

Supplementary material from:

Farinelli, S. M., Keith-Diagne, L. W., Garnica, J., Keiman, J., & Luther, D. (2024). Quantifying minimum survey effort to reliably detect Amazonian manatees using an unoccupied aerial vehicle (UAV) at an *ex situ* soft-release site. *Latin American Journal of Aquatic Mammals*, 19(1), 42-60. <https://doi.org/10.5597/lajam00319>

Table S1. All surveys conducted to evaluate detecting *ex situ* Amazonian manatees using an unoccupied aerial vehicle that were used in generalized linear mixed-effect (GLMM) and detection models. Survey effort is given in minutes. Total survey effort was used as the survey effort covariate in GLMMs, whereas survey effort (one pass) was used as the survey effort covariate in detection models.

Survey ID	Date	Survey type	Total survey effort (min.)	Survey effort (one pass; min.)	Time of day	Observed behaviors			Total detections
						Breathing	Foraging	Milling	
56	4/29/2022	Short	8.18	8.18	A	0	0	1	1
57	4/29/2022	Short	8.63	8.63	E	2	0	1	3
58	4/29/2022	Short	7.52	7.52	E	0	0	2	2
86	4/29/2022	Short	7.52	7.52	A	0	0	0	0
1	4/30/2022	Long	40.10	7.58	M	10	0	0	10
2	4/30/2022	Long	40.35	9.48	M	4	0	0	4
3	4/30/2022	Long	38.02	7.07	A	8	0	0	8
4	4/30/2022	Long	40.37	8.18	A	10	2	0	12
5	4/30/2022	Long	41.03	7.53	A	11	2	6	19
59	5/2/2022	Short	6.98	6.98	M	2	0	0	2
60	5/2/2022	Short	7.43	7.43	M	1	0	0	1
61	5/2/2022	Short	7.72	7.72	A	3	0	0	3
62	5/2/2022	Short	7.47	7.47	A	3	0	1	4
63	5/2/2022	Short	7.00	7.00	A	0	1	3	4
64	5/2/2022	Short	7.90	7.90	E	3	1	6	10
6	5/3/2022	Long	60.65	6.95	M	6	0	0	6
7	5/3/2022	Long	40.65	7.08	M	12	0	0	12
8	5/3/2022	Long	61.43	7.43	A	13	2	0	15
9	5/3/2022	Long	60.52	7.28	A	15	1	6	22

10	5/3/2022	Long	33.43	6.88	E	10	0	9	19
65	5/4/2022	Short	6.80	6.80	M	2	0	0	2
66	5/4/2022	Short	7.30	7.30	M	1	0	0	1
67	5/4/2022	Short	8.00	8.00	M	1	0	0	1
68	5/4/2022	Short	7.15	7.15	A	2	0	0	2
69	5/4/2022	Short	6.70	6.70	A	0	0	2	2
87	5/4/2022	Short	6.83	6.83	A	0	0	0	0
88	5/4/2022	Short	6.87	6.87	A	0	0	0	0
11	5/5/2022	Long	61.42	7.13	A	9	0	0	9
12	5/5/2022	Long	60.93	6.88	A	14	0	0	14
13	5/5/2022	Long	25.48	6.83	A	4	0	4	8
14	5/6/2022	Long	60.98	6.67	M	6	0	0	6
15	5/6/2022	Long	15.95	7.05	A	2	0	0	2
16	5/6/2022	Long	61.18	6.52	A	9	1	0	10
17	5/6/2022	Long	18.07	7.12	A	2	1	0	3
18	5/6/2022	Long	41.13	6.58	E	10	2	1	13
70	5/6/2022	Short	7.47	7.47	M	1	0	0	1
71	5/6/2022	Short	4.00	-	M	2	0	0	2
72	5/6/2022	Short	6.85	6.85	M	1	0	0	1
89	5/6/2022	Short	6.97	6.97	M	0	0	0	0
90	5/6/2022	Short	7.50	7.50	M	0	0	0	0
91	5/6/2022	Short	7.02	7.02	M	0	0	0	0
21	5/7/2022	Long	59.27	6.65	M	6	0	0	6
22	5/7/2022	Long	59.35	7.22	A	6	0	0	6
23	5/7/2022	Long	17.15	7.05	A	3	0	0	3
24	5/7/2022	Long	13.33	6.97	A	2	0	0	2
25	5/7/2022	Long	32.62	7.97	A	5	0	3	8
73	5/7/2022	Short	6.67	6.67	E	2	0	2	4
26	5/9/2022	Long	39.93	7.12	A	6	1	0	7
27	5/9/2022	Long	13.22	6.77	A	1	3	0	4

28	5/9/2022	Long	11.43	6.83	A	2	1	0	3
29	5/9/2022	Long	12.97	6.32	E	1	0	0	1
74	5/9/2022	Short	6.78	6.78	M	2	0	0	2
75	5/9/2022	Short	7.57	7.57	M	4	0	0	4
76	5/9/2022	Short	6.95	6.95	M	2	0	0	2
77	5/9/2022	Short	7.32	7.32	M	2	0	0	2
78	5/9/2022	Short	7.22	7.22	M	3	0	0	3
92	5/9/2022	Short	6.13	6.13	E	0	0	0	0
101	5/9/2022	Short	6.70	6.70	M	0	0	0	0
30	5/10/2022	Long	30.17	6.70	M	7	2	0	9
31	5/10/2022	Long	30.45	6.67	A	11	0	0	11
32	5/10/2022	Long	2.07	-	A	2	0	0	2
33	5/10/2022	Long	3.48	-	A	2	0	0	2
34	5/10/2022	Long	3.55	-	A	3	0	0	3
35	5/10/2022	Long	1.93	-	A	1	0	1	2
36	5/10/2022	Long	0.65	-	A	1	0	1	2
37	5/10/2022	Long	2.38	-	A	1	1	0	2
38	5/10/2022	Long	14.57	6.30	A	3	0	0	3
79	5/10/2022	Short	6.33	6.33	E	1	0	0	1
39	5/11/2022	Long	11.65	6.27	M	4	0	0	4
40	5/11/2022	Long	1.95	-	M	1	0	0	1
41	5/11/2022	Long	13.48	6.93	M	3	0	0	3
42	5/11/2022	Long	25.98	6.33	M	1	1	0	2
43	5/11/2022	Long	13.67	6.57	A	1	0	0	1
44	5/11/2022	Long	1.50	-	A	2	0	0	2
45	5/13/2022	Long	2.42	-	A	1	1	0	2
80	5/13/2022	Short	7.08	7.08	E	0	2	0	2
93	5/13/2022	Short	6.35	6.35	A	0	0	0	0
46	5/14/2022	Long	25.13	6.32	M	2	1	0	3
47	5/15/2022	Long	1.47	-	M	1	0	0	1

48	5/15/2022	Long	15.23	6.47	M	3	0	0	3
49	5/15/2022	Long	12.45	5.95	M	2	0	0	2
50	5/15/2022	Long	2.52	-	M	1	0	0	1
51	5/15/2022	Long	10.77	6.28	M	5	0	0	5
52	5/15/2022	Long	4.83	-	M	1	0	0	1
53	5/15/2022	Long	25.80	6.08	M	1	0	0	1
81	5/15/2022	Short	6.18	6.18	A	1	0	0	1
82	5/15/2022	Short	6.22	6.22	A	1	0	0	1
94	5/15/2022	Short	6.35	6.35	A	0	0	0	0
95	5/15/2022	Short	6.57	6.57	A	0	0	0	0
54	5/16/2022	Long	9.53	6.62	A	3	1	0	4
55	5/16/2022	Long	2.27	-	E	0	0	2	2
83	5/16/2022	Short	6.50	6.50	M	1	1	0	2
84	5/16/2022	Short	6.07	6.07	M	1	0	0	1
85	5/16/2022	Short	6.52	6.52	A	1	0	0	1
96	5/16/2022	Short	6.33	6.33	M	0	0	0	0
97	5/16/2022	Short	6.35	6.35	M	0	0	0	0
98	5/16/2022	Short	6.83	6.83	M	0	0	0	0
99	5/16/2022	Short	6.48	6.48	A	0	0	0	0
100	5/16/2022	Short	6.57	6.57	A	0	0	0	0

Note: The following long survey IDs detected a manatee after a single pass was made over the lake and were therefore included as a non-detection in detection models: 2, 4, 6, 9, 15, 17, 21, 23, 24, 26, 29, 42, 43, 48, 49, 53. Long surveys and one short survey with ‘-’ for survey effort (one pass) were not included in detection models as a full pass was not completed.

Table S2. Results of the backwards stepwise approach to model selection to determine factors that influence the time-to-detection when using an unoccupied aerial vehicle to detect Amazonian manatees at an *ex situ* soft-release site.

Model	AIC	ΔAIC
Water depth*water transparency + time of day + wind speed + cloud cover + behavior + survey effort + (1 Date:Transect)	160829	0
Water depth*water transparency + time of day + wind speed + behavior + survey effort + (1 Date:Transect)	160866	37
Time of day + wind speed + cloud cover + behavior + survey effort + (1 Date:Transect)	161018	189
Water depth*water transparency + time of day + cloud cover + behavior + survey effort + (1 Date:Transect)	161151	322
Water depth*water transparency + time of day + wind speed + cloud cover + behavior + (1 Date:Transect)	182604	21775
Water depth*water transparency + time of day + wind speed + cloud cover + survey effort + (1 Date:Transect)	182630	21801
Water depth*water transparency + wind speed + cloud cover + behavior + survey effort + (1 Date:Transect)	163019	2190

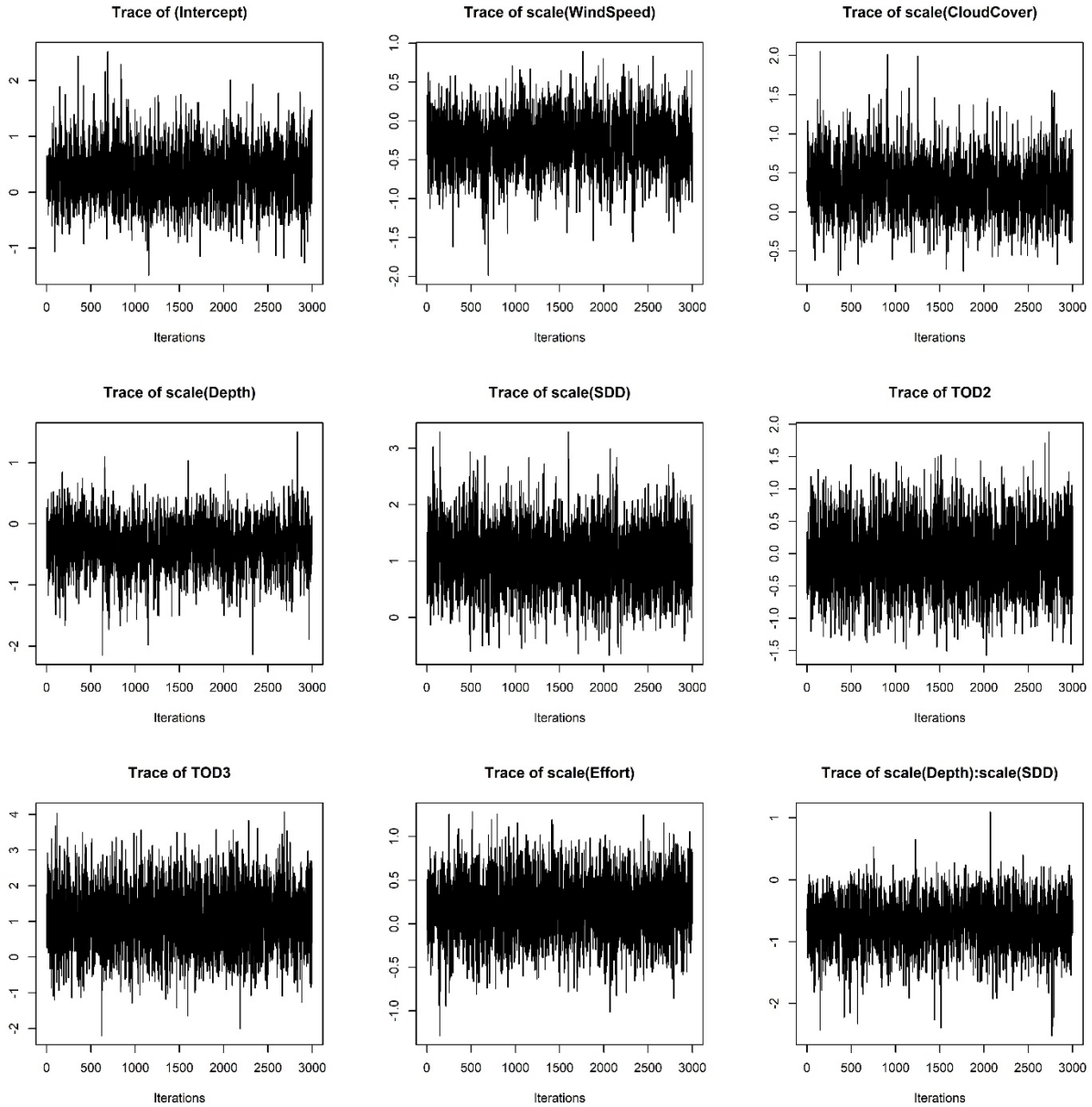


Figure S1. Trace plots of detection covariates in the global model (m.g in Table 3) indicating adequate mixing. Detection covariates include wind speed, cloud cover, water depth, water transparency (SDD), time of day (TOD2 = afternoon, TOD3 = evening, morning is used as the reference), survey effort (Effort), and the interaction between water depth and water transparency (Depth:SDD). All continuous covariates in the model were scaled for standardization.