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Genetic potential of oil-eating bacteria from the BP oil spill decoded

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Surface oil slick from the Deepwater Horizon oil spill. Research, including this latest study, has identified which bacteria were most important in breaking down the oil. Credit: Andreas Teske, University of North Carolina Chapel Hill.

Microbiologists at The University of Texas at Austin and their colleagues have cracked the genetic code of how bacteria broke down oil to help clean up the Deepwater Horizon oil spill, revealing that some bacteria have far greater potential for consuming oil than was previously known. The findings, published in the journal *Nature Microbiology*, have applications for responding to future oil spills and other ecological disasters, while shedding light on the ways in which tiny microbes played an outsized role in limiting damage from the 2010 spill caused by the explosion of a BP oil rig.

Since the spill in the Gulf of Mexico, scientists have studied how communities of bacteria that grew exponentially after the disaster helped to eat away at the vast range of chemicals there, but little was known about the genetic underpinnings of the process. Brett Baker, an assistant professor in the Department of Marine Science; Nina Dombrowski, a postdoctoral researcher in his lab at The University of Texas Marine Science Institute; and colleagues sequenced the DNA of oil-munching microbes to reveal the genetic potential in different bacterial species, including ones newly identified as important to the cleanup task.

"Oil is extremely complicated but it has two major compounds: alkanes, which are relatively easy for bacteria to break down, and aromatic hydrocarbons, which are much trickier to get rid of," Dombrowski said. "We found a number of bacteria surprisingly capable of dealing with the more dangerous compounds. This has implications for future oil spills and how we take advantage of the natural environmental response."

One bacterium known to have oil-eating abilities, Alcanivorax, was previously thought incapable of consuming the more stable hydrocarbons the spill left behind. Others, like Neptuniibacter, weren't known to be involved with degrading oil in the Gulf. Not only did the gene sequencing show several bacteria could break down aromatic hydrocarbons, it illuminated how various species worked together to maximize the genetic potential of the whole microbial community.

"We used new methods to obtain genomes of bacteria that haven't been grown in the lab to enhance our understanding of how bacteria consume oil in nature," Baker said.

The scientists catalogued the genes of numerous bacteria from the Deepwater Horizon oil spill to figure out how microbes gobble up the complex mix found in oil, which consists of as many as 1,000 types of chemical compounds. The researchers pinpointed specific pathways where members of the complex, native bacterial community work together to consume oil.

"It's equivalent to a concert," Dombrowski said. "All the musicians have to work together to make a piece of beautiful music. After the spill, all bacteria must work together to efficiently degrade oil."

The scientists even found that some bacteria might assist with "cleanup after the cleanup," meaning they also could eat what humans pour into the water to clean up the oil. These dispersants can cause environmental problems themselves. The DNA sequencing revealed evidence that some bacteria can degrade sulfur-containing compounds such as those found in dispersants used after the Deepwater Horizon spill.

Not all bacteria respond well to dispersants, however, and Dombrowski says the importance of "bacteria-friendly" dispersants that will not interfere with this microbial teamwork is clear. Understanding how bacteria are genetically programmed to eat oil provides scientists with clues for how to create better dispersants and ocean cleanup strategies.

"Bacterial communities already present at the site of an oil spill can respond in a rapid and efficient manner, becoming abundant during the spill and actively degrading oil compounds," Dombrowski said. "This illustrates the importance of maintaining a healthy and diverse bacterial community, and why we need to be careful to make sure our response to a spill doesn't interfere with this natural response."

More information: Nina Dombrowski et al, Reconstructing metabolic pathways of hydrocarbon-degrading bacteria from the Deepwater Horizon oil spill, *Nature Microbiology* (2016). DOI: 10.1038/NMICROBIOL.2016.57

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