

READING PASSAGE 3

You should spend about 20 minutes on **Questions 27-40**, which are based on Reading Passage 3 below.

How to clean a beach

As oil-spill specialists continue to tackle the Prestige slick, they are drawing on knowledge from decades of clean-up operations. John Whitfield reports from Spain's Galician coast.

From the coast road, the beaches of Lira seem as they should be: yellow sand and blue sea. But walk down to the tide's edge and things change. A whiff of petrol taints the sea spray. Water in rock pools has an oily sheen and boulders that should be wet and slippery have a tacky, tarry coating. After the oil-tanker Prestige spilt her cargo last November, these coves in Galicia, in northwest Spain, were a metre deep in a mixture of oil and sea water known to pollution specialists as 'chocolate mousse'. "There was no ocean, only oil," says Pablo Garcia, manager of the Stolt Sea Farm, an aquaculture company in Lira, the area that became known as Ground Zero of the spill.



The Prestige is the latest exhibit in the tanker hall of infamy. But while each new incident brings environmental destruction and financial loss, it also improves our understanding of how to deal with oil spills. This knowledge is hard-won — aggressive clean-ups have sometimes caused more damage than the oil. Government priorities can also clash with those of scientists. But such difficulties apart, a rough consensus on how to juggle the political, economic and ecological issues involved in clearing up oil spills has begun to emerge.

Oil is much less damaging at sea than on shore, so the best option is to suck and skim a slick off the water using specially equipped ships, or break it up with chemical dispersants. Booms can also be used to protect the coastline. But the sea around the Prestige was too rough and much of the coast too exposed for booms to work, so there was little that could be done except watch the oil wash up.

The human touch

When oil arrives onshore, the question becomes how best to save affected plants and animals while minimizing damage to the surrounding ecosystem, and without running up a huge bill. In large spills, leaving nature to do the job is a bad idea. Even the oiliest shore will return to normal, but without human intervention this can take a long time. In 1974, the *Metula* spilled 50,000 tonnes of oil into the Strait of Magellan at the southern tip of South America. Because of the remoteness of the region and the rough seas, no clean-up was mounted, and patches of asphalt-like residue stain the rocks to this day. "It looks like a cheap driveway," says David Page, a chemist at Bowdoin College in Brunswick, Maine.

In the case of the *Prestige*, the volume of oil spilt and the wildlife, fishing and tourist value of the Galician coast demanded action. The first priority in a clean-up is to remove oil from the beaches as quickly as possible. If washed back out to sea, or buried in the beach, oil can do more damage some other time or place.

Cleaning beaches is ideally done manually. People with shovels are the only tools sensitive enough to remove the oil while protecting the ground beneath. Only the human eye can distinguish patches of oil from the clean areas in between: on some of the Galician beaches, oil-coated rocks and apparently unaffected rocks sit side by side. And people can work on isolated rocky shores where heavy machinery cannot go.

But at Lira in early December, manual labour was having no effect. "We got the full load of a couple of tanks of the *Prestige* — 15,000 tonnes on two kilometres of coast," says Garcia. "You'd see guys working manually, and at the end of the day, the area occupied by the slick was the same."

To decide what to do next, specialists combined their experience with local knowledge in an assessment process known as net environmental benefit analysis. Factors taken into account include environmental considerations, such as whether an oiled beach is home to a breeding colony of seals or seabirds. Socioeconomic considerations also come into play: local people may rely on nearby shellfish beds, for example, or an affected beach could be a tourist destination. And practical realities, such as how much a particular clean-up option will cost, and how easy it will be to implement, are also assessed.

Every intensive clean-up option has its drawbacks. When high-pressure hot water was used to scrub the Alaskan shoreline oiled by the Exxon Valdez spill in 1989, beaches that got this treatment recovered more slowly than those that did not, although conditions seemed about equal after three years. This technique is now used less often, says Alan Mearns, a marine ecologist with the Hazardous Materials Response Division of the US National Oceanic and Atmospheric Administration (NOAA) in Seattle, Washington. "We have a go-easy policy on using rigorous methods," he says. "The coastguard understands that you don't have to go in with all guns blazing." In Spain, high-pressure water has so far been used only on man-made structures such as jetties and harbour walls.

Chemical cleaners also do damage. When the Torrey Canyon ran aground off the south coast of Cornwall, UK, in March 1967, oiled beaches were sprayed with 10,000 tonnes of powerful solvents and detergents, including industrial degreasers. The chemicals were more toxic than the oil: many seashore invertebrates died, and the nutrients in the dispersants caused an explosion of seaweed growth.

Dispersants are much milder now, but they can still be used inappropriately. Peter Dyrinda, a marine biologist at the University of Wales Swansea, UK, says that after the Sea Empress ran aground off the southwest coast of Wales in 1996, dispersants were used on some patches of oil but were not washed off. The resulting mix was more toxic than either oil or dispersant alone, and killed animals that had survived until then. Such problems, as well as the fact that dispersants are ineffective against thick oil, have prevented their use in Galicia.

Softly, softly

A gentler option is bioremediation, which involves using fertilizer to speed the growth of naturally occurring oil-digesting bacteria. But this won't work on every spill, says Richard Swannell, a bioremediation specialist with Momena, a consultancy company near Oxford, UK, that works with the British government. The oily shore must be sheltered, otherwise the sea will wash the oil and bacteria away. Oil buried in sediments can't be digested. And if the natural bacterial growth is limited by temperature rather than by nutrients, the treatment will have no effect.

The oil must also be biodegradable: light crude oils of the type spilt by the Exxon Valdez are broken down easily, but heavier types contain compounds that microbes find indigestible. Finally, sites must be secluded, so that they do not offend the senses of local people and tourists during the several months the bacteria need to work. The remote Alaskan shores polluted by the Exxon Valdez fitted the bill, but many others do not. "For marine spills, bioremediation is a niche market," Swannell concludes. Spanish researchers began bioremediation experiments on oiled beaches late last month, although the Prestige's thick, poorly biodegradable oil might not respond well to the treatment.

In Galicia, local people wanted heavy machinery to come in and remove large quantities of oil quickly. But this has its own environmental costs. There were no tracks to the worst-affected beaches and building them would have harmed the surrounding landscape. "If you've got a site that no one visits, then it's ideal to leave for natural clean-up. If it's an area that people go to all the time you can't do that, because people will be getting oil on them," says Rob Self of Oil Spill Response, a company in Southampton that worked out of the command centre in La Coruña to advise the Spanish authorities on the clean-up operation. But at Lira, oil on the surface of the beaches was likely to be washed into the pipe that supplied water to Garcia's fish farm. In the end, the desire to protect the farm tipped the balance in favour of building tracks for bulldozers and earthmovers, which scooped up the chocolate mousse from the beach.

Heavy machinery has not been used in all areas affected by the Prestige spill. Saltmarshes and estuaries are such delicate terrain that almost any activity does more damage than the oil. After the Amoco Cadiz disaster in 1978, when nearly a quarter of a million tonnes of oil were spilt off the coast of Brittany, in northwest France, heavy equipment was sent into some polluted salt-marshes, where it scraped up the top half-metre of sediment. Twelve years later, these areas had still not recovered, whereas the oiled marshes that went uncanceled seemed in good shape.

In Galicia, some marshy areas were placed completely off-limits, even to people, when it became clear that volunteers were cleaning with excessive gusto. "People were pushing the oil into the substrate, and that has more of an effect than if you just left it," says Self. "In the end we had to close the site."

Using a combination of manual labour and heavy machinery, the Prestige spill has now moved from what Self calls the emergency phase — high-profile, high-pressure — to a long-term, painstaking project. Cleaning beaches, for example, is a Sisyphean task. At Carnota, one of the most heavily affected areas of Galicia, the high-water mark on the beach in February continues to be marked by a chain of thumbnail-sized oily gobbets. Dozens of volunteers and soldiers work their way along six kilometres of sand on hands and knees, picking up the small lumps with what look like wallpaper scrapers. At other beaches nearby, people sift the sand and comb seaside plants by hand to remove the oil and stop it becoming buried.

Perhaps the most difficult decision, and one usually taken by local politicians, is when to stop. As the coastline becomes cleaner, the clean-up starts to cost more for progressively less reward and more environmental damage. On rocky shores, once the bulk of the oil is recovered, the decision often comes down to whether the beach is an eyesore. Once workers have done all they can with shovels and pompoms — balls of plastic strips that soak up oil — stubborn patches still remain under rocks and in crevices. Moving oily boulders down the beach into the surf can accelerate the natural cleaning process, as can flushing — pumping sea water over the shore and sifting the oil out of the run-off.

As the Prestige clean-up continues into spring and summer, researchers are starting to try to assess the spill's effects. Marine toxicologist Ricardo Beiras of the University of Vigo in Galicia hopes to produce data on damage to local fisheries on which compensation claims can be based. Researchers will also be called on to pronounce when the coast has recovered. This doesn't necessarily mean that no trace of oil remains — old, weathered oil is not very toxic, and oil locked in sediments may not harm organisms.

But the definition of recovery is disputed. The owners of the Exxon Valdez are still fighting with Alaskans over whether the area hit by the spill is still suffering. Page, whose funding comes partly from Exxon, thinks it isn't. "With all spills there are places you can go back to and dig and find a deposit," he says. "The question is whether those isolated remnants are biologically relevant. And the answer is no, they're not."

Others disagree. Stanley Rice of NOAA's Alaska Fisheries Science Center in Auke Bay says the oil is still damaging animals that live and feed on the seashore, such as otters and salmon. "These damages are new and continuing from the remaining oil, and not just a slow recovery from the original hit," says Rice. To try to minimize such chronic effects, he advocates a swing towards more intensive cleaning. "I would push for a more aggressive clean-up, realizing that for the short term you are going to suffer more damage."

Political science

Resolving issues such as these will require more research, but studies of spills are often only carried out in the fraught atmosphere after a disaster. As a result, clean-up efforts are not as well informed or coordinated as they could be. "We don't clean up spills as well as we should be able to," says Ian White, managing director of the London-based International Tanker Owners Pollution Federation, which responds to spills around the world. "Spills take on a political significance that's hard to control."

Research tends to be improvised and opportunist, as local scientists drop what they were doing and start studying the pollution. "In the early days of a major spill, things are terribly chaotic," says Dyrinda. "Scientific study is not a top priority." Like many others, Dyrinda had oil-pollution research thrust upon him when the Sea Empress ran aground close to where he works. Scientists in northwest Spain are having the same experience, and once again the research is not running smoothly. "There are different individual studies, but they're not coordinated. People are diverting resources from other projects," says Beiras.

But despite the gaps in our knowledge, scientists say that the major threat to the coast, should another spill occur, is not lack of research but of government preparedness. There have been six major oil spills in Galicia. The region is also a hotbed of marine science, with four institutes in Vigo alone. But such experience doesn't guarantee that government officials will talk to local experts. "There's not a lack of knowledge, there's a lack of communication," says plankton ecologist Pablo Serret, of the University of Vigo.

Many Spanish researchers accuse their government of ignoring scientific advice in their handling of the spill — particularly in its decision to tow the Prestige out to sea rather than into port — and of seeking to play down the incident's severity. At the end of January, the scientific community rejected the original plan for studying the clean-up and recovery, put together behind closed doors by the government's National Research Council; the replacement was published only last week, four months after the spill. Just before Christmas, Galician researchers, worried that the government was giving Spanish researchers a bad name, put together a letter of protest. They circulated it around the research community, and got 385 signatures in 24 hours.

Research into clean-up methods may be coming together. But as the strength of feeling among Spanish researchers attests, good science is of limited use unless scientists have the backing of politicians. Without that, the damage from oil spills risks going unchecked. "We haven't learnt from the past," says Beiras.

References

Whitfield, J. How to clean a beach. *Nature* 422, 464–466 (2003).

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