Northern Saw-whet Owl Migration: Linking Conifer Seed Abundance to Owl Numbers

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Abstract

We investigated the migration dynamics of the Northern Saw-whet Owl using an audio lure broadcasting the male territorial call to attract owls into mist nets. These nets were operated from late October to early December. This method is essential, as the species' presence is challenging to detect without mist-netting. Captured owls were sexed using size criteria and aged using wing molt criteria, then banded, and released.

The study location was Camp Hydaway, Campbell County, VA and observations spanned 2002-2007, 2012-2017, and 2020-2022, providing an extensive time frame for study. Due to substantial variation in the species' reproduction and the degree of migration from year to year, long-term studies are necessary for a comprehensive understanding of its migration dynamics. This extended time frame allows patterns, trends, and influential factors affecting the migratory behavior of the Northern Saw-whet Owl to be discerned.

Previous studies have shown a correlation between reproduction in Northern Saw-whet Owls and population levels of their prey on the breeding grounds. This study investigated whether the volume of hatch-year birds migrating though the southern portion of their nonbreeding range was correlated with an important food item of their principal prey.

Seed abundance data for conifer species, the preferred seed of the owl's rodent prey, was obtained from Mastree+ Data Explorer for southern Canada and the northern United States. There was a significant relationship between conifer seed abundance and the number of hatch-year owls banded the following fall at our study site, suggesting a bottom-up trophic cascade. These findings highlight the importance of food availability in influencing the abundance and distribution of Northern Saw-whet Owls, providing insights into their behavior and ecology.

Introduction

The Northern Saw-whet Owl *(Aegolius acadicus)* is the smallest owl in Eastern North America (Figure 1). Many individuals leave the more northerly areas of its range in the winter and migrate as far south as Alabama, Louisiana, and Northern Florida (Figure 2). They migrate at night, using several migration routes across North America (Rasmussen et al. 2020). Despite their widespread distribution, Northern Saw-whet Owls are known for their elusive nature, making them challenging to study. However, their migration behavior offers a unique opportunity to investigate them, and migration studies are crucial to understanding the behavior and ecology of the Northern Saw-whet Owl.

Long term banding studies are ongoing throughout the United States to investigate the ecology of the Northern Saw-whet Owl. Through the collection of long-term data, it has been seen that numbers of Northern Saw-whet Owls fluctuate greatly, with larger movements seen every four years, on average (Confer et al. 2014). These fluctuations are presumed to follow prey dynamics seen in woodland mice (Cheveau et al. 2004, Cote et al. 2007), their primary food on the breeding grounds, whose populations are cyclical in nature (Henry et al. 2015). Just as Northern Saw-whet Owl numbers are linked to prey numbers, small mammal numbers are linked to production of seeds they feed on. Previous studies have thus suggested that variations in primary production such as mast years characterized by high seed production may influence the abundance and movements of Northern Saw-whet Owls (Confer et al. 2014).

Small forest rodents seem to follow a population fluctuation cycle that is highly influenced by forest seed crop in the autumn. This is because overwinter rodent deaths are greatly reduced when there is high seed production (Falls et al. 2007). This seems to correspond to a bottom-up trophic system where seed production influences small mammal populations, which influences Northern Saw-whet Owl prevalence (Power 1992) (Figure 3).

This study investigated the migration dynamics of Northern Saw-whet Owls and explored the relationship between migration numbers and seed production. Specifically, we investigated if there was a correlation between mast years and the abundance of migrating Northern Saw-whet Owls, which would suggest a bottom-up trophic cascade.

Methods

The owl banding site lies atop a ridge at Camp Hydaway, Campbell Co, VA (37° 20'35" N, -79°09'40" W) (Figure 4). The flora at the site consists of a moderate understory common in eastern deciduous forests with evergreens interspersed. The net site consisted of five mist nets. An electronic audio lure continuously broadcast of the male territorial call was set up at the center of the nets to attract migrating owls.

Banding operations began in late October and concluded anywhere from mid-November to mid-December depending on the year. Operations began in 2002 and continued from 2002-2007, 2012-2017, and 2020-2022. Nets were opened, and the audio lure was started a half-hour after sunset. Nets were checked for owls every hour, with adjusted timing if an owl was caught. Captured owls were held in kennels and placed in a dark room until processing.

Owls were banded with U.S. Fish and Wildlife Service aluminum tarsal bands. Wing chord and mass measurements were taken, and owls sexed using a wing length-mass function (Project Owlnet 1997). Owls were also aged based on wing molt criteria. All owls were released soon after processing.

Data on seed abundance were obtained from Mastree+ Data Explorer. A data set containing data on conifer (*Picea*, *Pinus*) species was chosen because it is the preferred seed of red-backed voles and deer mice (Lobo 2014), the favored prey on the breeding grounds. The chosen data set (Greene 2021) from Ontario, CA, and Maine, USA observed abundance of conifer species from 2005-2017. A second data set (Bouchard et al. 2018) from Quebec, CA, Ontario, CA, and Michigan, USA observed abundance of conifer species from 2005-2014. These sets were chosen because our banding station has recorded recaptures of Northern Saw-whet Owls from this area. A correlation was performed on the conifer abundance data and the proportion of hatch-year owls we netted the following year. This time lag is used because seed crops that affect small mammal populations in an owl breeding year are produced the year prior to the banding year (Henry et al. 2015). Because of this time lag, seed production data from 2007 was not used because there was no owl data from 2008 to compare with it.

Figure 1 Northern Saw-whet Owl, Photo by Morgan Alexander, 2023

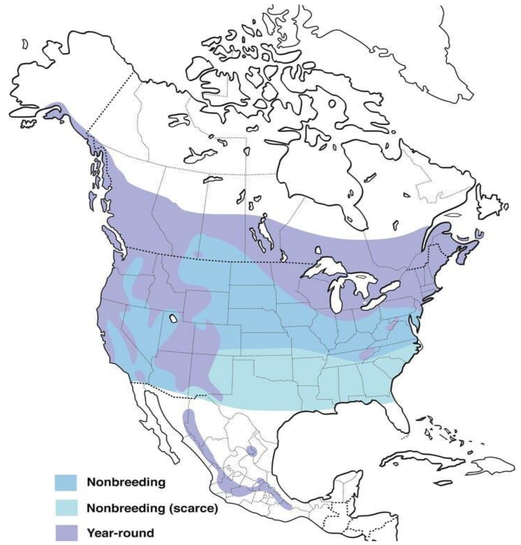

Figure 2 Northern Saw-whet Owl Range (Cornell, N.d.)

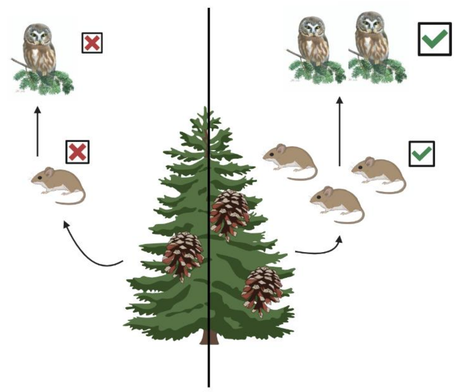

Figure 3 Bottom-up trophic interactions between conifers, small mammals, and Northern Saw-whet Owls. During poor seed crop years (left) fewer mice survive the winter and reproduce the following spring, resulting in fewer Saw-whet owls produced that breeding season. During good seed crop years (right) more mice survive the winter and reproduce the following spring, resulting in more Saw-whet owls produced that breeding season.

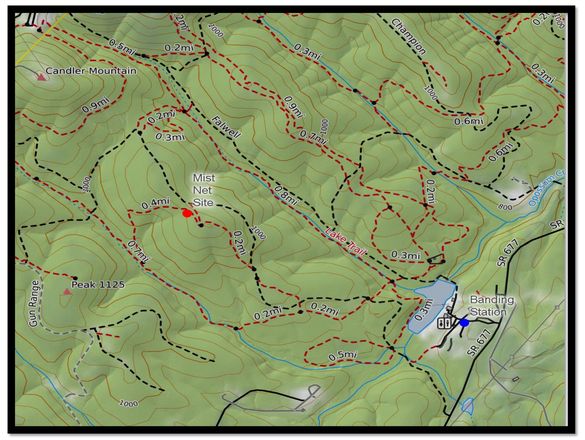

Figure 4 Map of Banding Station and Mist Net Site located at Camp Hydaway, Campbell Co, VA (CalTopo)

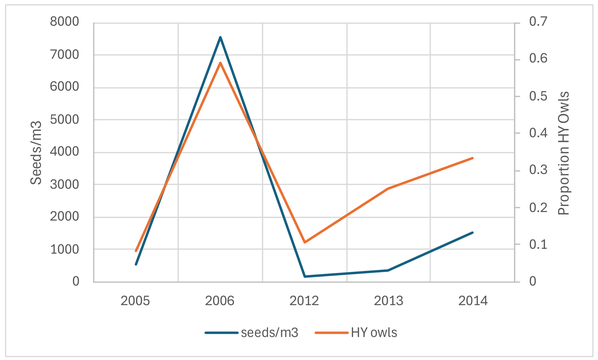

Figure 5 The proportion of hatch-year (HY) Northern Saw-whet Owls banded during the autumn migration from 2005-2014 compared to the average number of conifer seeds produced the previous year. Data from Bouchard et al. 2018.

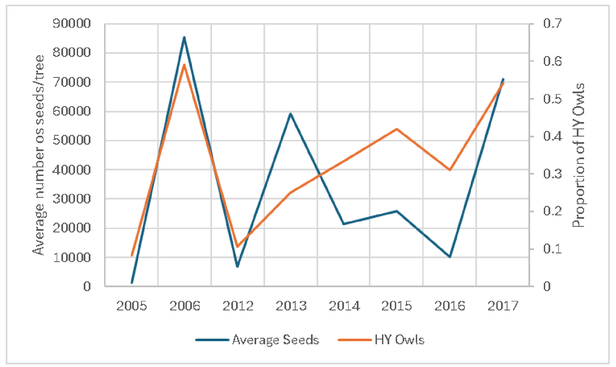

Figure 6 The proportion of hatch-year (HY) Northern Saw-whet Owls banded during the autumn migration from 2005-2014 compared to the average number of conifer seeds produced the previous year. Data from Bouchard et al. 2018..

Results and Discussion

Results:

Over the course of banding operations at Camp Hydaway, 515 owls have been captured since 2002. The number of owls captured showed substantial annual variation, with a range of 4 to 102 individuals captured per fall season. There was a significant relationship between conifer seed abundance and the number of hatch-year owls banded the following fall for both data sets from Greene 2021($r = 0.80$ d.f.= 7 $p = 0.018$) (Figure 5) and Bouchard et al. 2018 ($r=0.91$, d.f.=5, $p = 0.010$) (Figure 6).

Discussion:

The proportion of hatch-year Northern Saw-whet Owls banded varied greatly between 2002 and 2022, with higher proportions occurring every 3-5 years. These peaks coincide with patterns seen in the abundance of red-backed voles, which are the primary breeding ground prey species (Swengel & Swengel 1995, Cheveau et al. 2004). A positive correlation was found between primary production and the number of hatch-year owls banded the following year (Figure 5,6). These findings are consistent with previous studies suggesting that variations in food availability can impact the abundance and distribution of Northern Saw-whet Owls and seem to suggest a bottom-up trophic cycle (Figure 3). These bottom-up trophic interactions are thought to be the controlling factor of fluctuations in predators like the Northern Saw-whet Owl (Henry et al. 2015). The understanding of trophic relationships like this one are important in evaluating the migration dynamics in the Northern Saw-whet Owl and can have implications for forestry management and conservation (Cheveau et al. 2004).

Summary & Key Findings

Objective: Determine if there is a relationship between Northern Saw-whet Owl migration numbers in Central Virginia and prey food supply in the breeding range.

Methodology: Mist netting and banding owls in the autumn and age owls using wing molt criteria. Obtain data on conifer seed production from owl's breeding range. Compare seed production data to hatch-year owl numbers from the following year.

Results: 515 owls captured with large annual variation (4-102 owls captured per year). A significant relationship was found between conifer seed abundance and the number of hatch-year owls banded the following fall.

Implications: Food availability influences Northern Saw-whet Owl abundance, suggesting a bottom-up trophic cascade (Figure 3). Peaks in owl numbers come one year after seed production peaks (Figures 5,6)

References

Cheveau, M., Drapeau, P., Imbeau, L., and Y. Bergeron. 2004. Owl winter irruptions as an indicator of small mammal population cycles in the boreal forest of eastern North America. Oikos, 107(1), 190-198.

Confer, J.L., Kanda, L. and I. Li. 2014. Northern Saw-whet Owl: regional patterns for fall migration and demographics revealed by banding data. Wilson Journal of Ornithology 126(2):305-320

Côté, M., Ibarzabal, J., St-Laurent, M. H., Ferron, J., and R, Gagnon. 2007. Age-dependent response of migrant and resident Aegolius owl species to small rodent population fluctuations in the eastern Canadian boreal forest. Journal of Raptor Research, 41(1), 16-25.

Bouchard, H., Guittonny, M., and S. Brais. 2018. Early recruitment of boreal forest trees in hybrid poplar plantations of different densities on mine waste rock slopes. Forest Ecology and Management, 429, 520-533.

Falls, J.B., Falls, E. and J, Fryxell. 2007. Fluctuations of deer mice in Ontario in relation to seed crops. Ecological Monographs 77(1)

Greene, D. 2021. Abundance of Conifer Species in Ontario, CA, and Maine, USA. [Unpublished data]. Mastree+ Data Explorer. https://mastreeplus.shinyapps.io/mastreeplus/

Henry, S., Nol, E., and W, Wehtje. 2015. Influence of bottom-up trophic dynamics on Northern Saw-whet Owl irruptions revealed by small-scale banding data in Central Ontario. Ontario Birds. 33:122-131

Lobo, N. 2014. Conifer seed predation by terrestrial small mammals: A review of the patterns, implications, and limitations of top-down and bottom-up interactions. Forest Ecology and Management 328:45-54.

Power, M.E. 1992. Top-down and bottom-up forces in food webs: do plants have primacy. Ecology 73(3):733-746.

Project Owlnet. 1997. Age and sex determination in Northern Saw-whet Owls. https://www.projectowlnet.org/.

Rasmussen, J. L., S. G. Sealy, and R. J. Cannings 2020. Northern Saw-whet Owl (Aegolius acadicus), version 1.0. In Birds of the World, A. F. Poole, Editor. Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.nswowl.01

Swengel, A.B. and S.R. Swengel. 1995. Possible four-year cycle in amount of calling by Northern Saw-whet Owls. Passenger Pigeon 57(3):149-155