APPENDIX A: SIMULATION STUDY.

We did a small simulation study to investigate differences in performance between the *observation confirmation* and *site confirmation* models when analyzing data that were collected under an *observation confirmation* sampling design (see main manuscript for details). To assess model performance under contrasting situations that could be encountered in the field (e.g., high vs. low occupancy of the focal species), we simulated datasets for several contrasted parameter values, as follows: (i) occupancy probability: ψ = {0.1, 0.9}; (ii) probability of ≥1 observation-level true detection: s_1 = {0.1, 0.9}; and (iii) probability of ≥1 observation-level false positive: s_0 = {0.1, 0.7}. Because data were simulated under an *observation confirmation* sampling design, we also needed to specify the proportion of sites (hereafter, denoted as 'δ') for which observations were confirmed. We also used two contrasted values (δ = {0.05, 0.50}) to check a potential influence of this sampling characteristic. For each possible parameter combination (16 total, see Table A1), we simulated 1,000 datasets, consisting of 5,000 surveyed sites and 30 survey occasions. We used such large samples because to best approximate asymptotic behaviors of the models. To assess model performance, we calculated the expected bias, standard error (SE) and root mean square error (RMSE) of the occupancy probability estimator. These expected measures were approximated, over the 1,000 simulations, as follows:

$$Bias = \bar{\hat{\psi}} - \psi = \left(\frac{1}{n}\sum_{s=1}^{n}\hat{\psi}_s\right) - \psi$$

$$SE = \sqrt{\frac{1}{n-1}\sum_{s=1}^{n}\left(\hat{\psi}_s - \bar{\hat{\psi}}\right)^2}$$

$$RMSE = \sqrt{Bias^2 + SE^2} = \sqrt{\frac{1}{n}\sum_{s=1}^{n}\left(\hat{\psi}_s - \psi\right)^2} \quad ,$$

where ψ is the true occupancy probability, $\hat{\psi}_s$ is the estimated occupancy probability from the s^{th} simulated dataset, with $s = \{1, \ldots, n\}$, and $\bar{\hat{\psi}}$ is the average estimate of occupancy probability, over the total of n = 1,000 simulations. Code for implementation of this simulation study is provided as Supplemental Material (Supplement S2).

Simulation results are shown in table A1. As expected the asymptotic bias is null. When rounded at the second decimal, standard errors appear very equivalent between the two models. Only when detection and false positive probabilities are small (s_1 = 0.1, s_0 = 0.1 and δ = 5%) does the *observation confirmation* model seem to provide slightly more precise estimates than the *site confirmation* model. However, despite this apparent equity between the two models, we found that the numerical maximization of the *site confirmation* model was much less stable and more sensitive to initial values, likely due to an issue of identifiability. As illustrated in Table A2, when the initial values are far enough from the real values, the optimization of the likelihood of this latter model could easily fail at providing the 'correct answer', because of convergence to a local maximum. We found that, in presence of data from an *observation confirmation* sampling design, the log-likelihood of the *site confirmation* model usually had two (or more) maxima of similar magnitude. The *observation confirmation* model, on the other hand, seems to always converge to a unique global log-likelihood maximum. Example code to quickly and easily assess this convergence issue is also provided (Supplement S2).

TABLE A1. Results of the simulation study to assess the performance of the *site confirmation* (Site Conf.) and *observation confirmation* (Obs. Conf.) models when analyzing data that were collected under an *observation confirmation* sampling design. We used measures of bias, standard error and root mean square error (RMSE) for the occupancy estimator to evaluate model performance (see definitions in the text above). We used 1,000 simulated datasets for each possible parameter combination. Each simulated data set consisted of 5,000 sites and 30 survey occasions. The parameters shown in the table are: occupancy probability (ψ); probability of ≥1 observation-level true detection (s_1); probability of ≥1 observation-level false positive: (s_0); and proportion of sites for which observations were confirmed (δ).

Parameters (true values)				Bias		Standard Error		RMSE	
ψ	s_1	s_0	δ	Site Conf.	Obs. Conf.	Site Conf.	Obs. Conf.	Site Conf.	Obs. Conf.
0.1	0.1	0.1	0.05	<0.01	<0.01	0.02	0.01	0.02	0.01
0.1	0.1	0.1	0.5	<0.01	<0.01	0.01	0.01	0.01	0.01
0.1	0.1	0.7	0.05	<0.01	<0.01	0.02	0.02	0.02	0.02
0.1	0.1	0.7	0.5	<0.01	<0.01	0.01	0.01	0.01	0.01
0.1	0.9	0.1	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.1	0.9	0.1	0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.1	0.9	0.7	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.1	0.9	0.7	0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.9	0.1	0.1	0.05	<0.01	<0.01	0.02	0.01	0.02	0.01
0.9	0.1	0.1	0.5	<0.01	<0.01	0.01	0.01	0.01	0.01
0.9	0.1	0.7	0.05	<0.01	<0.01	0.02	0.02	0.02	0.02
0.9	0.1	0.7	0.5	<0.01	<0.01	0.01	0.01	0.01	0.01
0.9	0.9	0.1	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.9	0.9	0.1	0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.9	0.9	0.7	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
0.9	0.9	0.7	0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE A2. Illustration of the convergence issue displayed by the *site confirmation* model, but not by the and *observation confirmation* model. Estimates of model parameter are shown for two different sets of initial values. We can see that the *observation confirmation* model converge to the same global maxima in both cases and provides accurate estimates in both cases, while the *site confirmation* model reaches a local maxima and provides the 'wrong answer' with the second set of values, which are further from the real values. Model parameters are: occupancy probability (ψ); site-level (true) detection probability from the ambiguous detection method (p_{11}); site-level probability of false positive (p_{10}); site-level (true) detection probability from the unambiguous detection method (r_{11}); probability of ≥1 observation-level true detection (s_1); probability of ≥1 observation-level false positive: (s_0).

	Site Confirmation Model				*Observation Confirmation* Model		
Parameters	ψ	p_{11}	p_{10}	r_{11}	ψ	s_1	s_0
Real values	0.80	0.73	0.10	0.70	0.80	0.70	0.10
	First set of initial values (Deviance = 2524)				*First set of initial values* (Deviance = 5309)		
Initial values	0.73	0.73	0.12	0.73	0.73	0.73	0.12
Estimated values	0.77	0.74	0.12	0.70	0.78	0.70	0.10
	Second set of initial values (Deviance = 2662)				*Second set of initial values* (Deviance = 5309)		
Initial values	0.27	0.27	0.88	0.27	0.27	0.27	0.88
Estimated values	0.59	0.37	0.83	0.70	0.78	0.70	0.10