Boat Visitation Rates from Acoustic Detections on Paired Artificial-Natural Reefs on the West Florida Shelf

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photo: University of Florida
Introduction

- Goals of establishing artificial reefs:
  - fisheries management and conservation
  - social and economic benefits

- Various ways to quantify social and economic benefits... including quantifying boats
  - boater surveys (e.g., Swett et al. 2011)
  - charter log books (e.g., Leeworthy et al. 2006)
  - direct observations (e.g., Leeworthy et al. 2006)
Can also monitor boat traffic with acoustic recordings

- Naval and other government surveillance since WWII (e.g., SOSUS)
- Conservation purposes (e.g., Koenig & Coleman 2011)

- Advantages:
  - Synoptic data collection (spatial and temporal)
  - Data collection regardless of weather, daylight, etc.
Purpose of Study

To investigate boat visitation rate patterns on artificial and natural reef pairs on the central West Florida Shelf using autonomous acoustic recorders

Data Collection

- 4 artificial – natural reef pairs on West Florida Shelf
- Reefs range from ~9m to ~30m depth
- Site of concurrent studies on marine mammal, fish and invertebrate communities
Data Collection

- DSG (Digital SpectroGram) acoustic recorders
- 10 second / 10 minute duty cycle
- Moored on bottom

Data collected to date

- Since April 2013
- About 900,000 acoustic files (~1 TB)
- *How do you look for boat noise in 900,000 files?*
Boat detection algorithm

Boat noise is typically characterized by...
- Harmonics
- Higher sound amplitude at lower frequencies
Boat detection algorithm

- Algorithm performance (Simard et al. submitted):
  - test set of data from the study area: 2,742 files
    - 184 with boat noise, 2558 without boat noise
  - overall success rate 94.5%
    - 26.6% true positives
    - 0.7% false positives
Converting Detections to Number of Boats

Probability of detection by detection algorithm
= 0.266

Probability of false detection by detection algorithm
= 0.007
Converting Detections to Number of Boats

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Fluctuations in detection range (e.g., season) to be determined

0 0 0 0 0 0 1 0 0
0 1 0 1 1 0 1 0 0
0 0 0 0 1 0 1 0 1
0 1 0 0 1 0 1 0 1
0 0 0 0 1 0 1 0 0
0 0 1 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0
0 1 0 0 0 0 0 0 0
Converting Detections to Number of Boats

- Probability of detection by detection algorithm = 0.266
- Probability of false detection by detection algorithm = 0.007
- Fluctuations in detection range (e.g., season) **to be determined**
- Probability of detection from duty cycle = 0.539
Converting Detections to Number of Boats

Probability of detection by detection algorithm
  = 0.266

Probability of false detection by detection algorithm
  = 0.007

Fluctuations in detection range (e.g., season) to be determined

Probability of detection from duty cycle
  = 0.539

Probability of boat in acoustic range but not stopping at reef
  Clearwater (artificial) = 0.62
  21HS (natural) = 0.11
Results & Discussion:
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Clearwater Reef (artificial reef)

• Boat visitation rates peak May – Sept
  • Similar to general recreational boat usage (Sidman et al. 2004)
  • Similar to visual boat counts during USF research cruises

• High numbers of boats visiting reef
  • Similar to visual boat counts during USF research cruises
Results & Discussion:

21HS (natural reef)

- Boat visitation rates sporadic, but diffuse peak from May - December
  - Similar to visual boat counts during USF research cruises
  - Due to high proportion of “drive-by” boats?
- Very few boats visiting reef
  - Similar to visual boat counts during USF research cruises
Results & Discussion:

• Boat visitation rates at Clearwater artificial reef up to 150x rates at 21HS natural reef

• May – September 2013
  • Clearwater artificial reef: 7000 boats visiting
  • 21HS natural reef: 100 boats visiting

• **WHY?** Natural reef is relatively unknown? Fishing perceived as not as good?
Conclusions:

• Acoustic recordings an effective method of estimating boat visitation rates
• Improvements to algorithms
• Concurrent use of alternate methods

• Preliminary results from this study...
  • boat visitation rates for Clearwater artificial reef peaked from May to September 2013
    • seasonal trend not as strong for the corresponding natural reef 21HS
  • Clearwater artificial reef had far more boat traffic than 21HS natural reef (up to 150x)
    • possibly due to lack of knowledge of 21HS or perceived recreational value
Acknowledgments:

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• USF CMS Fish Ecology Lab, David Mann, Adam Frankel, Shannon Gowans

References:

Koenig & Coleman 2011. Protection of grouper and red snapper spawning in shelf-edge marine reserves of the northeastern Gulf of Mexico. MARFIN report.


