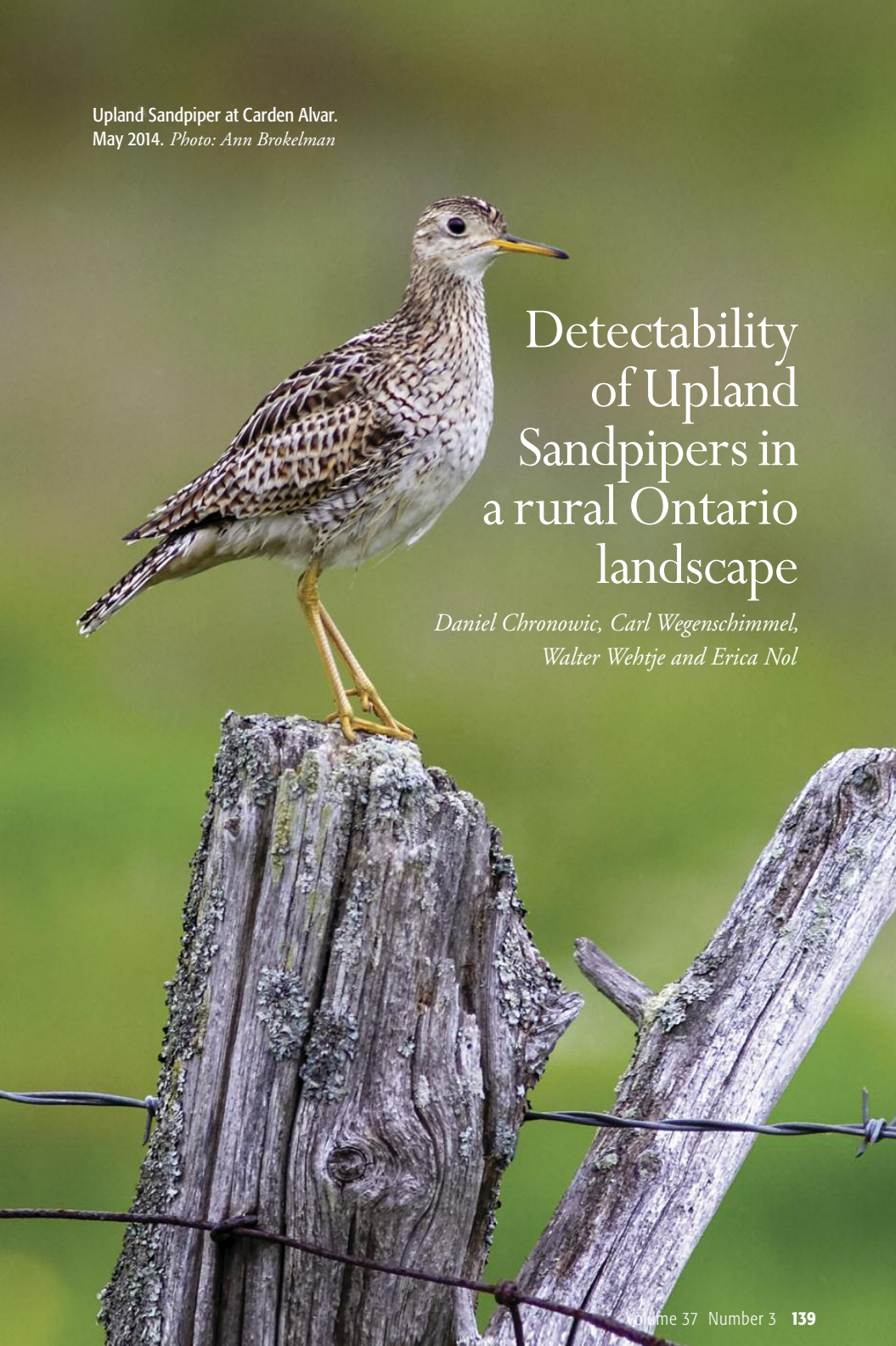


Upland Sandpiper at Carden Alvar. May 2014. *Photo: Ann Brokelman*

Detectability of Upland Sandpipers in a rural Ontario landscape

Daniel Chronowic, Carl Wegenschimmel, Walter Wehtje and Erica Nol

Abstract

We examined Upland Sandpiper (*Bartramia longicauda*) detectability in rural Peterborough and Kawartha Lakes, Ontario. Our objectives were to examine variation in detectability between surveys and among points, validate survey protocols, determine the effectiveness of call playback for enhancing detectability, and determine if landscape level habitat features could predict detectability of Upland Sandpipers in Southern Ontario. Initial point counts were conducted in 2014 at occupied point counts identified during the 2001-2005 Ontario Breeding Bird Atlas and suitable habitat. Upland Sandpipers were detected at 31 of 133 (23.3%) sites surveyed. In 2015, we chose a subset of sites occupied in 2014 to re-survey using a protocol from Wildlife Preservation Canada's Eastern Loggerhead Shrike Adopt-A-Site population monitoring program. Detectability was low, with six surveys of at least 18 minutes each needed to ensure detection during the breeding season. Detection was highest in mid-June. The Wildlife Preservation Canada protocol detects Upland Sandpiper most efficiently during the second round of point counts when birds are most vocal. Playbacks did elicit some minor response, indicating that they could potentially play a role in detecting Upland Sandpipers when they persist at low relative abundance. The proportion of open habitat did not affect detection on the landscape.

Introduction

The ability to detect birds by both sight and sound can vary greatly among species. Abundance, physical features such as colouration, size, activity level, and the frequency, length and volume of vocalizations, can all play a role in detectability. For example, the large, all black, conspicuous American Crow (*Corvus brachyrhynchos*) is easily identified by sight and their recognizable "caw-caw" vocalizations, and is, by far, more recognizable and easier to detect by human observers than the small and cryptic Grasshopper Sparrow (*Ammodramus savannarum*), with its faint ticks and insect-like buzzing. Therefore, it is important to select appropriate methods for enhancing survey detectability to ensure accuracy in detecting target species during point count surveys.

For breeding species, home range size impacts the density of individuals on the landscape. Given similar body size and audibility of territorial calls, common species with small ranges should be more likely to be detected than less common species with large home range sizes, as the former will be encountered more frequently on the landscape. An inverse relationship between home range size and density could lead to issues when attempting to detect less common species with large home ranges.

The Upland Sandpiper is sparsely distributed across southern Ontario (McIlwrick 2007). Detectability can be an issue, as this species occurs at low density. Individuals of this species in Kansas prairies have home ranges between 0.8 – 33.7 km^2 with a mean of 8.42 km^2 (Sandercock *et al.* 2015). Additionally,

Upland Sandpiper have very cryptic plumage and hence, are often inconspicuous in a grassland landscape when not vocal, displaying or perching in the open. Thus, on many surveys, Upland Sandpiper detections might be limited and the resulting density estimates biased low. Male Upland Sandpipers are quite vocal during flight displays, at heights up to 100 m (Houston *et al.* 2011), giving long mellow whistles at 2 to 3 minute intervals, with displays lasting up to 15 minutes (Ailes 1976). However, if Upland Sandpipers are not displaying, the frequency of other calls, such as tattler alarm calls, is low. Thus, the frequency of Upland Sandpiper vocalizations could also be a factor in the rate of detection on the landscape.

The Upland Sandpiper occupies similar habitat to the Loggerhead Shrike (*Lanius ludovicianus*) in southern Ontario, selecting areas with open vegetation such as pastures and grasslands with available perches (Yosef 1996). The Loggerhead Shrike is critically endangered in Canada (COSEWIC 2014) and Ontario (OMNRF 2016), leading to intensive efforts by both government and non-government organizations to promote its conservation. One non-government organization, Wildlife Preservation Canada, has been organizing volunteer- and staff-run surveys of Loggerhead Shrike annually since 2003. In the process, volunteers and staff have also been recording the presence of other grassland bird species including the Upland Sandpiper. According to the Wildlife Preservation Canada protocol, grassland patches should be surveyed for Loggerhead Shrike three times during the breeding season, once during each of three survey windows: 15-30 April, 15-31 May and 15-30 June and last 20 minutes per visit (Wheeler 2015). Volunteers also select best vantage points for roadside surveys to enhance detection of all species. These data are useful for helping to understand peak periods of detectability of the Upland Sandpiper and other grassland species that potentially share habitat with the Loggerhead Shrike.

The distinct vocalizations of Upland Sandpiper should enhance detectability during the season when birds are singing or calling. However, given the large territories of this species, detectability might be reduced due to the possibility of birds calling from a portion of the territory too distant from the observer to be heard. Additionally, low detectability may result from survey timing not matching temporally restricted periods for calling. Call broadcasts can be used during point counts to enhance detectability of target species, e.g., Rusty Blackbird (*Euphagus carolinus*) (Powell *et al.* 2014). Upland Sandpiper playbacks may similarly enhance detectability.

The objectives of this study were to (1) document variation in detectability both within the breeding season and within a point count station, (2) validate the use of Wildlife Preservation Canada's sampling protocol to detect Upland Sandpiper (3) determine whether Upland Sandpiper playbacks increase detection and (4) determine whether Upland Sandpipers are detected more frequently at sites with a higher proportion of open habitat in the landscape around the point count station.

Methods

Point count surveys were conducted in 2014 and 2015 in Peterborough County and the City of Kawartha Lakes, Ontario. The survey region consisted of a mix of agriculture, forests, shrub lands, grasslands, wetlands, alvar rock plateaus, urban development, and freshwater lakes, rivers and streams. Slight variation in elevation occurred on the landscape due to sparse numbers of small- to moderate-sized hills.

In 2014, CW conducted 10 minute unlimited radius point count surveys at 133 sites that were (a) known to have been occupied 9 to 13 years ago (2001-2005) during the most recent Ontario Breeding Bird Atlas (Cadman *et al.* 2007) (n=63) and (b) sites selected as possible suitable Upland Sandpiper habitat (n=70) based on subjective examination of the presence of open (non-treed) habitat using Google Earth™ images (Figure 1). Each survey began with five minutes of passive listening and visual scanning for birds followed by Upland Sandpiper call playbacks for a duration of one minute, followed by four more minutes of passive observation (total 10 min point count). Each site was visited three times between 11 May and 31 July for a total of 399 point count surveys. Roadside surveys began after 06:00 hrs (EST) and were concluded prior to 10:00 hrs (EST). Surveys were postponed when rainy and windy conditions occurred. Detection data from 2014 surveys were not separated by detections occurring during periods with or without playback.

Using these initial 2014 surveys, we selected a subset of sites (n=20) where Upland Sandpiper were detected to explicitly test how many surveys and what duration of observation was necessary to detect Upland Sandpiper, given the assumption that these 2014 sites would again be occupied in 2015. DC conducted unlimited-radius roadside point counts between 27 April and 29 July 2015 (Figure 2). These 20 sites were surveyed eight times, on a bi-weekly basis, except between the first and second visits. The initial two visits to sites were sampled with a one week interval due to early season weather conditions and to determine if birds arrived on the landscape during the first Wildlife Preservation Canada Adopt-A-Site survey window, 15-30 April 2015. Counts took place between sunrise and 10:00 hrs (EST) on days that lacked rain, fog, strong winds (> 30km/hr) and high temperatures (> 30°C) (Wheeler 2015). Sampling occurred over three successive days, plus an additional day if sampling was halted due to weather, to cover all 20 sites prior to the end time of 10:00. If at least one Upland Sandpiper was detected, either visually or by vocalizations over the duration of the survey, it was recorded as a detection (i.e., multiple Upland Sandpipers at one site were considered a single detection).

In 2015, point count surveys were conducted for a total duration of 18 minutes. During the first five minutes of the survey, the observer stayed in one location. Between minute 5 and 15, the observer moved about the roadside, not exceeding 50 m from the point count centroid, while remaining parallel to the

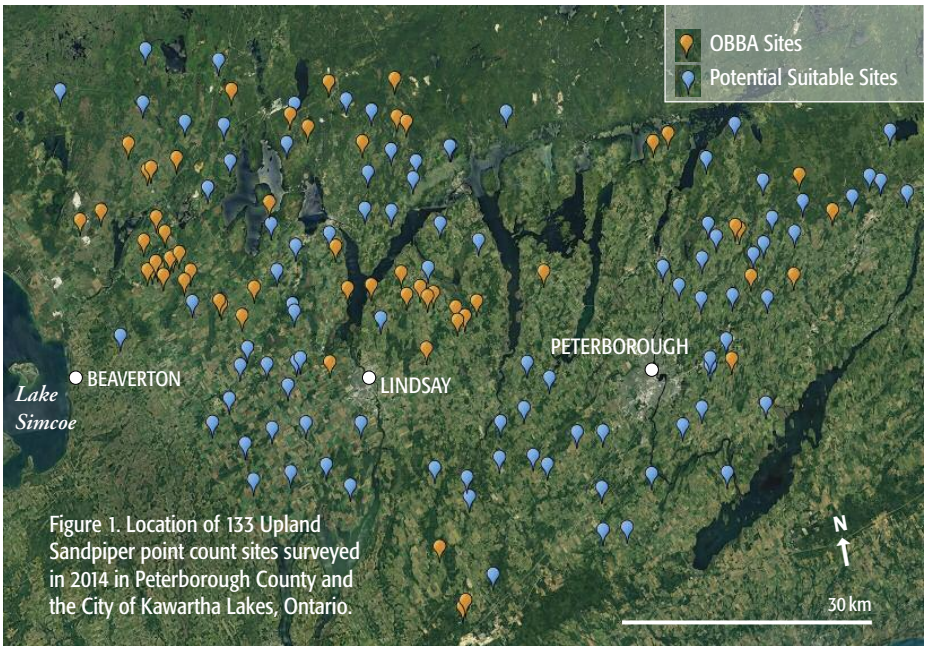


Figure 1. Location of 133 Upland Sandpiper point count sites surveyed in 2014 in Peterborough County and the City of Kawartha Lakes, Ontario.

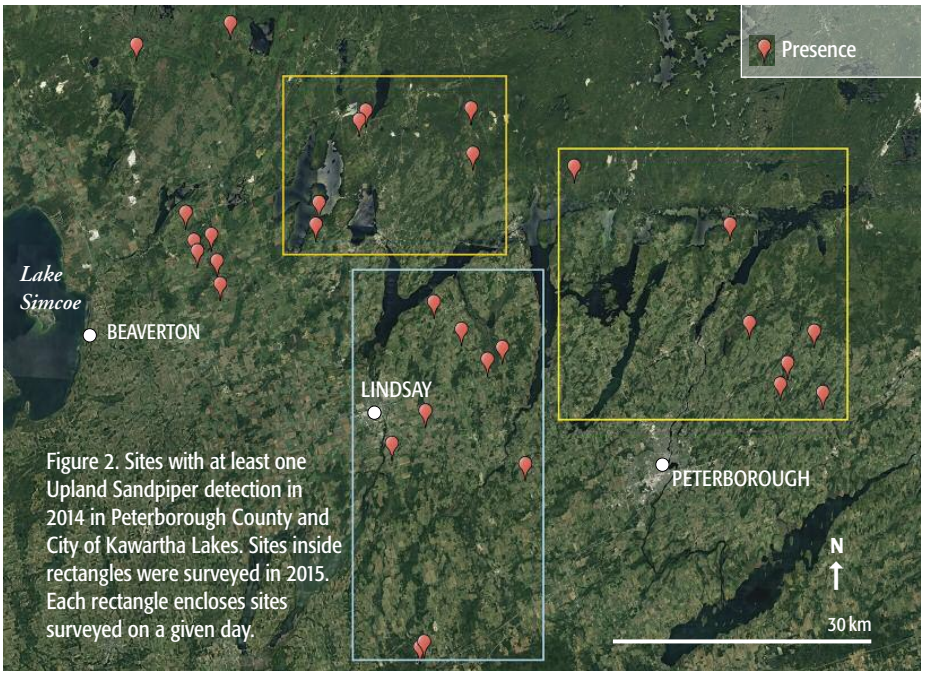
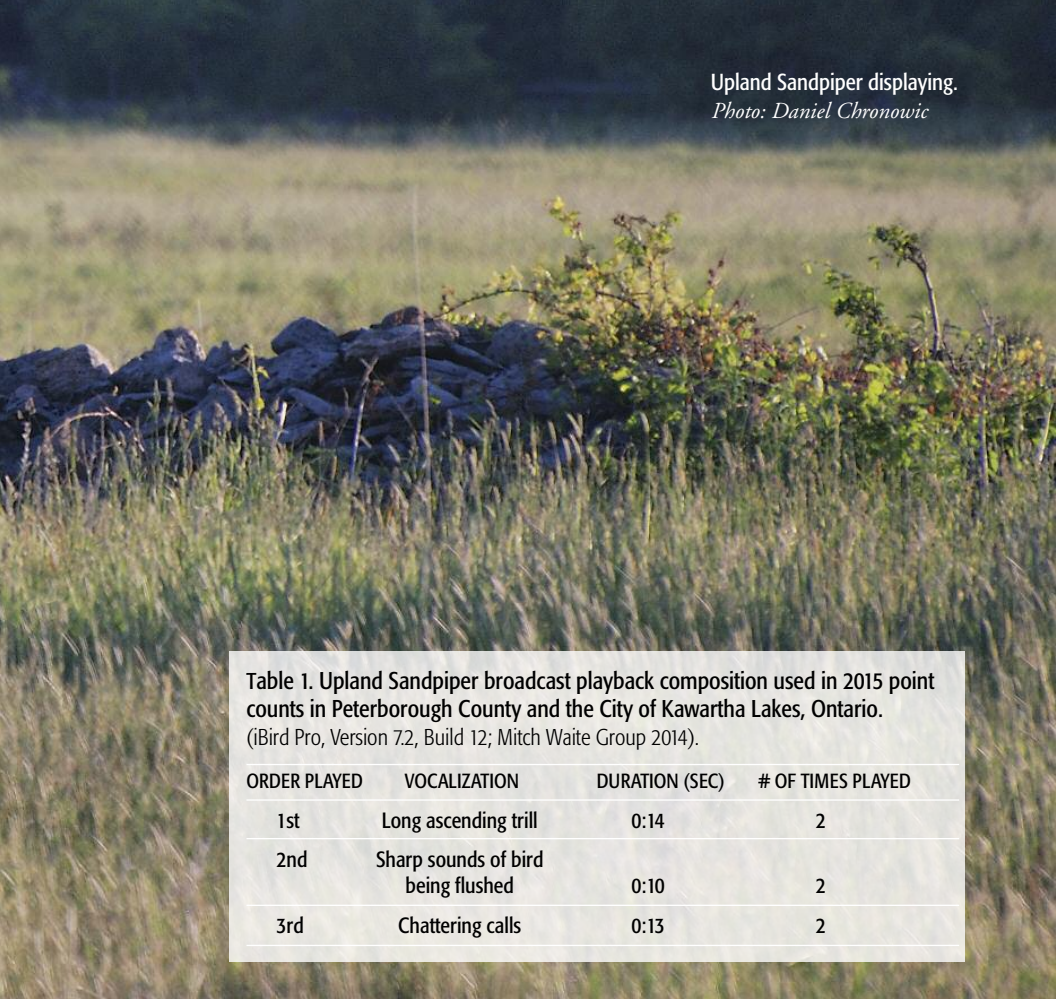


Figure 2. Sites with at least one Upland Sandpiper detection in 2014 in Peterborough County and City of Kawartha Lakes. Sites inside rectangles were surveyed in 2015. Each rectangle encloses sites surveyed on a given day.

road, to modify and expand the vantage points for both visual and auditory detections. These movements occurred as part of the protocol because Wildlife Preservation Canada surveys did not use specific UTMs for surveys, thus leaving roadside vantage points to the discretion of the observer (Wheeler 2015). Visibility was, therefore, site and observer specific.

Call playbacks were used in an attempt to enhance detection. Upland Sandpiper vocalizations were obtained from iBird Pro, Version 7.2, Build 12 (Mitch Waite Group 2014). Playbacks included three types of vocalizations (Table 1). Broadcast playback began at the beginning of minute 15 of the survey, using an iPhone 4s connected with a 3.5 mm stereo audio cable to a Sony – SRS-X2 Personal Audio System. The total duration of Upland Sandpiper vocalizations was one minute and fourteen seconds. Sequence of playbacks was arbitrary with song first, followed by associated calls, as listed in iBird Pro. The playback was, followed by a period of passive observation (2 min: 46 sec), at the original point count location.



Upland Sandpiper displaying.
Photo: Daniel Chronowic

Table 1. Upland Sandpiper broadcast playback composition used in 2015 point counts in Peterborough County and the City of Kawartha Lakes, Ontario.
(iBird Pro, Version 7.2, Build 12; Mitch Waite Group 2014).

ORDER PLAYED	VOCALIZATION	DURATION (SEC)	# OF TIMES PLAYED
1st	Long ascending trill	0:14	2
2nd	Sharp sounds of bird being flushed	0:10	2
3rd	Chattering calls	0:13	2

The audibility of each of the three vocalizations was tested by an observer standing at varying distances from the speaker in a flat, open agricultural landscape while an assistant held the playback setup and repeated each vocalization. All broadcast vocalizations were clearly audible by DC at 100 m and 250 m. Vocalization playbacks started to become unclear at a distance of 403 m. Broadcasts were not audible at a distance of 500 m. As a result of these distances, we established that buffers for habitat-related analyses would have a radius of 500 m.

Annual Crop Inventory (ACI) data (Government of Canada 2017) from 2015 were used to obtain landscape-level habitat features. Circular buffers with a radius of 500 m, covering an area of 0.7854 km^2, were drawn around the centroid of each of the 20 sites using ArcGIS (ESRI 2011). Buffers did not overlap. Agricultural landscape data were extracted around each of the sites using RStudio (Rstudio Team 2015) and the raster package in r (Hijmans *et al.* 2019). Of the 67 crop classifications within the Annual Crop Inventory dataset, 14 landcover types were

extracted as raw data (water, exposed/barren, urban/developed, shrubland, wetland, grassland, pasture, coniferous, mixed wood, soybeans, broadleaf, fallow, wheat, corn). The total proportion of grassland, pasture, wheat, fallow, exposed/barren and water were combined to create a single variable: proportions of open habitat.

Beta regression, with a logit link, was used to assess the relationship between proportional detectability, the proportion of detections per site and the proportion of open habitat on the landscape (Ferrari and Cribari-Neto 2004), using data from the 2015 survey season. Analyses were run using the betareg package in r (Zeileis *et al.* 2016) with $\alpha = 0.05$ set *a priori*.

Results

In 2014, we observed or heard at least one Upland Sandpiper at 31 of 133 sites (23.3%). Detections occurred during 54 of 399 point counts (13.5%) with 39 detections (20.6%) at Ontario Breeding Bird Atlas sites and 15 detections (7.1%) at CW's possible suitable sites. Upland Sandpiper abundance by site ranged from one to five birds (mean = 1.9).

In 2015, we saw or heard at least one Upland Sandpiper at 16 of 20 2014 sites (80%), over eight surveys per site. The abundance of Upland Sandpipers detected per survey ranged from one to three birds, with one bird detected during 31 surveys, two birds detected during eight surveys and three birds detected during six surveys (mean=1.4). The overall mean probability of detection was 28.1% (45 of 160 surveys). For the 16 sites with at least one detection during the eight survey visits, probability of detection was 35.2% (45 of 128 surveys). Detection of Upland Sandpiper was greater earlier during the 18 minute period and declined as time progressed (Figure 3). Of the initial detections at each site, 86.7% (39 of 45 birds) were detected in the first 15 minutes of the survey, prior to the use of playbacks and only six occurred either during the playback or the passive listening period (i.e., the final three minutes of the survey). Behavioural responses to playback were limited with 4.4% (two of 45) of surveys having birds appear to respond directly to playback by both vocalizing and approaching the source of playback. In an additional 11.1% of the surveys (five of 45), birds vocalized after playback, but did not approach the location of the call-broadcast. The six initial detections that occurred in the final three minutes of the survey occurred over six of the eight visits between 26 April and 9 July. The final three minutes of the point count surveys accounted for the only detections at 12.5% (two of 16) sites at which Upland Sandpipers were detected.

Of the 20 sites occupied in 2014, the cumulative proportion occupied in 2015 increased throughout the breeding season between the first visit (27 April) and sixth visit (30 June) (Figure 4). After the sixth visit, site occupancy plateaued with no detections at any of the four remaining unoccupied sites, suggesting that Upland Sandpipers were not present at these sites in 2015. There was a significant positive relationship between the cumulative proportion of sites occupied and the number of visits (Pseudo $R^2 = 0.8441$, $Z_{1,6} = 6.63$, $p < 0.001$).

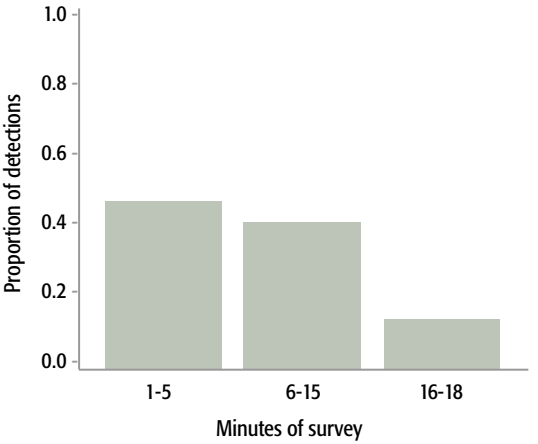


Figure 3. Temporal distribution of initial Upland Sandpiper detections (n=45) during point counts at 20 sites surveyed in Peterborough County and the City of Kawartha Lakes in 2015.

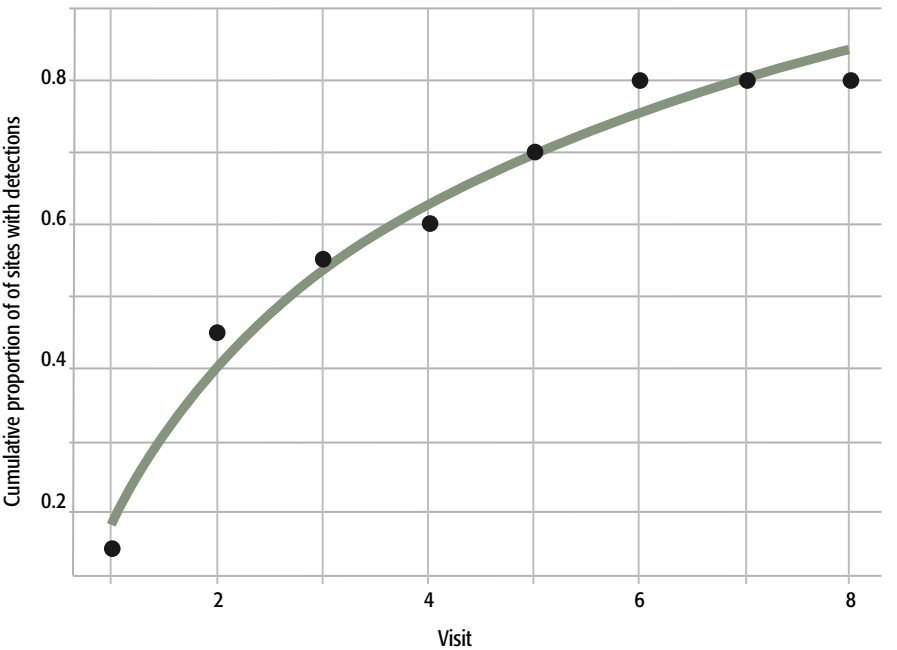


Figure 4. Cumulative proportion of point count sites in Peterborough County and the City of Kawartha Lakes (n=20) with Upland Sandpiper detections over eight visits between 27 April and 30 June 2015. (Pseudo $R^2 = 0.8441$, $Z_{1,6} = 6.63$, $p < 0.001$).

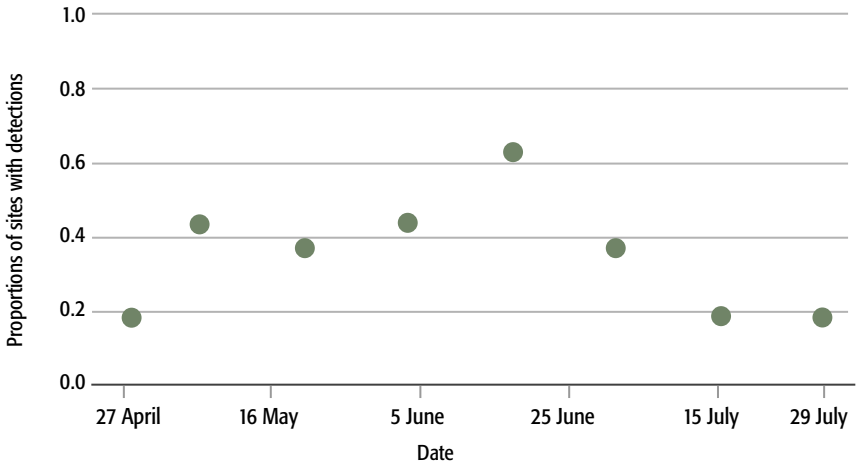


Figure 5. Proportion of 20 point count sites in Peterborough County and the City of Kawartha Lakes with Upland Sandpiper detections during each sampling period between 27 April and 30 June 2015. (Pseudo $R^2 = 0.06503$, $Z_{1,6} = -0.651$, $p = 0.515$).

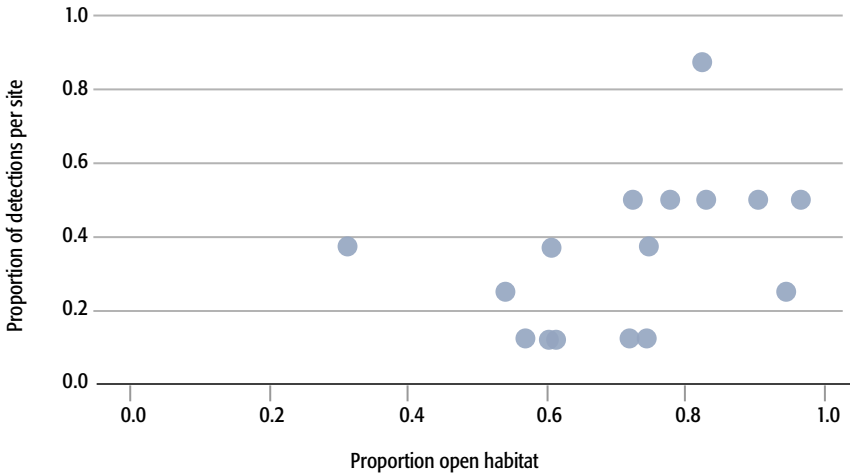


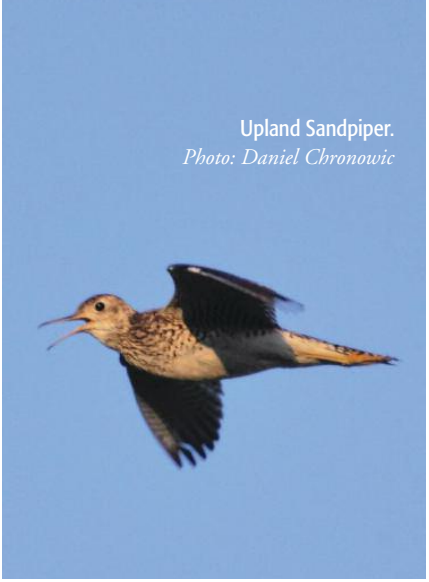
Figure 6. Relationship between proportion of detections and proportion of open habitat within a 500 m buffer around the point count centroid, at 16 occupied sites surveyed in Peterborough County and the City of Kawartha Lakes in 2015, based on eight visits per site. (Pseudo $R^2 = 0.1373$, $Z_{1,14} = 1.704$, $p = 0.0883$).

The proportion of Upland Sandpiper detections by week (Figure 5) did not vary as a function of visit (Pseudo R^2 = 0.06503, $Z_{1,6}$ = -0.651, p = 0.515). Peak detection corresponded with the fifth visit, or the middle of June. Detection was lowest in late April and at the end of the breeding season in July.

Upland Sandpiper detection was not higher in survey locations with more open habitat. Detections were marginally higher but did not significantly increase with an increase in the proportion of open habitat, as classified by the total proportion of grassland, pasture, wheat, fallow, expose/barren and water, within the 500 m buffer (Figure 6) (Pseudo R^2 = 0.1373, $Z_{1,14}$ = 1.704, p = 0.0883).

Discussion

We detected very few Upland Sandpipers across two Ontario municipalities where the species is known to persist in low densities. Additionally, while repeated occupation between years was high (80%), the probability of Upland Sandpiper detection in each survey was low in 2015 at sites that were known to be occupied in 2014. Multiple surveys were necessary to ensure detection: a minimum of six surveys, each with a duration of at least 18 minutes, was required to detect 86% of Upland Sandpiper present. Playbacks have the potential to enhance detection when Upland Sandpiper relative abundance is low on the landscape. Habitat with a greater degree of openness on the landscape had marginally but non-significantly, higher detection than sites that were less open.



Upland Sandpiper.
Photo: Daniel Chronowic

Detectability of Upland Sandpiper was greater earlier in the breeding season prior to hatching, and most likely in the laying period prior to incubation. While we did not find nests, Peck and James (1983) suggest that this species has eggs in nests between 12 May and 9 July, and thus the second visit, 4 May to 6 May, may have corresponded with territory establishment and pair formation. The earlier dates documented by Peck and James (1983) coincide with most eggs hatching prior to the end of June (incubation period of 23-24 days, Houston *et al.* 2011). Increased survey effort should occur at the beginning of the breeding season well prior to hatching, which could begin as early as the beginning of June (Peck and James 1983). After hatching, adults are harder to detect, as they become silent to avoid attracting predators to their flightless offspring. Upland Sandpiper detectability may also decrease during the breeding season as vegetation height increases on the landscape, reducing the number of visual detections. Detecting the true site occupancy increased

throughout the breeding season, as more visits occurred per site, and leveled off by the sixth visit in the beginning of July.

Detectability was low in late April when birds were arriving on the breeding grounds and in July when chicks had left nests. Upland Sandpiper activity, including vocalizations and displays, may reduce in vigour and persistence as birds form pairs and initiate laying; adults may not be seen or heard as frequently during incubation. The cumulative proportion of birds detected reached a plateau in week eight, or the sixth visit (Figure 4), which corresponds with the third survey window of volunteer point count sampling of Wildlife Preservation Canada. Therefore, if Upland Sandpiper are present they should be detected prior to the third survey window as long as there has been enough survey effort early on in the breeding season.

Fragmentation of the landscape in southern Ontario changes both habitat composition and configuration (Fahrig 2003). Upland Sandpiper occurrence is driven by composition rather than configuration of habitat variables on the landscape (Shahan *et al.* 2017). It may be easier to detect Upland Sandpipers when there is more open and flat habitat due to a greater likelihood of both audible and visual detections. There was a slightly greater proportion of detections on sites with a greater proportion of open habitat, although this relationship was not significant, which we believe was due to a sample size of only 16 sites. The degree of visibility and number of obstructions on the landscape, as created by habitat configuration and variation in elevation, could potentially limit Upland Sandpiper detections.

Six detections occurred during or after call playbacks, but whether these six detections were a result of the playbacks or of the extra three minutes of survey duration is unknown. Playbacks did elicit some minor response; two birds showed a direct response by approaching the source of playbacks, however, since these birds were initially detected at the site prior to the playbacks being played, the playbacks did not enhance survey detectability. The minor response may indicate that playbacks could potentially play a role in detecting Upland Sandpipers when they are sparsely distributed on the landscape. Bird species have varying responses to call broadcasts. The Black-capped Chickadee (*Poecile atricapillus*) is highly responsive to conspecific playbacks (Hurd 1996), yet not all bird species exhibit such a heightened response. Call playbacks did not aid in the detection of the secretive nesting Least Bittern (*Ixobrychus exilis*) (Tozer *et al.* 2007), however, other studies have shown that call-response broadcast surveys for Least Bittern did yield more detections than passive surveys (Cherukuri *et al.* 2018). With these studies indicating a contradicting effect of playbacks on the detection of Least Bittern, and with inconclusive results from our use of playback, we believe more research is needed on the effect of call playbacks on the Upland Sandpiper.

In southern Ontario, Upland Sandpiper population densities are low within suitable habitat, with few locations, other than the Carden Alvar, having a

relative abundance greater than one individual per 25 point counts (McIlwrick 2007). With a limited detectability and low relative abundance, availability for detection can affect survey results. Lituma *et al.* (2017) examined calling frequency of male Northern Bobwhites (*Colinus virginianus*) using radio-transmitters and found that males called more frequently in the presence of other males, increasing their availability for detection. Future studies could consider tracking individual Upland Sandpipers to account for how availability for detection influences detectability when birds are known to be present prior to each survey.

Our second objective was to determine whether methods used by Wildlife Preservation Canada were sufficient to detect Upland Sandpiper. The second Wildlife Preservation Canada survey period coincides with peak breeding activity of Upland Sandpiper when they are most vocal. They become more secretive, both in their movements and vocalizations, once eggs have hatched, presumably to reduce exposing offspring to potential predators. Perhaps with access to the centre of grassland patches at the Wildlife Preservation Canada survey sites, methods can be used after hatching to increase detectability. Walking transects could also be used to enhance detection once Upland Sandpipers have become more secretive late in the breeding season.

These results suggest that careful consideration be put into survey methods that would ensure the greatest likelihood of detection. With accurate estimates of populations necessary to derive informed conservation initiatives and management practices, such fine tuning of methods is vital. Managers should carefully consider the biology and life history strategies of their focal species when developing sampling methods and identify the implication for data analyses prior to data collection.

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