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contained 1 to 2 parts per million of oil (1 or 2 milliliters in a cubic meter of seawater). Most parts of the plume, however, had lower concentrations; farther than 10 kilometers from the wellhead, concentrations were in the parts-per-billion range.

If something like 20% of the oil—15,000 barrels a day—dispersed into the deep sea, as the report has it, precious little of it has been showing up in plume observations. That raises

the issue of biodegradation and how quickly microbes might be consuming the oil. The report states that according to early signs, the oil “is biodegrading quickly.” It provides no documentation for that claim, while hearsay about observations awaiting publication and public release is mixed. “The message I’ve heard is that everywhere we look, oil is degrading extremely rapidly,” says Overton. Joye, who has generated some of the relevant data,

is more cautious. “Sure it’s getting degraded, but we don’t know how fast,” she says.

Ultimately, determining the rates of oil degradation, evaporation, and dilution in the gulf rather than this report’s parsing of the oil’s immediate fate will show where the oil went. Such analysis should determine whether, as Lehr puts it, “Mother Nature is almost always the best removal mechanism.”

—RICHARD A. KERR

## GULF OIL SPILL

# An Audacious Decision in Crisis Gets Cautious Praise

How BP came to spray 1.1 million gallons of chemical dispersants a mile beneath the ocean surface is a story of scientists turning to desperate measures during desperate times. And the government’s decision to let BP do so, among the most gutsy calls of the entire *Deepwater Horizon* saga, was a classic case of pitting the devil you know against the devil you don’t.

Roughly a week after the magnitude of the gusher became clear in late April, former Exxon-Mobil scientist Gerard Canevari suggested that BP might try spraying chemicals called dispersants right at the billowing wellhead. Dispersants are usually used in small quantities on the surface of the ocean to break up slicks. Canevari’s idea would mean releasing giant amounts of the fairly nasty chemicals in the cold and high-pressure world of the ocean floor, something that had never been tried. “At first we were going, ‘Yeah, right,’” recalls Charlie Henry, a top scientist on Gulf of Mexico issues for the National Oceanic and Atmospheric Administration (NOAA). “It was out of the norm”—a massive proposed undersea experiment.

But, he says, the unprecedented nature of the problem meant nothing was off the table. While outlining the pros and cons on white boards in NOAA’s New Orleans office, says Henry, the basic tradeoff seemed clear. Every drop of oil that made it to the surface was a potential threat to coastal ecosystems, fish, and marine mammals. Dispersants, which are mostly detergents, break up globs of crude into microscopic droplets that are more readily devoured by microbes. So keeping as much oil as possible below the surface would give microbes a leg up in eating the oil. And

injecting dispersants into the hot, vigorously mixing oil of the busted riser would presumably mean they would work especially effectively. Smaller quantities would then presumably be needed at the ocean surface.

Some drawbacks emerged during a conference call with 25 industry and academic scientists arranged by NOAA in early May: The risks to undersea marine life—eggs, larvae, fish, coral, and other bottom dwellers—were largely unknown. One possibility was particularly frightening: Giving microbes a feast of hydrocarbons might massively increase their numbers, starving the water column of oxygen and creating dead zones.

So government scientists proposed a three-tiered plan to try the undersea injection as safely as possible. First, teams across the country began adapting existing undersea models of oil plumes to predict how they might move, referencing data on nearby sea life from the Department of the Interior. Second, they required that BP conduct aggressive monitoring, including ocean surface-to-floor water sampling, toxicity tests using zooplankton, and tests with fluorometers, which would continuously track the oil droplets. And if the dispersant injection created unexpected effects during tests, an “adaptive management” plan would enable the feds to halt the procedure immediately.

The Environmental Protection Agency (EPA) and the Coast Guard agreed to the procedure on 15 May. “I don’t think I’ve had to make a harder decision,” EPA Administrator Lisa Jackson told reporters at the time. BP deployed a specially built tube with tiny ▶



**Desperate measures.** Spraying chemical dispersants at the undersea wellhead seems to have spared coastal ecosystems, but at what cost?

CREDITS: REUTERS (INSET); AP/GETTY IMAGES

holes that was clamped in place to release the chemical right at the spurting pipe.

On 27 May, the first real vetting of the new approach came at a meeting of scientists culled largely from academia and the non-profit sector, hastily organized by NOAA. The outsiders were asked “to second-guess us,” says Henry. Chemist Jeffrey Short of Washington, D.C.-based Oceana recalls feeling skeptical on his way to Louisiana State University (LSU). “You don’t want me down there; you know what I think about dispersants,” he told Nancy Kinner of the University of New Hampshire, the organizer.

But the fluorometry data presented at LSU showed that the dispersant was working and had broken up the big globs into droplets between 1 and 10 micrometers—

and the microbial feast wasn’t starving the system of oxygen. So after 2 days of intense debate, Short and the rest of the group gave their approval in a report. “I was struck by the fact that all 50 were in agreement that continuing the subsurface injection was the best option in a bad situation,” recalls toxicologist Ronald Tjeerdema of the University of California, Davis.

Since then, researchers have by and large stuck with that opinion. NOAA estimates that roughly 409,000 barrels of oil have been dispersed underwater by the technique. Toxicity tests have suggested an acute risk of dispersant-oil mixtures no greater than that of oil alone. Daniels says some of the dispersed oil has risen toward the surface, while some has formed a loose band, or plume,

between 1000 and 1300 meters in depth. No negative impacts on deep-sea life have yet been recorded, although NOAA Administrator Jane Lubchenco says one of the worst case scenarios involving longer exposures due to dispersed oil—big losses of spawning bluefin tuna populations—may not be detectable for years. That’s led some scientists to suggest that letting the oil rise to the surface would have been a better move, as it could be more easily collected.

Jacqueline Savitz, an environmental scientist with Oceana, says because of the unknown risks of dispersants, it was “a lose-lose” decision—and despite optimistic projections (p. 734), all the benefits and costs may not be known for decades.

—ELI KINTISCH

With reporting by Erik Stokstad.

## INFECTIOUS DISEASES

# Yellow Fever Mosquito Shows Up in Northern Europe

**AMSTERDAM**—In the latest display of mosquitoes’ predilection for modern travel, entomologists have found a small colony of the tropical species *Aedes aegypti*—also known as the yellow fever mosquito—in the Netherlands. The insects were found on and near two facilities of a company that imports used tires and presumably originated in the hot southern part of the United States. *Ae. aegypti* is an important vector not just of yellow fever but also of two other viral diseases, dengue and chikungunya.

The mosquitoes, found by a team led by Ernst-Jan Scholte of the Dutch government’s Center for Vector Monitoring, don’t pose a direct public health threat and are unlikely to survive the winter, says Scholte. Still, scientists are amazed, because the insects were last seen in Europe more than 50 years ago. “You’re kidding. ... Really?” entomologist Paul Reiter of the Pasteur Institute in Paris says when told about the find. “Wow.”

*Ae. aegypti* originated in Africa but has colonized tropical and subtropical areas around the world. It’s notorious as the vector of the dengue virus, which can cause severe malaise and fever, unbearable joint pains, and a fatal syndrome called dengue hemorrhagic fever. *Ae. aegypti* once roamed southern Europe as well but probably disappeared after World War II, says Reiter, perhaps in response to

DDT spraying. Although the Dutch climate may be inhospitable for the species, a similar transplantation to southern Europe could trigger a recolonization, says Francis Schaffner, a French mosquito-control expert at the University of Zürich in Switzerland.

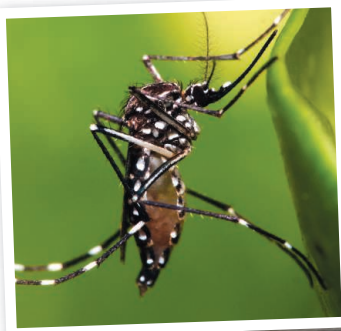
The team found the mosquitoes during a routine surveillance program aimed at keeping out another species, the Asian tiger mosquito, or *Ae. albopictus*, which can transmit dengue and chikungunya as well. That mosquito

But *Ae. aegypti* was not known to be such a frequent stowaway. When Scholte’s team first caught the intruder in one of their traps, they misidentified it as a tiger mosquito, which they also found in the same area. When a genetic test unmasked it as *Ae. aegypti*, “I couldn’t believe it, a tropical mosquito flying around in Holland,” says Scholte. The team believes the most likely origin for both species is a tire shipment from Miami—where both occur—that arrived in late May.

Both last summer and this year, the team also found a third foreign species, *Ae. atropalpus*, or the American rock pool mosquito, near the tire importer. That species inhabits the northern United States and southeastern Canada and probably would have little trouble establishing itself this far north in Europe, says Scholte. But *Ae. atropalpus* is not believed to be an important disease vector.

The Dutch government—which ceased mosquito-control operations decades ago—has hired Schaffner and another

French expert to help get rid of all three species, using a two-pronged attack involving deltamethrin for adults and biological control for larvae. Schaffner believes it’s possible to nip the incursion of all three species in the bud. But countries that monitor for new invasions less rigorously may not be so lucky, says Scholte. “It’s the shape of things to come,” says Reiter. “Everything can be imported everywhere.” —MARTIN ENSERINK



**Foreign trade.** Spraying started at a Dutch tire yard on 30 July to wipe out three exotic mosquito species, including *Aedes aegypti* (inset).

has relentlessly colonized new territory over the past 2 decades, becoming a highly annoying fixture in many Mediterranean countries, from where it is now pushing northward (*Science*, 16 May 2008, p. 864). The “tiger” is known to hitch a ride in secondhand tires, shipped around the world in containers. In the Netherlands, tiger mosquitoes have also been found in greenhouses that import lucky bamboo, a popular plant from Asia.