

Low-frequency noise influences fin whale songs

Valentina Caradonna, Daniela Silvia Pace, Giulia Pedrazzi, Arianna Azzellino, Diego Vicinanza, Paul White, Silvano Buogo, Junio Fabrizio Borsani

Supplementary information

Results of the Shapiro-Wilk test

Variable	W	N	p-value
IPI cb	0.844	8	0.083
IPI bb	0.799	8	0.111
Min frequency c.	0.938	8	0.594
Max frequency c.	0.945	8	0.659
BW c	0.919	8	0.420
Peak frequency c.	0.942	8	0.634
Center frequency c.	0.935	8	0.560
Min frequency b.	0.942	8	0.630
Max frequency b.	0.921	8	0.440
BW b	0.954	8	0.747
Peak frequency b.	0.950	8	0.712
Center frequency b.	0.930	8	0.516
N. of notes per song	0.835	8	0.066
Song duration	0.932	8	0.536
Noise levels	0.929	8	0.504

Table S1. Results of the Shapiro-Wilk test for deployment 1 for those variables having a normal distribution.

Variable	W	N	p-value
IPI cc	0.844	7	0.107
IPI cb	0.877	9	0.146
IPI bc	0.985	9	0.986
Min frequency c.	0.915	9	0.352
Max frequency c.	0.96	9	0.797
BW c	0.909	9	0.312
Peak frequency c.	0.918	9	0.375
Center frequency c.	0.898	9	0.242
Min frequency b.	0.973	9	0.922
Max frequency b.	0.928	9	0.46
BW b	0.918	9	0.373
Peak frequency b.	0.968	9	0.877
Center frequency b.	0.957	9	0.762
Pulse rate	0.933	9	0.512
Rest duration	0.935	9	0.534
Noise levels	0.944	9	0.627

Table S2. Results of the Shapiro-Wilk test for deployment 3 for those variables having a normal distribution.

Variable	W	N	p-value
IPI cc	0.781	5	0.057
IPI cb	0.865	5	0.248
IPI bc	0.982	5	0.946
IPI bb	0.805	4	0.112
Min frequency c.	0.971	5	0.881
Max frequency c.	0.867	5	0.254
BW c	0.923	5	0.552
Center frequency c.	0.787	5	0.063
Min frequency b.	0.91	5	0.467
Max frequency b.	0.93	5	0.594
BW b	0.912	5	0.482
Peak frequency b.	0.924	5	0.554

Center frequency b.	0.968	5	0.864
Pulse rate	0.943	5	0.689
Song duration	0.927	5	0.577
N. notes per song	0.896	5	0.39
Rest duration	0.832	3	0.193
Noise levels	0.883	5	0.325

Table S3. Results of the Shapiro-Wilk test for deployment 5 for those variables having a normal distribution.

Variable	W	N	p-value
IPI bb	0.856	4	0.247
Min frequency c.	0.892	8	0.246
Max frequency c.	0.909	8	0.348
BW c	0.956	8	0.769
Center frequency c.	0.975	8	0.931
Min frequency b.	0.937	8	0.578
Max frequency b.	0.93	8	0.519
BW b	0.946	8	0.667
Peak frequency c.	0.977	8	0.948
Peak frequency b.	0.919	8	0.42
Center frequency b.	0.867	8	0.142
Pulse rate	0.879	8	0.185
Song duration	0.876	8	0.171
N. notes per song	0.889	8	0.228
Rest duration	0.881	7	0.229
Noise levels	0.911	8	0.358

Table S4. Results of the Shapiro-Wilk test for deployment 8 for those variables having a normal distribution.

Variable	W	N	p-value
IPI cc	0.952	6	0.76
IPI cb	0.941	6	0.665
IPI bc	0.92	6	0.508
IPI bb	0.903	6	0.394
Min frequency c.	0.845	6	0.144
Max frequency c.	0.923	6	0.527
BW c	0.933	6	0.602
Center frequency c.	0.917	6	0.481
Min frequency b.	0.97	6	0.893
Max frequency b.	0.947	6	0.716
BW b	0.963	6	0.841
Peak frequency c.	0.863	6	0.2
Center frequency b.	0.893	6	0.333
Pulse rate	0.831	6	0.109
Song duration	0.808	6	0.069
Rest duration	0.897	4	0.415
Noise levels	0.934	6	0.613

Table S5. Results of the Shapiro-Wilk test for deployment 7 for those variables having a normal distribution.

Scatterplots of each acoustic parameter against noise levels for each deployment

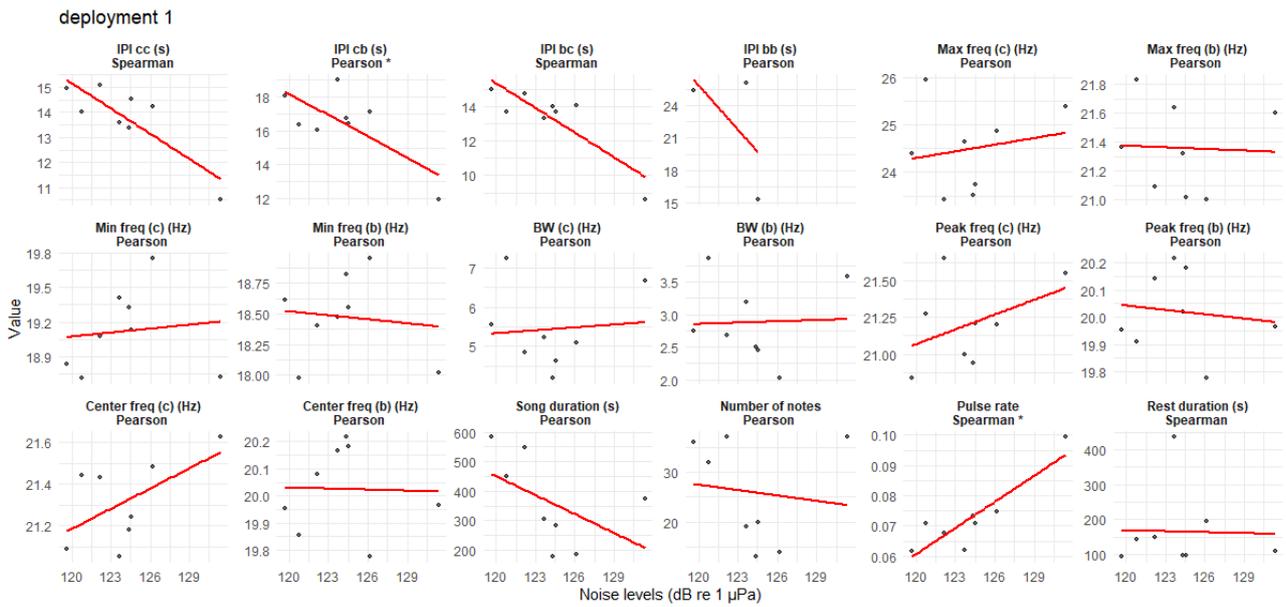


Figure S1. Scatterplots showing the relationship between noise levels and each acoustic variable, with added linear regression lines for deployment 1. Statistically significant relationships based on the p-values of simple linear regressions are indicated by * ($p < 0.05$); a dot (.) denotes $p \leq 0.10$.

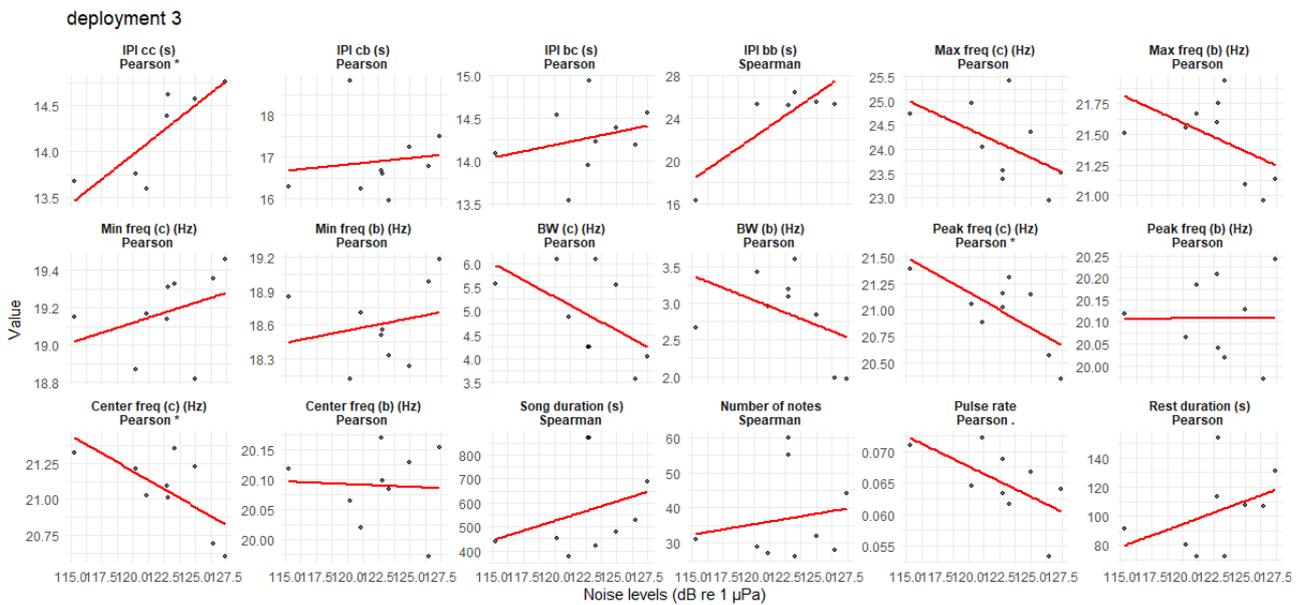


Figure 2. Scatterplots showing the relationship between noise levels and each acoustic variable, with added linear regression lines for deployment 3. Statistically significant relationships based on the p-values of simple linear regressions are indicated by * ($p < 0.05$); a dot (.) denotes $p \leq 0.10$.

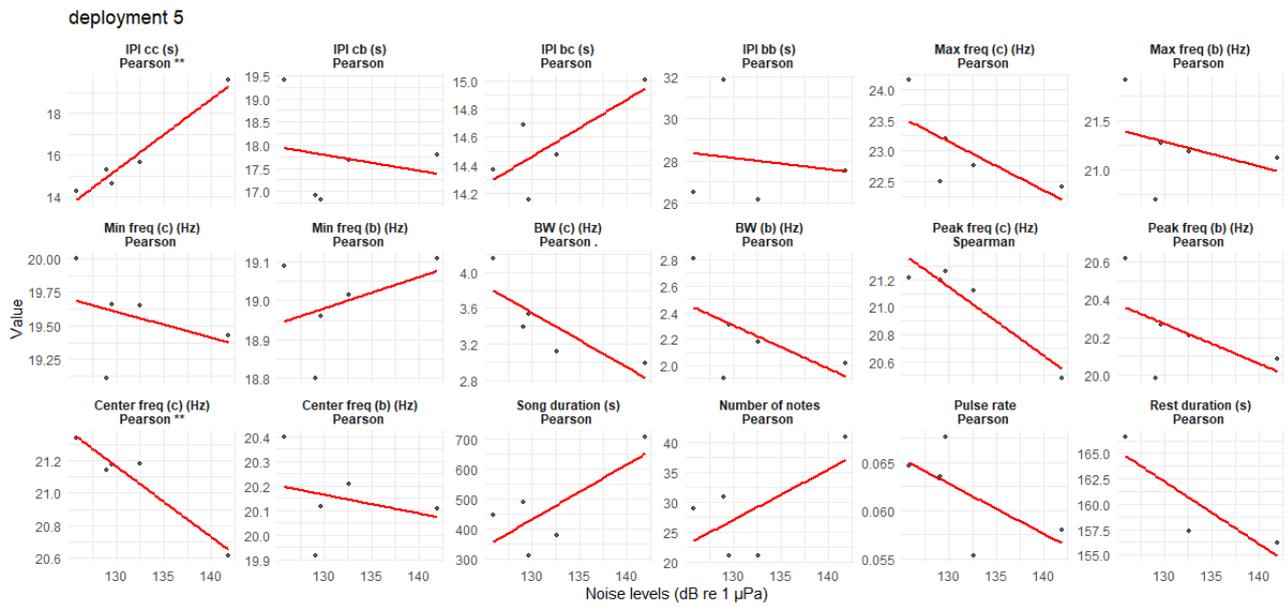


Figure S3. Scatterplots showing the relationship between noise levels and each acoustic variable, with added linear regression lines for deployment 5. Statistically significant relationships based on the p-values of simple linear regressions are indicated by * ($p < 0.05$); a dot (.) denotes $p \leq 0.10$.

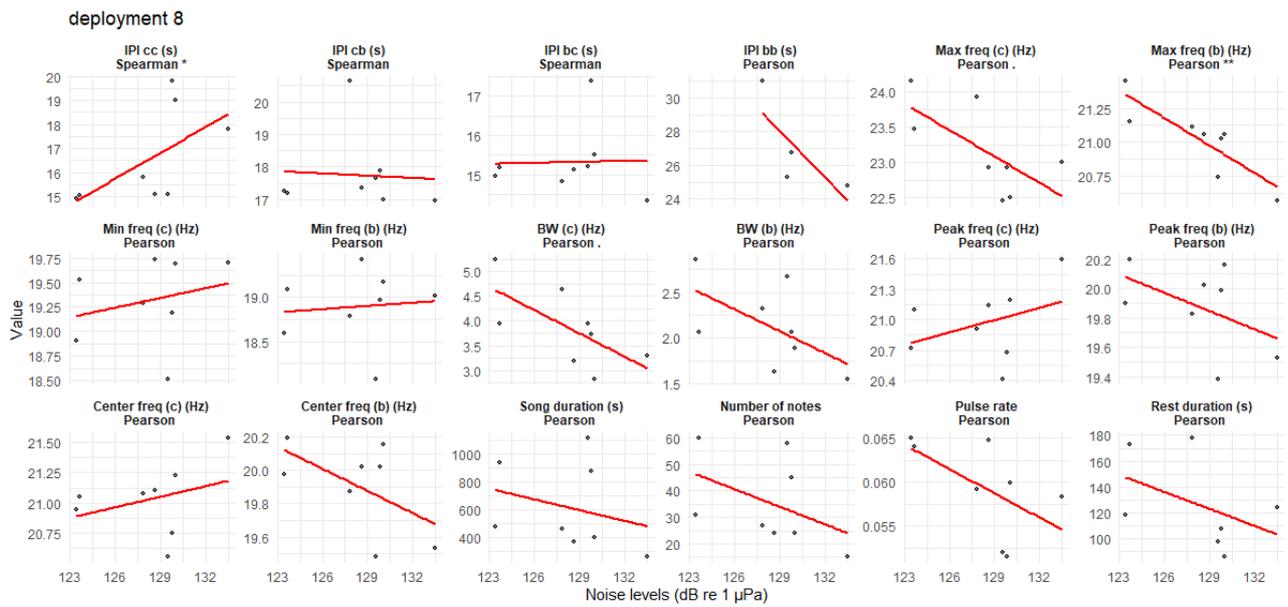


Figure S4. Scatterplots showing the relationship between noise levels and each acoustic variable, with added linear regression lines for deployment 8. Statistically significant relationships based on the p-values of simple linear regressions are indicated by * ($p < 0.05$); a dot (.) denotes $p \leq 0.10$.

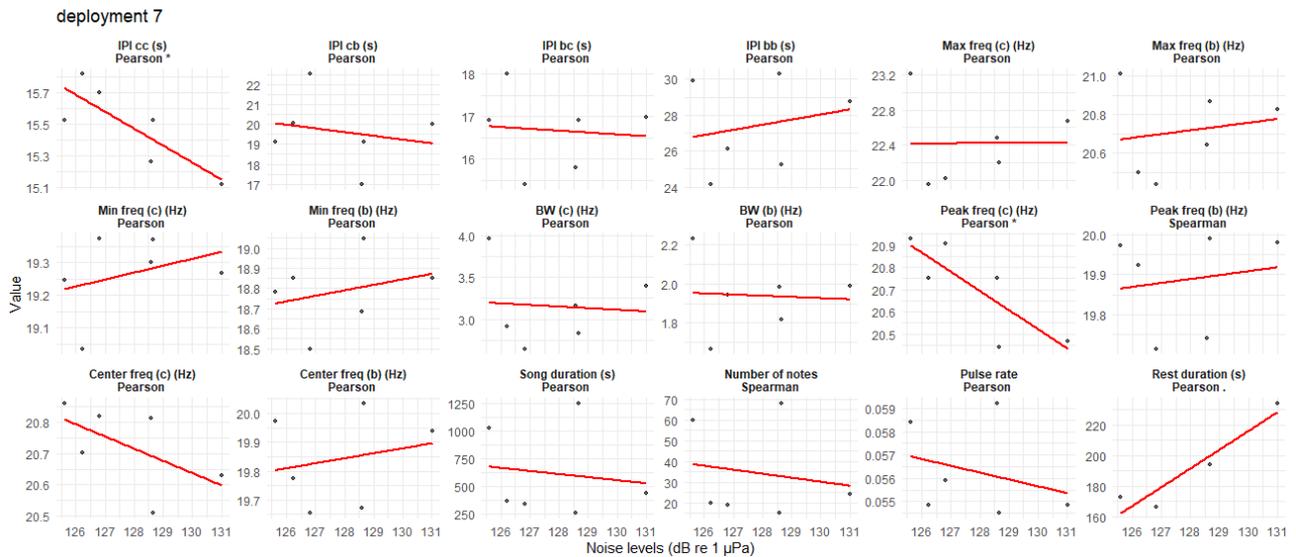


Figure S5. Scatterplots showing the relationship between noise levels and each acoustic variable, with added linear regression lines for deployment 7. Statistically significant relationships based on the p-values of simple linear regressions are indicated by * ($p < 0.05$); a dot (.) denotes $p \leq 0.10$.

Vessel density map from Emodnet

Figure S6 shows vessel density in the Ligurian Sea. This map is based on data from 2017-2023, however it can be considered still valid for our study, as it provides the reader a general idea of the marine traffic distribution in the study area.

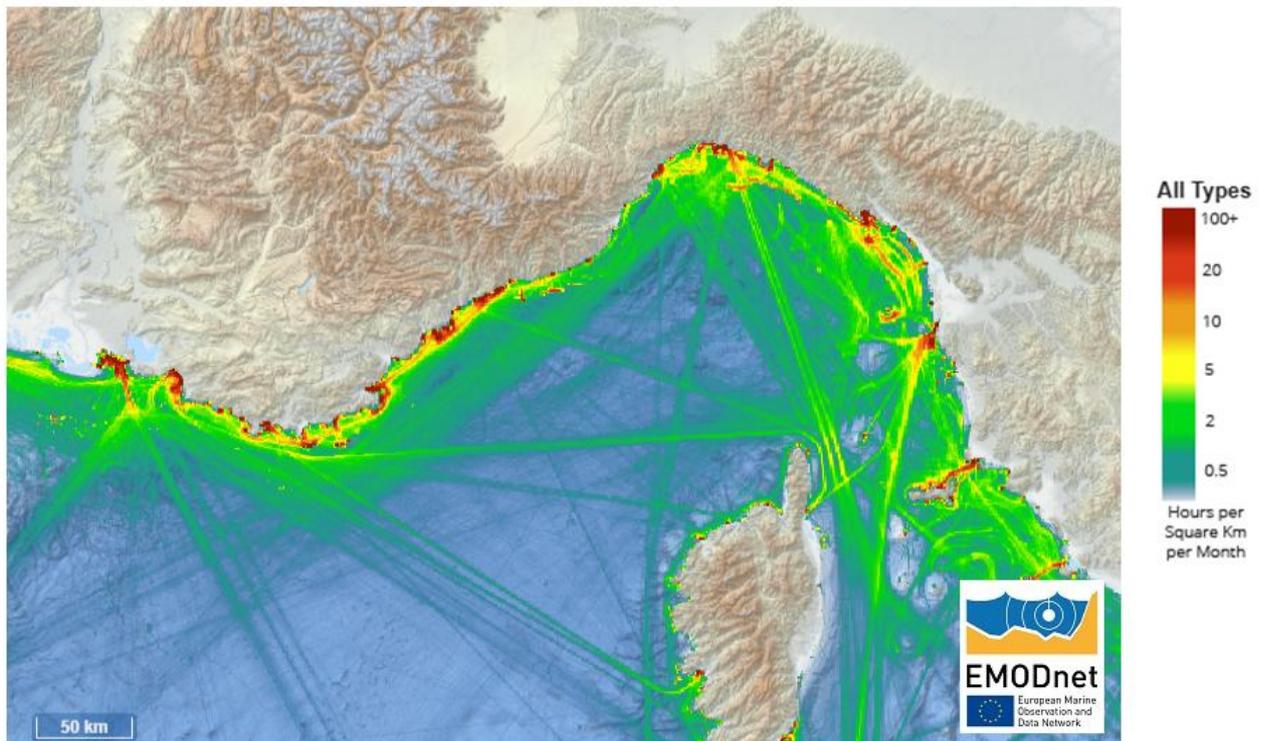


Figure S6. Annual Averages 2017-2023 of vessel density in the Pelagos Sanctuary. From Emodnet map viewer (<https://emodnet.ec.europa.eu/geoviewer/#/>)