

## DISTRIBUTION, ABUNDANCE AND POPULATION STRUCTURING OF BEAKED WHALES IN THE GREAT BAHAMA CANYON

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### Background

Atypical mass strandings of beaked whales have been correlated with naval sonar exercises, highlighting a need for a better understanding of beaked whale population ecology. This project is filling key data gaps on the distribution, abundance, habitat use and population structuring of beaked whales in the Great Bahama Canyon. The study area includes the US Navy's Andros-AUTEC Operating Areas where fleet readiness training involves regular use of mid-frequency active sonars.

### Objectives

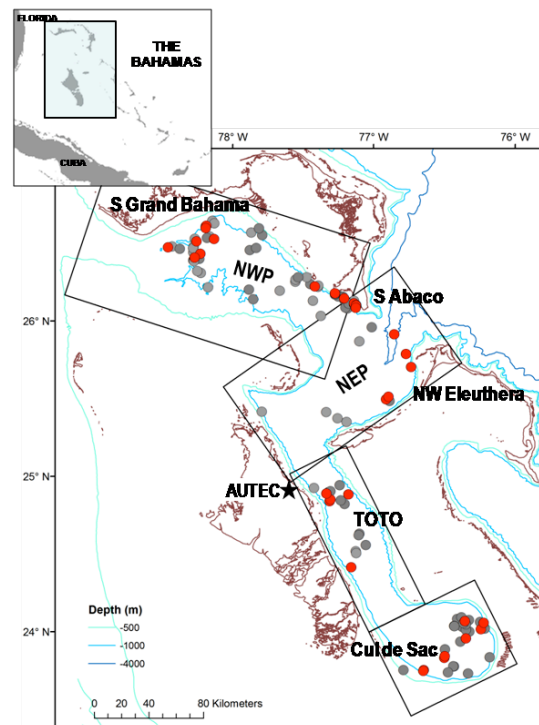
The objectives of the study are:

- 1) To use visual surveys to document beaked whale distribution and habitat use, and to estimate abundance.
- 2) To use photo-identification to examine the distribution, movements and social affiliations of identified individuals, and to assess abundance using mark-recapture techniques.
- 3) To collect skin and blubber biopsy samples to investigate beaked whale diet through fatty acid, stable isotope and contaminant analyses; and stock structure using molecular genetic approaches.

### Methods

Using standardized line-transect methods, three ship-based visual and acoustic surveys covered 8,885 km, to assess patterns of distribution and relative abundance in the Great Bahama Canyon. Transect lines were randomly placed within four rectangular strata (NE Providence Channel, NW Providence Channel, Tongue of the Ocean and the Cul de Sac, Figure 1) using a saw-tooth pattern to allow equal area coverage. Upon sightings, the ship broke transect to confirm species identification, estimate group size and to collect photo-ID and biopsy samples. An additional fourth survey returned to areas of highest concentration of beaked whales to increase the number of biopsy samples.

Analysis to identify primary foraging habitats and prey preferences has been completed under the direction of G. Ylitalo at NOAA's Northwest Fisheries Science Center. Blubber and skin biopsy samples from 48 individual beaked whales were analyzed for their nitrogen and carbon stable isotope ratios, blubber fatty acids, and lipid class compositions. Blubber samples will also be analyzed for persistent organic pollutants (POPs) which will be completed in FY10. Genetic analysis of population structure and relatedness will be conducted by P. Morin at NOAA's Southwest Fisheries Science Center in FY10, involving DNA extraction, sequencing and genotyping of 91 archival and recent beaked whale samples.



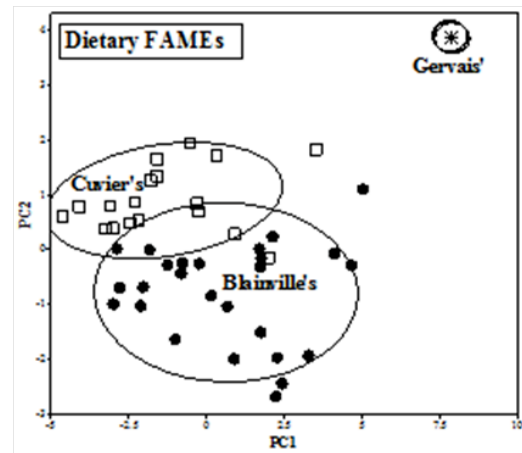
**Figure 1.** Beaked whale sightings in the Great Bahama Canyon during which biopsy samples were taken (red circles) and were not taken (grey circles). The four rectangular survey grids in NW Providence (NWP) and NE Providence (NEP) Channels, Tongue of the Ocean (TOTO) and the Cul de Sac are shown.

## Results

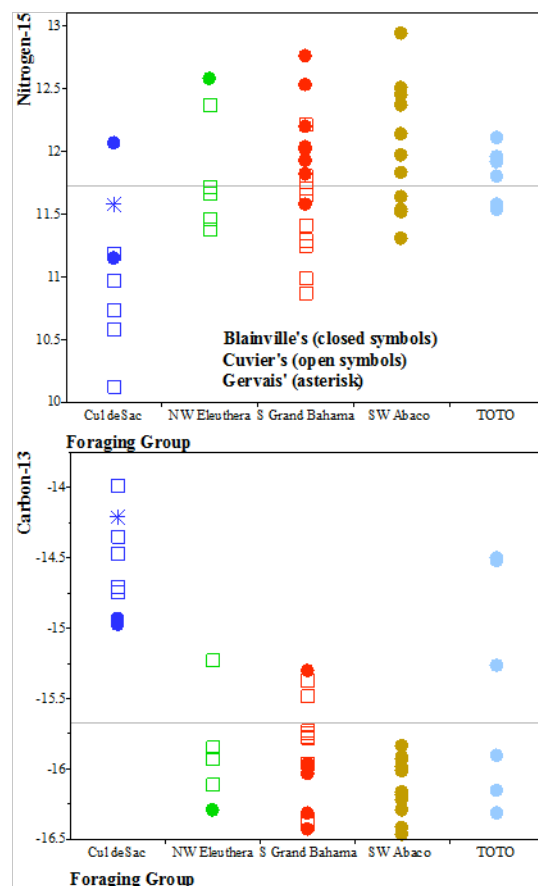
There were 127 sightings of beaked whales in the Great Bahama Canyon, comprising 3 species: Blainville's beaked whale (*Mesoplodon densirostris*), n=64, Gervais' beaked whale (*M. europaeus*), n=10 and Cuvier's beaked whale (*Ziphius cavirostris*), n=31. Seventy-seven sightings were made during line transects which can be used to model detection probabilities for analysis of abundance and density using Multiple Covariates Distance Sampling and Density Surface Modeling methods (to begin during FY10). The relatively high density of beaked whales in the NW Providence Channel may explain why the highest mortality of beaked whales occurred along the southern coast of Grand Bahama Island during the anti-submarine warfare GAP exercise on 15<sup>th</sup> March 2000. However, these results are preliminary.

Nitrogen and carbon stable isotope ratios and blubber fatty acids were analyzed in biopsy samples from 48 beaked whales (Blainville's, n=28; Cuvier's, n=19; Gervais', n=1). The patterns of dietary fatty acids are notably different among the three species (Figure 2), suggesting that they feed on largely different prey. Stable isotopes ratios also differed among species, with higher <sup>15</sup>N isotope values and lower <sup>13</sup>C isotope values found in Blainville's than in Cuvier's beaked whales (p<0.05), suggesting that Cuvier's whales not only feed upon prey that is different from the Blainville's whales, but also feed in different habitat, possibly greater depths. Differences in isotope ratios were also found among foraging regions suggesting that whales feed repeatedly within localized areas rather than foraging throughout the entire Great Bahama Canyon study area (Figure 3)<sup>1</sup>. Mark-recapture analysis of photo-identification data has also shown site-fidelity of Blainville's beaked whales to the AUTECH range in Tongue of the Ocean and to long-term study sites off Abaco, providing further support for population structuring on a relatively small spatial scale. The planned genetic analyses will help elucidate this hypothesis.

This multi-faceted study is providing key data on the population ecology of beaked whales on and around the US Navy ranges in the Bahamas, information which is critical to future mitigation and monitoring.



**Figure 2. Principal Component Analysis plot depicting the differences in dietary fatty acid profiles among Blainville's (closed symbols), Cuvier's (open symbols), and Gervais' (asterisk) beaked whales. Ovals represent the 80% probability density intervals for each species.**



**Figure 3. Comparison of stable isotope ratios (<sup>15</sup>N and <sup>13</sup>C) among the five identified sampling/foraging locations for Blainville's (closed symbols), Cuvier's (open symbols), and Gervais' (asterisk) beaked whales.**

<sup>1</sup> Analysis reported by David P Herman, Douglas G. Burrows, Gladys K. Yanagida, Richard H. Boyer and Gina M. Ylitalo, NOAA Northwest Fisheries Science Center.