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Road-Kill Census of Mammals in Northeastern Arkansas

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veloped, apparently another case of a non-target organism being selected for resistance.

After 25 years of heavy insecticide usage on cotton in Arkansas, several pest insects and mites have developed resistance to the 3 principal groups of insecticides and miticides: the chlorinated hydrocarbons, the organophosphorous compounds, and the carbamates.

The first reaction of the farmer to resistance is to increase the dosage and frequency of insecticide application. During the brief period that this approach is partially effective, it exaggerates the problem of environmental contamination.

Cotton is in dire straits economically. Every effort is being made to reduced the cost of production. But the resistance problem adds to the cost of production.

Cotton insects are the subject of this presentation, but the situation is similar for many of our food and feed crops. Furthermore, a pest species may develop a high level of resistance from exposure to insecticides on cotton, making it difficult to control on other crops. Examples include cabbage looper on greens crops and bollworm on soybeans.

It is neither cheap nor easy to discover new chemical groupings that will control insects and meet acceptable standards of safety and economics. Several years and millions of dollars are required to carry out the research to serve as the basis for registration. Prospects are so discouraging that at least 4 major companies have closed their primary synthesis and screening laboratories in the past 3 years.

It appears unlikely that new insecticides can be synthesized and developed rapidly enough to offset the present rate of obsolescence of insecticides through resistance. More realistic requirements on registration of new insecticides would help, but would not solve the problem. Biological insecticides (bacteria, viruses, etc.) are under more stringent registration restrictions than are chemical insecticides.

There are many exciting possibilities of insect control that do not depend upon conventional insecticides. There are only a few proven successes to date. To adequately implement these new approaches in terms of practical insect control will require many years, tremendous investments in research, and a high level of cooperation by many disciplines of the biological and physical sciences.

SUMMARY

In 25 years of heavy insecticide usage on cotton in Arkansas, resistance has become a problem with several pest insects and mites to the 3 principal groups of insecticides and miticides: the chlornated hydrocarbons, the organophosphorns compounds, and the carbamates.

Development of control measures, chemical or otherwise, is not proceeding at a sufficiently rapid pace to stay ahead of the problem posed by insect resistance to insecticides.

A Road-Kill Census of Mammals in Northeastern Arkansas

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INTRODUCTION

It is the purpose of this study to investigate species composition and numbers of mammals killed on selected highways in northeastern Arkansas. Roadside counts have been used by wildlife personnel to determine population indices for areas under study for a wide variety of game species. Hendrickson (1939) was the first to describe the roadside census as an inventory method for rabbits. Wight (1959) used roadside counts to estimate statewide rabbit population trends in Missouri. Regular predetermined highway routes were driven in an automobile at a prescribed time of day and rabbits were counted per mile. Lord (1955, 1961) used the roadside census method to count rabbits in Illinois and made comparisons of censuses taken during early morning and night. Newman (1959) reported on weather factors influencing the roadside counts of cottontail rabbits.

Ornithologists have used the roadside census technique for many years. Nice and Nice (1921) used this method to study Oklahoma bird populations as early as 1920. Since their pioneer studies, this technique has been used by a number of research workers. Kendeigh (1944) evaluated the roadside census in relation to other types of censuses used in studying birds. Dice (1938, 1952) thoroughly discussed and compared numerous census methods. Howell (1951) made detailed studies using relative conspicuousness in determining bird numbers along roadsides in Tennessee. The roadside census is used as a method of determining relative abundance and not absolute abundance. Variability of roadside cen-

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suses have been reported on by Peterle and Eherhardt (1958).

An Annual Progress Report, W - 29 - R - 14 (1966-67), conducted in Louisiana contains many roadside censuses taken in that state of both living and dead wildlife species including the cottontail rabbit. This technique has been used for determining relative abundance for a number of game species in many areas of the United States by wildlife biologists.

ACKNOWLEDGEMENTS

Some of the censuses taken for this study were completed by Bob R. Singleton and James R. Grissom, graduate students at Arkansas State University. Dr. Max Nickerson critically read the manuscript. The writers are grateful for their assistance.

METHODS

A total count of species of wildlife mammals was taken by automobile census during early morning and late afternoon on highways in northeastern Arkansas. Counties where censuses were conducted included Clay, Greene, Craighead, Poinsett, and Jackson. Secondary blacktop delta roads transversing slash-cleared agricultural areas were mainly utilized for this study. The census period extended from September 1969 through March 1970 .

DESCRIPTION OF AREA

All of northeastern Arkansas is extensive delta with the exception of Crowley's Ridge. The flat land reaches to the base of the Ouachita hills at the edge of North Little Rock. It then continues north into southeastern Missouri and south into Louisiana without any natural break. Crowley's Ridge runs for a distance of 200 miles from southeastern Missouri down to the Mississippi River at Helena, Arkansas. Accounts of the geology of Crowley's Ridge are given by Call (1889). Magill (1958) summarized the various theories concerning the origin of the ridge.

DISCUSSION AND RESULTS

Lowland deciduous woods in northeastern Arkansas are being destroyed at a rapid rate by slash clearance. These once swampy areas are being drained and cleared for fields to be planted in cotton, soybeans, and rice. Destruction of swampy woods has decreased wildlife habitats over this vast area of the state for most species of mammals so that many are forced into poor cover along the edge of the roadside where one of their greatest dangers is the automobile.

Mortality of wildlife species, caused by the automobile, is not an entire loss to the area in terms of energy loss within the biotic community. These dead mammals are eaten by species of hawks and the Common Crow. There is a large population of Red-tailed Hawks in northeastern Arkansas during the fall and winter months. Many of these can be observed from the roadside perched on a tree or telephone pole. During early morning hours on several occasions, the Common Crow was observed feeding on dead rabbits killed by automobiles. It is apparent that one of the greatest enemies of the cottontail rabbit, opossum, and skunk is the automobile.

During this census 10,025 miles were driven and a total of 438 dead mammals were counted. The average mammal kill per 100 miles was 4.37 (Table 1). Twelve species of mammals were recorded as roadside kill. These included 263 rabbits **(Sylvilagus floridanus** and **Sylvilagus aquaticus)**, 108 opossums **(Didelphis marsupialis)** 42 skunks **(Mephitis mephitis)**, eight gray squirrels **(Sciurus carolinensus)**, six raccoons **(Procyon lotor)**, four muskrats **(Ondatra zibethicus)**, two fox squirrels **(Sciurus niger)**, two Norway rats **(Rattus norvegicus)**, one cotton rat **(Sigmodon hispidus)**, one red fox **(Vulpes fulva)**, and one coyote **(Canis latrans)**.

TABLE 1. ROADSIDE CENSUS OF TOTAL MAMMAL KILL FROM SEPTEMBER 1969 TO MARCH 1970

MONTH	NO. MI. TRAVELED	TOTAL KILL PER 100 MI.	Rabbit	Opossum	Skunk	Raccoon	Muskrat	Fox Squirrel	Gray Squirrel	Red Fox	Coyote	Norway Rat	Cotton Rat
September	686	3.79	5	15	4	-	-	2	-	-	-	-	-
October	987	5.27	23	23	3	2	-	-	-	-	-	1	-
November	1458	5.76	50	21	9	3	-	-	-	-	-	-	1
December	1809	5.31	83	4	4	1	-	-	3	1	-	-	-
January	1750	1.71	23	7	-	-	-	-	1	-	1	1	-
February	2041	3.43	38	20	12	-	-	-	-	-	-	-	-
March	1294	6.18	41	21	10	-	4	-	4	-	-	-	-
Total	10025	4.37	263	108	42	6	4	2	8	1	1	2	1

Total mammal kill per 100 miles was highest during March with an average of 6.18 per 100 miles, and the lowest counts were in January with an average of 1.71 per 100 miles. The January low count possibly reflects less movement of opossums and skunks as they are not as active during the colder weather. The rabbit count of 23 for January was also lower than other census months. Early low counts of rabbit mortality during September and October may be accounted for in part because of large acreage of crops and cover remaining in most fields. As these areas are harvested, much of the cover is destroyed forcing the rabbits to move about in search of better cover.

SUMMARY

A roadside census of mammal kill was conducted in northeastern Arkansas from September 1969 through March 1970. Some 10,025 miles were driven, and a total of 438 dead mammals were censused. An average of 4.37 mammals were killed per 100 miles. Twelve species of mammals were recorded as roadside kills with rabbits having the greatest mortality.

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Notes on the Habitat and Distribution of the Odonata of Franklin County, Arkansas

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INTRODUCTION

There is no publication dealing with the Odonata of Arkansas on a state-wide basis. Information on odonates in this state is scattered in the literature, and it is usually found only in broad regional works with only incidental mention of Arkansas.

The ranges of a few species are listed as extending to Arkansas by Hagen (1861), and by Muttkowski (1910). Needham and Heywood (1929) list six species of Odonata for the State, and Needham and Westfall (1955) list eleven species of the Anisoptera.

The most significant contributions on Arkansas Odonata are a list included in "Predaceous insects, spiders, and mites of Arkansas cotton fields", by Whitcomb and Bell (1964), which includes twenty-six species of the