

Habitat-based density model for fin whale in the AFTT area

Laura Mannocci, Jason J Roberts, David L Miller, Patrick N Halpin

October 1, 2016

This report documents the habitat-based density model for fin whale in the Atlantic Fleet Testing and Training Area (AFTT) area. Information on the first stage of the modeling approach, including classification of ambiguous sightings, detection function fitting and $g(0)$ estimation can be found in individual taxon reports presented in Roberts et al. (2016) for the U.S. Atlantic and Gulf of Mexico.

Citation for this model: Mannocci L, Roberts JJ, Miller DL, Halpin PN (2016). Habitat-based density model for fin whale in the AFTT area. 2016-10-01. Marine Geospatial Ecology Lab, Duke University, Durham, NC.

Citation for the related publication: Mannocci L, Roberts JJ, Miller DL, Halpin PN. Extrapolating cetacean densities to quantitatively assess human impacts on populations in the high seas. In review in Conservation Biology.

1- Available data

Table 1: Effort (km) and sightings per surveyed region (CAR: Caribbean, EC: East coast, EU: European Atlantic, GM: Gulf of Mexico, MAR: Mid-Atlantic ridge). Details on the origin of sightings used in this study can be found in Table 1 of the associated publication.

Region	Effort	Sightings
CAR	24264.473	3
EC	1044357.704	1781
EU	27526.342	192
GOM	194715.349	1
MAR	2424.421	12
All regions	1293288.288	1989

Table 2: Effort (km) and sightings per month.

Month	Effort	Sightings
January	77892.79	59
February	123591.37	41
March	117923.54	58
April	117929.72	134
May	149765.03	255
June	132713.99	370
July	162324.31	487
August	129660.43	223
September	71696.07	60
October	82560.18	132
November	69210.92	103
December	58019.93	67
All Months	1293288.29	1989

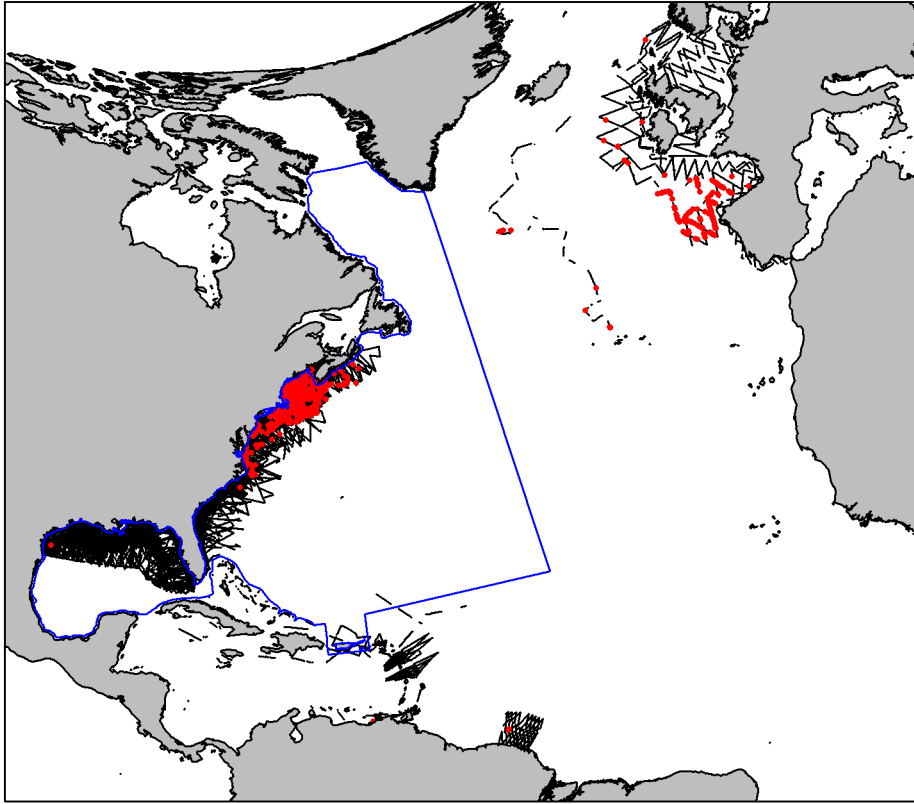


Figure 1: Map of segments (black lines) and sighting locations (red dots). An Albers equal area projection optimized for the AFTT area is used.

2- Methodological decisions

Methodological decisions reported in this section were made according to information available to us in the literature as well as feedback from a number of experts we consulted.

Modeled taxon

Fin whale (*Balaenoptera physalus*)

Modeled season

Contrary to humpback whales, fin whales do not undertake long-range migrations that result in distinct distributions in summer and winter (Edwards et al. 2015, Aguilar 2009). In addition, there is evidence that some fin whales remain at mid latitudes year-round, indicating that not all individuals engage in concerted migrations (Hain et al. 1992). Given this information, it seemed reasonable to fit a year-round model.

Segments

We incorporated segments from the east coast, Gulf of Mexico and Caribbean. Incorporating segments from the mid-Atlantic ridge and the European Atlantic resulted in lower predicted densities on the continental shelf and slope, and higher predicted densities in oceanic waters. This appeared inconsistent with the known affinity of fin whales for the continental shelf and slope in our study area (Hain et al. 1992, Hamazaki 2002). Sightings in the western North Atlantic were concentrated on the continental shelf, whereas they were mostly beyond the shelf on the eastern North Atlantic, suggesting that fin whales may target different prey or respond to different underlying environmental drivers in each part of the basin. Based on this presumption, we included segments from the western North Atlantic only.

3- Best model

- **Predictors:** slope, distance to SST fronts (DistToFront), production of epipelagic micronekton (EpiMnkPP), sea surface temperature (SST)
- **Model summary:**

```
##
## Family: Tweedie(p=1.186)
## Link function: log
##
## Formula:
## abundance ~ s(Slope, k = 4, bs = "ts") + s(DistToFront1, k = 4,
##      bs = "ts") + s(EpiMnkPB, k = 4, bs = "ts") + s(SST, k = 4,
##      bs = "ts") + offset(log(area_km2))
## <environment: 0x1ebc5c34>
##
## Parametric coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -7.3225     0.1273  -57.54  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##              edf Ref.df      F p-value
## s(Slope)      2.479     3 57.448 < 2e-16 ***
## s(DistToFront1) 1.051     3  6.124 1.06e-05 ***
## s(EpiMnkPB)   2.942     3 65.588 < 2e-16 ***
## s(SST)        2.923     3 44.945 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  0.0141  Deviance explained = 22.9%
## -REML = 12188  Scale est. = 24.488    n = 120884
```

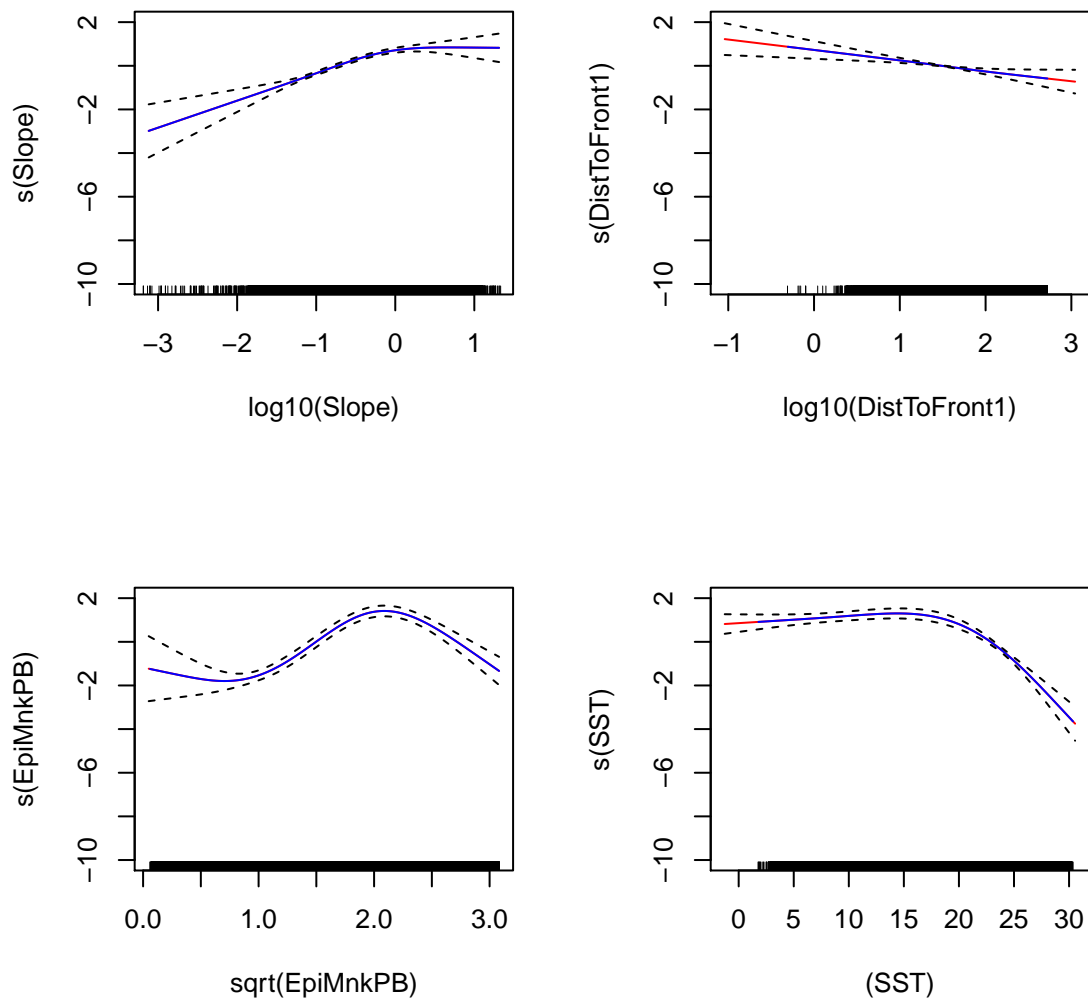


Figure 2: GAM term plots with the log-transformed abundance on the y axis. The solid blue line is the smooth function fitted to the data. The solid red line is the smooth function extrapolated to all covariate values in the prediction area. The dashed lines represent the approximate 95% confidence intervals. The rug plot on the x-axis shows covariate values sampled in the data. Note that transformations were used for some covariates.

4- Environmental envelopes

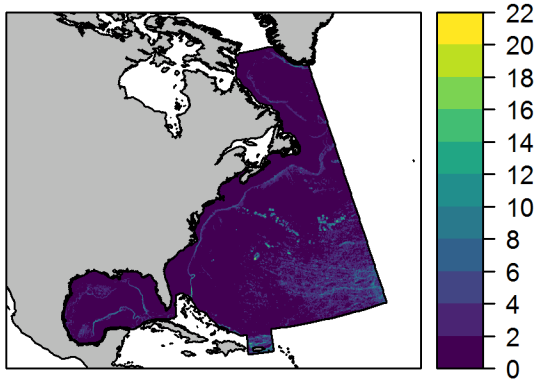
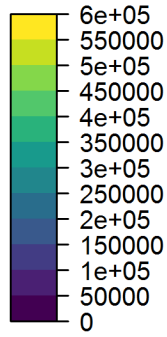
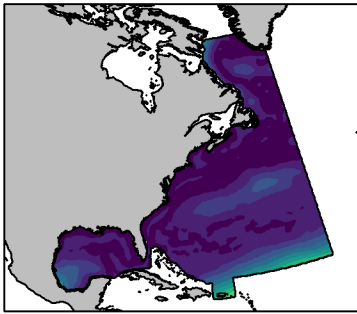
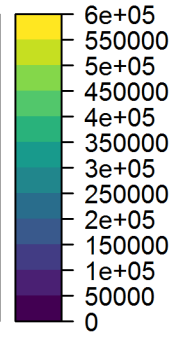
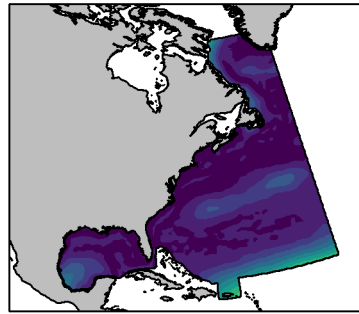


Figure 3: Environmental envelope for slope. White cells within the AFTT polygon indicate areas where covariate values fell beyond the range of covariate values sampled by the surveys.

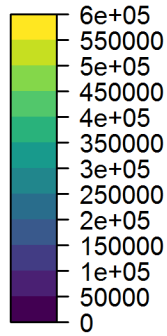
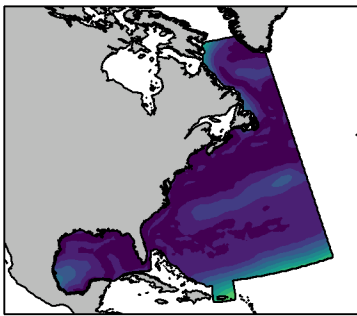
January



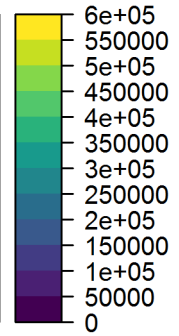
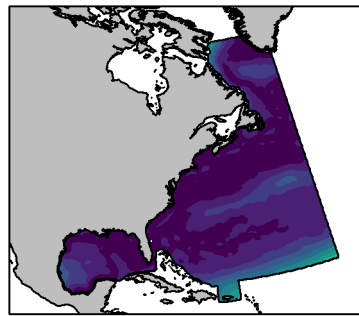
February



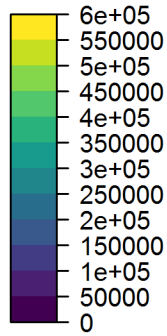
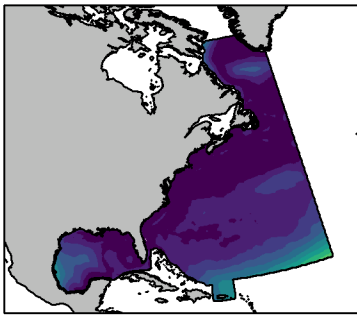
March



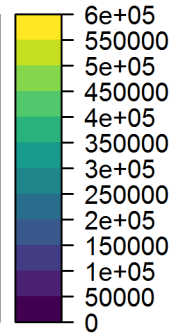
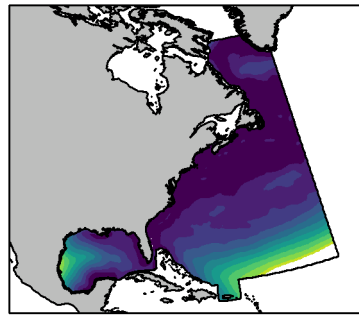
April



May



June



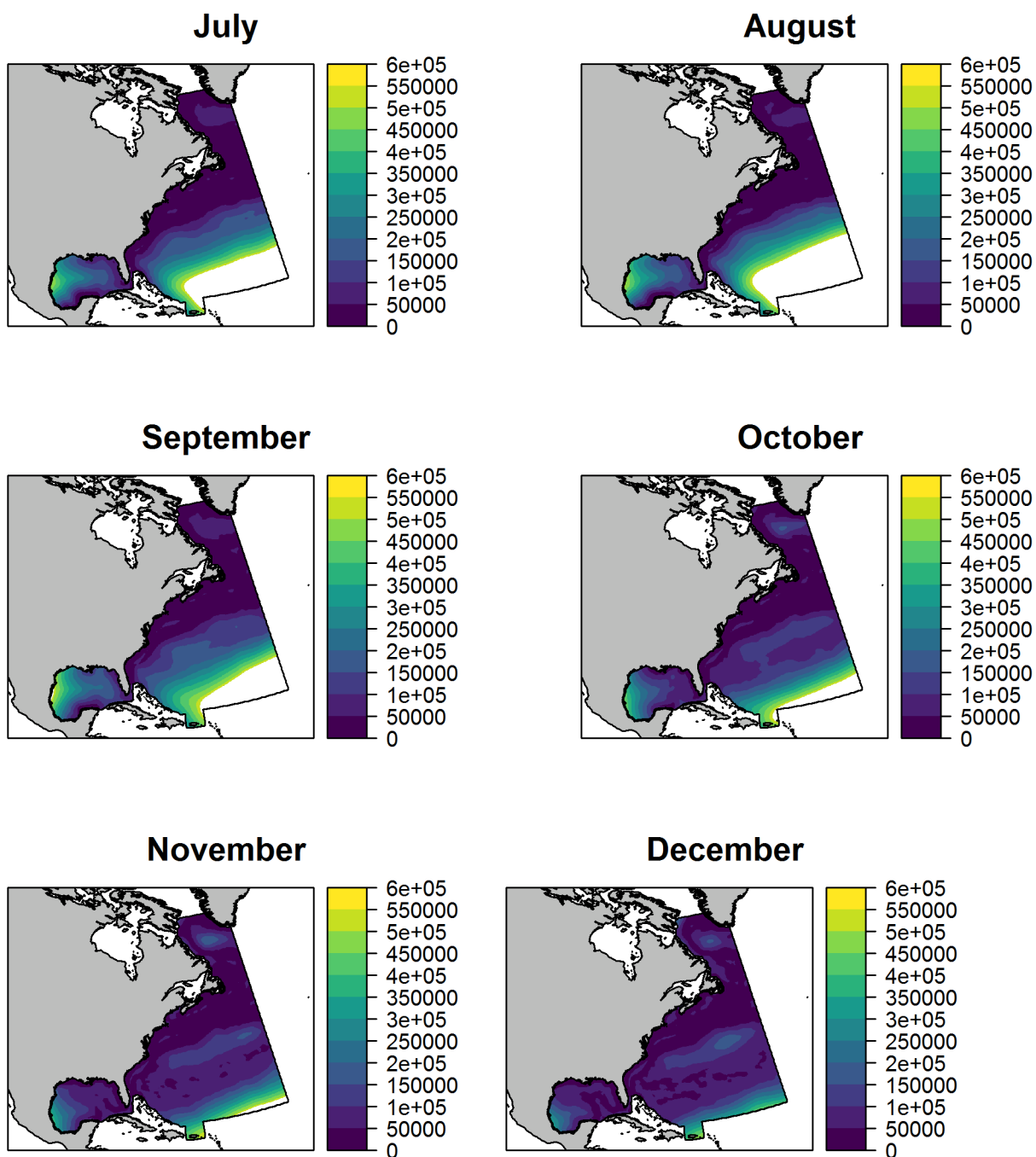
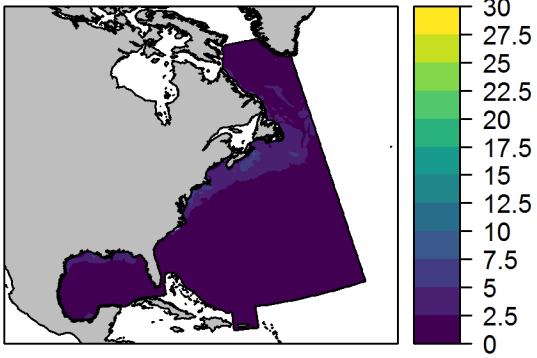
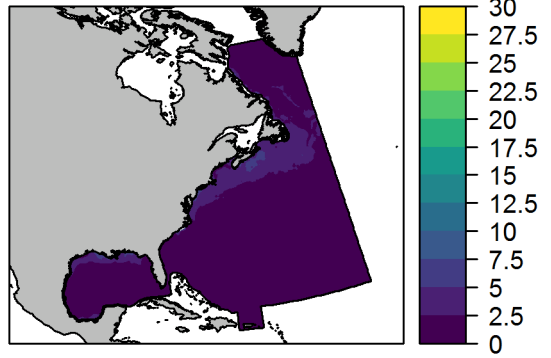


Figure 4: Monthly environmental envelopes for distance to SST fronts. White cells within the AFTT polygon indicate areas where covariate values fell beyond the range of covariate values sampled by the surveys.

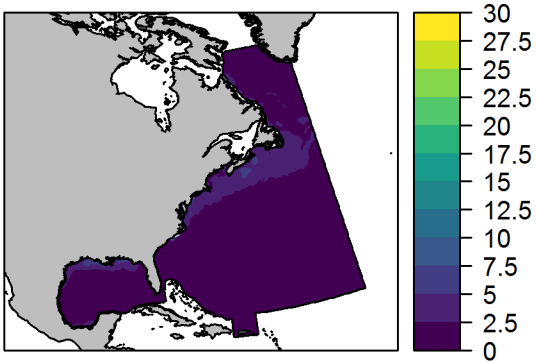
January



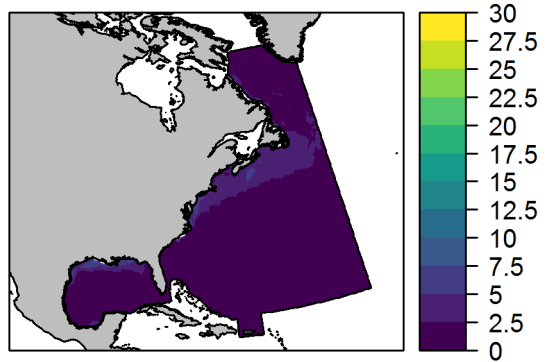
February



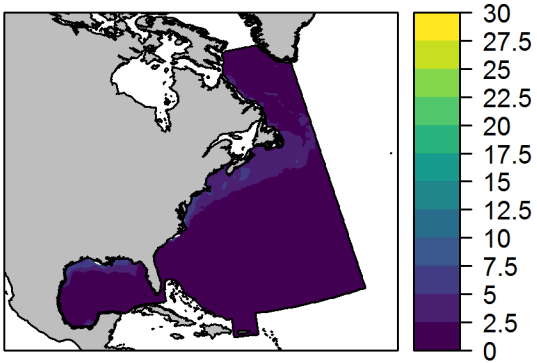
March



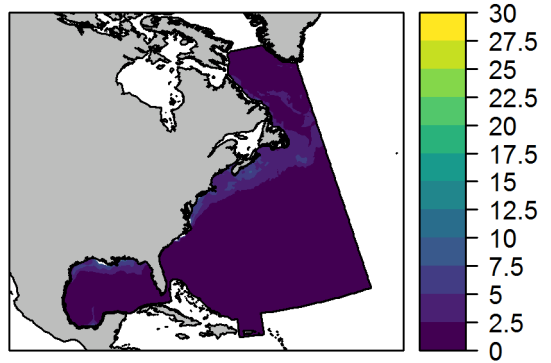
April



May



June



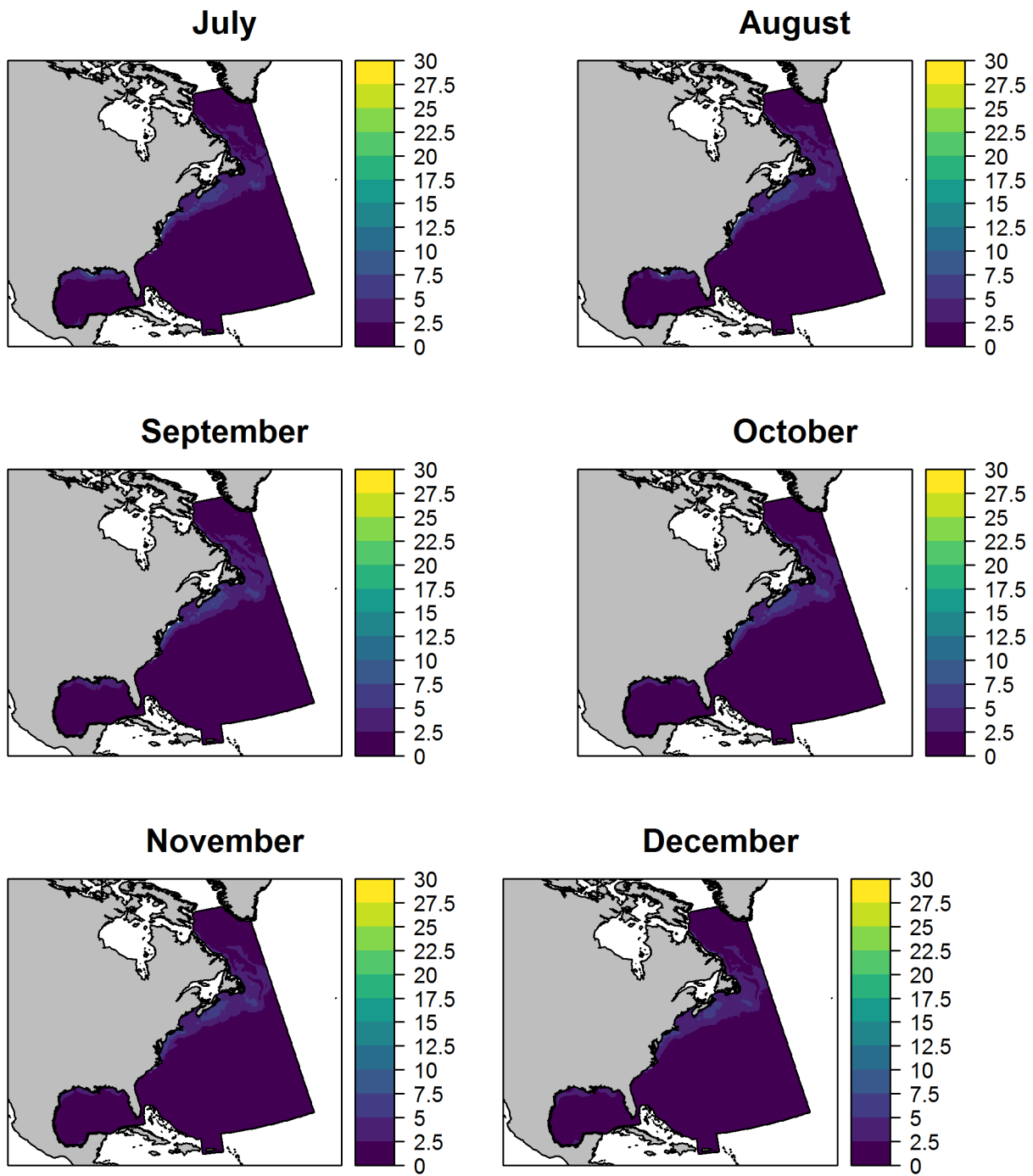
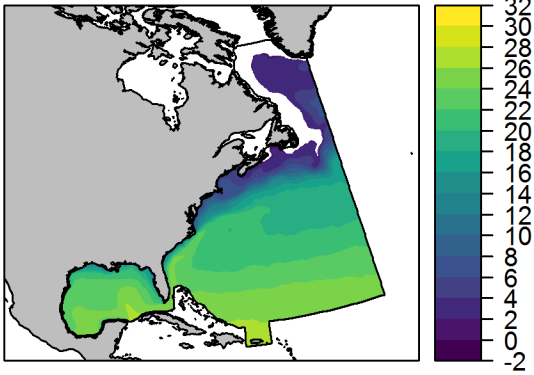
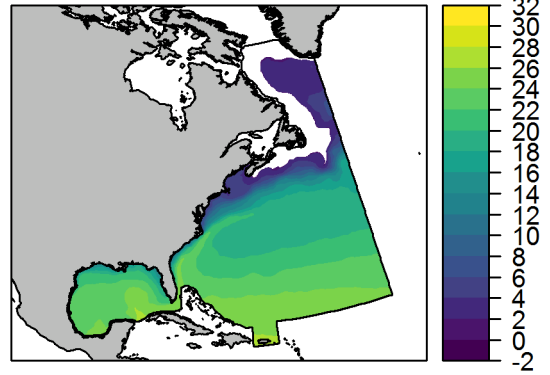


Figure 5: Monthly environmental envelopes for production of epipelagic micronekton. White cells within the AFTT polygon indicate areas where covariate values fell beyond the range of covariate values sampled by the surveys.

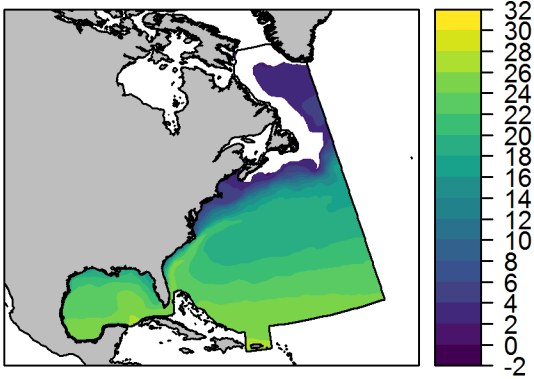
January



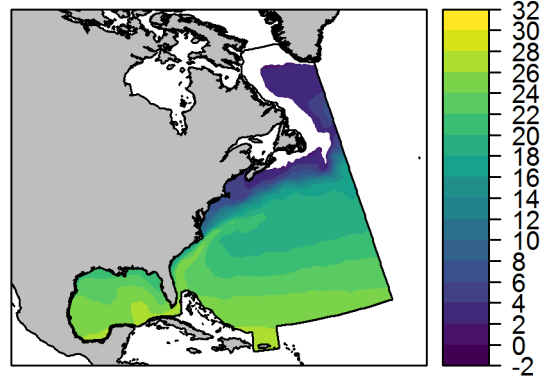
February



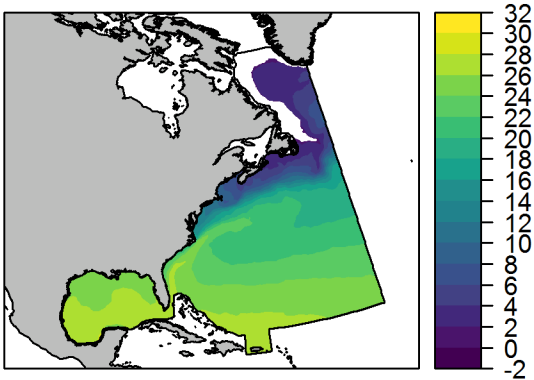
March



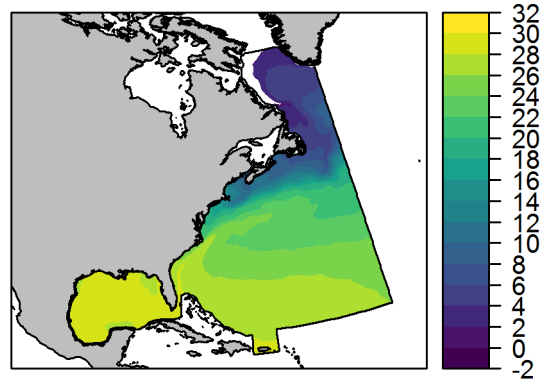
April



May



June



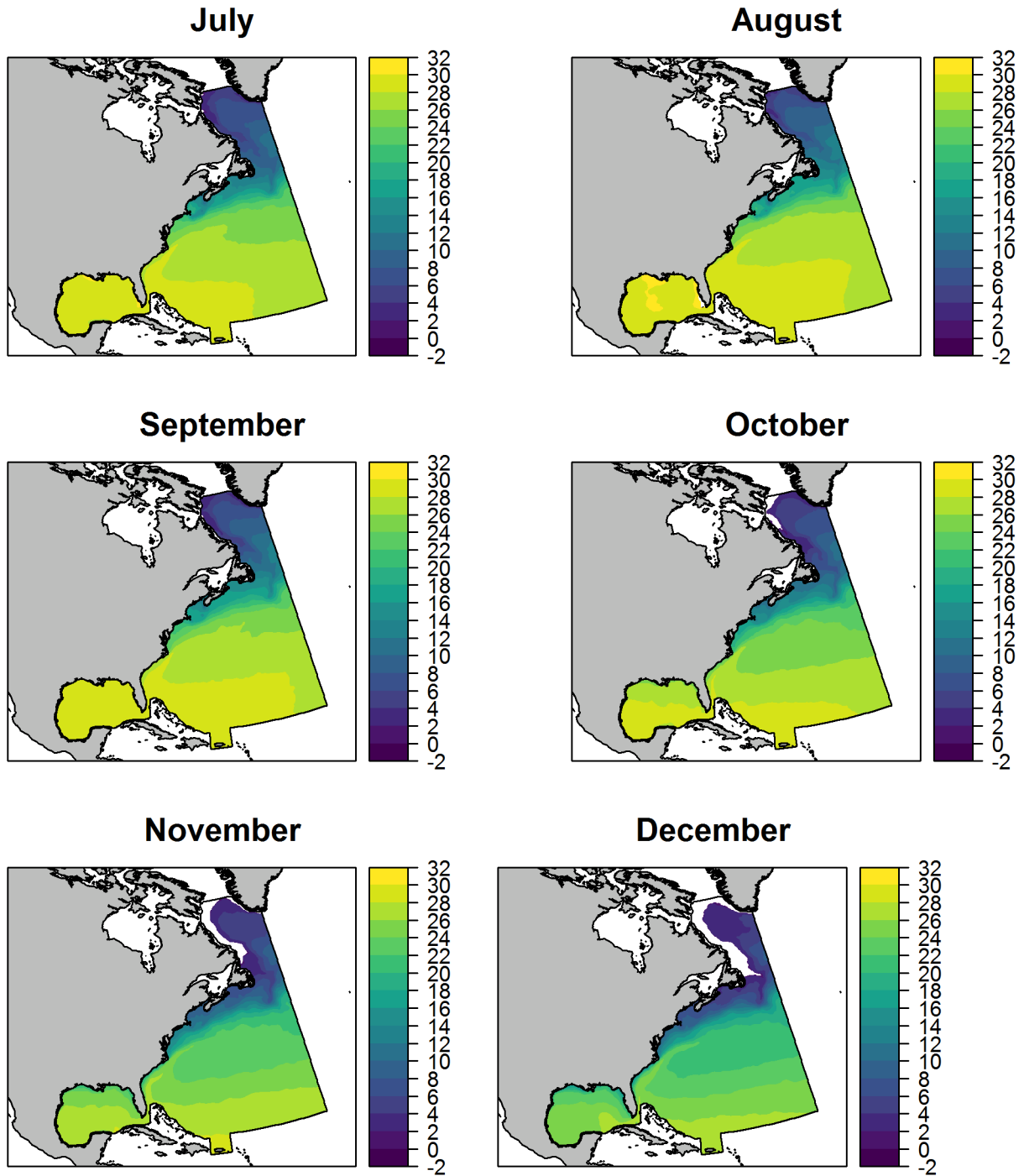


Figure 6: Monthly environmental envelopes for sea surface temperature. White cells within the AFTT polygon indicate areas where covariate values fell beyond the range of covariate values sampled by the surveys.

5- Predicted densities

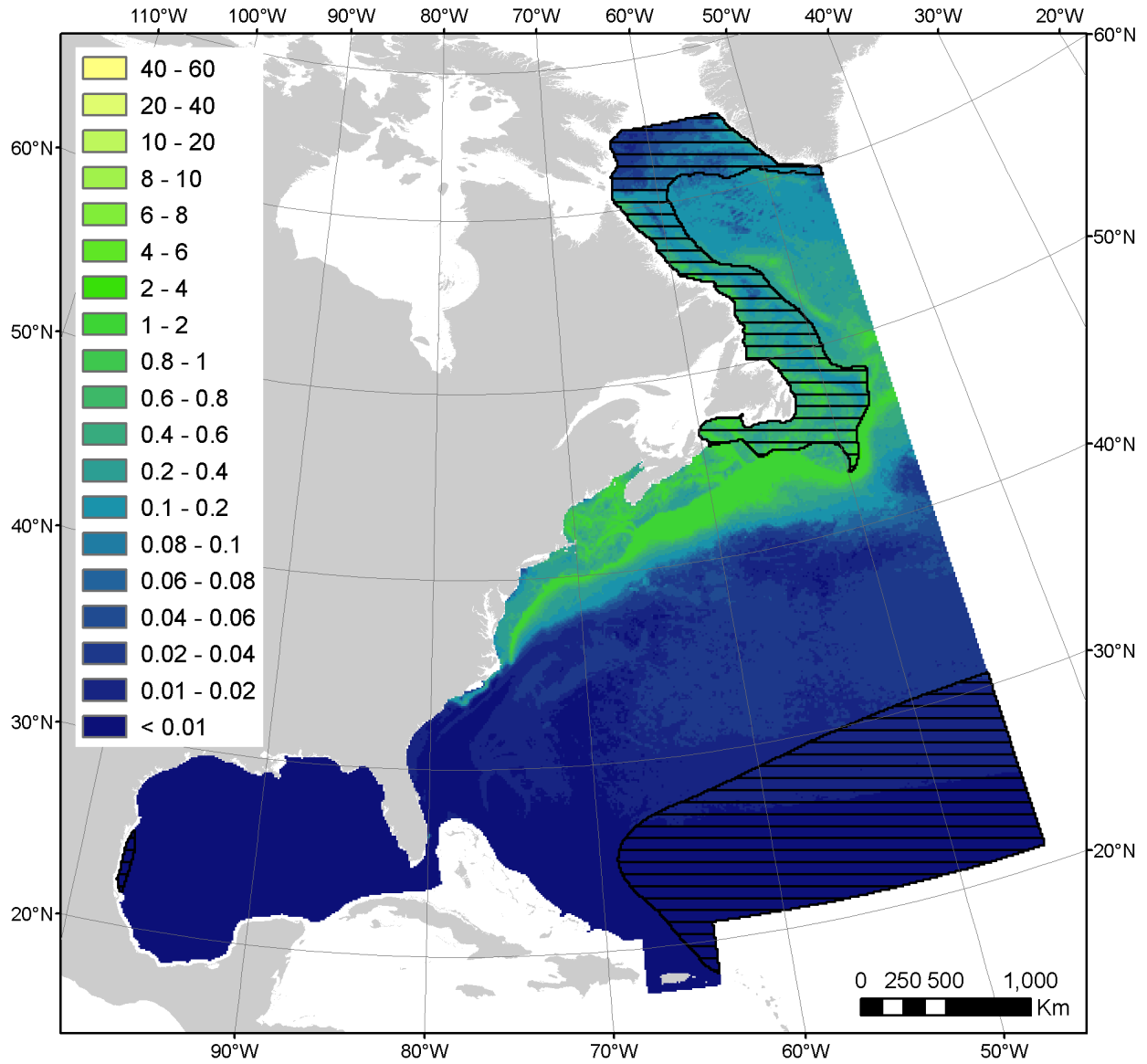


Figure 7: Mean predicted densities (individuals 100 km⁻²) in the AFTT area. Areas where we extrapolated beyond sampled predictor ranges and predicted densities should not be trusted are indicated with black crosshatches. An Albers equal area projection is used.

6- Coefficients of variation

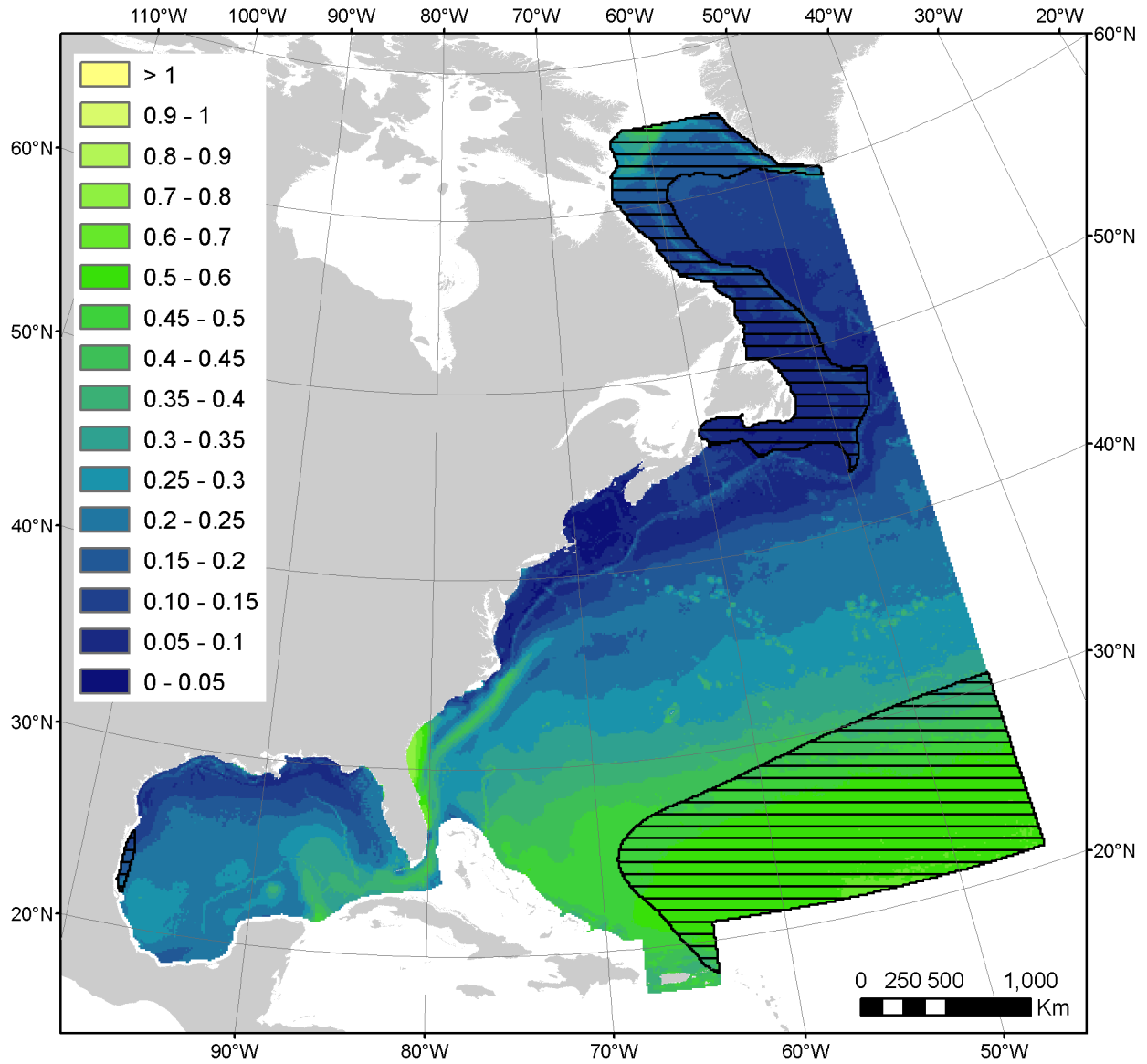


Figure 8: Mean predicted coefficients of variation derived from GAM parameters in the AFTT area. Areas where we extrapolated beyond sampled predictor ranges and coefficients of variation should not be trusted are indicated with black crosshatches. An Albers equal area projection is used.

7- Predicted densities per province

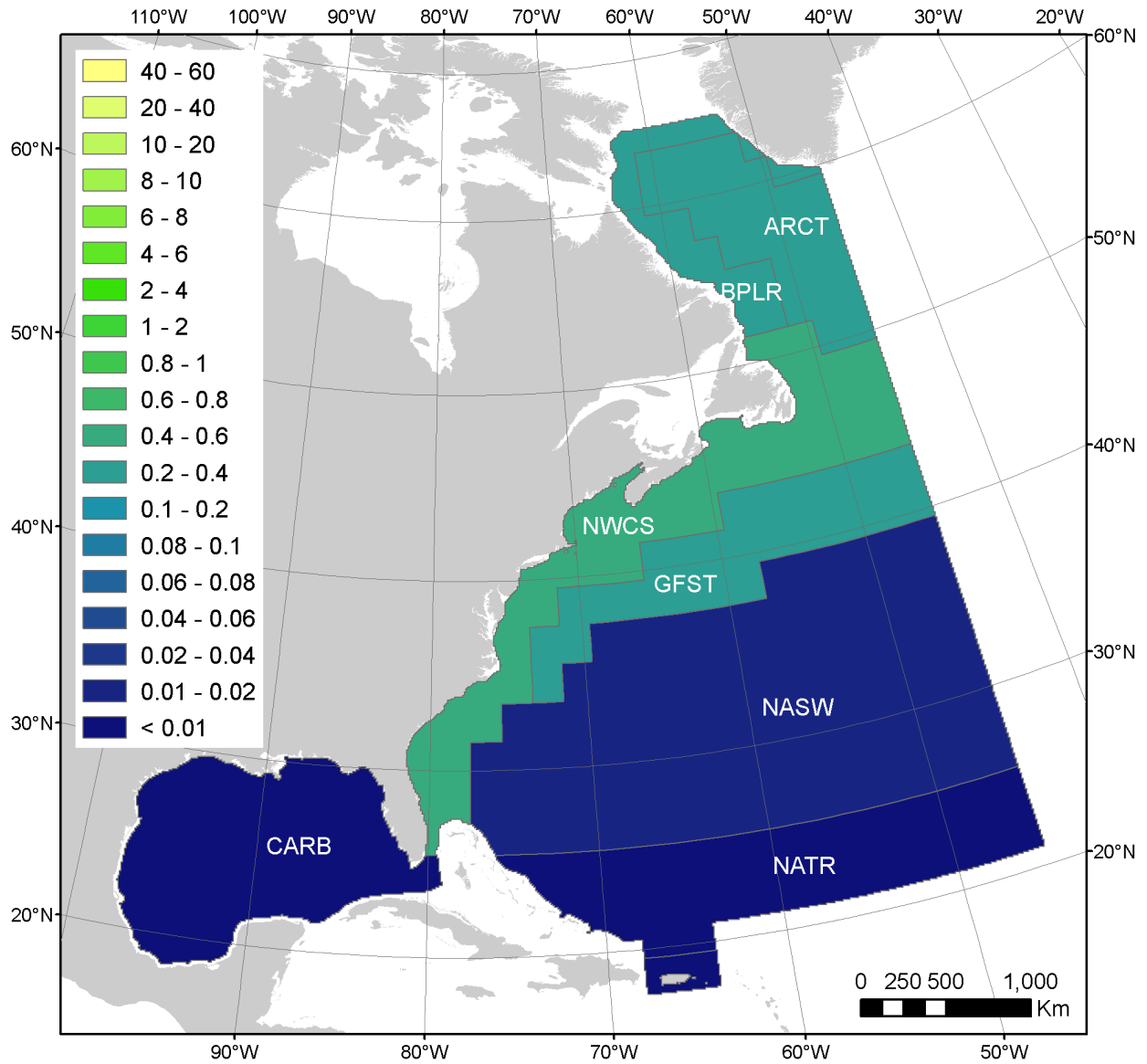


Figure 9: Predicted densities (individuals 100 km⁻²) averaged per Longhurst's biogeographical province. Note that the color scheme is the same as in Figure 7. Provinces: ARCT: Atlantic Arctic Province; BPLR: Boreal Polar Province; CARB: Caribbean Province; GFST: Gulf Stream Province; NATR: North Atlantic Tropical Gyral Province; NASW: North Atlantic Subtropical Gyral Province (West); NWCS: North West Atlantic Shelves Province.

8- Alternate models

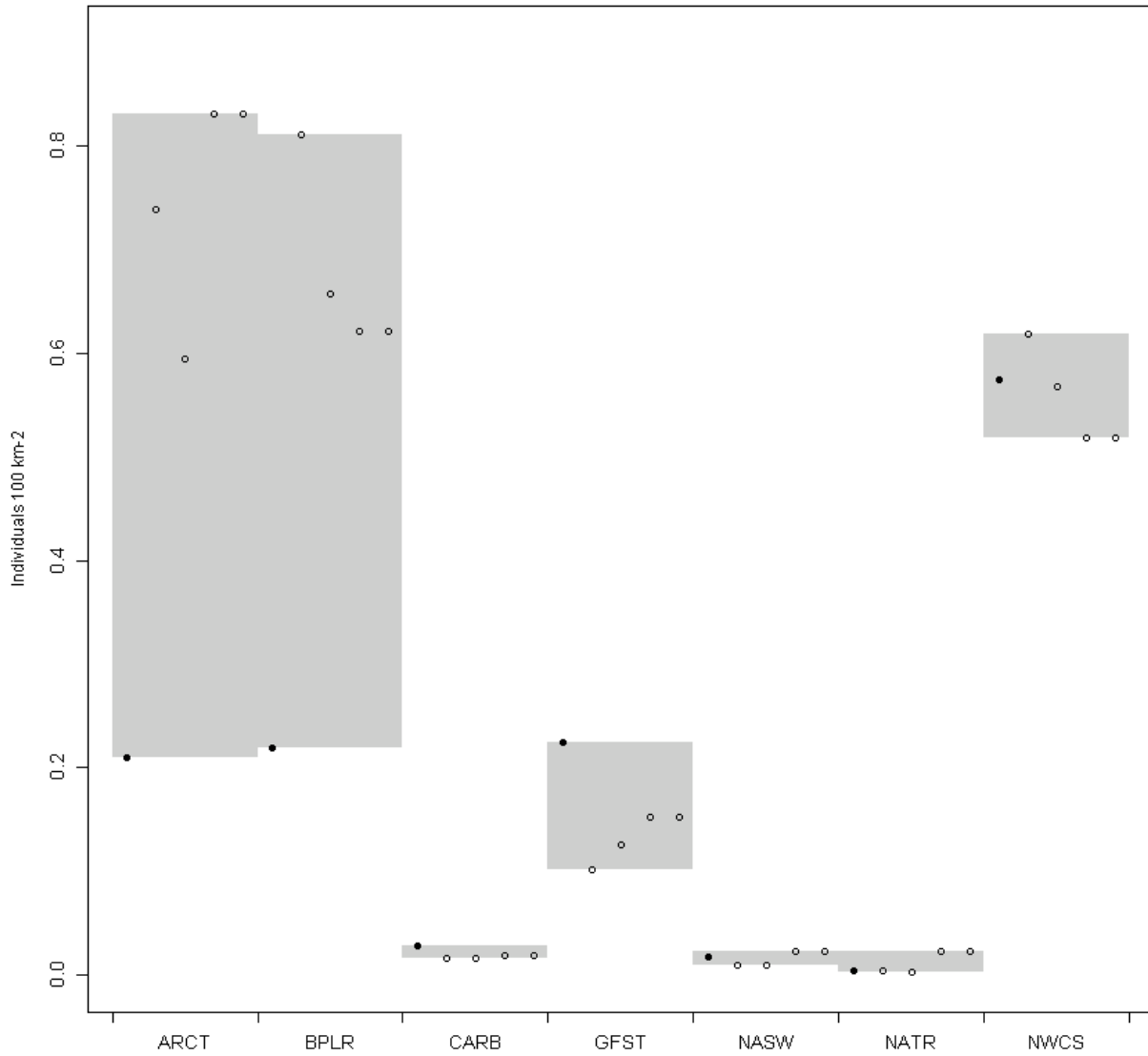


Figure 10: Sensitivity of densities predicted by the five top models per Longhurst's biogeographical province. Points represent predicted densities (individuals 100 km⁻²) for the five top models listed in Table 3, with the first to fifth models ordered from left to right. Filled points correspond to models with some support (sensu Burnham and Anderson (2002), i.e., $\Delta AIC < 2$) while hollow points correspond to models with little support (i.e., $\Delta AIC > 2$). The shaded areas indicate the range of densities predicted by the five top models for each province. Provinces: ARCT: Atlantic Arctic Province; BPLR: Boreal Polar Province; CARB: Caribbean Province; GFST: Gulf Stream Province; NATR: North Atlantic Tropical Gyral Province; NASW: North Atlantic Subtropical Gyral Province (West); NWCS: North West Atlantic Shelves Province.

Table 3: List of the five top models with lowest AIC values. Ns: non-significant. Predictor variables: EKE: eddy kinetic energy, SLAStDev: standard error of sea level anomaly, SST: sea surface temperature, PkPP: zooplankton production, PkPB: zooplankton biomass, EpiMnkPP: epipelagic micronekton production, EpiMnkPB: epipelagic micronekton biomass, VGPM: vertically generalized production model, CHL: chlorophyll-a concentration.

		Predictors		AIC	delta AIC
DistToFront1	Slope	EpiMnkPB	SST	121288.2	0.0
DistToFront1	Slope	PkPB	SLAStDev	121291.9	3.7
DistToFront1	Slope	PkPB	EpiMnkPP	121292.9	4.7
DistToFront1	Depth	PkPB	ns	121295.1	6.9
DistToFront1	Depth	PkPB	ns	121295.1	6.9

9- Residual diagnostics

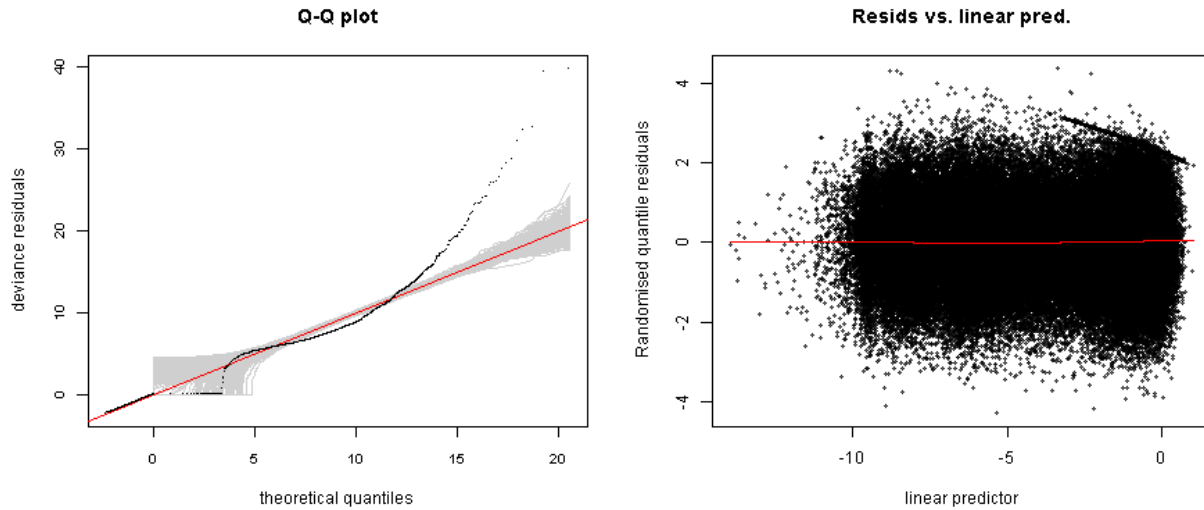


Figure 11: Diagnostic plots of residuals. Left: Quantile-quantile (Q-Q) plot of deviance residuals generated using the `qq.gam` function with 100 simulations (Augustin et al. 2012). Grey lines are possible simulated Q-Q plots under the assumption that the model is correct. The red reference line indicates perfect agreement between residual and theoretical residual distributions. Points lying away from the red line suggest poor model fit for the corresponding quantiles. Zeros appear to the left of the Q-Q plot in alignment with the reference line. Because, by design, models were not tightly fitted to the data (see discussion of the paper), deviations from the red line may be observed. Specifically, points far above the red line for large quantiles indicate that the model underestimates high abundances observed on some segments. Right: randomized quantile residuals vs. linear predictor. A LOWESS regression is shown as a red line to illustrate any trend in the points. This plot should be generally free of any pattern. Expanding y-range indicates non-constant variance (heteroskedasticity) in the model.

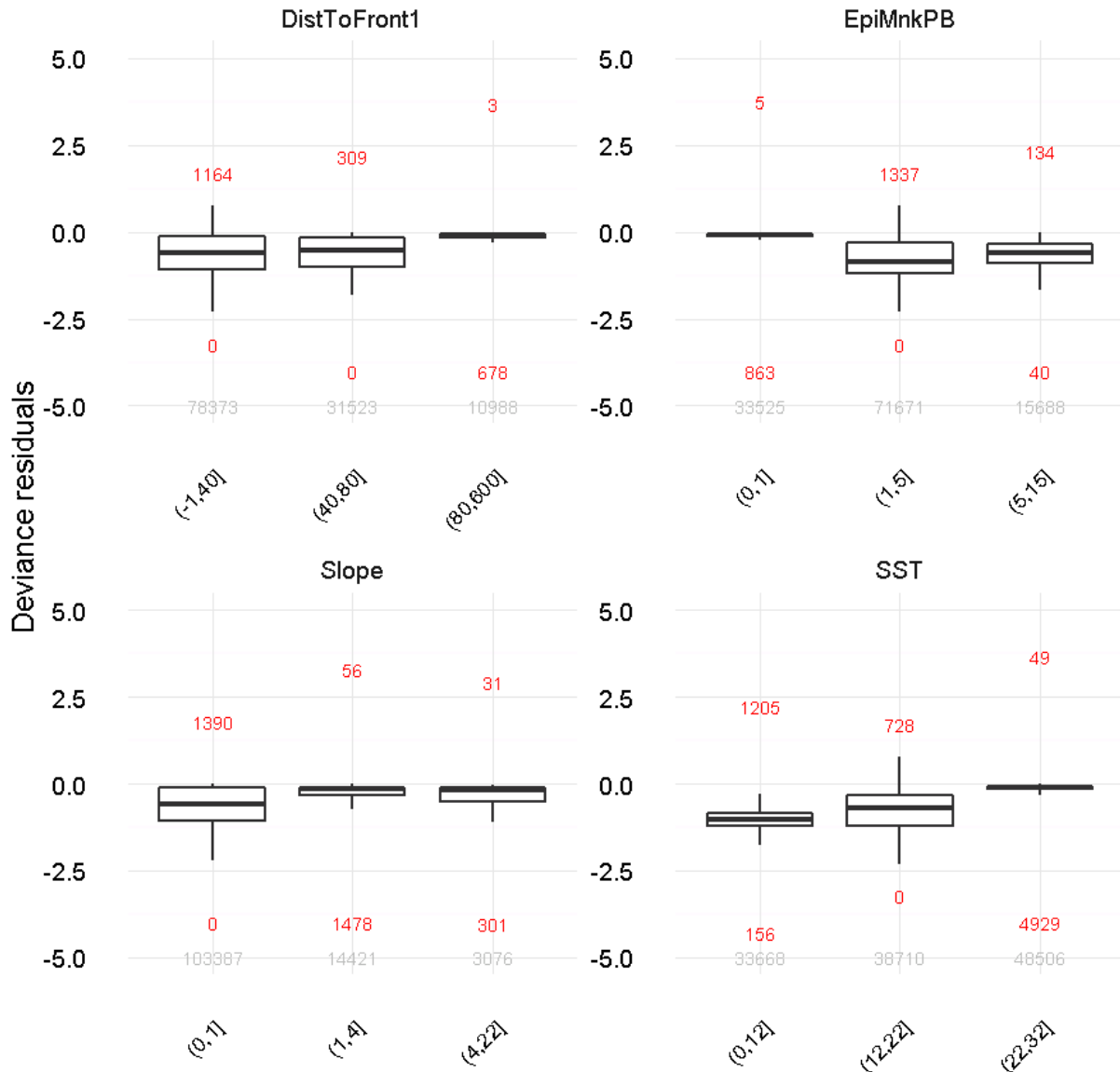


Figure 12: Boxplots of deviance residuals, binned for each predictor. The horizontal line represents the median, and the bottom and top of the box represent the first and third quartiles respectively. Whiskers extend 1.5 times the inter-quartile range following McGill et al. (1978). Total counts of outliers beyond the whiskers are indicated in red. Numbers of segments per bin are indicated in grey. Boxplots for the different bins of predictors should generally overlap. A boxplot having its median away from zero indicates poorer model fit for that predictor bin. Boxplots often have their medians close to zero and fewer outliers for predictor bins characterized by low abundances of the species, suggesting that model fit is generally better in low abundance areas. We believe this is an inherent feature of models applied to count data with numerous zeros.

10- Brief discussion and overall confidence in predictions

Description of confidence levels

We group taxa in three categories reflecting our relative level of confidence in predicted densities.

Level 1

This category includes tropical and warm temperate taxa for which survey data were available within most of the distributional range in the AFTT area. High/intermediate densities predicted beyond surveyed areas were supported by sightings available from OBIS-SEAMAP and the scientific literature. Very low densities predicted at northern latitudes were consistent with the described absence of these taxa. We have a reasonable confidence in predicted densities for these taxa.

Level 2

This category encompasses taxa for which a large part of the distributional range is in cold temperate and sub-polar waters. Models fitted to available survey data and extrapolated to cold temperate and sub-polar waters successfully predicted their occurrence, but predicted densities were largely speculative. The incorporation of line transect survey data from Canada and Greenland would be extremely useful to increase the reliability of predicted densities at northern latitudes. Unfortunately we were unable to obtain permission for using these data in our models. We remain hopeful that collaborations can be established in the future, and that the Canadian and Greenlandic surveys may be incorporated into a new version of our models. We have medium or low confidence in predicted densities for these taxa.

Level 3

This category includes taxa that are not known to primarily occur in cold temperate and sub-polar waters but were predicted in low/intermediate densities at higher latitudes. For these taxa, we believe predicted densities were likely overestimated at higher latitudes. However, predicted densities were supported by sightings available from OBIS-SEAMAP and the scientific literature within their core distributional range. The incorporation of line transect survey data from Canada and Greenland would be extremely useful to help correct the probable overestimation of densities at northern latitudes. We remain hopeful that collaborations can be established in the future, and that the Canadian and Greenlandic surveys may be incorporated into a new version of our models. We have medium or low confidence in predicted densities for these taxa.

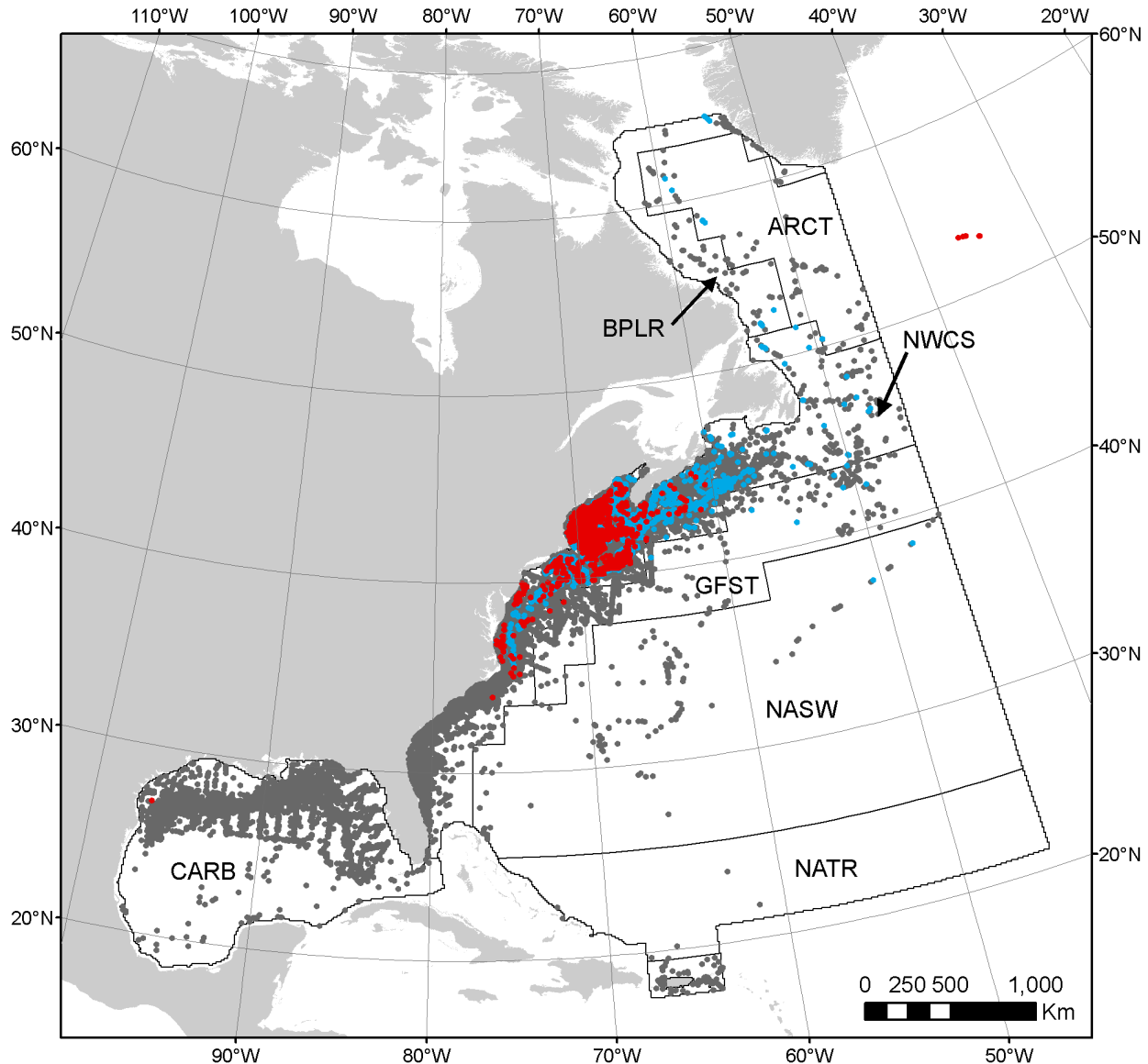


Figure 13: Red points are sightings of the taxon from line transect surveys used in this study. Blue points are sightings of the taxon reported by other datasets not used in our study for 1992-2016 (e.g., because they were not compatible with our methodology). Underlain grey points are sightings of other cetacean species, taken from these other datasets. Blue and grey points were extracted from OBIS-SEAMAP (accessible at <http://seamap.env.duke.edu/>) (Halpin et al. 2009); citations for individual datasets are provided at the end of this report. Longhurst's biogeographical provinces are shown as polygons. Dense patches of grey points without red or blue points suggest locations where the taxon of interest may be absent, under the presumption that observers who reported other cetacean taxa would have reported this one if sighted. However, important caveats apply: the map does not quantify observation effort, which was not available for all datasets and was very difficult to standardize across disparate sources (e.g., scientific surveys, whale watching logs, opportunistic sightings). The spatial distribution of effort was highly heterogeneous in both space and time. Only openly accessible datasets were considered; other cetacean datasets are known to exist for the AFTT area but have not been released for public use (e.g., the 2007 Trans North Atlantic Sightings Survey (TNASS) in Canada). The presumption that grey dots imply absence may not always hold; for example, if effort conducted in that area was directed towards particular species, sightings of our taxon of

interest may not have been recorded.

General

We used a total of 1785 sightings to fit the habitat-based density model (the vast majority of the sightings came from surveys in the U.S. east coast). The lowest AIC model included micronekton biomass, slope, sea surface temperature and distance to fronts (listed in decreasing order of importance according to F-scores) and had an explained deviance of 22.9%. It was the only statistically supported model sensu Burnham and Anderson (2002) (Table 3). All top five models included distance to fronts as a predictor and the top three models also included slope. Predicted densities from all top five models were very low in the CARB, NASW and NATR provinces (Figure 10). They were fairly similar in the NWCS province while they differed by a factor 2 in the GFST province and a factor 4 in the ARCT and BPLR province. When examining these results, it is important to keep in mind that the second, third, fourth and fifth models had a large delta AIC and therefore little statistical support sensu Burnham and Anderson (2002).

Overall, model predictions appeared concordant with the described distribution of fin whales in temperate and sub-polar waters of the North Atlantic mostly north of 30°N and their affinity for the continental slope (Aguilar 2009; Edwards et al. 2015). Fin whales are generally more abundant at high latitudes in warmer months and at low latitudes (greater than 20°N) in colder months (Edwards et al. 2015). Unlike humpback and blue whales, fin whales do not undertake long-range migrations (Edwards et al. 2015, Aguilar 2009) and there is evidence that some individuals remain at mid latitudes year-round (Hain et al. 1992). It has been suggested that fin whales disperse in offshore waters in winter, possibly to breed (Hain et al. 1992; Aguilar 2009), but no definite wintering grounds have been identified.

We now discuss the quality of predictions per biogeographic province by comparing them with available literature and observations from OBIS-SEAMAP.

Boreal polar (BPLR) and Atlantic Arctic (ARCT) provinces

In these Northern provinces, fin whales were predicted both on the continental shelf and in offshore waters beyond the continental slope. We warn that extrapolation to colder waters occurred throughout the BPLR province and therefore predictions should be considered with extreme caution.

In West Greenland fin whales are hunted for aboriginal subsistence and surveys have been conducted to monitor their abundance. Fin whales were sighted on 78 occasions during an aerial survey in September 2005 (Heide-Jørgensen et al. 2008), and on 45 occasions during a shipboard survey at the same period (Heide-Jørgensen et al. 2007). Sightings were distributed near the 200m isobath along the coast of West Greenland, with largest concentrations observed in offshore waters off Central West Greenland (Heide-Jørgensen et al. 2008).

An aerial survey conducted in West Greenland in August-September 2007 recorded 24 fin whale sightings, mostly located near the western edge of the surveyed area (Heide-Jørgensen et al. 2010). The authors noted that the survey covered a small portion of fin whale's presumed distribution throughout Baffin Bay and suggested that the West Greenland population could be increasing, as suspected for populations in the eastern North Atlantic (Vikingsson et al. 2009). Satellite tracking data from two individuals tagged in West Greenland indicated a potential large range of fin whales in West Greenland (Heide-Jørgensen et al. 2003). Heide-Jørgensen et al. (2003) also noted numerous sightings of fin whales in offshore waters of Baffin Bay (although these sightings were from the 1980s). Finally, Figure 13 shows several offshore sightings in Baffin Bay (Figure 13).

Together, these results suggest that fin whale's distribution extends far into the offshore waters of Baffin Bay, supporting the intermediate densities predicted by our model. However, no data are currently available to support the relatively high predicted densities in offshore waters between 50 and 56°N.

During the TNASS survey in summer 2007, fin whales were sighted once in the BPLR province (Lawson and Gosselin 2009). A few sightings were also reported in OBIS-SEAMAP on the continental shelf in the southern part of this province (but observation effort was very sparse) (Figure 13). Predicted densities on the Canadian continental shelf remain largely speculative as they are currently supported by relatively few available sightings.

North West Atlantic shelves (NWCS) and Gulf Stream (GFST) provinces

Predicted densities were highest on the continental shelf and slope north of Cape Hatteras where fin whales were sighted year-round.

High fin whale densities were predicted on the continental slope between 40 and 46°N, corresponding to the eastern part of the NWCS province/western part of the Gulf Stream province. Predicted densities on the continental slope between 40 and 42°N were supported by extensive survey effort which revealed large numbers of fin whales. Predictions on the continental slope north of 42°N were supported by comparatively little survey effort. We believe these predictions are plausible as they are supported by some sightings from OBIS-SEAMAP (Figure 13).

During the TNASS survey in summer 2007, fin whales were sighted on 17 occasions east of Newfoundland, 55 occasions south of Newfoundland and 44 occasions on the Scotian shelf (Lawson and Gosselin 2009) (sightings not contributed to OBIS-SEAMAP and therefore not shown on Figure 13). Fin whales have also been reported near the Gully canyon, on the Scotian shelf edge (Hooker et al 1999). In OBIS-SEAMAP, large numbers of sightings were reported on the Scotian shelf, while sightings were sparser on the continental shelf and slope south and east of Newfoundland (but observation effort was also much sparser). Predicted densities on the continental shelf and slope in the northern part of the NWCS province did not seem incompatible with these sightings. However, they should be considered with extreme caution as they were derived from extrapolation to colder waters.

The southernmost sightings were reported near 36°N. The model predicted low fin whale densities in coastal waters as far south as 33°N. We believe these predictions are potentially realistic as one sighting was reported in OBIS-SEAMAP at 34°N (Figure 13) and a fin whale was photographed off Sapelo Island, Georgia in March 2012 (Florida Fish and Wildlife Conservation Commission, unpublished).

North Atlantic tropical gyral (NATR) and North Atlantic subtropical gyral (NASW) provinces

Hydrophone array data from the Integrated Undersea Sound Surveillance System in the western North Atlantic indicated that fin whales calls peaked in winter and were more common at high latitudes (off eastern Canada and the northeastern U.S.) than low latitudes (North of the Antillean Arc) (Clark and Gagnon 2004). These findings seemed to support the relatively low densities predicted in the NATR and NASW provinces. Similarly, passive acoustic detections along the mid-Atlantic ridge peaked in winter months north of 32°N (Nieukirk et al. 2004, 2012), supporting the hypothesis that fin whales disperse in mid-latitudes offshore waters during the wintertime.

Despite very sparse observation effort, we note two sightings reported in OBIS-SEAMAP in the northern part of the NASW province (Figure 13).

We warn that extrapolation further from fronts occurred in large parts of the NATR and NASW provinces and therefore predicted densities should be considered with extreme caution.

Caribbean (CARB) province

Very low densities were predicted in the Gulf of Mexico and near Puerto Rico. Fin whales have been reported near Puerto Rico in winter on only 3 occasions (Mignucci-Giannoni 1998) and are considered of accidental occurrence in the Gulf of Mexico (Jefferson and Schiro 1997).

Overall confidence: level 2

Large amounts of survey data were available in the Gulf of Maine feeding ground and predictions in northern waters were largely derived from these data. The model successfully predicted the occurrence of fin whales at high latitudes where they are known to feed in summer but predicted densities remain speculative as they were derived from extrapolation to colder waters. The incorporation of line transect survey data from Canada and Greenland would be critical to increase the reliability of predicted densities at high latitudes where fin whales are known to feed in summer. Unfortunately we were unable to obtain permission for using these data in our model. We remain hopeful that collaborations can be established in the future, and that the Canadian and Greenlandic surveys may be incorporated into a new version of our models.

11- References

- Aguilar, A. 2009. Fin whale. Pages 433-437 Encyclopedia of marine mammals 2nd Edition. Academic Press.
- Augustin NH, Sauleau E-A, Wood SN. 2012. On quantile quantile plots for generalized linear models. *Computational Statistics & Data Analysis* 56:2404-2409.
- Burnham KP, Anderson DR. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. Springer Science & Business Media.
- Clark, C. W. 1995. Application of US Navy underwater hydrophone arrays for scientific research on whales. *Rep. int. Whal. Commn* 45:210-212.
- Clark, C. W., and G. J. Gagnon. 2004. Low-frequency vocal behaviors of baleen whales in the North Atlantic: Insights from Integrated Undersea Surveillance System detections, locations, and tracking from 1992 to 1996. *Journal of Underwater Acoustics (USN)* 52:48.
- Edwards, E. F., C. Hall, T. J. Moore, C. Sheredy, and J. V. Redfern. 2015. Global distribution of fin whales *Balaenoptera physalus* in the post-whaling era (1980-2012). *Mammal Review* 45:197-214.
- Hain, J. H., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. *Rep. Int. Whal. Comm.* 42:653-669.
- Halpin P et al. 2009. OBIS-SEAMAP: The World Data Center for Marine Mammal, Sea Bird, and Sea Turtle Distributions. *Oceanography* 22:104-115.
- Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). *Marine Mammal Science* 18:920-939.
- Heide-Jørgensen, M. P., D. L. Borchers, L. Witting, M. J. Simon, K. L. Laidre, A. Rosing-Asvid, and D. Pike. 2007. Final estimates of large whale abundance in West Greenland waters from an aerial survey in 2005. IWC/SC/59/AWMP7. Available from the International Whaling Commission (<http://www.iwcoffice.org/>).
- Heide-Jørgensen, M. P., M. J. Simon, and K. L. Laidre. 2008. Estimates of large whale abundance in Greenlandic waters from a ship-based survey in 2005. *J. Cetacean Res. Manage* 9:95-104.
- Heide-Jørgensen, M. P., L. Witting, and M. V. Jensen. 2003. Inshore-offshore movements of two fin whales (*Balaenoptera physalus*) tracked by satellite off West Greenland. *J. Cetacean Res. Manage* 5:241-245.
- Heide-Jørgensen, M. P., L. Witting, K. L. Laidre, R. G. Hansen, and M. Rasmussen. 2010. Fully corrected estimates of common fin whale abundance in West Greenland in 2007. *J. Cetacean Res. Manage* 11:75-82.
- Hooker, S. K., H. Whitehead, and S. Gowans. 1999. Marine Protected Area Design and the Spatial and Temporal Distribution of Cetaceans in a Submarine Canyon. *Conservation Biology* 13:592-602.
- Lawson, J. W., and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey-A component of the 2007 TNASS. Canadian Science Advisory Secretariat= Secrétariat canadien de consultation scientifique. McGill R, Tukey JW, Larsen WA. 1978. Variations of Box Plots. *The American Statistician* 32:12-16.
- Mignucci-Giannoni AA. 1998. Zoogeography of cetaceans off Puerto Rico and the Virgin Islands. *Caribbean Journal of Science* 34:173-190.
- Nieukirk SL, Mellinger DK, Moore SE, Klinck K, Dziak RP, Goslin J. 2012. Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999-2009. *The Journal of the Acoustical Society of America* 131:1102-1112.
- Nieukirk SL, Stafford KM, Mellinger DK, Dziak RP, Fox CG. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. *The Journal of the Acoustical Society of America* 115:1832-1843.
- Roberts JJ et al. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. *Scientific Reports* 6:22615.

Víkingsson GA, Pike DG, Desportes G, Øien N, Gunnlaugsson T, Bloch D. 2009. Distribution and abundance of fin whales (*Balaenoptera physalus*) in the Northeast and Central Atlantic as inferred from the North Atlantic Sightings Surveys 1987-2001. *NAMMCO Sci. Publ* 7:49-72.

Citations for individual datasets from OBIS-SEAMAP

- Ampela, K. and G. Miller-Francisco. 2016. JAX FIREX Aerial Surveys 5-8 September 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/880>) on 2016-08-15.
- Barco, S. 2014. Virginia and Maryland Sea Turtle Research and Conservation Initiative Aerial Survey Sightings, May 2011 through July 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1201>) on 2016-08-15.
- Barco, S. 2014. Virginia CZM Wind Energy Area Survey- Vessel Survey Sightings - November 2012 through April 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1196>) on 2016-08-15.
- Barco, S. 2015. Marine Mammal and Sea Turtle Sightings in the Vicinity of the Maryland Wind Energy Area 2013-2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1340>) on 2016-08-15.
- Barco, S. 2015. Virginia CZM Wind Energy Area Survey - Left side - May 2014 through December 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1229>) on 2016-08-15.
- Barco, S. 2015. Virginia CZM Wind Energy Area Survey - Right side - May 2014 through December 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1231>) on 2016-08-15.
- Barco, S. 2015. Virginia CZM Wind Energy Area Survey- Right side - November 2012 through April 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1194>) on 2016-08-15.
- Barco, S. 2016. Virginia CZM Wind Energy Area Survey- Left side - November 2012 through April 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1192>) on 2016-08-15.
- Boisseau, O. 2014. Visual sightings from Song of the Whale 1993-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1158>) on 2016-08-15.
- Bolanos, J., J. Blumenthal, J. Luksenburg, A. Henriquez, A. Bogomolni, A. Mignucci-Giannoni, N. Landrau, J. Casas, M. Iniguez, J. Khan, C. Rinaldi, G. Ferrer, L. Suty and N. Ward. 2014. Killer whales of the Caribbean Sea 1866-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1012>) on 2016-08-15.
- Cole, T. and C. Khan. 2016. NEFSC Right Whale Aerial Survey. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/513>) on 2016-08-15.
- Contillo, J. 2013. SEFSC Dolphin Photo ID. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/226>) on 2016-08-15.
- Diaz, G. 2011. NOAA Southeast Fishery Science Center (SEFSC) Commercial Pelagic Observer Program (POP) Data. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/103151496>) on 2016-08-15 and originated from iOBIS (<http://www.iobis.org>).
- DiMatteo, A. 2013. US Navy marine mammal and sea turtle sightings from aerial surveys, Vieques, Puerto Rico 2000. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1007>) on 2016-08-15.
- Dunn, C. 2013. Bahamas Marine Mammal Research Organisation Opportunistic Sightings. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/329>) on 2016-08-15.
- Epperson, D. 2012. BOEM Sperm Whale Seismic Study (SWSS) S-Tag Argos Telemetry. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/810>) on 2016-08-15.
- Epperson, D. 2013. BOEM Sperm Whale Seismic Study (SWSS) MPS cetacean sightings 2002-2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/911>) on 2016-08-15.
- Epperson, D. 2013. BOEM Sperm Whale Seismic Study (SWSS) MPS sperm whale trackings 2004-2005. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/912>) on 2016-08-15.
- Epperson, D. 2013. BOEM Sperm Whale Seismic Study (SWSS) PhotoID 2002-2005. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/910>) on 2016-08-15.
- Epperson, D. 2013. BOEM Sperm Whale Seismic Study (SWSS) S-Tag cetacean sightings 2002-2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/903>) on 2016-08-15.
- Epperson, D. 2013. BOEM Sperm Whale Seismic Study (SWSS) S-Tag cetacean sightings 2005. Data

downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/905>) on 2016-08-15.

Epperson, D. 2015. BOEM Sperm Whale Seismic Study (SWSS) S-Tag sperm whale trackings 2002-2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/904>) on 2016-08-15.

Garrison, L. 2013. Gomex Sperm Whale Survey 2000. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/96>) on 2016-08-15.

Garrison, L. 2013. SEFSC Atlantic surveys 1992. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/3>) on 2016-08-15.

Garrison, L. 2013. SEFSC Atlantic surveys 1999. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/5>) on 2016-08-15.

Garrison, L. 2013. SEFSC Atlantic surveys, 1998 (3). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1>) on 2016-08-15.

Garrison, L. 2013. SEFSC Caribbean Survey 1995. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/11>) on 2016-08-15.

Garrison, L. 2013. SEFSC Caribbean Survey 2000. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/7>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1992 (199). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/13>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1993 (S). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/17>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1993 (W). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/15>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1994. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/19>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1996. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/25>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1997. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/27>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 1999. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/29>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 2000. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/21>) on 2016-08-15.

Garrison, L. 2013. SEFSC GoMex Oceanic 2001. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/23>) on 2016-08-15.

Garrison, L. 2013. SEFSC Gomex Shelf 1994. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/35>) on 2016-08-15.

Garrison, L. 2013. SEFSC Gomex Shelf 1998. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/31>) on 2016-08-15.

Garrison, L. 2013. SEFSC Gomex Shelf 2000. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/37>) on 2016-08-15.

Garrison, L. 2013. SEFSC Gomex Shelf 2001. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/33>) on 2016-08-15.

Garrison, L. 2013. SEFSC Mid-Atlantic Tursiops Survey, 1995 (1). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/90>) on 2016-08-15.

Garrison, L. 2013. SEFSC Mid-Atlantic Tursiops Survey, 1995 2. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/89>) on 2016-08-15.

Garrison, L. 2013. SEFSC Mid-Atlantic Tursiops Survey, 1995 3. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/88>) on 2016-08-15.

Garrison, L. 2013. SEFSC Southeast Cetacean Aerial Survey 1992. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/87>) on 2016-08-15.

Garrison, L. 2013. SEFSC Southeast Cetacean Aerial Survey 1995. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/86>) on 2016-08-15.

Harris, Lei E. 2015. DFO Maritimes Region Cetacean Sightings. Version 6 In OBIS Canada Digital Collections. Bedford Institute of Oceanography, Dartmouth, NS, Canada. Published by OBIS, Digital <http://www.iobis.org/>.

Holst, M., O. Lee and H. Smith. 2014. Lamont-Doherty/LGL/NSF cruises. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/511>) on 2016-08-15.

Hyrenbach, D. 2011. Hatteras Eddy Cruise 2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/322>) on 2016-08-15.

Hyrenbach, D. and H. Whitehead. 2008. Sargasso sperm whales 2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/306>) on 2016-08-15.

Hyrenbach, D. and H. Whitehead. 2013. Sargasso 2005 - cetacean sightings. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/332>) on 2016-08-15.

Hyrenbach, D., F. Huettmann and J. Chardine. 2012. PIROP Northwest Atlantic 1965-1992. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/280>) on 2016-08-15.

Johnston, D. and Z. Swaim. 2013. DURL vessel-based surveys for proposed JAX USWTR site 2009-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/582>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Aerial Cruise Fall 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1245>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Aerial Cruise Spring 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1247>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Aerial Cruise Summer 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1249>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Aerial Cruise Summer 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1233>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Aerial Cruise Winter 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1243>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Shipboard Cruise Summer 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1269>) on 2016-08-15.

Josephson, B. 2015. AMAPPS Northeast Shipboard Cruise Summer 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1271>) on 2016-08-15.

Josephson, B. 2016. AMAPPS Northeast Aerial Cruise Spring 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1379>) on 2016-08-15.

Josephson, B. 2016. AMAPPS Northeast Aerial Cruise Winter 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1381>) on 2016-08-15.

Josephson, B. 2016. AMAPPS Northeast Shipboard Cruise Spring 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1377>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Fall 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1288>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Spring 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1259>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Summer 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1273>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Summer 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1275>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Winter 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1277>) on 2016-08-15.

Josephson, B. and L. Garrison. 2015. AMAPPS Southeast Aerial Cruise Winter 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1289>) on 2016-08-15.

Kopelman, A. 2013. Opportunistic marine mammal sightings from commercial whale watching vessels, Montauk, New York 1981-1994. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1006>) on 2016-08-15.

Kopelman, A. 2015. CRESLI marine mammal observations from whale watch cruises 2000-2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/896>) on 2016-08-15.

LaBrecque, E. 2011. Cape Hatteras 04-05. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/298>) on 2016-08-15.

Lanfredi, C. and G. Notarbartolo di Sciara. 2014. Tethys Research Institute shipboard survey cetacean sightings 1986-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/774>) on 2016-08-15.

Lapolla, F. 2013. The Dolphin Project. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/304>) on 2016-08-15.

Latusek-Nabholz, J. 2013. Sightings for Airborne Mine Neutralization System Aerial Monitoring in the NSWC PCD Study Area from October 2011, 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/948>) on 2016-08-15.

Latusek-Nabholz, J. 2013. Sightings for Airborne Mine Neutralization System Vessel Monitoring in the NSWC PCD Study Area from December 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/949>) on 2016-08-15.

Latusek-Nabholz, J. 2013. Sightings for AN/AQS-20 Sonar Aerial Monitoring in the NSWC PCD Study Area from July 2011 and May 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/947>) on 2016-08-15.

Latusek-Nabholz, J. 2014. Acoustic Detections for Airborne Mine Neutralization System Passive Acoustic Monitoring in the NSWC PCD Study Area from December 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/950>) on 2016-08-15.

Latusek-Nabholz, J. 2014. Sightings for AN/AQS-20 Sonar Test Event - April-May 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1096>) on 2016-08-15.

Latusek-Nabholz, J. 2014. Sightings for AN/AQS-20 Sonar Test Event - December 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1113>) on 2016-08-15.

Latusek-Nabholz, J. 2014. Sightings for REMUS Sonar Test Event - July 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1098>) on 2016-08-15.

Latusek-Nabholz, J. 2014. Sightings for SSAM2-BOSS Sonar Test Event - June 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1097>) on 2016-08-15.

Mallette S.D., Lockhart G.G., McAlarney R.J., Cummings E.W., Pabst D. A., McLellan W.A., Barco S.G. 2016. Offshore Energy Planning: Documenting Megafauna off Virginia's Coast Using Aerial Surveys. VAQF Scientific Report. 2016-04.

Mallette S.D., Lockhart G.G., McAlarney R.J., Cummings E.W., Pabst D. A., McLellan W.A., Barco S.G. 2016. Offshore Energy Planning: Documenting Megafauna off Virginia's Coast Using Aerial Surveys. VAQF Scientific Report. 2016-04.

Maughan, B. and K. Arnold. 2010. UK Royal Navy Marine Mammal Observations. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/64>) on 2016-08-15.

McLellan, W. 2005. UNCW Aerial Survey 1998-1999. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/272>) on 2016-08-15.

McLellan, W. 2006. UNCW Marine Mammal Sightings 1998-1999. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/66>) on 2016-08-15.

McLellan, W. 2007. UNCW Marine Mammal Sightings 2002. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/67>) on 2016-08-15.

McLellan, W. 2010. UNCW Marine Mammal Sightings 2001. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/65>) on 2016-08-15.

McLellan, W. 2011. UNCW Aerial Surveys for monitoring of proposed Onslow Bay USWTR site - Left side -. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/435>) on 2016-08-15.

McLellan, W. 2011. UNCW Marine Mammal Aerial Surveys 2006-2007. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/400>) on 2016-08-15.

McLellan, W. 2011. UNCW Right Whale Aerial Survey 05-06. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/360>) on 2016-08-15.

McLellan, W. 2011. UNCW USWTR JAX Aerial Surveys May - Oct 2010 - Left side. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/687>) on 2016-08-15.

McLellan, W. 2011. UNCW USWTR JAX Aerial Surveys May - Oct 2010 - Right side. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/688>) on 2016-08-15.

McLellan, W. 2011. USWTR JAX Aerial Survey -Left side- 2009-2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/590>) on 2016-08-15.

McLellan, W. 2011. USWTR JAX Aerial Survey -Left side- 2010-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/745>) on 2016-08-15.

McLellan, W. 2011. USWTR JAX Aerial Survey -Right side- 2010-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/747>) on 2016-08-15.

McLellan, W. 2011. USWTR Onslow Bay Aerial Survey -Left side- 2008-2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/586>) on 2016-08-15.

McLellan, W. 2011. USWTR Onslow Bay Aerial Survey -Left side- 2010-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/749>) on 2016-08-15.

McLellan, W. 2011. USWTR Onslow Bay Aerial Survey -Right side- 2008-2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/588>) on 2016-08-15.

McLellan, W. 2011. USWTR Onslow Bay Aerial Survey -Right side- 2010-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/751>) on 2016-08-15.

McLellan, W. 2012. USWTR JAX Aerial Survey -Left side- 2011-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/857>) on 2016-08-15.

McLellan, W. 2012. USWTR JAX Aerial Survey -Right side- 2009-2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/592>) on 2016-08-15.

McLellan, W. 2012. USWTR JAX Aerial Survey -Right side- 2011-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/859>) on 2016-08-15.

McLellan, W. 2013. UNCW Aerial Surveys for monitoring of proposed Onslow Bay USWTR site - Right side -. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/437>) on 2016-08-15.

McLellan, W. 2013. UNCW Right Whale Aerial Surveys 2008. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/464>) on 2016-08-15.

McLellan, W. 2014. AFAST Hatteras Aerial Survey -Left side- 2011-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/851>) on 2016-08-15.

McLellan, W. 2014. AFAST Hatteras Aerial Survey -Right side- 2011-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/855>) on 2016-08-15.

McLellan, W. 2014. AFTT Hatteras Aerial Survey -Left side- 2012-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1138>) on 2016-08-15.

McLellan, W. 2014. AFTT Hatteras Aerial Survey -Right side- 2012-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1140>) on 2016-08-15.

McLellan, W. 2014. AFTT JAX Aerial Survey -Left side- 2012-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1128>) on 2016-08-15.

McLellan, W. 2014. AFTT JAX Aerial Survey -Right side- 2012-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1136>) on 2016-08-15.

McLellan, W. 2015. AFTT Cape Hatteras Aerial Survey -Left side- 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1237>) on 2016-08-15.

McLellan, W. 2015. AFTT Cape Hatteras Aerial Survey -Right side- 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1235>) on 2016-08-15.

McLellan, W. 2015. AFTT JAX Aerial Survey -Left side- 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1241>) on 2016-08-15.

McLellan, W. 2015. AFTT JAX Aerial Survey -Right side- 2014. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1239>) on 2016-08-15.

McLellan, W. 2016. UNCW Hatteras Aerial Survey - Left side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1350>) on 2016-08-15.

McLellan, W. 2016. UNCW Hatteras Aerial Survey - Right side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1352>) on 2016-08-15.

McLellan, W. 2016. UNCW JAX Aerial Survey - Left side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1362>) on 2016-08-15.

McLellan, W. 2016. UNCW JAX Aerial Survey - Right side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1364>) on 2016-08-15.

McLellan, W. 2016. UNCW Norfolk Canyon Aerial Survey - Left side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1354>) on 2016-08-15.

McLellan, W. 2016. UNCW Norfolk Canyon Aerial Survey - Right side - 2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1356>) on 2016-08-15.

Olsen, E. 2013. Long-Distance Movement of a Sei Whale in the North Atlantic, 2005. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/888>) on 2016-08-15.

Palka, D. 2011. NEFSC 1995 AJ9501 (Part I). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/56>) on 2016-08-15.

Palka, D. 2013. Harbor Porpoise Survey 1992 (AJ92-01). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/302>) on 2016-08-15.

Palka, D. 2013. NEFSC 1995 AJ9501 (Part II). Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/290>) on 2016-08-15.

Palka, D. 2013. NEFSC 1995 pe9501. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/296>) on 2016-08-15.

Palka, D. 2013. NEFSC 1995 pe9502. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/294>) on 2016-08-15.

Palka, D. 2013. NEFSC 1999 aj9902. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/300>) on 2016-08-15.

Palka, D. 2013. NEFSC Aerial Circle-Back Abundance Survey 2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/398>) on 2016-08-15.

Palka, D. 2013. NEFSC Aerial Survey - Experimental 2002. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/107>) on 2016-08-15.

Palka, D. 2013. NEFSC Aerial Survey - Summer 1995. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/109>) on 2016-08-15.

Palka, D. 2013. NEFSC Aerial Survey - Summer 1998. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/113>) on 2016-08-15.

Palka, D. 2013. NEFSC Deepwater Marine Mammal 2002. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/292>) on 2016-08-15.

Palka, D. 2013. NEFSC Mid-Atlantic Marine Mammal Abundance Survey 2004. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/396>) on 2016-08-15.

Palka, D. 2013. NEFSC Survey 1997. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/58>) on 2016-08-15.

Palka, D. 2013. NEFSC Survey 1998 1. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/60>) on 2016-08-15.

Palka, D. 2013. NEFSC Survey 1998 2. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/62>) on 2016-08-15.

Read, A. 2012. Duke Harbor Porpoise Tracking. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/83>) on 2016-08-15.

Serrano, A. 2011. Cetacean diversity, distribution, and abundance in northern Veracruz, Mexico. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/530>) on 2016-08-15.

Smith, A. 2014. Mystic Aquarium's marine mammal and sea turtle stranding data 1976-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/945>) on 2016-08-15.

Speakman, T. 2011. NOAA Atlantic bottlenose dolphin sightings in the coastal and estuarine waters near Charleston, SC - 1994-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/737>) on 2016-08-15.

Spontak, D. 2012. JAX ASWEX Aerial Monitoring 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/868>) on 2016-08-15.

Spontak, D. 2012. JAX MAVEX Aerial Monitoring 2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/875>) on 2016-08-15.

Spontak, D. 2012. JAX MISSILEX Aerial Monitoring 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/874>) on 2016-08-15.

Spontak, D. 2012. JAX SEASWITI Aerial Monitoring 2010 . Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/866>) on 2016-08-15.

Spontak, D. 2012. JAX SEASWITI Vessel Monitoring 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/867>) on 2016-08-15.

Spontak, D. 2012. VACAPES ASWEX Aerial Monitoring 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/869>) on 2016-08-15.

Spontak, D. 2012. VACAPES FIREX Aerial Monitoring 2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/871>) on 2016-08-15.

Spontak, D. 2013. JAX GUNEX Aerial Monitoring Surveys October 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/893>) on 2016-08-15.

Spontak, D. 2013. JAX MAVEX September 2012. Data downloaded from OBIS-SEAMAP (<http://seamap>.

env.duke.edu/dataset/895) on 2016-08-15.

Spontak, D. 2013. VACAPES FIREX and ASW Aerial Monitoring 2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/870>) on 2016-08-15.

Spontak, D. 2013. VACAPES MISSELEX Aerial Monitoring March 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1017>) on 2016-08-15.

Spontak, D. 2014. Norfolk/VA Beach MINEX Vessel Surveys. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1072>) on 2016-08-15.

Spontak, D. 2015. Norfolk/VA Beach Inshore Vessel Surveys Nov 2012- Nov 2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1071>) on 2016-08-15.

Stevick, P. 2006. Allied Humpback Whale Catalogue, 1976 - 2003. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/73>) on 2016-08-15.

Stevick, P. 2013. YoNAH Encounter. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/274>) on 2016-08-15.

Swaim, Z. 2016. DUML vessel-based photo-id and biopsy surveys for proposed JAX USWTR site 2012-2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/906>) on 2016-08-15.

Swaim, Z. 2016. DUML vessel-based photo-id and biopsy surveys in Onslow Bay CHPT OPAREA 2011-2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/902>) on 2016-08-15.

Swaim, Z. 2016. DUML vessel-based photo-id and biopsy surveys in VACAPES OPAREA off Hatteras 2009, 2011-2015. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/907>) on 2016-08-15.

Taylor, J. 2015. Bottlenose dolphins off Outer Banks 2007-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/837>) on 2016-08-15.

Thillet, M. 2011. Deep Panuke whale Acoustic 2003. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/651>) on 2016-08-15.

Thillet, M. 2011. Deep Panuke whale sightings 2003. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/650>) on 2016-08-15.

Tyson, R. 2014. Community structure and abundance of bottlenose dolphins *Tursiops truncatus* in coastal waters of the northeast Gulf of Mexico. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/571>) on 2016-08-15.

Urian, K. 2013. DUML New River surveys on the occurrence, distribution and density of marine mammals in Camp Lejeune 2010-2011. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/959>) on 2016-08-15.

Urian, K. 2013. DUML surveys for the stock discrimination of bottlenose dolphins along the Outer Banks of North Carolina 2011-2012. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1010>) on 2016-08-15.

Urian, K. 2013. DUML vessel-based line transect surveys for proposed Onslow Bay USWTR site 2007-2010. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/433>) on 2016-08-15.

Urian, K. 2014. DUML coastal surveys on the occurrence, distribution and density of marine mammals in Camp Lejeune 2010-2013. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/957>) on 2016-08-15.

Van Parijs, S. 2013. NEFSC Marine Mammal Abundance Cruise 2004 Passive Acoustic Monitoring - Rainbow Click Detections. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/509>) on 2016-08-15.

Van Parijs, S. 2013. North Atlantic right whale up-calls in Stellwagen Bank National Marine Sanctuary 2006-2007. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/892>) on 2016-08-15.

Whitt, A. 2015. Marine mammal records of Cuba. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1190>) on 2016-08-15.

Wolff, N. 2011. Aerial survey of upper trophic level predators on PLatts Bank, Gulf of Maine. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/103150267>) on 2016-08-15 and originated from iOBIS (<http://www.iobis.org>).