AN EVALUATION OF THE TECHNIQUES USED TO RESTOCK UNOCCUPIED WILD TURKEY HABITAT IN VIRGINIA

by

Danford Erld Cantner

Thesis submitted to the Graduate Faculty of the
Virginia Polytechnic Institute
in candidacy for the degree of

MASTER OF SCIENCE
in
Wildlife Conservation

APPROVED:

Director of Graduate Studies	Head, Department of Biology
Dean of Agriculture	Major Professor

June, 1955

Blacksburg, Virginia

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

APPENDIX FIGURES

ACKNOWLEDGEMENTS

The writer wishes to express his appreciation to Dr. Henry S. Mosby, Assistant Unit Leader, of the Virginia Cooperative Wildlife Research Unit at Virginia Polytechnic Institute for his counsel and guidance during the course of this study. The help of other members of my graduate committee including Dr. J. J. Aulbach, Mr. A. B. Massey and Dr. J. S. Lindzey, is gratefully acknowledged. Thanks are also due the Game Wardens and Game Managers operating within the area studied; who was formerly with the Unit; of the Forestry Department; the United States Forest Service; of the Commission of Game and Inland Fisheries; the graduate students of the Unit and other individuals too numerous to mention.

Thanks are also extended to Mr. Kramer of the Statistical Department of Virginia Polytechnic Institute.

INTRODUCTION

During the past 25 years several states have attempted wild turkey restocking. Various methods of propagation and releases have been tried with varying degrees of success. The Virginia Cooperative Wildlife Research Unit, in cooperation with the Virginia Commission of Game and Inland Fisheries, reviewed the current techniques being used throughout the United States for restocking wild turkeys and made a detailed study of the propagation pen method of restocking now being used in Virginia.

The objectives of the field investigation were:

1. To assemble all available data on factors influencing the production of young turkeys in propagation pens in southwestern Virginia.
2. To determine, in so far as possible, the survival of young turkeys after they leave the propagation pens.
3. To compare the degree of success attained by the propagation pen method with other methods of turkey restocking, including the liberation of wild-trapped turkeys.
4. To compare selected habitats near propagation pen sites with similar habitats within occupied wild turkey range as regards cover type, age of forest, mast production, and related factors.

For purposes of definition in this paper the various methods and terms used in restocking are defined as follows:

Captivity-reared wild turkey - Any wild strain (M. g. silvestris) turkey reared in confinement.

Game-farm wild turkey - Production of turkeys by incubating eggs collected in the annual crossing of captivity-reared wild hens with captivity-reared wild gobblers.

Wild-mated turkey - A turkey produced by mating a captivity-reared wild hen with a native wild gobbler.

Propagation pen method - A system of producing turkeys by placing selected wing clipped captivity-reared wild hens and gobblers in a four to eight acre pen within desirable habitat where they are permitted to produce young with a minimum of contact with humans. Turkeys produced by this method are permitted to leave the enclosure and restock the surrounding area.

Direct release method - Liberation of wild-mated turkeys, in suitable habitat, directly from transporting crates.

Holding pen release - Wild-mated turkeys are held in small (20' x 50') holding pens at the point of release for a period of from two to four weeks. This confinement gives the turkey a chance to adjust itself to the new environment before being liberated.

Trapped-wild turkey - A turkey of native wild stock trapped for the purpose of restocking suitable range.

It should be observed that the diversity of habitat conditions throughout the United States and different responses

of turkeys to restoration efforts, make it important that procedures be developed to accommodate local conditions.

This study was not intended to be an intensive evaluation of all of the techniques used in restoration attempts but rather is a review of certain broad techniques used throughout the United States accompanied by general indications of their effectiveness. The restoration program in Virginia is analyzed in detail and recommendations are made for Virginia on the basis of this analysis.

A new technique employing drugged grain was investigated for use in capturing wild turkeys for restocking purposes. These turkeys are being liberated in unoccupied potential turkey habitat in Southwestern Virginia. In order to compare the unoccupied potential turkey range with the occupied wild turkey range a reconnaissance survey was run on both of these ranges.

HISTORY AND STATUS OF WILD TURKEY RESTOCKING IN THE UNITED STATES

The wild turkey of the United States played an important role in the development of this country. This bird was one of the first game species to attract wide attention from the settlers and was used extensively as food. In the early days of America the range of the wild turkey extended from the Atlantic coast in Maine through southern Ontario to South Dakota, south through Colorado and into Mexico. This range included all, or portions of, thirty-nine of the forty-eight states (Mosby and Handly: 21). The ancestral range of the wild turkey is shown in Figure 1.

Settlements gradually began to grow and pioneers slowly moved outward from the eastern colonies. The turkey, which needs a considerable amount of forest habitat, began a slow retreat into the wilderness areas of its range to the south and west as populations continued to grow and spread. In order to care for the increasing number of people huge cities and factories were built. Great demands were made on the forests for lumber and other products. Each new spread of civilization and industry decreased the turkey range until in 1943 it occupied approximately 28 percent of its original range (Mosby and Handley, 1943: 15). Mosby (1949) has estimated that the eastern (M. g. silvestris) and Florida (M. g. osceola) turkeys occupied approximately 12 percent of their ancestral range in 1948.

Accounts of turkey numbers in the east began to show a decline as early as 1765. A Maryland writer at this time stated that wild turkeys, formerly abundant, were rarely seen. Pennsylvania reported turkeys as being very scarce in 1770. Connecticut, in 1813, records the last occurance of this native bird within its boundaries (Zimmer, 1924: 2).

Due to the slower development of the western part of America, the turkey survived in larger numbers for a longer period of time. Large numbers of turkeys were still being seen in the bottom lands of the upper Mississippi around 1846. By 1892, however, turkeys were rare in Minnesota and by 1893 Michigan reported that turkeys were almost completely gone. Between 1897 and 1920 the species disappeared from Indiana, Ohio, Iowa, Nebraska, and South Dakota (Zimmer, 1924: 3-4).

History of Wild Turkey Restocking in the United States

As the turkey population continued to decrease, conservationists throughout the country realized that something must be done to halt the rapid decline of the wild turkey population.

Wild turkey restocking, at this early stage of game management in the United States, appeared to be the most intelligent way of encouraging a declining population. The rearing of wild-strain turkeys in captivity for restocking purposes was begun by a number of states (Boyer, n.d.).

Occasionally, wild trapped turkeys were used for restocking purposes. As early as 1887 two pairs of wild turkeys from the Indian Territory were brought to Lake Koshkonong, Wisconsin, and released in order to breed in the wild. In 1890, estimates of the population around Lake Koshkonong varied from 23 of pure stock to more than 200 of pure and mixed stock (Schorger, 1942: 180).

In 1905 the Pennsylvania Game Commission proposed a program of trapping and transplanting wild birds (Latham, 1941: 7). A small number of the wild gobblers were to be held in captivity with a flock of half-wild hens. The resulting broods from these turkeys were to be used for restocking purposes. No definite information is available regarding the outcome of this proposal.

In 1912 a recommendation was made and accepted by the Pennsylvania Game Commission to build enclosures of four or five acres surrounded by an eight foot fence. Hens with one wing clipped were placed in these enclosures and allowed to breed with native-wild gobblers. The young and surplus turkeys from this type pen are used for restocking purposes (Latham, 1941: 7).

During the early part of 1929 the Wild Turkey Conservation Association made a nation-wide survey of the turkey. The information obtained from this survey was compiled by Dr. Samuel P. Boyer of Johnstown, Pennsylvania.

The data obtained from this booklet indicated that 26 states had attempted wild turkey culture, ranging from the most simple methods of propagation to extensive experiments, and that eight had abandoned this type of restocking. In 17 states game-farm wild turkeys were used with nine of the states reporting failures and eight reporting unknown success. New Mexico reported that in 1927-1928 a considerable number of wild turkeys were trapped and transplanted and that all such plantings were successful to some degree. Arizona reported that in placing wild turkeys it was best to release them in pairs. Boyer, in summarizing the wild turkey propagation program as of 1929, states that, ". . . the most extensive work along this line has been done during the past two years" (Boyer, n.d.: 19). This statement indicates that as early as 1929 conservationists were beginning to intensify the program of replenishing turkey populations by restocking.

During the 1930's Virginia, Pennsylvania, and Missouri initiated a program to produce a wilder strain of game-farm turkeys. This method involved the use of captivity-reared wild hens crossed annually with native wild gobblers. The development of the propagation and restocking program in Virginia is treated in greater detail under History and Status of Wild Turkey Restocking in Virginia. Missouri, after releasing 14,000 turkeys produced by this system, discontinued the liberation of captivity-reared turkeys in 1943 after 12 years of operation (Leopold, 1944: 143).

Today Pennsylvania and Virginia are still using the "wild-mated" method of producing captivity-reared turkeys. Detailed information of the number of birds stocked and their success is not available from Pennsylvania but reports from various sources within the state indicate an extensive and successful restocking program.

Status of Wild Turkey Restocking in the United States in 1954

The collection of data by means of a questionnaire does not permit a complete statement by the correspondent and summarizing such data is not without hazard. However, it is believed that the results presented in Table 1 and Figures 2 and 3 provide information that is essentially correct. This data was collected by means of a nationwide survey in February, 1954, to determine the status of turkey restocking in the United States. Questionnaires were sent to the game commission of each state (Appendix Figure 1A).

Stocking of turkeys by private individuals or organizations was disregarded because of inadequate information.

It was found that 38 of the 48 states have at some time used either pen-reared or wild-trapped turkeys, or both, in their restocking programs and that approximately 122,000 turkeys were used in the restoration efforts. The results of this survey are shown in Table 1 and are summarized graphically in Figures 1 and 2.

Table 1. Status of wild turkey restocking efforts for 38 states which have released captivity-reared or wild-trapped turkeys, or both, in restocking programs

(W. T. means wild-trapped and C. R. means captivity-reared)

States which have released captivity-reared or wild-trapped turkeys or both, in restocking programs	Sub Species Stocked					Source of Birds				Area Stocked		Results of Program are										Plan to Continue Restocking					Approximate No. Birds Used	Status of Restocking Program	
												Wild-trapped					Captivity-reared					Yes			No	Undecided			
	Eastern	Rio Grande	Merriam's	Florida		W.T. out of State	W.T. in State	C.R. in State	Purchased Commercially	Unoccupied Potential Range	Occupied Wild Turkey Range	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Wild-trapped	Captivity-reared	Both				Number Years in Effect	Year Terminated if Restocking Abandoned
Alabama	x						x			x		x										x					500	12	-
Arizona			x				x			x				x								x					400	5	1950
Arkansas	x						x		x	x		x									x	x					700 C.R. 150 W.T.	-	-
California			x			x		x	x	x		Reports Moderate Success for Entire Program										x						-	20	-
Colorado			x				x			x	x	x										x						500	12	-
Delaware	x								x	x											x					x	30	2	-
Florida				x			x	x		x	x	x								x		x						1675 C.R. 725 W.T.	5	-
Georgia	x						x			x				x								x						75	6	-

Table 1. Status of wild turkey restocking efforts for 38 states which have released captivity-reared or wild-trapped turkeys, or both, in restocking programs (Continued)

States which have released captivity-reared or wild-trapped turkeys or both, in restocking programs	Sub Species Stocked				Source of Birds				Area Stocked		Results of Program are										Plan to Continue Restocking					Approximate No. Birds Used	Status of Restocking Program	
											Wild-trapped					Captivity-reared						Yes			No	Undecided			
	Eastern	Rio Grande	Merriam's	Florida	W. T. out of State	W. T. in State	C. R. in State	Purchased Commercially	Unoccupied Potential Range	Occupied Potential Range	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Wild-trapped	Captivity-reared	Both				Number Years in Effect	Year Terminated if Restocking Abandoned
Idaho	Unknown							x	x		Reports Complete Failure for Entire Program													x		12	-	1934
Illinois	x				x		x		x					x									x			2000	4	-
Indiana	x							x	x		Reports Complete Failure for Entire Program													x		181	2	1938
Iowa	x		x		Unknown				x		Results Unknown													x		Unknown	-	1920's
Kentucky	x					x	x		x			x							x				x			1500 C.R. 180 W.T.	7	-
Louisiana	x							x	x	x										x	x					3000	4	-
Maryland	x					x	x		x	x	Reports Excellent Success for Entire Program												x				8000	20	-
Massachusetts	x						x		x											x				x		66	1	1947
Michigan	Unknown						x		x										x		Unknown					25 to 50	2	1920
Minnesota	x						x	x	x											x				x		250	2	1926

Table 1. Status of wild turkey restocking efforts for 38 states which have released captivity-reared or wild-trapped turkeys, or both, in restocking programs (Continued)

States which have released captivity-reared or wild-trapped turkeys or both, in restocking programs	Sub Species Stocked				Source of Birds					Area Stocked		Results of Program are										Plan to Continue Restocking					Approximate No. Birds Used	Status of Restocking Program	
												Wild-trapped					Captivity-reared												
																						Yes			No	Undecided			
	Eastern	Rio Grande	Merriam's	Florida	W.T. out of State	W.T. in State	C.R. in State	Purchased Commercially	Unoccupied Potential Range	Occupied Wild Turkey Range	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Wild-trapped	Captivity-reared	Both				Number Years in Effect	Year Terminated if Restocking Abandoned
Mississippi	x					x		x	x		Reports Moderate Success for Entire Program										x					125	15	-
Missouri	x					x	x	x	x	x			x							x	x					14,000	30	C.R in 1943
Nebraska	x						x	x	x											x	Unknown					50	3	1936
New Jersey	Has not restocked turkeys within the last twenty years. Prior to that time birds of unknown origin were used in a restocking program but it proved to be a failure.																												
New Mexico		x	x		x	x			x	x	x										x					576	24	-
New York	x						x	x	x		Too Soon to Determine Success of Program											x				700	1	-
North Carolina	x					x			x				x								x					9	1	-
Ohio	x						x	x	x		Too Soon to Determine Success of Program												x			150	2	-
Oklahoma	x	x			x		x	x	x	x		x						x					x			200+	7	-
Oregon	x						x		x										x					x		1,504	8	1933

Table 1. Status of wild turkey restocking efforts for 38 states which have released captivity-reared or wild-trapped turkeys, or both, in restocking programs (Continued)

States which have released captivity-reared or wild-trapped turkeys or both, in restocking programs	Sub Species Stocked				Source of Birds				Area Stocked		Results of Program are										Plan to Continue Restocking					Approximate No. Birds Used	Status of Restocking Program	
											Wild-trapped					Captivity-reared						Yes			No	Undecided			
	Eastern	Rio Grande	Merriam's	Florida	W. T. out of State	W. T. in State	C. R. in State	Purchased Commercially	Unoccupied Potential Range	Occupied Wild Turkey Range	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Excellent	Moderate	Satisfactory	Unsatisfactory	Failure	Wild-trapped	Captivity-reared	Both				Number Years in Effect	Year Terminated if Restocking Abandoned
Pennsylvania	x						x		x	x						x						x				60,000	24	-
South Carolina	x					x			x				x								x					74	4	-
South Dakota			x		x	x			x		x								x		x					189	6	-
Tennessee	x						x		x	x									x Where protected properly		x					3,669	10	C.R.in 1950
Texas	x	x	x			x	x	x	x	x	Reports Moderate Success for Entire Program										x						6,185	25	-
Utah	x		x		x			x	x		x									x	x					42	-	-
Virginia	x						x		x	x							x						x			11,737	25	-
West Virginia	x					x	x		x		x									x	x					15	9	-
Wisconsin	x							x	x											x	Uncertain x-If carried on in future					2,941	11	1940
Wyoming			x		x	x			x				x								x					150	19	-

APPROXIMATE TOTAL: 122,285

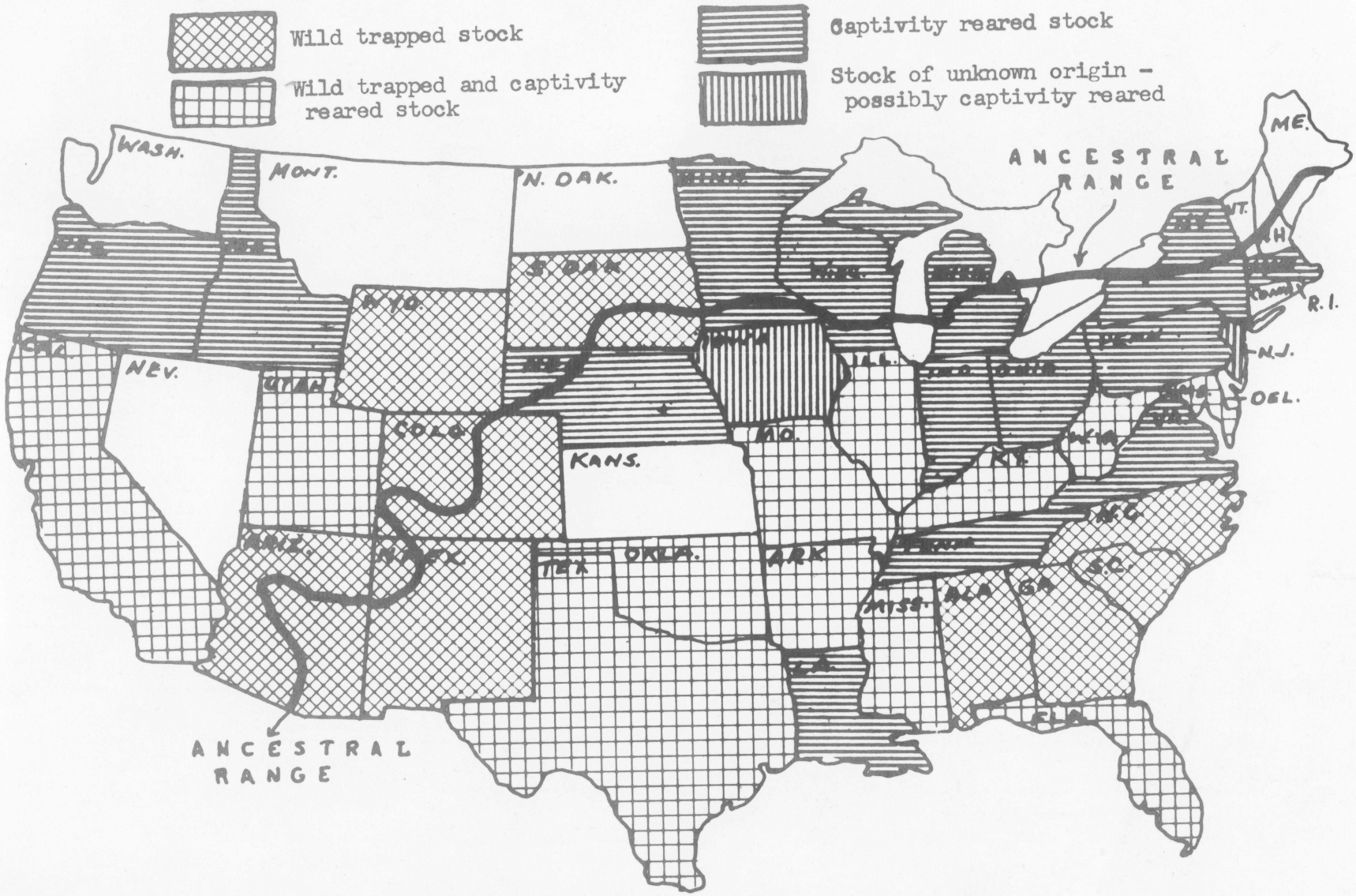


Figure 1. Types of wild turkey used in the 38 states which have attempted wild turkey restoration, 1954.

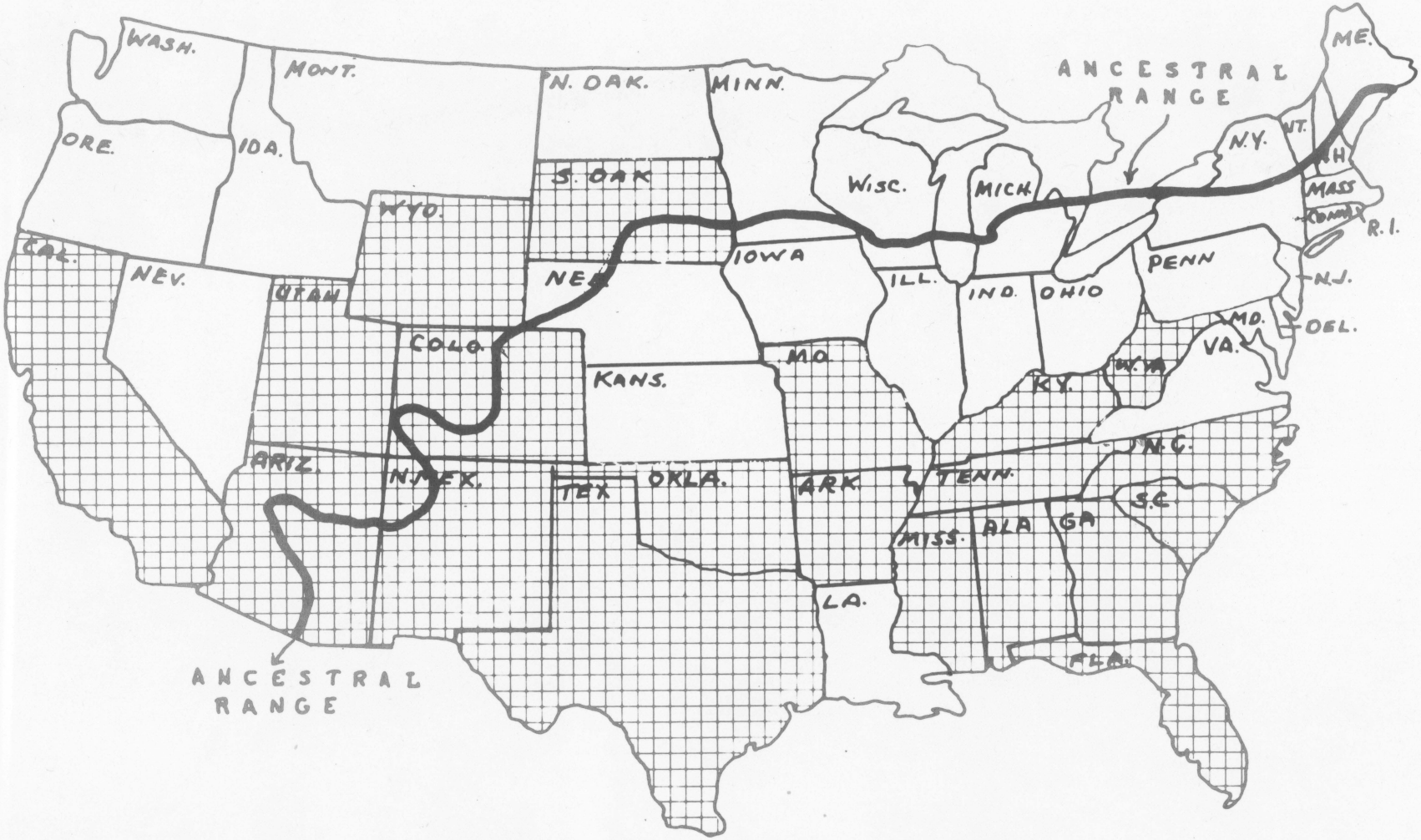


Figure 2. States reporting satisfactory results, or better, using wild-trapped turkeys in their restocking program, 1954.

One of the most interesting facts appearing in the survey is the success of the states which used wild-trapped turkeys. Nine states (Alabama, Arizona, Colorado, Georgia, New Mexico, North Carolina, South Carolina, South Dakota, and Wyoming) used only wild-trapped turkeys in their restocking programs and all report satisfactory results, or better.

In six states (Arkansas, Florida, Kentucky, Missouri, Utah, and West Virginia) where captivity-reared and wild-trapped turkeys were used in restocking, all six states report unsatisfactory results or failures for the captivity-reared turkeys, but report satisfactory results, or better, for the wild-trapped turkeys.

The ten states (Delaware, Idaho, Indiana, Louisiana, Massachusetts, Michigan, Minnesota, Nebraska, Oregon and Wisconsin) which used only captivity-reared turkeys reported unsatisfactory or failure for their restocking program.

Five states (California, Maryland, Mississippi, Oklahoma, and Texas) report satisfactory or better results using both captivity-reared and wild-trapped turkeys but did not differentiate as to the success of each. The degree of success of plants using wild-trapped turkeys reported in other states may indicate that the wild-trapped birds used in these states were important in obtaining the satisfactory results.

Only three states (Pennsylvania, Tennessee, and Virginia) report satisfactory or better results using only captivity-reared turkeys.

Illinois reports a complete failure using both captivity-reared and wild-trapped turkeys.

Three states (Iowa, New York, and Ohio) reported that it was too early to determine the success of their restocking program at the time the survey was made.

New Jersey restocked with birds of unknown origin more than twenty years ago and reports a complete failure for the restocking program.

Of the 38 states which have used turkeys in the past, 20 plan to use only wild-trapped turkeys in the future; two report that they are going to use only captivity-reared turkeys; six report they are going to use both captivity-reared and wild-trapped turkeys; six states are going to discontinue their restocking program; and one state is undecided as to its future plans for restocking.

The results of the survey indicate rather definitely that the national trend is towards restocking with native-wild turkeys. This seems to be a logical development in restocking methods because of the degree of success attained by the states using wild-trapped turkeys.

Results of Restocking with Wild-trapped Turkeys

The results from some of the states which have used wild-trapped turkeys in their restocking programs are very interesting.

Wyoming, on March 6, 1935, placed eight hens and six gobblers in the Laramine Peak area of the central part of the state. These turkeys were of wild Merriam stock and originated on the Hall's Peak Game Refuge west of Wagon Mound, New Mexico. In 1943 the population from the original plant of 14 had increased to between 400 and 600 and had spread into 16 townships (Ligon, 1943: 1, 14-16).

South Dakota, in March 1948, began releasing native-wild Merriam turkeys in the Black Hills section. At this time six hens and two gobblers were received from New Mexico. Two other imports, 14 from Colorado and six from New Mexico, were made in 1950 and 1951. In February 1954 these 28 turkeys had increased until the population was estimated to be approximately 3000 (Anonymous, 1954: 2, 3, & 6).

Kentucky trapped and transplanted 45 eastern wild turkeys (M. g. silvestris) between 1947 and 1949. These birds were trapped from the Kentucky Woodlands Refuge and released at two points. Thirty-seven birds were liberated at Beaver Creek and eight were liberated at Mammoth Cave. In the fall of 1949 the estimated population at Beaver Creek was 135 and the eight turkeys at Mammoth Cave had increased to 50 (Hoody, 1953).

Georgia, in 1944 and 1945, released twelve wild-trapped turkeys in the Piedmont Refuge. By 1954 the population in this area was estimated to be approximately 200 (Ambrosen, 1954).

South Carolina stocked Bull's Island in 1940 with 14 wild-trapped turkeys and in 1943 the population was estimated to be 125 (Baldwin, 1954). In 1949 trapping began on Bull's Island and 55 turkeys, from the above 125, were transferred to the Sandhills National Wildlife Refuge between 1949 and 1952. Observations of turkey sign on the refuge indicated a population of approximately 60 birds in 1954 (Womble, 1954).

One of the most phenomenal records of restocking with wild-trapped turkeys (M. g. osceola) comes from Florida. In 1949 and 1950, 162 wild turkeys were trapped from the Fish-eating Creek Wildlife Management Area in Glades County, Florida. These birds were released in the Peace River Valley. In October of 1953 the population was estimated at 2,800 turkeys (Stanberry and Gainey, 1953).

California in 1949 and 1950 released 24 wild-trapped Merriam turkeys (M. g. merriami) in southern Tulare County near Kernville in the Sequoia National Forest. During the fall of 1951 a conservative estimate of the population was 200 birds (Burger, 1954: 137-38).

Information from the nation-wide turkey restocking survey made by the author indicates that Utah stocked 16

native-wild Merriam turkeys on October 15, 1952. On February 5, 1954, the population was estimated to be 41.

West Virginia reports that nine wild-trapped turkeys were released in the Bluestone Reservoir area of Summers County in the spring of 1953. A minimum of 30 birds was reported during the fall of 1953. In addition to this plant, six wild-trapped turkeys were placed in Cooper's Rock State Forest, which lies in Preston County, in March of 1950. An estimate of the fall population in 1953 places the number of turkeys at 30 (Bailey, 1954).

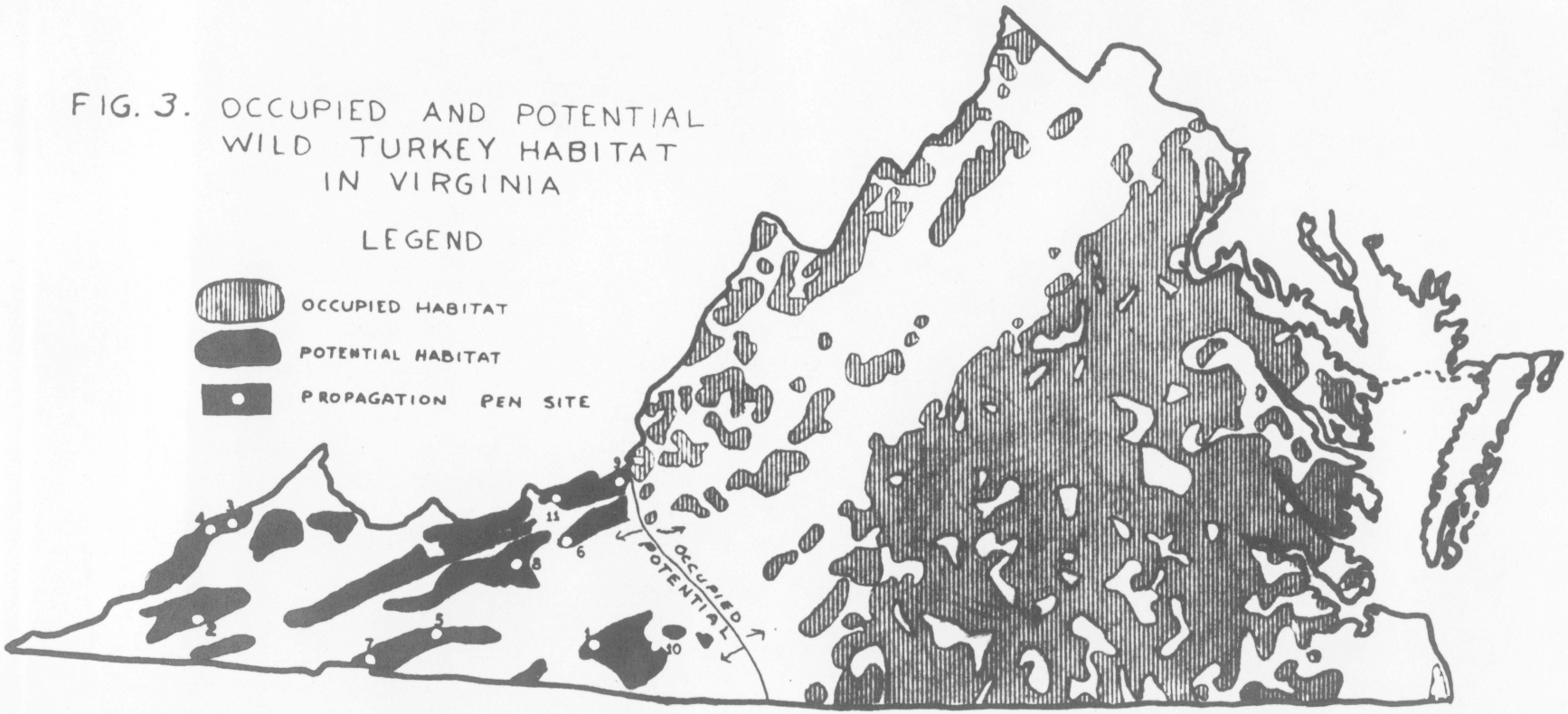
Texas has undertaken an extensive restocking program using the Rio Grande turkey (M. g. intermedia). Walker (1949: 339) reports that in the period 1938 through 1947, Texas transplanted 2,728 wild-trapped turkeys. Newman (1945: 283) reports that 19 release points using M. g. intermedia in east Texas (ancestral range of M. g. silvestris) were checked and 18 of these releases were failures. Thus, it appears that wild trapped M. g. intermedia liberation records have been successful within the ancestral range of this species in Texas but have been failures outside the range of the species.

HISTORY AND STATUS OF WILD TURKEY PROPAGATION IN VIRGINIA

As a result of the early disappearance of turkeys from southwest Virginia, plus a rapid decline in the remaining turkey population, serious thought was given to turkey restoration around 1922. Boyer (1929) states that correspondence from Virginia indicates that propagation of captivity-reared wild turkeys was being carried out on an 8,000 acre refuge around 1922 by Mr. Edmunds of South Boston, Virginia. This propagation technique involved the careful selection of suitable hens which resembled the wild turkey as much as possible in actions, coloration and build. Six hens were commonly placed in 100 square feet enclosures. Feed was scattered on the exterior of these enclosures to attract wild gobblers. After a period of two weeks, during which time native gobblers were attracted to the enclosure, the hens were released to reproduce in the wild (Boyer, n.d.).

In the spring of 1929 Virginia purchased brood stock for the State Game Farm (Handley, 1938: 847) to restock the occupied wild turkey range of Virginia and the unoccupied potential turkey range in the southwestern section of the state. Figure 3 shows the occupied and unoccupied potential turkey range and the propagation pen locations listed according to their numerical rank in poult production. There appears to have been little change in occupied turkey range since 1929.

FIG. 3. OCCUPIED AND POTENTIAL WILD TURKEY HABITAT IN VIRGINIA



One hundred and fifty captivity-reared wild turkeys were purchased from an out-of-state game breeder and the game farm production of turkeys for restocking was begun at the State Game Farm in 1930.

During the five years from 1930 to 1935 the game farm produced 1,328 turkeys (Handley, 1938). At the end of this period it was apparent that this type of bird was not acceptable for restocking because of the inability of the birds to care for themselves in the wild and their tendency to become domesticated.

In 1935 the Virginia Cooperative Wildlife Research Unit began work on developing a more suitable system for producing captivity-reared wild turkeys at Camp Lee Game Refuge in Prince George County. Work was carried on here until the fall of 1940 when it was moved to the Cumberland State Forest in Cumberland County. The propagation system using captivity-reared wild turkey hens placed in one to four acre wire enclosures was started in 1936. These hens mated with native wild gobblers and the resulting eggs were collected for incubation purposes. During the three year period 1936-1938, 700 turkeys were produced by this wild-mated method. This type of propagation produced a turkey that was somewhat superior to the bird produced by the game farm system. As a result of this superior strain of bird, the Commission enlarged its facilities in 1939 to permit production of from 1,000 to

2,000 birds each year (Mosby and Handley, 1943: 180-184). Turkeys produced by this wild-mated technique are still being used (1955) for restocking.

These turkeys have been released by both the direct and holding pen techniques during different seasons of the year. Experiments to increase restocking success also have included the release of various age classes and various numbers of turkeys.

In addition to using the direct and holding pen release methods for restocking, Virginia initiated an experimental wild turkey propagation pen system in 1953. This system was based on a technique developed in Pennsylvania which was described by Latham in 1941. Four propagation pens were used in Virginia. Only one had a reasonable degree of success with a 271.3 percent survival of brood stock plus their progeny (Richards, 1954: 30).

Richards (Ibid) also reports that a total of 11,077 captivity-reared wild turkeys were released in Virginia in the period 1929 to July 1, 1953. He presents detailed data on the county of release, number released and information regarding the distribution of these turkeys. Between July 1, 1953, and January 1, 1955, an additional 3,285 captivity-reared wild turkeys were liberated. Thus, a total of 14,362 turkeys were liberated in Virginia during the 26 year period 1929-1954, inclusive.

As indicated previously, most states using captivity-reared turkeys for restocking report unsatisfactory results. For this reason and since Virginia's annual production of captivity-reared turkeys for restocking is now between 2,000 and 3,000 birds, it seemed desirable to evaluate the results of Virginia's restocking efforts. Richards (Ibid) summarized the results of 25 years work with direct and holding pen releases and the results of the four propagation pens in operation during 1953.

The following sections summarize the results of eleven propagation pens in operation during the 1954 breeding season in Southwest Virginia. In addition, a reconnaisance survey was made to determine if any measurable deficiency existed in the potential wild turkey habitat of Southwestern Virginia which would adversely affect the turkey restocking program in this region.

Most states that have used wild-trapped turkeys in their restocking program report encouraging results. The trapping of native turkeys has received some attention in Virginia but no suitable trapping technique has been developed. Additional work done in trying to develop a suitable technique for capturing turkeys by traps and/or by the use of drug treated grain is also summarized.

THE 1954 PROPAGATION PEN PROGRAM IN VIRGINIA

Description and Operation of Propagation Pens

Location, Construction and Operation of Pens. During the 1954 breeding season the Game Commission operated eleven wild turkey propagation pens which were located in nine counties of the state as shown in Figure 3. Table 2 lists these pens in their descending order of poult production and gives the county in which located plus the brood stock distributed to each.

Table 2. The eleven wild turkey propagation pens operated in 1954 listed in order with the most successful first, showing also location and brood stock

Name of pen	County	Turkeys received alive		
		Males	Females	Total
1. Worleys Hope	Patrick	2	20	22
2. High Knob	Wise	4	23	27
3. Breaks #2	Dickenson	2	35	37
4. Breaks #1	Dickenson	2	15	17
5. Comers Rock	Wythe	2	19	21
6. McCoy	Montgomery	2	20	22
7. Feathercamp	Washington	2	20	22
8. Peak Creek	Pulaski	2	20	22
9. Barbours Creek	Craig	3	20	23
10. Stoney Creek*	Giles	2	20	22
11. Philpott Island*	Patrick	2	20	22

* Not used in analysis because of incomplete pen reports

Selection of the propagation pen sites was made, where possible, with the following criteria in mind.

1. Presence of an all-weather stream of water flowing through some part of the site.
2. Located near or within a suitable forest type for turkey production.
3. A mixed area of hardwoods and pine, a small grassy area and a brushy area or some other type of dense cover.

Ten hens and one gobbler were placed in each of the propagation pens. All of the pens except the Philpotts pen were approximately four acres in area and enclosed by a hog-wire fence four feet high. Poultry wire was used for enclosures of various types but could not withstand a running deer. Existing trees were used as fence posts where possible, to cut down on the expenses involved.

In addition to the propagation pen a small holding pen approximately 20 x 14 feet was constructed in the vicinity but out of sight of the propagation pen. This temporary holding pen was built with poultry wire and enclosed completely. A reserve of ten hens and one gobbler was placed in the holding pen to be used as replacements for turkeys lost in the propagation pen. Under normal conditions this reserve number of turkeys would be placed in the large propagation pen within ten days to two weeks.

In case severe predation or other losses occurred in the propagation pen the reserve of turkeys was held until the responsible predator, or other cause of loss, was controlled and conditions returned to normal. The reserve stock was then used to replenish the propagation pen.

Between March 15 and April 15 each of these pens received a shipment of turkeys from the Cumberland State Game Farm. Due to mortality as a result of shipment some of the pens received less than the prescribed 22 turkeys. Other pens that had heavy losses due to predation or that received turkeys when a surplus existed at the game farm, received more than the prescribed number. Upon arrival from the State Game Farm the primary feathers were clipped from one wing to prevent the turkey from flying out of the pen.

Maintenance of Pens. Each pen was assigned to a sportsman's club, game warden, game manager or other individual who assumed responsibility for maintenance of the area, predator control work and submission of a weekly pen report. A copy of the Weekly Wild Turkey Propagation Pen Report form appears in the Appendix (Appendix Figure 2A).

In order to minimize daily contact between the operator and the penned turkeys, large range type poultry feeders were installed with a feed hopper capable of holding a week's supply of mash. Small poult feeders were installed prior to the first hatch and were kept filled at all times.

Pellet mash "Layena"[1]/feed was delivered to the pen operators prior to the arrival of the turkeys. This feed is considered suitable until the first hatch of poults. At this time the feed must be changed to "Growena"[2]/which is small enough to be taken by the poults yet is also adequate for the older turkeys.

Predator control work was carried on outside of all pens with varying degrees of success. The writer's personal experience indicates that a number 2 coil spring trap is the most efficient. Its small size allows a neat set yet it is strong enough to hold animals up to the size of a large dog. Naturally, predator control work must be stopped as soon as the poults start leaving the enclosure.

Personal contact with the various pens indicated that crows, skunks and o'possums caused the greatest loss of eggs. Most pen operators discovered this to be true early in the season and concentrated their efforts on lowering the population of these three species as much as possible.

Data on Eleven Propagation Pens During the Breeding Season of 1954

Survival and success data for the eleven propagation pens during the 1954 breeding season are shown in Table 3. These data were summarized from the weekly reports submitted by the pen operators supplemented by personal interviews with each of the eleven operators.

1/ Trade name of turkey laying mash sold by Purina.
2/ Trade name of turkey poult feed sold by Purina.

Table 3. Results achieved at each of the eleven wild turkey propagation pens during the 1954 breeding season. The pens are arranged, from left to right, according to their success in producing poults

	Patrick Co.	High Knob	Breaks #2	Breaks #1	Comers Rock	McCoy	Feathercamp	Peak Creek	Barbours Creek	Total
Adults received alive	22	23	27	37	17	21	22	22	23	214
Adults lost - predation	1	8	0	8	3	9	13	22	20	84
Adults lost - straying & unknown	1	7	21	22	10	5	7	0	1	73
Total adults lost	2	15	21	30	13	14	20	22	21	158
Adults in pen near end of 1954 breeding season	20	8	6	7	4	7	2	0	2	56
Total nests	21	6	13	9	4	15	4	4	5	81
Nests lost	9	6	7	7	2	11	4	4	5	55
Remaining nests	12	0	6	2	2	4	0	0	0	26
Total eggs	214	75	151	128	3	71	24	47	65	778
Eggs Lost	73	73	74	90	2	74	30	47	65	528
Remaining eggs	141	2	77	38	1	0	0	0	0	259
Poults hatched	121	31	72	32	17	13	0	18	0	304
Poults lost	72	1	49	18	8	12	0	18	0	178
Poults raised	42	30	23	14	9*	1**	0	0	0	119
Predators killed	27	19	5	1	2	21	16	0	9	100

*Poults produced outside pen
**Poults produced from unlocated nest

Discrepancies appear in Table 3 because it is almost impossible to secure full records on turkeys even in a four acre enclosure. Operators were cautioned to report only those facts which they observed. Under these circumstances, the records tabulated are in all cases conservative and certain inconsistencies are apparent.

Table 3 shows that the Patrick County pen (Worley's Hope) produced the largest number of poults during the 1954 breeding season. One specific reason why this pen produced the largest number of poults is not easily found. However, the data from all pens combined show that there is a correlation between the number of predators taken and such factors as poults lost, adults lost, and nests lost. Assuming that predator control is the limiting factor in propagation pen production, the success of the Worley's Hope pen is easily explained.

This propagation pen was managed by three interested members of a sportsman's club operating on the headwaters of the Smith River in Patrick County. All three of these men lived nearby and much time was devoted to an almost constant predator control program during the entire breeding season. The sportsmen also conducted predator control work in the immediate vicinity of the pen for approximately three years prior to construction in the spring of 1954. From 1951 through 1953 it is reported that over 200 foxes were taken.

The almost constant vigil by the three operators gave them a rather complete picture of what was taking place in and around the pen at all times. When a predator killed a turkey or destroyed eggs, elimination of the predator usually took place the following night.

One account which stands out in the writer's mind occured during one of the visits to the pen site. The general topic of the conversation revolved around the effect of small mammals and crows on egg production. One of the three operators of this particular pen remarked that a considerable amount of their time had been devoted to lowering the crow population and that they now had it down to three individuals. A second pen operator remarked that only one crow had been seen the day before. The third member of the party quipped that he had killed two of the crows but failed to mention it.

This is the caliber of predator control that appears to pay off in more poults for future reproduction.

Aside from the fact that intensive predator control work was carried on the year round, the Worley's Hope pen differs very little from the other pens that were in operation during the 1954 breeding season. One slight difference in this pen is the fact that it has a six-foot poultry fence rather than the four-foot hog wire fence. Most operators feel that the poultry wire fence is a better precaution against predators than is stock wire. It has been the writer's experience,

however, that fences are of little protection to the turkeys when mammalian predators are interested in entering a pen. Dog destruction of turkeys in more than one of the completely wire enclosed holding pens is a case in point.

The operators of the Worley's Hope pen have expressed their desires to try using an electric fence outside the poultry wire during the 1955 breeding season. The electric fence, in conjunction with a thorough predator control program, should produce excellent results from this particular pen during the 1955 season.

The High Knob pen in Wise County produced the second highest number of poults. The success of this pen probably is also due to predator control work but it was performed on a small scale. The Wise County pen was maintained by a game manager whose other responsibilities made it impossible for him to devote sufficient time to control the predators. If more time for predator control work could have been arranged for this pen, poult production probably would have been higher. An inspection of this pen on July 14, 1954, indicated that poult production was being curtailed due to predators. Two nests had just been broken up; one with 19 eggs and one with 17 eggs. An intensive predator control program could possibly have averted this type of loss. This pen was not affected to any great extent by crow predation. The losses were due primarily to mammals which might have been captured by steel traps.

An old abandoned logging road, which ran through the center of the pen, served as an excellent observation line for making counts of both adults and young turkeys. This was one of the few pens in which a satisfactory count could be made on the turkeys with a minimum of disturbance.

The two pens in Dickenson County, Breaks Number 2 and Breaks Number 1, fall third and fourth, respectively, in poult production. During the 1953 breeding season, when only four propagation pens were in operation in Virginia, the Breaks Number 1 pen led in total production with a survival of 271.3 percent (brood stock of 21 plus progeny) alive in September, 1953 (Richards, 1954: 30).

As a result of the excellent success of the Breaks Number 1 pen in 1953, a second pen was established nearby for the 1954 breeding season. A very interesting development took place at these pen sites. In 1954, the new pen produced a larger number of poults than the old pen. Production for the old pen in 1953 was between 40 and 50 poults (Richards, 1954: 34) and the 1954 production was only 14. The low recorded production of the Number 1 pen during 1954 may have resulted from the increased difficulty of observing the turkeys present in the pen in 1954 as compared to 1953. This pen, constructed in the early spring of 1953, included a new one acre brushed field which by 1954 had grown head high in sprouts. This thick vegetation considerably lowered the number of effective observations that could be made within the area in 1954.

Breaks Number 2, which was constructed fairly close to a well traveled dirt road, had a considerable amount of interference from the visiting public. One nest of 16 eggs was abandoned as a result of the visiting public. The number of other nests broken up by this cause is unknown.

Predator control was carried on as much as possible at these two pens. Here, as at High Knob, the situation arose where the operators, a game manager and a game warden, did not have sufficient time to conduct an intensive predator control program.

The Comers Rock pen, located in Wythe County, had a peculiar poult-production record. While clipping the wings of the turkeys as they were being transferred from the shipping crates to the pen, one hen managed to escape from a crate before her wing was clipped and flew into the surrounding woods. Later in the summer six poults were produced in the propagation pen but disappeared. These birds disappeared, according to the pen operator, approximately two weeks after hatching. The free-ranging hen, which had escaped from the crate, returned to the vicinity of the pen, successfully nested, and produced nine poults outside the area. This was the only known surviving reproduction from this pen.

The McCoy pen, located in Montgomery County, raised only one poult from the entire brood stock of 21 turkeys. The writer was in close contact with this pen and attributes

the low poult production to an extremely large crow and skunk population. Even though 17 steel traps were set at all times until the poults were old enough to leave the pen, approximately 75 eggs were lost due to skunks, crows and o'possums with crows accounting for at least two-thirds of the total. Approximately one fourth of the area (one acre) of the pen was in young pine woods which were adjacent to a pine thicket containing a crows roost. This roost was not discovered until after the pen had been constructed and in operation for some time.

Another cause for poor production was a large number of visitors moving around and through the pen. Each Monday morning at least six of the steel traps would be thrown by the visiting public. One nest of twelve eggs was found abandoned on June 21. A later conversation with the landowner revealed that a college student had lifted the hen by her tail to count the eggs which she was brooding. It is thought that this disturbance may have caused the hen to abandon these eggs.

From the experience the writer obtained at the McCoy pen it is apparent that merely checking the traps daily is not sufficient to keep predators at a minimum. In order to rear a satisfactory number of poults, predator control should be a full time job.

The Feathercamp pen, located in Washington County, as a result of heavy predation by a male bobcat (later caught) and grey foxes, had no poult production. These predators kept the

hens in such a constant turmoil that nesting was curtailed. The four hens that were observed to nest lost their eggs to predators and consequently no reproduction was reported. Here, again, the game manager was assigned to maintain the pen as well as carry out other duties.

The Peak Creek pen, located in Pulaski County, produced a total of 18 poults but none of these survived. A major factor contributing to the poor success of this pen was stray dogs. On one occasion a dog entered the small holding pen and killed ten turkeys in one night.

Heavy predation also accounts for the poor success of the Barbours Creek pen located in Craig County. Here twenty of the original 23 turkeys were killed, primarily by foxes. Of five nests destroyed within the pen, four were definitely destroyed by foxes and the fifth nest was listed as probably destroyed by the same predator. A large pine snake was killed while trying to swallow an egg from a nest containing seven eggs. The hen returned to this nest and layed seven more eggs but was later killed by a fox.

The remaining two pens, which were not listed in Table 3, were excluded from the summary because of inadequate weekly pen reports. One of these pens, Philpott Island, located in Philpott Reservoir, had the advantage of being completely surrounded by water. The vegetation on the island was very dense. This, as well as the size (25 acres) made it

extremely difficult to locate and count turkeys for the pen reports. The few counts that were obtained were the result of turkeys coming out on a small beach to water.

Before the brood stock was placed on this island an effort was made to remove as many predators as possible. It was assumed that the water would act as a natural barrier and prevent any influx of additional predators. However, during the drought in the fall of 1954, the water in the reservoir dropped approximately 20 feet. Just prior to this time personnel of the United States Army Corp. of Engineers reported having seen 25 young plus several adults on the beach. While the water was at low ebb a group of dogs proceeded to cross the once filled "moat" and drive the turkeys off the island. Reports from local residents indicate that two flocks of turkeys survived and are located three miles from the pen. Each flock contains approximately 15 turkeys.

The second propagation pen dropped from the report because of inadequate records was located on Big Stoney Creek in Giles County. The game manager in charge of this pen became ill after the pen was constructed and was, therefore, unable to submit sufficient data. During one of the visits to the pen the writer noticed several eggs that had been destroyed by crows. It is believed that one hen which had escaped from the pen raised a brood of young outside, but the number in the brood is unknown.

Reproduction and Survival Through August 1954

It should be emphasized again that the figures used in this report are conservative as they are based only on observed results.

One of the operators from the Worley's Hope pen once remarked to the writer, "It seems that half the eggs are lost before hatching and only half the poults which hatch survive until September." It appears that this reasoning is fairly accurate when the information from all pens is combined and analyzed.

Of the 778 eggs reported by the pen operators 304, or 67.8 percent, produced poults. The number of poults surviving was 119, or 39 percent. Thus, approximately 60 percent of the young turkeys were lost sometime between hatching and September. The causes of this loss are unknown since the poults disappeared without leaving a trace. It was rare indeed for a pen operator to observe a dead poult.

Table 4 shows the percent survival (adults left in pen at the end of the breeding season plus progeny) for the various pens during 1954.

Table 4. Productivity* of turkeys in nine propagation pens during the 1954 breeding season in southwest Virginia

Pen	Breeding stock	Poults produced	Poults plus adults at end of season	Productivity in present adults plus progeny
Patrick Co.	22	42	62	281.8
High Knob	23	30	38	165.2
Breaks #2	27	23	29	107.4
Breaks #1	37	14	21	56.7
Comers Rock	17	9	13	76.4
McCoy	21	1	8	38.1
Feathercamp	22	0	2	9.0
Peak Creek	22	0	0	0.0
Barbours Cr.	23	0	2	8.6
TOTAL	214	119	175	

*For purposes of definition, productivity in each pen was expressed as a percent figure with the number of adults plus progeny as of September 1st as the numerator and the total brood stock placed in the pen in the spring as the denominator.

Predators

The writer has mentioned several times previously that predator control work appears to be important in raising a sufficient number of poults for future reproduction. Each pen operator carried on a predator control program which had to be fitted into his other activities. For this reason the time that could be devoted to predator control work was limited

and the average number of predators caught for each pen was only eleven. Table 5 shows the number of predators and other animals taken at the nine propagation pens during 1954.

Table 5. Predators and other animals taken at nine propagation pens in southwestern Virginia during the 1954 breeding season

Species	Number Caught	Percent of Total
Skunk	20	20
Fox	16	16
Crow	14	14
O'possum	11	11
House Cat	8	8
Hawk	7	7
Owl	6	6
Dog	3	3
Coon	3	3
Songbirds	2	2
Rabbits	2	2
Rats	2	2
Chipmunk	2	2
Weasel	2	2
Bobcat	1	1
Blacksnake	1	1
TOTAL: 16 Species	100	100

When the data obtained on predators taken are plotted graphically and compared with adults lost, poults lost, and nests lost there appears to be a correlation. Figures 4, 5, and 6 show the above data plotted graphically in two week intervals for the entire breeding season.

These graphs appear to show that there is some correlation between the number of predators taken in a given period and adult turkey losses, nest and egg losses and poult survival. A correlation coefficient test was applied to the data to evaluate these relationships. In this test the correlation coefficient, r, varies between -1 and +1 with values above 0 indicating a high value of one associated with high values of the other and values below 0 indicating a high value of one associated with a low value of the other. Figures 4, 5, and 6 show the three graphs relating to predators taken-nest losses; predators taken-adult losses; and predators taken-poult losses.

The correlation coefficient, r, for the nests lost-predators taken data is + 0.05; for the predators taken-adults lost data it was found to be +0.59; and for the predators taken-poults lost data the coefficient is found to be -0.29.

In dealing with biological data many factors are at work and losses are not usually the result of only one specific cause.

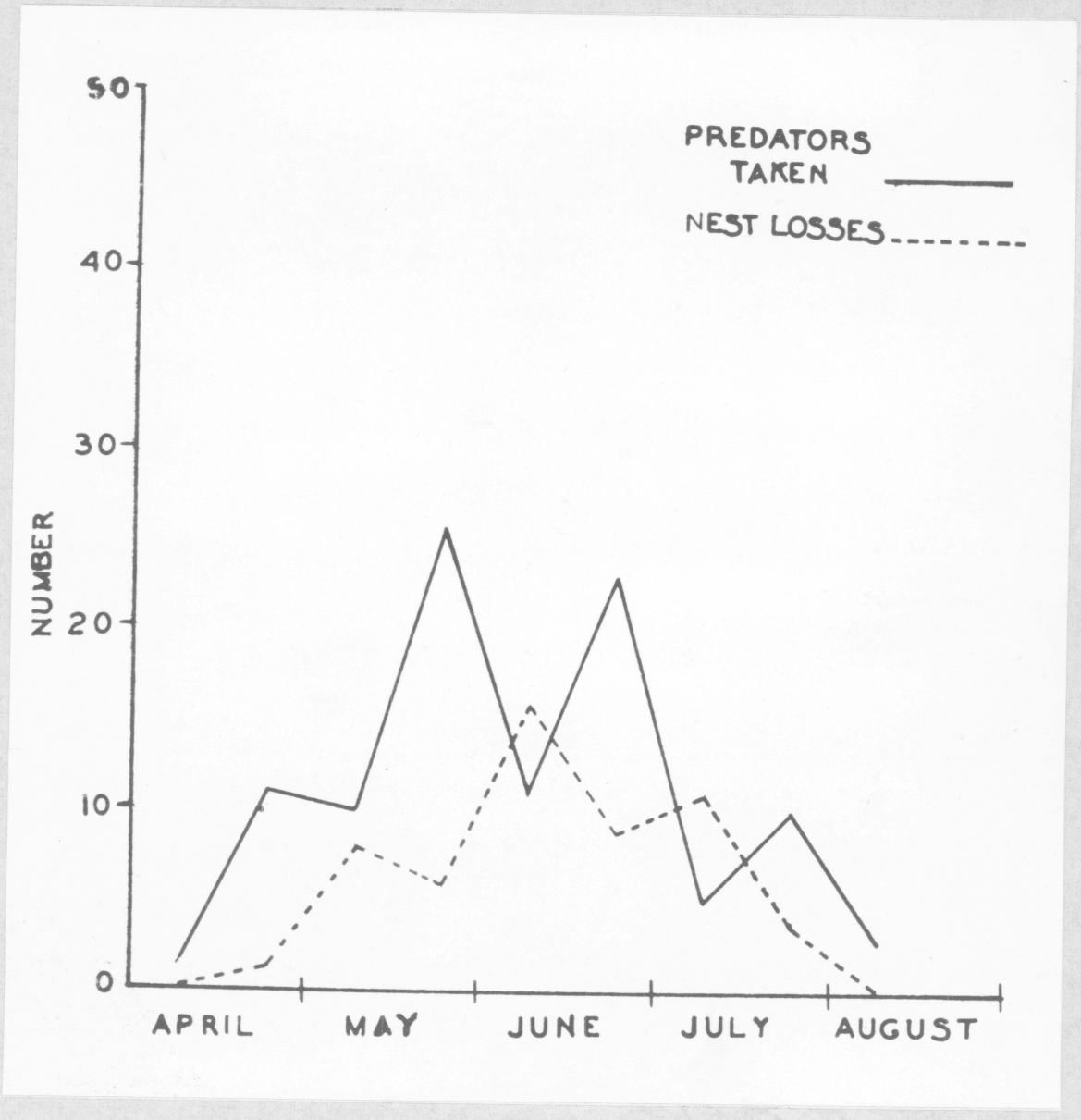


Figure 4. Relationship between the number of predators taken and the number of nests lost in nine propagation pens in the southwestern part of Virginia during the 1954 breeding season

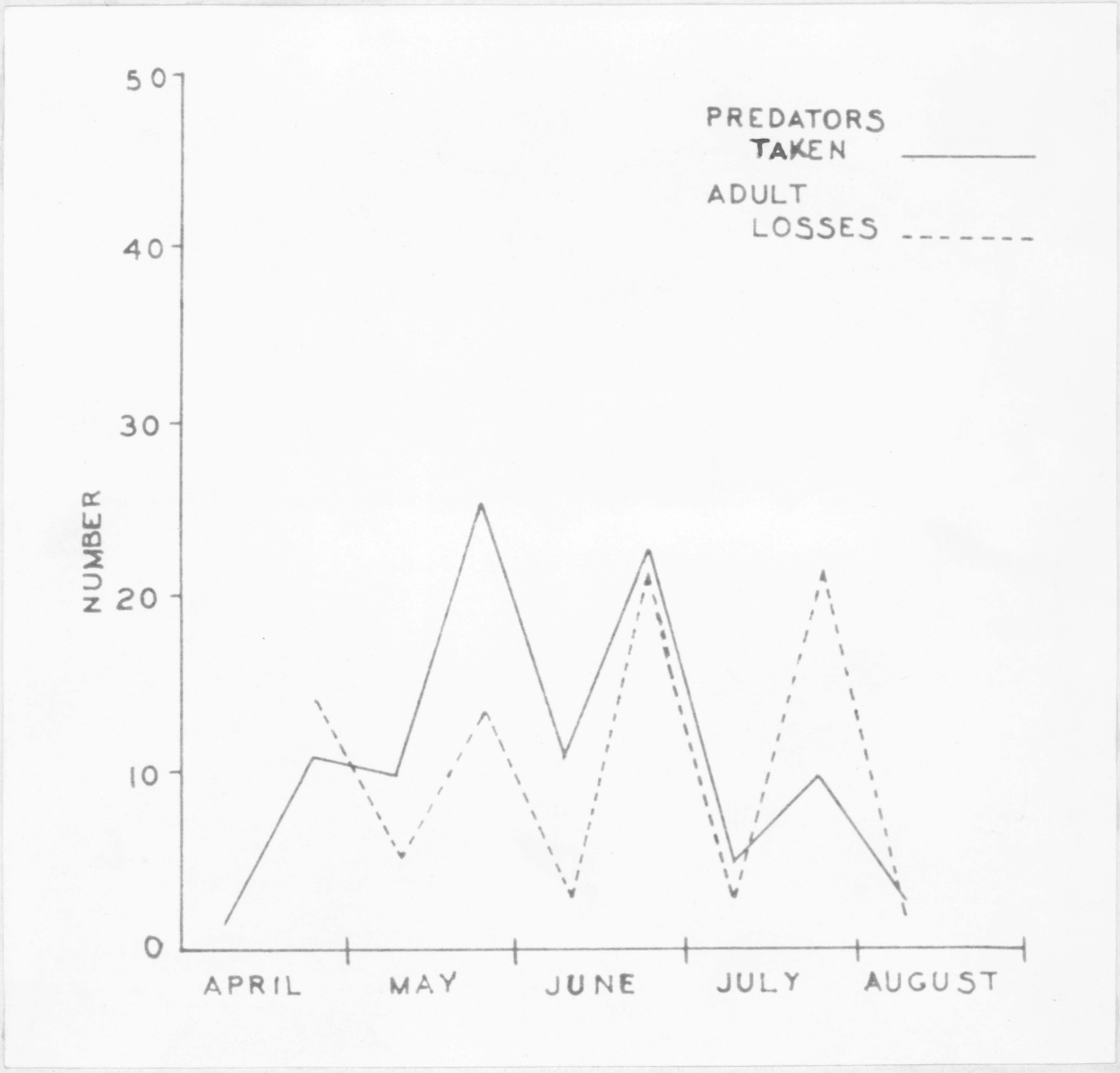


Figure 5. Relationship between the number of predators taken and number of adults lost in nine propagation pens in the southwestern part of Virginia during the 1954 breeding season

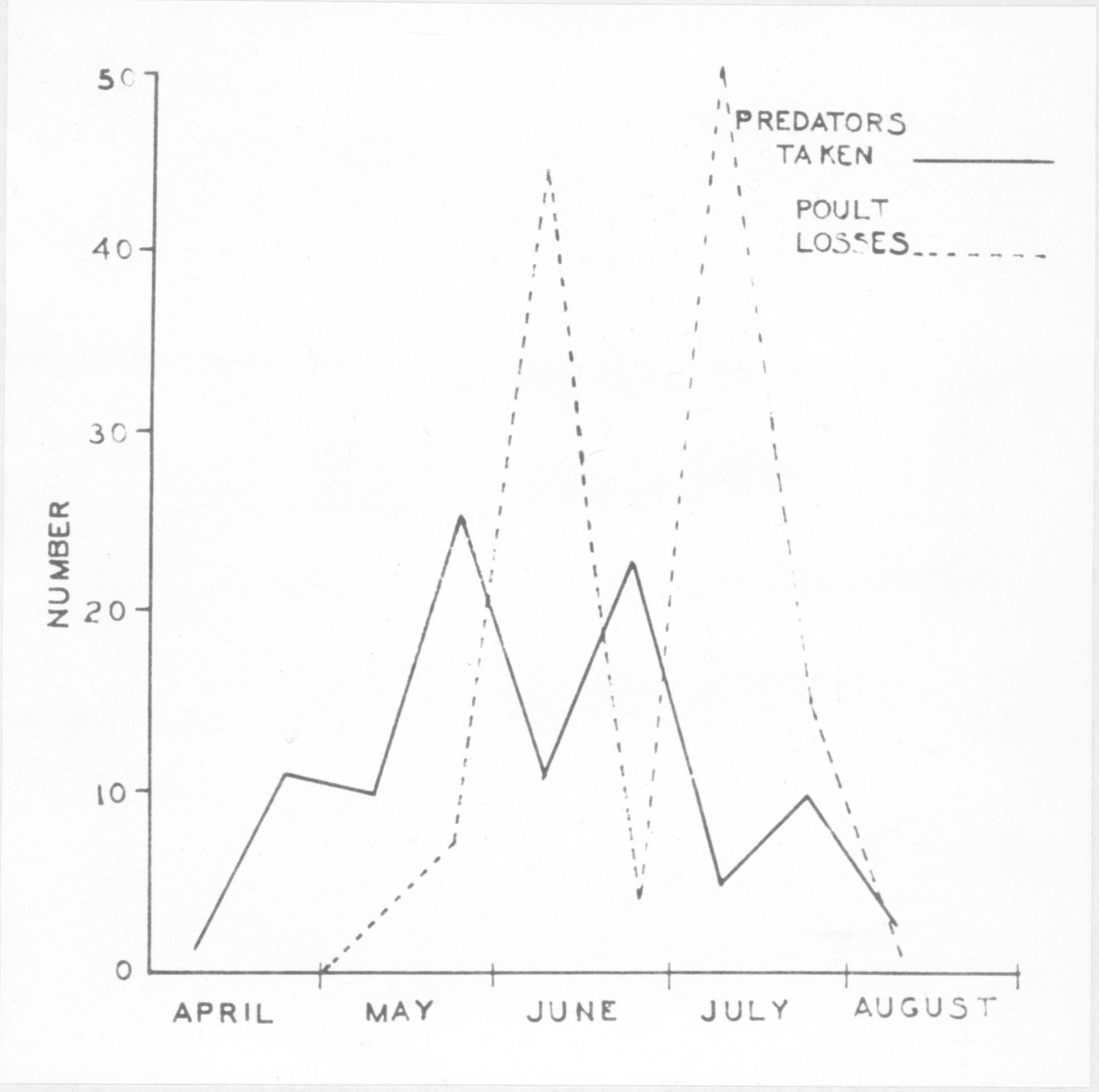


Figure 6. Relationship between the number of predators taken and poults lost in nine propagation pens in the southwestern part of Virginia during the 1954 breeding season

The losses to nests and adults in this case, however, were associated directly with the numbers of predators present. When the population of predators was high, more predators were caught and more adults and nests were lost. Carried on over a long period, to the point of controlling the population of predators, it is believed that the correlation would have become a negative one for individual pens.

A question arises as to why the predators taken-poult losses data gives a negative correlation coefficient in contrast to the positive correlation for adults and nests lost. This may indicate that the trapping protected the young turkeys; that predators preferred adult birds, or that young birds were harder to catch. However, it is believed more probable that the data was inadequate.

Overwinter Survival of Turkeys from Propagation Pens

In April of 1955 correspondence with the pen operators revealed the following information (Table 6) on the number of turkeys surviving through the winter.

Table 6. Overwinter survival of turkeys from eleven propagation pens in southwestern Virginia, April 20, 1955

Name of pen	Location	Adults plus young (September)	Number flocks (April)	Total number turkeys (April)
Worley's Hope	Patrick Co.	62	3	50
High Knob	Wise Co.	38	-	-
Breaks #1 and Breaks #2	Dickenson Co.	29 21	4	33
Comers Rock	Wythe Co.	13	-	-
McCoy	Montgomery Co.	8	2	11*
Feathercamp	Washington Co.	2	-	-
Peak Creek	Pulaski Co.	0	-	-
Barbours Cr.	Craig Co.	2	-	-
Philpott	Patrick Co.	-	2	30*
Big Stoney	Giles Co.	-	-	-
TOTAL		175	11	124

*Approximate number; exact figure unknown

Reports from local residents in the vicinity of the Patrick County (Worley's Hope) pen indicate that three flocks (containing a total of 50 turkeys) survived through the winter of 1954-1955. Additional reports, which were not checked by the pen operators, place the over-winter survival at 80 turkeys. All birds were reported within a three-mile radius of the propagation pen.

The operator of the High Knob propagation pen in Wise County reports that no turkeys have been seen since November of 1954. The number seen at this time was not reported.

An unreported number of turkeys were seen in the vicinity of the Comers Rock propagation pen in Wythe County prior to the hunting season. Since that time turkeys have not been sighted by local residents.

Two flocks (containing a total of 11 turkeys) have been reported in the vicinity of the McCoy pen in Montgomery County.

Local residents of Philpott Station, Patrick County, report two flocks (containing a total of approximately 30 turkeys) which apparently were driven off the island in Philpott Reservoir.

Reports from local residents in Dickenson County indicate that four flocks (containing a total of 33 turkeys) are present in the immediate vicinity of Breaks #1 and Breaks #2 propagation pens.

Although the reports from a few of the pens are encouraging it is believed much too early to predict whether the pen reared turkeys will in these cases be successful in restocking the areas. The survival and reproduction from the original brood stock of 214 adults is reported as approximately 124 turkeys including the adults and last years poults. This survival and reproduction is poor when contrasted with reported results of the states using wild trapped birds for restocking.

Comparison of Captivity-reared and Native Wild Turkey Production

One of the objectives of this investigation was to ascertain the factors which lead to the poor success of captivity-reared turkeys in restocking an area of suitable habitat. Turkeys used in a restocking program should have inherited wild traits, which can be passed to their progeny, in order to sufficiently reproduce and survive once liberated.

In a survey made during 1953 at the Virginia Cooperative Wildlife Research Unit it was found that the majority of respondents reported that turkeys released within occupied native turkey range in Virginia were sufficiently wild for restocking purposes. However, within unoccupied range the majority of people considered the game-farm turkeys too tame for restocking purposes (Richards, 1954: 30).

The writer believes that game-farm turkeys should not be released in occupied turkey range because of the hazard of introducing disease into the native stock and because captivity-reared turkeys are not needed where wild turkeys are present.

Captivity-reared turkeys have not been observed to demonstrate sufficient wildness to indicate a good chance of survival in natural habitats. As used here wildness refers only to the inherent behavior patterns and other

adaptations that permit the successful existence of free populations (Leopold, 1944: 135-136). On several occasions the writer has been able to closely approach captivity-reared turkeys in the wild without greatly alarming them. Furthermore, authentic incidents have been reported in which it was necessary to drive these birds from well-traveled roads to allow cars to pass. Another incident involved turkeys coming into a drive-in theatre in Augusta County. This does not seem to be the type bird that would be capable of prospering in the wild nor is it the type that the majority of hunters would like to stalk.

Another factor which may affect the suitability of captivity-reared turkeys for restocking purposes is the apparent inability of these hens to successfully carry through a brood once hatched in the wild. In the writer's opinion this inadequacy is also due to a lack of wildness.

Leopold, in summarizing his detailed study of poult survival states that ". . . we can positively say, therefore, that wild hens are successful in raising larger broods than the hybrid hens." He goes on to say ". . . the difference in productivity probably lies in the superior survival of wild juveniles" (Leopold, 1944: 168-169).

However, a comparison of the Virginia data available on the productivity of the captivity-reared turkey and the wild turkey shows only a slight difference between the two.

Records from 13 nests of captivity-reared turkeys in the propagation pens indicate an average clutch size of 16.5 eggs for each nest, based on 13 nests (Std. dev. 5.9, range 10-26 eggs). It was found that the average clutch size, based on 34 nests, for wild turkeys during the 1953 breeding season was 12.3 eggs (Std. dev. 2.4, range 7-18 eggs) per nest (McDowell, 1954: 14).

There appears to be a sizeable difference in clutch size between the two strains of birds. This may be a result of multiple nests or an inadequate sample of nests of captivity-reared turkeys. If this difference is not the result of an inadequate sample or multiple nests, the average clutch size is approximately 25 percent larger for the captivity-reared birds. This factor should give the captivity-reared turkeys an advantage over the native turkeys in poult production.

In comparing the hatch of the captivity-reared hen with that of the wild hen, however, there is a difference in success ratio between the two. Of 13 game-farm hen nests for which complete records are available during 1954, only 163 of 214 eggs or 76.1 percent were hatched. For the same number of wild hens, McDowell (1954: 17) reports that 147 eggs or 93.0 percent of 158 hatched. This hatch is considerably better than the captivity-reared hens.

A comparison of brood sizes of wild and captivity-reared hens during the month of September shows very little difference between the two. McDowell (1954: 26) found that for wild birds the average brood size in September was 8.5 (Sta. dev. 3.3, range 3-15) based on 53 broods. The writer's data, based on 13 broods produced by captivity-reared hens, indicates an average September brood size of 7.5 (Sta. dev. 3.6, range 1-14).

Assuming that the average hybrid clutch size is larger by 4.2 eggs, this larger clutch could make up for the deficit in percentage of eggs that hatch. (Wild: 93 percent of 12.3 eggs equals 11.4; Captivity-reared: 76.1 percent of 16.5 eggs equals 12.6)

The data indicate that in September the wild hen has only one poult more than the captivity-reared hen on the average. Inasmuch as the September brood sizes of the captivity-reared and wild hens are approximately equal, and since the captivity-reared birds have not as yet established themselves in restocked range, the writer believes that the adult and young of captivity-reared turkeys lack sufficient heritable wildness to survive through the winter in large enough numbers to establish a population.

CAPTURING AND TRANSPLANTING WILD TURKEYS

Manually Operated Traps for Wild Turkeys

During the past two years the Commission of Game and Inland Fisheries, in cooperation with the Virginia Cooperative Wildlife Research Unit, experimented with techniques for trapping native-wild turkeys for use in the restocking program. Richards (1954) unsuccessfully tried trapping turkeys in 1953. During 1954 the writer tried baiting turkeys to the five manually operated traps previously constructed by Richards and assisted a Commission technician in the construction and operation of two manually operated, drop-door traps. No turkeys were caught in these traps. This may be partially explained by a heavy mast crop in Virginia in 1953 and 1954. In both of these years of trapping it was found that the turkeys were shy of the traps and would not enter under any conditions. On several instances turkeys would feed around the outside of the poultry wire inclosure, but would not venture inside.

Capturing Turkeys with Avertin

Since positive trapping results were not obtained with the manually operated traps the Wildlife Unit at VPI began experimenting with a new technique, based on the findings of Wight (1953), involving the use of Avertin. Avertin is

the trade name given tribromoethanol by Winthrop Stern. Each cubic centimeter of Avertin contains one gram of tribromoethanol and 0.5 gram of amylene hydrate. This drug is used for both humans and domestic animals as a basal anesthetic and is injected rectally, normally as a 2.5 percent solution.

Since turkeys are physiologically different from humans, the dosage table for humans was not considered completely applicable. However, as a starting point for experiments using this drug the initial dosage for the turkeys was computed on the basis of the amount that a human of the same weight would have received. On this assumption, a ten pound turkey received 0.45 cc of undiluted Avertin.

Three captivity-reared wild turkey hens, each weighing seven pounds and two domestic turkeys, each weighing eight pounds, were used in this experiment.

Techniques and Dosage. On August 3, 1954, 0.5 cc of Avertin diluted in 5.0 cc of distilled water was placed on 50 cc of cracked corn. This feed was placed before one of the captivity-reared hens but very little was taken. Since the turkeys were on a diet of whole grain corn the cracked corn probably was not eaten because of the sudden change in type of food. The treated grain was removed and whole grain, untreated corn was once again placed before the bird.

On the 4th of August, 35 grains of whole corn were treated with 0.5 cc of undiluted Avertin. The following observations were recorded after force-feeding this treated grain to a captivity-reared hen.

Time	Observation
4:47 p.m. -	Force fed all 35 grains of corn.
4:50 p.m. -	Wings drooping, unsteady on feet.
4:53 p.m. -	Head layed back on neck.
4:54 p.m. -	Head starting to droop, wings still drooping.
4:56 p.m. -	Still responsive to human touch.
4:57 p.m. -	Responsive to truck horn twelve feet away.
5:04 p.m. -	Beak within 1/2 inch of ground.
5:05 p.m. -	Head raised to 1/2 normal height.
5:12 p.m. -	Beak on ground.
5:14 p.m. -	Beak and top of head on ground.
5:16 p.m. -	Startled by car: raised up and almost fell due to loss of equilibrium.
5:18 p.m. -	Walked around in very wobbly fashion.
5:21 p.m. -	Head layed back on neck once more and falling to one side; eyes partially closed.
5:44 p.m. -	Still wobbly on feet; pupil of eye slightly enlarged.

The results from the above dosage were not satisfactory to completely anesthetize the turkey for purposes of handling and transporting. Therefore, the dosage was increased to

0.75 cc of Avertin, undiluted, on 45 grains of whole corn and placed before a different captivity-reared hen on the 5th of August. The following observations were recorded.

Time	Observations
2:36 p.m. -	Feed placed before bird; some taken.
2:53 p.m. -	Inclement weather required that the remaining corn be force fed.
2:54 p.m. -	Wobbly on feet.
2:56 p.m. -	Wings drooping and head drooping. Not responsive to truck horn 12 feet away.
2:58 p.m. -	Head drooping half-way to ground.
3:01 p.m. -	Writer picked up bird. Bird could still walk but with no control; could not fly.
3:02 p.m. -	Bird fell down while walking.
3:08 p.m. -	Head near ground once more.
3:10 p.m. -	Writer handled bird once more; it was still incapable of flight.
3:11 p.m. -	Head starting to droop once more.
3:20 p.m. -	Writer walked up to bird which did not Offer to move. Bird, upon being pushed off its feet, reared up again falling down. Walked around in very wobbly fashion.
3:26 p.m. -	Bird chased around pen very slowly; made no attempt to fly.
3:28 p.m. -	Bird stretched neck and shook head vigorously.
3:30 p.m. -	Partially asleep once more.
3:34 p.m. -	Bird stood up, fell down and then remained on ground.

3:37 p.m. -	Bird still down with head upside down, flat on ground. No offer to move when probed with finger.
3:40 p.m. -	Handled bird again; no resistance.
3:43 p.m. -	Rain aroused bird momentarily but no offer made to stand up. Side of head now flat on ground.
3:50 p.m. -	Bird handled as desired.
4:02 p.m. -	Bird used wings to balance self. Still unable to fly.
4:17 p.m. -	Bird flew short distance; now reviving fast.
4:23 p.m. -	Almost fully recovered.
4:27 p.m. -	Still showed signs of drowsiness, but nearly fully recovered.

The above experimental dosage gave satisfactory results but a great deal of Avertin was not adsorbed by the corn. In order to compensate for this the following experiment utilized an extra 15 grains of corn. On the 6th of August 0.75 cc of undiluted Avertin was placed on 60 grains of whole corn and placed before the third captivity-reared hen. The following observations were recorded.

Time	Observations
10:45 a.m. -	Feed placed in pen.
10:50 a.m. -	Bird wobbly on feet.
10:52 a.m. -	Fell down then got back on feet.
10:54 a.m. -	Fell down once more then regained footing.
10:55 a.m. -	Equilibrium very poor.

10:58 a.m. - Bird handled as desired; down flat on ground completely asleep.

11:00 a.m. - Aroused bird and it fell down; completely incapable of flight.

11:40 a.m. - Bird still lying down.

11:43 a.m. - Bird aroused; stood up and then fell down. Still unable to fly.

12:13 p.m. - Bird still asleep on ground; very wobbly once awakened.

2:06 p.m. - Bird standing in a relaxed position and asleep. Still unable to fly in a satisfactory manner. Very wobbly on feet.

2:16 p.m. - Bird asleep with wings and neck drooping; not responsive to cap pistol when fired 12 feet away.

2:23 p.m. - Bird awake.

2:25 p.m. - Again eating corn (untreated).

2:27 p.m. - Asleep once more.

The above hen took 58 grains of the treated corn or approximately 0.75 cc of Avertin. The completely anesthetized condition of a captivity-reared turkey given approximately 0.75 cc of Avertin is illustrated in Figure 7.

The use of 0.75 cc of Avertin on 60 grains of corn was believed satisfactory for field experiments with wild turkeys. As a further check, however, the same dose was prepared and tried on the two domestic turkeys (1.50 cc of Avertin on 120 grains of corn). Treated grain was placed before the hens on the 16th of August. The following observations were made.

Condition of turkey after five minutes

Condition of turkey after ten minutes

Figure 7. Anaesthetized turkey under the influence of approximately 0.75 cc of Avertin

Time	Observations
1:39 p.m. -	Corn placed in pen.
1:45 p.m. -	Hen No. 1 started eating corn.
1:47 p.m. -	Stopped eating corn because of disturbance.
2:17 p.m. -	Both hens taking corn.
2:23 p.m. -	Hen No. 1 wobbly on feet.
2:32 p.m. -	Hen No. 1 lying down.
2:48 p.m. -	Same hen down again.
2:50 p.m. -	Head down on wire.
2:55 p.m. -	Head still down on wire. Hen No. 2 apparently got very little of the treated grain.
	Hen No. 1 went back once more to eat corn. Hen No. 2 went back three times for more corn.

Hen No. 1 recovered very fast apparently indicating a physiological difference exists between the captivity-reared turkey and the domestic turkey. It was also apparent that the domestic turkey could take a greater amount of Avertin without becoming as drowsy as the captivity-reared wild birds.

Since the first of the captivity-reared hens used in the experiments had not been in contact with the Avertin for 12 days it was decided to place a large amount of grain before her to see how much she would eat. On the 19th of August 2.25 cc of Avertin on 180 grains of corn were placed before the hen. She began eating the grain immediately after it was placed in the pen. In approximately nine minutes she

was dopey and did not take any more grain. It was found that she had taken 35 grains of corn which would have contained approximately 0.45 cc of Avertin. Since the amount of drug consumed was small she recovered very quickly and was normal within 15 minutes.

The second captivity-reared hen was also given 2.25 cc of Avertin on 180 grains of corn on the 20th of August. This bird took 76 grains of corn and then stopped eating. Another 44 grains of corn were force-fed to the hen bringing the dose to 120 grains of corn containing 1.5 cc of Avertin. This bird was completely asleep in ten minutes and did not recover for 3 hours and 15 minutes. No ill effects were noted in the hen after recovering from the experiment.

On the 20th of August treated corn was again placed before the domestic turkeys. The corn was gone in five minutes and the two birds had consumed 208 grains with 2.6 cc of Avertin. This amounted to approximately 104 grains of corn and 1.3 cc of Avertin for each turkey. After 25 minutes the birds showed practically no symptoms of having been exposed to the drug.

In a later experiment on the domestic turkeys one of these birds took a total of 185 grains of corn. Between 2:25 p.m. and 4:10 p.m. 94 grains were taken. The writer was forced to leave the pen at this time. By 10:00 p.m. another 91 grains of corn had been taken for a total of 185 grains.

This corn carried approximately 2.31 cc of Avertin. At 10:00 p.m., the hen was found lying on her side, completely asleep, with one leg sticking up in the air. She could not stand when she was placed on her feet. The following morning no ill effects could be detected from the Avertin.

It was decided that Avertin would be acceptable as a technique for capturing wild turkeys and experiments were planned with wild turkeys on the Big Levels Refuge in Augusta County.

A Technique for Removing Avertin from the Crop. As a precaution against losing turkeys from lethel doses of Avertin, an irrigator was designed to wash out the crop contents. This device (Figure 8) consists of a vented one-gallon supply jug connected by flexible tubing (6' long x 1/4" inside diameter) to a straight piece of copper tubing (36" long x 3/32" inside diameter) which is heat annealed to a piece of plastic tubing (36" long x approximately 3/8" inside diameter). The copper tubing with the plastic tubing securely heat annealed to it for 30 inches is greased with a vegetable fat and inserted into the esophagus and gradually worked into the crop as the bird's neck is held firmly stretched. The jug is then raised and inverted and water pressure is supplied by blowing on the vent tube in the water jug. Water passes through the small copper tubing into the crop and mixes with the crop contents flushing it out through the larger tube. Congestion

Figure 8. Irrigating equipment being used to flush Avertin from a turkey crop

of the feed in the tube may be minimized by the use of a thin stirring rod slightly longer than the plastic tube which will break up the feed jam. The neck and head of the bird should be inclined downward when flushing to avoid excessive pressure buildup in the crop and to prevent water entering the lungs.

This device, without the stirring rod mentioned above, was used successfully on a captivity-reared gobbler which was force fed in excess of 2 cc of Avertin on scratch grain. Approximately 1/2 gallon of cold water was circulated through the crop, but as a result of the plastic flushout tube becoming plugged by the grain, only about one third of the grain was removed. The circulation of the water, however, apparently removed enough of the Avertin to prevent death. The bird did not rally during the next 30 minutes and at the end of this time the respiration rate had fallen to 5½ per minute. However, by the following morning the gobbler was apparently normal. It ate food readily and no ill effects were noticed. No subsequent complications developed.

Big Levels Experiments Using Avertin and Traps. The writer found that the use of Avertin in capturing turkeys is a time consuming and nerve wracking job. Avertin deteriorates upon exposure to air and the sun. Therefore, Avertin treated bait was normally prepared and put out within an hour before the turkeys were expected to visit the baited area.

Constant observation was maintained on all drug treated grain bait spots so that turkeys taking the grain could be watched, captured and if necessary given irrigation treatment. Twelve bait spots were established on the Big Levels area during the first half of August 1954. Due to the heavy mast crop in one section of the Refuge in 1954, the bait spots were not used with any degree of regularity. However, Avertin treated bait was tried several times without success at the most promising spots.

In November, treated corn was placed at the bait spot where a flock of eight turkeys had been coming with some degree of regularity. On the particular morning the spot was baited only two hens appeared (around 9:30 a.m.) and both were captured after succumbing to the drug. One of the hens took an overdose of the treated corn and was dead at 2:00 p.m. that afternoon. (The irrigator previously described had not yet been developed when this incident occured.) The other hen was successfully transported to the Poor Valley Wildlife Management Area in Tazewell county and released the same afternoon. Autopsy of the dead hen revealed that she had taken 313 grains of corn (containing approximately 3.91 cc of Avertin) which is five times the minimum computed dose and 2 1/2 times the maximum computed dose of Avertin. During September, October and November 200.00 cc of Avertin were used in attempts to capture wild turkeys at Big Levels.

During the second week of January further work was undertaken to establish regularly used bait spots and during February two manually operated, drop-door traps were constructed. These traps were approximately 30 feet long, 12 feet wide and six feet high. Turkeys on several occasions would feed to within a few feet of the overhanging door of these new traps but failed to enter them. In all instances the birds were wary about entering the trap but were not afraid of the structure. After it became apparent that the turkeys would not enter the new traps, additional emphasis was given the use of Avertin in an attempt to obtain wild birds for restocking.

Preliminary evidence indicated that wild turkeys could normally withstand, without detriment, more Avertin than captivity-reared turkeys. On March 4th, Avertin treated scratch grain sufficient for 21 turkeys was broadcast at one of the established bait spots frequented by six turkeys to assure that the six birds would pick up a sufficient amount of the drug to stupefy them. Three times the calculated dosage of 0.75 cc per bird was used in treating the grain. Treated grain was mixed with untreated grain.

Four hens and a gobbler came to the bait spot at 8:15 a.m. and began taking bait at 8:18 a.m. The birds began showing signs of being unsteady on their feet at 8:30 and at 8:35 a.m. left the bait spot and entered the woods near

the road. The writer waited ten minutes to give the Avertin sufficient time to take effect and then drove to the bait spot. One old hen, one young hen, and one young gobbler were picked up and crated for delivery to southwest Virginia. A third hen, noticeably affected by the drug, escaped into the brush while the three birds were being picked up. The two hens, which were observed to take more grain than the gobbler, were given 0.2 cc of ephedrine sulfate as an antidote for the Avertin before leaving the refuge. As an additional precaution the birds were taken to Waynesboro, Virginia, and the hen which appeared most heavily drugged was administered raw oxygen to help restore normal respiration. The birds were then transported to the Poor Valley Wildlife Management Area in Tazewell County and two of them were released at 5:30 p.m. The hen which had been heavily drugged and was still rather drowsy was held in a wire enclosure overnight and released the following morning.

Since only three birds were removed from the flock of six, further attempts were made to capture the remaining three birds. The hen that left the bait spot on the morning of the 4th in a drowsy condition recovered and returned to the bait spot on the 8th along with the other two hens. However, on the second attempt to capture the birds in this flock it was found that these turkeys which had taken Avertin treated grain apparently avoided taking it a second time.

Several methods of offering the treated grain were tried including: treated grain broadcast with untreated grain; treated grain partially covered with dust from the road; and individual piles of untreated grain and treated grain. It was observed that the turkeys ate only the untreated grain and avoided the "Avertinized" grain. It would appear from this experience that when capturing turkeys with Avertin, a large quantity of drugged grain should be put out so that they can be captured on their first exposure to the drug.

Field experience also indicated that it is difficult to completely avoid exposing wild turkeys to an overdose of Avertin. Therefore, experiments with counter-acting drugs were attempted. Ephedrine sulfate, recommended for counteracting Avertin in human medicine, was tried but did not appear to be satisfactory when used on captivity-reared turkeys. The irrigating device previously described was developed in an attempt to minimize or eliminate losses due to overdoses of Avertin. Limited preliminary experiments with captivity-reared birds indicate that this technique may prove effective in reducing losses of drugged birds.

COMPARISON OF OCCUPIED AND UNOCCUPIED WILD TURKEY RANGE

Methods Used in Survey

A reconnaissance type habitat survey was made to determine if any gross differences existed between the occupied and unoccupied (Figure 3) wild turkey habitat of Virginia. No attempt was made to obtain detailed information. One tract of approximately 500 acres on the Big Levels Game Refuge, Augusta County, was chosen as representative of the occupied range while an area of equal size near Isom in Dickenson County was chosen to represent unoccupied potential turkey range. Data were obtained for the two areas on the cover type, average age of the trees, average diameter, average number of trees per acre, amount of land in clearings, and the average amount of available mast per acre. In each cover type five 1/5 acre sample plots were examined to obtain average age, diameter and number of trees per acre. Within each sample plot a line quadrant 36 feet long and 12 inches wide was established to determine the available mast on the area. All mast along these lines was examined for identity and condition, and counted. The available "usable" mast was converted into bushels per acre for each forest type to provide a volumetric comparison of the two ranges. The results of this survey are shown in Table 7.

Table 7. Results of surveys of occupied native-wild turkey range in Augusta County and unoccupied potential turkey range in Dickenson County, February and March of 1955

Cover Type[1]	Average Age	Average Diameter[2]	Average Number Trees/acre	Average Quantity Oak Mast Per Acre[3]	Average Quantity Good Oak Mast/acre	Number Acres in Clearings (Entire Area)
BIG LEVELS, AUGUSTA COUNTY, SURVEY DATA						
Pitch Pine-Oak	50 yrs	9.2"	130	3.30 bushels	0.18 bushels	
White Oak	50 yrs	7.4"	112	4.07 bushels	0.39 bushels	28.6
Chestnut Oak	50 yrs	8.3"	125	1.20 bushels	0.08 bushels	
Overall Avg.	50 yrs	8.3"	122.3	2.86 bushels	0.22 bushels	
DICKENSON COUNTY SURVEY DATA						
Oak-Hickory	45 yrs	9.1"	85	4.47 bushels	0.57 bushels	
Yellow Poplar-Hemlock-Beech	45 yrs	9.6"	59	17,182 Beech Burs[4]	3,630 Beech Burs[4]	11.4
Overall Avg.	45 yrs	9.35"	72	4.47 bushels 17,182 Beech Burs[4]	0.57 bushels 3,630 Beech Burs[4]	

[1]Note variation in cover types
[2]Based on trees over 3" dbh
[3]Toumey, J. W. and C. F. Korstian (1949: 160-163) Conversion factors for mast numbers to pounds and pounds to bushels of mast.
[4]No conversion factor found for beech burs to bushels

Results of Survey

No great difference exists between the two areas with the exception of the difference in average number of trees per acre and variation in type classification. The average number of trees per acre is slightly greater in the Big Levels area which has a very poor, sandy, shallow soil. The soil on the Isom tract is somewhat richer and deeper and appears to result in a better and faster tree growth with fewer trees per acre.

Although there were no great differences between the areas, a number of slight variations were noted. Pine is relatively scarce on the Isom tract and common on the Big Levels tract. However, the paucity of pine-roosting cover in the Isom tract is offset by the presence of sufficient hemlock to meet the turkey requirements.

The results of the mast count indicate that the Big Levels area has a slightly higher quantity of oak mast available per acre than the Isom tract. The beech nuts which occured in the quadrats on the Isom tract, though important, cannot be given too much weight in range evaluation because they vary in availability from year to year. Local residents advised the writer that the beech-nut crop produced during 1954 was the best observed in Dickenson County for several years.

With respect to clearings which may be used by the wild turkeys, there are more in the Big Levels area. Clearings available on the Isom tract are scattered mountain farms,

while those available on the Big Levels tract are clearings specifically created to improve wildlife habitat.

The writer believes that there are no important natural differences between these two ranges which should affect turkey survival in the Isom area. However, restocking success in this area may be affected by stray dogs and poachers. These two factors were reported as important by competent local observers. It is not believed, however, that the dog population will affect wild turkeys seriously although they are a serious menace to captivity-reared turkeys in propagation pens. The poaching is of course extremely important to both wild and captivity-reared turkeys and can be offset by good public relations work.

SUMMARY AND CONCLUSIONS

This investigation of the methods of restocking unoccupied wild turkey habitat in Virginia was conducted primarily to determine the success or failure of the propagation pen program during the 1954 breeding season and to compare the success of this type of restocking with restocking programs of other states using wild-trapped turkeys. The data summarized in this report were obtained from: (1) a questionnaire sent to all 48 states to determine the status of their wild turkey restoration program; (2) the Virginia Weekly Propagation Pen Reports; (3) a comparison between the clutch sizes, hatching percentages, and September brood sizes of captivity-reared hens and wild hens in Virginia; and (4) a survey of occupied turkey range and unoccupied potential turkey range in the mountainous regions of western Virginia.

Data obtained from the 1954 nation-wide wild turkey restoration questionnaire indicate that 38 states have used more than 122,000 turkeys in their restoration programs.

In 15 states satisfactory or better results were obtained where wild trapped turkeys were used for restocking. Sixteen states reported unsatisfactory results or failures where captivity-reared turkeys were used for restocking. Five states reported satisfactory or better results using both captivity-reared and wild trapped turkeys but did not differentiate as to the success of each. Three states report satisfactory or better results using only captivity-reared turkeys.

Of the 38 states which have used turkeys in their restoration programs, 20 of these states plan to use only wild trapped turkeys in the future. From this data it appears that wild trapped turkeys produce far better results in a restocking program than captivity-reared turkeys.

During the spring of 1954, breeding stock consisting of 214 turkeys was placed in 11 propagation pens in southwestern Virginia. The productivity of the nine pens from which adequate information was available ran from 281 percent for the Worleys Hope pen in Patrick County to 0 percent for the Peak Creek pen in Pulaski County. The survival percent (including the adults and their progeny) for all nine pens in 1954 was only 82 percent. In general, therefore, the 1954 propagation pen productivity was poor.

Records from 13 nests of captivity-reared turkeys in the propagation pens indicate an average clutch size of 16.5 eggs per nest (Sta. dev. 5.9 range 10-26 eggs). For the wild hen in Virginia, based on 34 nests, McDowell (1954) found the average clutch size to be 12.3 eggs (Sta. dev. 2.4, range 7-18 eggs). This difference in clutch size between the propagation pen turkeys and the wild turkeys may be the result of multiple nests in the propagation pen data or an inadequate sample of these nests.

A comparison of the hatch of the captivity-reared hen with that of the wild hen indicates that the wild hen has

a hatch of 93.0 percent (McDowell, 1954) while the captivity-reared hen has a 76.1 percent hatch.

A comparison of brood sizes of wild and captivity-reared hens during the month of September shows very little difference between the two. McDowell (1954) found that for the wild birds the average brood size in September was 8.5 (Sta. dev. 3.3, range 3-15) based on 53 broods. The writer's data, based on 13 broods produced by captivity-reared hens, indicate an average September brood size of 7.5 (Sta. dev. 3.6, range 1-14). A surviving September population, for all pens combined, of 175 (adults plus their progeny) was reported by the pen operators. This amounted to approximately 82 percent of the original stock.

The one factor which appears radically different between the wild and propagation pen turkeys is the "wildness" possessed by the native turkeys. It seems apparent that the wild birds can successfully survive wild conditions, but that the young and adults of the captivity-reared birds suffer critical losses under wild conditions. The writer feels that this factor is significant in contributing to the low measure of success in the Virginia propagation pen system. The pen reared birds are apparently unable to care adequately for themselves and consequently are lost to predators or other decimating factors.

A survey of the unoccupied and occupied turkey ranges indicates that no great natural differences exist in the

unoccupied range that would be detrimental to a turkey population. The factors examined in this survey included cover type, average age of the forest, average diameter, average number of trees per acre, average quantity of available mast per acre, and number of acres in clearings.

A problem of stray dogs and poaching exists in the unoccupied potential wild turkey habitat and may have some adverse effect on a turkey restoration program in southwest Virginia. However, it is believed that the lack of success achieved to date lies primarily in the "wildness" of the birds being used.

A small percentage of the turkeys produced by the captivity-reared hens in propagation pens may survive in the wild if conditions are favorable. Eventually, through a process of natural elimination, sufficient wildness may appear in these turkeys to enable them to perpetuate the stock. The writer does not believe that turkey restocking by the propagation pen method will be as successful in Virginia as restocking with transplanted native wild turkeys. At the present time the propagation pen method may be justified since it produces results which are equal to or better than direct releases of captivity-reared turkeys. At this time, Virginia has facilities for producing annually several thousand wild-mated turkeys for their restoration program. However, it is believed that the use of native wild trapped turkeys to rehabilitate the unoccupied wild turkey habitat in southwestern Virginia would

eliminate the need for the present expensive program of rearing turkeys in captivity. There is every reason to think that the use of wild trapped turkeys would produce more satisfactory results. Information obtained from other states indicates that excellent results have been attained in those restoration programs which utilize wild trapped stock.

Attempts to capture wild turkeys in Virginia with seven drop-door, manually operated traps have failed to produce results during the past two years (1953-1954). However, the writer believes that the Avertin drug technique described for capturing wild turkeys holds much promise in such a program. It is believed that the irrigating device described may be important in reducing or eliminating losses through overdoses of the drug. A side benefit which indicates another use for Avertin is its effect in keeping the extremely nervous wild turkeys in a placid condition during transportation.

RECOMMENDATIONS

Information presented by Richards (1954) and field observations by the writer indicate that all forms of wild turkey restocking which have been tried in Virginia up to this time have produced minimum results for the time and expense involved. The liberation of more than 14,000 wild turkeys during the period 1929 through 1954 has produced relatively insignificant results. The liberation of captivity-reared turkeys in occupied wild turkey range has seldom if ever produced demonstrable results and, on at least two occasions, appears to have introduced disease into the wild. For this reason, it is recommended that the liberation of captivity-reared wild turkeys in range now occupied by wild turkey be curtailed or eliminated. The propagation pen method of restocking unoccupied wild turkey range is not satisfactory but has produced results that compare favorably with other methods of wild turkey restocking which have been tried in Virginia. A survey of the wild turkey restocking program and accomplishments of all 48 states indicate that the only method of re-establishing wild turkeys which has consistently produced results elsewhere is by live trapping and transplanting native wild turkeys. Therefore, the principal recommendation made by the writer is that every effort be made to inaugurate a wild turkey live trapping-transplanting program in Virginia. Until such a program can be

initiated, it is recommended that the major efforts of the Virginia wild turkey restoration program be directed to Southwestern Virginia, using only the propagation pen technique.

The following recommendations, made in summary form, are believed important prerequisites to the sound administration of the wild turkey restoration program:

1. Assign a qualified employee of the Commission to the turkey restoration project who will assume full responsibility for all wild turkey work in Virginia. This would include the development of techniques using drugs and traps for a wild turkey capturing-transplanting program of sufficient magnitude to be effective, the supervision of the turkey propagation pen project, the tabulation of turkey productivity in various regions of Virginia, and any other related activities. It is recommended that use of Avertin drugged bait be given further trials.
2. Until such time as an effective wild turkey capturing and transplanting program can be initiated, continue the operation of all, or a selected number, of the 11 propagation pens now constructed and give these pens the best brood stock and most careful attention possible.

Should the propagation pen program be operated in the future, the following recommendations are offered:

1. Assuming that the game farm turkey production permits and that funds and personnel are adequate, all 11 propagation pens should be operated. If available turkeys are limited, or close surveillance cannot be given, it is recommended that only the five pens with the best results in the preceding year be operated. During 1954, these five pens were: Worleys Hope pen in Patrick County; High Knob in Wise County; Breaks #2 pen in Dickenson and Breaks #1 in Dickenson County; and Comer's Rock in Wythe County.
2. Assign one Commission employee the responsibility of supervising and securing adequate records from all pens.
3. Assign a game manager, or a local man operating under the supervision of the game manager, to each pen with written instructions in which operating the turkey pen is given priority over other activities.
4. Begin predator control operations in and around all pens to be operated as soon after January 1st as possible.
5. Deliver 20 hens and 2 gobblers, of the best available brood stock, to each operating pen not later than March 1st. Hold an adequate number of turkeys at

the game farm until May 1st for any pen that should lose a majority of their brood stock prior to this date.

6. Turkey Layena should be delivered in 200 pound lots prior to the arrival of the turkeys on March 1st. As soon as the first poults have hatched, the feed should be switched from Layena to Growena. Poult feeders should be installed prior to the first hatch.
7. As a precaution against the spread of disease, all turkey feeding equipment should be moved at least once every two weeks and maintained on dry sites exposed to direct sunlight at least during part of the day.
8. Detailed daily records should be kept by the pen operator and a summary should be sent to the project supervisor at the end of each week.
9. All turkeys with poults should be permitted to leave the pen at will. No effort should be made to confine any hen with poults to the pen when they are capable of flying out of the enclosure.

LITERATURE CITED

Ambrosen, D. R. 1954. Personal correspondence to H. S. Mosby dated February 26, 1954. Filed at the Va. Coop. Wildl. Res. Unit, Blacksburg, Va.

Anonymous. 1954. Wild turkeys trapped and transplanted as sportsmen eye season. South Dakota Consv. Digest. 21(2) pp. 2, 3, 16. Pierre, S. D.

Bailey, W. 1954. Personal correspondence to H. S. Mosby dated August 5, 1954. Filed at Va. Coop. Wildl. Res. Unit, Blacksburg, Va.

Baldwin, W. P. 1954. An island population of wild turkeys. Unpub. Ms., Fish and Wildl. Service, Regional Office, Atlanta, Ga.

Boyer, S. P. No Date. The wild turkey - a survey. Pub. by the Wild Turkey Conservation Association, Johnstown, Pa.

Burger, G. V. 1954. The status of introduced wild turkeys in California. Calif. Fish and Game, 40(2) pp. 137-138. Sacramento, Calif.

Handley, C. O. 1938. Recent progress in wild turkey propagation in Virginia. 3rd N.A. Wildl. Conf. Trans., pp. 847-851, Wash., D.C.

Hoody, F. C. 1953. Personal correspondence to H. S. Mosby dated October 29, 1953. Filed at Va. Coop. Wildl. Res. Unit, Blacksburg, Va.

Latham, R. M. 1941. The history of the wild turkey in Pennsylvania. Pa. Game News, 12(9) pp. 6-7, 32, Harrisburg, Pa.

Leopold, A. S. 1944. The nature of heritable wildness in turkeys. The Condor, 46(4) pp. 133-197.

Ligon, J. S. 1943. Mountain turkeys in Wyoming. Wyo. Wildl., 8(10), pp. 1, 14-16. Cheyenne, Wyo.

McDowell, R. D. 1954. Productivity of the wild turkey in Virginia. Unpub. Ph.D. thesis, V.P.I., Blacksburg, Va.

Mosby, H. S. and C. O. Handley. 1943. The wild turkey in Virginia: its status, life history and management. Comm. of Game and Inland Fisheries, Richmond, Va.

Mosby, H. S. 1949. The present status and the future outlook of the eastern and Florida wild turkeys. Trans. 14th N.A. Wildl. Conf., pp. 346-354.

Newman, C. C. 1945. Turkey restocking efforts in east Texas. Jour. Wildl. Mngt., 9(4) pp. 279-289.

Richards, C. E. 1954. An evaluation of the wild turkey restoration program in western Virginia. Unpub. M.S. thesis, V.P.I., Blacksburg, Va.

Schorger, A. W. 1942. The wild turkey in early Wisconsin. The Wilson Bulletin, 54(3) pp. 173-182.

Stanberry, F. W. and L. Gainey. 1953. Peace river turkey restoration. Florida Wildl., 7(5) pp. 32-33, 39.

Toumey, J. W. and C. F. Korstain. 1949. Seeding and planting in the practice of forestry. John Wiley and Sons, Inc., N. Y.

Walker, E. A. 1949. Status of the wild turkey west of the Mississippi River. Trans. 14th N. A. Wildl. Conf., pp. 336-345.

Wight, H. W. 1953. A suggested method of capturing birds with a narcosis-producing drug. Publication of Missouri Conserv. Comm.

Womble, H. M. 1954. Personal correspondence to H. S. Mosby dated March 5, 1954. Filed at Va. Coop. Wildl. Res. Unit, Blacksburg, Virginia.

Zimmer, J. T. 1924. The wild turkey. Zool. Leaflet #6, Field Museum of Natural History, Chicago, Ill. 15 pp.

The vita has been removed from the scanned document

APPENDIX

Virginia Cooperative Wildlife Research Unit
Va. Polytechnic Institute
Blacksburg, Virginia

Feb. 1954

State_____

WILD TURKEY RESTOCKING EVALUATION

Information supplied by:

_____

Has your state undertaken the restocking of wild turkeys?

Title:_____

_____Yes _____No

If the answer to the above is YES, please check the most appropriate answer or answers to the following:

1. The species of turkey which has been used in our restocking program is:
   _____Eastern _____Rio Grande _____Merriam's _____Florida
2. The source of turkeys for our restocking program has been from:
   _____Wild-trapped turkeys _____Pen-reared turkeys
3. The source of our turkeys has been:
   _____Wild-trapped in state _____Wild-trapped out-of-state
   _____Pen-reared by state _____Purchased commercially
4. Approximate number of years restocking program has been undertaken:
   _____years.
5. The restocking program is carried out in
   _____Occupied native wild range
   _____Unoccupied but potential wild turkey range
6. Release sites utilized in our restocking program are chosen
   _____by game biologist
   _____by public demand
   _____both by demand and by biologist
7. Results of the restocking program are considered to be
   _____Excellent _____Satisfactory
   _____Moderate only _____Unsatisfactory
   _____Complete failure
8. The present plan is to continue the turkey restocking program:
   _____Yes _____No
   (If answer is yes), it is the present plan to utilize:
   _____Wild-trapped stock
   _____Pen-reared stock
   _____Both wild-trapped and pen-reared
9. Approximate total number utilized in the entire wild turkey restocking program to date is_____turkeys.
10. Our restocking program has been undertaken for approximately_____years. (If discontinued), program terminated in 19_____.

Appendix Figure 1A. Questionnaire sent to each of the 48 states to determine the status of the wild turkey restocking program

NAME OF PEN_____

WEEKLY WILD TURKEY PROPAGATION PEN REPORT

Dates covered by this report - from_____195__through_____195__

PROPAGATION PEN SUMMARY FOR THIS REPORTING PERIOD:

1. Known hens in pen_____ Known gobblers in pen_____ Date of count_____
2) Known total of all eggs in pen_____Date of count_____
2) Known total of all nests in pen_____Date of count_____
3. Known poults in pen_____Date of count_____
(Give details of the above summary report in the sections below)

1. REPORT OF LOSSES OF ADULT TURKEYS DURING REPORTING PERIOD:

Hens lost during period_____; gobblers lost during period_____Total____
Causes of losses: dog, predator, unknown and other_____
(Encircle any known causes of losses)

2. REPORT OF LOSSES OF EGGS AND NESTS DURING REPORTING PERIOD:PLUS NEW EGGS, NESTS:

Number of nests previously reported_____Number of known eggs_____

Number of new nests during period_____Number of known eggs_____

Number of nests lost during period_____Number of known eggs_____

Total existing nests to date_____Total eggs in nests_____
(List causes of losses of both nests and eggs in REMARKS below)

3. REPORT OF NEW POULTS HATCHED AND POULTS LOST DURING PERIOD:

Total of all poults reported previously.....____

Total of new poults hatched during period.....____

Total loss of poults during this reporting period.....____

Total number poults present at end of this reporting period.____
(List causes of losses of poults in REMARKS below)

REPORT OF PREDATORS KILLED DURING THIS PERIOD:_____

REMARKS (include causes of losses of eggs, nests, poults or adult turkeys):_____

(Use reverse side of this page if necessary)

Appendix Figure 2A. Weekly wild turkey propagation pen report