

INVESTING IN SPILL PREVENTION: HAS IT REDUCED VESSEL SPILLS AND ACCIDENTS IN WASHINGTON STATE?

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ABSTRACT: *Washington State is a major crude oil refining center also known for its high quality of life and salmon-producing waters. The state is dependent economically on a variety of waterway uses, including Pacific Rim trade, aquaculture, tribal culture, tourism, commercial fishing, and recreational boating. Since the passage of the Oil Pollution Act of 1990 (OPA 90) and the establishment of the Washington State spill prevention program in 1991, federal and state government, in conjunction with industry, have made considerable investments in spill prevention. During this intervening period, major oil spills from all sources, particularly vessels, have declined substantially.*

This study evaluated the overall effectiveness of these prevention efforts by comparing data on the rate of significant vessel oil spills and vessel casualties in Washington State with national data, and with data from three other key coastal states with busy ports and high vessel traffic—California, New York, and Texas. Overall, Washington appears to be significantly ahead of the United States as a whole in terms of reduction in the number of vessel spills, as well as by rates of spillage by tonnage transport and transit. Washington is ahead of the states of California, New York, and Texas in some categories of comparison but not others. The rate of reduction in vessel spills in Washington, however, was considerably greater than the other coastal states studied.

It is hard to demonstrate the value of spill prevention programs. The difficulty lies in the inability to count spills that have not occurred as a result of increased diligence on the part of the private and public sectors. However, it is clear from this study that spill prevention programs do work, and that the reduced frequency of major spills is not a reason for complacency.

Washington State vessel spill prevention program

Background. Washington State has two principle commercial waterways. The Strait of Juan De Fuca and Puget Sound share a border with British Columbia, Canada, and are the major approaches to the Port of Vancouver in British Columbia and Washington's ports, including Seattle and Tacoma, and five oil refineries. The Columbia River system is a major commercial

conduit to the cities of Portland, Oregon and southern Washington ports.

Washington is one of the United States' larger crude oil refining centers and is a major center for Pacific Rim trade. Over 15.1 billion gallons of oil cargo and fuel transited the Strait of Juan De Fuca in 1999. A variety of vessels transit the waters, including those from the nation's third-largest naval port, the nation's largest public ferry system, Pacific Rim dry cargo trade, Alaskan North Slope crude oil transshipment, extensive tug and barge traffic, the high per capita recreational boat ownership, and the commercial fishing fleets of Washington, Columbia, and Alaska (which home ports in Seattle), all of which contribute to the risk of oil spills. With the state's pristine waters and economic reliance on water-based activities, there is considerable public support for protecting these resources from oil spills. Long hydraulic retention and the biologically sensitive and productive cold waters increase the importance of spill prevention over response.

Additionally, a recent U.S. Coast Guard study (USCG, 1999) projected that the risk of major Puget Sound vessel spills over 10,000 gallons will increase 28% over the next 25 years to one every 3.6 years due to projected increases in vessel traffic.

Vessel spill prevention program. The state of Washington has been active in oil spill prevention and response since the early 1970s when an oil transfer inspection program was briefly implemented. Since that time the state has maintained an active spill response, investigation, enforcement and natural resource damage assessment program. Marine and inland facilities have also been required to submit state spill prevention, control and countermeasure plans.

As a result of the 1988 Washington State *Nestucca* and the 1989 Alaskan *Exxon Valdez* oil spills, the legislature established a comprehensive spill preparedness and response program in July 1990 and a spill prevention program in 1991. Vessels were regulated by the newly established state Office of Marine Safety (OMS) while facilities and response continued to be the responsibility of the Department of Ecology (DOE). Principal statutes and regulations in Washington's program are shown in Table 1.

Table 1. Washington State principle oil prevention statutes and regulations.

Principal Washington State statutes
<i>RCW 90.56</i> – Oil and Hazardous Substance Spill Prevention and Response
<i>RCW 88.46</i> – Vessel Oil Spill Prevention and Response (basic program 1991; operations program for vessel inspections 1993; incident and near-miss reporting 1995)
Principal Washington State regulations
<i>WAC 173-183</i> – Preassessment Screening and Oil Spill Compensation Table (1992)
<i>WAC 317-10</i> – Vessel Contingency Plans (1992)
<i>WAC 317-31</i> – Cargo and Passenger Vessel–Substantial Risk (established vessel inspection program in 1996)
<i>WAC 317-40</i> – Bunkering Operations (established a bunkering check list and inspection program in 1994)
<i>WAC 317-21</i> – Tank Vessel Oil Spill Prevention Plans (1995) ¹

¹ As a result of the U.S. Supreme Court *Intertanko* partial preemption in March 2000, the rules are being withdrawn.

The program currently has a staff of 48 statewide. In addition to the vessel-related services described below, it provides 24-hour oil and hazardous material spill response capability statewide. It also implements expanded spill prevention and contingency planning functions for facilities.

Some of the more important specific Washington vessel elements established in statute by 1991 include the following:

- *Contingency planning*: All vessels over 300 GRT are required to submit oil spill contingency plans to DOE. Development of these plans also educates plan holders of the importance of spill prevention.
- *Tank vessel spill prevention plans, cargo and passenger vessel inspections, vessel bunkering checklists and inspections, and enforcement*: Monetary penalties were increased to up to \$100,000 per day, and felony sanctions were established.
- *Natural resource damage assessment (NRDA)*: The state established a precedent-setting damage compensation table.
- *\$10-million state oil spill response and cleanup fund*.

Vessel operators in the state are, of course, also subject to the comprehensive regulatory regimes of the International Maritime Organization's (IMO) international and U.S. Coast Guard.

The legislature merged OMS with DOE in July 1997. Since that time, the vessel program has continued to be implemented, with the exception of the state's Tank Vessel Oil Spill Prevention Plan rule. This rule was withdrawn in June 2000 as a result of the U.S. Supreme Court's decision in favor of federal preemption in the *Intertanko* case.

The DOE program is funded with a 5-cent-per-barrel tax on oil transferred in bulk from tankers and barges. The program probably has the most comprehensive state vessel spill prevention program in the nation. The purpose of this paper was to determine if these initiatives have made a difference in preventing vessel oil spills.

Methodology

Vessel oil spill and casualty data from the U.S. Coast Guard Marine Casualty Database, as well as data from Environmental Research Consulting Database (over 100,000 records) and Washington DOE were analyzed with respect to spills in Washington,

total U.S. spills, and spills in other selected coastal states (California, New York, and Texas). Vessel transit and tonnage transport data were derived from the U.S. Army Corps of Engineers, Washington DOE, and Lloyd's Maritime Information Service.

Vessel spills rates *throughout* the United States have been influenced by preventive measures in OPA 90 and various state regulations developed in its aftermath, in addition to heightened concerns over potential spill costs for response, damages, and penalties (Etkin, 2001). To assess the *relative* effectiveness of Washington's spill prevention program, it was necessary to analyze current spill rates in relation to *preprogram* rates as well as spillage in relation to spill risk, as measured by vessel transits and tonnage. Washington was compared with the United States as a whole and with the states of California, New York, and Texas with respect to such factors as casualty (grounding, allision, and collision) rates for vessels, spills per casualty, spills per vessel transit, and vessel spill rates.

Vessel spill *numbers* as opposed to the *amount* of oil spilled are of particular interest in looking at casualty and spill rates since any one large incident can distort the overall data. It is important to consider that any one spill incident can result in anywhere from 1 gallon to several thousand to millions of gallons. The fact that spill *numbers* often are dominated by small operational spills and spill *amounts* generally are dominated by larger accidental spills adds some difficulty to the analysis.

Results of data analysis

U.S. vessel spill and accident rates. Oil spills from all vessel types increased from 1985 to 1993, declined briefly, and gradually increased again between 1995 and 1999 (Etkin, 2001). Vessels *other than* tankers and barges have driven much of this trend. Apparent increases in spills from fishing vessels and other smaller vessels may reflect increased enforcement and reporting rather than actual spill incidents.

Tankers and barges carrying oil cargo, as well as bunkers and machinery oils, still present the greatest risk for larger spills. Between 1985 and 1999, tanker and barge spills made up 25% of vessel spills in terms of *numbers* of spills, and 83% of the total *amount* spilled. Fortunately, tanker and barge spills appear to be declining, having decreased during 1985–1999, with a particularly significant drop since 1993 (Etkin, 2001, in press).

While the largest portion of spills from tankers and barges result from incidents involving lightering, bunkering, and loading of fuel and oil as cargo, the most serious spill incidents with the greater oil spillage usually involve accidents—collisions, allisions, and groundings. In the United States, the actual number of tanker *accidents* (with and without resulting oil spillage) has dropped since reaching a peak in 1990. There was only one-eighth the number of tanker accidents in 1999 as there were in 1990. Annually, only 0.2% of the more than 41,000 tanker transits result in accidents, and of these accidents less than 2% result in oil spills. In the United States, 26% of vessel transits are by tankers.

Washington State vessel spill and accident rates. In the state of Washington, the spill picture has been somewhat different from the national picture, since nearly one-third of the oil spilled from vessels between 1985 and 1999 came from fishing vessels, due in large part to the *F/V Tenyo Maru* spill. At the same time, fishing vessel spills represented only 17% of the number of spills (see Figures 1–3). Tankers and barges made up only 3% of the *numbers* of spills, but 27% and 39%, respectively, of the *amounts* spilled in this time period. Overall, the *number* of spills from

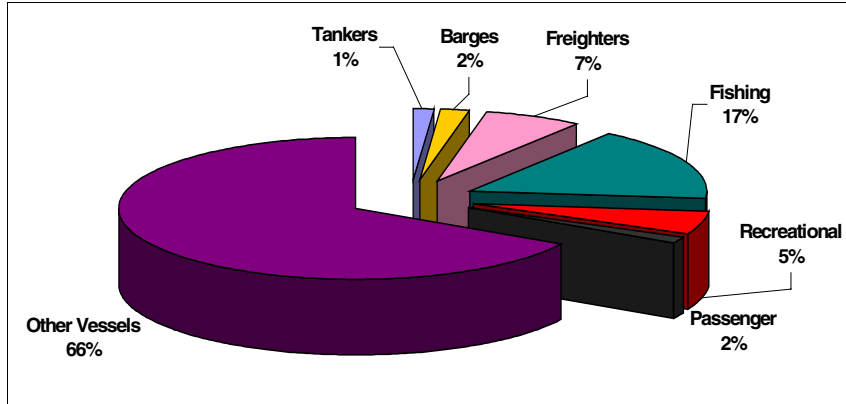


Figure 1. A relative percentage of numbers of oil spills into Washington State waters by vessel type (1985–1999) (Environmental Research Consulting Database).

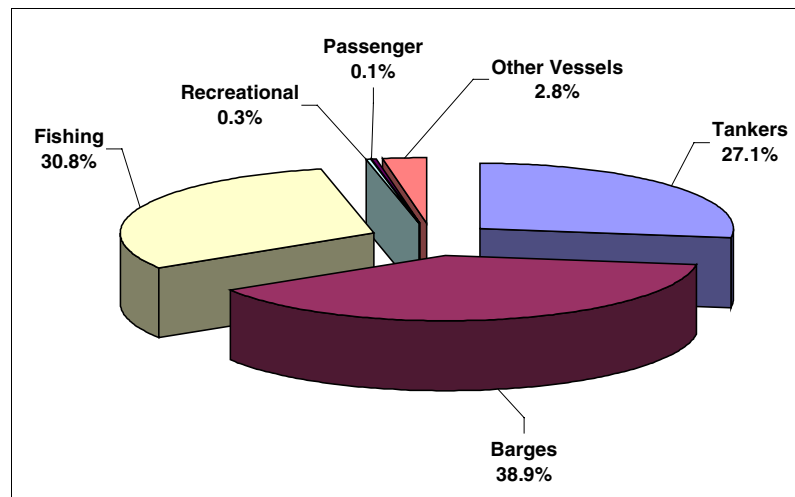


Figure 2. Relative amounts of oil spilled into Washington State waters by vessel type (1985–1999) (Environmental Research Consulting Database)

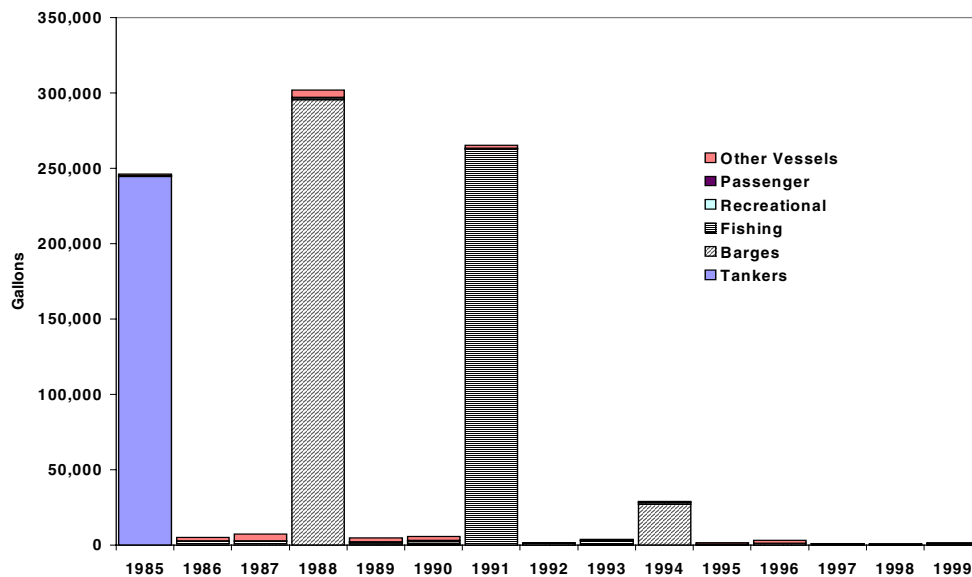


Figure 3. Total amount of oil spilled by vessels in Washington State waters (1985–1999) (Environmental Research Consulting Database).

vessels decreased during 1990–1999, after having reached a peak in 1990 (Figure 4). There was a sharp decrease in 1992 immediately after the state program was established. Lower spill rates recorded in 1985–1986 probably were due to lower reporting rates—a trend seen in national data as well.

The spill trend largely is influenced by spills of 1–9 gallons from unclassified vessels (Figures 5–7). With the number of all spills going down, the relative percentage of spills in this smallest size class has risen since 1985. Again, as in the United States as a whole, some, if not most, of this increase can be attributed to increased enforcement and reporting of these types of smaller spill events. As with U.S. data, the smallest spills represent the greatest numbers while in total making up a relatively small

amount of the total oil spillage in terms of volume. Nearly 72% of the number of spills is comprised of spills less than 10 gallons in size, though these smaller spills only comprise 0.7% of the total amount spilled during 1985–1999. Spills of 100,000 gallons and up comprise over 72% of the total volume, spills of 10,000 gallons and up comprise nearly 87% of the total volume, and spills of 1,000 gallons and up comprise nearly 92% of the total spillage. The average spill size was 258 gallons. According to Neel *et al.* (1997), there were four vessel spills over 10,000 gallons in the 7-year period from 1985 through 1991. In the 9 years since 1991, there has been only one vessel spill of that size in the state.



Figure 4. Annual number of vessel oil spills in Washington State waters (1985–1999) (Environmental Research Consulting Database).

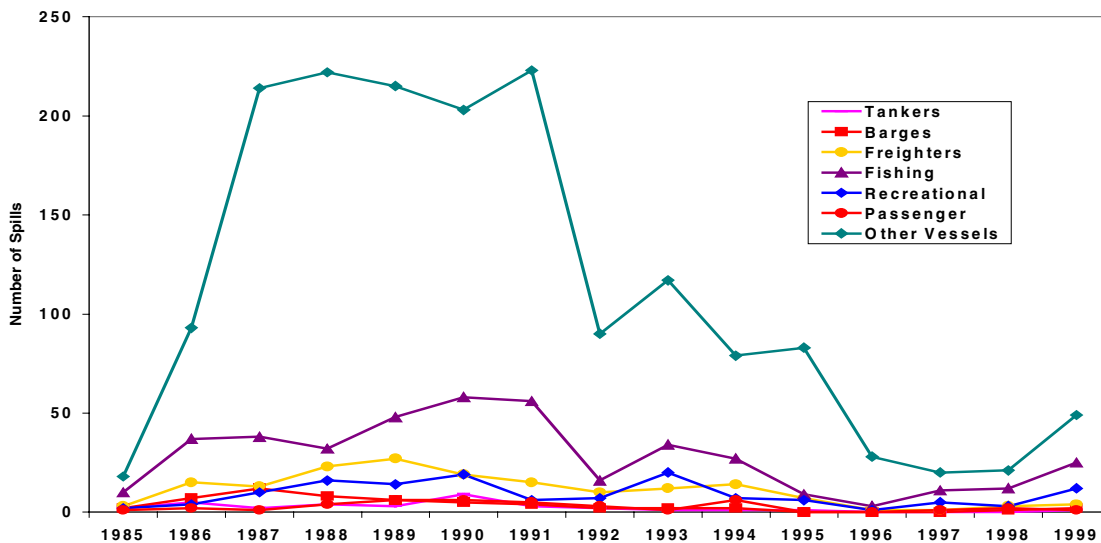


Figure 5. Annual number of vessel oil spills in Washington State waters by vessel type (1985–1999) (Environmental Research Consulting Database).

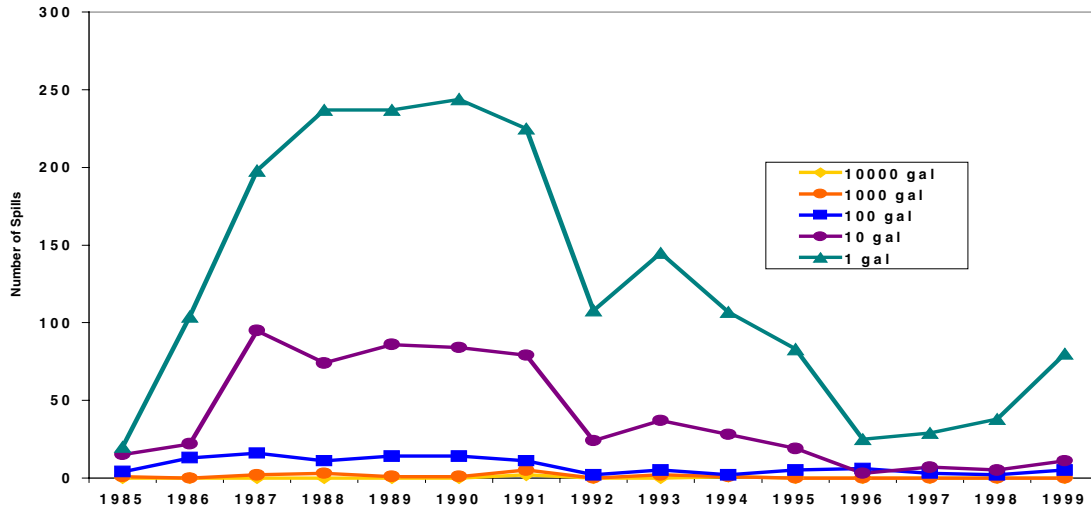


Figure 6. Annual number of vessel oil spills in Washington State waters by spill size category (1985–1999) (Environmental Research Consulting Database).

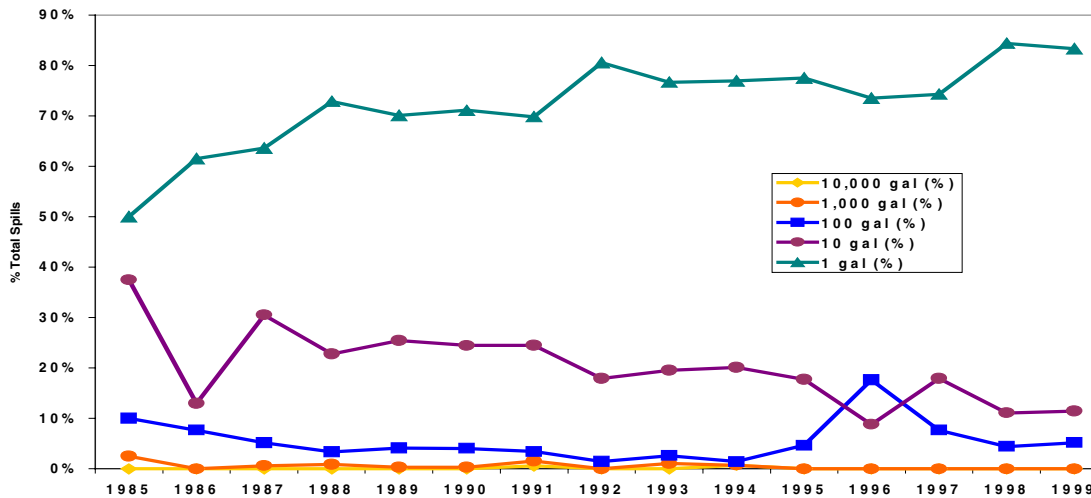


Figure 7. Percentage of Washington State vessel oil spills in different size classes (1985–1999) (Environmental Research Consulting Database).

In Washington, tanker traffic comprises only 7% of total vessel transits. Dry bulk vessels (38%), container vessels (32%), and other vessels (23%) make up the majority of the 9,480 annual vessel transits through Washington State waters, according to U.S. Army Corps of Engineers and Washington DOE data. The annual number of oil spills per vessel transit fell sharply between 1993 and 1996 and has risen slightly since then (Figure 8). There have been no tanker accidents in Washington State since 1993. Of the 21 groundings, allisions, and collisions that have occurred in state marine waters (Table 2), six have involved ferries, two have involved cargo vessels, five have involved fishing vessels, and eight have involved barges. Less than one-third of these incidents have resulted in oil spillage over 25 gallons.

Washington vessel spill rates relative to other states and the total United States. Spill rates per transit for vessels over 300 GRT

in Washington during 1992–1999 have been significantly lower than in the United States as a whole for tank vessels (including tank barges), freighters, and other vessels (see Figures 9–12). This relationship, however, does not always hold true when Washington is compared with the states of California, New York, and Texas specifically (Table 3). Washington’s spill rates are lower for all vessel categories except tankers and barges when compared to Texas. There is no significant difference between Texas and Washington in tanker spill rates for 1992–1999. Washington has lower rates than New York for tankers and other vessels, but there is no difference for vessels as a whole, and Washington’s freighter spill rates are significantly higher than New York’s in this time period. There is no difference between California and Washington in tanker/barge and freighter spill rates, though Washington’s rates are lower for other vessels and across all >300 GRT vessels.

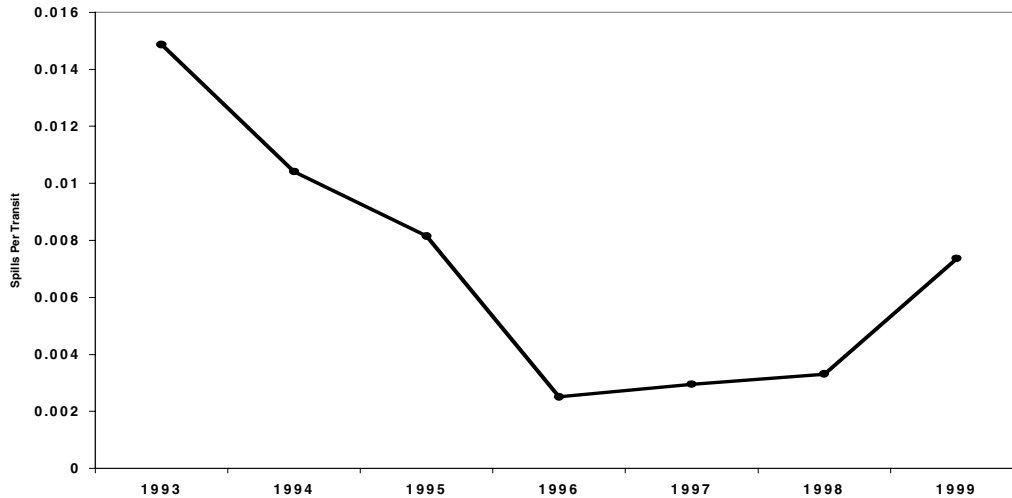


Figure 8. Annual oil spills per transit in Washington State waters (all vessels) (1993–1999) (Washington DOE transit data, Environmental Research Consulting spill data).

Table 2. Washington State vessel accidents (1994–2000) (Washington DOE data).

Accident type	No oil spill	With oil spill	Total incidents
Grounding	5	4	9
Allision	6	0	6
Collision	4	2	6
Total	15	6	21

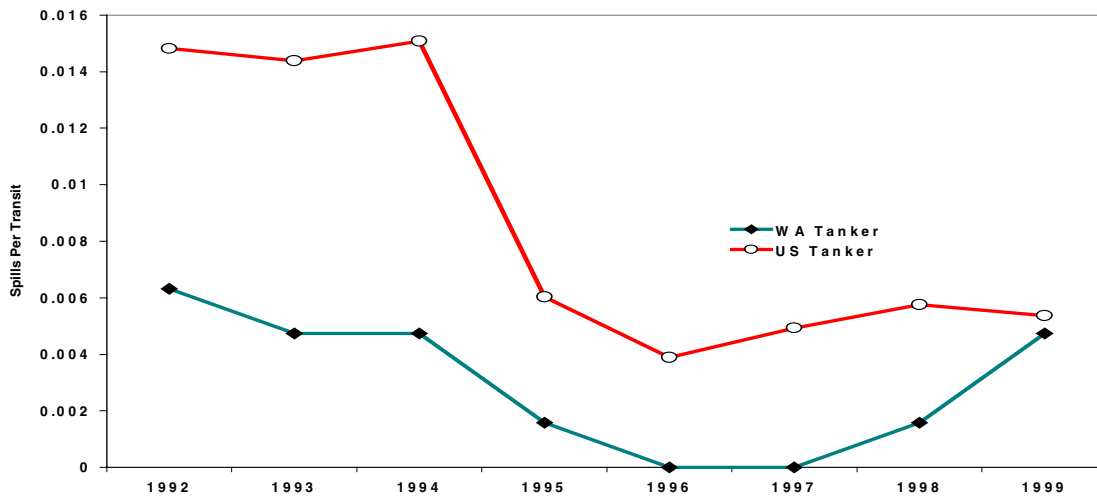


Figure 9. Oil spills per transit from tankers (1992–1999) (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

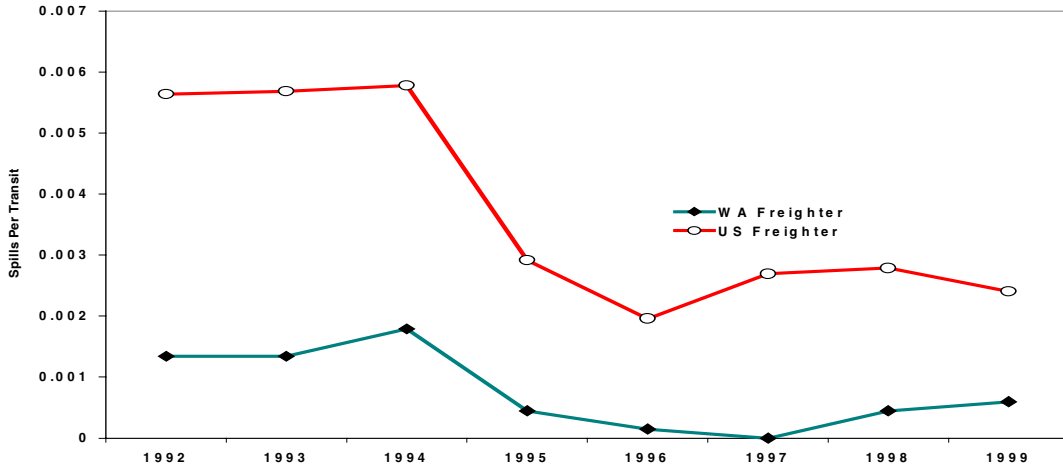


Figure 10. Oil spills per transit from freighters (1992-1999) (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

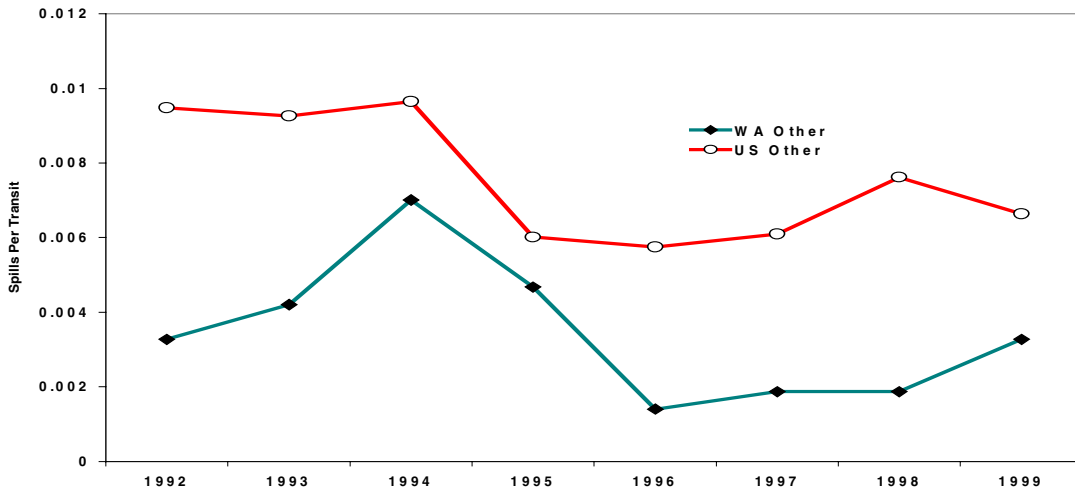


Figure 11. Oil spills per transit from other >300 GRT vessels (1992-1999) (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

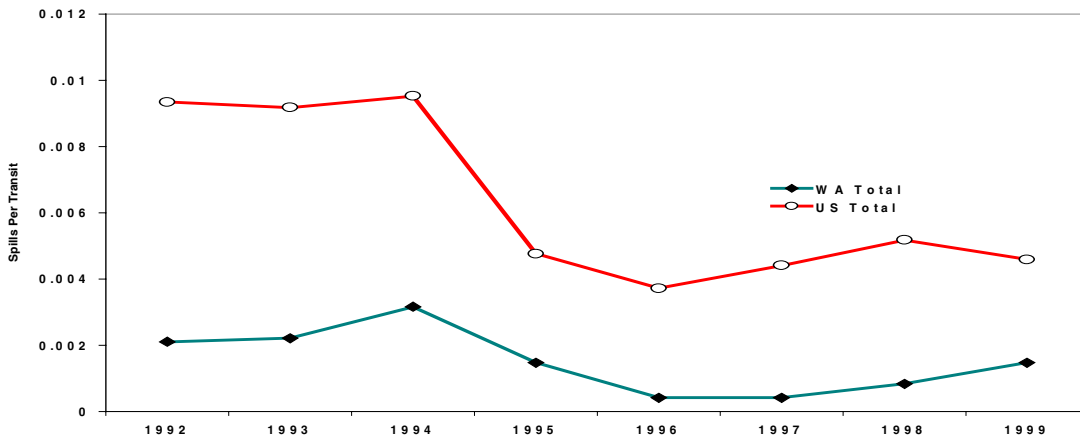


Figure 12. Oil spills per transit from all >300 GRT vessels (1992-1999) (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

Table 3. Analysis of Washington spill per transit trends (1992–1999) compared with California, New York, Texas, and the total United States (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

Vessel type	California	New York	Texas	Total United States
Tankers/barges	No difference	NY higher ($p < 0.05$)	No difference	US higher ($p < 0.001$)
Freighters	No difference	WA higher ($p < 0.01$)	TX higher ($p < 0.01$)	US higher ($p < 0.001$)
Other >300 GRT	CA higher ($p < 0.001$)	NY higher ($p < 0.05$)	TX higher ($p < 0.001$)	US higher ($p < 0.001$)
Total >300 GRT	CA higher ($p < 0.01$)	No difference	TX higher ($p < 0.05$)	US higher ($p < 0.001$)

Nationally, 0.79% of tanker transits between 1993 and 1999 resulted in oil spills, compared to 0.25% in Washington (Table 4), and 0.35% of freighter transits resulted in oil spillage nationally, while only 0.07% of freighter transits in Washington resulted in spillage. Spill rates from other vessels (>300 GRT) and all vessels of this size nationally were 0.73% and 0.59%, respectively, compared to 0.35% and 0.14% for Washington.

Between 1987 and 1999, the states of Texas and California followed similar trends in vessel spills (Figure 13), showing a reduction in spill numbers beginning in 1993. New York’s spill numbers were relatively constant during this time period. An analysis of the regressions of these curves show that Washington’s relative change in vessel spill numbers was over 5,000%, meaning that there were one-fifth the average annual number of spills of at least 25 gallons in the late 1990s as there were in the late 1980s (Figure 14). California, New York, and Texas and the United States as a whole also showed reductions, though not as dramatic as those in Washington. This also holds for spills of 1 gallon and over as well, though New York showed an increase in spills in this size category during 1987–1999.

All four states are significantly below the national average spillage per tonnage transport (1993–1999) for both spill numbers and amounts, though the states do not differ significantly in terms of amounts (Figures 15–16). Washington is equal to New York and somewhat lower than California in terms of number of spills per tonnage transport, though not as low as Texas, as state with

waterborne tonnage transport (over 427 million tons annually) four times as high as that of Washington, New York, and California.

Overall, Washington State appears to be significantly ahead of the United States as a whole in terms of reduction in the number of most categories of vessel spills, as well as by rates of spillage by tonnage transport and transit. Washington is ahead of the states of California, New York, and Texas in some categories of comparison but not others.

Discussion

The state of Washington’s vessel program was established by statute in 1990 and 1991 and enforcement sanctions went into effect at that time. California and Texas also have had active state vessel spill prevention programs (vessel traffic systems, high penalties, bunkering/lightering regulations), though the program in California came into effect during the latter half of the 1990s. Operators of vessels in Washington State waters were also immediately aware of the scope of the new state program and it (along with changes to the national and international regimes) began to influence marine safety even before the implementation of all statutes and regulations. A number of prevention program elements were phased-in over the next couple of years as

Table 4. Percentage of vessel transits resulting in oil spills (1993–1999) in Washington, California, New York, Texas and total United States (U.S. Army Corps of Engineers transit data, Environmental Research Consulting spill data).

Vessel type	Washington	California	New York	Texas	Total United States
Tankers/barges	0.25%	0.20%	0.43%	0.19%	0.79%
Freighters	0.07%	0.08%	0.00%	0.25%	0.35%
Other >300 GRT	0.35%	0.94%	0.19%	0.08%	0.73%
Total >300 GRT	0.14%	0.28%	0.19%	0.18%	0.59%

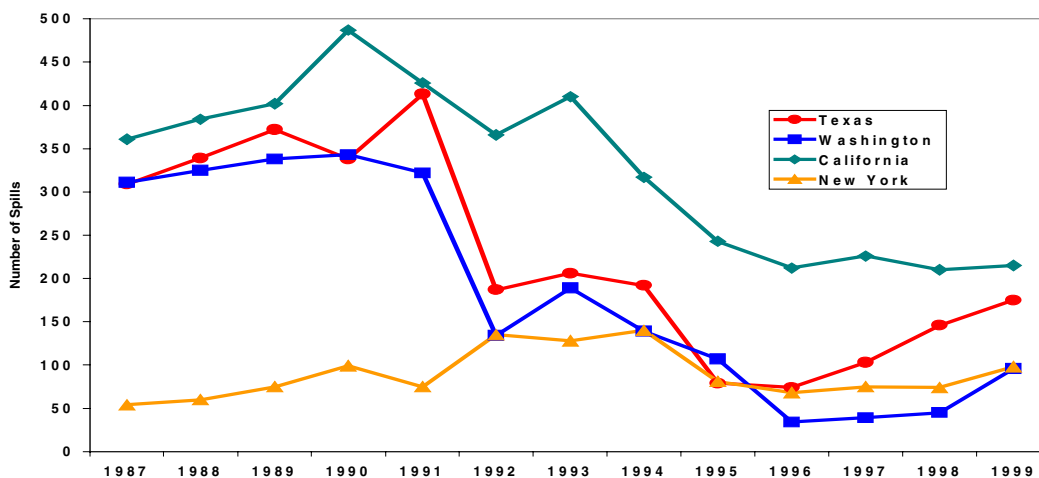


Figure 13. Annual number of oil spills from vessels (1987–1999) in Texas, Washington, California, and New York (Environmental Research Consulting Database).

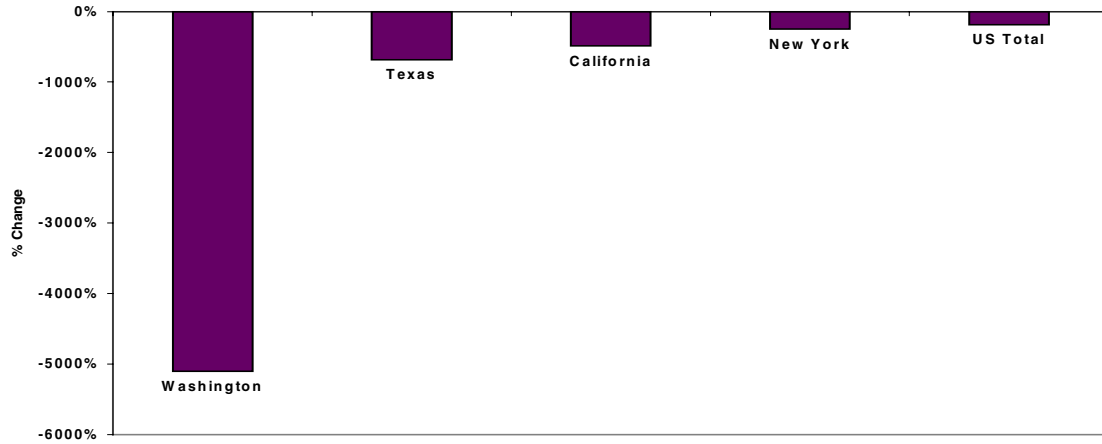


Figure 14. Percent change in vessel oil spills 25 gallons and over (1987–1999) (Environmental Research Consulting Database).

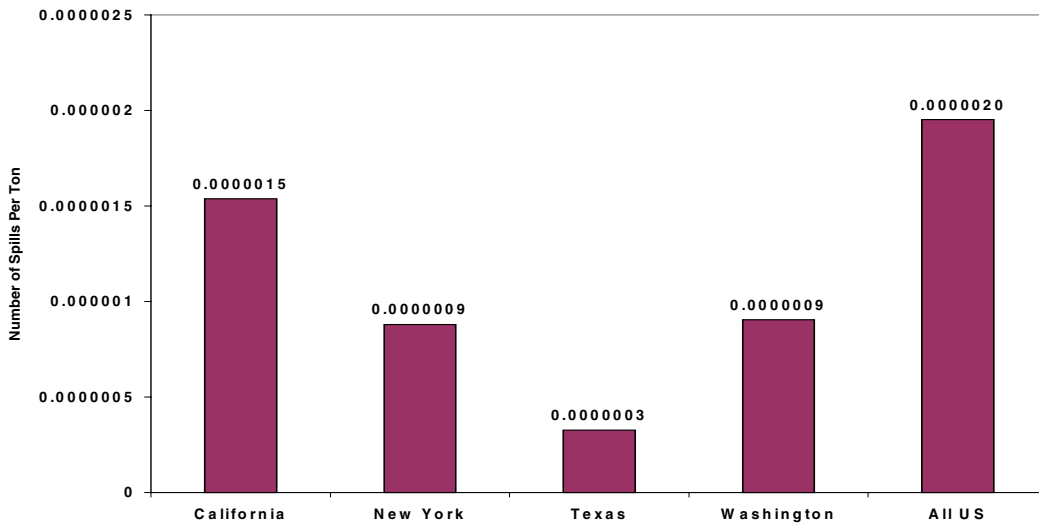


Figure 15. Annual number of oil spills per tonnage transport (1993–1999) (Environmental Research Consulting Database, U.S. Army Corps of Engineers tonnage data).

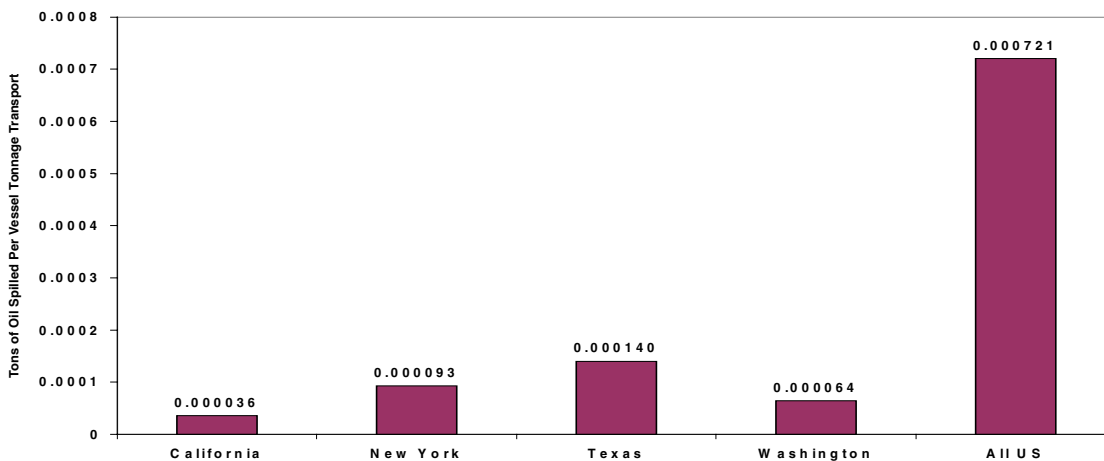


Figure 16. Annual amount of oil spilled per tonnage transport (1993–1999) (Environmental Research Consulting Database, U.S. Army Corps of Engineers tonnage data).

implementing regulations were drafted and finalized. The reduction in vessel spills was observed nationally, and even to some extent internationally, as a greater awareness of these incidents—and the magnitude of potential consequences—became realized.

It is not surprising that Washington data on spills per tonnage are only slightly below that of California, New York, and Texas. Unlike these other coastal states, Washington vessels must make a much longer transit through confined water of either the Strait of Juan De Fuca and Puget Sound or through the Columbia River to reach their port of destination. The longer transit provides a greater opportunity for operator fatigue, multiple potential grounding hazards, greater opportunity for mechanical malfunction, and increased traffic encounters—all of which increase the risk of spills.

The value of the results and conclusions in this study is limited by that fact that spill reporting was relatively inconsistent in the United States prior to 1990 and there continues to be a distinct lack of consistent data collection and management protocols.

Conclusion

Public and private sector investments in spill prevention in the state of Washington have reduced the incidence of spills significantly below national averages and generally below that of other coastal states with active spill prevention programs. If national and international regulatory regimes were applied with uniformity throughout the nation, one would conclude that Washington's program was very effective. However, the data sample size and spill incident details are below that required to clearly delineate the specific reasons for the benefits. The sharp decline in Washington vessel spills in 1992, immediately after passage and initial implementation of state legislation, is a potential indicator of the impact of the state program, particularly given that a similar decline in national spill rates did not occur until 1993 or 1994.

It is hard to demonstrate the value of spill prevention programs. The difficulty lies in the inability to count spills that have *not* occurred as a result of increased diligence on the part of

the private and public sectors. However, it is clear from this study that spill prevention programs do work and that the reduced frequency of major spills is not a reason for complacency, particularly in light of the projected increases in vessel traffic in Washington and throughout the United States in the years to come. The elevated public expectations by the citizens of Washington State for environmental protection and a high quality of life has resulted in better marine safety than in other coastal states.

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