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Chapter Twenty-Four

THE VALDEZ OIL SPILL: ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS

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INTRODUCTION

The occurrence of accidental oil spills in the ocean became significant when ocean transportation grew due to the development of the oil fields in the non-consuming countries of the world. In order to market the oil for such regions in the Middle East, Venezuela, North Africa, and Nigeria great tanker fleets have been built. As demand for oil grew, the world movement of oil grew from a little less than 3,500 million barrels of oil in 1960, to 12,500 million barrels in the early 1970s, to about 15,000 million barrels in recent years.

The first major oil spill from a supertanker occurred on March 18, 1967 when the Torrey Canyon grounded on Seven Stones Shoal about 21 miles off Cornwall's Land End. The tanker spilled 840,000 barrels of Kuwait oil into the sea. Since then there have been scores of accidents of vessels creating spills of oil in the oceans. The most recent one occurred on March 24, 1989 when the Exxon Valdez ran aground on Bligh Reef in Prince William Sound, shortly after leaving Valdez, Alaska. This chapter describes and analyzes the Exxon Valdez oil spill as to its environmental impact, economic effects, and social disruptions of the area and concludes with some recommendations for management of future oil spills.

Technology

Although massive oil spills have been occurring for more than two decades, there is still no acceptable technology to protect the environment. It is now recognized that many of the remedial measures taken in Prince William Sound to clean the beaches may have actually had a negative impact on the environment. The technologies used to clean the beaches were adapted from techniques used for other purposes. Many questions have been raised about the process that used high temperatures and high pressure sprays, repeated 10 to 20 times to clean the oil from the beach. In the cool waters of the Sound the hot waters have a tendency to kill all animal life thus destroying the natural ecosystem.

The oil that was collected was in general biodegradable and placed in plastic bags. Because of the quantity there was no place to deposit the oil in Alaska and most was transported to a hazardous waste landfill in Arlington, Oregon, one of two hazardous waste landfills in the Pacific northwest. At the time of the spill there were no facilities available for ocean incineration. By late summer the Environmental Protection Agency allowed small quantitites to be burned on ocean barges. Out of this experience it is hoped that federal guidelines will be developed for disposal of emulsified oils. The development of biodegradable bags and the determination of the affect of salt water on the oily waste could aid the cleanup process.

Control of the Spill

At the time of the Valdez accident there had been little planning to manage a major oil spill. Prior to this spill the general attitude had been that such an event could not occur. As a result a computer system to teach spill movement, location of vulnerable areas, availability of personnel, and a clean-up program were not in place.

After the oil spill there was a "window of response" that lasted about 72 hours during which effective mechanical removal of oil from the surface of the water was possible. Dispersants and burning techniques would have been effective, particularly to control movement of the spill, during this period. The initial "window" ended when the oil was emulsified during a stormy day. After the storm, there was a second window of lessor opportunity of about one week during which a significant portion of the emulsified oil could have been recovered by mechanical pick up. This period also represented the optimal time for preventive booming of sensitive beaches (Harrald, Marcus, Wallace, 1989).

During this 10-day period, however, resources were not available at the scene of the accident to remove the oil effectively. In addition, there was a lack of coordination between industry, state and federal agencies. In this period, less than 5 percent of the oil was contained, removed, dispersed or burned. With an optimal response another 10 to 20 percent of the oil may have been prevented from reaching shore. After the first 10 days, little else could have been done to reduce the amount of oil impacting on the beach, although protective booming could still have influenced where the oil reached the beach. During severe weather in Prince William Sound, no amount of equipment or dispersants could have kept the oil from the beaches.

In spite of an ineffective system of oil removal, an inventory by the U.S. Forest service of the Sound four weeks after the spill, indicated that about 35 percent of the oil had evaporated, 17 percent recovered, 8 percent burned, 5 percent biodegraded, and 5 percent was dispersed. Another 18 percent of the oil had been deposited on the beaches, and 10 percent was contained in oil slicks. To clean the more than 300 miles of beaches more than 4,000 persons worked in the area in this early recovery period.

Environmental Impact

The effects of the oil spill on the ecosystem will be difficult to evaluate until years have gone by. The spill occurred in one of the world's richest biological areas. Within one week after the oil spill a U.S. Fish and Wildlife Service biologist estimated that more then 15,000 seabirds had been exposed to oil. There was also concern about the safety of the area's 5,000 sea otters. They are especially vulnerable to oil because it reduces their insolation and buoyancy of their fur. In an attempt to survive they can ingest fatal doses of oil while licking if off their coats. Of the dozens of otters that were cleaned of oil in the weeks after the spill, only a few survived. Hundreds died in the first days after the spill on remote oil-fouled shores.

The evidence is still outstanding of the effects of the oil spill on a wide variety of plants and animals. Such questions remain, what is the effect on the plankton that are the foundation of the food chain in the sound; can the spawning habits of herring and salmon survive the oilspill; what will be the effect on the bears of the region from eating polluted animals, will whales and sea lions be able to pass through the Sound?

By Fall 1989 an initial evaluation of damage to the ecosystem could be made. It was conservatively estimated that in the Prince William Sound area 33,000 birds, 980 otters, 30 harbor seals, 17 gray whales and 14 sealions had died. In addition an observer of aberrant bird behavior indicted that 75 percent of the bald eagles of the area failed to nest.

Economic Costs

Fishing is the major economic activity in the towns of the Prince William Sound. In 1988 these waters yielded $131 million worth of salmon, herring, halibut, and shellfish. The spill occurred just prior to the herring season. As a result the herring season was canceled with a loss to local fisherman of about $12 million. The oil spill also occurred just prior to the scheduled release of millions of salmon fry to the ocean.

The long-term economic impact on the fishing industry can not be evaluated until the 1992 to 1994 fishing seasons. Clayton McAuliffee of Chevron Oil indicates that "extensive studies show it is highly unlikely that the crude oil spill or the chemical dispersion used to control the spill will cause mortality of marine organisms in the water column or in bottom sediments." In opposition a study by the National Oceanic and Atmospheric Administration states that oil remains toxic to sea life in subarctic waters at least 12 months after an oil spill and fish will suffer during this period.

The economic cost to Exxon two years after the accident exceeded $500 million, but the ultimate cost will not be determined for many years. In 1991 Exxon was initially fined $100 million, but the courts have contested this amount as being far too low. There is also a court decision that Exxon pay Alaska $1.2 billion for damages. This decision is also being contested. Besides the major costs, there are scores of smaller claims that will be adjudicated by the courts in the next decade. The court cases will continue for many years.

Social Disruption

The Valdez oil spill occurred in a region of sparse population. To measure the social impact on a community, the team of Picou, Gill, Dyer and Curry (1990) surveyed the people of Cordova as to how the spill changed their lives. Cordova on Prince William Sound is isolated from other settlements by mountains, glaciers and the sea. The single road to the rest of Alaska was destroyed in the 1964 earthquake. The economy of Cordova is dominated by the fishing industry. Cordova fishermen hold 55 percent of the salmon and 44 percent of herring licenses of the Prince William Sound area. The town people have a history of subsistence practices stemming directly from a Native-Alaskan heritage. About 20 percent of the residents of Cordova are Native-Alaskans. Although the oil spill did not reach the Cordova beaches, it impacted critical fishing grounds used by local fishermen.

In the disaster assessment two towns were selected, one that was directly affected by the spill, Cordova, and a control town, Petersburg, that was not affected by the spill. The research design included the collection of data in a stratified random sample of households, an ethnographic sample of native Alaskans, and a random telephone survey of the inhabitants.

Four questions were asked of residents in Cordova and Petersburg. The first question was have you noticed any changes in the way your family gets along together. In the control area (Petersburg) 91 percent responded no change and 9 percent a change, while in the impact (Cordova) area the response was 61 percent no change and 39 percent a change in family relationships. Of the question, have you made any changes in the plans for the future, the families of the control area responded 86 percent no and 14 percent yes, but in the impact area 51 percent answered yes and 49 percent no. To add to the information the question, have other family members changed their future plans, was asked. The impact area families indicated 70 percent no and 30 percent yes, and in the control area, 83 percent no and only 17 percent yes. Finally, the question was asked, have things changed for you at work. The Cordova residents responded 68 percent yes and 32 percent no, while the Petersburg residents indicated 81 percent no change and only 19 percent a work change (Picou and others, 1990).

These results indicate that the spill had a significantly greater social disruption in Cordova than in the Petersburg area. These disruptions included family relations and future plans of the community members. The four researchers who conducted this study felt that the general uncertainty that characterized Cordova residents was directly related to the threat posed by the spill for future economic viability in the community.

In another survey, measuring post-traumatic stress disorders, there were also significant different responses between the residents of Cordova and Petersburg. The majority of the residents of Cordova had such intrusive recollections of the spill such as inadverted thoughts. unexpected negative pictures and thoughts that would result in an emotionally upset. Other contrasts in the emotions between the residents of the two communities included stress behavior in Cordova in the avoidance and recollection of the traumatic aspects of the spill. In summation the results of this research report clearly documented the existence of significantly more social disruption and post-traumatic stress disorders in Cordova.

Management Planning

The technology to control oil spills is still in an initial stage of development. In 1979 a report of the National Research Council of the National Academy of Sciences stated that, "Little attention has been paid to how government and industry would respond to a major maritime casualty involving hazardous cargo...(and)...the technical community...is not concerned about the capability to do so." In a 1984 *Management Science* article, it concluded, "The problem of providing an immediate response (to an oil spill) in areas where major environmental damage may be done in less than 6-12 hours has not been solved or extensively studied."

The difficulty in preparing for and responding to oil spills stems from the fact that there are extremely rare events (Harrald, 1989). Society has not learned how to deal effectively with low probability, high consequence events, particularly when the risk is due to technological failure. The attitude of the public and governmental officials toward these events tends to be polarized. When there is low probability the normal reaction is that the event will never occur and therefore any response plan is wasteful. In contrast, others recognize the consequences of the possible disaster, and would totally prohibit the activity. In the latter situation the catastrophe develops high initial interest, but if it does not reoccur, interest quickly diminishes. A system has been developed to handle small accidents that occur routinely, but a procedure has not been developed to deal rationally with catastrophic and rare events (Wenk, 1986).

The Exxon Valdez oil spill has demonstrated, however, that these catastrophic accidents cannot be ignored. A system must be developed that can effectively control the environmental and economic damages and keep social disruptions at a minimum. This involves a number of steps.

In retrospect, it has become apparent that determination of the ecological impact of the Valdez oil spill on the environment was hampered by a lack of scientific information on birds, fish and other wildlife in the area. Basic information needed to assess the impact on the ecosystem was found to be sorely lacking. A hodgepodge of scientific studies have been completed, but no one has developed a comprehensive analysis.

To correct this deficiency the U.S. Environmental Protection Agency in 1990 began a long term project known as EMAP—The Environmental Monitoring and Assessment Program. The program will collect basic scientific data on the nation as a whole. When this information, is placed on a gird it can provide basic environmental and ecological information for any ocean area around the United States. If, for example, a tanker ran aground in the Delaware Bay area, scientists could immediately secure information about the environment of that area. EMAP will provide a geographic information system that will be vital for decision making in oceanic disasters.

From a technological viewpoint an initial step is to reduce the risk of the accident. These procedures include the making of the port facilities and the harbor channel safer, the control of vessel traffic in the harbor, and the establishment of personnel standards. All oil tankers must be constructed to reduce spills. Of those modifications, the use of the double hull is crucial. In these vessels if the outer hull is penetrated no oil will escape (Harrald, 1989).

Beyond these initial endeavors there must be contingency planning in the high risk areas so that an immediate response can be mounted at the time of the accident. Necessary equipment must be present including computer based aids to allocate resources, provide information on spill movement, and clean-up progress, and allocate key personnel to strategic areas.

REFLECTIONS

The control of major oil spills has not received high priority by either industry or government in the past in spite of the fact that the environmental, economic, and social impacts have been significant in the areas of the oil spills. Although these catastrophes have been infrequent and are geographically widely distributed in the world, there must be the establishment of the organizational, financial, and technological resources required to minimize the impact of these incidences.

SELECTED REFERENCES

Davidson, A., 1990. "Valdez Reflections." *Sierra* 75(May-June):42-49 + .

Gibson, T. December, 1989. "Impacts of an Environmental Disaster on a Small Local Government: The Valdez, Alaska, Oil Spill." *Public Management* 71:18-19.

Harrald, John, Henry Marcus, and William A. Wallace, 1989. *The Management of a Maritime Crisis: The Integration of Planning, Prevention and Response.* Boulder, CO: The Natural Hazards Research and Information Center, Quick Response Report, #34.

Lewis, Thomas A., 1979. "Tragedy in Alaska." *National Wildlife* 23:(June-July):5-9.

Mason, Rachel, 1989. *Community Preparation and Response to the Exxon Oil Spill in Kodiak, Alaska.* Boulder, CO: The Natural Hazards Research and Information Center, Quick Response Report #36

Niering, Frank E. May, 1989. "Implications of Alaskan Oil Spill." *Petroleum Economist* 56:149-151.

Nulty, Peter. 1989. "The Future of Big Oil: Is Exxon's Muck-up at Valdez a Reason to Bar Drilling in One of the Industry's Hottest Prospects? Not According to Those Closest to the Scene: The Alaskans." *Fortune* 119(May 8):46-49.

Picou, Steven, Duane A. Gill, Christopher L. Dyer and Evans W. Curry, 1990. *Social Disruption and Psychological Stress in an Alaskan Fishing Community: The Impact of the Exxon Valdez Oil Spill.* Boulder, CO: The National Hazards Research and Information Center, Quick Response Report #35.

"Special Report: Troubled Waters." 1989. *Amicus Journal* 11(Summer):10-31. (Five articles assessing the aftermath of the Valdez oil spill).

U.S. Congress. House. Committee on Interior and Insular Affairs. Subcommittee on Water, Power and Offshore Energy Resources, 1989-1990. *Investigation of the Exxon Valdez Oil Spill, Prince William Sound, Alaska: Oversight Hearings: Pts 1-3, May 5-July 28, 1989.* 101st Cong, 1st sess. Washington, DC: GPO, 3 pts.

Wenk, Edward, Jr., 1986. *Tradeoffs: Imperatives of Chance in a High-Tech World.* Baltimore, MD: Johns Hopkins University Press.