Restoring a Degraded Gulf of Mexico:

Wildlife and Wetlands Three Years Into the Gulf Oil Disaster

April 2013

NATIONAL WILDLIFE FEDERATION

Introduction

Three years after the Deepwater Horizon disaster, this report gives a snapshot view of six wildlife species that depend on a healthy Gulf and the coastal wetlands that are critical to the Gulf's food web.

In August 2011, scientists did a comprehensive health examination of a 16-year-old male bottlenose dolphin. This dolphin—dubbed Y12 for research purposes—was caught near Grand Isle, a Louisiana barrier island that was oiled during the Gulf oil disaster.[i]

Like many of the 31 other dolphins examined in the study, Y12 was found to be severely ill—underweight, anemic and with signs of liver and lung disease. The dolphins' symptoms were consistent with those seen in other mammals exposed to oil; researchers feared many of the dolphins studied were so ill they would not survive.[ii]

Seven months later, Y12's emaciated carcass washed up on the beach at Grand Isle.[iii]

Ecosystem-wide effects of the oil are suggested by the poor health of dolphins, which are at the top of the Gulf's food chain. The same may be true of sea turtles, which also continue to die in alarmingly high numbers.

More than 650 dolphins have been found stranded in the oil spill area since the Gulf oil disaster began. This is more than four times the historical average.

Research shows that polycyclic aromatic hydrocarbon (PAH) components of oil from the Macondo well were found in plankton even after the well was capped.[iv, v] PAHs can have carcinogenic, physiological and genetic effects. Killifish residing in coastal marshes showed evidence of physiological impairment even at low levels of oil exposure,[vi] and corals hundreds of years old on the Gulf floor were killed by oil from the Gulf oil disaster. A recent study found that very low levels of PAH exposure reduced hatch rates and survival in fish such as mahi mahi, and resulted in impaired cardiac development and swimming performance in the fish that did survive.[vii]

Furthermore, recent laboratory studies have found that the mixture of oil and the dispersant Corexit can prevent coral larvae from building new parts of a reef[viii] and was as much as 52 times more toxic than oil alone on rotifers, a microscopic grazing animal at the base of the Gulf's food web.[ix]

Other oil spill disasters have taken years to reveal their full effects,[x] and often recovery is still not complete decades later. Nearly a quarter-century after the Exxon Valdez spill in Prince William Sound, clams, mussels, sea otters and killer whales are still considered "recovering," and the Pacific herring population, commercially harvested before the spill, is showing few signs of recovery.[xi]

This report three years after the Gulf oil disaster follows on our one- and two-year reports, and it includes the most current scientific information available. As before, we focus on wetlands and six species of special concern due to their ecological importance and exposure to oil. We also describe how the outcome of the civil and criminal proceedings against BP and the other companies responsible for the spill will create—or have created—different sources of funding that will be used to restore the Gulf of Mexico. We also provide some initial suggestions as to how this funding can be used to improve the outlook for the species discussed in the report.

Scientists with the National Oceanic and Atmospheric Administration have done extensive research into the oil spill's impacts as part of the Natural Resources Damage Assessment required under the Oil Pollution Act. The results of these studies have been kept confidential as they are being used in the civil trial currently underway. Once the trial is concluded or the parties have settled, it is important that the federal government comply with the Freedom of Information Act by releasing this valuable scientific information so the public finally gains a better picture of the full impacts of the Gulf oil disaster.

Given the huge quantity of oil spilled, its widespread distribution, the fact that even small amounts of oil can have significant biological effects and that those effects may be slow to develop after exposure to oil, our understanding of the full scope of the Gulf oil disaster will likely be unfolding for years or decades.

Recommendations for a true restoration of the Gulf of Mexico:

1. **The Department of Justice must hold the parties responsible for the Gulf oil disaster fully accountable for gross negligence and willful misconduct in violation of federal environmental laws including the Clean Water Act and the Oil Pollution Act.**
2. **Final settlement of claims must include a "reopener clause" to hold responsible parties accountable for future damages that may occur but are not yet known, as the Oil Pollution Act requires full compensation for all natural resource damages.**
3. **Federal, state and local officials should commit Restore Act funds from civil Clean Water Act fines in the 2010 Gulf oil disaster to ecological restoration, thereby making the Gulf healthier and safer for wildlife and people, and bolstering the economy of the region.**
4. **Congress and the Administration must reform oil and gas leasing practices and permitting requirements to better safeguard wildlife and the environment.**

Note: The rating system in this report looks at the overall picture of the status in the Gulf of Mexico, including the impact of the oil spill, the historical status, and what the future seems to hold based on current trends.

Coastal Wetlands

Status in the Gulf: POOR

Oil Impact: About 1,110 miles of shoreline were oiled,[xii] including coastal wetlands. The extent of damage is highly variable depending upon the severity of contamination. Oil contamination and efforts to clean it up can damage wetlands, killing vegetation and thereby causing accelerated erosion and conversion of land to open water.[xiii] In reality, cleaning up oiled wetlands is virtually impossible.

Historical: Coastal wetlands provide food, refuge and nurseries for numerous species of wildlife, fish and shellfish and are therefore a critical link in the Gulf of Mexico's food web, but these vital habitats are threatened across the region.

Unfortunately, the area of the Gulf Coast that is losing wetlands the most rapidly—the Mississippi River Delta—was also one of the places hit hardest by the Gulf oil disaster. Formed where the Mississippi River meets the Gulf of Mexico, the delta is incredibly rich in fish and wildlife. The Louisiana coast has lost a total of almost 1,900 square miles in the last 80 years and continues to lose an average of a football field of wetlands, barrier islands and other habitats every hour.[xiv] The huge net loss has been caused primarily by levees and channelization of the river for flood control and shipping, dredging of extensive canals for oil and gas development, and land subsidence, which is a natural process that can be severely exacerbated by the withdrawal of oil and gas.[xv, xvi, xvii]

Future Trends: Without large-scale restoration, Louisiana is projected to lose another 1,750 square miles of coastal wetlands by 2060.[xviii]

How BP's Oil Spill Fines Can Help: In the Mississippi River Delta, fund barrier island restoration projects and the sediment diversions that build sustainable wetlands, as recommended in Louisiana's recently-passed 2012 Coastal Master Plan. Across the Gulf, restore coastal wetlands to support a healthy food web. Implement strategies to reduce heavy nutrient loads carried in rivers, which cause large dead zones in the Gulf.

Bottlenose Dolphins

Status in the Gulf: FAIR

Oil Impact: More than 650 stranded dolphins have been found since the Gulf oil disaster began. More than 130 of that number were infant or stillborn calves. Dolphin strandings in the oil spill area have been above the historic average (2002-2009) every month since just before the Deepwater Horizon rig exploded. However, the true number of stranded dolphins is likely far higher, as research shows that only about one in every 50 dead marine mammals in the northern Gulf of Mexico are ever found.[xix]

Dolphin strandings were five times above historic levels in 2011; in 2012 they dropped slightly, but are still two and half times the historic average. The spike and subsequent gradual decline in dolphin strandings strongly implicate the Gulf oil disaster as a major factor in what the National Oceanic and Atmospheric Administration (NOAA) has declared as an Unusual Mortality Event (UME).[xx] NOAA has not identified a reason for the UME, which started two months before the Gulf oil disaster began. However, the agency has ruled out two of the most common causes (morbillivirus and marine biotoxins such as red tide) of previous dolphin UMEs in the Gulf.[xxi] Dolphin strandings continued at six times the historical average for infant dolphins in January and February of 2013.

Exposure to oil can reduce the fitness of dolphins, making them more susceptible to other impacts such as disease and cold water stunning.[xxii] Direct exposure to oil, consumption of contaminated prey and reduced food availability due to possible reduction in prey populations are all factors that could affect dolphin fitness.

Historical: Insufficient information is available to provide reliable estimates of dolphin populations throughout the Gulf of Mexico, including the oil spill area.[xxiii] Although a protected species, accidental injury and death may occur from recreational and commercial fishing. Health may be impaired by pollutants such as PCBs.[xxiv] Death can occur from "cold stunning" during unusually cold winter weather[xxv] and biotoxins (red tide).[xxvi]

Future Trends: The poor health of dolphins in heavily-oiled areas and continuing unprecedented strandings, including babies, ever since the Gulf oil disaster, suggest that some local populations could be in decline. How long these effects will last and how dolphins will fare in less heavily-oiled areas are unknown and are cause for concern. Healthy dolphin populations are dependent upon clean water and healthy, productive ecosystems.

How BP's Oil Spill Fines Can Help: Restore coastal wetlands and ensure a more natural pattern of river flows into Gulf estuaries to support a healthy food web. Improve water quality by upgrading coastal communities' wastewater and stormwater systems, protecting sensitive land in watersheds, rebuilding oyster reefs and other efforts. Support long-term monitoring and research.

Atlantic Bluefin Tuna

Status in the Gulf: POOR

Oil Impact: The western population of Atlantic bluefin tuna breeds only in two areas of the northern Gulf of Mexico. The Gulf oil disaster occurred as the April-May breeding season was underway, when eggs and young are very vulnerable to contaminants such as oil. Contact with oil may have reduced the number of juvenile bluefin produced in 2010 by 20%,[xxvii] with a potential reduction in future populations of about 4%.[xxviii] For species in peril, reductions of reproductive success and lower populations can be major impediments to recovery. Even though most spawning habitat and larval populations were outside the oil spill area,[xxix] there is still the unknown potential for indirect effects through impacts on food resources.

Historical: Considered the greatest big game fish in the world,[xxx] the western Atlantic bluefin tuna population has declined by 82% from the 1970s.[xxxi] Recent studies estimated that the 2011 adult population of Atlantic bluefin tuna were 75% lower than the population in 2005.[xxxii] Commercial overfishing is the primary reason for their long-term decline,[xxxiii] as well as their bycatch in long-line fishing for swordfish and yellow tuna.[xxxiv] As top-level predators, they are indicators of ecosystem health.[xxxv]

Future Trends: There are encouraging signs that Atlantic bluefin tuna may be showing a positive response to lowered commercial fishing quotas in 2010 and 2011, as well as reductions in illegal bluefin tuna fishing due to stronger enforcement.[xxxvi] But there is intense pressure to expand bluefin tuna fishing quotas around the world. In January 2013, a 489-pound Pacific bluefin tuna was purchased in Japan for $1.8 million.[xxxvii] It is important for commercial bluefin tuna catch quotas to be based on sound science[xxxviii] and that they are strictly enforced.[xxxix] Reducing bycatch of bluefin tuna in long-lining for other species is also important for recovery.

How BP's Oil Spill Fines Can Help: Fund the purchase of more selective fishing gear for commercial fishermen, such as "greenstick" gear for yellowfin tuna fishing and swordfish buoy gear[xl] as a substitute for long-line fishing, to reduce incidental take of bluefin tuna (and the bycatch of about 80 other species). Improve water quality in the Gulf of Mexico by restoring natural sedimentation through diversions of the Mississippi River water channel to coastal wetlands, thereby reducing the offshore river flow that is a major cause of oxygen-depleted "dead zones" in the Gulf. Support research into adjusting timing and location of long-line fishing in the Gulf of Mexico to minimize bluefin tuna bycatch.[xli, xlii]

Shrimp

Status in the Gulf: GOOD

Oil Impact: The Gulf oil disaster contaminated coastal wetlands, which shrimp require for juvenile stages, and some oil remains in these wetlands. Shrimp are a key component of the food web, feeding on plankton and other microscopic organisms, and are an important source of food for game fish and other wildlife, such as dolphins and sea turtles.

Shrimp seasons were closed for a portion of 2010 because of the Gulf oil disaster, and shrimpers may have been reluctant to harvest even when the season was open, due to collapsed markets for Gulf Coast seafood. Not surprisingly, Louisiana's 2010 shrimp harvest was the lowest in several decades. However, Louisiana's 2011 shrimp landings were commensurate with annual shrimp landings of the past two decades.[xliii]

Historical: Shrimping has been a way of life for Gulf Coast communities for nearly 250 years. Shrimp are savored whether "boiled, fried, stewed, in a Creole sauce, an etouffee, stuffed with breadcrumbs and rice (or) found in gumbos and jambalayas."[xliv] Several species of shrimp are commercially fished in the Gulf. Shrimping is an important source of employment and annual shrimp landings usually exceed $100 million in value in Louisiana alone.[xlv]

Future Trends: The continued decline in coastal wetlands is a long-term threat to shrimp. Brown, white and pink shrimp depend upon shallow wetland/coastal habitats for their early life stages. Due to considerable year-to-year variation in shrimp harvest, multi-year trends are better indications of shrimp health than any single year.

How BP's Oil Spill Fines Can Help: Improve near-shore water quality, restore coastal wetlands, mimic natural river processes and restore sustainable wetlands to support juvenile stages of shrimp and provide a healthy food web.

Sea Turtles

Status in the Gulf: POOR

Oil Impact: Sea turtle strandings were at record-breaking levels in 2010 and 2011 and continued to be above normal in 2012. On average, about 240 sea turtles are stranded annually; more than 1,700 turtles have been found stranded between May 2010 and November 2012.[xlvi, xlvii] Most strandings have been the highly endangered Kemp's ridley sea turtle, which nests only in the Gulf of Mexico.[xlviii]

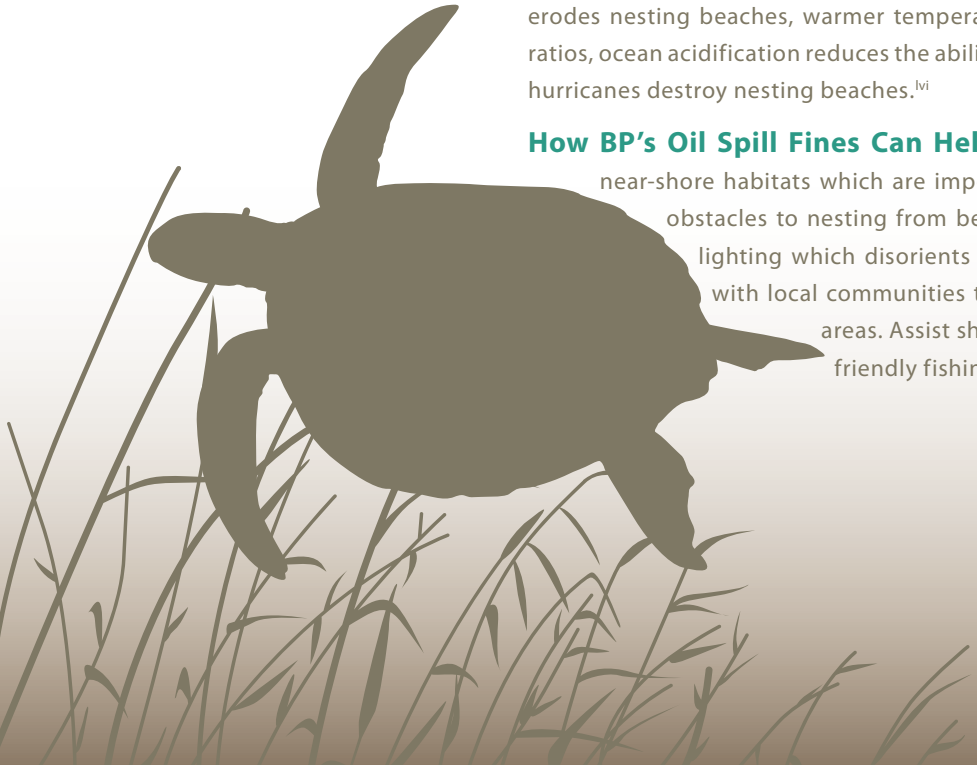
In the first year after the Gulf oil disaster, some 1,149 sea turtles were stranded or found debilitated, of which 613 were dead or dying. Of the 461 caught at sea, nearly all were alive and oiled.[xlix] These numbers, although high, considerably under-represent the total strandings, as it is well known that only a very small portion of dead sea turtles are ever found.

Oil and dispersants stress sea turtles, potentially making them more susceptible to disease, as well as to capture and drowning in shrimp nets. It is indisputable that the Gulf oil disaster has impacted sea turtles, and highly plausible that it is a major factor in the highly-elevated rates of sea turtle deaths after the Gulf oil disaster.

Historical: The five species of sea turtles that occur in the Gulf are listed under the Endangered Species Act. Four are endangered, while the fifth is listed as threatened. Populations are far below historical levels due to incidental capture in trawling nets and long-lineline fishing gear,[l, li, lii, liii] mortality due to marine debris,[liv] loss of coastal nesting beaches, and oil spills.[lv] In 1987, Turtle Excluder Devices, or TEDs, became required for shrimp fishing in some, but not all areas. Compliance with the TED regulations has been controversial and difficult to enforce, especially as the state of Louisiana has long refused to enforce federal TED regulations.

Future Trends: Low populations render sea turtles very vulnerable to impacts from oil pollution, loss of nesting habitat, marine debris and incidental take in commercial fishing. Without full implementation and enforcement of TED regulations, sea turtle recovery will remain hampered. Climate change looms as a threat as sea level rise erodes nesting beaches, warmer temperatures affect reproductive success and sex ratios, ocean acidification reduces the ability of their prey to create shells and stronger hurricanes destroy nesting beaches.[lvi]

How BP's Oil Spill Fines Can Help: Protect and restore seagrass beds and near-shore habitats which are important habitat for juvenile turtles. Remove obstacles to nesting from beaches at night. Reduce and modify beach lighting which disorients nesting turtles and hatchlings by working with local communities to install "turtle friendly" lighting in beach areas. Assist shrimpers in purchasing more turtle-friendly fishing gear.



Brown Pelicans

Status in the Gulf: GOOD

Oil Impact: As of May 2011, some 826 brown pelicans were collected in the oil spill area, of which 577 were dead or later died. More than 40% of all pelicans collected were visibly oiled and the oiling status of another 29% wasn't recorded.[lvii] Oil contaminated some island mangrove thickets used for nesting. Effects of the oil on prey fish abundance are being studied.

Historical: The brown pelican was listed as endangered in 1970. Killing for feathers and food in the early 20th century reduced once-abundant pelican populations, followed by extensive DDT use that caused egg-shell thinning and widespread reproductive failure.[lviii] Brown pelicans had completely disappeared from Louisiana. The banning of DDT in 1972 initiated recovery efforts, followed by relocating birds from the Atlantic coast population to Louisiana,[lix] eventually leading to their removal from the federal endangered species list in 2009.[lx] At that time, the Texas/Louisiana population was estimated at about 12,000 pairs.[lxi]

Tropical storms have destroyed nesting islands.[lxii] In June 2005, tropical storm Arlene washed over pelican nesting colonies in Breton National Wildlife Refuge at a time when eggs were still in nests and many young were unable to fly to safety. Making matters worse, an oil spill at the time covered many of the storm survivors in oil, resulting in many more pelicans dying.[lxiii] Later that year, Hurricane Katrina eroded beaches and marshes on the island, and destroyed vegetation important for stabilizing the terrain. The historical (and future) threat of oil and gas to Gulf wildlife, including brown pelicans, was demonstrated by Hurricanes Katrina and Rita, which destroyed 113 oil and gas platforms and damaged 457 pipelines, resulting in 741,000 gallons spilled.[lxiv, lxv]

Future Trends: Brown pelicans continue to inhabit the Atlantic and Pacific coasts and other areas of the Gulf of Mexico.[lxvi] Although the brown pelican is no longer endangered, and is protected by the Migratory Bird Treaty Act which prohibits disturbing or killing them, continued loss of coastal habitats is likely to reduce nesting sites and food abundance. Sea level rise and stronger tropical storms due to climate change are likely to accelerate loss of pelican nesting sites. Oil spills are an ongoing concern, as in addition to adult mortality, contamination of eggs from the breast feathers of incubating adults reduces egg hatching success.[lxvii]

How BP's Oil Spill Fines Can Help: Comprehensive restoration of Gulf Coast ecosystems, including restoration of natural processes that create wetlands and islands from deposition of sediments carried by the Mississippi River. Restore vegetation on barrier islands used as rookeries to slow erosion.

Deep Sea Coral

Status in the Gulf: FAIR

Oil Impact: After the Gulf oil disaster, some of the once-vibrant deep sea coral colonies in the Gulf of Mexico died. Soon after the spill, a survey of coral colonies 12 or more miles away from the wellhead showed no apparent impacts, whereas the same survey reported a coral colony seven miles away with numerous signs of distress. In a laboratory study, coral larvae species from the Florida Keys exposed to oil, Corexit and an oil/Corexit mixture exhibited lower survival rates.[lxviii] Marine life associated with the deep sea corals also showed visible signs of impact from the oil.[lxix]

Historical: Although challenging to study, it is known that a variety of deep sea corals live on the Gulf floor, including black corals, some of which have been growing continuously for at least 2,000 years.[lxx] Deep sea coral colonies provide the foundation for a diverse assortment of marine life,[lxxi] including many invertebrates and fish.[lxxii]

Future Trends: The full extent of the damage from oil and Corexit to deep sea corals is still uncertain. Furthermore, it is unknown what the long-term effects will be on corals and the marine communities they harbor, because corals grow and reproduce so slowly. Human fingernails grow at 2,000 times the rate of black coral.[lxxiii] Recovery of dead and damaged corals to pre-spill conditions could take centuries. Unless Congress takes action to strengthen regulations governing deep-water offshore oil and gas drilling and development, deep sea coral communities will continue to be at high risk.

How BP's Oil Spill Fines Can Help: Upgrading coastal communities' wastewater and stormwater systems, protecting sensitive land in watersheds and rebuilding oyster reefs, all of which help improve water quality. Funding scientific research into more effective and less harmful ways to address deep-water oil pollution and methods of ecosystem restoration.

Gulf Oil Disaster Restoration Funding

The outcome of the current civil proceedings in federal court against BP and the other responsible parties will create different sources of funding that will be used to restore the Gulf of Mexico. Additionally, the Department of Justice has structured the criminal settlements so that much of the money from these fines will also be used for Gulf restoration.

What follows is a brief guide to the different sources of restoration funding, each controlled by different entities and designated for specific purposes. Because BP is likely to pay the most substantial damages and penalties, herein we collectively refer to all these sources of funding from the responsible parties as "BP's oil spill fines."

Natural Resource Damage Assessment:

Amount: To Be Determined

Under the terms of the Oil Pollution Act, the companies responsible for the spill will pay the full cost of a Natural Resource Damage Assessment to determine harm from the spill, the loss of the public use, and the full cost of a comprehensive plan to restore, replace, rehabilitate or acquire the equivalent of each natural resource that was harmed. In this case, the National Resource Damage Assessment trustees include the U.S. Department of the Interior, the National Oceanic and Atmospheric Administration and the natural resource agencies for each of the five Gulf States. Because ocean water, oil, dispersants, fish and wildlife move and the wellhead was over a mile beneath the surface of the ocean, assessing the actual damage is a complex and lengthy process.

Clean Water Act Civil Penalties:

BP: Up to $17.6 billion (pending the outcome of the civil trial)
Transocean: $1 billion

Congress recognized that polluters often reap large profits by taking risky shortcuts that foul the nation's waters. To prevent this behavior, the Clean Water Act includes civil fines linked to the amount of oil spilled and the degree of negligence in the behavior that led to the spill.

The Restore Act, signed into law in July 2012, directs 80% of the Clean Water Act fines paid by BP and other parties responsible for the oil spill to a Gulf Coast Restoration Trust Fund. Of the money deposited in the trust fund, 35% is equally allocated among each of the Gulf States; 30% is dedicated to the development and implementation of a Gulf-wide Comprehensive Ecosystem Restoration Plan; 30% will be used for state-specific environmental restoration plans; 2.5% will provide grants for research; and 2.5% will be used for long-term fisheries monitoring and ecosystem science.

The Comprehensive Ecosystem Restoration Plan is being developed by a federal-state council tasked with increasing the long-term ecological health of the Gulf. While the Natural Resource Damage Assessment plan will only address restoration of impacted resources, the Council's Comprehensive Ecosystem Plan can address ecological restoration needs that existed prior to the disaster.

Criminal Penalties

BP: $4 billion

In January 2013, the Court approved a $4 billion settlement for BP's criminal violations of the Clean Water Act, the Migratory Bird Treaty Act, obstruction of Congress and for the loss of 11 lives. Of that, the National Fish and Wildlife Foundation will distribute $2.4 billion over five years for environmental restoration projects in the Gulf and another $350 million will go to the National Academy of Sciences for research.

Transocean: $400 million

In February 2013, the Court approved a $400 million settlement with Transocean for its criminal violations of the Clean Water Act. Money from the criminal settlement will be split as follows: $150 million will be distributed by the National Fish and Wildlife Foundation for Gulf Coast environmental restoration, $150 million will fund a National Academy of Sciences Gulf environmental protection and offshore oil safety research and education endowment; and $100 million will be deposited into the Oil Spill Liability Trust Fund.

Prepared by:

Douglas B. Inkley, Ph.D., Senior Scientist, Conservation Programs

with

Sara Gonzalez-Rothi Kronenthal, Esq., Senior Policy Specialist for Protecting and Restoring Coasts and Floodplains

Lacey McCormick, Communications Manager, National Water Policy and Gulf of Mexico Restoration

Acknowledgments:

This report was made possible by the generous contributions of many NWF supporters to our Gulf oil disaster response. The skilled efforts, support and input from Debbie Anderson, Susan Kaderka, Jessica Koelsch, John Kostyack, Steve Murchie, Mary Price, Alisha Renfro, Shell Rumohr, Emily Guidry Schatzel, Bruce Stein, Aileo Weinmann and David White are truly appreciated and made this document possible. Marydele Donnelly, Director of International Policy for the Sea Turtle Conservancy kindly assisted with her expertise on sea turtle conservation.

References:

[i]www.flickr.com/photos/66432153@N06/7008743561/in/set-72157629651167107/

[ii]www.gulfspillrestoration.noaa.gov/2012/03/study-shows-some-gulf-dolphins-severely-ill/

[iii]www.flickr.com/photos/66432153@N06/7008743609/in/set-72157629651167107/

[iv]Mitra, S., G. Kimmel, J. Snyder, K. Scalise, B. McGlaughon, M. Roman, G. Jahn, J. Pierson, S. Brandt, J. Montoya, R. Rosenbauer, T. Lorenson, F. Wong and P. Campbell. 2012. Macondo-1 well oil derived polycyclic aromatic hydrocarbons in mesozooplankton from the northern Gulf of Mexico. Geophysical Research Letters 39.

[v]Graham, W., R. Condon, R. Carmichael, I. D'Ambra, H. Patterson, L. Linn and F. Hernandez. 2010. Oil carbon entered the coastal planktonic food web during the Deepwater Horizon oil spill. Environ. Res. Lett. 5, 045301.

[vi]Whitehead, A., B. Dubansky, C. Bodiniera, T. Garcia, S. Miles, C. Pilley, V. Raghunathan, J. Roach, N. Walker, R. Walter, C. Rice and F. Galvez. 2011. Genomic and physiological footprint of the Deepwater Horizon oil spill on resident marsh fishes. Proceedings of the National Academies of Science. www.pnas.org/cgi/doi/10.1073/pnas.1109545108

[vii]Oil Spill Toxicology. 2012. m.rsmas.miami.edu/pages/pressrelease/2012/oil-spill-toxicology

[viii]Goodbody-Gringley G., D.L. Wetzel, D. Gillon, E. Pulster, A. Miller et al. 2013. Toxicity of Deepwater Horizon Source Oil and the Chemical Dispersant, Corexit® 9500, to Coral Larvae. PLoS ONE 8(1): e45574.

[ix]www.biology.gatech.edu/news/release.html?nid=174381

[x]http://archive.orr.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=241&subtopic_id(entry_subtopic_topic)=13&topic_id(entry_subtopic_topic)=1

[xi]www.evostc.state.ak.us/recovery/status.cfm

[xii]Ramseur, J., L. Hagerty and L. Curry. 2013. Deepwater Horizon Oil Spill: Recent Activities and Ongoing Developments (Report). CRS Report for Congress. Congressional Research Service.

[xiii]Silliman, B., J. van de Koppel, M.W. McCoy, J. Diller, G.N. Kasozi, K. Earl, P.N. Adams and A.R. Zimmerman. 2012. Degradation and resilience in Louisiana salt marshes after the BP-Deepwater Horizon oil spill. Proceedings of the National Academy of Sciences 109. www.pnas.org/content/109/28/11234

[xiv]Couvillion, B.R., J.A. Barras, G.D. Steyer, W. Sleavin, M. Fischer, H. Beck, N. Trahan, B. Griffin and D. Heckman. 2011. Land area change in coastal Louisiana from 1932 to 2010: U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000, 12 p. pamphlet. pubs.usgs.gov/sim/3164/

[xv]EPA and Louisiana Geological Survey. 1987. Saving Louisiana's Coastal Wetlands – The Need For a Long-Term Plan of Action. EPA-230-02-87-026. 9/20/2005.

[xvi]National Wetlands Research Center. 2005. The Oil and Gas Industry: Impacts Come Full Circle. Louisiana Coastal Wetlands Restoration and Conservation Task Force Website.

[xvii]Kolker, A.S., M.A. Allison and S. Hameed. 2011. An evaluation of subsidence rates and sea-level variability in the northern Gulf of Mexico. Geophysical Research Letters 38.

[xviii]issuu.com/coastalmasterplan/docs/coastal_master_plan-v2?mode=window&layout=

[xix]Williams, R., G. Shane, L. Bejder, J. Calambokidis, S. D. Kraus, D. Lusseau, A. J. Read and J. Robbins. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. Conservation Letters 1–6.

[xx]www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm

[xxi]www.gulfspillrestoration.noaa.gov/2012/03/gulf-dolphins-answers/

[xxii]www.audubooninstitute.org/media/releases/lmmstrp-asks-extra-eyes-out-water-during-cold-weather

[xxiii]www.nmfs.noaa.gov/pr/sars/species.htm#bottlenose

[xxiv]www.oceanservice.noaa.gov/news/weeklynews/feb10/dolphins.html

[xxv]www.audubоninstitute.org/media/releases/lmmstrp-asks-extra-eyes-out-water-during-cold-weather

[xxvi]www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bottlenosedolphin.htm

[xxvii]www.esa.int/esaCP/SEM1K4WO1FG_index_0.html

[xxviii]online.wsj.com/article/SB10001424052970204083204577080734209935416.html

[xxix]Muhlinga, B.A., M.A. Roffer, J.T. Lamkin, G.W. Ingram Jr., M.A. Upton, G. Gawlikowski, F. Muller-Karger, S. Hantese and W.J. Richards. 2012. Overlap between Atlantic bluefin tuna spawning grounds and observed Deepwater Horizon surface oil in the northern Gulf of Mexico. Marine Pollution Bulletin 64(4)679–687. www.sciencedirect.com/science/article/pii/S0025326X12000574

[xxx]www.bigmarinefish.com/bluefin.html

[xxxi]www.wildlifeextra.com/go/news/bluefin-tuna938.html#cr

[xxxii]Atlantic Bluefin Tuna Status Review Team. 2011. Status Review report of Atlantic Bluefin Tuna (Thunnus thynnus). National Marine Fisheries Service, National Oceanic and Atmospheric Administration.

[xxxiii]www.en.wikipedia.org/wiki/Thunnus_thynnus#Reproduction

[xxxiv]www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/PEG_GulfLonglinePilotPRGMr8.pdf

[xxxv]www.nmfs.noaa.gov/stories/2011/05/bluefin_tuna.html

[xxxvi]bigstory.ap.org/article/fisheries-nations-set-discuss-bluefin-tuna

[xxxvii]www.businessinsider.com/bluefin-tuna-sells-for-record-breaking-18-million-2013-1

[xxxviii]www.huffingtonpost.com/2012/11/27/bluefin-tuna-quotas_n_2197221.html

[xxxix]www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/atl_bluefin_tuna.htm

[xl]www.pewenvironment.org/news-room/fact-sheets/protecting-bluefin-tuna-in-the-gulf-of-mexico-a-promising-solution-to-a-decades-old-problem-85899434887

[xli]Teo, S. L.H. and B.A. Block. 2010. Comparative Influence of Ocean Conditions on Yellowfin and Atlantic Bluefin Tuna Catch from Longlines in the Gulf of Mexico BMC Genomics 5(5)1-11.

[xlii]Armsworth, P., B. Block, J. Eagle and J. Roughgarden. 2011. The role of discounting and dynamics in determining the economic efficiency of time-area closures for managing fishery bycatch. Theoretical Ecology 4(4)513-526.

[xliii]Derived from www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index

[xliv]www.louisianafolklife.org/LT/Articles_Essays/creole_art_shrimping_overv.html

[xlv]Derived from: www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index

[xlvi]www.nmfs.noaa.gov/pr/species/turtles/gulfofmexico.htm

[xlvii]Assessments of sea turtle strandings were based on data from the Sea Turtle Stranding and Salvage Network (STSSN). www.sefsc.noaa.gov/species/turtles/strandings.htm

[xlviii]www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm

[xlix]www.nmfs.noaa.gov/pr/pdfs/oilspill/species_data.pdf

[l]R.L. Lewison and L.B. Crowder. 2006. Putting longline bycatch of sea turtles into perspective. Conservation Biology 21: 79-86. Wallace, B.P., R.L. Lewison, S.L. McDonald, R.K. McDonald, C.Y. Kot, S. Kelez, R.K. Bjorkland, E.M. Finkbeiner, S. Helmbrecht and L.B. Crowder. 2010. Global patterns of marine turtle bycatch. Conservation Letters 3: 131-142.

[li]Moore, J.E., B.P. Wallace, R.L. Lewison, R. Žydelis, T.M. Cox and L.B. Crowder. 2008. A review of marine mammal, sea turtle and seabird bycatch in USA fisheries and the role of policy in shaping management. Marine Policy 33: 435-451.

[lii]Gulf of Mexico Fishery Management Council. 2009. Scoping Document for Amendment 31 to Address Bycatch of Sea Turtles in the Gulf of Mexico Reef Fish Bottom Longline Fishery. www.gulfcouncil.org.

[liii]Griffin, E., K.L. Miller, S. Harris and D. Allison. 2008. Trouble for Turtles: Trawl Fishing in the Atlantic Ocean and Gulf of Mexico. Oceana, Washington, D.C.

[liv]www.conserveturtles.org/seaturtleinformation.php?page=marine_debris.

[lv]Wilson, E. G. 2010. Potential Impacts of Deepwater Horizon Oil Spill on Sea Turtles. Oceana, Washington, D.C. na.oceana.org/sites/default/files/Potential.

[lvi]Glick, P., D. Inkley and G. Appelson. 2011. SEA TURTLE HOMECOMING, CLASS OF 2010: A Proactive Coastal Conservation Agenda for Florida. National Wildlife Federation, Florida Wildlife Federation and Sea Turtle Conservancy.

[lvii]www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

[lviii]www.fws.gov/contaminants/pdf/brown_pelicanfactsheet09.pdf

[lix]www.newscientist.com/article/dn19035-how-endangered-are-the-gulfs-brown-pelicans.html

[lx]www.gpo.gov/fdsys/pkg/FR-2009-11-17/pdf/E9-27402.pdf#page=1

[lxi]www.fws.gov/contaminants/pdf/brown_pelicanfactsheet09.pdf

[lxii]www.gpo.gov/fdsys/pkg/FR-2009-11-17/pdf/E9-27402.pdf#page=1

[lxiii]www.fws.gov/breton/pelican_web/pelican_habitat.html

[lxiv]blog.skytruth.org/2007/12/hurricane-katrina-gulf-of-mexico-oil.html

[lxv]docs.lib.noaa.gov/noaa_documents/DWH_IR/reports/1890_HistoricalSpillsGulfofMexico.pdf

[lxvi]www.newscientist.com/article/dn19035-how-endangered-are-the-gulfs-brown-pelicans.html

[lxvii]Parnell, J.F. M.A. Shields and D.Frierson Jr. 1984. Hatching Success of Brown Pelican Eggs after Contamination with Oil. Colonial Waterbirds 7(22-24). www.jstor.org/discover/10.2307/1521078?uid=3739704&uid=2&uid=4&uid=3739256&sid=21101819961931

[lxviii]Goodbody-Gringley G., D.L. Wetzel, D. Gillon, E. Pulster, A. Miller et al. 2013. Toxicity of Deepwater Horizon Source Oil and the Chemical Dispersant, Corexit® 9500, to Coral Larvae. PLoS ONE 8(1): e45574.

[lxix]White, H., K. Hsing, H. Pen-Yuan, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A.W. Demopoulos, C.R. German; J.M. Brooks, H. Roberts, W. Shedd, C.M. Reddy and C.R. Fisher. 2012. Impact of the Deepwater Horizon oil spill on a deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Sciences of the United States of America 109(50)20303-20308.

[lxx]Prouty, N. G., E. B. Roark, N. A. Buster and S. W. Ross. 2011. Growth rate and age distribution of deep-sea black corals in the Gulf of Mexico. www.int-res.com/abstracts/meps/v423/p101-115/

[lxxi]Lessard-Pilon, S.A., E.L. Podowski, E.E. Cordes and C.R. Fisher. 2010. Megafauna community composition associated with Lophelia pertusa colonies in the Gulf of Mexico. Deep-Sea Research Part II, Topical Studies in Oceanography 57:21-23.

[lxxii]Galkiewicz, J. P., S.H. Stellick, M.A Gray, A. Michael and C.A. Kellogg. 2012. Cultured fungal associates from the deep-sea coral Lophelia pertusa. Deep-Sea Research Part I, Oceanographic Research Papers 67:12-20.

[lxxiii]www.usgs.gov/newsroom/article.asp?ID=2745