CARMMHA EE: Cetacean Health - Evidence Dossier
Workshop: 15th & 16th Jan 2020, SWFSC - *La Jolla*, CA.

Introduction

We will begin the workshop with a presentation from CARMMHA Chief Scientist, Dr Lori Schwacke - to summarise the effects of oiling observed in Bay, Sound and Estuary (BSE) bottlenose dolphins. Expert elicitation workshops are informed by an Evidence Dossier, which the experts can review in advance. The main purpose of the dossier is to ensure that all relevant information is assembled and is available to all the experts during elicitation to aid the experts in making judgements. Experts have been briefed using a pre-webinar on the scope and approach to this elicitation:

- Notes and video of webinar (part 1 and part 2)

This dossier summarises information from other sources, each of which has a dedicated link to the source. If you would like to download all supporting documents for the CARMMHHA expert elicitation workshops - click here. Some documents are to support the other workshop. Please do not share the contents of this folder with others, without checking with holder/author - as it contains unpublished data/papers and is not to be used without consent.

This expert elicitation serves to update two models.

- An age-structured model for BSE bottlenose dolphins (BND) - detailed in the Schwacke et al 2019 paper and Supplementary Information.
- A stage-structured model for all other cetacean species in the Gulf of Mexico - described in MMIQT -NRDA and summarised here.

N.B. We are only considering 'exposed animals' - ie those that have been exposed to DWH oiling (and/or experienced secondary effects via their prey species negatively being affected).

Background

Cetaceans in the Gulf of Mexico (GOMx)

"*There are [...]21 cetaceans species (in the Gulf of Mexico). [...] Cetaceans have adapted to a wide variety of habitats in the marine environment and can be found throughout the northern Gulf of Mexico (Rosel & Mullin 2015)*" PDARP *Chapter 4* (see Species Table at end of this dossier). "*In the GOMx, accounts of Bottlenose Dolphins, mostly from stranded animals, suggest the presence of both offshore and coastal ecotypes (Gunter 1942, Shane et al. 1982, Würsig et al. 2000), and current classification of T. truncatus in the GOMx includes both the offshore and coastal ecotypes based on genetic analyses, with the coastal ecotype found in BSE, coastal, and shelf waters and the offshore ecotype confined primarily to deeper waters of the continental shelf and slope (Curry 1997, Vollmer 2011, Waring et al. 2013).*

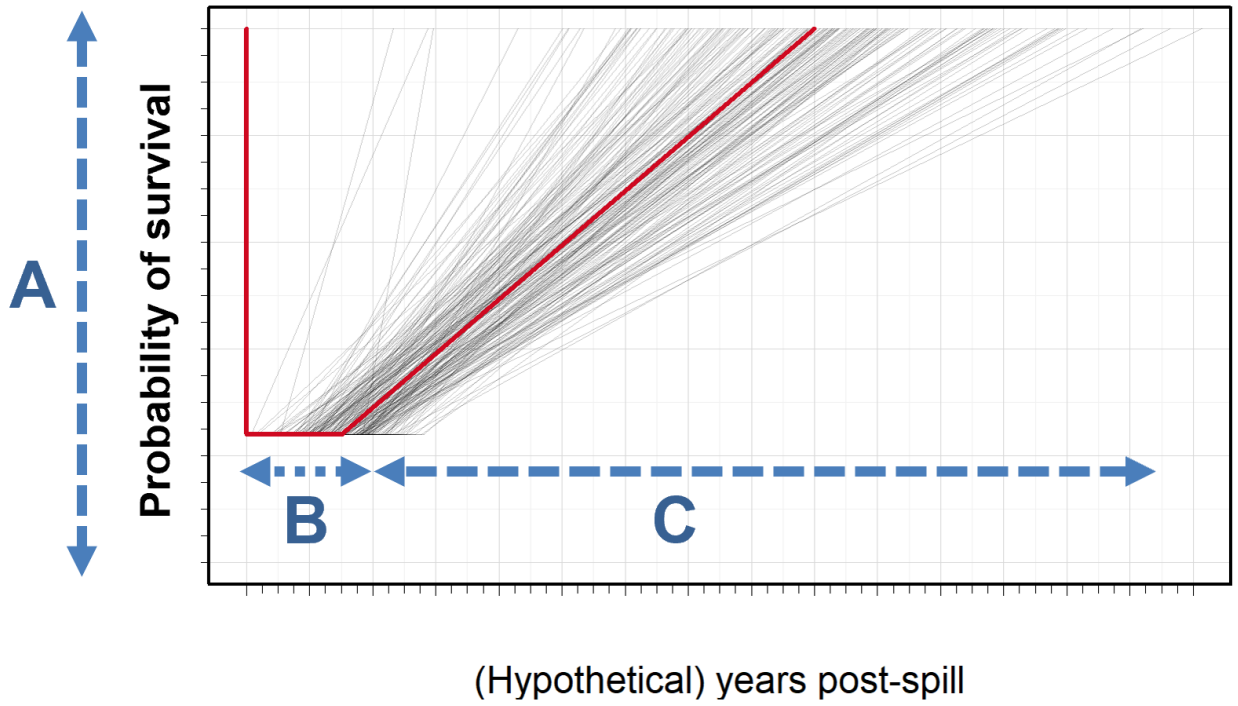
Furthermore, research based on skull morphology suggests that the offshore ecotype is larger than the coastal ecotype (Turner and Worthy 2003).” (from Vollmer & Rosel, 2013).

Quantities of Interest:

Below are the desired list of quantities of interest for which we would like to carry out expert elicitation exercises. We recognise this is more than can be achieved in a single workshop, but the list below reflects the priorities and thus the order in which we'll elicit.

1. Time to recovery for survival for BSE BND (C in the figure below) N.B. we have empirical data to estimate A and B for BSE BND.
2. Mortality effects for stage-structure species groups (A)
3. Time to recovery for survival for stage-structured species groups (B & C)

If time allows we will explore estimating fecundity effects and recovery for stage-structured species.



GoMRI Toxicology Report

GoMRI, who investigate the impacts of oil, dispersed oil and dispersant on the Gulf ecosystems, sponsored a workshop to discuss and synthesis the newly acquired knowledge on the toxicology of oil in vertebrates. The workshop, held in October 2019, included researchers from across disciplines and a broad array of study taxa. The resulting workshop report, led by Ailsa Hall (here) provides an excellent summary of the knowledge base for the effects of oil exposure on marine mammals and other taxa. In particular, see the summary table (Table 1) and Conceptual models (F = fish, B = birds, H = humans, MM = marine mammals)(Tables & Figures only: TOV workshop report). The main categories considered were effects on reproduction, adrenal, respiratory (lungs) and cardiac (heart).

The report summarises that reproductive capacity is typically affected, with reduced reproductive success in exposed animals. Additionally, Smith et al. detail the mechanisms behind failures in BSE BND - Smith et al), where maternal illness was determined to be the primary driver. More broadly, Hall et al note that across taxa: "*the reproductive system is susceptible to the toxic effects of contaminants, whether it is the developing gonads, embryos or through hormonal disruption. In addition, these outcomes will affect the survival of the offspring with the additional potential for long-term effects where contaminants are teratogenic.*" (ie disturb the development of the embryo or fetus).

Oil exposure has been shown (following the DWH spill) to affect the adrenal function in bottlenose dolphins, where animals were observed to have impaired stress response. In addition, many of the animals were observed to have severe lung disease (and this continues to be observed in young animals, with possible increases in recent years (K. Colegrove pers. comm.). If lung disease compromises aerobic performance, this might impact foraging in mobile and deep diving animals (which could potentially impact the animals energetically). The report highlights how similar effects have been observed in other taxa, with reduced aerobic performance in fish and humans following exposure to oil. Rusiecki et al 2018 examines the human coastguard cohort following oil exposure. Heart disease/conditions were been prevalent in examined dolphin following the exposure, though it is unclear to what extent this impacts survival. There are well established links between lung disease and heart disease in terrestrial mammals and humans (1) and (2) (from air pollutants).

Finally, many of the effects listed above are observed in fish species (some of which may be prey of GOMx cetacean species. It is not clear to what extent increased toxicity in prey species (e.g. fish and invertebrates) will impact marine mammals, though bioaccumulation up the food chain is a pathway to consider.

GOMx Cetacean Species

Common Name/Species	**Specific Name**
Atlantic spotted dolphin	*Stenella frontalis*
Blainville's beaked whale	*Mesoplodon densirostris*
Bryde's whale	*Balaenoptera edeni*
Clymene dolphin	*Stenella clymene*
Common bottlenose dolphin	*Tursiops truncatus*
Cuvier's beaked whale	*Ziphius cavirostris*
Dwarf sperm whale	*Kogia sima*
False killer whale	*Pseudorca crassidens*
Fraser's dolphin	*Lagenodelphis hosei*
Gervais' beaked whale	*Mesoplodon europaeus*
Killer whale	*Orcinus orca*
Melon-headed whale	*Peponocephala electra*
Pantropical spotted dolphin	*Stenella attenuata*
Pilot whale (short-finned)	*Globicephala macrorhynchus*
Pygmy killer whale	*Feresa attenuata*
Pygmy sperm whale	*Kogia breviceps*
Risso's dolphin	*Grampus griseus*
Rough-toothed dolphin	*Steno bredanensis*
Sperm whale	*Physeter macrocephalus*
Spinner dolphin	*Stenella longirostris*
Striped dolphin	*Stenella coeruleoalba*