

Appendix 1.

Table A1.1 Estimated effective detection radius (EDR) and parameter estimates from count removal models including both the human observer and autonomous recording unit (ARU) data with survey type included as a fixed effect factor (ARU (1) versus human as the reference category (0)) to test for a difference in species availability for 41 species (see Methods). Bold denotes parameter estimates for which 95% confidence intervals suggest the probability of an individual singing (and being detected) at least once during the cumulative duration of the count differed between human observer (p_H) and transcription from ARU (p_A).

Species	Latin Name	Sample size			Intercept		Survey Effect	
		Human	ARU	EDR (m)	β	SE	β	SE
Ruffed Grouse	<i>Bonasa umbellus</i>	43	87	95	-1.73	0.34	0.84	0.37
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	65	54	68	-2.10	0.36	-0.03	0.56
Hairy Woodpecker	<i>Picoides villosus</i>	18	16	53	-1.02	0.27	0.02	0.43
Northern Flicker	<i>Colaptes auratus</i>	39	24	128	-15.50	NA	12.95	NA
Pileated Woodpecker	<i>Dryocopus pileatus</i>	47	55	167	-1.71	0.31	0.21	0.39
Alder Flycatcher	<i>Empidonax alnorum</i>	69	64	102	-1.12	0.13	-0.22	0.22
Least Flycatcher	<i>Empidonax minimus</i>	18	19	46	-0.95	0.22	-0.10	0.32
Philadelphia Vireo	<i>Vireo philadelphicus</i>	24	30	53	-1.54	0.35	0.53	0.43
Red-eyed Vireo	<i>Vireo olivaceus</i>	229	217	81	-1.00	0.07	0.30	0.09
Black-capped Chickadee	<i>Poecile atricapillus</i>	33	31	56	-1.62	0.30	-0.16	0.48
Red-breasted Nuthatch	<i>Sitta canadensis</i>	65	56	88	-2.12	0.38	-0.31	0.67
Brown Creeper	<i>Certhia americana</i>	47	63	42	-1.28	0.21	-0.14	0.30
Winter Wren	<i>Troglodytes hiemalis</i>	111	100	101	-0.89	0.11	0.09	0.16
Ruby-crowned Kinglet	<i>Regulus calendula</i>	98	77	86	-1.21	0.12	0.18	0.18
Swainson's Thrush	<i>Catharus ustulatus</i>	135	136	91	-1.23	0.11	0.20	0.14
Hermit Thrush	<i>Catharus guttatus</i>	163	145	139	-1.29	0.10	0.03	0.15
American Robin	<i>Turdus migratorius</i>	64	52	92	-1.94	0.30	0.68	0.36
Cedar Waxwing	<i>Bombycilla cedrorum</i>	42	49	34	-2.51	0.57	-0.08	0.83
Ovenbird	<i>Seiurus aurocapilla</i>	203	201	77	-0.91	0.06	0.14	0.08
Tennessee Warbler [†]	<i>Oreothlypis peregrina</i>	200	192	63	-1.08	0.07	0.25	0.10
Orange-crowned Warbler	<i>Oreothlypis celata</i>	43	35	59	-2.07	0.43	0.18	0.58
Nashville Warbler	<i>Oreothlypis ruficapilla</i>	33	41	46	-1.55	0.30	0.16	0.39
Connecticut Warbler	<i>Oporornis agilis</i>	24	25	74	-1.28	0.25	0.48	0.34
Mourning Warbler	<i>Geothlypis philadelphia</i>	73	76	64	-1.31	0.16	0.15	0.22
Common Yellowthroat	<i>Geothlypis trichas</i>	19	19	62	-0.91	0.27	-0.24	0.41
American Redstart	<i>Setophaga ruticilla</i>	40	42	51	-0.66	0.14	-0.05	0.19
Cape May Warbler	<i>Setophaga tigrina</i>	22	27	37	-1.31	0.32	0.40	0.40
Magnolia Warbler	<i>Setophaga magnolia</i>	122	122	54	-1.24	0.11	0.21	0.16
Bay-breasted Warbler	<i>Setophaga castanea</i>	62	59	39	-1.60	0.22	0.25	0.30
Blackburnian Warbler	<i>Setophaga fusca</i>	40	39	41	-0.93	0.19	-0.60	0.34

Chestnut-sided Warbler	<i>Setophaga pensylvanica</i>	51	47	55	-1.13	0.15	0.43	0.20
Palm Warbler	<i>Setophaga palmarum</i>	34	37	65	-1.51	0.26	0.19	0.34
Yellow-rumped Warbler	<i>Setophaga coronata</i>	134	115	64	-1.72	0.16	0.35	0.21
Canada Warbler	<i>Cardellina canadensis</i>	20	22	61	-0.82	0.24	0.49	0.34
Chipping Sparrow	<i>Spizella passerina</i>	160	151	73	-2.10	0.21	0.66	0.24
Clay-colored Sparrow	<i>Spizella pallida</i>	20	15	70	-1.25	0.29	-0.31	0.55
Fox Sparrow	<i>Passerella iliaca</i>	17	19	131	-1.59	0.44	-0.04	0.60
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	26	28	69	-0.82	0.23	-0.22	0.34
White-throated Sparrow	<i>Zonotrichia albicollis</i>	260	259	99	-1.15	0.06	0.08	0.08
Dark-eyed Junco	<i>Junco hyemalis</i>	76	65	70	-1.89	0.23	0.54	0.29
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	33	39	85	-0.87	0.21	-0.40	0.32

Table A1.2 Estimated scaling constants (δ and both lower (LCL) and upper (UCL) 95% confidence intervals) relating counts from autonomous recording units (ARUs) to those by human observers for 35 species and calculated as $\sqrt{\exp(\beta)}$ from generalized linear mixed effects regression models (see Methods). Presented are maximum likelihood (MLE) estimates of δ and 95% CIs estimated as the median and the 2.5 and 97.5% quantiles from 10,000 Monte Carlo simulations drawn from a multivariate normal distribution treating the model coefficients (including the survey effect β) as the mean and the estimated variance-covariance matrix. Also presented are calibration δ and empirical ratios (dividing the mean ARU count by the mean human observer count) derived from 50 repeated random (70% versus 30%) sub-samples of the data (see Methods).

Species	MLE estimates			Repeated Random Sampling					
	LCL	δ	UCL	Calibration			Empirical Ratio		
	LCL	δ	UCL	LCL	δ	UCL	LCL	δ	UCL
Yellow-bellied Sapsucker	0.71	0.86	1.03	0.80	0.87	0.94	0.66	0.85	1.20
Hairy Woodpecker	0.62	0.84	1.14	0.71	0.84	0.99	0.41	1.03	2.12
Pileated Woodpecker	0.84	1.03	1.26	1.00	1.06	1.11	0.96	1.08	1.23
Alder Flycatcher	0.76	0.90	1.06	0.81	0.86	0.92	0.64	0.93	1.38
Least Flycatcher	0.73	0.93	1.18	0.90	0.95	1.03	0.81	0.97	1.24
Philadelphia Vireo	0.77	1.00	1.31	0.86	1.00	1.16	0.73	0.97	1.22
Black-capped Chickadee	0.70	0.88	1.11	0.83	0.91	0.97	0.66	0.92	1.35
Red-breasted Nuthatch	0.74	0.90	1.08	0.89	0.93	0.99	0.82	0.91	1.16
Brown Creeper	0.83	1.01	1.23	0.97	1.05	1.14	0.91	1.11	1.37
Winter Wren	0.78	0.91	1.05	0.88	0.92	0.94	0.81	0.91	1.18
Ruby-crowned Kinglet	0.76	0.87	1.00	0.83	0.86	0.90	0.68	0.80	1.11
Swainson's Thrush	0.91	1.01	1.12	0.96	0.99	1.03	0.91	1.00	1.18
Hermit Thrush	0.84	0.93	1.02	0.88	0.91	0.94	0.82	0.91	1.05
American Robin	0.68	0.82	0.98	0.77	0.82	0.88	0.62	0.83	1.21
Cedar Waxwing	0.85	1.02	1.23	0.94	1.00	1.07	0.90	1.04	1.25
Ovenbird	0.86	0.92	0.99	0.91	0.93	0.95	0.84	0.90	1.03
Orange-crowned Warbler	0.75	0.95	1.20	0.94	1.10	1.21	0.70	1.10	1.49
Nashville Warbler	0.87	1.10	1.39	1.00	1.11	1.21	0.70	1.10	1.49
Connecticut Warbler	0.69	0.88	1.13	0.76	0.85	0.91	0.57	0.73	0.83
Mourning Warbler	0.86	1.01	1.18	0.90	0.98	1.06	0.80	0.99	1.29
Common Yellowthroat	0.74	1.00	1.34	0.87	0.95	1.05	0.76	1.14	2.17
American Redstart	0.92	1.09	1.30	0.98	1.04	1.11	0.79	1.03	1.24
Cape May Warbler	0.80	1.06	1.42	0.97	1.07	1.17	0.76	1.09	1.43
Magnolia Warbler	0.82	0.93	1.05	0.92	0.95	0.98	0.85	0.96	1.12
Bay-breasted Warbler	0.77	0.92	1.09	0.90	0.94	0.99	0.80	0.95	1.18
Blackburnian Warbler	0.80	1.00	1.25	0.85	0.94	1.02	0.74	0.95	1.27
Palm Warbler	0.87	1.11	1.42	0.97	1.10	1.23	0.70	1.09	1.55
Yellow-rumped Warbler	0.79	0.89	1.00	0.84	0.89	0.94	0.77	0.89	1.10
Canada Warbler	0.73	1.00	1.36	0.94	1.00	1.07	0.90	1.05	1.27
Clay-colored Sparrow	0.55	0.77	1.09	0.65	0.78	0.86	0.71	0.75	0.81
Fox Sparrow	0.84	1.12	1.49	1.01	1.09	1.19	0.87	1.13	1.44
Lincoln's Sparrow	0.81	1.12	1.55	0.86	0.99	1.19	0.79	1.15	1.85
White-throated Sparrow	0.91	0.97	1.03	0.96	0.98	1.00	0.92	0.97	1.08

Dark-eyed Junco	0.71	0.84	0.98	0.77	0.85	0.94	0.62	0.87	1.29
Rose-breasted Grosbeak	0.86	1.10	1.39	0.97	1.06	1.13	0.86	1.05	1.25
