2012

Autumn Migration of the Northern Saw-whet Owl on the Lower Delmarva Peninsula: Fall 2012 Report

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Recommended Citation:

Smith, F. M. Smith, B. D. Watts, B. J. Paxton, and D.Z. Poulton. 2012. Autumn Migration of the Northern Saw-whet Owl on the Lower Delmarva Peninsula: Fall 2012 Report. Center for Conservation Biology Technical Report Series, CCBTR-12-13. College of William and Mary & Virginia Commonwealth University, Williamsburg, VA. 15 pp.

Project Partners:

U.S. Fish and Wildlife Service
VA Department of Game and Inland Fisheries
VA Department of Conservation and Recreation
The Center for Conservation Biology at The College of William and Mary & Virginia Commonwealth University

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's 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.

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EXECUTIVE SUMMARY

The Northern Saw-whet Owl (*Aegolius acadicus*) 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 Northern 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 19-year study, 3,850 owls have been banded and more than 100 foreign recaptures and returns have been recorded. We have also recorded more than 1000 same year recaptures.

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 2012, 315 new owls were captured and processed during 44 nights and 8,343 hours of operation. Capture rate was 7.2 owls/night or 3.8 owls/100 net-hours. Age ratio was 86.0% (271 birds) hatching-year (HY) birds compared to 14.0% (44 birds) after-hatching-year (AHY). Nine Eastern Screech Owls (*Otus asio*) were also captured during the season.

BACKGROUND

Context

Each fall millions of passerines, shorebirds, and raptors travel along the eastern seaboard of North America to over-winter in areas further south. Included with these migrants are populations of Northern Saw-whet owls (*Aegolius acadicus*). Northern Saw-whet Owls breed throughout the boreal and hardwood forest of southern Canada and northern United States with populations scattered in the higher elevations of the Appalachians and Rocky Mountains (Rasmussen et al., 2008). Although Northern Saw-whet Owls are resident year-round throughout much of their breeding range, some populations that breed in higher latitudes migrate to lower latitudes for the winter months (Mueller and Berger, 1967; Holroyd and Woods, 1975; Weir, et al., 1980). The Atlantic shoreline is one of the routes Northern Saw-whet Owls appear to use on their way to their wintering grounds (Rasmussen et al., 2008; Brinker et al., 1997; Whalen et al, 1997). 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 (Rasmussen et al., 2008). 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). 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). In the last twenty years the winter range and the migration route of the Northern Saw-whet Owl is becoming clearer as more trapping and banding of Northern Saw-whet Owls occur throughout the east.

The Northern Saw-whet Owl is a small, secretive owl that inhabits areas where the vegetation is dense, making visual observations of the owl difficult. Night surveys that have been useful in detecting the movements of larger owls have not been as successful for detecting Northern Saw-whet Owl movements (Russell et al., 1991). In this respect, the expansion of banding stations that concentrate on the capture and banding of Northern Saw-whet Owls have been indispensable for exploring their fall movements. In the twenty years that some of the banding stations have been operating, capture records and foreign recaptures have indicated that the Atlantic Coastal Plain serves as a Northern Saw-whet Owl migration route that extends from Nova Scotia to the southeast (Holroyd and Woods, 1975). For instance, 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. Northern Saw-whet Owls have also been banded each fall at several locations in Maryland, including Assateague Island National Seashore (Brinker et al., 1997). Finally, banding stations on the lower Delmarva Peninsula regularly capture owls originally banded in Cape May or Assateague Island National Seashore and vice versa, indicating an exchange of migratory Northern Saw-whet Owls in the fall. Collaboration between Northern Saw-whet Owl banding operations have provided insight into the magnitude and direction of their fall migration.

In 1994 three banding stations were established on the tip of the Lower Delmarva Peninsula to investigate the migration ecology of the Northern Saw-whet Owl. Since

1994 these stations have caught 3,350 Northern Saw-whet Owls, over 100 foreign recaptures and over 1000 same year recaptures. This ongoing study has most recently documented mass variation in Northern Saw-whet Owls and the implication for the much used sexing criteria (Paxton and Watts, 2008). It has also 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, 2000) of Northern Saw-whet Owls migration 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 on the tip of the lower Delmarva Peninsula that defines the mouth of the Chesapeake Bay to the north (Figure 1). Owls were trapped at three stations located within a 10 km^2 area and each station was approximately 3-5 km from the other stations. Stations were located on the Eastern Shore of Virginia National Wildlife Refuge (ESVNWR), Gatr Tract/ Mockhorn Island Wildlife Management Area (GATR), and Kiptopeke State Park. In 2006, the Eastern Shore of Virginia NWR station was moved to an area slightly north after many trees and shrubs were lost after Hurricane Isabel. Each of the stations are found in forest patches composed of a mixture of Loblolly Pine (*Pinus taeda*), Eastern red cedar (*Juniperus virginiana*), and various hardwoods (*Quercus* spp., *Carya* spp., *Acer rubrum*, *Prunus serotina*). The understory was moderately dense with dominant species being green briar (*Smilex* spp.), poison ivy (*Toxicodendron radicans*) and tree saplings and shrubs.

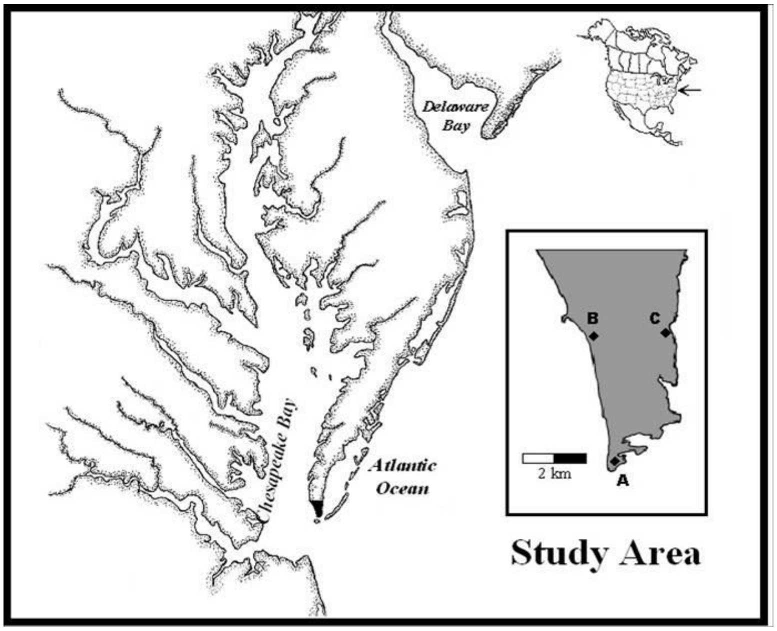

Figure 1. Map of study area on lower Delmarva Peninsula. Inset map shows location of trap sites within A) Eastern Shore of Virginia National Wildlife Refuge, B) Kiptopeke State Park, and C) Gatr Tract/ Mockhorn Island Wildlife Management Area.

Trapping

A continuous line of six mist-nets was erected along an east-west axis at each trapping station. The mist-nets were 12m long by 2m tall and were made of 60mm 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, an amplifier, a 12 V deep cycle marine battery, and a loud-speaker. A continuous-loop broadcast of a Northern Saw-whet Owl "advertisement call" (Rasmussen et al., 2008) was played from the audio-lure. The effectiveness of the audio-lure has been demonstrated by increasing capture rates 5-10 fold in the United States (Erdman and Brinker, 1997; Duffy and Matheny, 1997; Evans, 1997). It should be noted that this technique may exaggerated 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 2012 and continued nightly, weather permitting, until 15 December 2012. Nets were opened at a half hour after dusk and closed at a half hour before dawn. Net checks were conducted every three hours thereafter. A net check consisted of driving to all of the stations in the order in which they were opened and checking the nets for captured owls. All owls were placed in a holding box until processed. Until 2006, owls were processed at the College of William and Mary field house, located on the Eastern Shore of Virginia NWR. Since 2006, owls have been processed in the area of the trapping station. After processing, owls were released near the point of capture.

Photo of holding boxes used for transporting owls for processing. Photo by Bryan Watts.

Banding

Owls were banded with federal aluminum tarsal bands. A standard leg gauge was used to determine proper band size. Natural (unflattened) wing cord 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). Northern Saw-whet Owls were aged as hatching-year (HY) if all primary and secondary remiges and coverts appeared uniform in color. They were aged 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. Owls that show only two generations of feather can be further aged as second-year owls (SY), additionally birds with three or more generations of feathers can be aged as after-second-year (ASY) owls (Pyle, 1997).

Bird (top left) showing typical hatching year plumage pattern with single generation of light brown feathers. Bird (top right) showing one of the plumage patterns of a second-year bird with two generations of feathers. Bird (bottom left) showing one of the plumage patterns of an After-second year bird with more than two generations of feathers. Photos by Jethro Runco.

RESULTS

In 2012, 315 Northern Saw-whet Owls and 4 newly banded Eastern Screech owls were netted over a period of 44 days (Table 1). Additionally, 92 Northern Saw-whet Owls were recaptured during the season. There were 16 foreign recaptures of Northern Saw-whet Owls in 2012. There were 4 screech owls captured this year that were banded in previous years at this station. The stations operated for a total of 8,343 net hours (Table 1). The capture rate was 7.2 owls per trap night or 3.8 owls per 100 net-hours. The capture rate was higher than average compared to the capture rate for invasion years and was over seven times the rate of the previous year.

Table 1. Effort, capture totals, and capture rates for newly captured Northern Saw-whet Owl trapping on the lower Delmarva Peninsula, 21 October-15 December, 1994-2012.

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	1007	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	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	1.7	No
2005	48	7,421	73	1.5	1.0	No
2006	41	7,704	21	0.5	0.3	No
2007	45	8,577	460	10.2	5.4	Yes
2008	44	7,228	72	1.6	1.0	No
2009	41	7,572	32	0.8	0.4	No
2010	37	6,550	80	2.2	1.2	No
2011	40	7,415	40	1.0	.54	No
2012	44	8,343	315	7.8	3.8	Yes
Invasion Year Average	42.1	8,090	550	13.1	6.8	
Non-Invasion Year Average	39.9	7,566	78.6	1.9	1.0	

The trapping station at the Eastern Shore National Wildlife Refuge caught 30.1% (n=95) of the Northern Saw-whet Owls in 2012, which is above average for both invasion and non-invasion years (Table 2). Capture rates have increased on ESVANWR after moving the trap site to a more vegetated forest site in 2006. This followed the loss of dense woody vegetation (and presumably good Northern Saw-whet Owl migration habitat) on Wise Point due to Hurricane Isabel in 2003.

Table 2. Summary of capture locations for newly captured Northern Saw-whet Owls on the lower Delmarva Peninsula, 21 October- 15 December 1994-2012.

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	Station 1 ESVANWR		**Station 2 GATR**		**Station 3 Kiptopeke**		
Year	**#**	**%**	**#**	**%**	**#**	**%**	**Totals**
1994	17	32.7	21	40.4	14	26.9	52
1995	237	23.5	323	32.1	447	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	50.0	22
1999	117	16.8	272	39.1	306	44.0	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	37.0	35	47.9	73
2006	3	14.3	13	61.9	5	23.8	21
2007	105	22.8	97	21.1	258	56.1	460
2008	10	13.9	17	23.6	45	62.5	72
2009	12	37.5	8	25.0	12	37.5	32
2010	18	22.5	22	27.5	40	50.0	80
2011	16	40.0	10	25.0	14	35.0	40
2012	95	30.1	78	24.8	142	45.1	315
Invasion Year Average	**123**	**22.4**	**165.4**	**30.1**	**261.6**	**47.5**	**550**
Non-Invasion Year Average	**13.9**	**17.7**	**30.2**	**38.5**	**34.4**	**43.8**	**78.5**

In 2012, the age ratio between hatching-year (HY) and after-hatching-year (AHY) was skewed towards HY with fewer AHY owls captured (Table 3). There is much annual age variation at this site through the years (Table 3).

Table 3. Patterns in age ratios of newly captured Northern Saw-whet Owls on the lower Delmarva Peninsula 21 October-15 December 1995-2012.

	Hatching-year Birds		**After Hatching-year Birds**	
Year	**Number**	**%**	**Number**	**%**
1995	836	83.0	171	17.0
1996	15	14.2	91	85.8
1997	59	58.4	42	41.6
1998	11	50.0	11	50.0
1999	559	80.4	136	19.6
2000	18	17.8	83	82.2
2001	215	78.8	58	21.2
2002	58	42.3	79	57.7
2003	71	59.7	48	40.3
2004	75	52.1	69	47.9
2005	57	78.1	16	21.9
2006	8	38.1	13	61.9
2007	374	81.5	85	18.5
2008	9	12.5	63	87.5
2009	17	53.1	15	46.9
2010	63	78.8	17	21.3
2011	25	62.5	15	37.5
2012	271	86.0	44	14.0
Invasion Year Average	**451**	**82.0**	**98.8**	**18.0**
Non-Invasion Year Average	**37.4**	**46.4**	**43.2**	**53.6**

DISCUSSION

The magnitude of Northern Saw-whet Owl migration fluctuates from year to year at banding stations across eastern United States and Canada (Brinker et al., 1997). Our data demonstrates that considerable year to year variation exists in the number of owls migrating through the lower Delmarva Peninsula. This year there was nearly an eightfold increase in the number of owls captured when compared to last year's numbers. In 2012, the stations caught a total of 315 Northern Saw-whet Owls (7.8 owls/100-net hours); this follows four years where the capture rate was lower than 2.2 owls/100-net hours. For the past nineteen years of operation, the stations have recorded five seasons in which the capture rate for Northern Saw-whet Owls was over 5 owls per trap night. Other stations in the east have recorded similar booms and busts in Northern Saw-whet Owl numbers particularly in 1995 where stations in New Jersey, Maryland, and Virginia all recorded high numbers of birds (Brinker, et al., 1997). The large fluctuations in numbers of Northern Saw-whet Owls caught at these stations have led researchers to hypothesize that some populations follow an irruptive migration pattern (Whalen et al., 1997; Stock et al., 2006).

Populations that follow an irruptive pattern for migration are commonly dependent on food sources that are cyclic in their availability and therefore the population moves in accordance to food abundances (Newton, 2006). Northern Saw-whet Owls are an opportunistic feeder that frequently prey upon small mammals, such as deer mice and white-footed mice (*Peromyscus* spp.), and in boreal habitats, red-backed voles (*Myodes* spp.) (Rasmussen et al., 2008; Whalen et al, 2000). Although red-back voles do follow a cyclical pattern in productivity, Northern Saw-whet Owls are not entirely dependent on voles throughout their range. Their ability to feed on a variety of small mammals prevent them from being irrevocably linked to cyclical prey items (Cote, et al., 2007). However, it is still possible that some populations of Northern Saw-whet Owls are irruptive migrants. Marks and Doremus (2000) propose that Northern Saw-whet Owls are the first example in North America to be irruptive without depending on a cyclical prey because of the low site fidelity they observed in nesting Northern Saw-whet Owls. It is suggested that there is a continuum between species that are regular (obligate) migrants and those that are irruptive (facultative) migrants (Newton, 2006). Although Northern Saw-whet Owls do not depend on a cyclical prey throughout their range, they do possess other characteristics of irruptive migrants.

Each year there was an irruption of Northern Saw-whet Owls into the mid-Atlantic, the predominate age class captured were immature birds. In the invasion years of 1995, 1999, 2001, and 2007; immature birds composed 83%, 80.4%, 78.8%, and 81.5% respectively, of the total captures. Interestingly, the year immediately following the irruptions; 1996, 2000, 2002, and 2008 recorded a complete inversion of the age ratios with 85.5%, 82.2%, 57.7% and 87.5% respectively, of the total capture aged as adults (Figure 2). In 2008, 81% of the adult owls were further aged as second-year birds, meaning they were hatched in the previous irruptive year, 2007. This suggests that irruptive years of Northern Saw-whet Owls may have its roots in high productivity. It has been suggested that annual variation in the number of Northern Saw-whet Owls is almost entirely due to variations in breeding success (Weir et al., 1980; Cote, et al., 2007). However there are several years that pass between invasion years where capture rates of Northern Saw-whet Owls are low and the age ratio is constant. Therefore other factors must influence the magnitude of migration over the years.

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. For example, studies in the boreal forest during the fall 2006 suggested a rare, synchronized bumper seed crop from both conifers and hardwood trees across eastern Canada and northern United States (Pittaway, 2006). It is presumed that this bumper seed crop produced an increase of productivity of small mammals, particularly red-backed voles (Pittaway, 2006). This banner seed crop year (and subsequent rise in prey population) likely increased the productivity of Northern Saw-whet Owls in 2007. However, studies in 2007 discovered that the seed crop for 2007 was greatly reduced which respectively caused, in addition to increased depredation pressure, a crash in vole populations (Pittaway, 2007). Just as productivity for Northern Saw-whet Owls peaked, one of their food sources crashed presumably causing many owls to move south for the 2007 winter season. Therefore, it is likely that irruptions of Northern Saw-whet Owls are caused by both competition for food sources and high productivity.

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 date of 7 November for Northern Saw-whet Owls trapped at Cape May. This is nine days before the mid-migration date on the lower Delmarva. Over 90% of Northern Saw-whet Owl captures at Cape May occur during a 5 week period between 16 October and 19 November (Duffy and Kerlinger 1992). On the lower Delmarva 90% of Northern Saw-whet Owls were caught during a five week period occurring between 1 November and 5 December. However it is increasingly clear that age classes move during slightly different time periods.

Although Northern Saw-whet Owls breed almost exclusively in the northern boreal 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 were 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 Northern Saw-whet Owls as rare on the coastal plain should be attributed to the secretive nature of the species rather than its relative abundance.

ACKNOWLEDGMENTS

We thank Zak Poulton for handling all aspects of the field work, including net rounds and net maintenance, data collection and entry, and audio-lure maintenance. We thank Sue Rice, Phil West, and Forrest Gladden 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. This project was supported by financial or in-kind support provided by the Virginia Department of Game and Inland Fisheries, the US Fish and Wildlife Service, and the Center for Conservation Biology at the College of William and Mary.

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