

Supplementary Material

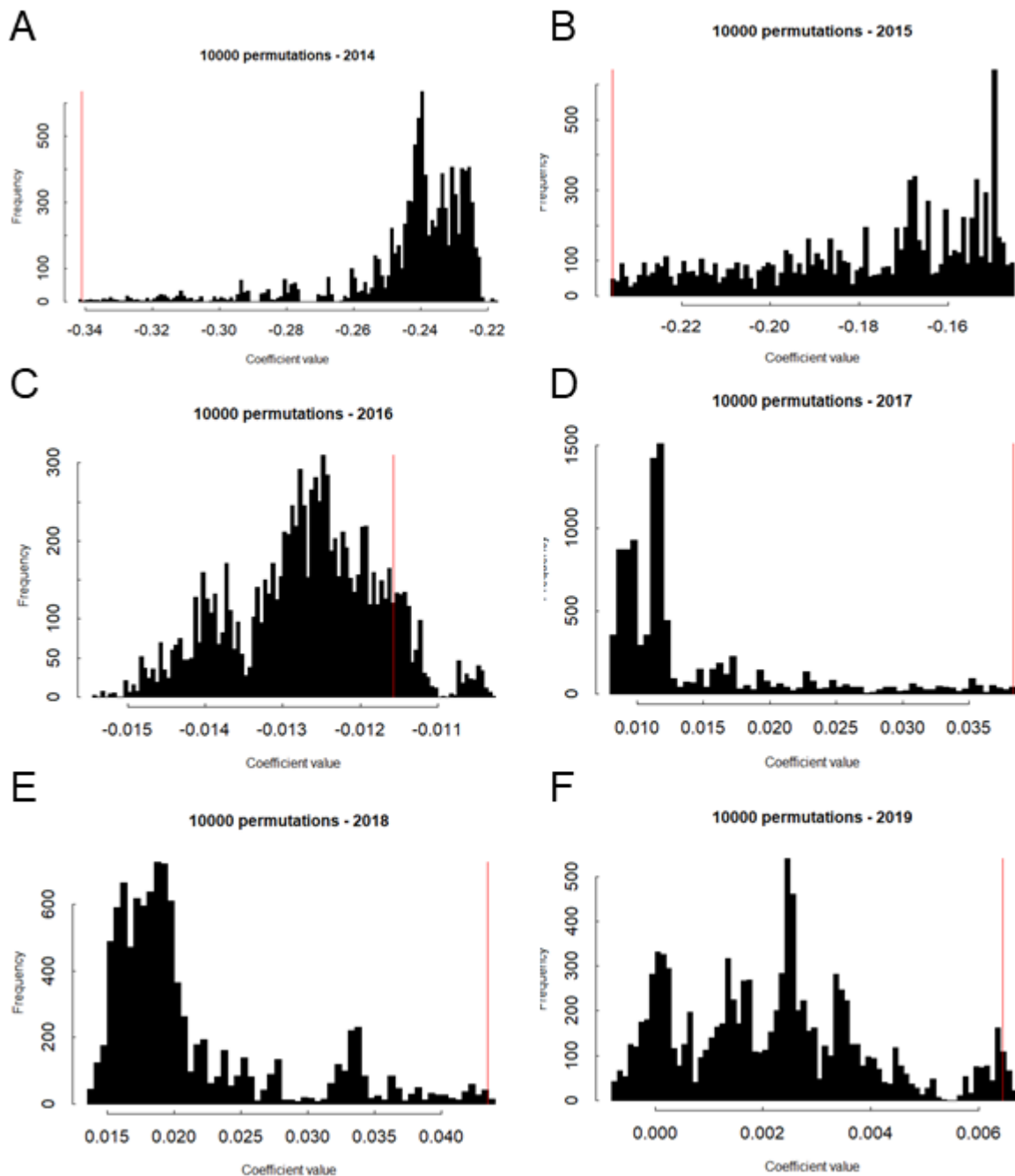


Figure S1: Plotted results of comparison of observed and permuted networks across individual years (2014 – 2019). Observed association strength indices (red line) were significantly different to permuted values ($p = 0.025$) for all year except 2016.

Table S1: Tagging meta data and tag information for all sharks considered in analyses

Shark ID	Sex	Size (TL cm)	Tag Year	Tag Type	Tag Family	Tag Power	Tag Life (days)	Tag Latitude	Tag Location
11_05	F	157	2011	internal	V16-6x-069k-1	High	3033	34.2462	Ventura
12_01	F	146	2012	internal	V16-6x-069k-1	High	3033	34.2462	Ventura
12_07	M	145	2012	internal	V16-6x-069k-1	High	3033	33.9910	Santa Monica Bay
12_08	M	143	2012	internal	V16-6x-069k-1	High	3033	34.1540	Ventura
13_01	F	159	2013	internal	V16-6x-069k-1	High	3033	33.9973	Santa Monica Bay
14_04	U	182	2014	dart	V13-1x-069k-3	High	362	33.8826	Santa Monica Bay
14_05	U	182	2014	dart	V13-1x-069k-3	High	362	33.8875	Santa Monica Bay
14_06	U	182	2014	dart	V13-1x-069k-3	High	362	33.8765	Santa Monica Bay
14_07	M	198	2014	internal	V16-6x-069k-1	High	3033	33.8798	Santa Monica Bay
15_01	U	152	2015	dart	V13-1x-069k-3	High	362	34.2462	Ventura
15_02	U	152	2015	dart	V13-1x-069k-3	High	362	34.2462	Ventura
15_03	U	152	2015	dart	V13-1x-069k-3	High	362	34.2462	Ventura
15_04	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_05	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_06	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_07	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_08	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_09	U	168	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_10	M	150	2015	internal	V16-6x-069k-1	High	3033	34.1522	Oxnard
15_12	U	152	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_14	U	182	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_15	U	152	2015	dart	V13-1x-069k-3	High	361	33.7237	Surfside
15_18	U	182	2015	dart	V13-1x-069k-3	High	362	33.7237	Surfside
15_19	F	164	2015	internal	V16-6x-069k-1	High	3033	34.4057	Santa Barbara
15_1MX	M	161	2015	internal	V16-6x-069k-2	High	3046	28.2139	Vizcaino
16_2MX	F	193	2016	internal	V16-6x-069k-2	High	3576	27.8671	Vizcaino
16_4MX	F	190	2016	internal	V16-6x-069k-2	High	3042	27.8751	Vizcaino
17_02	U	152	2017	dart	V13-1x-069k-3	High	3039	33.7514	Belmont
17_03	U	182	2017	dart	V13-1x-069k-3	High	653	33.7514	Belmont
17_04	U	152	2017	dart	V13-1x-069k-3	High	653	33.7514	Belmont
17_05	U	182	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_06	U	213	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_07	U	213	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_08	F	182	2017	internal	V16-6x-069k-1	High	3039	33.7514	Belmont
17_09	F	176	2017	internal	V16-6x-069k-1	High	3039	33.7514	Belmont
17_10	U	182	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_11	F	186	2017	internal	V16-6x-069k-1	High	3039	33.7514	Belmont
17_12	U	245	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_13	U	275	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point

Shark ID	Sex	Size (TL cm)	Tag Year	Tag Type	Tag Family	Tag Power	Tag Life (days)	Tag Latitude	Tag Location
17_14	U	275	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_15	U	275	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_16	U	182	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_17	U	213	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_18	U	243	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_19	M	149	2017	internal	V16-6x-069k-1	High	653	34.2462	Ventura
17_1MX	F	148	2017	internal	V16-6x-069k-2	High	653	27.8671	Vizcaino
17_20	F	144	2017	internal	V16-6x-069k-1	High	3033	34.1522	Oxnard
17_22	F	131.5	2017	internal	V16-6x-069k-1	High	3033	34.2462	Ventura
17_23	U	213	2017	dart	V13-1x-069k-3	High	3033	33.4590	Dana Point
17_24	U	274	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_26	U	304	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_27	U	304	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_28	U	304	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_29	U	274	2017	dart	V13-1x-069k-3	High	653	33.4590	Dana Point
17_2MX	M	152	2017	internal	V16-6x-069k-2	High	3033	27.8662	Vizcaino
17_30	F	168	2017	internal	V16-6x-069k-1	High	3033	34.4057	Santa Barbara
17_3MX	M	153	2017	internal	V16-6x-069k-2	High	3033	27.8657	Vizcaino
17_4MX	F	149	2017	internal	V16-6x-069k-2	High	3033	27.8533	Vizcaino
17_5MX	M	176	2017	internal	V16-6x-069k-2	High	3033	27.9127	Vizcaino
18_01	U	213	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_03	U	167	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_04	U	150	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_05	U	225	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_06	U	210	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_07	U	175	2018	dart	V13-1x-069k-3	High	653	34.4040	Santa Barbara
18_09	M	135	2018	internal	V16-6x-069k-1	High	3033	34.1522	Oxnard
18_10	F	139.5	2018	internal	V16-6x-069k-1	High	3033	34.1522	Oxnard
18_11	F	164	2018	internal	V16-6x-069k-1	High	3033	34.4057	Santa Barbara
18_13	U	325	2018	dart	V16-4x-069k-2	High	3033	36.4016	Rocky Point
18_14	U	350	2018	dart	V16-6x-069k-2	High	3033	35.2090	Diablo Canyon
18_15	U	228	2018	dart	V16-6x-069k-2	High	2088	35.2090	Diablo Canyon
18_17	U	230	2018	dart	V16-4x-069k-2	High	1825	35.2090	Diablo Canyon
19_01	M	166	2019	internal	V16-6x-069k-1	High	1825	34.1522	Oxnard
19_03	M	142	2019	internal	V16-6x-069k-1	High	2088	34.2462	Ventura
19_05	F	321	2019	dart	V13-1x-069k-3	High	602	34.4140	Santa Barbara
19_07	U	152	2019	dart	V13-1x-069k-3	High	602	32.9961	Solana Beach
19_08	F	154	2019	internal	V16-6x-069k-1	High	2088	34.4057	Santa Barbara
19_09	M	304.8	2019	dart	V16-4x-069k-2	High	3650	35.2090	Diablo Canyon
19_10	F	274.3	2019	dart	V16-5x-069k-2	High	3650	35.2090	Diablo Canyon
19_13	U	289.56	2019	dart	V16-4x-069k-2	High	2088	35.2090	Diablo Canyon
19_14	M	274.32	2019	dart	V16-4x-069k-2	High	2088	35.2090	Diablo Canyon
19_16	M	213.36	2019	dart	V16-6x-069k-1	High	2088	35.2090	Diablo Canyon

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Shark ID	Sex	Size (TL cm)	Tag Year	Tag Type	Tag Family	Tag Power	Tag Life (days)	Tag Latitude	Tag Location
19_17	F	213.36	2019	dart	V13-1x-069k-3	High	602	35.2090	Diablo Canyon
19_20	U	295	2019	dart	V16-4x-069k-2	High	3047	34.4040	Santa Barbara
19_21	U	272	2019	dart	V16-4x-069k-2	High	2088	34.4040	Santa Barbara

Table S2: Detection and network metadata for all sharks identified as nodes in significant communities. *N.b.* the column size class reflects assumed growth of sharks between detection years

Shark ID	Network Year	First Detection	Tag Type	Tag Life (days)	Last Detection	Days Detected	# Stations	Size Class	Sex	# Sharks Associated	# Distinct Regions	Mean Shared Time-groups	± SD
13_01	2014	2014-02-21	internal	3033	2014-12-31	168	10	3	F	4	2	1.75	0.50
14_04	2014	2014-11-07	dart	362	2014-12-31	44	8	3	U	3	2	2.67	0.58
14_05	2014	2014-11-07	dart	362	2014-12-31	44	7	3	U	2	2	3.00	0.00
14_06	2014	2014-11-07	dart	362	2014-12-31	45	6	3	U	1	2	3.50	0.71
13_01	2015	2015-01-01	dart	362	2015-11-01	149	15	4	F	5	4	5.40	1.52
14_04	2015	2015-01-01	dart	362	2015-12-24	128	13	4	U	3	2	3.33	0.52
14_06	2015	2015-01-01	dart	362	2015-08-11	75	10	4	U	2	2	2.00	0.00
15_01	2015	2015-03-20	dart	362	2015-06-08	47	2	2	U	2	3	3.00	1.41
15_02	2015	2015-04-22	dart	362	2015-06-08	80	3	2	U	1	1	2.00	0.00
15_04	2015	2015-05-22	dart	362	2015-12-10	200	4	2	U	10	4	4.40	2.95
15_05	2015	2015-05-22	dart	362	2015-10-13	154	6	2	U	9	4	3.11	2.03
15_06	2015	2015-05-22	dart	362	2015-07-13	135	5	2	U	7	4	2.00	1.15
15_07	2015	2015-05-22	dart	362	2015-12-13	83	4	2	U	4	2	1.75	1.50
15_08	2015	2015-05-22	dart	362	2015-12-12	47	4	2	U	1	1	1.00	0.00
15_11	2015	2015-08-05	dart	362	2015-10-29	86	5	2	U	2	1	1.00	0.00
15_12	2015	2015-08-05	dart	362	2015-09-19	44	5	2	U	2	1	1.50	0.71
12_08	2016	2015-12-31	internal	3033	2016-12-29	29	1	5	M	1	1	1.00	0.00
15_04	2016	2016-01-05	dart	362	2016-12-30	12	1	3	U	1	1	1.00	0.00
15_10	2016	2016-05-12	internal	3033	2016-05-23	46	6	3	M	1	1	1.00	0.00
15_18	2017	2017-02-10	dart	362	2017-08-01	59	10	5	U	1	1	1.00	0.00
15_19	2017	2017-02-17	internal	3033	2017-05-29	63	8	4	F	1	1	1.00	0.00
17_02	2017	2017-05-02	dart	362	2017-12-30	187	18	2	U	3	4	3.33	1.53
17_03	2017	2017-05-02	dart	362	2017-12-31	83	9	3	U	8	1	1.50	0.84
17_04	2017	2017-05-02	dart	362	2017-08-08	152	19	2	U	8	3	1.75	1.16

17_08	2017	2017-05-10	internal	3039	2017-12-31	177	22	3	F	2	3	1.50	0.71
Shark ID	Network Year	First Detection	Tag Type	Tag Life (days)	Last Detection	Days Detected	# Stations	Size Class	Sex	# Sharks Associated	# Distinct Regions	Mean Shared Time-groups	± SD
17_10	2017	2017-05-24	dart	653	2017-09-05	85	8	3	U	4	1	1.50	0.58
17_11	2017	2017-05-25	internal	3039	2017-08-06	42	11	3	F	3	1	1.00	0.00
17_13	2017	2017-06-02	dart	653	2017-10-28	48	10	7	U	2	1	1.00	0.00
17_14	2017	2017-06-03	dart	653	2017-09-07	68	10	7	U	1	1	3.00	0.00
17_24	2017	2017-09-30	dart	653	2017-10-21	19	2	7	U	2	1	1.50	0.71
17_26	2017	2017-09-30	dart	653	2017-11-30	35	2	8	U	1	1	2.00	0.00
15_19	2018	2018-01-01	internal	3033	2018-12-29	37	6	5	F	4	1	1.25	0.50
17_08	2018	2018-02-20	internal	3039	2018-06-30	181	23	4	F	1	1	1.00	0.00
17_13	2018	2018-03-27	dart	653	2018-05-24	36	4	8	U	6	1	2.00	0.89
17_29	2018	2018-03-27	dart	653	2018-05-24	18	5	8	U	5	2	2.00	1.41
18_01	2018	2018-03-29	dart	653	2018-09-27	53	5	4	U	3	1	1.00	0.00
18_03	2018	2018-04-15	dart	653	2018-07-09	28	5	2	U	2	1	1.50	0.71
18_06	2018	2018-04-15	dart	653	2018-08-18	45	9	4	U	1	1	1.00	0.00
18_14	2018	2018-11-16	internal	3033	2018-12-30	17	1	9	U	1	1	1.00	0.00
18_06	2019	2019-01-31	dart	653	2019-12-29	19	9	5	U	1	1	2.00	0.00
18_11	2019	2019-02-04	internal	3039	2019-12-31	51	22	3	F	1	1	1.00	0.00
18_13	2019	2019-03-20	dart	3033	2019-10-04	2	1	10	U	2	1	1.00	0.00
19_01	2019	2019-09-25	internal	1825	2019-11-23	55	12	2	M	1	1	1.00	0.00
19_09	2019	2019-09-25	dart	3650	2019-12-31	16	3	8	M	1	1	1.00	0.00
19_10	2019	2019-10-07	dart	3650	2019-12-31	23	4	7	F	2	2	1.50	0.71
19_13	2019	2019-10-07	dart	2088	2019-12-31	15	1	7	U	2	2	2.00	0.00
19_14	2019	2019-12-26	dart	2088	2019-12-27	63	1	7	M	1	1	1.00	0.00

Table S3: Comparison of AIC values in model selection. AIC values are shown for each of the three most parsimonious models in each year, along with Δ AIC values and associated weights for each reported model. Best model for all years was found to be association strength as a function of size class, plus the interaction of the number of detections, and the number of days detected.

Year	Model	AIC	Δ AIC	AIC weight
2014	strength~size.class + Detections*Days	4.66	0	0.818
2014	strength~Days	8.61	3.95	0.113
2014	null (strength ~ 1)	10.59	5.93	0.042
2015	strength~size.class + Detections*Days	6.68	0	0.996
2015	strength ~ Detections	18.89	12.21	0.002
2015	strength~size.class + Days	19.69	13.01	0.001
2016	strength~size.class + Detections*Days	9.02	0	0.902
2016	strength~ Detections + StatVis	13.52	4.5	0.095
2016	null (strength ~ 1)	21	11.98	0.002
2017	strength~size.class + Detections*Days	30.31	0	0.289
2017	null (strength ~ 1)	30.33	0.02	0.286
2017	strength~StatVis	31.26	0.95	0.179
2018	strength~size.class + Detections*Days	12.14	0	0.998
2018	strength~size.class	26.78	14.64	0.001
2018	null (strength ~ 1)	27.06	14.92	0.001
2019	strength~size.class + Detections*Days	-52.75	0	1
2019	strength~size.class + Days	-28.52	24.23	0
2019	strength~Days + size.class	-28.18	24.57	0