How to defend against future oil spills

Researchers and regulators need to keep up with the changing risks, and share information, says **Arne Jernelöv**, as tanker spills decline and pipeline leaks and blowouts become more of a concern.

The Deepwater Horizon oil spill has received unprecedented media attention as an ecological disaster — but worse might lie ahead. The potential for future spills is huge, particularly as nations with strong ties between their government and oil industry expand drilling activities into deeper and more difficult wells. Technologies for mitigating spills are not improving fast enough, and lessons are not being learned — information from the last major blowout in the Mexican Gulf doesn't seem to have been at the fingertips of responding bodies this time around.

Things can and must be done to limit future risk and damage. More oil profits should be diverted into research to ensure that clean-up knowledge and technologies keep pace with advances in drilling, and are targeted at potential future problems rather than those experienced today. Information about spills needs to be made more freely available and national research projects better coordinated so that each can learn from the others. And watchdogs need to work harder to ensure that good regulations are in place and upheld.

Over the past three or four decades, there has been a shift in how human-released crude oil enters the marine environment (see graphic). In the 1980s and '90s, tanker accidents such as that of the *Exxon Valdez* caught most of the publicity. But the majority of spilled oil came from operational discharges, such as when fuel-oil sludge was dumped or tanks washed out with sea water. These activities typically released just 1–10 tonnes of oil at a time, but were so regular for the tanker fleet of 6,000–7,000 ships that they made up the bulk of the 457,000 tonnes that ships released annually during these decades, according to the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP). Accidental spills of more than 7 tonnes each averaged about 115,000 tonnes a year over the same time period, according to the International Tanker Owners Pollution Federation.

Even small spills can be significant. In 1976, 5 tonnes of oil released by a tanker wash into the Baltic Sea created an inviting smooth patch of water in stormy seas that attracted and killed 60,000 of the winter population of local long-tailed duck. That was about the same number of birds as were killed by the 37,000-tonne *Exxon Valdez* spill (Deepwater Horizon, by comparison, has resulted in less than 1,200 documented bird deaths thus far). The amount of oil that seeps into the Mexican Gulf naturally over the course of a year is about 140,000 tonnes — compared to the estimated 250,00 to 400,000 tonnes so far spilled from Deepwater Horizon. Releasing the oil quickly in one spot makes a huge and obvious difference to its impact.

Today, tank washing is banned in most territorial waters. Accidental tanker spills have been reduced from an annual average of 314,000 tonnes in the 1970s to 21,000 tonnes in the 2000s, thanks to mandatory double-layer hulls, the sectioning of oil tanks and better ship traffic control. Global Positioning System navigation has also made a huge difference: even drunk or inexperienced captains now know where they are. When a Chinese ship veered out of its shipping lane and hit the Great Barrier Reef this April, it was a rare and surprising incident.

G. HERBERT/AP

Even a small spill can kill birds.

Moving target

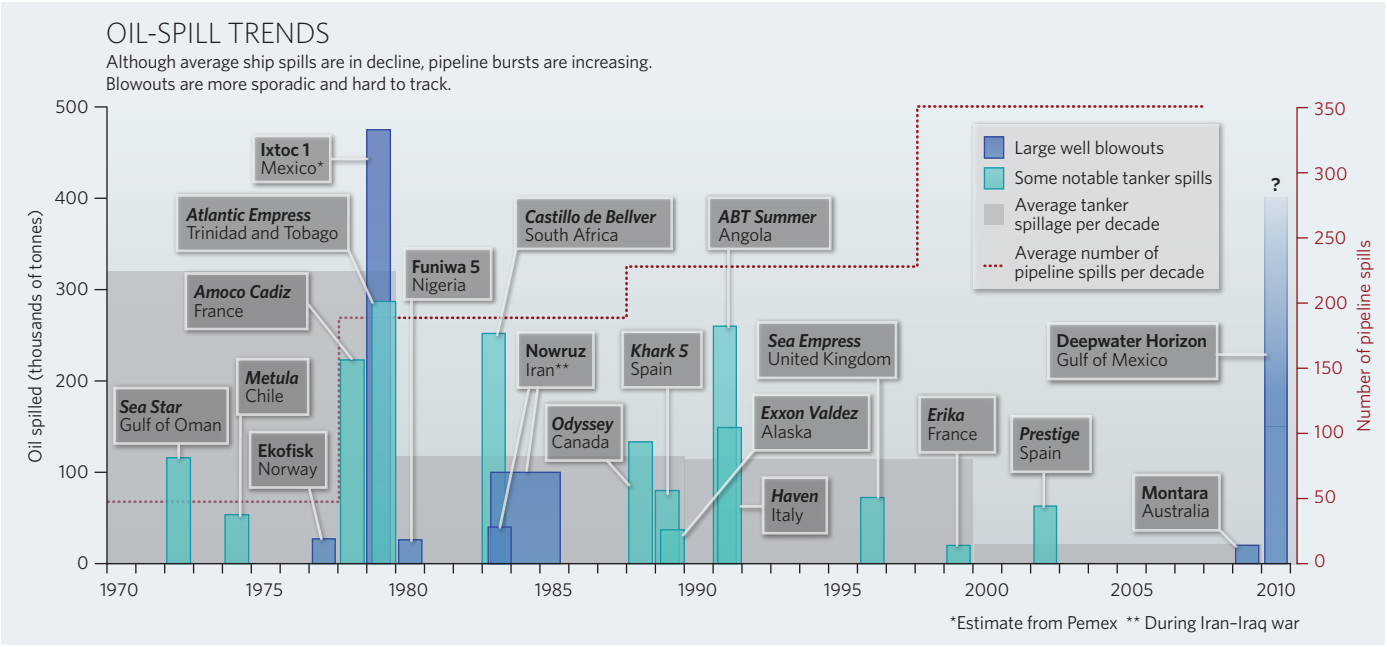
Other sources of spills have come to the fore. Many pipelines in Russia and in former Soviet states and West Africa are now old and poorly maintained, and leaks are sometimes not fixed, because this would cost more than the lost oil. In Russia, more than 100,000 tonnes of oil leaked from one pipeline near the town of Usinsk over half a year. The oil collected behind a dam that broke in 1994, releasing the oil over the tundra and into the Pechora River. In Nigeria and the Amazon, pipelines are often targets of military action. The number of spills from offshore and coastal pipelines has risen from an average of 47 per year during 1968–77, to 188, 228 and 350 in the following decades. Few are investigated or publicized; figures on the quantities spilled in this way are uncertain.

Blowouts of wells on land or in shallow water are usually dealt with quickly and don't release much oil, but deep-water blowouts are more problematic. The amount of oil released is difficult to estimate — as the Deepwater Horizon case illustrates — and most publicized estimates come from the operators themselves. GESAMP estimates that, on average, spills from exploration and production platforms released some 20,000 tonnes of oil into the ocean annually in the 1990s.

Oil companies are pushing into deeper waters, waters capped by sea ice and stormy seas, and areas where the oil lies beneath complex layers of sediment and rock. In Brazil, several mega oilfields have been discovered in recent years at sites under more than 2 kilometres of water (compared to Deepwater Horizon's 1.5-kilometre depth) and up to 5 kilometres of sediments. The Brazilian oil company Petrobras is interested in exploiting these, once technological challenges are overcome. Russian gas and oil companies, such as Gazprom and Rosneft, are starting to develop areas that are difficult to operate in, such as in the Arctic, Sakhalin in the Pacific and Shtockman in the Barents Sea. Exploration of all these fields holds both huge economic promise and large risk.

Unlike tanker or pipeline oil spills, there is a long time between serious blowouts in any one country. The localized and sporadic nature of these disasters makes it hard to share knowledge or keep research programmes active. Even the US National Oceanic and Atmospheric Administration seems to have forgotten what was learned from Ixtoc 1 — the previous largest underwater blowout, which affected an exploratory well being drilled by Mexico's government-owned oil company Pemex in 1979 (A. Jernelöv and O. Lindén *Ambio* **10**, 299–306; 1981). I led an expert group sent by the UN Environment Programme (UNEP) and the UN Food and Agriculture Organization, on the request of the Mexican government, to investigate that spill and its impacts. The incident made clear that a blowout from the ocean bottom contains a mix of oil, gas, water and sand, only some of which will reach the surface, and that the volume of oil and its progress can't be well monitored by planes or satellites. This basic information seemingly needed to be rediscovered after a generation gap.

There are other barriers to information



SOURCE: ITOPF

exchange. The best collection of blowout data is held by SINTEF, an independent research organization in Trondheim, Norway, which has catalogued 573 events since 1955. Its offshore blowout database, however, is available only to project partners. It should open access to outside researchers. UN reports must be cleared for publication by the commissioning nation; our Ixtoc report, in which we criticized Pemex, was never published in full. What is needed is a system for information exchange, and an international freedom of information act, to make oil-spill information available to all parties. UNEP could be mandated to handle this.

Although the technologies for drilling have advanced rapidly in recent decades, spill response efforts have not. People are using the same booms, dispersants and oil herders as they did for Ixtoc. The only thing that has changed is the terminology: Deepwater Horizon had a 'top hat' plug; Ixtoc had a 'sombrero'.

A long-term funding source for research on the effects of oil spills and countermeasures should be organized. In Sweden, the Coast Guard and the Petroleum Institute jointly funded a decade-long study in the 1970s at IVL, the Swedish Environmental Research Institute. This rare, early effort should serve as a model for others to follow. The US Oil Spill Liability Trust Fund, which collects fees from oil companies in case of accidents, should finance more ongoing research in the United States. Oil company BP has promised US$500 million for research on the effects of oil and dispersants in the Gulf of Mexico. This is a huge sum, but it seems destined to largely study areas that have been studied before, rather than focusing on areas of future importance, such as deeper-water blowouts, oil movement at natural seeps and the effects of such oil on coral and marine life. We should not wait for the next disaster before funding such work.

Close relationships

Oil companies, like other commercial enterprises, will occasionally take short cuts to make things cheaper, easier and quicker, particularly if they can do so with little risk of detection or reprimand. Among the countries with significant oil resources, the strongest national regulations are currently in the United States and Norway; but they are not strong enough. All deep-sea drilling projects should be required to drill a second hole that could be turned into a relief well within a few days of a blowout, for example. Supervision by regulatory bodies and strict penalties are also required.

This is often made difficult by the relationship between the oil industry and their regulators. US President Barack Obama has criticized the closeness between the Minerals Management Service — the federal agency that manages US natural-gas and oil resources — and oil companies, and called for a change in practice. Much cosier relationships exist in other nations, where oil companies are major sources of government revenue and sometimes more powerful than ministries. The Mexican company Pemex, for example, limited its liability in the Ixtoc case by claiming sovereign immunity against US lawsuits. Russian gas and oil and gas companies such as Gazprom act both internally and internationally as arms of government. In Brazil, Petrobras was until about a decade ago a legal monopolist in the oil business and still receives special exploitation rights. Such power makes it important that independent watchdogs such as environmental non-governmental organizations keep a close eye on activities. National governmental watchdogs with teeth are badly needed, along with an internationally agreed code of conduct for oil companies.

The long-term effects of the Deepwater Horizon spill remain unknown. Shrimp, squid and some fish populations were severely hit by the Ixtoc oil, but they recovered quickly partly thanks to the much-reduced fishing pressure in the following few years. That may well happen again. But it is worth noting that the Mexican coastline has only narrow inlets into the lagoons lying behind its sand beaches, which helped to protect some of its ecosystem. The Louisiana wetlands are more exposed. Dispersants were not used underwater in the Ixtoc case, and the effects of oil and dispersants on deep-water corals and reef species remain uncertain.

The most rational way to minimize damage is to ensure that such blowouts do not happen. The only positive outcome of dramatic spills is that they focus public and political attention. A tightening of deep-water drilling rules and oversight is likely to happen in the United States, Canada and Europe, followed by Australia, which had its own blowout disaster in 2009, and New Zealand. Action is needed to ensure that the rest of the world follows. ■

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