

EVALUATION OF FACTORS INFLUENCING TRAPPING
SUCCESS FOR MOURNING DOVES
IN WESTERN OKLAHOMA

By

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Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1969

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1973

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ACKNOWLEDGMENTS

I would like to express my appreciation to Dr. John A. Morrison, leader of the Oklahoma Cooperative Wildlife Research Unit, who, as my major adviser, guided me throughout all facets of this study. Mr. James C. Lewis also provided valuable assistance in the field and helped with the interpretation of data. Thanks are also due to Drs. Arthur E. Harriman and John S. Barclay for their valuable suggestions while preparing the manuscript and to Dr. Larry Claypool for helping with statistical analyses. Support was provided by the Oklahoma Cooperative Wildlife Research Unit.*

I would also like to express my appreciation to Messrs. Lynn Hodges, James Hamm, and David Ferguson for their assistance in the field and to the many landowners in the study area who were so cooperative. Special thanks are due to the other Unit Fellows for their help during this study.

*The Oklahoma Cooperative Wildlife Research Unit has as its cooperators; Oklahoma Department of Wildlife Conservation, Oklahoma State University, U. S. Bureau of Sport Fisheries and Wildlife, and Wildlife Management Institute.

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CHAPTER I

INTRODUCTION

Mourning dove (Zenaidura macroura) management is more dependent on population information from banding studies than is management of other avian species such as waterfowl. This situation exists because dove research lacks the census methods available for other game-bird species. Although 100,000 doves are banded in the United States annually, migration, local movement, and hunter harvest data are incomplete for most areas (Reeves, Geis, and Kniffin, 1968). To provide for these management needs, more effective banding programs are necessary. Along with intensifying the banding effort, the quality and efficiency of the capture techniques require improvement.

To operate a banding program efficiently, the cost per dove trapped should be offset by the value of the information obtained from the band return. It was the purpose of this study to identify problems in and suggest improvements for increasing dove-trapping success to enable banders to catch a maximum number of doves with a minimum amount of time, effort, and expense.

Although a variety of mourning dove census techniques have been practiced for 25 years, the current population management policy results from the banding analyses conducted during the 1953-1957 period. The data obtained during that period resulted in the establishment of three management units: the Eastern, Central, and Western

Management Units. These units are considered ideal because 95 percent of the doves harvested in each unit are produced in that unit. Thus each unit is independent of the others, and their uniqueness facilitates management organization (Kiel, 1959a). The Central Management Unit, of which Oklahoma is a part, and the Western Unit have received little research attention compared to that given the Eastern Unit.

Dove research is especially important in Oklahoma because large numbers of doves migrate through the state, considerable dove production occurs in some areas, and doves are hunted statewide. Arkansas, Colorado, Kansas, Missouri, New Mexico, South Dakota, Texas and Oklahoma are the only states that allow hunting of mourning doves in the 14-state Central Management Unit. Since band returns from hunters provide the most accurate means of estimating population characteristics, the hunting states of the Central Unit must assume the responsibility of collecting most of the data concerning mourning dove populations (Kiel, 1959b). It is possible to estimate populations only if enough doves are banded in a state to make resident and migrant flocks discernible. Since adult doves show a tendency to return to the same nesting area in successive years, banding is a valuable tool for predicting future population trends (Tomlinson, Wight, and Baskett, 1960; Harris, 1961).

The Oklahoma Cooperative Wildlife Research Unit at Oklahoma State University has banded adult and immature mourning doves each year including 1968 through 1971. This work has been a part of a nationwide program to generate band-return data sponsored by the Bureau of Sport Fisheries and Wildlife in cooperation with state wildlife conservation departments, and has also been an effort to investigate problems of

trapping doves in Oklahoma. Despite large numbers of doves occurring in many areas of Oklahoma, previous attempts to trap them have not been sufficiently productive to justify the time and expense involved. Consequently, the Unit's dove trapping efforts have included experimental innovations in technique, seeking improvements that will provide an acceptable cost-benefit ratio.

Although for several years there have been small-scale trapping efforts conducted by the U. S. Bureau of Sport Fisheries and Wildlife and the Oklahoma Department of Wildlife Conservation in several areas of the state, the large-scale 1968-1971 banding efforts made by the Oklahoma Cooperative Wildlife Research Unit have been concentrated in Major County in northwest Oklahoma and in Greer County in southwest Oklahoma. These areas support unusually large nesting populations of doves because preferred habitat is abundant and remains attractive to mourning doves until autumn. Both of these areas are arid during the summer months, and doves concentrate in large numbers around available sources of water. This offers a relatively favorable trapping opportunity since trap placements may be highly concentrated rather than sparsely scattered throughout the area. There is also an abundance of preferred foods, both natural and cultivated. Carpenter (1971) found that wheat (Triticum aestivum) was the food consumed most by doves during July and August in northwest Oklahoma, and wheat is the main crop grown in Major County. Carpenter found croton (Croton sp.), tropic croton (Croton glandulosus) and sunflower (Helianthus sp.) to be the most important natural foods, and these species are also abundant in Major County.

Considerable nesting habitat occurs in Major County, contributing

to the high dove production in this region. An area containing a large number of low trees or shrubs is a preferred nesting habitat for doves (Hopkins and Odum, 1953). The study area in northwest Oklahoma contains abundant mesquite (Prosopis glandulosa) and osage orange (Maclura pomifera) trees, both of which make ideal nesting habitat. The mesquite is frequently left in strips around the borders of the wheat fields or in thickets or pastures where cattle graze the understory grasses.

The present study was conducted near the towns of Orienta and Fairview, Major County, during July, 1970. This area, rather than the southwest area, was chosen because more doves had been trapped there in previous years and Unit personnel were more familiar with it. Objectives were: (1) to evaluate comparative capture success in some of the most commonly used types of traps to test design modifications intended to increase trap catchability for doves, (2) to evaluate the influences of habitat types and kinds of perches at trap sites, (3) to estimate the effect of decoys or live doves in attracting doves to a trap site, and (4) to estimate the effect of weather and agricultural practices on capture success.

CHAPTER II

METHODS

Selection of Types of Traps, Habitats, and Perches

Prior to designing the structure of the study and collecting data, it was necessary to tentatively select favorable types of traps, habitats for trap sites, and types of perches at trap sites. These were selected on the basis of past trapping success and prestudy reconnaissance.

Preliminary Testing of Standard Types of Traps

One hundred and twenty captures of doves in nine traps were observed during the month of July, 1970. The nine traps included three each of three types that have been used extensively for dove trapping in the past (Table I). These were the Kniffin modified funnel trap (Figure 1), the Thompson drop-door trap, and the modified Stoddard collapsible swing-type trap (Figure 2). Observations were made on each kind of trap until 40 captures were witnessed. These types were chosen for analysis because they are recommended by the Bureau of Sports Fisheries and Wildlife (Reeves et al., 1968) and because they have been used for the last 3 years by the Oklahoma Cooperative Wildlife Research Unit in its trapping program. The purpose of these 120 observations

TABLE I

COMPARATIVE SUCCESS FOR CAPTURING MOURNING DOVES IN THREE
TYPES OF TRAPS DURING PRELIMINARY TESTING

Type of trap	Number of doves approaching trap	Number of doves entering trap	Number retained	Number escaped	Number of multiple catches	Percent success of capture
						$\frac{\text{No. retained}}{\text{No. entering}}$
Kniffin funnel	63	40	21	19	4	52%
Thompson drop-door	59	40	37	3	1	92%
Stoddard swing-wire	112	40	38	2	6	95%
Total	234	120	96	24	11	79%

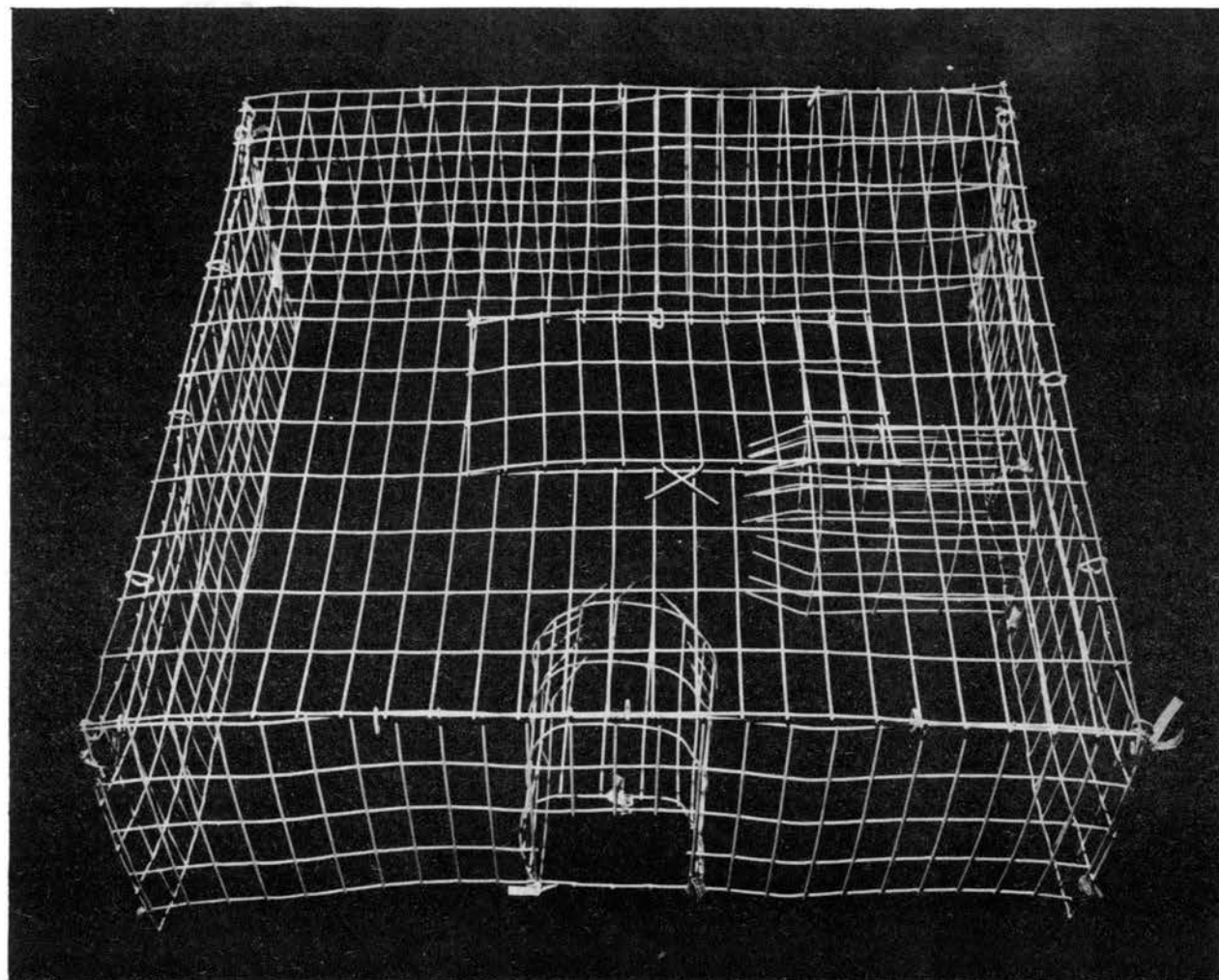


Figure 1. Regular-Funnel (RF) Trap, or Kniffin Modified-Funnel Trap

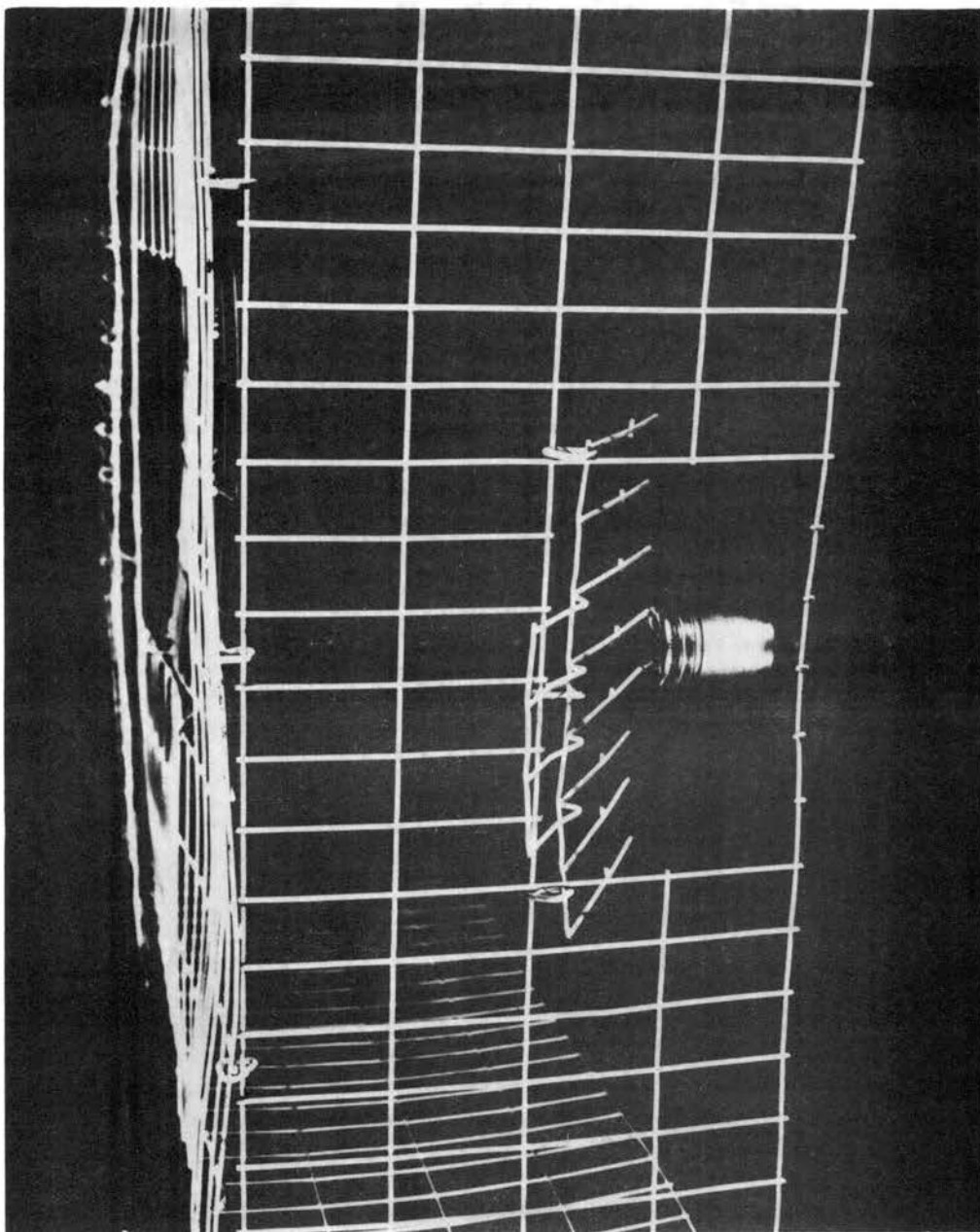


Figure 2. Stoddard Swing-Wire (SW) Trap

was to note the behavior of doves at traps and to detect deficiencies in the three types of traps. A deficiency was considered to be any recurring factor in the trap or its function that interfered with the trapping process. Suggestions for correcting these deficiencies through modifying the traps could then be hypothesized, and the efficiency of the modified traps could be compared to the efficiency of the original designs.

Several precautions were taken during these observations to reduce bias in the results. Traps were spaced 100 ft apart to minimize the influence of one trap on the responses of doves to adjacent traps. Also, the traps were placed in various kinds of habitat to be certain that factors other than trap design were not influencing trapping success. Three observation points were occupied for each type of trap and only one trap was observed from each point. These points were blinds located in vegetation or in tree rows dense enough to conceal the observer and sufficiently distant from the traps to prevent interference with approaching doves. A 30X Bausch & Lomb spotting telescope with tripod was used for the observations. Observations were made twice daily, the first period being from 6 to 9 AM and the second from 6 to 9 PM. Each observation point was occupied for 10 min. The traps were baited daily with millet placed in consistent amounts and positions within the traps. Millet was chosen because it proved to be the most effective bait in the 1968 and 1969 trapping conducted in the same area by the Oklahoma Cooperative Wildlife Research Unit.

The pilot study revealed trap deficiencies as follows:

1. The Kniffin modified funnel trap had two major deficiencies. The aperture height of the funnels was only 4 inches, consequently

the head of a dove frequently touched the top of the funnel. When this occurred, the dove often became excited and left the aperture. This usually occurred when the bait was not sufficiently abundant on the floor of the funnel, and the dove stood upright more frequently. This also occurred when the dove was disturbed while in the feeding posture and stood upright. The problem was intensified when other doves already in the trap were trying to escape and startled the bird in the funnel.

The second deficiency of the Kniffin trap was the ease with which trapped birds could escape. If a dove did not become excited after it was trapped, it sometimes fed inside the trap then exited through the funnel aperture. The incidence of escape was not as great among doves that became frightened while in the trap. Birds that flew against the side or top of the trap rarely escaped. Seventy-three percent of the escapes were made by birds that remained calm while trapped, whereas 27 percent of the escapes were made by doves that became excited.

2. The principal deficiency of the Thompson dove trap was its inadequacy for multiple catches. The number of doves trapped was dependent on the number entering the trap before the trigger wire was tripped. Although this trap was designed as a double-compartment trap with each cell functioning independently of the other, a dove trapped and attempting to escape in one compartment often tripped the trigger wire in the other compartment. This reduced the trap's efficiency because both doors were closed to any dove lured to the area by the bait provided. Of the 40 trappings observed in this type of trap, only one was a multiple catch.

A major advantage of the Thompson trap was that doves had greater difficulty in escaping from it. Only 8 percent of the doves captured in Thompson traps escaped.

3. The main fault of the modified Stoddard swing-wire trap was that doves had much difficulty trying to enter it. Although grain was placed in front of the door, the birds seemed unable to perceive the entrance. Also, some birds that contacted the door were frightened when it moved, and they flew away. These factors contributed to the low catch/approach ratio of 36 percent. The highest rate of capture occurred when a small amount of bait was placed around the outside of the door and a larger amount deposited immediately inside the door.

Similar to the Thompson trap, the major advantage of the Stoddard trap was the difficulty doves had in escaping from it. Only 5 percent of the doves entering Stoddard traps succeeded in escaping.

Trap Modification Tested for Improving Capture Success

The three types of traps observed in the preliminary study were constructed in accordance with specification suggested by Reeves et al. (1968). To overcome the apparent deficiencies of these three kinds of traps, modifications were made as follows:

1. Swing-wire trap with leads (SWWL): Leads or wings were extended from the entrance of the Stoddard swing-wire trap (Figure 3). This addition was an attempt to solve the problem of doves failing to find and enter the trap entrance. The leads were 11 inches long and 7 inches high and the lowermost horizontal mesh-wire at the bottom of the lead was removed so that the protruding vertical pieces of wire could be stuck into the ground. This worked well unless the ground was too

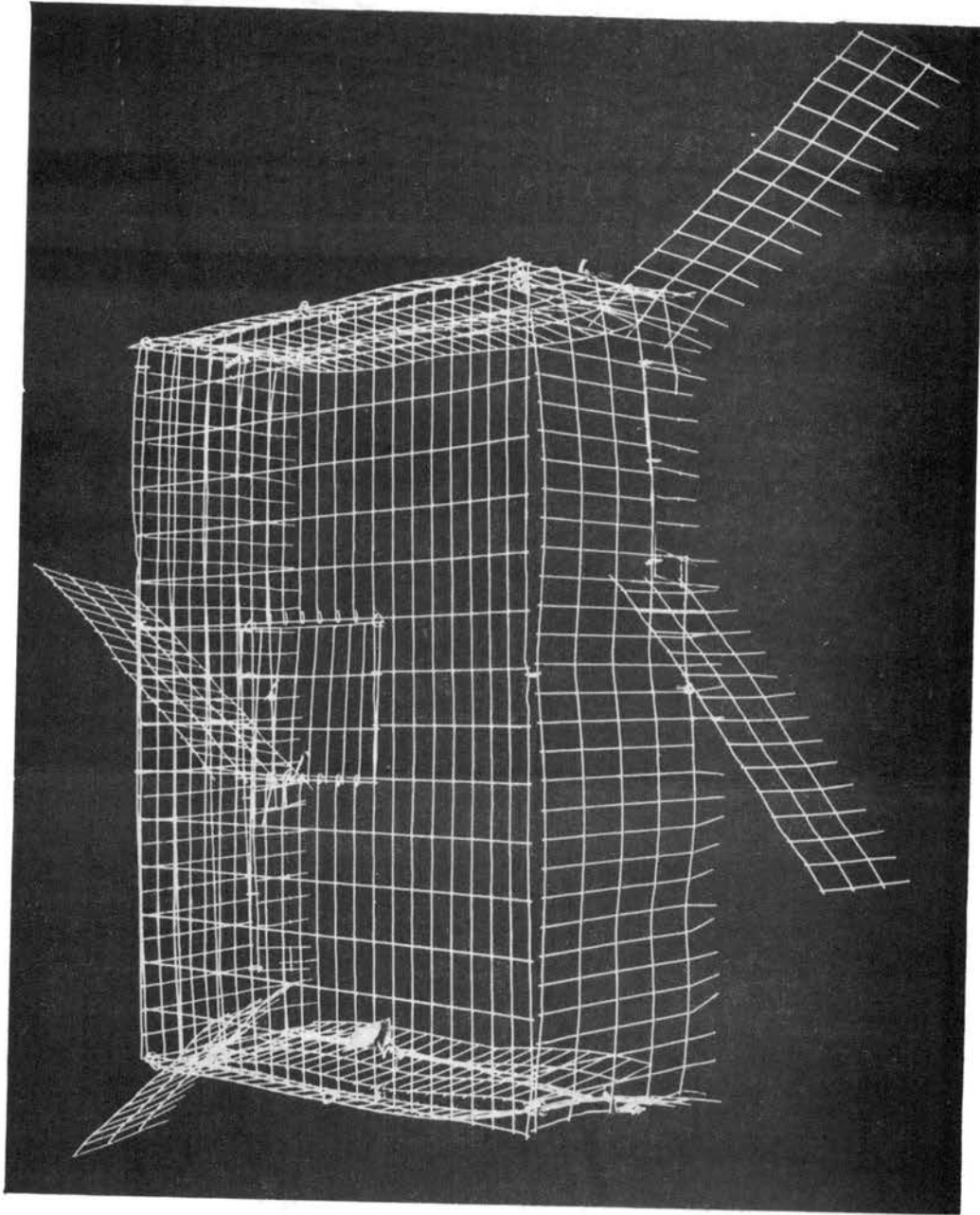


Figure 3. Swing-Wire Trap With Leads (SWWL)

hard, in which case a small channel was dug with a shovel, the lead was placed in the channel, and dirt was filled in around the bottom of the lead.

A lead was placed on each side of a trap aperture at a 45-degree angle to the trap side. Bait was placed in a line between the two leads and extended past the door and into the trap where a substantial quantity (about 1 lb) was deposited.

2. Short-funnel trap (SF): This modification involved shortening the funnels of the Kniffin funnel trap from 11 inches to 6 inches (Figure 4). Because many doves became frightened when parts of their body touched the funnel during entry, the funnel was shortened in the hope of reducing the time spent in it. All other aspects of the Kniffin trap were kept the same. The baiting procedure involved placing a small quantity of grain outside the funnel with a line of grain running through the funnel and inside the trap where approximately 1 lb of grain was placed in a pile.

3. Short-funnel hang-wire trap (SFHW): Since ease of escape was a deficiency noted in the funnel or Kniffin trap in the initial observation period, the SFHW modification was made in order to reduce the number of escapes. The funnel was shortened as in Modification Number 2; however, a hanging wire was added to the funnel to deter escape through the funnel aperture (Figure 5). This wire was attached to the roof of the trap and it hung down to the trap pad. It was positioned so that when in a vertical position it fell between the sides of the inner end of the funnel. The hanging wire could swing inward only; the funnel served as a block to its outward motion when pushed by a dove in the trap. This trap was baited in the same manner as the

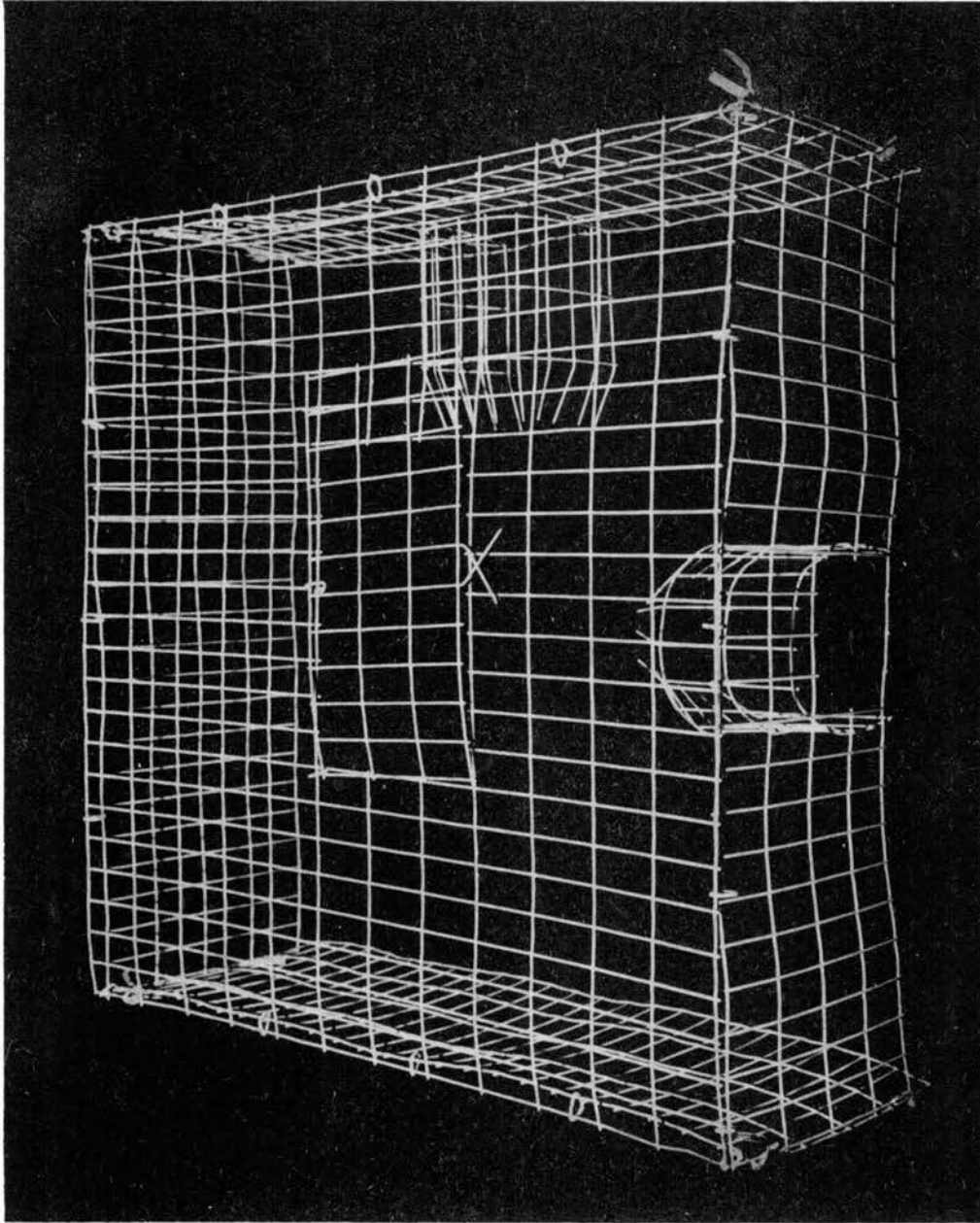


Figure 4. Short-Funnel (SF) Trap

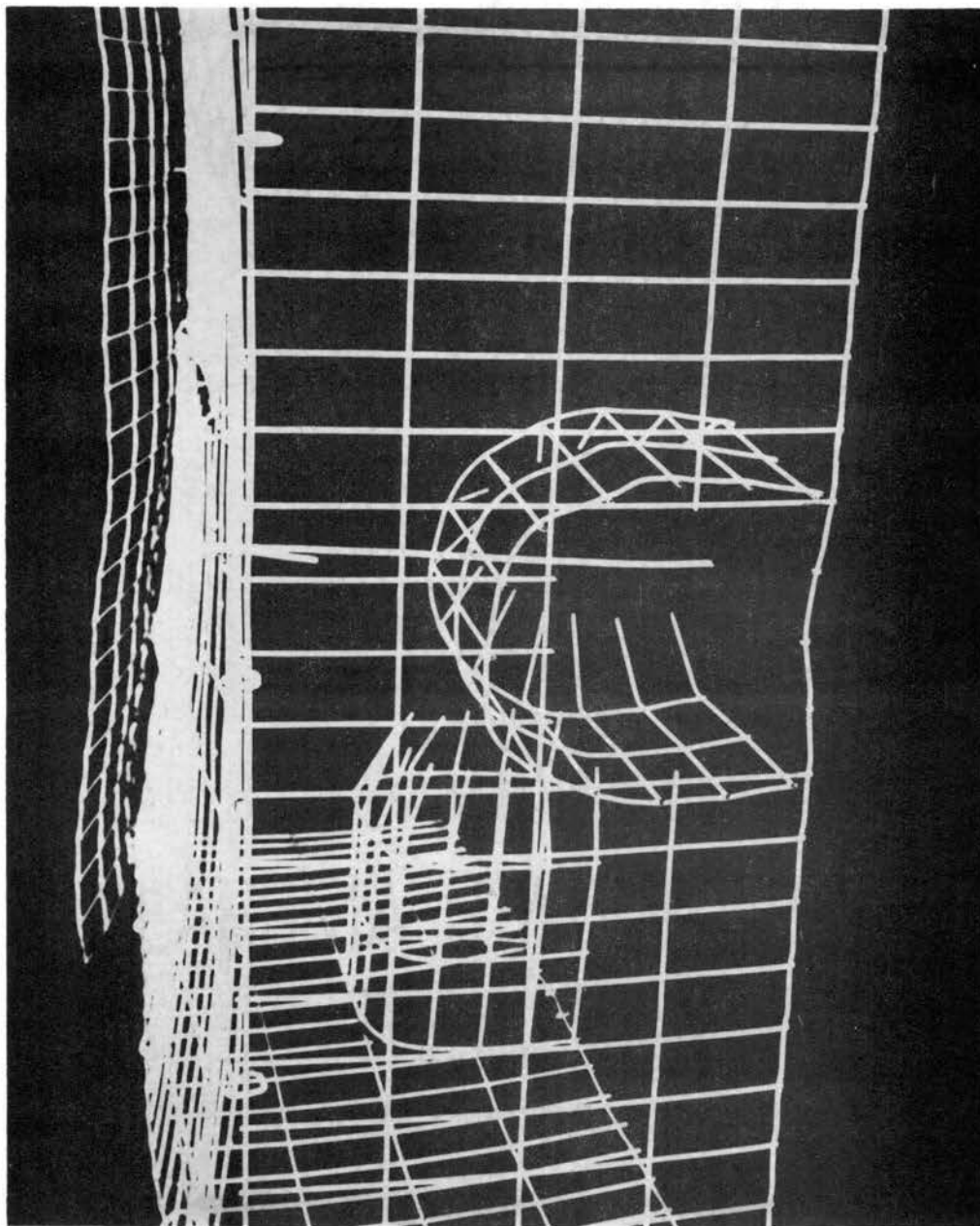


Figure 5. Short-Funnel Hang-Wire (SFHW) Trap

other funnel traps.

4. Swing-wire drop-door trap (SWDD): This modification was a combination of two types of traps. The swing-wire door with leads (Modification Number 1) was added to the Thompson drop-door trap (Figure 6). The swing-wire doors were placed on opposite sides of the trap from each other and 6 inches from the opposite ends of the trap. Also, the partition was removed from the middle of the trap, making it a one-celled compartment. This was done because the initial observations showed that both doors are frequently tripped when a single dove is in one cell. The addition of the swing-wire doors was to give the trap a better capability for multiple catches. The trigger wire was placed so that a dove entering from any of the four openings would trip both drop doors and become trapped. At the drop-door openings, bait was placed only at the threshold and inside the trap. If grain was placed outside the trap in front of the drop doors, then doves arriving after the doors had closed could feed on this bait without having to attempt entry through the swinging doors into the trap. The swing-wire doors were baited in the same manner as the swing-wire trap with leads (Modification Number 1).

The four kinds of modified traps were used in conjunction with the Kniffin funnel trap and the Stoddard swing-wire for a total of six types of traps observed during the month of August. The Kniffin funnel trap and Stoddard swing-wire trap were used as controls because they had been used in the preliminary trapping, and records were available on their comparative trapping success. The records from the preliminary observations could be used as references in case some new, external factor changed the expected rate of trapping success in these

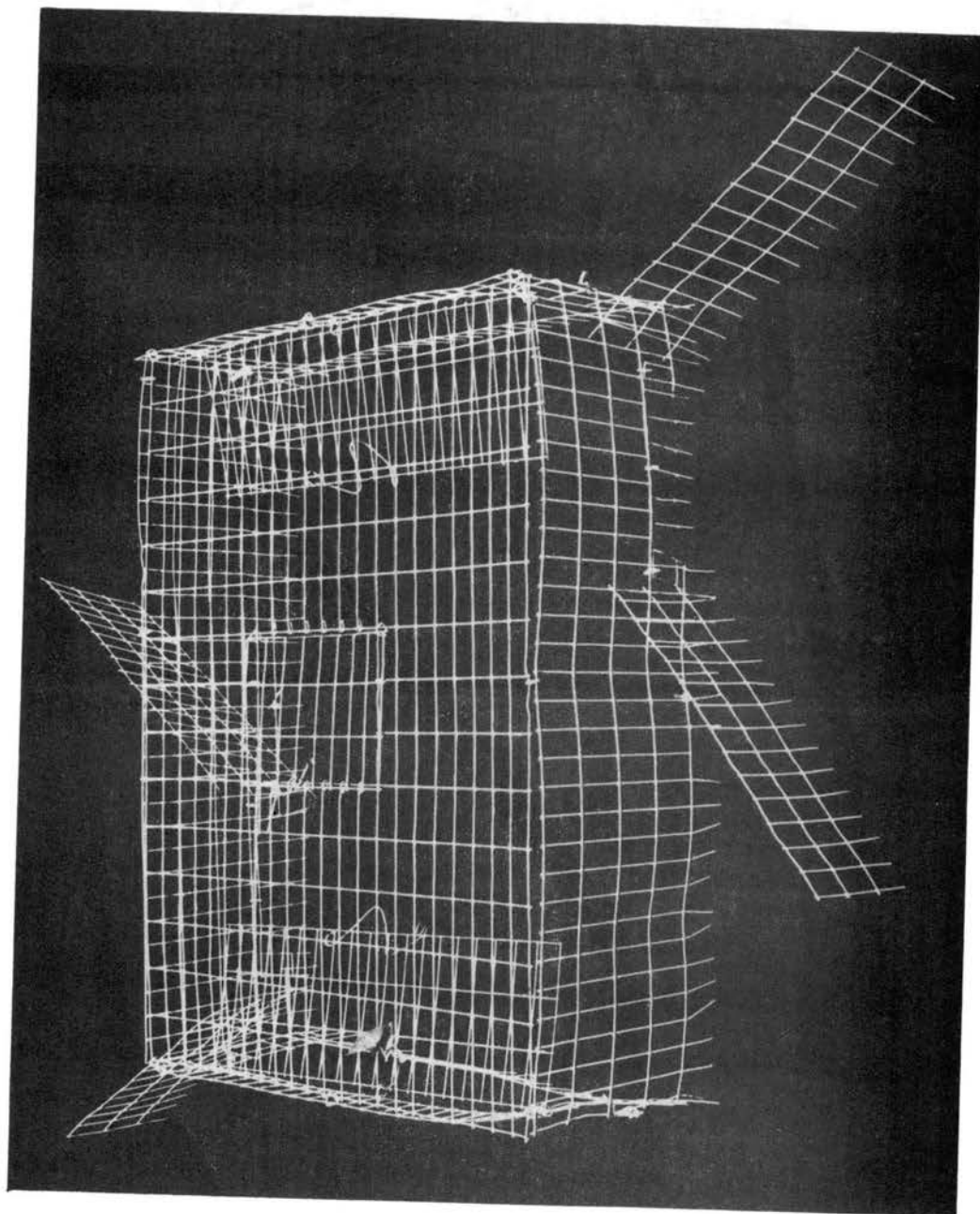


Figure 8. Swing-Wire Drop-Door (SWDD) Trap

two kinds of traps while they were being used as controls with the four kinds of modified traps under testing. The Kniffin and Stoddard traps were considered sufficient for controls, so the Thompson trap was not employed.

Selection of Habitat Types

Five types of habitat were selected for preliminary observations. These five types were chosen either because large numbers of doves were seen in them or because they had characteristics similar to the favorable trapping habitats listed in Mourning Dove Capture and Banding (Reeves et al., 1968).

Barren-ground habitat was land denuded of vegetation, usually from an agricultural practice. These areas were commonly terraces constructed in wheat fields to retain and divert surface water. These terraces were about 4 ft high, 15 ft wide, and of various lengths and positions following contours across the fields. They differed from the surrounding field in that they were not planted to wheat and thus were not plowed or disced. They were firmly packed, smooth strips running through the fields.

The plowed-field type is self descriptive. Most agricultural practices in this area were related to wheat farming, and during June the fields were disced to turn the wheat stubble under. The plowed-field habitat represented a field in this condition.

The pond-bank habitat consisted of either pond dams or areas where the water had receded due to drought and left a flat expanse of exposed pond bottom. Neither of these places contained vegetation.

The sandy-clearing habitat was a broad expanse of sand with little or no vegetation. These were areas cleared and leveled by oil companies to facilitate their drilling operations. These areas were found only near the Cimarron River, which probably accounted for the prevalence of sand.

The pasture habitat was usually the grass-covered floor of a mesquite thicket. These areas were grazed by cattle periodically, and consequently the grass was rarely over 5 inches in height. To avoid having cattle interfere with traps, only areas of this type from which cattle had been removed were chosen.

During the early morning and late afternoon, large numbers of doves were usually found on the pond-bank or sandy-clearing habitats. The doves observed around the ponds were watering and obtaining grit, and those observed at the sandy clearings were obtaining grit. Doves could usually be found in the pasture habitat during midmorning or early afternoon. These were the warmest periods of the day, and the doves may have been seeking the shade afforded by mesquite trees. The barren-ground and plowed-field habitats were usually visited during the early morning and late afternoon. This schedule varied, however, in accordance with changes in weather conditions and precipitation, and many doves could be observed frequently on these areas throughout the day. I believe that the birds fed in these areas because grains of wheat spilled in the June harvest could be found on the soil surface of both types.

After these five types were selected for observations, daily estimates were kept on the number of doves seen in a particular habitat type. Each type of habitat was watched for a 30-min. period daily

throughout 1 month, and when a large number of doves was observed in an area, traps were set there. To maintain uniform characteristics of trap sites, each site was cleared of vegetation within a radius of 3 ft around the trap so that visibility of the trap would remain as comparable as possible in all areas. After the traps were set, the number of doves observed in the trapping area was compared to the number of doves caught in the area. This facet of the study was carried on simultaneously with the preliminary observations on types of traps mentioned previously. Each area received the same number of each type of trap to eliminate bias due to preference for any type of trap.

At the end of July, the catch/observed ratio was calculated (Table II). As a result of these measurements, the sandy-clearing and the pasture habitats were discarded as test sites for further study because of their lower number-caught/number-seen ratio. Although doves congregate periodically on these areas, their primary interest did not seem to be feeding, thus trapping success was low compared to the other types. The barren-ground, plowed-field and pond-bank types were retained as study sites because they had the potentiality for producing large catches, which was essential for statistical treatment.

Selection of Perch Types

Because a dove must see a trap before it can be lured to the trap and caught, circumstances involved in a dove's seeing the trap play an important role in capture success. Elevated objects or perches could therefore have an important role in trapping success (Amend, 1969).

An attempt was made in the trial study to analyze the effect of perches on capture success. Five kinds of perches were chosen for

TABLE II
COMPARATIVE TRAPPING SUCCESS IN FIVE TYPES OF
HABITAT IN NORTHWEST OKLAHOMA

Habitat type	Estimated number of doves seen	Number of doves caught	Percent captured
			$\frac{\text{Number caught}}{\text{Number seen}}$
Barren ground	1500	52	.035%
Plowed field	1500	22	.015%
Pond bank	2000	26	.013%
Sandy clearing	2000	12	.006%
Pasture	1500	8	.005%

analysis. In addition, absence of a perch constituted a sixth category for analysis. The five types of perches were selected through observations of dove behavior. Because the study area is a flat expanse with relatively few trees or shrubs, there are a limited number of elevated objects; nevertheless, the types of perches used by doves were: telephone wire (about 40 ft above ground), fence (about 4 ft above the ground), mesquite tree (5 to 25 ft above the ground), telephone wire and mesquite combination, and telephone wire and fence combination. A combination of mesquite tree and fence did not occur within the study area.

These types of perches were observed during July, and although more doves were seen on telephone wire than on other types of perches, a large enough number of doves did occur on the other types to justify studying them further during August.

The purpose of these observations in the preliminary study was to establish a study design that would lend itself to meaningful analysis. The definitive study in August was made on six types of traps, three types of habitat and six types of perches.

Organization of Traps and Trap Sites

The trapping tests for statistical analysis were made with 108 traps organized into six groups of 18 traps each. Each group contained three traps of each of the six types described previously. Traps in each group were set on permanently established sites spaced 100 ft apart in a generally linear arrangement.

The purpose of organizing six groups was to expose equally all types of traps to the doves in the selected kinds of habitat within the

ecosystem of the study area and thereby reduce bias on the catchability of any type of trap.

Within each group, traps were exchanged between sites every 4 days to eliminate bias from local variations of the habitat within close proximity to the group of traps. The traps were initially positioned identically in each group of 18 traps by establishing three consecutive subgroups. In each subgroup the six kinds of traps were arranged in the same sequence. The number sequence was determined from a table of random numbers.

In each rotation of traps, the six traps of each subgroup were moved systematically from one trap site to the next in line; the trap at site number six in each case being brought back to site number one. Each type of trap thereby occupied each site for 4 days during the 24-day trapping period.

Placement of Traps to Analyze Habitat Preferences

In selecting the locations for permanent trap sites, it was also necessary to locate them in such a way that equal numbers of each type of trap were located simultaneously in each of the three types of habitat,

Thirty-six traps (six of each type) were placed in each of the three habitat types. Because these traps were also being used for the evaluation of trapping success, the analysis for influence of habitat type included the same six rotations at 4-day intervals.

Placement of Traps to Analyze Perch Type Preferences

It was necessary also to locate the traps in such a way that each type of trap was equally exposed to each of the six types of perches identified in the prestudy period.

Eighteen traps (three of each type) were associated with each type of perch, and because these were used for evaluating comparative success of trap-types and habitat types, they received the same rotations of position six times at 4-day intervals.

Analysis of the Effect of Decoys in Attracting Doves to a Trap Site

Forty-eight full-bodied, papier-maché dove decoys were used to measure the effect of artificial decoys in attracting doves to a trap site. These 48 decoys were divided into six groups of eight decoys each, and each of the six trap lines received eight decoys. The decoys were placed at alternate traps in a group. At first, the decoys were placed so that decoys two, four, six and eight were placed on the top of the trap while decoys one, three, five and seven were placed on a fence or perch close to the trap. This placement was changed, however, when it became apparent through observations that the decoys placed on the traps seemed to keep doves from approaching the trap. The decoys on the traps were moved away from the trap to a perch near the trap. Thus, the final decoy placement was eight decoys, placed at alternate traps in each group, each decoy on a perch within 20 ft of the trap site. If no perch site was available at the trap site, then the decoy was placed on the ground within 20 ft of the trap.

For each dove trapped, it was noted whether or not the trap was associated with a decoy. A comparison was then made between traps with and traps without decoys.

To measure the effect of live-dove decoys in attracting doves to a trap site, a record was kept of the number of multiple catches versus single catches. This is not entirely representative of the effect of live-dove decoys since some types of traps were more capable than others for making multiple catches.

Evaluation of Weather and Agricultural Practices on Trapping Success

To measure the effect of weather on trapping success, daily climatological data were obtained from the United States Department of Commerce reporting stations at Fairview and Canton, Oklahoma, and plotted against daily trapping success.

Notes were kept on any significant agricultural alterations of the habitat in or around the study area, and these were also plotted against trapping success. Most of the agricultural alterations involved discing or plowing wheat fields, and records were kept as to what types of farming practices were employed and when they occurred.

These extrinsic factors were considered important to this study because they may have disturbed, increased, or decreased the dove population in the study area and therefore had an effect on trapping success.

CHAPTER III

DESCRIPTION OF THE STUDY AREA

Location and Physical Characteristics

This study was conducted in south-central Major County in northwest Oklahoma. The trapping sites were inside a 3-mile-square area approximately 9 miles northwest of Fairview, Oklahoma.

Soils in this area are typically developed from fine-grained sandstones, shales and Permian clays. Gypsum is present in large quantities. Duck and Fletcher (1944) denoted this area as the Mixed-Grass Eroded Plains Game Type. The study location, however, is subclassified as the Mixed-Grass Mesquite-Plains Type (Duck and Fletcher, 1944). The study area has a preponderance of mesquite trees growing in thickets with a short-grass understory composed mainly of buffalo grass (Buchloe dactyloides), blue grama (Bouteloua gracilis), side-oats grama (Bouteloua curtipendula), and little blue stem (Andropogon scoparius). Grasses are close-cropped by cattle, as the mesquite thickets provide the only available natural pasture in the area.

Mesquite thickets are usually surrounded by wheat fields. Thus, they are pockets of cover amidst the large expanses of wheat fields surrounding them. These thickets and the vegetation along a few creek bottoms are the only cover available to wildlife in the area. This is especially significant during the summer months when the wheat fields

are plowed and lack vegetation.

Agriculture in the study area consists mainly of wheat farming, but it also includes small plots of millet, cotton, and alfalfa. Livestock raising is confined to cattle, the production of which is limited by the low occurrence of natural pastures and the prohibitive costs of importing supplemental feed.

Climatic Factors

The study area lies within a climatic region classified as sub-humid, mesothermal and deficient in moisture during all seasons (Duck and Fletcher, 1944). Annual rainfall varies from 22 to 30 inches. Lack of moisture is a serious problem in this area because the ground surface is nonporous and much moisture is lost as runoff. Also, during the late summer months, the area is frequently subjected to long periods of drouth. The annual mean temperature for the study year was 60.9 F although extreme yearly temperature fluctuations occur (Bruner, 1931), as shown in Table III.

TABLE III
AVERAGE MONTHLY TEMPERATURE AND TOTAL MONTHLY
PRECIPITATION ON THE STUDY AREA, 1970*

Month	Average monthly temperature (F)	Total monthly precipitation (inches)
January	33.6	.07
February	45.0	trace
March	42.6	2.99
April	57.5	5.73
May	74.5	.39
June	79.1	.63
July	85.4	1.38
August	86.3	.42
September	75.9	2.71
October	59.8	.75
November	47.5	.08
December	43.4	.75
Total Annual		15.90

*Records compiled by U. S. Department of Commerce (1970).

CHAPTER IV

RESULTS AND DISCUSSION

Method of Statistical Analyses

Due to the nature of the experimental design, a conservative mode of analysis was chosen. The experiment was laid out as a factorial arrangement of three factors (type of trap, type of habitat, and type of perch) at six, three and six levels, respectively, with measurements taken over each of six 4-day periods. Because the information is count data, many of the 108 treatment combinations showed extremely small counts. Thus, an individual analysis is given for each of the three factors by collapsing the original design into a randomized block structure. The number of treatment combinations was equal to the number of levels for the factor being analyzed, and the six blocks corresponded to the six 4-day observation periods. As a result of this type of design, no comparison can be made involving two or more of the factors.

Experimental Comparison of Types of Traps

To facilitate avoidance of repetitious phraseology in reference to the six types of traps under consideration, the following abbreviations will be used henceforth in reference to the various types:

Experimental Modifications

SWWL = Swing-wire with leads (Stoddard collapsible swing-wire with wings extending out from the openings).

SF = Short-funnel (Kniffin with 6-inch funnels).

SFHW = Short-funnel hang-wire (Kniffin with wire suspended in 6-inch funnel).

SWDD = Swing-wire drop-door (Thompson drop-door lacking center partition but with two swinging doors with leads added).

Controls

RF = Regular-funnel (Kniffin with 11-inch funnel).

SW = Swing-wire (Stoddard collapsible swing-wire).

Analysis of Comparative Capture Success

According to Type of Trap

Catch per type of trap was recorded throughout August (Table IV) and these figures were tested statistically by the analysis of variance and the Newman-Keuls test (Snedecor and Cochran, 1967).

Analysis of Variance

Potential variance among types of traps was analyzed. Two assumptions are associated with the analysis of variance and must be recognized before an interpretation can be made. These are: (1) experimental errors are random, independent, and have a normal distribution about a mean of zero with a common variance, and (2) the effects due to external and treatment factors are additive (Steele and Torrie,

1960). The hypothesis tested by the analysis of variance was that no difference existed among trap types. When tested with an F test, the hypothesis was rejected (Table IV).

Newman-Keuls Test

Since the analysis of variance indicated a difference among types of traps, it was necessary to find the origin of this difference. The Newman-Keuls test was used for this differentiation. The Newman-Keuls test is designed to analyze comparatively two factors and indicate whether or not the difference between them is due to chance. Although only two units can be analyzed simultaneously, this test can be used sequentially on several units to test their comparative differences (Snedecor and Cochran, 1967).

The results of the analysis of variance and the Newman-Keuls show that capture success was significantly higher in the SWDD trap than in the other five types of traps. Also, the SWWL trap was more successful than the RF trap (Table IV).

Swing-Wire Drop-Door

The high capture success of the SWDD trap is probably attributable to several factors. The large drop-doors, when opened, allow an uninterrupted view through the trap which may serve to reduce the amount of caution usually displayed by a dove approaching a trap. Also, this trap offers four entrances whereas the other traps offer only two. Although a dove may enter the trap and trip the doors at both ends, other doves can still enter the trap through the swing-wire doors. This is important when considering that a trapped dove may attract

TABLE IV
COMPARATIVE NUMBERS OF CAPTURES AND RETENTIONS IN
THE EXPERIMENTAL TYPES OF TRAPS DURING
FOUR-DAY PERIODS OF TRAPPING

Blocks (4-day periods)	Types of traps						Sums (Bj)
	RF	SF	SFHW	SWWL	SW	SWDT	
1	20	28	26	38	31	81	224
2	10	18	22	22	25	54	151
3	26	35	34	47	33	65	240
4	16	32	27	20	12	60	167
5	6	8	13	23	13	40	103
6	14	18	28	18	25	42	145
Sum (Ti)	92	139	150	168	139	342	1,030

Analysis of Variance

Source			
Total Corrected	35	9606.5556	
Blocks (B)	5	2213.8889	442.7777
Treatments (T)	5	6329.5556	1265.9111
Error (E)	25	1063.1111	42.5244

Hypothesis: There is no difference among trap types.

F test: calculated $F = 29.7690$; tabulated $F_{(5,25)}$ at $.01 = 2.60$
(for treatments)

The hypothesis is rejected.

TABLE IV (Continued)

Newman-Keuls Test

Treatment MeansRegular Funnel (\bar{x}_1) = 15.333Short Funnel (\bar{x}_2) = 23.166Short Funnel Hang-Wire (\bar{x}_3) = 25.000Swing-Wire with Leads (\bar{x}_4) = 28.000Swing-Wire (\bar{x}_5) = 23.166Swing-Wire Drop-Door (\bar{x}_6) = 57.000Ranking of Means in Order of Capture Success $\bar{x}_6, \bar{x}_4, \bar{x}_3, \bar{x}_5, \bar{x}_2, \bar{x}_1$ Comparisons Showing Significant Differences

$$\bar{x}_6 - \bar{x}_1 = 41.667 > (2.66 \times 4.36) = 11.624$$

$$\bar{x}_6 = \bar{x}_2 \text{ or } \bar{x}_5 = 33.834 > (2.66 \times 4.16) = 11.065$$

$$\bar{x}_6 - \bar{x}_3 = 32.000 > (2.66 \times 3.52) = 9.363$$

$$\bar{x}_6 - \bar{x}_4 = 29.000 > (2.66 \times 2.91) = 7.740$$

$$\bar{x}_4 - \bar{x}_1 = 12.667 > (2.66 \times 3.89) = 10.397$$

other doves in the area. Another important factor contributing to the success of this trap is the difficulty trapped doves have in escaping from it. All doors of this trap are locked from the inside, consequently there are no escape routes.

Some precautions in the placement of bait are necessary if this trap is to be used with maximum efficiency. The bait placed under the drop-door entrances must not extend past the outer perimeter of the trap because once the doors are shut any bait outside the doors may be used by doves outside the trap, distracting their perception of bait at the swing-wire entrances. Also, a handful of bait should extend only 6 inches outside the swing-wire entrances, with two handfuls immediately inside the doors. It is beneficial to have about a pound of bait inside the trap as this not only serves to attract doves to the trap, but also induces trapped doves to continue feeding rather than to attempt escape which may frighten other doves near the trap site.

Swing-Wire With Leads

The SWWL trap, which was significantly better in capture success than the RF trap, had as its main advantage the leads or wings extending from the entrance of the trap. Apart from these leads, the trap was the same as the SW trap, suggesting that the higher success was due to the leads. Also, the difficulty it presented to doves trying to escape added to its advantage.

Baiting procedures were those used for the swing-wire doors of the SWDD trap.

Trap Types Having Statistically Indistinguishable

Capture Success

Although this analysis provides no statistical base for preferring the SFHW trap over any other type of trap, the ease of installing the hang-wire in the funnel portion of the trap could benefit any trapper using funnel traps by an increased retention rate of trapped doves. Baiting consisted of placing a handful of grain outside the trap and extending it through the funnel to a larger amount (about a pound) inside the trap.

The main deficiency of the SW trap was the difficulty it presented to doves trying to enter. The swing-wire doors seemed insufficiently distinguishable from the wall of the trap to be perceived and entered by doves feeding around the trap. The fact that trapping success increased when leads were added to this trap seems to substantiate this assumption. The major attribute of this trap is that doves have greater difficulty escaping from it. The baiting procedures were the same as those used for the SWWL trap.

The shortened funnel of the SF trap seemed to improve the catchability of this type, although the difference was not statistically ascertainable, over the regular-funnel trap. This may be due to the shorter length of time the dove remains in the funnel when entering the trap. Possibly, the less time spent in the funnel, the less apt the dove is to become alarmed, and this decreases the possibility of escape during the entry phase of the capturing process. The main drawback of this type of trap was the ease of escape it afforded trapped doves. The baiting procedures involved placing a small line of bait

outside the funnel leading to a larger amount (about a pound) immediately inside the trap,

The RF trap had the lowest trapping success. The length of the funnel possibly affected capture success adversely by frightening doves inside the funnel due to the length of time they remained in the funnel and the greater possibility of bumping against it before passing through into the trap. Also, the comparative ease of escape through the funnel contributed to the lower capture success. The baiting procedure was the same as that in the SF trap. A small amount of grain led through the funnel to a larger quantity (about a pound) inside the trap.

Analysis of Effect of Type of Habitat on Capture Success

Capture success according to the three types of habitat was analyzed statistically by the same testing methods used for comparing the types of traps discussed in the previous section (Table V). It was hypothesized that there was no difference between habitat types in trapping success. The F test applied to the data in Table V indicates that this hypothesis should be rejected. The Newman-Keuls test was used to locate the areas of variation (Table V).

Interpretation of Analysis of Effect of Types of Habitats

Barren Ground

Barren-ground habitat was found to be the most productive trapping area. Since these areas were mostly terraces constructed for water

TABLE V
NUMBER OF CAPTURES ACCORDING TO TYPES OF HABITAT
DURING FOUR-DAY PERIODS OF TRAPPING

Number of doves caught Treatments (Habitat Types)				
Blocks (4-day periods)	Barren ground	Plowed field	Pond bank	Sums (Bj)
1	117	51	56	224
2	77	40	34	151
3	132	80	28	240
4	76	67	24	167
5	37	37	20	103
6	68	45	32	145
Sum (Ti)	507	320	203	1,030

Analysis of Variance

Source			
Total Corrected	17	14073.112	
Blocks (B)	5	4427.7778	885.555
Treatments (T)	2	7837.4445	3918.7222
Error (E)	10	1807.8889	180.7888

Hypothesis: There is no difference in trapping success between habitat types.

F test: calculated $F = 21,6756$; tabulated $F_{(2,10)}$ at $.01 = 4.10$
(for treatments)

The hypothesis is rejected.

TABLE V (Continued)

Newman-Keuls Test

Treatment MeansBarren Ground (\bar{x}_1) = 169.000Plowed Field (\bar{x}_2) = 106.667Pond Banks (\bar{x}_3) = 67.667Ranking of Means in Order of Capture Success $\bar{x}_1, \bar{x}_2, \bar{x}_3$ Comparisons Showing Significant Differences

$$\bar{x}_1 - \bar{x}_3 = 101.333 > (5.49 \times 3.88) = 21.301$$

$$\bar{x}_1 - \bar{x}_2 = 62.333 > (5.49 \times 3.15) = 17.292$$

$$\bar{x}_2 - \bar{x}_3 = 39.000 > (5.49 \times 3.15) = 17.292$$

retention, capture success may be attributable to the prominent distinction from the surrounding terrain. Traps placed on them were especially conspicuous. The surface texture of the soil on these areas was smooth and evenly colored, enabling doves to see the bait easily.

Plowed Field

Plowed fields were statistically more productive trapping sites than were pond banks. There was no attempt to distinguish between plowed fields containing wheat stubble and those without stubble because all fields were plowed at some time during the study period, and the plowing would have altered the condition of the field which in turn would have altered the design of the study. Had all stubble been plowed under at the beginning of the study, trapping success may have been improved because stubble makes traps less visible to doves. Also, unless the soil has been tilled several times, the large amount of grain remaining from the harvest tends to reduce the attractiveness of the bait at the trap. This is especially true when stubble is present in the field. Another condition that may reduce trapping success in plowed fields is the rough texture of the soil surface. Although the area immediately around a trap was cleared and smoothed, the surrounding roughness of the soil may have decreased visibility of the trap as well as reduced the desirability of the area as a place to land.

Pond Banks

This kind of trapping area had the lowest rate of capture success. Although the smooth texture of the soil surface and the prominence of these areas, compared to the surrounding terrain, indicate that these

should be excellent trapping areas, the doves that came to them seemed to be more interested in obtaining water than in feeding. During the early morning and late evening, large concentrations of doves occurred on these areas; however, few of them appeared to notice the bait around the trap.

Analysis of Influence of Type of Perch on Capture Success

Capture success in relation to the six types of perches (Table VI), which were defined and discussed in the Methods section of this paper, were also analyzed statistically by the analysis of variance and the Newman-Keuls test. The hypothesis used for the analysis of variance was that there was no difference in trapping success between perch types. This hypothesis was rejected. The Newman-Keuls test was used to rank the types of perch with respect to trapping success (Table VI).

Telephone Wire

Telephone wire was the kind of perch associated with the greatest capture success. It had significant statistical superiority over no-perch, fence, and telephone wire-and-mesquite-combination perches. Telephone wires probably offered better visibility of the traps to approaching doves than did other perches. The higher success of this type over the combination of telephone wire and mesquite suggests that mesquite, when associated with the telephone wire, possibly hinders trap visibility to approaching doves or may harbor greater threat from predators.

TABLE VI
COMPARATIVE NUMBERS OF CAPTURES ACCORDING TO TYPES OF
PERCHES DURING FOUR-DAY TRAPPING PERIODS

Numbers of doves caught per treatment (types of perches)							
Blocks (4-day periods)	Telephone wire	Fence	Mesquite	Wire & mesquite	Wire & fence	No perch	Sum (Bj)
1	83	26	23	35	40	17	224
2	41	20	24	29	24	13	151
3	42	44	45	51	45	13	240
4	20	27	48	12	47	13	167
5	21	9	26	20	15	12	103
6	56	10	22	13	28	16	145
Sum (Ti)	263	136	188	160	199	84	1,030

Source	Analysis of Variance			
	Degrees of freedom	Sum of squares	Mean square	F
Total Corrected	35	8156.5556		
Blocks (B)	5	2213.8889	442.777	
Treatments (T)	5	3074.8889	614.9777	5.3611
Error (E)	25	2867.7778	114.7111	

Hypothesis: There is no difference in trapping success between perch types.

F test: calculated $F = 5.3611$ tabulated $F_{(5,25)}$ at $.01 = 2.60$
(for treatments)

The hypothesis is rejected.

TABLE VI (Continued)

Newman-Keuls Test

Treatment MeansTelephone Wire (\bar{x}_1) = 43.833Fence (\bar{x}_1) = 22.667Mesquite (\bar{x}_3) = 31.333Telephone Wire and Mesquite (\bar{x}_4) = 26.667Telephone Wire and Fence (\bar{x}_5) = 33.167No Perch (\bar{x}_6) = 14.000Ranking of Means In Order of Capture Success $\bar{x}_1, \bar{x}_5, \bar{x}_3, \bar{x}_4, \bar{x}_2, \bar{x}_6$ Comparisons Showing Significant Differences

$$\bar{x}_1 - \bar{x}_6 = 29.833 > (4.37 \times 4.36) = 19.053$$

$$\bar{x}_1 - \bar{x}_2 = 21.167 > (4.37 \times 4.16) = 18.179$$

$$\bar{x}_1 - \bar{x}_4 = 17.167 > (4.37 \times 3.89) = 16.999$$

$$\bar{x}_5 - \bar{x}_6 = 19.167 > (4.37 \times 4.16) = 18.179$$

$$\bar{x}_3 - \bar{x}_6 = 17.333 > (4.37 \times 3.89) = 16.999$$

Telephone Wire and Fence

The combination of telephone wire and fence was found statistically to be more effective than the no-perch type. The elevation it afforded to doves landing near a trap site was undoubtedly responsible for its success. The fence probably had little effect on the success of this perch; it did little to obstruct the view of approaching doves, however, and thus capture success remained relatively high.

Mesquite

The mesquite perch was statistically superior to the no-perch type. The elevation it provided to approaching doves, although not as great as the telephone wire, was probably responsible for this higher success. Also, the mesquite trees were often used for nesting or roosting, and many of the doves trapped in these areas moved in and out of nearby mesquite thickets in their daily routines of feeding and nest tending.

General Comments

Capture success near the combination of telephone wire and mesquite type of perch, which was significantly less successful than the telephone wire perch, was probably hindered by the fact that approaching doves would usually land on the telephone wire whereupon the mesquite below obstructed their view of the trap. Judging by the higher number of recaptures taken from traps under these types of perches, I believe that most of the doves trapped were locally oriented birds that either nested or roosted in the nearby mesquite trees.

The main fault of the fence-only perch seemed to be lack of elevation. Very few of the doves trapped around this type of perch landed on the fence before approaching the trap. Most of the observed trappings near fences involved a dove landing on the ground close to the trap and approaching the trap by walking rather than first landing on the fence then flying down to the trap.

The no-perch situation was the least successful of all. This suggests the importance of a perch or elevated object in association with a trap site. In order for a dove to approach a trap lacking a nearby perch, the bird must make a direct aerial approach to the trap site. This is undesirable for trapping since it requires aerial recognition of a trap plus subsequent approach without the benefit of pausing to observe the trap site.

Effect of Artificial Decoys on Trapping Success

Papier-maché decoys were placed at alternate trap sites to evaluate the possibility of their presence increasing trapping success. The results are as follows:

Doves captured in traps associated with artificial decoys - 487.

Doves captured in traps not associated with artificial
decoys - 543.

This comparison indicates that artificial decoys have little effect on trapping success. It would take a substantial increase in trapping success to justify the use of artificial decoys because they cost 45¢ each. The result of this comparison indicates that the cost of decoys would probably have bolstered overall trapping success had

it been invested in materials with which to construct and operate more traps.

Comparison of Weather with Total Trapping Success

August in northwest Oklahoma is characterized by hot, arid, windy days with little variation in daily conditions. However, when certain weather variations occurred, the rate of capture changed markedly.

Temperature

The monthly average of daily maximum temperatures at Fairview, Oklahoma, during the study period was 100.2 F while the monthly average of minimum daily temperatures was 72.4 F (U. S. Department of Commerce, 1970). Deviations from these coincided with variations in trapping success as depicted in Figure 7. A decrease in temperature was associated with an increase in trapping success while an increase in temperature was associated with a decrease in trapping success. This is substantiated further by the fact that most of the doves trapped during the study period were captured during the early morning and late evening hours when temperatures were near the daily lows,

Wind

Wind velocity was measured at the U. S. Department of Commerce Canton Dam Field Station, which is situated approximately 20 miles south of the study area. Data obtained from this station are believed to be representative of the study area also. It was found that as winds increased in velocity there was a decrease in trapping success

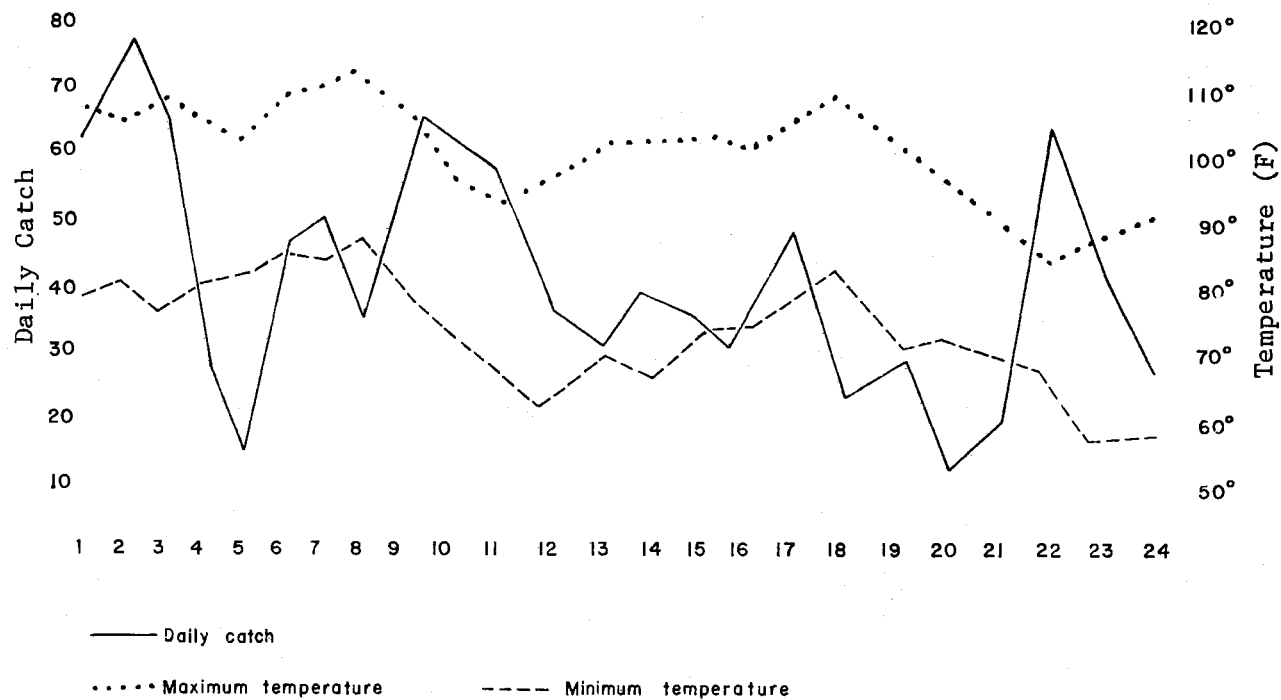


Figure 7. Comparison of Daily Temperatures and Total Daily Capture Success

and when winds were minimal, trapping success increased. These results are presented in Figure 8.

Precipitation

Precipitation may have more influence on trapping success than any other climatic factor. Rainfall during the month of August in the study area is characteristically low and any precipitation during this period was associated with a marked increase in trapping success. The U. S. Department of Commerce Field Station at Orienta reported a total rainfall of 2.79 inches during the study period. The rainfall occurred during 6 days of the 24-day trapping period and each occurrence of precipitation was followed by an increase in trapping success (Figure 9). During 19 and 20 August, the study area received 1.85 inches of precipitation; Figure 9, however, indicates a reduction in trapping success on these dates. This reduction probably occurred because the unusually large amount of rainfall washed bait from the traps and made roads too muddy for Unit personnel to check the traps.

Association of Agricultural Practices and Trapping Success

Although not all of the land within the study area was cultivated for agricultural crops, no group of traps was more than one-half mile from cultivated land. Most of the farming in the study area involved wheat fields in post-harvest condition, and the post-harvest treatment of these fields occurred closely together temporarily, at regular intervals, and involved the same procedures. These procedures consisted of discing the land at least three times and then plowing it two or

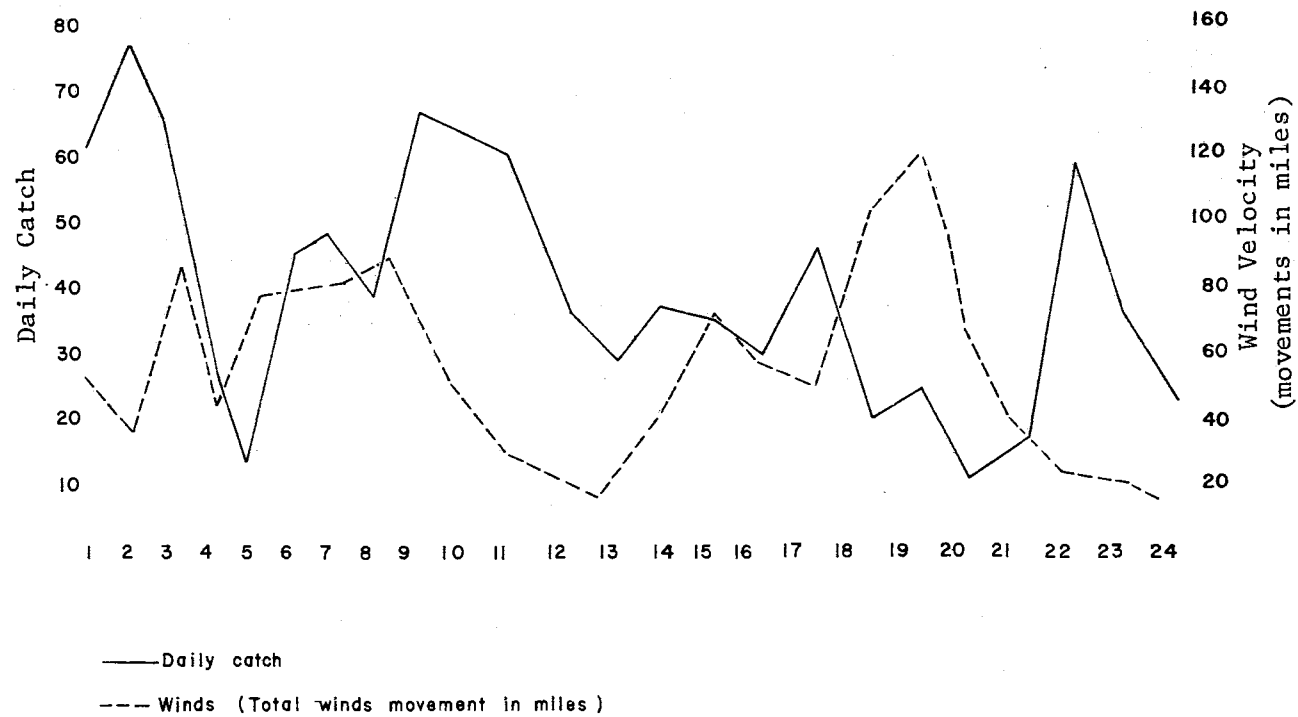


Figure 8. Comparison of Wind Velocity and Total Daily Capture Success



Figure 9. Comparison of Precipitation and Total Daily Capture Success

three times. During the study period, only discing occurred; plowing began after the study period ended. Because the method of discing remained constant and occurred at regular intervals, records were kept of the dates of discing and these were compared to the trapping results during these periods to reveal any relationship discing may have with trapping success. If a group of traps was not in a wheat field, the wheat field closest to the trap group was used for study. All adjacent wheat fields were no further than one-fourth mile from the group.

Although not all of the fields under study were disced on the same day, the maximum duration of any one discing period in the study fields was 6 days. All but one of the study fields were disced twice during the study period, once during the period of August 3 to August 9 and once during the period of August 17 to August 23. The latter discing period was the final one of the season; the land was plowed in early September. When the study began, the land had already been disced once so that all the fields were in the same condition at the beginning of the study.

Discing dates were compared to the number of doves caught in the three types of habitat previously analyzed (Table VII) and (Figure 10). Immediately before the first discing, the catch was high in all three types of habitats. During and immediately after this first discing date, trapping success decreased. It then increased again 2 days after discing was completed. During the second discing period, trapping success decreased again; however, the study period terminated before any further change could be detected in trapping success.

The results of this analysis indicate that discing may interfere with trapping success. During discing, machinery in the field may

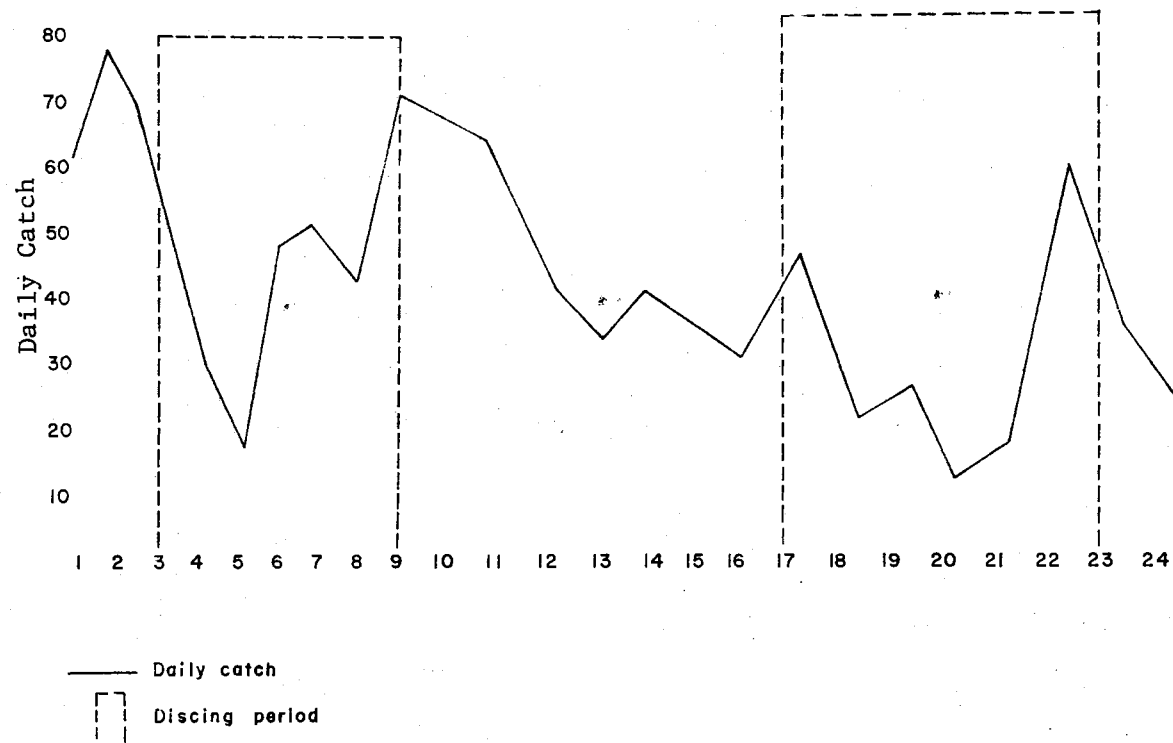


Figure 10. Comparison of Discing Periods in Plowed Field Habitat and Total Daily Capture Success

TABLE VII
EFFECT OF DISCING ON TRAPPING SUCCESS

Numbers of Doves Caught Treatments (Habitat Types)				
4-Day trapping periods	Barren ground	Plowed field	Pond bank	Total
1	117	51	56	224) Discing
2	77	40	34	151) Period
3	132	80	28	240) I
4	76	67	24	167) Discing
5	37	37	29	103) Period
6	68	45	32	145) II

frighten doves away; and immediately after discing, the recognition of trap sites by doves may be hindered due to alterations of the land surface. Trapping success was higher 2 or 3 days after the first discing than it was beforehand, suggesting that discing improves trapping success after the field has been worked and then left undisturbed. This was not as evident after the second discing period, however, and the increase after the first discing period may be due to weather, to an increase of juveniles capable of flight, or to some other factor.

CHAPTER V

SUMMARY

This research was conducted to compare capture success in six kinds of dove traps, to compare the relationships between certain habitat types and perch types to trapping success. Also, artificial decoys, weather and agricultural practices were analyzed as to their possible effect on dove trapping. The study was conducted from 1 August 1970 to 24 August 1970 in a 9-sq-mile study area northwest of Fairview, Oklahoma. An analysis of variance and the Newman-Keuls test were the statistical means by which trap types, habitat types and perch types were tested for correlation to trapping success.

Two standard traps, the Kniffin funnel trap and the Stoddard collapsible swing-wire trap, were analyzed in conjunction with four types of modified traps: the short-funnel, the short-funnel hand-wire, the swing-wire with leads, and the swing-wire drop-door. Analysis of variance was used to determine if significant differences occurred between the trap types, and the Newman-Keuls test was used to determine which kinds of traps were responsible for any differences that occurred. The tests showed that the swing-wire drop-door trap had significantly greater capture success than the other five types, and the swing-wire with leads trap was significantly better than the regular funnel trap.

The habitat-type comparison involved three types of habitat commonly found in the study area. These types were: barren ground, plowed field, and pond bank. The results of the statistical tests showed that the barren-ground type supported higher captive success than the plowed-field type, which, in turn, was superior to the pond-bank type.

A comparison of capture success according to types of perches near trap sites involved six types of perches commonly found in the study area. The types were: telephone wire, fence, mesquite tree, telephone wire and mesquite tree combination, telephone wire and fence combination, and no-perch. The statistical tests showed that the telephone wire perch was associated with better trapping success than no-perch, fence perch, and telephone wire and mesquite tree combination perch. Also, the telephone wire and fence combination perch was superior to the no-perch types. The mesquite tree perch was also superior to the no-perch types.

Artificial decoys had no beneficial effect for trapping doves and may have been detrimental to the trapping effort. Live doves in the trap probably enhanced trapping success by luring other doves to the trap.

Some weather alterations seemed to affect trapping success considerably. Capture success increased with reduced temperature and wind velocity and after an increase in precipitation. However, changes in temperature, wind or precipitation often occurred simultaneously, making it impossible to attribute changes in trapping success to any one of these factors. There was probably a considerable amount of interaction between these factors that warrants further study.

During and immediately after periods of cultivation of fields in the study area, trapping success decreased, possibly due to the altered landscape and the machinery in the fields which frightened the doves.

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