

# BEHAVIOR OF A RADIO-TAGGED SAW-WHET OWL

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BECAUSE of the difficulty of watching nocturnal animals such as owls, few data are available on their behavior. Nicholls and Warner (1972) used radiotelemetry to study the Barred Owl (*Strix varia*). This paper reports a radiotelemetry study of the movements, activity, and home range of a Saw-whet Owl (*Aegolius acadicus*) for a 20-day period on the 5000-acre Cedar Creek Natural History Area approximately 30 miles north of Minneapolis, Minnesota.

## METHODS

A Saw-whet Owl of undetermined sex, weighing 75 g, captured in a mist net on 28 October 1965, was released at the capture point at 1111 29 October 1965. A 7.5-g transmitter package with a 7-inch whip antenna and powered by two Mallory RM675RT2 batteries was attached to the owl by a modified version of the harness described by Marshall (1963). The bird immediately adjusted itself to the transmitter on its back and flew 40 feet to a perch where it engaged in preening. Two successive flights of 20 and 60 feet appeared to be normal. The owl was seen once more before the radio stopped transmitting at 1545 17 November 1965.

Owl activity and positions were monitored and recorded automatically (Cochran et al. 1965). This system can locate a radio-tagged animal every 45 sec, but a transmitter out of tune makes a few blank periods. All activity data were classified as moving or resting. A resting (nonmoving) owl produced a steady radio signal, but movement caused a pulsing signal frequently accompanied by a change in bearing at the radio receiving towers. All bearings were determined to the nearest degree, and the beginning and end of each movement and rest period were documented to the nearest minute. Each location the owl used was categorized and defined in one of three ways. The place where the owl spent the day without moving was called a roost site. A spot where it remained without moving for 10 min or more at night was called a rest site. When the owl moved between rest sites its position was sampled at 10-min intervals. The fixed point where the bird was at the particular point in time when the sample was taken was called a moving location.

The home range was determined by plotting and connecting consecutive locations during the 20-day period. When the transmitter was out of tune for 1 h or more before or after a single location, and when this location was outside the accumulating home range boundary, it was plotted as a point outside of the home range. Because these points represent real but discontinuous owl locations, the size of the home range presented is conservative.

The accuracy of the owl's locations, based on triangulation from the two towers, depended on the relative position of the owl to the towers. Because the relative position of the home range to the two signal receiving towers gave varying degrees

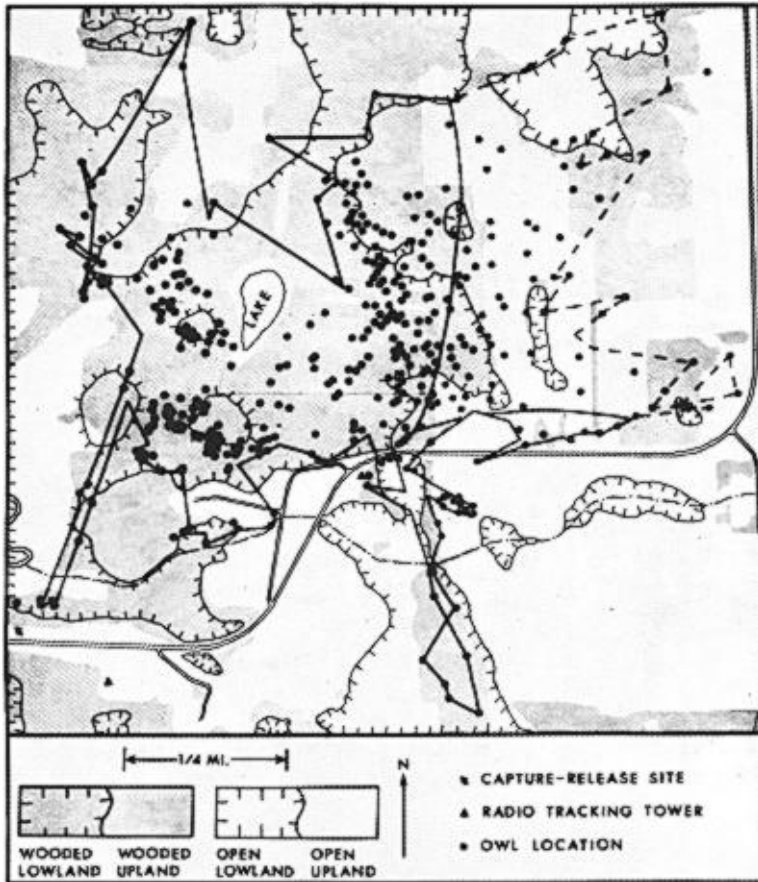


Fig. 1. The 20-day, 280.8-acre, home range of the Saw-whet Owl composed of the known home range (solid line) and assumed home range (dashed line). Dots represent all locations used one or more times.

of accuracy to the owl's location, we divided the home range into two sections (Fig. 1) based on the 400-foot error line described by Sargeant et al. (1965). The greatest possible error within the sector bounded by dashed lines ranges from 400 feet to infinity. As owl activity was not dependent on the accuracy of the owl's location, this was the only information used from this area. All other activity, locality, and movement data came from the sector bounded by solid lines in Fig. 1, in which the greatest possible error is less than 400 feet. Most of the recorded owl locations from this sector are within  $\pm 10$  feet of the true position, sufficiently accurate to determine habitat utilization. Throughout this paper, days (D) and nights (N) are numbered 1 through 20 and 1 through 19 respectively starting with 29 October 1965.

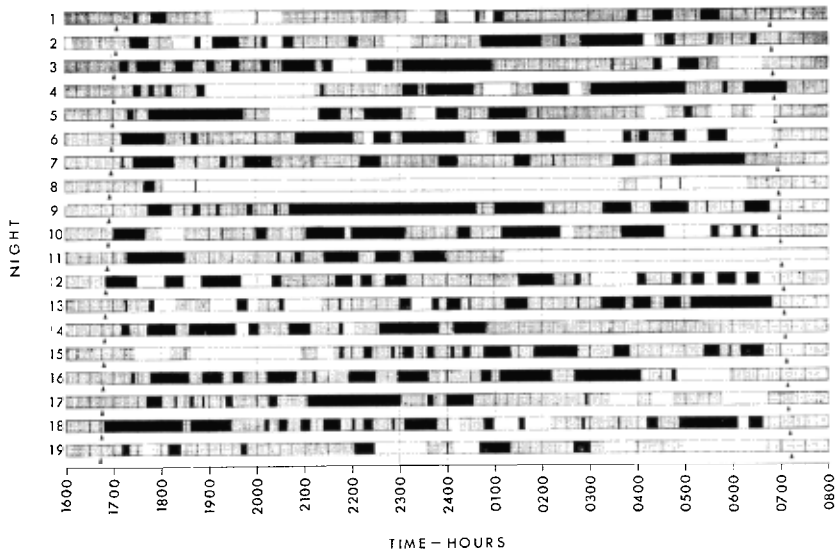


Fig. 2. Saw-whet Owl nocturnal activity showing the relationship of movement periods (black) to rest periods (shaded). Open spaces represent periods when the transmitter was out of tune. The small triangles indicate sunrise and sunset.

#### HOME RANGE

The total home range for the 20 days was 280.8 acres (Fig. 1), but four portions of this were used only 1 night each. The most prominent of these were the movements of N-9, when the owl crossed the road and used the 9.6-acre southeast extension of the home range, making a 149-min circuit of a tamarack swamp. A 78-min movement on N-12 toward the northeast accounted for another 38.8 acres of the home range. The long narrow 4.0-acre leg extending to the southwest was used only the first night. Finally the 23.6-acre northwest sector was used only 42 min on N-3. Thus 76.0 acres (27.0%) of the 280.8-acre home range were used a small portion of the time.

The home range appeared to shift between the first 10 days and the last 10 days, which correlated with the general weather pattern for these two periods. The first 10 days were characterized by clear sky, no precipitation, and relatively high daily maximum (range +44 to 68°F) and minimum (range +15 to 35°F) temperatures. During the latter 10 days the sky was overcast, snow flurries were recorded on 5 days, and the maximum (+16 to 39°F) and minimum (+5 to 29°F) temperatures were relatively cool.

Although the home range shifted the last 10-day period, the owl's nightly activity patterns were similar for each of these 10-day periods

(Fig. 2). During the first 10 nights the owl used primarily the cedar swamp and visited the open land to the east during parts of only 2 nights (Fig. 1). On eight of the latter 10 nights the owl frequented open uplands and lowlands of the home range and shifted the diurnal roost sites to the eastern portion of the cedar swamp within the area bounded by solid lines.

The 182.4-acre portion of the home range bounded by the solid line in Fig. 1 was classified into five habitat types: Cedar swamp, edge, oak upland, maple-basswood, and miscellaneous. The following descriptions of these habitats were taken from Pierce (1954); no noticeable changes have occurred since then.

The cedar swamp type covers 109.0 acres, 59.7% of the sections within the solid lines. This is the wooded lowland centered around the 3.2-acre lake. Northern white cedar (*Thuja occidentalis*) averaging 4 inches in diameter and 30 feet tall is the most abundant species in the canopy. The dominant tree, but less common than the cedar, is tamarack (*Larix laricina*) most of which are 4–10 inches in diameter and 45–50 feet tall. Paper birch (*Betula papyrifera*) and yellow birch (*Betula lutea*) are also common. Two shrubs, alder (*Alnus rugosa*) and red osier dogwood (*Cornus stolonifera*), are most abundant where there is no cedar or where there is no cedar or where the canopy is of birch.

The edge type comprises 7.8 acres (4.2%) in a strip 25 feet wide on either side of the line separating the wooded upland and lowland (Fig. 1). This is a transitional community often containing elements of both the upland and lowland types. The most characteristic trees are ash (*Fraxinus*) and elm (*Ulmus*).

The oak upland covers 27.2 acres (14.9%) along the east margin and southwest corner of the cedar swamp, and is composed primarily of northern pin oak (*Quercus macrocarpa*) of all size classes up to 24 inches in diameter and 45 feet tall. White oak (*Quercus alba*) and paper birch are also present. The most common shrub is hazel (*Corylus* sp.), ranging from 4–6 feet tall.

The maple-basswood habitat covers 4.8 acres (2.6%) in two "islands," one south, the other southwest of the lake. The primary tree species are red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), and basswood (*Tilia americana*). The red oaks are up to 25 inches and 55 feet tall, while the latter two range up to 12 inches and 50 feet tall. Other species include white oak, (*Quercus alba*), northern pin oak, white birch, hop hornbeam (*Ostrya*), and red maple (*Acer rubrum*). The shrub layer is primarily hazel 3 feet tall; this type is the most open and contains the tallest trees within the home range.

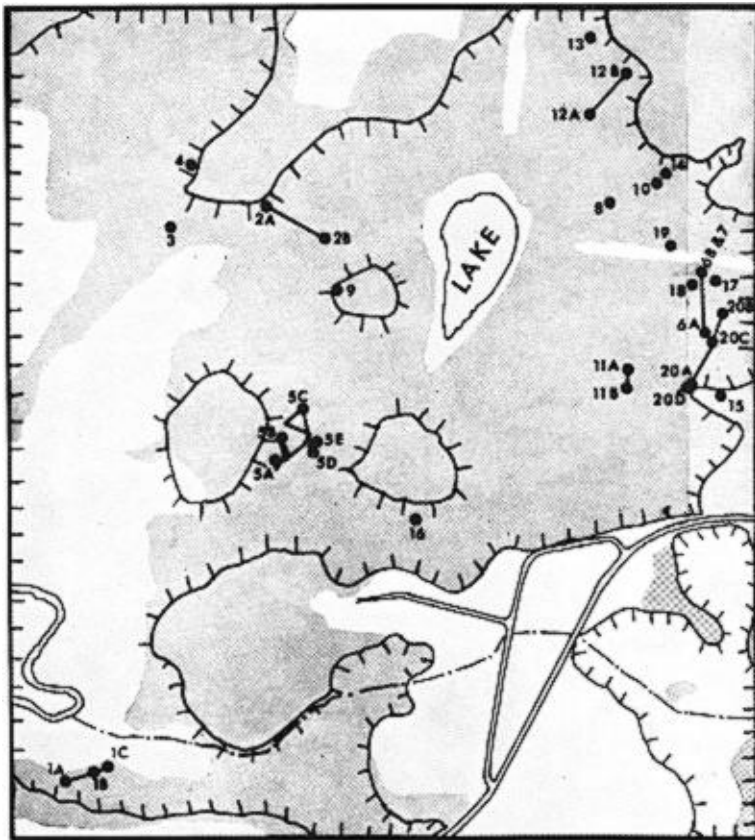


Fig. 3. Saw-whet Owl diurnal roost sites on days 1-20. When more than one roost per day was used, they are lettered consecutively and connected by a line.

The remaining 33.6 acres (18.4%) classified as miscellaneous were little used by the owl. They contained 8 acres of pine-oak (upland) and 8.8 acres of ash swamp in the northwest corner, tamarack swamp of 4.8 acres in the southeast extension, 2 acres of pine in the northwest corner, and 10.6 acres of abandoned fields.

For reasons stated earlier, the portion of the home range bounded by dashed lines (Fig. 1). was not included in the analysis of the owl's habitat utilization, but as the owl spent approximately 71 hours on 10 different nights there it merits describing. Generally this 98.4 acres (35.0% of the total home range) consists of 77.6 acres of abandoned fields spotted with low shrubs and containing two cattail marshes bordered by birch and willow (*Salix* sp.). The remaining 20.8 acres are oak upland.

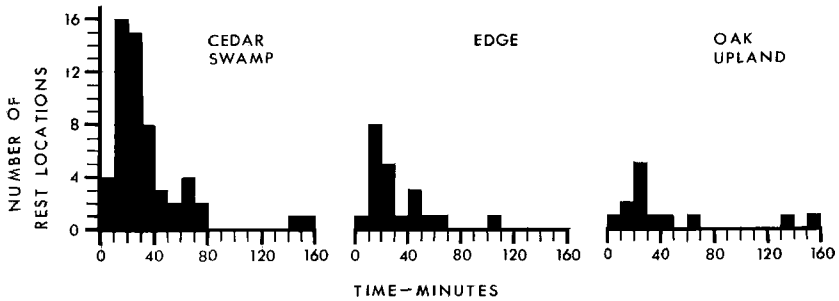


Fig. 4. Number of Saw-whet Owl rest sites by habitat and length of time periods in 10-min intervals spent at each.

#### HABITAT USE

During the day the owl roosted primarily in the cedar swamp (Fig. 3), but also used four roosts in the edge and one in the oak upland. Only once, on D-7, did the owl use the same roost site as the previous day. The owl definitely preferred the cedar for day roosting and usually moved there before sunrise.

Table 1 shows the nightly variation in the number of occupancies of the five habitat types and is based on 351 owl locations at the 296 map points within the area bounded by solid lines. The bird occupied 55 of these points more than once. Of the 351 locations, 244 were moving locations and 107 were resting sites. Time at resting sites totaled 3847 min for the 19 nights.

The white cedar swamp was the most used habitat. The owl was rarely recorded in the center of the swamp, but fixes were heavily concentrated around its edge and near the two maple-basswood islands.

The second most used habitat was the edge. The lengths of nocturnal rests in the three most used of the five habitats are presented in Fig. 4. The mode of the time length of each rest was 10 to 20 minutes in this habitat, the same as in the cedar swamp.

The number of moving locations in the oak upland was equal to that in the edge (Table 1). The total time spent at night rests in the oak upland was quite similar to the edge, but the rests were fewer in number. The mode of the lengths of the rests (Fig. 4) in this habitat was slightly longer than in either the edge or cedar swamp. Most of the rests were either shorter than 1 hour or longer than 2 hours.

The owl almost completely avoided the maple-basswood habitat, although it was in the center of the home range (Table 1). The following summarizes the remaining rest sites listed under miscellaneous habitats.

TABLE 1  
 OWL UTILIZATION OF THE FIVE MAJOR HABITATS

Night	Cedar swamp			Edge			Oak upland			Maple-basswood			Miscellaneous		
	Time <sup>1</sup>	NR <sup>1</sup>	NM <sup>1</sup>	Time	NR	NM	Time	NR	NM	Time	NR	NM	Time	NR	NM
1	317	4	9	21	1	-	159	1	-	-	-	-	-	-	-
2	271	6	8	84	3	4	-	-	1	-	-	-	43	1	5
3	83	5	8	33	2	1	-	-	3	-	-	-	320	4	4
4	45	3	2	-	-	1	-	-	-	-	-	-	104	3	2
5	67	2	7	18	1	2	26	1	2	-	-	-	-	-	-
6	15	1	13	33	2	3	-	-	2	17	1	1	-	-	-
7	243	8	19	29	1	-	42	1	1	28	1	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	21	1	4	14	1	-	28	1	2	-	-	-	123	3	22
10	71	2	5	76	2	2	-	-	2	-	-	-	-	-	-
11	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
12	187	3	5	-	-	2	27	1	5	-	-	-	-	-	2
13	-	-	1	-	-	2	10	1	2	-	-	-	-	-	-
14	-	-	4	110	1	1	24	1	3	-	-	-	-	-	-
15	205	11	13	22	1	6	-	-	-	-	-	-	-	-	-
16	164	6	14	41	1	5	-	-	2	-	-	3	27	1	1
17	35	2	18	114	4	2	205	4	4	-	-	-	-	-	-
18	39	1	9	-	-	-	-	-	-	-	-	-	64	3	3
19	18	1	-	70	1	-	154	2	1	-	-	-	-	-	-
TOTAL	1781	56	140	665	21	31	675	13	30	45	2	4	681	15	39

<sup>1</sup> Time = total time in min spent resting per night, NR = number of rest sites per night, NM = number of moving locations per night.

Hardwood swamp, four on N-3 and three on N-4; red pine-white spruce windbreak, three on N-9; abandoned field, three on N-18 and one on N-16; and pine-oak, one on N-2. We recorded 36 moving locations in the following miscellaneous habitats: Pine windbreak 10, tamarack swamp 12, abandoned field 4, ash swamp 5, pine-oak 2, and the edge of the cedar swamp bordering the abandoned field 3.

It was not possible to determine whether the owl was using the oak upland or the abandoned fields within the area bounded by the dashed line (Fig. 1). On N-18, three night rest sites that totaled 64 min and three moving locations occurred in the abandoned field within the area bounded by solid lines located at the extreme south edge of the area bounded by dashed lines, indicating the owl was using the abandoned fields within the latter area. Scott (1938) believed that Saw-whet Owls in Iowa did most of their winter hunting in similar fields spotted with low shrubby growth.

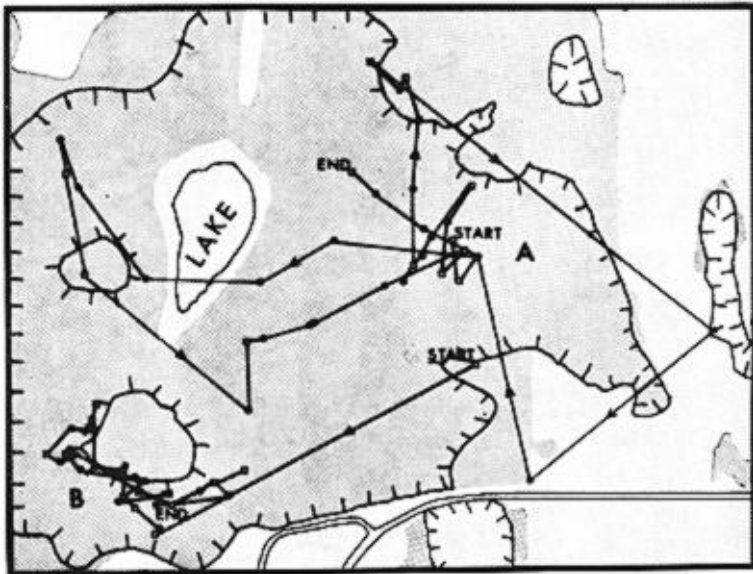


Fig. 5. Saw-whet Owl movements for night 7 (A) and 15 (B). Symbols represent moving locations (solid) and rest sites (open).

#### ACTIVITY

The owl's activities were classified as either resting or moving. Total nocturnal activity periods for the 19 nights are presented in Fig. 2. We define the nocturnal activity period as the time period between the time the owl was last noted at a daytime roost in the evening until it was first recorded at a daytime roost the following morning. These periods always began after sunset (Table 2 and Fig. 2). The average beginning of activity was 22 min after sunset (range 0 to +55). The average end of the night activity was 18 min before sunrise (range -40 to +15). On two of the nights (N-2 and N-4) the owl's activity ended 2 and 15 min after sunrise.

The alternate movement and rest periods (Fig. 2) during the night were totally unpredictable. Times of moving and resting were not consistent, and these periods varied greatly in length. The 19 nocturnal activity periods totaled 14,565 min (Table 2); during 2675 min of this time the transmitter was out of tune. During 11,890 min of documented nocturnal activity, the owl rested 6771 (57%) and moved 5119 (43%) min.

The mean and standard error of the mean were not computed for the nightly movement and rest time because of difficulty in setting valid con-



TABLE 2  
NOCTURNAL ACTIVITY PERIODS

Night	Time (min)				Start and end of nocturnal activity period relative to:	
	Total	Useable	Resting	Moving	Sunset	Sunrise
1	803	638	534	104	+21	+2
2	787	680	399	281	+17	-19
3	807	711	440	271	+7	
4	821	669	333	336	+25	+15
5	813	621	330	291	+19	
6	818	637	277	360	+10	
7	792	792	456	336	+14	-40
8	761	52	38	14	+43	
9	782	782	318	464	+49	-13
10	811	764	421	343	0	-29
11	475	475	287	188	+24	
12	838	681	362	319	0	
13	814	692	420	272	+25	-16
14	459	446	196	250	+21	
15	792	595	386	209		-29
16	752	686	313	373	+36	
17	782	666	444	222	+55	
18	829	741	377	364	+3	-35
19	829	562	440	122	+27	
TOTAL	14,565	11,890	6771	5119	+396	-164

fidence limits to account for the varying periods when the transmitter was out of tune. We have complete data for N-7 and N-9 during which the owl moved 336 and 464 min respectively with reciprocal respective night rests of 456 and 318 min.

Movement stopped abruptly at 0049 on N-14 (Fig. 2), and the owl stayed in that spot until 1838 the following evening. Weather was the only factor that we could correlate with this prolonged inactivity. The weather that night was unique for the 20-day period. Static began to appear on the film record between 1045 and 1320 indicating the approach of a storm. That night the only measurable precipitation for the period occurred, 0.75 inches between 0400 and 1600, which started as rain that later turned to sleet and snow with temperatures ranging from 38° to 34°F.

Fig. 5 traces two examples of night movements. Usually the owl ranged extensively over the home range as on N-7 (Fig. 5A). These movements can be compared with the corresponding activity pattern illustrated in Fig. 2. For example, on N-7 the owl left the day roost at 1712 (14 min after sunset) and moved 225 feet south where it rested until 1725. Then

it moved again, first northeast 200 feet, then west to the second night rest site, west of the lake, where it stayed from 1817 until 1843. It then moved back to a night resting site in the cedar swamp near the starting point, stopping to rest at two sites along the way, one on the maple-basswood island, the other in the cedar swamp. The owl was in the general vicinity of the starting point from 2021 until 0125. During this time it rested at four sites. It then moved north, where it occupied three night rest sites (edge, oak upland, cedar swamp) between 0145 and 0444. This was the last night rest site the owl used on N-7. The next five records were moving locations taken at 10-min intervals, one of which was the same as the first moving location of the night. This brought the owl to the D-8 roost at 0617, which was 40 min before sunrise and 550 feet northwest of the previous day roost.

Fig. 5B shows the owl's movements for N-15, demonstrating an intensive use of a restricted portion of the home range. The owl left the day roost between 1727 and 1749 and by 2136 was near the south edge of the maple-basswood island. The remainder of the night the bird moved along the edge of this island where it remained throughout the following day. The total distances traveled these 2 nights were 2.4 miles on N-7 and 0.9 miles on N-15. As far as we were able to determine the total distance traveled the other nights was within this range.

The owl confined its diurnal activity to roosting; on several of the 20 days it used more than one roost (Fig. 3), two on 4 days, four on 1 day, and five on 1 other day. The day of release it used three roosts before sunset. When it used multiple roosts, it moved directly between them and never took more than 3 min. The daily multiple roosts were never more than 500 feet apart.

Only on 1 day did extended movement periods occur (Fig. 3). On D-5 the owl left its roost (location 5-A) at 0848. It continued moving until 0855 when it reached a second roost 110 feet to the north (5-B) where it remained for 31 min. Then it began a second movement that ended at 0950 at 5-C, 225 feet northeast of location 5-B, where it stayed until 1303. The two movements periods totaled 31 min, and the area covered was less than 1 acre. The owl used two additional roosts on D-5.

#### OWL OBSERVATION

The owl was actually seen only once during the study. On D-13 using a portable radio receiver (Cochran and Nelson 1963) Forbes and Jay Schnell found the owl at 1300 facing west on the first horizontal branch of a white cedar about 15 feet off the ground, and 4 feet from the trunk on the north side of the tree.

Shortly after we arrived a Black-capped Chickadee (*Parus atricapillus*) appeared and began calling the "chick-a-dee-dee" call in a more pronounced and lower pitched tone than normal. A moment later a second chickadee arrived and uttered this same deep-toned call. These small birds at times flew to within 4 feet of the owl, and were still harassing it when we left. The owl did not leave this spot until 1715.

Under that roost we found three excreta deposits and one fresh  $1.4 \times 0.5$ -inch pellet containing remains of a *Peromyscus*. We also found one fresh  $2 \times \frac{1}{2}$ -inch piece of red-backed mouse (*Clethrionomys gapperi*) fur 40 feet east of the roost. Five potential prey species of mammals were believed to be present within the home range during the study. Gunderson (1950) studied the small mammal populations within the owl's home range and found the following species of mice: white-footed mouse (*Peromyscus leucopus*), red-backed mouse, meadow vole (*Microtus pennsylvanicus*), and jumping mouse (*Zapus hudsonius*). In addition the deer mouse (*Peromyscus maniculatus*) inhabited the abandoned fields within the home range (pers. obs.). All these prey species were available to the owl except the jumping mouse, which was probably hibernating. It has been well-documented that the Saw-whet Owl preys primarily on mice (Roberts 1932: 633-636; Bent 1938; Scott 1938).

#### DISCUSSION

Our data clearly demonstrate that computing an owl home range on diurnal sightings alone can be misleading both in size and habitat occupied. For example, a calculation based on the diurnal locations (Fig. 3) shows a home range of approximately 58 acres of almost all cedar swamp habitat, compared to 280.8 acres and five habitats as shown in Fig. 1. Furthermore the owl did not use its entire home range. In this respect, the home range was similar to that of the red foxes (*Vulpes fulva*) Storm (1965) described as "a series of pathways which connect high-use areas."

Bent (1938) described the Saw-whet Owl as a woodland bird that prefers coniferous to hardwood forest and swampy woodland to uplands. Mumford and Zusi (1958) found that most of their birds preferred tamarack swamp. Both these descriptions, based primarily on diurnal observations, fit quite closely the cedar swamp habitat our owl used during the day. The upland hawthorn (*Crataegus* sp.) thicket Scott's (1938) owls used was quite different from our habitat. He indicated that his birds hunted a different habitat at night, as we also found. Our data show that the Saw-whet Owl uses primarily the niche between upland and lowland habitat types. During activity periods it avoided maple-basswood,

pine windbreak, tamarack swamp, ash swamp, and pine-oak upland habitats. In comparing our data to those of Nicholls and Warner (1972), from the same region at about the same time, we find that the Saw-whet Owl appeared to avoid the Barred Owl's preferred habitats; although the home ranges of the two species overlapped.

Throughout the night the owl moved until it selected a night rest site. The time spent at these locations varied from 10 to 60 or more min. We speculate that at these sites, the owl remained perched and watching for prey, and that in many instances this perching period was ended by a kill or an attempted kill. The owl spent most of its time in dark wooded upland and lowland habitat prior to snowfall, and in open grassland after snowfall. In speculation, this may have been because such prey species as white-footed mice and red-backed mice become more difficult to hear when their movements are muffled by snow, while deer mice and meadow mice in the grassland are easier to see against the white background of snow.

Collins (1963) suggested that the Saw-whet Owl may have two activity periods when foraging, in the evening and just before the dawn. This he based on the two peaks in the Saw-whet Owl's metabolic cycle described by Graber (1962). As we noted no change in our owl's nocturnal activity, we conclude that it foraged the entire night.

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#### SUMMARY

The 20-day home range of a Saw-whet Owl was 280.8 acres. The major habitats were cedar swamp, edge, maple-basswood, oak upland, and several miscellaneous habitats. The cedar swamp was the heart of the home range. Shifts in the part of the home range the owl used were correlated with weather changes.

Habitat utilization showed a definite trend toward using the edge of all habitat types, with an apparent selection toward wooded lowland types in general. The owl spent the daylight hours in the cedar swamp almost exclusively.

The owl was extremely nocturnal in its movement activities and it spent much more of the night time perched than moving. More than one day roost per day was common, and these were never more than 500 feet apart. In at least one instance weather affected the owl's activity. On the one night it rained and snowed activity came to an abrupt halt. Total distances traveled on two nights were 2.4 and 0.9 miles.

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