EFFECTS OF THE DEEPWATER HORIZON OIL SPILL ON SEA TURTLES

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- Florida Fish and Wildlife Conservation Commission
- In-water Research Group
- Riverhead Foundation
- Audubon Nature Institute
- Gulf World Marine Park
- Institute for Marine Mammal Studies
- LA, AL, FL Charter vessel captains and crews
- University of Florida, College of Veterinary Medicine
- Many more...

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the view of NOAA or of any other natural resource Trustee for the BP/Deepwater Horizon NRDA.
DEEPWATER HORIZON OIL SPILL

- 87 days of free release of oil (April 24-July 15, 2010)
- 1 mile (1.61 km) deep, 50 mi (~80 km) offshore
- 134 million gallons released
- Surface and deep-sea
- Maximum extent the size of Switzerland
- Complex and unprecedented response across the entire area and duration of the spill
Pelagic Sargassum within a convergence line, Gulf of Mexico, 2009
Pelagic Sargassum and petroleum within a convergence line, Gulf of Mexico, 2010
SEA TURTLES WERE EXPOSED TO OIL THROUGHOUT THE GULF OF MEXICO

Nesting females, basking turtles (Hawaii), nests and hatchlings are vulnerable to oil on shorelines.

Larger turtles become coated with oil at the surface, inhale vapors, and ingest oil, contaminated food, or sediment.

Winds and currents create ocean fronts, bringing together oil, dispersants, and Sargassum communities. This can result in prolonged exposure.

Hatchling and small juvenile turtles become mired in oil, preventing their movement and risking ingestion and inhalation.

Prey and forage may be killed by the physical and chemical effects of oil.

Damage to important habitat that turtles rely upon for food and shelter may affect their diet, energy resources, and exposure to predators.

Potential routes of exposure to oil and effects in marine and terrestrial habitats. Illustration by Kate Sweeney.
Significant, unprecedented challenges presented by a remote, enormous spill

1° mission to save sea turtles (and other resources) from oil

2° mission to estimate total turtle exposures and injuries caused by oil
APPROACHES TO THE DWH NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA)

Mortality was the key metric of injury caused to sea turtles

Veterinary-based assessments
Toxicology-based assessments

Field observations
Clinical & necropsy data
Chemical analyses
Comparative toxicology data
Surrogate freshwater turtle study

How many sea turtles died as a result of the DWH oil spill?
AVAILABLE DATA BY LIFE STAGE

Surface-pelagic juveniles
Most recovered as live, oiled individual rescued by response vessels

Neritic juveniles & adults
Primarily recovered as dead, stranded, non-oiled carcasses
EXPOSURE

- Direct documentation of exposure
  - Directed captures
  - Surveillance for stranded turtles*

- Alternative approaches
  - Aerial surveys (detection of larger turtles)
  - Detection of oil on water - SAR
EXPOSURE: rescue and assessment

Offshore Search Efforts for Sea Turtles, 17 May - 21 September 2010
BOAT-BASED RESCUES SAVED TURTLES AND PRODUCED CRITICAL DATA
INJURY ASSESSMENT

- Veterinary evaluation of oiled turtles
  - Hematology, plasma biochemistry, blood gases
  - Veterinary evaluation over months of captivity
  - Necropsy
- Toxicological assessment based on estimated dosage regime and published toxicity thresholds
  - Laboratory exposure study using surrogate freshwater species

- Analysis of nesting activity within response area
- Relocation of nests under imminent threat
INJURY ASSESSMENT: KEY FINDINGS

- Physical fouling: the most readily apparent & immediate threat to oiled sea turtles
- Predominant clinical findings in oiled turtles: nonspecific hemodynamic and metabolic derangements
  - Potentially confounded by capture and transport
- Few direct observations of neritic turtles
- Most of the strandings concurrent with the DWH spill & in subsequent years were neritic juvenile Kemp’s ridleys
  - Most (~96%) had no evidence of oil or dispersant exposure
  - Occurred as seasonal pulses in spring & summer months
  - Characterized by good nutritional condition, lack of injuries or evidence of significant disease, many feeding on fish
QUANTIFICATION

- Estimates of density of surface pelagic life stage
- Estimates of density of neritic juveniles and adults
- Mortality percentages estimated for different degrees of oil exposure
- Severity of oiling modeled over time and space

- Lost reproduction
  - Relocated nests
  - Deterrence
  - Adult females estimated to have died
Estimating Sea Turtle Exposures to *Deepwater Horizon* Oil
B.P. Wallace et al.
Abt Environmental Research, Inc.

Electronic Supplement

This electronic supplement contains daily probabilities of heavy oil exposure for every centroid of the integrated 5x5km grid product across the cumulative *Deepwater Horizon* (DWH) oil spill footprint. We also overlaid daily turtle capture locations and associated probabilities of heavy oil exposure. We estimated probabilities of heavy oil exposure for sea turtles that were sighted or captured during DWH response operations between May and September 2010 (pentagons) or sighted during aerial surveys (triangles) between April and September 2010.

The heavy oiling probabilities were estimated by a statistical relationship between observed oiling status of sea turtles captured during DWH response operations and spatio-temporal proximity of satellite-derived surface oil [i.e., daily synthetic aperture radar (SAR)]. See text for more details on the methodology.
### PDARP/PEIS Injury Estimates

<table>
<thead>
<tr>
<th>Life stage</th>
<th>Kemp’s</th>
<th>Loggerhead</th>
<th>Green</th>
<th>Hawksbill</th>
<th>Unidentified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface-pelagic juveniles</td>
<td>10-20% of all 1-2yo turtles</td>
<td>2,100-11,000</td>
<td>16,000-57,000</td>
<td>620-3,000</td>
<td>1,400-4,200</td>
<td>56,000-170,000</td>
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<tr>
<td>Larger juveniles &amp; adults</td>
<td>10% of nesting females</td>
<td>2,200-3,600</td>
<td>-</td>
<td>-</td>
<td>630-890</td>
<td>4,900-7,600</td>
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<tr>
<td>Hatchlings: response injuries</td>
<td>&lt;3% of cumulative losses 2011-2014</td>
<td>34,000</td>
<td>455</td>
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<td>35,000</td>
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<tr>
<td>Hatchlings: unrealized reproduction</td>
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</table>
SUMMARY

- Heavy oiling represented a grave threat to survival without intervention
  - Implicated as a significant cause of sea turtle mortality during DWH
- Few carcasses of oiled turtles recovered d/t low probability of discovery
- Intervention highly successful, but most oiled sea turtles could not be rescued due to size and duration of the DWH spill
- Better understanding is needed of the impacts on turtles, especially chronic, delayed & sublethal effects
### Restoration Funding in Dollars

<table>
<thead>
<tr>
<th>Major Restoration Categories</th>
<th>Unknown Conditions</th>
<th>Regaline-wide</th>
<th>Open Ocean</th>
<th>Alabama</th>
<th>Florida</th>
<th>Louisiana</th>
<th>Mississippi</th>
<th>Texas</th>
<th>Total Restoration Funding*</th>
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<tr>
<td>1. <strong>Restore and Conserve Habitat</strong></td>
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<td>Wetlands, Coastal, and Nearshore Habitats</td>
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<td>Early Restoration (through Phase IV)</td>
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<td>15,622,567</td>
<td>259,625,700</td>
<td>80,000,000</td>
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<td>2. <strong>Restore Water Quality</strong></td>
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<td>Nutrient Reduction (Nonpoint Source)</td>
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<td>3. <strong>Replenish and Protect Living Coastal and Marine Resources</strong></td>
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<td>Early Restoration Fish and Water Column Invertebrates</td>
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<td>Submerged Aquatic Vegetation</td>
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<td>Marine Mammals</td>
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<td>4. <strong>Provide and Enhance Recreational Opportunities</strong></td>
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<tr>
<td>Monitoring and Adaptive Management</td>
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<td>200,000,000</td>
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<td>225,000,000</td>
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<td>Administrative Oversight and Comprehensive Planning</td>
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<td>Adaptive Management NRD Payment for Unknown Conditions</td>
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<td><strong>Total NRD Funding</strong></td>
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<td>$295,567,000</td>
<td>$228,151,458</td>
</tr>
</tbody>
</table>

*The total restoration funding allocation for the Early Restoration work, each restoration type, and monitoring, adaptive management, and administrative oversight is $5.1 billion (plus up to an additional $700 million for adaptive management and unknown conditions).
Questions?
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