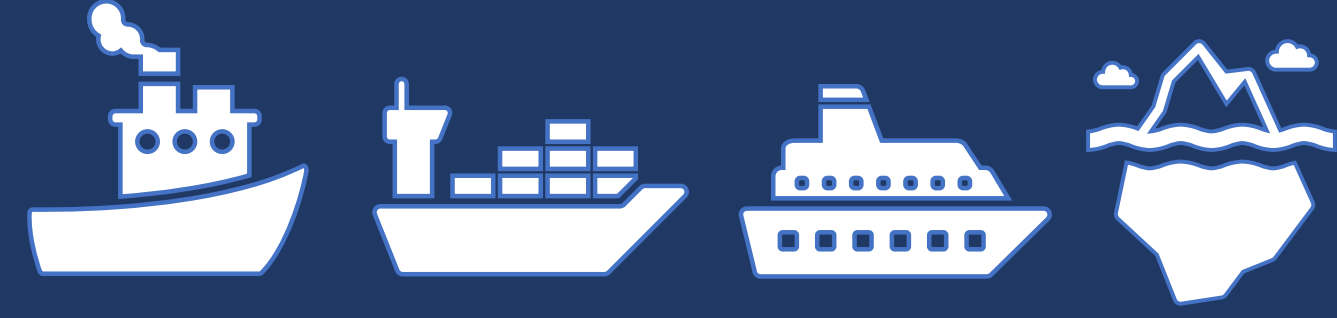
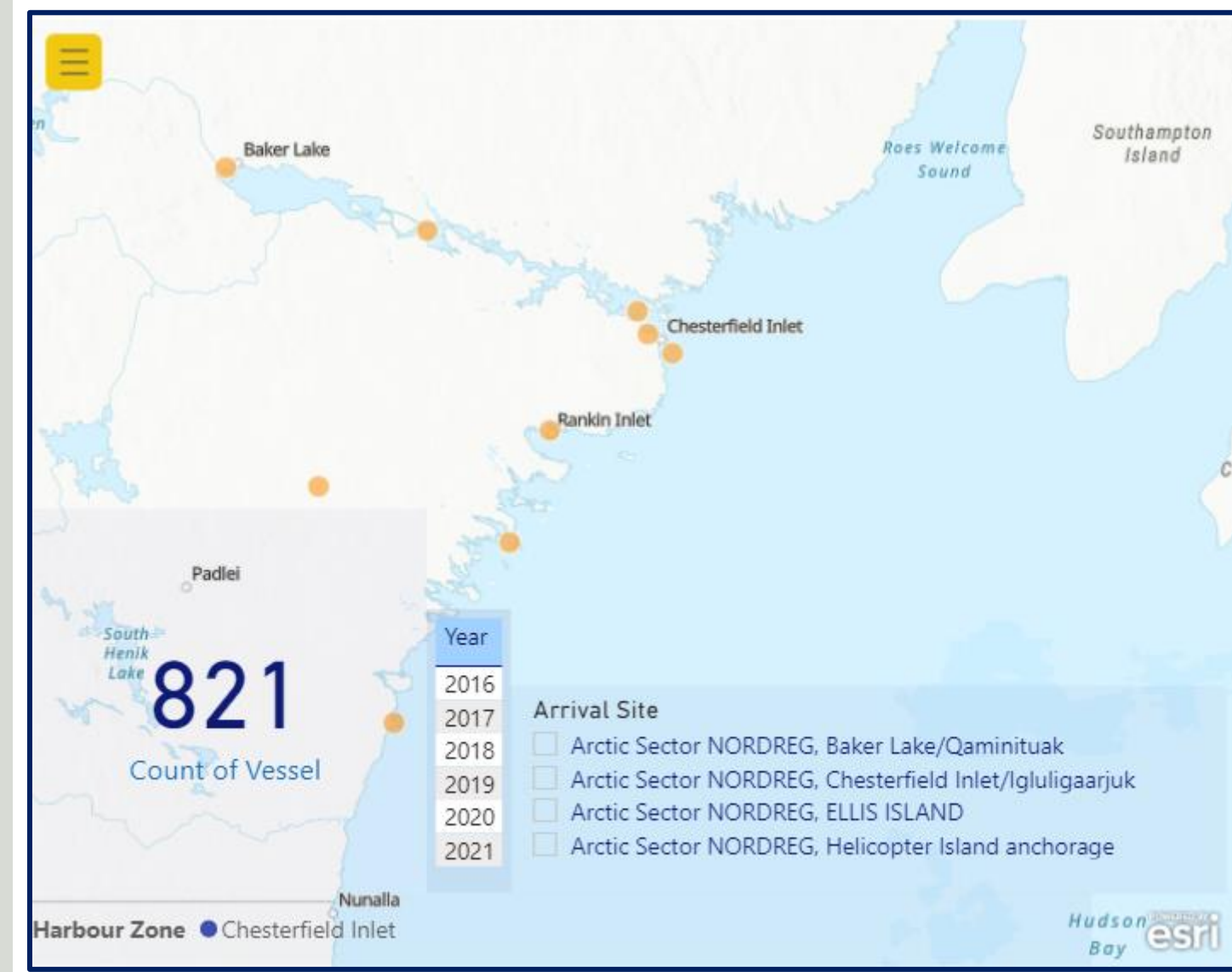


Marine Disturbance From Arctic Vessels: A Geospatial Impact Support Analysis of Increased Arctic Shipping on Marine Mammals in Chesterfield Inlet Kivalliq Region

GEOG 4660
Environmental Science and Studies Honours Thesis Project
Progress Report poster
Joshua Kakepetum 7793902
Supervisor: Dr. Nicole J. Wilson



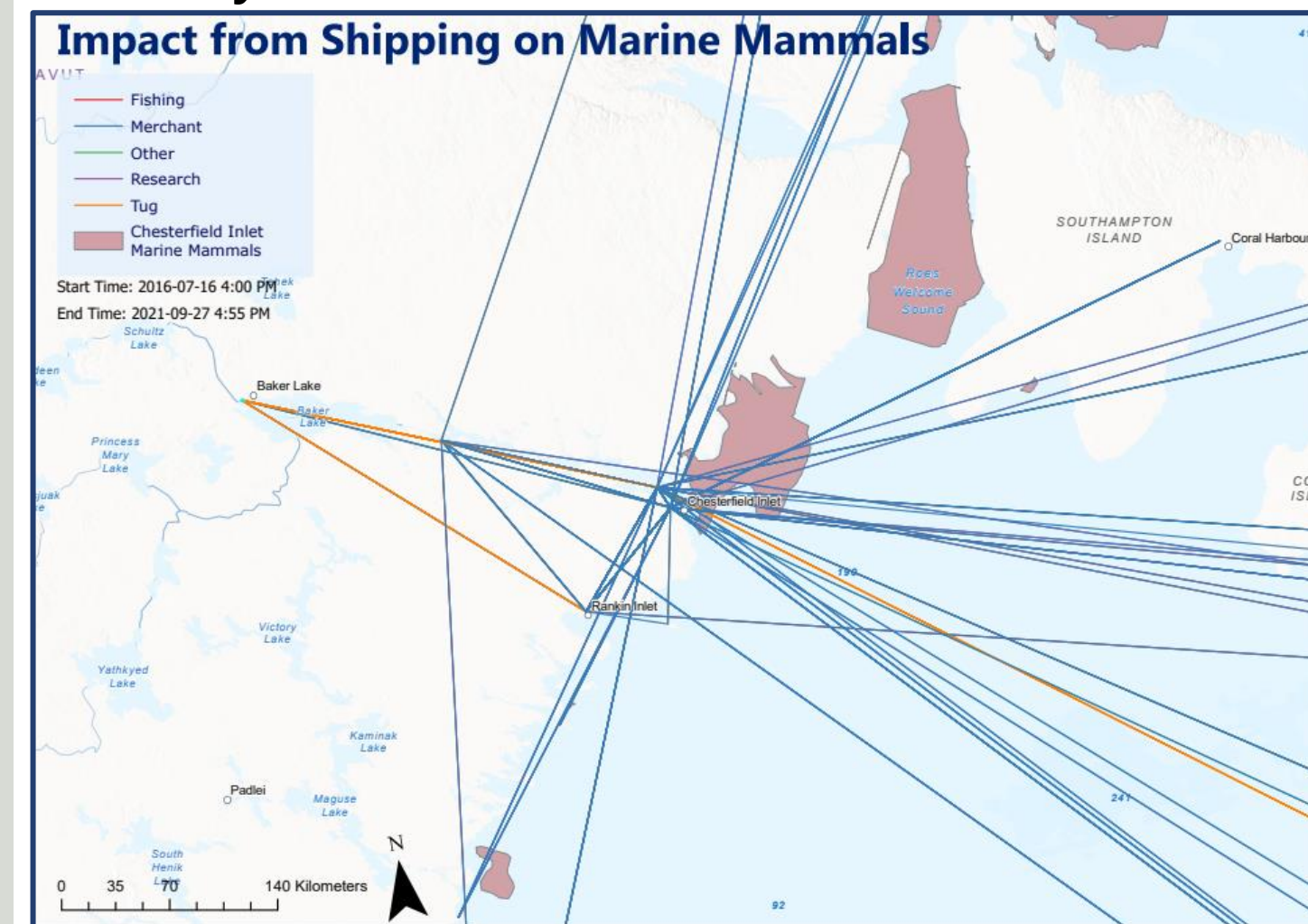
Objectives



There has been an increase in shipping in the Arctic region due to climate change and international interest. Chesterfield Inlet is a hamlet located in the Kivalliq region of Nunavut. The economy is based on traditional means which include hunting and trapping. A workshop hosted by the community in 2016 raised concerns shipping had on traditional harvesting of marine mammals. The issue is the difficulty to have proper community representation on issues surrounding shipping impacts. A healthy ocean is vital for a healthy culture.

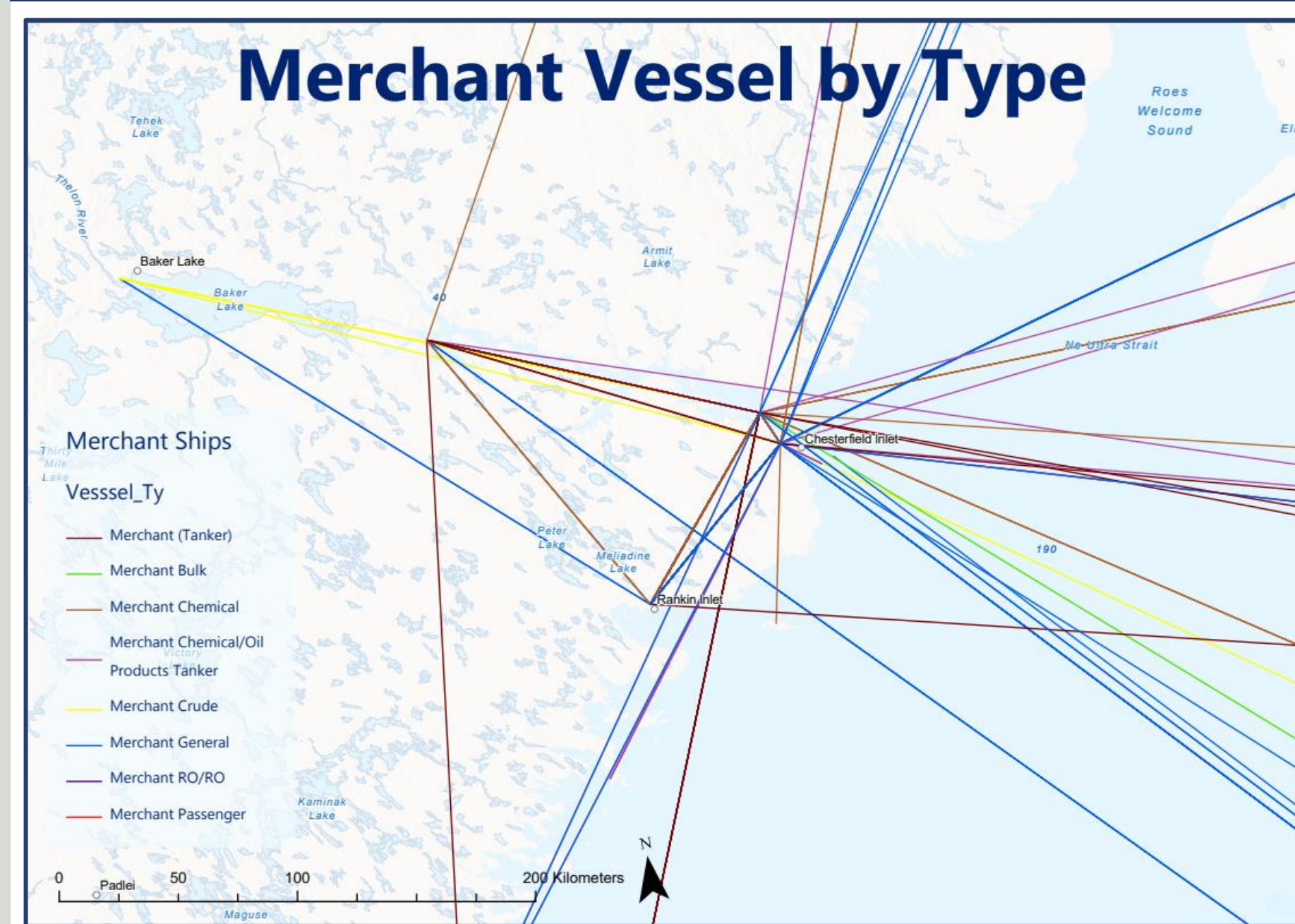


In 2015, the World Wildlife Fund (WWF) launched a program called 'Community Voices' which aims to provide sufficient support to communities with ecological concerns. The increase of shipping throughout the years in Chesterfield Inlet has been raised orally by hunters, Elders and community members due to the impact it has on marine harvesting. Traditional harvesting is important to Chesterfield Inlet because a significant amount of Inuit diet comes directly from the marine environment.



An increase in shipping activity negatively impacts cultural hunting practices, livelihoods, food security and health. It is noted that culturally, hunters feed the community. A localized geospatial analysis surrounding shipping in the Kivalliq region has not been widely done. The objectives of this analysis are to highlight the effects of increased shipping in Chesterfield Inlet and to provide data-driven methods to support the current literature and voiced concerns about the ecological impacts.

Methods



There are current gaps in knowledge for harvesting totals in Chesterfield Inlet which makes it difficult to assess and analyze up-to-date data. There exists the most comprehensive harvesting data called the Nunavut Wildlife Harvest Study (NWHs) which provides the total amount of marine mammals in Chesterfield Inlet from June to May on a year-by-year basis. This dataset is used alongside shipping data to provide insight in the relationship between shipping and marine mammals.

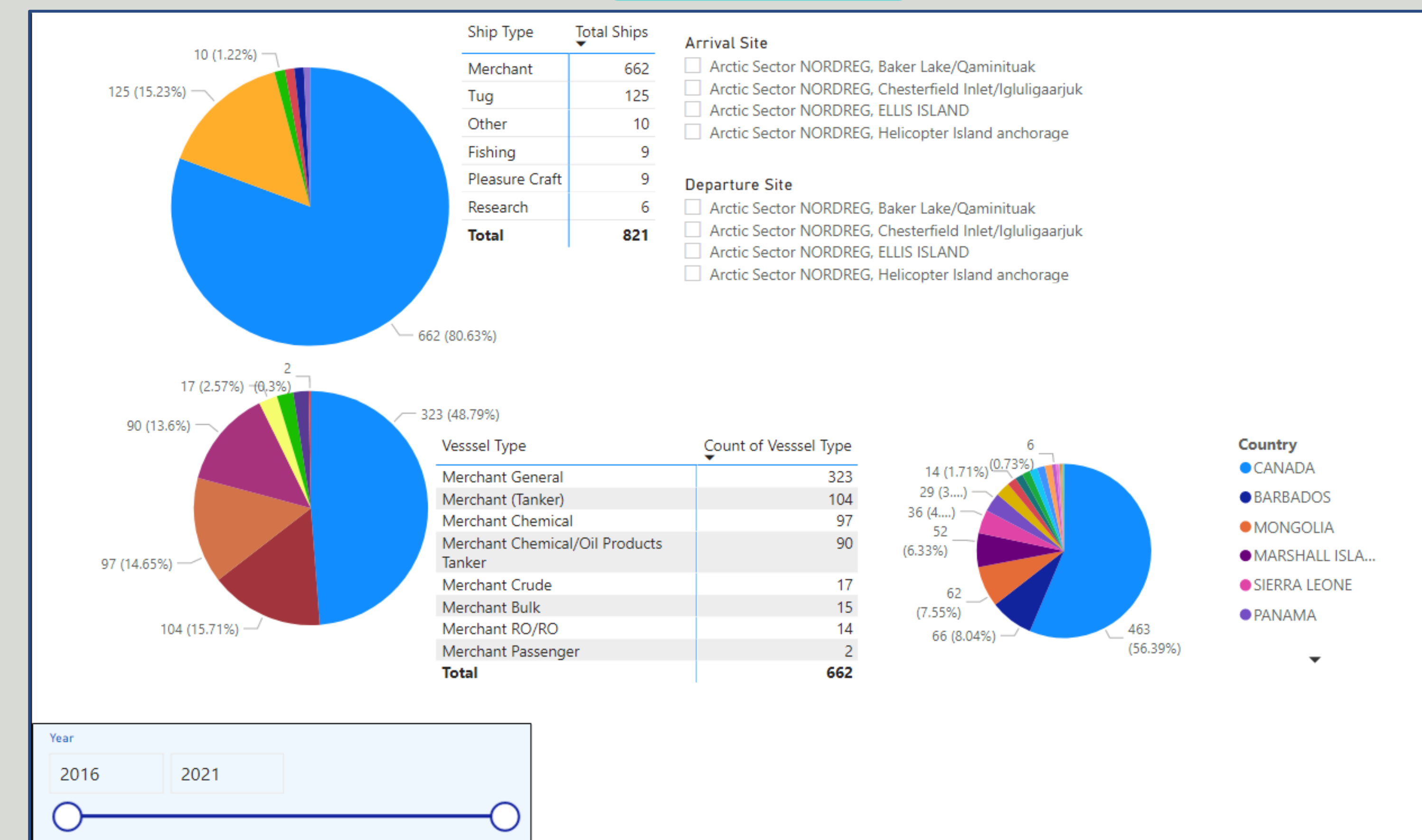
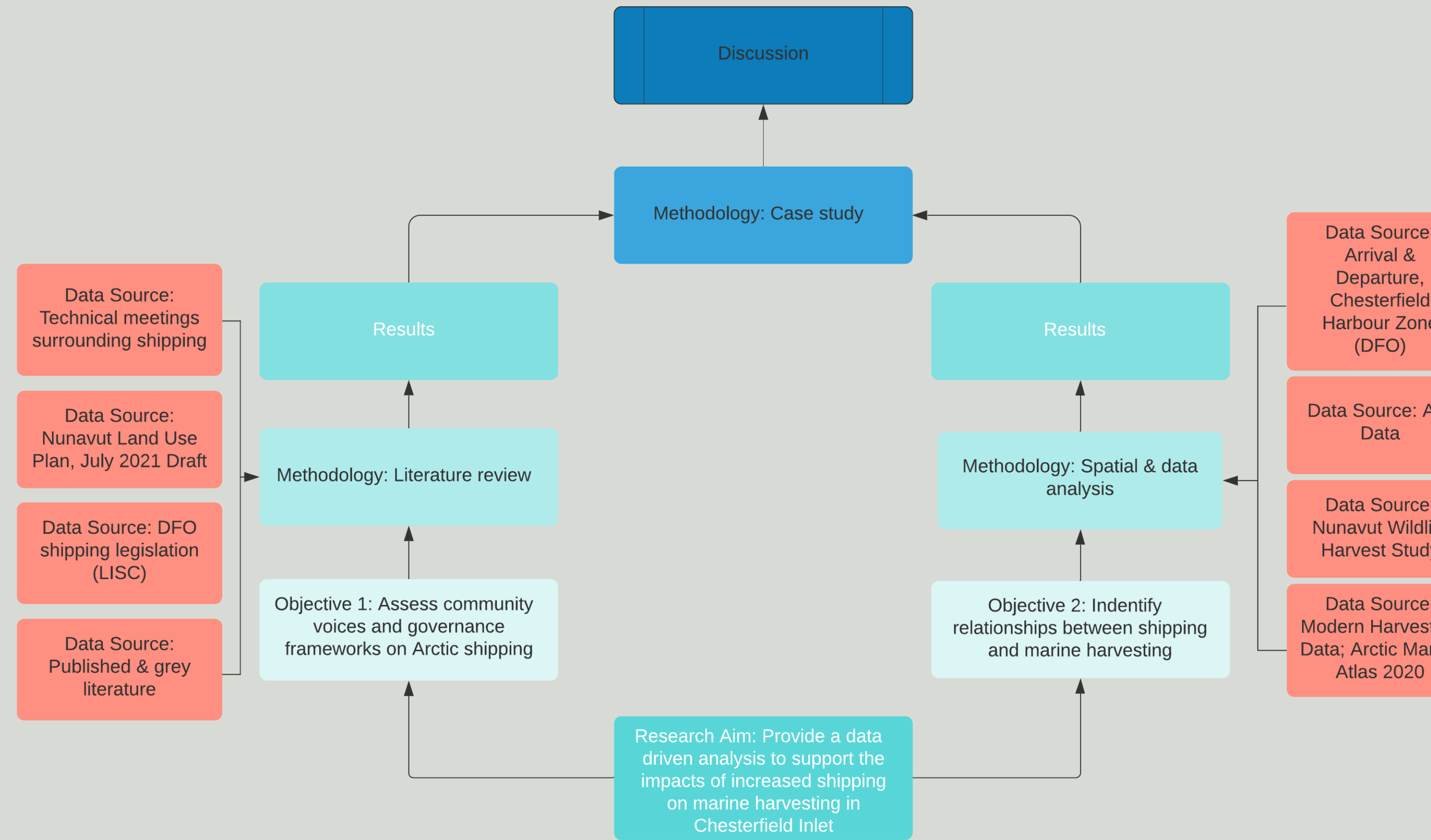
Shipping data in a Automatic Identification System (AIS) format is analyzed with ArcGIS Pro and Microsoft PowerBI for the discovery, interpretation and communication of patterns found within the dataset. The visualization method (data analytics) provides insight into shipping by filtering through a variety of data including year, shipping type, total ships, and country of origin.

Shipping Insight

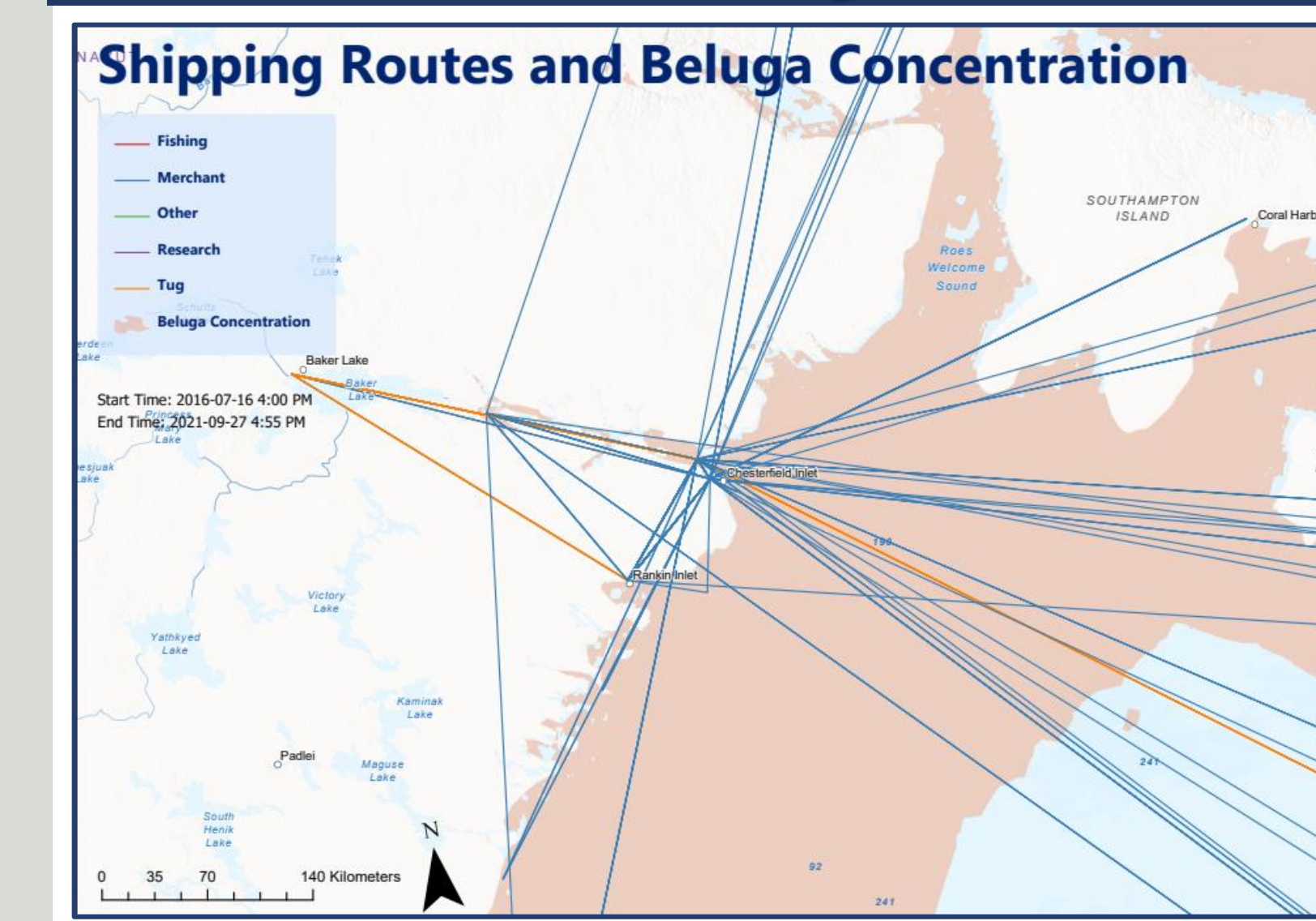
Understanding shipping patterns provides insight into why shipping is increasing. Insight is drawn from both a literature review and data analytics which helps better understand the relationship between shipping and marine mammals.

Risk to Marine Mammals

Maps created in ArcGIS Pro display the overlap between shipping routes and distribution of three marine mammals; Beluga, Ringed Seal, Walrus

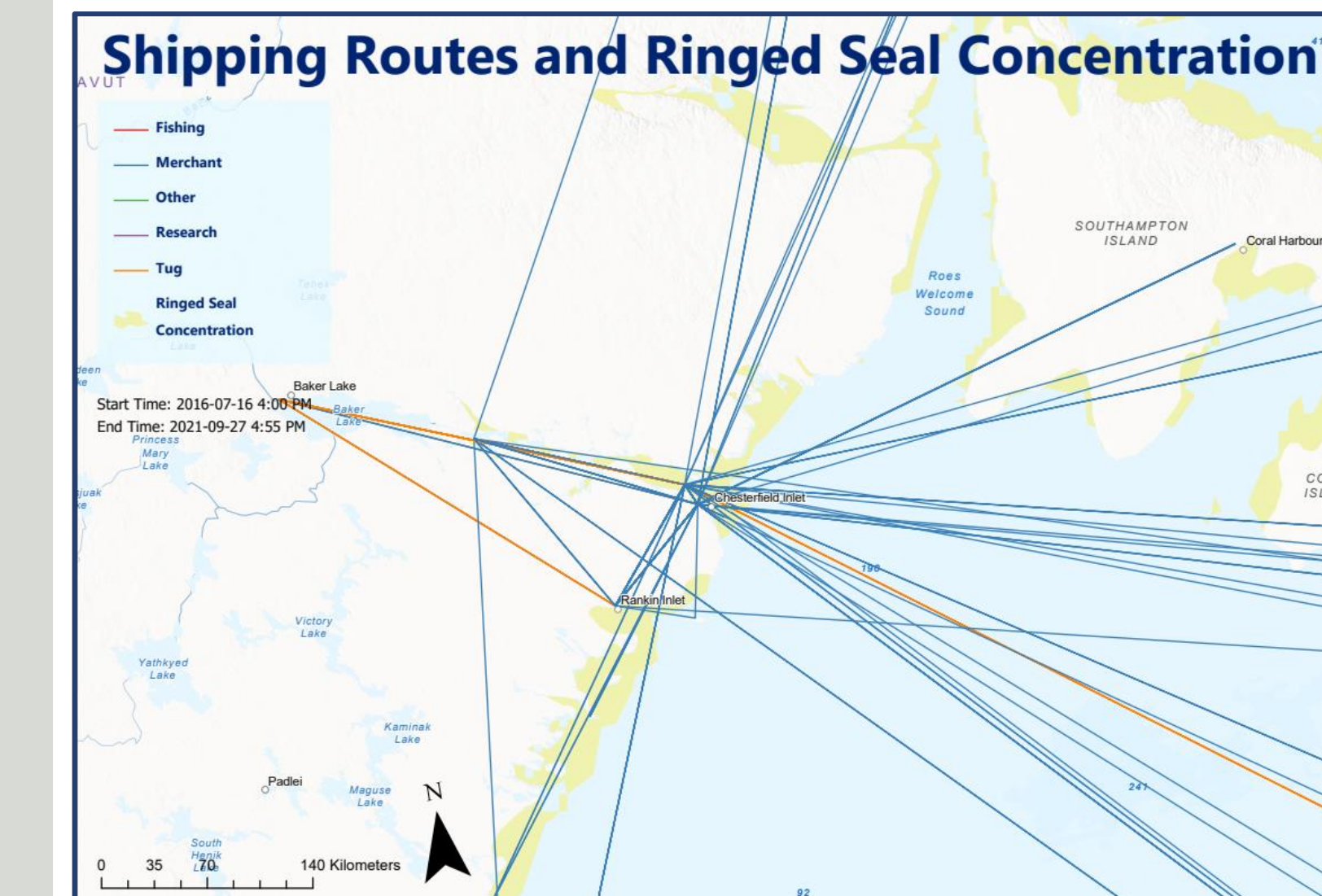


Preliminary Results & Discussion

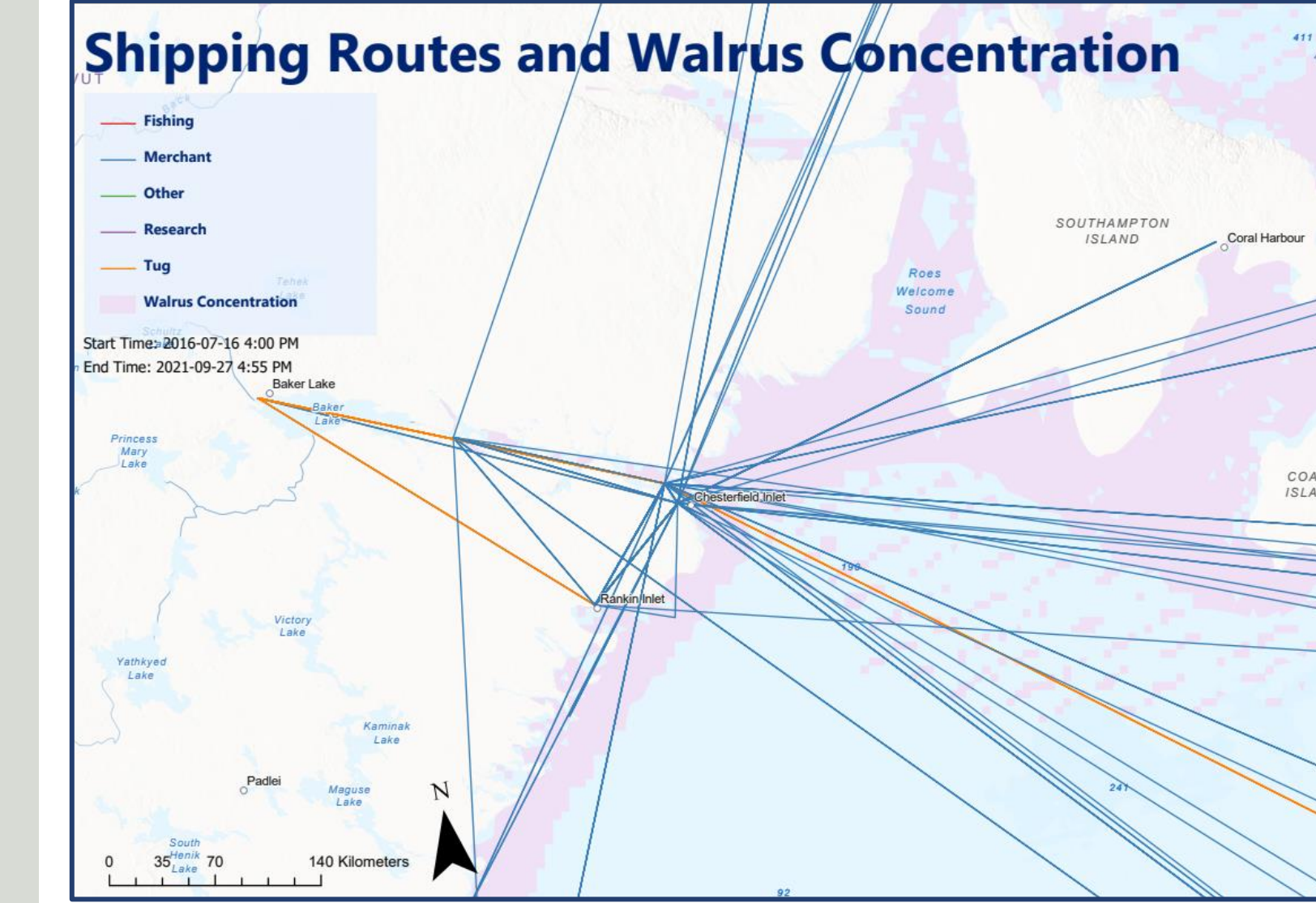


Shipping arrival and departure were mapped in ArcGIS Pro from years 2016 – 2021 to illustrate the overlap between shipping vessels and marine mammal concentration in the Kivalliq region.

Three marine mammals have been mapped with their displayed concentration, which are Beluga, Ringed Seal and Walrus. Marine mammal concentration is provided by Canada's Arctic Marine Atlas 2020 and shipping data is provided by Fisheries and Oceans Canada. The maps illustrate overlap between potential shipping routes and marine mammal concentration and further display marine disturbance near the concentration areas in Chesterfield Inlet.



Data analytics reveal that many vessels arriving in Chesterfield Inlet from years 2016-2021 are tagged with 'Merchant' which has 8 different classifications. Further analytics reveal that the second most vessel type in the 'Merchant' classification arriving near and passed Chesterfield Inlet are 'Chemical/Oil Products'. This may be due to the needs



of Agnico Eagle Limited Mine located north of Baker lake. This conclusion was drawn from a preliminary literature review of the Nunavut Impact Review Board document hearing on June 16th, 2021. The illustrations (maps) provide an overview of potential impact between shipping routes and marine mammal concentrations. To better understand and analyze this relationship, a Pearson correlation coefficient analysis was applied to the dataset.

Relationship Between Shipping and Marine Mammals

The NWHs only had data over 5 years so shipping data from 2016-2020 was chosen because of the incompleteness of the year 2021 data. The total amount of shipping vessels was negatively correlated with Beluga, Walrus and Ringed Seal over 5 years. This relationship illustrates that as the number of total ships arriving near and around Chesterfield Inlet increases, the total amount of marine mammals decreases in the concentration areas near Chesterfield Inlet.

Year	Ships	Beluga	Walrus	Ringed Seal
Year 1	32	31	4	147
Year 2	151	23	1	97
Year 3	181	10	1	34
Year 4	202	19	3	32
Year 5	207	3	4	150
Correlation		-0.81	-0.27	-0.49

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

Discussion

The type of data illustrated in this analysis is meant to be used as support to the current voiced concerns of hunters from the Hunters and Trappers Organization (HTO), Elders and community members. Data analytics and the visualization of data is meant to help understand the relationships between increased shipping and the impacts they may have on the concentration of marine mammals. The preliminary findings do not prove a causation between this relationship. They do, however, provide usable analytics that a user can filter through to gain insight, interpret data, and discover meaningful patterns towards effective decision-making. It is important to note that the harvest areas used by hunters did not change significantly compared to today, meaning the negative correlation in the concentration areas between shipping vessels and marine mammals are still present, as voiced by HTO. Furthermore, community members have expressed that they no longer want shipping activity occurring in July when traditional cultural hunting practices occur. These concerns highlight that shipping is disturbing the marine ecosystem in Chesterfield Inlet, and thus the cultural traditions of hunting. These concerns are important to address because a significant amount of Inuit diet comes directly from the marine environment.

Limitations

The harvest studies used to identify the spatial relationship between shipping and marine mammals are decades old (latest edition is 2004). Though it is noted in the literature that harvesting numbers did not significantly change, a more recent comprehensive harvest study should be conducted in the Kivalliq region to reflect harvesting patterns alongside the increase of shipping vessels arriving near and around Chesterfield Inlet. Furthermore, the AIS data provided by Fishers and Oceans Canada does not read as a proper AIS data set. This could be due to sensors on vessels not always transmitting their precise location on a consistent frequency. This limits the amount of analysis that can be done. The exact routes, common paths and exact overlap between marine mammal concentration and shipping vessels could not be created and so this type of analysis could not be conducted.

Projection: WGS 1984 North Pole LAEA Canada

Data Sources: Nunavut Wildlife Harvest Study, Canada's Arctic Marine Atlas, Chesterfield Inlet Harbour Zone Arrival and Departure Fisheries and Oceans Canada.

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