Gulf of Mexico Marine Assessment Program for Protected Species -GoMMAPPS-

Marine Mammals

Keith D. Mullin
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New Orleans, Louisiana
GoMMAPPS Marine Mammals

Primary Objective

Gulf of Mexico cetacean species:

Up-to-date seasonal Spatially Explicit Density Maps

• inform stock assessments
• assist with management decisions related to energy development
Gulf-wide Approach  
(future funding)

• GOMx small relative to cetaceans’ ability to travel

• >50% of GOMx non-U.S.: Mexico & Cuba

• Southern Gulf not assessed by any country with broad scale surveys

• Changes in abundances & distributions difficult to interpret without GOMx-wide perspective
Gulf of Mexico Habitats and Cetacean Species & Stocks

- Bays, Sounds & Estuaries (BSE)
  - Bottlenose dolphins – 31 stocks
- Coastal Waters (0 – 20 m)
  - Bottlenose dolphins – 3 stocks
- Continental Shelf (20 – 200 m)
  - Atlantic spotted dolphins – 1 stock
  - Bottlenose dolphins – 1 stock
- Oceanic Waters (≥ 200 m)
  - 21 species – 21 stocks (tropical cetacean community)

Vollmer & Rosel 2013
Gulf of Mexico Oceanic Cetaceans

21 species routinely inhabit oceanic waters; currently – 21 stocks

- Bryde’s whale (ESA listing proposed)
- Sperm whale (ESA-listed)
- Dwarf sperm whale
- Pygmy sperm whale
- Cuvier’s beaked whale
- Blainville's beached whale
- Gervais’ beaked whale
- Short-finned pilot whale
- Killer whale
- Pygmy killer whale
- Melon-headed whale
- False killer whale
- Risso’s dolphin
- Bottlenose dolphin
- Rough-toothed dolphin
- Fraser’s dolphin
- Atlantic spotted dolphin
- Pantropical spotted dolphin
- Striped dolphin
- Clymene dolphin
- Spinner dolphin
Bryde’s Whales in the Gulf of Mexico

- Genetic analyses
- Significantly different from Bryde’s whales worldwide
- Unique evolutionary lineage
- Extremely low genetic diversity

Examples of Oceanic GOMx Abundance & Distribution Results

Group sightings from 1992-2009; abundances from Waring et al. (2012)

Bryde’s whale: $N = 33$ (1.07)

Sperm whale: $N = 763$ (0.38)

Pantropical spotted dolphin: $N = 50,880$ (0.27)

Short-finned pilot whale: $N = 2415$ (0.66)
GoMMAPPS Marine Mammal Objectives

Broad-scale multi-year seasonal abundance & distribution data

1. Continental shelf (0—200 m) – Seasonal aerial surveys
2. Oceanic waters (> 200 m) — Seasonal ship surveys

Data Analyses

1. Assemble and evaluate historical aerial and ship surveys
2. Assess bias-corrected population size of species/stocks
3. Develop models that incorporate habitat characteristics to translate current and past surveys into spatially-explicit maps of species density & uncertainty
   stock/species abundance
   spatially explicit density

Program Management

Data Management
** The timing of the proposed summer 2018 survey may change to a more optimal season if needed based upon a seasonal environmental variability analysis and availability of ship time.
Line-transect Surveys

Abundance estimates negatively biased for oceanic GOMx species

g(0) = probability of detecting an animal group/animal directly on the transect line

g(0) = 1: assumed for GOMx oceanic species but not always true

Perception bias – missed by observers (varies by survey conditions)
Availability bias – below surface

e.g., Barlow et al. (2015) (North Pacific Ocean):
  g(0) ≈ 1 for large schools of delphinids
  g(0) < 1 (0.40 – 0.70) for large whales
  g(0) << 1 (0.25 – 0.45) for Kogia and beaked whales

\[ N_i = \sum_{j=1}^{3} \frac{A_j \cdot n_{i,j} \cdot S_{i,j} \cdot f_i(0)}{2 \cdot L_j \cdot g(0)} \]
Ship-based Surveys

- Seasonal line-transect survey (60 days duration)
  - Two-teams to account for perception bias
- Biopsy samples
  - Stock structure
- Oceanographic data
  - CTD, XBT, EK60, Thermosalinograph
- Passive acoustic sampling
  - towed array
- Seabird survey
GoMMAPPS Passive Acoustics

Towed Hydrophone Array

Spectrogram

Bearing Track

Target Motion Localization
In-situ Oceanographic Sampling

XBT Stations

24 hour Thermosalinograph

(Left) Overall view of the SBE 21 SEACAT Thermosalinograph model. (Right) Thermosalinograph installed onboard the NOAA ship Ronald H. Brown.
Stock Structure — Sample Collection

- Large vessel surveys - shelf and oceanic species
- Skin samples for genetics
  - From the bow - bowriding species (small delphinids)
  - Deploy RHIB for large whales & larger delphinids

Typical biopsy sample which is subsampled for multiple analyses
Continental Shelf: Aerial Surveys

- Visual line-transect surveys (60 days duration)
- Two-team method to account for perception bias
- Seasonal surveys
- Bottlenose dolphins, Atlantic spotted dolphins & sea turtles
### Historical Data: GOMx Oceanic Cetacean Abundance Surveys

<table>
<thead>
<tr>
<th>Estimates</th>
<th>Years</th>
<th>Season</th>
<th>Type</th>
<th>Partners</th>
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<tbody>
<tr>
<td>Mullin &amp; Fulling 2004</td>
<td>1996-2001</td>
<td>Spring</td>
<td>“piggyback”</td>
<td>SEFSC/BOEM</td>
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<td>Waring et al. 2012</td>
<td>2009</td>
<td>Summer</td>
<td>Dedicated</td>
<td>BOEM</td>
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- “Piggyback” – conducted during spring bluefin tuna plankton surveys

![GOMx Oceanic Surveys](image)

Relative Effort

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Remotely-sensed Data

Real-Time Mesoscale Altimetry - Mar 24, 2012

Sea surface height anomaly

Sea surface temperature

CoastWatch chlorophyll 3-day composite viewed on NOAA's HABSOS.

Ocean color - chlorophyll
Topographic Data

Water depth

Bottom slope

Distance from features
  - MS River Delta
  - Shelf break
  - Canyons
Outcomes: Spatially Explicit Density Maps

Integrate
- Historical data
- Seasonal survey data
- *In situ* oceanographic data
- Remote sensing data
- Topographic data
Outcomes: Spatially Explicit Density Maps

AMAPPS example: Bottlenose dolphin density and spatial distribution

- AMAPPS seasonal maps of density from vessel and aerial survey data (SEFSC and NEFSC)
- A major GoMMAPPS objective is to produce and disseminate operational mapping products