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EASTERN SCREECH-OWL HOME RANGE AND USE OF SUBURBAN HABITATS IN SOUTHERN CONNECTICUT

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The Eastern Screech-Owl (*Otus asio*) is widespread in North America and common in the mosaic of woodland and meadow habitats that characterize much of the eastern United States (Bent 1938). Our observations reveal that it is the most abundant raptor in suburban, rural, and urban open space habitats of southern Connecticut. Despite local abundance, little is known of its ecology because of its nocturnal activity patterns and concealed roosting during the day.

Previous studies have focused on food habits (e.g., Errington 1932, Ross 1969) and life history (e.g., Allen 1924, Kelso 1938, Van Camp and Henny 1975). We used radiotelemetry to investigate changes in home range and habitat use by screech-owls from November through June in suburban environments of southern Connecticut.

METHODS AND MATERIALS

We captured 15 screech-owls using a modified bal-chatri trap (Smith and Walsh 1981) and by periodically checking 35 nest boxes placed at intervals of 45–80 m in 2 of the 4 study areas (New Canaan and Orange). Captured owls were weighed and fitted with radiotransmitters (Custom Electronics, Urbana, Ill., and Wildlife Materials, Inc., Carbondale, Ill.) in 1 of 3 backpack styles (Smith and Gilbert 1981). Transmitters weighed 4.6–6.3 g. Flight ability of each transmitter-equipped owl was tested in an 8 × 12 m enclosure before release at the site of capture.

Bearings were taken simultaneously from 2 stations using receivers (TRX-24, Wildlife Materials, Inc.) with 3 element yagi antennas mounted on aluminum tripods equipped with a compass rose. Walkie-talkies were used to synchronize bearings. During the first month, November, bearings were obtained at intervals of .5–1.5 h throughout the night. Starting in January, bearings were usually taken on alternate nights from 4–5 h after twilight (or first detected movement) to 2300, 2300–0300, or 0300 to light (or last detected movement). Intervals between readings ranged from 1–3 min during periods of movement to 5–15 min at other times. We tried to obtain readings during at least a portion of every hour of darkness or movement at least once per month and in all weather conditions.

Because problems of radio-signal "bounce" and frequency interference occur in suburban areas, we subdivided the study areas into several blocks, each with 2 designated stations from which to obtain readings. When the owl moved into another block, we discontinued readings and moved our equipment to designated stations in the new block. Distance of the owls from one or both receivers ranged from 6–70 m in each block. We checked accuracy of azimuth readings at these distances with

TABLE 1. Home range of 6 screech-owls tracked in New Canaan, Connecticut.

Month	Owl no.	Sex[a]	Total locations	Monthly home range[b] Area (ha)	Max. dia (km)	Av. nightly home range[b] No. nights	Av. area	Range
November	NC-4	U	161	75.2	1.67	3	26.5 ± 17.1	13.5–45.2
December	NC-5	U	16	8.8	0.25	—	—	—
	NC-7	U	42	39.4	0.84	—	—	—
	NC-8	U	30	28.2	0.52	—	—	—
January	NC-6	F	94	32.7	1.16	4	15.7 ± 14.2	5.1–35.6
February	NC-6	F	127	100.2	1.35	10	15.3 ± 11.7	3.9–35.6
March	NC-6	F	201	85.1	1.38	13	5.9 ± 4.9	1.3–15.2
April	NC-6	F	265	42.7	1.11	9	5.9 ± 4.9	1.3–12.7
May	NC-6	F	14	13.8	0.75	1	—	—
	NC-10	M	13	9.9	0.68	1	—	—
June	NC-6	F	162	107.5	1.40	9	8.9 ± 5.1	2.7–19.9
	NC-10	M	118	95.3	1.15	8	7.6 ± 7.5	2.4–19.9
Total observed home range	NC-6	F	863	130.2	1.55	—	—	—
	NC-10	M	131	103.4	1.27	—	—	—

[a] Sex: M = male, F = female, U = unknown.
[b] Based on a minimum of 10 locations.

hand-held transmitters placed at varying heights and distance intervals in each block. In addition, early in the study, we spotlighted owls whose locations had been plotted. Azimuth errors ranged from 0° to ± 2° at maximum distances, and average error of azimuth in each block was approximately ±0.5°. Locations were determined by triangulation and plotted on 1:2400 aerial photographs. We placed all locations at the center of the error polygon (Springer 1979). Home range boundaries were determined by the minimum area method (Mohr 1947).

We recognized 11 categories of habitats on the suburban study area including 3 types of woodland, each with distinctive herb and shrub layer components, and 2 hedgerows which provided different cover: (1) Lawn—maintained lawn around houses with a variety of ornamental trees and shrubs; (2) Old Field—field of various grasses and forbs, with a variety of low trees and shrubs often present including *Juniperus virginiana, Cornus* sp., *Betula* sp., *Acer* sp. Portions infrequently mowed; (3) Apple Orchard—orchard of *Malus pumila* with ground layer of mowed grasses; (4) Red Maple Woodland—primarily deciduous woods dominated by *A. rubrum,* 7–18 m in height with an understory of *Lindera benzoin, Hamamelis virginiana,* saplings of *A. rubrum* and *Betula* sp. Wettest portions with some *Symplocarpus foetidus*; (5) Upland Woodland—primarily deciduous woods of *A. saccharum, Carya* sp., primarily *C. ovata, Quercus* sp., *Liriodendron tulipifera,* trees 8–20 m in height, understory

of *Cornus* sp., *Betula* sp., *Prunus serotina, Kalmia latifolia*; (6) Evergreen Woodland—primarily evergreen woods of *Tsuga canadensis, Pinus strobus,* or *Picea* sp. (usually *P. abies*); (7) Mixed Woodland—deciduous and evergreen components approximately equal in canopy and understory height; (8) Pond—shallow pond including edge and small treeless islands; (9) Deciduous—hedgerow of small trees or shrubs, often *Solanum dulcamara,* or *Ligustrum* sp.; (10) Evergreen—hedgerow of small trees or shrubs, often *Tsuga canadensis, Thuja occidentalis,* or *Rhododendron* sp.; (11) Edge—a strip extending 7 m on either side of the boundary between adjacent habitats.

Owl locations in each habitat type were compared with the availability of that type, both within the owl's home range and within the entire study area, following methods described by Johnson (1980) and Steventon and Major (1982). The latter comparison assumed that owls selected a portion of the entire available area for their home range. Habitat use was calculated by multiplying the number of locations in a habitat by the percent area of the habitat within each owl's territory. Resultant percentages gave each owl equal weighting and were pooled to provide average measures of screech-owl habitat use. Chi-square goodness of fit was used to test habitat use compared to its availability. When differences were significant, we used the Bonferroni z statistic to calculate confidence intervals to indicate habitats used more often or less often than expected (Neu et al. 1974).

RESULTS AND DISCUSSION

Field work included 218 h of radiotelemetry over 109 days and 9 months. Three of the 15 owls removed the transmitters within 2 days and 2 other owls either left the area or their transmitters failed within 3 days. The number of days each of the 10 owls carried a transmitter averaged 31.5 ± 18.8 and ranged from 5–199, while the number of days in which locations of an owl were obtained averaged 14.1 ± 7.9 and ranged from 3–84. Owls with fewer than 26 locations were included in further analyses because each had been tracked throughout at least 3 nights. Locations determined per owl ranged from 11–863.

The home ranges of 6 screech-owls tracked in New Canaan, Connecticut (Table 1) were significantly correlated with number of locations ($r = .64$; $t = 2.43$; $P < .05$) and they varied with month and amount of time an individual was followed. Total monthly home ranges varied from 8.8 ha in December (88 locations for 3 owls) to 107.5 ha in June (280 locations of 2 owls). Home ranges were smallest during December and January and during nesting in April and May. The total home range of female NC-6, tracked from January through June, was 130.2 ha with a maximum diameter of 1.55 km. Her mate, NC-10, was tracked from May through June and had a home range of 95.3 ha with a maximum diameter of 1.15 km. Although the male's smaller home range may in part be a function of sampling intensity, he exhibited smaller monthly

home ranges than his mate in both May and June. Both members of this pair had typically hunted only a small portion of their total home range each night and a larger cumulative portion each month.

The cumulative home range of the 3 owls tracked for the longest time periods, NC-4, NC-6, and NC-10, continued to increase throughout the time monitored. For example, the cumulative home range of owl NC-6 increased 50%, from 32.7 ha (94 locations) to 85.3 ha (185 locations). By 730 locations, the cumulative home range was 90% of the total home range and at 785 locations, the cumulative home range was equal to the total home range. Fuller (1979) found that 2 owl species he studied increased their total home range throughout the study period.

The monthly home range of NC-6 increased in February and March (77% and 65% of her total observed home range respectively) while she was maintaining a territory and selecting a nest site. By late March, NC-6 had prepared at least 2 tree cavities spaced approximately 0.6 km apart, and by 14 April she laid a clutch of 4 eggs in 1 of the cavities. Her April and May home ranges decreased with the onset of nesting and were but 33% and 11% respectively of her total home range. The home range of her mate, NC-10, was also very limited during May. After destruction of their nest by a raccoon (*Procyon lotor*) on 7 June, both owls ranged widely, the female covering 83% of her total observed home range and the male about 96% of his home range during the remainder of the month. Similar changes in home range size during the nest cycle have been reported in a variety of avian species. Marked decreases through incubation and brooding have also been reported in other avian species. Marked decreases from before laying through incubation and brooding have been observed in Great Horned Owls (*Bubo virginianus*) and Barred Owls (*Strix varia*) by Fuller (1979).

Observed nightly home ranges were largest from November through February and decreased during spring and summer months. Owl NC-6 covered an average of 15.5 ha (12% of total home range) on 4 nights in January and 10 in February compared to an average coverage of 5.4 ha (4%) in March and April and 8.9 ha (7%) in June. Another owl, NC-4, covered an average of 35% of its total home range on 3 nights in November. The larger nightly home ranges during winter may reflect a need to cover greater areas to obtain adequate food.

Habitat selection.—A comparison of habitat use with habitat availability was made for all radio-tracked owls (Table 2). Although 66% of our data were from owl NC-6, those data did not differ significantly in habitat use from those of other owls tracked during the same time periods. Habitat use of other owls was determined from at least 3 complete nights of tracking. We pooled data of all owls for further analysis.

Use of available habitats differed significantly ($\bar{x} = 122.4$, $P < .05$, $df = 10$). Habitats with the greatest absolute use included red maple woodland (41.2%), lawn (16.0%), and edge (9.0%). Comparison of observed habitat suggests that 4 habitats, red maple woodland, upland

TABLE 2. Comparison of screech-owl habitat use with habitat available in southern Connecticut.

Habitat	% of available habitats	Expected no. Screech Owl locations in habitat type[1]	Obs. no. Screech Owl locations in habitat type	% of home range	Confidence interval of obs. (%)
Lawn	39.3	514	209[b]	16.0	$13.5 \leq p_1 \leq 18.5$
Old field	10.5	138	156	11.9	$10.4 \leq p_2 \leq 13.4$
Apple orchard	0.4	5	14	1.1	$0.4 \leq p_3 \leq 1.8$
Red maple woodland	24.6	322	540[c]	41.2	$39.0 \leq p_4 \leq 34.3$
Upland woodland	2.8	38	67[c]	5.1	$4.1 \leq p_5 \leq 6.1$
Evergreen woodland	9.7	127	104[b]	7.9	$6.7 \leq p_6 \leq 9.1$
Mixed woodland	5.7	75	23[b]	1.8	$0.9 \leq p_7 \leq 2.7$
Pond	2.0	26	28	2.1	$1.4 \leq p_8 \leq 2.8$
Deciduous hedgerow	1.4	18	18	1.4	$1.1 \leq p_9 \leq 1.7$
Evergreen hedgerow	0.5	6	33[c]	2.5	$1.8 \leq p_{10} \leq 3.2$
Edge	3.1	41	118[c]	9.0	$7.7 \leq p_{11} \leq 10.3$
Totals	100.0	1310	1310	100.0	

[a] Calculated as proportion of number of locations to available habitat.
[b] Use less than expected ($P < .05$).
[c] Use greater than expected ($P < .05$).

woodland, evergreen hedgerow, and edge were used more often than expected, and 3 habitats, lawn, mixed, and evergreen woodland, were used less often than expected. Use of the other 4 habitats, apple orchard, old field, pond, and deciduous hedgerow, did not differ from the number of locations expected if the owls had entered the habitat by chance alone.

Monthly use of the 11 habitat categories by 6 screech-owls traced on the New Canaan study area from November–June is presented in Table 3. Observed frequency of use is compared with expected frequency of use based on habitat availability within each owl's home range during each month. Chi-square results indicate that the owls selected certain habitats in all months ($P < .01$) except December and May, but the latter may reflect nest-site placement within the study area. Comparison of observed and expected habitat use within the owl's home range and within the total study area clearly shows that home range placement is the first measure of screech-owl habitat selection, followed by greater use of selected habitats within the home range. For example, the expected number of locations in habitat such as lawn is consistently higher for the total study area as compared to the home range, and the reverse is true of such selected habitats as red maple woodland. Use of lawn was highest during May, at which time it comprised a large portion of the nesting pair's territory. Lawn use was variable during other months.

TABLE 3. Bimonthly screech-owl habitat use compared with habitat available within home range and within the total suburban study area of New Canaan, Connecticut.[a]

	Nov/Dec			Jan/Feb			Mar/Apr			May/June		
		Exp[b]			Exp			Exp			Exp	
Habitat	Obs	I	II	Obs	I	II	Obs	I	II	Obs	I	II
Lawn	43	58	98[c]	29	69[c]	87[c]	72	129[c]	183[c]	64	98[c]	121[c]
Old field	31	50[c]	27	37	28	23[d]	43	91[c]	49	39	44	32
Apple orchard	2	4	1	0	1	1	6	4	2[d]	2	1	1
Red maple woodland	123	94[d]	61[d]	85	72	55[d]	203	138[d]	115[d]	101	104	75[d]
Upland woodland	19	11[d]	7[d]	8	4[d]	6	16	6[d]	13	10	7	9
Evergreen woodland	8	7	24[c]	5	32[c]	21[c]	37	63[c]	44	48	33[d]	29[d]
Mixed woodland	1	1	14[c]	2	6[c]	12[c]	11	10	26[c]	9	8	18[c]
Pond	11	10	5[d]	6	3	5	5	8	9[c]	4	10[c]	7
Deciduous hedgerow	0	2	3	7	2[d]	3[d]	8	2[d]	7	3	1[d]	4
Evergreen hedgerow	0	1	1	14	2[d]	1[d]	13	6[d]	24	6	1[d]	1[d]
Edge	11	8	8	28	4[d]	7[d]	53	9[d]	14[d]	21	4[d]	10[d]
Totals[e]	249	246	249	221	223	221	467	466	464	307	311	307

[a] Methods of determining expected number of locations within home range and for total study area described in text.
[b] I = within home range; II = within total study area.
[c] Use less than expected ($P < .05$).
[d] Use greater than expected ($P < .05$).
[e] Totals of observed and expected may differ due to rounding.

Although not classified as a selected habitat, lawn was a major component of all monthly home ranges and we often observed screech-owls using ornamental trees and shrubs as perch sites while hunting in this habitat. Use of a wet woodland, such as red maple woodland in this study, is consistent with the behavioral ecology and food habits of this species as summarized by Bent (1938). Use of red maple woodland and upland woodland was highest from November through March, coincident with the period of minimum ground cover and tree and shrub foliage. Use of these 2 woodland habitats decreased with growth of ground cover and leafing out during late spring and summer. We did, however, observe extensive use of red maple woodland by the nesting pair hunting insects during April and part of May. Use of an old field was highest during winter months and decreased with growth of grasses and herbs. Most of the .4–.8 ha homelots had one or more boundaries of deciduous or evergreen hedgerows. Screech-owl use of evergreen hedgerows of yew, rhododendron, hemlock, and arbor vitae was greater than expected in 5 of 8 months, probably because of the increased concealment provided by the evergreen foliage during the winter months. Use of edge was lowest during November and December and thereafter was greater than expected each month through June. Approximately 85% of all edge locations were of types of woodland or woodland and old field habitats, and less than 5% were of woodland and lawn habitats. The latter may reflect the fact that woodland-lawn boundaries are often sharply defined in suburban habitats and do not provide the increased diversity of plant and animal life characteristic of most edge habitats. Screech-owl use of other habitats was inconsistent and no clear trends could be determined.

Ellison (1980) examined habitat selection of resident screech-owls near Amherst, Massachusetts, by analyzing time spent in each habitat. His results were similar to ours and showed a positive association with edge, running water, wet woodlands, and open, weedy areas, and a negative association with dry upland woods, especially softwoods.

The New Canaan study area is an older suburban community comprised of a variety of habitats that at least partially offset the presence of large amounts of lawn. More recent suburban developments are often comprised largely of lawn and lack mature trees which provide nesting and roosting sites. These factors may limit screech-owl presence and use of new suburban developments.

SUMMARY

Ten Eastern Screech Owls were tracked from November–June using radiotelemetry. Home ranges varied with month, number of locations, and total amount of time an individual was tracked. Total home range of one female was 130.9 ha, but she typically hunted only a small portion of this each night and a larger cumulative portion each month. Home range was largest while a female was selecting a nest site. Smallest home range was during egg laying, incubation, and care of young. Owls tracked

preferred red maple and upland woodland, edge, and evergreen hedgerows. Less used habitats included lawn and mixed and evergreen woodlands.

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