THE RING-NECKED PHEASANT; ITS RELATION TO AGRICULTURE WITH SPECIAL REFERENCE TO MICHIGAN STATE COLLEGE FARMS AND EXPERIMENTAL CROPS

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Harold Howard Burgess

1946

THE RING-NECKED PHEASANT; ITS RELATION TO AGRICULTURE WITH SPECIAL REFERENCE TO MICHIGAN STATE COLLEGE FARMS AND EXPERIMENTAL CROPS

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Harold Howard Burgess

1946

This is to certify that the

thesis entitled

"THE RINGNECK PHEASANT: ITS RELATION TO AGRICULTURE With Special Reference to Michigan State College Farms and Experimental Crops".

presented by

Harold Howard Burgess

has been accepted towards fulfillment
of the requirements for

M. S. degree in Zoology

H.R. Hunt
Major professor

Date August 6, 1946

M-795

THE RING-NECKED PHEASANT; ITS RELATION TO AGRICULTURE WITH SPECIAL REFERENCE TO MICHIGAN STATE COLLEGE FARMS AND EXPERIMENTAL CROPS

BY

HAROLD HOWARD BURGESS

A THESIS

Submitted to the School of Graduate Studies of Michigan State College of Agriculture and Applied Sciences in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Zoology

1946

THESIS

TABLE OF CONTENTS

THE RING-NECKED PHEASANT; ITS RELATION TO AGRICULTURE

With Special Reference to Michigan State College Farms and Experimental Crops

INTRODUCTION

Previous to 1939 the few departments whose areas were affected by wildlife damage on Michigan State College farms attempted to control the resident wildlife in their own way.

Ring-necked pheasants (Phasianus colchicus torquatus) were reported not very important crop destroyers as late as 1932 by Damon, who states, "Lack of pheasant damage to the crops on the college farm in 1931-32 indicates that a concentration of 20 to 25 pheasants spread over a section of land (640 acres) as determined by two censuses is not likely to be serious in general farming land upon which such crops as corn, small grains, beans, and hay are grown." (Damon, 1933)

The damage done by concentrations of pheasants, and other wildlife, was so great in 1939, however, that the college requested permission to allow the campus police to shoot destructive wildlife found in critical crop areas. An investigation was made by a member of the Game Division of the Michigan Conservation Department and sufficient damage was observed to warrant granting such a permit.

Many sportsmen denounced the college policy of "re-

sorting to guns before trying some other method", after an outdoor editor had criticized the secrecy blanketing the issuing of the permit. (East, 1939)

It was apparent that the management of wildlife on the Michigan State College farms needed a thorough study: first to acquaint our technicians with the basic reasons for the concentrations and damages, and second to experiment with types of control less controversial than shooting.

History of Project

In October, 1939, the Conservation Institute was asked by the college administration to give special attention to the wildlife management problems.

Animal ecology students, under the direction of Professor J. W. Stack of the Zoology Department, were at that time studying the ecology of the pheasant concentrations (Burgess, Cooley, Denman, and Dunning, 1939), and this study was followed later with a live-trapping project during the winter of 1939 and 1940 (Burgess, Cooley, and Hyme, 1940). Therefore it was not necessary for the Conservation Institute to direct any of these activities until the late spring damage period of 1940, when the previous investigations needed greater consolidation, and future investigations required closer coordination between all of the departments concerned.

From July 19, 1940, to February 20, 1942, the Conservation Institute continuously employed one or more

wildlife investigators. During the summer of 1940, Don. W. Hayne, Research Assistant of the Zoology Section of the Experiment Station, directed the investigations of Fred. C. Durchman in these problems. During the fall of 1940, Harold H. Burgess was employed by the Conservation Institute to carry on the investigations.

ACKNOWLEDGEMENT

Appreciation is gratefully expressed to Michigan State College and in particular to Director L. R. Schoenmann of the Conservation Institute for guidance and for providing means for carrying on this project; to Mr. B. T. Ostenson, and Mr. J. W. Stack of the Zoology Department for guiding the management studies; to Dr. H. T. Darlington of the Botany Department for assistance in identifying stomach contents; to Mr. R. S. Hudson for cooperation in attempting to coordinate farm and wildlife management; to the Michigan Conservation Department and its Game Division personnel; and especially to Mr. H. D. Ruhl, Mr. Farley Tubbs and Dr. Durward Allen for valuable suggestions and assistance. I am indebted to Mr. D. W. Hayne, for his suggestions and field notes.

The suggestions of the late Mr. H. M. Wight of the University of Michigan, School of Forestry and Conservation, were greatly appreciated. Appreciation for the graduate study guidance of Dr. H. R. Hunt and Dean E. A. Bessey is here expressed.

I am very grateful to Marvin Cooley, Robert Dunning, Sally Denman, Robert Hume, Morton Livingston, Fred Durchman, Robert Scholes, Bruce Wilson, and Robert Bartlett, who at different times assisted on this project.

Gratitude is also expressed to the M. S. C. Forestry Club, the M. S. C. Conservation Club and the Lansing Boy Scouts for their cooperation in making wildlife censuses.

The contributions of many other students, faculty members, farm field men, associates and friends were so numerous that they cannot be acknowledged individually even though their efforts have assisted this investigation greatly.

I am very grateful to Mr. F. Foster and student Miss Margaret True of the Department of Geology and Geography for their cooperation in preparing the photostatic cover map of the Michigan State College farms presented on page 14.

Grateful acknowledgement is given of the constant companionship and untiring assistance during these studies of Bonnie, my English setter.

DESCRIPTION OF AREA

The area included in this study is 1800 acres in extent, and is located on the property of Michigan State College at Town 4 North, Ranges 1 and 2 West in Lansing and Meridian townships of Ingham County, Michigan. This block is bounded by the Red Cedar River on the north, Harrison Road on the west. (See Map Page 14.) The adjoining areas were also included in the studies whenever convenient, but only to gain a clearer picture of their environmental relationships.

Physiography and Soils

The area consists of a portion of Grand Ledge till plain, bordered on the north by the Grand Ledge Moraine, and on the south by the Lansing Moraine. The land is undulating sandy clay plains with low relief, gentle slopes, and having a large proportion of swampland and Hillsdale Conover soil associations with the exception of a small area of hilly sandy land on the west border and level sandy and gravelly plains on the northwest corner of the area. The highest points in the area are at the central and the southwest corner and are 869 feet above sea level; the lowest point is on the Red Cedar River at Harrison Road and is 837 feet. According to Veatch (1941) this is first class general agricultural land. The principal crops of Ingham County are corn, small grains, and hay.

Climate

The climate of Ingham County is characterized by cold winters and mild summers. The normal annual precipitation is 31.43 inches. The annual snowfall averages 47.4 inches. Wind movement and evaporation are relatively low, and humidity is moderately high. The mean annual temperature is about 47°F. The mean winter temperature is about 24°F. while the mean summer temperature is about 68.6°F. The average number of frost free days (corn growing season) is 160 days. (Veatch, Adams et. al. 1941)

Original Vegetation

This portion of Michigan was originally covered by various associations of hardwoods. The principal species were sugar maple, beech, red oak, white oak, black oak, hickory, red maple, silver maple, and swamp white oak, with an admixture of smaller amounts of walnut, butternut, black cherry, sycamore, cottonwood, and tuliptree, in less concentrated stands. Such shrubs as red osier (other) dogwoods, winterberry, rose, wild blackberry, and raspberry were common associates. (Veatch, Adams, et. al. 1941)

AGRICULTURE PRACTICES

Management

All of the college land outside of the campus is managed under two types of supervision. Approximately 400 acres used for experimental and demonstrational purposes are under the departments most closely concerned, while the rest of the 1800 acres of farmland is under the Michigan State College Farm and Horse Department and is operated as a large farm.

Land Use

Pheasant life is quite closely correlated with the use and production of the land, since it is only in rich agricultural areas that large numbers of pheasants are produced.

Leedy (1939) comments on this correlation as follows: "The abundance of the pheasant depends upon various phases of land-use. Food habit studies indicate that most of the subsistance of the pheasant consists of cultivated crops or their by-products. The crop plants and the weeds associated with them also provide valuable cover."

The college crop land is used as indicated in Table I, page 8.

TABLE I MICHIGAN STATE COLLEGE FARM LAND USE 1941

CROPS	ACREAGE	% OF TOTAL
Alfalfa or alfalfa and brome hay	425	26.
Oats, or oats and barley	179	11.5
Alfalfa and misc. pasture	173	11.0
Ungrazed hardwoods	173	11.0
Blue grass, etc., (permanent)pasture	130	8.0
Silage corn	123	8.0
Ear corn	94	6.5
Timothy (winter) pasture	45	3.0
Livestock paddocks	74	5.0
Fruit orchards	25	2.0
Fallow land or summer fallowed	20	1.0
Sugar beets	16	1.0
Berries	15	1.0
Clover (sweet, red, and alsike in plots)	14.5	1.0
Wheat	10.5	.5
Potatoes	10	.5
Timothy or timothy and fesque	10	.5
Experimental sheep pastures	9	.5
Beans	9	.5
Soybeans	4	.22
Sweet corn	4	.22
Chicory	2	.12
Misc. vegetables	2	.12
Melons	1	.06
Tomatoes	1	.06
TOTAL	1569.0	100.00

Cover Types

With the exception of 173 acres of ungrazed woodland, most of the area has been under cultivation for a half century or more, and therefore is divided into various artificial cover types. In this study, cover is classified according to its value for shelter in winter and spring, as woodlots, dispersed trees, shrubs, dispersed shrubs, perennial herbs, new herbs, water, and bare ground. (See map, page 14.)

Woodlot Types

Two large and several small hardwood woodlots as well as several small coniferous plantations are maintained on the college farm for practical forestry study. These can best be described by individual areas.

Baker Woodlot

This 70 acre hardwood multi-purpose woodlot, formerly known as Woodlot 17, is very important to this study, situated as it is, near the central portion of the most important critical crop experimental areas. Throughout the year it provides shelter for numerous pheasants and other wildlife, which at times seriously interfere with experimental research.

Baker woodlot is predominately a sugar maple-beech association with a heavy interspersal of red oak and black cherry on the southwest portion. Shrub growth is intense

in open areas and intermingled throughout the woodlot. A double row of ponderosa pine on the south side and a stagnated plantation of black walnut on the north have been added to the area.

W. A. A. Woodlot

This 5 acres of beech-maple woodlot provides winter shelter at times for as many as 200 pheasants. The association is predominately beech-maple with maple seedling and sapling understory. Its value as a shelter is indicated by the large number of pheasants using the area.

Sanford Woodlot

These 55 acres of maple and beech, formerly known as the "River Woodlot" or the "College Sugar Bush", carries about 25 pheasants and 100 squirrels over winter. No critical crop areas are located in the vicinity.

Toumey Woodlot

This 20 acres of maple and beech provides shelter for some pheasants and crows near the Farm Crop's experimental areas during the spring and summer, but carries very few pheasants during the winter.

Hudson Woodlot

This newly acquired 15 acres of selectively cut-over maple and beech hardwoods provides shelter for about 20 pheasants during the winter far from any critical crop areas.

Redman Woodlot

This formerly grazed 5 acres of hardwood has little undercover, but will become increasingly important as the undercover grows in. No critical crops are grown in the near vicinity.

Pinetum

This plantation of white pine with no undergrowth is almost entirely valueless as pheasant cover.

Sandhill Plantation

This mixed plantation of Norway spruce, black spruce, and pine provides little food and ground cover for wildlife, but in the past has been regularly used for roosting by a flock of 25 pheasants.

Dispersed Trees

Scattered trees are found throughout the area as individuals, small groves, or in lines on fence rows and road sides. These trees also play an important part in the pheasants' lives. During the spring, the pheasants often nest in the vicinity of these trees; in the fall and winter they roost in the branches and often can be observed feeding around the base, when these trees happen to be food producers.

Shrubs

Shrubs are important both for shelter and food. The fruits of shrubs are often the main fall and winter foods

and often make the difference between starving or surviving during critical periods. Shrubs are common around woodland borders and in openings, swales, and fence rows, where they supply valuable nesting and escape cover, as well as food.

Perennial Herbs

Perennial herbs are here classified as herbaceous plants which are carried over as cover from fall to the following spring. Most hayfields and lightly grazed pastures are in this classification. Perrenial herbs are important in the spring to the pheasants because they supply attractive early nesting cover. The fact that they may be mowed before hatching time increases their importance in this study.

New Herbs

New herbs are here classified as herbaceous plants which are carried over the winter, not as cover, but usually in root form. They consist mainly of grazed pasture, wheat and rye fields.

Bare Areas

Bare areas are those areas which during early spring have little or no vegetation. The area may be lying fallow, or being fitted for a summer crop. Neither the new herb type nor the bare area type are very attractive to the pheasant during the early spring, and their later value

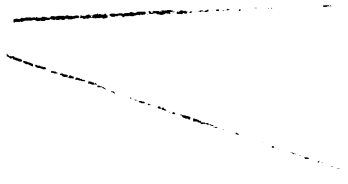
varies with their use.

Water

Besides the Red Cedar River there are many other water areas on the college farm. Numerous ditches, swales, ponds, kettle holes, and other depressions cut and dot the area providing surface water at many places on the farm.

Transition

Because of the interspersal of vegetation, some areas cannot be classed as of one single type, but instead represent a transition type. This is true of the woodland borders, fence-rows, various experimental plots, and water area borders. (See Cover Map, page 14.)



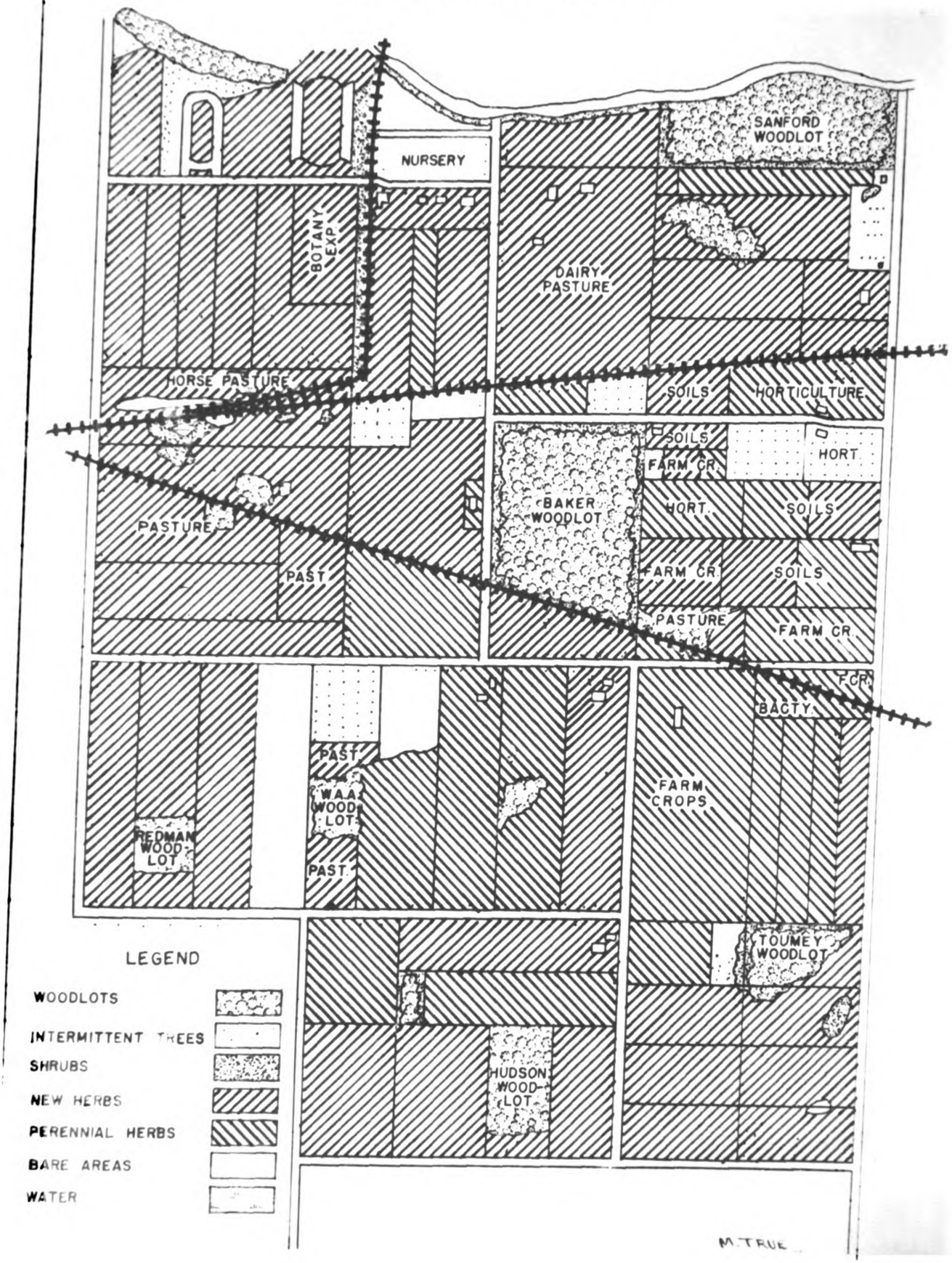
[illegible]

Cook-closing area

[illegible]nt

MICHIGAN STATE COLLEGE FARMS

COVER MAP, APRIL TO JUNE 1941



THE RING-NECKED PHEASANT

The ring-necked pheasant (Phasianus colchicus torquatus), a hybrid between the English black-necked and the Chinese ring-necked, was first introduced into Michigan in 1895. Rearing and liberation operations began at the State Game Farm at Mason in 1917; by 1925, pheasants were common and a pheasant hunting season was opened.

The ring-necked pheasant thrives best on cultivated agriculture land. When this land is interspersed with woodlots and fence rows, and the pheasants have year around protection from hunters, as on the college farms, conditions are favorable for their rapid increase.

Populations

During the falls of 1931, 1932 (Damon 1933) and 1939, estimates were made of the pheasant population by flushing the pheasants and plotting and counting the home sites on the area. During the winters of 1939, 1940, estimates were made by totaling the largest number of pheasants seen in each concentration area. Line drive censuses were made quarterly from the fall of 1940 to the winter of 1942, to estimate the number and sex ratio of the pheasants in the study area. (Table II, page 16.)

Pheasant Populations

TABLE II

Date	Acres	M	F	?	Total	A/ph	Sex Ratio	Authority
Fall 1931	1700				60	28.3		Damon
Spring 1931	1200				46	27.6		Damon
Fall 1939	1000	137	138		275	3.6	1:1.0	Burgess et.al.
Winter 1940	1000	142	213		355	2.8	1:1.5	Burgess et.al.
Spring 1940	1000	40	60		100	10.0	1:1.5	Living-ston
Oct.13,1940	1800	168	178		346	3.4	1:1.3	Burgess
Jan.26,1941	2000	210	250	26	486	4.0	1:1.2	Burgess
Apr.12,1941	1200	58	66	4	128	9.4	1:1.1	Burgess
July 8,1941	720	10	15	5	30	24.0	1:1.5	Burgess
Oct.1941	1200				494	2.5		Burgess
Jan.25,1942	1200	93	102	276	471	2.5	1:1.1	Burgess

In 1931 the fall census indicated about 1 pheasant for each 28 acres (Damon,1933), while fall censuses found 1 bird for each 2.5 acres in 1941, indicating an increase of 11 times its 1931 population in 10 years!

Line-drive Census Techniques

The line-drive censuses used for counting pheasants is a modification of the deer line-drive census. About 25 drivers are lined up on a block boundary 200 feet apart. These men, keeping equidistance apart and in a straight line, move forward across the boundary flushing the pheasants, counting the birds that move back over the census line. Individual drivers count those birds crossing

the line at their right, while boundary drivers also count the pheasants that fly over the side boundaries. Counters spaced about 1000 feet apart, tally all of the pheasants that pass over the forward boundary on their right.

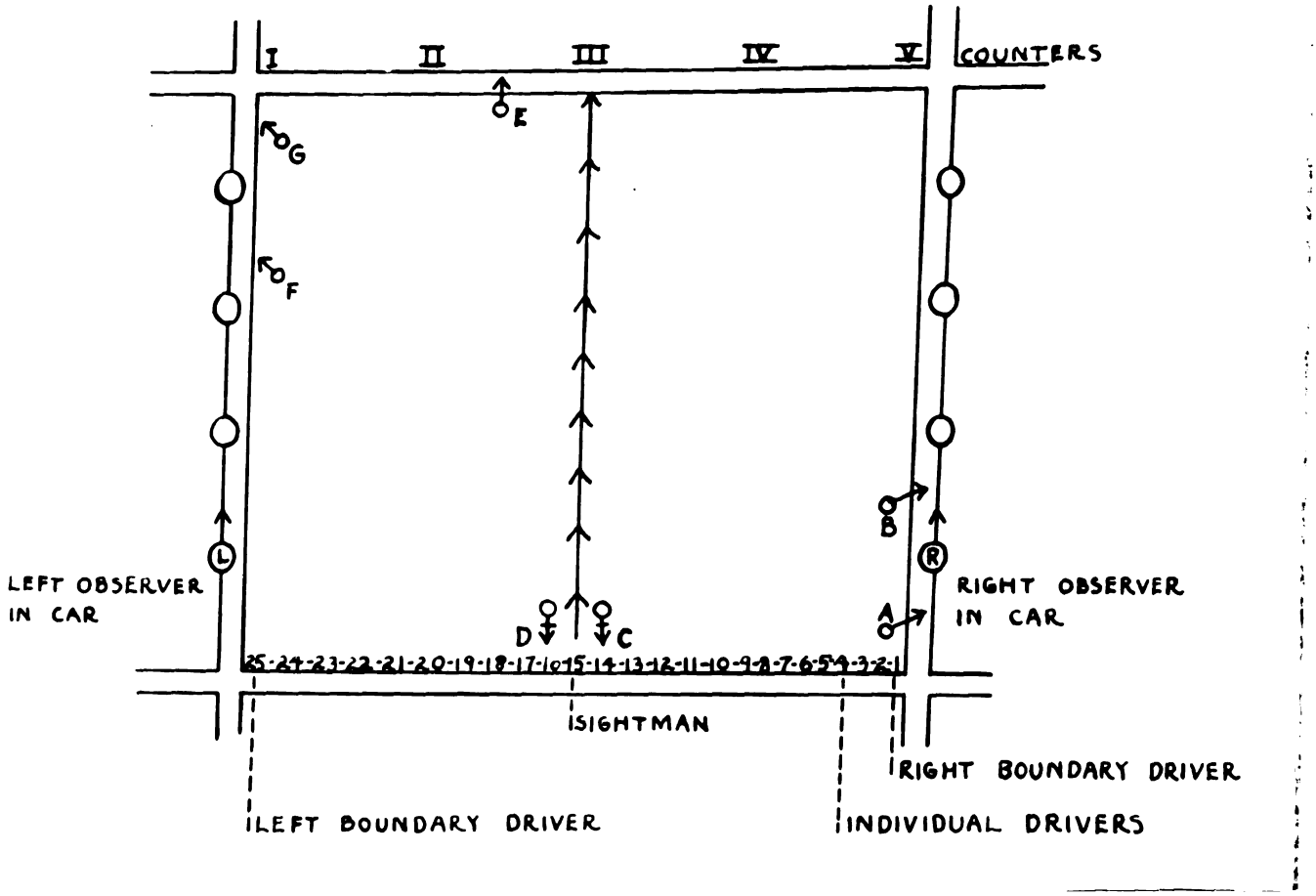


Diagram I. Mechanics of Line-drive Census

A sight man, in the center of the line, regulates the pace. Observers in cars keep the operations functioning and count boundary transits not tallied by the drivers or counters. For example, A pheasant is counted by driver #1, B by observer R, C by driver 15, D by driver 16, E by counter #2, and F by observer L, while G may be counted by either counter #1 or observer L after they consult with each other as to who should count it.

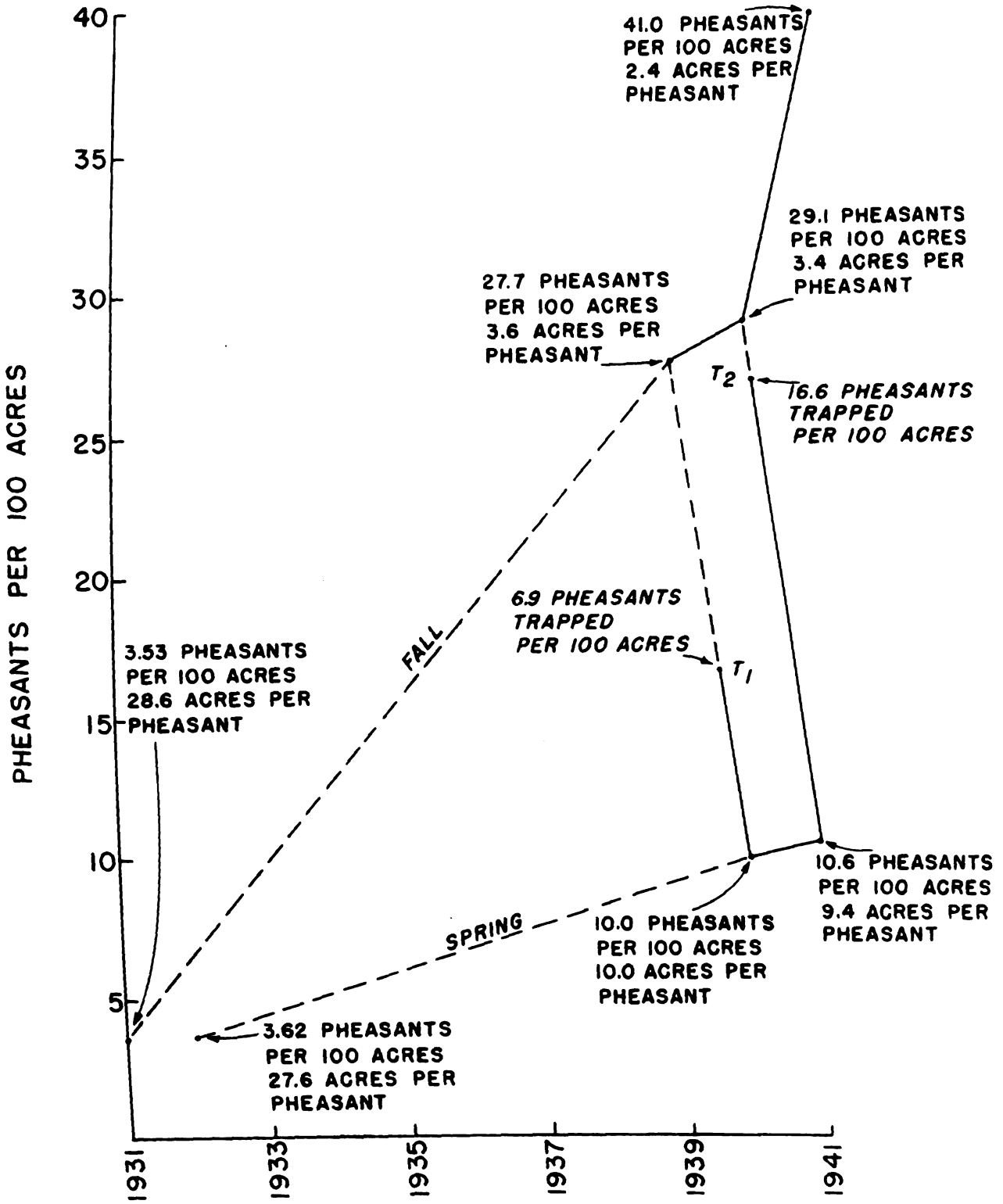
Birds reflushed during the census are not recounted. If they fly into the same or different census blocks, they are credited only to the block from which they were initially flushed and are subtracted from the total number flushed in the block to which they fly.

The data summarized in Trend of Population graph on page 18 illustrates an upward trend during the period studied, and that the maximum pheasant population would probably be still greater than those previously reached.

The 1941 fall population of 1 pheasant per 2.4 acres apparently from the spring breeding population of 1 pheasant per 9.4 acres, indicated that both the breeding potential and production capacity of the college farm was high for pheasants.

The effect of trapping operations in the reduction of population during the winters 1939 and 1940 is shown by T_1 and T_2. The 166 pheasants trapped in 1941 accounted for more than nine-tenths of the difference between the fall of 1940 and the spring 1941 populations. It might be assumed that this population reduction would reduce the 1941 spring breeding population and thus reduce the 1941 fall population. In this assumption it must be kept in mind that with a greater concentration of pheasants there would probably follow a greater outflux and a heavier winter mortality.

TREND OF PHEASANT POPULATION
1931 - 1941



INVENTORY

Photo 1. Line-drive pheasant census through Horticulture and Forestry Experimental areas.

PRODUCTION

Photo 2. Twenty three pheasant nests were found in hayfields.

Photos by H.H.Burgess from M.S.C.Cons. Inst.

Life Cycle

The pheasant mating season begins in late winter and early spring, at which time the cock selects his crowing area. By crowing and displaying, he announces his intention of keeping off intruders, and courts all females which come near. Livingston (1940) reported on observation of 5 unsuccessful nests. Further studies were made during the spring of 1941 as a part of the current study.

Cock-crowing and Spot mapping

An attempt was made during the latter part of March 1941 to determine the home range of individual male pheasants by marking on a base map his crowing sites for several mornings or evenings.

Over 80 different male pheasants' crowing areas were thus plotted. Concentrations and erratic wandering complicated the location of more cock-crowing areas. This study has substantiated other workers' conception that these breeding areas are definitely associated with cover and topography. This is shown on the overlay of the cover map on page 14, by the five crowing areas grouped in a single depression in the dairy pasture east of Farm Lane.

Sex Ratio

The sex ratio of approximately 1 male to 4 female pheasant seems to have remained constant throughout the year of 1941 (See Table II page 16). Cocks were observed alone and with as many as 4 hens. Other investigators

studying pheasants have observed as many as a dozen females with one male. The pheasant is polygamous and promiscuous so that it is improbable that any healthy male or female pheasant on the college farms goes through a breeding season without mating.

Nesting Studies

During the spring of 1941, intensive searches were made in bushy fence-rows, woodlot borders, and herbaceous-covered fields for pheasant nests, since apparently that was the only good nesting cover at that time. In this work, an English setter dog was used on a 12-foot leash for the narrow bushy areas and on a 100-foot rope for the fields. Direct search did not prove satisfactory as no nests were found by this method.

Cooperation in reporting nests was requested from all employees, faculty members, and students who might be working or studying in pheasant habitats. This method has proved the most satisfactory as 32 nests were found and reported by cooperators while 1 other nest was accidentally found in the course of field investigations.

TABLE III

Departmental Cooperators in Pheasant Nest Study

	Coop.	Crops	Farm	Botany	Hort.	Ent.	Zool.	For.	Cons.	Inst.
No. of Nests Reported	15	11	1	1	1	2	1		1	

The date the first egg was laid was computed in our studies by subtracting 1 day per egg from the date the nest was discovered. If the eggs were being incubated, the number of days of incubation was determined by the incubative stage of the eggs, and this number was also subtracted from the date the nest was discovered. The largest number of nests known to be initiated in any 15 day period was the 5 nests started between May 1 and 15. Since the dates of the first eggs laid were estimated for 14 nests, the 5 nests initiated during the first half of May indicate that about one-third of the nests were started at that time. The average size nest of approximately 12 eggs (11.6) was computed from the 13 nests of which the most complete data were were obtained. (See Appendix I, pages 1 and 2.)

In comparison, with studies made by Randall (1940) in Lehigh County, Pennsylvania, where climate factors are similar, this was about half a month earlier than his most important nesting period in 1940.

Nest Mortality

Twenty-three of the 33 nests studied in 1941 were located in hayfields, where three succeeded in hatching. Sixteen of these nests were destroyed by mowing. Crows, floods, and man's disturbances were the agents of destruction of the other four hayfield nests.

TABLE IV Agents of Nest Destruction

Site	Agent: Mowing	Felled Tree	Predators	Desertion	Hatched	Percentage of Failure
Hayfields	16		2	2	3	87
Woodlots			2	1		100
Pastures	1			1	1	67
Coniferous Plantings		1			1	50
Orchard			1		1	100
Total	17	1	5	4	6	81.8

Brood Study

The first chicks to hatch in this area were the five hatched on June 3rd in an incubator where they were placed after a tree fell and broke up a nest in a windbreak along the railroad spur. The first brood to hatch naturally consisted of eight chicks hatched in the Horticulture rhubarb on June 6th. The five other successful nests under observation, were located one each in: an alfalfa pasture, a coniferous planting, and three in alfalfa hayfields.

During the summer of 1941, 104 observations were made on pheasant broods. Many of these were made in the early morning when the young pheasants left the wet vegetation

for partly denuded areas. The broods could often be found at the edges of the roads at that time, where it was a simple matter to obtain an apparently complete count of the brood by hunting out each individual with a setter dog. Counts were obtained on 32 broods, the average size of which was 8.3 chicks. Of the four broods on which complete mortality records were obtained, 56% were alive at the age of ten weeks. In our nesting records we find that 83.3% of the eggs of the average successful nests hatched. This means that 10 chicks were hatched in the average successful nest. If the average successful brood suffered 44% mortality after hatching, as indicated by mortality records obtained on four broods, the average brood at 10 weeks would be 5.6 chicks.

TABLE V — Brood Study Summary

No. Eggs per Nest	No. Chicks Hatched	No. in Brood all ages	No. in Brood at ten weeks	Nest Failures	Brood Mortality
12	10	8.3	5.6	81.8%	44%

The abnormal mortality and diminishing reproductive index were indicative for hayfields and other very vulnerable areas, but were not true for the areas as environments. In less vulnerable environmental areas, nests data were much harder to collect and therefore could not be properly evaluated.

FOOD HABIT STUDIES

Stomach Analysis

In our food habit studies at Michigan State College, 82 pheasants were collected. Sixty-four of these individuals were collected in 1939 previous to the present study, by the campus police and farmhands shooting any pheasants observed in or near critical experimental areas. Two additional pheasants have been collected by this method since this study began. The remaining 16 individuals were found dead in traps during trapping operations, in fields, or on roads.

TABLE VI Collection Distribution by Months

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
7	10	0	0	3	21	7	27	8	1	0	0

From the above distribution table, it is observed that the greatest numbers of pheasants have been collected during the summer months, the time of the most critical crop damage. Since many investigations have been based on male pheasants collected during the fall hunting season, this collection should have unusual value in providing data from other seasons, particularly pertaining to sex and age.

TABLE VII Distribution of Sex and Ages of Pheasants Collected

	Males	Females	Undetermined	Total
Adults	27	34	0	61
Immatures	10	8	1	19
Undetermined	1		1	2
Total	38	42	2	82

Sex ratio: 1 male: 1.105 females

Age ratio: 1 immature: 3.2 adults

All of the specimens were autopsied, by the Michigan Conservation Department Game Division Laboratory technicians. The crops and gizzards were taken out of the birds, tied in a small cheese cloth, labeled, and stored in a solution of formaldehyde until needed for analysis. The volumetric analyzing method, as modified by Davison (1941) of the U. S. Soil Conservation Service, was used in our stomach analysis. Each kind of plant or animal was measured by volume to determine its percent of total food contents. Materials of less than 1 c.c. were tabulated only as traces. Grit was measured separately by volume.

The following procedure was followed:

1. The contents of the stomach were placed in a cheese cloth bag and washed in running water.

2. Total crop volume contents were measured. Grit from the gizzard was measured and discarded.

3. The contents were decanted so as to separate them into light and heavy materials.

4. Material was examined and separated into similar species.

5. Recognizable material was identified and each species was measured in cubic centimeters and percentages of total food contents were computed.

6. Unclassified material was separated and measured and samples were labeled with Game Division autopsy numbers and filed for future reference.

7. Unknown material was identified.

TABLE VIII Summary of Contents of Stomachs of Pheasants Collected on Michigan State College Farms (See Appendix II)

	Average Percent of Total Crop Contents	Average Percent of Total Gizzard Contents
Corn	62.0	25.7
Oats	9.0	7.0
American Elm	8.5	0.0
Wheat	6.0	11.5
Beans	5.5	4.0
Insects	4.0	7.5
Unknown leaves	2.0	21.0
Barley	2.0	2.0
Rumex	0.0	2.0
Grass and Clover leaves	1.0	11.5
Lamb's Quarters	0.0	0.5
Wild Cherry	0.3	6.0
Bindweed	0.0	2.0
Ragweed	0.0	0.2

In the summaries a discrepancy exists between the data collected from the crops and gizzards. A preponderance of the least digestible food occurred in the gizzards, indicating a differentiation of digestive action instead of a difference in food habits. A large amount of unidentified plant material was found in this organ because digestion made it impossible to recognize the material. Investigators usually use the gizzard analysis as supplementary facts, and the crop data for the main indicators. However, some investigators eliminate crop data, when birds are trapped in heavily baited traps; but this was not done in this study because the bait habit was assumed to be a phase of the normal efforts of the pheasant to obtain palatable food. This will be seen in Appendix II, pages 1 and 2. Contents of 44 crops were analyzed out of 82 specimens autopsied.

TABLE IX Comparison of the Most Important Foods of Four Studies

Burgess(1941) (Michigan)	Dalke(1937) (Michigan)	Hicks(1936) (Ohio)	English and Bennett(1940) (Pennsylvania)
1. Corn	Corn	Corn	Corn
2. Oats	Wheat	Ragweed	Lesser ragweed
3. American Elm	Barley	Wheat	Grasshopper
4. Wheat	Ragweed	Foxtail	Buckwheat
5. Beans	Beans	Smartweed	Skunk cabbage
6. Insects	Oats	Oats	
7. Barley	Buckwheat	Black bindweed	
8. Leaves of Grass and Clover	Fox Grape	Ground Cherry	
9. Wild Cherry	Hog peanut	Red clover seeds	
10.	Lepidoptera (Larvae)	Buckwheat	

Although corn was the most important pheasant food on the MIchigan State College farms, only about 5% of the stomachs of the pheasants shot in June (season of corn pulling) contained corn, while almost all of the pheasant crops obtained in February were filled with corn. This indicates that corn plays much less importance as pheasant food during the critical spring damage period than during the winter.

CROP DEPREDATION

Innocent or partially innocent species are often unjustly blamed for damage committed by some other variety of wildlife, because little definite information on the identification of crop damage is available to the agriculturists. The pheasant is accused of damaging tomatoes, melons, seedling and ear-corn, and various other crops. By numerous observations, exclusion fences, controlled experiments and trapping, various types of crop depredations have been identified and classified.

In attempting to identify crop depredation it is pertinent to know which species are on the critical areas. Numerous pheasants, crows, "blackbirds", (starlings, grackles, and redwings), and fox squirrels were observed on the critical experimental areas. (Table X page 32)

TABLE X Wildlife sighted on Critical Areas
Aug. 9th to Oct.10th, 1941

AREA	CROWS	PHEASANTS	RABBITS	PASSERINES	TOTAL
Horticulture tomatoes	132	10 imm.	2	Few	144
Horticulture sweet corn	57	12 imm.	2	Numerous	71
Horticulture melons	100	2 imm.	1	Few	103
Horticulture vicinity	237	12 imm.	2	Numerous	251
Botany tomatoes	6	3 adults	1	Few	10
TOTAL	532	39	8		579

The presence of cottontail rabbits and Norway rats was ascertained by trapping.

TABLE XI Trapping Records--Horticulture Vegetable Plots
August 9th to October 10, 1941

CROP and COVER	PHEASANTS	RABBITS	NORWAY RATS	TOTAL
Early sweet corn and tomatoes	6 imm. 1 adult (E)	0	0	7
Early sweet corn and fallow	6 imm.	0	0	6
Late sweet corn and melons	1 imm.	8	7	16
TOTAL	13 imm. 1 adult (F)	8	7	29

The relative abundance of various species of wildlife in specific areas were indicated by the number of separate track sets counted.

TABLE XII Track Sets Counted July 9th to Sept. 1, 1941

Horticulture Tomato Track Strips

SPECIES	CROWS	PHEASANTS	RABBITS	TOTAL
Sets of Tracks	81	21	10	112
Part of Total	72%	19%	9%	100%

All of the critical areas were scanned daily with a pair of binoculars from an automobile for wildlife activity. The areas were then hunted thoroughly with an English setter to flush wildlife, after which a detailed examination of current damage, traps, and tracks were made. A crow trap, two Ohio-type pheasant traps, and six live-mammal (cat) traps, were set in the Horticulture Department's Vegetable plot. Track count strips were maintained in critical and test areas by daily raking these 12 inch paths after the counts were tabulated. Five exclusion cages, which kept out pheasants and crows were placed over some melons, thereby assisting in identifying rodent damage. Controlled feeding of tomatoes and melons to captive pheasants provided type examples of damage. This feeding indicated the place of succulent fruit in the pheasant's food habits.

PHEASANT DAMAGE TO CORN

Photo 3. Holes made by pheasants digging corn seedlings.

Photo 4. Pheasants sometimes feed on low ear corn.

Photo 5. Pheasant damage is usually negligible to final yield in fields of 10 or more acres of corn.

Photos by David Damon from M.S.C. Cons. Inst. files.

Corn

During the period of corn sprouting, pheasants and crows destroyed a considerable number of corn seedlings. The pheasant damage could be identified by the distinct hole and mound of dirt left by the pheasant in digging out the corn. The crow, on the other hand, left no noticeable hole, for it grasped the stalk in its beak, and often left a telltale beak mark as it jerked out the seedling. In both cases the kernel was eaten and only in very few cases was any other portion of the seedling consumed.

FIG. 1 PHEASANT DAMAGE

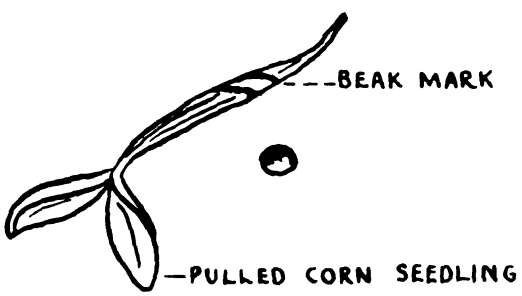


FIG. 2 CROW DAMAGE

During the spring, pheasant damage to corn in fields of five or more acres was negligible. However, pheasants destroyed over 50% of two border rows of sweet corn in the unpatrolled Horticulture plots near Baker Woodlot, indicating their possible detriment to small experimental

DAMAGE OFTEN ATTRIBUTED TO THE PHEASANT

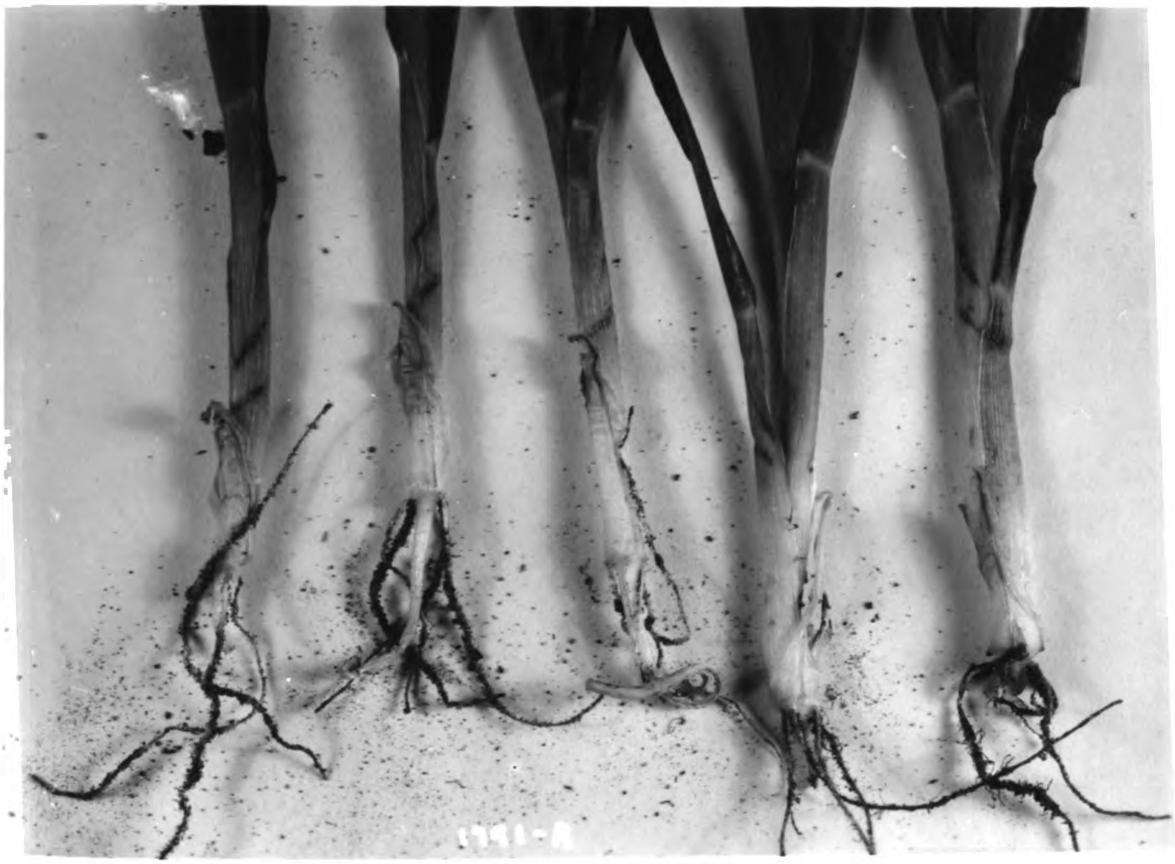


Photo 6. Corn seedlings pulled by crows. (Note beak marks)

Photo by Huby, M.S.C. Photo Lab. Files

areas or gardens.

No important spring damage could be blamed on crows, with the exception of an estimated 25% denudation of a five-acre Horticulture plot of late-sown sweet corn.

During the summer, pheasants punctured numerous corn stalks, probably to obtain moisture, but as a whole this destruction was insignificant, even in the experimental plots. The pheasants also pecked at numerous low ears attached up to eighteen inches off the ground but this damage was important only in low-eared sweet corn, and even there, crow damage was much more significant.

Several intensive surveys were made on field corn plots, which were observed to be affected by wildlife damage. In these studies the fraction of the ear damaged, as well as the number of ears damaged, were noted so that the actual damage could be computed. Only those injured ears which were less than two feet from the ground were considered damaged by pheasants, but this damage may have been due to any of several other animals. The following tables demonstrate that pheasant damage was negligible to field corn in the green ear stage.

DAMAGE OFTEN ATTRIBUTED TO PHEASANTS

Photo 7. Crow damage to ear corn

Photo 8. Red-wing damage to ear corn.

Photo 9. Flocks of 500 or more crows have been observed on the college farms.

Photos by David Damon from M.S.C. Cons. Inst. files.

TABLE XIII Wildlife Damage to Field Corn, Aug.20, 1941

Soils Blocks	Good Ears	Crow Damaged No.	Crow Damaged %Tot. Ears.	Pheasant Damaged No.	Pheasant Damaged %Tot. Ears	Passerine Damaged No.	Passerine Damaged %Tot. Ears	Smut	Total
617-624	133	65	14	6	3	0	0	3	207
201-204	192	0	0	1	0	0	0	5	198
South Block	533	0	0	0	0	0	0	0	533
Soil Fertility Plots (South Block)	150	0	0	1	0	0	0	0	151
Muck Plots (South Block)	225	1	0	0	0	2	0	0	228
Total	1233	66	5.3	8	.6	2	.16	8	1317

TABLE XIV Wildlife Damage to Field Corn, Sept. 16, 1941

Soils Blocks	Good Ears	Crow Damaged No.	Crow Damaged %Tot. Ears	Pheasant Damaged No.	Pheasant Damaged %Tot. Ears	Passerine Damaged No.	Passerine Damaged %Tot. Ears	Smut	Total
617-624	90	79	45	0	0	0	0	4	173
201-204	54	0	0	0	0	1	1.85	2	57
South Block	235	7	.8	0	0	0	0	2	244
Muck Plots (South Block)	223	1	0	0	0	4	1.8	0	228
Total	602	87	14.6	0	0	5	.83	8	702

TABLE XV Pheasant Damage to Seedling Corn--Spring, 1941

AREA	CONTROL AND COST	DAMAGE
Soils Experimental Plots	Patrol: 68 hrs. @ 40¢ $27.20 Control neglected half of damage season	25%
Fertilizer Plots	Patrol: 68 hrs. @ 40¢ $27.20	0%
Muck Plots	Feed rows and scare-crows, extra bushel of corn,, @ 60¢	0%
Horticulture Gardens	Heavy planting. 4 extra bushels of corn, $2.40. Heavy planting made this damage tolerable	30%
Botany Plots	No control except modi-fication of environment	0%
M. S. C. Farms	Large fields, no control	0%
Farm Crops	Patrol 176 hrs. @ 40¢ $70.40 A number of small fields totaling about 25 acres	0%

Tomatoes

Wildlife damage to early tomatoes was critical during early August 1941, due perhaps, in part, to lack of drinking water accessible to crows and pheasants.

TABLE XVI Horticulture Early Tomatoes--August 4, 1941

ROW	RIPE		% OF TOTAL	GREEN		% of TOTAL
	GOOD	DESTROYED		GOOD	DESTROYED	
289	42	51	55.	290	10	3.

Tomatoes damaged by pheasants usually had a shallow excavation or a single deep puncture (fig. 3), while tomatoes damaged by crows showed deeply and circular scooped cavities (fig. 4)

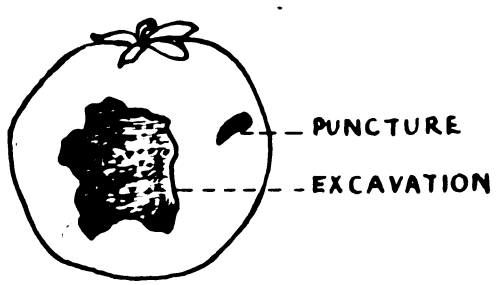


FIG. 3 PHEASANT DAMAGE

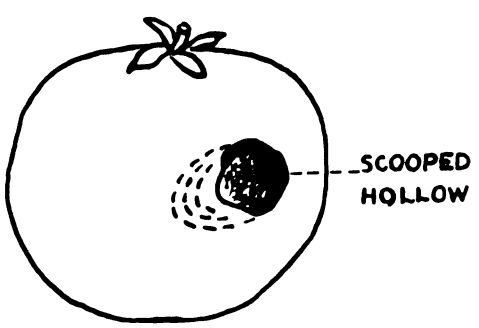


FIG. 4 CROW DAMAGE

Criteria for differentiating the damages committed by the several involved wildlife species were used only after repeated observations and in the case of pheasant damage by controlled feeding to penned birds.

About 67% of the wildlife damage in the Horticulture tomatoes was committed by crows, and 33% committed by pheasants. The damage attributed to diseases was about twice as great as the damage attributed to wildlife. Damage due to both disease and wildlife was 6.5% of the total yield, but only about a tenth of this damage or .6% of the total yield could be attributed to the pheasant according to the following table.

TABLE XVII Horticulture Tomatoes--August 19, 1941

ROW	UNDAMAGED	DAMAGED FRUIT				REMARKS
		CROWS	PHEASANTS	MISC. &rot	TOTAL	
289	352	1	0	50	403	Early, flat, exposed
326	446	0	15	5	466	Near corn, spreading
430	254	1	0	0	255	Late, upright
2 E	512	5	0	16	533	Late, upright
374	259	25	0	25	309	Upright
381	241	0	0	5	246	Late, upright
TOTAL	2,064	32	15	101	2,212	

Since the theory is often advanced that pheasants eat tomatoes during dry periods primarily to supplement their water requirements, a number of troughs of water were placed in critical areas to help supply this need. A track strip was prepared around the troughs and maintained for 53 days, but counts indicated very little, if any, actual utilization of this available water.

TABLE XVIII Water Trough Track Strips July 9, - Sept.1, 1941

SPECIES	CROWS	PHEASANTS	RABBITS	PASSERINES
Sets of Tracks	14	14	1	12

These troughs were put out after the tomato-eating habit was acquired. They apparently did not reduce the wildlife damage.

Adult pheasants that had been in captivity for more than a year and had plenty of water and grain, ate tomatoes ravenously. On the other hand, newly-captured immature pheasants from flocks which had acquired the tomato eating habit ate tomatoes sparingly. These experiments demonstrated that tomatoes were primarily utilized, and were needed to supplement the food-supply of the old captive flock, since a constant water supply was available. Field observations during the summers of 1940-1941, found a decline in pheasant damage to tomatoes immediately after rains, indicating their supplementary use as a source of water.

Melons

Bird damage to melons was usually found on the upper surface or side of the melon and consisted of a large excavation when committed by pheasant and a narrow round hole when committed by crows. Rodent damage was confined to the easily penetrated base of the melon and consisted of a gnawed hole into the pulpy interior from which seeds were dragged out.

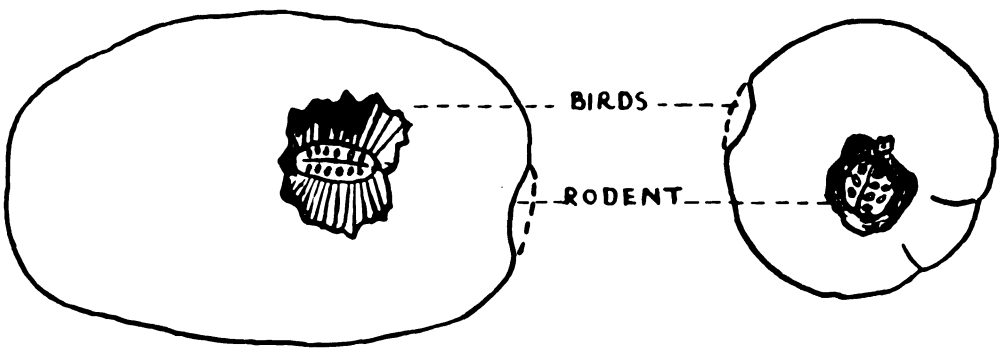


FIG. 5 SIDE AND FRONT VIEW OF DAMAGED MELON

About one half of the early muskmelons and one quarter of all melons, both muskmelons and watermelons in the Horticulture plots, were destroyed by wildlife during 1941. The earlier damage was primarily due to crows which flocked into the melon patch regularly each morning and evening. Pheasants also caused considerable damage at this time. Later, the damage done by a combination of crows, pheasants, Norway rats, and cottentail rabbits, reduced the final yield to about 75% of what it should have been. Pheasants alone probably damaged less than 6% of the total melon crop.

Miscellaneous Crops

Pheasants also committed some damage to other crops. Several potatoes were pecked by pheasants in the muck plots; and since many flocks lived almost entirely in grain fields, it is probable that pheasants consumed a quantity of such grain as wheat, oats, and barley. Early in 1941, pheasants dug up a number of pea seedlings in small isolated areas but the total damage was not significant.

Photo 10. Damaged Muskmelons and Tomatoes

	Left	Right
Upper: Muskmelons:	Pheasants	Rodents
Lower: Tomatoes	Crows	Pheasants

Photo by H.H.Burgess
in Cons. Inst. files

CONTROL OF PHEASANTS

Relief Methods

Our studies have clearly indicated that pheasants have destroyed seedling and ear corn, tomatoes, melons, and various other crops. It has been necessary to develop methods of immediate relief.

SHOOTING: Shooting was the universal method of eliminating the wildlife that was harmful to agriculture. This method was used by the college until the spring of 1940, when due to public disapproval, it was discontinued. It should only be practiced as a last resort, as it will never be popular with the hunting public and is an acknowledgement of an unsolved land management problem.

PATROLLING: The method most widely used to protect sprouting corn during 1940 and 1941 was patrolling newly planted areas from daylight to 9 A.M., and from 3 P.M. to dark, the pheasants' normal feeding time, for ten days, by which time the corn kernels were usually absorbed by the new seedlings.

BUFFER ROWS: Buffer rows were used on the border of the Muck Farm to protect experimental plots in which scarecrows were used to scatter and equally distribute further focal points of damage to seedling corn. The Horticulture Department planted corn heavily and adapted their experiments with an expectation of wildlife damage.

FENCING: A two-foot high chicken netting fence around a quarter acre of sweet corn was successful in keeping out pheasants during the ear stages. Twelve pheasants were trapped out of the Horticulture sweetcorn and tomatoes, so that pheasant damage was probably reduced there below normal.

LARGE FIELDS: The Farm and Horse Department has relied, apparantly successfully, on its large fields to make any damage committed on its boundaries negligible.

MODIFICATION OF ENVIRONMENT: An important focal point of pheasant damage in 1939 and 1940 was the tomato plots in the Botany Experimental area. During the summer of 1941, the weedy railroad right-of-way, used as a travel lane to this area by numerous pheasants, was cleaned up; one surrounding semi-permanent pasture was summer-plowed while another was mowed. This resulted in the pheasants shifting to areas with better cover and practically eliminated all pheasant damage in these plots.

PREDATION: During the spring of 1941, crows destroyed more than 11% of 34 pheasant nests. Cooper's hawks have killed 30 more pheasants on the college farms in 1939-1941. Red shouldered, rough-legged, red-tailed, and marsh hawks and horned, barn, barred, and short-eared owls have also been observed, but did not seem to be important pheasant predators on the college farms.

HUNTING: Hunting is an effective and normal method of reducing ring-necked pheasant pupulations. Although hunting is forbidden on the college farms, both the Grand Trunk and Pere Marquette Railroads' right-of-ways were hunted during the regular pheasant season.

LIVE TRAPPING: Previous to 1939, there was no live trapping of pheasants on a large scale in Michigan but the Ohio Wildlife Experimental Station was using a technique by which they were catching more than 2000 a winter. The ohio men used a modified water-lily type trap, 20 feet long and 2½ feet high. The entrance was shaped into a "V", narrowing down to a 4 inch opening. Figure 6 shows the top view of the trap.

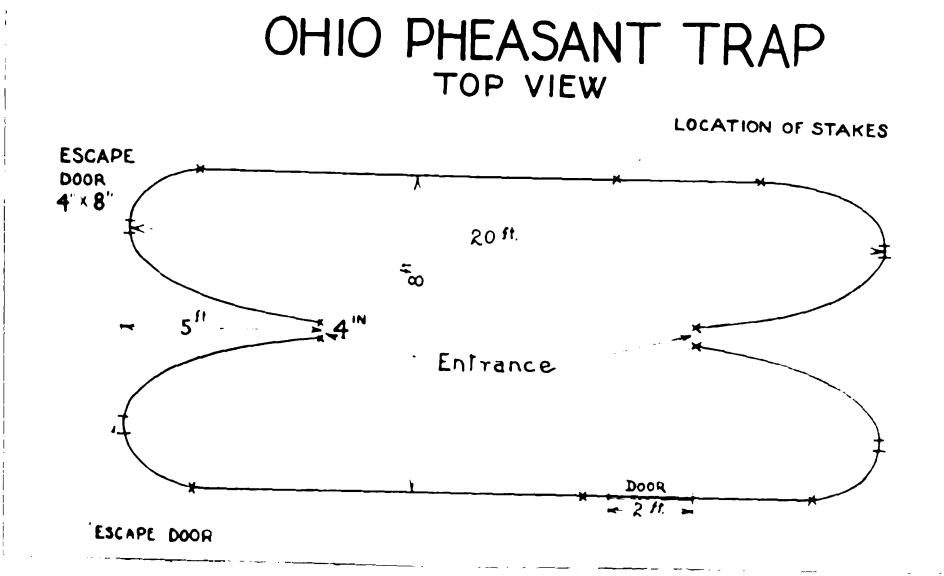


Fig 6. Photostat taken from "Techniques of Pheasant Trapping and Population Control" (Hicks and Leedy 1939)

The sides were made of two sections of #11 electric welded lawn fencing, 35 feet long by 2½ feet high. One side was in the form of a large "C" and the other side a reversed "C". Chicken wire netting of 2 inch mesh, cut to fit, formed the top and was loosely fastened down with cord or wire.

Since our concentrations were smaller than those in Woods County, Ohio, it was thought that a smaller model would serve more efficiently. A hundred foot roll of lawn fencing was cut into four twenty-five foot sections usable for two fifteen food traps.

Effective trapping season extended from the first heavy snow until spring dispersal of winter concentrations. Corn was found to be the most practical bait. Three methods of baiting were used in 1939, namely; impaling ear corn on spiked boards, scattering shell corn, and stacking ear corn in a pile. Impaling kept the corn above the snow but took too much time to be practical. Scattered shell corn was covered by each snowstorm, but was especially valuable where small mammals carried away the bait supply. Piled ear corn, however, was the most efficient because it usually projected above the snow and enough (100 lbs.) could be put out at one time to last a couple of weeks.

Since food is abundant in most of the area, successful trapping usually occurred when the ground was covered with two or three inches of snow. Such conditions were

infrequent and lasted only for short periods. Efforts to coordinate trapping with these periods were only partially successful, since they were hard to forrcast.

A system of trapping, whenever the bait was being rapidly consumed, and of discontinuing when no more birds were trapped, proved to be the most practical.

Few scalping fatalities occurred due to the loosely hung top netting which yielded readily with the pheasants when they jumped. Wing injuries were frequent, but these were only minor and healed readily.

COST OF TRAPPING: Since there are many areas, such as this, where a surplus of pheasants is found on areas on which hunting is not desired, it was thought that these surpluses might be harvested economically by live-trapping, elsewhere, as well as here.

Because of this, a close and accurate check was kept on our trapping operations to determine the cost of trapping a pheasant. In 1939 and 1940 with no labor cost figures, trapping operations to capture 69 pheasants cost about 63 cents per bird, but with labor cost of 30 cents per hour, the cost would have been about $1.25 per bird.

In comparison, Pennsylvania Game Commission, during 1939-1940, trapped 3,211 pheasants at approximately 42 cents per bird (Cramer 1941). Ohio had previously trapped 1,800 pheasants annually in Wood County at an average cost of 35 cents (Hicks and Leedy 1939).

In 1940-41, our trapping costs were as follows:

Labor, 55 hours at 40 cents per hour.....	$22.00
5 traps at $3.00 depreciation cost	$15.00
605 lbs. ear corn at 93 cents per 100 wt.....	5.63
90 lbs. shell corn at $1.27 per 100 wt.....	1.14
450 miles at 4 cents per mile	18.00
	$61.77

Thus the 154 trapped live pheasants were trapped and turned over to the Michigan Conservation Department at a total cost of $61.77 or 40 cents each. This reduction in our cost to less than 1/3 that of 1940 and to a cost comparable with that of Pennsylvania and Ohio was accomplished by more efficient trapping.

SUMMER TRAPPING: During the summer of 1940 an attempt was made to capture pheasants in critical areas by using drift fences leading into "Ohio type" traps. Eighteen pheasants were trapped. Fourteen more pheasants were thus captured in 1941.

MANAGEMENT

The control methods discussed in this paper were attempts to relieve an intolerable condition resulting from the incompatibilities of ring-necked pheasant and cultivated crops. They are not to be considered as the answer for an unsolved land management problem, although they may be important factors in its final solution. It will require a far-sighted and coordinated land-use plan to approach an adjustment that is compatible with both game and agricultural crops.

The Michigan State College Extension service advises farmers to include wildlife as a farm crop in their land-use planning--and we believe this a sound policy. Yet, if the public were to consider our own experimental farms where wildlife management has not been properly coordinated with other agricultural practices, these teachings would be discredited. Wildlife must be considered when the use of land is planned, for we cannot practically shoot, trap, scare, or exclude specific wildlife from plots which are constantly attracting various species from surrounding concentrations.

Surveys are made to identify and analyze the effects of soil, drainage, and locations of areas, before allotments on the college farms are made for various experiments, but up to this time, little thought has been given to the effects of prevalent wildlife species or wildlife cover in

close proximity. When crops vulnerable to wildlife damage, such as those in the Horticulture vegetable plots, are surrounded by woodlots, partially grazed pasture and cover-crop plots, heavy damage must be expected as an alternative to heavy control costs. Often the wildlife cover or environment can be eliminated or modified as was done around the Botany Plots with good results; but in many cases this would not be advisable. It would not be a good policy to clear out Baker woodlot which serves as a forestry laboratory because pheasants concentrate there and feed in the nearby Horticulture plots, or because fox squirrels from this woodlot constantly interfere with the Soil Department's nearby corn plots. It is much simpler to move the experiments to less vulnerable areas, to use relief methods, or to stand the loss as a natural disturbing factor.

When agricultural extension workers advise farmers to include wildlife in their land-use planning, they consider game animals to be harvestable for food and/or recreation. At present the pheasant can only be harvested on the college farms by trapping or permit shooting, in which case, neither food nor recreation values are involved.

Controlled Hunting on M.S.C. Farms

It is self-evident that indiscriminate hunting on institutional-owned property such as the M.S.C. Farms, is not feasible. Vandalism, interference with experiments, and over-crowding would eliminate completely the

possibility of such a method. However in 1929, a group of Ingham County farmers, with a very similar problem, organized a controlled hunting system, now nationally known as the "Williamston plan". By 1941, 110 clubs in 24 counties controlling 497,563 acres were managed by similar controlled hunting methods.

This method has proved itself practical for many of the southern Michigan farms and possibly with the proper modification, it could be just as practical on those college farm lands lying south of the Pere Marquette Railroad and other outlying M.S.C. landholdings.

Michigan State College had approximately 60 Wildlife Management, 200 Forestry, and 60 Police Administration students in 1941--more than enough men to adequately patrol any area of land the college might designate as open to controlled hunting. These men and their instructors need experience in patrolling, in collecting data, and in other forms of conservation work connected with such a controlled hunting system.

A controlled hunting area on Michigan State College property would serve many purposes. It would partially solve the problem of over-population of wildlife; it would offer students and faculty an opportunity to obtain further field laboratory training in game management; it would serve as a demonstration area for correct management methods; and it would serve the public in opening a much needed recreation area.

SUMMARY

1. The wildlife depredation to vulnerable crops was so great on Michigan State College farms in the summer of 1939 that the Michigan Conservation Department issued permits to shoot pheasants and other crop-destroying wildlife.

2. The Conservation Department requested that Michigan State College make a study of the pheasant in an attempt to develop controls less controversial to the public than shooting.

3. During the fall of 1939 and winter of 1939-1940, ecological studies were made under the supervision of Prof. J. W. Stack of the Zoology Department. During 1940-42, further investigations were carried out through the Conservation Institute, under the direction of Prof. B. T. Ostenson, and with the cooperation of various acknowledged organizations and students.

4. The Michigan State College farms consistee of 1800 acres of typical Southern Michigan Agricultural land.

5. The Ring-necked pheasant (Phasianus colchicus torquatus) was the basis of most of the complaints and therefore was chosen as the species to study for the present thesis.

6. The pheasant had increased from 1 pheasant per 28 acres during the fall of 1931 to 1 pheasant per 2.5 acres by the fall of 1941, indicating an increase of 11 times its 1931 population in ten years. Counts were made by plotting home ranges and by line drive censuses. A spot map of cock-crowing areas indicated a correlation with cover types and topography. The sex ratio remained close to 1:1, which is probably normal for unhunted concentrations.

7. Direct search with an English setter on a short leash was unproductive in finding nests, but 32 nests were reported by field laborers and other workers. The average nest contained 12 eggs.

8. Seventeen percent of the nests observed, hatched with an average clutch of 10 chicks which suffered a mortality of about 44%, resulting in an average of 5.6 chicks in a successful brood at 10 weeks.

9. Food content studies were made of 44 stomachs and gizzards of pheasants collected in 1939. Corn, oats, elm seed, wheat, beans, and insects were found to be the most important foods.

10. Identification of damage to corn, tomatoes, and melons was made by observations, exclusion fences, and controlled feeding experiments.

11. Shooting, patrolling, buffer rows, scarecrows, fencing, and modification of immediate environment, all proved valuable as relief methods for intolerable depredation.

12. The crow and Cooper's hawk were the most effective pheasant predators.

13. Live trapping with Ohio type traps has been carried on. Corn was the best bait. Traps were set when corn was being most rapidly consumed. 154 pheasants were live trapped and turned over to the Michigan Conservation Department during the winter of 1940-41 for release. These birds cost the college 40¢ each to trap. Thirty-two pheasants were live-trapped during the summers of 1940 and 41.

14. It will take a far-sighted and coordinated land-use plan to produce pheasants and other agricultural crops compatibly on the college farms.

15. Hunting is forbidden on the college farms. Under the present conditions, pheasant can not be harvested for either food or recreation.

16. Controlled hunting could be a practical method of harvesting surplus pheasants. Besides reducing the pheasant population, it would give students and instructors in Conservation, Wildlife Management, Forestry, and Police Administration, an opportunity for experience in farm game management and patrolling.

REFERENCES USED

Bennett, L.J. and English, P.F., 1939

"The Fall Foods of the Ringneck Pheasant and Bobwhite." Pennsylvania Game News. 10:(1) pp. 8,9, 29

Burgess,H.H., Cooley,M.E., Denman,S., and Dunning, 1939

"A Study of the Pheasant Damage on Michigan State College Property." Unpublished report in Department of Zoology files, Michigan State College.

Burgess,H.H., Cooley,M.E., and Hume,R., 1940

"M.S.C. Pheasant Control Study." Unpublished report in Department of Zoology files, M.S.C.

Burgess,H.H. 1940, 1941

1940. "Fall Pheasant Management--1940". Unpublished report in Conservation Institute files, M.S.C.

1941. "Winter Pheasant Management at M.S.C.--1941". Unpublished report in Conservation Institute files, M.S.C.

1941b. "Pheasant Management Studies on M.S.C.Farms--Spring, 1941." Unpublished report in Conservation Institute files, M.S.C.

1941c. "Pheasant Management Studies on M.S.C. Farms--Summer, 1941." Unpublished report in Conservation Institute files, M.S.C.

1941d. "Wildlife Management on M.S.C. Property for 1939, 1940, and 1941". In Conservation Institute files, M.S.C.

Cardinell, H.A., and Hayne,D.W., 1945

Corn Injury by Red-Wings in Michigan. Technical Bulletin 198, Michigan State College Agricultural Experiment Station.

Cramer, W.M., 1941.

Summary of Pennsylvania Game Commission's 1940 Pheasant Trapping. Letter in Conservation Institute files, M.S.C.

Dalke,P.L., 1937

"Food Habits of Adult Pheasants in Michigan, Based on Crop Analysis Method." Ecology 18: (2) pp. 199-213

Damon, David, 1933

A Study of Crop Damage by Wild Birds and Mammals in The Southern Penninsula of Michigan. Unpublished thesis for M.S. Degree, M.S.C.; obtainable in Michigan State College Library.

Davison, Verne F., 1940

"A Field Method of Analyzing Game Bird Foods". The Journal of Wildlife Management, Vol. 4 (2) pp. 105-116

Durchman,F., and Hayne,D., 1940

Report on the Summer's Wildlife Studies. Unpublished. Conservation Institute files M.S.C.

East, Ben., 1939

"Declares War on Pheasants." The Grand Rapids Press, Aug. 12, 1939, page 20, Grand Rapids, Michigan

Hayne, Don., 1941

Field Notes. In Zoology Department's file, M.S.C.

Hicks, L.E. 1936

Food Habits of the Ring-Necked Pheasant. Release No. 36 Ohio Wildlife Research Station.

Hicks, L.E., and Leedy,D.L., 1939

"Techniques of Pheasant Trapping and Population Control", Transaction of 4th N.Am. Wildlife Conference pp. 449-461

Leedy, D.L. 1939

"Some Land-Use Factors Related to Pheasant Production." Transaction 4th North American Wildlife Conference.

Livinston, Morton, 1941

Pheasant Nesting Study M.S.C., Spring, 1940. Unpublished report in Conservation Institute file at M.S.C.

McAtee, W.L. 1945 (Edited by)

"The Ring-Necked Pheasant", American Wildlife Institute, Washington, D.C.

Randall, P.E., 1939

"Nesting Habits and Causes of Nest Mortality of the Ringnecked Pheasant." Pennsylvania Game News 10: (9) pp. 6-7, 30

Veach, J.O., Adams, H.G., Hubbard, E.H., Dorman, C., Jones, L.R., Moon, J.W., and Monser, C.H., 1941

Soil Survey Ingham County, Michigan. Series 1933, No. 36. U.S.D.A. Bureau of Plant Industry

Veach, J.O. , 1941

Agricultural Land Classifications and Land Types Michigan. Special bulletin 231 (Revised). Agricultural Experiment Station, Michigan State College.