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## **Autumn migration of Northern Saw-whet Owls on the Lower Delmarva Peninsula 1994-2005: Project Report 2005**

F. M. Smith

*The Center for Conservation Biology, fmsmit@wm.edu*

B. J. Paxton

*The Center for Conservation Biology, bjpaxt@wm.edu*

B. D. Watts

*The Center for Conservation Biology, bdwatt@wm.edu*

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College of William and Mary**

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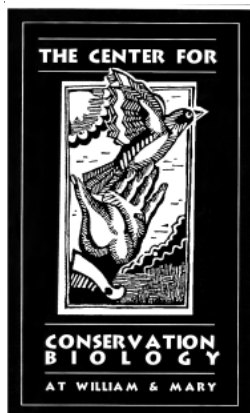
January 2006

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**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



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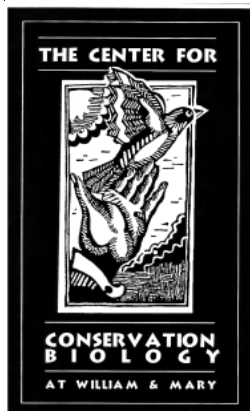
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Center for Conservation Biology**



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 12-year study, more than 2,800 owls have been banded, more than 500 birds recaptured during the same season, and more than 60 foreign retraps 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. The project seeks to determine 1) the annual variation in the magnitude and timing of Saw-whet Owl migration through the lower Delmarva Peninsula, 2) the spatial pattern of habitat use near the tip of the Delmarva Peninsula, 3) the relative timing of passage for different age classes of Saw-whet Owls, and 4) the rate of movement of Saw-whet Owls down the Atlantic Flyway.

During the fall of 2005, 73 new owls were captured during 48 nights and 7,421 hours of operation. Capture rate was 1.5 owls/night or .98 owls/100 net-hours. Age ratio was 78.1% hatching-year birds compared to 21.9% after-hatching-year birds. The capture rate was the lowest since 1998 and was similar to capture rates on the non-invasion years of 1994, 1996, 1997, 1998, 2000, 2002, 2003, and 2004. The age ratio observed was slanted heavily towards hatching-year birds and is consistent with the age ratios observed during the invasion years of 1995, 1999, and 2001. However, the volume of birds captured indicates that this was a non-invasion year. Largely due to the unique bottleneck effect on the lower Delmarva Peninsula, same station recapture rates continue to be extremely high, with 25 same station recaptures in 2005. Two foreign recaptures were processed during the 2005 owl trapping season.

# 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 (Am. Ornithol. Union 1983, Milling et al. 1997, Smith et al. 1988). Although 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 (See Figure 1 for a map of all current trapping stations). 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 Saw-whet Owls migrate at least as far south as Cape May, New Jersey, every year. Beginning in 1991, 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 (Audubon CBC Data 2005).

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 project seeks to determine 1) the annual variation in the magnitude and timing of Saw-whet Owl migration through the lower Delmarva Peninsula, 2) the spatial pattern of habitat use near the tip of the Delmarva Peninsula, 3) the relative timing of passage for

different age classes of Saw-whet Owls, and 4) the rate of movement of Saw-whet Owls down the Atlantic Flyway.

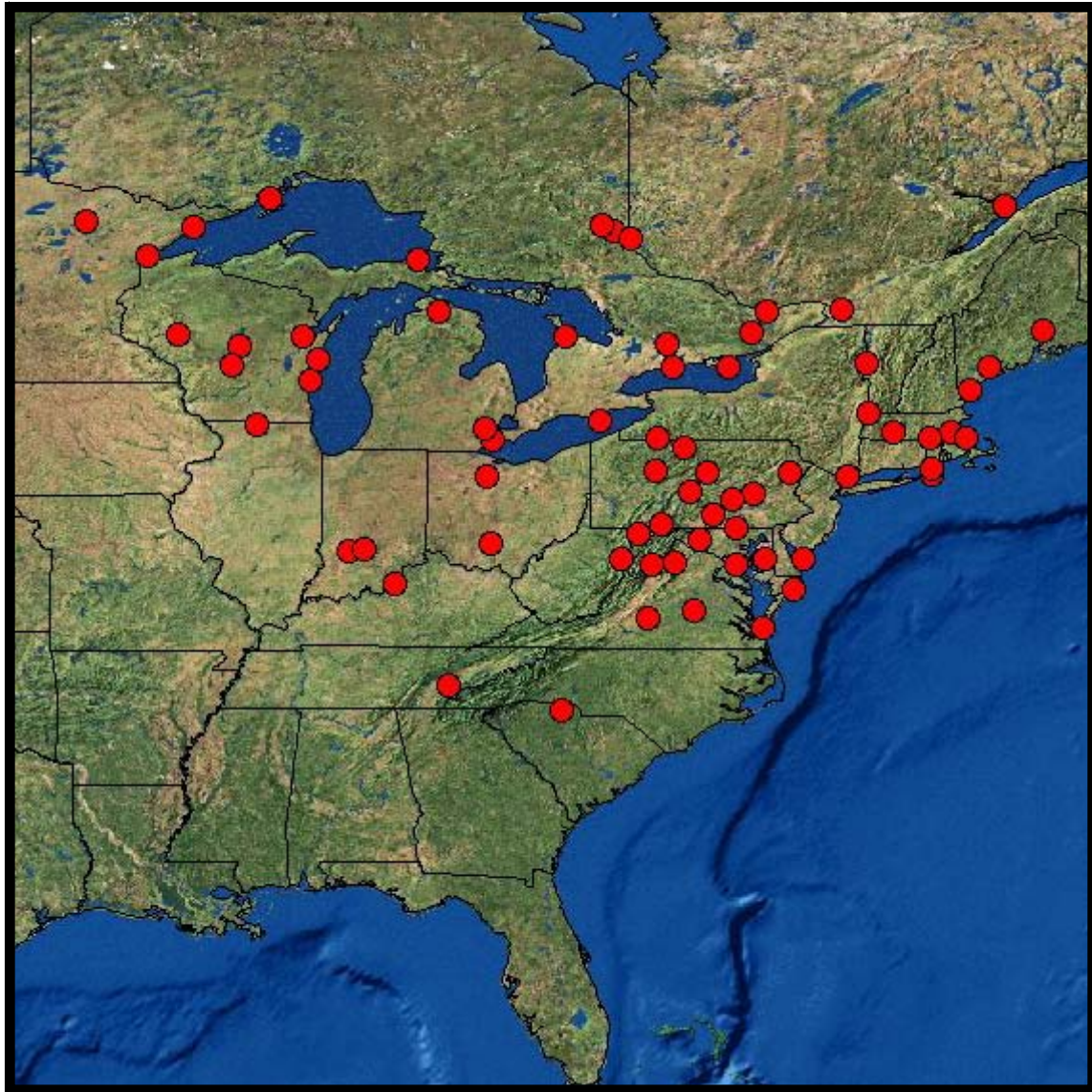


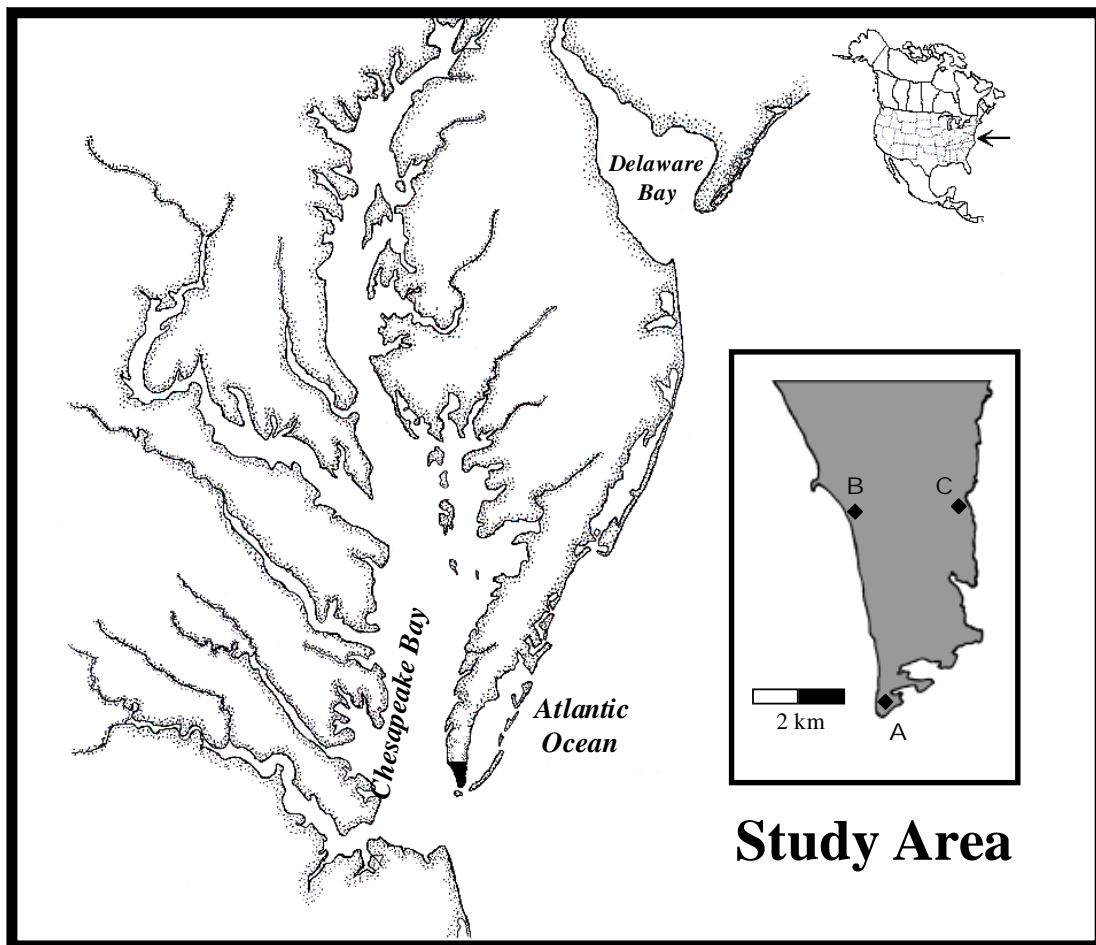
Figure 1. Location of all Saw-whet trapping stations in 2005. Note the lack of stations on the mid-Atlantic Coastal Plain compared to the Appalachian flyway. Map includes both constant effort and part-time stations. Map by Dave Brinker and Project Owl-net.



## METHODS

### Study Area

This study was conducted within the lower Delmarva Peninsula, which forms the northern shoreline near the mouth of the Chesapeake Bay (Figure 2). Owls were trapped at 3 stations located within a 10 km<sup>2</sup> 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 are wooded with a mixture of loblolly pine (*Pinus taeda*) and hardwoods and contained moderate to dense understory vegetation. The Eastern Shore NWR site is dominated by loblolly pine, but a high percentage of the understory vegetation hasn't recovered from the salt spray of Hurricane Isabel(2003).



**Figure 2.** 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 Saw-whet “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 North America (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, 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 2005 and continued nightly, weather permitting, until 15 December 2005. Nets were generally opened 0.5 hour after sunset and closed 0.5 hour before sunrise. Net checks were usually conducted at 2100, 2400, 0300, and 0600. 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, or in the field with the use of a portable blacklight. After processing, owls were released near the point of capture.

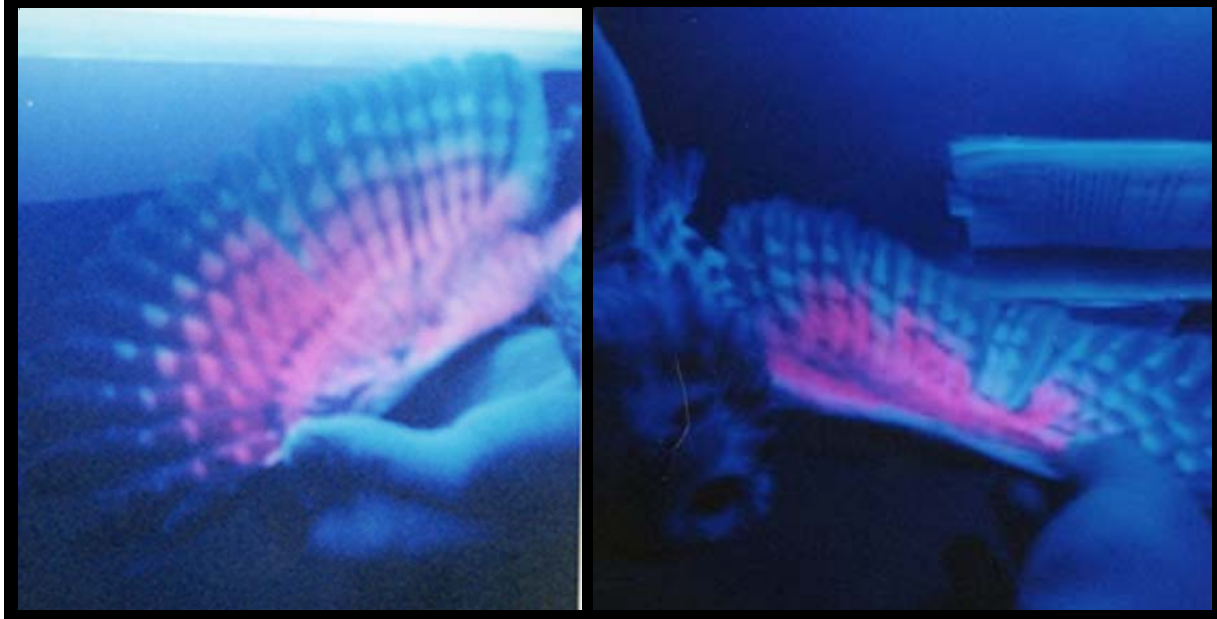
*Photo of holding boxes used to transport owls to field station for processing. Photo by Bryan Watts.*



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 0.1 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 of HY owls 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**

Banding operations were conducted on 48 nights between 25 October and 15 December. Total effort was 7,421 net-hours. A total of 100 owl captures were made, including 75 new owls (including 2 foreign recaptures, see Appendix I for details on foreign recaptures) and 25 same-year recaptures. This number of new owls resulted in a capture rate of 1.5 owls/night or .98 owls/100 net-hour. The capture rate in 2005 was much lower than that of the invasion years of 1995 and 1999 and similar to that of the non-invasion years of 1994, 1996, 1997, 1998, 2000, 2002, 2003, and 2004 (Table 1). The 2005 capture rate of 1.5 owls/trap night and .98 owls/100 net-hours was the third lowest in the project history.

Capture rates varied between the three trap sites. Kiptopeke State Park accounted for 47.9% of all new captures, followed by Gatr Tract Wildlife Management Area at 39.2% and the Eastern Shore of Virginia National Wildlife Refuge at 15.1% (Table 2). The low capture rates at the Eastern Shore of Virginia National Wildlife Refuge the last three years could be attributed to the hurricane damage that Wise Point suffered in the fall of 2003. A high percentage of trees and shrubs were lost after Hurricane Isabel and have not shown signs of recovery. In 2003, the normal trapping lane was completely inundated the entire

**Table 1.** Effort, capture totals, and capture rates for Saw-whet Owl trapping on the lower Delmarva Peninsula, 21 October-15 December, 1994-2005.

|                       | 1994  | 1995  | 1996  | 1997  | 1998  | 1999  | 2000  | 2001  | 2002  | 2003  | 2004  | 2005  | Invasion<br>Year<br>Average | Non-<br>invasion<br>Year<br>Average |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------------------|-------------------------------------|
| Trap-<br>Nights       | 32    | 44    | 42    | 40    | 22    | 48    | 46    | 48    | 37    | 43    | 46    | 48    | 46.7                        | 37.4                                |
| Net-Hours             | 6,903 | 9,481 | 8,817 | 8,212 | 4,499 | 9,633 | 9,477 | 9,804 | 7,287 | 8,279 | 8,559 | 7,421 | 9,639                       | 7,639                               |
| Owl<br>Captures       | 52    | 1,007 | 106   | 101   | 22    | 695   | 101   | 273   | 137   | 119   | 144   | 73    | 658                         | 91                                  |
| Owls/Trap-<br>Night   | 1.6   | 22.9  | 2.5   | 2.5   | 1     | 14.5  | 2.2   | 5.7   | 3.7   | 2.8   | 3.1   | 1.5   | 14.1                        | 2.4                                 |
| Owls/100<br>Net-Hours | 0.8   | 10.6  | 1.2   | 1.2   | 0.5   | 7.2   | 1.1   | 2.8   | 1.9   | 1.4   | 1.6   | 0.98  | 6.8                         | 1.2                                 |

season, so the nets were set up along the road approximately 10 meters north of the usual net lanes. During the fall 2005 trapping season, the strong westerly winds coming off of the Chesapeake Bay kept the refuge site closed on 19 nights that the other sites were in operation. This reduced the number of net-hours by approximately 1,140 hours. As the understory lost due to Hurricane Isabel recovers, the effect of wind should diminish and capture rates may increase.

Age ratios in 2005 were 78.1% hatching-year birds and 21.9% after-hatching-year birds. This age ratio is highly skewed toward hatching-year birds and is consistent with the age ratios observed during invasion years (Table 3). However, the low numbers caught on the mid-Atlantic Coastal Plain during the 2005 season suggest that an invasion did not take place.

A total of 21 hatching-year and 4 hatching-year owls were recaptured. The recapture rates at this trapping station are typically much higher than other trapping stations.

**Table 2.** Summary of capture locations for Saw-whet Owls on the lower Delmarva Peninsula, 21 October-15 December, 1994-2005.

| Year                             | Station 1<br>ESVANWR |      | Station 2<br>Gatr/Mockhorn |      | Station 3<br>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                         | 37.0 | 35                     | 47.9 | 73     |
| <b>Invasion Year<br/>AVG</b>     | 138.3                | 21   | 217.3                      | 33   | 302.3                  | 45.9 | 658.3  |
| <b>Non-Invasion<br/>Year AVG</b> | 15.1                 | 16   | 39.2                       | 41.3 | 40.7                   | 42.8 | 95     |

**Table 3.** Patterns in age ratios of Saw-whet Owls captured 21 October-15 December, 1995-2005.

| 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 |
| <b>Invasion Year AVG</b>     | 536.7               | 81.5 | 121.7                     | 18.5 |
| <b>Non-invasion Year AVG</b> | 40.4                | 45.3 | 48.7                      | 54.7 |

## 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 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 10 times higher than in 1996, 14 times higher than in 1994, and 21 times higher than in 1998. The 1999 capture rate, while lower than that of 1995, was 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 2005 trapping season, 78.1% of Saw-whets trapped were hatching-year, while 21.9% were after-hatching year. During the invasion years of 1995, 1999, and 2001, 83%, 80.4%, and 78.8% of the Saw-whets trapped on the lower Delmarva were immature birds, while that 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 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 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.

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 Saw-whet Owl invasions seen on the Atlantic Coast in 1995 and 1999. The seasonal timing of the 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 Saw-whets trapped at Cape May. This is 9 days before the mid-migration date on the lower Delmarva. During 1980-1988, 90% of Saw-whet captures at Cape May occurred during a 5 week period between 16 October and 19 November. On the lower Delmarva, 90% of Saw-whets 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 Saw-whet Owls on Virginia's Coastal Plain. However, in many years since, more Saw-whets 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 Virginia Coastal Plain should be attributed to the secretive nature of the species rather than to its relative abundance.



## ACKNOWLEDGMENTS

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**Appendix I.** Location of foreign recaps caught in 2005.

| <b>Original Capture Location</b> | <b>Distance from Lower Delmarva</b> | <b>Original Banding Date</b> | <b>Date of Recapture on the Lower Delmarva Peninsula</b> |
|----------------------------------|-------------------------------------|------------------------------|--|
| Cape May, NJ                     | approximately 150 miles             | 10/27/2005                   | 10/28/2005   |
| Cape May, NJ                     | approximately 150 miles             | Fall 2005                    | 11/25/2005   |