THE FALL MIGRATION OF THE NORTHERN SAW-WHET OWL ON THE LOWER DELMARVA PENINSULA

A thesis submitted in partial fulfillment of the requirement for the degree of Bachelor of Arts with Honors in Biology from the College of William and Mary in Virginia,

by

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ABSTRACT

Northern Saw-whet Owls (Aegolius acadicus) were captured and banded at 3 sites on the lower Delmarva Peninsula during the fall of 1994. Beginning on 27 October and ending on 12 December, 52 individual owls were caught and 28 recaptures occurred for a total of 80 owl captures. Of the 52 new owls, 5 were already banded at stations other than ours. The seasonal timing of migration was analyzed and 50% of new owl captures occurred between 10 and 19 November.

The majority of saw-whet owls captured (63%) were adults (after-hatch year). On a nightly basis, 48% of total owl captures occurred during the first 3 hours after sunset. New owl captures were distributed evenly between the bayside, the seaside and the tip of the peninsula. However, the bayside site accounted for fewer recaptures than expected. The majority of new owls were captured on nights when the temperature fell below 5° C. Recapture rate was not influenced by temperature. The rate of recaptures increased throughout the study and more than half of recaptures occurred after 25 November. Mean stopover time was 10.3 +/- 8.7 days.

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INTRODUCTION

Although the Northern Saw-whet Owl (Aegolius acadicus) is a common species in the forests of Canada and the northern U.S., its breeding range in the eastern and southern U.S. seems to be limited to mountainous regions (Cannings 1993). In 1911, Taverner and Swales first proposed that the saw-whet owl may be a migratory species. However, Bent (1938) suggested that the movement of saw-whet owls is irregular in nature. The results of numerous banding studies from the 1960's to the present have since shown the species to be a common fall migrant in the Great Lakes region (Mueller and Berger 1967, Weir et al. 1980), the Appalachian Mountain Range (Brinker and McKearnan 1990) and the Atlantic Coastal Plain (Duffy and Kerlinger 1992, Brinker, unpublished data).

Banding studies conducted at Cape May Point, New Jersey since 1980 (Duffy and Kerlinger 1992) and at Assateague Island National Seashore since 1991 (Brinker, unpublished data) have documented the importance of the Atlantic coast as a fall migration route for saw-whet owls. Although sporadic winter recoveries in North Carolina, Georgia (Holroyd and Woods 1975) and Florida (Miller and Loftin 1984) suggest that these states contain wintering sites for saw-whet owls, a banding study targeting this species has never before been conducted in the state of Virginia or at any location south of Maryland.

Each autumn, migrating passerines, shorebirds and diurnal raptors are known to occur in huge numbers on the Atlantic coast. Many of these migrating bird species become concentrated around physical barriers such as the Chesapeake Bay. Since a high concentration of migrating saw-whet owls have been documented each fall at Cape May Point, it seems likely that the Delmarva Peninsula may also serve as a bottleneck during the southward migration of this species. However, saw-whet owls are strictly nocturnal and highly secretive. To date, very few records of this species exist for Virginia's coastal plain. In order to determine the importance of the Delmarva Peninsula to migrating saw-whet owls, this study was undertaken. The objectives of the study are to:

1) Determine both the daily and seasonal movement patterns of the species on the Delmarva Peninsula. 2) Analyze the spatial dynamics of the fall passage of the species. 3) Identify any differences in the timing of migration and space use by different sex and age categories. 4) Determine the influence of weather patterns on movement of owls during fall migration. 5) Determine the minimum length of stopover times.

METHODS

Study area

The study area included 3 stations confined within an area of approximately 10 km^2 at the southern tip of the Delmarva Peninsula (See Figure 1). At this location the peninsula forms the northern boundary of the mouth of the Chesapeake Bay. Local habitat in the study area can be characterized as a mixture of woodlands, idle grasslands and cultivated fields with a scattering of commercial and residential buildings. The seaside of the peninsula is primarily comprised by coastal marshes while the bayside is mostly sandy beaches. Specific locations for banding stations were selected according to relative ease of access, availability of habitat suitable for saw-whet owls and minimal disturbance to local residents.

Description of study stations

Station 1 was located on the Eastern Shore of Virginia National Wildlife Refuge. The site was situated at the extreme southern terminus of the Delmarva peninsula and was within approximately 50 - 100 m of the beaches on the bayside, the coastal marsh on the seaside, and the mouth of the bay where the Chesapeake Bay Bridge-Tunnel reaches land. Vegetation within this site was dominated by a 30 - 40 year old stand of loblolly pine (Pinus taeda) with a dense understory of wax myrtle (Myrica pennsylvanicus) and other woody shrubs.

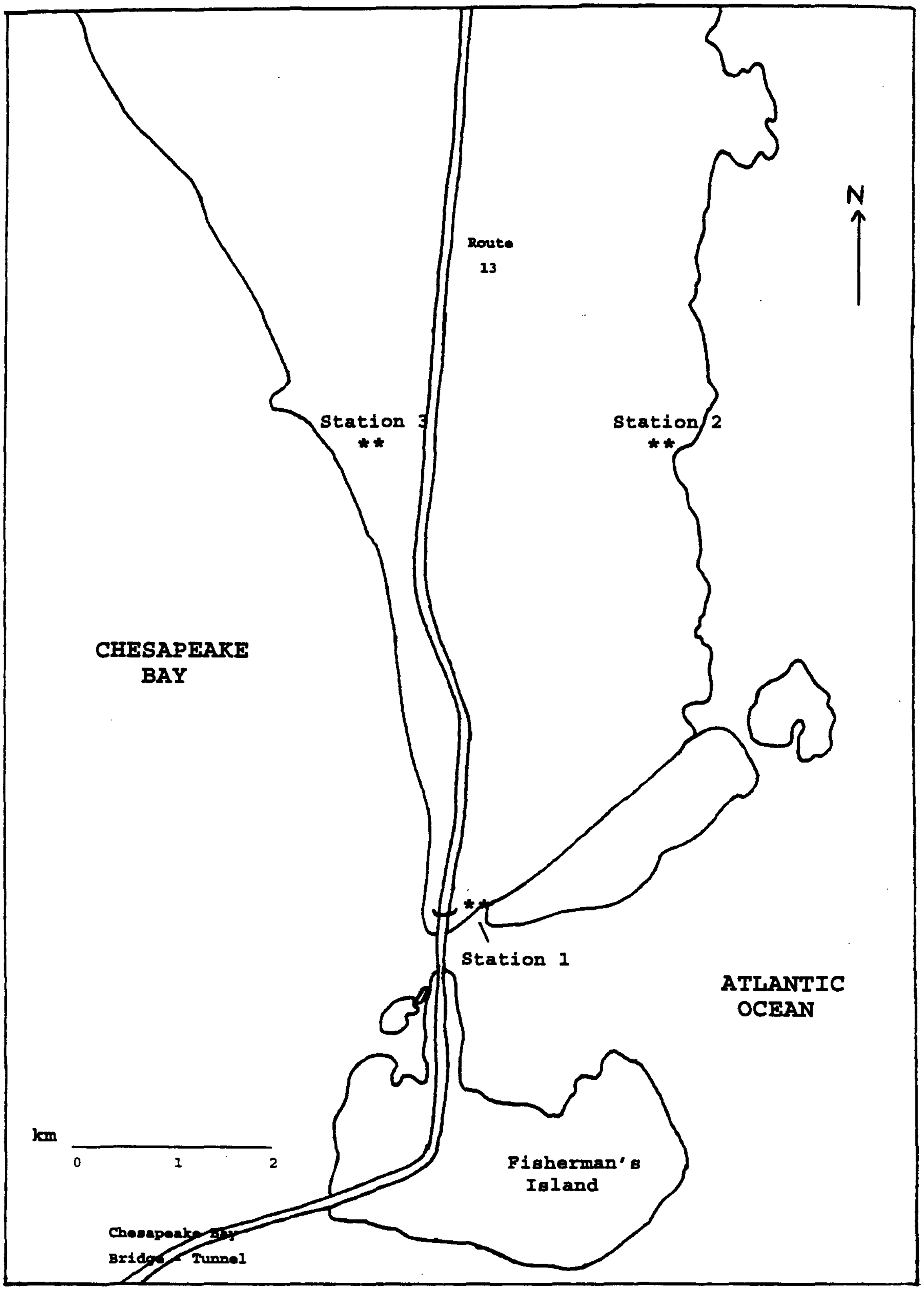

Figure 1. Map of the lower Delmarva Peninsula showing saw-whet owl banding stations.

Station 2 was located on the Gatr Tract/Mockhorn Island Wildlife Management Area on the seaside of the peninsula approximately 3 km north of the tip. The site was situated roughly 100 m inland from the seaside coastal marsh bordering the eastern shoreline of the peninsula's mainland. The vegetation was dominated by a 40 - 50 year old stand of loblolly pine with a scattering of red cedar (Juniperus virginianus) and a moderate understory of woody shrubs.

Station 3 was located on Kiptopeke State Park on the bayside of the peninsula about 3 km north of the tip. The site was initially located on the northern edge of a mixed pine stand. However, after 5 nights of operation the site had to be relocated due to complaints from nearby campers about the noise of the audio-lure (used to attract owls). Station 3 was moved about 500 m south to the southern boundary of the park within 100 m of the beach on the Chesapeake Bay for the remainder of the study. Vegetation at the site was dominated by various oaks (Quercus sp.) with a scattering of loblolly and Virginia pine (Pinus virginianus) and a relatively sparse understory of American holly (Ilex opaca).

Net set-up

Net lanes were cleared at each station during the third week of October 1994. Low hanging branches and understory vegetation were manually cleared using a hand-saw and swing-blade. Net lanes were cut to a length of about 75 m and a width of 1 - 2 m. At each site, six black nylon mist nets were erected in a configuration that approximated a fairly straight east/west axis. The nets were 31 mm mesh size and measured 12 m in length with 4 panels per net. At each station the nets were numbered from 1 - 6 with net 1 being the westernmost and net 6 being the easternmost. Likewise, the panels on a given net were numbered low to high as 1 - 4 and the 2 sides of the net were designated as the northern side and the southern side.

Audio equipment

Electronic audio-lures were assembled in order to attract saw-whet owls to each site. Each audio-lure consisted of an audiotape player with external speaker jack and external power source jack, an adapter leading from the power jack to 12 V battery clips, a 12 V deep cycle marine battery, a 40 W amplifier, and a 15 or 40 W outdoor horn speaker. Three-minute, continuous loop audiotapes of a Northern Saw-whet Owl call were used. Each audio-lure was housed in a protective casing and situated at the center of each net lane (between nets 3 and 4) with the speaker aimed to the north to attract owls migrating south. Audio-lures produced an estimated sound output of around 100 db and could be heard at a distance of up to 2 km depending on weather conditions.

The effectiveness of the audio-lures at attracting owls to the trapping stations was demonstrated by the concentration of owl captures occurring in nets 3 and 4, the 2 nets immediately adjacent to the audio-lure. These nets accounted for 49% of total owl captures, significantly more than expected by chance (χ^2 = 8.55, df = 1, P < 0.01).

Data collection

Stations were operated on 32 nights between 22 October and 12 December 1994. On each night, nets were opened and audio-lures were started generally during the first hour after sunset. Nets were checked for owls in rounds at 21:00, 24:00, 3:00, and dawn. An individual round took approximately 30 - 60 minutes and involved driving to all 3 stations in the order in which they were opened and inspecting nets for captured owls. In addition, temperature and wind conditions were recorded on each round. Nets were closed and callers were turned off on the last round. The order in which sites were opened, checked and closed was varied night to night to reduce time biases.

Nets were checked for owls with the aid of headlamps. Upon discovery of a captured owl, the bird was untangled from the net. Time of capture, net number, height of capture and side (north/south) of net in which the capture occurred were recorded for each bird. Owls were typically stored in 1 of 2 holding boxes (capable of holding 8 owls each) until the round of net checks was completed. The holding boxes were then taken to the William & Mary field station (located on the Eastern Shore of Virginia National Wildlife Refuge) where the owls were processed. After processing, owls were returned to the site of capture and released.

Each owl was fitted with a U.S. Fish and Wildlife Service aluminum tarsal band. Each band has a unique numeric code which allows for identification of individuals upon recapture. Measurements taken included unflattened wing chord, tail length and mass. Unflattened wing chord was defined as the distance from the bend in the wing to the tip of the longest primary and tail length was defined as the distance from the base of the uropigial gland to the tip of the longest retrix. Linear measurements were recorded to the nearest mm. Individual owls were inserted into a small netted bag which was then weighed with either a 100 or 300 gm Pesola scale. Mass was recorded to the nearest 0.5 gm.

Owls were aged and sexed according to criteria established by the U.S. Fish and Wildlife Service (Anonymous 1977). Saw-whet owls were sexed as male if wing chord measured 131 mm or less and female if wing chord measured 143 mm or more. Birds with wing chord measuring 131 - 143 mm could not be sexed. Owls were aged as HY (hatch year) if all primary and secondary remiges and coverts appeared uniform in colour or as AHY (after-hatch year) if primary and secondary remiges and coverts were not uniformly coloured (for example, if P1 through P5 were paler and more faded than P6 through P10). In addition, HY owls typically show a washed-out white, brown and buff coloration on the breast, throat and facial disk while adult birds typically show a distinct brown streaking against a white background on breast and throat plumage.

RESULTS

Over the course of the study, 80 saw-whet owl captures were made including 52 different individuals and 28 repeats (See Appendix). Total capture rate was 1.16 owls/100 net-hours (net-h) including 0.75 and 0.41 owls/100 net-h for new and repeat owls, respectively. Of 52 new owls captured, 33 were AHY and 19 were HY while 5 were male, 19 were female and 28 could not be sexed. Median dates of capture were 12 November for new and AHY owls, 13 November for HY owls, 19 November for males, and 11 November for both females and unknown sex. Fifty percent of new owl captures occurred between 10 and 19 November. In addition to saw-whet owls, 4 Eastern Screech Owls (Otus asio) were captured. The total effort for the duration of the study was 6903 net-h (3 stations x 6 nets/station x 388.5 hours of operation) with a nightly mean of 215.7 +/- 12.7 net-h (mean +/- S.D.).

Seasonal timing and spatial distribution of migration

New saw-whet owl captures were not evenly distributed over the course of the study ($\chi^2 = 16.94$, df = 2, $P < 0.001$) (See Figure 2). In order to analyze the seasonal distribution of owl captures, the study was divided into 3 periods. Period 1 was 22 October to 7 November, period 2 was 8 November to 24 November and period 3 was 25 November to 12 December. Of 52 new owls netted, 7 owls (13%) were captured during period 1, 31 owls (60%) were

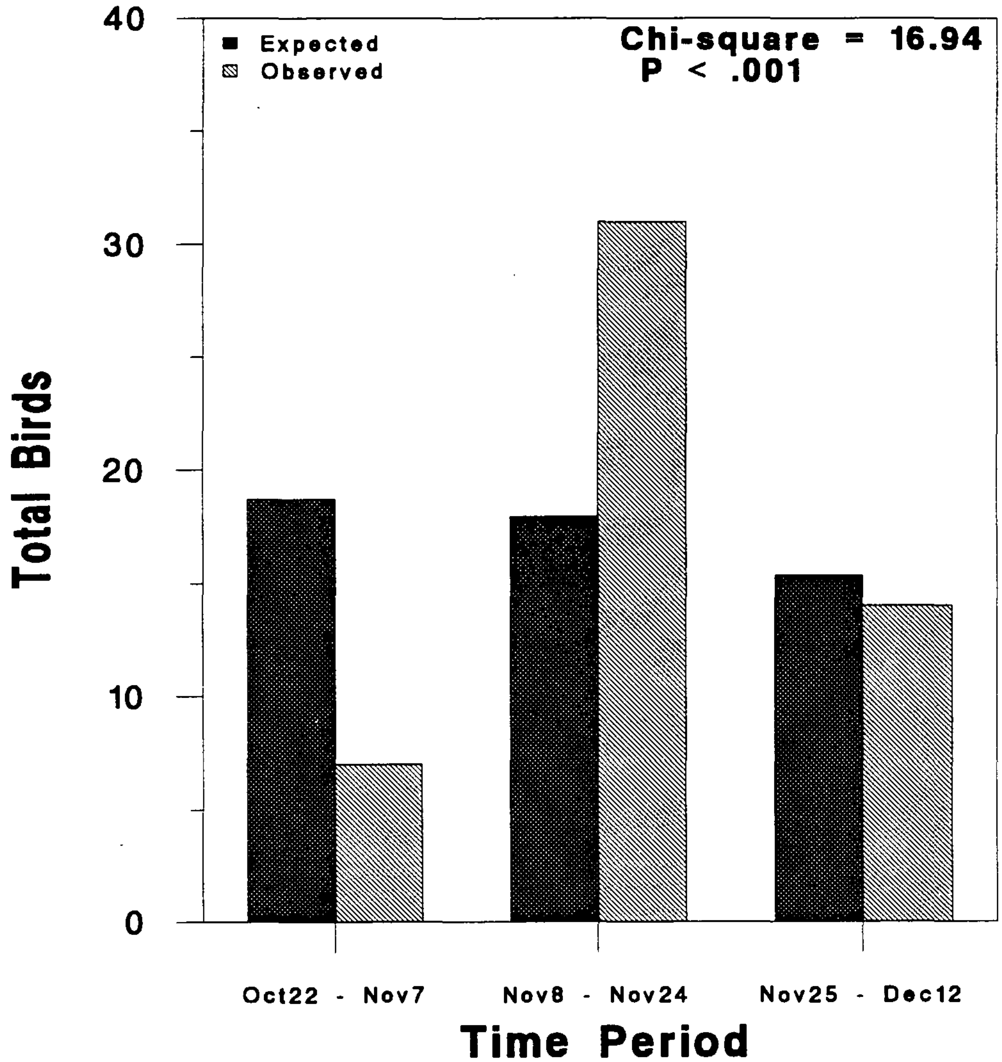

Figure 2. The seasonal distribution of new owl captures (expected vs. observed).

captured during period 2, and 14 owls (27%) were captured during period 3. Figure 3 shows the new owl capture rate during each time period.

The spatial distribution of new owl captures was fairly even throughout the study ($\chi^2 = 1.41$, df = 2, P > 0.30) (See Figure 4). Station 1 accounted for 17 new owls (33%), station 2 accounted for 21 new owls (40%) and station 3 accounted for 14 new owls (27%). Figure 5 shows the new owl capture rate at each station.

Nightly timing of migration

On a nightly basis, the distribution of total owl captures (new owls + repeat owls) differed from that expected by chance ($\chi^2 = 16.67$, df = 3, P < 0.001) (See Figure 6). Each night was divided into 4 time intervals as follows: dusk to 21:00, 21:00 to 24:00, 24:00 to 3:00 and 3:00 to dawn. Out of 80 total saw-whet owl captures, 38 captures (48%) occurred during the first time interval after nets were opened, 14 captures (18%) occurred during interval 2, 18 captures (23%) occurred during interval 3 and 10 captures (13%) occurred during the last interval. Figure 7 shows the total owl capture rate during each nightly time interval.

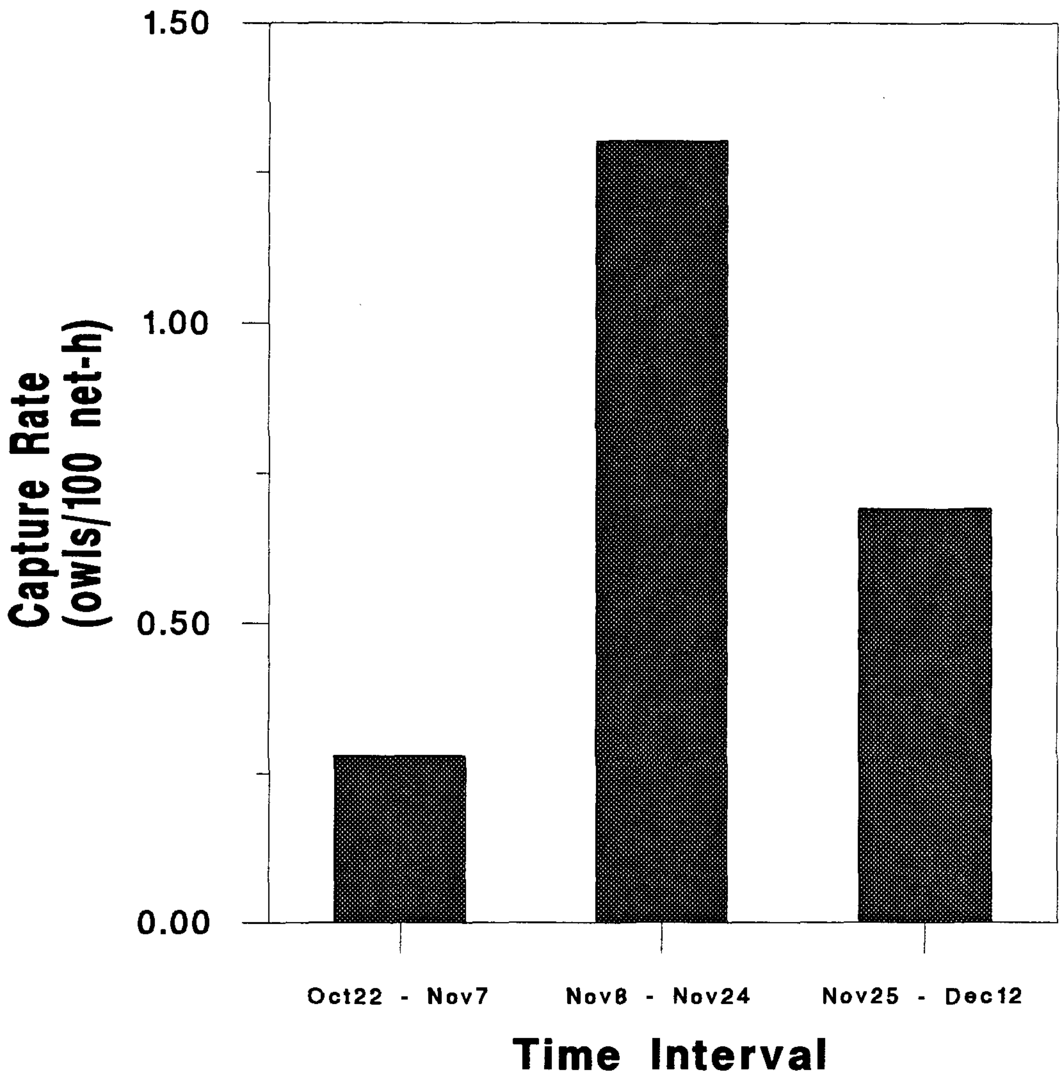

Figure 3. Seasonal capture rates of new owls.

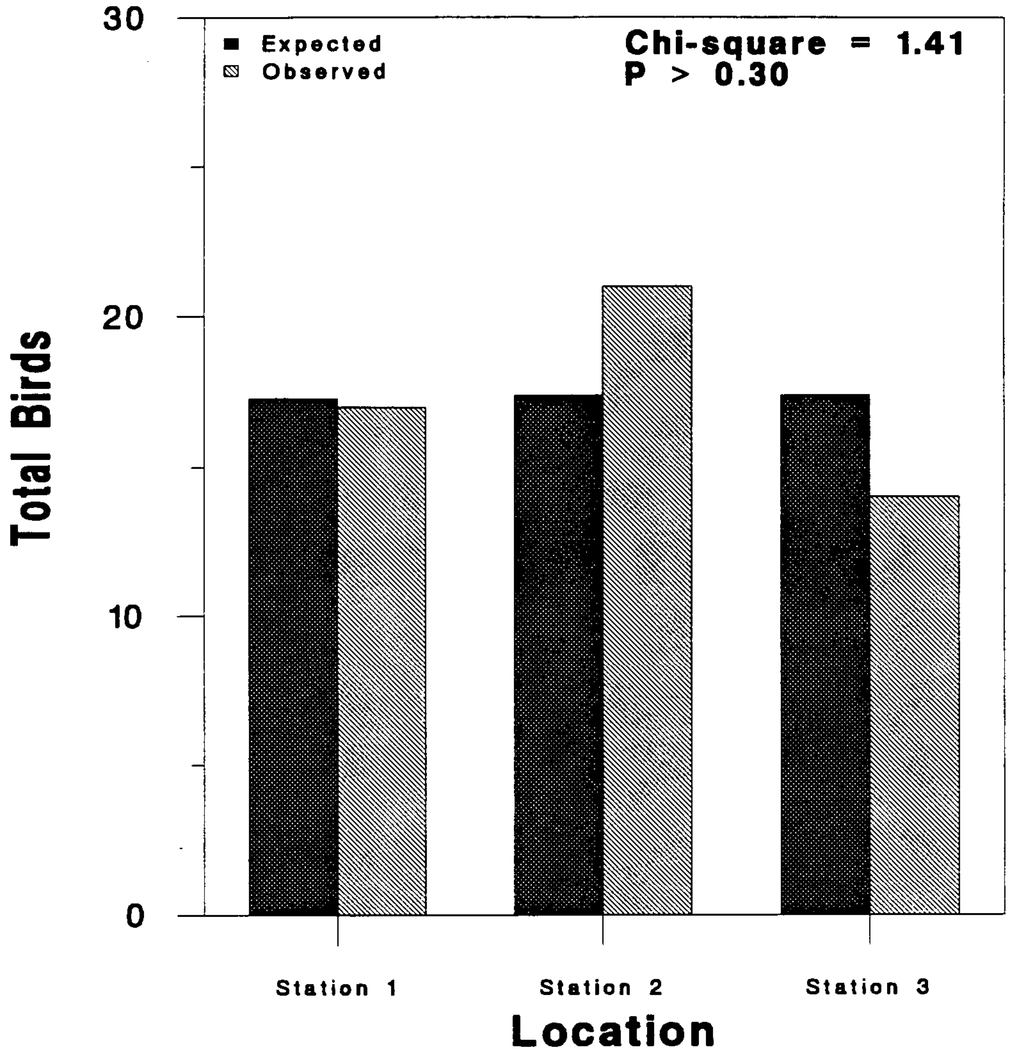

Figure 4. The spatial distribution of new owl captures (expected vs. observed).

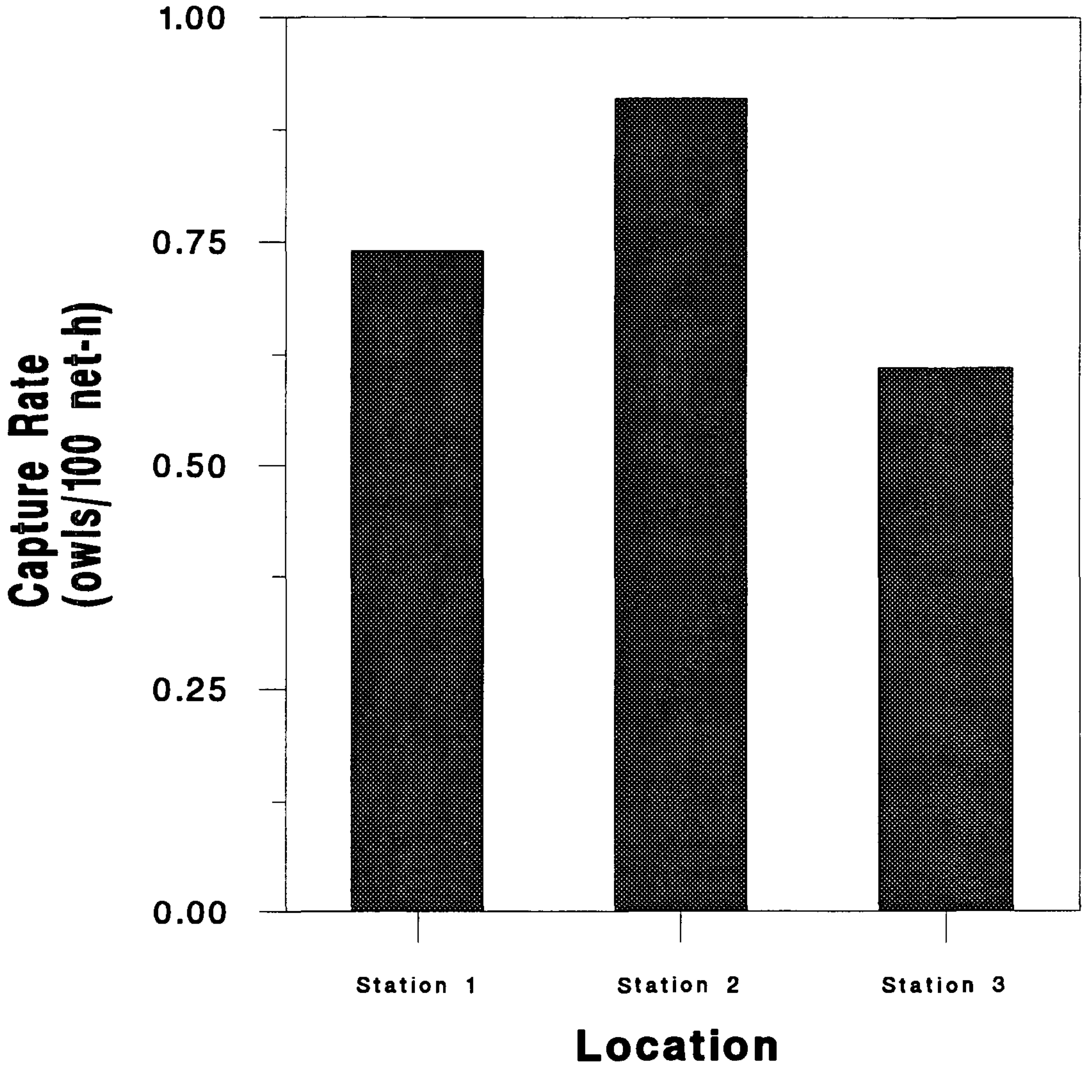

Figure 5. Capture rates for new owls by station.

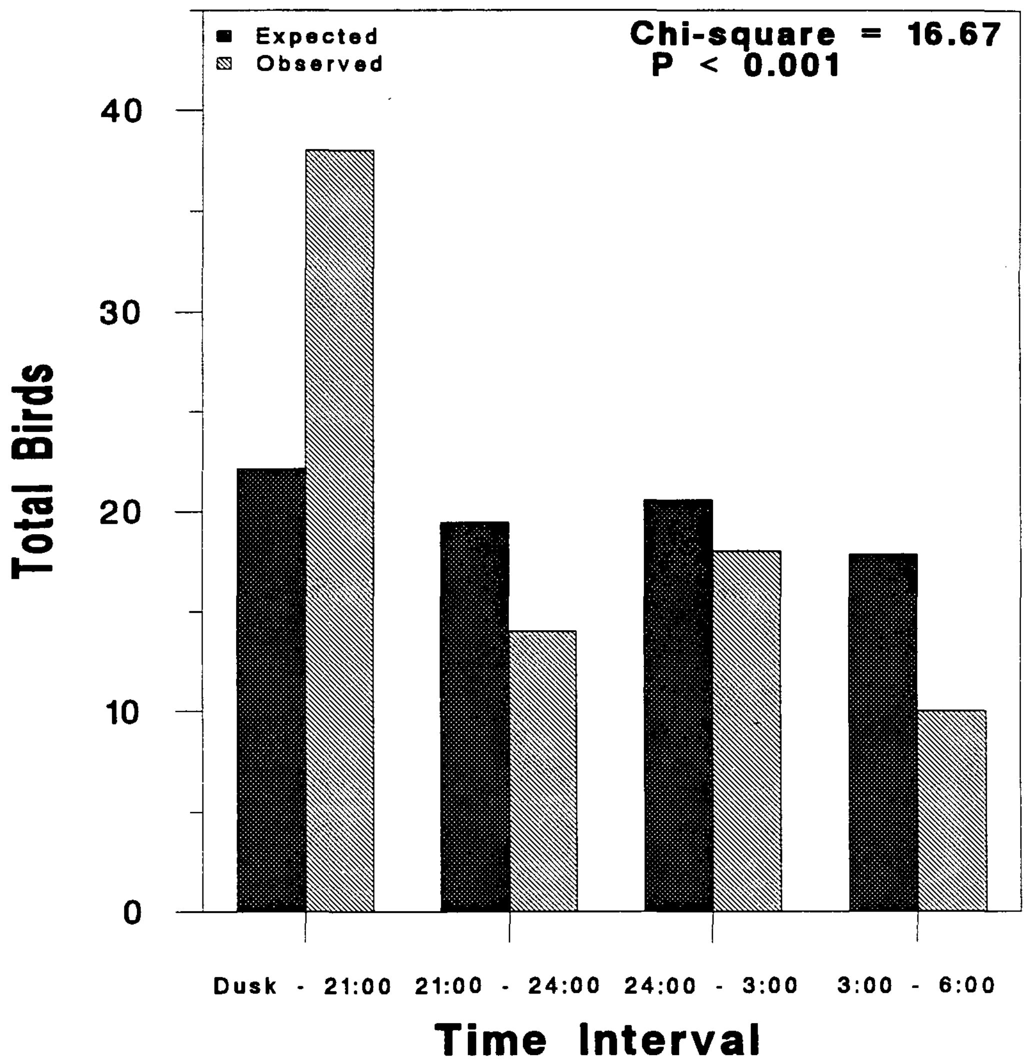

Figure 6. The nightly distribution of total owl captures (expected vs. observed).

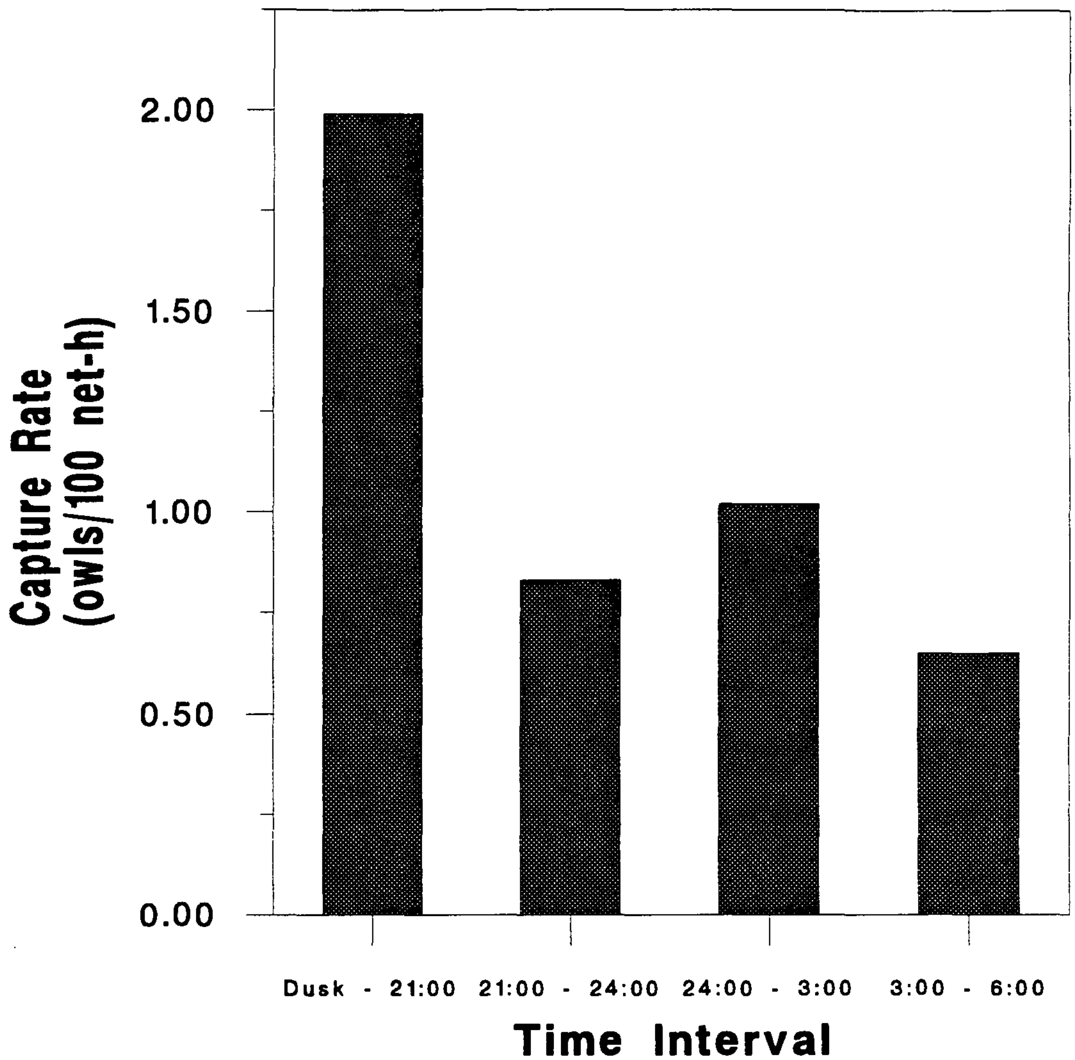

Figure 7. Nightly capture rates of total owls (new + repeats).

Recaptured owls

Among the 52 new saw-whet owls captured, 21 owls were later recaptured. Out of these 21 repeat owls, 14 were recaptured once and 7 were recaptured twice for a total of 28 recaptures. The minimum stopover time, determined from the time span between date of first capture and date of final capture, ranged from 1 - 28 days with a mean of 10.3 +/- 8.7 days.

As was the case with new owls, the temporal distribution of repeat owls was not even on a seasonal basis ($\chi^2 = 6.60$, df = 2, $P < 0.05$) (See Figure 8). Period 1 accounted for 5 recaptures (18%), period 2 accounted for 9 recaptures (32%) and period 3 accounted for 14 recaptures (50%). Recapture rates during the seasonal time periods are shown in Figure 9. The ratio of new owls to repeat owls captured was 1.4 : 1 during period 1, 3.4 : 1 during period 2 and 1 : 1 during period 3 (See Figure 10).

As was found with new owls, the spatial distribution of repeats was even when tested across all 3 stations ($\chi^2 = 5.50$, df = 2, $P > 0.05$). However, when tested against the combined recapture results at stations 1 and 2, the number of repeats at station 3 was significantly lower than expected ($\chi^2 = 4.60$, df = 1, $P < 0.05$) (See Figure 11). Of 28 recapture incidents, 14 (50%) occurred at station 1, 10 (36%) occurred at station 2 and 4 (14%) occurred at station 3. Recapture rates for each station are shown in Figure 12.

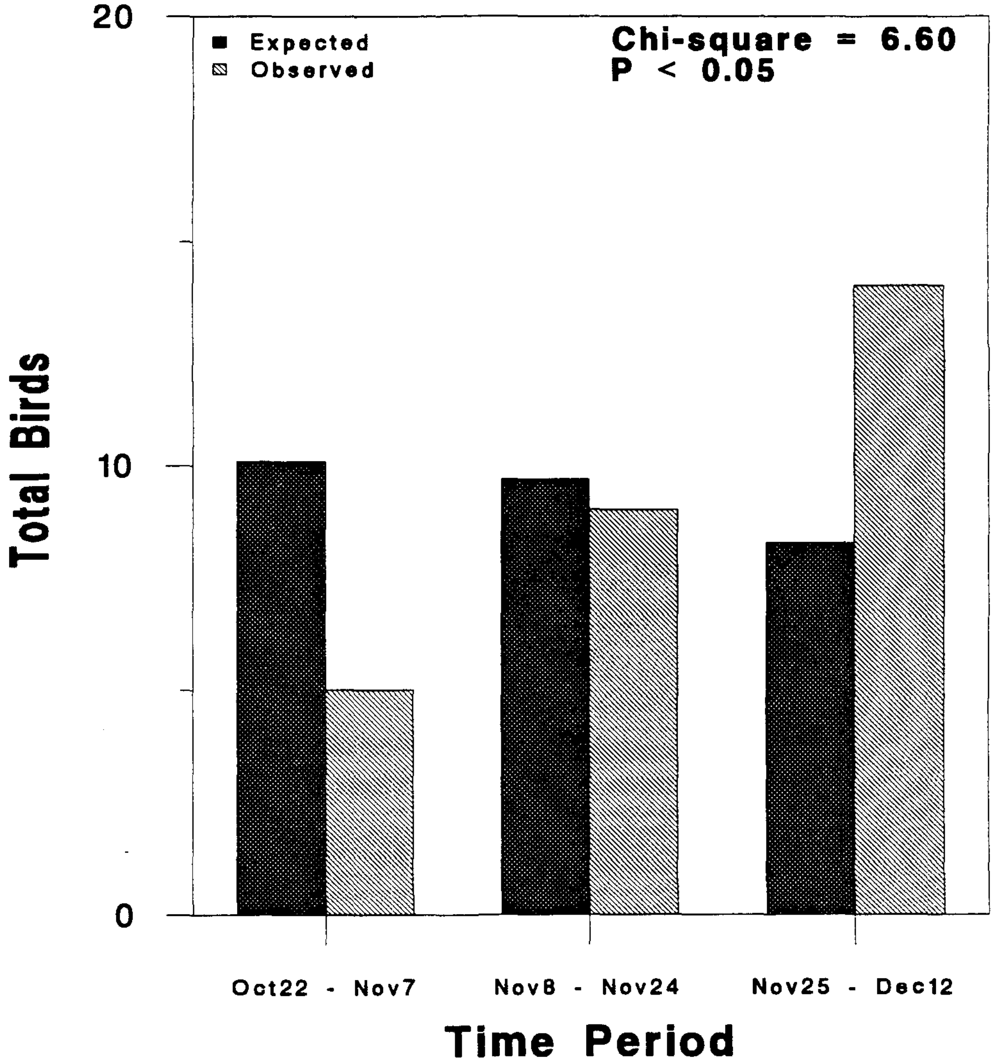

Figure 8. The seasonal distribution of recaptured owls (expected vs. observed).

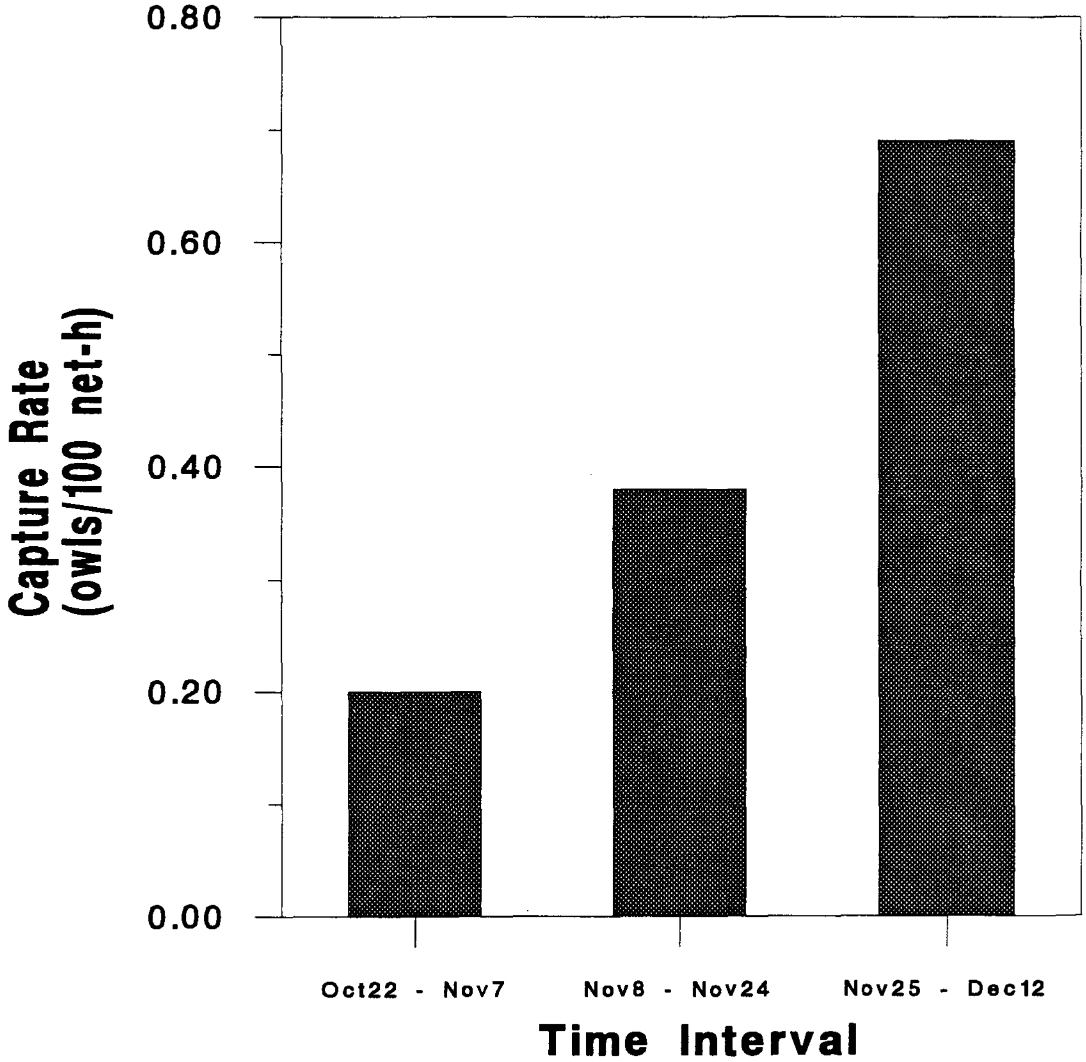

Figure 9. Seasonal recapture rates.

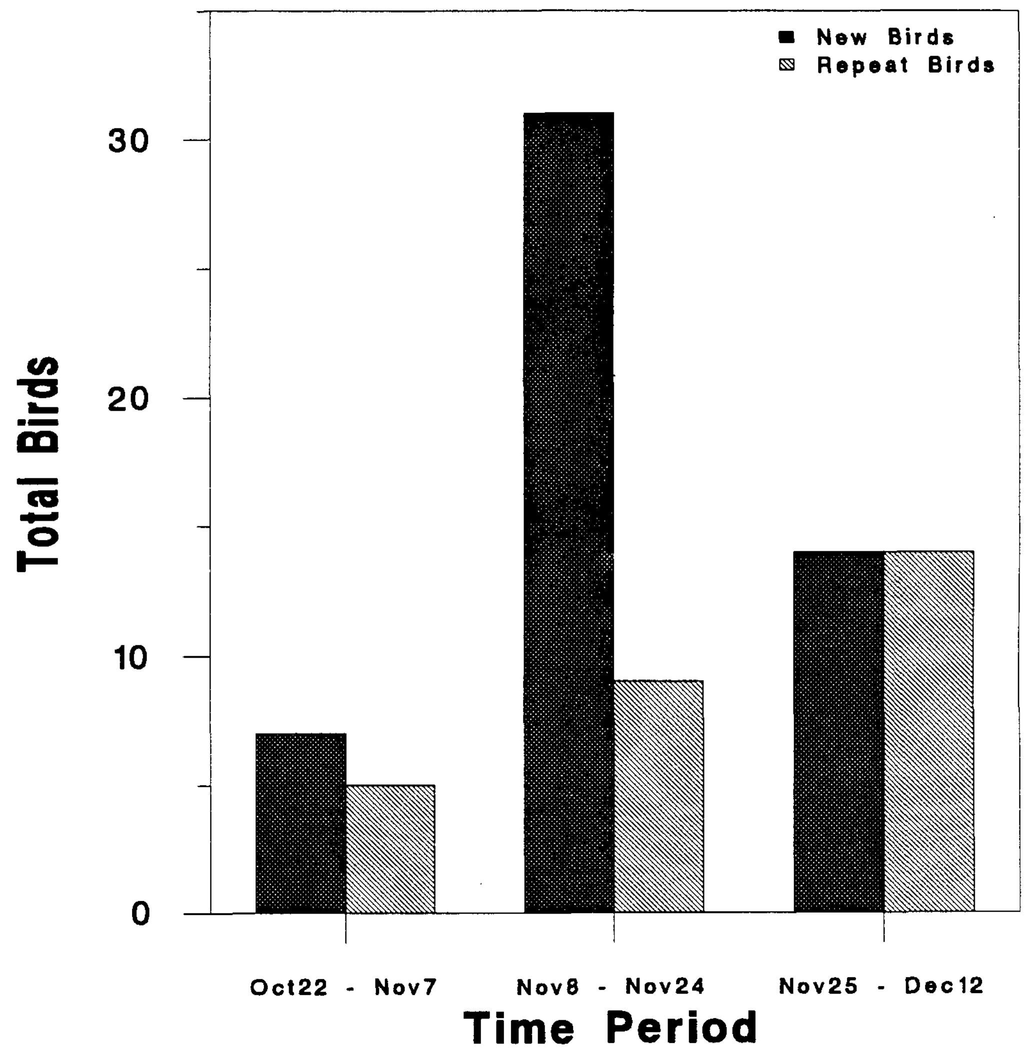

Figure 10. Comparison of the seasonal distribution of new captures to recaptures.

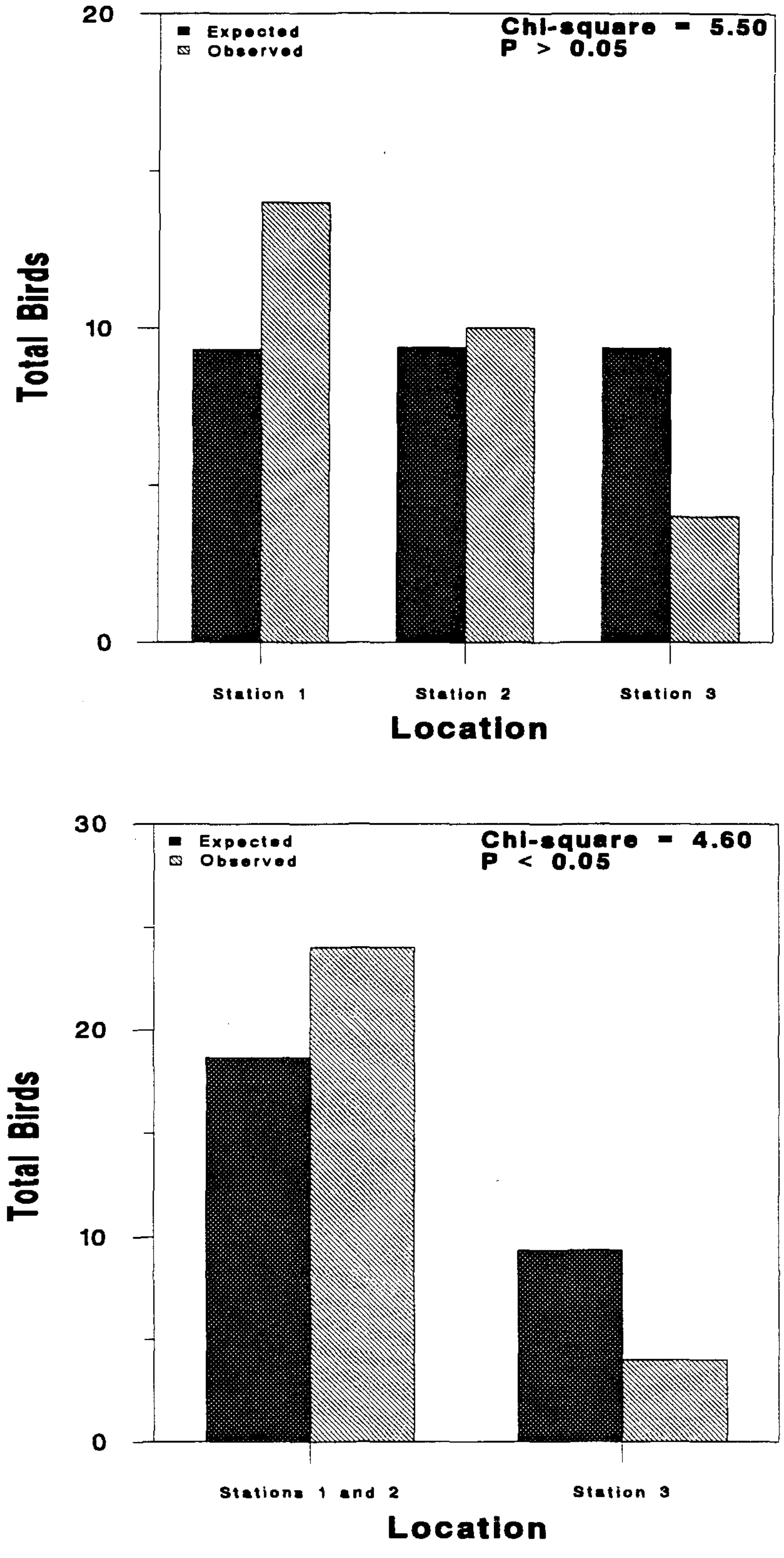

Figure 11. The spatial distribution of recaptures at all stations and at station 3 vs. stations 1 & 2 combined (expected vs. observed).

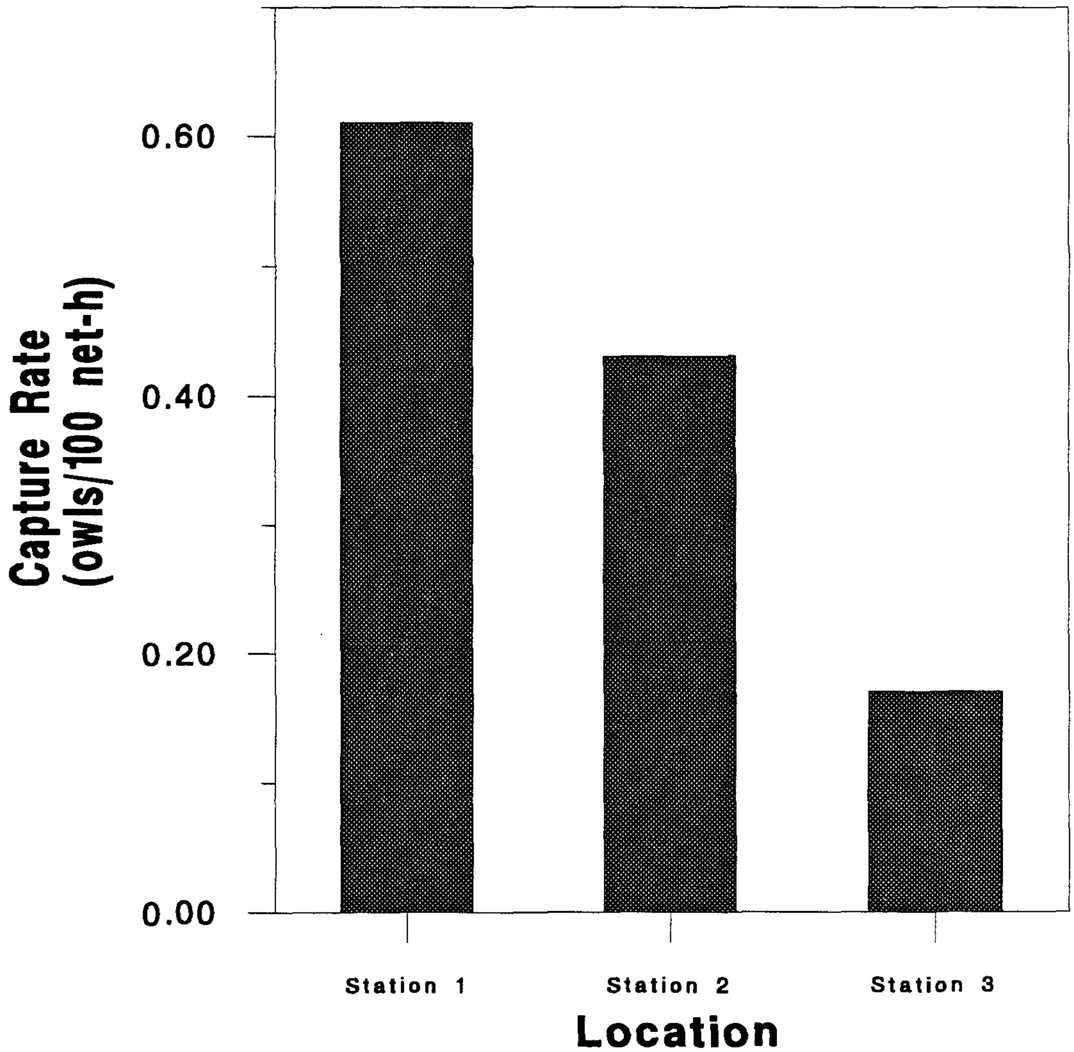

Figure 12. Recapture rates by station.

Influence of temperature on new and recaptured owls

The temperature dropped below 5^{O} C on 11 out of the 32 nights of banding operation and the majority of new owls (62%) were captured on these nights. The distribution of new owl captures occurring on these nights versus all other nights was not even ($\chi^2 = 16.90$ df = 1, $P < 0.001$). Capture rates for new owls were 3 times higher on nights with minimum temperatures < 5^{O} C than on nights with minimum temperatures > 5^{O} C. The distribution of repeat owls was even when tested across the same temperature categories as above ($\chi^2 = 0.29$, df = 1, $P > 0.50$). Recapture rates were only 1.2 times higher with minimum temperatures below 5^{O} C than with minimum temperatures above 5^{O} C (See Figure 13).

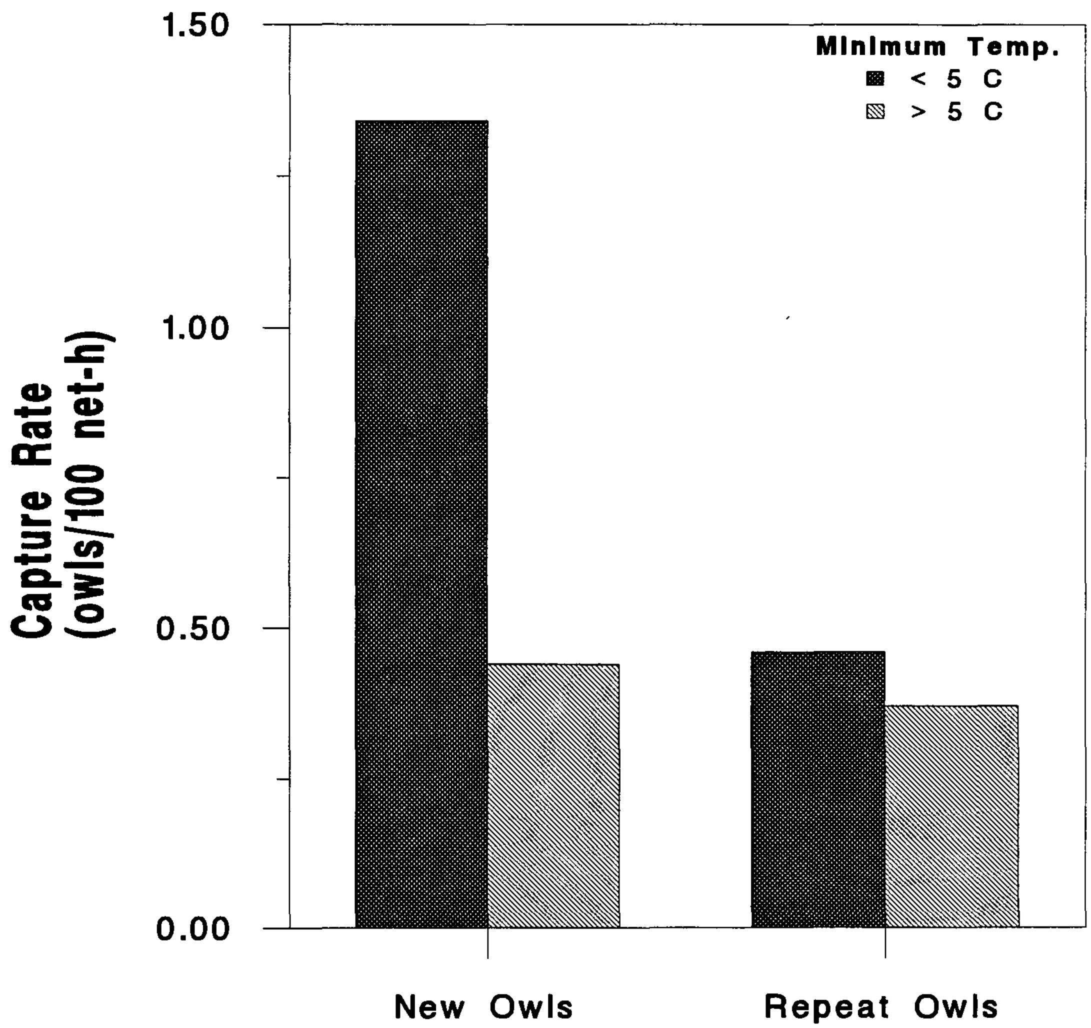

Figure 13. The effect of minimum nightly temperatures on new and repeat capture rates.

DISCUSSION

The results of this study provide the first substantial information about the fall migration of the Northern Saw-whet Owl in Virginia. No previous data exists pertaining to the migratory habits of the species in the state or at any other points this far south. However, the results of several studies to the north, especially those conducted on the Atlantic coast by Duffy and Kerlinger (1992) at Cape May Point (CMP) in New Jersey and by Brinker (unpublished data) at Assateague Island National Seashore (AINS) in Maryland, provide a frame of reference for our study.

Unexpectedly, the majority of saw-whet owls caught on the lower Delmarva Peninsula were adult birds (63%, N = 52). Previous data from CMP (Duffy and Kerlinger 1992), AINS (Brinker, unpublished data), and stations in the mountains of western Maryland (Brinker and McKearnan 1990) suggest that a relatively greater proportion of juvenile birds migrate along the Atlantic coast while a relatively greater proportion of adults migrate along the Appalachian Mountain range. At CMP, 67% (N = 631) of owls captured from 1980 - 88 were HY birds (Duffy and Kerlinger 1992) and at AINS, 75% (N = 155) of owls netted from 1991 - 93 were also HY birds (Brinker, unpublished data). At Finzel Swamp, located in the mountains of western Maryland, juveniles accounted for only 44% (N = 261) of saw-whet owls banded from 1986 - 90, including only 31% (N = 65) in 1989 (Brinker and McKearnan 1990). At Casselman River, also located in the mountains of western Maryland, HY birds comprised 45% (N = 44) of those captured in 1993 (Brinker, unpublished data). In a 4 year study conducted at Prince Edward Point (PEP), Ontario, Weir et al. (1980) found that 84 - 100% of the annual difference in the age ratios of migrating saw-whet owls was accounted for by fluctuations in the number of HY birds alone. More data needs to be collected on the lower Delmarva Peninsula and elsewhere regarding geographic differences in the relative proportions of age classes of migrant saw-whet owls.

The median date of migration for AHY owls preceded that of HY owls by only 1 day. As a result a seasonal difference in the timing of migration by the 2 different age groups was not significant in this study. At CMP, adults have been shown to migrate later than juveniles but a considerable amount of overlap is seen between the 2 age groups (Duffy and Kerlinger 1992). Studies conducted in Cedar Grove, Wisconsin from 1962 - 64 (Mueller and Berger 1967) and at PEP from 1975 - 78 (Weir et al. 1980) show no significant differences in the seasonal distribution of owls by age.

Although the median dates of migration for male and female saw-whet owls was separated by 8 days, the sample size was too small to draw any firm conclusions. The results of the PEP study in Ontario show 2 years in which females preceded males in migration (Weir et al. 1980). Data from CMP, however, shows no temporal difference in the migration of the sexes (Duffy and Kerlinger 1992).

Our results indicate a predominance of owls caught in the early part of the evening. Sixty-five percent (N = 80) of owl captures occurred before 24:00, including 48% before 21:00. This trend was also seen at AINS in 1991 when 77% (N = 65) of saw-whet owls were caught before 24:00 (Brinker, unpublished data) and at Finzel Swamp from 1986 - 89 when 67% (N = 147) of captures occurred before 24:00 (Brinker and McKearnan 1990). At CMP, however, 40% of captures took place during the 4 hour period before sunrise (Duffy and Kerlinger 1992). Duffy and Kerlinger (1992) suggest that the concentration of owl captures just prior to dawn at CMP may not be due to differences in the distribution of migrating owls throughout a given night, but may instead be due to owls moving at lower altitudes in search of roosting sites before daybreak. The apparent discrepancy may be due to the fact that audio-lures were used in our study and in the studies in Maryland but not in the CMP study. It is possible that in the early part of the evening either more owls are migrating or more owls are responsive to the audio-lure and that prior to dawn at least some owls searching for roosts are repelled by the noise of the audio-lure.

Out of 52 individual saw-whet owls netted, 5 had already been banded at other stations. Three of these birds were banded at CMP, 1 was banded at AINS and another was banded at a currently unknown banding station. The first of these owls was banded 10 November at CMP and found in our nets at 3:30 on the morning of 12 November. Over parts of 2 nights this owl traveled an approximate linear distance of 230 km. Two owls banded consecutively at CMP on 7 November were caught in our nets on 26 November and 8 December. The single foreign retrap from AINS was released from that banding station at 7:00 on 11 November and found in our nets at 4:00 on the following morning. Presumably this owl roosted at AINS until at least 17:00 on the day that it was released. Consequently this bird traveled an approximate linear distance of 120 km in less than 11 h of flying time so its mean rate of flight was at least 11 km/h.

While the rate of capture for new owls peaked in mid-November and then leveled off in late November and early December, the rate of recaptures continued to increase throughout the study. Of 15 saw-whet owl captures that took place in December, 73% were repeat owls. This result suggests that some owls remain confined to the lower Delmarva Peninsula either to winter or to wait until ideal conditions occur before crossing the Chesapeake Bay. Sample size was not large enough to analyze movement of recaptured owls between stations but patterns are suggestive. Of 28 repeat owls, 8 birds were originally captured at station 2 and then subsequently recaptured at station 1, almost 3 times more than would be expected if movement between stations was equal. This finding may reflect a southward movement of owls along the shore from station 2 to station 1.

The results show a strong relationship between low nightly temperatures and the influx of new saw-whet owls. These periodic cold spells are caused by the passage of northern fronts which are most often accompanied by northerly winds that facilitate the southward migration of saw-whet owls (as well as numerous other bird species). The occurrence of repeat owls, however, does not

indicate a correlation between temperatures and recapture rate. This result may be due to owls being stalled at the tip of the peninsula by mild weather until the passage of a cold front and northerly winds carry them across the bay. Warmer temperatures and the lack of good northerly winds may cause some degree of inactivity in saw-whet owls and may therefore prevent recapture rates from increasing during these periods.

Although this study demonstrates the importance of the lower Delmarva Peninsula as a corridor for migrating saw-whet owls, the overall results for 1994 at CMP, at AINS and at banding stations in the mountains of western Maryland suggest that last fall may have been a down-year with regard to the magnitude of migrating saw-whet owls in the east (Brinker, personal communication). As a result, even greater numbers of saw-whet owls may pass through the lower Delmarva Peninsula in other years.

The fact that the majority of individual owls banded on the lower Delmarva Peninsula were never recaptured and the lack of any recapture incidents at banding stations to the north suggest that a significant number of saw-whet owls cross the Chesapeake Bay at some nearby location. After crossing the bay, the owls presumably proceed south to wintering sites in the Carolinas, Georgia and northern Florida. Together with the results of studies in New Jersey and Maryland, this and future studies in Virginia will help to improve our understanding of the seasonal movements of saw-whet owls. Ultimately, this

information can be combined with the knowledge about the habits of diurnal migrants to further assess the needs for conservation of coastal habitat.

Appendix. Nightly results for new and repeat owl captures.

Date	Net-h	New owls captured	Repeats captured	Total owls captured
10/22	188.5	0	0	0
10/23	213.0	0	0	0
10/27	200.0	3	0	3
10/28	197.0	0	1	1
10/29	203.5	0	0	0
10/30	220.5	0	0	0
11/1	210.5	0	0	0
11/2	222.0	2	0	2
11/3	198.0	2	2	4
11/4	215.5	0	2	2
11/5	213.0	0	0	0
11/6	202.5	0	0	0
11/10	187.0	7	0	7
11/11	201.9	10	1	11
11/12	214.0	4	0	4
11/13	225.0	3	3	6
11/14	216.0	0	2	2
11/15	225.5	0	1	1
11/19	223.5	2	1	3
11/20	223.5	1	1	2
11/22	230.5	2	0	2
11/23	216.0	1	0	1
11/24	220.5	1	0	1

11/25	**225.0**	**4**	**1**	**5**
11/26	**238.5**	**6**	**2**	**8**
12/1	**216.0**	**1**	**5**	**6**
12/3	**222.0**	**0**	**0**	**0**
12/6	**225.0**	**0**	**1**	**1**
12/7	**234.0**	**0**	**0**	**0**
12/8	**234.0**	**3**	**3**	**6**
12/9	**228.0**	**0**	**0**	**0**
12/12	**213.0**	**0**	**2**	**2**
TOTALS	**6902.9**	**52**	**28**	**80**

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