Northern Saw-whet Owls (*Aegolius acadicus*) Captured at Cape May Point, NJ, 1980-1994: Comparison of Two Capture Techniques

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Abstract.—During autumn migration 1980-1994, 1,270 Northern Saw-whet Owls (*Aegolius acadicus*) (NSWO) were captured and banded at Cape May Point, NJ. From 1980-1988, captures were effected by passive mist-netting. From 1989-1994, an audiolure (NSWO territorial song broadcast loudly from dusk to dawn in the trapping area) was used to enhance capture rate. 638 NSWOs were captured with an audiolure during five seasons (3.08 owls/100 net-hours), while 632 NSWOs were captured in nine seasons by passive mist-netting (0.51 owls/100 net-hours). Comparisons of age, mass, weather conditions when peak capture rates occurred, seasonal timing of migration and time of night of capture revealed differences and similarities of results between the two capture techniques. For both capture techniques, the proportion of NSWOs captured that were adults varied from year to year. Without an audiolure, 38 percent were adults (range 13-88 percent). With an audiolure, 42 percent were adults (range 10-58 percent). Discriminant analysis of wing chord-mass values to assign sex showed that females were more likely to be captured irrespective of technique. With an audiolure, the mean mass of NSWOs captured increased as did the proportion of females. With either technique, most captures occurred on the nights immediately following the passage of cold fronts, when high pressure dominated the study area. With either technique, most captures occurred when the wind direction was northwest (west through northeast), although the capture rate when wind direction was southwest through east was greater with an audiolure than during passive netting. Diel timing of the majority of captures shifted from pre-dawn without an audiolure to earlier in the night when an audiolure was employed. Seasonal timing of migration was similar with both techniques.

Landforms concentrate owls during migration as they do diurnal raptors. The Cape May peninsula funnels thousands of raptors each fall including numerous Northern Saw-whet Owls (*Aegolius acadicus*) (NSWO). Diurnal raptor migration may be monitored by a variety of effective tech-niques including conducting counts and attracting hawks with lures for trapping. Techniques for monitoring owl migration are few, yet effective owl monitoring is necessary for conservation. Counting owls has severe limitations (Russell *et al.* 1991). Traditional hawk trapping methods depend on the ability of the raptor to see a lure, often from a great distance. Consequently, most owl capture has been passive, with numerous mist nets placed where owls were likely to be during migration.

The development of a new capture method, the audiolure, revolutionized NSWO monitoring during migration (Erdman and Brinker 1997). When an audiolure, consisting of the territorial song of an NSWO broadcast loudly from dusk to dawn, was used at a trap site, the capture rate increased markedly.

For the past few decades, several stations have monitored owl migration in the Great Lakes area within or near prime NSWO breeding habitat. These stations first captured owls passively, but switched to using an audiolure in the late 1980s. At Cape May, NJ, owls have been captured since 1969 (Clark 1972), at that

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time the only station conducting fall migration monitoring outside NSWO breeding range. Since 1991, several stations in the middle Atlantic states have monitored fall owl migration using audiolures. Cape May is the only owl migration station in the mid-Atlantic area where large numbers of NSWOs have been captured both passively and with the aid of an audiolure. In this paper we compare age, sex, mass, diel timing of migration, weather during peak captures and seasonal timing of migration for NSWOs captured by each method.

STUDY AREA AND METHODS

Owls were captured at six locations (Duffy and Kerlinger 1992) near the tip of the Cape May peninsula in New Jersey, USA (38°56'N, 74°58'W) (fig. 1). From 1980 through 1988, banding efforts began between 28 September and 10 October (median date = 1 October) and ended between 22 November and 5 December (median date = 26 November). From 1989 through 1994, banding efforts began between 7 and 28 October (median date = 23 October) and ended between 15 and 26 November (median date = 19 November).

Capture effort (number of nets and net-hours) and use of each of the six sites varied from year to year during 1980-1988 because of flooding, succession, changes in land ownership and other habitat modifications. From 1989-1994, the results of capture efforts at a site using an audiolure are reported here. During most years from 1989 and 1994, the study site was located in the South Cape May Meadows, although a nearby cultivated field was used in 1989, and a hay field was used in 1991 after the South Cape May Meadows study site was flooded.

The number of nets used each year and the number of nights of operation varied (table 1). The audiolure, a territorial song of a male NSWO recorded on a loop tape and broadcast at a volume sufficient to be heard 0.8 km distant, was located within a square made of four mist nets. Three or four additional mist nets in a line extended from one side of the square and up to eight other mist nets were located within 0.15 km. In 1989 the audiolure was located behind a line of 11 mist nets.

Nets were opened at sunset, closed approximately one hour before sunrise and checked at 1-2 hour intervals; net checks were conducted more frequently on nights when many owls were captured and when temperatures were ≤ 5°C. Nets were not operated during fog or precipitation or when winds were ≥ 30 km-h^{-1}. NSWOs were banded with U.S. Fish and Wildlife Service aluminum leg bands, measured (mass and unflattened wing chord) and aged. Adult (AHY = after hatch year) owls have more than one generation of flight feathers, whereas juveniles (HY = hatch year) have only one generation of flight feathers. The pattern of retained old feathers was recorded for AHY owls.

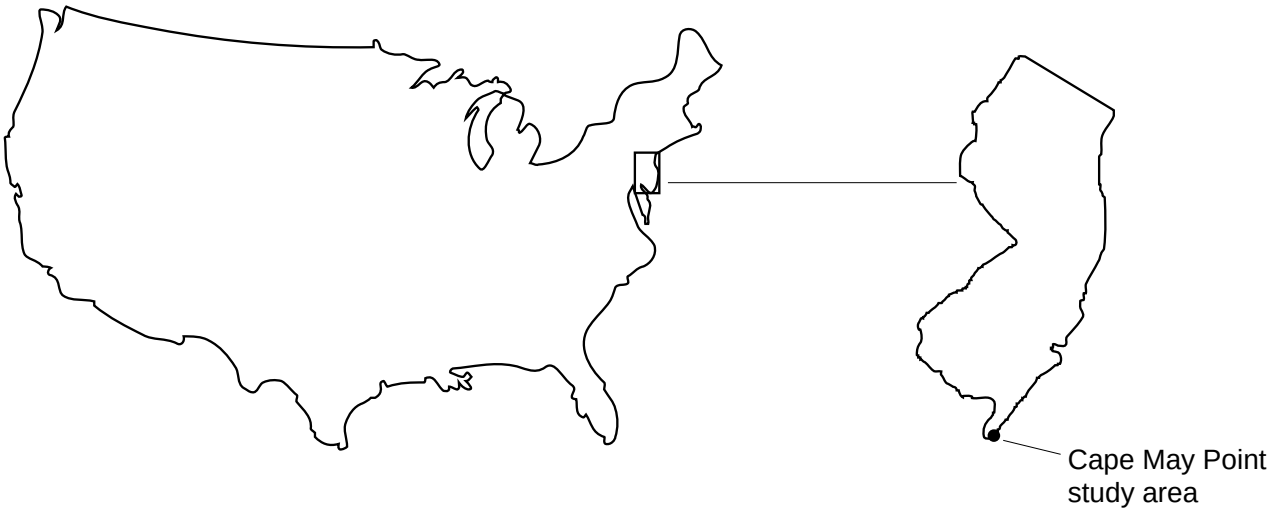


Figure 1.—*Location of Cape May Point, New Jersey, USA.*

Table 1.—*Summary of Northern Saw-whet Owls banded and netting-effort with passive mist-netting, 1980-1988, and with audiolure, 1989-1994, Cape May Point, NJ.*

Year	N	Number of nights	Net-hours	Owls/100 net-hours
Passive				
1980	115	46	11,375	1.01
1981	109	47	15,552	0.7
1982	53	36	9,767	0.54
1983	79	44	12,765	0.62
1984	8	49	26,173	0.03
1985	30	40	23,870	0.13
1986	78	49	17,329	0.45
1987	73	44	17,119	0.43
1988	87	38	12,413	0.7
Total	632	393	146,363	
Mean	**70.2**	**43.7**	**16,263**	**0.51**
SD	32.9	4.4	5,287	0.28
Audiolure				
1989	136	31	5,453	2.49
1990	136	23	3,489	3.9
1991	82	23	2,770	2.96
1992	24	17	1,632	1.47
1993	187	28	3,300	5.67
1994	73	23	3,658	2.0
Total	638	145	20,302	
Mean	**106.3**	**24.2**	**3,387**	**3.08**
SD	52.8	4.4	1,141.7	1.38

ANOVA for owls/100 net-h captured by passive mist-netting and with an audiolure: $F=25.28$, $P<0.01$

RESULTS AND DISCUSSION

Use Of Audiolure

Passive mist netting from 1980-1988 resulted in the capture of 632 NSWOs, while use of an audiolure accounted for the capture of 638 NSWOs from 1989-1994 (table 1). From 1980-1988, all migratory owls were considered target species for this study. With the advent of the audiolure, NSWOs became the focus of this monitoring study; starting and ending dates were chosen to take advantage of peak NSWO migration (Duffy and Kerlinger 1992).

When an audiolure was used, less capture effort was required: nights of operation were reduced and fewer mist nets were used (table 1). However, the number of NSWOs captured varied dramatically from year to year. The annual variation does not only reflect netting-effort, but may be due to prevailing fall weather patterns and other factors, e.g., nest success rate for NSWOs in the migratory population.

The audiolure effectively attracts NSWOs—most are captured in nets in closest proximity to the audiolure, which is consistent with the results obtained by Erdman and Brinker (1997). When the audiolure was moved experimentally in 1989, the majority of captures shifted to the nets nearest the new location of the audiolure.

Age

The proportion of adults captured each year fluctuated (table 2). Without an audiolure, 13-88 percent of the NSWOs were adults (mean = 38 percent). With an audiolure, 10-58 percent were adults (mean = 42 percent). An analysis of variance showed that there was no significant difference in the age structure of owls captured with either technique (F = 0.08). Most adults with both capture techniques displayed a molt pattern that indicated they were second-year birds (Evans and Rosenfield 1987, Duffy unpubl. data).

Sexing of NSWOs

The mean mass of NSWOs captured with the audiolure is slightly greater (table 2). From 1980-1988, mean weight of NSWOs captured at Cape May was 89.8 g; from 1989-1994, the mean weight was 92.1 g an increase of 2.3 g. The difference in mass between NSWOs captured passively and those captured with an audiolure was significant (F = 7.32, P < 0.025). NSWOs are sexually dimorphic, so the difference in mass is attributed to the increase in the proportion of females captured (table 3). As in Tengmalm's Owls (*Aegolius funereus*) and other owls, sexual dimorphism in NSWOs is manifested mostly as a difference in mass (Korpimaki 1987, McGillivray 1987). Comparison of our data with the discriminant analysis devised by Brinker *et al*. (1997) for determining sex of NSWOs based on their mass and wing chord showed that the mean mass of females captured by either technique and the mean mass of males captured by either technique were not significantly different (table 3). The increase in the proportion of females captured with an audiolure was significant (table 3).

Our capture data with and without an audiolure suggested that NSWOs may experience a differential migration, with females wintering farther south than males (Brinker *et al.* 1997). Analysis of data on NSWOs captured during migration along the East Coast north and south of Cape May may offer insights on the differential migration hypothesis. Several owl stations have been operated south of Cape May (Brinker *et al.* 1997) for the past few years; a few additional owl monitoring stations were established north of Cape May in 1996. However, when Loos and Kerlinger (1993) sexed by dissection 41 NSWO road-kills found in the Cape May area primarily in winter, they found that only 20 (49 percent) were female. The wintering population may have a 1:1 sex ratio.

Table 2.—*Age and mass of Northern Saw-whet Owls (NSWO) captured at Cape May Point, NJ.*

Year	N	% AHY	Mean Mass (g)
Passive			
1980	115	18	90.4
1981	109	33	89.6
1982	53	59	88.5
1983	79	34	85.8
1984	8	88	92.0
1985	30	13	91.2
1986	78	23	91.1
1987	73	43	90.3
1988	87	35	89.5
Mean	**70.2**	**38**	**89.8**
SD	32.9	22	1.7
Audiolure			
1989	136	53	92.2
1990	136	35	91.4
1991	82	56	91.3
1992	24	58	91.7
1993	187	10	91.7
1994	73	38	94.4
Mean	**106.3**	**42**	**92.1**
SD	52.8	17	1.1

ANOVA (F=0.08) showed that there was no significant difference between NSWO captured with each technique in regard to age; ANOVA (F=7.32, P<0.025) showed that there was a significant difference between NSWO captured with each technique in regard to mass.

Diel Timing of Migration

The diel timing of capture has changed with the use of an audiolure. During passive mist-netting, 26 percent of NSWOs were captured during the first 4-hour period of the night, 33 percent during the second 4-hour period and 40 percent during the last 4-hour period (fig. 2). With an audiolure, the majority of captures occurred during the first two 4-hour periods, 35 percent and 36 percent, respectively, while only 28 percent were caught during the last 4-hour block (fig. 2); X^2 = 19.16, P < 0.0001.

Table 3.—*Sex of Northern Saw-whet Owls captured at Cape May Point, NJ based on discriminant analysis (Brinker* et al*. 1977).*

Year	% Male	Mean Male Mass (g)	% Female	Mean Female Mass (g)	N[1]
Passive					
1980	19	79.3	65	95.0	115
1981	18	79.5	66	94.0	109
1982	29	78.5	56	94.9	52
1983	35	77.0	50	92.2	78
1984	0		88	93.7	8
1985	23	80.6	63	96.4	30
1986	18	78.4	65	96.4	77
1987	25	78.9	67	95.6	73
1988	19	78.4	68	93.3	84
Mean	**21**	**78.8**	**65**	**94.6**	
SD	9.1	0.98	9.7	1.35	
Audiolure					
1989	13	79.1	78	95.4	136
1990	13	78.7	77	94.4	129
1991	12	76.3	81	94.1	81
1992	17	77.3	83	94.6	24
1993	13	79.0	76	94.8	187
1994	10	79.9	86	96.6	72
Mean	**13**	**78.4**	**80**	**95.0**	629
SD	2.1	1.21	3.5	0.83	

[1] N included only those individuals for which both wing chord and weight were measured and recorded.
ANOVA showed that the differences in mass of males and females captured with and without an audiolure were not significantly different. ANOVA showed that the increase in the proportion of females captured with an audiolure was significant ($F=11.1$, $P<0.01$), but that the decrease in the proportion of males with an audiolure was not significant.

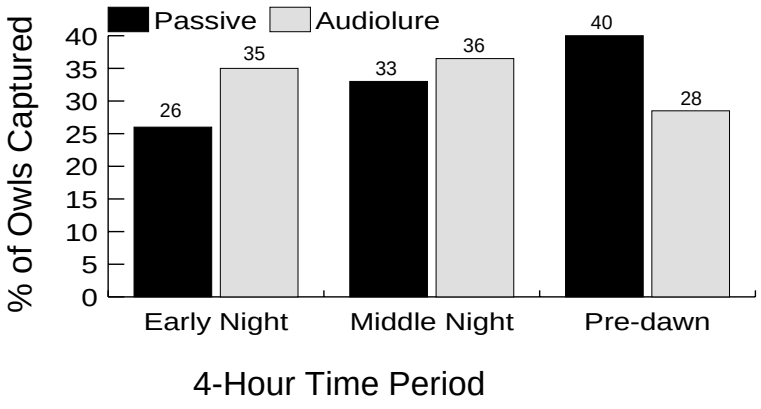


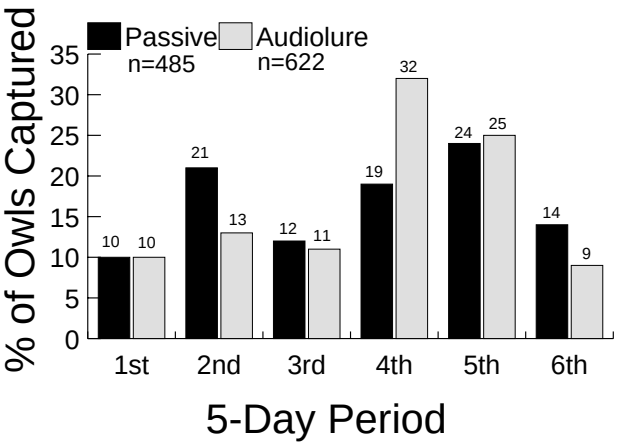
Figure 2.—*Diel timing of Northern Saw-whet Owls captured at Cape May Point, NJ by passive mist-netting and with an audiolure.*

Mist nets only capture NSWOs flying ≤ 2.5 m above the ground. Without an audiolure, the highest capture rate in the last third of the night might be a result of capturing migratory owls actively hunting or seeking a daytime roost. The higher capture rate earlier in the night with an audiolure might be due to the audiolure attracting NSWOs that are migrating (Brinker *et al*. 1997).

Seasonal Timing of Migration.

Migration of NSWOs begins in mid-October and continues throughout November, with peak migration occurring during the first half of November (fig. 3). When NSWOs captured during the peak migration period in 1980-1988 were compared with NSWOs captured using an audiolure during the same time periods in 1989-1994, two differences appeared. With an audiolure, the proportion of NSWOs caught during 26-30 October has decreased. There has also been a significant increase in the NSWOs caught during 5-9 November when an audiolure was employed (X^2 = 37.0; P < 0.0001).

The reason(s) for the shift in captures noted during 26-30 October and 5-9 November is unknown. The increase in captures in the latter period was so great that it dampened the relative magnitude of captures occurring during other time intervals.



1st =10/21 – 10/25
2nd=10/26 – 10/30
3rd=10/31 – 11/4
4th=11/5 – 11/9
5th=11/10 – 11/14
6th=11/15 – 11/19

Figure 3.—*Seasonal timing of Northern Saw-whet Owl migration at Cape May Point, New Jersey.*

Weather

Most NSWO captures occurred following the passage of a cold front, when high pressure dominated the study area. Weather conditions propitious for capture were similar to those reported by Evans (1980). With either technique, most captures occurred when the wind direction was northwest (west through northeast). The capture rate when wind direction was less favorable (southwest through east) was greater with an audiolure (20 percent, n = 556) than during passive netting (12 percent, n = 545).

SUMMARY

This study provided a comparison of data on NSWO migration in the mid-Atlantic acquired by passive capture and through the use of an audiolure. Owls captured with each technique did not differ significantly with regard to age, but there was a significant increase in mass and in the proportion of females captured with an audiolure. Time of night of peak capture shifted to earlier in the night with an audiolure. Seasonal timing of capture was similar, although there was a significant increase with an audiolure in the capture rate during 5-9 November. An audiolure augmented captures significantly, warranting its use at all East Coast owl migration stations, especially where a small number of NSWOs pass. Conservation of NSWOs depends upon an improved knowledge of the distribution of these secretive forest owls during all aspects of their life history, so monitoring at additional sites in the Northeast and mid-Atlantic during migration is encouraged.

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LITERATURE CITED

Brinker, D.F.; Duffy, K.E.; Whalen, D.M.; Watts, B.D.; Dodge, K.M. 1997. Autumn migration of Northern Saw-whet Owls (*Aegolius acadicus*) in the middle Atlantic and northeastern United States: what observations from 1995 suggest. In: Duncan, J.R.; Johnson, D.H.; Nicholls, T.N., eds. Biology and conservation of owls of the northern hemisphere: 2d international symposium; 1997 February 5-9; Winnipeg, Manitoba. Gen. Tech. Rep. NC-190. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 74-89.

Clark, W.S. 1972. Migration trapping of hawks (and owls) at Cape May, New Jersey—fifth year. Eastern Bird Banding Association News. 35: 121-131.

Duffy, K.; Kerlinger, P. 1992. Autumn owl migration at Cape May Point, New Jersey. Wilson Bulletin. 104(2): 312-320.

Erdman, T.C.; Brinker, D. 1997. Increasing mist net captures of migrant Northern Saw-whet Owls (*Aegolius acadicus*) with an audiolure. In: Duncan, J.R.; Johnson, D.H.; Nicholls, T.N., eds. Biology and conservation of owls of the northern hemisphere: 2d international symposium; 1997 February 5-9; Winnipeg, Manitoba. Gen. Tech. Rep. NC-190. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 533-544.

Evans, D.L. 1980. Multivariate analyses of weather and fall migration of Saw-whet Owls at Duluth, Minnesota. Fargo, ND: North Dakota State University. 49 p. M.S. thesis.

Evans, D.L.; Rosenfield, R. 1987. Remigial molt in fall migrant Long-eared and Northern Saw-whet Owls. In: Nero, R.W.; Clark, R.J.; Knapton, R.J.; Hamre, R.H., eds. Biology and conservation of northern forest owls: symposium proceedings;1987 February 3-7; Winnipeg, Manitoba. Gen. Tech. Rep. RM-142. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest Experiment Station: 209-214.

Korpimaki, E. 1987. Sexual size dimorph-ism and life-history traits of Tengmalm's Owl: a review. In: Nero, R.W.; Clark, R.J.; Knapton, R.J.; Hamre, R.H., eds. Biology and conservation of northern forest owls: symposium proceedings; 1987 February 3-7; Winnipeg, Manitoba. Gen. Tech. Rep. RM-142. Fort Collins, CO: U.S. Department of Agricul-ture, Forest Service, Rocky Mountain Forest Experiment Station: 157-161.

Loos, G.; Kerlinger, P. 1993. Road mor-tality of saw-whet and screech-owls on the Cape May peninsula. Journal of Raptor Research. 27(4): 210-213.

McGillivray, W.B. 1987. Reversed size dimorphism in 10 species of northern owls. In: Nero, R.W.; Clark, R.J.; Knapton, R.J.; Hamre, R.H., eds. Biology and conservation of northern forest owls symposium; 1987 February 3-7; Winnipeg, Manitoba. Gen. Tech. Rep. RM-142. Fort Collins, CO: U.S. Department of Agricul-ture, Forest Service, Rocky Mountain Forest Experiment Station: 59-66.

Russell, R.; Dunne, P.; Sutton, C.; Kerlinger, P. 1991. A visual study of migrating owls at Cape May Point, New Jersey. Condor. 93: 55-61.