OKLAHOMA STATE UNIVERSITY

HABITAT SELECTION BY TRANSPLANTED MULE DEER IN NORTHWESTERN OKLAHOMA

By

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Scope and Method of Study: During 1965, sixty-five mule deer, captured in northwest Colorado, were transplanted to four localities in northwestern Oklahoma. Transplants were 200 miles east of the presently known mule deer range in Oklahoma. Attempts, beginning five months after the releases, to locate the mule deer within the areas of release were unsuccessful. Assuming that the transplanted mule deer had moved out of the release areas, a new approach was indicated. Ecological factors associated with mule deer habitat were measured on a type area. Data were analyzed in an attempt to find one or more common denominators characteristic of mule deer habitat. These data were compared with that from the transplant areas.

Findings and Conclusions: Mule deer were observed in every zone (mesa tops, slopes, and canyon floors) on the type area. Despite their general occupation of the whole region mule deer showed marked preferences for particular ecological situations. On the type area 91.3% of the mule deer seen in resting cover and 98.0% of those in flight were in association with the slope zone. The slope zone contained trees and shrubs. This combination of life-form elements (trees-shrubs) was absent from the mesa tops and canyon floors of the type area and also absent from all the release sites. The type area can be characterized as a mesa-canyon topographic type with biotic affinities with the foothills of the southern Rocky Mountains. The general release region is characterized as a rolling to strongly sloping upland prairie dissected by large gully-like drainageways. Only five sightings of the transplanted mule deer have come to my attention. As reported these deer were seen within approximately one mile of the nearest release site and within about one month of the release date. Four deaths (6.1%) occurred shortly after release and two deer were found to be heavily parasitized by ticks. One doe was treated for pneumonia and re-released. No evidence was found to suggest that Rocky Mountain mule deer were ever associated with the type of vegetation characteristic of the release sites.

ADVISER'S APPROVAL _____

HABITAT SELECTION BY TRANSPLANTED

MULE DEER IN NORTHWESTERN

OKLAHOMA

Thesis Approved:

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Dean of the Graduate College

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CHAPTER I

INTRODUCTION

The Rocky Mountain mule deer, Odocoileus hemionus hemionus (Rafinesque), presently occurs naturally in one region of Oklahoma, the northwestern corner of Cimarron County. During 1965, sixty-five mule deer, captured in northwestern Colorado, were transplanted to four locations in northwestern Oklahoma outside of the Panhandle. The release sites are approximately 200 miles east of the presently-known mule deer range in Oklahoma.

The original plan was to ascertain the seasonal use of regional resources comprising habitat that the released mule deer might have selected. Approximately five months after the deer were released, field work began. Attempts to locate the mule deer within the release area were unsuccessful.

Assuming that the transplanted mule deer had moved out of the release areas, a new approach was initiated. The objectives of this study were to:

(1) Measure or otherwise appraise ecological factors characteristic of mule deer habitat on a type area in Oklahoma.

(2) Analyze pertinent information in an attempt to find one or more common denominator features which transcend one or more vegetation types.

(3) Compare ecologically the type area with the transplant area.

(4) Evaluate the findings regarding the transplants and their relation to future releases.

Full-time field work extended from June, 1965 to February, 1966. Additional weekend trips were taken in mid 1966 to supplement previous observations.

CHAPTER II

DESCRIPTION OF STUDY AREAS

The Type Area

The type area is located in northwestern Cimarron County, Oklahoma (Figure 1). Elevation of the region varies from 4,000 feet to the highest point on the Mesa de Maya (Black Mesa) in Oklahoma wich is 4,978 feet. This region can be characterized as a mesa-canyon topographic type. The mesas and/or canyon sides are steep, covered with a rubble of stone of varying coarseness, which in turn is covered with a scant vegetation. Naturally flowing water generally is intermittent. The height of the lava-capped table and of some of the sandstone-capped erosional remnants is about 500 feet above the valley floor of the Cimarron River (Blair and Hubbell, 1938). The steep slopes below the lava cap of the Mesa are littered with angular talus fragments, while on the sandstone slopes the talus is sandstone blocks. (U.S.D.A. Cimarron County Soil Survey, 1956).

The climate of the region is of the continental type, characterized by long, hot summers and comparatively mild winters (Wahlgren, 1941) with prevailing winds from a southwesterly and southerly direction. The entire area is cooler and drier than areas eastward in Oklahoma. The total rainfall averages 15.5 inches in the west side of the county. Most of this moisture comes as local thunder showers of which much is lost as run-off. The driest year on record was in 1934 with 8.62 inches

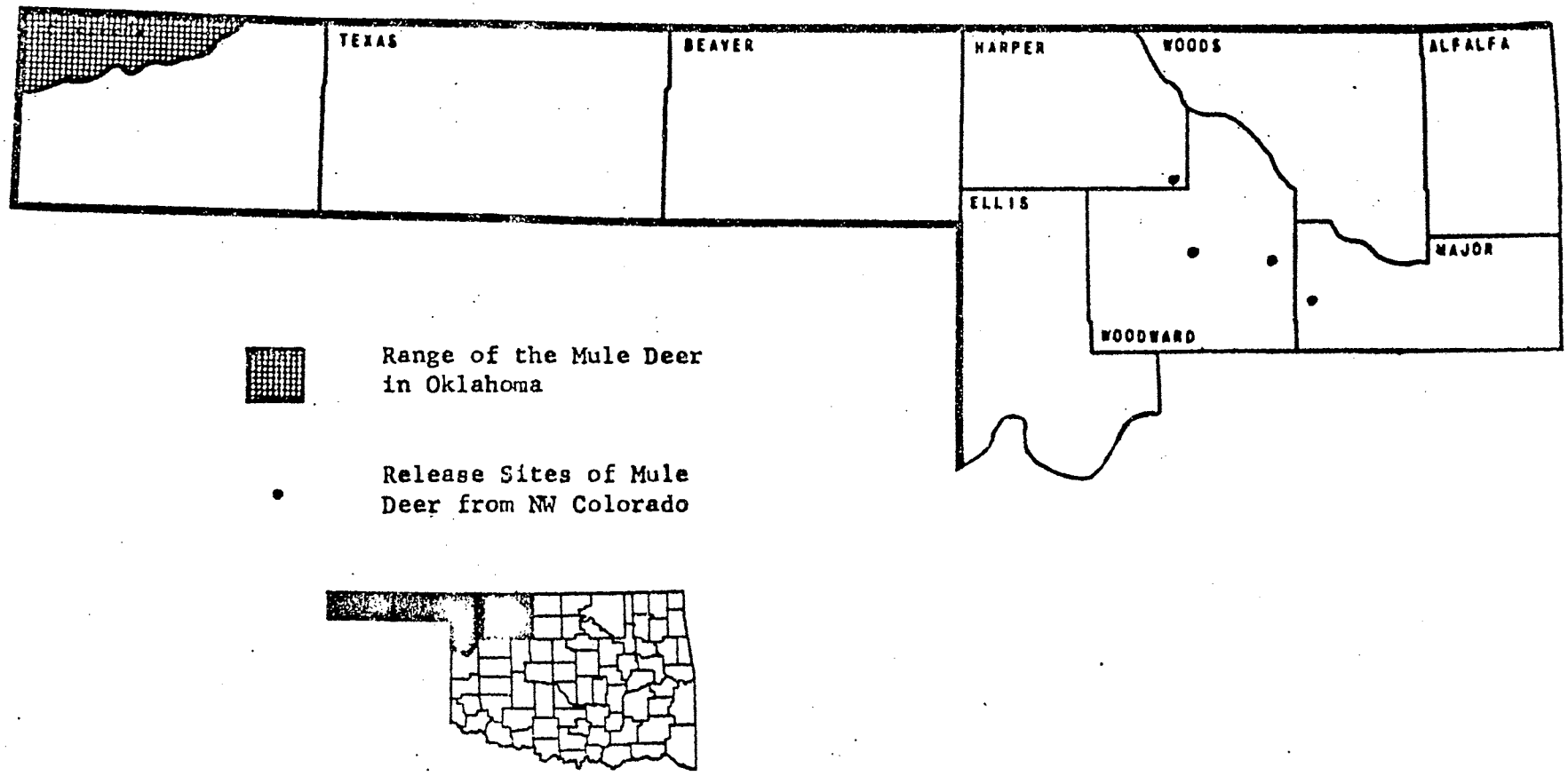

Fig. 1. Range of Mule Deer in Oklahoma and Release Sites of Transplanted Mule Deer from Northwestern Colorado.

and the wettest in 1919 with 38.97 inches. The average temperature for a 46-year period is 54.4 degrees F. with 108 degrees F. and -20 degrees F. being the extremes. The average frost-free growing season is 180 days from April 27 to October 15, at Boise City (U.S.D.A., Cimarron County Soil Survey, 1956).

The biota of the mesa slopes and/or canyon walls have strong affinities with that of the foothills of the southern Rocky Mountains (Blair and Hubbell, 1938; Dice 1943; Rogers, 1953 and 1954). These slopes actually represent an eastward outlier of these foothills.

One-seeded juniper (Juniperus monosperma)[1] grows on the mesas. The understory of the mesa tops is composed primarily of side oats grama (Bouteloua curtipendula), black grama (B. eriopoda), blue grama (B. gracilis), and buffalo grass (Buchloe dactyloides).

The mesa slopes are covered in many places with a low-growing woody vegetation that seldom exceeds four or five feet in height. This is formed chiefly by netleaf hackberry (Celtis reticulata), mountain mahogany (Cercocarpus montanus), Gambel's oak (Quercus Gambelii), skunk bush (Rhus trilobata), and one-seeded juniper. On the north-facing slopes, pinyon pine (Pinus edulis) is found growing in close association with junipers. Various grasses are intermingled among the shrubs, including little bluestem (A. scoparius) and Indian grass (Sorghastrum nutans).

Characteristic plants of the canyon floors are tree cactus (Opuntia imbricata), honey mesquite (Prosopis glandulosa), rabbit brush (Chrysothamnus nauseosus), galleta grass (Hilaria jamesii), hairy grama (Bou-

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[1]Most of the Botanical Nomenclature according to Waterfall, U. T. 1962. Key to the Flora of Oklahoma.

Celoua hirsuta), black grama, blue grama, bee flower (Cleome serrulata), toothed euphorbia (Euphorbia dentata). Salt cedar (Tamarix gallica) and eastern cottonwoods (Populus deltoides) grow on the banks of the Cimarron River and its tributaries forming lines of open and intermittent woods.

Some of these bottomlands are used for the production of cultivated crops, but livestock ranching is the region's chief industry.

Release Sites

The greatest distance between the two most widely separated release sites is approximately 80 miles. No major climatic differences between the four release areas were found (U.S. Weather Bureau, Climatological Data of Oklahoma, Annual Summary, 1965). The yearly range of temperature is wide and changes may occur rapidly. Lowest and highest temperatures recorded for the areas were -25 and 115 degrees F. Winter temperatures occassionally drop to 15 degrees below zero. The average frost-free season is 190 days, from April 10 to October 27, at Woodward (U.S.D.A. Woodward County Soil Survey, 1960). The prevailing winds were from a southwesterly and southerly direction.

BENT CANYON. This release site is situated in the southeastern corner of Harper County (Figure 1). Elevation is approximately 1,800 feet, and the topography a rolling to strongly sloping upland dissected by large, gullies. Drainage is northeastward into the Cimarron River (U.S.D.A., Harper County Soil Survey, 1956). Water comes from continually-flowing springs, but most of the annual rainfall is lost as runoff. Sleeping Bear Creek, which drains the canyon, is a tributary of the Cimarron River.

The prairie vegetation surrounding Bent Canyon is characterized by blue grama, annual threeawn (Aristida oligantha), hairy goldaster (Chrysopsis villosa), wild buckwheat (Eriogonum annuus), and sand sage (Artemisia filifolia). The slope dropping 70 feet from the prairie to the canyon floor, is characterized by a cover of sideoats grama, blue grama, sand dropseed (Sporobolus cryptandrus), little bluestem and eastern red cedar (Juniperus virginiana).

The canyon floor itself is primarily a woods interspersed with grasses. Trees found in this area are American elm (Ulmus americans), chittamwood (Bumelia lanuginosa), bur oak (Quercus macrocarpa), willow (Salix sp.), eastern red cedars, cottonwoods, Kentucky coffee tree (Gymnocladus dioica), soapberry (Sapindus Drummondi), western hackberry (Celtis occidentalis), roughleaf hackberry (C. laevigata), black locust (Robinia Pseudo-Acacia).

The surrounding prairie in a few places had been cultivated for sorghum and winter wheat, but the area is used almost entirely for livestock production.

BOILING SPRINGS STATE PARK. Release site No. 2 is situated centrally in Woodward County (Figure 1) at approximately 1,800 feet elevation. The North Canadian River runs through the south side of the park. There the soils are moderately well drained bottom land inclined to duning (U.S.D.A. Woodward County Soil Survey, 1960).

The park supports a dense wood containing some species not usually associated with western Oklahoma, such as dogwood (Cornus Drummondi), and red bud (Cercis canadensis). Other woody species are American elm, cottonwoods, chittamwood, green ash (Fraxinus pennsylvanica), walnut (Juglans sp.), bur oak, poison ivy (Rhus radicans), coral berry (Sym-

Symphoricarpos orbiculatus), smooth sumac (Rhus glabra), soapberry, western hackberry, and roughleaf hackberry. Kentucky coffee trees and black locusts are common. Salt cedar occurs near the river bank.

The main vegetative components of the surrounding prairie are sand sagebrush, sand dropseed, little bluestem, doveweed (Croton glandulosus), fall witchgrass (Leptoloma cognatum), witchgrass (Panicum capillare), western ragweed (Ambrosia psilostachya), wild buckwheat, tumble grass (Schedonnardus paniculatus), and sideoats grama.

The park is an important recreational area, and the surrounding areas are utilized for ranching and farming. Whitetail deer were common in the park and surrounding area during the study.

JOHNSON'S CANYON. Release site No. 3 is near the Woodward-Major County line in central Woodward County (Figure 1). Elevation of this area is about 1,700 feet. The topography is a dissected gypsum plain. (U.S.D.A. Woodward County Soil Survey, 1960).

This canyon is approximately five miles long, with many side branches. The main canyon varies in width from approximately 50 to 500 yards, and its depth is approximately 80 feet. West Creek, which drains the canyon, is a tributary of the Cimarron River. One spring flows through the year.

Plants found in the adjacent prairie are sand dropseed, half-shrub sundrop (Oenthera serrulata), hairy goldaster, little bluestem, hairy grama, blue grama, sideoats grama, prickly pear (Opuntia sp.) and paper flower (Psilostrophe villosa).

The south-facing slopes of Johnson Canyon are characterized by the presence of skunk brush, while north-facing slopes support red cedars and bur oaks. Representative plant components of the canyon floor are

windmill grass (Chloris verticillata), silver bluestem (Andropogon saccharoides), sunflowers (Helianthus sp.), Texas croton (Croton texensis), and cocklebur (Xanthium sp.). A narrow, sparsely vegetated band of woody plants parallel West Creek. Salt cedar, American elm, and soapberry are common in this area.

Some uplands in areas adjacent to the canyon are cultivated for winter wheat and sorghum, but cattle ranching is the chief agricultural industry.

GRIEVER CANYON. Griever Canyon, the 4th release site, is located in west-central Major County near the Woodward County line (Figure 1). Elevation of this area is approximately 1,600 feet. The canyon in the area of the release is 75 to 80 feet deep and much of it is inaccessible to livestock (U.S.D.A. Major County Soil Survey, 1965).[2]

There are a few ponds in the upper end of the canyon, mostly constructed on the tributaries of Griever Canyon. These deep canyons occur for about 8 to 12 miles, and then the canyon flattens out into a wide valley which joins the Cimarron River flood plains.

The trees of the canyon floor are principally American elm, cottonwood, western hackberry, green ash, eastern red cedar, and blackjack oak (Quercus marilandica). The understory was composed of little bluestem, sidecats grama, blue grama, Indian grass, switch grass, some buffalo grass and coral berry.

The surrounding prairie drops off abruptly into the canyon, with slopes in many places ranging from 70 to 90 degrees. The prairie itself is characterized by little bluestem, hymenopappus (Hymenopappus sp.),

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[2]U.S.D.A. 1965. Major County Soil Survey. Personal communication.

annual threeawn, sand dropseed, tumble grass, greenthread (Thelesperma ambigium), sand sage, sand plum (Prunus anguistifolia) and wild buckwheat.

CHAPTER III

METHODS OF INVESTIGATION

Attempts to locate the transplanted mule deer began at the release sites and ended in northwestern Oklahoma proper. The northwestern section of Cimarron County, Oklahoma was known to be inhabitated by a naturally-occurring mule deer population, and for this reason was chosen as a type area study. Comparative vegetation analyses were made of this area and the four release sites.

Vegetation Analyses

The "point-centered quarter" developed by Curtis and Cottam (1956) for forest sampling and modified for grassland by Dix (1958 and 1961) was used. Both life-form and species were measured. The life-form classification used which was modified from DuRietz (1931), follows:

(1) Trees - woody plants with a distinct trunk remaining unbranched in its lower parts.

(2) Shrubs - woody plants not developing a distinct main trunk with the stem branched from its basal part above the soil surface.

(a) Shrub - >80 cm. in height.

(b) Dwarf Shrub - <80 cm. in height.

(3) Grasses - narrow-leaved, herbaceous plants with parallel venation.

(a) Mid Grasses - >25 cm. <50 cm. in height.

(b) Short Grasses - < 25 cm. in height.

(4) Forbs - broad-leaved, herbaceous plants, usually having netted venation.

(a) Mid Forbs - > 25 cm. < 80 cm. in height.

(b) Short Forbs - < 25 cm.

The type area and the four release areas were divided into their component zones:

(1) Adjacent Prairie - the flat mesa tops on the type area and prairie regions of the release areas.

(2) Slopes - the regions between the mesa tops and the canyon floor on the type area and the region between the upland and the canyon floor on the release areas.

(3) Canyon Floor - the area contiguous with the waterways, which usually was wooded.

Field Observations

Tracks, pellets and other signs were useful in locating mule deer. Observation from horseback allowed a more rapid and thorough coverage of a larger area. Spotlights and car headlights were used for observing cultivated fields at night. Deer use of life-forms was investigated by recording numbers and activities of deer observed in association with various life-forms.

Food Use

Food materials used by mule deer were largely determined by direct observation of feeding deer. Fecal material was examined for seeds and other identifiable material.

The rumens of nine mule deer killed during hunting season were examined. About one quart of the rumen content was removed and fixed in 10 percent formalin. In the laboratory each sample was examined with a binocular dissecting microscope. All identifiable material was noted.

CHAPTER IV

RESULTS AND DISCUSSION

Mule Deer In The Type Area

Deer on the type area were not known to be seasonally migratory. They occupied every zone - mesa tops, slopes, and canyon floors - in the region at some time during the course of this study. Despite their general occupation of the whole region, the deer showed marked preferences for particular sites.

The following aspects of mule deer ecology were selected for appraisal: resting and retreat cover, and food use.

Resting Cover

Fifty-three mule deer were observed in resting cover and 16 additional bed locations were examined. Of these resting places, 91.3% were located on the slopes, and 8.7% on the mesa tops (Table I). No mule deer were observed resting and no beds were found on the canyon floors, not even in the riparian woodlands. Bed sites were usually located near the cap rock on the upper portions of the slopes. Generally, mule deer appeared to exploit the advantages of the topography when selecting bed sites. Dorrance (1965) reported that the slope aspect with its characteristic vegetation was probably one of the most important factors in mule deer distribution. He further pointed out that distribution of cover types used for resting were more important in

determining the distribution of deer than were vegetative types used for feeding.

TABLE I

NUMBERS OF OBSERVATIONS AND PERCENT FREQUENCY WITH WHICH CERTAIN ZONES AND LIFE-FORMS PROVIDED RESTING COVER FOR MULE DEER ON THE TYPE AREA

Zone and Life-Form	Number of Observations	Percent Frequency
Mesa Tops:		
Trees	6	8.7
Shrubs	0	0.0
Subtotal	6	8.7
Slopes:		
Trees	35	51.4
Shrubs	12	17.6
Rocks	16	25.0
Subtotal	63	91.3
Canyon Floors:	0	0.0
Subtotal	0	0.0
Total	69	100.0

Five species of trees and shrubs provided resting cover. These were: one-seeded juniper, recorded as being used 30 times (61.2%); Gambel's oak, 7, (14.2%); pinyon pine, 6, (12.2%); mountain mahogany, 4, (8.1%); and skunk brush, 1, (2.0%).

Four mule deer (an adult doe, two yearling fawns, and a spiked buck) were observed in a west-facing "rincon" for about two hours in mid-December. During this time each deer moved bed locations twice

except for one of the yearlings who moved three times. The location of the second and third beds were only a few yards from the original.

Retreat Cover

One hundred and fifty-four retreats were observed during this study, 108 on mesas and 46 from cultivated fields (alfalfa and wheat). No escapes were made to the canyon floors.

Of the 108 mule deer encountered on the mesas, 102 (95.0%) were on the slopes while six (5.0%) were from under trees on the mesa tops. Ten (9.3%) of the mule deer encountered on the slopes made their escape to the mesa tops, 92 (85.2%) made their escape around the slopes, and six (5.6%) retreated down the slopes acrossed to the other side of the canyon.

Forty-six deer were spotlighted in cultivated fields during the night. Of these, 44 retreated to the mesas, while only two entered the riparian woods. During the rutting season, at least two different bucks each with four or five does were found eating alfalfa. Upon spotlighting, the does immediately retreated to the mesas and the lone buck headed in the opposite direction toward the riparian woodlands. The buck did not enter the woodlands but paralleled them for several hundred yards before circling back toward the mesa used by the does.

The majority of retreats (98.0%) were made in association with the slopes. The pronounced inclination of mule deer to use the slopes for escape may be explained by a combination of life-form elements and topography. Generally, mule deer, escaping on the slopes, were visible for short periods, but deer escaping on the mesa tops or canyon floors remained visible for some time.

Food Use

Even though food use by mule deer is well documented (Robinson, 1937; Cowan, 1945; Martin et al., 1951; Lassen et al., 1952; Dasmann and Blaisdell, 1954; Hill, 1956; Lovaas, 1958) apparently there is little published information on the use of food materials by non-migratory mule deer, especially of populations found in southwestern juniper-pinyon regions (Anderson et al., 1964).

As part of the present study information was recorded on 27 plants, 7 (25.9%) browse species, 16 (59.2%) forbs, and 4 (14.5%) grasses (Tables II, III and IV). Tables II and III present food use based on direct observation and fecal examination, respectively. Cultivated plants, such as alfalfa, grain sorghum and winter wheat also were used by mule deer.

Rumen Analyses - Stomach contents of nine mule deer were collected during the hunting season (November 20-28) for analyses. Analysis of the stomach contents have been used extensively by wildlife researchers as an indicator of animal diets (Norris, 1943). Rush (1932) found that identification was difficult because of the fragmentary condition of all the plants in the stomach. Hill (1956) pointed out the difficulty of specific identification of herbaceous species by stomach analysis.

Many plants could not be identified because mastication and rumination resulted in the loss of diagnostic characters. Stomach contents are summarized in Table IV.

The Transplanted Mule Deer

The 65 transplanted mule deer were trapped in the "Pinyon-Juniper and Mountain-Browse Type associations" of northwestern Colorado. The

TABLE II

FOOD USE BY MULE DEER ON A TYPE AREA
BASED ON DIRECT OBSERVATION

Species	Number of Instances of Observed Use
1. Pinyon Pine (Pinus edulis)	9
2. Mountain mahogany (Cercocarpus montanus)	5
3. Gambel's Oak (Quercus gambelii)	2
4. One-seeded Cedar (Juniperus monosperma)	3
5. Skunk Brush (Rhus trilobata)	1
6. Rabbit Brush (Chrysothamnus nauseosus)	2
7. Alfalfa (Medicago sativa)	approx. 40
8. Winter Wheat (Triticum aestivum)	approx. 40
9. Toothed Euphorbia (Euphorbia dentata)	3
10. Pig Weed (Amaranthus sp.)	1
11. Louisiana Sagewort (Artemisia ludoviciana)	1
12. Vine Mesquite (Panicum obtusum)	1
13. Sideoat Grama (Bouteloua curtipendula)	1

TABLE III

FOOD USE BY MULE DEER ON A TYPE AREA BASED ON EXAMINATION OF 19 PELLET GROUPS

Plants	No. of Pellet Groups In Which Plants Were Identified	% of Occurrence
1. Tree cactus (Opuntia imbricata)	19	100.0
2. Lamb's quarter (Chenopodium sp.)	17	89.5
3. Pig weed (Amaranthus sp.)	16	84.2
4. Prickly pear (Opuntia sp.)	13	68.4
5. Compositae	7	36.8
6. Bee flower (Cleome serrulata)	6	31.6
7. Canadian thistle (Cirsium undulatum)	3	15.8
8. Russian thistle (Salsola kali)	2	10.5
9. Gramineae	2	10.5
10. Pig weed (Amaranthus sp.)	1	5.3
11. Unidentified	3	15.8
12. Unidentified	2	10.5
13. Unidentified	1	5.3
14. Unidentified	1	5.3
15. Unidentified	1	5.3

TABLE IV

PLANTS USED AS FOOD BY MULE DEER ON A TYPE AREA BASED ON EXAMINATION OF SAMPLES FROM NINE RUMENS

Plants	No. of Samples in Which Species were Identified	Occurrence
1. Prickly pear (Opuntia sp.)	5	33.3
2. Sorghum (Sorghum vulgare)	5	33.3
3. Lamb's quarter (Chenopodium sp.)	5	33.3
4. Pig weed (Ameranthus sp.)	5	33.3
5. Compositae	4	26.6
6. Panicum (Panicum sp.)	3	20.0
7. Gramineae	2	13.3
8. Nightshade (Solanum sp.)	2	13.3
9. Pinyon pine (Pinus edulis)	1	6.6
10. Arctium minus	1	6.6
11. Tree cactus (Opuntia imbricata)	1	6.6
12. Pussytoes (Antennaria sp.)	1	6.6
13. Cucurbitaceae	1	6.6
14. Croton (Croton sp.)	1	6.6
15. Sunflower (Helianthus sp.)	1	6.6

predominant browse consituents in that area were: serviceberry (Amelanchier utahensis), antelope bitterbrush (Purshia tridentata), mountain mahogany (Cercocarpus montanus), big sagebrush (Artemisia tridentata), Gambel's oak (Quercus gambelii), rabbitbrush (Chrysothamnus viscidiflorus and C. nauseosus) (McKean, 1965).[1] As seen from this plant list, there are similarities between the vegetation of northwestern Colorado where the deer were trapped and that part of Cimarron County serving as a type area for the present study.

Ear tag numbers were not recorded. The general condition of the transplanted mule deer was described as "fair to poor". The sex and age ratios were: does 40% (mostly yearlings), fawns 35% (50-50 males and females), and bucks 25% (mostly yearlings). These deer were released in accordance with the schedule provided in Table V. See also Figure 1.

TABLE V

SITES, DATE, NUMBERS AND SEXES OF RELEASES OF MULE DEER IN NORTHWESTERN OKLAHOMA

Release Sites	County	Dates	Sex Ratio
1. Bent Canyon (T33N-R25W-Sec.20)	Harper	January 21, 1965	9 Bucks and 11 Does
2. Boiling Springs State Park (T24N-R23W-Sec.20)	Woodward	February 11, 1965	6 Bucks and 6 Does
3. Johnson's Canyon (T23N-R23W-Sec.17)	Woodward	February 18, 1965	3 Bucks and 16 Does
4. Griever Canyon (T8N-R21W-Sec.16)	Major	February 24, 1965	2 Bucks and 12 Does

[1]McKean, W. T. 1965. Personal Communication.

A few sightings of the transplanted mule deer were made by residents near release sites one and three. Mule deer released at sites two and four were not known to have been seen again in these vicinities. All sightings were made within approximately one mile of the nearest release site and within about a month of the release dates. The absence of sightings in the release areas after about one month cannot be correlated with any climatological events. The five sightings made are summarized in Table VI.

TABLE VI

RELEASE SITE, NUMBER, SITUATION AND TIME OF DAY OF THE SIGHTING OF THE TRANSPLANTED MULE DEER

Release Site	Number	Situation	Time of Day
Bent Canyon	3 to 6	In an open area in lowland woods	Dusk
Bent Canyon	3 to 6	In an open area in lowland woods	Dusk
Bent Canyon	1	Lying down in an open area in lowland woods	Afternoon
Johnson's Canyon	3	Feeding in wheat field	Dusk
Johnson's Canyon	1	Jumped from resting cover under eastern red cedar on canyon floor	Afternoon

It can be reasonably assumed that the sightings at Bent Canyon and at Johnson's Canyon were actually of mule deer because no whitetailed deer are known to occur in these areas.

Four deaths (6.1%) have been reported of the transplanted mule deer. The dead animals were found within approximately two miles of the nearest release site. They are believed to have died within two to five weeks after the time of their respective release. One dead deer was

found near release site one, two near site two and one near site four. A sick deer found near site three was heavily infested with ticks. This sick deer was taken to a veterinarian whose diagnosis was pneumonia. The deer was treated and re-released at Boiling Springs State Park. One of the dead deer was also reported to have had a heavy infestation of ticks. Moffit (1935) and Van Volkenberg and Nicholson (1943) have reported that deer, usually in poor condition, are found to be heavily parasitized.

Woody plants used as food by mule deer on the type area were determined by direct observation, pellet group examination, and rumen analyses. The information regarding use was compared with that reported from three Rocky Mountain states (Colorado Game and Fish Comm., 1941; Smith, 1952; and Anderson et al., 1964). (Table VII).

TABLE VII

WOODY PLANTS KNOWN TO BE USED AS FOOD BY MULE DEER IN COLO., N. MEX., AND UTAH AND THEIR USE BY MULE DEER ON THE TYPE AREA AND THEIR PRESENCE OR ABSENCE IN THE RELEASE AREAS

Species	Present on Type Area in Oklahoma	Present in the Release Areas
Mountain Mahogany (Cercocarpus sp.)	yes	no
Scrub Oak (Quercus sp.)	yes	no
Rabbit Brush (Chrysothamus sp.)	yes	no
Juniper (Juniper monosperma)	yes	no
Pines (Pinus spp.)	yes	no
Skunk Brush (Rhus trilobata)	yes	yes

Skunk brush was the only woody species used by mule deer on the type area which was also found in the release areas. Usually this plant occurs solitarily and does not form stands.

Homing behavior (Bartlett, 1932; McBeath, 1941; Stebler and Schemnitz, 1955; Schemnitz, 1958) should not be overlooked as a motive for the deers' disappearance. Craven (1965)[2] has reported that there is a tendency for transplanted deer to return to their original range. He further reported an instance of one deer that had traveled 700 miles from a release site back to its original range. Zalunardo (1964), Dorrance (1965), and Leopold et al. (1951) have shown that mule deer do seem to have a specific and localized home range.

The general eastern edge of mule deer range from the Dakotas to Oklahoma lies at about 102° west longitude. This suggests that mule deer generally are not associated with the type of ecological situations found in the release areas. While this species has occupied northwestern Cimarron County for many years it has not extended its range eastward. Warren (1911) had no records of mule deer occurring in the plains counties of Colorado. According to Taylor (1956) one of the barriers to mule deer distribution has been flat rolling prairie grasslands devoid of trees or shrubs. No evidence was found to suggest that Rocky Mountain mule deer were ever associated with the types of vegetation present in the release areas. It is generally true that since the Pleistocene most species of our wildlife have spread to all habitats suitable for them (Cottam, 1956).

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[2]Craven, E. W. 1965. Personal Communication.

Life-Form and Mule Deer Habitat

The widespread distribution of the mule deer (Taylor, 1956) is due in part to their adaptability to the regional resources upon which they have come to depend. The habitat of mule deer, a species with a large geographic range, may be analyzed more readily on a basis of comparative plant life-form physiognomy. Such comparison is provided in Figures 2, 3, and 4. These figures are based on percentage occurrence of each life-form element found on the mesa tops and adjacent prairies, slopes, and canyon floors of the type area and of the release sites. A comparative approach on this basis yields insight into the matter of habitat selection by mule deer.

On the type area the various zones and life-forms were available for mule deer use, but the deer showed marked preferences for specific zones and life-forms (Table I). Mule deer activity on the type area was predominantly associated with the slope zone. The slope zones on the type area contained 14.5% trees, 21% shrubs, 8.5% dwarf shrubs, 33% mid grasses and forbs, and 23% short grasses and forbs (Figure 3). More specifically, mule deer activity on the slope zones of the type area was associated with tree and shrub life-form elements (Table I). Figure 3 gives a comparison between the slope zones of the type area and the release sites. The slopes of Bent Canyon were 97.5% mid and short grasses, and 2.5% mid and short forbs. Boiling Springs State Park and Griever Canyon lacked a physiographic unit that could be designated as slope zones, and Johnson's Canyon slopes were vegetated with 81.5% short grasses and forbs and 18.5% mid grasses and forbs.

The life-form of the mesa tops (Figure 2) of the type area was 100% short grasses and forbs. The vegetation of the unit of physiographic

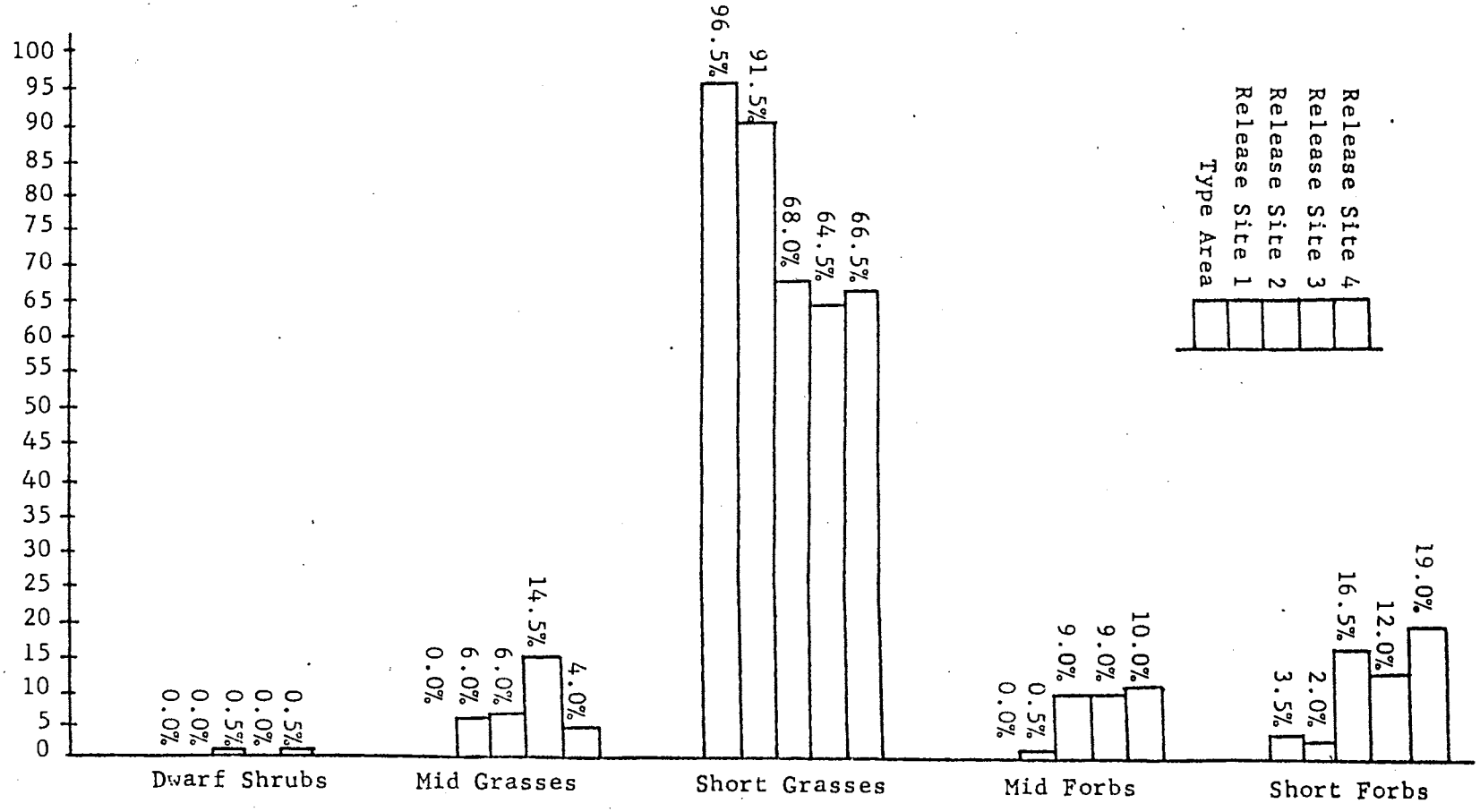

Figure 2. Life-Forms of Mesa Tops and Adjacent Prairie Areas of Type Area and Release Sites 1, 2, 3, and 4, Respectively, Based on Percent of Occurrence of Each Life-Form Element.

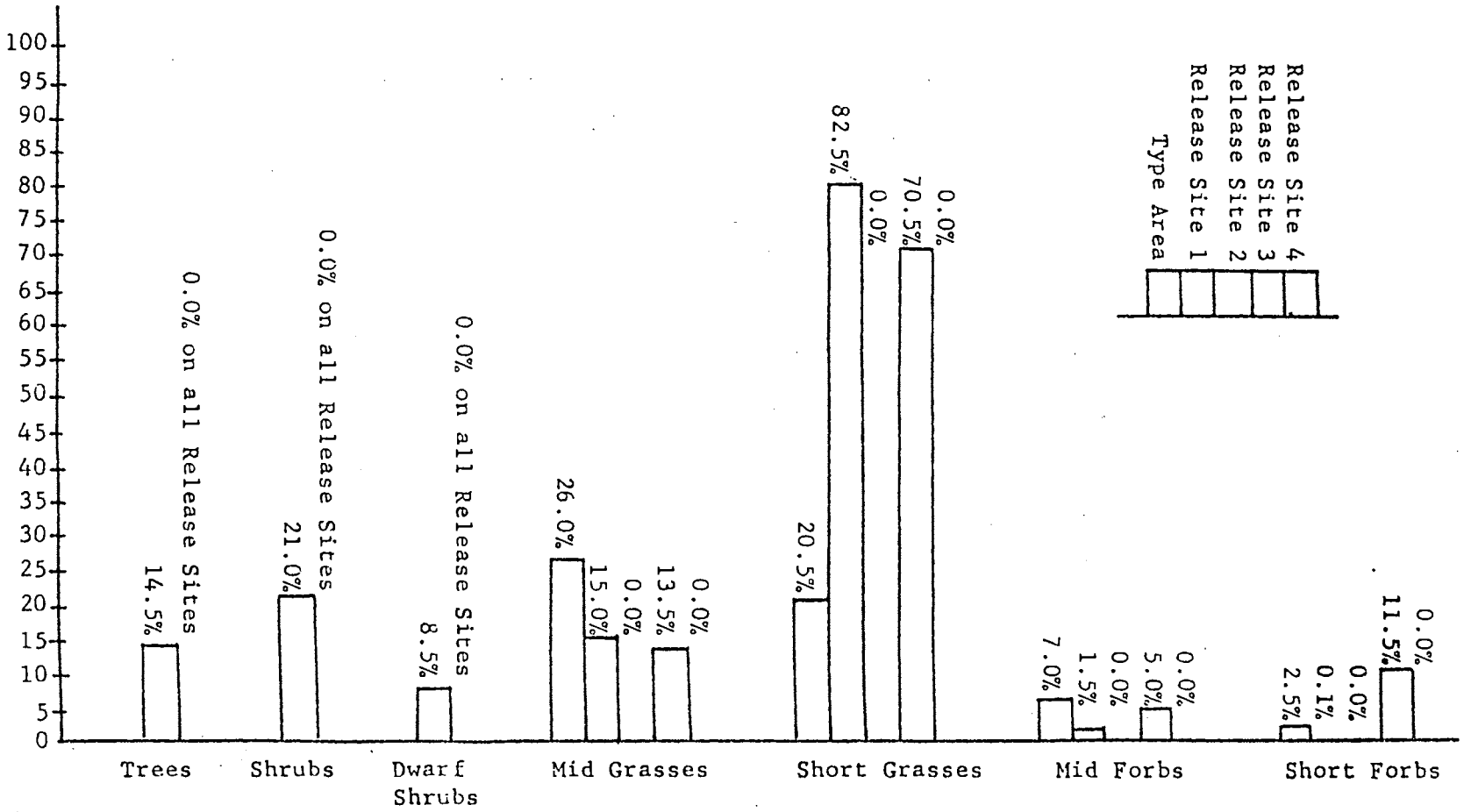

Figure 3. Life-Forms of the Slopes of the Type Area and Release Sites 1, 2, 3, and 4, Respectively, Based on Percent of Occurrence of Each Life-Form Element.

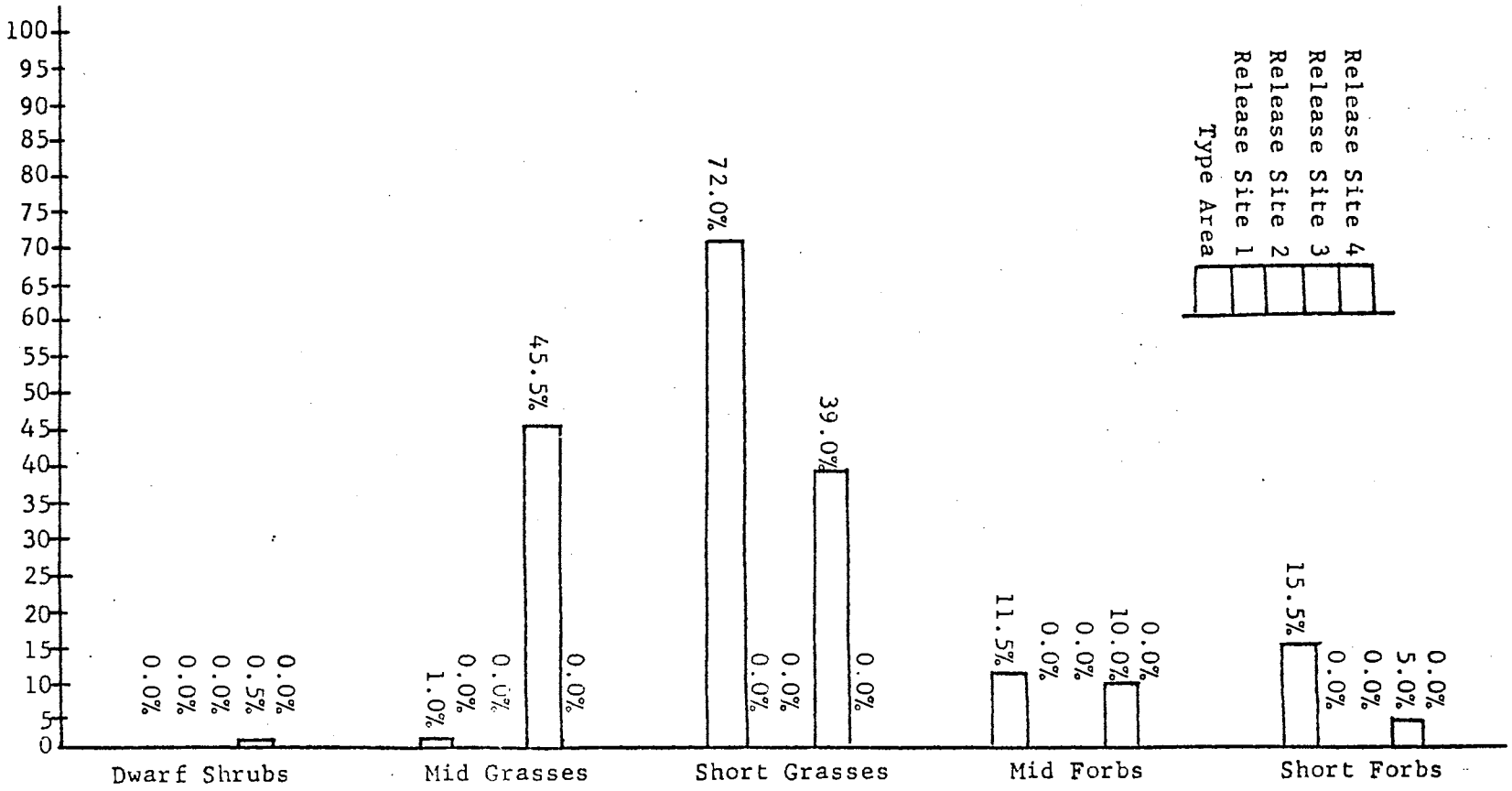

Figure 4. Life-Forms of Prairie Areas of Valley Floor of Type Area and Release Sites 1, 2, 3, and 4, Respectively, Based on Percent of Occurrence of Each Life-Form Element.

configuration of the release sites, corresponding to the mesa tops of the type area is summarized in Figure 2. The adjacent prairie areas to Bent Canyon contained 93.5% short grasses and forbs and 6.5% mid grasses and forbs. The prairie areas next to Boiling Springs State Park were composed of 84.5% short grasses and forbs, 15% mid grasses and forbs, and 0.5% dwarf shrubs. The prairies adjacent to Johnson's Canyon consisted of 76.5% short grasses and forbs and 23.5% mid grasses and forbs. The grasslands surrounding Griever Canyon were composed of 85.5% short grasses and forbs, 14% mid grasses and forbs and 0.5% dwarf shrubs. Only six mule deer were observed on the mesa tops on the type area. The combination of life-form elements (trees and shrubs) used predominantly by mule deer on the type area was lacking from both the mesa tops of the type area and from all the release sites.

The prairie areas of the canyon floor of the type area were characterized by a life-form of 100% mid and short grasses and forbs. Only six mule deer were observed in this zone. These deer were making their retreat from one mesa slope to another, a distance of a few hundred yards. Bent Canyon, Boiling Springs State Park, and Griever Canyon contained no prairie area on the canyon floors, only riparian woodlands. The prairie on the floor of Johnson's Canyon was comprised of 99.5% mid and short grasses and forbs and 0.5% dwarf shrubs.

Two mule deer were observed on the type area retreating through the periphery of a stand of riparian trees. From the general lack of use of the riparian woods by mule deer on the type area it might be assumed that the riparian woods of the release sites would be unattractive to mule deer.

The combination of life-form elements (trees and shrubs) on the

slopes of the type area which were used extensively by mule deer were entirely absent (0.0%) from the release sites.

Appendix B presents supplemental data from "point-centered quarter" vegetation sampling of the type area and the four release areas. This data further characterizes the type area and the release sites.

CHAPTER V

SUMMARY AND CONCLUSIONS

Analysis was made of various ecological factors included within the limitations of the study, and these were correlated with mule deer activity.

The general topography of the type area was a combination of mesas and canyons. The variation in height between the tops of the mesas and the contiguous canyon floors was approximately 500 feet. Differences between the adjacent prairies and the canyon floors of the general release area was approximately 80 feet. In part the climate and physiography directly affects plant species composition, growth form and distribution of the vegetation. The biota of the type area studies was similar to that found in the southern foothills of the Rocky Mountains, and unlike the biota of the release sites.

Results of this study showed that mule deer on the type area in Cimarron County had marked preferences for specific ecological situations. Plants of the tree and shrub life-forms received intense use by mule deer (Table I), and apparently provided essential elements of mule deer habitat. On the type area this combination of life-form elements was found only on the steep slopes of the mesas (Figures 2, 3, and 4). In the mesa country 91.3% of mule deer in resting, and 98.0% of the retreat cover were in association with slope zone. Only two mule deer were observed retreating into the riparian woodlands, six were seen on

the mesa tops, and six were seen retreating from one mesa slope to another mesa across an expanse of canyon floor prairie, a distance of a few hundred yards. The combination of life-form elements (trees and shrubs) used predominately by mule deer on the type area was lacking not only from the mesa tops and canyon floors of the type area, but also from all the release sites.

Mule deer on the type area used several browse species (Table VII). Of these only one, Rhus trilobata was found in the release areas. Most of the food plants utilized by mule deer were found on the slopes.

The releases were 200 miles east of presently known mule deer range in Oklahoma. Only five sightings were made of the transplanted mule deer after their releases. All sightings were made within approximately one mile of the nearest release sites and within about four weeks of the release dates.

No evidence was found to suggest that Rocky Mountain mule deer were ever associated with the type of vegetation characteristic of the release areas.

This study, though limited in time and scope, has revealed the complexities involved in habitat study. Since so little is known of the actual constituents of the habitat of mule deer, it is suggested that it be subjected to definitive study.

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APPENDIX A

APPENDIX

A List of Plant Names Used in This Report

Scientific Name	Common Name
Amaranthus sp.	Pigweed
Ambrosia psilostachya	Western Ragweed
Amerlanchier utahensis	Serviceberry
Andropogon saccharoides	Silver Bluestem
Andropogon scoparius	Little Bluestem
Antennaria sp.	Pussytoes
Arctium minus	
Aristida oligantha	Annual Three Awn
Artemisia filifolia	Sand Sage
Artemisia ludoviciana	Louisiana Sagewort
Artemisia tridentata	Big Sagebrush
Bouteloua curtipendula	Side Oats Grama
Bouteloua eriopoda	Black Grama
Bouteloua gracilis	Blue Grama
Bouteloua hirsuta	Hairy Grama
Buchloe dactyloides	Buffalo Grass
Bumelia lanuginosa	Chittamwood
Celtis laevigata	Roughleaf Hackberry
Celtis occidentalis	Western Hackberry
Celtis reticulata	Netleaf Hackberry

Cercis canadensis	Red Bud
Cercocarpus montanus	Mountain Mahogany
Chenopodium sp.	Lambsquarter
Chloris verticillata	Windmill Grass
Chrysopsis villosa	Hairy Goldaster
Chrysothamnus nauseosus	Rabbit Brush
Chrysothamnus viscidiflorus	Canadian Thistle
Cleome serrulata	Bee Flower
Cornus Drummondii	Dogwood
Croton glandulosus	Dovewood
Croton texensis	Texas Croton
Eriogonum annuus	Wild Buckwheat
Euphorbia dentata	Toothed Euphorbia
Fraxinus pennsylvanica	Green Ash
Gymnocladus dioica	Kentucky Coffee Tree
Helianthus sp.	Sunflower
Hilaria Jamesii	Galleta Grass
Hymenopappus sp.	Hymenopappus
Juglans sp.	Walnut
Juniperus monosperma	One Seeded Juniper
Juniperus virginiana	Eastern Red Cedar
Leptoloma cognatum	Fall Witchgrass
Medicago sativa	Alfalfa
Oenothera serrulata	Half Shrub Sundrop
Opuntia imbricata	Tree Cactus
Opuntia sp.	Prickly Pear Cactus
Panicum capillare	Witchgrass

Panicum obtusum	Vine-mesquite
Pinus edulis	Pinyon Pine
Populus deltoides	Eastern Cottonwood
Prosopis glandulosa	Honey Mesquite
Prunus angustifolia	Sand Plum
Psilostrophe villosa	Paperflower
Purshia tridentata	Antelope Bitterbrush
Quercus Gambelii	Gambel's Oak
Quercus macrocarpa	Bur Oak
Quercus marilandica	Blackjack Oak
Rhus glabra	Smooth Sumac
Rhus radicans	Poison Ivy
Rhus trilobata	Skunk Bush
Robinia Pseudo-Acacia	Black Locust
Salix sp.	Willow
Salsola Kali	Russian Thistle
Sapindus Drummondi	Soapberry
Schedonnardus paniculatus	Tumble Grass
Solanum sp.	Nightshade
Sorghastrum nutans	Indian Grass
Sporobolus cryptandrus	Sand Dropseed
Symphoricarpos orbiculatus	Coral Berry
Tamarix gallica	Salt Cedar
Thelesperma ambiguum	Greenthread
Triticum aestivum	Wheat
Ulmus americana	American Elm
Xanthium sp.	Cockle Bur

APPENDIX B

APPENDIX B

SUPPLEMENTAL DATA FROM "POINT-CENTERED QUARTER" VEGETATION SAMPLING OF THE TYPE AREA AND THE FOUR RELEASE AREAS

TYPE AREA

Mesa Tops

	$\sum d$	$\sum occ$	$\sum f$
Short Grasses	595	193	50
Short Forbs	18	7	5
Total	613	200	55

Slopes

	$\sum d$	$\sum occ$	$\sum f$
Trees	29	29	8
Shrubs	42	42	14
Dwarf Shrubs	32	17	9
Mid Grasses	1032	52	23
Short Grasses	746	41	18
Mid Forbs	217	14	6
Short Forbs	12	5	2
Total	2110	200	80

Canyon Floors

	$\sum d$	$\sum occ$	$\sum f$
Mid Grasses	14	2	1
Short Grasses	625	144	41
Mid Forbs	105	23	7
Short Forbs	186	31	14
Total	930	200	63

BENT CANYON

Prairies

	$\sum d$	$\sum occ$	$\sum f$
Mid Grasses	135	12	9
Short Grasses	958	183	50
Mid Forbs	19	3	3
Short Forbs	7	2	2
Total	1119	200	64

Slopes

	$\sum d$	$\sum occ$	$\sum f$
Mid Grasses	354	30	21
Short Grasses	1173	165	49
Mid Forbs	44	3	3
Short Forbs	17	2	2
Total	1588	200	75

BOILING SPRING STATE PARK

Prairies

	$\sum d$	$\sum occ$	$\sum f$
Dwarf Shrubs	10	1	1
Mid Grasses	201	12	8
Short Grasses	1114	136	47
Mid Forbs	180	18	15
Short Forbs	308	33	18
Total	1813	200	89

JOHNSON'S CANYON

Prairies

	$\sum d$	$\sum occ$	$\sum f$
Mid Grasses	1079	29	14
Short Grasses	2724	129	43
Mid Forbs	760	18	11
Short Forbs	666	24	15
Total	5229	200	83

Slopes

	$\sum d$	$\sum occ$	$\sum f$
Mid Grasses	525	27	17
Short Grasses	2658	141	45
Mid Forbs	161	9	6
Short Forbs	722	23	17
Total	4066	200	85

Canyon Floors

	$\sum d$	$\sum occ$	$\sum f$
Dwarf Shrubs	9	1	1
Mid Grasses	1379	91	33
Short Grasses	538	78	33
Mid Forbs	313	20	11
Short Forbs	87	10	8
Total	2326	200	86

GRIEVER CANYON

Prairies

	$\sum d$	$\sum occ$	$\sum f$
Dwarf Shrubs	4	1	1
Mid Grasses	100	7	6
Short Grasses	952	131	48
Mid Forbs	140	21	14
Short Forbs	304	39	25
Total	1755	200	94

added copy

VITA

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