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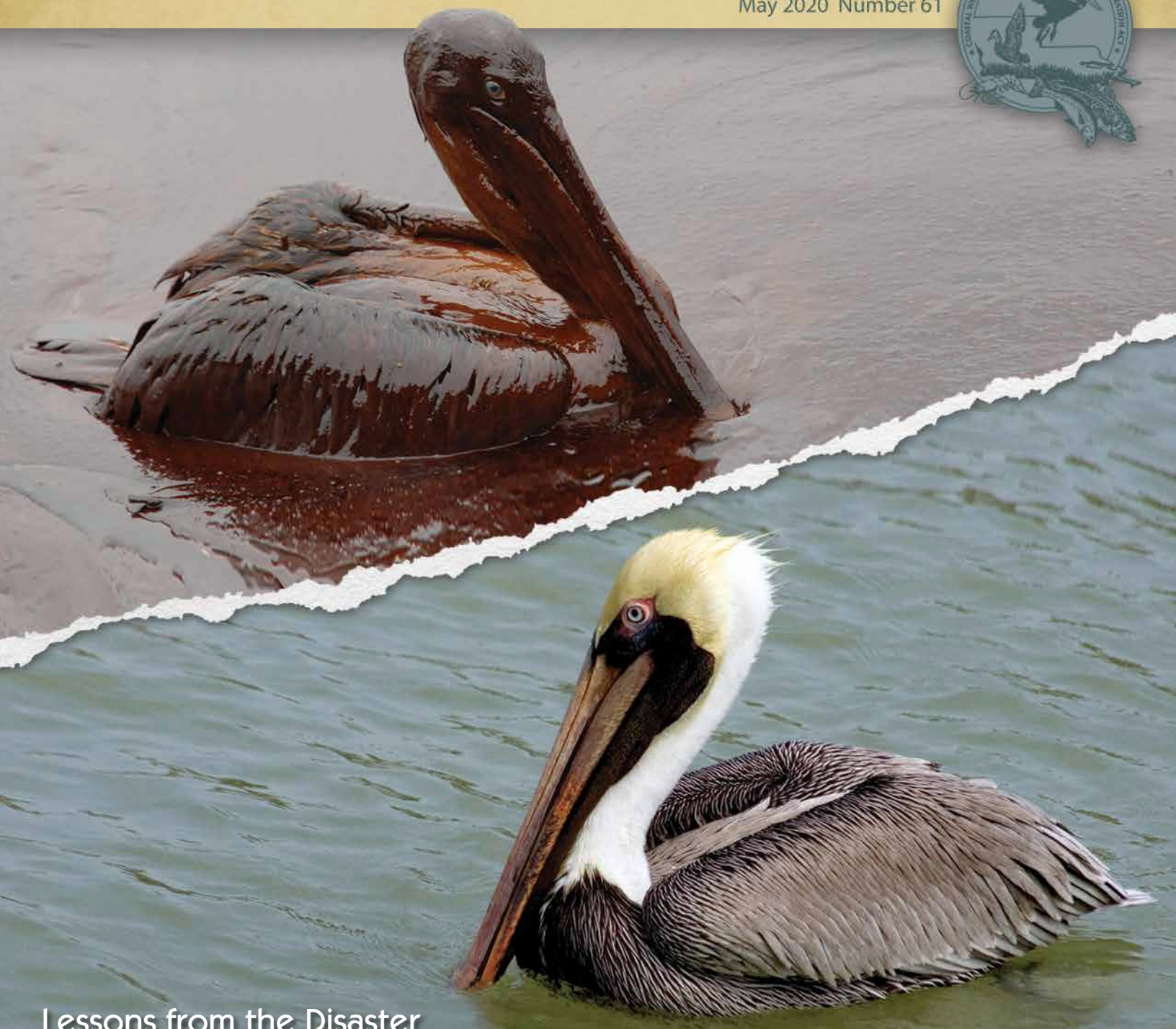
Water Marks

Louisiana Coastal Wetlands Planning, Protection and Restoration News

May 2020 Number 61



Lessons from the Disaster

A Decade of Recovery Following the Deepwater Horizon Oil Spill

May 2020
Number 61

WaterMarks is published two times a year by the Louisiana Coastal Wetlands Conservation and Restoration Task Force to communicate news and issues of interest related to the Coastal Wetlands Planning, Protection and Restoration Act of 1990.
This legislation funds wetlands restoration and enhancement projects nationwide, designating nearly $80 million annually for work in Louisiana. The state contributes 15 percent of total project costs.

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ABOUT THIS ISSUE'S COVER . . .

A decade after the Deepwater Horizon oil spill, Gulf Coast ecosystems, species, economies and populations have made progress toward recovery, although effects linger and scientists continue to document the long-term consequences of the disaster.

Cover photo credits
Top: Courtesy of the Office of the Governor of Louisiana, 2010
Bottom: R, Cammauf, National Park Service

Above right: Even tiny microorganisms, the basis of the food chain, were affected by the oil spill.

WATERMARKS

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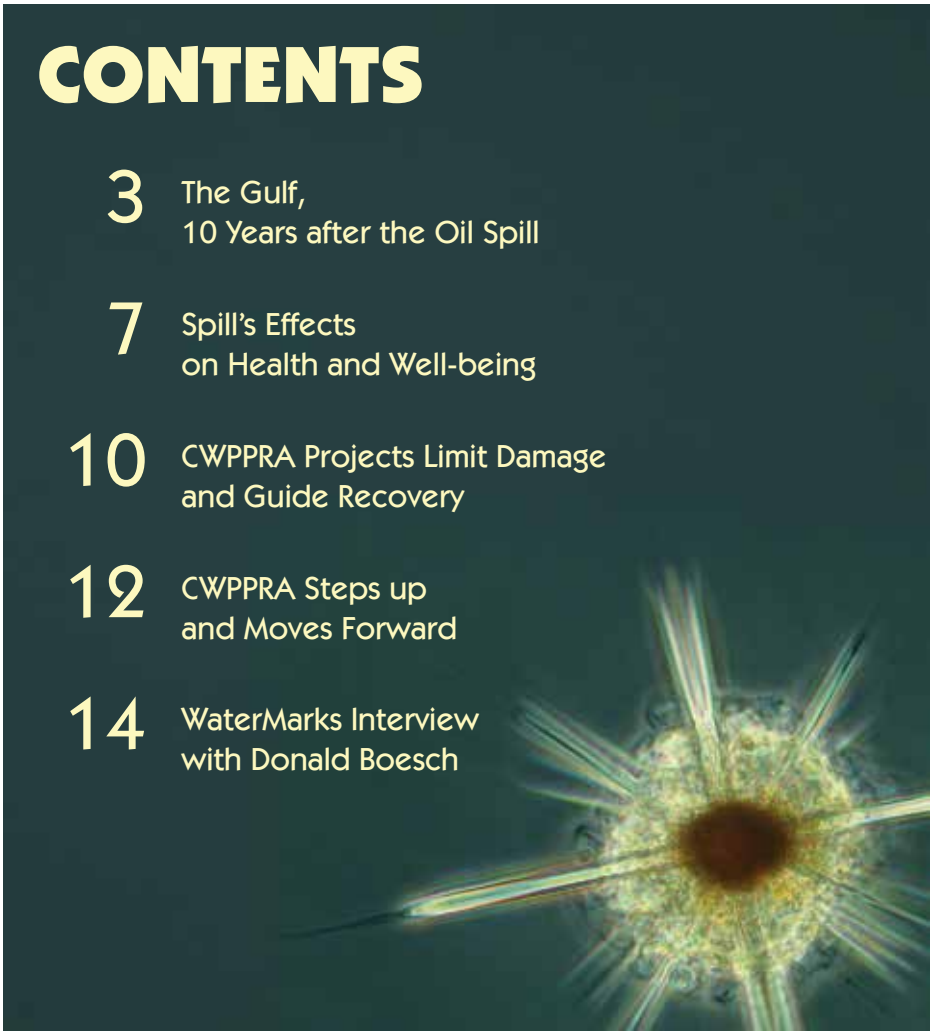

Courtesy of Dr. John R. Dolan, Laboratoire d'Oceanographique de Villefranche; Observatoire Oceanologique de Villefrance-sur-Mer

For more information about Louisiana's coastal wetlands and the efforts planned and under way to ensure their survival, check out these sites on the World Wide Web:

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Markus Huettel, Gulf of Mexico Research Initiative

Assessing the Damage, Gauging the Recovery

The Gulf, 10 Years after the Oil Spill

On April 20, 2010, the Deepwater Horizon oil rig exploded some 40 miles offshore of Louisiana, killing 11 workers and seriously injuring 17 others. Before the wellhead could be capped 87 days later, some 200 million gallons of crude oil spilled into the Gulf of Mexico's waters and onto its sea floor. Carried by winds and ocean currents, the oil contaminated shorelines of five Gulf states, disrupting ecosystems; endangering fish and wildlife; and imperiling residents' health, livelihoods and well-being. Louisiana's coast, already rendered fragile by erosion and sediment starvation, was hit hardest.

Ten years after the oil spill occurred, its effects continue to be evaluated, and ongoing research contributes to the implementation of restoration strategies. The following summaries review consequences of the spill on various components of the Gulf's ecosystem a decade after the disaster.

Oil's toll on vegetation and soils

At sea, oil destroyed an estimated 23 percent of sargassum, a floating seaweed providing habitat for young fish and sea turtles. Closer to shore, oil ravaged approximately 272 acres of seagrass beds. In Louisiana's wetlands, up to 53 percent of salt marsh plants were killed. The loss of these plants, essential in holding marsh soils together, led to a doubling of erosion rates along more than 100 miles of shoreline for at least three years.[1]

"In heavily oiled wetlands, vegetation and invertebrates

At the interface of Gulf waters and the marsh, grasses coated with oil suffocated and died. Loss of their root systems exacerbated erosion along Louisiana's fragile coast and altered conditions for vegetative growth. Less visible was the damage of oil seeping into the community of organisms living in the marsh soil. Consequences to these creatures, fundamental to the wetland ecosystem's food chain, are still being monitored and evaluated.

either were smothered or succumbed to the oil's toxicity," says John Fleeger, professor emeritus of biology at Louisiana State University. "Although there is evidence of recovery, the plant community has not completely returned to pre-spill conditions. Gaps in the vegetative cover change temperature and light conditions in the soil, which affect algal growth."

Below ground, roots and rhizomes that hold the marsh soil together and contribute organic matter are taking more than a decade to regenerate. "Recovery of animals correlates to recovery of the soil," says Fleeger. "With less organic matter the soil is denser. The invertebrate community, including relatives of earthworms that live deep underground, still have not regained their diversity, and the effects cascade through the food web. For example, small shrimp feed on animals that live in the soil. With less food abundance, shrimp either shift their diet or become less robust."

Oil's toll on birds

Photographs of oil-coated birds were dramatic images that, for many, conveyed the heart-wrenching consequences of the oil spill on the natural environment. In addition to damaging plumage, which limits birds' ability to stabilize body temperatures and to fly, oil ingested through preening or feeding caused injury to internal organs and blood cells. While some estimates of bird deaths resulting directly from the spill exceed 100,000, assessing its long-term, indirect effects on avian populations, such as loss of habitat, disruption of migration patterns and reduced nesting and hatching success, eludes numeration.[2]

Oil's toll on animals

Corals: More than four square miles of mid-depth coral reefs along the edge of the continental shelf were extensively damaged by the oil spill, devastating not only to the polyps that form the coral reefs but to the fish that rely on reef habitat. Specialists estimate it will take 50 to 100 years for corals to grow back to their pre-spill size.[3]

Marine mammals: Recovery is also slow for dolphins and whales. A study conducted by the National Oceanic and Atmospheric Administration concluded that the oil spill likely caused the largest and longest-lasting die-off of bottlenosed dolphins in the Gulf of Mexico. As well as a high number of strandings in heavily oiled areas following the spill, illnesses related to petroleum exposure, notably lung and adrenal diseases, persist in surviving dolphins.[4] Oil exposure has depressed reproductive success; five years after the spill, 75 percent of pregnant dolphins failed to give live birth. Some experts expect the Gulf dolphin population, with their intricate social bonds and slow rates of maturation, will take at least four decades to recover from the loss of reproductive adults.[5]

Whales also suffered mortality from the oil. Half of the estimated 50 endangered Bryde's whales in the Gulf were exposed to the spill; a quarter died. According to National Wildlife Federation, recovery of the population remains in question.[6]

Restoration strategies for marine mammals include:

- increased monitoring to expand knowledge and understanding of this

Researchers compared the tissues of seaside sparrows' feathers from oiled and non-oiled sites to determine their exposure to Deepwater Horizon oil. Scientists concluded that these land-based sparrows, feeding on both terrestrial and marine invertebrates, ingested oil from the spill through the food web. Oil toxicity may be responsible for the species' reduced rate of reproduction in the years immediately following the spill.

Andrea Bonisoli Alquati, Gulf of Mexico Research Initiative

resource and promote scientifically supported management adaptations

- reducing anthropomorphic threats such as collision with vessels and entanglement in fishing gear
- conserving the marine, coastal, estuarine and riparian habitats upon which these animals depend

Sea turtles: Estimates of turtle mortality caused by the oil spill, including hatchlings injured during response operations, range from 61,000 to 173,000.[7] Unrealized reproduction of sea turtles killed by the oil spill account for the loss of thousands more potential hatchlings. Restoration strategies include reducing threats to turtles from fishing vessels and curtailing destruction of nesting habitat.

Oil's toll on fish

Areas of Gulf waters were closed to fishing for up to a year following the Deepwater Horizon explosion. Seafood was rigorously tested for oil contamination prior to reopening the waters. Study of the health effects of Gulf seafood consumption continues, with no undue risk as yet discovered.[8]

The oil spill injured marine organisms throughout the food chain, from bacteria to large, predatory fish. Damage assessment specialists estimated the oil killed billions of larval fish. Individual fish directly exposed to the oil exhibited numerous physical disorders, including cardiac, neural and reproductive disfunctions; skin lesions; and feeding and swimming disabilities.

Dan DiNicola, RECOVER Outreach Coordinator

The disaster opened opportunities for scientists to conduct research on oil's effects on marine and coastal ecosystems. Pop-up satellite archival tags capture data on fish's depth, migration and spawning in the wild as well as on water temperature. Results are compared to fish exposed to oil in a laboratory setting.

Following the spill, scientists did not observe the sharp declines in some fish populations and in the marine food web that many had anticipated. Studies conducted eight or more years after the spill still discerned no lasting, large-scale impact on fish populations.[9] This possibly was due to the suspension of fishing, which increased survival rates and reproductive success of fish otherwise bound for human consumption. Other factors, such as unusually cool water temperatures preceding the spill, may also have helped to protect fish numbers from noticeable decline.

An offshoot of the oil spill is funding for projects such as the Ocean Fish Restoration Project. Under the guidance of the National Atmospheric Administration (NOAA) and the National Fish and Wildlife Foundation (NFWF), the program aims to restore the spill-damaged Gulf of Mexico pelagic fishery, which includes yellowfin tuna, swordfish and mackerel; and to increase the overall health of Gulf fisheries by developing alternatives to longline fishing gear and encouraging methods of reducing bycatch.[10]

Oil's toll on shellfish

Shrimp: Initially the estimate of shrimp loss due to the oil spill was enormous – more than 2,300 tons of young shrimp lost over 2010 and 2011.[11] But abundance of brown and white shrimp in heavily oiled estuaries surged in the years immediately following the spill. Scientists think that the moratorium on shrimping boosted their numbers by allowing increased reproduction.[12]

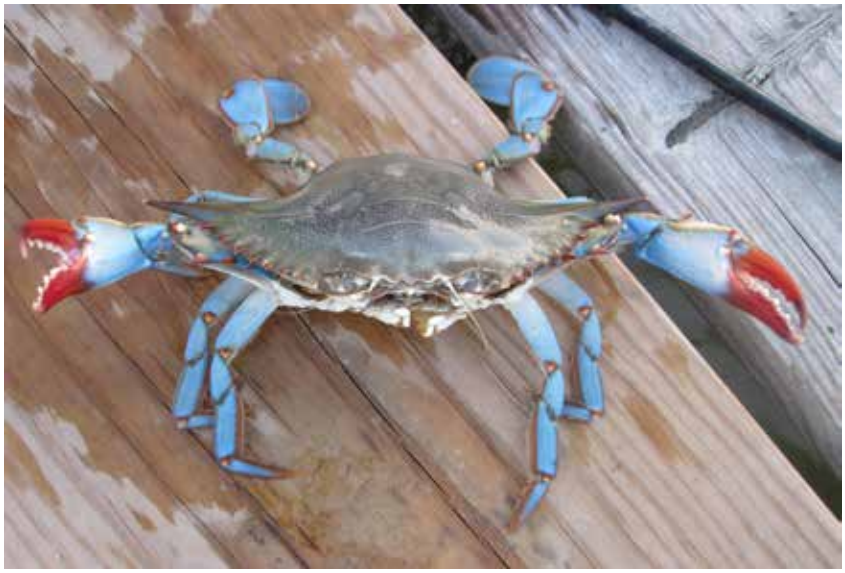
Oysters: As a consequence of the oil spill and clean-up efforts, as many as 8.3 billion oysters – up to 508 million pounds of oyster meat – were lost. While oysters under stress were able to stop feeding, thus limiting their intake of oil and dispersants, they remained vulnerable to the influx of fresh river water that was released to push oil away from shorelines and to marsh clean-up methods that physically disturbed oyster habitat. Damage to the oyster population has reverberated for years, with a decline in the number of reproductive adults and with the destruction of mature oyster shells that larvae adhere to in order to grow.[13]

Spill penalties are funding region-wide restoration projects to help Gulf oysters rebound. Focus is on improving oyster abundance by increasing spawning stock and larvae. Related projects construct habitats suitable for oyster larvae to settle on, and thus create an ecosystem functional for all members of a reef community, including fish, crabs, birds, and other wildlife.[14]

Blue crab: Researchers have not determined any negative effect of the oil spill on the Gulf's blue crabs. However, they caution a lack of baseline information and the dynamic complexity of the ecosystem hampers analysis. Sub-lethal and indirect effects of an oil spill, such as the slow recovery of periwinkles on which blue crab feed, can take years, even decades, to manifest.[15]

Preparing for the next spill

Experts warn that without changes to regulations governing oil drilling another disaster on the scale of Deepwater Horizon is all but inevitable. They have called on both government and industry to take steps to increase the safety of deepwater oil extraction and to strengthen spill response capabilities. While the 2010 spill has funded research to understand the complex, interrelated ecosystem of the Gulf of Mexico more completely, fundamental questions remain about the long-term effects of oil on the environment. WM



Bree Yednock Gulf of Mexico Research Initiative

Oil resistant – or just slow to exhibit consequences of the spill? Initially, economically important blue crabs appeared to be uninjured by the oil, but researchers caution the species could yet show negative effects of changes in the food chain – or that its apparent resilience is due only to researchers lacking a prior, robust knowledge base.

Footnotes

[1]https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Chapter-4_Injury_to_Natural_Resources_508.pdf

[2]Maung-Douglass, Emily, et al. Birds of a Feather — Coping with Oil, Sea Grant Programs of the Gulf of Mexico, http://masgc.org/oilscience/birds-and-oil.pdf

[3]Erik Cordes, Ecosystem Impacts of Oil and Gas Inputs to the Gulf research consortium, https://ecogig.org/

[4]https://response.restoration.noaa.gov/about/media/summarizing-five-years-noaa-research-impacts-deepwater-horizon-oil-spill-dolphins.html

[5]http://www.int-res.com/articles/esr2017/33/n033p265.pdf

[6]www.nfwf.org/pll

[7]ibid

[8]Wickliffe, Jeffrey et al, (2018). Consumption of Fish and Shrimp from Southeast Louisiana Poses No Unacceptable Lifetime Cancer Risks Attributable to High-Priority Polycyclic Aromatic Hydrocarbons. Published by the Society for Risk Analysis. 38. 10.1111/risa.12985.

[9]https://www.nwfsc.noaa.gov/news/features/deepwater/index.cfm

[10]www.nfwf.org/pll

[11]https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Chapter-4_Injury_to_Natural_Resources_508.pdf

[12]Hale, Christine, et al. Impacts from the Deepwater Horizon Oil Spill on Gulf of Mexico Fisheries, Sea Grant Programs of the Gulf of Mexico, http://masgc.org/oilscience/oil-spill-science-fish-impacts.pdf

[13]Oysters and Oil Spills, Sea Grant Programs of the Gulf of Mexico, http://masgc.org/oilscience/oysters-oil-spills.pdf

[14]For more information about the impacts of oil spills on wildlife and other spill-related topics, visit www.gulfseagrant.org

[15]Grey,Erin, et al, Evaluation of Blue Crab, Callinectes sapidus, Megalopal Settlement and Condition during the Deepwater Horizon Oil Spill, Public Library of Science, https://www.ncbi.nlm.nih.gov/pmc/articlesPMC4535880/

PO3 Patrick Kelley, United States Coast Guard

A WATERSHED MOMENT FOR COASTAL RESIDENTS

Spill's Effects on Health and Well-being

The spill and its aftermath profoundly affected the health, livelihoods and well-being of coastal residents. For some, oil in the environment led to emotional strain as well as to symptoms of physical illness. For others, it was the final trauma – following hurricanes, coastal erosion and a nation-wide recession – that compelled them to uproot their families and move from the region. The spill left an indelible mark on coastal communities, dealing a blow from which some could not recover and threatening the future of bayou culture and customs.

Oil's toll on the coastal economy

Traditionally reliant on natural resource-based jobs, many coastal residents suffered monetary losses as the oil spill closed waters to fishing, suspended deepwater drilling and disrupted normal economic activity. Repercussions rippled outward as customers turned to other sources to purchase seafood and tourists and outdoor enthusiasts shunned an oiled coastline. For some Louisianans, the spill was the disaster that finally drove them to abandon their livelihoods and lifestyles and seek other work in other places.

Research conducted at the University of Mississippi estimated that the oil spill cost Louisiana's coastal parishes 22,000 jobs.[1] According to Robert Habans, an economist at the New Orleans-based non-profit organization The Data Center, between the years 2010 and

For months the spill caused widespread unemployment among coastal residents as industries including oil and gas exploration, fishing, seafood processing and tourism were curtailed or shut down. Some people sought temporary work on shoreline clean-up crews or on boats attempting to corral the oil at sea. In the decade since the spill, the region's economy has shifted away from jobs involving resource extraction toward careers in water control and management, which generally require a higher level of education.

Robert Kaufmann, FEMA

People whose culture and livelihoods were closely tied to threatened or damaged natural resources, such as fisheries, reported more mental and emotional difficulties and recovered from the spill more slowly than did other coastal residents. Following a decade of hurricanes that damaged property and disrupted traditions, facing rising sea levels and receding shorelines, even some multi-generational swamp dwellers decided it was time to leave the bayous.

Sgt. Rashawn D. Price, U.S. Army National Guard

Populations that have experienced past trauma, such as hurricane evacuations and displacement and loss of jobs and income, tend to be more psychologically vulnerable to future disasters. Community resilience programs help people prepare for and rebound from the next incident, while close community ties reduce stress on families and individuals.

2018 natural resource-based employment in southeast Louisiana fell by 25 percent. "This category includes jobs in agriculture, forestry, fishing and hunting; in mining, quarrying and oil and gas extraction," says Habans. "Absolute numbers are hard to come by as we know a lot of these jobs, notably in fishing, are under-reported."

Oil-spill fines and penalties are bringing billions of dollars into the region and are fueling a rebounding economy. Employment numbers are nearing pre-spill levels.[2] In Louisiana, most of the spill compensation money allocated to the state is directed toward water-related work.

The Data Center reports that the civil construction industry most closely associated with flood protection and coastal restoration added more than 3,000 jobs between 2010 and 2018, boosting employment numbers in the industry to 10,000 workers in southeast Louisiana. "While the focus is on mitigating coastal deterioration and developing better ways to live with water," says Habans, "the money will diversify and strengthen the economy for the long term."

Oil's toll on human health and well-being

Following the spill, concerns about the physical health of Louisiana's coastal population centered on three issues: illnesses contracted through direct contact with oil, illnesses developed following oil spill clean-up operations, and the mental health of affected communities.

Residents exposed to oil or to oil dispersants during clean-up operations were likely to report (in order of frequency) the following symptoms:

- shortness of breath
- headaches
- skin rash
- chronic cough
- weakness
- dizzy spells
- painful joints
- chest pain

In a follow-up study seven years after the Deepwater Horizon spill, researchers determined that symptoms had not significantly abated in study participants exposed to oil or to dispersants

NOAA

The oil spill made clear the importance of baseline data for all components and functions of a wetland ecosystem. While sophisticated instrumentation can collect some data remotely and computer modeling expands data applications, personal observation and collecting samples from the field remain indispensable for understanding wetland conditions.

used in clean-up operations. Further, almost all of them had developed new symptoms of progressive respiratory-system deterioration. Other health effects among clean-up workers included persistent alterations or degradations in their blood, liver, lung and heart functions.[3]

Studies[4] of the spill's effects on residents' emotional and mental health reveal that the most vulnerable people were those with strong economic, social and cultural attachments to threatened or damaged natural resources. Disrupted routines and economic uncertainty increased tendencies toward depression, anxiety and alcohol abuse, as did a history of past exposure to disasters such as hurricanes.

People with strong community attachments displayed fewer mental and behavioral problems than did those without a robust social network. Researchers determined that improving community resilience by undertaking measures to prepare for disasters and to formulate response and recovery programs can help individuals adapt to and recover from traumatic events such as the Deepwater Horizon oil spill. WM

Footnotes

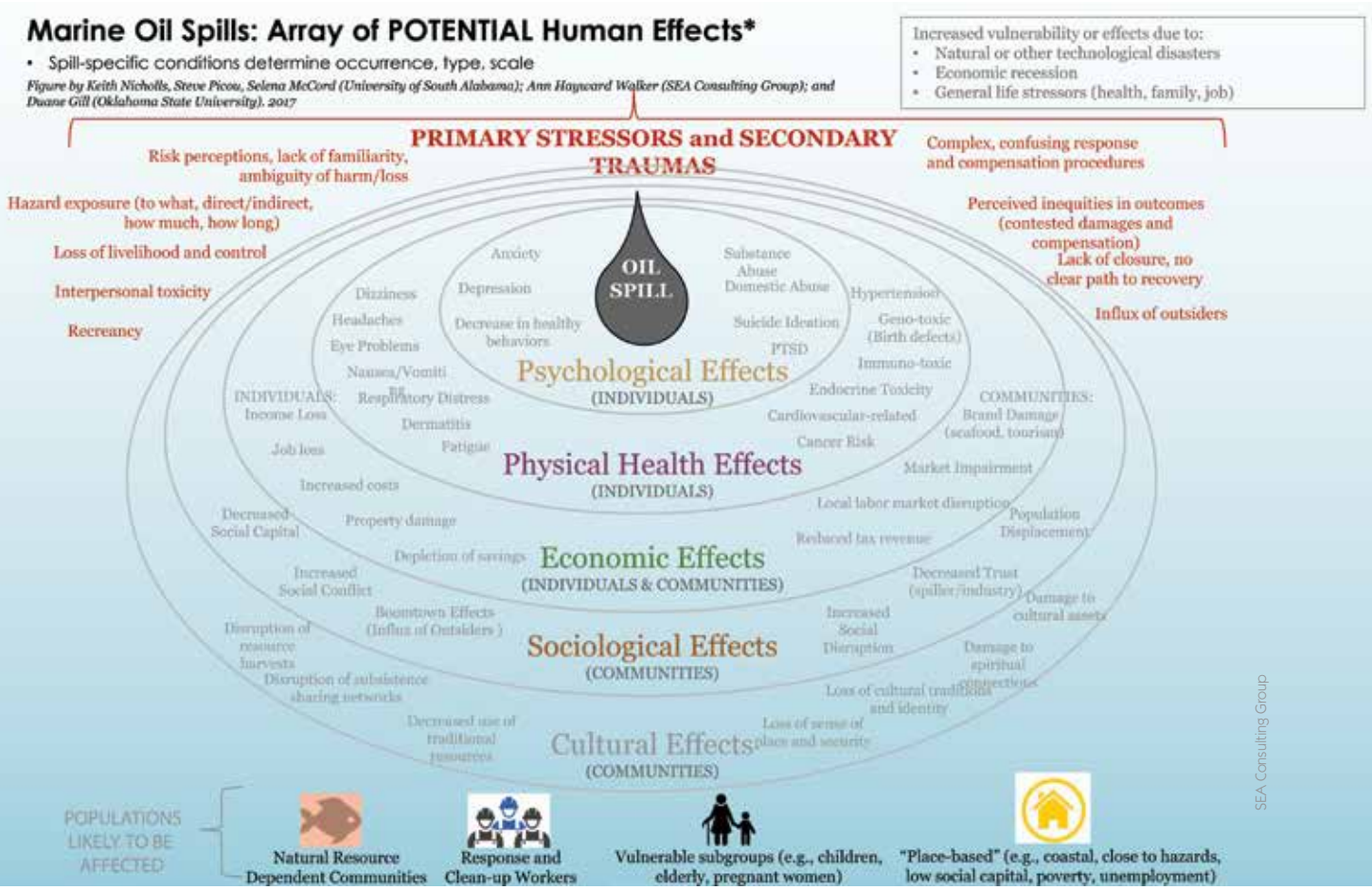
[1]http://thesis.honors.olemiss.edu/749/1/An%20Economic%20Analysis%20of%20the%20Deepwater%20Horizon%20Economic%20Settlement.pdf

[2]ibid

[3]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5932154/

[4]Graham, Larissa, et al. The Deepwater Horizon Oil Spill's Impact on People's Health: Increases in Stress and Anxiety, Sea Grant Programs of the Gulf of Mexico, http://masgc.org/oilscience/oil-spill-science-mental-health.pdf

U.S. regulations aim at managing oil-spill pollution as safely, quickly and effectively as possible. Assuming measures are in place to protect workers and the public, other impacts on people – such as socio-economic damages – are addressed through claims and compensation processes … Anything that is considered personal injury (e.g., psycho-social impacts, including stress-related impacts on individuals, families and communities) must be litigated, which exacerbates the problem. When Congress passed the Oil Pollution Act of 1990, they were probably unaware of all possible human effects from oil spills, as illustrated in the graph below, and therefore such matters were not included in the legislation. (adapted from Ann Hayward Walker, personal e-mail)



CWPPRA Projects Limit Damage and Guide Recovery

Flowing for 87 days, the Deepwater Horizon disaster spewed an estimated 200 million gallons of oil into the Gulf of Mexico, covering as much as 68,000 square miles of the ocean and washing up on more than 13,000 miles of Gulf coast shoreline.[1] The damage to Louisiana's fragile wetlands was severe, yet without decades of CWPPRA[2] projects it would most probably have been worse.

Ron Boustany, a biologist at the Natural Resources Conservation Service in Lafayette, Louisiana, says, "I feel quite certain that CWPPRA projects throughout the affected area limited the spill's damage. For example, restoration projects stabilized and augmented barrier islands such as Whiskey and Timbalier. Certainly these islands repelled some of the oil as it made its way toward shore and prevented the oil from penetrating more deeply into coastal marshes."

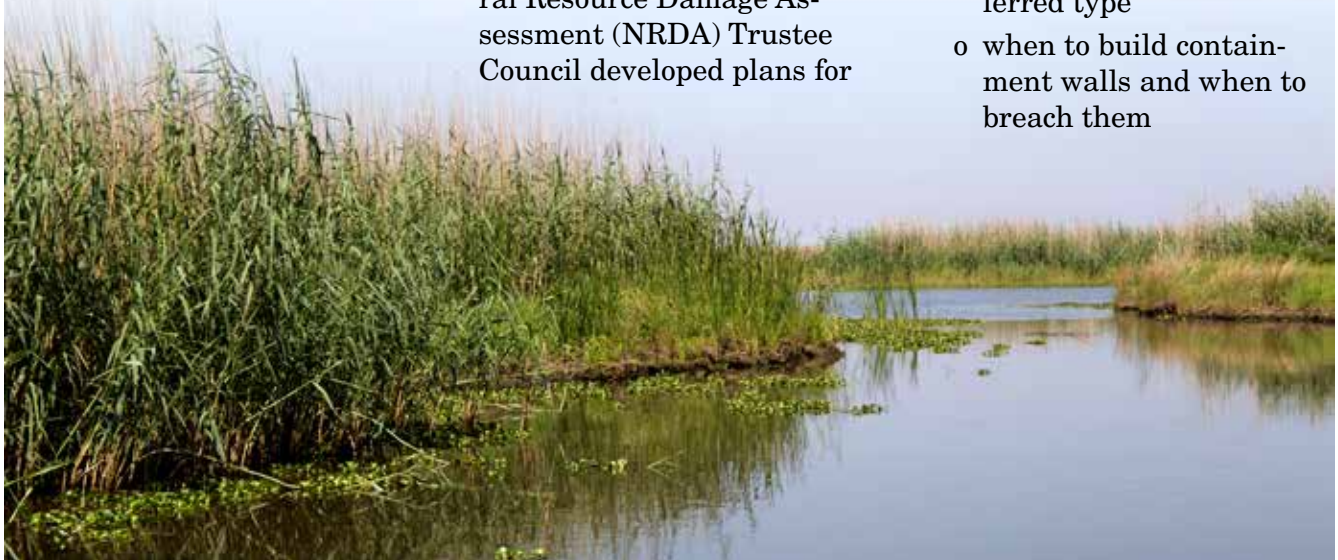
Other kinds of projects also stymied the oil's advance. "Diversions increased their release of fresh water in order to push oil away from the marshes," says Boustany, "and structures designed to restrict the tidal intrusion of salt water into wetland areas limited the infiltration of oil as well."

Intended to protect wetlands from waves and storm surges, marsh creation projects and vegetative plantings impeded oil's spread. Although grasses at the edge of the marsh that became coated with oil could not survive, they retarded the oil's advance. As damaging as the spill proved to be, without CWPPRA's work to protect and restore Louisiana's wetlands, the consequences would have been even more calamitous.

CWPPRA's knowledge and experience speeds recovery

Following the spill, the Deepwater Horizon Natural Resource Damage Assessment (NRDA) Trustee Council developed plans for restoring the environment and to assist in natural-resource recovery. The Council recommended building many types of coastal restoration projects that CWPPRA has tested and refined over the years. While CWPPRA's resources have limited the scale of projects it has constructed, its on-the-ground experience and its ability to test new ideas provide coastal restoration specialists with a body of knowledge about what works where – and what doesn't. Restoration methods that the Council recommended and that CWPPRA has implemented include

- *Creating and improving wetlands*: CWPPRA's experience provides data on such questions as
  - how to select appropriate sediment for marsh-building, where to obtain it and how to deposit it
  - how to determine elevation to achieve long-lasting marsh of the preferred type
  - when to build containment walls and when to breach them



CWPRA

- where to place sediment-trapping terracing and what its shape should be
- what to plant, and when, to make vegetating a project area successful

- *Shoreline protection*: As an incubator of new ideas, CWPPRA has experimented with various materials and designs. Records of CWPPRA projects' outcomes helps Deepwater Horizon restoration projects select materials and techniques best suited to a project site.
- *Restoring barrier islands and beaches*: CWPPRA's experience provides insight into island morphology, such as the importance of back bays to increase their longevity, and techniques for rebuilding and protecting these dynamic, vulnerable environments.
- *Strategic use of dredged sediments*: CWPPRA's success in building or nourishing marshes with sediment dredged from shipping channels helped to change laws and increase the availability of such sediment. CWPPRA's Bayou Dupont sediment delivery project has demonstrated the efficacy and value of using a pipeline to convey river sediments to restoration sites.
- *Diversions*: Citing it as a long-term strategy to address regional land loss, the Council has recommended implementing controlled diversions of the Mississippi River to deliver nourishment and sediment to adjacent wetlands. While CWPPRA has undertaken only a few, small-scale diversion projects, they provide important lessons in diversion operations and in resolving obstacles to their application.

Other CWPPRA contributions to oil spill recovery projects include the wealth of data collected by its Coastwide Reference Monitoring System and the methodology of its Wetland Value Assessment, developed to calculate probable habitat and estimate benefits to wetlands in project areas.

Shovel-ready projects jump-start recovery

In addition to knowledge and experience valued by restoration specialists implementing Council recommendations, at the time of the spill CWPPRA had in its pipeline projects designed and ready to be built. Transferring projects to NRDA shifted funding to sources other than CWPPRA, put their construction on a fast track and jump-started Louisiana's oil spill recovery.

"Transferring designed projects to another authority with money to build it happens often," Boustany says. "It is a way to leverage dollars. Recently we combined two CWPPRA projects and transferred them to the RESTORE[3] Act's Gulf Coast Ecosystem Restoration Council for funding consideration."

Boustany cites the capacity to work through different authorizations as the beauty of the CWPPRA program. "On numerous occasions CWPPRA has been the incubator for projects that get built through other funding sources. CWPPRA has the continuity of consistent science and engineers to produce ideas that often may be handed over to other programs as funds become available." WM

CWPRAA

CWPRAA

The simplicity of many coastal restoration ideas – build a rock barrier to keep waves from washing away a shoreline, or pipe sediment into shallow water until land emerges – belies the complexity of their execution. Over the years CWPPRA projects have tested approaches and techniques to answer myriad how-to and why questions and advance the science and engineering of coastal restoration.

Footnotes

[1]NOAA Office of Response and Restoration

[2]Coastal Wetlands Planning, Protection and Restoration Act

[3]Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States

CWPPRA/Aero Photo

Aiding post-spill planning and policy

CWPPRA Steps Up and Moves Forward

"The Deepwater Horizon oil spill reminded us of the fragility of our coast," says Ron Boustany, a biologist with the Natural Resources Conservation Service in Lafayette, Louisiana. "The disaster added another potential threat that every restoration project going forward has to consider. While the spill did not directly cause changes to any specific CWPPRA project, it did affect our thinking about how we use our natural resources and how we must manage them to reduce the coast's vulnerability."

The disaster intensified pressure to respond to Louisiana's coastal crisis. "The spill caused restoration specialists to re-examine project priorities." says Boustany.

"They emphasized that, in order really to influence coastal conditions, projects need to be much larger than those yet built. We have long recognized the value of increasing land masses to separate basins, soften tidal movements across shoreline boundaries and limit saltwater intrusion. The spill demonstrated how such 'land bridges' could contain yet another kind of threat and has driven synergy among agencies to build them."

The trend toward marsh creation as a favored restoration technique is reflected in CWPPRA's Priority Project List selections since 2010: 38 of 44 projects focus on marsh creation. Project timelines that the spill influenced include speeding up finalization of the state's plan for Barataria Basin, accelerating planning for the mid-Barataria sediment diversion by two years, and completing the 13-mile Caminada Headland barrier island restoration project. Fines and penalties funded early restoration projects, and settlement dollars will continue to finance a portion of Louisiana's coastal protection and restoration for years to come.

The CWPPRA project *Dedicated Dredging on the Barataria Landbridge* used dredged sediment to nourish fragmented marsh and build new marsh in open water, while nearby wetlands outside of the project's footprint continue to disintegrate and vanish. Deepwater Horizon fines and penalties are funding additional components of a comprehensive plan to expand and strengthen the Barataria land bridge and restore historic salinities in the upper Barataria basin.

Learning techniques for recovery

Scientists tracking recovery of marsh vegetation and invertebrates point to lessons learned from the Deepwater Horizon spill. "We have observed how plants lead the way in marsh recovery," says John Fleeger, professor emeritus of biology at Louisiana State University. "Plants bind sediments together, enrich the soil and slow water flow. They form the foundation of the food web, encourage invertebrate colonization and provide animal habitat. We believe mitigation of future oil spills should include the planting of foundation species such as Spartina."

Fleeger cites a need for more research to determine the best methods for implementing such plantings. "What varieties of marsh grass best restore an oiled marsh?" he asks. "Can fertilizer boost recovery rates in a marsh? If so, what kind, when and how much fertilizer should be applied? What are the differences among vegetative responses in a marsh smothered in oil and one experiencing chronic but mild levels of oiling? Considering such questions can refine and enhance ways we use vegetation to mitigate the inevitable next spill."

CWPPRA's contributions to recovery

Long before the 2010 disaster, coastal restoration scientists had realized the value of CWPPRA's years of experience. Its capacity to test various methods and materials, such as for building shoreline protection or constructing artificial oyster reefs, gives post-spill projects a significant boost. Similarly, CWPPRA's methodologies for calculating the value of restored wetlands or computing probable annual habitat units over a project's lifetime speed up implementation. Examining CWPPRA's records help analysts estimate costs of various aspects of a project: engineering and design, land rights acquisition, construction, operation and maintenance, monitoring and oversight, and contingencies for cost overruns.

It was CWPPRA's experience and knowledge of processes and techniques that laid a foundation for the development of Louisiana's Master Plan for Coastal Restoration. Yet CWPPRA's contributions to coastal restoration exceed the nitty-gritty, the nuts and bolts of project construction. CWPPRA brings the strength of established relationships forged among restoration specialists over 30 years. These professionals have long been a model for successful inter-agency cooperation. And most importantly, CWPPRA's public outreach and experience in enrolling people in discussion has created an informed citizenry engaged in public decision-making and committed to the future of their coast. WM

CWPPRA's mission includes educating people about wetlands, explaining their ecological complexity, environmental functions and economical importance. Outreach to schools builds a constituency interested in science, engaged with the natural world, and involved in civic affairs.

Plants are essential components in stable, functional marshes. Although thin reeds of newly planted marsh grass may appear to be more hopeful than effective, revegetating a project area taps into the power of nature to heal an ecosystem and boosts the chances of the project's success.

WaterMarks Interview with Donald Boesch

Dr. Boesch is a professor emeritus and past president of the University of Maryland Center for Environmental Science. He was a member of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling.

WATERMARKS: Shortly after the Deepwater Horizon disaster occurred, President Obama appointed a presidential commission to investigate the accident. What did the commission do?

Boesch: The seven-member commission was charged with finding the root causes of the spill and to recommend measures to reduce the likelihood of a repeat. Its report determined that the accident was caused by a chain of mistakes taken by the many parties involved, including the lease holder, the drill rig operators and federal regulatory agencies.

WATERMARKS: Let's start with lease holders – the companies that hold the permits to drill offshore. What changes did the commission suggest?

Boesch: The commission recommended a number of actions for the oil and gas industry to take. Some dealt with creating a private organization to set and self-enforce safety standards within the industry, some with establishing international safety and response protocols, and others with developing technology and resources for containing spills.

WATERMARKS: Has the industry acted on these recommendations?

Boesch: Somewhat. It established the Center for Offshore Safety to promote improvements in drilling operations. But as an arm of the American Petroleum Institute, the Center does not have the independence and transparency that the commission called for.

Oil-producing regions around the globe operate with different rules – North Sea's drilling regulations are more stringent than in the Gulf of Mexico, north Africa's less so. Developing universal standards has proved difficult to achieve.

WATERMARKS: So we've seen some action on safety standards and policies. What about improvements in dealing with spills directly?

Boesch: The industry has been much more successful in developing a capacity to cap wells and stop blow-outs than in developing a capability to control spills once they occur. When the Deepwater Horizon disaster occurred, there was no method of containment; the spill's damage was far greater because it could not be capped quickly. At the insistence of the commission and the Department of the Interior, the industry put together two organizations to manage, cap and contain blowouts. Now this capacity reduces the risk of damage from spills. Furthermore, it has been replicated and deployed worldwide.

WATERMARKS: This was one action that the federal government took as a result of the spill. What else did the commission propose?

Boesch: At the time of the spill, the Minerals Management Service was responsible for offshore drilling safety, leasing and collection of revenues. We recommended reorganizing the single agency into three to reduce conflicts among these responsibilities. The Department of the Interior did so through executive action in 2010, and the new Bureau of Safety and Environmental Enforcement (BSEE) put into place a number of our recommendations, including rules for well control, inspection of blow-out preventers and real-time onshore monitoring, that improved overall safety.

But ten years later, we have seen a weakening of the regulatory role of the BSEE and a relaxation of many of its rules. There definitely have been some improvements, but there has also been backsliding.

WATERMARKS: Is this generally true of federal actions following the spill?

Boesch: Other recommendations, most notably those encouraging stronger environmental policies, tougher regulatory enforcement and greater interagency collaboration, received little action even immediately after the spill. There remains much that our government could do to improve

drilling safety, safeguard the environment and protect citizens' health.

WATERMARKS: Did the commission address community concerns?

Boesch: Ultimately the spill's consequences come down to specific locations and individual people. Recognizing that the spill caused psycho-social distress and economic disruption in coastal communities, we suggested developing plans and procedures to respond to future disasters and to assure fair compensation to the people affected. Some action has taken place – there have been studies and meetings – but I'm not sure how much progress has been made.

WATERMARKS: How did the report influence state and local actions?

Boesch: The commission's work helped push the RESTORE Act through Congress, which stipulated that 80 percent of fines and penalties resulting from the Deepwater Horizon spill be dedicated to the recovery and protection of the Gulf Coast's natural resources, wildlife, ecosystems and economy. Restoration activities have prioritized making a difference on the ground. Not much money has been allocated to research or to modeling restoration options – except in Louisiana. CWPPRA's years of experience and the trove of data collected through its Coastwide Reference Monitoring System underpins the state's Master Plan for Coastal Restoration. Having a plan already in place gave Louisiana a jump-start on using oil spill money effectively.

Bureau of Safety and Environmental Enforcement (BSEE)

Improvements in oil spill response and in well capping technology were mandated by federal agencies following Deepwater Horizon. While some measures to increase the safety of offshore drilling have been taken, action on other recommendations has been slow, even sometimes going backwards.

WATERMARKS: Ten years after the oil spill, do you think we are better prepared for the next disaster?

Boesch: In some respects we are fortunate that BP was responsible for the spill. It had the resources to pay the fines and penalties, and it had a global reputation to protect. A smaller company would have walked away after reaching the limit of liability set by Congress.

Many of the commission's recommendations for reorganizing government, increasing the liability cap, and funding regulatory agencies and scientific research have gone unheeded. We need to increase a company's financial obligation in the event of a spill. We need to conduct more research on effective oil spill control, including maximizing the effectiveness and minimizing the damage from dispersants. There's still much work to be done.

WATERMARKS: For you, what is the final take-away?

Boesch: Oil spills and leaks are happening every day, usually from wells owned by small, independent companies. It is a chronic problem for Louisiana's wetlands. We must remember that an oil spill need not be on the scale of Deepwater Horizon to damage the environment and threaten health, but use that experience to reduce the risks and better protect sensitive resources against spills large and small. WM

Scott Zengel, Gulf of Mexico Research Initiative

Natural resource recovery efforts following the oil spill were hampered by lack of adequate baseline data for the vast and complex Gulf of Mexico ecosystem. Although some scientific research received funding through oil spill fines and penalties, a much larger, ongoing investment is needed to understand how an oil spill affects the ecosystem and all its denizens.

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Oil Spill Highlights Need for Research

Developing an in-depth, baseline knowledge about Gulf of Mexico organisms, habitats, conditions and dynamics will improve recovery efforts after the next oil spill – and experts are certain there will be one. Following the Deepwater Horizon disaster, fines and penalties funded the Gulf of Mexico Research Initiative for 10 years. Research projects explored questions such as *Where did the oil go? What causes oil to persist or degrade? What instruments best monitor marine conditions? How did exposure to oil affect the myriad creatures that came into contact with it? How long do environmental effects last? What are the social, economic and health risks of a spill to a coastal population?* Continued research adds to knowledge about oil in the ecosystem, but the need for greater understanding remains enormous.