OIL SPILL SCIENCE
SEA GRANT PROGRAMS OF THE GULF OF MEXICO

SEA TURTLES AND THE DEEPWATER HORIZON OIL SPILL

— UPDATED 2021 —

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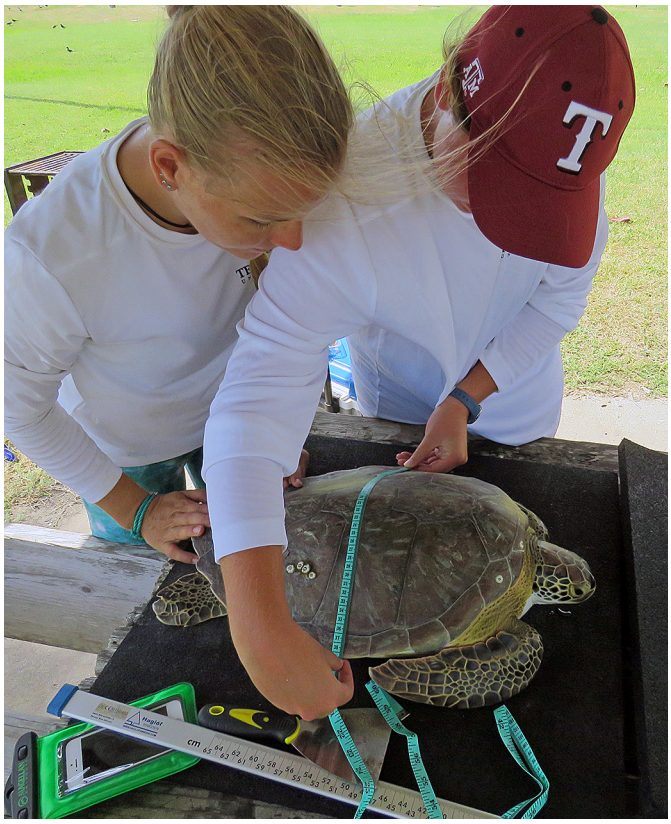
Emergency response personnel, natural resource managers, non-profit organization staff, scientists, volunteers, and many others worked together after the 2010 Deepwater Horizon oil spill to rescue sea turtles, some of the world's most recognized endangered and threatened animals.

SEA TURTLE LIFE CYCLE BASICS

Sea turtles are air-breathing, long-lived—surviving to be 50 and even up to 100 years old—reptiles that spend most of their lives in the water. They are highly **migratory** and depend on several habitats across large geographic areas throughout their life cycle. As **hatchlings**, sea turtles emerge from eggs located in nests on sandy beaches. Hatchlings crawl from their nests to the nearest coastal waters and swim out into the open ocean. After a few weeks, these **juvenile** turtles spend the next phase of their lives feeding and growing in and around areas where open ocean currents come together, called convergence zones. As juveniles, they spend much of their time at or near the ocean's



Dr. Christine Figgener and an assistant weigh, measure, and attach trackers to captured sea turtles to better understand their populations in the Gulf of Mexico. This activity was conducted pursuant to NMFS ESA Permit No. 22822. (Texas Sea Grant/Kimber De Salvo Anderson)

*__Original publication by Christine Hale, Larissa Graham,__ Emily Maung-Douglass, Stephen Sempier, Tara Skelton, LaDon Swann, and Monica Wilson

THE SEA GRANT and GOMRI PARTNERSHIP

The mission of Sea Grant is to enhance the practical use and conservation of coastal, marine, and Great Lakes resources in order to create a sustainable economy and environment. There are 34 university-based Sea Grant programs throughout the coastal U.S. These programs are primarily supported by the National Oceanic and Atmospheric Administration and the states in which the programs are located.

In the immediate aftermath of the Deepwater Horizon spill, BP committed $500 million over a 10-year period to create the Gulf of Mexico Research Initiative, or GoMRI. It is an independent research program that studies the effect of hydrocarbon releases on the environment and public health, as well as develops improved spill mitigation, oil detection, characterization, and remediation technologies. GoMRI is led by an independent and academic 20-member research board.

The Sea Grant oil spill science outreach team identifies the best available science from projects funded by GoMRI and others, and only shares peer-reviewed research results.

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surface away from land where they grow slowly over the next three to ten years, dependent on species type. Then they swim back toward the **continental shelf** where they mature, mate, and spend the majority of their lives. During the nesting season, mature females return to the same coastal area from which they emerged as hatchlings to dig their nests and lay eggs (**Figure 1**).[1,2]

THREATS AND PROTECTIONS

The federal **Endangered Species Act (ESA)** classifies all sea turtle species found in U.S. waters as **endangered** or **threatened**. Of the seven species of sea turtles in the world, five are regularly found in the Gulf of Mexico: loggerhead, leatherback, green, Kemp's ridley, and hawksbill (**Figure 2**). Loggerheads are listed as threatened, while the other four are listed as endangered. Because of their status, many international treaties protect sea turtles. For example, the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** prohibits international trade of some endangered wildlife, including sea turtles.

International and domestic protections only partly insulate sea turtles from natural and human threats. Sea turtle eggs are frequently eaten by animals.[1] When hatchlings emerge from the nest, they are at risk of being eaten during their race across the beach to the water.[1] Scientists estimate that only 1 in 1,000 hatchlings live to adulthood, though this rate varies.[3,4] Additionally, drastic drops in water temperature cause cold-stunning in sea turtles. Cold-stunned turtles become sluggish and are unable to avoid predators, and many are eaten or wash ashore.[1] Sea turtles also die from a variety of diseases.[1] Beyond the many and varied natural causes of death, they also face a multitude of threats from humans:

- Destruction and alteration of nesting and feeding habitats.
- Incidental capture in commercial and recreational fishing gear.
- Becoming entangled in or ingesting trash in the ocean.
- Exposure to harmful chemicals.
- Being struck by vessels.
- Poaching or illegal collection of turtles and their eggs or shells for consumption or trade.[1]

Potential Oil Impacts on the Sea Turtle Life Cycle

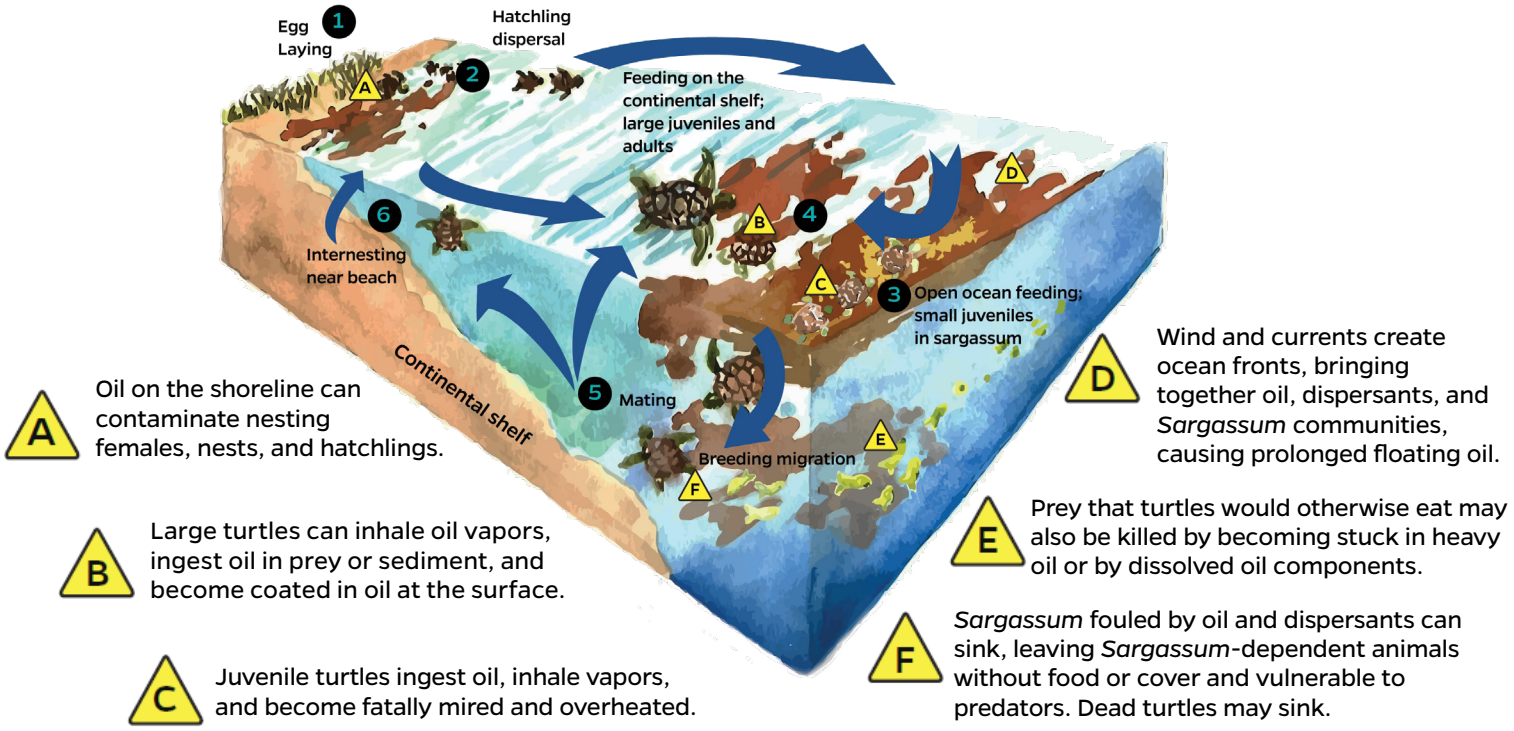


FIGURE 1. *Sea turtles in the Gulf of Mexico live in many different types of habitat throughout their long lives, potentially putting them at multiple risks during oil spills. Letters indicate habitats where turtles might encounter oil. Numbers one to six indicate the life cycle of a sea turtle — internesting is the period of up to a month when turtles remain in the area between laying clutches of eggs. (Anna Hinkeldey, adapted from NOAA/ Kate Sweeney)*

Scientists are still learning how oil spills impact sea turtles. Researchers used ocean circulation models to find connections between major turtle nesting beaches and the paths that oil from the Deepwater Horizon (DWH) spill travelled.[5] Models, which are computer simulations of the turtles' paths, estimated that more than 95% of the sea turtles that were likely located near the spill were from non-U.S. nesting populations (**Figure 3**).[5] These results emphasize how a relatively local disturbance such as an oil spill can have far-reaching impacts. Multi-national collaboration is necessary to improve the protection of sea turtles.[5]

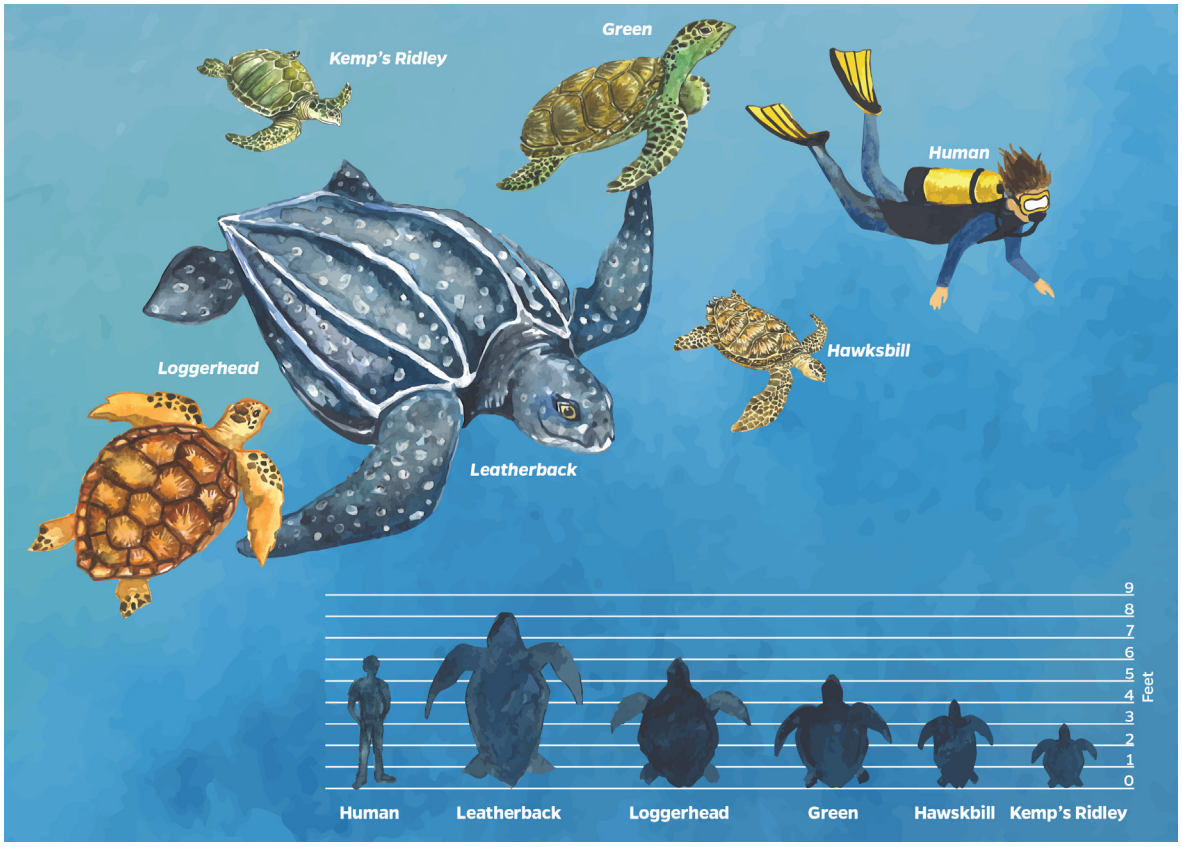


FIGURE 2. *The five species of sea turtles found in the Gulf of Mexico have a wide range of sizes. (Anna Hinkeldey)*

CHANGES IN THE KEMP'S RIDLEY POPULATIONS

Scientists studied the role the 2010 Deepwater Horizon oil spill may have played in the fate of the Kemp's ridley sea turtle—the world's most-endangered sea turtle—and their progress since.[4,6] In the 1960's, the Kemp's ridley population declined severely, rebounding only after two decades of bi-national conservation efforts.[6,7] The National Marine Fisheries Service predicted that Kemp's ridleys would be moved from the category of endangered to threatened by 2011, and potentially removed from the list completely by 2024.[7,8] However, in 2010, the Kemp's ridley nesting was below expectations, suggesting that population recovery will take longer than predicted and that conservation efforts must continue, and all changes investigated.[4,7] The Kemp's ridley remains endangered.

Since Deepwater Horizon

Scientists have not yet pinpointed what caused the 2010 decline in Kemp's ridley nesting, but they suggest that a combination of factors may have played a role.[9] Potential contributing causes include cold seawater temperatures around nesting grounds, reduced egg production due to a delay in nesting season, fewer food sources, and oiling damages.[4,7] Computer models suggest that Kemp's ridley hatchlings did not encounter Deepwater Horizon oil directly. However, the majority of sea turtles found dead during and after the spill were Kemp's ridleys.[10,11] The **Natural Resource Damage Assessment (NRDA)** found many sea turtles were exposed to oil in the Gulf of Mexico. Turtle deaths from oil exposure would have removed them from the breeding population of turtles, an example of a potential impact that scientists must consider as they evaluate long-term outcomes to all sea turtle species after the spill.[11]

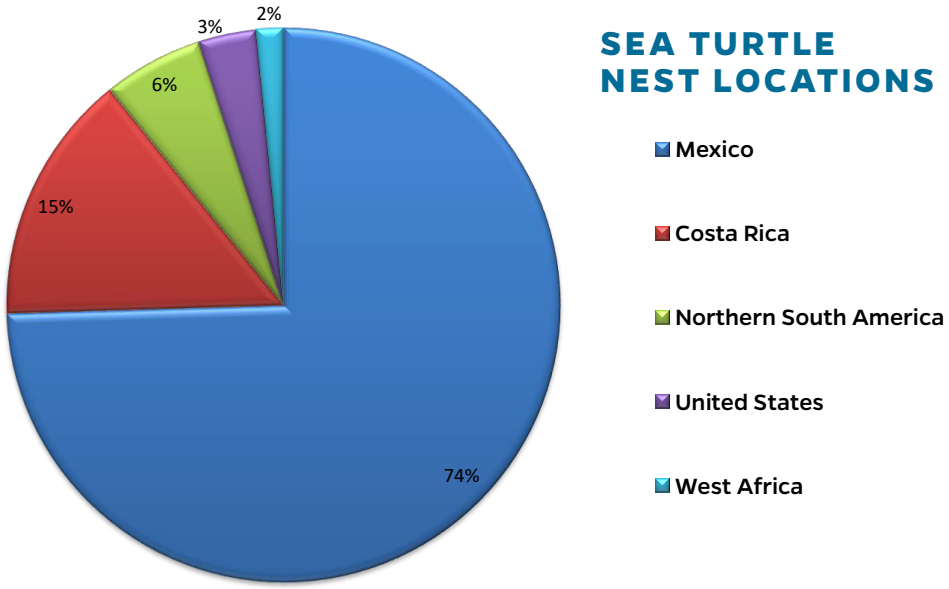


FIGURE 3. *Scientists estimate that 97% of the sea turtles impacted by Deepwater Horizon were hatched outside of the U.S, emphasizing the need to work with international partners.*[5]

SEA TURTLES AND THE OIL SPILL

Risk

DWH oil spilled for 87 days in the northern Gulf of Mexico, spreading from the open ocean to the continental shelf, coastal wetlands, and beaches.[2,11] Sea turtles use all these habitats, so they were at high risk of oil exposure (**Figure 1**).[2,11] Sea turtles may not always swim away from oil spills, and they must take large breaths of air above the water before they dive.[1,12] This behavior can lead to inhaling or ingesting surface oil. Additionally, sea turtles feed in convergence zones, an area where *Sargassum* often grows and where oil accumulates, potentially causing them to eat oil with their food (**Figure 4**).[1,2,11]

Rescue

Representatives from many organizations worked together to rescue oiled sea turtles during and following the spill. These included fishermen, marine mammal and sea turtle stranding networks, federal and state agency personnel, scientists from various institutions, and volunteers. Rescuers recorded 937 juvenile sea turtles in the spill area, with 574 captured and examined.[13] Of those captured, 81% had been visibly oiled. More than half of the turtles found in convergence zones were Kemp's ridleys, and the rest were a combination of green turtles (30%), loggerheads, hawksbills, and a few unidentified sea turtles.[13] Rescuers cleaned and examined the sea turtles, obtained oil samples, and moved turtles to rehabilitation facilities in Louisiana, Mississippi,

FIGURE 4. *a. Rescuers attempt to locate and pull oiled turtles out of a thick surface oil slick. b. This juvenile sea turtle, like many others found during the Deepwater Horizon oil spill, is entirely coated in oil, making it virtually impossible for it to not inhale or ingest oil. c. Sea turtles encounter lethally hot sea surface temperatures caused by oil slicks. d. Emergency responders sometimes find stranded turtles with clumps of oil trapped in their windpipes.*[11]

and Florida to receive veterinary care. Sea turtle experts rehabilitated more than 450 oiled sea turtles and later released them into oil-free waters.[14]

Experts also relocated nearly 275 loggerhead turtle nests from oiled beaches and those under threat from being oiled along the northern Gulf to the Atlantic coast. To do so, they excavated eggs and placed them in special foam boxes. They transported approximately 28,000 sea turtle eggs to an incubation facility in Florida. Authorities there monitored the eggs in a climate-controlled environment until the hatchlings emerged and could be released on unoiled Atlantic coast beaches.[14]

Impact

The DWH spill spread oil throughout turtle habitats. Adult females, eggs, and hatchlings encountered oil on beaches and in coastal waters. They swam through oil at the surface of the water, including oil trapped within floating *Sargassum* habitats. Responders retrieved many sea turtles from the water that were completely **mired** in oil.[11] Being mired in oil decreases a sea turtle's ability to move and dive and may cause exhaustion, dehydration, overheating, and death. Responders also found turtles with oil coating their eyes, nasal openings, and mouths, resulting in vision loss and causing them to inhale and ingest oil (**Figure 5**).[11] Without intervention from rescuers, sea turtles mired in oil most likely died.[11,15,16]

TABLE 1. *Scientists conducted multiple studies following the DWH oil spill to estimate sea turtle injury throughout the Gulf of Mexico.*[11, 13, 24]

Estimated Injuries	Type of Turtles
Estimate 1 Only continental and nearshore waters[24]	
2,215	Loggerhead
1,688	Kemp's ridley
631	Unidentfied hardshell
Estimate 2[11]	
35,000	Hatchlings — All species
55,000—160,000	Small juvenile — All species
4,900—7,600	Large juvenile and adult — All species
Estimate 3[13]	
~402,000	All species

Scientists have conducted a variety of injury assessments on all Gulf sea turtle species (**Table 1**).[11] Overall, these estimates indicated thousands to hundreds of thousands of sea turtles may have been exposed to oil from the DWH spill. Most were not rescued and rehabilitated due to the size of the spill.[13] Damage assessments also included impacts to the reproductive potential of sea turtles in the Gulf, meaning that thousands of the

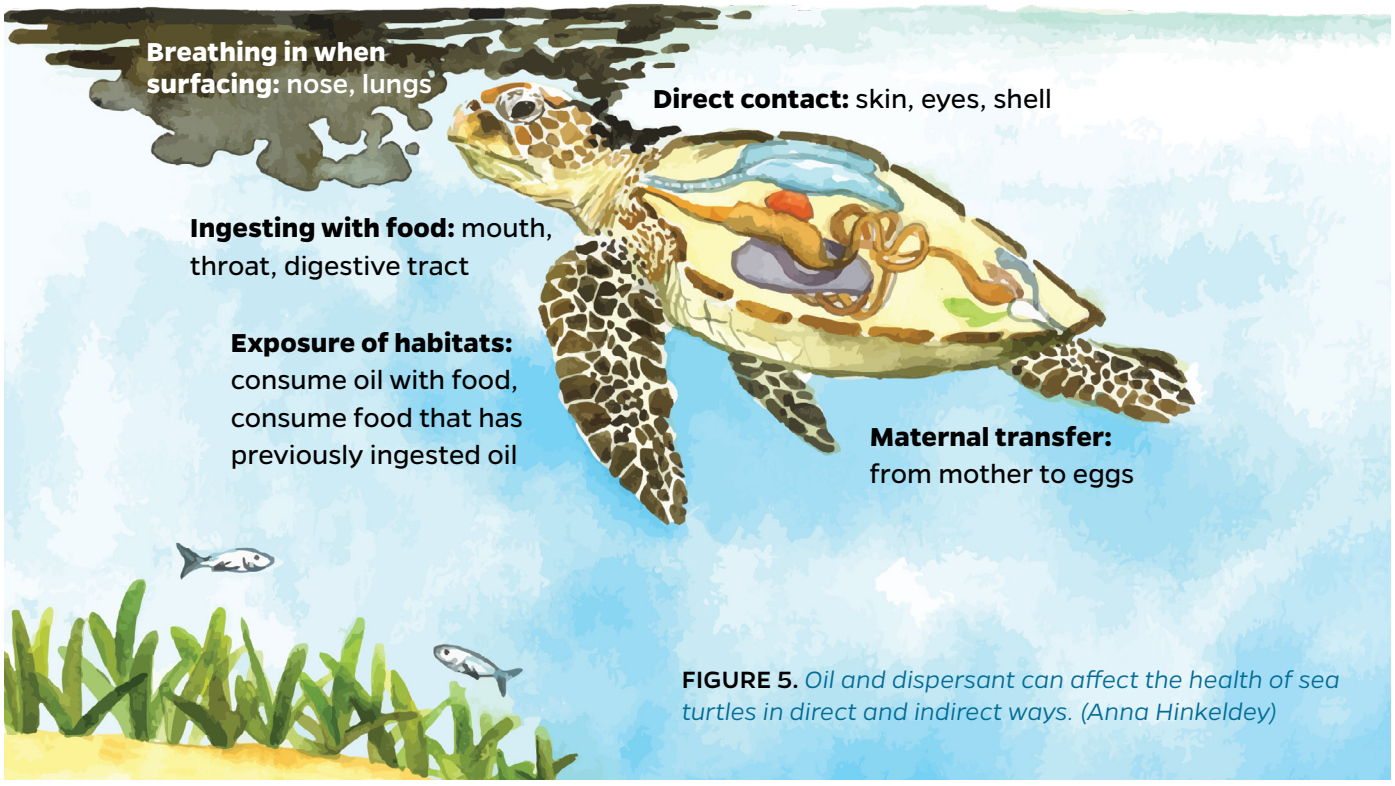


FIGURE 5. *Oil and dispersant can affect the health of sea turtles in direct and indirect ways. (Anna Hinkeldey)*

next generation of turtles were not born as a result of DWH.[11] Researchers observed fewer nests and lower nesting densities on oiled beaches than expected in 2010, including a loss of 215 nests—an approximate 36% reduction—in a study on loggerhead nesting sites in a small area of northern Florida.[17] The magnitude of sea turtle loss has made it challenging for scientists to estimate when populations might recover.[11]

In addition to the effects of the oil itself, actions taken to clean-up the environment also unintentionally impacted sea turtles. Equipment such as oil-containing booms blocked turtle access to nesting beaches, controlled burns to remove oil entrapped turtles, increased vessel traffic likely contributed to the number of turtles struck and killed, and turtles were exposed to chemicals from **dispersant** use.[11,17,18] Also, hatchlings from eggs that were moved from Gulf to Atlantic beaches to avoid the imminent threat of oil likely were lost to the Gulf population.[11] The emergency response community must often weigh the benefits and risks of available tools and approaches when making oil spill response decisions.[19] To learn more about how emergency responders make these choices, read the Sea Grant publication ***Oil on the water: Insights into oil spill response***.

ONGOING RESEARCH AND MONITORING

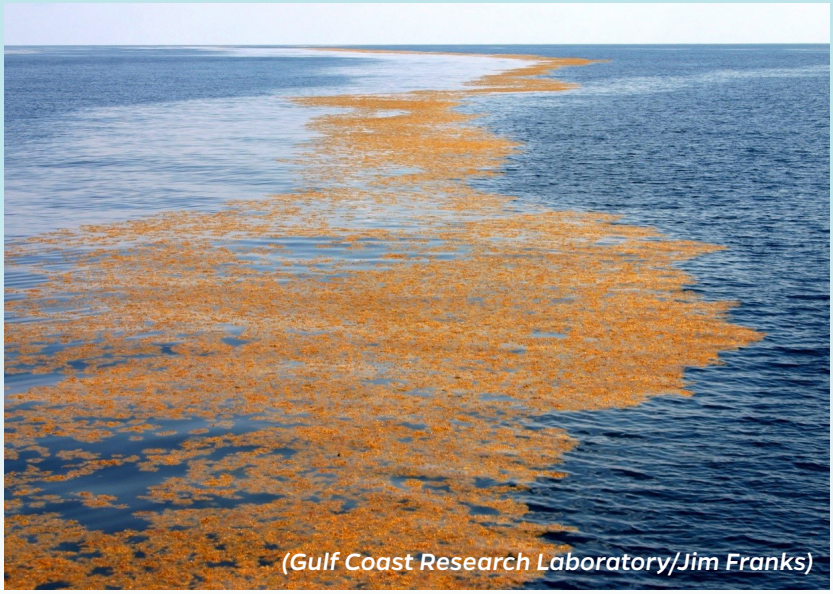
Ongoing research continues to improve scientists' and natural resource managers' understanding of the impacts of oil and dispersants on sea turtles.[11] For example, the type of oil and extent of **weathering** can alter the severity of adverse effects. Researchers found that fresh oil is more toxic to turtle embryos than weathered oil.[16] Additionally, heavily oiled turtles following DWH had high levels of **polycyclic aromatic hydrocarbons (PAHs)**, toxic chemicals found in oil, in their livers and digestive systems.[20] The threats and damages from dispersant exposure are closely tied to the location and timing of their applications on slicks.[20] Only 1 out of 68 heavily oiled turtles tested positive for the presence of chemicals found in dispersants; no other sampled turtles had detectable levels of dispersant based on the available tests.[20] Scientists continue to monitor Gulf sea turtle populations by counting numbers of nests, hatchlings, and adult females on beaches. In addition, the Sea Turtle Stranding and Salvage Network documents sea turtle strandings to monitor causes of mortality and collect valuable information related to threats and wildlife health.

Sea turtles are far more difficult to track once they reach the open ocean.[5] Scientists have coined this period of a sea turtle's life as the "lost years."[21] In the past, scientists thought juvenile sea turtles drifted along with strong ocean currents.[21] More recently, scientists have used computer models and satellite tracking tags to study turtle migration. They found that juvenile green, loggerhead, and Kemp's ridley turtles actively swim in the open ocean and do not act as passive drifters.[21,22]

Scientists continue to fill in knowledge gaps about sea turtles so that they can better understand how threats like oil spills impact populations, with the aim of ultimately improving species management.[5,20,22,23] For example, scientists are learning more about where

FLOATING SAFE HARBORS

The National Oceanic and Atmospheric Administration (NOAA) considers *Sargassum*, a floating type of algae, to be an **Essential Fish Habitat (EFH)** because many species use it for spawning, feeding, protection, and growth. *Sargassum* floats and drifts with currents in the ocean, accumulating in convergence zones, as do surface oil slicks.[1,11] Oil from the DWH spill caused the loss of nearly 25% of the *Sargassum* habitat in the northern Gulf and the deaths of numerous small juvenile sea turtles within oiled habitat.[11] Losing such an important habitat threatened the lives of juvenile and young adult sea turtles.[11]



(Gulf Coast Research Laboratory/Jim Franks)

turtles feed. From 1998 to 2011, they tagged and tracked female Kemp's ridleys to identify preferred foraging areas. They discovered a critical foraging corridor in the northern Gulf, including coastal Louisiana, Alabama, and Mississippi.[23] Knowing the location of important sea turtle habitats and migration routes helps managers target areas for protection.[23]

Recovery for these endangered species is ongoing. Additional research, with the inclusion of new baseline data collected from healthy turtles, may improve our understanding about the impacts of oil spills on these vulnerable species. For more information about the Deepwater Horizon oil spill's impact to wildlife and other oil spill science topics, visit gulfseagrant.org/.

GLOSSARY

Continental shelf — A shallow undersea plain of varying widths forming a border to a continent and typically ending in a comparatively steep slope to the deep ocean floor.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) — An international agreement between governments to ensure that international trade in wild animals and plants does not threaten their survival.

Dispersants — Chemicals that are used during oil spill response efforts to break up oil slicks and limit floating oil from impacting sensitive ecosystems such as coastal habitats.

Endangered — Under the U.S. Endangered Species Act, a species is listed as endangered if it is in danger of becoming extinct throughout all or a significant portion of its range.

Endangered Species Act (ESA) — U.S. legislation that provides a framework for conservation and protection of endangered and threatened species and their habitats.

Essential Fish Habitat (EFH) — Under the U.S. Magnuson-Stevens Fishery Management and Conservation Act, NOAA identifies EFH as waters and submerged lands that fish need for spawning, breeding, feeding, and growth.

Hatchling — A young animal that has recently emerged from an egg.

Juvenile — An early phase of growth associated with youth.

Migratory — Having to do with the periodic travel of an animal from one area to another, often over long distances.

Mired — To be covered in, stuck or entrapped within, or be hindered by, a sticky, heavy, or muddy substance.

Natural Resource Damage Assessment Trustees (NRDA) — The legal process used to determine the impacts of oil spills, hazardous waste sites, and ship groundings on natural resources and humans.

Polycyclic aromatic hydrocarbons (PAHs) — A chemical group found in many sources, including but not limited to oil, tar, ash, coal, car exhaust, chargrilled animal fats, and smoke from burning oil or wood.

Threatened — Under the U.S. Endangered Species Act, a species is listed as threatened if it is likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

Weathering — Process by which oil changes physically and chemically. Includes processes such as oil spreading, evaporation, dispersing, dissolving, settling on the seafloor, and breakdown by sunlight and microbes. These processes are influenced by factors (such as type of oil being weathered, temperature, waves, and bacteria present).

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