

# ECHO Program

Summary report: 2021 voluntary inshore lateral displacement in the Strait of Juan de Fuca

Vancouver Fraser Port Authority

June 2022

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## **Acknowledgements**

The ECHO Program would like to thank Transport Canada, Fisheries and Oceans Canada, and the Canadian Coast Guard for their contribution of data analysis to this report; the ECHO Program's vessel operators committee and advisory working group members for their valuable input, advice and support; the Canadian and U.S. Coast Guards, for their help coordinating the implementation of the initiative and the Canadian and U.S. marine transportation organizations for their participation in the initiative.

Transport Canada reached out to several Indigenous communities before implementation of the initiative and shared valuable input from them. The Pacheedaht First Nation also provided valuable input directly to the ECHO Program before, during, and after the initiative and made their input available for this report.

## Executive summary

This report summarizes the development, implementation and results of the 2021 voluntary inshore lateral displacement in the Strait of Juan de Fuca and has been prepared by the Vancouver Fraser Port Authority-led Enhancing Cetacean Habitat and Observation (ECHO) Program. The lateral displacement initiative was coordinated and implemented by the ECHO Program, with support from Transport Canada, Canadian and U.S. Coast Guards, and the Canadian and U.S. marine transportation industries. The ECHO Program's advisory working group and vessel operators committee members provided valuable input and advice throughout the initiative. Fisheries and Oceans Canada evaluated acoustic data and provided results of their analysis to the ECHO Program. The Canadian Coast Guard evaluated tug traffic data and provided results of their participation analysis to the ECHO Program. Transport Canada gathered additional valuable input from the Pacheedaht First Nation before, during and after the initiative.

The southern resident killer whale population has wavered over the last several years, with a current population of 73 individuals, as of December 31, 2021 (Center for Whale Research). Research indicates that underwater vessel noise can interfere with the southern resident killer whale's ability to navigate, communicate and find their prey. Historical data indicates that southern resident killer whales are most frequently detected in Salish Sea waters, including the Strait of Juan de Fuca, between June and October.

Building on the lessons and success of the 2018, 2019 and 2020 voluntary lateral displacement initiatives, and in an effort to support ongoing recovery measures for the southern resident killer whales, the ECHO Program engaged the tug sector and other partners to implement another voluntary inshore lateral displacement initiative in 2021. The purpose of the initiative was to reduce underwater vessel noise impacts by laterally displacing tugs away from an enhanced management area defined by the Government of Canada as important habitat for the southern resident killer whales.

To evaluate the effectiveness of the inshore lateral displacement, underwater noise and tug traffic movements were measured and analyzed before and during the initiative to determine participation as well as the level of underwater noise reduction that could be achieved by moving individual vessels further away from the southern resident killer whale enhanced management area.

Between June 1 and October 31, 2021, when safe and operationally feasible to do so, all tugs transiting in the Canadian inshore area of the Strait of Juan de Fuca were requested to move south of the known killer whale area and navigate through the inshore lateral displacement zone while maintaining a buffer distance of 1,000 metres from the traffic separation scheme. The inshore lateral displacement zone was 1,500 metres wide and covered a distance of approximately 28 nautical miles (approximately 52 kilometres). Tugs transiting in the outbound lane of the traffic separation scheme were also considered to be participating.

The voluntary inshore lateral displacement saw significant participation rates with 126 of 143 (88%) of tugs able to spend over half of their transit in the lateral displacement zone or outbound shipping lane. Of all the tugs that transited the area during the study period, 57% transited in the outbound shipping lane, 30% transited in the inshore lateral displacement zone, with only 1% using the buffer zone and 8% using the enhanced management area for more than half their transit. The primary reason that tugs did not participate was due to a lack of awareness of the initiative. Compared to 2017 baseline tug traffic conditions, tugs shifted an average of 0.91 nautical miles (1,685 metres) away from the enhanced management area in 2021.

Underwater noise was monitored in the southern resident killer whale enhanced management area before and during the initiative using the Jordan River hydrophones installed and operated by Fisheries and Oceans Canada.

Since implementation of the inshore lateral displacement in 2018, there has been a significant change in the behaviour and transit routes of the tug traffic in the area. Little change in the distance between vessel transits and the Jordan River hydrophone was noted during the comparison of the pre-displacement

control period (April-May 2021) and the lateral displacement period (June-October 2021), indicating that even outside of the official timing of the lateral displacement each year, tugs are typically transiting outside of the SRKW enhanced management area. This would provide significant benefits to whales whenever they are in the area. Due to this change in traffic, overall differences in ambient noise were not assessed, however two representative tugs were evaluated to demonstrate the benefit of moving a tug from the enhanced management area to the lateral displacement zone.

The assessment of these two vessels indicated an average broadband noise reduction of 4.5 dB, or an approximately 64% reduction in sound intensity when comparing the noise levels of these two tugs while inside and outside of the enhanced management area.

Although the number of tug transits in the Strait of Juan de Fuca is relatively low compared to deep sea traffic in the shipping lanes, results indicate that even a modest shift of tugs away from the southern resident killer whale enhanced management area is an effective way of significantly reducing underwater noise in that area, especially at the higher-frequency bands important for foraging.

According to cetacean sightings data provided by the B.C. Cetacean Sightings Network, there were 345 reported sightings of 1,935 marine mammals in the Strait of Juan de Fuca during the lateral displacement period. Of the total marine mammals sighted, 1,132 (59%) were killer whales, with 383 being southern resident killer whales (certain or possible).

In an effort to better understand the presence and behavior of whale species in both Swiftsure Bank and the Strait of Juan de Fuca, the ECHO Program supported Pacheedaht First Nation to undertake marine mammal observations in both regions between June and November 2021. During the 27 field excursions, 79 sightings of 128 animals were recorded in the Strait of Juan de Fuca and Swiftsure Bank, two of which were killer whales.

Overall, the voluntary lateral displacement initiative was successfully managed by the ECHO Program and partners with no dangerous occurrences or incidents recorded during the study period. There were no safety or operational concerns recorded with the vessels navigating in the inshore zone during the lateral displacement period.

Any future lateral displacement initiatives in the Strait of Juan de Fuca will build on the lessons learned from all previous lateral displacements.

## 1. Background

This report summarizes the development, implementation and results of the 2021 voluntary inshore lateral displacement in the Strait of Juan de Fuca. The initiative was coordinated and implemented by the Enhancing Cetacean Habitat and Observation (ECHO) Program, with support from Transport Canada, Canadian and U.S. Coast Guards, Fisheries and Oceans Canada, and the Canadian and U.S. marine transportation industries. The ECHO Program's advisory working group and vessel operators committee members provided valuable input and advice throughout the development, implementation and evaluation of the initiative. Pacheedaht First Nation provided valuable input to the initiative before, during and after the study period.

The purpose of the initiative was to reduce underwater vessel noise impacts by laterally displacing tugs away from the coastal area known to be important to southern resident killer whales (SRKW). Data collection and analysis was undertaken to help measure both the level of underwater noise reduction achieved by moving tugs further away from SRKW areas, as well as the level of voluntary vessel participation achieved.

The lateral displacement took place in the Strait of Juan de Fuca between June 1 and October 31, 2021 and involved the movement of tugs transiting Canadian waters into either an inshore lateral displacement zone or the outbound lane of the traffic separation scheme (Figure 1). The term tugs refers to vessels that are engaged in towing other vessels or objects, or assisting in the maneuvering of ocean-going vessels.

### 1.1. The ECHO Program

The ECHO Program is a Vancouver Fraser Port Authority-led initiative aimed at better understanding and managing the effects of large commercial vessel-related activities on at-risk whales throughout the southern coast of British Columbia.

The geographic scope of the Vancouver Fraser Port Authority's jurisdiction is limited, and so, in order to adequately understand and address the cumulative effects of commercial ship activity on whales regionally, a collaborative approach is required. To this end, since 2014 the port authority has been collaborating with an advisory working group and technical committees made up of Canadian and U.S. government agencies, marine transportation industries, Indigenous communities, conservation and environmental groups, and scientists to advance ECHO Program projects within the Salish Sea, including the Strait of Juan de Fuca. The long-term goal of the program is to quantifiably reduce threats to at-risk whales as a result of large commercial vessel-related activities.

### 1.2. Context for the voluntary inshore lateral displacement

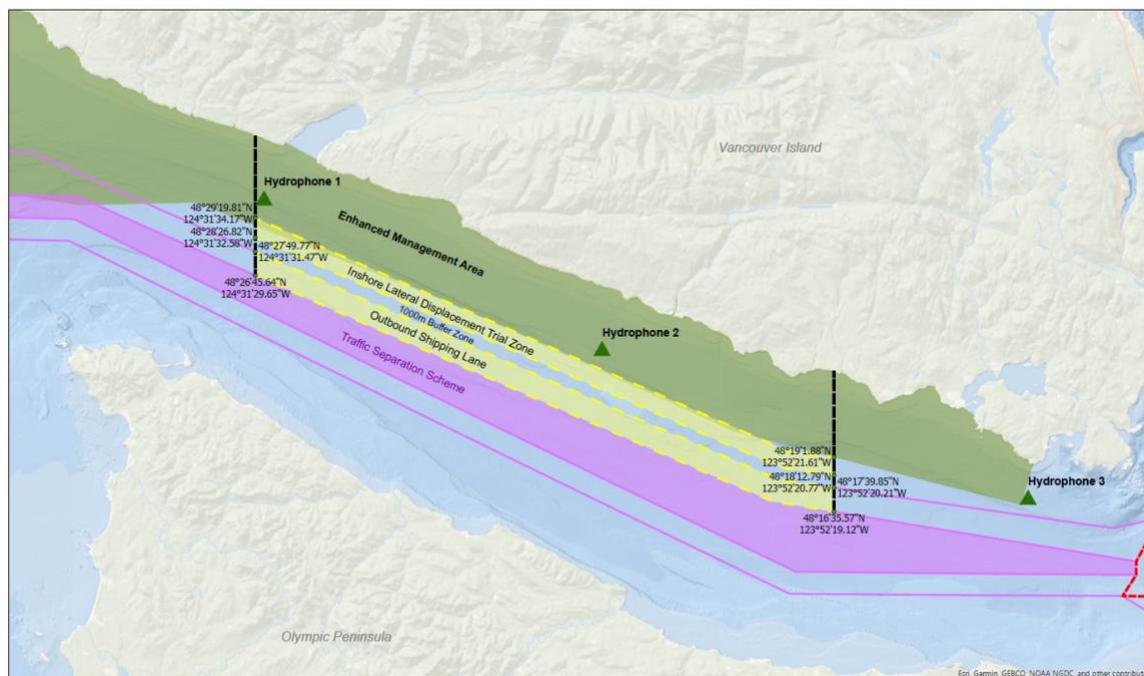
A number of at-risk species of cetaceans (whales, dolphins and porpoises) inhabit the Pacific waters of southern B.C. and northern Washington State. Key among these species is the endangered SRKW, with a population of only 73 individuals (Center for Whale Research, December 31, 2021). The main threats to SRKW and other at-risk whales in this region include acoustic disturbance (underwater noise), physical disturbance (presence and proximity of vessels), environmental contaminants and availability of prey. Acoustic disturbance related to shipping traffic is a priority focus area for the ECHO Program.

In 2017, the Canadian Science Advisory Secretariat published a science advisory report which identified notable SRKW areas of high use along the northern side of the Strait of Juan de Fuca (Ford et al., 2017). Additionally, in early 2018, the Minister of Fisheries, Oceans, and the Canadian Coast Guard and the Minister of Environment and Climate Change noted that the SRKW population is facing imminent threats to its survival and recovery. In early 2021, DFO published a Science Advisory Report on areas for mitigation of vessel related threats to survival and recovery for southern resident killer whales (Fisheries and Oceans Canada, 2021). The Strait of Juan de Fuca was identified as an important area for SRKW.

Under normal operating conditions, inshore tug traffic often transits through the SRKW the DFO-defined 'enhanced management area' (Figure 1). Since 2018, the ECHO Program and Transport Canada have coordinated voluntary initiatives—supported by the Canadian and U.S. Coast Guards, Fisheries and Oceans Canada, and the Canadian and U.S. marine transportation industries—to voluntarily shift tug transits southward away from the enhanced management area to reduce underwater noise levels.

Building on the findings and success of the initial voluntary lateral displacement trials in 2018-2019, and to support ongoing whale recovery measures for the southern resident killer whales, the ECHO Program has engaged the tug sector and other partners to implement an annual voluntary lateral displacement since 2020.

**Figure 1: 2021 voluntary inshore lateral displacement area**



Source: Vancouver Fraser Port Authority

### 1.3. Development of the parameters

#### 1.3.1. Inshore lateral displacement area

In the lateral displacement area, vessel traffic is cooperatively managed by both Canada and the United States. The Cooperative Vessel Traffic Services Agreement (CVTSA) has been in place since 1979 and establishes the structure for the management of vessel traffic in the region. Under this agreement, vessel traffic services in the Strait of Juan de Fuca are provided by the United States Coast Guard in both Canadian and American waters. A joint coordinating group (JCG) consisting of the Canadian Coast Guard and the United States Coast Guard, which Transport Canada attends, works to ensure safe and efficient trans-boundary operations. The inshore lateral displacement zone was defined with the support of the JCG.

The majority of the inshore lateral displacement zone is located within the traditional marine territory of the Pacheedaht First Nation.

Unchanged from 2020, the 2021 inshore lateral displacement zone was designed to move tug traffic away from the SRKW enhanced management area defined by the Government of Canada, while keeping a safe distance from deep-sea vessels transiting in the outbound lane of the traffic separation scheme

(Figure 1). The inshore lateral displacement zone was 1,500 metres wide and occurred in the area between 123° 52' W and 124° 31' W, covering a distance of approximately 28 nautical miles. As requested by the JCG, the inshore lateral displacement zone was positioned 1,000 metres north of the traffic separation scheme in order to provide a safety buffer.

### 1.3.2. Participation instructions

In the area between 123° 52' W and 124° 31' W all tugs transiting the inshore area were requested to move southwards and transit within the designated inshore lateral displacement zone while maintaining a 1,000 metre distance from the outbound shipping lane (buffer zone identified in Figure 1).

Under normal conditions, some tugs transit the Strait of Juan de Fuca in the outbound lane of the traffic separation scheme. As these tugs are already transiting further away from the enhanced management area, these tugs were not requested to change their transit pattern and were deemed to be participating if they were transiting in the outbound lane.

### 1.3.3. Duration

Historical data from Fisheries and Oceans Canada, Ocean Wise's B.C. Cetacean Sightings Network and Orca Network indicates that southern resident killer whales are most frequently detected in Salish Sea waters—including the Strait of Juan de Fuca—between June and October. The initiative began on June 1, 2021, and ended 22 weeks later on October 31, 2021.

## 2. Implementation

The implementation of the voluntary inshore lateral displacement initiative required the preparation of materials, communication and engagement with stakeholders, and the technical aspects of evaluating the success of the lateral displacement initiative through tug participation and underwater noise monitoring. The following section provides further details on the implementation of the 2021 voluntary inshore lateral displacement.

### 2.1. Engagement and communications

The ECHO Program worked closely with Transport Canada, the Canadian and U.S. Coast Guards, Fisheries and Oceans Canada, and the Canadian and U.S. marine transportation industries—in particular the Council of Marine Carriers and the American Waterways Operators—to coordinate the implementation of the voluntary inshore lateral displacement in the Strait of Juan de Fuca.

The ECHO Program team received valuable input, advice and support from the ECHO Program advisory working group which convened three times in 2021 throughout the development, implementation and evaluation phases of the inshore lateral displacement. The Fraser Basin Council provided independent facilitation services for all ECHO Program advisor meetings. The advisory working group member organizations are listed online [here](#).

The ECHO Program team also received valuable input, advice and support from the vessel operators committee which convened approximately monthly throughout the year to support the development of parameters and the practical implementation and monitoring of vessel participation for various ECHO Program operational noise reduction initiatives, including the lateral displacement. The vessel operators committee member organizations are listed online [here](#).

#### 2.1.1. Tug operators engagement

A communications plan was developed by the ECHO Program, in collaboration with members of the ECHO Program vessel operators committee, to ensure that tug operators transiting the area would be aware of the 2021 voluntary inshore lateral displacement and its operational parameters.

Communication materials included fact sheets, maps, newsletters, presentations and a webpage. In addition to the general distribution of materials by the ECHO Program, the Council of Marine Carriers (a trade association which represents Western Canadian tug and barge operators) supported the targeted distribution of materials and ongoing communication to their members throughout the initiative. The American Waterways Operators (a trade association representing U.S. tug and barge operators) also supported in the distribution of materials and communication to their members regarding the initiative. A Canadian Coast Guard navigational warning (NAVWARN) and a US Coast Guard Notice to Mariners (NOTMAR) were issued at the start of the lateral displacement and were terminated on October 31, 2021. Email newsletters from the ECHO Program were sent biweekly and included updates on tug participation rates.

Frequent updates and communications were provided to the Council of Marine Carriers and American Waterways Operators. Direct email communications were used to support the promotion and awareness of the lateral displacement to regional tug operators.

Formal recognition was given to each participating company, by way of participation certificate, after the lateral displacement.

### **2.1.2. Government-led engagement**

Transport Canada participated collaboratively in the development of the parameters as a member of the ECHO Program advisory committees, but also helped to support the initiative as a part of its work under the federal Whales Initiative. Transport Canada has existing relationships with, and obligations to, other federal departments and agencies in Canada and the United States.

Transport Canada worked directly with the Canadian Coast Guard and the U.S. Coast Guard through the existing joint coordinating group to ensure that the lateral displacement could be executed and managed safely. The 2021 lateral displacement area was unchanged from 2020.

The Government of Canada created communications materials which outlined many southern resident killer whale measures taking place in the Salish Sea throughout the 2021 season. The inshore lateral displacement zone was highlighted on select maps which were distributed to the public and recreational mariners.

### **2.1.3. Indigenous engagement**

The Government of Canada also has a duty to consult Indigenous communities when contemplating actions that may have an impact on Indigenous rights.

As part of its work under the federal Whales Initiative, since 2018 Transport Canada recognized the potential for future traffic management practices to be informed by the results of the voluntary lateral displacement. As a precautionary measure to avoid or minimize any impacts of the initiative on Indigenous groups, Transport Canada reached out to several Indigenous communities before implementation. Transport Canada, with Fisheries and Oceans Canada, continued to have ongoing communication with Indigenous communities throughout the initiative period. The lateral displacement initiative was also a topic of discussion with Indigenous groups during the Crown consultation on 2021 southern resident killer whale recovery measures implemented by the Government of Canada.

Through engagement with the U.S. Coast Guard, Indigenous communities in Canada, and the Puget Sound Partnership, Transport Canada heard that Indigenous groups (tribes) in the U.S. should also be aware of the lateral displacement initiative as they have rights and interests in the transboundary waters of the Salish Sea and the Strait of Juan de Fuca. With the help of the Puget Sound Partnership and the U.S. Coast Guard, Transport Canada was able to inform several tribal representatives about the initiative, using existing councils and meetings for engagement.

## **2.2. Monitoring**

### **2.2.1. Acoustic recorders**

Fisheries and Oceans Canada used data from previously deployed hydrophones in the Strait of Juan de Fuca to monitor the underwater soundscape in the enhanced management area before and during the initiative. The hydrophone sites are shown on Figure 1 and were located off Port Renfrew (DFO hydrophone 1), Jordan River (DFO hydrophone 2) and Sooke (DFO hydrophone 3). The results of the 2018, 2019 and 2020 initiatives indicated that the hydrophone located near Jordan River provided the most accurate representation of the potential benefits of the inshore lateral displacement, as tug traffic generally transited in consistent east-west tracks in this area. Differing vessel traffic patterns near Sooke and Port Renfrew resulted in challenges interpreting the acoustic data. As such, only the data collected from the Jordan River hydrophone was used to evaluate underwater noise reductions resulting from the inshore lateral displacement.

### **2.2.2. Automatic Identification System monitoring**

The Automatic Identification System (AIS) is an automated, autonomous vessel tracking system which is used extensively in the maritime industry for the exchange of navigational information and used by vessel traffic services (VTS) globally to track vessel movements.

In accordance with international convention (Regulation 19 of the International Maritime Organization's International Convention for the Safety of Life at Sea), all vessels travelling in international waters with a gross tonnage of 300 or more, those with a gross tonnage of 500 or more in any waters, and all passenger vessels must carry a Class A AIS transponder. Other vessels, typically fishing and recreational vessels, may choose to carry AIS transponders and typically these would be Class B transponders. Although towage or escort vessels may be below the tonnage threshold requirements for carriage of AIS transponders, best practices and regulations in Canada and the U.S. ensure that the majority of tug traffic is equipped with AIS.

Transport Canada monitored and analyzed vessel traffic movements during the initiative using both Class A and Class B AIS data from Canadian Coast Guard Terrestrial AIS infrastructure. This analysis was used to determine tug presence and participation in the inshore lateral displacement zone or the outbound shipping lane during the initiative. The analysis also included a comparison to AIS data from the previous lateral displacement initiatives, and traffic patterns from 2017, prior to lateral displacement trials.

### **2.2.3. Marine mammal monitoring**

In an effort to better understand the presence and behavior of whale species in both Swiftsure Bank and the Strait of Juan de Fuca, the ECHO Program supported Pacheedaht First Nation to undertake marine mammal observations in both regions between June and November 2021. The full study report will be incorporated into the 2021 Swiftsure Bank slowdown report, available on the ECHO Program website summer 2022.

Marine mammal sightings data in the Strait of Juan de Fuca was also requested from the BC Cetaceans Sightings Network.

The results of these monitoring activities are described Section 4.1.

### 3. Tug participation results

Participation of tug traffic in the inshore lateral displacement was evaluated over the 22-week period through analysis of the AIS data. A detailed report prepared by Transport Canada (AIS Summary Analysis, June 1 – October 31, 2021) is provided in Appendix A.

To evaluate participation, the AIS data was filtered to include those vessels transmitting their AIS vessel type as a tug. The AIS data was then amalgamated as vessel tracks and analyzed to evaluate participation using two methods:

- Participation rate: an evaluation of the amount of a tug’s transit distance spent in the inshore lateral displacement zone or the outbound shipping lane. Participation was categorized as a tug spending 50% or more of their transit within the inshore lateral displacement zone or outbound shipping lane.
- Distribution analysis: a statistical analysis of the shift in the distribution of tug AIS vessel positions in the inshore lateral displacement zone and outbound lane compared to a 2017 baseline for traffic positions in 2019, 2020 and 2021

Transits near the shore with a total length less than half of the typical inshore lateral displacement transit length were filtered out after identifying that some tugs were transiting very short distances between two coastal locations (seen in Figure 2), thus could not reasonably be expected to use the inshore lateral displacement zone or the outbound shipping lane.

#### 3.1. Participation rates

In 2021, inshore tug traffic demonstrated a significant shift southward into the inshore lateral displacement zone and outbound shipping lane relative to 2017 baseline conditions, with 126 out of 143 (88%) vessel transits spending more than half their transit in the zone and outbound shipping lane. Participation rates have steadily increased from 76% in 2019, 82% in 2020 to now 88% in 2021.

The numbers presented in Table 1 show a comparison of the baseline period 2017 (no lateral displacement) and both the 2019 and 2020 years where only inshore traffic was asked to displace. The 2018 trial year is not included in the comparison as 2018 included both tugs and deep-sea vessels, and the spatial and temporal parameters were also different to those of the 2019 and 2020 initiatives.

**Table 1: Comparison of participation rates for tug traffic in 2017, 2019, 2020 and 2021**

Participation rate for tugs	2017 (baseline, no trial)		2019		2020		2021	
	June 17 - Oct 31, 2017		June 17 - Oct 31, 2019		June 1 - Oct 31, 2020		June 1 - Oct 31, 2021	
# Trips ≥50% in the outbound lane and Inshore Trial Zone	52	55%	93	76%	138	82%	126	88%
# Trips ≥25%-<50% in the outbound lane and Inshore Trial Zone	5	5%	6	5%	11	7%	7	5%
# Trips >0%-<25% in the outbound lane and Inshore Trial Zone	12	13%	5	4%	7	4%	0	0%
# Trips 0% in the outbound lane and Inshore Trial Zone	26	27%	18	15%	12	7%	10	7%
Total # of Tug Trips in the Strait of Juan de Fuca	95		122		168		143	

Source: Transport Canada

Table 2 shows the breakdown of where tugs spent the majority of their time. Fifty-seven percent of the total transits (81 out of 143) spent half or more of their time in the outbound shipping lane and 30% (43 out of 143) spent half or more of their time in the inshore lateral displacement zone. Vessels that spent more than half of their transit in either of these zones were deemed to be participating.

**Table 2: Summary of tug transit patterns during 2021 lateral displacement**

Zone of tug transit (listed north to south)	Number of tug trips that spent $\geq 50\%$ of transit in each zone	Percentage of tug trips that spent $\geq 50\%$ of transit in each zone
Enhanced management area	12	8%
Inshore lateral displacement zone ( <i>participation zone</i> )	43	30%
Buffer zone	1	1%
Outbound shipping lane ( <i>participation zone</i> )	81	57%
Not in any zone for $>50\%$ of transit	6	4%
Total	143	

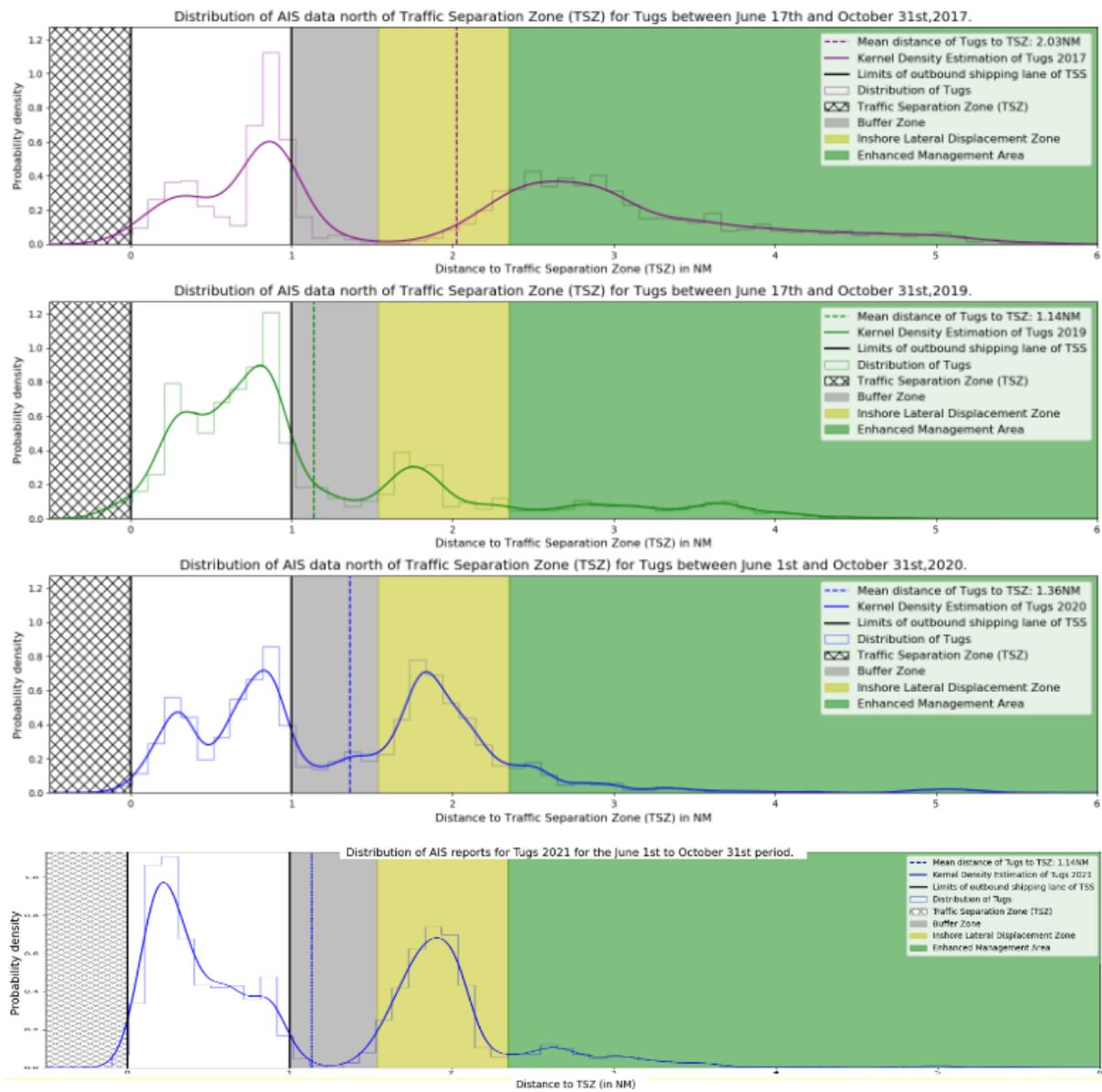
Source: Transport Canada

### 3.2. Tug traffic distribution analysis

The distribution of tracks for tug traffic within the outbound lane and inshore lateral displacement zone was analyzed June 17 to October 31 in 2017 and 2019 and June 1 to October 31, 2020 and 2021 (Figure 3). Results for 2021 (fourth panel) show two distinct increases in density of traffic in the two participation zones, and lower traffic density in the buffer zone and enhanced management area compared to the 2017 baseline.

In 2021, tugs showed an average shift of 0.91 nautical miles or 1,685 metres southwards, away from the southern resident killer whale enhanced management area during the 2021 lateral displacement period relative to a similar time period under 2017 baseline conditions. With each year of the initiative, fewer tugs are transiting in the enhanced management area or buffer zone.

**Figure 2: Distribution analysis of tug traffic between 2017, 2019, 2020 and 2021**

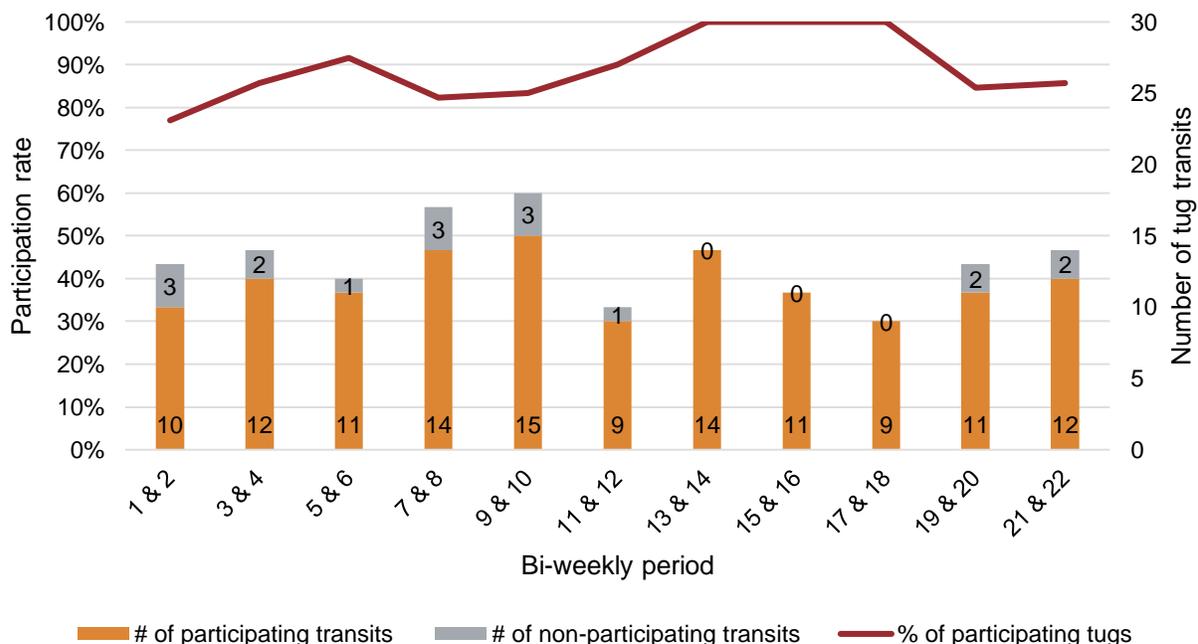


Source: Canadian Coast Guard and Transport Canada

### 3.3. Biweekly participation results

A summary of biweekly participation rates (more than 50% of transit in inshore lateral displacement zone or outbound shipping lane) during the 22-week period is presented in Figure 3. Over the course of the 22-week period, an overall participation rate of 88% was achieved.

**Figure 3: Overview of participation rates in 2021**



Source: Canadian Coast Guard and Transport Canada

AIS data access was provided to Transport Canada from the Canadian Coast Guard. A bi-weekly summary was prepared by Transport Canada and shared with the ECHO Program, allowing these data to be shared with the tug associations and owner/operators as appropriate. At times when tug vessels were found to not be participating, communications were shared, and the company was encouraged to participate. In some cases, the GPS coordinates of the lateral displacement zone area needed to be updated to increase participation accuracy. Due to the generally low total number of tug transits per week, if a small number of tugs were either not aware of the initiative or were unable to participate in a particular week, the overall participation rate was impacted.

### 4. Acoustic results and whale presence

As previously noted in Section 2.2.1 and shown in Figure 1, a hydrophone installed by Fisheries and Oceans Canada near Jordan River to monitor underwater noise in southern resident killer whale critical habitat was used to evaluate the potential acoustic benefit of the lateral displacement.

The underwater noise analysis and evaluation of the potential acoustic benefits of the initiative was conducted by Fisheries and Oceans Canada. The results analyzed for the lateral displacement and other underwater noise reduction initiatives conducted in the Salish Sea in 2021, will be provided in a technical report in the fall of 2022. Preliminary analysis was provided to Vancouver Fraser Port Authority for inclusion in this report.

During the lateral displacement period, Pacheedaht First Nation and B.C. Cetacean Sightings Network gathered whale presence data in the Strait of Juan de Fuca. A breakdown of the whale sightings by month and by species is included in Section 4.2.

#### 4.1. Differences in underwater sound levels due to lateral displacement

Since the inception of the inshore lateral displacement in 2018, there has been a shift in transit routes for tugs, even outside the timeframe of the seasonal lateral displacement initiative (June – October). When DFO analysed AIS traffic data for assessment of the sound levels at the Jordan River hydrophone, it was found there were very few tug transits within the enhanced management area in the six months preceding the 2021 initiative, or during the initiative. Findings also indicated there was little change in distance between vessel transits and the mooring at Jordan River during these time periods. This change in tug traffic routing provides a significant benefit to the southern resident killer whales whenever they may be in the area but poses a challenge for evaluating against an acoustic control period.

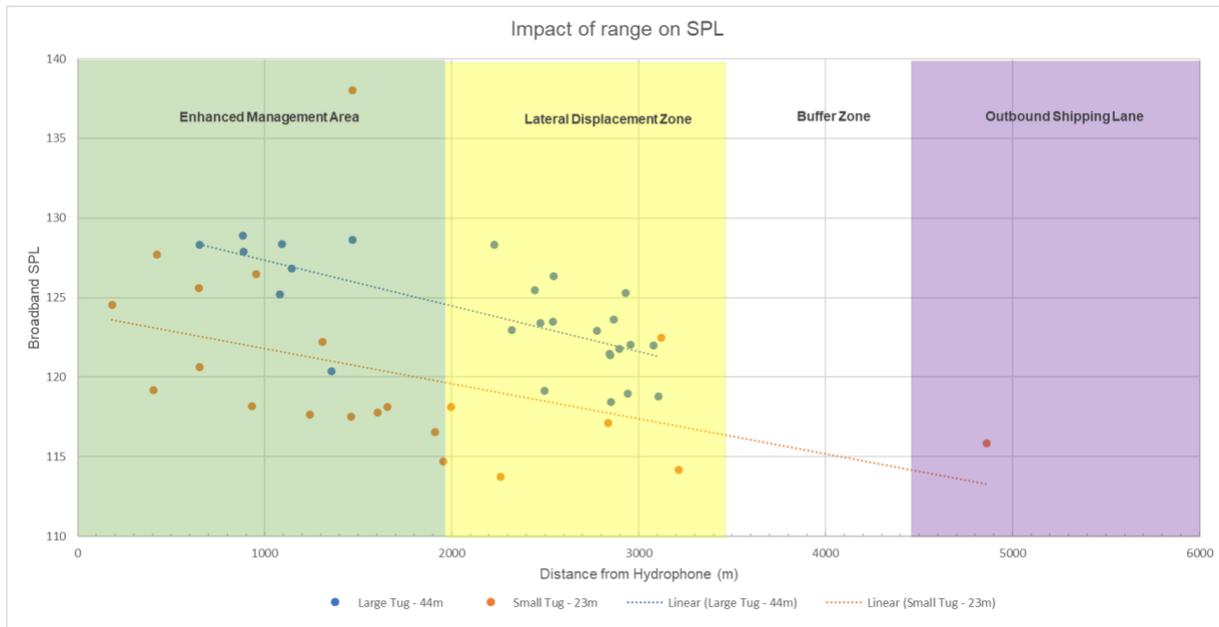
Due to the changes in tug traffic, an evaluation of total ambient noise differences between a pre-displacement control period and the 2021 lateral displacement initiative could not be conducted. During the six months prior to, and the time of the lateral displacement, there were two vessels that could be used to evaluate the acoustic benefit of displacement. Figure 4 plots data provided to the ECHO Program by DFO, identifying broadband sound pressure level (SPL) received at the Jordan River hydrophone, against distance from the hydrophone for two tugs (referred to as “small tug” and “large tug”). There are other factors, such as vessel speed, that affect the noise levels of a vessel, and the relationship between noise level and distance to the hydrophone is not truly linear, however, Figure 4 is used to illustrate the general trend in decreased noise level with distance from the receiver.

Figure 4 shows total broadband levels, however, decreases in the higher frequency ranges showed an even steeper reduction in SPL as distances increased up to 3500 m from the hydrophone. Noise reductions of 10 to 12 dB re 1  $\mu$ Pa were observed in frequency ranges up to 10 kHz when comparing the vessel’s closest transit to the hydrophone, against its farthest transit distance, for both tugs analysed. Even more significant reductions in SPL were seen for the high frequency/ echolocation range above 15 kHz between closest and farthest transits.

Evaluation of the 2019 lateral displacement (Vagle et al. 2020) indicated that by moving tug traffic to greater than 3 kilometres from the hydrophone receiver—in this instance the Jordan River hydrophone—their contribution to received sound level at most frequencies becomes negligible.

If one were to evaluate the average broadband sound levels of transits within the enhanced management area, versus outside of the enhanced management area (i.e. the lateral displacement zone and outbound shipping lane) for each tug, an average reduction of 4.7 dB would be achieved for the small tug, and a reduction of 4.3 dB for the large tug, or 4.5 dB overall.

**Figure 4: Distance versus sound level from Jordan River hydrophone for two tugs**

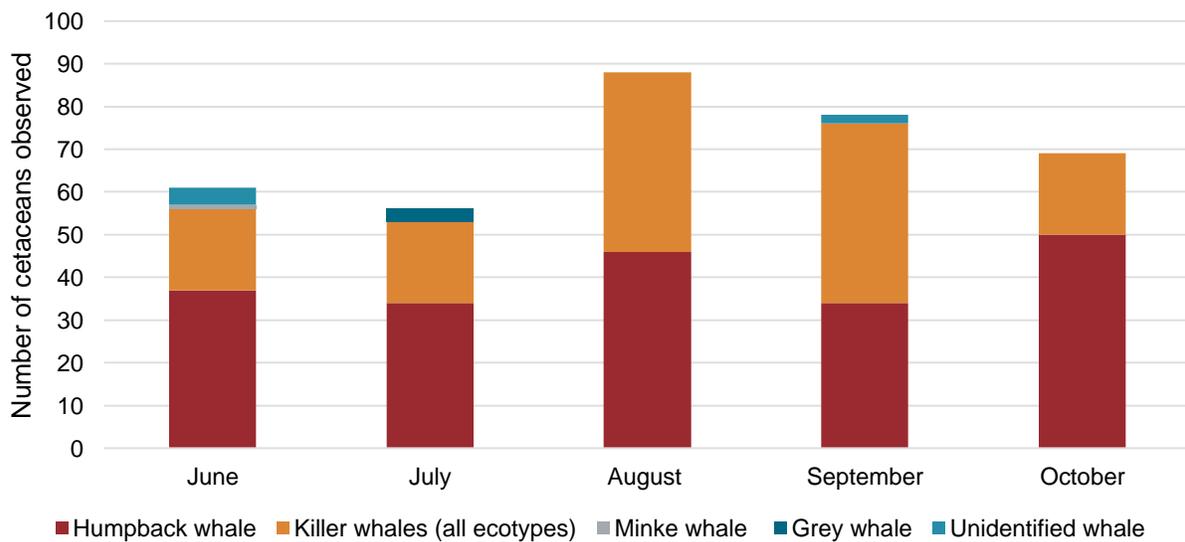


Although the number of tug transits in the Strait of Juan de Fuca proximate to the Jordan River hydrophone is relatively low compared to deep sea vessels transiting in the shipping lanes, results indicate that the potential underwater noise reduction from even a modest shift away from the SRKW feeding habitat by tug traffic can make a significant difference.

#### 4.2. Whale presence during the inshore lateral displacement

Between June 1 and October 31, 2021, the B.C. Cetacean Sightings Network received 345 reports of humpbacks, killer whale, minke and grey whale sightings in the Strait of Juan de Fuca area. Based on these reports, an estimated 1935 individual marine mammals were observed. Figure 5 shows a breakdown of the individuals observed by month and by species.

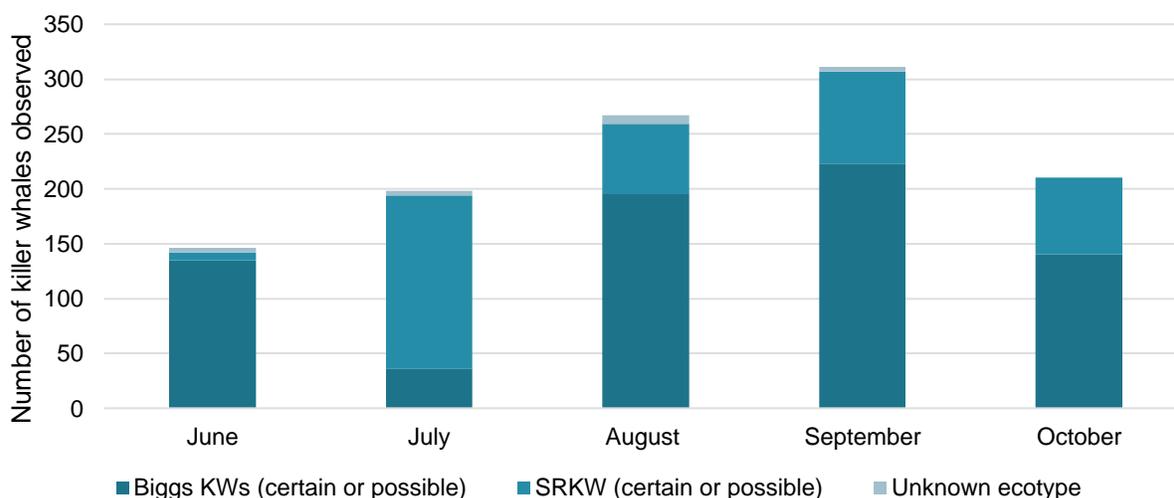
**Figure 5: Cetacean count from B.C. Cetacean Sightings Network - Strait of Juan de Fuca**



Source: Ocean Wise Research Institute and Fisheries and Oceans Canada. Data not corrected for observer effort. Used with permission.

Of the total estimated 1,935 marine mammals observed, 1132 (59%) were killer whales of various ecotypes. Figure 6 indicates that the majority of killer whales observed were Bigg's (transient) killer whales, followed by southern resident killer whales. There were 27 reports of 383 SRKWs (certain or possible) on 15 days during the lateral displacement period in the Strait of Juan de Fuca.

**Figure 6: Killer whale count from B.C. Cetacean Sightings Network - Strait of Juan de Fuca**



Source: Ocean Wise Research Institute and Fisheries and Oceans Canada. Data not corrected for observer effort. Used with permission.

Data obtained from the B.C. Cetacean Sightings Network were collected opportunistically with limited knowledge of the temporal or spatial distribution of observer effort. As a result, absence of sightings at any location does not demonstrate absence of cetaceans.

To further support marine mammal observations in the Strait of Juan de Fuca and Swiftsure Bank, the ECHO Program collaborated with Pacheedaht First Nation to undertake marine mammal observations over 27 field excursions between June and November 2021. The Pacheedaht First Nation marine mammal observers recorded 79 sightings of 128 animals at either Swiftsure Bank or the Strait of Juan de Fuca, of which two were killer whales observed on two separate occasions. Humpbacks were the most frequently observed animal during the study, followed by harbour porpoise (Hall et al., 2021). This complete study report will be incorporated into the Swiftsure Bank slowdown report and will be available on the ECHO Program website.

## 5. Safety and operational results

Before the inshore lateral displacement period, safety considerations were discussed by both the Joint Coordinating Group and the ECHO Program vessel operators committee. These discussions ultimately informed the development of operational procedures to ensure that the initiative could be executed and managed safely. As a result, no dangerous occurrences or safety incidents were recorded during the initiative period.

The following report sections summarize input from industry participants and Indigenous communities during and following the lateral displacement initiative regarding its operational impacts and feasibility.

## 5.1. Industry input

The ECHO Program interviewed a representative from the Council of Marine Carriers following the conclusion of the lateral displacement. This input, along with general feedback from the ECHO Program vessel operators committee members, indicated that no direct or indirect costs or operational challenges were incurred as a result of the inshore lateral displacement. The top reason reported for participating was to support whale conservation and the top reason reported for not participating was lack of awareness of the initiative.

## 5.2. Input from Indigenous communities

The Government of Canada has been undertaking Indigenous engagement on measures in the Strait of Juan de Fuca since 2018, as described in Section 2.1. In 2018, some Indigenous communities expressed an interest in being involved in future decision making, receiving data and results from the initiative and communicating on potential mitigations in the event they might interfere with harvesting and/or travel and/or other Indigenous rights of communities.

Another common message received, in particular from tribal representatives in the United States, was that a temporary initiative was fine, however should the findings of this lateral displacement lead to the development of any more permanent measures or structural changes to the way in which vessels navigate in the transboundary waters of the Salish Sea and the Strait of Juan de Fuca, a more formal consultation process would be required.

While several First Nations expressed an interest in the lateral displacement initiative, Pacheedaht First Nation has been particularly active and involved in the ECHO Program and the development of the initiative since the majority of the displacement takes place within their traditional marine territory. Pacheedaht First Nation actively governs and manages their territory and continues to practice protocols consistent with their Nuuchahnulth values. Pacheedaht are a whaling people who are culturally and spiritually tied to whales. In the Pacheedaht world view, the killer whale and wolf are of the same spirit, with the ability to transform from one creature to the other as they move from land and sea. Killer whales, including southern resident killer whales, are held in the highest regard for their cultural importance to the identity and governance system of the Pacheedaht people. Pacheedaht First Nation maintains as a priority seeking data and appropriate engagement related to their marine territory including by participating in decision-making; the community is interested in how the findings from the lateral displacement may inform future work to build on efforts to ensure their aboriginal rights are protected.

In 2020, Pacheedaht First Nation became a member of the ECHO Program's advisory working group. In 2020 and 2021, the ECHO Program also worked collaboratively with Pacheedaht First Nation to undertake marine mammal observations in the Strait of Juan de Fuca and Swiftsure Bank. As part of this collaboration, marine mammal observer training and certification was provided to a team of observers from Pacheedaht and Ahousaht First Nations by SeaView Marine Sciences and SMRU Consulting. Results of this study will be included as an appendix to the ECHO Program's Swiftsure Bank slowdown trial report which will be available on the ECHO Program website.

## 6. Key findings, conclusions and recommendations

The following key findings can be summarized from the 2021 voluntary inshore lateral displacement:

- The inshore lateral displacement saw significant tug traffic participation rates with 88% of tugs able to spend over half of their transit in the inshore lateral displacement zone and outbound shipping lane.
- Tug traffic in the Strait of Juan de Fuca appears to be shifting away from the DFO-defined enhanced management area, even outside of the lateral displacement time frame, providing additional benefit to southern resident killer whales. As such, assessment of underwater ambient noise reductions against a pre-displacement control period is becoming more challenging.
- The assessment of two vessels were utilized for an evaluation of the acoustic benefits of shifting tug traffic. An average broadband noise reduction of 4.5 dB, or an approximately 64% reduction in sound intensity was measured when comparing the noise levels of these two tugs while inside and outside of the enhanced management area.
- According to data from B.C Cetacean Sightings Network, an estimated 1,935 marine mammals were observed in the Strait of Juan de Fuca during the study period. Of those sightings, 1132 (59%) were killer whales, of which 383 were confirmed or possible southern resident killer whales. Pacheedaht First Nation marine mammal observers recorded 79 marine mammal sightings, two of which were killer whales, in the Strait of Juan de Fuca and Swiftsure Bank on their 27 field excursions between June and November 2021.

Overall, the lateral displacement was successfully managed with no dangerous occurrences or incidents recorded. There were no safety or operational concerns recorded with the vessels navigating in the inshore zone during the study period.

The following key conclusions and recommendations can be drawn from the 2021 voluntary inshore lateral displacement:

- Communications about the initiative and collaborations between transboundary partners were effective and resulted in an overall strong participation rate
- Additional communications with tug operators who are not affiliated with the Council of Marine Carriers or the American Waterway Operators in advance of and throughout future initiatives will further improve participation rates
- With no dangerous occurrences or incidents recorded during the initiative, the 1,000 metre buffer zone is an effective way to manage safety risk
- Significant underwater noise reduction can be achieved by laterally displacing tugs away from areas of importance for SRKW, especially at the higher-frequency bands important for foraging.
- Due to the shift in transit routes of tugs in the Strait of Juan de Fuca, and few tugs within the enhanced management area, direct acoustic measurement of benefits using the Jordan River hydrophone is not recommended in the future. Each tug transit displacing from inside the enhanced management area, into either the lateral displacement zone or the outbound shipping lane provides a significant reduction in received noise, and this shift is being seen even in non-displacement time frames, providing additional benefits to SRKW.
- Whale presence data should continue to be collected in any future lateral displacement efforts in the Strait of Juan de Fuca to evaluate ongoing southern resident killer whale presence and to estimate potential benefits of the efforts.

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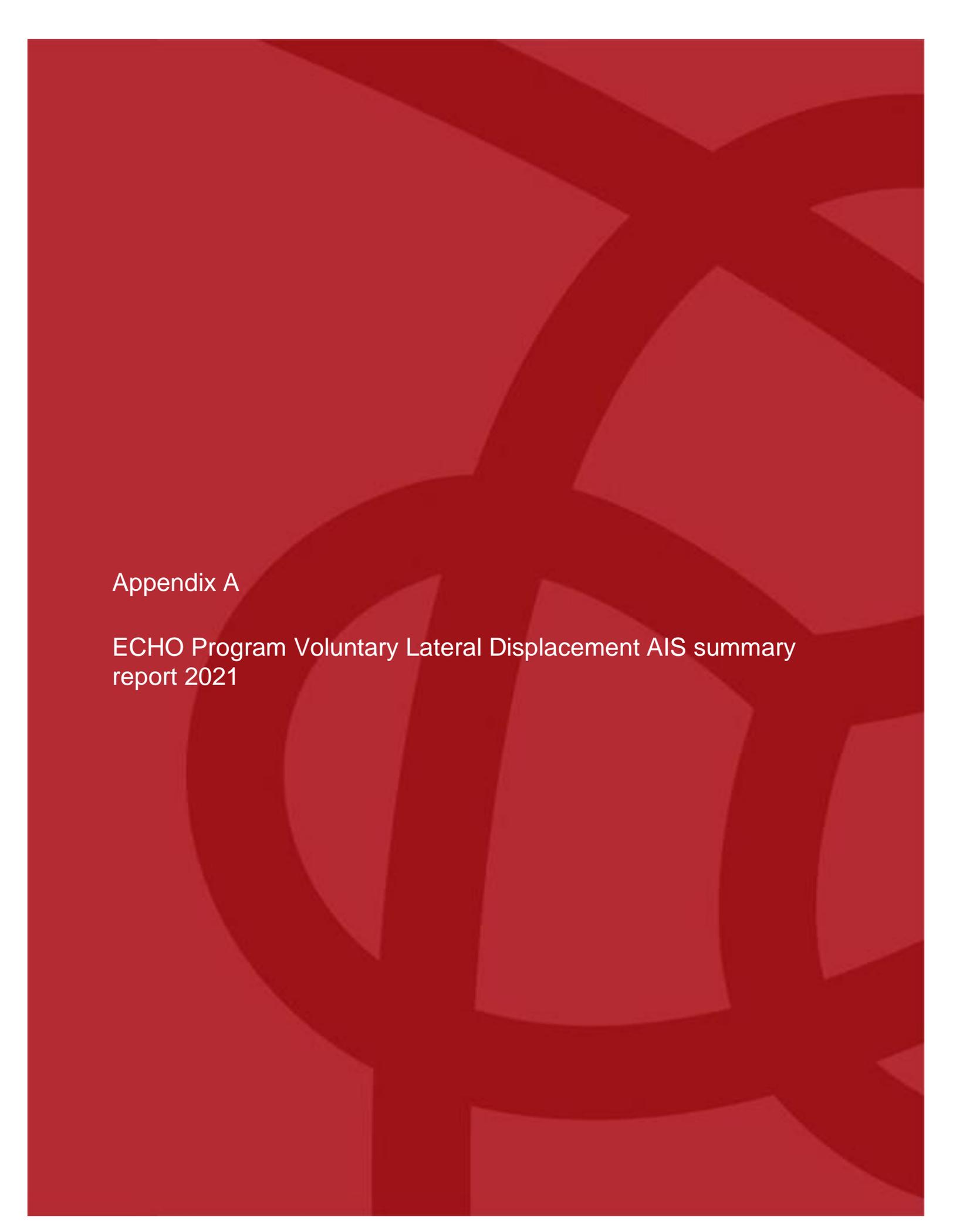
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Vancouver Fraser Port Authority

Summary report: 2021 voluntary inshore lateral displacement in the Strait of Juan de Fuca

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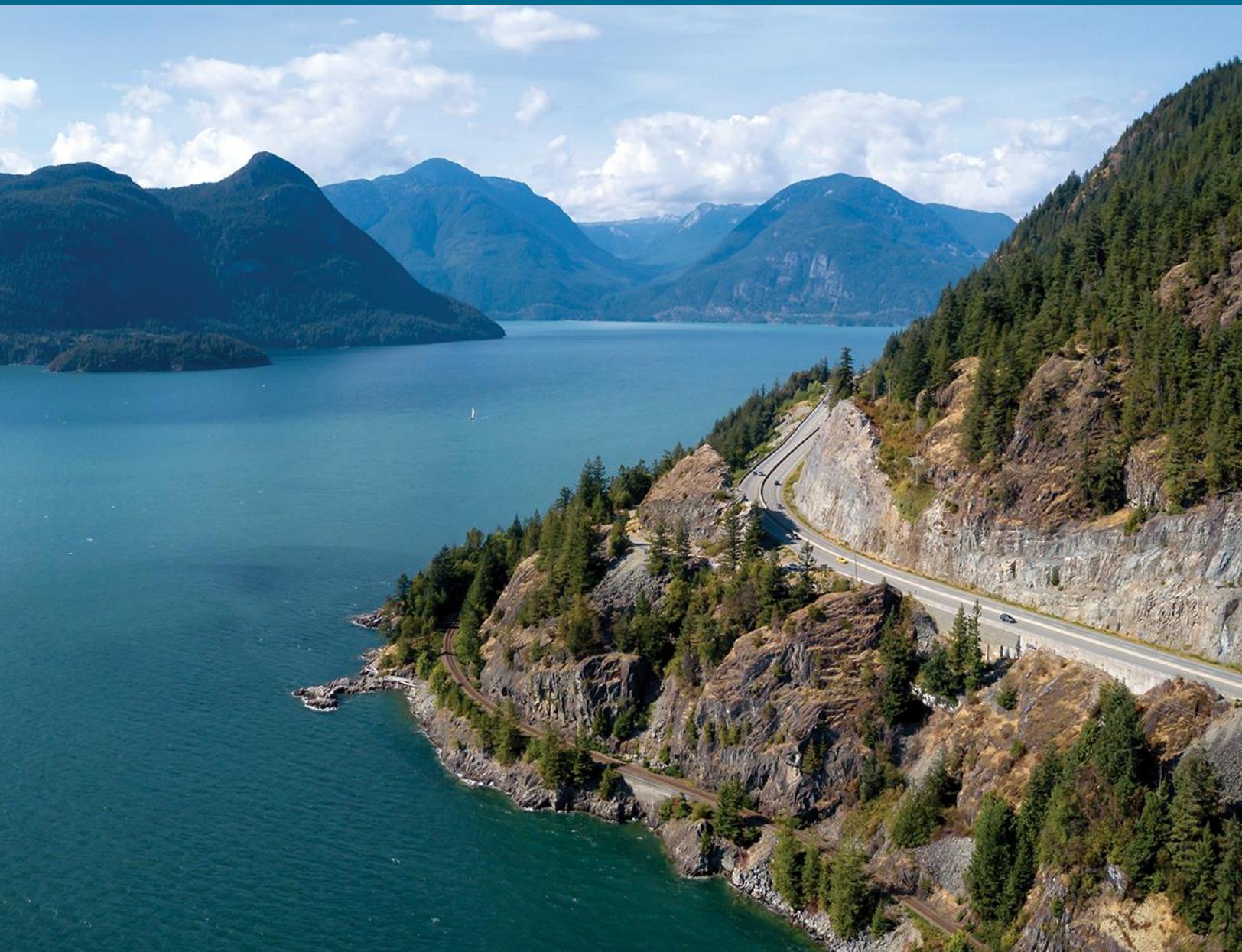


Appendix A

ECHO Program Voluntary Lateral Displacement AIS summary  
report 2021

# STRAIT OF JUAN DE FUCA LATERAL DISPLACEMENT INITIATIVE 2021: AIS SUMMARY ANALYSIS

June 1st to October 31st, 2021



Government  
of Canada

Gouvernement  
du Canada

Canada

## **ECHO PROGRAM**

2021 Voluntary Inshore Lateral Displacement / AIS Summary Analysis

### **Acknowledgements**

Transport Canada acknowledges the contribution of the Canadian Coast Guard for providing all AIS data, as well as the scripts for data analysis, to ensure consistency throughout the duration of this project.

### **Abstract**

In order to help reduce vessel noise impacts in key southern resident killer whale feeding areas, the ECHO Program advanced a voluntary inshore lateral displacement in the Strait of Juan de Fuca to study how moving tug vessels away from known feeding areas affects underwater noise levels in those areas. Several analyses were conducted to assess the impact of this initiative, including this AIS analysis. This document describes the high level of engagement for most of the tug traffic in the area of study.

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## I. CONTEXT

The Enhancing Cetacean Habitat and Observation (ECHO) Program is a Vancouver Fraser Port Authority-led initiative aimed at better understanding and managing the impact on shipping activities on at-risk whales throughout the southern coast of British Columbia.

In 2018, the ECHO Program and Transport Canada supported by U.S. Coast Guard, Fisheries and Oceans Canada (DFO), Canadian Coast Guard (CCG), Canadian and U.S. marine transportation industry and Indigenous communities undertook a voluntary trial to study how laterally displacing commercial vessels away from known southern resident killer whale (SRKW) feeding areas along the northern side of the Strait of Juan de Fuca would affect the underwater noise levels in those areas. Findings showed that displacing inshore tug and barge traffic resulted in a significant reduction in underwater noise within southern resident killer whale foraging habitat.

Since 2019, the ECHO Program has asked tug and barge vessels to participate in the voluntary inshore lateral displacement. The overall purpose of the initiative is to reduce vessel noise impacts in these key SRKW feeding areas.

The 2021 voluntary inshore lateral displacement initiative began on June 1 and ended on October 31, 2021.

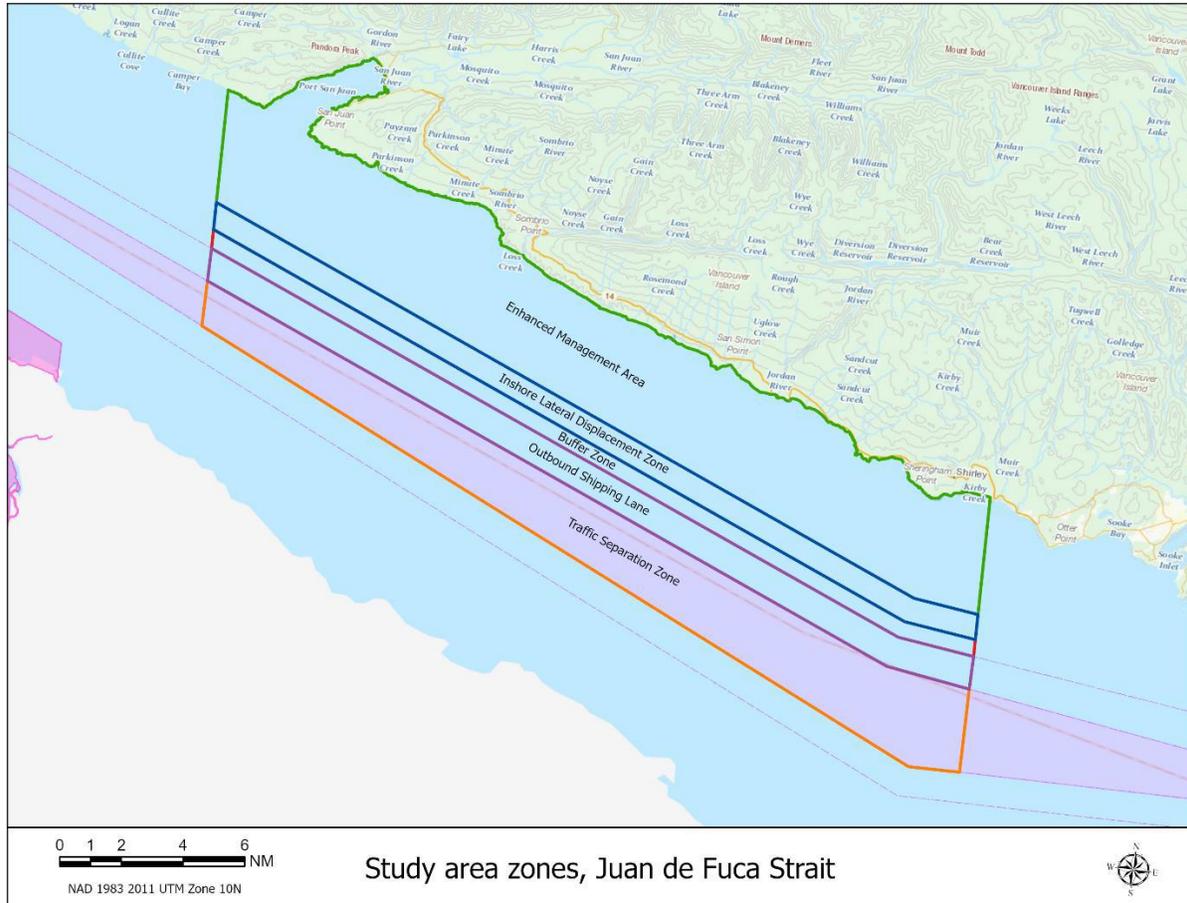
During the study, CCG provided Automatic Identification System (AIS) data to Transport Canada to advance the understanding of vessel participation. Transport Canada analysed vessel participation rates and provided bi-weekly summary reports describing traffic patterns to the ECHO Program team. Regular updates on the initiative were released publicly via the ECHO Program newsletter.

The current document summarizes the analysis based on the terrestrial AIS data collected during the initiative. It aims to illustrate tug participation and changes in traffic pattern in 2021 and provide a comparison to previous years of the lateral displacement initiative.

## II. METHODOLOGY

### 1) STUDY AREA AND TIME FRAME

The study area boundary was restricted to the waters in the Strait of Juan de Fuca, more precisely indicated by the zones defined by the ECHO Program in Figure 1.



**Figure 1:** Study area zones for the Lateral Displacement Initiative in 2019, 2020 and 2021.

The Inshore Lateral Displacement Zone is 1500 meters wide and occurs in the area between 123° 52' West and 124° 31' West, over a distance of approximately 28 NM (Figure 1). The zone is positioned 1,000 meters north of the Traffic Separation Scheme (TSS) area in order to provide a safety buffer for vessels transiting the area. An Enhanced Management Area (EMA) was identified by the Government of Canada along the northern side of the Strait of Juan de Fuca as a key foraging areas for SRKW (indicated by the green outlined area in Figure 1). During the initiative, tugs were requested to transit either in the outbound shipping lane or between the EMA and the buffer zone within the designated Inshore Lateral Displacement Zone.

The data collection and analysis took place for the duration of the initiative, from June 1st, 2021 to October 31st, 2021, and reporting was completed on a bi-weekly basis.

## 2) DATA

This analysis is based on CCG Terrestrial AIS data. AIS is a 4-S system (ship-to-shore / ship-to-ship) originally envisioned as a vessel tracking system by Vessel Traffic Services (VTS) and harbour authorities that evolved to improve vessel collision avoidance. In 2004, the International Maritime Organization (IMO) adopted Regulation 19 of the International Convention for the Safety of Life at Sea (SOLAS) Chapter V, “Carriage requirements for shipborne navigational systems and equipment”, which listed mandatory navigational equipment to be carried on board vessels, based on vessel type. This included a new requirement for all vessels to carry Automatic Identification Systems (AIS).

There are two different types of AIS classes. Class A AIS is required aboard all vessels of 300 gross tonnage and upwards engaged on international voyages, cargo vessels of 500 gross tonnage and upwards not engaged on international voyages and all passenger vessels irrespective of size. Class A transponders transmit AIS position reports more frequently: every 2-10 seconds while moving or every 3 minutes when the vessel is at anchor. Class B AIS position reports are sent every 5-30 seconds and every 3 minutes when speed over ground is less than 2 knots. The transmit power of a Class A AIS transponders is also higher than Class B AIS transponders and therefore allows for comparatively better coverage overall.

In this analysis, both Class A and Class B AIS messages were used. Class B AIS data is mostly produced by fishing vessels and recreational vessels. Due to the specificities of Class B transponders, a gap in the data was observed near Port Renfrew which limits our ability to represent the traffic accurately for Class B vessels in this area.

## 3) METHOD

### A) FILTERING AND EDITING THE AIS DATA

In order to perform this analysis, AIS data was collected through Canadian Coast Guard Terrestrial AIS infrastructure.

Transport Canada automatically processed the AIS data to identify tug trips based on the Maritime Mobile Service Identity (MMSI) as well as the timestamp for each location. Vessels are assigned to one of 11 different vessel types based on their classification, as transmitted by static AIS messages (type 5 and type 24 messages for Class A and Class B, respectively). However, the classification listed in the AIS messages can contain errors as this information is manually submitted and is therefore prone to human error. In order to identify tugs from other vessels, the vessel type was verified using Marine Traffic, an external online vessel search service. .

In order to only report participation on eligible transits, every transit with a total length less than half of the typical transit length (approximately 28.2 Nautical Miles) have been filtered out in the participation analysis (Sections III)1) and III)2) ). This measure was taken after identifying that some transits were very short distances between two coastal locations, thus could not reasonably be expected to use the inshore lateral displacement zone or the outbound shipping lane.

Between 2018 and 2020, CCG undertook the data analysis for vessel participation. At the time, data was extracted for the area of interest between June 17th and October 31st of 2017 (baseline), 2019 (previous lateral displacement trial), and between June 1st and October 31st 2020.

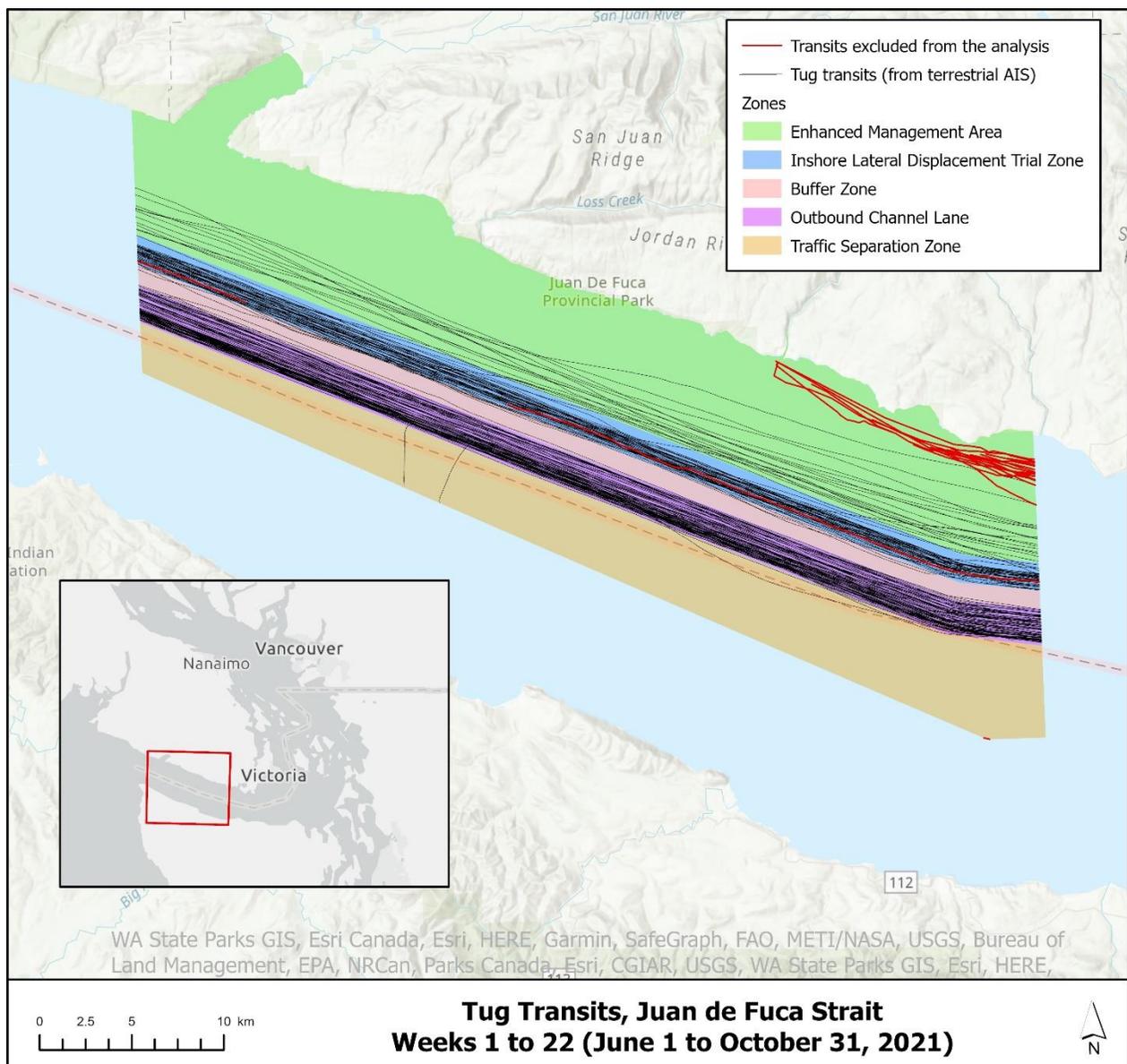
In 2021, Transport Canada undertook the data analysis for June 1<sup>st</sup> to October 31<sup>st</sup>. Since baseline data from 2017 and previous years participation data was unavailable to repeat the comparative analysis, a modified comparison was conducted using graphics previously provided by CCG (Figure 5).

## B) INDICATORS

Indicators were measured for each vessel trip using spatial analysis. These indicators were used to automatically identify whether the trip was to be considered for the analysis or not. This also allowed the quantification of the ratio of each transit within the different zones.

In 2019 through 2021, tug vessels were asked to transit within the outbound lane of the Traffic Separation Scheme (TSS) or inshore lateral displacement zone (See Figure 1). The 1000m zone in-between named “Buffer Zone” was intended to act as a separator between inshore traffic and outbound lane traffic.

Figure 2 represents all the tug transits based on Terrestrial AIS data that were used for this analysis of the 2021 initiative. The transits filtered out as mentioned in the last sub-section II)3)a) are represented in purple, while all the other transits are represented in orange.

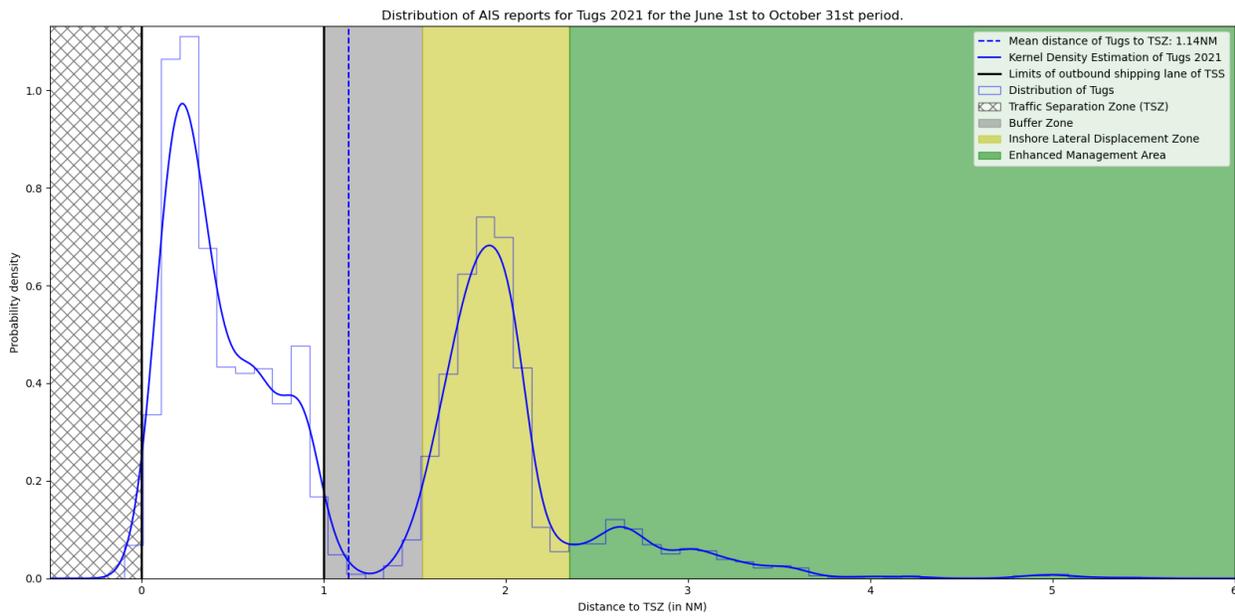


**Figure 2:** All tug transits during the lateral displacement period in 2021.

### C) DISTRIBUTION ANALYSIS

In order to confirm and better quantify the shift in tug traffic in the Strait of Juan de Fuca due to the initiative, a distribution analysis was undertaken on the reported AIS positions in the study area.

In Figure 3, we can see the probability density (measured as the number of AIS position reports divided by the total number of observation multiplied by the bin width) of the position reports received by tugs navigating in the zone in 2021 on the Y-axis and the distance to the TSZ in nautical miles for the X-axis. The integral under the histogram and the Kernel Density Estimation are both equal to one.



**Figure 3:** Distribution analysis (tug vessels positions in 2021)

### III. TUG TRAFFIC ANALYSIS

#### 1) OVERALL PARTICIPATION

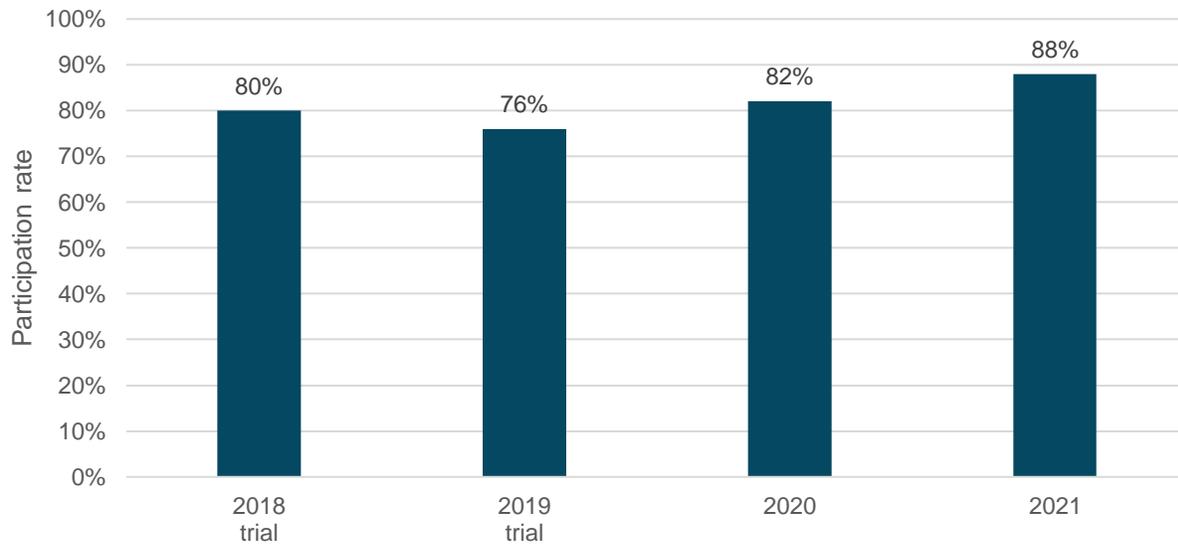
One hundred and forty three (143) tug transits were observed in the study area between June 1 and October 31, 2021. Table 1 outlines the baseline and participation rates between 2018 and 2021 for the lateral displacement initiatives.

Achieving rate for tugs	2017* (baseline, no trial)		2018*		2019*		2020		2021	
	June 17 - Oct 31, 2017		August 20 - Oct 31, 2018		June 17 - Oct 31, 2019		June 1 - Oct 31, 2020		June 1 - Oct 31, 2021	
# Trips ≥50% in the outbound lane and Inshore Trial Zone	52	55%	61	80%	93	76%	138	82%	126	88%
# Trips ≥25%-<50% in the outbound lane and Inshore Trial Zone	5	5%	2	3%	6	5%	11	7%	7	5%
# Trips >0%-<25% in the outbound lane and Inshore Trial Zone	12	13%	4	5%	5	4%	7	4%	0	0%
# Trips 0% in the outbound lane and Inshore Trial Zone	26	27%	9	12%	18	15%	12	7%	10	7%
Total # of Tug Trips in the Canadian Strait of Juan de Fuca	95		76		122		168		143	

**Table 1: Tugs lateral displacement achieving rates 2018 – 2021 with baseline tug behaviour in 2017.**

*\*In 2018, the first year of the trial, tugs were asked to laterally displace as close as possible to the outbound shipping lane. In 2019, the second trial year, a 1,000m buffer between the outbound shipping lane and the inshore lateral displacement area was added and has remained in place for each subsequent year. The 2017 baseline period was selected to mirror the 2019 temporal and spatial parameters.*

Tug transits were classified based on the proportion of the trip conforming to the vessel's presence in the outbound shipping lane ("outbound lane") and Inshore Lateral Displacement Zone ("Inshore Displacement Zone"). In 2021, 88% of tug transits had greater than or equal to 50% presence in these two zones. This is a significant increase from 55% in 2017 and is the highest achieved rate to date.



**Figure 4:** Achieving rates of tugs in the Strait of Juan de Fuca lateral displacement 2018 – 2021

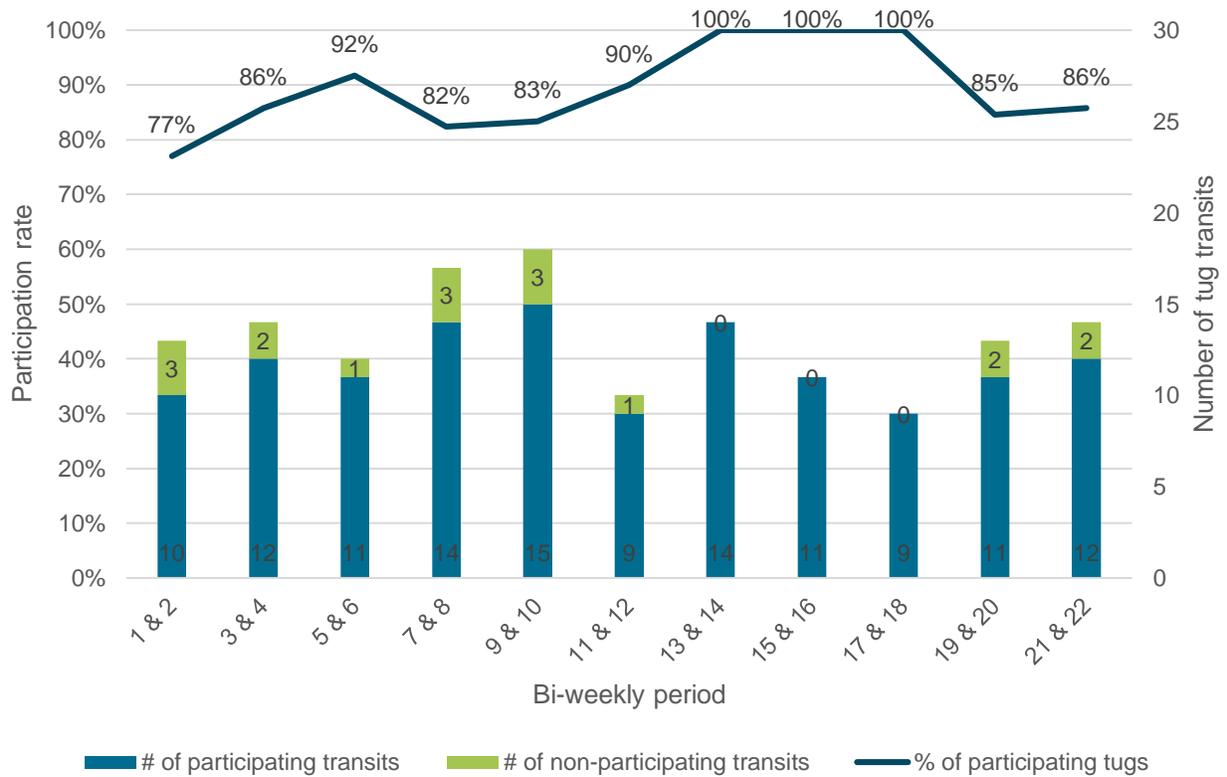
Table 2 presents a breakdown of tug transits by zone (as defined in Figure 1: Study area zones for the Lateral Displacement Initiative in 2019 and 2020. Figure 1). A majority of the participating tug transits, 57%, spent 50% or more of their time in the outbound shipping lane while 30% of tugs spent the majority of their time in the inshore lateral displacement zone. Six transits (4%) did not spend more than 50% of their transit in any of the zone but only a minority of their transit in multiple zones.

Zone tug was present for >50% in the transit	Number of tug transits	Percentage of tug transits
Outbound shipping lane ( <i>participating zone</i> )	81	57%
Buffer zone	1	1%
Inbound lateral displacement zone ( <i>participating zone</i> )	43	30%
Enhanced management area	12	8%
<i>Did not spend 50% of transit in any one zone</i>	6	4%
Total tug transits in 2021	143	

**Table 2:** Breakdown of tug transits by zone for 2020

The bi-weekly participating rate and the number of participating and non-participating transits is shown in Figure 4. The week with the lowest percentage of participation occurred in week 1 (77%) while there was a 6-week streak with 100% participation between weeks 7 and 9.

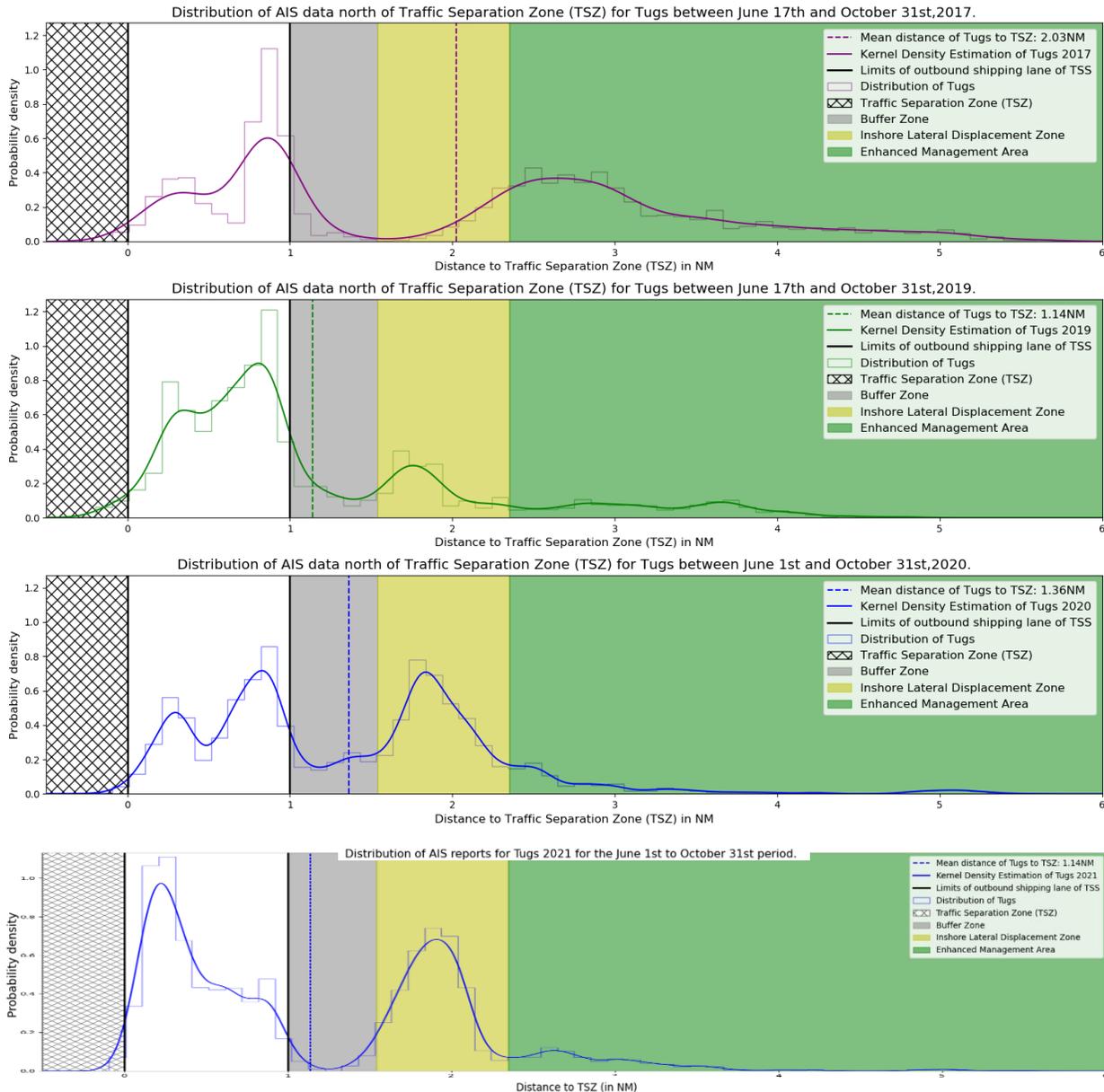
## 2) TEMPORAL DISTRIBUTION



**Figure 4:** Bi-weekly participation analysis (trips  $\geq 50\%$  in the outbound shipping lane and inshore displacement zone)

### 3) SPATIAL DISTRIBUTION

The tug traffic distribution patterns shown in Figure 5 provides a comparison of the position reports for 2017, 2019, 2020 and 2021.



**Figure 5: Distribution Analysis for Tugs by year**

Figure 5 shows two distinct modes of high tug traffic density in the outbound shipping lane (white area) and the inshore lateral displacement zone (yellow area) while low use in the buffer zone (grey zone) and the Enhanced Management Area for southern resident killer whales (green area).

Within the outbound shipping lane of the Traffic Separation Scheme (white area) tug traffic has presented two modes of density, one showing a higher distribution further away from the Traffic Separation Zone. The

density of these nodes in 2021 is different from the previous years, showing a higher density closer to the Traffic Separation Zone (cross hatched area).

Overall, the mean distance to the TSZ varied as follows:

- 2.05 NM in 2017 (baseline)
- 1.14NM in 2019 (0.91NM further away from EMA compared to 2017)
- 1.36NM in 2020 (0.69NM further away from EMA compared to 2017)
- 1.14NM in 2021 (0.91NM further away from EMA compared to 2017)

The increased change in distance away from the EMA compared to baseline in 2021 over 2020 is indicative of the higher participation rate and the high density of tugs in the outbound shipping lane.

## **IV. CONCLUSION**

The effect of the initiative is clearly apparent by the reduced distribution within the Enhanced Management Area, with higher density of tugs in both the outbound shipping lane of the TSS and the Inshore Lateral Displacement Zone.