Understanding Factors that Motivate Participation of Container Ships in the Quiet Sound Voluntary Commercial Vessel Slowdown

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Abstract

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This thesis seeks to understand the factors that motivate container ship participation in the Quiet Sound voluntary vessel slowdown, given that container ships account for the majority of vessel transits and are the largest contributor of anthropogenic underwater noise among target vessels. The goal of this research is to inform and improve program design and engagement with the shipping industry to increase the impact of the slowdown. This qualitative case study developed an analytical framework to understand the impact of various factors on motivation to participate, including: Program characteristics, information sharing and exchange, operational factors, external influences, and intrinsic values. Sustainability reports and websites of 18 shipping lines calling Puget Sound ports, 6 vessel agents, the Ports of Seattle and Tacoma and the Northwest Seaport Alliance were analyzed. Key informant interviews were conducted with representatives from: Shipping lines, a shipping association, pilotage authority, the ECHO program, the Ports of Seattle and Tacoma, and the Northwest Seaport Alliance.

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Positionality

I am a white researcher of settler descent from coastal Connecticut, the ancestral land of the Mohegan and the Mashantucket Pequot peoples. I have resided in Seattle for nearly a decade, the traditional lands of Coast Salish nations. For over five years, I had the privilege of living on a sailboat in Shilshole Marina on Duwamish ancestral territory, which fostered my connection to our shared waters. That said, I am not a commercial mariner and therefore my perspective is heavily informed by experiences of others, not my own. I recognize that Seattle's industrial maritime heritage is a story of both pride and injustice. The rise of maritime trade and the

livelihoods it subsequently supported cannot be disentangled from the displacement of Indigenous peoples and degradation of environmental and cultural resources.

Conflict of Interest

I am employed by Washington Maritime Blue, the non-profit organization which administers the Quiet Sound program. Washington Maritime Blue is a strategic alliance propelling the Pacific Northwest toward global leadership in ocean-based innovation. Quiet Sound is a non-regulatory coalition whose goal is to better understand and reduce the cumulative effects of acoustic and physical disturbance from large commercial vessels on Southern Resident killer whales throughout their range in Washington state. At the time of writing, I am a Program Manager for Quiet Sound, where my responsibilities include administering the voluntary commercial vessel slowdown in Admiralty Inlet, the focus of this thesis research. Interview respondents were informed of this potential conflict of interest prior to participating.

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Executive Summary

Marine mammals use sound as their primary means of communication, foraging, socialization, and navigation (*GloNoise Partnership*, n.d.). Commercial shipping is the largest contributor to anthropogenic underwater noise (Hildebrand, 2009). Container ships account for most underwater noise generated by shipping (Jalkanen et al., 2022). The Southern Resident killer whales (SRKWs), listed as endangered in 2005, are a unique ecotype of killer whale found only in the area from central California to southeast Alaska that feed primarily on protected Chinook salmon. The SRKWs have immeasurable cultural and spiritual importance to Indigenous communities throughout the Salish Sea. Underwater noise is identified as one of the three major threats facing the endangered SRKWs, among prey availability and contaminants in their food and water. Low frequency sound generated by vessels overlaps with frequency ranges used by SRKWs, resulting in temporary or permanent hearing loss, increased stress response and disruption to foraging and breeding (NOAA Fisheries, 2025a).

Small reductions in vessel speed produce significant reductions in underwater noise (Findlay et al., 2023). Quiet Sound, a program of the nonprofit Washington Maritime Blue, administers a voluntary slowdown in Admiralty Inlet and north Puget Sound to reduce acoustic and physical impacts from large commercial vessels during months when SRKW are most commonly present. In the 2023-24 slowdown, 71% of vessel transits reduced their speed and 59% of vessel transits fully met the suggested speed targets, which resulted in a 50% reduction in median broadband sound levels (Quiet Sound, 2024). Container ships represented nearly half of the vessel transits (405 of the 843) through the slowdown zone from October 12, 2023 to January 12, 2024. Of those 405 transits, 272 container ship transits fully reached target speeds, a 67% participation rate (Quiet Sound, 2024). According to Quiet Sound's acoustic analyses, container

ships were the third largest contributor to vessel-generated underwater noise in Puget Sound during the 2023-24 baseline period.

This thesis seeks to understand the factors that motivate container ship participation in the Quiet Sound voluntary vessel slowdown, given that container ships account for the majority of vessel transits and are the largest contributor of anthropogenic underwater noise among participating vessel types. The goal of this research is to inform and improve program design and engagement with the shipping industry to increase impact of the voluntary slowdown. This qualitative case study developed an analytical framework to understand the impact of various factors on motivation to participate, including: Program characteristics, information sharing and exchange, operational factors, external influences, and intrinsic values. Sustainability reports and websites of 18 shipping lines calling Puget Sound ports, 6 vessel agents, the Ports of Seattle and Tacoma and the Northwest Seaport Alliance were analyzed. Key informant interviews were conducted with 8 representatives from: shipping lines, a shipping association, pilotage authority, the ECHO program, the Ports of Seattle and Tacoma, and the Northwest Seaport Alliance.

While 12 out of the 18 shipping lines reported participating in voluntary speed reduction programs, only 2 mentioned the Quiet Sound program specifically in their annual reporting. Companies positioned their slowdown participation under efforts to protect biodiversity, typically in alignment with Sustainable Development Goal #14 Life Below Water. According to sustainability reports and company websites, 4 shipping lines have undertaken more extensive biodiversity assessments, but just 2 lines were Green Marine certified. Interview respondents viewed participation in the slowdown as a way to demonstrate action to protect biodiversity. Respondents expressed less interest in financial incentives and awards and more interest in public recognition. Respondents also expressed an intrinsic desire to reduce their impacts on

whales and a curiosity to understand more about how participation in the slowdown advances recovery efforts.

Operationally, 11 out of 18 shipping lines name slow-steaming as a strategy for fuel conservation and emissions reduction, specifically to meet Carbon Intensity Indicator (CII) requirements. Interview respondents noted that understanding the emissions reduction and fuel savings would be one more tool in their toolbox of reducing environmental impact. According to document analysis, route optimization allows shipping lines to avoid bad weather, minimize idling time outside ports and therefore save fuel, and meet berthing times all while participating in voluntary speed reduction measures. This was validated by interview respondents who noted scheduling delays as the primary reason for not participating in the slowdown, but typically there was enough buffer in the schedule to accommodate participation when planned ahead of time.

Recommendations for the Quiet Sound program, which may be relevant to other voluntary vessel speed reduction programs, include:

- Communicate how reducing speeds benefits whales throughout the slowdown, especially when the SRKW are confirmed to be in the slowdown zone.
- Quantify the emission reduction and fuel savings co-benefits of the slowdown.
- Establish multiple points of contact within shipping lines, including building relationships with Operations Managers and Sustainability Leads.
- Celebrate shipping line participation publicly in places where stakeholders, shareholders, and competitors can see.
- Point companies to underwater noise reduction frameworks like Green Marine as a way to not only receive further acknowledge participation in voluntary speed reduction programs but also to guide future underwater noise mitigation efforts.

Background

Commercial Shipping and the Pacific Northwest

Maritime shipping is recognized as the most cost effective and carbon efficient means of moving cargo (*Sustainable Shipping*, n.d.). It is the backbone of international trade, moving 80% of the world's cargo (United Nations Conference on Trade and Development, 2021). Washington's maritime industry is a significant driver of the state's economy. In 2022, the maritime sector supported 174,300 jobs, $14.4 billion in labor income, and $45.9 billion in revenue (McKinley Research Group, 2023). Washington's maritime logistics and shipping sector alone employed 23,500 people within 980 businesses and was responsible for almost $3 billion in labor income and $9.4 billion in revenues (McKinley Research Group, 2023). Logistics and shipping activities include export of inland products, such as grain, operation of tugs and pilotage vessels for safe movement of cargo, receiving of international imports, reorganizing of cargo into appropriate container units by stevedores, drayage trucking and rail support for long-distance transport of goods, port and harbor operations, and storage (McKinley Research Group, 2023)

The Northwest Seaport Alliance (NWSA), a partnership between the Ports of Seattle and Tacoma, is the fourth-largest container gateway in North America (McKinley Research Group, 2023). NWSA serves 47 direct port connections, connecting the U.S. to Canadian and Asian markets, as well as Alaska and Hawaii to the continental U.S. (The Northwest Seaport Alliance, 2024b). In 2023, NWSA handled 3 million twenty-foot equivalent units (TEUs) of containerized cargo over the course of 868 container vessel calls (The Northwest Seaport Alliance, 2024a). Fourteen international container carriers call the Ports of Seattle and Tacoma on a weekly basis, including: ANL, CMA CGM, COSCO SHIPPING Lines, Evergreen Line, Hapag-LLoyd, HMM,

Maersk, Mediterranean Shipping Co. (MSC), Ocean Network Express (ONE), OOCL, SM Line, Swire Shipping, UWL, and Yang Ming Line (*Ocean Carriers*, 2025). Four domestic container carriers provide regular service between Seattle and Tacoma and Alaska and Hawaii, including: Alaska Marine Lines, Aloha Marine Lines, Matson, and TOTE Maritime Alaska (*Ocean Carriers*, 2025).

Environmental Impacts of Commercial Shipping

Commercial shipping generates a number of negative impacts on the environment. This thesis takes a closer look at shipping's impact on whales and air emissions as these are the primary targets for vessel speed reduction programs.

Commercial Shipping Impacts on Marine Mammals

Commercial shipping is responsible for most anthropogenic underwater noise, with other significant sources including oil and gas exploration, construction, and military sonar (Hildebrand, 2009). An analysis of 1,500 ships found that half of underwater noise was generated by 15% of the fleet (Veirs et al., 2018). Container ships accounted for 43% of those gross noise polluters, more than any other vessel class (Veirs et al., 2018). These vessels generate sound predominantly in lower frequencies—less than 80 hertz (hz). Since the 1960s, low frequency noise has increased in the North Pacific Ocean by 10-12 decibels (dB) (Transport Canada, 2020). According to an analysis of noise emissions from ships from 2014-2020, underwater noise from commercial shipping is expected to double every 11.5 years (Jalkanen et al., 2022). This is due to an increase in both the number of ships and the size of ships, since larger ships typically produce more noise (Kaplan & Solomon, 2016). Most ships can reduce their broadband source level by one dB for every knot in reduced speed (Veirs et al., 2016).

Marine mammals use sound as their primary means of communication, foraging, reproduction, and navigation (*GloNoise Partnership*, n.d.). The low frequency sound generated by large commercial vessels overlaps with the frequency ranges used by marine mammals, including frequencies used for echolocation by Southern Resident killer whales (SRKWs) (*GloNoise Partnership*, n.d.; Veirs et al., 2016). This can result in temporary or permanent hearing loss, increased stress response, and disruption to foraging and breeding (NOAA Fisheries, 2025b). In addition to impacts from underwater radiated noise, accidental collisions, or vessel strikes, threaten whale populations (Walker et al., 2019). An analysis estimated that government-led collision-prevention policies exist for less than 10% of areas of concentrated whale presence globally (Nisi et al., 2024).

Commercial shipping lanes in Washington waters overlap with SRKW critical habitat (NOAA Fisheries, 2025a). In Puget Sound, as background noise from vessels increases, SRKW call amplitude also increases, meaning that SRKW are expending more energy in noisy environments (Holt et al., 2008). When vessels are within 400 yards, SRKW make fewer dives and spend less time deep foraging (NOAA Fisheries, 2021). A 2024 study found that for each decibel increase in vessel noise, search for prey increased by 4%, but pursuit by female SRKW decreased by 58% and successful prey capture decreased by 12.5% (Tennessen et al., 2024). These studies demonstrate how vessel noise increases the metabolic demand of foraging while reducing the pay-offs. Failure to meet energetic requirements, particularly for reproductive females, threatens their health and that of their calves. Beyond noise, vessel presence and use of echosounders, devices that use sonar to detect fish and measure bottom depth, also impact foraging abilities (Holt et al., 2021).

Air Emissions Generated by Commercial Shipping

In 2018, the shipping industry accounted for 3% of anthropogenic CO_2 emissions globally (*Maritime Shipping*, n.d.). The industry's greenhouse gas (GHG) emissions are projected to increase 16% from 2018 to 2030, and 50% by 2050, largely due to growing reliance on natural gas as marine fuel (*Maritime Shipping*, n.d.). According to OECD, container ships represent the largest share of CO_2 emissions at over 20% in 2022, as compared to other ocean-going vessel types (Clarke et al., 2023).

About the Southern Resident Killer Whales

Regional and Cultural Significance of the Southern Resident Killer Whales

The Southern Resident killer whales, *Orcinus orca,* are a unique ecotype of killer whales found only in the area from central California to southeast Alaska. Unlike the other orca ecotypes in Washington State, offshore and transient (Bigg's) killer whales, SRKWs primarily eat Chinook salmon, *Oncorhynchus tshawytscha***,** a species that is also in decline in the Pacific Northwest (*Southern Resident Killer Whale Task Force*, 2025). SRKWs are a culturally significant species to Indigenous communities of the Pacific Northwest, including the Tulalip Tribes, Suquamish Tribe, Lummi Tribe, and Makah Tribe (Kalliber, 2018). Many Coast Salish Tribes regard the orcas as kin. As sovereign nations, Tribes have stewarded the lands and waters that have supported the orcas, and their primary food source Chinook salmon, since time immemorial. As an iconic Pacific Northwest species, the orcas are also a tourism draw for the region. The economic value of the whale watching industry in Washington and British Columbia is estimated to be over $200 million dollars (Martin Associates, 2024).

Path to Recovery

SRKWs were designated as endangered in Canada under the Species at Risk Act in 2001, and in the United States under the Endangered Species Act in 2005. They are one of NOAA Fisheries' Species in the Spotlight due to their elevated risk of extinction (NOAA Fisheries, 2025a). The live-capture of the 1960s and 1970s for amusement parks and aquaria flattened the population from 140 to 68 animals (NOAA Fisheries, 2025a). The population increased to 98 whales in 1995, but has been declining since (*Southern Resident Killer Whale Task Force*, 2025). In Washington, vessel approach regulations were first passed in 2011 and updated in 2025 (NOAA Fisheries, 2025c). The SRKWs were the subject of global attention in 2018 when the orca designated J35 carried her dead calf for nearly three weeks through Washington waters. Earlier that year, Washington Governor Jay Inslee created the Southern Resident Killer Whale Task Force to support recovery efforts in the state (*Southern Resident Killer Whale Task Force*, 2025). The Center for Whale Research's July 2024 census confirmed the current population at 73 individuals (*Southern Resident Orca (SRKW) Population*, 2024). Experts have identified three primary threats to SRKW recovery: Availability of their predominant prey species, Chinook salmon, contaminants in the food and water, and disturbance from noise and vessel traffic (*Recovery of Southern Resident Orcas*, 2025).

Washington State Regulations to Reduce Boater Disturbance of Killer Whales

Updated vessel approach regulations went into effect January 1, 2025 requiring recreational and commercial boaters, including kayakers and paddleboarders, in Washington waters: Stay 1,000 yards away from SRKW, adhere to a 7-knot speed while attempting to navigate out of their path, and disengage transmission if a SRKW approaches within 400 yards (RCW 77.15.740, 2024). The regulation is enforced by the Washington Department of Fish and

Wildlife (*Killer Whale Resources and Regulations for Boaters*, 2025). Commercial vessels transiting in vessel traffic lanes are exempt from this regulation.

Strategies to Address Underwater Radiated Noise

International Guidance to Address Underwater Radiated Noise

The International Maritime Organization (IMO) first developed draft voluntary guidelines for ship designers, shipbuilders, and ship operators to reduce underwater noise from shipping for the protection of marine life in 2014 and revised them in 2023 (Marine Environment Protection Committee, 2023). Most of the underwater radiated noise generated by ships operating at their designed ship speed is due to propeller cavitation, whereby the rotation of the propeller causes the formation and collapse of bubbles (Marine Environment Protection Committee, 2023). In addition to design considerations and noise-reducing technologies, IMO guidelines also address operational measures such as incorporating protected areas and speed reduction measures in route planning and reducing RPM, and therefore speed (Marine Environment Protection Committee, 2023).

Five international classification societies provide notations for underwater radiated noise: American Bureau of Shipping (ABS), Bureau Veritas (BV), Det Norske Veritas Germanischer Lloyd (DNV), Lloyd's Register (LR), and Registro Italiano Navale (RINA) (Ainslie et al., 2022). However, because the classifications differ in their methodology for measurement and reporting, they are not comparable, which reduces their utility (Ainslie et al., 2022). Reducing underwater noise made to lessen vessel impacts on marine animals is one of the performance indicators measured by Green Marine, a voluntary environmental certification program for the maritime

industry. Participation in voluntary slowdowns helps ship owners meet the second level of the underwater noise criteria (*Underwater Noise*, 2025).

Relationship Between Underwater Noise and Energy Efficiency

Many operational measures intended to reduce underwater radiated noise, including speed reduction, voyage planning and fleet management, also reduce fuel consumption and GHG emissions (Bouman et al., 2017). As speed increases above a vessel's hydrodynamic boundary point, hull resistance increases exponentially, and therefore fuel consumption becomes less efficient (Bouman et al., 2017). By reducing their speed 10%, a vessel can reduce fuel consumption by nearly 20% (*Speed Management*, 2024). In recent years, there has been increased attention on ship design and operational considerations that simultaneously address energy efficiency and underwater radiated noise (International Maritime Organization, 2023). In 2023, the ECHO Program commissioned Starcrest Consulting Group to conduct an analysis of the air emissions reductions resulting from their voluntary vessel slowdowns for SRKW conservation in Haro Strait/Boundary Pass and Swiftsure Bank. Results of analyses showed that the program's slowdowns could reduce greenhouse gas and air pollutant emissions (carbon dioxide, sulfur and nitrogen oxides, and particulate matter) by between 11% and 25% (Starcrest Consulting Group, 2023). Further, many vessel speed reduction programs in other regions target emissions in addition to whale conservation.

Per MARPOL Annex VI, beginning in January 2023, all ships are required to calculate their Energy Efficiency Existing Ship Index (EEXI) and collect data to annually report their operational carbon intensity indicator (CII) rating (*EEXI and CII - Ship Carbon Intensity and Rating System*, 2025). Speed and route optimization are measures vessels can employ to achieve a higher CII rating.

The Quiet Sound Voluntary Commercial Vessel Slowdown in Admiralty Inlet

Quiet Sound is a non-regulatory coalition whose goal is to better understand and reduce the cumulative effects of acoustic and physical disturbance from large commercial vessels on SRKWs throughout their range in Washington State (*About Quiet Sound*, 2025). The program was created in 2021 in response to recommendations from the Governor's Orca Task Force in Washington, which identified physical and acoustic disturbance from vessels as a major threat to the endangered SRKWs. Quiet Sound is a program of the non-profit Washington Maritime Blue. The strategic direction of Quiet Sound is set by the Leadership Committee, which includes representatives from state, federal, and tribal agencies, maritime industry, and conservation organizations. Quiet Sound program staff implement initiatives with guidance from a broad advisory group. This includes efforts to increase the number of SRKW detections and subsequent alerts to mariners, developing voluntary operational measures to reduce vessel impact, and promoting the adoption of vessel quieting technology.

In 2022, Quiet Sound implemented a trial voluntary slowdown where large commercial vessels were asked to reduce their speeds when transiting through Admiralty Inlet and north Puget Sound. In the trial slowdown, 70% of vessel transits reduced their speed and half achieved the recommended speed targets (Quiet Sound, 2023). Median broadband sound levels reduced by 2.8 dB, a 45% reduction in sound intensity (Quiet Sound, 2023). The SRKW were present in the slowdown zone for 45% of the slowdown period (Quiet Sound, 2023). Shipping industry representatives reported no impacts to maritime safety and minimal impacts to maritime trade. Following the success of the trial slowdown, Quiet Sound continued implementing annual slowdowns. Currently, the Quiet Sound slowdown is the only vessel speed reduction program in Washington waters targeting whale conservation.

The slowdown occurs seasonally in the months from October through January when SRKW most commonly utilize their Puget Sound habitat (Shields, 2023). In the first year of implementation, Quiet Sound's slowdown used a pre-defined start and end date. This was in response to industry's preference for predictability. The Quiet Sound program currently employs a dynamic start, in which the slowdown becomes 'in effect' when the SRKWs enter the Puget Sound for the season. This was done to further minimize disruptions to maritime trade. The slowdown's end date remains predefined though this may change in the future as the program adaptively manages the parameters of the slowdown.

Quiet Sound adopted the speed targets used by the Enhancing Cetacean and Habitat Observation (ECHO) program, administered by the Vancouver Fraser Port Authority. This provided two benefits: Simplified communication to mariners transiting through both British Columbia and Washington slowdowns, and capitalized on the research and engagement conducted by the ECHO program to validate the speed targets. Container ships, vehicle carriers, cruise ships are asked to reduce their speed to 14.5 knots speed through water, and general cargo, bulkers and tankers are asked to reduce their speed to 11 knots when safe and operationally feasible. The slowdown zone encompasses a 22 nautical mile stretch of the vessel traffic lanes in Admiralty Inlet and north Puget Sound (see Figure 1).

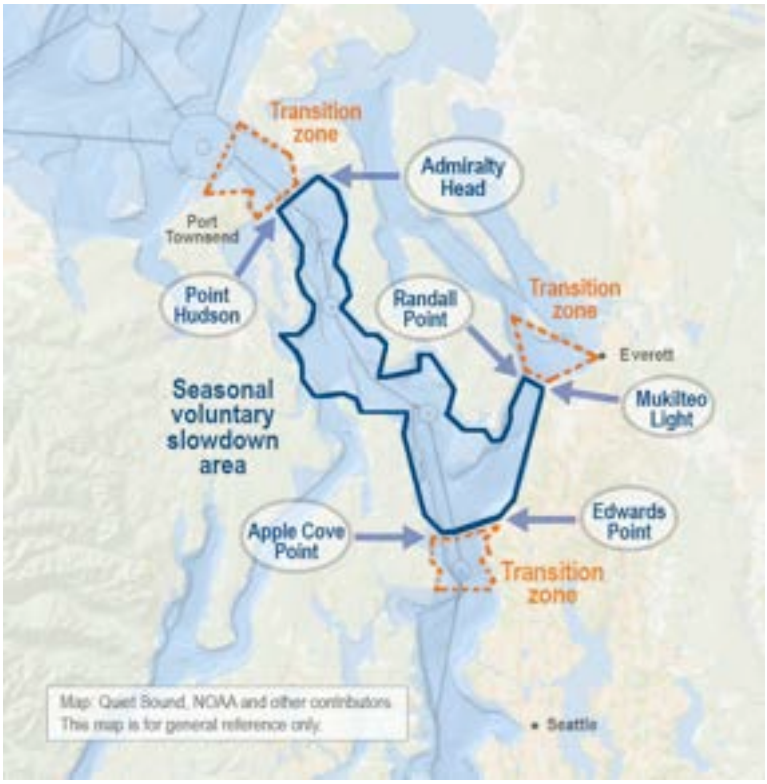

Figure 1. Map of the Quiet Sound voluntary vessel slowdown zone, 22 nautical miles in Admiralty Inlet and north Puget Sound (Quiet Sound).

Quiet Sound adaptively manages slowdown parameters, reviewing and revising each season. Parameters include the slowdown geography, vessel speed targets, dates in effect, and monitoring approach. The program debriefs with stakeholders who help implement the program to collate lessons learned and identify ways to improve. Proposed parameters and their rationale are presented to the Leadership Committee for approval. Quiet Sound disseminates parameters through a number of channels. The Marine Exchange of Puget Sound and Pacific Merchant Shipping Association (PMSA) share the parameters with their members. Quiet Sound works with the U.S. Coast Guard Sector Puget Sound to distribute a Local Notice to Mariners (LNM) and a Marine Safety Information Bulletin (MSIB). The Port of Seattle assists in the translation of

parameters into Greek, traditional and simplified Chinese, Russian and Tagalog and printing of the instructional brochure. The brochures are provided to the Puget Sound Pilots at the pilot station.

All foreign-flag commercial vessels and vessels engaged in international trade are required to have a Puget Sound Pilot on board between Port Angeles and Puget Sound ports. This includes bulkers, tankers, cruise ships, and container ships. The pilot's role is to work with the ship captain, or master, and crew to safely navigate the vessel either in or out of the Sound. A few hours prior to the vessel's scheduled arrival to or departure from a Puget Sound port, the shipping company or agent books a pilot. While the slowdown is in effect, pilots share the instructional brochure with each vessel they board. Pilots discuss participation with the master. At the end of the transit, pilots report whether or not the vessel participated in the slowdown.

At the start of the slowdown, Quiet Sound asked companies to indicate their 'Intent to Participate', a form that asks the company to identify vessels in its fleet and a contact person. The program uses this information to provide the company with their fleet's participation.

Quiet Sound deploys a passive acoustic recorder (hydrophone) in Useless Bay off Whidbey Island to measure changes in underwater noise during the slowdown and for a baseline period after the slowdown (Quiet Sound, 2024). Participation data is collected by the Puget Sound Pilots, who board all commercial vessels transiting through Puget Sound (Quiet Sound, 2024). SMRU Consulting calculates the number of transits who meet suggested speed targets using Automatic Information System (AIS) data provided by the Marine Exchange of Puget Sound, corrected for tides and currents (Quiet Sound, 2024).

In the 2023-24 slowdown, 59% of vessel transits fully met the suggested speed targets, which resulted in a 50% reduction in median broadband sound levels (Quiet Sound, 2024). Container ships represented the largest vessel class, accounting for 405 of the 843 transits through the slowdown zone from October 12, 2023 to January 12, 2024. Of those 405 transits, 272 container ship transits fully reached target speeds, a 67% participation rate (Quiet Sound, 2024).

Literature Review

I conducted a literature review to understand how the design and implementation of the Quiet Sound slowdown differed or aligned with other voluntary vessel speed reduction (VSR) programs, as well as existing research on factors that impact a firm's decision to participate in voluntary environmental programs. I searched Google Scholar using the following keywords: Vessel speed reduction program, VSR effectiveness, VSR incentives, container ship voluntary slowdown, and container ship slow steaming. I limited the search to studies published between 2000-2025. To draw meaningful conclusions relevant to the voluntary vessel slowdown implemented by Quiet Sound, I excluded studies regarding mandatory or regulatory programs, unless their methods included soliciting perspectives of shippers, liners, or vessel operators. I read abstracts to identify articles related to voluntary speed reduction program design, incentives, effectiveness and use of slow steaming by container ships. Reference lists of the selected articles were used to identify additional relevant literature. I categorized the findings from the literature review into concepts based on how they impact container ship motivation to participate in vessel speed reduction programs: Program characteristics, information sharing and exchange,

operational factors, external influences, and intrinsic values. These factors informed the analytical framework.

Vessel Speed Reduction Programs

Vessel speed reduction programs are an increasingly common strategy for reducing vessel impacts to whales. As of October 2024, there were at least 22 mandatory and voluntary governmental measures to reduce the negative impact of large commercial ships on whales around the world, as collated by the World Shipping Council (Mun, 2024). These include slowdown zones, areas to be avoided, and vessel traffic re-routing measures. Some measures are implemented year-round, while others are seasonal or ad hoc in response to whale presence.

Below, I briefly detail the history of select voluntary vessel speed reduction programs in North America designed to reduce vessel impact on whales and/or reduce air emissions. This includes: the Green Flag Program administered by the Port of Long Beach (POLB), the Point Loma Vessel Speed Reduction Program administered by the Port of San Diego, the Protecting Blue Whales and Blue Skies program, the Clean Vessel Incentive Program administered by the Port Authority of New York and New Jersey, the ECHO Voluntary Ship Slowdown administered by the Vancouver Fraser Port Authority, and the Quiet Sound Voluntary Vessel Slowdown.

In Table 1, I compare the characteristics of the current iterations of these voluntary vessel speed reduction programs, including their purpose, target vessels, incentives, and public recognition efforts associated with participation.

Table 1. Characteristics of select vessel speed reduction programs in North America.

	Vessel Speed Reduction Programs					
VSR Program	Green Flag Program (Port of Long Beach)	Point Loma Vessel Speed Reduction Program (Port of San Diego)	Protecting Blue Whales and Blue Skies (National Marine Sanctuaries in California)	Clean Vessel Incentive Program (Port Authority of New York/New Jersey)	ECHO Voluntary Ship Slowdown (Haro Strait/ Boundary Pass, Swiftsure Bank)	Quiet Sound Voluntary Vessel Slowdown (Admiralty Inlet)
Purpose	Emissions reduction	Emissions, underwater noise reduction	Emissions, strike risk, underwater noise reduction	Emissions reduction, fuel conservation, marine mammal protection	Underwater noise reduction	Underwater noise reduction
Target vessels	Ocean carriers	Cargo vessels, cruise	Container ships, auto carriers, bulk, tankers	Ocean-going vessels	Car carriers, cruise, container ships, bulkers, tankers, government ships	Car carriers, cruise, container ships, bulkers, tankers
Financial Incentive	15-25% dockage fee reduction	None	None	$1,000 - $3,000 per call***	Pilotage fee/ pilotage slippage cost reimbursements	None
Participation Recognition	Green Flag award	None	Traditional media, social media, awards ceremony	Recognizes top three lines	Recognition certificates	Recognition certificates

*25% dockage fee reduction for 90% compliance in the 40 nm zone; 15% reduction for 90% compliance within the 20 nm zone (*Green Flag Program*, 2024).
**Percentage of total distance traveled at 10 knots. Only includes companies who opt-in (California Marine Sanctuary Foundation, 2025)
***Range of financial incentive available to vessel calls only when the VSR participation is combined with their ESI score. Operators must make at least 15 calls per year. (*Clean Vessel Incentive Program*, 2025).

In 2021, the Ports of Los Angeles and Long Beach in California began implementing a voluntary vessel speed reduction program to reduce smog-forming nitrogen oxides, diesel particulate matter, and greenhouse gases (*Green Flag Program*, 2024). The ports ask cargo ships to reduce their speed to 12 knots or below within a 20 nautical mile (nm) and 40 nm area around the harbor (*Green Flag Program*, 2024). The program offers a 25% reduction in dockage fees and a Green Flag award for shipping companies who achieve a 90% compliance rate within the 40 nm zone, or a 15% reduction in fees for 90% compliance in the 20 nm zone (*Green Flag Program*, 2024). As of 2024, 97% of cargo vessels comply with the 20 nm zone and 93% comply with the 40 nm zone (*Green Flag Program*, 2024). Vessel speed is measured by the Marine Exchange of Southern California (*Green Flag Program*, 2024). The Port of San Diego began implementing a voluntary vessel speed reduction program in 2009 to address air emissions and reduce underwater noise (*Vessel Speed Reduction Program*, 2025). Cruise ships are asked to reduce their speeds to 15 knots and cargo vessels are asked to reduce their speed to 12 knots in a 20 and 40 nm zone surrounding the port (*Vessel Speed Reduction Program*, 2025). In 2024, 94% of vessels met the speed target in the 20 nm zone and 72% in the 40 nm zone (*Vessel Speed Reduction Program*, 2025).

Beyond port-administered slowdowns, there are a number of vessel speed reduction zones along the coast of California to reduce emissions, protect whales from ship strikes, and reduce underwater noise (California Marine Sanctuary Foundation, 2025). This includes the NOAA Greater Farallones, Cordell Bank, Monterey Bay, and Channel Islands National Marine Sanctuaries as well as local air pollution control districts (California Marine Sanctuary Foundation, 2025). Protecting Blue Whales and Blue Skies is a third-party program that verifies participation in the VSR programs, quantifies emissions reduction and noise reduction amounts,

and recognizes participants. The program asks companies who opt-in to sign a formal Participant Agreement. Vessels over 300 gross tons (GT) are asked to reduce their speeds to 10 knots from May to December (California Marine Sanctuary Foundation, 2025). In 2024, 49 shipping lines reduced their speed to 10 knots for 85% of their total distance traveled (California Marine Sanctuary Foundation, 2025). Participation metrics only include operators who opted in. Underwater noise was reduced by 38%, fatal ship strike risk reduced by 50% and 49,000 metric tons of GHG emissions were avoided (California Marine Sanctuary Foundation, 2025). The program stopped offering financial incentives in 2023.

The Port Authority of New York and New Jersey began implementing a voluntary VSR program in 2010 to reduce air pollution, fuel consumption, and whale strikes (*Clean Vessel Incentive Program*, 2025). The Port Authority asks vessels who are required to reduce their speed to 10 knots or below from November 1 through April 30 to comply with NOAA's Right Whale Ship Strike Reduction Rule, to voluntarily reduce their speeds to 10 knots throughout the remainder of the year (*Clean Vessel Incentive Program*, 2025). The zone extends 20 nm from Ambrose Channel. Participation in the program awards points to operators, charters, and agents of ocean-going vessels in their Clean Vessel Incentive Program (*Clean Vessel Incentive Program*, 2025). Operators with more than 15 transits per year can earn $1,000-$3,000 per call when VSR participation is combined with the vessel's Environmental Ship Index (ESI) score. The Port Authority publishes the companies with the three highest VSR compliance rates. In 2023, K Line participated at 71%, MOL Americas participated at 70% and Yang Ming Line participated at 69% (*Clean Vessel Incentive Program*, 2025).

The Enhancing Cetacean and Habitat Observation (ECHO) program administered by the Vancouver Fraser Port Authority implements voluntary slowdowns in Swiftsure Bank and Haro

Strait/Boundary Pass and a lateral displacement to reduce vessel impact on SRKWs (*ECHO Program Projects and Initiatives*, 2025). The program asks car carriers, passenger ships and container ships to reduce their speeds to 14.5 knots or less, and 11 knots or less for bulkers, tankers, and government vessels (*ECHO Program Projects and Initiatives*, 2025). The ECHO program worked with the BC Coast Pilots to simulate the safest, slowest speed when transiting through their particular waterways. This is a key difference between the Quiet Sound and ECHO slowdowns and the VSR programs in California, and New York/New Jersey which provide a blanket speed limit. The ECHO program utilized these speed targets to address concerns about the fairness of a singular speed target, whereby some vessel types are being asked to reduce their speed more than others. ECHO found that the same underwater noise reduction was achieved even when the different 'equitable' speed targets were used, as compared to a blanket speed target applicable to all vessel types. The ECHO program circulates an 'Intent to Participate' form at the start of their slowdown season. In 2023, the participation across measures was 87% (*ECHO Program Projects and Initiatives*, 2025). Participation metrics include all transits during the slowdown period.

Existing Research on Firm's Motivations to Participate in Voluntary Environmental Programs

While the majority of the literature focused on a single aspect of program design, efficacy, benefits or drawbacks, Linder provides a broad analytical framework of how multiple factors interact to impact participation in a detailed case study of a the VSR programs administered by the Ports of Los Angeles and Long Beach (Linder, 2018). Linder conducted interviews with employees of vessel operators, Port of Long Beach and Port of Los Angeles, California Air Resources Board and Pacific Merchant Shipping Association, in addition to

surveying over 40 vessel operators (Linder, 2018). An events history compiled by the University of Southern California Metrans Center articulated the specific regulatory, scientific and economic events occurring at that time that could have influenced participation in the VSR programs. Linder found that pressures from the community and minimizing environmental impact voluntarily so as to avoid regulation were more important than financial incentives in motivating participation in the voluntary program (Linder, 2018). The design of the program, clarity of goals, and having a way to monitor and measure participation were also important factors in influencing participation. Further, Linder notes that these drivers often interact, and called for more research to understand how the different factors are prioritized in different situations (Linder, 2018).

Researchers analyzed motivations for the development of a voluntary strategy to address air pollution adopted by the Ports of Long Beach and Los Angeles (Giuliano & Linder, 2013). Acknowledging the differences in jurisdiction and targeted outcomes, their four theories explaining motivations for environmentally responsible behavior are relevant: to gain social legitimacy, as a response to social pressure, to avoid or shape regulation, or to capitalize on eco-efficiencies or new market opportunities (Giuliano & Linder, 2013). A key difference between their framework and the analytical framework presented in this thesis is the absence of a sense of moral obligation. They note that altruism did not motivate the creation of the voluntary air pollution plan, but rather they were motivated to act altruistically to obtain the social license (Giuliano & Linder, 2013).

Research Question

What are the factors that motivate container ship participation in the Quiet Sound Voluntary Vessel Slowdown?

Rationale

Container ships account for most underwater noise produced by commercial vessels. In the Puget Sound, they represent nearly half of commercial vessel transits. The benefit to whales of the Quiet Sound slowdown can be improved by increasing participation of container ships. While other vessel speed reduction programs have articulated why firms participate in voluntary efforts, this has yet to be done in the Washington context. The Quiet Sound slowdown is a relatively new program with an explicit focus on adaptive management. Because the slowdown is a voluntary initiative, understanding container ship motivation can inform program improvements and ultimately result in higher participation rates and environmental benefits. This research intends to inform program design and engagement with the shipping industry specific to the Quiet Sound program but findings could be applicable for vessel speed reduction programs in other contexts.

Analytical Framework

The analytical framework used in this thesis is based on the literature review and prior knowledge of the Quiet Sound program. The framework is designed to enable the analysis of how various factors internal and external to shipping companies impact decision-making of different actors. The analytical framework informed the development and organization of the codebook used in the document analysis and thematic analysis of interviews.

Actors

Actors that influence container ship motivation to participation in the Quiet Sound slowdown include shipping lines as owners of container ships or operators (if they charter the vessel), shipping associations who represent the interests of the shipping industry, agents who are hired to act on behalf of shipping lines to handle necessary duties of port calls, Puget Sound Pilots who captain all commercial vessels to ensure a safe transit through Puget Sound, the Ports of Seattle and Tacoma who lease terminals to logistics companies loading and unloading cargo from container ships, and beneficial cargo owners who transport their goods on container ships.

Container Shipping Lines

There are 14 international container carriers with weekly service to the ports of Seattle and Tacoma: ANL, CMA CGM, COSCO SHIPPING Lines, Evergreen Line, Hapag-Lloyd, HMM, Maersk, Mediterranean Shipping Co. (MSC), Ocean Network Express (ONE), OOCL, SM Line, Swire Shipping, UWL, and Yang Ming Line (*Ocean Carriers*, 2025).

Container shipping companies form alliances to increase efficiency, reliability, and competition (*2025 Global Container Shipping Alliances*, 2025). Following a restructuring in late 2024, the industry fell into three major alliances occupying 63% of the market (*2025 Global Container Shipping Alliances*, 2025). Of the liners calling the Puget Sound region, Hapag-Lloyd and Maersk are part of the Gemini Cooperation alliance; HMM, ONE and and Yang Ming Line are part of the Premier Alliance; and CMA CGM, Evergreen Line, COSCO SHIPPING Lines, and OOCL are part of the Ocean Alliance (*Ocean Carriers*, 2025). MSC, formerly in the 2M Alliance with Maersk, is now operating independently (*2025 Global Container Shipping Alliances*, 2025). Swire Shipping is also independent.

There are 4 domestic shipping lines that regularly call the Ports of Seattle and Tacoma: Alaska Marine Lines, Aloha Marine Lines, Matson, and TOTE Maritime Alaska. Goods shipped by water between U.S. ports must be shipped on vessels that are built, owned, and crewed by U.S. citizens, per the Jones Act, a section of the Merchant Marine Act of 1920 (U.S. Customs and Border Protection, 2024).

Shipping Associations

Shipping associations help shipping companies engage in whale conservation measures, such as informing the design of mitigation measures and disseminating program information. By engaging with international and regional regulatory bodies and program implementers, shipping associations influence program design such that it takes into account the priorities and restraints faced by the shipping industry. The World Shipping Council (WSC) represents shipping liners from around the world, focusing on issues of sustainability, safety, and security. Pacific Merchant Shipping Association (PMSA) is a not-for-profit shipping association whose members engage in international trade between Asia and the U.S. West Coast, in addition to Europe, the Mediterranean, and South America (*About Us*, 2025). Their members include ocean carriers, marine terminal operators, agents, tug companies, cruise lines, and freight forwarders. PMSA has been a partner and advocate of vessel speed reduction programs in California and Washington. PMSA is a member of the Quiet Sound Leadership Committee. PMSA was one of the original partners in the Puget Sound Clean Air Forum which established the Puget Sound Maritime Emissions Inventory (Mike Moore, 2021).

Agents

Agents are hired by some, but not all, vessel owners to carry out the logistics of a vessel's transit, and arrival and departure from port. Central to this is understanding and navigating local regulations and programs while maintaining timeliness and reliability. Agents act in accordance with their understanding of their client's needs and priorities. The 6 primary agents that serve Puget Sound ports include: ACGI Cargo Logistics, Inchcape Shipping Services, Norton Lilly International, Talon Marine Services, Transmarine, and Wilhelmsen.

Ports

Formed in 2015, the Northwest Seaport Alliance (NWSA) manages cargo shipping operations at the Port of Seattle and Port of Tacoma. The ports individually manage their own facilities, fleet maintenance, and development projects. As an independent port authority, NWSA constructs, maintains, and operates marine terminals. NWSA then leases port terminals to private operators, who manage operations, own equipment and contract with shipping companies. The NWSA is also tasked with addressing transportation and air quality issues.

The Port of Seattle has a strong focus on environmental stewardship and sustainability. On their website, they share regulations regarding vessel approach laws in Washington and best practices for the public to preserve SRKW habitat. In 2019, the Port was a key convener of a workshop to discuss implementing a program like ECHO to reduce underwater noise impacting SRKWs in Puget Sound (Port of Seattle, 2019). The Port of Seattle is a founding member of the Quiet Sound Leadership Committee and provides the program financial support (Port of Seattle, 2025).

Puget Sound Pilots

The Puget Sound Pilots are the pilotage service for the inland waters of the Puget Sound. Central to their mission is safety and protecting the marine environment (Puget Sound Pilots, 2025). Pilots distribute information about the Quiet Sound voluntary vessel slowdown and collect post-transit participation data. In 2019, Puget Sound Pilots became the first pilotage authority to earn the Green Marine certification for two of their boats (Green Marine, 2019).

Factors

The factors are organized by category as identified in the analytical framework, namely: Slowdown program characteristics, information sharing and exchange, operational factors, external influences, and intrinsic values. These factors are presented in Figure 2.

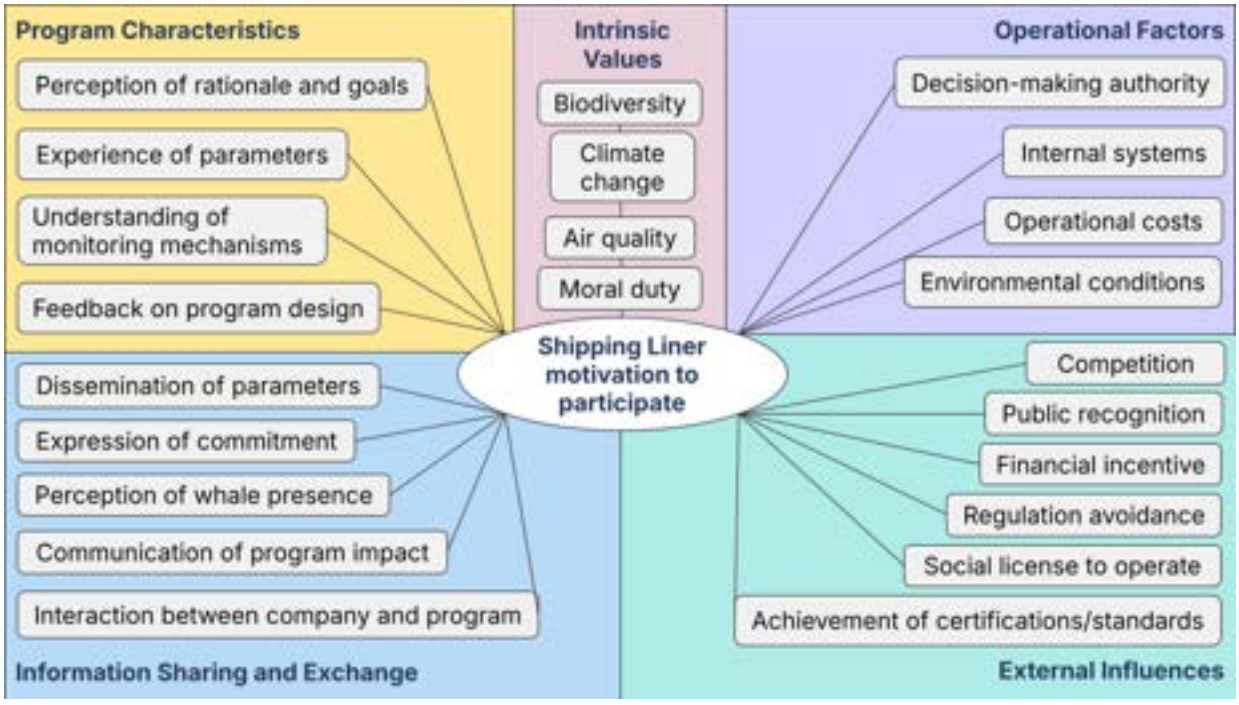

Figure 2. Analytical framework of factors that impact shipping liner motivation to participate in the Quiet Sound voluntary slowdown.

Slowdown Program Characteristics

Clearly delineated parameters, program rationale, and goals, as perceived by shipping companies, are expected to increase container ship motivation to participate in the slowdown. In addition, the presence of feedback loops to support continuous improvement and mechanisms to monitor program impact are also expected to increase motivation to participate.

Voluntary programs that have clear targets and mechanisms to compare performance to a baseline are believed to produce better results (European Environmental Agency, 1997). Programs with clearly defined goals allow operators to better plan for participation and reduce transaction costs (Linder, 2018). Interviews and surveys of operators who participated in the Port of Los Angeles (POLA)/ Port of Long Beach (POLB) VSR program indicated that the program's clear and straightforward requirements combined with a willingness to adapt over the years contributed to their participation (Linder, 2018).

Voluntary programs offer several advantages to regulatory programs. Voluntary programs are shown to be cheaper to implement than a regulation with an enforcement cost (Khanna, 2001). They can often be implemented faster than a regulation. The voluntary vessel speed reduction program implemented by the POLA and POLB was seen as a measure to address emissions from ocean-going vessels that could be immediately enacted in the face of increasing public and regulatory pressure (Linder, 2018). Further, voluntary programs supported by a broad coalition can be more durable than regulatory efforts due to their adaptability. Vessel operators participating in the vessel speed reduction program at the POLB preferred a voluntary program for its ability to accommodate rare circumstances, as opposed to a rigid regulation that fails to understand the realities of shipping (Linder, 2018).

Information Sharing and Exchange

Effective dissemination of parameters, mechanisms for shipping companies to express commitment to participate, shipping company perception of whale presence and program impact, and regular communication between the company and Quiet Sound are expected to increase container ship motivation to participate in the slowdown.

Effectively communicating the parameters of a vessel speed reduction program is necessary for vessel operator buy-in. Researchers examining the effectiveness of seasonal advisory broadcasts asking vessels to reduce speeds to 10 knots when transiting a 75 nm area in Southern California found that a local Notice to Mariners did not impact speeds (McKenna et al., 2012). Another team assessing whale conservation measures in the Gulf of Panama found that vessel compliance with a traffic separation scheme (TSS) was high (>80%) but compliance with the speed limit was low (10-15%) (Guzman et al., 2020). Low compliance was likely a result of insufficient communication to mariners and the absence of the speed limit zone on printed and digital charts (Guzman et al., 2020). Linder found that operators were aware of the Port of Long Beach slowdown but noted changes in crew and internal communications could be improved within vessels (Linder, 2018).

Firm's Operational Factors

Clear articulation of desire to participate by shipping company decision-makers and effective internal processes to operationalize participation are expected to increase container ship motivation to participate in the slowdown. When operational costs associated with participating in the slowdown are perceived as nominal and not consequential to the transit, or align with fuel conservation initiatives, container ship motivation to participate in the slowdown is expected to

increase. Scheduling delays, safety concerns due to weather, or timing of tides are expected to decrease motivation to participate.

In addition to external communication of parameters to operators, the message must also be relayed effectively internally. Training, internal communication, and reminders to changing crews were the biggest drivers of non-participation in the POLB vessel speed reduction program, according to a survey of vessel operators (Linder, 2018).

Shipping costs include daily operating costs (crew, supplies, repairs, maintenance, insurance, administration), variable voyage costs (fuel, port fees such as pilotage, berthing and traffic control system dues), and cargo-handling costs (loading and unloading). Cargo-handling at ports has evolved from operating on a first come, first serve basis to utilizing fixed berthing windows, wherein a shipping company can schedule a time slot to avoid waiting in line (Bhonsle, 2024). Shipping companies are willing to pay a premium to ensure timely berthing to provide reliability and predictability to their customers, while also minimizing fuel costs from idling outside of a port (Bhonsle, 2024). Schedule constraints, or concerns about missing the fixed berthing window, were reported to be the biggest operational and financial challenge to participating in the VSR program according to a survey of vessel operators (Linder, 2018). However, with adequate foresight and planning, most operators believed they could participate while also meeting scheduled arrival and departure times (Linder, 2018).

Slow-steaming, the process of deliberately reducing the cruising speed of a vessel, is a fuel conservation strategy that grew in popularity in the early 2000s as a response to rising bunker fuel prices (Sanguri, 2012). In 2008, as an effort to reduce fuel costs and understand the safety risks of slow-steaming, Maersk Line pioneered the approach by operating vessels at 10% of maximum load on a transit from North America to Singapore (Maersk, 2012). The transit

proved successful, reducing emissions and fuel consumption, and has since been adopted across the industry (FathomShipping, 2013). In a simulation of container transits operating between Long Beach, California and ports in Asia, Maloni et al found that extra slow steaming (15 knots) was associated with a 20% reduction in total costs and 43% reduction in carbon dioxide emissions (Maloni et al., 2013).

While slow-steaming is considered to be an effective way to reduce fuel consumption, and thus operational costs on long voyages, reducing speeds over shorter distances to comply with vessel speed reduction programs could increase operational costs for shipping companies. Surveys with operators participating in a voluntary vessel speed reduction program in POLB/POLA affirmed that slowing down increases transit times which impacts their bottom line when it reduces the number of transits a cargo vessel might take (Linder, 2018). Further, some vessel operators noted that any fuel savings gained by slowing down while in the VSR zones may be negated by increasing speed later on to make up for lost time (Linder, 2018). Affirming this, researchers conducted an economic analysis by looking at the inventory carrying costs (i.e. increased time) and vessel transit costs (i.e. fuel) associated with a range of vessel re-routing and speed reduction alternatives through the Channel Islands National Marine Sanctuary (Gonyo et al., 2019). Re-routing vessels reduced shipping costs by 1.6-3.4% while vessel speed reductions increased shipping costs by 1.3-2.0% (Gonyo et al., 2019).

Beneficial cargo owners are also impacted by slow-steaming. In 2013, researchers sought to understand the impacts of slow steaming from the perspective of six Swedish companies (Finnsgård et al., 2020). Shippers reported experiencing longer transit times and no change in reliability (Finnsgård et al., 2020). Notably, none of the shippers connected slow steaming to improved environmental performance (Finnsgård et al., 2020). However, others argue that

environmental values are viewed as still positively influencing a firm's bottom line (Dixon & Clifford, 2007). This is reinforced by the increased offering of ‘carbon-neutral’ and ‘whale-safe’ shipping options for beneficial cargo owners whose customers share those values.

In the United Nations Conference on Trade and Development’s 2024 Review of Maritime Transport, mention of underwater noise was noticeably absent, while emissions were mentioned 28 times. This is likely because GHG emissions contribute directly to climate change, which in turn threatens the reliability of international shipping (U.S. Department of Transportation, 2023). However, concern about underwater noise from commercial shipping has grown in recent years. Further, Many owners and operators of older vessels are reducing their speeds to comply with IMO regulations requiring vessels to improve their energy efficiency and reduce their GHG emissions, such as the CII and EEXI (*EEXI and CII - Ship Carbon Intensity and Rating System*, 2025). Leveraging the operational overlap between underwater noise reduction and energy efficiency could motivate participation in the slowdown.

External Influences

Public recognition for participation in the slowdown, achievement of certifications, and incentives are expected to increase motivation for container ships to participate. Additionally, the desire of shipping companies to distinguish themselves as environmentally friendly to improve their competitiveness, obtain social license to operate, and prevent regulation is expected to increase motivation to participate.

Pressure from community and environmental organizations has been linked to firms’ improved environmental practices (Alberini & Segerson, 2002). Firms have been shown to do this through creating a position for an environmental manager, establishing connections in their communities, conducting audits and aligning themselves with environmental advocates (Bansal

& Roth, 2000). Firms often adopt environmental practices that go beyond what is legally required in order to preempt, and even shape future regulation (Giuliano & Linder, 2013).

Salzmann proposed that firms demonstrate environmentally responsible behavior as a way to garner strategic legitimacy and make the context in which they operate friendlier to them (Salzmann et al., 2005). Affirming this, Linder notes that social license to operate was historically viewed as granted by regulators and the public to firms but the dynamic is shifting, where firms are taking actions to increase their license to operate (Linder, 2018). POLB and POLA vessel operators viewed their performance in the VSR programs as very important to port, government and regulatory officials, and that by participating they positively impacted their relationship (Linder, 2018). Operators viewed their participation in the VSR program as a way to convey the shipping industry's commitment to reducing emissions, which Linder interpreted as evidence of participation furthering their social license to operate (Linder, 2018).

In addition to keeping regulation at bay, by adopting beyond compliance behavior or technologies, firms gain a competitive advantage when seen as an early adopter (Giuliano & Linder, 2013). Indeed, vessel operators indicated their decision to participate in VSR programs in California was due to their desire to be seen as a 'frontrunner in clean transportation' (Linder, 2018). The POLB VSR program saw increased participation after publicly reporting participating rates on their website (Linder, 2018). Linder viewed this increase in participation as an indicator of competition between operators. The literature offers opposing views regarding the perceived importance and actual importance of consumer behavior in impacting firm behavior. Research shows that pressure from activists and consumer pressure can influence firm behavior (Giuliano & Linder, 2013). However, operators participating in the POLB/POLA VSR program believed their customers and clients did not particularly value their participation (Linder, 2018).

Regulations can also influence beyond compliance behavior as a way to manage increased costs. Researchers analyzed the impact of vessel emission regulations and economic events on vessel traffic variability for transits off the coast of California (Moore et al., 2018). Speed reductions were more likely influenced by clean fuel standards, which require the use of higher cost fuels, thus influencing vessels to reduce their speeds to conserve fuel consumption (Moore et al., 2018).

Participation in voluntary programs may increase a firm's operational costs. To offset that, some programs offer financial incentives to motivate continued participation. The Ports of Los Angeles and Long Beach took different approaches to incentives and recognition, which provide a convenient comparison. In 2005, the POLB established the Green Flag program, where vessel operators who participated at 100% received a green flag, and those who participated at 90% were recognized in a ceremony. In 2006, the POLB began offering a 15% rebate on dockage fees for vessel operators with a 90% or higher participation rate (Linder, 2018). The Port of Los Angeles publicized results but only began to offer a financial incentive in 2008, when it combined with an incentive-based low sulfur fuel program. In 2009, the ports aligned the incentive structure and increased the VSR area from 20 to 40 nm. Vessels who slowed in the 20 nm zone received a 15% dockage fee reduction at both ports. Vessels which slowed in the 40 nm zone received a 25% dockage fee reduction at POLB and a 30% reduction at POLA (Linder, 2018). The Port of Los Angeles distributed almost $20 million in incentives to fleets with a participation rate of 90% in VSR programs between 2008 and 2019 (Office of Transportation and Air Quality, 2021). Surveys indicated that the majority of vessel operators were not motivated to participate in the VSR program by the financial incentive. Further, an operator who received the discount for participating in the POLB VSR program donated a portion of it to the City of Long

Beach, indicating that being seen positively by the community was more important than the financial incentive (Linder, 2018).

Researchers sought to understand the efficacy of reducing a ship's dockage fee as a financial incentive for complying with the POLB Green Flag Program when the VSR area expanded from 20 nm to 40 nm and the incentive increased from 15% to 25% dockage fee reduction (Ahl et al., 2017). While dockage fees represent only a small part of a vessel's port costs, discounts were indeed effective at motivating operators to comply with the speed reduction (Ahl et al., 2017). By increasing the dockage-fee discount by 1%, the Port could improve the probability of vessels reducing their speeds by 2.1% for container ships (Ahl et al., 2017).

Another team of researchers looked at the impact of adding incentives to an existing voluntary VSR program through the Channel Islands National Marine Sanctuary (Freedman et al., 2017). Researchers offered $2,500/transit to the seven companies who agreed to reduce their speeds to 12 knots or less (Freedman et al., 2017). Financially incentivized transits reduced their speed significantly more than non-incentivized transits, to an average of 12.6 knots as opposed to 16.8 knots, respectively. The researchers believed the financial incentives could help make up for increased fuel and operational costs incurred by operators, but noted the difficulty in understanding all the factors involved (Freedman et al., 2017).

Intrinsic Values

Employees and operators of shipping companies who intrinsically value the marine ecosystem, cleaner air, and feel a moral obligation to do the right thing are expected to increase the motivation of container ships to participate in the slowdown. While the literature has documented and quantified the intrinsic value of marine ecosystems, there is little research on

whether or not mariners or shipping companies intrinsically value the environment (Himes et al., 2024).

Methods

This research utilizes a qualitative case study approach to understand the factors that motivate container ship participation in the Quiet Sound voluntary vessel slowdown (Yin, 2014). The case study approach is best suited to address the complexity of motivations of shipping lines to participate in the specific context of the Quiet Sound slowdown (Yin, 2014). A literature review was conducted to inform the analytical framework of factors and actors that influence container ship participation in the slowdown. Document analysis helped identify firms' external facing priorities. Semi-structured interviews with actors involved in the design and implementation of the slowdown, or participants in the slowdown validated which factors influenced participation and to what extent. This research did not include an events history, which could have helped to understand how outside events (labor strikes, weather events, elections, world events, media etc) could have impacted motivations.

Document Analysis

To understand the perspectives and priorities of key stakeholders who could influence container ship participation in the slowdown, I conducted a document analysis of sustainability reports and websites of 18 shipping liners and 6 vessel agents, a shipping association, and environmental and climate strategies published by the ports of Seattle and Tacoma and Northwest Seaport Alliance, and the Puget Sound Pilots. My goal was to collate where the slowdown was mentioned, or not mentioned, including whether it was regarded as a strategy for

whale conservation, biodiversity or emissions reduction. Results of the document analysis were used to individualize interview questions for each respondent.

Semi-Structured Interviews

The prospective interview list included stakeholders who either helped design the slowdown, implement the slowdown or participate in the slowdown. This included: Ocean shipping liners, vessel agents, Puget Sound Pilots, Port of Seattle, Port of Tacoma, Northwest Seaport Alliance, and Pacific Merchant Shipping Association. Outreach to prospective interviewees was conducted over email using contacts that I had through my professional relationships, with the exception of vessel agents whose contact information was gathered from company websites. Interviews were conducted in February and March 2025. Respondents included: Port of Seattle (1), Port of Tacoma/Northwest Seaport Alliance (1), Puget Sound Pilots (1), ECHO Program (1), Shipping Liners (2), Shipping Association (1). Interviews were largely conducted virtually with the exception of one that was conducted in person. Interviews lasted 30 to 90 minutes. Respondents were provided a transcript following the interview, where they had the opportunity to redact any sensitive information or provide edits to incorrect depictions. The standard interview guide is provided in Appendix A. Table 3 includes the codebook used for analysis and definitions of codes. Code categories reflect factors articulated in the analytical framework.

Table 3. Codebook and code definitions.

Category	Primary Code	Definition
Program Characteristics	Experience of parameters	Whether or not the speed target of 14.5 knots for container ships and geographic area of the slowdown are perceived as fair or practical.
	Perception of rationale and goals as clear	Whether shipping companies view the reason for the slowdown and its intended impact as clear.
	Understanding of monitoring mechanisms	The extent to which shipping companies are aware of and value mechanisms for measuring program impact (participation, whale presence, underwater noise reduction).
	Feedback on program design	Whether input or feedback from mariners or shipping stakeholders is incorporated into program design.
Information Sharing and Exchange	Dissemination of parameters	Who the company learns about the slowdown from (USCG, shipping and maritime associations, Quiet Sound or the Puget Sound Pilots).
	Expression of commitment	Whether or not the company provides a voluntary confirmation of intent to participate in the slowdown prior to the slowdown start (i.e. through an Intent to Participate form, master-pilot exchange, or formal agreement).
	Perception of whale presence	Whether, when, how long whales are perceived by mariners to be in the slowdown area while the slowdown is in effect (i.e. through WRAS or other means).
	Interaction between company and program	Whether, how often, and the nature of communication between the company and the program (i.e. receipt of reminders, fleet participation data).
	Communication of program impact	Whether and to what extent program impact is communicated and understood by companies (i.e. ecological benefit of underwater noise reduction to whales, co-benefits of reduced air emissions and fuel consumption).
Operational Factors	Decision-making authority	The role of the program's primary contact within the company, their authority over the decision to participate, and other entities involved in decision-making (i.e. multiple departments, HQ, vessel agents, pilot-master interaction).
	Internal systems	Whether or not the company has systems in place to facilitate participation (i.e. route planning tools, experience from participating in other programs).

	Operational costs	Costs incurred or saved (or expected to) by the company as a result of participation in the slowdown (labor costs, fuel costs, demurrage fees from scheduling delay).
	Environmental conditions	Whether and to what extent concerns about safety, weather, or timing the tides impact the decision to participate.
External Influences	Recognition for participation	The method of acknowledgement a shipping company receives for participation (i.e. awards, publicity, tokens of appreciation).
	Achievement of certifications or standard	Whether or not participation in the slowdown helps a company achieve an environmental certification (i.e. Green Marine) or meet an industry standard.
	Social license to operate	Whether or not the company views participation in the slowdown as a way to demonstrate sustainable practices to customers, consumers and the public.
	Regulation avoidance	Whether or not the company views participation in the slowdown as a way to prevent regulation.
	Competition amongst companies	Whether the company views participation in the slowdown as a way to distinguish themself from competitors.
	Financial incentive	Whether or not a company receives or values receiving financial incentives to participate.
Intrinsic Values	Protecting biodiversity	Whether or not a company values protecting biodiversity, and specifically whale conservation.
	Emissions reduction	Whether or not a company values reducing their emissions for climate change mitigation and/or air quality improvement.
	Moral duty	Whether or not a company views participating in the slowdown as the right thing to do.

Findings

Findings resulting from the document analysis and interviews are presented according to the factors that motivate container ship participation in the slowdown as articulated in the analytical framework. Key findings are bolded to assist with communication.

Document Analysis

Of the 18 shipping lines analyzed, 16 published sustainability reports. Just one vessel agent published a sustainability report. The Port of Seattle, Port of Tacoma and Northwest Seaport Alliance each publish their own sustainability reports. Neither Pacific Merchant Shipping Association nor the Puget Sound Pilots published a sustainability report, but environmental stewardship was clearly delineated as a priority on their websites. Findings are grouped by shipping alliance when possible.

Program Characteristics

Beyond geography, shipping companies did not mention program characteristics, such as the length, duration or speed targets specified by slowdown programs, in their reporting.

Information Sharing and Exchange

A minority of companies mention the use of systems to understand whale presence while in transit in their reporting. CMA CGM uses collision prevention tools (real-time whale location system in the Mediterranean and Caribbean, notifications from Whale Safe in California and the East Coast). The Pacific Merchant Shipping Association, the Port of Seattle and Northwest Seaport Alliance identify their involvement in the Quiet Sound program on their websites. No shipping lines explicitly articulated a working relationship with Quiet Sound.

Operational Factors

Route optimization and slow-steaming are more often listed as strategies to reduce GHG emissions than as strategies to reduce underwater noise. Of the 16 shipping lines who published sustainability reports, 12 lines named emission reduction and fuel conservation as key priorities.

Gemini Cooperation Alliance: Hapag-Lloyd's strategies to reduce emissions includes vessel speed reduction, in addition to improved design, maintenance, and hull modifications (Hapag-Lloyd AG, 2025). Maersk specifically names underwater radiated noise and vessel disturbance to marine species and ecosystems in their annual report. Maersk has a goal to achieve net-zero by 2040 (A.P. Moller-Maersk, 2025). Strategies they are employing include alternative fuels, electrification of landside assets, optimized sailing speed, and increased ocean transport efficiency by leveraging Gemini network routing (A.P. Moller-Maersk, 2025).

Premier Alliance: HMM uses voyage optimization tools to manage speed and reduce fuel consumption (HMM ESG Team, 2024). Their emissions reduction strategies are focused on capture technologies, alternative fuels, and shore power (*Sustainability | Environment*, 2025). Ocean Network Express (ONE) aims to be net-zero by 2050, through actions in carbon management, operational efficiency, green investment, alternative fuels and ecosystem building (Ocean Network Express, 2024). They optimize their routing to scheduled berthing times and utilize speed reduction to reduce unnecessary fuel burn at congested ports (Ocean Network Express, 2024). Beyond operational changes, ONE also ensures proper hull cleaning, more efficient propeller design and technologies to improve their fleet's fuel efficiency (Ocean Network Express, 2024). In 2023, Yang Ming began slow-steaming as a way to reduce fuel consumption and carbon emissions (Yang Ming Marine Transport Corp., 2024). The company

uses weather routing and route optimization to avoid unnecessary fuel consumption before arrival (Yang Ming Marine Transport Corp., 2024). Yang Ming increased the frequency of hull cleaning, and has made modifications to bows and propellers to further increase fuel efficiency (Yang Ming Marine Transport Corp., 2024). Their Smart Ship Center monitors speed and energy efficiency, providing weekly meetings for feedback to operations teams (Yang Ming Marine Transport Corp., 2024).

Ocean Alliance: CMA CGM aims to reduce greenhouse gas emissions by 30% by 2030, and by 80% by 2040 across their operations (CMA CGM, 2025). CMA CGM is using ship speed reduction alongside a number of other measures (i.e. alternative fuels, aerodynamic design, reduced biofouling, wind-assist, shore power, and emissions-capture technologies) to meet those targets. CMA CGM's Fleet Center optimizes routes to improve fuel efficiency, avoid bad weather, facilitate early arrival in busy ports, and notably, to participate in marine wildlife protection measures (CMA CGM, 2025). Evergreen Line aims to be net-zero by 2050. Speed management and route optimization are named amongst a variety of strategies for improving fuel efficiency and reducing emissions. COSCO SHIPPING Lines implemented a 'deceleration plan' to reduce ship speeds and employs route optimization to reduce unnecessary accelerations into congested ports to reduce emissions. OOCL uses route optimization to avoid bad weather and unnecessary fuel burn (Orient Overseas (International) Limited, 2024).

Mediterranean Shipping Company (MSC) utilizes slow-steaming to reduce fuel consumption and emissions to meet the Carbon Intensity Indicator (CII) requirements, but has added vessels to ensure cargo-carrying capacity is not impacted (MSC, 2024). Route planning and optimization tools allows MSC to reduce unnecessary fuel burn and stalling outside ports (MSC, 2024).

Swire utilizes slow-steaming and voyage optimization to reduce emissions, in addition to regular hull cleaning and inspection (Swire Shipping, 2024). Operational efficiency of vessels is checked monthly using internal fleet efficiency Key Performance Indicator scorecards (Swire Shipping, 2024). Prior to each transit, Masters and Chief Engineers are briefed on best practices for maximizing fuel efficiency and relevant environmental regulations and programs to be aware of (Swire Shipping, 2024). The company has set short-term, medium-term and long-term to reduce GHG emissions and become net-zero by 2050.

Matson aims to achieve net-zero Scope 1 fleet emissions by 2050 (Matson, 2024). Strategies to achieve this include energy efficient design of new vessels, alternative fuels, and retrofits (Matson, 2024). Matson notes that they are assessing strategies to improve fuel efficiency and reduce emissions through standardizing vessel speeds, optimizing trim, and installing lubrication systems (Matson, 2024).

As a ship manager and agent, Wilhelmsen helps vessel owners measure and meet emissions targets through digital platforms, training crew on alternative-fuel vessels, supervising new ship builds and recycling older vessels (Wilhelmsen Ship Management, 2024).

In their Implementation Plan for the Northwest Port Clean Air Action Plan, the NWSA commits to reducing GHG emissions by 50% by 2030 (in comparison to the 2005 baseline), 70% by 2040, and phasing out all emissions from seaport-related activities by 2050. The Northwest Ports Clean Air Strategy (NWPCAS) is an international collaboration between the Northwest Seaport Alliance, the Port of Seattle, the Port of Tacoma, and the Port of Vancouver in British Columbia to address emissions in the Puget Sound-Georgia Basin Airshed (NWSA, 2024). In 2020 the strategy was renewed with a plan to phase out emissions from seaport-related activities by 2050, including from ocean-going vessels. In the Maritime Climate and Air Action Plan, the

Port of Seattle outlines strategies to reach its own emissions reductions targets, in addition to those laid out in the Northwest Ports Clean Air Strategy. This includes emissions from port administrative activities (facilities, fleet vehicles, employee commutes) as well as maritime activities (ocean-going vessels, harbor vessels, cargo-handling equipment) (MCAAP, 2024) under the Port of Seattle's jurisdiction. The plan specifically names evaluating the emissions benefits of slow-steaming as a key intervention.

Participation in re-routing and speed reduction measures to reduce impacts on whales is facilitated by route-planning and centralized fleet operations centers.

Gemini Cooperation Alliance: Maersk specifically addresses the impact of vessel traffic and underwater radiated noise on ecosystem health and biodiversity of marine species, including whales, in their 2025 Annual Report (A.P. Moller-Maersk, 2025). Maersk is using the World Shipping Council's Whale Chart to integrate protected areas and slowdown zones into their fleet energy efficiency platform to utilize in 2025 (A.P. Moller-Maersk, 2025).

Ocean Alliance: CMA CGM engages in whale protection measures by rerouting to avoid sensitive areas and reducing speed to minimize the risk of collision on the East Coast and in California (CMA CGM, 2025). Their Fleet Center integrated the Whale Safe whale collision risk index with a dashboard that monitors navigation rules (CMA CGM, 2025). This allows the center to track compliance speed restrictions and anticipate dynamic speed reduction zones. Evergreen Line observes vessel speed reduction zones for whale protection and has committed to not using Arctic shipping routes.

Beginning in 2023, Matson began implementing route and schedule adjustments, in addition to propeller improvements, to further reduce underwater noise (Matson, 2024). ONE

uses route planning to avoid navigating through environmentally sensitive and protected areas (Ocean Network Express, 2024).

A number of shipping lines participate in multiple VSR initiatives, with participation in the Protecting Blue Whales Blue Skies program in California highlighted most often.

Gemini Cooperation Alliance: Hapag-Lloyd also participates in the Protecting Blue Whales Blue Skies program (Hapag-Lloyd AG, 2025).

Premier Alliance: HMM participates in vessel speed reduction programs, namely the East Coast VSR program for the protection of right whales and the Port of Long Beach Green Flag program (HMM ESG Team, 2024). ONE participates in mandatory and voluntary speed reduction initiatives on the US East Coast, South Korea, Balboa, New Zealand, New York, California and Vancouver (Ocean Network Express, 2024). ONE has participated in Blue Whales Blue Skies since 2018 and achieved the Sapphire award tier for the 88% participation rate, an improvement from the previous seasons (Ocean Network Express, 2024). Since 2016, Yang Ming has participated in the Protecting Blue Whales and Blue Skies program in California, receiving the ‘Sapphire Award’ in 2023 (Yang Ming Marine Transport Corp., 2024).

Ocean Alliance: Since 2018, COSCO SHIPPING Lines has participated in the Protecting Blue Whales and Blue Skies Program in California to reduce ship strikes, underwater noise, and air pollution (COSCO SHIPPING Lines Co., Ltd., 2023). Evergreen Line received the Gold level recognition for participation in the Protecting Blue Whales Blue Skies speed reduction program (Evergreen Marine Corp., 2023). OOCL participated in the ECHO Program’s 2017 trial slowdown (Orient Overseas (International) Limited, 2024). OOCL attained the ‘Sapphire’ level in the 2023 Protecting Blue Whales and Blue Skies program and participated in the expanded

VSR program at the Ports of Long Beach and Los Angeles (Orient Overseas (International) Limited, 2024). They have received a Green Flag award for their participation every year since 2005 (Orient Overseas (International) Limited, 2024).

Matson participates in voluntary speed reduction programs to reduce impacts from vessels on whales in California, Puget Sound (though their sustainability report does not mention Quiet Sound by name), British Columbia, and New Zealand (Matson, 2024).They received a 'B' rating by WhaleSafe for their efforts off the California coast (Matson, 2024).

MSC reroutes vessels in Greece and Sri Lanka to avoid sperm whale and blue whale critical habitat, adjusting 570 routes in 2023 (MSC, 2024). MSC has consistently participated in the Protecting Blue Whales and Blue Skies program in California, and achieved the highest participation level in 2023 (MSC, 2024). In 2023, MSC achieved an A grade from WhaleSafe for cooperating with NOAA's voluntary speed restriction in Santa Barbara and San Francisco (MSC, 2024).

In 2023, Swire received a 100% compliance rate for the Port of Long Beach's Green Flag Program targeted for air pollution, and a Sapphire Award for the Protecting Blue Whales and Blue Skies program targeted for reducing air pollution, strike risk, and underwater noise (Swire Shipping, 2024). Swire also participates in the ECHO Program's slowdowns in British Columbia.

While many shipping lines participate in voluntary speed reduction programs, only one explicitly mentioned Quiet Sound in their reporting, while another noted a slowdown in Puget Sound. While Swire's report does not mention the Quiet Sound slowdown by name, it does include an image of the Recognition Certificate the program provided Swire for their

participation in the 2023 slowdown. In their sustainability report, MSC highlights their 96% participation rate in the 2023-24 Quiet Sound slowdown (MSC, 2024).

Shipping lines are exploring other ways to reduce underwater noise and protect biodiversity beyond vessel slowdowns.

Gemini Cooperation Alliance: Maersk is participating in awareness campaigns regarding the IMO's revised guidelines on Underwater Radiated Noise Management. Maersk is also conducting URN measurements of their fleet's vessels to understand their baseline noise and develop a plan to reduce (A.P. Moller-Maersk, 2025). MSC is reducing underwater radiated noise from their vessels through retrofits that utilize quieter propellers and are incorporating recommendations from the IMO draft revised Guidelines for the Reduction of Underwater Noise from Commercial Shipping (MSC, 2024).

Premier Alliance: To mitigate their impact on biodiversity, HMM is conducting research to analyze the level of underwater noise produced from their vessel as well as developing technologies that could predict the noise radiated at different distances (HMM ESG Team, 2024).

Ocean Alliance: CMA CGM is involved in a European consortium focused on technologies to reduce noise from vessels (CMA CGM, 2025). Starting in 2023, the group has worked with the ECHO Program to evaluate the acoustic signature of its vessels.

Vessel agents primarily market themselves on their reliability, timeliness, and personalized service, and none mentioned facilitating participation in voluntary VSR programs.

External Factors

All but two shipping lines published a sustainability report, indicating a strong interest in externally communicating strategies and targets to reduce environmental impact. Only one vessel agency, Wilhelmsen, published a sustainability report. While

Wilhelmsen mentions protecting biodiversity and ecosystems, they do not mention specific activities and there is no mention of whales through the report. Norton Lilly International does have a sustainability page on their website but they do not articulate targets. Neither ACGI Cargo Logistics, Inchcape Shipping Services, Transmarine, nor Talon Marine Services mentioned sustainability, environmental stewardship, or biodiversity on their websites.

As part of their environmental policy, Lynden, the parent company of Alaska Marine Lines and Aloha Marine Lines, says they will establish and review environmental targets (*Environmental Stewardship*, 2025). However, these targets are not listed on their website and there is not a publicly available report. While a component of SM Line's brand is a commitment to providing 'eco-friendly' services, the company does not have any environmental targets listed on their website, nor a sustainability report. TOTE did not have any environmental stewardship targets listed on their website, as well as no mention of activities to support biodiversity. They do not have a publicly available sustainability report. UWL does not have a publicly available sustainability report and there was no mention of whales or biodiversity on their website.

Premier Alliance: ONE featured their participation in the Protecting Blue Whales and Blue Skies program in California as a case study in their 2024 sustainability report.

Ocean Alliance: Evergreen Line has published a sustainability report every year since 2014. The cover of the 2023 Sustainability Report features an edited image of a shipping container and whale with the tagline 'Nature Above All' (Evergreen Marine Corp., 2023).

In their 2023 Sustainability Report, MSC addresses how the shipping and logistics industry can manage its contributions to the 'triple planetary crisis' of climate change, biodiversity loss, and pollution (MSC, 2024).

Sustainability and environmental stewardship are priorities for the Port of Tacoma. The Port of Tacoma's Environmental Action Plan articulates clean air, water quality, environmental remediation, habitat restoration, and climate resiliency are focus areas (Port of Tacoma, 2024). Further, they acknowledge that actions in those areas produce co-benefits, including improved air quality, operational cost savings, and support for wildlife. However, none of the strategies explicitly mention reducing underwater noise, reducing vessel speed, or improving habitat for SRKW directly.

Targets to guide biodiversity actions are largely driven by the SDGs and GRI, with just two companies being Green Marine certified. As part of CMA CGM Group's strategy to protect biodiversity, they are pursuing certifications as a way to measure a baseline and methodically implement continuous improvement (CMA CGM, 2025). CMA CGM became Green Marine certified in October 2024, which provides a framework for seven indicators: Invasive aquatic species, emissions of air pollutants, GHG emissions, oily discharges, waste management, underwater noise, and ship recycling (CMA CGM, 2025). TOTE Maritime received their Green Marine certification in 2024 (TOTE Maritime, 2025). As part of their efforts to achieve Level 3 of the Green Marine Certification, the Port of Seattle is developing an Underwater Noise Mitigation and Management Plan (Butsick, 2022).

Targets and reporting are largely based on the UN Sustainable Development Goals (SDGs), Global Reporting Initiative (GRI) and IMO regulations. Whale conservation measures typically fall under SDG #14 Life Below Water, and GRI Standard 304 Biodiversity 2016, which covers: operating in areas of high biodiversity value, activities that impact biodiversity, habitats protected or restored, and habitats of IUCN Red List species and national conservation list species (Global Reporting Initiative, 2016).

A few shipping lines appear to be adopting environmentally friendly practices as a result of consumer demand.

Gemini Cooperation Alliance: Hapag-Lloyd markets their sustainability efforts to their customers, offering a 'greener' way to transport their goods (Hapag-Lloyd AG, 2025). For example, through their Ship Green program, customers can pay a premium to reduce the emissions of their transits through the use of biofuel (Hapag-Lloyd AG, 2025). The company also won a bid to provide service for 17 members of the Zero Emission Maritime Buyers Alliance, including companies like Amazon, Tchibo, Patagonia, IKEA, Nike, and Meta (Hapag-Lloyd AG, 2025). Maersk also offers ways for customers to meet their sustainability goals by articulating their current emission footprint and providing ways to reduce it (*Sustainability at Maersk*, 2025). More than half of Maersk's customers are looking to understand and reduce their scope 3 emissions, those associated with the supply chain (*Sustainability at Maersk*, 2025). Maersk's ECO Delivery offers customers reduced emission transport by air, ocean and inland (*Sustainability at Maersk*, 2025).

Swire's SailGreener program allows customers to offset the carbon footprint of their shipments (*Thriving Environment*, 2025). Swire's Green Voyages program allows customers to elect to use sustainable biofuels for their transits (Swire Shipping, 2024).

Most of the cargo coming through the NWSA is discretionary, meaning it is not delivered locally. The NWSA remains cognizant of imposing standards that would result in diversion of goods to another port and therefore reduce the economic throughput of the Port of Seattle and Port of Tacoma. They emphasize the importance of international and national standards that 'level the playing field'. An analysis of sustainability plans and emissions reporting of twelve beneficial cargo owners (BCOs) calling the Northwest Seaport Alliance identified five as

particularly well-suited to partner with NWSA: Walmart, Home Depot, Dollar Tree, NIKE, and IKEA (Carr, 2022). This was due to their articulated plans and work-to-date to reduce emissions through low/zero-emissions trucking, ocean-going vessels and cargo handling equipment (Carr, 2022).

Some shipping lines and a shipping association view exhibiting above compliance behavior as strategic. In their 2023 Sustainability Report, Wilhelmsen's President & CEO calls out the company's efforts to reduce emissions, fuel consumption, comply with regulations and transition to renewable energy as no longer optional, but necessary to comply with regulations and meet stakeholder demands (Wilhelmsen Ship Management, 2024). Further, the company views environmental efforts as a business opportunity to capitalize on. MSC advocates for industry action for whale protection. MSC is part of the Whale Navigation Group which helps develop the World Shipping Council's Whale Chart (*Protecting Endangered Whales with Actions*, 2025). They hosted the International Whales Protection Workshop in 2023 that brought together scientists, IMO representatives, industry stakeholders and others to share the latest research, tools, and technologies to reduce impact on whales. (MSC, 2024). PMSA engages in community efforts and regulatory processes in California and Washington on behalf of their members, and serves as an environmental information hub for the industry (*About Us*, 2025). PMSA's active stance allows them to help advance environmental stewardship policies and practices while ensuring safety and maritime jobs are not compromised (Mike Moore, 2021).

Intrinsic Values

Commitment to sustainability and environmental stewardship is of interest to all liner companies, though some prioritize it more than others. A few companies address

underwater radiated noise as a threat to marine biodiversity but many stop short at whale conservation.

Alaska Marine Lines and Aloha Marine Lines are shipping services underneath the Lynden transportation company that serve Alaska, Hawaii, and the Yukon. Environmental protection is important to Lynden, given their history operating in sensitive locations. Lynden aims to 'meet or exceed environmental regulations, maximize fuel efficiency, and guard against accidents, emissions and avoidable pollution' (*Environmental Stewardship*, 2025).

Ocean Alliance: Central to Australia National Line's (ANL) brand is sustainability and environmental stewardship, naming their commitment to 'build Oceania's sustainable shipping network' explicitly on their website (*Company Overview*, 2025). ANL is a member of the CMA CGM Group. CMA CGM Group's sustainability strategy is built on three pillars: actions for the planet (fighting climate change, protecting biodiversity, and promoting a circular economy), people and fair trade. CMA CGM Group provides Woods Hole Oceanographic Institution with financial support for the installation and maintenance of two passive acoustic hydrophone buoys for the protection of the right whales. Evergreen Line identifies themselves as 'Guardians of the Green Earth' and exhibits beyond compliance behavior. A quote from Evergreen Line's founder, Dr. Yung-Fa Chang, on their Corporate Responsibility page reads, "We will not wait for legislation to be introduced. We will use the latest technology as soon as it is available so as to minimize the impact of container shipping operations on marine life, port communities and humanity worldwide" (Evergreen Marine Corp., 2025).

Matson works with NOAA and PMSA to report whale sightings, which increases mariner understanding of whale behavior in addition to conservation efforts to map migration patterns (Matson, 2024). Matson is currently engaging with Woods Hole Oceanic Institution to pilot

thermal imaging on cameras for whale detection. Matson has provided funding and operational support for a handful of clean-up and education initiatives to support ocean health. In 2023, the Chamber Shipping of America awarded 16 of Matson's vessels the Environmental Achievement award for meeting all international, national, and local environmental requirements over a 2-year period (Matson, 2024). They participate on the Advisory Board of Smithsonian Environmental Research Center and for the Cordell Bank National Marine Sanctuary.

Companies are conducting biodiversity assessments to help guide their actions.

Gemini Cooperation Alliance: Hapag-Lloyd underwent a biodiversity resilience analysis in 2024 and noted their commitment to develop and implement effective measures in the future (Hapag-Lloyd AG, 2025).

Premier Alliance: HMM conducts biodiversity assessments when they have changes to their operations or equipment to understand and mitigate impact (HMM ESG Team, 2024).

Ocean Alliance: OOCL undertook a marine biodiversity assessment, which guided their strategies to minimize hazardous materials, treat ballast water, reduce oil spills, and curb the trade of endangered and protected marine species (OOCL, 2025).

MSC undertook a Locate, Evaluate, Assess, and Prepare (LEAP) assessment in 2023 to understand their nature-related impacts (MSC, 2024). Protecting biodiversity, and whale conservation in particular, is an explicit articulated priority for MSC. MSC brands themselves as an early adopter of initiatives to reduce ocean shipping's impact due to their 'nautical heritage and genuine passion for the sea' (*Protecting Endangered Whales with Actions*, 2025). MSC recognizes shipping's impact on the Arctic and is committed to not utilizing routes that transit the region. They attribute this to their intention to not further inhibit marine species, such as whales, through underwater noise, not contribute to pollutant emissions that further harm

ecosystems and disrupt Arctic communities cultural identity (MSC, 2024). MSC is exploring using thermal cameras on their vessels to increase their awareness and provide training to crew (MSC, 2024).

Interview Analysis

I present key findings from the interview analysis, including quotes from respondents to preserve their points of view. Key findings are bolded. Frequency of codes by interview respondent can be found in Appendix B. Information sharing and exchange was mentioned most frequently. However, frequency of codes may not indicate relative importance. Rather it is more representative of the amount of time dedicated to the topic during the interview. Other factors mentioned fewer times might have been a result of clear communication, where further explanation was not needed. Finally, as respondents understand my role and scope, it is possible that they targeted their response to the factors I have influence over.

Program Characteristics

When shipping companies view the slowdown parameters—speed targets, timing, geography, and monitoring mechanisms—as practical, fair, minimally disruptive to business, and beneficial to whales, motivation to participate was positively impacted. Operations managers found the territorial limits of the slowdown zone clear but expressed the desire for a shared map of Quiet Sound and ECHO slowdowns, particularly for shipping liners transiting between Vancouver and Seattle. Some operators still prefer a defined start and end date, citing challenges in how fast speed can realistically be reduced in a moment's notice. For example, a pilot noted, *"I believe that a set slowdown zone with set dates is the way to work it. Having a slowdown based on sightings - ships can't slow down that quickly, and they might have*

passed the point where the slowdown should have been by the time they are down to 14.5 knots or less."

However, as operators become more familiar with the program and adapt their systems, there is growing interest in a dynamic start and end to the slowdown. A representative from the ECHO Program noted, *"What we're hearing from industry now is that [that desire for consistency] has changed. There have been a lot of technological advancements and familiarity with slowdowns and whale measures around the world that they want to do what's right for the whales, and seem to be more open to a dynamic start and stop."* This was affirmed by a pilot, *"Since you have a dynamic start, maybe you need to have a dynamic end, maybe sometimes it warrants to keep it past January 12. It might be better for you to have the flexibility to say, 'we need to extend it for at least a week'."* Additionally, a shipping line operations manager believed that by not being responsive to whale presence, the program risked credibility, *"I think if you had blanket windows that actually that's where there's more danger of losing credibility, because people feel like, why am I slowing down?"*

Operations managers understand the slowdown's rationale but expressed interest in learning more about how the program ties into other conservation efforts critical for SRKW recovery. When encouraging participation in the slowdown to their members, a representative of a shipping association reiterated how the program fits into the larger SRKW recovery picture, *"It's just one of those three things you're looking at - salmon, toxicity, and noise. And if everyone agrees that those are the three drivers, and you're reducing this by 50%, then it's participating in a suite of things that is trying to give them a better chance. You're not wasting your time here."* Indeed, an operations manager expressed curiosity in understanding what drives orca migration patterns during an interview. While prey availability and water quality are beyond the scope of

the Quiet Sound program, articulating the connection between efforts is important for operators to know that their actions are not for nothing, and would likely increase motivation to participate.

Information Sharing and Exchange

Having opportunities for shipping companies to express both formal and informal commitments to participate in the slowdown increases their motivation to participate. Operations managers were asked whether a more formal opt-in process would increase their motivation to participate and they said that they'd be happy to formally indicate their intent to participate. Further, they suggested this touchpoint be utilized to build a relationship, *"We certainly would have no problem with an opt-in. So rather than that just being a notification, something where we have to sort of formally, sign up or opt-in. If you guys see that we signed up last year and we haven't signed up this year, actually giving us a chase up could be quite helpful."* A representative of a shipping association agreed that the opt-in, whether it be a form or formal agreement, be the start of back-and-forth engagement between the person responsible on the company side and Quiet Sound. They suggested, *"Here's a map. You have the target dates and what's going to happen. Please add this on your bridges and agents. Please remind them and have them give you feedback. Yes, we received it. We fully understand. Some kind of verification thing."*

Quiet Sound's ability to develop relationships with right people within shipping companies is essential to motivating container ship participation in the slowdown. Before Quiet Sound was founded, the Port of Seattle brought together a variety of stakeholders, many of whom later became founding members of the 'Leadership Committee', to build a shared understanding of underwater noise and why it matters to SRKW recovery. A representative from the Port viewed this initial stakeholder engagement as critical, *"Generating a common*

knowledge base such that everyone was coming in with a similar platform, and providing an opportunity to have discussions and get questions answered." A key consideration in the design of the Quiet Sound program was where the program should live in order to effectively engage stakeholders across sectors. The Port representative noted, *"We needed to think about where this program will live, to support longevity and growth such that we can maintain the trust and confidence that was built through the planning process among these really diverse stakeholders."* Rather than sitting within one agency or port, Quiet Sound was situated within the non-profit Washington Maritime Blue, a neutral convening organization. The Port representative reflected, *"What's really important for the success of Quiet Sound is industry partners, along with our scientific partners…being able to generate a lot of confidence and trust in each other over time."*

Consistent communication and intentionally developing a relationship with the right person within the shipping company motivates participation in the slowdown. Operations managers did not perceive Quiet Sound communications and outreach as excessive. In fact, they encouraged more follow up, *"We got a lot of annoying emails, so you'd really be adding to the volume kind that's actually more useful. We'd be more worried about missing something rather than getting one extra reminder."* A representative from the ECHO program encouraged connecting in person, whenever possible and to go where the shipping industry is. Increased opportunities for direct interactions can support three things: establishing a new connection, reinforcing an existing connection, or encouraging internal communication within a shipping company. This can happen if the person's role is not involved directly in participation in the slowdown. Shipping liner companies are large and distributed, so finding the staff who care about participating in the slowdown or are responsible for participating in the slowdown takes

deliberate outreach. A shipping association representative shared, *"If we find out who's who, what their role and responsibility is, and we validate that again. That is the best way to increase participation."* They articulated how the role of the sustainability lead has changed over time, *"And then you start sprinkling environmental stewardship, maybe with respect to oil spills first, then maybe other waste streams, then air emissions reductions, down all the way to whale mitigation measures. So now all that goes under the umbrella called 'sustainability'. Then you have champions inside the company that are trying to promote A, B, C and D within their operations group. So it's a mapping process for every company to find the right person."*

Container ship motivation to participate in the slowdown is maintained, and even increased, when the program communicates the positive impact to whales that results from their fleet's speed reduction. Both operations managers and a shipping association representative appreciate the program understanding how the slowdown positively impacts orca habitat:

- Shipping Line Operations Manager: *"Anytime you can describe how the program is beneficial, how the reduction of just a few knots of speed makes such a big difference, I think that goes a long way towards telling us that this is not a waste of time, by any means. It gives us more incentive to kind of stick with it."*
- Shipping Line Operations Manager: *"I think any extra context is quite helpful. Much of this is about how we communicate, both internally and externally. So having a headline number of participation rate is good because it gives you something for people to latch on to, but more about what that 90% or 80% actually means would be good."*
- Shipping Association Representative: *"They just say, let us know what they're asking us to do. Not all of them, but some will say, 'And is it doing any good?' It's just that they're*

trusting that if we're recommending they do it, that there's an overall good reason to be doing it."

Communicating underwater noise reduction metrics alongside the context increases operators comprehension and makes the results more meaningful.

While the purpose of the Quiet Sound slowdown is to mitigate the acoustic and physical impacts of commercial vessels on SRKWs, operators indicated that quantifying and acknowledging the air emissions reductions and fuel savings would only positively impact their motivation to participate. International shipping liners transit through other speed reduction zones designed for air emissions reduction, and utilize slow steaming to conserve fuel. Therefore, they are aware of the benefits of reducing speed, beyond mitigating impact to whales. *"One of the first things we would look at, aside from our natural inclination to participate, there's obviously going to be bunker savings and reduced fuel burn. And that's certainly another benefit to doing this,"* noted an operations manager.

Shipping companies want to demonstrate that they are voluntarily engaging in opportunities to reduce their environmental footprint when possible. One operations manager shared, *"We do a number of things to try and reduce vessel emissions through more efficient hull designs or propeller designs. We also do things like slow steaming to reduce the amount of fuel that we burn. And so something like this is right in line with wildlife preservation. And so we recognize that this effort, along with others around North America, like the [Blue Whales Blue Skies] initiative down in California, or maybe it's right whales on the East Coast. Those are initiatives that we want to do everything we can to try and facilitate."*

An ECHO representative acknowledged the shipping industry's increased focus on emissions and fuel savings, noting that data could be a selling point for increasing participation

in the slowdown. This was affirmed by a pilot, *"I think it impacts the decision in a positive way. However the extra benefits can be relayed as part of the outreach. If fuel and emissions reductions could be quantified, it would be a big plus. It would be another tool in the bag of reasons to participate."* Operations managers viewed those benefits as an additional reason to participate, but would not necessarily be the deciding factor. One noted, *"I wouldn't say it would be a decision tipping point in doing it or not doing it. So if it is, and it may well be quite a lot of additional work, I don't think it would necessarily tip us. But, if it's available, then yeah, it would be a nice upside."* Further, a shipping association representative highlighted that reductions are not equal across pollutants, *"Slowing down doesn't always save. Are you optimizing for NOx? For SOx? For DPM? So overall, if you were managing a bunch of ships, you might try for the sweet spot where all those curves are about as low as I can."* Quantifying those benefits specific to the Quiet Sound slowdown would be key. This was affirmed by a pilot, *"I think [understanding the emissions reductions and fuel savings of the slowdown] is a great thing to do, because everyone's focused on emissions these days. But you need to quantify it, right? People like to see numbers. Take a vessel of a certain size with a certain main engine, running full speed versus slowing down, over the distance of the slowdown - what that will save in fuel and emissions."*

Operational Factors

Motivation to participate in the slowdown depends upon the authority level of a particular role within the company, prioritization, and effectiveness of internal communication. Typically, the people that have vested interest in participating include those in Operations and Sustainability/Environmental Stewardship roles. A shipping association representative noted that both types of roles are being asked to handle an increasing number of

responsibilities. They shared, *"Talking to a sustainability person is a different conversation than talking to the President of North American operations. That's one of 500 things on the President of Operations' plate."* Understanding where the authority for deciding whether or not to participate in the slowdown lies within a company is also critical for effectively motivating behavior. A shipping association representative articulated, "*Is it the sustainability person? Or should we just copy the vessel's operational management side of things and send it to you? Or do we send it to them and copy the sustainability officer? That means she would have to call the operations guy and go, 'How do you want to do this?' and then you push the conversation internally, which could be very helpful."*

In one shipping company interviewed, the decision to participate in the slowdown was made at the headquarters level. *"[Slowdown logistics] are all handled internally through our company, directed out of our corporate headquarters in Singapore. In this case, they issued an instruction to vessel masters to, whenever possible, comply with the slowdown request,"* shared an operations manager. A pilot affirmed, *"Generally the captains will do what the office asks of them, as long as it's safe to do so."*For one shipping company, the decision to participate was a collaborative decision across the sustainability and operations teams. "*It's sort of in partnership with our sustainability team and department, which are based in our head office in Singapore. Between the teams, we've agreed that this is a program that we want to support,"* the operations manager noted. How the decision is made and by whom may be a function of the maturity of a sustainability team within a company. A shipping association representative noted, *"They're still piecing that stuff together. 40 years ago, none of them had environmental directors. 30 years ago, almost none had environmental directors. 20 years ago, three had environmental directors. Sustainability used to be under operations."*

Either way, once the decision has been made, it applies to all vessel transits while the slowdown is in effect. An operations manager noted, *"We have fixed schedules. When it comes to Quiet Sound, we don't make a decision case-by-case with the ships. Our plan, and hope and expectation, is that all ships during the months the Quiet Sound slowdown is on, comply, and that's the directive we give to them."* Further, the decision is communicated multiple times at different levels. The redundancy implies that participation in the slowdown is a priority for the company, which likely increases motivation of the master to participate. An operations manager shared, *"At the start of the season, we send a message to all the ships that we want them to be slowing down. And then we also send the windows to the ship managers based in Singapore. Those are the technical managers who communicate with the ships more regularly than we do. We include it in our standard arrival instructions. It's just repeating the messages more regularly so that there's fewer times when it's been forgotten."*

Effective internal communication is critical to ensuring the directive to participate in the slowdown is effectively relayed to masters. Operations managers noted the importance of effective internal communication, *"Ensuring that the vessel does slow down is as much about making sure that the individuals aboard are aware that they should be. If ever the ships are not slowing down, that message has broken down somewhere."* This sentiment was shared by a shipping association representative, *"You have to get the information out there, but it's not confusing. It's a matter of whether it gets to the right hand."* However, some companies leave the decision to participate up to the masters, noted a shipping association representative, *"We give them all the information. We defer to the masters to manage the voyage safely."*

Whether or not a company has an internal process to monitor participation in the slowdown could also impact motivation of masters to comply. A shipping association

representative emphasized, *"That's why I tell them it's gotta be more than a memo. You must have an internal system to have implementation."* An internal process that seeks to explain variation among masters could shed light on ways to address lower participation. They further suggested, *"They might need to review their implementation. Here you got a couple different masters. But it looks like maybe one master is much better at participating than another. And you go, why is that?"* For a company who articulated a directive to participate when safe and feasible, understanding those reasons for not participating may be seen as part of an operations manager's role. According to a representative from a shipping association, the motivations of operations managers include, *"Operating schedule on time, getting it done efficiently, and the fuel is being managed, the cost is being managed, and you've made sure the crew is taken care of."*

It remains unclear how much of the slowdown logistics are handled by vessel agents hired by shipping companies. The companies interviewed handled those logistics internally. One agent who did not agree to an interview stated that the agency was not involved in slowdown logistics. One pilot's perspective was that agents with more experience would be more inclined to recommend participating to their principals, whereas a newer agent might prioritize essential job functions. A pilot noted, *"Over the years, some of these agencies might have little or a lot of turnover. If they're only there for a short period of time, they're not going to take a deep dive into extracurricular stuff. They're going to do whatever it takes to clear the ship with customs and immigration and order a pilot. But for somebody who has been there for a long time, they can quickly get all this done."*

Given the important role agencies play in helping shipping companies navigate arrival and departure logistics, future research should focus on their awareness and

motivations behind recommending participation in the slowdown. A shipping association representative articulated the importance of bringing agents into the fold, *"Some of these agents cover so many arrivals. We've got to make sure the agents understand what [the slowdown] is and what it's not. Getting them to be really succinct and consistent about advising their principals of the slowdown. Not just ours, but also Swiftsure and Haro/Boundary Pass. "* Unlike the Quiet Sound program, the ECHO program asks companies and agents if they intend to participate in their slowdowns at the time of pilot booking. Most companies and agents respond neither affirmatively nor negatively, but rather that their participation is 'conditional'. It is unknown the impact this has on the pilot's decision to suggest participation once on board. *"That [intent to participate response] gets pulled into the piloted data. Once the pilot is on board and they do their reporting, we can compare whether the agent said yes, but pilot said no because of these reasons, or agents said conditional depending on scheduling concerns and pilot said no ultimately because there were scheduling concerns," shared an ECHO program representative.* An operations manager includes the slowdown in their pre-arrival communications with the vessel, which likely increases motivation of the master to participate, if safe and feasible. *"When we're communicating with the vessel about what their arrival time should be, as the Port Angeles pilot, we might bring [the slowdown] forward a bit. We usually have enough buffer anyway, the slowdown doesn't materially impact. It's a relatively short distance and only delays them by about 90 minutes to two hours generally,"* an operations manager noted.

Pilots board the vessel either at port or using a pilot boat from the pilot station in Port Angeles, into the Strait of Juan de Fuca. Once onboard, the pilot and captain information critical to the transit, including vessel characteristics, scheduled berthing time, and tides. This interaction is sometimes facilitated using a standardized MPX form. While not a formal part of the MPX,

this is typically when the pilot will ask the master if they would like to participate in the slowdown. A pilot recalls, *"When I step on, we do an MPX, a master pilot exchange. That's essentially a sheet that every ship has, that gives us the details of the ship's handling characteristics, speed and so forth. During that conversation, I'll probably give them a flyer unless they already have one. I'll ask, 'Have you been here before? Are you familiar with the slowdown for the orcas?" If they aren't, then I'll explain where the zone is, that we're going to try to keep 14.5 knots through the water going through the zone. They're generally quite accepting of doing anything that's perceived to be the right thing to do."* One operations manager suggested providing the pilots with a list of companies who noted an affirmative intent to participate, and their vessels, *"Ensuring that the pilots are either aware that this ship has signed up or that it's part of their standard procedure to ask the ship whether they're taking part would be quite helpful. We don't get onboard the ships until they're already berthed, and then they won't be going back through for another six weeks."* Many vessel masters are already primed, likely due to a directive from headquarters or a regional office. With that information in hand, the pilot's conversation with the master could be a final reminder before the transit is underway, especially for transits coming in from open ocean to a port.

The utilization of route-planning and voyage optimization processes facilitates participation in the slowdown. When a container ship is ahead of schedule, a master is more likely to be motivated to participate, as it's seen as a win-win scenario. An operations manager emphasized, *"A lot of it is because of congestion on the West Coast ports, there's no reason to hurry up and wait. So we throttle back."* Reducing speed when there is slack in the schedule also allows a ship to reduce their fuel consumption, which is a growing cost for companies. A shipping representative articulated, *"They're well aware now of fuel costs. 40 years ago, not so*

much. It was very cheap, but it was still a substantial part of the daily operational cost. But they let the master manage the voyage. And I'm telling you, it was not optimal. They were doing weather routing and different kinds of things, but different masters would [vary their speeds]."

Both operations managers confirmed that buffer time to participate in the slowdown is built into the vessel transit schedule:

- *"We know we're going to be participating, we're going to be slowing down once we get to Puget Sound. It's built into the schedule. Maybe a ship has been slow-steaming across the Pacific. It might pick up speed for a few hours to make up for the anticipated slowdown. And then going back to Vancouver, if that were the pattern, it'd be the same kind of thing. They would build that into the operational schedule."*
- *"We're in charge of the port schedules and their movements to try and meet those port schedules. We have ownership of that vessel schedule and part of that is building in time for the slowdowns for Quiet Sound and other programs."*

Further, both operations managers view the increase in transit time due to participation in the slowdown, which represents roughly a 22 nautical mile portion of the transit, as nominal.

- *"We have seen an increase in throughput and participation in the program, even though there might be a fairly small increase in steaming time, really isn't a big factor for us, because it doesn't really hurt us."*
- *"Because it's a relatively short distance, it's only delaying them by about 90 minutes to two hours generally. We have that buffer in the schedule anyway."*

Shipping companies are more motivated to participate in the slowdown when participation does not increase operational costs, when it decreases costs, or when it

increases profits. There was agreement across all interviewees that scheduling concerns are the primary reason for not participating, followed by weather or safety concerns:

- Pilot: *"The only time participation hasn't been done is if there are scheduling issues…Or weather or tug availability, if I need to be there at a certain time because the tugs are available to help."*
- Operations Manager: *"The way the labor contracts work for the longshoremen is you can only start shifts at a particular time. If a shift starts at 8am, our ship has to be ideally at the port by 6am in order to start work at 8. So if we're arriving at 10 am, then that's a bit difficult because then you might only start working at 4:30pm, the way the labor contracts work. But in general, we shouldn't be cutting it that close. We're planning ahead so that the slowdown isn't the reason for that delay."*
- Operations Manager: *"The only thing that might change that is if something happens with pilot availability, and we're behind schedule, and we have labor ordered to start at a certain time. Chances are pretty good that we would not slow down, because we'd be subject to tens of thousands of dollars in standby labor costs."*

This is because the result of missing or being late to a scheduled berthing time, or not having a tug available, is very financially consequential for a shipping company.

Shipping companies can also incur additional labor costs if they are late arriving at the pilot station. However, once the pilot is onboard, the cost of the pilot's time does not materially change. Compensation for participation is one difference between the Quiet Sound slowdown and the ECHO slowdowns. In the first year of the ECHO slowdowns, they offered a financial incentive for participation, but companies largely opted out of receiving it, saying they did not need it. The program does offer a discount to address operational costs. If by participating in the

slowdown, a vessel's transit through piloted waters extends into an additional pilotage hour, Transport Canada will reimburse the agent or company automatically. It seems as though the financial incentive is not a primary motivator, but the reimbursement is. This could be because reimbursement is more responsive to the actual increased operational cost and results in potentially more money back to the company. Or it could be that companies feel like their effort to participate is better acknowledged through the reimbursement. Finally, the reimbursement could help reduce tension between companies and the pilots, if participating in the slowdown requires an extra hour of pilot pay, the company is being compensated for that cost. An ECHO Program representative noted, *"We heard that costs in general are, of course, a concern, and the slowdowns can be up to a half hour delay, so it can make the vessel go into the next hour, or even into overtime past eight hours. And so that's something really important to industry, knowing that the company is not paying to participate."* While this reimbursement is important to companies and agents, it's a big cost to the program. Quiet Sound, nor do the surrounding ports, offer any financial incentive for slowdown participation. While a NWSA representative had received requests to reduce fees for participation, operators interviewed did not consider it a major consideration, *"As far as incentives, when it comes to having reductions in port fees or something, they're nice to have, but they're not a huge motivator for us. I don't think we would stop doing Quiet Sound's slowdown because it's not giving us some rebates, and commit to doing Long Beach because it does."*

External Influences

Container ship motivation to participate in the slowdown is likely increased when they know ahead of time what recognition they can expect to receive, if their efforts feel appreciated, and if participation is made public where competitors or consumers can see.

Preferences for recognition mechanisms differ depending on role and internal metrics. A sustainability officer might care more about public recognition than an operations manager would, as noted by a shipping association representative, *"A sustainability officer would love any recognition. But the people running the company are just looking to hit their marks on their budget and have things safe."* In companies with strong internal communication between teams, the operations manager ensures that the more public-facing sustainability team receives the season's participation data. An operations manager noted the process, *"Then forward it to our corporate groups to make sure that they do include that, because we definitely want that to be communicated out."*

Operations managers view publicizing their participation rate as a way to uphold company commitments. This sentiment was expressed multiple times:

- *"I don't think it hurts to be recognized, especially where we are making environmental issues such a big part of our corporate identity. I think it really demonstrates that we're living up to our commitment to try and support those things."*
- *"We have various pillars and one of them is the environment in which we operate. Marine biodiversity is a priority for our sustainability strategy. So this is kind of an obvious area where we can show commitment for that. And so if we're going to do it in Vancouver, then we should be doing it everywhere. Wherever there is a program up and down the West Coast, we've signed up to be a part of it."*
- *"Obviously we like being recognized, showing that we are part of this. Especially as part of sustainability reporting and requirements, to not just say things to show things."*

Operations managers agreed that a call-out in a trade publication would be welcomed. This is likely because their shipping company competitors would see. Generally, companies liked

being recognized after each season. They showed support in physical recognition certificates that can be displayed to demonstrate long-term commitment to the program. While companies enjoyed public recognition, both operations managers did not indicate a strong interest in award ceremonies, particularly when the cost of doing so is expensive. One said, *"I don't think we have particularly strong feelings. We like having a way to show that we took part. I think the money could probably be better spent elsewhere, rather than doing big events."*

They appreciate recognition for every individual effort to reduce their environmental impact and are not interested in awards that lump multiple actions together. This was also expressed by an ECHO Program representative: *"What we've heard from industry right now is 'we don't want to [add slowdown participation to the Blue Circle Awards] because it's important to be recognized for every effort taken."* Finally, the frequency of awards does not always allow adequate time to integrate actions. A Port of Seattle representative shared, *"We just shifted the awards to be every other year instead of annually because we received some feedback that doing it annually didn't give them enough time to demonstrate or integrate these practices, whether it was better waste management or participation in Quiet Sound. It just didn't give them enough time to implement the program and accumulate the data related to that."*

Deliberately communicating a shipping company's participation in the context of overall container ship participation to upper level management could motivate participation. A shipping association representative suggested, *"You have some public acknowledgement for some companies that did a stellar job, and then we spread that around all the other companies at the right organizational level. When you're a CEO and a big company CEO goes, hey, we need to work on this, and you're at a board meeting, it has a better chance of being implemented."* Some operations managers voiced support for a tiered recognition structure that differentiates levels of

participation. Doing so could increase motivation to participate in the way of competition between shipping liners. One noted, *"In terms of increasing participation, just thinking whether there would be any benefit in you putting table, showing how all the carriers stack up. Maybe that creates some sort of competition and encourages people to improve. Obviously, if you're giving people their percentages, to some extent, there is a ranking but it's not as direct as you publishing a league table."*However, both the ECHO program and shipping association representative acknowledged that tiers might be demotivating if perceived as public shaming.

Intrinsic Values

While the literature suggested that positive actions by shipping companies are to avoid regulation or increase their social license, the mariners interviewed have an inextricable connection to the water, and that includes the living things within it.

A pilot shared their understanding of the value of the program, *"The goal here is to make a better habitat for the Southern Resident orcas, and whatever we could do, at least in my mind, to help them forage for food and increase their population, grow their family, that would be helpful. And it seems that, as we have learned from ECHO, by slowing down and creating less noise, it's helping them to communicate and forage for food."* A shipping association representative noted that shipping companies are driven by an intrinsic desire as well, *"I think some of them want to, just as a sustainability practice, participate. We live in the water too."* Operations managers demonstrated a desire to learn about SRKW behavior and gaining access to whale location tools. Operators' motivations to participate increase when they are provided with real-time whale presence and informed about the recovery situation of the orcas. Finally, a pilot noted the role of morality in decisions to participate, *"They're generally quite accepting of doing anything that's seemed to be the right thing to do."*

Discussion

Key Takeaways

Maritime shipping is a complex system that is constantly adapting to global economic and political shifts, regulations, and societal pressures. Accordingly, the reasons shipping companies participate in the Quiet Sound voluntary vessel slowdown are also complex. All of the factors identified in the analytical framework interact. Below I articulate key takeaways, recommendations for the Quiet Sound program, and future research possibilities largely in alignment with the factor categories, calling out interactions between factors when relevant.

Program Characteristics: Interview responses agree with the literature in that clearly delineated parameters, program rationale, and goals positively impact motivation to participate in the slowdown. Companies who included their participation in voluntary vessel speed reduction programs in their sustainability reports generally did not include the speed targets or length of geographic area, but did specify location. This might be because, as indicated in interviews, they trust the program to set parameters that are targeted to maximize benefit for the local whale species. That said, shipping liners did articulate the importance of continuing to target the slowdown period for when SRKWs are present to the best of the program's ability. Shipping companies appreciate the fact that there are monitoring mechanisms in place to measure impact. However, they did express interest in understanding how the Quiet Sound slowdown interacts with other SRKW recovery efforts.

Information Sharing and Exchange: Respondents receive information about the slowdown from shipping associations or Quiet Sound directly. In agreement with the literature,

announcements published by the U.S. Coast Guard, such as the Notice to Mariners, is not the primary way companies learn of the slowdown.

The lack of shipping companies who mentioned participating in the Quiet Sound slowdown in their sustainability reports while including participation in other voluntary vessel speed reduction programs indicates a lack of relationship between the Quiet Sound program and the shipping company. It could be that shipping companies are participating but do not know their fleet participation rate due to lack of engagement with Quiet Sound staff. It can also indicate a disconnect between operations personnel and sustainability reporting staff, if a fleet is participating and Quiet Sound communicates fleet participation rates to the operations team, but it does not get relayed to the reporting team. Respondents from companies that do have direct relationships with Quiet Sound staff encouraged persistent communication from the Quiet Sound team. Regular communication before, during and after the slowdown would further motivate participation.

Knowing when the SRKWs are present in Puget Sound is important to respondents. They expressed a willingness to reduce their speeds but want to know that they are not doing it in vain. To that end, they would want to understand how speed reduction is benefiting the SRKWs. Reinforcing that reducing speeds particularly during times when the SRKWs are confirmed in the slowdown zone would motivate participation.

Operational Factors: All shipping line sustainability reports included goals or specific actions the company was taking to address GHG emissions and air pollution. Many of those companies articulated slow-steaming and route-planning as strategies to reduce emissions and air pollution, as well as conserve fuel. This was validated by interview respondents who indicated that emissions reductions and fuel savings are a priority for the industry. And while they would

participate in the slowdown and articulating the co-benefits of participation in the slowdown would be another tool in the toolbox. Few companies made the connection between slow-steaming and underwater noise reduction. More often, participation in vessel speed reduction programs was situated under 'protecting biodiversity'. This is likely due to the relative lack of global strategies and reporting for underwater noise in comparison to the plethora of frameworks for energy efficiency and GHG reduction. Despite participation in voluntary speed reduction programs being a 'Level 2' metric for Green Marine's underwater noise performance indicator for ship owners, only two of the shipping companies were Green Marine certified.

External Influences: Document analysis and interviews agreed with the literature that avoidance of, or the possibility to help shape regulations, is a motivator for shipping companies to participate in the Quiet Sound slowdown. The literature was mixed on the impact of financial incentives on motivating participation in vessel speed reduction programs. Respondents indicated that they would view a financial incentive as a bonus, not a deal-breaker. Respondents viewed public recognition on websites, traditional media, and trade magazines as more valuable than a physical award. In agreement with the literature on maintaining their social license to operate, respondents expressed the desire to demonstrate that they are upholding commitments and acting in good faith. Evident in their sustainability reports, multiple shipping lines are beginning to market their services as 'environmentally friendly'. Indeed, the literature identified a number of beneficial cargo owners who demonstrated a preference for minimizing their environmental impact when shipping their goods.

Intrinsic Values: Little research is available on the intrinsic values of shipping companies, or rather the employees of those companies. Further, it is difficult to disentangle whether participation is motivated by a desire to protect biodiversity, mitigate climate change, or

improve air quality, as opposed to the desire to be perceived as valuing those things. That said, respondents valued protecting biodiversity, reducing GHG emissions and air pollution, and doing the right thing because in addition to working for a shipping line, operations managers and mariners also call the Puget Sound home.

Recommendations

1. **Better articulate how the slowdown fits in with other SRKW recovery efforts.**

The slowdown is often presented as a voluntary measure to address one of the three major threats faced by SRKW: vessel impacts. Articulating the connections between interventions addressing the three threats with a theory of change helps contextualize and validate the rationale for the slowdown.

2. **Solicit feedback on parameters from operators when considering changes to the program.**

As systems improve and companies become more familiar with slowdowns, their capacity and desire to change their behavior to maximize impact for the whales increases. When considering changes to the geographic location, speed targets, and timing of the slowdown, solicit feedback from operators to maximize benefit to the whales while also being operationally feasible and safe.

3. **Develop relationships with liners that regularly call the area.**

Making a concerted effort to engage each of the shipping lines that call the Northwest Seaport Alliance can help increase the slowdown's visibility. The Northwest Seaport Alliance publishes the pro forma schedule of anticipated vessel arrivals and departures for a two-month period on their website. Further, many shipping liners are on a six-string schedule, meaning they return to a

particular port every six weeks. Establishing regular contact and sending reminders before a vessel is scheduled to call the port could improve participation.

4. **Ensure the slowdown information is reaching the right people within the company.**

Further, identifying and building a relationship with staff that are directly involved in the decision to participate in the program, the implementation of vessel operations, and the utilization of participation data for reporting or marketing purposes could help increase transparency, understanding and accountability between the program and shipping company.

5. **Articulate the 'so what' when sharing fleet participation data.**

When sharing fleet participation data with the shipping company, clearly explain what the noise reduction metrics mean and how that benefits the SRKWs.

6. **Communicate when SRKWs are in the Puget Sound during the slowdown.**

Facilitate access to WRAS for operations staff to inform pre-transit awareness. Consider wider communications about the likelihood of it being a day when whales are likely to be present in any part of Puget Sound.

7. **Highlight vessel speed reduction as a tool for energy efficiency and underwater noise reduction.**

While the purpose of the Quiet Sound slowdown is to mitigate the acoustic and physical impacts of commercial vessels on SRKWs, quantifying and acknowledging the air emissions reductions and fuel savings could increase motivation to participate. Companies are already using route-planning and slow steaming to improve their fuel efficiency and reduce emissions. Communicating how their participation in the slowdown contributes to those efforts could improve participation.

8. **Point companies to existing frameworks to guide their underwater noise reduction strategy.**

Pointing companies to frameworks such as Green Marine's underwater noise performance indicators could help them articulate strategies and set targets for addressing their underwater noise. If what gets measured, gets managed, then providing structure to shipping companies would increase their motivation to participate in the slowdown as one part of a broader strategy.

9. **Prioritize recognition efforts over financial incentives, and communicate how participation in the slowdown improves SRKW habitat.**

Publicly acknowledging a company's participation in the slowdown in places where their shareholders, stakeholders, and competitors can see.

10. **Encourage companies to pursue external certifications.**

Third-party certifications like Quiet Vessel notations and Green Marine, help companies get credit for actions. Vessel owners can achieve Level 2 of the Green Marine certification by participating in the Quiet Sound slowdown. Getting credit for their participation through Green Marine helps companies maintain social license to operate.

11. **Identify shipping lines with regional offices or Operations Managers based in the Puget Sound region.**

Increasing awareness of the slowdown's impact on the SRKWs can increase buy-in, particularly of employees who live or work in the Puget Sound.

Future Research

Future research could explore the following lines of inquiry:

- Whether shipping line interaction in the parameter-setting process is correlated with higher participation rates.

- How shipping lines learn about the Quiet Sound program initially, and how they receive updates on parameters ahead of each slowdown season. This could help inform Quiet Sound's communication strategy for effective dissemination.
- How perception of whale presence, whether through the Whale Report Alert System, PWWA application, community groups, news outlets, or other sources impacts participation in the slowdown.
- Co-benefits of the slowdown, particularly emissions reduction and fuel savings.
- Conduct an events history to understand how global, regional and local events and moments correlate with participation.
- Which beneficial cargo owners would value shipping their goods on 'whale safe' ships, and articulate mariners' perspectives on the intrinsic value of biodiversity.

Conclusion

In conclusion, this research provides a unique glimpse into the factors that motivate container ship participation in the Quiet Sound slowdown. The findings and recommendations put forth are particularly nascent for the Quiet Sound program but may also be relevant to other voluntary vessel speed reduction programs around the world. With just 73 endangered Southern Resident killer whales remaining, thoughtful program design and implementation can help create an ocean where shipping and whales thrive together.

Bibliography

2025 Global Container Shipping Alliances. (2025, January 3). Logistics Plus. https://www.logisticsplus.com/2025-global-container-shipping-alliances/

About Quiet Sound. (2025). Quiet Sound. https://quietsound.org/program

About Us. (2025). Pacific Merchant Shipping Association. https://www.pmsaship.com/our-association

Ahl, C., Frey, E., & Steimetz, S. (2017). The effects of financial incentives on vessel speed reduction: Evidence from the Port of Long Beach Green Flag Incentive Program. *Maritime Economics & Logistics*, *19*(4), 601–618. https://doi.org/10.1057/mel.2016.12

Ainslie, M. A., Martin, S. B., Trounce, K. B., Hannay, D. E., Eickmeier, J. M., Deveau, T. J., Lucke, K., MacGillivray, A. O., Nolet, V., & Borys, P. (2022). International harmonization of procedures for measuring and analyzing of vessel underwater radiated noise. *Marine Pollution Bulletin*, *174*, 113124. https://doi.org/10.1016/j.marpolbul.2021.113124

Alberini, A., & Segerson, K. (2002). Assessing Voluntary Programs to Improve Environmental Quality. *Environmental and Resource Economics*, *22*(1), 157–184. https://doi.org/10.1023/A:1015519116167

A.P. Moller-Maersk. (2025). *Annual Report 2024*. https://investor.maersk.com/static-files/31bf05a1-6f0c-4fbd-a3c7-3f58e044f668?_gl=1*8cam95*_gcl_au*MTUyMDU4NzYzOS4xNzQ0MTI0MDY5*_ga*MTkxMDgyMzkwNy4xNzQ0MTI0MDY5*_ga_QCD0MQYKLF*MTc0NDEyNDA2OS4xLjEuMTc0NDEyNjkxNS41OS4wLjA.

Bansal, P., & Roth, K. (2000). Why Companies Go Green: A Model of Ecological Responsiveness. *The Academy of Management Journal*, *43*(4), 717–736. https://doi.org/10.2307/1556363

Bhonsle, J. (2024, November 11). What is Fixed Berthing Window Concept at Container Ports and Terminals? *Marine Insight*. https://www.marineinsight.com/marine-navigation/fixed-berthing-window-concept/

Bouman, E. A., Lindstad, E., Rialland, A. I., & Strømman, A. H. (2017). State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review. *Transportation Research Part D: Transport and Environment*, *52*, 408–421. https://doi.org/10.1016/j.trd.2017.03.022

Butsick, D. (2022, December 5). *Port Invests in Research and Technology to Quiet the Sound*. Port of Seattle. https://www.portseattle.org/blog/port-invests-research-and-technology-quiet-sound

California Marine Sanctuary Foundation. (2025). *About Blue Whales Blue Skies*. Protecting Blue Whales Blue Skies. https://www.bluewhalesblueskies.org/about

Carr, G. (2022, August 15). *Emissions Reduction Partnerships: Potential Points of Collaboration Between the Northwest Seaport Alliance and Their Key Cargo Partners*.

University of Washington | Program on Climate Change. https://pcc.uw.edu/blog/2022/08/15/emissions-reduction-partnerships-potential-points-of-collaboration-between-the-northwest-seaport-alliance-and-their-key-cargo-partners/

Clarke, D., Chan, P., Dequeljoe, M., Kim, Y., & Barahona, S. (2023). *CO2 emissions from global shipping: A new experimental database* (OECD Statistics Working Papers No. 2023/04; OECD Statistics Working Papers, Vol. 2023/04). https://doi.org/10.1787/bc2f7599-en

Clean Vessel Incentive Program. (2025). Port Authority of New York and New Jersey. https://www.panynj.gov/content/port/en/our-port/sustainability/clean-vessel-incentive-program.html

CMA CGM. (2025). *2024 CSR Report*. https://www.cmacgm-group.com/api/sites/default/files/2025-03/2024%20CSR%20Report%20CMA%20CGM%20Group.pdf

Company Overview. (2025). ANL. https://www.anl.com.au/about-us/company-overview

COSCO SHIPPING Lines Co., Ltd. (2023). *2023 Sustainability Report*. https://lines.coscoshipping.com/lines_resource/pdf/quality2023en.pdf

Dixon, S. E. A., & Clifford, A. (2007). Ecopreneurship—A new approach to managing the triple bottom line. *Journal of Organizational Change Management*, *20*(3). https://doi.org/10.1108/09534810710740164

ECHO Program projects and initiatives. (2025). Vancouver Fraser Port Authority. https://www.portvancouver.com/environment/healthy-ecosystem/echo

EEXI and CII - ship carbon intensity and rating system. (2025). International Maritime Organization. https://www.imo.org/en/MediaCentre/HotTopics/Pages/EEXI-CII-FAQ.aspx

Environmental Stewardship. (2025). Lynden. https://www.lynden.com/about/environmental-stewardship/

Evergreen Marine Corp. (2023). *2023 Sustainability Report*.

Evergreen Marine Corp. (2025). *Corporate Sustainability*. https://csr.evergreen-marine.com/?en

FathomShipping. (2013, July 2). The Rise of a Sustainability Leader: Maersk's Journey to the Triple-E. *gCaptain*. https://gcaptain.com/maersk-triple-e-sustainability-emission/

Findlay, C. R., Rojano-Doñate, L., Tougaard, J., Johnson, M. P., & Madsen, P. T. (2023). Small reductions in cargo vessel speed substantially reduce noise impacts to marine mammals. *Science Advances*, *9*(25), eadf2987. https://doi.org/10.1126/sciadv.adf2987

Finnsgård, C., Kalantari, J., Roso, V., & Woxenius, J. (2020). The Shipper's perspective on slow steaming—Study of Six Swedish companies. *Transport Policy*, *86*, 44–49. https://doi.org/10.1016/j.tranpol.2019.10.005

Freedman, R., Herron, S., Byrd, M., Birney, K., Morten, J., Shafritz, B., Caldow, C., & Hastings, S. (2017). The effectiveness of incentivized and non-incentivized vessel speed reduction programs: Case study in the Santa Barbara channel. *Ocean & Coastal Management*, *148*(7–8), 31–39. https://doi.org/10.1016/j.ocecoaman.2017.07.013

Giuliano, G., & Linder, A. (2013). Motivations for self-regulation: The clean air action plan.

Energy Policy, *59*, 513–522. https://doi.org/10.1016/j.enpol.2013.04.007

Global Reporting Initiative. (2016). *GRI 304: Biodiversity 2016*. https://www.globalreporting.org/publications/documents/english/gri-304-biodiversity-2016/

GloNoise Partnership. (n.d.). International Maritime Organization. Retrieved March 29, 2025, from https://www.imo.org/en/OurWork/PartnershipsProjects/Pages/GloNoise-Partnership.aspx

Gonyo, S. B., Goedeke, T. L., Wolfe, K. E., Jeffrey, C. F. G., Gorstein, M., Poti, M., & Dorfman, D. S. (2019). An economic analysis of shipping costs related to potential changes in vessel operating procedures to manage the co-occurrence of maritime vessel traffic and whales in the Channel Islands region. *Ocean & Coastal Management*, *177*, 179–187. https://doi.org/10.1016/j.ocecoaman.2019.04.024

Green Flag Program. (2024). Port of Long Beach. https://polb.com/business/incentives/#green-flag-program

Green Marine. (2019, June 7). *Puget Sound Pilots becomes the first pilotage association to achieve Green Marine certification*. Green Marine. https://green-marine.org/stayinformed/news/puget-sound-pilots-becomes-the-first-pilotage-association-to-achieve-green-marine-certification/

Guzman, H. M., Hinojosa, N., & Kaiser, S. (2020). Ship's compliance with a traffic separation scheme and speed limit in the Gulf of Panama and implications for the risk to humpback whales. *Marine Policy*, *120*, 104113. https://doi.org/10.1016/j.marpol.2020.104113

Hapag-Lloyd AG. (2025). *Sustainability Progress Report 2024*. https://www.hapag-lloyd.com/360applications/sustainability/index4.html

Hildebrand, J. (2009). Anthropogenic and natural sources of ambient noise in the ocean. *Inter-Research*, *395*, 5–20. https://doi.org/10.3354/meps08353

Himes, A., Muraca, B., Anderson, C. B., Athayde, S., Beery, T., Cantú-Fernández, M., González-Jiménez, D., Gould, R. K., Hejnowicz, A. P., Kenter, J., Lenzi, D., Murali, R., Pascual, U., Raymond, C., Ring, A., Russo, K., Samakov, A., Stålhammar, S., Thorén, H., & Zent, E. (2024). Why nature matters: A systematic review of intrinsic, instrumental, and relational values. *BioScience*, *74*(1), 25–43. https://doi.org/10.1093/biosci/biad109

HMM ESG Team. (2024). *2023 HMM ESG Report*. https://www.hmm21.com/data_files/company/files/download/HMM_ESG_Report_2023(ENG).pdf

Holt, M. M., Noren, D. P., Veirs, V., Emmons, C. K., & Veirs, S. (2008). Speaking up: Killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. *The Journal of the Acoustical Society of America*, *125*(1), EL27–EL32. https://doi.org/10.1121/1.3040028

Holt, M. M., Tennessen, J. B., Hanson, M. B., Emmons, C. K., Giles, D. A., Hogan, J. T., & Ford, M. J. (2021). Vessels and their sounds reduce prey capture effort by endangered

killer whales. *Marine Environmental Research*, *170*, 105429. https://doi.org/10.1016/j.marenvres.2021.105429

International Maritime Organization. (2023). *Workshop on the Relationship between Energy Efficiency and Underwater Radiated Noise from Ships* [Meeting Summary]. International Maritime Organization. https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/Workshop-on-Energy-Efficiency-and-Underwater-Radiated-Noise-from-Ships.aspx

Jalkanen, J.-P., Johansson, L., Andersson, M. H., Majamäki, E., & Sigray, P. (2022). Underwater noise emissions from ships during 2014–2020. *Environmental Pollution*, *311*, 119766. https://doi.org/10.1016/j.envpol.2022.119766

Kalliber, K. (2018, September 19). Protecting our Salish Sea, the salmon and the southern resident orcas. *Tulalip News*. https://www.tulalipnews.com/2018/09/19/protecting-our-salish-sea-the-salmon-and-the-southern-resident-orcas/

Kaplan, M. B., & Solomon, S. (2016). A coming boom in commercial shipping? The potential for rapid growth of noise from commercial ships by 2030. *Marine Policy*, *73*, 119–121. https://doi.org/10.1016/j.marpol.2016.07.024

Khanna, M. (2001). Economic Analysis of Non-Mandatory Approaches to Environmental Protection. *Journal of Economic Surveys*, *15*(3), 291–324. https://www.researchgate.net/publication/4764855_Economic_Analysis_of_Non-Mandatory_Approaches_to_Environmental_Protection

Killer whale resources and regulations for boaters. (2025). Washington Department of Fish & Wildlife. https://wdfw.wa.gov/species-habitats/at-risk/species-recovery/orca/regulations

Linder, A. (2018). Explaining shipping company participation in voluntary vessel emission reduction programs. *Transportation Research Part D: Transport and Environment*, *61*, 234–245. https://doi.org/10.1016/j.trd.2017.07.004

Maersk (Director). (2012, January 2). *Slow steaming* [Video recording]. https://www.youtube.com/watch?v=tchWf313Va0

Maloni, M., Paul, J. A., & Gligor, D. M. (2013). Slow steaming impacts on ocean carriers and shippers. *Maritime Economics & Logistics*, *15*(2), 151–171. https://doi.org/10.1057/mel.2013.2

Marine Environment Protection Committee. (2023). *Revised guidelines for the reduction of underwater radiated noise from shipping to address adverse impacts on marine life* (No. Circ.906). International Maritime Organization.

Maritime Shipping. (n.d.). International Council on Clean Transportation. Retrieved March 29, 2025, from https://theicct.org/sector/maritime-shipping/

Martin Associates. (2024). *Economic Impacts of Pacific Whale Watch Association Tourism in the Salish Sea*. https://static1.squarespace.com/static/581cbad4be6594d1fe23358b/t/65cd0211ff8f6d4183014aab/1707934226004/PWWA+Economic+Impact+Report+-+Feb.+2024.pdf

Matson. (2024). *2023 Sustainability Report*. https://www.matson.com/media/Sustainability_Report_2023.pdf

McKenna, M., Katz, S., Condit, C., & Walbridge, S. (2012). Response of Commercial Ships to a Voluntary Speed Reduction Measure: Are Voluntary Strategies Adequate for Mitigating Ship-Strike Risk? *Coastal Management*, *40*(6). https://doi.org/10.1080/08920753.2012.727749

McKinley Research Group. (2023). *Economic Impacts of Washington's Maritime Industry 2022*. http://www.maritimefederation.com/uploads/1/0/9/1/109194033/wa_maritime_impacts_2022_-_report.pdf

Mike Moore. (2021, July 23). *Evolving Public Policies Aimed at Maritime Require an Effective, Positive Response*. Pacific Merchant Shipping Association. https://www.pmsaship.com/maritime-insights-blog/evolving-public-policies-aimed-at-maritime-require-an-effective-positive-response

Moore, T. J., Redfern, J., Carver, M., Hastings, S., Adams, J., & Silber, G. (2018). Exploring ship traffic variability off California. *Ocean & Coastal Management*, *163*. https://doi.org/10.1016/j.ocecoaman.2018.03.010

MSC. (2024). *2023 Sustainability Report*. https://www.msc.com/-/media/files/sustainability/reports/2023-msc-sustainability-report.pdf?rev=2fa75fec28b5427fa25d5bd5627782e6

Mun, W.-J. (2024). *WSC Whale Chart: A global voyage planning aid to protect whales* (No. Second Edition). World Shipping Council. https://static1.squarespace.com/static/5ff6c5336c885a268148bdcc/t/672e33f771bca527f4adda11/1731081219615/WSC+Whale+Chart_+A+global+voyage+planning+aid+to+protect+whales+%28Oct+2024%29.pdf

Nisi, A. C., Welch, H., Brodie, S., Leiphardt, C., Rhodes, R., Hazen, E. L., Redfern, J. V., Branch, T. A., Barreto, A. S., Calambokidis, J., Clavelle, T., Dares, L., de Vos, A., Gero, S., Jackson, J. A., Kenney, R. D., Kroodsma, D., Leaper, R., McCauley, D. J., … Abrahms, B. (2024). Ship collision risk threatens whales across the world's oceans. *Science*, *386*(6724), 870–875. https://doi.org/10.1126/science.adp1950

NOAA Fisheries. (2021, January 12). *Nearby Vessels Interrupt Feeding of Southern Resident Killer Whales, Especially Females* (West Coast). NOAA. https://www.fisheries.noaa.gov/feature-story/nearby-vessels-interrupt-feeding-southern-resident-killer-whales-especially-females

NOAA Fisheries. (2025a, January 14). *Killer Whale | NOAA Fisheries* (Alaska,New England/Mid-Atlantic,Pacific Islands,Southeast,West Coast). NOAA Fisheries. https://www.fisheries.noaa.gov/species/killer-whale

NOAA Fisheries. (2025b, February 18). *Ocean Noise | NOAA Fisheries* (National). NOAA. https://www.fisheries.noaa.gov/national/science-data/ocean-noise

NOAA Fisheries. (2025c, April 18). *Saving the Southern Resident Killer Whales* (West Coast). NOAA.

https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/saving-southern-resident-killer-whales

Ocean Carriers. (2025). The Northwest Seaport Alliance. https://www.nwseaportalliance.com/service-providers/ocean-carriers

Ocean Network Express. (2024, October 15). *Sustainability Report 2024*. https://us.one-line.com/sites/g/files/lnzjqr1451/files/2024-10/ONE_Sustainability%20Report%202024.pdf

Office of Transportation and Air Quality. (2021). *Port Operational Strategies: Vessel Speed Reduction*. U.S. Environmental Protection Agency. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10119QQ.pdf#page=3

OOCL. (2025). *Marine Biodiversity Conservation*. OOCL | Environmental Care. https://www.oocl.com/eng/aboutoocl/Environmentalcare/marinebiodiversity/Pages/marinebiodiversity.aspx

Orient Overseas (International) Limited. (2024). *Sustainability Report 2023*. https://www.ooilgroup.com/corporate/environmentalprotection/Documents/E-00316SR-24042024.pdf

Port of Seattle. (2019, October 7). *Port Gathers Diverse Maritime Interests to Protect Endangered Orcas by Reducing Ship Noise*. Port of Seattle. https://www.portseattle.org/news/port-gathers-diverse-maritime-interests-protect-endangered-orcas-reducing-ship-noise

Port of Seattle. (2025). *2024 Environment and Sustainability Annual Report*. https://www.portseattle.org/sites/default/files/2025-05/2024%20Environment%20and%20Sustainability%20Annual%20Report.pdf

Port of Tacoma. (2024). *Environmental Action Plan 2024 | Tacoma Harbor*. https://www.flipsnack.com/BC9AED88B7A/port-of-tacoma-environmental-action-plan-2024/full-view.html

Protecting endangered whales with actions. (2025). MSC. https://www.msc.com/en/sustainability/blue-planet/whale-protection

Puget Sound Pilots. (2025). *Environment*. Puget Sound Pilots. https://www.pspilots.org/our-mission/environment/

Quiet Sound. (2023). *Results of the 2022-2023 Voluntary Commercial Shipping Slowdown Trial in Washington Waters for the Protection of Southern Resident Killer Whales*. https://quietsound.org/wp-content/uploads/2023/09/Quiet-Sound-Results-of-the-22-23-Voluntary-Commercial-Shipping-Slowdown-Trial-in-WA-for-protection-of-SRKW-FINAL-v-9-13-23.pdf

Quiet Sound. (2024). *Results of the 2023-2024 Voluntary Commercial Vessel Slowdown in Washington Waters for the Protection of Southern Resident Killer whales*. https://quietsound.org/wp-content/uploads/2024/08/2023-24-Quiet-Sound-Slowdown-Final-Report_Aug6.pdf

RCW 77.15.740, RCW 1 (2024). https://app.leg.wa.gov/RCW/default.aspx?cite=77.15.740

Recovery of Southern Resident Orcas. (2025). Puget Sound Partnership. https://www.psp.wa.gov/recovery-of-southern-resident-orcas.php

Salzmann, O., Ionescu-Somers, A., & Steger, U. (2005). The Business Case for Corporate Sustainability: Literature Review and Research Options. *European Management Review*, *23*(1), 27–36. https://doi.org/10.1016/j.emj.2004.12.007

Sanguri, M. (2012). *The Guide to Slow Steaming on Ships*. Marine Insight. https://www.marineinsight.com/wp-content/uploads/2013/01/The-guide-to-slow-steaming-on-ships.pdf

Shields, M. W. (2023). 2018–2022 Southern Resident killer whale presence in the Salish Sea: Continued shifts in habitat usage. *International Association for Biological Oceanography*, *11*, e15635. https://doi.org/10.7717/peerj.15635

Southern Resident Killer Whale Task Force. (2025). Southern Resident Orca Recovery. https://orca.wa.gov/

Southern Resident Orca (SRKW) Population. (2024). Center for Whale Research. https://www.whaleresearch.com/orca-population

Speed management. (2024). GloMEEP. https://glomeep.imo.org/technology/speed-management/

Starcrest Consulting Group. (2023). *Air Emissions Benefit of Vessel Speed Reduction During Enhancing Cetacean Habitat and Observation (ECHO) Program*. https://www.portvancouver.com/wp-content/uploads/2021/05/2023-05-05-Framing-document-Co-benefits-study-.pdf

Sustainability | Environment. (2025). HMM. https://www.hmm21.com/company/esg/sustainability-environment.do

Sustainability at Maersk. (2025). Maersk. https://www.maersk.com/sustainability/our-solutions

Sustainable Shipping. (n.d.). World Shipping Council. Retrieved March 29, 2025, from https://www.worldshipping.org/sustainable-shipping

Swire Shipping. (2024). *Sustainability Report for the Calendar Year 2023*. https://files.swireshipping.com/assets/Sustainability/Swire_Shipping_Sustainability_Report_2023.pdf

Tennessen, J. B., Holt, M. M., Wright, B. M., Hanson, M. B., Emmons, C. K., Giles, D. A., Hogan, J. T., Thornton, S. J., & Deecke, V. B. (2024). Males miss and females forgo: Auditory masking from vessel noise impairs foraging efficiency and success in killer whales. *Global Change Biology*, *30*(9), e17490. https://doi.org/10.1111/gcb.17490

The Northwest Seaport Alliance. (2024a). *2023 Annual Trade Report*. https://s3.us-west-2.amazonaws.com/nwseaportalliance.com.if-us-west-2-or/2024-04/2023%20NWSA%20Annual%20Cargo%20Report.pdf

The Northwest Seaport Alliance. (2024b). *Facilities Guide: Seattle & Tacoma Harbors, USA*. https://s3.us-west-2.amazonaws.com/nwseaportalliance.com.if-us-west-2-or/2024-09/Facilities%20Guide%2020240923.pdf

Thriving Environment. (2025). Swire Shipping. https://www.swireshipping.com/information/info-pages/sustainability/thriving-environme

nt/
TOTE Maritime. (2025). *Environment*. https://www.totemaritime.com/environment
Transport Canada. (2020, October 6). *Understanding Anthropogenic Underwater Noise*. Government of Canada. https://tc.canada.ca/en/initiatives/oceans-protection-plan/understanding-anthropogenic-underwater-noise
Underwater noise. (2025). Green Marine. https://green-marine.org/certification/performance-indicators/underwater-noise/
United Nations Conference on Trade and Development. (2021). *Review of Maritime Transport 2021*. UNITED NATIONS. https://unctad.org/system/files/official-document/rmt2021_en_0.pdf
U.S. Customs and Border Protection. (2024). *The Jones Act*. https://www.cbp.gov/sites/default/files/2024-12/Jones%20Act%20ICP_Complete_04DEC24.pdf
U.S. Department of Transportation. (2023). *Decarbonizing the Maritime Shipping Industry: Starter Guide to Reducing Greenhouse Gas Emissions from Maritime Shipping*. https://www.transportation.gov/sites/dot.gov/files/2023-09/OSTX-Momentum-Toolkit-Maritime-Shipping.pdf#:~:text=9%20https://www.iea.org/topics/transport%2010%20The%20IMO%20reported%20that,2.89%20percent%20of%20all%20human%2Dcaused%20GHG%20emissions.&text=The%20IMO's%20Initial%20Strategy%20on%20Reduction%20of,percent%20by%202030%20as%20compared%20to%202008.
Veirs, S., Veirs, V., Williams, R., Jasny, M., & Wood, J. (2018). A key to quieter seas: Half of ship noise comes from 15% of the fleet. *ResearchGate*. https://doi.org/10.7287/peerj.preprints.26525v1
Veirs, S., Veirs, V., & Wood, J. D. (2016). Ship noise extends to frequencies used for echolocation by endangered killer whales. *PeerJ*, *4*, e1657. https://doi.org/10.7717/peerj.1657
Vessel Speed Reduction Program. (2025). Port of San Diego. https://www.portofsandiego.org/environment/energy-sustainability/maritime-environment
Walker, T. R., Adebambo, O., Del Aguila Feijoo, M. C., Elhaimer, E., Hossain, T., Edwards, S. J., Morrison, C. E., Romo, J., Sharma, N., Taylor, S., & Zomorodi, S. (2019). Chapter 27—Environmental Effects of Marine Transportation. In C. Sheppard (Ed.), *World Seas: An Environmental Evaluation (Second Edition)* (pp. 505–530). Academic Press. https://doi.org/10.1016/B978-0-12-805052-1.00030-9
Wilhelmsen Ship Management. (2024). *Sustainability Report 2023* [News]. Wilhelmsen. https://www.wilhelmsen.com/ship-management/esg/sustainability-report-2023/
Yang Ming Marine Transport Corp. (2024). *2023 Sustainability Report*. https://esg.yangming.com/upload/esg_custom_sustainability_report_document_files/enL_esg_custom_sustainability_report_document_23J03_v0F2bRPVRy.pdf
Yin, R. K. (2014). *Case Study Research Design and Methods* (5th ed.). Sage.

https://www.researchgate.net/publication/308385754_Robert_K_Yin_2014_Case_Study_Research_Design_and_Methods_5th_ed_Thousand_Oaks_CA_Sage_282_pages

Appendices

Appendix A. General Interview Guide

Interview guides were subsequently tailored for each interview and respondent type.

Shipping Line Operations Managers

- Why does [company] participate in the Quiet Sound voluntary vessel slowdown?
- Are there operational practices you employ to participate in the slowdown while also having a high volume throughput?
- Do you incorporate the slowdown into your route planning?
- Do you find participating in the Quiet Sound slowdown to be straightforward?
- What are your biggest barriers to participating?
- How do you communicate with your vessel masters to encourage participation in the slowdown?
- Do you participate in other voluntary speed reduction initiatives?
- Who within your company values your fleet participation metrics?
- Would knowing the air emissions reductions and fuel savings associated with your participation in the Quiet Sound slowdown impact your decision to participate?

Shipping Association Representative

- What elements of the slowdown design do you view as 'non-negotiable' for getting large commercial vessels to participate? (Dates, communication, results?)
- What elements of the slowdown design are 'nice to have' from your perspective?
- What are the major reasons shipping liners participate in the slowdown in Washington? Does that change for agents?
- What do you see as the biggest barriers to participation faced by liners?
- How does the slowdown factor into the liner's list of priorities?
- How important is recognition for participating in environmental programs, like voluntary slowdowns, to liners?
- Do you think liners would be interested in knowing the air emissions reductions associated with their fleet's participation in the Admiralty Inlet slowdown?
- Would liners be interested in knowing whether participating in the slowdown resulted in fuel savings?

Port Representatives

- Do you think the Northwest Seaport Alliance's focus on sustainability increases the competitiveness of the Port of Seattle and Port of Tacoma?
- How do you view the Port's role in influencing vessels' decisions to adopt environmentally friendly practices, such as participating in the slowdown?

- Would you be interested in knowing whether – and if so, how much – the Quiet Sound slowdown reduces emissions, in addition to underwater noise pollution?
- Do you think that knowing the emissions reductions co-benefits, and potential fuel savings, of the Quiet Sound slowdown could increase participation in the program?
- How important is recognition in incentivizing sustainable practices by the shipping industry?

Pilots

- How familiar are the captains of the container ships you board with the Quiet Sound slowdown?
    - Is this impacted by crew turnover?
    - Do you know if the captains/crews receive any training related to slowdowns, such as the 'Be Whale Wise' or 'Whales in our Waters' training?
    - Do captains express interest in the rationale behind the slowdown?
- How often do you recommend participating in the slowdown to the captain?
    - What are the most common reasons you might not recommend participating?
- How often do captains heed your advice and participate?
    - On transits that they do not, what reasons do captains give for not participating?
    - Thinking specifically about container ships, what reasons do they give?
- In your perspective, how impactful are recommendations from shipping liners to their captains to participate in the slowdown in the captain's decision making to participate?
- What elements of the Quiet Sound slowdown do you think encourage participation for container ships?
- Do you have suggestions for increasing participation amongst container ships?
- Pilots are active in the maritime historic and education community and engage in a lot of environmental stewardship projects. How does being a partner in the Quiet Sound slowdown fit into what it means to be a pilot?
- Do you think that knowing the air emissions reductions and fuel savings associated with participation in the Quiet Sound slowdown impact a shipping liner or captain's decision to participate?
    - Would you like to know the emissions reductions and fuel savings benefits?
    - Would knowing those impact your decision to recommend participation in the slowdown?

ECHO Program Representative

- Which elements of program design do you think most influence vessel participation in ECHO's voluntary slowdowns? Does that also hold true for container ships?
- Can you describe your engagement with shipping liners in the months before the slowdown starts, while the slowdown is in effect, and after the slowdown has concluded? How about vessel agents?

- How important is public recognition or other external pressures to shipping liner participation in your voluntary initiatives?
- Was the air emissions reductions co-benefits study conducted as a way to increase participation in your voluntary initiatives?

Agents

- Does [agent] participate in the Quiet Sound slowdown?
    - What elements of the program design facilitate your participation?
    - What factors make it difficult for [agent] to participate?
- Do shipping liners express interest in agents that participate in the slowdown?
    - If so, how does participation rank in their other priorities (scheduling, transit costs, etc)?
- Does [agent] market your ability to navigate parameters of the Quiet Sound slowdown when soliciting business from liners?
- Does [agent] participate in voluntary slowdowns in other areas (perhaps California or Canada)?
    - If yes, how does participating in the Quiet Sound slowdown compare to other VSR programs in terms of ease of participation and clarity of communication?
- How important is receiving recognition for participation in the slowdown for your decision to participate or not?
- The Quiet Sound voluntary vessel slowdown is designed to provide improved habitat for the endangered Southern Resident killer whales. Beyond whale conservation, reduced speeds also reduce air emissions and fuel consumption. Would knowing the air emissions reductions and fuel savings associated with your participation in the Quiet Sound slowdown impact your decision to participate?

Appendix B. Frequency of Codes

	Program Characteristics	Information Sharing and Exchange	Operational Factors	External Influences	Intrinsic Values
Shipping Line Operations Manager	3	11	7	2	2
Shipping Line Operations Manager	0	11	7	5	0
Shipping Association Representative	8	9	5	4	1
NWSA Representative	7	9	1	12	4
Port of Seattle Representative	11	3	1	1	0
Pilot	7	9	7	4	3
ECHO Program Representative	14	18	9	8	7
Code frequency total	50	70	37	35	17