Top Model Outputs

Table S1: whale shark top model output from global model without lunar

Predictors	Incident rate ratios	Confidence intervals	P-value
(Intercept)	0	0.00 – 0.00	<0.001
SST	0.91	0.78 – 1.06	0.232
Temperature	1.06	1.01 – 1.12	0.031
SALINITY	0.86	0.70 – 1.06	0.153
CHLA	0.05	0.01 – 0.24	<0.001
ONI	0.7	0.60 – 0.80	<0.001
CurrentCode	0.96	0.90 – 1.03	0.299
Visibility	1.03	1.01 – 1.04	0.001
SIN TIME	0.68	0.56 – 0.82	<0.001
COS TIME	0.27	0.23 – 0.32	<0.001
Year y	1.06	1.04 – 1.08	<0.001
(Intercept)	2.01	1.49 – 3.38	
Zero-Inflated Model			
(Intercept)	0	0.00 – Inf	0.994
Random Effects			
σ^2	5.36		
$\tau_{00\ DiverCode}$	0.03		
$\tau_{00\ SiteCode}$	0.81		
ICC	0.13		
N $_{DiverCode}$	45		
N $_{SiteCode}$	17		
Observations	29804		
Marginal R^2 / Conditional R^2	0.139 / 0.255		

Table S2: manta ray top model output from global model without lunar

Predictors	Incident rate ratios	Confidence intervals	P-value
(Intercept)	1.5×10^{28}	$1.2 \times 10^{27} - 1.9 \times 10^{29}$	<0.001
SST	0.87	0.78 – 0.98	0.026
Temperature	0.94	0.90 – 0.99	0.014
SALINITY	1.04	0.88 – 1.23	0.651
CHLA	1.24	0.33 – 4.59	0.749
ONI	1.04	0.93 – 1.17	0.515
CurrentCode	0.96	0.90 – 1.03	0.293
Visibility	1.02	1.01 – 1.04	<0.001
SIN TIME	1.08	0.93 – 1.26	0.317
COS TIME	0.92	0.82 – 1.02	0.118
Year y	0.95	0.93 – 0.97	<0.001
(Intercept)	1.12	1.10 – 1.15	
Zero-Inflated Model			
(Intercept)	0	0.00 – Inf	0.99
Random Effects			
σ^2	3.62		
τ_{00} DiverCode	0.05		
τ_{00} SiteCode	0.16		
ICC	0.05		
N DiverCode	45		
N SiteCode	17		
Observations	29805		
Marginal R^2 / Conditional R^2	0.042 / 0.094		

Table S3: mobula ray top model outputs; model average between the global model without salinity and the global model without lunar

Predictors	Incident rate ratios	Confidence intervals	P-value
cond((Int))	1.4×10^{48}	$5.6 \times 10^{5} - 3.6 \times 10^{70}$	<0.001
cond(SST)	0.78	$0.70 - 0.88$	<0.001
cond(Temperature)	0.96	$0.91 - 1.00$	0.049
cond(SALINITY)	1.16	$1.00 - 1.34$	0.048
cond(CHLA)	1.45	$0.39 - 5.37$	0.574
cond(ONI)	1.17	$1.06 - 1.30$	0.002
cond(CurrentCode)	1.12	$1.05 - 1.19$	<0.001
cond(Visibility)	1.04	$1.02 - 1.05$	<0.001
cond(SIN TIME)	1.71	$1.50 - 1.94$	<0.001
cond(COS TIME)	0.87	$0.79 - 0.97$	0.01
cond(Year y)	0.95	$0.92 - 0.97$	<0.001
zi((Int))	0	$0.00 - \text{Inf}$	0.987
cond(LunarDistance)	0.98	$0.95 - 1.00$	0.078
cond(LunarPhase8Full)	0.84	$0.66 - 1.08$	0.176
cond(LunarPhase8Last quarter)	1.34	$1.06 - 1.69$	0.016
cond(LunarPhase8New)	1.42	$1.12 - 1.80$	0.004
cond(LunarPhase8Waning crescent)	1.1	$0.86 - 1.40$	0.436
cond(LunarPhase8Waning gibbous)	0.97	$0.76 - 1.24$	0.813
cond(LunarPhase8Waxing crescent)	1.26	$0.99 - 1.61$	0.057
cond(LunarPhase8Waxing gibbous)	0.86	$0.67 - 1.10$	0.232
N $_{DiverCode}$	45		
N $_{SiteCode}$	17		
Observations	29805		

Residual Plots
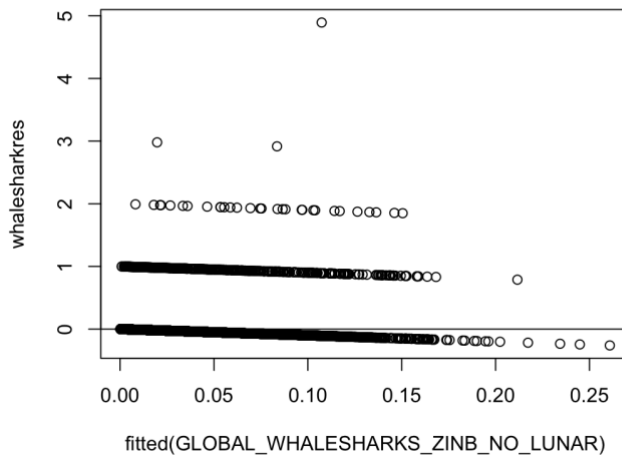
Whale Sharks:

Figure S1: residual vs. fitted for whale shark top model
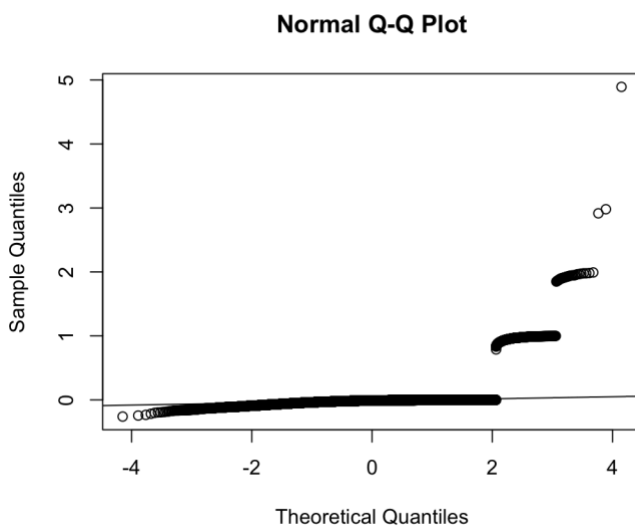

Figure S2: normal Q-Q Plot for whale shark top model
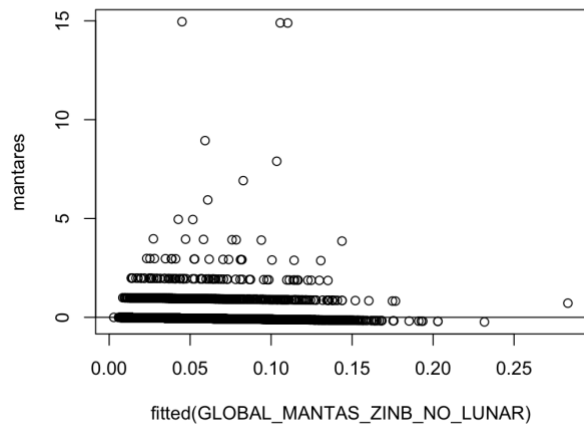
Manta Rays:
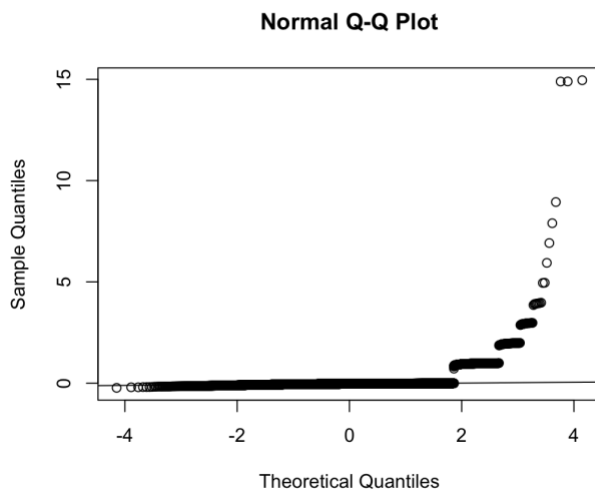

Figure S3: residual vs. fitted for manta top model

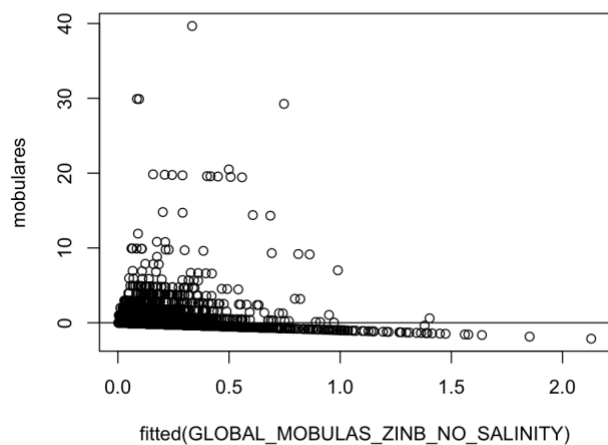**Figure S4:** normal Q-Q Plot for manta top model

Mobula Rays:

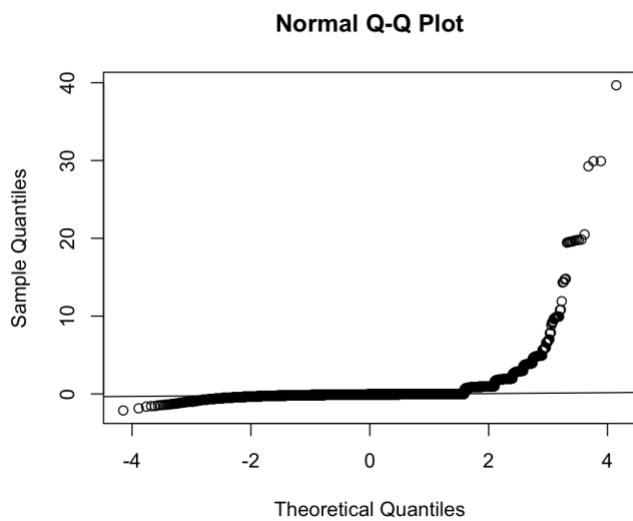**Figure S5:** residual vs. fitted for mobula top model

Figure S6: normal Q-Q Plot for mobula top model

Supplemental Model Rankings and AIC

Table S4: whale shark model rankings and AIC

Model Name	K	AICc	Delta AICc	ModelLik	AICcWt	LL	Cum.Wt
Global Model ZINB No Lunar	15	5522.179	0	1.000000e+00	9.999788e-01	-2746.081	.9999788
Global Model ZINB No SST	22	5544.841	22.66151	1.199816e-05	1.199790e-05	-2750.403	.9999908
Global Model ZINB No Salinity	22	5545.887	23.70840	7.108497e-06	7.108497e-06	-2750.927	.9999979
Global Model ZINB	23	5548.351	26.17178	2.074248e-06	2.074748e-06	-2751.157	1.0000000
Global Model ZINB No Current/Visibility	21	5646.526	124.34723	9.961668e-28	9.961668e-28	-2802.248	1.0000000
Global Model ZINB No Temperature at Depth	22	5794.728	272.54849	6.559134e-60	6.558995e-60	-2875.348	1.0000000
Global Model ZINB No Chlorophyll A	22	6238.607	716.42824	2.688965e-156	2.688908e-156	-3097.288	1.0000000

Table S5: manta model rankings and AIC

Model Name	K	AICc	Delta AICc	ModelLik	AICcWt	LL	Cum.Wt
Global Model ZINB No Lunar	15	9192.312	0	1.000000e+00	9.999705e-01	-4581.148	.9999705
Global Model ZINB No SST	22	9213.605	21.29283	2.378595e-05	2.378525e-05	-4584.786	.9999943
Global Model ZINB No Salinity	22	9217.429	25.11723	3.514492e-06	3.514389e-06	-4586.698	.9999978
Global Model ZINB	23	9218.396	26.08350	2.167900e-06	2.167836e-06	-4586.179	1.000000
Global Model ZINB No Current/Visibility	21	9328.349	136.03726	2.883259e-30	2.883174e-30	-4643.160	1.000000
Global Model ZINB No Temperature at Depth	22	10007.223	814.91111	1.107391e-177	1.107359e-177	-4981.596	1.000000
Global Model ZINB No Chlorophyll A	22	10453.482	1261.16965	1.381943e-274	1.381902e-274	-5204.725	1.000000

Table S6: mobula model rankings and AIC

Model Name	K	AICc	Delta AICc	ModelLik	AICcWt	LL	Cum.Wt
Global Model ZINB No Lunar	15	16428.02	0	1.000000e+00	4.916905e-01	-8198.99	.4916905
Global Model ZINB No SST	22	16428.79	.7702069	6.803802e-01	3.345365e-01	-8192.376	.8262270
Global Model ZINB No Salinity	23	16430.10	2.0852498	3.525281e-01	1.733347e-01	-8192.032	.9995617
Global Model ZINB	22	16442.06	14.0453428	8.914409e-04	4.383130e-04	-8199.013	1.000000
Global Model ZINB No Current/Visibility	21	16740.66	312.6419826	1.290197e-68	6.343776e-69	-8349.313	1.000000
Global Model ZINB No Temperature at Depth	22	17511.75	1083.7385413	4.668376e-236	2.295396e-236	-8733.961	1.000000
Global Model ZINB No Chlorophyll A	22	18840.55	2412.5393289	0.000000e+00	0.000000e+00	-9398.261	1.000000

Table S7: Models used for AIC. Models were run for the presence and absence of the three species included in this study: mantas, mobulas, and whale sharks.

Model	Description
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Sea Surface Temperature + Salinity + Chlorophyll A + Lunar Distance + Lunar Phase + Current + Visibility + Year + sin () + cos()	Global Model
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Sea Surface Temperature + Salinity + Chlorophyll A + Current + Visibility + Year+ sin() + cos()	Global Model without Lunar Factors
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Sea Surface Temperature + Chlorophyll A + Lunar Distance + Lunar Phase + Current + Visibility + Year + sin() + cos()	Global Model without Salinity
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Sea Surface Temperature + Salinity + Lunar Distance + Lunar Phase + Current + Visibility + Year + sin() + cos()	Global Model without Chlorophyll A
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Salinity + Chlorophyll A + Lunar Distance + Lunar Phase + Current + Visibility + Year + sin() + cos()	Global Model without Sea Surface Temperature
Species Abundance ~ Ocean Nino Index + Sea Surface Temperature + Salinity + Chlorophyll A + Lunar Distance + Lunar Phase + Current + Visibility + Year+ sin() + cos()	Global Model without Temperature at Depth
Species Abundance ~ Ocean Nino Index + Temperature at Depth + Sea Surface Temperature + Salinity + Chlorophyll A + Lunar Distance + Lunar Phase + Year + sin() + cos()	Global Model without Current and Visibility