APPENDIX E

Vessel Traffic Analysis USCG AIS Data

Vessel Traffic Analysis for NNYB PARS

Analysis conducted by the USCG Navigation Center (NAVCEN) in Alexandria, VA

LCDR Ian Hanna, Division Head, Waterways Risk Assessment and Support Division, NAVCEN

LTJG Sydney Wagner, Waterways Risk Assessment Project Officer, NAVCEN

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Introduction and Background

This traffic analysis examines data from 2017-2019 to identify trends and unique or significant variations of vessel transits and characteristics in the Northern New York Bight (NNYB). The study area for this traffic analysis is the same as the study area previously defined for the NNYB PARS.

Materials and Data

Nationwide Automated Identification System (NAIS) Data

Traffic data from 01 January 2017 to 31 December 2019 is from NAIS collected by the USCG. Column headings are included in Table 1. Dimensions are all originally reported in meters, then draft and length were converted to feet for this report.

Column Header	User-Defined?	Explanatory Information
MSG_TYPE	No	Identifies AIS unit as either Class A or Class B
MMSI	No	Maritime Mobile Service Identity, unique identifier for the ship, can change over time
IMO_NUMBER	Yes	International Maritime Organization Number, remains the same for the vessel's life, Not used in this report.
CALL_SIGN	Yes	Not used
LAT_AVG	No	Aggregate of latitude reports for 2.5 min on either side of time in PERIOD field.
LONG_AVG	No	Aggregate of longitude reports for 2.5 min on either side of time in PERIOD field.
PERIOD	No	Date/Time Stamp of AIS transmission.
SPEED_KNOTS	No	Speed of vessel at time of transmission
COG_DEG	No	Course over ground of vessel at time of transmission
HEADING_DEG	No	True heading of vessel at time of transmission if fitted with gyro compass
SHIP_AND_CARGO_TYPE	Yes	A numerical value between 10 and 99, delineating the vessel's service
DRAUGHT	Yes	Vessel Draft
DIM_BOW	Yes	"Bow Dimension" Distance from transceiver antenna to bow. Used to calculate Length
DIM_STERN	Yes	"Stern Dimension" Distance from transceiver antenna to stern. Used to calculate Length
DIM_PORT	Yes	"Port Dimension" Distance from transceiver antenna to port side. Used to calculate beam.
DIM_STARBOARD	Yes	"Starboard Dimension" Distance from transceiver antenna to starboard side. Used to calculate beam.
DESTINATION	Yes	

Table 1: AIS Data Overview

As indicated above, AIS data include fields that are user-defined; thus they are prone to error and often missing inputs. Additionally, while AIS accepts ship types 1-99, for this analysis, these ship types are aggregated into 10 categories, included in Table 2.

AIS Ship Type Code	Vessel Group
70-79	Cargo
30	Fishing
0/ Null	Not Available
1-20, 23-29, 33-34, 38-51, 53-59, 90-99	Others
60-69	Passenger
36,37	Pleasure Craft / Sailing
35	Military
80-89	Tanker
31-32, 52	Tug / Tow

Table 2: AIS Ship Types to Vessel Groups

The type "Not available" means either the type was not recorded by NAIS correctly or the user defined a ship type that is invalid. The type "Others" includes ships transmitting ship type "Other" (90-99) and various other specified ship types such as dredging, diving, and law enforcement vessels.

AIS traffic does not capture all of the vessels that operate in the study area. Certain vessels are required to broadcast on AIS in accordance with US or international regulations. This includes, but is not limited to, vessels of 65 feet or greater, towing vessels of 26 feet or greater, vessels certificated for 150 or more passengers, dredging vessels near a channel, fishing vessels, and vessels over 300 gross tons on an international voyage. Reference 33 CFR 164.46 for a full description of general US requirements and vessel types required to broadcast on AIS in US waters.

Despite these limitations, AIS traffic data does provide a good representation of the traffic in the study area. Larger and deep draft vessels are required to broadcast; the counts of these vessels as well as their geographic locations is accurate. Even for the vessel types that are undercounted because they are not required to use AIS, such as smaller recreational craft, the common transit areas for these boats are still apparent in the data. Overall, since not all vessels are required to broadcast on AIS, the number of actual vessels in the study area is larger than what is shown in this report.

Software

Track lines were constructed in the International Lighthouse Association's Risk Assessment (IALA) Software, IWRAP. Track line data extracted from IWRAP were used to create the charts in Microsoft Excel. Traffic densities and charts with track lines displayed were created in ArcGIS, ArcMap 10.5.

Methodology

Traffic Composition Analysis

The traffic composition section provides counts of vessel tracks anywhere in the study area. AIS transmission data was used in IWRAP to construct and enumerate these tracks. In this report, a trip or track is defined as a continual passage through the study area which starts when the vessel enters the area and ends when either it exits the area or stays stationary for more than 6 hours.

The traffic composition section includes counts of all tracks by vessel type in an area over a given year. This means that if a ship transits in the area multiple times, each transit is counted as a track. For example, if the container ship CGALLTHEWAY transits into New York, moors, unloads cargo, proceeds to anchor for greater than 6 hours, and finally transits out of the study area, three tracks are tallied under the type "Cargo." The first is for the entrance transit, the second for the transit to anchorage, and the third is for the exit transit.

In addition to these track counts, unique vessel counts are also provided. This tally indicates the number of unique vessels by type. For the unique vessel counts, CGALLTHEWAY is counted only once under "Cargo," regardless of the number of transits it makes in the study area. Overall, these counts provide a broad overview of the vessels present in the study area.

Passage Line Analysis

While transit counts give a broad idea of traffic composition over the total study area, they dilute the information because the area evaluated is very large. A passage line analysis allows for more specific study of the major routes present. This is accomplished by counting the transits across a line placed over the areas with the highest traffic density, perpendicular to the general traffic flow. A transit is counted every time a vessel crosses a passage line chosen for the study. These tracks are enumerated and then reported by vessel type.

Figure 1 outlines the passage line analysis conducted for this study. The high density areas are shown in red, and the passage lines are shown in green. The majority of the passage lines in this study span the width of the traffic lanes and are named for the lanes as they appear on the nautical charts. "New Jersey Near Shore" and "Long Island Near Shore" are the exceptions; they were selected due to the high volume of traffic in those areas and do not represent a designated traffic lane.

Continuing the above example, for the passage line analysis conducted for NNYB, the CGALLTHEWAY is counted every time it crosses one of the passage lines. If they transit from Ambrose to Hudson Canyon and Hudson Canyon to Ambrose, those tracks are tallied separately for each of those passage lines and counted under "Cargo." If the vessel transits from Hudson Canyon to Ambrose in January, March, and October in 2019, three tracks are recorded under this passage line for "Cargo" for that year.

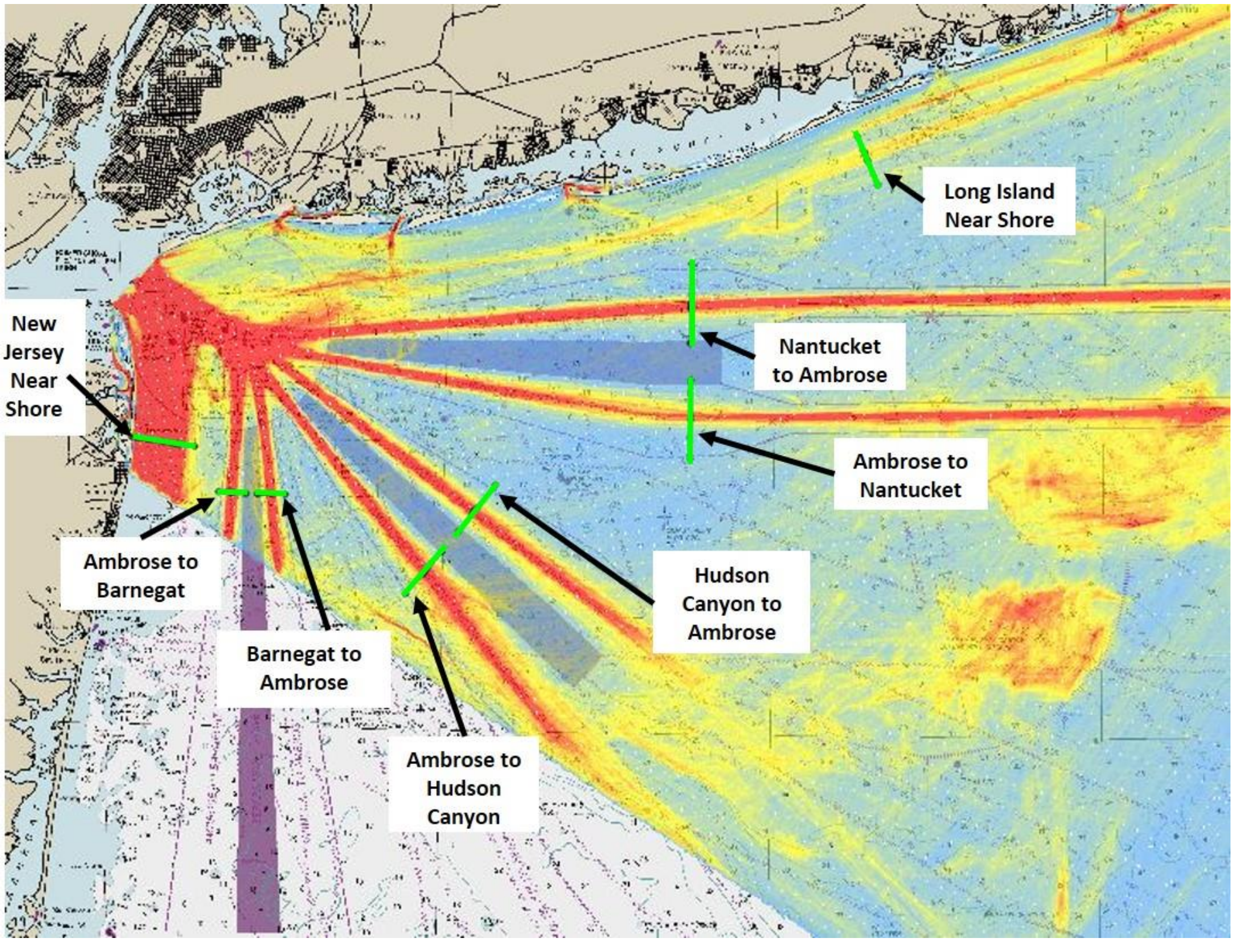


Figure 1: Passage Line Analysis Outline

Comparing Traffic Composition and Passage Line Analyses

The traffic composition figures (under the "Analysis" section titled "Traffic Composition Analysis") look at the study area as a whole, while the passage line analysis looks at subsets of the area that are of particular interest. These subsets do not together encompass the entire study area. In other words, passage lines were not drawn that encapsulate every portion of the study area, just selected locations. Vessels transit not only across the passage lines, but also in the areas surrounding these lines. Thus, the number of transits recorded in the passage line analysis section will not add up to the total number of transits in the traffic composition section which does take into account every vessel track.

Consider fishing vessels as an example. While some fishing vessels transit in the traffic lanes, many do not. Because of this, a large portion of the total number of fishing vessels that pass through the study area will not be captured by the passage lines in this analysis. In the passage line analysis section, if across all passage lines there are a total of 200 fishing vessel transits in 2018, there will be more than 200 transits recorded in the traffic composition section for this vessel type. Overall, it is informative to compare the traffic that crosses a passage line to the traffic composition of the whole study area. However, it is not expected that taken together the traffic crossing the passage lines will reflect all the traffic in the study area.

Vessel Length and Draft Distributions

The vessel length distributions report the sizes of vessels that transited the study area. These distributions show the count of the number of transits recorded by vessels of particular lengths. The vessel length from every track line is counted, so a vessel that visits the study area multiple times is counted each time. The draft distributions are the same, using draft as the metric.

Traffic Densities

The charts in the traffic density section were created in ArcMap using the line density function. The same data used in the traffic composition section were used to create track lines then density plots. The density graphics show all vessel traffic for the listed attribute over the course of a year. For example, the All Vessels density shows the conglomerate of the track lines of all the vessel groups combined, while the Cargo Ship density shows only the track lines associated with cargo ships. Densities are calculated by enumerating the length of transits per square mile $\frac{\text{Miles transited(year)}}{mile^2}$, and are represented on a blue, yellow, red scale where low density is blue and high density is red.

Results

Results for this analysis are maintained by NAVCEN in Word, Excel, PDF, ArcMap and IWRAP documents. For more information, please contact NAVCEN:

General U.S. Coast Guard Navigation Center 7323 Telegraph Rd Stop 7310 Alexandria, VA 20598-7310 (703) 313-5900 https://navcen.uscg.gov/	LCDR Ian Hanna Ian.S.Hanna@uscg.mil (703) 313-5858 LTJG Sydney Wagner Sydney.E.Wagner@uscg.mil (703) 313-5645

Analysis

Traffic Composition Analysis

Thousands of track lines are recorded every year in the study area. In 2019, there were over 60,000 transits. Plotted individually on a chart, these track lines overlap and cover each other, hiding much relevant data from view. While as a whole it is not optimal to view the study area by charting all the track lines, taken in smaller time periods, the general traffic mix can be inferred. Figure 2 shows the track lines from September of 2019, the busiest month of the year with over 15,000 tracks. “Other” and “Not Available” ship types were excluded from this graphic, and “Cargo” and “Tanker” were combined since they have similar transit patterns.

The legend is organized based on the drawing order in the graphic. Pleasure craft were drawn first so those tracks appear underneath the tracks for the other ship types. Cargo and tank ships were drawn last, so their tracks are on top of the tracks for the other ship types. Due to this drawing order, the passenger vessel tracks in the main channels are covered by the cargo ships, and some passenger vessel track lines off the NJ coast are hidden by the tow boats. Fishing vessels along the shore of Long

Island Sound are hidden by the tow boat traffic. The pleasure craft that cross a main transit area for any of the other vessel types are also covered.

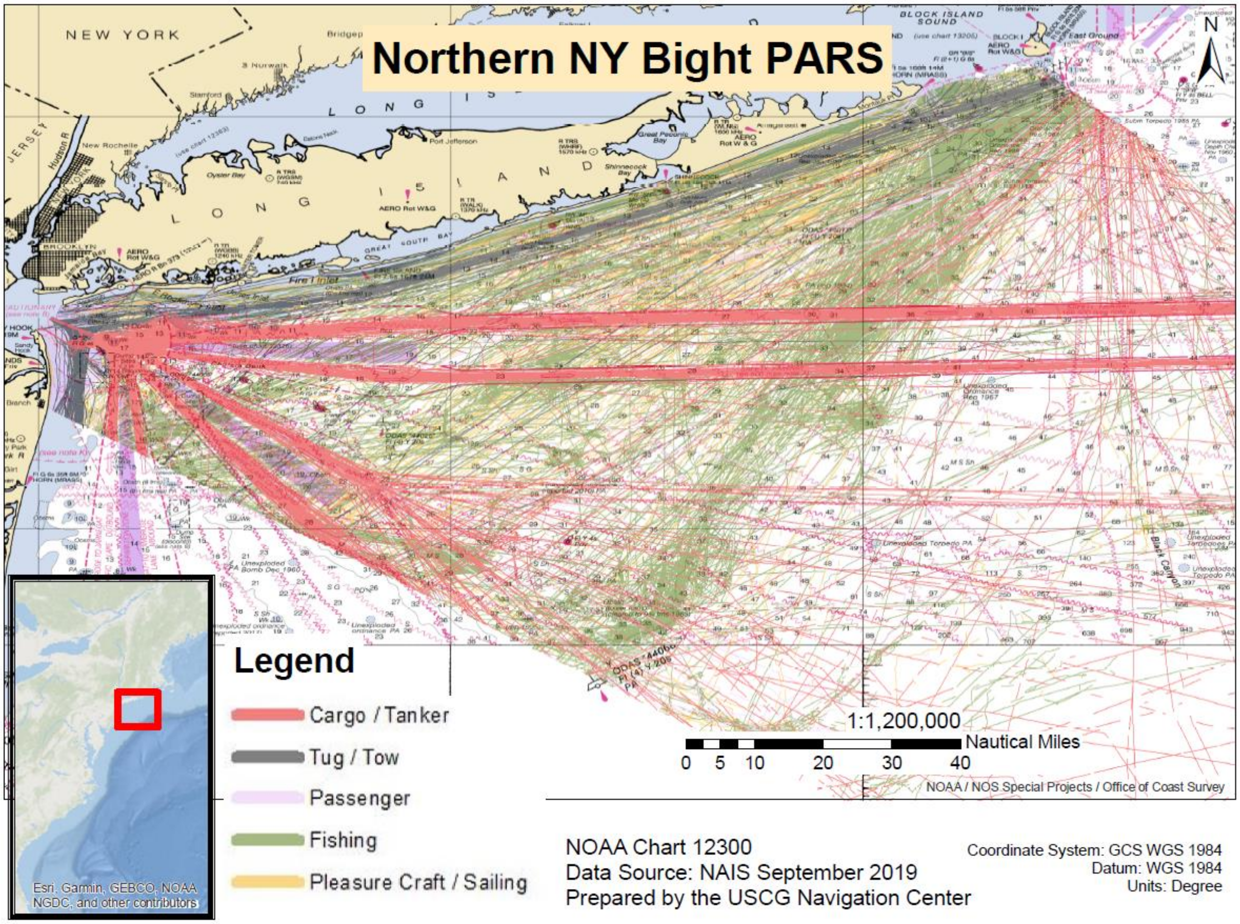


Figure 2: September 2019 Vessel Tracks

This graphic shows that cargo vessels and tankers primarily transit within the channels. Fishing vessels are often depicted crossing channels or operating in a variety of areas outside the channels, while much of the tow boat traffic is concentrated near Long Island and the NJ coast.

Traffic Composition Details

Number of Vessel Transits and Unique Vessels by Vessel Type (Figure 3-Figure 5) show how many transits a certain vessel type made in the study area over the identified year. These charts also show a count of the number of unique vessels in the identified year by type. For example, in 2018, 232 unique Tug Tow vessels conducted 4,716 total transits in the study area.

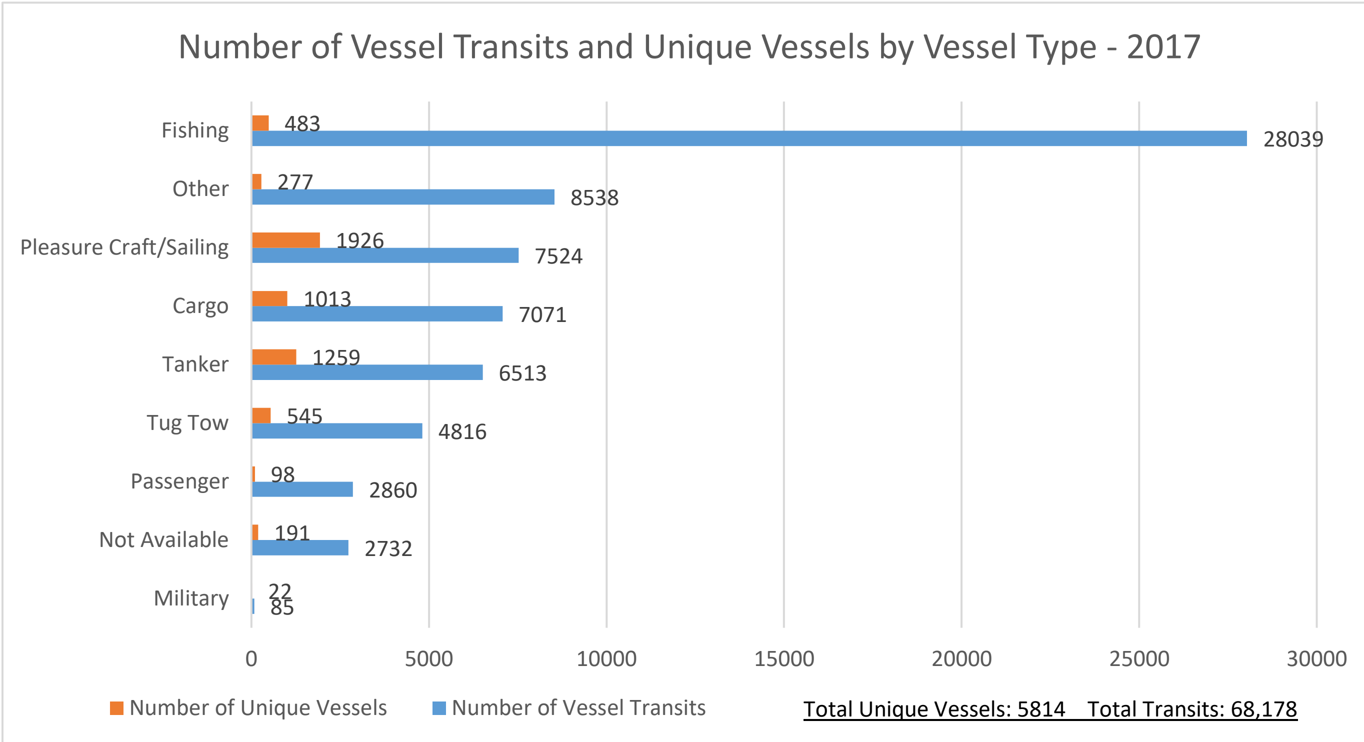


Figure 3: Number of Vessel Transits and Unique Vessels by Type - 2017

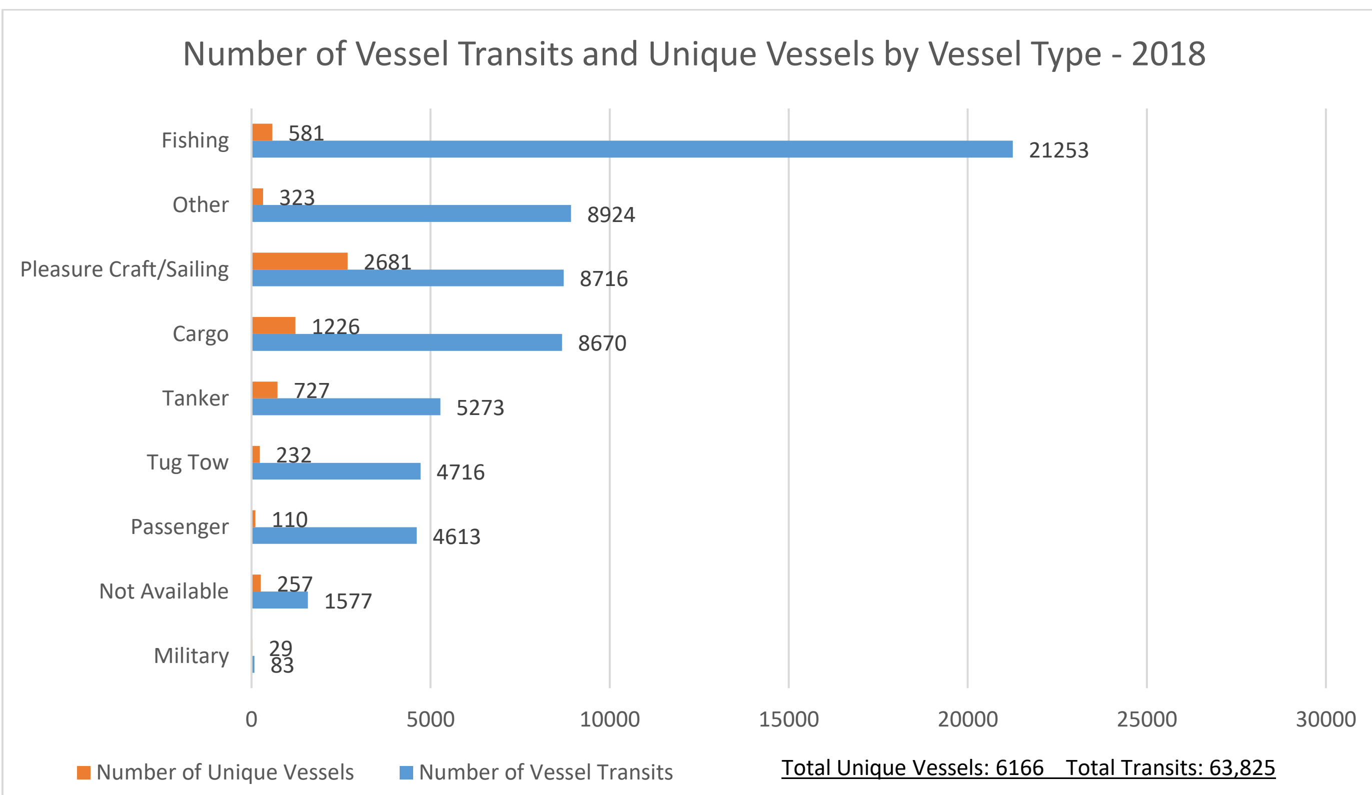


Figure 4: Number of Vessel Transits and Unique Vessels by Type - 2018

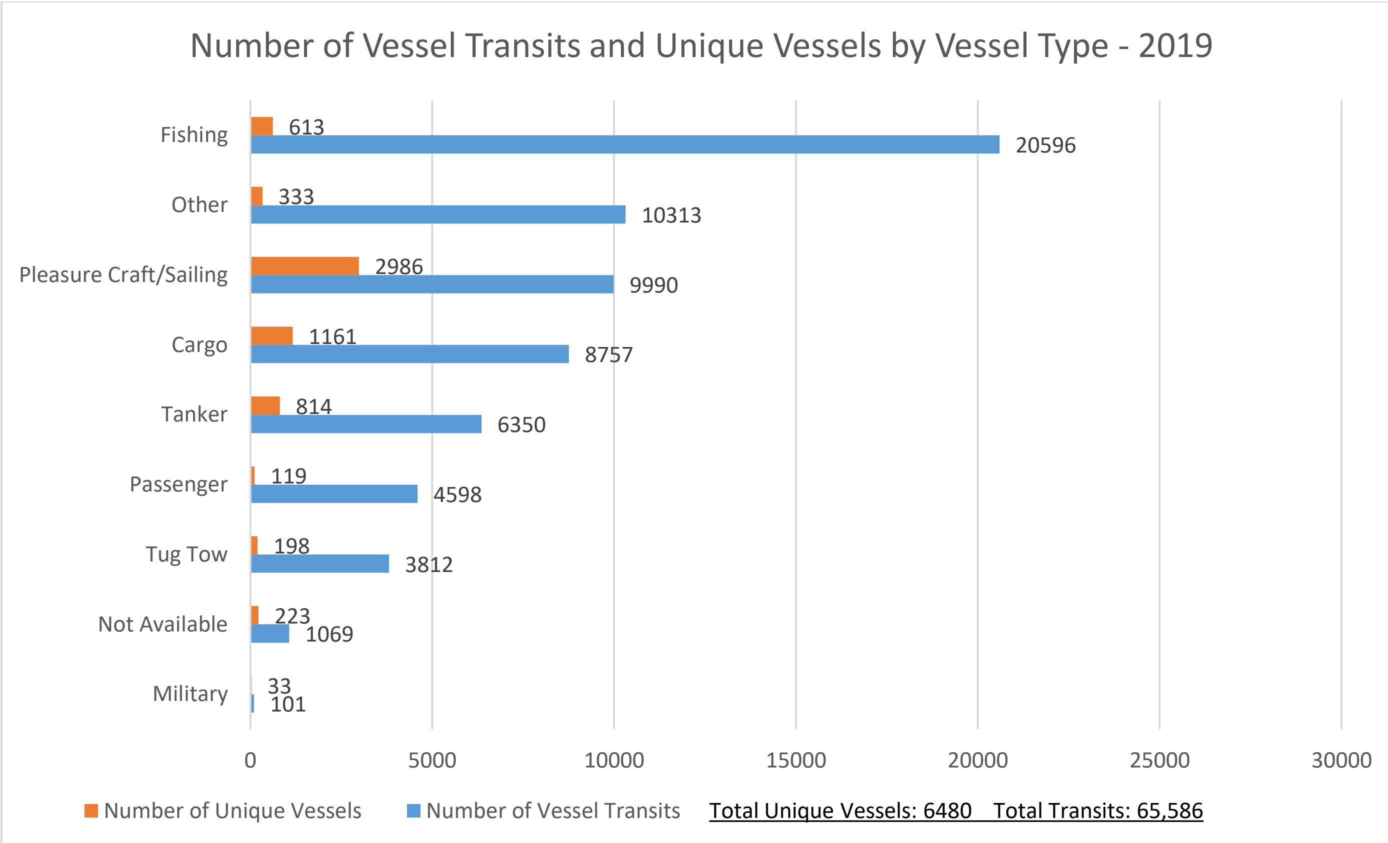
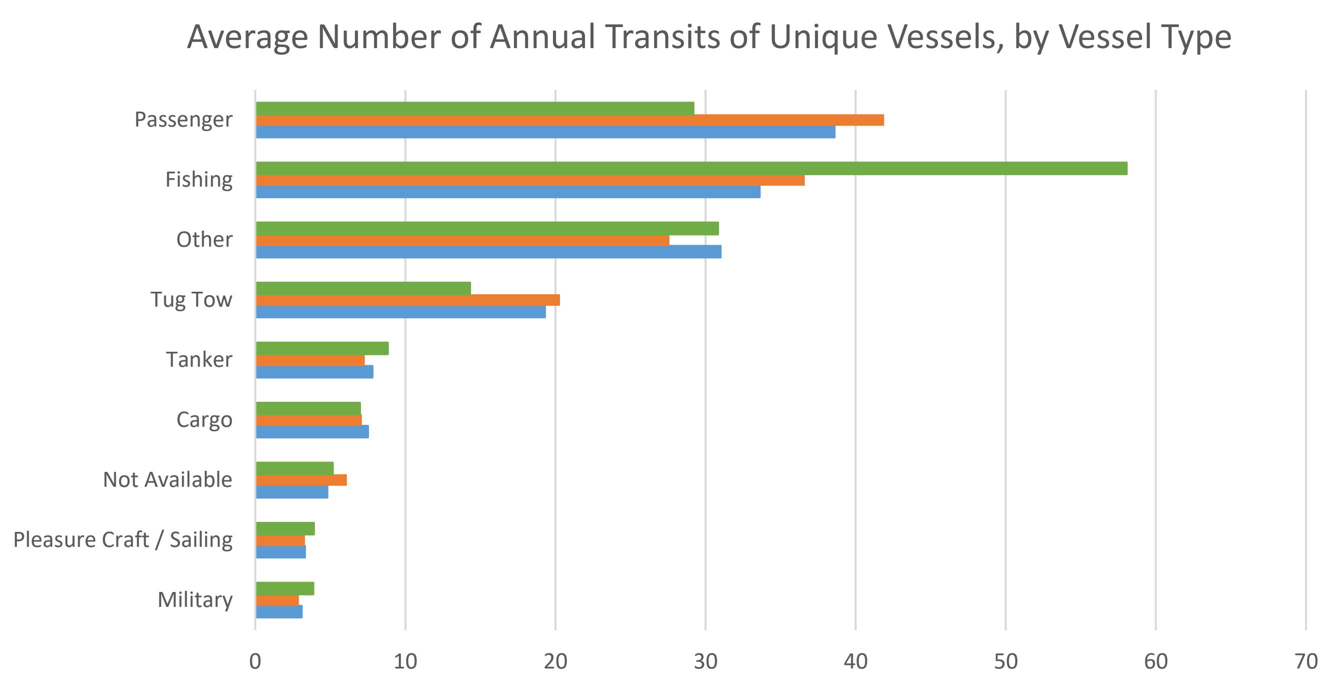


Figure 5: Number of Vessel Transits and Unique Vessels by Type - 2019

Another way to combine and visualize the transit and unique vessel information is to consider the number of tracks attributed to each unique vessel. This is approximated by dividing the total number of transits by the total number of unique vessels for each category, resulting in a value indicating transits per vessel, shown in Figure 6. For example, in 2019 each unique cargo ship in the data set made on average 7.5 transits. In practice, some vessels visit the study area more frequently than others. However, these values still show the average number of transits conducted by each unique vessel by type in the study area per year, providing a comparison point for the traffic patterns between the years.



	Military	Pleasure Craft / Sailing	Not Available	Cargo	Tanker	Tug Tow	Other	Fishing	Passenger
2017	3.9	3.9	5.2	7.0	8.8	14.3	30.8	58.1	29.2
2018	2.9	3.3	6.1	7.1	7.3	20.3	27.6	36.6	41.9
2019	3.1	3.3	4.8	7.5	7.8	19.3	31	33.6	38.6

Figure 6: Average Number of Annual Transits of Unique Vessels, by Vessel Type

Trends From Year to Year

The number of transits by each type of vessel as well as the number of unique vessels appear to remain consistent between the years of data for pleasure craft, passenger, other, not available, military, and cargo vessels. This indicates that at least over the short period of three years, the traffic for these types has not significantly increased or decreased. Tug tow, fishing, and tanker tracks have some noticeable differences. The number of tug tow transits decreased from 2018 to 2019 by almost 1000 tracks. Additionally, although the number of transits from 2017 to 2018 were close, the number of unique vessels dropped by almost 300. In 2017, despite significantly more fishing vessel tracks, there are fewer unique fishing vessels. Data between 2018 and 2019 for this vessel type remained consistent. For tankers, the number of unique vessels decreased from 2017 but remained similar between 2018 and 2019.

The number of trips per vessel appears to remain consistent across most types. This indicates that, even if the number of transits change between years, the change is proportional to the number of unique vessels that transit in the area. In other words, the distribution of each type of vessel remains consistent. Fishing, especially in 2017, is the only type that appears to contradict this conclusion.

Although these observations are informative, data across a longer timeframe is needed to make definitive conclusions about the traffic trends for this area over the years.

Observations About Some Vessel Types

The most tracks fall under the vessel type Fishing, even though there are fewer unique fishing vessels than tankers, pleasure craft, or cargo vessels. Fishing vessels make frequent, short transits and vary their transit locations based on the season and catch thus this result was expected.

Military vessels appear to make up the smallest portion of the total traffic. However, these values are likely undercounted since military vessels often do not transmit their locations for security reasons.

Passage Line Analysis

The Total Crossings chart (Figure 7) shows the number of crossings across all vessel types for each of the designated passage lines shown in Figure 1. Charts for each individual passage line showing the number of crossings by type are also provided in Figure 8-Figure 15.

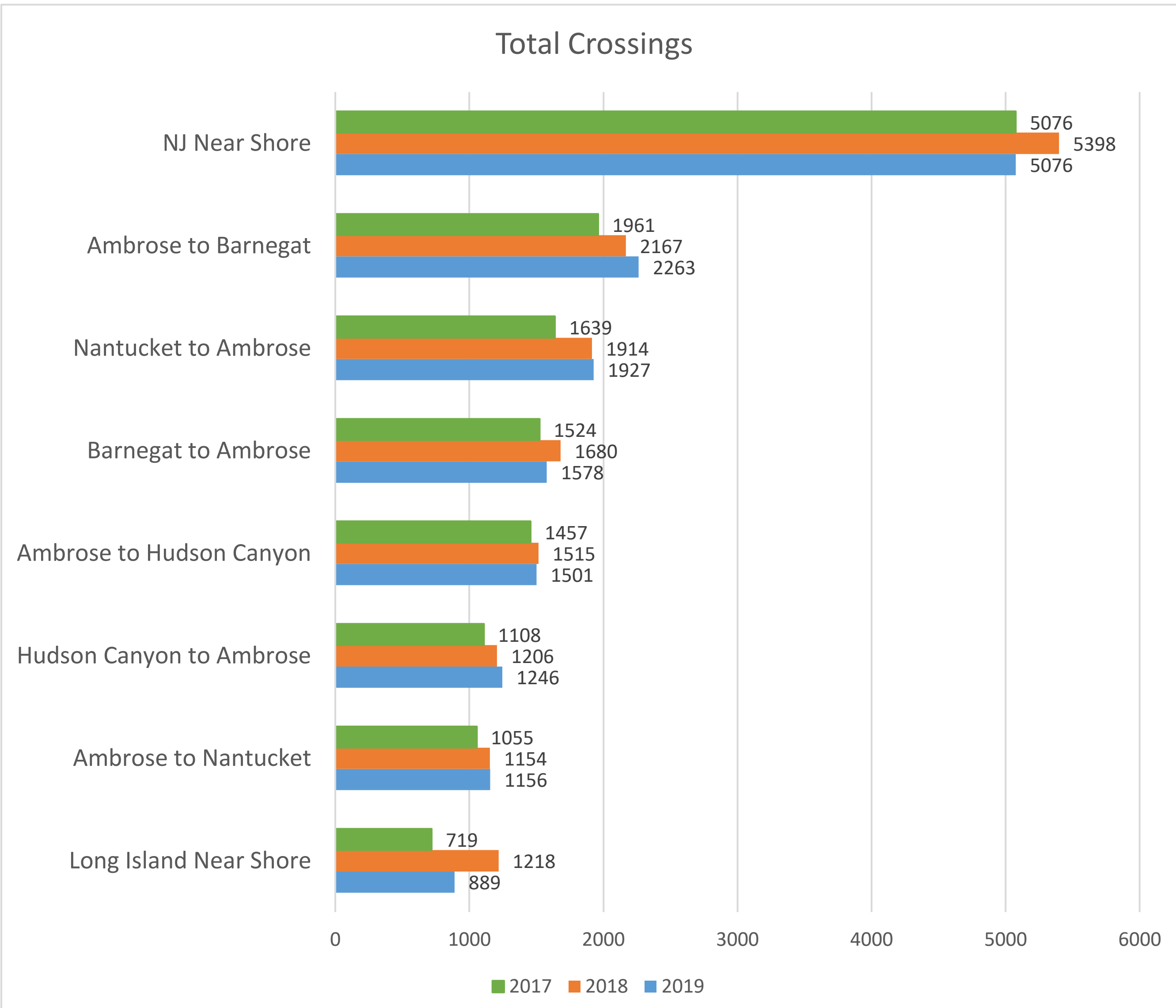


Figure 7: Total Crossings

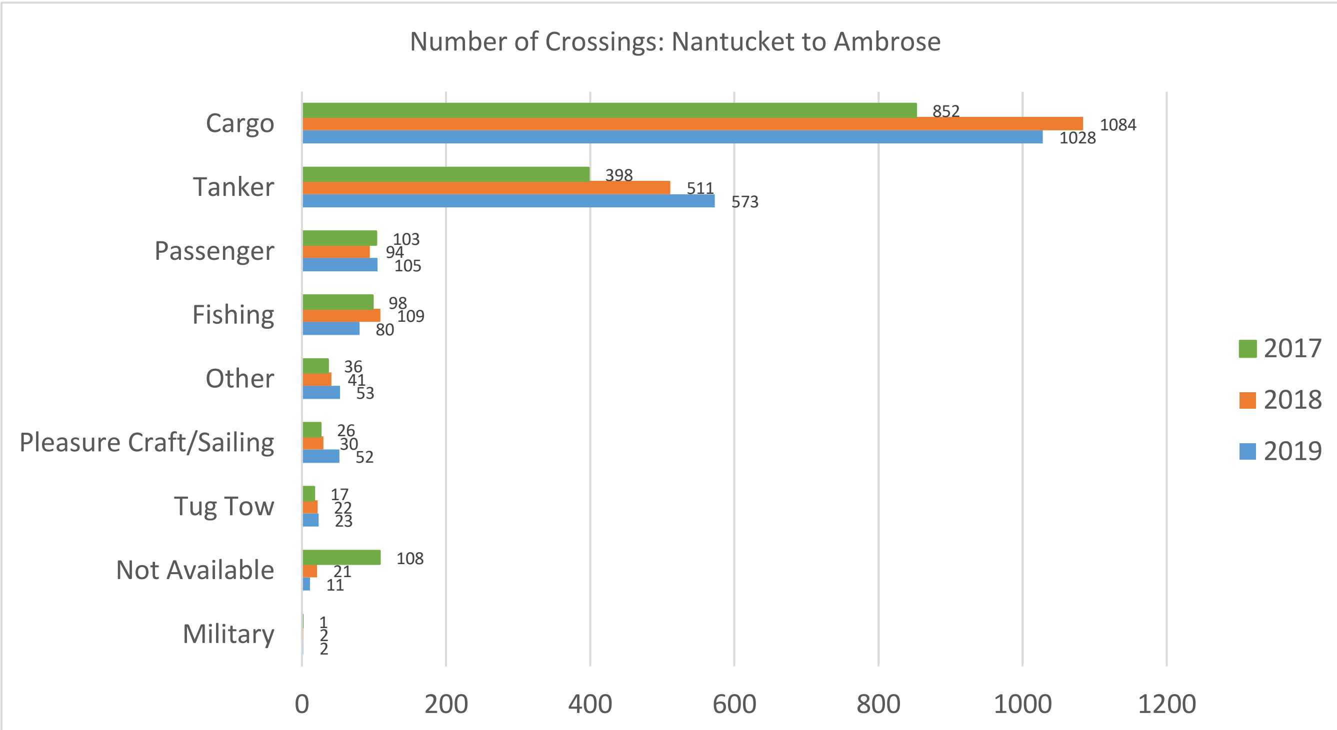


Figure 8: Nantucket to Ambrose Crossings

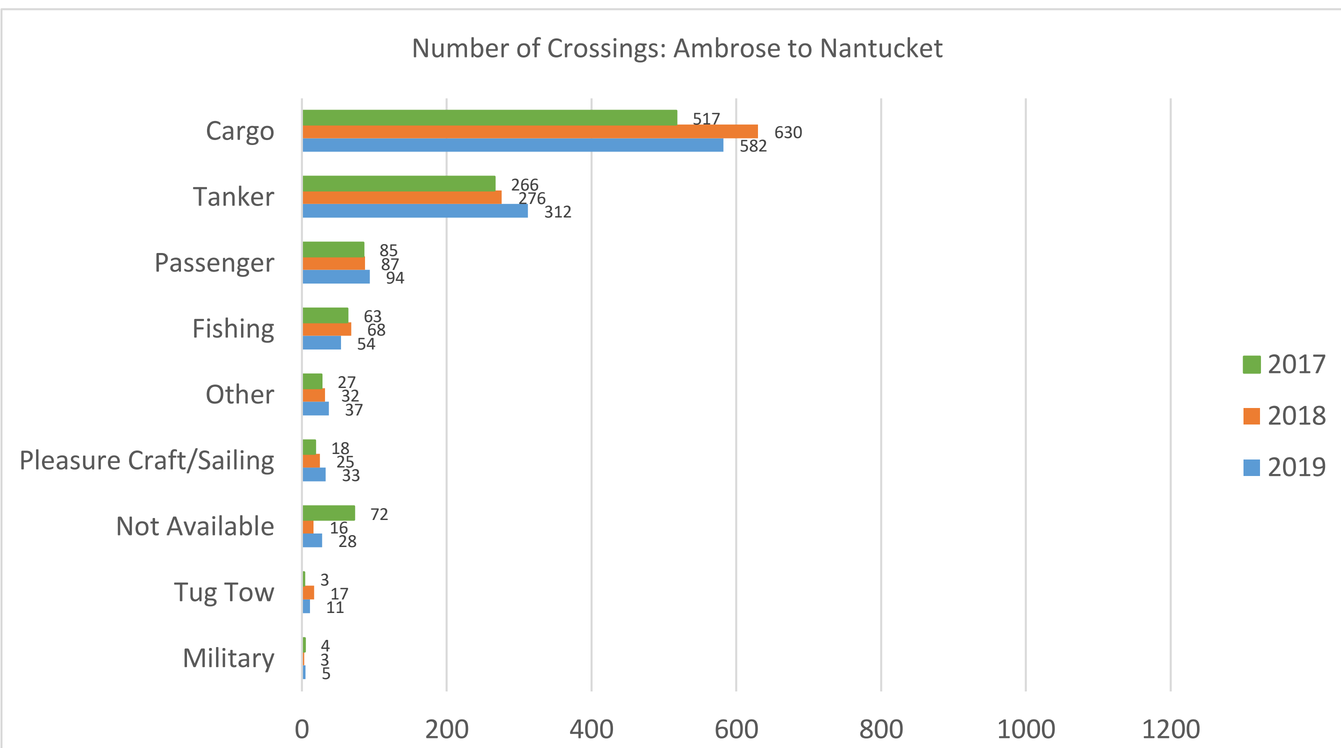


Figure 9: Ambrose to Nantucket Crossings

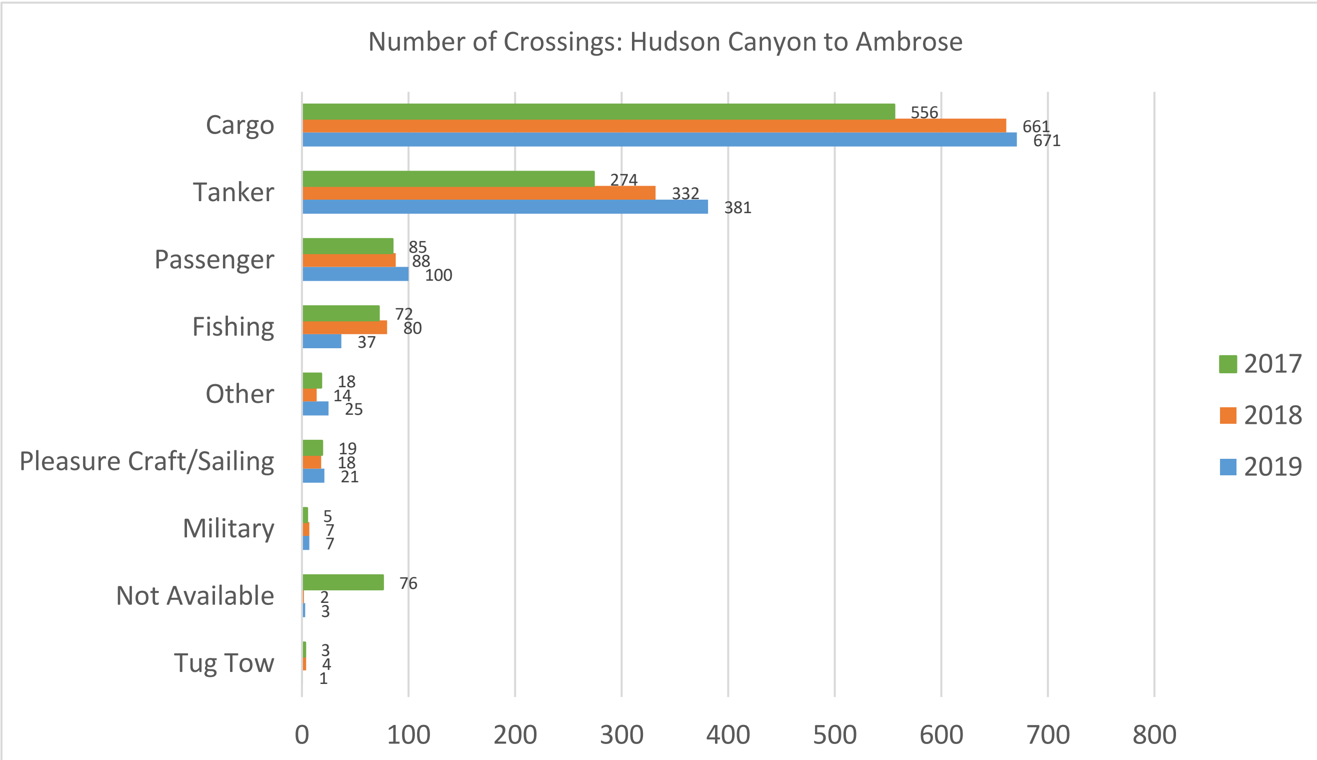


Figure 10: Hudson Canyon to Ambrose Crossings

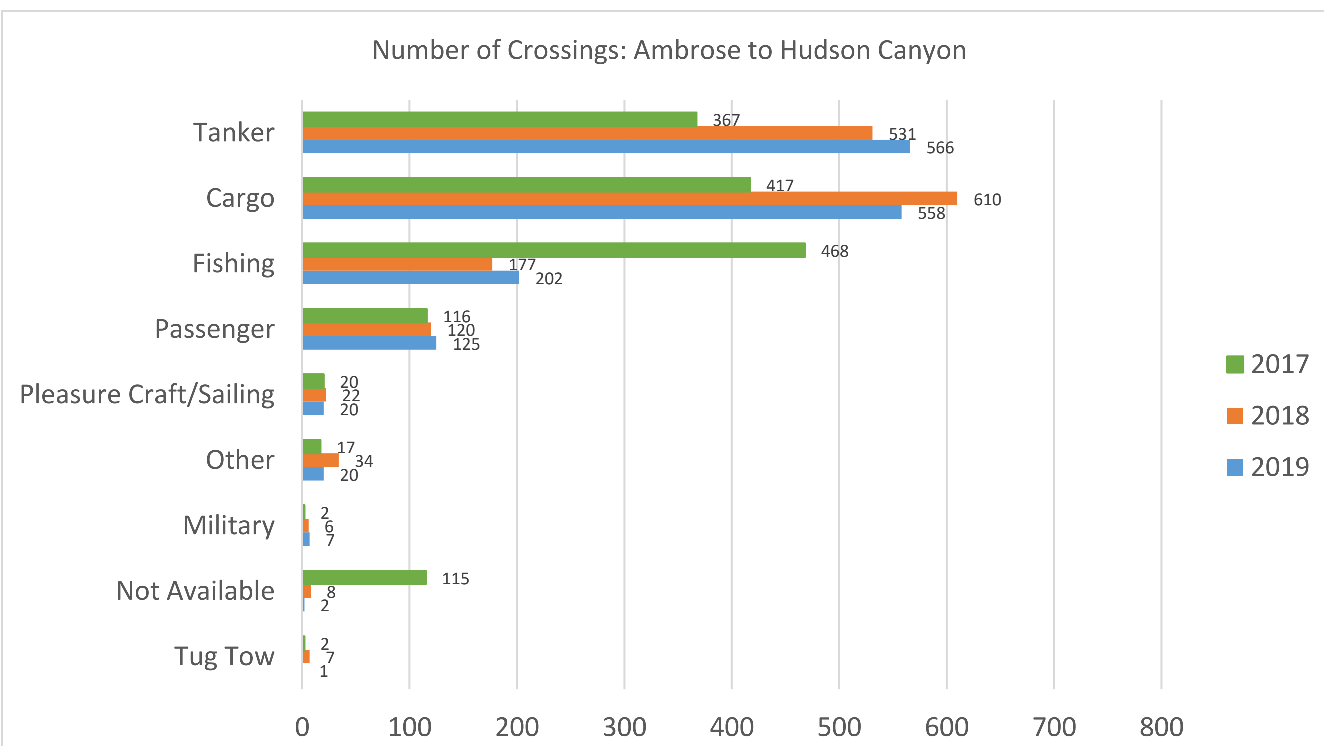


Figure 11: Ambrose to Hudson Canyon Crossings

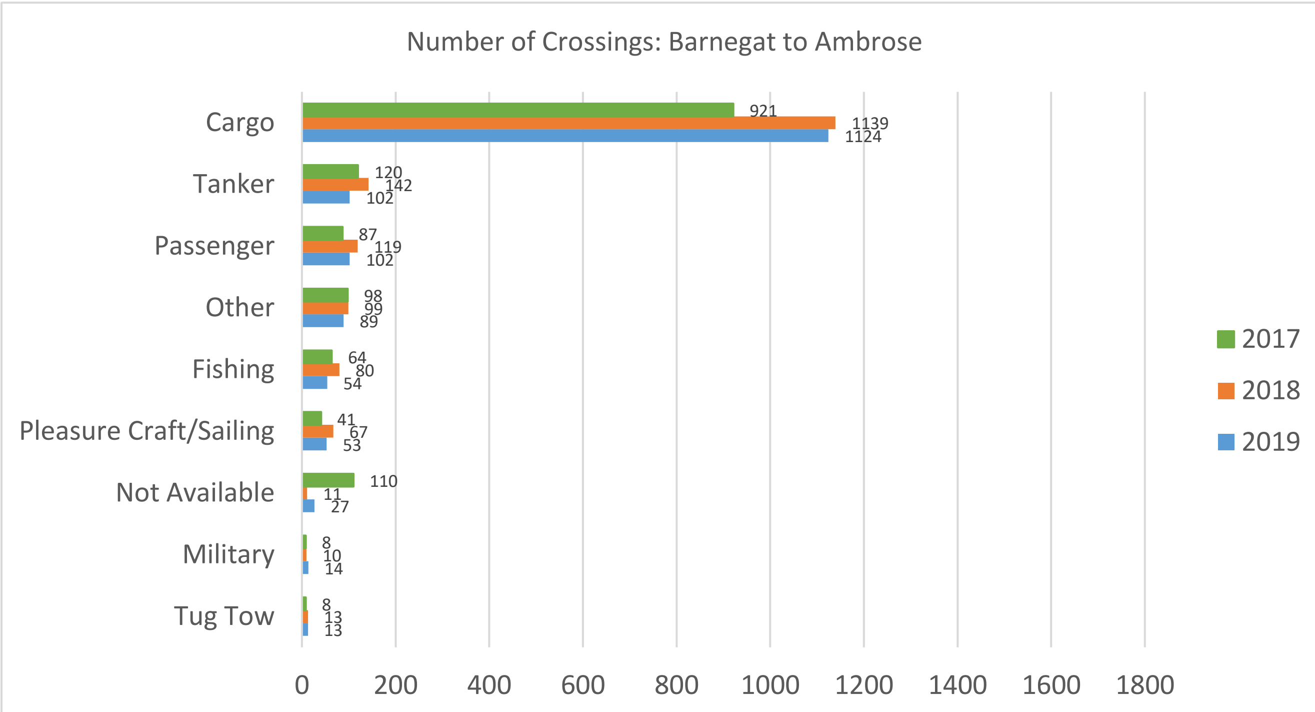


Figure 12: Barnegat to Ambrose Crossings

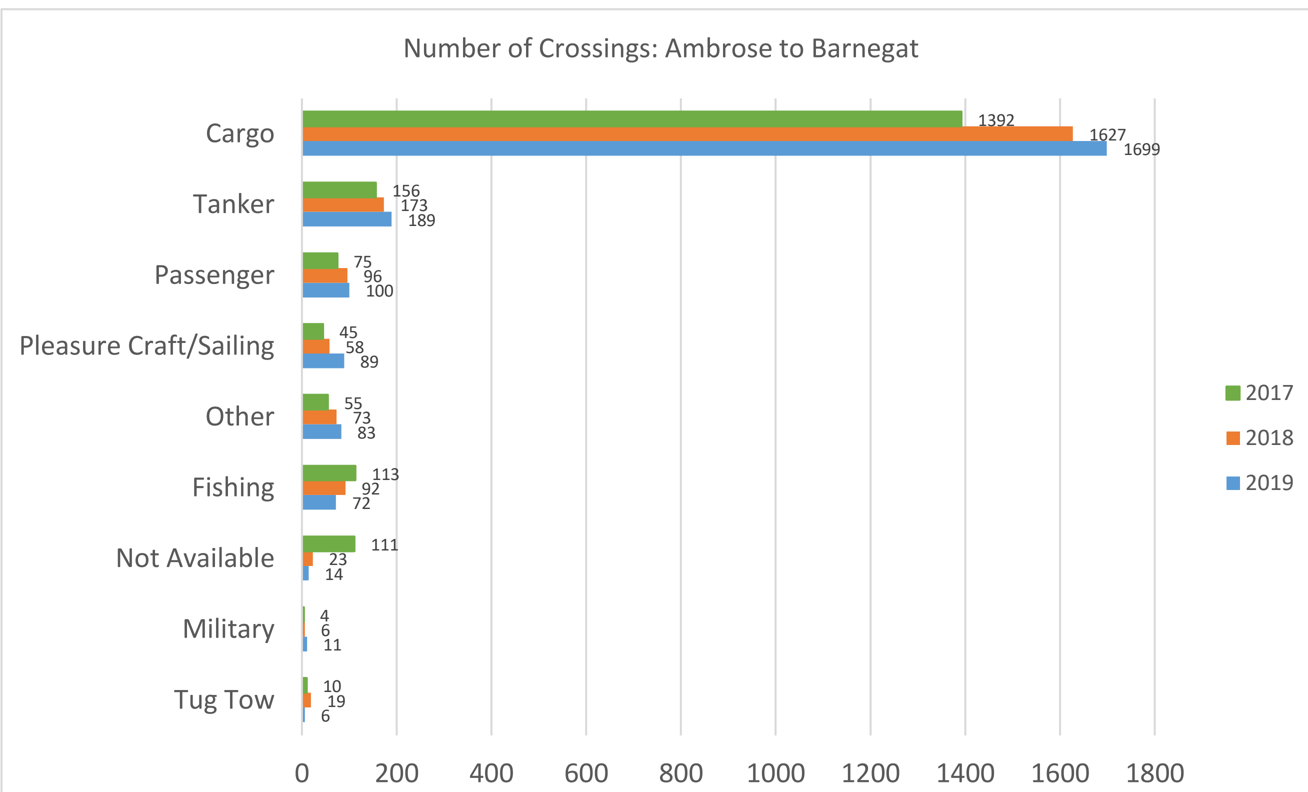


Figure 13: Ambrose to Barnegat Crossings

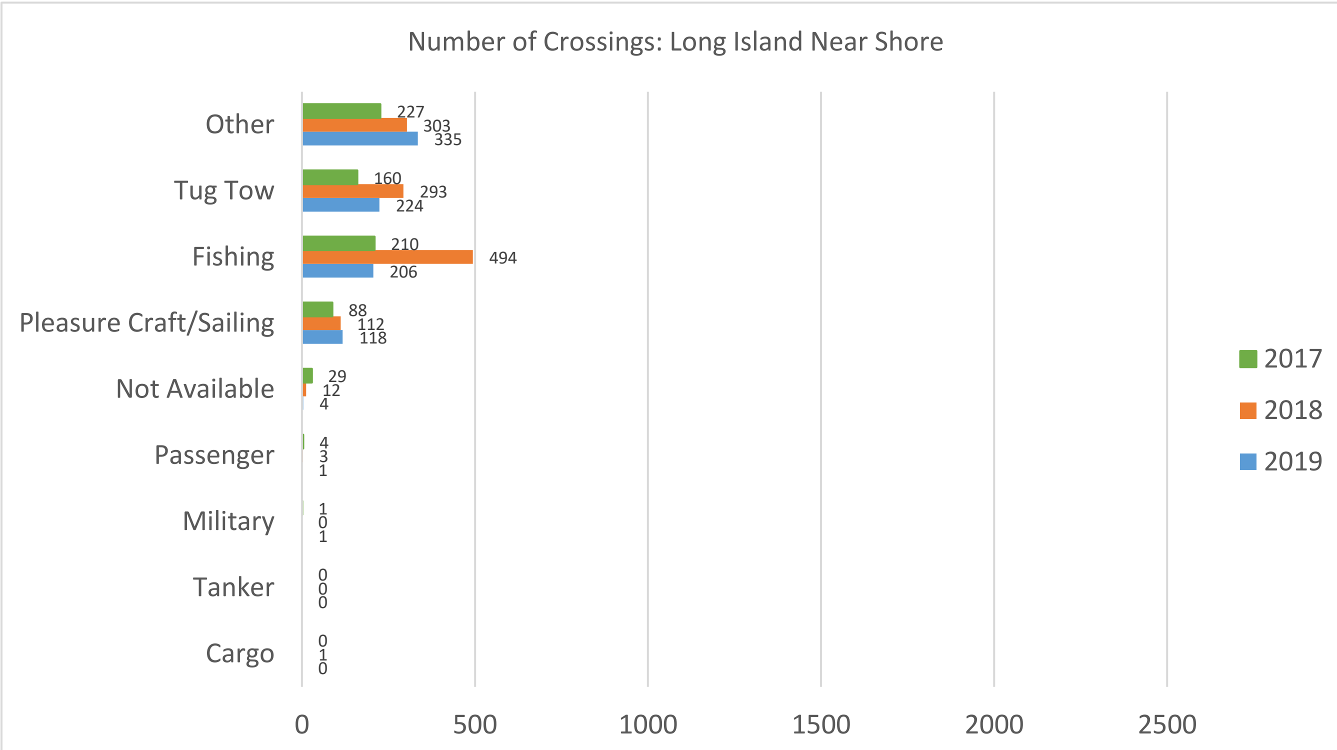


Figure 14: Long Island Near Shore Crossings

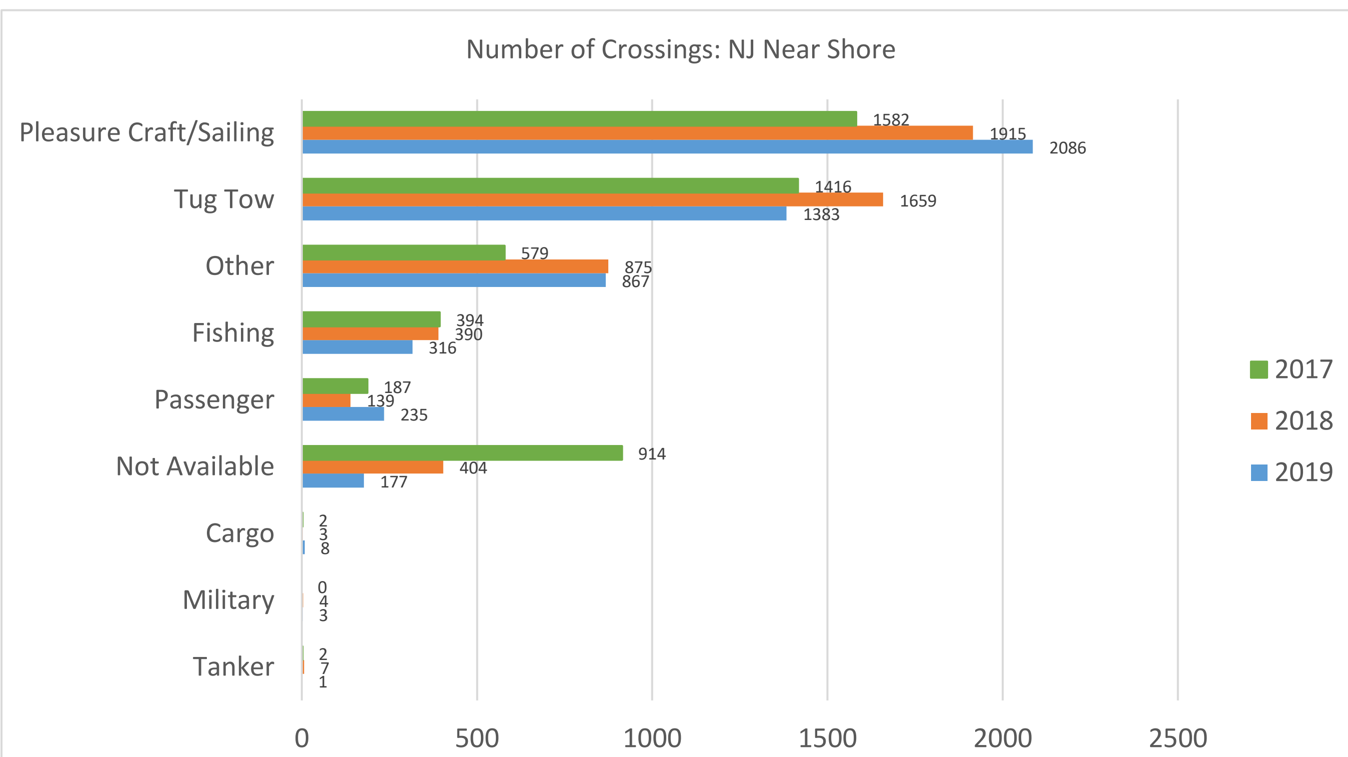


Figure 15: NJ Near Shore Crossings