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After Oil Spills, Hidden Damage Can Last for Years

By JUSTIN GILLIS and LESLIE KAUFMAN

On the rocky beaches of Alaska, scientists plunged shovels and picks into the ground and dug 6,775 holes, repeatedly striking oil — still pungent and dangerous a dozen years after the Exxon Valdez infamously spilled its cargo.

More than an ocean away, on the Breton coast of France, scientists surveying the damage after another huge oil spill found that disturbances in the food chain persisted for more than a decade.

And on the southern gulf coast in Mexico, an American researcher peering into a mangrove swamp spotted lingering damage 30 years after that shore was struck by an enormous spill.

These far-flung shorelines hit by oil in the past offer clues to what people living along the Gulf Coast can expect now that the great oil calamity of 2010 may be nearing an end.

Every oil spill is different, but the thread that unites these disparate scenes is a growing scientific awareness of the persistent damage that spills can do — and of just how long oil can linger in the environment, hidden in out-of-the-way spots.

At the same time, scientists who have worked to survey and counteract the damage from spills say the picture in the gulf is far from hopeless.

“Thoughts that this is going to kill the Gulf of Mexico are just wild overreactions,” said Jeffrey W. Short, a scientist who led some of the most important research after the Exxon Valdez spill and now works for an environmental advocacy group called Oceana. “It’s going to go away, the oil is. It’s not going to last forever.”

But how long will it last?

Only 20 years ago, the conventional wisdom was that oil spills did almost all their damage in the first weeks, as fresh oil loaded with toxic substances hit wildlife and marsh grasses, washed onto beaches and killed fish and turtles in the deep sea.

But disasters like the Valdez in 1989, the Ixtoc 1 in Mexico in 1979, the Amoco Cadiz in France in 1978 and two Cape Cod spills, including the Bouchard 65 barge in 1974 — all studied over decades with the improved techniques of modern chemistry and biology — have allowed scientists to paint a more complex portrait of what happens after a spill.

It is still clear that the bulk of the damage happens quickly, and that nature then begins to recuperate. After a few years, a casual observer visiting a hard-hit location might see nothing amiss. Birds and fish are likely to have rebounded, and the oil will seem to be gone.

But often, as Dr. Short and his team found in Alaska, some of it has merely gone underground, hiding in pockets where it can still do low-level damage to wildlife over many years. And the human response to a spill can mitigate — or intensify — its long-term effects. Oddly enough, some of the worst damage to occur from spills in recent decades has come from people trying too hard to clean them up.

It is hard for scientists to offer predictions about the present spill, for two reasons.

The ecology of the Gulf of Mexico is specially adapted to break down oil, more so than any other body of water in the world — though how rapidly and completely it can break down an amount this size is essentially unknown.

And because this spill is emerging a mile under the surface and many of the toxic components of the oil are dissolving into deep water and spreading far and wide, scientists simply do not know what the effects in the deep ocean are likely to be.

Still, many aspects of the spill resemble spills past, especially at the shoreline, and that gives researchers some confidence in predicting how events will unfold.

Remarkable Persistence

In 1969, a barge hit the rocks off the coast of West Falmouth, Mass., spilling 189,000 gallons of fuel oil into Buzzards Bay. Today, the fiddler crabs at nearby Wild Harbor still act drunk, moving erratically and reacting slowly to predators.

The odd behavior is consistent with a growing body of research showing how oil spills of many types have remarkably persistent effects, often at levels low enough to escape routine notice.

Jennifer Culbertson was a graduate student at Boston University in 2005 when she made plaster casts of crab burrows. She discovered that instead of drilling straight down, like normal crabs, the ones at Wild Harbor were going only a few inches deep and then turning sideways, repelled by an oily layer still lingering below the surface.

Other researchers established that the crabs were suffering from a kind of narcosis induced by hydrocarbon poisoning. Their troubles had serious implications for the marsh.

“Fiddler crabs normally play a crucial role in tilling the salt marsh, which helps provide oxygen to the roots of salt marsh grasses,” Dr. Culbertson said about her study.

In Alaska, the Exxon Valdez spill dumped nearly 11 million gallons of oil into Prince William Sound, and it spread down the Alaska coast, ultimately oiling 1,200 miles of shoreline. By the late 1990s, the oil seemed to be largely gone, but liver tests on ducks and sea otters showed that they were still being exposed to hydrocarbons, chemical compounds contained in crude.

Dr. Short, then working for the National Oceanic and Atmospheric Administration, mounted a series of excavations to figure out what had happened, with his team ultimately digging thousands of holes in Alaska's beaches. Oil was found in about 8 percent of them, usually in places with too little oxygen for microbes to break it down.

Exactly how much damage continues from the oil is a matter of dispute, with Exxon commissioning its own studies that challenge the government's findings on the extent of the impact. But it is clear that otters dig for food in areas containing oil, and that they, like nearly a dozen other species of animals, have still not entirely recovered from the 1989 spill.

At the rate the oil is breaking down, Dr. Short estimates that some of it could still be there a century from now.

Increasing the Stress

Perhaps the greatest single hazard from the Deepwater Horizon disaster in the gulf is the long-term erosion of delicate coastal wetlands it could cause. At another spill site on the Massachusetts coast, not far from the West Falmouth spill, the legacy of oil contamination is evident in the difference between two marshes on either side of a pebbly shoreline road.

On one side, where the marshes were suffused in 1974 when the grounded Bouchard 65 barge dumped 11,000 to 37,000 gallons of fuel oil into the sea, the grasses are stunted and sparse. They cling tentatively to the edge of the sandy beach. But the grasses on the other side, untouched by oil, rise tall and thick.

Louisiana's coastline contains some of the most productive marshes in the world, delivering an abundance of shrimp and oysters and providing critical habitat and breeding ground for birds and fish.

But even before the spill, the land was under enormous environmental stress, largely due to human activity. Dams on the Mississippi River and its tributaries have slowed the flow of sediment to the marshes, and global warming has caused sea level to rise.

The Louisiana marshes are eroding at an extraordinary rate — a football field's worth sinks into the Gulf of Mexico every 38 minutes, according to the Louisiana Office of Coastal Management — and the worry now is that the oil spill will accelerate that erosion.

The Bouchard shows how that could happen. When the barge ran aground, thousands of gallons of a particularly toxic fuel oil spilled into the icy water and were swept to shore by the strong tides.

The oil made landfall just two miles north of where the West Falmouth oil spill had washed up only five years earlier. Winsor Cove, a classic New England bay surrounded by bluffs and stately homes, bore the brunt. Razor clams suffocated and rose to the surface by the hundreds to die.

But the lasting damage of the spill, severe erosion of the shoreline, took months longer to unfold.

George Hampson, now retired, was on the scientific team at the Woods Hole Oceanographic Institution that studied a series of spills in the area. He recalled that after the 1974 spill the beach grasses, called spartina, which had grown like luxuriant matting along the shore, died.

"The first year it was just like a moonscape," Mr. Hampson said.

Spartina, a common beach grass that fills the marshes along the North Atlantic and in the Gulf of Mexico, is a crucial factor in keeping marshlands from eroding into the sea. Its roots act as a vast net keeping soil in place.

But the oil in Winsor Cove set off a vicious downward spiral. "It was a race between how much peat was eroding and how quickly the grass was coming back," Mr. Hampson said.

Over the course of the next several winters, six feet of shore eroded, including a sand berm that stood above the rest of the beach. And as the view from the pebbled road indicates, the vegetation still struggles for a foothold today.

“It’s been 35 years, and I’d say the grasses are just beginning to grow back,” Mr. Hampson said.

It is certain that some of the heavily oiled spartina in Louisiana will die. For now, heavy oiling is limited to just the marsh fringes, but a strong surge in front of a hurricane could change that.

Bad Choices

Oil spills produce a powerful impulse to clean up the oil and restore as much of the environment as possible. But that impulse can itself be a source of destruction.

No case illustrates that point more starkly than the 1978 spill of the Amoco Cadiz tanker. Caught in a gale, it was propelled against rocks near the shore of northwestern France, spilling 67 million gallons of crude oil that washed over 200 miles of the coast of Brittany.

The immediate damage was bad enough: at least 20,000 seabirds found dead, thousands of tons of oysters lost and fish ridden with ulcers and tumors. But then the French authorities made it worse.

The area had marshes, and they were hit hard by oil that sank deep into the sediments. The authorities felt they needed to act aggressively.

Using bulldozers and tractors, they scraped close to 20 inches of oiled sediment from the top in the most polluted marshes and also straightened and deepened some natural tidal channels, to improve flushing.

Over time, these proved to have been disastrous judgments.

In areas that were not bulldozed, nature ultimately broke down most of the oil and the vegetation came back. But marsh plants turned out to be highly sensitive to the depth of the sediment, and more than a decade after the spill, the bulldozed marshes are still missing as much as 40 percent of their vegetation.

“In the case of Amoco Cadiz, the cleanup operations were more deadly than the pollution itself,” said Jean-Claude Dauvin, a professor of marine biology and ecosystems at the University of Lille in northern France.

Much the same dynamic played out in Alaska after the Exxon Valdez spill. In some areas, Exxon power-washed oiled beaches with high-pressure, hot-water sprayers. It made for dramatic television images, with the company seemingly working hard against the spill. But scientists ultimately determined that it was a disaster for the tidal ecology, with clams and other organisms showing greatly delayed recovery on the laundered beaches, compared with oiled beaches that were not cleaned.

The lesson, scientists say, is not that people should never try to clean up an oil spill. It is possible to do too little as well as too much. But the calculation of how much to do is tricky, demanding deep scientific understanding of an area’s ecology. Applying supposed common sense has repeatedly led to mistakes.

Already in Louisiana, battles have erupted between the Army Corps of Engineers and local residents, led by Gov. Bobby Jindal, over proposals to build sand and rock barriers to block the oil from coming into the marshes. The corps has been cautious on approval permits and recently rejected a plan to build a rock barrier outside Barataria Bay, arguing that such structures would change water-flow patterns to the possible detriment of the marsh ecology.

No matter how that battle plays out, a tough and potentially contentious issue in Louisiana in coming months may be the question of whether the marshes should be burned.

If the top layer of grasses and the clinging oil are burned off, the roots should survive and allow healthier grasses to sprout back. But scientists say that can be done only if there is no chance of new oil coming in, since burning might expose the roots buried in the sediment, making them vulnerable to absorbing the oil. Given the immensity of the spill, it is not clear when that hazard will have passed.

“If you consider the volume,” said Ronald J. Kendall, chairman of environmental toxicology at Texas

Tech University, “we could see re-oiling for years to come.”

Natural Resilience

The other day, a Mexican fishing boat threaded its way deep into a coastal mangrove swamp on the Bay of Campeche. It carried two scientists, an American, Wes Tunnell, and a Mexican, Julio Sánchez.

They were looking for remnants of an oil spill that happened 30 years earlier, when the Ixtoc 1 well in the bay exploded and gushed oil for 10 months. It has stood for decades as the worst accidental release of oil in any ocean. (It may or may not have been surpassed by the BP spill; estimates vary.)

Mangroves are vital coastal plants, providing rich habitat for many types of creatures and serving as a nursery for many marine species. To the untrained eye, the ones in Mexico appeared healthy, billowing up from the shoreline in shades of green, balanced on a gray carpet of roots that protruded from the water.

But Dr. Tunnell pointed out subtle signs of damage. There were clearings in the foliage, instead of an unbroken tangle of roots and mangrove trees. The branches of the outer layer of red mangroves seemed stunted.

“For a mangrove swamp, this should be much denser,” Dr. Tunnell said. “We shouldn’t even be able to see in here.”

The scientists scrambled out of the boats to a small clearing. Dr. Sanchez bent down, sliced out a layer of sediment and broke it to reveal gooey tar in the middle.

Dr. Tunnell sniffed. “It smells like a newly paved road,” he said.

They could not be sure it was oil from the Ixtoc well, since smaller spills have hit the area too, but the scientists agree with local fishermen that much of the damage to the mangroves goes back to Ixtoc.

They sent the sample to a laboratory. The fishermen also said that oysters that used to be found clinging to the mangrove roots seemed to have vanished after the spill and never returned.

The Ixtoc blowout of 1979-80 is the closest analogy to the BP spill, even though it happened in much shallower water. Ixtoc soiled hundreds of miles of beaches, all the way to Texas.

Dr. Tunnell, of the Harte Research Institute for Gulf of Mexico Studies at Texas A&M, Corpus Christi, was early in his career then. He was dismayed to see the oil kill 50 percent to 80 percent of the bottom-dwelling creatures in some areas near the Texas shore.

"As a young scientist, I thought, 'Oh, no, this is wiping out our beaches,' " Dr. Tunnell said.

But then he watched in amazement as the recuperative powers of the gulf kicked in.

Because oil constantly seeps into the gulf from natural fissures, the water is teeming with microbes adapted to break oil down and use it as food. The breakdown happens faster there than in colder bodies of water, and the warm water helps some species recover faster, too.

Along the Texas coast, within a few years after the Ixtoc spill ended in 1980, it was hard to tell that anything had gone wrong. Creatures repopulated the areas that had been wiped out.

No one can be sure that the recovery from the BP spill will be a replay of Ixtoc. But the greatest reason for optimism is nature's demonstrated capacity to handle the assaults on it.

"Thirty years ago, that 140 million gallons of oil went somewhere," Dr. Tunnell said. "The gulf recovered and became very productive again. My concern is: Is it as resilient today as it was 30 years ago?"

Elisabeth Malkin contributed reporting from Isla Arena, Mexico, and Dheepthi Namasivayam from Roscoff, France.