Elevational occurrence of the ticks Dermacentor Andersoni and Dermacentor Parumapertus in Utah County, Utah

William J. Despain
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ELEVATIONAL OCCURRENCE OF THE TICKS DERMACENTOR

ANDERSONI AND DERMACENTOR PARUMAPERTUS

IN UTAH COUNTY, UTAH

A Thesis
Presented to the
Department of Zoology and Entomology
Brigham Young University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
William J. Despain
May 1968
This thesis by William J. Despain is accepted in its present form by the Department of Zoology and Entomology of Brigham Young University as satisfying the thesis requirement for the degree of Master of Science.

March 1968
Date

Typed by Berna B. Allred
ACKNOWLEDGMENTS

I express appreciation to Dr. Dorald M. Allred, chairman of my advisory committee, for his help and advice, and to Dr. Dennis Trent for his critical review of the manuscript. Acknowledgment is given to the late Dr. D Elden Beck for his helpful suggestions on identification techniques. Thanks is given to D. Elmer Johnson, Ecology and Epizoology Research, University of Utah, for the valuable information regarding the altitudinal distribution of ticks near Dugway.

Special acknowledgment is made to Robert Burge for his statistical analysis of the data.

I am grateful to the Department of Zoology and Entomology, Brigham Young University, for supplying equipment and space, and for an assistantship which helped make this study possible.
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INTRODUCTION

Considerable research on ticks has been done since it was discovered that the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, was a principal vector of Rocky Mountain spotted fever. Additional disease agents of man are also transmitted by *D. andersoni*. This tick and a closely related species, *Dermacentor parumapertus* Neuman, occur commonly in Utah. The two species are often closely associated, although *D. andersoni* is believed to occur in the mountains, whereas *D. parumapertus* is in the desert valleys. Diseases affecting animals in nature are transmitted by ticks of both species. Consequently, any interaction between the two may be influential in the maintenance of diseases in nature communicable to man and his domestic animals.

The geographical distribution of these two species is known, but little is known of their elevational distribution. The objectives of this study are to determine the lowest elevational distribution of *D. andersoni* and the highest elevational distribution of *D. parumapertus* in selected areas in Utah County, Utah. Such information will contribute to a
better understanding of where each species occurs in relationship to the epidemiology of tick-borne diseases.
REVIEW OF THE LITERATURE

Occurrence

Little information on elevational occurrence has been published. Bishopp (1911) reported collections of D. andersoni taken at elevations between 500 and 9000 ft, but greatest numbers occurred between 3000 and 5000 ft. Cooley (1911) mentioned taking a nymphal D. andersoni from a ground squirrel at 5600 ft, and about 100 adults were taken from a co-worker at an elevation between 5000 and 7500 ft. Bishopp and King (1913) noted the collection of D. andersoni in late June at 7200 ft in Colorado, and between 5500 and 6500 ft early in July in western Montana. Few specimens were collected by them at elevations between 3000 and 5000 ft. Collections at 4000, 5000, 5500, and 6000 ft were made by Burgdorfer and Eklund (1959, 1960). Herrin (1966) reported that records for D. andersoni from Banff, Alberta, Canada are above 4500 ft.

In Utah, D. andersoni adults occur as high as 9000 ft, with greatest populations between 6000 and 8000 ft (Herrin, 1966). The lowest elevation recorded by Herrin for D. andersoni was 5500 ft. Coffey (1953) noted records of D. andersoni
taken at elevations of 6000 to 8000 ft. Ho (1962) found *D. andersoni* above elevations of 6000 ft. Peterson (1967) noted collections of *D. andersoni* from golden-mantled ground squirrels at 5750 ft. Beck (1955) found adults in Cedar Valley, Utah County, between 5500 and 7000 ft.

In the environs of Dugway Proving Ground, Tooele County, Utah, *D. parumapertus* usually occurs below 6000 ft (Johnson, unpublished data). Coffey (1953) reported that one adult male *D. parumapertus* was taken from *Peromyscus maniculatus* at Aspen Grove, Utah County (6800 ft elevation). No other records are known for the elevational distribution of this species.
METHODS AND PROCEDURES

Study Areas

Payson Canyon, located southeast of Payson, was initially selected for study. Because of an apparent low population of ticks at the Payson site, a second area was chosen in Pole Canyon located approximately 1.4 miles south of Cedar Fort. These two canyons were selected because in each it was possible to establish a transect progressing from a low elevation, desert habitat in the valley to a higher, montane habitat. Each transect was divided into trapping sites selected on the basis of elevation and type of vegetation. A brief description of each follows.

Payson Canyon

Site 1. Elevation 6470 ft, approximately 7.7 miles from bridge at mouth of canyon. North side of road in area of sagebrush (Artemisia tridentata). Bordered by quaking aspen (Populus tremuloides) and firs (Abies concolor) on west and east, and by mountain maple (Acer glabrum) on north. Scattered among sagebrush were various grasses, a species of
mustard (Descurainia sp.), mullein (Verbascum thapsus), and Penstemon sp. An open, somewhat grassy area lies south of site.

**Site 2.** Elevation 5800 ft, approximately 2.4 miles below site 1. East side of road in area of sagebrush, and considerable cheatgrass (Bromus tectorum) in south end. North end of site had overstory of large Rocky Mountain maple and Gambell oak (Quercus gambelli) with understory of yellow sweet clover (Melilotus officianalis) and sagebrush. Snakeweed (Gutierrezia sarothrae) scattered throughout site. Heavy growth of Gambell oak and Rocky Mountain maple bordering east, north, and south sides.

**Site 3.** Elevation 5515 ft, about 0.4 mile off main road on dirt side-road and 1.5 miles below site 2. On east-facing slope with tall, scattered clumps of Gambell oak. Lupine (Lupinus sp.), wild sweet clover, bluebunch wheatgrass (Agropyron spicatum) and other grass (Poa sp.) among sagebrush. Heavy grazing by cattle evident.

**Site 4.** Elevation 5120 ft, approximately 1.6 miles below site 3 and about 200 ft below first cattle guard. On east-facing slope on west side of road. Predominant vegetation sagebrush interspersed with clumps of Gambell oak and widely scattered Rocky Mountain maple and squawbush (Rhus
trilobata). Cheatgrass interspersed among sagebrush. Relatively sparse because of heavy grazing.

Site 5. Elevation 4960 ft, about 1.4 miles below site 4 and at second cattle guard. On east and west sides of road. Sagebrush predominant vegetation with rabbitbrush (Chrysothamnus viscidiflorus) scattered around area. Cheatgrass, wild lettuce (Lactuca sp.) and gumweed (Grindelia squarrosa) occurred in open spaces. Rocky Mountain maple and Gambell oak prevalent on west limits of site. Heavy grazing and dry conditions evident.

Site 6. Elevation 4865 ft, about 0.7 mile below site 5 and 200 yards above bridge and road junction at mouth of canyon. On steep, east-facing slope next to road. Predominant vegetation Gambell oak, sagebrush, and scattered squawbrush. Among sagebrush was cheatgrass, rattlesnake grass (Bromus brizaeformis), clumps of blue grass (Poa secunda), bluebunch wheatgrass, and lupine. Oregon grape (Mahonia repens) growing at base of oak. Top part of hill had more open area and cheatgrass. Bitterbrush (Purshia tridentata) at top of hill. Soil rocky and sandy.

Site 7. Elevation 5090 ft, south of Santaquin on highway 91 just north of Utah-Juab county line. On west side
of road in large expanse of sagebrush. Little herbaceous vegetation except for sparse growth of cheatgrass and snakeweed. Soil dry and gravelly.

Site 8. Elevation 4780 ft, about 2 miles west of Santaquin on highway 50. Irrigation pond on north side of highway. Site across highway and slightly southeast of pond. Sagebrush predominant vegetation for wide expanse. Cheatgrass and wild, yellow sweetclover among sagebrush. Irrigation canal borders on west.

Site 9. Elevation 4515 ft, southeast of southernmost pond at Goshen Springs. Predominant vegetation rabbitbrush (Chrysothamnus nauseosus) with cheatgrass among it. Two clumps of squawbush present. On west-facing slope with marsh to west and rabbitbrush for wide expanse on south. Steep, large hill with junipers (Juniperus utahensis) on east border. Soil very rocky on southern half of site.

Pole Canyon

Site A. Elevation 6440 ft, about 4.1 miles from highway 73. On steep, south-facing slope with heavy stands of Gambell oak. Sagebrush and some rabbitbrush in open strips and patches. Cheatgrass abundant in open sagebrush stands.
Chokecherry (*Prunus melanocarpa*) and Rocky Mountain maple in immediate area surrounding site.

**Site Bl.** Elevation 6115 ft, about 0.9 mile below site A. Heavy stands of Gambell oak. Sagebrush between oak. Cheatgrass and other grass species sparsely scattered. Other herbaceous vegetation sparse. Soil rocky.

**Site B.** Elevation 5585 ft, about 1.1 miles below site A at widened flat wash area in bottom of canyon. Both sides of road. Gambell oak about one-half of predominant vegetation with rabbitbrush and sagebrush making up other half. Considerable mullein along dry wash. Cheatgrass and various other herbs scattered in area. North-facing slope with considerable bitterbrush.

**Site Cl.** Elevation 5910 ft, about 0.3 mile below site B. At end of large, dense stands of Gambell oak. Short sagebrush in open spaces between oak. Cheatgrass and snakeweed between sagebrush.

**Site C.** Elevation 5715 ft, about 0.8 mile below site B. Junipers scattered throughout area at intervals of about 50 to 100 feet. Sagebrush predominant vegetation between junipers. Bitterbrush scattered throughout area at intervals of about 25 feet. Cheatgrass abundant between sagebrush.
Snakeweed present but relatively sparse.

**Site D2.** Elevation 5440 ft, about 0.5 mile below site C on north side of road where road crosses dry wash. Soil has larger rocks than other sites. Sagebrush and junipers predominant vegetation. Some bitterbrush present. Cheatgrass and snakeweed scattered throughout site.

**Site D1.** Elevation 5310 ft, about 0.2 mile below site D2 on north side of road. Vegetation essentially same as site D2 but without bitterbrush. Soil rocky and relatively bare of vegetation.

**Site D.** Elevation 5180 ft, about 1.6 miles from site C and 0.6 mile from highway 73. Located few hundred yards out of junipers on north side of road. Sagebrush predominant vegetation with considerable snakeweed. Cheatgrass relatively abundant in certain areas, especially near road. Other areas sparse in herbaceous vegetation.

**Field Methods**

Collecting in Payson Canyon was conducted from June to October, 1965, and in June, 1966; in Pole Canyon from July to October, 1966. One-half of the sites were trapped each week. Museum Special snap-back traps baited with dry oatmeal
were used to catch small rodents. Thirty to forty traps were spaced at intervals of 25 ft in a line at each site, and were set in the evening and picked up at daybreak the following morning. Each rodent was placed into a white paper bag which was sealed with a staple, and the collection data were recorded on the bag. A 16-guage shotgun was used to collect rabbits (*Lepus californicus* and *Sylvilagus auduboni*) and a porcupine (*Erethizon dorsatum*) which were also placed into white paper bags.

The elevation at each site was determined with an altimeter. A known elevational point located at the northeast corner of the Brimhall building on the Brigham Young University campus was used as a standard for setting the instrument.

Laboratory Methods

Bags containing the rodents were placed into a refrigerator and maintained at 13°C for 24 hours. Cooling of the host's body caused the ticks to detach. The hosts were then placed into a white enamel pan over which a 60-watt lamp was suspended. This light, as a heat source, stimulated the ticks to crawl to the tips of the host's hair. The host's fur and the inside of the paper bag were carefully searched
for ectoparasites. The ectoparasites were picked up with the moist end of a pair of forceps and placed into vials of 70% ethyl alcohol. A collection data label was included in each vial with the ectoparasites.

Adult ticks were identified under a high-power, dissecting microscope. Larval and nymphal ticks were cleared in lactic acid, and were then mounted in Hoyer's medium on microslides. Each specimen was oriented with its ventral side up and its anterior end toward the observer. After a coverslip was placed over the specimen, the slide was heated over an alcohol flame to extend the legs of the tick. Slide mounts were placed in a warming oven and maintained at 33°C for seven days.

Identification of larvae. The distinguishing characteristic used to separate larval *D. parumapertus* from *D. andersoni* was the width (angle) of the first coxal spur (Brinton and Beck, 1965). Mounted specimens show this spur much better than unmounted ones. A criterion for the determination of the width limitations for the two species was established in the following manner. Mounted larvae, which were reared from adults of known species, were examined with the 40X objective and 10X ocular of a binocular, compound
microscope. Outlines of the spurs of each specimen were
drawn by means of a camera lucida. A compass was used to
scribe an arc with a 10 mm radius across the drawing, with
the pivot point of the compass at the apex of the spur.

To measure the spur, the points of a draftsman's di-
vider were placed at the two points where the arc transected
the edges of the spur. The points of the dividers were then
placed on a scale and the width was measured to the closest
one-half millimeter. Dimensions of the right and left coxal
spurs of 170 specimens of each species were determined. These
were reared from adults which came from five localities in
Utah and one locality each in Colorado, Montana, and Nevada.
Those ticks whose right and left coxal spurs were 16 mm or
less were considered to be *D. andersoni*; those with measure-
ments of 17 mm or more were considered to be *D. parumapertus*
(Fig. 1).

There is some question of the identity of those speci-
mens whose measurements were in the overlap region. To de-
terminate the probability of the identity of such a specimen,
a discriminant function formula was used (U. S. Forest Service,
1964). A computed value for the variable which may be used
to determine whether an individual belongs to one or the other
Fig. 1. Frequency of occurrence of widths of first coxal spurs of larval D. andersoni and D. parumapertus.

(Note: Dips marked by asterisk are probably due to measurements by units of 0.5 mm.)
group is known as the discriminant. To develop the discriminant, width measurements of the average of the right and left spurs were taken ($X_1$).

The next step was to compute the difference between the species means and the corrected sums of the squares for each species. The difference of the means for *D. andersoni* and *D. parumapertus* was 1.74 ($d_1$). From the corrected sums of squares the pooled variance ($S_P^2$) was determined to be 0.6668. The next step was to fit a function of the form $Y = b_1 X_1$ so that the value of $Y$ for measured values of $X_1$ would enable the classification of an individual as *D. andersoni* or *D. parumapertus*. The solution for $b_1$ is:

$$S_P^2 b_1 = d_1, \quad b_1 = \frac{d_1}{S_P^2} = 2.60948$$

The discriminant was applied as follows: The mean value of the discriminant for *D. andersoni* (D.a.) and *D. parumapertus* (D.p.) was computed: $\bar{Y} = b_1 \bar{X}_1$, thus, D.a. = 44.8831. The mean of these two values (42.61285) served as a criterion for classifying an individual as *D. andersoni* or *D. parumapertus*. Any individual for whom $\bar{Y} (\bar{Y} = 2.60948 X_1)$ was less than 42.61285 was classified as *D. andersoni*. An
individual for whom \( \bar{y} \) was greater than 42.61285 was classified as \( D. \) \textit{parumapertus}.

Before using the discriminant function for classification purposes, however, its significance was tested with an F test and \( n-p-1 \) degrees of freedom. There was a significant difference in the mean values of the discriminant between \( D.p. \) and \( D.a. \) at the 5% level.

Use of the discriminant function may result in the misclassification of some individuals. However, the probability of misclassification can be estimated by using \( K = \frac{D}{2} \) as a standard normal deviate to determine the probability of \( Y > K \) from a table of the cumulative normal distribution:

where \( D = (b_1d_1)^{1/2} \) and \( K = 1.065 \). The probability of obtaining a standard normal deviate larger than 1.065 is approximately \( P = 0.1434 \). Using this function, about 14% of the individuals classified may be assigned to the wrong group. For the data used to develop the discriminant, 41 (12%) of 340 known individuals would have been misclassified.

After the calculation of the discriminant value, 23 changes were made in the tentative species assignments given to questionable specimens.
RESULTS

A total of 1193 ticks, of which 775 belonged to the genus Dermacentor, was collected from 461 hosts. Of these ticks, 616 larvae, 61 nymphs, and 20 adults of D. andersoni were collected. Dermacentor parumapertus larvae totaled 60, nymphs 8, and adults 10.

Host-tick Relationships

The number of D. andersoni and D. parumapertus ticks collected from each host species is shown in Table 1. The average number of ticks per infested host was 3.2 at Payson Canyon and 7.1 at Pole Canyon. Table 2 shows the species of hosts, number collected, and the percentage infested with Dermacentor spp.

Dermacentor parumapertus larvae were collected mostly from P. maniculatus. A few were taken from S. auduboni, D. ordii, and P. parvus at Pole Canyon. Dermacentor andersoni larvae were taken from all hosts except E. dorsatum, R. megalotis, and the Green-tailed towhee (a bird).

Dermacentor parumapertus nymphs were not collected at
Payson Canyon. Nymphs were taken at Pole Canyon from *P. maniculatus*, *Lepus* and *Sylvilagus*. Adult *D. parumapertus* were taken at Pole Canyon from *Lepus* and *Sylvilagus auduboni*. Nymphal *D. andersoni* were taken at all sites in Payson Canyon except sites 4, 5, and 7. They were collected from *P. maniculatus*, *P. parvus*, *E. minimus*, and *M. montanus*. In Pole Canyon, nymphs were taken from *P. maniculatus*, *P. parvus*, *E. dorsatum*, *S. auduboni*, and *D. ordii*. Adult *D. andersoni* were collected from *E. dorsatum* and *S. auduboni* at Pole Canyon only.

**Seasonal and Elevational Occurrence**

Figures 2 and 3 show the relative numbers of larval ticks occurring at each elevational site.

In the Payson study area the highest percentage of hosts with ticks was collected in Sept. At the Pole Canyon study sites, the highest number of infested hosts was collected in Aug.; a sharp decline occurred in Sept. The average number of ticks per infested host was highest in July and Aug. at the Payson study area, and at Pole Canyon a sharp increase occurred during Aug.

In the Payson area the monthly numbers of *D. parumapertus*
Fig. 2. Abundance of larval *D. andersoni* and *D. parumapertus* at different elevations in Payson Canyon. (Numbers of larvae shown are not actual numbers taken, but have been adjusted relative to the number of hosts examined at each site.)
Fig. 3. Abundance of larval D. andersoni and D. parumapertus at different elevations in Pole Canyon. (Numbers of larvae shown are not actual numbers taken, but have been adjusted relative to the number of hosts examined at each site.)
Table 1. Number of *D. andersoni* and *D. parumapertus* ticks collected from each host species.

<table>
<thead>
<tr>
<th>Host</th>
<th>No. of <em>D. andersoni</em></th>
<th>No. of <em>D. parumapertus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Dipodomys ordii</em> Woodhouse</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td><em>Erethizon dorsatum</em> Cuvier</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><em>Eutamius minimus</em> (Bachman)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>Lepus californicus</em> Gray</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td><em>Microtus montanus</em> (Peale)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><em>Perognathus parvus</em> (Peale)</td>
<td>79</td>
<td>4</td>
</tr>
<tr>
<td><em>Peromyscus maniculatus</em> (Wagner)</td>
<td>562</td>
<td>53</td>
</tr>
<tr>
<td><em>Peromyscus trueii</em> (Shufeldt)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><em>Reithrodontomys megalotis</em> (Baird)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sylvilagus auduboni</em> (Baird)</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Table 2. Number of hosts collected and percentage infested with *Dermacentor* spp.

<table>
<thead>
<tr>
<th>Host</th>
<th>Payson Canyon</th>
<th>Pole Canyon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. collected</td>
<td>% infested</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dipodomys ordii</em></td>
<td>7</td>
<td>72</td>
</tr>
<tr>
<td><em>Erethizon dorsatum</em></td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td><em>Eutamias minimus</em></td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td><em>Lepus californicus</em></td>
<td>3</td>
<td>83</td>
</tr>
<tr>
<td><em>Microtus montanus</em></td>
<td>3</td>
<td>67</td>
</tr>
<tr>
<td><em>Perognathus parvus</em></td>
<td>16</td>
<td>31</td>
</tr>
<tr>
<td><em>Peromyscus maniculatus</em></td>
<td>280</td>
<td>19</td>
</tr>
<tr>
<td><em>Peromyscus truei</em></td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td><em>Reithrodontomys megalotis</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>Sylvilagus auduboni</em></td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td><strong>Bird</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Chlorura chlorura</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>313</td>
<td>20</td>
</tr>
</tbody>
</table>
larvae were small but relatively constant; a small peak was reached in Aug. Greatest numbers of larval *D. andersoni* were collected in Sept. In Pole Canyon, a marked increase in numbers of *D. parumapertus* and *D. andersoni* occurred in Aug.
DISCUSSION

Identification and Use of Immature Ticks

Little ecological information about the immature stages of *Dermacentor* has been previously reported due to the difficulty of differentiating between species. Host specificity, distribution, habitat, and elevation are the criteria which have been used by previous workers to identify the immature stages of *Dermacentor*. Rearing the immature ticks to adults as a basis for identification is most reliable, but is time consuming, requires special facilities, and is not always practical. In this study the immature stages of ticks were chosen as elevational indicators for the following reasons: (1) both *D. andersoni* and *D. parumapertus* occur on small rodents. (2) The small rodents can be easily obtained. (3) A common host, *Peromyscus maniculatus*, occurs throughout the range of the ticks at high and low elevations. (4) The range of movement for rodent hosts is not as great as for the larger hosts of the adults, such as deer and domestic animals, principally cattle and sheep (Allred and Beck, 1963; Redman and Sealander, 1958). Therefore,
The elevational occurrence of immature ticks would not be due to migration of their rodent hosts.

The presence of a definite, internal, coxal spur is usually reliable for distinguishing *D. andersoni* nymphs from *D. parumapertus* nymphs, but to clearly distinguish this characteristic the nymphs should be mounted on microslides. Within the larvae there is considerable variation of the spurs; consequently, the larval *Dermacentor* must be mounted on microslides in order to clearly distinguish the spurs as a basis for identification of the species. Despite the difficulty in identifying larval specimens of *Dermacentor*, most larvae can be correctly assigned to species using the discriminant function method. Drawing and measuring of the coxal spurs was required for only about 30% of the specimens identified. The other 70% were identified by the typical spur appearance of each species. The length of the spur might prove to be a useful criterion, inasmuch as the specimens of *D. parumapertus* usually have a shorter spur than do those of *D. andersoni*. This is especially true where the spur shows a small angle or width. However, a more accurate means of measuring the coxal spurs than that used in this study should be devised.
Elevational Occurrence

Dermacentor andersoni

Previous studies in Utah indicate the upper limit of D. andersoni to be almost 9000 ft (Herrin, 1966). Studies by Coffey (1953), Beck (1955), and Ho (1962) indicate that adult ticks in Utah occur mostly above elevations of 6000 ft. My findings show that D. andersoni has a lower elevational range in Utah (4515 ft) than previously reported by Beck (1955) and Herrin (1966). In Payson Canyon the species occurs throughout the elevational range studied (Fig. 2). It is probable, however, that immature D. andersoni found at the lower elevations are present because the adults are transported there from higher elevations by domestic animals. In Payson Canyon, cattle are grazed in the forest lands during the summer and brought back to the ranches in the fall (Weissert, personal interview). However, the lower study sites are privately owned, and cattle are usually retained in those locations throughout the year.

Spotten (personal interview) stated that in May, sheep are brought into one of the lower areas (site 8) from the foothills west of Eureka, Utah County. After a short
time they are transported by trucks into the higher mountains for summer grazing. In November they are again returned to the same lower area for a few days before being shipped back to the winter range. After the visit of the sheep in May, members of the Spotten family became infested with adult ticks when they walked through the sagebrush near the sheep-holding area. Another of the lower sites (site 9) is grazed by cattle, but Spotten indicated that they are herded along the same trail as are the sheep.

In Pole Canyon, *D. andersoni* occurs throughout the elevational range that was studied (Fig. 3). Sheep are grazed during the summer within a fenced area above 7000 ft, but they are trailed to and from this grazing area (Cook, personal interview). The trailing of the sheep could distribute the ticks along the canyon.

Studies done in the mountain ranges and valleys around Dugway Proving Ground, Tooele County, suggest that the presence of sagebrush has an influence on the elevational distribution of *D. andersoni*. Johnson (unpublished data) stated the following:

In our area this tick [*D. andersoni*] is found principally in the foothills and mountains, usually in association with stands of sagebrush, *Artemisia tridentata*, at
elevations above about 6000 feet. Where suitable habitat occurs at lower elevations, particularly on the eastern slopes of the mountains that are grazed by sheep, the ticks may also occur.

Johnson further indicated that the lower elevational distribution of *D. andersoni* could extend into the valleys. He remarked that on the west slopes of the mountains east of Dugway, *D. andersoni* did not occur below where the sagebrush merged into greasewood (*Sarcobatus* sp.). This is at an elevation of about 6000 ft.

*Dermacentor parumapertus*

Reasons for the elevational distribution of *D. parumapertus* are less clear than for *D. andersoni*. Although sheep have not as yet been shown to be a host for *D. parumapertus*, it is possible that as transport hosts, they transport the ticks to higher elevations in Pole Canyon. Further studies on ticks infesting sheep are needed to ascertain if these animals are important in the distribution of *D. parumapertus*. No ticks of *D. parumapertus* were collected at two intermediate sites (Bl and D1), but rodents were trapped in these areas only once or twice.

Johnson's studies (personal interview) near Dugway showed that *D. parumapertus* reaches its upper elevational
limits at about 6000 ft. Although they were not found between 5090 and 5800 ft in Payson Canyon, they were collected at 5800 ft and above. The upper-most sites are in the Uintah National Forest, and it is possible that cattle from the lower winter ranges transport D. parumapertus to the higher elevations. Previous workers have shown that cattle serve as hosts for this tick (Bishopp and Trembley, 1945). However, the confinement of cattle on privately owned lands would prevent them from serving as transfer hosts. This may account for the lack of ticks at the intermediate sites (3 to 5).

Abundance

Dermacentor andersoni

In Payson Canyon there was an increase in the numbers of D. andersoni as the elevation decreased. This is opposite of the expected pattern. The concentration of sheep and subsequent dropping of adult ticks may account for the relatively high abundance of D. andersoni larvae at the lower elevations, and the presence of cattle may help maintain a higher population of ticks at these sites. The larger population of rodents at site 6 may be the reason for the higher
tick population in that area. However, site 2 was lowest in numbers of *D. andersoni*, but the greatest rodent population occurred there. Perhaps the heavy oak growth surrounding this latter site kept larger hosts from the area in sufficient numbers to reduce the adult tick population. Site 1, where ticks were abundant, had a high rodent population, and the surrounding area was favorable for grazing cattle.

Pole Canyon showed the expected pattern of distributional abundance for *D. andersoni*—generally the ticks decreased in numbers as the elevation decreased. The greater number of *D. andersoni* at a lower site (D) probably is influenced by the sheep kept in corrals immediately south of this site at certain times of the year (Cook, personal interview). The greater number of ticks at the higher sites (A and B) are probably due to greater rodent populations (Hunter and Bishopp, 1911).

*Dermacentor parumapertus*

In the Payson study area, the higher relative number of *D. parumapertus* at site 8 supports the theory that sheep may serve as transport hosts for the ticks of this species. Sites 1 and 2 probably had more *D. parumapertus* than sites
6 or 7 because of their higher rodent populations.

In Pole Canyon the greater number of ticks at sites A and B was probably due to larger rodent populations at these sites.

Seasonal Occurrence

In Payson Canyon only small numbers of *D. parumapertus* were collected throughout the summer months. In Pole Canyon there was a marked increase in larvae in Aug. Studies of seasonal abundance of *D. parumapertus* on the black-tailed jackrabbit by Fremling and Gastfriend (1955) and by Rosasco (1957) revealed that the larvae did not occur on the rabbits from the middle of June to the first part of Sept. The nymphs were not on the rabbits from the first part of July until the last of Aug. Results of my study of rodent hosts show considerable variation from this pattern. Apparently the difference of hosts for the larvae accounts for this variation.

In Pole Canyon during Aug. there was an increase in larval numbers of both *D. parumapertus* and *D. andersoni*. Beck's (1955) study also showed an increase in *D. andersoni* larvae during Aug. Such an increase has been noted in other
parts of the United States by Cooley (1932) and Burgdorfer and Eklund (1959, 1960). Other workers indicated that the peak occurs in the first two weeks of July (Bacon, Drake and Miller, 1959).

A more complete life history of *Dermacentor* is needed to accurately determine seasonal population trends in relationship to elevational and geographic distribution.

**Interaction of Tick Species**

Some investigators maintain that in Utah, *D. parumapertus* occurs in the lower desert valleys, and *D. andersoni* at higher elevations (Coffey, 1953; Beck, 1955; Fremling and Gastfriend, 1955). My findings in Goshen Valley and Cedar Valley do not agree. *Dermacentor andersoni* was relatively abundant in the valleys as well as at higher elevations. This casts some doubt on Coffey's (1953) theory that *D. parumapertus* probably accounts for the majority of the ticks at the lower elevations in Cedar Valley. He noted that grazing by domestic animals was evident near his study area. Thus, it is likely that *D. andersoni* occurs at the lower elevations there also.

The extensive overlap in the elevational distribution
of *D. andersoni* and *D. parumapertus* has been accounted for by transport by domestic animals. Studies similar to the present one need to be made in other grazed and ungrazed areas to determine to what extent domestic animals extend the normal limits of the elevational distribution of *D. andersoni* and *D. parumapertus*. 
LITERATURE CITED


Johnson, D. E. Ticks of Dugway Proving Ground and vicinity and their host associations. Unpublished manuscript.


ABSTRACT

The objectives of this study were to determine the lowest elevational distribution of Dermacentor andersoni and the highest elevational distribution of D. parumapertus in two canyon areas in Utah County, Utah.

Immature ticks collected from rodent hosts were used as a basis for the study. Collections were made from June 17 to October 1, 1965 and 1966.

Totals of 695 D. andersoni and 78 D. parumapertus ticks were taken from 461 hosts. Identification of the ticks was based on the width of the coxal spurs. A discriminant function was used to statistically separate the species.

Dermacentor andersoni was collected throughout the study areas (4515 ft to 6470 ft). The distribution of D. parumapertus was discontinuous, but occurred at the highest and lowest elevations.

The elevational limits of the distribution of D. andersoni and D. parumapertus were not ascertained in this study.