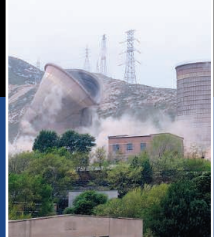

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GULF OIL DISASTER

Louisiana Begins Controversial Engineering to Ward Off Oil Spill

Regardless of when BP finally manages to stop its undersea gusher from the *Deepwater Horizon*, a massive slick will likely remain in the Gulf of Mexico for some time. With public officials desperate for action, the magnitude of the disaster—the largest oil spill in U.S. history—has inspired an unprecedented and untested idea for combating it: an extensive sand trap. But scientists are dubious about the project's chance of success and say it could even jeopardize long-term restoration of Louisiana's wetlands, which have been disappearing for decades.

First cut. Dredges like this will collect sand, which will be shipped and then dropped in front of barrier islands.

In mid-May, Louisiana Governor Bobby Jindal—frustrated at what he saw as an inadequate federal response to the spill—proposed a 2-meter-tall sand berm to protect 160 kilometers of his state's coast from oil. The project would require dredging an estimated 68 million cubic meters of sand and cost at least $350 million—perhaps three times that figure. "I was stunned," says Joseph Kelley, a coastal geophysicist at the University of Maine, Orono. "This is a big proposal and not well thought out."

Last week, the Army Corps of Engineers, after examining the proposal and getting input from experts at other agencies, granted Louisiana an emergency permit to build two portions of the proposed berm. But scientists at those agencies and at universities question how effective or durable the berm would be, and some say the corps' analysis was too hasty. "You're spending a couple hundred million dollars and crossing your fingers," says Robert Young, a coastal geologist at Western Carolina University in Cullowhee, North Carolina.

The rationale for the berm is fairly simple. Oil is much easier to remove from a sandy beach than from a vegetation-rich wetland, where cleaning would probably cause additional harm to the fragile ecosystem. But Louisiana's sandy barrier islands have been greatly damaged by storms in recent years. In some places, the Chandeleur Islands have eroded into shallow shoals over which oil could flow unimpeded toward sensitive wetlands. In addition to catching oil, the massive berms would shunt oily water toward tidal inlets, making it more efficient for booms and boats to collect it.

But soon after the state applied for the emergency permit on 11 May, federal agencies and academic scientists raised objections. "My concern is if we rush into this and don't have any idea about what the impacts might be," says Gregory Stone of Louisiana State University (LSU) in Baton Rouge. The dredging might exacerbate erosion of the islands, for example, or further disturb breeding birds or nesting sea turtles that have already been affected by the oil.

In granting the emergency permit last week, the government recognized those worries. "There are a lot of doubts whether this is a valid oil spill–response technique," Coast Guard Admiral Thad Allen, who heads the

GULF OIL DISASTER

No 'Smoking Gun' for Killer Oil

As turtle and dolphin corpses wash up on Gulf of Mexico beaches, scientists face a sleuthing challenge worthy of *CSI*: determining whether oil had a hand in the deaths.

In the past month, the stranding network operated by the National Oceanic and Atmospheric Administration (NOAA) has counted more than 200 dead sea turtles and more than 20 dead dolphins. Turtles normally strand during the summer nesting season, and the number of strandings in May has averaged 47 in the past 5 years. Although that's far below the current tally, none of the dead turtles had oil on its shell or skin, only one dolphin appeared to be oiled, and the 67 turtle necropsies that had been performed when *Science* went to press had failed to find oil internally. However, officials are loath to either implicate or rule out oil as the culprit.

In addition to rescuing and cleaning oiled animals, NOAA is simultaneously gathering evidence for the government's Natural Resource Damage Assessment (NRDA), the estimate of a humanmade disaster's environmental impact that ultimately goes to court. Animals that died from exposure to oil factor into that estimate, says Michael Ziccardi, a University of California, Davis, wildlife veterinarian currently advising NOAA's efforts in Houma, Louisiana.

"The more environmental damage due to a spill, the higher the damage assessment is on a dollar basis," Ziccardi says. "Animals do directly affect the amount."

But pinning an animal's death to oil is tricky. Clues could be as obvious as oil on an animal's skin and in its mouth, eye irritation, or, during a necropsy, a tarball in the intesti-

Victim. Just one of the dead dolphins found so far had oil on its body.

CREDITS (TOP TO BOTTOM): CHARLIE VARLEY/SIPA PRESS/NEWSCOM; PLAQUEMINES PARISH GOVERNMENT/AP PHOTO

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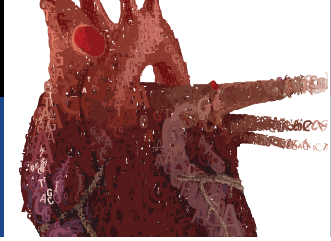

The case of the missing genetic risk factors

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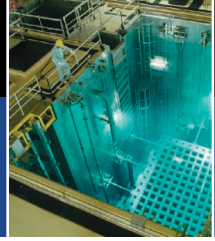

Nuclear security technology

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national response, said at a press conference. "But we're not averse to attempting this as a prototype." The permit allows the state to build 72 kilometers of berm, less than half of its proposal. The federal government will front the bill for one section of the berm (with hopes of collecting from BP). The rest would have to be funded by the state, which could likewise try to get reimbursed by BP.

The scope of the permit may be expanded—and the federal government would consider funding more of it—if the project shows a "net environmental benefit," according to Allen. It's not clear what that means, but it could be as simple as checking whether the berms hold up and collect oil. "If these berms are keeping the beaches behind them clean, then that's a pretty persuasive argument that they are doing something good," Young says.

Still, experts doubt that the berms will catch much oil. For one thing, it could take many months to construct them, given that hurricane season has begun. And the 100-meter-wide berm will likely wash away quickly. Because the berm is steeper than the natural beach, waves erode it faster than normal. Even small storms could do serious damage and likely scatter the sand about the muddy sea floor where it couldn't be retrieved. That would mean that much sand—a precious commodity needed for coastal restoration—would be lost.

Far out. Louisiana wants to build an extensive array of offshore sand berms to keep oil from reaching wetlands, but many scientists are skeptical that it will work.

Coastal scientists are relieved that the project is starting out at half-scale and that the corps put the most plentiful and easily accessed sources of high-quality sand off-limits to dredging for now. The permit allows sand to be gathered only from Pass a Loutre, a wide channel of the Mississippi. "It's probably quite good sand and could be replenished by the river," says Denise Reed of the University of New Orleans. In addition, the dredging and bulldozing will have to follow guidelines for avoiding harm to endangered species that live there, such as the piping plover.

Robert Twilley of LSU is hoping that the permit can be modified to allow sand to be placed not on a berm in front of the western barrier islands but rather on top, where it would be likely to escape erosion. "If we're going to move sand, we should do that for the purpose of restoration, so we're not building an artificial landscape," Twilley says.

–ERIK STOKSTAD

MAP SOURCES: U.S. ARMY CORPS OF ENGINEERS; 2010 GOOGLE AND TERRAMETRICS

nal tract and oil in unexpelled feces. But some clues show up only under a microscope.

Oil "causes profound effects in clinical pathology," which vary based on the dosage and length of exposure, says Gregory Bossart, a veterinary pathologist and immunologist at the Georgia Aquarium in Atlanta who worked with oiled birds and turtles during the massive spills of the Persian Gulf War. The most toxic components of crude oil are polycyclic aromatic hydrocarbons (PAHs), volatile molecules that irritate every system in the body. Pathologists looking at mucous membrane tissue under a microscope might see inflammation, a sign of inhaling fumes. Ingested oil causes hemorrhaging in the gastrointestinal tract and damage to the liver and kidneys.

But even these microscopic clues aren't the final word, Ziccardi says: "The same cellular changes can be seen with diseases … [or] starvation. That's why a lot of this is very much like *CSI*, trying to put together the clues."

On the other hand, "death tends to be a dynamic process," Bossart says. Oil exposure can kill by making animals more vulnerable to other diseases, signs of which "could cloud the picture if you're trying to see a simple cause and effect." After the *Exxon Valdez* tanker spill, for instance, sea otters that had inhaled fumes developed pneumonia, he notes. "These are very complex morbidity and mortality issues that we need to be careful in how we interpret."

Toxic PAHs are usually metabolized and flushed fairly quickly, and that makes them hard to use as a marker for oiling. But they can also accumulate in fatty tissue like ovaries and other reproductive tissues, says NOAA environmental scientist and ecotoxicologist Simeon Hahn, who is leading the ongoing NRDA for sea turtles and marine mammals. This could be especially useful for determining oiling in animals too decayed to necropsy. His team will send tissue samples from all found animals to a laboratory to be analyzed for PAHs and their metabolites, he says. It could take weeks or months for those results to be announced.

Meanwhile, the unprecedented use of nearly 4 million liters of chemical dispersants has added a new wrinkle, forcing NOAA to develop protocols analogous to PAH testing to flag dispersant poisoning, something it's never had to do before, and a scientific challenge, Hahn says: "In general, there's not a good understanding of how the material accumulates in tissue."

–LAUREN SCHENKMAN

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