

HABITAT USE BY EASTERN SCREECH-OWLS IN CENTRAL KENTUCKY

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Abstract.—Habitat use by 17 radio-tagged Eastern Screech-Owls (*Otus asio*) was examined in central Kentucky. On a rural study area, owls used woodlot (deciduous forest) and edge habitats more than expected based on availability, and used pastures, old fields and cropland less than expected. Screech-owls may prefer wooded habitats because they offer increased prey availability and suitable hunting perches. During the non-breeding period, some adult screech-owls increased use of woodlot habitat. This shift may reflect improved hunting conditions in woodlots and changes in roosting behavior during winter, i.e., owls shift to roosting in tree cavities in woodlots. Juvenile screech-owls used edge habitats more during the non-breeding (post-dispersal) period. If woodlot habitat is preferred during this period, as indicated by the behavior of adults, then resident, adult screech-owls may be limiting juveniles to suboptimal edge habitats.

HABITAT UTILIZADO POR *OTUS ASIO* IN LA PARTE CENTRAL DE KENTUCKY

Síopsis.—Se estudió en la parte central de Kentucky la utilización de hábitat por individuos del buho *Otus asio*, colocándoles radiotransmisores a 17 individuos. En un área rural de estudio, los buhos utilizaron, más de lo esperado (en base a disponibilidad de hábitat), áreas de bosques (bosque deceduo) y hábitats marginales y en menor grado, que lo esperado, pastizales, campos agrícolas y tierras de cultivos. Las aves pueden haber preferido áreas de bosques porque éstas podrían ofrecer mayor probabilidad de encontrar perchas adecuadas para cazar y presas. Durante la época no-reproductiva, algunos buhos adultos incrementaron el uso de áreas de bosques. Este cambio puede reflejar una mejoría en las condiciones para cazar en estos bosques y cambios en la conducta de pernoctar durante el invierno (ej. que los buhos cambien a pernoctar en cavidades en los bosques). Los juveniles utilizaron hábitat marginal con mayor frecuencia durante la época no-reproductiva. Si las áreas de bosque son preferidas durante este período por los adultos, como indicado por su conducta, es probable entonces que los adultos residentes muy bien puedan estar forzando a los juveniles a utilizar hábitats subóptimos.

Eastern Screech-Owls (*Otus asio*) are common nocturnal predators distributed throughout much of eastern North America. These owls occupy a wide variety of areas, including deciduous woods, orchards, rural-agriculture areas and urban-suburban towns and cities (Bent 1938, Duley 1979, Ellison 1980, Smith and Gilbert 1984). Despite their presence in each of these areas, use of specific habitats is known only for suburban areas (Ellison 1980, Smith and Gilbert 1984) and areas with orchards treated with rodenticide (Hegdal and Colvin 1988). Additionally, little is known concerning habitat use by paired adults or family groups. In this study, we examined habitat use by paired adults and young Eastern Screech-Owls in central Kentucky. Specifically, our objectives were to (1)

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examine habitat use by adult and juvenile screech-owls in a rural area, (2) determine seasonal changes in habitat use by adults and (3) determine if habitat use by juveniles prior to dispersal differed from habitat use following dispersal.

METHODS

We tracked screech-owls from 30 May 1985 through 5 Jul. 1986 in and near the 680-ha Central Kentucky Wildlife Management Area (CKWMA), located 17 km southeast of Richmond, Madison County, Kentucky. The management area consists of small deciduous woodlots and thickets interspersed with cultivated fields and old fields (Belthoff 1987, Sparks 1990). Areas surrounding the CKWMA are mainly agricultural.

We captured adult Eastern Screech-Owls either at artificial nest boxes and natural tree cavities, or by luring them into mist nets by broadcasting bounce songs (Ritchison et al. 1988). Nests were located by following radio-tagged adults and by examining suitable tree cavities. We captured nestlings at nests several days prior to fledging. Adults and juveniles were equipped with radio-transmitters (Wildlife Materials, Inc., Carbondale, Illinois) and U.S. Fish and Wildlife Service aluminum bands. Transmitters were attached backpack style with woven nylon cord (Smith and Gilbert 1981).

We determined locations of owls by triangulation using receivers (TRX-24, Wildlife Materials, Inc. or TR-2, Telonics Inc., Mesa, Arizona) and two-element yagi antennas. Two individuals at separate stations and in radio contact took simultaneous readings. Tracking periods usually began at or shortly after sunset and ranged from 2 to 4 h in duration. We conducted all tracking sometime during the period between 1800 and 0400 hours. Locational error determined in all habitat types and at different times during the study averaged ± 1 degree (Sparks 1990). We typically located individual owls at 20–30-min intervals during tracking sessions. Although true statistical independence (Swihart and Slade 1985) between successive locations was probably not achieved, we considered successive locations biologically independent (Lair 1987) because a 20-min interval was sufficient for owls to cover their entire home range.

We determined habitat use by adult Eastern Screech-Owls for two biological periods: breeding (1 Mar.–31 Jul.) and non-breeding (1 Aug.–28 Feb.). Habitat use by juvenile screech-owls was also determined for two biological periods: pre-dispersal (period beginning the day young owls left nest cavities and ending the day young left the range of their parents) and post-dispersal. Juvenile screech-owls in central Kentucky typically fledge from nest cavities during the third week in May and initiate dispersal in mid-July (Belthoff and Ritchison 1989). The post-dispersal period began the day after a juvenile initiated dispersal and continued until the juvenile died or its radio-transmitter failed.

We categorized the CKWMA into six habitat types and noted each on a 1:660 color aerial photograph of the study area. Habitat types were as

follows. (1) Woodlot. Primarily deciduous woods with shagbark hickory (*Carya ovata*), sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), and green ash (*Fraxinus pennsylvanica*) in the overstory and roughleaf dogwood (*Cornus drummondii*), redbud (*Cercis canadensis*), spicebush (*Lindera benzoin*), and pawpaw (*Asimina triloba*) in the understory. (2) Woodlot edge. A strip extending 15 m on either side of the boundary between a woodlot and adjacent habitats. (3) Woodrow edge. An area extending 15 m on either side of the center of a narrow strip of woods (typically along either a fence or stream). (4) Old field. Fields containing various grasses and forbs (e.g., *Solidago altissima*, *Aster simplex*, *A. divaricatus*, *Festuca arundinacea*, and *Rubus allegheniensis*), with a variety of small trees and shrubs (e.g., eastern redcedar [*Juniperus virginiana*], Virginia pine [*Pinus virginiana*], and smooth sumac [*Rhus glabra*]) often present. (5) Pasture. Areas consisting largely of fescue (*Festuca pratensis*) and other grasses. (6) Cropland. Areas consisting of corn (*Zea mays*) and sunflowers (*Helianthus* sp.).

We determined boundaries of screech-owl home ranges (Belthoff et al. 1993) using the TELEM program (minimum convex polygon method; Koeln 1980) and superimposed them on aerial photographs of the CKWMA. Using a compensating polar planimeter, we calculated the proportion of each habitat type found within each home range. By multiplying total number of telemetry locations by the proportion of that habitat available (Neu et al. 1974), we calculated the expected number of locations in each habitat type. We assumed that screech-owls frequented areas surrounding nest sites because of the presence of nests rather than preference for a particular habitat type. Thus, we excluded locations (i.e., error polygons [Springer 1979]) containing a pair's nest site from analyses until 1 wk after young screech-owls left the nest.

Using a Calcomp plotter (Model 1073), radio-locations were placed at the center of an error polygon (determined using mean telemetry error of ± 1 degree) with an area of 450 m². If error polygons were entirely within one habitat type, we recorded locations as being in that habitat. If error polygons included a woodlot or a woodrow plus another type of habitat, we classified locations as either woodlot edge or woodrow edge. For open habitats (old field, pasture, and cropland), we used the center of error polygons to classify habitat type.

We used Chi-squared goodness-of-fit tests to test for non-random use of habitats by comparing number of locations in each habitat with availability of habitat types within home ranges of owls. When significant differences were detected, we used the Bonferroni z statistic to calculate confidence intervals to indicate habitats used more or less often than expected (Neu et al. 1974). We set rejection levels at $\alpha = 0.05$.

RESULTS

We radio-tracked 17 Eastern Screech-Owls, including five adult males, five adult females and seven juveniles (Table 1). Individuals were tracked over periods ranging from 31 to 372 d ($\bar{x} = 174$ d). We used 3538 locations

to determine habitat use by Eastern Screech-Owls. Individual habitat locations were not pooled among owls because habitat use differed significantly among individuals ($\chi^2 = 499.8$, $df = 80$, $P < 0.0001$). Habitat use among individuals also differed significantly during the breeding/pre-dispersal ($\chi^2 = 427.9$, $df = 75$, $P < 0.0001$) and non-breeding/post-dispersal ($\chi^2 = 276.8$, $df = 50$, $P < 0.0001$) periods, respectively.

Overall.—Ten Eastern Screech-Owls (four adult males, three adult females, and three juveniles) were radio-tracked during both the breeding/pre-dispersal and non-breeding/post-dispersal periods. Four owls (two adult males and two adult females) exhibited no significant differences (χ^2 , $P > 0.05$) in habitat use between these periods so we pooled their locations into one overall (i.e., annual) category.

Both adult males used edge habitat significantly more than expected; one male used woodrow edges more than expected, and the other male used woodlot edges more than expected. Both males used old field habitat significantly less than expected. One adult female used woodrow edge significantly more than expected and old fields and cropland significantly less than expected. The other adult female used no habitats significantly more than expected and used old fields significantly less than expected.

Breeding/pre-dispersal period.—Adult male Eastern Screech-Owls ($n = 5$) exhibited significant differences ($\chi^2 = 60.1$, $df = 20$, $P < 0.0001$) in habitat use during the breeding season. All males, however, used either woodlot edge ($n = 2$) or woodrow edge ($n = 3$) habitats significantly more often than expected (Fig. 1a). Four males used old fields significantly less than expected and two males used cropland significantly less than expected.

Adult female screech-owls ($n = 5$) exhibited significant differences ($\chi^2 = 203$, $df = 16$, $P < 0.0001$) in habitat use during the breeding season. Two females used woodrow edges significantly more than expected, and one female used woodlot edges significantly more than expected (Fig. 1b). Both cropland and old fields were used significantly less than expected by three females.

All paired males and females ($n = 4$ pairs) exhibited significant differences (χ^2 , $P < 0.0001$ for three pairs and $P = 0.007$ for one pair) in habitat use during the breeding season. Males used edge habitats (especially woodrow edges) more than expected and females used woodlots and woodlot edges more than expected.

Juvenile screech-owls ($n = 6$; three juveniles in each of two families) exhibited significant individual variation ($\chi^2 = 96.2$, $df = 25$, $P < 0.0001$) in habitat use during the pre-dispersal period. Siblings within each family also exhibited significant differences in habitat use ($\chi^2 = 38.3$, $df = 10$, $P < 0.0001$ and $\chi^2 = 21.1$, $df = 10$, $P = 0.002$, respectively). In one family, all three juveniles used woodlot habitat significantly more than expected, and two juveniles used woodlot edges significantly more than expected (Fig. 1c). Two juveniles used old fields significantly less than expected, and cropland and pasture were each used significantly less than expected by one juvenile. In the other family, two juveniles used woodlot

TABLE 1. Habitats used by 17 Eastern Screech-Owls in rural central Kentucky. Home ranges for adults represent overall home ranges (i.e., breeding and non-breeding periods combined). For juveniles, pre-dispersal and post-dispersal home ranges (if tracked during both) are indicated. * denotes $P < 0.05$.

| Owl | Sex | Age ^a | Family | Home range (ha) | Locations (N) | Tracking period ^b | Woodrow | | | | | |
|-----|-----|------------------|--------|-----------------|---------------|------------------------------|--------------------------|-------------------------------|-------------------------------|----------------------------|--------------------------|------------------------|
| | | | | | | | Woodlot (% use (avail.)) | Woodlot edge (% use (avail.)) | Woodrow edge (% use (avail.)) | Old field (% use (avail.)) | Pasture (% use (avail.)) | Crops (% use (avail.)) |
| 866 | M | A | 1 | 68.4 | 282 | 5/85-5/86 | 22 (17) | 40 (25)* | 34 (34) | 4 (24)* | 0 (0) | 0 (0) |
| 876 | F | A | 1 | 59.7 | 214 | 5/85-2/86 | 21 (25) | 13 (18) | 62 (34)* | 4 (18)* | 0 (0) | 1 (5)* |
| 867 | U | J | 1 | 53.3 | 189 | 5/85-11/85 | 33 (19)* | 36 (31) | 27 (28) | 4 (20)* | 0 (0) | 0 (2)* |
| 868 | U | J | 1 | 188.6 | 356 | 5/85-1/86 | 24 (15)* | 24 (13)* | 47 (29)* | 3 (11)* | 1 (29)* | 1 (3)* |
| 869 | U | J | 1 | 49.8 | 180 | 5/85-7/85 | 32 (18)* | 38 (29)* | 24 (24) | 6 (29)* | 0 (0) | 0 (0) |
| 874 | M | A | 2 | 46.6 | 351 | 6/85-9/85 | 27 (18)* | 20 (21) | 44 (34)* | 7 (20)* | 1 (4)* | 1 (3)* |
| 875 | F | A | 2 | 48.4 | 474 | 6/85-6/86 | 44 (27)* | 28 (15)* | 22 (27) | 5 (17)* | 0 (13)* | 1 (1) |
| 870 | U | J | 2 | 46.7 | 195 | 6/85-9/85 | 36 (28) | 28 (16)* | 34 (39) | 1 (13)* | 0 (0) | 1 (4)* |
| 871 | U | J | 2 | 12.3 | 140 | 6/85-7/85 | 58 (67) | 31 (23) | 10 (6) | 1 (4)* | 0 (0) | 0 (0) |
| 872 | U | J | 2 | 26.1 | 136 | 6/85-7/85 | 37 (46) | 50 (38)* | 8 (12) | 5 (4) | 0 (0) | 0 (0) |
| 863 | M | A | 3 | 38.6 | 123 | 7/85-5/86 | 25 (20) | 20 (26) | 50 (31)* | 4 (20)* | 1 (3) | 0 (0) |
| 864 | F | A | 3 | 20.9 | 102 | 7/85-5/86 | 25 (21) | 39 (26) | 27 (17) | 6 (30)* | 3 (6) | 0 (0) |
| 877 | U | J | 3 | 88.9 | 185 | 5/85-12/85 | 17 (15) | 36 (16)* | 39 (31) | 5 (27)* | 2 (8)* | 1 (3) |
| 317 | M | A | 4 | 15.9 | 57 | 4/86-7/86 | 17 (13) | 28 (23) | 42 (24)* | 13 (40)* | 0 (0) | 0 (0) |
| 316 | F | A | 4 | 8.0 | 54 | 4/86-5/86 | 38 (31) | 60 (45) | 0 (0) | 2 (24)* | 0 (0) | 0 (0) |
| 308 | M | A | 5 | 57.0 | 290 | 11/85-7/86 | 40 (34) | 25 (14) | 31 (33) | 3 (17)* | 0 (0) | 1 (2) |
| 315 | F | A | 5 | 35.4 | 210 | 2/86-7/86 | 31 (36) | 44 (43) | 19 (6)* | 5 (8) | 0 (0) | 1 (7)* |

^a A = adult; J = juvenile or young of the year.

^b Mo/Yr.

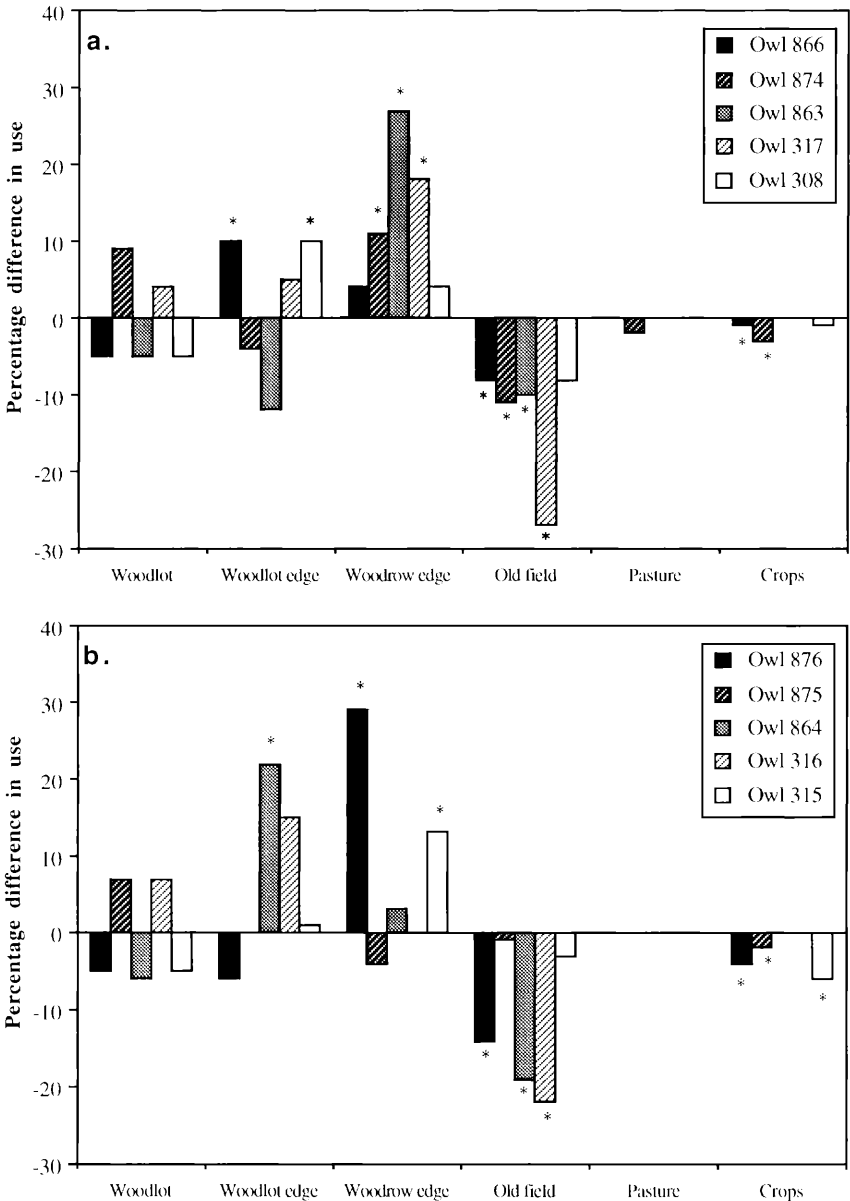


FIGURE 1. Habitat use by Eastern Screech-Owls during the breeding season by (a) adult males, (b) adult females, and (c) juveniles. Values represent percentage differences in use versus availability for each habitat type (i.e., % used minus % available). Significant differences ($P < 0.05$) between habitat use and availability are indicated by an *.

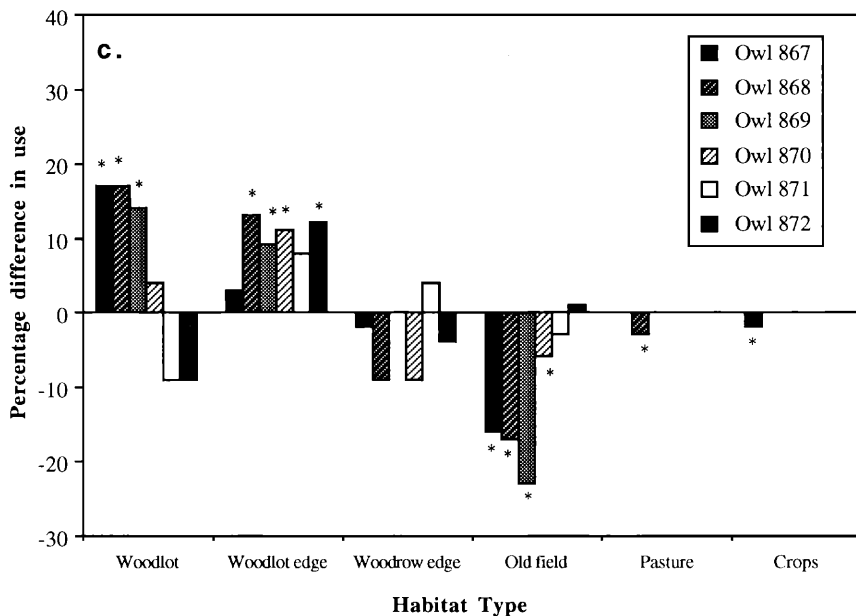


FIGURE 1. Continued.

edges significantly more than expected, and two juveniles used old fields significantly less than expected.

Non-breeding/post-dispersal.—Adult male Eastern Screech-Owls ($n = 4$) differed significantly ($\chi^2 = 58.1$, $df = 15$, $P < 0.0001$) in habitat use during the non-breeding season. Three males used woodlot habitat significantly more than expected, and two males used woodrow edges significantly more than expected (Fig. 2a). All four males used old field habitat significantly less than expected, and one male used cropland significantly less than expected.

Adult female screech-owls ($n = 3$) exhibited significant differences ($\chi^2 = 33.3$, $df = 10$, $P < 0.0001$) in habitat use during the non-breeding season. All females used edge habitats significantly more than expected, two females used woodrow edges more than expected, and one female used woodlot edges more than expected (Fig. 2b). The latter female also used woodlot habitat significantly more than expected. All three females used old fields significantly less than expected, and one female used pasture significantly less than expected.

Individual juvenile Eastern Screech-Owls ($n = 4$) differed significantly ($\chi^2 = 103.7$, $df = 15$, $P < 0.0001$) in habitat use during the post-dispersal period. Three juveniles used woodrow edges significantly more than expected, and the fourth juvenile used woodlot edges significantly more than expected (Fig. 2c). Three juveniles used old fields significantly less than expected, and both cropland and pasture were used significantly less than expected by two juveniles.

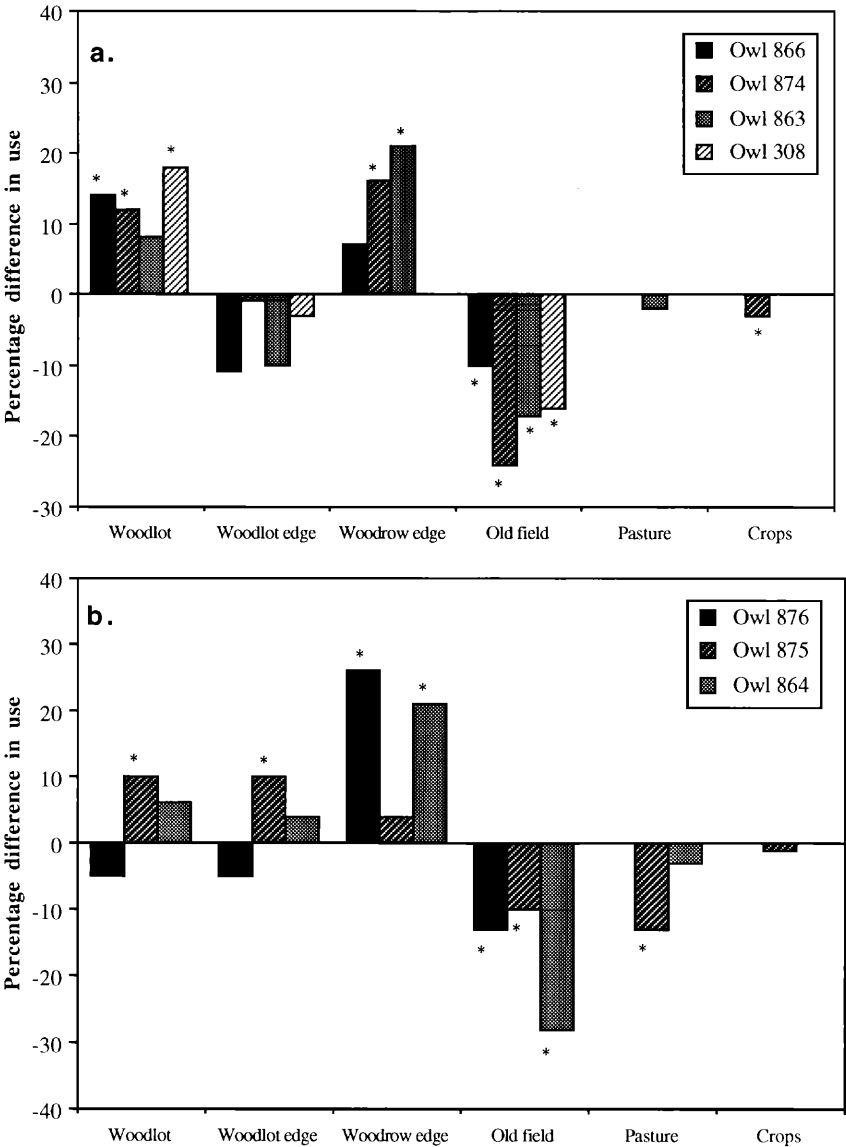


FIGURE 2. Habitat use during the non-breeding/post-dispersal period by (a) adult males, (b) adult females, and (c) juveniles. Values represent percentage differences in use versus availability for each habitat type (i.e., % used minus % available). Significant differences ($P < 0.05$) between habitat use and availability are indicated by an *.

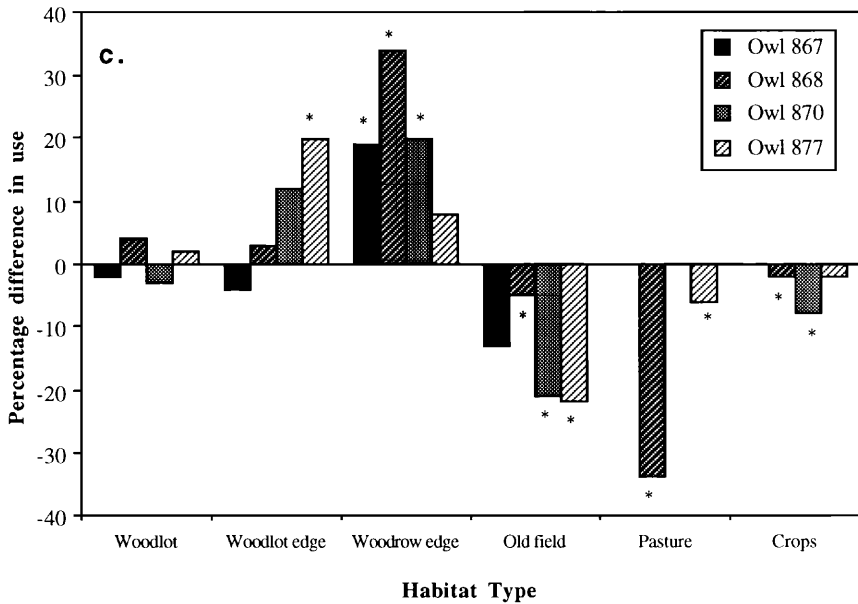


FIGURE 2. Continued.

Seasonal variation in habitat use.—Six (two of four adult males, one of three adult females, and three of three juveniles) of ten screech-owls radio-tracked during both the breeding/pre-dispersal and non-breeding/post-dispersal periods exhibited significant variation in habitat use between periods. The adult female used all but one habitat as expected during the breeding season (cropland was used less than expected) but used both woodlot and woodlot edge habitats significantly more than expected during the non-breeding season. One adult male used woodrow edges more than expected during both the breeding and non-breeding periods but also used woodlot habitat more than expected during the non-breeding period. The other adult male used woodlot edge more than expected during the breeding period but used woodlot habitat more than expected during the non-breeding period. Two juveniles used woodlots more than expected during the pre-dispersal period while the third used woodlot edges more than expected. All three juveniles used woodrow edges more than expected during the post-dispersal period.

DISCUSSION

Our results corroborate those of other investigators (Ellison 1980, Hegdal and Colvin 1988, Smith and Gilbert 1984) in that adult and juvenile Eastern Screech-Owls in rural central Kentucky typically used woodlot, woodlot edge and woodrow edge habitats. Old fields, pastures, croplands, lawns and coniferous forests were generally used significantly less than

expected (Ellison 1980, Smith and Gilbert 1984, this study). Thus, whether in rural or suburban areas, screech-owls use habitats containing a significant woody component, which consists primarily of deciduous trees and shrubs with abundant edge.

Habitat use by screech-owls and other raptors has frequently been interpreted in terms of habitats used by their prey (Ellison 1980, Hegdal and Colvin 1988, Janes 1985, Lynch and Smith 1984, Smith and Gilbert 1984). Ellison (1980:71) observed that for Eastern Screech-Owls "patterns of habitat use are consistent with patterns of predation . . .," and Hegdal and Colvin (1988:256) noted that screech-owl "use of orchard and field-pasture at night should be indicative of foraging behavior . . ." Studies of prey use by Eastern Screech-Owls reveal that voles (*Microtus* sp.) and mice (*Peromyscus* sp.) are among the most frequent mammalian prey, emberizids and muscicapids the most frequent avian prey, and moths and butterflies (O. Lepidoptera), beetles (O. Coleoptera), and crickets and grasshoppers (O. Orthoptera) the most frequent invertebrate prey (Ritchison and Cavanagh 1992). These prey occupy a wide variety of habitats, including, but not limited to, woodlot and edge habitats (Burt and Grossenheider 1964, Craighead and Craighead 1956). Some of these prey species might be found in greater numbers in other habitats, however. For example, Craighead and Craighead (1956) found the highest densities of meadow voles (*Microtus pennsylvanicus*) in habitats with dense grass cover. In addition, many orthopterans are more abundant in open habitats such as old fields (pers. obs.). Thus, although prey availability may promote frequent use of woodlot and edge habitats by Eastern Screech-Owls, other factors are probably important as well.

Eastern Screech-Owls are sit-and-wait predators (Marshall 1967, Norberg 1987). They generally forage "by a short flight from a tree to capture the prey on the ground . . .," and such foraging "is facilitated by open woodland growth, where there is bare ground under the trees and around the edges of groves" (Marshall 1967:7). Frequent use of woodlot and edge habitats may be due in part, therefore, to greater availability of suitable foraging perches in such habitats. In addition, the presence or absence of ear asymmetry may be used to infer the relative importance of hearing versus vision in the hunting strategy employed by owls (Norberg 1987). Owls that hunt in dense forests, such as Boreal Owls (*Aegolius funereus*), must rely more on hearing, and ear asymmetry may enhance foraging efficiency by facilitating detection and localization of prey (Norberg 1987). Absence of ear asymmetry in Eastern Screech-Owls (Marshall 1967) suggests that they rely more on vision when hunting. If true, presumably greater light levels in edge habitats (compared to woodlots) may promote frequent use of such habitats by screech-owls.

Eastern Screech-Owls nest in tree cavities (Belthoff and Ritchison 1990a) and typically roost in either dense foliage, e.g., eastern redcedars (*Juniperus virginiana*) and various deciduous trees covered with vines (Belthoff and Ritchison 1990b), or tree cavities (Smith et al. 1987a; pers. obs.). Use of such nesting and roosting sites, which are typically found

in woodlot and edge habitats, may also contribute to selective use of woodlot and edge habitats by screech-owls.

Our results suggest that Eastern Screech-Owls vary their use of habitats by season. Three adults (two males and one female) used woodlot habitat more during the non-breeding season than during the breeding season (see also Smith and Gilbert 1984). Increased use of woodlot habitat during autumn and winter may reflect changes in relative prey abundance or improved hunting conditions. Smith and Gilbert (1984) noted that periods of increased use of woodland coincided with periods of minimum ground cover and tree and shrub foliage. Loss of foliage may also increase light levels within woodlots, which may be important if screech-owls rely primarily on vision when hunting.

Changes in roosting behavior may also contribute to increased use of woodland habitat by screech-owls during the non-breeding period. During the breeding period, Eastern Screech-Owls typically use open limb, tangle or conifer roosts (Belthoff and Ritchison 1990b). In contrast, during the non-breeding period, Eastern Screech-Owls frequently roost in tree cavities (Belthoff and Ritchison 1990b, Smith et al. 1987a), which are typically found in woodlot habitat. During the non-breeding period, and especially during colder weather, screech-owls sometimes remain in cavity roost sites for extended periods during the night (pers. obs.). Screech-owls may carry prey to cavities before feeding to reduce their vulnerability to predation by larger owls (VanCamp and Henny 1975) and, in addition, cavities provide a more favorable microclimate during periods of cold weather (McComb and Noble 1981, Smith et al. 1987a).

In contrast to adults, three juvenile screech-owls radio-tracked during both the pre- and post-dispersal periods used woodlot or woodlot edge habitats significantly more than expected during the pre-dispersal period but used woodrow edge habitat significantly more than expected during the post-dispersal period. Assuming that increased use of woodlot habitat by adult screech-owls during the non-breeding period indicates that this habitat provides several beneficial features (e.g., suitable cavities for roosting and improved hunting conditions because of limited foliage), increased use of woodrow edges and decreased use of woodlots by juveniles during this same period seems puzzling. One possible explanation is that resident adult screech-owls, who defend their territories throughout the year (Belthoff et al. 1993, Ritchison et al. 1988, Smith et al. 1987b), may sometimes limit juvenile screech-owls to suboptimal habitats.

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