Variation of white-tailed deer home ranges in fragmented urban habitats around Chicago, Illinois

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Abstract: Behavior of white-tailed deer (*Odocoileus virginianus*) has been studied extensively in refuges and agricultural regions, although little research has focused on deer in urban environments. Dramatic urbanization and development fragments habitat available for wildlife species and deer densities often exceed ecosystem carrying capacity in remnant natural areas. This may impact deer social behavior and spatial home range patterns. We radio-marked 21 female white-tailed deer in the Des Plaines and Palos Forest Preserves near Chicago, Illinois to study spatial use of deer relative to conditions in urban forest preserves. Telemetry locations were collected once per week and included both day and night fixes (May 1998 – March 1999). The effects of differences in urbanization and human demographics surrounding both Des Plaines and Palos Forest Preserves were evaluated using a Geographical Information System. We found that female deer in Des Plaines had smaller, more linear home ranges that stretched into urban areas outside the forest preserve whereas female deer in Palos remained within preserve boundaries and maintained smaller, more centralized home ranges. Understanding spatial patterns and habitat selection of urban deer will increase the knowledge and predictive capabilities of deer managers.

Key words: Chicago, forest preserve, home range, Illinois, Midwest, radio-telemetry, urban wildlife, white-tailed deer

Today, managers face the daunting task of deer management in the urban matrix (Decker et al. 1995). Recent trends in land use have caused increased residential and commercial development expanding outward from urban centers. White-tailed deer (*Odocoileus virginianus*) have adapted to exploit suitable areas in urban and residential environments (Jones and Witham 1995). Despite the fast growth of urban and suburban areas, little research has focused on deer behavior and ecology in these environments (Swihart et al.

1995). Nixon et al. (1991) reported an average home range of 114 ha for female deer in agricultural areas of Illinois. In an urban deer population in Bloomington, Minnesota, Grund (1998) reported an average home range of 86.5 ha for females. Deer using a homogeneous habitat may forage in all directions from a core area, whereas deer in a heterogeneous or poorer quality habitat may need larger elongated home ranges to access required habitat resources. Thus encroachment of deer into urban areas may be a function of habitat condition, deer density, and the size and shape of the preserve. To increase our understanding of this behavior, we compared the home ranges and habitat use of female white-tailed deer in 2 urban forest preserves near Chicago, Illinois.

Study area

We selected the Des Plaines and Palos Forest Preserves because urbanization characteristics, human demographics, habitat differences, and deer densities represent the range of conditions found in urban forest preserves. An intensively developed urban area surrounds Des Plaines and human use of the preserve is high (Figure 1). Des Plaines vegetation is overbrowsed displaying a distinctive browse line. The preserve is dominated by scrub buckthorn (*Rhamnus* spp.) and maples (*Acer* spp.) and has few mast-producing trees. By contrast, Palos is located in a less intensively developed area and is less accessible to humans (Figure 2). Palos vegetation is dense, and mast-producing trees such as oaks (*Quercus* spp.) and hickories (*Carya* spp.) are abundant.

Methods

We captured deer using remote-controlled drop nets (Ramsey 1968) and dart guns (Kilpatrick et al. 1997). Deer were manually restrained and immobilized with Cervazine® or a Telazol®/Cervazine® mixture antagonized with yohimbine hydrochloride or reversed with Antagonil®. Deer were fitted with radio collars (Advanced Telemetry Systems, Isanti, Minnesota) and numbered ear-tags. Telemetry locations were collected once per week and varied between day and night fixes (May 1998 – March 1999). We monitored each deer to acquire a minimum of 14 locations for estimation of 95% minimum convex polygon (MCP, Mohr 1947) home ranges. Radio bearings were taken from fixed points that were surveyed with a Geographic Positioning System (GPS) to obtain triangulated locations on each animal. Bearings were taken from 2 truck-mounted, 4-element yagi antennas, aligned in a null-peak configuration. Telemetry bearings were entered into Locate II (Nams 1990) to estimate locations and we used CALHOME (Kie et al. 1996) to plot home ranges. Home ranges were imported into a Geographical Information System (GIS, ArcInfo® and ArcView®) for analysis with respect to digital land cover maps. We used a t-test (= 0.05) to compare home range sizes between preserves (Sokal and Rohlf 1995). Home range shapes were also measured to test for linearity. For each home range we measured the longest linear axis (LLA) possible and the longest linear axis perpendicular to the LLA. The ratio of the perpendicular to the LLA was used to index shape (scale: 1 [circular] – 0 [linear]). Shape indices were compared using a Kruskal-Wallis test. GIS images were used to classify the land-use surrounding both preserves and to describe how this may affect spatial home range patterns.

Results

We captured and radio-collared 21 female deer, 10 in the Des Plaines study site and

11 in the Palos study site. Mean home range area of urban female deer was 43.3 ha. Mean home range area differed significantly ($P < 0.02$) between the 2 preserves (Table 1). Mean 95% MCP contours were larger in Des Plaines (60.8 ha) than in Palos (25.8 ha). The shape index was significantly different ($P < 0.02$) between Des Plaines (mean = 0.43) and Palos (mean = 0.62) indicating that home ranges at the Des Plaines site were more linear. Home ranges at both study sites showed substantial overlap (Figures 1,2). Des Plaines females used more non-preserve areas including some urban habitats whereas Palos females restricted their home ranges to forest and grassland cover types within the preserve.

Table 1. Comparison of mean 95% minimum convex polygon (MCP) home ranges for female deer from Des Plaines and Palos Forest Preserves (Chicago, Illinois, 1998-99).

Preserve	*n*	MCP (ha)	SE
Des Plaines	10	60.7570	13.174
Palos	11	25.8409	4.919

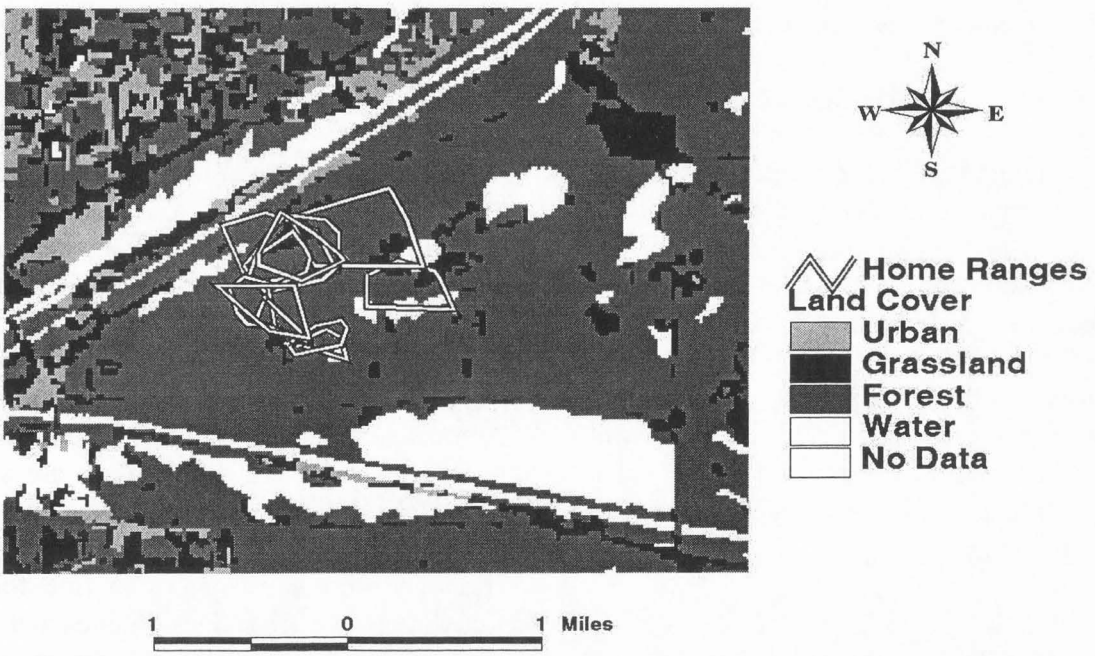

Figure 1. Home ranges of female white-tailed deer in Des Plaines Forest Preserve (Chicago, Illinois, 1998-99).

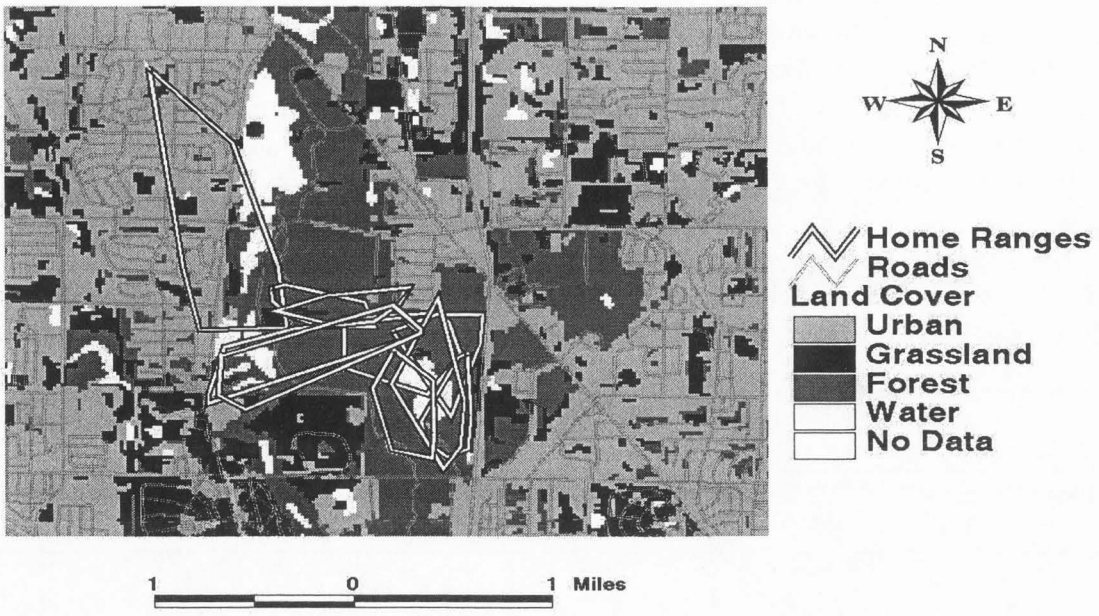

Figure 2. Home ranges of female white-tailed deer in Palos Forest Preserve (Chicago, Illinois, 1998-99).

Discussion

Differences in home range area and shape between preserves might be explained by differences in landscape patterns, particularly urban development. Female deer in Des Plaines crossed rivers and roads to feed in residential areas (Figure 1). In particular, a Des Plaines doe established a home range that extended into urban areas to access isolated green spaces well outside of forest preserve boundaries. Deer in Palos maintained home ranges within the preserve boundaries (Figure 2).

Landscape composition, deer density, and food availability within preserves interact to determine a deer's home range characteristics. If deer densities exceed ecosystem carrying capacity, intraspecific competition increases and available food resources decrease. We hypothesize that the combination of small preserve width and overbrowsed vegetation prompted deer to expand home ranges into residential areas at Des Plaines. Fertilized lawns, flowers, shrubs, and ornamental plants provide nutritious food for urban deer (Swihart et al. 1995). Additionally, competition for fawning sites in high-density preserves may force subordinate females into neighboring areas to raise fawns. Home ranges of Palos deer are smaller, possibly because food resources and habitat are more abundant. Thus, female deer traveled shorter distances to find food and cover. Deer from Des Plaines used areas outside the security of the forest preserve resulting in linear home ranges (Figure 1). Palos deer maintained centralized, circular home ranges and apparently did not need to forage outside preserve boundaries (Figure 2).

Home ranges of does around Chicago are among the smallest reported for whitetails throughout their range (e.g. Progulske and Baskett 1958, Smith 1970, Nixon et al. 1991, Grund 1998). Past studies have reported that home range sizes of deer increase with population decrease (Bridges 1968, Smith 1970). Our observations suggest that home range area may expand when deer densities exceed ecosystem carrying capacity. Thus, it may be especially important to control deer densities in urban areas to preserve local plant communities and to minimize deer/human conflicts. Understanding urban deer movement and habitat use will assist managers and landscape designers to minimize deer/human conflicts. It will also assist with ecosystem management of insular forest preserves and provide information for lethal and non-lethal deer management.

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