Appendix 1. Estimating the effective detection radius for autonomous recording units under noisy conditions

Playback methods

To estimate how far we could hear owls on autonomous recording units (ARUs) in noisy areas compared to quiet areas, we broadcast owl calls from a speaker at different distances from the ARU along 5 control transects and 5 noisy transects between November 25 and December 5, 2014. Control transects were located in forested areas unaffected by road or traffic noise. Noisy transects extended away from a compressor station. Using the same methods and equipment as Yip et al. (2017), we broadcast recorded owl calls using an Alpine digital CD Receiver (CDE-122) connected to an Alpine 6.5-inch speaker and tweeter set (SPR-60) contained within a wooden box (25x29x38cm). The speaker was attached to a tripod at a height of 1.5 metres, a height similar to other avian playback studies (Koloff and Mennill, 2013; Sandoval et al., 2015). The speaker faced the ARU and broadcast calls at 30 standardized distances ranging from 12 to 1,312 meters measured using a handheld GPS unit (GARMIN GPSmap 78, accuracy ± 3m). For both noisy and quiet transects, a single ARU (an SM2+ Song Meter by Wildlife Acoustics, Inc., Maynard, Massachusetts, USA) was attached at a height of approximately 1.5m on trees with a smaller diameter than the width of the ARU (18 cm). The ARU was set to record continuously in stereo format at 44.1 kHz with a 16-bit resolution. The ARU remained stationary and the speaker was moved to each distance interval to simulate an owl calling from increasing distances from the ARU. For noisy transects the ARU was positioned approximately 100m from a compressor station.

Owl calls were broadcast in the following order: Northern Saw-whet Owl (*Aegolius acadicus*), Boreal Owl (*Aegolius funereus*), Great Gray Owl (*Strix nebulosa*), Long-eared Owl (*Asio otus*), and Barred Owl (*Strix varia*). We used a two second interval between calls to avoid signal overlap. This sequence was broadcast at a sound pressure level of 90dB (re 20 µPa) which we normalized using Adobe Audition CS6 (Adobe Systems Inc., San Jose, California, USA) and calibrated using a handheld sound level meter (Sper Scientific 840018) by measuring a 1000Hz pure tone one meter from the speaker (based on fast-time A-weighting). We used Adobe Audition CS6 to generate the 1000Hz pure tone. Although we broadcast owl calls at 90dB, we do not know how closely this reflects the real sound level of owl calls. This information is difficult to obtain and there is little published on this for any avian species, thus we acknowledge that this method can only determine relative differences in detection distances between noisy and quiet areas.

Sound Processing

Recorded playbacks were extracted from recordings using Adobe Audition CS6. Owl calls from each sequence were clipped into individual sound files (n = 1070) using an automated script and the 'textgrid' function in Praat V5.4.06 (Boersma and Weenink, 2015). These clips were randomized and joined together in sets of 10 sounds with 2 second spacing to create a single sequence of randomized sounds using an automated batch script. These sequences were given to 2 trained observers who identified sounds by listening to the recordings at standardized volume levels and from visually scanning spectrograms in Adobe Audition CS6 (window type: Blackman-Harris; window length: 2048). Volume levels were selected to maximize amplitude and detections while avoiding any risk of hearing damage. Fifteen percent of sounds were blank ambient background sound consisting of low levels of wind and vegetation noise normally present in recordings to control for false positive identifications. Randomization of sounds removed an observer's ability to predict which sounds would occur in what order although observers were aware of all possible species that could be presented.

We used a half-normal detection function to calculate Effective Detection Radius (EDR) using the same approach as Yip et al. (2017). EDR is the parameter, τ, in the half-normal detection function: $p(d) = \exp(-d^2/\tau^2)$. EDR is defined as the distance at which number of individual birds detected outside τ is equal to the number of missed individuals within τ. We ran generalized linear models (GLMs) with a fixed intercept at 0, complimentary log-log link function, and binomial distribution. Interaction with distance was included in models for all parameters of interest but main effects were excluded to accommodate a fixed intercept. This allowed us to calculate EDR using a linear modelling framework. We transformed distance to $x = -d^2$ before modelling so that distance was a linear predictor. We estimated EDR for all species (Table A1.1) by summing the beta coefficients of variables related to distance in our best models (β). We calculated EDR using: $\tau = (1/\beta)^{0.5}$.

Table A1.1. Estimated effective detection radius (EDR), lower and upper 90% confidence intervals (CI) and the estimated area sampled by an autonomous recording unit (ARU) for the territorial calls of five species of owls in loud and quiet conditions.

Species	Conditions	EDR (m)	Lower 90% CI	Upper 90% CI	Area sampled (ha)
Barred Owl	Loud	221.54	185.49	261.38	15.42
	Quiet	491.68	391.57	609.35	75.95
Boreal Owl	Loud	179.81	146.51	211.75	10.16
	Quiet	468.64	375.90	576.41	69.00
Great Gray Owl	Loud	203.61	167.79	239.40	13.02
	Quiet	675.69	517.15	936.22	143.43
Long-eared Owl	Loud	189.95	158.62	219.33	11.34
	Quiet	390.83	313.52	473.48	47.99
Northern Saw-whet Owl	Loud	277.22	232.39	338.04	24.14
	Quiet	442.88	346.39	543.15	61.62

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