

SUPPLEMENTARY INFORMATION

Detection of habitat shifts of cetacean species: A comparison between 2010 and 2017 habitat suitability conditions in the Northwest Atlantic Ocean.

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Table S1. Number of animals seen on-effort from 2010 to 2017 by platform included in the habitat models.

Platform	HUWH	FIWH	SEWH	MIWH	SPWH	GOBW	SWBW	SFPW	LFPW	GRAM	WSDO	SADO	ASDO	STDO	BODO	HAPO
NE Shipboard	370	534	28	32	536	410	29	2082	666	3349	61	20082	1835	9948	4051	6
NE Aerial	219	131	56	133	22	5	0	238	174	825	4348	15166	0	621	1093	2826
SE Shipboard	77	65	33	12	238	238	1	1988	312	503	261	2223	3776	1463	3955	21
SE Aerial	17	40	0	18	10	10	1	1491	0	549	0	9183	3256	110	10328	13
TOTAL	683	770	117	195	806	663	31	5799	1152	5226	4670	46654	8867	12142	19427	2866

Table S2. Number of groups seen on-effort from 2010 to 2017 by platform included in the habitat models.

Platform	HUWH	FIWH	SEWH	MIWH	SPWH	GOBW	SWBW	SFPW	LFPW	GRAM	WSDO	SADO	ASDO	STDO	BODO	HAPO
NE Shipboard	157	346	20	32	325	152	28	232	41	509	3	449	63	237	361	4
NE Aerial	163	115	26	112	14	2	0	36	45	115	313	590	0	16	119	1047
SE Shipboard	46	42	28	9	120	120	1	107	44	56	27	69	107	15	215	11
SE Aerial	13	28	0	15	10	10	1	71	0	60	0	177	176	1	1073	8
TOTAL	379	531	74	168	469	284	30	446	130	740	343	1285	346	269	1768	1070

Table S3. Species analyzed from the 2010 to 2017 time period, model identification code and percent deviance explained (DE). For complete details, model fit and cross-validation see Palka *et al.* (2021).

Species	Model Code	Covariates	Total DE
Atlantic spotted dolphin	ASDO	6	37.8
Beaked whale, Cuvier's	GOBW	5	32
Beaked whale, Sowerby's	SWBW	5	41.2
Common bottlenose dolphin	BODO	7	27.9
Fin whale	FIWH	5	42.2
Harbor porpoise (Clustered)	HAPOc	5	55.7
Harbor porpoise (Spread)	HAPOs	4	30.8
Humpback whale	HUWH	8	41.7
Minke whale	MIWH	8	29.5
Short-finned pilot whale	SFPW	7	58.3
Long-finned pilot whale	LFPW	5	63.5
Risso's dolphin	GRAM	9	52.3
Sei whale	SEWH	3	39.1
Common dolphin	SADO	7	50.3
Sperm whale	SPWH	6	52.3
Striped dolphin	STDO	6	71.6
White-sided dolphin	WSDO	4	46.2

Table S4. Proportion of the estimated abundance included in the core habitat by species and seasons. Core habitat is defined as the upper 20% of predicted abundance values from the GAM fits. S-core = spring core habitat, SU-core= summer core habitat, F-core = fall core habitat, W-core= winter core habitat.

Species	2010				2017			
	S-core	SU-core	F-core	W-core	S-core	SU-core	F-core	W-core
Atlantic spotted dolphin	0.646	0.621	0.660	0.741	0.607	0.610	0.617	0.760
Beaked whale, Cuvier's		0.604				0.619		
Beaked whale, Sowerby's		0.864				0.877		
Common bottlenose dolphin	0.668	0.601	0.637	0.660	0.634	0.606	0.578	0.648
Fin whale	0.881	0.901	0.884	0.895	0.860	0.862	0.902	0.887
Harbor porpoise	0.720	0.916	0.828	0.657	0.754	0.926	0.864	0.800
Humpback whale	0.696	0.721	0.757	0.818	0.732	0.714	0.724	0.823
Minke whale	0.573	0.562	0.556	0.696	0.544	0.541	0.541	0.647
Short-finned pilot whale	0.799	0.781	0.795	0.850	0.806	0.768	0.784	0.825
Long-finned pilot whale	0.972	0.967	0.965	0.985	0.990	0.989	0.991	0.990
Risso's dolphin	0.725	0.751	0.743	0.722	0.738	0.738	0.782	0.767
Sei whale	0.630	0.674	0.683	0.710	0.553	0.598	0.570	0.570
Common dolphin	0.763	0.908	0.859	0.779	0.779	0.905	0.929	0.840
Sperm whale	0.680	0.658	0.675	0.644	0.625	0.650	0.658	0.635
Striped dolphin	0.957	0.950	0.957	0.937	0.930	0.922	0.911	0.920
White-sided dolphin	0.807	0.908	0.890	0.876	0.953	0.961	0.957	0.965

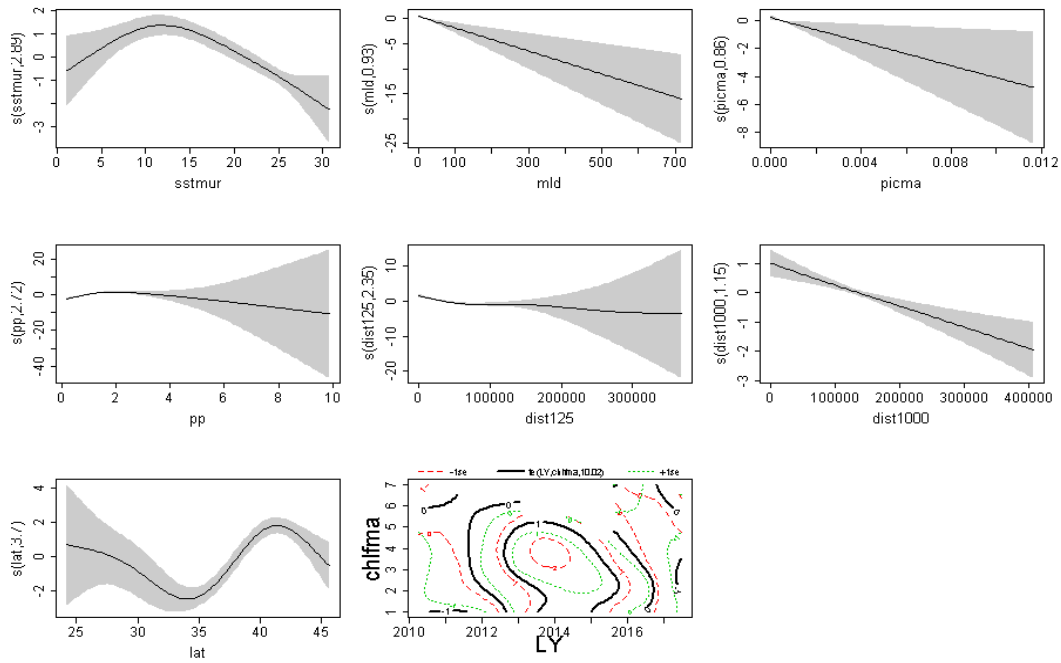


Figure S1. Humpback whale model partial smooths and interaction terms of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur = SST; mld= Mixed layer depth; picma= Particulate inorganic carbon; pp= Primary productivity; dist125= Distance to the 125m isobath; dist1000= Distance to the 1000m isobath; lat= Latitude; LY= Interaction term Chlorophyll fronts and 8-day period-Year.

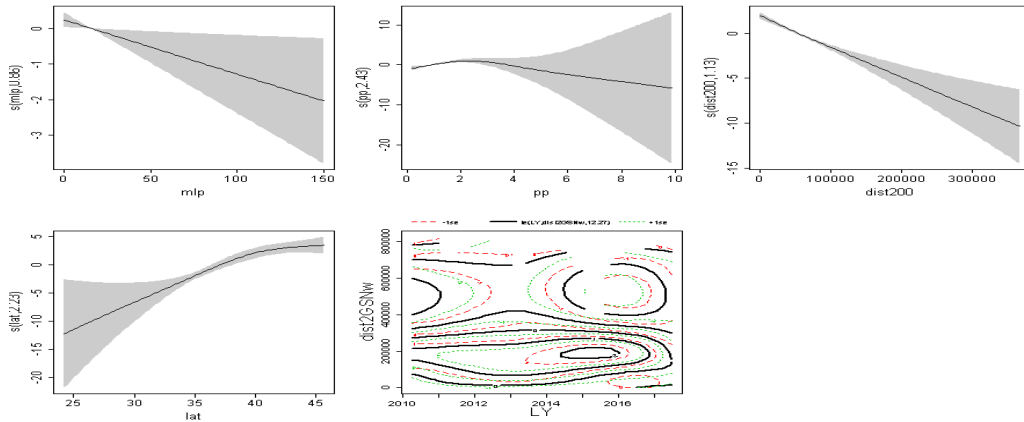


Figure S2. Fin whale model partial smooths and interaction terms of the density-habitat model, the shaded regions represent the 95% credible intervals. mld= Mixed layer depth; pp= Primary productivity; dist200= Distance to the 200m isobath; lat= Latitude; LY= Interaction term Distance to the Gulf Stream North wall and 8-day period-Year

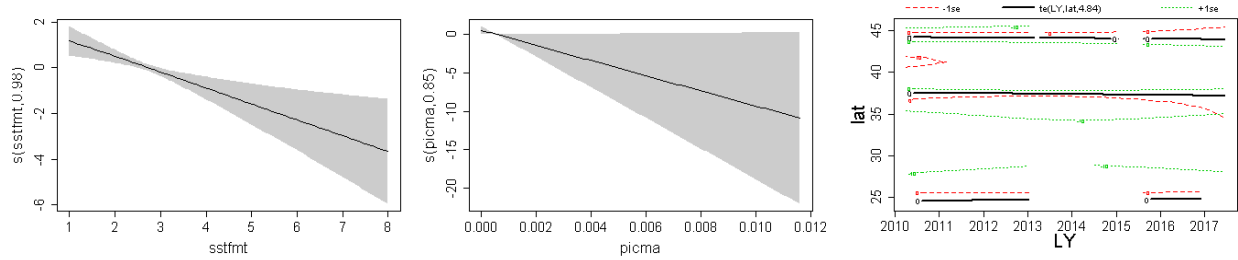


Figure S3. Sei whale model partial smooths and interaction terms of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur = SST; picma= Particulate inorganic carbon LY= Interaction term change in latitude and 8-day period-Year

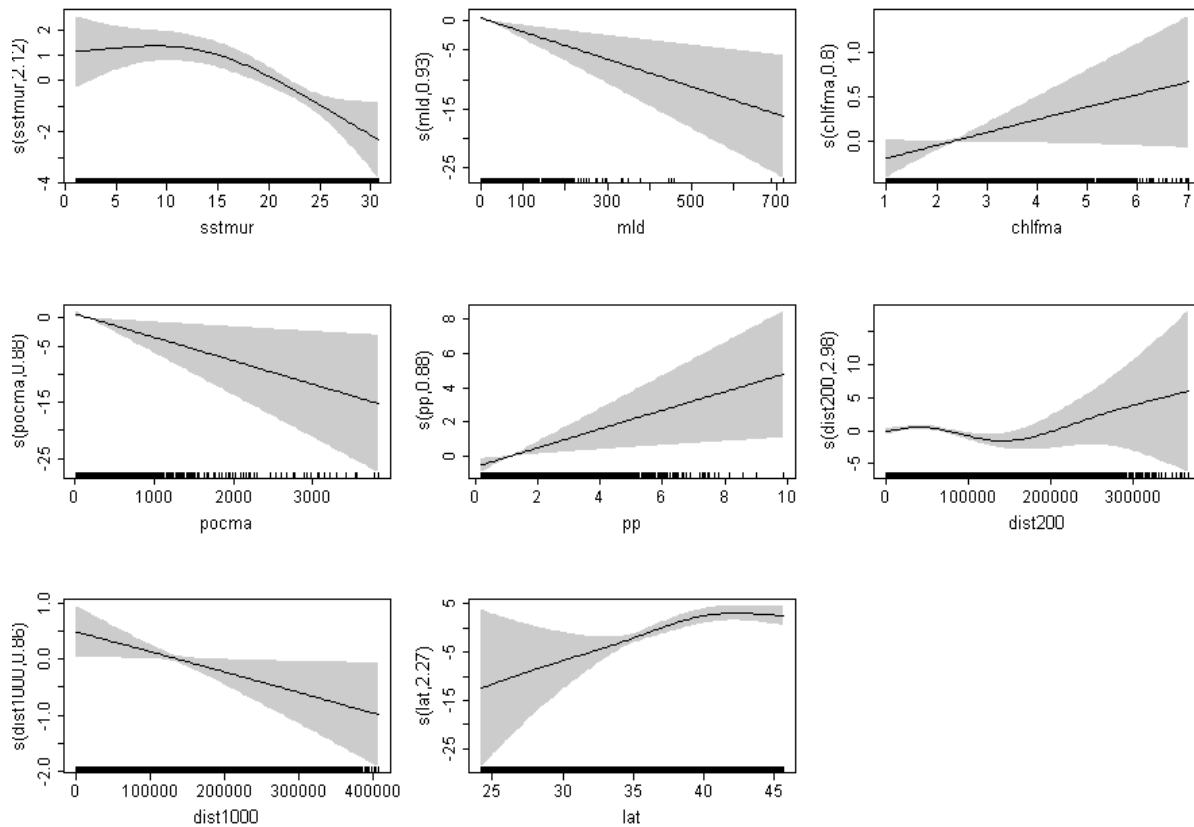


Figure S4. Minke whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur = SST; mld= Mixed layer depth; chlflma= Chlorophyll fronts; pocma= Particulate organic carbon; pp= Primary productivity; dist200= Distance to the 200m isobath; dist1000= Distance to the 1000m isobath; lat= Latitude

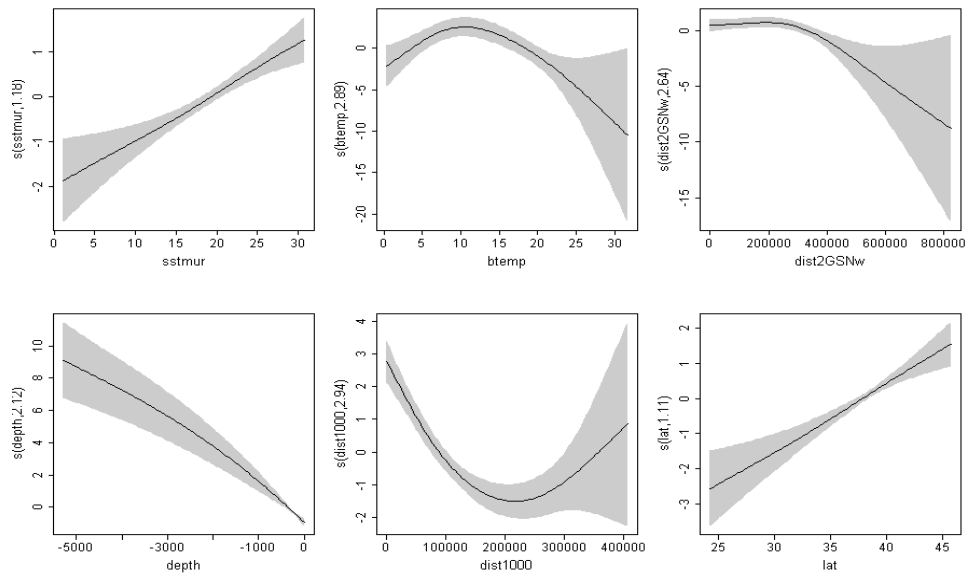


Figure S5. Sperm whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur = SST; btemp= Bottom temperature; dist2GSNw= Distance to the Gulf Stream North wall; depth= Depth; dist1000= Distance to the 1000m isobath; lat= Latitude

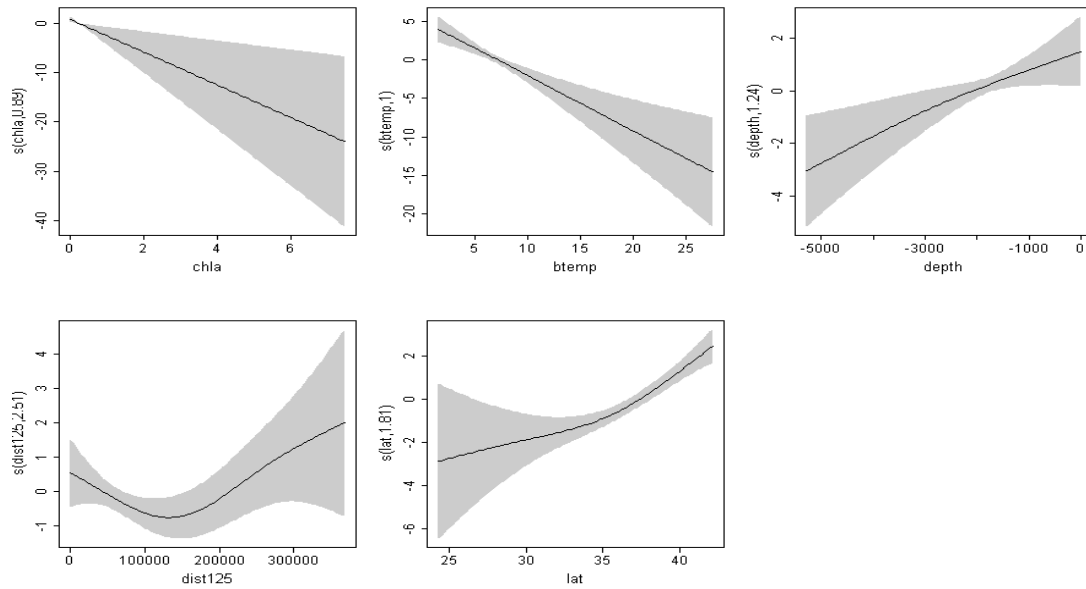


Figure S6. Cuvier's beaked whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chla = Chlorophyll; btemp= Bottom temperature; depth= Depth; dist125= Distance to the 125 m isobath; lat= Latitude

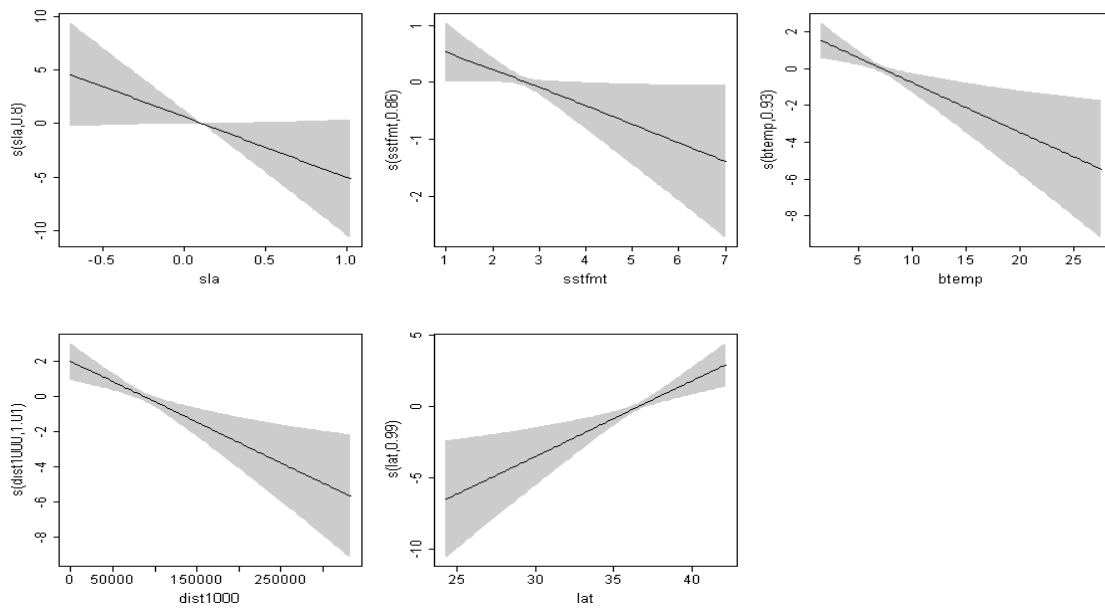


Figure S7. Sowerby's beaked whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sla = Sea Surface Height Anomaly; sstmt= SST; btemp= Bottom temperature; depth= Depth; dist1000= Distance to the 1000 m isobath; lat= Latitude

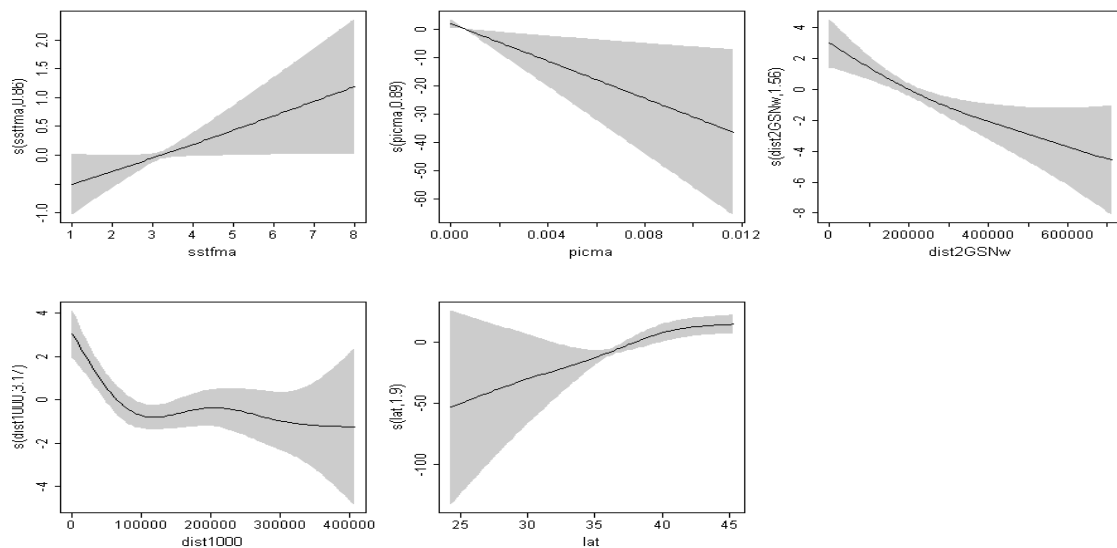


Figure S8. Long-finned pilot whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sstma= SST; picma= Particulate inorganic carbon; dist2GSNw= Distance to the Gulf Stream North wall; dist1000= Distance to the 1000 m isobath; lat= Latitude

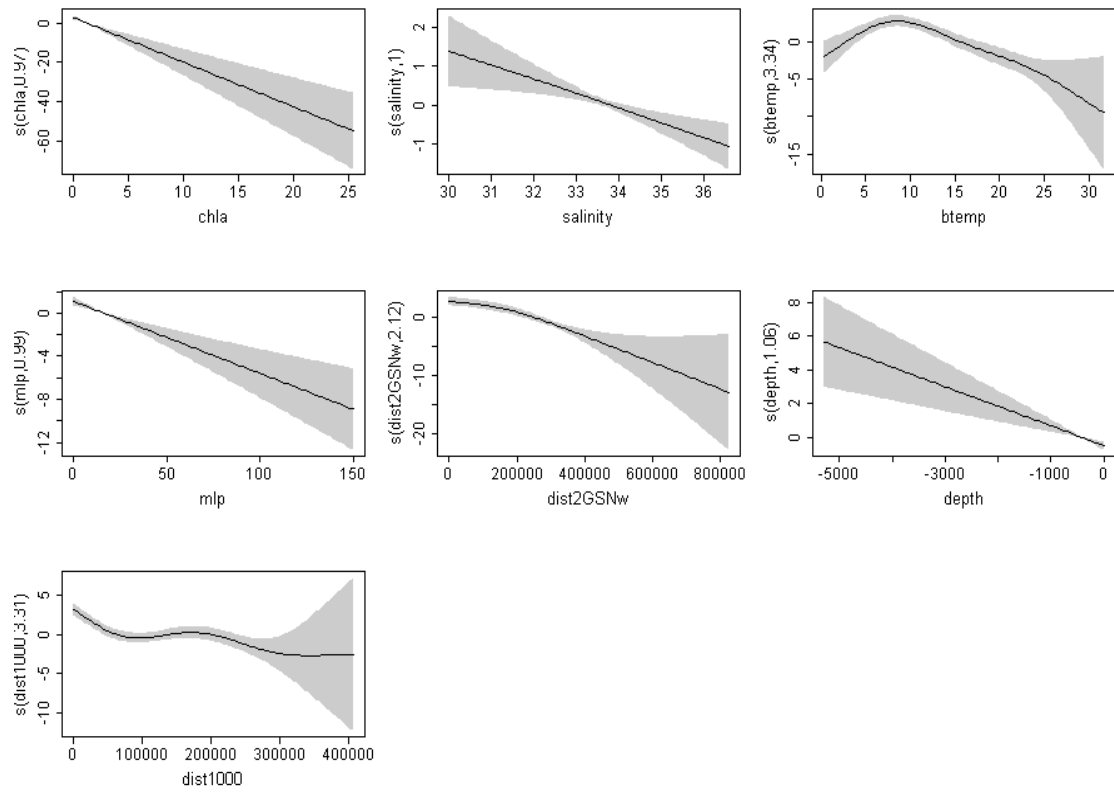


Figure S9. Short-finned pilot whale model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chla = Chlorophyll; salinity = Salinity; btemp = Bottom temperature; mlp = Mixed layer thickness; dist2GSNw = Distance to the Gulf Stream North wall; depth = Depth; dist1000 = Distance to the 1000 m isobath

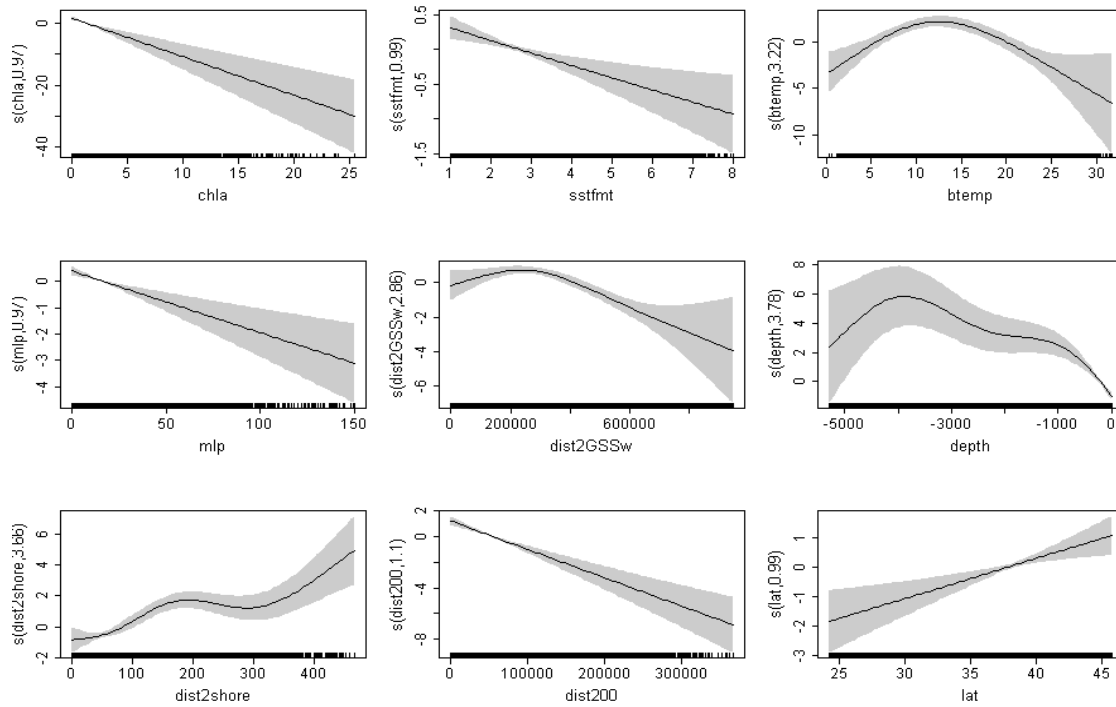


Figure S10. Risso's dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chla= Chlorophyll; sstfmt= SST; btemp= Bottom temperature; mlp= Mixed layer thickness; dist2GSSw= Distance to the Gulf Stream South wall; dist2shore= Distance to shore; dist200= Distance to the 200 m isobath; lat= Latitude

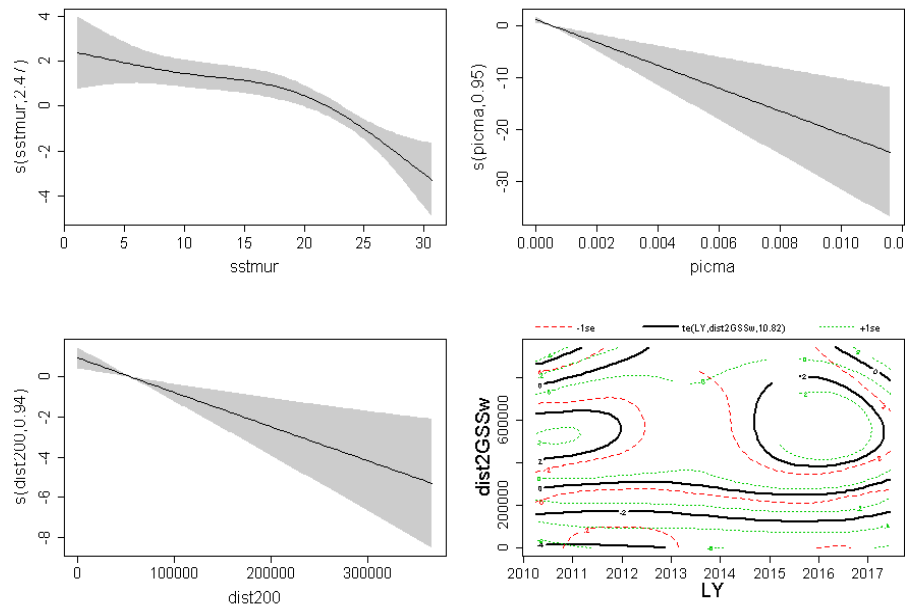


Figure S11. Atlantic white-sided dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur= SST; picma= Particulate inorganic carbon; dist200= Distance to the 200 m isobath; LY= Interaction term Distance to the Gulf Stream South wall and 8-day period-Year

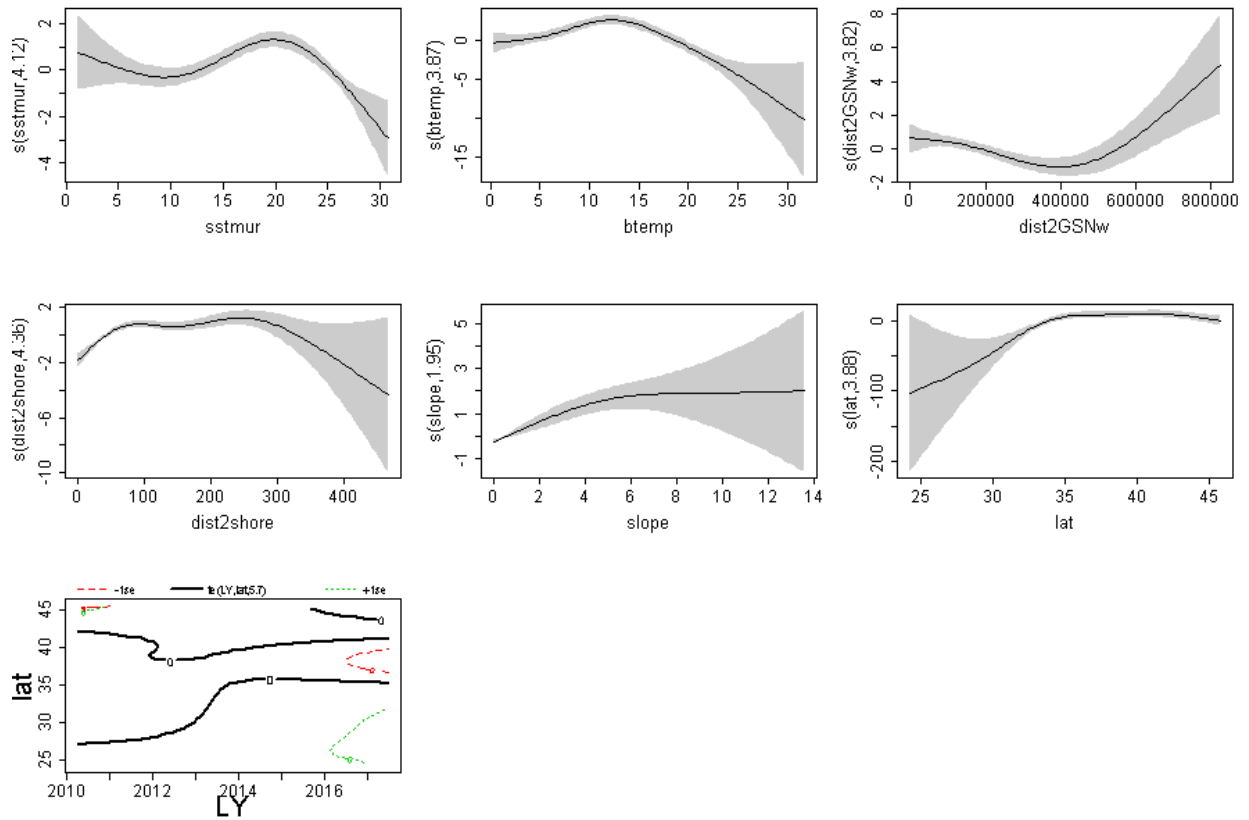


Figure S12. Common dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. sstmur= SST; btemp= Bottom temperature; dist2GSNw= Distance to the Gulf Stream North wall; dist2shore= Distance to shore; slope= Seafloor slope; lat= Latitude; LY= Interaction term latitude and 8-day period-Year

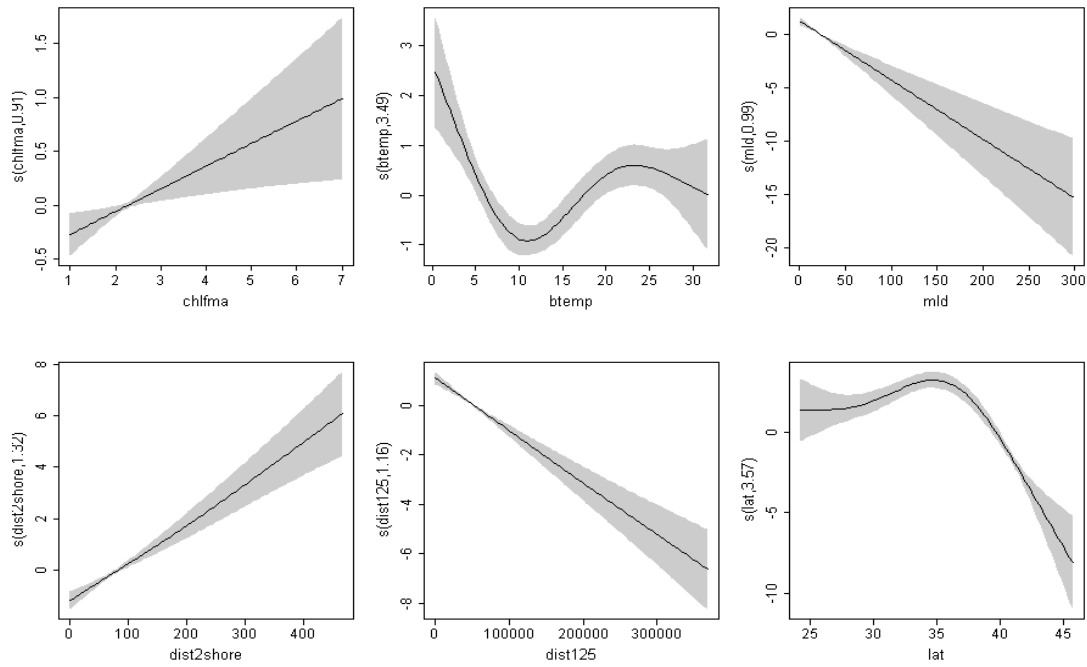


Figure S13. Atlantic spotted dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chlflma= Chlorophyll fronts; btemp= Bottom temperature mld= Mixed layer depth; dist2shore= Distance to shore; dist125= Distance to the 125 m isobath; lat= Latitude

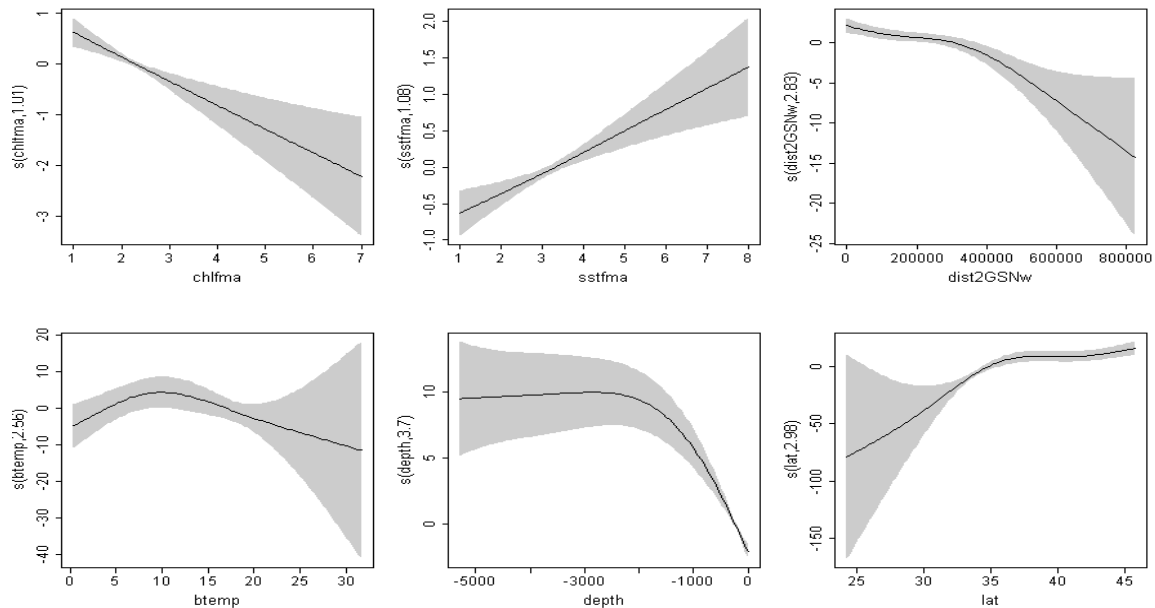


Figure S14. Striped dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chlflma= Chlorophyll fronts; sstflma= SST fronts; distGSNw= Distance to the Gulf Stream North wall; btemp= Bottom temperature depth= Depth; lat= Latitude

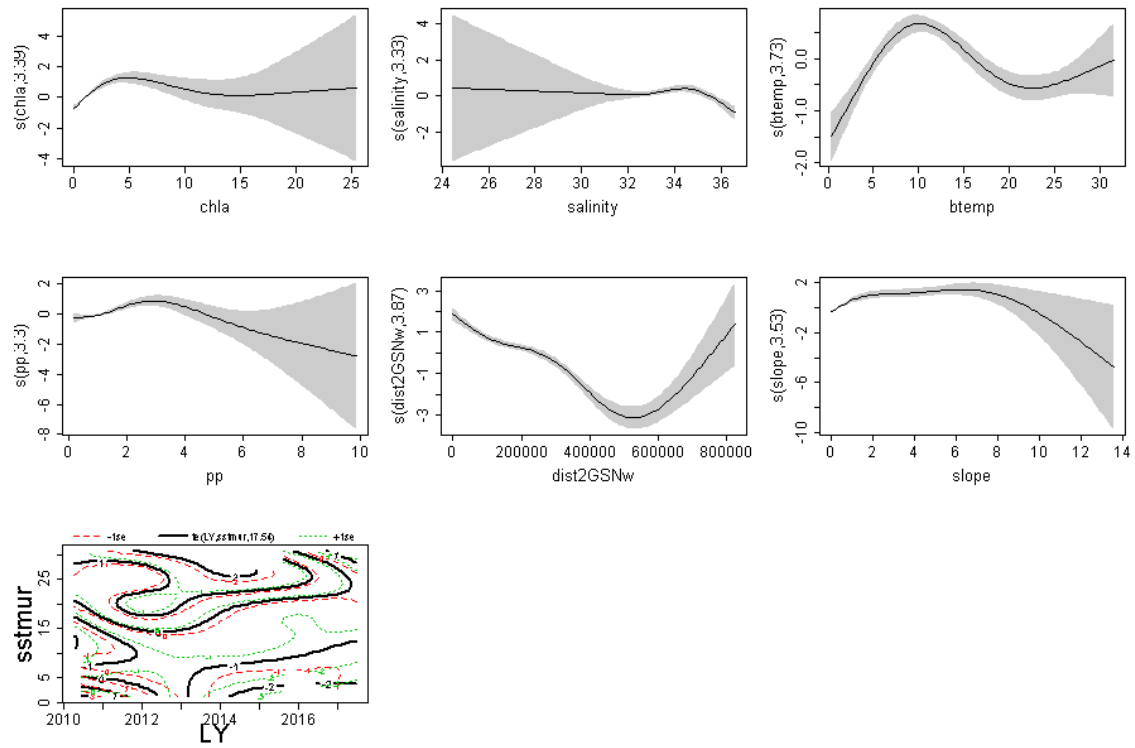


Figure S14. Common bottlenose dolphin model partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. chla= Chlorophyll; salinity= Salinity; btemp= Bottom temperature; pp= Primary productivity; distGSNw= Distance to the Gulf Stream North wall; slope= Seafloor slope; LY= Interaction term SST and 8-day period-Year

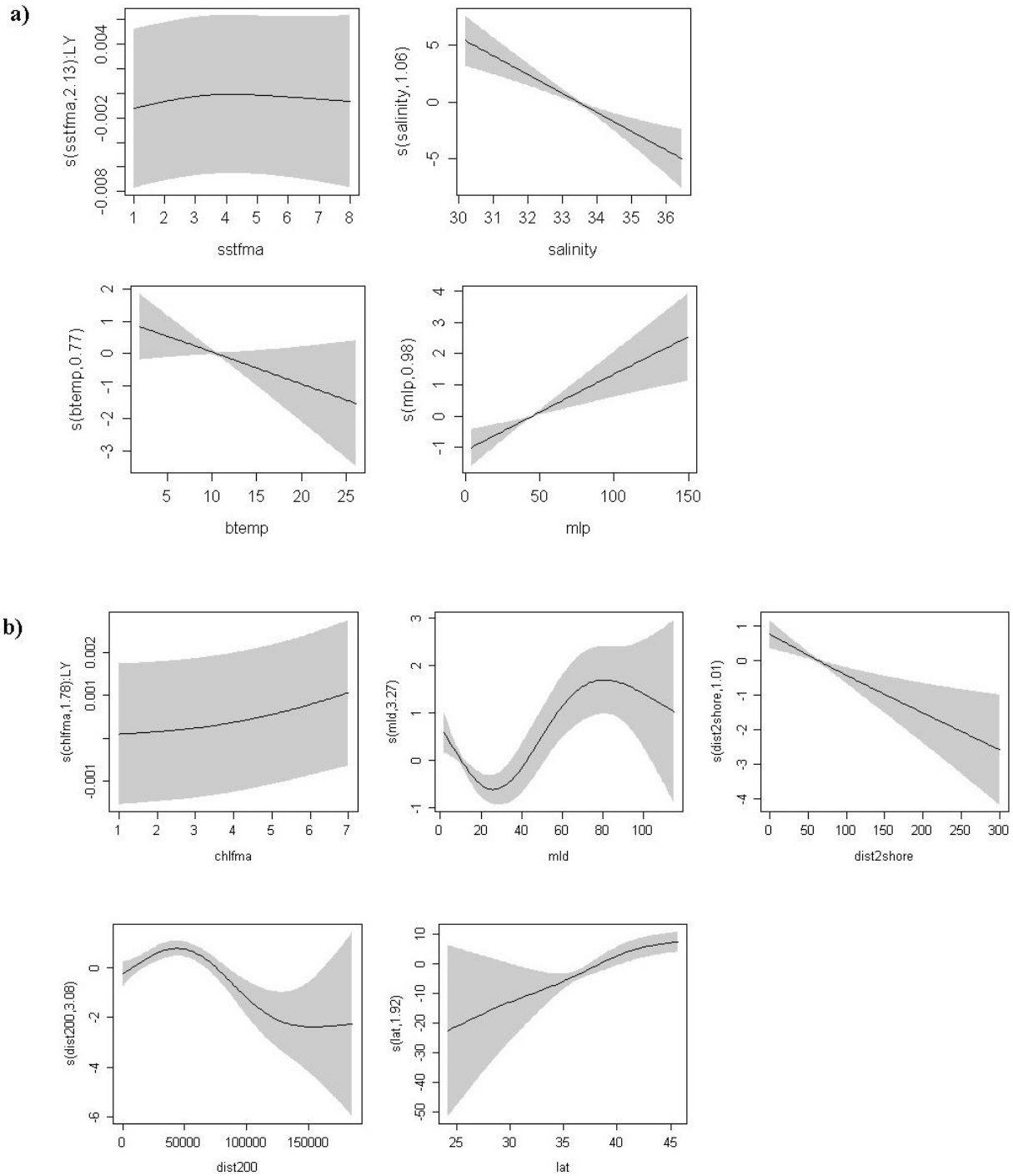


Figure S15. Harbor porpoise models partial smooths of the density-habitat model, the shaded regions represent the 95% credible intervals. (a) Spread out distribution model (November to May). Sstfma= SST fronts; salinity= Salinity; btemp= Bottom temperature; mlp= Mixed layer thickness. and (b) Compact distribution model (June to October. chlhma= Chlorophyll fronts; mld= Mixed layer depth; dist2shore= Distance to shore; dist200= Distance to the 200 m isobath; lat= Latitude

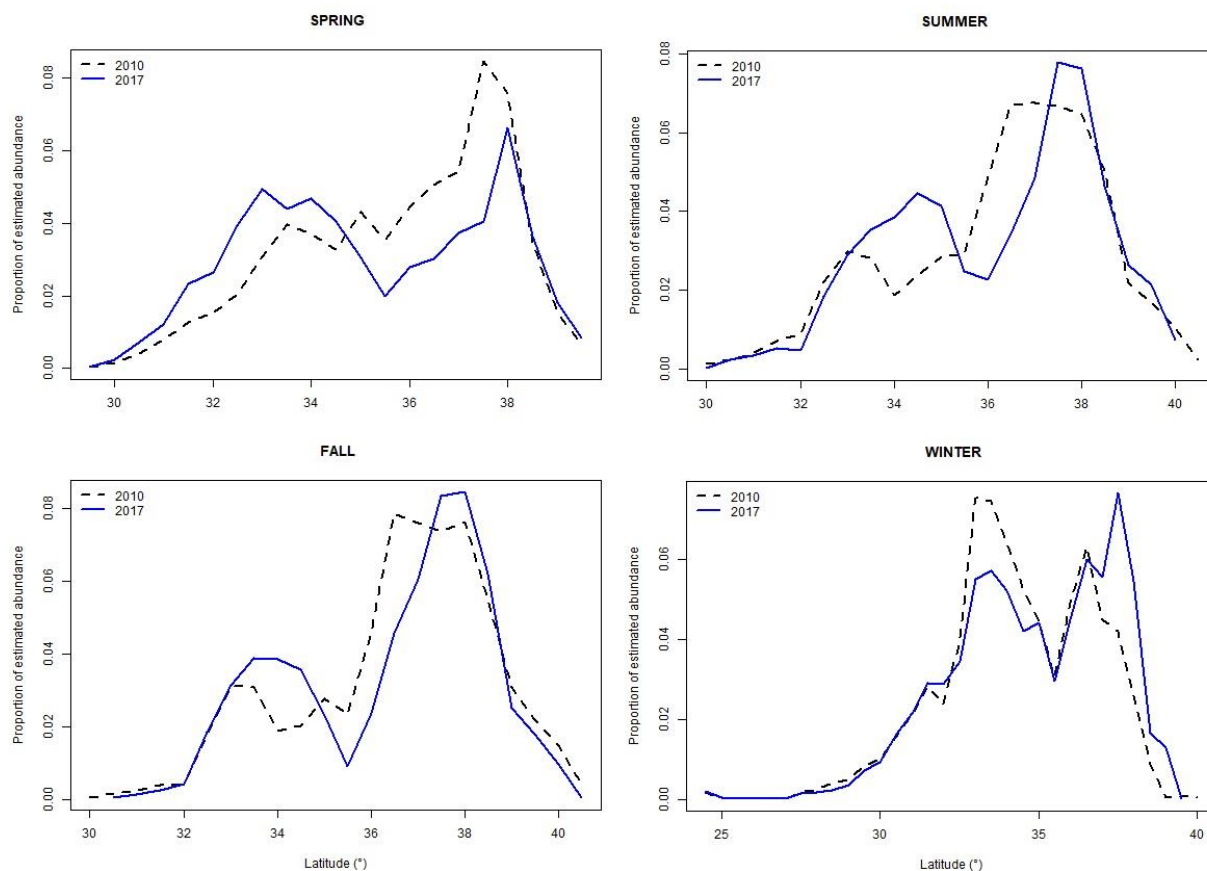


Figure S16. Seasonal comparison of the proportion of the estimated abundance within the core habitat for Atlantic spotted dolphin by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

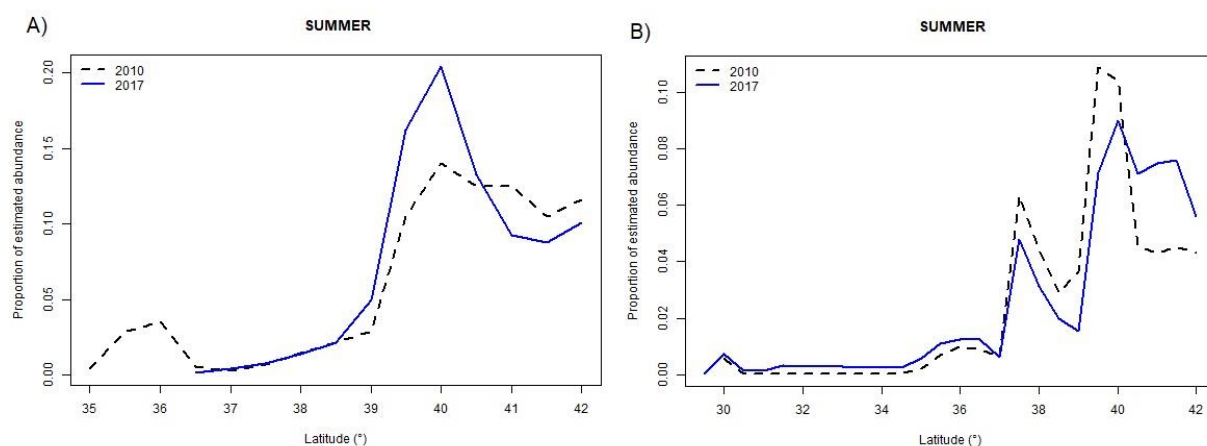


Figure S17. Summer comparison of the proportion of the estimated abundance within the core habitat for A) Sowerby's beaked whale and B) Cuvier's beaked whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

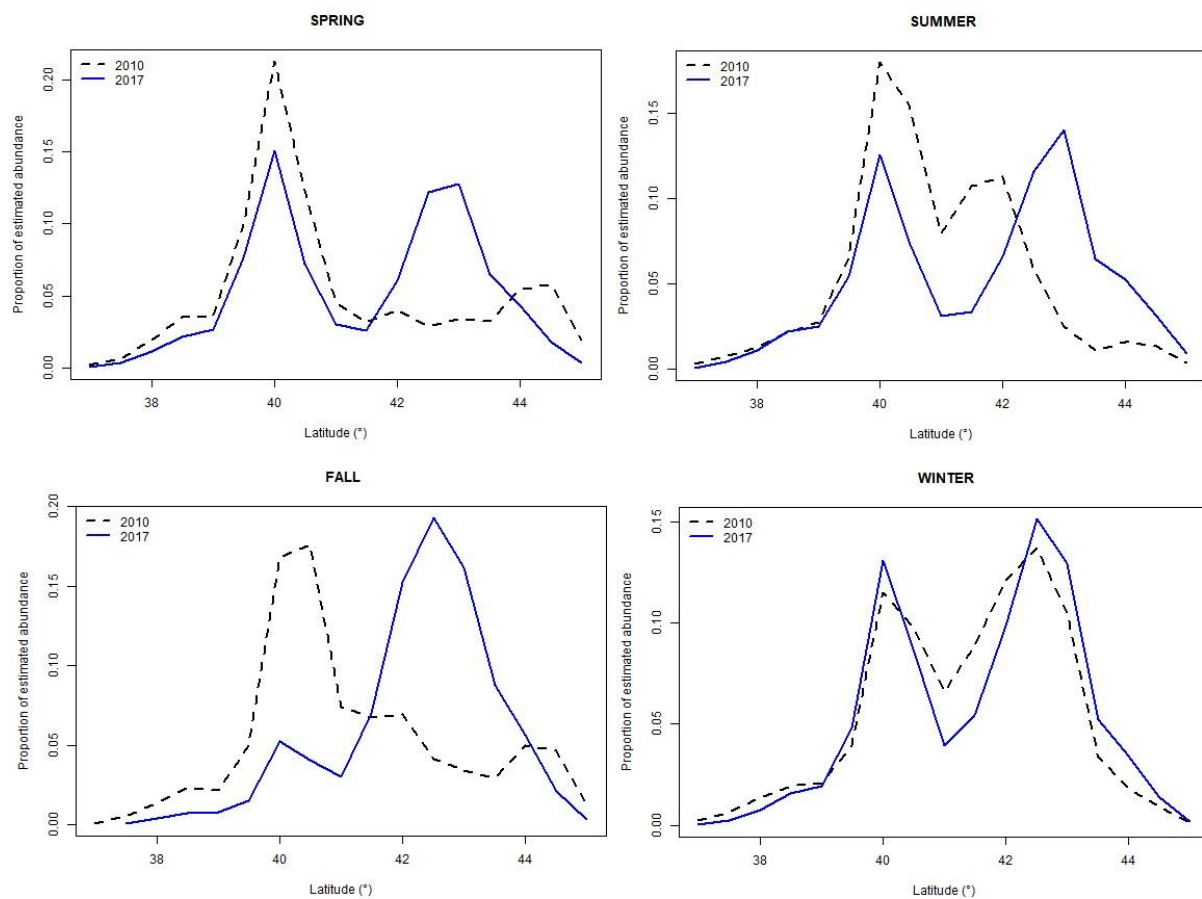


Figure S18. Seasonal comparison of the proportion of the estimated abundance within the core habitat for fin whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

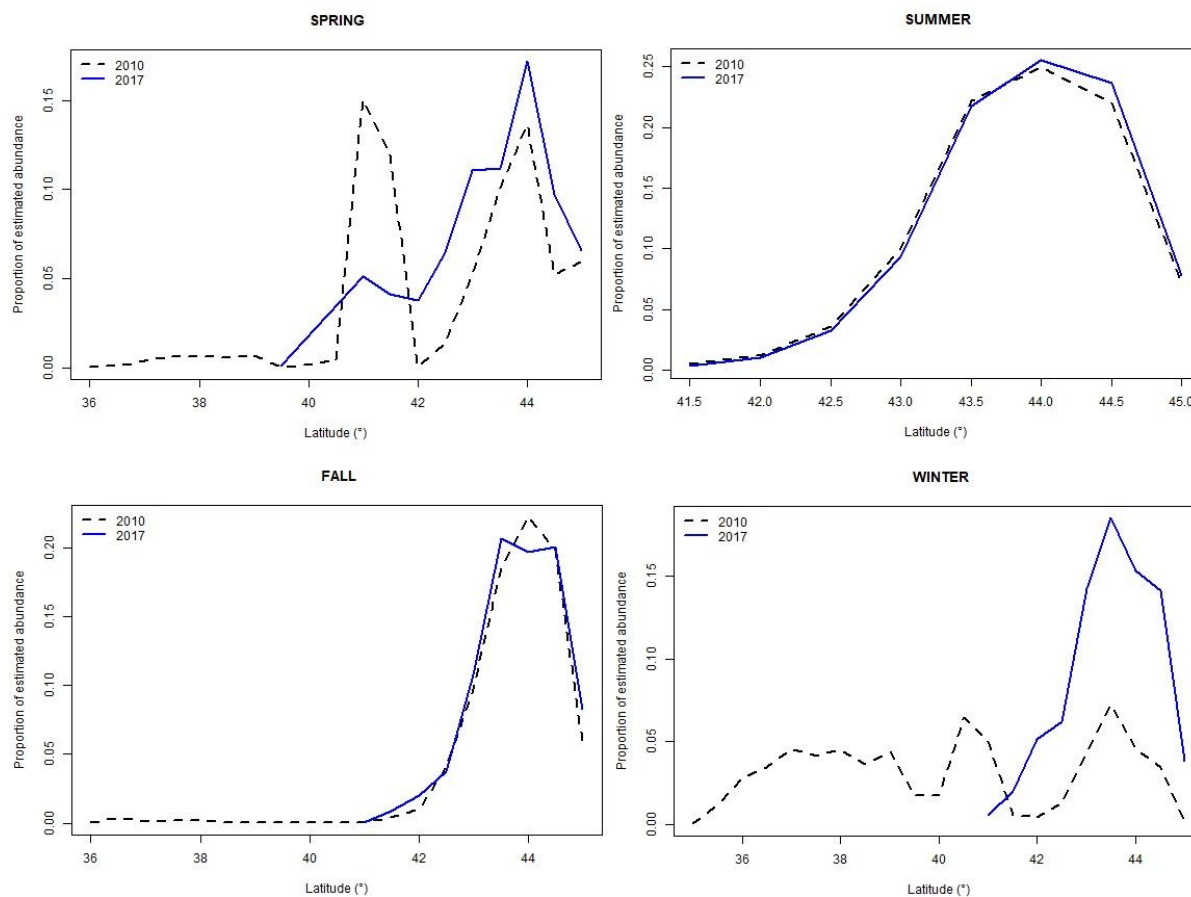


Figure S19. Seasonal comparison of the proportion of the estimated abundance within the core habitat for harbor porpoise by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

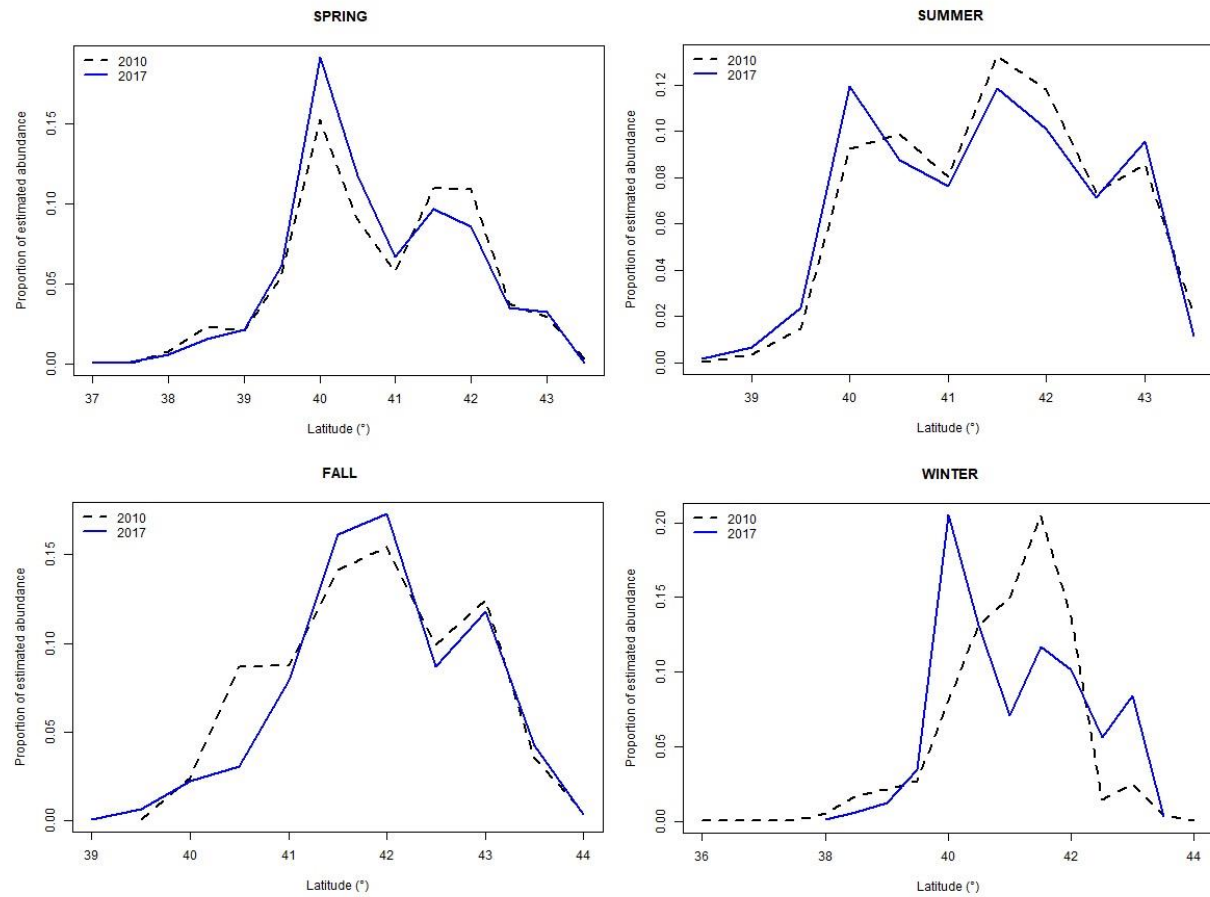


Figure S20. Seasonal comparison of the proportion of the estimated abundance within the core habitat for humpback whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

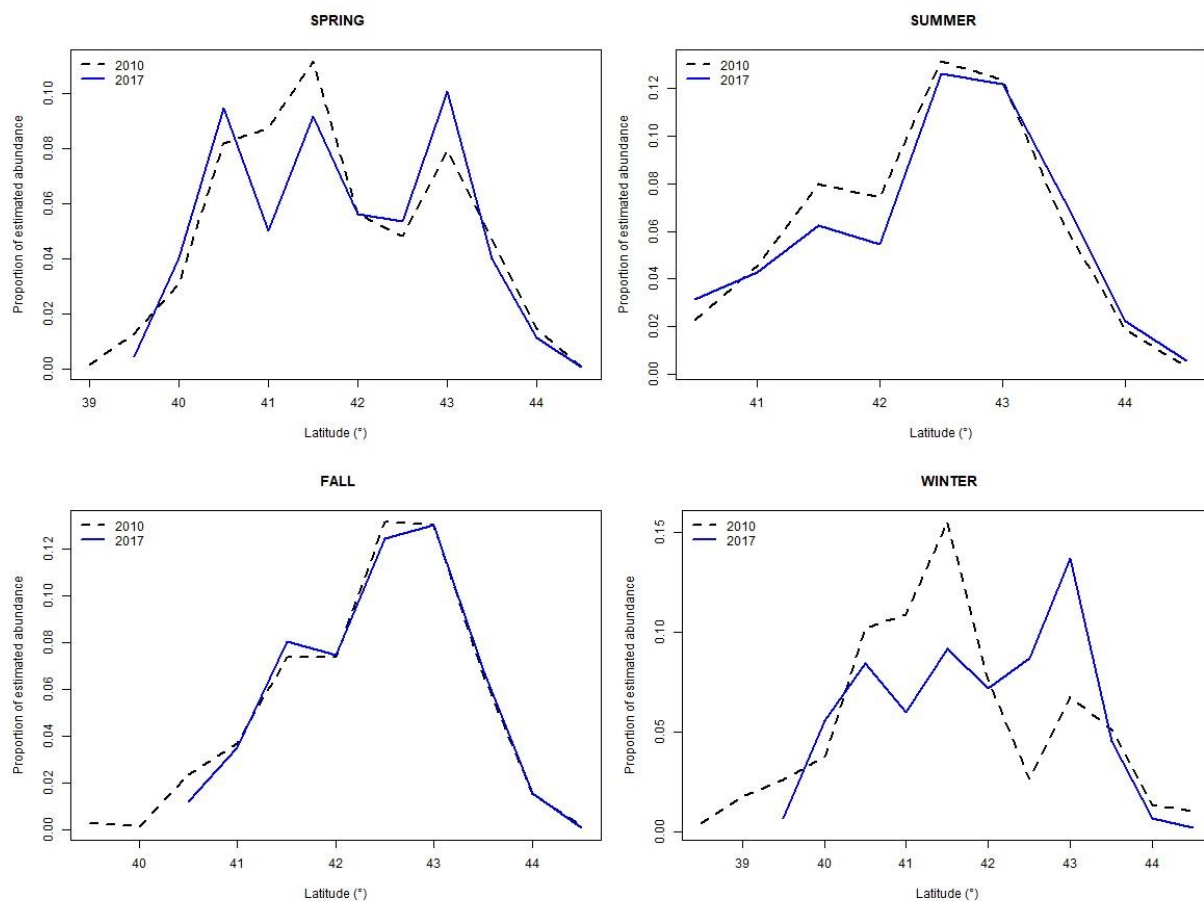


Figure S21. Seasonal comparison of the proportion of the estimated abundance within the core habitat for minke whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

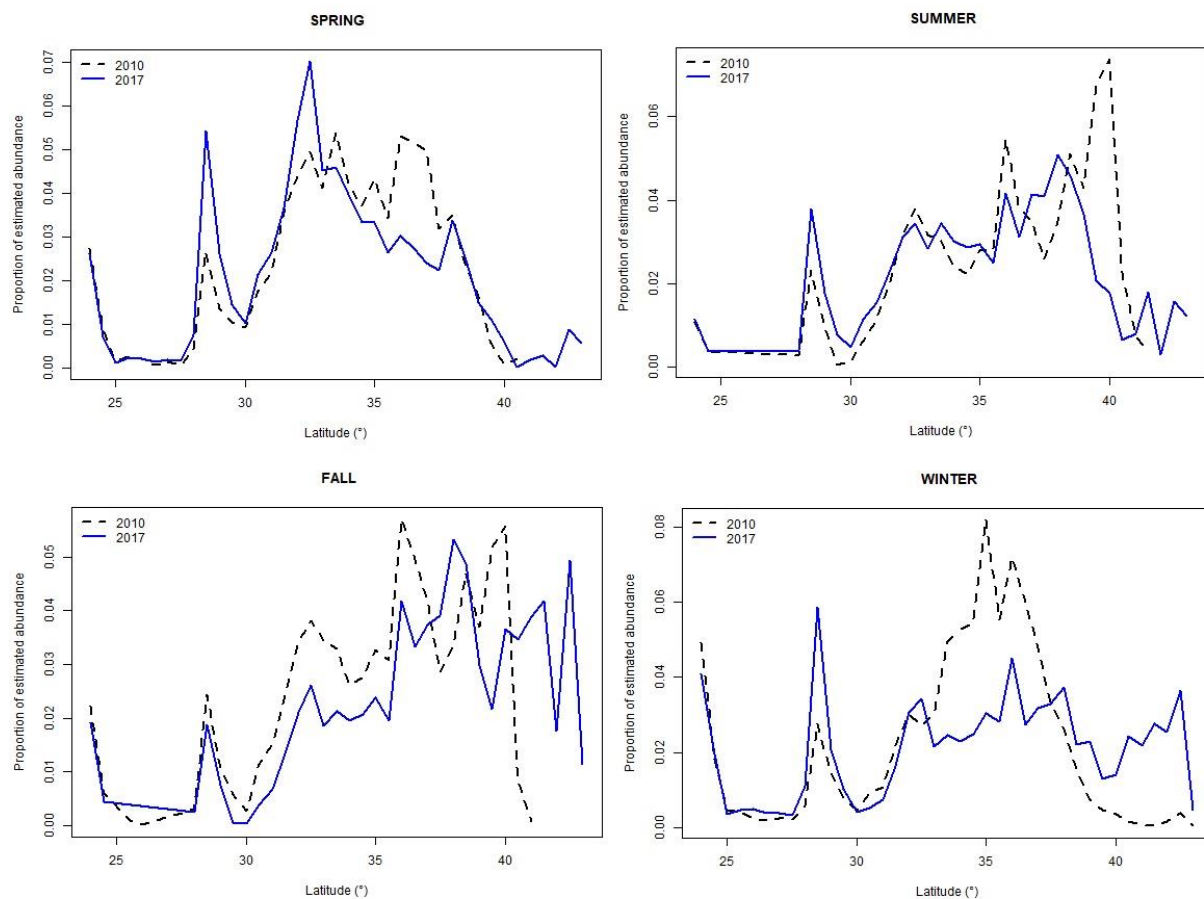


Figure S22. Seasonal comparison of the proportion of the estimated abundance within the core habitat for short-finned pilot whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

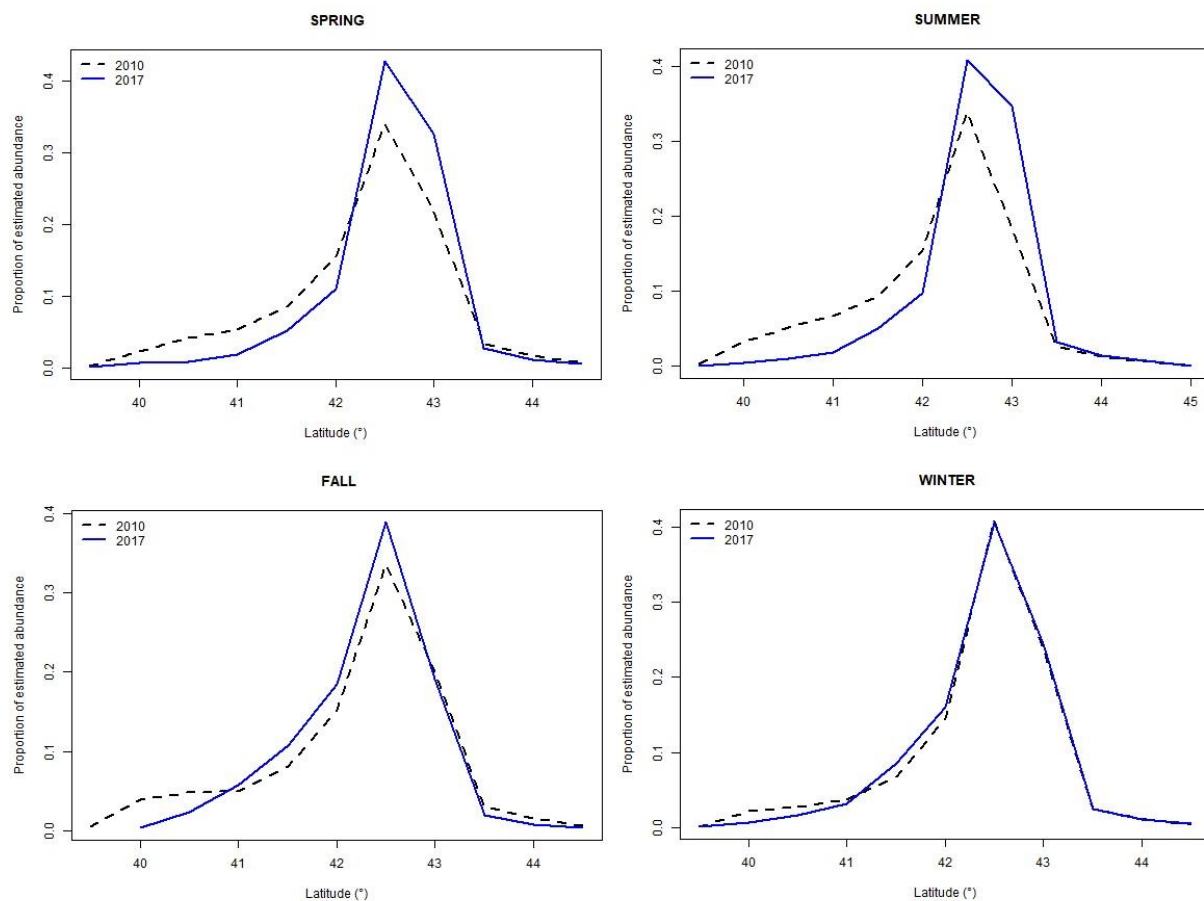


Figure S23. Seasonal comparison of the proportion of the estimated abundance within the core habitat for long-finned pilot whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

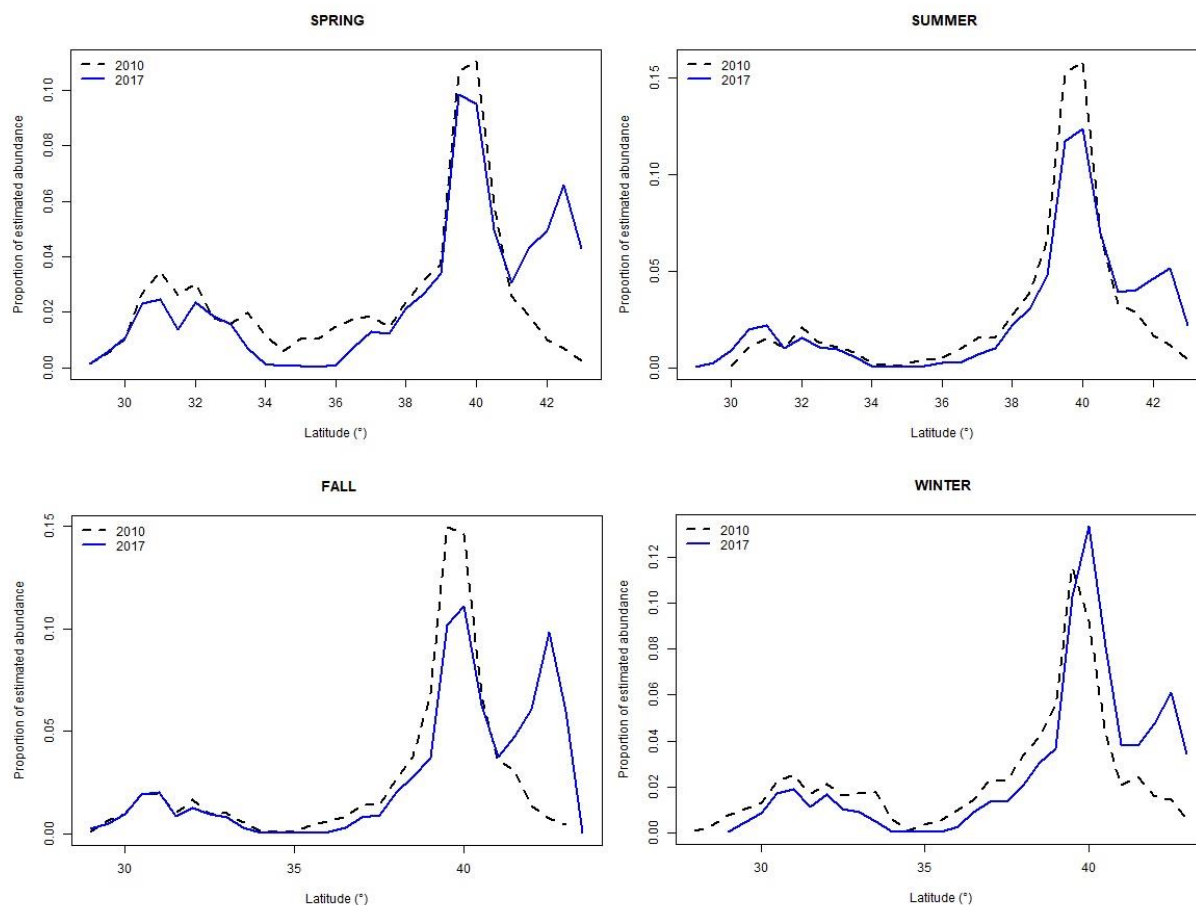


Figure S24. Seasonal comparison of the proportion of the estimated abundance within the core habitat for Risso's dolphin by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

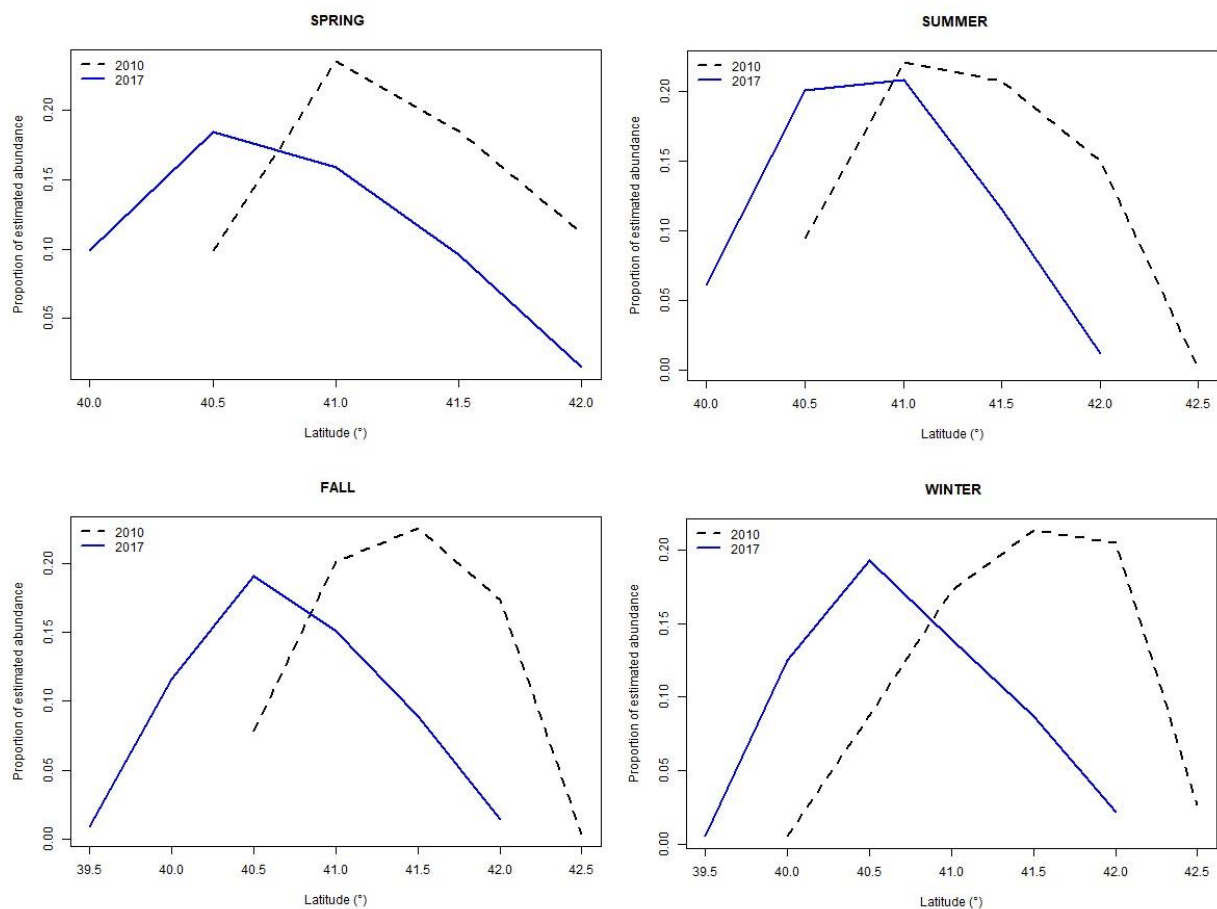


Figure S25. Seasonal comparison of the proportion of the estimated abundance within the core habitat for sei whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

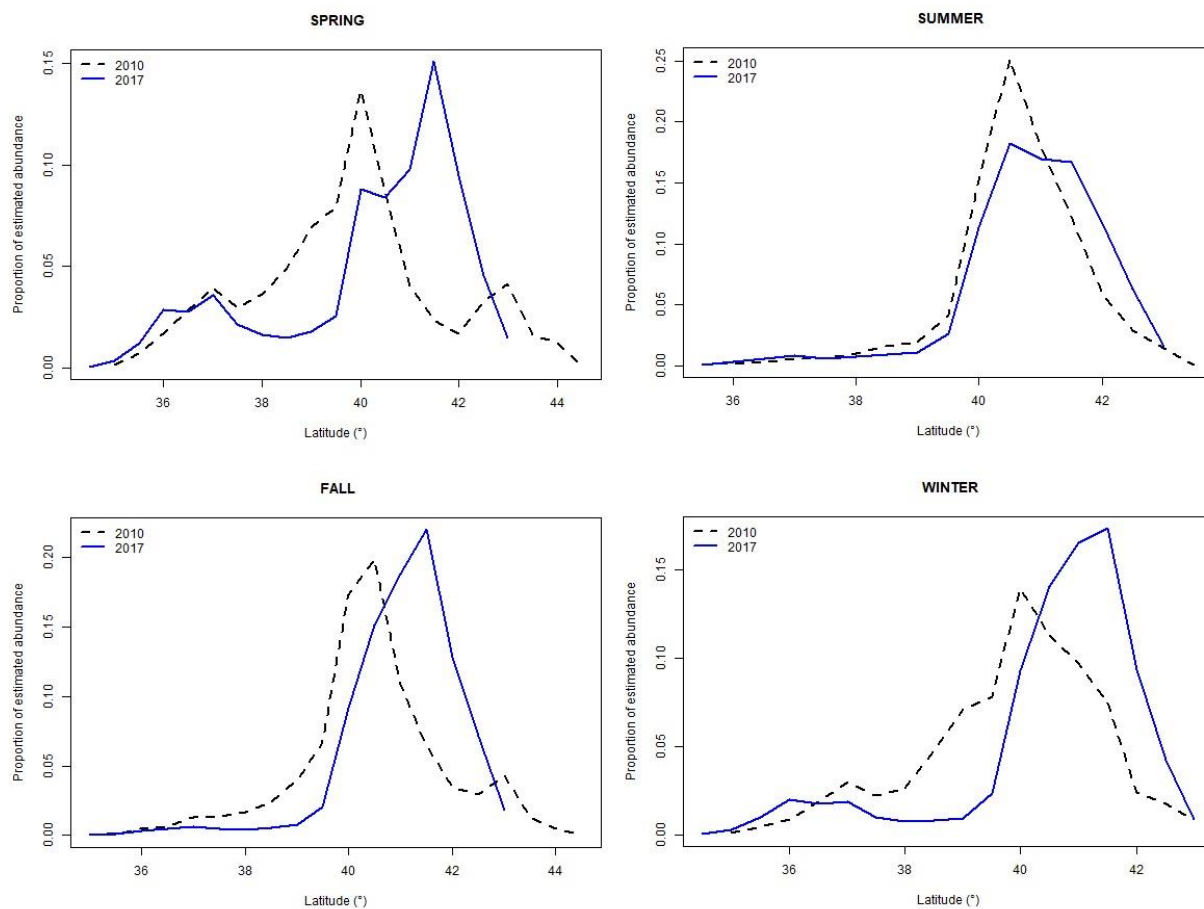


Figure S26. Seasonal comparison of the proportion of the estimated abundance within the core habitat for common dolphin by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line.

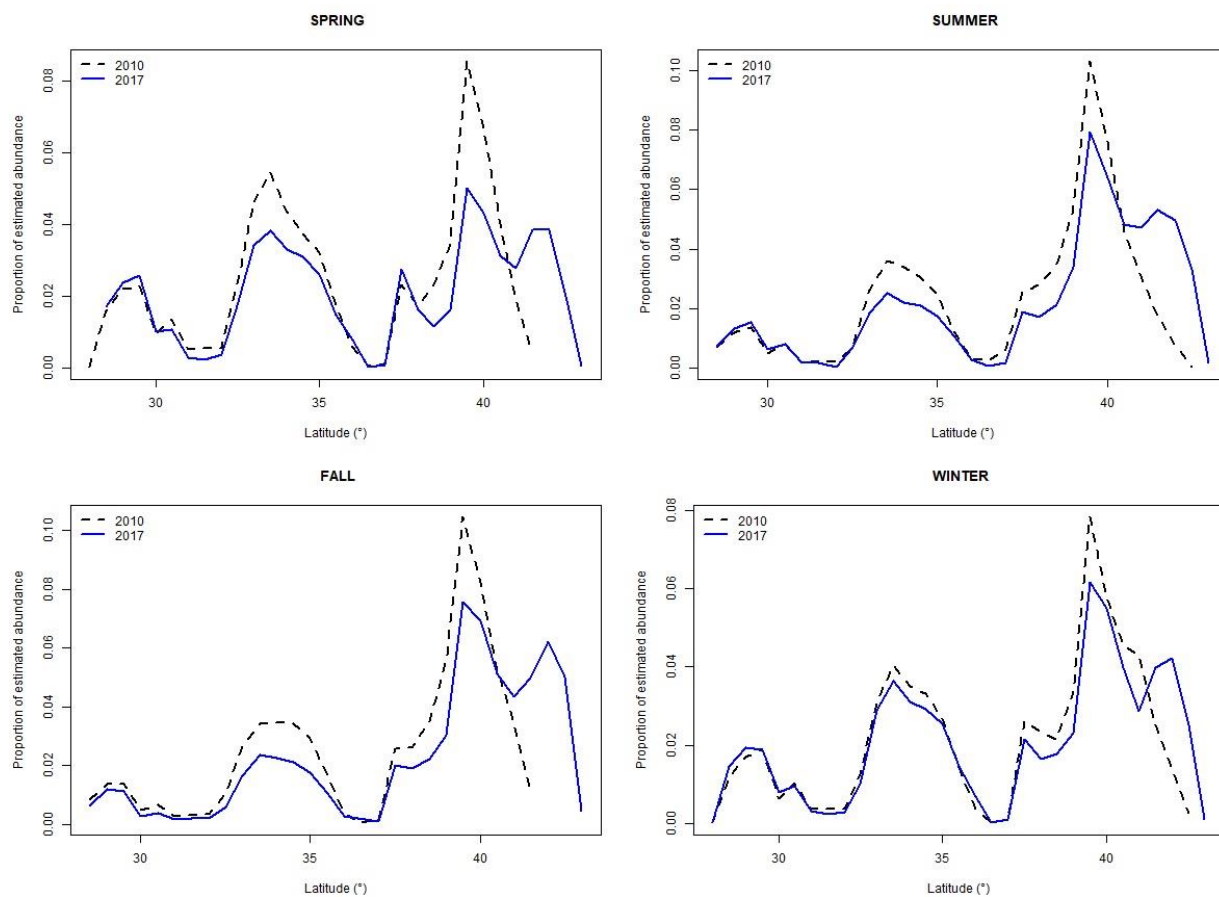


Figure S27. Seasonal comparison of the proportion of the estimated abundance within the core habitat for sperm whale by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line

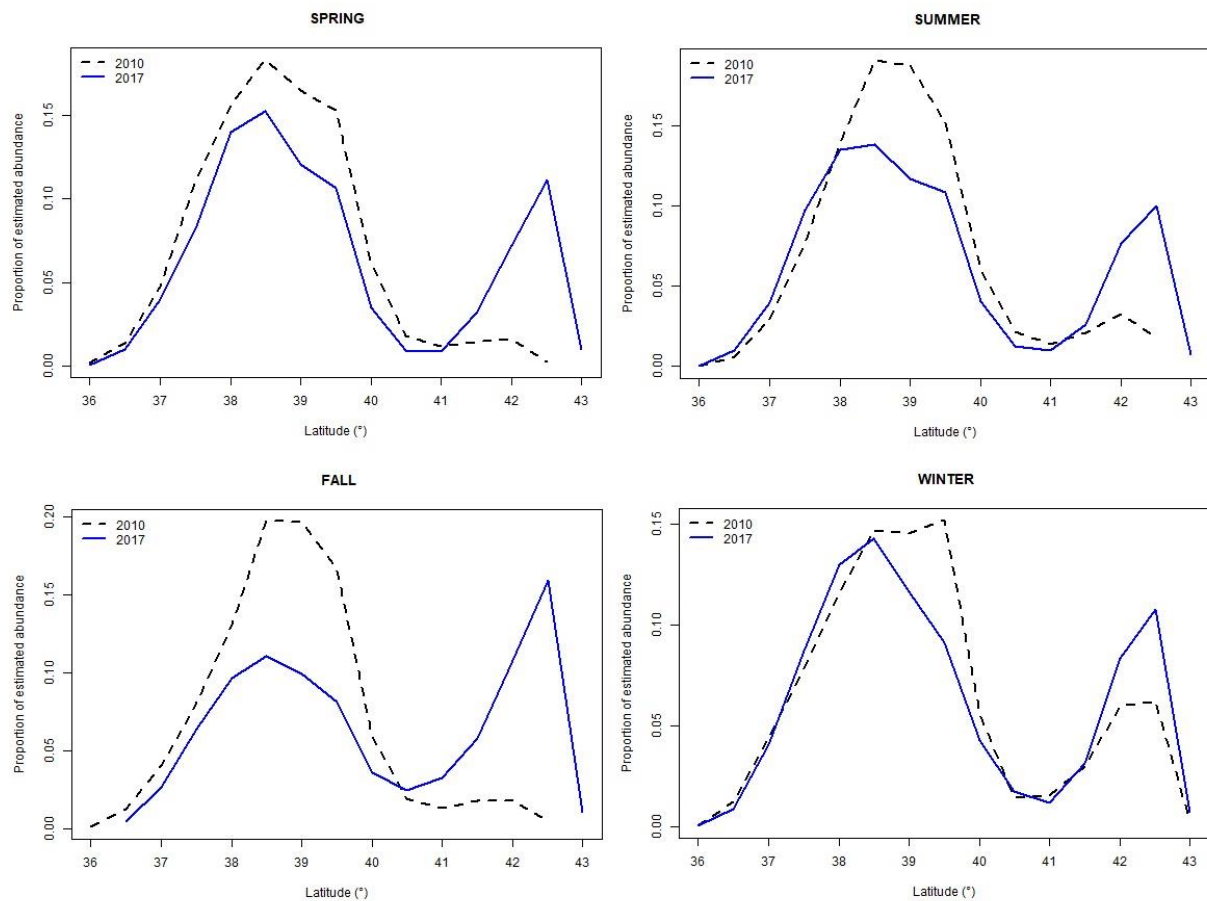


Figure S28. Seasonal comparison of the proportion of the estimated abundance within the core habitat for striped dolphin by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line

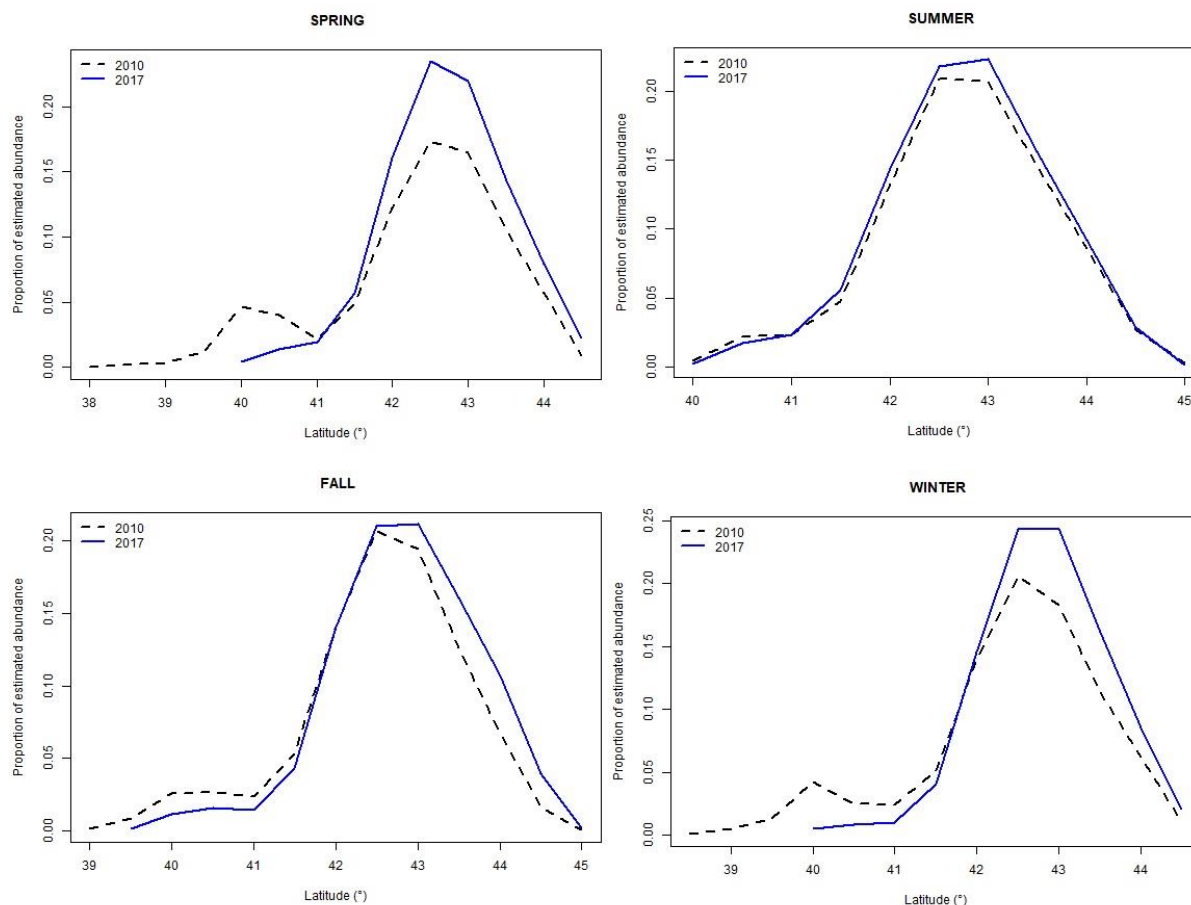


Figure S29. Seasonal comparison of the proportion of the estimated abundance within the core habitat for white-sided dolphin by 0.5° latitudinal bins. 2010 dotted-black line, 2017 solid blue line

REFERENCES

Palka D, Aichinger Dias L, Broughton E, Chavez-Rosales S, Cholewiak D, Davis G, DeAngelis A, Garrison L, Haas H, Hatch J, Hyde K, Jech M, Josephson E, Mueller-Brennan L, Orphanides C, Pegg N, Sasso C, Sigourney D, Soldevilla M, Walsh H. 2021. Atlantic Marine Assessment Program for Protected Species: FY15 – FY19. Washington DC: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-051. 330 p. <https://marinecadastre.gov/espis/#/search/study/100066>