

Seasonal dynamics of occurrence and group size of three species of cetaceans (Delphinidae and Phocoenidae) on the southwestern coast of the Black Sea

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Supplementary material

Table S1. Decomposition of the sighting frequency time series into three components

Year/month	Observed	Seasonal component	Trend	Random error
<i>Tursiops truncatus</i>				
2018				
January	0.38	-0.27968750	NA	NA
February	1.50	-0.12760417	NA	NA
March	0.50	0.12281250	NA	NA
April	1.19	0.78531250	NA	NA
May	0.83	-0.48385417	NA	NA
June	0.50	0.16072917	NA	NA
July	0.39	-0.03427083	0.6183333	-0.194062500
August	0.25	-0.01093750	0.5733333	-0.312395833
September	0.00	-0.41927083	0.5441667	-0.124895833
October	0.17	-0.24364583	0.5695833	-0.155937500
November	0.00	-0.67031250	0.5583333	0.111979167
December	1.75	1.20072917	0.5479167	0.001354167
2019				
January	0.30	-0.27968750	0.5783333	0.001354167
February	0.50	-0.12760417	0.6262500	0.001354167
March	0.80	0.12281250	0.6758333	0.001354167
April	1.50	0.78531250	0.7133333	0.001354167
May	0.25	-0.48385417	0.7325000	0.001354167
June	0.83	0.16072917	0.6679167	0.00134167
July	0.79	-0.03427083	0.6275000	0.196770833
August	1.00	-0.01093750	0.6958333	0.315104167
September	0.44	-0.41927083	0.7316667	0.127604167
October	0.63	-0.24364583	0.7150000	0.158645833
November	0.00	-0.67031250	0.7795833	-0.109270833
December	0.20	1.20072917	NA	NA
2020				
January	0.88	-0.27968750	NA	NA
February	1.56	-0.12760417	NA	NA
March	0.60	0.12281250	NA	NA
April	1.30	0.78531250	NA	NA
May	2.00	-0.48385417	NA	NA
<i>Phocoena phocoena</i>				
2018				
January	0.50	0.46381944	NA	NA
February	0.30	-0.80826389	NA	NA
March	0.79	0.05006944	NA	NA
April	1.94	2.48006944	NA	NA
May	0.50	0.65006944	NA	NA
June	0.21	-0.15284722	NA	NA
July	0.06	-0.18180556	0.4500000	0.208194444
August	0.00	-0.16555556	0.4666667	-0.301111111
September	0.00	-0.77222222	0.4587500	0.313472222
October	0.00	-0.79868056	0.5212500	0.277430556
November	0.00	-0.82805556	0.6208333	0.207222222
December	0.75	0.06340278	0.6816667	0.004930556
2019				
January	1.20	0.46381944	0.7312500	0.004930556
February	0.00	-0.80826389	0.8033333	0.004930556
March	0.90	0.05006944	0.8450000	0.004930556
April	3.33	2.48006944	0.8450000	0.004930556
May	1.50	0.65006944	0.8450000	0.004930556
June	0.67	-0.15284722	0.8179167	0.004930556
July	0.79	-0.18180556	0.7537500	0.218055556
August	1.00	-0.16555556	0.8545833	0.310972222
September	0.00	-0.77222222	1.0758333	-0.303611111
October	0.00	-0.79868056	1.0662500	-0.267569444
November	0.00	-0.82805556	1.0254167	-0.197361111
December	0.10	0.06340278	NA	NA
2020				
January	0.31	0.46381944	NA	NA
February	3.31	-0.80826389	NA	NA
March	2.90	0.05006944	NA	NA
April	1.10	2.48006944	NA	NA
May	2.75	0.65006944	NA	NA
<i>Delphinus delphis</i>				
2018				
January	0.08	0.25097222	NA	NA
February	0.00	-0.62097222	NA	NA
March	0.21	-0.53763889	NA	NA
April	0.25	0.03236111	NA	NA
May	0.17	3.12069444	NA	NA
June	0.29	0.13944444	NA	NA
July	0.06	-0.30472222	0.1579167	0.20680556

Year/month	Observed	Seasonal component	Trend	Random error
August	0.00	-0.21993056	0.1691667	0.05076389
September	0.25	-0.18243056	0.1645833	0.26784722
October	0.00	-0.42493056	0.1775000	0.24743056
November	0.20	-0.42243056	0.3441667	0.27826389
December	0.25	-0.32847222	0.5125000	0.06597222
2019				
January	0.35	0.25097222	0.5350000	0.06597222
February	0.00	-0.62097222	0.5550000	0.06597222
March	0.10	-0.53763889	0.5716667	0.06597222
April	0.67	0.03236111	0.5716667	0.06597222
May	3.75	3.12069444	0.5633333	0.06597222
June	0.75	0.13944444	0.5445833	0.06597222
July	0.14	-0.30472222	0.5195833	-0.07486111
August	0.40	-0.21993056	0.5387500	0.08118056
September	0.25	-0.18243056	0.5683333	-0.13590278
October	0.00	-0.42493056	0.5404167	-0.11548611
November	0.00	-0.42243056	0.5687500	-0.14631944
December	0.00	-0.32847222	NA	NA
2020				
January	0.00	0.25097222	NA	NA
February	0.81	-0.62097222	NA	NA
March	0.00	-0.53763889	NA	NA
April	0.10	0.03236111	NA	NA
May	5.00	3.12069444	NA	NA

Mean seasonal effects (\$figure) extracted from the sighting frequency time series

Tursiops truncatus

\$figure

[1] -0.27968750 -0.12760417 0.12281250 0.78531250 -0.48385417 0.16072917
 [7] -0.03427083 -0.01093750 -0.41927083 -0.24364583 -0.67031250 1.20072917

Phocoena phocoena

\$figure

[1] 0.46381944 -0.80826389 0.05006944 2.48006944 0.65006944 -0.15284722
 [7] -0.18180556 -0.16555556 -0.77222222 -0.79868056 -0.82805556 0.06340278

Delphinus delphis

\$figure

[1] -0.25097222 -0.62097222 -0.53763889 0.03236111 3.12069444 0.13944444
 [7] -0.30472222 -0.21993056 -0.18243056 -0.42493056 -0.42243056 -0.32847222

Table S2. Decomposition of the group size time series into three components.

Year/month	Observed	Seasonal component	Trend	Random error
<i>Tursiops truncatus</i>				
2018				
January	2.40	0.3609028	NA	NA
February	2.86	3.6492361	NA	NA
March	8.60	0.7700694	NA	NA
April	4.40	0.6909028	NA	NA
May	2.80	-2.6549306	NA	NA
June	2.80	0.2838194	NA	NA
July	2.00	-0.7324306	2.835417	-0.102986111
August	1.30	-0.8415972	2.977500	-0.835902778
September	0.00	-1.6236806	2.885417	-1.261736111
October	2.30	0.3684028	2.616667	-0.685069444
November	0.00	-2.3915972	2.454167	-0.062569444
December	4.43	2.1209028	2.341667	-0.032569444
2019				
January	2.67	0.3609028	2.341667	-0.032569444
February	6.00	3.6492361	2.383333	-0.032569444
March	3.25	0.7700694	2.512500	-0.032569444
April	3.30	0.6909028	2.641667	-0.032569444
May	0.00	-2.6549306	2.687500	-0.032569444
June	2.90	0.2838194	2.648750	-0.032569444
July	1.90	-0.7324306	2.594583	0.037847222
August	2.40	-0.8415972	2.470833	0.770763889
September	2.00	-1.6236806	2.427083	1.196597222
October	3.40	0.3684028	2.411667	0.619930556
November	0.00	-2.3915972	2.394167	-0.002569444
December	3.50	2.1209028	NA	NA
2020				
January	2.30	0.3609028	NA	NA
February	3.40	3.6492361	NA	NA
March	4.80	0.7700694	NA	NA
April	1.38	0.6909028	NA	NA
May	1.50	-2.6549306	NA	NA
<i>Phocoena phocoena</i>				
2018				
January	1.46	0.49243056	NA	NA
February	2.60	-1.37631944	NA	NA
March	2.81	-0.03631944	NA	NA
April	2.23	0.62368056	NA	NA
May	1.00	0.68368056	NA	NA
June	1.40	2.93159722	NA	NA
July	1.00	-0.09173611	1.1929167	-0.10118056
August	0.00	-0.09152778	1.0966667	-1.00513889
September	0.00	-1.24923611	0.9312500	0.31798611
October	0.00	-1.22048611	0.8687500	0.35173611
November	0.00	-1.22111111	0.9116667	0.30944444
December	1.67	0.55534722	1.0841667	0.03048611
2019				
January	1.75	0.49243056	1.2270833	0.03048611
February	0.00	-1.37631944	1.3458333	0.03048611
March	1.44	-0.03631944	1.4458333	0.03048611
April	2.10	0.62368056	1.4458333	0.03048611
May	2.16	0.68368056	1.4458333	0.03048611
June	4.38	2.93159722	1.4179167	0.03048611
July	1.45	-0.09173611	1.3795833	0.16215278
August	2.40	-0.09152778	1.4254167	1.06611111
September	0.00	-1.24923611	1.5062500	-0.25701389
October	0.00	-1.22048611	1.5112500	-0.29076389
November	0.00	-1.22111111	1.4695833	-0.24847222
December	1.00	0.55534722	NA	NA
2020				
January	1.50	0.49243056	NA	NA
February	1.35	-1.37631944	NA	NA
March	2.03	-0.03631944	NA	NA
April	1.63	0.62368056	NA	NA
May	1.63	0.68368056	NA	NA
<i>Delphinus delphis</i>				
2018				
January	3.50	-0.6534375	NA	NA
February	0.00	-4.5221875	NA	NA
March	4.70	7.2278125	NA	NA
April	2.75	0.9465625	NA	NA
May	5.50	-0.1867708	NA	NA
June	3.86	-0.5451042	NA	NA
July	8.00	7.2211458	2.813333	-2.0344792

Year/month	Observed	Seasonal component	Trend	Random error
August	0.00	-1.2121875	2.809167	-1.5969792
September	2.50	-0.9955208	3.113333	0.3821875
October	0.00	-3.7778125	3.542500	0.2353125
November	0.00	-2.7173958	3.634167	-0.9167708
December	3.00	-0.7851042	3.619167	0.1659375
2019				
January	3.40	-0.6534375	3.887500	0.1659375
February	0.00	-4.5221875	4.356250	0.1659375
March	12.00	7.2278125	4.606250	0.1659375
April	5.75	0.9465625	4.637500	0.1659375
May	4.70	-0.1867708	4.720833	0.1659375
June	4.30	-0.5451042	4.679167	0.1659375
July	14.00	7.2211458	4.412500	2.3663542
August	5.25	-1.2121875	4.533333	1.9288542
September	3.25	-0.9955208	4.295833	-0.0503125
October	0.00	-3.7778125	3.681250	0.0965625
November	2.00	-2.7173958	3.468750	1.2486458
December	0.00	-0.7851042	NA	NA
2020				
January	0.00	-0.6534375	NA	NA
February	6.30	-4.5221875	NA	NA
March	0.00	7.2278125	NA	NA
April	3.00	0.9465625	NA	NA
May	2.35	-0.1867708	NA	NA

Mean seasonal effects (\$figure) extracted from the group size time series

Tursiops truncatus

\$figure

[1] 0.3609028 3.6492361 0.7700694 0.6909028 -2.6549306 0.2838194 -0.7324306
 [8] -0.8415972 -1.6236806 0.3684028 -2.3915972 2.1209028

Phocoena phocoena

\$figure

[1] 0.49243056 -1.37631944 -0.03631944 0.62368056 0.68368056 2.93159722
 [7] -0.09173611 -0.09152778 -1.24923611 -1.22048611 -1.22111111 0.55534722

Delphinus delphis

\$figure

[1] -0.6534375 -4.5221875 7.2278125 0.9465625 -0.1867708 -0.5451042 7.2211458
 [8] -1.2121875 -0.9955208 -3.7778125 -2.7173958 -0.7851042