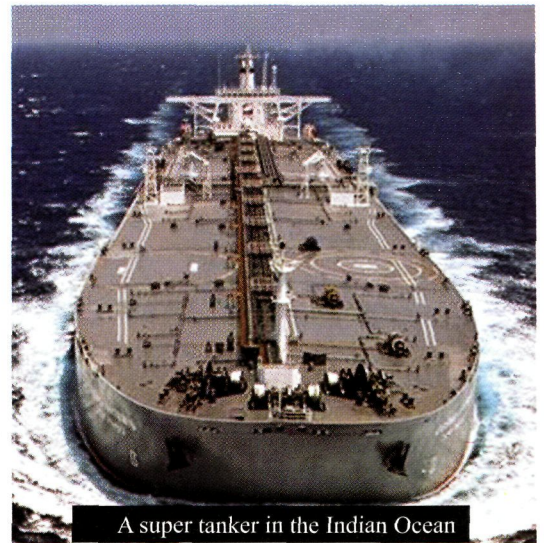


# THE SLIPPERY COASTLINE

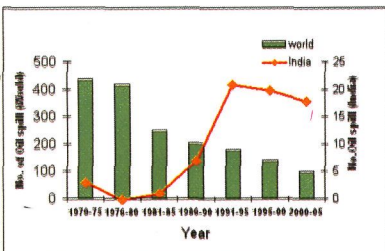
Since the sea lanes of the Indian Ocean, provide passage to nearly 70 per cent of world oil trade, the Indian coastline is highly vulnerable to serious ecological disaster from oil pollution, points out **B. S. INGOLE** and **S. SIVADAS**



**O**n an average, 40 super tankers pass through the Indian waters daily. In addition,

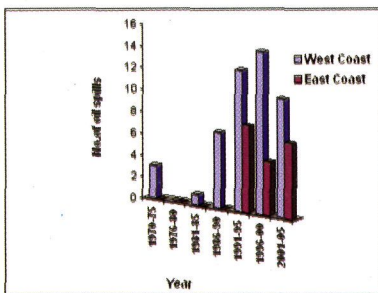
and Strait of Malacca on the east coast. Due to the narrowness of these lanes, the routes are accident-prone.

increased with nearly 71 per cent of the incidents occurring along the west coast. The west coast is more prone to oil pollution due to the heavy vessel traffic in the Arabian Sea. Monitoring of oil pollution in the Arabian Sea has been in progress since 1978 and a good database has been built up by National Institute of Oceanography, Goa. Further, the oil spill incidence data reveals that the majority of the oil spills occurred during the SW Monsoon. Model studies, based on historical data of winds and surface currents indicate that the Indian west coast is vulnerably exposed to any spills in the Arabian Sea, mostly during the SW Monsoon months (May-September). It is undoubtedly clear that the Indian coast, particularly the west coast, is located at a vulnerable position to oil pollution.



Comparison of oil spills (World & India)  
(Source: ITOFP and Indian coast guard,

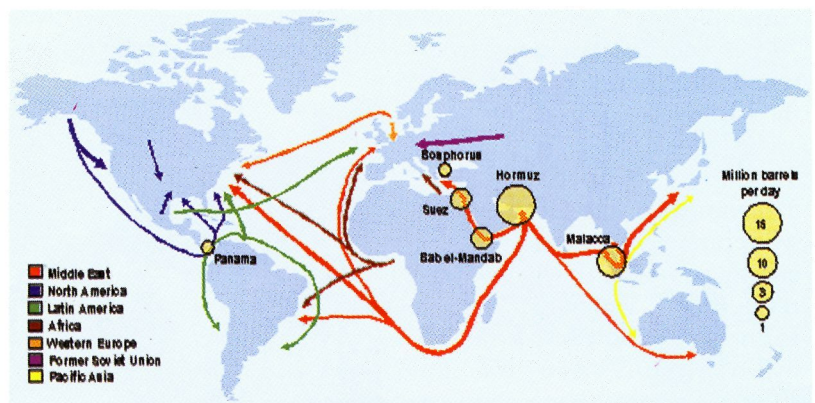
Currently, India has only 0.4 per cent of the world's proven hydrocarbon reserves. However, there are indications of larger deposits in the deeper continental margin. The offshore Mumbai High field is the largest oil producing field of the country. The demand for oil is increasing and the import of crude oil has taken quantum leaps as a result the country imports 70 per cent of the oil to meet the growing demand.



Incidence of oil spills along the East and West Coast of India

Even though there has been an increase in volume of oil movement, the number and volume of tanker spills have substantially decreased since the 1970s globally. Contrary to the global scenario, incidents of oil spills along the Indian coast have

Indian ports and harbours handle about 3810 tankers carrying about 84 million tones of petroleum, oil, lubricants every year. Further, the Indian peninsula lie between two major choke points of the world, the Strait of Hormuz on the west



Major oil routes and oil choke points of the world

The Indian Ocean, representing nearly 20 per cent of the total water area of the world, has been and remains the frontier of intercontinental trade. Petroleum is the most significant mineral in the Indian Ocean, which accounts for 28.5 per cent of the total world oil production. Studies suggest that about 70 per cent of the total sea transport is ferried through the Indian Ocean waters. Moreover Asia's largest ship breaking yard Alang is also located along the Gujarat coast.

## Impact of Accidental Oil Spill on Marine Organism

Oil when enters the sea is modified physically and chemically, a process called weathering. The prevailing hydrodynamic conditions

contrary to the global decrease in the incidents of oil spills, spills along the Indian coast have increased with nearly 71 per cent of the incidents occurring along the west coast

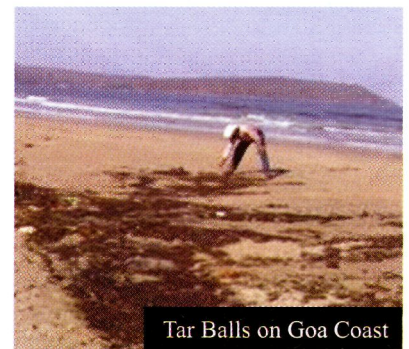
make the floating oil to spread to a wider spectrum of area from the point of release. If wave action is sufficiently intense, the oil may also be mixed to some depth in the water column, where sensitive organisms are exposed and injured.

It was during this first phase of the 'Exxon Valdez' oil spill that most of the recorded mortality of seabirds and marine mammals occurred. The oil forms sticky layers on the surface, preventing free diffusion of gasses, clogs adult organisms feeding structures and decreases the sunlight available for photosynthesis. As a result of the blocking of the air-sea exchange, the phytoplankton population gets severely depleted and production of zooplankton is retarded.

After the volatile components of oil are evaporated, the heavier tars left behind forms tar balls. This tar balls finally ends up in the sea bed and may be assimilated by bottom organisms or incorporated into sediments. Experimental evidence shows that 56 per cent of spilled oil becomes adsorbed onto bottom sediment and oxidation takes several years. Thus, the degree of oil pollution in the marine environment may be more accurately assessed by measuring oil in the sediments. Moreover, the oils in the seabed are re-released in potentially toxic concentrations after several years.

Tar balls and oil slicks deposited in the sea bed are stirred up by the wave action particularly during the

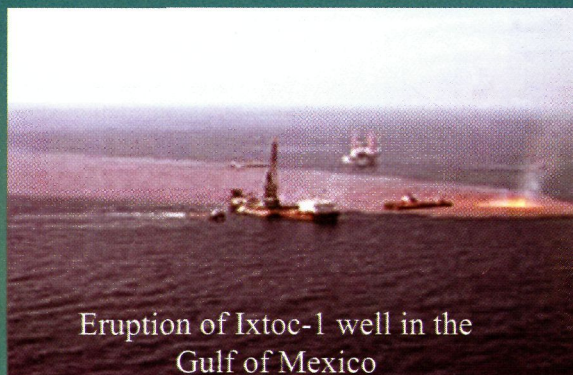
Monsoon and are washed ashore frequently. This phenomenon is observed on all the major beaches, around the onset of Monsoon and sometimes throughout the year. A two-year study, gave a figure of 40 tones of yearly deposit of tar balls along the beaches of Goa. In



Tar Balls on Goa Coast

August 2005, heavy deposition of tar ball was noticed along the major tourist beaches of Goa and heavy mortality of beach communities. The incidents of tar balls have become a frequent occurrence along the beaches of Goa. In the last two decades, the state has experienced four incidences of tanker spills. Recently, in May 2006 a bulk carrier, MV Ocean Seraya was grounded in the oyster rock, Karwar due to the rough weathers. The ship spilt and

Accidental oil accounts to 12 per cent of the total oil entering the sea. Historically, the blow-out at Ixtoc-1 well, Gulf of Mexico is the largest accidental oil spill reported. Among the accidental tanker spills, 34.4 per cent spills occurred due to



Eruption of Ixtoc-1 well in the Gulf of Mexico

groundings of vessel and 28.3 per cent due to collisions. Oil pollution is important, in particular to the Indian coast as 70 per cent of the oil is transported through the Indian Ocean.

the spilled oil was reported up to Benaulim, a famous tourist beach in south Goa. Although the spill was of small volume, however, frequent occurrence and, in particular, during the crucial period of the life cycle of marine organism can have a disastrous effect in the long run.

Benthic communities are organisms associated with the sediment. Majority of them are sessile and therefore cannot avoid any environmental perturbation. Hence, benthos is widely used as environmental indicators worldwide. Further, they also play an important role in the marine food web, especially the demersal fish. Benthic communities are generally sensitive to oil spills, but the effects of oil pollution strongly depend on the proportion of hydrocarbon-sensitive species.

The vulnerability of organisms to oil is related to seasonal changes in their distribution and abundance. Monsoon is the recruitment period of most tropical benthic organisms and commercial fish. More than 90 per cent of the benthic organisms have a planktonic larval stage. The environmental condition during

in August 2005, heavy deposition of tar balls was noticed along the major tourist beaches of Goa and heavy mortality of beach communities. Also, the last two decades, Goa has experienced four incidences of tanker spills

SW Monsoon period along the west coast is optimum with plenty of plankton food resulting from the seasonal upwelling. Spawning periodicity of majority of fishes coincide with Monsoon, so that the larvae could utilize the abundance phyto- and zooplankton population for survival. Effect of oil is first observed in water which spreads

over larger surface area under the influence of winds affecting the pelagic organisms. Data exist on the susceptibility of early developmental stages to oil, especially at the cellular and sub-cellular level, sometimes at substantially low concentrations. Many commercial fishes exploit the estuarine and nearshore areas for spawning and development of early sensitive stages. This could work against them when the near shore areas become contaminated with toxic material such as oil. Survival through planktonic development stages is believed to be the most important event controlling abundances of marine organism. The early stages of an organism are vulnerable to significant losses due to natural events and further affected by anthropogenic disturbances like oil spills.

Significant changes in commercial stocks of fish do take place in inshore areas, although attempts are not usually made to link them with any single pollutant however, according to the general understanding, oil spills could be one of the major reasons for fluctuation in total fish catch. McIntyre (1982) comments

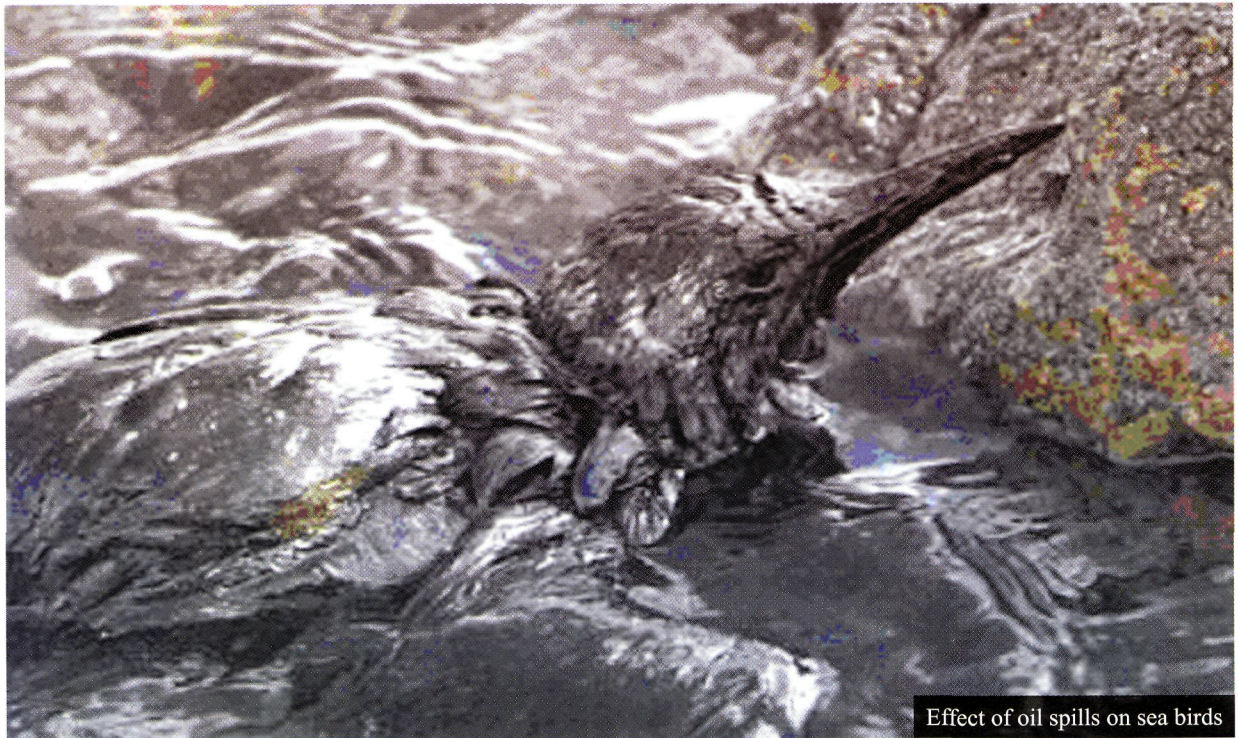
## Exxon Valdez Oil Spill



A dead sea Otter

The Exxon Valdez oil spill is considered one of the most devastating man-made environmental disasters ever to occur at sea. The oil tanker Exxon Valdez departed the Valdez oil terminal, Alaska at 9:12 p.m. March 23, 1989 with 53 million gallons of crude oil bound for California. The tanker failed to return to the shipping lanes and struck Bligh Reef at around 12:04 a.m. March 24th, 1989. The accident resulted in the discharge of approximately 11 million gallons of oil (240,000 barrels), 20 per cent of the cargo, into

Prince William Sound. The region is a habitat for salmon, sea otters, seals, and sea birds. Thousands of animals died immediately—250,000–500,000 seabirds, 2,800–5,000 sea otters, approximately 12 river otters, 300 harbour seals, 250 bald eagles, and 22 orcas, as well as the destruction of billions of salmon and herring eggs. Even today, the loss in wildlife, fishing and tourism, in Alaska is hard to describe. Only 7 of 26 monitored species and resources have recovered to pre-spill health and abundance.



Effect of oil spills on sea birds

upon the absence of long-term adverse effects on fish stocks that can be attributable to oil, but is cautious to note that local impacts can be extremely damaging in the short-term. Hence, the fish production from specific localities can be tainted from exposure at the Parts Per Billion (PPB) level, and remain unmarketable for long periods. Fisheries on the continental shelves are therefore, at greater risk than those offshore, and that effects on shallow coastal intertidal areas may last for years.

Fish catch along the Indian coast has increased in the last decade, which is attributed to mechanization and phenomenal increase in the number of fishing trawlers as well as advancement in gear technology. On the other hand, landings of major fisheries' resources in the Indian Ocean region have declined significantly and overexploitation is considered as a major problem world over. Thus, overexploitation and increased incidents of oil spills along the west coast probably have further effect on the fishery production of the area.

Among the other marine

organisms, seabirds have been used as monitors of the marine environment and of incidence of oil pollution for decades. Oil at sea is readily absorbed by the plumage, which decreases the bird's insulation, waterproofing and buoyancy, leading

**in the past fifty years, oil pollution has become a major problem in the coastal zone. Concerns have arisen recently about the number of illegal discharges from the large volume of shipping within the region. This could certainly affect marine organisms**

to death. The toxic compounds in the oil, when ingested or inhaled, can also lead to fatal effects. Due to frequent overlapping of shipping activities and seabird distribution, it is not surprising that dead and live oiled seabirds have been reported after chronic spills for decades. Moreover, there is experimental evidence that small amounts of oil transferred to eggs can significantly reduce hatching success. The worst case is when oil impacts the feeding grounds, which may have a long-term impact on sea bird population.

Several beaches of India, particularly Orissa's coast of Gahirmata are the breeding grounds of the world famous turtle, Olive Ridley turtle. Data on the breeding turtle population indicate fluctuating figures, however considering the proposed industrial development in the east coast, particularly the oil exploration, the turtles migration and breeding beaches are matter of great concern.

Sea mammals with restricted coastal distributions and ones that breed on shorelines are more likely to encounter oil than wide-ranging



Oil spill in the sea

species moving quickly through the area. Species at particular risk are those, which rely on fur for conservation of body heat (e.g. otters). If the fur becomes matted with oil, they rapidly lose heat and die of hypothermia. Whales, dolphins and seals are at less risk because they have a layer of insulating blubber under their skin.

In the past fifty years, oil pollution has become a major problem in the coastal zone. It has been observed that there is an increase in the incidents of oil spill in the Arabian Sea, with majority of them occurring during the Monsoon

season. Concerns have arisen recently about the number of illegal discharges from the large volume of shipping within the region. This could certainly affect marine organisms including pelagic fishery and west coast accounts to 73 per cent of the total marine fish catch of the world.

The vulnerability of marine organism to oil pollution is generally recognized, and it is essential that such areas are protected to ensure the health of aquatic organisms. Thus, the long coastal belt of India, which is known to be rich in fishery and mineral resource,

is, therefore, at high risk of a serious ecological disaster from oil pollution. Exploration of the oil from the onshore region is the need of the day, however, the commercial exploration should not be at the cost of the non renewable natural resources which could be lost forever. Immediate steps, therefore, are required to deal with management conservation of the natural living resources more judiciously.

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## The Largest Spills in History

- One of the two largest oil spills in history occurred in 1979 which did not involve an oil tanker. The IXTOC 1 oil well, located in the middle of the Gulf of Mexico accidentally sank its drill into an underwater oil reservoir. 140 million gallons of oil came bursting into the gulf.
- Another equally large spill occurred in 1991 when Iraqi soldiers dumped hundred-thousands of gallons of oil from a loading dock in Kuwait into the Persian Gulf during the Gulf War. This oil spill, besides IXTOC 1 spill, dwarf all other oil spills in history.
- In 1967, the super tanker TORREY CANYON ran into Pollard Rock off the coast of England resulting in a massive spill of more than 500,000 barrels of oil into the sea, polluting the coast of England, France and Spain.
- In 1979, the supertanker AMOCO CADIZ ran aground in the English Channel spilling nearly 70 million gallons of oil into the water. This spill was six times more than the EXXON VALDEX spill.