

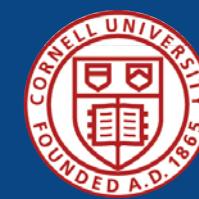


Passive Acoustic Monitoring for Marine Mammals in the Gulf of Mexico

John Hildebrand

Scripps Institution of Oceanography
University of California San Diego

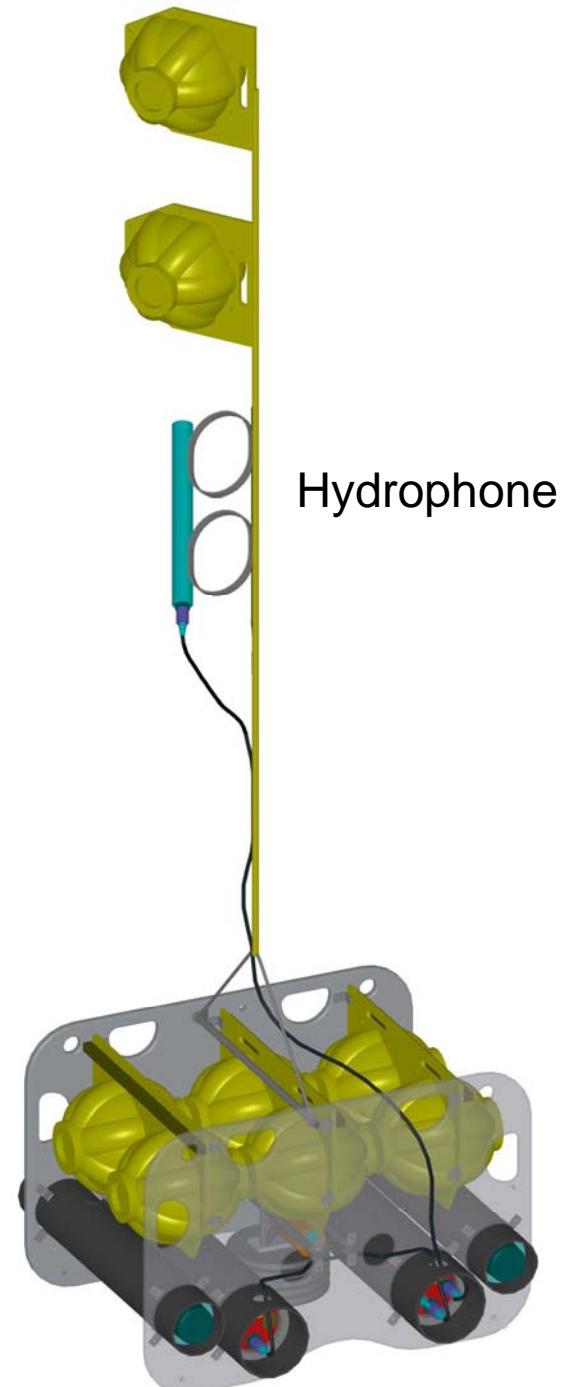
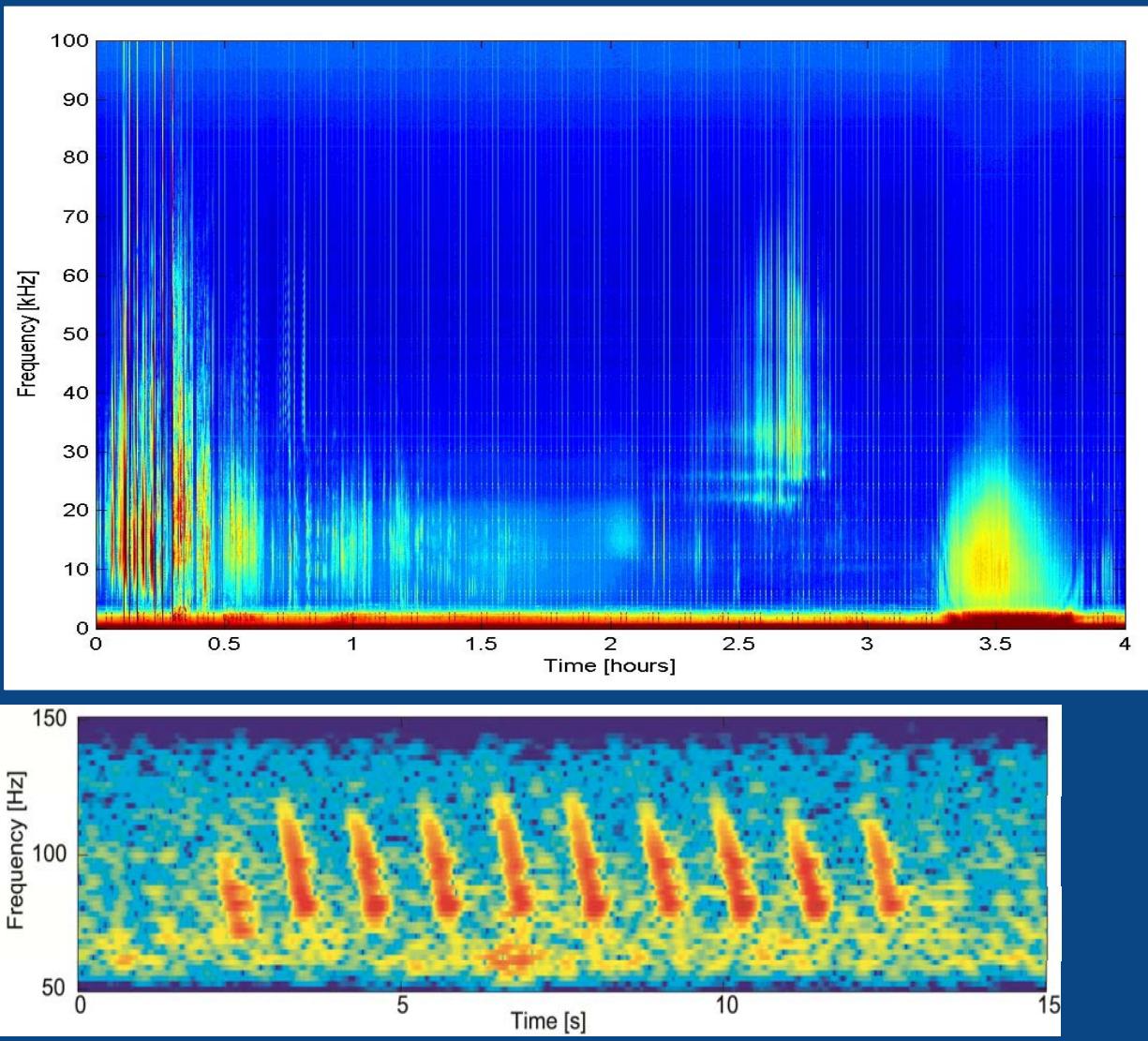
With contributions from:
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Aaron Rice arice@cornell.edu



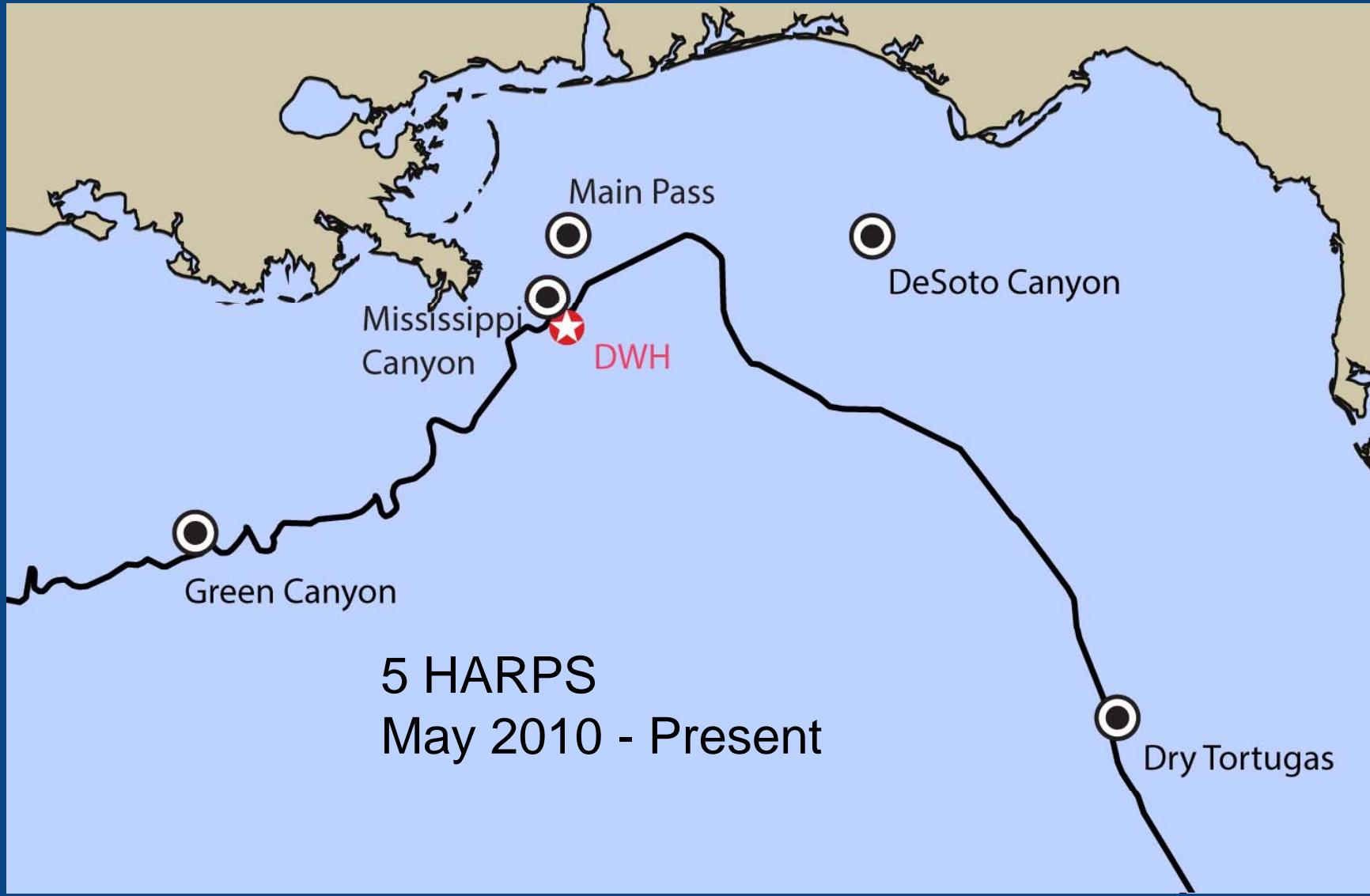
April 7, 2015 - Gulf of Mexico
Marine Mammal Research and Monitoring Meeting
Astor Crowne Plaza, New Orleans, LA

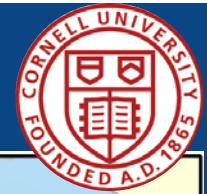


High-frequency Acoustic Recording Package (HARP)

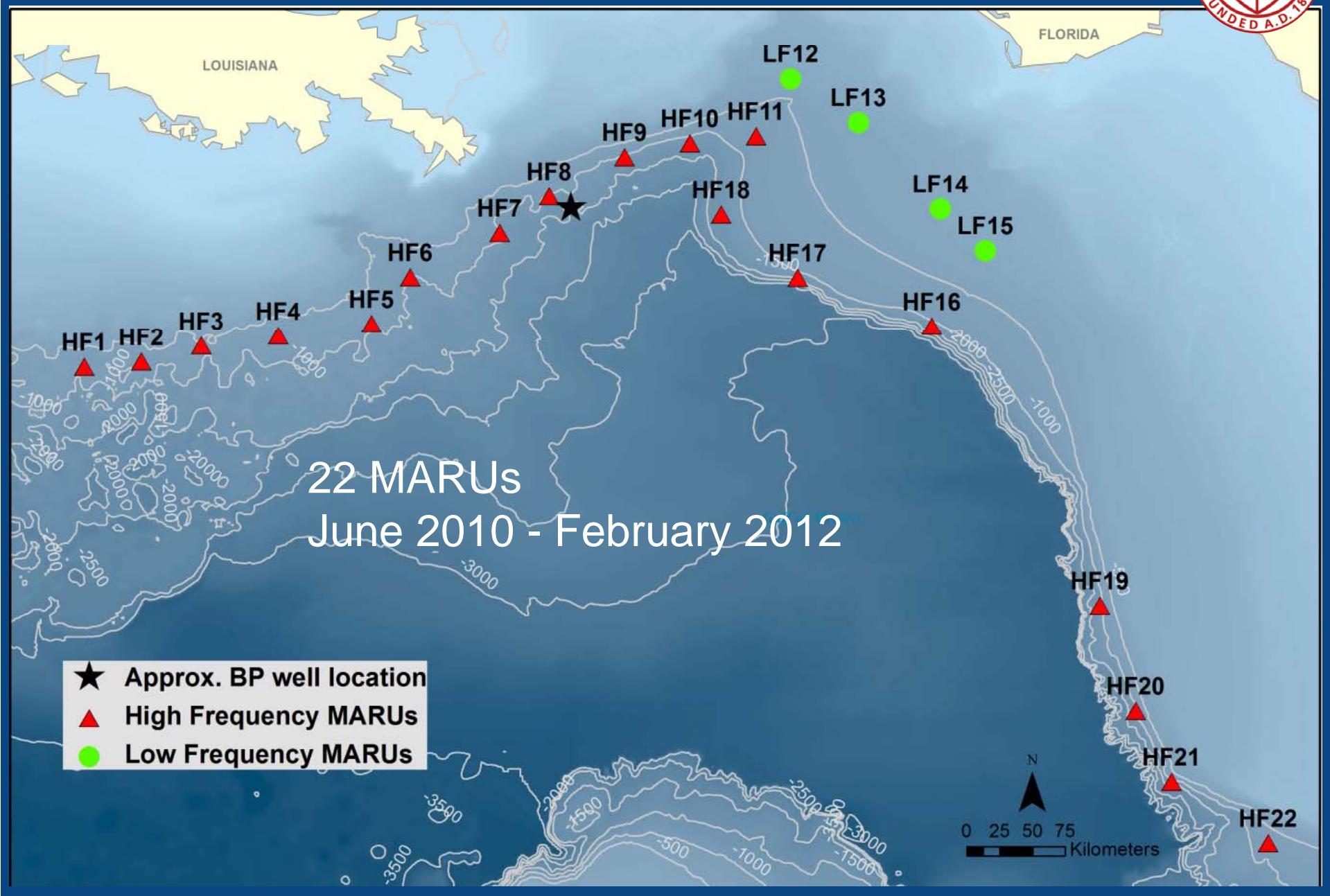


SIO HARP - Passive Acoustic Monitoring

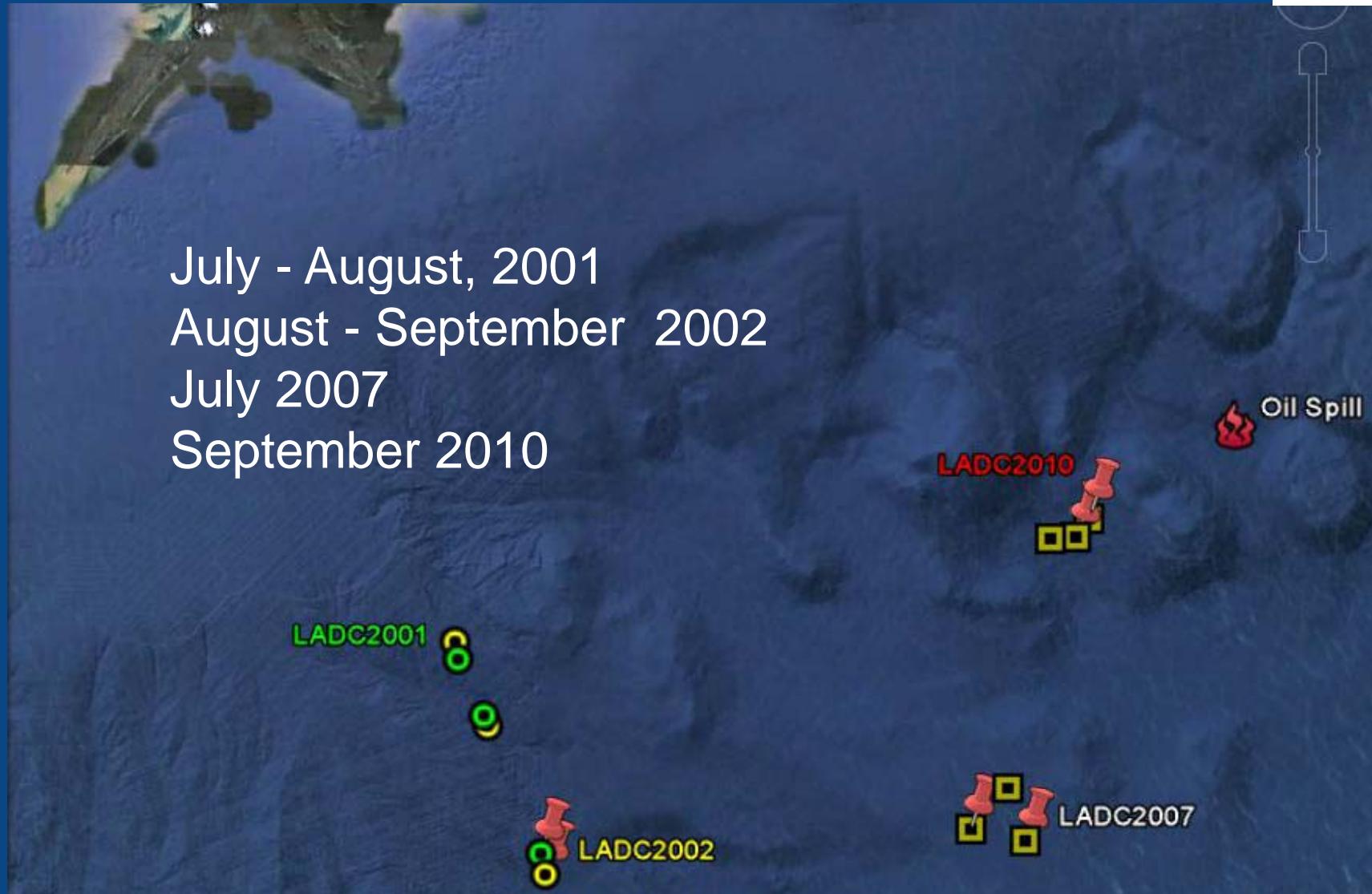




Cornell MARU – Passive Acoustic Monitoring



LADC EARS – Passive Acoustic Monitoring



July - August, 2001

August - September 2002

July 2007

September 2010

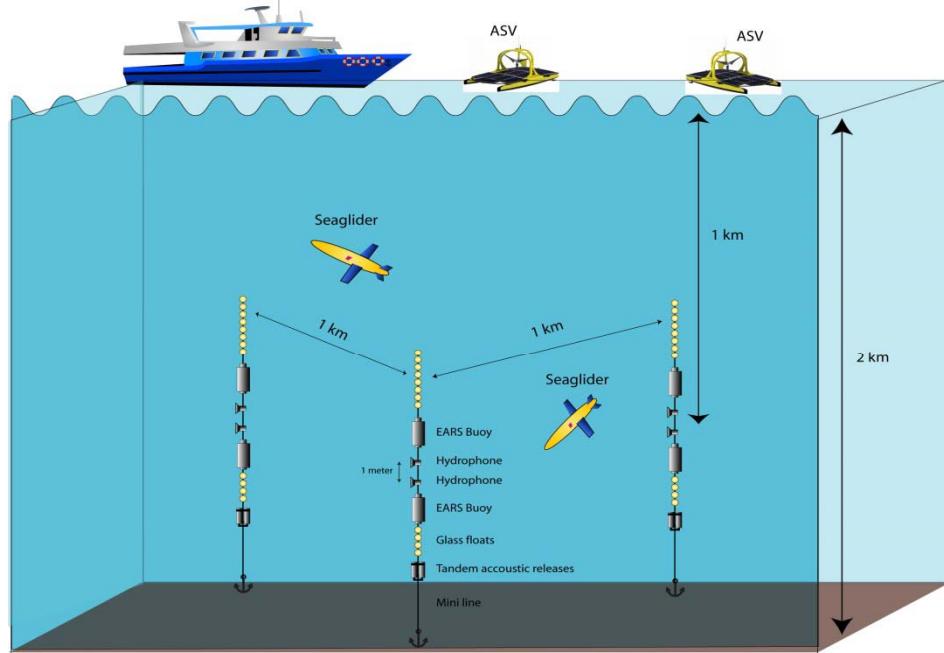


LADC GEMM

Gulf Ecological Monitoring and Modeling



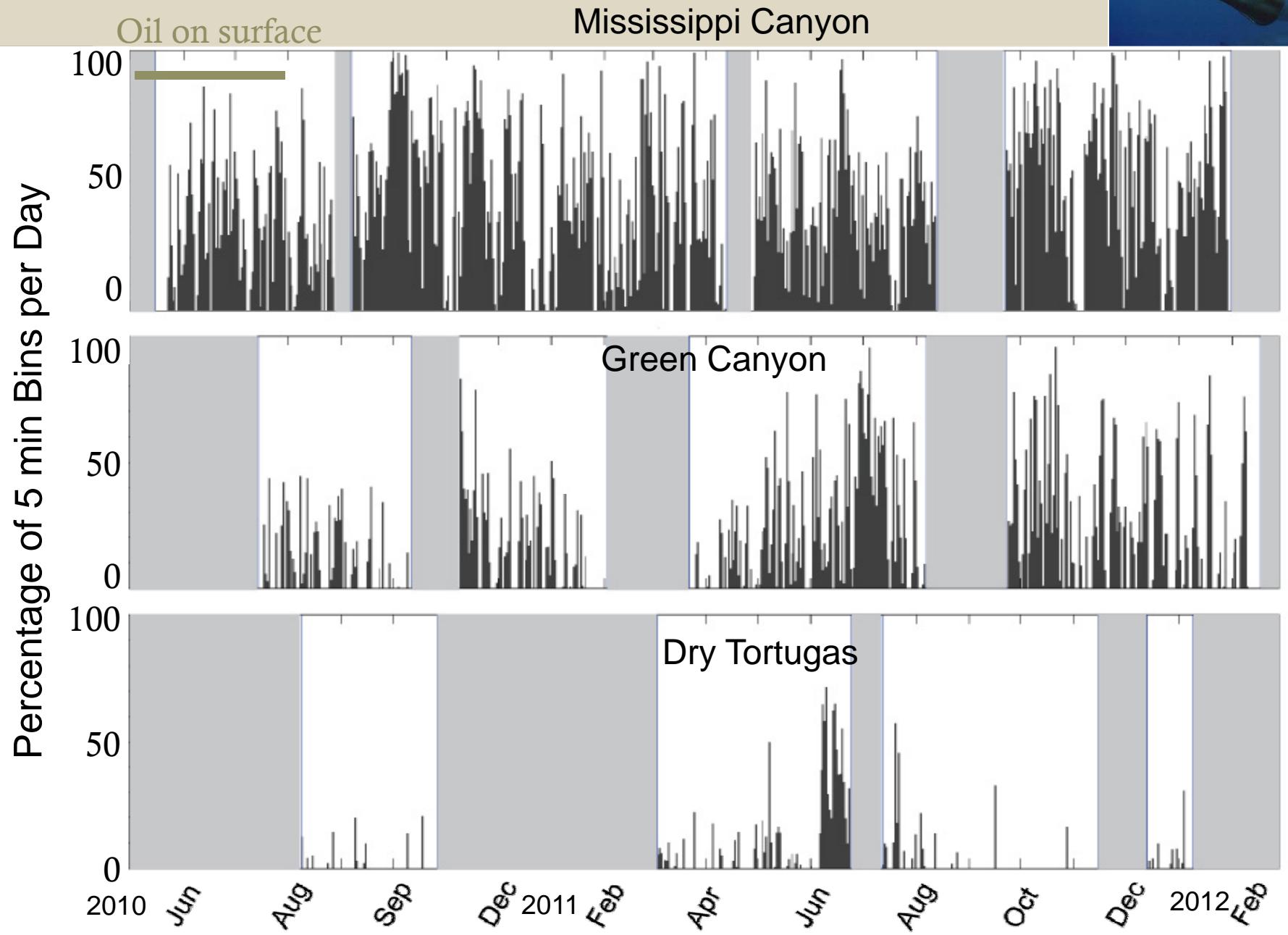
2015-2017



2015-2017 objectives:

1. Long-term ecosystem-centered passive acoustic monitoring (E-PAM) of marine mammal recovery after the spill;
2. Comparison of E-PAM platforms for cost-effective near real-time monitoring (bottom-moored buoys, Seagliders, and ASV);
3. Integrated acoustic data processing techniques connecting abundance variations and ecosystem indicators (soundscapes, food supply, stock composition);
4. Population dynamics predictive modeling.

Sperm Whale Detections



Density Estimation Equation

$$\hat{D}_{kt} = \frac{n_{kt}}{\pi} \frac{(1 - c_k)}{w^2 \hat{P}_k} \frac{s}{\hat{P}_v T_{kt}}$$

\hat{D}_{kt} density @ site k week t

n_{kt} number groups detected

c_k % false positives

s estimate group size

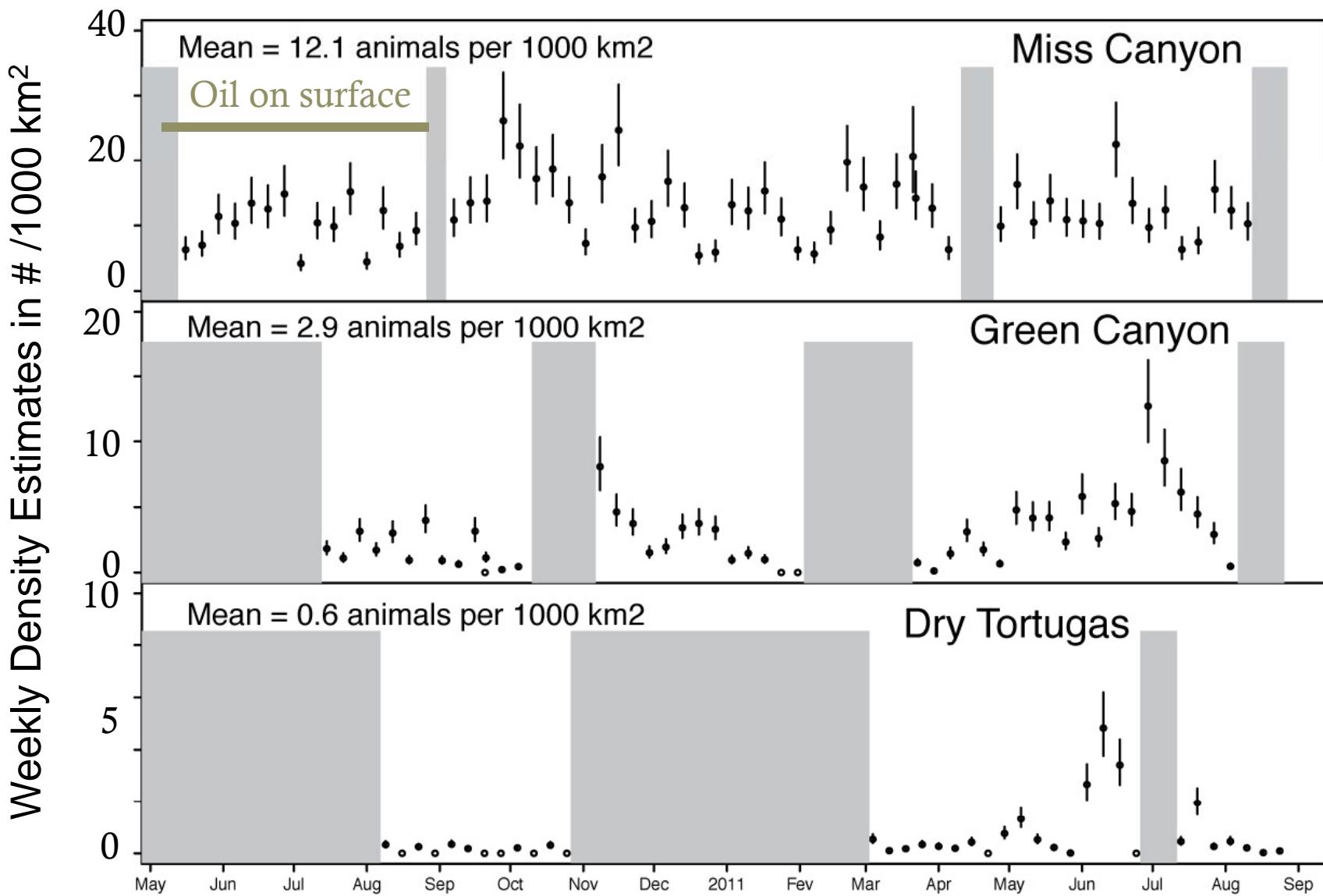
w maximum range for detection

\hat{P}_k prob detect group within radius w

\hat{P}_v prob group acoustically active

T_{kt} number intervals sampled

Sperm Whale Density Estimation – Results

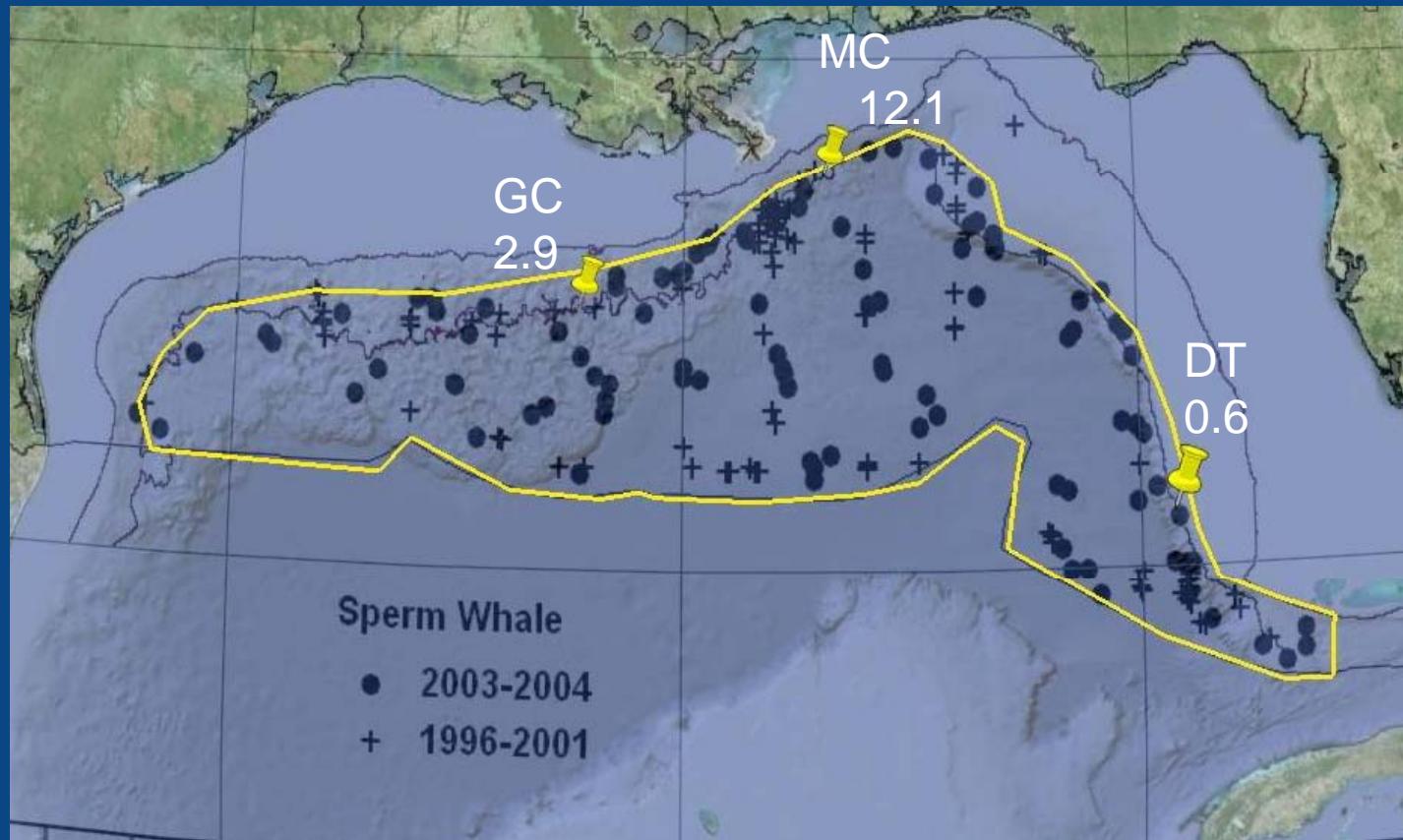


Sperm Whale Visual and Acoustic

NMFS Visual Surveys in 1996-2001 and 2003-2004

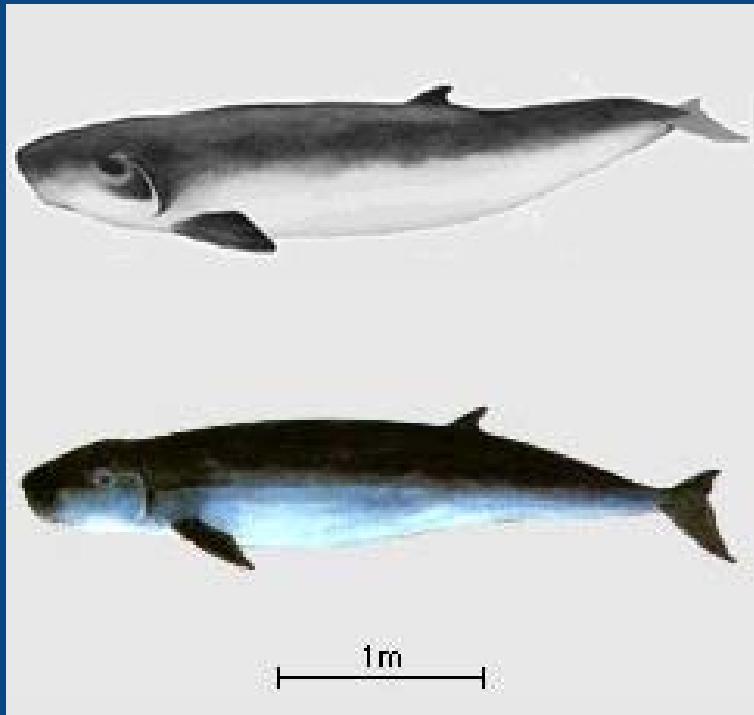
Number = 1,665 (CV=0.20) Sighting Area = 311 x 1000 km²

Visual Density Estimate = 5.4 / 1000 km²

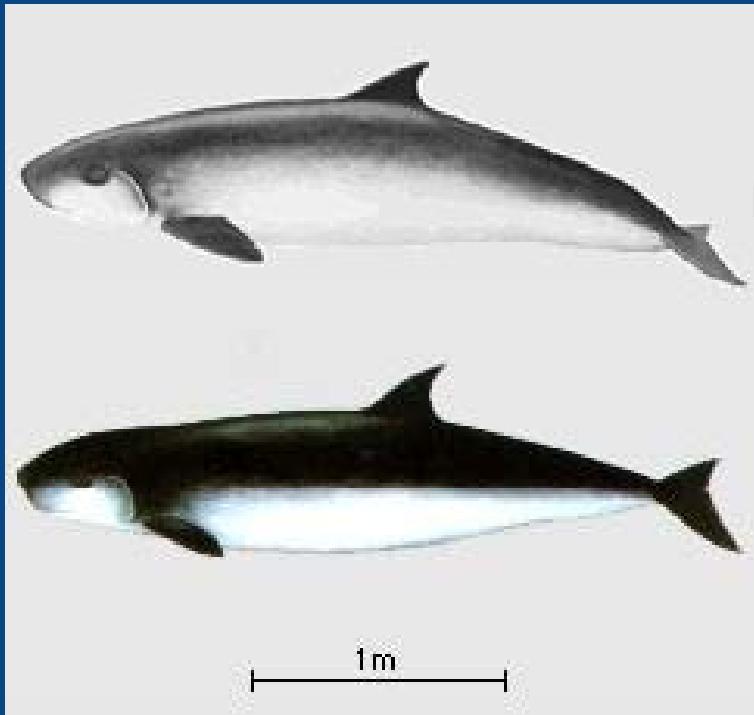


Acoustic Density Estimates in # /1000 km²

Pygmy and Dwarf Sperm Whales



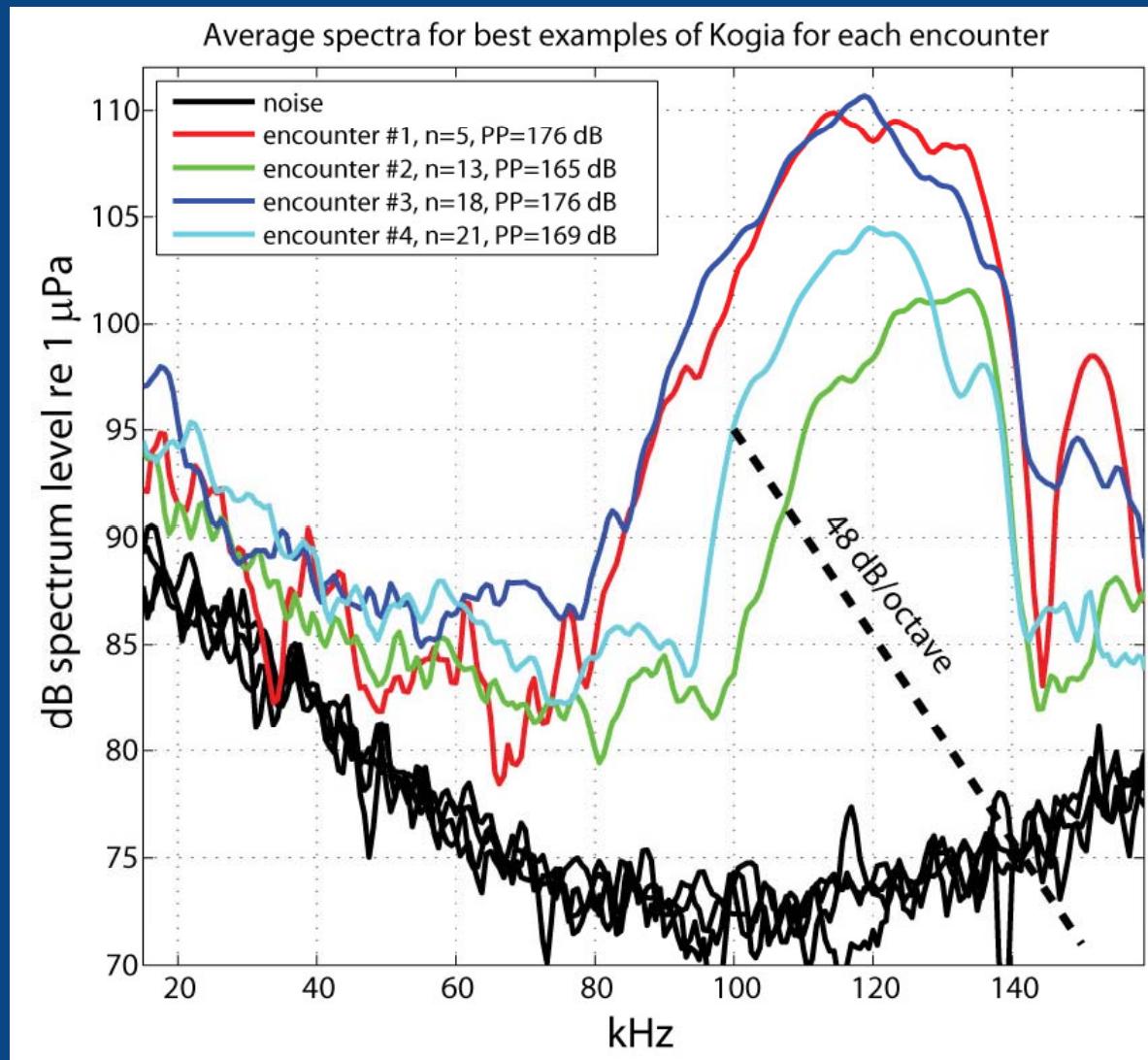
Pygmy Sperm whale



Dwarf Sperm whale

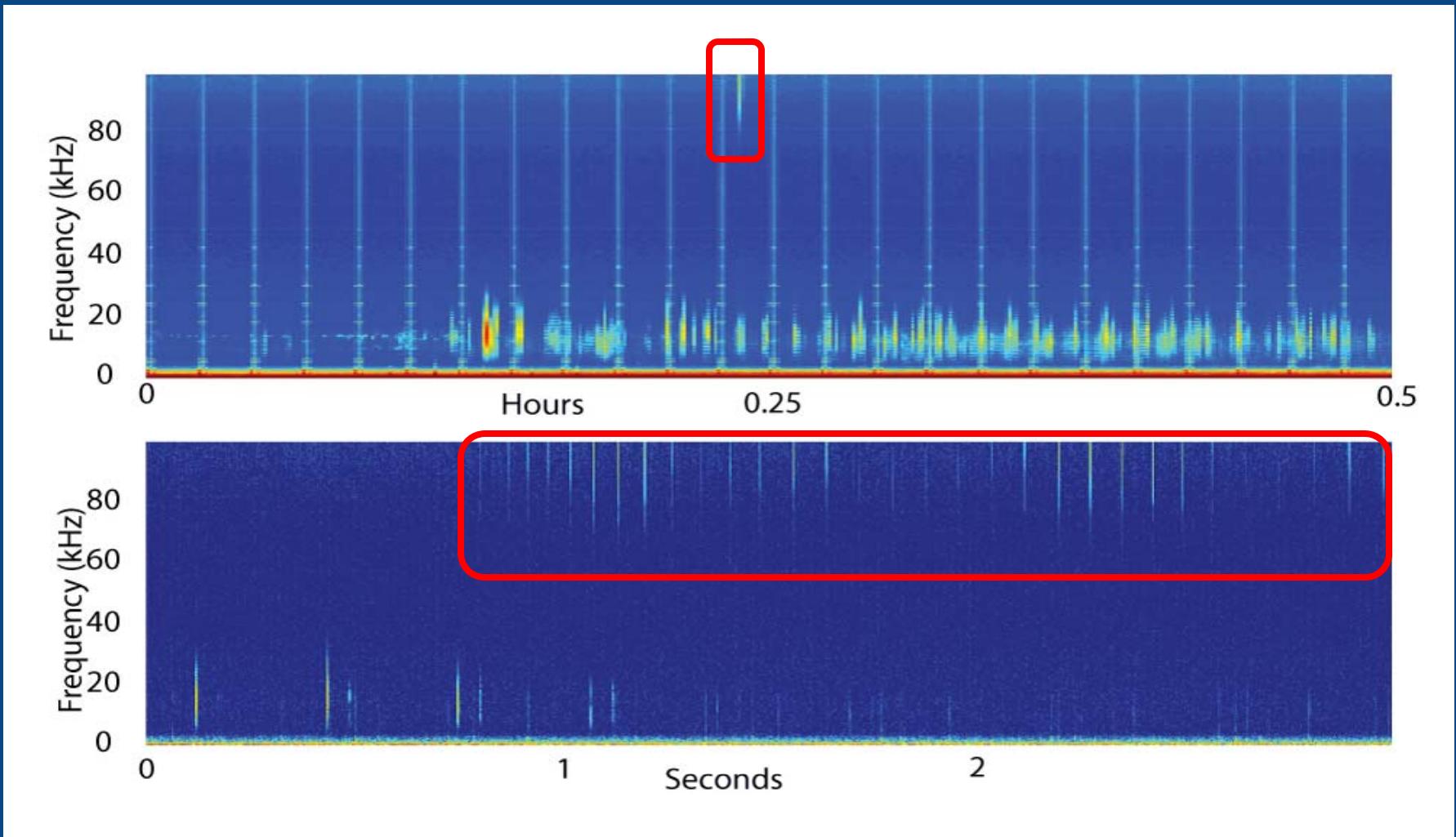
Kogia spp. echolocation clicks

HARP sampled at 320 kHz



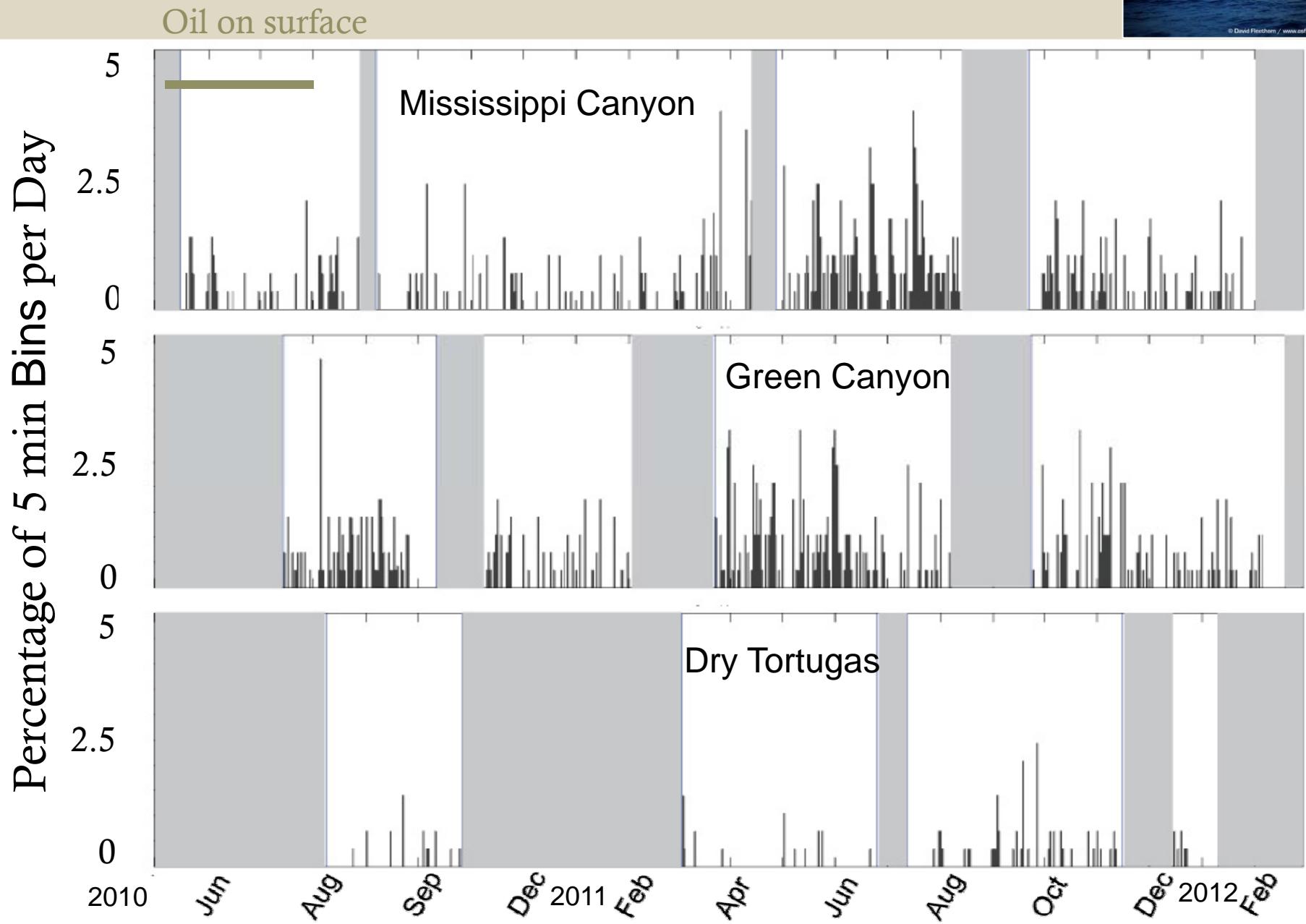
Kogia spp. echolocation clicks

MC HARP sampled at 200 kHz



Dwarf & Pygmy Sperm Whale Detections

ARKive
www.arkive.org

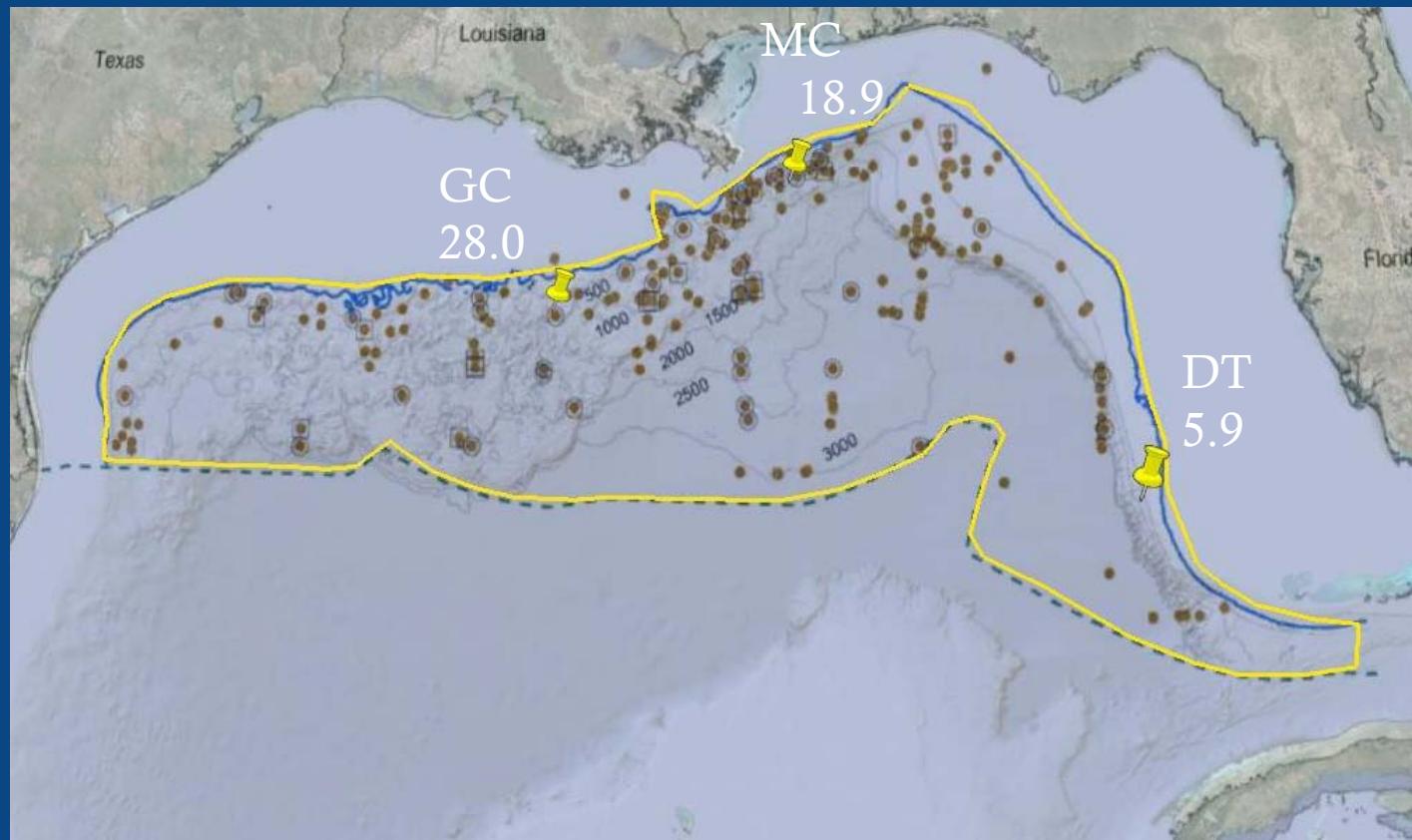


Kogia Spp. Visual and Acoustic

NMFS Visual Surveys

Number = 453 (CV=0.35) Sighting Area = 378 x 1000 km²

Visual Average Density = 1.2 / 1000 km²



Acoustic Density Estimates in # /1000 km²

Beaked whales in Gulf of Mexico



Gervais' beaked whale



Cuvier's beaked whale

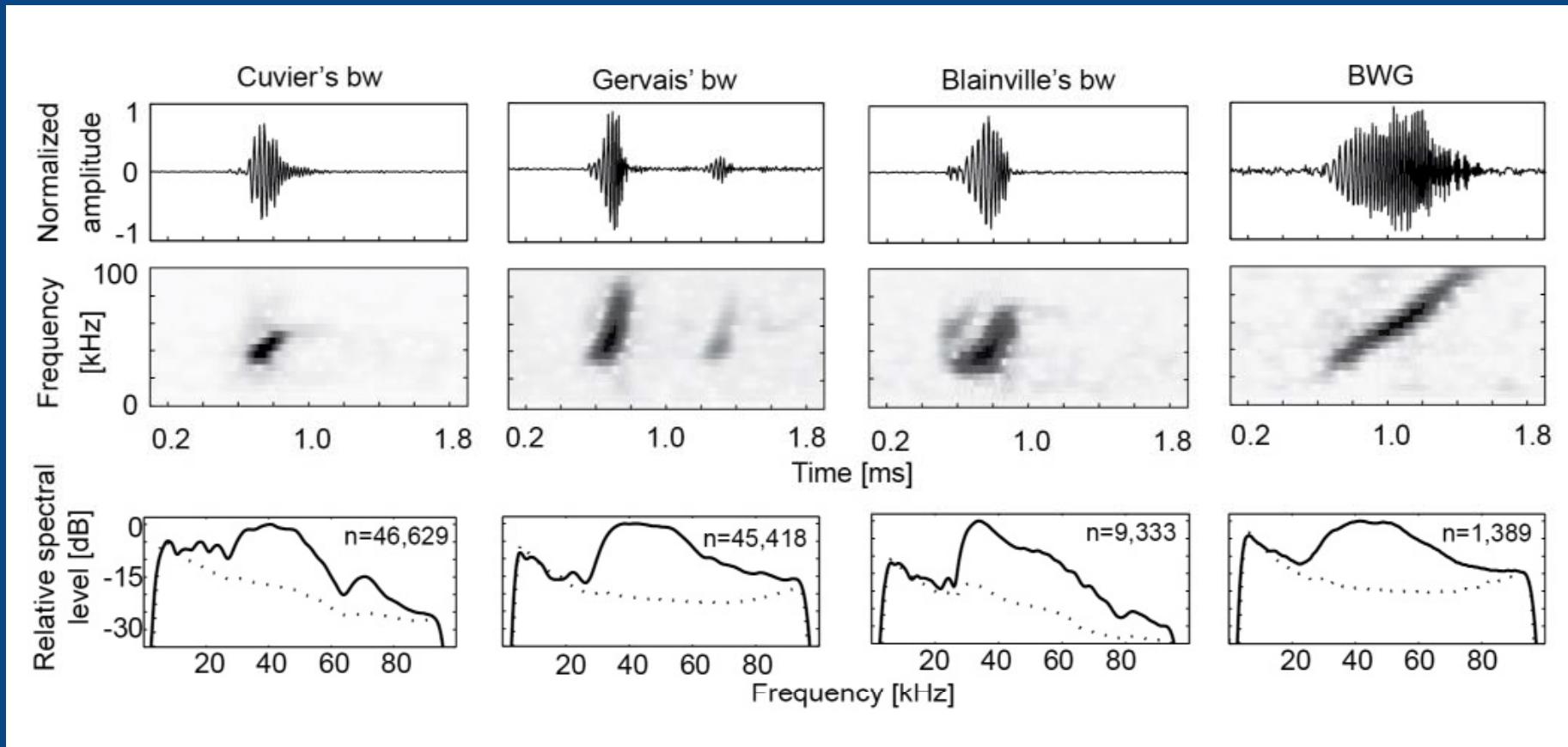


Blainville's beaked whale

?

Unknown Beaked Whale BWG

Beaked whale acoustics



Cuvier's 49.8%

Gervais' 48.7%

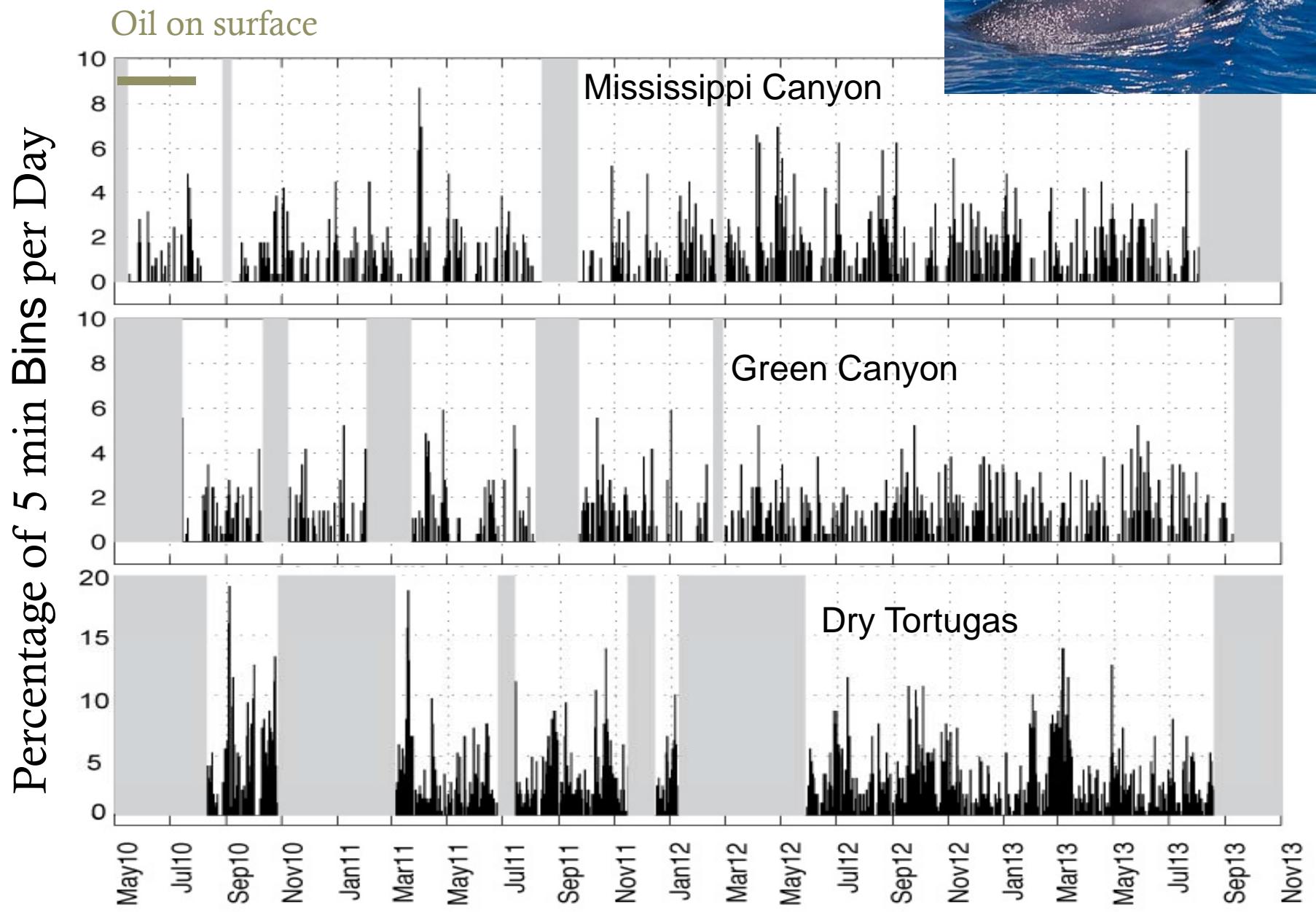
Blainville's 0.4%

BWG 1.1%

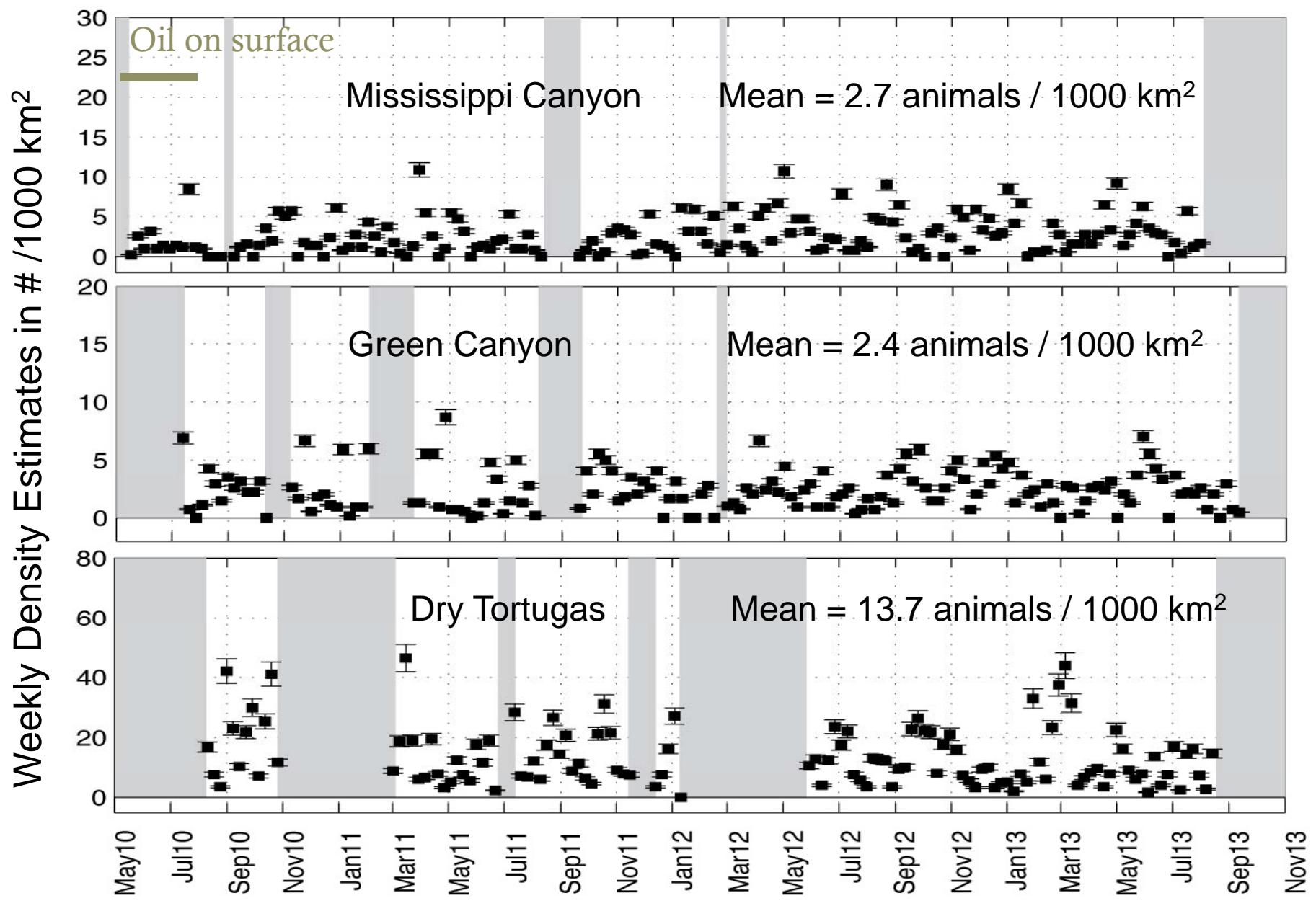
Percentage encounters for Beaked Whales in the Gulf of Mexico

From Simone Baumann-Pickering

Gervais' Beaked Whale Detections



Gervais' Beaked Whale Density



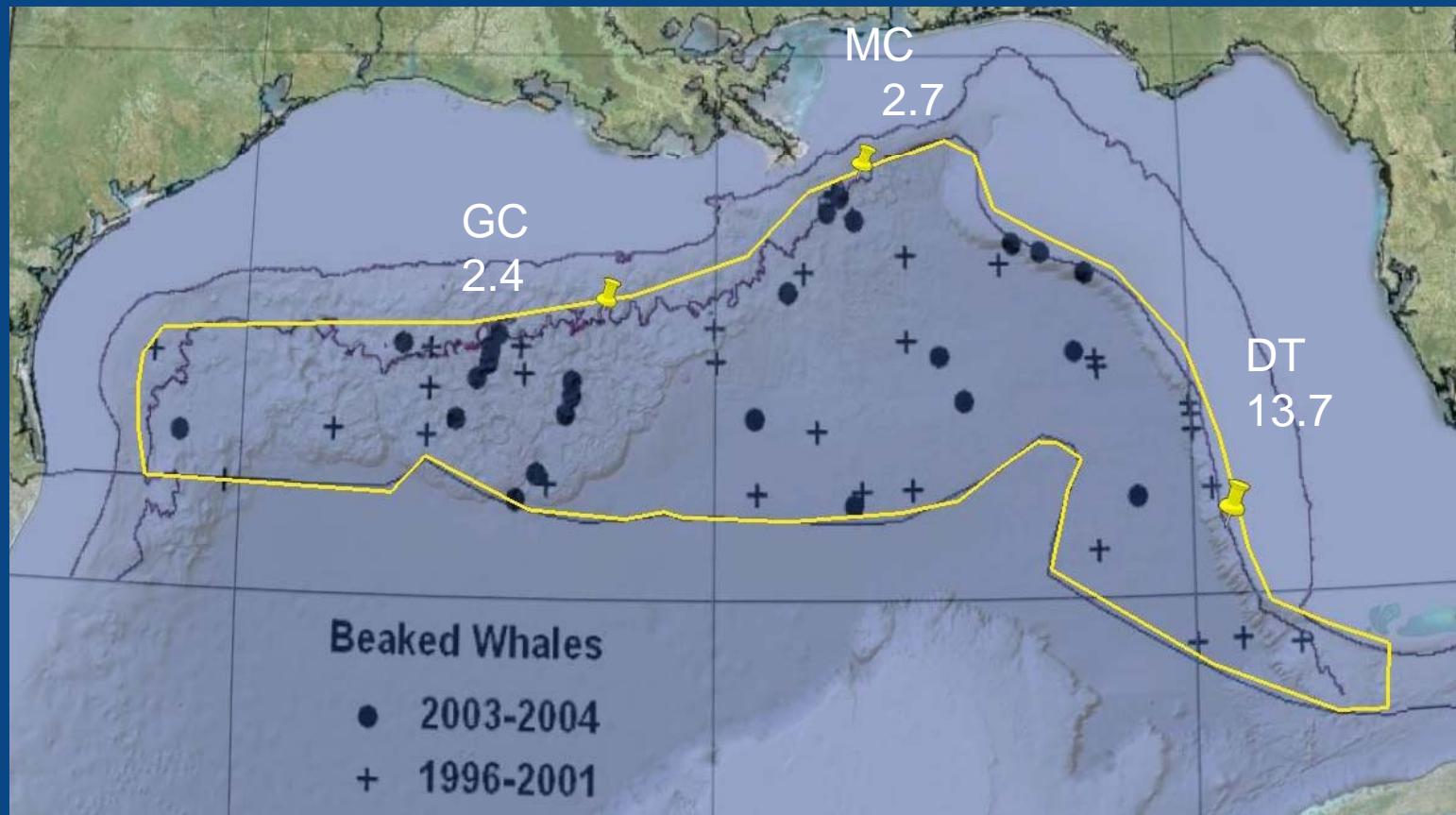
Gervais' Beaked Whale Visual and Acoustic

NMFS Visual Surveys:

Mesoplodon spp. 57 (CV=1.40); Ziphiidae 337 (CV=0.40)

Sighting Area = 303 x 1000 km²

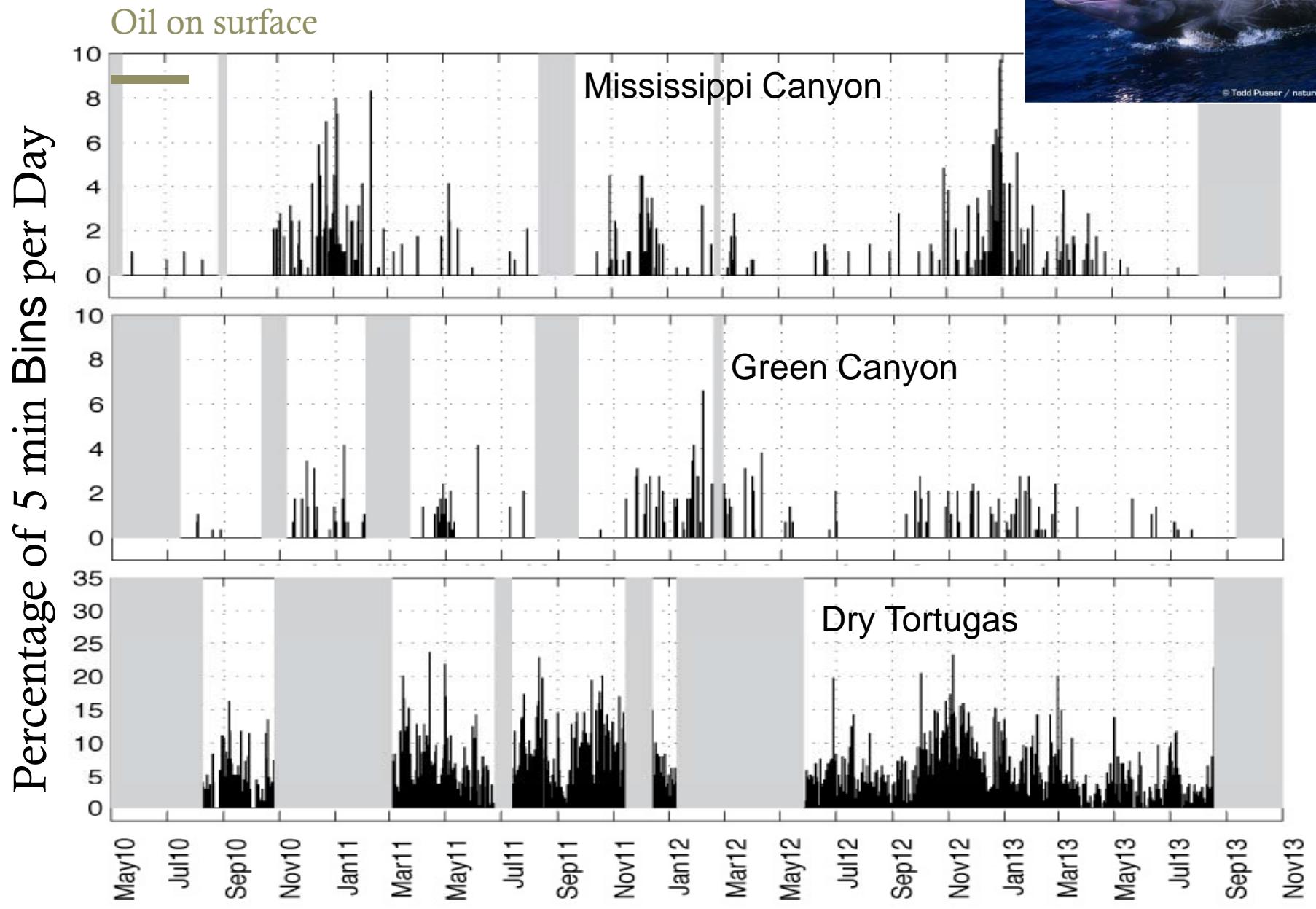
Visual Density (Max) = 1.3 / 1000 km²



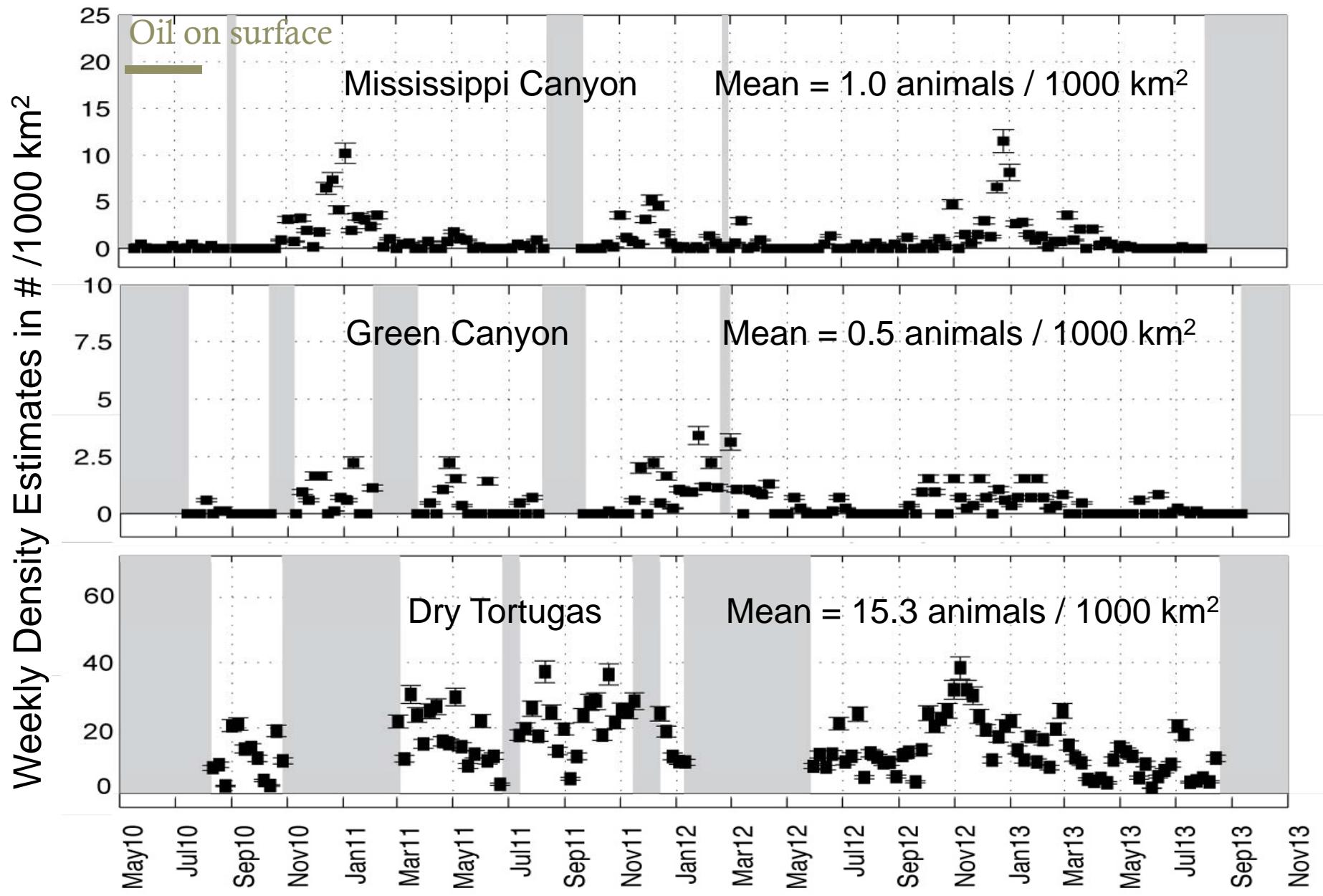
Acoustic Density Estimates in # /1000 km²

Cuvier's Beaked Whale Detections

ARKIVE
www.arkive.org



Cuvier's Beaked Whale Density



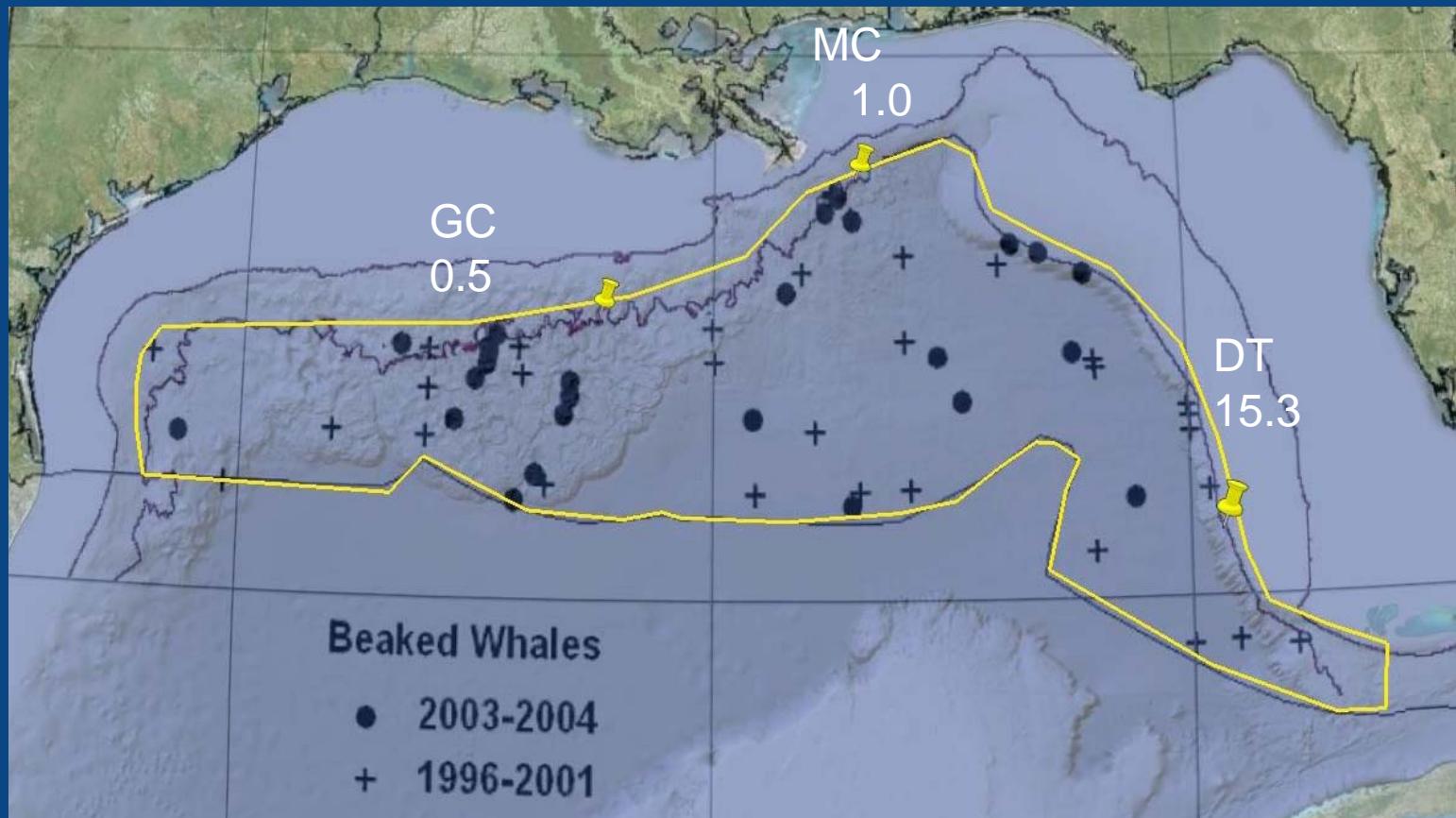
Cuvier's Beaked Whale Visual and Acoustic

NMFS Visual Surveys:

Cuvier's 65 (CV=0.67); Ziphiidae 337 (CV=0.40)

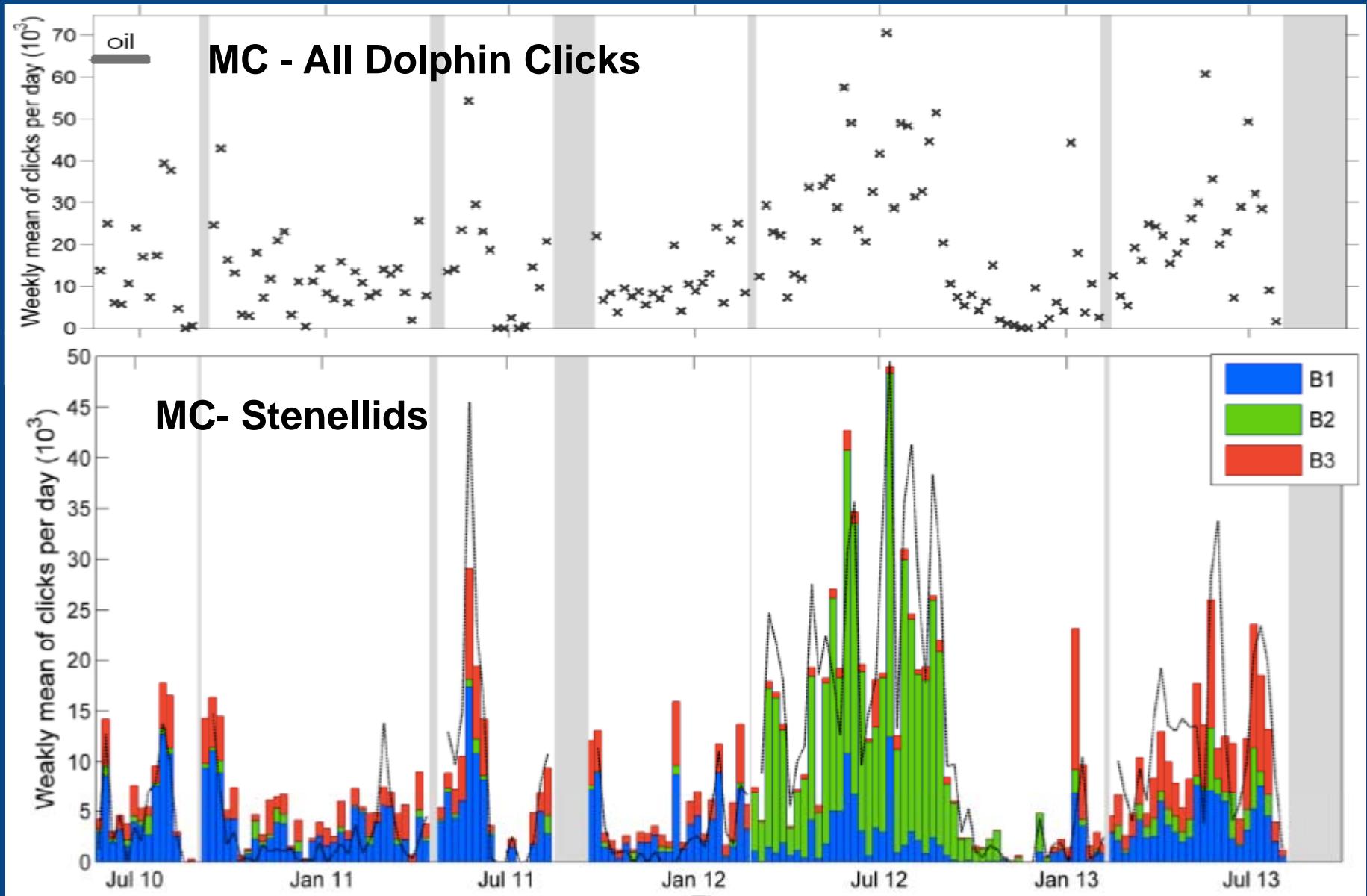
Sighting Area = 303 x 1000 km²

Visual Density (Max) = 1.3 / 1000 km²



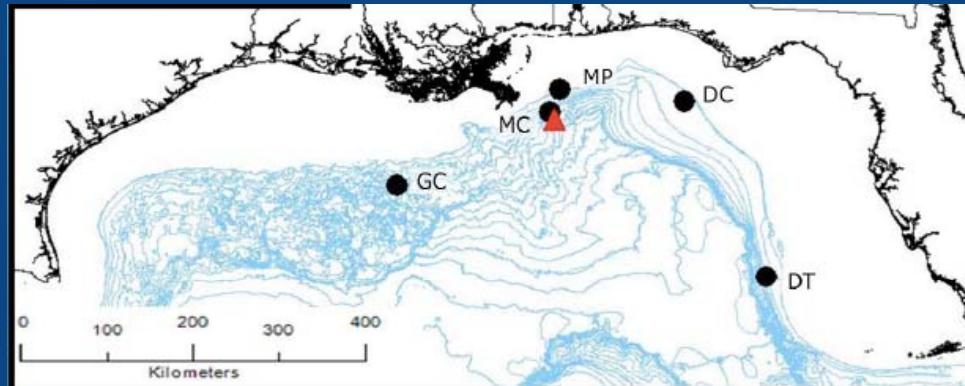
Acoustic Density Estimates in # /1000 km²

K. Frasier- Delphinid Passive Acoustic Monitoring



Summary recommended priorities:

- Support for on-going time-series data collection
- Effort in areas of the Gulf not currently well sampled:
 - Deepwater (non slope)
 - Western Gulf
 - Mexican waters



- Collect acoustic (towed array) data on visual surveys to refine understanding of delphinid calls
- Effort on tagging and tracking to refine density estimation parameters