

ACTIVITY PATTERNS AND HOME-RANGE USE OF NESTING LONG-EARED OWLS

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ABSTRACT.—A study of the movements of two pairs of nesting Long-eared Owls (*Asio otus*) was conducted during the spring and summer of 1982. Activity patterns, movements, and home-range use of the owls changed during the nesting season. The female incubated and brooded the young, while the male did most of the foraging, particularly when the female was attending eggs or very small nestlings. Mates shared a common core home range immediately around the nest site, but foraged in different areas away from the nest. The home-range areas of adjacent nesting pairs overlapped. Although changes in temperature significantly affected the movements of one of the female owls, wind speed, precipitation, and cloud cover appeared to have little influence on movements of the birds. During their nocturnal period of activity, owls were least active from 20:00–22:00 and 05:00–06:00. Received 8 Apr. 1987, accepted 28 Sept. 1987.

Most research on Long-eared Owls (*Asio otus*) in North America has dealt with food habits, productivity, and nest-site selection (Armstrong 1958, Marti 1976, Craig and Trost 1979, Roth and Powers 1979, Marks 1986). Little information has been published on activity patterns, movements, and home-range.

We used radio-telemetry to study the activity patterns and movements of Long-eared Owls on the Idaho National Engineering Laboratory (INEL) in southeastern Idaho during the summer of 1982, in an attempt to obtain information on home-range, activity patterns, and movements of adult Long-eared Owls during the nesting season.

STUDY AREA AND METHODS

The INEL encompasses 231,600 ha of flat to gently rolling cool desert (Odum 1971) on the Upper Snake River Plain dominated by big sagebrush (*Artemisia tridentata*)-grass vegetation (Harniss and West 1973). The Big Lost River flows across the INEL, and the typical vegetation of the Snake River Plain is interrupted along the banks of the river by cottonwood trees (*Populus* sp.), which range in height to well over 9 m. There are few shrubs beneath the trees, probably because flow of the river is reduced or eliminated in late summer as a result of irrigation upstream and decreased snowmelt, although river hawthorn (*Crataegus rivularis*) and wild rose (*Rosa* sp.) do occur. Long-eared Owls nested in old Black-billed Magpie (*Pica pica*) nests in the cottonwood trees along the river. Adult owls were captured in mist nets at 3 nest sites during May and June 1982. Each captured adult was banded with a U.S. Fish and Wildlife Service band and fitted with a back-pack radio harness. The radios weighed 4–5 g (<2% of total body weight) and were attached with elastic straps that fit around the base of each wing. The range of the radios varied with weather conditions,

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but was generally about 3 km. Birds at 2 of the nests, approximately 3.5 km apart, were monitored for the entire nesting season (21 May–9 July). At the third site both owls abandoned their nest 2 days after we attached the radios on 22 May. The male was never located after this (including aerial searches), but the female was found about 3 km from the nest 5 days after nest abandonment.

The owls at one nest (3-pole) were tracked for 8 nights from late incubation until the young left the nest area; about a week after branching (the time when young owls that leave the nest perch in the surrounding vegetation). The owls at the second nest (KB5) were tracked for 9 nights from the time the young were about 12 days old until they left the nest area. Tracking was delayed at least 4 days after radio-tagging to allow the birds time to adjust to the transmitters. Radio locations were determined by triangulation using 2 portable towers (4.6 m high) equipped with out-of phase 5-element yagi directional antennae and a null combiner system (Telonics, Mesa, Arizona). Two people at separate stations and in radio contact took simultaneous readings on first one adult and then the other at a nest site at 10-min intervals throughout the night. Tracking began between 20:00 and 21:00 and continued through 05:00 to 06:00. Sunset occurred at about 20:30 and sunrise at about 06:15 (MDT). One nest was monitored each tracking night.

In addition to location, we recorded temperature, wind speed, cloud cover (recorded on a scale of 1–4), precipitation and general weather conditions at each 10-min interval. Regression analysis was used to examine possible relationships between owl movements and environmental factors. Because owl movements changed significantly during the nesting season, we analyzed data separately for each day. Regression analysis was also used to analyze the relationship between age of the young and time adults spent in the nest area.

Locations were plotted on a map of the study area and triangulation error was estimated with readings on both moving and stationary transmitters at known locations (after Springer 1979). Average locational error of a stationary transmitter at 0.5 km was ± 24 m ($\pm 2.5^\circ$ error). Readings taken on a transmitter 0.5 km away, moving along a known route at a velocity of approximately 6.5 km/h, yielded an average locational error of ± 41 m ($\pm 5.8^\circ$ error). These errors varied with the angle and distance of the owls from the tracking stations (Springer 1979). Because of possible locational error, we were unable to determine if owls were on the nest or adjacent to it; therefore, in data analysis birds were described as being in the “nest area.” Home ranges, or use areas, were determined using a modification of the grid system described by Rongstad and Tester (1969) and Laundré and Keller (1981). We included in our home range maps, however, all grids entered by the owls regardless of distance from the closest neighboring grid in which the owls were recorded. Grids were 300 m on a side (8.8 ha) with the nest the center of the grid system. Home ranges of female owls were more accurate estimates of actual use areas than those of males because males were frequently out of range of the tracking towers.

Distances moved were determined by measuring the minimum straight-line distance between successive radio locations. Distance data were analyzed using regression analysis. Movements per hour were analyzed by dividing the number of moves by the total number of radio locations per hour (expressed as a percentage). Hourly movement data were analyzed using a chi-square goodness-of-fit test with Yates' correction for continuity (Zar 1974).

Food habits were determined from castings collected at nest sites. Castings were soaked in a weak NaOH solution and sieved through screen wire and 0.3-cm hardware cloth.

RESULTS AND DISCUSSION

Initially, both study nests contained 4 eggs; however, only 2 young branched from one nest (KB5), whereas at least 3 young branched from

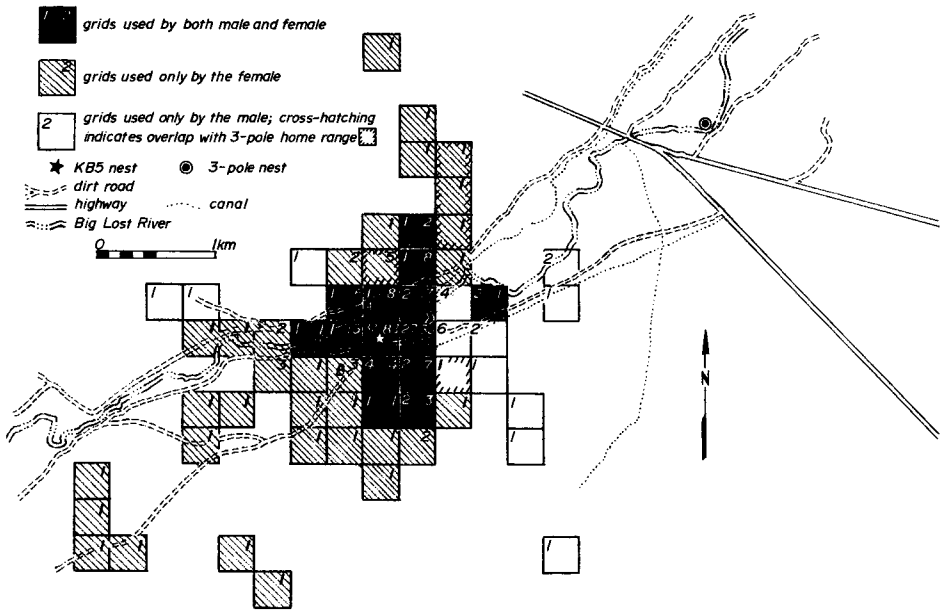


FIG. 1. Home-range areas of adult male and female Long-eared Owls at the KB5 nest on the Idaho National Engineering Laboratory. Numbers in the upper right (female) and left-hand (male) corner of the squares indicate how many radio locations were obtained per bird in each 8.8 ha grid during the nesting season. Letters indicate the locations of the tracking stations.

the second nest (3-pole). The young at KB5 branched at 35 days, and the young at 3-pole branched at 24 days of age. Most other researchers have reported that young Long-eared Owls branch within 3 weeks of hatching (Armstrong 1958, Craig and Trost 1979, Hilliard et al. 1982, Wijnandts 1984, Marks 1986). The owlets at KB5 had scabs around their eyes and one disappeared from the nest 2–3 weeks after hatching.

Influence of environmental factors on movements.—There was no relationship between the distance the male or female moved each day and wind speeds up to 25 km/h, cloud cover, or precipitation ($P > 0.05$). We did not, however, monitor the birds during lightning storms, and owl behavior may have changed during these periods. Similarly, DeLong's (1982) direct observations revealed no relationship between prey deliveries and wind speed (up to 20–27 km/h). In addition, he found no relationship between the rate of prey delivery by males and cloud cover, light precipitation, or temperature, but noted that prey deliveries were not made during extended periods of heavy rain.

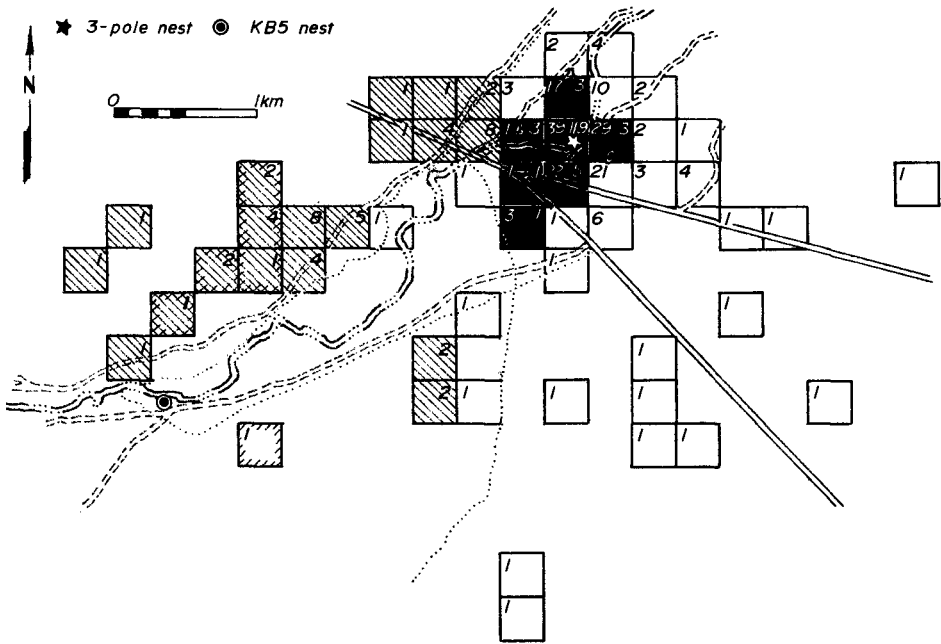
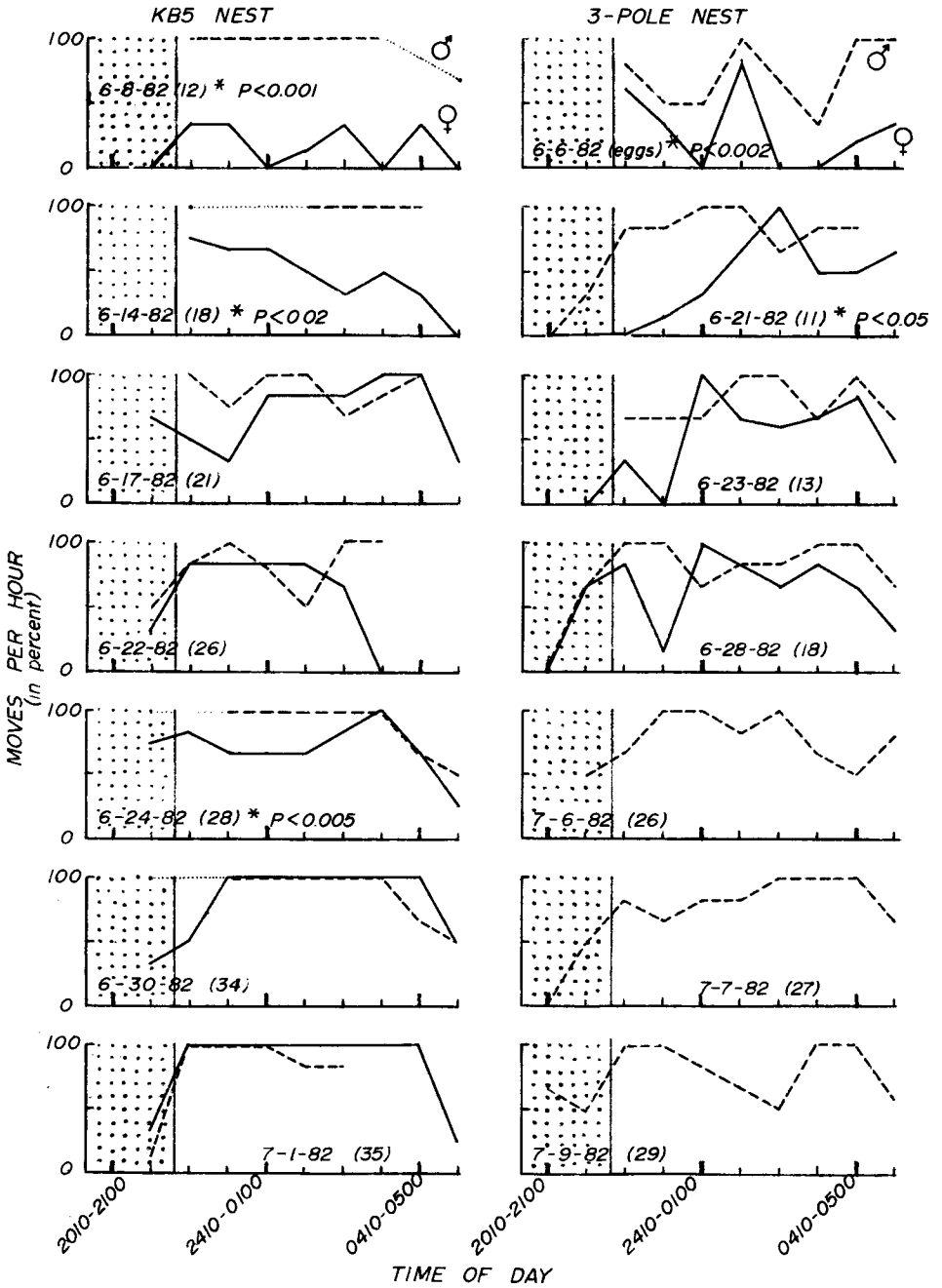


FIG. 2. Home-range areas of the male and female Long-eared Owls at the 3-pole nest on the Idaho National Engineering Laboratory. Numbers in the upper right- (female) and left-hand (male) corner of the squares indicate how many radio-locations were obtained per bird in each 8.8 ha grid during the nesting season. Letters indicate the locations of the tracking stations. The key is the same as for Fig. 1 except as noted.

The distances that the KB5 female moved decreased significantly with colder temperatures when the young were 12, 18, and 21 days old ($P < 0.002$, $P < 0.001$, and $P < 0.001$, respectively). None of the other owls showed any correlation between temperature and distances moved ($P > 0.05$).

Home-range use and activity patterns.—Owls at both nests frequently were located in open sagebrush areas close to the river (Figs. 1 and 2). The Long-eared Owls at KB5 were never recorded in a scattered juniper area 0.7 km southwest of their nest. Other researchers have reported that Long-eared Owls prefer to hunt in open, rather than timbered or shrub areas (Getz 1961, Sonnenberg and Powers 1976).

Incidental daytime observations and piles of castings indicated that the male owls generally roosted in the same tree or shrub within several hundred meters of their nests. Radio locations of the female at 3-pole indicated that she was in the nest area at daylight each night we tracked



her. When the young at KB5 were 26 days old the female began to perch away from the nest at daybreak.

Owls became active as darkness approached, but from 20:00–22:00 owls moved significantly fewer times than from 22:00–05:00 ($P < 0.05$, KB5 male: $\chi^2 = 3.97$, KB5 female: $\chi^2 = 4.80$, 3-pole male: $\chi^2 = 16.89$, 3-pole female: $\chi^2 = 7.65$) (Fig. 3). The activity of the birds also was lower between 05:00–06:00, although the KB5 female was the only owl that moved significantly less ($\chi^2 = 8.24$, $P < 0.001$) during this time. Delong (1982) observed a significant decrease in prey deliveries at Long-eared Owl nests from 20:00–21:00 and 05:00–06:00. He observed that delivery rates were highest during the first half of the evening, but not significantly higher until 2 h before sunrise. Periods of peak activity did not occur during the same time each night (see Fig. 3) and the activity patterns for the KB5 male may be biased because he was out of range much of the time.

At both nest sites the male and female shared a common core area (grids in a home-range entered by both adults) in the vicinity of the nest (Figs. 1 and 2), but often foraged in different directions away from the nest on a given night (Fig. 4). This may have kept adults at a nest site from competing for prey and may have served to maximize hunting efficiency. The home ranges of the KB5 and 3-pole birds overlapped slightly (Figs. 1 and 2) with the ranges of the females overlapping more (approximately 10% of the pairs' home-range) than those of the males (approximately 2% of the pairs' home-range).

The northern pocket gopher (*Thomomys talpoides*) and the Great Basin pocket mouse (*Perognathus parvus*) were the primary prey items (36.7% and 34.4% frequency of occurrence, respectively) at the 3-pole nest. The KB5 birds preyed on the Great Basin pocket mice, deer mice (*Peromyscus maniculatus*), sagebrush vole (*Lagurus curtatus*) and northern pocket gophers most often (45.7%, 17.1%, 17.1%, and 8.6%, respectively). Long-eared Owls are reported to be opportunistic in their food habits (Marks 1984, Craig et al. 1985). The difference in prey taken on the INEL supports

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FIG. 3. Activity patterns of mated Long-eared Owls at 2 nest sites on the Idaho National Engineering Laboratory. Movements are calculated as the number of times each owl moved from the previous radio location divided by the total number of radio locations each hour and expressed as percents. Dates of radio-tracking are indicated for each graph with approximate age of the young listed in parentheses. An asterisk indicates nights on which there was a significant difference between male and female movements. Shaded areas indicate the time of night (20:00–22:00) when all owls showed significantly fewer movements.

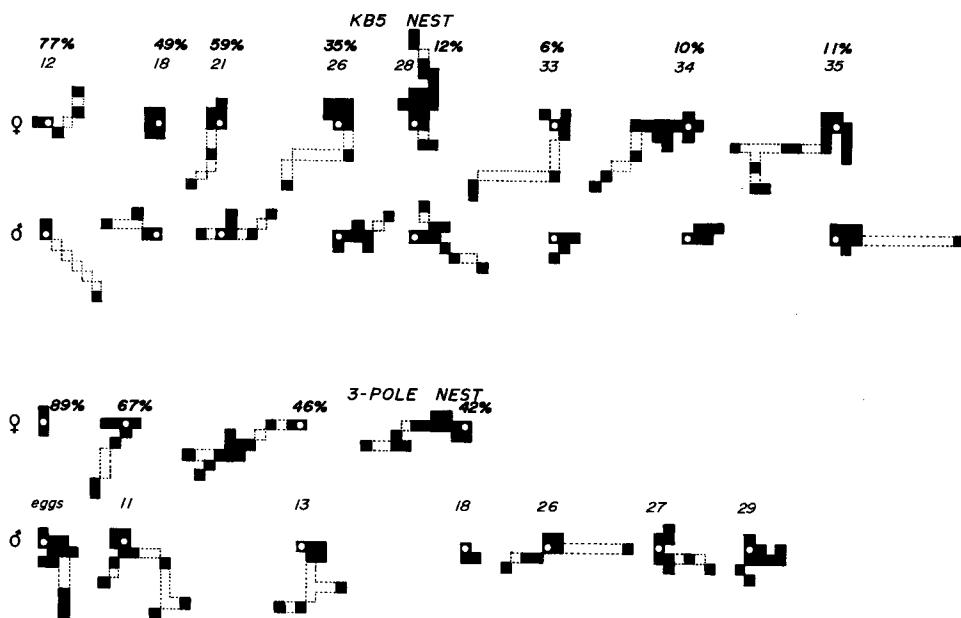


FIG. 4. Home range size and shape (black grids) of adult male and female Long-eared Owls at nest sites on the Idaho National Engineering Laboratory during individual nights throughout the nesting season. The open circles show the location of the nest and the numbers indicate the age of the young for each map. Dashed lines connect the use areas of the owls. Percent of total radio-locations that were in the nest grid are indicated for the female owls.

our radio location data that show the two pairs did most of their hunting in separate areas.

During incubation and until the young were approximately 12 days old the total home ranges of the females were relatively small ($\bar{x} = 7.0 \pm 2.4$ grids) and they spent 67–89% of their time within the nest grid (see Fig. 4). At this time, the males used a larger area than did the females, often moving out of range of our tracking towers. The males were out of range 40% of the time during incubation and when the young were 12 days old or less. Because of this, home range maps for the males underestimate actual use areas, particularly for the KB5 male. On the other hand, the KB5 and 3-pole females were out of range an average of 3.5% and 0.5% of the time, respectively, until the young fledged, and thus their home range maps are more accurate estimates of actual use areas.

The home ranges of the females more than doubled in size ($\bar{x} = 16.4 \pm 1.6$ grids) after the young were older than 12 days. In addition, at this time, the females spent less time in the nest grid and more in the remainder

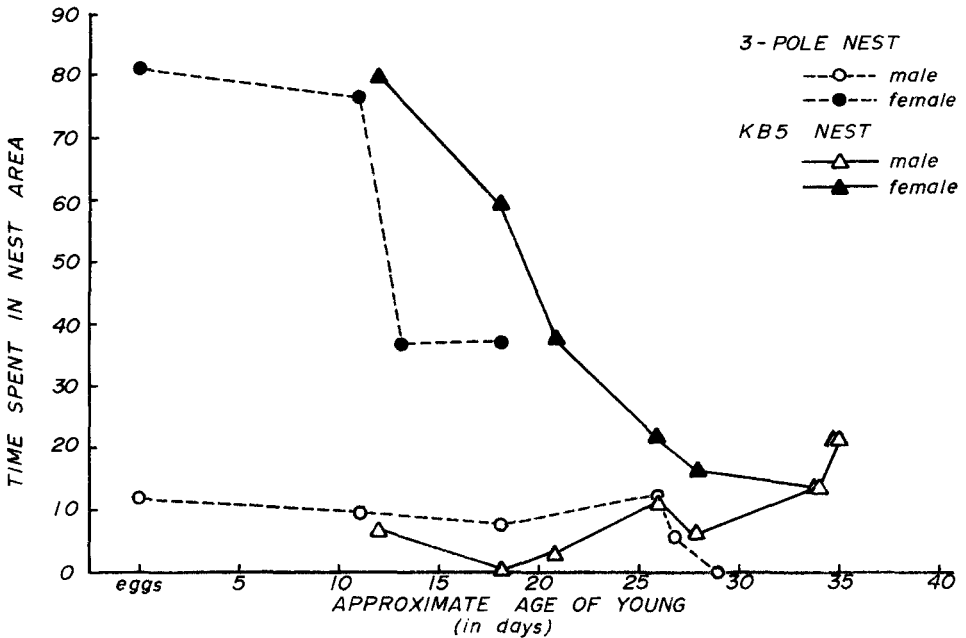


FIG. 5. Percent of time 2 mated pairs of Long-eared Owls spent in the nest area (radio-locations that indicated either bird was at the nest) on the Idaho National Engineering Laboratory.

of the home range area (Fig. 4). Home range of the 3-pole male appeared to decrease slightly during this time (Fig. 4), and he was also out of range less (11.5% of the time). The KB5 male continued to be out of range of our tracking towers and no trend could be seen. When nestlings were less than 2 weeks of age, females spent 70–80% of their time in the nest area (Fig. 5), but as nestling age increased, females spent less time and the KB5 male spent more time in the nest area. These data combined with the movement data suggest that females played an increasingly important role in provisioning the young as the nesting season progressed. The relationship of nestling age to time spent in the nest area was significant for the owls at KB5 (male: $r^2 = 0.63$, $F = 9.5$, $P < 0.025$; female: $r^2 = 0.84$, $F = 26.67$, $P < 0.0025$) but not for either owl at 3-pole (Fig. 5). The female at 3-pole disappeared, however, when the young were between 18 and 26 days old, and the fewer tracking days for this owl may have biased our data. The male owl at 3-pole successfully raised the young to branching age.

The average distance moved by the males generally decreased with the

progression of the nesting season, whereas the distances moved by the females increased, but the trends were not significant ($P > 0.05$). A similar phenomenon was observed in the movements of a male Long-eared Owl tracked in southwestern Idaho by Hilliard et al. (1982). There was a significant difference in the moves/h of the male and female at 3-pole until the young were approximately 11 days old. During this time the female made few movements away from the nest area. Similarly, birds at KB5 displayed a significant difference in moves/h until the young were about 18 days old, and again after the young were 28 days old (Fig. 3), with the female moving out of the nest area infrequently. The KB5 nestlings may have required brooding by the female for a longer period of time than young at 3-pole, because of their physical condition and so she may not have moved from the nest as often. According to Delong (1982), female Long-eared owls incubate and brood the young and males provide most of the food for the family group. We found that at approximately 2 weeks of age when the nestlings were able to maintain body temperature (Wijnandts 1984), there was an increase in the size of the females' home range, as well as in her number of moves and distance moved between radio-locations. These data suggest that at this time, female owls as well as males forage for food for the young.

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