frontiers

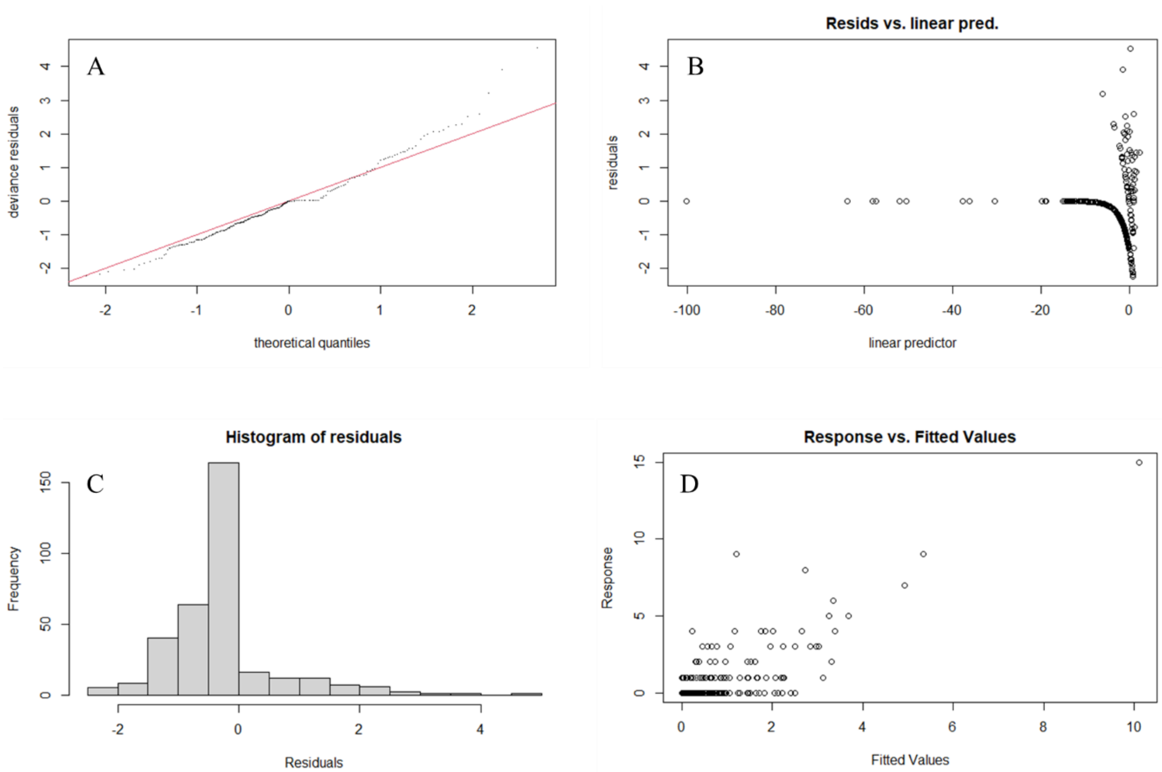
Supplementary Material

1.1 Supplementary Figures

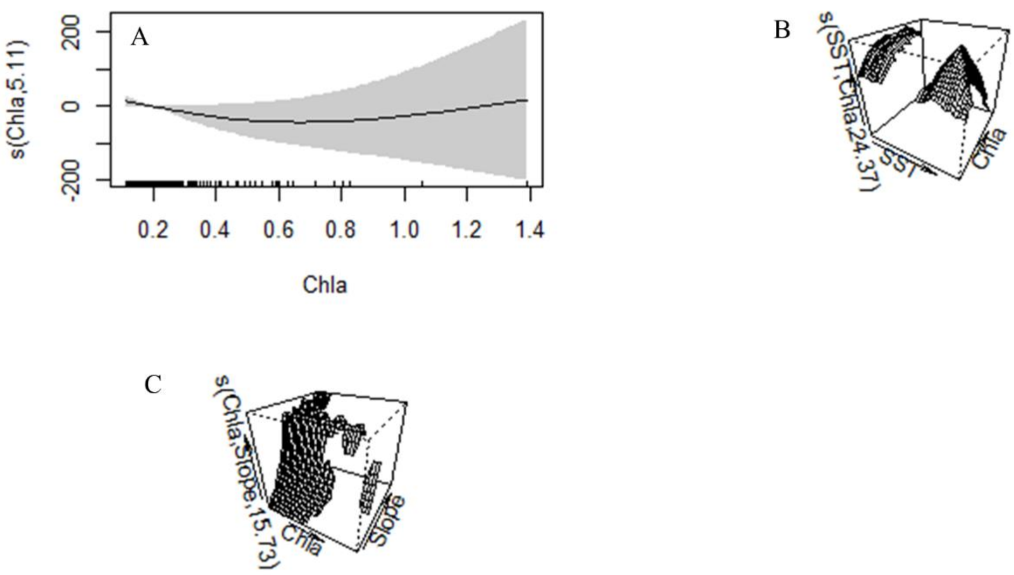
Supplementary Figure S1. Fin whales sighted outside Barcelona and Tarragona Ports in May 2021. (A-D) Fin whales in front of Barcelona port, (D) fin whale called Bruixa the 19th of May. (E) Fin whale in front of Tarragona port the 10th of May 2021. Photographs by Seán A. O’Callaghan.

```
library(mgcv)

GAMmodel <- gam(Nanimals ~ s(Chla, bs = "cs") + s(Chla, SST) + s(Chla, Slope) + Depth + CC
         - log(Effort), family = poisson,  data = DB_P, method = "GACV.Cp", optimizer = c("outer", "newton"))

summary(GAMmodel)
gam.check(GAMmodel)

plot(GAMmodel,pages=1,residuals=TRUE)
plot(GAMmodel,pages=1,scheme=TRUE)

vis.gam(GAMmodel, view=c("Chla","Slope"), plot.type = "persp", theta=20, phi=40)
vis.gam(GAMmodel, view = c("SST", "Chla"), plot.type = "persp", theta=30, phi=30)


PredMarch <- predict.gam(GAMmodel, March, type = "response", se.fit = T)
PredApril <- predict.gam(GAMmodel, April, type = "response", se.fit = T)
PredMay <- predict.gam(GAMmodel, May, type = "response", se.fit = T)

write.table(PredMarch, sep = ";", dec = ",", file = "PredMarch.csv")
write.table(PredApril, sep = ";", dec = ",", file = "PredApril.csv")
write.table(PredMay, sep = ";", dec = ",", file = "PredMay.csv")
```

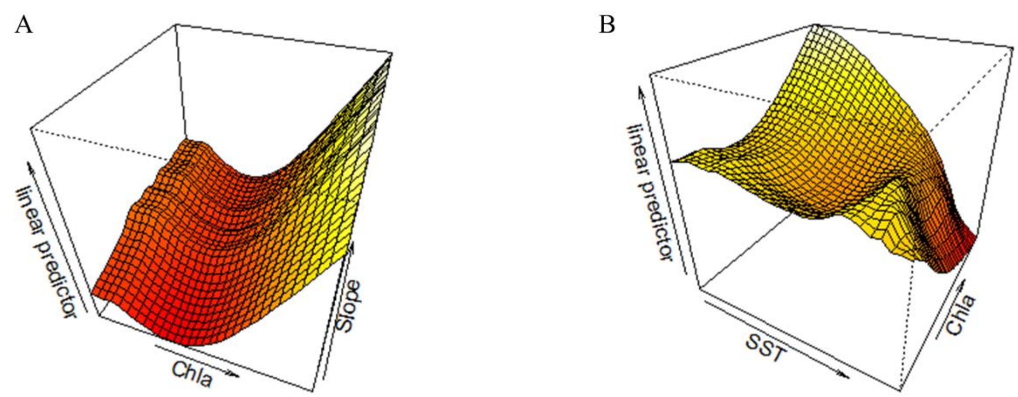
Supplementary Figure S2. R code used to perform the GAM model. This is the code according to the GAM model presented in the paper, the residual plots and the predicted results used on the distribution model.



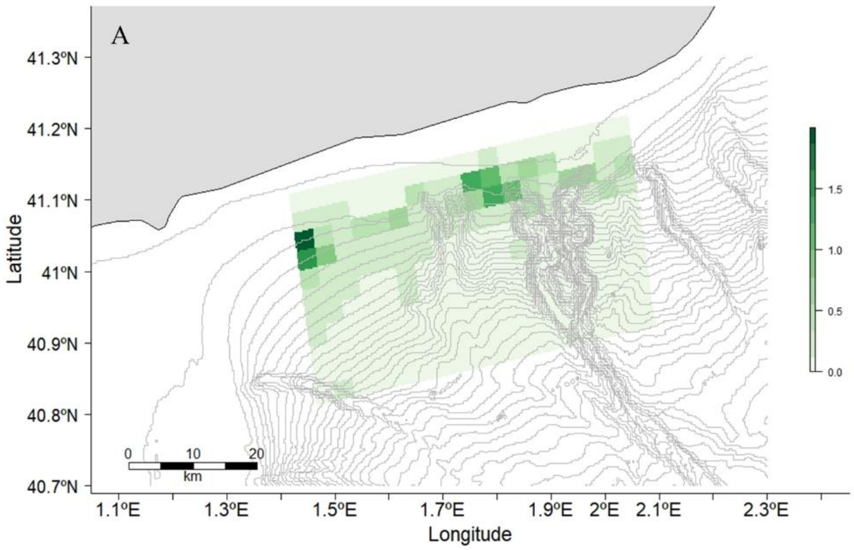
Supplementary Figure S3. Residual plots of the GAM model. The zero inflated problem is present in the residuals, but the model is considered valid. The Q-Plot (A) showed a light heavy tail on the upper part of the graphic. The residual vs. linear predicted (B) shows the zero inflated problem. The Histogram of residuals (C) also shows the zero inflated problem. The Response vs Fitted Values (D) are correct but the zero inflation problem is also present.



Supplementary Figure S4. The explanatory variable functions. In the upper left there is the Chla spline function, on the upper right the spline interaction between Chla and SST and on the bottom left the Chla and the Slope interaction.



Supplementary Figure S5. Plots of the explanatory variables of the GAM model related to the predictions. In the first plot there is the perspective plot of the Chla, the Slope and the linear predictor. In the second plot there is the perspective plot between Chla SST and the linear predictor.


A
41.3ºN
41.2ºN
41.1ºN
41ºN
40.9ºN
40.8ºN
40.7ºN
Latitude
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1.3ºE
1.5ºE
1.7ºE
1.9ºE
2ºE
2.1ºE
2.3ºE
Longitude
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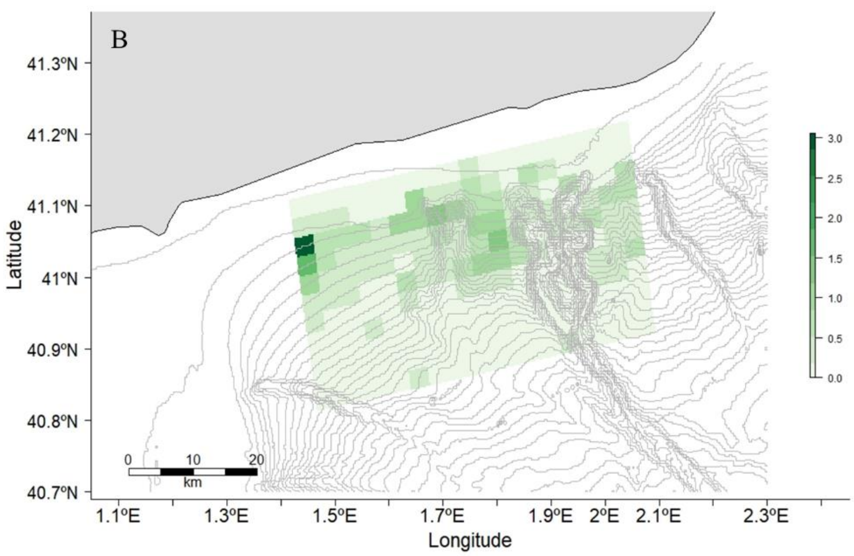
10
20
km
1.5
1.0
0.5
0.0


B
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Latitude
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1.3ºE
1.5ºE
1.7ºE
1.9ºE
2ºE
2.1ºE
2.3ºE
Longitude
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km
3.0
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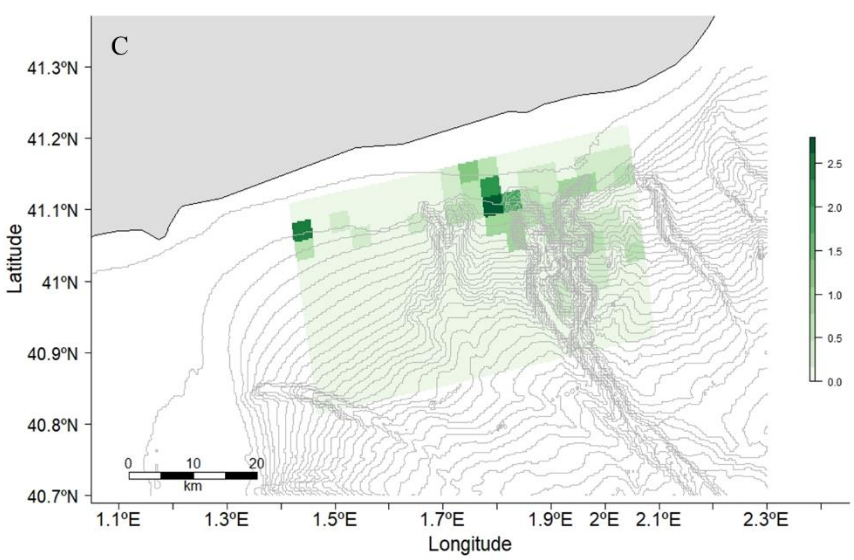
C
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40.7ºN
Latitude
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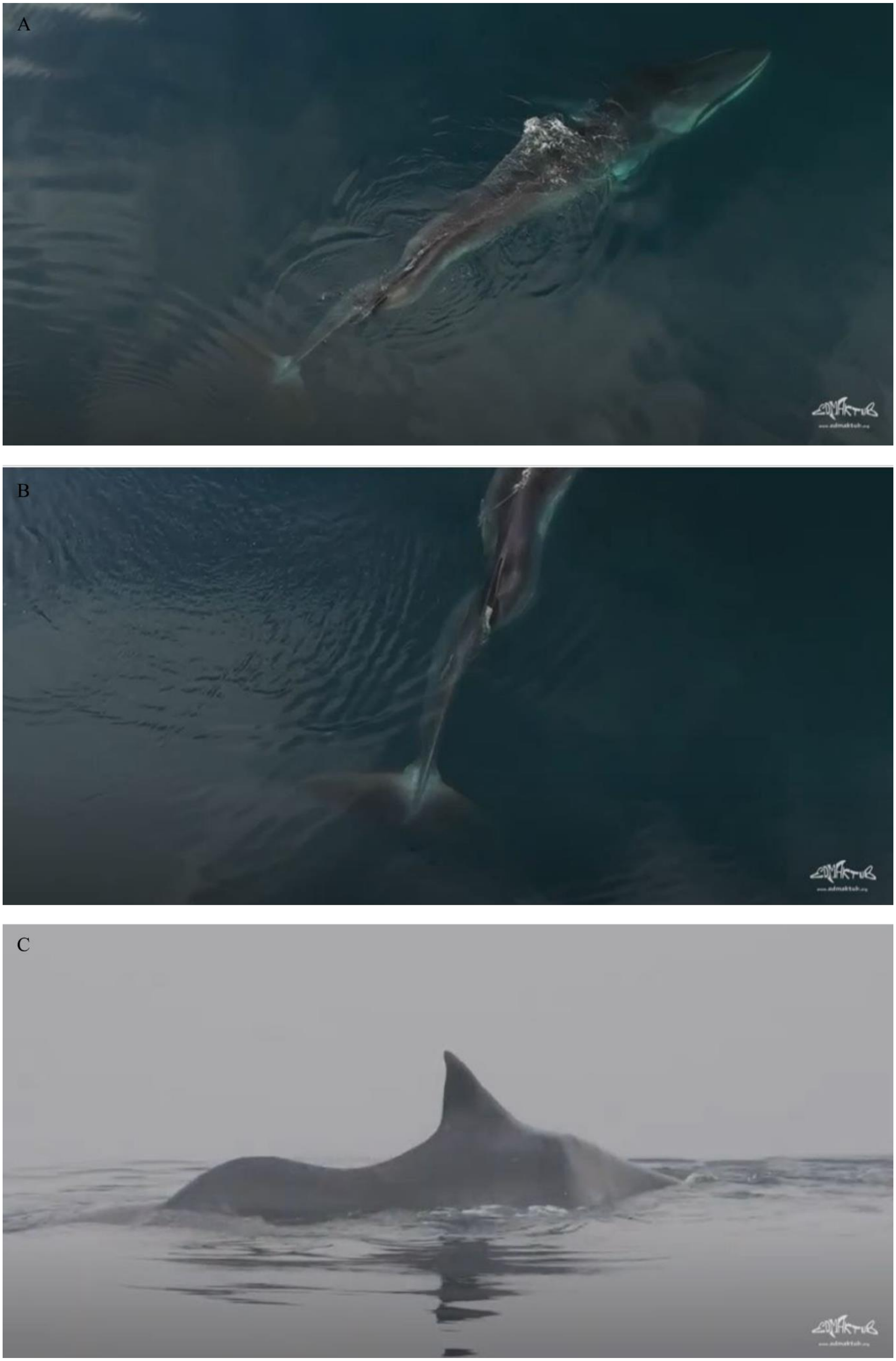
1.3ºE
1.5ºE
1.7ºE
1.9ºE
2ºE
2.1ºE
2.3ºE
Longitude
0
10
20
km
2.5
2.0
1.5
1.0
0.5
0.0

Supplementary Figure S6. Maps with the standard error of the GAM model distribution for March, April and May.

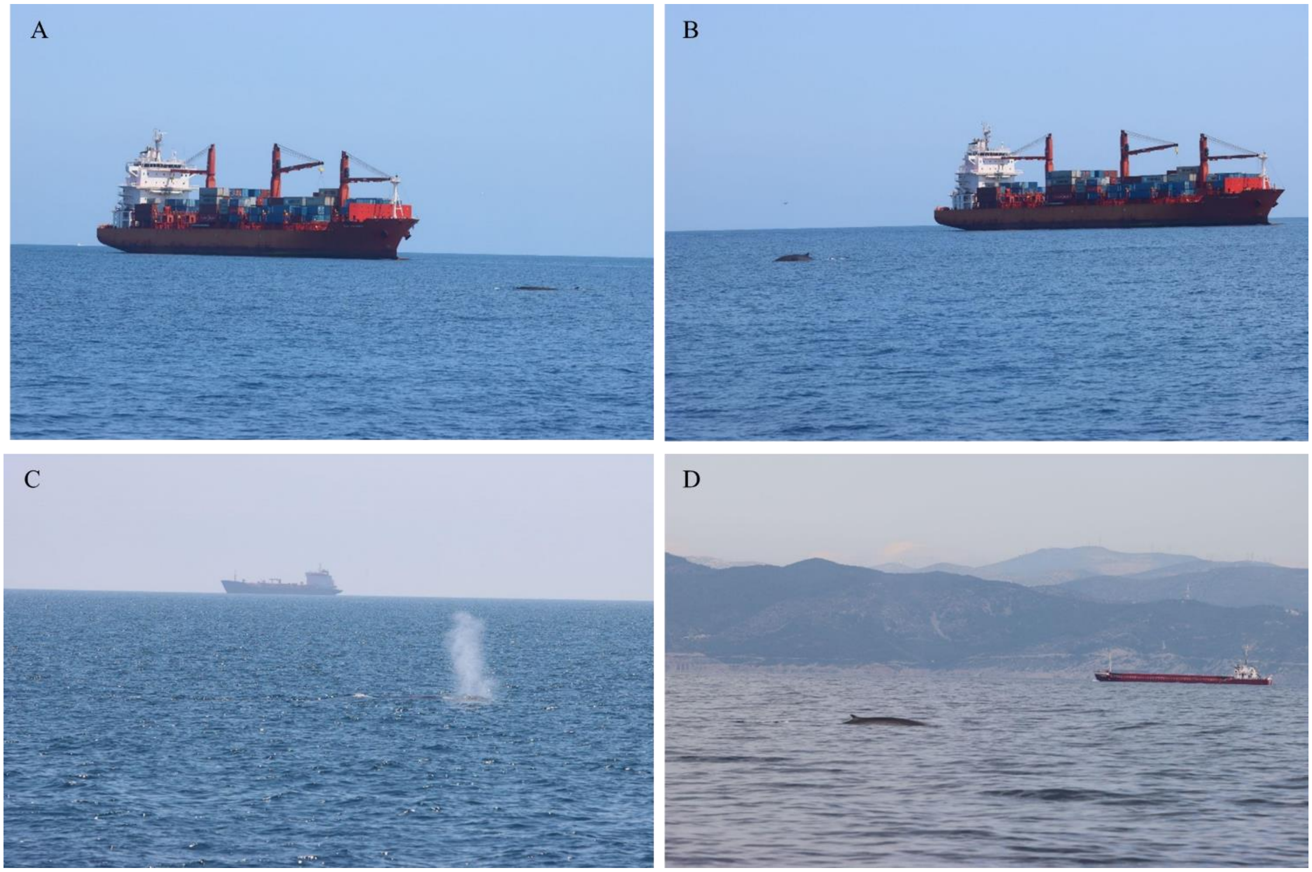
Supplementary Figure S7. Fin whale in the study area displaying an idiopathic scoliosis. Individual sighted in 2021.


A
B
C

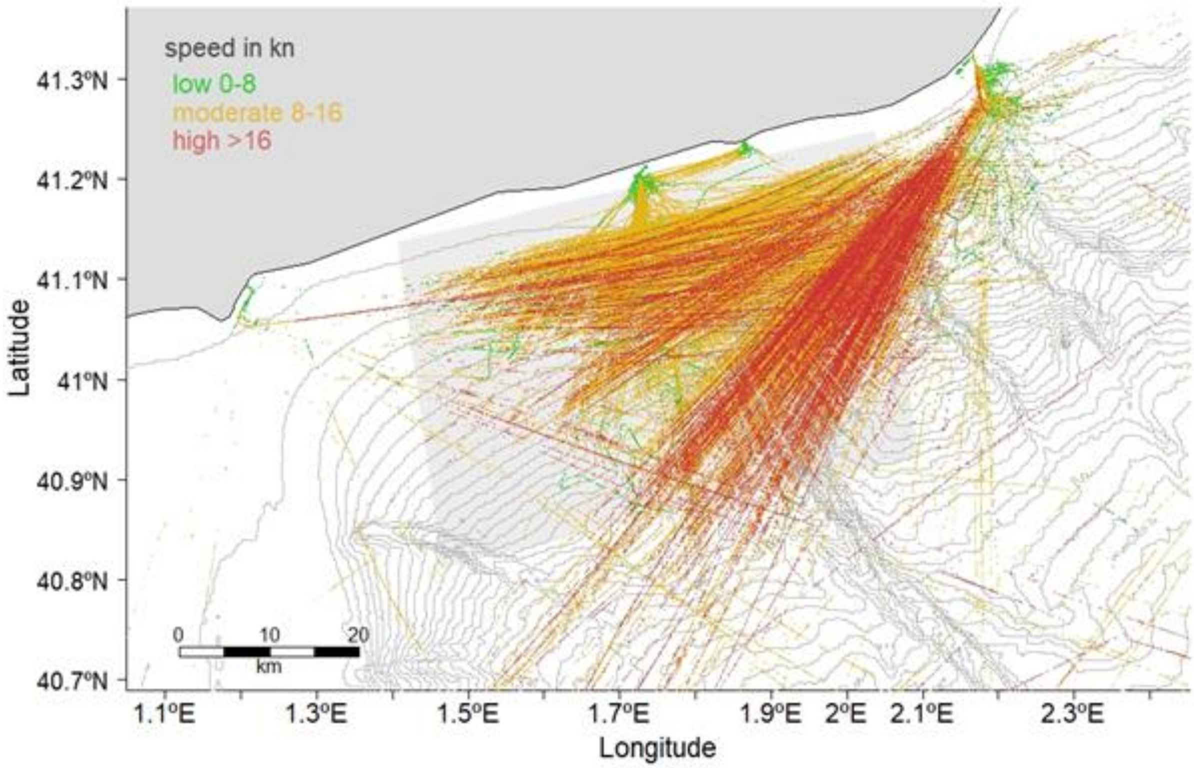
Supplementary Figure S8. Fin whale in the study area displaying scoliosis. Individual sighted in 2018.

Supplementary Figure S9. Fin whale in the study area displaying a left lateral scar. Individual sighted in 2021.

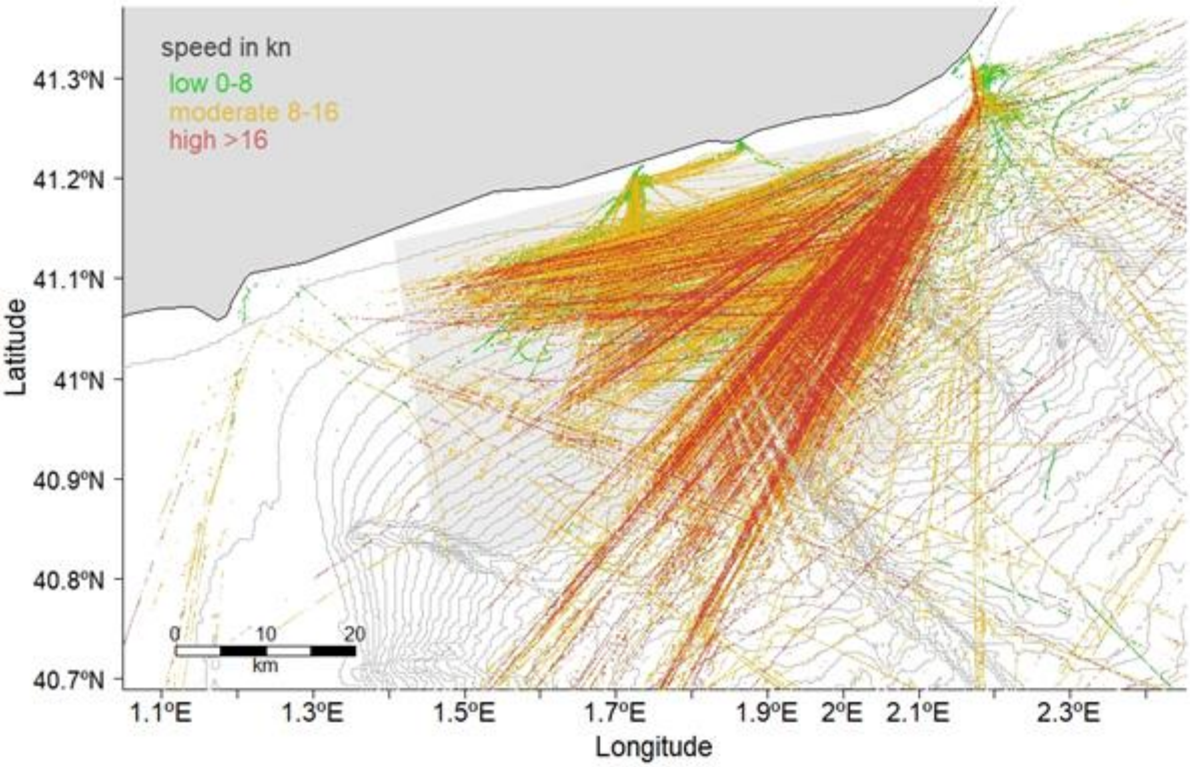
Supplementary Figure S10. Fin whale in the study area displaying a tailstock cut. Individual sighted in 2021.



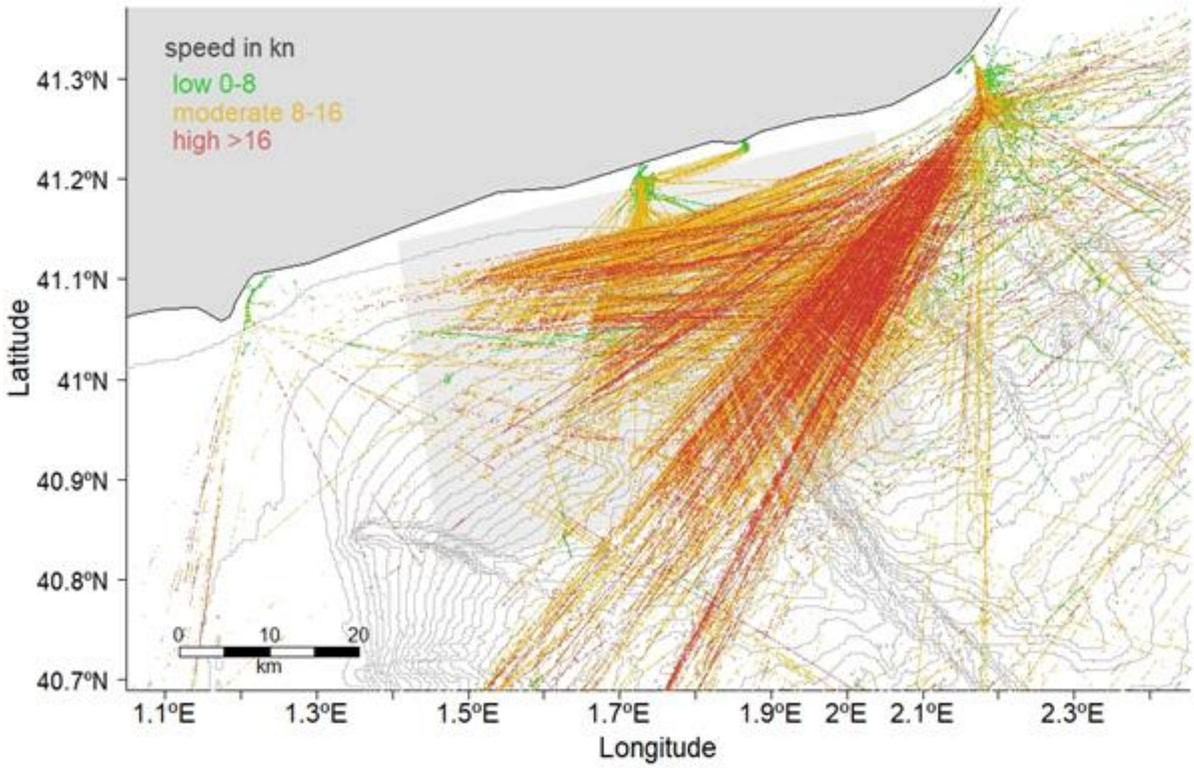
Supplementary Figure S11. A fin whale in close proximity to a cargo vessel on 27 May 2021 (A) and , fin whales in the vicinity of tanker vessels on 3 March and 29 April 2021. Photographs by Seán A. O'Callaghan.



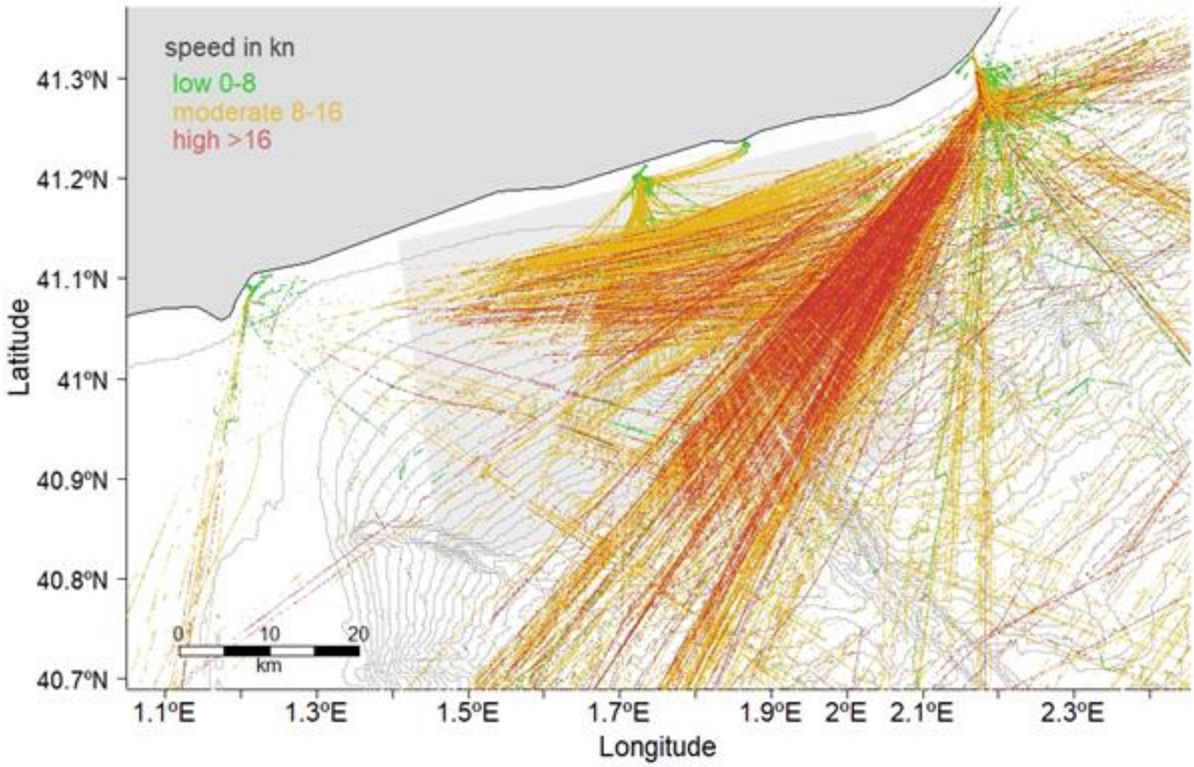
Supplementary Figure S12. Cargo vessel positions in February from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



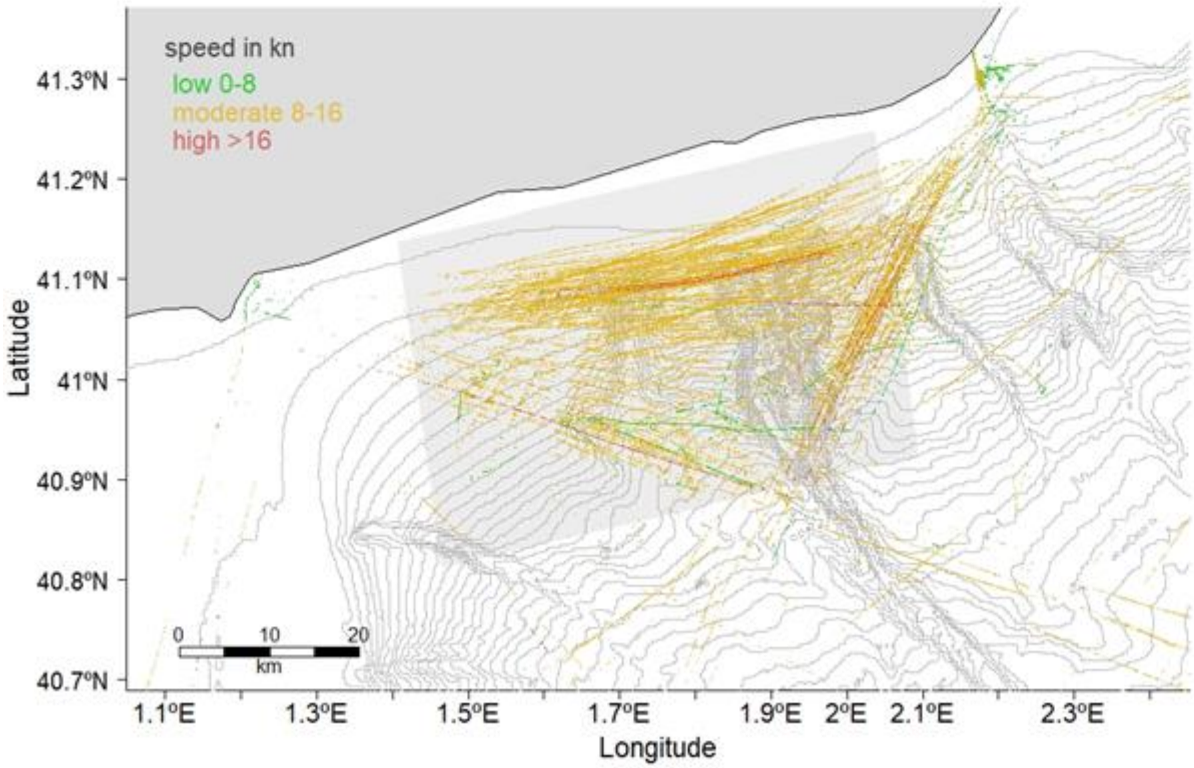
Supplementary Figure S13. Cargo vessel positions in March from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



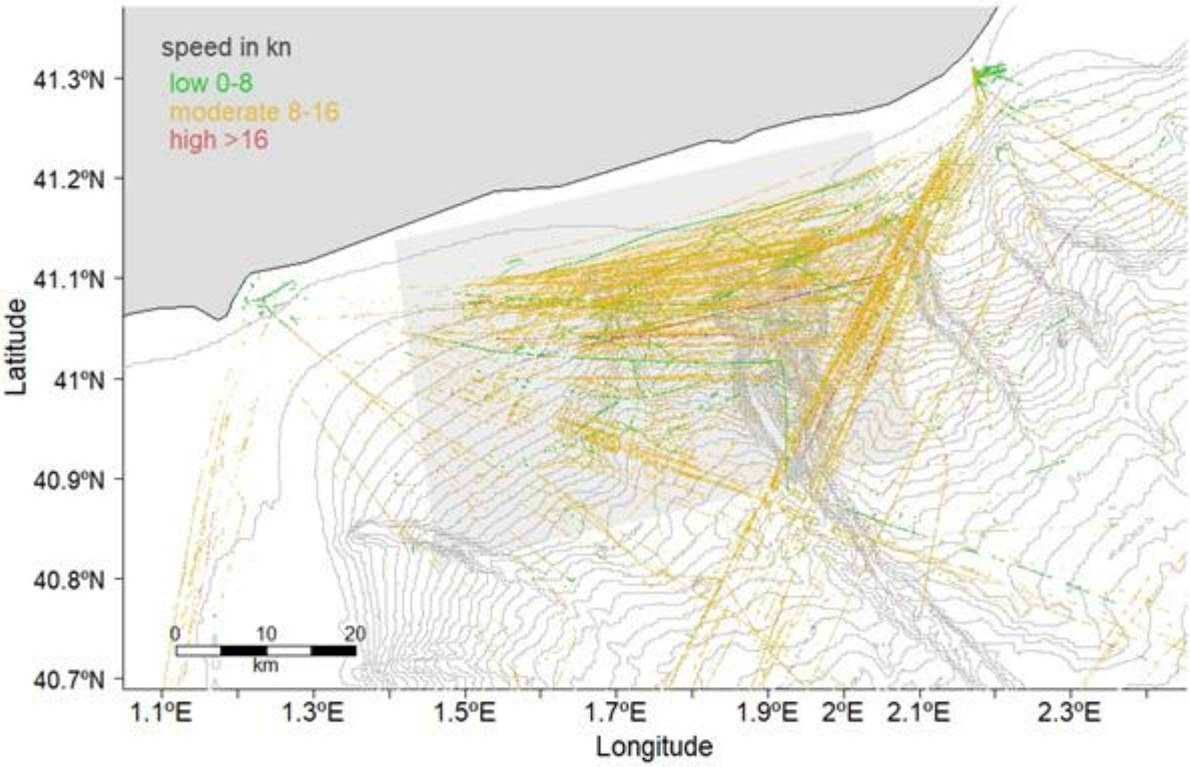
Supplementary Figure S14. Cargo vessel positions in May from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



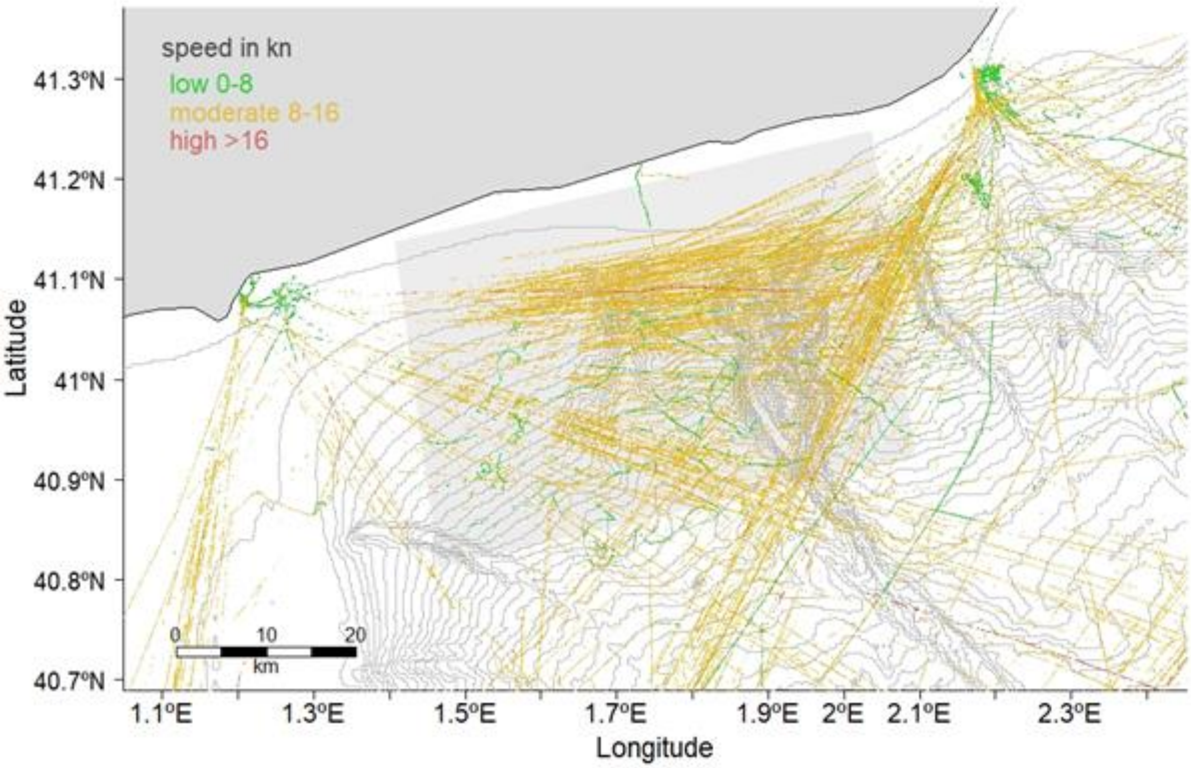
Supplementary Figure S15. Cargo vessel positions in June from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



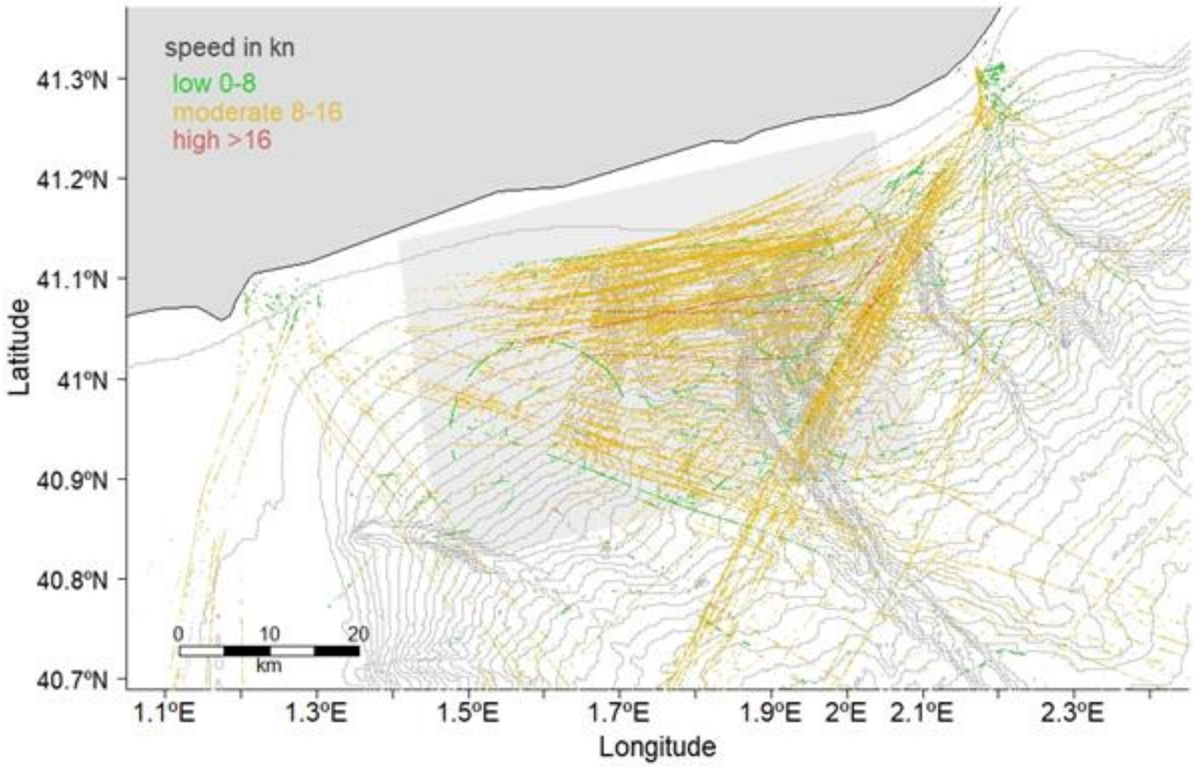
Supplementary Figure S16. Tanker vessel positions in February from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



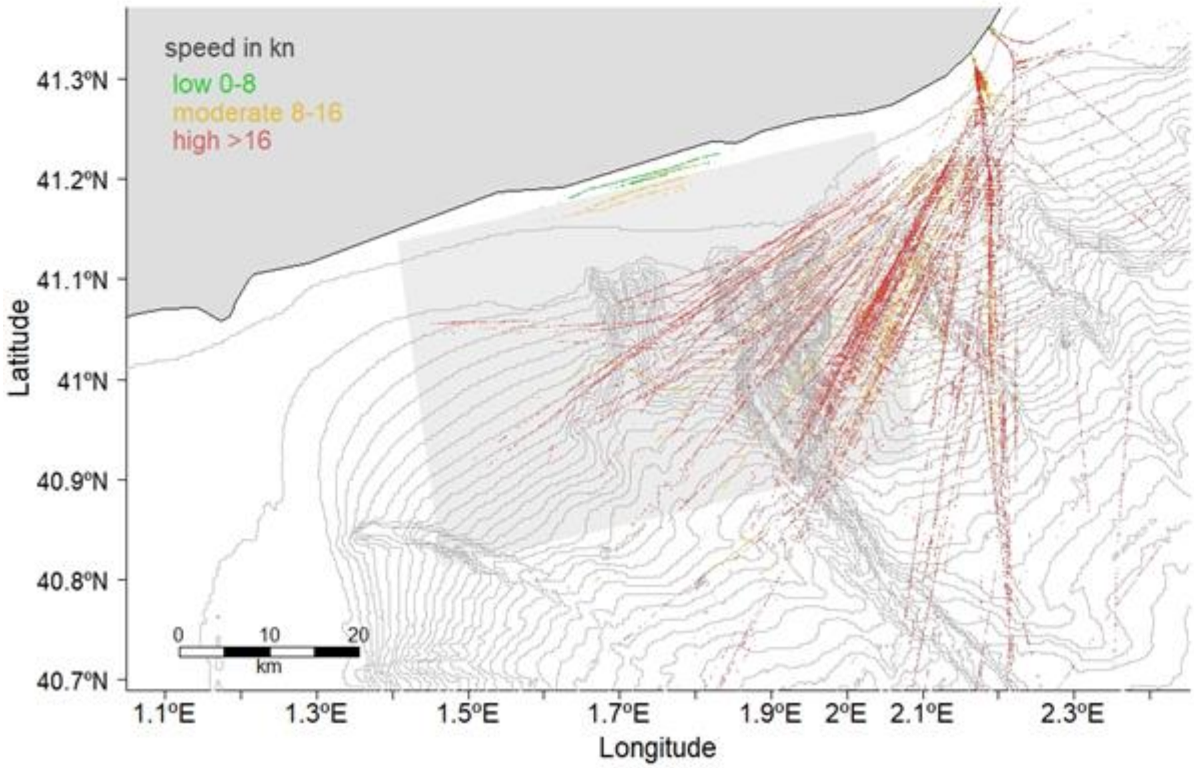
Supplementary Figure S17. Tanker vessel positions in March from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



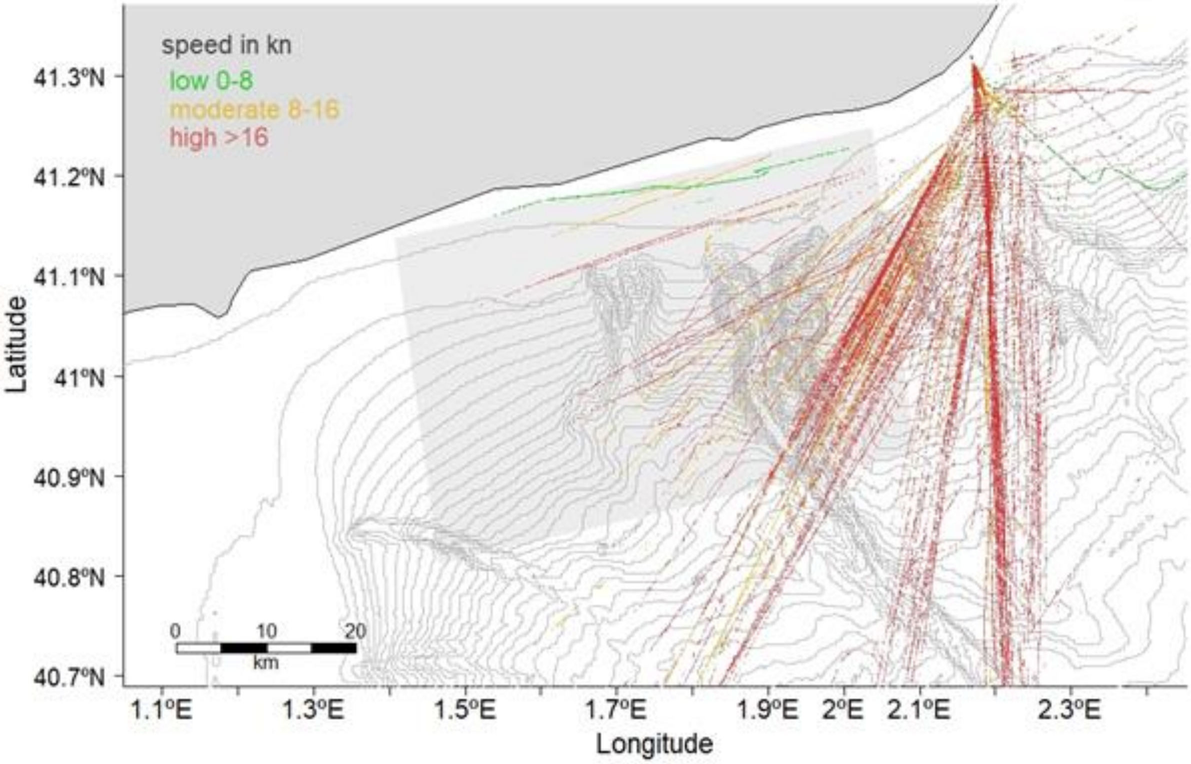
Supplementary Figure S18. Tanker vessel positions in May from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



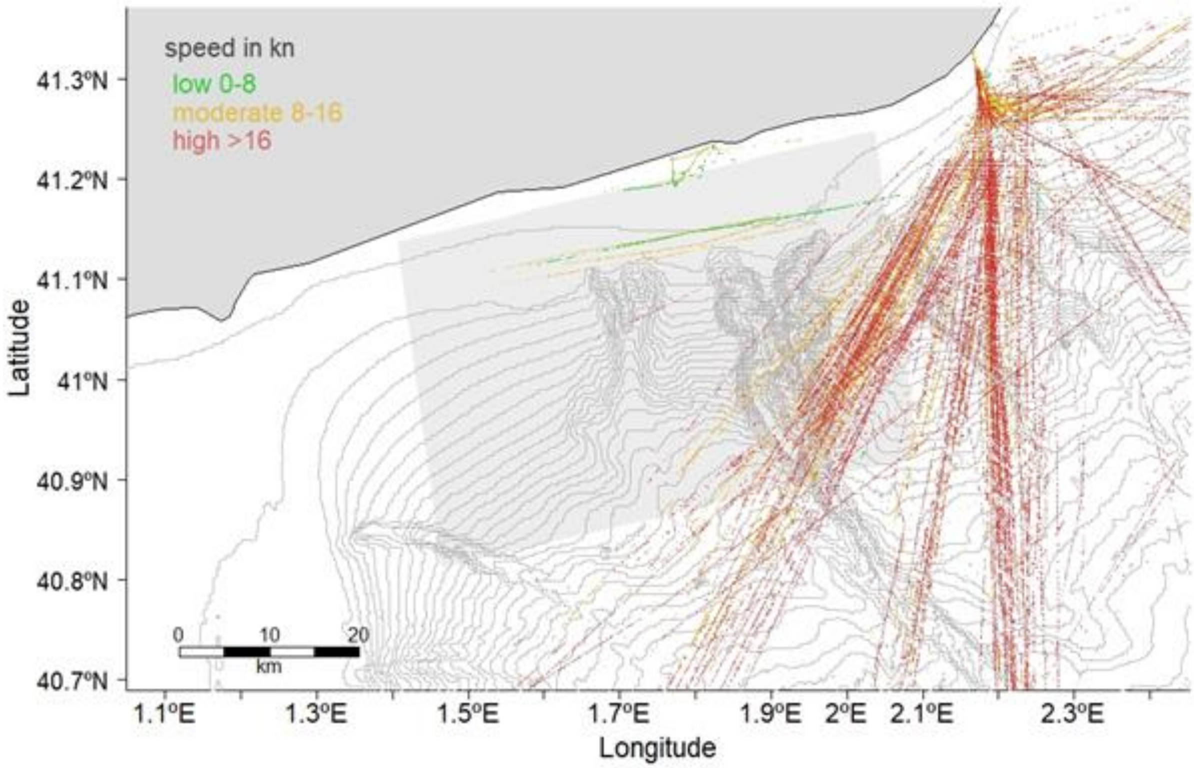
Supplementary Figure S19. Tanker vessel positions in June from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



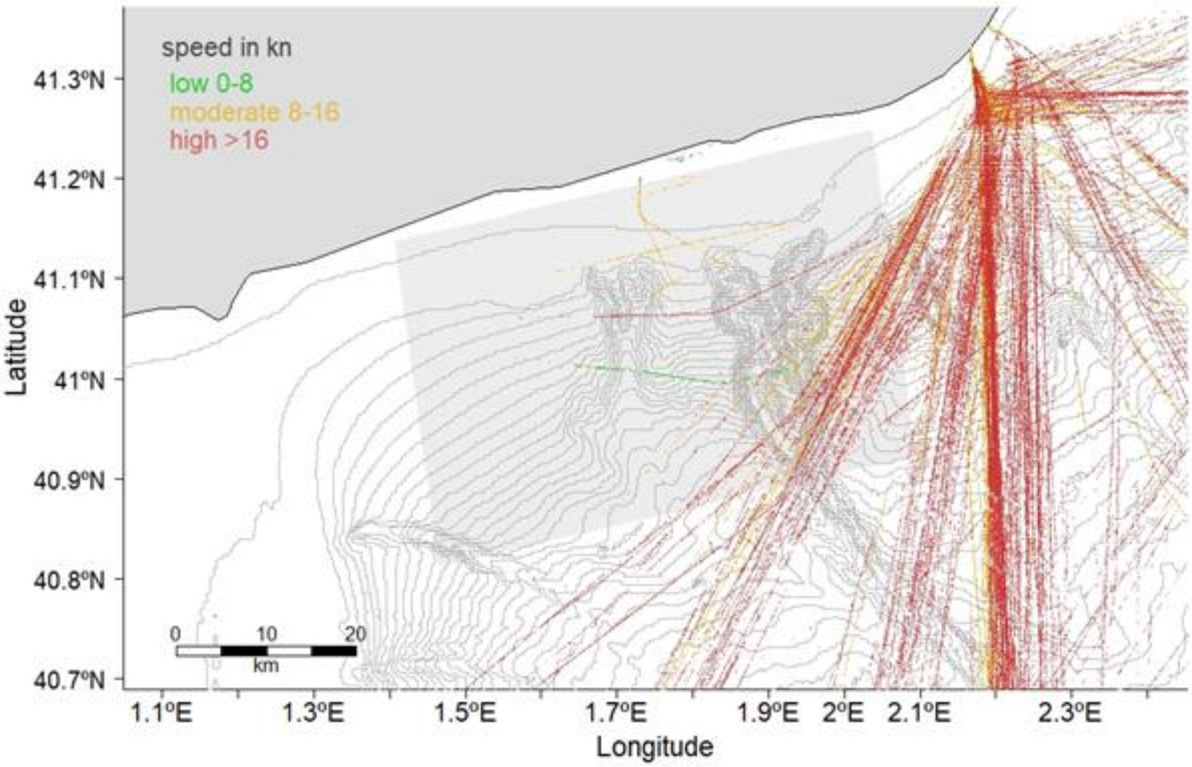
Supplementary Figure S20. Passenger vessel positions in February from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



Supplementary Figure S21. Passenger vessel positions in March from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



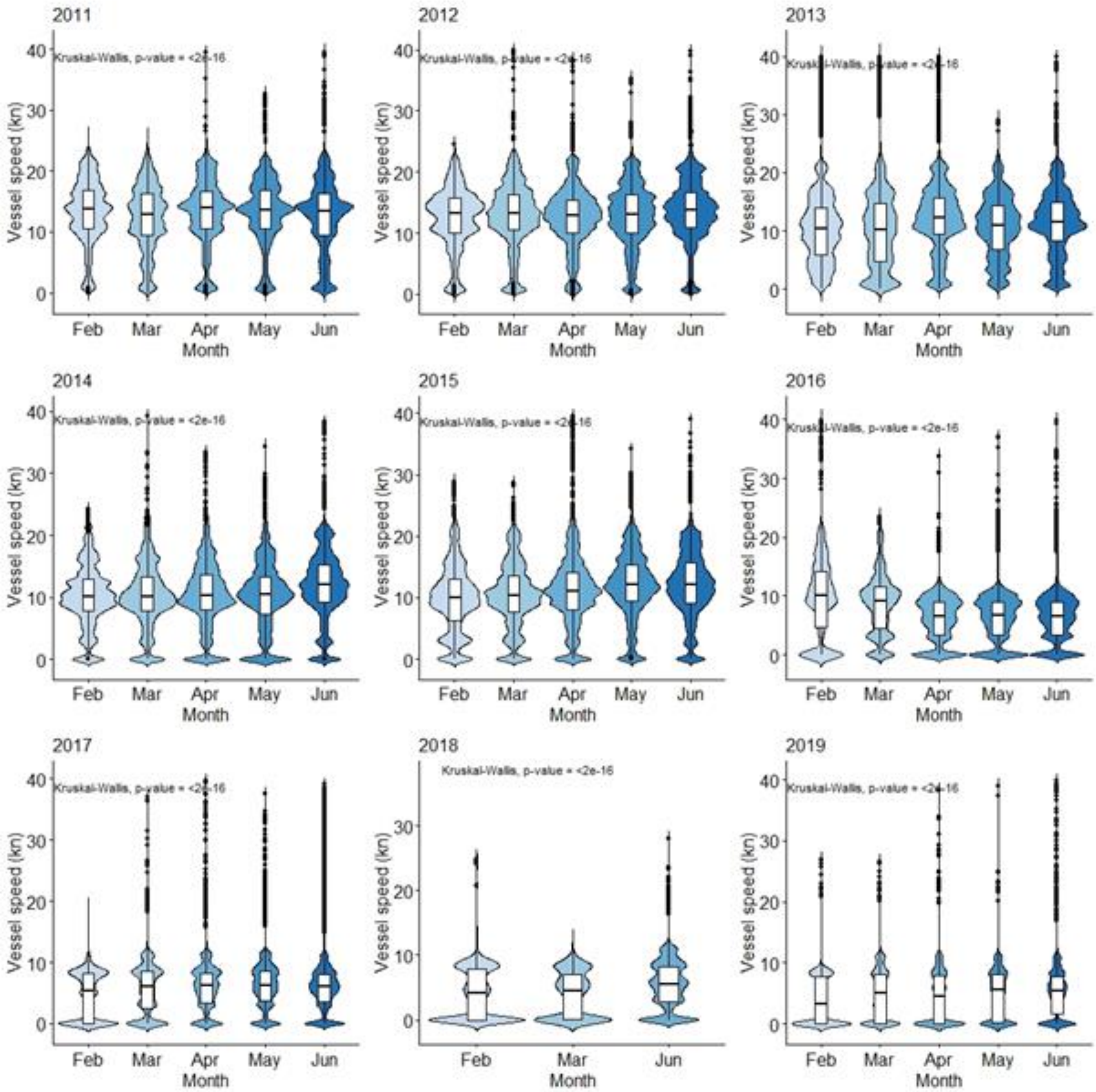
Supplementary Figure S22. Passenger vessel positions in May from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.



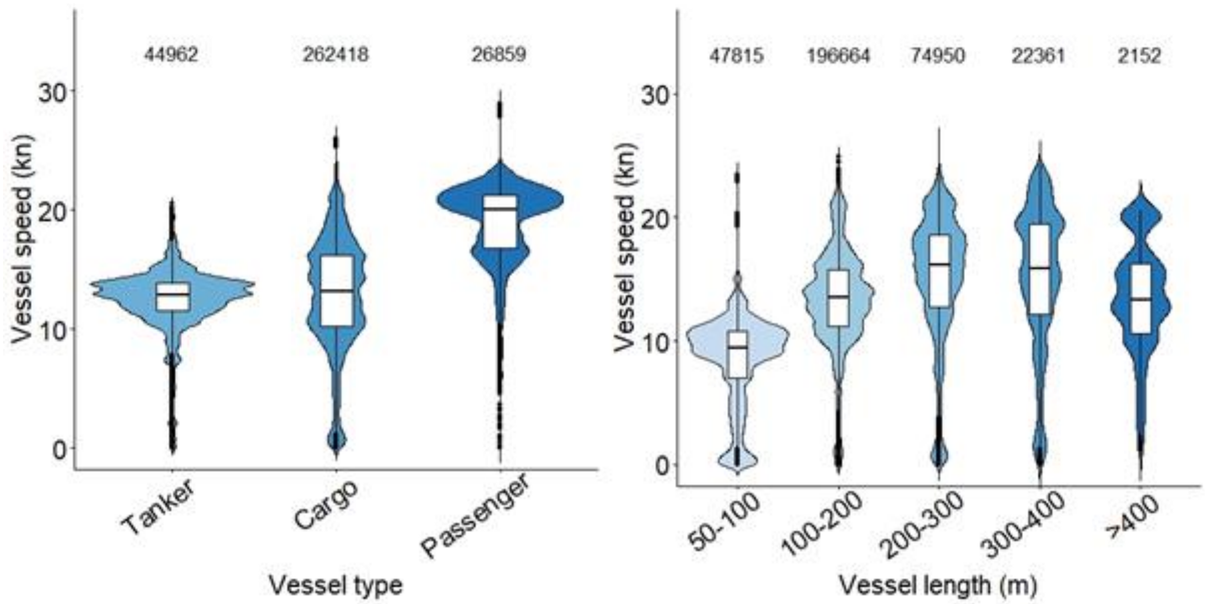
Supplementary Figure S23. Passenger vessel positions in June from pooled AIS data from 2011 to 2020. The bathymetry is represented by isobaths every 50 m and the study area is shadowed.

Month	Statistic	Vessel type: Cargo	Passenger	Tanker	Vessel length in meters: 50-100	100-200	200-300	300-400	>400
February	25%	10.20	16.80	11.50	7.00	11.20	12.70	12.20	10.60
	50%	13.20	20.00	12.90	9.40	13.50	16.10	15.90	13.30
	75%	16.20	21.20	13.90	10.80	15.80	18.60	19.50	16.20
	CV	37.35	18.24	22.46	44.02	30.87	34.92	38.15	33.06
March	25%	10.10	16.40	10.90	7.10	10.90	12.40	9.80	11.70
	50%	12.90	19.30	12.60	9.70	13.30	15.50	13.60	13.70
	75%	16.10	20.70	13.90	10.70	16.00	18.40	17.70	15.50
	CV	39.09	21.69	29.34	42.60	34.82	34.55	42.28	16.92
April	25%	10.70	14.90	10.90	5.20	11.60	12.90	12.00	10.80
	50%	13.60	18.30	12.70	9.60	13.70	15.60	15.60	11.35
	75%	16.10	20.60	14.10	10.70	15.90	18.20	18.20	13.10
	CV	33.90	23.90	34.54	52.66	31.58	30.26	32.08	27.85
May	25%	10.90	15.70	10.80	4.40	11.50	12.70	11.60	11.50
	50%	13.60	18.50	12.30	9.40	13.60	15.80	14.40	13.70
	75%	16.30	20.40	13.60	11.00	16.20	18.20	17.60	14.40
	CV	33.78	21.98	31.52	58.92	31.51	31.93	33.87	17.94
June	25%	11.00	16.50	11.00	5.70	11.70	12.60	12.90	7.40
	50%	13.60	19.40	12.70	9.60	13.80	15.30	16.10	14.10
	75%	16.00	20.70	13.80	11.60	16.50	17.80	18.80	15.20
	CV	31.54	19.03	32.36	62.40	30.96	31.85	30.75	32.21

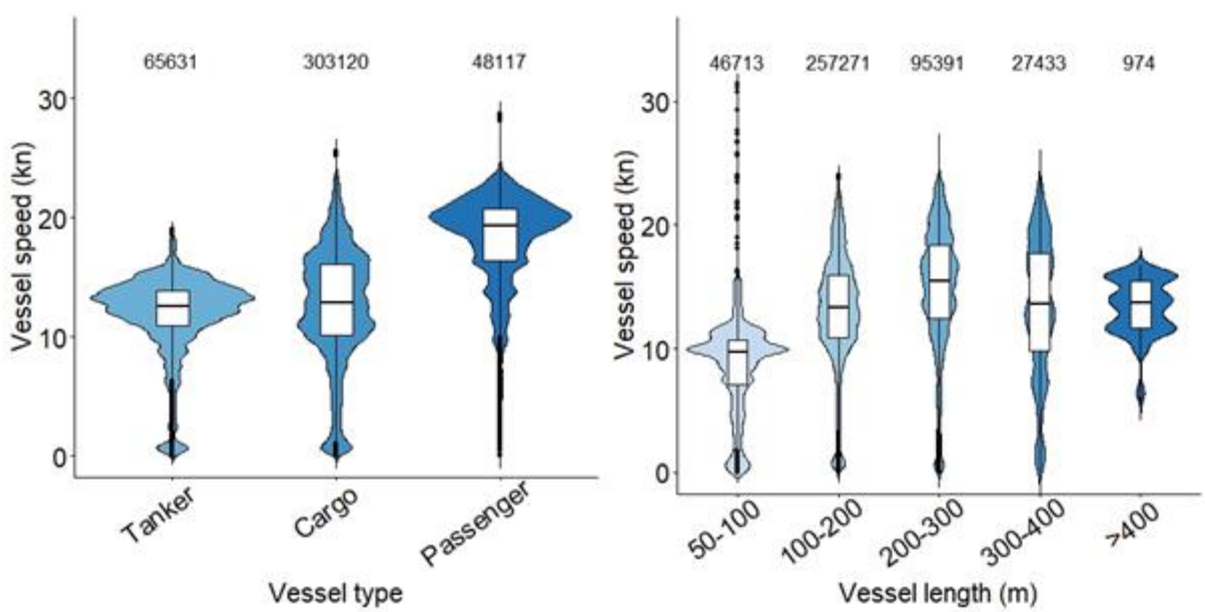
Supplementary Figure S24. The 25th, 50th (median), 75th percentiles and the coefficient of variation (%) of vessel speed distribution in knots, for two vessel categories. Vessel type: cargo, passenger and Tanker vessels; and vessel length in meters: 50-100, 100-200, 200-300, 300-400 and >400 m long. The statistics are monthly estimated from February to June, from pooled AIS data between 2011 and 2020.



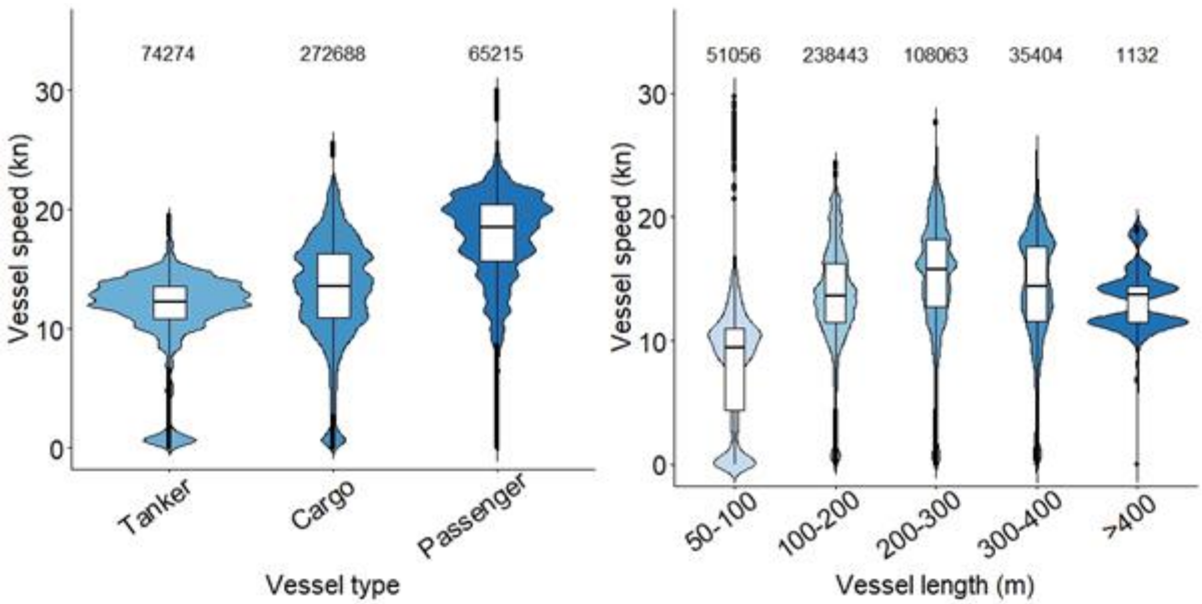
Supplementary Figure S25. Comparison of vessel speed distribution by month within a year.



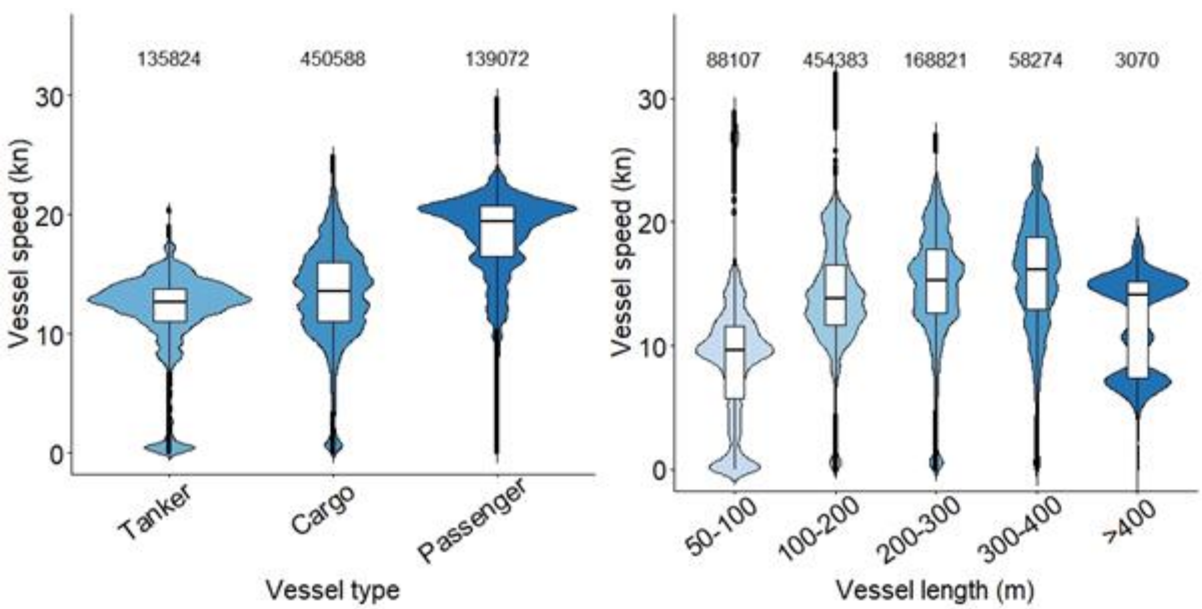
Supplementary Figure S26. The distribution of vessel speeds in February (from pooled AIS data between 2011 and 2020) by vessel type and vessel length in the study area, where fin whales were observed surface feeding. The number of unique vessels in each category is indicated at the top of each violin plot.



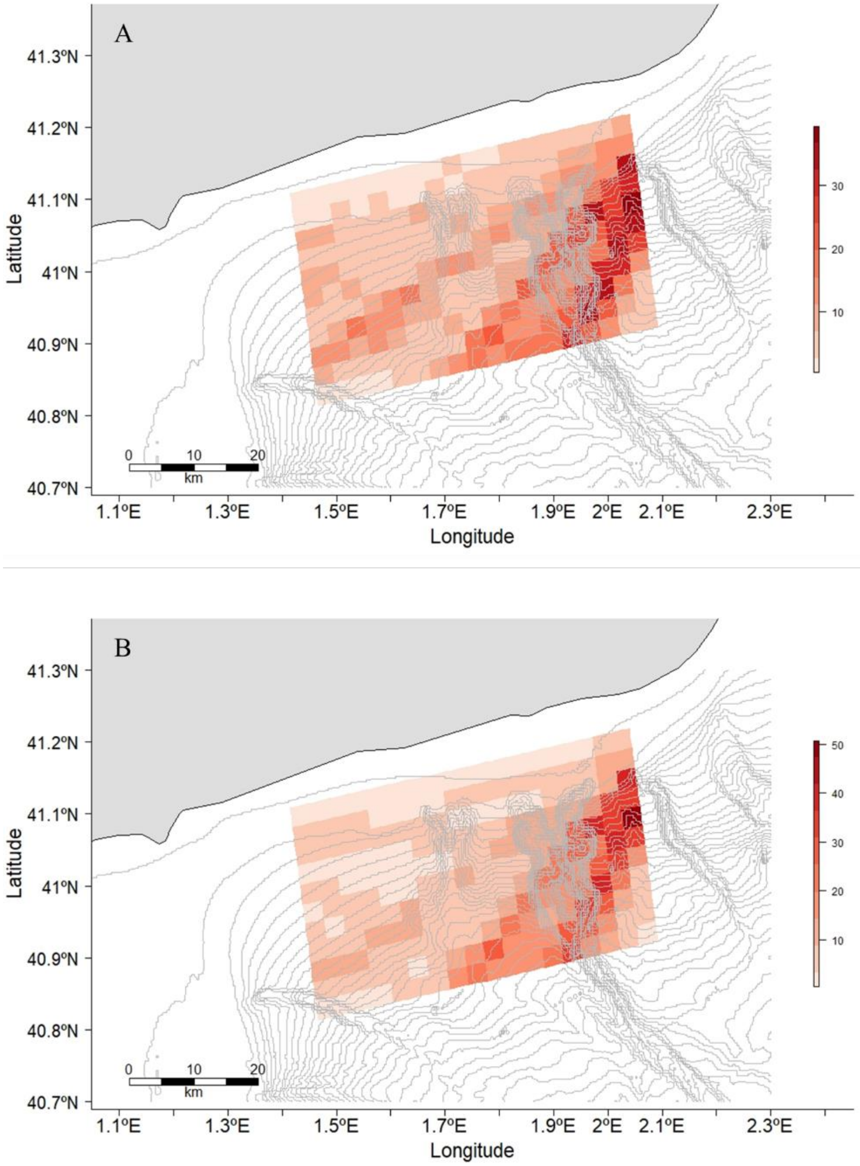
Supplementary Figure S27. The distribution of vessel speeds in March (from pooled AIS data between 2011 and 2020) by vessel type and vessel length in the study area, where fin whales were observed surface feeding. The number of unique vessels in each category is indicated at the top of each violin plot.



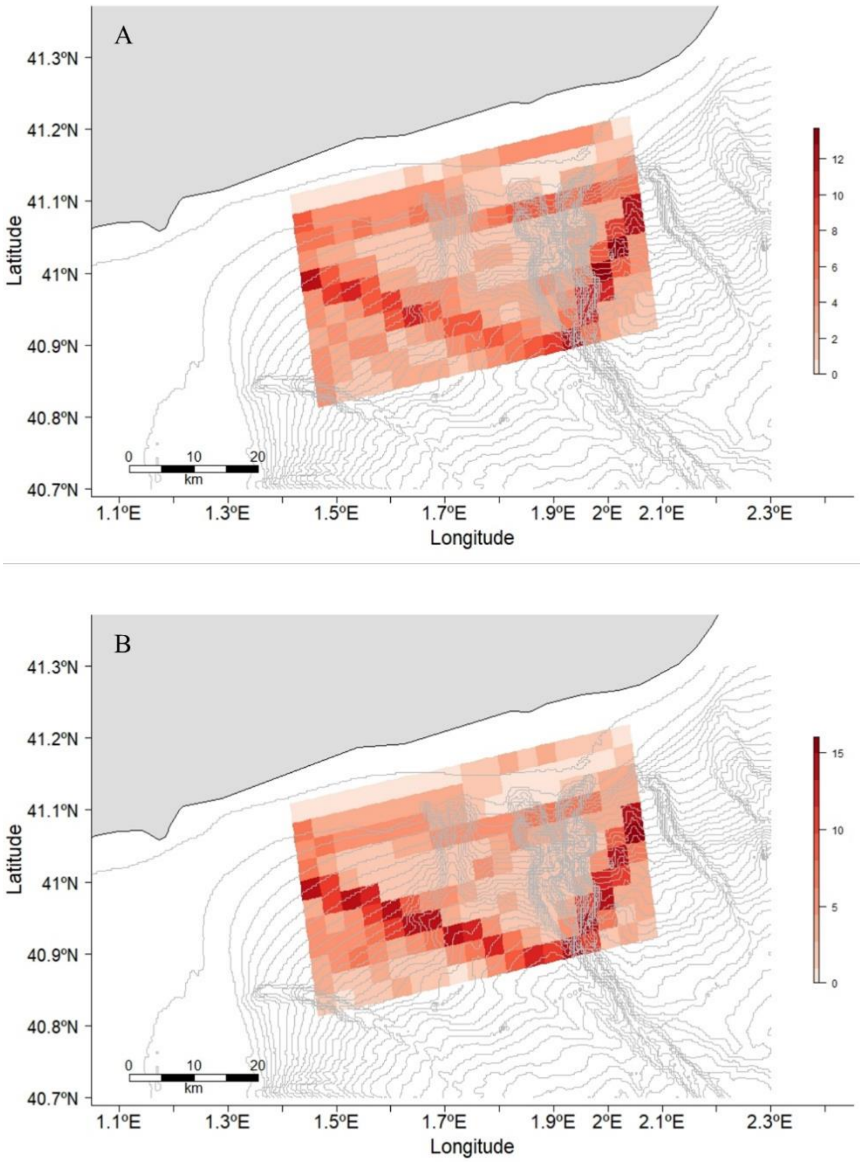
Supplementary Figure S28. The distribution of vessel speeds in May (from pooled AIS data between 2011 and 2020) by vessel type and vessel length in the study area, where fin whales were observed surface feeding. The number of unique vessels in each category is indicated at the top of each violin plot.



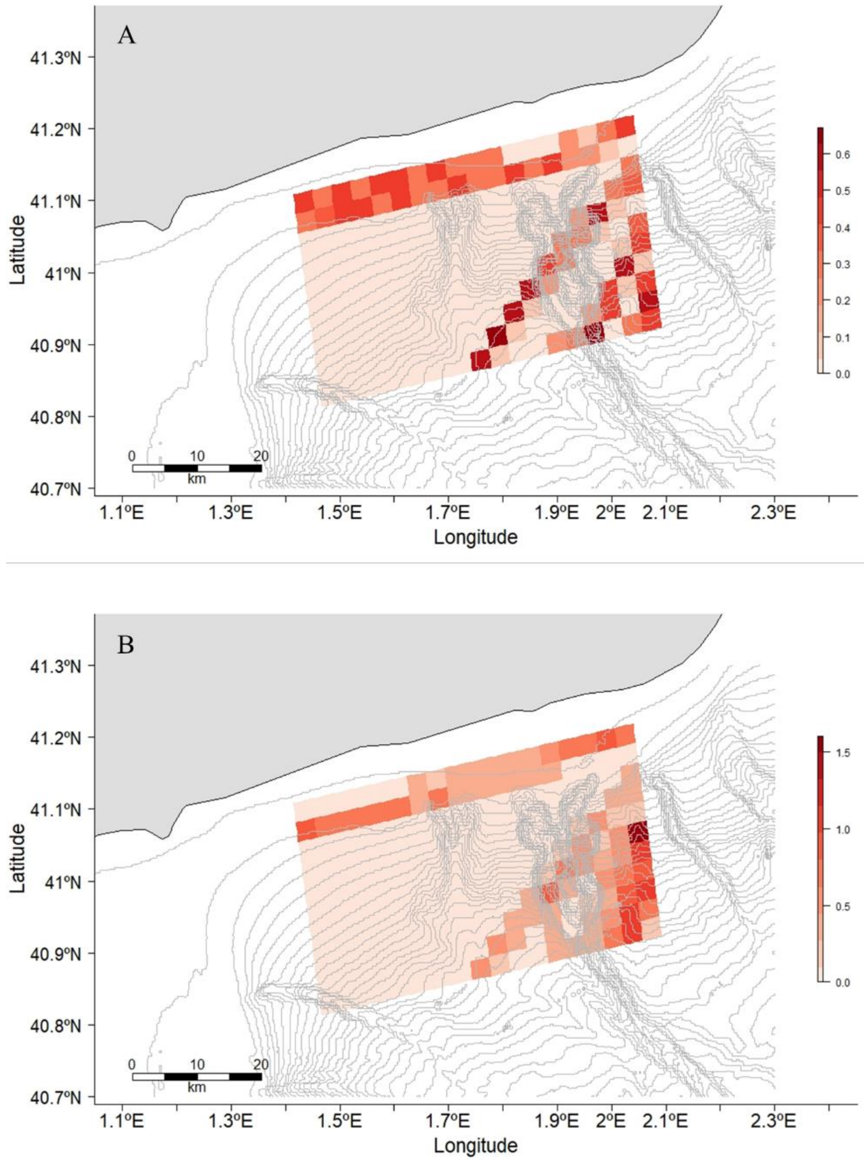
Supplementary Figure S29. The distribution of vessel speeds in June (from pooled AIS data between 2011 and 2020) by vessel type and vessel length in the study area, where fin whales were observed surface feeding. The number of unique vessels in each category is indicated at the top of each violin plot.



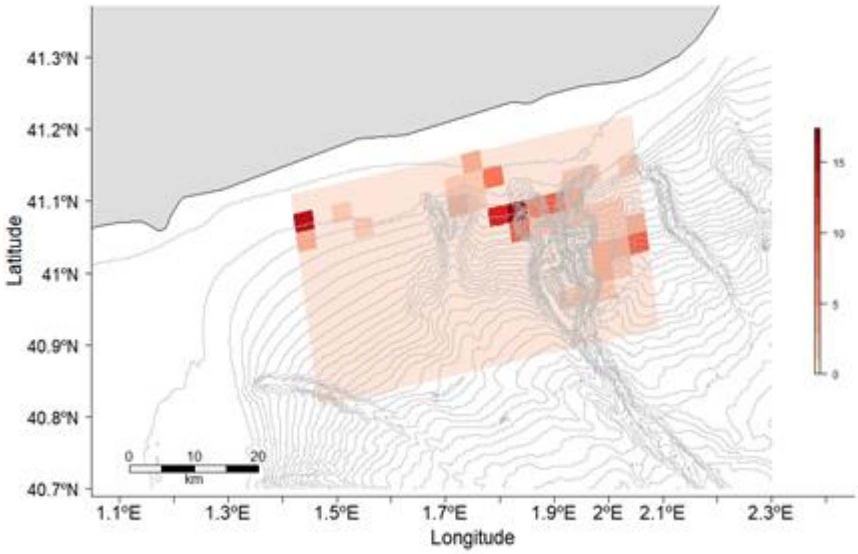
Supplementary Figure S30. Cargo ship density from March to April 2021 in the study area.



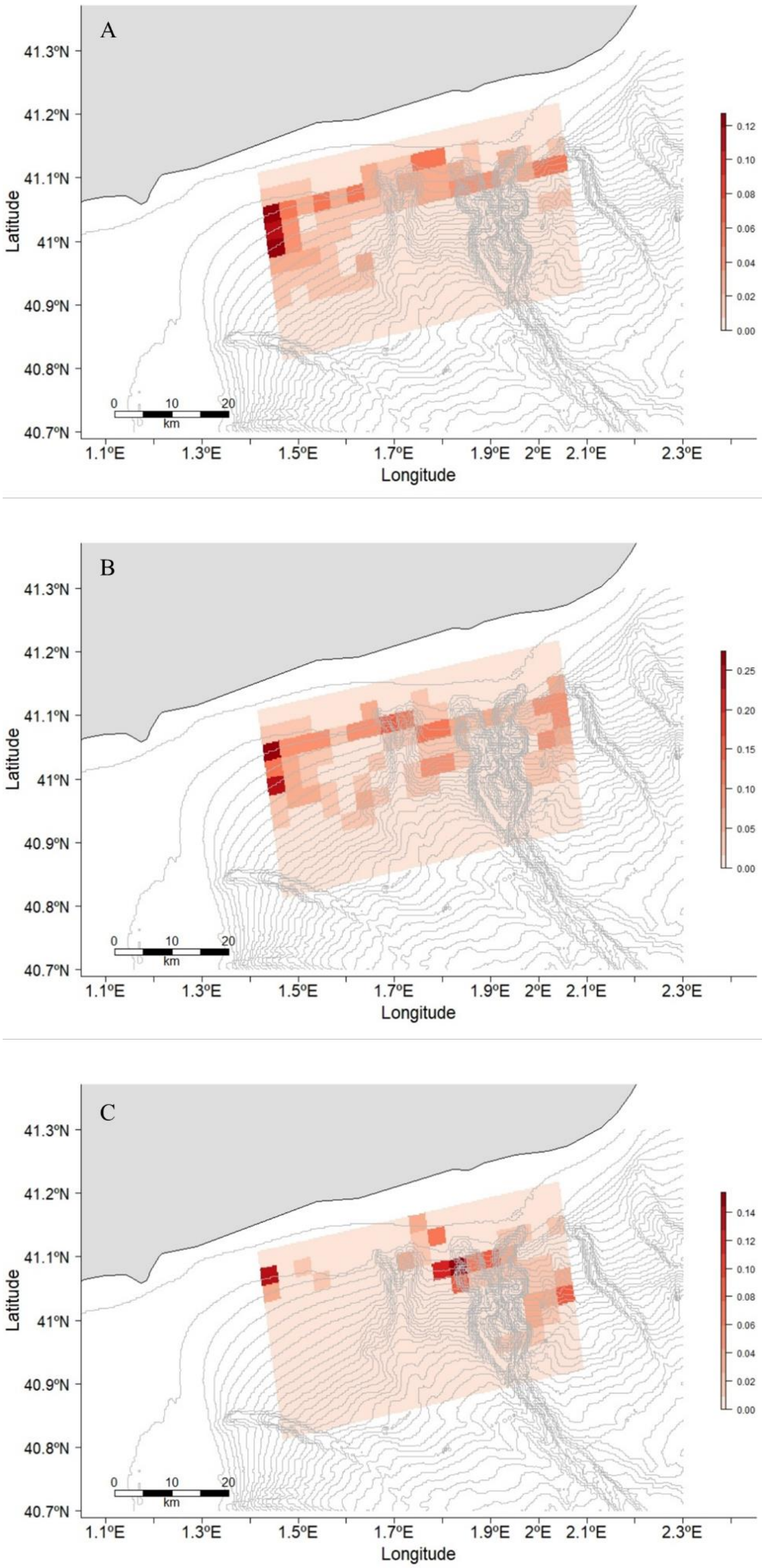
Supplementary Figure S31. Tanker Ship density from April to May 2021 in the study area.



Supplementary Figure S32. Passenger ship density from March to April in the study area.



Supplementary Figure S33. Risk of collision between a fin whale and a cargo ship in May 2021.


A
41.3ºN
41.2ºN
41.1ºN
41ºN
40.9ºN
40.8ºN
40.7ºN
Latitude
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Longitude
0.12 0.10 0.08 0.06 0.04 0.02 0.00
B
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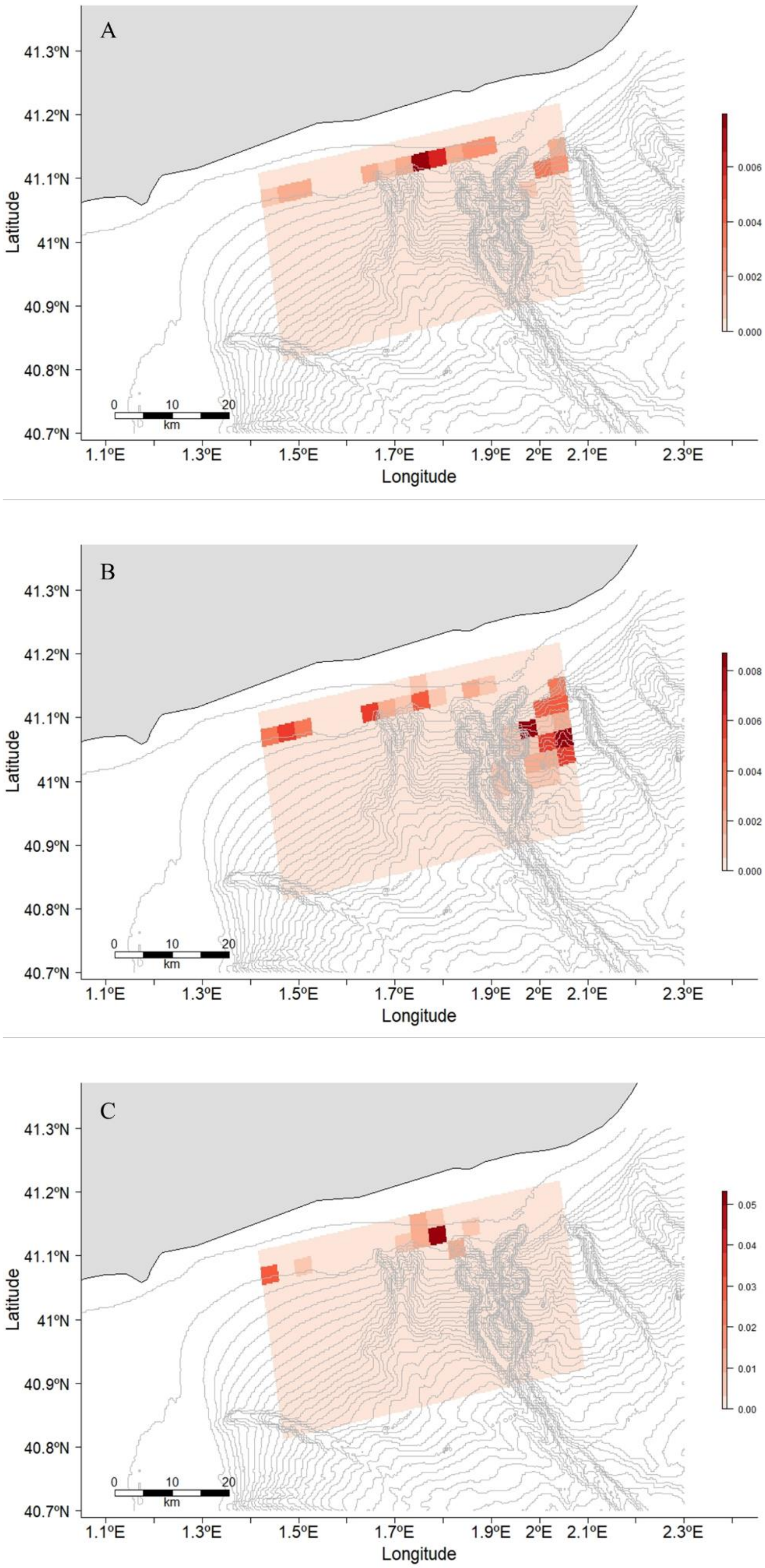
Supplementary Figure S34. Risk of collision between a fin whale and a tanker ship in between March - May 2021.


A
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40.9ºN
40.8ºN
40.7ºN
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km
0.000
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0.004
0.006
0.008
0.00
0.01
0.02
0.03
0.04
0.05

Supplementary Figure S**35**. Risk of collision between a fin whale and a passenger ship in between March - May 2021