Ecology and management of Merriams turkey in the long pines, southeastern montana
by Robert James Jonas

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in Fish and Wildlife Management
Montana State University


Abstract:
A sixteen month field study during the three year period 1961-63 was conducted to obtain information on movements, population characteristics, habitat use, life history and management of the introduced Merriam1s turkey (Meleagris gallopavo merriami) in the Long Pines of southeastern Montana. A total of 6,271 turkeys comprising 468 flocks were classified into one of five types. Their activities were related to six described plant communities. Roost trees and nesting sites were described. Growth and productivity characteristics of the turkey population from the time of initial introduction of 18 birds in February 1955 through 1963 were discussed in relation to 1,103 turkeys removed by hunting, trapping and miscellaneous factors. Population trends, densities and productivity were' related to emigration and hunter harvest. About 50 per cent annual population turnover and longevity of turkeys determined from records of 132 individually marked birds were discussed. Composition and sizes of 468 flocks were related to sex, age and activities of birds by seasons. The "fall shuffle" was described. Season, sex and age were discussed as factors influencing movements of 83 marked birds relocated 561 times.

The courtship period was divided into two sequential phases on the basis of sex, age, activity and behavior of the birds involved'. Age of first breeding, hatching dates and brood survival were determined and factors affecting each were discussed. Growth rates were determined for various age classes of 72 individually marked birds. Whole weights of 263 turkeys were related to sex, age and season. Relationships between harvest, number of hunters, hunter success and weather were evaluated. Productivity and age ratios were related to hunter harvests. Seasonal food habits were discussed from data available on the contents of 243 crops and 1,604 droppings. Miscellaneous observations were made on parasites, predation and color aberrations. Merriam1s turkey in the Long Pines was discussed from the standpoint of habitat management and hunting controls.

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Approved:

Head, Major Department

Chairman, Examining Committee

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## ABSTRACT

A sixteen month field study during the three year period 1961-63 was conducted to obtain information on movements, population characteristics, habitat use, life history and management of the introduced Merriam's turkey (Meleagris gallopavo merriami) in the Long Pines of southeastern Montana. A total of 6,271 turkeys comprising 468 flocks were classified into one of five types. Their activities were related to six described plant communities. Roost trees and nesting sites were described. Growth and productivity characteristics of the turkey population from the time of initial introduction of 18 birds in February 1955 through 1963 were discussed in relation to 1,103 turkeys removed by hunting, trapping and miscellaneous factors. Population trends, densities and productivity were related to emigration and hunter harvest. About 50 per cent annual population turnover and longevity of turkeys determined from records of 132 individually marked birds were discussed. Composition and sizes of 468 flocks were related to sex, age and activities of birds by seasons. The "fall shuffle" was described. Season, sex and age were discussed as factors influencing movements of 83 marked birds relocated 561 times. The courtship period was divided into two sequential phases on the basis of sex, age, activity and behavior of the birds involved. Age of first breeding, hatching dates and brood survival were determined and factors affecting each were discussed. Growth rates were determined for various age classes of 72 individually marked birds. Whole weights of 263 turkeys were related to sex, age and season. Relationships between harvest, number of hunters, hunter success and weather were evaluated. Productivity and age ratios were related to hunter harvests. Seasonal food habits were discussed from data available on the contents of 243 crops and 1,604 droppings. Miscellaneous observations were made on parasites, predation and color aberrations. Merriam's turkey in the Long Pines was discussed from the standpoint of habitat management and hunting controls.

# INTRODUCTION

Merriam's wild turkey (Meleagris gallopavo merriami) was first described as a subspecies in 1900 by E. W. Nelson primarily on the basis of color. The rectrices, tail coverts and lower rump feathers are white tipped in contrast to intergrades through various shades from buff to dark brown in the other subspecies. Perhaps Merriam's turkey differs from the other subspecies most significantly by its apparent success in a distinctive habitat, forests of Pinus ponderosa often associated with rugged terrain.

Originally Merriam's turkey was common in the mountains of central Colorado and southward into wide areas of Arizona, New Mexico and west Texas eastward to the Guadalupe Mountains. The ancestral range had already started to diminish by the time this subspecies was described. It was greatly reduced especially on its northern boundary where the bird nearly disappeared. Complete extirpation occurred in west Texas. Most evidence suggests that alteration of habitat was responsible for the reduction but it is probable that a combination of factors was involved. Ligon (1946) thought the population low, probably 15 per cent of the original, occurred between 1935 and 1940.

Spectacular success in reintroducing Merriam's turkey into much of its former range has been reported in recent years. Successful introductions outside the ancestral territory have been accomplished in Montana,

Wyoming, Nebraska, South Dakota, Utah, North Dakota, Idaho, Washington, Oregon and California (State bulletins and personal communications). The first six states listed have had recent hunting seasons on turkeys.

At least six turkey introductions between 1939 and 1960, by private individuals, mostly in the eastern one-half of Montana were complete failures. The sources were primarily farm-reared "wild" turkeys from eastern stock but Rio Grande turkeys (M. g. intermedia) were used once (Bergeson 1954, Egan 1964). Apparent success of transplants of wild-trapped Merriam's turkey into suitable areas of Wyoming and South Dakota encouraged personnel of the Fish and Game Department in efforts to establish this strain in Montana. The first Departmental introduction consisting of 13 birds from Colorado in November 1954 was into the Judith Mountains of central Montana. Eighteen Merriam's turkeys from Wyoming were transplanted into the Long Pines of southeastern Montana in January 1955. In October 1956 and January 1957, introductions totaling 26 birds from Wyoming were made in Powder River County.

Population growth of the Department introductions was sufficient to permit hunting and removal for transplanting. The Long Pines population has been one of the most successful, providing six either-sex fall hunting seasons and one spring gobbler season. It has also provided birds for 11 transplants in the state. Turkeys have spontaneously emigrated from there

into four more or less separate areas nearby.

Rose (1956) conducted the initial investigation to evaluate the success of the first two introductions. He reported the fate of the Judith Mountain transplant as being uncertain, but the Long Pines population gave early indications of remarkable success. He provided general information about the birds, and in 1957 as an employee of the Montana Fish and Game Department conducted a trap-mark-release program.

As turkey populations expanded and additional transplanting occurred it became evident that quantitative information was needed about Merriam's turkey in the northern extension of its range. In this study, data were gathered on movements, population characteristics, habitat use and life history. Marked individuals were used as much as possible to secure this information. The Long Pines study area was selected because it is almost an island of habitat, largely public land and has one of the most successful populations. The writer was in the field nearly full-time for 16 months: June through December 1961, June through September 1962 and March through September 1963. Occasional short visits were made to the area at other times. Laboratory work yielded information about crop contents, parasites, weights and other measurements.

## PHYSIOGRAPHY OF THE AREA

The Long Pines Division of Custer National Forest in southeastern Montana, approximately 65,000 acres, encloses a forested "L"-shaped ridge 1,200 feet above the surrounding plains. This ridge extends about 15 miles north-and-south and 11 miles across its base. It divides Box Elder Creek drainage to the west from the Little Missouri River drainage to the east (Figure 1). From 4,300 feet at ridge-top (Tri Point Lookout), rolling hills extend to the plains north and east, whereas precipitous slopes and sharply cut canyons mark the western and southern margins. Parent rocks are Tertiary clay and sandstone deposits which form mostly "gumbo" soils and some locally restricted sands. The former are high in clay and alkali content, with high runoff and low water penetration. Shallow, rocky soils are common.

Most drainageways have running water only during the spring runoff or after heavy rains. There are numerous natural springs, small seeps and beaver ponds as well as about 40 small catch-basin reservoirs and 70 stock-watering tanks developed by ranchers and Forest Service personnel.

The mean annual temperature is 44.1° F. Extremes are -43° F (February 1936) to 108° F (July 1936). The average annual precipitation is 13.27 inches, over one-half of which falls during the months of May, June and July. Annual precipitation maximum and minimum are 21.97" (1963) and 6.35" (1936). Departures in total annual precipitation from the long-term

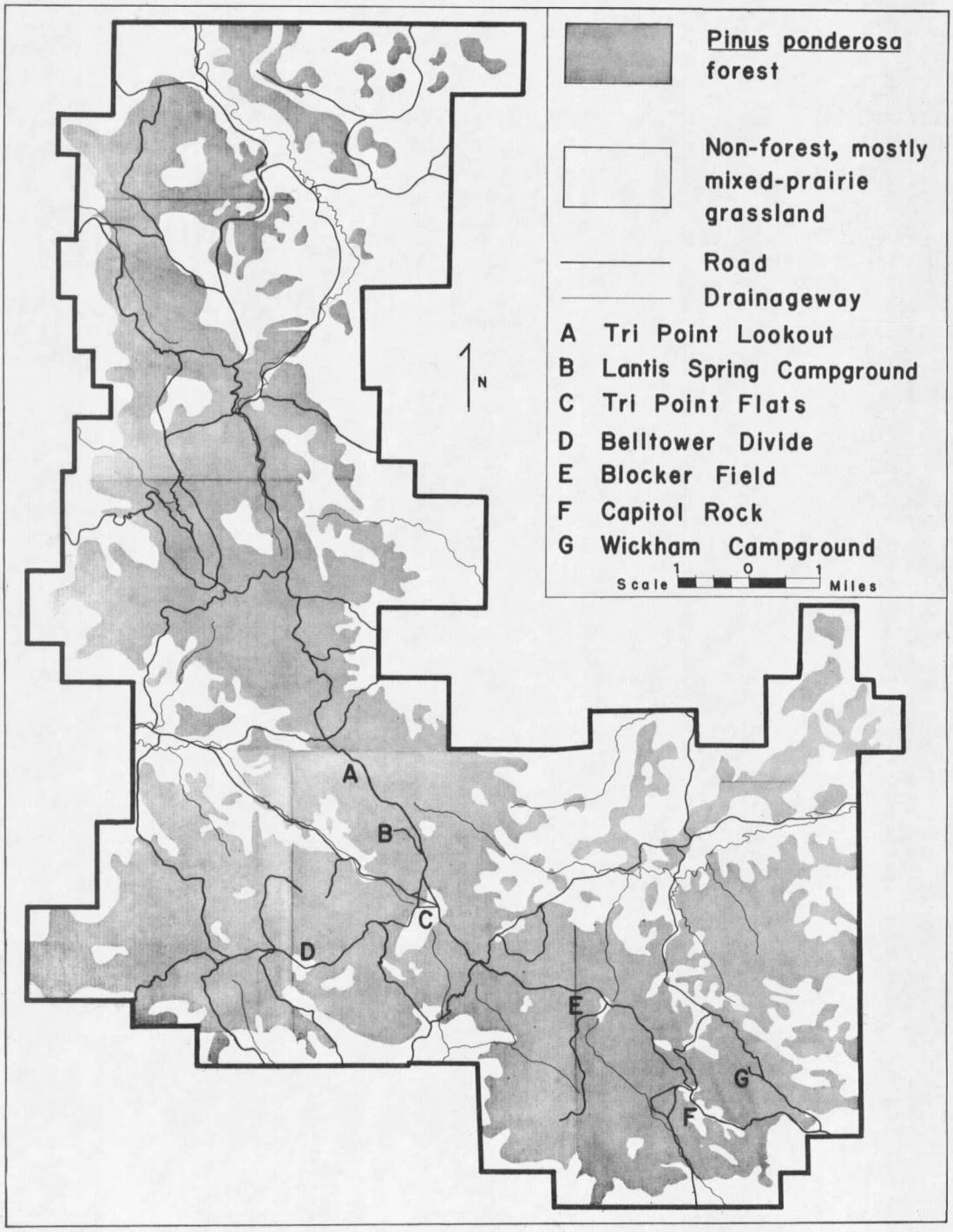


Figure 1. Map of the Long Pines Study Area.

mean during this study were -1.41" (1961), +7.48" (1962) and +7.70" (1963). The mean annual snowfall is 22.3 inches. (Climatic data for Ekalaka, Montana from the Climatic Summary of the U.S.--Supplement for 1931 through 1952 and Climatological Data, U.S. Weather Bureau.) The hills have a light snow cover most of the winter while the low slopes are generally snow free.

## VEGETATION OF THE AREA

About 40 per cent of the vegetative cover of the Long Pines Division consists of Pinus ponderosa forest which is best represented on the north and east slopes of the main ridge. Gallery forest extend as far as one mile into the prairie along some drainageways. The non-forested area is mostly a mixed prairie in scattered small parks (Figure 2) and more extensive tracts on ridge-top flats and on the slopes below the forest (Figure 3). Numerous drainageways with heterogeneous vegetation dissect the entire area. Cultivation on public land in the hills ended in the 1920's and at present grain cropping is practiced only on the lower slopes outside the forest.

### Pinus ponderosa Community

Size-class stands of Pinus ponderosa were classified following Forest Service terminology as sawlog, pole or sapling. In July 1963, five 16 x 66 foot plots were established in each of three widely separated stands for each of the three classes. For trees in the diameter class of four inches or over dbh (diameter breast height) best represented in each plot, in the sawlog and pole stands, the tree nearest the base point was increment-bored to determine its age, its dbh recorded from tape measurements and its height determined with an Abney level. In the sapling stands, these measurements were taken on trees with a height greater than

Figure 2. Pinus ponderosa Community with Parks of Mixed Prairie Vegetation.

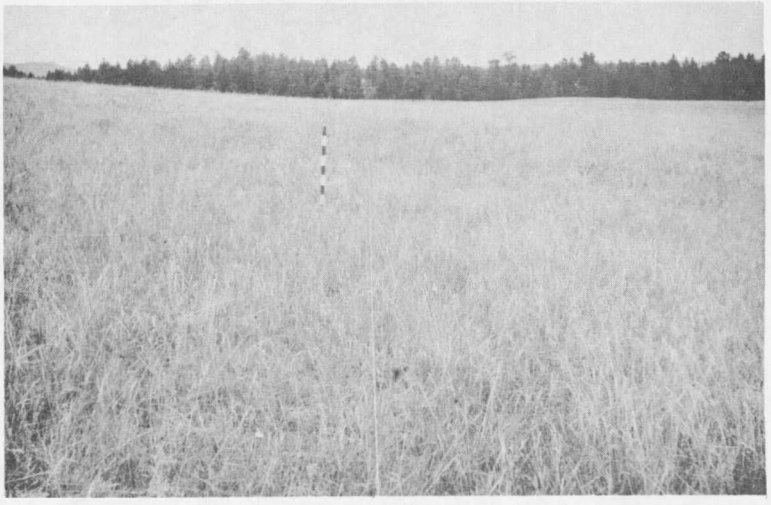

Figure 3. Bouteloua-Carex-Agropyron Community. Gallery Forest in Background. (40" Stick Marked in Tenths)

one yard in the diameter class 0-4 inches dbh. The average of these measurements was used for a "representative" age, dbh and height for each type (Table I). The percentage of the entire forested area occupied by each size-class was obtained from Forest Service figures based on cover-type maps made from aerial photos in 1955.

TABLE I. CHARACTERISTICS OF SIZE-CLASSES OF PINUS PONDEROSA COMMUNITIES.

| Characteristic | Size-classes | | |
|---|---|---|---|
| | Sawlog | Pole | Sapling |
| Percentage of Forested Area | 61 | 36 | 3 |
| "Representative" Age (Years) | 114+ | 55 | 29 |
| "Representative" DBH (Inches) | 15.5 | 7.1 | 2.5 |
| "Representative" Height (Feet) | 62 | 40 | 17 |

All pines in the plots over four inches tall were recorded in seven dbh size-classes. Density was calculated from plot data as the average number of trees per acre (Table II).

The high density of the lowest diameter class of Pinus ponderosa occurring in the sawlog stand may be accounted for by the open canopy of this type. The density/acre of trees in the 4-8 inch dbh size-class was greater in the sapling stands than in the pole stands. However, in the sapling stands most trees of this class were just over four inches dbh; whereas, most trees in the pole stands of the same class were near eight inches dbh.

TABLE II. AVERAGE NUMBER/PLOT AND CALCULATED DENSITY/ACRE OF DIAMETER CLASSES OF PINUS PONDEROSA IN THREE SIZE-CLASS COMMUNITY TYPES.

| Diameter Class (Breast Height) | Size-classes | | | | | |
|---|---|---|---|---|---|---|
| | Sawlog | | Pole | | Sapling | |
| | Number | Density | Number | Density | Number | Density |
| 0-4" < 1 yd. tall | 41.0 | 1,691.3 | 4.4 | 181.5 | 11.3 | 466.1 |
| 0-4" > 1 yd. tall | 12.6 | 519.8 | 3.7 | 152.6 | 112.7 | 4,648.9 |
| 4-8" | 0.1 | 4.1 | 5.9 | 243.4 | 6.5 | 272.3 |
| 8-12" | 1.2 | 49.5 | 3.1 | 127.9 | 0.3 | 12.4 |
| 12-16" | 2.5 | 103.1 | 0.3 | 12.4 | 0.2 | 8.3 |
| 16-20" | 0.3 | 12.4 | — | — | — | — |
| 20-24" | 0.1 | 4.2 | — | — | — | — |
| Total | 57.9 | 2,388.4 | 17.3 | 713.4 | 131.1 | 5,407.9 |

The understory was evaluated by listing taxa by life-form and recording abundance in each plot. Life-form categories were: trees (single bole, ca. 9 yards tall); tall shrubs (fruticose, ca. 1 yard tall); short shrubs (fruticose, less than 0.5 yard tall); grasses and sedges; and forbs. Abundance was rated by estimates as: 1 (infrequent), 2 (common) or 3 (abundant). Relative abundance represents classes based upon the sums of the estimates: Class 1 = sum 1-10; Class 2 = sum 11-20; Class 3 = sum 21-30 (Table III).

TABLE III. CONSTANCY AND ABUNDANCE-RATINGS OF UNDERSTORY TAXA BY LIFE-FORMS IN PINUS PONDEROSA SIZE-CLASS STANDS.

| Life Form | Taxon | Pinus Ponderosa Size-classes | | |
|---|---|---|---|---|
| | | Sawlog | Pole | Sapling |
| Tree (ca. 9 yds.) | Juniperus scopulorum | — | 33/1[1]/ | — |
| Tall Shrub (ca. 1 yd.) | Prunus virginiana | 100/3 | 100/3 | 100/3 |
| Short Shrubs (ca. 0.5 yd.) | Symphoricarpos albus | 100/3 | 100/3 | 100/2 |
| | Rosa arkansas | 100/2 | 100/2 | 100/2 |
| | Berberis repens | 66/1 | 100/2 | 100/2 |
| | Apocynum androsaemifolium | 100/1 | 100/2 | 66/1 |
| | Amelanchier alnifolia | 66/1 | 100/2 | 66/1 |
| | Arctostaphylos uva-ursi | 66/1 | 33/1 | 100/1 |
| | Spiraea betulifolia | — | 33/1 | 100/2 |
| | Rhus trilobata | 33/1 | 66/1 | 66/1 |
| | Ribes setosum | — | 66/1 | 33/1 |
| | Juniperus communis | — | 66/1 | 33/1 |
| | Crataegus succulenta | — | 33/1 | 33/1 |
| | Rhus radicans | — | 66/1 | — |
| Grasses and Sedges | Stipa viridula | 100/3 | 100/3 | 100/2 |
| | Danthonia spicata | 100/3 | 100/2 | 100/2 |
| | Stipa comata | 100/2 | 100/2 | 66/1 |
| | Carex spp. | 100/2 | 66/1 | 100/2 |
| | Agropyron griffithsii | 66/1 | 100/2 | 100/1 |
| | Poa pratensis | 66/1 | 33/1 | 100/1 |
| | Andropogon scoparius | 100/1 | 66/1 | — |
| | Agropyron smithii | 66/1 | 33/1 | 33/1 |
| | Agrostis scabara | 33/1 | 66/1 | 33/1 |
| | Bromus anomolus | — | 66/1 | 33/1 |
| | Poa secunda | 33/1 | — | 33/1 |
| | Andropogon gerardii | 33/1 | — | — |
| | Bromus japonicus | 33/1 | — | — |
| | Muhlenbergia racemosa | — | — | 33/1 |

TABLE III.--Continued.

| Life Form | Taxon | Pinus Ponderosa Size-classes | | |
|---|---|---|---|---|
| | | Sawlog | Pole | Sapling |
| Forbs | Galium boreale | 100/2 | 100/3 | 100/2 |
| | Achillea millefolium | 100/2 | 100/2 | 100/1 |
| | Anemone patens | 100/2 | 100/1 | 100/2 |
| | Campanula rotundifolia | 100/1 | 100/2 | 100/1 |
| | Artemisia ludoviciana | 100/2 | 100/2 | 33/1 |
| | Antennaria neglecta | 33/1 | 100/1 | 100/2 |
| | Smilacina stellata | 33/1 | 100/2 | 66/1 |
| | Solidago mollis | 33/1 | 66/1 | 100/1 |
| | Vicia americana | 66/1 | 100/1 | 33/1 |
| | Cerastium arvense | 66/1 | 100/1 | 33/1 |
| | Astragalus dasyglottis | 100/1 | 33/1 | 33/1 |
| | Glycyrrhiza lepidota | 100/1 | 66/1 | — |
| | Tragopogon dubius | 66/1 | 100/1 | — |
| | Psoralea argophylla | 66/1 | 66/1 | 33/1 |
| | Fragaria virginiana | 33/1 | 66/1 | 66/1 |
| | Monarda fistulosa | 33/1 | 66/1 | 33/1 |
| | Echinacea pallida | 66/1 | 66/1 | — |
| | Thermopsis rhombifolia | — | 66/1 | 33/1 |
| | Lupinus argenteus | 33/1 | 66/1 | — |
| | Aster ptarmicoidea | — | 66/1 | 33/1 |
| | Liatris punctata | 66/1 | 33/1 | — |
| | Heuchera parviflora | — | 66/1 | 33/1 |
| | Aster falcatus | 33/1 | 66/1 | — |
| | Eriogonum annuum | 66/1 | — | — |
| | Anemone cylindrica | — | 66/1 | — |
| | Petalostemon candidum | 33/1 | 33/1 | — |
| | Perideridia gairdneri | 33/1 | 33/1 | — |
| | Taraxacum officinale | — | 33/1 | 33/1 |
| | Penstemon wilcoxi | 33/1 | 33/1 | — |
| | Viola rugulosa | — | 33/1 | 33/1 |
| | Spiranthes romanzoffiana | 66/1 | — | — |
| | Hedeoma drummondii | — | 66/1 | — |
| | Antennaria parviflora | — | 33/1 | — |
| | Gayophytum nuttallii | 33/1 | — | — |
| | Aster oblongifolius | — | 33/1 | — |
| | Oxytropis besseyi | 33/1 | — | — |

TABLE III.--Continued.

| Life Form | Taxon | Pinus Ponderosa Size-classes | | |
|---|---|---|---|---|
| | | Sawlog | Pole | Sapling |
| Forbs | Helianthus nuttallii | --- | 33/1 | --- |
| | Artemisia frigida | --- | 33/1 | --- |
| | Grindelia squarrosa | --- | 33/1 | --- |
| | Sisyrinchium angustifolium | 33/1 | --- | --- |
| | Ratibita columnifera | 33/1 | --- | --- |
| | Petalostemon purpureum | 33/1 | --- | --- |
| | Linum lewisii | 33/1 | --- | --- |
| | Astragalus missouriensis | 33/1 | --- | --- |
| | Astragalus crassiocarpus | 33/1 | --- | --- |
| | Melilotus officinalis | --- | 33/1 | --- |
| | Tradescantia occidentalis | --- | 33/1 | --- |
| | Lappula redowski | --- | --- | 33/1 |
| | Polygonum convolvulus | --- | --- | 33/1 |
| | Thalictrum venulosum | --- | --- | 33/1 |
| | Zygadenus venenosus | --- | --- | 33/1 |

1/ The first number expresses the percentage of the stands in which the taxon was found (5 plots examined in each of 3 stands); the second number is the abundance rating (see text).

In the understory of the sawlog-type, the spring aspect-dominant was Anemone patens. Rosa arkansas and Prunus virginiana were not prominent apparently due to heavy browsing by deer. The grasses Stipa viridula, Danthonia spicata and Stipa comata usually were prominent during the summer but Artemisia ludoviciana was often locally most conspicuous (Figure 4). Symphoricarpos albus was the aspect-dominant in late fall and winter.

Pole stands had more understory species than the other types. The floor of the forest had a more open appearance in these stands than in the other two types due to low density of pine regrowth (Figure 5). Thermopsis rhombifolia was most evident in spring and Berberis repens was locally conspicuous. In summer, important grasses were Stipa viridula, S. comata, and Agropyron griffithsii. Prunus virginiana dominated the undergrowth at all seasons along with Symphoricarpos albus and Rosa arkansas to a lesser extent.

The understory was poorly developed in sapling or "doghair" stands (Figure 6) but Carex spp., Antennaria neglecta, Prunus virginiana, Symphoricarpos albus and Berberis repens were wide spread.

Pinus ponderosa stands similar to those of the Long Pines have been described in western North Dakota by Potter and Green (1964).

Figure 4. Stand of Mature Pinus ponderosa of the sawlog type. Understory is Sapling Pine, Stipa viridula and Artemisia ludoviciana.

Figure 5. Pole Stand of Pinus ponderosa. Understory of Prunus virginiana and Stipa viridula. (40" Stick Marked in Tenths)

Figure 6. Sapling Stand of Pinus ponderosa with a Poorly Developed Understory. (40" Stick Marked in Tenths)

## Prairie Grass Communities

Eight stands of grass (I through VIII, see Table IV) were studied in accordance with the canopy-coverage and frequency method proposed by Daubenmire (1959). Stands I through VII were representative of turkey range; the Andropogon scoparius stand (VIII) was measured for descriptive and comparative purposes. Forty plots, 20 x 50 cm, were placed along a line at 50 cm intervals. Canopy-cover of each taxon was recorded by class for each plot. Classes used were: Class 1 = 0-5%; Class 2 = 5-25%; Class 3 = 25-50%; Class 4 = 50-75%; Class 5 = 75-95%; Class 6 = 95-100%. The average per cent canopy-coverage for all plots in the stand was calculated from these estimates. Duff, litter, moss and bare ground were recorded and evaluated by the per cent cover each made up of a smaller plot, 71 x 71 mm.

Carex-Bouteloua-Agropyron Community (Stands I through VII, Figure 3).

This is the major grassland type of the Long Pines. The relative importance of Stipa comata in the stands and information from other studies (Coupland 1950, Weaver and Albertson 1956) indicate that under more favorable conditions Stipa comata would possibly replace Agropyron smithii in importance.

TABLE IV. AVERAGE PER CENT CANOPY COVERAGE AND PER CENT FREQUENCY OF FORTY 20 X 50 CM PLOTS IN EACH OF EIGHT STANDS OF PRAIRIE GRASSLAND, JULY 7-14, 1963.

| | Stands of the Carex-Bouteloua-Agropyron Community | | | | | | | Stand of *A. Scoparius* |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII |
| *Carex* spp.[1] | 13/85[2] | 14/85 | 7/85 | 33/100 | 38/100 | 25/98 | 23/100 | 4/65 |
| *Bouteloua gracilis* | 30/100 | 29/98 | 13/90 | 13/90 | 17/95 | 11/88 | 16/100 | 3/45 |
| *Agropyron smithii* | 15/100 | 32/98 | 4/63 | 6/80 | 7/80 | 20/95 | 12/98 | +/3[3] |
| *Stipa comata* | 4/33 | 13/58 | 7/55 | 11/63 | 11/90 | 24/68 | 17/90 | 2/28 |
| *Koeleria cristata* | 2/20 | +/5 | 2/48 | 1/38 | 4/63 | .6/10 | 5/83 | 3/30 |
| *Artemisia frigida* | 1/15 | +[4] | 11/88 | 15/98 | 5/60 | 1/13 | 9/83 | +/8 |
| *Stipa viridula* | 1/5 | +/3 | 14/75 | 7/58 | +/8 | +/3 | -- | +/3 |
| *Selaginella densa* | 2/15 | + | 23/90 | +/8 | 8/30 | -- | -- | 29/93 |
| *Antennaria parviflora* | 4/20 | + | 17/34 | 7/23 | 3/5 | +/3 | .6/13 | + |
| *Psoralea argophylla* | .9/10 | + | 8/33 | +/3 | 8/48 | +/5 | .9/10 | 5/48 |
| *Cerastium arvense* | -- | + | 18/20 | +/5 | + | -- | -- | 4/30 |
| *Rosa arkansas* | +/3 | + | 1/30 | .9/13 | 5/29 | + | -- | -- |
| *Phlox hoodii* | +/8 | + | + | 8/73 | 2/40 | -- | -- | 1/33 |
| *Andropogon scoparius* | -- | + | -- | -- | + | +/3 | + | 48/98 |
| Bare ground | 33/80 | 23/60 | 7/33 | 25/65 | 12/35 | 45/90 | 22/60 | 2/13 |
| Litter | 2/3 | 3/5 | 14/58 | 7/38 | 19/63 | 8/38 | 14/68 | 17/63 |

1/ Excluded from the table were taxa with less than 5 per cent coverage in all stands. They are listed in Table XXX of the Appendix.

2/ The figure preceding each / is average per cent canopy coverage for all plots in the stand; the figure following is per cent frequency (coverage the basis of inclusion) in the same plots.

3/ +/ indicates occurrence in the plots at coverage value less than 0.6 per cent.

4/ A single + indicates occurrence in the stand without sufficient abundance to be encountered in the plots.

Generally three strata occurred in this community of mixed prairie grasses. The upper 4-6 inches consisted of midgrasses, some forbs (viz. Psoralea argophylla, Potentilla pennsylvanica, Aster falcatus, Echinacea pallida, Lupinus argenteus, Liatris punctata) and scattered shrubs (viz. Artemisia frigida, Rosa arkansas). Most numerous in the 1-4 inch level were Bouteloua gracilis, Carex spp., Hedeoma drummondii, Gaura coccinea and Phlox hoodii. Selaginella densa, Antennaria parviflora (exclusive of flowering parts) and lichens occupied the lowest position on the surface of the soil.

The short-grass Bouteloua gracilis was more prominent in the most severely grazed stands. Under this condition forbs and shrubs were locally important, especially Artemisia frigida and to a lesser extent Psoralea argophylla, Antennaria parviflora, Cerastium arvense and Polygala verticillata.

Festuca octoflora was conspicuous throughout most of the community for a short period in late May and early June, but it was dried up by July. Many stands of Calamovilfa longifolia were scattered throughout the grassland in locally sandy soils at all elevations. It reached maximum development in late summer.

The character of the Carex-Bouteloua-Agropyron community differed on exposed slopes below the forest on western and southern boundaries of the

study area. Artemisia tridentata with scattered distribution was conspicuous in the west. More prominent there than at higher elevations were Sphaeralcea coccinea, Gaura coccinea, Opuntia polyacantha and Buchloe dactyloides. Slopes on the southern periphery were similar, but Artemisia cana was conspicuous near the forest edge and farther out was replaced in importance by A. tridentata. Buchloe dactyloides was best developed on the south and tended to form a short-grass community with Bouteloua gracilis.

Large tracts of grassland on the ridge-top, disturbed by cultivation, had been invaded by Pinus ponderosa (Figure 7). Encroachments of this type were evident on Blocker Field, Belltower Divide and Tri Point Flats.

Most conspicuous in the disturbed sides along roads were Cleome serrulata, Euphorbia glykosperma, Dyssodia papposa, Grindelia squarrosa, Melilotus officinalis, Chrysothamnus nauseosus, Gutierrezia sarothrae, Chrysopsis villosa and Thlaspi arvense.

In this semi-arid climate, vegetation of the grassland varied considerably with fluctuations in annual precipitation from the long-term mean (Figure 8). Figure 8 illustrates: a drought year (1961), the short-grass type was conspicuous (Bouteloua gracilis and Carex spp.); a wet recovery year (1962), Artemisia frigida was most important; a second wet year (1963), midgrasses became prominent (Stipa spp. and Agropyron smithii).

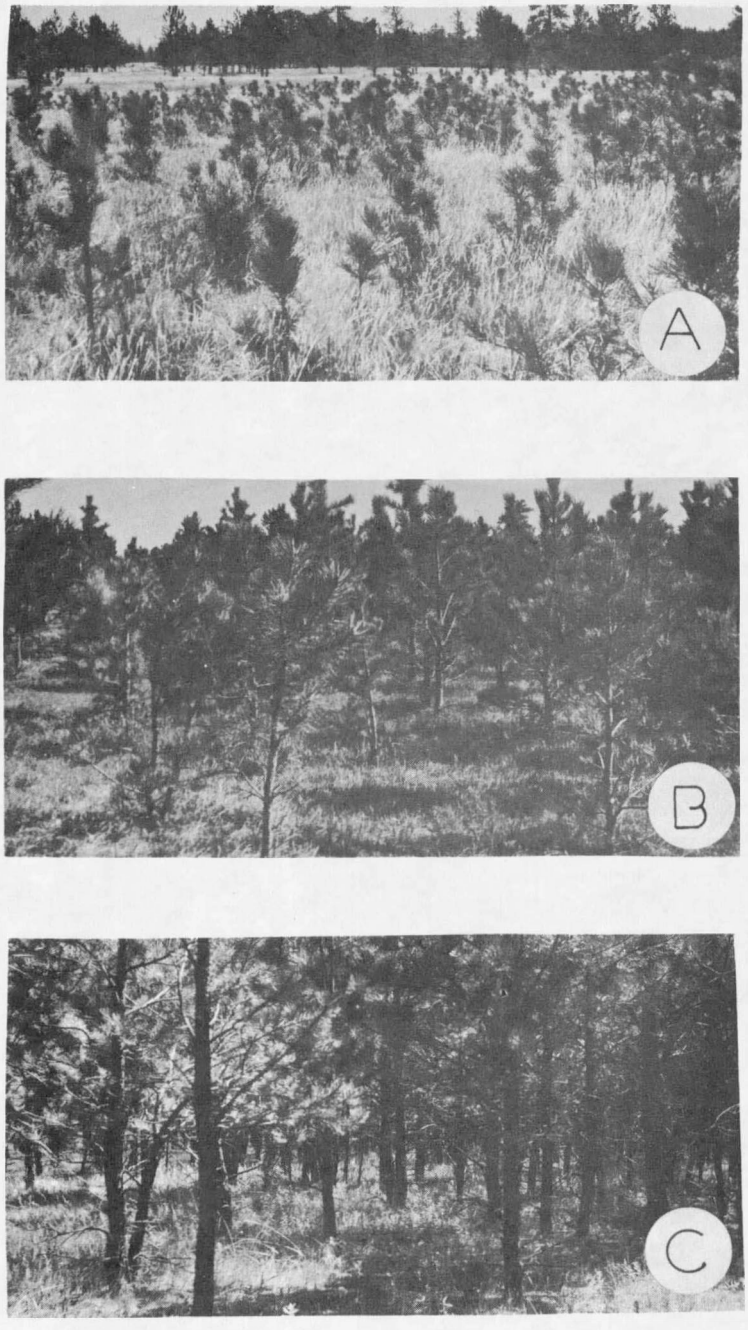


Figure 7. Encroachment of Pinus ponderosa in a Formerly Cultivated Field on Tri Point Flats. (A) 1938 (B) 1946 (C) 1956 (U.S. Forest Service Photographs)


Figure 8. Effects of Differences in Annual Precipitation Upon the Vegetation. (A) August 26, 1961 (drought) (B) August 28, 1962 (wet) (C) August 26, 1963 (wet)

Andropogon scoparius Community (Stand VIII, Table IV).

Bunches of this grass were scattered throughout the mixed prairie, especially in rocky soil on sheltered north and east slopes. Extensive stands occurred in the south Plum Creek drainage and elsewhere in the southeast section of the hills. This grass appeared to be utilized little by cattle and was conspicuous where present. In nearly pure stands, its prominence greatly reduced most other species.

## Deciduous Tree and Brush Communities

Symphoricarpos albus Community.

Generally pure stands of Symphoricarpos albus were not abundant, but some swales provided local topo-edaphic conditions suitable to the growth of isolated patches (Figure 9). Often associated with it in the 16-24 inch height-class were Rosa sp. and Monarda fistulosa. A low brush-grass ecotone, seldom over 100 yards wide, was wide-spread along the edges of the forest (Figure 10). It consisted of mixed vegetation from the forest understory (viz. Symphoricarpos albus) and from the Carex-Bouteloua-Agropyron community. Coverages by the two types appeared to be about equal but Symphoricarpos albus was most conspicuous. Often there were a few scattered Pinus ponderosa in this ecotone.

Figure 9. Nearly Pure Stands of Symphoricarpos albus in Patches and at the Edge of the Forest.

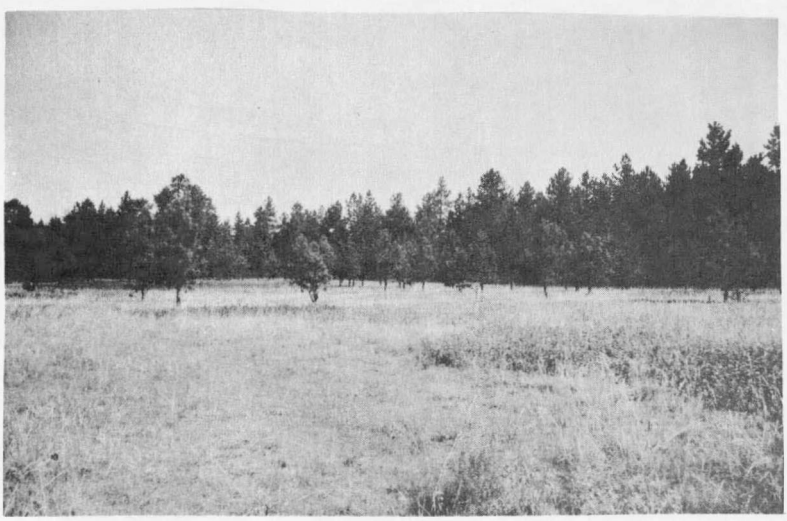

Figure 10. Brush-grass Zone (Symphoricarpos-Carex-Bouteloua-Agropyron) at the Forest's Edge.

Generally other shrub communities were not abundant. Just below the edge of the forest, some draws had Prunus americana and Crataegus succulenta associated in dense masses 6-8 feet tall. Rhus trilobata was scattered throughout the grassland but not in extensive patches. The slopes in the northeast section of the study area had some scattered, dense mats of Juniperus horizontalis.

Populus tremuloides Community (Figure 11).

Groves of this species were seldom over 500 square yards in area. They were common at upper ends of broad drainageways. Most common species in the understory were of the 12-16 inch height-class: Symphoricarpos albus, Ribes setosum, Rosa sp., Monarda fistulosa, Artemisia ludoviciana, Galium boreale, Apocynum androsaemifolium, Poa pratensis, Agropyron griffithsii, Stipa viridula and Carex spp.

Fraxinus-Acer-Crataegus-Prunus Community (Figure 12).

Generally the drainageway vegetation exhibited three strata. The first consisted of trees (30-40 feet tall): scattered Fraxinus pennsylvanica, Acer negundo and Pinus ponderosa. The first two species were most common and in draws extended beyond the pine forest into the flats. The shrub layer (4-8 feet tall) consisted mostly of Crataegus succulenta, Prunus americana, P. virginiana, Shepherdia argentea,

Figure 11. Populus tremuloides Stand at the Head of a Broad Drainageway.

Figure 12. Fraxinus-Acer-Crataegus-Prunus Community in Drainageway, Grassland in Foreground and Open Stand of Pinus ponderosa in Background.

Amelanchier alnifolia, Ribes aureum and Rosa sp. The first three were most abundant. The third stratum (0-3 feet tall) was a mixture of shrubs, forbs and grasses: Artemisia frigida, A. ludoviciana, Erigeron canadensis, Monarda fistulosa, Achillea millefolium, Stipa comata, S. viridula, Agropyron smithii, Andropogon gerardii, A. scoparius, Aristida longiseta, Elymus canadensis, Hordeum jubatum, Bouteloua curtipendula, B. gracilis and Carex spp.

Most conspicuous in broad drainageways beyond the forest were Fraxinus pennsylvanica and Acer negundo with an occasional Populus sargentii. Usually under the trees were thickets of Crataegus succulenta, Prunus americana, Shepherdia argentea and Rosa sp.

In deep ravines where permanent moisture was available, stratification of the vegetation was not evident because of steep sides and luxuriant growth of shrubs and forbs. Plants characteristic of this more mesic habitat, in addition to those already listed for the drainageway communities, were Cornus stolonifera, Salix sp., Rubus idaeus, Solidago gigantea, Rhus radicans, Smilacina stellata, Cornus canadensis, Clematis ligusticifolia and Mentha arvensis.

## USE OF VEGETATIVE TYPES BY TURKEYS

As an indication of the use of vegetative types, all observations of "undisturbed" turkeys were tabulated according to the plant communities in which the birds were seen (Table V). There were observations of 6,271 birds comprising 468 groups recorded as follows: 1961, 1,795 birds in 110 groups; 1962, 1,417 birds in 105 groups and 1963, 3,059 birds in 253 groups.

The Carex-Bouteloua-Agropyron community, followed by Symphoricarpos albus and pole stands of Pinus ponderosa, provided the greatest number of observations. The Fraxinus-Acer-Crataegus-Prunus community was utilized slightly more than sapling and sawlog stands of the Pinus ponderosa community. Turkeys were never seen in Andropogon scoparius or Populus tremuloides possibly because of the limited occurrence of these types.

In summer, grassland received greater total usage than any other type mainly because of increased usage late in the season which was possibly related to a change in turkey food habits from grasshoppers to grass seeds (see Food Habits). Symphoricarpos albus provided the greatest number of observations in early summer. There was a marked increase in use of Fraxinus-Acer-Crataegus-Prunus and a corresponding decrease in use of Symphoricarpos albus in fall as compared to summer. In winter, the Fraxinus-Acer-Crataegus-Prunus community had the highest percentage of seasonal use for any type at any season. Winter usage of all other types

TABLE V. LOCATION BY PLANT COMMUNITIES OF 6,271 TURKEYS IN 468 GROUPS, 1961, 1962 AND 1963.

| Community | Summer | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Carex-Bouteloua-Agropyron | 1,774 | 35.5 | 257 | 36.6 | 58 | 21.7 | 168 | 55.5 | 2,257 | 36.0 |
| Symphoricarpos albus | 1,572 | 31.5 | 92 | 13.1 | -- | -- | 76 | 25.1 | 1,740 | 27.7 |
| Pinus ponderosa Sawlog | 251 | 5.0 | 10 | 1.4 | -- | -- | 14 | 4.6 | 275 | 4.4 |
| Pole | 1,145 | 22.9 | 144 | 20.5 | 14 | 5.2 | 42 | 13.9 | 1,345 | 21.4 |
| Sapling | 97 | 1.9 | -- | -- | -- | -- | 1 | 0.3 | 98 | 1.6 |
| Fraxinus-Acer-Crataegus-Prunus | 158 | 3.2 | 200 | 28.4 | 196 | 73.1 | 2 | 0.6 | 556 | 8.9 |
| Populus tremuloides | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Andropogon scoparius | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

was the lowest for any season. A shift back to grassland was indicated for spring.

### Carex-Bouteloua-Agropyron Community

Grasslands provided more than one-third of all observations for each season except winter, but only 9 per cent of the turkeys seen were at greater distances than 100 yards from the cover of trees or shrubs. Most observations were of feeding birds. Poults in broods provided most of the observations in summer. Most turkeys observed in grassland during winter were on slopes near deciduous tree and brush thickets of lower drainageways. Of 19 courtship groups (98 birds) observed in spring, 12 (75 birds) were in grassland. Ninety and 60 per cent of non-courting males and females, respectively, observed in April were in grassland; while in May, the respective figures were 40 per cent and 25 per cent. This decrease was possibly related to nesting. Leopold (1944) and Dalke and Spencer (1946) reported similar usage of grassland in spring.

### Symphoricarpos albus Community

Only 9 per cent of the turkeys seen in Symphoricarpos albus were in "pure" stands. All others were in the brush-grass ecotone at the edge of the forest. Most turkeys seen in this type were poults in broods. Consequently, 90 per cent of the observations in Symphoricarpos albus occurred

in summer. Young poults of small size used this type of cover for concealment, but older poults retired into the forest when disturbed. The percentage of observations in the Symphoricarpos albus community decreased each month from late August to early November. No birds were observed in this type from mid-November until April 1. Observations increased through the spring as hens nested and brought off broods.

### Pinus ponderosa Community

Trees in the pole size-class represented 36 per cent of the Pinus ponderosa forest, but 78 per cent of 1,718 turkeys observed in this community were in stands of this size-class. Preference for pole stands over other stands was about the same for all seasons. This was possibly due to: A comparatively open understory, aiding turkeys which rely upon eyesight for security (Latham, 1956); a greater variety of plants for food and a closed canopy which gave more protection from hawks and eagles as well as providing shade in summer.

In summer, loafing was the activity recorded for 634 turkeys; 71 per cent were in the Pinus ponderosa community. The pole stands provided most observations for this activity, but in sapling stands all groups but one were loafing. Except for one bird, all observations of turkeys in sapling stands occurred in summer. Observations in the pine community diminished from early fall to winter. The use of the conifer forest in fall might

be altered during years of "good" pine seed production. Turkeys attracted to pine nuts for food as reported by Jantzen (1959) and others could increase the use of more mature sawlog stands and the Pinus ponderosa community in general. There was no "good" production of pine seeds during the time of this study. In winter, 14 birds in 3 flocks were seen in the Pinus ponderosa community. Seven turkeys in April and 25 in May were observed here. Most males and all courtship flocks seen in the pine community in spring were within 50 feet of a clearing.

The size-class of pine used most often for escape appeared to be that nearest the birds when disturbed. If there was a choice, it appeared that preference was in this order: pole, sawlog, sapling. This seemed to be related to the relative open condition of the cover and reliance by turkeys upon keen vision for escape. Turkeys in the study area were seldom seen to use "doghair" stands as escape cover. Hoffman (1962) reported that dense stands of pine provided good escape cover in Colorado. Topography may have influenced the choice in the Long Pines. The birds generally ran up hill and often utlized the rugged terrain in escaping.

All but one roosting site were in the Pinus ponderosa community. Measurements and observations were recorded for 26 of these sites (Table VI). The tree measured at each site was the one with the most roosting birds if more than one tree was occupied.

TABLE VI. AVERAGES AND RANGES FOR MEASUREMENTS OF 26 PINUS PONDEROSA ROOST TREES AND FOR PER CENT SLOPE OF THE 26 SITES.

| | Pinus ponderosa Roost Trees | | | Slope |
|---|---|---|---|---|
| | Age | DBH | Height | |
| | yrs. | in. | ft. | % |
| Average | 121+ | 17.9 | 64 | 34 |
| Range | 65-157+ | 12.2-26.6 | 44-91 | 0-48 |

Usually Pinus ponderosa roost trees were of the mature sawlog type (Figure 13). Turkeys disturbed at roosting time often selected smaller trees. Most roost trees were located on a sheltered slope facing south or southeast (Figure 14). The trees in the vicinity were generally scattered and the floor of the forest had an open appearance. Some roosting sites appeared to be used more consistently than others. The turkeys tended to restrict roosting to one site commonly in winter and early spring, possibly because of reduced daily range. At other seasons, choice of a roost was possibly influenced by the location of the birds at roost time. Apparently Merriam's turkey is capable of adapting to a wide variety of roosting trees and sites (Suetsuga and Menzel 1963, Hoffman 1962).

### Fraxinus-Acer-Crataegus-Prunus Community

The one roost tree discovered outside the Pinus ponderosa community was a Fraxinus pennsylvanica tree about 30 feet tall in the Fraxinus-Acer-

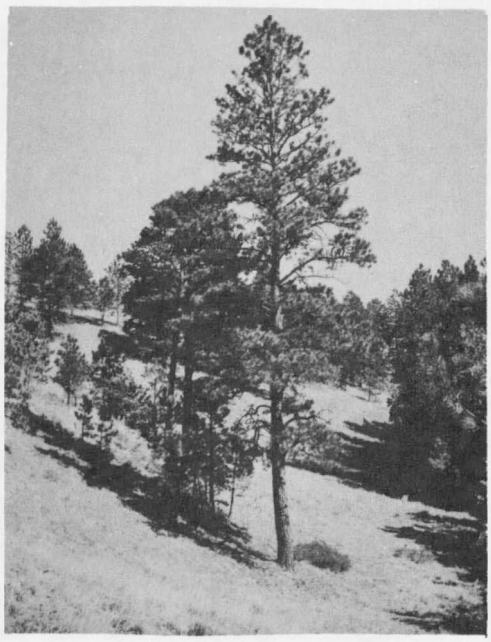

Figure 13. An Example of a Pinus ponderosa Roost Tree, 140+ Years Old, 24.5 Inches dbh and 76 Feet Tall.

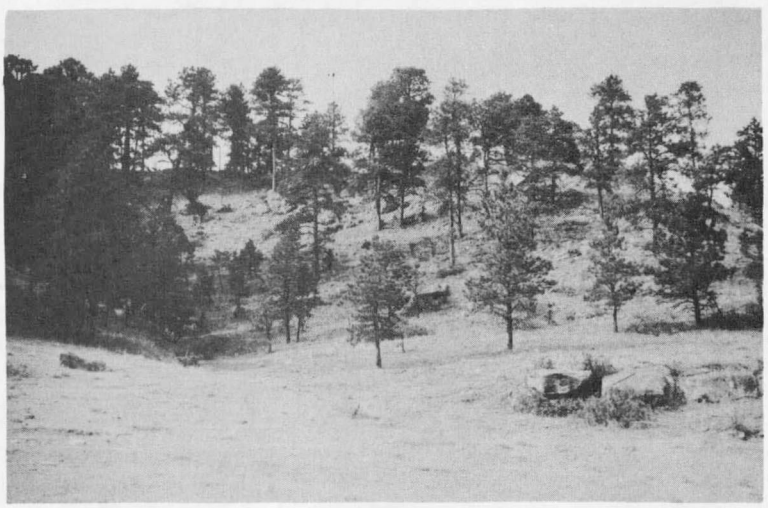

Figure 14. Roosting Site with a Southeast Slope of 48 Per Cent.

Crataegus-Prunus community. The roost was used by one female and brood for a few nights early in August 1962.

Sixty per cent of 158 turkeys seen in the Fraxinus-Acer-Crataegus-Prunus community in summer were recorded for the first part of September. Observations of birds in the deciduous tree-brush habitat (Figure 15) of lower drainageways continued to increase through the fall. The high percentage of observations in the Fraxinus-Acer-Crataegus-Prunus community during winter was possibly due to: location on the lower slopes where weather conditions were less severe; excellent cover and a good source of food when the bushes produced berries. In spring, there was a pronounced decrease of observations in this vegetative type. Only two turkeys were seen in the Fraxinus-Acer-Crataegus-Prunus community from April 1 through July 15.

No marked difference in the use of vegetative types was noted for any of the years of this study. The use of vegetative communities followed the same general pattern reported for the Long Pines by Rose (1956). However, Rose noted considerable use of livestock-feeding areas and cultivated fields in fall and winter. The use of these artificial types was almost negligible during the time of this study. This may have been due to: effects of recent liberal hunting seasons; suspended operations of two ranchers who had encouraged turkeys to use their feed lots and milder winters.

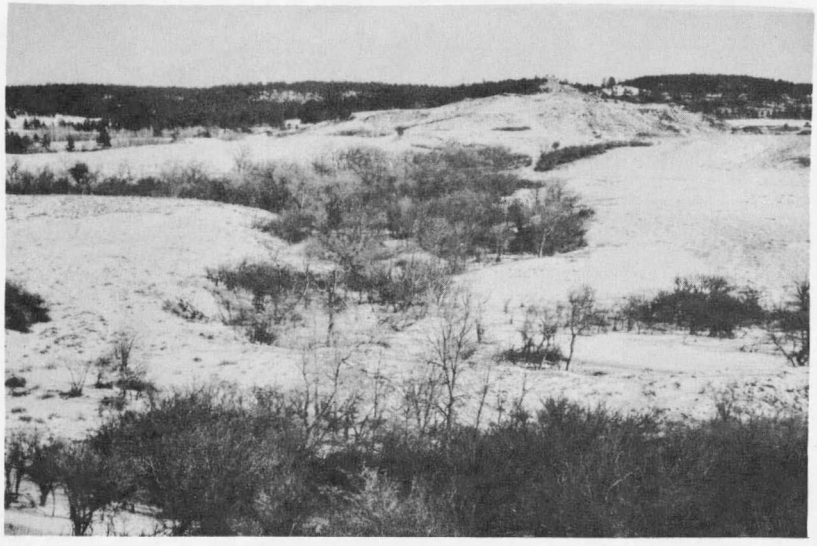

Figure 15. A Drainageway below the Ridge with the Fraxinus-Acer-Crataegus-Prunus Community. This was the Vegetative Type Most Used by Turkeys in Late Fall and Winter.

Three nest sites were located. A nest for each of two years was indicated for one site. Apparently there was only one nest for each of the other two. Condition of the shell membranes indicated success for two of the nests. The two sites with successful nests were located at the edge of the Fraxinus-Acer-Crataegus-Prunus community on opposite sides of the same drainageway. One was on the south hillside at the base of a Fraxinus pennsylvanica tree (Figure 16). The successful nest at this site was previous to 1962. In 1962, the eggs were removed from a nest at this site by a forest crew after flushing the hen. The second site with a successful nest, probably 1961, was located on the south-facing slope between two boulders under a mixture of low bushes: Prunus virginiana, Rhus trilobata and young Fraxinus pennsylvanica (Figure 17). The other unsuccessful nest was found in the late spring of 1962 in an old burn area of the forest on a gentle north-facing slope (Figure 18) under a downed, dead tree in a Symphoricarpos albus thicket (Figure 19). It contained four rotten eggs and was apparently abandoned. Nests reported here were in about the same types of locations reported for Merriam's turkey in South Dakota (Gage 1952) and in New Mexico (Ligon 1946).

A report was received that a hen had been flushed and nest destroyed by mowing operations in a hay field 100 feet from the cover of trees and bushes near the Little Missouri River about five miles from the study area.

This type of nesting site for Merriam's turkey has been reported by Burger (1954) in California and Hoffman (1962) in Colorado.

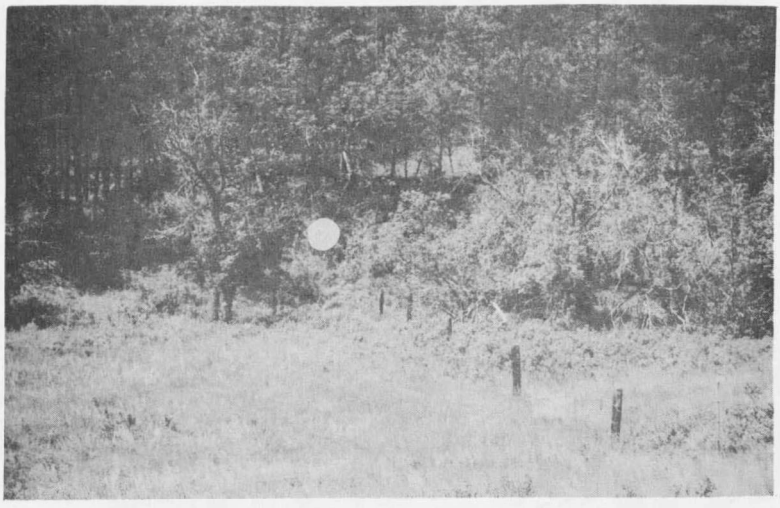

Figure 16. Nest Location (circle) at the Base of a Tree in the Fraxinus-Acer-Crataegus-Prunus Community. (1962)

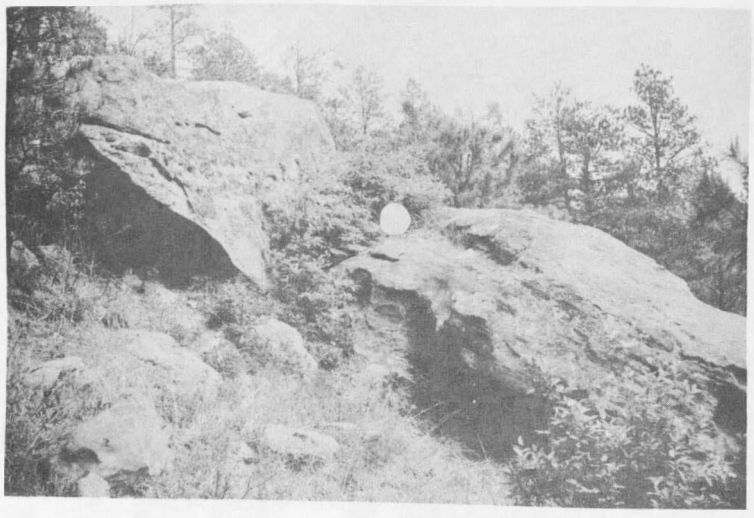

Figure 17. Nest Location (circle) under Short Brush across the Drainageway from the Nest in Figure 16. (1961)

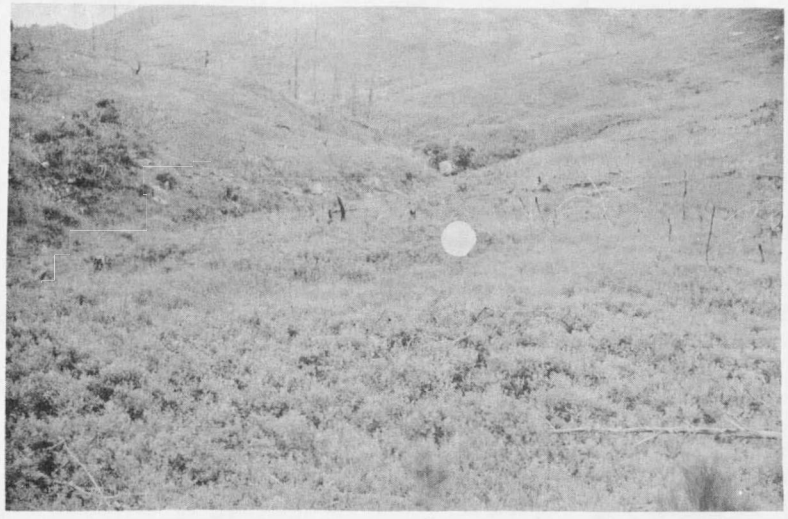

Figure 18. Location of a Nest (circle) in a Symphoricarpos albus Patch in an Old Forest Burn Area. (1962)

Figure 19. Closeup of Nest Location (circle) in Figure 18.

## POPULATIONS

Five toms and 13 hens from the Black Hills of northeastern Wyoming were released near Capitol Rock on January 27, 1955. One year later the population was an estimated 82. By fall 1957, or three breeding seasons, the number was about 700 (Montana Fish and Game Department records). The birds were distributed over most of the Long Pines and had emigrated to three separate adjacent areas. This increase corroborates a statement by Bailey (1957): "Wild turkeys transplanted to suitable, unoccupied range closely attain the reproductive potential of the species." Similar population growths have been reported for Merriam's turkey introduced in South Dakota (Gage 1952) and Nebraska (Suetsuga and Menzel 1963).

The first hunting season was three years and eight months, or four breeding seasons, after introduction. In seven years a minimum of 1,103 turkeys are known to have been removed: 858 by hunting; 217 trapped for transplanting elsewhere; 19 collected for scientific purposes and 9 miscellaneous. There were no accurate data available for determining total populations for years of this study. Calculations by the Lincoln Index using marked birds indicate a minimum post-breeding season population for each year: 1961, 654; 1962, 550 and 1963, 464. Because of sample sizes and vagarities of returns by hunters, only the first two are considered valid approximations. These data suggest the population had reached a peak and leveled off as early as 1957 (see above and section on Emigration).

If three-fourths of the Long Pines (about 75 square miles) is suitable late summer habitat for turkeys, densities for that season in 1961 and 1962 were about 8.72 and 7.33 per square mile respectively.

## Trends

Most observations of turkeys were made from a vehicle with the aid of 7 x 35 binoculars or 25X spotting scope. Each of two 12-mile trend routes traversing the area were traveled twice weekly at 10 mph when skies were generally clear and wind less than about 10 mph. Each route was traveled once in the morning beginning at sunrise and once in the evening beginning at the time necessary to complete travel about one-half hour before sunset. Direction of travel was reversed for the evening route. In addition to the regular trend routes, all passable roads were covered at least once a week following approximately the same general pattern each week. In summer, observations were from sunrise to about 10:30 A.M. and from about 3:30 P.M. until dark. Observations were conducted through most of the day during other seasons.

Population trends for the three years of this study were determined from total numbers of turkeys observed along the two trend routes during eight weeks each year from mid-July to mid-September (Table VII). The two trend routes were run a total of 32 times (384 miles) each year. Days when general observations were made during the eight-week period in 1961, 1962

and 1963 totaled 36, 37.5 and 40.5 respectively. Data from general observations were used only to increase sample size for expressing poults/hen ratios (Table VIII).

TABLE VII. TURKEY POPULATION TRENDS AND POULTS/HEN RATIOS FOR THREE YEARS AS INDICATED BY OBSERVATIONS ALONG TREND ROUTES, MID-JULY TO MID-SEPTEMBER.

| | 1961 | 1962 | 1963 |
|---|---|---|---|
| Poults | 343 | 157 | 191 |
| Hens | 52 | 15 | 23 |
| Toms | — | — | — |
| Unclassified | — | 44 | 10 |
| Total | 395 | 216 | 224 |
| Poults/Hen | 6.6 | 10.5 | 8.3 |

TABLE VIII. POULTS/HEN RATIOS AS DETERMINED BY ALL OBSERVATIONS (TREND ROUTES AND GENERAL OBSERVATIONS), MID-JULY TO MID-SEPTEMBER.

| | 1961 | 1962 | 1963 |
|---|---|---|---|
| Poults/Hen | 6.7 | 7.9 | 7.7 |
| (Sample size) | (848) | (562) | (1,401) |

The population as indicated by trend route data was highest in 1961, lowest in 1962 and intermediate in 1963. Average sizes of flocks seen varied with population changes: 1961, 22.4; 1962, 14.0 and 1963, 18.1. Dalke, Leopold and Spencer (1946) and Spicer (1959) thought flock sizes

were directly proportional to population densities.

Productivity was estimated from the ratio of total poults to total hens observed. Trend route data showed production to be highest for 1962 and lowest for 1961 (Table VII). Data for all observations show similar trends (Table VIII). Juveniles/adult hen ratios determined for hunter kills examined at checking stations are shown in Table IX. These data corroborate the production indicated by trend routes and general observations. Productivity was inversely related to population densities. This appears to reflect the inversity principle of summer gains to spring densities expressed by Errington (1945).

TABLE IX. JUVENILES/ADULT HEN RATIOS FOR HUNTER KILLS.

| | 1963 | 1962 | 1963 |
|---|---|---|---|
| Juveniles/Adult Hen (Actual ratios) | 8.5 (51:6) | 18.0 (36:2) | 11.8 (59:5) |

Differences in productivity may have been related to precipitation. For the three months critical to nesting, hatching and rearing success (April, May and June), deviations in precipitation from the long-term mean were as follows: 1961, -2.03"; 1962, +2.01" and 1963, +6.30". The dry spring of 1961 had been preceded by two abnormally dry years. Possibly most effects of precipitation in the dry years (1959, 1960, 1961) and the

wet 1962 were indirect through influence upon vegetation and hence cover. Cover was poor in 1961 and excellent in 1962. It was also superior in 1963; however, four heavy snows occurred at intervals of about one week in April (one 17 inches) and rainfall was 4.81 inches above the average for June. Weather may have had a direct adverse affect upon reproductive success that year. Further evidence of this is apparent from some late hatching dates for 1963, resulting from retarded first nests or renesting (see Hatching Dates). Effects of weather upon turkey reproduction in general have been cited by Jantzen (1959), Burget (1957), Wheeler (1948), DeArment (1959), Glazener (1962) and others.

## Turnover and Longevity

Records were available for 132 individually marked turkeys. Ninety-five were marked during the time of this study and 37 in 1957 (Montana Fish and Game Department records). Adults and juveniles were captured by "mortar-projectile" nets and drop-gate traps. Ten adults and 54 juveniles were marked by different color combinations of four leg bands each. Six adults and 14 juveniles were wing-tagged with 6" x 1½" colored strips of plasticized nylon fabric attached to the patagium by large numbered aluminum "rivets" (described by Knowlton, Michael and Glazener 1964). Forty-eight poults, 2 to 56 days old, were captured on the ground by hand and net or noosed from trees with a 22-foot pole. These were marked with

numbered "Jiffy" chick wing tags (National Band and Tag Co., Newport, Kentucky). Six poults weighed over one pound and were additionally marked for field recognition by attaching 3" x ½" colored strips of plasticized nylon fabric to the "Jiffy" tags.

Of the total number, no subsequent sightings or kills were recorded for 49 (37 per cent). Ninety of the 132 birds were leg-banded or wing-tagged for individual recognition in the field. Records of these 90 were used to estimate the population turnover (Table X).

TABLE X. NUMBER OF BIRDS MARKED AND THE NUMBER SEEN (OR ACCOUNTED FOR) FOR THE LAST TIME IN EACH OF THE FOLLOWING YEARS.

| Year | Number Marked | Interval from Marking to Last Record (Years) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 |
| 1957 | 37 | 20 | | | | | | |
| 1958 | -- | -- | 8 | | | | | |
| 1959 | -- | -- | -- | 1 | | | | |
| 1960 | -- | -- | -- | -- | 1 | | | |
| 1961 | 19 | 10 | -- | -- | -- | 2 | | |
| 1962 | 7 | 4 | 1 | -- | -- | -- | 0 | |
| 1963 | 27 | 26 | 2 | 2 | -- | -- | -- | 0 |
| Total | 90 | 60 | 11 | 3 | 1 | 2 | 0 | 0 |
| Averages | 22.5 | 15 | 3.7 | 1.5 | 1 | 2 | 0 | 0 |

Thirteen (15 per cent) of these were not seen after release. Individual relocations of the remaining 77 ranged from 1 to 47 times. These 77 birds were tabulated by yearly intervals from the time marked and released until

last observed (54) or killed (23). These data suggest over 50 per cent of the population disappeared each year whether hunted or not. Hunting was initiated in the fall of 1958 and was continued in each of the subsequent years. Thus birds banded in 1957 (March 6-20 and October 11) were not subjected to hunting until October 4-6, 1958. Of 20 birds marked in 1957 which disappeared from the population within one year, only one was removed by hunting. The remainder were last relocated a minimum of seven months before the first hunting season. This suggests that over 50 per cent of the unhunted population disappeared within one year. In New Mexico, the annual mortality rate of Merriam's turkey was estimated to be 50-60 per cent (Wischonofske 1960). Complete turnover for the Long Pines population appears to occur within five years, very similar to that reported for bobwhite quail (Colinus virginianus) (Errington 1945) and pheasants (Phasianus colchicus) (Leopold, Sperry, Feeney and Catenhusen 1943).

Turkeys over five years old should be unusual. Only three turkeys over five years of age were recorded in the Long Pines. The oldest was a tom at least $6\frac{1}{2}$ years old. It was an adult released with the original introduction (1955) and shot in 1959. One male and one female marked as juveniles (1957) were last seen when about $5\frac{1}{2}$ years old (1962). Ligon (1946) stated that the maximum age of Merriam's turkey does not exceed 10 years. Various authors have pointed out the short life expectancy of other wild turkey

subspecies (Amadon 1960, Latham 1956, Powell 1963, Wilson and Lewis 1959).

## Emigration

Turkeys emigrating from the Long Pines must cross open prairie to reach suitable habitat. Gallery forests and brushy drainageways may provide avenues of travel. Spicer (1959) reported emigrations of turkeys 20-30 miles across deserts in New Mexico.

Although no specific quantitative data are available, two distinct emigration periods from the Long Pines were apparent. The first apparently resulting from population pressure in 1957-58 coincided with the initial build-up of the population before the first hunting season. Similar emigration-type range extensions of Merriam's turkey were reported in Nebraska during initial expansion of the population following introduction (Suetsuga 1962).

Egan (1958) reported birds moved the following airline distances from the nearest turkey habitat in the Long Pines to these areas: 2.5 miles, Sheep Mountains; 1 mile, Humbolt Hills and 8 miles, Ekalaka Hills. In addition, 13 turkeys trapped in the Long Pines were transplanted into the Ekalaka Hills in 1958. Habitats of these three areas were similar to the Long Pines, but smaller.

Turkeys in the Sheep Mountains increased. They have been hunted since 1959. Investigations in the summer of 1961 revealed no turkeys in the Humbolt or Ekalaka Hills despite a report of about 20 in the latter area in early spring of that year.

The second period of emigration apparently occurred in 1962. Reports from resident ranchers were received of turkeys in the Ekalaka Hills, Humbolt Hills and along the Little Missouri River 2.5 miles from the Long Pines. I verified the presence of birds in the latter area. In 1962 birds were seen farther out on the periphery of the Long Pines than in 1961. Two factors may have contributed to this peripheral movement and apparent emigration: improvement of cover and population pressure with a preponderance of juveniles resulting from high production that year. Lack (1954) reported young birds emigrate more readily than older ones because of their low status in the "peck order." Eng (1959a) found for ruffed grouse (Bonasa umbellus) that break-up of broods was accomplished by an extension of the ranges of individual birds. Following three dry years, superior cover in 1962 may have made formerly submarginal habitats suitable for turkeys. Thus improvement rather than deterioration of the habitat may promote turkey emigrations. Describing emigrations in New Mexico, Spicer (1959) stated: "It was felt that food and water were in better supply at the time of emigration than they were in the previous year."

## FLOCKING

During the three years of this study, 6,271 turkeys were recorded in 468 gobbler, hen, brood, mixed or courtship flocks (Table XI). Composition of these and ranges in size were as follows: gobbler, males only, 1-10; hen, females only, 1-4; brood, hen(s) with young, 2-40; mixed, gobblers and hens (with or without young), 5-38 and courtship, displaying gobblers with hens, 2-27.

TABLE XI. SEASONAL FLOCKING OF 6,271 TURKEYS IN 468 GROUPS, 1961, 1962 AND 1963.

| | Spring | | | Summer | | | Fall | | | Winter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Fl. | Avg. | No. | Fl. | Avg. | No. | Fl. | Avg. | No. | Fl. | Avg. |
| Gobbler | 75 | 31 | 2 | 102 | 18 | 6 | 39 | 8 | 5 | 18 | 4 | 5 |
| Hen | 22 | 21 | 1 | 14 | 9 | 2 | 3 | 3 | 1 | 1 | 1 | 1 |
| Brood | 88 | 9 | 10 | 4,478 | 258 | 17 | 223 | 16 | 14 | — | — | — |
| Mixed | 18 | 2 | 9 | 403 | 20 | 20 | 438 | 33 | 13 | 249 | 19 | 13 |
| Courtship | 100 | 19 | 5 | — | — | — | — | — | — | — | — | — |

Composition of spring flocks reflected breeding activities. Gobbler flocks, with few individuals, and courtship flocks were conspicuous. The relative importance of summer flocks was influenced by production. Population intermingling is suggested by the figures for fall compared to summer. In summer, 6.6 per cent of the flocks was in the mixed category as compared to 55 per cent in fall. This trend continued to the period of least sexual segregation which was winter. Of 21 winter flocks, percentage composition

by flocks was gobbler, 19.1 per cent, hen, 4.8 per cent and mixed, 76.2 per cent. Dalke et al. (1946) reported percentages for 36 winter flocks of the Eastern Turkey (M. g. silvestris) as follows: gobbler, 19 per cent; hen, 6 per cent and mixed, 75 per cent. Seasonal flocking patterns for turkeys in the Long Pines generally followed that reported for Merriam's turkey in other areas (Ligon 1946, Burget 1957, Hoffman 1962, Spicer 1959).

## Gobbler Flocks

Many mature gobblers deserted mixed or courtship flocks by mid-spring to establish individual or small group "territories" (see Reproduction). Gobbler flocks averaged smaller, 2.4 (1-6 individuals, in spring than in summer, 5.7 (1-9), but the number of flocks decreased in summer. These changes apparently resulted from the break-up of courtship groups and consolidation of individual gobbler flocks. Summer was the period of maximum sexual segregation for adults. From late summer until spring, sizes and numbers of gobbler flocks gradually decreased.

## Hen Flocks

Hens seldom formed flocks. Of 34 observations of hens only, 30 were of single individuals. These were mostly hens in spring and the number of observations gradually diminished as hens brought off broods or unsuccessful hens associated with brood or mixed flocks.

## Brood Flocks

Average size of brood flocks increased from 9.8 in spring to 17.4 for summer as individual broods joined others, apparently when poults were about 7 to 10 days old. Of 34 poults captured from 22 flocks and "aged" at 10 days or more, 22 were from 19 flocks with more than one hen each. The greatest number of hens seen in one brood flock was five. Each of 16 poults under 7 days of age that were captured came from one of three flocks with single hens.

Once established, composition of flocks varied little until late summer. Flocks scattered by trapping operations regrouped. Separate brood groups of older poults seldom mingled. Occasionally two groups joined and apparently were amiable for a few minutes to a few days and then separated. Wheeler (1948) reported flocks feeding together then separating.

The "fall shuffle" of late summer and early fall most evident from changes in brood flocks was characterized by: fighting among poults of the same flock, especially males; more general movements (see Movements); incomplete regrouping of disturbed flocks and flocks gaining or losing members after one or two months of stable composition. An example of the latter was a flock with four white poults observed nine times July 21 to September 17. On September 19 two of the white poults were missing, but

all were accounted for in the following hunting season or subsequent observations.

Despite the apparent unstable position of individual birds in the social order, some factor appeared to maintain the approximate summer composition of flocks during this "shuffle" as exemplified by 17 observations of one flock August 1 to September 11, 1961. Three marked hens, one adult and two yearlings, and 18 poults in one flock were seen three times August 1 to 15. One yearling apparently had no young. By August 18 she was replaced in the flock by a four-year-old marked hen. This combination was seen eight times August 18 to September 4. September 5 the four-year-old hen was replaced by an unmarked hen. This association was observed six times September 5 to 11. On the latter date, one poult was missing. This group was not seen again and apparently left the summer range. Several other observations seemed to indicate this same stability for flock composition but some shuffling of individuals.

"Fall shuffle" in turkey populations has been mentioned by Dalke, et al. (1946) and for the bobwhite quail by Stoddard (1931). Weather was cited as possibly affecting the time and duration of this "shuffle." Observations in the Long Pines suggest that combined social and spatial factors are likely the primary control. Indications of the "shuffle" were apparent about the same time each year even though weather conditions during

this period were very different each of three years. Indications of the "fall shuffle" were most evident in 1962, the year of highest production. This was the only year poults were seen unaccompanied by hens and more "losses" and "gains" were noted in late summer flocks. Unattached birds during the "fall shuffle" possibly represent the surplus of the fall population structure. Break-up of broods in fall and dispersal of individuals have been described for ruffed grouse (Eng, 1959a) and Blue grouse (Dendragapus obscurus) (Mussehl, 1960).

No brood flocks were recognized in late fall. Disturbances of the hunting season combined with the "fall shuffle" possibly contributed to this.

## Mixed Flocks

Two mixed flocks recorded for spring may have been courtship groups in which I failed to see displaying males. Males in mixed spring groups were predominately yearlings. No mixed flocks were seen May 16 to August 3. Sixteen of 20 mixed flocks observed in summer were recorded in September. Formation of mixed groups coincided with the "fall shuffle." In early fall, most consisted of yearling males and brood groups. Mixed groups gradually gained importance in the population during fall and became most prominent in winter.

## Courtship Flocks

The mixed flocks of winter gradually became the courtship flocks of spring, usually in late March and early April. Often individual males joined or deserted these groups. Flock sizes gradually diminished through the season as mature males departed to form "territories" and females began nesting. In April the average flock size was 9.0 and in May it was 3.1.

## MOVEMENT AND HOME RANGE

Season, sex and age as factors influencing movements were studied. Birds were classified as juveniles until June 21 of the year following hatching. Distances between observations represent minimum movements compiled from records of 83 individually marked birds relocated 561 times. The average number of relocations per bird was 6.8 (1-47). Measurements were to the nearest one-fourth mile on a map scaled two inches to the mile. Maximum seasonal movements for individuals relocated at least two times a minimum of 10 days apart were averaged (Table XII). Forty-eight birds provided 71 measurements.

The average of movements for all seasons was greatest for juveniles, possibly indicating lower status in the social structure. Age may account for less movement by young in summer. No movements for marked juveniles were made during winter. Their movements likely approximated those of adults because mixed flocks were prominent at that season.

Averages were calculated by sex and age-class for the greatest distances between points of marking and most distant relocations for 83 birds (Table XIII). The longest direct airline movement for any marked turkey was 14.5 miles by a yearling male. Juveniles moved greater average distances than adults. Among juveniles, males moved farhter than females. Among adults, females moved farther than males. There appeared to be no direct relationship between movement and the time lapse between marking

TABLE XII. AVERAGES OF MAXIMUM SEASONAL MOVEMENTS FOR MARKED BIRDS.

| | Spring | | | Summer | | | Fall | | | Winter | | | All Seasons (Avg.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. 1/ | Avg. 2/ | Max. 3/ | No. | Avg. | Max. | No. | Avg. | Max. | No. | Avg. | Max. | No. | Avg. | Max. |
| Adults | 4 | 2.3 | 2.8 | 18 | 7.2 | 3.4 | 13 | 4.9 | 5.8 | 3 | 4.3 | 3.4 | 38 | 5.6 | 4.3 |
| Juveniles | 13 | 4.9 | 6.7 | 14 | 6.0 | 2.8 | 6 | 3.5 | 8.1 | -- | -- | -- | 33 | 5.0 | 6.1 |
| All Birds | 17 | 4.4 | 6.0 | 32 | 6.8 | 3.1 | 19 | 4.6 | 6.4 | -- | 4.3 | 3.4 | 71 | 5.4 | 4.7 |

1/ No.- Number of birds.
2/ Avg.- Average number of relocations per bird.
3/ Max.- Maximum average distance traveled (miles).

TABLE XIII. AVERAGES OF MAXIMUM DISTANCES BETWEEN POINTS OF MARKING AND MOST DISTANT RELOCATION FOR MARKED BIRDS.

| | No. | Average No. Relocations | Max. Distance Between Observations (Miles) | | Elapsed Time Between Observations (Days) | |
|---|---|---|---|---|---|---|
| | | | Range | Average | Range | Average |
| Juvenile Males | 39 | 7.8 | 0-14.5 | 5.5 | 4-395 | 92 |
| Juvenile Females | 26 | 5.9 | 0-10.0 | 4.4 | 2-610 | 160 |
| Adult Males | 5 | 2.4 | 0-4.5 | 2.4 | 2-268 | 101 |
| Adult Females | 13 | 10.0 | 0-12.0 | 2.9 | 5-302 | 95 |
| All Birds | 83 | 6.8 | 0-14.5 | 4.4 | 2-610 | 113 |

and recovery. This was also observed by Powell (1963) for wild turkeys in Florida.

Generally summer ranges were at higher elevations than winter ranges. Movements between seasonal ranges apparently were not controlled by the availability of food or water (see Food Habits). Weather appeared to control the time of movement from summer range (see Fall Movements). The tendency of turkeys to be in or near the Pinus ponderosa forest, except during winter, indicated the influence of that vegetational type upon movement. Neither altitude nor vegetational type can account for distance or direction of travel in all instances. Because of the topography of the Long Pines, movement of one mile would permit almost maximum choice of vegetational type or change in altitude. Considerably greater movements can only be explained by random wandering, movements resulting from population pressure, return to a seasonal range or a combination of these. In reference to Merriam's turkey, Ligon (1946) wrote: "Probably no other upland game bird is so persistent in methodical seasonal associations."

### Spring Dispersal and Return to Summer Range

Activities associated with reproduction and shift to summer range appeared to be concomitant factors affecting spring movements. Early movements appeared to be related more to the former and late movements to the latter.

Average movements occurring exclusively in spring were calculated by sex and age class for 17 marked birds (method as used for Table XII). These were compared to average direct airline miles moved by 31 birds from winter to summer range (Table XIV).

TABLE XIV. AVERAGES OF MAXIMUM SPRING AND WINTER TO SUMMER RANGE MOVEMENTS FOR MARKED BIRDS.

| Movements | Juvenile Males | Juvenile Females | Adult Males | Adult Females | All Birds |
|---|---|---|---|---|---|
| Exclusively in Spring | 7.0 (9)[1/] | 5.8 (4) | -- | 2.8 (4) | 6.0 (17) |
| Winter to Summer Range | 8.6 (10) | 6.6 (11) | 4.0 (3) | 4.6 (7) | 6.5 (31) |

1/ Sample size.

These data appear to indicate that some movement to summer range occurred after the breeding season. Young birds showed the greatest movement. They became sexually active later than adults and space for reproductive activities near the winter range was occupied by adults. This would be most evident for territorial males (see Reproduction). Juveniles traveling greater distances than adults from summer ranges in the fall would require longer travel to return.

Known movements of eight juvenile toms were mapped to demonstrate seasonal movements and return to summer range (Figure 20). Birds 1 and 2 from different flocks were wing-tagged at about 18 days of age June 22

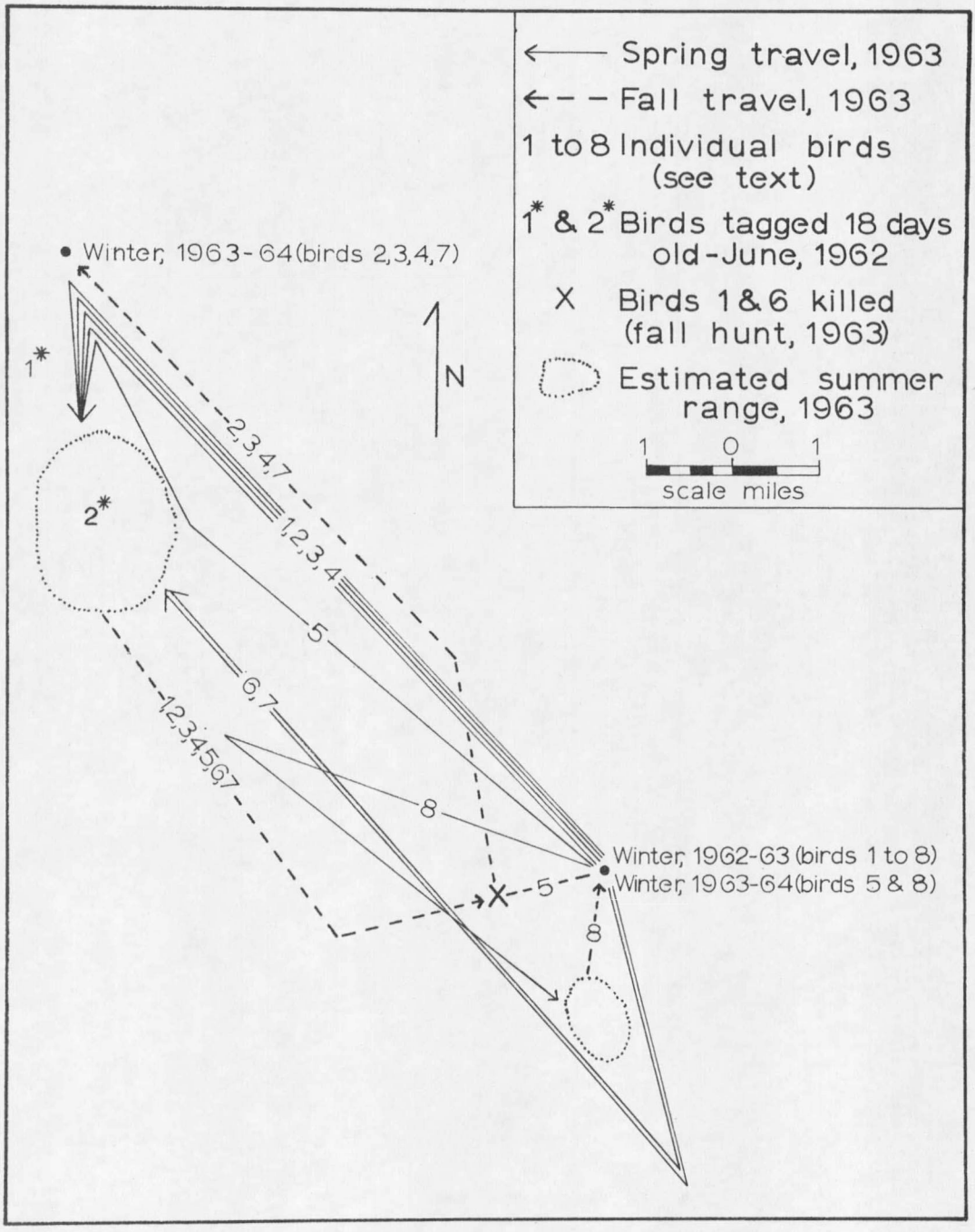


Figure 20. Spring Dispersal and Fall Movements of Eight Yearling Toms.

(position 1*) and June 23, 1962 (position 2*) respectively. They were recaptured February 10, 1963 with six other juvenile males on the winter range 9.0 and 7.5 miles from their respective summer tagging sites. All eight were marked for individual recognition. Daily observations indicated dispersal from the winter range April 12, 1963. Seven were on or near one summer range in late May and became one flock by July 19. Birds 1 and 2 were relocated 1.0 and 0.5 miles from their respective original tagging sites. Birds 6 and 7 at first moved in almost opposite directions from the others, but turned and joined them on the summer range. Bird 8 moved in the same general direction as the majority, but returned to arrive on another summer range by May 22. The erratic movements of birds 6, 7 and 8 may indicate random dispersal and then return to a summer range.

No extensive movements for marked adult males were recorded in early spring. They remained close to "territories" and with courtship groups. Later egress was abrupt. They were not recorded again until found on the summer range.

For spring dispersal and movements of six juvenile and two adult hens, see Figure 21.

Only one female was relocated the summer following tagging as a poult. Marked at about 30 days of age July 5, 1962 she was shot September 28, 1963 one mile from the point of tagging.

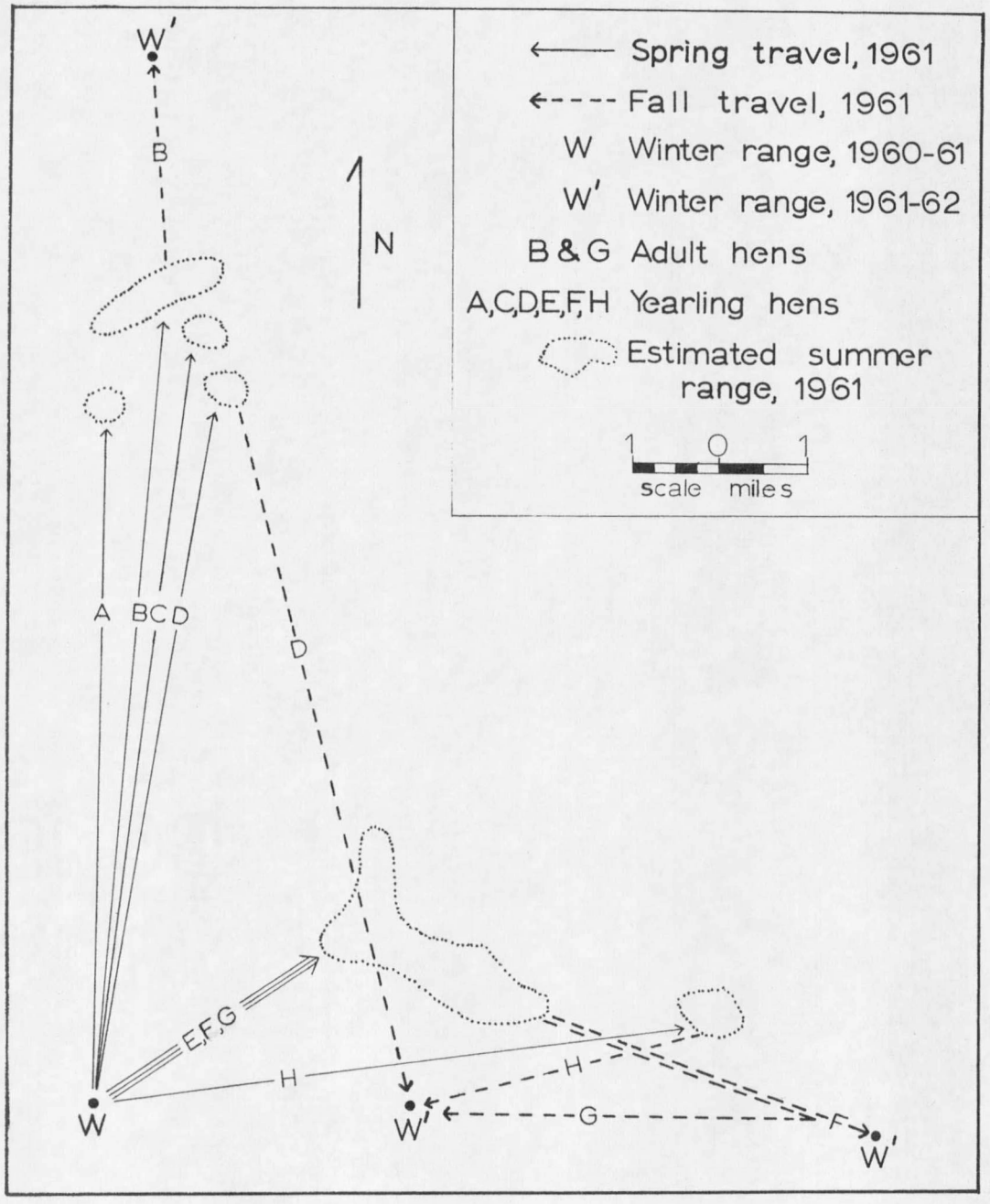


Figure 21. Spring Dispersal of Eight Hens and Movement of Five to Winter Range. (1961)

Adult females moved less than one-half the distance of yearling females in early spring. Possibly because of this low initial movement, proportionately greater movement occurred to reach the summer range than with yearling hens.

Hens may move considerable distances with young poults. This may represent movement to the summer range for those hens not nesting on or near it. Hatching dates were back-calculated for poults seen with two marked hens in separate flocks. The hens had been captured while laying or beginning incubation. These birds each moved a minimum 2.75 miles over rugged terrain with poults less than two weeks old. Additional indications of extensive movements of young poults were secured from a comparison of 15 marked at less than eight weeks of age and returned during the fall hunting season. Five marked at less than 10 days of age moved an average 4.2 miles; whereas, 10, two to eight weeks of age, were returned from an average 1.8 miles.

## Summer Range

Three gobbler flocks observed 11 times (2-6) during summer indicated their estimated summer ranges of four to six square miles were larger than those of brood flocks. Of observations of 101 toms in 17 flocks seen during summer, only 13 in three flocks were observed on the ridge-top. The others frequented the mesic drainageways and lower grasslands.

Summer ranges of brood flocks were difficult to evaluate because of rugged terrain. Estimates based on movements of nine individually recognizable flocks observed 123 times (8-24) during three years indicate a summer range of 2.5 to 3.5 square miles. Most brood flocks were seen on the open ridge-top. They appeared to move within a restricted area of about 200 acres for three or four days and then suddenly move to another part of the summer range. Two or three of these "favorite" areas within each range were noted. Often one location appeared to be used more than the others. There was no evidence of summer range being influenced by available water or food.

One hen marked as an adult during the winter of 1960-61 was seen in subsequent seasons on three different summer and two different winter ranges other than the one where marked (Figure 22 and bird "G" of Figure 21). Forty-seven relocations were used to estimate movements and ranges. Summer ranges did not coincide but there was some overlap.

## Fall Movements and Return to Winter Range

Apparently weather was the primary factor determining the time of departure from the summer range. September 1961 and 1962 each had one heavy snowfall and cold wet weather early in the month. September 1963 had no snow and was comparatively dry and warm. Counts for trend routes along the ridge showed differences in the average number of turkeys per

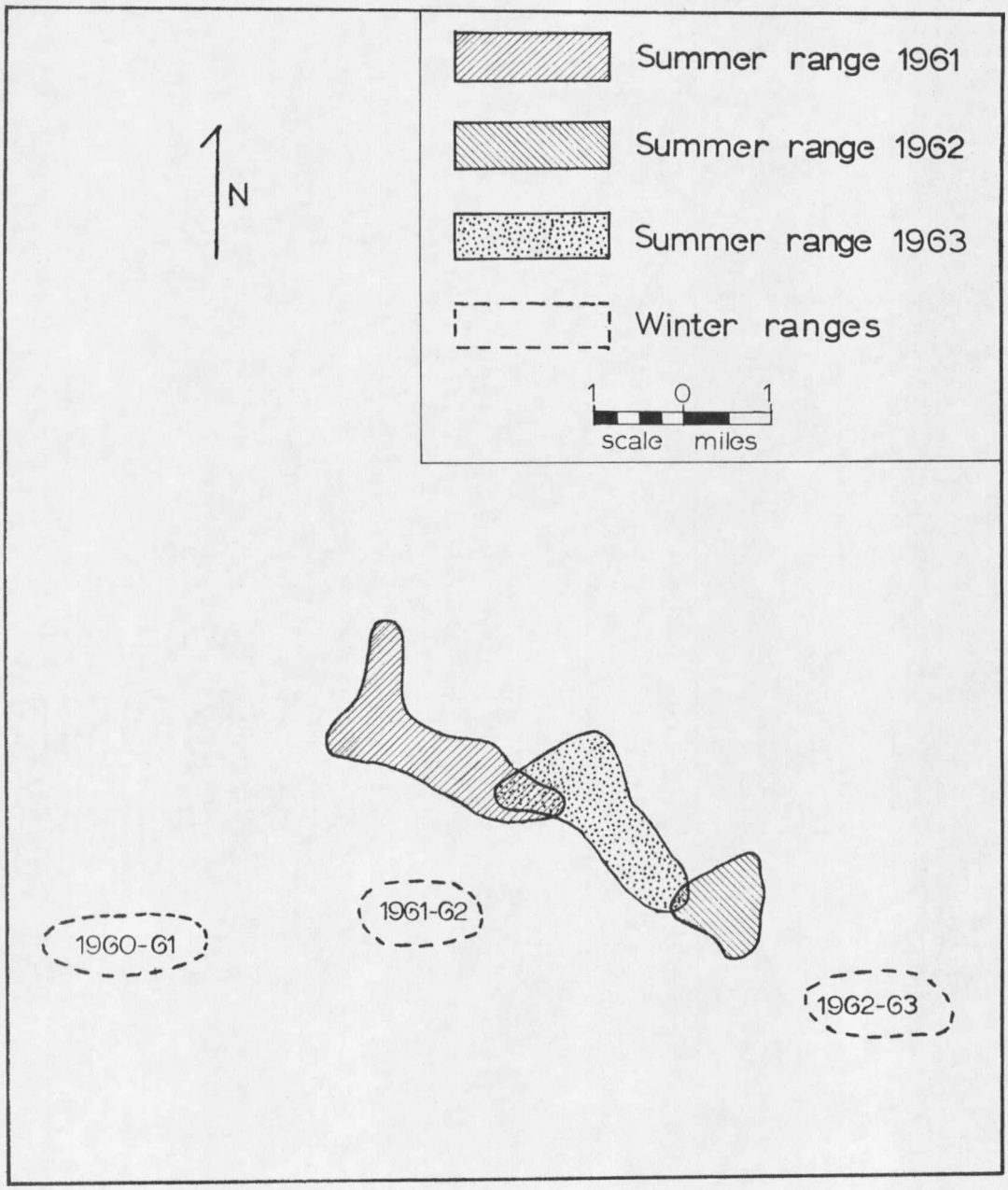


Figure 22. Three Summer and Winter Ranges Estimated from 47 Relocations for an Adult Hen Marked on the 1960-61 Winter Range. (Bird "G" of Figure 21).

mile for the last three weeks in the month for each year: 1961, 0.38; 1962, 0.49 and 1963, 1.07. This suggested later movements in 1963 when the weather was more favorable. It appeared that gobbler groups started their fall migrations earlier than brood groups.

Average distances moved for all birds indicated a difference from the pattern of spring movements and return to summer range (see Table XIV). Movements then were 6.0 and 6.5 miles respectively. Based on observations of 45 birds, comparable fall and summer to winter range movements were 6.4 and 5.0 miles respectively. These data and observations indicated considerable wandering and widespread movement in fall before birds reached their winter ranges. This was especially true for juveniles. The inate urge of young birds to roam and the random nature of their travel was pointed out by Hochbaum (1955). Thorpe (1944; cited in Hochbaum, 1955) thought these initial exploratory efforts were not for initial satisfaction or reward, but the familiarity gained with the area might be of eventual use to the bird.

Movements to the winter range were determined for six yearling males of eight marked in one flock the previous winter (see Figure 20). Seven of the eight were seen together six successive times on the summer range July 19 to September 20. On September 24 they were six miles southeast of their summer range and apparently moving toward the previous winter

range. About two miles from the former winter range, birds 1 and 6 were killed October 1, and the remaining ones apparently scattered. Bird 5 returned to the winter range of the previous year by early December. He was joined by bird 8 that spent the summer separate from the main group. The remaining four returned eight miles to spend the winter about one mile from the summer range. The latter group included bird 2 which spent the winter within 2.5 miles of the site where originally tagged in the summer 1962.

Spring dispersal in 1961 by six juvenile and two adult hens and movements to subsequent winter ranges by five were mapped (Figure 21). There seemed to be little tendency to move to their former winter range. Birds "D", "G" and "H" moved in that general direction. Only bird "G" was seen the following winter, 1962-63. The sequential summer and winter ranges of this bird suggested more affinity to the previous summer range than to any winter range (Figure 22).

Certain summer and winter ranges were obvious favorites of turkeys and were almost always occupied during those respective seasons. Evidence indicated that turkeys in the Long Pines tended to return to their former summer ranges and with less certainty to their former winter ranges. Of 14 marked turkeys recorded during at least two successive years on winter ranges, eight (57 per cent) were on approximately the same range. Of nine

marked birds observed during at least two successive years on summer ranges, eight (89 per cent) were on about the same range.

## Winter Range

Movements to the winter range toward the periphery of the Long Pines provided a total of approximately 10 square miles more for winter ranges than was used for summer ranges. There was less overlap of the ranges of flocks than occurred during the summer on the relatively narrow ridge-top. Eighteen observations (3-8) on four winter flocks suggested ranges of about one to two square miles, principally in the lower drainageways of the Acer-Fraxinus-Crataegus-Prunus communities (see Figure 15).

During periods of snowy or windy weather, turkeys apparently roosted all day or restricted their movements to 100 acres or less. Temperatures down to -10° F did not appear to restrict the birds as they fed or loafed on the bare slopes.

During periods of warm weather, birds often moved up into the Pinus ponderosa forest even into one or two feet of snow when the slopes below were comparatively bare. They moved down the slopes to roost.

The relationship of winter range to food availability was not clear. Turkeys took a wide variety of foods. Seven known winter ranges were occupied each of three successive winters even when there were considerable variations in the amounts and types of food available (see Food Habits).

Leopold (1944) thought the selection and occupation of particular areas appeared to be influenced by supply and distribution of winter food.

## REPRODUCTION

### Courtship

Observations of 195 birds in 65 groups in April and May 1963 suggested courtship of turkeys may be divided into two sequential phases--"gregarious" and "solitary." These are exemplified by changes in the flocking pattern from April to May (Table XV).

TABLE XV. FLOCKING HABITS OF 195 TURKEYS, APRIL AND MAY 1963.

| | Courtship Flocks | | | Solitary Birds | | |
|---|---|---|---|---|---|---|
| | No. Flocks | No. Birds | Birds/Flock | No. | Male | Female |
| April | 10 | 72 | 7.2 | 6 | 1 | 5 |
| May | 25 | 93 | 3.7 | 24 | 10 | 14 |

The number of courtship flocks increased during spring, but flock sizes in May were about one-half those of April. Four times as many solitary birds were observed in May as in April. The male:female ratio of solitary birds changed from 1:5 in April to 1:1.4 in May.

"Gregarious" Courtship.

From about mid-March to mid-April, mixed flocks of winter became the courtship flocks of spring. Flocks maintained their approximate winter compositions of females and most of the yearling males. Adult and some yearling males joined or deserted the groups. Territorial behavior was not observed but "dominance" in displaying by adult gobblers was evident.

Movements of the flocks were determined by travel of the hens. The largest courtship flock was observed on April 6. It consisted of 27 birds: four adult males, 12 yearling males and eight hens.

All adult males in a gregarious flock have been observed to display at once. Yearling males were never seen to display in these flocks. No direct fighting or aggressive contact between birds was observed. Gobblers displayed in response to gobbling of other males, the presence of another adult gobbler within three to five feet or a nearby hen. It appeared that tail feathers forming the "fan" were fully extended when the gobbler faced the hen directly or when she was directly behind. Only that side of the "fan" nearest the hen was fully extended when they were located at oblique or right angles to each other. Often a tom circled a hen while displaying and led away running two to four feet. Intensity of this activity increased if a hen approached the periphery of the flock or if she followed the gobbler. Only once was a hen observed to follow a gobbler and to separate from the group.

As laying progressed, adult hens spent less and less time with the groups and eventually deserted them as incubation began. About this time yearling birds departed. Apparently yearling hens moved considerable distances before laying. One was recorded with a brood nine miles from the last observation in a courtship group. Yearling males began to wander

widely. Adult gobblers in excess of one or two departed to form territories or associate with harems. The remaining gobbler(s) established a territory in the region most frequented by the former flock.

"Solitary" Courtship.

Generally adult males established territories or attached to female groups (harems) after break-up of "gregarious" courtship flocks and after mating had commenced. This suggests that most territorial and harem activities involved yearling hens. Decrease in the number of available adult hens and general dispersal of yearling hens may have resulted in more intense competition among males and thus stimulated territorial formation. Because territorial behavior among breeding males did not begin until mating was underway, Leopold (1944) wrote: ". . . breeding territories among gobblers are ill defined at best and do not play the important part in mating that is characteristic of other birds."

Three gobblers observed a total of eight times showed territorial behavior. Two were solitary and one was accompanied by two non-participating yearling males. Size of the territory seemed to be determined by terrain and vegetation rather than by any particular dimension. Broad, grassy drainageways near the Pinus ponderosa forest appeared to be favored. Limits of the territory were roughly determined by the area of the clearing. Adults on territory gobbled and displayed in response to

gobbling, approach of males or females and apparently at times for no discernible reason. Males unaccompanied by hens apparently waited for them to come to the territory. Twice toms followed hens off the presumed territory. Once a gobbler remained on territory while an "intruder" gobbler followed the hens for at least 0.5 mile (see below). Dalke et al. (1946) found no evidence of continued and active defense of gobbling territory. Thomas (1955) reported mating territories may change slightly from day to day. He attempted to drive a male out of his presumed territory and found that the tom stayed within 200 to 250 yards of his territory.

Observations were made of an "intruder" adult tom moving into a territory occupied by a gobbler and two hens. The intruder approached within 75 to 100 yards, stopped, displayed continuously for about five minutes and then slowly approached the group without displaying. The territorial male displayed and attempted to stay between hens and intruder. If the hens approached the intruder, he displayed and walked away. When the territorial male intervened, the intruder did not display but appeared to feed. All four moved a short distance to roost separately. The next morning, the territorial male returned directly to his territory. The females moved away along the periphery of the forest, followed by the intruder male for 0.5 mile until disturbed by the observer.

Adult males not establishing territories attach to females forming harem groups. Usually one gobbler "dominated" groups in which there were more than one gobbler. Direction of travel and preference for certain areas appeared to be determined by the females. Twelve harem flocks were observed in April and May (Table XVI). Three times as many flocks were observed in May as April, possibly because "gregarious" courtship had terminated. Sex ratio changes likely resulted from nesting activities.

One adult gobbler and two yearling hens in one harem group were individually trapped, marked and released separately from May 7 to May 12, 1963. The male was seen 2.5 miles away May 11, two days after trapping, but not thereafter. The two females were together again about 100 yards from the trap side on May 18. They traveled separately after bringing off broods, even though their summer ranges overlapped.

For the first 20 to 30 days of adult male courtship, yearling males showed no apparent signs of sexual activity. During the "solitary" phase of courtship, some yearling males were non-participating members of harem flocks or with older gobblers on territories. Most were solitary or in yearling male groups. They ranged widely. Their heads became brightly colored and they responded to gobbling. Apparently capable of breeding at this time, they did not gobble or display in the presence of adult males (see Age of First Breeding).

TABLE XVI. COMPOSITION OF 12 HAREM FLOCKS, APRIL AND MAY. 1963.

| | Number of Harems | Hens | | | Gobblers | | | All Birds | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | Range | Avg./Flock | No. | Range | Avg./Flock | No. | Range | Avg./Flock |
| April | 3 | 8 | 1-4 | 2.7 | 4 | 1-2 | 1.3 | 12 | 2-5 | 4.0 |
| May | 9 | 15 | 1-2 | 1.7 | 15 | 1-4 | 1.7 | 30 | 2-5 | 3.3 |
| Both Months | 12 | 23 | 1-4 | 1.9 | 19 | 1-4 | 1.6 | 42 | 2-5 | 3.5 |

End of courtship in mid-May was abrupt. Birds in courtship flocks the first half of May totaled 6.6 per observational day; whereas, there were 1.1 per observational day in the last one-half of the month.

## Age of First Breeding

There was no evidence of yearling males breeding in the Long Pines. They appeared to be sexually active toward the end of the courtship season but were prevented from breeding by older males. Recent reports indicate that yearling male Merriam's turkeys bred successfully in other areas of Montana (Eng 1959b), Colorado (Burget 1957) and Nebraska (Suetsuga and Menzel 1963).

Three marked yearling hens with individual broods indicate breeding of that sex and age class in the Long Pines. Brood sizes for two in August 1963 were 8 and 10. Hatching dates were about June 14 and July 4 respectively. This suggests at least average fertility and hatching dates somewhat delayed beyond the peak for that year.

## Nesting

For details of nesting sites see Vegetative Use by Turkeys. One active nest reported by a forest crew contained 11 eggs May 4, 1962. The hen broke two eggs when flushed. The remaining eggs removed by the crew were incubated by a chicken. Six hatched on May 29, 1962. None of

the poults survived beyond June 13. Beginning of laying for this clutch occurred about April 15 and beginning incubation about May 1, based on a 28 day incubation period reported by Latham (1956) and others. From hatching dates given below, the peak periods for beginning of laying occurred April 10 to 20 and beginning incubation April 25 to May 5.

Rose (1956) discovered a nest of Merriam's turkey containing 10 eggs. This nest was located August 16, 1955 in the Judith Mountains of central Montana.

## Hatching Dates

Hatching dates for birds of the year were estimated from development of primary wing-feathers. Calculations were based on measurements provided by Knoder (1959) for Eastern wild turkeys. A hatching date of June 12 was assigned to one poult tagged at about 10 days of age and a hatching date of June 5 was assigned to this bird returned during the hunting season. Five other juveniles tagged between 50 and 125 days of age were returned during the hunting season 30 to 61 days later. The second estimates of hatching dates varied 4 to 10 days from those first assigned.

Although hatching dates assigned on the basis of data for the Eastern wild turkey may not be entirely valid, they provide means of estimating hatching chronology and aid in year-to-year comparisons. Fifty-nine birds

captured in the field and 109 wings collected at fall hunter checking stations were used to estimate hatching dates for 168 birds (Table XVII). For birds captured in the field and also returned in the fall hunting season, the first age determination was used.

Peak hatching period all three years appeared to be the latter one-third of May. Suetsuga (1962) indicated a possible early hatch during late May with the peak occurring the first week of June for Merriam's turkey in Nebraska. Dalke and Spencer (1946) reported the peak hatching period for Eastern wild turkeys in Missouri was May 20 to June 10. In the Long Pines, May 20 and July 18, 1963 were the first and last estimated hatching dates respectively. May 31, 1963 was the earliest date poults were observed. In Colorado, the earliest Merriam's turkey broods reported were in the second week of June (Hoffman 1962) and May 25 in Nebraska (Suetsuga 1962).

Percentages of the hatch occurring June 1 or after were 17.1 per cent, 45.0 per cent and 45.2 per cent for 1961, 1962 and 1963 respectively. Percentages of juveniles retaining the eighth juvenile wing-primary during the fall hunting season in 1961, 1962 and 1963 were 37.1 per cent, 40.7 per cent and 44.7 per cent respectively. This corroborates data in Table XVII indicating progressively later hatching dates for 1961, 1962 and 1963. This information suggests a direct relationship to weather,

TABLE XVII. HATCHING DATES OF 168 BIRDS ESTIMATED FROM MEASUREMENTS OF PRIMARY WING-FEATHERS.

| | 1961 | | | 1962 | | | 1963 | | | All Years | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Field Capture | Check. Sta. | Total | Field Capture | Check. Sta. | Total | Field Capture | Check. Sta. | Total | Field Capture | Check. Sta. | Total |
| May 1-10 | -- | -- | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 1 |
| 11-20 | -- | 7 | 7 | -- | 5 | 5 | 3 | 9 | 12 | 3 | 21 | 24 |
| 21-31 | -- | 22 | 22 | 1 | 16 | 17 | 17 | 17 | 38 | 18 | 55 | 73 |
| June 1-10 | -- | 5 | 5 | 7 | 6 | 13 | 10 | 10 | 16 | 17 | 21 | 38 |
| 11-20 | -- | 1 | 1 | 1 | -- | 1 | 11 | 5 | 16 | 12 | 6 | 18 |
| 21-30 | -- | -- | -- | 4 | -- | 4 | 1 | 2 | 3 | 5 | 2 | 7 |
| July 1-10 | -- | -- | -- | -- | -- | -- | 3 | 3 | 6 | 3 | 3 | 6 |
| 11-20 | -- | -- | -- | -- | -- | -- | -- | 1 | 1 | -- | 1 | 1 |
| Totals | -- | 35 | 35 | 13 | 27 | 40 | 46 | 47 | 93 | 59 | 109 | 168 |

TABLE XVIII. MONTHLY PRECIPITATION AND DEVIATIONS FROM THE LONG-TERM MEANS FOR APRIL, MAY AND JUNE 1961-63. 1/

| | 1961 | | 1962 | | 1963 | |
|---|---|---|---|---|---|---|
| | Ppt. | Dev. | Ppt. | Dev. | Ppt. | Dev. |
| April | 1.33 | +0.17 | 0.96 | -0.15 | 3.11 | +2.00 |
| May | 1.81 | -0.16 | 5.37 | +3.42 | 1.97 | +0.02 |
| June | 0.81 | -2.04 | 1.70 | -1.26 | 7.24 | +4.28 |

1/ U.S. Weather Bureau Climatological Data for Ekalaka, Montana.

especially precipitation, for April, May and June for those years (Table XVIII). The year of 1961 was a dry "normal" year. Higher percentages of hatches occurring later in the wetter 1962 and 1963 suggests delay in nesting or renesting. Some of the disruption may have been due to cooler temperatures accompanying the rain and snow. At the beginning of the peak hatching period May 21, 1963, a temperature of 18° F was recorded.

## Brood Survival

Evaluation of early brood losses was difficult since few exact brood counts were obtained before mid-July. Records of 46 poults tagged at ages of eight weeks or less in 1962 and 1963 were studied to estimate ages of greatest poult losses. Percentages accounted for by end of the fall hunting season in 1963 were used to estimate comparative survival of poults from the 0-2 weeks age-class and the 2-8 weeks age-class (Table XIX).

TABLE XIX. RETURNS FROM 46 POULTS IN TWO AGE GROUPS.

| Age when Tagged | No. Marked | No. Returned | Per cent Returned |
|---|---|---|---|
| 0-2 weeks | 32 | 4 | 12.5 |
| 2-8 weeks | 14 | 6 | 42.9 |
| All-age classes | 46 | 10 | 21.7 |

Over three times the percentage return from the 2-8 week age-class suggests higher survival of the older birds.

Seventy-seven observations of 94 poults in six brood flocks indicated few losses of older poults. One flock was first seen July 19 and the other five from August 1 to 15. Observations of all six flocks continued until September 20. Five poults disappeared in the interval. Two may have been desertions during the fall shuffle.

## GROWTH RATES AND WEIGHTS

Growth rates were calculated from measurements of 51 poults captured in the field, 1962 and 1963, and of 21 juvenile turkeys at checking stations during the late-September to early-October hunting seasons in 1961, 1962 and 1963 (Table XX). Ages were determined by development of primary wing-feathers (Knoder 1959). Whole weights were measured by spring scales to the nearest ounce. Poults were assigned a weight of 1.5 ounces at hatching based on Leopold's (1944) reported hatching weight of 42 gm (1.48 ounces) for a hybrid game farm turkey.

TABLE XX. GROWTH RATES CALCULATED FROM MEASUREMENTS OF 72 TURKEYS, 0-20 WEEKS OF AGE.

| Age Class | Sample Size | Age Range | Weight Range | Average Gain | Average Gain |
|---|---|---|---|---|---|
| | | Days | Ounces | Ounces/Day | % of Weight/Day |
| 1-4 weeks | 39 | 2-25 | 2-7 | 0.20 | 6.0 |
| 4-8 weeks | 12 | 30-55 | 10-39 | 0.72 | 3.8 |
| 8-20 weeks | 21 | 83-135 | 84-168 | 1.71 | 1.3 |

Average gain in weight per day increased with age. Average percentage of weight gained per day decreased with age. Gain per day from hatching until fall hunting season averaged 1.08 ounces. On the average, juveniles attained 81.2 per cent of their first year maximum weight by the fall hunting season.

Whole weights of 263 turkeys, 1957 to 1963, were measured to the nearest one-fourth pound (Table XXI). Weights prior to 1961 were obtained from records of the Montana Fish and Game Department. Birds were classified as juveniles until June 21 of the year following hatching.

The heaviest bird recorded was an adult gobbler weighing 18 pounds 11 ounces on May 21, 1963. Juvenile males averaged heavier than adult females all months after July and this differential accelerated as the season progressed. Maximum weights were attained by most birds in mid-winter. Average weights were similar or slightly greater than those reported for Merriam's turkey in Nebraska (Suetsuga and Menzel 1963), Colorado (Hoffman 1962), Wyoming (Crump and Sanderson 1951) and New Mexico (MacDonald 1961).

Measurements of 127 turkeys at checking stations during the fall hunting seasons in 1961, 1962 and 1963 provided hunter-dressed (eviscerated) and whole weights to the nearest one-fourth pound (Table XXII). Hunter-dressed weights only were secured for 101 and whole weights only for 26.

TABLE XXI. AVERAGE WHOLE WEIGHTS IN POUNDS OF 263 TURKEYS BY SEX-AGE CLASSES FOR NINE MONTHLY PERIODS, 1957-63.

| | Juvenile Males | | | Juvenile Females | | | Adult Males | | | Adult Females | | | All Birds | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Avg. | Range | No. | Avg. | Range | No. | Avg. | Range | No. | Avg. | Range | No. | Avg. |
| Aug. | 3 | 7.9 | 6.8-8.5 | 1 | 5.0 | -- | -- | -- | -- | 1 | 7.8 | -- | 5 | 7.3 |
| Sept. | 17 | 9.3 | 6.3-10.5 | 13 | 7.3 | 5.3-8.5 | 2 | 16.0 | 15.8-16.3 | 4 | 9.2 | 8.5-9.5 | 36 | 8.9 |
| Oct. | 18 | 10.9 | 9.5-12.8 | 10 | 7.9 | 7.5-8.8 | -- | -- | -- | - | -- | -- | 28 | 9.8 |
| Nov. | 14 | 12.4 | 11.3-14.3 | 20 | 9.2 | 7.5-11.8 | 1 | 18.3 | -- | 2 | 10.9 | 10.8-11.0 | 37 | 10.7 |
| Dec. | 24 | 13.7 | 11.5-15.8 | 31 | 8.8 | 7.3-10.8 | 1 | 10.8 | -- | 1 | 9.5 | -- | 57 | 10.9 |
| Jan. | 15 | 13.4 | 11.0-14.8 | 14 | 8.9 | 7.5-10.5 | 1 | 10.8 | -- | 3 | 12.2 | 9.5-16.8 | 33 | 11.4 |
| Feb. | 14 | 13.3 | 11.0-15.3 | 26 | 8.3 | 7.0-11.5 | 1 | 14.0 | -- | 2 | 10.8 | 10.3-11.3 | 43 | 10.2 |
| March | 4 | 13.6 | 10.8-18.3 | 10 | 8.2 | 7.5-9.3 | 1 | 18.8 | -- | 4 | 10.4 | 8.5-12.5 | 19 | 10.4 |
| April | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| May | -- | -- | -- | 3 | 9.8 | 9.0-10.0 | 2 | 17.3 | 15.8-18.8 | -- | -- | -- | 5 | 12.8 |
| ALL | 109 | 12.1 | 6.3-18.3 | 128 | 8.5 | 5.3-11.8 | 9 | 15.9 | 10.8-18.8 | 17 | 10.3 | 8.5-16.8 | 263 | 10.4 |

TABLE XXII. AVERAGE WEIGHTS IN POUNDS OF 101 HUNTER-DRESSED BIRDS AND 26 WHOLE BIRDS TAKEN DURING LATE-SEPTEMBER TO EARLY-OCTOBER HUNTING SEASONS, 1961-63.

| | Hunter-dressed | | | Whole | | |
|---|---|---|---|---|---|---|
| | No. | Avg. | Range | No. | Avg. | Range |
| Adult males | 7 | 14.0 | 13.0 - 14.8 | 1 | 16.3 | - |
| Adult females | 8 | 7.8 | 6.8 - 8.5 | 1 | 8.5 | - |
| Juvenile males | 46 | 8.0 | 5.3 - 10.8 | 13 | 9.4 | 6.3 - 10.5 |
| Juvenile females | 40 | 6.3 | 4.3 - 9.0 | 11 | 7.4 | 5.3 - 9.8 |
| All birds | 101 | 7.8 | 4.3 - 14.8 | 26 | 8.8 | 5.3 - 16.3 |

Total average weight of eviscerated birds when increased by 12.8 per cent equalled the total average weight of whole birds. Average differences of 12 per cent and 13 per cent between the two types of weights were reported for Merriam's turkey by Suetsuga and Menzel (1963) and MacDonald (1961) respectively.

## HUNTER HARVEST INFORMATION

Hunter checking stations were operated the first two days of each season, 1958-63. Stations were maintained at other times when personnel were available. During the 1961 season, checking stations were operated and/or personnel checked hunters in the field each day of the season. Over 77 per cent of the hunters that season hunted the first two days, a weekend, and over 75 per cent of the birds harvested were killed those first two days. Heaviest hunting pressure and kills occurring in the early part of the season were similar to those reported for pheasants (Allen 1947; Harper, Hart and Shaffer 1951).

Total harvest, percentage hunter success, number of hunters interviewed at checking stations the first two days of the season and average hours hunted are given in Table XXIII.

There were no restrictions as to weapons used. Bag limit was one bird of either sex per season. One-half of the Long Pines was open to hunting the first year. The greatest kill and highest Hunter success occurred in 1959. This was possibly due to the opening of the entire area for the first time which resulted in harvesting of unwary birds that had inhabited ranch and farm yards in a semi-domestic manner. All available information indicates that this segment of the initial populations was largely eliminated following the initiation of annual hunting seasons.

TABLE XXIII. HUNTER INFORMATION AND TOTAL HARVEST FOR FALL HUNTING SEASONS, 1958-63.

| Hunting Season | Total Kill 1/ | % Hunter Success 1/ | Checking Station Information First 3 Days of Hunting Season | |
|---|---|---|---|---|
| | | | No. Hunters | Avg. Hours Hunted |
| 1958 (Oct. 4-6) | 89 2/ | 18.6 | 479 | 7.8 |
| 1959 (Oct. 3-11) | 313 | 48.3 | 591 | 4.1 |
| 1960 (Oct. 1-15) | 117 | 18.9 | 467 | 12.5 |
| 1961 (Sept.30-Oct.10) | 108 | 24.9 | 202 | 13.6 |
| 1962 (Sept.29-Oct.13) | 118 | 25.0 | 122 | 7.7 |
| 1963 (Sept.28-Oct.12) | 105 | 26.3 | 246 | 11.9 |
| Averages | 143.3 | 27.0 | 351.2 | 9.4 |

1/ Estimated from Montana Fish and Game Department mailed questionnaires; 100 per cent survey of all license holders, except 1958 and 1963 which were estimated from checking station information.

2/ Only one-half of area opened to hunting.

Harvest was fairly constant thereafter despite the fact that hunting pressure diminished in general as the sport became less novel and more areas in the state were opened to hunting of turkeys. Harvest was about average in 1962 when number of hunters was at a minimum, weather was extremely poor and roads in the Long Pines were almost impassable. Thus, yearly harvests were related to the number of vulnerable birds in the population and not to the number of hunters. This has also been reported for pheasants (Allen 1947).

Percentage hunter success was similar to that reported for Merriam's turkey in Wyoming (Gustafson 1960) and South Dakota (Robbins 1962). In the Long Pines, unsuccessful hunters averaged about two hours longer in the field than successful hunters. Average hours spent hunting were generally less than reported in Nebraska (Suetsuga and Menzel 1962) and South Dakota (Robbins 1962).

During six fall hunting seasons, 508 turkeys were recorded at checking stations (Table XXIV).

TABLE XXIV. CLASSIFICATION OF 508 TURKEYS CHECKED DURING FALL HUNTING SEASONS, 1958-63.

| | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | Totals |
|---|---|---|---|---|---|---|---|
| Adult males | 19 | 28 | 7 | 7 | 2 | 3 | 66 |
| Adult females | 9 | 27 | 9 | 6 | 2 | 5 | 58 |
| Juvenile males | 33 | 44 | 25 | 29 | 27 | 23 | 181 |
| Juvenile females | 26 | 54 | 24 | 20 | 9 | 35 | 168 |
| Unclassified males | -- | -- | -- | 1 | -- | -- | 1 |
| Unclassified females | 1 | -- | -- | 1 | -- | 4 | 6 |
| Unclassified juveniles | 1 | 21 | -- | 2 | -- | 1 | 25 |
| Unclassified adults | -- | 2 | -- | -- | -- | 1 | 3 |
| Totals | 89 | 176 | 65 | 66 | 40 | 72 | 508 |

Juveniles ranged from 2.1 to 9.0 times as numerous as adults in the harvest each year (Table XXV). Yearly variations generally reflected productivity. The lowest ratio occurred in 1959, the first year the entire area was opened to hunting.

TABLE XXV. ADULT:JUVENILE RATIOS FROM 501 TURKEYS RECORDED DURING FALL HUNTING SEASONS, 1958-63.

| | Adults | Juveniles | Totals | Ratios |
|---|---|---|---|---|
| 1958 | 28 | 60 | 88 | 100:214.3 |
| 1959 | 57 | 119 | 176 | 100:208.7 |
| 1960 | 16 | 49 | 65 | 100:306.3 |
| 1961 | 13 | 51 | 64 | 100:392.3 |
| 1962 | 4 | 36 | 40 | 100:900.0 |
| 1963 | 9 | 59 | 68 | 100:655.5 |
| Totals | 127 | 374 | 501 | 100:374.0 |

On the average, there were slightly more males than females in the harvest (Table XXVI). This possibly suggests differential sex ratios or hunter selection for the larger, darker males as reported for Merriam's turkey in Nebraska (Suetsuga and Menzel 1963), Wyoming (Gustafson 1960) and New Mexico (Wischnofske 1960).

TABLE XXVI. MALE:FEMALE RATIOS FROM 480 TURKEYS CHECKED DURING FALL HUNTING SEASONS, 1958-63.

| | Males | Females | Totals | Ratios |
|---|---|---|---|---|
| 1958 | 52 | 36 | 88 | 100:69.2 |
| 1959 | 72 | 81 | 153 | 100:112.4 |
| 1960 | 32 | 33 | 65 | 100:103.1 |
| 1961 | 37 | 27 | 64 | 100:72.9 |
| 1962 | 29 | 11 | 40 | 100:37.9 |
| 1963 | 26 | 44 | 70 | 100:169.2 |
| Totals | 248 | 232 | 480 | 100:93.5 |

The first spring gobbler season in Montana was in the Long Pines, April 7 to April 21, 1963. Extremely poor weather prevailed most of the season and roads were almost impassable. Personnel of the Montana Fish and Game Department mailed questionnaires to all license holders. Estimates from those returned indicated 58 individuals hunted, 7 birds were killed and 12 per cent of those hunting were successful.

## FOOD HABITS

Percentage volume and frequency of occurrence of items in 226 turkey crops collected during six fall hunting seasons are given for each year (Tables XXVII and XXXI of the Appendix). Volumes were determined by water displacement. Aggregate volume method described by Martin, Gensch and Brown (1946) was used to determine percentages of volume. Seeds, fruits, berries, etc. were the most important items recorded, but importance of individual items varied with years. High utilization of pine seeds in 1958 suggested a "good" production of seeds for Pinus ponderosa, but "poor" production was indicated for subsequent years. Comparative scarcity of other items in the diet for 1958 indicated the apparent preference by turkeys in the Long Pines for pine seeds when available. Amounts of fruits and berries of different plants in the diet varied possibly because of differences in yearly yields. Nearly two-thirds of the crops contained domestic grain in 1959, the first year the entire Long Pines area was open to hunting. The number of turkeys feeding in cultivated fields and farm yards appeared to decrease thereafter. Orthopterans, mostly grasshoppers of the family Acrididae, were the only important animal group and occurred in over 50 per cent of the crops each fall.

Crops of 15 turkeys were collected at widely separated locations in the Long Pines during three winters, November to February (Table XXVIII).

TABLE XXVII. PERCENTAGE VOLUME AND FREQUENCY OF OCCURRENCE OF ITEMS IN 226 CROPS COLLECTED DURING FALL HUNTING SEASONS, 1958-63.

| Year: | 1958 | | 1959 | | 1960 | | 1961 | | 1962 | | 1963 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Size: | 58 | | 46 | | 18 | | 57 | | 29 | | 18 | |
| Item[1] Percentage: | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. |
| Tree | | | | | | | | | | | | |
| Pinus (S)[2] | 68.6 | 90 | 0.1 | 26 | 8.1 | 39 | tr | 9 | 4.4 | 17 | -- | -- |
| Shrubs | | | | | | | | | | | | |
| Symphoricarpos (S) | 1.8 | 35 | 6.9 | 48 | 4.3 | 89 | 12.1 | 39 | 17.7 | 55 | 6.3 | 50 |
| Arctostaphylos (S) | 0.1 | 3 | 1.0 | 4 | 7.5 | 50 | 21.3 | 28 | 0.7 | 7 | 2.4 | 6 |
| Crataegus (S) | 0.6 | 3 | -- | -- | 12.2 | 17 | 0.1 | 4 | 0.3 | 7 | -- | -- |
| Arctostaphylos (L)[3] | tr | 3 | -- | -- | tr | 33 | 9.1 | 14 | -- | -- | -- | -- |
| Prunus (S) | tr | 7 | tr | 11 | 5.3 | 28 | tr | 2 | -- | -- | tr | 6 |
| Rhus (S) | 0.2 | 16 | tr | 7 | 1.1 | 22 | 0.3 | 16 | 2.0 | 7 | -- | -- |
| Rosa (S) | tr | 2 | 3.5 | 30 | -- | -- | 0.7 | 7 | 0.7 | 3 | 2.1 | 6 |
| Berberis (S) | -- | -- | 0.1 | 9 | 1.2 | 39 | -- | -- | -- | -- | -- | -- |
| Shepherdia (S) | -- | -- | 2.2 | 9 | -- | -- | -- | -- | -- | -- | -- | -- |
| Forbs | | | | | | | | | | | | |
| Polygonum (S) | -- | -- | 0.1 | 4 | 4.3 | 11 | tr | 7 | 0.6 | 24 | 0.3 | 44 |
| Ratibida (S) | -- | -- | 1.5 | 57 | 0.9 | 39 | 0.1 | 14 | 4.6 | 41 | 2.2 | 72 |
| Thlaspi (S) | -- | -- | tr | 4 | 2.7 | 11 | -- | -- | 0.1 | 7 | -- | -- |
| Lappula (S) | -- | -- | -- | -- | -- | -- | -- | -- | 4.3 | 14 | 1.8 | 10 |
| Geranium (L) | -- | -- | 1.0 | 15 | 0.3 | 6 | 0.1 | 4 | -- | -- | -- | -- |
| Grasses | | | | | | | | | | | | |
| Gramineae (L) | 0.6 | 74 | 2.5 | 70 | 5.6 | 61 | 7.8 | 79 | 0.4 | 35 | 5.1 | 78 |
| Gramineae (S) | 0.8 | 64 | 4.0 | 59 | 2.6 | 67 | 1.7 | 47 | 3.5 | 86 | 3.6 | 61 |
| Domestic Grain (S) | 23.8 | 17 | 46.4 | 65 | 28.3 | 11 | 19.0 | 18 | 42.9 | 10 | 33.8 | 10 |
| Animal | | | | | | | | | | | | |
| Orthoptera | 1.7 | 53 | 26.0 | 63 | 12.0 | 83 | 24.6 | 72 | 12.6 | 66 | 39.8 | 61 |

1/ Excluded from the table were items less than 1.0 per cent of the volume in each year. These are listed in Table XXXI.

2/ Seeds, Fruits, Achenes, Berries, etc.

3/ Leaves.

TABLE XXVIII. PERCENTAGE VOLUME AND FREQUENCY OF OCCURRENCE OF ITEMS IN 15 CROPS COLLECTED DURING WINTERS 1961, 1962 AND 1963.

| Item | Years: | 1961-1962 | | 1962-1963 | | 1963-1964 | |
|---|---|---|---|---|---|---|---|
| | Sample Size: | 5 | | 7 | | 3 | |
| | Percentage: | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. |
| Trees | | | | | | | |
| Pinus (S)[1] | | -- | -- | 1.2 | 43 | -- | -- |
| Pinus (L)[2] | | tr | 20 | -- | -- | -- | -- |
| Juniperus (S) | | -- | -- | 0.5 | 29 | -- | -- |
| Shrubs | | | | | | | |
| Rosa (S) | | 0.9 | 20 | 9.1 | 29 | 1.3 | 67 |
| Crataegus (S) | | 0.1 | 20 | -- | -- | 0.5 | 33 |
| Arctostaphylos (S) | | -- | -- | 2.2 | 43 | -- | -- |
| Symphoricarpos (S) | | -- | -- | 1.5 | 43 | -- | -- |
| Rhus (S) | | 0.8 | 20 | -- | -- | -- | -- |
| Ribes (S) | | -- | -- | 0.1 | 14 | -- | -- |
| Forbs | | | | | | | |
| Astragalus (L) | | 0.3 | 60 | tr | 14 | -- | -- |
| Lappula (S) | | -- | ---- | 1.7 | 71 | 3.9 | 33 |
| Cerastium (L) | | -- | -- | 0.1 | 14 | 0.3 | 33 |
| Eriogonum (L) | | 1.1 | 40 | -- | -- | -- | -- |
| Thlaspi (S) | | -- | -- | 1.1 | 29 | -- | -- |
| Anemone (S) | | -- | -- | 1.0 | 14 | -- | -- |
| Potentilla (L) | | -- | --- | 0.3 | 14 | -- | -- |
| Ratibida (L) | | -- | --- | 0.2 | 14 | -- | -- |
| Amaranthus (L) | | -- | -- | 0.2 | 14 | -- | -- |
| Galium (L) | | -- | -- | 0.1 | 43 | -- | -- |
| Lupinus (L) | | tr | 20 | 0.1 | 29 | -- | -- |
| Cleome (L) | | -- | -- | 0.1 | 14 | -- | -- |
| Taraxacum (L) | | -- | -- | -- | -- | tr | 33 |
| Forb, unidentified (L) | | -- | -- | 5.1 | 71 | -- | -- |
| Forb, unidentified (S) | | 0.2 | 80 | 1.0 | 14 | 0.2 | 33 |
| Grasses | | | | | | | |
| Gramineae (L) | | 92.0 | 100 | 14.0 | 86 | 93.2 | 100 |
| Gramineae (S) | | 2.1 | 40 | 57.9 | 100 | -- | -- |

TABLE XXVIII.--Continued.

| Item | Years: | 1961-1962 | | 1962-1963 | | 1963-1964 | |
|---|---|---|---|---|---|---|---|
| | Sample Size: | 5 | | 7 | | 3 | |
| | Percentage: | Vol. | Freq. | Vol. | Freq. | Vol. | Freq. |
| Animal | | | | | | | |
| Orthoptera | | 0.3 | 20 | 2.2 | 43 | 0.1 | 33 |
| Coleoptera | | tr | 20 | tr | 14 | -- | -- |
| Lepidoptera | | -- | -- | 0.1 | 28 | -- | -- |
| Diptera | | -- | -- | 0.1 | 14 | -- | -- |
| Hymenoptera | | -- | -- | tr | 14 | -- | -- |
| Insect pupae cases | | 0.2 | 20 | -- | -- | -- | -- |
| Miscellaneous | | | | | | | |
| Grit, Rocks | | 2.0 | 60 | 0.9 | 71 | 0.5 | 33 |
| Detritus | | tr | 20 | 0.2 | 14 | -- | -- |

1/ Seeds, fruits, achenes, berries, etc.

2/ Leaves.

Crop contents of individual birds were similar for birds taken the same winter, but there were considerable yearly variations. Late fall rains in 1961 brought about a "greening up" of the vegetation and most of the crop contents that winter consisted of green grass blades. Effects of above average rainfall the spring and summer of 1962 were evident in crop contents the following winter. Food was mostly grass seeds, primarily those of Bouteloua gracilis. Crop contents were mostly green grass blades for the winter of 1963-64. A heavy frost during the preceding May destroyed blossoms of most fruiting shrubs and a very dry late summer limited development of grass seeds. Rose (1956) found domestic grain the most

abundant item in 671 droppings in winter from the Long Pines. Next in abundance were Symphoricarpos sp. fruits and heads of Bromus sp. None of these items were important winter food items 1961-63. This suggests a change of habits by the turkeys following establishment of annual hunting seasons. Other than the major items, winter food preferences in this study generally followed those reported by Rose.

One crop obtained during April 1963 contained 81.4 per cent by volume green grass blades. The remaining percentage was divided among Anemone sp. leaves, Ranunculus sp. leaves, Carex sp. achenes and grass seeds. Cursory examination of droppings during spring indicated considerable use of green grass blades.

The crop of one poult in mid-July 1963 contained 100 per cent grasshoppers. Poults probably fed almost exclusively upon insects in early summer. Rose (1956) found in the analysis of 933 summer droppings (apparently all age classes) from the Long Pines that insects of the order Orthoptera, primarily grasshoppers, were in 89.3 per cent of the droppings. Other frequencies of occurrence of major food items for summer reported by Rose were Symphoricarpos sp. fruit, 54.9 per cent; grass leaves and stems, 26.4 per cent; Rhus trilobata fruit, 26.6 per cent and achenes of Carex spp., 20.7 per cent.

It has been suggested that seeds of Pinus ponderosa as food may be the most important factor in making pine a much sought turkey habitat (Murie 1946, Reeves and Swank 1955). Evidence from the Long Pines indicated that pine seeds were taken when available, but the birds were not dependent upon this specific mast.

Plant materials, seeds and leaves, made up at least 60 per cent of the diet in all seasons except summer. Highest use was in winter and spring. Percentage volume of plant items in crops was as high as 99.4 per cent for the winter of 1963-64. Generally food habits in the Long Pines followed that reported elsewhere for Merriam's turkey (Ligon 1946, Hoffman 1962, Spicer 1959) except for dependence upon domestic grains and a specific mast.

## MISCELLANEOUS OBSERVATIONS

### Parasites and Disease

All turkeys from the Long Pines that were handled appeared to be free of disease and in excellent condition. The lice Mecacanthus stramineus, Chelopistes meleagridis and Lipeurus sp. were common ectoparasites. Five turkeys collected the winter of 1962-63 were thoroughly examined for parasites by personnel of the Montana State College Veterinary Research Laboratory. Metroliasthes lucida, a tapeworm of the small intestine, was found in each bird.

From June 12 to September 12, 1963, blood smears were obtained from 36 turkeys. Parasites were identified from the blood smears by personnel of the Rocky Mountain Laboratory at Hamilton, Montana (Table XXIX). Birds of the year ranged in age from 9 days to 125 days.

TABLE XXIX. ORGANISMS IDENTIFIED IN BLOOD SMEARS FROM 36 TURKEYS, 1963.

| Age Class | Sample Size | Number of Turkeys Harboring Parasites | | | |
|---|---|---|---|---|---|
| | | None | Plasmodium[1] | Leucocytozoon[2] | T.L.O[3] |
| 0-8 wks. | 25 | 19 | 1 | — | 5 |
| 8-16 wks. | 3 | — | 2 | — | 2 |
| 16-24 wks. | 5 | — | 5 | — | 1 |
| Adults | 3 | — | — | 2 | 2 |
| Totals | 36 | 19 | 8 | 2 | 10 |

1/ Plasmodium, probably lophurae.

2/ Leucocytozoon, probably smithi.

3/ T.L.O., Toxoplasma-like organism.

## Predation

The only known predation upon turkeys in the Long Pines was an adult tom killed by an unknown predator on or about August 9, 1962. Potential predators in the Long Pines included coyotes (Canis latrans), bobcats (Lynx rufus), raccoons (Procyon lotor), striped skunks (Mephitis mephitis), golden eagles (Aquila chrysaetos) and great horned owls (Bubo virginianus). Two turkeys were known to have been poached.

## Color Aberrations

In 1961, five white poults were observed in one flock of 23 birds. One disappeared in early July and three were killed during the fall hunting season. The remaining bird was seen in November but not thereafter. Two white turkeys from the Long Pines were reported in 1956 by Rose (1956) and one in 1958 (Montana Fish and Game Department records). White birds in wild turkey populations have been reported in West Virginia (Bailey 1955), Nebraska (Suetsuga and Menzel 1963) and elsewhere. It has been suggested that white wild turkeys result from interbreeding with tame birds. Accordingly the three white birds in the Long Pines, 1956-58, were removed from the population. Apparently lack of coloration is a recessive characteristic making attempts to completely remove this trait from the population a futile effort. Removal of these birds becomes even less

imperative in view of the naturally occurring high turnover rate of the population. No intergrades between all white birds and normally colored turkeys have been observed in the Long Pines as has been reported in other areas (Williams 1964).

Of the 109 birds examined at hunting check station 1961-63, two showed non-barring of the primaries. From studies of domestic turkeys, Asmundson (1939) concluded the gene for non-barring of flight feathers was independent of the genes for colored plumage. Apparently this is a fairly common aberrancy in wild turkeys (Williams 1964).

## DISCUSSION AND MANAGEMENT SUGGESTIONS

The outstanding success of the transplant of Merriam's turkeys into the Long Pines can be attributed primarily to placement of at least the minimum number of birds into suitable habitat. The latter apparently included proper interspersion of Pinus ponderosa forest with non-forested types, food, water and rugged terrain. Other than providing for a harvest of yearly surpluses, management of wild turkeys is essentially maintenance of habitat. Habitat management in the Long Pines is largely in the hands of personnel of the U.S. Forest Service. Effects of forest and range management practices upon turkeys have been given consideration in the "multiple use" program of that agency.

Beneficial practices of forest management would maintain semi-open pole stands of Pinus ponderosa, the type most used by turkeys in the Long Pines. Selective cutting as practiced in the Long Pines appeared to be important in maintaining optimum turkey habitat as noted in other areas by Hollis (1947); Bailey, Uhlig and Breiding (1951); Latham (1956) and Edminster (1954). Limited lumbering operations in which mature trees are removed annually from areas no larger than 550 acres have not unduly disturbed the turkeys. Most potential roost trees were not removed because of their location in relatively inaccessible portions of the terrain. Extensive thinning of sapling stands, a regular practice, has resulted in densities of trees more nearly like that of pole stands. Construction of

logging roads created new travel lanes and dusting spots for the birds. Access roads may increase harvest by greater distribution of hunters.

Small openings properly distributed are important. Except for the "edge effect," large open areas are not beneficial since turkeys seldom venture far from cover. The tree planting in one large opening may be of benefit if resulting densities of trees are not too great and some openings remain. In one burned-over portion of the Long Pines, about 60 per cent of the area was stocked for 800 trees per acre survival. Even though this will probably result in a density of trees higher than that preferred by turkeys, subsequent thinning and planting in patches will provide better interspersion.

There have been few recent fires burning large areas in the Long Pines. Fire supression has been effective and the fire season generally occurs late enough that chances are remote for destruction of nests or poults. In southeastern United States, some fires apparently have improved the habitat of turkeys by maintaining the open understory in the forests (Lay 1959, Stoddard 1963). This may also be true in the Long Pines. Rose (1956) reported that about two weeks after a 0.7 acre fire in the Long Pines, plots in the burn were utilized by turkeys more frequently than plots in the unburned habitat.

The open cattle range in the Long Pines was generally heavily grazed in summer. Most authors consider over-grazing as detrimental to wild turkeys (Stoddard 1963; Lay 1959; Dalke, et al. 1946; Ligon 1946). In the Long Pines there was no evidence to support or reject these claims. During the record year for precipitation (1963), grasses and shrubs were so tall, even under the usual heavy grazing, poults had difficulty flying from the ground when flushed. In three cases, this aided in capturing birds on the ground for tagging purposes.

There was heavy browsing of shrubs by deer in the study area. Damage to food-bearing shrubs and forbs has been cited as a serious threat to the survival of turkeys (Bailey, et al. 1951; Wheeler 1948). Turkeys in the Long Pines apparently adjusted to a wide variety of available foods. Some browsing might improve the summer habitat by reducing the understory to the level preferred by the turkeys. Heavy browsing in brushy thickets of the lower drainageways could conceivably damage this cover type which is used by turkeys almost exclusively in winter.

There was no apparent relationship between turkey movements in the Long Pines and any particular water source. This is interpreted to be evidence of sufficient and well distributed water supply. Extensive development of reservoirs and stock-watering tanks have been especially beneficial in this respect.

Little contact with domestic turkeys has been one feature of the Long Pines population which has contributed to maintenance of their wild characteristics. There were only one or two small flocks of tame turkeys on the periphery of the study area and annual hunting seasons by removal of marginal wild turkeys largely eliminated the possibility for infusion of domestic traits.

Low precipitation during winter months generally results in a light snow cover. Relatively heavy rains and some cool temperatures in spring may delay nesting, but all evidence indicates that this is no serious threat to productivity. Moisture on the vegetation early in the morning is common in June. Apparently this is no particular problem to poults 10 to 15 days old that have been seen feeding in moisture-soaked vegetation on several occasions.

Direct management of turkeys in the Long Pines was accomplished by annual hunting seasons. Increase of hen:poult ratios since the initial peak of the population and after the entire area was opened to hunting indicates that removal of surpluses permitted a fuller expression of the reproductive potential of the species. Summer gains were inversely related to spring densities. Approximately 50 per cent natural annual mortality of the population has been replaced at least in part with birds in the bag. Since the apparent stabilization of the population, the

harvest has been about the same each year independent of the number of hunters. This indicates that hunting pressure has been sufficient to remove annual surpluses.

The late-September to early-October hunting season appears to be timed correctly in the Long Pines. Birds of the year which make up the bulk of the kill have reached over 80 per cent of their maximum first year weight at that time. Surpluses of the population are most available because of the "fall shuffle." Most of the birds are fairly well dispersed resulting in a more even distribution of the harvest. Delay in the season would increase the risk of encountering poor weather making the Long Pines inaccessible to hunters and poorer distribution of the kill.

Evidence from this study indicates the spring gobbler season would accomplish the best kill if it was delayed until about the last ten days in April through the first ten days of May. Cold and snowy weather, common in early April, would largely be avoided. Gregarious courtship flocks would be dispersed by that time. Yearling toms which should provide the bulk of the kill would be most available then. Because of their relatively late period of sexual activity it is only then that they become responsive to gobbling and hence to "artificial calls" by hunters. They are better dispersed during this period of maximum wandering. There is no evidence to indicate that a high kill of gobblers would limit the

reproductive potential of the population because of polygamous (promiscuous) breeding habits and the fact that yearling toms are fertile.

Indices of productivity based on hen:poult ratios were best obtained from mid-July to late-August. Before that time the birds are too small to be counted and after that time juvenile males become almost indistinguishable from adult hens. Surveys conducted at this time allow for the early poult losses and resultant tallies are more likely to be indications of effective production.

## SUMMARY

This study was conducted to obtain information on movements, population characteristics, habitat use, life history and management of the introduced Merriam's turkey in the Long Pines of southeastern Montana. Sixteen months were spent full-time in the field during the three year period 1961-63.

A physiographic description of the area was given.

Six plant communities including three distinct stands of the Pinus ponderosa community were described. Observations of 6,271 birds comprising 468 groups provided information on the use of vegetative types by turkeys. Grasslands adjacent to Pinus ponderosa received more usage in spring, summer and fall than any other vegetative type; 55, 35 and 37 per cent respectively of usage of all types. The 73 per cent usage of the deciduous tree-brush communities in the lower drainageways was the highest percentage of seasonal use for any type at any season. Twenty-six roost trees of Pinus ponderosa averaged 121+ years in age, 17.9 inches dbh and 64 feet in height. Two nesting sites were in Fraxinus-Acer-Prunus-Crataegus communities and one was in a Symphoricarpos albus community.

The turkey population increased from the original introduction of 18 birds in February 1955 to its peak, an estimated 700, after three breeding seasons. A minimum of 1,103 birds were removed by hunting, trapping and miscellaneous factors in six years, 1957 to 1963.

The population indicated by trend route data was highest in 1961, lowest in 1962 and intermediate in 1963. Trend route data for poults/hen ratios were 6.6, 10.5 and 8.3 for the three years respectively. Productivity was inversely related to population density.

Records on 132 individually marked turkeys suggested over 50 per cent of the population disappeared each year whether hunted or not and complete population turnover within five years.

Although no specific quantitative data were available, two distinct emigration periods from the Long Pines were apparent. The first resulting from population pressures in 1957-58 coincided with the initial build-up of the population. The second occurred in 1962 coinciding with the high production of that year.

A total of 6,271 turkeys was recorded in 468 gobbler, hen, brood, mixed or courtship flocks. Average sizes of groups ranged from 1 to 20. Composition of flocks was largely determined by predominating activities of the birds during different seasons. Greatest segregation of flocks according to sex and age occurred in late spring and least segregation during winter. The average size of 283 brood flocks was 16.9 with a range of 2-40. Brood flocks commonly consisted of two or three hens with young. These flocks remained intact until the "fall shuffle" which was characterized by more general movements, antagonism between flocks and individuals and "shuffling" of surplus individuals between flocks.

Home range data were compiled from records of 83 individually marked birds relocated 561 times. The longest direct airline movement for any marked turkey was 14.5 miles by a yearling male. The average maximum annual movement of 6.1 miles for juveniles was greater than for any other segement of the population. This possibly indicated lower status in the social structure, an inate urge to roam and a need to gain familiarity with an area. Two marked hens in separate flocks each moved a minimum of 2.8 miles over rugged terrain with poults less than two weeks old. Movements of 23 individually marked birds recorded during at least two successive years on winter ranges or summer ranges indicated turkeys in the Long Pines returned to their former summer ranges more often than to their former winter ranges. There was no clear relationship of winter range to food availability.

Observations of 195 birds in 65 groups indicated courtship was divided into two sequential phases--"gregarious" and "solitary." Flocks of winter became the gregarious courtship flocks of spring. Territorial formation and harem activities initiated the second phase after mating had commenced. Courtship, territorial and harem flock behavior was described. Adult males possibly prevented yearling males from breeding, but at least three marked yearling hens did breed. Hatching dates for 168 birds of the year estimated from development of primary wing-feathers

indicated the peak hatching period was the latter one-third of May. Data indicated progressively later hatching dates for 1961, 1962 and 1963, possibly related to differences in weather. Records of 46 poults tagged at less than eight weeks of age indicated more than three times the losses in the 0-2 weeks age-class as compared to losses in the 2-8 weeks age-class.

Measurements of 72 birds of the year indicated average gain in weight per day increased from 0.2 ounces per day in the 1-4 weeks age group to 1.71 for the 8-20 weeks group. Average percentage of weight gained per day decreased from 6 per cent in the first group to 1.3 per cent in the second. Juveniles attained 81.2 per cent of their maximum weight of the first year by time of the hunting season in late September. Averages of whole weights for each of nine months, August to May, were obtained from 263 turkeys. Maximum weights were attained by most birds in mid-winter. The heaviest bird recorded was an adult gobbler weighing 18 pounds 11 ounces.

During the 1961 hunting season, over 77 per cent of the hunters hunted the first two days, a weekend, and over 75 per cent of the birds harvested were killed those first two days. The greatest harvest, 313 birds, occurred in 1959, the first year the entire area was open to hunting. Unwary birds which had inhabited ranch and farm yards in a

semi-domestic manner were largely eliminated following the establishment of annual hunting seasons. Annual kills after 1959 ranged from 105 to 118, even though annual numbers of hunters for the first two days of the season fluctuated from 122 to 467. Yearly harvest was related to the number of vulnerable birds and not to the number of hunters. A male:female ratio of 100:94, calculated from a total of 480 turkeys checked during six hunting seasons, suggested differential sex ratios or hunter selection for males.

Examination of 243 crops and 1,604 droppings indicated plant materials, mostly seeds and leaves, made up at least 60 per cent of the diet of turkeys in fall, winter and spring. Pinus ponderosa seeds were preferred when available. Insects, especially grasshoppers, were the main items in summer diets.

Miscellaneous observations on parasites, predators and color aberrations of turkeys were reported.

Habitat management and hunting controls were discussed.

# APPENDIX

TABLE XXX. PLANTS WITH LESS THAN 5 PER CENT CANOPY COVERAGE IN ALL EIGHT STANDS OF PRAIRIE GRASSLAND, JULY 7-14, 1963. (SEE TABLE IV)

| Occurred in at Least One Plot | Occurred in the Stands but Not Encountered in any Plot |
|---|---|
| Artemisia cana | Symphoricarpos albus |
| A. dracunculus | Rhus trilobata |
| Aristida longiseta | Calamagrostis longifolia |
| Agropyron trachycaulum | Bromus japonicus |
| Festuca octoflora | Bouteloua curtipendula |
| Poa secunda | Andropogon gerardii |
| Poa pratensis | Sisyrinchum angustifolium |
| Lucocrinum montanum | Zygadinus venenosus |
| Petalostemon purpureum | Allium textile |
| Oxytropis lamberti | Yucca glauca |
| Thermopsis rhombifolia | Calochortus nuttallii |
| Geum trifolium | Astragalus crassiocarpus |
| Potentilla concinna | A. dasyglottis |
| P. pennsylvanica | Vicia americana |
| Anemone patens | Lupinus argenteus |
| Echinacea pallida | Solidago mollis |
| Aster falcatus | Aster laevis |
| Achillea millefolium | Gutierrezia sarothrae |
| Chrysopsis villosa | Erigeron strigiosus |
| Artemisia ludoviciana | Haplopappus spinulosus |
| Liatris punctata | Ratibida columnifera |
| Erigeron canadensis | Taraxacum officinale |
| Lycodesmia juncea | Besseya cinceria |
| Grindelia squarrosa | Oenothera nuttallii |
| Senecio integerrimus | Erysimum asperum |
| Circium undulatum | Lithospermum incisum |
| Tragopogon dubius | Asclepias stenophylla |
| Opuntia fragilis | Echinocola sp. |
| Mamillaria vivipara | Glycyrrhiza lepidota |
| Hedeoma drummondii | |
| Sphaeralcea coccinea | |
| Orthocarpus lutea | |
| Penstemon nitidus | |
| Gaura coccinea | |
| Plantago purshii | |
| Polygala verticillata | |
| Euphorbia glyptosperma | |
| Viola rugulosa | |
| Chenopodium alba | |
| Linum rigidum | |
| Arabis holboellii | |
| Lichens | |

TABLE XXXI. ITEMS WITH LESS THAN 1.0 PER CENT VOLUME EACH YEAR IN 226 CROPS COLLECTED DURING FALL HUNTING SEASONS, 1958-63. (SEE TABLE XXVII)

| Percentage of Total Volume for at Least One Year, 0.1%-0.9% | Percentage of Total Volume for Each Year Less Than 0.1% (trace) |
|---|---|
| Tree | Trees |
| *Pinus* (L)[1/] | *Juniperus* (L) |
| Shrubs | *Juniperus* (S) |
| *Rhus* (L) | Shrubs |
| *Ribes* (L) | *Berberis* (L) |
| *Ribes* (S)[2/] | *Shepherdia* (L) |
| *Symphoricarpos* (L) | Shrub, unidentified (S) |
| Shrub, unidentified (L) | Forbs |
| Forbs | *Amaranthus* (L) |
| *Anemone* (L) | *Artemisia* (L) |
| *Anemone* (S) | *Chenopodium* (S) |
| *Astragalus* (L) | *Clematis* (L) |
| *Chenopodium* (L) | *Eriogonum* (L) |
| *Cleome* (S) | *Erysium* (S) |
| *Delphinium* (L) | *Fagopyrum* (S) |
| *Geranium* (S) | *Helianthus* (S) |
| *Lupinus* (S) | *Lithospermum* (S) |
| *Medicago* (L) | *Stellaria* (S) |
| *Salanum* (S) | *Trifolium* (S) |
| *Taraxacum* (S) | Animal |
| *Vicia* (S) | Diplopoda |
| Forb, unidentified (L) | Gastropoda (Snails) |
| Forb, unidentified (S) | Dermaptera |
| Sedge | Homoptera |
| *Carex* (S) | Hymenoptera |
| Animal | Neuroptera |
| Araneae | Insect, unidentified |
| Coleoptera | Miscellaneous |
| Diplopoda | Detritus |
| Diptera | |
| Hemiptera | |
| Lepidoptera | |
| Insect Larvae | |
| Miscellaneous | |
| Grit, Rocks | |

1/ Seeds, Fruits, Achenes, Berries, etc.

2/ Leaves.

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