NORTHERN SAW-WHET OWL (AEGOLIUS ACADICUS) MIGRATION IN THE PACIFIC NORTHWEST

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ABSTRACT.—Northern Saw-whet Owls (Aegolius acadicus) were captured in north central Oregon, USA, during autumn 1999 and 2000 as a pilot study on migration in the Pacific states. We captured 70 individuals, with annual capture rates comparable to those reported for larger studies in the eastern and midwestern U.S. We investigated differential capture by time of night, time of season, and age. No results were significant due to small samples and brief duration of the study, although some results tended toward significance (P < 0.10). Here we provide a descriptive account of our observations of Northern Saw-whet Owl migration in north central Oregon, the first such study to be presented for the Pacific states.

Key words: Northern Saw-whet Owl, Aegolius acadicus, migration, differential migration timing, diel migration timing, seasonal migration timing, Pacific Northwest, Oregon.

Autumnal migration is well documented for Northern Saw-whet Owls (Aegolius acadicus; hereafter NSWO) in the eastern and midwestern United States (e.g., Mueller and Berger 1967, Holroyd and Woods 1975, Weir et al. 1980, Brinker et al. 1997, Duffy and Kerlinger 1992). More NSWO are banded annually than any other owl species in North America (Bird Banding Laboratory) due to the large, coordinated efforts made to study fall migration in the eastern and midwestern U.S. Nevertheless, little is known about NSWO migration in the western United States and little has been done to study it. The few extant western migration studies are concentrated in the Rocky Mountain region (e.g., Lucky Peak, Idaho; Bridger Mountains, Montana; West Yellowstone, Montana), leaving migration in the Pacific region undocumented. In this paper we present results from a migration study of NSWO in north central Oregon. To our knowledge, this is the first study of NSWO migration presented for the Pacific Northwest. Our primary intention is to originally document the migration occurring in this region. In addition, we describe general patterns observed during our study. Our samples are relatively small, producing results that are uniformly lacking in precision and statistical significance. Thus, we do not present these data as final answers to the myriad questions surrounding NSWO migration in the Pacific Northwest, but rather as descriptive indicators of apparent patterns that allow for general comparison with other studies. These general tendencies in our limited data are important in that, to date, they constitute the only available information on NSWO migration in the Pacific Northwest.

METHODS

During autumn 1999 and 2000, we banded NSWO on the eastern slope of the Cascade Mountains in north central Oregon. In 1999 mist netting was conducted just north of the Bear Springs Work Center (45°06.24'N, 121°31.14'W, 949 m elevation) of the Mt. Hood National Forest. The area is characterized by mature Douglas-fir (Pseudotsuga menziesii)/ponderosa pine (Pinus ponderosa) forest with smaller grand fir (Abies grandis) abundant beneath the canopy. Relief is minor with no prominent ridges or drainages within 5 km of the station. In 2000 trapping was conducted on the top of Bonney Butte (45°16.08'N, 121°59.72'W, 1754 m elevation) of the Mt. Hood National Forest. The area is characterized by subalpine fir (Abies lasiocarpa), mountain hemlock (Tsuga martsensiana), Pacific silver fir (Abies amabilis),...
and lodgepole pine (*Pinus contorta*) are predominant tree species, with many grassy openings and rock outcroppings fragmenting the forest. Topography is extreme, with a drop of approximately 200 m on the east side of the ridge to a forested cirque below and a drop of approximately 650 m on the west to the floor of the White River valley. Width of the ridge top at the banding station is <80 m. On 26 October 2000, because of threat of road closure from snow, the banding station was moved approximately 1.5 km southwest, to the west slope of Bonney Butte above the White River valley, in a contiguous forest of Douglas-fir and western hemlock (*Tsuga heterophylla*) at an elevation of approximately 1250 m.

Trapping took place between 31 August and 14 November 1999 and 6 September and 3 November 2000. We drew owls into mist nets during hours of darkness with an audiolure (Erdman and Brinker 1997) broadcasting the NSWO male primary song (Cannings 1993). Mist nets were positioned between likely perches and across open flight paths (e.g., game trails, footpaths). The number of mist nets varied slightly within each season as new nets were acquired, old nets were retired, or nets were removed for use in other studies. For simplicity, we present the weighted mean m² of net used in each season based on the number of hours each net combination was used. Trapping was conducted on all nights that we were available and that weather allowed. There was no selective bias for “good” trapping nights, except that we did not trap on nights of high wind or precipitation. Trapping always began after dusk and ended before dawn. We checked mist nets and removed owls approximately every hour. Captured owls were taken to a nearby (<0.5 km) banding station, processed, and released. Processing entailed banding, measuring (e.g., mass, wing-chord, tail length, culmen length), and aging according to criteria outlined by Pyle (1997).

Owls were placed into 1 of 5 age categories: hatch year (HY), second year (SY), third year (TY), after hatch year (AHY), or after second year (ASY). For this paper we grouped all birds other than HY into the AHY category. Chi-square analyses were conducted for descriptive purposes and for general comparisons. Our sample sizes were too small and the study duration too brief to arrive at precise conclusions with such analyses.

**Results**

In 1999 we banded 31 NSWO in 37 nights and 175.4 hours of effort (Table 1). In 2000 the total catch was 39 NSWO in 19 nights and 88.7 hours of effort (Table 1). Capture rates corrected for effort (owls/10 m² net/100 hours) were more than twice as high in 2000 as in 1999 (Table 1), although this may be due merely to differences between the annual netting locations. For this reason, all data from combined years should be interpreted cautiously.

Twenty-three (74%) captured owls were HY and 8 (26%) were AHY in 1999, whereas the following year 22 (56%) captured birds were HY and 17 (44%) were AHY. Fewer AHY owls were captured prior to (3 in 1999, 5 in 2000) and more following (5 in 1999, 12 in 2000) the median owl captured during both years. In contrast, more HY owls were captured prior to (12 in 1999, 14 in 2000) and fewer following (10 in 1999, 7 in 2000) the median owl captured during both years. Sex ratios and differential capture timing by sex were not examined due to the uncertain reliability in current sexing techniques.

We examined differences in numbers of owls captured during the three 3-hour periods of the night in which most trapping took place (1900–2200, 2200–0100, 0100–0400 PDT), and during the four 2-week periods of the trapping season in which most owls were captured (15–30 September, 1–15 October, 15–30 October, 16–31 October). Times and dates outside these parameters were omitted because of the small number of owls encountered and because trapping seasons were unequal in duration. Variation in number of owls captured during the four 2-week periods of the season was not notable either within years (χ² = 3.634, df = 3, P = 0.30 in 1999; χ² = 3.385, df = 3, P = 0.34 in 2000) or when data from both years were pooled (χ² = 2.253, df = 3, P = 0.52). It may be interesting to note, however, that observed captures between 16–31 October 1999 and 1–15 October 2000 were slightly higher than expected, whereas observed captures for all remaining 2-week periods within each year were slightly lower than expected. Fifty-one (73%) owls were caught between 1 and 31 October, although effort was not consistent throughout the season. Fewer owls than expected were captured during the first 3-hour period of the night than during either of the
Table 1. Total Northern Saw-whet Owls (NSWO) captured in 1999 and 2000, with details regarding conditions of capture.

<table>
<thead>
<tr>
<th></th>
<th>NSWO captured</th>
<th>Total nights</th>
<th>Total hours</th>
<th>Mean m² net/ hour</th>
<th>Owls/10 m² net/ 100 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>31</td>
<td>37</td>
<td>175.4</td>
<td>113</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>39</td>
<td>19</td>
<td>88.7</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>70</td>
<td>56</td>
<td>264.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

following 3-hour periods. Results tended toward significance in 1999 ($\chi^2 = 5.551$, df = 2, $P = 0.06$) and in both years combined ($\chi^2 = 5.403$, df = 2, $P = 0.07$), but in 2000 the pattern was not as pronounced ($\chi^2 = 3.391$, df = 2, $P = 0.18$).

**Discussion**

The great age ratio fluctuation between years in our study was also experienced from 1991 through 1996 (Brinker et al. 1997) at Cape May, New Jersey; Assateague Island, Maryland; Casselman River, Maryland; and Cape Charles, Virginia. Extremes reported for these stations were 86% ($n = 102$) AHY (1996 at Cape Charles) and 10% ($n = 187$) AHY (1993 at Cape May). Weir et al. (1980) reported great fluctuation in age ratios at Price Edward Point, Ontario, without the use of an audiolure. Whether this variation is the result of annually differential breeding productivity, annually differential prey availability farther north, or some other factor is unknown. Unveiling the mechanism behind this variation is essential to a complete understanding of NSWO migration ecology.

At Prince Edward Point, migration timing by age class varied between years (Weir et al. 1980). At Cape May Point, immature owls were captured earlier in the season than adults from 1980 to 1988 (Duffy and Kerlinger 1992). During both seasons our results were consistent with those from Cape May. The number of HY owls in our study decreased later in the season, while the number of AHY owls increased. However, lacking precise peak dates, we used the median owl captured as a reference point in making this observation. The long-term consistency of this pattern remains to be seen and warrants further investigation.

Without the use of an audiolure, Weir et al. (1980) captured fewer owls during the 4-hour period before 2200 than during either of the 2 succeeding 4-hour periods (2200–0200, 0200–0600), as did Duffy and Kerlinger who experienced a peak at Cape May Point (1992) between 0200 and 0600. Duffy and Matheny (1997) found that when an audiolure was employed at Cape May Point, diel capture timing shifted so that most owls were captured between 2200 and 0200 and were more evenly distributed throughout the night. All of these results are consistent with our Oregon results, which suggest a peak sometime after 2200. However, our periods were only 3 hours in duration and we did not trap during the 4-hour period between 0400 and dawn. The period preceding dawn is often highly productive for owl capture in the eastern U.S. (D. Brinker personal communication), so including it in our sample may have strengthened our results.

From 1980 to 1988 at Cape May Point, NSWO migration peaked between 16 October and 19 November, with 90% of owls passing between these dates (Duffy and Kerlinger 1992). No audiolure was used in that study, but Duffy and Matheny (1997) found no seasonal shift in capture timing when an audiolure was employed at this location. Sample sizes were too small to identify a peak with precision in our study. Also, we closed our banding stations on 14 November and 3 November in 1999 and 2000, respectively. These early closures were due primarily to the arrival of winter weather. Had we continued through November, a seasonal pattern may have been more apparent. However, owl captures tapered off in November 1999, suggesting a peak prior to that time. Also, although effort was not consistent throughout the season, 51 (73%) owls were caught between 1 and 31 October. These data point to a peak sometime during the month of October, but the influence of annual weather patterns and moon phases is unknown.

Brinker et al. (1997) reported total annual captures ranging from 21 to 1007 for 4 stations in the eastern U.S. (Cape May, Assateague...
Island, Casselman River, Cape Charles) for the years 1991 to 1996. Erdman et al. (1997) reported annual NSWO captures ranging from 526 to 864 ($\bar{x} = 668$) for 1986 through 1990 at the Little Suamico Ornithological Station, Wisconsin. The vast discrepancies in total annual captures between many of the cited studies and our own are attributable primarily to the size (number of nets and effort) of the respective banding operations. We used fewer mist nets ($3-7$ nets; $34-156$ m$^2$ net) and trapped for fewer hours than the typical major eastern and midwestern banding stations. Twenty-one mist nets ($504$ m$^2$ net) were used at Cape May Point in 1995 for 19 nights with an additional 8 nets ($192$ m$^2$ net) used for 7 nights (Brinker et al. 1997). Eighteen nets ($432$ m$^2$ net) were operated for 52 nights at Cape Charles in 1995 (Brinker et al. 1997). Thus, standardized capture rates are the only means of comparing results.

We may have missed the start and tail end of migration at our stations during both years, thus biasing our capture rates upward. However, the lesser numbers of owls toward the beginning and end of our trapping seasons indicate that we did not miss much of the migration, so biases should be minimal. Although we did not trap consistently throughout the season, we trapped whenever we were able to and the weather permitted. Thus, the nights we chose were randomly selected with respect to "good" trapping nights and time of season. Our capture rates should therefore be representative of rates we would have encountered had effort been full time. As such, they indicate that migration at our study sites may be similar in magnitude to many sites in the East and Midwest. Rates (owls/10 m$^2$ net/100 hours) reported by Brinker et al. (1997) ranged from 0.168 to 6.61 from 1991 through 1996. Eleven of 19 (58%) annual capture rates presented for these stations remained below our 2000 capture rate (3.624 owls/10 m$^2$ net/100 hours).

However, we must consider 2 factors with respect to the above comparisons. First, there is major geographical variation between the eastern sites and our own. Our sites are separated from most of the cited eastern studies by nearly the entire width of the North American continent, and it is unclear what influence this factor has on NSWO migration. The climate, topography, and habitat at these 2 ends of the continent are often extremely different. Also, it is unknown whether NSWO migrating through the western U.S. are genetically isolated from those migrating through the eastern U.S. If gene flow is limited between these groups, then migratory tendencies may vary as a result. Second, there is significant variation at individual sites between years in the eastern U.S. We do not know whether such extreme variation occurs in the Pacific region or if our results are from uncharacteristically high years (as experienced in 1995 at several eastern stations; Brinker et al. 1997). If these are uncharacteristically high rates for our study sites, then the typical Pacific migration may be of lesser magnitude than that observed in the eastern U.S. If they are not, however, then a larger effort at our sites should yield sample sizes comparable to those of the aforementioned studies.

The only previously published NSWO migration studies are from the eastern and midwestern U.S., where large-scale, coordinated migration banding has yielded information on corridors, timing, travel speed, and other details concerning NSWO migration. We now know that an autumn migration of NSWO also occurs in the Pacific Northwest, but a large-scale effort similar to that in the East is needed to provide a comprehensive understanding of this phenomenon throughout the western U.S.

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