What We Need to Know About Biological Risk

- What’s there?
- How many are there?
- How are they distributed in time & space?
- Why are they there?
- What is the mechanism that leads to risk?
Importance of Understanding Bioacoustics

• Sound is an essential component to many (if not all) species of marine vertebrates
  - Used for communication, foraging, navigation, predator avoidance
  - Biological sounds travel across scales up to 1000s of km

• Anthropogenic activities have raised ambient noise levels 1000x in only 40 years
  - What is the impact of current activities on the acoustic ecosystem?
  - How does this effect organisms’ habitat?
  - What are the consequences of expanded development?
Context:
Understand seasonal occurrence of large whale species in the Virginia Offshore Wind Energy Planning Area

Challenge:
Extremely sparse data on baleen whale occurrence in mid-Atlantic waters
Species of Interest

North Atlantic right whale

- ~400 individuals
- Spend summers feeding in Canada, winters calving near Georgia/Florida
- Immense scientific and regulatory concern

Up-call

- Most common right whale vocalization (Parks & Clark 2007)
  - thought to function as contact call
- Can automatically detect using algorithm (e.g., Urazghildiiev et al. 2009)
Right Whale Migration + Wind Areas

- Mass Bay/Cape Cod Bay - Winter/Spring
- Great South Channel - Spring/Summer
- Bay of Fundy - Summer/Fall
- Scotian Shelf - Summer/Fall
- Calving Grounds - Fall/Winter

Migration schematic from WHOI
Marine Autonomous Recording Unit (MARU)

• Archival recorder
• Records for up to ~ 4 months
• Sampling rates up to 64 kHz, typically 2 kHz

• Can be used for presence/absence or deployed in arrays for localization
Passive Acoustic Monitoring

**Advantages**
- Excellent for detecting vocally active species
  - particularly species that are difficult to see
- Provides pervasive record
- Ability to simultaneously detect multiple species
- Ability to detect other environmental sounds
- Ability to detect anthropogenic activity
- Non-invasive

**Disadvantages**
- Can’t detect non-vocalizing species
- Many unknown calls
- Challenging to analyze and curate large datasets
Cornell Survey Locations

Norfolk
Virginia Beach
Acoustic Monitoring to Understand Ecology and Biodiversity

Archival Acoustic Data

Automated Sound Analysis and Signal Processing

Detectors/classifiers

Identified Whale Sounds (+ metadata)

Baseline Ecological Records

Right Whale Fin Whale

Temporal

Month

Spatial

Time-stamp and sensor location of sounds of interest becomes the foundation for understanding spatial and temporal occurrence patterns
Results: Right Whale Monthly Occurrence
Conclusions from Virginia Acoustic Survey

New understandings of right whale occurrence
• Present throughout year
• Peak occurrence is Feb/March
• Call most regularly at dusk
• Influence timing of different construction activities

Cornell work ongoing:
• 2nd year of VA data being collected
• Also collecting data at other Atlantic coast sites

Long-term surveys in focal areas can:
• Reduce data gaps
• Further reduce risk to developers
• Help minimize environmental impacts
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