THE EFFECTS OF CHANNELIZATION AND IMPOUNDMENT ON RIPARIAN SMALL MAMMAL COMMUNITIES IN SOUTH CENTRAL OKLAHOMA

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The zone of riparian bottomland vegetation that extends within 100 meters of the edges of most prairie streams is important to many small animals. It forms a corridor habitat of trees and shrubs which provides for species that could not otherwise occur due to a lack of essential food, cover or other niche parameter. Alteration of such riparian zones has occurred in connection with projects of the U. S. Army Corps of Engineers, the Soil Conservation Service, and private operations. To assess the effects of such stream alteration on the attendant small mammal populations, an analysis of those populations was run as a part of an overall study of the impact of stream alteration on riparian flora and fauna in Oklahoma.

The specific objectives of this study included:

(1) to assess the composition and structure of the small mammal community within 100 meters of the banks channelized and unchannelized portions of south-central Oklahoma streams;

(2) to assess the composition and structure of the small mammal community within 100 meters of the banks of streams above and below impoundments in south-central Oklahoma;

(3) to determine the environmental impact of the above two types of stream alterations on the small mammal communities associated with south-central Oklahoma streams;

(4) to develop guidelines for future use in assessing the environmental impact of channelization and impoundment on south-central Oklahoma streams using small mammal data.

CHAPTER II

MATERIALS AND METHODS

Site Selection

Analysis of 13 south-central Oklahoma streams and 7 reservoirs was carried out by senior project personnel during the spring of 1976. Eighteen physical, hydrological, informational, and accessability factors were obtained with relative weights assigned to the data obtained for each stream and reservoir and a site selection matrix was generated. Wildhorse and Rush creeks had the highest combined values and these were selected. Fort Cobb Reservoir possessed the highest value for the impoundment portion of the study.

In May, 1976, project field personnel began locating individual sites along each stream and the reservoir. Attention was given to channel type, channel history, land usage, habitat type and accessability in the stream sites, and position in relation to the dam and habitat type in the reservoir sites. An attempt was made to obtain as diverse a range of habitats as possible and also to pair like habitats across channelization type. See Figures 1, 2 and 3 for site locations and land resource areas in which they occur.

The land resource areas, or eco-geographic regions, seen in Figures 2 and 3 consist of the Crosstimbers, characterized by deciduous woodlands dominated by oaks and intermixed with prairie, the Central

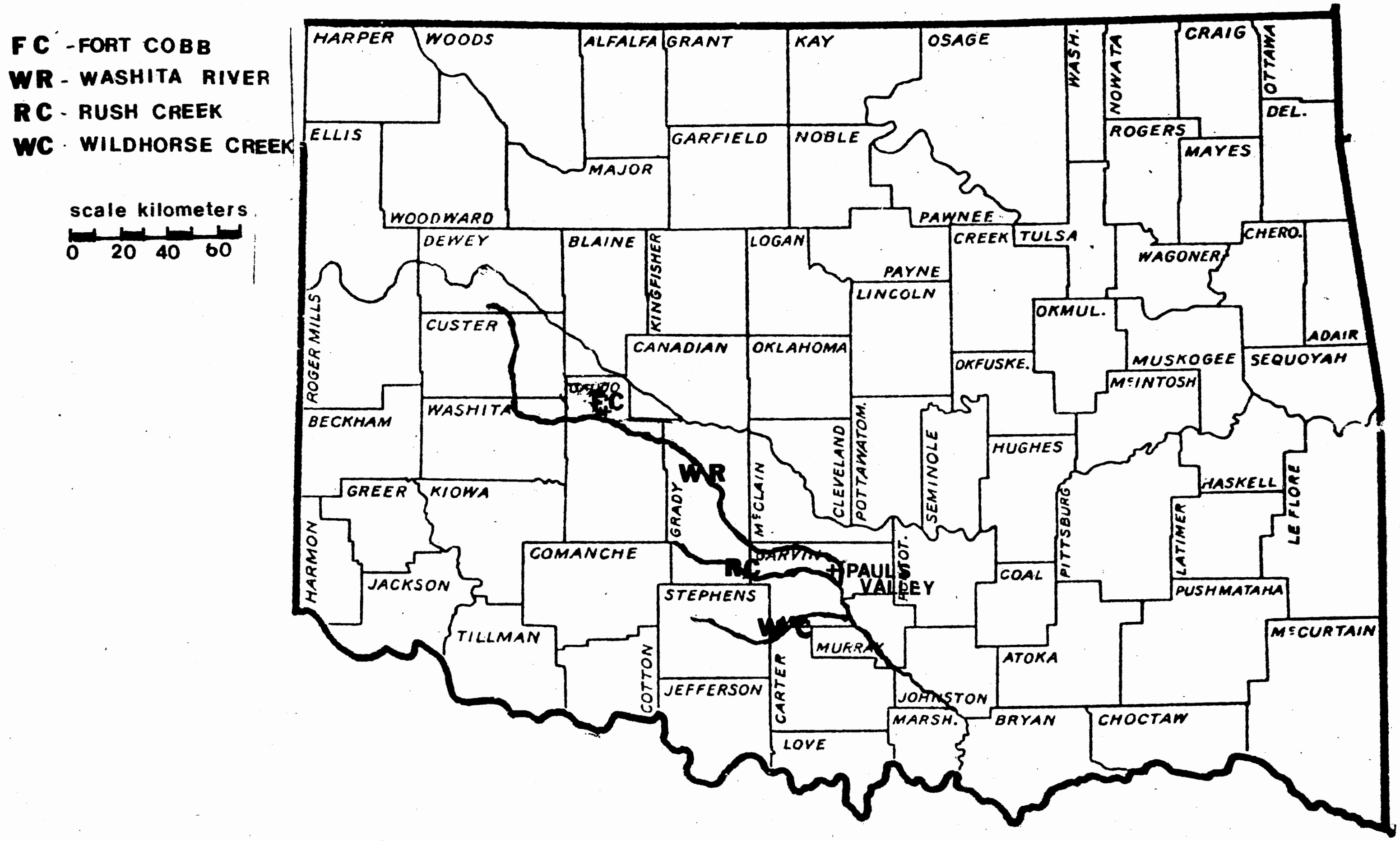

Figure 1. Map of Oklahoma (Excluding the Panhandle) with the Washita River, Rush Creek, Wildhorse Creek and Fort Cobb Reservoir Indicated

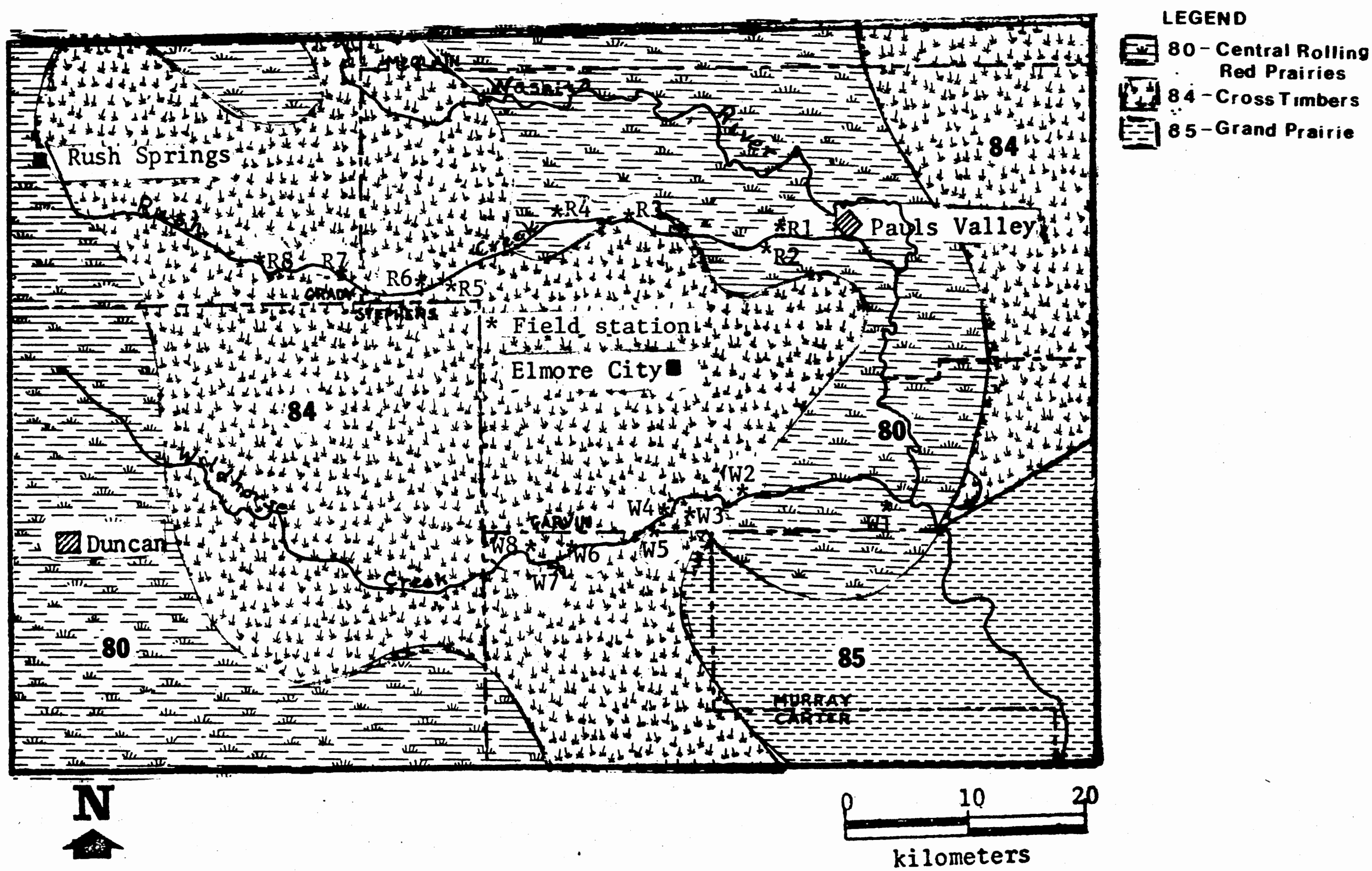

Figure 2. Locations of Rush and Wildhorse Creeks and Selected Riparian Study Sites with Ecological Regions Indicated (Bailey, 1976)

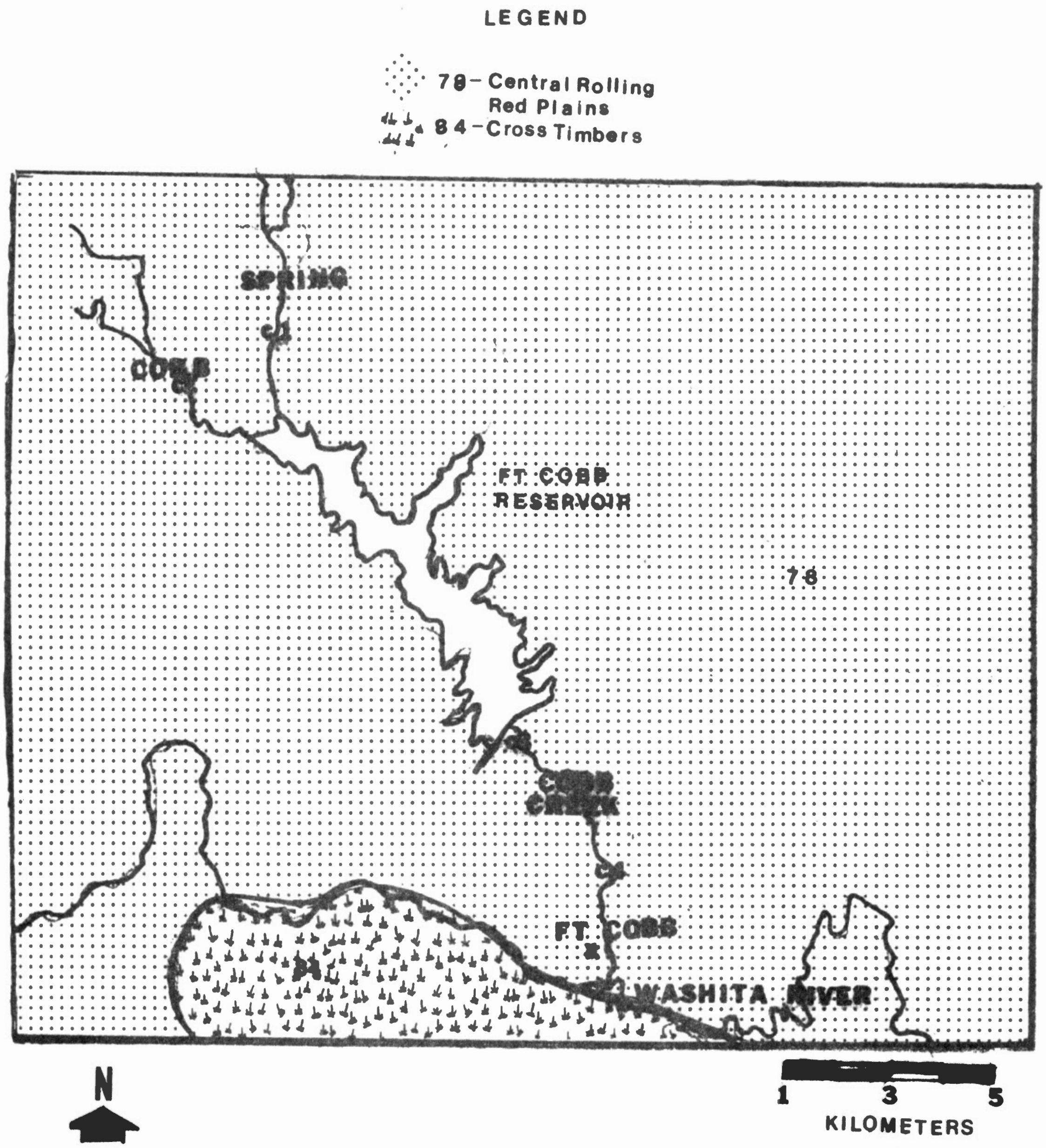

Figure 3. Locations of Fort Cobb Reservoir Study Sites in Caddo County, Oklahoma, with Ecological Regions Indicated (Bailey, 1976)

Rolling Red Plains characterized by mixed and short grasses, the Central Rolling Red Prairies with mixed and tall grasses, and the Grand Prairie, also of mixed and tall grasses (Bailey, 1976).

The overall ecological conditions of each region will, of course, influence the small mammal species present (Blair, 1937), however, since this project dealt with a riparian stream-edge vegetation base, the natural habitat at each site was assumed to have originally been bottom land hardwoods typified by oak, pecan, and walnut, with grasses, forbs and shrubs intermixed in the understory.

Site Descriptions

Rush Creek

R_1 - Old channelization. Banks 5 m high with intermittent vegetation. Johnson grass extends from bank edge 10 m to corn field.

R_2 - Old channelization. Banks as described above. Pecan/bermuda grass extends from bank edge. Ungrazed.

R_3 - Technically unchannelized but due to extensive stream alteration above and below, the site is old channelized in effect. Banks 8 m high with no vegetation. Island of bottomland hardwoods in process of being cleared. Grazed. 150 m x 200 m in extent.

R_4 - Old channelization. Banks 3 m high with no vegetation. Bermuda grass pasture with no shrubs or trees. Heavily grazed.

R_5 - Unchannelized. Banks 5 m with vegetation. Native grass planted 15 years previously. Grazed.

R_6 - Unchannelized. Banks 5 m with vegetation. Island of bottomland hardwoods 300 m x 200 m in extent.

R_7 - Unchannelized. Banks as described above. Site was channelized but the creek has since returned to original bed leaving channelized banks as a levee. Bottomland hardwoods with ryegrass understory. Ungrazed.

R_8 - Unchannelized. Banks as described above. Bottomland hardwoods. Grazed.

Wildhorse Creek

W_1 - Unchannelized. Banks 4 m with no vegetation. Bottomland hardwoods. Grazed.

W_2 - Channelized. Banks 3 m with intermittent vegetation. Alfalfa croplands.

W_3 - Channelized. Banks 2 m with no vegetation. Bermuda grass pasture with no trees or shrubs. Heavily grazed.

W_4 - Channelized. Banks 4 m with vegetation. Pecan/bermuda grass. Heavily grazed.

W_5 - Channelized. Banks 5 m with no vegetation. Bottomland hardwoods. Old channel winds through area. Grazed.

W_6 - Channelized. Banks as described above. Pecan/bermuda grass. Heavily grazed.

W_7 - Recent channelization. Banks 4 m with vegetation. Alfalfa cropland.

W_8 - Unchannelized. Banks 2 m with vegetation. Bottomland hardwoods. Grazed. Oil field present.

Fort Cobb Reservoir

C_1 - Above dam on Lake (Spring) creek. Riparian bottomland hardwoods. Grazed.

C_2 - Above dam on Cobb Creek. Narrow riparian bottomland hardwoods. Alfalfa from edge.

C_3 - Below dam on Cobb Creek. Riparian bottomland hardwoods. Alfalfa from edge.

C_4 - Below dam on Cobb Creek. Intermittent riparian bottomland hardwoods with rye grass planted beneath. Alfalfa from edge.

Data Collection

Data collection began 1 June 1976 and was terminated by 15 August 1976 for all sites except W_1 and W_5. Periodic visits were made to these sites in November, February, and June of 1976-1977, to monitor general population conditions.

The majority of small mammal data were collected using the North American Standard Small Mammal Census (NAS) developed by Calhoun (1948). Traplines were set with 0.75 m of cord per trap, 3 traps per station, 7.5 m between stations, and 20 stations per line. Traplines were run for three consecutive nights using Museum Special snaptraps with lines run parallel to the stream, baited each night with peanut butter. The number of lines set for each site was dependent upon the habitat "subzones" present, one line per "subzone." Line 1 was placed in the first flood terrace where that zone was present. The first flood terrace was typically a low lying willow-salt cedar band immediately along the stream bank averaging approximately 5-10 m wide. The vegetation generally consisted of grasses and sedges with intermittent clumps of early successful weeds and bush. This zone was the one most frequently affected by stream alteration and was present only on sites R_5, R_6, R_7, R_8, and W_4. Line 2 was located along, or near, the baseline transect all members of the project used as the 0 meter baseline. It ran along the actual creek bank which formed the physical barrier between the primary flood terrace where present, and the "riparian" vegetation consisting of woodlands, pasturelands, and croplands. This line was run in all cases but one, R_7. It was not run in that instance due to the effect of a levee which created a stairstep arrangement of three banks. The project baseline was established along the levee. Line 3 was located approximately 25-50 m inland from the baseline. This line sampled the "riparian" zone. In all there were 12 lines run for channelized sites and 12 lines for unchannelized sites.

Several species of small mammals are not susceptible to the NAS trapping technique and other methods were employed in an effort to sample these species. Active nest counts and 4-way rattraps were used for *Neotoma*, mound counts and gopher traps for *Geomys*, and miscellaneous capture methods, such as hand caught, for various species.

Sites were run in pairs so that similar habitats across channel type should not be confounded with seasonal variation. All creek sites were sampled once during the summer of 1976. Sites W_1 and W_5 were monitored with one NAS line #3 each in November of 1976 and

February and June of 1977.

The same techniques were used at the Fort Cobb sites with the exceptions of 1) only one NAS line was run per site; 2) sites were sampled twice during the summer of 1976 and not at all during the fall and spring of 1976-1977, and 3) all 4 sites were run simultaneously.

The above listed variations in the Fort Cobb data collection techniques were necessary due to the need to sample all four reservoir sites simultaneously due to restrictions in time and equipment. The Fort Cobb sites were each sampled twice in order to obtain replicates for statistical procedures.

Representative study skins from each site were placed in the Oklahoma State University Museum. All species were identified according to Walker (1975), Blair (1939), and Burt and Grossenheider (1964).

Data Analysis

Small mammal data were qualitatively and quantitatively analyzed. Quantitative methods consisted of statistical analysis where possible. The tests used were largely nonparametric due to the nature of the data obtained and included chi-square (X^2) and Mann-Whitney Rank which were non-parametric and F, T, and Index of Diversity which were parametric comparisons. These tests were run according to the standards, formulas and tables found in Zar (1974). The 95% confidence level was used to decide significant differences between comparisons.

Qualitative analysis was based on the relative ecological position and value of the species represented by various census methods at each site. Each species was assigned an ecological rank based on its respective trophic level, feeding strategy and niche breadth. The latter was in part influenced by the species' frequency of occurrence across diverse habitats. This was done to establish an index of the species' sensitivity to habitat alteration in order to determine in the future, a habitat's condition by looking for key species. The matrices used to generate individual species' ranks are found in Tables I and II. The differences found between certain species' value ranks and their assigned ranks were the result of weighing the described factors with more discrimination than was applicable to the table format.

TABLE I

MATRIX SHOWING FACTORS AND ASSIGNED VALUES FOR EACH SPECIES OCCURRING IN THE RUSH AND WILDHORSE CREEKS DATA AND THE RESULTING ECOLOGICAL SPECIES' RANKS

Species In Ecological Rank Order	Frequency of Occurrence	Frequency Ranked	+	Number of Habitats Occupied	+	Feeding Strategy/ Trophic Level	=	Total Value	Value Ranked	Assigned Rank	Source for Feeding Strategy Trophic Level Information
Mus musculus	9	5		7*		3		15	5	1	Vaughn, 1972
Geomys bursarius	70	10		7		4		21	2	2	Glass, 1951
Peromyseus leucopus	142	11		7		2		20	1	3	King, 1968
Neotoma floridana	59	9		2		2		13	6	4	Walker, 1975
Peromyscus maniculatus	56	8		5		2		15	3	5	King, 1968
Perognathus hispidus	12	7		6		3		16	4	6	Vaughn, 1972
Sigmodon hispidus	9	5		3		4		12	8	7	Walker, 1975

TABLE I (Continued)

Species In Ecological Rank Order	Frequency of Occurrence	Frequency Ranked	+	Number of Habitats Occupied	+	Feeding Strategy/ Trophic Level	=	Total Value	Value Ranked	Assigned Rank	Source for Feeding Strategy Trophic Level Information
Scalopus aquaticus	9	5		4		1		10	7	8	Vaughn, 1972
Reithrodontomys fulvescens	7	3		3		2.5		8.5	9	9	Walker, 1975
Blarina brevicauda	2	1.5		2		1		4.5	10	10	Walker, 1975
Cryptotis parva	2	1.5		2		1		4.5	10	11	Whitaker, 1974

**Mus* are commensal with man and are found near human dwellings regardless of habitat type.

TABLE II

MATRIX SHOWING FACTORS AND ASSIGNED VALUES FOR EACH SPECIES OCCURRING IN THE FORT COBB DATA AND THE RESULTING ECOLOGICAL SPECIES' RANKS

Species In Ecological Rank Order	Frequency of Occurrence	Frequency Ranked	+	Number of Habitats Occupied	+	Feeding Strategy/ Trophic Level	=	Total Value	Value Ranked	Assigned Rank	Source for Feeding Strategy Trophic Level Information
Peromyscus leucopus	36	8		1		2		11	3	1	King, 1968
Geomys bursarius	18	6		1		4		11	2	2	Glass, 1951
Neotoma floridana	47	9		1		2		12	1	3	Walker, 1975
Sigmodon hispidus	10	5		1		4		10	4	4	Walker, 1975
Perognathus hispidus	2	3		1		3		7	7.5	5	Vaughn, 1972
Reithrodontomys fulvescens	2	3		1		3		7	7.5	6	Walker, 1975
Scalopus aquaticus	26	7		1		1		9	5	7	Vaughn, 1972
Microtus pinatorum	2	3		1		4		8	6	8	Walker, 1975
Onychomys leucogaster	1	1		1		1		3	9	9	McCarty, 1978

*only one habitat (edge between riparian woods and croplands) sampled.

CHAPTER III

RESULTS AND DISCUSSION

Channelization Effects

Quantitative

Statistical results from all tests run are summarized in Appendix A, and data are summarized in Appendix B and C. Unchannelized sites had consistently higher values than did the channelized sites (Figures 4, 5, and 6). The differences in trapping success were not significant statistically however, when analyzed using X^2, Mann-Whitney Rank or T tests. The total number of individuals captured using all sampling techniques was significantly higher at the .05 level for the unchannelized sites overall when compared to the channelized sites according to the Mann-Whitney Rank test and the T-test. The index of species diversity was not significantly different. The relationship between the numbers of individuals per channel type and habitat type divided as to whether the number was based on only North American Standard census data or on a composite of all census techniques can be seen in Figure 6.

The difference between channelized and unchannelized woodlands using only NAS data is not significant using X^2 or Mann-Whitney Rank tests, although it is significantly higher for the unchannelized woodlands by the T-test. There was no detectable difference in the species diversity index between the two types of woodlands. Using the data

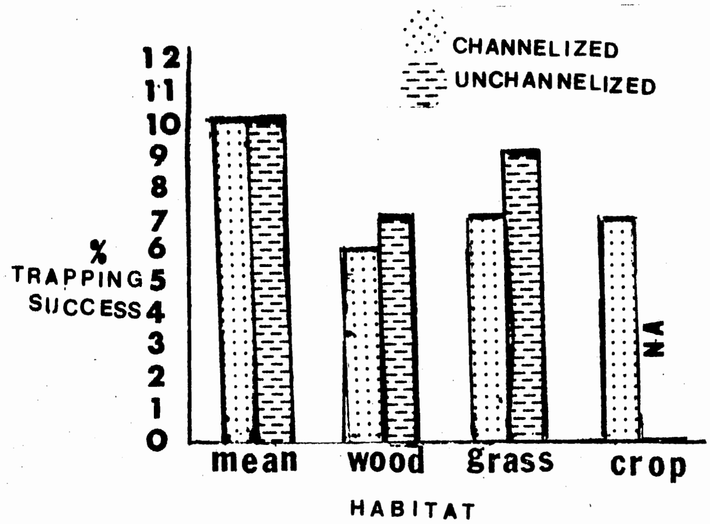

Figure 4. Trapping Success by Habitat Type and Channel Type for Rush and Wildhorse Creeks

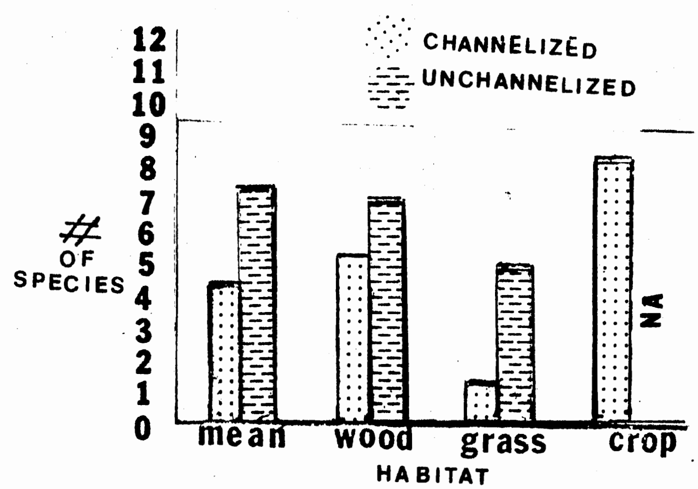

Figure 5. Number of Species by Habitat Type and Channel Type for Rush and Wildhorse Creeks

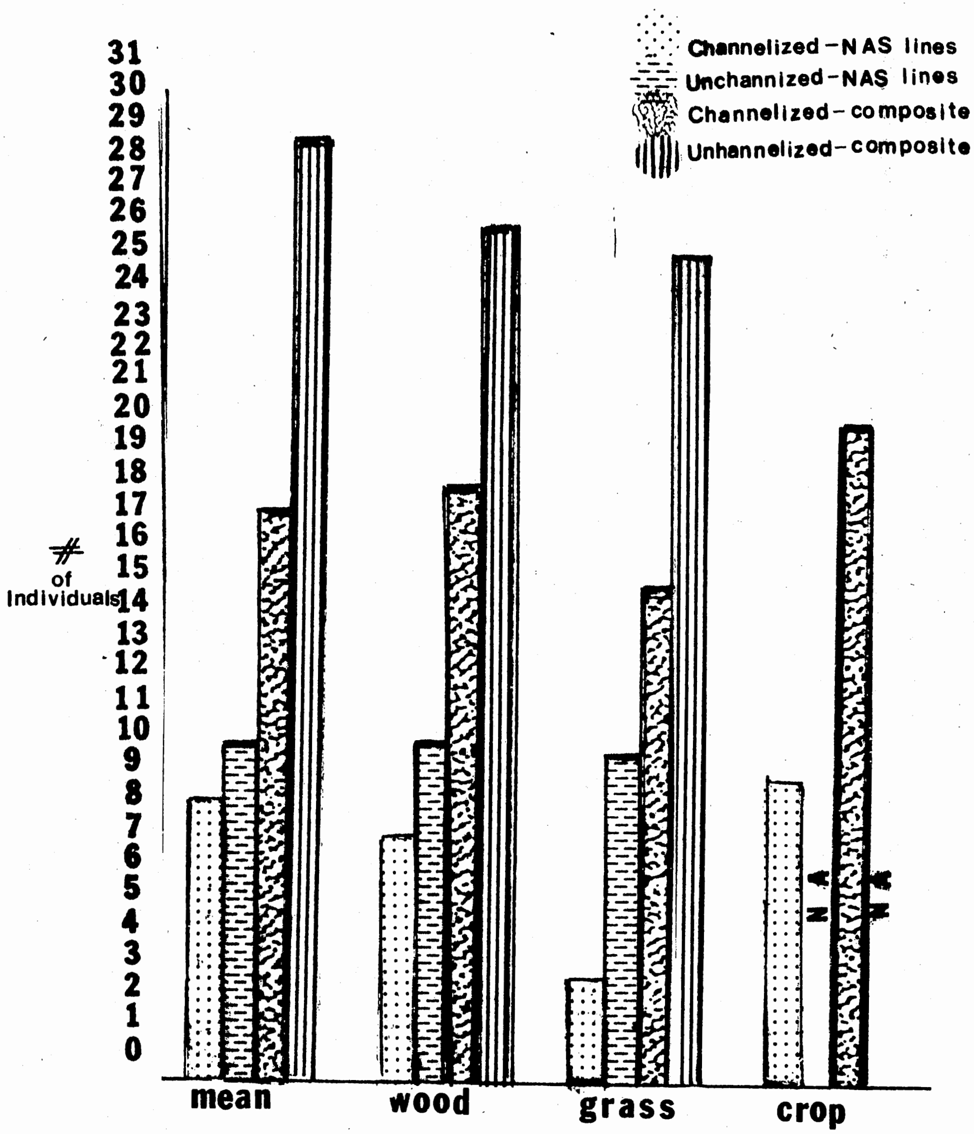

Figure 6. Number of Individuals by Habitat, Channel and Census Type on Rush and Wildhorse Creeks

generated by the composite of all sampling methods (i.e., NAS, visual observations, sign trapping, etc.), the unchannelized woodland sites are significantly higher using the T-test.

Unchannelized grasslands were significantly higher in species diversity for both NAS and composite data. The X^2 for the composite data base indicated no significant differences for the grasslands along the two channel types and the T-test was not applicable due to significant F values resulting from a lack in availability of unchannelized replicates. The X^2 for the NAS data showed the unchannelized grasslands significantly higher in numbers.

It was not possible to test for the effect of stream alterations on croplands as there were no unchannelized croplands to sample.

Using certain sites, one can compare habitats within a channel type based on the small mammal data from this project. This was done with channelized woodlands (sites W_5 and R_3) contrasted to channelized pecan groves with a tamegrass understory (sites R_2, W_4 and W_6), to channelized tamegrass without pecans (sites R_4 and W_3) and to channelized croplands (sites R_1, W_2 and W_7). The woodland sites trapping success was not significantly higher than that of the pecan-grasslands according to X^2, Mann-Whitney Rank and T-tests. Using only the NAS data the woodlands were superior to the pecan-grasslands only according to the T-test, not according to the other three tests. The composite sampling data showed no significant difference between the two habitats within a channel type.

Compared to channelized grasslands without pecans present, channelized woodlands were not demonstratably higher in trapping success using X^2 tests. None of the other tests were applicable. The NAS data for the two habitat types indicated a significantly higher number of individuals from the woodlands sites according to the X^2 test. When all census types were considered all tests indicated no significant difference between the woodlands and the bermuda grasslands.

When compared to channelized croplands, channelized woodlands had a significantly higher trapping success according to the Mann-Whitney test but the T-test was not applicable due to a significant F value. All four tests were used to examine the NAS data for the two site types and none were significant at the .05 level of confidence, nor were they for the composite census data.

The number of species present by habitat and channel type are demonstrated in Figure 5. None were significant according to X^2, T, Mann-Whitney, or Index of Diversity tests.

Qualitative

Ecological Assessment. The matrix used to generate ecological ranks for the species in the Rush and Wildhorse creeks data is represented in Table I. Those species which occupy a high trophic level and were consequently lower numbers, were assigned the highest ranks while those of low trophic level and high numbers have a low rank. The above ranking results from a habitat of lower primary production being unable to support as many individuals or as high a trophic level consumers as a habitat with higher primary production.

As can be seen in Figure 7, when the number of individuals of each species per site is multiplied by that species rank and then totaled for each site, a site value, or rank, can be obtained. The site rank thus generated is not an intrinsic "value" per se, but rather it establishes

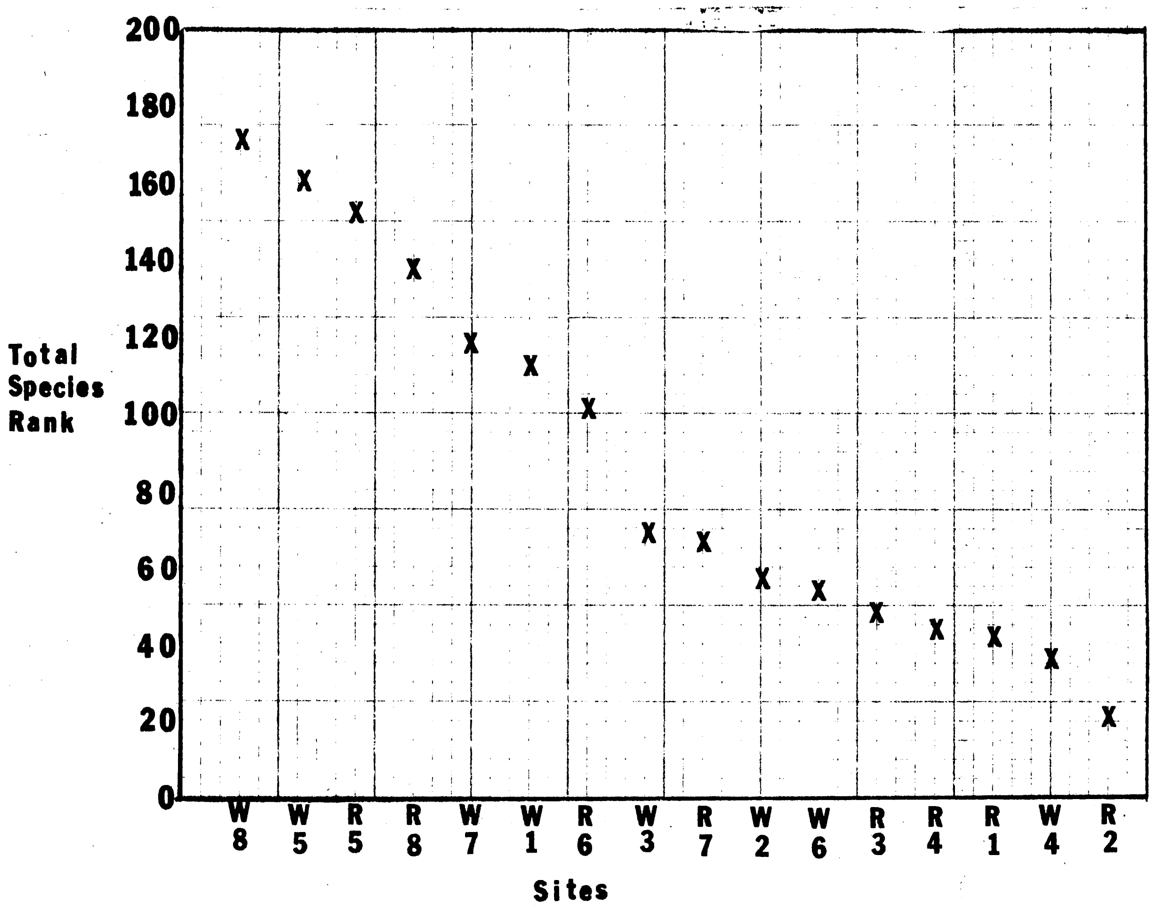

Figure 7. Ecological Species Rank Times Individuals, Per Species Totaled for Each Site and Graphed from Highest Total Site Rank to Lowest Total Site Rank

a relative standing among the sites sampled in relationship to the diversity, kind and respective frequency of small mammals on those sites. It is of interest to note in Figure 7 that, were the sites divided into two groups of eight based on their ranks, five of the six unchannelized sites are in the higher group as are five of the seven woodland sites, although this is not a significant distribution by the X^2 analysis.

The relationship between the channelized and unchannelized site rankings can be further illustrated in Figure 8. When the above listed statistical tests were applied to the mean ranks of the two conditions of sites, the unaltered sites were significantly higher in rank than the altered sites according to X^2, T, and Mann-Whitney tests. The Index of Diversity was not applicable to these data. The channelized woodlands were not demonstratably lower than the unchannelized woodlands except according to X^2 and the altered versus unaltered grasslands were not significantly varied either.

Certain species of small mammals may serve as indicators of ecological habitat conditions based upon data obtained by this project as well as by the sources noted in Tables I and II.

Insectivores. Shrews, and to a lesser extent, moles, occupy the roles of secondary and tertiary consumers ecologically and are dependent upon the litter/humus layer for their niche parameters. Consequently, they are quite sensitive to any alterations in the production of the lower trophic layers which would reduce their food supply or to any change in the litter/humus horizon that would likewise affect them. Sites having *Cryptotis* spp. and/or *Blarina* spp. present are unlikely to be overgrazed or otherwise in possession of a damaged litter/humus

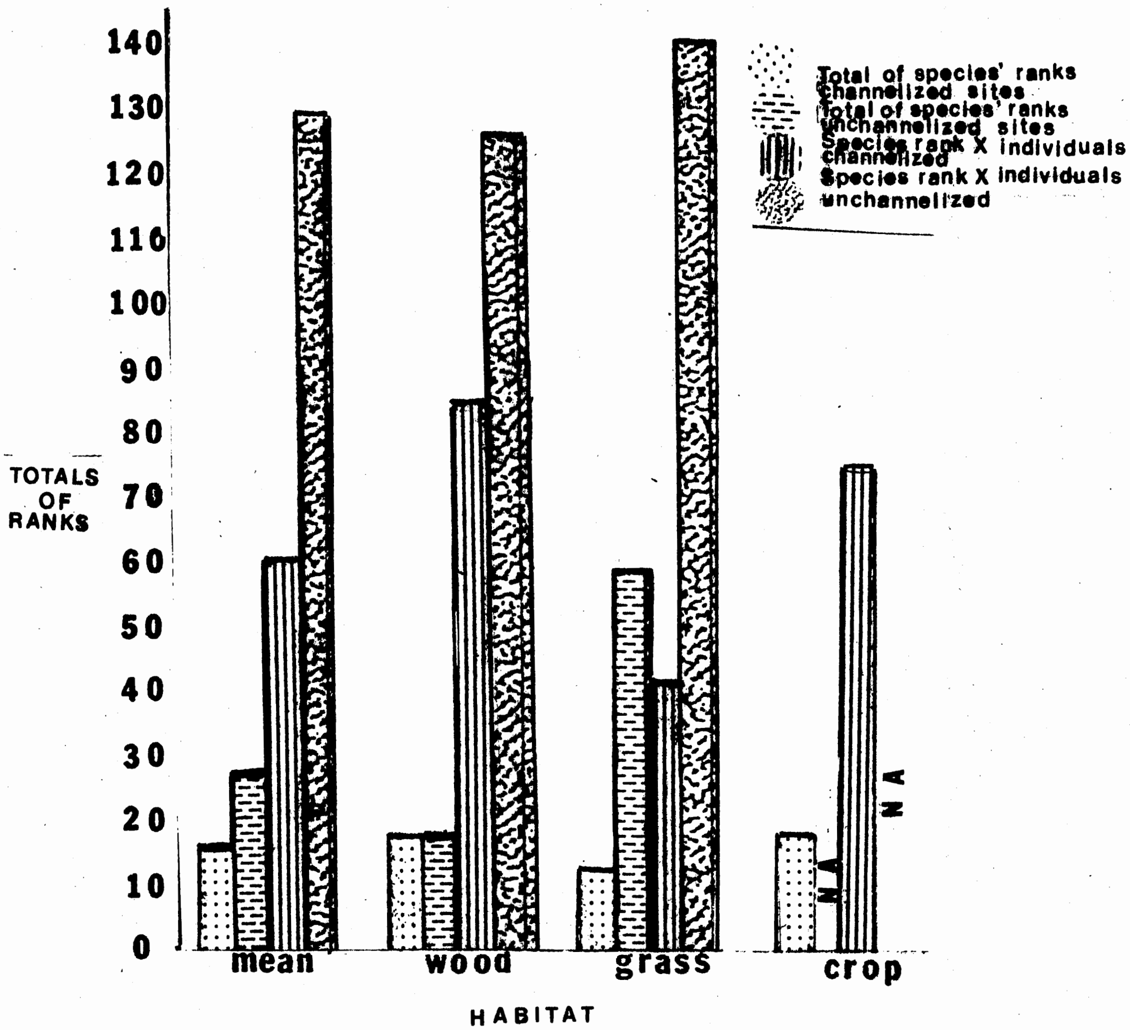

Figure 8. Totals of Species' Ranks and Species' Rank Times Number of Individuals of Each Species According to Channel Type and Habitat Type

TABLE III

THE DIFFERENCES IN MEAN DISTANCE BETWEEN MALES OF THREE SPECIES ACCORDING TO CHANNEL TYPE OR POSITION IN RELATION TO THE FORT COBB DAM

Species	Mean Distance Between Males		X^2	
	Channelized	Unchannelized	OSL	DF.
Peromyscus leucopus	21.28 m.	10.79 m.	33.5*	13
Peromyscus maniculatus	20.23 m.	17.53 m.	1.37	8
Reithrodontomys fulvescens	34.09 m.	45.45 m.	9.37*	2
	Above Dam	Below Dam		
Peromyscus leucopus	12.30 m.	7.44 m.	1.92	2

*significant at the .05 (95% confidence) level.

layer and have sufficient primary production to maintain these higher small mammal trophic levels. This also in turn indicates good soil moisture content and good decomposer actions. Sites lacking higher trophic level organisms indicate lowered production and potentially lowered litter layer as a result which would in turn reduce soil moisture, decomposer activity and nutriment cycling.

Rodents. Certain rodent species can serve as excellent indicators of ecological conditions in a habitat. Mus musculus are commensal with man and are seldom found far from human habitations. The presence of Perognathus hispidus (Walker, 1975) and Geomys bursarius (Glass, 1951) suggest lowered soil moisture due to increased sand, reduced litter and/or a lowered water table or similar reasons (Watts, 1970). Both species prefer more arid habitat usually accompanied with less tree and shrub cover. Other small mammals occupy rather narrow niches consequently requiring specific conditions to exist in an area. For example, Reithrodontomys require grasslands for the most part and Sigmodon heavy weeds or shrub for cover (Walker, 1972). All these species can be used as indicators of the habitat conditions by their presence. If a relative species rank is assigned, as it was in this report, based on niche parameter, as opposed to a pure value judgment, a numerical value can be generated to compare various habitats in terms of production, diversity and ecological condition.

Parasitism

Parasitism by botfly larvae (Cuterebra sp.) on Neotoma floridana, Peromyscus leucopus and Peromyscus maniculatus was observed on woodland sites W_1, W_5, W_8, R_3, R_5, and R_6 between 15 June and 29 June 1976.

Three of the 4 captured Neotoma (75%) and 44 of 104 Peromyscus (42%) had one or more bots present. The larvae of the Neotoma were located in the throat and 33% of those having bots had 2 present. The Peromyscus bots were inguinally located with 8% possessing 2 larvae. All the larvae appeared to be the same size (approximately 25 mm) and in the same stage of development, suggesting a synchronized introduction into the population. It is possible that the metabolic stress placed on the infected individuals (Smith, unpublished) induced them to respond to the baited traps with a higher frequency than did uninfected individuals thus giving an inflated value for the infestation rate of the population as a whole. It has also been found by Smith and Wecker (1962) that at least 75% of infected mice are sterilized and consequently removed from the breeding population if they survive the infestation.

The presence of botfly larvae only in the woodland small mammal populations and not seen in other habitats could be due to any of three conditions, 1) population stress being higher in the woodlands, 2) habitat conditions not being suitable for the presence of botfly larvae except in the woodlands, or 3) the bots maturing and dropping off their hosts to pupate before the non-woodland sites were sampled. It was not possible to determine which of the above may have caused the observed variation in parasitism between sites.

Distribution of Individuals

On fifty occasions more than one individual was taken per trap station. Thirty-two percent (16) of the incidents were of individuals taken at the same locations but the individuals were of different species, 42 percent (21) were of individuals of the same species but different sex, and the remaining 26 percent (13) were of the same species and sex. In the later grouping, 5 were male-male capture-pairs and 8 were female-female capture-pairs. None of these relationships were statistically significant according to X^2 tests but the data suggest that for Peromyscus leucopus, Peromyscus maniculatus and Reithrodontomys fulvescens, individuals were more likely to tolerate others of the same species if they were of opposite sex and that females were more tolerant of other females than were males of other males. The mean distances between males of the same species was averaged over channel type for the Rush and Wildhorse creeks data (Table III). Habitats with higher primary production are able to support more individuals of the same species than are habitats with lower production, as said before. The statistically significant difference between channelized and unchannelized mean distances between individuals indicates therefore that unchannelized sites were capable of supporting more Peromyscus leucopus and Reithrodontomys fulvescens per area than were channelized sites. This indicates that the unchannelized sites had a higher production of food and cover suitable for these two species than did channelized sites.

Impoundment Effects

Quantitative

One difficulty in analyzing the Fort Cobb Reservoir data stemmed from the significant difference (F-test) between the two trapping periods (July and August). The above and below the dam data were significantly different according to the F test as well, consequently pooling of the data may not be valid. Tests were carried out therefore, both with the data pooled and with it unpooled and T-tests were not run (Figures 9, 10, and 11). According to X^2 and Mann-Whitney tests, there was no measurable difference at the .05 confidence level between the above and below the dam site positions using trapping success, NAS data or the composite of all census techniques. The two exceptions included a Mann-Whitney test on the trapping success results which showed a significantly higher value for the above dam sites and a significant difference in the species diversity index with the below dam sites being the higher of the two.

When the data were analyzed according to sampling period (i.e., July or August), there was a significant difference between them according to a X^2 test of the NAS and composite data. There was no detectable difference between the trapping success results using either X^2 or Mann-Whitney between the two time periods, nor was there a significant difference in the Index of Species Diversity.

Qualitative

Ecological Assessment. Ranks were assigned to species as described previously with the species' ranks for the Fort Cobb sites (Table II). The results of the above dam/below dam comparisons based on the ecological ranks (Figure 12) were not significant for any statistical test used.

Indicator species for the Fort Cobb area were established as they were for the Rush and Wildhorse creeks sites. The species selected as ecological indicators included those described for the two creeks and,

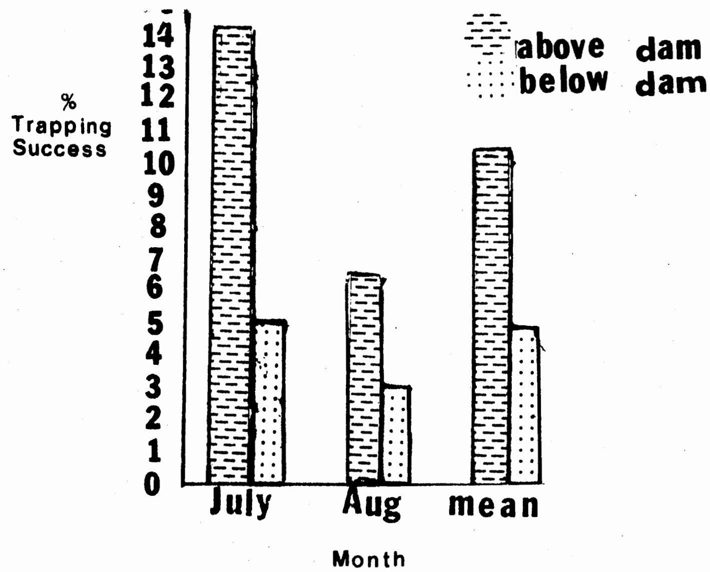

Figure 9. Trapping Success by Month and Relationship to Dam at Fort Cobb

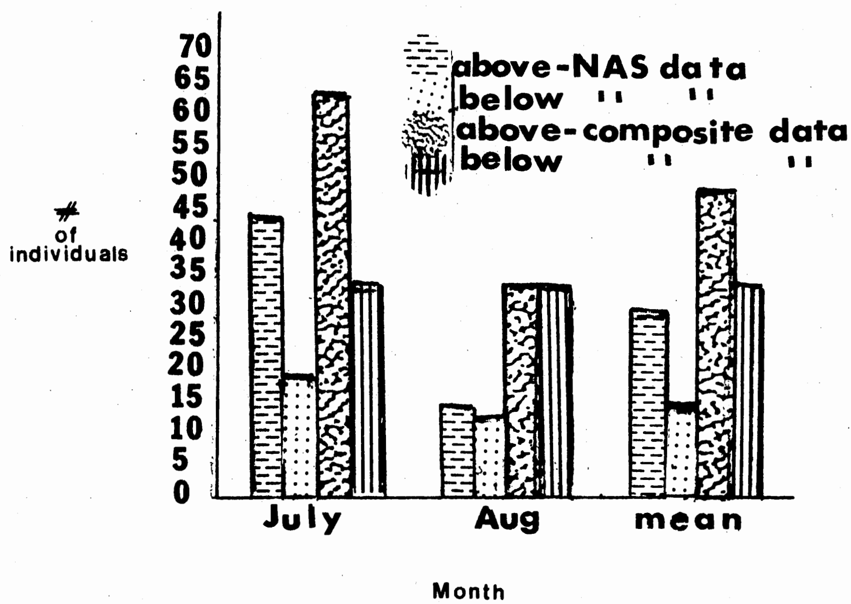

Figure 10. Number of Individuals by Month, Relationship to Dam and Census Technique at Fort Cobb

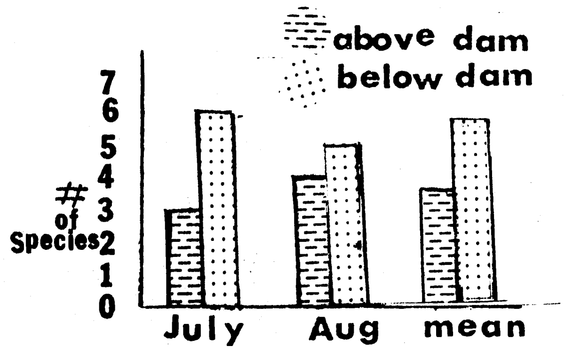

Figure 11. Number of Species by Month and Position in Relation to Dam at Fort Cobb

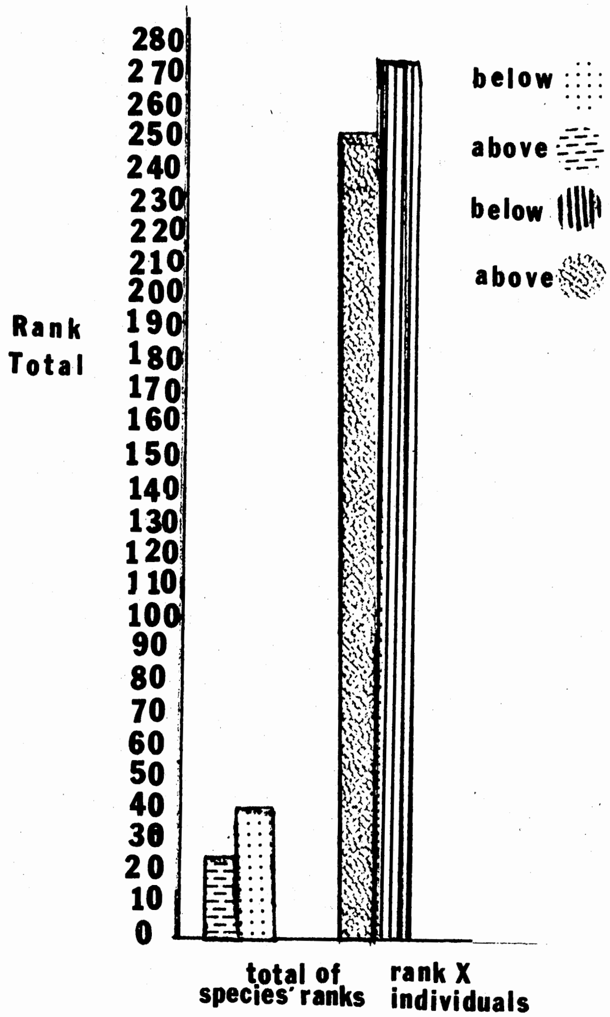

Figure 12. Total of Species' Ranks and Species' Ranks Times Number of Individuals Per Species According to Position in Relation to the Dam at Fort Cobb

in addition, Microtus pinatorum and Onychomys leucogaster. Pine voles are characteristic of early successional grassy meadows with a good litter layer and scattered trees and shrubs (Walker, 1975). Grasshopper mice are found in semi-arid habitats with sufficient production to sustain a small mammal secondary consumer. This species is not as sensitive an indicator as most shrews, however, due to the tendency of individuals to range widely and seldom maintain a permanent home range (McCarty, 1978).

Distribution of Individuals

A chi-square test was run to determine if there was a significant difference in the mean distance between male Peromyscus leucopus above the dam as opposed to below (Table III). No such difference was indicated. This implies that there was probably insufficient variation in food and cover production between the two habitat types to make a significant difference in the distribution of con-specifics.

County Species Record

One male and one female pine vole (Microtus pinatorum) were taken on 12 August 1976 at site C_4 (Figure 3) in Caddo County, Oklahoma. The male weighed 18.5 gm and was 177 mm in length (total). The female was 16.8 gm and 125 mm (total). This species has been recorded from Comanche County and Logan County, according to Blair (1939) indicating that these individuals may be the northwestern most record of this species in Oklahoma.

Variability Between Trapping Periods

A significant drop in the small mammal population at the Fort Cobb sites was documented in this study. The overall drop in the population which the data suggests (see Appendix C) could have been due to one, or many, causes this project was not designed to monitor. It is most probable, however, that the small mammal population was responding to the drought conditions which had become prevalent throughout the great plains by August of 1976.

CHAPTER IV

CONCLUSIONS

1) These data do not conclusively demonstrate that stream alteration has a direct impact on riparian small mammal communities. Predictable effects are strongly suggested, however, by the consistency with which the unchannelized sites, regardless of habitat, were higher in number of species, number of individuals, and ecological ranking than are the channelized sites (see Figures 4-8). Statistical significance was shown only for the number of individiuals and species rank times individuals per species pooled across habitat.

2) Habitat type and condition has the most profound effect on species diversity and as a stream becomes altered either by channelization or impoundment, the land use practices change which in turn further alters the habitat as shown by these small mammal data. When stream alteration has occurred without habitat alteration there is little statistical evidence of change in species composition or numbers of individuals. The alteration of a stream certainly effects (and often removes) the microhabitats nearest the banks which accounts for the drop in diversity, individuals and consequent ecological rank that is to be seen in Figures 4-8.

3) No conclusive evidence was found to differentiate sites existing above versus below stream impoundments on the basis of ecological ranks of sampled sites. There was statistically significant evidence

to suggest that the sites occurring below the dam at Fort Cob Reservoir were higher in species diversity but lower in number of individuals.

4) The Fort Cobb data showed a significant difference between trapping results in August compared to July with the July results being the greater.

5) Indicator species suggested for future assessments include: those of high trophic level as indicators of good food and cover production in a habitat such as *Blarina* spp., *Cryptotis* spp. or *Onychomys* spp.; those adapted to a fairly narrow niche such as *Microtus pinatorum* or *Reithrodontomys* spp.; and those indicative of overgrazing and/or reduced soil moisture such as *Geomys* spp. or *Perognathus* spp.

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APPENDIXES

APPENDIX A

STATISTICAL TESTS OF VARIOUS COMPARISONS

	X^2		Mann Whitney		Test[1] F		T		Diversity Index	
	DF	OSL	DF	OSL	DF	OSL	DF	OSL	DF	OSL
Species Rank x Individuals Grasslands CxU	4	28*		NA	5,0	NA	—	—		NA
Species Rank x Individuals Croplands CxU	NA			NA		NA	NA			NA
Pecan/Grassland x Woodland CxC TS	3	4.1	2,3	6	2,1	—	3	—		NA
Pecan/Grassland x Woodland CxC NAS	3	10.7	2,3	4.6	2,1	1.17	3	4.6*		—
Pecan/Grassland x Woodland CxC Composite	3	.3	2,3	7	2,1	.44	3	1.38		—
Grassland x Woodlands CxC TS	3	2.2	2,2	4	1,1	—	2	—		NA
Grassland x Woodlands CxC NAS	3	28.9*	2,2	4	1,1	—	2	—		—
Grassland x Woodlands CxC Composite	3	.09	2,2	2	1,1	—	2	—		—
Above X Below Dam TS	2	—	4,4	—	3,3	—	6	—		—
Above X Below Dam NAS	2	14*	4,4	24*	3,3	29.9*	6	1.5		
Above X Below Dam Composite	2	17.6*	4,4	14.5*	3,3	15	6	1	190	2.9*
July X August TS	2	—	4,4	—	3,3	—	6	—		—
July X August NAS	2	18*	4,4	17.5*	3,3	17.8*	6	2.25		—
July X August Composite	2	23*	4,4	13.5*	3,3	10.2	6	.9	200	.185
July X Below Composite	2	—	—	—	1,1	4	2	3.7*		—
August Above X Below Composite	2		—	—	1,1	1	2	.47		—

[1]All significance (*) is at a .05 level (95% confidence level).
NA = Not applicable; NAS - North American Standard; C = channelized; U = Unchannelized;
TS = trapping success

Hypothesis Tested "No Difference"	X^2 DF	X^2 OSL	Mann Whitney DF	Mann Whitney OSL	Test[1] F DF	F OSL	T DF	T OSL	Diversity Index DF	Diversity Index OSL
Trapping Success All Sites CxU	14	1.3	10,6	41.5	9,5	3.6	14	1.6	NA	
Trapping Success Woodlands CxU	4	.17	4,2	2.9	4,1	.05	5	1.2	NA	
Trapping Success Grasslands CxU	4	1.8	NA		5,0	NA	—	—	NA	
Trapping Success Croplands CxU	NA		NA		NA		NA		NA	
NAS All Sites CxU	14	5.5	10,6	47.5*	9,5	1.83	14	7.3*	200	.75
NAS Woodlands CxU	4	3	5,2	.9	4,1	3.8	5	2.7*	175	.57
NAS Grasslands CxU	4	12.8*	NA		5,0	NA	—	—	135	9.02*
NAS Croplands CxU	NA		NA			NA	NA		NA	
Composite All Sites CxU	14	4.8	10,6	47.5*	9,5	1.9	14	3*	86	1.47
Composite Woodlands CxU	4	.19	5,2	7	4,1	3.8	5	5.7*	1000	1.96
Composite Grasslands CxU	4	1.7	NA		5,0	NA	—	—	200	6.8*
Total of Species' Ranks All Sites CxU	14	4.1	10,6	11.5	9,5	3.7	14	1.9	NA	
Total of Species' Ranks Woodlands CxU	4	1.8	5,2	.6	4,1	.28	5	.124	NA	
Total of Species' Ranks Grasslands CxU	4	36*	NA		5,0	NA	—	—	NA	
Total of Species' Ranks Croplands CxU	NA		NA			NA	NA		NA	
Species Rank x Individuals All Sites CxU	14	26.1	10,6	49*	9,5	4.19	14	3.8*	NA	
Species Rank x Individuals Woodlands CxU	4	2.2	4,2	12	4,1	.05	5	.5	NA	

APPENDIX B

RESULTS OF ALL CENSUS METHODS BY SITE, SPECIES AND TRAPPING SUCCESS FOR RUSH AND WILDHORSE CREEKS

Site	Species	Number of Individuals	Total	Trapping Success
R_1	Peromyscus leucopus	8		
	Reithrodontomys fulvescens	1	21	7
	Sigmodon hispidus	3		
	Mus musculus	9		
R_2	Peromyscus leucopus	5	6	1
	Peromyscus maniculatus	1		
R_3	Peromyscus leucopus	11	14	6
	Neotoma floridana	3		
R_4	Peromyscus leucopus	2		
	Reithrodontomys fulvescens	1	18	1
	Geomys bursarius	15		
R_5	Peromyscus leucopus	7		
	Peromyscus maniculatus	2		
	Perognathus hispidus	2		
	Sigmodon hispidus	4		
	Reithrodontomys fulvescens	3	26	5
	Geomys bursarius	4		
	Blarina brevicauda	1		
	Crypototis parva	1		
	Scalopus aquaticus	2		
R_6	Peromyscus leucopus	10		
	Peromyscus maniculatus	4		
	Neotoma floridana	5	23	5
	Geomys bursarius	2		
	Crypotis parva	1		
	Scalopus aquaticus	1		
R_7	Peromyscus leucopus	8		
	Reithrodontomys fulvescens	2	15	4
	Sigmodon hispidus	2		
	Geomys bursarius	3		
R_8	Peromyscus leucopus	15		
	Peromyscus maniculatis	3	44	4
	Neotoma floridana	9		
	Perognathus hispidus	2		
	Geomys bursarius	15		
W_1	Peromyscus leocopus	16		
	Peromyscus maniculatus	11	29	12
	Neotoma floridana	2		
W_2	Peromyscus maniculatus	6	11	3
	Perognathus hispidus	5		
W_3	Peromyscus leucopus	6		
	Peroghathus hispidus	1	26	3
	Geomys bursarius	17		
	Neotoma floridana	2		

Site	Species	Number of Individuals	Total	Trapping Success
W_4	Peromyscus leucopus	2		
	Geomys bursarius	6	10	4
	Scalopus aquaticus	2		
W_5	Peromyscus leucopus	8		
	Peromyscus maniculatus	5		
	Neotoms floridana	18	35	6
	Blarina brevicauda	1		
	Scalopus aquaticus	3		
W_6	Peromyscus leucopus	2		
	Perognathus hispidus	1	17	1
	Geomys bursarius	14		
W_7	Peromyscus leucopus	15		
	Peromyscus maniculatus	13		
	Perognathus hispidus	1	30	9
	Scalopus aquaticus	1		
W_8	Peromyscus leucopus	19		
	Peromyscus maniculatus	11	50	13
	Neotoma floridana	20		
Totals		375		5.25

APPENDIX C

RESULTS OF ALL CENSUS METHODS BY SITE, SPECIES

AND TRAPPING SUCCESS FOR FORT COBB

Site	Species	Number of Individuals	Total	Trapping Success
C_1 - Jul.	Peromyscus leucopus	22	58	21
	Neotoma floridana	22		
	Scalopus aquaticus	3		
	Geomys bursarius	1		
Aug.	Peromyscus leucopus	4	25	4
	Neotoma floridana	16		
	Scalopus aquaticus	4		
	Geomys bursarius	1		
C_2 - Jul.	Peromyscus leucopus	8	18	7
	Sigmodon hispidus	8		
	Perognathus hispidus	2		
Aug.	Peromyscus leucopus	7	9	5
	Neotoma floridana	1		
	Scalopus aquaticus	1		
C_3 - Jul.	Peromyscus leucopus	5	23	6
	Reithrodontomys fulvescens	2		
	Onychomys leucogaster	1		
	Geomys bursarius	9		
	Neotoma floridana	1		
	Scalopus aquaticus	5		
Aug.	Peromyscus leucopus	4	18	2
	Geomys bursarius	2		
	Scalopus aquaticus	12		
C_4 - Jul.	Peromyscus leucopus	6	10	4
	Sigmodon hispidus	1		
	Scalopus aquaticus	2		
	Geomys bursarius	1		
Aug.	Peromyscus leucopus	4	15	4
	Sigmodon hispidus	1		
	Microtus pinatorium	2		
	Geomys bursarius	2		
	Scalopus aquaticus	6		
Totals		176		6.6

VITA[2]

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