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Habitat Use of Red Deer *(Cervus elaphus* L.) in Çatacık Forest*

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Abstract: Population ecology and habitat preferences of red deer *{Cervus elaphus* L.) were investigated in Çatacık Forest between 1989-1991. In this study 2350 pellet count plots were established through the area of 8776 ha. Presence-absence method (1) and point-distance technique (2) were used on the plots. Plants supplying food for the red deer were investigated on vegetation plots. Habitat selection was studied by a special computer programme based on distribution of pellets in different vegetation types, altitudes, aspects and proximity to water springs and roads. Habitat share between deer and domestic ungulates or wild herbivore mammals in the study area were also studied based on pellet frequencies. It was found that deer mainly used plantations and openings in the forest. The utilization was the highest near the boundaries of the different habitat types and well interspersed habitats. Namely, "Edge Effect" was an important factor on deer's habitat use.

Key Words: Red deer *(Cervus elaphus* L), Habitat Preferences, Food Habits, Pellet Counts, Direct Counts, Çatacık Forest.

Çatacık Ormanı'nda Geyiğin Habitat Kullanımı

Özet: Bu çalışmayla, 1989-1991 yılları arasında Çatacık Ormanı'ndaki Geyik *(Cervus elaphus* L.) populasyonun ekolojisi ve habitat tercihi araştırılmıştır. Bu maksatla, 8776 hektarlık bir sahada 2350 deneme alanı alınarak, bu alanlarda Baddeley'in "Var-yok" metoclu ve Batcheler'in "Nokta-mesafe" tekniği uygulandı. Vejetasyon plotları alınarak, bunlarda geyiğin beslendiği bitkiler araştırıldı. Habitat seçimi; vejetasyon tipleri, yükseklik kademeleri, bakı ve su veya yola yakınlığa göre kaydedilen dışkı dağılımını esas alan özel bir bilgisayar programı ile incelendi. Yine dışkı frekansları kullanılarak, geyikle sahadaki evcil çifttırnaklılar veya diğer yabani memeli herbivorlar arasında cereyan eden habitat paylaşımı irdelendi. Sonuç olarak; geyiğin başlıca ağaçlandırma sahaları ve ormaniçi açıklıkları kullandığı, faydalanmanın farklı habitat tiplerinin sınırları civarında yoğunlaştığı, yani "Kenar etkisi"nin geyiğin habitat tercihinde önemli bir faktör olduğu tespit edildi.

Anahtar Kelimeler: Geyik *(Cervus elaphus* L), Habitat Tercihi, Gıda Biyolojisi, Dışkı Sayımı, Doğrudan Sayım, Çatacık Ormanı.

Introduction

There are 24 protected areas covering about 4 000 km^2 for red deer *(Cervus elaphus* L) in Turkey. Çatacık Conservation Area is one of these. At present, hunting is prohibited in the area. However, efficient protection has not been implemented until the 80's (3) and red deer population in Çatacık has been subjected to increasing hunting as in throughout Turkey over a long period. After establishing the conservation areas in the 70's to prevent illegal hunting, the range of red deer in Çatacık was also allocated as a "preservation and breeding site" in 1970.

Although it seems that the population has been growing in this area, there are no reliable data for population density and habitat preference due to lack of surveys. For this reason, a survey based on pellet counts was planned to estimate the population density and habitat selection of red deer in in the survey area covered 8776 ha. With the study (4), deer's uses of main habitat types and plant species in a 3 yea'r-period (1989-91) were determined from pellet frequencies by use of pellet count techniques (1,2). Before the survey, a tentative work was conducted in the area in September-1989 to get an idea about the population.

Red deer has been sharing the area with livestock, especially small groups of goat, sheep and cattle as well as wild boar *(Sus scrota* L.) and hare *(Lepus europaeus* L). It is known that there is predation on the population, especially in winter. Wolves *(Canis lupus* L) affect the red deer in this area and to a lesser extent so do stray dogs.

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Study Area

The study area located on Sündiken mountains has a relatively humid climate. Mean annual temperature is 9.2° and the long-term average rainfall is 875.5 mm. The area consists of mainly wood, plantations and meadows. High-forests cover 70% of the area. The main tree species, Scots pine *(Pinus sylvestris* L), covers large areas between 1200 and 1800 m elevations. At lower elevations, between 750-1200 m., Austrian pine *(Pinus nigra* var. *paliasiana)* occurs. The other trees, oak *(Quercus* spp.), junipers *(Juniperus* spp.) and aspen *(Populus tremula)* are also mixed with Austrian pine on southern slopes. Pines are the dominant canopy tree while other species are locally important (5).

Forest in the study area covered pine stands of 10-15 year old and of fully stocked structure as well as some small or wide cutting areas. There are many glades or openings in the woods and large meadows in the lower parts of the area. In these areas, there are oaks, aspen and other pioneer bushy broad-leaves and a rich cover of herbs and grasses. Plenty of openings in the plantations, which covered by very diverse species, are valuable for deer feeding. Thus, the glades which have herbaceous communities offer various grazing possibilities to red deer in the area.

Northern and southern parts of the area, which are close to villages, are mostly covered by small meadows and croplands. Especially on the southern lower slopes, diverse broad-leaved shrubs of *Berberidaceae, Rocaceae* and *Caprifoliaceae* occur. These meadows are rich in grasses and in many other herbs.

Survey area of 8776 ha included the most part of Çatacık and Degirmendere forests (31°08-31°15 E and 39° 52-39° 59 N). In making up survey units, the area was categorised for main characteristics of the plant communities such as dense and open stands or plantation and meadows.

Methods

Data for distribution and habitat selection of deer were obtained based on dispersion of pellet groups in the area and presence or absence of intact dung pellets on the plots. Also, distributions of the pellets in different vegetation types, altitudes and aspects and proximity of pellets to water springs and roads open to vehicular traffic were used for estimating the distribution of the population. Habitat share was estimated by comparing the dung frequencies of deer and other wild or domestic mammals. To compare the differences in distribution and habitat use, all types of habitats, altitudes and slopes were classified. The categorised types are shown in Table 1.

Table 1. Classification of Main Habitat Types, Altitudes and Slopes in the Survey Area.

Main Habitat Types:

API	Dense stands of Austrian pine
AP2	Stands of Austrian pine with glades of cutting
AP3	Degraded Austrian pine stands under-stocked
SP1	Scot pine stands full-stocked
SP2	Scot pine stands with glades of cutting
MPI	Full-stocked pine stands of Austrian pine and Scot pine
MP2	Mixed stands of Austrian pine and Scot pine with glades of cutting
MM	Mixed stands of Austrian pine, oaks and aspen
PL	Plantation areas
SHI	Shrub and bushy form of oak, aspen and juniper
SH2	Shrub and bushy form of junipers mixed pines
CR	Cropland, especially fields of cereal
ME	Meadows

Altitudinal Strata:

EI	1100 - 1190 m
E2	1200 - 1290 m
E3	1300 - 1390 m
E4	1400 - 1490 m
E5	1500 - 1590 m
E6	1600 - 1690

Slopes (%)

MI=0-15 M2= 16-30 M3= 31-45 M4=46-60 M5>60

Proximity to water and roads were described as follows:

If a plot, which contains any intact pellet, was close to any water spring or any road open to vehicular traffic to a maximum distance of 50 m, this was considered as an effective proximity.

At each plot, any road or a water spring close to the plots was recorded. For this, any water spring and road opens to vehicular traffic within 50 m of the plot centre was considered. On the basis of the above

classifications, the study area was divided into six sub-areas (survey units).

The study was conducted during the months of February, May, July and September in 1989-1991. Deer numbers were estimated by combining pellet group density and disappearance rate estimates (1) by assuming defecation rate of 1.25±1.4 pellet groups/ deer/day (6). During each survey the disappearance rate of deer pellet groups (7) was measured.

Trends in deer density and habitat use were inferred from pellet densities using following two different counting techniques:

Pellet Density Indices (PDIs)

PGDs was calculated by the presence/absence technique for single intact pellets (2), were used to describe distribution of the population. Plots of 114 cm radius were placed along 42 transects located semi-randomly throughout the area. For this, firstly, number of plots and transects required, were estimated (1). Secondly, a grid of one-hectare-squares was made up on the map of the survey area. Squares on x and y axes were numbered from 0 to 10. Random numbers were used to pick the origins of the transects. The origins were established where the largest water course leaves the square. Sections where the squares did not contain a water course, closest square was used. All the transects, with plots spaced 15 m apart began at bottoms of slopes and finished at ridges. Vegetation types described within 10x10 m vegetation plots placed every 60 m along the transects. A total of 2350 pellet count plots were established on the transects located throughout the area.

Pellet Group Densities (PGDs)

PGDs were derived from counts of pellet groups on 3 m radius plots spaced 15 m apart along the same transects. Pellet groups were defined as six or more intact pellets the same defecation, with at least one being visible above the ground litter (1). Distance measurements were recorded to a maximum of 300 cm (Truncation Distance) and only the first neighbour distance (r) was used to correct for the aggregation.

The PGDs were used to assess deer distribution and numbers (2). Altitude, aspect, slope, terrain and vegetation were recorded for each plot. Differences in PGDs between subareas or site types were assumed to reflect differences in deer density. To compare deer distribution patterns between site types, for sub-areas with different overall densities, a relative use index was used. Formula for the index was:

Relative use (RU)=PGD for the site type/(PGD for the sub-area (7, 8)

Disappearance rates of pellet groups were assessed on 8 belt transects with a width of 3 m and length of 10 km. Along these, 1055 groups were marked in diverse habitats in May 1990. All the transects were re-assessed after 125 days from the initial marking. Counts on the transects were repeated in 1991.

Two different computer programmes were developed for assessing population density, distribution and habitat use of deer. The first one, DS.BAS (9), based on Batcheler (2)'s point-distance nearest-neighbour distance technique, assuming a defecation rate of 12.5±1.38 pellet groups/deer/day (6) and a truncation distance (R) of 300 cm. were used for calculating of the population densities in each sub-area. Another one, SR.BAS (10), was prepared for assessing the distribution and habitat use.

Vantage point counts were conducted in each survey unit (sub-areas) over 10 days in each July and September. Individuals were observed in certain points and preferably in glades over periods of not less than 2 hours (11). During the observations deers were counted at 0600-0900h and 1830-2 lOOh in July and 0800-1 lOOh and 1700-2000h in September. Numbers of individuals were recorded in each point. To avoid human disturbance, all counts were made by waiting silently. In addition, some data were obtained from observations of randomly-encountered adults or yearling animals. These data were used to record animal's activity (namely, what the individual was doing and which kind of habitat it was in). In addition, supplemental data for preferred plants species were obtained from these observations.

Chi-square analysis was used to determine the statistical significance of departures in the observed frequency distributions of both animals and pellet groups in different habitats.

Summer food habits were determined by two methods, line transect and feeding site. For line transect method, numbers of browsed twigs (of trees or shrubs) or eaten stems (of herbs) were counted for each species on 5x5 m plots (in plantation areas and woods) and 5 m radius plots (in meadows). Plots were examined approximately once in every 10 days in May, July and September. For the feeding site method, certain openings were chosen in the plantations. Species and number of twigs consumed were recorded in three permanent plots fenced against cattle. Diet composition was estimated by counting browsed spe-

cies and foraging groups in the plots. And browsing impact by deer was determined by degree of browsing the vegetation.

Winter woody plant preference was estimated using circular (r=15 m) plots. Supplemental information on winter food habits was obtained by following deer tracks on the snow and tallying all feeding along its route in months of February. All habitat types passed through were noted, as were cases of bedding, loafing etc. (12-14). Usage of the plants by deer was divided into 3 groups as light use (f%=0-33), moderate use (f%=34-66) and heavy (f% = 67-100) use based on degree of preference or relative frequencies. The relative frequencies for the herbaceous plants were produced by using formula: f_h=Number of plot which have at least one eaten stem of certain herb/ Total number of plot which have any eaten herb. Another formula, was used for the woody plant, was: f_w= Number of browsed twigs of each tree of shrub/ Total number of twigs, within 1.6 m height, in plots which deer used.

Results

Distribution of the Red deer in the area

Red deer were present throughout much of the survey area but in different numbers in different survey units and different habitats. Intact deer pellets were recorded on 35 of the 42 transects. Pellet frequencies were generally higher in the habitat types of SHI, AP2 and AP3 at elevation of E4-E6, with preferably occurring on southern slopes. No deer pellets were recorded in croplands while some yearlings had been observed in the fields during the tentative survey.

Altitude

Deer were more frequent in elevations E4 and E5 (Table 2) with plenty of large or small openings covered by pioneer species such as aspen and various species of *Poaceae* and *Fabaceae.*

Despite of habitats have less forest cover at lower altitudes, palatable vegetation is present in these strata (El and E2). For the reason, there was little use by deer because of lack of sufficient hiding cover. However, adjacent altitude E3 was mostly covered by habitats of AP2, AP3 and SH which offers both food and cover preferred more by deer. On the other hand, in winter deer preferred the lower zones El, E2 and partly E3 due to a thick snow on higher altitudes.

Goats tended to be found at lower altitudes than deer where both species were present in the same habitats. However, in unit C, which was nearer to the villages and where few deer was present, goats were frequently recorded at low altitudes.

Hares were more abundant in mid (E3 and E4) and low (El and E2) elevations than in higher altitude forest zone in E5 and E6. Highest pellet frequencies were recorded in 1200-1400 m a.s.l stratum (E2 and E3). On comparing the altitude classes within each survey unit, all the units showed significant differences of preferences with respect to altitude except unit C (x^2 = 8.98, P = 0.05).

Aspect

Pellet frequencies have suggested that deer are likely to prefer the drier and warmer aspects of the area and marked aspect preference was apparent. Throughout the survey area pellet frequencies were highest on south and south-western aspects (Table 3). Hare also preferred southern slopes as deer. However, wild boar showed a significant higher use than deer on northern aspects.

Table 2. Altitudinal Distribution of Deer in the Survey Area Based on Pellet Densities in Each Stratum

Altitude (m)	Pellet Density (PDIs)
RI	2.04
R2	8.00
R3	13.03
R4	33.12
R5	35.22
R6	9.59
	100.00

Table 3. Distribution of Deer Pellets in Different Aspects (n=657)

Aspects	Number of Plots with Pellets
S	199
SW	137
E	95
NW	83
NE	54
N	49
SE	36
W	4
Total	657

Slope

Distribution of deer 1991 in relation to slope is shown in Table 4. As seen in the table, deer use decreased as the stepness of the terrain increased.

Table 4. Distribution of Deer in Relation to Slope

Slope class (%)	PGDs
SI	18.3
S2	46.4
S3	22.0
S4	7.8
S5	0.3

Proximity to roads

Effect of forest roads on habitat use was shown in Table 5. A relative use index from number of plots with pellets and total number of plots was used in the table.

Table 5. Relative Use of Deer Relation to Proximity to Roads.

Survey unit	RU
A	1.03
B	0.00
C	0.00
D	0.53
E	0.80
F	0.20

Deer used more frequently roads in unit A and UE than the others. However, it must be considered that there was a dense road network in these units.

Population density

Disappearance rates:

There was significant differences (x^2=15.2; P=0.05) among the estimates of disappearance rate of different survey units (see Table 6).

Since there was no significant difference between disappearances of both UA and UB in 1990 and in 1991 (Table 6), it was assumed that disappearance rates did not differ during these two years, and DRs in 1990 were used for latter calculation of the other units.

Table 6. Disappearance Rates in the Survey Units (c%).

Unit	1990	1991
A	0.175±0.023	0.171+0.026
B	0.231 ±0.040	-
C	0.187±0.033	-
D	0.230±0.044	-
E	0.180±0.034	0.181±0.032

Pellet Group Densities:

There was no significant difference (Table 7) between PGDs of survey units of B, C and D (P=0.05), but survey units of A and especially E showed markedly higher densities both in 1990 and in 1991.

Direct Counts:

Observed numbers of deer in the survey units were shown in Table 8 to compare the numbers estimated from pellet counts with directly counted numbers in 1990.

Change in Deer Density:

Deer number were calculated by using surface areas of the units and deer densities in each survey unit. And these numbers were compared with direct counts. Increase in densities in the survey units in 1990-1991 were showed in Table 9.

Table 7. Pellet Group Densities in the Survey Units.

Survey Unit	Number of Plots	PGD 1990	PGD 1991
A	300	150.±1.42	199.±2.91
B	268	61.1 ±0.55	89.±1.48
C	330	80.±0.99	93.6±1.77
D	604	67.3±0.25	78.1 ±0.89
E	592	254.±1.47	276.±2.79
F	240	83.±0.90	107.±1.67

Table 8. Deer Numbers Estimated from Pellet Counts and Direct Counts in 1990

Survey Unit	Estimated numbers	Observed numbers
A	29	14
B	16	14
C	19	12
D	29	13
E	43	21
Total	136	67

Table 9. Increasing in the Population Density in Period 1900-91.

Units	Years	Density (Deer/km²)	Numbers (n)	Increase (n)	(%)
A	1990	2.11	29		
	1991	2.73	38	9	31.03
B	1990	1.22	16	-	-
	1991	1.66	21	5	31.25
C	1990	1.20	19		
	1991	1.40	22	3	15.79
D	1990	1.24	29		
	1991	1.44	34	5	17.24
E	1990	3.66	43		
	1991	4.01	47	4	9.30
F	1990	1.20	12		
	1991	1.56	15	3	25.00
Totals	1990	1.68	148		
	1991	20.01	177	29	19.59

Use of vegetation types by deer

Deer used different vegetation types in different rates. Relative use in each type were found as follows (Table 10):

All preferred types of AP2, SP2, PL and SH have plenty of glades containing Aspen, Oak and various herbs. Therefore, the most important factor affecting preference were the presence of bushy plants, which offered browsing possibility to deer, and herbaceous communities, using for grazing, in the glades.

Table 10. Relative use by deer in Different Vegetation Types

Vegetation type	Relative Use
API	0.17
AP2	0.62
AP3	0.14
SP1	0.13
SP2	0.84
MP1	0.09
MP2	0.56
MM	0.13
PL	0.83
SHI	0.37
SH2	0.5
ME	0.66
CR	0.00

Seasonal Food Habits of Red Deer

Red deer used various species of trees, shrubs and herbs (Table 11) to different degrees in spring, summer and autumn.

Table 11. Seasonal Food Habits of Deer Excluding Winter.

Trees:	Relative Use Spring	Summer	Autumn
Aceraceae			
Acer campestre L	-	-	L
Acer hyrcanum Fish, et Mey.	-	-	L
Cupressaceae			
Juniperus communis L	-	-	L
Juniperus excelsa Bieb.	-	-	L
Juniperus foetidissima Willkd.	-	-	M
Junipures oxycedrus L	-	-	L
Fagaceae			
Quercus cerris L.	M	M	-
Quercus infectoria Olivien	M	M	-
Quercus ithaburensis Browica	M	L	-
Quercus petraea	M	M	-
Quercus pubescens Willd.	M	L	-
Quercus robur L.	M	M	-
Salicaceae			
Populus alba I	H	L	M
Populus tremuia L.	H	L	M
Salix caprea L	L	-	-
Shrubs:			
Caprifoliaceae			
Viburnum lantata L.	-	-	M

Table 11. Continue

Berberidaceae			
Berberis vulgaris L.	-	-	L
Rosaceae			
Crateagus spp.	M	M	M
Mai us sylvestris Mill.	-	-	M
Prunus spp.	H	M	H
Rosa pinpinellifolia L.	L	M	M
Rosa canina L.	L	M	M
Rubus canescens L.	M	-	L
Rubus ideaus L.	M	-	L
Rubus hirtus\N.K.	-	-	L
Rubus tomentatus Barckh.	-	-	L
Rubus spp.	-	-	L
Sorbus spp.	L	-	L
Herbaceous species:			
Asteraceae			
Achillaea millefolium L.	L	-	-
Carduus personata Jaca.	M	M	L
Cirsium arvense (L.) Scop.	L	L	-
Poaceae			
Agropyron elongatum (Host) Beauv.	M	M	L
Bromus secalinus L.	M	M	L
Bromus tectorum L.	H	M	L
Carex glauca	L	-	-
Festuca ovina L.	H	L	M
Festuca spp I.	M	L	L
Koeleria cristata (L) Pers.	M	L	M
Koeleria spp.	M	L	M
Melica nutans	L	L	-
Poa bulbosa L.	-	H	M
Ericaceae			H
Pyrola spp.	-	-	L
Lamiaceae			
Thymus spp.	L	-	L
Fabaceae			
Trifolium medium L.	M	M	-
Trifolium repens L.	M	H	M
Vicia villosa Roth.	M	M	-
Onagraceae			
Epilobium angustifolium L.	-	M	M

Abbreviations: L = Light M = Moderate H = Heavy

Aspen (P. *tremula)* used by deer more frequently than other broad-leaves trees in early April and in July. The data from feeding site indicated that deer mostly used aspen especially in glades of different stands. The consumption of aspen was highest in early May, late July and early August. Species eaten by deer in winter was shown in Table 12.

Table 12. Deer's Food Habit in Winter.

	Relative Use
Aceraceae	
Acer spp.	L
Berberidaceae	
Berberis vulgaris L	L
Caprifoliaceae	
Viburnum lantata L.	M
Cupressaceae	
Juniperus spp.	H
Fagaceae	
Quercus petraea	H
Quercus spp.	L
Salix caprea L.	L
Poaceae	
Brom us spp.	H
Festuca spp.	M
Poa spp.	H
Fabaceae	
Astragalus sp.	H
Onanis spinosa Miller	M
Lorantaceae	
Viscum album L.	M
Onagraceae	
Epilobium angustifolium L.	H
Rosaceae	
Cretaegus tanecetifolia	M
Malus sylvestris Mill.	M
Prunus spp.	L
Rosa pinpinellifolia L.	M
Rhamnaceae	
Rhamnus sp.	L
Salicaecea	H
Populus tremula L.	H
Salix caprea I.	L
Usneacea	
Evernia prunastri (L.) Hoffm	H

Discussion

The surveys in 1990 and 1991 showed an overall increase of 19.59% in deer numbers. Results from direct counts confirm this estimation.

Since at lower altitudes, habitats have less forest cover, deer used was generally lower than the highers. For instance, despite of palatable vegetation is present in the strata El and E2, there was little use by deer because of lack of sufficient hiding cover. However, adjacent altitude E3 was mostly covered by habitats of AP2, AP3 and SH which offers both food and cover preferred more by deer. In winter, deer preferred the lower zones E1, E2 and partly E3 due to a thick snow cover at higher altitudes. The fact that the habi-

tat types of AP2, SP2 and SH were apparently preferred in every altitudinal class suggest that vegetation type is a more important determinant of preference than elevation. For instance, in each class deer highly used Scots pine stands with glades of cutting (SP2) in the zone of E2-E6. On considering less preference of SP1, which is in the same altitudinal range as SP2, but has more homogenous structure and almost no openings, and as a result contain no broadleaves or grasses in these glades, the fact that vegetation has stronger effect than altitude can be easily seen. While homogenous vegetation occurs on the upper elevations (E5, E6), several vegetation types meet in the lower classes (E3 and E4). Thus, ecotones, for instance formed by pine stands and brushland, increased the habitat use in these parts. Besides, openings or glades were created by cuttings, provide a diversity of habitat types in the dense pine stands. As a result, the increased dispersion and interspersion of habitat types was the increased habitat use in cut areas (15, 16). Thus, the higher use in AP2, SP2 and MP2 can be explained by these mosaics and their dispersion of communities which have both sufficient food and hiding cover to deer (17). Plantation areas, which also have a diversity with young pine trees and various broadleaves and herbaceous communities among these, attracted deers. Another vegetation type attracted deer occurred along the roads went across the dense pine stands. For it is known that wildlife species are affected negatively by the low understory production that characterizes closed-canopy, even-aged stands (15-16), such habitats in the area, which have a sufficient hiding cover but have a poor forage before became suitable sites for deer after the construction of the roads. Because, many understory species of shrubs and herbs, which could not get sufficient sunlight before, growed up easily after the cutting of trees above for new roads. Thus, deer obtained new species for feeding.

The reason for not recording any pellets in the cropland (CR) was partly due to the fact that very few plots were placed in fields. Since during the most of the survey period these parts of the area were covered by crop plants, only few plots were placed in CR.

Data from feeding sites indicated that deer generally used aspen in various types of habitat, because of aspen communities provide valuable forage for deer. However, deer visited only those parts of the aspen habitats which both propped forage and hiding cover available. In very small glades in where the stands had a dense overstory canopy cover, but a low understory cover, deer showed a little use of aspen because of likely unavailability of the other herbaceous communities. In contrast, in the restocking areas and plantations, deer occurred in aspen habitats because of sufficient herbs in the same patches. Both deer utilization and pellet frequencies of other animals were the highest near the cover/restock boundary. Deer demonstrated a preference for aspen communities near thee boundaries. On the other hand, the reason for increased aspen consumption by deer in late summer was likely due to dry period of mid July-August. Since deer could not find enough fresh and palatable grass, they might have be preferred aspen. This was confirmed by the observation that browsing of aspen increased as herbaceous forage declined in July and September.

Arboreal lichens play a critical role in the winter diet of deer as well as shrubs species such as *Berberis spp. Rosa spp* and *Creteagus spp.* Another important species for winter diet of deer is mistletoe *{Viscum album).* Deer often visit cuttings for mistletoe provided that snow is not too tick for locomotion.

A high increase in deer numbers in unit A and unit E is a result of big proportion of the cutting areas as well as plantation areas were in these units. Because, glades of cutting and plantations provide proper forage but adjacent canopy cover of old trees provide hiding cover. Therefore, it can be claim that the higher proportion of the small openings in the dense stands is the higher increase in deer number. And this might have given rise to a marked increase in the units A and E.

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