

Density model for Seals in the AFTT area - version 1

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

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This report documents the density model developed for Seals 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 Seals in the AFTT area. Version 1, 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	1044357.70	1126
EU	27526.34	56
All regions	1071884.05	1182

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

Month	Effort	Sightings
January	71406.04	11
February	96993.70	31
March	98664.69	75
April	105121.39	183
May	107303.24	282
June	117542.82	134
July	140391.18	154
August	110040.12	225
September	52584.62	24
October	57619.14	35
November	60008.94	13
December	54208.17	15
All Months	1071884.05	1182

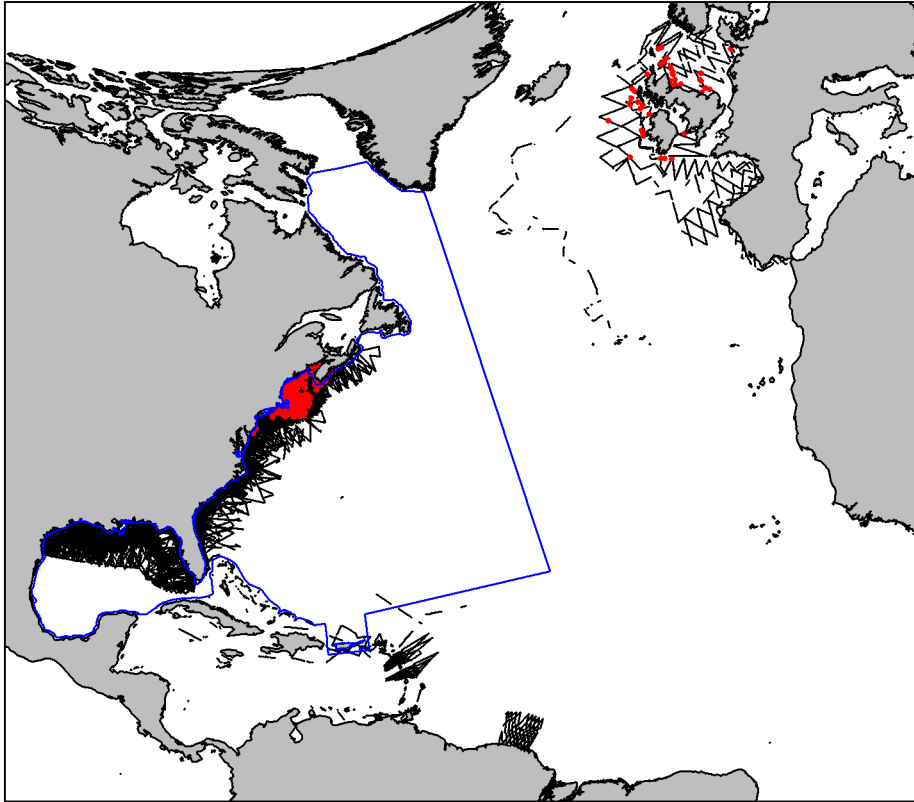


Figure 1: Map of segments (black lines) and sighting locations (red dots). An Albers equal area projection optimized for the AFT area is used.

2- Methodological decisions

Modeled taxon

Seals Since grey seal (*Halichoerus grypus*) and harbor seal (*Phoca vitulina*) are not differentiable at sea, leading to a high number of ambiguous sightings in the data, we modeled them together within the seals group.

Model type

We fitted a stratified density model.

Modeled season

We fitted a year-round model.

Segments

We used segments from the East coast with a Beaufort sea state lower than 2.

Area of assumed presence

Seals were assumed present in waters shallower than 1000m to the North of Cape Hatteras, in accordance with their dominant geographic area of distribution (Burns 2009, Hall and Thompson 2009)

3- Predictions

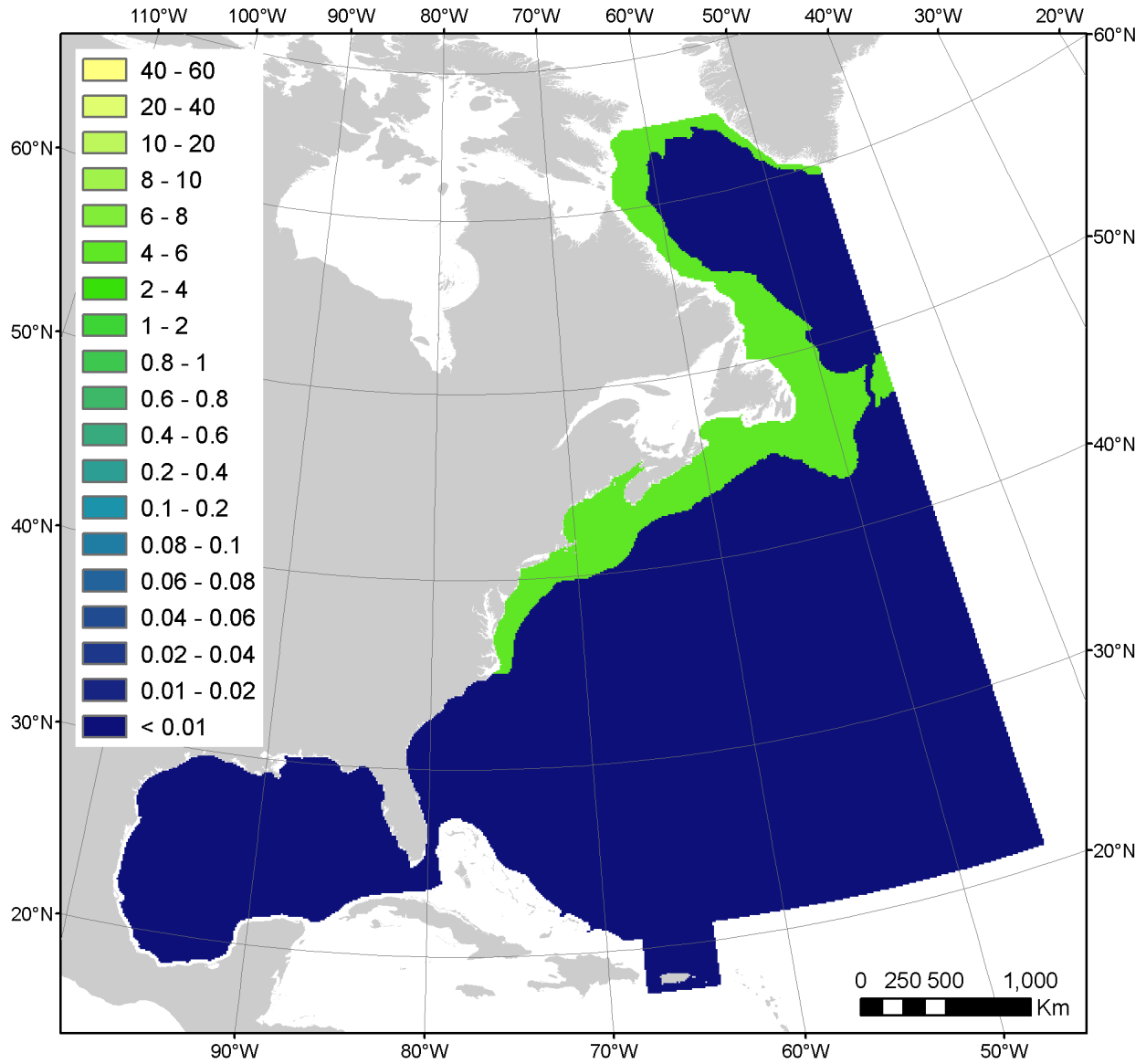


Figure 5: Mean predicted densities (individuals 100 km²) in the AFTT area. An Albers equal area projection is used.

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
50076	0.008

4- Uncertainty

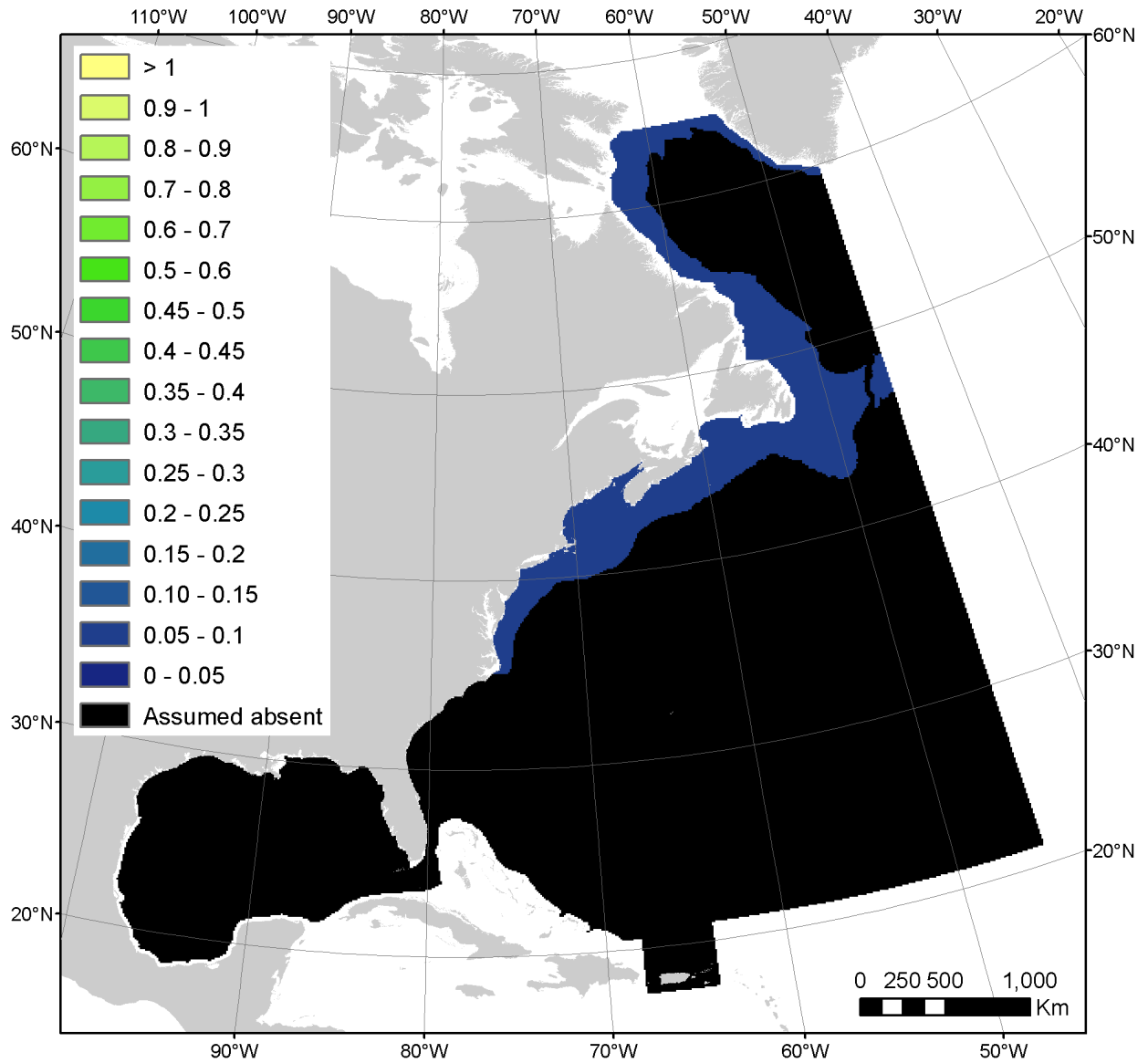


Figure 6: Mean predicted coefficient of variation (unit-less) in the AFTT area. An Albers equal area projection is used.

5- Qualitative evaluation of predictions

Future model improvements

We believe a different modeling methodology incorporating data collected at rookeries (pup counts, telemetry) would increase the reliability of density predictions compared to the current modeling methodology based on at-sea surveys.

REFERENCES

Burns, J. J. 2009. Harbor seal and spotted seal. Pages 533-542 Encyclopedia of marine mammals 2nd Edition. Academic Press.

Hall, A., and D. Thompson. 2009. Gray seal. Pages 500-503 Encyclopedia of marine mammals 2nd Edition. Academic Press.