TELEMETRIC DETERMINATION OF MOVEMENTS AND BEHAVIOR OF RELEASED PHEASANTS

by

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TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

The state of Virginia has been attempting to establish a self-sustaining population of exotic game birds of the genus *Phasianus* since 1958. At present this program has had modest success in only a few areas of the state. Little research has been done on the results of these stocking attempts to determine the possible causes of difficulty in achieving established populations. This study was designed to gather information pertaining to a released group of game-farm reared pheasants, and to determine the causes for success, or failure, of the release.

Little is known about the movements of pheasants released into unoccupied habitat. The majority of pheasant movement data concerns releases made on shooting preserves in areas within the established pheasant range. Further, little work has been done concerning unexploited populations. Some questions which require answers include: Do the released birds remain near the release point or do they disperse? Do the released birds disperse indiscriminately or do they home? If not released into suitable habitat, will the birds attempt to locate an area better suited to their needs?

Knowledge of suitable habitat for released pheasants would prevent the wasting of stock on unacceptable areas and also would increase the chances of success on suitable areas by permitting a larger number to be released on these areas. If the birds disperse widely, more birds may be required to achieve establishment in a chosen area due to high egress losses. Depending on the degree of dispersal, the distance between release sites may need to be altered.

The objectives of this study were:

1. To determine the movement of game-farm reared black-necked x ring-necked pheasants (Phasianus colchicus talischensis x P. c. torquatus) following release in a farm habitat in Southwest Virginia.
2. To determine the type of farm habitat utilized by these released pheasants.
3. To determine the suitability of this cross-bred pheasant to Southwest Virginia coverts.

The pheasant group is known for its sporting qualities. The sulking characteristics which make it a desirable game species also make it difficult to study in the field. The bird is wary and is generally located in or near concealing cover. The birds hearing and eyesight are superior to man's. One characteristic, not generally noted in other game birds is the habit of attempting to walk or run from danger rather than "freezing." Most game birds are prone to freeze in their tracks when alarmed and then explode into flight if the danger approaches too close. The pheasant does sometimes react in this manner; however, the more likely pheasant reaction would be to walk or run and escape into deeper cover when danger approaches. With their acute hearing and eyesight the pheasant is likely to have fled or be concealed and undetectable in thick cover when an observer walks by.

In a field study of free-ranging animals the presence and interference of an observer can introduce a bias in the behavioral characteristics of the subject under study. In an attempt to minimize human disturbance of the pheasants, a number were equipped with biotelemetry transmitters. Biotelemetry is a means of gathering information pertaining to the animal from a distance that is great enough to eliminate the bias created by human presence.

The presence of a transmitter on the pheasant probably influences its behavior but it is felt that any changes caused are far less significant than those that would be caused by the disturbing presence of an observer. Both the quantity and quality of information on the movements and general behavior are greatly increased by telemetry over the usual field method using only direct observation.

There are four apparent advantages of marking pheasants with biotelemetry transmitters. The birds do not have to be observed as would be the case with wing streamers or neck tags. Information can be obtained at a distance and therefore human disturbance does not occur. Individual birds can be located more quickly and therefore more times during a tracking period. The birds do not have to be captured for identification as is the case with leg bands.

LITERATURE REVIEW

Introduction of the Pheasant in America

Foreign game birds have long been desired by hunters and game bird fanciers in North America. The first successful stocking of pheasants on this continent occurred in Oregon's Willamette Valley in 1881 when Judge Denny released 28 Chinese ring-necks (*Phasianus colchicus torquatus*) that had been trapped in Shaghai, China (Dale 1956:37; Lauckhart and McKean 1956:43; Acton et al. 1961:3). After ten years the results of this stocking had spread over an area 40 miles by 180 miles and had become so abundant that an open season was declared in 1891 (Dale ibid). Acton (ibid) reports that in 1888 the English, or common, pheasant (*P. c. colchicus*) was successfully introduced in New Jersey.

Studholme and Benson (1956:389) state, "While credit for the first known successful stocking of pheasants in North America belongs to Oregon, the first attempt was made in New York. The earliest known record for introduction of the pheasant in North America is contained in Chapter 601 of the Colonial Laws of New York, passed November 1, 1733 and entitled, 'An Act to preserve the breed of English Pheasants in This Colony.'" They continue by saying "The next record of introductions shows that Richard Backe, son-in-law of Benjamin Franklin, obtained English pheasants about 1790 for his estate near Beverly, New Jersey (Phillips 1928)."

Except for a few isolated instances Kimball (1956:204) states, "Most of the early introductions failed. Dispersion of small groups, poaching, poor habitat, and unfavorable weather have been cited as causes of failure. However, good populations now are established at many sites where early stocking did not succeed, and it is possible that other, little understood factors were involved."

Speaking of the ring-necked pheasant, Nelson (1964:4) writes, "... numerous organized and unorganized attempts have been made to establish this exotic in every state. Successful establishment has been attained, however, in roughly the northern half of the country. Although a number of theories have been formulated as to why this bird has not taken hold in sections south of the present range, no concrete evidence exists."

Possible Causes of Failure of Previous Stocking Attempts

Writing about pheasants in the north central states, Leopold (1931:125) advanced what is generally referred to as the "glaciation hypothesis" which postulated "that some plant growing on these soils, or some substance such as kind of lime or gravel, contained in them was necessary to the welfare and breeding vigor of exotics in this region." This led to the theory that pheasant distribution was limited by the availability of calcareous grit in the soil.

Studies at Patuxent Research Center in Maryland showed that pheasants given a normal diet but confined to granite grit failed to produce viable eggs while others on the same diet but with limestone grit laid eggs that hatched normally (Dale 1956:19). Harper (1963:366) states that distribution and abundance of pheasants may be limited by available calcium but cautioned "studies that attempt to measure only the amount of available calcium-bearing grit on an area can be misleading unless the ability of the pheasant to select calcium-rich grit during periods of growth and reproduction is considered."

Reporting on a study using penned pheasants, Chambers, et al, (1966:72) concluded "that hens with restricted calcium intake in the wild might be unable to produce enough eggs in a second nesting attempt to add significantly to the population, whereas those with adequate calcium intake could make significant second nesting attempts." In another study, Greeley (1962) found that when the percentage of calcium in the diet fell to 1.09%, and below, there occurred reductions in egg production rate, eggshell thickness, and amount of ash in leg bones of pheasants. He concluded that a diet containing approximately 2% calcium was best for pheasants.

Another factor which has been thought to limit the southern distribution of ring-necked pheasants is temperature (Hart et al. (1956:117). Graham and Hesterberg (1948) postulated that intense spring insolation was detrimental to exposed eggs during oviposition but added that this was probably not the only controlling factor in pheasant distribution.

Concerning temperature, Allen (1956:448) reported on the work of R.E. Yeatter.

> "In this connection the findings of Ralph E. Yeatter (1950) of the Illinois Natural History Survey are likely to have a place in the final assemblage of facts which explain the pheasant - distribution enigma. Yeatter observed that late pheasant nests at the southern limit of range in Illinois largely failed to hatch and contained partially developed embryos. This contrasted with the

ability of the bobwhite quail to nest successfully throughout almost all of the deep South.

"Accordingly, he set up a controlled experiment in which paired lots of pheasant and quail eggs were subjected to preincubation temperatures ranging from 62 degrees to 88 degrees Fahrenheit, from 8:00 a.m. to 5:00 p.m. for 7 days. The pheasant eggs showed a progressive decline in hatchability from 75 percent at the lowest temperature to 42.1 percent at the highest. In contrast, the hatchability of quail eggs declined from 76.2 percent to 68.4 per cent - a drop of only 7.8 percent.

"To compare the heat tolerance of midwestern and far-western birds, Yeatter obtained ringneck eggs from the California Division of Fish and Game, and with a comparable supply of Wisconsin pheasant eggs, exposed experimental hatches of both to pre-hatching temperatures from 62 degrees to 88 degrees Fahrenheit. He found that California eggs had a higher hatching success than Wisconsin eggs following exposure to high temperatures.

"This suggests that speciation - the steady, natural selection of birds most fit to survive, and the culling out of those least fit - is showing its effect under the extreme California conditions."

Cahn (1938:809) felt that the climograph could be used to investigate the acceptability of a given area to a given exotic. The climograph is a graphic presentation of temperature and relative humidity and is used to compare these two climatic factors between two areas, usually the proposed release area and the habitat in which the pheasants have been established.

McCabe et al. (1956:319) cites Charles and Elizabeth Schwartz's 1949 work which disclosed "pheasant range in Hawaii, where as much as 300 inches of rain falls annually." Thus annual rainfall extremes do not seem to be an important factor restricting pheasant establishment.

A third possible factor in limiting the southern distribution of ring-necked pheasants is evapotranspiration. McCabe et al. (1956:324), citing Thornthwaite's 1948 work, state, "The category Mesothermal B 1 with a potential evapotranspiration of 22.44 inches is an almost perfect correlation with the distribution of Lake States pheasants. This we consider to be more than just coincidence. How potential evapotranspiration affects the range is not known. There is no apparent correlation between the Mesothermal B 1 zone and soil, vegetation, or agricultural practices in the Lake States."

Francis (1968:45) states, "Selection of pheasant hens of cover type having favorable microclimate is probably an important factor in nesting success, and consequently in the ability of a pheasant population to maintain itself in a given area. The great differences in saturation deficits found among various cover types suggest that humidity conditions, affecting evaporation from eggs may be of greater importance than temperature per se. The availability of cover providing a favorable microclimate may be as important as the macroclimate in determining pheasant distribution."

Bennitt and Terrill (1940:429) state, "There is no apparent correlation between successful pheasant range and either zonal soil groups, climatic humidity, or seasonal distribution of moisture. Pheasants have established themselves on podzols, prairie soils, chernozems, and others in some places, not elsewhere. They occur on both humid and semiarid lands and upon lands with adequate or deficient moisture throughout the year. Moreover, there is no evident correlation between survival of the individual and atmospheric temperature as such.

Pheasants live and breed in captivity in the South; individual birds survive there, sometimes for years; in a few places they both survive and breed regularly."

Hart (1971a:4) states, "It appears that pheasant establishment is basically a matter of evolving locally adapted strains through natural selection."

Dale (1956:16) sums up the discussion on the pheasant distribution problem by stating, "Although there has been much speculation and some research on reasons for the spotty distribution of the pheasant in North America, no single explanation so far seems to give a complete answer to the problem."

Movements of Stocked Pheasants

One of the reasons frequently given for failure of pheasants to establish themselves in a newly stocked area is excessive dispersal. Bohl and Bump (1970:2) state, "Liberated birds tend to disperse widely. To discourage this, many are liberated by the gentle release method. Certain species, however, tend to disperse widely regardless of release techniques. These include...and the ring-necked pheasant group." Speaking about game farm pheasants released in Virginia, Hart (1971a:5) states, "..., excessive dispersal remains a common factor in initial stockings, continuing with lessening impetus into immediately following generations."

Working with wild-trapped pheasants in Pennsylvania, Hartman (1971: 12) reported, "The average distance travelled from the point of release by the transplanted pheasants was 1.3 miles." In an earlier study, Hartman et al. (1967:2) reported an average recovery distance of one mile or less for cocks, with a maximum distance travelled of 20 miles in 7 months for one cock.

Nelson (1964:16), working in Kentucky, found only 28 cases of long-range dispersal (i.e., greater than 5.5 miles) out of a total of 21,069 birds released. The maximum distance travelled was by a cock who moved 177 miles in seven months. Nine of the 28 were cocks and 19 were hens; 22 of the birds were found dead. Release sites used by Nelson were two miles apart, and by observing different colored neck tags, it was found that within several days after release it was not unusual to find birds from several release sites banded together.

In a New Jersey study of band returns from cock ring-necked pheasants, MacNamara and Kozicky (1949:293) states, "About 50 per cent of the pheasants were shot within one mile and 98 per cent within ten miles of their release point. The maximum drift was 23 miles by one bird." In a similar study in Indiana, Ginn (1947:229) found "...that 29.8 per cent were taken at distances from ¼ to 1 mile; 38.2 per cent from over 1 to 5 miles; and 20.9 per cent over 5 miles from the release point. Of those travelling over 5 miles, 46 travelled from over 5 to 10 miles; 18 from over 10 miles to 20 miles; and 4 travelled over 20 miles. In the last mentioned group, a hen travelled 24 miles and a cock 97 miles."

In an Illinois study (Anderson 1964:261) involving the recovery of 383 pheasants, the average distance dead birds were found from their release sites were approximately 0.7 mile. In Montana, Roby (1951:305) found 41.7% of the birds stocked moved less than one mile, 50% moved from 1 to 3 miles and 2.1% moved from 4 to 5 miles. The remaining 6.2% moved from 9 to 14 miles.

Hessler et al. (1970) found very little dispersal of pen-reared pheasants during the first 28 days after release, with most birds remaining within one quarter mile of the release sites. Their findings support Burger's (1964:719) work which concluded "...it seems apparent that the disappearance of released pheasants does not always signify egress, and that generalizations on their fate should not be made without thorough study."

Leopold et al. (1938:11) conducted a pheasant movement study in Wisconsin and concluded "Where food and cover were good and coverts of ample size (greater than 10 acres), there was no dispersion...Where food was good but coverts small and scattered, the released birds held well in some instances...Where food and cover were both poor, dispersion was immediate and complete."

George et al. (1968:12), studying wild-trapped pheasants released in suitable habitat in Pennsylvania found that the birds remained "relatively close" to release areas. Leg bands returned by hunters all were recovered within 2½ miles of the release site.

Effect of Release Method on Movements

Method of release has been thought to influence subsequent rate of dispersal of stocked pheasants. The "violent release" method (i.e., taking the birds from shipping crates and placing them in coverts) apparently frightens the birds and adds impetus to their dispersal.

The "gentle" and "supra-gentle release" methods allow the birds to first acclimatize to their surroundings before they are allowed to fly or walk from a holding pen. Thus the birds are not frightened before they reach the coverts.

Roby (1951:302) investigated the dispersal of both violent and gentle released pheasants in Montana. "The first week after release there was an average of 13.6 per cent of the violent and 20.3 per cent of the gently released birds observed on the areas daily. For the remaining weeks the percentages were as follows: second, 5.7 per cent violent, 7.7 per cent gentle; third, 6.4 per cent violent, 5.2 per cent gentle; fourth, 3 per cent violent, .9 per cent gentle; fifth, 2 per cent violent and .6 per cent gentle." This would indicate a slower initial rate of dispersal for gentle-released birds but after a few weeks the advantage would have vanished and both release methods appear to yield approximately the same result.

Ellis and Anderson's (1963:229) study concerning violent and gentle release methods support the findings of Roby. They state, "Survival was not markedly influenced by the method employed to release the birds into the wild."

Chambers (1969:4) reported on a Missouri study that first-year dispersal following the supra-gentle release of pheasants was as great as 5 miles from the release site.

Biotelemetry

Biotelemetry is a relatively recent method of studying animals which has resulted from the tremendous advances in transistors and miniaturized electronic circuits generated by space exploration. Electronic devices for biotelemetry work are available for all but the smallest vertebrate animals. The first free-ranging animals were tracked around 1962 (Brander and Cochran 1969:95)

"Telemetry is a technique for obtaining measurements at a distance which, when used on life systems, is usually termed biotelemetry" (Brander and Cochran 1969:95). Possibilities for the improved study of movements, social relationships, activities, and interspecific relationships of free-ranging birds and mammals are the result of development of biotelemetry systems (Verts 1963). The advantages of biotelemetry systems are also given by Marshall and Kupa (1963); Southern (1964); Craighead and Craighead (1965); and Sanderson (1966); among others.

On the other side of the ledger, Cochran (1967) states that the "reliability of even the simplest animal-borne transmitters is a serious problem." Other authors who have described difficulties which occurred with biotelemetry equipment are Ellis (1964); Sanderson (1966); Kuck et al. (1970); Marshall and Kupa (1963) Doebel (1967); Hessler et al. (1970); Southern (1964; 1970); Proud (1969).

Brander and Cochran (1969) list transmitter package weights for various birds and mammals. As a rule of thumb, package weights should not exceed 4% of body weight for birds, and 6% of body weight for mammals. These authors also cite from the literature numerous sources of circuits and physical transmitter designs. Most of these sources also give details for the construction of receiving systems.

LeMunyan et al. (1959) describe a low frequency, low range transmitter for surgical implantation on woodchucks (Marmota monax). The low frequency is more suitable for burrowing animals than high frequency. Craighead et al. (1963) discuss the use of biotelemetry in studying grizzly bear (Ursus arctos). Southern (1964; 1970) describes the use of biotelemetry in studying bald eagles (Haliaetus leucocephalus) and herring gulls (Larus argentatus). Williams et al. (1968) studied nesting wild turkeys in Florida using biotelemetry. Raybourne (1968) used biotelemetry to study wild turkey movement in Virginia as did Proud (1969) in New York.

Biotelemetry has been used to study raccoon (Procyon lotor) by Ellis (1964); ruffed grouse (Bonasa umbellus) by Marshall and Kupa (1963); pheasant (Phasianus colchicus) by Hessler et al. (1970) and Kuch et al. (1970); and striped skunk (Mephitis mephitis) by Verts (1963), among many other species of game and non-game wildlife.

Techniques used in obtaining a biotelemetry "fix" are described by Verts (1963). The use of the null instead of peaks is recommended by Cochran and Lord (1963) due to the increased accuracy of the null method. The activity of biotelemetry equipped animals can be determined by audible variations in the sound from the transmitters attached to the animals (Marshall and Kupa 1963).

Tagging

The dependence on aluminum leg bands for identifying individual mortalities is sometimes unsatisfactory. Ginn (1947:231) relates that in one study of pheasants only 11 bands were recovered from 40 known predations by fox. Labisky and Mann (1962) felt that monel-metal leg bands do not yeild satisfactory data.

Colored markers on pheasants have been used by several investigators as an aid in conducting field work. Craighead and Hornocker (1962:226), working with an unexploited population of game farm pheasants, some equipped with colored neck-markers, concluded that the neck-markers increased the size of the recovery sample and gave improved precision in obtaining data on natural mortality. Nelson (1964:40) found that using colored neck-tags on pheasants increased the percentage of identity of mortalities found from 34.5% to between 81.4 and 100%.

Labisky and Mann (1962) compared the durability of aluminum leg bands to plastic impregnated nylon back-tags and found that the back-tags were more durable than the leg bands. They also stated that yellow was the preferred color for back-tags. Nelson (1964:107) stated that light-colored tags were better than dark-colored tags, and he preferred solid white or yellow color.

Increased vulnerability to predation may result from the use of colored neck-tags. Taber (1949:280) states, "Predation upon marked birds has not been measured, but it seems reasonable to assume that they would be more vulnerable than unmarked." However, he continues by saying "...an intensive field study of pheasant behavior has revealed no differences between unmarked birds and those which have borne markers for four months or longer." Labisky and Mann (1962) postulated that back-tags may act either as "target areas" for avian predators or they may repel attacks. These investigators also found that over a 6 year period, involving 2,689 marked pheasants, only three were known to have died as a result of the back-tags. These birds entangled their back-tags in obstacles.

The relative permanance of back-tags was pointed out by Nelson (1955:415) when he stated "...97 per cent of the birds trapped from one to seven months after release were found to have retained the tags." In a later study, Nelson (1964:33) reported that a hen pheasant retained the back-tag for almost three years.

Game Farm Pheasants

A considerable difference of opinion exists among wildlife managers as to the value of game-farm reared pheasants. McCabe et al. (1956:342) state, "The state game farm, and the value of propagated birds, are points upon which there is no unanimity of opinion among sportsmen, administrators or technicians. It is obvious that without initial stocking, we would have had no pheasants."

Lauckhart and McKean (1956:45) credit Oregon with the "first large scale, state-operated game farm" for pheasants in this country which was established in 1911. Dale (1956:40) states, "The first-ranking pheasant state of the nation, South Dakota, achieved success without a game farm, and with relatively small releases. A few, such as Pennsylvania and Michigan, trace pheasant success from the establishment of game farms."

The game farm had its origin in the Old World. Allen (1956:435) states, "The rearing and stocking of pheasants has long been a way of life for many workers in this field. It came down to us from feudal England, where the game keeper was a prominent staff member on large estates. Labor was cheap and the fiscal side of game management got little consideration." Hart (1971b:18) states, "Because of the persisting wildness of Phasianus, game people from time immemorial have been able to farm these birds with great advantage to hunters."

Trippensee (1948:81), speaking of game-farm pheasants, said, "The release of artifically reared pheasants has been the most popular form of pheasant management practiced in the United States. Stocking is necessary on range where the birds are not yet established or where hunting depletes the breeding stock each season."

Kabat et al. (1955) give five objectives of the pheasant stocking program in Wisconsin. They are: 1. establish breeding populations 2. increase the populations 3. re-establish populations 4. increase the immediate hunting opportunity 5. sustain shootable populations.

He also gave figures for the cost of putting a game farm reared cock pheasant in the hunter's fall bag. If the birds are held until August the cost per male bird harvested was from $1.95 to $2.28. If the birds were released in March the cost per male bird harvested was from $7.37 to $11.38. In a later study in Pennsylvania, Hartman et al. (1967:62) stated "October and November releases of roosters gave a higher return than did spring and summer stockings. Most pre-season birds were bagged the first day of the season. The majority of the in-season releases were taken the day following liberation."

Acton et al. (1971:13) published figures for producing pheasants at game farms in Ohio. These costs do not include the cost of delivery or cost incurred at holding pens at the various districts. The cost of producing a day-old chick was 23½ to 29½ cents. A six-week old pheasant cost $1.25 to $1.57 whereas, a pheasant held for release during the fall hunting season cost $1.76 to $2.22.

The figures presented above show that although the costs entailed in holding a bird until fall are of course higher, the cost per bird harvested is much lower, due to the low rate of harvest for spring released birds.

Released birds which were not bagged during their first hunting season are seldom found in the bags for subsequent seasons. Burger (1964:715), working on a Wisconsin shooting preserve, found, "Less than 1 percent of the 2,714 pheasants not bagged in the season of their release were shot on the preserve in subsequent years.

The fact that few released pheasants survive to see a second hunting season is not surprising. Wild stock does not have a very long life span either. Leedy and Hicks (1945:67) state, that in Ohio, "The pheasant population, as a whole, is relatively youthful, birds a year or more of age, making up only 17 per cent of the male, and 32 per cent of the female, contingents, or 28.6 per cent of the total. The average life span, according to the information at our disposal, is 9.85 months for males and 20.83 months for females...In these statements we are considering only pheasants that attain at least 3 months of age, i.e., survive until October 1...Thus, average pheasant longevity, if based on total eggs laid, is only about one-fourth that indicated above, or, if based on total young hatched, the average pheasant longevity is only about 60 per cent of that indicated above."

McCabe et al. (1956:308), found that "About four-fifths of the pheasants must die from one cause or another during their first year - whether they are hunted or not."

Lauckhart and McKean (1956:78) concluded that, "...good game-farm birds survived almost as well as wild-trapped pheasants, when both groups were transferred to new habitat...It also should be noted that all of the wild pheasants in North America today can have their ancestry traced back a relatively few generations to some game-farm stock. This is interpreted to indicate that there is nothing basically inferior about a propagated pheasant or that it is possible to propagate a bird that is nearly the equal of wild stock. The difficulty has been with the use of these birds in that they are employed largely to 'over stuff' an already saturated habitat."

Hartman et al. (1967:18) states, "Once a stocked bird has survived the first two or three months in the wild its chances for continued existence are about equal to those of a native ringneck...Six years of banding records show that some released pheasants live through the hunting season. One cock survived four years before being shot. Four ringnecks lived three years in the wild, and four others persisted for two years." Kabat et al. (1955) share the same view on game farm birds and state that there is "...little difference in superiority of the wild birds over the game farm birds in either survival or vulnerability to the gun."

Studholme and Benson (1956:429) caution against stocking pheasants on areas that already possess a full complement of birds.

They recommend that, "In any stocking program it must be remembered that the number of birds that can be supported by any given area of habitat is determined by range quality. This is the inherent carrying capacity of the land. Any birds released after this population is reached are doomed to failure before long. That is why, in spite of repeated stocking, results have been poor on thousands of areas. Stocking can be a tool of pheasant management or simply public appeasement, according to its use."

Many authors have been pessimistic about the contribution game farm pheasants make when released into the wild. Leopold (1931:120) wrote, "...obviously newly planted birds, especially pen-raised pheasants are not normal in their subsequent movements, ..." Later, Leopold et al. (1938:3) concluded that, "It may safely be assumed that wild-trapped stock is of superior quality, ..." Trippensee (1948:81) expressed the opinion that, "...mortality among released birds may be significantly greater than among wild birds."

Allen (1956:440) wrote, "When pen-raised poults go out to make their own way in the world, their domestic beginnings obviously place them at a disadvantage. In the weeding-out of the less fit, the game-farm pheasant is likely to be converted into soil fertility long before the gun is added to the hazards of his career. The matter of low survival has had great emphasis in the published literature..."

DESCRIPTION OF STUDY AREA

Introduction

This study was conducted on typical Southwest Virginia farmland located near Blacksburg in Montgomery County. This area was chosen because of its diverse intensive agricultural practices and its proximity to the University. The area also has several ungrazed woodlots with sufficient understory vegetation to provide cover during the winter months. Figure 1 shows the study area and the land use during the study. Figures 2 and 3 are aerial photographs of the study area.

General Description

The area on which this study was conducted consisted of approximately 2000 acres and included portions of the Virginia Polytechnic Institute and State University Farm, Smithfield Farm, and Heth Farm. The area will be referred to collectively as the University Farms. The entire area, with the exception of the Heth Farm, is a game sanctuary on which general hunting and trapping is prohibited except for experimental purposes and then only under careful supervision.

The study area is in the Transistional Life Zone, the Limestone Valleys and Ridges Soil Region, and the terrain is typically gently rolling.

Soils

The soil on the study area is Copper Ridge Dolomite origin and is of silt loam texture. Detailed soil type and land capability data

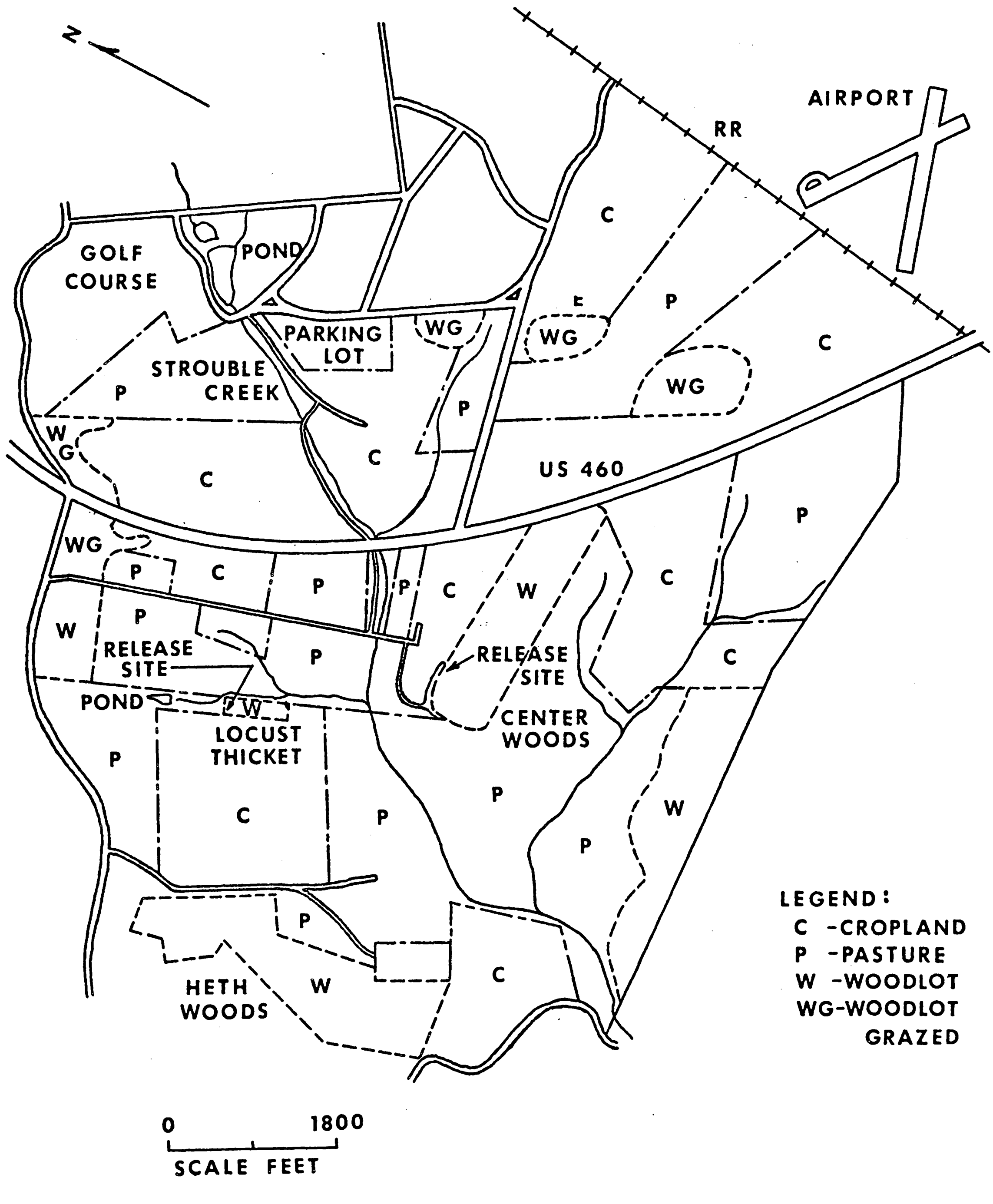

Figure 1. Land use as practiced on the University Farms, 1971-72.

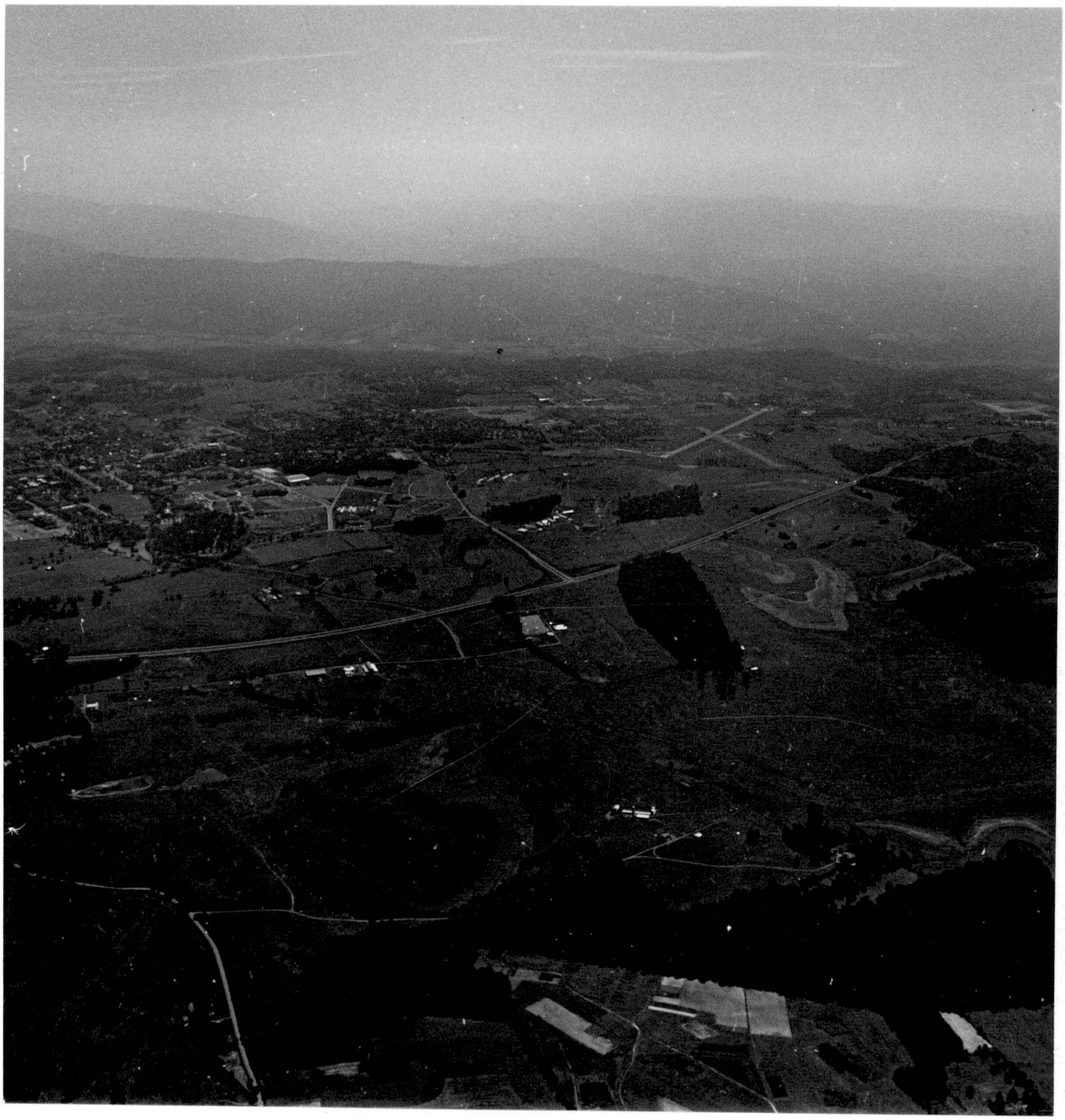

Figure 2. The study area looking east.

Figure 3. The study area looking south.

are available for the Heth Farm and these data are cited as an example for the entire study area. Approximately 50% of the soil on the Heth Farm is Groseclose Silt Loam on Class III land (75 per cent or more of the topsoil removed). Approximately 25% of this farm is Class II land (25-75 per cent of the subsoil removed) and of Groseclose and Fredericks silt loams. The remaining 10 per cent of this farm is Class VII (occasional gullied) and wet land. This farm extends across the drainage of the study area and approximately the same agricultural practices have been used on this farm as the other units on the study area. Therefore, it seems reasonable to assume that the entire study area is composed of approximately the same soils and land use capability classes.

Climate

The study area has a latitude of approximately 37 degrees and 18 minutes and a longitude of 80 degrees and 31 minutes. The elevation is approximately 2040 feet above sea level. The climate is rather humid, having an average annual precipitation of 38.04 inches and average annual temperature of 52.4 degrees Fahrenheit. The snowfall is moderate, averaging 16.4 inches per year. This amount of annual snowfall generally has little influence on the animals present due to the fairly wide daily range in temperature. Snow generally does not remain on the ground for extended periods in normal years.

Biotic

Although no attempt was made to census any species of animal on the study area except the released pheasants, field notes were kept on other animals encountered during the course of the study. This record indicates the area was used by at least one red fox (Vulpes fulva fulva). Cottontail rabbits (Sylvilagus floridanus mallurus) appeared to be abundant on the study area as were woodchucks (Marmota monax monax). The grey squirrel (Sciurus carolinensis carolinensis) population was normal in all woodlots except the locust thicket located on the Heth Farm. This woodlot contained no oaks (Quercus) or hickories (Carya) but consisted primarily of black locust (Robinia pseudocacia) so was not suited for squirrel occupancy. A pregnant female least weasal (Mustela rixosa) which is rare in the area was collected during the winter near the north edge of the locust thicket on the Heth Farm.

Bird life was abundant on the study area. Various songbirds were frequently observed. Other birds included bobwhite quail (Colinus virginianus) over most of the area and common snipe (Capella gallinago delicata) and killdeer (Charadrius vociferus) along Stroubles Creek and in wet areas. Also along the creek various ducks, primarily mallards (Anas platyrhynchos), were frequently seen. These ducks were probably from the nearby ponds located on the university campus. Crows (Corvus brachyrhynchos) were common on the study area. Raptors included Cooper's hawks (Accipiter cooperii), red-tailed hawks (Buteo jamaicensis) sparrow hawks (Falco sparverius) and a goshawk (Accipiter gentilis). A large owl (species unknown) was sighted several times by construction workers on the study area. One hen pheasant was known to have been killed by a Cooper's hawk (A. cooperii).

The domestic animals on the University Farms were cattle, sheep, hogs, and a few horses. Stray dogs were not observed on the study area; however, several house cats were seen. It was not known if these house cats were feral or not.

The majority of the land area of the University Farms is in pasture; therefore, the most common plant on the study area is blue grass (*Poa* spp). Waste areas and some parts of the pastures contain broomsedge (*Andropogon virginicus*). Cultivated crops included corn (*Zea mays*), wheat (*Triticum aestivum*), clover (*Trifolium* spp.) and alfalfa (*Meticago sativa*). Several corn fields were planted in rye (*Secale cereale*) after the corn was removed for silage in the fall. These areas provided very little winter cover but there was a large amount of corn on the ground available for feed throughout most of the winter.

Fencerows were generally devoid of shrubby vegetation. Where plants were permitted to grow along fencerows, blackberries (*Rubus* spp.), hawthorne (*Crategus* spp.), black locust (*R. pseudoacacia*), and cherry (*Prunus serotina*) furnished both food and excellent cover for travel lanes and resting.

The various woodlots on the study area had oaks (*Quercus*) as the dominant species, except for the locust thicket on the Heth Farm which, as mentioned previously was made up primarily of black locust. White oak (*Q. alba*) was the most abundant tree species. Other trees present on the woodlots were hickory (*Carya* spp.), cherry (*P. serotina*), hawthorne (*Crategus* spp.), black locust and white pine (*Pinus strobus*).

Along the woods' edge and in openings in the canopy, blackberry (Rubus spp.) thickets provided cover for the pheasants. Privit (Ligustrum vulgare) was present in all woodlots, and in some places formed dense thickets. Greenbrier (Smilax spp.) was also present on all the woodlots, as was honeysuckle (Lonicera japonica).

The two woodlots in which the major portion of the field study was conducted were Center Woods and the Heth locust thicket. Center Woods is approximately 80 acres and is situated on the top of a small hill. It is bounded on the east by a four-lane divided highway, on the west and south by pasture and on the north by a cornfield which was planted to rye during the fall. The locust thicket is approximately 15 acres and is on the east side of a small hill. It is bounded on the north and east by pastures and on the south and west by crop land. The crop during the first portion of the study (from Fall 1970 to Spring 1971) was hay, comprised of alfalfa and clover. In the spring of 1971 the area was planted to corn. A small stream flows along the north edge of the locust thicket from a nearby farm pond.

TECHNIQUES AND PROCEDURES

Biotelemetry Equipment

Transmitters

Mr. O. Lee Wilkins, of Deerfield, Virginia manufactured the transmitters used in this study. The following description of the transmitters was furnished by Mr. Wilkins.

> The transmitter is a single transistor oscillator circuit with the oscillating frequency crystal controlled. The frequency range is between 31.19 and 31.3 megahertz at 1 kilohertz intervals to give a total capacity of 10 separate channels with one transmitter operating on each channel. The power input to the transmitter is between 1.3 - 2.7 milliwatts to a series-tuned network between tuned crystal tank and antenna. The power input is provided by one Mallory type RM12RT2 battery. The tuned crystal tank and antenna are designed to yield maximum signal strength possible from the antenna. The radiated energy is approximately 20 - 30% of the input power. Voltages to antenna are on the order of 0.9 volts at peak amplitude. The antenna is constructed of approximately 12 inches of guitar string. The measured range, line of sight, was one mile. Severe attenuation from vegetation was evident. One meter of thick foilage, such as a hedge, reduced signal strength by one-half. The entire unit is enclosed in waterproof General Electric Silicone Seal, clear and black varieties.

The transmitter as received from the manufacturer is illustrated in Figure 4.

Surgical tubing was used to attach the transmitters to the pheasants. Two 12-inch lengths of 1/8 inch I.D., 3/16 inch O.D. surgical tubing were attached to opposite sides of the transmitter using black vinyl plastic electricians tape. Additional tape was then used to completely enclose the transmitter in an effort to increase the protection from weather. A plastic embossing tape was then attached to the

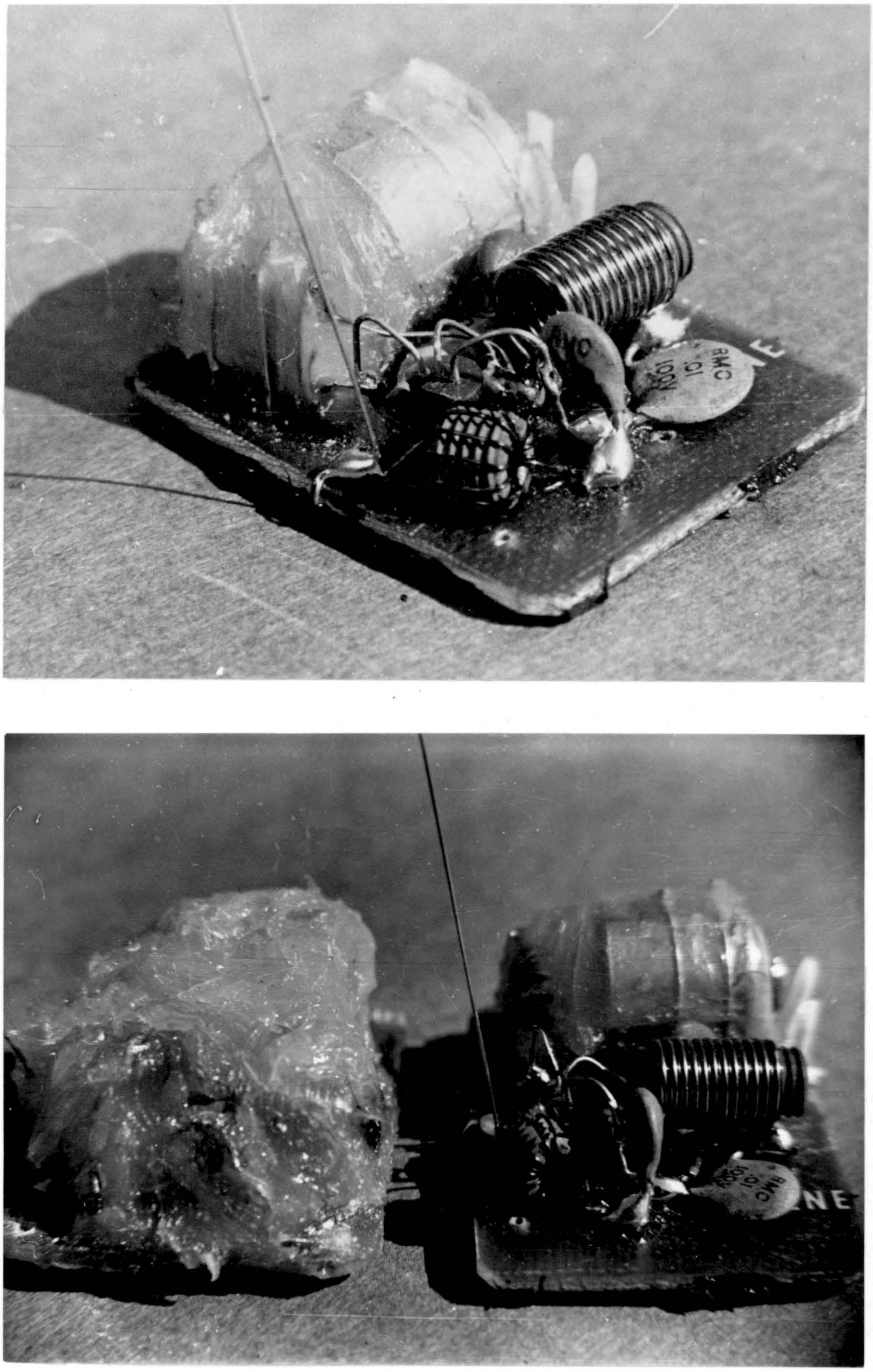

Figure 4. (<u>Top</u>) Transmitter before application of casing and (<u>bottom left</u>) transmitter as received from manufacturer.

transmitter which identified the particular channel, the University and the Department of Forestry and Wildlife. The completed package weighed less than 40 grams. This was not thought to be an excessive weight for a 900 gram pheasant to carry and was near the 4% of body weight suggested as a limit for birds (Brander and Cochran 1969:96).

The transmitter package was attached to the instrumented pheasants following a procedure used for turkeys and described by Williams (1968). The transmitter was first positioned on the pheasant's back between the wing butts with the ends of the surgical tubing oriented anteriorly and posteriorly. One of the tubings was then tied snugly under each wing using a square knot. Care was taken to center the load on the pheasant's back. The excess tubing was then cut off near the square knot. Figure 5 shows a pheasant with the transmitter attached.

Receiver

The receivers used in this study were also constructed by Mr. O. Lee Wilkins. The following description of the receivers was furnished by him.

> Electrically, the receiver is a completely transistorized double superhetrodyne receiver with the hetrodyne second detector crystal controlled for stability. The only possible source of frequency instability is the main tuning capacitor and is in the order of 110 kilohertz. The tuning dial is graduated into 10 channels over 180 degrees of tuning dial. The audio beat note may be changed by tuning to satisfy the ear for frequency and as a means of combatting radio interference. The receiver is sensitive to a signal of one microvolt.
>
> The receiver components are housed in an aluminum case for strength and lightness. An antenna receptical

Figure 5. Pheasant with transmitter attached.

> is on top for antenna attachment. Antennae suitable are loop, high gain yagi and multi-wave length. Antenna removal is simplified for storage and handling ease.

The receiver, complete with its 6-volt lantern battery power source, weighed approximately 5 pounds. The unit was easily portable with carrying problems only arising when attempting to penetrate dense thickets where the loop antenna frequently got entangled. Radio interference on the study area presented a problem with some channels but the degree of interference varied from day to day. The receiver and its use are illustrated in Figures 6 and 7.

Radio Tracking Procedures

The methods of obtaining transmitter location in this study are essentially that outlined by Verts (1963). The location of a transmitter was determined by the intersection of bearings obtained from two or more known points. The bearings were determined by first tuning the receiver to maximum signal strength and adjusting the volume to a suitable level. The receiver was then slowly rotated until a null was obtained. The bearing was then taken perpendicular to the plane of the antenna. The receiver was then moved to another location and the above procedure was repeated. The intersection of these bearings indicated the location of the transmitter.

The error introduced by the movement of the transmitter equipped pheasant while the receiver was being moved to obtain subsequent bearings was thought to be minor. This was due to the short time, usually no more than five minutes, that elapsed between readings.

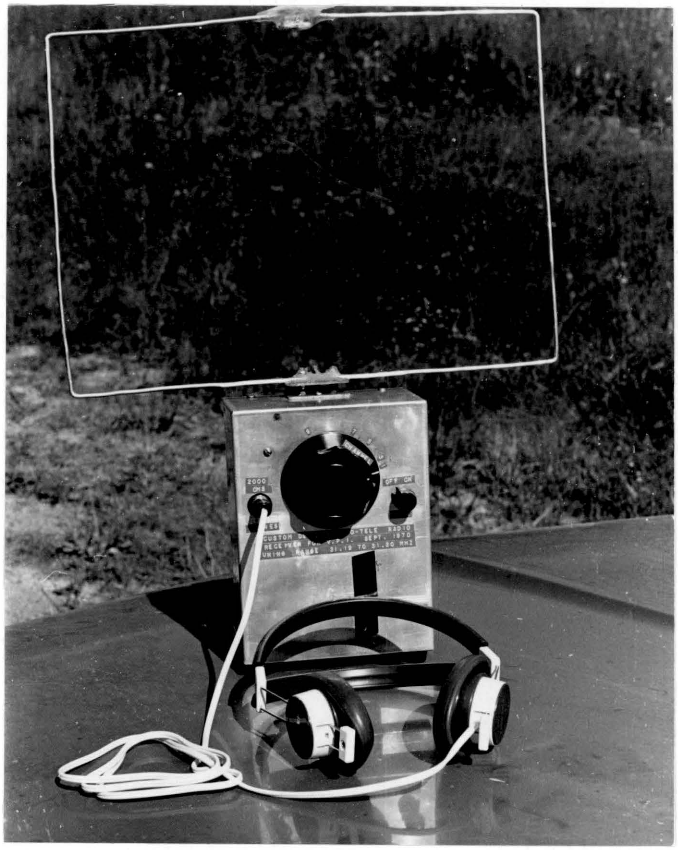

Figure 6. Portable receiver used in this study.

Figure 7. Field use of receiver.

Some error was introduced in obtaining the null location. To determine the null location the receiver was rotated through the maximum signal strength and the null until a signal was barely audible. The bearing of the receiver was noted at this position. The receiver was then rotated in the opposite direction until a signal was barely audible on the opposite side of the null. The bearing of the receiver was again noted in this position. The location of the transmitter bearing was then determined to be the midpoint of the two bearings thus determined.

The transmitter location was plotted on a field map drawn on a 4 x 6 card. Other data such as time of day, weather condition and nature of the signal were also recorded. These cards were also used to record observations of uninstrumented pheasants and other field notes. One or more cards was used for each day's data, depending upon the amount of data gathered. This system provided sufficient information for constructing larger maps from the field cards.

Banding and Tagging

All the pheasants had numbered aluminum leg bands when they were released. In addition to a number each band was also identified as belonging to the Virginia Commission of Game and Inland Fisheries.

The 50 pheasants released in the fall were not neck-tagged but the pheasants released in April (i.e., second release) were equipped with colored neck-tags. Taber (1949), Roby (1951), and Nelson (1964) have all reported on the use of a similar neck-tag for pheasants.

The colored neck-tags were constructed from strips of vinyl plastic coated nylon and rustproof brass number 1 safety pins. The strips of nylon were 1.5 cm wide by 15 cm long. The strips were folded 2 cm from one end. The folded portion of the strip was then inserted halfway through the safety pin. This portion of the strip was then folded over the stationary arm of the safety pin and secured with two staples. The staples passed through four layers of the nylon and resulted in a strong attachment to the safety pins.

The tags were numbered by two methods. A number was written on the tag with a ball point pen. The number was also written with a ball point pen on the end of the strip enclosed in the folds around the safety pin. On the opposite end of the strip the tag was notched to represent the number. The sides of the strip were used for the unit places and the end of the strip was used for the tens places. To represent the number twenty-five, two notches were placed on one side of the tag and three notches were placed on the opposite side. On the end of the strip two notches were cut.

The neck-tag was attached to the pheasant by inserting the safety pin through a pinch of skin at the base of the back of the neck. See Figure 8. Nelson (1964) reported a hen pheasant that retained a neck-tag attached in the same manner for approximately 3 years.

Figure 8. (Top) Male pheasant with neck tag and transmitter and (bottom) female pheasant with neck tag and transmitter.

RESULTS

Pheasant Releases

Two releases of 50 pheasants each were made on the University Farms near Blacksburg, Virginia. The pheasants were obtained from the Virginia Commission of Game and Inland Fisheries Game Farm in Cumberland, Virginia, and were produced as a part of a program which seeks the establishment of these exotic game birds in Virginia. No population of these pheasants exists in the area of this study; therefore, all observed birds were assumed to be from the releases made during this study.

On October 21, 1970, 50 pheasants were released on the University Farms. The release was comprised of 25 birds of each sex, all being birds of the year. The birds were released at two different sites approximately one-quarter mile apart. Five male and five female pheasants were equipped with transmitters. All 50 of the pheasants were banded with Virginia Commission of Game and Inland Fisheries leg bands.

One release site was located at the locust thicket on the Heth Farm adjacent to the University Farm boundary. The other release site was at the deer pens located in Center Woods on the University Farm. See Figure 1.

On March 30, 1971, a second release of 50 pheasants was made at the same release sites. In an effort to get reproduction the sex ratio in this release was unbalanced in favor of the females 4:1. Only five transmitters were available for this portion of the study and they were placed on three females and two males. All 50 of the pheasants were banded with Virginia Commission of Game and Inland Fisheries leg bands. In addition all the birds, except one which escaped from the crate before she could be tagged, were equipped with colored neck-tag markers. Two colors were used to distinguish between birds from the two release sites. The neck-tags made field observations easier and also differentiated between fall and spring released birds.

With few exceptions, the birds flew strongly when released. Two hens, equipped with transmitters, had difficulty flying. After reaching a height of approximately three feet they would apparently lose their balance and lose altitude until they returned to the ground. The two birds were last seen running into the underbrush. Several possible reasons for this problem come to mind. The weight of the transmitters may have shifted the center of gravity of the hens, and also the attachment of the transmitters around the wing butts may have interfered with the normal beat of the wing. It should be noted that these two birds were of course reared in pens and were not accustomed to much flying.

The remaining pheasants equipped with transmitters had no apparent difficulty flying. Several birds, not equipped with transmitters, flew into obstacles such as trees and fences but apparently suffered no harm as they quickly righted themselves and disappeared into thick vegetation.

Biotelemetry

The releases were completed late in the afternoon and little time was left to attempt radio tracking on the release dates. Therefore, the tracking commenced the day following the releases. The first thing noted when tracking procedures began was the abundance of spurious signals present on the study area. The origin of these signals was not determined but they were present in varying degrees and intensities on almost every day that tracking was attempted. These signals made tracking the transmitter equipped birds difficult and some of the locations made during the study are of questionable validity.

Transmitter No. 4 used in the fall release, did not operate properly when it was put in operation the night before the release was made. Its signal was intermittant and appeared to be weaker than the other transmitters. In spite of these difficulties the transmitter was used as it was thought some data might be gathered from its use.

Transmitter No. 6 in the spring release was not operating the day after it was placed on the pheasant. The bird was observed at a distance of approximately five feet and no signal could be detected. The neck-tag on the bird made possible the identification of the transmitter number.

The range of the radio transmitters was not as great as had been anticipated. In one case the maximum distance through thick vegetation at which a transmitter could be detected was thirty yards. Over flat and open terrain, with the transmitter placed approximately twenty feet above the ground, the line of sight range of the transmitter was found to be 500 yards. The range of the transmitter under normal field conditions was thought to be no more than 200 yards. This limited range greatly curtailed the ability to monitor closely the movements of the highly mobile birds.

A total of 82 radio telemetry locations were made during the fall phase of the study. Many of these were questionable due to the radio interference present on the area. The spring phase of the study yielded only twelve locations. Occasionally more than two nulls were obtained in one 360 degree rotation of the antenna while the receiver remained tuned to the same frequency.

The last radio contact with fall released birds was on November 18, about 29 days after the birds were released. The last radio contact with spring released birds was on April 9, eleven days after the birds were released. Frequent excursions to the study area and surrounding areas were made in an attempt to re-establish radio contact with no success. It was not known whether the pheasants dispersed out of range of the equipment or if the transmitters stopped functioning. However, data in the form of observations and field sign continued to be recorded after radio contact was lost.

Field Observations

Field observations constituted the major source of data collected during this study. This was necessary due to the unexpected difficulties encountered with the telemetry equipment. A total of 196 observations were recorded on 69 different occasions. Ninety-five hens, 73 cocks and 28 birds of unknown sex were observed. On 32 occasions the author made the observation, the remaining 37 were reported by other individuals.

The birds were most frequently encountered in woodlots, or in fields within 100 yards of woodlots. Waste areas along streams were also used frequently. Birds were observed in pasture fields only on four occasions.

For the first week following the fall release the pheasants were seen in small groups near the release sites. During the second week, four straight days of heavy rains curtailed field work. Following the rainy period, only a few of the pheasants could be sighted. Whether the inclement weather sped up dispersal, or made the birds more vulnerable to predation, is not known. For the remaining portion of the fall study, the birds left on the study area were seen infrequently. The known longevity record is held by a hen which was killed by an automobile after 344 days in the wild. Two other road-killed hens had survived for 180 and 120 days.

The spring released pheasants exhibited a more gradual decrease in number of birds seen on the study area. Field work was terminated after 40 days and pheasants still could occasionally be sighted. Three hens, thought to be nesting, were reported killed by mowing machines. During the summer, one hen was reported with a brood of two chicks.

The author received a report of a sighting of five cocks and four hens on November 1, 1971 on the study area. It was not known whether the birds were from the fall or spring release or if they were young of the year.

Figure 9 shows the areas where the pheasants were sighted or located by biotelemetry on the study area.

Dispersal

Problems encountered with the telemetry equipment prevented the surveillance of transmitter equipped birds which may have dispersed off the study area. Seven pheasants, however, were known to have dispersed off the study area. None of these birds was known to be instrumented. The day following release a pheasant (sex unknown) was seen at the Blacksburg Airport, approximately 1½ miles east of the nearest release site. Fifty-six (56) days following release two sightings were reported off the study area. Several birds were sighted approximately 3 miles west of the release sites, and one bird was sighted approximately 3 miles northeast of the release sites on the opposite side of the town of Blacksburg. The sex of the birds reported in these sightings was not known.

Sixty-five (65) days after release a cock bird was found approximately 4 miles west of the release sites. A hen, thought to be from the spring release, was seen 2 miles northeast of the release sites on April 17, 1971. This was 18 days after the spring release. A hen was found 1½ miles east of the release site 21 days after her release. The last incidence of dispersal was also the known longevity record for the study. A hen from the fall release was found 3½ miles south of the release site 344 days after it had been released.

Figure 10 is a map of Montgomery County showing the location of the known dispersals off the study area.

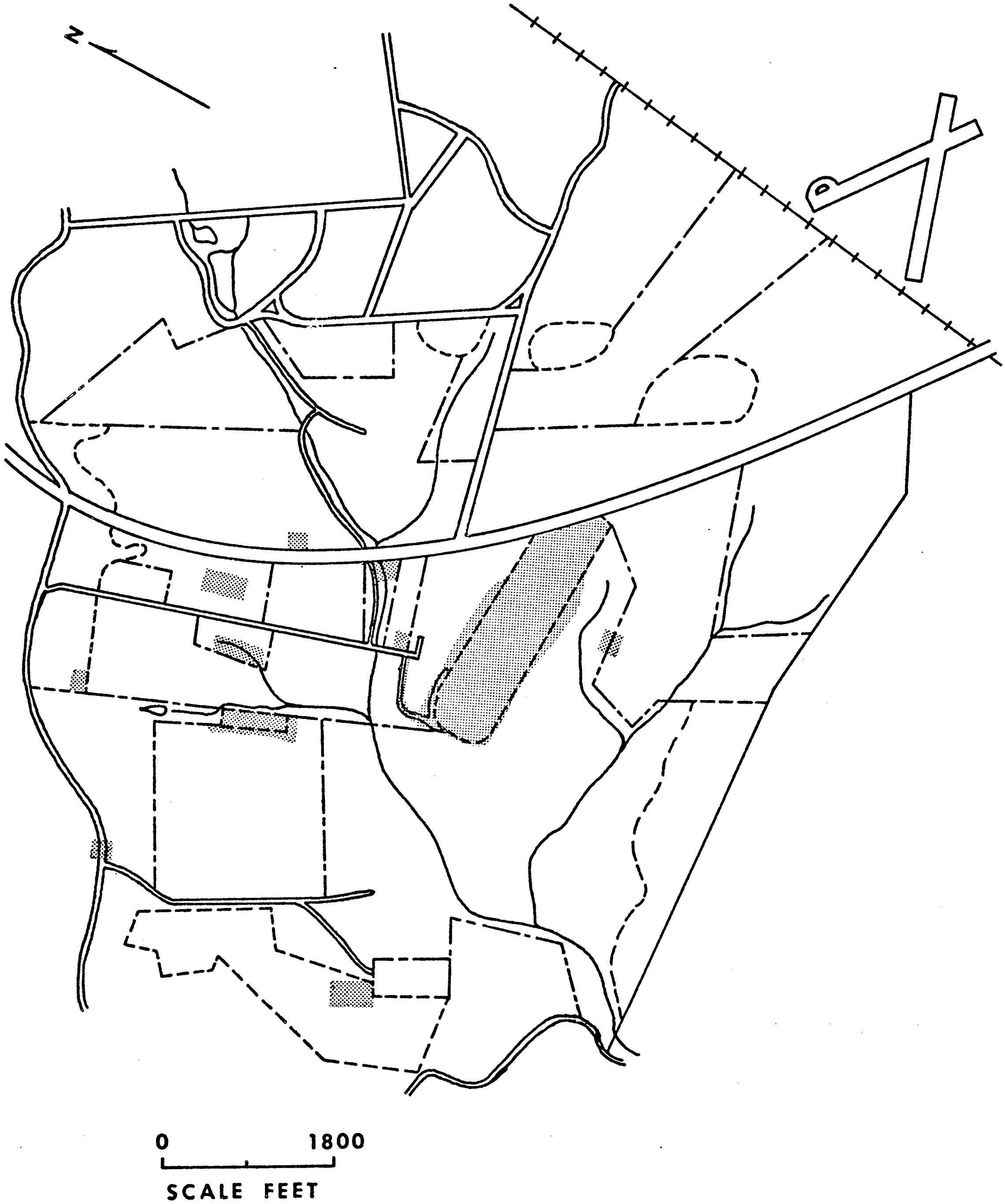

Figure 9. Areas where pheasants were observed on study area.

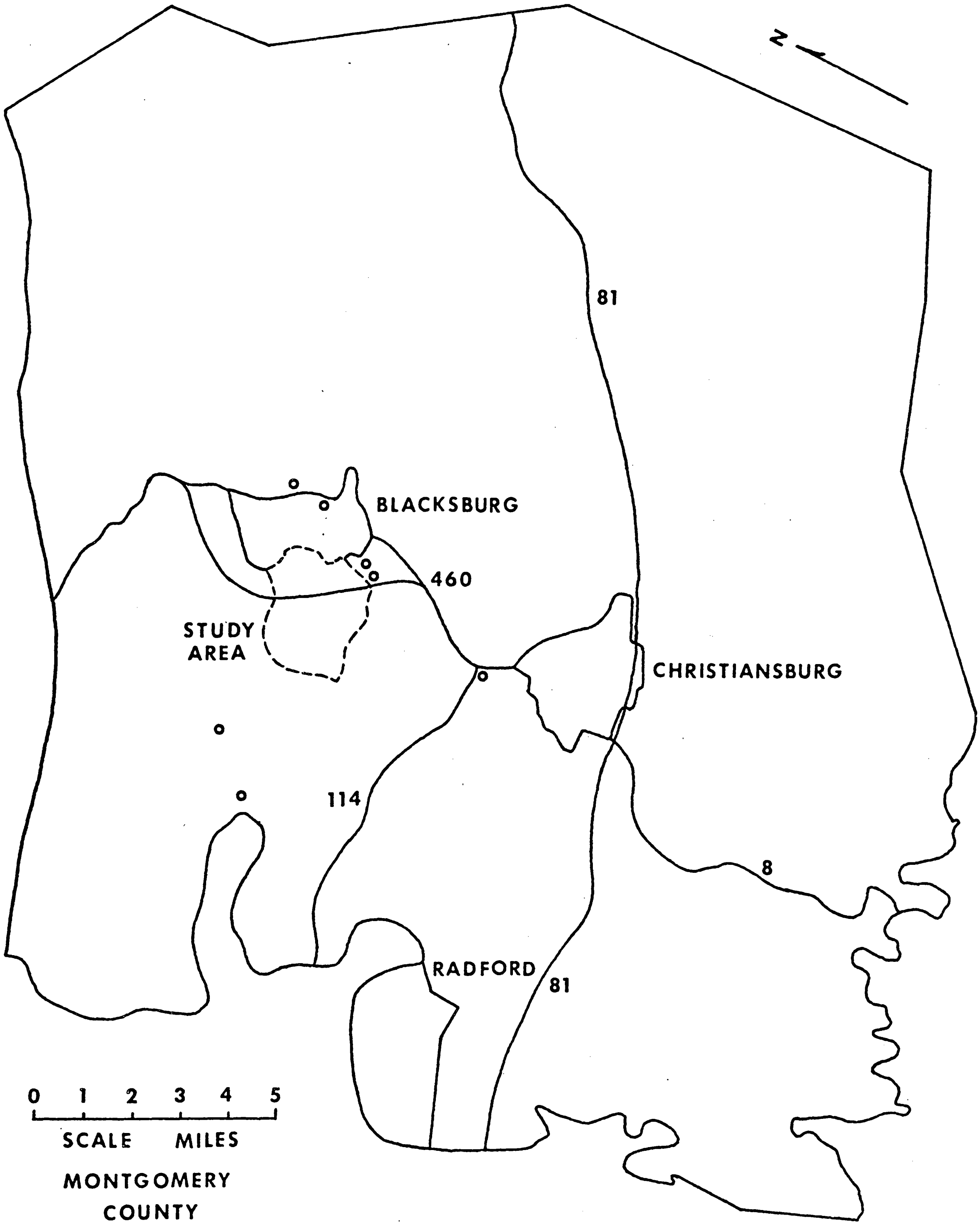

Figure 10. Dispersal limits recorded for released pheasants.

Mortalities

A total of 26 pheasant mortalities were recorded during the course of this study. This represents 26% of the birds released. Thirteen of these mortalities could be identified as fall released birds. Seven mortalities were identified as spring released birds. The remaining 6 mortalities could not be identified due to the lack of leg bands or neck tags. Nine of the mortalities were cock birds. This represented 28.7 percent of the total number of cocks released. Fifteen hens were known to have died. This represented 23.1 percent of the total number of hens released. Two mortalities were reported to the author but the sites could not be located and the sex of the birds and the cause of death was not known.

Sixteen of the mortalities (8 cocks; 8 hens) were attributed to predation. A Cooper's hawk (*Accipiter cooperii*) was known to have killed one hen. The remaining 15 mortalities could not be attributed to a specific predator. Red foxes (*Vulpes fulva fulva*), red-tailed hawks (*Buteo jamaicensis*), goshawks (*Accipiter gentilis*), and house cats were observed on the study area.

Three hens were killed by automobiles on a four lane divided highway approximately one-half mile from the release site. Another hen was killed by an automobile 3½ miles south of the release site. Three more hens were known to be killed by mowing operations in hayfields on the study area. Although nests were not located it was thought that these hens were setting on nests.

The remaining known mortality, a cock, died spectacularly on Christmas day when he flew through a large picture window in a home approximately 4 miles west of the release site.

DISCUSSIONS

Pheasant Movements and Dispersal

The data collected in this study did not reveal the desired amount of information pertaining to pheasant movements. Difficulties encountered with the telemetry equipment prevented the surveillance of the released birds as closely and for as long a time as had been anticipated. The bulk of the data gathered was from field observations and other field sign gathered on the study area.

From the data obtained it was concluded that the strain of pheasant in this study contains individuals that do remain in the general area of their release and other individuals that disperse from the release area. There were only seven known cases of dispersal off the study area; however, the rapid decrease with time of number of birds seen per trip to the field indicated a decline in numbers present. It is doubtful if the number of predators on the study area were the sole, or even major, cause of the rapid decline in the population. The most logical conclusion, in view of the meager evidence available was that egress losses were initially high, then reduced to near zero as the remaining birds adapted to their new surroundings. Possibly the area was not capable of supporting the number of birds released and the decline in numbers was only an adjustment to meet the carrying capacity. This was not thought to be the case, however, as both food and cover appeared to be in good supply.

The theory that dispersal was initially high is supported by the findings of Bohl and Bump (1970:2) and Hart (1971a:4). The findings of Anderson (1964:261), Hessler et al. (1970) and Burger (1964:719), however, conclude that dispersal is not great with stocked pheasants. The maximum distance that a pheasant was known to disperse was 4 miles. Three other birds were known to have travelled 3 miles or more. The birds did not exhibit any directional tendency in their dispersal, as individuals were known to have travelled in each of the four compass directions.

The frequent presence of the observer on the study area and in the coverts was thought to have sped up dispersal. In one instance 10 birds were known to have been driven from the locust thicket into surrounding open pasture by the author walking around the woodlot and maintaining a distance of approximately fifteen feet from the woodlot side of the fence. The difficulty encountered with the biotelemetry equipment necessitated the increased disturbance created by this presence. Other people were occasionally present on the study area, with the frequency being greatest in the warm spring months.

Mortality

The known pheasant mortality for this study was 26 birds (26%). The actual mortality figure probably is much higher due to the chance of many mortalities going undetected since there was generally only one observer in the field. Predation accounted for 16 deaths but in only one instance was the predator identified. The author flushed a Cooper's hawk from the freshly killed carcass of a hen pheasant. The remaining fifteen mortalities attributed to predation could not be classified as to type of predator but several of the recovered transmitters had teeth punctures in the electricians tape covering indicating that they had been chewed by mammals.

Three hens were killed during mowing operations in hayfields and although nests were not discovered it was thought that these birds were nesting. The effect of mowing during nesting season can be doubly destructive to farmland ground-nesting birds because it not only destroys the nest but frequently, as in these cases, destroys the hen.

Highway mortality accounted for the loss of four hens. The actual number could conceivably be higher since no systematic attempt was made to inspect the highway shoulders for the birds. The four mortalities that were recovered were either in the roadway, or on the shoulder in sight of passing vehicles.

Habitat Preference

The data gathered in this study indicated the pheasants are attracted to ungrazed woodlots where the understory provides sufficient cover and cultivated fields are nearby. This coincides with the findings of Bohl and Bump (1970:6) who stated, "The predominant cover favored by the Iranian pheasants is cultivated lands and adjacent woody-brushy areas." Trippensee (1948:62) and Nelson (1964:33) also mention the wood lot as being important in pheasant habitat requirements. The majority of pheasant observations that were made in woodlots were made in areas where the understory was thick.

As expected, pasture fields were not very attractive to the pheasants. Birds were observed in pasture fields on only four occasions.

On the other hand, wet, swampy areas along streams were used by the pheasants if the areas were not grazed and were allowed to get brushy.

Cultivated fields were used both for feeding and for nesting. Pheasants were frequently observed in the cultivated fields, especially along the edges of wood lots. Only two pheasant crops were examined and the contents of both consisted mainly of corn. One seed of black locust and one of wheat were also found in the crops.

Suitability of Pheasants for Southwest Virginia

The two criteria used by Hart (1971a:5) to determine the suitability of an area for pheasants following a release are the observance of over-winter survival and brood rearing. Both these criteria were met, to a small degree, by the pheasants released in this study. The continued release for several years, preferably in the spring, of approximately the same number of pheasants should result in a local population, that with protection, in time could become self-sustaining.

Dispersal of pen-reared birds is a problem that apparently cannot be eliminated. The author feels that spring releases help to minimize this problem due to the preoccupation of the birds with activities associated with breeding. Also, if brood rearing is successful, the locally produced birds should have less tendency to disperse and those that survive should be better adapted to the conditions present on the area.

Biotelemetry

The biotelemetry equipment used in this study did not perform as had been anticipated. The expected maximum period of transmitter operation, based on battery life, was 90 days. The greatest elapsed time between last radio contact and the release day was 29 days. Whether the problem was created by transmitter failure or by lack of range is not known. It is thought that the difficulties resulted from a combination of the two. In one instance, a bird was observed at close range the day following release and a signal could not be detected. Another time, the maximum distance that a transmitter-equipped pheasant concealed in thick brush could be detected was 30 yards.

It is possible that the whip antenna could have been a source of trouble. The antenna was rigidly attached to the transmitter and repeated flexing at this point could have resulted in breakage with a resulting loss of signal. For future studies this type of antenna construction should be carefully evaluated before field use.

The material used for casing the transmitters was a flexible substance when it cured. Pressure applied to this casing was transmitted to the components housed within and could result in connecting leads being bent or broken. It was possible to alter the tone of the transmitter signal by lightly pressing on the casing. A more rigid casing material should be used to eliminate this possible source of transmitter failure in future studies.

Signals from sources other than the transmitters were a problem with this study. The difficulty in determining the origin of signals no doubt resulted in errors being made in determining the location of transmitters. Prior to future biotelemetry studies, the study area should be visited by qualified electronics personnel, with appropriate testing equipment, and the available frequencies least likely to have interference should be determined.

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TELEMETRIC DETERMINATION OF MOVEMENTS
AND BEHAVIOR OF RELEASED PHEASANTS

by

Gary Hampton Spiers

ABSTRACT

Two releases of 50 birds each were made on the Virginia Polytechnic Institute and State University Farm. One release was made in the fall, the other release was made in the spring. The birds were a cross between Western Iranian black-necked (*Phasianus colchicus talischensis*) and Chinese ring-necked pheasants (*P. c. torquatus*).

Ten of the pheasants released in the fall and five of the pheasants released in the spring were instrumented with transmitters. Equipment difficulties with both releases reduced the ability to monitor the birds. As a result of these difficulties, field observations were resorted to for the bulk of the data.

Known mortality amounted to 26% of the total number of birds released. Seven cases of dispersal off the study area were recorded. The dispersal ranged from 1½ to 4 miles from the release sites. The pheasants were most frequently observed in, or adjacent to, woodlots.

The spring-released pheasants exhibited a more gradual decline in numbers observed on the study area than the fall

released birds. Breeding activity was thought to be partly responsible for the increase in spring observations. Three hens which were thought to be nesting were killed by mowing operations in hayfields. Several broods were observed during the summer.