Characteristics of Reported Inland and Coastal Oil Spills

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Abstract

Oil Spill Intelligence Report (OSIR) and Emergency Response Notification System (ERNS) data indicate that similarities and differences exist in the characteristics of inland and coastal oil spills. This paper examines data on reported oil spills over the last few years, comparing inland and coastal spill characteristics such as the number of spills, spill sizes, spill sources, and the types of oil spilled. Previous studies indicated that vessels are a major source of inland oil spills and that refined petroleum products dominate inland spills whereas crude oil spills are common in coastal areas. However, our examination of data on large spills in recent years indicates that pipelines are a much more significant spill source in inland waters than vessels. Recent reports also indicate that large spills of crude oil often occur in inland areas. Finally, although coastal spills tend to be highly publicized, the majority of large oil spills in the United States are to inland areas. Spills to inland areas often affect sensitive environments and can have greater impacts to public health and welfare than spills to coastal areas. Studying characteristics and patterns of larger inland and coastal spills may help in developing oil spill prevention policies and response planning.

Introduction

There are a number of data sources that oil spill planners can use to analyze characteristics of inland and coastal spills. For example, ERNS data include initial notifications to the National Response Center or the Environmental Protection Agency (EPA) of oil discharges that have occurred to U.S. waters. OSIR's *International Oil Spill Statistics* annual

report includes information on spills of at least 10,000 gallons that occur worldwide. An American Petroleum Institute (API) report by Gibson (2001) contains statistics for discharges that are in the database maintained by the United States Coast Guard (USCG). The Department of Transportation's Office of Pipeline Safety (OPS) also tracks pipeline incidents.

To study the characteristics of inland and coastal spills, we examined oil spill data from ERNS, OSIR, and API. Whereas previous studies involved spills of all sizes, our analysis focused on spills above 10,000 gallons. We expected that, compared to a data set consisting of spills of all sizes, a set of these larger oil spills would show fewer different sources and types of oil spilled. For example, the characteristics of the Top 10 ERNS spills in 1999 are different from the characteristics of all spills in that year. The majority of these 10 spills occurred in inland areas and half were crude oil spills. All of the top ten spills were either from fixed facilities or pipelines. In contrast, smaller spills of diesel fuel or lubricating oil often occur from sources such as motor vehicles or machinery.

In this paper, we compare 1995 and 1996 ERNS data on spills of all sizes with OSIR annual summary data on large spills for the same years. We then compare the 1995 and 1996 OSIR annual summary data on large spills with a data set that included annual summary data for the years 1995 to 1999 to see whether there are differences in the patterns of spill sources and oil types. We also examine API's summary report on USCG spill data for the year 1999.

Are most spills inland or coastal?

ERNS data from 1996 indicated that 60 percent of all spills were inland and 40 percent were in coastal areas. Larger spills were more likely to be in inland areas; for spills above 1,000 gallons, 77 percent were inland. Our examination of OSIR spills of 10,000 gallons or more in

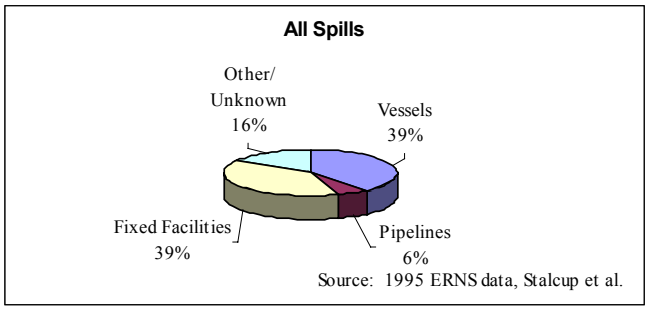
the United States (Cutter Information Corp. 1996 to 2000) indicates an even larger percentage of inland spills (88%) and fewer coastal spills (12%).

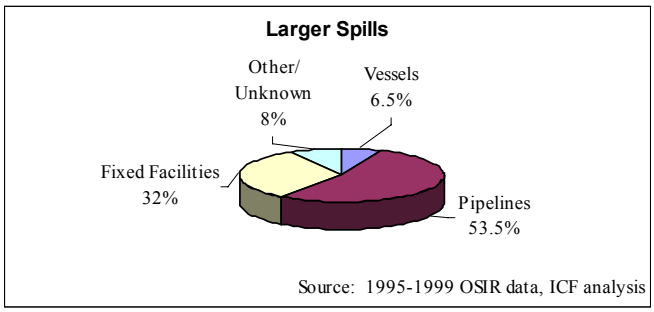
What are the most important types of oil spill sources?

One finding in the analysis of 1995 ERNS data by Stalcup et al. (1997) concerned types of sources. Pipelines were found to be a relatively minor source of spills in both inland and coastal waters, and vessels (e.g., barges) were found to be a major source in both areas. Similar results were found in an examination of ERNS data for 1996. For the two years, 37 to 39 percent of inland spills were from fixed facilities, 33 to 39 percent were from vessels, 6 to 8 percent were from pipelines, and the remaining spills were from other or unknown sources. Vessels and offshore facilities (i.e., platforms) were the major sources of coastal spills. In the API data, nearly two-thirds of spills were from vessels, 12 percent from fixed facilities, and only 1 percent from pipelines.

OSIR spills of 10,000 gallons or more in the United States show a much different pattern. For the combined years 1995 and 1996, 56 percent of inland spills were from pipelines and only 7 percent were from vessels. Similar percentages exist for inland spills of 10,000 gallons or more during the entire period from 1995 to 1999. Exhibit 1 shows the sources of inland spills, comparing the 1995 ERNS data to the OSIR data on large spills. As for coastal spills, both ERNS and OSIR data indicate that the majority of coastal spills were from vessels.

Exhibit 1
Sources of Inland Spills



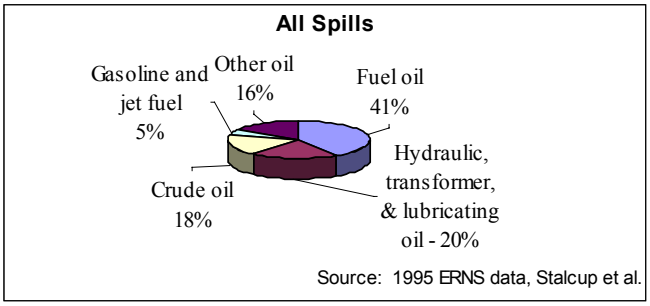


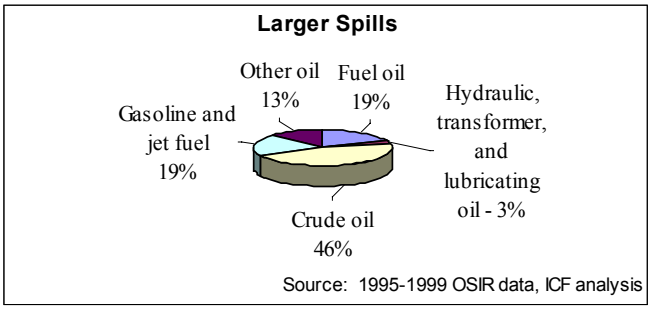
It is clear that, compared to spills of all sizes reported in ERNS, more of the larger inland spills in OSIR tended to be from pipelines and fewer were from vessels. This pattern for larger spills was even more striking when we considered only the OSIR inland spills above 100,000 gallons. Of the 75 such spills between 1995 and 1999, nearly 60 percent were from pipelines and 5 percent were from vessels. This difference suggests that many vessel spills in inland waters are relatively small.

What types of oil are most commonly spilled?

In terms of types of oil spilled in 1995 and 1996, ERNS data showed that about 41 percent of inland spills were fuel oil; 20 to 22 percent were hydraulic, transformer, and lubricating oil; 13 to 18 percent were crude oil; 5 to 7 percent were gasoline and jet fuel; and the remainder of the spills were other types of oil. API data showed a similar distribution -- 35 percent of spills were fuel oil; 12 percent were hydraulic, transformer, and lubricating oil; 16 percent were crude oil; and 7 percent were gasoline and jet fuel. As shown in Exhibit 2, however, the larger inland spills in OSIR include a much higher fraction of crude oil spills and a smaller fraction of fuel oil spills. The majority of the larger coastal spills were fuel oil spills.

Exhibit 2
Types of Oil Spilled Inland





We can derive other information about large spills by considering both the type of source and the type of oil. Over one-third of the 411 inland spills of 10,000 gallons or more were crude oil spills from pipelines. Crude oil spills from fixed facilities and gasoline/jet fuel spills from pipelines each accounted for a little over 10 percent of the spills, and fuel oil spills from fixed facilities accounted for 9 percent of the spills. For inland spills above 100,000 gallons, 40 percent were crude oil spills from pipelines. With respect to coastal spills, however, the majority were fuel oil spills from vessels.

In what region do most spills occur?

Exhibit 3 shows how the OSIR spills are distributed by EPA region. Spills in Region 6 are the most frequent, with 170 inland and 21 coastal spills. Within Region 6, Texas dominates, with 97 inland spills, of which 57 are crude oil spills from pipelines.

Exhibit 3
Number of Spills Above 10,000 Gallons by EPA Region (1995-1999)

	10,000 to 99,000 gallons		100,000 gallons or more		
	Inland	Coastal	Inland	Coastal	Total
Region 1	6	0	0	2	8
2	18	4	1	1	24
3	15	3	2	1	21
4	34	6	4	0	44
5	30	0	11	0	41
6	129	16	41	5	191
7	29	0	4	0	33
8	28	0	2	0	30
9	37	10	7	0	54
10	10	7	2	0	19
Total	336	46	74	9	465

Discussion

As we mentioned above, there are many data sources that planners can use for information on reported oil spills. Each source contains different types of oil spill notifications, creating inconsistencies between the sources and making certain sources more useful than others, depending on the user's needs. For example, ERNS contains data from initial notifications that may or may not be updated as more data become available. Updates and notifications coming from various sources may cause duplicate records within the database. In addition, for the most part ERNS is likely to include spills that are required to be reported (i.e., if the spill caused a sheen on surface water or adjoining shoreline, violated applicable water quality standards, or caused a sludge or emulsion to be deposited beneath the surface of the water or shoreline). OSIR

data may include additional spills (of 10,000 gallons or more) that did not enter water but may be important to consider when planning for and responding to spills. However, the ERNS database may be more comprehensive than other sources because it contains spills of all sizes reported to the National Response Center or EPA. Spills found in OSIR are often verified using newspapers and other publications. In its summary of spills reported to the USCG, API also verifies information on spills above 10,000 gallons. Finally, although OPS data are limited to pipeline incidents, the database contains other useful information such as property damage amounts and the amount of oil recovered.

Of course, most reported oil spills are small. ERNS data showed that over 95 percent of inland spills were less than 1,000 gallons. API data, which emphasize spills from vessels because those are most often reported to the USCG, showed an even larger fraction of spills below 1,000 gallons. Nonetheless, each year the OSIR summaries contained several dozen spills over 10,000 gallons in the United States.

Differences in the number of inland and coastal spills, spill sizes, spill source, and type of oil spilled found in the comparison of data from ERNS, OSIR, and API's summary report can be attributed to a number of factors. Our analysis of OSIR data was limited to a small fraction of the total spills, because OSIR only includes spills above 10,000 gallons whereas the other sources include spills of all sizes. However, chances are that more information is known about the largest spills and that reports of occurrences of such spills are more accurate or more likely to be updated. When a large spill occurs, there is also less uncertainty about whether it needs to be reported than there may be for a small spill. Clearly, environmental damages and overall costs are likely to be more significant for larger spills.

Inland vs. coastal spills. OSIR data on spills above 10,000 gallons show a larger percentage of inland spills than ERNS data on spills of all sizes. One difference between the ERNS and OSIR data sets, in addition to the spill sizes, is that the studies using ERNS data only included spill reports that indicated which waterway the spill affected. (This information was used to determine whether a spill occurred in an inland or coastal area.) If the ERNS studies had included spill reports that did not indicate an affected waterway, the number of inland spills would most likely have been higher. In any event, the majority of spills above 10,000 gallons occured in inland areas rather than coastal.

Inland spills are more likely than coastal spills to occur near populated areas or biologically sensitive areas. Such spills often impact human health and activities, disrupt municipal water supplies, and result in significant damages to property and the environment. For example, an inland spill in Knoxville, Tennessee on February 10, 1999, caused $7 million in property damage. The spilled high sulfur diesel fuel contaminated 18,000 tons of soil and ten nearby homes, and part of the adjacent river was temporarily closed. Given the potential damages associated with larger spills, response planners need to recognize the threat to inland areas.

Source. Our analysis of OSIR annual summary data indicates that pipelines are a significant source of oil spills, a fact that was not apparent in previous studies using ERNS. Reasons for this finding include the fact that ERNS includes spills of all sizes, allowing for a greater variety of spill sources. The larger variety of sources found when looking at spills of all sizes reflects the fact that some sources of spills (e.g., trucks, storage tanks) can hold only limited amounts of oil, whereas pipelines have a continuous flow of oil, leading to larger spills. In addition, a spill must only be reported to ERNS if it reaches U.S. waters, whereas OSIR includes

spills regardless of whether the spill reached water. Therefore, pipeline spills that did not reach water may be included in OSIR but not in ERNS, thus helping to explain the greater number of pipeline spills found in the OSIR data.

Because pipelines are such a significant source of large spills, it is important to plan for spills from this source. Knowledge of pipeline locations can be an important factor in a community's preparedness for major oil spills. Pipeline spills may cause lost product (and thus, lost revenue), commercial disruption (e.g., closing the pipeline for repair), property damage, groundwater contamination, and other impacts on human health and the environment. For example, on June 10, 1999, approximately 230,000 gallons of gasoline were released from a pipeline in Bellingham, Washington and spilled into Whatcom Creek (Cutler and Barber 2001). OPS reported that only 4 percent of the oil was recovered and $1 million in property damages was incurred. In addition, the spill and explosion caused three fatalities and nine injuries. The nearby Interstate highway was closed, surrounding water supplies were affected, and 4,000 residents lost electricity. For three weeks during the emergency phase, more than 2,770 people responded to the spill and explosion, with concerns about toxic smoke fumes affecting the responders. Although this spill was quite large, our review of OSIR data shows that, on average, seven spills above 200,000 gallons occur in U.S. inland areas each year.

Oil type. Our analysis shows that crude oil spills are more significant than would be expected based on previous studies. Some crude oil spills can be particularly expensive to clean up and can cause substantial damage. For example, a crude oil spill from a pipeline in Cocodrie, Louisiana on May 16, 1997, had significant damage and cleanup expenses. Over 200,000 gallons were spilled, and $50,000 was lost from the oil that was not recovered. OPS reported $1 million in property damages, and the responsible party was reported to have spent approximately

$10 million in cleanup costs. In addition, the costs include repair of the pipeline and impacts to Lake Barre and the shrimp and oyster harvests nearby (Publisher et al. 1999). The type of data we present in this paper can suggest a starting point for spill prevention efforts, but different types of crude oil, for example, can require different response techniques. Planners should obtain more detailed information about the specific types of oil and specific sources in their planning areas.

Spills by region. Our analysis shows that a large proportion of the spills in the United States were reported in EPA Region 6. Although spills larger than 100,000 gallons have occurred in every region, these data suggest that spill responders in Region 6, particularly in Texas, are likely to have expertise in handling large spills and may have insights to share with responders in other regions.

Conclusion

A data set of large spills tends to exhibit characteristics that are different from those exhibited by a data set of spills of all sizes. In studying larger spills, we see more pipeline spills, crude oil spills, and inland spills. In addition, inland spills are different from coastal spills. Although inland spills more often come from pipelines and involve crude oil, coastal spills frequently come from vessels and involve fuel oil. Although major coastal spills tend to be highly publicized, a large percentage of major spills in the United States are to inland areas. Knowledge of where, when, and what types of large spills have occurred most often in the past will help government agencies and private-sector industries in preventing, planning for, and responding to future oil spill incidents.

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