Influence of Audio Lure During Spring and Fall Migration in Southwestern Alberta, Canada

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Abstract

We compared the influence of different lengths of audio playback on attracting migrating passerines during spring and fall in southwestern Alberta in 2014. The short audio playback was started 1.5 hr before sunrise while the long audio playback was started 4.5 hr before sunrise. During both spring and fall we captured significantly more birds on days when we played the audio lure than on silent days. During spring migration, the short audio was equally as good at attracting birds as was the long audio, whereas during fall migration, the long audio attracted more birds than the short audio. However, there were differences among species, age and/or sex classes. Overall, using a short audio lure seems to be an acceptable compromise between increasing capture rates and early landfall, which may affect behavior or flight resources.

Introduction

Using audio lures to attract migrating birds to land where mist nets can capture them has long been used in European bird banding (e.g., Schaub et al. 1999, Lecoq and Catry 2003). But in North America they are only commonly used to attract migrating Northern Saw-whet Owls (*Aegolius acadicus*) during night-time capture and banding (Erdman and Brinker 1997). Migrating Sora (*Porzana carolina*) and Virginia Rail (*Rallus limicola*) have also been studied (Kearns et al. 1998) using playback. Audio lures are more commonly used to attract individuals for species-specific studies during breeding and/or non-breeding seasons: e.g., Black-throated Blue Warbler (*Setophaga caerulescens*) (Sillett and Holmes 2002) and Yellow-rumped Warbler (*S. coronata*) (Toews et al. 2013). According to Ralph (2013), at least two banding stations in the US have used an audio lure to capture migrants, but neither have published their results, so it has been impossible to evaluate the method adequately. Many analyses of banding data are limited by number of individuals caught, with insufficient sample sizes to determine trends with confidence (e.g., Crewe et al. 2008, Smith et al. 2009). Using audio lures could help alleviate this problem by increasing capture numbers.

After participating in a migration monitoring project in Mexico in spring 2013, where we started the audio lure 4.5 hr before sunrise (Gahbauer et al. 2016), I (CMS) visited a banding station in France that fall that started the audio playback only 1.5 hr before sunrise to attract migrating passerines. We became interested in testing the influence of different playback times on capture rates. While the use of an audio lure is known to increase numbers of birds captured (e.g., Shaub et al. 1999, Gahbauer et al. 2016), there is uncertainty over how much of a difference it makes to start the broadcast earlier in the night compared to closer to sunrise. Starting the audio lure closer to sunrise may not induce migrants to stop much short of their normal time of day, thus reducing potential impacts on behavior or flight resources (Harper 1994).

As our site was not part of the Canadian Migration Monitoring Network of stations, it was a good location to conduct this experiment in comparing passive mist netting to various periods of audio luring during spring and fall migration without compromising the consistency of a long-term data set.

Methods

Study site. The project was conducted on private property, located 1 km west of Mountain View, Alberta (49° 08'N, 113° 38'W) (Fig. 1) at 1325 m elevation. It is a 2.8-ha parcel of human-modified habitats (buildings, lawn, pasture, deciduous shrubs and trees, coniferous trees, and a pond) surrounded by agricultural pasture land. The nearest extensive forested site is 3 km south in the vicinity of Payne Lake Recreation Area. Intermittent passive mist-netting during migration had been done at this site in both spring and fall from 2011 to 2013, providing baseline information on species and migration phenology.

Audio lure. On audio lure days, we used a laptop and speaker system to continuously broadcast songs of seven species of migrants expected to fly through the area. To test the effectiveness of using an audio lure, and of differing lengths of playback time, we utilized a three-day repeating cycle of treatments. On day 1 (silent) no audio lure was played. On day 2 (short audio) the audio lure turned on 1.5 hr (± 15 min) before local sunrise, as per the protocol of the Centre for Research on the Biology of Bird Populations at the National Museum of Natural History, France (C. Baudoin, pers. comm.). On day 3 (long audio) the audio lure turned on 4.5 hr (± 15 min) before local sunrise as per the protocol of the Santa Alejandrina Bird Observatory, Minatitlan, Veracruz, Mexico (Gahbauer et al. 2016). On both audio days, the recordings were broadcast in an endless loop until the nets were closed. We used an outdoor digital block heater timer to turn the audio unit on. We used an electric guitar amplifier, which had an average output of 114 decibels (maximum 126 decibels, measured with a sound level meter).

Species broadcast. Based on previous captures at the site, the species targeted were anticipated to be relatively common migrants, which would increase the probability of capture, thus providing a large enough sample size to increase confidence in any trends observed. Some additional species can be expected to be drawn in along with target species (Møller 1992, Ralph 2013, Gahbauer et al. 2016). As the seasons progressed different migrants were expected, therefore two suites of species' calls were broadcast in spring, and another two suites were broadcast in fall. A single song clip for each of seven species was repeated for 20 seconds, for a total recording of 2 min and 20 s. Song clips were excerpted from Cornell Laboratory of Ornithology (1992) and Neville (1997). The loop was created in Audacity®, with a standardized output level.

Fig. 1. Location of Study site in Southwestern Alberta, Canada

The first suite of spring calls was broadcast from 2 May to 20 May, featuring Chipping Sparrow (*Spizella passerina*), Savannah Sparrow (*Passerculus sandwichensis*), Lincoln's Sparrow (*Melospiza lincolnii*), White-throated Sparrow (*Zonotrichia albicollis*), Orange-crowned Warbler (*Oreothlypis celata*), Common Yellowthroat (*Geothlypis trichas*), and Yellow-rumped Warbler (*Setophaga coronata*). From 21 May to 3 June, we broadcast the second suite of calls, featuring Western Wood-Pewee (*Contopus sordidulus*), Swainson's Thrush (*Catharus ustulatus*), Gray Catbird (*Dumetella carolinensis*), Tennessee Warbler (*Oreothlypis peregrina*), MacGillivray's Warbler (*Geothlypis tolmiei*), American Redstart (*Setophaga ruticilla*), and Wilson's Warbler (*Cardellina pusilla*).

The first suite of fall calls was broadcast from 10 August to 27 August, featuring Least Flycatcher (*Empidonax minimus*), Gray Catbird, Chipping Sparrow, Clay-colored Sparrow (*Spizella pallida*), Lincoln's Sparrow, Yellow Warbler (*Setophaga petechia*), and Wilson's Warbler. From 28 August to 17 September, we broadcast the second suite of calls, featuring Swainson's Thrush, Lincoln's Sparrow, White-throated Sparrow, White-crowned Sparrow (*Zonotrichia leucophrys*), Orange-crowned Warbler, Yellow-rumped Warbler, and Wilson's Warbler.

Capture and banding. We operated up to 10 mist nets (30-mm mesh; 2.6 m tall x 12 m long) on as many days as possible in spring (2 May to 3 June) and fall (10 August to 17 September). Nets were opened at sunrise and operated for six hr, weather permitting. Net checks occurred at least every 30 min. If adverse weather or other circumstances prevent opening the nets on a given day, the sequence of the repeating schedule was maintained, to try to keep the number of sample hours for each treatment (silent, short audio, long audio) similar during the migration session. Except for hummingbirds (released unbanded), all birds captured were identified to species, age, and sex and, if unbanded, were banded with a uniquely-numbered USFWS aluminum leg band. Each bird captured, including recaptures, was aged and sexed using Pyle (1997).

Data analyses. Statistical analysis focused on determining whether the capture rate of species and individuals differed among the three treatments during either spring or fall migration. All capture rates are expressed as number of birds per 100 net-hours (b/100nh). Frequencies of capture among categorical variables such as treatment (silent, short audio, long audio), age (second year *vs*. after second year in spring, hatch year *vs*. after hatch year in fall) and sex (male, female), were compared using chi-squared tests (Fowler and Cohen 1996) and only for first captures, not recaptures. Yates' Correction for Continuity (Fowler and Cohen 1996) was used for analyses with two degrees of freedom. Sample size differed in some age and sex comparisons because individuals of unknown age or sex were removed from the dataset. Analyses were limited to species with ≥ 25 individuals captured during that session. Results were considered significant if P<0.05. Minimum apparent stopover duration was calculated as the difference (in days) between the initial capture date and the date that the bird was last recaptured in the study area (Kaiser 1999, Arizaga et al. 2008).

Results

During spring migration, between 2 May and 3 June 2014, we operated for 27 days (nine cycles of the three treatments), losing six days to weather events, for a total of 1,436 net-hr (453 silent, 483 short audio, and 500 long audio). We captured 665 birds of 41 species. During fall migration, between 10 August and 17 September 2014, we operated for 30 days (10 cycles), losing nine days to weather events, for a total of 1,685 net-hr (600 hours silent, 535 hr short audio, and 550 hr long audio). We captured 747 birds of 39 species. In both seasons and overall, the majority of birds were captured on days using the audio lure (Fig. 2) (X^2=8.97, P=0.011; X^2=19.68, P<0.001; X^2=12.51, P=0.002, respectively). In spring, this was driven by the significant difference between silent and short audio (X^2=7.20, P=0.007), while there was no difference between short and long audio. But in fall, this was driven by long audio attracting more birds than short audio (X^2=7.51, P=0.006), while the difference was not significant between silent and short audio. For both seasons combined, there was a significant difference in number of birds captured between silent and short audio (X^2=4.57, P=0.033), but not between short and long audio.

During the two spring sessions combined, Swainson's Thrush, Lincoln's Sparrow, Orange-crowned Warbler, and Common Yellowthroat were captured in significantly higher numbers during audio treatments than on silent days, but there was no significant difference among the three treatments for Chipping Sparrow, Savannah Sparrow or Yellow-rumped Warbler (Table 1). Comparing only the two audio treatments, Lincoln's Sparrow and Orange-crowned Warbler were captured in significantly higher numbers during the long audio treatment (X^2=5.90, P=0.015 and X^2=7.05, P=0.008, respectively), Chipping Sparrow was higher during the short audio treatment (X^2=4.79, P=0.029), and there was no significant difference between audio treatments for Swainson's Thrush or Common Yellowthroat. Western Wood-Pewee, Gray Catbird, White-throated Sparrow, Tennessee Warbler, MacGillivray's Warbler, American Redstart, and Wilson's Warbler all had fewer than 25 captures in spring, so they were removed from the analysis of treatment type.

During the two fall sessions combined, Clay-colored Sparrows they were captured in significantly higher numbers during silent days, while Lincoln's Sparrow, White-crowned Sparrow and Yellow Warbler were captured in significantly higher numbers during audio treatments than silent days (Table 2). There was no difference for Wilson's Warbler. Comparing only the two audio treatments, White-crowned Sparrows were captured in significantly higher numbers during the long audio treatment (X^2=37.98, P<0.001). Least Flycatcher, Swainson's Thrush, Gray Catbird, Chipping Sparrow, White-throated Sparrow, Orange-crowned Warbler, and Yellow-rumped Warbler all had fewer than 25 captures in fall, so were removed from the analysis of treatment type.

Among the eight species with at least 25 individuals captured in spring, only Clay-colored Sparrow was not on the audio lure, and it was only slightly more numerous on short audio lure days than on silent days. Among the six species with at least 25 individuals captured in fall, only House Wren (*Troglodytes aedon*) was not on the audio lure, and there was no difference among treatments.

In spring, significantly higher numbers of both after second year (ASY) and second year (SY) Lincoln's Sparrows were captured during audio days (X^2=14.84, P=0.001 and X^2=29.03, P<0.001, respectively), there was no significant difference for Savannah Sparrows, and more ASY Yellow-rumped Warblers were captured on silent days (X^2=7.17, P=0.028) while there was no difference for SY birds (Fig. 3). Comparing only the two audio treatments, ASY Savannah Sparrows were captured in higher numbers during long audio than short audio (X^2=3.98, P=0.046), while there was no difference between audio treatments for the other two species and age classes. Too few SY Orange-Crowned Warblers were captured in spring (n=4) to enable that age class to be included in a statistical comparison, but significantly higher numbers of ASY birds were captured during audio treatments than silent treatment (X^2=29.55, P<0.001), and more ASY birds were captured during long audio than short audio (X^2=5.06, P<0.024).

In spring, both male (X^2=16.74, P<0.001) and female (X^2=18.63, P<0.001) Orange-crowned Warblers were captured in higher numbers on audio lure than silent days. Only females were captured in higher numbers on long audio (X^2=4.59, P=0.032), and there was no significant difference between audio treatments for males. There was no difference between sexes for Yellow-rumped Warblers. No other species were captured in sufficient numbers for sex comparisons.

Only hatch year (HY) Clay-colored Sparrows and after hatch year (AHY) Yellow Warblers were captured in higher numbers on silent than audio days (X^2=52.47, P<0.001 and X^2=7.51, P=0.023, respectively) in fall (Fig. 4). Both HY and AHY Lincoln's Sparrows were captured in higher numbers on audio lure days (X^2=11.79, P=0.003 and X^2=16.65, P<0.001, respectively), as were both HY and AHY White-crowned Sparrows (X^2=12.59, P=0.002 and X^2=24.93, P<0.001, respectively), HY Yellow Warblers (X^2=46.68, P<0.001), and AHY Wilson's Warblers (X^2=26.43, P<0.001). The only significant difference between audio captures were for AHY Wilson's Warblers, where short audio was significantly higher than long audio (X^2=9.63, P=0.002).

In fall, both male and female Yellow Warblers (X^2=6.02, P=0.049 and X^2=11.35, P=0.003, respectively), and female Wilson's Warblers (X^2=7.32, P=0.026) were captured in higher numbers on audio lure days. No other species were captured in sufficient numbers for sex comparisons.

Twenty-nine individuals of 13 species were recaptured in spring (4.4% of total captures) and 43 individuals of 10 species in fall (5.8% of total) (Table 3). The median length of minimum number of days stopover in both spring and fall was two days; however, the range was greater in fall (1-12 *vs*. 1-6 in spring). There was no difference in stopover duration between species included on the audio lure versus not on the audio lure.

Discussion

During spring and fall, and both seasons combined, we captured significantly more birds on days when we played the audio lure than on silent days. This finding was similar to other studies (e.g., Schaub et al. 1999, Gahbauer et al. 2016). In spring, the short audio was equally as good at attracting birds as was the long audio, whereas in fall the long audio attracted more birds than the short audio. However, there were some differences among species, age and/or sex classes. The song clips chosen for our audio lure may have influenced the attractiveness of the playback to various age and/or sex classes, if they were of a different dialect or from a different geographical location than migrants passing through our site (e.g., Searcy et al. 1997).

At the family level, our only thrush (Swainson's) was captured at significantly higher rates in spring on days when the audio lure was used, which was similar to the results of Gahbauer et al. (2016). Among sparrows, capture rates of two species (Chipping and Savannah) showed no influence of audio lure during spring while Lincoln's Sparrow showed a significant difference. In fall, all three species of sparrow (Clay-colored, Lincoln's and White-crowned) were captured at higher rates on audio lure days. The pattern was similar for the warblers, with two species (Orange-crowned and Common Yellowthroat) captured at significantly higher rates in spring on audio lure days, while there was no difference for Yellow-rumped Warbler. In fall, Yellow Warbler capture rates were higher on audio lure days, while Wilson's Warbler rates were not. While this was a small selection of thrushes, sparrows and warblers, there was no evidence for certain families being attracted to audio lures in higher numbers than other families, however, within families, some species appear to be more attracted than others.

Other studies using audio lures have reported a potential for bias in age (Brotons 2000) and/or sex ratios (e.g., Herremans 1989, Lecoq and Catry 2003) for certain species. While this seemed to be highly variable among species in our study, the majority showed no bias in capture rates. For five of seven species (four sparrows and three warblers) that we captured in spring and fall there was no evidence of differential attraction to the audio lure by age: the two exceptions were warblers. Three of four species (all warblers) that were captured in sufficient numbers to assess capture rates by sex showed no difference between males and females. Differential attraction to audio lure by different age or sex classes may be confounded by season, weather and perhaps habitat. It should be noted that even passive mist netting may show capture bias due to age and/or sex differences in arrival times at breeding sites or different migration routes (e.g., Hussell 2004). We recommend that any demographic researchers utilizing audio lure should conduct pilot studies to understand any age/sex bias for targeted species.

There was no difference in the median length of minimum stopover between spring and fall, however, a few individuals stayed twice as long in fall than in spring. This may have been due to inclement weather events, such as snow or unfavorable winds. There were no injuries or mortalities during our study.

While caution is warranted in interpreting our results as the number of species and sample sizes in our study were low, our data suggest that using a short audio lure (i.e., starting at 1.5 hours before sunrise) would be an acceptable compromise between increasing capture rates over passive mist netting and concerns over inducing early landfall.

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Table 1. Number of birds captured, and birds captured per 100 nh, by treatment type (silent, short audio, long audio), for all species included on the audio lure which had at least 25 individuals captured, during spring migration. Significant results (P<0.05) of chi-square tests are in bold type.

Species	Total No. Captured	No. Captured			Captured / 100 nh				
		Silent	Short	Long	Silent	Short	Long	x2	p
Swainson's Thrush	26	2	13	11	0	3	2	8.69	**0.013**
Chipping Sparrow	60	22	25*	13	5	5	3	5.08	0.073
Savannah Sparrow	46	17	14	15	4	3	3	1.07	0.586
Lincoln's Sparrow	73	6	24	43*	1	5	9	32.27	**<0.001**
Orange-crowned Warbler	37	3	10	24*	1	2	5	21.73	**<0.001**
Common Yellowthroat	31	2	16	13	0	3	3	12.15	**0.002**
Yellow-rumped Warbler	161	55	47	59	12	10	12	1.97	0.373
Net hours	*1436*	*453*	*483*	*500*	*453*	*483*	*500*		

Table 2. Number of birds captured, and birds captured per 100 nh, by treatment type (silent, short audio, long audio), for all species included on the audio lure which had at least 25 individuals captured, during fall migration. Significant results (P<0.05) of chi-square tests are in bold type.

Species	Total No. Captured	No. Captured			Captured / 100 nh				
		Silent	Short	Long	Silent	Short	Long	x2	p
Clay-colored Sparrow	100	52	25	23	9	5	4	12.51	**0.002**
Lincoln's Sparrow	43	5	14	24	1	3	4	14.09	**0.001**
White-crowned Sparrow	74	9	17	48*	2	3	9	37.98	**<0.001**
Yellow Warbler	222	57	78	87	10	15	16	10.08	**0.007**
Wilson's Warbler	112	31	42	39	5	8	7	3.44	0.179
Net Hours	*1685*	*600*	*535*	*550*	*600*	*535*	*550*		

* indicates that length of audio lure had significantly higher capture rates than the other length

Table 3. Stopovers from recaptures: the median time between initial and last capture of 29 individuals recaptured during spring migration, and 43 individuals recaptured during fall migration, was two days.				
	SPRING		FALL	
Species	No. of Birds	No. of Days Stopover	No. of Birds	No. of Days Stopover
Willow Flycatcher			1	2
Warbling Vireo			1	5
Swainson's Thrush*	1	2	1	3
American Robin	1	2		
Gray Catbird*			1	9
Chipping Sparrow*	2	2,1		
Clay-colored Sparrow [F]	1	4	5	5,4,2,2,1
Savannah Sparrow*	1	5		
Lincoln's Sparrow*	6	6,5,4,3,1,1	2	1,1
White-throated Sparrow*	2	2,1		
White-crowned Sparrow [F]	5	4,3,3,2,1	6	12,5,3,1,1,1
Oregon Junco	5	6,6,2,1,1		
Orange-crowned Warbler*	1	1		
Common Yellowthroat [S]	2	5,3	1	4
Yellow Warbler [F]	1	1	18	6,6,4,4,4,4,3,3,3,3,3,2,2,2,2,2,1,1
Wilson's Warbler*			7	5,2,2,2,1,1,1
Lazuli Bunting	1	1		

** Species on audio in both spring and fall*
F Species on audio only in the fall
S Species on audio only in the spring

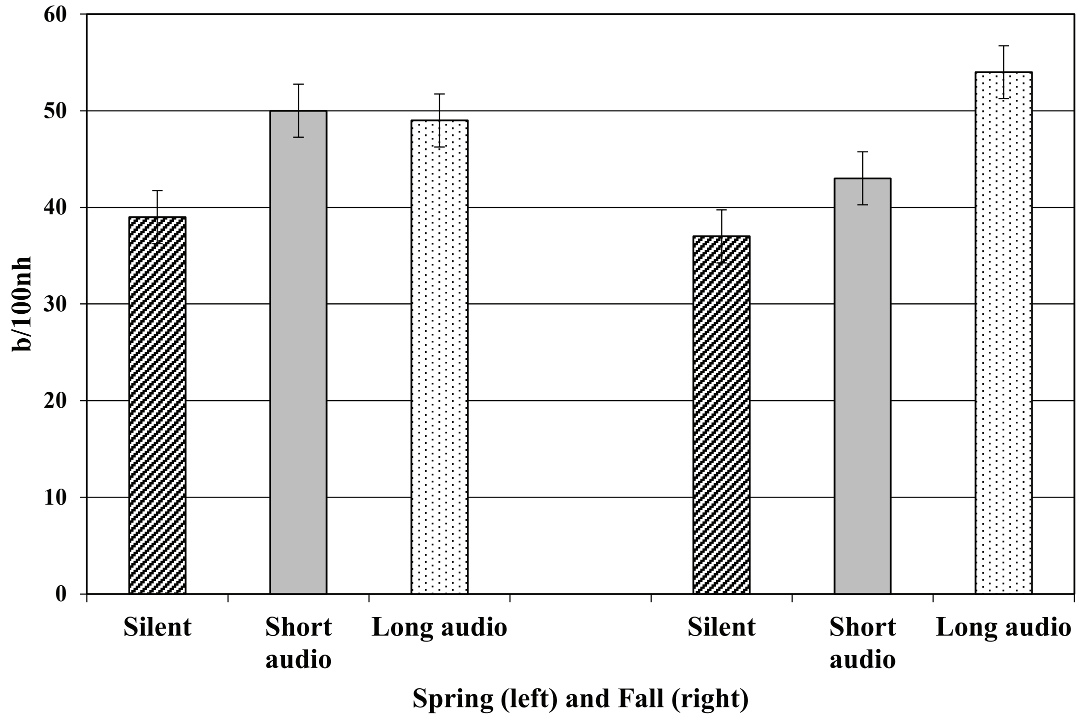

Fig. 2. More birds were captured per 100 nh on audio lure days than on silent days, in both spring and fall migration. Error bars are ± 1 SE

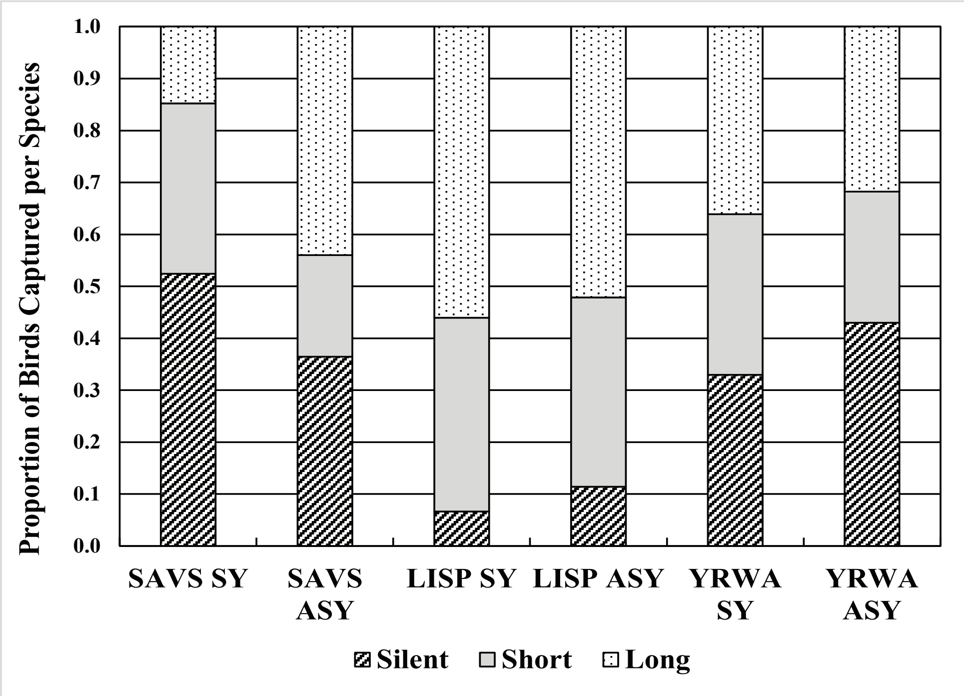

Fig. 3. Spring captures: proportion of Savannah Sparrow (SAVS, *n*=27), Lincoln's Sparrow (LISP, *n*=66) and Yellow-rumped Warbler (YRWA, *n*=149) captured, by age (second year or SY *vs.* after second year or ASY) and treatment (silent, short audio, long audio). Dashed lines separate species.

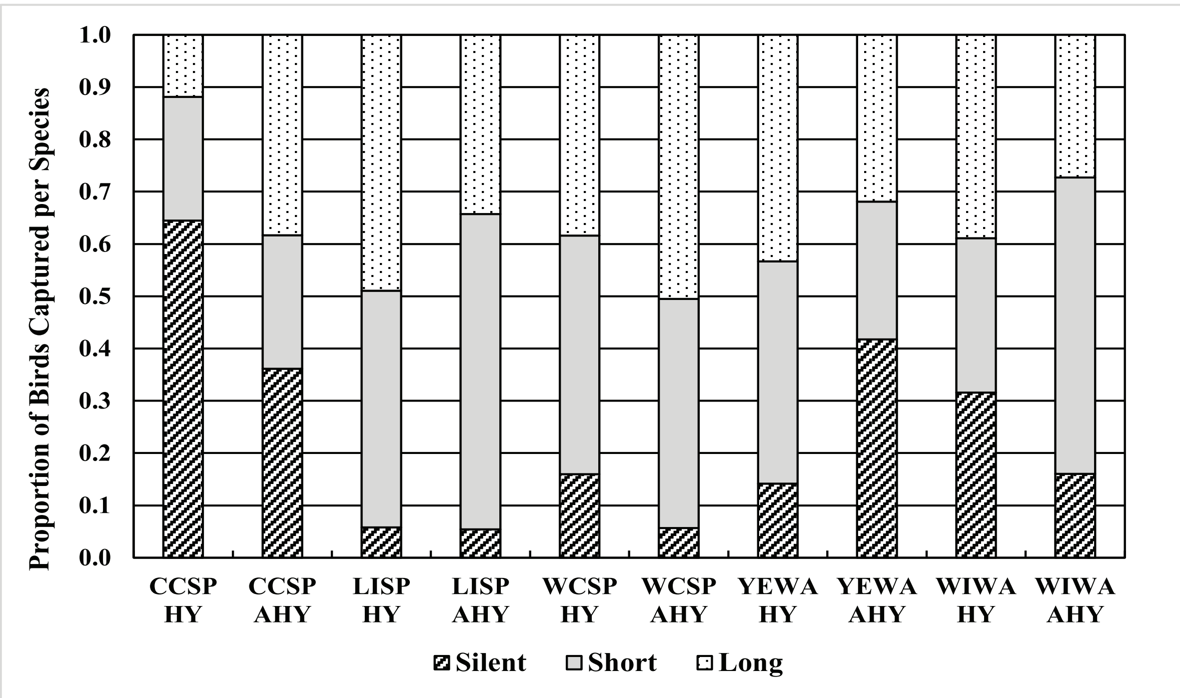

Fig. 4. Fall captures: proportion of Clay-colored Sparrow (CCSP, *n*=96), Lincoln's Sparrow (LISP, *n*=33), White-crowned Sparrow (WCSP, *n*=74), Yellow Warbler (YEWA, *n*=212), and Wilson's Warbler (WIWA, *n*=111) captured, by age (hatch year or HY *vs.* after hatch year or AHY) and treatment (silent, short audio, long audio). Dashed lines separate species.

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Saw-whet Owl
Photo R. Pantle