Density model for Northern bottlenose whale in the AFTT area - version 1

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This report documents the density model developed for Northern bottlenose whale in the AFTT area. It provides information on available data, methodological decisions, the selected model, predictions, uncertainty and qualitative evaluation of predictions based on the literature. Information on classification of ambiguous sightings, detection function fitting and g(0) estimates can be found in the EEZ model report for this taxon (Roberts et al. 2015).

Citation for this model: Mannocci L, Roberts JJ, Miller DL, Halpin PN (2015) Density model for Northern bottlenose whale in the AFTT area. Version 3, 2015-01-23. Marine Geospatial Ecology Lab, Duke University, Durham, NC.

Citation for the related peer-review publication: Mannocci L, Roberts JJ, Miller DL, Halpin PN. Here be dragons: extrapolating cetacean densities into the unsurveyed high seas of the western North Atlantic. Submitted to Ecological Applications.

1- Available data

Table 1: Effort (km) and sightings per region (CAR: Caribbean, EC: East coast, EU: European Atlantic, GM: Gulf of Mexico, MAR: Mid-Atlantic ridge).

Region	Effort	Sightings
EC	1044358	4
All regions	1044358	4

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

Month	Effort	Sightings
January	71406.04	0
February	96993.70	0
March	98664.69	0
April	105121.39	0
May	107303.24	0
June	116575.15	0
July	113832.51	3
August	110040.12	1
September	52584.62	0
October	57619.14	0
November	60008.94	0
December	54208.17	0
All Months	1044357.70	4

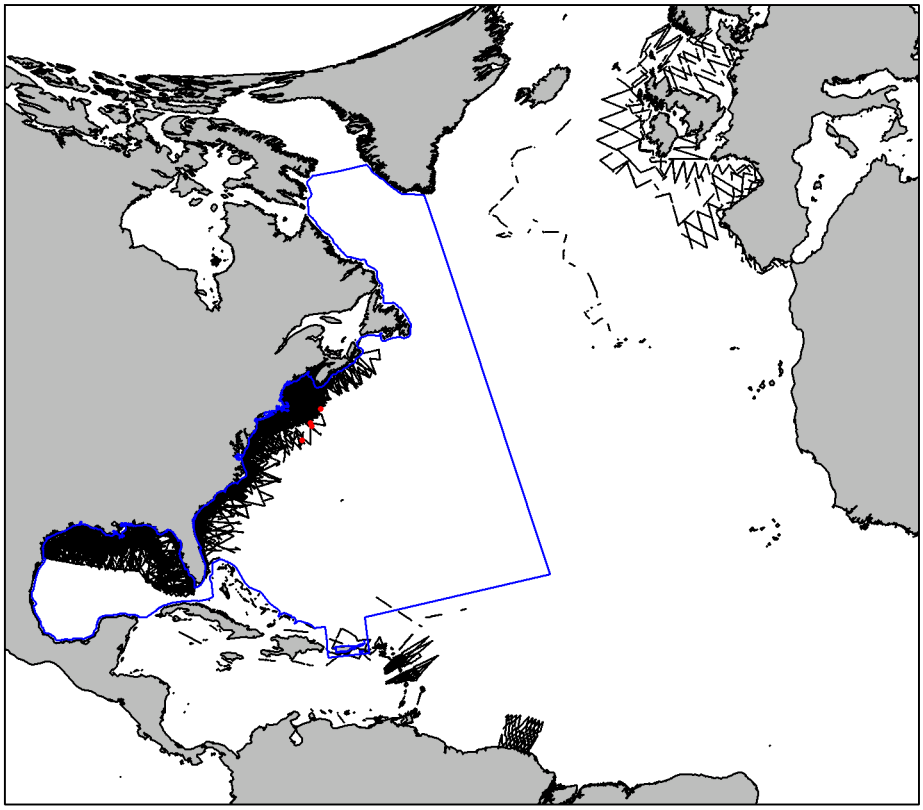

Figure 1: Map of segments (black lines) and sighting locations (red dots). An Albers equal area projection optimized for the AFT area is used.

2- Methodological decisions

Modeled taxon

Northern bottlenose whale (*Hyperoodon ampullatus*)

Model type

The extremely small sample size did not allow us to fit a habitat-based density model for this taxon; as a result we fitted a stratified density model.

Modeled season

The sample size was too small to consider fitting seasonal models so we fitted a year-round model.

Segments

We used segments from the east coast since it was the only region where sightings were reported.

Area of assumed presence

Northern bottlenose whales were assumed present in waters characterized by: sea surface temperatures $<$ 22°C, depth $>$ 2000 m and distances to canyons $<$ 100 km, in agreement with their presumed occurrence in cold offshore waters and their affinities for submarine canyons, including the Gully (Mead 1989, Hooker et al. 2002, Wimmer and Whitehead 2004).

3- Predictions

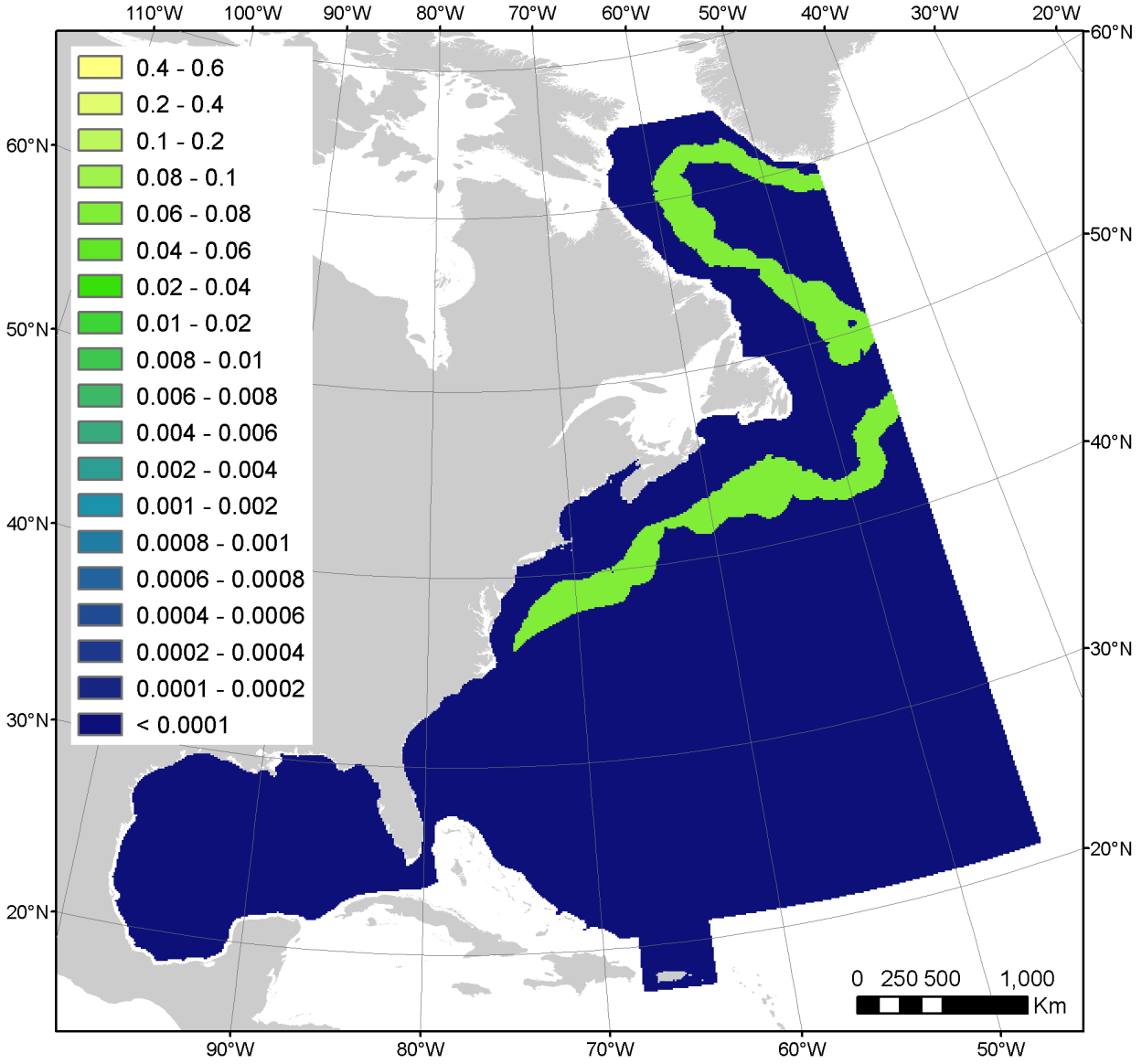

Figure 5: Mean predicted densities (individuals 100 km-2) in the AFTT area. Areas where we extrapolated beyond the sampled covariate ranges are indicated with black crosshatches. An Albers equal area projection is used.

Table 3: Mean predicted abundance (individuals) in the AFTT area and associated coefficient of variation (CV). The CV only reflects uncertainty in the estimated GAM parameters (in this case only the intercept) and is therefore strongly underestimated.

Abundance	CV
689	0.631

4- Uncertainty

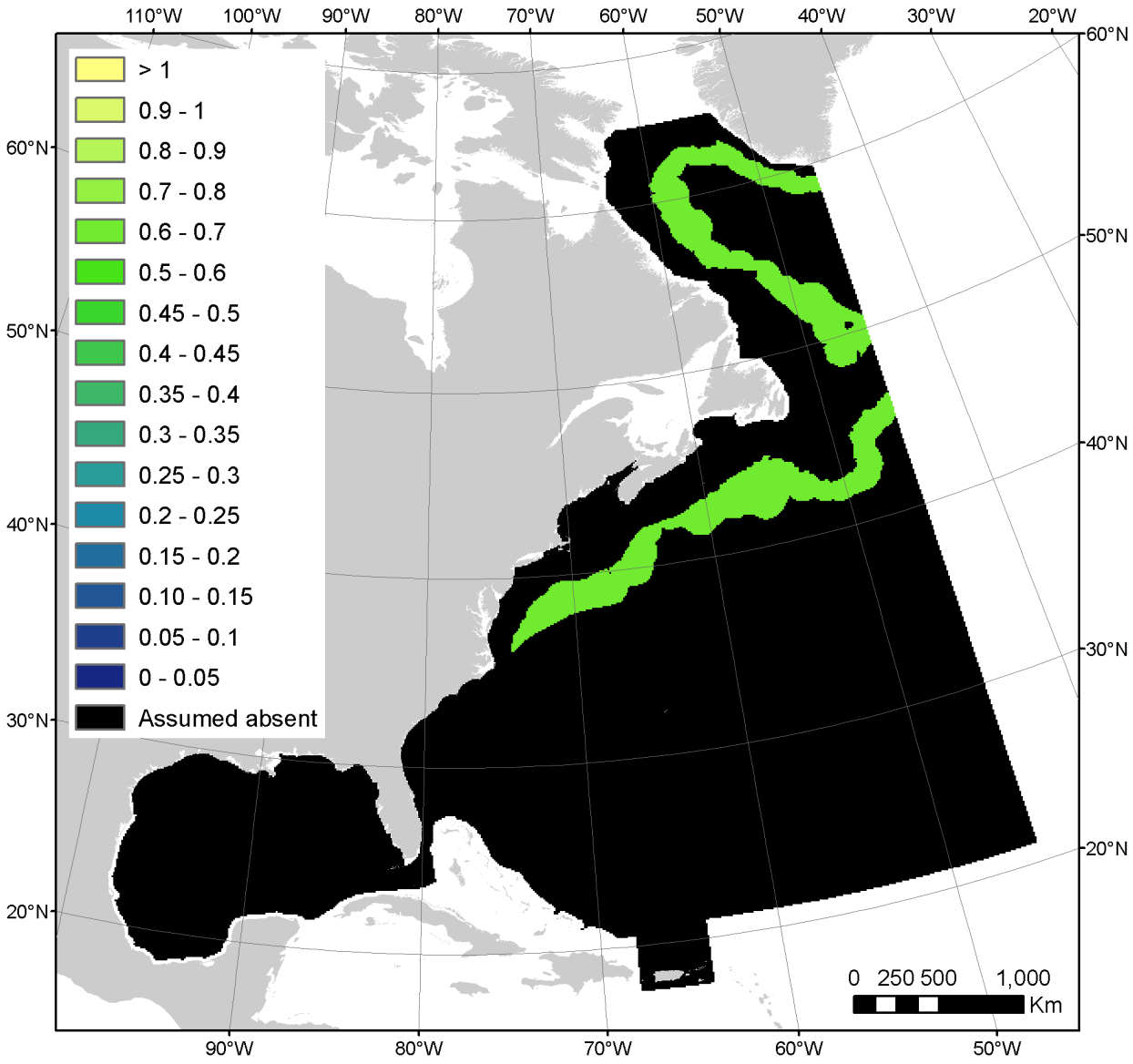

Figure 6: Mean predicted coefficient of variation (unit-less) in the AFTT area. An Albers equal area projection is used.

5- Qualitative evaluation of predictions

Model predictions are compatible with the mark-recapture abundance estimate of 230 individuals in the Gully canyon (Whitehead et al. 1997).

Future model improvements

More data would be needed to increase the reliability of density predictions for this rare taxon.

REFERENCES

Hooker, S. K., H. Whitehead, S. Gowans, and R. W. Baird. 2002. Fluctuations in distribution and patterns of individual range use of northern bottlenose whales. Marine Ecology Progress Series 225:287-297.

Mead, J. G. 1989. Bottlenose whales. Pages 321-348 Handbook of marine mammals. Sam H. Ridgway and Sir Richard Harrison. Academic Press.

Whitehead, H. A. L., S. Gowans, A. Faucher, and S. W. Mccarrey. 1997. Population analysis of northern bottlenose whales in the Gully, Nova Scotia. Marine Mammal Science 13:173-185.

Wimmer, T., and H. Whitehead. 2004. Movements and distribution of northern bottlenose whales, Hyperoodon ampullatus, on the Scotian Slope and in adjacent waters. Canadian Journal of Zoology 82:1782-1794.