

Supplementary Information

Table S1. Generated additive models generated for the selection of the best fit model relating presence and absence of manta rays in the Paranaguá Estuarine Complex with environmental and temporal variables. + marks the variables added to the models. In bold the selected model. WindDir = wind direction, Effort= Daily effort, MoonIllum = Moon Illumination, SST = 8-day sea surface temperature, WindVel = Wind velocity, df = degree of freedom, AICc = corrected Akaike's information criterion, Δ AIC = AIC delta value, s = smooth function, f = factor.

PRESENCE AND ABSENCE MODEL SELECTION

Model	f(Year)	s(WindDir)	s(Effort)	s(MoonIllum)	s(SST)	s(WindVel)	df	AICc	Δ AIC
1			+		+		7	182.1	0.00
2			+		+	+	7	182.1	0.00
3	+		+		+	+	9	182.4	0.31
4	+	+	+		+	+	9	182.4	0.31
5	+	+	+		+		9	182.4	0.31
6	+		+		+		9	182.4	0.31
7		+	+		+	+	9	183.0	0.84
8		+	+		+		9	183.0	0.84
9			+	+	+		11	183.3	1.18
10			+	+	+	+	11	183.3	1.18
11	+	+	+	+	+	+	10	183.7	1.60
12	+	+	+	+	+		10	183.7	1.60
13	+		+	+	+		13	183.8	1.69
14	+		+	+	+	+	13	183.8	1.69
15		+	+	+	+	+	10	184.7	2.59
16		+	+	+	+		10	184.7	2.59
17	+			+	+		12	186.9	4.75
18	+	+		+	+		12	186.9	4.75
19	+			+	+	+	12	186.9	4.75
20	+	+		+	+	+	12	186.9	4.75
21	+				+		8	187.7	5.54
22	+				+	+	8	187.7	5.54
23				+	+		9	187.7	5.58
24				+	+	+	9	187.7	5.58
25					+		5	187.8	5.62
26					+	+	5	187.8	5.63
27	+	+			+	+	8	188.2	6.05
28	+	+			+		8	188.2	6.05
29		+			+		7	188.5	6.34
30		+			+	+	7	188.5	6.34
31		+		+	+		10	189.2	7.10
32		+		+	+	+	8	189.9	7.74
33	+		+				6	195.8	13.71

34	+		+		+	6	195.8	13.71
35	+	+	+		+	6	195.8	13.71
36	+	+	+			6	195.8	13.71
37	+		+	+		11	195.9	13.80
38	+	+	+	+		11	195.9	13.80
39	+		+	+	+	11	195.9	13.80
40	+	+	+	+	+	11	195.9	13.80
41		+	+			6	197.7	15.55
42		+	+		+	6	197.7	15.55
43		+	+	+	+	7	197.9	15.74
44		+	+	+		10	198.6	16.46
45			+	+		8	198.9	16.80
46			+			4	199.2	17.02
47			+		+	4	199.3	17.15
48			+	+	+	8	199.5	17.38
49	+			+	+	10	209.1	26.96
50	+	+		+	+	10	209.1	26.96
51	+			+		8	209.4	27.22
52	+	+		+		8	209.4	27.22
53				+	+	8	210.4	28.28
54	+					3	211.2	29.06
55	+	+				4	211.2	29.06
56		+		+	+	9	211.3	29.17
57	+				+	6	211.5	29.39
58	+	+			+	6	211.5	29.39
59					+	3	212.7	30.55
60				+		5	213.0	30.91
61		+			+	5	213.4	31.25
62		+		+		5	213.8	31.67
63						0	214.3	32.15
64		+				2	215.0	32.90

Table S2. Generated additive models for the selection of the best fit model relating number of breaches for day of manta rays in the Paranaguá Estuarine Complex with environmental and temporal variables. + marks the variables added to the models. In bold the selected model. WindDir = wind direction, Effort= Daily effort, MoonIllum = Moon Illumination, SST = 8-day sea surface temperature, WindVel = Wind velocity, df = degree of freedom, AICc = corrected Akaike's information criterion, Δ AIC = AIC delta value, s = smooth function, f = factor.

REACHING FREQUENCY MODEL SELECTION

Model	f(Year)	s(WindDir)	s(Effort)	s(MoonIllum)	s(SST)	s(WindVel)	df	AICc	Δ AIC
1	+	+	+	+	+	+	28	551.3	0.00
2	+	+	+	+	+		26	554.6	3.31
3		+	+	+	+	+	30	554.6	3.32
4		+		+	+	+	28	555.9	4.63
5		+	+	+	+		27	558.2	6.93
6			+	+	+	+	25	558.8	7.59
7	+	+		+	+	+	29	559.8	8.52
8	+	+	+		+	+	22	561.6	10.30
9			+	+	+		20	564.2	12.97
10	+		+	+	+	+	28	565.5	14.26
11	+	+	+		+		24	566.9	15.60
12	+	+		+	+		26	567.0	15.71
13		+	+		+	+	25	568.0	16.74
14	+		+		+	+	22	570.1	18.87
15	+		+	+	+		23	570.4	19.12
16		+	+		+		21	572.4	21.19
17	+		+		+		18	575.9	24.60
18		+		+	+		24	576.2	24.97
19			+		+	+	19	576.4	25.18
20		+	+	+		+	23	581.1	29.87
21	+	+	+	+		+	24	581.2	29.98
22	+		+			+	20	584.1	32.83
23	+	+			+	+	21	585.8	34.49
24			+	+		+	22	585.9	34.66
25	+		+	+		+	24	586.0	34.76
26	+	+		+		+	28	588.2	36.89
27			+		+		15	589.1	37.86
28	+	+	+			+	22	589.8	38.52
29		+		+		+	26	590.2	38.97
30	+	+	+				19	595.9	44.62
31	+	+			+		18	597.9	46.67
32		+	+			+	21	598.3	47.08
33		+			+	+	20	599.8	48.51
34			+			+	17	599.8	48.56
35	+	+	+	+			21	600.3	49.04

36	+		+	+			19	600.6	49.29
37	+		+				14	600.6	49.36
38			+	+			16	603.4	52.10
39		+	+	+			19	604.1	52.86
40				+	+	+	21	604.5	53.20
41	+			+	+	+	24	605.5	54.25
42		+	+				17	607.7	56.48
43	+	+		+			21	621.5	70.28
44	+	+				+	19	627.9	76.60
45	+			+	+		18	630.0	78.73
46			+				11	630.9	79.66
47		+			+		15	634.3	83.05
48	+			+		+	21	637.5	86.25
49				+	+		15	637.9	86.66
50	+				+	+	14	639.9	88.60
51		+				+	17	640.4	89.10
52		+		+			19	642.3	91.07
53					+	+	12	647.0	95.73
54				+		+	18	650.2	98.94
55	+				+		10	657.0	105.71
56	+	+					13	666.6	115.38
57	+			+			13	683.7	132.47
58					+		7	683.7	132.48
59	+					+	10	686.1	134.86
60						+	10	691.8	140.52
61				+			9	706.7	155.42
62		+					10	714.1	162.81
63	+						6	721.6	170.30
64							3	769.9	218.61

Table S3. Percentages of occurrence of manta rays in the Paranaguá Estuarine Complex in tide states for year and depth and coastal distance for tide states and years.

TIDE STATE	DEPTH (m)								
	4	6	10	11	13	14	17	4-10	11-17
Ebb	25.7	30.4	12.0	2.1	1.0	25.1	3.7	68.1	31.9
Flood	23.8	31.7	12.9	3.0	0.0	26.7	2.0	68.3	31.7
High	27.0	20.6	28.6	1.6	3.2	19.0	0.0	76.2	23.8
Low	15.6	34.4	18.8	3.1	6.3	18.8	3.1	68.8	31.3
All	24.5	29.5	15.5	2.3	1.6	24.0	2.6	69.5	30.5

YEAR	DEPTH (m)								
	4	6	10	11	13	14	17	4-10	11-17
2012	40.4	25.3	3.0	5.1	1.0	23.2	2.0	68.7	31.3
2013	15.0	31.3	20.4	1.4	2.0	25.9	4.1	66.7	33.3
2014	29.7	34.4	12.5	3.1	0.0	18.8	1.6	76.6	23.4
2015	18.2	27.3	24.7	0.0	2.6	26.0	1.3	70.1	29.9
All	24.5	29.5	15.5	2.3	1.6	24.0	2.6	69.5	30.5

TIDE STATE	COASTAL DISTANCE (m)									
	0 - 100	101 - 500	501 - 1000	1001 - 1500	1501 - 2000	2001 - 2500	2501 - 3000	3001 - 3500	0 - 1000	1001 - 3500
Ebb	12.0	33.5	36.6	12.0	4.2	0.5	1.0	0.0	82.2	17.8
Flood	9.9	39.6	31.7	10.9	7.9	0.0	0.0	0.0	81.2	18.8
High	12.7	22.2	39.7	15.9	7.9	0.0	1.6	0.0	74.6	25.4
Low	0.0	37.5	28.1	9.4	6.3	0.0	12.5	6.3	65.6	34.4
All	10.6	33.6	35.1	12.1	5.9	0.3	1.8	0.5	79.3	20.7

YEAR	COASTAL DISTANCE (m)									
	0-100	101-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000	3001-3500	1-1000	1001-3500
2012	10.1	46.5	30.3	1.0	7.1	0.0	3.0	2.0	86.9	13.1
2013	8.2	21.8	42.2	18.4	6.1	0.7	2.7	0.0	72.1	27.9
2014	14.1	50.0	23.4	9.4	3.1	0.0	0.0	0.0	87.5	12.5
2015	13.0	26.0	37.7	16.9	6.5	0.0	0.0	0.0	76.6	23.4
All	11.0	34.0	35.0	12.0	5.8	0.1	1.7	0.4	80.0	20.0