Spring and Summer Habitat Preferences of Blue Grouse on the Bear River Range, Utah

Robert M. Maestro
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SPRING AND SUMMER HABITAT PREFERENCES OF
BLUE GROUSE ON THE BEAR RIVER RANGE, UTAH

by

Robert M. Maestro

A thesis submitted in partial fulfillment
of the requirements for the degree
of
MASTER OF SCIENCE
in
Wildlife Biology

UTAH STATE UNIVERSITY
Logan, Utah

1971
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The author is also indebted to Norman Slade for his help with the statistical analysis.

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Robert M. Maestro
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ABSTRACT

Spring and Summer Habitat Preferences of Blue Grouse on the Bear River Range, Utah

by

Robert M. Maestro, Master of Science
Utah State University, 1970

Major Professor: Dr. Jessop B. Low
Department: Wildlife Resources

A study of the spring and summer habitat preferences of blue grouse was conducted on the Bear River Range in northern Utah. The main objective was to determine the important factors associated with habitat selection by blue grouse during the breeding season.

One hundred and two sampling areas, delimited by similarities in vegetation and topography, were thoroughly searched with a dog for blue grouse. Fifty-four biological and physical variables were measured for each sampling area.

Chi-square tests performed on all variables showed 11 of the 54 variables to be significant at an alpha of 0.20. These 11 variables (listed below) were considered to be the important factors influencing habitat selection by blue grouse.

(1) search area type
(2) area exposure
(3) elevation
(4) percent forested
(5) understory density
The chi-square test only determined if a variable significantly effected habitat selection by blue grouse. To determine whether this effect was positive or negative, the percent occurrence of areas on which blue grouse were present, or absent, was determined. Results indicated that the most favorable blue grouse habitat was draws at 5,500-6,499 feet elevation. This favorable habitat contained 1-10 percent cover by maples, or a higher percent of maple which provided a large amount of edge effect; the presence of mixed brush or sagebrush, a medium understory, and an area incline of 5-19 percent.
INTRODUCTION

Blue grouse (*Dendragapus obscurus*) were first discovered by Say in 1820, and classified by him as *Tetrao obscurus* (James, 1823). Since their discovery, blue grouse have undergone many name changes. Original names, reference to original descriptions, and present names for each subspecies were given in the A.O.U. Check-List of North American Birds (American Ornithologist's Union Committee, 1957).

Blue grouse are members of the family Tetraonidae (grouse and ptarmigans), within the order Galliformes (gallinaceous birds), of the superorder Neognathae (typical birds) within the subclass Neornithes (true birds), all of which comes under the class Aves (birds) (American Ornithologist's Union Committee, 1957).

Eight subspecies of blue grouse are recognized: *D. o. obscurus* (Dusky grouse), *D. o. richardsonii* (Richardson's grouse), *D. o. fuliginosus* (Oregon grouse), *D. o. sitkensis* (Sitka grouse), *D. o. sierrae* (Sierra grouse), *D. o. howardi* (Mount Pinos grouse), and *D. o. oreinus* (Great Basin grouse), (Aldrich, 1963).

Blue grouse are found in the western portions of Canada and the United States. Populations extent southward to the southern half of New Mexico, northward into the Yukon, and eastward from the west coast to the eastern portion of Colorado (Figure 1).

*D. o. oreinus, D. o. obscurus, and D. o. pallidus* may possibly be found in Utah (Figure 1). The species present on the study area was believed to be *D. o. obscurus* (Stanford, 1932; Lee, 1936; Behle, 1944; and Aldrich, 1963).
Figure 1. Original distribution of blue grouse (*Dendragapus obscurus*) subspecies. From Aldrich (1963).
Objectives

Klyver and Tinbergen (1953, p274) working with titmice, stated that, "in principle, density at a certain locality is determined by three main processes: reproduction, mortality and habitat selection (in a broad sense)." Since habitat is the easiest of these factors to manage, it seems logical that management of blue grouse should head in this direction. It therefore appeared appropriate for initial research on blue grouse in Utah to be directed toward the determination of habitat requirements.

The main purpose of this study was to give proper direction for future habitat studies on blue grouse in Utah. The second purpose was to give sufficient background information for other phases of blue grouse research. This information is given in an enlarge literature review.

Objectives of this study were (1) to determine the important factors associated with habitat selection by blue grouse during spring and summer, and (2) to prepare recommendations for future blue grouse research in Utah.

Blue grouse occupy two completely different types of habitat during the year. During late fall and winter, the grouse occupy coniferous areas at high elevations. As spring approaches, the birds move to the lower elevations of the foothills for the breeding season, and remain there until the chicks are near maturity in late summer (Anthony, 1903; Munro, 1919; Caswell, 1954a; Mussehl, 1960; and others). The breeding season habitat was selected for the study due to the greater population regulation and management implications associated with it.
REVIEW OF LITERATURE

General


For general articles on *D. o. obscurus*, see Caswell (1954a), Heebner (1956), Steinhoff (1956), and Mussehl (1960). A relatively thorough account of *D. o. obscurus* in Colorado has been compiled by Rogers (1968). Aside from Nygren (1962), no published studies were found on blue grouse in Utah. Harvest information on blue grouse in Utah is given by Utah State Division of Fish and Game (1969). A comparison of life histories of blue grouse with other game birds was given by Bent (1932) and Edminster (1954).

Migration

Bendell (1954 and 1955a) reported that migration of males to higher elevations during late summer and fall coincided with cessation of breeding activity. They believed that the migration of hens and young followed the altitudinal maturation of plant foods. Bendell also reported that most yearling males do not breed and do not migrate
from the winter range the first spring after hatching, and that this was correlated with a lack of gonadal development.

Anthony (1903), Munro (1919), Lincoln (1920), Brooks (1926), Wing (1947), Caswell (1954a), Heebner (1956), Mussehl (1960), Blackford (1963), and others, have also described the process of migration. Fall brood migration was described by Wing, Beer, and Tidyman (1944).

Zwickel, Buss and Brigham (1968) measured fall migration distances of blue grouse in Vancouver, British Columbia. Fifty percent of their tagged birds were recovered over 5 miles from the breeding range. Roger's (1968) measurements in Colorado indicated movement no further than 1,000-3,000 feet.

**Capture and Tagging Techniques**

Zwickel and Bendell (1967) used a snare on the end of a telescoping aluminum pole to capture blue grouse. Most researchers believe this to be the most efficient method for capture of adults. Mussehl (1960) used a 30-36 inch diameter hoop net on a 9-10 foot handle. This method appeared to be best suited for brood capture. Anderson and Hamerstrom (1967) used a prairie chicken stuffed in the precoupulatory position to lure male prairie chickens to a bow net or noose carpet. During the thesis research, this same method was used, substituting a stuffed female blue grouse, a snaring pole, and taped female mating calls.

Tomlinson (1963) developed a method for drive trapping female blue grouse and their broods. Drewien, et al. (1967) developed a back-packing, night-lighting outfit for capturing ducks and pheasants. Such a unit might be suitable for capturing blue grouse in areas easily accessible at night. Humphrey, Bridge and Lovejoy (1968) have
developed a one man, portable mist-netting system for capture of birds at heights of at least 30 meters. This method may be successful with blue grouse due to their habit of soaring down the middle of a draw at heights below 30 meters when flushed.

The tagging method of Labisky and Mann (1962) has been successful on upland game birds. Rectangular, plastic colored tags were pinned to the back of the neck with safety pins. This method was used successfully by Philips (1965) on ruffed grouse in northern Utah, and could easily be used with blue grouse.

Pyrah (1964) used the same type of material as Labisky and Mann, but with a hole in the center. This was placed over the head of the bird, and the neck feathers resisted movement over the head. Many upland game bird researchers prefer the tagging method of Pyrah over that of Labisky and Mann.

Dyeing plumage with Rhodamine B, Auramine, Methyl Violet, or Victoria Green saturated in 95 percent ethanol was a successful marking method with ruffed grouse (Gullion, Eng and Kupa, 1961). Bendell (1954) used Christmas ornament balls filled with lacquer which were thrown at blue grouse.

Sexing and Aging Techniques

Sexing of blue grouse is easy with the bird in hand. The side of the neck is stroked upward, and a flash of white is evidence of a male (Caswell, 1954b; Boag, 1965). Mussehl and Leik (1963) compared lengths of the 6th, 8th, and 10th primaries for determination of sex.

Distinction between juvenile and adults was determined by van Rossem (1925) using outer retrices, and by Boag (1965) who used
retricies and outer primaries. Boag found weight to be unreliable as an aging technique. Bendell (1955a and 1955b) also described aging techniques. Many of the techniques described by Petrides (1942) for aging American gallinaceous game birds may be useful in aging blue grouse.

Smith and Buss (1963) were able to separate juvenile blue grouse into weekly age categories using growth rates and molt characteristics. Zwickel and Lance (1966) modified the method of Smith and Buss, making weekly age determination easier and more accurate.

Parasites and Disease

Mitchell and Bigland (1960) found larval forms of Physaloptera sp. (a nematode of the digestive tract) encysted in the breast of D. o. fuliginosus from three western states for external and internal parasites. Names and numbers of parasites were given. Buss, Conrad, and Reilly (1958) found ulcerative enteritis in captive blue grouse.

Pesticides

Hoffmann, Janson, and Hartkorn (1958) found no adverse effects on blue grouse with application of DDT at 1 pound per acre. Mussehl and Finley (1967) also applied DDT at 1/2 pound per acre. A significant negative effect on survival or productivity was not shown. Finley (1965) compared bird activity before and after application of phosphamidon at the rate of 1 pound per acre. He found a decrease in activity on sprayed plots and an increase on unsprayed plots.
Breeding Behavior

Bent (1932) gave one of the most thorough accounts of the breeding behavior of most of the subspecies of blue grouse. Other good accounts of breeding behavior were found in Wing (1946), Bendell (1955a), Hoffmann (1956), Blackford (1958 and 1963), and Rogers (1968). Specific information on nesting and renesting was found in Pemberton (1928) and Zwickel and Lance (1965).

Blackford (1963) went into much detail about blue grouse vocalizations and their relation to communication. Vocalization in relation to breeding behavior was also described by Edson (1925), Brooks (1926), Stewart (1967), and Rogers (1968).

Breeding age was discussed by Buss and Schottelius (1954), and breeding phenology by Boag (1965). Male display postures were illustrated by Brooks (1926), Bendell and Elliott (1966a), and Rogers (1968). Bendell and Elliott (1966a) found that males returned to almost exactly the same territory each year, as shown by their maps illustrating the territorial boundaries of males for consecutive years.

Census Methods

Rogers (1963:579), in surveying all census techniques for blue grouse, found that "blue grouse census studies range from none at all to complicated procedures involving almost year-round effort." A census method utilizing recorded female mating calls was developed by Stirling and Bendell (1966). The call elicited response from males.
These authors also used tape recordings of chick distress calls for response from females. Hoffmann (1956) attempted census by counting displaying males in the spring and analyzing roost sites in the winter.

**Food Preferences**

Food habits of blue grouse have been studied by Bendire (1889), Munro (1919), Fowle (1944), Stewart (1944), Marshall (1946), Hoffmann (1961), Boag (1963) and Rogers (1968).

Curtis and Elder (1965), studied the effects of blue grouse feeding on ponderosa pine (*Pinus Ponderosa*) seedlings. Lawrence, Kverno, and Hartwell (1961) have compiled a guide which enables one to identify damage by blue grouse to Douglas fir (*Pseudotsuga menziesii*).

Lacher and Lacher (1965) successfully raised blue grouse in captivity for 5 years. They started the birds on natural foods and eventually maintained them on commercial feeds.

**Taxonomy**

Ridgeway and Friedman (1946) presented the most detailed account of taxonomy of blue grouse. They gave thorough descriptions of subspecies, listed synonyms, and listed references which made mention of each synonym. The authors also included a key for separation of subspecies. They recognized all subspecies except *D. o. orienus*, which was subsequently described by Behle and Selander (1951).

Additional information on the taxonomy of blue grouse was given by Brooks (1926), Swarth (1926 and 1931), and Hoffmann (1956).
Moffitt (1938) described the downy young for six of the eight subspecies and included a color plate.

**Habitat**

Many workers have described the breeding habitat of blue grouse. Boag (1958) described habitat use in Alberta, Canada. Heebner (1956) discussed habitat selection of blue grouse in Idaho. Many workers have described habitat selection for blue grouse in British Columbia, Canada. Among these are Munro and Cowan (1947), Bendell (1954) Fowle (1960), and Zwickel (1965). Jewett et al. (1953) described habitat selection of blue grouse in the state of Washington. Hoffmann (1956) described the habitat utilized by blue grouse in California, and Rogers (1968) discussed habitat selection in Colorado. Caswell (1954a) presented a chart depicting monthly use of cover by blue grouse in west central Idaho.

Other researchers have also given descriptions of habitat used by breeding blue grouse—Bendire (1889), Bent (1932), Beer (1943), Wing, Beer and Tidyman (1944), Caswell (1954a), and Aldrich (1963). One of the few studies on blue grouse habitat for all seasons was given by Marshall (1946).
THE STUDY AREA

The study area (Figure 2) was within the Bear River Range which extends in a north-south direction, forming the eastern boundary of Cache Valley, Cache County, Utah. The Bear River Range merges with the Wasatch Range at the southern end of the Valley. This area was chosen because it appeared to contain a good concentration of blue grouse. Information on concentrations of blue grouse in this area was obtained from reports by the U. S. Forest Service and the Utah Division of Fish and Game.

The region below heavily timbered areas was rugged and steep, with many slopes rising 2,000 feet in 1 mile. Areas within timbered areas were less steep and rugged (Figures 3 and 4). Nygren (1963) divided vegetation in the area into two basically different types, separated by an arbitrary 7,500 foot elevation line. Nygren (1963, p 4-5) gives the following description:

Above 7500-foot altitudes shaded north-facing slopes were primarily of alpine fir, Douglas-fir, and occasionally limber pine and white fir. Quaking aspen was found on moist canyon floors and some north-facing slopes.

South-facing slopes above 7500-foot altitudes occasionally contained Douglas-fir and quaking aspen, but usually contained Utah juniper and some bigtooth maple, curleaf mountain-mahogany, limber pine and Rocky Mountain juniper. Clearings and ridges usually contained black sagebrush, snowbrush, and occasionally beardless bluebunch wheatgrass.

Below 7500-foot altitudes vegetation may be further classified as to north-facing or south-facing slopes. In general vegetation was more dense on north-facing than south-facing slopes. Dense growths of big-tooth maple or true mountain mahogany occurred on some north-facing slopes. In canyon floors, boxelder, chokecherry, narrowleaf cottonwood, skunkbrush sumac, water birch, and willows were common.
Figure 2. Location of study area relative to the state of Utah.
Figure 3. Portion of study area depicting typical topography.
Figure 4. Portion of study area depicting typical topography
South-facing slopes were generally of two major types: (1) juniper/sagebrush/cheatgrass, or (2) maple/sagebrush/bunchgrass-cheatgrass. Nygren (1963, p 4-5)

Notation of the common and scientific names of vegetation on the study area are given in Appendix D.
METHODS AND PROCEDURES

Selection of Sampling Areas

Once male blue grouse establish their territories on the breeding range their activities are restricted to an area of 1-2 acres (Bendell, 1955a; Blackford, 1958 and 1963) until the fall migration begins. It appeared from field observations that the area in which both males and females were restricted corresponded well with the boundaries of a topographic feature, such as a draw, and/or a specific type of plant community. The importance of the plant community was also expressed by Seiskari (1962). He noted that most of the important environmental factors in the breeding habitat were related to the plant community, or, were dependent upon it. Therefore, the selection of sampling was based on plant communities and topography. There were basically four different types of topography, and consequently four types of sampling areas: draws, inclines, flats, and ridge tops (Appendix C)(Figures 5 and 6).

The boundaries of a sampling area were first determined by topography (either a draw, incline, flat or ridge top), and secondly by plant communities. If one type of plant community occupied the topographic type, the entire topographic type was considered as one sampling area. One topographic type was divided into more than one sampling area only if there was more than one plant community present (Figure 7). Differences in plant communities were determined at the brush, shrub, and tree levels only.
Figure 5. An inclined sampling area.
Figure 6. A draw sampling area.
An inclined area divided into three sampling areas

A draw divided into three sampling areas

Figure 7. Examples of conditions under which a topographic type was divided into more than one sampling area. Dotted lines separate individual sampling areas.
Search Techniques

Once the boundaries of the sampling area were determined, the sampling area was searched by walking or riding (on horseback) transects with a black Labrador retriever. The same dog was used on all sampling areas. Search was begun at a boundary of the sampling area, and a straight line of sight transect was followed to the opposite boundary. The next transect was followed back to the boundary from which searching began. The distance between transects varied, depending on the width of area covered by the dog, so that all transects overlapped.

Transects were run over the entire sampling area until a blue grouse was flushed. When one blue grouse was flushed, search of that sampling area was discontinued, and the sampling area was classified as one in which blue grouse were present. If the entire sampling area was searched with no blue grouse being flushed, it was classified as a sampling area in which blue grouse were absent.

Within the study area, 102 sampling areas (composed of draws, inclines, flats, or ridge tops) were searched for blue grouse. Sampling areas were chosen selectively within the study area to insure a sampling of as many different types of habitat as possible. Search of relatively similar sampling areas and elevations was distributed evenly throughout the time the study was conducted.

Dates for initial occupation of the breeding range by blue grouse, and dates for initiation of fall migration vary regionally (Anthony, 1903; Marshall, 1946; Wing, 1947; Caswell, 1954a; Bendell, 1955a; and Mussehl, 1960). Dates from the above references along with personal
observations during 1968 and 1969 were used as a guide in determining the initiation and duration of searching operations. Sampling areas were searched from May 17 to July 25, 1969.

Once established on the breeding range, blue grouse activity is concentrated in the early morning and late afternoon (Caswell, 1954a; and Bendell, 1955a). Bendell (1955a), reported that these activity periods were regulated by light intensity. The lengths of morning and afternoon activity periods were determined from hooting counts, and all searching was performed between these two periods.

Selection and Measurement of Variables

Fifty-four variables (Appendix A) expressing differences in biological and physical characteristics of the environment, were measured for each sampling area. Selection of variables was determined from observations by the author during 1968, and from reports of other researchers, such as Munro (1919), Caswell (1954a), Mussehl (1960), and Zwickel, Buss and Brigham (1968).

All incline measurements were taken with an Abney level. The average of several measurements was taken to decrease error.

Measurement of many variables was taken from 1963 U.S. Forest Service aerial photographs. All photographs were scaled 1:15,840 at the datum plane. Most sampling areas were above the datum plane, therefore all measurements from photographs (except for total acres) were taken in large enough intervals to encompass changes in scale. This was shown in test plots with changes in photographic scale up 1/2 inch. Wilson (1949) and Moessner (1957) reported that when using
effective areas of contact aerial photographs, no bias in measurement results when local relief ranges from 500-1,000 feet. Only effective areas on contact aerial photographs were used in this study.

Before field data collection began, all variables were sub-divided into categories, examples of which follows:

<table>
<thead>
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<th>Variable</th>
<th>Categories</th>
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<tr>
<td>sampling area type</td>
<td>draw; incline; flat; ridge top</td>
</tr>
<tr>
<td>location--township</td>
<td>actual</td>
</tr>
<tr>
<td>area exposure</td>
<td>N; S; E; W; NE; NW; SE; SW</td>
</tr>
<tr>
<td>area percent incline</td>
<td>0-5%; 6-10%; 11-20%; 21-30%; 31-40%; 41-50%;</td>
</tr>
<tr>
<td></td>
<td>51-60%; 61-70%; 71-80%; 81-90%; over 90%</td>
</tr>
</tbody>
</table>

The recorded measurement of each variable was selected from one of the pre-established categories of that variable.

**Statistical Analysis**

All data were coded and placed on I.B.M. cards. The data were then summarized utilizing a computerized quest program. Summations for each variable were placed in contingency tables (an example of which is given below). Sampling areas on which blue grouse were present (hereby referred to as "present" areas) were compared with sampling areas on which blue grouse were absent (hereby referred to as "absent" areas) for all categories of every variable. Each category in which the number of observations for "present" and "absent" areas totaled two or less were discarded.
A chi-square test for independency was performed on each category (each pair of cells). A pair of cells was eliminated if one cell of the pair had an expected value of less than three (Ostle, 1963). A chi-square value was also obtained for the variable by summing the chi-square values obtained from the cell pairs of that variable.

The chi-square test only determined if a category had a significant effect on habitat selection by blue grouse. To determine whether this was a positive or negative effect, the percent occurrence of "present" areas and "absent" areas were determined for each category. Percents were calculated by dividing the total number of category observations into the number of observations for "present" areas, and for "absent" areas. A positive effect was attributed to a category if the percent occurrence of "present" areas was higher than "absent" areas, and vice versa. The degree of effectiveness was indicated by the amount of difference between the two percents.
RESULTS

Variables and categories which were considered to be important in influencing habitat selection by blue grouse were determined by their level of significance. An arbitrary alpha level of 0.20 was selected for distinguishing important categories and variables (Table 1). Eleven variables were significant at alpha levels from 0.20-0.0005. These variables are listed below.

(1) search area type
(2) area exposure
(3) elevation
(4) percent forested
(5) understory density
(6) primary cover species
(7) secondary cover species
(8) percent cover maples (*Acer grandidentatum*)
(9) percent cover mixed brush
(10) percent cover sagebrush (*Artemisia tridentata*)
(11) total acres

It should be noted that 10 of the 11 variables given above were significant at an alpha of 0.05. Total acres was significant at an alpha level of 0.20. Total acres therefore may not have been as important as the other ten variables.

Seventeen categories, indicating a positive effect for habitat selection by blue grouse, were significant at an alpha of 0.20 (Table 1).
<table>
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<th>Categories</th>
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<td>&quot;present&quot; areas</td>
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<td>1</td>
<td>9</td>
<td>00</td>
</tr>
<tr>
<td>&quot;(north) d&quot;</td>
<td>dense</td>
<td>0.0005</td>
<td>0</td>
<td>14</td>
<td>00</td>
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<td>medium</td>
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<td>30</td>
<td>19</td>
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<td>mean elevation in intervals of 6,000-6,499</td>
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<td>13</td>
<td>6</td>
<td>68</td>
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<td>0.20</td>
<td>17</td>
<td>11</td>
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<tr>
<td></td>
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<td>0.20</td>
<td>5</td>
<td>12</td>
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<tr>
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<td>1</td>
<td>5</td>
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<td>0.025</td>
<td>6</td>
<td>1</td>
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</tr>
<tr>
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<td>0.05</td>
<td>20</td>
<td>13</td>
<td>61</td>
</tr>
<tr>
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<td>0.05</td>
<td>1</td>
<td>7</td>
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<td>0.20</td>
<td>16</td>
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<td>9</td>
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<td>chokecherry</td>
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<td>1</td>
<td>5</td>
<td>17</td>
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<td>Number of Observations</td>
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<td>0.05</td>
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<td>6</td>
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<td>6</td>
<td>4</td>
<td>60</td>
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<tr>
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<td>0.10</td>
<td>3</td>
<td>39</td>
<td>07</td>
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<tr>
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<td>41-50 percent</td>
<td>0.025</td>
<td>1</td>
<td>10</td>
<td>09</td>
</tr>
<tr>
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<td>0 percent</td>
<td>0.025</td>
<td>1</td>
<td>10</td>
<td>09</td>
</tr>
<tr>
<td>&quot;(north)&quot;</td>
<td>0 percent</td>
<td>0.10</td>
<td>13</td>
<td>32</td>
<td>29</td>
</tr>
<tr>
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<td>5-9 percent</td>
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<td>5</td>
<td>64</td>
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<td>0.10</td>
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<td>29</td>
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<td>0.20</td>
<td>9</td>
<td>1</td>
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<tr>
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<td>5-9 percent</td>
<td>0.025</td>
<td>9</td>
<td>1</td>
<td>90</td>
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<tr>
<td>mixed brush</td>
<td>10-19 percent</td>
<td>0.20</td>
<td>8</td>
<td>2</td>
<td>80</td>
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<td>species</td>
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<td>1</td>
<td>5</td>
<td>17</td>
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* in decreasing order of significance, b positive effect on habitat selection by blue grouse, c negative effect on habitat selection by blue grouse, d see (Appendix A)
Among these "draws" expressed the highest level of significance with an alpha value of 0.0005. The next highest level of significance was shown equally by "mixed brush as a primary cover species", "5-9 percent incline of north slope", and "41-50 percent cover by maples" (*Acer grandidentatum*). All three were significant at an alpha level of 0.025.

There were also 17 categories, significant at an alpha value of 0.20 which indicated a negative effect for habitat selection (Table 1). The highest level of significance was expressed by "dense understory" at an alpha value of 0.0005. The next highest level of significance was shown equally by "inclines" and "0 percent cover by maples."
DISCUSSION

It is difficult to compare results of this study to other habitat studies on blue grouse because the vegetation and topography of other study areas vary in differing degrees.

Bendell and Elliott (1966b) discussed blue grouse habitat selection on Vancouver Island in British Columbia, Canada. They found that blue grouse preferred "open" vegetation over "dense" vegetation. Vegetation on the study area of Vancouver Island was composed mainly of coniferous forests in varying densities. The open areas consisted of burns, and much of the habitat was composed of stumps and logs. The breeding range in northern Utah, conversely, consisted of relatively open vegetation with practically no burns, stumps, or logs.

Mussehl (1963) studied habitat in relation to brood cover in Montana. He found that the herbaceous cover used by broods expressed relatively consistent physical characteristics of height, canopy cover, and plant interspersion. The herbaceous cover consisted mainly of native bunch­-grasses and associated forbs. It appeared that this same type of vegetation also existed in northern Utah.

Mussehl (1968) believed that it was the physical characteristics of the herbaceous cover, rather than the specific plant species that was important. The herbaceous cover present in Montana does not occur on Vancouver Island, where a good population of blue grouse occurs, but other types of vegetation such as ferns use the same physical characteristics (Mussehl, 1968). Bendell and
Elliott (1966b) likewise stated that the logs and stumps on their summer range study area may have approximated the physical characteristics of sagebrush (*Artemisia* sp.).

This same logic applies to maples as an important habitat factor. It appears that maples are important for adult blue grouse in northern Utah. Blue grouse are present in many regions where maples are absent, but other vegetation is present which approximates the physical characteristics of maples. This was also supported by Pitelka (1941) and Harris (1952). They have indicated that habitat selection may be related to the physical structure of the dominant vegetation, rather than the species composition.

Habitat selection by blue grouse may not be conditioned by early experience. Wecker (1963) showed that prairie and forest races of Michigan deer mice (*Peromyscus maniculatus*) had an innate response to habitat, and that this response could not be reversed by early experience. Bendell and Elliott (1966b) found this to be true with blue grouse. Chicks born in dense vegetation selected open habitat when adult. Bendell and Elliott (1966, p443) further stated that:

The selection of prairie-like habitat as breeding range by blue grouse is partly explained by their possible evolution from prairie-dwelling precursors. Blue grouse may be placed close to the Sage Grouse (*Centrocercus*), Prairie Chicken (*Tympanuchus*), and Sharp-tailed Grouse (*Pedioecetes*) on the basis of secondary sexual characteristics, breeding behaviour, and other features of their biology. The use of prairie or prairie-like habitat as breeding range by the four genera adds to their similarity.

Acceptance or rejection of a hypothesis does not mean that the hypothesis has been proved or disproved (Ostle, 1963). Some of the 11 variables which show significance at an alpha of 0.20 or better, and
particularly significant categories within these variables, contain low numbers of observations. Some categories have as few as six total observations (Table 1). It can therefore be assumed that such categories or variables may be important influences in habitat selection of blue grouse.

Statistically significant results may be misleading at times. The 31-40 and 41-50 percent categories under "(north) slope percent forested" indicate significance for a positive effect on habitat selection by blue grouse (Table 1). From field observations it was noticed that those habitat types which were 31-40 and 41-50 percent forested contained large amounts of edge effect. It is believed that it was the edge effect, rather than the amount of area forested, that positively effected habitat selection by blue grouse. Likewise, if the 31-40 and 41-50 percent forested area was continuous with little edge effect, it would most likely have negatively affected habitat selection by blue grouse. The same applies for those habitat types which contained 41-50 percent cover by maples (Table 1).

Maples as a primary cover species was a more important influence on habitat selection than indicated in Table 1. From field observations, it was observed that maples in low percents of cover (1-10 percent) was the most important factor in determining presence of blue grouse. Higher percentages of cover by maples were also important if the cover had a large amount of edge effect. However, most sampling areas in the Bear River Range (particularly draws, which were shown to be the most significant sampling area type) did not contain large amounts of maple.

The importance of maples is also expressed in the variable "(north)"
slop percent cover maples" within the category 0 percent (Table 1). Complete absence of maples (43 observations) is significant at alpha 0.005 for negatively effecting habitat selection by blue grouse (Table 1).

Mixed brush as a primary cover species is shown to be significant at alpha 0.025 for having a positive effect on habitat selection by blue grouse (Table 1). However, this importance is not as great as it appears. Most sampling areas which contained maples also contained a higher percent of mixed brush. Therefore, it was almost impossible for blue grouse to "select" areas which did not have more mixed brush than maples.

This relationship is also evident in the variable "(north)' slope secondary cover species" in which mixed brush is significant at alpha of 0.05 for having a negative effect on habitat selection by blue grouse. If mixed brush was the primary cover species for those areas in which blue grouse were present, it would logically prove significant for the absence of blue grouse in these same areas when measured as a secondary cover species.
RECOMMENDATIONS

1. The same study area should be utilized in future studies of the eleven variables found to be important in this study.

2. Research on the eleven important variables should be so conducted to show relationships among them.

3. The influence of maple on habitat selection by blue grouse should be investigated in more detail. Minor thinning of dense stands of maple may be advantageous to blue grouse during the breeding season.

4. Since wyethia and the associated forbs appear to be extremely important for brood raising, research should be undertaken on spraying and other practices which may alter this habitat component.

5. A tagging program should be begun to obtain knowledge of the migration patterns of blue grouse in northern Utah. This information would be of benefit in the formulation of habitat management programs.

6. A census method for blue grouse would be a valuable tool for population management. The author has found that during the peak of the breeding season, a "wing rip" or "wing flutter" by one male usually set-off a chain reaction of "wing rips" by all other males in the area. The duration of time between "wing rips" of an individual male is typically long enough that the second "wing rip" does not occur until other males in the area have similarly responded. Although this method would not measure
absolute numbers of blue grouse, it could be used as an index to population density.

7. Further habitat studies should be conducted on the breeding range because it appears that population limitation factors are in affect here rather than on the winter range.

8. The affect of livestock grazing on blue grouse breeding habitat should be investigated.
SUMMARY

A study of the spring and summer habitat preferences of blue grouse was conducted in 1968 and 1969 on the Bear River Range in northern Utah. The objectives were (1) to determine the important factors associated with habitat selection by blue grouse during spring and summer, and, (2) to prepare recommendations for further blue grouse research in Utah.

One-hundred and two sampling areas, delimited by similarities in vegetation and topography, were thoroughly searched with a dog for blue grouse. Search of a sampling area was discontinued after locating one blue grouse, and the sampling area was classified as one in which blue grouse were present. Fifty-four biological and physical variables were measured for each sampling area.

Data were summerized utilizing a computerized quest program and summations of observations for each category of every variable were calculated. These summed data were organized in contingency tables for application of independency chi-square tests.

Chi-square tests performed on variables and on individual categories of variables showed 11 of the 54 variables to be significant at a alpha of 0.20. These 11 variables listed below were considered to be the important factors influencing habitat selection by blue grouse.

(1) search area type
(2) area exposure
(3) elevation
(4) percent forested
(5) understory density
(6) primary cover species
(7) secondary cover species
(8) percent cover maples
(9) percent cover mixed brush
(10) percent cover sagebrush
(11) total acres

The chi-square test only determined if a category significantly affected habitat selection by blue grouse. To determine whether this effect was positive or negative the percent occurrence of areas on which blue grouse were present, or absent, were determined. Results indicated that the most favorable blue grouse habitat was draws at 5,500-6,499 feet elevation. This favorable habitat contained 1-10 percent cover by maples, or a higher percent of maple which provided a large amount of edge effect; the presence of mixed brush or sagebrush, a medium understory, and an area incline of 5-19 percent.

Recommendations were made for further research on blue grouse breeding habitat, development of a census method, the affect of grazing, the importance of maples, the affect of wyethia spraying, and seasonal movement.
LITERATURE CITED


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Appendix A

List of Variables Measured for all Sampling Areas Searched for Blue Grouse

(1) date
(2) time
(3) location--township
(4) location--range
(5) location--section
(6) sampling area type
(7) mean elevation in intervals of 500 feet
(8) area exposure
(9) slope exposures
(10) area percent incline
(11) "north" slope percent incline
(12) "south" slope percent incline
(13) draw length
(14) "north" slope average height
(15) "south" slope average height
(16) slope top distance
(17) presence of blue grouse
(18) "(north)" a slope primary cover species

a Since many of the sampling areas were draws many variables were measured for both slopes. All draws did not have slopes with north and south exposures as indicated by quotation marks. If a sampling area was not a draw, measurements were recorded under the "(north)" slope ...heading, and 0 was recorded under the "south" slope ...heading, as indicated by the parentheses. "(North)" slope ...represented north, northeast, northwest, and east facing slopes. "South" slope ...represented south, southeast, southwest, and west facing slopes.

In order to eliminate confusion on the part of the reader, the prefixes "(north)" slope ...and "south" slope ...were deleted from the text.
(19) "(north)" slope secondary cover species
(20) "(north)" slope tertiary cover species
(21) "south" slope primary cover species
(22) "south" slope secondary cover species
(23) "south" slope tertiary cover species
(24) "(north)" slope understory density
(25) "south" slope understory density
(26) "(north)" slope percent cover exposed rock
(27) "south" slope percent cover exposed rock
(28) total acres
(29) "(north)" slope percent forested
(30) "south" slope percent forested
(31) "(north)" slope percent cover maple (Acer grandidentatum)
(32) "south" slope percent cover maple (Acer grandidentatum)
(33) "(north)" slope percent cover mountain mahogany (Cercocarpus sp.)
(34) "south" slope percent cover mountain mahogany Cercocarpus sp.)
(35) "(north)" slope percent cover chokecherry (Prunus virginiana)
(36) "south" slope percent cover chokecherry(Prunus virginiana)
(37) "(north)" slope percent cover juniper (Juniperus sp.)
(38) "south" slope percent cover juniper (Juniperus sp.)
(39) "(north)" slope percent cover Douglas fir (Pseudotsuga menziesii)
(40) "south" slope percent cover Douglas fir (Pseudotsuga menziesii)
(41) "(north)" slope percent cover alpine fir (Abies lasiocarpa)
(42) "south" slope percent cover alpine fir (Abies lasiocarpa)
(43) "(north)" slope percent cover pine (Pinus sp.)
(44) "south" slope percent cover pine (Pinus sp.)
(45) "(north)" slope percent cover aspen (Populus tremuloides)
(46) "south" slope percent cover aspen (*Populus tremuloides*)
(47) "(north)" slope percent cover serviceberry (*Amelanchier alnifolia*)
(48) "south" slope percent cover serviceberry (*Amelanchier alnifolia*)
(49) "(north)" slope percent cover mixed brush
(50) "south" slope percent cover mixed brush
(51) "(north)" slope percent cover sagebrush (*Artemisia tridentata*)
(52) "south" slope percent cover sagebrush (*Artemisia tridentata*)
(53) "(north)" slope percent cover alfalfa (*Medicago sativa*)
(54) "south" slope percent cover alfalfa (*Medicago sativa*)
Appendix B

Method of Measuring Variables Recorded for all Sampling Areas Searched for Blue Grouse

Date
Calendar day, month, and year.

Time
The time a sampling area was searched was calculated as the mean time of the area, rounded off to the nearest hour. For example, if search of a sampling area began at 12:00 (noon) and ended at 4:00 p.m. the time recorded was 2:00 p.m. All time was recorded as Mountain Daylight Time.

Location--township, range, and section
From U.S. Forest Service maps.

Sampling area type
See Appendix C

Mean elevation
From United States Geological Survey topographic maps.

Area exposure
Compass reading to the nearest direction of N, NE, E, SE, S, SW, W, or NW.

Slope exposures
Compass reading to the nearest direction of N-S, E-W, NE-SW, or NW-SE.
Area percent incline

With a draw, this measurement was taken along the draw bed. The upper or lower portions of the draw bed were not included in the measurement if the percent incline of these portions differed by at least 10 percent from the percent incline of the middle section of the draw bed. These same conditions applied to ridge tops.

"North" and "south" slope percent incline

Measured with an Abney level.

Draw length

Measured along the draw bed from aerial photographs and United States Geological Survey maps. Measurements were taken in 100 yard intervals.

"North" and "south" slope average height

Average height was estimated in the field and checked from aerial photographs. If aerial photographs were not available, the field estimates were used. Height was measured in intervals of 25-100 yards.

Slope top distance

The mean distance between slope tops of a draw was measured from aerial photographs or United States Geological Survey topographic maps. Measurements were recorded in intervals of 25-100 yards.

Presence of blue grouse

Discussed previously (Search techniques, page 20.)
"(North)" and "south" slope primary, secondary, and tertiary cover species

Determined on the basis of quantity, the most abundant species being the primary species, etc. All vegetation was considered except forbs. Estimates were made at a distance during the fall when differences in coloration facilitated identification.

"(North)" and "south" slope understory density

Understory density was measured subjectively as light, medium, and dense. Light understory was defined as presenting little restriction to movement through it on foot and by having at least 50 percent bare ground. Dense understory had less than 20 percent bare ground and was difficult to walk through. Medium density referred to conditions lying between light and dense.

Ocular estimates of the percent of bare ground were taken in the field.

"(North)" and "south" slope percent cover of exposed rock

Ocular estimates taken in the field.

Total acres

Measured with a 64 dot per square inch grid. Each dot represented 0.625 acres at the datum plane. Most areas were above the datum plane, therefore, each dot was calculated to represent an average of 0.7 acres.

"(North)" and "south" slope percent forested

Distant ocular estimate of percent crown cover of tree species.
Percent cover of plant species

The percent cover of species (species measured are given in Appendix A) was estimated at a distance in the fall, when identification of individual species was facilitated by color differences. In order to eliminate difficulties in distinguishing between species of the same color, a rough map of the vegetation present on a sampling area was made in the field. The map was referred to when percent cover was estimated.
Appendix C

Definitions of Variables Recorded for all Sampling Areas Searched for Blue Grouse

Search area type

**Draw.** A draw was defined as an area with two inclined sides, each with at least a 5 percent incline. The height of each slope was at least 10 yards and the average distance between slope tops was not more than approximately 1/4 mile. A relatively straight draw was classified as one sampling area even if the plant communities were different on the opposite slopes. There was only one condition under which a draw was divided into more than one sampling area. This occurred when a draw changed direction by at least 45 degrees. The two portions, separated at the point of the turn, were considered as two separate sampling areas.

**Inclined area.** An inclined area was defined as any area with an incline exceeding 5 percent without an opposite slope for at least 1/4 mile. Sampling areas within inclined areas were also delimited by different plant communities and/or a change in direction of at least 45 degrees.

**Flat area.** A flat area was defined as any area with an incline of less than 5 percent. Sampling areas within flat areas were determined by plant communities. If two different plant communities occurred on different portions of the same flat area, two different sampling areas were classified.

**Ridge tops.** Ridge tops were areas with at least a 5 percent incline on two sides. These areas were limited laterally by an arbitrary
line approximately 50 yards down each side. The number of sampling areas on one ridge top was determined by the number of different plant communities and by a sudden rise or drop of the ridge top.

**General exposure**

General exposure of the entire habitat type.

**Area percent incline**

Average percent incline of the habitat type.

**Location—township, range, section, and quarter section**

The terms township, range, and section are directional locators on United States Forest Service maps. The same method was used, along with Forest Service maps, to indicate location of habitat types. Township gives N-S direction, and range defines E-W direction. Specification of township, X, and range, Y, locates an area divided into 36 sections.

"(North)" and "south" slope understory density

Understory refers to vegetation less than four feet in height and categorized as light, medium, or dense.

"(North)" and "south" slope terrain type

The percent of exposed rock present.

"(North)" and "south" slope percent forested

Species measured under this category were maple, mountain mahogany, chokecherry, juniper, aspen, and conifers.

"(North)" and "south" slope percent cover mixed brush

Mixed brush included sagebrush, bitterbrush, ninebark (*Physocarpus*
and other species of corresponding physical structure.

When mixed brush was measured, no entry was made under "percent cover sagebrush."
Appendix D

Native and Introduced Plants Observed on
Sampling Areas Searched for Blue Grouse

Trees and Shrubs

Alpine fir  Abies lasiocarpa
Antelope bitterbrush  Purshia tridentata
Bigtooth maple  Acer grandidentum
Big sagebrush  Artemisia tridentata
Black sagebrush  Artemisia nova
Blueberry elder  Sambucus acerula
Boxelder  Acer negundo
Broom snakeweed  Gutierrezia sarothrae
Chokecherry  Prunus virginiana
Creeping mahonia  Mahonia repens
Curlleaf mountain mahogany  Cercocarpus ledifolius
currant  Ribes sp.
Douglas fir  Pseudotsuga menziesii
Limber pine  Pinus flexilis
Lombardy poplar  Populus nigra italica
Mallow ninebark  Physocarpus malvaceus
Myrtle pachistima  Pachistima myrsinites
Narrowleaf cottonwood  Populus angustifolia
Quaking aspen  Populus tremuloides
Rockspirea  Holodiscus discolor
Rocky Mountain juniper  Juniperus scopulorum
rose  Rosa sp.
Rubber rabbitbrush  Chrysothamnus nauseosus
Saskatoon serviceberry  Amelanchier alnifolia
Singleleaf pinyon  Pinus monophylla
Skunkbush sumac  Rhus trilobata
Slenderbush eriogonum  Eriogonum microthecum
Smooth sumac  Rhus glabra
Snowbrush  Ceanothus velutinus
Sticky rabbitbrush  Chrysothamnus viscidiflorus
True mountain mahogany  Cercocarpus montanus
Utah juniper  Juniperus osteosperma
Water birch  Betula occidentalis
White fir  Abies concolor
Whortleleaf snowberry  Symphoricarpos vaccinoides
willows  Salix sp.

Grasses

Beardless bluebunch wheatgrass  Agropyron inerme

Nygren (1963)
Cheatgrass brome  
Crested wheatgrass  
Indian ricegrass  
Kentucky bluegrass  
Mountain brome  
Rattlesnake grass  
Red threeawn  
San dropseed  
Sandberg bluegrass  
Smooth brome  
Spikefescue  
Subalpine needlegrass  

Bromus tectorum  
Agropyron cristatum  
Crysopelis hymenoides  
Poa pratensis  
Bromus carinatus  
Bromus brizaeformia  
Aristida longiseta  
Sporobolus cryptandrus  
Poa secunda  
Bromus inermis  
Hesperochloea kingii  
Stipa columbiae

Forbs

Alumroot  
Arrowleaf balsamroot  
Aspen fleabane  
aster  
Canada thistle  
Common sunflower  
Dogbane  
Eriogonum  
Falseyarrow  
fireweed  
Goldenrod  
Goldenrod  
Hairy goldastor  
larkspur  
Lewis flax  
Louisiana sagebrush  
Mulesear wyethia  
nettle  
onion  
paintbrush  
Pale alyssum  
Phacelia  
phlox  
Primrose  
Rock spirea  
salsify  
Segolily mariposa  
Showy goldeneye  
Skyrocket gilia  
Spider milkweed  
Tapertip hawksbeard  
Tufted evening primrose  
Tumbling russianthistle  
Utah locoweed  
Veronica  
Western ragweed  

Heuchera parvifolia  
Balsamorhiza sagittata  
Erigeron speciosus  
Aster sp.  
Cirsium arvense  
Helianthus annuus  
Apocynum pumilum  
Eriogonum umbellatum  
Chaenactis douglasii  
Epilobium sp.  
Fetidaria pumila  
Solidago lepida  
Chrysopsis villosa  
Delphirtum sp.  
Linum lewisii  
Artemisia ludoviciana  
Wyethia amplexicaulis  
Urtica sp.  
Allium sp.  
Castilleja sp.  
Alvisum alyssoides  
Phacelia leucophylla  
Phlox sp.  
Oenothera pallida  
Petrophytum caespitosum  
Tragopogon sp.  
Calochortus nuttallii  
Viguiera multiflora  
Gilia aggregata  
Asclepias capricorny  
Crepis acuminata  
Oenothera caespitosa  
Salsola kali  
Astragalus utahensis  
Veronica campyloploda  
Ambrosia pilostachya
Western virgin's bower
Western yarrow
Wild fuchsia
Wild morning glory

Clematis ligusticifolia
Achillea lanulosa
Eauschneria garrettii
Convolvulus arvensis
VITA

Robert M. Maestro

Candidate for the Degree of

Master of Science

Thesis: Spring and Summer Habitat Preferences of Blue Grouse on the Bear River Range, Utah

Major Field: Wildlife Biology

Biographical Information:


Education: Attended elementary school in Norwalk, Connecticut; graduated from Norwalk High School in 1961; received Bachelor of Arts from the University of Vermont, with a major in botany in 1965; did graduate work in fungal physiology and taught introductory botany, plant microtechnique, and plant physiology laboratories at the University of Maryland, 1965-1968; completed requirements for the Master of Science degree, specializing in wildlife biology, at Utah State University in 1970.