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THE EXXON VALDEZ OIL SPILL: A review

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Abstract**: At 12:04 a.m., March 24, 1989, The Exxon Valdez, an oil tanker en route from Valdez, Alaska to Los Angeles, California, ran aground on Bligh Reef. The tanker moved outside its normal shipping lanes in an attempt to avoid icebergs. An estimated 11 million gallons of crude oil gushed into the Prince William Sound in under five hours. Oil spread to a distance of over 750 km from the spill site, contaminating 1750 km of shoreline along the way. Many people lost source of income due to a decrease in fish population, countless number of animals were killed with estimates at 250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles, up to 22 killer whales, and billions of salmon and herring eggs. The remediation measures included the use of booms, in situ burning of oil, use of absorbent barriers and skimmers and bioremediation. Lessons learnt include the change of tanker designs to double haul and the use of clean-up methods that are in tandem with the environmental condition. This review paper presents a summary of one of most devastating oil spills to ever have taken place in the world.

I. INTRODUCTION

Prince William Sound is located near the top of the 1367.94 km arc of the Gulf of Alaska which encompasses the Aleutian Islands on the west to the islands of southeast Alaska.

It is a pristine area especially more natural before the spill. Prince William Sound, being one of the most prominent tidal estuary systems is a rich environment where rivers meet and mix with the tides. With a surface area equalling the size of Chesapeake Bay, its many island and bays, Prince William has a shoreline of more than 2,000 miles long. The Sound lies close to the Chugach National Forest. To the southwest is the Kenai Peninsula, within which lies the Kenai Fiords National Park. The presence of the Nellie Juan-College Fiord Wilderness Area; both the National Forest and National Park, which are accessible by air and water makes the area ideal for recreationists.

The local climate nourishes a lush landscape. Bears, whales, bald eagles, puffins, seals, sea lions, and sea otters are among the wildlife people come to see. Glaciers that carved the intricate finds still send icebergs floating out to sea. These are the largest glaciers outside Antarctica and Greenland. They descend from permanent ice fields capping the coastal Chugach mountain range. The Trans-Alaska Pipeline System terminates at the port of Valdez on the northern edge of the Sound. In 1989, the pipeline conveyed two million barrels a day of oil produced on ACE 10917125 Alaska's North Slope. Two tankers per day load Trans-Alaska Pipeline System oil at Valdez and transit the Sound [1].

At 12:04 a.m., March 24, 1989, the tanker Exxon Valdez, hauling north of 50 million gallons of North Slope crude oil, ran aground and ruptured its tanks on Bligh Reef in Alaska's Prince William Sound. The oil spill that ensued became the largest tanker spill in U.S. history. An estimated 11 million gallons of crude oil gushed into the Prince William Sound in under five hours. By August 1989, the oil had spread over 10,000 square miles of water in Prince William Sound and the Gulf of Alaska. Over 1,000 miles of shoreline were affected [1]. This paper provides a review encompassing the accident, the damage it caused, and the lessons learnt.

THE CAUSE OF THE ACCIDENT

The Exxon Valdez, an oil tanker en route from Valdez, Alaska to Los Angeles, California, ran aground on Bligh Reef. The tanker moved outside its normal shipping lanes in an attempt to avoid icebergs. Within four hours of the incident, an estimated 10.9 million gallons had been discharged into the ocean out of its 53 million gallons cargo [2].

THE EXTENT OF DAMAGE

After the grounding, oil was blown onto south western islands by storm winds emanating from the northeast 72 hours days after the incident. Within 21days, approximately two fifths of the spilled crude oil reached Prince William Sound beaches, and a quarter of the oil moved into the Gulf of Alaska. Oil spread to a distance of over 750 km from the spill site, contaminating 1750 km of shoreline along the way [3].

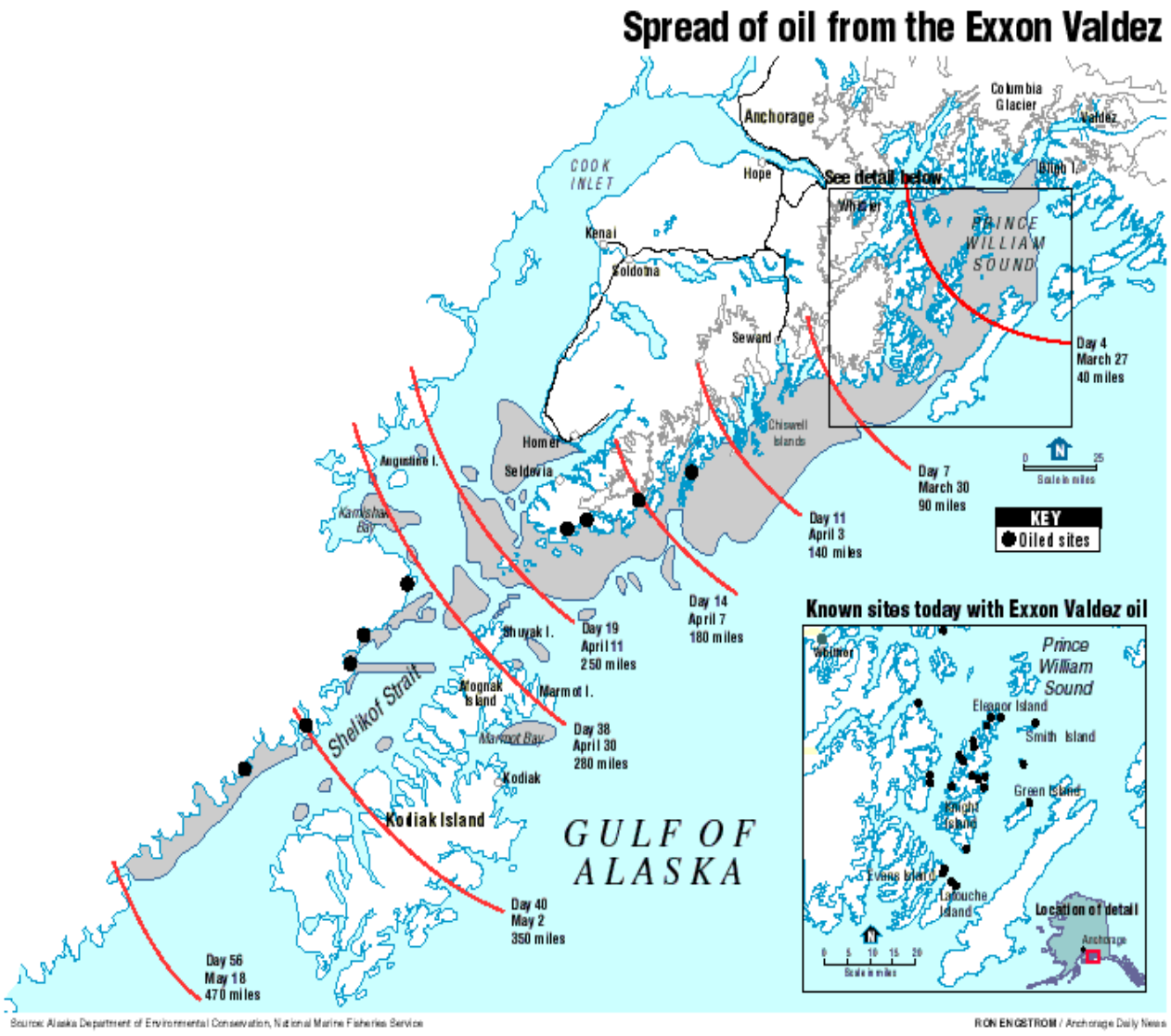

Figure 1: Map of Gulf of Alaska depicting timeline of oil spill spread after 56 days (www.earthlyissues.com)

Many people lost source of income due to decrease in fish population [4]. A countless number of animals died; estimates are: 250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles, up to 22 killer whales, and billions of salmon and herring eggs.

Immediate Costs (in millions of dollars) included Cleanup (1989-90): $2,000; Fishermen: $300; Out-of-Court Settlement (1991–2001) Damage assessment: $214; Habitat protection: $375; Administrative costs: $35; Research, monitoring and general restoration: $180; Restoration reserve: $108; Accumulated interest less Court fees: $12 totalling $3.224 billions. Civil Trial (1995) approved compensation to fishermen of $287 million and Punitive compensation (under appeal) of $5 billion dollars [3].

THE ENVIRONMENTAL DAMAGE

Contrary to initial expectations after the spill, some impacts have persisted for decades. Currently, experts know the oil persists in subsurface patches, its chemical composition, and projected distribution and quantity in Prince William Sound. There are now new ways of detecting bioavailability of low-level petroleum contaminants in the environment by looking at gene transcription patterns in marine organisms [5].

At the time of the spill, there was little or no wind or wave activity to move the oil. During the first few days after the spill, the slick was spread to the southwest by a combination of water currents, gravity, and surface tension. However, on March 26, two and a half days after the spill, a violent windstorm, moving from the east to northeast, drove the oil slick toward the extensive island system in the western sound and eventually, after March 30, into the north western Gulf of 2,000 miles of shoreline were oiled [1].

A countless number of animals perished estimated at 250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles, up to 22 killer whales, and billions of salmon and herring eggs [6].

REMEDIATION MEASURES

The following remediation measures were adopted for the cleanup and management of the oil spill:
1. Boom. These were deployed to prevent further spread of oil by fishermen when they noticed that there was heavy delay from the oil companies in managing the situation [7].

2. In situ burning of oil. This was an attempt to reduce the contamination by setting on fire the oil layer on top of the ocean. This was short-lived for the Exxon Valdez case [8].

3. Bio-remediation. The use of bioremediation as an additional cleanup technology in the Exxon Valdez oil spill, in Prince William Sound, Alaska, proved to be learning point of the merits and demerits associated with the operationalization of the technology. In situ studies by the U.S. Environmental Protection Agency have proved that oil degradation by indigenous micro plants on the beaches of Prince William Sound was catalyzed by the addition of fertilizer directly to the contaminated beach surfaces. Much as several types of fertilizers were utilized in the studies, only the results from the application of a fertilizer, with a high oil affinity, are presented. The fertilizer accelerated biodegradation of the oil [8].
In situ tests jointly conducted in PWS by the United States Environmental Protection Agency (USEPA), the Alaska Department of Environmental Conservation and Exxon showed, with high statistical significance, that the rate of oil degradation was a function of the ratio of nitrogen/oil, the non-polar hydrocarbon fraction remaining, and time.[8] It is imperative to note that biodegradation does not eliminate all of the hydrocarbons in crude oil – some compounds are recalcitrant to microbial attack such as higher-molecular-weight PAHs and the polars (NSO – molecules containing nitrogen, sulfur and oxygen). Further, if the biodegradation rate cannot be accelerated significantly by a factor of at least 2, other methods other than biodegradation, should be considered [9].

4. Use of absorbent barriers and skimmers [10].

LESSONS LEARNT-FOLLOW UP ACTIONS

1. The change in designs of oil tankers from single haul to double haul fuselage to minimize the future oil leakage risks was the biggest lesson learnt from this accident. By 2010, it became a law that all oil carrying vessels should be double haul.
2. Chemical and physical clean-up efforts can result in strong biological reactions with the environment.
3. Exposure to weathered oil effects fish growth and behavior.
4. Oil that has seeped into soil can resurface over time.
5. Type of environment influences oil degradation rates.
6. Oil penetrates deep and weathers slowly on rocky, rubble shores.
7. Extensive damage to animals can take place from long-term interactions with their environment.

CONCLUSIONS

Exxon-Valdez oil spill is one of the worst environmental disasters ever. The extent of damage both monetary and environmental is extremely significant. A number of lessons were learnt from this incident and hopefully such disasters will be averted in the future. The application of technology has shown that such spills can be contained and remediated. Much progress has taken place since this incident and only one major incident took place since this event: Deepwater Horizon oil spill. Scientific advancements and policy frameworks must work hand-in-hand to ensure prevention of any such scenario in future and its appropriate, timely and environmental-conscious management at the earliest.

REFERENCES

[1] R.T. Carson, R.C. Mitchell, W.M. Hanemann, R.J. Kopp, S. Presser and P.A. Ruud. Online at http://mpra.ub.uni-muenchen.de/6984/ MPRA Paper No. 6984, posted 4. February 2008

[2] R.T. Paine, L. Jennifer, A. Ruesink, S. Elaine: *Trouble on oiled waters: Lesson form the Exxon Valdez Oil Spill*. 1996

[3] V. P. Goldberg, "*Recovery for Economic Loss following the Exxon "Valdez" Oil Spill*," The Journal of Legal Studies 23, no. 1 , Jan., 1994

[4] D. G.R. Aderhold, M. R. Lindeberg, K. Holderied and S. W. Pegau, *Spatial and temporal ecological variability in the northern Gulf of Alaska*: What have we learned since the Exxon Valdez oil spill?, Deep Sea Research Part II,

[5] J .E Hose , M D McGurk, , G D Marty , D E Hinton, , E D Brown, and , T. T .Baker. *Sublethal effects of the (Exxon Valdez) oil spill on herring embryos and larvae: morphological, cytogenetic, and histopathological assessments*, 2011

[6] O. R. Harrison : *An Overview of the Exxon Valdez Oil Spill*. International Oil Spill Conference Proceedings: March ,1991

[7] P.H. Pritchard, I J.G. Mueller, J.C. Rogers, F.V. Kremer and J.A. Glaser 5, 1 Environmental Protection Agency, Environmental Research Laboratory, 1992

[8] Atlas R and Bragg, J: *Bioremediation of marine oil spills*: When and when not-The Exxon Valdez experience, Louisville, 2009

[9] J. A. Noerager and R. H. Goodman: *Oil Tracking, Containment, and Recovery during the Exxon Valdez Response*. International Oil Spill Conference Proceedings: March 1991, Vol. 1991

[10] Inho Kim : *Milking" Oil Tankers: The Paradoxical Effect of the Oil Pollution* Act of 1990.*Natural Resources Journal.* Vol. 47, No. 4, 2007