A model of entanglement risk for lobster fishing off the coast of Maine

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Approach:

Estimate the expected number of whale/fishing gear encounters per year – this will depend on:

- fishing effort
  - vertical line density
  - trap string configuration
- whale activity
  - density
  - behavior (transiting, feeding, etc.)
- topography
  - water depth
  - bottom characteristics

Estimate reductions in risk (encounters/year) from adjustments to fishing effort (time, location, gear configuration).
Vertical Line Risk

Probability of whale-line encounter

= f ( lines/km$^2$
     whale track/km$^2$
     [whale size] )
Ground Line Risk

Probability of whale-line encounter

\[ = f \left( \frac{\text{h line length}}{\text{km}^2}, \frac{\text{whale track}}{\text{km}^2}, \text{[whale size]}, \text{water depth}, \text{whale diving} \right) \]
Model Polygons and Fishing Zones
Fishing Activity Data

5.9 million VL-months

Exempt state: 70.6%
Non-ex. state: 22.7%
3-6 miles: 3.2%
6-12 miles: 1.4%
12-40 miles: 2.1%
Fishing Gear in the Water

Estimated Vertical Lines

January  
February  
March  
April  
May  
June  
July  
August  
September  
October  
November  
December
Sightings per Unit Effort, Opportunistic and Satellite Tagged Locations of Right Whales in Maine State Waters
Survey effort is concentrated offshore
Modeled Whale Activity

Modeled Whale Activity

511,500 km whale track

Whale track distribution:

- State exempt: 0.3%
- State non-ex.: 0.8%
- 3-6 miles: 1.7%
- 6-12 miles: 5.7%
- 12-40 miles: 91.5%
Model Input Summary
Baseline: Expected Encounters 2011

expected encounters/year:

VL  2,163
GL  342
total  2,505
### Baseline: Expected Encounters

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- **23%**
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- **6%**
- **8%**
- **10%**

**Column Totals:**

- **2,505**
Sensitivity Analysis

• Both fishing effort and whale activity data sets incorporate assumptions
  – allocation of active traps to areas
  – whale activity level in nearshore waters

• Results: risk hot spots predicted by the model are robust over wide range of input assumptions
Example: Sinking Ground Line Rule

12% reduction in total pre-rule encounter risk

(347 avoided encounters/year)
Main Points

• Spatial distribution of risk is sensitive to assumptions about inshore whale activity
  – Assuming inshore activity = 0 is a sure way to NOT address significant percentage of total risk

• Risk is concentrated in temporal/spatial hot spots
  – Danger: blanket measures that miss hot spots are unlikely to reduce risk significantly (though they may reduce VLs)
  – Opportunity: targeted management measures can reduce risk with minimal disruption of fishing (but may be harder to enforce)
Acknowledgements

Collaborators:

Chris Brehme, Keene State College
Tara Hetz, WHOI Summer Student Fellow
Scott Kraus, New England Aquarium
Kerry Lagueux, New England Aquarium
Cris Lutazzi, WHOI Summer Student Fellow
Patrice McCarron, Maine Lobstermen’s Association
Heather Tetreault, Maine Lobstermen’s Association
Sophia Weinman, WHOI Guest Student
Brooke Wikgren, New England Aquarium

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