DERMACENTOR ANDERSONI IN NATIONAL FOREST RECREATION SITES OF UTAH

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Shortly after the turn of the century, the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, was recognized as the principal vector of Rocky Mountain spotted fever in western North America. The presence of *D. andersoni* in the recreational sites of the foothills, canyons, and mountains of Utah still offers a potential threat to the health of man. Expanding human population and increased use of recreational facilities enhances this potential. The objective of this study was to determine the prevalence of adult ticks of *D. andersoni* in the recreational sites of Utah.

The Rocky Mountain wood tick is known from northern New Mexico, northern Arizona, northeastern California, Nevada, Utah, western Colorado, western Nebraska, western South Dakota, southwestern North Dakota, Wyoming, Montana, Idaho, northeastern Oregon, eastern Washington, and southern British Columbia, Alberta and Saskatchewan (Hooker, 1909; Bishopp, 1911; Hunter and Bishopp, 1911; Cooley, 1938; Bishopp and Trembley, 1945; Gregson, 1956). In Utah it has been reported from every county except Carbon County (Banks, 1908; Hunter and Bishopp, 1911; Edmunds, 1948, 1951; Coffey, 1953, 1954; Beck, 1955). Other records in the Department of Zoology and Entomology of Brigham Young University show collections from Carbon County, as well as all other Utah counties.

Much information relative to the distribution, ecology, and biology of *D. andersoni* and its relationship to Rocky Mountain spotted fever has been published by scientists working on the control of the wood tick and spotted fever in western Montana and Canada. Although the literature is replete with such reports, only the major works and those related directly to this study are cited in the "Results and Discussion" section of this paper.

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Methods and Techniques

Ninety-one recreational sites in the seven national forests of Utah were selected for study. Selection was based on geographic location,

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automobile accessibility, elevation, size, and frequency of use as designated by the U. S. Department of Agriculture (1963). Table 1 lists the study areas in each national forest, and their locations are shown in Figure 1.

Recreational sites were visited from the first week in May until the latter part of August in 1964. An unusually late spring, inclement weather, and distance made it difficult to visit most areas more than once, although 30 were visited two or more times. Adult ticks were collected by dragging a four-foot by three-foot white flannel

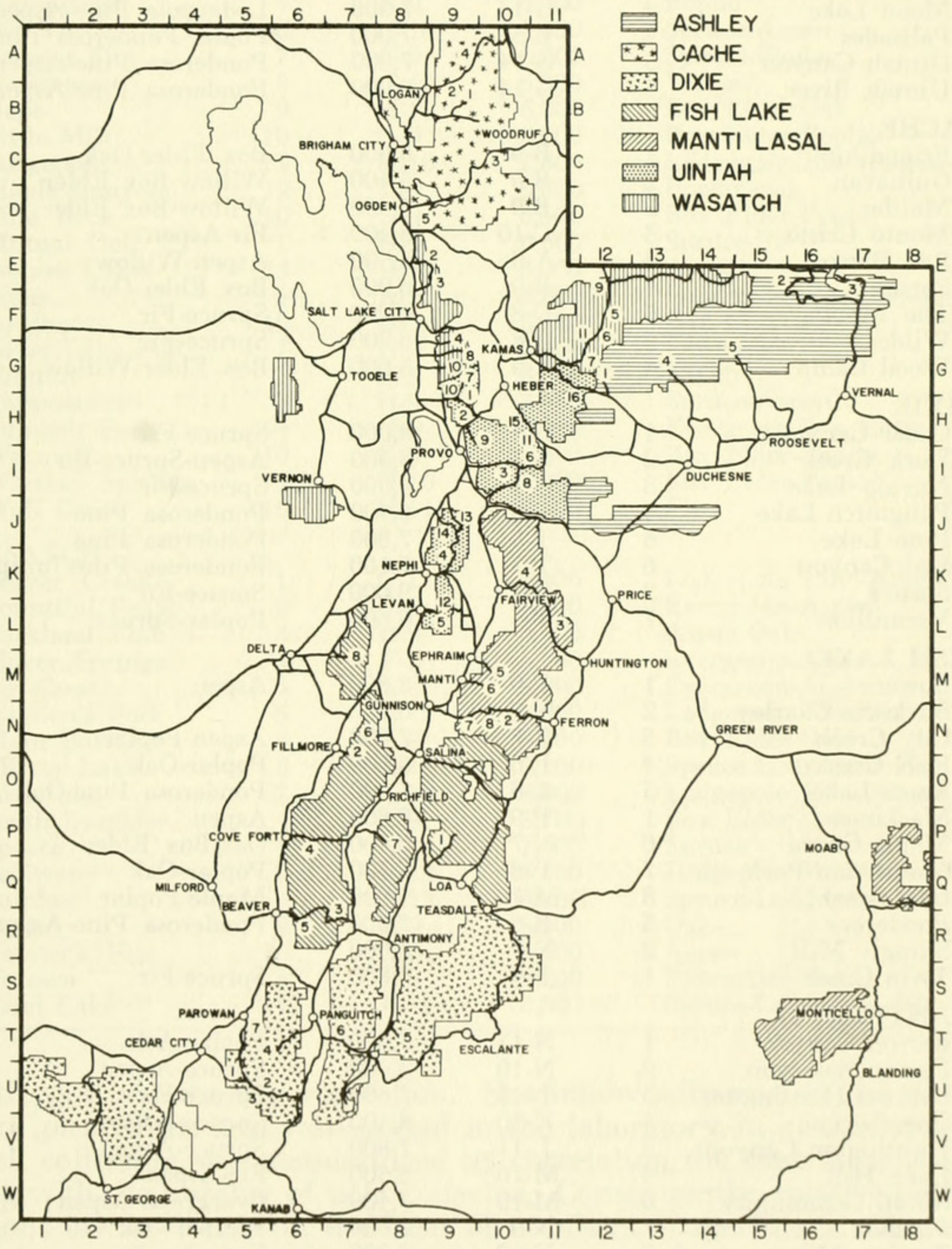

Fig. 1. Location of recreational sites used as study areas in the seven national forests of Utah.

Table 1. Recreational sites used as study areas in the seven national forests of Utah. (Refer to Figure 1 for specific geographic location.)

National forest and recreational site	Map ref. no.	Map coor-dinate	Eleva-tion	Plant community
ASHLEY				
Aspen Grove	1	G-12	7,500	Aspen-Spruce
Carmel	2	E-5	6,500	Poplar-Spruce
Green Lakes	3	E-17	7,100	Ponderosa Pine
Greendale	3	E-17	7,000	Ponderosa Pine
Hades Canyon	1	G-12	7,700	Aspen-Spruce
Moon Lake	4	G-13	7,900	Lodgepole Pine-Aspen
Palisades	2	E-5	7,000	Poplar-Ponderosa Pine
Uintah Canyon	5	G-14	7,900	Ponderosa Pine-Aspen
Uintah River	5	G-14	8,000	Ponderosa Pine-Aspen
CACHE				
Friendship	1	B-9	6,000	Box Elder-Oak
Guinavah	2	B-9	5,400	Willow-Box Elder
Malibu	2	B-9	5,300	Willow-Box Elder
Monte Cristo	3	C-10	8,400	Fir-Aspen
Red Banks	4	A-9	6,500	Aspen-Willow
Spring	1	B-9	6,000	Box Elder-Oak
The Maples	5	D-8	6,200	Spruce-Fir
Wildcat	5	D-8	6,200	Spruce-Fir
Wood Camp	4	A-9	5,600	Box Elder-Willow
DIXIE				
Cedar Canyon	1	U-5	8,000	Spruce-Fir
Duck Creek	2	U-5	8,500	Aspen-Spruce-Fir
Navajo Lake	3	U-5	9,000	Spruce-Fir
Panguitch Lake	4	T-5	6,400	Ponderosa Pine
Pine Lake	5	T-8	7,800	Ponderosa Pine
Red Canyon	6	T-7	7,100	Ponderosa Pine-Juniper
Spruce	3	U-5	9,000	Spruce-Fir
Vermillion	7	T-5	6,600	Poplar-Spruce
FISH LAKE				
Bowery	1	P-9	8,800	Aspen
Buckskin Charley	2	N-7	6,100	
City Creek	3	R-7	7,600	Aspen-Poplar
Fish Creek	4	P-6	6,000	Poplar-Oak
Kents Lake	5	R-6	7,900	Ponderosa Pine-Oak
Mackinaw	1	P-9	8,800	Aspen
Maple Grove	6	N-7	6,400	Oak-Box Elder
Monrovian Park	7	P-8	6,300	Poplar-Oak
Oak Creek	8	M-7	5,900	Maple-Poplar
Ponderosa	5	R-6	7,000	Ponderosa Pine-Aspen
Shingle Mill	2	N-7	6,000	
Twin Creek	1	P-9	8,800	Spruce-Fir
MANTI-LASAL				
Ferron Canyon	1	N-11	7,000	Poplar-Ash
Ferron Reservoir	2	N-10	9,600	Spruce-Aspen
Forks of Huntington	3	L-11	7,600	Spruce-Fir
Gooseberry	4	K-10	8,400	Spruce-Aspen
Huntington Canyon	3	L-11	7,800	Spruce-Aspen
Lake Hill	5	M-10	8,500	Fir-Aspen
Manti Community	6	M-10	7,400	Evergreen-Aspen
Pinchot	7	N-9	7,000	Juniper-Oak
Twelve Mile	8	N-10	9,800	Spruce
Willow Lake	2	N-10	9,000	Spruce-Aspen

Table 1 (continued)

National forest and recreational site	Map ref. no.	Map coordinate	Elevation	Plant community
UINTAH				
Altamont	1	H-9	7,200	Aspen-Spruce
Aspen Grove	2	H-9	6,800	Aspen-Poplar-Evergreen
Balsam	3	T-10	6,000	Maple-Fir
Bear Canyon	4	K-9	6,800	Poplar
Bench	2	H-9	6,800	Aspen-Poplar-Evergreen
Chicken Creek	5	L-9	6,200	
Cottonwood	4	K-9	6,400	Poplar
Dip Vat	6	I-10	7,000	Spruce-Aspen
Granite Flat	7	G-9	6,800	Spruce-Poplar
Hawthorn	8	I-10	6,000	Willow
Hope	9	H-10	6,600	Box Elder-Oak
Little Mill	10	G-9	6,000	Box Elder-Poplar
Lodgepole	11	H-10	7,800	Lodgepole Pine-Aspen
Maple Canyon	12	L-9	6,800	Poplar-Oak
Mile Rock	10	G-9	6,400	Box Elder-Poplar
Mutual Dell	1	H-9	6,600	Spruce-Fir
Payson Lakes	13	J-9	8,000	Aspen
Pines	4	K-9	6,200	Ponderosa Pine-Poplar
Roadhouse	10	G-9	6,200	Box Elder-Poplar
Silver Lake Flat	7	G-9	7,400	Spruce-Fir
Summit	1	H-9	8,000	Aspen
Timpooneke	1	H-9	7,400	Spruce-Aspen
Tumbolt Park	14	J-9	6,200	Evergreen-Box Elder
Warnick	10	G-9	6,200	Box Elder-Poplar
Whiskey Springs	15	H-10	6,600	Box Elder-Poplar
Wolf Creek	16	H-11	9,600	Fir
WASATCH				
Beaver Creek	1	G-11	7,400	Lodgepole Pine-Aspen
Bountiful Peak	2	E-9	7,500	Evergreen-Aspen
Buckland Flat	3	E-9	6,900	Aspen-Oak
Clover Springs	4	F-9	6,900	Evergreen-Aspen
Fir Crest	4	F-9	6,800	Evergreen-Aspen
Hayden's Fork	5	F-12	9,000	Lodgepole Pine-Aspen
Main Boxelder	4	F-9	5,800	Box Elder-Oak
Mirror Lake	6	F-12	10,200	Spruce-Lodgepole Pine
Soapstone	7	G-12	8,000	Lodgepole Pine-Aspen
South Boxelder	4	F-9	5,700	Box Elder-Oak
Spruce	8	G-9	7,400	Spruce
Stillwater	9	E-12	8,500	Lodgepole Pine-Aspen
Sulphur	5	E-12	9,000	Spruce-Lodgepole Pine
Sunset	2	E-9	8,200	Oak
Tanner's Flat	10	G-9	7,100	Aspen
Terrace	4	F-9	6,200	Evergreen-Maple
Trial Lake	11	F-12	10,000	Spruce-Lodgepole Pine

cloth slowly over the vegetation. Specimens adhering to the cloth were picked off, and transported to the laboratory in an ice cooler. Each collection was standardized by correlating the time spent flagging with the number of ticks collected. Consequently, relative populations are indicated on the basis of numbers of specimens collected per hour. The habitat from which ticks were taken was classified as to plant type, size, cover, and age. Vegetation types were categorized as (1) grass, (2) grass and/or herbs, and (3) grass and/or herbs and short shrubs. The vegetation sizes were arbitrarily designated as (1) short, less than 6 inches, (2) medium, six to 12 inches, and (3) tall, 12 to 24 inches. Designations for the degree of vegetative cover were (1) scanty, less than 25% cover, (2) sparce, 25% to 50% cover, (3) medium thick, 50% to 75% cover, and (4) thick, 75% to 100% cover. The age of the vegetation was considered in the three categories of (1) young, (2) seed head stage, and (3) the drying or dry stage.

Results and Discussion

Distribution

All the recreational sites from which *D. andersoni* adults were taken lie along the slopes of the Wasatch and Uintah Mountains, and in the Colorado Plateau country of southern Utah. Coffey (1953) noted a similar mountainous distribution for *D. andersoni*, but in other parts of the Great Basin this tick was uncommon.

Three hundred fifty-eight adult *D. andersoni* (135 males and 223 females) were collected in 115 attempts. The highest population was 60 per hour at Kents Lake in Fish Lake National Forest. The next highest were 52.5 at Manti Community in Manti-Lasal National Forest, and 52 several miles north of Payson Lakes in Uintah National Forest. Populations above 25 per hour were also observed in six other areas (Table 2). The average collection rate for all attempted

Table 2. Tick population density based on collection rates per hour for all collections. Areas where no ticks were found are omitted (see Table 1).

National forest and recreational site	Date	Population density		
		Males	Females	Total
ASHLEY				
Moon Lake	16 July	0	1.7	1.7
Uintah River	15 July	2	0	2
CACHE				
Friendship and Spring	7 July	4	4	8
Guinivah and Malibu	8 July	0	1.2	1.2
Wood Camp	8 July	3	0	3
DIXIE				
Cedar Canyon	3 June	4	8	12
Pine Lake	3 June	0	2.4	2.4
Red Canyon	3 June	3	3	6
Vermillion	3 June	12	24.3	46.3
FISH LAKE				
Bowery	4 June	2.2	2.2	4.4
Buckskin Charley and Shingle Mill	2 June	6	0	6
City Creek	2 June	24	21	45
	28 July	1.7	8.6	10.3
Fish Creek	2 June	4	16	20
Kents Lake	2 June	26	34	60

Table 2 (continued)

National forest and recreational site	Date	Population density		
		Males	Females	Total
Mackinaw	4 June	0	1.7	1.7
Maple Grove	4 June	5.3	8	13.2
Monrovian Park	2 June	10.3	20.6	30.9
Oak Creek	2 June	0	7.5	7.5
Ponderosa	2 June	16.8	24	40.8
MANTI-LASAL				
Lake Hill	10 July	1.7	6.9	8.6
Manti Community	10 July	22.5	30	52.5
Pinchot	10 July	8	10	18
UINTAH				
Altamont	25 June	6	12	18
Aspen Grove	25 June	3	7.5	10.5
	23 July	2.4	0	2.4
Balsam	6 May	2	0	2
	27 May	4.4	3.2	7.7
	23 July	0	1.7	1.7
Bear Canyon	28 May	0	2.2	2.2
Bench	25 June	0	12	12
Chicken Creek	4 June	4	0	4
Cottonwood	28 May	4.8	4.8	9.6
Granite Flat	26 May	5.3	9.3	14.7
	25 June	4.5	3	7.5
Hawthorn	27 May	3	9	12
Little Mill	26 May	1.3	5.3	6.6
Maple Canyon	10 July	4	4	8
Mile Rock and Warnick	3 July	4	0	4
Mutual Dell	25 June	8	12	20
North of Payson Lakes	28 May	26	26	52
Pines	6 May	4	0	4
	28 May	2.6	8	10.6
Silver Lake Flat	25 June	3	12	15
Timpooneke	25 June	8	22	30
	23 July	2	0	2
Tumbolt Park	10 July	4	4	8
Whiskey Springs	10 June	8	12	20
WASATCH				
Beaver Creek	14 July	0	8	8
Buckland Flat	16 June	0	10.5	10.5
Fir Crest and Clover Spring	8 July	3	0	3
Soapstone	22 August	0	1.7	1.7
Sunset	7 July	0	2.4	2.4
Tanner's Flat	12 June	2	2	4

collections was 6.8 per hour. The population density data presented in Table 2 indicate a considerable variation in tick populations at different sites. When ticks were collected in high numbers they were generally found concentrated in small areas. These variations probably are due to differences in biotic and abiotic factors present at different sites. Cooley (1932) indicated that the reason ticks are very abundant in one spot and not in another is that nymphal ticks are dropped and molt in a particular spot, and the new adults remain in this spot to wait for a passing host. However, Cooley (1932) and

Philip (1937) observed ticks to crawl "considerable" distances and become "moderately" concentrated along game trails and other areas where hosts are most likely to be encountered.

The state was arbitrarily divided latitudinally into three sections: (1) a south part consisting of the Dixie and Fish Lake National Forests; (2) a middle part consisting of the Manti-Lasal and Uintah National Forests; and (3) a north part consisting of the Ashley, Wasatch, and Cache National Forests (Figure 1). The average population densities in these sections were 12.2 per hour in the south section, 8.6 in the middle, and 1.6 in the north. Based on number of collections, Coffey (1953) and Beck (1955), however, showed the wood tick to be more abundant in the northern half of the state. Their records reveal that although almost twice as many adults were collected from the northern half than from the southern half of the state, the average number of specimens per collection was 4.0 in the northern half and 8.2 in the southern half. More collection attempts likely were made by them in northern than in southern areas; thus, more collections and consequently more ticks were recorded from northern Utah. Their records support the implications in this study that, where ticks are present, population densities are greater in the southern part of the state.

Highest populations were found between 6,500 and 7,500 feet elevation (Figure 2). No ticks were collected above 8,800 feet. The lower limit was not determined inasmuch as collections were made only as low as 5,500 feet in this study. This elevational distribution corresponds closely with that noted by other workers. Coffey (1954) recorded collections from elevations ranging between 6,000 and 8,000 feet and noted the lack of ticks on animals at 9,000 feet. Beck (1955) noted an abundance of ticks from elevations of 5,500 to 7,000 feet in the mountains surrounding Cedar Valley in Utah County, and in another area in central Utah from elevations of 6,100 to 7,000 feet. Ho (1962) indicated that the wood tick is usually found at elevations above 6,000 feet.

Greater populations were found at higher elevations in southern than in northern Utah (Figure 2). The optimum elevations were 7,000 to 7,500 feet in southern areas and 6,500 to 7,000 feet in northern areas. This latitudinal difference in elevational distribution is also suggested by several notations in the literature. Bishopp (1911) reported the elevational range of *D. andersoni* to be 500 to 9,000 feet, but reaching its greatest numbers between 3,000 and 5,000 feet. His report dealt primarily with studies conducted in western Montana. Bishopp and King (1913) recorded the collection of ticks late in June at 7,200 feet in Colorado and at 5,500 to 6,500 feet early in July in western Montana. In their studies on Colorado tick fever in western Montana, Burgdorfer and Eklund (1959, 1960) collected wood ticks at elevations of 4,000, 5,000, 5,500, and 6,000 feet. In personal communication, Wilkinson (1954) stated that the Canada Department of Agriculture has records of collections from Baniff, Alberta at over 4,500 feet. Thus, the elevational distribution

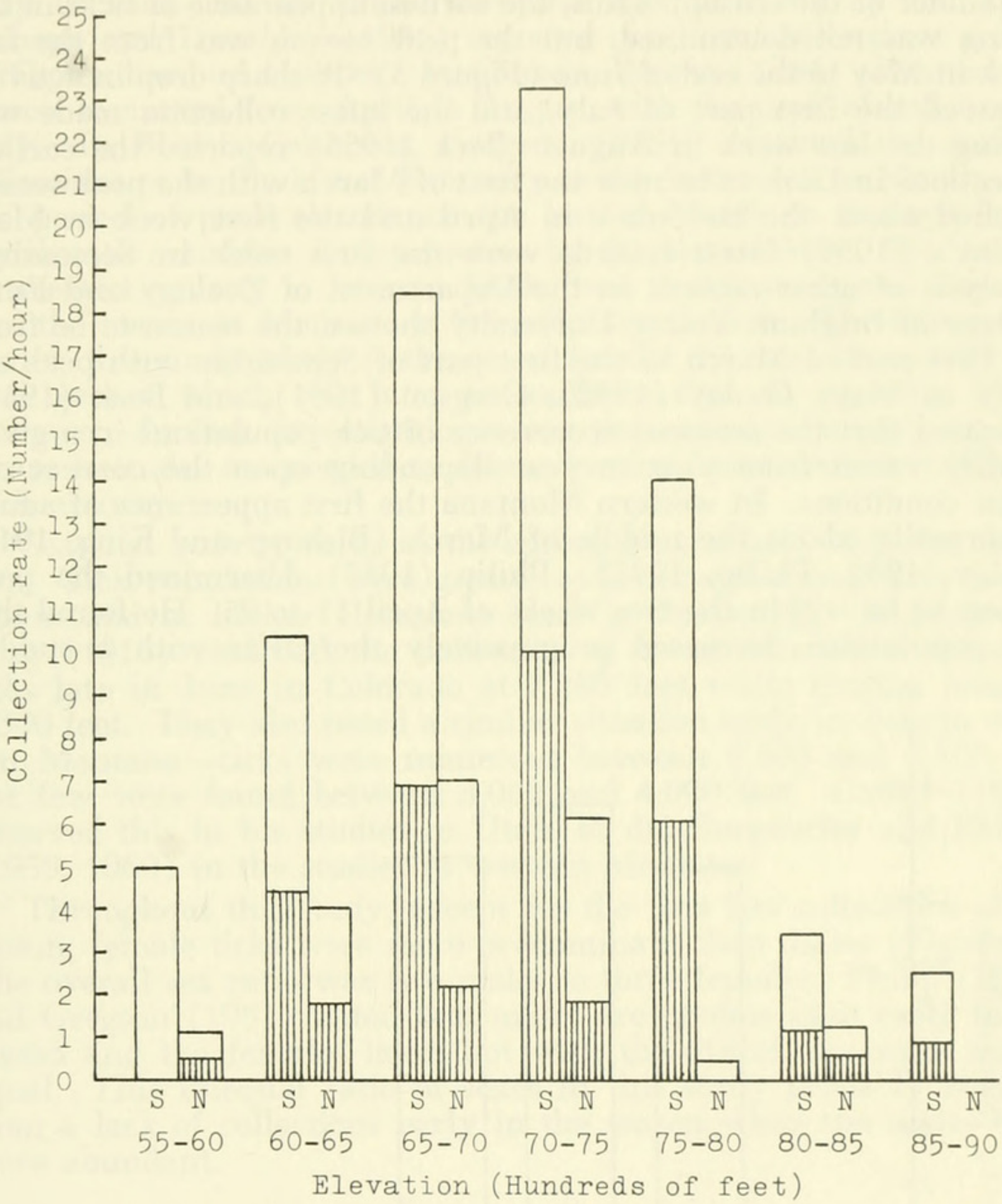

Fig. 2. Relative density of *D. andersoni* adults at various elevations in the southern (S) and northern (N) halves of Utah. Lined columns represent males, unlined columns females.

of the wood tick likely varies with the latitudinal distribution. The optimum elevation becoming lower as one progresses from the southern limits of the range toward the northern limits. Further studies at selected sites dealing specifically with elevational distribution are needed to determine the lower and upper limits of the elevational distribution of the wood tick in relation to latitude.

SEASONAL OCCURRENCE

First attempts to collect ticks were made the first week in May, but inclement weather prevented further attempts until the fourth week in May. Relatively constant surveys were made for the remainder of the season. Thus, the earliest appearance of ticks in the spring was not determined, but the peak season was from the last week in May to the end of June (Figure 3). A sharp drop in activity occurred the first part of July, and the latest collection made was during the last week in August. Beck (1955) reported the earliest collections in Utah to be near the first of March with the peak season reached about the last week in April and the first week in May. Coffey's (1953) latest records were the first week in September. Analysis of other records in the Department of Zoology and Entomology at Brigham Young University showed the season to be from the first part of March to the first part of September with peak activity in May. Cooley (1932), Gregson (1951), and Beck (1955) indicated that the seasonal occurrence of tick populations in a given locality varies from year to year depending upon the current climatic conditions. In western Montana the first appearance of adults is normally about the middle of March (Bishopp and King, 1913; Cooley, 1932; Philip, 1937). Philip (1937) determined the peak season to be within the two weeks of April 11 to 25. He found that the populations decreased progressively thereafter with a sudden

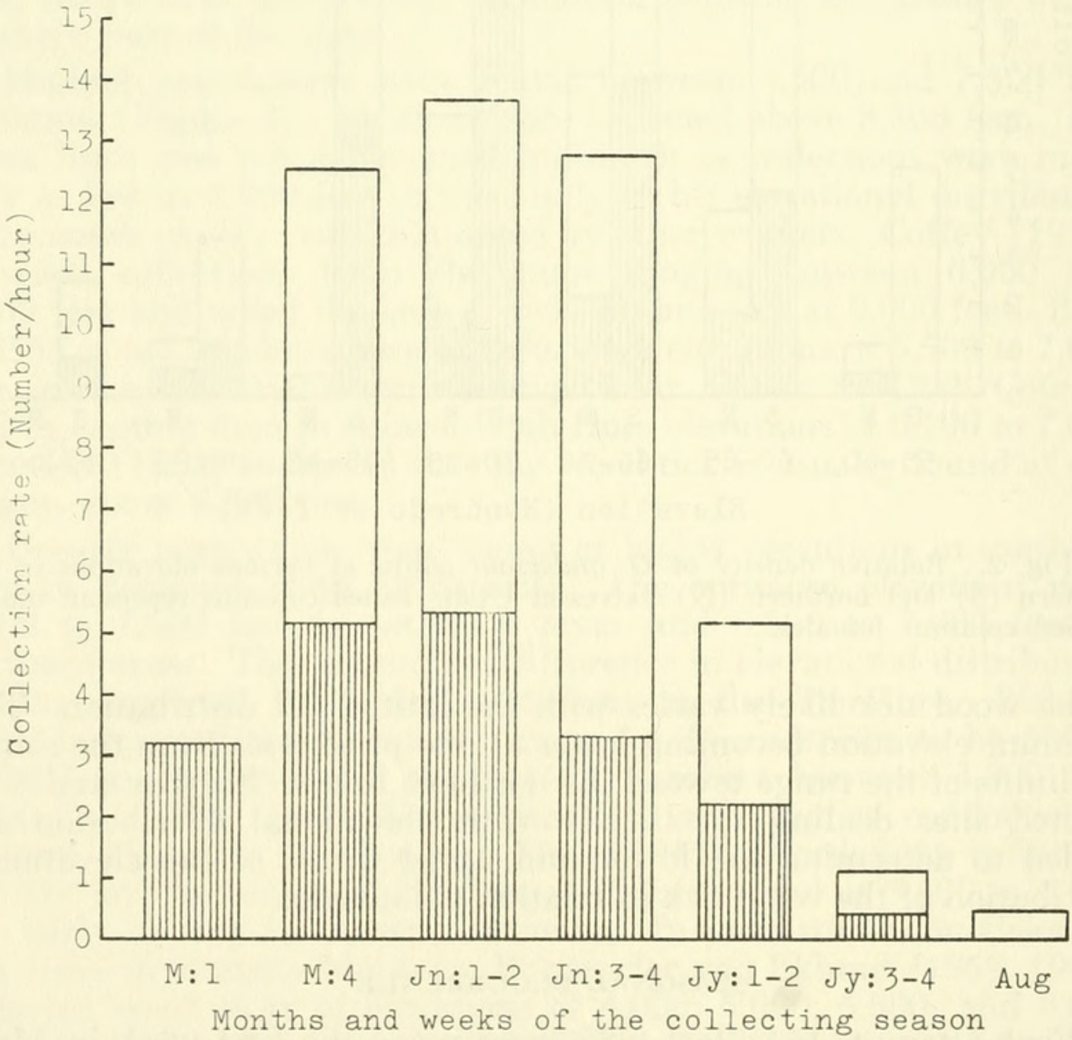

Fig. 3. Relative density of *D. andersoni* adults during May, June, July and August. Lined columns represent males, unlined columns females.

drop in June and an almost complete disappearance by mid-July. Bishopp and Trembley (1945) reported occasional collections as late as September and October. In Canada, Brown (1944) observed the season to extend from April to August with the peak abundance in May. In British Columbia, Gregson (1951) reported the earliest collections to be the last of February to the first week in March, and the period of peak abundance the last of March to the middle of April with a sudden disappearance by the last of May. The season of greatest activity is later in Utah than in Montana and Canada, and the season in Montana is later than in Canada. The late spring during this study likely is the cause for the unusual lateness of the peak season which was later in southern than in northern Utah. However, further investigations into the seasonal activity at different latitudes are needed to determine the factors which influence such activity.

Seasonal activity early in the spring is correlated with the elevation. Tick populations were greater at lower elevations early in the season and at higher elevations later in the spring. Bishopp and King (1913) recorded the collection of a considerable number of ticks late in June in Colorado at 7,200 feet while finding none at 5,300 feet. They also noted a similar situation early in July in western Montana—ticks were numerous between 5,500 and 6,500 feet but few were found between 3,000 and 4,000 feet. Coffey (1953) observed this in his studies in Utah, as did Burgdorfer and Eklund (1959, 1960) in the studies in western Montana.

Throughout this study, except for the first few collections of the season, female ticks were more predominant than males (Figure 3). The overall sex ratio was two males to three females. Philip (1937) and Gregson (1951) noted that males are predominant early in the season and the females later, but with the overall sex ratio nearly equal. This unequal ratio of sexes in this study probably resulted from a lack of collections early in the season when the males were more abundant.

BIOTIC FACTORS RELATED TO POPULATION DENSITY

In this study the preferred habitats for ticks seeking a host were open, unshaded areas of short, scanty, young grass. Ticks were most abundant in areas with a mixture of grass and herbs at higher elevations, and in grass at lower elevations. Population densities were greater in short vegetation at higher elevations and medium to tall vegetation at lower elevations. The same was evident for vegetative cover—greatest populations were found in scanty to sparse vegetation at higher elevations, and in thick vegetation at lower elevations. The grass does not grow tall and thick until later in the season at the time when populations of ticks begin to decrease. Consequently, the size and age of the vegetation is only an indication of seasonal occurrence. The reason for a greater abundance of ticks on scanty to sparse, short grass and herbs at higher elevations and on thick, taller grass at lower elevations probably is that these types of vegetation are more characteristic of the respective elevations, and not that the habits of the ticks differ. Cooley (1913, 1932) observed that adults ascended dead vegetation to await the passing of hosts, but indicated that they also will ascend living vegetation as well. Philip (1937) observed many ticks on dead grass and weed stems very early in the spring. However, it is doubtful that the ticks actually prefer dead over living vegetation. Ticks normally would be found on dead vegetation early in the spring before the new vegetative growth is tall enough to afford good waiting positions.

Bishopp (1911) and Cooley (1911, 1932) indicated that the population densities of wood ticks are greatly influenced by the availability of two general classes of hosts—small mammals on which immature stages feed, and large wild and domestic mammals on which the adults feed. Parker (1918), Cooley (1932), Brown (1944), and Gregson (1951, 1956) found ticks in all types of country where proper host animals were present. The types of hosts present were related to the type of vegetation available for sufficient food and cover. The type of vegetation in an area is dependent upon soil and climatic conditions, and other physical factors. Parker, Philip, Davis, and Cooley (1937) found the wood tick to be most abundant in localities where the vegetation was low and brushy with open areas. Gregson (1956) in Canada determined that the most favorable habitat was characterized by talus slopes backed by rocky bluffs where there was sufficient moisture to support vegetation. Beck (1955), Coffey (1953), and Ho (1962) in Utah listed hosts on which each of the stages feeds, and Coffey observed that tick populations were greater in areas where these hosts were most abundant. Wilkinson (1964) suggested that rodent hosts are probably more abundant in camp sites because of the refuse left by campers and picnickers. Such a concentration of hosts may account for the greater populations of ticks in some recreational sites.

ABIOTIC FACTORS RELATED TO POPULATION DENSITY AND ACTIVITY

The activity of ticks increased gradually throughout the day to a high point in the late afternoon. The collection day was divided into four three-hour periods—7 a.m. to 10 a.m., 10 a.m. to 1 p.m., 1 p.m. to 4 p.m., and 4 p.m. to 7 p.m. The collection rates expressed in number per hour for the respective periods were: 4.4, 4.8, 6.5, and 13.4. Slight differences in daily activity at different elevations were noted in this study but probably are not significant. No seasonal change in daily activity was evident. Temperatures taken one foot from the ground at the time of each collection ranged from 12° to 38° C. There was no apparent optimum temperature range for tick activity even though the population densities were slightly higher at some temperatures. Although the average mean temperature increases as the season progresses, this change apparently has little or no affect on tick activity.

Philip (1937) and Brown (1944) noted that ticks were nearly as active at night as during the middle of the day. Brown suggested that ticks should be just as active during the night as the day because it is at night that the host animals are the most active, and the drop in temperature might produce increased activity. Moderate temperature changes apparently have little effect on tick activity. Gregson (1951) failed to find any striking change in tick activity with fluctuations of temperature and humidity. He suggested that the disappearance of ticks later in the season is due to some form of diapause, the cause of which is unknown. Philip (1937) and Brown (1944) observed decreased tick activity during very hot, very cold, and stormy weather. They also noted that ticks did not seek shelter during adverse weather but remained in a more or less inactive state on the vegetation. Bishopp and King (1913) found that tick activity in the spring begins within six to 12 days from the time when the daily mean temperature ranges between 3° and 6° C. for several consecutive days. They also suggested that dormancy is produced in the fall when temperatures range between 9° and 12° C. Mail (1942) determined the lethal temperature for wood ticks to be —10° to —14° C at the lower range and 45° to 46.5° C at the higher range. He also observed that ticks from regions of colder climate and longer winters have a greater resistance to freezing than those from regions of warmer climate and shorter winters. If ticks in colder climates are more resistant to cold and less resistant to heat, it is expected that they would have an earlier season. This may partly explain why the seasonal occurrence in the northern ranges is earlier than in the southern ranges.

In the present study tick activity was slightly greater on partly cloudy to cloudy days than on clear occasions. Cooley (1913, 1932) observed that ticks were stimulated by an abrupt appearance of a shadow or change in light intensity, and suggested that ticks in nature are made aware of an animal by its shadow. As a cloud cuts off the sun light the ticks may be stimulated to activity in a manner similar to the shadow of an approaching animal.

Tick activity increased proportionately relative to an increase in wind velocity, although increased activity could not be related to very strong, gusty winds because the flag was blown from the vegetation and collecting operations were hampered. The average collection rates (expressed in number per hour) were as follows: still days, 5.3; breezy days, 7.5; and windy occasions, 11.2. Cooley (1913), experimenting with ticks in a cage, observed that activity was increased by blowing the breath through the top of the cage. He further suggested that ticks may be informed of the presence of a host by feeling its breath. These observations indicate that ticks are stimulated to activity either by air movement or an increased amount of carbon dioxide in the immediate environment. Thus, on breezy and windy occasions ticks may be stimulated to greater activity by the movement of air and vegetation which may be interpreted as being caused by an approaching animal.

Summary

Three hundred fifty-eight adult *Dermacentor andersoni* (135 males and 223 females) were collected from 48 recreational sites during the spring and summer of 1964. The average collection rate (population density) for all collections was 6.8 per hour, but populations varied between sites. Populations were greater in the middle and southern parts of the state than in the northern. The greatest populations were at elevations between 6,000 and 8,000 feet with the upper limit just under 9,000 feet. The elevational distribution varied with the latitude—greater populations were found at higher elevations in southern than in northern Utah. The season of peak abundance was between the last week of May and the last of June. Populations were greater at lower elevations early in the season and at higher elevations later in the spring. Male ticks were more abundant early in the season, whereas females predominated later. The preferred habitat was open, unshaded areas of short, scanty, young grass. Ticks were collected in greater numbers in the afternoon than in the morning. Temperatures between 12° and 38° C apparently had little effect on tick activity. Activity was slightly greater on partly cloudy to cloudy days than on clear days, and increased proportionately relative to an increase in wind velocity.

Even with the present knowledge of *D. andersoni* in western North America, much yet remains to be learned about the biology and ecology of this important vector of Rocky Mountain spotted fever.

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