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Home range and movement of sika deer *(Cervus nippon)* in Maryland

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Abstract

Studied the home ranges and movements of a radiocollared male and female sika deer. The home range area of the male was 182.5 ha; that of the female was 127.8 ha. The male also exhibited significantly greater mean movement throughout its home range than did the female.

Introduction

Sika deer (*Cervus nippon*, Temminck) are native to Japan, and eastern Asia from Manchuria south to Vietnam. Introduced populations currently exist in England, Ireland, several other European countries, Australia and New Zealand. In the United States, feral populations occur in Texas, Virginia, Wisconsin, Kansas, Oklahoma and Maryland (Feldhamer 1982). Sika deer are highly adaptable and thrive in many types of habitat. Despite the numerous introductions and wide distribution of the species, few studies on their home range or movement patterns have been conducted. Davidson (1979) investigated the linear distance from the point of tagging to kill site of 54 sika deer in New Zealand. Maruyama et. al. (1978) calculated the home range of two radiocollared sika deer in Japan.

The primary objective of this study was to determine the activity pattern and home range of sika deer relative to sex and season of the year. A secondary objective was to test the utility of the harmonic mean measure of home range calculation (Dixon and Chapman 1980) on a large mammal.

In Maryland, sika deer *(C. n. nippon)* occur throughout the southern portion of Dorchester County, where they are sympatric with native white-tailed deer (*Odocoileus virginianus*, Zimmermann) (Feldhamer et al. 1978). The study area was located south of Blackwater National Wildlife Refuge (Fig. 1). It consisted of a wooded tract dominated by loblolly pine (*Pinus taeda*, Linnaeus) and oak (*Quercus* sp., Linnaeus) with a dense understory of greenbrier (*Smilax* sp., Linnaeus), bayberry (*Myrica* sp., Linnaeus), American holly (*Ilex opaca*, Aiton) and poison ivy (*Rhus radicans*, Linnaeus). To the north and west of the wooded area was marshland, primarily three-square rush (*Scirpus olneyi*, Gray). The study area ranged in elevation from sea level to approximately 2–3 m. Following rain,

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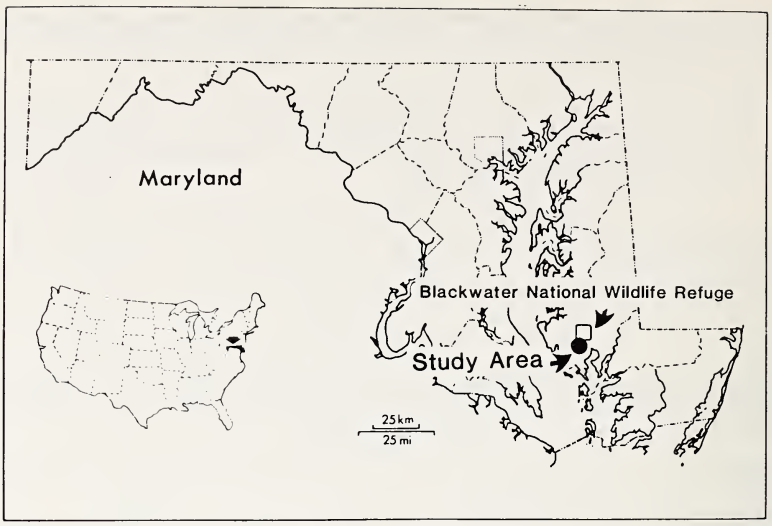

Fig. 1. Study area, south of Blackwater National Wildlife Refuge, Dorchester County, Maryland, U.S.A.

snow melt or high tide, water often inundated portions of the wooded area. The mean yearly precipitation in this region is 109 cm, of which 28 cm may be snow. Weather is fairly mild, with winter temperatures rarely below −4 °C. Summers are very humid and temperatures may exceed 35 °C. for extended periods.

Material and methods

Two sika deer calves, a female and a male both approximately 10 months old, were captured in Stephenson box traps on 5 and 7 March 1978, respectively. They were fitted with radio transmitter collars and released at the point of capture. Location bearings were taken from two or three of six stations 0.4 or 0.8 km apart, using a hand-held, 4-element Yagi antenna and a compass. Bearings for each fix were taken within a 5-min time interval. When possible, a series of locational fixes were taken at hourly intervals to investigate the extent of circadian movements. Movements, as determined by the linear distance between consecutive hourly locations, were analyzed on a daily and seasonal basis. Seasons were defined as 3-month periods as follows: spring (March–May); summer (June–August); fall (September–November); and winter (December–February). Daily activity patterns were based on four 6-h periods: 0100–0700; 0700–1300; 1300–1900; and 1900–0100.

Home range and center of activity analyses were done using a harmonic mean method (Dixon and Chapman 1980) which was developed using data on brush rabbits (*Sylvilagus bachmani* Waterhouse). The present study is the first to apply this technique to a large mammal. With this method, the calculated center of activity is located at the point of greatest activity and the isopleths of activity are directly related to the frequency of occurrence of each deer within its home range. Unlike traditional arithmetic mean center of activity calculations in which a single "center" is established, the harmonic mean method may establish several centers of activity which may be associated with shifts in home range use.

Results and discussion

Between 12 April and 9 September 1978, when the transmitter failed, 66 locational fixes were obtained for the male sika deer. His home range encompassed 182.5 ha. This deer was killed by a hunter on 27 November 1978, 4.2 km from the point of capture and 4.3 km from the final location fix. For the female, a total of 235 locational fixes was obtained during the period 12 April 1978 to 25 February 1980. Although this represented 169 more

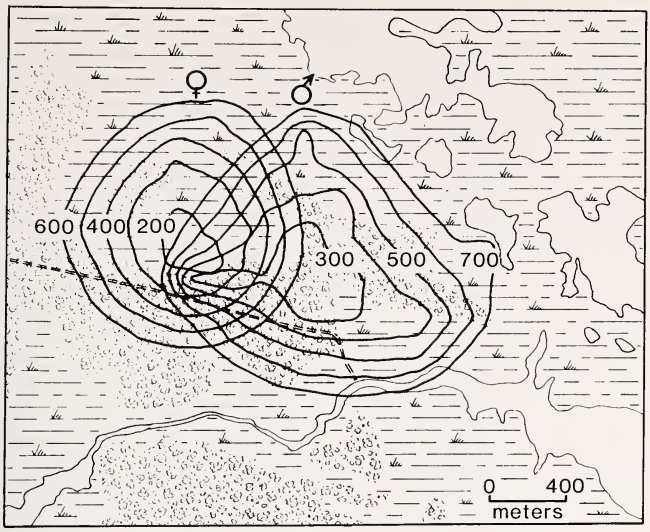

Fig. 2. Home range isopleths of male and female sika deer and associated degree of overlap. Numerals denote activity isopleth values in meters. Dashed line represents a road

locational points than for the male, the home of the female was only 127.8 ha, or 42.8 % less than that of the male (Fig. 2). Differential seasonal use of the home range area by the male was noted during the five months he was monitored, as denoted by the shifts in his centers of actvity (Fig. 3). Much smaller shifts were noted for the female, despite the much longer period during which she was monitored and the greater number of locational fixes.

Considering seasonal activity, as determined by mean linear distances moved hourly, the female showed no significant seasonal differences in movement (see Table). The only difference occurred when comparing distance moved by the female in the spring of 1978 vs. spring of 1979. She moved significantly less as a calf (spring 1978) than she did as a yearling. Seasonal comparison of activity was limited to the spring and summer of 1978 for the male, and no difference was noted.

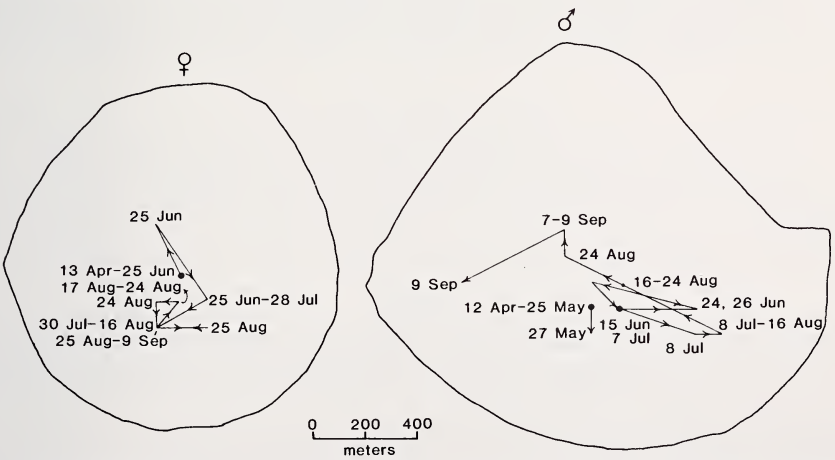

Fig. 3. Centrograms of female (left) and male (right) sika deer from 12 April to 9 September, 1978, and associated dates of shifts in centers of activity

Table

Seasonal comparisons of the mean distances moved between consecutive hourly location points

	Seasonal comparison	Mean distance moved (m)	Student t_{cal}
Female			
1978	spring	152.9 (10)[1]	1.610
	vs.		
	summer	237.9 (40)	
1978	summer	237.9 (40)	1.152
	vs.		
	fall	197.3 (42)	
1978	fall	197.3 (42)	0.107
	vs.		
1979	spring	201.7 (31)	
1979	spring	201.7 (31)	0.363
	vs.		
	winter	179.3 (20)	
1978	spring	152.9 (10)	5.552[2]
	vs.		
1979	spring	201.7 (31)	
Male			
1978	spring	456.5 (11)	0.990
	vs.		
	summer	338.4 (23)	

[1] Number of fixes in parentheses. – [2] Significant difference $P < 0.05$

In 1978, when both radiocollared sika were on the study area, the male exhibited significantly greater mean movement (in meters) than the female, both in the spring [male $\bar{X} = 456.5$ ($n = 11$); female $\bar{X} = 152.9$ (10); $P < 0.05$] and in the summer [male $\bar{X} = 338.4$ (23); female $\bar{X} = 237.9$ (40); $P < 0.05$].

This difference in activity was further illustrated by greater shifts in the centers of activity of the male than those of the female during the spring and summer of 1978 (Fig. 3). Thus, the male exhibited both a larger total home range area and greater mean activity and movement within that area.

Seasonally, no statistically significant differences in activity (movement) were seen among the four 6-h intervals. This was due in part at least, to the very large variances associated with each mean and the limited samples sizes. For both seasons during which data were collected on the male, the most active interval was between 1300–1900 h. This was also the most active period for the female in three of the five seasons she was monitored.

Numerous environmental factors influence home range size, as do methods used to analyze the data. Comparisons between studies may show general patterns or trends, however. *Maruyama* et al. (1978) reported home range sizes for two adult male sika deer, calculated by the "observation-area curve" method, as 6.5 and 19.0 ha, respectively. Data were limited to 39 locational fixes during a 4-day period in the first case, and 42 locational fixes during a 35-day period in the second. In addition, the study of Maruyama et al. (1978) was conducted from September through November, when adult males may have used only a portion of their home range, that is, established territories in association with the rut. Yearling sika males probably do not establish territories and breed. In the present study, the male (a yearling in the fall of 1978) may have been forced out of the study area

by adult males during the rut. As noted previously, it was killed 4.3 km from the final location fix. This was similar to the mean linear distance from tagging to kill site off 2.5 km for yearling sika males in New Zealand (Davidson 1979). Miura (1974) also noted that males tended to "wander" outside their previous home range areas during the pre-rut period.

Sika deer on the study area were active intermittently throughout each 24-h period. The longest distances moved during hourly intervals occurred in the afternoon during most of the year. Home range use by the female sika deer was not affected by seasonal environmental changes; food was not critical and the weather was generally mild. Intraspecific behavioral interactions may have mitigated against similar restriction of home range by the young male sika, however.

The activity of the female was more restricted as a calf than as a yearling. When radiocollared as a calf, she probably was still closely associated with her dam, although she probably was weaned by this time (Kiddie 1962). Few female sika deer shot on the study area during the hunting season (November–December) were lactating. Thus, in spring 1978, the dam probably was pregnant, forage was not limited, and she (and her calf) may not have been inclined to move great distances. As a yearling, the radiocollared deer may not have been as closely associated with her dam, and as a result showed a greater range of movement.

The results of this study show that the harmonic mean measure of home range calculation can be applied to large mammals with correspondingly larger home ranges as well as to small mammals with smaller home ranges. When the same units of measurement are used in determining the reciprocal distance deviations, the isopleth values are directly comparable. Thus, the isopleth value determining the home range boundary of brush rabbits was 30 m (Dixon and Chapman 1980), whereas with sika deer the values were 600 m for the female and 700 m for the male.

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W. Bruce Taliaferro, Thomas D. Beaver and numerous students from the Appalachian Environmental Laboratory aided in trapping deer and attempts over a 2-year period to capture additional animals. Mr. William Spicer and Mr. P. A. Ransome kindly allowed traps to be placed on their property and assisted in many facets of this study. The computer time for this project was supported in part through the facilities of the Computer Science Center of the University of Maryland. We also thank Fran Younger, Chesapeake Biological Laboratory, for drawing the figures. The Maryland Wildlife Administration provided use of the deer traps. This is Contribution No. 1320-AEL, Appalachian Environmental Laboratory, Center for Environmental and Estuarine Studies, University of Maryland, and Federal Aid to Wildlife Restoration W-49-R Maryland.

Zusammenfassung

Reviergröße und Ortswechsel beim Sika-Hirsch (Cervus nippon) in Maryland

Mit telemetrischen Methoden wurden Reviergröße und Ortswechsel eines männlichen und eines weiblichen Sika-Hirsches in Maryland untersucht. Der Lebensraum des Hirsches war 182,5 ha groß, der des weiblichen Stückes nur 127,8 ha. Außerdem war der Hirsch stärker tätig als die Hirschkuh.

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WISSENSCHAFTLICHE KURZMITTEILUNGEN

Der Dachs, *Meles meles* (Linnaeus, 1758), in NW-Syrien[1]

Von D. Kock und R. Kinzelbach

Eingang des Ms. 16. 6. 1982

Das Vorkommen des Dachses in Syrien ist bisher allein durch einen Schädel (BM. 30.3.3.1) belegt, dessen exakte Herkunft jedoch unbekannt ist (Harrison 1968: 242; Kumerloeve 1975b). Die Verbreitungskarte (Abb. 1, n. Harrison 1968, 1972: 628; Kumerloeve 1967, 1975a) zeigt, daß *Meles meles* zumindest in NW-Syrien zu erwarten ist.

Am 31. 7. 1978 fand die Nahost-Exkursion 1978 (RK) des Zoologischen Institutes der Universität Mainz einen überfahrenen *M. meles* etwa 20 km südlich Tartous. Dieser Nachweis fällt in die Verbreitungs-„Lücke", die ökologisch (vgl. Lehmann 1966) oder zoogeographisch schwerlich erklärbar wäre. Das erkennbare Farbmuster des nicht einge-

Verbreitung von *Meles meles* im Nahen Osten. Stern: syrisches Vorkommen

[1] Ergebnisse der Reisen von R. Kinzelbach im Vorderen Orient, Nr. 51.

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