Within a few weeks of application of water and nitrogen, a rapidly growing population of prairie voles existed in the dense vegetation. Under a grazing regime, Grant et al. (1982) found that *Microtus* numbers decreased dramatically due to a reduction in vegetative cover below a site specific threshold which is sufficient to support dense populations of *Microtus*. They did not define the threshold.

As discovered in this study, and as found in a review of the literature, any reduction in vegetation as well as a lack of, or reduction in, quality of the forage seems to have a detrimental effect on populations of prairie voles. Since burning of prairie enhances primary productivity of forbs and grasses, thereby enhancing forage quality, *Microtus* populations increase following burning.

Taitt and Krebs (1985) found in a review of studies done by Baird and Birney (1982); Krebs et al.(1976) and Myers and Krebs (1971) that if resident voles are removed, immigrant voles will colonize the vacant area. They did not determine whether the increase in population was due to a surplus from resident populations of nearby areas. Gaines et al. (1979) found that if the colonizers were allowed to remain in the area, they would establish a breeding population. As discovered in this study, there was no significant effect on overall population densities when voles were removed from the area as compared to when voles were released back into the plot. Presumably, the lack of a significant difference was due to immigration by voles from surrounding areas plus capture of transient voles.

Since a significant interaction between burning-no burning and removal-no removal existed among the plots, each plot had to be tested individually against the others. When burned plots were examined with removal as the variable, a significant difference existed with more voles being caught from the burned, non-removal plot. However, on the unburned plots there was no significant effect on the population due to removal. A possible explanation for the absence of a significant effect on the population of *Microtus* on the unburned plots is that low numbers of *Microtus* existed in the unburned plots due to low quality of vegetation for forage and cover so that removal of existing animals and subsequent immigration from surrounding areas resulted in the population in the removal plot remaining at essentially the same level as the population in the non-removal plot.

Numbers of animals in the burned plots were greater because of the quality of vegetation; the number of juvenile voles on burned plots was almost twice that of unburned plots. Hence, with the removal of animals from the burned plot, for example pregnant females with their unborn young, you are not removing one individual but many, there was a greater effect due to removal on that plot and immigration alone was not enough to offset the differences in number of individuals between the plots.

When non-removal plots were examined with burning as the variable, a significant difference existed with more voles being caught on the burned, non-removal plot. However, on the removal plots there was no significant effect on the population due to burning. Vegetation differences that exist between burned and unburned have been noted. The burned plot was able to support a much larger vole population on the non-removal plot because of increased vegetation quality. The effect of removal seems to affect both burned and unburned areas equally such that the advantages of burning could not overcome the effect of removal in this particular case.

As shown in Table 1, the average male to female ratio for the entire trapping period was 59 males: 100 females, with the peak difference in the month of May when there were 40 males:100 females. Gaines and Rose (1976) found no apparent trend in differential trapability by sex and found no significant deviations from a sex ratio of 100 males: 100 females in 4 eastern Kansas populations. Conversely, Taitt and Krebs (1985) reported that Frank (1957) found differences in habits between the sexes led to distorted sex ratios in _M_. _arvalis_. Martin (1956) also found this to be true with the difference in numbers of females significantly higher than the number of males. Another possible explanation is that I incorrectly sexed some animals.

It was found that individuals caught for 3 consecutive nights suffered high mortality rates. Presumably this mortality was caused by the stress of prolonged confinement in traps. There was no mention of similar occurrences in the literature reviewed.

Juvenile animals were caught as early as the last week in March. This indicates that parturition began in late February or early March. The gestation period for _Microtus_ is 21 days. The smallest juvenile caught weighed 7 g. According to Cole and Batzli (1979), weaning occurs between the weights of 11.9 and 18.4 g. On 2 separate occasions, females were caught with young attached to their nipples.

Figures 11, 12, 13 and 14 show numbers of individuals by age class for each plot. The percentages for all trapping periods and plots combined were juveniles, 16.89%; sub-adults, 24.89% and adults 58.22%. Since juveniles are not as mobile as sub-adults and adults, their actual percentage of the population was probably greater than the one expressed. Also, the Fitch traps may not have been effective in catching and retaining juveniles. In a population study by Martin (1956), it was found that juveniles comprised 8.22%; sub-adults, 14.06% and adults - 77.72% of the catch. Although the differences between this and Martin's study are not great, they may be due to the different locations of the studies (Martin's study was in N. E. Kansas), time of the year study was done, time span between the studies, method of age determination (Martin used pelage coloration), type of bait or type of traps used.

Spring burning has a direct, positive impact on quality of prairie forbs and grasses, and the quality of the vegetation following burning has a direct impact on the density of prairie vole populations. With increased forage quality and increased overhead cover due to burning there is a significant increase in the number of individual <u>Microtus</u> inhabiting a burned area into the following year. As previously mentioned in the INTRODUCTION, voles maintain extensive surface runways. Thus, with the removal of ground litter by burning, perhaps a more physically inhabitable environment is created for these voles by eliminating the need to construct these runways. Since prairie voles are primary consumers, from a wildlife aspect an increase in the number of voles present on a given area would mean an increase in the food supply available to predators of that area and subsequently a more ecologically sound food web.

Therefore, spring burning is a benefit not only to the prairie voles but to the secondary consumers of the area as well. The null hypothesis of no effect of spring burning on population densities is rejected.

Removal trapping alone had no effect on the numbers of voles inhabiting a given area when compared to an area where voles were released back into the plot. If removal trapping is thought of as a form of intense predation on a defined area, then predation of these animals has no decreasing effect on population size due to immigration from surrounding areas. Then, possibly, natural predation on a much larger scale with less intensity will have the same effect. The null hypothesis of no effect of removal trapping on population densities is not rejected.

SUMMARY

1. This study was conducted at Ross Natural History Reservation (R.N.H.R.) in Lyon County, Kansas from November, 1985 through mid-June, 1986. The primary objective was to determine the effects, if any, of spring burning on the numbers of voles present in burned and unburned areas. A second objective was to determine the effect of removal trapping on the number of voles present when compared to non-removal areas.

2. Four trapping plots were established as a 2 factor crossed design using burning-no burning and removal-no removal as the variables. Burning occurred in mid-April, 1985. Trapping began on 2 November 1985 and ended 12 June 1986. Analysis of variance was used to test for differences between and among the plots.

3. A significantly higher number of individual voles were captured on burned plots than on unburned plots. There was no significant difference in numbers of voles captured on removal plots versus non-removal plots. However, a significant interaction was found to exist among the variables of burning-no burning and removal-no removal. A significantly higher number of individuals were caught on the non-removal, burn grid than on the removal, burn grid. Also, a significantly higher number of individuals were caught on the burn, non-removal grid than on the no burn,

non-removal grid.

4. Because of increased vegetation quality on the burned plots, *Microtus* responded with an increase in numbers. The effects of removal alone on numbers of animals are insignificant when compared to non-removal plots suggesting that immigration is able to maintain essentially the same numbers on the removal plots that exist on the non-removal plots.

LITERATURE CITED

Cole, F. R. and G. O. Batzli. 1979. Nutrition and population dynamics of the prairie vole, _Microtus ochrogaster_, in central Illinois. J. of Anim. Ecol. 48:455-470.

Cook, S. F. 1959. The effects of fire on a population of small rodents. Ecology 40:102-108.

Gaines, M. S., A. M. Vivas and C. L. Baker. 1979. An experimental analysis of dispersal in fluctuating vole populations: demographic parameters. Ecology 60:814-828.

Gaines, M. S. and R. K. Rose. 1976. Population dynamics of _Microtus ochrogaster_ in Eastern Kansas. Ecology 57: 1145-1161.

Getz, L. L. 1985. Habitats. Pp. 286-309, in Biology of New World _Microtus_ (R. H. Tamarin, ed.). Spec. Publ., Amer. Soc. Mamm. 8:1-893.

Grant, W. E., E. C. Birney, N. R. French and D. M. Smith. 1982. Structure and productivity of grassland small mammal communities related to grazing induced changes in vegetative cover. J. Mammal. 63:248-262.

Grant, W. E., N. R. French and D. M. Smith. 1977. Response of a small mammal community to water and nitrogen treatment in a shortgrass prairie ecosystem. J. Mammal. 58:637-652.

Hadley, E. B. and B. J. Kieckhefer. 1963. Productivity of two prairie grasses in relation to fire frequency. Ecology 44:389-395.

Hulbert, L. C. 1969. Fire and litter effects in undisturbed bluestem prairie in Kansas. Ecology 50:874-877.

Hyde, R. M. and C. E. Owensby. 1971. Bluestem range burning. Cooperative Extension Service, Kansas State University.

Kaufman, D. W., G. A. Kaufman and E. J. Finck. 1983. Effects of fire on rodents in tallgrass prairie of the Flint Hills region of Eastern Kansas. Prairie Nat. 15(2):49-56.

Kucera, C. L. and J. H. Ehrenreich. 1962. Some effects of annual burning on central Missouri prairie. Ecology 43:334-336.

Lemen, C. A. and M. K. Clausen. 1984. The effects of mowing on the rodent community of a native tall grass prairie in Eastern Nebraska. Prairie Nat. 16(1):5-10.

Martin, E. P. 1956. A population study of the prairie vole (Microtus ochrogaster) in N. E. Kansas. Univ. Kansas Publ., Mus. Nat. Hist. 8:361-416.

Peterson, S. K., G. A. Kaufman and D. W. Kaufman. 1985. Habitat selection by small mammals of the tall-grass prairie: experimental patch choice. Prairie Nat. 17(2):65-70.

Rose, R. K. and E. C. Birney. 1985. Community Ecology. Pp. 310-339, in Biology of New World Microtus (R. H. Tamarin, ed.). Spec. Publ., Amer. Soc. Mamm. 8:1-893.

Schramm, P. and B. J. Willcutts. 1983. Habitat selection of small mammals in burned and unburned tallgrass prairie. Pp. 49-55 in Proceedings: 8th North American Prairie Conference (R. Brewer, ed). Western Michigan University, Kalamazoo.

Schwartz, C. W. and E. R. Schwartz. 1981. The Wild Mammals of Missouri. University of Missouri Press.

Soil Survey of Lyon County, Kansas. 1981. United States Department of Agriculture Soil Conservation Service.

Spencer, D. 1980. Ross Natural History Reservation: The First Twenty Years. Emporia State University Press, Emporia, Kansas.

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., Amer. Soc. Mamm. 8:1-893.

Terman, M. R. 1978. Population dynamics of Microtus and Sigmodon in Central Kansas. Trans. Kansas Acad. Science 81:337-352.

Vacanti, P. L. and K. N. Geluso. 1985. Recolonization of a burned prairie by meadow voles (Microtus pennsylvanicus). Prairie Nat. 17(1):15-22

Signature of Graduate Student

Signature of Major Advisor

I, Crispin H. Dippel, hereby submit this thesis to Emporia State University as partial fulfillment of the requirements of an advanced degree. I agree that the Library of the University may make it available for use in accordance with its regulations governing materials of this type. I further agree that quoting, photocopying, or other reproduction of this document is allowed for private study, scholarship (including teaching), and research purposes of a nonprofit nature. No copying which involves potential financial gain will be allowed without written permission of the author.

Signature of Author

25 August 1989

Date

Some Effects on Prairie Vole Populations in Burned and Unburned Prairie

Title of Thesis Report

Signature of Graduate Office Staff Member

August 27, 1989

Date Received