Microbes consumed oil plume, study says

David Brown, Washington Post, 8-26-10

The Gulf of Mexico ecosystem was ready and waiting for something like the Deepwater Horizon blowout, and seems to have made the most of it, a new scientific study suggests.

Petroleum-eating bacteria - which had dined for eons on oil seeping naturally through the seafloor - proliferated in the cloud of oil that drifted underwater for months after the April 20 accident. They not only outcompeted fellow microbes, they each ramped up their own internal metabolic machinery to digest the oil as efficiently as possible.

The result was a nature-made cleanup crew capable of reducing the amount of oil in the undersea "plume" by half about every three days, according to research published online Tuesday by the journal Science.

The findings, by a team of scientists led by Terry C. Hazen of the Lawrence Berkeley National Laboratory, in California, help explain one of the biggest mysteries a mystery of the disaster: Where has all the oil gone?

"What we know about the degradation rates fits with what we are seeing in the last three weeks," Hazen said. "We've gone out to the sites, and we don't find any oil, but we do find the bacteria."

The species dominating the digestion of the oil is a newly discovered one, Hazen said.

The findings point to a different conclusion from that drawn by many readers of a study published last week, also in the journal Science. That research by scientists at Woods Hole Oceanographic Institute found no reduction in the oxygen content of the gigantic oil plume, suggesting that microbes were consuming the oil very slowly.

The Berkeley team study published Tuesday also indicates indirectly that dispersants used to break the wellhead stream of oil into a mass of sub-microscopic particles may might have speeded the cleanup. By increasing the surface area between oil and water, the dispersants seem to have provided the deep-sea microbes greater access to this unusual food source.

Alan Mearns, a senior staff scientist in the emergency response of the National Oceanic and Atmospheric Administration, called the new Berkeley team study "critical to the understanding of the fate of what remains in the Gulf. This study shows that microbes are quickly degrading some components of subsurface oil found in the deep ocean without creating hazardous dead zones."

Some of the spill's 206 million gallons of oil has come ashore, some has sunk into bottom sediments, and a little is still a floating froth. But the mile-wide, 650-foot-high oil cloud of oil that drifted for months drifted 4,000 feet underwater seems to have disappeared in the six weeks since the well was plugged.

The plume's whereabouts has been a contentious matter.

In tThe Woods Hole study published last week, scientists described finding an undersea oil cloud on June 23 to 27 similar to the one Hazen and his colleagues found between May 25 and June 2. - which was similar to one found soon after by people from the Montereyâ?? Bay Aquarium Research Institute.

But in early August, two weeks after the well was plugged July 15, federal scientists from the federal government argued that half the oil was gone from the water and the rest was disappearing. That assertion was seen as unreasonably rosy to many experts.

However, Hazen's calculation of the speed with which bacteria consumed the oil - combined with his recent findings that oil can no longer be detected in deep gulf waters - supports the credibility of all those positions.

"We were all right," he said.

In the new study, the Berkeley research team took water samples both inside and outside the oil plume. The samples were analyzed for oil, bacteria, complex compounds such as fats, building-block chemicals such as nitrogen and phosphorous, and dissolved oxygen.

Inside the plume, the researchers found there were about twice as many bacterial cells per milliliter of water as outside it. There was also twice as much "phospholipid," a type of compound in cell membranes. Both findings pointed to an oil plume teeming with life. In fact, the researchers detected 951 different subfamilies of bacteria containing in all more than 10,000 distinct species. Curiously, 16 of those 951 subfamilies were especially abundant in the plume samples. compared with samples specimens outside the plume.

They were of a type called gamma-Proteobacteria (and dominated by the order of bacteria called Oceanospirillales) known to be able to degrade oil-like substances in cold water.

The scientists then looked at the roughly 5,000 genes active in the bacteria. They found that the 1,600 genes involved in "hydrocarbon degradation" were cranked up to much higher concentrations in the plume bacteria than in the bacteria outside it.

From a purely Darwinian point of view, this was no surprise. About 500,000 barrels of oil get into into the gulf's water each years through seafloor seeps. (In comparison, the 1989 Exxon Valdez spill in Alaska in 1989 was 260,000 barrels.) Natural selection has favored microbial species able to quickly use oil as a nutrient when it' is around. It's particularly favored ones that can use it in very cold, bottom waters - conditions generally not conducive to rapid bacterial growth. Many of the species flourishing in the samples taken by the Berkeley group actually consume oil better at 40 degrees Fahrenheit than at 70 degrees.

Dispersant chemicals sprayed into the wellhead may have helped break the oil into unusually small droplets - roughly 0.002 inches in diameter - that made it more available to the bacterial.

"We don't know what some of the effects of those compounds might be," Hazen said of the dispersants, which were used in unprecedented quantities. "But from what we know right now, it looks like they were pretty effective."

His research group calculated the amount of time it takes for half of a given quantity of oil to be broken down by microbes - the "half -life." Using data from both the field and laboratory experiments, they estimated the half- life to be 1.2 to 6.1 days - probably about three days, Hazen said.

That extremely rapid disappearance is happening to oil molecules that make up the majority of the spill (specifically, molecules with 26 or fewer carbon atoms in them). The bigger, sludgier compounds are also being eaten, but more slowly.

One thing that many scientists feared - severe depletion of oxygen as microbes consumed the oil - apparently hasn't happened. The Woods Hole study published last week found no decrease in oxygen in the oil plume, and the new study found only a slight one.

"Both of our papers suggest it is unlikely that the microbes would draw down oxygen to such a degree that it would affect fisheries and create dead zones," said Richard Camilli, the Woods Hole researcher.

The research team is continuing to collect deep-water samples. It could still find an oil plume two weeks after the well was plugged. No plume could be found in the past three weeks, however. The oil that remains appears to be too diluted out to be detected.