



# Marine Mammal Toxicological Research & Education

## Five summers in the Gulf of Mexico in response to the Deepwater Horizon disaster

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### Introduction: Expedition Goals

- Observe any chronic effects of the oil crisis on whales and the ecosystem
- Collect biological samples from whales to determine a baseline of exposure to petroleum products, chemical dispersants and metals
- Develop cell lines to determine impact of oil, chemical dispersants, mixed dispersant and oil, and metals, on whale DNA
- Put Gulf Sperm whales in global toxicological context with previous Voyage of the Odyssey data
- Collect opportunistic data from the more than 20 species of whales that are found in the offshore waters of the Gulf of Mexico



### Platform: RV Odyssey

The RV *Odyssey* is Ocean Alliance's primary research platform. Owned by OA since 1992, it has visited some of the most remote locations on the planet. The 'Voyage of the Odyssey' a 5 ½ year circumnavigation, was conducted from 2000-2005. During which time, OA collected the first-ever baseline global data set on toxic contaminants using sperm whales as a bio-indicator species.

A 93-foot ketch motor-sailer, the *Odyssey* is equipped with state-of-the-art communications equipment, as well as acoustic and sampling equipment for tracking and biopsying whales. Odyssey sleeps 12 people and can stay offshore for weeks at a time, with the capacity to work in conditions up to sea state 5.



### Summary of Expedition Efforts and Results

We collected 349 biopsy samples from 4 species of cetacean

- Scientific breakthroughs included:
- First-ever mammalian cell culture laboratory on a sailboat-and possible first at sea<sup>2</sup>
  - Became first laboratory to culture whale cells at sea (184 cell lines developed during 2010, 2011 & 2012 field season)<sup>2</sup>
  - Became first laboratory to culture Bryde's whale cells<sup>2</sup>

- Primary achievements:
- Chronic toxicological exposure and impact evaluation initiated
  - Baseline exposure data samples collected
  - Baseline DNA damage assessment underway
  - Chemical dispersant, oil & metal toxicity testing begun
  - Ocean Alliance/Wise Laboratory/Sea Shepherd marine toxicological research program established in field
  - Presence established as unique research program in Gulf of Mexico and Atlantic
  - Gulf of Mexico established as long-term on-going toxicological research site
  - The Odyssey optimised as unique deep-water marine research platform for engaged student learning opportunities

Crucially, whatever we find in the Gulf of Mexico can be put into the global context from the data set Ocean Alliance acquired during the five and a half year Voyage of the Odyssey. While analyses is still underway, preliminary analyses has revealed one significant discovery.

- Levels of Chromium and Nickel, both found in oil from the Deepwater Horizon well, are significantly higher in whales from the Gulf of Mexico than elsewhere in the world. These metals damage DNA and bioaccumulate in organisms, causing persistent exposure. The levels of Nickel were incredibly high: the global average of Nickel was 2.4ppm, compared to 15.9ppm in the Gulf. This work has demonstrated that metal exposure is a significant and understudied concern for the Gulf of Mexico marine environment.<sup>4</sup>

Numerous presentations have been made on this work. Of note is the fact that Drs' Wise and Kerr hosted a five speaker session at the American Academy for the Advancement of Science conference in February 2013: 'The Toxicological Impact of the Gulf of Mexico Oil Spill on Human and Wildlife Health'<sup>5</sup>  
<http://aaas.confex.com/aaas/2013/webprogram/Session5744.html> and at the 51<sup>st</sup> Annual Society of Toxicology Conference in San Francisco in March 2012: 'The Toxicological Impact of Metals, Crude Oil, and Chemical Dispersants from the Gulf of Mexico Oil Crisis on Human and Wildlife Health'.<sup>6</sup>

- In addition the Wise Laboratory reported that Chemical dispersants used in the Gulf of Mexico oil crisis are cytotoxic and genotoxic to sperm whale skin cells.<sup>7</sup>

### Media Efforts

From 2010 to 2013, Dr. Wise lead not only the scientific expedition, but also the media efforts, producing over 250 educational & scientific blogs and 7 campaign videos. In 2013 & 2014 Ocean Alliance & Sea Shepherd created:

- 10 Meet The Crew videos
- 5 Campaign Update videos
- 1 Robotics video (acquiring over 10,000 Youtube views on its own)
- Over 30 blog posts from members of the crew
- A social media campaign engaging between 20,000-60,000 users every week
- Robust outreach program in expedition home port of Pensacola, with numerous open-boat days, press engagements and interviews and two public talks involving Ocean Alliance CEO Dr. Iain Kerr and Founder/President Dr. Roger Payne.



### Innovative Research



**1. Forward Looking Infra Red (FLIR).** Using a military grade unit, loaned by the FLIR corporation, we tested the potential application of using infra-red technology to study and track whales at night.



**3. Drones for whale research – Snot Bot**  
With the help of Olin College of Engineering, we are developing a range of practical, cheap, waterproof drones, which can be used to collect an enormous range of information with little or no impact on the whales.



**2. Toxicology Laboratory in Aft Cabin**  
*Odyssey* has an advanced laboratory in the aft cabin, where we achieved many scientific breakthroughs, including the cell culture work.



**4. Whale Boom unique (undisturbed) access to whales**  
*Odyssey* is equipped with a 30-foot 'Whale-Boom' which allows us to get much closer to whales while mitigating potential disturbances.

### Concerns for the Future

We know remarkably little about the ecology and demography of the 22 species of marine mammals residing in the Gulf of Mexico. The need for further understanding is exacerbated by two pronounced threats, primarily in the offshore environment.

- The Gulf of Mexico is a heavily industrialised body of water, fuelled primarily by the vigorous activities of the petroleum industry and the shipping routes serving some of the largest ports in the western hemisphere. We need to have a better understanding of the current and potential future impacts of this activity on marine mammals, particularly endangered species/stocks such as Sperm and Bryde's whales.
- The dual threats posed by long-term runoff from the Mississippi basin and the 2010 oil spill make chemical contamination potentially the biggest and certainly, most understudied threat to cetaceans in this body of water. Our research has shown that Sperm whales closer to the spill epicentre have significantly higher levels of heavy metals in them<sup>4</sup>. Moreover, our research has established that these heavy metals, and the chemical dispersants used in the aftermath of the spill, could have serious implications for whale health and the ecosystem for many years to come.

Most concerning, based upon the severity of the situation, is the lack of effort being made to bridge this enormous gap in our knowledge. Our research demonstrates significant resources must be utilized to expand research and monitoring efforts of marine mammals in this biodiverse and economically significant body of water.



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