Autumn Migration of Northern Saw-whet Owls on the Lower Delmarva Peninsula 1994-2006: Project Report 2006

Center for Conservation Biology
College of William and Mary

March 2007

Autumn Migration of Northern Saw-whet Owls on the Lower Delmarva Peninsula 1994-2006: Project Report 2006

Fletcher M. Smith
Barton J. Paxton
Bryan D. Watts
Center for Conservation Biology
College of William and Mary
Williamsburg, VA 23187-8795

Cover photo of N. Saw-whet Owl by Ariel White

This paper is funded in part by grants from the Virginia Department of Game and Inland Fisheries. The views expressed herein are those of the authors and do not necessarily reflect the views of the funding agency.

Autumn Migration of Northern Saw-whet Owls on the Lower Delmarva Peninsula 1994-2006: Project Report 2006

Barton J. Paxton
Bryan D. Watts
Fletcher M. Smith
Center for Conservation Biology
College of William and Mary
Williamsburg, VA 23187-8795

Recommended Citation:

Paxton, B. J., B. D. Watts, and F. M. Smith. 2007. Autumn migration of Northern Saw-whet Owls on the Lower Delmarva Peninsula 1994-2006: Project Report 2006. Center for Conservation Biology Technical Report Series, CCBTR-07-01. College of William and Mary, Williamsburg, VA.

Project Funded By:

Va. Dept. of Game and Inland Fisheries
and
The Center for Conservation Biology
at the College of William and Mary

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within todays social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Northern Saw-whet Owl breeds in southern Canada and the northern United States. During the late fall months this species migrates south to the mid-latitudes of North America. Because of its secretive habits, little was known about the Saw-whet Owl's migration ecology and winter distribution, prior to the increase in the number of banding operations during the late 1990's. During the fall of 1994, The Center for Conservation Biology began a study of migrant Northern Saw-whet Owls along the lower Delmarva Peninsula. This study has been the first to document large numbers of migrants south of Maryland. During the 11-year study, more than 2,500 owls have been banded and more than 100 foreign retraps and returns have been recorded.

The owl migration project is conducted each year between the third week of October and the middle of December. Three trap sites (Eastern Shore of Virginia National Wildlife Refuge, Gatr Tract/Mockhorn Island Wildlife Management Area, and Kiptopeke State Park) consisting of 6 mist nets and a continuous-loop audio-lure are opened nightly from dusk to dawn. Among other objectives, the project seeks to 1) determine the annual variation in the magnitude and timing of Northern Saw-whet Owl migration through the lower Delmarva Peninsula, 2) determine the spatial pattern of habitat use near the tip of the Delmarva Peninsula, 3) determine the relative timing of passage for different age classes of Northern Saw-whet Owls, and 4) determine the rate of movement of Northern Saw-whet Owls moving down the Atlantic Flyway.

During the fall of 2006, 21 new owls consisting of 18 newly banded birds, 2 foreign recaptures, and one same station recapture, were captured and processed during 41 nights and 7,704 hours of operation. Capture rate was 0.51 owls/night or 0.27 owls/100 net-h. Age ratio was 62% after-hatching-year (AHY) birds compared to 38% hatching-year (HY) birds. The capture rate was much lower than the invasion years of 1995 and 1999 and lower than any of the previous non-invasion years. The age ratio observed was skewed towards AHY birds and is consistent with the age ratios observed during non-invasion years suggesting that 2006 was a non-invasion year.

BACKGROUND

Context

In eastern North America, Northern Saw-whet Owls (*Aegolius acadicus*) breed primarily in the coniferous forests of Canada and the northern United States (Cannings 1993). Some scattered breeding locations occur in the Allegheny Plateau of eastern West Virginia and western Maryland; and in the mountains of western North Carolina, eastern Tennessee, and southwestern Virginia and North Carolina (Am. Ornithol. Union 1983, Milling et al. 1997, Smith et al. 1988). Although Northern Saw-whet Owls are resident year-round throughout much of the breeding range, some populations that breed in higher latitudes migrate to lower latitudes for the winter months (Mueller and Berger 1967a, Holroyd and Woods 1975, Weir et al. 1980). The winter range of most northeastern populations is believed to be in the east-central United States, but the limits of this range are uncertain (Cannings 1993). With more trapping coverage in the east, this range is becoming clearer. Sporadic winter records of this species exist for all southeastern states including Florida (Holroyd and Woods 1975, Miller and Loftin 1984, Smith et al. 1988).

The Atlantic Coastal Plain may serve as a Saw-whet Owl migration route extending from Nova Scotia to the southeast (Holroyd and Woods 1975). Duffy and Kerlinger (1992) demonstrated that substantial numbers of Northern Saw-whet Owls migrate at least as far south as Cape May, New Jersey every year. Beginning in 1991, Northern Saw-whet Owls have also been banded each fall at several locations in Maryland including Assateague Island National Seashore (Brinker et al. 1997). Prior to 1994, there were very few fall or winter records of this species in Virginia (Kain 1987), and an incredibly small number of records on the Delmarva Peninsula (Anonymous 2004).

Beginning in the fall of 1994 a banding project was initiated to investigate the migration ecology of Northern Saw-whet Owls on the lower Delmarva Peninsula in Virginia. This location is a well-known migration bottleneck for passerines and diurnal raptors moving south along the Atlantic Coast. This ongoing study has documented passage times (Whalen et al. 1997), influence of audio-lure use on capture pattern (Whalen and Watts 1999), diet (Whalen et al. 2000), and some aspects of stopover ecology (Whalen and Watts 2002) for Northern Saw-whet Owls migrating through the mid-Atlantic Coastal Plain.

Objectives

The objectives of this ongoing study are to: 1) determine the magnitude of the autumn migration of Northern Saw-whet Owls on the lower Delmarva Peninsula, 2) analyze the spatial dynamics of migration on the lower Delmarva Peninsula, 3) determine the seasonal timing of migration, and 4) investigate age-specific differences in migration ecology.

METHODS

Study Area

This study was conducted within the lower Delmarva Peninsula that forms the northern shoreline near the mouth of the Chesapeake Bay (Figure 1). Owls were trapped at 3 stations located within a 10 km^2 area at the southern tip of the Delmarva Peninsula. Stations were located on the Eastern Shore of Virginia National Wildlife Refuge, Gatr Tract/ Mockhorn Island Wildlife Management Area, and Kiptopeke State Park. Kiptopeke State Park and Gatr Tract Wildlife Management Area each are wooded with a mixture of loblolly pine (*Pinus taeda*) and/or hardwoods and contained moderate to dense understory vegetation. The Eastern Shore NWR site was moved in 2006 to maximize the amount of understory present.

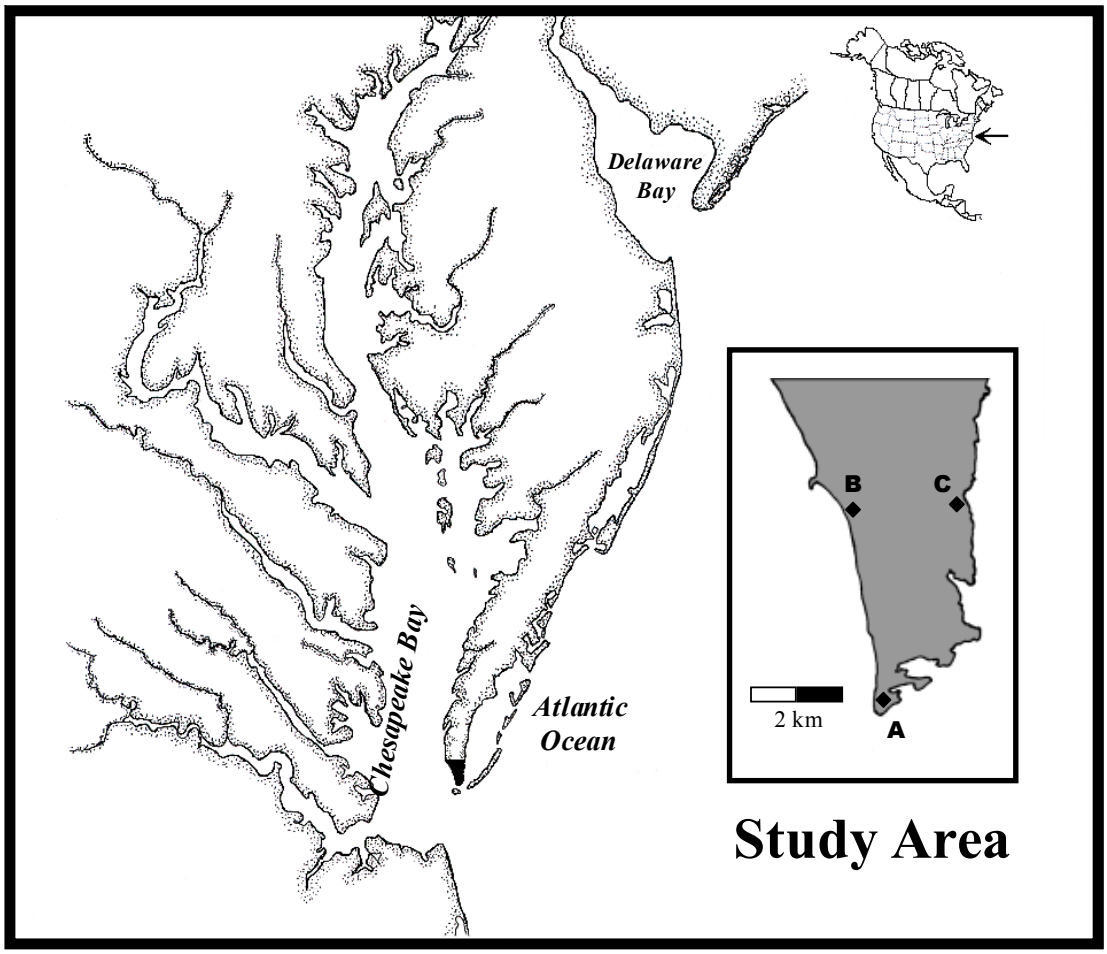
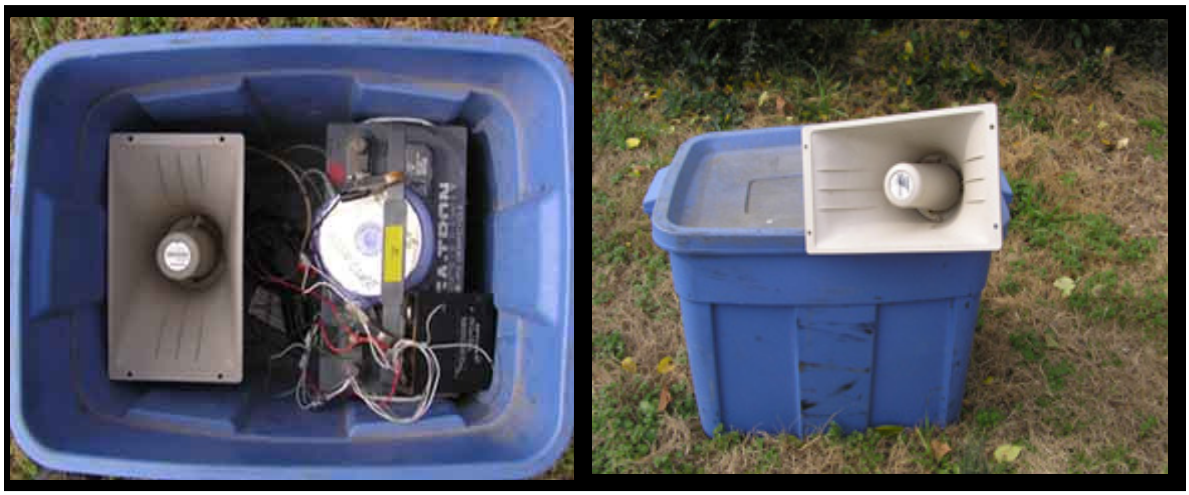


Figure 1. Map of study area on lower Delmarva Peninsula. Inset map shows location of trap sites within A) Eastern Shore of Virginia National Wildlife Refuge, B) Kiptopeke State Park, and C) GATR Tract Wildlife Management Area.

Trapping

A continuous line of 6 mist-nets was erected along an east/west axis at each trapping station. Mist-nets were 12 m long by 2 m tall and were made of 60 mm, black nylon mesh. An audio-lure was situated at the center of each net lane to attract migrating owls. Audio-lures consisted of a portable compact disk player, amplifier, 12 V deep cycle marine battery, and a loud-speaker. A continuous-loop broadcast of a Northern Saw-whet Owl "advertising call" (Cannings 1993) was played from the audio-lure. The effectiveness of audio-lures has been demonstrated by increased capture rates over passive trapping (i.e. trapping without an audio-lure) at other owl banding stations in the United States (Erdman and Brinker 1997, Duffy and Matheny 1997, Evans 1997). Capture rates are increased 5 to 10 fold when an audio-lure is used (Erdman, *personal communication*). It should be noted that this technique may exaggerate sex ratios (Whalen and Watts 1999).

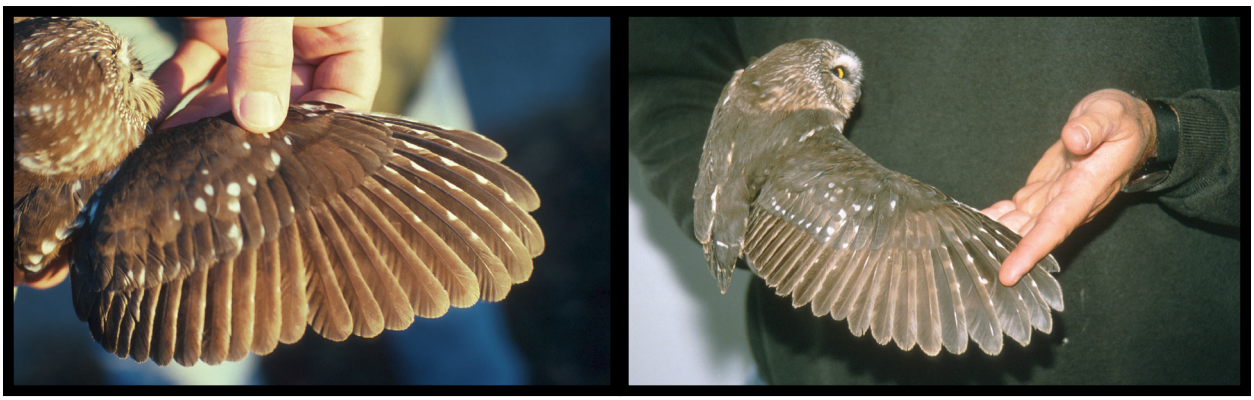


Photos of audio lure components. Photo on left shows components inside plastic container including battery, CD player, amplifier, and bell speaker and connectors. Photo on right shows audio lure in operation with external bell speaker. Photos by Fletcher Smith.

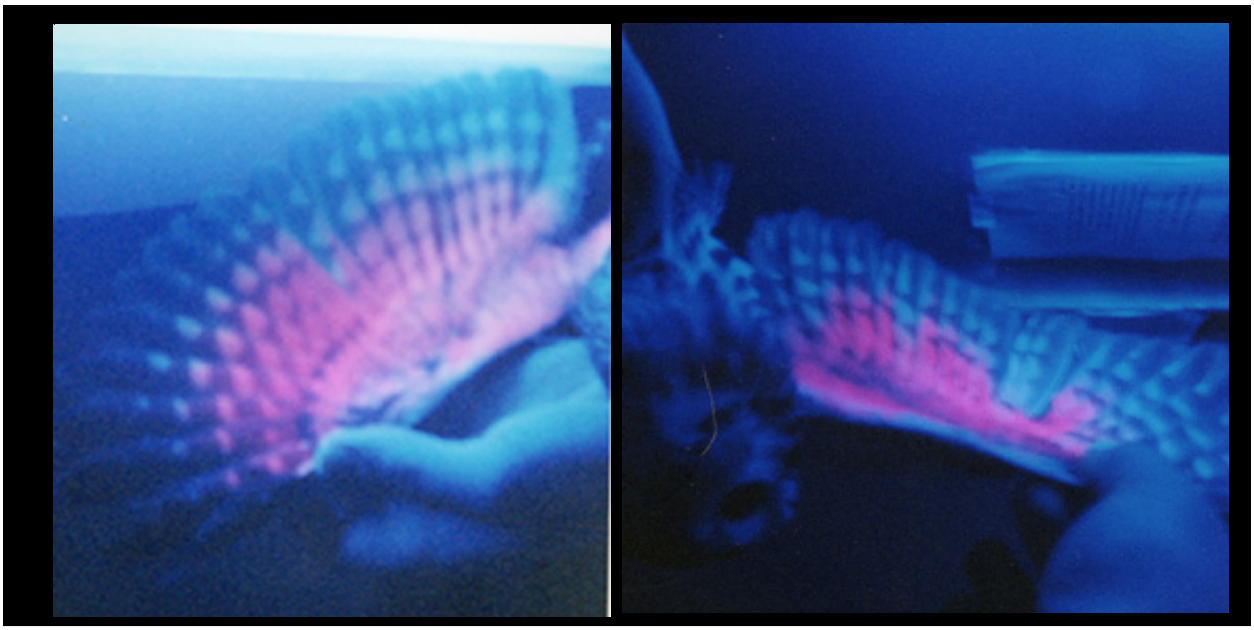
Banding began on 25 October 2006 and continued nightly weather permitting until 15 December 2006. Nets were opened at a half an hour after dusk and closed at a half an hour before dawn. Net checks were conducted at 21:00, 24:00, 03:00, and 06:00. A net check consisted of driving to all three net sites in the order in which they were opened and checking the nets for captured owls. All owls were placed in a holding box (see picture next page) until processed. Owls were processed at the College of William and Mary Field House, located on the Eastern Shore of Virginia National Wildlife Refuge. After processing, owls were released near the point of capture.

Photo of holding boxes used to transport owls to field station for processing. Photo by Bryan Watts.

Owls were banded with federal aluminum tarsal bands. A standard leg gauge was used to determine proper band size. Natural (unflattened) wing chord measurements were recorded to the nearest millimeter and mass was recorded to the nearest tenth of a gram using an electronic balance. Wings were inspected for evidence of molt to determine age (Evans and Rosenfield 1987, Pyle 1997). Saw-whet Owls were aged as hatching-year (HY) if all primary and secondary remiges and coverts appeared uniform in color or as after-hatching-year (AHY) if primary and secondary remiges were not uniform in color, indicating the presence of more than one generation of feathers (see photo this page). Ultra-violet blacklight was used to aid in aging of ASY birds (birds showing more than 2 generations of feathers) (see photo next page).



Bird (left) showing typical hatching-year plumage pattern with a single generation of light brown feathers. Bird (right) showing one of several after-hatching-year plumage patterns. This individual illustrates a typical second-year pattern with new outer primaries and retained inner primaries. Photos by Lee Walker.



Bird (left) showing typical hatching-year plumage pattern under blacklight. Notice all primaries and secondaries glow under blacklight. Bird (right) has multiple generations of feathers, and only feathers molted in this year luminesce. Blacklighting is a useful tool in deciphering after-hatching year vs. after-second year patterns. Photos by Fletcher Smith.

RESULTS

During the fall of 2006, 21 new owls consisting of 18 newly banded birds, 2 foreign recaptures, and one same station recapture, were captured and processed during 41 nights and 7,704 hours of operation. Capture rate was 0.51 owls/night or 0.27 owls/100 net-h. The capture rate was much lower than the invasion years of 1995 and 1999 and lower than any of the previous non-invasion years. Two foreign recaptures and one same station recapture were also processed during the 2006 owl trapping season. These sites continue to have some of the highest foreign recapture rates of any Northern Saw-whet Owl trapping stations.

Table 1. Effort, capture totals, and capture rates for Saw-whet Owl trapping on the lower Delmarva Peninsula, 21 October-15 December, 1994-2006.

Year	Trap-Nights	Net-Hours	Owl Captures	Owls/Trap-Night	Owls/100 Net-Hours	Invasion Year?
1994	32	6,903	52	1.6	0.8	No
1995	44	9,481	1,007	22.9	10.6	Yes
1996	42	8,817	106	2.5	1.2	No
1997	40	8,212	101	2.5	1.2	No
1998	22	4,499	22	1	0.5	No
1999	48	9,633	695	14.5	7.2	Yes
2000	46	9,477	101	2.2	1.1	No
2001	48	9,804	273	5.7	2.8	Yes
2002	37	7,287	137	3.7	1.9	No
2003	43	8,279	119	2.8	1.4	No
2004	46	8,559	144	3.1	1.6	No
2005	48	7,421	73	1.5	0.98	No
2006	41	7,704	21	0.51	0.27	No
Invasion Year Average	46.7	9,639	658	14.1	6.8	
Non-invasion Year Average	37.4	7,716	87.6	2.3	1.14	

Capture rates varied between the three trap sites. Gatr Tract Wildlife Management Area accounted for 62% of all new captures, followed by Kiptopeke State Park at 23.8% and the Eastern Shore of Virginia National Wildlife Refuge at 14.2% (Table 2). The capture rate at the Eastern Shore of Virginia National Wildlife Refuge improved slightly from the previous two years. The station was moved in 2006 to an area of higher understory density after many trees and shrubs in the old trapping lane were lost due to salt water inundation after Hurricane Isabel. In the previous two year, wind was a serious problem at the Wise Point station. Wind, which had been a problem at the former Wise Point site, was not a problem at the new trapping station.

Table 2. Summary of capture locations for Saw-whet Owls on the lower Delmarva Peninsula, 21 October-15 December, 1994-2006.

	Station 1 ESVANWR		Station 2 Gatr/Mockhorn		Station 3 Kiptopeke		
Year	**#**	**%**	**#**	**%**	**#**	**%**	**Totals**
1994	17	32.7	21	40.4	14	26.9	52
1995	237	23.5	323	32.1	446	44.4	1007
1996	29	27.4	40	37.7	37	34.9	106
1997	19	18.8	35	34.7	47	46.5	101
1998	3	13.6	8	36.4	11	50	22
1999	117	16.8	272	39.1	306	44	695
2000	13	12.9	56	55.4	32	31.7	101
2001	61	22.3	57	20.9	155	56.8	273
2002	20	14.6	55	40.1	62	45.3	137
2003	5	4.2	46	38.7	68	57.1	119
2004	19	13.2	65	45.1	60	41.7	144
2005	11	15.1	27	37	35	47.9	73
2006	3	14.2	13	62	5	23.8	21
Invasion Year AVG	138.3	21	217.3	33	302.3	45.9	658.3
Non-Invasion Year AVG	13.9	16.1	36.6	42.2	36.1	41.7	86.6

Age ratios in 2006 were 62% after-hatching-year (AHY) birds compared to 38% hatching-year (HY) birds. The age ratio observed was skewed towards AHY birds and is consistent with the age ratios observed during non-invasion years suggesting that 2006 was a non-invasion year (Table 3).

Table 3. Patterns in age ratios of Saw-whet Owls captured 21 October-15 December, 1995-2004.

	Hatching-year Birds		After Hatching-year Birds	
Year	**Number**	**%**	**Number**	**%**
1995	836	83	171	17
1996	15	14	91	86
1997	59	58	42	42
1998	11	50	11	50
1999	559	80	136	20
2000	18	18	83	82
2001	215	79	58	21
2002	58	42	79	58
2003	71	60	48	40
2004	75	52	69	48
2005	57	78.1	16	21.9
2006	8	38	13	62
Invasion Year Avg.	536.7	81.5	121.7	18.5
Non-invasion Year Avg.	41.3	45.0	50.2	55.0

DISCUSSION

Although Northern Saw-whet Owls occur regularly on the Atlantic Coast each autumn, the magnitude of the migration is irruptive in nature. The number of Northern Saw-whet Owls trapped at Cape May, NJ during 1980-1988 ranged from a low of 8 owls in 1984 to a high of 115 owls in 1980 (Duffy and Kerlinger 1992). Our data demonstrate that considerable year to year variation exists in the number of owls migrating through the lower Delmarva Peninsula. In 1995, the owl capture rate on the Delmarva was almost 46 times higher than in 2006, 10 times higher than in 1996, and 21 times higher than in 1998. The 1999 capture rate, while lower than that of 1995, was 31 times higher than 2006, 6 times higher than in 1996 and 1997, 7 times higher than in 1994 and 14 times higher than in 1998. It has been suggested that annual variation in the number of Saw-whet Owls is almost entirely due to variations in breeding success (Weir et al. 1980). However, huge variation in the magnitude of migration is likely to be caused by a number of additional factors. Newton (1979) suggests that the most important cause of annual fluctuations in the number of migrating raptors is variation in the amount of available prey. In years with particularly harsh weather, such as unusually cold temperatures and early snow cover, prey availability may decrease drastically. Predators may be forced to migrate to lower latitudes in search of a sufficient prey base. As a result, the magnitude of the raptor migration may be larger than normal.

Age ratios of captured owls were found to vary between years. During the invasion years of 1995, 1999, and 2001, immature birds dominated all captures with ratios of 83%, 80.4%, and 78.8%, respectively. This trend was reversed in 1996 and 2000 when 86% and 82 % of owls caught were adults. This suggests that exceptional levels of productivity are a contributing factor in causing a major irruption year for this species. However, the difference in the number of immature Northern Saw-whet Owls trapped in 1995, 1996, 1999, and 2000 is probably too extreme to be accounted for by variation in productivity alone. In 1995 more than 800 immature Northern Saw-whet Owls were trapped on the lower Delmarva while in 1996 only 15 immature owls were captured. In 1999 the number of immature owls captured increased to over 500 individuals while in 2000 this number dropped to 18. Fluctuations in the abundance of prey may be an important factor contributing to this difference. Lack (1954) proposed that prey cycles may intensify the effect of food shortages because low prey years may often be preceded by years of abundant prey in which predator populations experience low mortality and high productivity. Studies in the boreal forest during the fall of 2006 suggest a rare, synchronized bumper seed crop from both conifers and hardwood trees across Eastern Canada (Pittaway 2006). This seed crop drives the prey base of breeding boreal owls (including Saw-whets). It is likely that the 2007 breeding season will be highly productive, and it is also likely to be an irruptive year. The combination of high population levels and sudden prey shortages may cause a major migration year for a species that is capable of migrating in irruptive fashion. Such factors may have been responsible for the Northern Saw-whet Owl invasions seen on the Atlantic Coast in 1995 and 1999.

The seasonal timing of the Northern Saw-whet Owl migration on the lower Delmarva lags about 1.5 to 2 weeks behind the passage of this species on the Cape May Peninsula. Duffy and Kerlinger (1992) found a mid-migration of 7 November for Northern Saw-whet Owls trapped at Cape May. This is 9 days before the mid-migration date on the lower Delmarva. During 1980-1988, 90% of Northern Saw-whet Owl captures at Cape May occurred during a 5 week period between 16 October and 19 November. On the lower Delmarva 90% of Northern Saw-whet Owls were caught during a 5-week period occurring between 1 November and 5 December. However, it is increasingly clear that age classes move during slightly different time periods.

Although Saw-whet Owls breed almost exclusively in the northern forests of the United States and Canada, substantial numbers penetrate the Southeast each fall and winter. Prior to the start of owl banding efforts in 1994, there was only a scattering of fall and winter records of Northern Saw-whet Owls on Virginia's coastal plain. However, in many years since, more Northern Saw-whet Owls were captured on the Eastern Shore of Virginia than at any other owl-banding site in the eastern United States. Clearly this species occurs on Virginia's coastal plain as a regular transient each fall. Descriptions of Saw-whet Owls as rare on the coastal plain should be attributed to the secretive nature of the species rather than to its relative abundance.

ACKNOWLEDGMENTS

We thank Shannon Ehlers for her invaluable contribution to all aspects of the 2006 trapping season. We thank Sue Rice, Glen Askins, and Sam Sweeney for permitting access to the Eastern Shore of Virginia National Wildlife Refuge, the GATR Tract/ Mockhorn Island Wildlife Management Area, and Kiptopeke State Park, respectively. Jethro Runco, Kristina Baker, and Ariel White assisted with net rounds, data collection, and owl processing. This project was supported by funds provided by the Virginia Department of Game and Inland Fisheries and the Center for Conservation Biology at the College of William and Mary.

LITERATURE CITED

AMERICAN ORNITHOLOGISTS' UNION. 1983. Checklist of North American birds, 6th ed. Allen Press, Inc., Lawrence, KS, 877 pp.

ANONYMOUS. 2004. Audubon Christmas Bird Count Data on the Delmarva Peninsula. 1953-2004. <http://www.audubon.org/bird/cbc/hr/index.>

BRINKER, D.F., K.E. DUFFY, D.M. WHALEN, B.D. WATTS AND K.M. DODGE. 1997. Autumn migration of Northern Saw-whet Owls (*Aegolius acadicus*) in the Middle Atlantic and Northeastern United States: What observations from 1995 suggest. *In* J. R. Duncan, D. H. Johnson, and T. H. Nicholls, editors. Biology and conservation of owls of the northern hemisphere.USDA Forest Service General Technical Report Number NC-190.

CANNINGS, R.J. 1993. Northern Saw-whet Owls (*Aegolius acadicus*). *In* The Birds of North America, No. 42 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D. C.: The American Ornithologists' Union.

DUFFY, K. AND P. KERLINGER. 1992. Autumn owl migration at Cape May Point, New Jersey. Wilson Bull. 104(2):312-320.

EVANS, D.L. and R.N. ROSENFIELD. 1987. Remigial molt in fall migrant Long-eared and Northern Saw-whet owls, pp.209-214 *in* Biology and conservation of northern forest owls (R.W. Hamre, Eds.). U.S. For. Serv. Gen. Tech. Rep. RM-142

HOLROYD, G.L. AND J.G. WOODS. 1975. Migration of the Saw-whet Owl in northeastern Florida. Florida Field Nat. 12(1):11-12.

KAIN, T., ed. 1987. Virginia's birdlife: An annotated checklist. 2nd ed. Virginia Society of Ornithology, Virginia Avifauna 3.

LACK, D. 1954. The natural regulation of animal numbers. Oxford: University Press.

MILLER, L.M. AND R.W. LOFTIN. 1984. The Northern Saw-whet Owl in northeastern Florida. Florida Field Nat. 12(1):11-12.

MILLING, T.C., M.P. ROWE, B.L. COCKEREL, T.A. DELLINGER, J.B. GAILES, AND C.E. HILL. 1997. Population densities of Northern Saw-whet Owls (*Aegolius acadius*) in degraded boreal forests of the Southern Appalachians. *In* J. R. Duncan, D. H. Johnson, and T. H. Nicholls, editors. Biology and conservation of owls of the northern hemisphere.USDA Forest Service General Technical Report Number NC-190.

MUELLER, H.C. AND D.D. BERGER. 1967. Observations on migrating Saw-whet Owls. Bird Banding 38(2):120-125.

NEWTON, I. 1979. Population Ecology of Raptors. Berkhamsted, England: T & A D Poyser.

PITTAWAY, R. 2006. Winter Finch Forecast 2006-2007. <http://www.ofo.ca/2006-7winterfinchforecast.htm>

PYLE, P., D.G. SMITH, D.H. ELLIS, AND B.A. MILLSAP. 1988. Owls. Pages 89-117 *in* Proc. Southeast raptor management symposium and workshop. Natl. Wildl. Fed., Washington, D.C.

PYLE, P. 1997. Identification Guide to North American Birds. Bolinas, California: Slaty Creek Press.

WEIR, R.D., F. COOKE, M.H. EDWARDS, AND R.B. STEWART. 1980. Fall migration of Saw-whet Owls at Prince Edward Point, Ontario. Wilson Bull. 92(4):475-488.

WHALEN, D. M., B. D. WATTS, M. D. WILSON, and D. S. BRADSHAW. 1997. Magnitude and timing of the fall migration of Northern Saw-whet Owls through the Eastern Shore of Virginia, 1994-1996. *The Raven* 68:97-104.

WHALEN, D. M. AND B. D. WATTS. 1999. The influence of audio-lures on capture patterns of migrant Northern Saw-whet Owls. *Journal of Field Ornithology*. 70:163-168.

WHALEN, D. M., B. D. WATTS, AND D. W. JOHNSTON. 2000. Diet of autumn migrating Northern Saw-whet Owls on the Eastern Shore of Virginia. *Journal of Raptor Research* 34:42-44.

WHALEN, D. M. AND B. D. WATTS. 2002. Annual migration density and stopover patterns of Northern Saw-whet Owls (Aegolius acadicus). Auk 119:1154-1161.