

- DENTON, J. F., W. W. BAKER, M. N. HOPKINS, JR., L. B. DAVENPORT, JR., AND C. S. ROBBINS. 1977. Annotated checklist of Georgia birds. Occas. Paper, Georgia Ornithol. Soc. 6.
- GREENWOOD, P. J. AND P. H. HARVEY. 1982. The natal and breeding dispersal of birds. *Ann. Rev. Ecol. Syst.* 13:1-21.
- HAHN, H. W. 1937. Life history of the Ovenbird in southern Michigan. *Wilson Bull.* 49: 145-237.
- JOHNSTON, D. W. 1954. Supplemental notes on birds of the Athens area. *Oriole* 19:1-3.
- PULICH, W. M. 1976. The Golden-cheeked Warbler. Texas Parks and Wildlife Dept., Austin, Texas.
- RAPPOLE, J. H. AND D. W. WARNER. 1976. Relationships between behavior, physiology and weather in avian transients at a migration stopover site. *Oecologia* 26:193-212.
- AND ———. 1980. Ecological aspects of migrant bird behavior in Veracruz, Mexico. Pp. 353-393 in *Migrant birds in the Neotropics* (A. Keast and E. S. Morton, eds.). Smithsonian Inst. Press, Washington, D.C.
- TRAMER, E. J. 1968. A revised list of the birds of Athens, Georgia and vicinity. *Oriole* 33: 2-17.
- VERBEEK, N. A. M. 1970. Breeding ecology of the Water Pipit. *Auk* 87:425-451.

JOHN H. RAPPOLE, *Caesar Kleberg Wildlife Research Institute, P.O. Box 218, Texas A&I Univ., Kingsville, Texas 78363*; AND KEVIN BALLARD, *Dept. Biology, George Mason Univ., Fairfax, Virginia 22030*. Received 24 Apr. 1986, accepted 4 Dec. 1986.

Wilson Bull., 99(3), 1987, pp. 480-485

Spring migration of Long-eared Owls and Northern Saw-whet Owls at Nine Mile Point, New York.—Although Long-eared Owls (*Asio otus*) and Northern Saw-whet Owls (*Aegolius acadicus*) occur in New York State throughout the year, they are observed in greatest numbers during migration and in winter. Although hawk migration in spring has been studied for years along the southern shore of Lake Ontario (Haugh and Cade 1966, Smith and Muir 1978, Moon and Moon 1985), there are no published studies of owl migration there. Here we summarize data collected along the south shore of Lake Ontario on the spring migration of Long-eared Owls and Northern Saw-whet Owls during the springs of 1981 through 1986.

Study area and methods.—The study was conducted on the Richard A. Noyes Wildlife Sanctuary at Nine Mile Point, New Haven, Oswego County, New York, along the southeastern shore of Lake Ontario (Fig. 1). The 90-acre sanctuary is composed of northern hardwood forest (*Acer rubrum*, *Quercus rubra*, *Fagus grandifolia*, *Tsuga canadensis*), red pine (*Pinus resinosa*) plantations, and shrub (*Viburnum dentatum*, *Cornus* spp., *Alnus rugosa*) habitat.

Mist nets (30-114 mm mesh, 5-12 m length) were placed within wooded and shrub areas, across trails, and along ecotones on a total of 117 nights (9, 16, 18, 37, 18, 19; 1981-1986, respectively). The banding station was in operation from early March (weather permitting) until late April or mid-May, when migration appeared to end. The number of nets operated on a given night ranged from 4 to 40, depending upon weather conditions and the number of assistants available. The total effort for all years was 25,023 net-h. Nets were open from before sunset to after sunrise, unless weather conditions forced the closure of all or some of them. Nets were checked at 1 to 2.5 h intervals, depending upon weather conditions. For each owl captured, the date and time (EST), age and sex, location of the capture, and weather

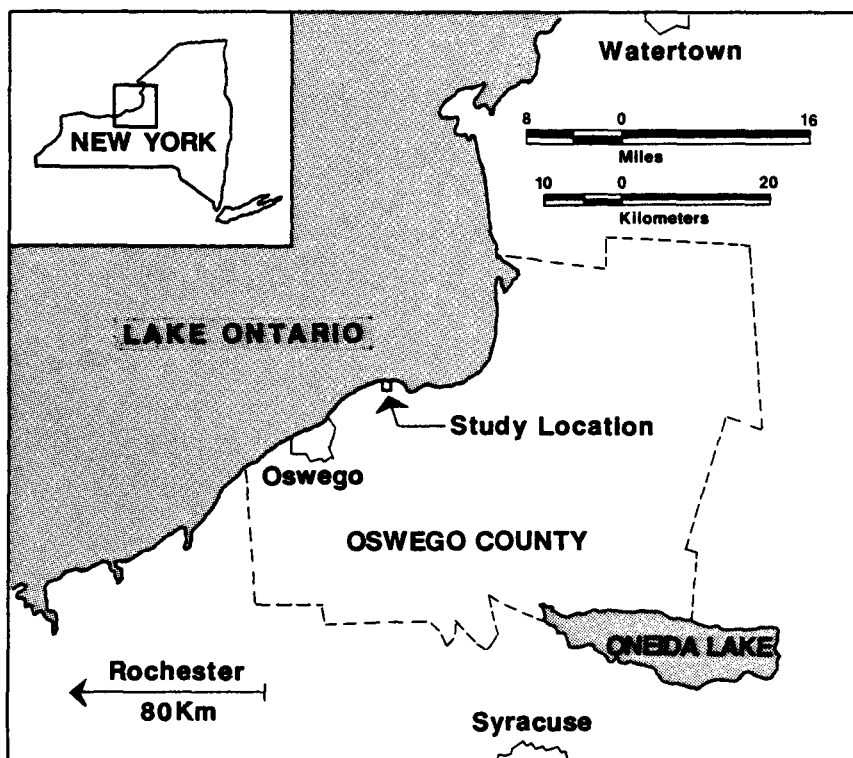


FIG. 1. Location of study area.

conditions at that time were recorded. Owls were aged (remige molt and fault bar pattern) and sexed (wing chord) based upon the criteria set forth in the Banding Manual (U.S.F.W.S. 1977).

Migration dates.—A total of 139 owls (37 Long-eared, 102 Northern Saw-whet) was captured. From 0 to 13 Long-eared Owls were captured each year, along with from 4 to 33 Northern Saw-whet Owls (Table 1). The initiation of Northern Saw-whet Owl migration apparently shifts from year to year, depending upon spring weather conditions. For example, in 1982, the first saw-whet was captured on 13 March and the last on 16 April; there was a peak between 24 March and 30 March, when 9 out of the 15 birds banded during the year were captured. This contrasts with 1984 when winter weather conditions persisted into the first week of April; all 27 birds for that year were captured after 28 March, with a peak of 9 being captured between 12 and 14 April. In 1983, recurring periods of unfavorable weather prolonged the saw-whet migration, which was relatively steady from 17 March to 4 May. In general, Northern Saw-whet Owl migration occurred between 16 March and 4 May. The earliest saw-whet captured (5 March 1983), which was recaptured at the site 7 days later, was probably a winter resident. Long-eared Owl migration, which occurred between 21 March and 14 April, did not appear to be as weather-dependent. Thirty-three of the 37 individuals were captured during this time period. Three individuals captured after 24 April probably were local breeding birds.

TABLE 1
SUMMARY OF OWL CAPTURES BY 5-DAY INTERVALS

Date interval	Northern Saw-whet Owls							Long-eared Owls						
	1981	1982	1983	1984	1985	1986	Total	1981	1982	1983	1984	1985	1986	Total
1-5 March	- ^a	-	1	-	-	-	1	-	-	0	-	-	-	0
6-10 March	-	-	0	-	1	-	1	-	-	0	-	0	-	0
11-15 March	-	1	0	0	0	1	2	-	0	0	0	0	0	0
16-20 March	-	0	7	0	1	0	8	-	0	0	0	0	0	0
21-25 March	-	5	0	0	0	4	9	-	2	0	1	0	1	4
26-30 March	1	5	2	2	1	10	21	0	2	0	0	1	3	6
31 March-4 April	1	0	4	2	0	2	9	0	0	1	4	0	4	9
5-9 April	0	0	2	2	1	0	5	0	0	2	4	3	0	9
10-14 April	0	2	1	9	1	0	13	0	0	0	3	2	0	5
15-19 April	1	2	0	2	0	0	5	0	0	0	0	1	0	1
20-24 April	0	0	2	3	0	1	6	0	0	0	0	0	0	0
25-29 April	1	0	6	5	0	0	12	0	0	0	1	0	0	1
30 April-4 May	0	-	7	0	0	-	7	0	-	2	0	0	-	2
5-9 May	-	-	1	0	-	-	1	-	-	0	0	-	-	0
10-14 May	-	-	0	1	-	-	1	-	-	0	0	-	-	0
15-19 May	-	-	-	1	-	-	1	-	-	-	0	-	-	0
20-24 May	-	-	-	0	-	-	0	-	-	-	0	-	-	0
Annual totals	4	15	33	27	5	18	102	0	4	5	13	7	8	37

^a No nets set.

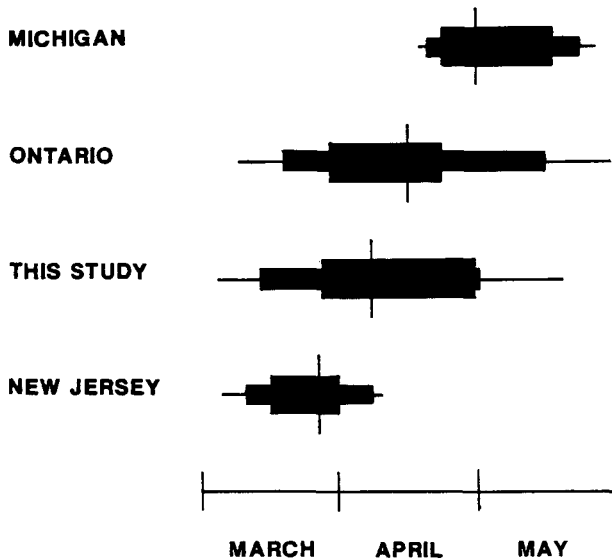


FIG. 2. Timing of spring migration of Northern Saw-whet Owls. Vertical bars indicate mean date, wide bars indicate 66% of the bandings, medium bars, 90%, and narrow lines the range. Data for Michigan, Ontario, and New Jersey are taken from Holroyd and Woods (1975).

Bull (1974) gives no dates on the spring migration of Long-eared Owls. For Northern Saw-whet Owls, he lists only one record, 10 birds observed along the Lake Ontario shoreline on 3 April 1952. In the Niagara Frontier (western New York), Beardslee and Mitchell (1965) reported the spring migration of Long-eared Owls as occurring from 29 March to 26 April, with saw-whets migrating from 21 March to 9 May. Our data are similar to those described by Holroyd and Woods (1975) who used banding data collected between 1955 and 1969 to analyze the migration of the Saw-whet Owl in eastern North America (Fig. 2).

Nocturnal activity pattern.—Our data (Fig. 3) indicate that Northern Saw-whet Owls migrate later in the evening than do Long-eared Owls. Long-eared Owls are known to leave their diurnal roosts approximately 30 to 60 min after sunset (Glass and Neilsen 1977, Bosakowski 1984). In their fall studies of saw-whets, Weir et al. (1980) had proportionately fewer captures of this species in the time period around sunset. For both species, many of the birds that were captured near sunrise were probably individuals that were searching for roost sites or hunting just prior to roosting.

Age analysis.—All but one Long-eared owl was aged as AHY (after hatching year). Therefore, no determination concerning the timing of migration in relation to age class of Long-eared Owls can be made. Northern Saw-whet Owls were assigned to three age categories: 31 ASY (after second year), 9 SY (second year), and 62 AHY. Based upon the date of first capture in each year, SY birds arrived on the average 11 days later than did ASY birds. Because of the large proportion of AHY birds, however, these data are inconclusive.

Wind direction.—Fifty-nine percent of the Northern Saw-whet Owls were captured on winds with a southerly component ($\chi^2 = 18.47$, $P < 0.01$). Fifty-two percent of the Long-eared Owls were captured on southeasterly to westerly winds. Twenty-four percent of the

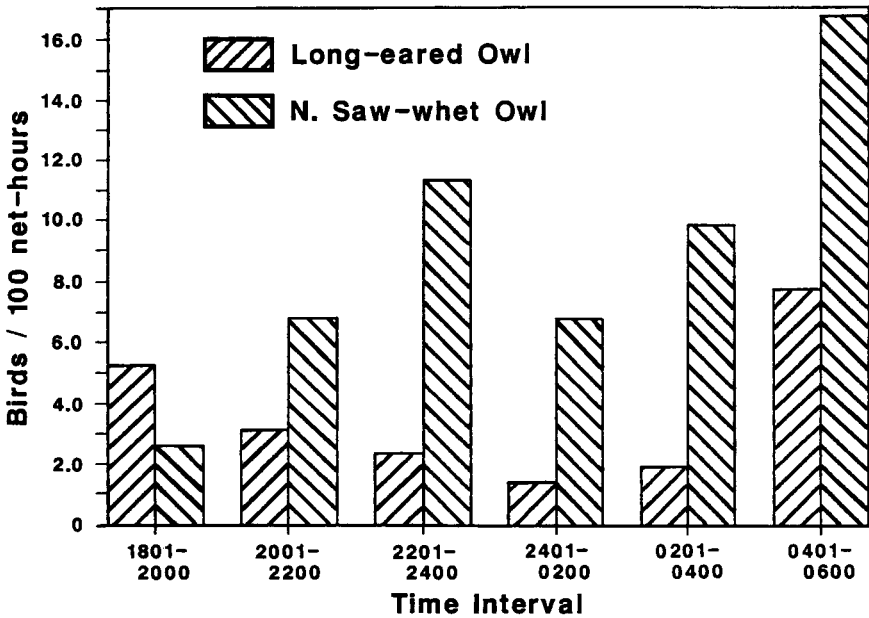


FIG. 3. Owl captures per 100 net-h within nightly time intervals.

Northern Saw-whet Owls and 32 percent of the Long-eared Owls were captured when winds were calm at the site. Thus, both species avoided migrating on northwesterly to easterly winds.

Acknowledgments.—This study was conducted on the Richard A. Noyes Sanctuary with the permission of the Board of Directors of the Onondaga Audubon Society, Syracuse, New York. The authors acknowledge the assistance of M. C. Lawler, H. E. Slack, III, E. T. Reed, and M. C. Reilly in conducting this study. Many others, especially R. Varnum, C. Williams, S. Harris, E. Williams, and S. Kahl assisted with tending of the nets. S. A. Gauthreaux, Jr., D. L. Evans, and K. L. Bildstein made helpful comments on the manuscript. W. L. Kalina assisted with the preparation of the figures. L. M. Bough typed the final manuscript.

LITERATURE CITED

- BEARDSLEE, C. S. AND H. D. MITCHELL. 1965. Birds of the Niagara Frontier Region. Bull. of the Buffalo Soc. of Nat. Sci., 22.
- BOSAKOWSKI, T. 1984. Roost selection and behavior of the Long-eared Owl (*Asio otus*) wintering in New Jersey. Raptor Res. 18:137-142.
- BULL, J. 1974. Birds of New York State. Doubleday Natural History Press, Garden City, New York.
- GLASS, M. L. AND T. H. NEILSEN. 1977. The evening departure of the Long-eared Owl (*Asio otus*) from the winter roost. Dansk. Ornithol. Foren. Tids. 61:100-106.
- HAUGH, J. R. AND T. J. CADE. 1966. The spring hawk migration around the southeastern shore of Lake Ontario. Wilson Bull. 78:88-110.
- HOLROYD, G. L. AND J. G. WOODS. 1975. Migration of the Saw-whet Owl in eastern North America. Bird-Banding 46:101-105.

- MOON, L. W. AND N. S. MOON. 1985. Braddock Bay spring hawk migrations. *Kingbird* 35:7-31.
- SMITH, G. A. AND D. G. MUIR. 1978. Derby Hill spring hawk migration update. *Kingbird* 28:5-25.
- U.S.F.W.S. 1977. North American bird banding techniques. Vol. 2, Pt. 6. Ageing and sexing. Canadian Wildl. Serv. and U.S. Fish and Wildl. Serv., Washington, D.C.
- WEIR, R. D., F. COOKE, M. H. EDWARDS, AND R. B. STEWART. 1980. Fall migratin of Saw-whet Owls at Prince Edward Point, Ontario. *Wilson Bull.* 92:475-488.

ROY S. SLACK AND CATHIE BAUMGARTNER SLACK, *Terrestrial Environmental Specialists, Inc., Box 388, RD 1, Phoenix, New York 13135*; RICHARD N. ROBERTS, *117 North Way, Camillus, New York 13031*; AND DIANE E. EMORD, *318 Shirley Drive, Syracuse, New York 13207*. Received 6 Aug. 1986, accepted 24 Jan. 1987.

Wilson Bull., 99(3), 1987, pp. 485-488

Nest-box use by Prothonotary Warblers (*Protonotaria citrea*) in riverine habitat.—Nest boxes are often used in studies of cavity-nesting species (e.g., Dahlsten and Copper 1979), and they have been particularly important in conservation studies of Eastern Bluebirds (*Sialia sialis*) (Zeleny 1976). Many cavity-nesting birds have been shown to prefer nest boxes to natural cavities (McComb and Noble 1981, Brawn 1984).

The Prothonotary Warbler (*Protonotaria citrea*) is one of only two cavity-nesting wood warblers in North America. They nest in swampy or flooded forest areas (Bent 1953), and their populations may be declining due to loss of habitat (Graber et al. 1983). Although nest box use has been well documented for many secondary cavity nesters, little work of this kind has been conducted on the Prothonotary Warbler.

In 1984, we conducted an evaluation of the effects of industrial fluoride contamination on the egg viability and clutch size of Prothonotary Warblers. We erected nest boxes to facilitate finding nests in our study areas. Here, we report on the use of three different types of nest boxes by Prothonotary Warblers, along with factors that may influence their selection.

Study area and methods.—In March 1984 we placed 301 nest boxes in flooded riparian habitat along the Tennessee River in Benton and Humphrey counties, Tennessee. Woody vegetation in the river floodplain is dominated by willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), elms (*Ulmus* spp.), and hackberry (*Celtis occidentalis*).

We erected 145 cardboard milk cartons (Fleming and Petit 1986), 84 standard wooden bluebird boxes (Zeleny 1977), and 72 tubes of black PVC pipe (30-cm long × 10.2-cm diameter) with plastic caps attached on top and bottom. The volume of each box was measured from the bottom of the box to the lower lip of the entrance hole. Tubes had the greatest volume (1226 cm³), followed by wooden boxes (1218 cm³) and milk cartons (903 cm³), respectively.

All boxes had entrance holes approximately 3.75 cm in diameter, centered 5 cm from the top of the box. Milk cartons and tubes were spray-painted gray in order to make them less conspicuous. Wooden boxes were not painted because their natural wood color made them sufficiently inconspicuous. All boxes were placed on trees, 1.5-2.0 m above the water surface