An Analysis of the Oregon Coastal Exchange Requirement

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Produced for the
Oregon Ballast Water Task Force

by
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Introduction

This report was generated at the request of the Oregon Ballast Water Task Force to address the issue of coastal shipping and exchange requirements along the West Coast of North America. The Oregon Ballast Water Management Program was established by SB 895 during the 2001 legislative session to address the introduction of aquatic nuisance species when ballast water is discharged from ships.

There are several levels of ballast water management in the United States. There is a national program for ballast water management as established by the National Invasive Species Act of 1996. However, the national program does not address the issue of interstate vessel voyages. Therefore, California, Washington and Oregon have established, or are considering, coastal ballast water management requirements in state laws. These requirements differ from state to state, making compliance with these laws difficult and confusing to vessel operators. This report is an analysis of the Oregon coastal exchange requirement and a discussion of the feasibility of a unified West Coast ballast water exchange program.

Background

Ballast water has been recognized as an important mechanism for the transport and introduction of invasive species around the world. Large vessels are capable of transporting over five million gallons of ballast water per voyage. The United States first recognized this problem in the Great Lakes with the introduction of the zebra mussel. In 1996 the National Invasive Species Act (NISA) was passed to manage the transport of invasive species in ballast water, establishing a voluntary mid-ocean exchange program for transoceanic vessels operating outside of the EEZ (US Congress, 1996). NISA requests that all transoceanic vessels exchange their ballast water in mid-ocean (200 nautical miles from shore or in waters 2,000 meters deep). NISA does not address vessels operating within the EEZ, and therefore it does not address the transport of ballast

water via interstate commerce. There is concern about the role of coastal shipping trade in the dispersal of aquatic nuisance species (ANS) because of the existence of highly invaded estuaries on the West Coast. In response to these concerns, some states have established their own programs for the management of coastal ballast water.

Washington was the first West Coast state to establish a coastal ballast water exchange requirement. This law was established in 2001 and requires all vessels operating within the EEZ and planning to discharge ballast water from a coastal port to do an exchange of their ballast water at least 50 nautical miles from shore (WDFW, 2002).

Oregon followed Washington in recognizing the increased potential for aquatic nuisance species (ANS) transport between coastal ports. The Oregon Ballast Water Management Program (ORS 783.60) was passed into law in January of 2002. The Oregon law requires that owners and operators of certain vessels entering State waters must report the time and place that ballast water was taken on and released during the last voyage of the ship. In addition, this Law requires all coastal vessels entering Oregon ports and discharging ballast water from Alaska or Canada to do a ballast water exchange above 50 °N Latitude or if they are coming from California or Mexico, to do an exchange below 40 °N Latitude. Those vessel coming to Oregon from a Washington or Vancouver, B.C. port are not required to do an exchange to comply with Oregon law. No distance from shore is specified in the law for the coastal exchange requirement because of concerns that such a requirement would interfere with a major regional shipping lane or commercial fishing areas. These unique requirements of the Oregon and Washington laws make it difficult to develop a coast wide coastal ballast water program.

When the report on the efficacy of the Oregon Ballast Water Management Program in 2002 was being written for the Oregon Legislature, it was noted that the state coastal exchange requirements were points of contention for the West Coast. The feasibility of an alternative to the current Oregon requirement was discussed. However, representatives from the Oregon Ballast Water Task Force voiced concerns about distance requirements for coastal exchange on the basis that requiring vessels to move to a location 50 miles from shore would require vessels to cross or interfere with a major regional shipping lane. Therefore it was decided that the Oregon Ballast Water Task

Force would discuss the feasibility of a regulation for other coastal exchange options in further detail.

Subsequently, California and Washington have begun the reauthorization process for their ballast water management laws. California is discussing the possibility of adding a distance requirement for coastal exchange to their law. There are no indications that Washington is thinking of changing or removing their 50 nautical mile exchange requirement.

Coastal exchange options were discussed at the January 2003 meeting of the Pacific Ballast Water Group. The distance from shore option was determined to be the most feasible at this time. However, a consensus on an appropriate distance from shore for ballast water exchange was not reached due to the lack of scientific research to support such an alternative. One option discussed in detail, was a 20 nautical mile coastal exchange requirement with 50 nautical mile exchange requirements around protected or potentially sensitive areas (i.e.: marine sanctuaries, estuaries, etc.). This option is still being considered, yet there is not enough data available at this time to support the implementation of such an alternative.

Since a unified regional or unified coastal approach was identified as a priority in the Report on the Efficacy of the Oregon Ballast Water Program in 2002, the Oregon Ballast Water Task Force requested further analysis on the Oregon data from coastal shipping in 2002. Therefore, this report was generated from an analysis of the Oregon coastal shipping data in 2002. The feasibility of distance from shore for exchange regulations based on this analysis was examined.

Methods

Vessels entering Oregon waters from a coastal port in 2002 submitted a report of their ballast water management in that vessel voyage. The data from these reports was entered into a Microsoft Access database that was used to assess the efficacy of the program for the report to the Oregon Legislature that was submitted in January of 2003. However, for the purposes of this study, we only included the data from coastal vessels (vessels whose last port of call was a port on the West Coast of North America). To analyze the Oregon coastal exchange data, the points that coastal vessels reported as the

endpoint of their coastal exchange were plotted using GIS software, (ArcView 3.2). In ArcView, three views were created overlaying a country shapefile (ESRI data), a geo-referenced Pacific Ocean map and latitude/longitude lines. Data points were converted into decimal degrees in Microsoft Excel and a spreadsheet was made with the following parameters: the converted latitude/longitude data points, vessel type, last port of call and a vessel ID (random number generated). The spreadsheet was then separated into three worksheets by last port of call (i.e.: Californian/Mexican ports, Alaskan/British Columbian ports and Washington/Vancouver, B.C. ports) and data were imported into ArcView as three separate tables.

The data points could then be added as separate event themes in each view. The data points from separate tables were overlaid in separate views, providing a visual reference for exchange points along the coast based on the specific coastal exchange regulations for those vessels. For further detail on vessel compliance, a 50 mile buffer shapefile surrounding each country was added in order to give the viewer a quick visual guide for distance scale. The plotted exchange points were also given a unique value (color) based on vessel type. Three different layouts were generated from the views. These maps were visually assessed from the range of variability of the data points (See Figures 1-3).

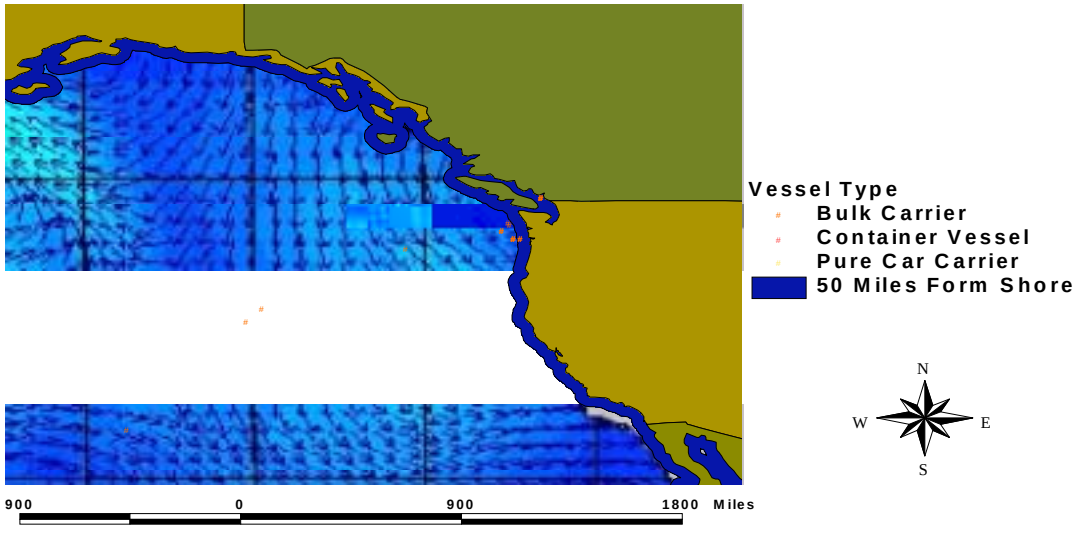

Figure 1. Exchange locations of vessels arriving in Oregon from ports in Washington or Vancouver, B.C. by vessel type between January 1 and October 31, 2002 with directional current flow.

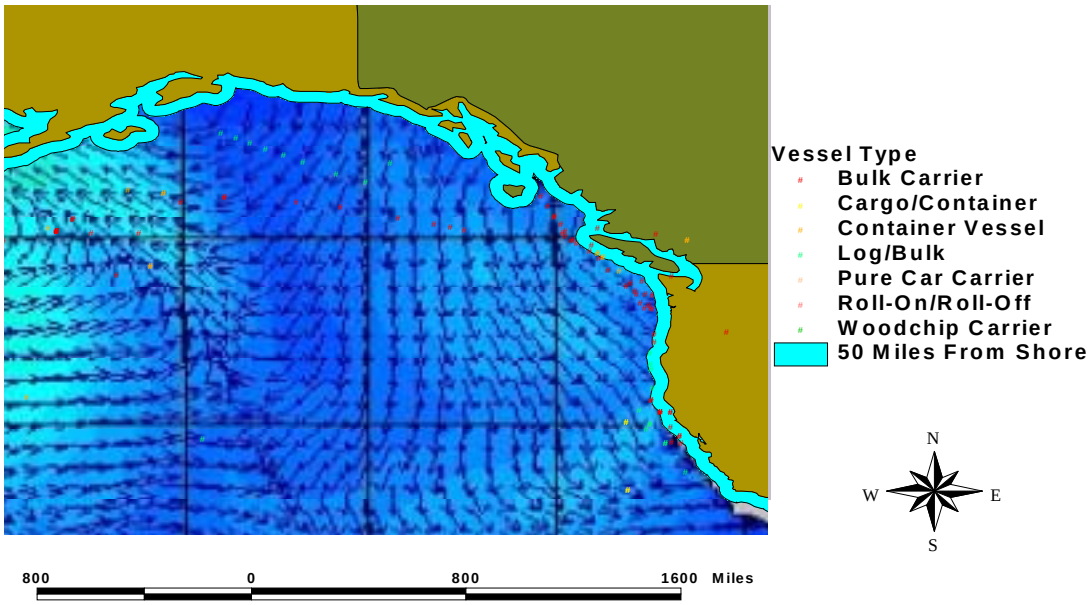

Figure 2. Exchange locations of vessels arriving in Oregon from ports in Alaska or B.C. by vessel type between January 1 and October 31, 2002 with directional current flow

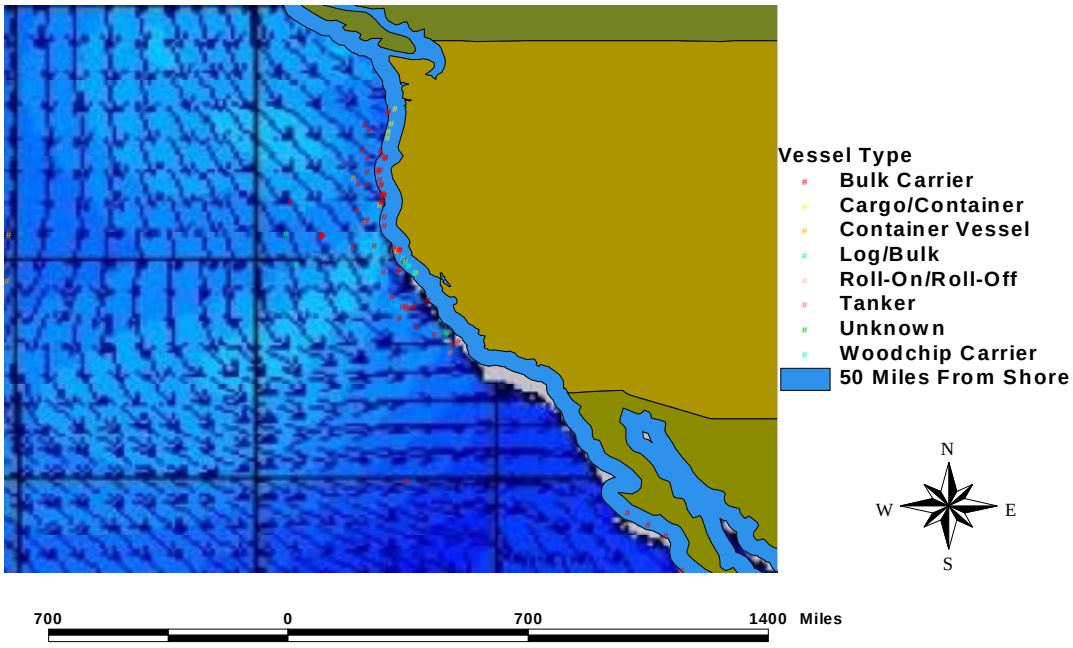

Figure 3. Exchange locations of vessels arriving in Oregon from ports in California by vessel type between January 1 and October 31, 2002 with directional current flow

The original data set for Oregon-bound coastal vessels included 423 vessels. Only 32 percent of these vessels were discharging ballast in Oregon and were therefore required to do an exchange prior to deballasting in Oregon waters. Nearly one quarter of these coastal reports are from vessels whose last port of call was in California. Only 34 of those California vessels were planning on discharging ballast in Oregon waters. There were a total of 82 tanks to be discharged from these 34 vessels.

Reported points for exchange locations that were positioned outside of a practical range of interstate or coastal travel (i.e.: those points that lay outside the EEZ or fell within the continental U.S.) were determined to be errors in reporting and were removed from the sample. The data set from those coastal vessels whose last port of call was in California was chosen for the final analysis.

The selection of this data set was based upon three factors. First of all, California ports are of high concern to Oregon for the transport of invasive species. Not only are these ports highly invaded, but also the transit times from California ports to Oregon ports are relatively short. These factors greatly increase the likelihood of the transportation of an aquatic invasive species from California. Secondly, nearly a quarter of the vessels coming to Oregon from coastal ports originated in California. And finally, upon a secondary visual analysis of the plotted exchange points (after the removal of those points determined to be unfeasible), this data set was the most representative of Oregon coastal shipping.

Preliminary Sampling

To determine the sample size needed to establish the mean distance from shore for coastal exchange, 15 exchange points were selected at random (via a random number generator in Microsoft Excel) to determine the average range of variation among data points. The sample size for the detailed study was determined by using the following equation: $n = [s^2 t^2_{\alpha(2),(n-1)}]/(d2)$ where s^2 is the variability in the population, $t^2_{\alpha(2),(n-1)}$ is the critical value of the t distribution based on a 95 percent confidence interval and an α of 2. The confidence interval selected was 5 miles (d = 2.5). Due to the high population variance, a smaller confidence interval is impossible to achieve based on the possible sample size. The estimated population variance is 131 miles (based on the highest value

of 146.91 miles and lowest of 15.20 miles). The initial hypothesized sample size was 100 necessary samples. When this was calculated:

$$n = \frac{(130)(1.984)^2}{(2.5)^2} = 81.87 \text{ samples}$$

Therefore a subsequent estimate of 82 necessary samples was made:

$$n = \frac{(130)(1.990)^2}{(2.5)^2} = 82.37 \text{ samples}$$

Therefore, 82 samples were necessary to achieve a 95% confidence interval no wider than 5 miles (Zar, 1999). Since this value was the same as the total sample size, the entire sample was used for the detailed analysis.

Detailed Analysis

A spreadsheet of the data points was created (in Microsoft Excel) from the original data table with an additional parameter entitled "distance from shore." Using the measuring tool in ArcView, the distance from each data point to the shore were measured. The identify tool was used to categorize each data point by its unique id number. Then the distance from shore (in miles) was recorded in the spreadsheet under the corresponding id number.

Results

The range of distance for exchange of the California coastal vessels was from 15.20 miles to 146.91 miles from shore. The mean distance that coastal vessels from California exchanged from shore was 49.9 miles. The median distance was 56.8 miles from shore. According to this study, there are two main "shipping lanes" that vessels travel. One lane occurs at approximately 30 miles from shore and the other occurs between 70 and 80 miles from shore (Figure 4).

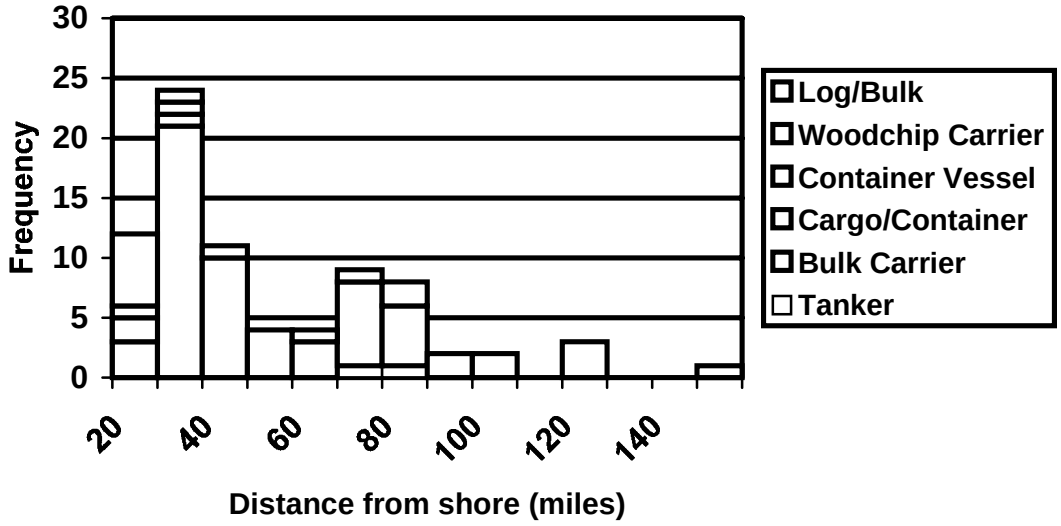

Figure 4. Frequency of distance from shore for exchange of vessels arriving in Oregon from California by vessel type between January 1 and October 31, 2002.

Most of the coastal traffic is bulk and container vessels. From the histogram in Figure 4, it is apparent that while bulk carriers make up the majority of the traffic, there are some vessel type-related patterns to distance from shore traveled. All of the woodchip carriers exchanged closest to shore, while all tankers exchanged at the 70-80 mile zone. This data must be analyzed with the number of vessels for each vessel type in mind. In examining the box and whisker plot in Figure 5, it is apparent that while there is variation in distance from shore by vessel type, these differences are minor due to the high variation in exchange distance even within vessels of the same type.

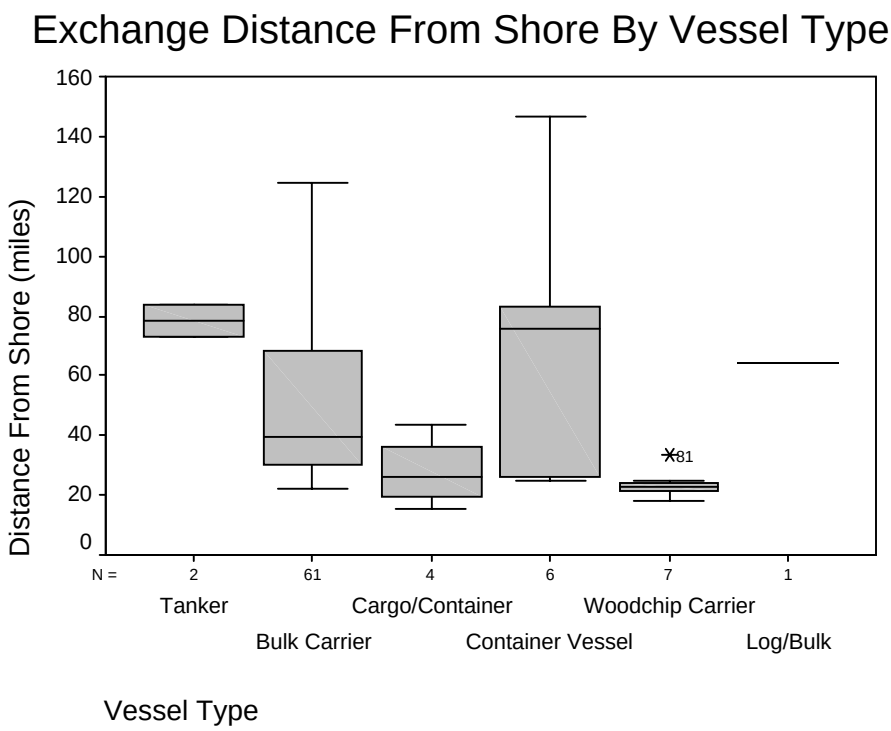

Figure 5. Exchange distance from shore of California coastal vessels by vessel type with associated sample size (n) values between January 1 and October 31, 2002.

To assess the relative feasibility of various distance requirements for coastal exchange several parameters were examined. The possibility of any vessel type-related trends in distance from shore that the vessels were performing an exchange was evaluated. Since the majority of the vessels were bulkers for this data set, this vessel type was the only vessel type that had large enough vessel numbers (n) to make such a trend analysis. The bulk carriers had a mean distance from shore of approximately 40 miles. We also looked at the number of vessels that would have to alter their normal shipping routes to comply with alternative exchange locations (Figure 6).

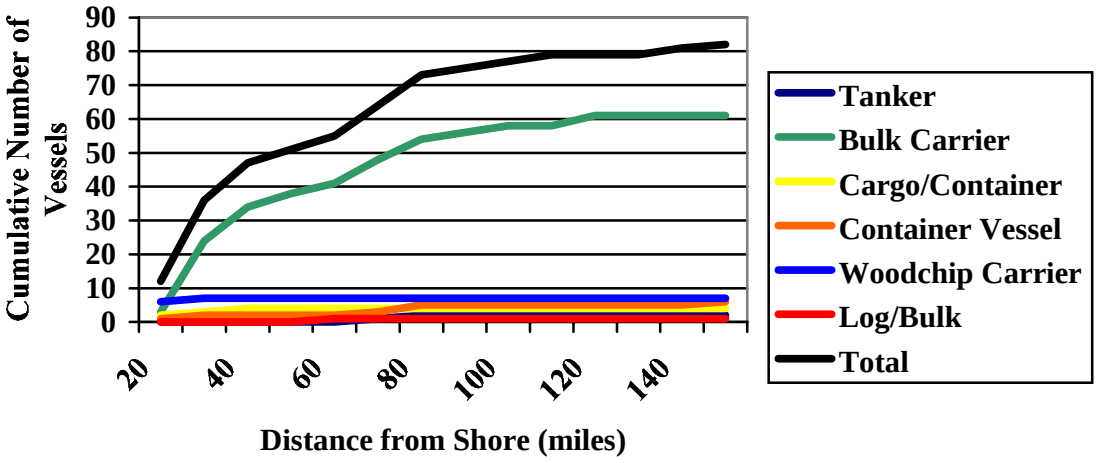

Figure 6. Cumulative number of vessels and relative distances from shore by vessel type between January 1 and October 31, 2002.

Discussion

The purpose of this study was to examine the feasibility of imposing a coastal exchange distance requirement on the West Coast. This study was based only on exchange locations reported for vessels arriving in Oregon from California ports between January and October of 2002. Yet, these statistics do give insight into the regular shipping paths of West Coast vessels and exchange patterns. The two most commonly suggested regulatory distances for exchange of ballast water for vessels on coastal voyages is either 20 miles from shore or 50 miles from shore. The feasibility of these options is discussed below.

To achieve a 20 nautical miles from shore minimal exchange distance, only 2 vessels, approximately 2 percent of all of the vessels examined, would have to alter their shipping patterns to comply. These two vessels (a woodchip carrier and a cargo/container ship) would have to move away from shore an average of 3.5 miles from their previous route of travel. Since nearly 98 percent of the vessels would not have to alter their paths, this seems to be a feasible option for coastal regulation.

To achieve a 50 nautical mile form shore minimal exchange distance, 50 vessels, approximately 61 percent of all of the vessels examined, would have to alter their shipping routes to comply. These vessels would have to move away from shore and

average of 13.5 miles from their previous route of travel. This would likely raise more concern in the shipping industry than the 20 nautical mile requirement.

Conclusion

Based on this analysis it is likely that more vessels would be able or more willing to comply with a 20 nautical mile exchange requirement than a 50 nautical mile exchange requirement. However, the proposed 20 nautical mile coastal exchange requirement with 50 nautical mile exchange requirements around protected or potentially sensitive areas does seem possible. Yet further scientific findings supporting the effectiveness of a distance from shore regulation is still necessary to justify such an alternative

Coastal ballast water management is undoubtedly going to be a continued issue for the future of invasive species management on the West Coast of the United States. It is clear that a unified West Coast ballast water management program is important to the successful limitation of transport of invasive species via interstate coastal traffic. However, it is not clear at this point how the West Coast will achieve such unity. To this end, this analysis is presented as a summary of the Oregon coastal exchange data as it pertains to the feasibility of distance regulations for the West Coast.

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