



THE ENVIRONMENTAL IMPACT OF THE HEBEI SPIRIT OIL SPILL, TAEAN, SOUTH KOREA (7TH DECEMBER 2007).

Introduction

When the fully laden VLCC HEBEI SPIRIT was struck on her port side by a crane barge in poor weather conditions on 7th December off the coast of the Republic of Korea, it quickly became apparent that the incident would be serious. Indeed, together with the SOLAR 1 in the Philippines in 2006, the TASMAN SPIRIT in Pakistan in 2003 and the PRESTIGE off Galicia in 2002, the HEBEI SPIRIT ranks as one of the largest tanker spills of recent years. Despite the best efforts of the crew to minimise the loss, approximately 10,500 tonnes of a mix of Iranian Heavy, Upper Zakum and Kuwait Export crude oils were spilled and resulted in large scale impacts to coastal resources and clean-up operations extending over several months.

In the immediate aftermath of a large tanker spill such as this, the thoughts of most people turn to historical images of heavily polluted shorelines and wildlife suffering whilst smothered with oil. Often the perception is that widespread and permanent environmental damage is inevitable and that there will be a loss of marine resources for years to come. For many it is difficult to imagine how the impacted coastline and its ecology can possibly recover after a spill of this magnitude. Fortunately though, the experiences of previous large spills such as AMOCO CADIZ, EXXON VALDEZ, NAKHODKA, SEA EMPRESS, ERIKA and PRESTIGE, have demonstrated that whilst the acute damage may be severe, the affected environments and associated marine life recover remarkably quickly.

The nature and duration of the impact of an oil spill depend on a number of factors. These include the type and amount of oil and its behaviour once spilled; the physical characteristics of the affected area; weather conditions and season; the type and effectiveness of the clean-up response; the biological and economic characteristics of the area and their sensitivity to oil pollution. By taking all of these elements into account and drawing on the experience of previous incidents, it is possible to make a generalised assessment of the likely environmental impact of the HEBEI SPIRIT incident.

However, an evaluation such as this cannot replace a rigorous scientific investigation. In order to better understand the likely extent and severity of the environmental damage resulting from the HEBEI SPIRIT oil spill and to estimate the rate of recovery for various sites, MOMAF, the Korean Ministry of Marine Affairs and Fisheries, have instructed Korea Ocean Research & Development Institute (KORDI) and Chungnam National University to carry out a thorough impact assessment. Researchers are collecting numerous samples of seawater, ocean sediment and marine organisms from sites throughout the affected area for analysis.

Pelagic Impacts

After an oil spill at sea, concerns are often expressed over the consequent risk to pelagic marine life such as plankton and fish, particularly the commercially important species. Yet impacts on pelagic ecosystems after even the largest oil spills have been patchy and transient with no detectable losses in productivity or diversity over time. Consequently, whilst localised mortality of planktonic organisms, including eggs and larval stages of fish, could certainly have been expected whilst the oil from HEBEI SPIRIT was on the sea surface, on the evidence of past spills there is no indication that there would be a significant decline in adult populations as a result.



The fishing industry is central to the economy of the Republic of Korea and is a focal part of the culture, and so it is hardly surprising that there are widespread fears of serious and long-term damage to wild fish stocks. Fortunately though, detectable impacts on populations of adult fish are also exceptionally rare after oil spills. Significant mortalities and sub-lethal effects such as tainting tend to be restricted to incidents involving substantial quantities of lighter oils being dispersed in shallow water very close to shore. An extreme example of such a case was the BRAER oil spill in Shetland, UK, in 1993 where the entire 84,700 tonne cargo of Gulfaks crude oil was released and the majority of it dispersed naturally by heavy wave action into shallow waters resulting in the tainting of some commercially important species.

While chemical dispersants were used in the initial stages of the response to the HEBEI SPIRIT spill, they were only ever applied far offshore where there was sufficient potential for dilution of the dispersed oil droplets. In addition, dispersed oil rarely results in elevated concentrations below a few metres and adult fish have demonstrated avoidance behaviour in laboratory tests when they detect elevated levels of oil in the surrounding water.

Thus, despite the quantity of oil that was released from the HEBEI SPIRIT and the considerable area of the sea surface that was temporarily covered with slicks of oil, lasting impacts to the pelagic ecosystem are unlikely.

Benthic Impacts

Concerns about the environmental impact of oil spills are rarely confined to the surface waters however. Typically there are also fears regarding marine life on the seabed. In most cases these fears are unfounded except occasionally, for instance, when slicks of higher density fuel oil mix with sediment particles in highly turbid nearshore waters and significant quantities of oil sink to the seabed. However, since the majority of oils float on seawater, and dispersed oil does not usually increase hydrocarbon concentrations below a few metres depth, for most spills the environmental impact is largely confined to the intertidal and shallow sub-tidal zones.

Seabird Impacts

The presence of oil at sea tends to raise concerns about seabirds, particularly given their high vulnerability to oil contamination. However, although observations of oiled seabirds were made while the HEBEI SPIRIT oil was still at sea, fortunately they were on a relatively small scale and the impacts to bird populations of the spill are believed to be minor. This is explained by the fact that the spill was initially concentrated on an area of coastline which is of relatively low importance to bird populations with no species of special conservation concern and none that are found in internationally important concentrations as reported by the conservation organisation 'Birds Korea'. During surveys carried out by Birds Korea around 330 oiled seabirds were recorded, mostly Black-tailed Gulls (*Larus crassirostris*).

Shoreline Impacts

The trajectory of floating oil slicks will, to some degree, define the eventual extent and severity of impact on coastal resources. In the case of the HEBEI SPIRIT the oil was carried towards the south east with prevailing westerly winds and coastal currents. Over a period of a few weeks, oil came ashore on sandy beaches, rocky shores, man-made structures and on many of the islands off the west coast of Korea and by early January, some of the oil had

travelled as far as 375 km south of the spill site (See Figure 1 for map of shoreline contamination).

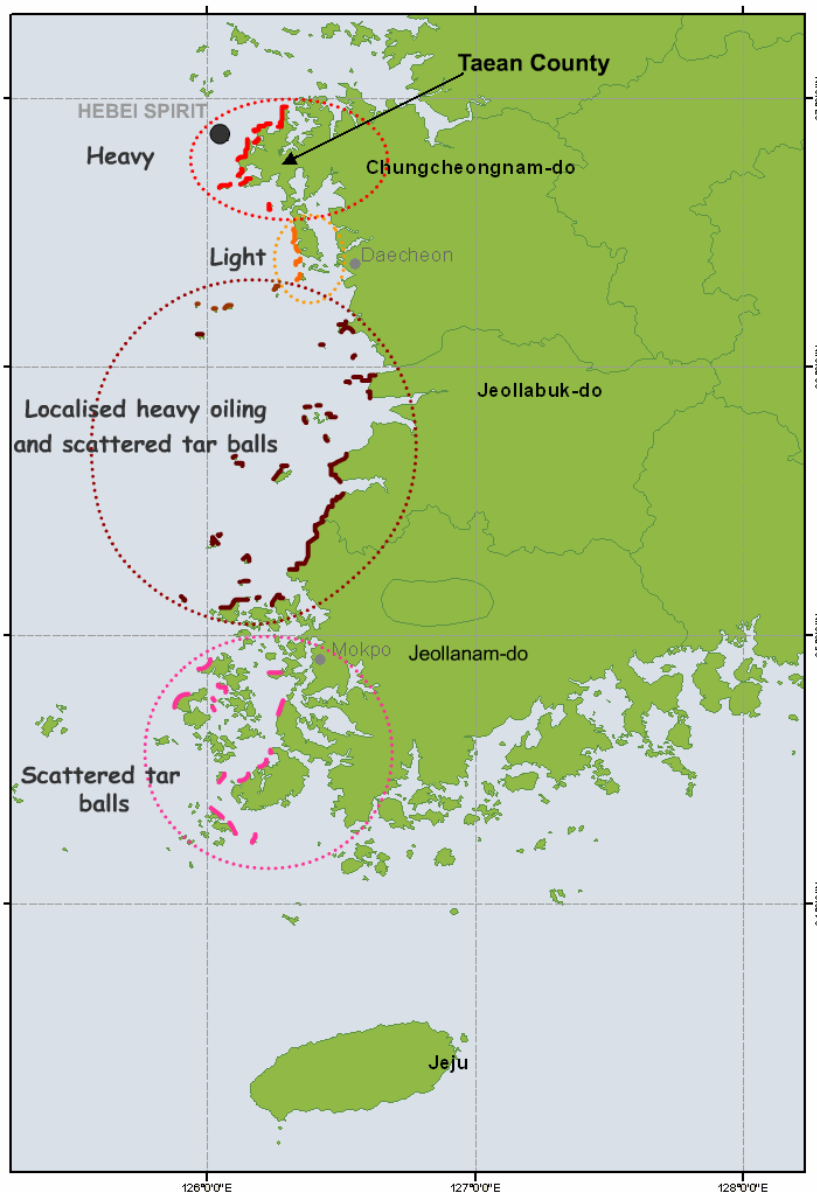


Figure 1: Map of shoreline contamination resulting from the HEBEI SPIRIT oil spill.

The impact of stranded oil on shoreline organisms depends on its state at the time it came ashore. Relatively fresh oil would be less viscous, allowing it to penetrate into sand and between pebbles and cobbles as has occurred around the coast of Taean County. It would also have a higher likelihood of causing toxic effects, and there were reports of mortalities of Japanese mud shrimps (*Upogebia major*), a burrowing crustacean that is not of commercial significance. The mortalities were found to be localised and ITOPF are not aware of any other observations of widespread losses of other shoreline organisms since the spill.

Weathered oil that has been at sea for several days or weeks is likely to be in the form of patches of oil emulsified with water or distinct tarballs which will have lost much of the toxic



components of the oil but can have a smothering effect. Such contamination tends to be more sporadic as has been observed at the southern extent of the affected coast of Korea. These locations would be expected to recover more rapidly as a result of the patchy nature of the contamination.

Fortunately, intertidal marine species are inherently tough since they must be able to tolerate periodic exposure to pounding waves, drying winds, high temperatures, rapid changes in salinity due to rainfall and other extreme stresses. This increased tolerance also gives many shoreline organisms the ability to withstand and recover quickly from oil spill effects. This is particularly true for rocky and sandy shores that are exposed to wave action and the scouring effects of tidal currents as is the case for the majority of the Taean County coastline. Such sites tend to be resilient to the effects of a spill as they usually self-clean quite rapidly, particularly rocky shores.

Despite the resilience of intertidal species to oil pollution, commercially important species such as oysters, short-neck clams and cockles are still susceptible to tainting, whereby the soft tissues take on an oily smell and/or unpleasant taste rendering them unfit for human consumption. In the case of the HEBEI SPIRIT spill, where there is a high concentration of mariculture facilities along the affected stretch of coastline, the direct contamination and tainting of both wild and cultured intertidal and shallow subtidal species of commercial importance is of the utmost concern. Given time, tainted marine organisms do eventually deplete (i.e. metabolise and excrete) the oil from their tissues and so lose their taint.

Recovery

The first step on the road to environmental recovery is a well conducted clean up operation beginning with the removal of bulk oil. This stage has been completed at most sites and contractors are currently removing residual oil from many locations under the supervision of the Korea Coast Guard and with the advice of ITOPF. However, it is important to note that aggressive clean-up methods can cause more harm than good and it is often better to let natural cleaning processes take their course, particularly in locations that are fully exposed to wave action.

As oil concentrations return to background levels through natural processes of removal such as biodegradation and photo-oxidation, biological communities should revert to normal levels of biodiversity and productivity, widely regarded as the most realistic measure of environmental recovery. The rate at which this recovery occurs will vary from site to site depending on the type of habitat, the degree of initial oil contamination and the type of clean-up activity carried out. However, the majority of the impacted sites are sandy beaches and rocky shores, many of which are fully exposed to the wave action. Such sites have a fairly low sensitivity to oil pollution and relatively rapid recovery times, and whilst it can take up to two or three years for the animal and plant communities to recover fully, broadly speaking one can expect a significant improvement after just one season based on evidence from past spills.