

A new tool for invasive species risk screening in ballast water

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Vessels may transport invasive species between ports in ballast water

Ballast water is pumped onboard a vessel to maintain stability, draft, and trim during a voyage. It is most often used when the vessel is not transporting cargo. Ballast water is discharged at the destination port when cargo is loaded. Organisms in the water are also loaded, transported, and discharged between locations.



<https://www.ventevilleballastwater.com/regulations/>

3 primary risk factors influence organism survival in a new location: habitat suitability, propagule pressure, and species viability

A species is more likely to survive if (1) the environmental conditions are similar to its origin, (2) a large number of the species is discharged at once or the same species is discharged frequently, and (3) the species is able to function and reproduce once discharged.

Ballast water discharge in the Columbia River

is commonly sourced from ports in China, Japan, South Korea, and California. These ports have similar water temperature and salinity as the Columbia River. Ballast water from Asia is typically older than water from CA. The ports of Portland, Longview, Kalama, and Vancouver received the majority of this ballast water.



We created a risk scale for vessels that discharge ballast water in freshwater and estuarine ports in Oregon¹

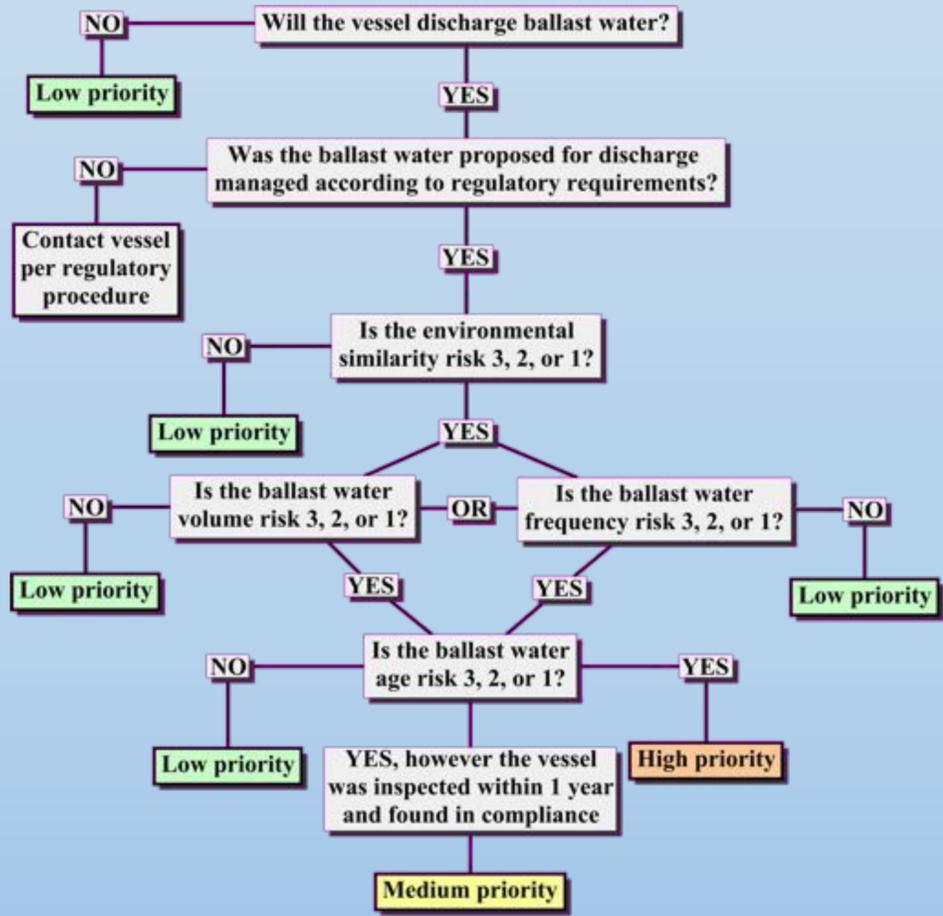
The primary ports for oceangoing vessels are on the lower Willamette and Columbia Rivers near Portland, the lower Columbia River at Astoria, and on the coast at Coos Bay. We used mandatory ballast water data submitted by vessels and collected by the Oregon Department of Environmental Quality during 2016. We assigned each factor an uncertainty value based on the current state of knowledge about its influence to invasive species risk.



	Very Low (5)	Low (4)	Medium (3)	High (2)	Very High (1)	Uncertainty	Method
Environmental distance	> 4	3 – 4	2 – 3	1 – 2	0 – 1	Low	Temperature and salinity similarity between source and discharge ports ²
Volume (m ³)	< 2,000	2,000 – 4,600	4,600 – 9,900	9,900 – 17,200	> 17,200	Medium	Relative scale of 20 th , 40 th , 60 th , and 80 th percentiles of ballast water discharge
Frequency (m ³ /month/source location)	< 3,300	3,300 – 10,600	10,600 – 22,400	22,400 – 67,700	> 67,700	Medium	
Age (days)	> 20	15 – 20	10 – 15	5 – 10	1 – 5	High	Days between source & discharge date

We arranged the risk factors into a decision tree for real-time assessment of arriving vessels

The factors are arranged by increasing uncertainty level. The decision tree also considers whether the vessel has properly managed its ballast water (this may vary by vessel route or jurisdiction). Importantly, with an appropriate risk scale per location, the decision tree is transferable to other port systems. Vessels are prioritized as low, medium, or high for compliance verification or inspection by regulatory personnel. In 2016, 24% of vessels that arrived in Oregon at our focus ports (233 of 953) were medium or high priority.



¹Adapted from Verna et al. 2016, ²Sensu Keller et al. 2011