

**Autumn Migration of Northern Saw-whet Owls on the
Lower Delmarva Peninsula 1994-2007:
Project Report 2007**



**Center for Conservation Biology
College of William and Mary**

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Cover photo of N. Saw-whet Owl by Shannon Ehlers



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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 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 14-year study, 3,290 owls have been banded and more than 100 foreign retraps and returns have been recorded. We have also recorded more than 500 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 2007, 460 new owls consisting of 439 newly banded birds and 21 foreign banded birds were captured and processed during 45 nights and 8,577 hours of operation. Capture rate was 10.2 owls/night or 5.4 owls/100 net-h. Age ratio was 81.3% (374 birds) hatching-year (HY) birds compared to 18.5% (85 birds) after-hatching-year (AHY). We were unable to determine the age of one owl. The capture rate was the third highest ever and was in line with the invasion years of 1995 and 1999 and was 20 times higher than last year. The age ratio observed was skewed towards HY birds and is consistent with the age ratios observed during previous invasion years suggesting that 2007 was an invasion year. In addition to the Northern Saw-whet Owls captured during the season, 1 Long-eared Owl and 10 Eastern Screech Owls were captured.

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 most recently documented mass variation in Northern Saw-whet Owls and the implication for the much used sexing criteria (Paxton and Watts, in press) and 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 2002) of 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 km² 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 before the 2006 trapping season to maximize the amount of understory present.

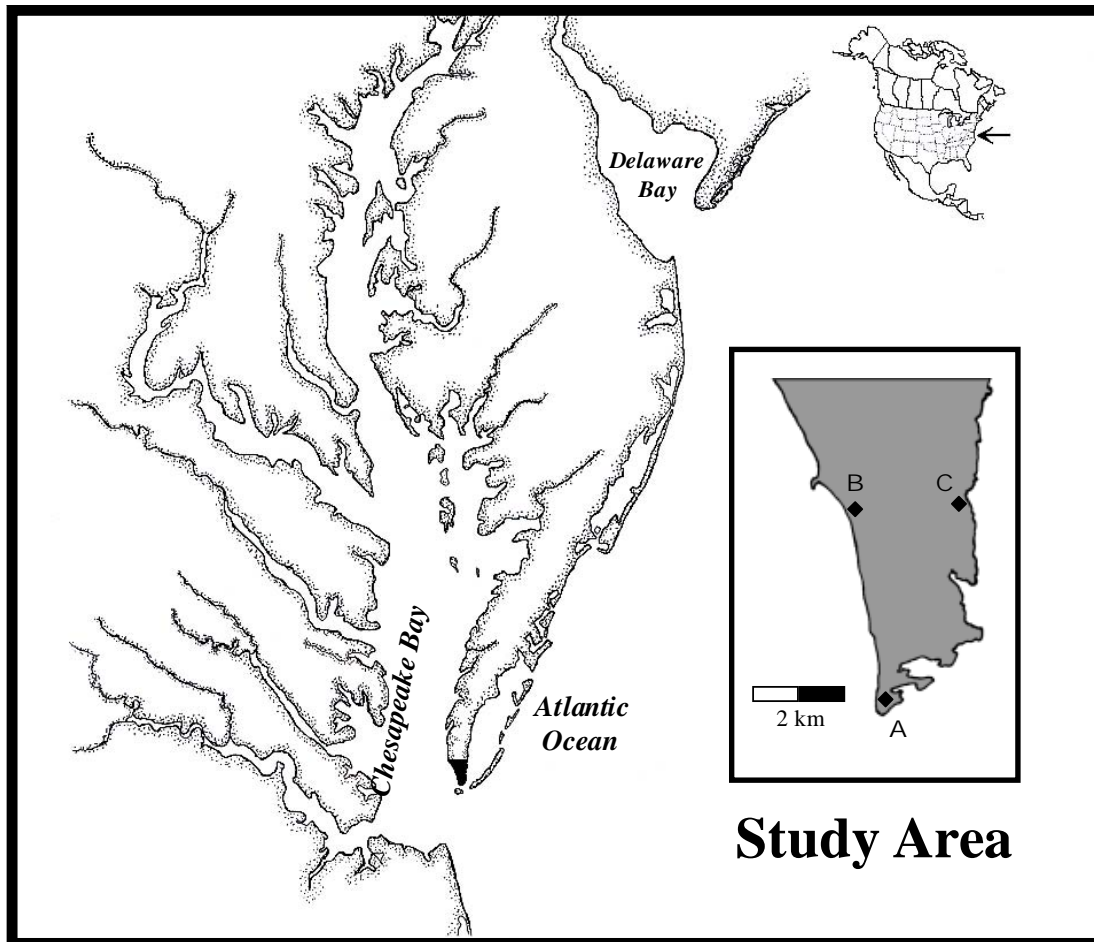
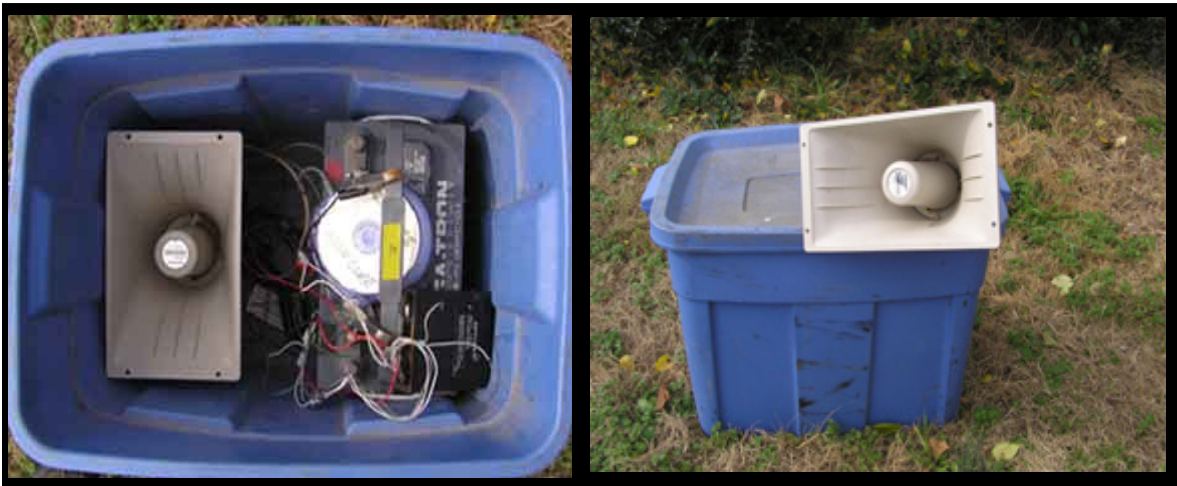


Figure 1. Map of study area on lower Delmarva Peninsula. Inset map shows location of trap sites within A) Eastern Shore of Virginia National Wildlife Refuge, B) Kiptopeke State Park, and C) GATR Tract Wildlife Management Area.

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 2007 and continued nightly weather permitting until 15 December 2007. 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.

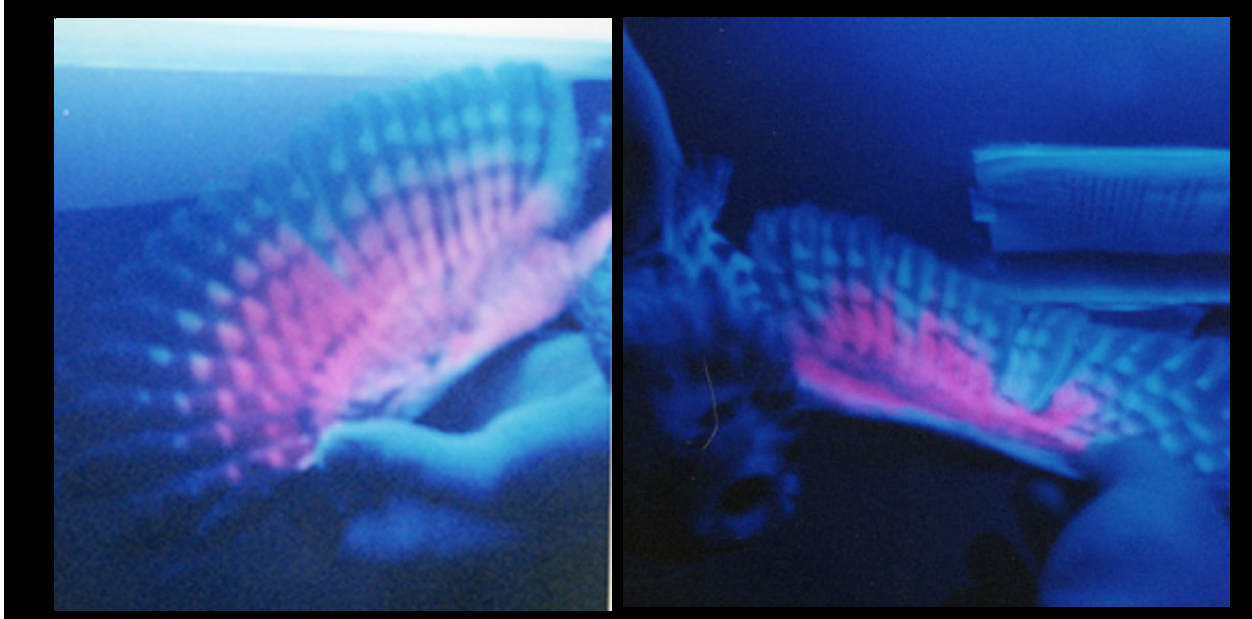
Photo of holding boxes used to transport owls to field station for processing. Photo by Bryan Watts.



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 2007, 460 new owls consisting of 439 newly banded birds and 21 foreign recaptures were captured and processed during 45 nights and 8577 hours of operation. Capture rate was 10.2 owls/night or 5.4 owls/100 net-h. The capture rate was the third highest ever, only lower than the invasion years of 1995 and 1999 and 20 times higher than the previous year. In addition to the new owls captured, 105 same year recaptures were recorded during the 2007 season. These trapping sites continue to have some of the highest foreign recapture rates and same year 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, 1994-2007.

| 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 | 1.0 | No |
| 2006 | 41 | 7,704 | 21 | 0.5 | 0.3 | No |
| 2007 | 45 | 8,577 | 460 | 10.2 | 5.4 | Yes |
| Invasion Year Average | 46.3 | 9,374 | 608.8 | 13.1 | 6.5 | |
| Non-invasion Year Average | 37.4 | 7,716 | 87.6 | 2.3 | 1.1 | |

Capture rates varied between the three trap sites. Kiptopeke State Park accounted for 56.1% of all captures (n=258). The Eastern Shore of Virginia National Wildlife Refuge accounted for 22.8% of all captures (n=105). Gatr Tract Wildlife Management Area accounted for 21.1% of all new captures (n=97). The capture rate at the Eastern Shore of Virginia National Wildlife Refuge was the highest since 1996. The station also captured the only Long-eared Owl of the season, and only the second since the start of Northern Saw-whet Owl trapping in 1994. Ten Eastern Screech Owls were captured during the season. 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 years after the hurricane and before the trap site was moved, wind was a serious problem at the Wise Point station and caused substantially less net-hours at the site. Wind has not been 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, 1994-2007.

| Year | Station 1 ESVANWR | | Station 2 Gatr/Mockhorn | | Station 3 Kiptopeke | | 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 |
| 2007 | 105 | 22.8 | 97 | 22.1 | 258 | 56.1 | 460 |
| Invasion Year AVG | 130 | 21.4 | 187.3 | 30.8 | 291.3 | 47.8 | 608.8 |
| Non-Invasion Year AVG | 13.9 | 16.1 | 36.6 | 42.2 | 36.1 | 41.7 | 86.6 |

Age ratio was 81.3% (n=374) hatching-year (HY) birds compared to 18.5% (n=85) after-hatching-year (AHY). We were unable to determine the age of one owl. The capture rate was the third highest ever and was in line with the invasion years of 1995 and 1999 and was 20 times higher than last year. The age ratio observed was skewed towards HY birds and is consistent with the age ratios observed during invasion years suggesting that 2007 was an invasion year (Table 3).

Table 3. Patterns in age ratios of Saw-whet Owls captured 21 October-15 December, 1995-2007.

| Year | Hatching-year Birds | | After Hatching-year Birds | |
|-------------------------------|---------------------|------|---------------------------|------|
| | 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 |
| 2007 | 374 | 81.3 | 85 | 18.5 |
| Invasion Year Avg. | 496 | 81.5 | 112.5 | 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 2007 capture rate, while lower than that of 1995, was 20 times higher than 2006, 4.5 times higher than in 1996 and 1997, 3.4 times higher than in 1994 and 11 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 the differences in capture rates. 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 suggested a rare, synchronized bumper seed crop from both conifers and hardwood trees across Eastern Canada (Pittaway 2006). This banner seed crop year (and subsequent rise in prey population) was likely the reason for the 2007 irruption. The combination of high owl population levels and sudden prey shortages may also cause a major irruption year. Such factors may have been responsible for the Northern Saw-whet Owl invasions seen on the Atlantic Coast in 1995 1999, 2001 and 2007. Data collected during the fall of 2007 (Pittaway 2007) suggests a poor seed crop in the boreal forest and could possibly mean a poor migration of owls next fall as the population of their main prey item (red-backed vole) crashes.

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.

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