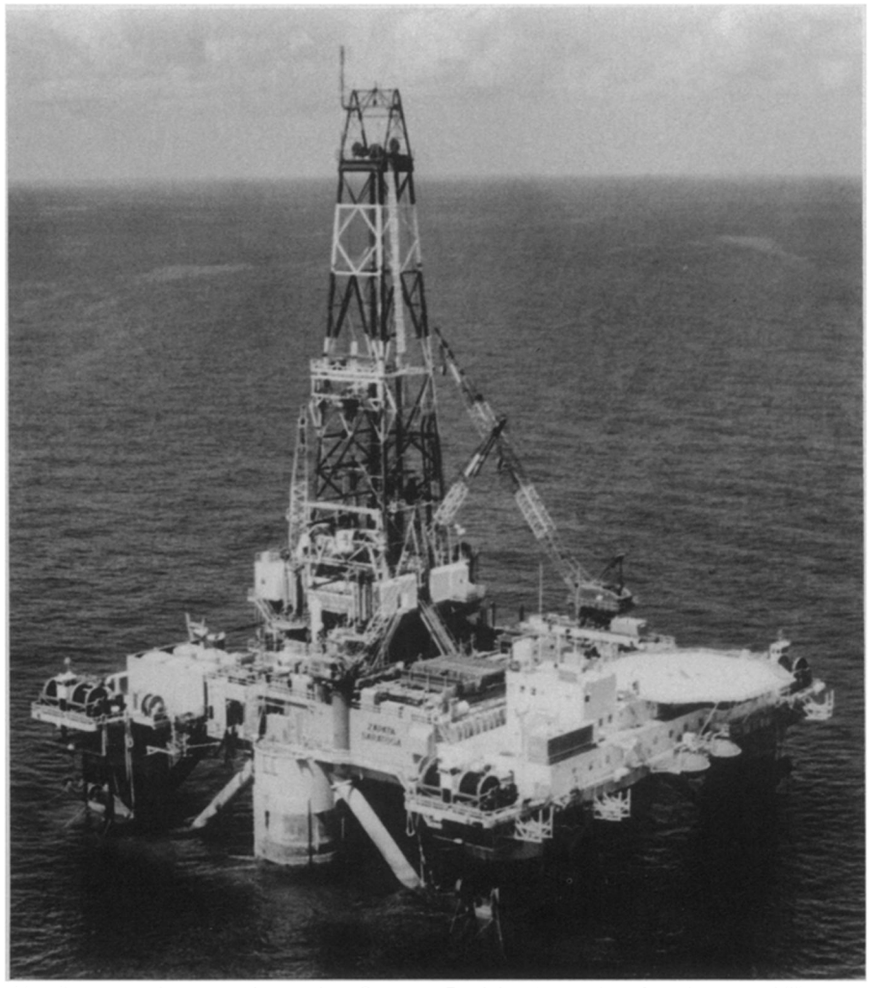
A Lobster's Look at Offshore Drilling

Effluents from drilling rigs may cause subtle changes in the behavior of ocean animals, which could reduce their ability to survive

By JULIE ANN MILLER

Immature lobsters live a free life, floating about in the ocean. But by the time they are about an inch long, they must settle down as proper bottom-dwelling creatures. To avoid becoming a miniature lobster dinner to a passing dogfish, cod or skate, the juvenile lobster burrows a home into the seafloor. During the next year of its life the young lobster spends much of its time in this self-made multi-entrance dwelling.

Burrow construction is one important aspect of lobster behavior that may be threatened by offshore drilling for oil and gas, report scientists from the Marine Biological Laboratory in Woods Hole, Mass. Up to a million gallons of drilling fluids (known as drilling mud) may be released into the ocean during drilling operations, which last 2 weeks to 6 months. These muds contain metals and organic compounds that are potentially toxic to ocean organisms. A variety of studies have examined the toxicity of drilling muds, and the results differ depending on the effluent sample and the organism observed. The studies have involved at least 35 drilling fluids and 48 species in more than 300 tests. Some scientists measure killing of organisms. Others look at growth rate or accumulation of metals. A recent review for the Environmental Protection Agency concluded that immediate toxicity of drilling muds is low, but some groups of organisms are more sensitive than others, and in general larval forms and molting animals are more sensitive than adults between molts.



Shell Oil Co.

No oil or natural gas was located on Georges Bank in 14 months of exploratory drilling.

In a new approach to the problem, Jelle Atema and colleagues at Woods Hole have looked at the physical effects of covering the laboratory equivalent of the ocean bottom with a particulate layer, such as might result from any drilling mud. They find that a layer 4 millimeters thick, and possibly even a layer as thin as 1 millimeter, causes a delay in shelter construction by juvenile lobsters. Atema, Dale F. Leavitt, Diana E. Barshaw and M. Carmela Cuomo write in the CANADIAN JOURNAL OF FISHERIES AND AQUATIC SCIENCES (Vol. 39, No. 5, 1982) that such thin coverings of drilling mud "may cause increased exposure of lobsters to predators and currents, resulting in the substrate becoming unsuitable for lobster settling and survival."

Concern for lobsters stemmed from the prospect of drilling on Georges Bank, a submerged Atlantic sandbank east of Massachusetts. Exploratory drilling began there in 1981 and came to a halt, at least temporarily, in September 1982. None of eight holes drilled by five different companies turned up any oil. (The major U.S. offshore drilling is going on in the Gulf of Mexico and off the California coast.) But findings about lobster, which are well-observed laboratory subjects, may be applicable to bottom-living creatures elswhere.

One difficulty in examining the effects of drilling muds is that there is no standard recipe. The composition varies with the site and depth of the drilling operation. Muds serve a variety of functions as they are pumped down the drill pipe, forced out the holes in the bit and made to carry cuttings back to the surface. The mud lubricates the bit, seals the wall of the drilled hole and maintains hydrostatic pressure to prevent blowouts. Hundreds of compounds are found in different drilling muds including thickening, thinning and weighting agents, detergents, bactericides, acidity control chemicals and lubricants.

After use the spent drilling muds are released from the rig into the ocean. Some are discharged continuously during the drilling operation; the rest are released periodically in bulk. Sometimes the fluids are reconstituted with additives and recirculated before being released. In the drilling operation high pressures and temperatures change the composition of the mud.

Atema and colleagues have investigated the effects of drilling muds, collected after use in drilling operations, on aspects of lobster behavior important to survival in the ocean. In Atema's laboratory, which is part of the Boston University Marine Program, scientists study lobster behavior in what they call "semi-natural" aquaria. They observe burrow digging, territory defense and even cohabitation by mating pairs. These investigators are particularly interested in the animals' sensing of chem-

ical cues with receptors on their mouth parts and legs.

Some drilling muds cause changes in the way the receptors on the lobsters' walking legs react to food odors, Charles Derby and Atema learned in earlier research. In more recent behavior studies, they find that in the presence of a drilling mud sample, many lobsters have a delayed response or no response to food. Atema speculates that such interference in an ocean population would reduce the exposed lobsters' growth and may reduce their ability to compete with other ocean animals. Exposure to drilling mud also produces delayed molting and excessive loss of limbs. "Although these lobsters with missing appendages were technically alive, they were ecologically dead, i.e. we must assume they would be easy prey in the field," the scientists conclude. These effects are due to the chemical toxicity of the drilling muds, they believe.

In contrast, physical effects of the drilling muds are caused by particles that settle on the ocean bottom. A similar effect is seen with a barite-bentonite mixture (the major solids of drilling mud) containing no metals or organic compounds. A 4-millimeter layer of this mixture or drilling mud increases the time it takes for a juvenile lobster to construct its burrow. In the experiments, without drilling mud or barite-bentonite sediment lobsters started bulldozing to dig dwellings after 38 minutes but with a 4-millimeter layer of particles lobsters did not begin bulldozing until after more than 7 hours. One-third of the lobsters did not make any burrow at all in the 4-millimeter layer, and another third made only a roofless depression. Thinner layers of drilling mud caused shorter, but still significant, delays in shelter construction.

"Some consequences at the population level may be increased exposure to pre tion, particularly by the large group of mersal [ocean-bottom] fish predators, a displacement by bottom currents," the vestigators conclude.

The implications of these results ocean dwelling creatures are controv sial. "It's lab work. It has nothing to do w what actually happens," says Norm Altstedter of Shell Oil Co.

Keith Hay of the American Petrole Institute comments, "What's import here is perspective. If you take so lobsters and put them in a confined a and subject them to drilling mud, you pect to get some reaction." He says t the normal amount of drilling mud fro rig is scattered by ocean currents, so it be detected only in a small area aro the rig. The mud is not very poisonous, even if it were to kill all lobsters withi mile of the drilling rig, there would be dent in the lobster harvest, he adds.

Jim Ray of Shell Oil Co. and chairma the American Petroleum Institute's s committee on drilling muds has more s cific objections to the study. He says t the drilling mud used in the experiments is atypical, containing more than 30 additives because the well from which it was collected was very deep and had unusual problems. In addition, Ray has questions about how the sample was taken and how it was shipped to researchers.

Preparation of the drilling mud for the experiments is also controversial. Ray says that in the ocean most of the mud released falls through the water column, so soluble components are washed off the mud and dispersed. "In the laboratory people are not going through the washing process," Ray says. "The preparation of drilling mud is not too realistic and to extrapolate from those experiments to the field is extremely difficult." Ray also doubts whether an extensive blanket of sediment would form in the ocean floor. He says that field sampling in the Gulf of Mexico shows most of the sediment is restricted to a few hundred meters from the drilling platform. "If you have a zone of 200 meters and a lobster doesn't find it suitable for burrowing, it may bounce off and find another place," he suggests.

Atema disagrees. He says, "From the few data now available, we can surmise that water column levels of 10 milligram per liter exist inside plumes as far as 1 kilometer from the source and that substrate cover of 1 millimeter can accumulate over areas of many square kilometers around the source." Due to local water movement he says that "sink" areas even far away from the source could accumulate heavy layers of discharged material. He and his colleagues conclude, "Thus, accumulation of drilling mud presents problems for benthic invertebrates, as demonstrated here for early juvenile lobsters during and after settling into a substrate."

Field tests will be needed to determine more conclusively whether the muds have detrimental effects to life on the ocean floor. However, funding by the Environmental Protection Agency for such a study of lobsters has been discontinued, Atema says.

A monitoring program surveying animal life around one drilling site in the Georges Bank area did not show any dramatic change over a year, says Judith Spiller of the University of New Hampshire, who analyzed research on drilling effluents in a report for the states of Maine, New Hampshire, Massachusetts and New Jersey. But she points out some problems with such a monitoring study. "It's a case of putting a chronic low-level pollutant into a dynamic system," Spiller says. She would not expect to see a major change around a drilling rig because storms periodically obliterate areas of Georges Bank and the animals repopulate. "These are organisms adapted to something like a drilling rig coming in," she says. She would expect any change to be more subtle and perhaps to occur at some distance from the drilling rig. The sediments may be transported to another location by ocean currents and have an effect there.

Because monitoring programs are expensive and difficult, Spiller believes that scientists need clearer ideas of just where the impact of drilling muds is likely to be and what effects can be expected. She points to the need for more work on the transport of materials by ocean currents and the importance, once again, of laboratory studies, like those of Atema, to establish what effects should be monitored in the field. □

Georges Bank is prime territory for American lobsters and other ocean animals. This lobster weighs almost 10 pounds.