Ship Strike Risk--North Atlantic Right Whales in Charleston and Savannah Entrance Channels

Ship Speed Compliance Report for 2020-2021 SMA Season

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June 18, 2021

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Abstract

The North Atlantic right whale ("right whale") is an endangered species under the Endangered Species Act, a depleted species under the Marine Mammal Protection Act, a Species at Risk under Canadian law, and listed as a Critically Endangered by the International Union for Conservation of Nature. Population numbers have declined since 2010 to a current best estimate of 356 whales. The female population is declining faster than males, with fewer than 95 reproductive-age females in existence. Primary threats to the species are serious injury and mortality from vessel strikes, entanglement, and declining reproductivity related to entanglement and ship strikes. Right whales are a coastal species and vulnerable to ship strikes in areas around major seaports; females with nursing calves are acutely vulnerable, being more confined to nearshore and surface areas. To protect right whales from ship strikes, federal law mandates that all regulated vessels 65 feet or longer must travel at 10 knots or less in certain areas between November 1 and April 30 each year. It is generally accepted that these federally implemented, mandatory speed restrictions have achieved a statistically significant reduction in ship strike injury and mortality, and that the rule has been effective in reducing right whale ship strike injury and mortality. But with compliance rates consistently below 5%, it is unlikely that ships entering Charleston and Savannah are participating in protections achieved in other portions of the Seasonal Management Area (SMA) system. In its report *North Atlantic Right Whale (Eubalaena Glacialis) Vessel Speed Rule Assessment, June 2020,* NOAA Fisheries Office of Protected Resources notes that:

> Vessels in certain SMAs exceed 10 knots at disproportionately high levels, especially OGVs ("ocean-going vessels") in channel entrances. OGVs entering southern ports under pilotage, represent an outsized proportion of vessels traveling at excess speed.

A discretionary feature of the speed regulation, the Navigational Safety Exception Provision ("safety deviation"), permits ship operators to exceed 10 knots in adverse conditions. It appears, based on our monitoring during the 2019-2020 and 2020-2021 SMA seasons, that the safety deviation has been used unjustifiably during most transits of the Charleston and Savannah entrance channels (EC), undermining the regulation's effectiveness. NOAA's *Vessel Speed Rule Assessment* reports that "there are indications that some vessels may be claiming severe maneuverability constraints without reasonable grounds." It recommends that "NMFS (National Marine Fisheries Service) should investigate modifications to the

regulatory language including possible contemporaneous electronic notification of safety deviations." We support NOAA's recommendation, which would allow ship logbook entries to be checked against vessel position reports and meteorological data for consistency.

Self-regulated and discretionary compliance may not achieve policy and management objectives to reduce the incidence and severity of ship collisions with right whales in this section of the Mid-Atlantic SMA. Modification to the rules, developed with pilot input, to establish effective, measurable standards, along with monitoring and enforcement, may allow regulators to achieve currently elusive policy and management objectives.

Introduction

The Charleston and Savannah entrance channels are subject to mandatory federal speed restrictions between November 1 and April 30. The seasonal speed restrictions were enacted to reduce the risk to migratory whales, including pregnant females, passing port areas enroute to calving and nursery grounds on the Georgia and Florida coasts each fall, and to the same migratory whales, including mothers and nursing calves, enroute to Northern latitudes in the spring. Every mother-calf pair represents one of fewer than 95 reproductive females in existence (Marine Mammal Commission, 2020), at a critical phase of the reproductive cycle. Population numbers have declined since 2010 to a current best estimate of 356 whales, with female numbers declining faster than the number of males (North Atlantic Right Whale Consortium 2020 Annual Report Card). To avoid continued losses and sliding ever closer to extinction, the migratory population, significantly including mothers and calves, must be protected from ship strikes around major port areas.

The entrance channels for the ports of Charleston and Savannah funnel traffic into the busiest containership port region on the East coast (United States Department of Transportation). Unlike other port areas in the SMA system, with deep approaches from the ocean, the ports of Charleston and Savannah are approached through federal channels--federally funded, designed, dredged, and maintained. Ships must stay in the channels to avoid grounding, and pilotage is compulsory. As inbound ships approach the entrance channels, they slow to pick up a pilot. Outbound ships follow the same procedure, disembarking a pilot at boarding areas seaward of the entrance channels. The entrance channels are long and narrow, and cut through shallow water as ships approach the coast. United States Army Corps of Engineers (USACE) dredging projects have made these channels deeper but not wider, to accommodate post-Panamax vessel traffic, creating efficiencies of scale and record cargo volumes touted by the South Carolina and Georgia port authorities. Whereas dredging deeper channels to accommodate larger ships is accomplished, dredging wider channels, which would improve navigational safety margins, have not been pursued by federal authorities.

Methods & Results

Vessel position reports (VPRs) used in this report were derived from Automatic Information Systems (AIS) data purchased from Vessel Finder/Astra Paging Ltd. for the Mid-Atlantic SMA dates of November 1, 2020 – April 30, 2021 ("2020-2021 SMA season"). Vessel positions were taken in 1-minute intervals for the duration of the season.

Our analysis focuses on post-Panamax and Panamax vessels in accordance with the USACE practice of evaluating the behavior of the largest ships anticipated in federal channels (Webb et al, 2019). Vessels not subject to the speed rule (e.g., military ops, law enforcement, search-and-rescue), tugs, fishing vessels, and dredge operations were scrubbed. The dataset was also scrubbed to remove position reports for vessels with unattainable high speed, course and heading errors, channel bends and pilot boarding areas. If only one single position was reported for a given ship the entry was removed. Full datasets are available for Charleston and Savannah on GitHub, and at the Maritime Whale website datasets page. The entire un-scrubbed dataset for Charleston and Savannah combined is available at GitHub raw data.

We prioritized Panamax (656-965 feet LOA) and post-Panamax (966-1200+ feet LOA) ships for analysis, based on the practice of modeling for the largest ships using the channels (Webb et al, 2019). We dropped sub-Panamax class vessels from this study; the remaining positions formed working datasets for Charleston and Savannah, composed entirely of Panamax and post-Panamax class vessels.
We documented sub-Panamax behavior at Charleston for the 2019-2020 SMA season (Maritime Whale, 2019); it is understood that smaller vessel classes pose ship strike risks similar to larger ships, a consequence of high ship speed (Vanderlaan et al., 2007). Sub-Panamax vessel positions totals have been included here for comparative purposes (Table 1).

Table 1

Panamax, Post-Panamax, and Sub-Panamax Position Totals

	Panamax & Post-Panamax	Sub-Panamax
Charleston	28,523	10,608
Savannah	25,597	19,517

Raw data for sub-Panamax ships for the 2020-2021 SMA season is available at riwhale.github. A more comprehensive discussion of our methodology is available at Maritime Whale docs on GitHub.

The boundaries of the Charleston entrance channel (Charleston Harbor Entrance and Approach, Chart 11528) are defined by US Coast Guard Light List Volume III, 2021, pages 20-21; the extent of the study area is a 9.7 nautical mile section of the channel between channel buoys R6 (geographic coordinates 32º 39' 22.769"N / 079º 40' 01.875"W) and R18 (32º 43; 26.672"N / 079º 48' 37.092"W). There are no turns in the Charleston EC. The channel is nominally 1000 feet wide, but because of the shoulder contour of the channel, post-Panamax ships are confined to a nominal channel width of 800 feet; construction of a wider channel has been avoided to control dredging costs and improve cost-benefit calculations (Webb et al., 2019), a longstanding pattern in the USACE planning and design process noted by the Society of Naval Architects and Marine Engineers (Gray et al., 2002). The Charleston EC is now 20 miles long and 52 feet deep, but remains 1000 feet wide, a width established in 1926, when cargo ships were 417-492 feet length overall (Viehmann, 1950).

The boundaries of the Savannah EC (Savannah River Approach, Chart 11505) are defined by US Coast Guard Light List Volume III, 2021, page 38; the study area is comprised of a 6.48 nautical mile section of the channel between channel buoys R2 (geographic coordinates 31º 58' 24.486"N / 080º 44' 07.675"W) and R14 (32º 01' 58.405"N / 080º 49' 06.525"W). The 600-foot-wide entrance channel is configured with five reaches, where channel alignment changes, connected by bends or "doglegs." Our study area includes one dogleg, connecting the Bloody Point range and Tybee range. USACE dredged the Savannah entrance channel to 22 feet in 1873, to 26 feet in 1907, to 30 feet between 1917-1935, to 34 feet between 1945-1954, to 38 feet in 1965, to 42 feet in 1994. Its width was established at 500 feet wide in 1935 (History of the Savannah District U.S. Army Corps of Engineers, 1929-1989. Barber et al, 1989), and widened to 600 feet in 1986 (Savannah Harbor Expansion Project—General Re-evaluation Report, 2012). USACE completed dredging the entrance channel to a maximum project depth of 49 feet (Vertical Ship

Motion Study for Savannah Georgia Entrance Channel, 2011), in March 2018, maintaining its 600-foot width.

Ships generally make one inbound and one outbound transit for each port call. At Charleston, post-Panamax ships comprised 61.52% of transits in the study (414 of 673 total). Panamax ships made up 38.48% of total transits (259 of 673 total). At Savannah, post-Panamax ships comprised 70.15% of transits in the study (550 of 784 total). Panamax ships made up 29.85% of total transits (234 of 784 total). Average ship size in our Charleston analysis was 984 feet in length overall (LOA), maximum LOA of 1210 feet. The average ship size at Savannah was 1008 feet LOA, maximum LOA was 1210 feet.
At Charleston, based on 28,523 unique position reports, mean ship speed in the Charleston EC was 14.5 knots (Figure 1); high speed was maintained by most ships for the duration of each transit (Figure 2). The proportion of Panamax to post-Panamax positions recorded in the Charleston study area was 36.53% for Panamax, 63.47% for post-Panamax. The combined compliance rate for post-Panamax and Panamax class ships was 4.87%. The compliance rate for Panamax ships was 5.33%, with a mean VSPD of 14.35 knots. The compliance rate for post-Panamax ships was 4.61%, with a mean VSPD of 14.58 knots. We observed little deviation in vessel speed between Panamax and post-Panamax ships, between inbound and outbound ships, or between nearshore and offshore positions (Table 2). See Maritime Whale for interactive versions of Figures 1-12.

Table 2

Charleston Entrance Channel Vessel Speed

	Proportion %	Compliance %	Mean VSPD kn	Mean VSPD kn Nearshore	Mean VSPD kn Offshore	Mean VSPD kn Inbound	Mean VSPD kn Outbound
Panamax	36.53	5.33	14.35	14.34	14.39	14.02	14.79
Post-Panamax	63.47	4.61	14.58	14.45	14.86	14.18	15.11
Combined	100	4.87	14.5	14.41	14.71	14.12	14.99

At Savannah, based on 25,597 position reports, mean ship speed was 14.05 knots (Figure 3); high speed was maintained by most ships for the duration of each transit (Figure 4). The proportion of Panamax to post-Panamax positions was 31.41% Panamax to 68.59% post-Panamax. The compliance rate for Panamax ships was 4.53%, with a mean VSPD of 13.93 knots. The compliance rate for post-Panamax ships was 3.14%, with a mean VSPD of 14.1 knots. The combined compliance rate for Panamax and post-Panamax ships was 3.58%. We observed little deviation in vessel speed between Panamax and post-

Panamax ships, between inbound and outbound ships, or between nearshore and offshore positions (Table 3).

Table 3

Savannah Entrance Channel Vessel Speed

	Proportion %	Compliance %	Mean VSPD kn	Mean VSPD kn Nearshore	Mean VSPD kn Offshore	Mean VSPD kn Inbound	Mean VSPD kn Outbound
Panamax	31.41	4.53	13.93	14.23	13.62	14.2	13.6
Post-Panamax	68.59	3.14	14.1	14.14	14.07	14.19	13.99
Combined	100	3.58	14.05	14.17	13.93	14.19	13.87

Wind Speed

Clearly, there are circumstances when deviation from the 10 knot speed limit is warranted. Container ships, car carriers and cruise ships have large windage areas that can complicate ship controllability in narrow channels (Gray et al., 2002). Navigating these ships in two-way traffic within the confines of the channel, subjected to high wind speeds, the pilots can reasonably assert that they must deviate from the speed restriction for safety reasons during high wind conditions (Webb et al., 2019).

We matched wind conditions with each AIS vessel position based on vessel and wind buoy timestamps, using data from the National Buoy Data Center (NBDC). Buoys typically record every ten minutes. Charleston's buoy ID is 41004 and Savannah's is 41008. Due to their proximity, the Charleston buoy served as an alternate for Savannah and vice versa, in the event of outages (outages Charleston 4.41%, Savannah 4.21%).

NBDC's offshore buoy at Charleston recorded a wind speed of 30 mph or higher 2.26% of the time during the 2020-2021 SMA season. Mean wind speed was 15.29 mph at Charleston during the study period, and mean gust speed (GST) 20.08 mph. Wind speed 25 mph or higher was recorded 10.03% of the time, and wind speed 20 mph or higher was recorded 27.17% of the time. Wind speed less than 20 mph was recorded 72.83% of the time (Figure 5). Therefore, wind speed is unlikely to have been a factor for most transits at Charleston.

Table 4

Charleston Entrance Channel Wind Speed

	Mean WSPD mph	Mean GST mph	WSPD < 20mph %	WSPD ≥ 20mph %	WSPD ≥ 25mph %	WSPD ≥ 30mph %	2-way with WSPD ≥ 30mph %	VSPD/WSPD CORR %
	15.29	20.08	72.83	27.17	10.03	2.26	0.25	--
Panamax	--	--	--	--	--	--	--	9
Post-Panamax	--	--	--	--	--	--	--	6
Combined	--	--	--	--	--	--	--	7

Mean wind speed was 13.32 mph at Savannah during the 2020-2021 SMA season, with mean gust speed 17.81 mph. Wind speed of 30 knots or higher was recorded 0.96% of the time during the study period. Wind speed 25 mph or higher was recorded 6.01% of the time, and wind speed 20 mph or higher was recorded 14.22% of the time during the study timeframe. Wind speed less than 20 mph was recorded 85.78% of the time (Figure 6). Like Charleston, wind speed is unlikely to have been a factor for most transits at Savannah.

Table 5

Savannah Entrance Channel Wind Speed

	Mean WSPD mph	Mean GST mph	WSPD < 20mph %	WSPD ≥ 20mph %	WSPD ≥ 25mph %	WSPD ≥ 30mph %	2-way with WSPD ≥ 30mph %	VSPD/WSPD CORR %
	13.32	17.81	85.78	14.22	6.0	0.96	0.0	--
Panamax	--	--	--	--	--	--	--	10
Post-Panamax	--	--	--	--	--	--	--	16
Combined	--	--	--	--	--	--	--	14

We expected to find a direct relationship between vessel speed and wind speed, based on the pilots' contention that to prevent "crabbing" ships must carry more speed when wind speed is higher. But at Charleston our analysis indicates a VSPD-WSPD correlation value of 7% (Table 4), (Figure 7), and at Savannah a VSPD-WSPD correlation value of 14% (Table 5), (Figure 8), indicating a weak direct relationship between wind speed and vessel speed; pilotage consistently resulted in high vessel speed in benign wind conditions.

Two-Way Traffic

Two-way transits are channel conditions where ships travel toward each other in the entrance channel. For our analysis the two-way condition applies to ship positions until VPRs indicate ships have passed one another, after which their positions are considered one-way.

USACE has identified two-way traffic involving post-Panamax ships combined with adverse wind conditions as a particular navigation concern (Webb et al., 2019). Of the 28,523 AIS position reports from the 2020-2021 SMA season, 12.53% involved two-way traffic at Charleston; the remaining 87.47% were one-way transits (Table 6).

Table 6

Charleston Entrance Channel One-way & Two-way Traffic

	AIS Positions	Proportion %	Mean VSPD kn	Max VSPD kn	VSPD SD kn
One-Way	24,949	87.47	14.54	19.6	2.09
Two-Way	3,574	12.53	14.21	19.0	2.27
Combined	28,523	100	14.50	--	--

We should note that two-way traffic may not be an adverse condition in the same category as high wind speed, because two-way traffic is a self-imposed condition. If a pilot is sufficiently concerned that navigational safety would be compromised by meeting and passing another ship in the channel, waiting for a one-way condition is an option. A two-way traffic condition reduces available channel width from 1,000 feet (800 nominal) to 400-500 feet per ship in the Charleston EC, depending on ship class and draft; the full width of the channel is available to pilots, at their discretion, for greater margins of navigational safety.

At Savannah, of the 25,597 AIS positions, 6.78% involved two-way traffic, and 93.22% were for one-way traffic (Table 7). Like Charleston, one-way traffic in the Savannah EC may not be an adverse condition in the same category as high wind speed since it is the result of a self-imposed navigational decision. If a pilot is sufficiently concerned that navigational safety would be compromised by meeting and passing another ship in the channel, waiting for one-way conditions is an option. A two-way traffic condition reduces available channel width from 600 feet 300 feet per ship; the full width of the channel is available to pilots, at their discretion, for greater margins of navigational safety.

Table 7

Savannah Entrance Channel One-way & Two-way Traffic

	AIS Positions	Proportion %	Mean VSPD kn	Max VSPD kn	VSPD SD kn
One-Way	23,862	93.22	14.08	19.1	5.9
Two-Way	1,735	6.78	13.66	17.6	6.0
Combined	25,597	100	14.05	--	--

USACE Adverse Conditions Benchmark

With the exception of high wind, mechanical failure, or other unusual conditions impacting safe navigation, the deviation provision may not be widely applicable, according to the conditions identified in a USACE ship simulation for Charleston (high wind combined with two-way traffic) (Webb et al., 2019). In the absence of similar analysis available for the Savannah EC, we have adopted the Charleston ship-bridge simulation model for adverse conditions as a proxy at Savannah, until additional analysis is available.

In the Charleston EC study area, 0.25% of AIS positions were two-way with wind speeds greater than or equal to 30 mph (71 of 28,523 positions analyzed). In the Savannah EC study area, 0.0% of positions were two-way with winds greater than or equal to 30 mph. The data indicate that the navigational safety exception was routinely invoked for one-way traffic in light to moderate wind conditions. We suggest a shift from two-way traffic to one-way traffic, when necessary, to improve margins of error for the maneuvering and station keeping ability of ships, to protect right whales in accordance with the federal speed regulation. Traffic can be limited to one-way, effectively doubling channel width, at any time.

Yaw and Effective Beam

We defined yaw as the absolute difference between course and heading. The Charleston pilots identify excessive yaw (“crabbing”) as a principal concern limiting their ability to comply with the speed regulation. Our analysis of yaw, using Panamax and post-Panamax ships, uses a model for maximum ship size/class per USACE guidelines (Webb et al., 2019). Yaw analysis was limited to confined sections within the entrance channels, to capture channel bank effects and confined propeller/rudder dynamics (Gray et al., 2002). Yaw values, length overall (LOA), and beam then were used to calculate “effective beam,” identified by the Charleston pilots as an important metric for evaluating navigational margins of safety (Cameron, 2014). Effective beam was calculated using the following formula, where effective beam, LOA and beam are all expressed in feet, yaw is expressed as a planar angle in degrees:

$$EB = \cos(90^{\circ} - yaw) * LOA + \cos(yaw) * beam$$

Channel occupancy is computed based on nominal channel width, defined as available channel width based on ship classification, and effective beam. Vessels subject to two-way conditions are limited to 50% of the nominal channel width, while ships in one-way conditions navigate 100% of nominal channel width. Higher yaw values translate to higher effective beams, yielding larger percentages of occupied channel, but two-way traffic conditions have a larger impact on channel occupancy. See Figure 9 for Charleston, and Figure 10 for Savannah.

The Charleston Branch Pilots identify a threshold of 10 degrees angle of yaw combined with two-way traffic as a particular navigational concern (*Navigation Update, 2014*). In the 2020-2021 SMA season, average yaw at Charleston was 1.49 degrees. For ships traveling 10 knots or less, the average yaw angle was 2.18 degrees; for ships traveling above 10 knots, the mean yaw angle was 1.46 degrees (Table 8). The difference in yaw between compliant and non-compliant ships at Charleston was 0.73 degrees, and 10 degrees of yaw cited as a concern in the Charleston Pilots' *Navigation Update* was recorded for only 70 out of 28,523 positions, a rate of 0.25%.

Table 8

Charleston Entrance Channel Yaw, & Percent Channel Occupied

	Yaw deg compliant	Yaw deg Non-compliant	Yaw deg combined	Yaw deg difference	% Channel	LOA ft	Beam ft
Mean	2.18	1.46	1.49	0.73	21.07	984.31	133.09
Min	--	--	0	--	9.8	656	98
Max	--	--	18	--	75	1210	171
SD	--	--	1.4	--	9.17	165.82	20.69

The average angle of yaw at Savannah was 1.24 degrees. For compliant ships, traveling 10 knots or less, the average yaw angle was 1.55 degrees; for non-compliant ships, traveling above 10 knots, mean yaw angle was 1.24 degrees (Table 9). The difference in yaw between compliant and non-compliant ships at

Savannah was just 0.31 degrees, and 10 degrees of yaw was recorded for 36 out of 25,597 positions, a rate of 0.14%. Bends in the Savannah entrance channel incur higher than normal yaw values, resulting from turning behavior. To prevent skewing our analysis, data from bends associated with changes in course/heading were ignored.

Table 9

Savannah Entrance Channel Yaw & Percent Channel Occupied

	Yaw deg compliant	Yaw deg Non-compliant	Yaw deg combined	Yaw deg difference	% Channel	LOA ft	Beam ft
Mean	1.55	1.24	1.25	0.31	27.96	1008.89	135.32
Min	--	--	0	--	16.33	656	98
Max	--	--	15	--	97.33	1210	171
SD	--	--	1.27	--	8.79	155.49	20.99

According to a report by The Society for Naval Architects and Marine Engineers ("SNAME"), the width of one-way channels should be between 4-5 times the maximum beam of ships expected to use it (Gray et al., 2002). The mean beam in our analysis was 133 feet at Charleston, and a maximum beam of 171 feet. With 800 feet of channel width to navigate within, the channel is therefore 4.7 times the maximum beam of the largest ships expected to use it and should give the largest ships ample room to navigate, under one-way traffic conditions. The mean beam in our analysis was 135 feet at Savannah, and a maximum beam of 171 feet. With 600 feet of channel width to navigate within, the channel is therefore 4.4 times the mean beam of ships expected to use it and should give most ships ample room to navigate, under one-way traffic conditions. The largest ships in the Savannah EC may experience margins of safety below the values recommended by SNAME.

Potential limitations of our yaw analysis arising from the scarcity of data for ships transiting at compliant speed (Figure 11, Figure 12) indicate the need for the USACE to conduct a well-designed simulation study of one-way traffic, with 10 knot speed runs simulated under varying conditions. The number of runs should be large enough to produce meaningful yaw and station keeping analysis over a range of navigational conditions, from benign to adverse (Gray et al., 2002). Additional leeway created by limiting traffic to "one-way only" may give pilots additional margins of safety to compensate for higher rates of yaw that may be associated with compliant speed.

The steady rise in post-Panamax ships calling at these ports (United States Department of Transportation) contrasts with NMFS' assurances that channel deepening to accommodate larger, less maneuverable ships would pose no potential for adverse effect on right whales (NMFS, 2015). There are no published reports on post-Panamax ships comparable to *Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed* (Vanderlaan, et al., 2007). Probability determinations, based on post-Panamax ships averaging and exceeding 15 knots, would be useful. Probability determinations might also consider the vulnerability of mother-calf pairs, and the unavailability of water column below ships in entrance channels--one means of collision avoidance potentially available to whales in deeper water.

Discussion

The level of expertise required to bring ships safely into harbor puts pilots in a position of trust, with near unassailable authority with respect to navigation through the entrance channels. Nevertheless, they appear to be using their position of authority to circumvent with federal speed regulations, putting right whales at risk of ship strikes.

Monitoring

The availability of unbiased, comprehensive AIS data allows efficient, accurate monitoring of ship speed across North Atlantic right whales' migration to and from seasonal calving grounds. Routine monitoring and the certainty of detection may be critical to effective protection under the existing regulation. Near-real time data is available for analysis, which can reliably identify patterns of non-compliance, and can be summarized for regulators and law enforcement in a timely manner. In this context, third-party monitoring can report compliance rates to regulators as soon as monitoring cycles are completed. Because data collection and methods are verifiable, compliance in high-risk areas can be efficiently targeted for ongoing active monitoring in the future. The certainty of detection, backed up by enforcement, can focus stakeholders' attention on compliance with the regulation, to avoid sanctions, penalties, and negative publicity (Organization for Economic Cooperation and Development, 2000). Maritime Whale, which we administer, monitors ship traffic at Charleston and Savannah and publishes daily summaries during the SMA season, at Maritime Whale (www.maritimewhale.com).

Enforcement

The Endangered Species Act creates an affirmative duty on the part of NMFS to protect North Atlantic right whales under its jurisdiction. NMFS must also assure that no federal action is taken that would jeopardize the continued existence of these whales. Other federal agencies are obligated to ensure that actions taken by them do not jeopardize the continued existence of the critically endangered species (Code of Federal Regulations). The United States Coast Guard (USCG) partners with NOAA's Office of Law Enforcement (OLE) to monitor and enforce the ship strike rule (US Department of Homeland Security, 2014). As the federal government's primary at-sea enforcement agency, USCG actions include detecting vessels in violation, hailing them, and informing them of the ship strike rule and speed requirements. USCG then provides written notification to NOAA OLE for further engagement, as necessary. Field units work with NOAA OLE on a case-by-case basis regarding egregious violations, and primary enforcement is conducted shoreside by NOAA OLE.

> The NOAA Fisheries Service Office of Law Enforcement investigates reported violations of the Endangered Species Act and Marine Mammal Protection Act, and violations can be prosecuted either civilly or criminally and are punishable by up to $100,000 in fines and up to one year in jail per violation (US Department of Homeland Security, 2014).

To the extent that enforcement is appropriate, the Endangered Species Act [Prohibited Acts, Section 9] Penalty Schedule is applicable. The range in penalties for a violation of the speed regulation is $2,500-$5,500 for the first violation; $5,000-$8,000 for the second violation; $7,500 to $52,596 for a third and subsequent violations for incidents involving prohibited acts under Section 1538 of the ESA. NOAA and the USCG may be deflecting their duties by not enforcing these violations.

Compliance Costs

Direct economic impacts have been built into other port areas in the SMA system since the speed rule's enactment in 2008 (Nathan, 2012). Perpetual avoidance of compliance costs gives Charleston and Savannah a competitive economic advantage over these other relatively compliant ports. Future compliance Charleston and Savannah may result in new, even unique economic costs associated with their narrow entrance channels, such as costs arising from the adoption of one-way transits for better margins of navigational safety. These potential new costs could be shared between federal and state authorities, easily offset by recent and projected windfall revenues associated with increased cargo volume and economic activity reported by the South Carolina and Georgia port authorities.

At Charleston, recently completed and planned investments through fiscal year 2022 total approximately $3.01 billion, consisting of South Carolina State Ports Authority (SCSPA) funded investments totaling $1.7 billion and state and federal capital Investments of $1.3 billion (SCSPA Capital Plan). The national and state economic interests are enumerated at USACE Post 45 Appendix C and SCSPA Home Page), respectively. The SCSPA cites $63.4 billion in port total economic impact in 2018, $12.8 billion total wages in port related jobs, and $1.1 billion in 2018 state tax revenues, with continuing revenue growth predicted as new infrastructure is completed. (Von Nessen, 2019). Export activity shipped through South Carolina port facilities totaled approximately $25.9 billion in 2018. Import activity in the same period totaled approximately $46.7 billion. Between 2009-2019 container volume grew at a compound annual growth rate of 7.5%, far outpacing U.S. growth overall (SCSPA 2021 Prospectus).

The total economic impact of Georgia's deep-water ports on Georgia's economy is $122.4 billion. This accounts for more than 10% of Georgia's total output in FY 2019. Of the total, $6.1 billion represents revenue from the ports industry and $116.3 billion is from ports users. The ports industry and port users support $51 billion in state gross domestic product (GDP), 8% of Georgia's total GDP. The combined economic impact on federal, state, and local tax collections was $9.5 billion (Humphreys, 2020). In March 2021, Georgia Ports Authority approved investment projects to increase the capacity at the Port of Savannah by 20 percent. In the coming decade, the Georgia Ports Authority plans to increase annual capacity of the port by 45 percent (Georgia Ports Authority, 2021).

Regulatory Exceptions

Regulatory effectiveness in Charleston and Savannah depends on the pilot's ability to comply with ship speed restrictions. Their capacity to comply under ordinary conditions must be distinguished from unusual conditions that would prevent compliance in the interest of navigational safety. Specific regulatory exceptions should be established to define adverse conditions for vessels under pilotage. Understanding the pilots' ability to comply, through consultation and analysis, should help address navigational safety concerns, eliminate obstacles to compliance, and motivate regulated organizations to comply. A well-designed USACE ERDC/CHL simulation may help distinguish between legitimate navigation problems and resistance to compliance arising from institutional, economic, and cultural incentives. Performance standards that promote protective policy goals, in accordance with federal law and that are practical from a navigational safety perspective, can be developed by USACE, with input from pilots and other stakeholders (Wiley et al., 2013).

Conclusion

Federal law mandates that all regulated vessels 65 feet or longer must limit vessel speed to 10 knots or less in SMAs, including the federal entrance channels at Charleston and Savannah. Federally implemented, mandatory speed restrictions have achieved reductions in ship strike injury and mortality. With documented compliance rates from 3.5% to 5.5%, most ships entering Charleston and Savannah are not participating in protections achieved by the SMA system generally. Monitoring indicates that during the 2019-2020 and 2020-2021 SMA seasons the safety deviation was routinely and unjustifiably invoked during most transits of the Charleston and Savannah entrance channels, undermining the regulation's effectiveness. As presently managed, the discretionary features of the speed rule will not reduce the incidence of ship collisions with right whales in this section of the Mid-Atlantic SMA. Modification to the rules, to establish effective, justifiable standards for deviation from the speed rule, coupled with monitoring and enforcement, may allow regulators to achieve elusive policy and management objectives.

Figures

Figure 1

Charleston--Mean Vessel Speed Histogram

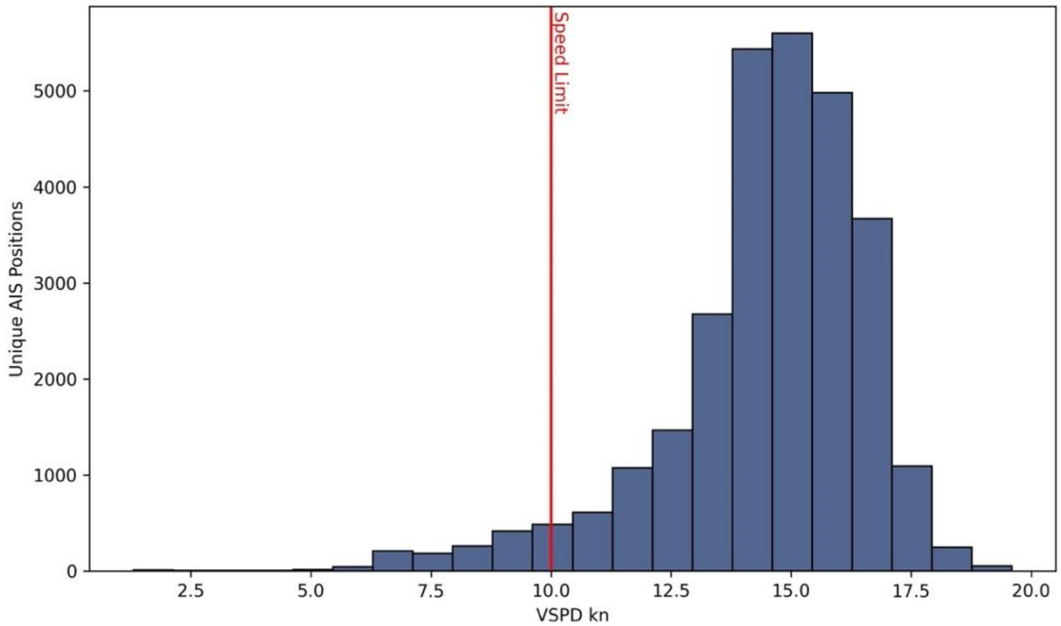


Figure 2

Charleston Vessel Speed Strip Chart

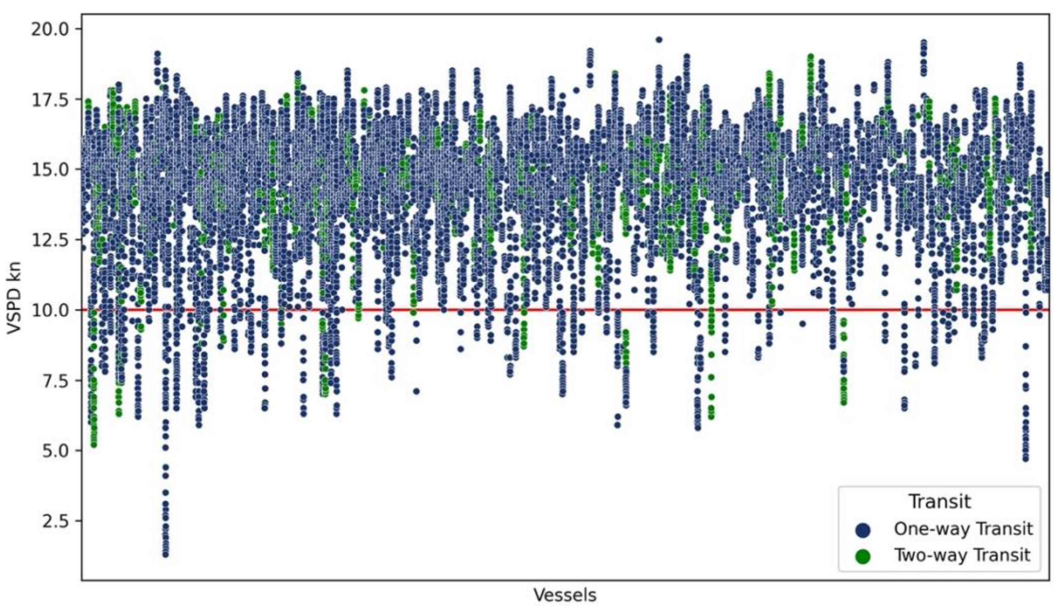


Figure 3

Savannah--Mean Vessel Speed Histogram

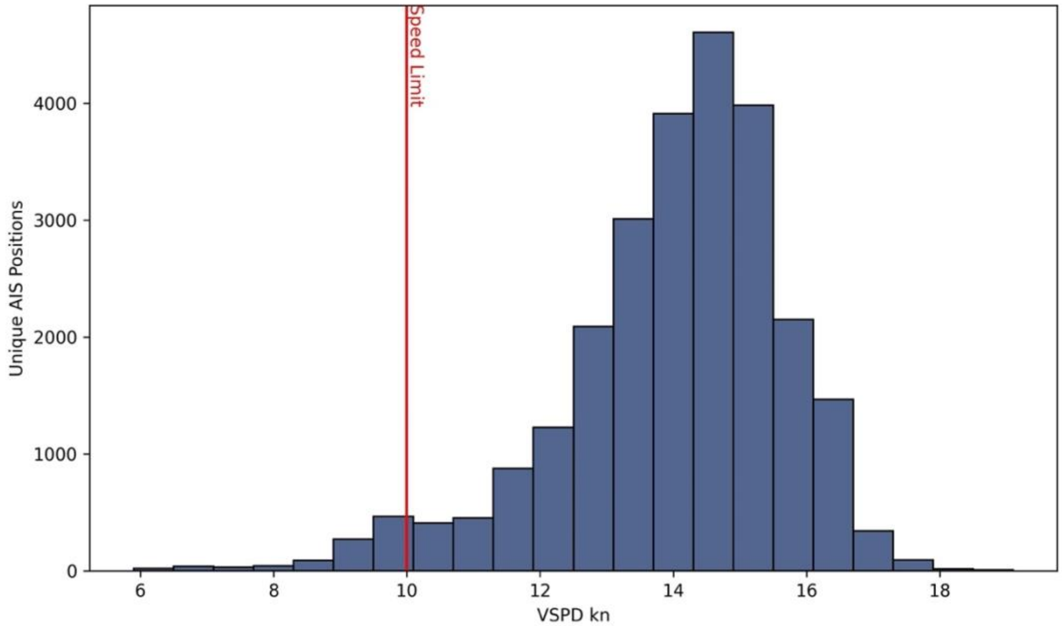


Figure 4

Savannah Vessel Speed Strip Chart

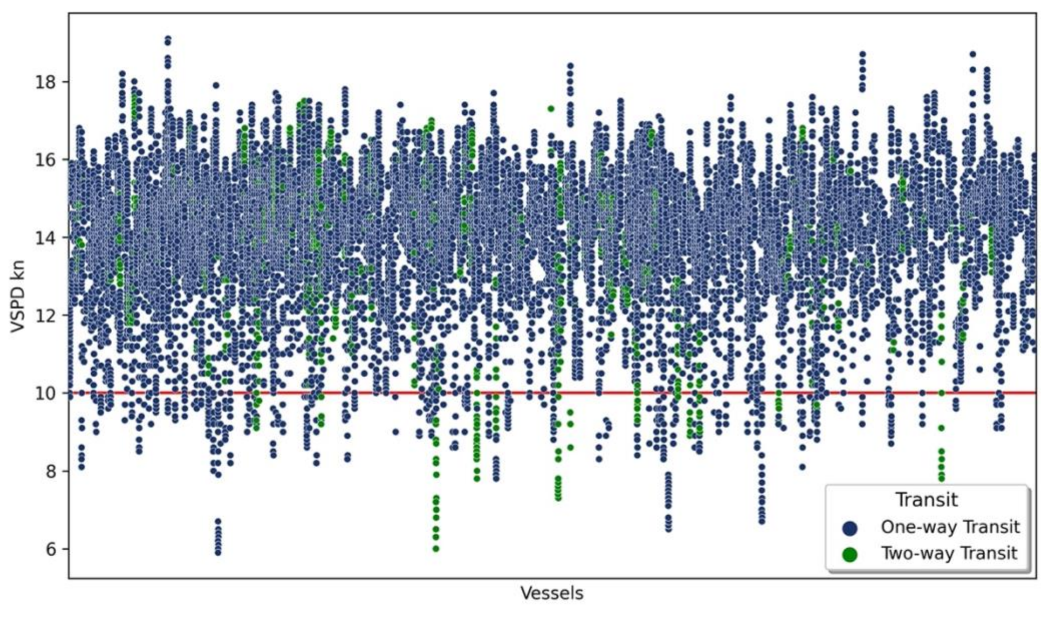


Figure 5

Charleston Wind Speed Histogram

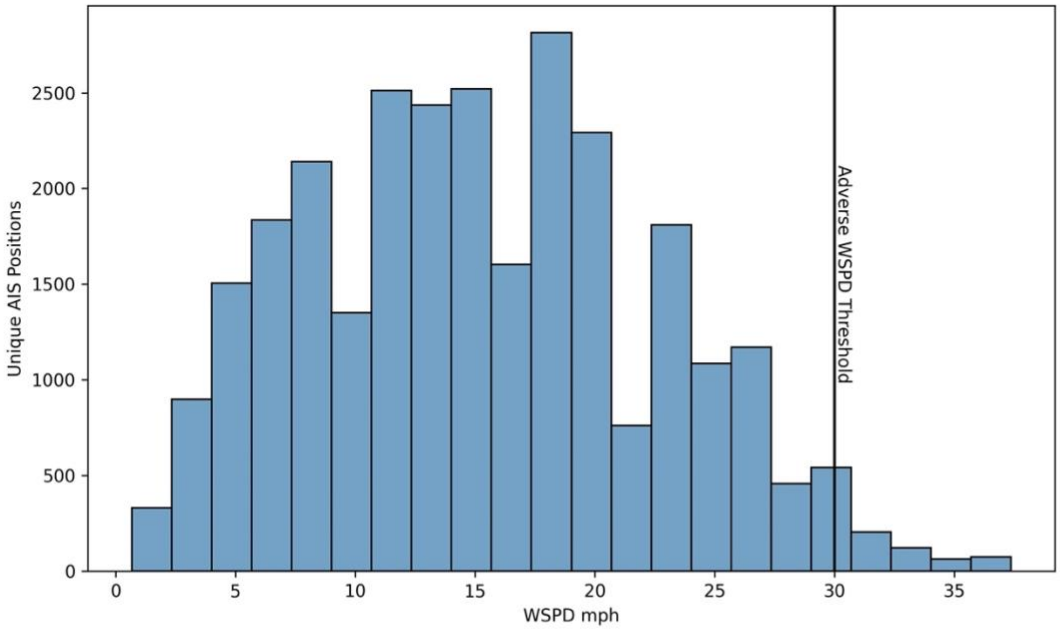


Figure 6

Savannah Wind Speed Histogram

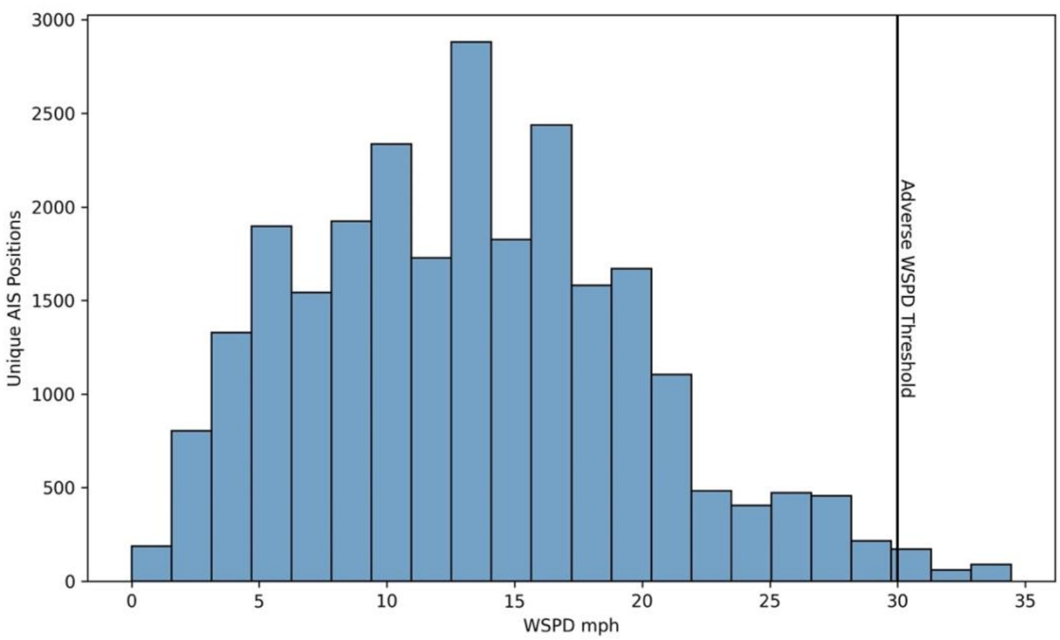


Figure 7

Charleston Vessel Speed vs. Wind Speed

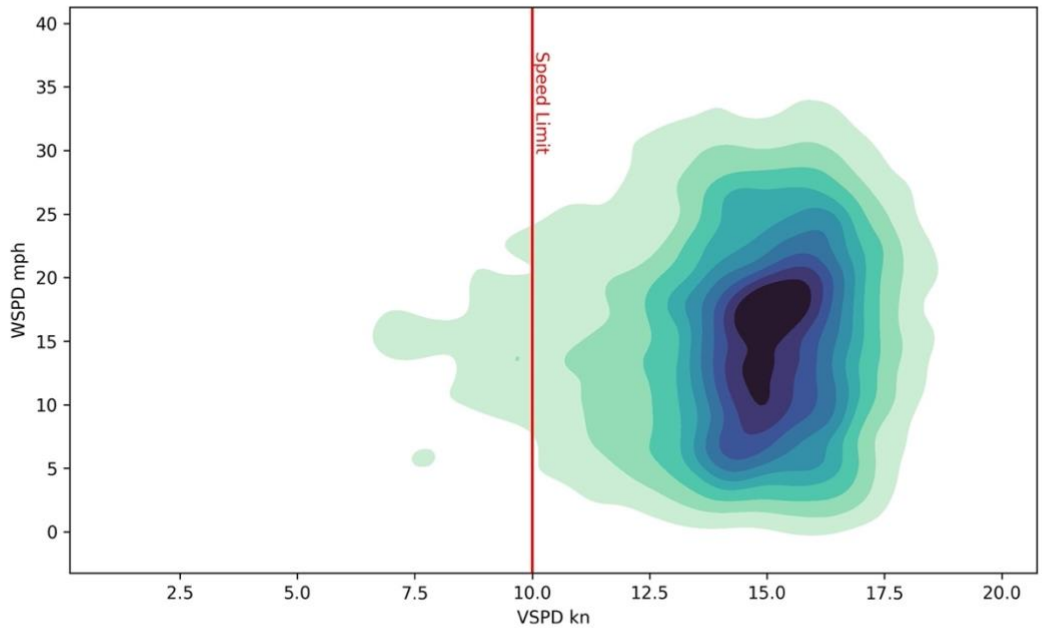


Figure 8

Savannah Vessel Speed vs. Wind Speed

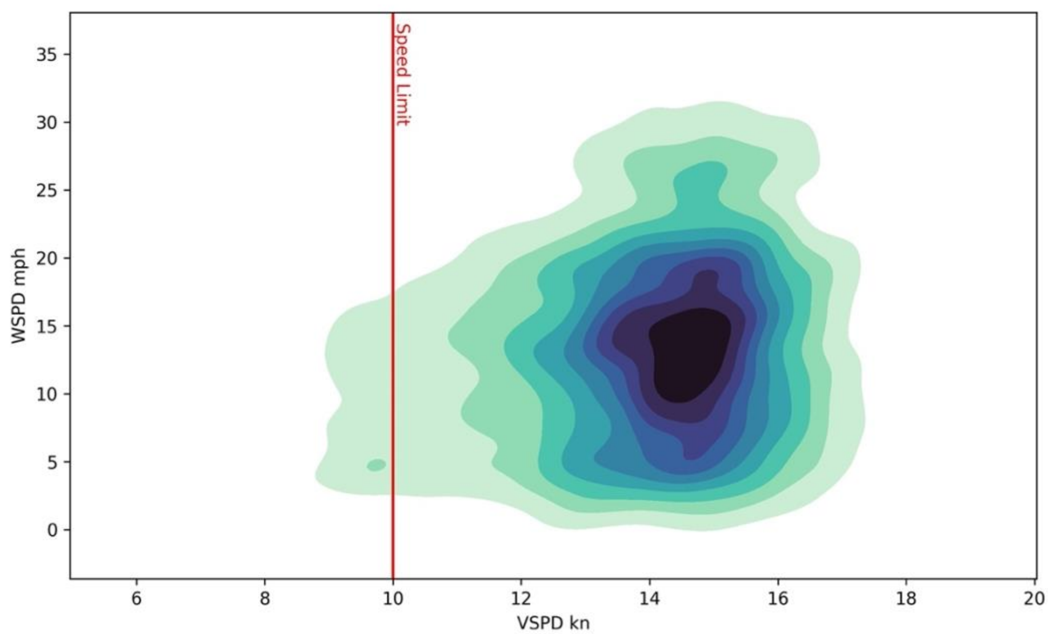


Figure 9

Charleston Channel Occupied Scatter Plot

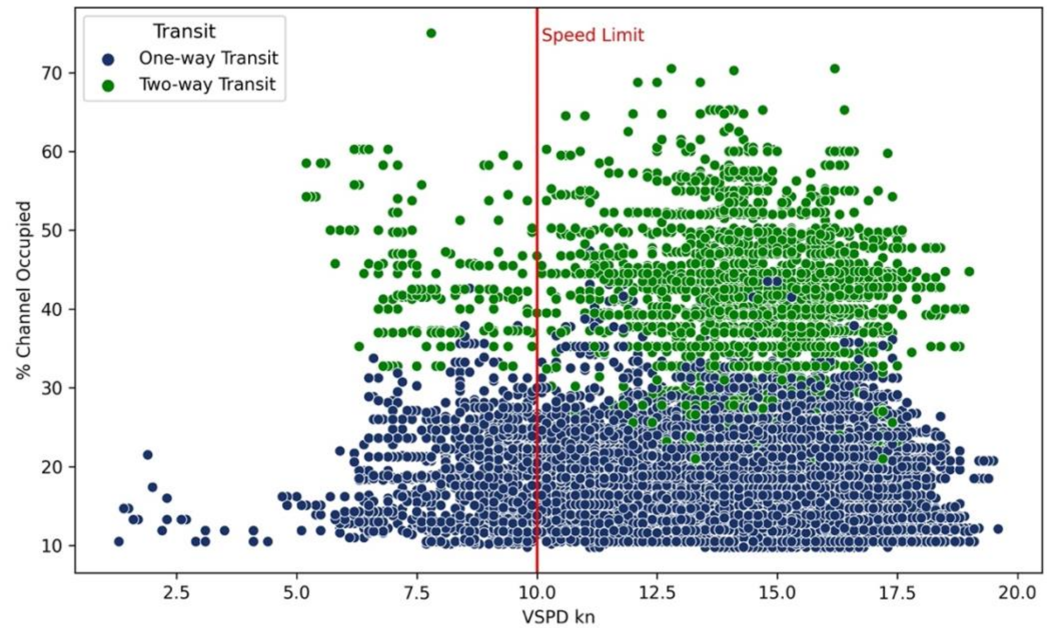


Figure 10

Savannah Channel Occupied Scatter Plot

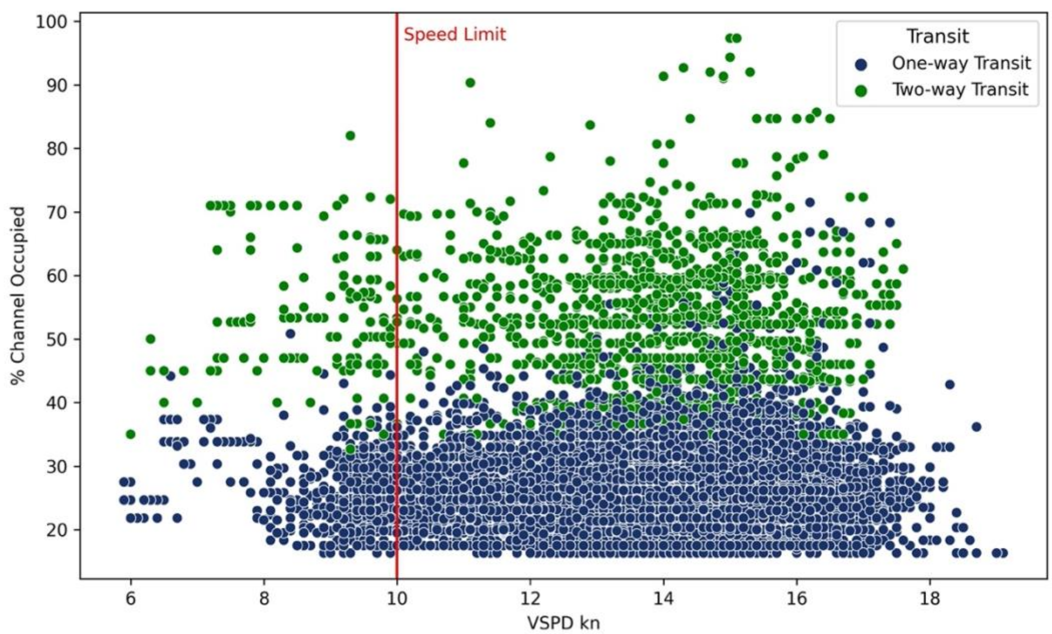


Figure 11

Charleston Vessel Speed vs. Yaw Line Plot

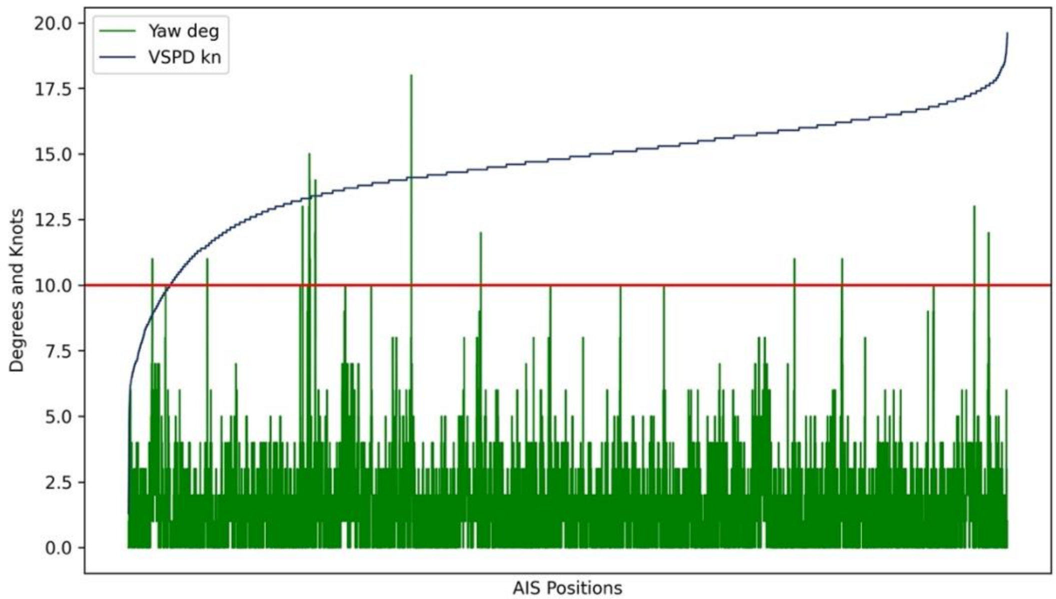
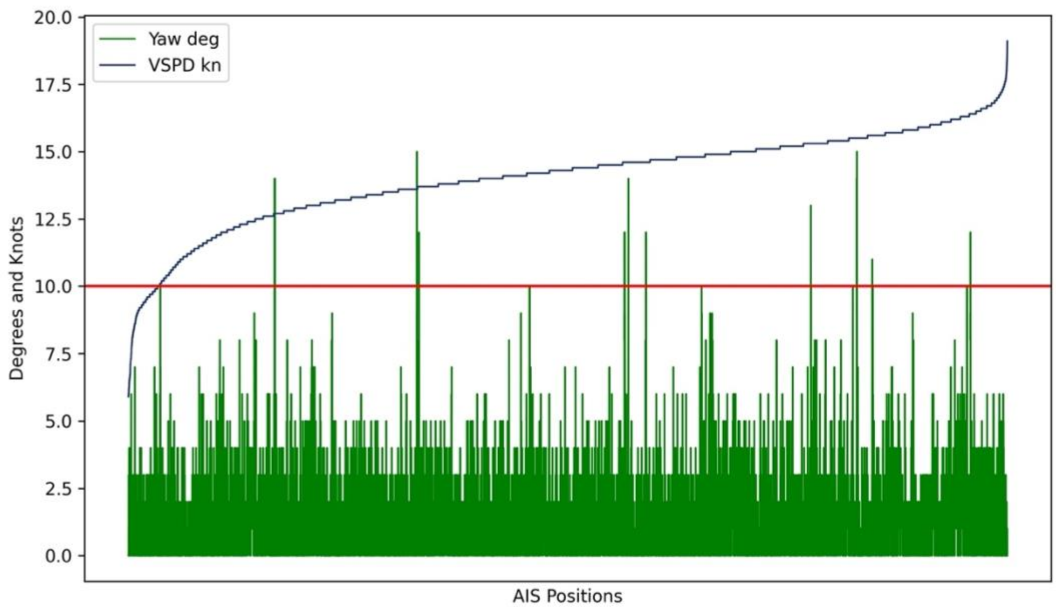


Figure 12

Savannah Vessel Speed vs. Yaw Line Plot



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