

A FINAL REPORT ON TENNESSEE'S EFFORTS TO INTRODUCE PHEASANTS¹

by

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INTRODUCTION

Prior to 1960 several thousand exotic game birds were reared and released in Tennessee. These included the Ringneck Pheasant *Phasianus colchicus torquatus*, Coturnix Quail *Coturnix coturnix*, and Chukar Partridge *Alectoris graeca*.

Since 1960 the state has been involved in a systematic program to introduce some exotic upland game bird. These efforts have been coordinated with the Foreign Game Bird Investigation Program.

It is the purpose of this paper to report on the pheasant introduction portion of the project since 1960.

ACKNOWLEDGEMENTS

This study has resulted from the combined efforts of many people. However, special recognition should be given to Mr. Joe Hardy who was project leader from 1961 to 1967. Mr. Hardy is quoted liberally throughout the paper and much of the earlier data were collected under his direction.

In addition, special thanks is given to all the district biologists who have assisted with releases, call counts, flush counts, and other inventory work. Included in this list are Bill Yambert, Don Orr, Dick Hurd, Larry Safley, Elmore Price, and Tom Grelen. Also thanks are extended to Mr. Willie Taylor for his cooperation on the Old Hickory Area.

Special thanks are extended to the game farm personnel, who have not only raised the birds but have assisted in many other aspects of the program.

Appreciation is also expressed to Dr. Gardiner Bump for his advice on propagation and selection of release areas.

It should also be noted that much of the data from the Old Hickory release area were collected by Mr. Eric Easterly during the course of his graduate studies on the area. These studies were a result of a cooperative agreement between the Tennessee Game and Fish Commission and Tennessee Technological University.

Lastly, appreciation is expressed to Mrs. Dale Green for typing the paper and to Dr. Ralph Demick, Gary Henry, and Richard Conley for reviewing the original manuscript.

Objectives

Hardy (1963b) stated that the overall objective of the program was to investigate the potential of different species and hybrids of foreign upland game birds as to their ability to survive and reproduce on land in Tennessee that no longer maintains native populations in numbers sufficient to provide good hunting. This concept of matching the bird to the present land use patterns, no doubt, grew out of the futile effort of most state game and fish agencies to improve upland game bird habitat on a state-wide basis. Madson (1962) pointed out that it may be possible to locate or produce a pheasant which will thrive in the south. Bump (1961) in explaining the program, stated that it is based on requests for assistance from state game and fish commissions following an ecological appraisal of their game-deficient habitats.

¹This report is based upon research conducted under P-R Project W-36-R

PROCEDURES

Propagation and Release

Brood stock for the Eastern Iranian Blackneck *Phasianus colchicus persicus*¹ and the Western Iranian Blackneck *Phasianus colchicus talischensis*² was obtained from the Foreign Game Bird Investigation Program. The Ringneck *Phasianus colchicus torquatus* brood stock originated from twenty-five wild-trapped birds obtained from the California Department of Fish and Game. According to correspondence on record, these birds were wild-trapped in the Sacramento Valley.

Propagation techniques have been based upon those described by Hart (1947). Through the years many modifications have been made but generally speaking these standard game farm procedures have been followed.

In the early portion of this program, very little effort was made to condition the birds for release. According to biologists associated with early releases, some birds were so poorly conditioned to wild circumstances that they made little effort to even fly after they were released. After 1962, when the propagation program was put under the auspices of a full time biologist, conditioning pens were constructed. Two to three weeks before the 8 to 9 week old birds were liberated, they were placed in 100 x 24 foot wire covered pens. Some natural feed was present in the pen and cover was either planted or natural cover permitted to grow. This allowed the birds to become accustomed to limited flight and conditioned to scratching for food. At eleven to thirteen weeks of age the birds were released. Although some other states have used a gentle release system extensively, none of the *Phasianus* group were gentle released in Tennessee until the last liberation of the Ringneck x Talisch. Ellis and Anderson (1963) reported that in southern Illinois survival was not markedly influenced by the releasing method employed. However, it would appear that a gentle release pen as described by Chambers (1967), would be superior to direct release if for no other reason than to give the birds a chance to recuperate from handling. There are other advantages of a gentle release system that are discussed at length by Chambers. Our only experience with gentle releasing of the *Phasianus* group involved the last release of the Ringneck x Talisch hybrid. Approximately 1,000 of a 2,000 bird release were released using two 60 x 24 gentle release pens throughout the summer of 1969. We do not have any statistically valid evidence that the technique increased survival in the field, but the spring following the fall gentle release, we recorded the highest call count ever recorded in Tennessee (5.7 calls per station).

In the early years of the program, releases varied a great deal both as to number of birds liberated and the number of years releasing continued. However, after 1961 the idea of mass releases for at least three consecutive years was pretty well adhered to. Both fall and spring releases have been made but the vast majority were made in the late summer and fall. Attempts at sexing young birds and disposing of some young cocks have been made. However, a 1:1 sex ratio was characteristic of most releases.

Releases into one area have varied in size from as few as 496 birds up to 5,000 birds. The number liberated varied according to the size of a particular hatch at the game farm.

The general procedure prior to release involved trapping the birds in one end of the flight pen. They were driven into the trap, caught by hand, tagged, crated, and hauled to the release area. The hauling took place at night and the birds were directly released early the following morning.

Prior to 1961 the selection of study areas was determined solely by district biologists. However, after 1961 they were selected and evaluated by the project leader and the district biologist concerned. Information was collected on

¹Phasianus colchicus persicus is referred to as Persian Pheasant in this paper.

²Phasianus colchicus talischensis is referred to as a Talisch Pheasant in this paper

land use practices, topography, soils, climate, and expected landowner cooperation. Due to the large number of release areas involved and the similarity of the areas, the full descriptions of some are being omitted. But if an area has shown some promise concerning establishment of a population or if a detailed description seems pertinent, it will be included.

Evaluation Techniques

Since 1960 pheasants have been liberated in twenty-four counties in Tennessee. These sites represent what appears to be the best potential pheasant habitat in the state. Follow up has presented problems throughout the program. In most cases district biologists have collected evaluation data. In some instances very good follow-up work was done, but due to the large number of areas and personnel involved, it was inevitable that some releases would not be followed up as intensively as others.

There have been five different approaches to evaluation (1) spring call counts, (2) flush counts, (3) land owner interviews, (4) brood counts, (5) nest counts.

The spring crow counts have been used most extensively. These data are included in Table 1. Land owner interviews are difficult to interpret quantitatively and serve only to give some general idea of population status. Flush counts are valuable in that they complement other inventory procedures. Brood and nest counts are important as indicators of reproductive efforts of the birds. However, brood data are insufficient to use as an indication of establishment.

Call Counts: In 1962 all areas that were considered to be active pheasant release areas were assigned permanent spring crow count routes and district biologists were given the responsibility of running them in most instances. The data resulting from these counts probably give the most accurate indication of population status. Hardy (1963a) outlines in detail the procedure used to conduct the counts.

Flush Counts: Due to the time and effort involved, flush counts have not been used so extensively. However, on areas where a more comprehensive population inventory was desired, flush counts have been used. The procedure is described by Hardy (1963a).

Land Owner Interviews: These interviews were carried out on most of the areas. The data collected in this manner provide little more than leads as to areas of concentration.

Brood Counts: There have been no systematic attempts to gather brood data on all areas. However, enough valid brood data have been collected to be significant concerning brood size, etc. Average brood size observed will be discussed later in the paper under mortality factors.

Nest Counts: There have been many nests reported by farmers and sportsmen throughout the study. These were found incidental to other activities in most cases and have yielded little data. Only one real concentrated effort to hunt for nests has been carried out. This was done in connection with Easterly's graduate studies on the Old Hickory area during the spring of 1968 and 1969.

RESULTS

Over forty-eight thousand pheasants have been liberated within the state since 1960 (Table II). Seventeen of the twenty-four areas have shown enough birds and reproduction to warrant follow up.

The most recent introduction was made in Tipton County and will be handled in more detail later. Greene County and Old Hickory areas have maintained straggling populations for eight and twelve years respectively and will also be discussed in detail later in the paper.

TABLE I
SPRING CALL (CROW) COUNTS

Release Area (County)	Species	Last Year Released	Total Number Birds Released	Average Calls					Number Stations			
				'63	'64	'65	'66	'67		'68	'69	'70
DeKalb	Ringneck	1967	4,187	-	2.5	3.6	4.8	2.7	3.7	1.1	1.0	15
	Ringneck x Talisch											
Monroe	Ringneck	1961	1,792	3.1	3.5	1.4	0.5	0.1	0.1	0.4	-	-
	Ringneck-Persian F2											
Meigs	Persian	1965	2,469	-	-	0.0	0.5	0.1	0.0	-	-	12
	Ringneck x Persian											
Greene	Ringneck-Persian F2	1962	1,899	2.6	1.6	1.7	1.9	1.2	1.2	1.9	0.9	15
	Ringneck x Ringneck-Persian											
Sequatchie	Ringneck x Ringneck-Talisch	1962	961	1.5	2.1	0.6	0.3	0.2	0.0	-	-	11
	Ringneck x Ringneck-Talisch											
Jefferson	Japanese Green	19y3	1,460	1.9	1.1	0.3	-	0.7	0.2	0.0	-	10
	Japanese Green											
Lauderdale	Talisch x Ringneck-Talisch	1963	1,248	0.3	0.8	0.7	0.4	-	-	-	-	15
	Talisch x Ringneck-Talisch											
Franklin*	Ringneck x Talisch	1965	4,511	0.3	1.1	2.5	1.2	1.3	0.3	0.7	-	15
	Ringneck-Persian F2											
Coffee	Ringneck x Talisch	1967	4,841	-	-	2.5	1.2	1.3	0.3	0.8	-	10
	Ringneck x Persian											
Chester**	Ringneck x Japanese Green	1964	3,061	2.2	2.1	2.9	2.9	-	0.3	-	-	15
	Ringneck x Japanese Green											
Henderson	Talisch	1969	1,519	-	-	0.0	0.0	-	0.1	0.2	-	-
	Talisch											
McNairy	Japanese Green	1966	496	-	0.5	0.7	0.3	0.6	-	-	-	12
	Japanese Green											
Dyer	Ringneck x Talisch	1969	5,161	-	-	-	-	3.0	3.2	1.2	5.7	15
	Ringneck x Talisch											
Tipton	Ringneck x Talisch	1969	2,417	-	-	-	-	-	-	0.1	0.4	-
	Ringneck x Talisch											
Haywood	Ringneck	1958	3,300	1.3	-	-	-	-	-	1.1	-	12
	Ringneck											

*One Area - AEDC

**Section of two counties

***Call counts incomplete (Old Hickory)

TABLE II
TOTAL NUMBER OF BIRDS RELEASED BY COUNTIES 1960-69

Release Area (County)	Species	Years Released	Number Released
Benton	Ringneck-Persian F2	1960	1,500
	Ringneck-Persian F2	1961	1,200
DeKalb	Ringneck	1960	500
	Ringneck x Talisch	1964	378
	Ringneck x Talisch	1965	1,192
	Ringneck x Talisch	1966	630
	Ringneck x Talisch	1967	1,487
Cumberland	Ringneck-Persian F2	1960	500
Johnson	Ringneck	1960	75
	Ringneck	1961	430
	Ringneck	1962	100
Madison	Ringneck	1960	750
Monroe	Ringneck	1960	68
	Ringneck-Persian F2	1960	924
	Ringneck-Persian F2	1961	800
Cheatham	Ringneck-Persian F2	1960	500
	Ringneck-Persian F2	1961	1,000
Meigs	Ringneck x Persian	1961	223
	Ringneck-Persian F2	1961	600
	Ringneck-Persian F2	1962	1,144
	Persian	1964	293
	Persian	1965	209
Greene	Ringneck x Ringneck-Persian	1962	1,899
Sequatchie	Ringneck x Ringneck-Talisch	1962	961
Jefferson	Japanese Green	1962	860
	Japanese Green	1963	600
Lauderdale	Talisch x Ringneck-Talisch	1962	648
	Talisch x Ringneck-Talisch	1963	600

Continued on following page

TABLE II, Continued

Release Area (County)	Species	Years Released	Number Released
Henry	Ringneck x Talisch	1961	573
	Ringneck x Talisch	1962	694
	Ringneck x Talisch	1963	350
Roane	Ringneck-Persian F2	1960	500
	Ringneck-Persian F2	1961	600
Coffee (AEDC)	Ringneck-Persian F2	1960	1,469
	Ringneck-Persian F2	1961	1,200
Franklin (AEDC)	Ringneck x Talisch	1963	717
	Ringneck x Talisch	1964	500
	Ringneck x Talisch	1965	625
Lawrence	Persian x Ringneck-Persian	1962	894
	Ringneck x Persian	1963	535
	Ringneck x Talisch	1964	539
	Ringneck x Talisch	1965	644
	Ringneck x Talisch	1966	742
	Ringneck x Talisch	1967	1,487
Chester	Ringneck x Japanese Green	1962	1,349
Henderson	Ringneck x Japanese Green	1963	1,236
	Ringneck x Japanese Green	1964	476
McNairy	Talisch	1965	191
	Talisch	1966	200
	Talisch	1967	453
	Talisch	1968	675
Dyer	Japanese Green	1964	250
	Japanese Green	1965	96
	Japanese Green	1966	150
Haywood	Ringneck x Talisch	1968	2,065
	Talisch	1969	352
Tipton	Ringneck x Talisch	1966	1,175
	Ringneck x Talisch	1967	1,571
	Ringneck x Talisch	1968	700
	Ringneck x Talisch	1969	1,715
Wilson	Ringneck	1957	2,300
	Ringneck	1958	1,000
Total Released			48,094

DeKalb County call counts recorded one call/station in the spring of 1970 (Table I). This indicates a significant number of birds being present. But a decline has been noted for two years and it is probably that this trend will not be reversed. Releasing was discontinued in 1967.

The remaining populations have all shown declines within two years after releasing was terminated and are considered failures.

There appears to be no correlation between the number of birds released and any tendency to become established (Tables I and II). However, there are enough unknown variables involved to prevent any concrete conclusions concerning this. Weather, quality of brood stock, method of release, or habitat conditions may over-ride any advantages that a mass release might have.

Tipton County Study Area

This was the last release of the project. In 1966 and 1967 the first Ringneck x Talisch Pheasants were liberated, via the direct release method, into Tipton County. Initial survival appeared good but a dramatic decline was observed in 1968 (3.2 calls/station to 1.2 calls/station). One more year of production of the Ringneck x Talisch hybrid had been planned for 1969. Consequently, it was decided to mass release the entire production into this area.

Description of Area: The study area encompasses a portion of the fertile flood plain of the Hatchie River in extreme West Tennessee. The bottom land is intensively farmed with major crops including soybeans, corn, and cotton. Some deterioration in habitat is experienced in the fall and winter due to fall plowing. However, judging from the presence of food and cover, it still appears that enough of both are available to provide good pheasant habitat.

Status: The releasing technique used has been described earlier in the paper under Procedures. It is significant that higher call counts were apparently achieved the spring following the gentle release. However, it would be emphasized that birds released on this area in 1966 and 1967 experienced a severe decline the first year after releasing terminated (Table I). In addition, it is important to note that this area does not contain any natural barriers that would limit dispersion to any extent. The only two areas that have maintained a population have natural barriers around an area of what appears to be good habitat.

Old Hickory Study Area

The release that produced this population was made prior to the inception of this program. However, since it was a forerunner of the present effort and because of the significance of the population still being present, it will be discussed in this report.

According to our records there were 2,300 Ringneck Pheasants released in the fall of 1957 and 1,000 in the fall of 1958. Since 1958 the area has held a straggling population with only one insignificant release of twenty-five Talisch cocks in 1962. The source of the Ringneck brood stock was the California Department of Game and Fish. The original stock consisted of twenty-five wild trapped birds from the Sacramento Valley. According to records on file they are predominantly Chinese Ringnecks *Phasianus colchicus torquatus* and may have a trace of Mongolian blood *Phasianus colchicus mongolicus*.

Description of Area: The release site is located in Wilson County in Middle Tennessee. A major portion of the occupied area is made up of an intensively managed waterfowl management area along the banks of the Old Hickory reservoir. This management area encompasses 3,500 acres and there are about 1,700 additional acres that make up the bottom land area that is inhabited by pheasants (Easterly per. comm.).

According to Soil Conservation Service records, soil associations in the area include Waynesboro on moderately steep to steep slopes, Lindside silty

clay and Huntington sandy loam on the gently sloping areas and other areas of Armour clay loam, Sequatchie sandy loam, and Captina silt loam are also found.

According to climatological data for the Nashville Weather Station, from 1965 to 1969, mean annual temperatures are 57.2 degrees F. to 59.2 degrees F.; mean annual rainfall is 45.66 inches. Average rainfall for April, May and June was 4.88, 4.60, and 3.21 inches respectively (U.S. Dept. of Commerce Weather Bureau - Local Climatological Data, 1965-69).

Estimates of the land use are presented in Table III. The 5,530 acre area offers more in the way of wildlife habitat than any of the surrounding area. In fact, much of the terrain around the managed area is made up of over-grazed pasture land, brush land, and second growth timber. It could best be described as a complete void of pheasant habitat.

During the 1969 growing season old fields, hay fields, and grains made up 53 percent of the study area and only 29 percent was in improved pasture. Grains account for 17 percent of the acreage involved (Easterly pers. comm.). Much of this is left standing or only partially harvested which would, of course, supply more food than this amount of land under normal agriculture practices.

Status: Unfortunately the population was not intensively monitored from the beginning. Judging from incomplete records, it appears that the characteristic decline occurred with only a few straggling birds left. In the late 1960's it became obvious that considerable numbers of birds were present and additional efforts were made to investigate their status. A new call count route was set up and area personnel were asked to record broods that were observed. In addition, winter flush counts were made. Call count data from the established routes are incomplete and are of little use.

Brood counts have been made by area personnel during the course of normal farming operations. In 1966, eight broods were observed and in 1967, nineteen broods were reported. In 1968 no brood report forms were sent out. In 1969 nine broods were observed. The average brood size for the thirty-six broods recorded was 4.9 chicks per brood (Table IV). There were never more than three men recording broods and in 1969 there were two men involved.

Flush counts were made in 1968 and 1969. Although these were not extensive counts, they covered enough of the area to give some idea of the population. The highest count was recorded in January 1969 when sixteen birds were flushed by two men and two dogs in 2 hrs., 45 min. of hunting (Table V).

Easterly (pers. comm.) estimated a spring breeding population of approximately 87 birds or one bird per 50 acres in the spring of 1970. He based his estimate upon the number of individual crowing cocks heard during the peak crowing period. The hen to cock ratio derived from previous winter flush counts was multiplied by the number of crowing cocks to determine the number of hens. Then the number of cocks was added to the number of hens for a total population estimate.

Flush counts made during the late winter of 1969-70 and observations of local people indicate that the 1970 spring population was the lowest in the last three years. Yet, the estimate of one bird per 50 acres is believed conservative.

In summarizing the status of the population, the best way to describe it is as a persistent straggling population. There undoubtedly have been years when the population density has increased. Yet it has never reached expansion levels where the birds could be termed as established.

The reasons for this population maintaining itself are not clear. However, there are some obvious factors which undoubtedly have had some effect.

- (1) The strip of bottom land inhabited offers an abundance of food and cover.
- (2) The surrounding terrain acts as a buffer thus preventing dispersion.
- (3) Some additional protection has been afforded due to the fact that they are located on a Wildlife Management Area.

- (4) This was an early release, being only two or three generations removed from the wild.

Greene County

From August to October of 1962, 1,899 pheasants were released in Greene County. These birds resulted from a Ringneck x Ringneck-Persian cross. The Ringneck brood stock was the same as that used on Old Hickory and the Persian brood stock was obtained from the Foreign Game Bird Introduction Program. In 1958, 500 Ringnecks were released within three miles of this study area. Therefore, it appeared that the bird was genetically very near to that of our straight Ringneck stock. However, in the spring of 1970, birds hatched from 1969 eggs collected in the wild in Greene County were penned and eggs from them incubated. These birds laid several days later than straight Ringnecks, and it took about a day longer to incubate them. Both of these characteristics are typical of *Phasianus colchicus persicus*. Therefore, it seems that this population very probably still contains some Persian blood.

Description of Area: The Greene County area is located in eastern Tennessee in the western part of Greene County along the Nolichucky River. The original area lies north of the river and is approximately two miles wide and five miles long. Pheasants now occupy 9,000 to 11,000 acres which constitutes most of the available habitat in the vicinity.

Hardy (1963c) describes the area by saying that both in general appearance and agriculture the area is more similar to productive pheasant range of the northern states than most other sections of Tennessee. Over 95 percent of the area is in agricultural use. Corn, the major crop, occupies about 40 percent of the area. A majority of this crop is harvested by mechanical pickers. Smaller portions are "hogged-off" and gathered by hand. Following the harvest, most of the corn land remains idle until spring plowing. Approximately 30 percent of the land is used for hay, small grains, truck crops, and tobacco. Clover and alfalfa are the main hay crops. Small grains are frequently grown, but generally are in relatively small acreages. Pasture, scattered woodland, and a few wasteland spots comprise the remaining 30 percent of the study area.

The topography of the study area is level to undulating. Elevation is 1,040 to 1,060 feet above sea level. Slopes range from 0 to 5 percent. The Congaree-Altavista soil association occupies the entire study area. The loams, which are chiefly alluvium are derived from granite, gneiss, and schist, are moderately high in fertility and well drained (Hardy 1963c). The soil is moderate to low in organic matter and is moderately acid, with a pH of 5.8 to 6.0 on unlimed areas. Medium to heavy fertilization is needed to maintain productivity, and fairly large amounts of lime are required to grow legumes and grasses. About one half of the study area is subject to overflow by the Nolichucky during extremely high water periods.

Mean annual precipitation as recorded from 1931 to 1955 is less than 44 inches with the greatest amount falling from November through March. The mean monthly rainfall for April, May and June is slightly less than 4 inches. Mean annual temperature of the study area is 58 to 60 degrees F. (Hardy 1963c).

Status: This population has been monitored since 1963 by spring call counts (Table I). These counts have indicated a consistent but straggling population for eight years. There was a decline in the count in the spring of 1970, but there is some evidence that illegal hunting was fairly widespread during the previous winter. This coupled with an apparent poor hatch year in 1969 has probably prompted the decline.

Brood counts have not been systematically recorded for the area. Yet, farmer interviews readily indicate that there has been a considerable amount of observed reproduction.

TABLE III
LAND USE ON OLD HICKORY AREA*

Categories	Acres	Per Cent
Pastures	1,564.0	29.33
Old Fields (Includes weed patches, grown-up pastures, and old crop fields)	1,392.0	26.11
Hay	473.8	8.89
Small Grain (Wheat and Oats)	342.0	6.42
Corn	292.8	5.49
Milo, Millet	203.6	3.82
Soybeans	93.2	1.75
Johnson Grass	50.0	.94
Not included in old fields		
Wooded Areas	874.0	16.40
Tobacco	45.1	.85
Totals	5,330.5	100.00

*Easterly pers. comm.

There have been fewer flush counts run on this area than Old Hickory, but generally they have been comparable. November 2, 1967, four hours of hunting by two men and three dogs yielded 15 birds (12 cocks, 1 hen, and 2 unknown). One short count run in February 1970 indicated a similar population (one hour and thirty minutes with two men and two gogs yielded 3 cocks and 1 hen).

There is much similarity between this population and the Old Hictory population. However, it appears that these birds have expanded the range occupied to a greater extent. This has been facilitated by more contiguous avenues of egress (adjoining creek bottoms, etc.) than are available to the Old Hickory population.

The reasons that these birds have remained are not clear. The release area is very similar to that of Old Hickory in that it is an area of apparently good habitat surrounded by poor habitat. It is possible that whatever factors are operating on the Old Hickory area are working on the Greene County area also.

Mortality Factors

Too little intensive study has been done to indicate what factors have prevented the establishment of pheasants in Tennessee. However, over a ten year period enough data have been collected to warrant some conjecture.

On occasion we have observed considerable mortality from predation after a large release. This can and has been reduced to a considerable extent by releasing a better quality bird. There have been other instances of predation noted on some of the older populations but its total effect is unknown.

TABLE IV
 BROODS OBSERVED ON OLD HICKORY STUDY AREA

	1966	1967	1968	1969	Total
No. Chicks/Brood	5.8 (8 broods)	4.9 (19 broods)	No Record	3.9 (7 broods)	4.9 (34 broods)
Number hens seen without broods	4	1	--	2	7

TABLE V
OLD HICKORY FLUSH COUNTS

Date	Area	No. Men	No. Dogs	Hours Hunted	Flushed		Flush Index (2)		
					Hens	Cocks		Unknown	Total
1/24/69	Weed Field Peninsula and Brown Bottom	2	2	2.6	6	10	-	16	1.16
4/12/69 ¹	Gun Club	2	3	3.0	5	3	2	10	.88
12/16/69	—	2	3	3.9	-	1	-	1	.05
Total		9.5		Total		27		Av. .70	
1/10/70	Brown Bottom Gun Club	4	0	2	0	2	-	2	.25
1/14/70	Jackson Bottom Gun Club	4	0	2	6	1	-	7	.88
1/15/70	McMillian Bottom	3	3	2.5	3	1	-	4	.27
1/27/70 ¹	Cairo Bend	3	3	4.5	4	3	-	7	.22
2/10/70	Spring Creek	2	1	3	1	1	-	2	.22
Total		25.3		Total		34		Av. .33	

(1) Run by Eric Easterly.
(2) $x = \frac{Y}{(a+b)c}$
 $a =$ Man-dog-hour flush index
 $b =$ No. of observers
 $c =$ No. of dogs
 $Y =$ Total number of birds flushed

$$X = \frac{Y}{(a+b)c}$$

Illegal hunting has exerted its effect. However, it is difficult to measure and there is not a single instance when the failure of a release can be determined to be from this cause. Generally it is easier to get cooperation from local people concerning exotics than on native species. The instances of illegal hunting that have been reported most frequently have come from the older release areas.

Dispersion is thought to be a factor preventing establishment of some species of exotic game birds including pheasants. Chambers (1967) reported that on his gentle release sites, he feels it is necessary to achieve a density of thirty hens per square mile for a spring breeding population. He has attempted to achieve these densities through an elaborate system of gentle release pens. Our only experience with the gentle release techniques has also achieved higher initial densities. However, if dispersal is a decimating factor, it is probable that it is only an indication that an environmental deficiency already exists. The first successful introduction in the United States was in 1881 in Oregon's Willamette Valley. It was comprised of only twenty-eight birds. In ten years they were abundant over an area forty miles wide and one hundred and eight miles long (Dale 1956). Certainly dispersion did not prevent this population from becoming established. Kimball (1956) states the high population of pheasants in the North-Central region was the result of introducing a few pheasants into suitable habitat where they multiplied rapidly.

Many people have felt that there must be some flaw in the reproductive process of pheasants in the Southeast, thus preventing establishment. Yetter (1950) found that exposure of eggs to high pre-incubation temperatures showed a decline in hatchability. He also observed that late pheasant nests at the southern limit of the pheasant range exhibited lower hatchability. However, Nelson (1964) observed many broods in Kentucky and concluded that based on brood size and limited nest studies that this portion of the reproductive cycle was normal. Yet attempts to introduce pheasants in Kentucky have failed. Nelson presented data on 526 broods from all of his areas. The brood size for all age classes were as high as those reported in good pheasant ranges. In most cases it was higher (Table VI).

Anderson (1964) carried out studies in Illinois south of the established pheasant range. His attempts to establish pheasants were not successful but his observed mean brood sizes appeared adequate. Fifty-two broods were observed in 1960 with a mean size of $7.4 + 0.4$ chicks/brood.

Brood data presented from Tennessee includes 91 broods. This does not represent the total observed reproductive effort by any means. These 91 broods are those that have been reported by Commission personnel and are considered valid observations. There have been hundreds of broods reported by farmers and sportsmen; but generally these have not been included. The mean brood size for the 91 broods was $5.4 + 2.14$, at the 95 percent level of probability (Table IV). It is noteworthy that the mean is somewhat lower than that of other states and there is extreme variability in brood size. It should be pointed out however, that these data have been collected from an atypical situation and they should be viewed with that in mind. In addition the data were collected over a seven year period which would probably increase the variability.

Anderson (1964) concluded that it appeared that the factors limiting the southward expansion of the pheasant were more concerned with survival rather than with reproduction. He further pointed out that there were indications of excessive hen mortality.

Although our studies have not been intensive enough to determine this, there has been some evidence that this situation has occurred in Tennessee. Flush counts have always shown a high cock to hen ratio. From 1964 until the present, 412.0 man-dog-hours were spent making flush counts; the cock to hen ratio has been 164 cocks to 108 hens. Behavior differences or ease in observation of cocks may account for some difference in observed birds but the

TABLE VI
BROODS OBSERVED ON VARIOUS AREAS IN TENNESSEE 1964 TO 1969

	Downy	¼ Grown (3 weeks)	½ Grown (6 weeks)	¾ Grown (9 weeks)
Mean Number Chicks/Brood	6.3 (6 broods)	5.7 (11 broods)	6.2 (29 broods)	4.8 (36 broods)
Mean chicks/brood for 91 broods: 5.4/brood Standard deviation: 3.38 CL (p. .05) +2.14				
MEAN BROOD SIZES FROM OTHER AREAS				
	Downy	¼ Grown (3 weeks)	½ Grown (6 weeks)	¾ Grown (9 weeks)
Kentucky - Nelson 1964 (526 broods)	9.0	8.0	8.0	6.9
Pelee Island - Stokes, 1948 (412 broods)	8.7	6.1	6.6	5.7
Iowa - Kosicky 1951 (81 broods)	7.0	7.1	6.7	5.6

*Size of chicks was not recorded on 11 broods.

data does suggest excessive hen mortality. Approximately 107 man-dog-hours run on Old Hickory in the spring of 1970 indicated a heavy hen to cock ratio. These are the only counts which have indicated such a ratio on this area or any other. There was considerable circumstantial evidence that illegal hunting during the fall of 1969 had altered this population in favor of hens.

Another mortality factor which probably has had an effect is the disadvantage that artificial propagation imposes upon the bird being released. The problem encountered with artificially propagated birds is maintaining that quality of wildness which is necessary for the birds survival. Some of the wild qualities appear to be lost as a result of raising the bird in a captive environment. Some researchers seem to think that wildness is inherited and have presented convincing evidence to support this (Leopold 1944), while others feel that it is conditioned. Based upon personal observation, I seriously doubt that conditioning during the latter stage of the bird's development has much effect upon wildness. However, it is obvious that birds raised on wire and without cover, where there is no necessity for seeking escape cover, or food, are at an even greater disadvantage than those that are conditioned two or three weeks prior to release. If conditioning does have an effect, it seems probable that the behavioral development prior to being placed in flight pens is as important as that period during the latter stages of development. This idea is supported by other biologists who have investigated pen reared releases of exotics (Smith 1968). It is logical to assume, based on observation and work with different species, that wildness is a result of a combination of inheritance and conditioning, and that conditioning or imprinting during the first few days of a bird's life may be more important than during latter stages of development. However, the degree to which inheritance or conditioning influences the behavior depends to a large extent upon the species in question. Junglefowl *Gallus gallus* has been reported by Beebe (1931) to be domesticatable in one generation. Madson (1962) feels that the Ringneck Pheasant can never be completely domesticated. The almost universal experience with pen reared wild turkey suggested that they become too domesticated to survive successfully in the wild after only one or two generations in captivity. It is interesting to note that the areas in Tennessee which have shown the most persistent pheasant population have been those areas which received birds during the early years of the program. These birds were only two or three generations removed from the wild, and undoubtedly were genetically a wilder bird. There is no doubt that conditioning of the birds was improved as the program progressed, but none of these later releases have shown any indication of establishment.

Cost

Due to the fact that exotic programs are common to many states and are generally controversial, the approximate cost of this program is being included. Based on actual known cost of production the 48,094 pheasants released during this study cost approximately \$3.00 per bird or a total cost of \$144,590.00. The salaries of biologists involved in selecting release sites, releasing, and doing follow up work is difficult to estimate. Certainly \$30,000.00 would be a conservative figure for this portion of the project. This would amount to a cost of \$174,590.00 for the pheasant introduction program since 1960.

DISCUSSION

This project has been a systematic approach to exotic introductions. The philosophy has been to release large numbers of quality birds in a variety of locations and soil types in Tennessee. It should be recognized that the pheasant introduction program was not just looking for a pheasant adapted to conditions in the Southeast but also trying to mold a bird to fit the environment through hybridization and mass releases.

This has been termed as a gene pool concept (Anderson 1964). The gene pool resulting from large numbers of hybrids and strains being released into an area was thought to increase the chances of a bird being produced through natural selection that would reproduce and survive under prevailing conditions. In view of the lack of success of this approach in Tennessee, it appears that at our present state of knowledge it is not feasible.

It is not clear what factors have caused the Old Hickory and Greene County populations to persist. However, it seems logical to assume that selection is taking place within these populations on a very realistic basis with each succeeding year. In view of this, it may be that in these two cases a bird more adapted to Tennessee conditions is being evolved.

Probably the two most glaring weaknesses in exotic programs in general are that we are unable to measure those factors in the environment which are important to the bird's survival. Consequently, by necessity this program has attempted pheasant introduction on a trial and error basis. Secondly, we have depended upon game farm production far too much. The poor results obtained by stocking pen reared native birds should point up the risk involved in using this technique to introduce exotics.

It may be that radical methods of artificial propagation could be developed that would enable the technique to be used in an exotic introduction program, particularly with some species. Also, as we become more proficient in measuring the factors in the environment which limit distribution of game birds, exotic introduction programs may become more practical, but present methods and approaches have produced a considerable number of failures and few successes.

LITERATURE CITED

- Anderson, William L. 1964. Survival and reproduction of pheasants released in southern Illinois. *J. Wildl. Mgmt.* 28(2):255-263.
- Beebe, C. W. 1931. Pheasants, their lives and homes. Doubleday, Doran and Co., Garden City, N. Y. Vol. 1, pp. 196-251.
- Bump, Gardiner. 1961. Red junglefowl and kalij pheasants. U. S. Fish and Wildl. Serv., Special Scientific Report—Wildl. No. 62. Washington, D. C.
- Chambers, Glenn D. 1967. A study of comparative success of establishment of experimental pheasants following release. Missouri Federal Aid Report No. 13-R-21. Columbia, Mo. 23 pp. (unpubl.)
- Dale, Fred H. 1956. Pheasants and pheasant populations. (in Allen, Durward L., Pheasants in North America.) *Wildl. Mgmt. Inst.*, Washington, D. C. pp. 1-42.
- Ellis, Jack A. and Wm. L. Anderson. 1963. Attempts to establish pheasants in southern Illinois. *J. Wildl. Mgmt.* 27(2):225-239.
- Hardy, Joe W. 1963a. Various techniques of evaluating exotic game bird releases. Proc. 17th annu. conf. S. E. Association Game and Fish Commissioners. (17): 108-111.
- . 1963b. A preliminary report of recent foreign game bird introduction studies in Tennessee. *Tenn. Academy of Science.* 9 pp.
- . 1963c. Experimental game bird project. Federal Aid Report No. W-36-R. Nashville, Tenn. 33 pp. (unpubl.)
- Hart, Dennis and T. R. Mitchell. 1947. Quail and pheasant propagation. *Wildl. Mgmt. Inst.*, Washington, D. C. 72 pp.
- Kimball, James W., E. L. Kozicky, and B. A. Nelson. 1956. Pheasants of the plains and prairies. (in Allen, Durward L. Pheasants in North America.) *Wildl. Mgmt. Inst.*, Washington, D. C. pp 205-263.

- Kozicky, Edward L. 1951. Juvenile ring-necked pheasant mortality and cover utilization in Iowa. 1951. Iowa State College Journal of Science. (26):85-93.
- Leopold, A. S. 1944. The nature of heritable wildness in turkeys. The Condor. 46(4):132-197.
- Madson, John. 1962. The ringneck pheasant. Conservation Dept., Olin Mathieson, East Alton, Illinois.
- Nelson, Lee K. 1964. A ten year study of ringnecked pheasant introductions in Kentucky. Kentucky Dept. of Fish and Wildl. Resources Technical Series No. 14. 153 pp.
- Smith, David M. 1968. An evaluation of Indian red junglefowl releases in Baldwin County, Alabama. Proc. 22nd annu. conf. S. E. Association Game and Fish Commissioners. (in press).
- Stokes, Allen W. 1948. Population studies of the ringneck pheasants on Pelee Island, Ontario. Ontario Dept. of Lands and Forest. Wildl. Series No. 4 154 pp.

WEIGHTS AND MEASUREMENTS OF GEORGIA COTTONTAILS AND AN ECOLOGICAL PRINCIPLE²

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ABSTRACT

Body weight and basic body measurements were recorded on 395 adult cottontails collected from three physiographic regions in Georgia. Eight different skull measurements were taken on 65 individuals.

Little variation was noted in the percentage change of paunched weights as compared to the animals' total body weight. No significant seasonal variations were noted in total body weight. Coastal Plain adults exhibited significantly greater hind foot length, ear length, total length, and body weight than Piedmont or Mountain rabbits. Six of eight Coastal Plain skull measurements were significantly greater than measurements from either Piedmont or Mountain cottontails. These data are in opposition to Bergmann's Rule which states that mammals in general increase in size as one proceeds northward.

Use of total body weight rather than paunched weight at any time of day or season was verified for cottontails in Georgia. General land use rather than basic soil fertility is suggested as having a greater influence on production of heavier, larger rabbits in the Coastal Plain as compared to Piedmont or Mountain regions of Georgia.

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