

# Density model for North Atlantic right whale in the AFTT area - version 2

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This report documents the density model developed for North Atlantic right 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 North Atlantic right whale in the AFTT area. Version 2, 2015-11-16. 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	1629
All regions	1044358	1629

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

Month	Effort	Sightings
January	71406.04	97
February	96993.70	39
March	98664.69	82
April	105121.39	241
May	107303.24	414
June	116575.15	312
July	113832.51	119
August	110040.12	47
September	52584.62	2
October	57619.14	43
November	60008.94	126
December	54208.17	107
All Months	1044357.70	1629

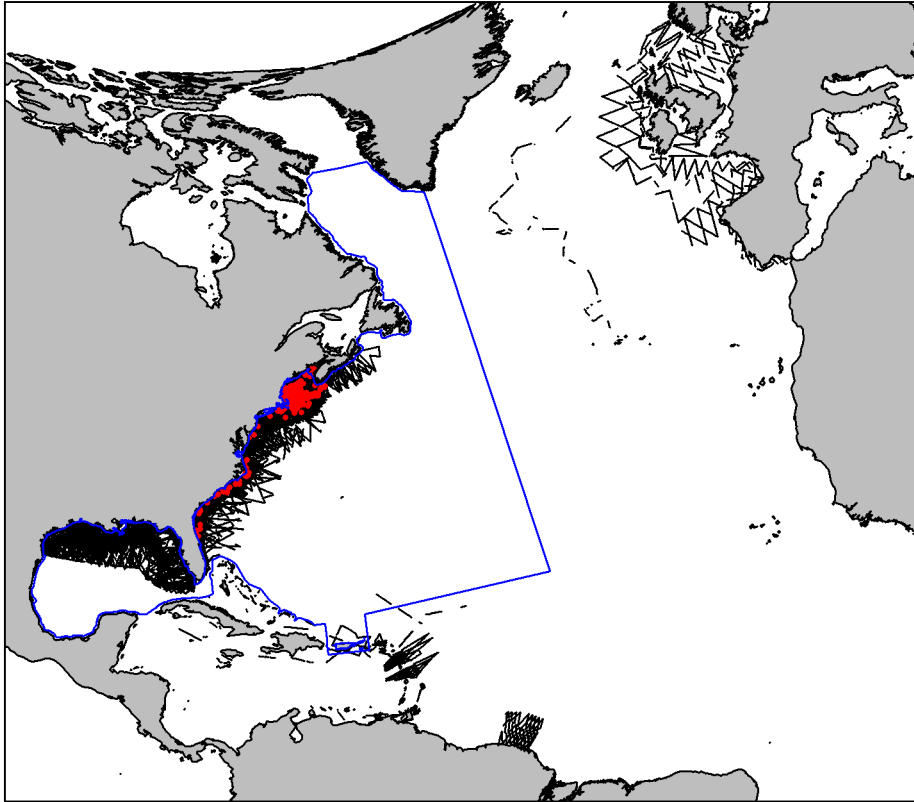


Figure 1: Map of segments (black lines) and sighting locations (red dots). An Albers equal area projection optimized for the AFT area is used.

## 2- Methodological decisions

### *Modeled taxon*

North Atlantic right whale (*Eubalaena glacialis*)

### *Model type*

Because the North Atlantic right whale has a very limited present-day distribution compared to its putative historical range (Reeves 2001), fitting a habitat-based density model to sightings in the east coast and extrapolating to the entire AFTT area would result in an overestimation of its present-day distribution and densities. As a result, we fitted a stratified density model.

### *Modeled season*

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*

North Atlantic right whales were assumed present in coastal waters shallower than 500 m (the deepest sighting was made at 500m) from Florida to the North of Nova Scotia where most of the population is distributed in the western North Atlantic (Kenney 2009).

### 3- Predictions

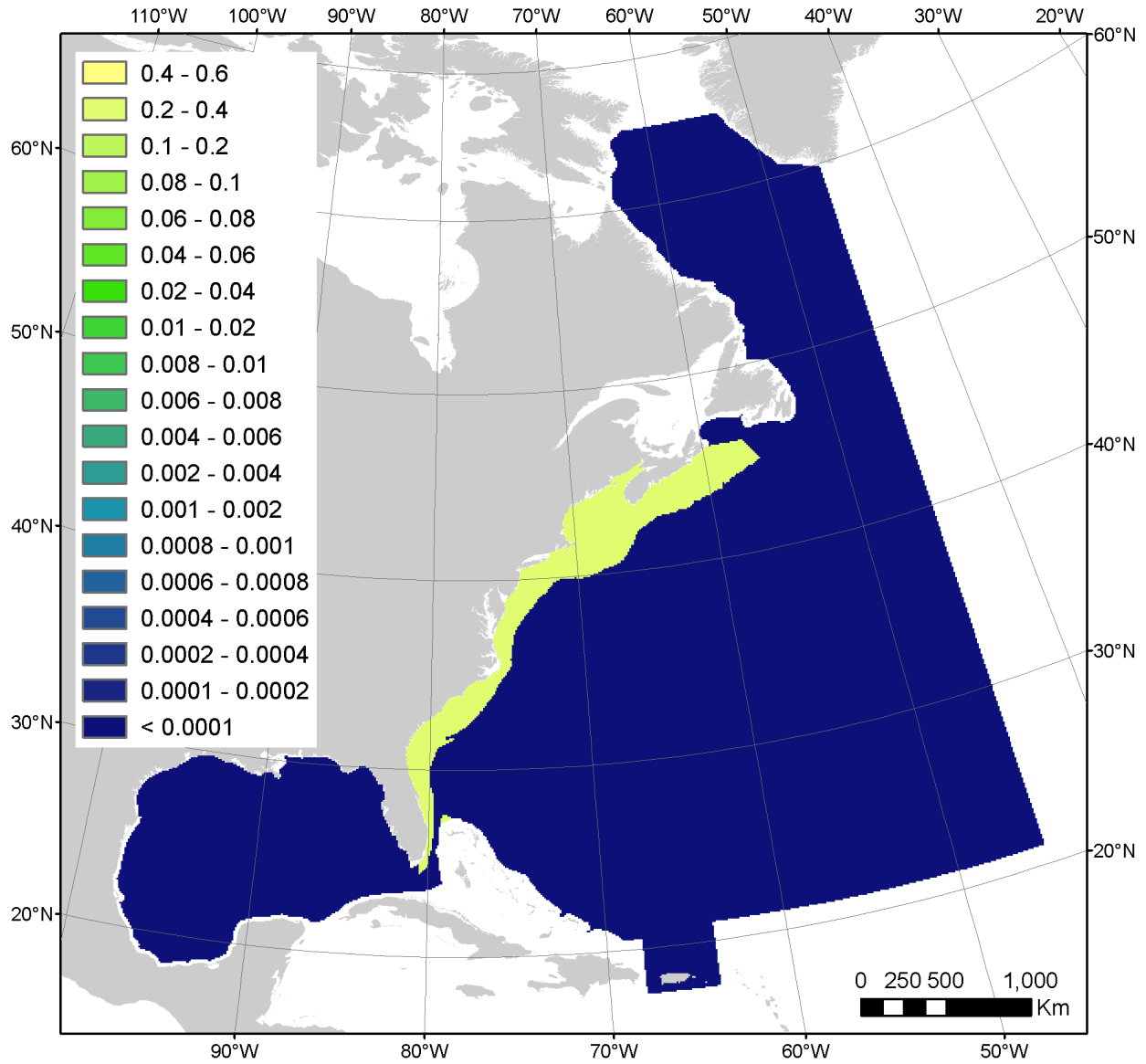


Figure 5: Mean predicted densities (individuals 100 km<sup>-2</sup>) in the AFTT area. An Albers equal area projection is used.

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
1721	0.035

## 4- Uncertainty

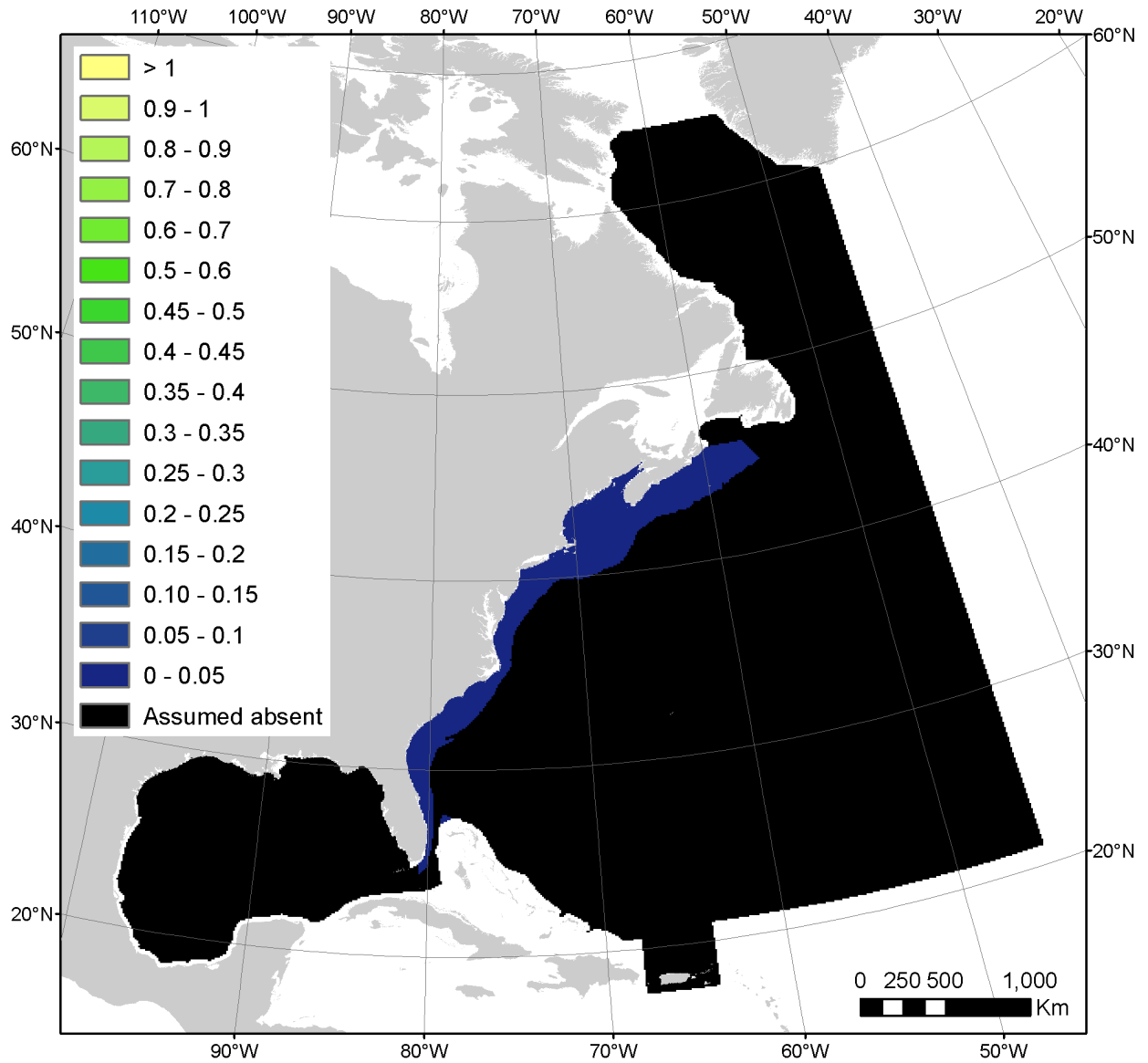


Figure 6: Mean predicted coefficient of variation (unit-less) in the AFTT area. An Albers equal area projection is used.

## 5- Qualitative evaluation of predictions

The model-predicted abundance is higher than the presumed 455 individuals in the western North Atlantic (Kenney 2009). We provide a precautionary estimate of 1721 individuals in line with the critically endangered status of this species. For more realistic predictions in the U.S. EEZ, see the East coast model (Roberts et al. 2015). Although sightings have been reported off Newfoundland and Labrador (Knowlton et al. 1992, Jacobsen 2004), North Atlantic right whales remain extremely rare North of Nova Scotia.

### *Future model improvements*

Information about sightings in Canadian waters would help refine the northern limit of their distribution in the western North Atlantic.

## REFERENCES

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- Reeves, R. R. 2001. Overview of catch history, historic abundance and distribution of right whales in the western North Atlantic and in Cintra Bay, West Africa. *The Journal of Cetacean Research and Management* 2:187-192.