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Seasonal Movements and Ranges of White-tailed Deer in the Adirondacks

Richard W. Sage Jr

A Special Report to Fulfill the Obligation of a

Final Job Completion Report

W-105-R

Jobs VI - 1, 2, and 4

Seasonal Movements and Ranges of White-tailed Deer in the Adirondacks

State: New York
Project No: W-105-R

Final Job Completion Report

Jobs VI - 1, 2, and 4

Study Number and Title: VI - Description and evaluation of the seasonal ranging and movement behavior of white-tailed deer.

Study Objective: To describe the location, configuration, and movements within and between seasonal home ranges and to account for the development, maintenance, and variability of seasonal ranging and movement patterns of a representative sample of white-tailed deer.

(1) Job No. and Title: VI-1 A description of the seasonal ranges and movements of white-tailed deer.

Job Objective: To determine the location, configuration, and variability of seasonal home ranges of a representative sample of white-tailed deer and their movements within and between these ranges.

(2) Job No. and Title: VI-2 An evaluation of patterns in the seasonal ranging and movement behavior of white-tailed deer.

Job Objective: To account for the temporal and spatial variability and the development and maintenance of patterns in the seasonal ranging and movement behavior of white-tailed deer.

(4) Job No. and Title: VI-4 Publication of a description and evaluation of ranging and movement behavior of white-tailed deer.

Job Objective: To disseminate information obtained to date to biologists, managers, administrators, and the general public.

Note: A draft manuscript which will eventually be submitted to the Journal of Wildlife Management for publication will serve as the final report for Jobs VI - 1, 2 and 4.

A separate, brief report following the traditional job completion report format has been prepared for each job and preceeds the attached manuscript.

(1) Job No. and Title: VI-1 A description of the seasonal ranges and movements of white-tailed deer.

Job Objective: To determine the location, configuration, and variability of seasonal home ranges of a representative sample of white-tailed deer and their movements within and between these ranges.

Abstract: Movements and ranges of white-tailed deer were studied for 8 years in the Adirondack Mountains. Deer were box-trapped on winter and summer range and 105 radio-collared deer and 266 deer marked with collars and ear streamers were released during the study. Summer ranges of deer on the study area averaged 184.3 ± 24.6 ha. Seasonal movements were correlated with snow depths of about 38 cm. There was no difference ($P < 0.05$) between summer and winter range size of males and females. Females and adult males used the same range year to year with few exceptions. A majority of 1 1/2 - 2 1/2 year-old males exhibited dispersal movements of 5 - 10 km. Range fidelity to a specific area was less pronounced in winter than summer.

Background: See attached manuscript.

Procedures: See attached manuscript.

Findings: See attached manuscript.

Analysis: See attached manuscript.

Recommendations: This job has been terminated. The attached draft manuscript will serve as a combined final report for Jobs VI - 1, 2 and 4.

Prepared by: ~~Richard W. Sage Jr.~~ Program Coordinator

Richard W. Sage Jr. — Title

Principal Investigator Richard W. Sage Jr. Program Coordinator

Richard W. Sage Jr. — Title

9/30/82

Date

Approved by: William F. Porter 9/30/82

William F. Porter — Date

Project Leader

Approved by: ______________________

Eugene Parks, Supervising — Date

Wildlife Biologist

Approved by: ______________________

Stuart Free, Chief — Date

Bureau of Wildlife

(2) Job No. and Title: VI-2 An evaluation of patterns in the seasonal ranging and movement behavior of white-tailed deer.

Job Objective: To account for the temporal and spatial variability and the development and maintenance of patterns in the seasonal ranging and movement behavior of white-tailed deer.

Abstract: Nine distinct groups of deer were identified from a marked population of 366 individuals on the study area. Groups showed different seasonal ranging and movement patterns and exhibited range area fidelity and range exclusiveness (between groups). Movements were influenced by timber harvesting both on summer and winter range. Of 13 habitat classifications, females showed a significant ($P < 0.05$) positive association with open areas and males a significant ($P < 0.05$) negative association with the logged hardwood forest. Summer range selection by individual deer was primarily influenced by social factors and not by the habitat types classified in this study. The ability to control deer densities for forest regeneration by intensive hunting on limited areas may be explained by the range fidelity of individual deer and deer groups. Management of winter deer habitat not being used by deer may be cost ineffective unless fidelity to a specific range can be altered.

Background: See attached manuscript.

Procedures: See attached manuscript.

Findings: See attached manuscript.

Analysis: See attached manuscript.

Recommendations: This job has been terminated. The attached draft manuscript will serve as a combined final report for Jobs VI - 1, 2 and 4.

Prepared by: *Richard W. Sage Jr.* Program Coordinator
Richard W. Sage Jr. Title

Principal Investigator *Richard W. Sage Jr.* Program Coordinator
Richard W. Sage Jr. Title

9/30/82
Date

Approved by: *William F. Porter* *9/30/82*
William F. Porter Date
Project Leader

Approved by: ______________________________
Eugene Parks, Supervising Date
Wildlife Biologist

Approved by: ______________________________
Stuart Free, Chief Date
Bureau of Wildlife

(4) Job No. and Title: VI-4 Publication of a description and evaluation of ranging and movement behavior of white-tailed deer.

Job Objective: To disseminate information obtained to date to biologists, managers, administrators, and the general public.

Abstract: A draft manuscript was prepared entitled "Seasonal Movements and Ranges of White-tailed Deer in the Adirondacks". This manuscript, following final reviews and appropriate minor revisions, will be submitted to the Journal of Wildlife Management for publication.

Background: See attached manuscript.

Procedures: See attached manuscript.

Findings: See attached manuscript.

Analysis: See attached manuscript.

Recommendations: This job has been terminated. Following review of the attached manuscript and submission to the Journal of Wildlife Management a popular style article should be developed and published in an appropriate magazine.

Prepared by: *Richard W. Sage Jr.* (signature) Program Coordinator
Richard W. Sage Jr. Title

Principal Investigator *Richard W. Sage Jr.* (signature) Program Coordinator
Richard W. Sage Jr. Title

9/30/82
Date

Approved by: *William F. Porter* (signature) 9/30/82
William F. Porter Date
Project Leader

Approved by:
Eugene Parks, Supervising Date
Wildlife Biologist

Approved by:
Stuart Free, Chief Date
Bureau of Wildlife

The following draft manuscript will serve as the Final Job Completion Report for Jobs VI - 1, 2, and 4 under PR Project W-105-R.

Tierson, W.C.
Star Route
Newcomb, NY 12852
(518) 582-4551

SEASONAL MOVEMENTS AND RANGES OF WHITE-TAILED DEER IN THE ADIRONDACKS

GEORGE F. MATTFELD, New York State Department of Environmental Conservation, 50 Wolf Rd., Albany, NY 12233

WILLIAM C. TIERSON, State University of New York, College of Environmental Science and Forestry, Newcomb, NY 12852

RICHARD W. SAGE JR., State University of New York, College of Environmental Science and Forestry, Newcomb, NY 12852

DONALD F. BEHREND, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Abstract: Movements and ranges of white-tailed deer were studied for 8 years in the Adirondack Mountains. Deer management requires information on seasonal movements, range fidelity and size, habitat utilization, and factors influencing these. Deer were box-trapped on winter and summer range and 105 radio-collared deer and 266 deer marked with collars and ear streamers were released during the study. Seasonal movements were correlated with snow depths of about 38 cm. There was no difference ($P < 0.05$) between summer or winter range size of males and females. Females and adult males used the same range year to year with few exceptions. A majority of 1 1/2 - 2 1/2 year-old males showed dispersal movements. Range fidelity to a specific area was less pronounced in winter than summer. Nine groups of deer were identified from a marked population of 366 individuals. Groups showed different ranging and movement patterns and exhibited range area fidelity and range exclusiveness (between groups). Movements were influenced by timber harvesting both on summer and winter range. Of 13 habitat classifications, females showed a significant ($P < 0.05$) positive association with open areas and males a significant ($P < 0.05$) negative association with the logged hardwood forest. Summer range selection by individual deer was primarily influenced by social factors and not by the habitat types classified in this study. The ability to control deer densities for forest regeneration by intensive hunting on limited areas may be explained by the range fidelity of individual deer and deer groups. Management of winter deer habitat not being used by deer may be cost ineffective unless fidelity to a specific range can be altered.

J. WILDL. MANAGE.

Key words: Adirondack, habitat, movements, New York, range, seasonal, telemetry, white-tailed deer.

Seasonal movements and ranging patterns for white-tailed deer (Odocoileus virginianus) vary over their geographic range. Cold temperatures and snow accumulations are the greatest influence on seasonal movements (Verme 1968, Rongstad and Tester 1969, Ozaga and Gysel 1972, Verme 1973, Drolet 1976). In areas of cold winter temperatures but little or no snow accumulation deer may occupy the same range year around (Sparrowe and Springer 1970).

Movement data from white-tails in more southern habitats suggest a year-long home range of considerable fidelity (Progulske and Baskett 1958, Marchinton and Jeter 1966, Marshall and Whittington 1968). Examples of long distance movements and range changes in these habitats are often related to dispersal of young males (Kammermeyer and Marchinton 1976).

Fat reserves of deer are often critical to winter survival (Mautz 1978) and the length of winter confinement is directly correlated with starvation mortality (Severinghaus and Cheatum 1956, Mattfeld 1974). As information on the winter energetics of white-tailed deer accumulates (Silver et al. 1969, Ozago and Verme 1970, Thompson et al. 1973, Mattfeld 1974, Moen 1978), there has been an increased awareness of the importance of summer range to winter survival of deer (Robbins and Moen 1975, Drolet 1976).

Factors that influence deer movements between seasonal ranges and the selection of a specific winter and summer range are important to wildlife biologists and forest land managers. An understanding of social patterns of movements and behavior is important to other research biologists.

The movements of white-tailed deer were studied from 1969-77 in the central Adirondack mountains of New York. The objectives were: to describe and evaluate the ranging and movement behavior of white-tailed deer; to describe the location and configuration of seasonal ranges and movements between these ranges; and to account for the development, maintenance and variability of these movement patterns for a representative sample of deer.

We gratefully acknowledge Finch, Pruyn & Co. Inc., N.L. Industries Inc., Tahawus Club Inc., and Melvin and Melvin, for permitting access to their private lands. The New York State Department of Environmental Conservation regional biologists, conservation officers, and research staff of the Wildlife Resources Center gave professional assistance, logistical support, and project review. The New York State Aviation Service and bush pilots H. and T. Helms provided helicopter and fixed wing flying service respectively. Forest Ranger A. Blanchette and several area residents provided many observations of marked deer. G. Canon assisted in computer programming. Research technicians R. Masters, A. Stirling, M. Tracy, and J. Wiley III who captured, marked, and followed the movements of hundreds of deer deserve special recognition, as do A. Boyer, D. Camenga, and C. Maddison who contrived, repaired, and maintained equipment. R. Brocke, R. Cameron, L. Cameron, C. Savino, G. Javes, J. Carr, and D. Huntley provided professional service, clerical and typing assistance. A. Cooperrider reviewed the manuscript. Financial support was provided by the U.S. Department of Interior, Fish and Wildlife Service, Federal Aid to Wildlife Restoration Project W-105-R and the State University of New York, College of Environmental Science and Forestry, Syracuse, NY. We are indebted to all of the above.

STUDY AREA

The core area was a 116 km^2 block comprised of The Archer and Anna Huntington Wildlife Forest Station (Huntington Forest) and the Santanoni Preserve, adjacent properties with a coterminous boundary. Most of the deer marked in this study were trapped and released on this area, while the study of deer movements was conducted on a surrounding 1,200 km^2 region. The flora and fauna have been described by Behrend (1966) and regional climate summarized by Smith (1966). Temperature and snow data pertinent to the study are shown in Fig. 1. Annual precipitation averages about 1,095 cm, equally divided between snow and rain.

Deer densities grew rapidly following early heavy cutting and fires and after 1920 some tree and shrub species were not successfully regenerating (Severinghaus and Brown 1956, Behrend 1966). Deer densities on the core study area estimated from deer drives, track counts, and roadside observations ranged from 10.4/km^2 in 1966 to 2.3/km^2 in 1976. Intensive hunting for deer on part of the Huntington Forest (1966-70), as well as limited hunting on the remainder of the 1,200 km^2 area occurred during this study. Data on marked deer killed during the hunting season were provided by numerous hunters.

About 70% of forests in the study area are in hardwood types and 30% in hardwood-conifer and conifer types. Timber harvesting took place summer and winter on various areas of the private lands in the study area concurrent with this study. Cutting in the hardwood types is usually a diameter limit selection harvest although limited areas are managed as even-aged forests. Conifer types are ordinarily clearcut in small blocks. Clearcutting of private land units $>$ 10 ha within the Adirondack region is currently restricted by state law. There is no cutting on state owned lands in the Adirondack region. Timber management on the Huntington Forest is primarily even-aged, using a 2-cut shelterwood for regeneration.

Natural predators on deer include the coyote (Canis latrans) and the bobcat (Felis rufus). Domestic and feral dogs are uncommon.

There are no influences of agriculture on deer within or surrounding the study area.

METHODS

Deer were captured in Stephenson-type box traps during winter and summer, from January 1969 to July 1976. Northern white cedar (*Thuja occidentalis* L.) was used as winter bait and salt (sodium chloride) as summer bait. Winter trapping was essentially terminated after the winter 1971-72 as summer trapping proved more effective (Mattfeld et al. 1972). Thirty five traps were used on the core study area. Deer were sexed, aged, tagged, weighed, and radio-collared using a holding box and, in the case of antlered males, tangle nets. Deer were aged as adults, fawns (< 1 year-old) and yearling (> 1 and < 2 year-old) using body size, weight, antler development, head configuration, presence of spots, etc. as criteria.

In addition, data from 38 deer captured and marked between 6/13/62 and 12/31/68 were incorporated in our data base.

Radio telemetry began in 1969 with 18 females and 4 males although the major telemetry effort started in 1972. In 1974 we began to routinely transmitter male deer.

Telemetry triangulation was from 2-way radio equipped trucks, snowmobiles, and occasionally on foot. Telemetry locations were also made from helicopters and fixed-wing aircraft by determining maximum signal strength when directly over the transmitter. Efforts were made to locate radio-collared deer at least once each week. Some deer, in inaccessible areas and during weather unsuitable for flying, were located at less frequent intervals. Precision of telemetry locations was generally ± 200 m. Most locations were made during daylight hours.

A forest type map of the 1,200 km^2 area was made by aerial photo interpretation with ground checks. The habitat of the area was classed as: conifer (> 85% conifer species); conifer-hardwood (61-84% conifer); mixed (40-60% hardwood or conifer combination); hardwood-conifer (16-84% hardwood); hardwood (> 85% hardwood); cut (> 50% of basal area removed in last 15 years); uncut; open; water; marsh; broken openings (usually old fire succession). Trees were classed as large pole sawtimber (> 15m high) and small pole sapling (< 15m high).

Field data on trapping success, deer captures, telemetry locations, etc., were incorporated in data files each day. All deer locations were indexed to a 100 m grid based on the Universal Transverse Mercator System.

Deer ranges were calculated using a smoothed polygon for range configuration and polar planimetry for range area measurement. No range area calculations were made for deer with < 5 position locations during any one season.

The beginning of the winter season was defined as the time when > 50% of the marked deer with different summer and winter ranges had left their summer range and had ceased transient movements to winter range. Transient locations between winter and summer ranges were not used in defining winter or summer range.

Data on precipitation, including snowfall and snow on ground, temperature, and humidity were collected at a National Weather Service Station (U.S. Dept. of Commerce) located on the Huntington Forest. In addition, depth of snow and sinking depth were measured at 6 stations during 1972-74. Three stations were in hardwood forests and 3 stations in conifer forests.

Table 7. Area of seasonal range of 9 white-tailed deer groups from a composite of all individual deer locations within a group. From the study area in the central Adirondack mountains.

	N	Group Range (ha)	
Group	Deer	Summer	Winter
A	61	1,926	1,627
B	16	959	1,095
C	22	1,167	353
D	7	868	545
E	12	1,853	623
F	4	861	375
G	98	3,008	1,570
H	6	644	190
I	85	1,012	1,223
$\bar{X}$		1,366.4	844.5

t = 1.68

SE = 311.3

Chi-square goodness-of-fit tests were used to determine if summer use of 13 habitat types was in proportion to their occurrence in deer range as determined by telemetry. Fifteen male and 15 female deer were randomly selected from the radio-collared population to minimize bias from deer with large numbers of locations in easily accessible areas. A 2 X 13 contingency table was tested for significance ($P < 0.05$) and then partioned and tested as described by Everitt (1977). Range sizes are presented ± 2 SE when sample size is > 30 and ± (t)(SE) when sample size is < 30 ($P < 0.05$).

RESULTS

There were 370 deer captured during this study. These, combined with the 38 deer previously marked (1962-68), constitute a total of 408 captures (Table 1). Of these, 25 escaped or were released unmarked, 12 died, and 371 were marked and released. Radio transmitters were placed on 31 males and 74 females, and 100 males and 166 females were marked by various techniques to permit individual recognition. Sex was determined for 391 of the deer captured (64% females and 35% males). No spotted fawns were captured in box traps.

Of 5,946 encounters with deer of known identity, 3,287 were telemetry location, 1,706 visual, and the remainder of various types (Table 2). Seventy seven (21%) marked deer were never observed after capture.

The summer ranges of the 371 deer captured, marked, and released on the core study area (116 km^2) occupied about 90% of this area. The sample of deer based on sex, age, and location appeared adequate to meet study objectives although trapping was obviously biased towards females

(Mattfeld et al. 1974), as a sex ratio based on hunter kill statistics was almost 50:50 (Behrend et al. 1970).

Seasonal Movements

Deer that exhibited seasonal range changes began movements to winter range as snow accumulations approached 38 cm. There was little direct correlation between ambient temperature on the onset of seasonal movements. Movements from summer to winter range seemed to follow major stream drainages and occurred within relatively short time periods. Movements up to 16 km took place within 24 hours. When snow depths were > 38 cm, > 50% of transmittered and marked deer had exhibited range changes.

Movements from winter to summer range were correlated with snow depths < 38 cm, but often took longer to complete than movements to winter range, and tended to follow south slopes where there were reduced snow depths. Late winter storms caused deer to retreat to winter range from summer range or from transient locations between winter and summer range.

These finding are generally supported by others. Drolet (1976) found 30.4 cm of snow a threshold for onset of seasonal movements and a similar behavioral response of deer to late winter storms. A short duration of movements to winter range was reported by Nelson and Mech (1981) for white-tails in Minnesota and by Georgii (1980) for red deer (*Cervus elaphus* L.) in the Alps. Rongstad and Tester (1969) concluded that effective snow depth (sinking depth) was the most important single factor causing changes in white-tailed deer monthly home range and percent of time spent in various habitats during day and night. Similar conclusions are drawn by Verme (1973). Nelson and Mech (1981) stated that snow depth never exceeded 35-40 cm when the first deer migrated but, in contrast to our findings, found deer movements to winter range influenced by freezing temperatures and, that 52% of radio marked deer had migrated when daily temperatures were < -7° C. Drolet (1976) found spring movements to summer range well correlated with temperature rise (number of degree days above 55° C).

Seasonal Range

Summer ranges for 100 females and 36 males and winter ranges for 49 females and 17 males were determined (Table 3). The summer ranges of the 136 deer were grouped into 11 range area size classes and show a strong central grouping of 50-200 ha, with the mode in the 101-150 ha class (Fig. 2).

Females occupied the same range during spring, summer and fall and the consistency of range size, configuration, and location from year to year is striking (Fig. 3). As an example, deer 59, an adult female when first captured on 16 January 1970 was marked with ear streamers and observed on the same summer range during 1970-73. She was recaptured and radio-collared on 8 June 1973, 15 May 1974, and 17 June 1976 and was found on the same summer range during this 7-year period.

Another, deer 31, a yearling female when captured on 19 May 1969 was radio-collared on 22 May 1973 and again on 2 July 1974. She was located on the same summer range each year from 1969-77, a 9-year record. Data from 52 radio-collared and 24 marked females with 2 or more years of data further documented this range fidelity (Table 4).

The general location of winter range of individual deer is the same year to year, but range fidelity to a specific area is less pronounced than for summer range. Variations in snow depth and physical characteristics and proximity of logging operations are presumed major factors influencing this reduced range fidelity. Data for adult males are limited, but all 5 deer with 2 winters record were observed on the same range each year.

No significant ($\underline{P} < 0.05$) differences between the area of winter range of males and females were found. Our winter range sizes appear to be significantly smaller than those reported from Minnesota (Rongstad and Tester 1969) and similar to those reported by Drolet (1976) in New Brunswick. Drolet found, as we did, a significant difference between summer and winter range area and considerable variation in winter range area related to winter severity. Heezen and Tester (1967) found an increase in daily winter home range area of deer with the onset of spring in Minnesota. Home range for Wisconsin deer residing on the same area year around are reported by Larson et al. (1978) and are comparable to our findings.

The obvious influence of winter severity and different habitats make range area comparisons difficult at best. Additionally, there are variations in accuracy of range data from telemetry as influenced by equipment, techniques, topography, base map accuracy, etc. (Ryan 1957, Tester and Siniff 1965, Heezen and Tester 1967) and by method of range area calculation (Mohr and Stumpf 1966, MacDonald et al. 1980).

Summer range area was significantly ($\underline{P} < 0.05$) larger than winter range for males and females combined (Table 3). Similar findings are reported by others (Drolet 1976, Nelson and Mech 1981) although there are considerable differences in range size {Nelson and Mech (1981) report winter ranges ($\bar{X}$ = 44 ha) that were 64% smaller than ours, and summer ranges ($\bar{X}$ = 83 ha) for females about 50% smaller). Marchinton and Jeter (1966) found minimum home ranges of 60-98 ha for 7 females in the Florida-Alabama region.

We compared fall and summer ranges of adult males and found no significant difference ($\underline{P}$ < 0.05) in area (Table 5). There was no significant difference in the area of fall range of females compared to spring-summer range. However, males showed a shift in the center of activity during the fall and when their spring, summer and fall ranges were combined, the total range size was significantly ($\underline{P}$ < 0.05) larger than that of females. We found no expansion or shift of fall range for females. Nelson and Mech (1981) compared summer and fall home range size for 2 adult females and 2 yearling males and reported no significant difference.

The summer and fall ranges of females and fawns appears to be the same whereas fall movements of males show an expansion or shift of spring-summer range (Fig. 4). Extended movements up to 28 km of 1 1/2 - 2 1/2 year-old males were determined (Table 6) and are probably related to dispersal of these deer as subsequent long distance movements were not observed. These young males used the same winter range as other deer occupying this spring-summer-fall range. Dispersal of young males took place in the fall season as 1 1/2 year-olds or during spring-summer-fall of the following year at 2 - 2 1/2 years of age. Dispersal movements of young males have been noted by several investigators (Carlsen and Farmes 1957, Hawkins and Klimstra 1970, Kammermeyer and Marchinton 1976).

Thirty nine of a marked population of 131 males showed dispersal movements (32, 1 - 2 1/2 year-old and 7 adults) while 9 of 240 marked females were known to have made a range change. Of the 131 males, 79 were aged as 1 - 2 1/2 year-old, and of these, 47 yielded insufficient data for analysis. Dispersal movements of young males (2 - 2 1/2 year-old) during spring, summer, and fall were reported by others with a majority related to the breeding season (Thomas et al. 1965, Downing et al. 1969).

Groups

We identified 9 groups of deer with different ranging and movement patterns. A group is defined as the deer that occupy the same geographic area and exhibit similar movement patterns. There were 366 marked or radio-collared deer which contributed to the identification of these 9 groups and seasonal ranges were determined for 149 (5 or > locations) (Table 7).

The area of the seasonal range of a group was calculated from a composite of all position locations for deer associated with that group (Table 7). The ranging and movement patterns for 6 of these groups that consistently changed their seasonal range (Fig. 5) and 3 groups that adjust their seasonal range (Fig. 6) suggest a group range fidelity and some range exclusiveness between groups.

We have identified deer groups without consideration of familial relationships in contrast to Severinghaus and Cheatum (1956) and more like the definition of Hawkins and Klimstra (1970) who stated "individual members of family groups are usually gentically related, but this was not necessarily a criterion during this study". They did not include adult males in their definition of family group whereas we included them in our definition of group.

We were unable to establish positive female-fawn relationships with the exception of one pair of fawns. However, we assumed that most doe-fawn associations determined through telemetry and visual identification were parent-offspring relationships. If true, then the seasonal movements of young deer of either sex, born within a group, were the same as that of their female parent, or the groups, throughout the first year. Females, 1 or 2 years old, established ranges adjacent to, and often overlapping, the ranges of the female parent of other group members and maintained similar seasonal movement patterns.

Of the 39 males classed as dispersals, 36 established ranges associated with another group, or left the study area for which we calculated group ranges, and 3 were either still associated with their original group or had not yet established a new range when last located (Table 6).

Timber Harvesting Influences

Winter logging often altered movements to winter range, occasionally holding deer throughout the winter period. An example was deer 31, which occupied the same winter range during 1970-72, spent the winter of 1973 on an active hardwood logging operation about 3.2 km from former winter range, and returned to former winter range location during 1974-75. We found several deer that remained on their summer range throughout the winter because of winter logging activity in hardwood and hardwood-conifer stands part of, or adjacent to, their summer range. Additionally, some deer which had moved to winter range were observed using adjacent hardwood and hardwood-conifer stands that were being logged and remained in these areas for the winter. Thus, winter harvesting was important in influencing seasonal movements and ranges of deer.

Habitat Utilization

The location of an individual deer within its summer range was used as a measure of habitat preference. The habitat of each telemetry location was classified for 15 males and 15 females and compared with the availability of that habitat type within the range of that individual deer. There was a significant ($P < 0.05$) negative association of males with cut hardwood forests and a significant ($P < 0.05$) positive association of females with open areas. All of the 12 other habitat type classifications were utilized in proportion to their availability.

A frequency distribution of the 13 habitat types on the core study area was compared with the distribution of these same habitat types within the summer range of the 15 males and 15 female deer. There was significantly ($P < 0.05$) less open habitat and significantly ($P < 0.05$) more old growth hardwood on the core study area than in the range of 30 deer.

DISCUSSION AND MANAGEMENT IMPLICATIONS

The fidelity of deer to a seasonal range suggests that management of these habitats is more important than once thought. The development of seasonal movement patterns and the fidelity of both movements and range area helps to explain the phenomenon of unused winter cover. We observed deer moving through areas of presumably suitable winter range (often used by other deer) while traveling to their winter range. Vegetation management for deer habitat improvement in unused winter ranges could prove cost-ineffective if deer movement behavior and fidelity to a specific range area could not be altered. Research in this area is needed.

This study began during a period of low deer density following severe winters and we were more easily able to identify discrete groups of deer as a result. As the population increased and as more deer were added to the marked-radio-collared pool, the summer ranges of these groups began to cover the core study area.

The existence of deer groups helps to explain the ability to control deer densities on relatively small manangement areas (2100 ha) as reported by Behrend et al. (1970). They showed no rapid influx of deer from surrounding, more densely populated areas and, our data suggests this would be unlikely to occur considering range area fidelity.

We hypothesize that regular winter timber harvesting on the Huntington Forest has altered former movement patterns of deer and deer groups have developed that utilize patchy areas of coniferous cover within, and adjacent to, summer range. Deer on the adjacent Santanoni Park continue to move to discrete winter range separated from summer range. Robinson (1960) noted similar utilization of patchy conifer cover by penned deer and showed that these deer maintained the same physical condition as those wintering in dense conifers. Our hypothesis has not been tested. The possibility of altering long-standing movement patterns has obvious management potential.

Deer population management by post season hunting (winter range) will often result in population control on widely separated summer ranges. Habitat management of summer range is important (Drolet 1976) and the fidelity of summer range use, both in time and space, documents the importance of summer range to deer survival.

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FIG. LEGENDS

Fig. 1. Mean monthly temperature and snow data on the study area in the central Adirondack mountains (1968-77). Mean maximums and minimums are 9-year averages of monthly extremes.

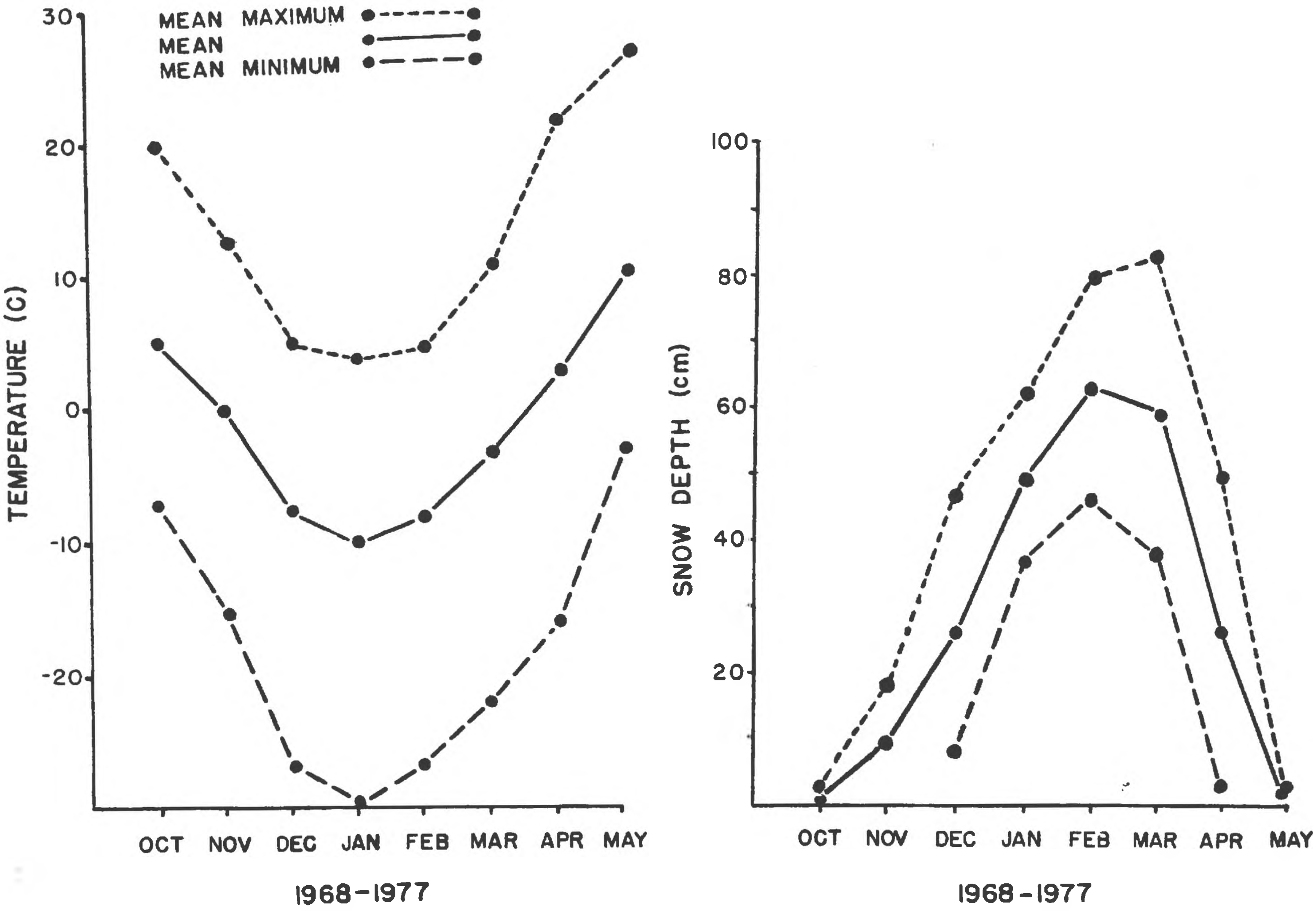
Fig. 2. Range size classes of 136 male and female white-tailed deer in the central Adirondack mountains.

Fig. 3. Six examples of the consistency of summer range location for female white-tailed deer in the central Adirondack mountains.

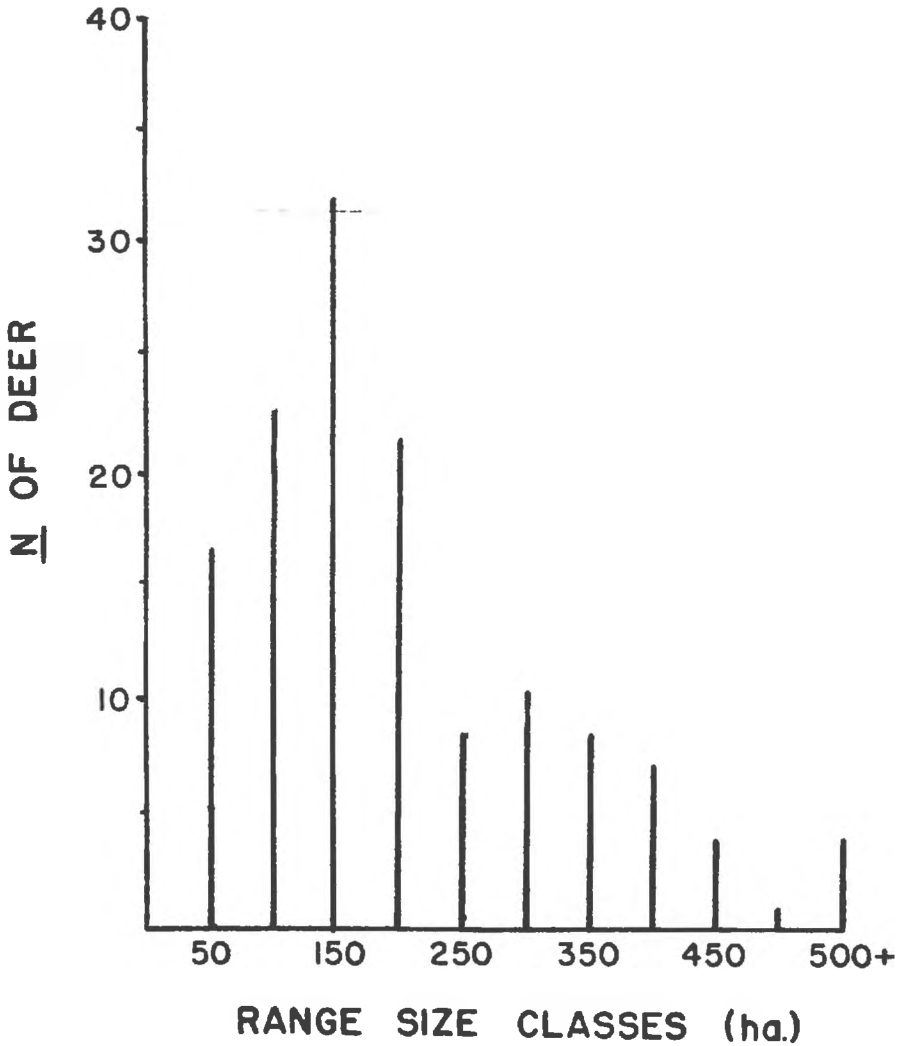
Fig. 4. Summer ranges and associated fall movements of male white-tailed deer in the central Adirondack mountains.

Fig. 5. Seasonal ranging and movements for 6 white-tailed deer groups that shift their seasonal range.

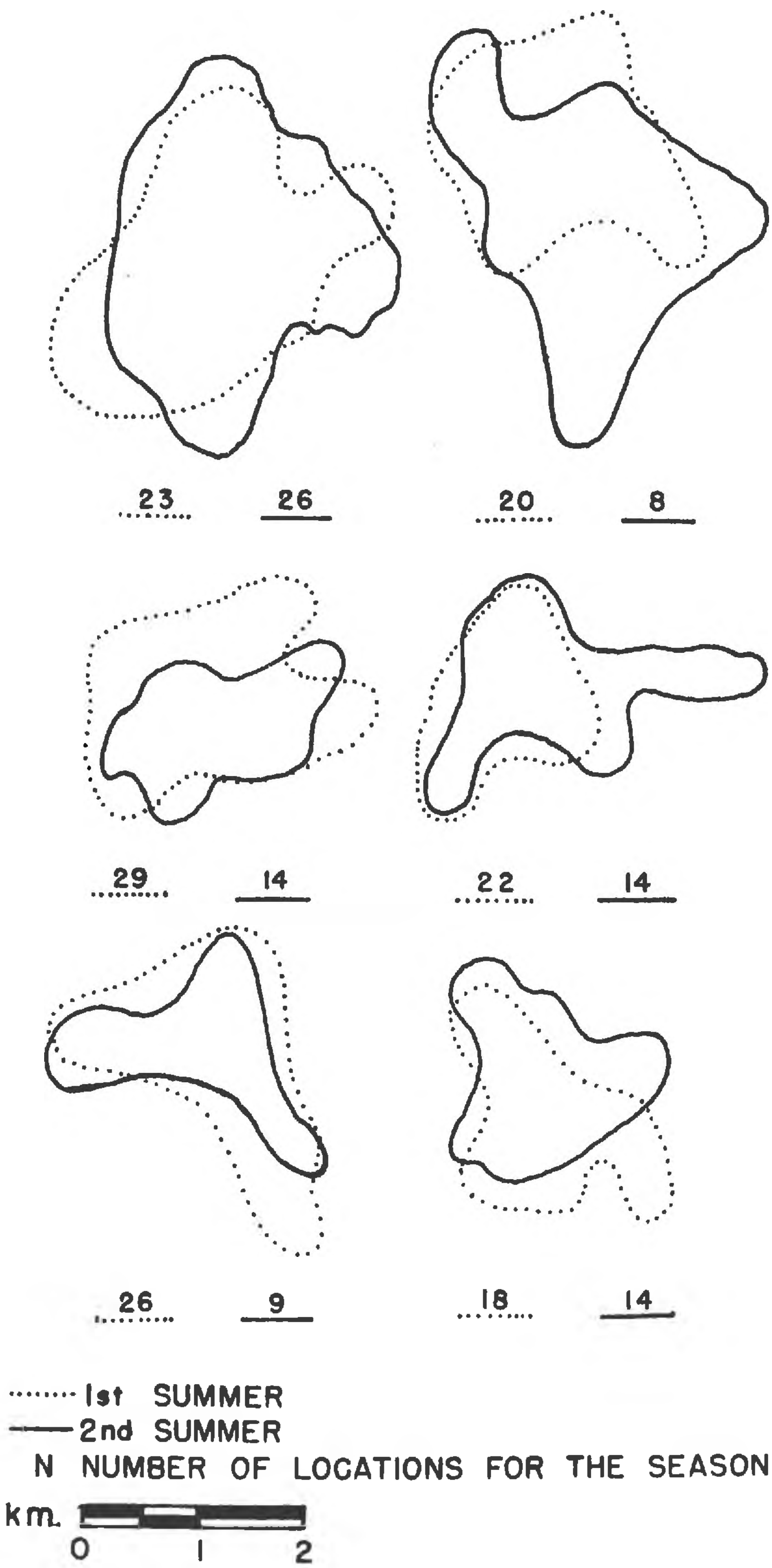
Fig. 6. Seasonal ranging and movements for 3 white-tailed deer groups that adjust their seasonal range.



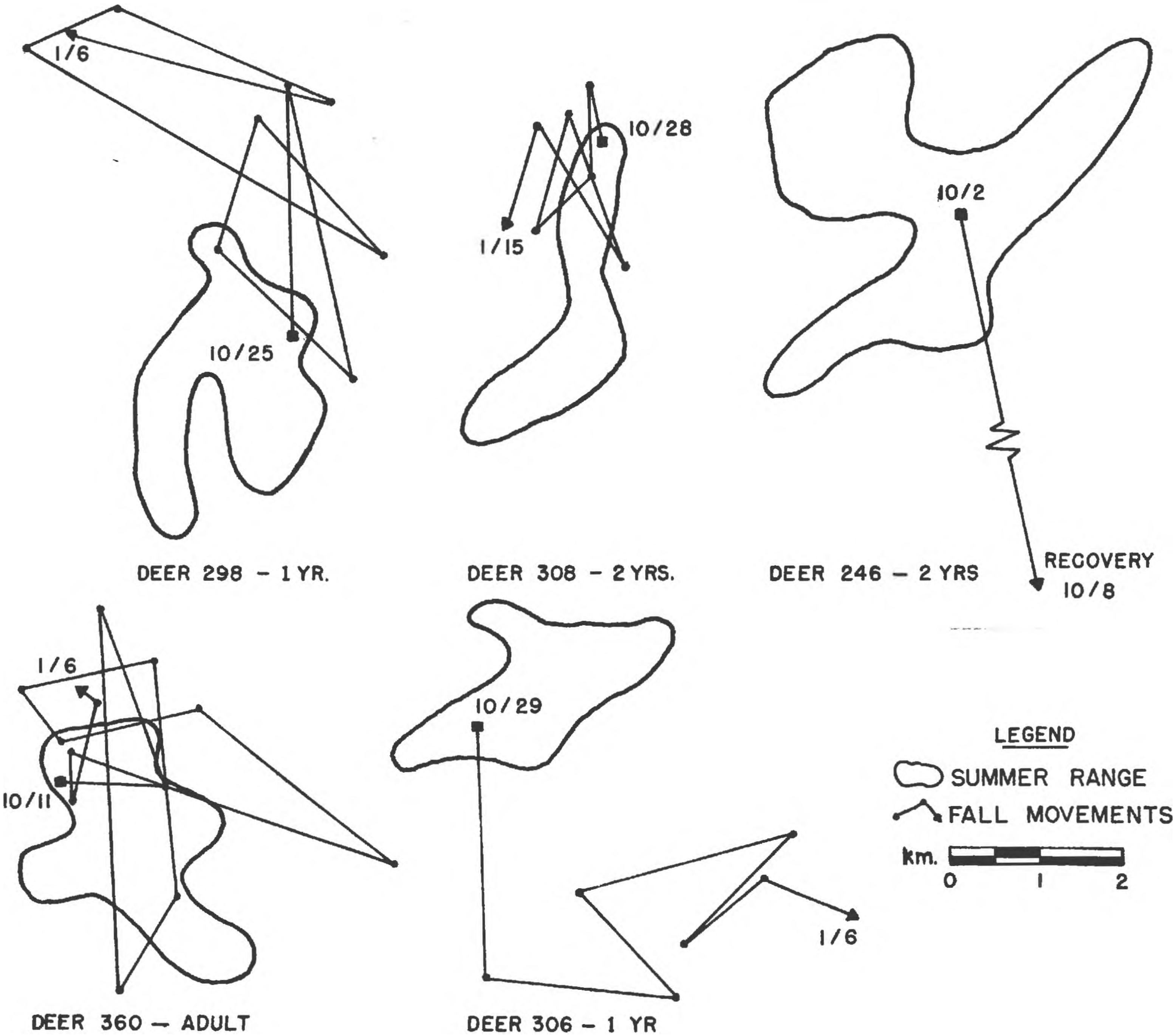
MEAN MAXIMUM
MEAN
MEAN MINIMUM
30
20
10
0
-10
-20
TEMPERATURE (C)
OCT NOV DEC JAN FEB MAR APR MAY
1968-1977
100
80
60
40
20
SNOW DEPTH (cm)
OCT NOV DEC JAN FEB MAR APR MAY
1968-1977

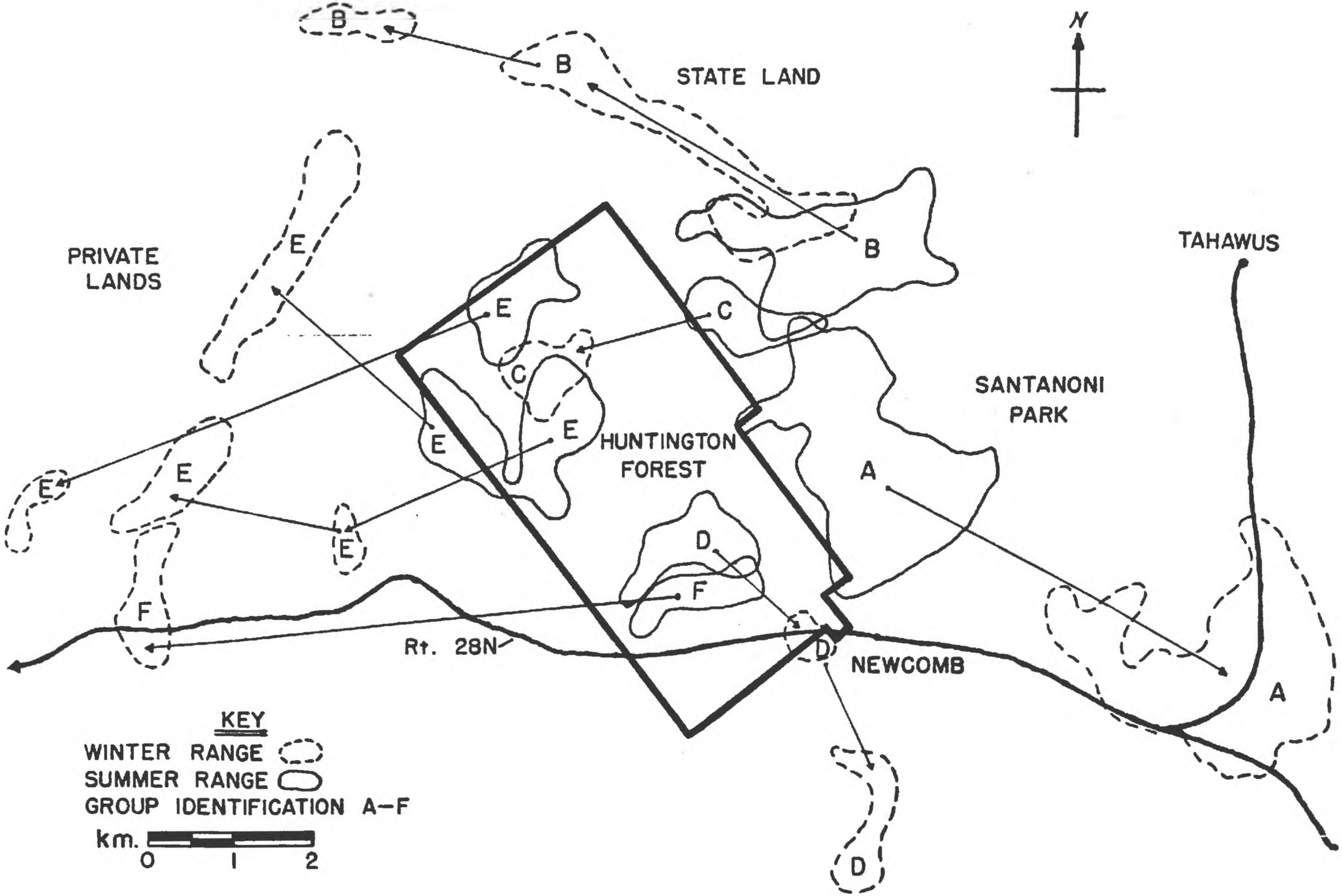


40
30
20
10
N OF DEER
50
150
250
350
450
500+
RANGE SIZE CLASSES (ha.)



23
26
20
8
29
14
22
14
26
9
18
14
1st SUMMER
2nd SUMMER
N NUMBER OF LOCATIONS FOR THE SEASON
km.
0
1
2


1/6
10/25
DEER 298 - 1 YR.
10/28
1/15
DEER 308 - 2 YRS.
10/2
RECOVERY
10/8
DEER 246 - 2 YRS
1/6
10/11
DEER 360 - ADULT
10/29
1/6
DEER 306 - 1 YR
LEGEND
SUMMER RANGE
FALL MOVEMENTS
km.
0
1
2


N
STATE LAND
PRIVATE LANDS
SANTANONI PARK
TAHAWUS
HUNTINGTON FOREST
NEWCOMB
Rt. 28N
A
B
C
D
E
F
KEY
WINTER RANGE
SUMMER RANGE
GROUP IDENTIFICATION A–F
km.
0
1
2

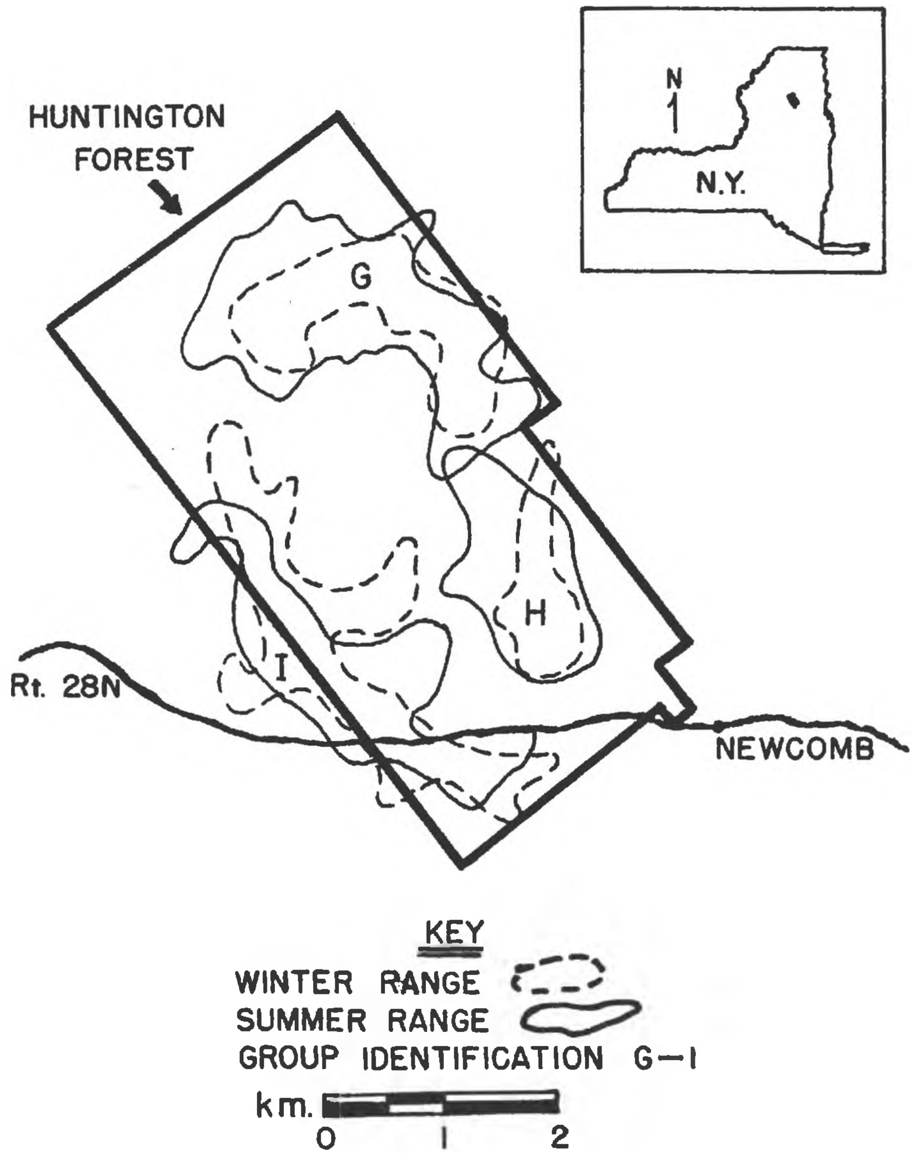

HUNTINGTON FOREST
N
N.Y.
G
H
I
Rt. 28N
NEWCOMB
KEY
WINTER RANGE
SUMMER RANGE
GROUP IDENTIFICATION G—I
km.
0
1
2

Table 1. N and sex of white-tailed deer captured[a] and marked on the study area in the central Adirondack Mountains during 1962-76.

Period	Total Captures	Sex M	Sex F	Radio collared M	Radio collared F	Other marking M	Other marking F
Prior 1969[b]	38	8	30			8	30
1969 W[c]	27	9	18		2	9	15
S[d]	30	10	20		5	9	15
1970 W	17	6	11		3	6	8
S	43	15	28	1	6	12	18
1971 W	9	1	8			1	8
S	38	13	16	1	2	12	18
1972 W	7	1	6		1	1	5
S	55	23	27		13	22	12
1973 W							
S	66	21	42	3	20	13	20
1974 W							
S	78	33	45	26	22	7	22
Total	408	140	251	31	74	100	166

[a] Includes 25 deer released or escaped unmarked and 12 capture mortalities.

[b] Includes all marked individuals of record from 6/13/62 to 12/31/68.

[c] Winter range trapping, usually mid-December - end March.

[d] Summer range trapping, usually May 1 - July 30.

Table 2. N of encounters[a] with marked white-tailed deer on the study area in the central Adirondack Mountains 1962-77.

Type of Encounter	N
Box trap capture	757
Other captures	76
Visual	1,706
Recovery[b]	80
Miscellaneous[c]	40
Telemetry	3,287
Total encounters	5,946

[a] Any single location of a deer of known identity.

[b] Hunter kill, predation, highway and trap mortality.

[c] Recovery of collar, transmitter, ear tags, etc.

Table 3. Range size[a] of marked white-tailed deer by sex and season in the central Adirondack Mountains.

Sex and season	N	Area in ha	2 SE
<u>Female</u>			
Summer	100	171.72	28.78
Winter	49	126.53	34.30
<u>Male</u>			
Summer	36	219.25	46.26
Winter	17	120.00	50.04
<u>Male & Female</u>			
Summer	136	184.30	24.62
Winter	66	124.85	28.36[b]

[a] For deer with 5 or more locations in 1 season.

[b] $P < 0.05$

Table 4. N of white-tailed deer with at least one location on seasonal range and N exhibiting range change or dispersal on the study area in the central Adirondack Mountains.

	Season			Years of Seasonal Data						Range change or dispersal	
				Summer			Winter				
Sex	Summer and Winter	Summer only	Winter only	2	3	4+	2	3	4+	Yearling	Adult
Male	37	54	9	30	3		7			32	7
Female	110	61	12	44	32	25[a]	35	4	5[b]	5	4
Total	147	115	21	74	35	25	42	4	5	37	11

[a] Includes 10 deer with 5 years record and 1 each of 6,7,8, and 9 years.

[b] Includes 1 deer with 5 years record and 1 each of 6 and 7 years.

Table 5. Summer and fall range size of adult male white-tailed deer in the central Adirondack mountains.

Deer Number	Summer Range (ha)	Fall Range (ha)
231	92	224
303	130	127
306	576	372
319	287	402
360	233	295
373	364	440
376	129	273
380	104	460
381	413	655
385	209	176
387	319	255
392	134	408
N	12	12
$\bar{X}$	249.17	340.58
t = 2.03		

Table 6. N of male white-tailed deer dispersals[a] by dispersal distance class and the relationship to their original group designation, from the central Adirondack mountains.

Dispersal distance[b] (m)	Changing Group	Dispersed within group	Dispersed outside area[c]
2,000 - 5,000	5	2	4
5,000 - 10,000	10	1	9
10,000 - 20,000	2		4
> 20,000			2
Total	17	3	19

[a] Comprised of 32, 1 - 2 1/2 year-old deer and 7 > 2 1/2 years old.

[b] Distance between geometric centers of two successive summer ranges.

[c] Outside the core area where original summer ranges were calculated.

Table 7. Area of seasonal range of 9 white-tailed deer groups from a composite of all individual deer locations within a group. From the study area in the central Adirondack mountains.

Group	N Deer	Group Range (ha) Summer	Winter
A	61	1,926	1,627
B	16	959	1,095
C	22	1,167	353
D	7	868	545
E	12	1,853	623
F	4	861	375
G	98	3,008	1,570
H	6	644	190
I	85	1,012	1,223
$\bar{X}$		1,366.4	844.5
t = 1.68			
SE = 311.3			