Supplementary Materials

1. Calibration plot method population estimates using different survey radii

	4 m radius		3.5 m radius		3 m radius		2 m radius	
	Population estimate	CI	Population estimate	CI	Population estimate	CI	Population estimate	CI
DUN B+C	5,805 (3,388–14,028)	183%	6,675 (3,974–14,203)	153%	7,948 (4,748–17,311)	158%	15,394 (6,857–76,350)	451%
DUN D	3,017 (1,306–8,022)	222%	3,777 (1,688–8,891)	191%	5,098 (2,261–12,494)	201%	9,665 (3,376–47,898)	460%

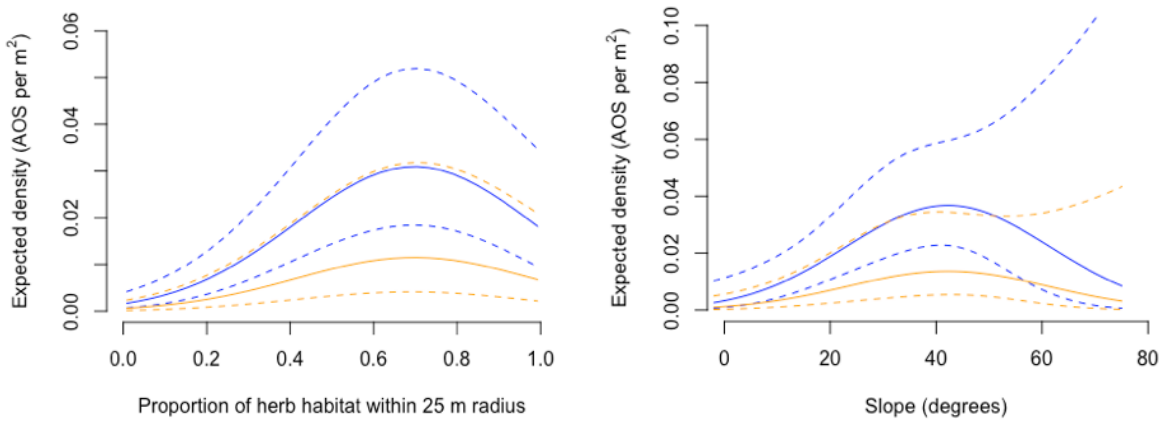
2. Covariate graphs for hierarchical distance sampling models

Covariate effects graphs for top-performing hierarchical distance sampling models. Dashed lines represent 95% confidence intervals.

DÙN

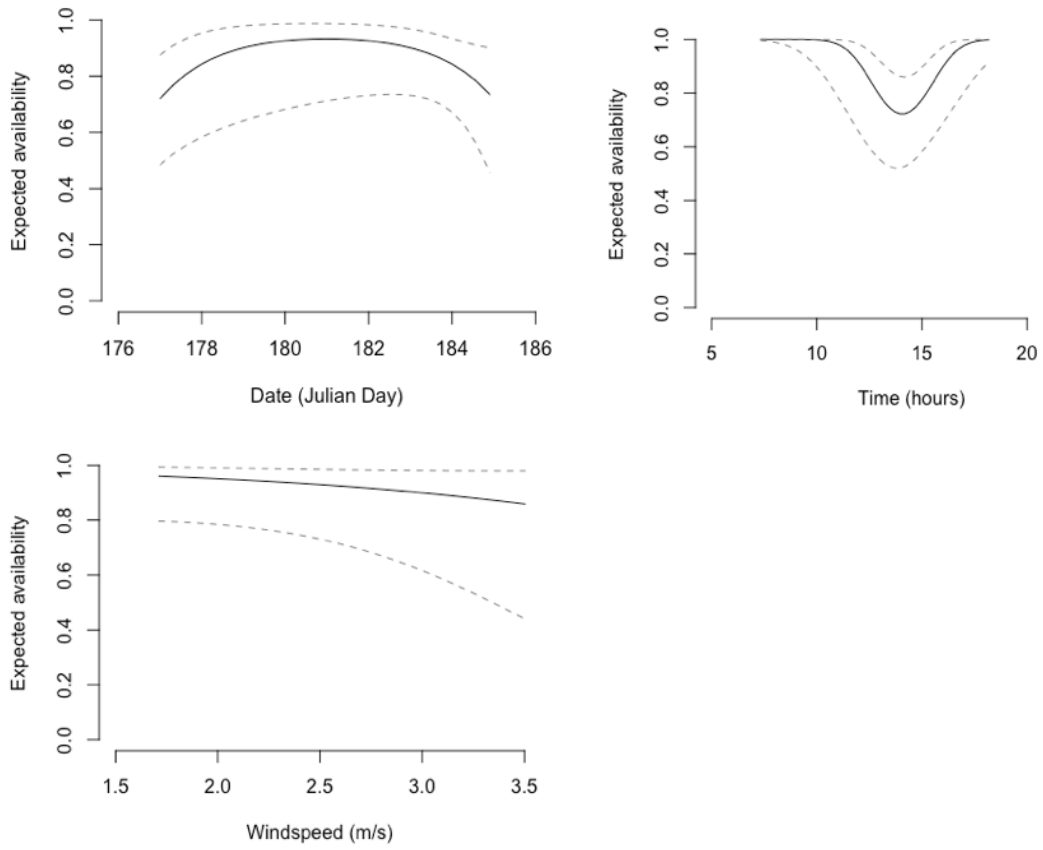
Abundance covariates

Blue lines represent the non-Puffin area (sectors B & C); orange lines represent the Puffin area (sector D).



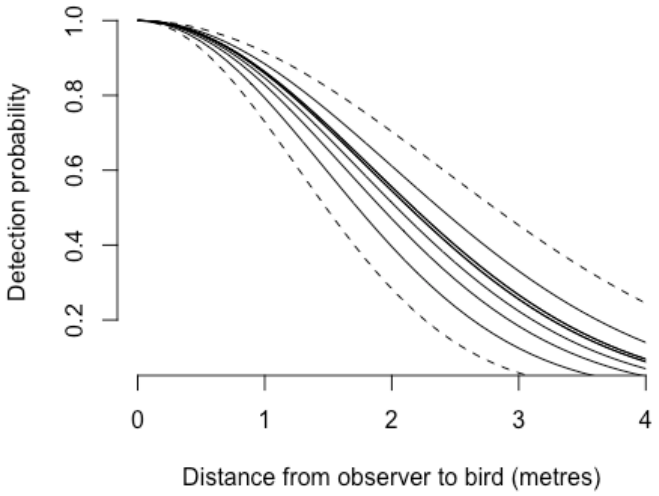
Availability covariates

Note that because response rate likely varies with distance from the observer, availability should not be treated as response rate directly. Availability and detection probability are not completely disentangled in this scenario. (See Supplementary Materials 3)



Detection function

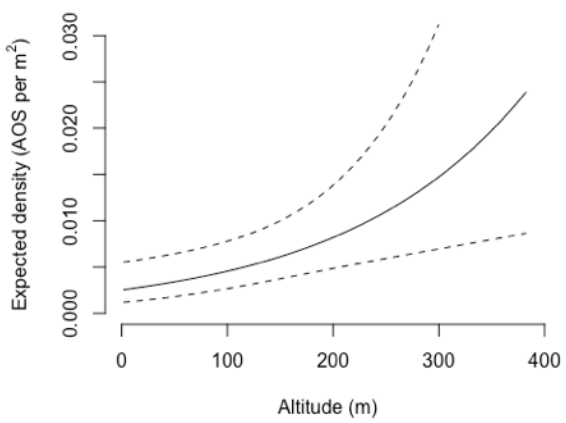
Each solid line represents the detection function for a different observer. The dashed lines show the limits of the confidence intervals for all observers. Note that availability and detection probability are not completely disentangled in this scenario.

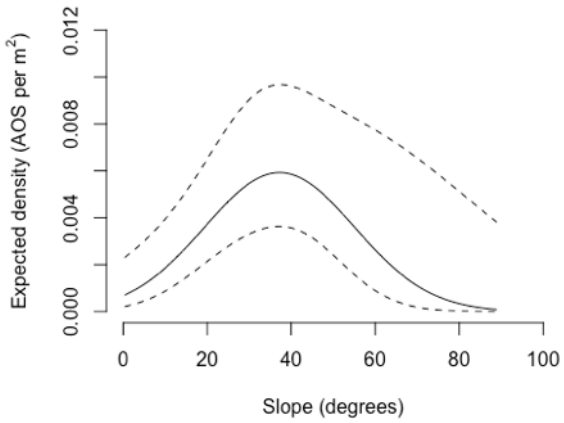


ALL ST KILDA

Abundance covariates

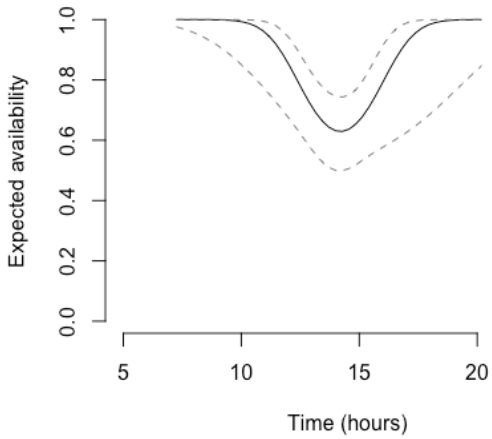
There was also an effect of 'combined sector' on abundance. Abundance covariates are plotted for combined sector BOR1-2.





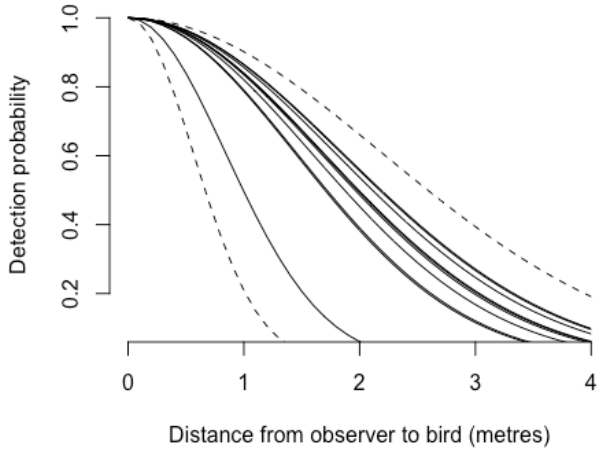
Availability covariates

Note that because response rate likely varies with distance from the observer, availability should not be treated as response rate directly. Availability and detection probability are not completely disentangled in this scenario. (See Supplementary Materials 3)



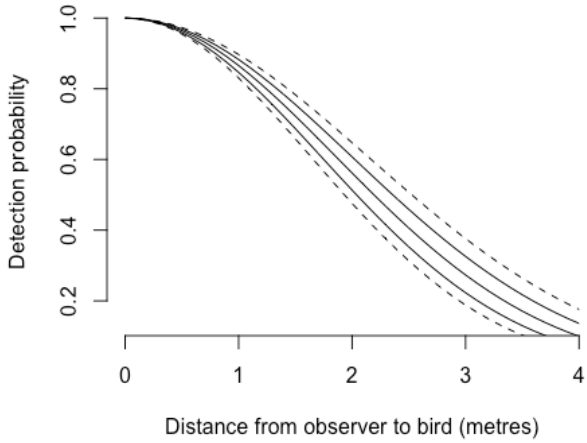
Detection probability

Each solid line represents the detection function for a different observer. The dashed lines show the limits of the confidence intervals for all observers. Note that availability and detection probability are not completely disentangled in this scenario.



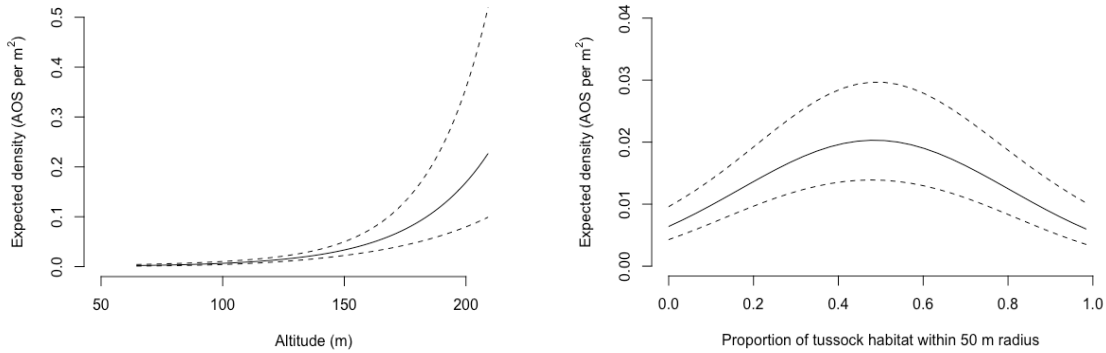
Windspeed

The top solid line represents the detection function at a windspeed of 2 m/s, the middle line a windspeed of 3 m/s and the bottom line a windspeed of 4 m/s. The dashed lines show the extremes of the confidence levels for all three windspeeds (i.e. the upper confidence limit for a windspeed of 2 m/s and the lower confidence limit for a windspeed of 4 m/s).



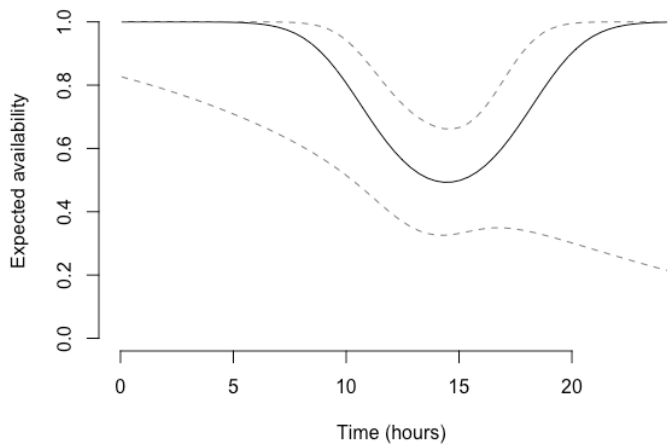
ELLIÐAEY

Abundance



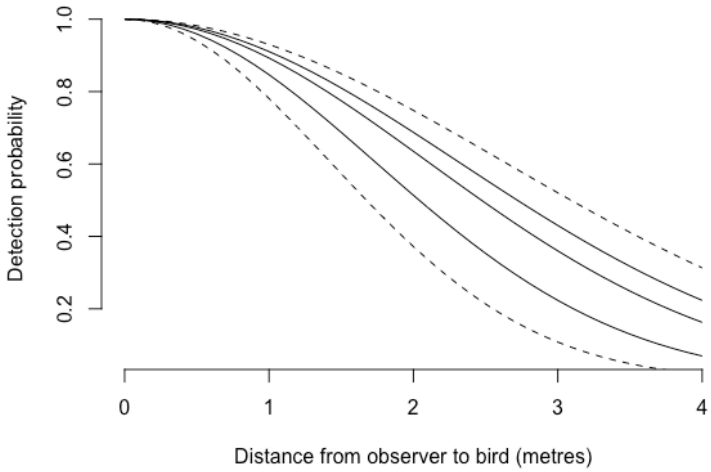
Availability

Note that because response rate likely varies with distance from the observer, availability should not be treated as response rate directly. Availability and detection probability are not completely disentangled in this scenario. (See Supplementary Materials 3)



Detection probability

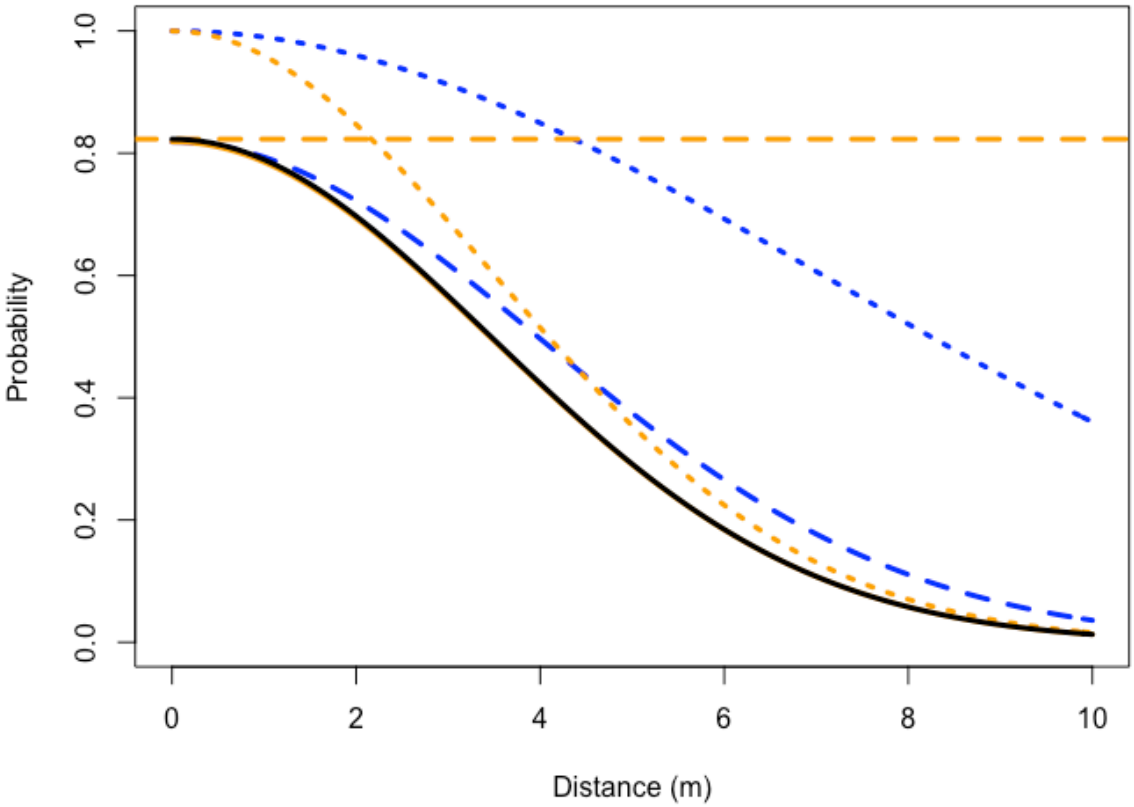
The bottom solid line represents the detection function on 24 June, the middle line 26 June and the top line 27 June. The dashed lines show the extremes of the confidence levels for all three dates (i.e. the upper confidence limit for 27 June and the lower confidence limit for 24 June. Note that availability and detection probability are not completely disentangled in this scenario (see Supplementary Materials 3).



3. Confounded availability and detection probability

For playback surveys, both the probability of a bird responding to playback (availability for detection) and the probability of an observer detecting a response (detection probability) are likely to decline with distance. Hierarchical distance sampling models do not explicitly account for a decline in availability with distance from the observer, so this has to be accounted for in the detection probability part of the model. Simulated data suggest that the models are able to do this effectively, with the product of availability and detection probability being identical for model outputs and the original simulated data. However, we must be aware that the outputs for availability and detection probability individually do not represent the real-world values for these parameters.

The below graph shows the simulated availability (blue dashed line) and detection probability (blue dotted line) and the model estimates for availability (orange dashed line) and detection probability (orange dotted line). Note that the availability estimate from the model is constant with distance from the observer, whereas in the simulated data availability declines with distance. The black line shows the product of availability and detection probability for both the simulated data and the model estimates, for which it is identical.


Probability
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
10
Distance (m)

4. Summary of repeated playbacks per sector

Numbers in brackets represent data used in the HDS method, where that differed from the calibration plot method. We removed some survey points from the HDS analysis because inaccuracies in the recorded GPS locations meant that environmental covariate data would have been inaccurate. Table 3 in the main text gives a summary of playbacks and responses for each combined sector.

Island	Combined sector	Sector	No. of playbacks per survey point							Sites	Repeats
			1	2	3	4	5	6	7		
Boreray	BOR1-2	BOR1	125		5	15				145	200
		BOR2	14			10		7	8	39	152
	BOR3+	BOR3	4							4	4
		BOR4	61		4					65	73
		BOR5	20		3					23	29
		BOR6	15							15	15
		BOR7	34					1		35	40
		BOR8	32							32	32
		BOR10	28							28	28
		BOR10a	39							39	39
		BOR11a	32							32	32
		BOR11b	32							32	32
	Cleitean	Cleitean	1	6 (5)	9 (7)	18	5	1		40 (37)	143 (135)
Dun	DUN B+C	DUNB	56 (40)	108 (101)	1 (0)	5	137	1		308 (284)	986 (953)
		DUNC	48 (30)							48 (30)	48 (30)
	DUN D	DUND	51				8			59	91
Hirta	Other	H19	17							17	17
		H20	10							10	10
	Carn Mòr	H21	171							171	171

Soay	SOY	SOY3	17							17	17
		SOY6	7							7	7
		SOY8	2							2	2
		SOY9a	8							8	8
		SOY9b	8							8	8
		SOY10	13							13	13
		SOY12	17							17	17
	SOY7	SOY7	44							44	44