

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

Prepared for Atlantic Large Whale Take Reduction Team
April 2011

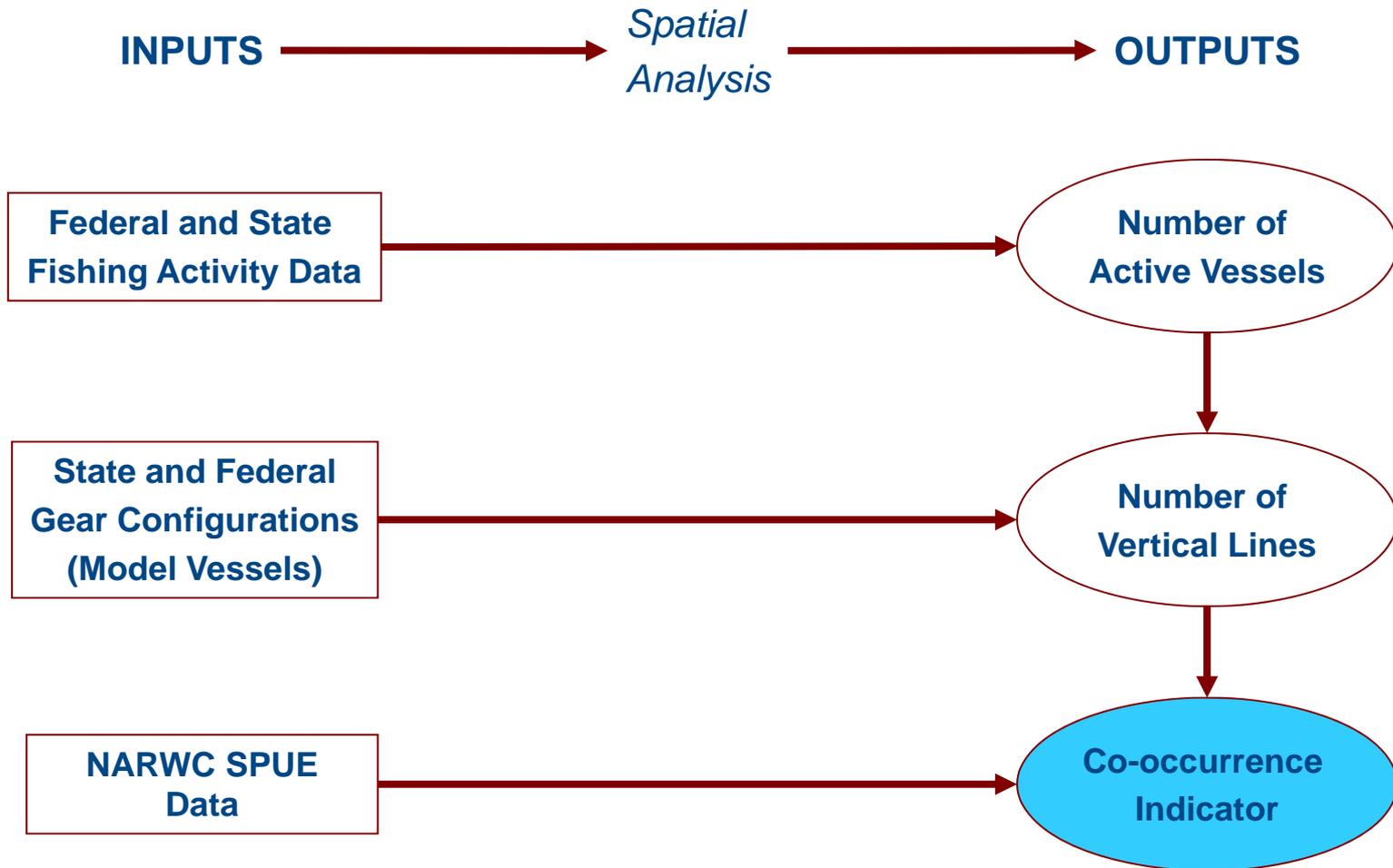
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NMFS / Northeast Regional Office

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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.

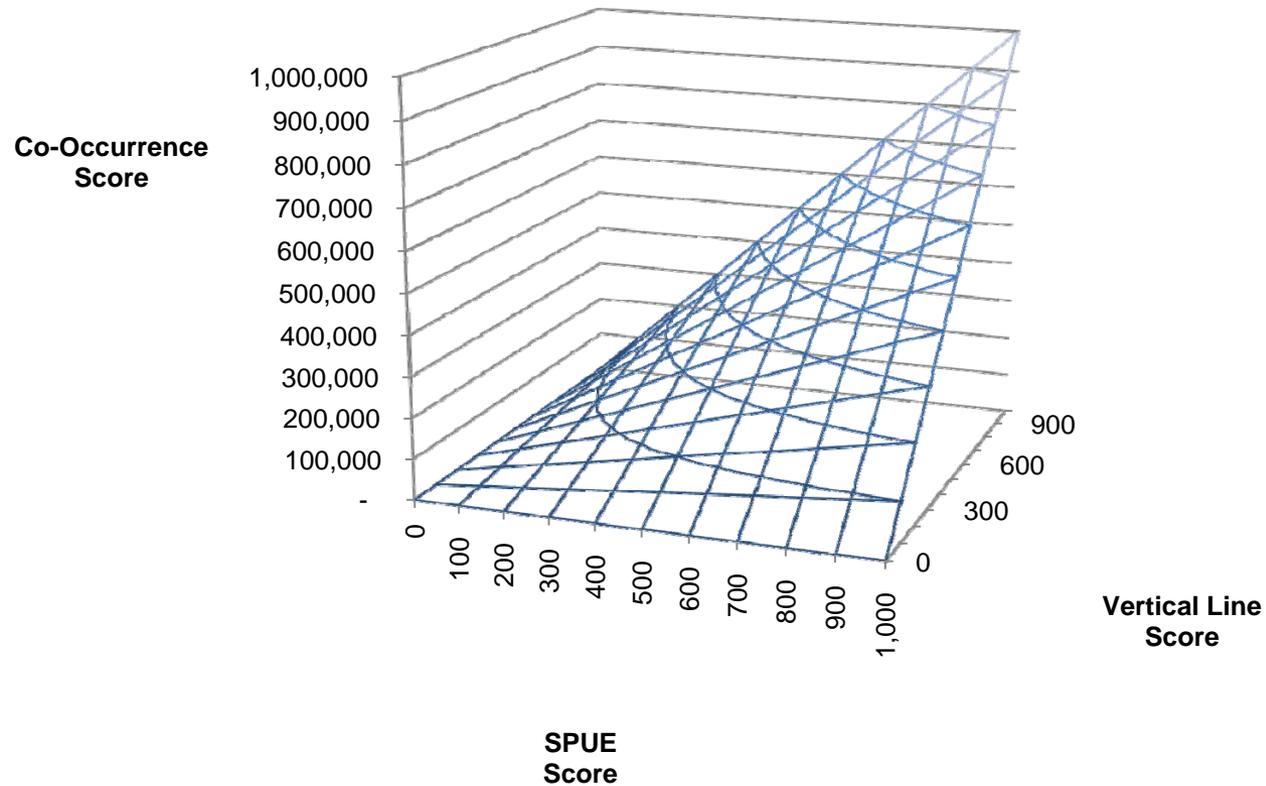
Co-Occurrence as an Indicator of Entanglement Risks

- 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, effort-corrected data on whale sightings 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 sightings score and the vertical line score; the maximum feasible co-occurrence score is 1,000,000 ($1,000_{\text{Sightings}} \times 1,000_{\text{VL}} = 1,000,000_{\text{CO}}$).

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 NARWC sightings 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.

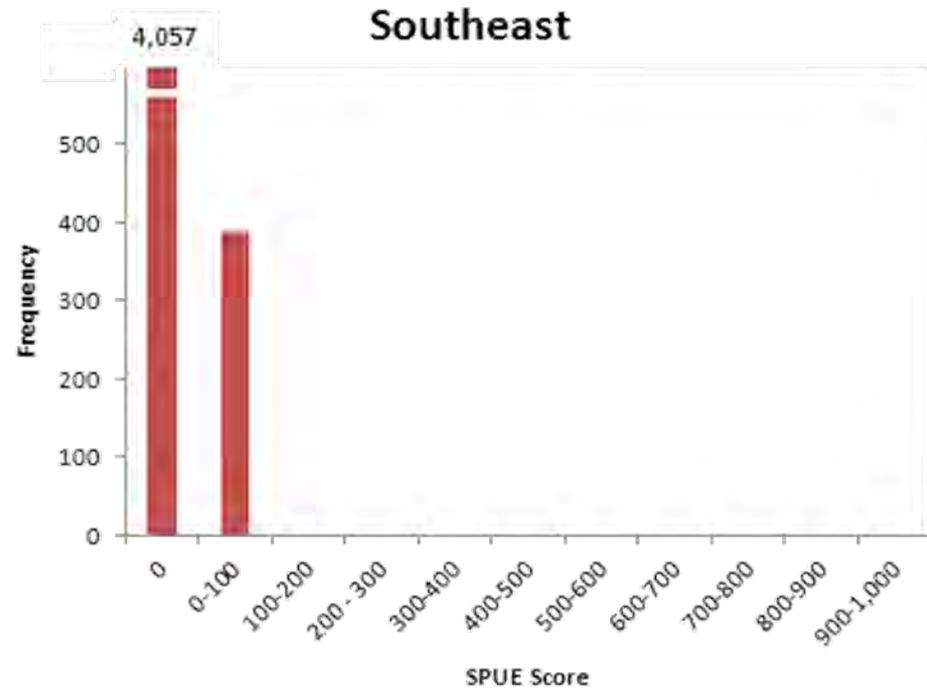
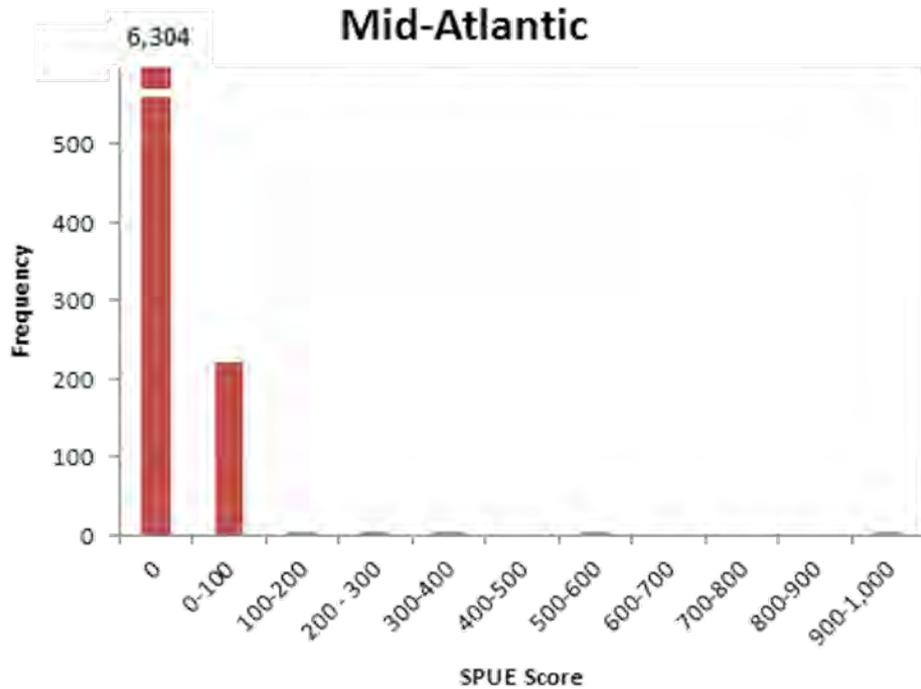
Baseline Co-Occurrence Analysis: All Species Combined

- Model produces more than 16,000 co-occurrence scores, each representing a grid cell and month for which both a whale sightings and vertical line score are reported.
- Distribution of scored observations by region:
 - Northeast: 5,742
 - Mid-Atlantic: 6,537
 - Southeast: 4,446
- Maximum scores in each region:
 - Northeast: 20,061 (July/Lobster Management Area 1)
 - Mid-Atlantic: 890 (May/Federal waters off Delmarva Peninsula)
 - Southeast: 531 (February/Northern Florida)

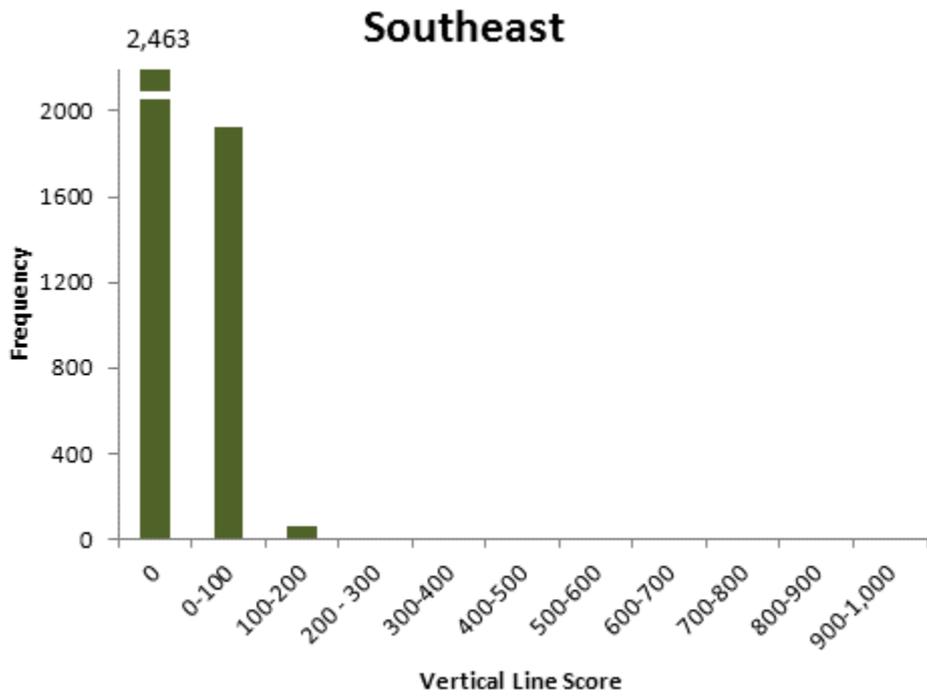
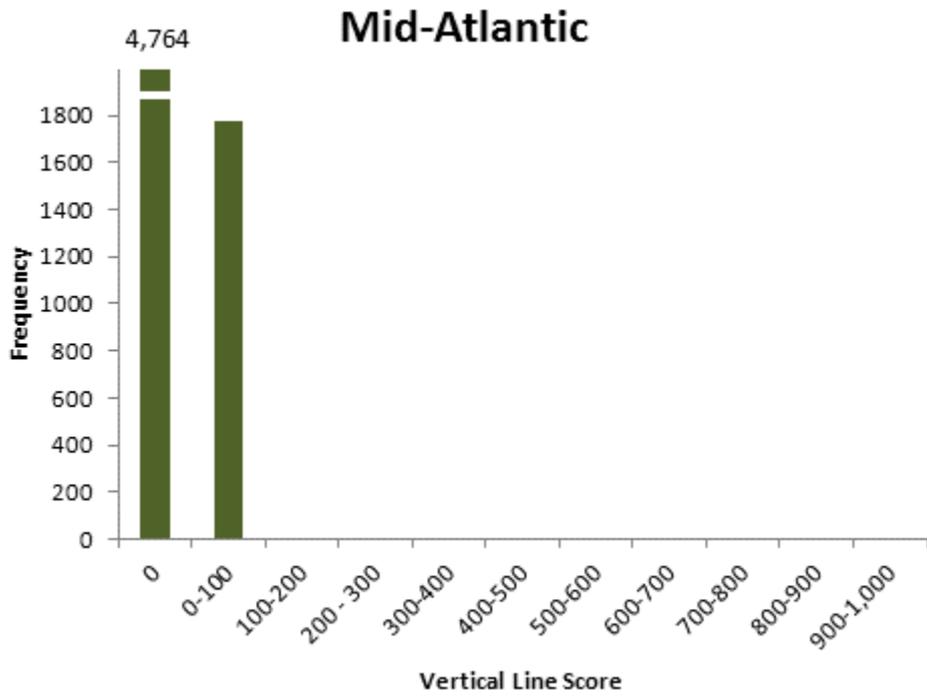
Baseline Co-Occurrence Analysis: All Species Combined

- The distribution of scores in the Mid-Atlantic and Southeast is heavily skewed toward zero.
- Percentage of non-zero scores by region:
 - Mid-Atlantic: approximately 1 percent;
 - Southeast: approximately 6 percent.
- The distribution of co-occurrence scores reflects the underlying distribution of whale sightings and vertical line scores.

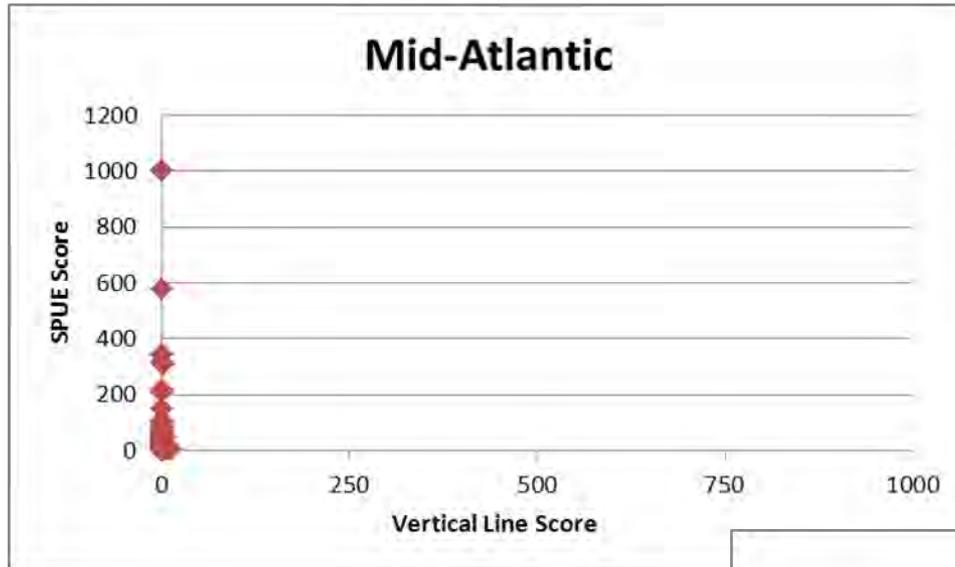
Distribution of Monthly Whale Sightings Scores: All Species Combined



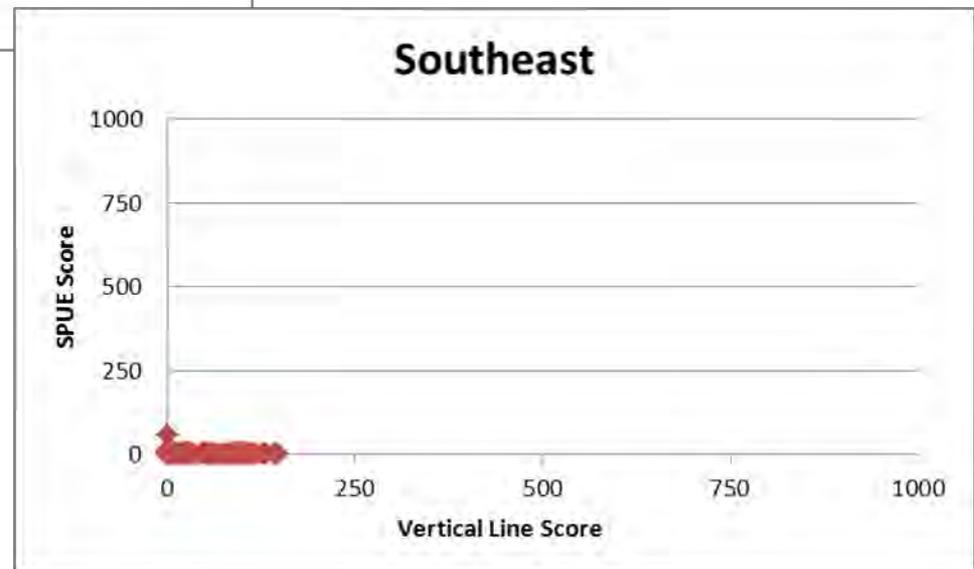
Distribution of Monthly Vertical Line Scores



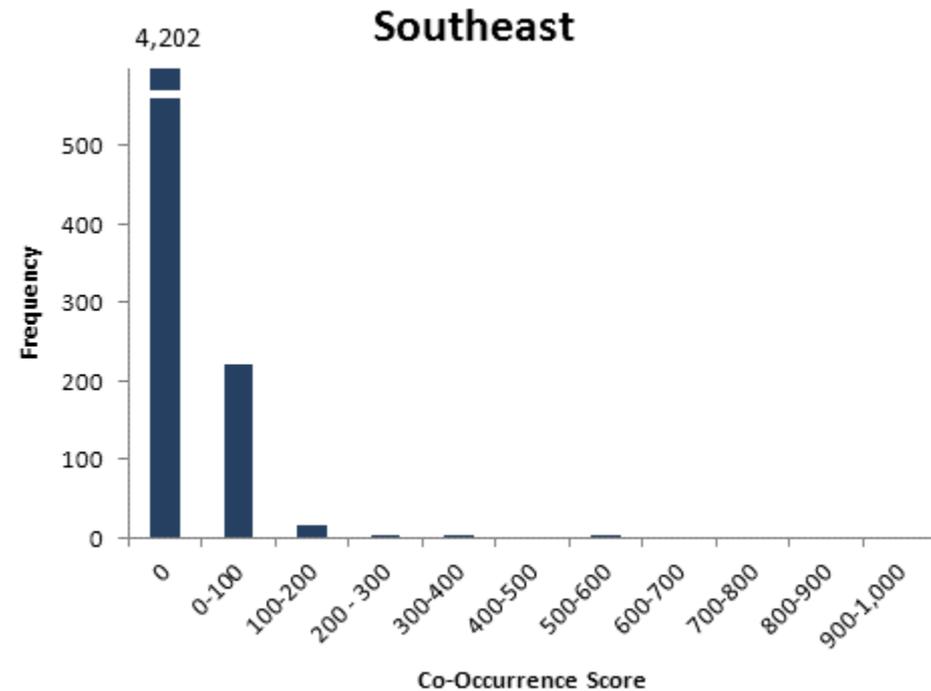
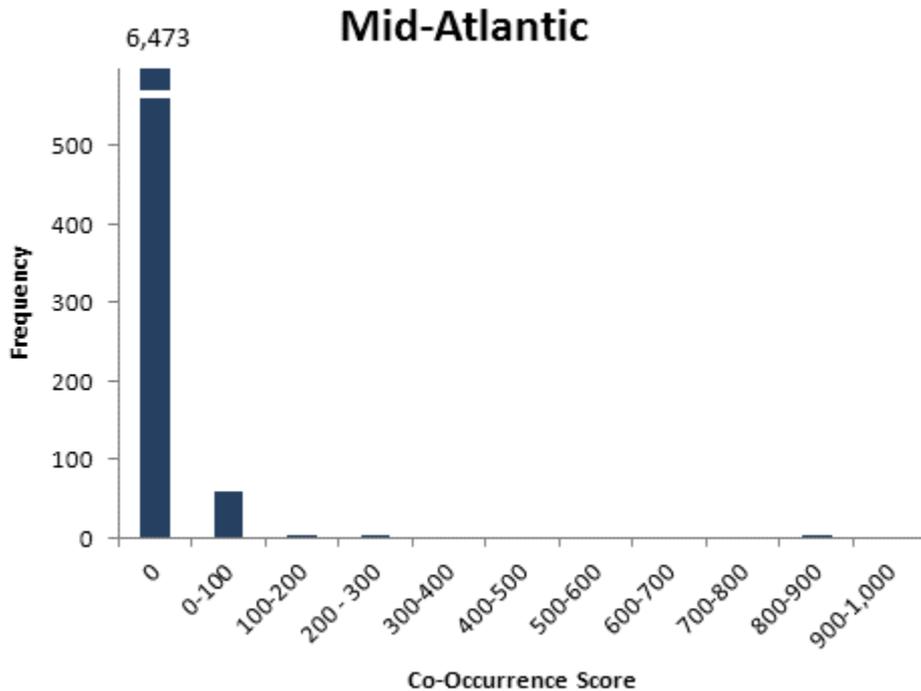
Scatter Plot of Monthly Whale Sightings (All Species) and Vertical Line Scores



* Excludes SPUE scores of 0



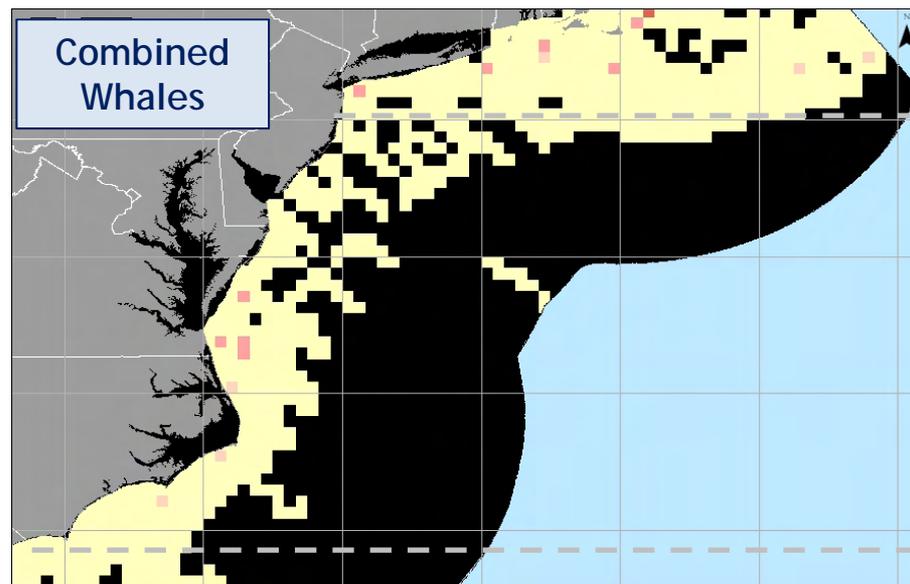
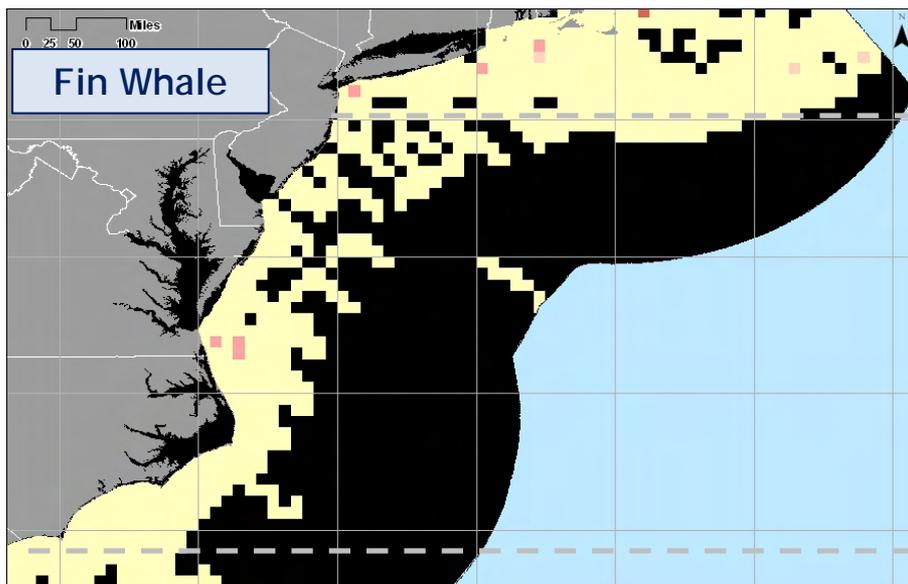
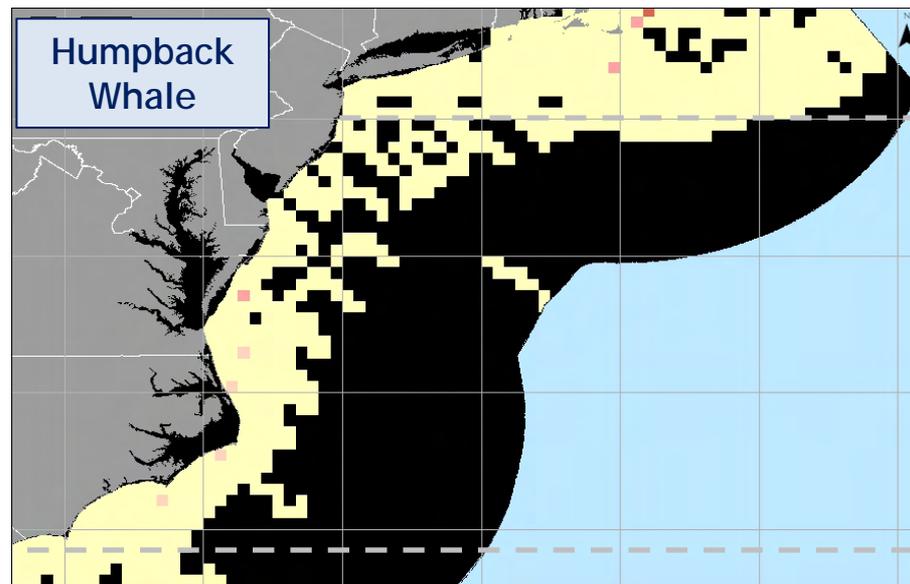
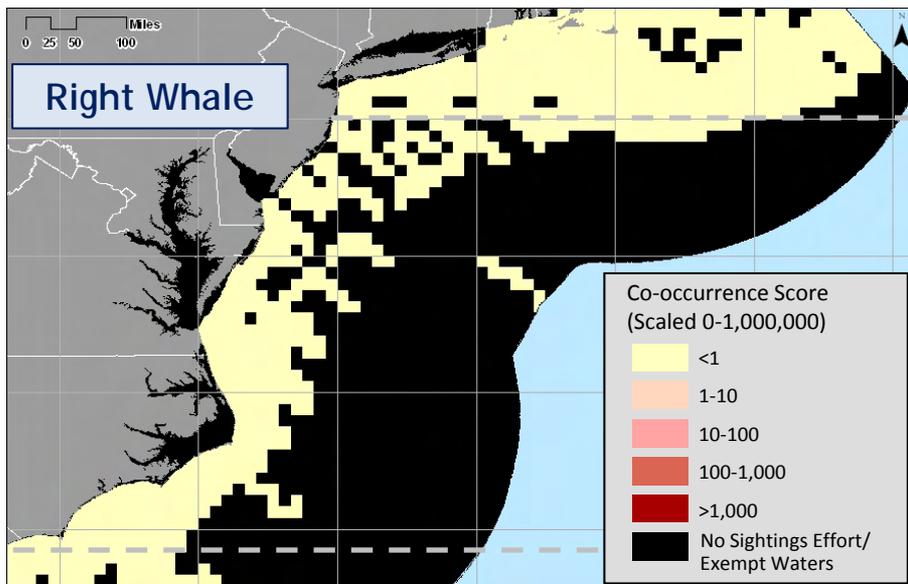
Distribution of Monthly Co-Occurrence Scores: All Species Combined



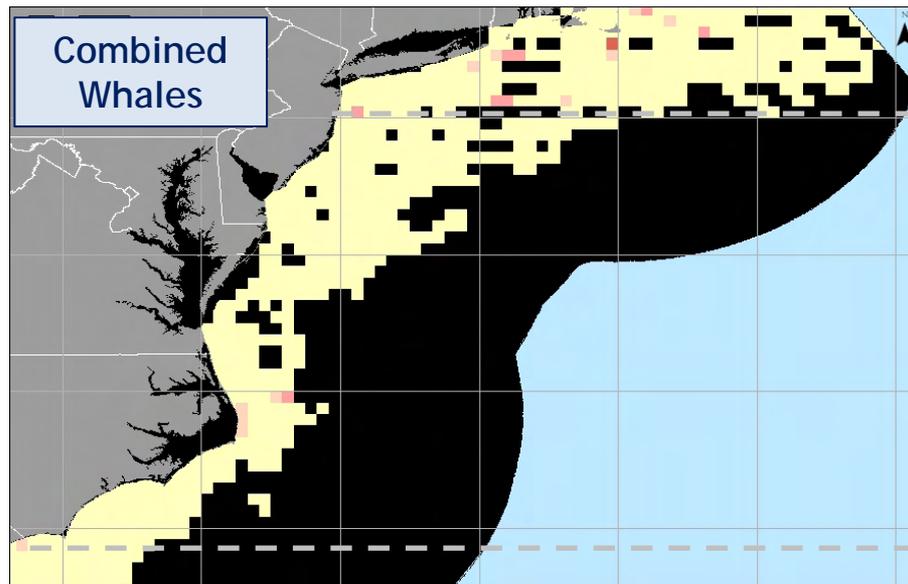
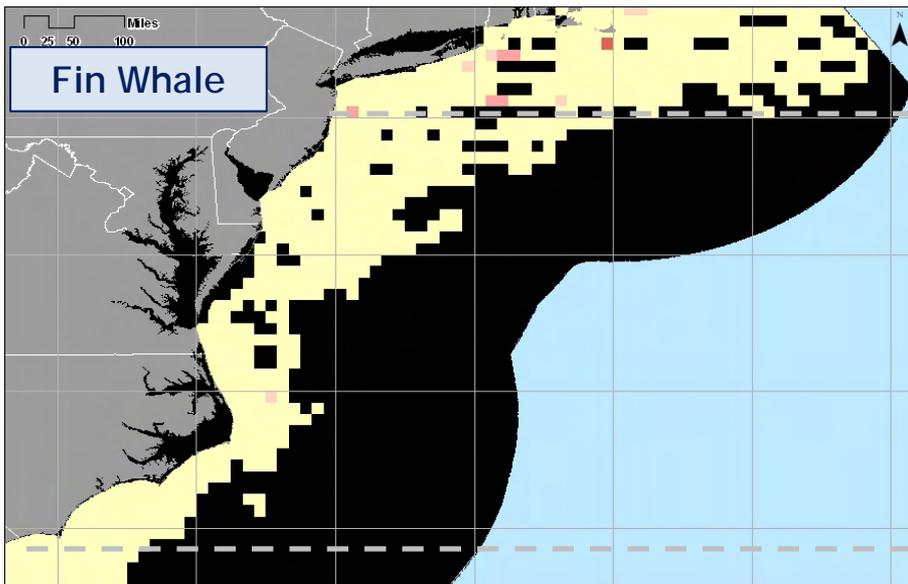
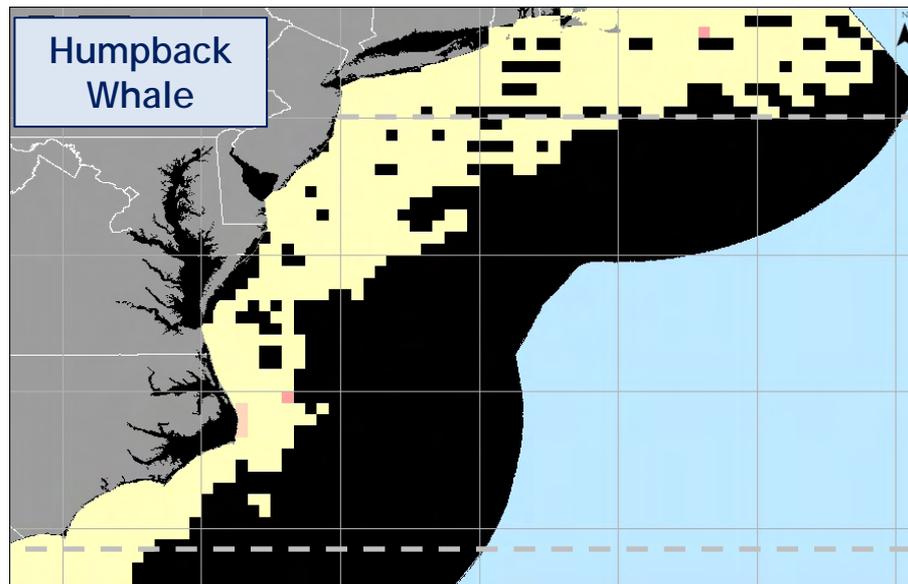
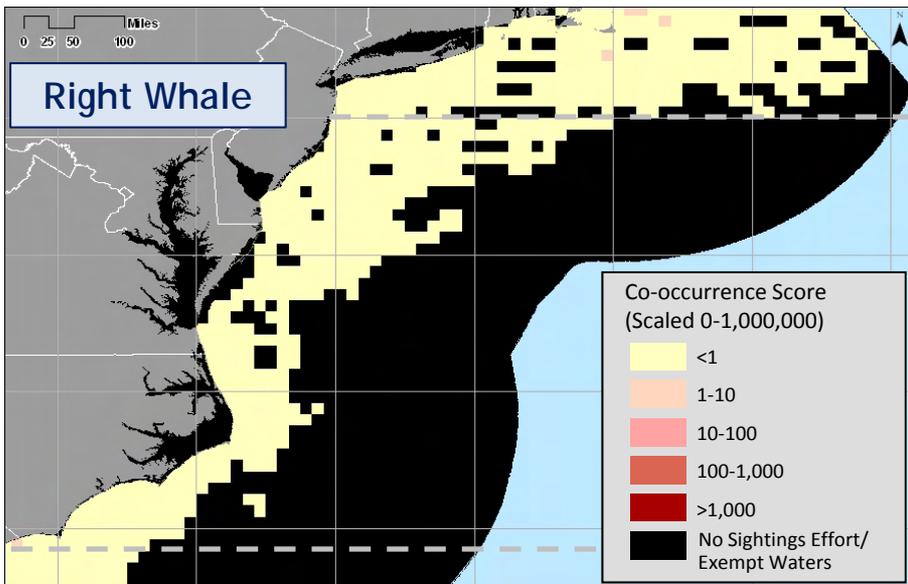
Spatial and Temporal Analysis of Co-Occurrence Scores

- The following maps illustrate the spatial distribution of co-occurrence scores by species and month in the Mid-Atlantic and Southeast.
- The monthly maps also illustrate the spatial distribution of co-occurrence scores for all species combined.
- Additional maps illustrate the average co-occurrence score, by species and for all species combined, for the following periods:
 - December through March;
 - November through April;
 - September through May;
 - Year-round.

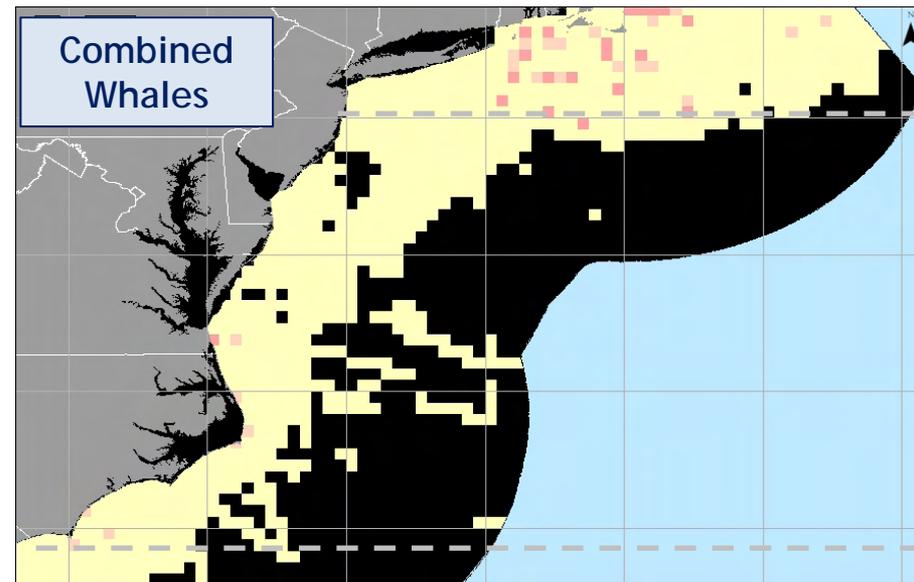
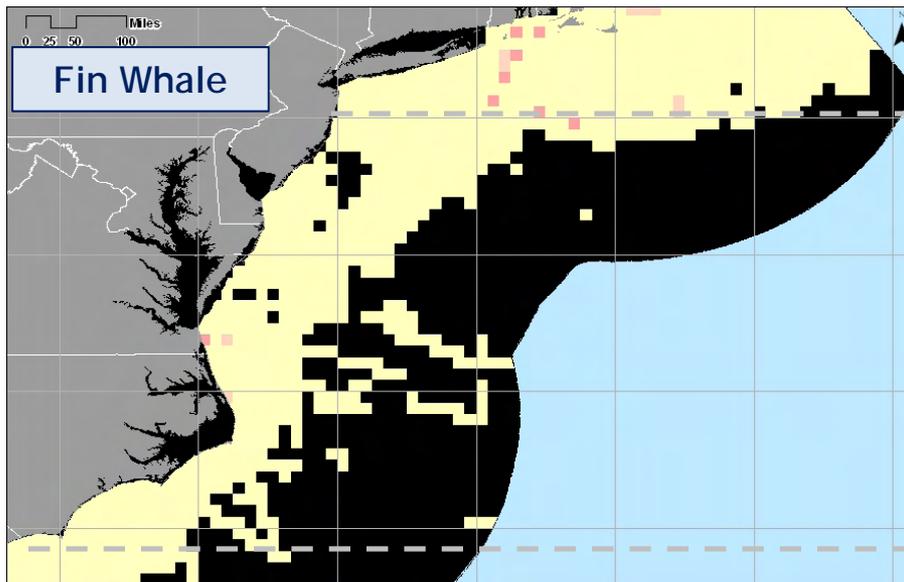
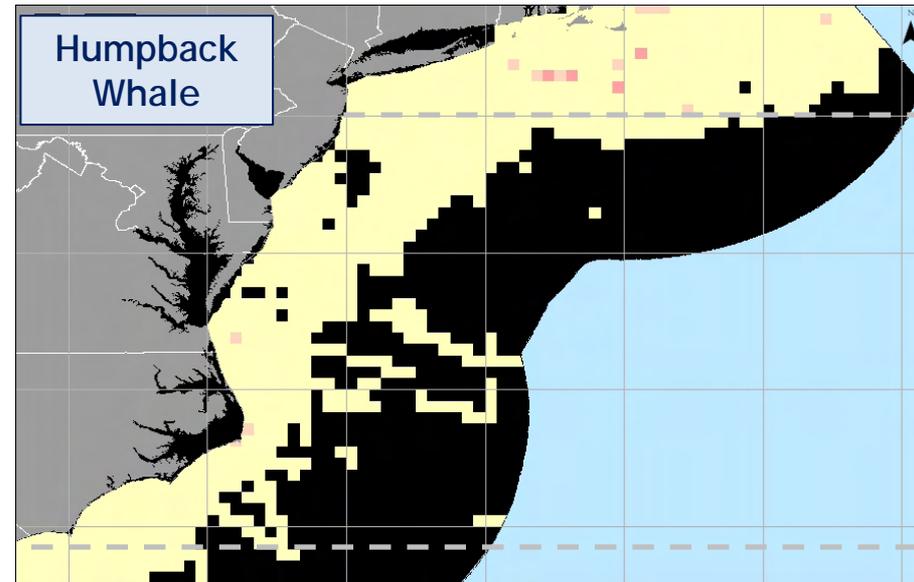
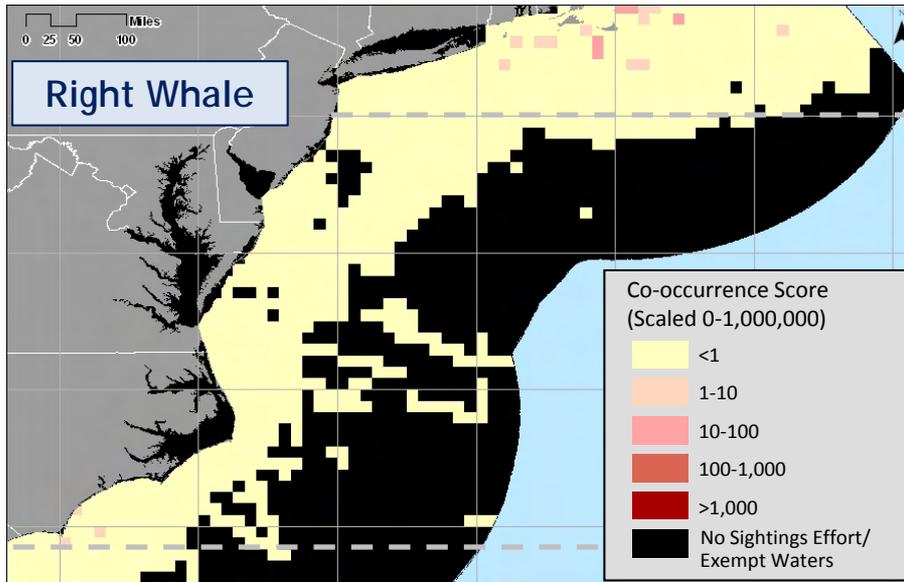
January Co-Occurrence: All Fisheries, Mid-Atlantic



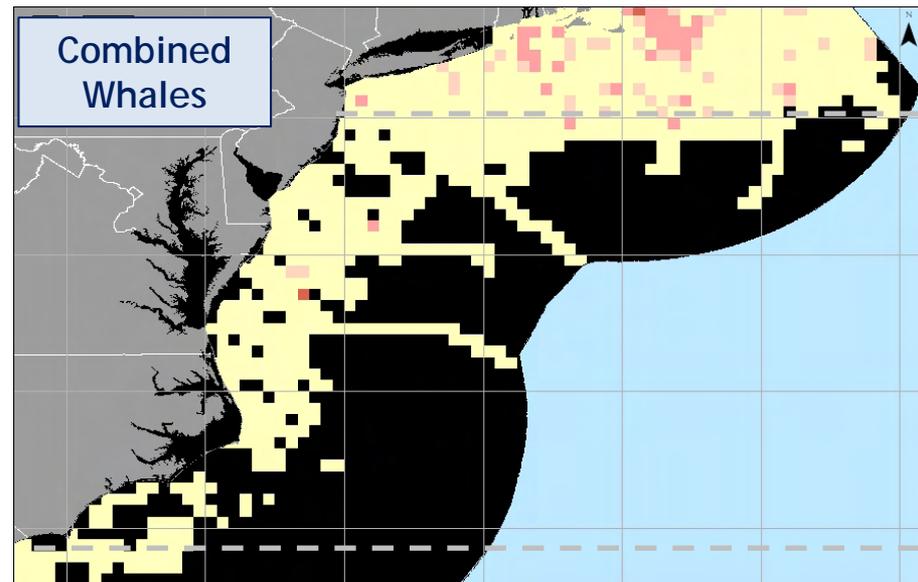
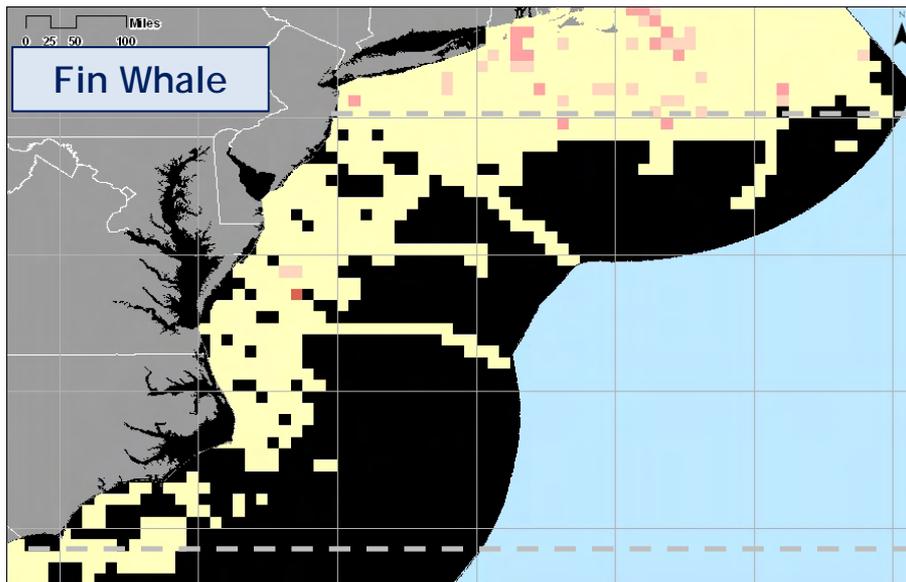
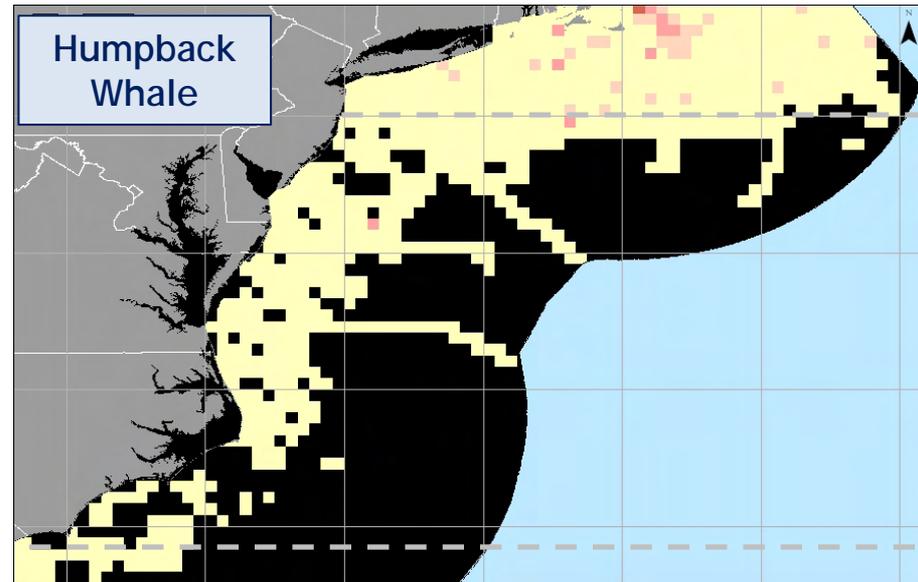
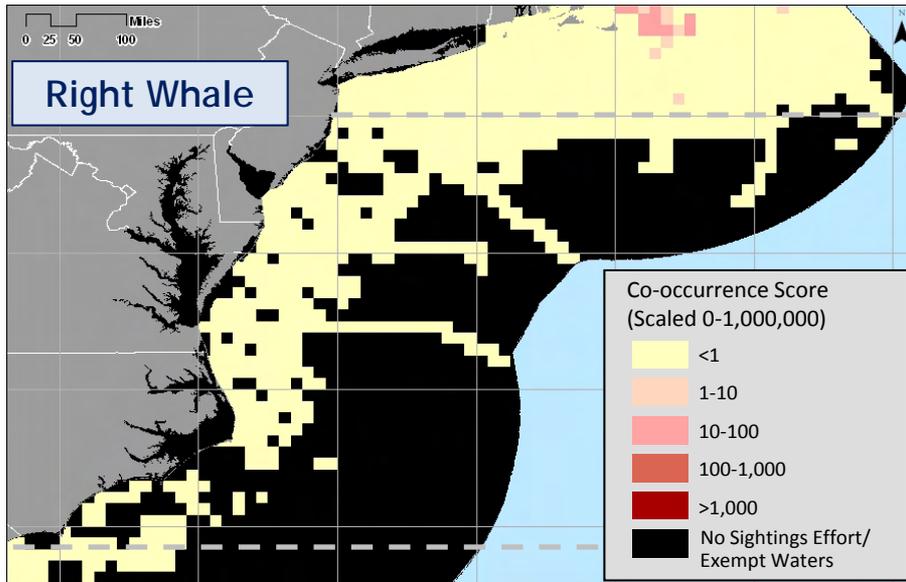
February Co-Occurrence: All Fisheries, Mid-Atlantic



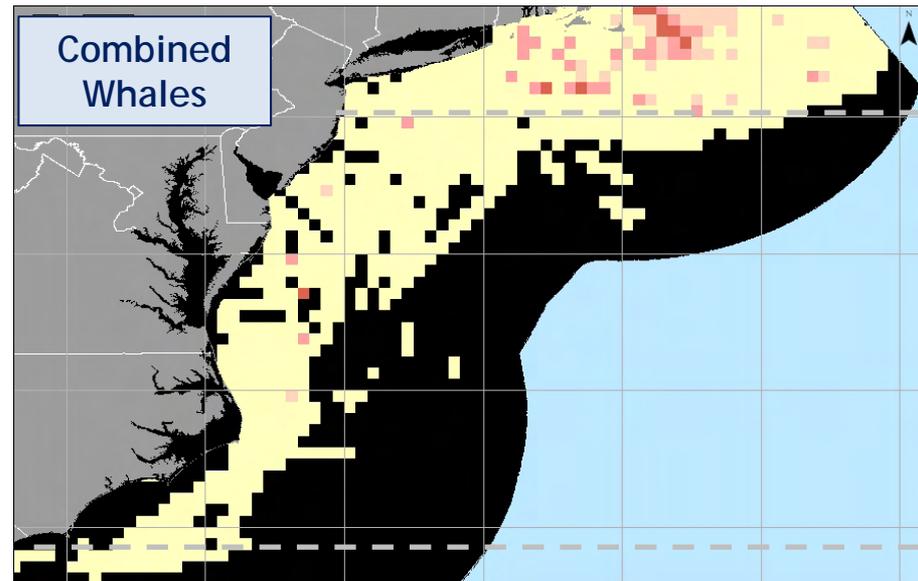
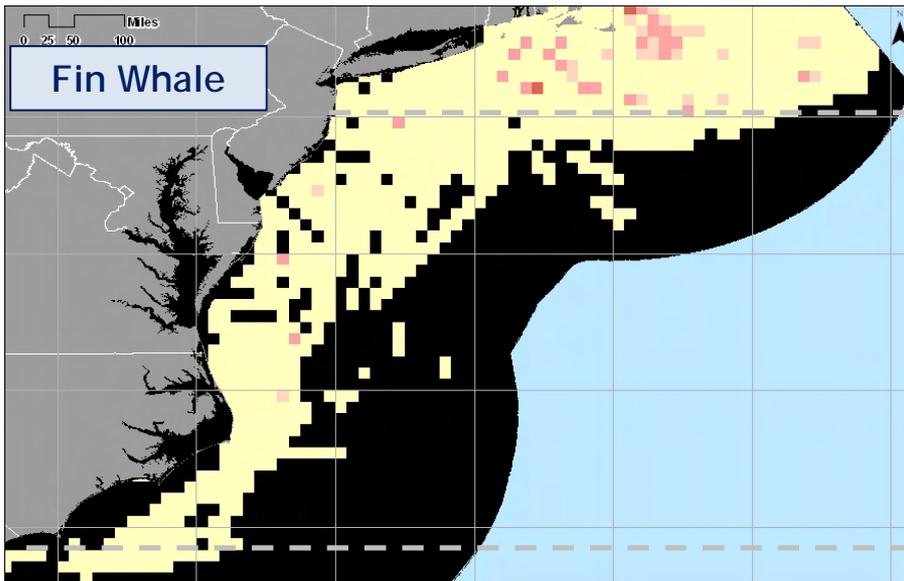
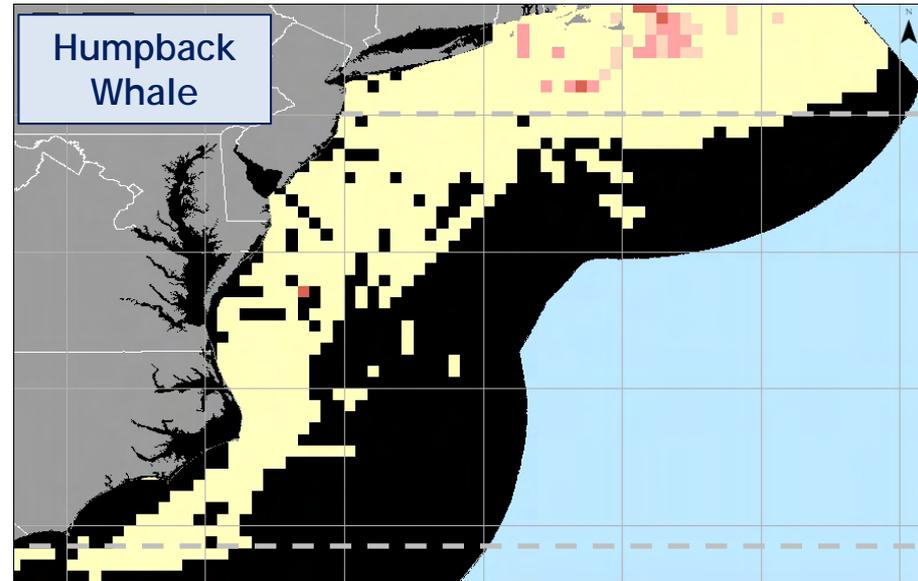
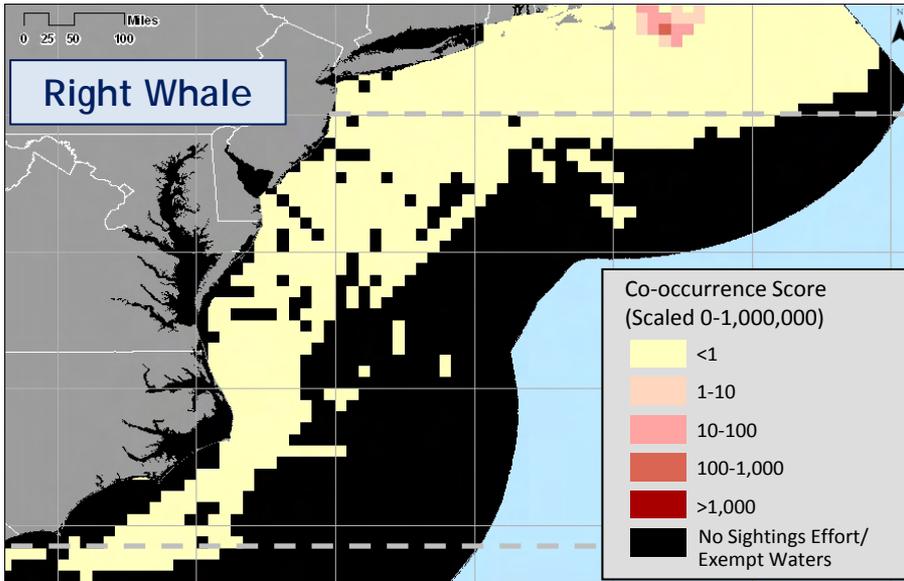
March Co-Occurrence: All Fisheries, Mid-Atlantic



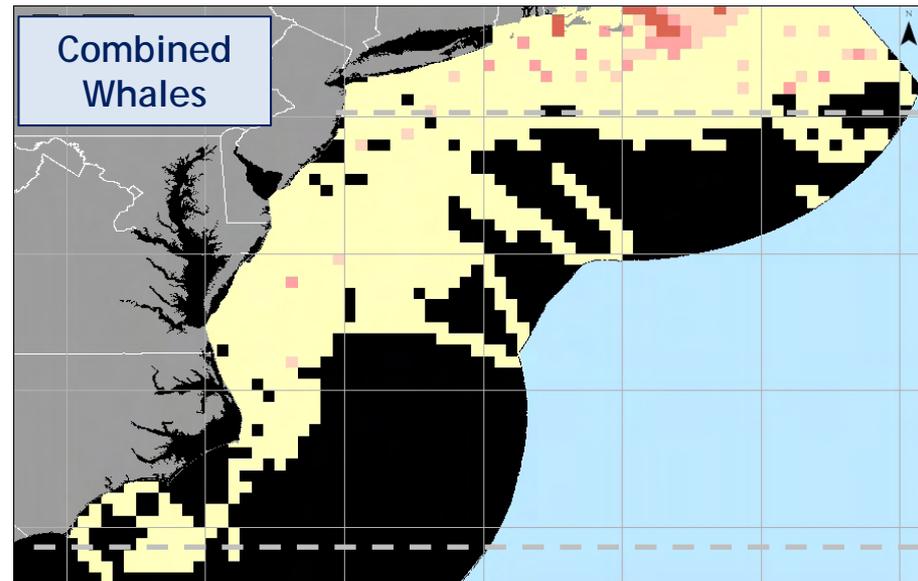
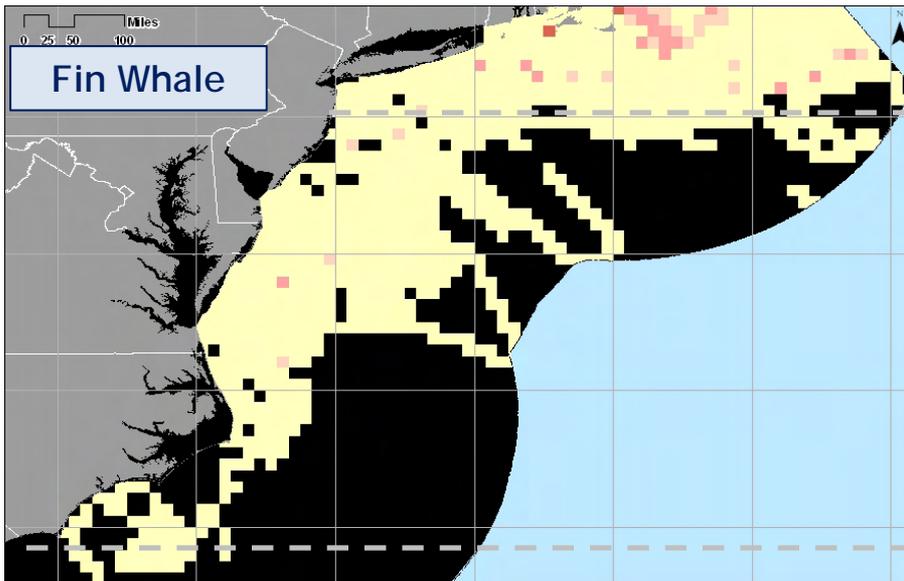
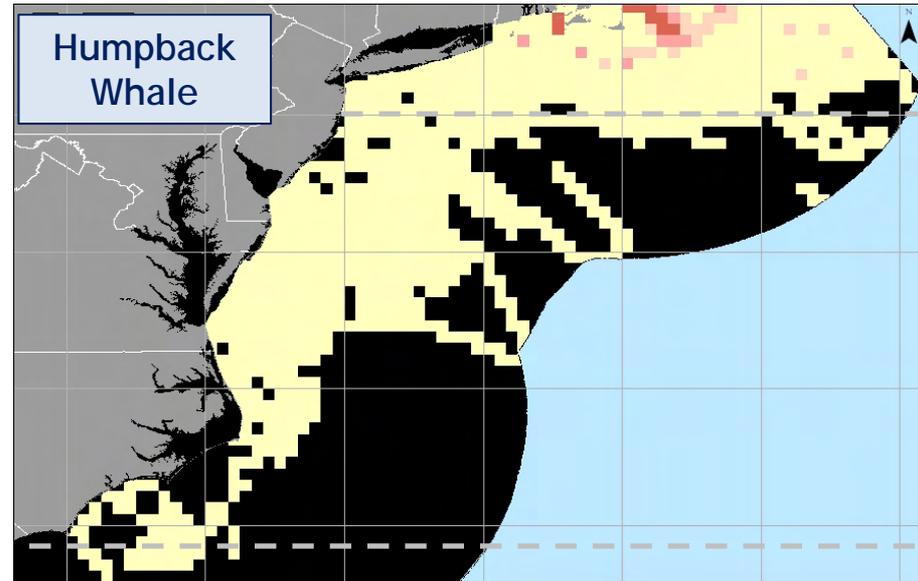
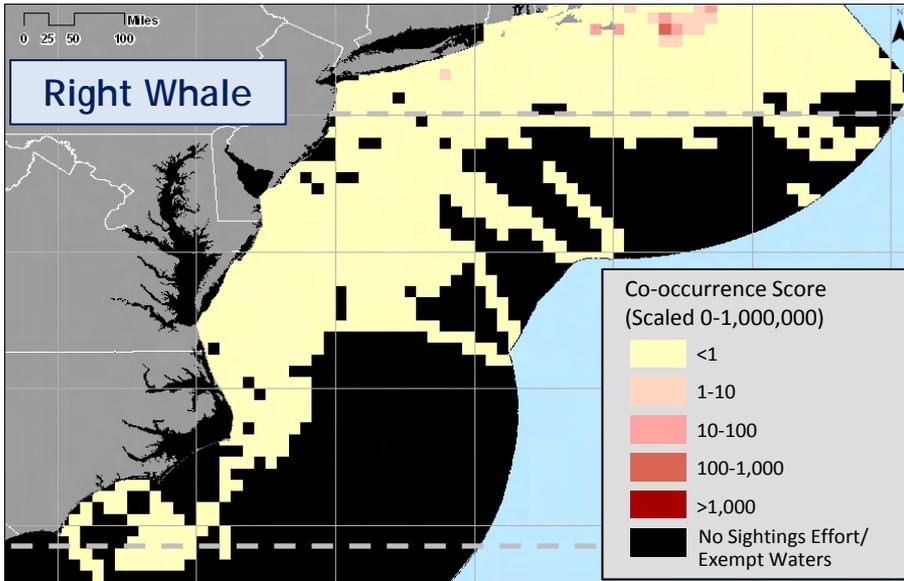
April Co-Occurrence: All Fisheries, Mid-Atlantic



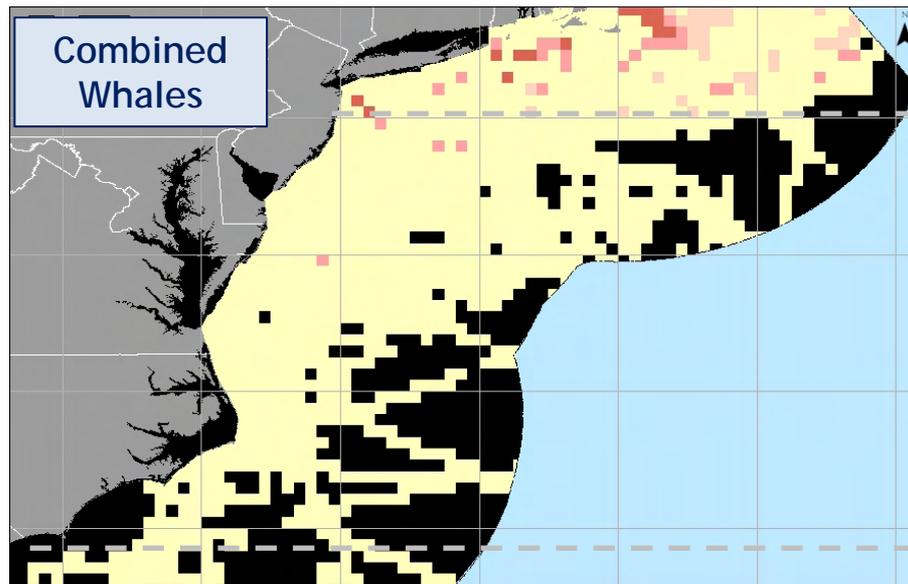
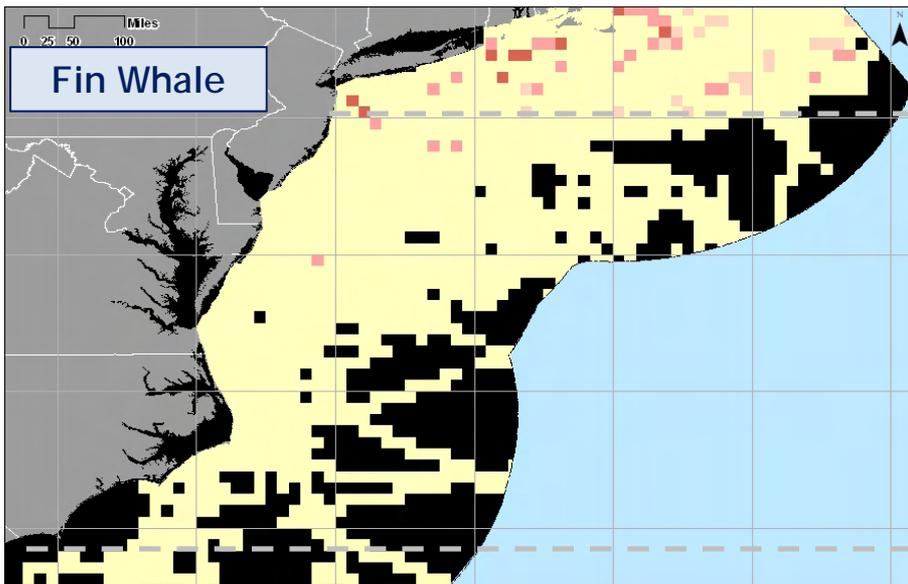
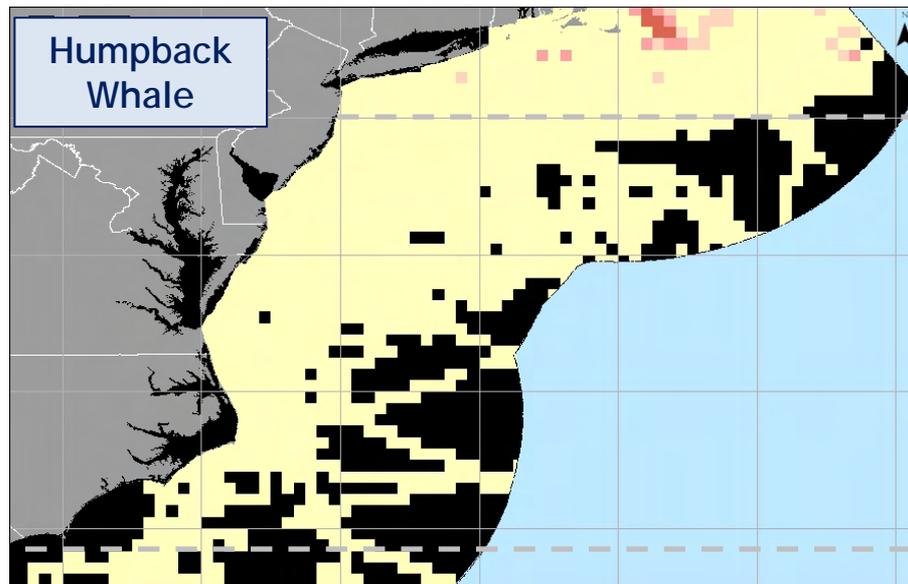
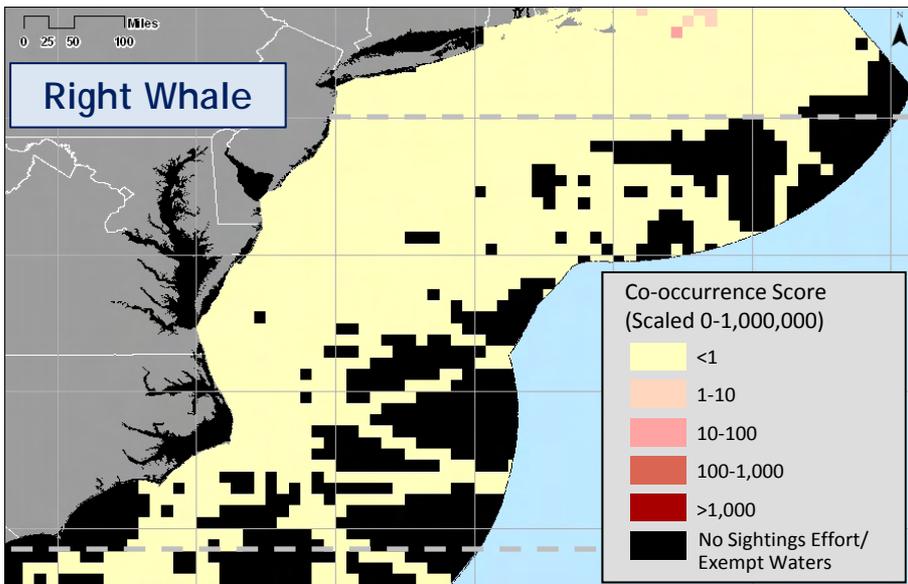
May Co-Occurrence: All Fisheries, Mid-Atlantic



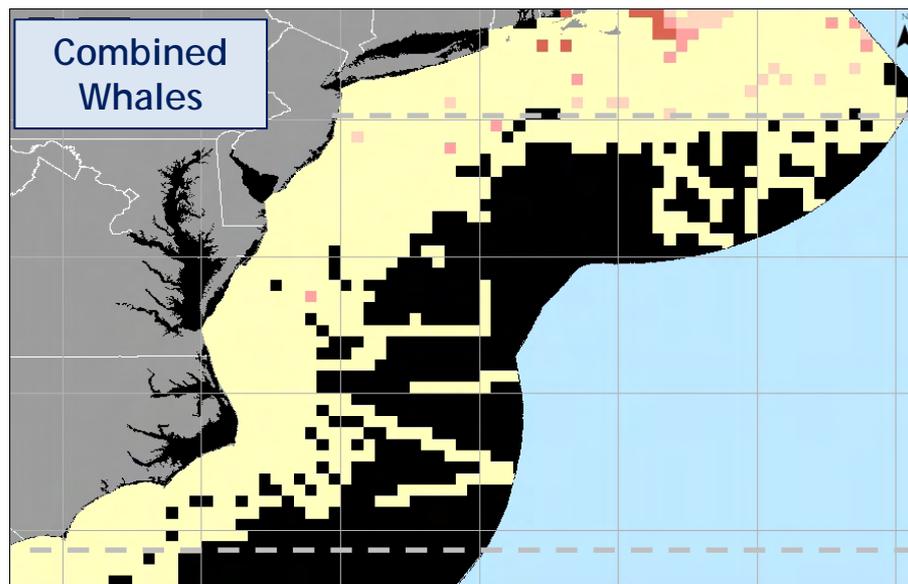
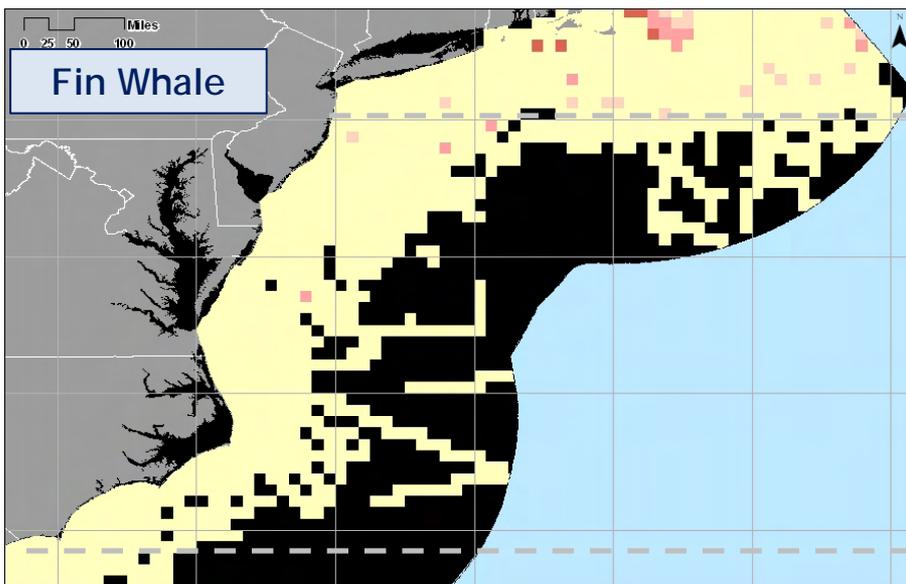
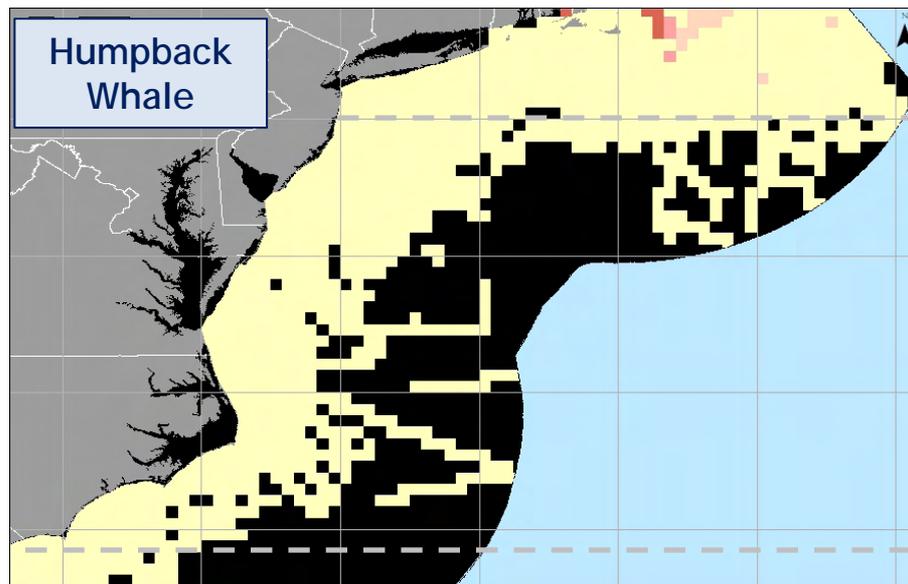
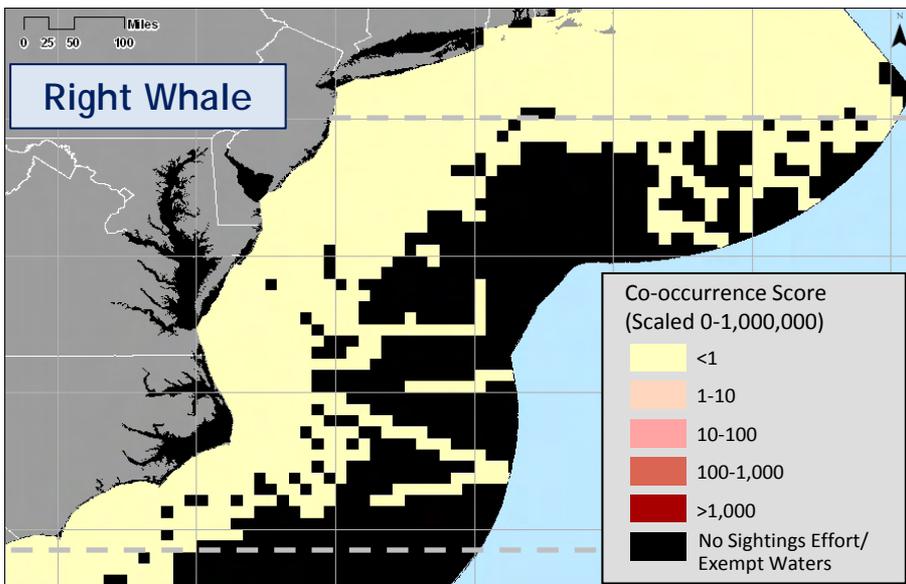
June Co-Occurrence: All Fisheries, Mid-Atlantic



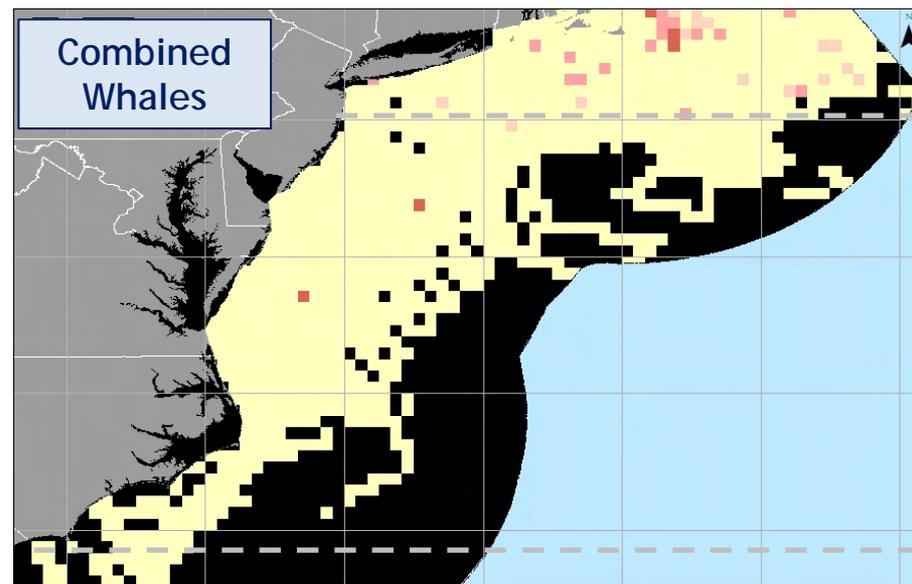
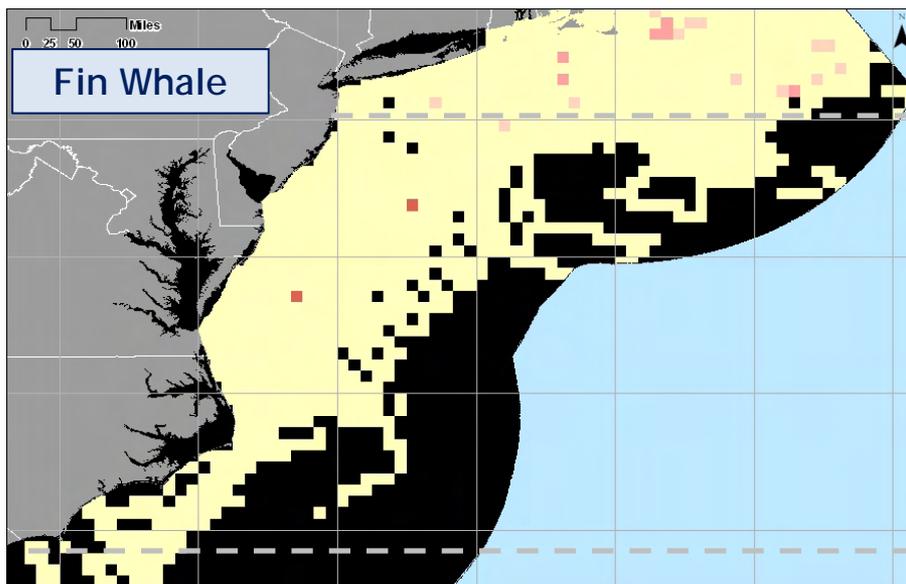
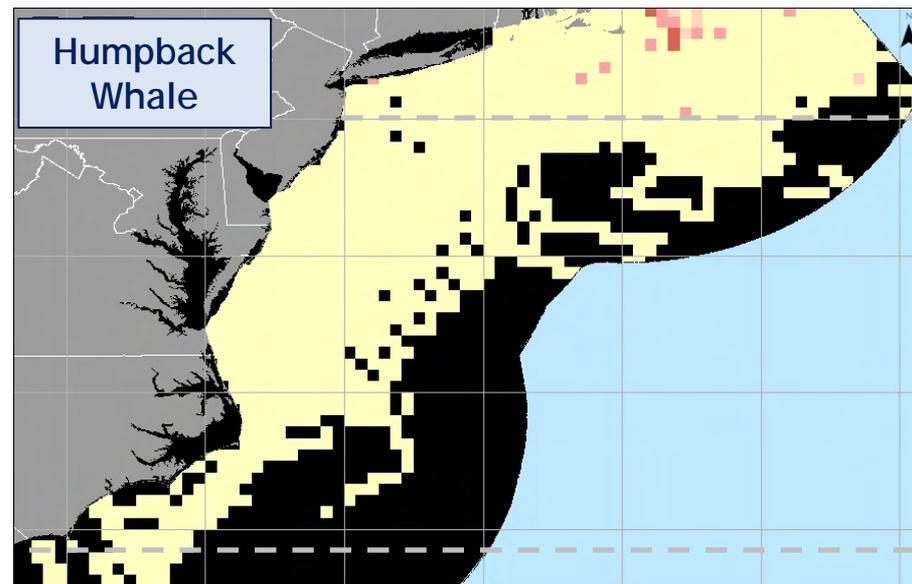
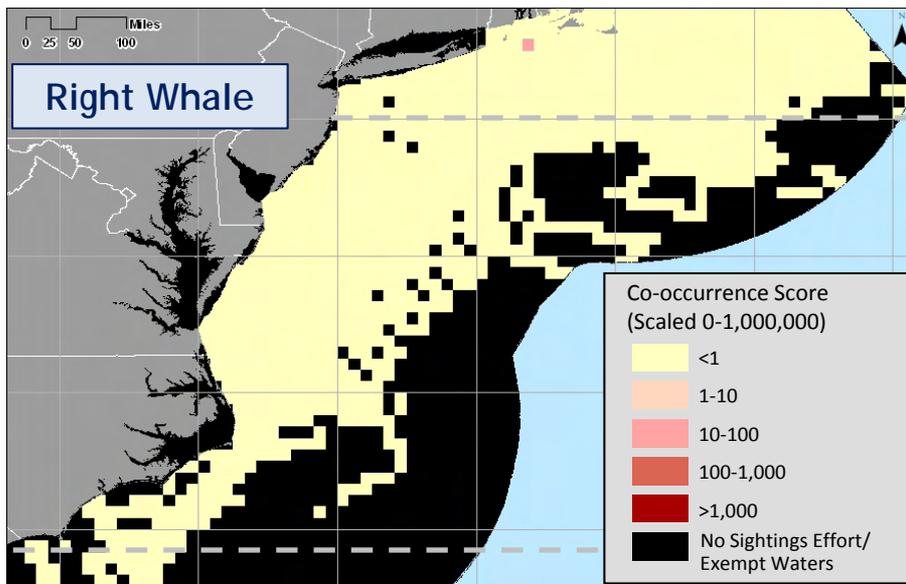
July Co-Occurrence: All Fisheries, Mid-Atlantic



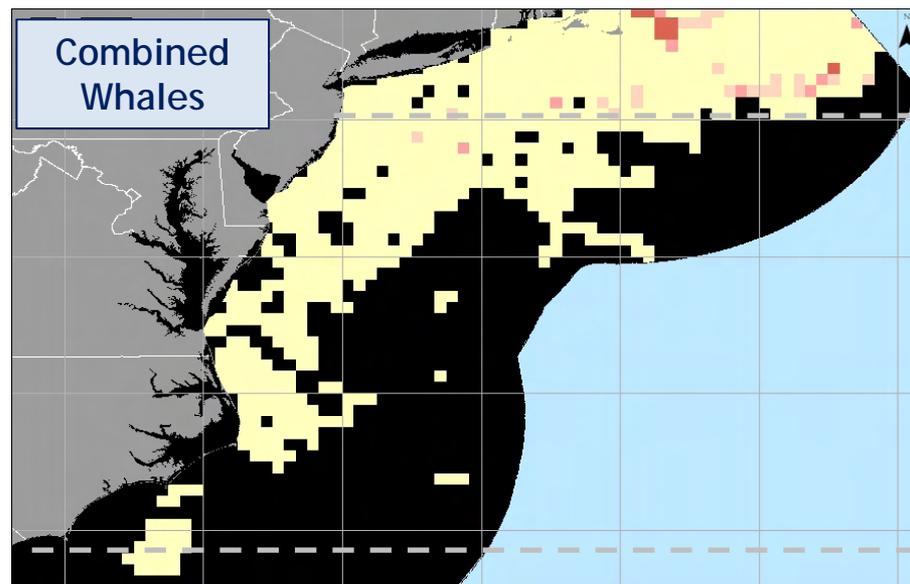
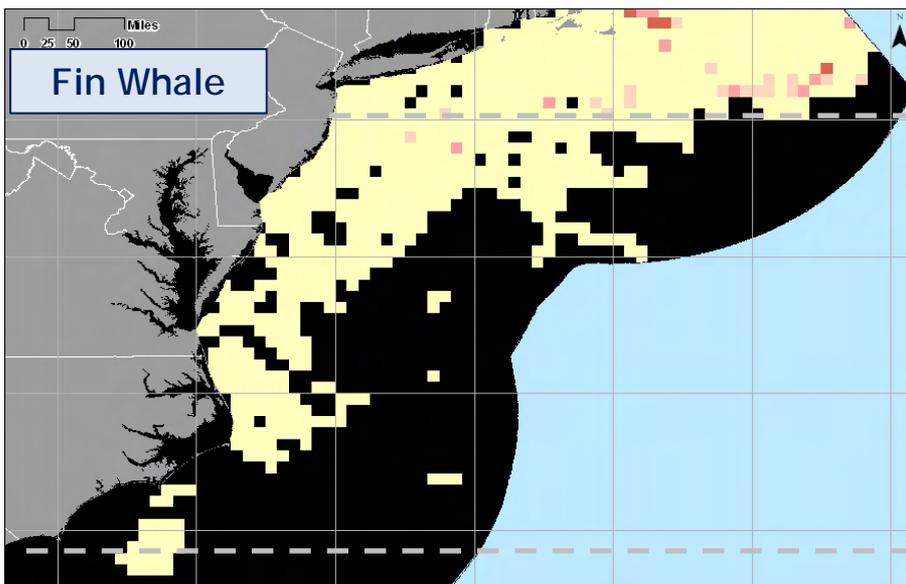
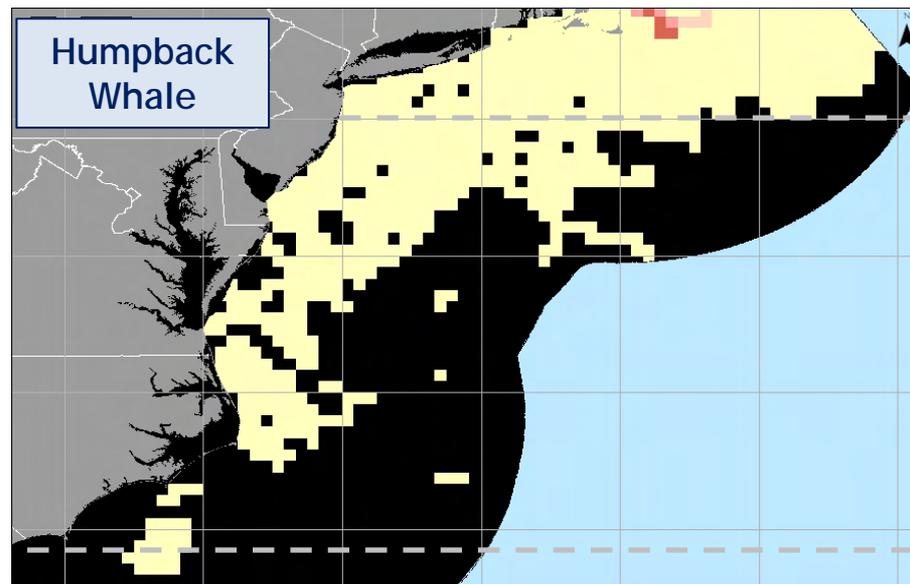
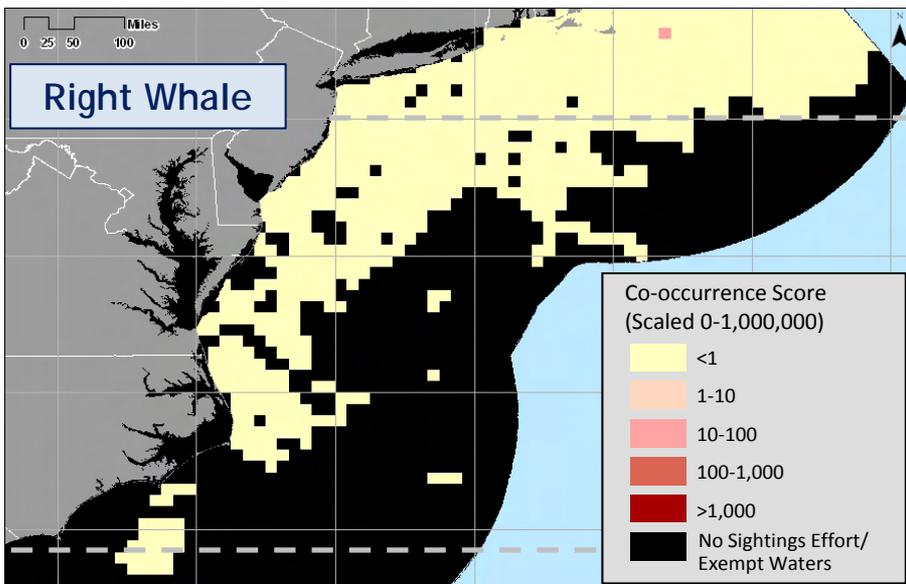
August Co-Occurrence: All Fisheries, Mid-Atlantic



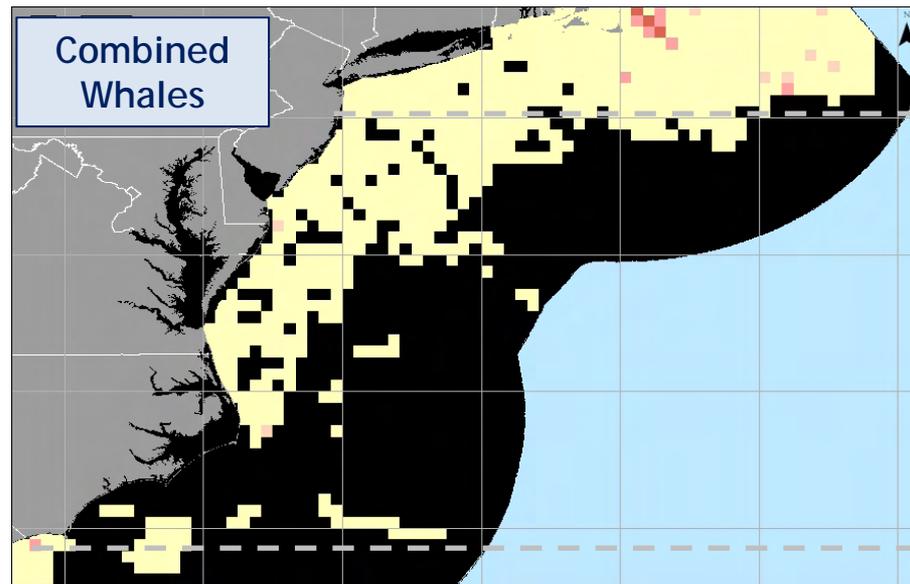
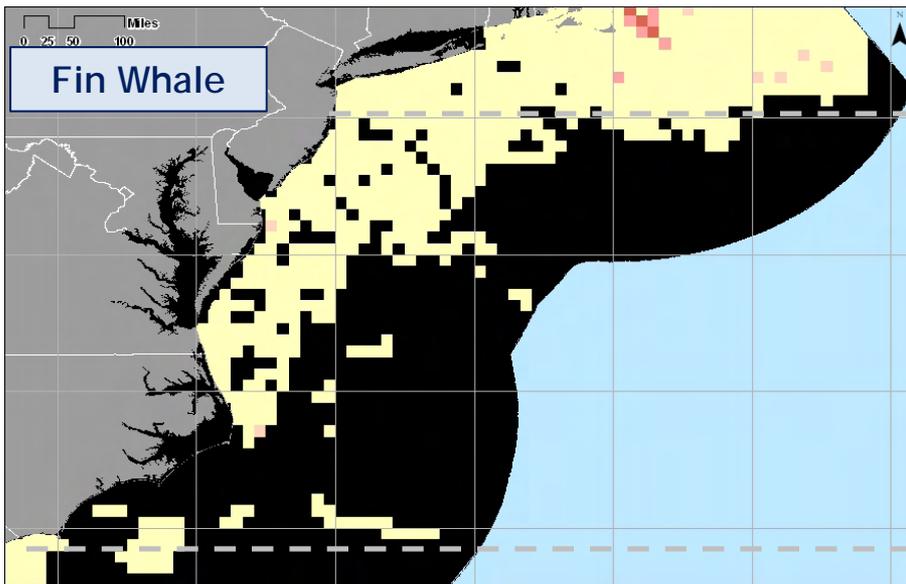
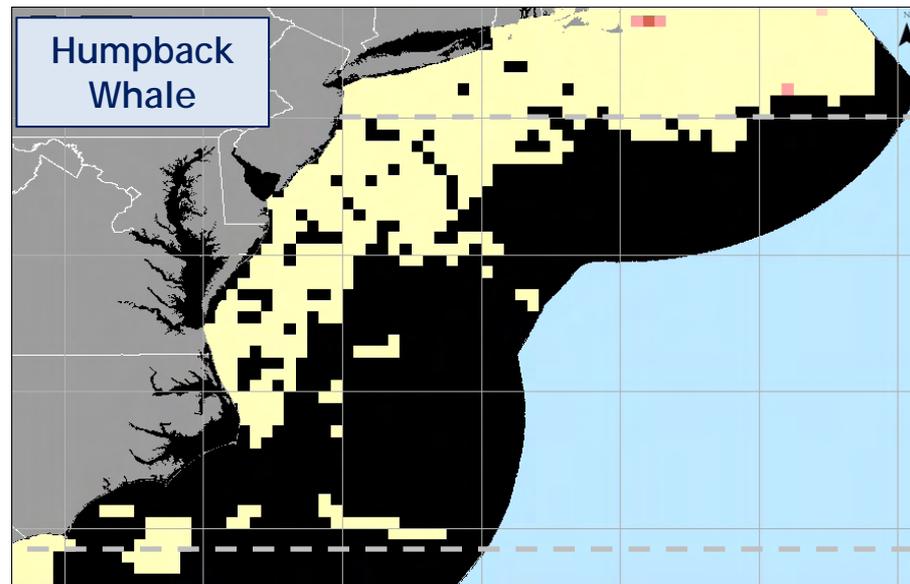
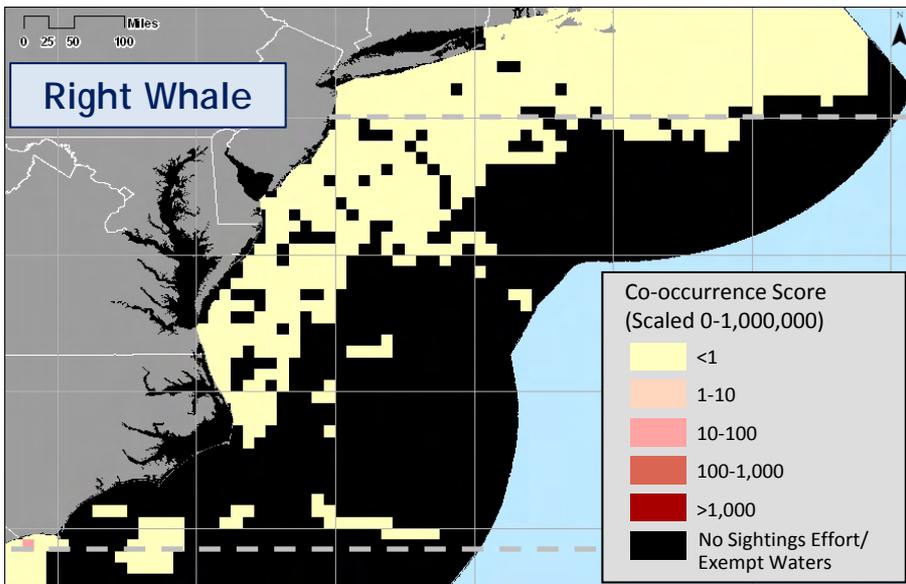
September Co-Occurrence: All Fisheries, Mid-Atlantic



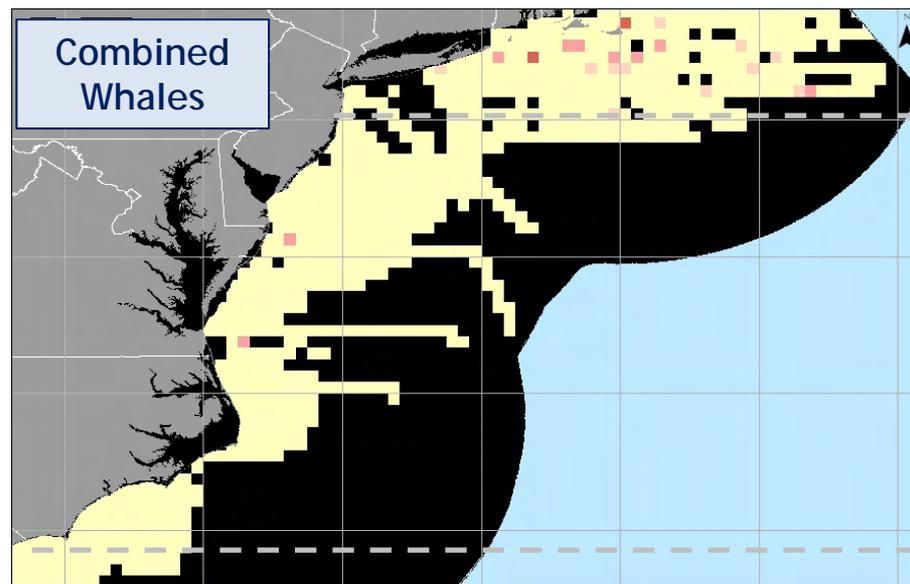
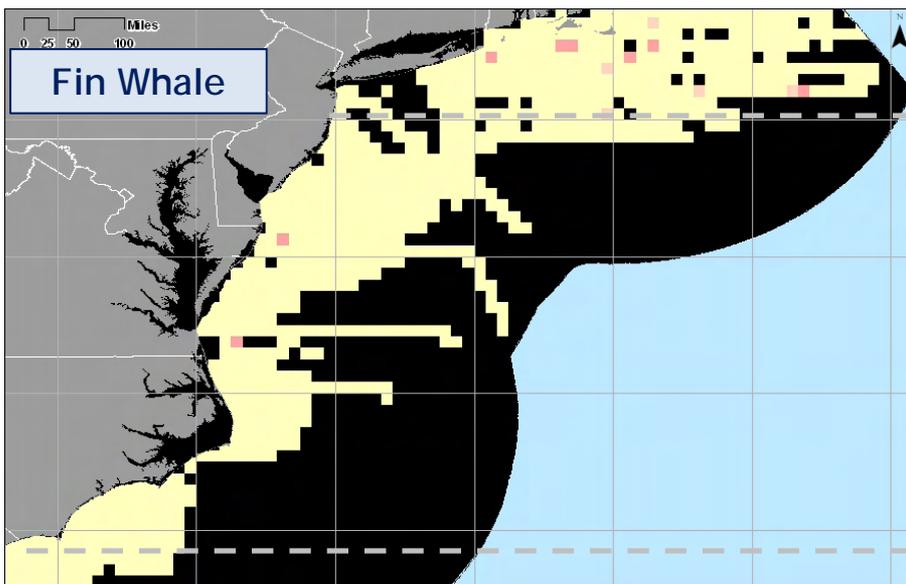
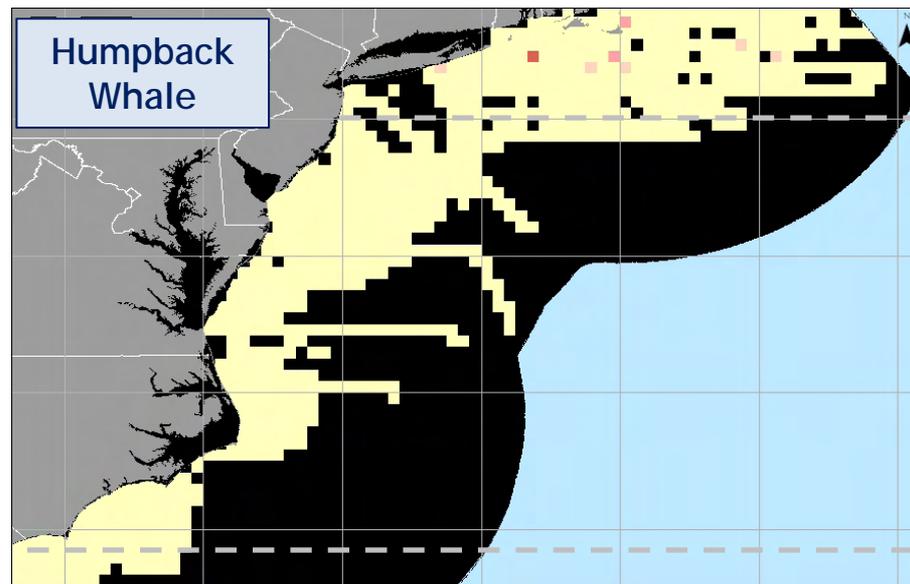
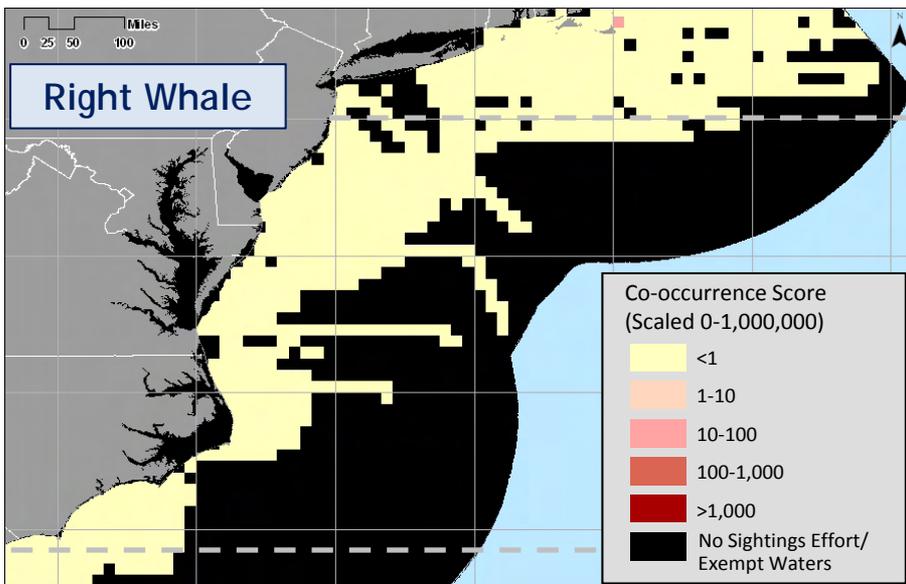
October Co-Occurrence: All Fisheries, Mid-Atlantic



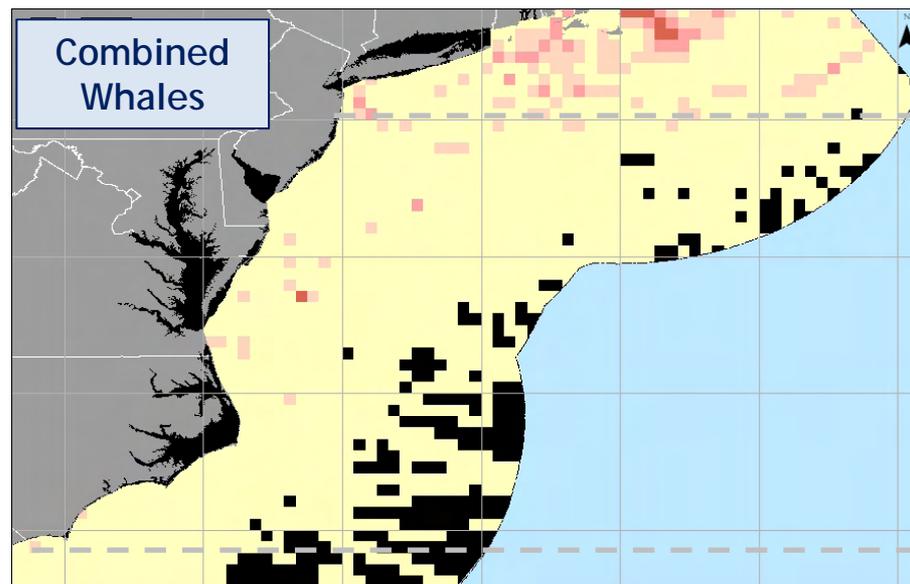
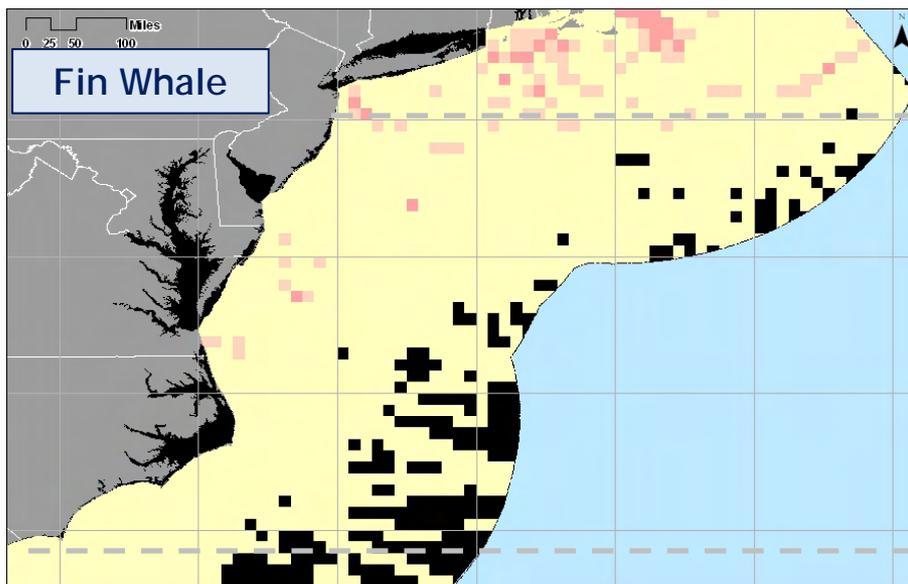
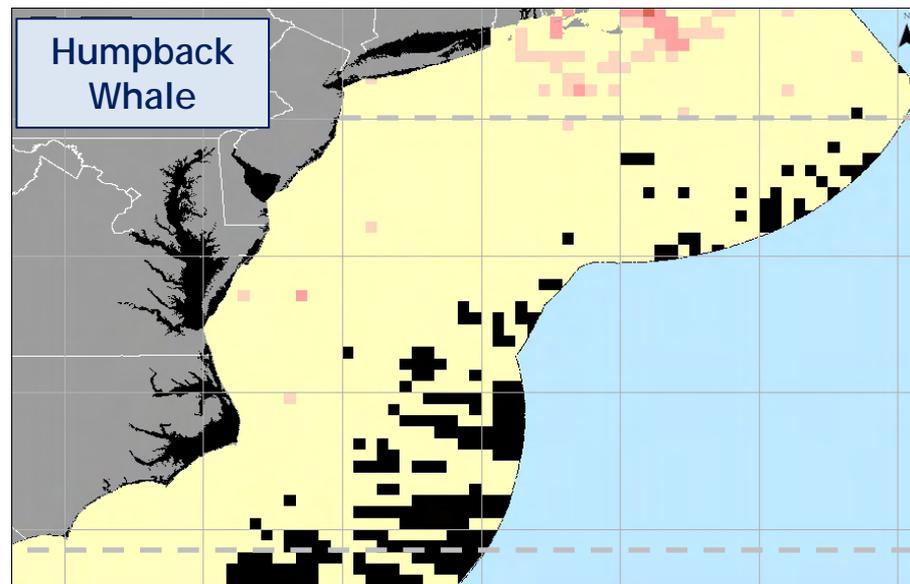
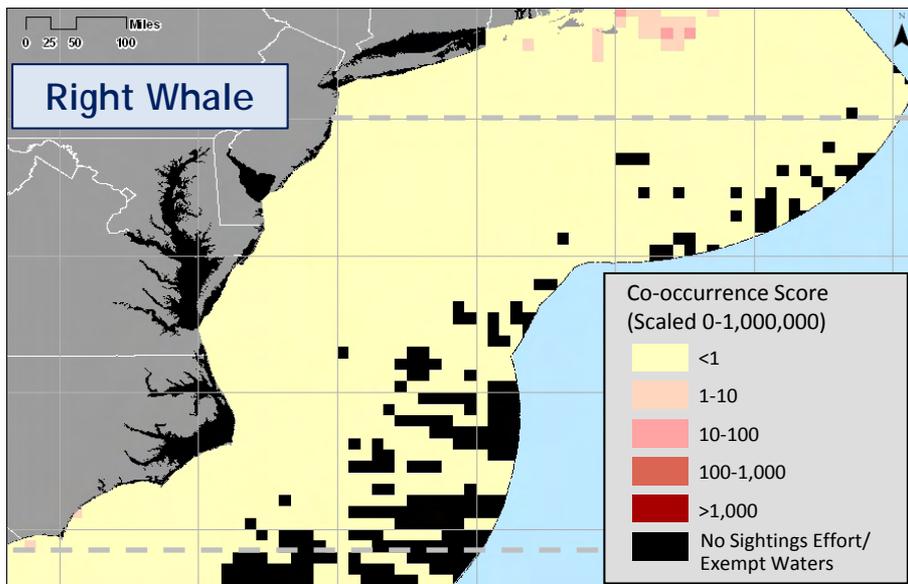
November Co-Occurrence: All Fisheries, Mid-Atlantic



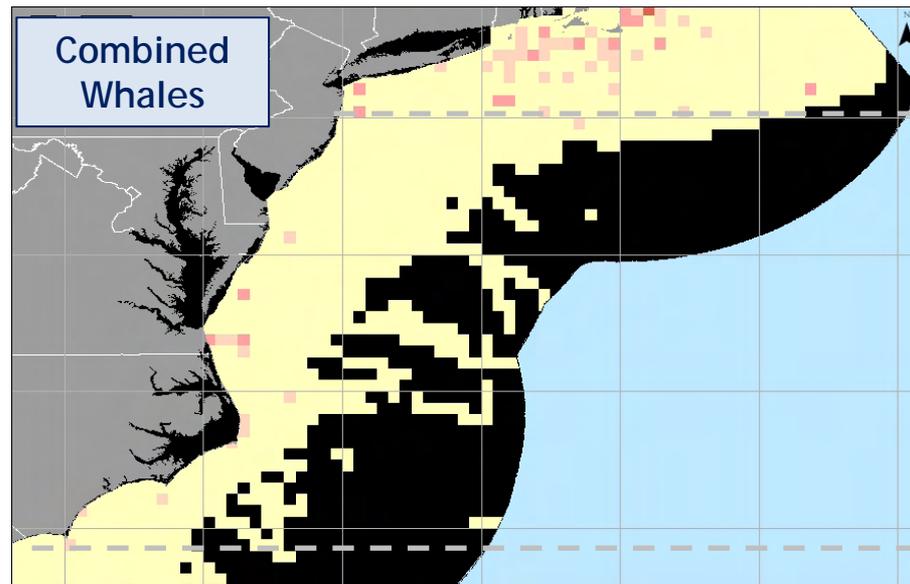
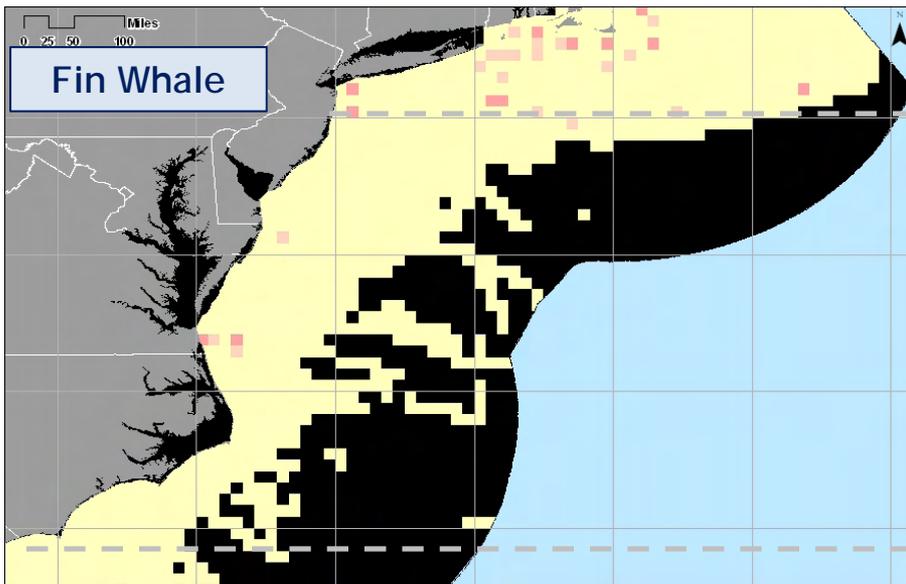
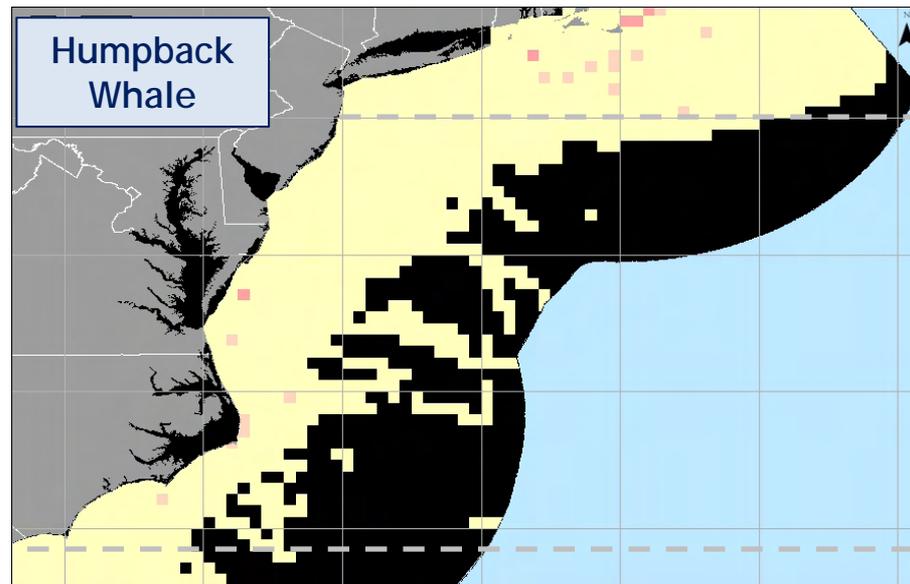
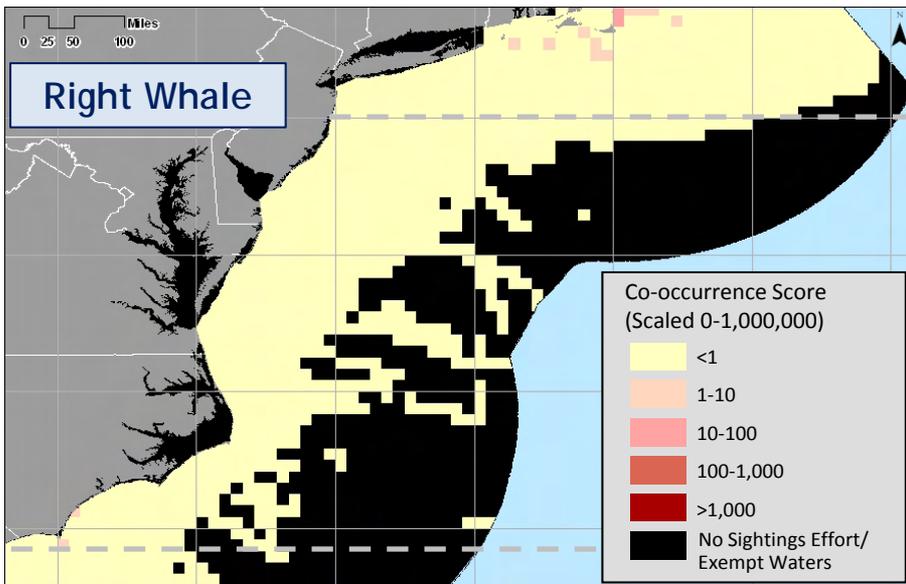
December Co-Occurrence: All Fisheries, Mid-Atlantic



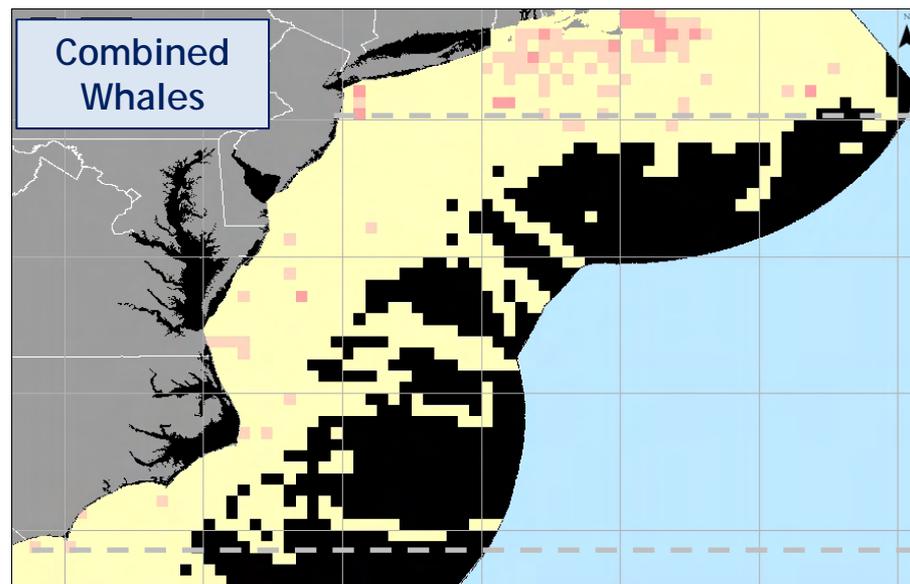
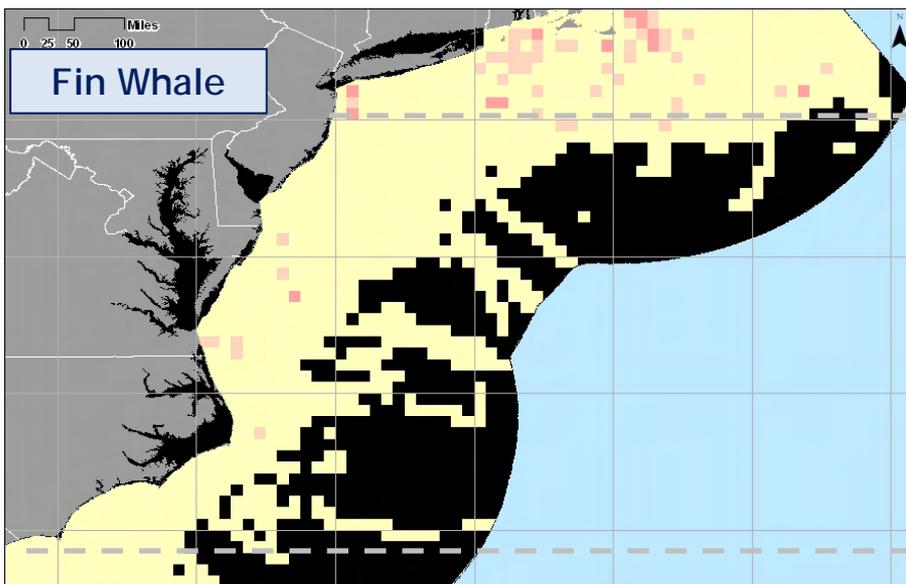
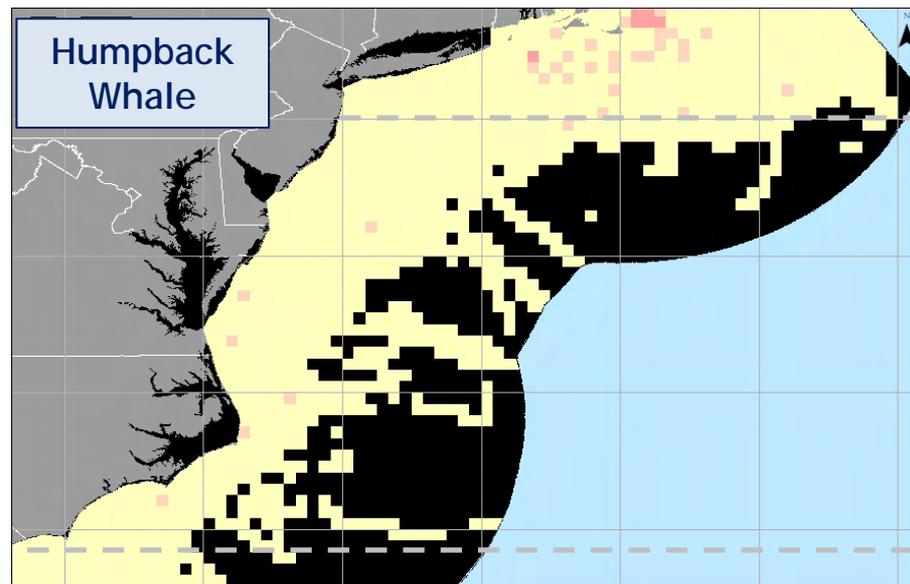
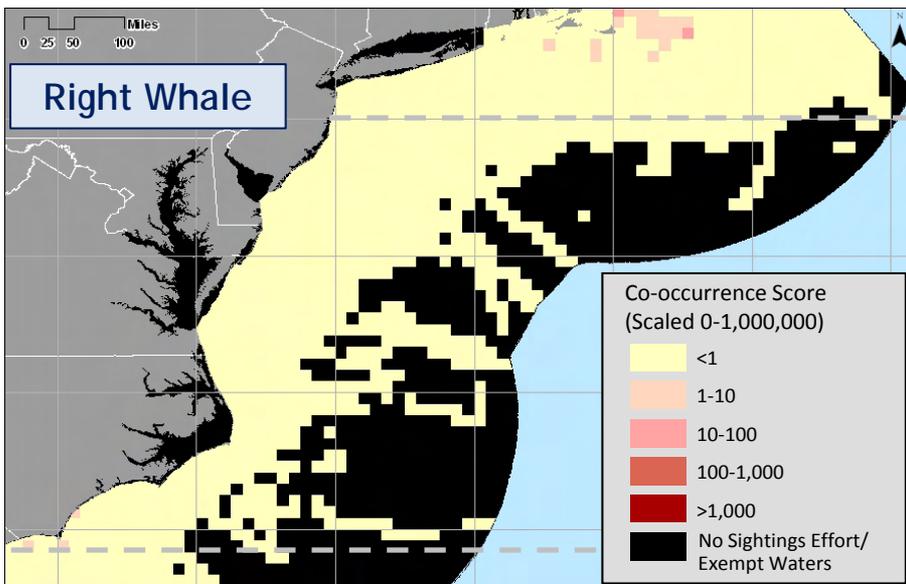
Average Co-Occurrence: All Fisheries, Mid-Atlantic



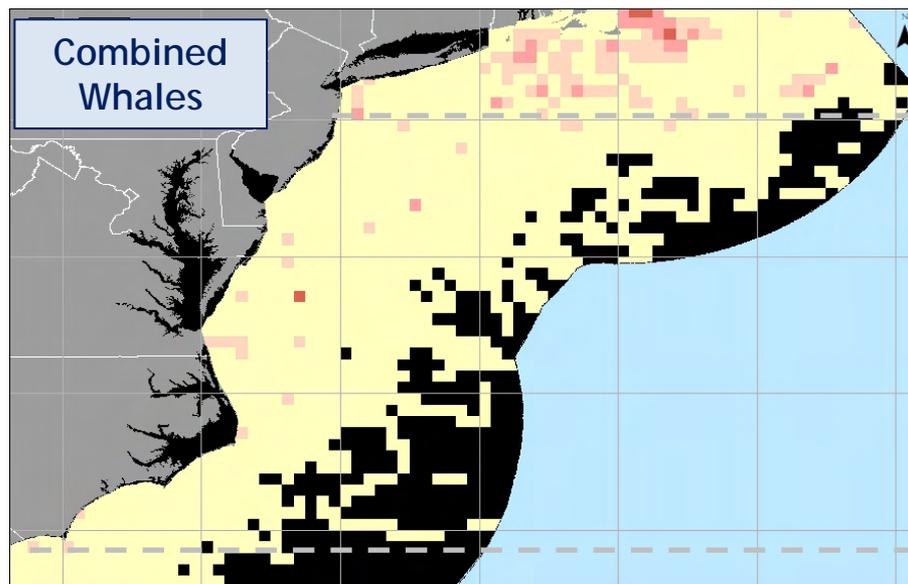
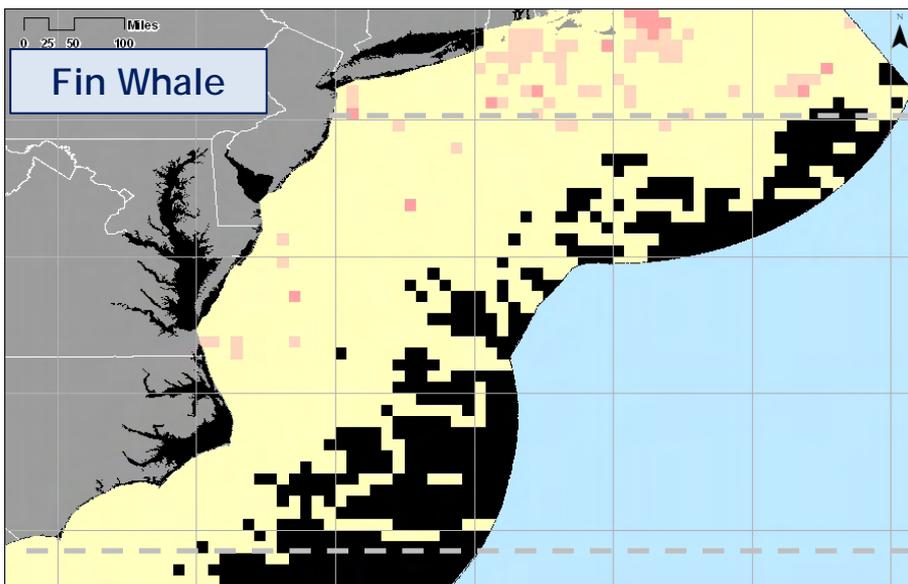
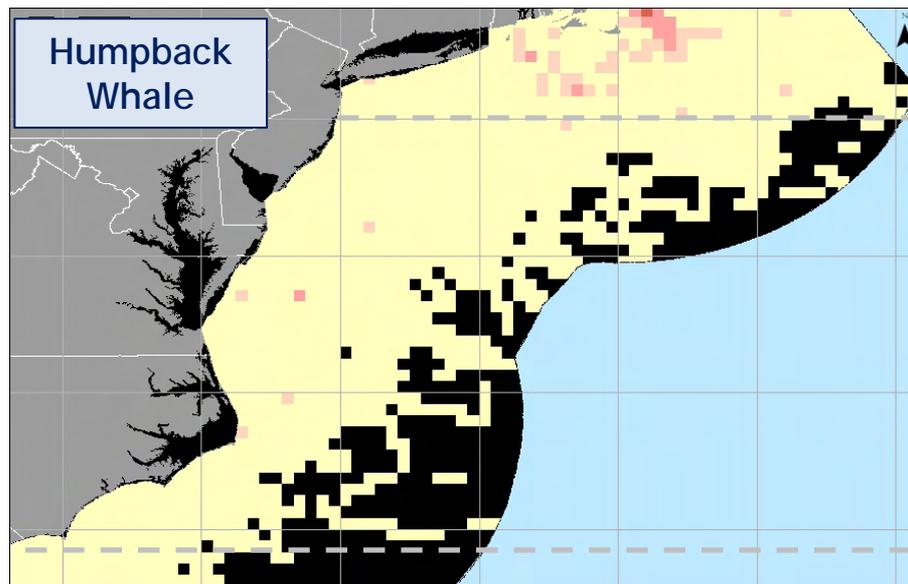
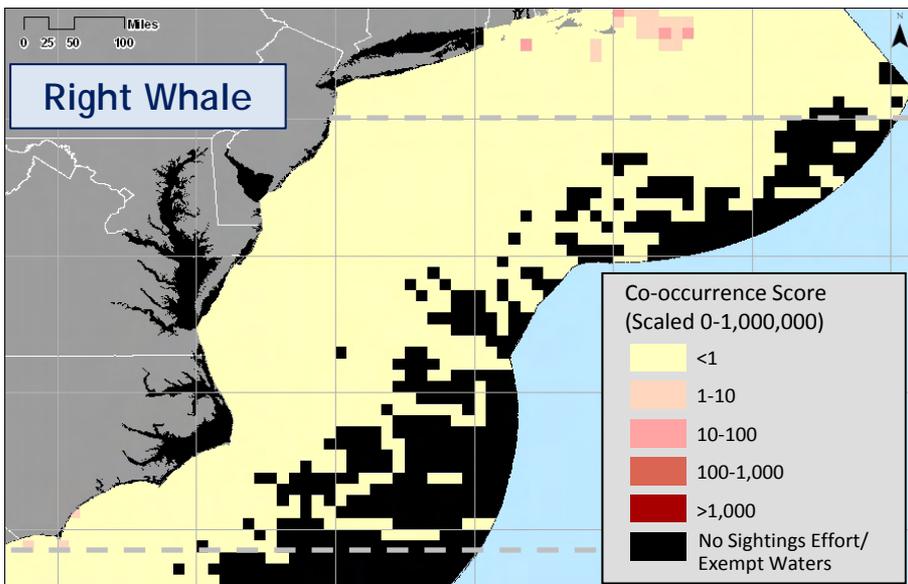
December-March Co-Occurrence: All Fisheries, Mid-Atlantic



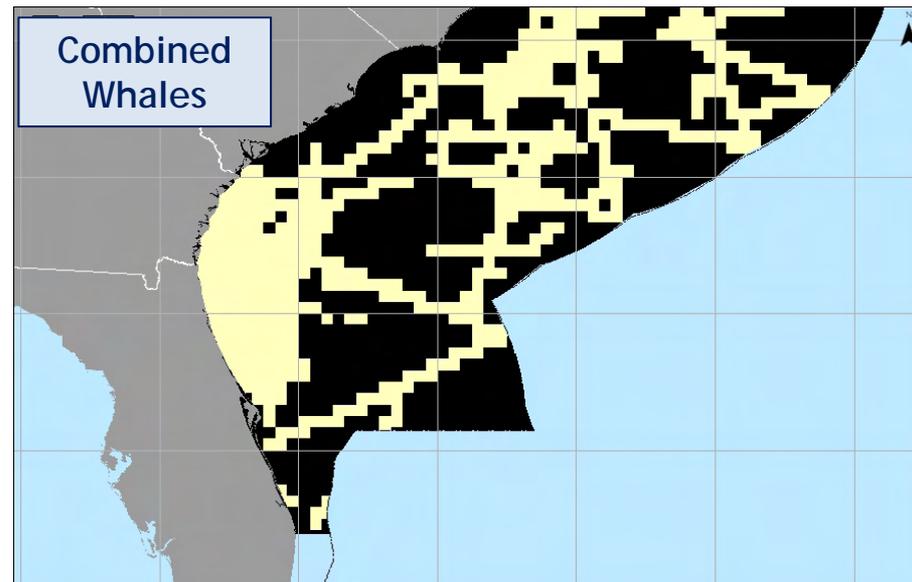
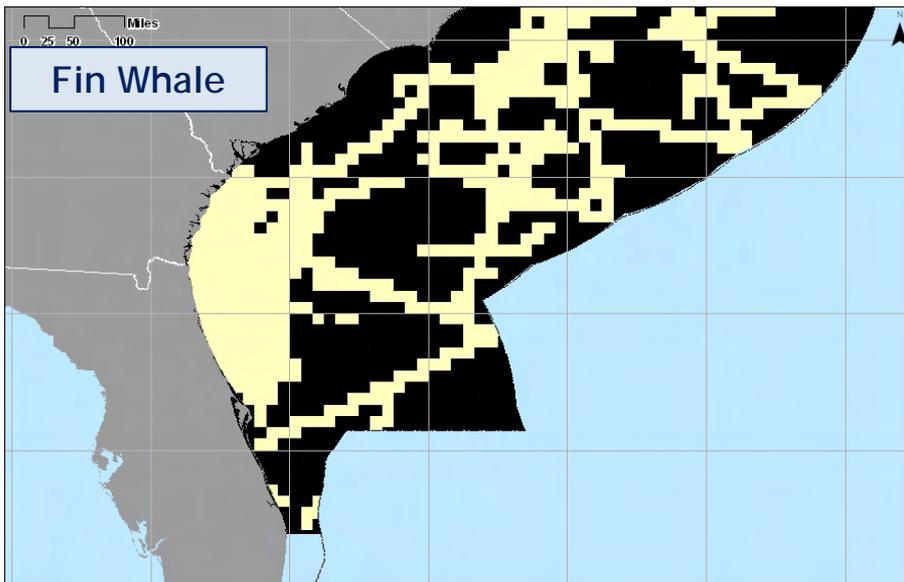
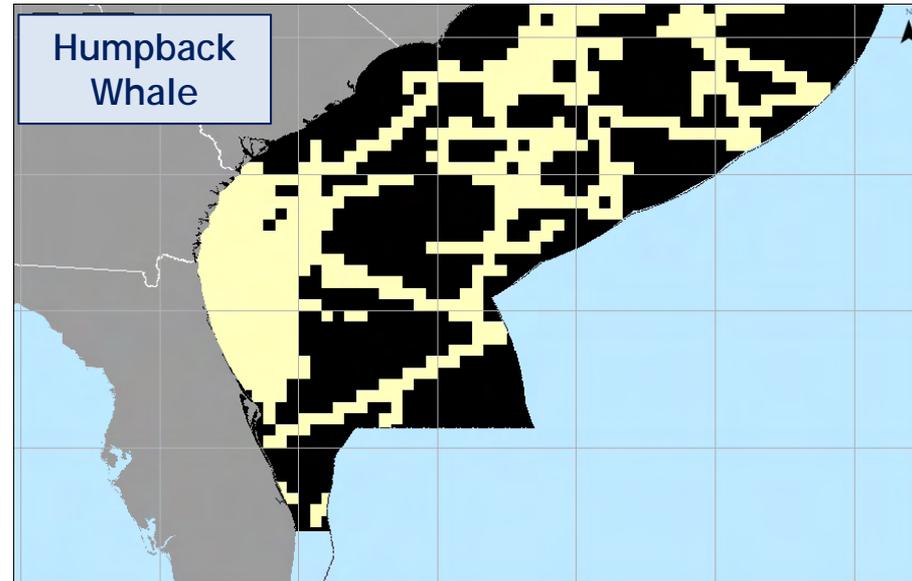
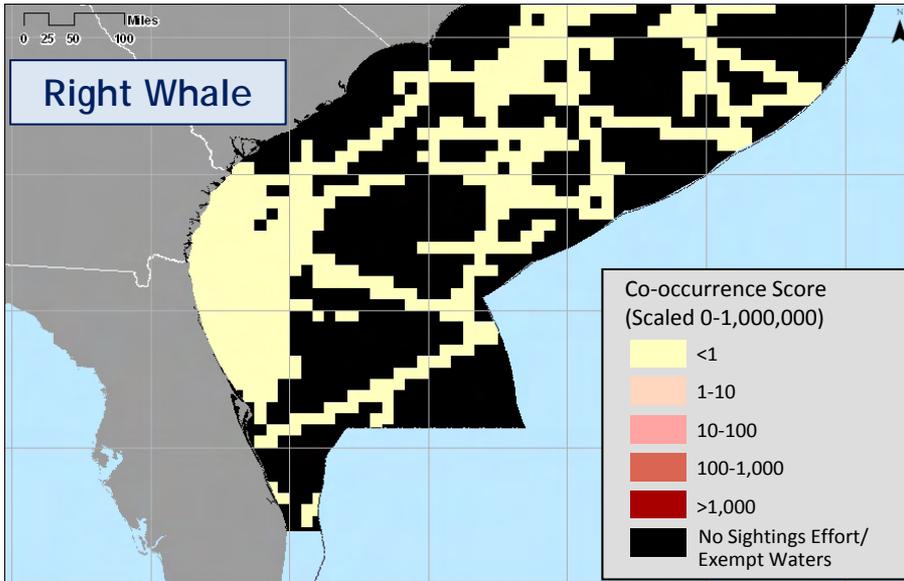
November-April Co-Occurrence: All Fisheries, Mid-Atlantic



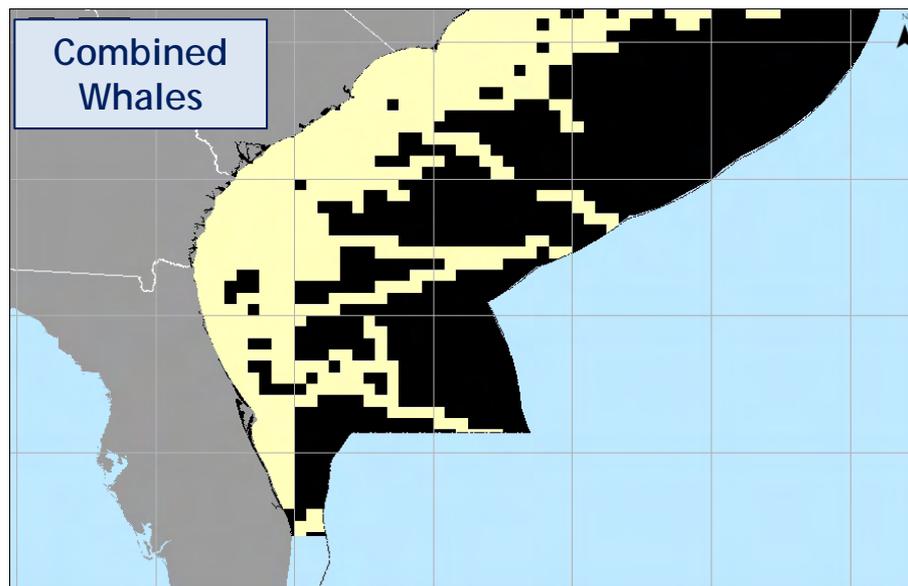
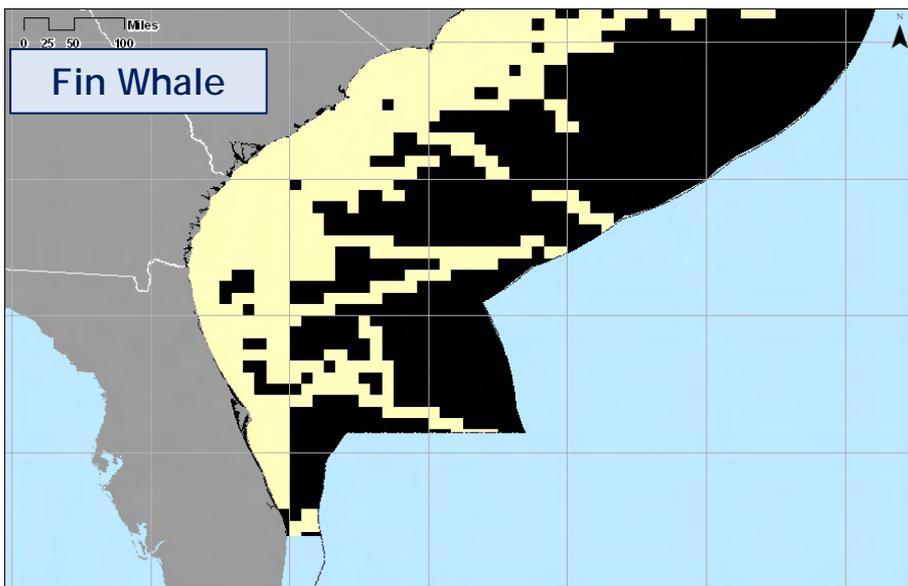
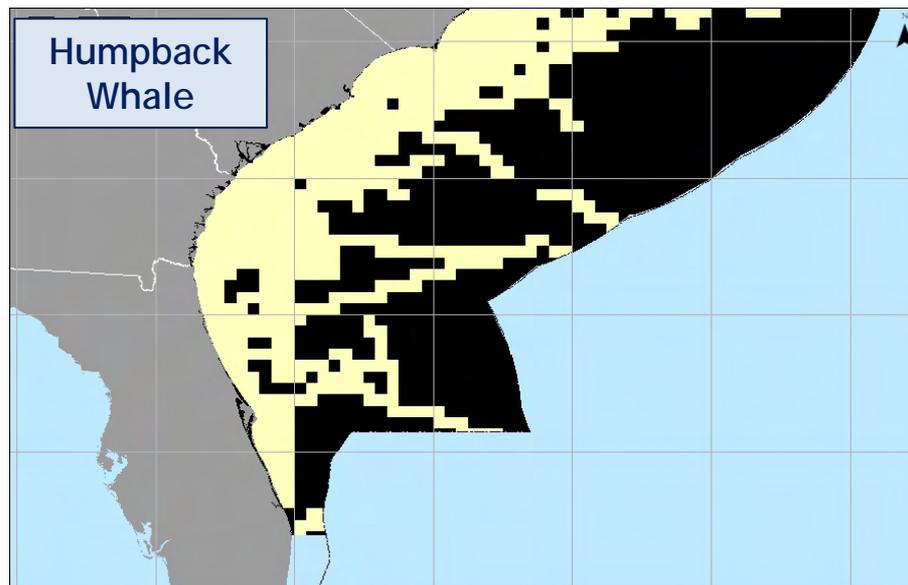
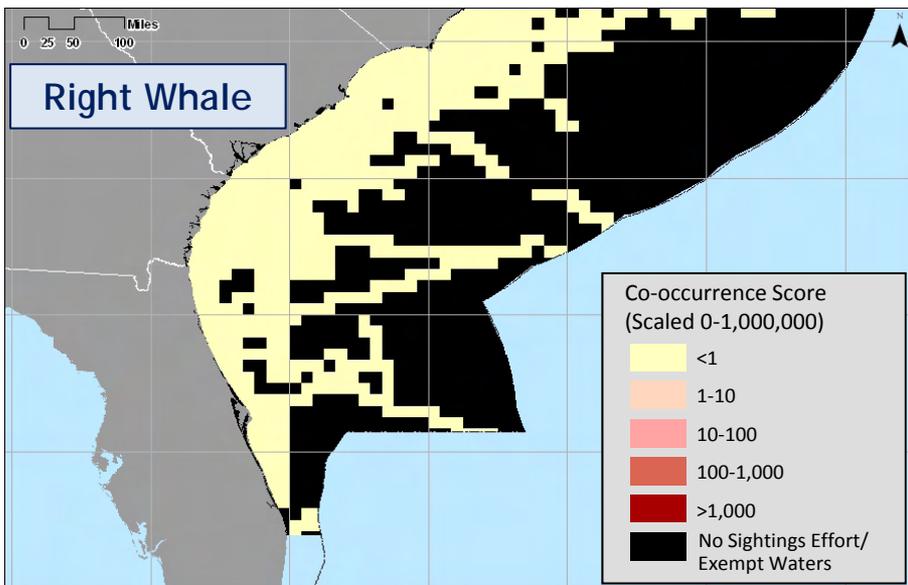
September-May Co-Occurrence: All Fisheries, Mid-Atlantic



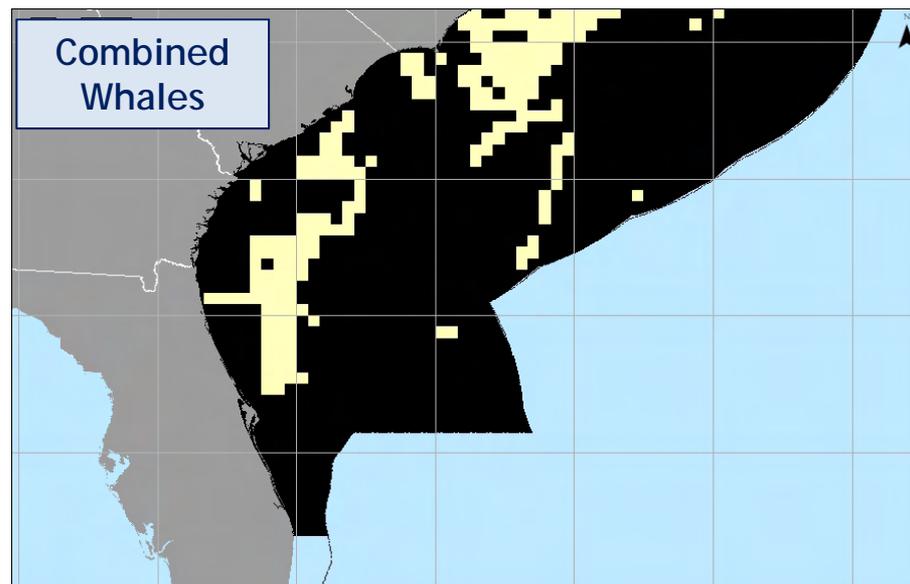
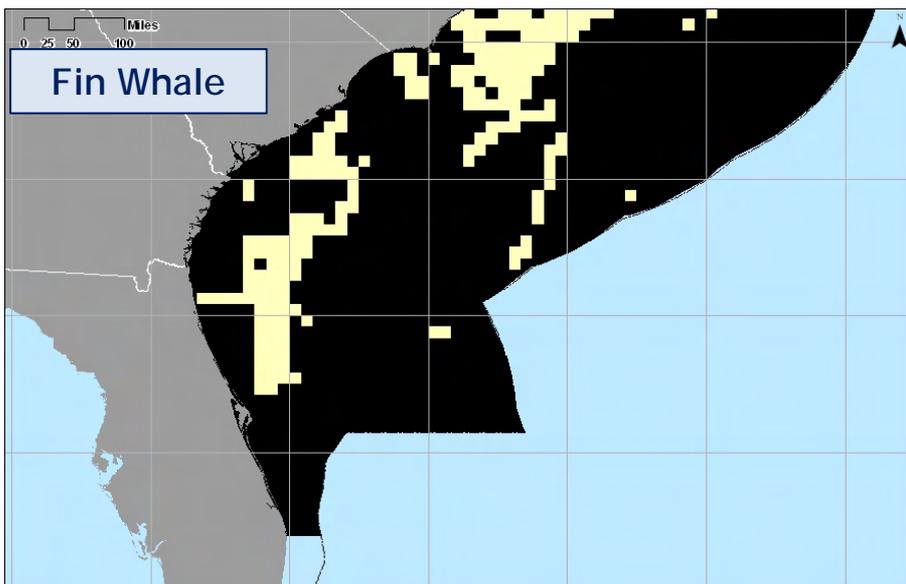
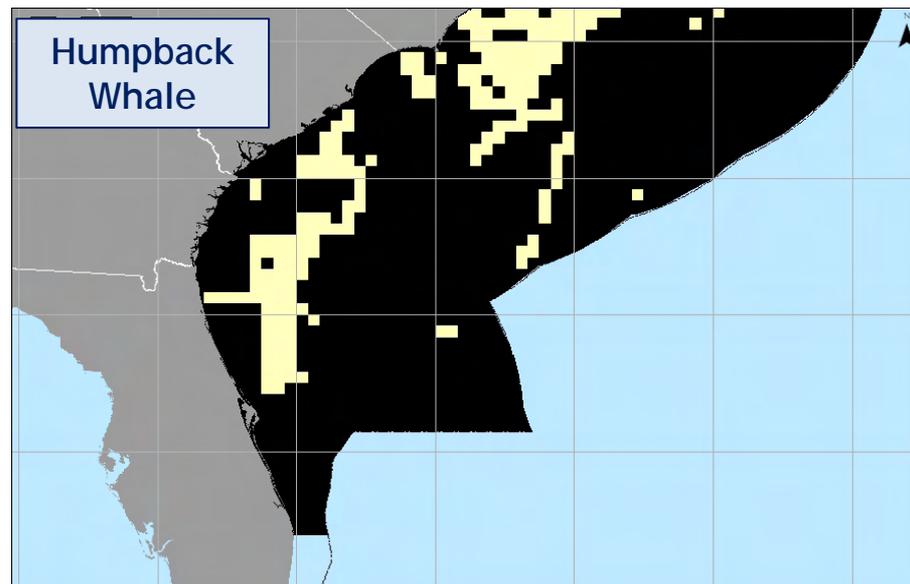
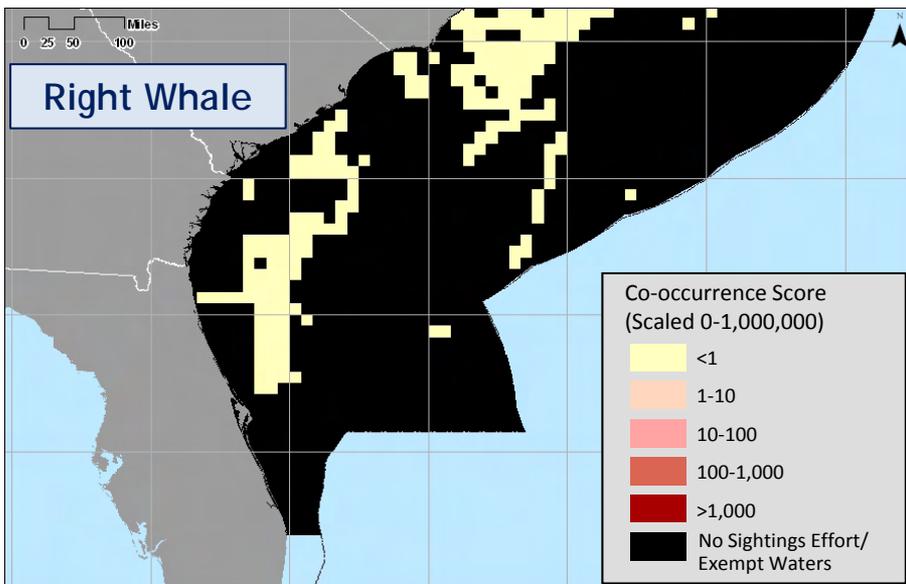
July Co-Occurrence: All Fisheries, Southeast



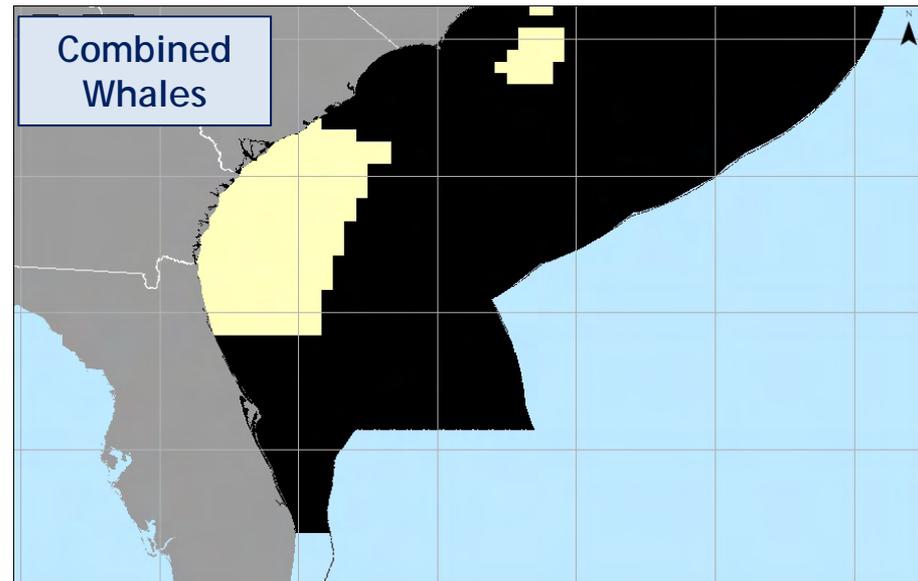
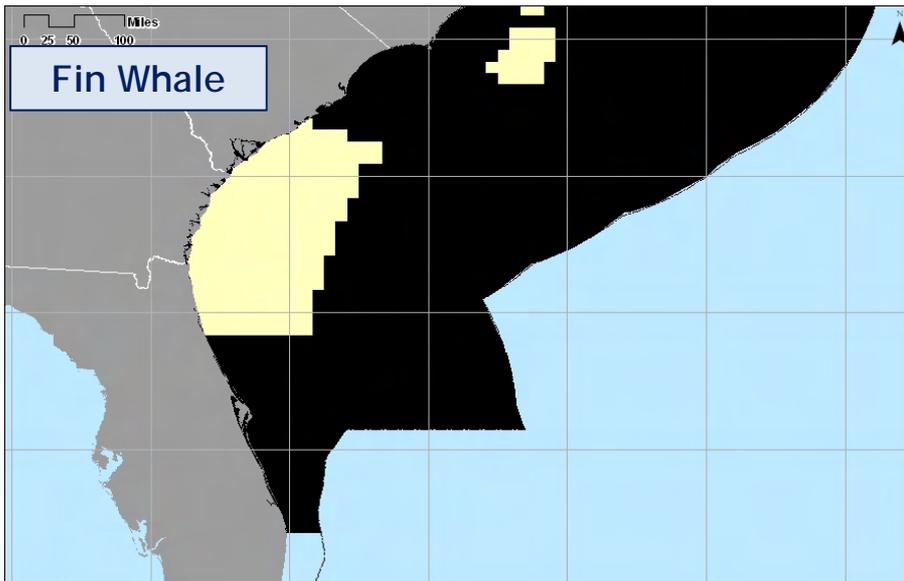
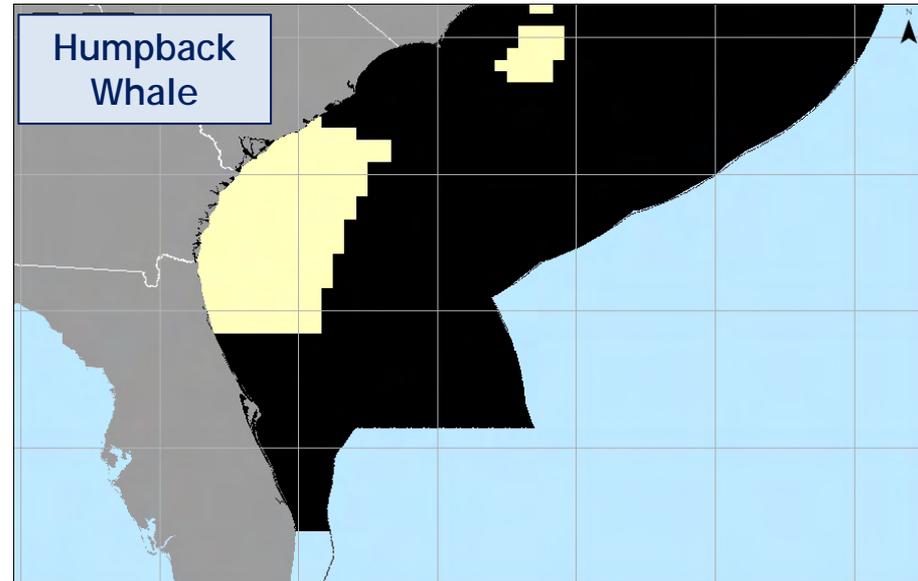
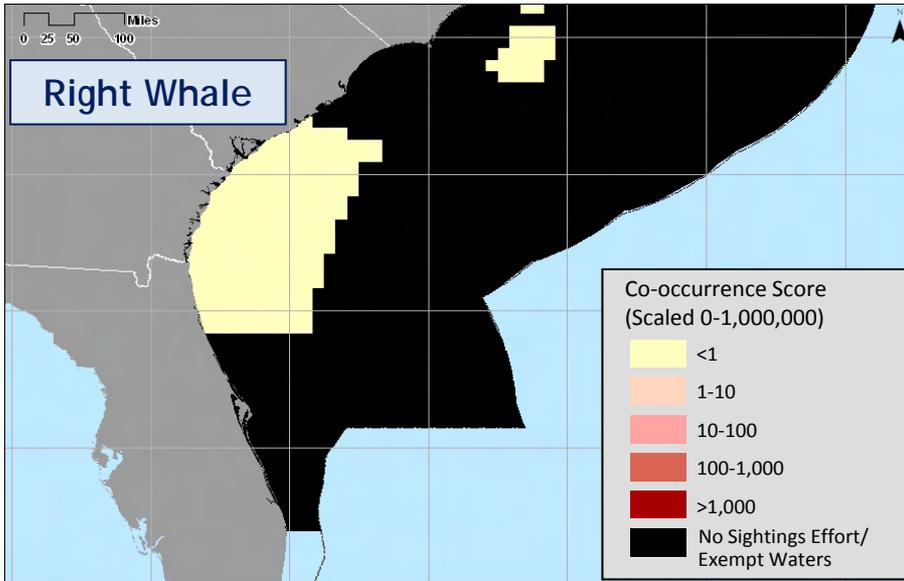
August Co-Occurrence: All Fisheries, Southeast



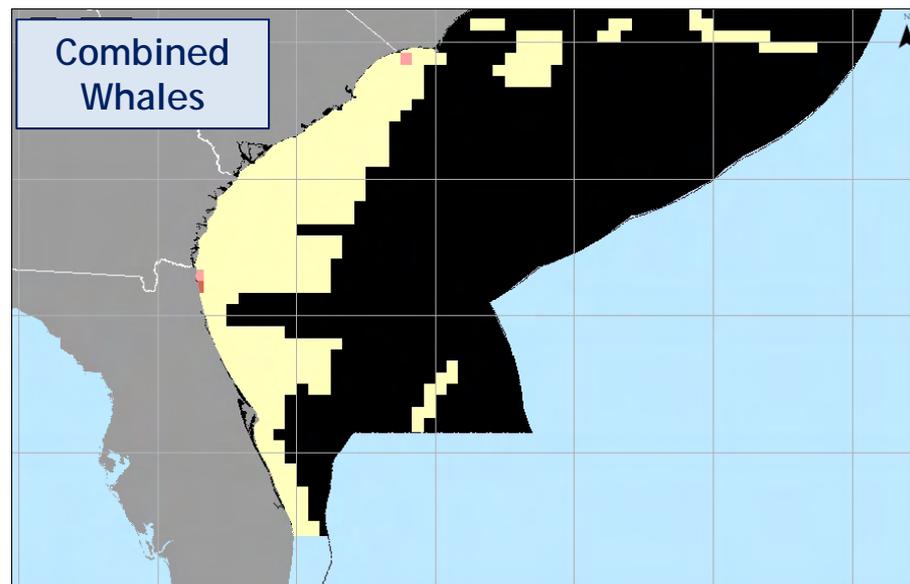
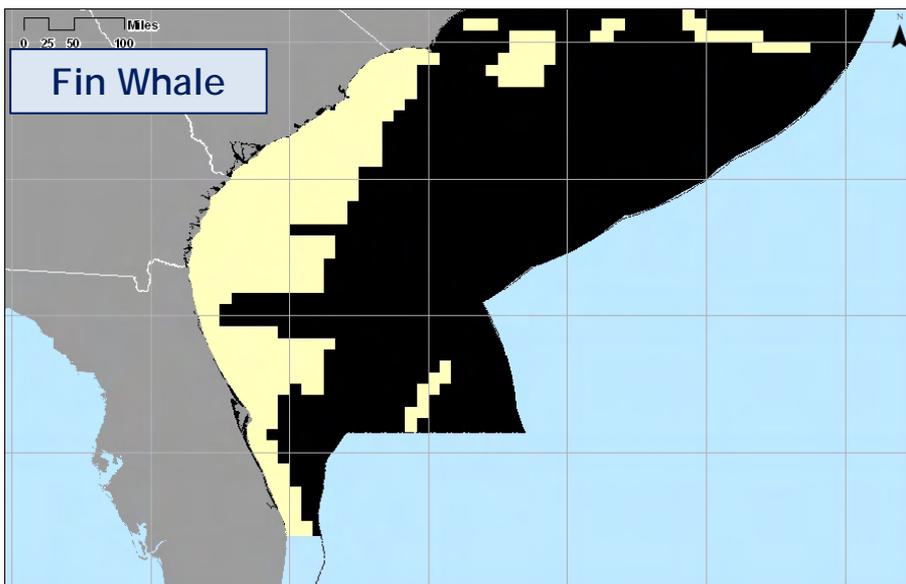
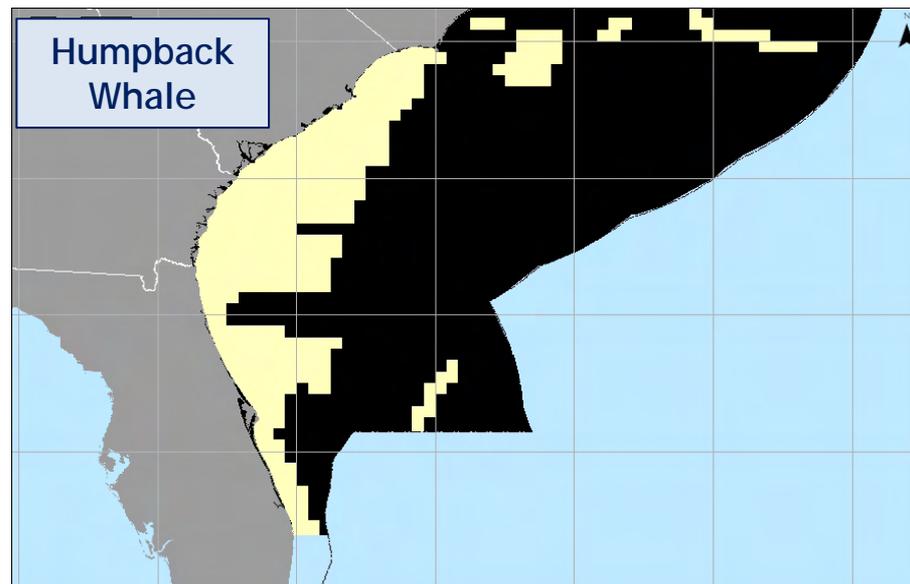
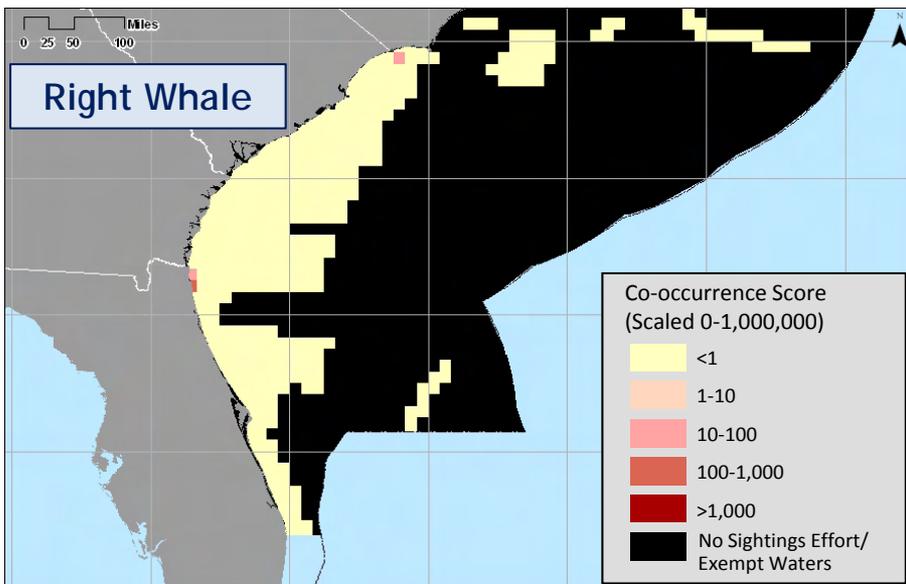
September Co-Occurrence: All Fisheries, Southeast



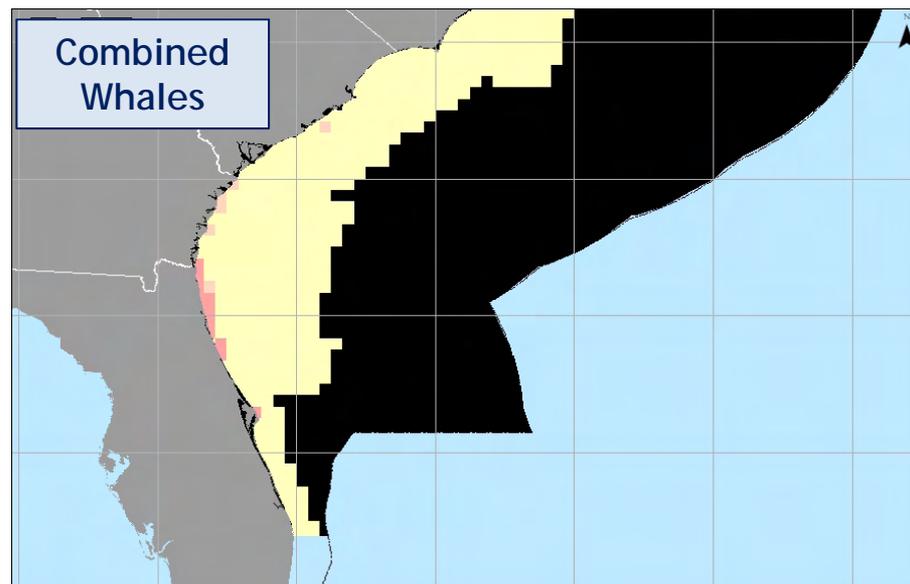
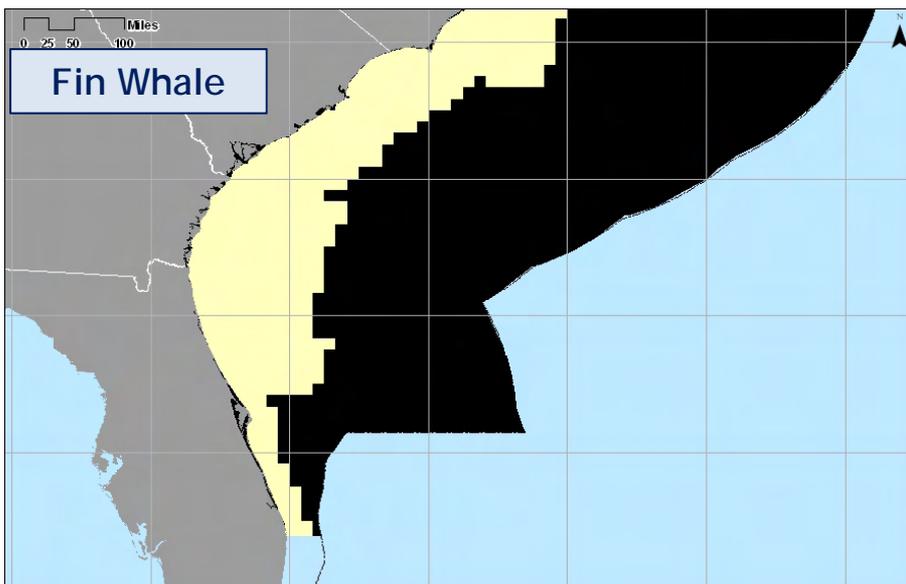
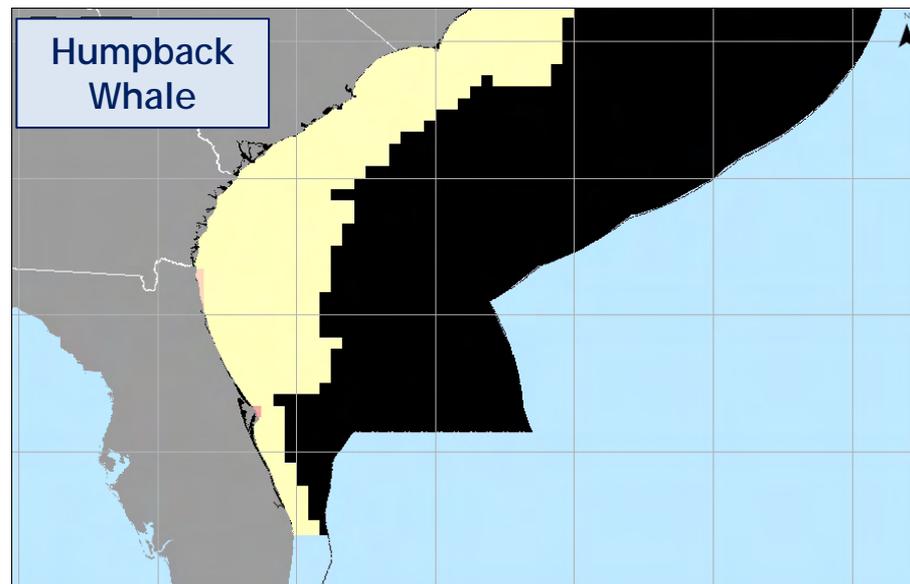
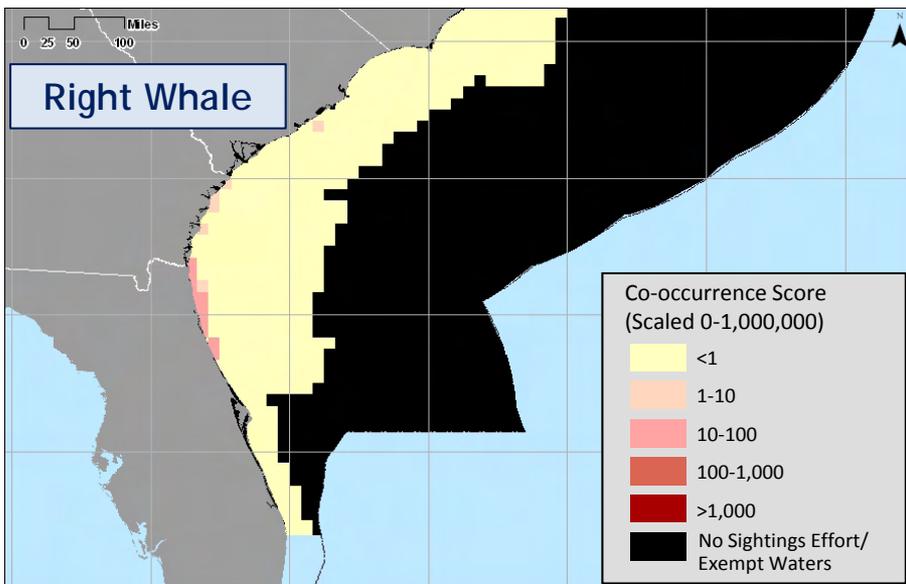
October Co-Occurrence: All Fisheries, Southeast



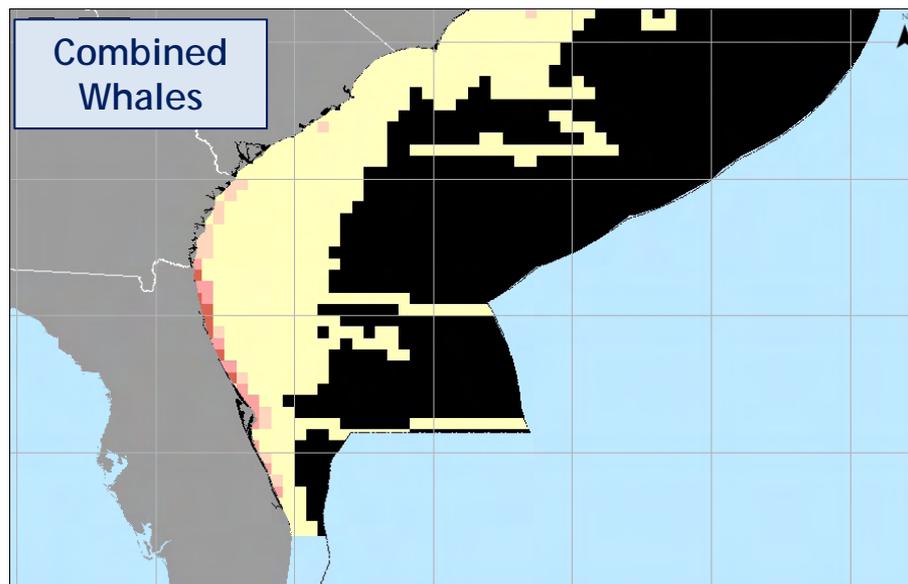
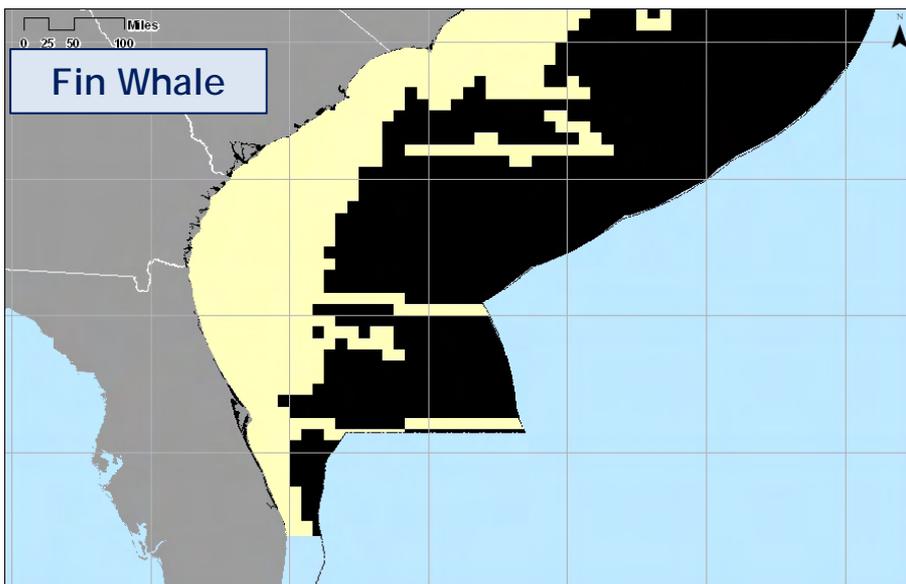
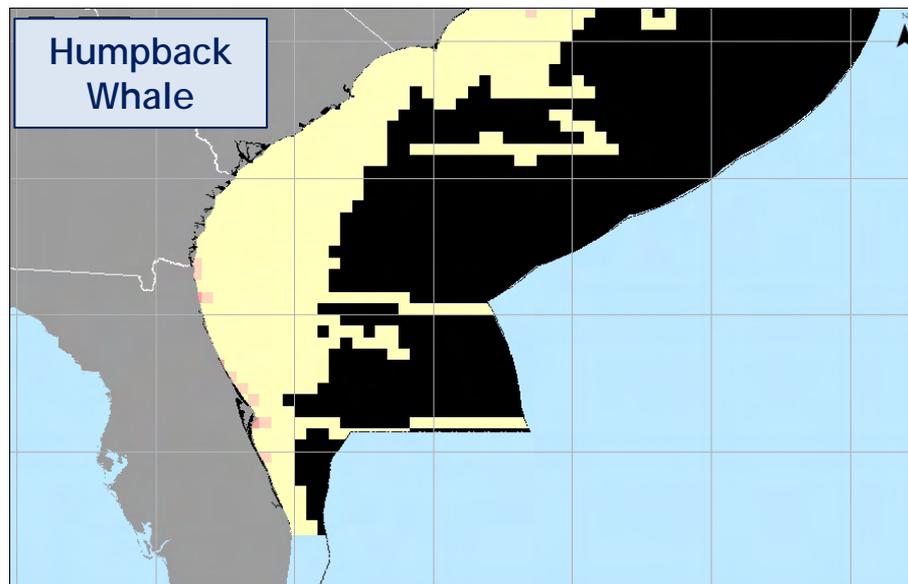
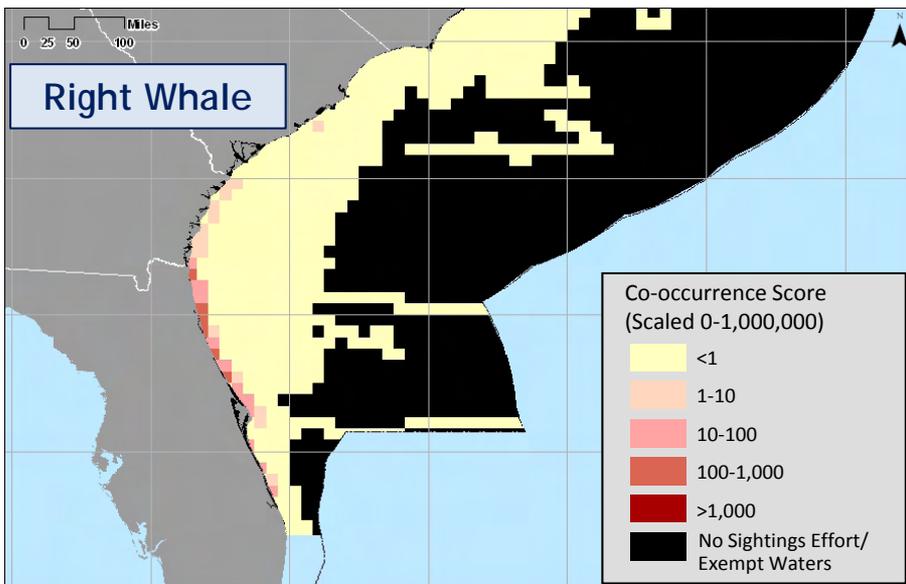
November Co-Occurrence: All Fisheries, Southeast



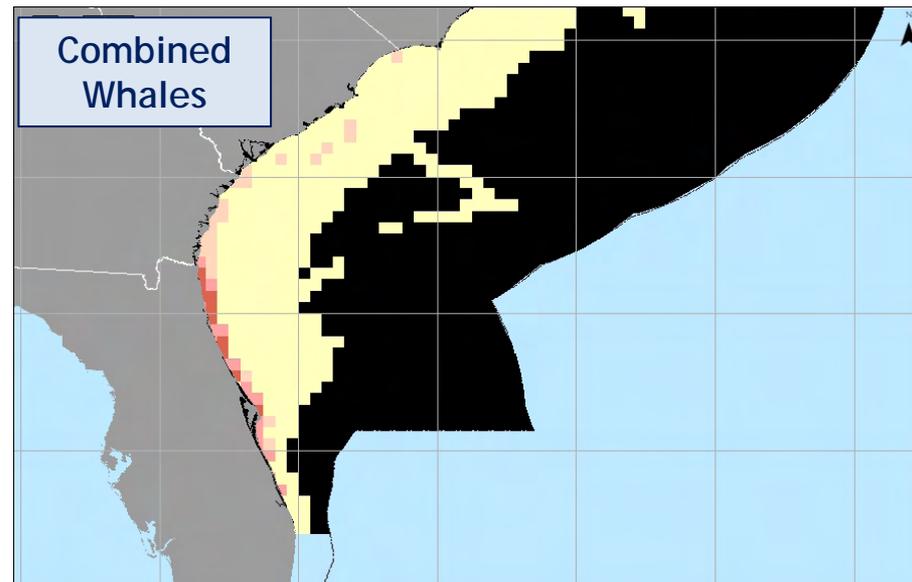
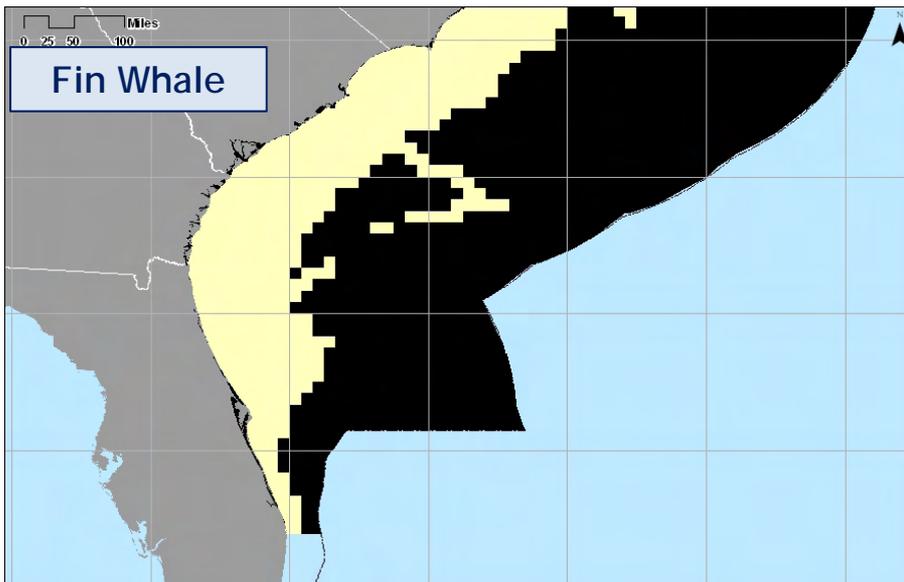
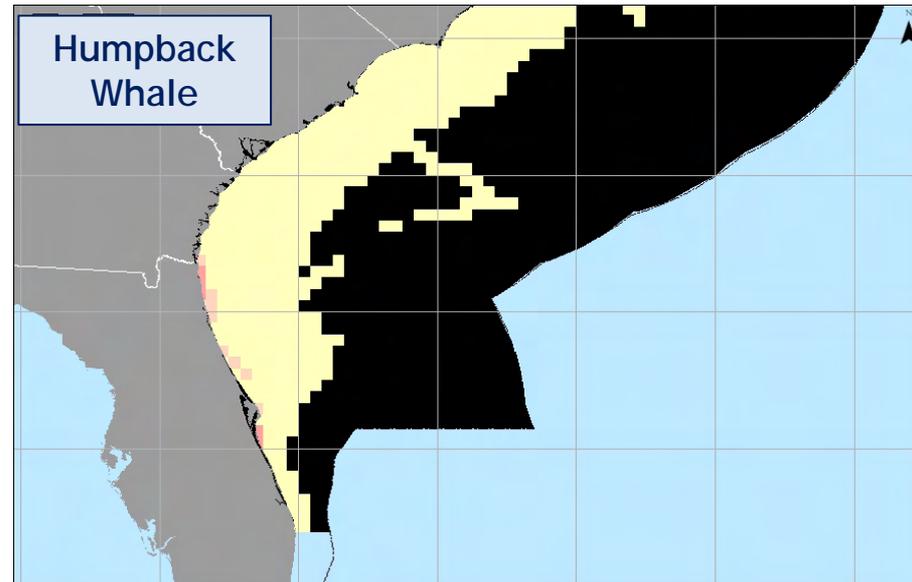
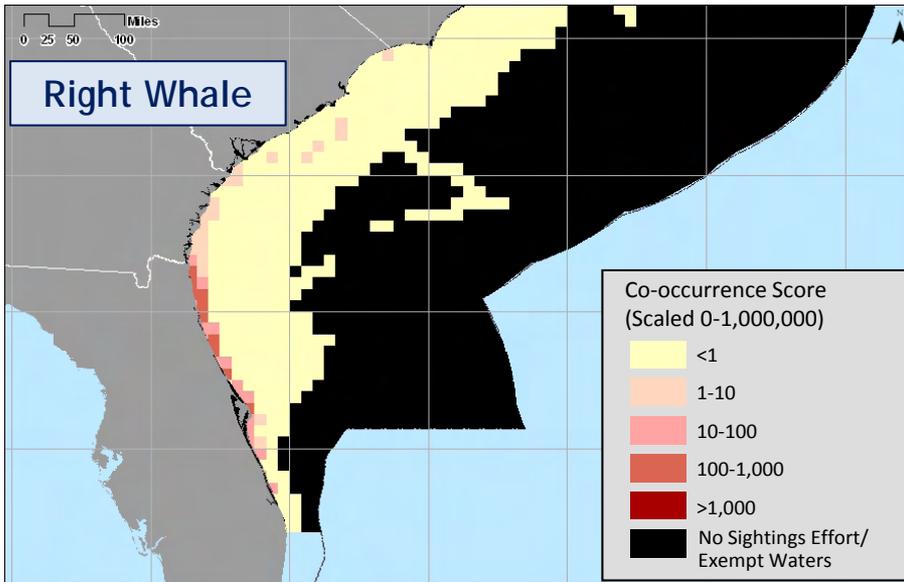
December Co-Occurrence: All Fisheries, Southeast



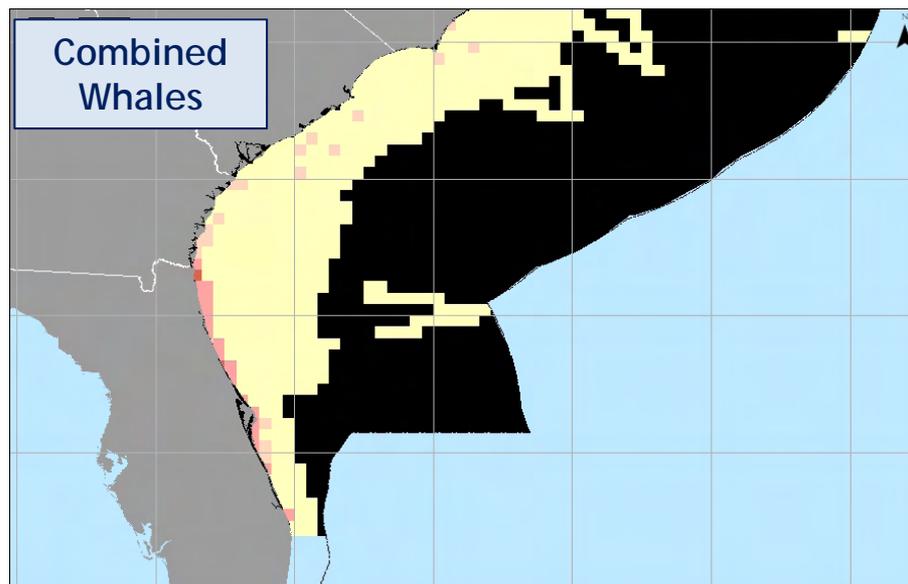
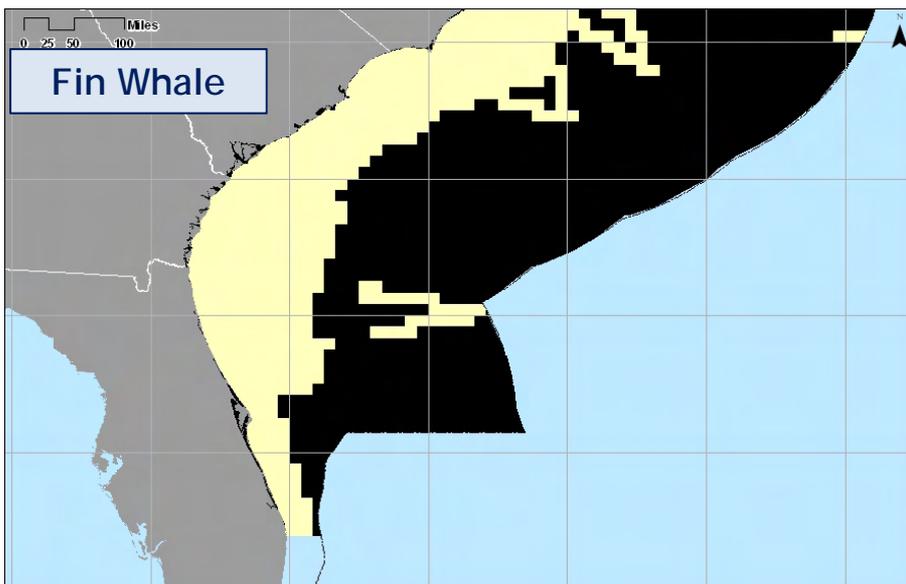
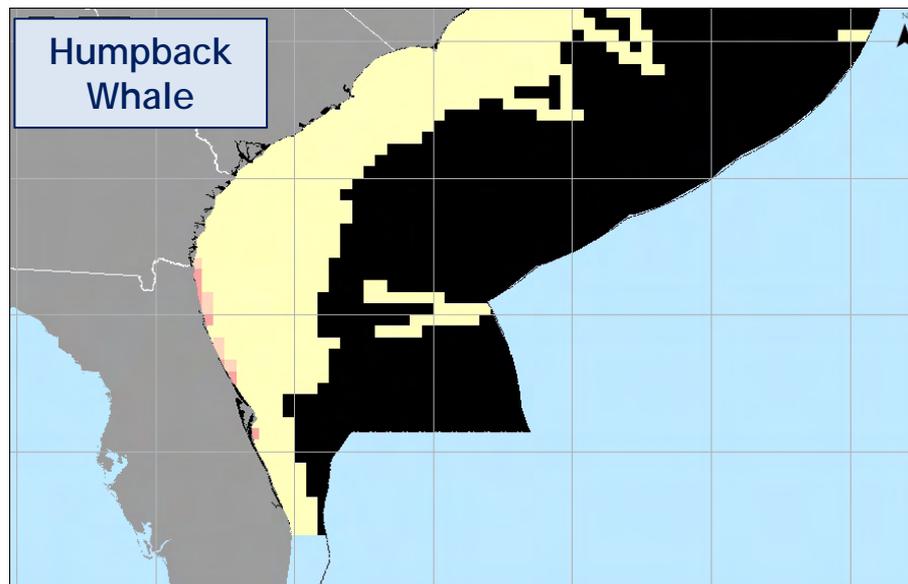
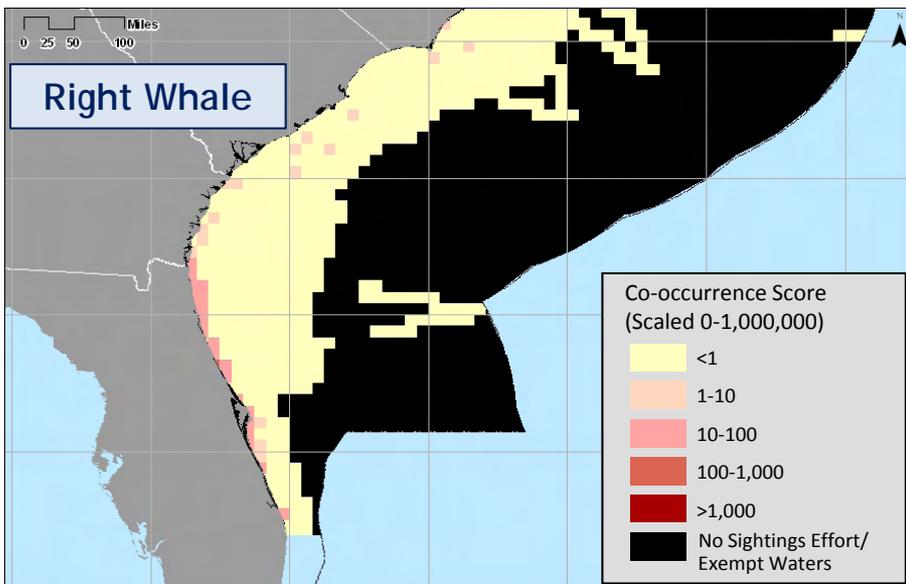
January Co-Occurrence: All Fisheries, Southeast



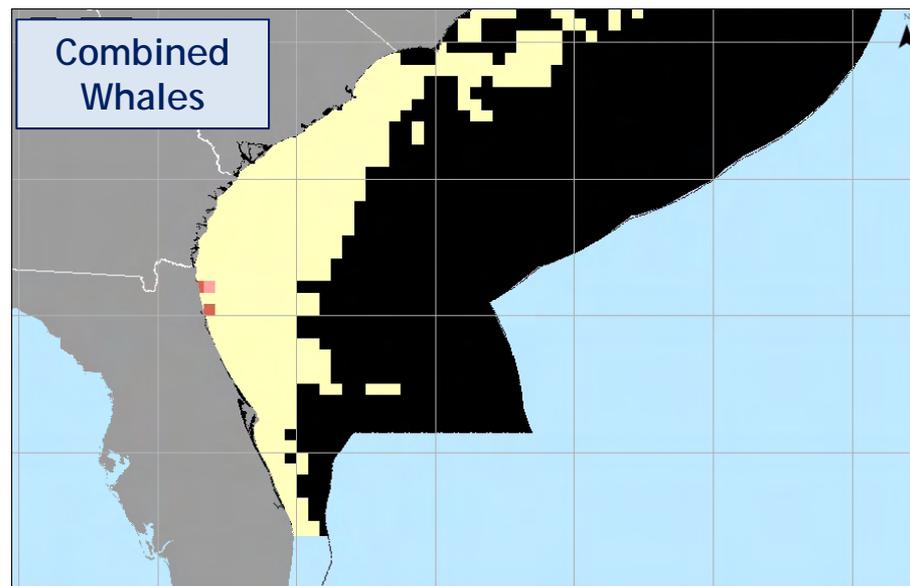
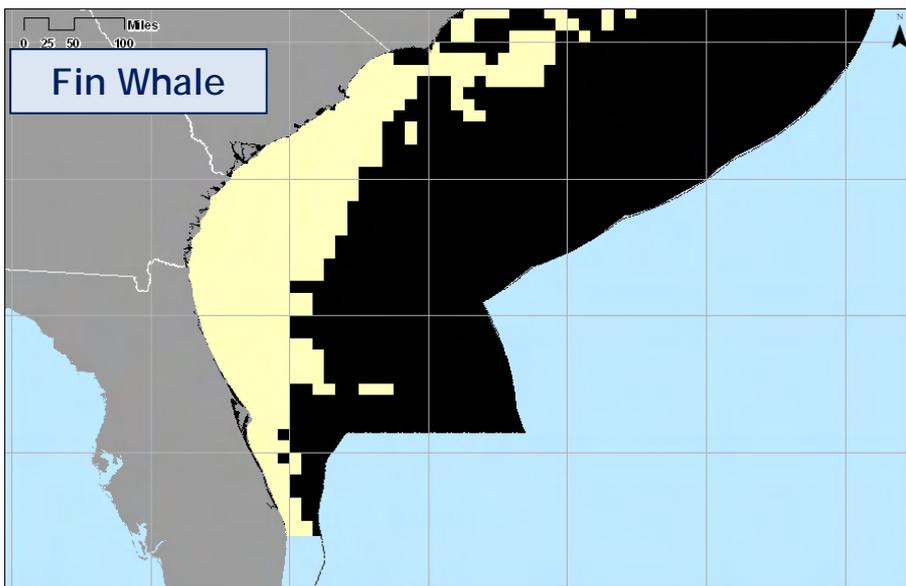
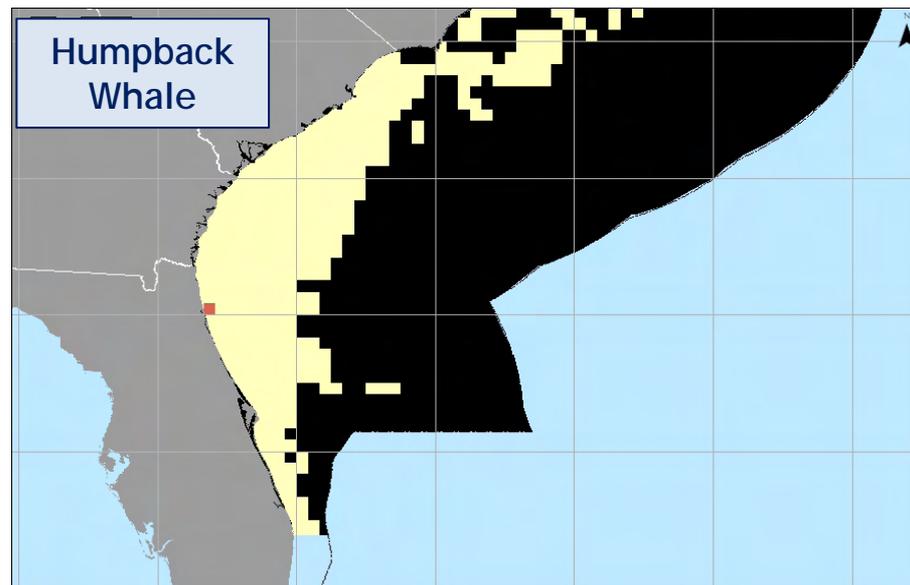
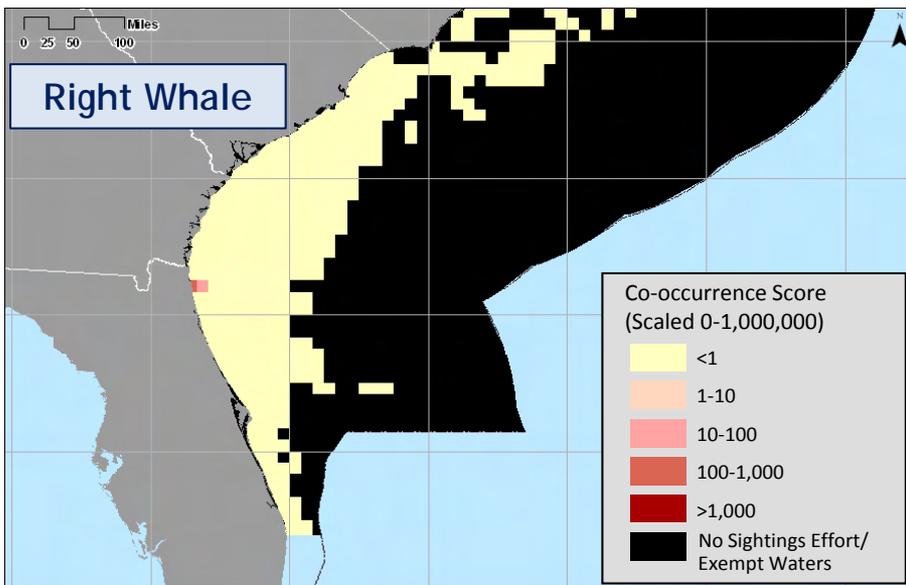
February Co-Occurrence : All Fisheries, Southeast



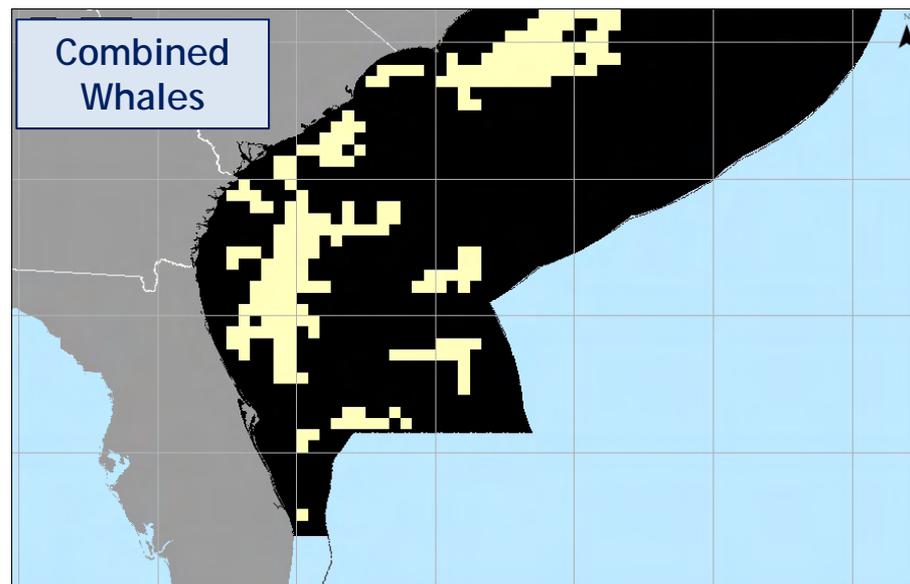
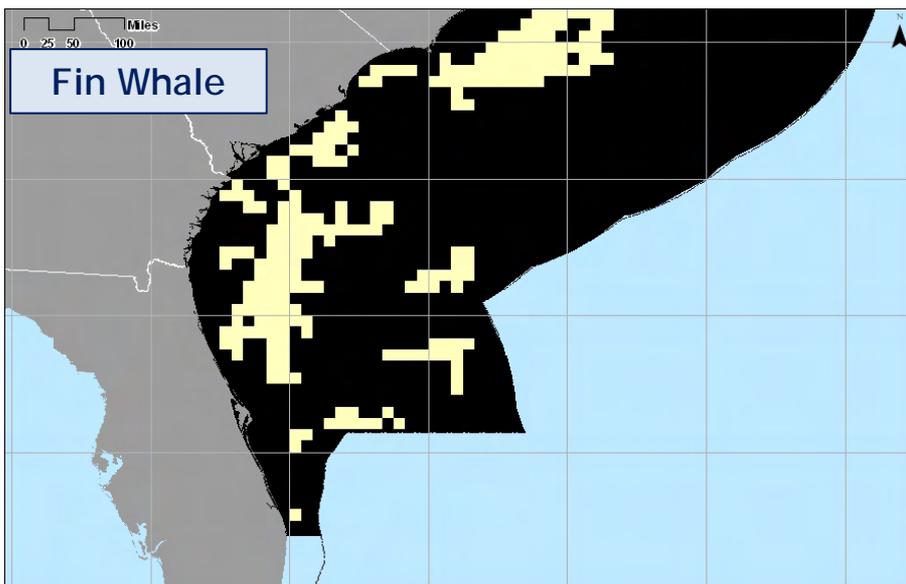
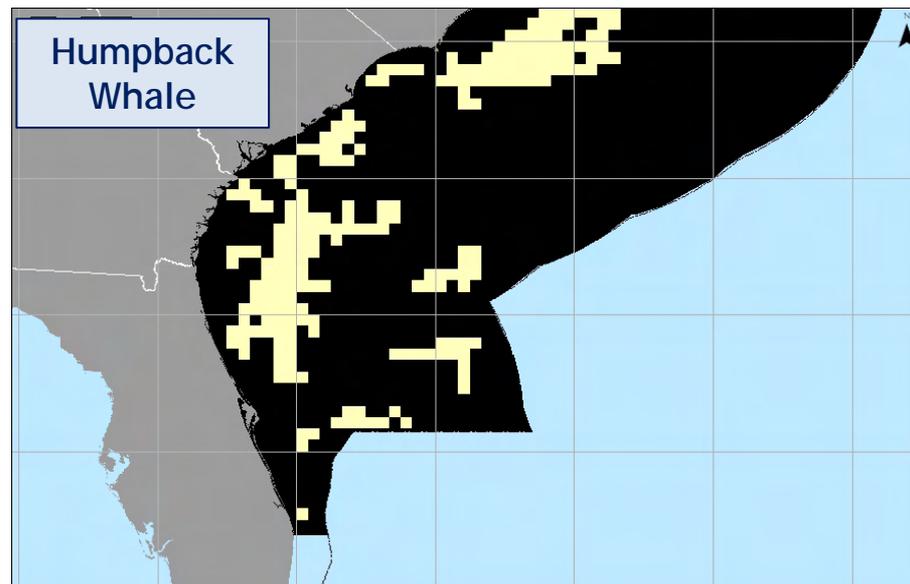
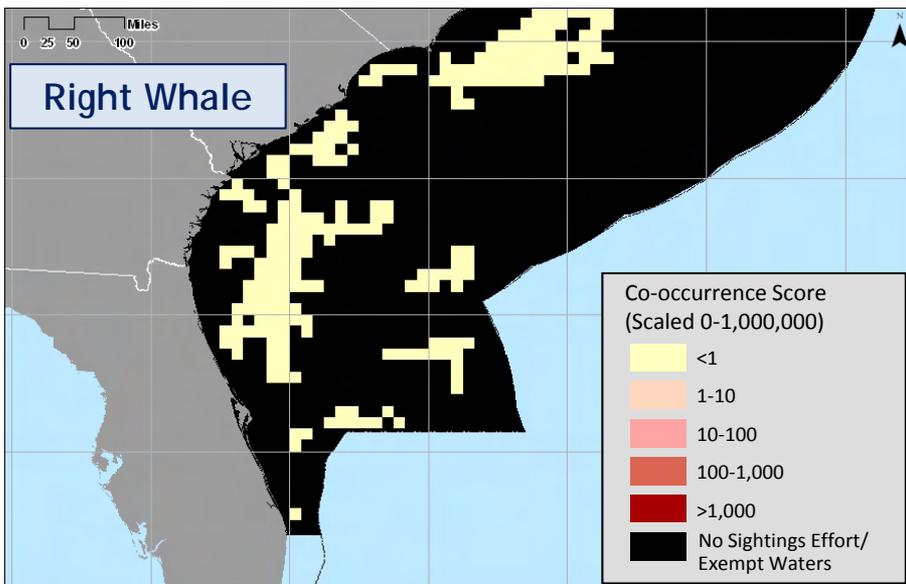
March Co-Occurrence: All Fisheries, Southeast



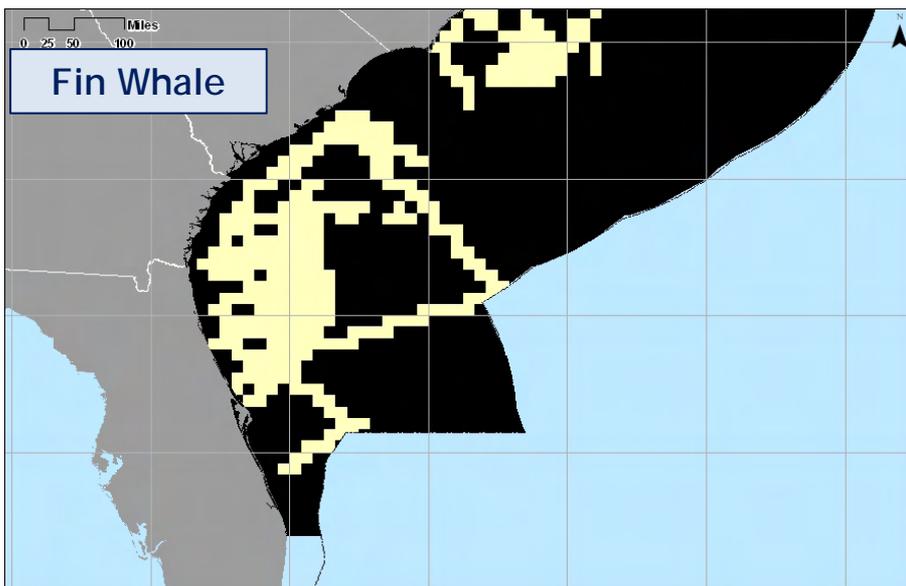
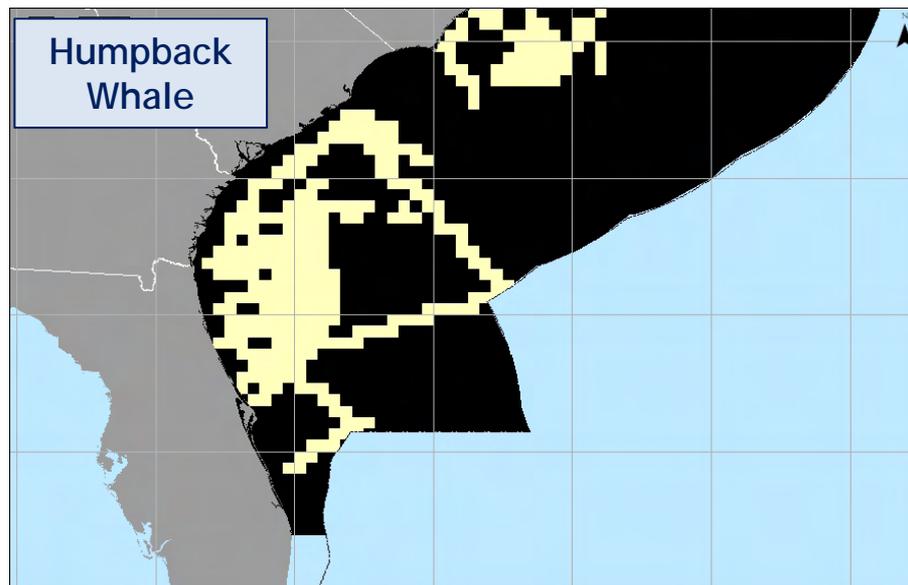
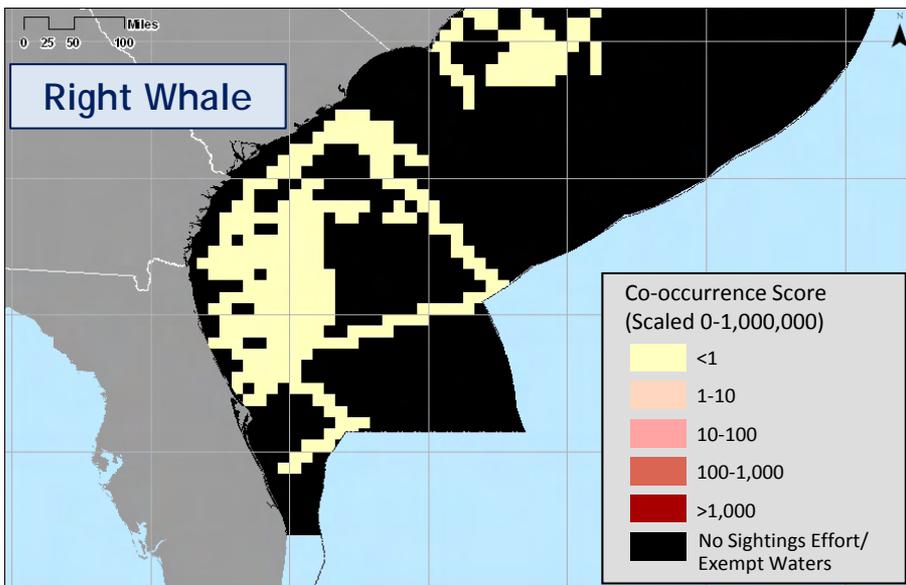
April Co-Occurrence: All Fisheries, Southeast



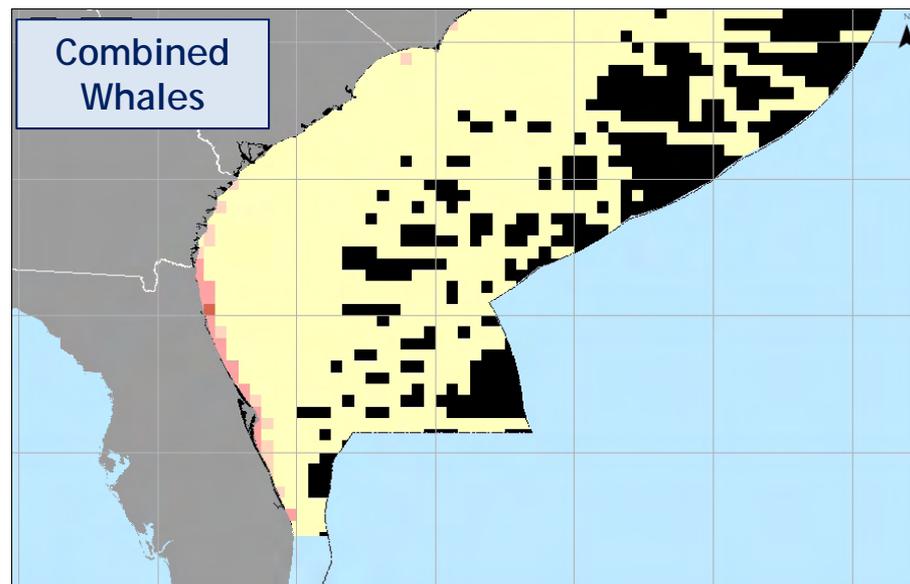
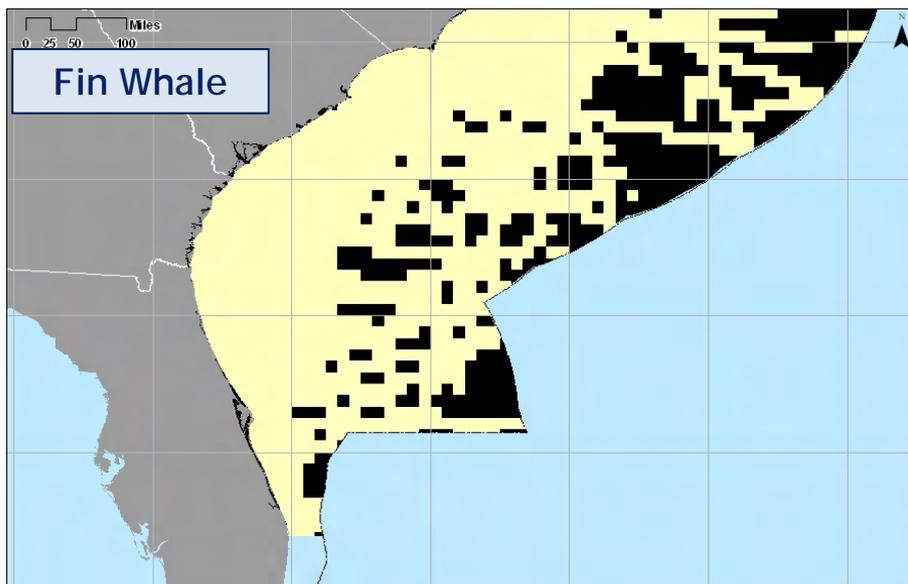
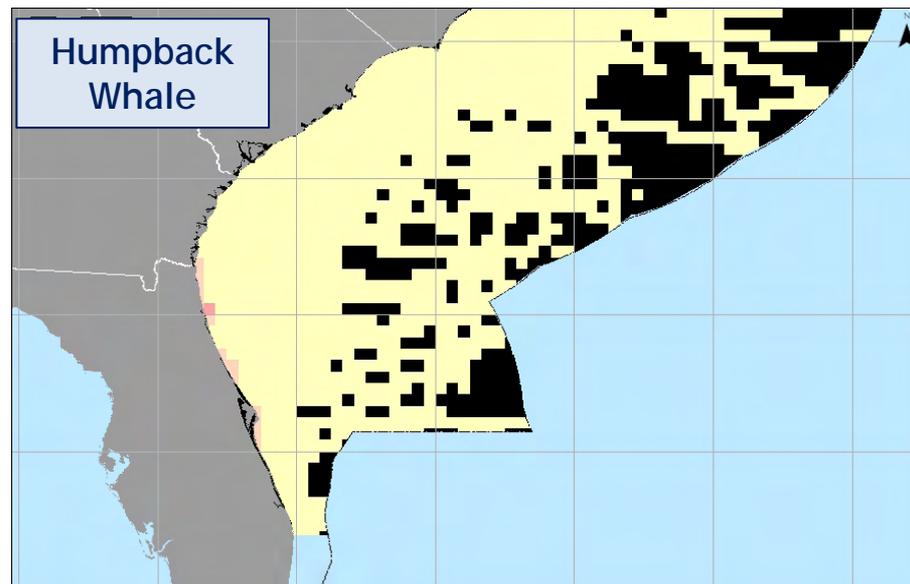
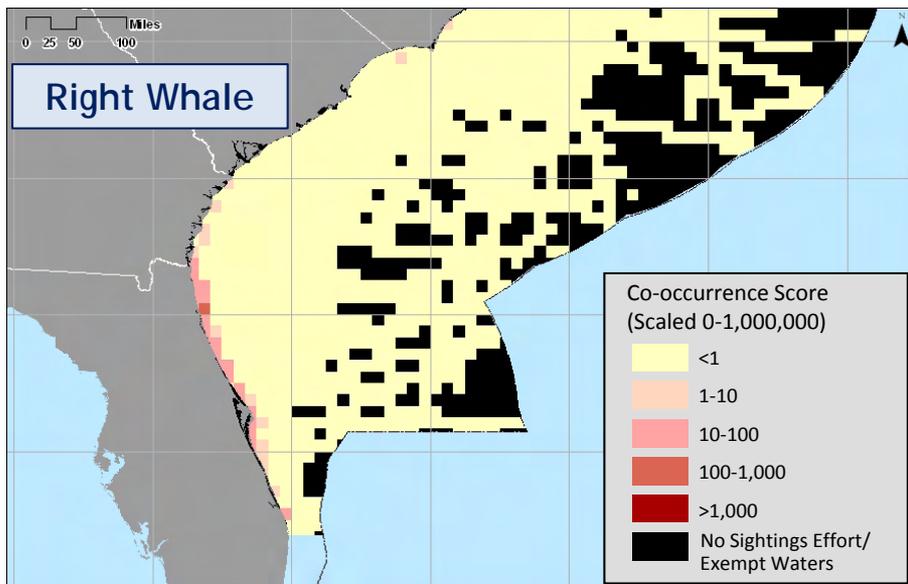
May Co-Occurrence: All Fisheries, Southeast



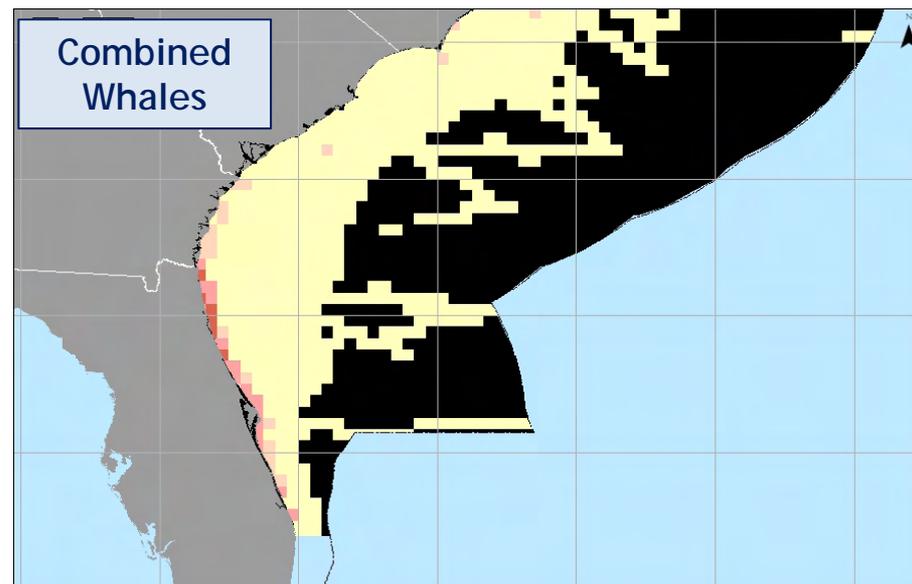
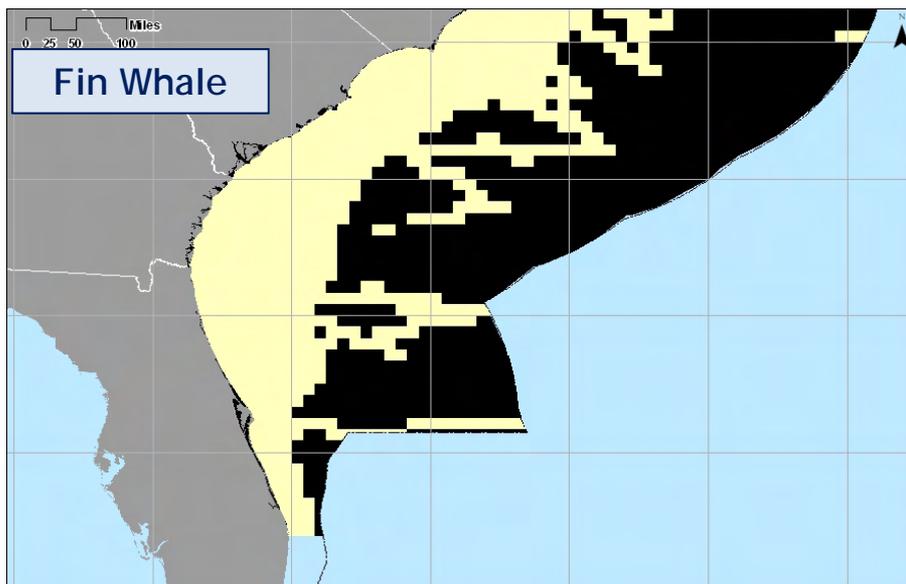
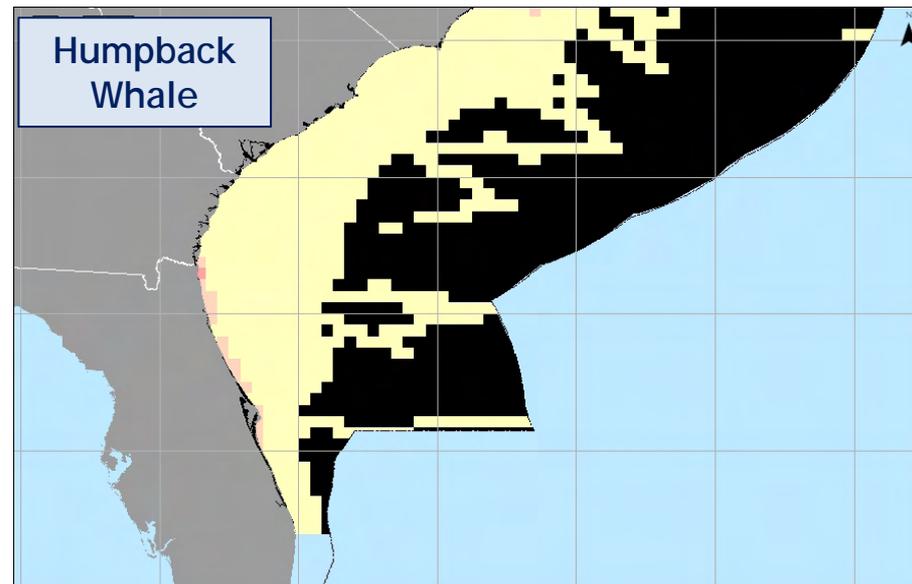
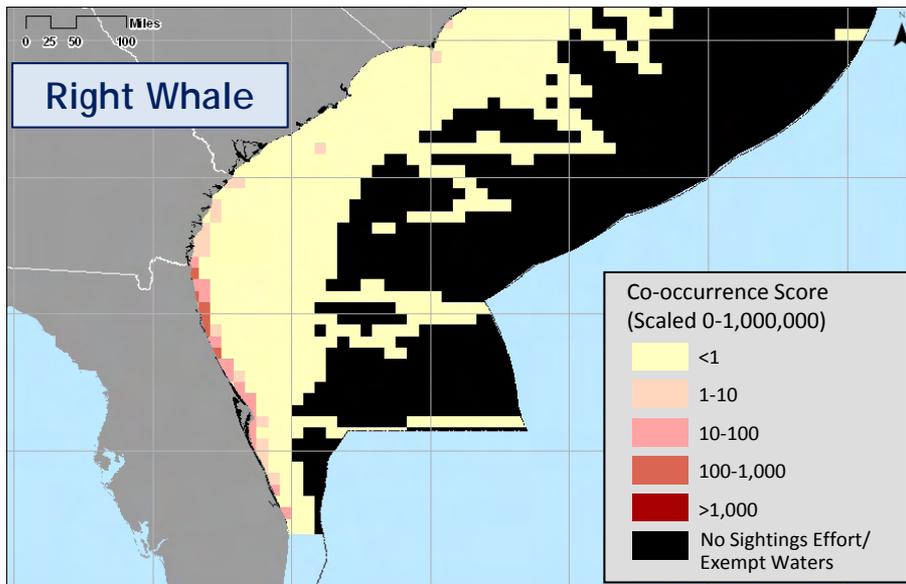
June Co-Occurrence: All Fisheries, Southeast



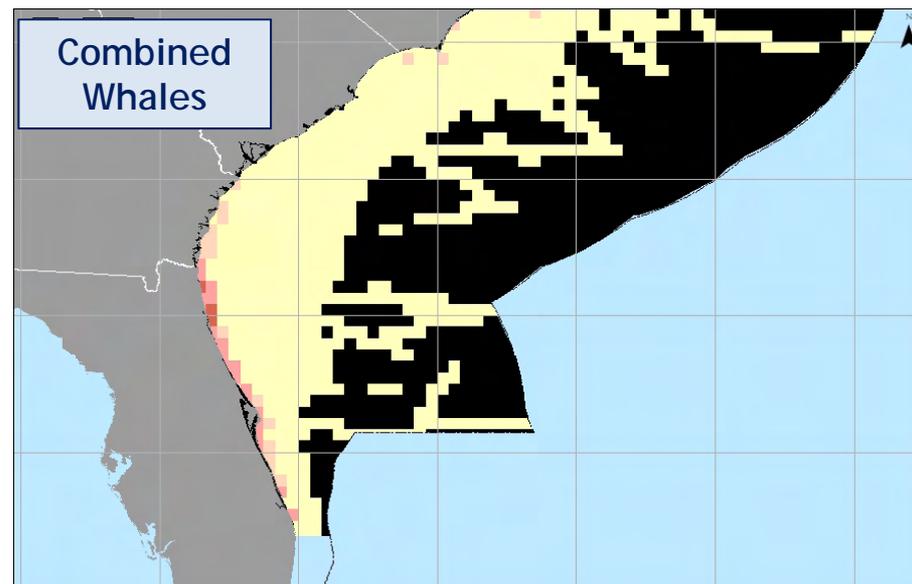
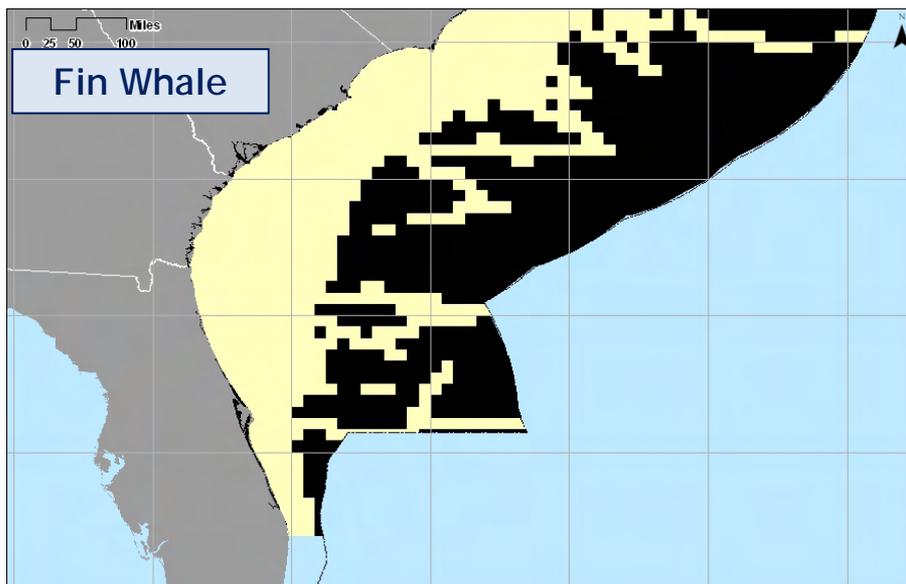
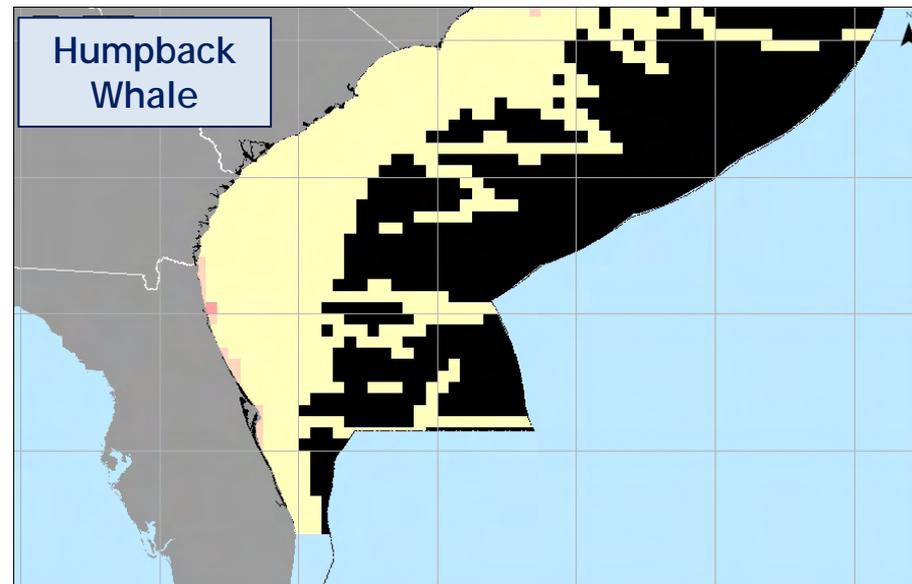
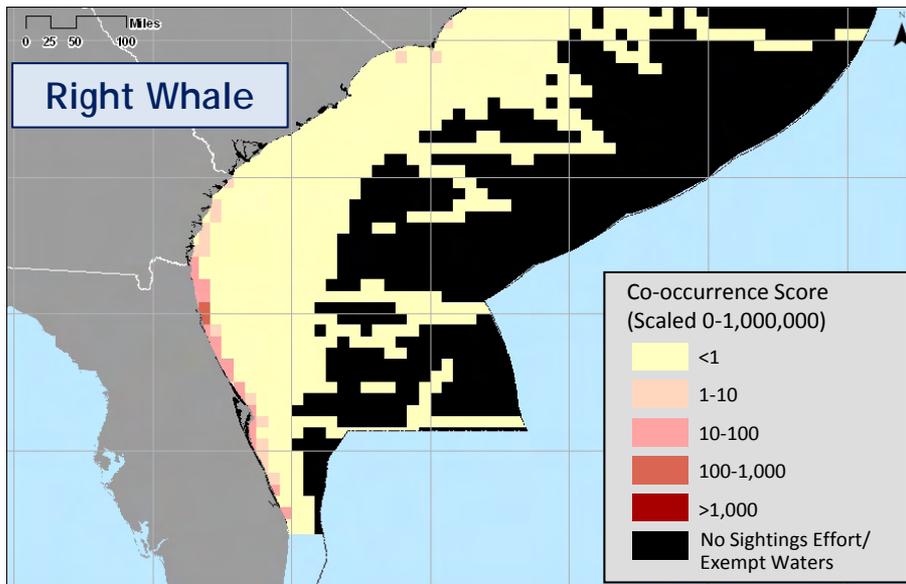
Average Co-Occurrence: All Fisheries, Southeast



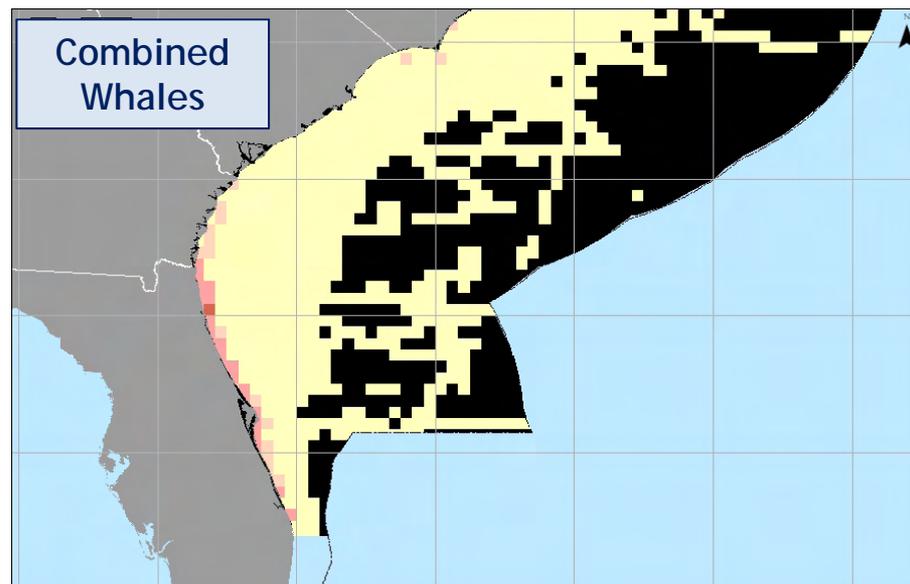
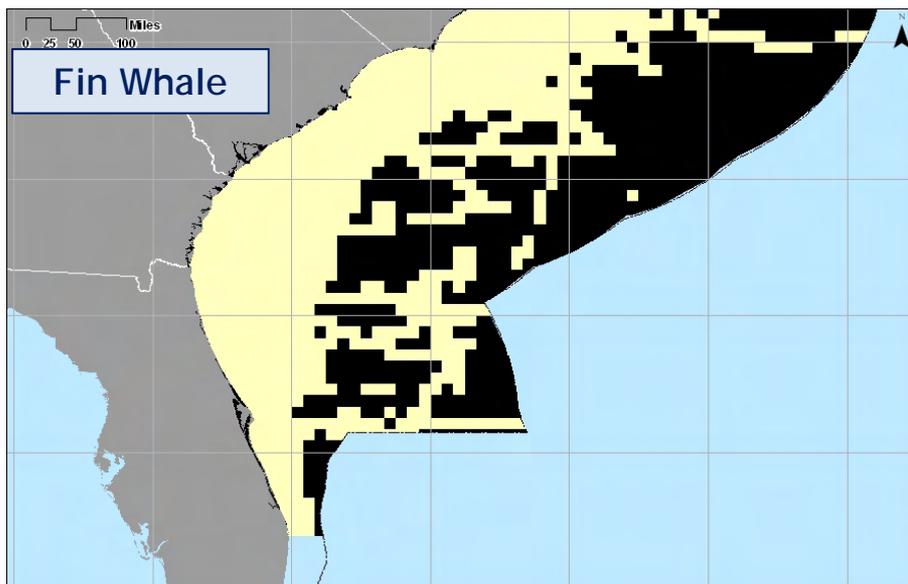
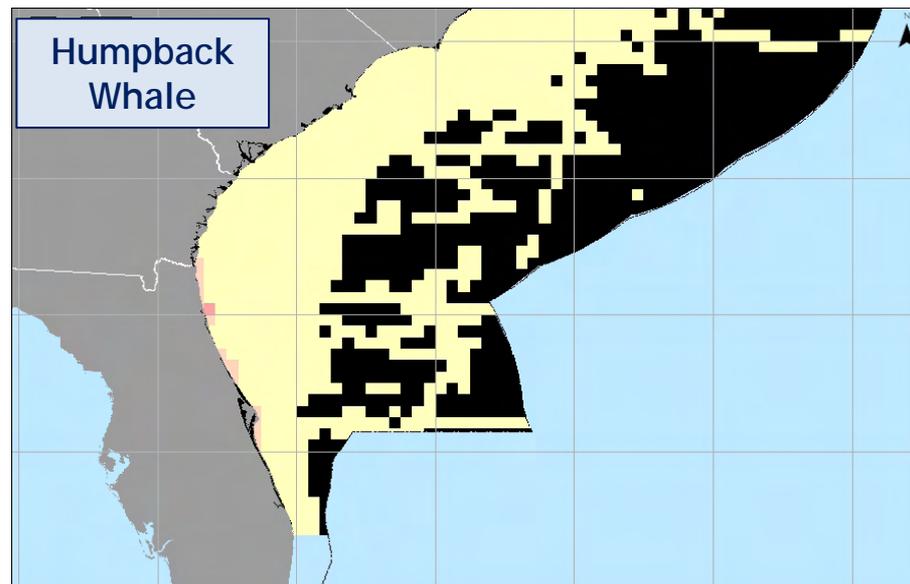
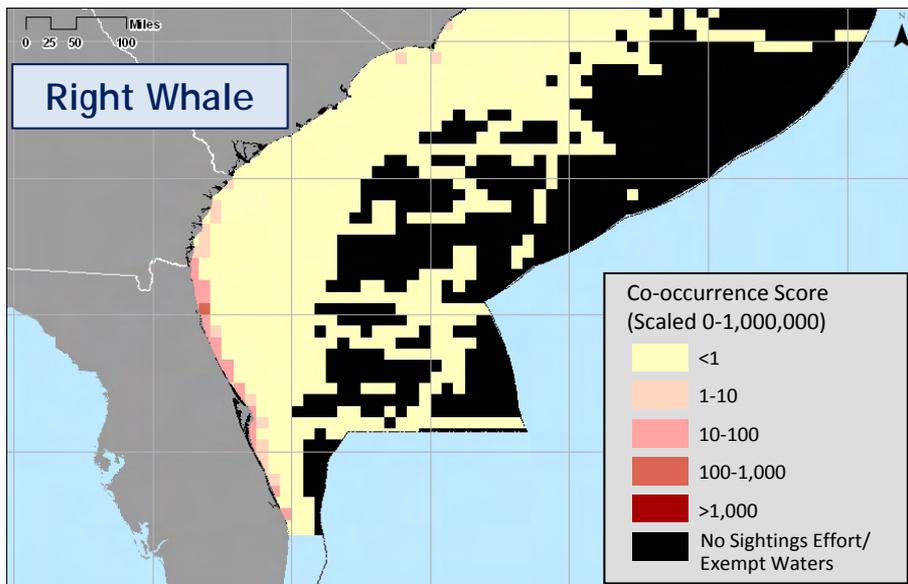
December-March Co-Occurrence: All Fisheries, Southeast



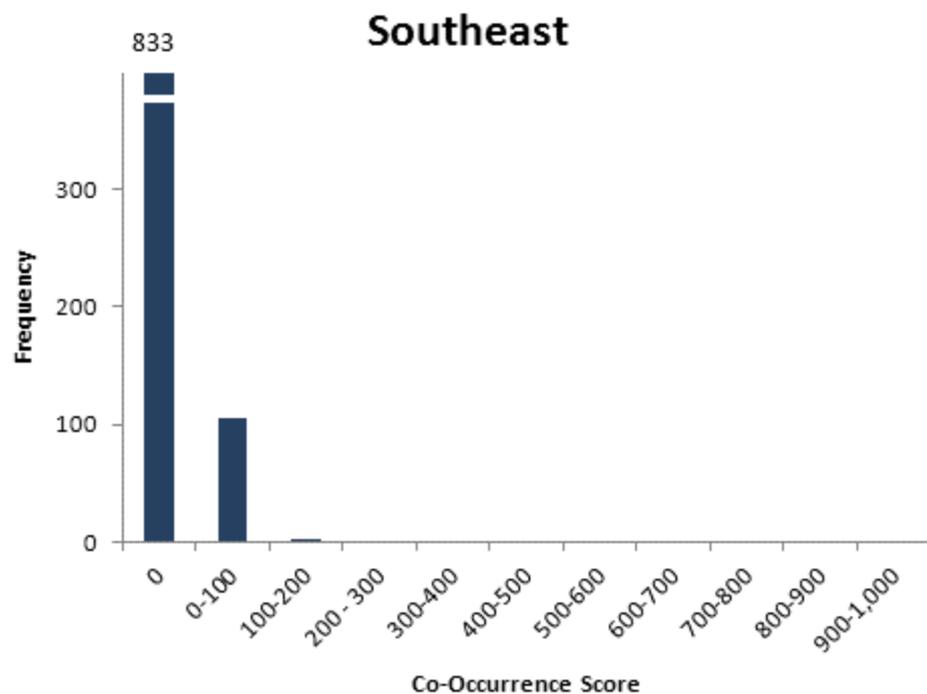
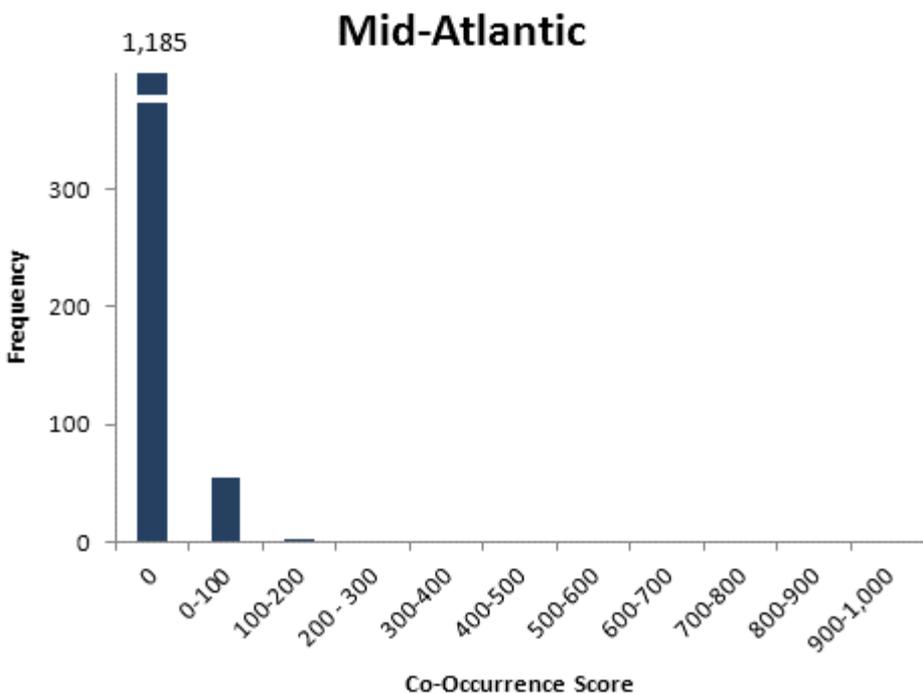
November-April Co-Occurrence: All Fisheries, Southeast



September-May Co-Occurrence: All Fisheries, Southeast



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



General Observations for the Southeast and Mid-Atlantic



- In the Southeast, the sole notable concentration of positive co-occurrence scores is found off Florida and Georgia from December through March.
 - These scores are driven primarily by the presence of right whales.
 - Improved information on the location of fishing activity may reduce co-occurrence scores within Florida's state waters.
- In the Mid-Atlantic, no notable concentration of positive co-occurrence scores is evident.
 - Scores greater than zero are few and widely scattered.
 - No clear seasonal pattern for any species.