

# Resource Injuries

## Open Ocean MAM Strategy Workshop

The injuries caused by the DWH spill cannot be fully described at the level of a single species, a single habitat type, or even a single region. Just as the injuries cannot be understood in isolation, restoration efforts must also be considered and implemented from a broader perspective. As such, the Trustees' preferred restoration alternative uses an ecosystem-level approach and allocates funds across Restoration Types and Restoration Areas. The Open Ocean Restoration Area allocations include funds for fish and water column invertebrates, sturgeon, sea turtles, marine mammals, birds, and mesophotic and deep benthic communities. The injuries caused by the DWH spill to each of these Restoration Types are described below.



### INJURY TO FISH AND WATER COLUMN INVERTEBRATES

- A vast quantity of water across the northern Gulf of Mexico was exposed to DWH oil, injuring water column resources. The surface slick alone covered a cumulative area of at least 43,300 square miles (112,000 square kilometers) across 113 days in 2010. The estimated average daily volume of contaminated water under surface oil slicks was 57 billion cubic meters. As a comparison, this volume is approximately 40 times the average daily discharge of the Mississippi River at New Orleans.
- Water-column resources injured by the spill include species from all levels in the food chain, from bacteria, to estuarine-dependent species, such as red drum, shrimp, and sea trout, to large predatory fish (e.g., bluefin tuna) that can migrate from the Gulf of Mexico into the Atlantic and as far as the Mediterranean Sea.
- The Trustees estimate that 2 to 5 trillion larval fish and 37 to 68 trillion invertebrates were killed in the surface waters, and between 86 million and 26 billion fish larvae and between 10 million and 7 billion planktonic invertebrates in deeper waters. Of these totals, 0.4 to 1 billion larval fish and 2 to 6 trillion invertebrates were killed in estuarine surface waters. The larval loss likely translated into millions to billions of fish that would have reached a year old. Larval fish that were killed but would not have survived to age 1 are also a significant loss; they are an energy source for other components of the ecosystem.
- The Trustees determined that additional injuries occurred, but these were not quantified. Examples include adverse effects to fish physiology (e.g., impaired reproduction and reduced growth) and adverse effects to reef fish communities (e.g., reductions in abundance and changes in community composition).



## INJURY TO STURGEON

- The Trustees conducted a focused assessment of potential injuries to Gulf sturgeon (*Acipenser oxyrinchus desotoi*), because Gulf sturgeon are listed as threatened under ESA and inhabit areas exposed to DWH oil.
- Between 1, 100 and 3,600 Gulf sturgeon were potentially exposed to DWH oil in the nearshore areas of the northern Gulf of Mexico in the fall of 2010. This estimated exposed population represents a substantial proportion of the total populations from six of the eight natal river systems. Although a direct kill of Gulf sturgeon from the oil was not observed, the Trustees found evidence of physiological injury, including exposure biomarkers for DNA damage and immunosuppression, to exposed Gulf sturgeon compared with Gulf sturgeon that were not exposed to the oil.



## INJURY TO SEA TURTLES

- The Trustees determined that four of the five species of sea turtles that inhabit the Gulf of Mexico were injured by the DWH oil spill (loggerhead, Kemp's ridley, green, and hawksbill). Leatherbacks were also likely exposed to oil, but injury could not be confirmed. All these species are listed as threatened or endangered under ESA, are long-lived, travel widely, and use a variety of habitats across the Gulf of Mexico and beyond.
- Sea turtles were injured by oil or response activities in open ocean, nearshore, and shoreline environments, and resulting mortalities spanned multiple life stages. The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species) and between 55,000 and up to 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill.



- Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were injured by response activities, and thousands more Kemp's ridley and loggerhead hatchlings were lost due to unrealized reproduction of adult sea turtles that were killed by the DWH oil spill.
- In addition, the injury assessment included injuries that were determined to have occurred



## INJURY TO MARINE MAMMALS

- The DWH oil spill resulted in the contamination of prime marine mammal habitat in the nearshore and offshore waters of the northern Gulf of Mexico. After inhaling, ingesting, aspirating, and potentially absorbing oil components, animals suffered from physical damage and toxic effects to a variety of organs and tissues, including lung disease, adrenal disease, poor body condition, immunosuppression, and a suite of other adverse health effects.
- Animals that succumbed to these adverse health effects contributed to the largest and longest marine mammal unusual mortality event (UME) on record in the northern Gulf of Mexico. The dead, stranded dolphins in the UME included near-term fetuses from failed pregnancies.
- Nearly all of the marine mammal stocks that overlap with the DWH oil spill footprint have demonstrable, quantifiable injuries. The remaining stocks were also likely injured, but there is not enough information to make a determination at this time.
- The Barataria Bay and Mississippi Sound bottlenose dolphin stocks were two of the most severely injured populations, with a 52 percent and 62 percent maximum reduction in their population sizes, respectively. Because cetaceans are long-lived animals, give birth to only one calf every few years, and are slow to reach reproductive maturity, these stocks will take many decades to recover without active restoration. Smaller percentages of the oceanic stocks were exposed to DWH oil. However, they still experienced increased mortality (as high as 17 percent), reproductive failure (as high as 22 percent), and adverse health effects (as high as 18 percent).



- Shelf and oceanic stocks were also affected. Of these stocks, Bryde's whales were the most affected, with 17 percent (confidence interval of 7 percent to 24 percent) excess mortality, 22 percent (confidence interval of 10 percent to 31 percent) excess failed pregnancies, and an 18 percent (confidence interval of 7 percent to 28 percent) higher likelihood of having adverse health effects (DWH MMIQT 2015).



## INJURY TO BIRDS

- At least 93 species of birds, including both resident and migratory species and across all five Gulf Coast states, were exposed to DWH oil in multiple northern Gulf of Mexico habitats, including open water, islands, beaches, bays, and marshes. Laboratory studies showed that exposure to DWH oil leads to injuries, including feather damage, abnormal blood attributes, organ damage, and death.
- Trustee scientists quantified that between 51,600 and 84,500 birds died as a result of the DWH oil spill, although significant mortality occurred that was unquantified. Further, of those quantified dead birds, the breeding-age adults would have produced an estimated 4,600 to 17,900 fledglings. Due to a number of factors that likely led to underestimation of mortality, true mortality is likely closer to the upper ranges than the lower. The magnitude of the injury and the number of species affected makes the DWH spill an unprecedented human-caused injury to birds of the region.



## INJURY TO MESOPHOTIC AND DEEP BENTHIC COMMUNITIES

- The Trustees documented a footprint of over 2,000 square kilometers of injury to benthic habitat surrounding the wellhead, within zones of varying impact. In the three inner zones (approximately 1,000 square kilometers), injuries included oil toxicity to organisms, smothering of organisms with drilling muds, reductions in the diversity of sediment-dwelling animals, and mortality and other health impacts to corals. Within the outermost zone (approximately 1,200 square kilometers), the chemical quality of the seafloor habitat was adversely affected by contamination and the food chain was fouled.
- Significant losses to resident corals and fish occurred across approximately 10 square kilometers of mesophotic reef habitat on the continental shelf edge. A larger area, between 8,500 and 45,000 square kilometers, of potential exposure extends beyond and between the areas where the Trustees have quantified injury. Many pelagic resources, such as grouper, use both reef top and surrounding habitats for feeding.