

ALWTRP Vertical Line Model: Development and Distribution of Baseline Co-Occurrence Scores

Prepared for Atlantic Large Whale Take Reduction Team
December 2010

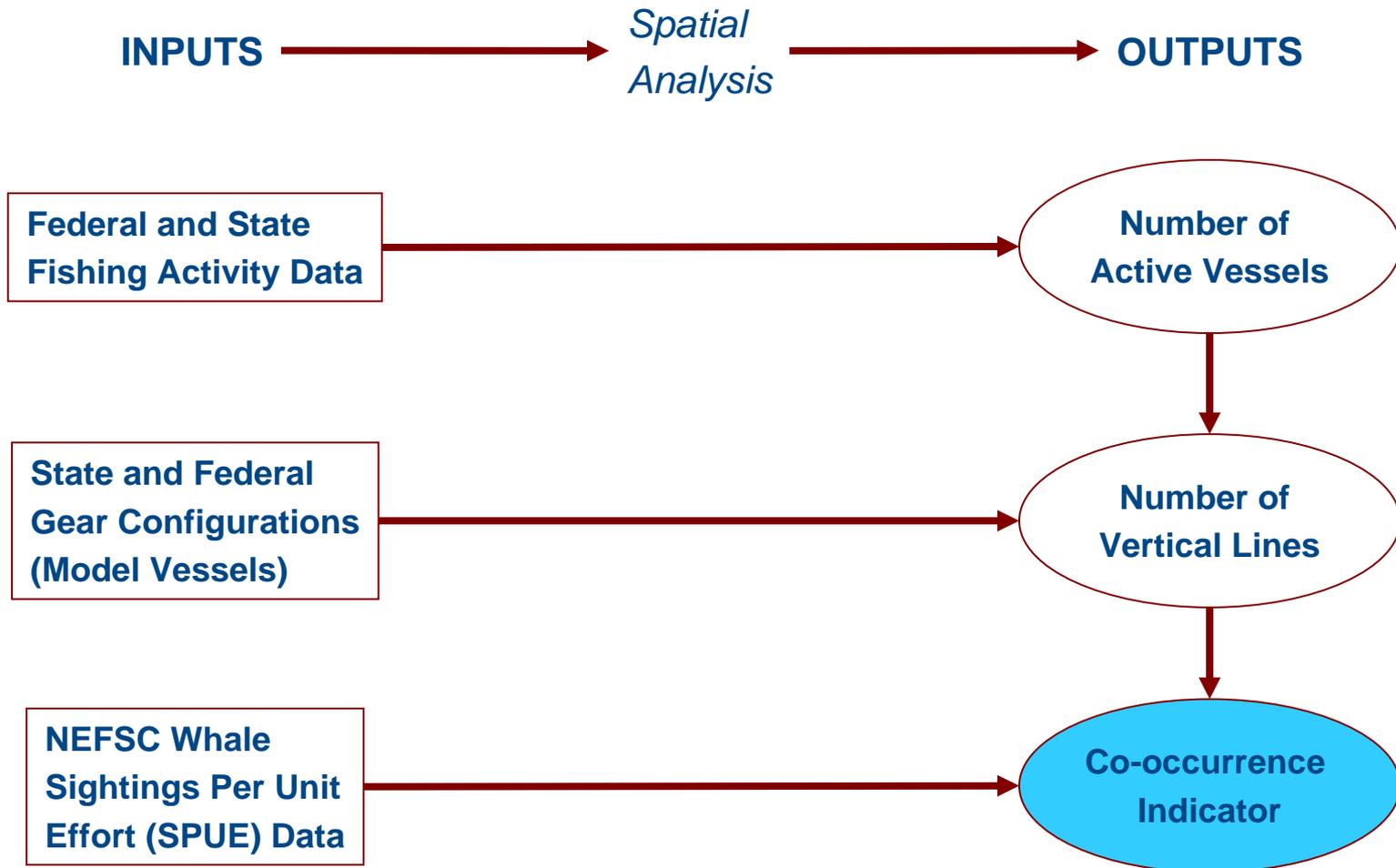
Funded by:
NMFS / Northeast Regional Office

Prepared by:

IEC

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Overview of Indicators



Introduction: A Note on Risk

- Goal of the ALWTRP: Reduce injuries and deaths of large whales due to incidental entanglement in fishing gear.
- The risk of injury or death due to entanglements is likely to be a function of many factors. For example:
 - The *probability* that an entanglement will occur may depend on the amount of gear deployed in a particular area, whether the gear is actively tended, the behavior in which a whale is engaged when gear is encountered (e.g., whether the whale is feeding), or other factors.
 - Similarly, the risk of injury or death *in the event of an entanglement* may depend on the characteristics of the whale involved (species, size, age, health, etc.), the nature of the gear (e.g., whether the gear incorporates weak links), human intervention (e.g., the feasibility and success of disentanglement efforts), or other variables.
- The factors that contribute to risk are not fully understood and are difficult to model.

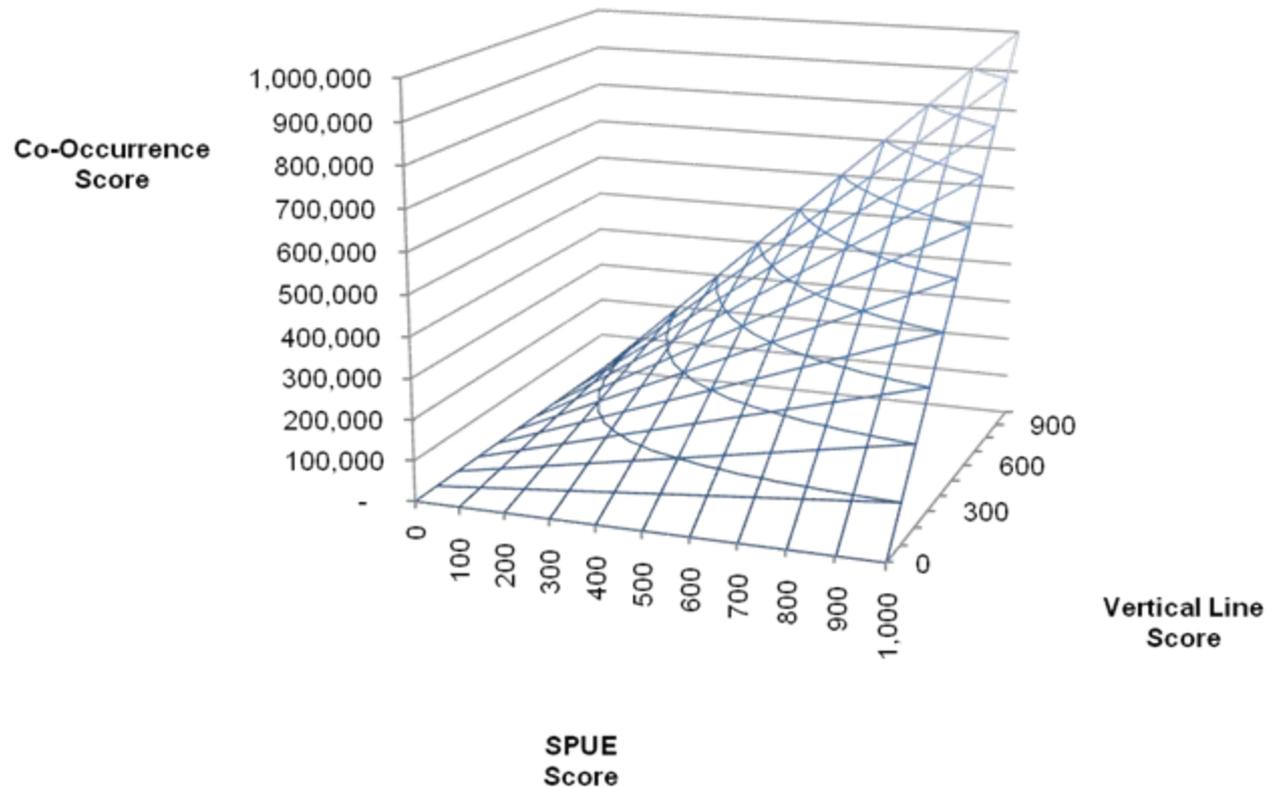
Co-Occurrence as an Indicator of Entanglement Risks

- In the absence of direct measures of risk, the Vertical Line Model employs a rough indicator of the likelihood that whales will encounter fishing gear: a “co-occurrence” score based on
 - The estimated concentration of gear at a particular place and time;
 - Survey data on sightings of large whales in that area at the same time of year.
- The co-occurrence score is an *indicator* of the potential for an entanglement to occur.
 - It is not a direct measure of the probability of an entanglement.
 - It does not address the risk of injury or death in the event of an entanglement.

Development of the Co-Occurrence Score

- As previously discussed, SPUE values are indexed on a scale from 0 to 1,000.
- Vertical line values are indexed on a similar scale:
 - The grid cell and month with the highest estimated concentration of vertical line is assigned a score of 1,000.
 - All other values are scaled proportionately, e.g.:
 - If the highest estimated concentration of vertical line for any grid cell and month is 20,000, then...
 - ...a grid cell with an estimated concentration of 10,000 vertical lines in September would be assigned a vertical line score of 500 for that month ($1,000 \times 10,000/20,000$).
- The co-occurrence score is the product of the SPUE score and the vertical line score; the maximum feasible co-occurrence score is 1,000,000 ($1,000_{\text{SPUE}} \times 1,000_{\text{VL}} = 1,000,000_{\text{CO}}$).

Relationship of Co-Occurrence Score to Underlying Values



Key Concepts and Caveats

- Co-occurrence scores vary in direct proportion to:
 - The estimated concentration of vertical line in an area;
 - The potential concentration of whales in the area, as represented by the SPUE data.
- Co-occurrence scores are not subject to a threshold, i.e., a minimum concentration of gear and/or whales below which the potential for an entanglement is assumed to be eliminated.
- Co-occurrence scores are assigned on a discrete basis to individual grid cells; this may imply a higher degree of geographic precision in characterizing the potential for an entanglement than the underlying data warrant.

Baseline Co-Occurrence Analysis

- The model allows the user to consider ground line as well as vertical line in developing a co-occurrence score.
- The model also provides users the ability to subjectively weight the importance of risks to individual species (i.e., right, fin, and humpback whales) in developing the co-occurrence score for all species.
- The analysis presented here focuses solely on vertical line and employs no weighting factors.

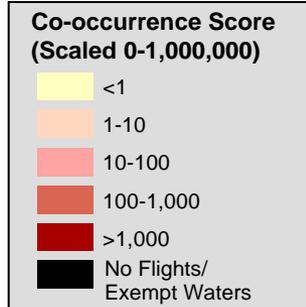
Baseline Co-Occurrence Analysis: All Species Combined



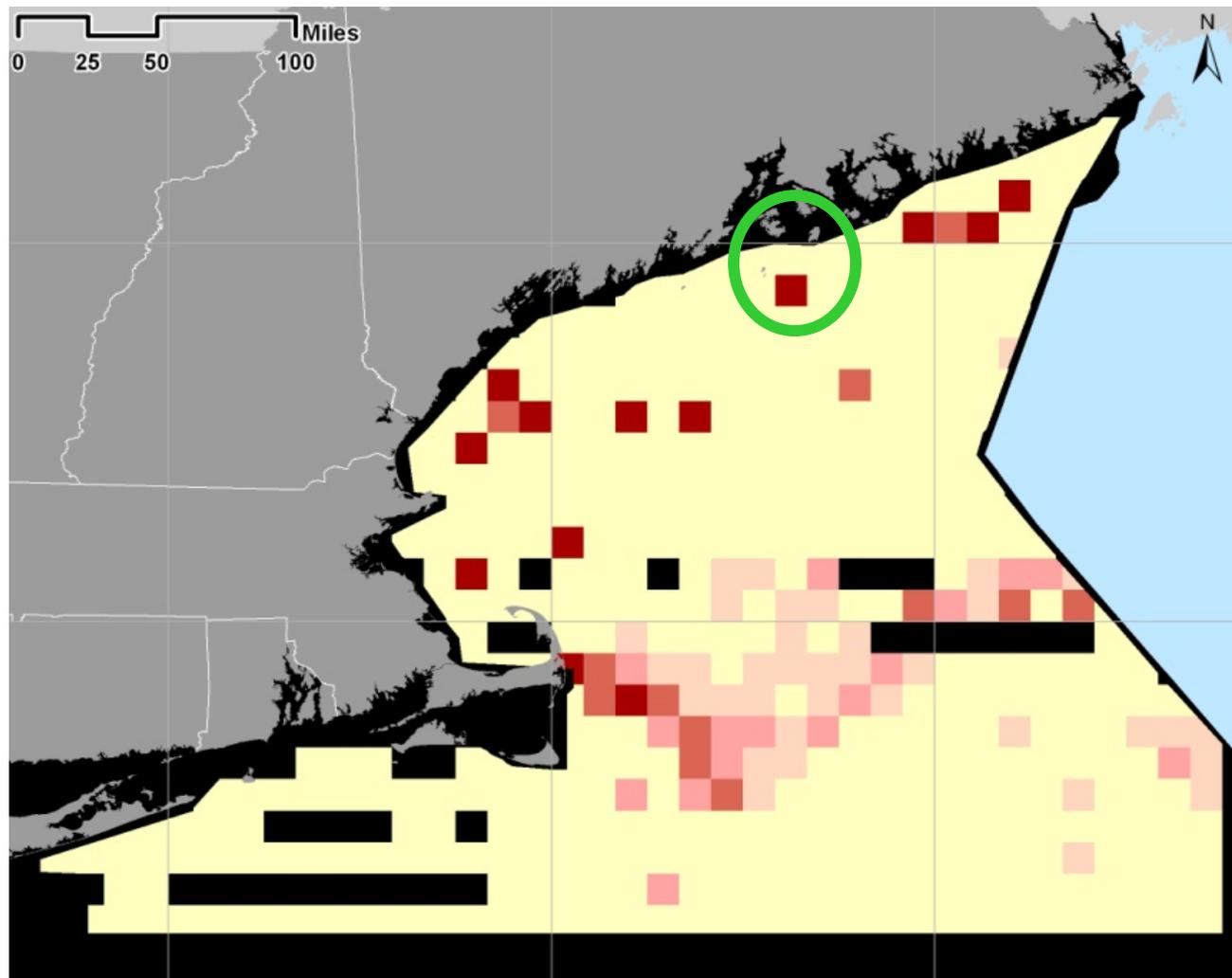
- The analysis yields 5,742 co-occurrence scores, each representing a grid cell and month for which both a SPUE and Vertical Line score are reported.
- The scores range from 0 to 44,747; the maximum reported score occurs in July in LMA 1.
- The distribution of scores is heavily skewed toward 0; less than 14 percent of the scores are greater than 0, and many of these are relatively low.
- The distribution of co-occurrence scores reflects the underlying distribution of SPUE and Vertical Line scores.

The Maximum Co-Occurrence Score: All Species Combined

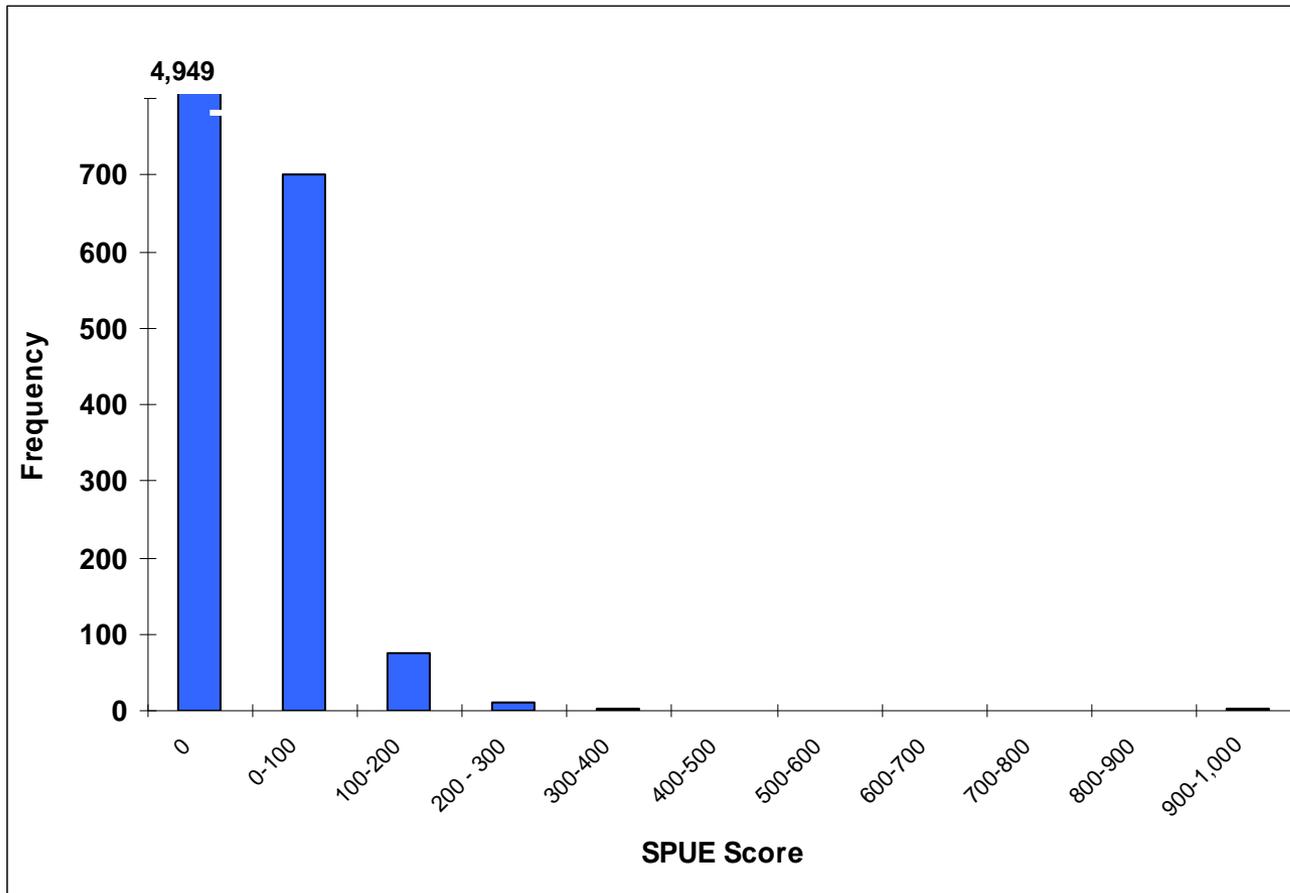
July Co-Occurrence Scores, Combined Whales (unweighted), All Fisheries



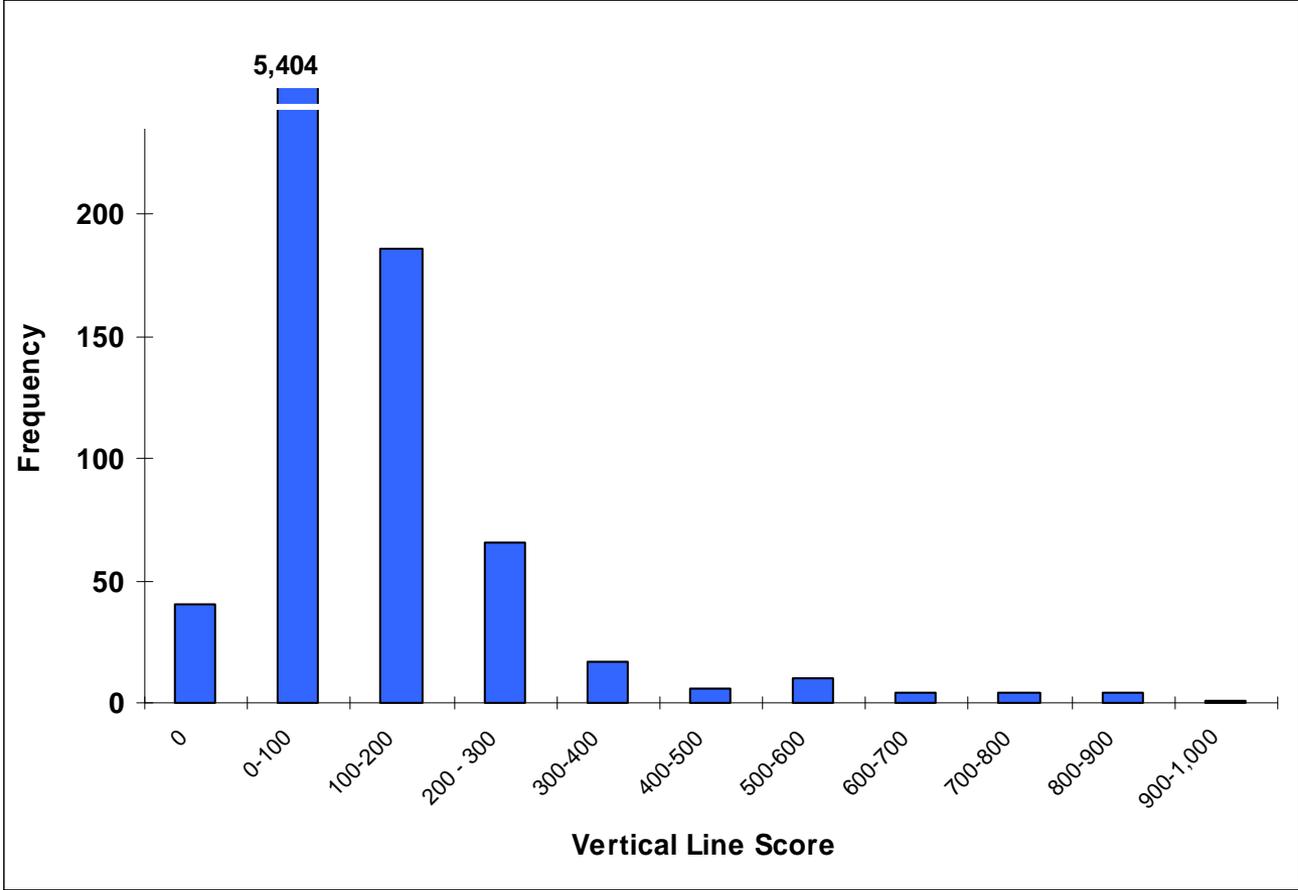
Note: Based on 2002-2007 SPUE data and 2008 vessel activity data.



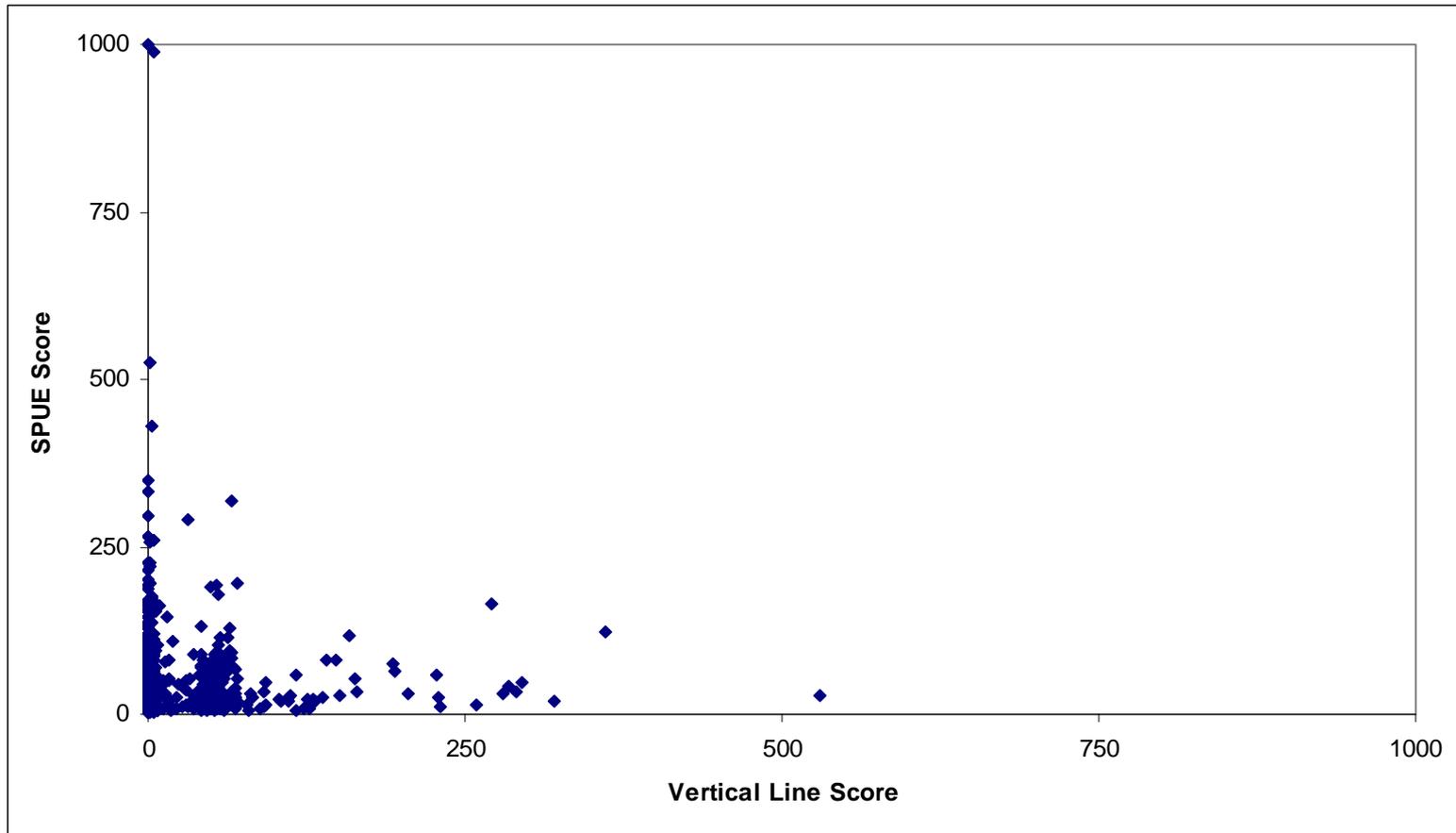
Distribution of Monthly SPUE Scores: All Species Combined



Distribution of Monthly Vertical Line Scores

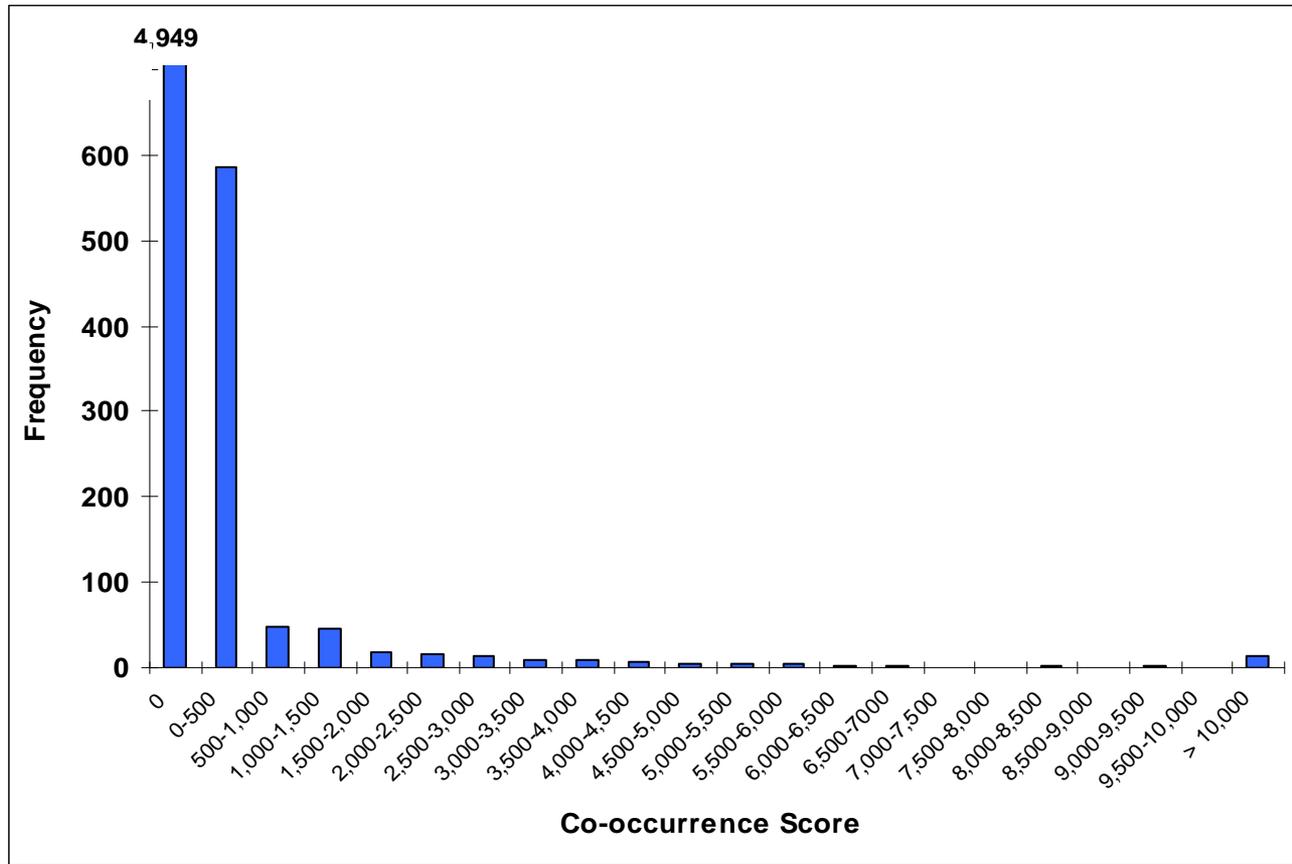


Scatter Plot of Monthly SPUE (All Species) and Vertical Line Scores



* Excludes SPUE scores of 0

Distribution of Monthly Co-Occurrence Scores: All Species Combined

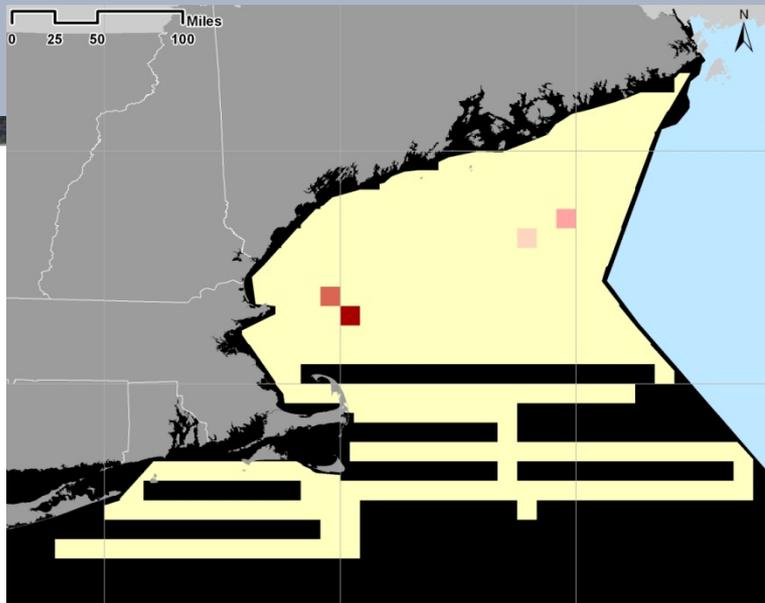


Spatial Analysis of Monthly and Average Annual Co-Occurrence Scores

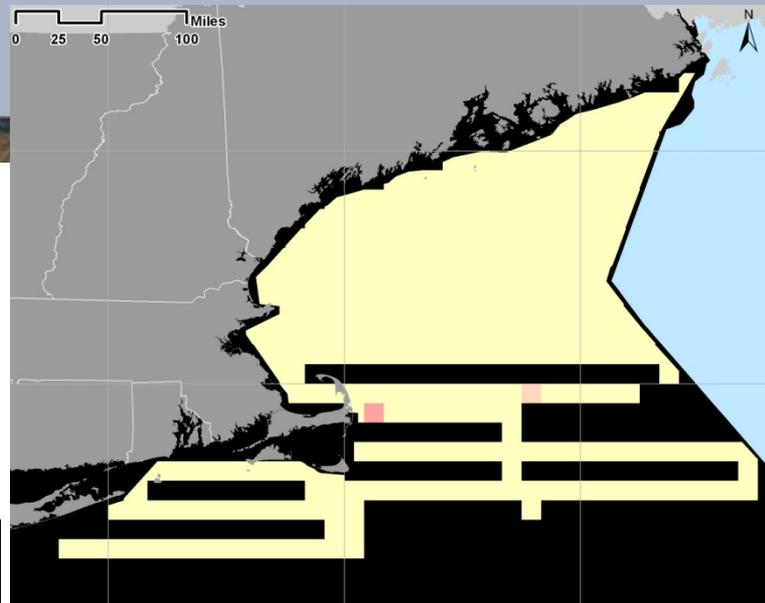
- The following maps illustrate the spatial distribution of co-occurrence scores by species and month.
- The monthly maps also illustrate the spatial distribution of co-occurrence scores for all species combined.
- The final map in the series illustrates the average co-occurrence score, by species and for all species combined, across all months.

January Co-occurrence, All Fisheries

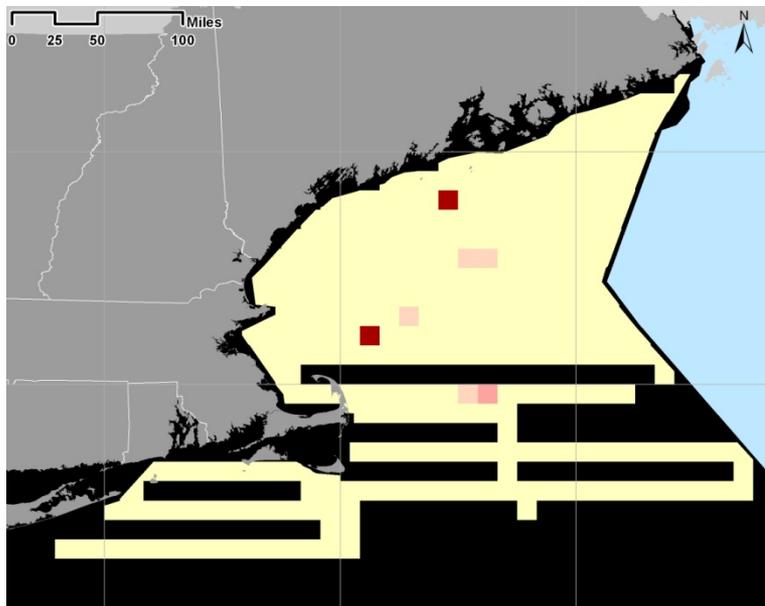
Right Whale



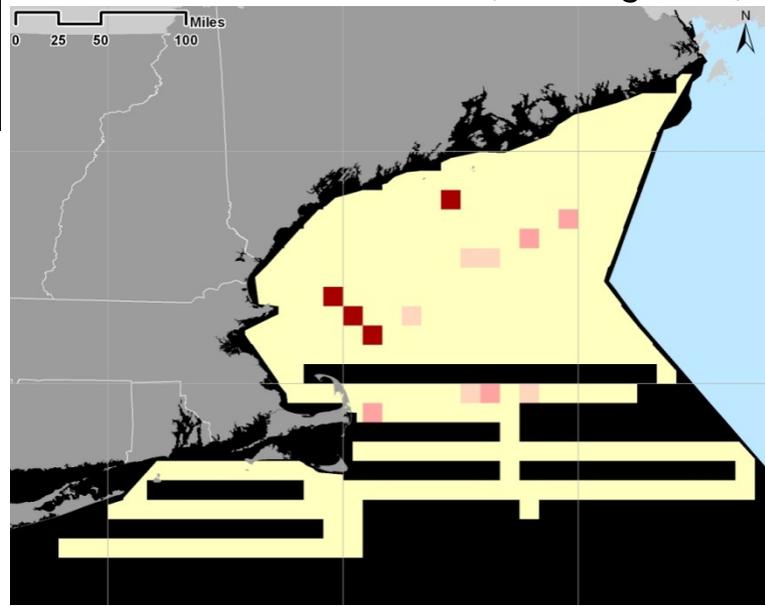
Humpback Whale



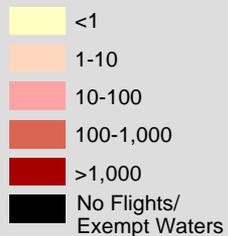
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
(Scaled 0-1,000,000)



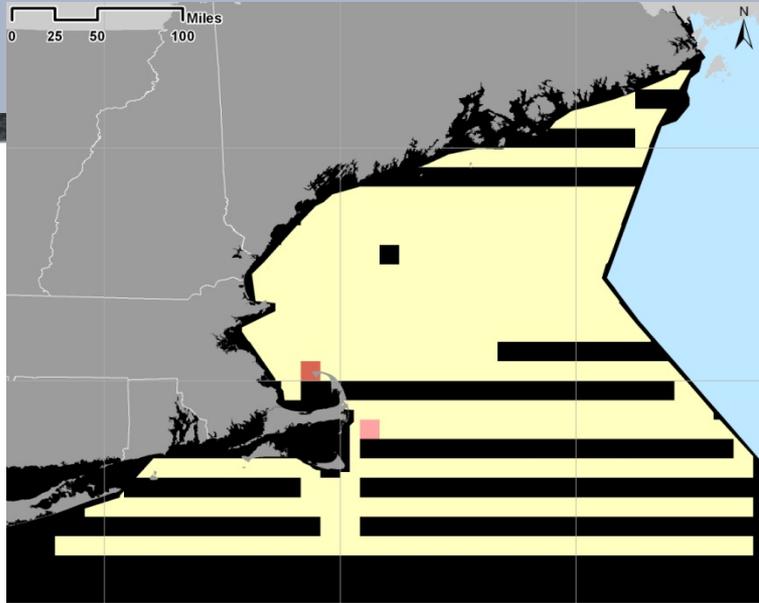
Note: Based on
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vessel activity
data.

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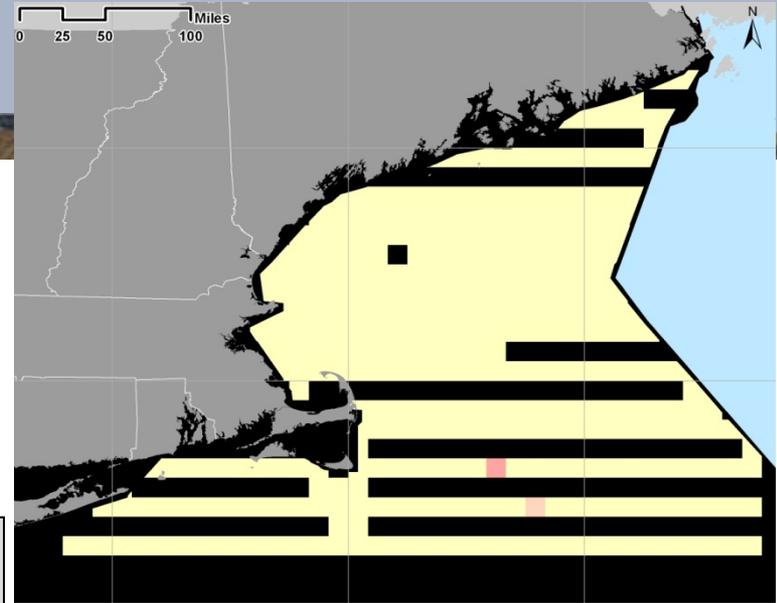
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February Co-occurrence, All Fisheries

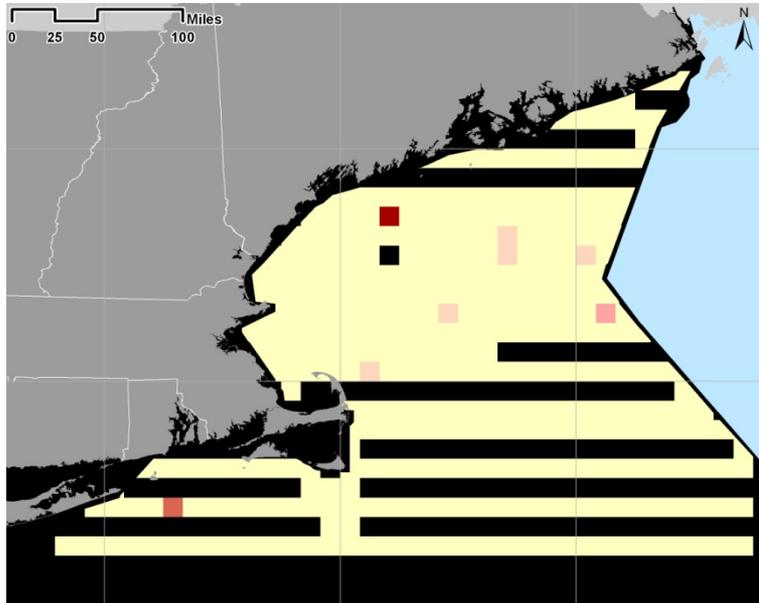
Right Whale



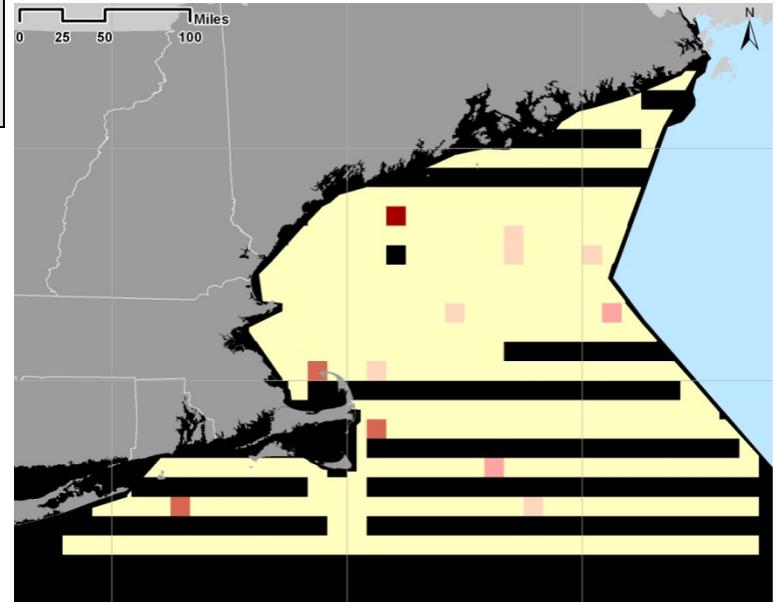
Humpback Whale



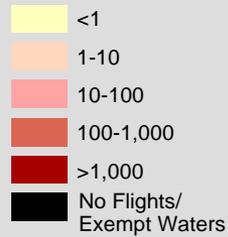
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Combined Whales (unweighted)



Co-occurrence Score
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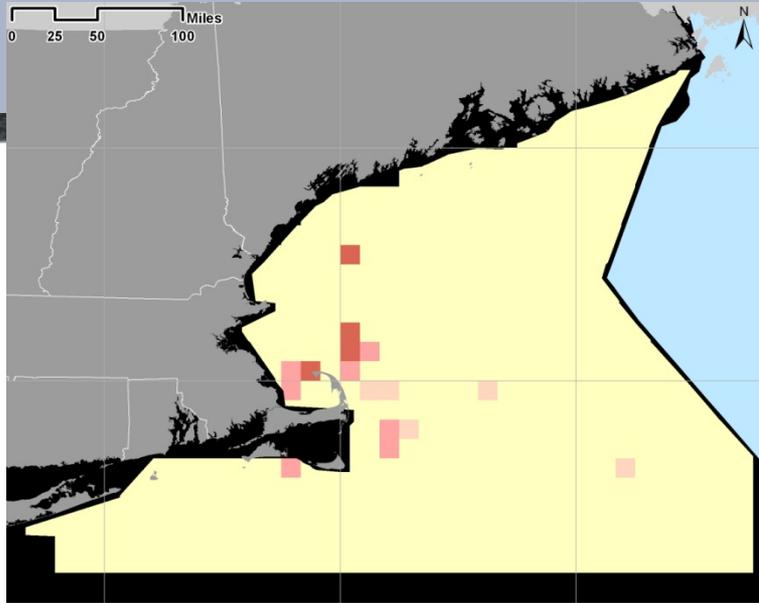
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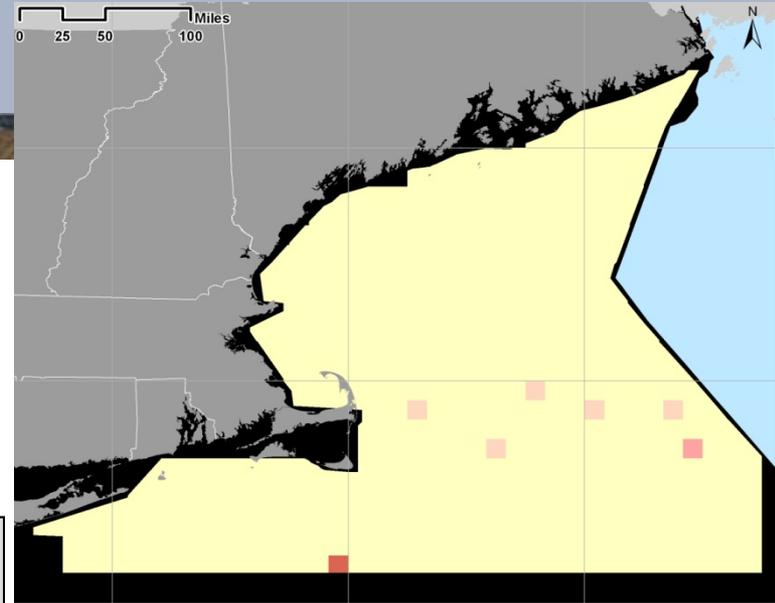
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March Co-occurrence, All Fisheries

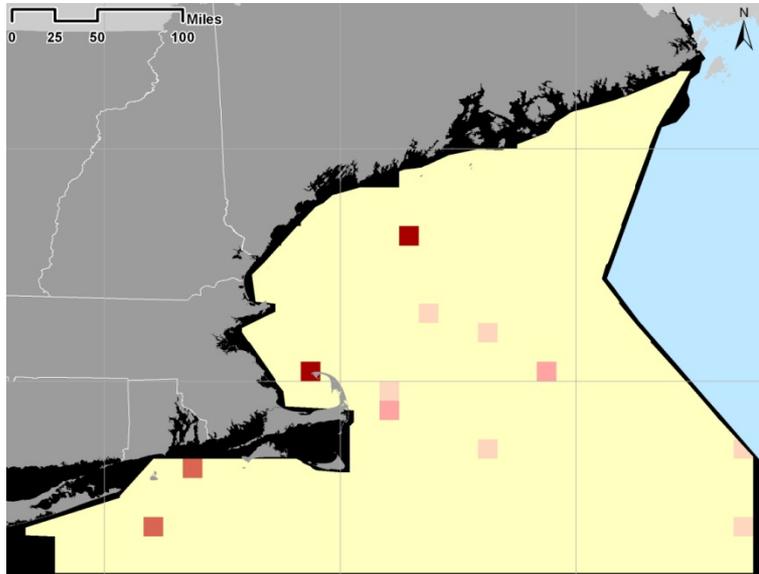
Right Whale



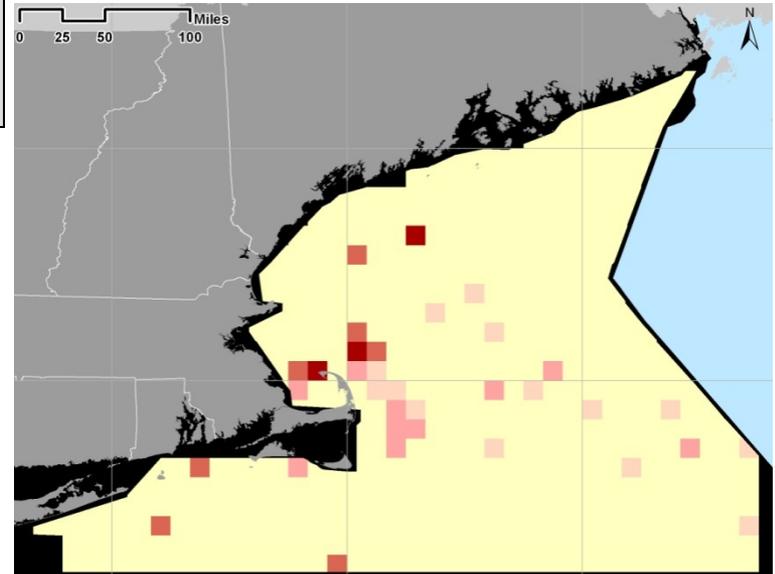
Humpback Whale



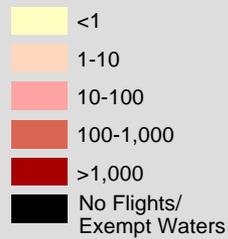
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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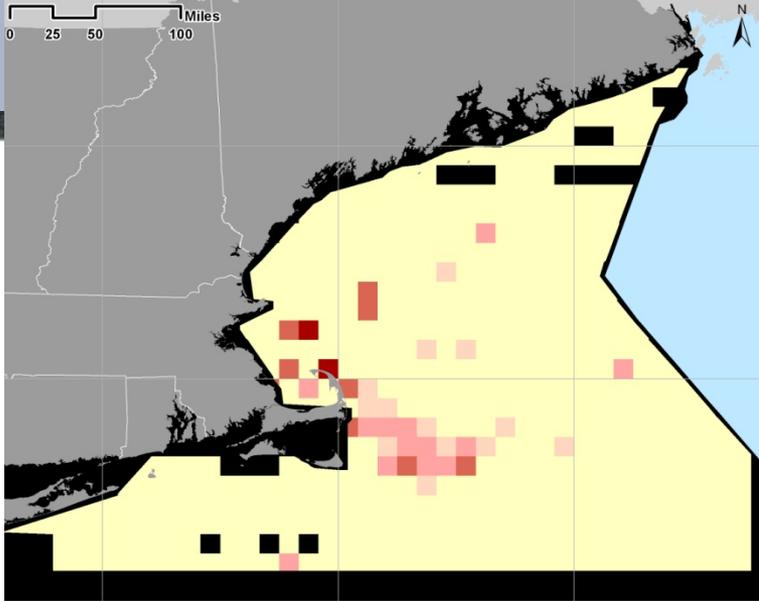
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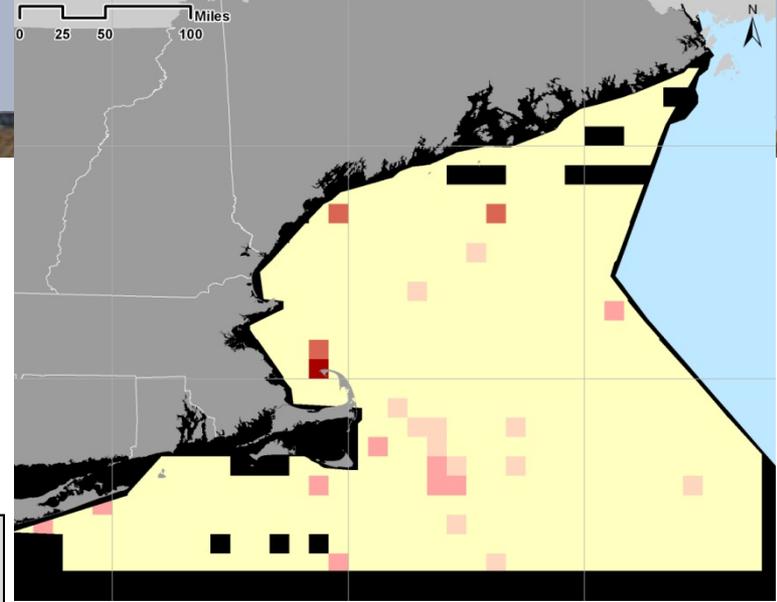
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April Co-occurrence, All Fisheries

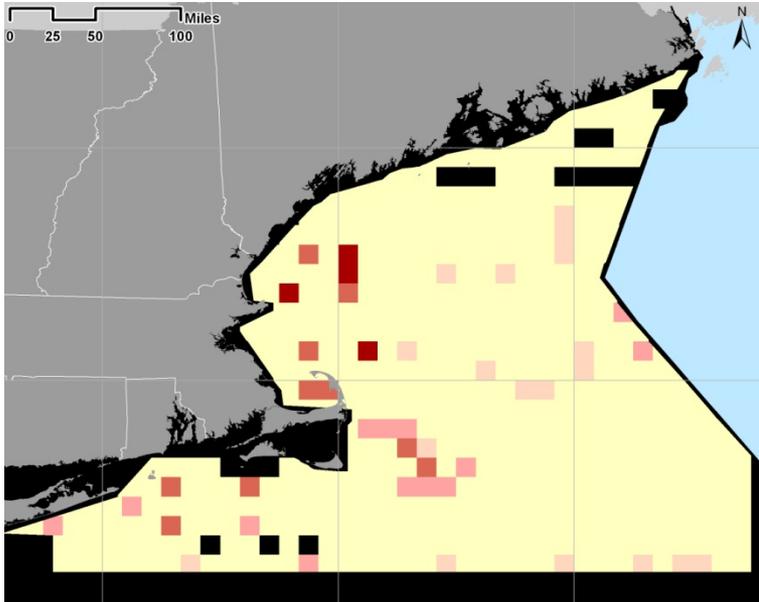
Right Whale



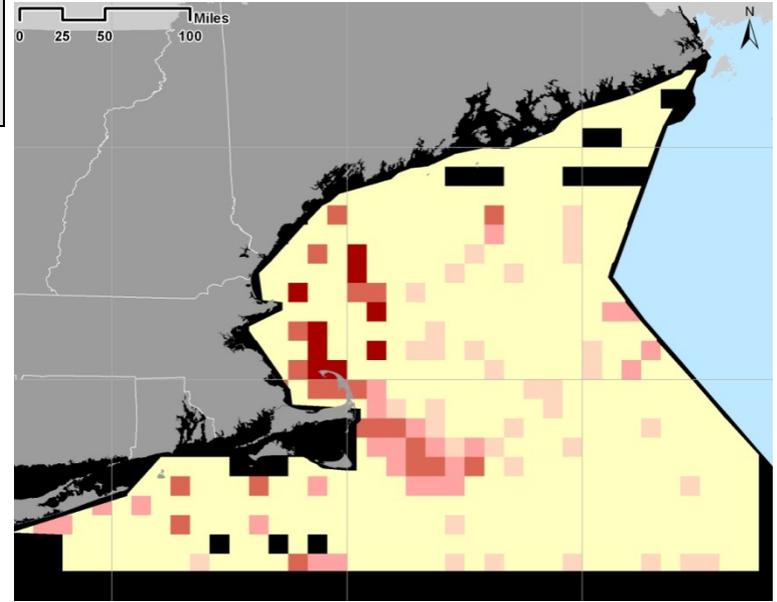
Humpback Whale



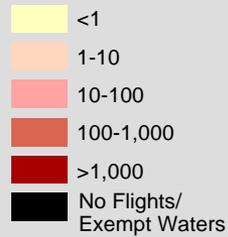
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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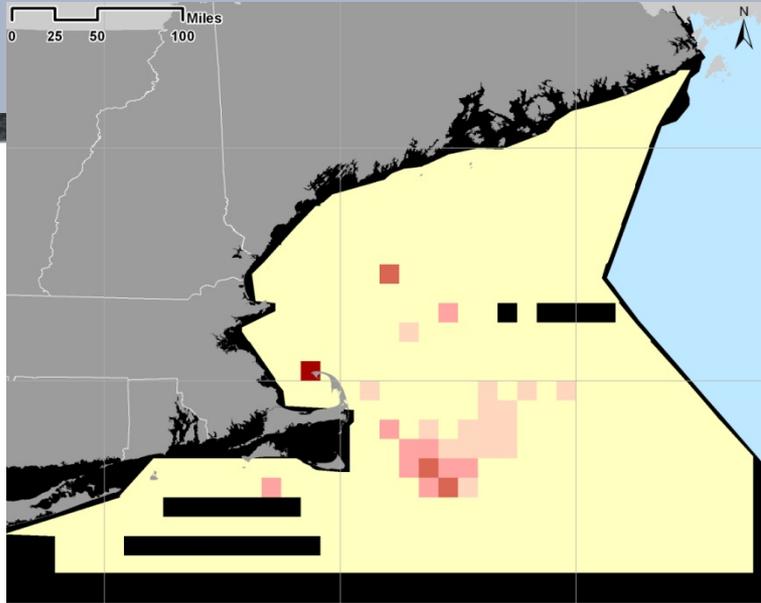
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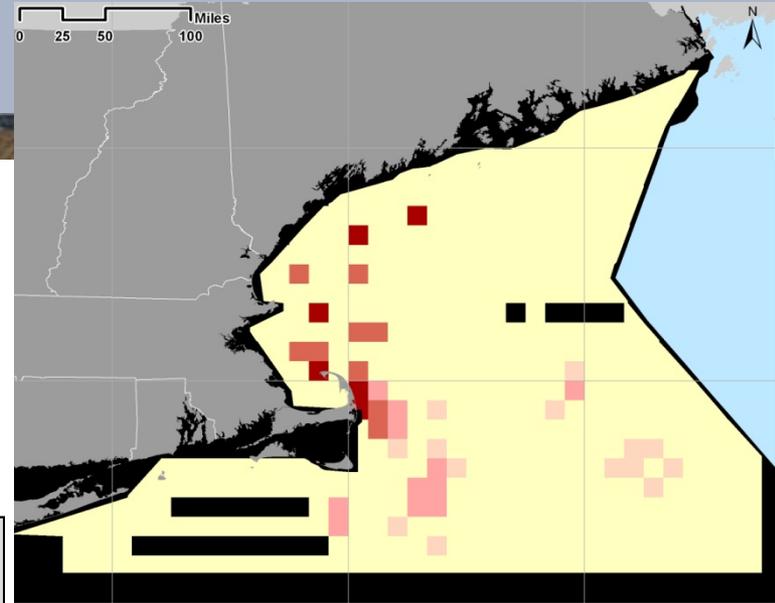
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May Co-occurrence, All Fisheries

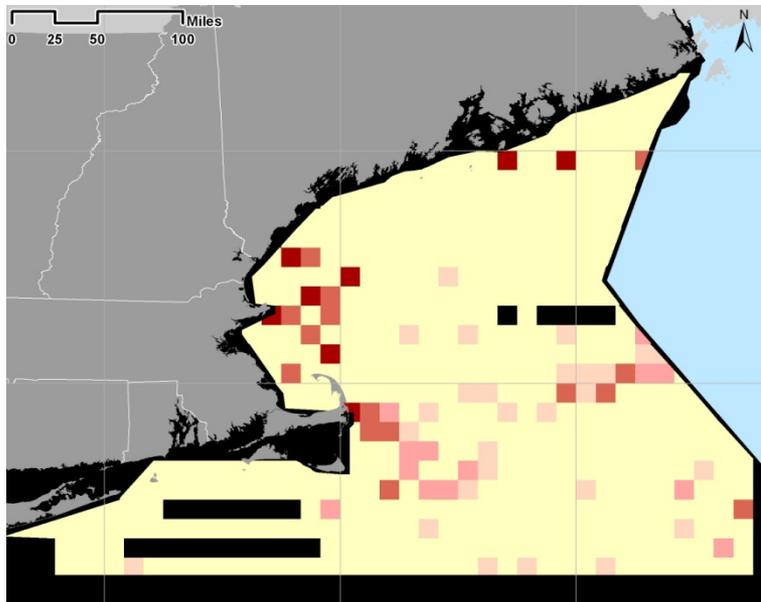
Right Whale



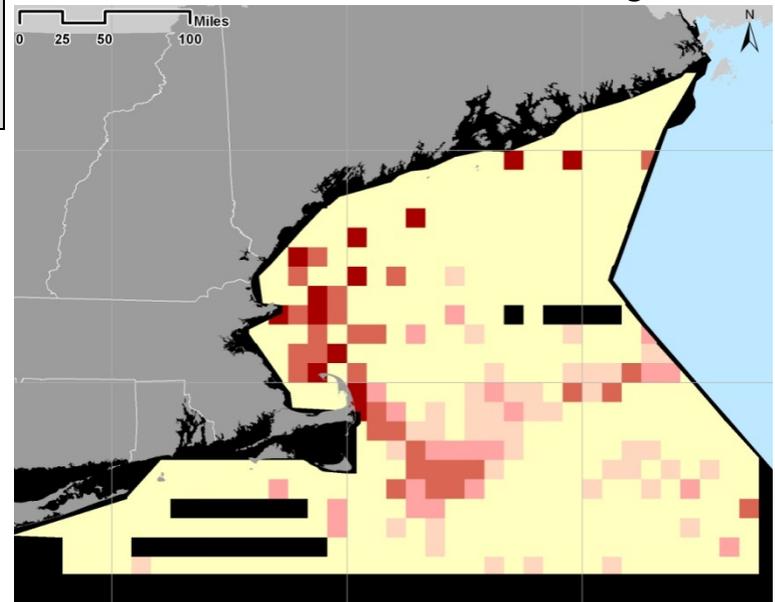
Humpback Whale



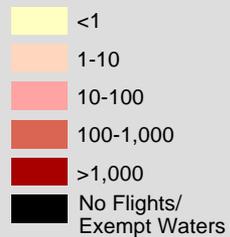
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Combined Whales (unweighted)



Co-occurrence Score
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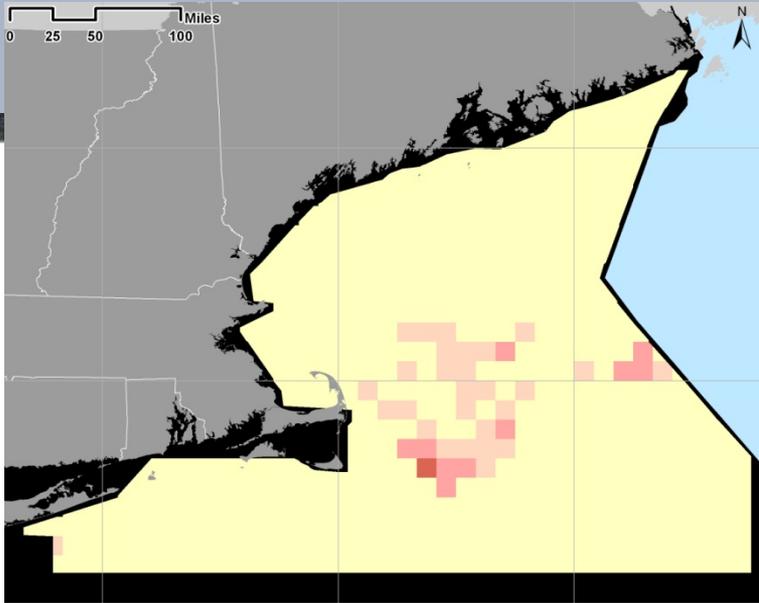
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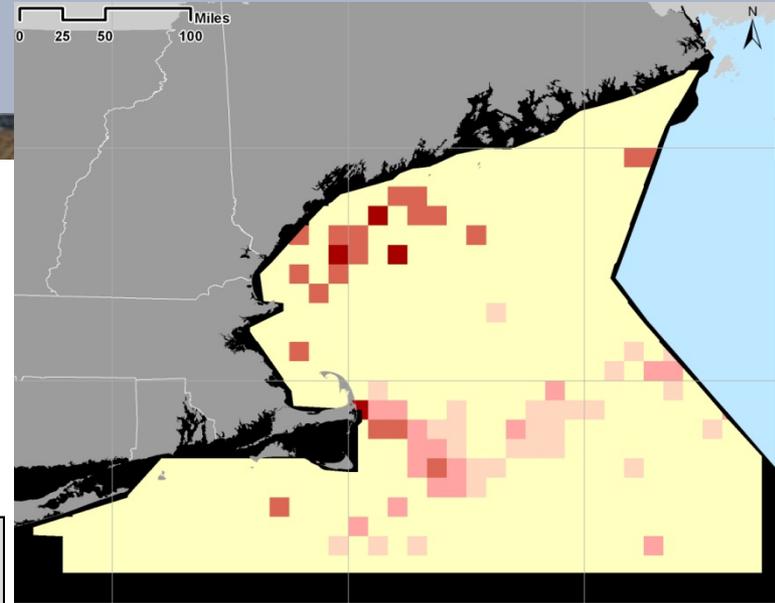
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June Co-occurrence, All Fisheries

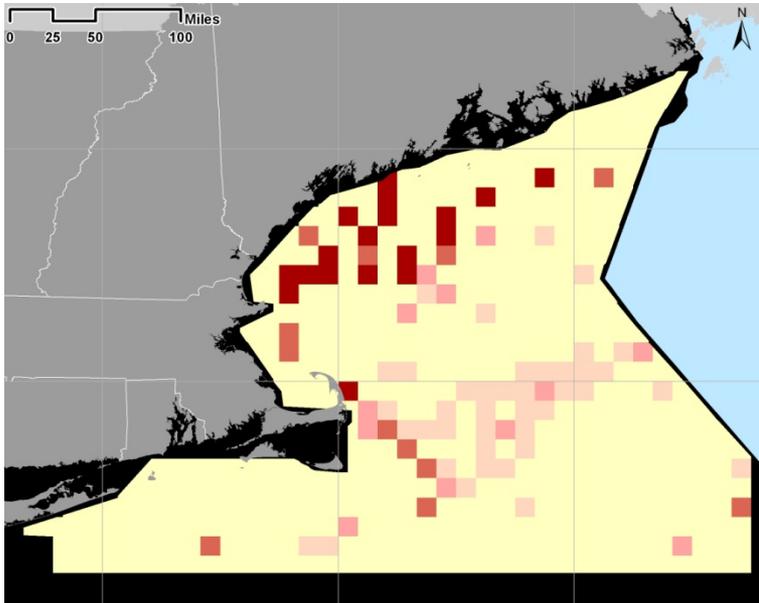
Right Whale



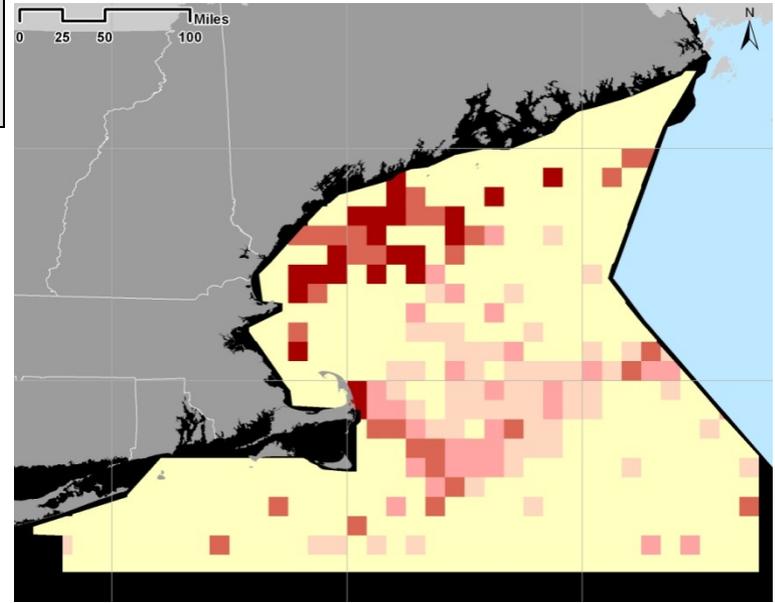
Humpback Whale



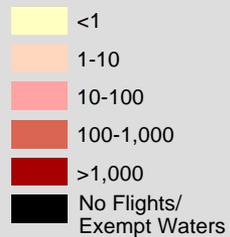
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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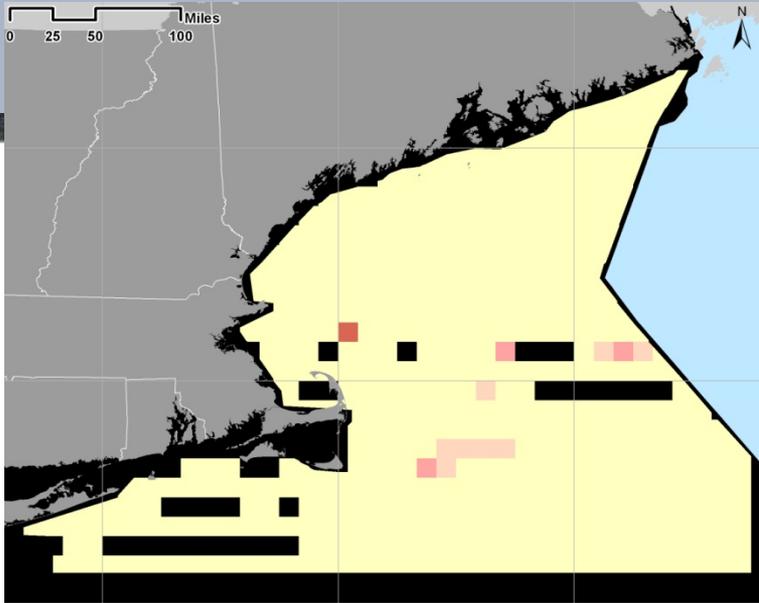
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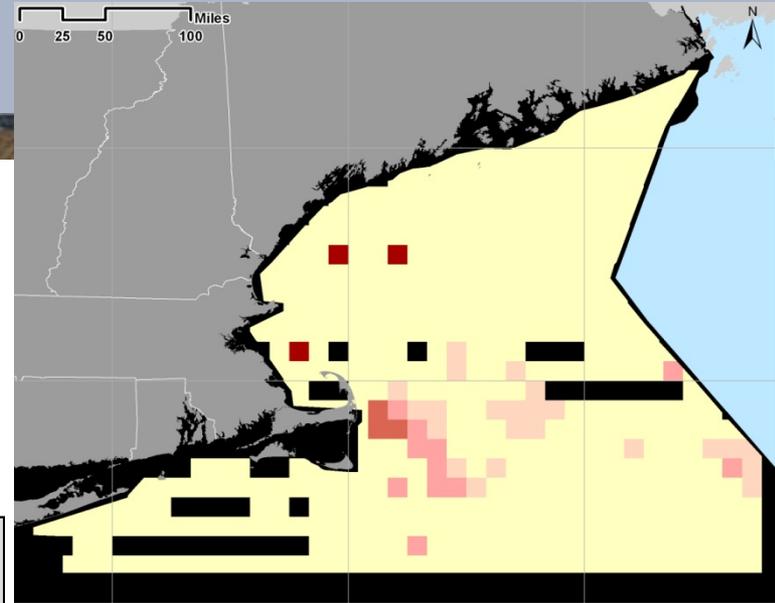
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July Co-occurrence, All Fisheries

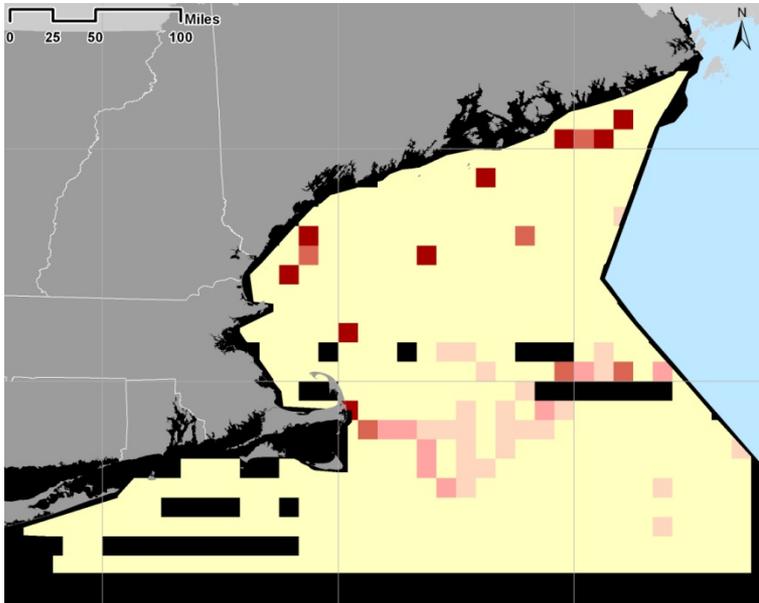
Right Whale



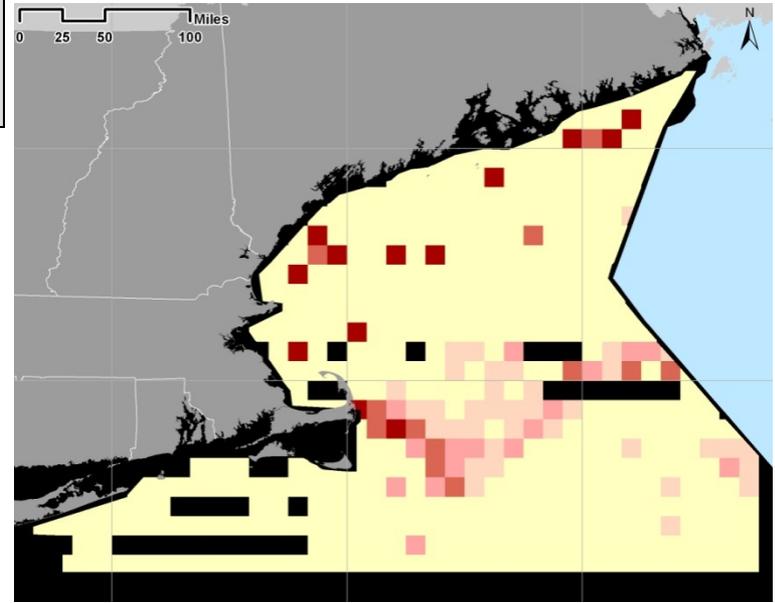
Humpback Whale



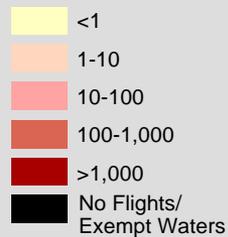
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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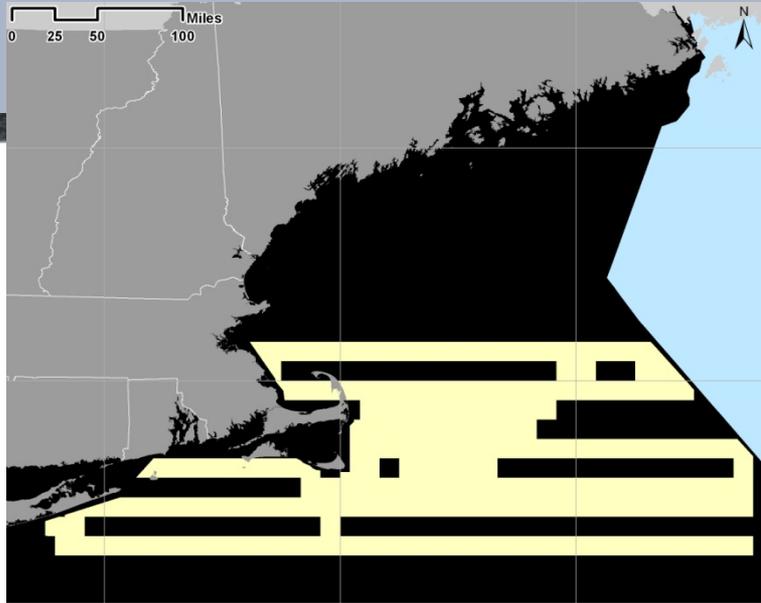
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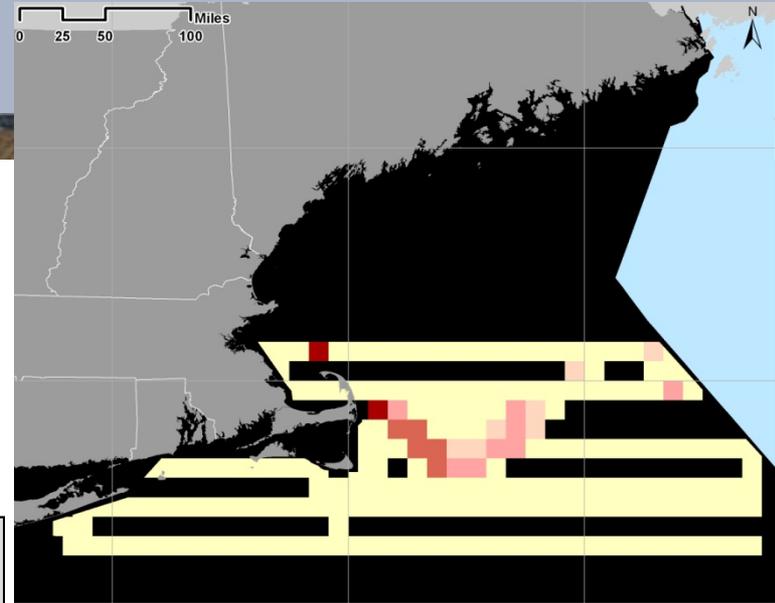
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August Co-occurrence, All Fisheries

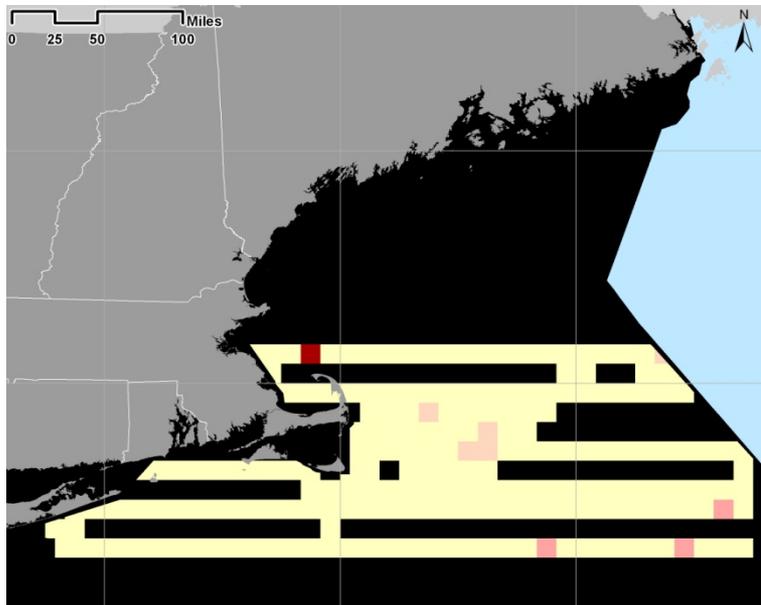
Right Whale



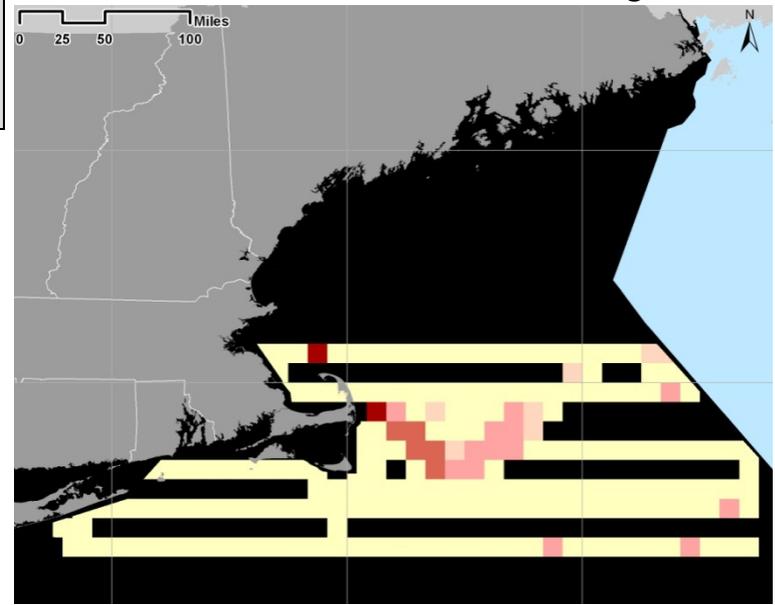
Humpback Whale



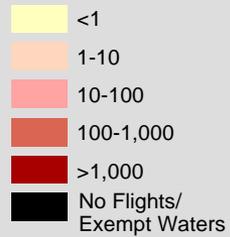
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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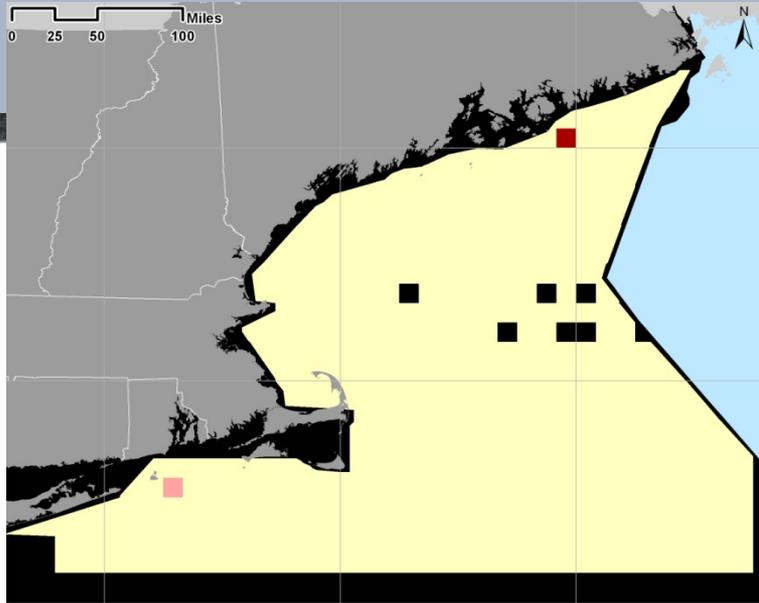
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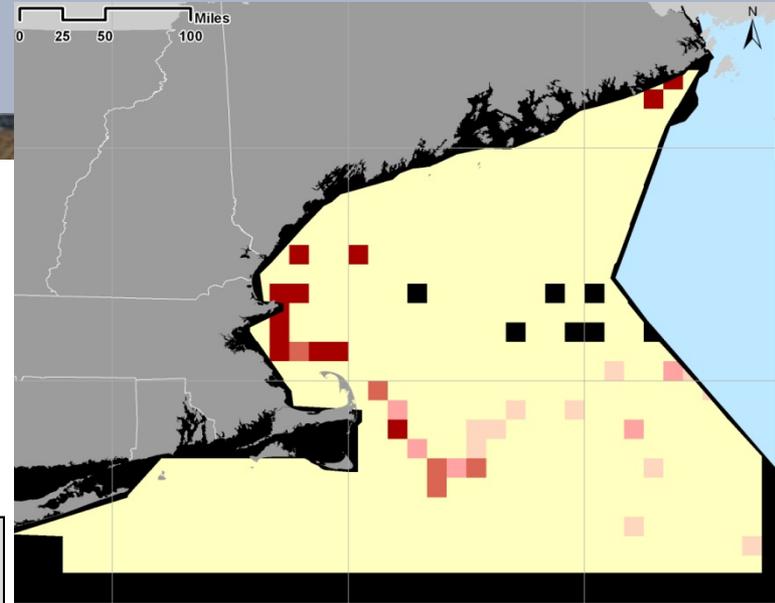
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September Co-occurrence, All Fisheries

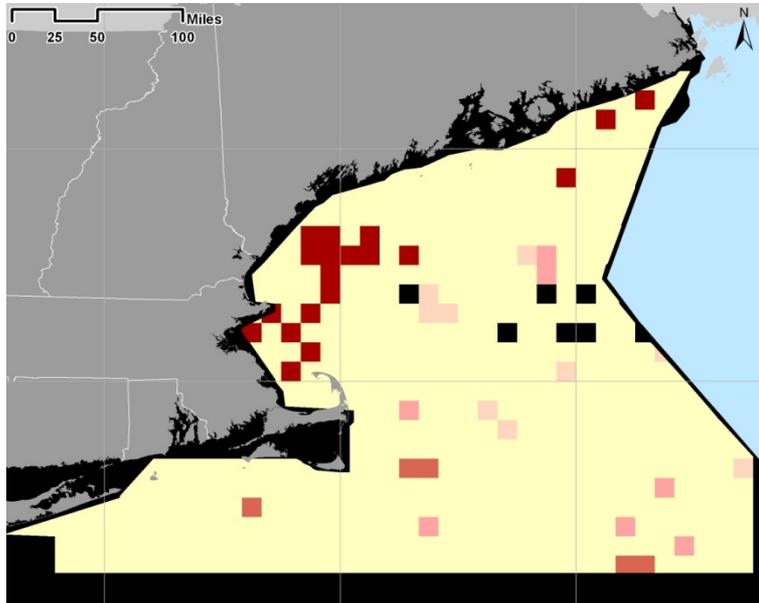
Right Whale



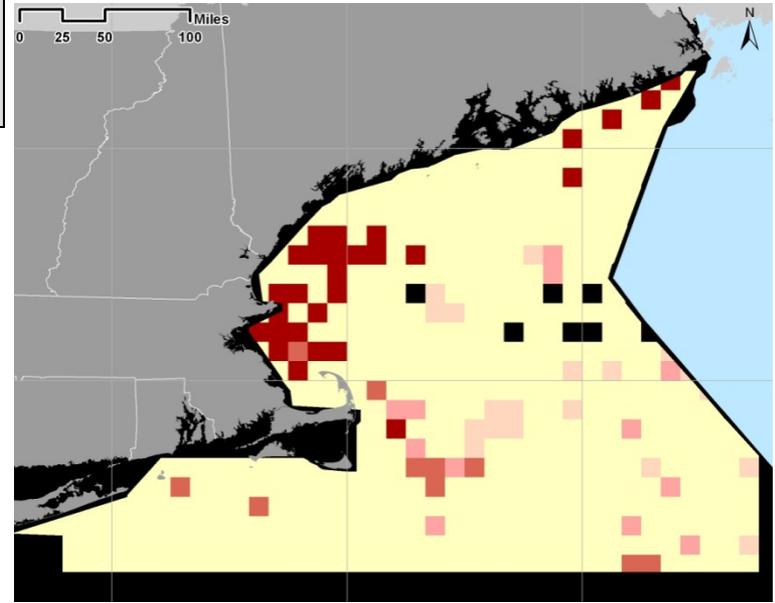
Humpback Whale



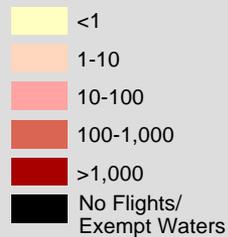
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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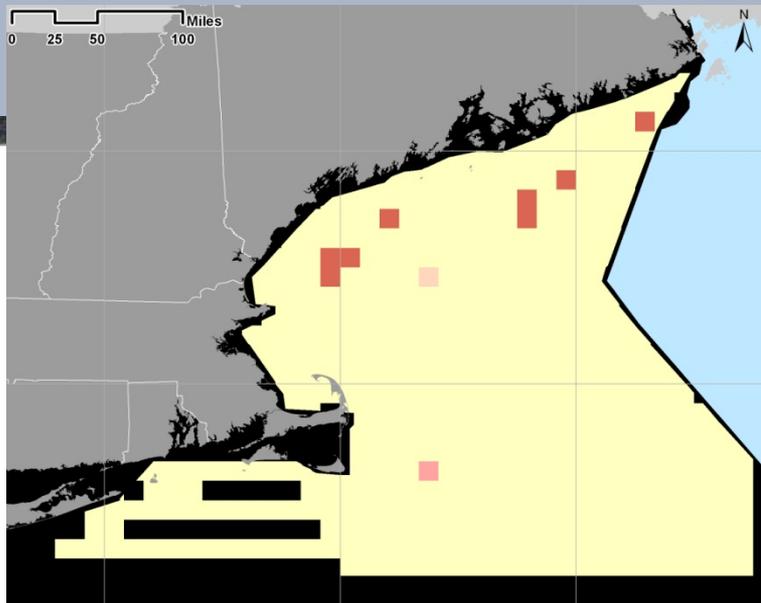
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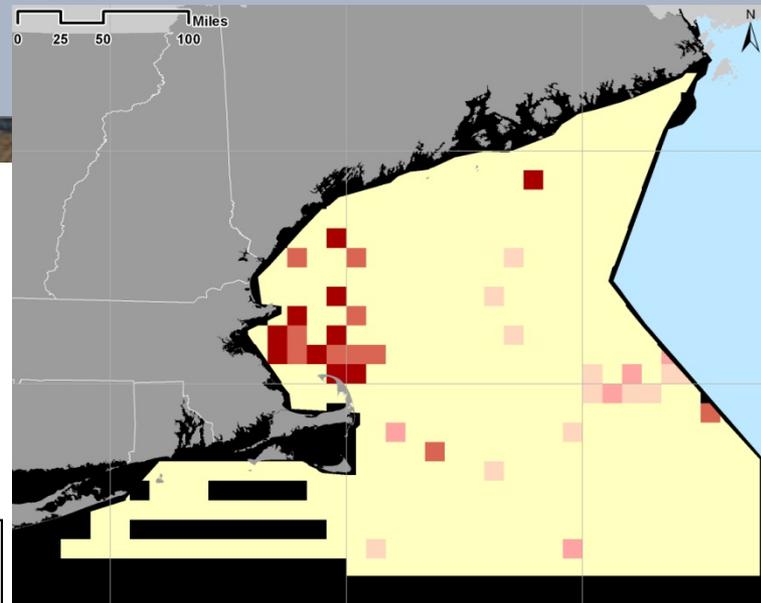
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October Co-occurrence, All Fisheries

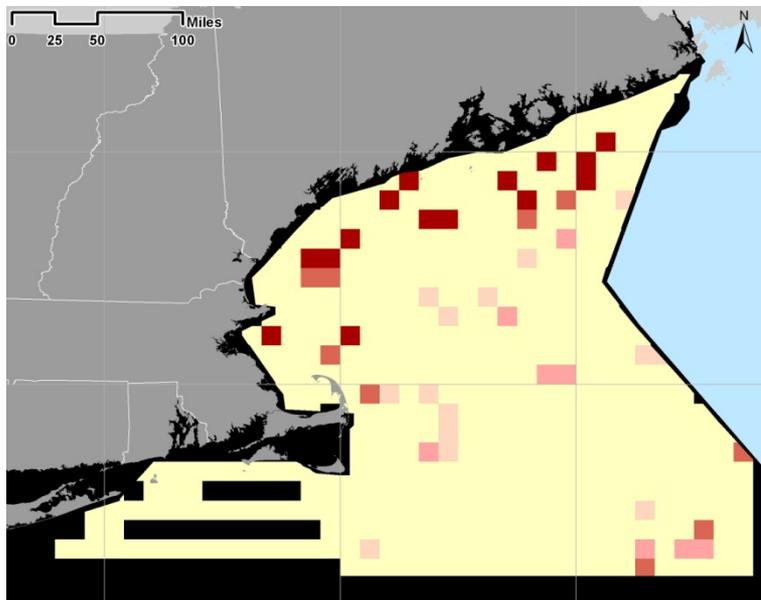
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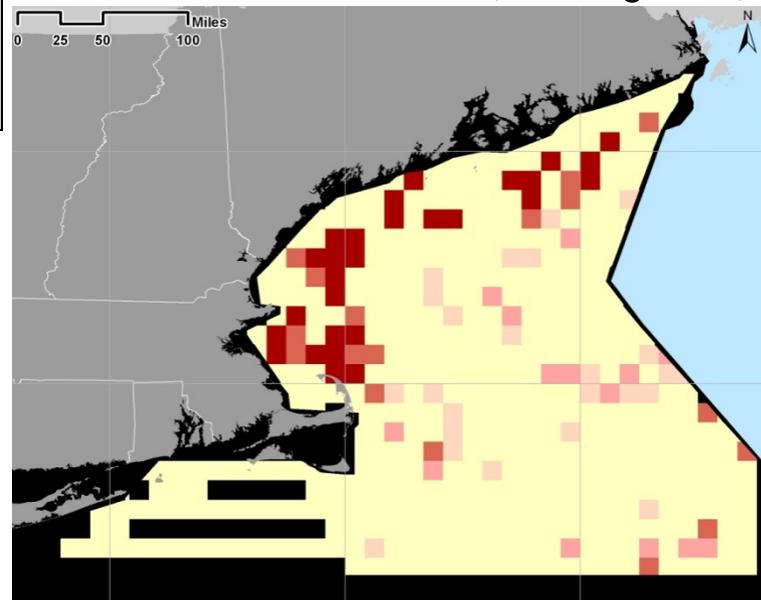
Humpback Whale



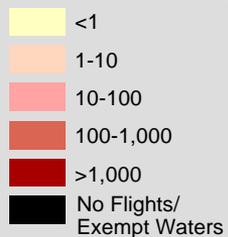
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
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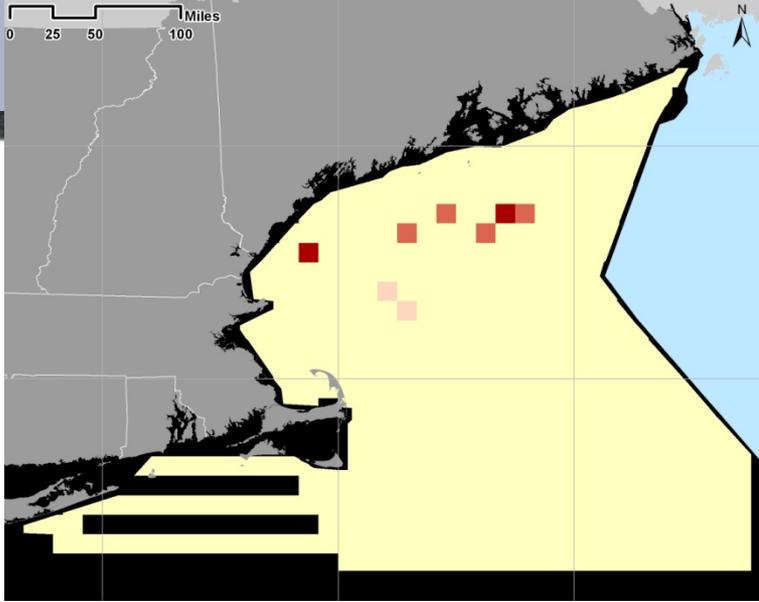
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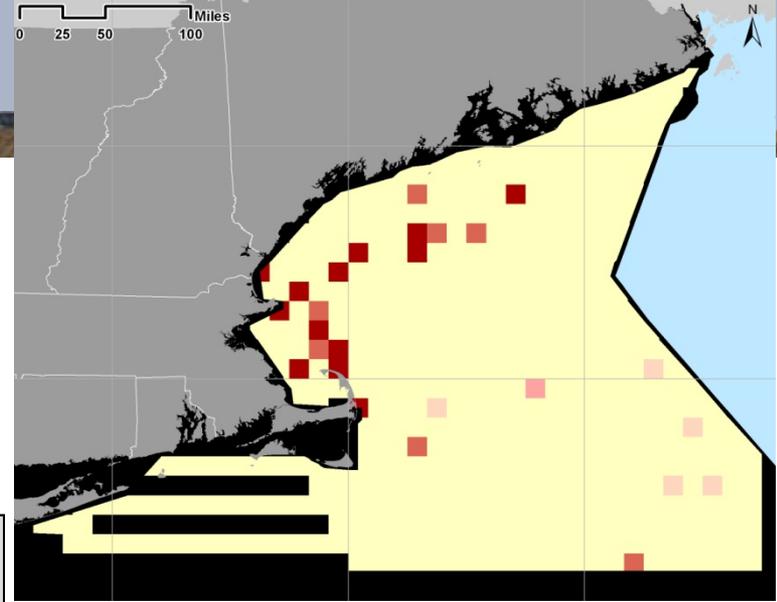
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November Co-occurrence, All Fisheries

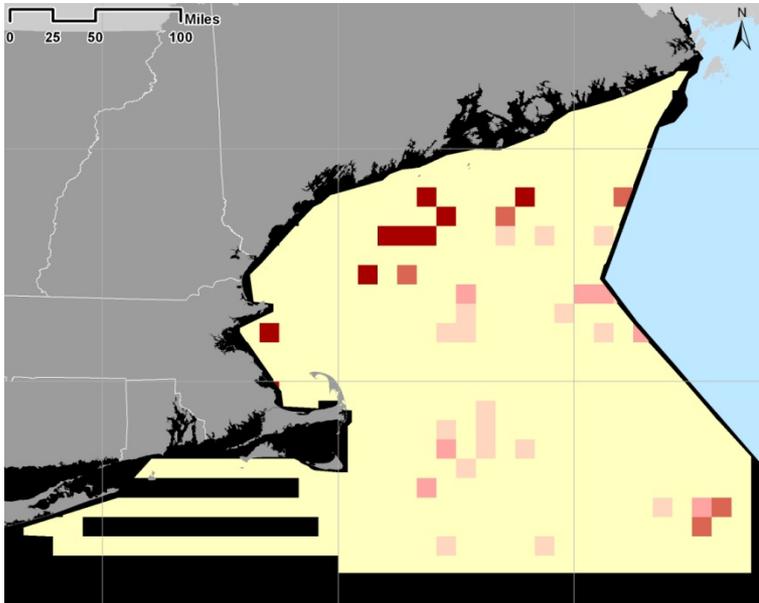
Right Whale



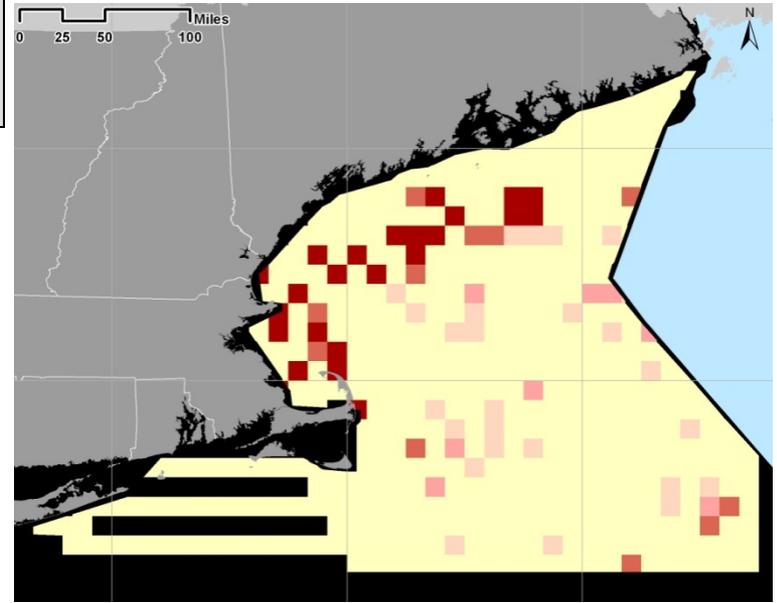
Humpback Whale



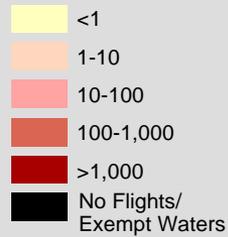
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
(Scaled 0-1,000,000)



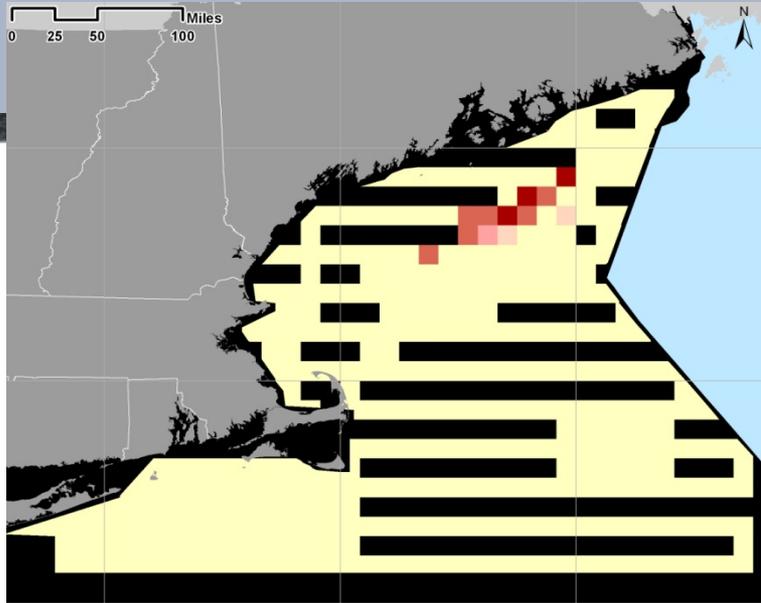
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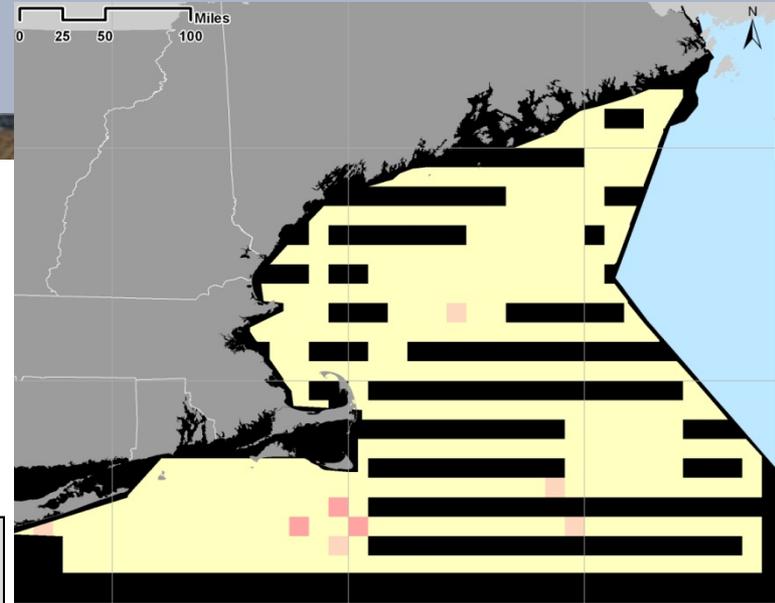
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December Co-occurrence, All Fisheries

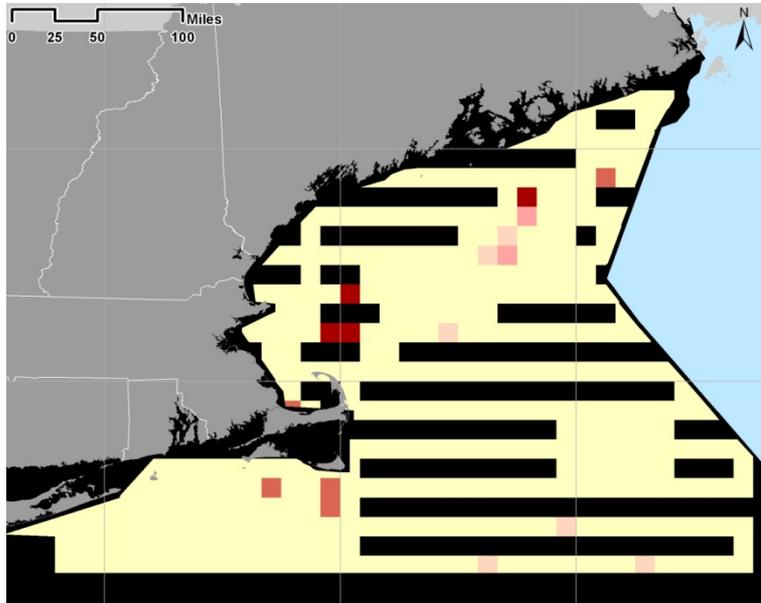
Right Whale



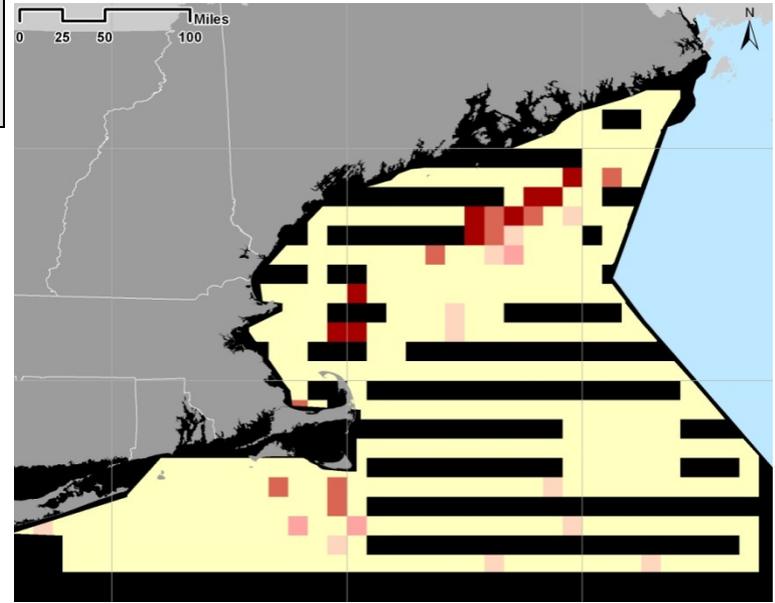
Humpback Whale



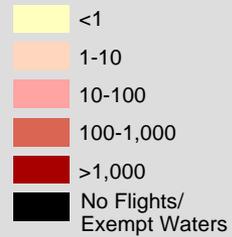
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
(Scaled 0-1,000,000)



Note: Based on
2002-2007 SPUE
data and 2008
vessel activity
data.

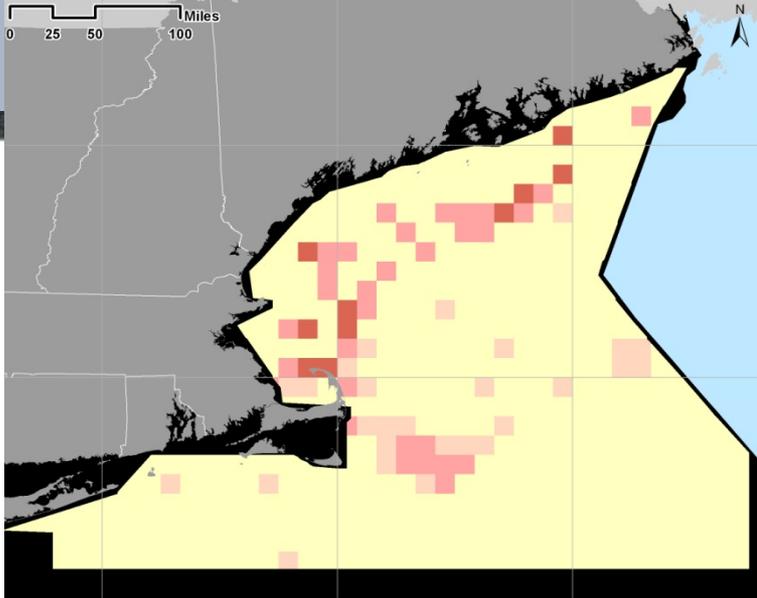
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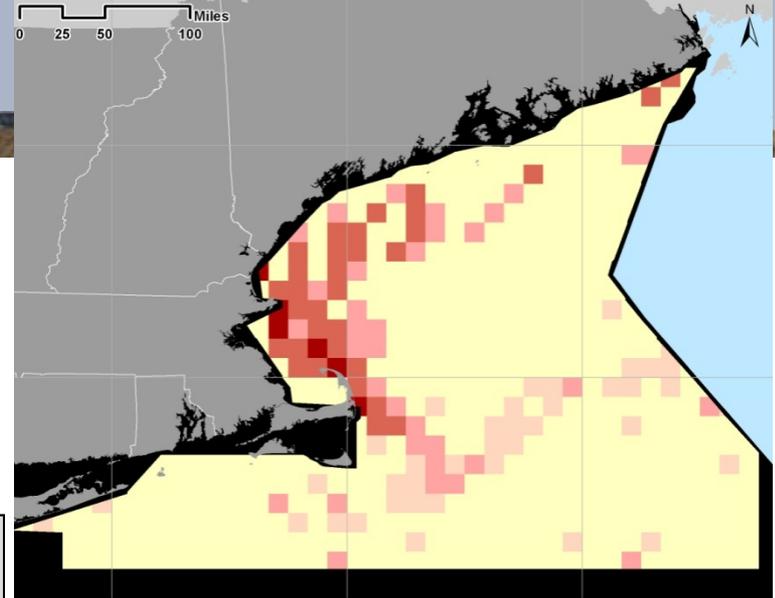
NOAA FISHERIES SERVICE, NORTHEAST REGIONAL OFFICE

Average Annual Co-occurrence, All Fisheries

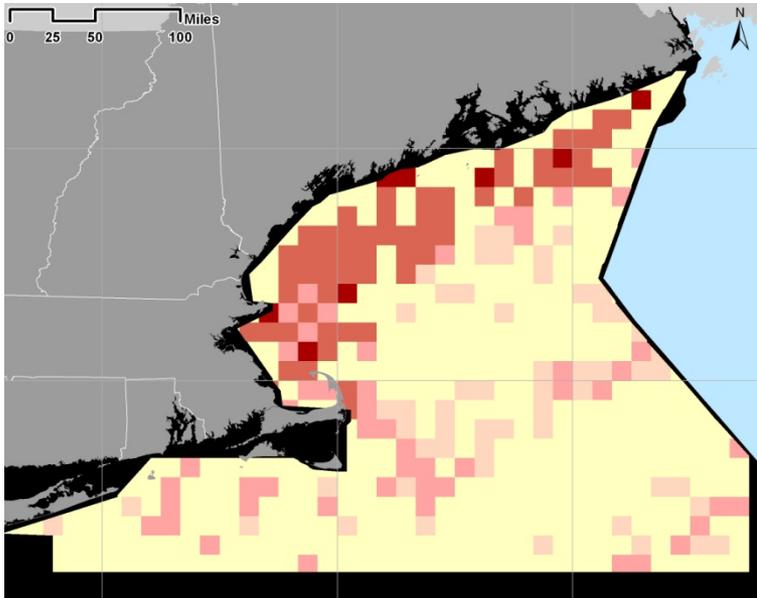
Right Whale



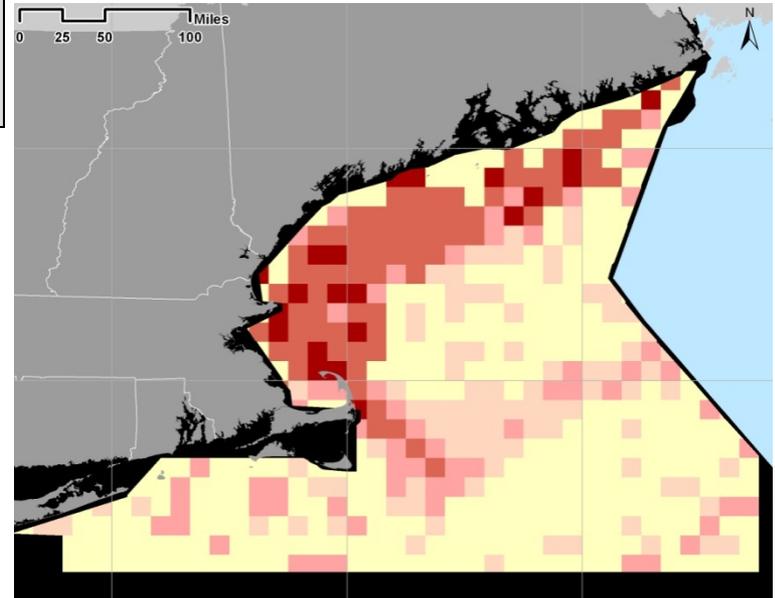
Humpback Whale



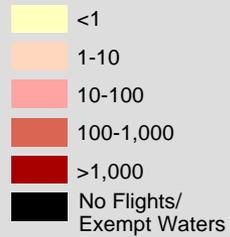
Fin Whale



Combined Whales (unweighted)



Co-occurrence Score
(Scaled 0-1,000,000)



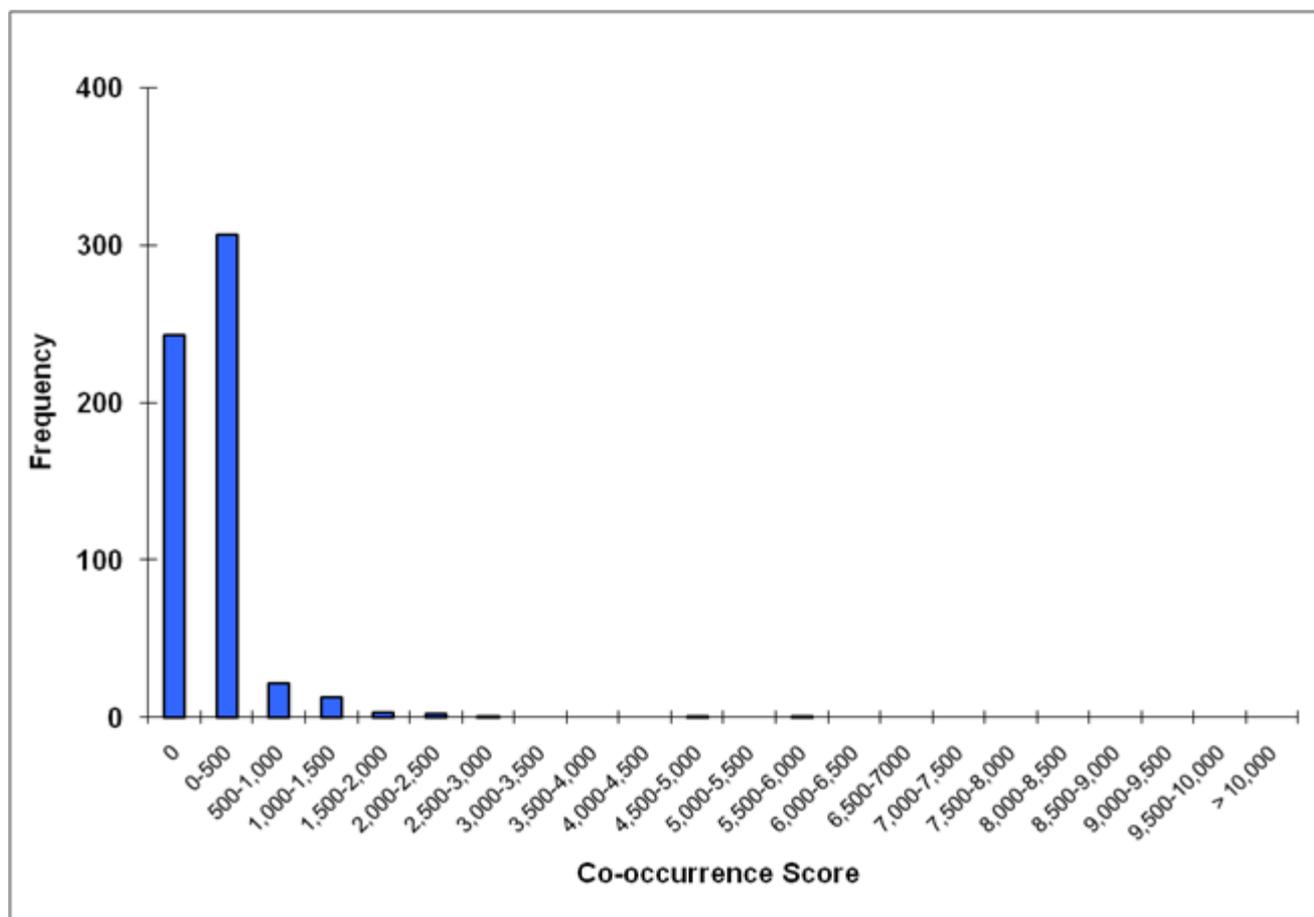
Note: Based on
2002-2007 SPUE
data and 2008
vessel activity
data.

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Distribution of Average Annual Co-Occurrence Scores, All Species Combined



General Observations

- Notable concentrations of higher co-occurrence scores by species:
 - Right whales: from April to June in portions of the Great South Channel and off of Cape Cod, and from October to December in LMA 1.
 - Humpbacks: off of Cape Cod and in parts of Massachusetts Bay from late spring into fall, and in LMA 1 in both late spring and early to mid-fall.
 - Fin whales: at various points within LMA 1.

General Observations

- Notable concentrations of higher co-occurrence scores/all species:
 - In the spring and summer in parts of Massachusetts Bay, northeast of Cape Ann, and in the Great South Channel.
 - At various points in LMA 1 in the spring, summer and fall.
- On average, LMA 1 and the Outer Cape LMA show greater concentrations of relatively high co-occurrence scores than other areas.
- Within LMA 3, the former Seasonal Area Management zone also contains contiguous areas of positive co-occurrence scores; these scores are generally lower than those in the areas noted above.
- Elsewhere, the areas showing positive co-occurrence scores are generally smaller, and the average scores are relatively low.