Graphs and Tables for *Ziphius* HHMM Paper

Note: see code for details on how to produce optional interactive graphs and tables. They are not included in the rendered version in the repository because they result in an html file that exceeds GitHub's file size rules.

Tag Deployment Summary

Table 1: Metadata for all analyzed tag deployments. Full record duration is usually longer than analyzed record duration because modeling included only time-periods where acoustic data were recorded (and many tags recorded high-resolution movement data for an additional period at the end of the deployment). In addition, only complete dives were included in analysis. All other columns in the table are computed for analyzed data only. The number of Typical and Variant dive cycles is based on the fitted HHMM, using the Viterbi algorithm to estimate the most likely state sequence for each whale. In addition to the number of dive cycles including MFAS sounds, we note the number of dive cycles for which review of the acoustic data indicated confirmed presence of echosounder, impulsive, or orca sounds.

Whale ID	Record Start (UTC)	Tagging Location	Record Duration (h)	Analyzed Record Duration (h)	N Dive Cycles	Typical Dive Cycles	Variant Dive Cycles	MFAS Dive Cycles	Echosounder Dive Cycles	Impulsives Dive Cycles	Orca Dive Cycles	Median N Non-Foraging Dives
Zica-2019	19-Oct-2019 16:43:59	-118.9226	141.6	123.6	37	13	24	2	1	0	0	4.5
Zica-2019	19-Oct-2019 20:38:04	-118.7881	167.2	122.0	42	25	17	5	2	18	0	4.0
Zica-2019	19-Nov-2019 22:45:03	-118.7881	289.2	118.6	39	30	9	4	3	4	0	4.0
Zica-2019	17-Nov-2019 18:00:06	-118.8221	8.1	2.7	2	1	1	0	0	0	0	4.0
Zica-2021	21-Nov-2021 22:02:43	-118.987167	274.4	166.2	52	43	9	8	0	0	0	5.0
Zica-2021	23-Nov-2021 18:24:30	-119.102167	99.6	96.7	50	3	47	2	0	0	0	3.0
Zica-2022	22-Jan-2022 18:22:20	-118.9546	161.9	159.7	51	49	2	5	0	0	1	3.0
Zica-2023	18-May-2023 19:06:26	-119.0669	259.0	252.2	84	39	45	3	0	20	0	3.0
Zica-2023	19-May-2023 23:07:08	-118.9746	245.5	240.5	80	60	20	2	5	17	0	4.0
Zica-2023	23-Jul-2023 18:48:26	-119.0363	63.5	59.5	20	15	5	7	0	8	0	5.0
Zica-2023	23-Jul-2023 20:45:37	-119.0218	48.1	47.1	18	14	4	6	1	10	0	3.0
Zica-2024	24-Dec-2024 22:11:43	-118.9486	241.8	217.7	66	43	23	7	2	7	0	5.0
Zica-2024	24-Dec-2024 20:00:10	-118.958	97.0	91.1	28	26	2	1	0	0	0	5.0
Total	NA	NA	2096.9	1697.6	569	361	208	52	14	84	NA	NA

Comparison of fitted models

These models were fitted including all dive cycles with acoustic data.

Table 2: Model comparison results for HHMMs.

Model	Intensity Metric	MFAS Effect at Dive-Cycle Scale	MFAS Effect at 5-Minute Scale	MFAS-before-EOE Effect	AIC	AIC Difference
1	cSEL	Yes	Yes	None	20417.9	0.0
2	cSEL	Yes	Yes	Additive	20420.9	3.0
3	cSEL	Yes	Yes	Interactive	20423.3	5.4
4	cSEL	Yes	No	None	20454.1	36.2
5	RMS	Yes	No	None	20454.9	37.0
6	RMS	Yes	No	Additive	20458.0	40.1
7	None	Yes	No	None	20459.4	41.5
8	RMS	Yes	No	Interactive	20461.2	43.3
9	None	No	No	None	20461.4	43.5
10	RMS, cSEL	Yes	Yes	None	20465.7	47.9
11	RMS	Yes	Yes	None	20466.7	48.8
12	RMS	Yes	Yes	Additive	20469.7	51.8
13	RMS, cSEL	Yes	Yes	Interactive	20471.7	53.8
14	RMS	Yes	Yes	Interactive	20473.3	55.4
15	cSEL	Yes	No	None	21663.1	1245.2

Rates of Transition Between States

Dive-cycle Scale

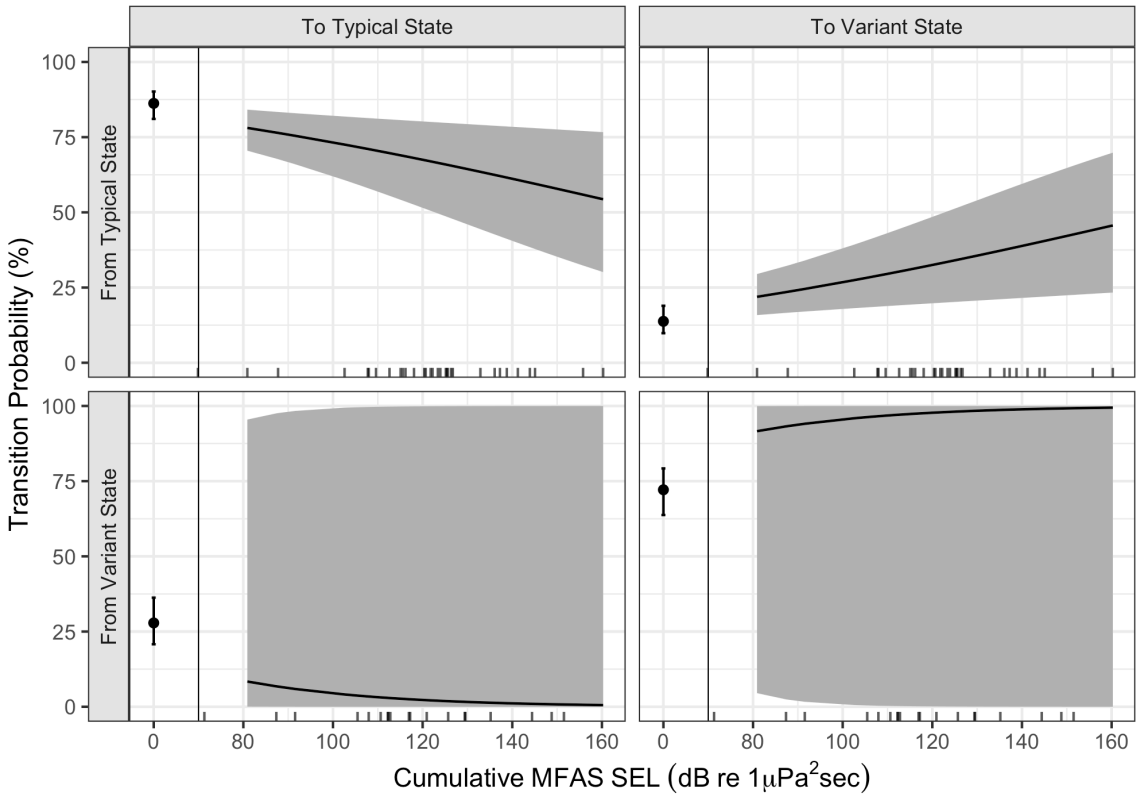

Figure 1: Rates of transition between states at the dive cycle scale. Rug plot on the x-axis indicates observed MFAS cSEL values, allocated to panels according to the most-likely decoded state sequence.

5-minute Scale

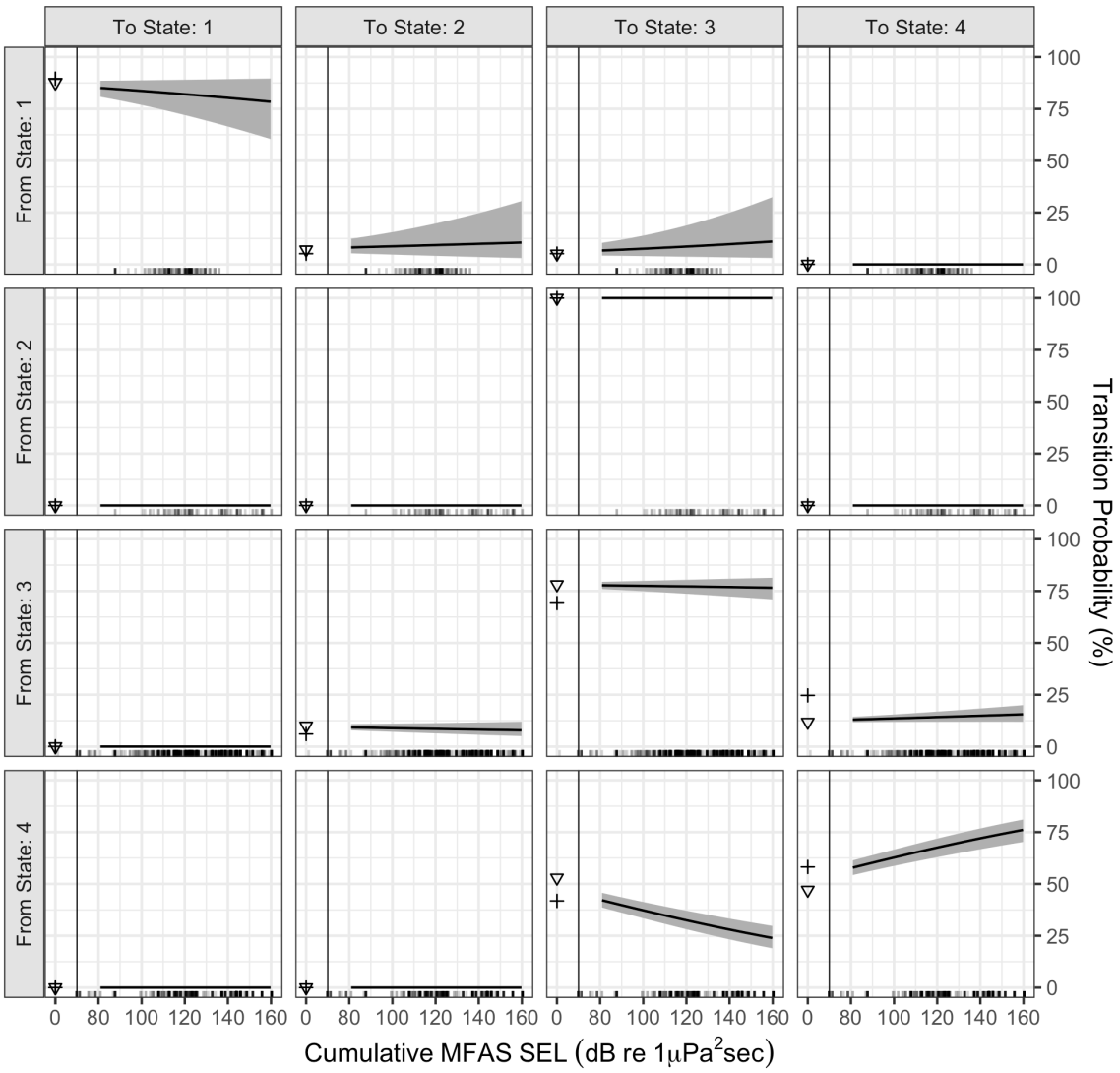

Figure 2: Rates of transition between states at the 5-minute scale.

State-dependent distributions with data

Dive-cycle Scale

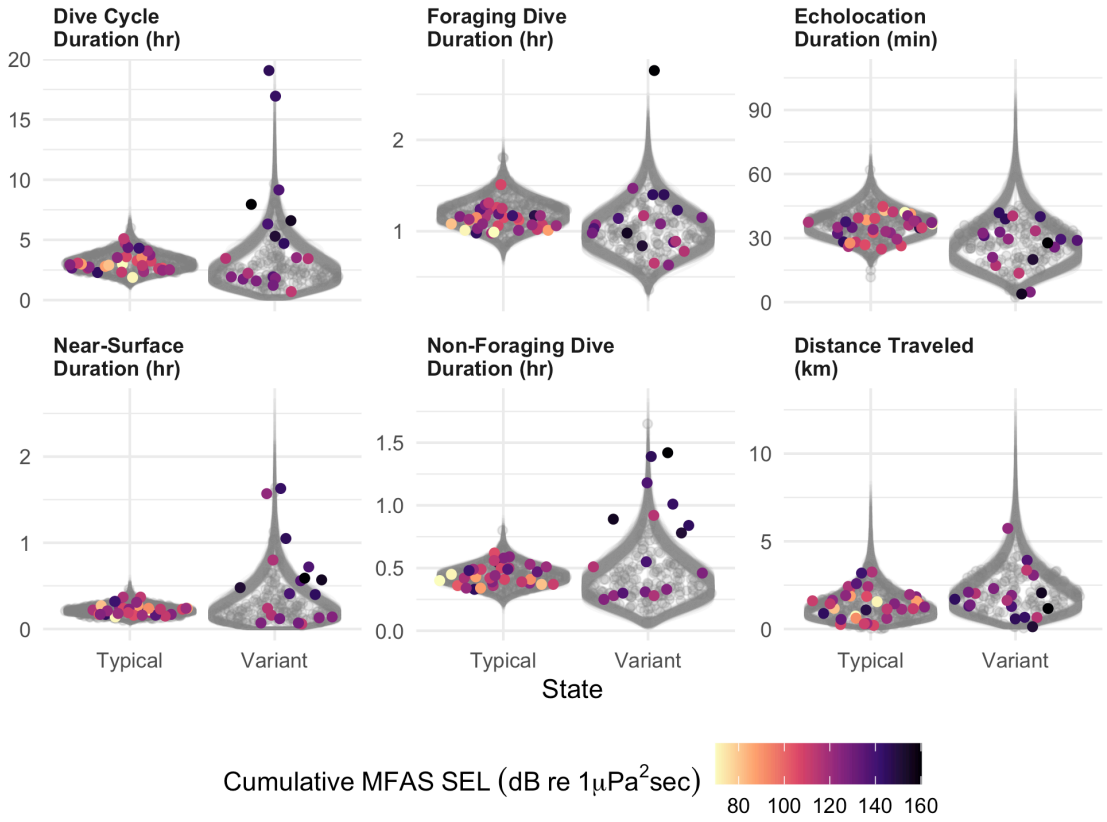

Figure 3: Characteristics of state-dependent distributions at the dive cycle scale.

5-minute Scale

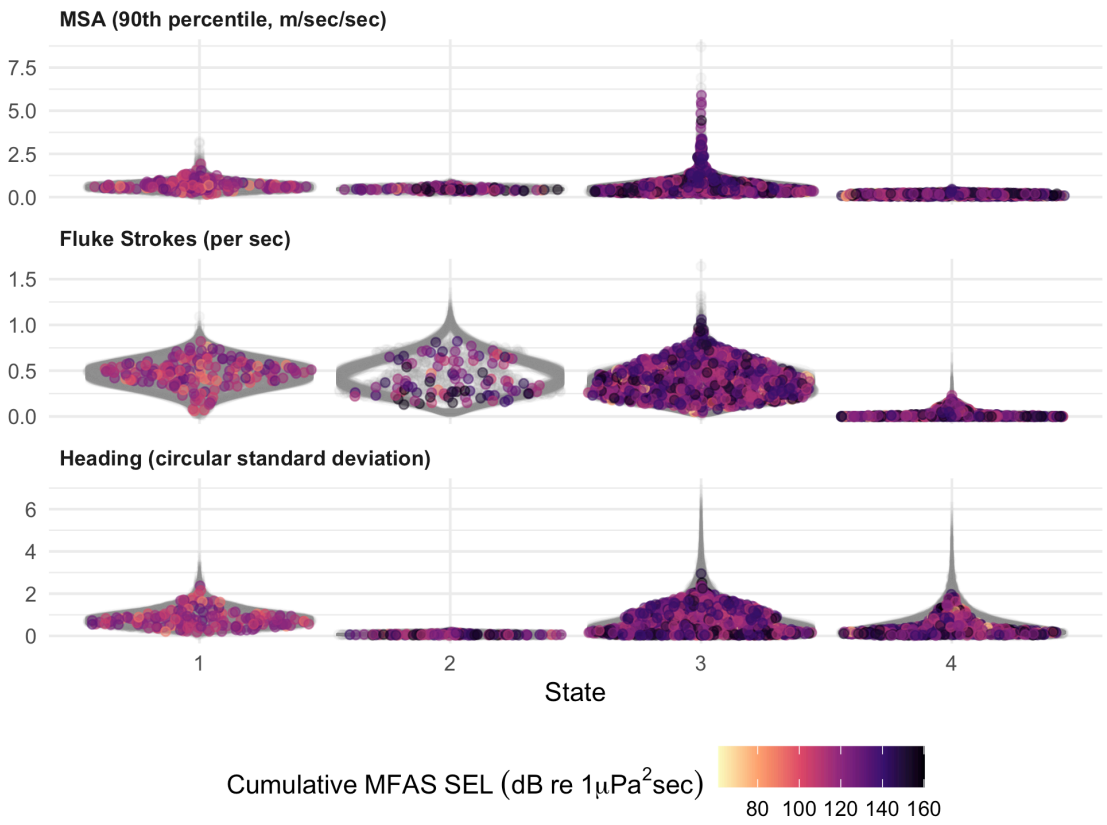

Figure 4: Characteristics of state-dependent distributions at the 5-minute scale.

Variant-state duration

How long do whales spend in the Variant state, according to the Viterbi decoded state sequences?

Also: based on the fitted model, what would the expected duration of a response be, if a whale responded to an MFAS exposure by switching to Variant state and then there was no further MFAS exposure subsequently?

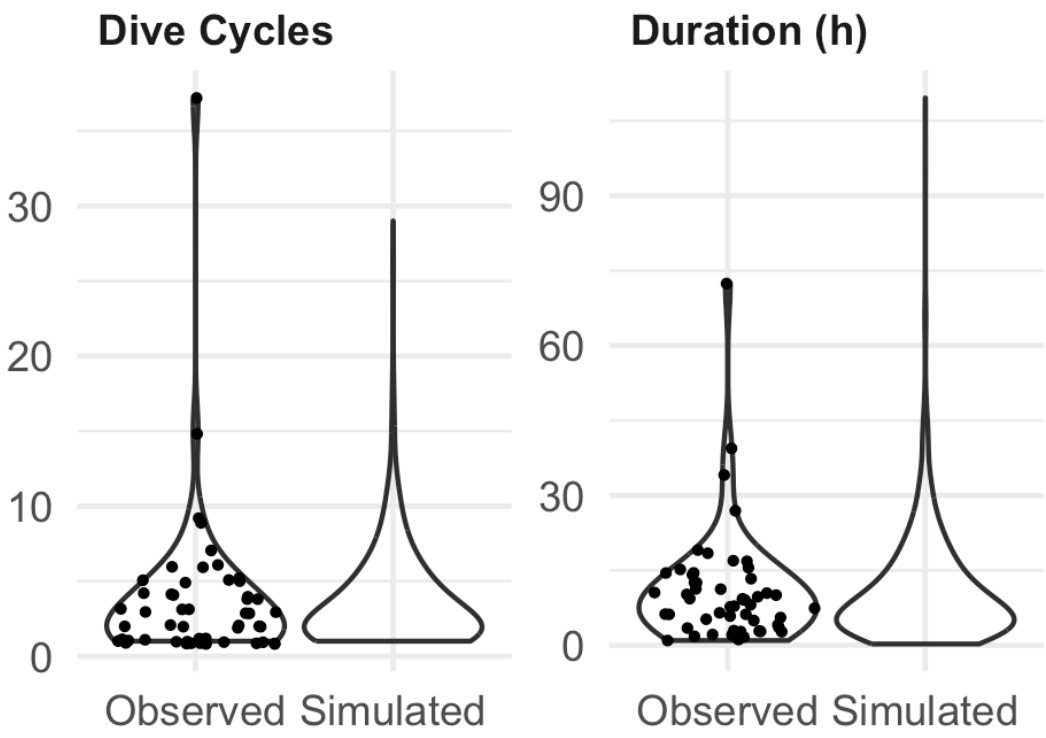

Figure 5: Duration of observed and simulated Variant state bouts.