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# Influence of Weather On Movement and Habitat Use of Hen Pheasants During Brood Rearing

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# INFLUENCE OF WEATHER ON MOVEMENT AND HABITAT USE OF HEN PHEASANTS DURING BROOD REARING

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser | Date

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# INTRODUCTION

Pheasants survive in a wide range of yearly weather extremes but can be limited by certain short-term weather factors (Graham and Hesterburg 1948). Study of short-term weather conditions can therefore be important in understanding pheasant survival.

Many studies have been done on yearly and seasonal effects of weather on pheasant production and survival. Bennitt and Terrill (1940) reported on possible temperature factors in pheasant management in the north central area of the United States. Effects of weather on pheasant reproduction were studied by Buss and Swanson (1950) and Kozicky et al. (1955). MacMullan and Eberhardt (1953) studied the tolerance of incubating eggs and young chicks to exposure. Labisky et al. (1964) discussed the influence of land use and weather on pheasant distribution.

A few studies have reported the daily effects of weather on movement and habitat use of pheasants. The ability of pheasants to withstand climatic elements was measured by Latham (1947). Restriction of pheasant movement by weather was reported by Shick (1952) and Weston (1954). Cover type use was related to weather by Grondahl (1953).

The previous studies were all done by visual observation. The development of radio-telemetry systems (LeMunyan et al. 1959, Marshall 1960, Cochrane and Lord 1963) and techniques (Marshall and Kupa 1963) have made possible the collection of more information on daily movement and habitat use. The use of computers to analyze these data has allowed more detailed studies to be done (Siniff and Tester 1965). Movement and behavior of hen pheasants during the nesting season were reported by

Kuck et al. (1970). Carter (1971) studied seasonal movement of pheasants. General habitat use and movement of hen pheasants during brood-rearing were studied by Hanson (1971).

Survival of broods may have as much influence on pheasant population as hatching success (Trautman and Dahlgren 1965). Since little is known about the influence of daily weather variations on hens during the brood-rearing period, the objective of this study was to determine the effect of selected weather conditions on the movement and habitat use of hen pheasants during the brood-rearing period.

# DESCRIPTION OF STUDY AREA

Field studies were conducted on private farmland (W $\frac{1}{2}$ and SE $\frac{1}{4}$ of Section 22 and SE $\frac{1}{4}$ of Section 21, Township 110 N, Range 49 W) 3 miles east of Brookings, South Dakota.

The topography is flat to gently sloping. Soils are glacial in origin with a loess overlay (Westin et al. 1958).

Climate is continental. Annual precipitation is 20 inches, generally occurring as frontal precipitation falling at a slow rate over a long period of time. About 80 percent of the precipitation comes during the growing season. Temperatures range between -30 F and 110 F with average monthly summer temperatures varying between 49 F and 74 F. Wind velocity averages about 10 MPH from the south during the summer (U. S. Dept. Commerce 1969, 1970, 1971). Barometric pressure can be highly variable but averaged 29.94 inches, corrected to sea level, for the period from 1931-1960 (U. S. Dept. of Commerce, Climatic Atlas of the U. S. 1970). Weather data for this study were obtained from the South Dakota State University Experiment Station located 3 miles west of the study area (Appendix Table 1).

Agriculture is the major activity on the area, with corn and sown small grain the major crops. The proportions of cover types changed slightly during the 3 years of the study, with the greatest change the last year (Table 1). In 1971, 100 acres that had been retired under the U. S. D. A. Feed Grain Program were put into small grain production. Even with this change, brood-rearing cover remained approximately 60 percent of the area each year of the study.

Table 1. General cover types on study area 1969, 1970, 1971.

| Cover Type | 1969 | | 1970 | | 1971 | |
|---|---|---|---|---|---|---|
| | Acres | Percent of Total | Acres | Percent of Total | Acres | Percent of Total |
| Corn | 188 | 29 | 205 | 32 | 247 | 38 |
| Small grain | 158 | 25 | 155 | 24 | 202 | 32 |
| Residual cover | 122 | 19 | 126 | 20 | 30 | 5 |
| Pasture | 56 | 9 | 56 | 9 | 54 | 8 |
| Summer fallow | 41 | 6 | 34 | 5 | 44 | 7 |
| Alfalfa | 37 | 6 | 26 | 4 | 25 | 4 |
| Treerow and farmstead | 17 | 3 | 17 | 3 | 17 | 3 |
| Ditches | 16 | 2 | 16 | 2 | 16 | 2 |
| Spoil pits | 4 | 1 | 5 | 1 | 5 | 1 |

# METHODS AND MATERIALS

## Capturing Birds

A pickup truck with floodlights (Labisky 1968) and a backpack generator (Drewien et al. 1967) were used to capture birds at night for marking. The backpack generator was used most because of its portability and usefulness for searching small areas of roosting cover.

## Marking Systems

Aluminum leg bands were used to mark all birds large enough to carry them. For individual field identification, backtags and/or radio-transmitters were used on all birds over 6 weeks old. Neck tags were used on younger birds. Backtags made of vinyl plastic (U. S. Naugahyde) were similar to those described by Labisky and Mann (1962). Neck tags resembling those described by Taber (1949) were made of model airplane covering (Super Monocote). Both types of tags were marked with numbers painted with vinyl paint (Ramcote). Backtags and radio-transmitters were mounted on the center of the back between the wings by a loop of narrow material around the base of each wing securing them in place. Elastic sewing braid, cured buckskin, and No. 18 automotive wire were used at different times to secure the backtags and radio-transmitters. The automotive wire proved most satisfactory as it caused no abrasion and was strong but remained flexible enough to allow freedom of movement. Necktags were placed on the dorsal side of the neck, midway between the head and the body. A short loop of monofilament line was threaded under a half-inch wide section of skin to attach necktags.

Kuck et al. (1970), Carter (1971), and Hanson (1971), using similar telemetry equipment, reported no adverse effect on pheasant mobility or behavior. During this study, radio-equipped hens nested and raised broods successfully. Radio-equipped hens were observed moving with non-radioed hens in harems and breeding with cocks with no apparent adverse effect from the radios.

## Radio-tracking Systems

The system for locating birds consisted of transmitters, a stationary receiving station and mobile receiving unit (Hanson 1971) and a hand-held receiving unit (Kuck et al. 1970).

Transmitters were built by the Electrical Engineering Department at South Dakota State University. The transmitters emitted a continuous signal on a frequency in the range of 150.0-151.1 MHz. The units had a life of about 100 days and a range of approximately 0.5 mile to the stationary antenna and 0.25 mile to the mobile unit.

A Drake tunable receiver with a converter was used on both the stationary and mobile receiving units. This fine tuning capability of the receiver allowed transmitters on close frequencies to be used with no problem in identifying individual birds.

The stationary tower was fitted with two yagi antennas matched to create a null in the signal when pointing at the transmitter's location. The direction or azimuth was read directly from the Telrex rotation indicator.

The mobile unit had a single yagi antenna. Determination of the azimuth was made by listening for nulls in the audible signal on either side of the loudest point. The degrees between these nulls was halved to find the midpoint direction.

Source of error in the location of birds have been reported as reading and recording the azimuth (Heezen and Tester 1967), the distance of bird from receiver (Cochrane et al. 1965), and antenna misalignment and bird movement (Kuck et al. 1970). Simultaneous locations from two stations eliminated bird movement as a source of error in this study. Distance from the transmitter to the mobile receiver was kept as small as possible by having 27 alternate sites scattered throughout the study area and always using the site closest to the bird for the recorded location. But distance to the central tower, antenna misalignment and data recording may have contributed to errors in readings. Hanson (1971) reported an error of 40-50 feet at a distance of 0.5 mile with this system. As most readings were made from shorter distances this error was considered acceptable.

## Data Analysis

Siniff and Tester (1965) described the use of computers in analyzing movement of animals. In this study, distances between locations on a given day were used to reflect activity. Weather conditions were averaged for the period of each movement and entered on IBM cards as were azimuths for each bird location. A computer program was developed to determine the distance between locations and the direction of bird movement.

Locations of birds to be used were selected by the following method. Only days between June 16 and October 15 with at least four locations for a given bird were selected. The four locations used were chosen by dividing the daylight hours (one-half hour before sunrise to one-half hour after sunset) into four equal periods, then selecting the location nearest in time to the midpoint of each of these periods. This selection criterion was used to insure a minimum number of locations per day for each bird to compare in the movement analysis.

Multiple regression was used to analyze movement data. Wind velocity, barometric pressure, precipitation and distance of bird movement were entered in the regression. Distance of bird movement was considered the dependent variable. Linear correlation was used to analyze both the direction of bird movement and wind. A probability level of 0.05 was used in all tests.

Cover-use indices (Robel et al. 1970) were compiled by dividing the percentage of the selected locations for all birds in a given cover type by the percentage of the study area occupied by that cover type. This was done to reduce bias in cover preference that might result from more readings being taken at a particular time of day (Hanson 1971). An index was prepared separately for three divisions (less than 28.12, 28.12-28.29, more than 28.29) under barometric pressure, two divisions (0-8 mph, over 8 mph) under wind velocity, and two divisions (0, any amount) under precipitation. These divisions were made based on the average values for these weather elements during the period of study. An index value of greater than 1.0 indicated greater than expected use.

Barometric pressure used in this study refers to the pressure recorded at the Brookings station not corrected to sea level. All weather values were averages for the period of bird movement to which they refer, except precipitation, which was recorded only as occurring or not. Direction of wind was the actual wind direction measured to the nearest of the eight major compass points to conform to the interpretation of bird direction by the computer.

# RESULTS

## Capture Data

A total of 202 birds was captured and marked in 1971. The majority of birds was captured in areas of undisturbed cover during the months of May and September. Larger numbers of hens were captured in the spring, while almost equal numbers of both sexes were caught in the fall. Greatest success in capturing birds was on calm, dark nights. During the summer months, heavy cover and dispersal of the birds made capture difficult.

## Radio-tracking Movement Data

Data from 21 hens were analyzed: Six adult and two juvenile hens in 1971 and eleven adult and two juvenile hens in 1969 and 1970 (Table 2). Of the adult hens, 13 had broods during the period that they were tracked (Table 3). The average age of these broods and the juvenile hens was 8 weeks. A total of 3,216 locations was obtained on these birds of which 1,068 were selected for analysis. The use of only four locations per day and the elimination of locations of incubating hens account for most of this large reduction in locations.

Data from all 3 years were combined for the movement study. Multiple regression showed no meaningful correlations between distance of bird movement and any of the weather factors tested. The amount of variance explained was only 0.008 or less of 11.3. These results compare with Duever and Fatora's (1968) study on bobwhite quail. They found no correlation between similar weather elements and daily activity patterns

Table 2. Summary of radio-tracking data.

| Bird No. | Age | Date On/Off | No. of Days Tracked | No. of Days Used | No. of Locations | No. of Locations Used |
|---|---|---|---|---|---|---|
| 215 | A | 6/26 - 10/20/69 | 106 | 36 | 400 | 144 |
| 216 | A | 6/30 - 7/23/69 | 21 | 8 | 72 | 32 |
| 218 | A | 7/10 - 8/ 1/69 | 20 | 7 | 62 | 28 |
| 273 | J | 9/25 - 12/ 4/69 | 20 | 1 | 33 | 4 |
| 308 | A | 9/23 - 10/17/69 | 20 | 5 | 53 | 20 |
| 312 | J | 8/24 - 12/ 6/69 | 22 | 2 | 45 | 8 |
| 332 | A | 6/21 - 8/27/70 | 24 | 4 | 57 | 16 |
| 334 | A | 7/16 - 9/ 1/70 | 36 | 11 | 113 | 44 |
| 336 | A | 8/10 - 9/ 4/70 | 21 | 9 | 68 | 34 |
| 350 | A | 8/25 - 9/21/70 | 20 | 12 | 75 | 48 |
| 425 | A | 9/ 4 - 9/11/70 | 5 | 4 | 25 | 16 |
| 426 | A | 9/ 4 - 10/ 6/70 | 24 | 9 | 79 | 36 |
| 427 | A | 9/16 - 9/29/70 | 12 | 1 | 26 | 4 |
| 509 | A | 5/ 7 - 9/ 1/71 | 118 | 21 | 368 | 84 |
| 551 | A | 5/11 - 7/29/71 | 78 | 27 | 290 | 108 |
| 562 | A | 5/22 - 8/13/71 | 83 | 10 | 332 | 40 |
| 567 | A | 7/30 - 8/16/71 | 17 | 7 | 65 | 28 |
| 569 | A | 8/10 - 12/31/71 | 143 | 52 | 668 | 208 |
| 574 | J | 9/10 - 10/ 3/71 | 23 | 13 | 93 | 52 |
| 581 | A | 8/11 - 9/ 5/71 | 25 | 16 | 193 | 64 |
| 621 | J | 9/ 8 - 10/ 1/71 | 23 | 14 | 99 | 56 |
| Totals | | | 861 | 269 | 3216 | 1068 |

Table 3. Summary of brood data.

| Bird No. | Adult or Juvenile | Dates Tracked | Brood | Age of Brood* |
|---|---|---|---|---|
| 215 | A | 8/ 5 - 10/15/69 | Yes | 6 weeks |
| 216 | A | 7/ 6 - 7/18/69 | Yes | 5 weeks |
| 218 | A | 7/11 - 7/28/69 | Yes | 4 weeks |
| 273 | J | 9/25/69 | No | 14 weeks |
| 308 | A | 9/25 - 10/15/69 | No | |
| 312 | J | 9/25 - 10/15/69 | No | 10 weeks |
| 332 | A | 6/25- 8/24/70 | No | |
| 334 | A | 7/22 - 8/24/70 | Yes | 3 weeks |
| 336 | A | 8/12 - 8/24/70 | Yes | 10 weeks |
| 350 | A | 8/22 - 9/18/70 | Yes | 6 weeks |
| 425 | A | 9/ 8 - 9/11/70 | Yes | 8 weeks |
| 426 | A | 9/ 8 - 10/ 6/70 | No | |
| 427 | A | 9/ 8 - 10/ 6/70 | Yes | 14 weeks |
| 509 | A | 8/ 2 - 9/ 1/71 | Yes | 0 week |
| 551 | A | 6/18 - 7/28/71 | Yes | 0 week |
| 562 | A | 7/30 - 8/13/71 | No | |
| 567 | A | 8/ 2 - 8/16/71 | Yes | 0 week |
| 569 | A | 8/10 - 10/15/71 | Yes | 5 weeks |
| 524 | J | 9/13 - 10/ 3/71 | No | 9 weeks |
| 581 | A | 8/12 - 9/ 5/71 | Yes | 5 weeks |
| 621 | J | 9/ 8 - 9/28/71 | No | 8 weeks |

*Age at start of tracking period

of quail. The results do not agree with the observations of Shick (1952) or Weston (1954). They reported restriction of pheasant movement by high wind velocity. However, their studies were both conducted in the winter.

Distance birds moved between locations was found to be highly variable. The average distance moved was 0.10 mile with a standard deviation of 0.12 mile. The inclusion of hens with broods of various ages probably accounts for much of this variation. Hanson (1971) found movements of hens increased directly with the age of broods. Also, no correlation was found between direction of bird movement and wind direction.

## Location of Birds

Because acreages of cover types varied during this study, percentage-of-bird-location data and habitat-use indices were compiled for each year separately (Appendix Tables 2, 3, 4).

In 1969, three cover types showed the widest variations between the categories of barometric pressure (Table 4). The percentage of bird locations in corn and small grain decreased by one-half as the pressure went from the lowest pressure category to the highest. Bird locations in alfalfa showed exactly an opposite trend, almost doubling as the pressure increased. Use in treerow and farmstead also doubled with an increase in barometric pressure from the less than 28.12 inch category to the over 28.29 category. The percentage of bird locations in corn and residual cover were the only values that changed greatly between the divisions of wind velocity. Bird locations in corn increased at wind

Table 4. Percentage of locations in cover types, 1969.

| | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| Barometric pressure | | | | | | | | | | |
| Less than 28.11 | 55 | 14.5 | 21.8 | 34.5 | 3.6 | 14.5 | 5.5 | 0.0 | 1.8 | 3.6 |
| 28.11-28.29 | 85 | 21.2 | 25.9 | 21.2 | 1.3 | 21.2 | 8.2 | 0.0 | 1.3 | 0.0 |
| 28.30 or higher | 92 | 8.7 | 28.3 | 16.3 | 1.1 | 30.4 | 10.9 | 1.1 | 1.1 | 2.0 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 128 | 8.6 | 33.6 | 19.5 | 0.0 | 26.6 | 7.8 | 0.8 | 0.0 | 3.1 |
| Over 8 mph | 104 | 22.1 | 16.3 | 26.0 | 3.8 | 19.2 | 9.6 | 0.0 | 2.9 | 0.0 |
| Precipitation | | | | | | | | | | |
| None | 206 | 16.0 | 21.4 | 24.8 | 1.9 | 25.7 | 7.3 | 0.5 | 1.5 | 1.0 |
| Any amount | 26 | 3.8 | 61.5 | 3.8 | 0.0 | 3.8 | 19.2 | 0.0 | 0.0 | 7.7 |

velocities over 8 mph, while locations in residual cover fell sharply. Large differences occurred in almost all cover types between the precipitation categories, but the small number of locations (26) in the zero precipitation division is probably responsible for these differences.

In 1970, no large changes in percentage of locations were noted in any cover type (Table 5). Locations in corn accounted for over 50 percent of the locations in all weather categories. The percentage of locations in residual cover and alfalfa were much lower than the 1969 figures.

The percentage of bird locations in each cover type remained close to the same levels in 1971 as they were in 1970 (Table 6). Fifty percent or more of all locations were in corn. The only changes in use occurred between the wind-velocity categories. Bird locations in corn increased by one-third between the low and high wind-velocity categories while locations in residual cover and alfalfa decreased by one-half.

For the three-year period, the highest percentage of locations were in corn, residual cover, alfalfa, and small grain.

Table 5. Percentage of locations in cover types, 1970.

| | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| Barometric pressure | | | | | | | | | | |
| Less than 28.11 | 74 | 60.8 | 10.8 | 12.2 | 8.1 | 4.0 | 0.0 | 4.0 | 0.0 | 0.0 |
| 28.11-28.29 | 66 | 65.2 | 0 | 16.7 | 10.6 | 6.0 | 0.0 | 1.5 | 0.0 | 0.0 |
| 28.30 or higher | 56 | 66.1 | 14.3 | 14.3 | 1.8 | 3.6 | 0.0 | 0 | 0.0 | 0.0 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 83 | 56.6 | 9.6 | 13.9 | 7.2 | 7.2 | 0.0 | 1.2 | 0.0 | 0.0 |
| Over 8 mph | 113 | 69.0 | 7.1 | 11.5 | 7.1 | 2.7 | 0.0 | 2.7 | 0.0 | 0.0 |
| Precipitation | | | | | | | | | | |
| None | 179 | 64.2 | 7.3 | 14.0 | 7.8 | 5.0 | 0.0 | 1.7 | 0.0 | 0.0 |
| Any amount | 17 | 58.8 | 17.6 | 17.6 | 0.0 | 0.0 | 0.0 | 5.9 | 0.0 | 0.0 |

Table 6. Percentage of locations in cover types, 1971.

| | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| Barometric pressure | | | | | | | | | | |
| Less than 28.11 | 156 | 63.5 | 9.0 | 3.8 | 5.8 | 16.0 | 1.3 | 0.6 | 0.0 | 0.0 |
| 28.11-28.29 | 232 | 56.5 | 6.0 | 5.2 | 6.5 | 21.1 | 2.2 | 2.6 | 0.0 | 0.0 |
| 28.30 or higher | 252 | 63.5 | 10.3 | 3.6 | 3.2 | 16.7 | 1.2 | 1.6 | 0.0 | 0.0 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 442 | 54.3 | 10.0 | 4.8 | 5.0 | 21.7 | 2.0 | 2.0 | 0.0 | 0.0 |
| Over 8 mph | 198 | 75.8 | 5.1 | 3.0 | 5.1 | 10.1 | 0.5 | .5 | 0.0 | 0.0 |
| Precipitation | | | | | | | | | | |
| None | 555 | 59.8 | 8.6 | 4.5 | 5.2 | 18.4 | 1.6 | 1.8 | 0.0 | 0.0 |
| Any amount | 85 | 68.2 | 7.1 | 2.3 | 3.4 | 16.5 | 1.2 | 1.2 | 0.0 | 0.0 |

## Habitat Use Indices

While the percentage of locations in various cover types provides a general indication of habitat use under varying weather conditions and overall use, habitat-use indices were compiled to determine habitat preferences. An index for each weather class was prepared for each of the 3 years of study. These indices were then combined and a weighted mean index value calculated for each weather class.

Alfalfa was the preferred cover type under all conditions (mean index 2.2-4.8). Corn was the only other cover type for which a preference was shown under all conditions (mean index 1.2-1.8).

Under low barometric pressure conditions, alfalfa, corn and residual cover were the preferred habitat types with indices over 1.0 (Table 7). Pasture and ditches had indices of 0.7 while all other cover types were 0.5 or less. In the mid-range class of pressures alfalfa, corn, residual cover, and treerow and farmstead were the preferred cover types. Preference for alfalfa and treerow and farmstead increased markedly in this class. Use of other cover types remained at the same levels. Under high pressure conditions the same four types remained preferred, but residual cover was preferred over corn, increasing from a mean index of 1.0 to 1.8. No changes in preference were noted in any other cover type.

Analysis of wind velocity showed three major shifts in preference (Table 8). At low wind velocity the mean index value for alfalfa was at the highest point (4.8). Other preferred cover types at low wind

Table 7. Cover-use index based on changes in barometric pressure.

| Year | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Station pressure 28.11 or less | | | | | |
| 1969 | 55 | 0.5 | 1.1 | 1.4 | 0.4 | 2.4 | 1.5 | 0.0 | 1.8 | 0.6 |
| 1970 | 74 | 1.9 | 0.5 | 0.5 | 0.9 | 1.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| 1971 | 156 | 1.7 | 1.8 | 0.1 | 0.7 | 4.0 | 0.4 | 0.3 | 0.0 | 0.0 |
| Weighted mean index | | 1.5 | 1.3 | 0.5 | 0.7 | 2.9 | 0.5 | 0.7 | 0.4 | 0.1 |
| | | | | | Station pressure 28.11-28.29 | | | | | |
| 1969 | 85 | 0.7 | 1.4 | 0.8 | 0.1 | 3.5 | 2.7 | 0.0 | 1.3 | 0.0 |
| 1970 | 66 | 2.0 | 0.0 | 0.7 | 1.2 | 1.5 | 0.0 | 0.8 | 0.0 | 0.0 |
| 1971 | 232 | 1.5 | 1.2 | 0.2 | 0.8 | 5.3 | 0.7 | 1.3 | 0.0 | 0.0 |
| Weighted mean index | | 1.4 | 1.0 | 0.4 | 0.7 | 4.3 | 1.0 | 0.9 | 0.3 | 0.0 |
| | | | | | Station pressure 28.30 or higher | | | | | |
| 1969 | 92 | 0.3 | 1.5 | 0.7 | 0.1 | 5.1 | 3.6 | 0.6 | 1.1 | 0.3 |
| 1970 | 56 | 2.1 | 0.7 | 0.6 | 0.2 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1971 | 252 | 1.7 | 2.1 | 0.1 | 0.4 | 4.2 | 0.4 | 0.8 | 0.0 | 0.0 |
| Weighted mean index | | 1.4 | 1.8 | 0.3 | 0.4 | 4.0 | 0.1 | 0.6 | 0.3 | 0.1 |

Table 3. Cover-use index based on changes in wind velocity.

| Year | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Wind velocity 0-8 mph* | | | | | |
| 1969 | 128 | 0.3 | 1.8 | 0.8 | 0.0 | 4.4 | 2.6 | 0.4 | 0.0 | 0.5 |
| 1970 | 83 | 1.8 | 0.5 | 0.6 | 0.8 | 1.8 | 0.0 | 0.6 | 0.0 | 0.0 |
| 1971 | 442 | 1.2 | 1.8 | 0.4 | 0.5 | 4.8 | 1.0 | 0.8 | 0.0 | 0.1 |
| Weighted mean index | | 1.2 | 1.8 | 0.4 | 0.5 | 4.8 | 1.0 | 0.8 | 0.0 | 0.1 |
| | | | | | *Wind velocity over 8 mph* | | | | | |
| 1969 | 104 | 0.8 | 0.9 | 1.0 | 0.4 | 3.2 | 3.2 | 0.0 | 2.9 | 0.0 |
| 1970 | 113 | 2.2 | 0.4 | 0.5 | 0.8 | 0.7 | 0.0 | 1.4 | 0.0 | 0.0 |
| 1971 | 198 | 2.0 | 1.0 | 0.1 | 0.6 | 2.5 | 0.2 | 0.3 | 0.0 | 0.0 |
| Weighted mean index | | 1.8 | 0.8 | 0.4 | 0.6 | 2.2 | 0.9 | 0.5 | 0.7 | 0.0 |

velocities were residual cover, corn and treerow and farmstead. When wind velocity increased to over 8 mph the only cover types still preferred by the birds were alfalfa and corn. The highest preference for corn (1.8) was reached under this condition while the lowest levels of 0.8 and 2.2 were reached for residual cover and alfalfa respectively.

During precipitation, preference for residual cover and treerow and farmstead increased markedly with the mean index for treerow and farmstead reaching 1.6, the highest level recorded (Table 9). Preference for alfalfa dropped rather sharply, going from 3.9 to 2.8 during periods of precipitation. Most other cover type preferences remained at the same level or dropped slightly during precipitation.

Table 9. Cover-use index based on occurrence of precipitation.

| Year | Number of Locations | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Spoil Pits | | Summer Fallow |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Precipitation none | | | | | |
| 1969 | 206 | 0.6 | 1.1 | 1.0 | 0.2 | 4.3 | 2.4 | 0.3 | 1.5 | 0.2 |
| 1970 | 179 | 2.0 | 0.4 | 0.6 | 0.9 | 1.3 | 0.0 | 0.8 | 0.0 | 0.0 |
| 1971 | 555 | 1.6 | 1.7 | 0.1 | 0.7 | 4.6 | 0.5 | 0.9 | 0.0 | 0.0 |
| Weighted mean index | | 1.5 | 1.3 | 0.4 | 0.6 | 3.9 | 0.8 | 0.8 | 0.3 | 0.0 |
| | | | | | Precipitation any amount | | | | | |
| 1969 | 26 | 0.1 | 3.2 | 0.2 | 0.0 | 0.6 | 6.4 | 0.0 | 0.0 | 1.3 |
| 1970 | 17 | 1.8 | 0.9 | 0.7 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 |
| 1971 | 85 | 1.8 | 1.4 | 0.1 | 0.4 | 4.1 | 0.4 | 0.6 | 0.0 | 0.0 |
| Weighted mean index | | 1.5 | 1.7 | 0.2 | 0.3 | 2.8 | 1.6 | 0.8 | 0.0 | 0.3 |

# DISCUSSION AND CONCLUSION

No significant relationships were found between distance of bird movement and any of the weather factors tested (P 0.05). Other studies such as that by Klonglan (1955), have shown weather to have an effect on daily activity of pheasants. In this study the weather parameters tested were assumed to reflect other weather elements. Further testing of additional weather factors may prove this assumption false. Normal daily fluctuations of weather elements did not affect pheasant activities to a large degree.

Mean index values for alfalfa and corn were high (greater than 1.0) for all weather conditions; mean index values for residual cover and treerows and farmstead were high under most conditions. While the preference for alfalfa was high at all times, it did vary. Under conditions of precipitation, high wind velocity, and low barometric pressure the preference index for alfalfa was much lower. With these same conditions an increase in use of corn and residual cover was noted. This seems to be a logical shift in usage because these two cover types offered more protection from the elements.

Index values for residual cover remained high the last year of the study despite the large reduction in amount of residual cover available, indicating a strong preference for this type of cover.

This was a quantitative study of habitat preference. Variations in quality of different cover types suggest that a qualitative study of habitat use could provide answers to questions about habitat preference.

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# APPENDIX

Appendix Table 1. Summary of weather information.

| | Barometric Pressure | | | Wind Velocity | | Precipitation | | Temperature | |
|---|---|---|---|---|---|---|---|---|---|
| | High | Low | Ave | High | Ave | Amount | ± Normal | Amount | ± Normal |
| **1969** | | | | | | | | | |
| June | 28.54 | 27.39 | 28.10 | 24 | 10.0 | 7.20 | +3.25 | 58.5 | -8.6 |
| July | 28.54 | 27.96 | 28.25 | 17 | 8.3 | 3.58 | +1.33 | 69.6 | -3.6 |
| Aug. | 28.45 | 27.88 | 28.21 | 24 | 10.1 | 1.53 | -1.44 | 69.7 | -1.5 |
| Sept. | 28.56 | 27.87 | 28.30 | 22 | 9.0 | 1.32 | -0.65 | 59.8 | -1.5 |
| Oct. | 28.63 | 27.68 | 28.26 | 23 | 10.0 | 1.87 | +0.65 | 42.0 | -7.5 |
| **1970** | | | | | | | | | |
| June | 28.51 | 27.79 | 28.17 | 23 | 10.9 | 4.22 | +0.27 | 66.8 | -0.3 |
| July | 28.56 | 28.00 | 28.24 | 20 | 8.5 | 2.35 | +0.20 | 71.0 | -2.2 |
| Aug. | 28.44 | 27.96 | 28.23 | 18 | 7.6 | 1.24 | -1.73 | 68.5 | -2.7 |
| Sept. | 28.56 | 27.69 | 28.22 | 24 | 9.4 | 1.13 | -0.84 | 58.2 | -3.1 |
| Oct. | 28.72 | 27.75 | 28.18 | 24 | 10.2 | 2.72 | +1.50 | 47.7 | -1.8 |
| **1971** | | | | | | | | | |
| June | 28.41 | 27.86 | 28.18 | 17 | 6.7 | 5.16 | +1.21 | 68.6 | +1.5 |
| July | 28.51 | 27.98 | 28.26 | 15 | 6.8 | 1.13 | -1.02 | 65.9 | -7.3 |
| Aug. | 28.57 | 28.04 | 28.28 | 18 | 7.0 | 3.00 | +0.03 | 68.6 | -2.6 |
| Sept. | 28.63 | 27.82 | 28.23 | 24 | 8.0 | 0.88 | -1.09 | 57.7 | -3.6 |
| Oct. | 28.62 | 27.52 | 28.22 | 24 | 7.7 | 3.56 | +2.34 | 48.7 | -0.8 |

Appendix Table 2. Number of locations in cover types, 1969.

| | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow | Total Locations |
|---|---|---|---|---|---|---|---|---|---|---|
| Station pressure | | | | | | | | | | |
| Less than 28.11 | 8 | 12 | 19 | 2 | 8 | 3 | 0 | 1 | 2 | 55 |
| 28.11-28.29 | 18 | 22 | 18 | 1 | 18 | 7 | 0 | 1 | 0 | 85 |
| 28.30 or higher | 8 | 26 | 15 | 1 | 28 | 10 | 1 | 1 | 2 | 92 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 11 | 43 | 25 | 0 | 34 | 10 | 1 | 0 | 4 | 128 |
| Over 8 mph | 23 | 17 | 27 | 4 | 20 | 10 | 0 | 3 | 0 | 104 |
| Precipitation | | | | | | | | | | |
| None | 33 | 44 | 51 | 4 | 53 | 15 | 1 | 3 | 2 | 206 |
| Any amount | 1 | 16 | 1 | 0 | 1 | 5 | 0 | 0 | 2 | 26 |

Appendix Table 3. Number of locations in cover types, 1970.

| | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow | Total Locations |
|---|---|---|---|---|---|---|---|---|---|---|
| Station pressure | | | | | | | | | | |
| Less than 28.11 | 45 | 8 | 9 | 6 | 3 | 0 | 3 | 0 | 0 | 74 |
| 28.11-28.29 | 43 | 0 | 11 | 7 | 4 | 0 | 1 | 0 | 0 | 66 |
| 28.30 or higher | 37 | 8 | 8 | 1 | 2 | 0 | 0 | 0 | 0 | 56 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 47 | 8 | 15 | 6 | 6 | 0 | 1 | 0 | 0 | 83 |
| Over 8 mph | 78 | 8 | 13 | 8 | 3 | 0 | 3 | 0 | 0 | 113 |
| Precipitation | | | | | | | | | | |
| None | 115 | 13 | 25 | 14 | 9 | 0 | 3 | 0 | 0 | 179 |
| Any amount | 10 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 17 |

Appendix Table 4. Number of locations in cover types, 1971.

| | Corn | Residual Cover | Small Grain | Pasture | Alfalfa | Treerow & Farmstead | Ditches | Spoil Pits | Summer Fallow | Total Locations |
|---|---|---|---|---|---|---|---|---|---|---|
| Station pressure | | | | | | | | | | |
| Less than 28.11 | 99 | 14 | 6 | 9 | 25 | 2 | 1 | 0 | 0 | 156 |
| 28.11-28.29 | 131 | 14 | 12 | 15 | 49 | 5 | 6 | 0 | 0 | 232 |
| 28.30 or higher | 160 | 26 | 9 | 8 | 42 | 3 | 4 | 0 | 0 | 252 |
| Wind velocity | | | | | | | | | | |
| 0-8 mph | 240 | 44 | 21 | 22 | 96 | 9 | 10 | 0 | 0 | 442 |
| Over 8 mph | 150 | 10 | 6 | 10 | 20 | 1 | 1 | 0 | 0 | 198 |
| Precipitation | | | | | | | | | | |
| None | 332 | 48 | 25 | 29 | 102 | 9 | 10 | 0 | 0 | 555 |
| Any amount | 58 | 6 | 2 | 3 | 14 | 1 | 1 | 0 | 0 | 85 |