Existing plans to contain and clean up any oil spill that might occur in the Arctic are woefully inadequate.

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A frozen hell

A year after the oil blowout in the Gulf of Mexico, **Jeffrey Short** and **Susan Murray** call for action to prevent an even more nightmarish scenario: a spill in the Arctic.

In a world of rising oil prices, there is pressure to drill for oil wherever it may be found — including 'frontier' areas such as the Arctic Ocean. With an estimated 80 billion barrels, or 4% of all the oil that could be recovered by conventional means, Arctic waters loom large in industry thinking. But extracting oil there comes with immense risks, thanks to the region's remoteness and harsh conditions, a dearth of experience in offshore drilling there and a rudimentary understanding of the marine ecosystem. On the anniversary of the Deepwater Horizon oil spill, itself the result of oil and gas exploration under extreme conditions, we outline the disastrous consequences of an Arctic spill, and consider how to prevent it.

Much is at stake. One area marked for development, the Chukchi Sea (see map), is among the world's most productive ocean areas. Throughout the Arctic, algae support a food web that includes clams, crabs, fish and marine mammals; millions of seabirds migrate there and indigenous communities rely on a healthy marine ecosystem for their subsistence way of life.

Warming conditions have expanded ice-free areas, enabling more fishing, shipping and oil and gas extraction. Development is most advanced in Alaska, which is thought to hold by far the largest portion of Arctic offshore oil. Onshore exploration there during the 1960s led to discovery of the 25-billion-barrel Prudhoe Bay oil field in 1968. The first production in the Beaufort Sea began from a gravel island at the Endicott field in 1987. In the US Arctic, ocean leases worth more than US$7 billion have been sold since 1980, leading to approximately 35 exploration wells, the discovery of a 206-million-barrel field (Northstar) and continued industry interest.

AT THE MERCY OF THE ELEMENTS

The Norwegian Sea's Snøhvit gas and condensate field began production in 2006, and plans are in place to develop fields off the Lofoten Islands. Exploration is also planned this year for the east and west coasts of Greenland, and the Arctic continental shelves of Russia and Canada.

Most of the Arctic offshore oil lies under less than 500 metres of water; the Deepwater Horizon rig was in 1,500 metres of water. But drilling is still hard. Along the Alaskan coast, nearly constant winds average about 20 kilometres per hour and can exceed 100 kilometres per hour, causing high seas. Frequent fogs and storms reduce visibility. Drilling rigs can be engulfed in ice floes up to a metre thick. All this, along with the distances to markets and supporting infrastructure, makes production extremely costly, requiring giant reservoirs of oil to justify initial investments. Giant reservoirs take a long time to drain, increasing the chance of a spill over a site's lifetime.

On the basis of extrapolations from more temperate climes, the US Department of the Interior puts the risk of a 5,000-barrel marine spill (one-fifth the size of the *Exxon Valdez*) at 40% for the Chukchi field over its operational life. The agency dismissed the risk of more catastrophic spills, but the Deepwater Horizon blowout has led some to re-appraise that view. Although the risks of low-probability, high-impact events are difficult to estimate, it is sobering that each major marine oil production area in the United States has seen at least one catastrophic spill: the 1969 blowout of a drilling rig off the coast of Santa Barbara, California; the 1989 *Exxon Valdez* tanker spill in Alaska; and the 2010 Deepwater Horizon blowout in the Gulf of Mexico.

Stopping, mitigating and cleaning up an Arctic spill would all be seriously impeded. In the Alaskan Arctic, the nearest US Coast Guard base is more than 1,500 kilometres away, and airstrips are small, few and scattered. Fog and snowstorms could ground workers for weeks at a time. Skimming or burning rarely removes more than a small fraction of the oil released by a major spill (8% for the 1989 *Exxon Valdez* spill; 10% for Deepwater Horizon), even when skimmers, booms and dispersants are abundant and nearby. When the Icelandic cargo ship *Godafoss* ran aground on the southern Norwegian coast in February, ice and weather prevented response teams from keeping a few hundred tonnes of heavy fuel oil from killing hundreds of birds and contaminating the shorelines of a nearby marine park. Shell has plans for "unprecedented oil spill response capabilities, including dedicated at-site vessels, a containment system and relief well rigs", according to the company. These are no doubt state-of-the-art and welcome commitments, but their effectiveness in Arctic conditions has yet to be tested. The record of oil-spill response elsewhere, under less challenging conditions, fails to inspire confidence.

BLACK DEATH

If oil does spill, a small fraction will dissolve into sea water, a larger fraction will evaporate and most will be slowly oxidized by microbes. Studies from an experimental oil spill in Baffin Island in 1981 and the 1989 *Exxon Valdez* spill show that microbial oxidation can remove much of the oil within a year. But buried masses of oil can persist for decades, sea ice can envelop oil and transport it considerable distances, and some oil might sink, contaminating seafloor communities. A blowout during autumn would spill among growing ice floes, spreading contamination further than it could be tracked and concentrating oil in the ice holes through which marine mammals breathe.

Evaluating the effects of oil discharged into these ecosystems is especially challenging because we know so little about them. In the 1970s and 80s, the Outer Continental Shelf Environmental Assessment Program provided information for the seas around southern Alaska, but less effort was devoted to the Arctic. Our knowledge of the Arctic's species is still patchy, and there is sparse monitoring for basic physical factors such as the speed and direction of winds and ocean currents.

Perhaps the greatest damage from a spill would be to the region's indigenous peoples. Fears about the safety of subsistence foods may erode hunting skills, and cause the younger generation to question the knowledge and wisdom of its elders. This happened to the Alutiiq peoples following the *Exxon Valdez* oil spill; oily clams and fish deterred many from their traditional hunting and gathering for years.

Environmental concerns have motivated conservation groups to insist on regulatory oversight, with some success. Court rulings and administrative actions have undermined leasing decisions and postponed drilling in the Chukchi and Beaufort seas. Citing the environmental and economic consequences of a spill, the Norwegian government recently decided to delay development of the Lofoten field.

SOURCES: UNEP; NEW SCIENTIST

A recent report by the US president's oil-spill commission, *Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling*, states that for activities to move forward in the Arctic there should be containment and response plans at every stage, the US Coast Guard and oil companies should be able to deal with an accident, and Congress should provide the resources to ensure that the Coast Guard has sufficient presence. Although laudable, literal adherence to these principles would halt offshore oil development immediately and indefinitely. We know that containment and response plans are woefully inadequate, and the cost of increasing the currently negligible US Coast Guard presence in the Arctic is immense and unlikely to be funded in the current budgetary climate.

PREPARING FOR THE WORST

Recognizing that the development of Arctic oil fields is likely, we recommend three guiding principles. First, greater investment in a science programme to provide an understanding of the environment in these new petroleum-producing provinces. Studies in the US Arctic have been useful, but they have been narrow and disjointed. Information gaps remain, including the locations of biologically important 'hot spots' that deserve priority protection.

Second, industry should be held to strict standards. A large spill in the Arctic could not be contained or mitigated, and we should stop pretending otherwise. Regulations and their enforcement should be strong enough to deter companies from skirting them. And oversight of industry should be shared with third-party citizen groups such as the Regional Citizen's Advisory Councils in the United States.

Finally, governments should consider how to manage exploration in ever-more challenging environments. The benefits of oil go mainly to shareholders, whereas the public bears the risks. Possible solutions include raising or removing liability limitations for spills, and requiring oil companies to issue performance bonds — advanced security deposits that cover the cost of a catastrophe.

The public is becoming increasingly aware of the need for caution in developing Arctic resources. The recently adopted US Arctic fishery management plan, for example, calls for a better understanding of the Arctic marine ecosystem before commercial fisheries are authorized. We can still minimize the impacts of oil development, but only if we avoid placing economic benefit above all else. The precedent set by the United States will strongly influence standards adopted elsewhere. ■

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