Supplementary Material

1 SUPPLEMENTARY METHODS

1.1 Ocean Voyager maintenance

The facility's water treatment and purification system for the 24 million liters of synthetic seawater (Instant Ocean/Spectrum Brands, Blacksburg, Virginia, USA) operates as a sophisticated closed recirculation system. It involves primary water treatment through protein skimming and high-rate sand filtration, facilitated by 70 Fybroc® pumps. The system further incorporates ozone disinfection (up to 30% side stream) and sulfur-based autotrophic denitrification (less than 1% side stream) for effective purification. Water then passes through a degas tower, maintaining appropriate gas balance and biological filtration, equipped with a 2.5-meter deep layer of AccuPac® plastic media (Brentwood Industries, Reading, Pennsylvania), covering a total surface area of 107,000 square meters. This setup allows for rapid system turnover of around 1 hour. Additionally, the system includes a recovery mechanism for backwash water from sand filters, which is processed and reused, significantly conserving water and sea salt resources. For a more in-depth explanation of the specialized water filtration device and exact details, please refer to Schreiber and Coco (2017) or Dove et al. (2011)

1.2 Time of day analyses

Day and night times were determined using the complete earth calculation (Sun, 2023) as a function of i) the Julian day at the time of observation, ii) the latitude, longitude, and altitude of the city of Atlanta, and finally iii) corrected for atmospheric refraction (US Department of Commerce, 2005). This calculation was performed on the full empirical datetime array of observations within the 4 years of study, hence the slight variations between black contours in figures S4 and S6.

1.3 Entropy and similarity indices

Shannon entropy, or the Shannon-Wiener index, H was calculated as follows:

$$H = -\sum_{i=1}^{k} p_i \log_2(p_i) \tag{S1}$$

where k is the number of depths and p_i is the proportion at each depth.

Simpson's similarity index l was calculated as follows:

$$l = \frac{\sum_{i=1}^{k} n_i(n_i - 1)}{N(N-1)} \tag{S2}$$

where k is the number of depths, n_i is the number of observations at each depth, and N is the total observations for that shark.

2 SUPPLEMENTARY TABLES AND FIGURES

2.1 Figures

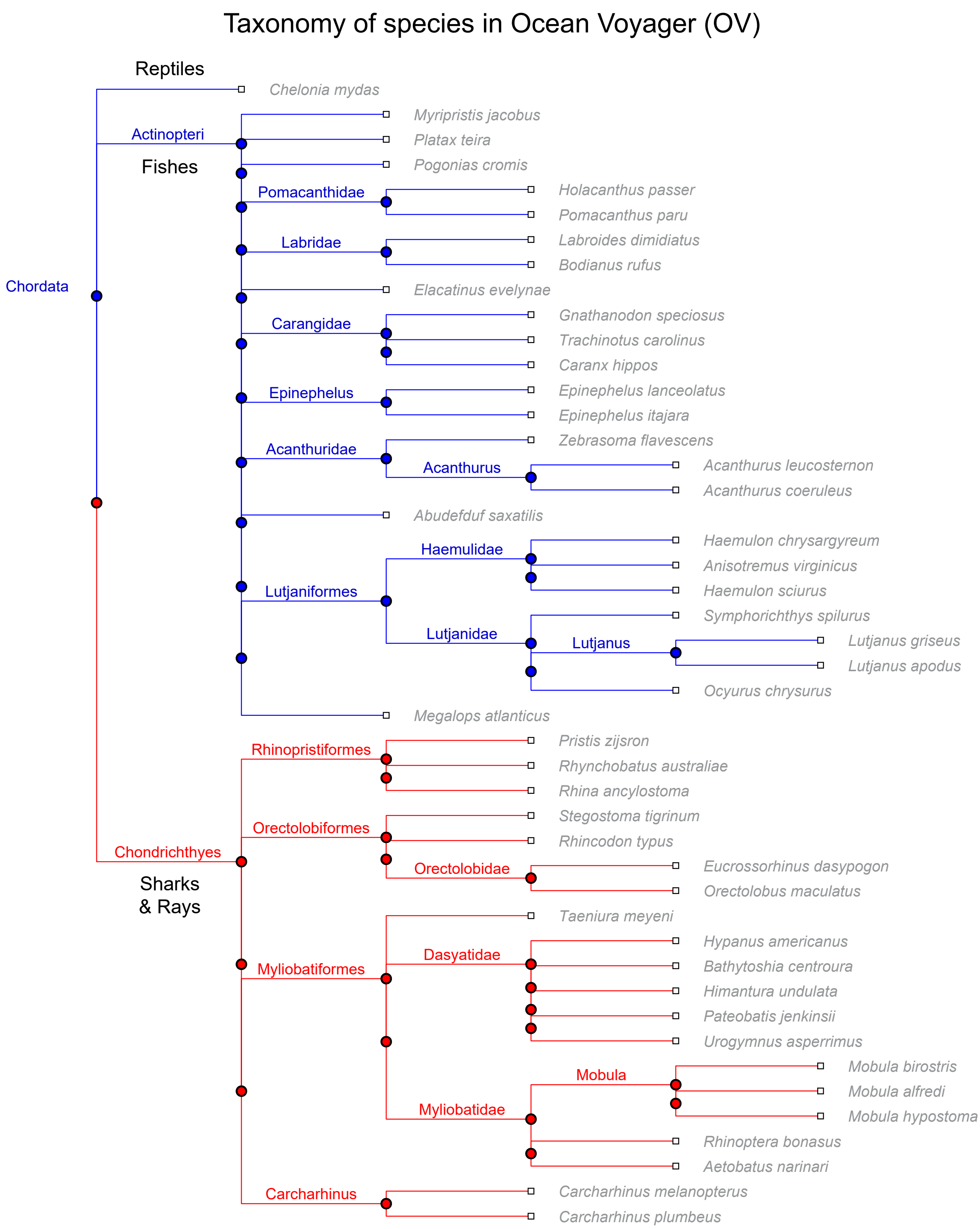

Figure S1. Species cohabitating in Ocean Voyager. OV is home to 46 species of fish, sharks and rays, and one reptile. Common name, scientific name, LSID, and their year of original description can be found in Table S1 below.

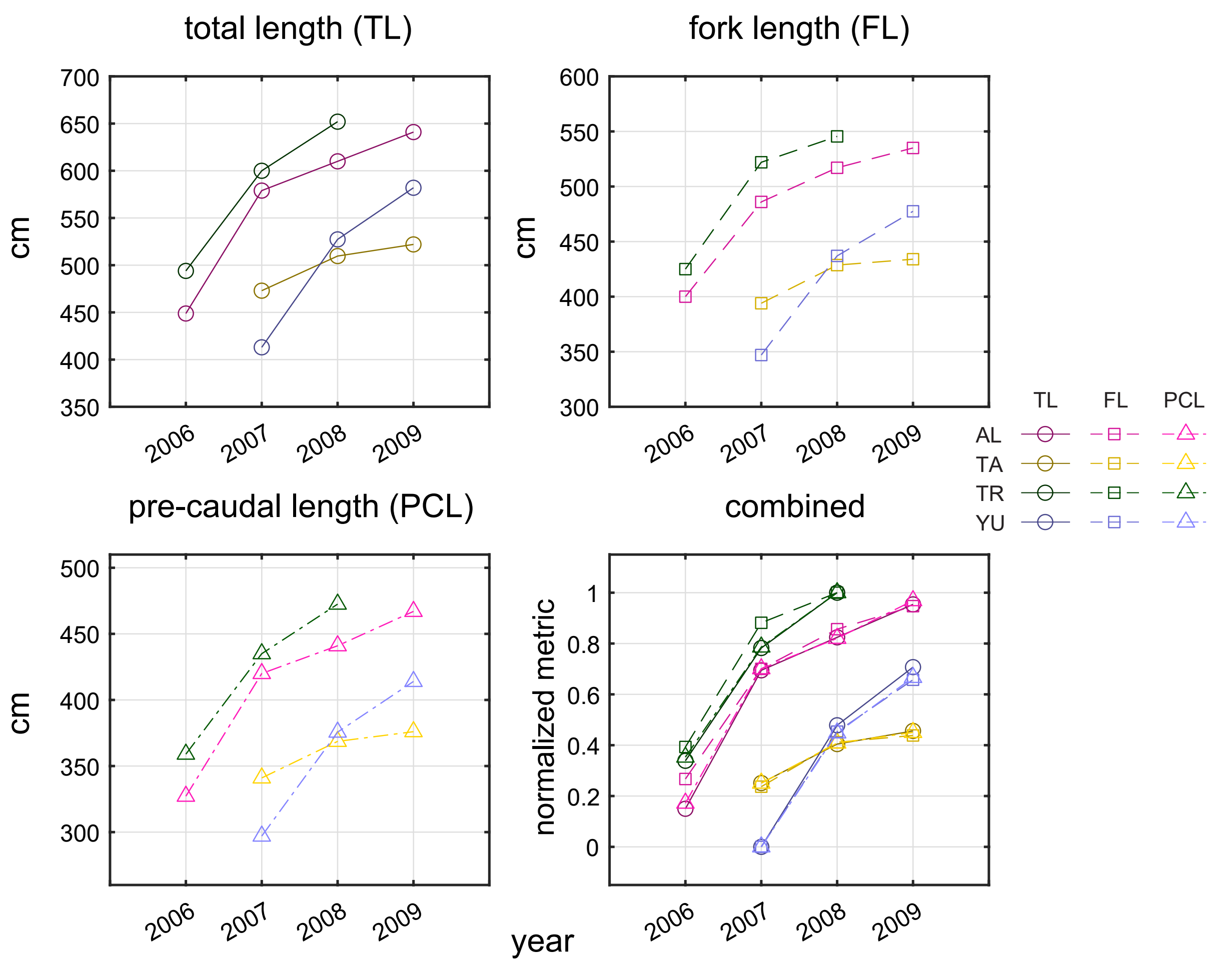

Figure S2. Concordant morphometric measurements for each shark each year. Common size metrics two years prior to study onset and during the first two years of study. Normalized length measurements in the bottom right quadrant illustrate the correlated relationship between total length (TL), fork length (FL), and pre-caudal length (PCL).

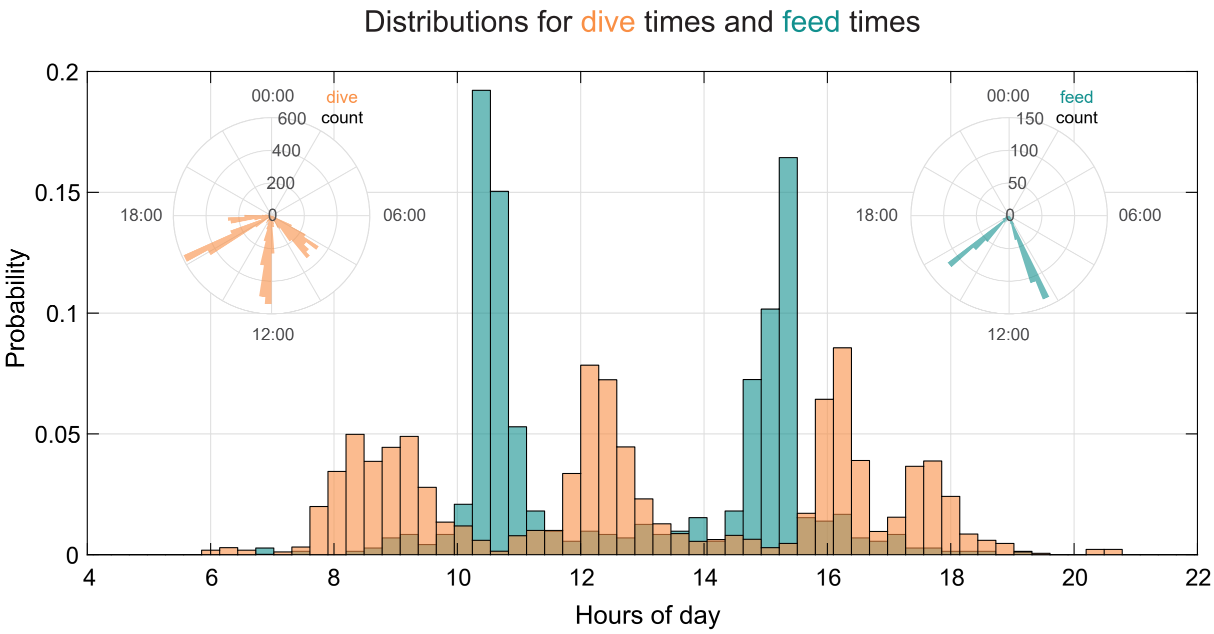

Figure S3. Divers were not present during feed. Time histograms juxtaposing periods where divers were indicated in the water with notes indicating shark feed.

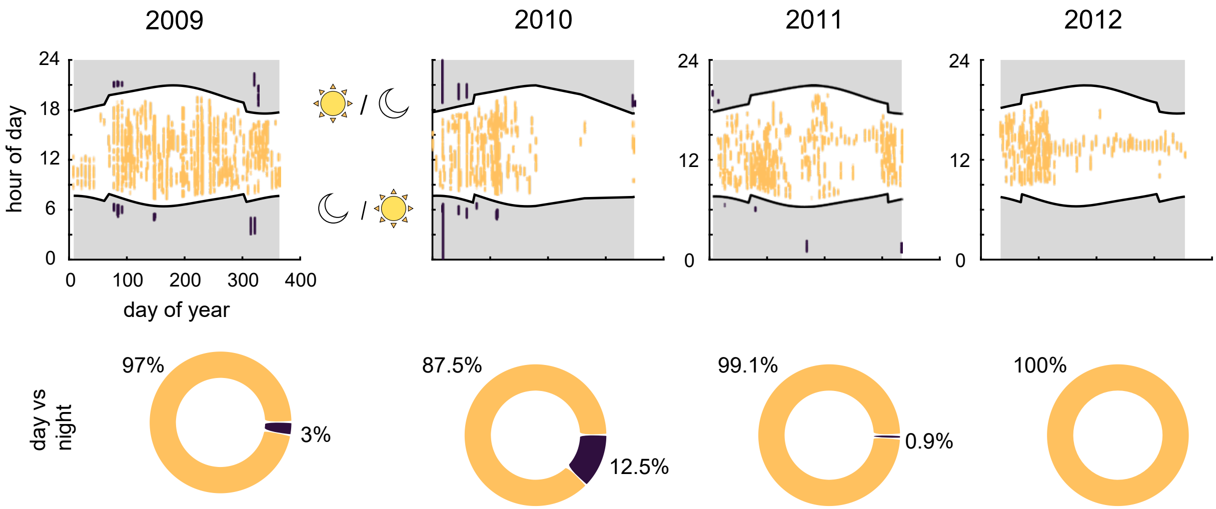

Figure S4. Expanded chronology of observations differentiating day and night for each full year. **Top:** Observations for years 2009-2012 of the study plotted as a raster, where each dot represents 1 observation with its corresponding day of year (x-axis) and time of day (y-axis), illustrating the chronology of active and inactive periods. Black lines near hours 6 and 18 show daylight hours (white region) and transitions to night (gray shaded region). **Bottom:** Proportion of observations for each year which fell into these daylight categories, expressed as a percentage.

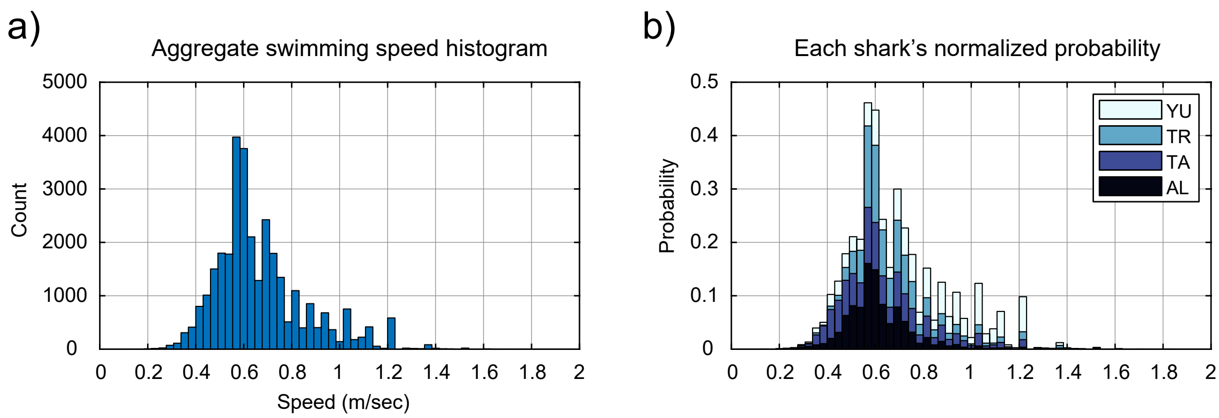

Figure S5. Raw aggregate and individually split speed distributions. (a) Histogram of the aggregate swimming speed of all sharks (N=4; mean = 0.67 m/sec). **(b)** Stacked histogram of swim speed normalized to a probability for each individual shark.

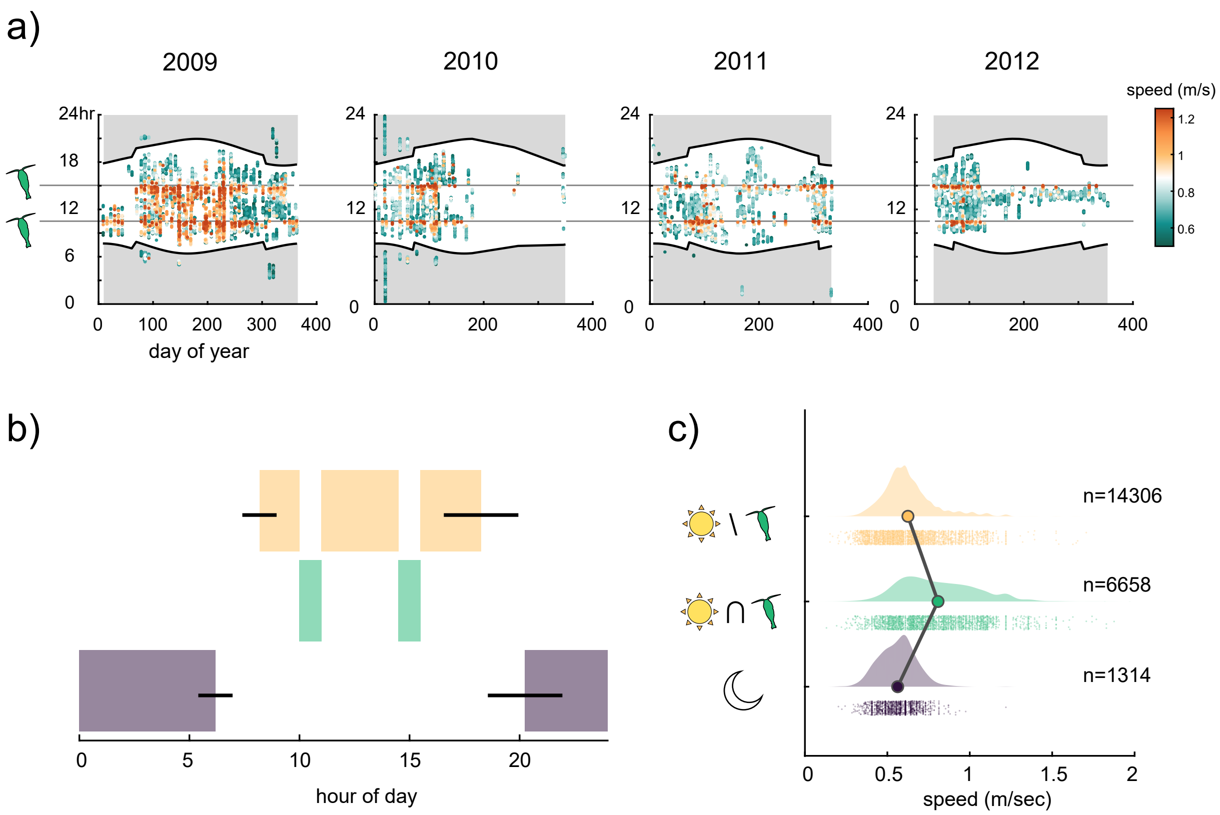

Figure S6. Expanded chronology shows feed times account for most of the values at the right-tail of the speed distribution. **(a)** Day and night split observations colored by shark swim speed, with feed times at plankton marked y-lines. Black contours again demarcate daylight hours (white region) and transitions to night (gray shaded region). **(b)** Illustrates the time windows that comprise three relevant analysis groups: the set difference between daylight and feed (i.e. daylight excluding feed; orange), the intersection of daylight and feed (green), and night-time observations (purple), with black lines representing the sliding nature of this definition based on the daylight savings (DLS)-corrected time of year. **(c)** Distributions for these three non-overlapping time windows ($\bar{X}_{D_{exclfeed}} = 0.62 \pm 0.16$, $\bar{X}_{D_{inclfeed}} = 0.81 \pm 0.23$, $\bar{X}_N = 0.56 \pm 0.11$)

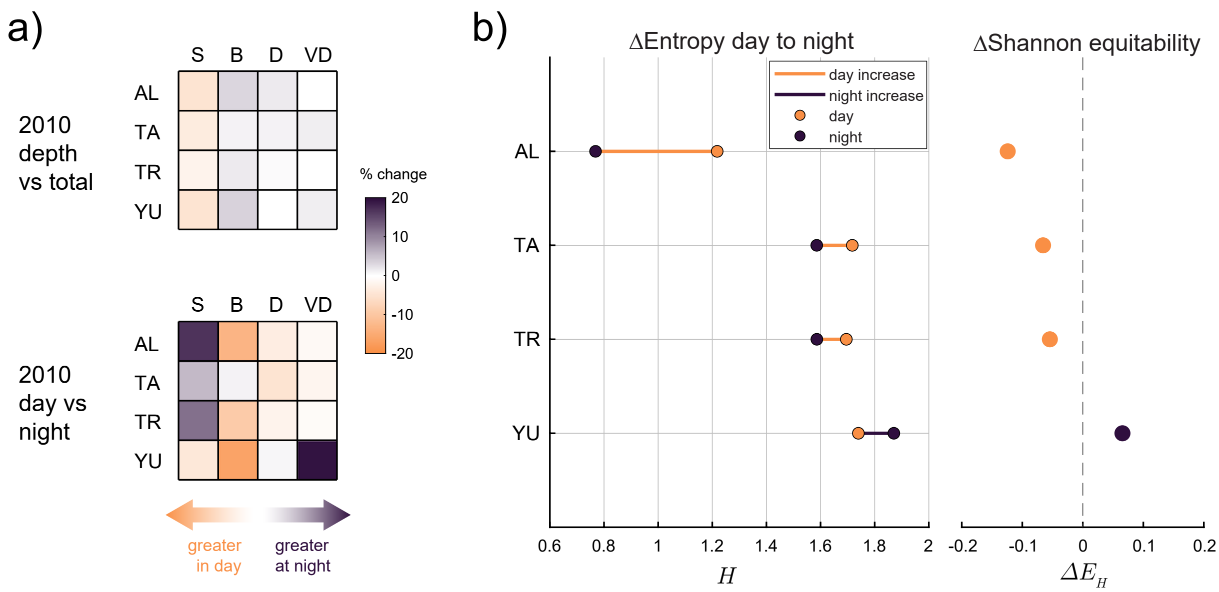

Figure S7. Differences in spatial preference from day to night. (a) Depth proportions for the year 2010 were highly representative of the overall depth preferences for the entire study (top). Day to night differences in 2010 plotted on the same scale show wider variability (bottom). **(b)** Shannon entropy (H) and change in Shannon equitability (ΔE_H) across 2010 day and night observations.

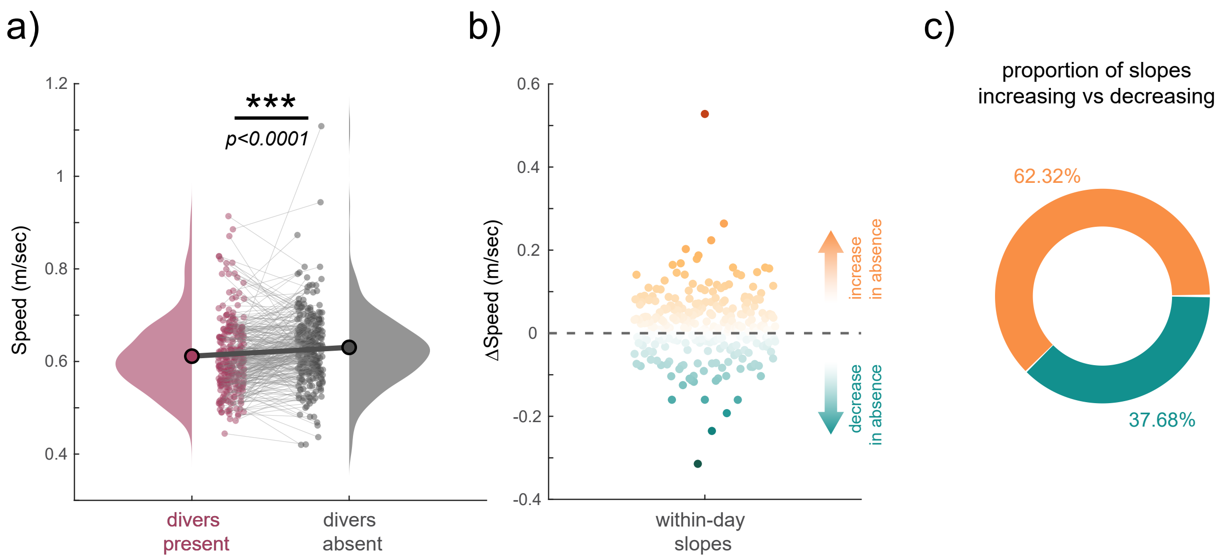

Figure S8. Marginal speed increase when divers are absent from the exhibit. **(a)** Within-day paired t-test of swim speed (excluding feed window) when divers were present or absent from the exhibit shows a slight mean speed increase in absence of divers $\bar{X}_{present} = 0.61 \pm 0.08$ vs $\bar{X}_{absent} = 0.63 \pm 0.08, t(275) = 3.96, p < 0.0001$. **(b)** Plotting the distributions of line slopes shows that speed increased more times than not in absence (orange), expressed as a percentage in **(c)**.

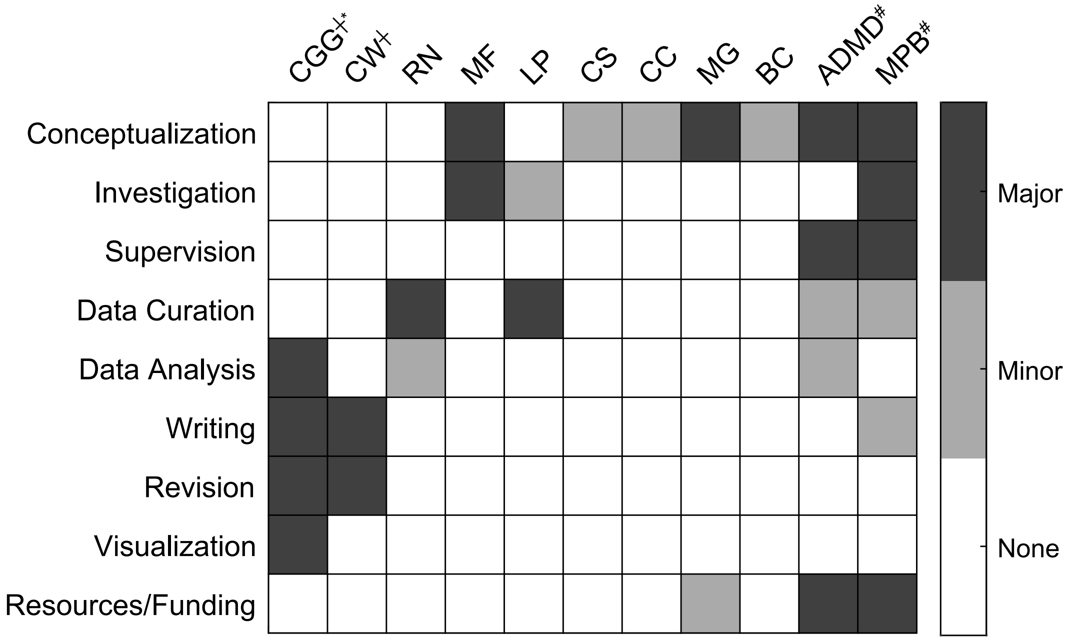

Figure S9. Specific contributions by all listed authors. Using 9 of 14 applicable terms from the Brand et al. (2015) CReDiT taxonomy.

Table S1: Entire species list for OV exhibit. LSIDs have the prefix "urn:lsid:marinespecies.org:taxname:", and were obtained from the World Register of Marine Species (WoRMS)

Class	Common name	Scientific name	LSID	Original description
Fish	Black Drum	*Pogonias cromis*	159333	Linnaeus, 1776
	Blackbar Soldierfish	*Myripristis jacobus*	159385	Cuvier, 1829
	Blue Tang SurgeonFish	*Acanthurus coeruleus*	159581	Bloch & Schneider, 1801
	Bluestreak Cleaner Wrasse	*Labroides dimidiatus*	219014	Valenciennes, 1839
	Bluestriped Grunt	*Haemulon sciurus*	275733	Shaw, 1803
	Crevalle Jack	*Caranx hippos*	126803	Linnaeus, 1776
	Florida Pompano	*Trachinotus carolinus*	159652	Linnaeus, 1766
	French Angelfish	*Pomacanthus paru*	276025	Bloch, 1787
	Giant Grouper	*Epinephelus lanceolatus*	218224	Bloch, 1790
	Golden Trevally	*Gnathanodon speciosus*	218429	Forsskål, 1775
	Goliath Grouper	*Epinephelus itajara*	159353	Lichtenstein, 1822
	Gray Snapper	*Lutjanus griseus*	159797	Linnaeus, 1758
	King Angelfish	*Holacanthus passer*	276016	Valenciennes, 1846
	Longfin Batfish	*Platax teira*	218710	Forsskål, 1775
	Porkfish	*Anisotremus virginicus*	279625	Linnaeus, 1758
	Powder Blue Tang	*Acanthurus leucosternon*	219628	Bennett, 1833
	Sailfin Snapper	*Symphorichthys spilurus*	282914	Günther, 1874
	Schoolmaster Snapper	*Lutjanus apodus*	159793	Walbaum, 1792
	Seargant Major	*Abudefduf saxatilis*	159288	Linnaeus, 1758
	Sharknose Goby	*Elacatinus evelynae*	280601	Böhlke & Robins, 1968
	Smallmouth Grunt	*Haemulon chrysargyreum*	275725	Günther, 1859
	Spanish Hogfish	*Bodianus rufus*	273541	Linnaeus, 1758
	Tarpon	*Megalops atlanticus*	126430	Valenciennes, 1847
	Yellow Tang	*Zebrasoma flavescens*	219683	Bennett, 1828
	Yellowtail Snapper	*Ocyurus chrysurus*	159803	Bloch, 1791
Sharks & Rays	Blacktip Reef Shark	*Carcharhinus melanopterus*	105795	Quoy & Gaimard, 1824
	Bottlenose Wedgefish	*Rhynchobatus australiae*	278217	Whitley, 1939
	Bowmouth Guitarfish	*Rhina ancylostoma*	217377	Bloch & Schneider, 1801
	Cownose Ray	*Rhinoptera bonasus*	158544	Mitchill, 1815
	Leopard Whipray	*Himantura undulata*	217413	Bleeker, 1852
	Lesser Devil Ray	*Mobula hypostoma*	158530	Bancroft, 1831
	Longcomb Sawfish	*Pristis zijsron*	217375	Bleeker, 1851
	Manta Ray	*Mobula birostris*	1026118	Walbaum, 1792
	Pointed-Nose Stingray	*Pateobatis jenkinsii*	1026118	Annandale, 1909
	Porcupine Ray	*Urogymnus asperrimus*	217424	Bloch & Schneider, 1801
	Reef Manta Ray	*Mobula alfredi*	1042871	Krefft, 1868
	Roughtail Stingray	*Dasyatis centroura*	105850	Mitchill, 1815
	Round Ribbontail Ray	*Taeniurops meyeni*	712972	Müller & Henle, 1841
	Sandbar Shark	*Carcharhinus plumbeus*	105797	Nardo, 1827
	Southern Stingray	*Hypanus americanus*	1042856	Hildebrand & Schroeder, 1928
	Spotted Eagle Ray	*Aetobatus narinari*	217426	Euphrasen, 1790
	Spotted Wobbegong	*Orectolobus maculatus*	281931	Bonnaterre, 1788

	Tasselled Wobbegong	*Eucrossorhinus dasypogon*	298163	Bleeker, 1867
	Whale Shark	*Rhincodon typus*	105847	Smith, 1828
	Zebra Shark	*Stegostoma tigrinum*	313100	Forster, 1781
Reptile	Green Sea Turtle	*Chelonia mydas*	137206	Linnaeus, 1758

Table S2. Depth observations for the entire study.

	Surface	Below Surface	Deep	Very Deep
AL	7236	2296	500	116
TA	3449	2909	1388	271
TR	3584	2872	1478	339
YU	2353	1275	726	288

Table S3. Pairwise Fisher's exact test of depth. Significant p-values are in **bold**.

Figure 4	Panel B					
Comparison		**Depth**	**Test**	**Bonferroni Correction**	**Critical p-value**	**Signif.**
Tested	Reference					
AL	TA	Surface	Fisher's exact	24 comparisons	5.21×10^{-4}	$\mathbf{p = 2.0 \times 10^{-323}}$
	TR					$\mathbf{p = 3.4 \times 10^{-322}}$
	YU					$\mathbf{p = 4.9 \times 10^{-131}}$
TA	TR					$p = 0.6922$
	YU					$\mathbf{p = 7.0 \times 10^{-17}}$
TR	YU					$\mathbf{p = 6.7 \times 10^{-16}}$
AL	TA	Below Surface	Fisher's exact	24 comparisons	5.21×10^{-4}	$\mathbf{p = 8.6 \times 10^{-91}}$
	TR					$\mathbf{p = 7.2 \times 10^{-74}}$
	YU					$\mathbf{p = 1.6 \times 10^{-10}}$
TA	TR					$p = 0.0376$
	YU					$\mathbf{p = 2.6 \times 10^{-24}}$
TR	YU					$\mathbf{p = 2.6 \times 10^{-17}}$
AL	TA	Deep	Fisher's exact	24 comparisons	5.21×10^{-4}	$\mathbf{p = 3.3 \times 10^{-162}}$
	TR					$\mathbf{p = 6.5 \times 10^{-175}}$
	YU					$\mathbf{p = 1.4 \times 10^{-106}}$
TA	TR					$p = 0.3543$
	YU					$p = 0.0142$
TR	YU					$p = 0.0012$
AL	TA	Very Deep	Fisher's exact	24 comparisons	5.21×10^{-4}	$\mathbf{p = 3.0 \times 10^{-25}}$
	TR					$\mathbf{p = 1.3 \times 10^{-37}}$
	YU					$\mathbf{p = 1.0 \times 10^{-68}}$
TA	TR					$p = 0.0149$
	YU					$\mathbf{p = 7.4 \times 10^{-14}}$
TR	YU					$\mathbf{p = 1.1 \times 10^{-7}}$

Table S4. Depth observations from 2010 split by day and night.

	Day				Night			
	Surface	**Below Surface**	**Deep**	**Very Deep**	**Surface**	**Below Surface**	**Deep**	**Very Deep**
AL	1175	457	114	18	188	29	8	0
TA	605	567	277	73	92	77	27	6
TR	585	517	261	58	95	49	29	6
YU	319	216	108	53	70	25	27	45

Table S5. Pairwise Fisher's exact tests of depth by day and night for a given shark against all others. Significant p-values are in **bold**.

Figure 4	**Panel C**					
Comparison		**Depth**	**Test**	**Bonferroni Correction**	**Critical p-value**	**Signif.**
Tested	Reference					
AL	all others	Surface	Fisher's exact	16 comparisons	7.81×10^{-4}	$p = 0.5703$
TA						$p = 0.4239$
TR						$p = 0.8526$
YU						$p = 0.0295$
AL	all others	Below Surface	Fisher's exact	16 comparisons	7.81×10^{-4}	$p = 0.0029$
TA						$p = 0.0060$
TR						$p = 0.6057$
YU						$p = 0.5529$
AL	all others	Deep	Fisher's exact	16 comparisons	7.81×10^{-4}	$p = 0.1524$
TA						$p = 0.2469$
TR						$p = 0.7257$
YU						$\mathbf{p = 3.9 \times 10^{-4}}$
AL	all others	Very Deep	Fisher's exact	16 comparisons	7.81×10^{-4}	$p = 0.0158$
TA						$\mathbf{p = 1.4 \times 10^{-4}}$
TR						$p = 0.0050$
YU						$\mathbf{p = 7.6 \times 10^{-13}}$

Table S6. Frequencies and comparisons for lead-follow interactions in Figure 5. Significant p-values are in **bold**.

Figure 5	**Panel C**					
Comparison		**Count**	**Test**	**Bonferroni Correction**	**Critical p-value**	**Signif.**
Leader	Follower					
AL	TA	388	Chi-square	12 comparisons	0.0042	$\mathbf{p = 3.3 \times 10^{-12}}$
	TR	341				$\mathbf{p = 2.7 \times 10^{-6}}$
	YU	99				$p = 1$
TA	AL	359	Chi-square	12 comparisons	0.0042	$\mathbf{p = 2.1 \times 10^{-15}}$
	TR	309				$\mathbf{p = 2.6 \times 10^{-5}}$
	YU	86				$p = 1$
TR	AL	268	Chi-square	12 comparisons	0.0042	$\mathbf{p = 8.8 \times 10^{-5}}$
	TA	273				$\mathbf{p = 4.0 \times 10^{-4}}$
	YU	105				$p = 0.27$
YU	AL	93	Chi-square	12 comparisons	0.0042	$p = 0.84$
	TA	92				$p = 0.98$
	TR	69				$p = 1$

REFERENCES

[Dataset] (2023). Sunrise equation. https://en.wikipedia.org/wiki/Sunrise_equation#Complete_calculation_on_Earth

Brand, A., Allen, L., Altman, M., Hlava, M., and Scott, J. (2015). Beyond authorship: Attribution, contribution, collaboration, and credit. *Learned Publishing* 28, 151–155. doi:10.1087/20150211

Dove, A. D. M., Coco, C., Binder, T., Schreiber, C., Davis, R., Carlson, B., et al. (2011). Acquisition, Husbandry, And Veterinary Care Of Whale Sharks (Rhincodon typus Smith 1828) In An Aquarium Setting. In *Third Bilateral Conference Between the United States and Russia* (Shepherdstown, WV: Khaled bin Sultan Living Oceans Foundation), 12–20

Schreiber, C. and Coco, C. (2017). Husbandry of Whale Sharks. In *The Elasmobranch Husbandry Manual II: Recent Advances in the Care of Sharks, Rays and Their Relatives* (Ohio Biological Survey). 87–98

[Dataset] US Department of Commerce, NOAA. (2005). ESRL Global Monitoring Laboratory - Global Radiation and Aerosols. https://gml.noaa.gov/grad/solcalc/calcdetails.html