

## Shipping Trends in Tallurutiup Imanga (Lancaster Sound), Nunavut from 1990 to 2018



*Woodward Group vessel transiting Tallurutiup Imanga to resupply fuel in Pond Inlet, Nunavut*

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### Data Management

Metadata for this study has been permanently housed in the Polar Data Catalogue and can be found here: <https://www.polardata.ca/> Polar Data Catalogue is a database of metadata and data that describes, indexes, and provides access to diverse data sets generated by Arctic and Antarctic researchers. The metadata records follow ISO 19115 and Federal Geographic Data Committee (GGDC) standard formats to facilitate exchange with other data centres.



## EXECUTIVE SUMMARY

This study involved in-depth examination of the past and present shipping activities across Tallurutiup Imanga (Lancaster Sound), Nunavut, Canada from 1990 to 2018. Marine traffic increased dramatically over the 29-year period examined in the study. The total distance travelled by all vessels almost tripled between 1990 (51,584 km) and 2018 (142,111 km), with a notably steep increase in distance between 2009 (61,783 km) and 2014 (104,098 km); furthermore, the distance travelled by some vessel types increased considerably more than others (e.g., pleasure crafts, passenger ships, and general cargo). The spatial concentration of ship traffic in Tallurutiup Imanga has been relatively consistent over time, with most vessels travelling in the middle of the channel as well as branching off to the five surrounding communities and to the Mary River Mine which is accessed through Milne Inlet. However, some changes in intensity and distribution are evident within certain vessel types. Notably, pleasure crafts and passenger ships are substantially more concentrated in routes on the way to communities as well as around Beechy Island on the southwestern tip of Devon Island. The overall spatial change in vessel traffic within 50 kilometres of each of the five communities varies quite a bit; however, it is noteworthy that the community of Pond Inlet, a community in the heart of the Tallurutiup Imanga region, has seen the greatest increase in vessel traffic compared to Canadian Arctic communities across all of Inuit Nunangat (see Dawson et al. 2017b; 2018).

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## INTRODUCTION

Recent reductions in sea ice extent in the Canadian Arctic are a result of global climate change and suggest that navigability and consequently marine shipping activities in the Arctic will increase (Smith & Stephenson 2013; Pizzolato et al. 2014; Stephenson et al. 2013). There are a variety of different vessels that have historically transited the Tallurutiup Imanga borders including; government vessels and icebreakers, container ships, general cargo, bulk carriers, tanker ships, passenger ships, pleasure craft, tub/barge, fishing vessels, and oil and gas exploration vessels (see Pizzolato et al. 2014 for a table of vessel types and typical operations). Within the Tallurutiup Imanga region, the shipping season lengthened between 1990 and 2013 (Dawson, Copland, Johnston, et al., 2017; Pizzolato et al., 2014) and there were increases in kilometres travelled by almost all sectors of vessel traffic between 1990 and 2015 (Dawson et al., 2018). Higher densities of marine shipping traffic has significant impacts on the flora and fauna in the Arctic through various vectors, such as invasive species from ballast water, noise pollution and risks related of oil and fuel spills (Dawson et al. 2017a; Ghosh & Rubly 2015). This report summarizes the specific temporal and spatial shipping trends in Tallurutiup Imanga (Lancaster Sound) which is National Marine Conservation Area. Understanding the past and present shipping trends will help to better evaluate the risks association with shipping to this region and could assist in management and other decision making initiatives.

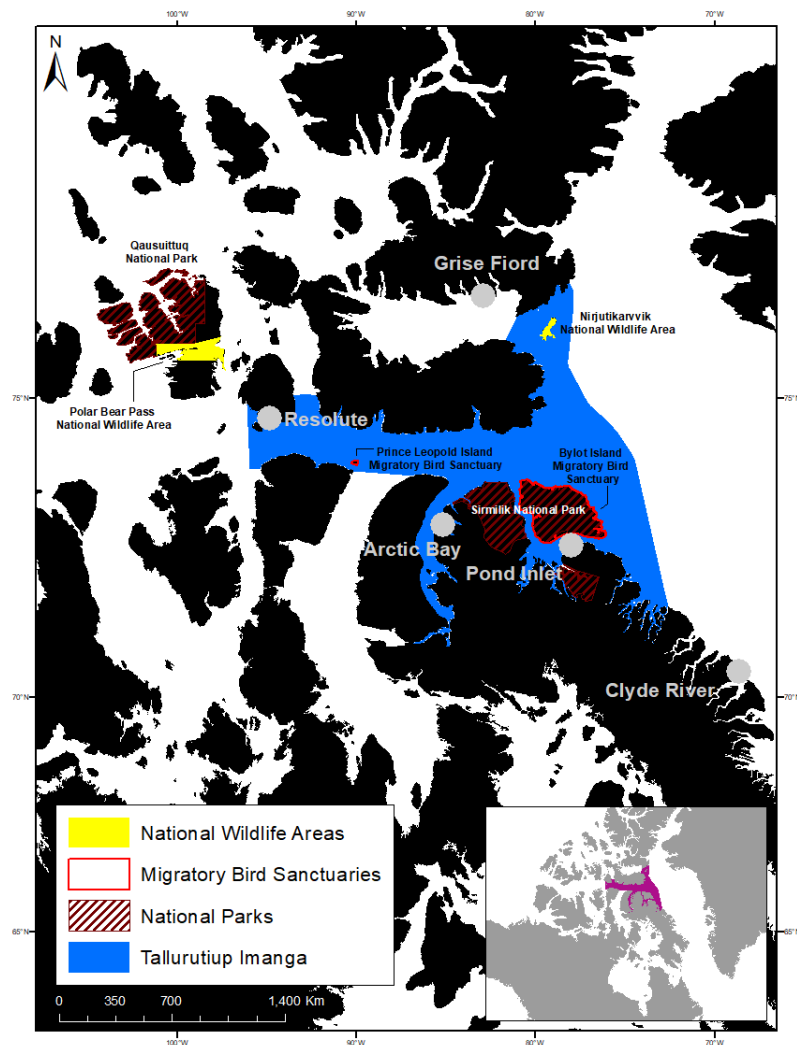
## METHODOLOGY

The database used for this study was created using Canadian Coast Guard non-spatial NORDREG ship archive data from 1990 to 2018. For further details on the process of constructing the database see Pizzolato et al. (2014; 2016); Dawson et al. (2017a,b); and Dawson et al. (2018).

The model used for developing the shipping trends and tracks database has certain limitations that should be acknowledged considering it is based on modelled ship tracks and not actual satellite-based locations. The modeled ship tracks are derived using a least cost path approach that considers a variety of different geophysical properties such as bathymetry, distance to land, and sea ice cover. The model algorithm used has been validated and was found to perform reasonably well but can sometimes overestimate kilometers traveled or can estimate ships tracks to be further from shore than in reality. Automatic Identification System (AIS) data which is based on satellite information is more geographically precise but this data does not capture ships prior to 2012 nor does it capture small vessels. We therefore chose to use the modelled data in order to understand historic trends.

## STUDY AREA

The study area was in the National Marine Conservation Area (NMCA) of Tallurutiup Imanga (Lancaster Sound). NMCAs are coastal land and water areas that Parks Canada manages for ecologically sustainable use (Parks Canada, 2018). Tallurutiup Imanga is located in Nunavut at the eastern entrance of the Northwest Passage, the sea route connecting the Pacific and Atlantic oceans. The area is ecological sensitivity and culturally significant because of the specific habitat it offers to various species such as polar bears, beluga whales, bowhead whales and narwhals (Parks Canada, 2018). There are five communities in and around Tallurutiup Imanga: Arctic Bay, Clyde River, Grise Fiord, Pond Inlet and Resolute (Figure 1). In 2016, the populations were as follows in the communities: 1,752 in Arctic Bay, 2,254 in Clyde River, 319 in Grise Fiord, 3,326 in Pond Inlet and 420 in Resolute (Government of Nunavut, 2016). There are also various protected areas in and around Tallurutiup Imanga: 2 National Parks, 2 Migratory Bird Sanctuaries and 2 National Wildlife Areas.



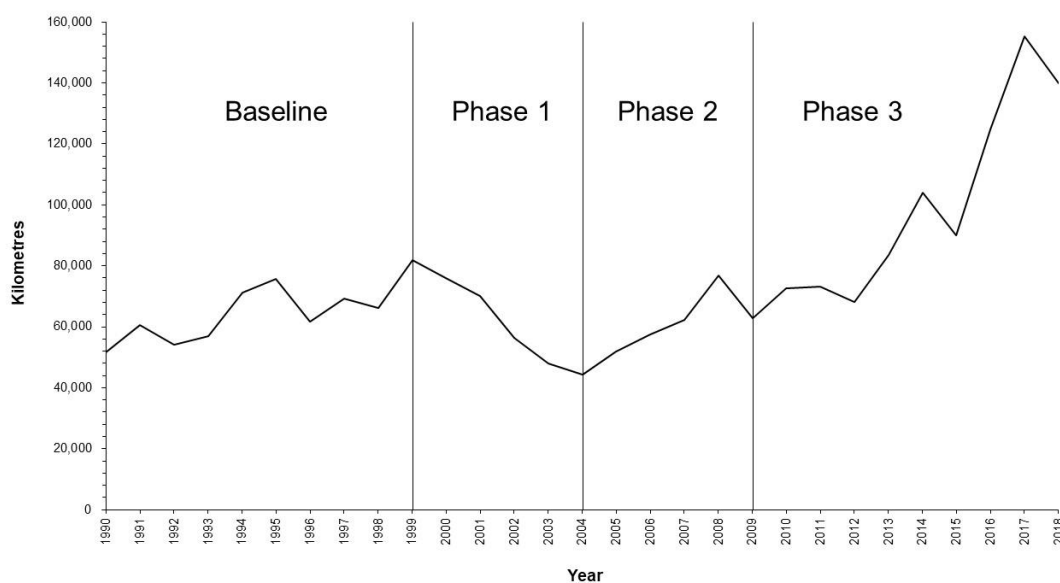
**Figure 1: Map of Tallurutiup Imanga in Nunavut, Canada, surrounding communities and protected areas**

## TEMPORAL TRENDS (1990-2018)

The total annual kilometres travelled by all vessel types in Tallurutiup Imanga in the 29 years of this study period has more than doubled. In 1990 the total kilometres travelled by vessels was 51,584 km and 142,111 km in 2018 (Figure 2). The year with the highest number of kilometres travelled within this record was in 2017 (157,820 km). Since 1990, the average vessel traffic has increased with some variation from year to year, including a drop between the years 2000 and 2004 (Figure 2).

To better understand the temporal changes in ship traffic, the study period (1990-2018) has been divided into four separate stages: i) baseline (1990-1999), representing a relatively stable period with limited growth; ii) phase 1 (2000-2004), a period of minor decline; iii) phase 2 (2005-2009), a period of rapid growth; and iv) phase 3 (2010-2018), a period of continued growth and development.

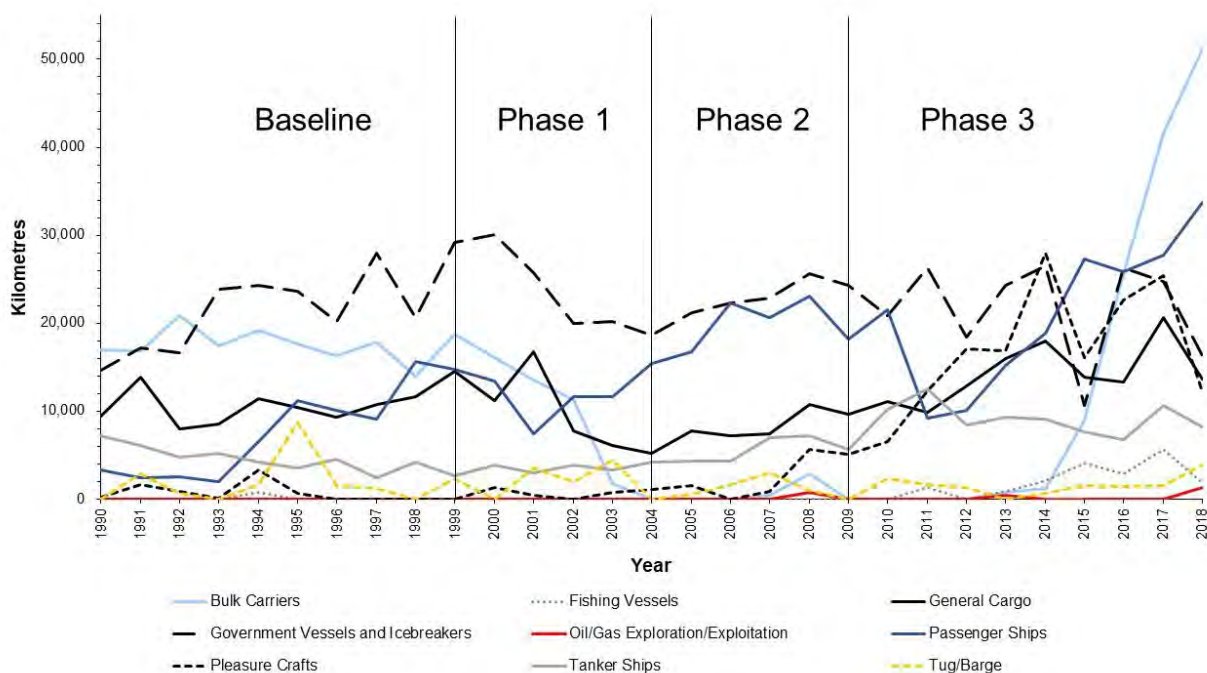
During the baseline period of 1990 to 1999 ship traffic remained relatively stable, fluctuating between 51,584 km and 81,969 km with an average of 64,916 km. During phase 1 the total annual distance travelled in Tallurutiup Imanga started to decrease, with the lowest distance travelled in 2004 at 44,416 km and the phase 1 average at 59,009 km. The annual average travelled in phase 2 was 62,257 km, which was higher than phase 1 but lower than the baseline period. The distances travelled in phase 2 ranged from 51,999 km to 76,753 km. The final phase 3 had the highest annual averaged distance travelled with 101,793 km and ranging from 68,160 km and 157,820 km.



**Figure 2: Total Annual Kilometres Travelled by All Vessel Types in Tallurutiup Imanga, from 1990-2018.**

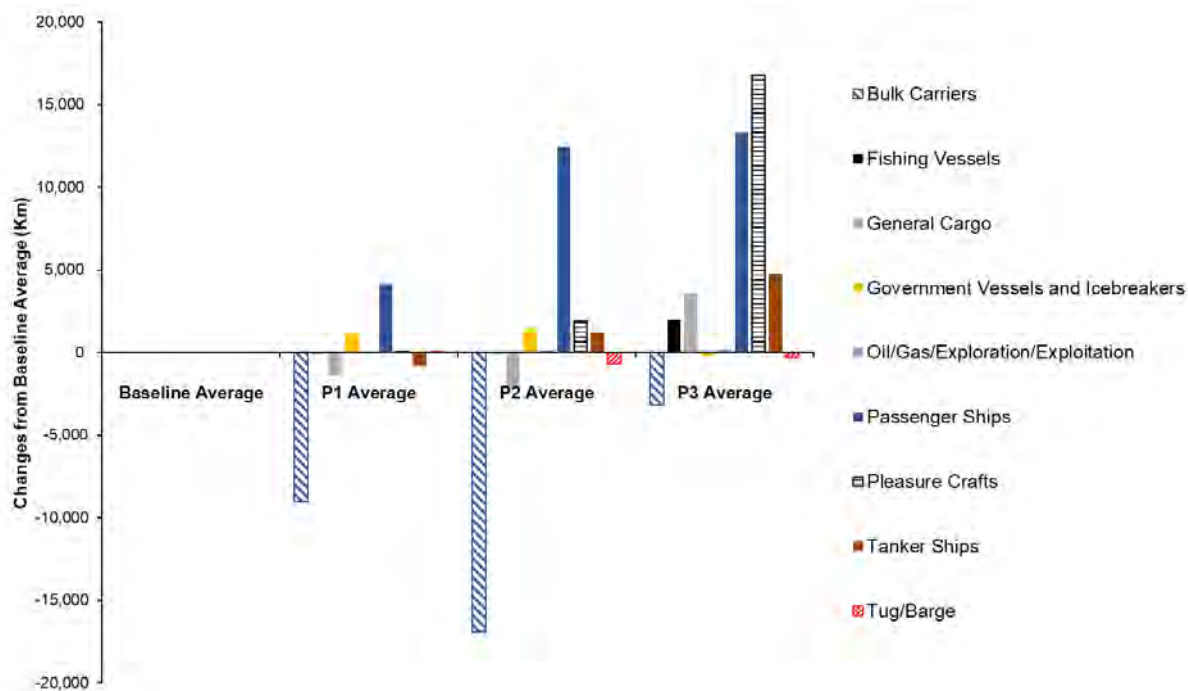


Figure 3 separates the total number of kilometres travelled by vessel type for the whole study period. Government vessels and icebreakers travel the greatest distances, almost every year. General cargo were relatively stable for the baseline and phase 1, but started to decline partway through phase 1 and incline again at a low rate in phases 2 and 3. Bulk carriers were one of the highest annual averages in between the years 1990 and 2002 but saw a big drop from the year 2003 to 2014 and have again increased in 2015 to 2018. Passenger ships have been on an increase since 1990 and are one of the highest vessel types in the latest half of phase 3. Tanker ships and pleasure crafts had relatively low annual averages of kilometres travelled from 1990 to the middle of phase 2 and have increased substantially in phase 3. Tugs and barges have relatively low averages, never going any higher than 8,758 km, while fishing vessels and oil/gas exploration had minimal data with only 8 and 3 years collected respectively which each had low values of kilometres travelled.



**Figure 3: Total Annual Kilometres Travelled in Tallurutiup Imanga, by Vessel Type, from 1990-2018.**

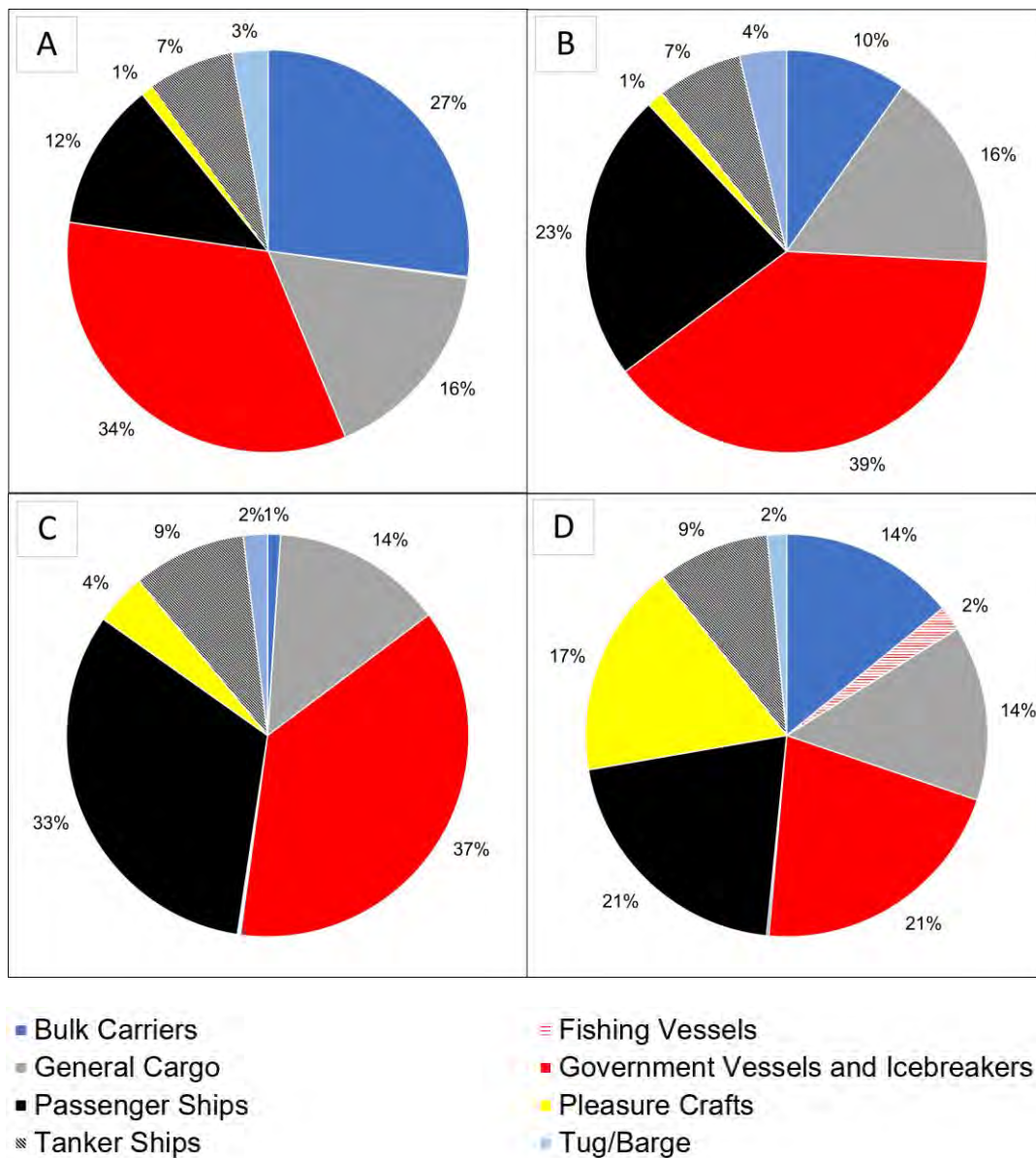
Figure 4 shows the change in annual average kilometres travelled by vessel type from the baseline period (1990-1999) compared to the trends in phase 1, 2 and 3. Bulk carrier activity decreased in all of the phases compared to the baseline. Fishing vessel and general cargo activity was below the baseline average until phase 3 where they began to increase. Government vessel and icebreaker activity was low in phase 1, saw a small increase in phase 2 and then decrease in phase 3. There was no data collected for the baseline in oil and gas exploration/exploitation vessels so the activity had a small increase in phases 2 and 3 where the change in annual average kilometres travelled was 154 km and 184 km respectively. Tugs and barges had low activity in phase 1 and decreased below the baseline average in phases 2 and 3. Passenger ship activity tripled from phase 1 to 2 and slightly increased again from phase 2 to 3. Tanker ships increased from phase 1 to phase 3. Finally, pleasure crafts show the steepest growth rates in terms of total vessel activity, increasing from phase 1 to 2 and increasing dramatically in phase 3 to have the highest change in annual average distance travelled.



**Figure 4: Change in Annual Average Kilometres Travelled from Baseline Period to Phase 1, Phase 2 and Phase 3 by Vessel Type.**

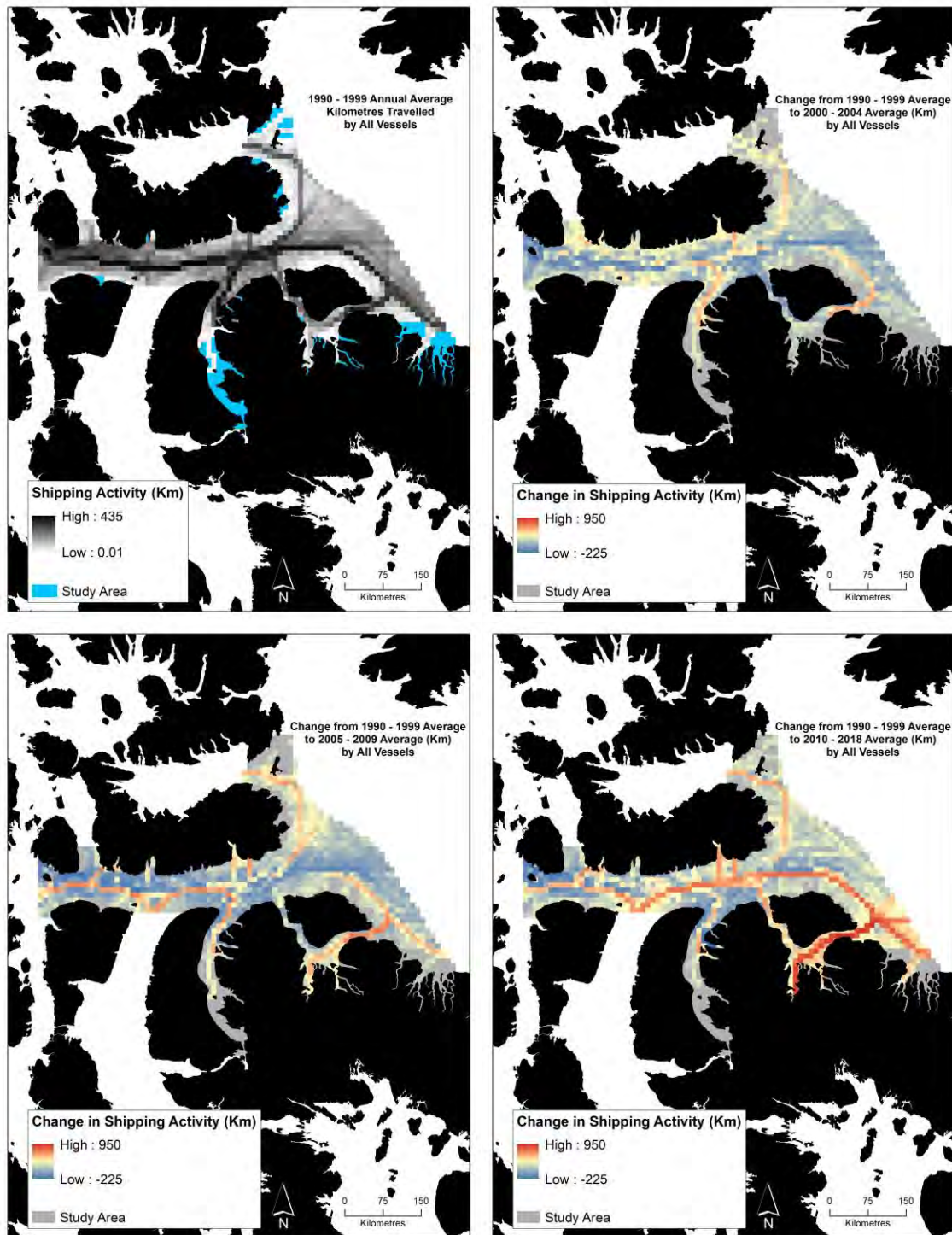
## DISTRIBTUION BY VESSEL TYPE

The distribution of shipping activity by kilometres travelled in Tallurutiup Imanga between 1990 and 1999 was 34% government vessels and icebreakers, 27% bulk carriers and 16% was general cargo. In phases 2 and 3 government vessel proportions slightly increased and then slightly dropped again in phase 3. Government vessels still dominated between the years 2010 and 2018 but more vessel types like passenger ships, pleasure crafts, general cargo and tanker ships increased to make the distribution more equalized.



**Figure 5: Relative Proportions of Ship Traffic in Tallurutiup Imanga Based on Annual Distance Travelled, where A is the Baseline Period (1990-1999), B is Phase 1 (2000-2004), C is Phase 2 (2005-2009) and D is Phase 3 (2010-2018).**

## SPATIAL TRENDS



**Figure 6: Annual Average Kilometres Travelled by All Vessel Types (Baseline: 1990-1999) (top left); Change in Annual Average Kilometres Travelled between Baseline and Phase 1 (2000-2004) (top right); Change in Annual Average Kilometres Travelled between Baseline and Phase 2 (2005-2009) (bottom left); Change in Annual Average Kilometres Travelled between Baseline and Phase 3 (2010-2018) (bottom right).**



## SPATIAL TRENDS BY VESSEL TYPE

### Bulk Carriers

Bulk carriers are vessels that carry either oil or loose or dry cargo (but not simultaneously) like timber and ore. During the baseline period, bulk carriers were spread across the whole region of Tallurutiup Imanga. There was a clear higher traffic area in the middle of the region, with arms reaching Arctic Bay and Resolute. During phases 1 and 2 bulk carriers decreased in concentration and spatial extent. In phase 3 bulk carriers still are limited in their spatial extent compared to the baseline; however, they are much more concentrated on the southeastern side of Bylot Island towards Pond Inlet and Milne Inlet where there is access to the Mary River Mine.

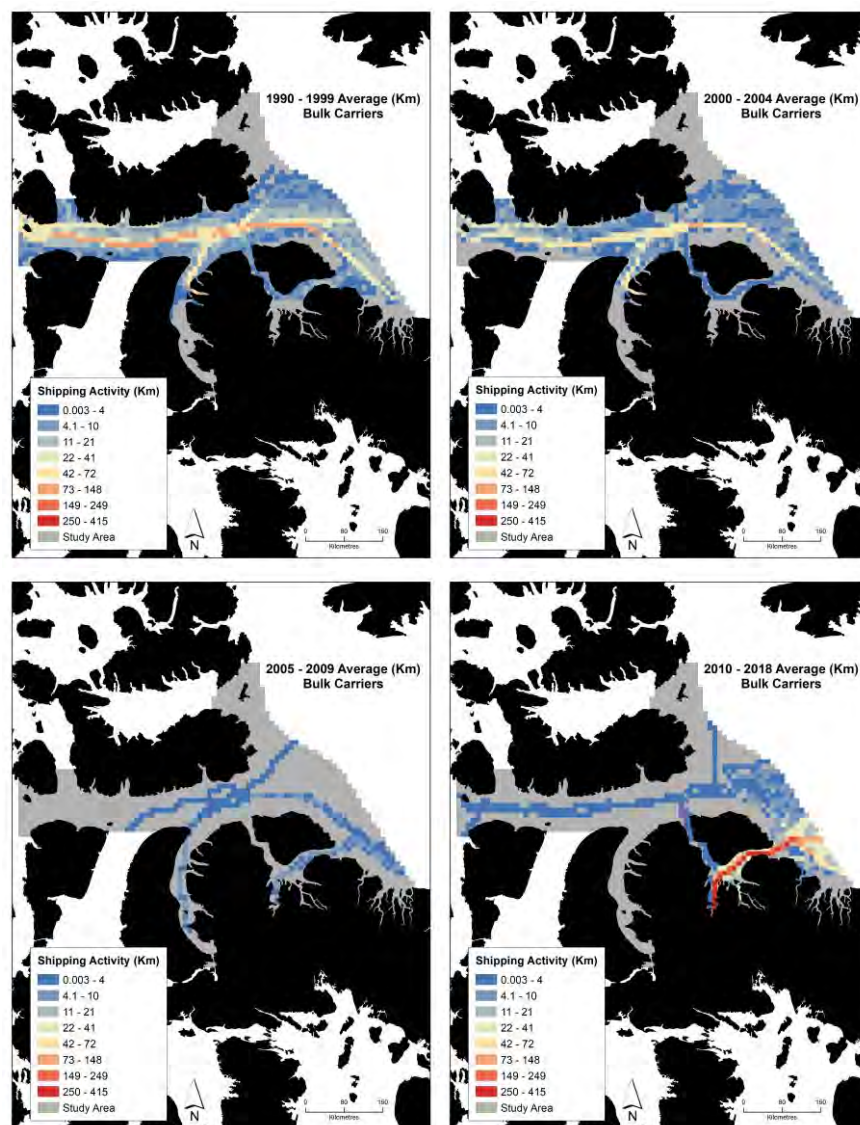
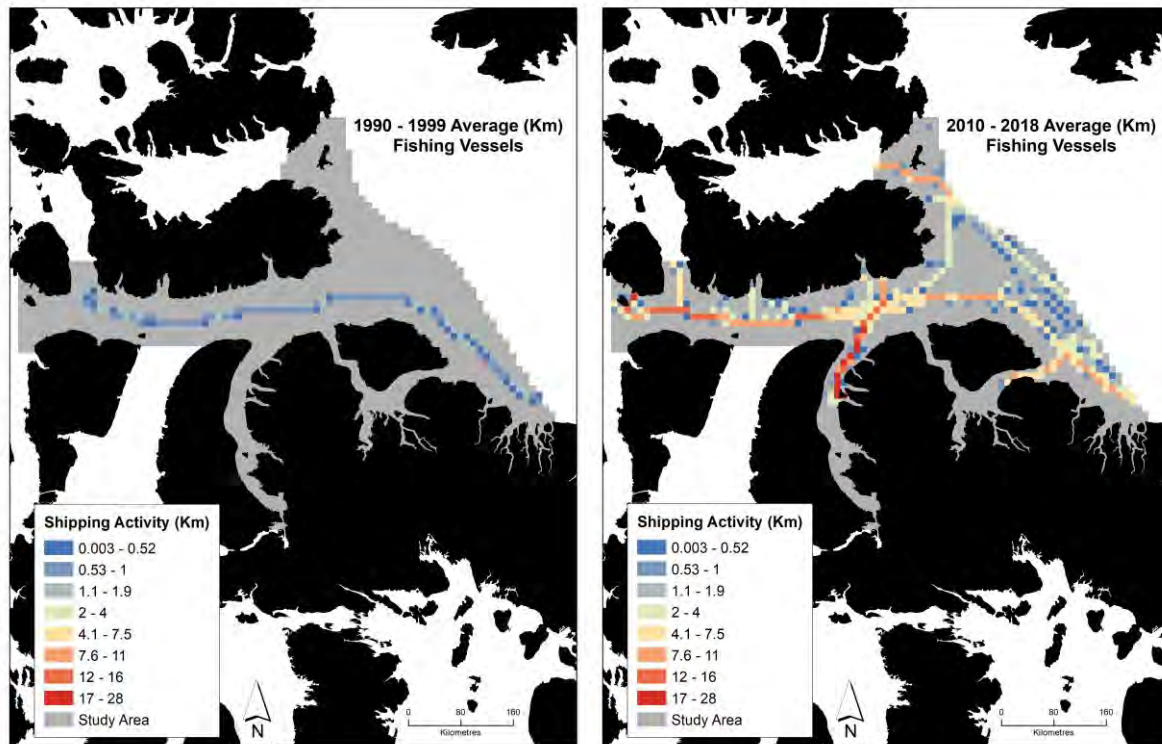


Figure 7: Annual Average Kilometres Travelled by Bulk Carriers, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).

## Fishing Vessels

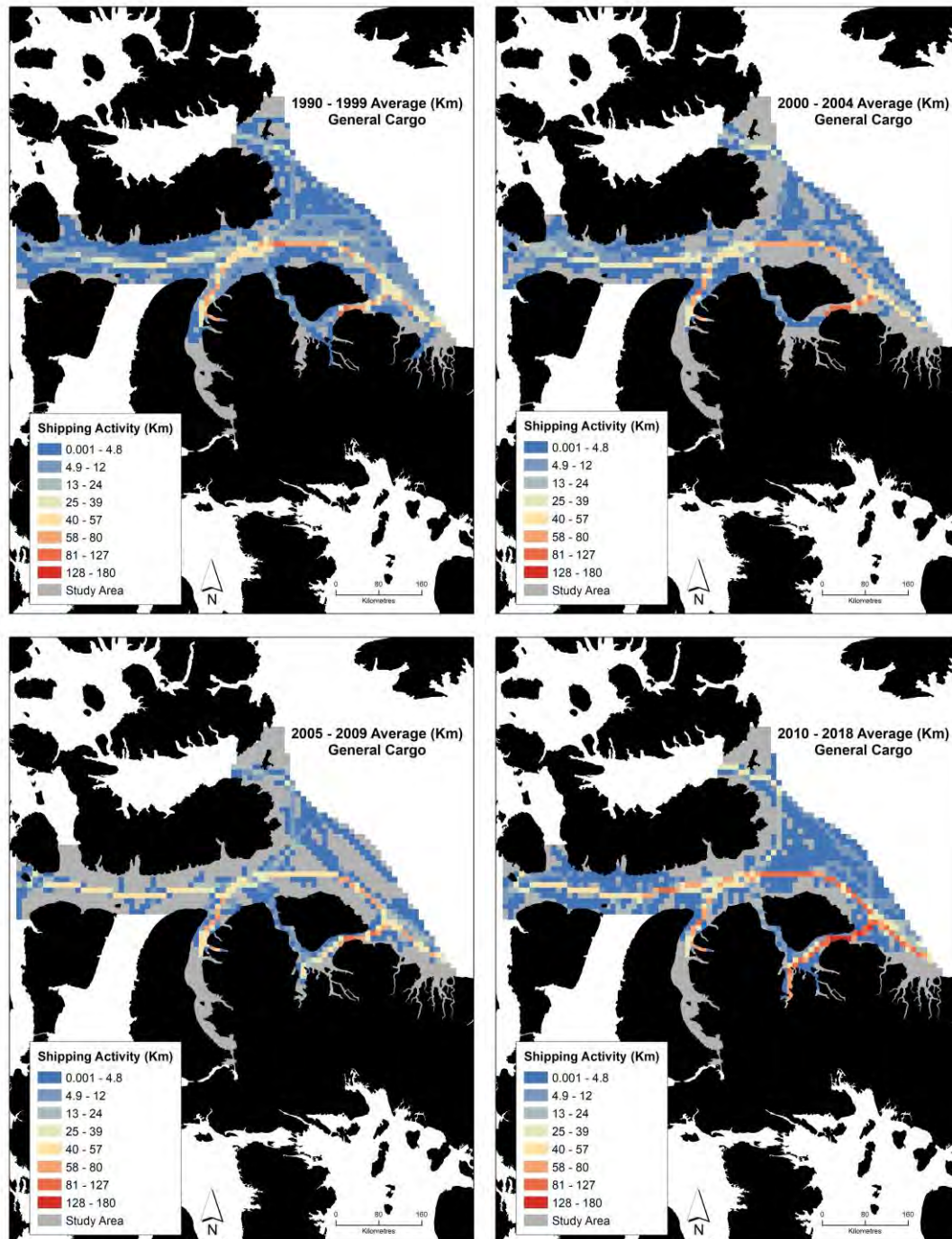
Fishing vessels are boats that are used for commercial fishing activities and are generally small vessels from 30 to 100 metres; these boats include trawlers, whaling boats and fish-processing boats. Fishing vessels were one of the vessel types with the lowest shipping activity. Since fishing vessels were only recorded in the years 1994, 2011, and 2013 to 2018, only the baseline period and phase 3 period could be analysed. In the baseline there was only one fishing vessel that travelled along the central route in Tallurutiup Imanga. In phase 3, there was more distribution of fishing vessels, with some going up to Jones Sound, Resolute and down to Arctic Bay.



**Figure 8: Annual Average Kilometres Travelled by Fishing Vessels, Baseline Period (left), Phase 3 (right).**

## General Cargo

General cargo refers to vessels that carry numerous types of cargo such as community re-supply and roll on/off cargo. General cargo in the baseline is spatially distributed more than any of the phases; however, in the most recent phase 3 there is a substantial increase in shipping activity along the northern and eastern edges of Bylot Island all the way to Pond Inlet.

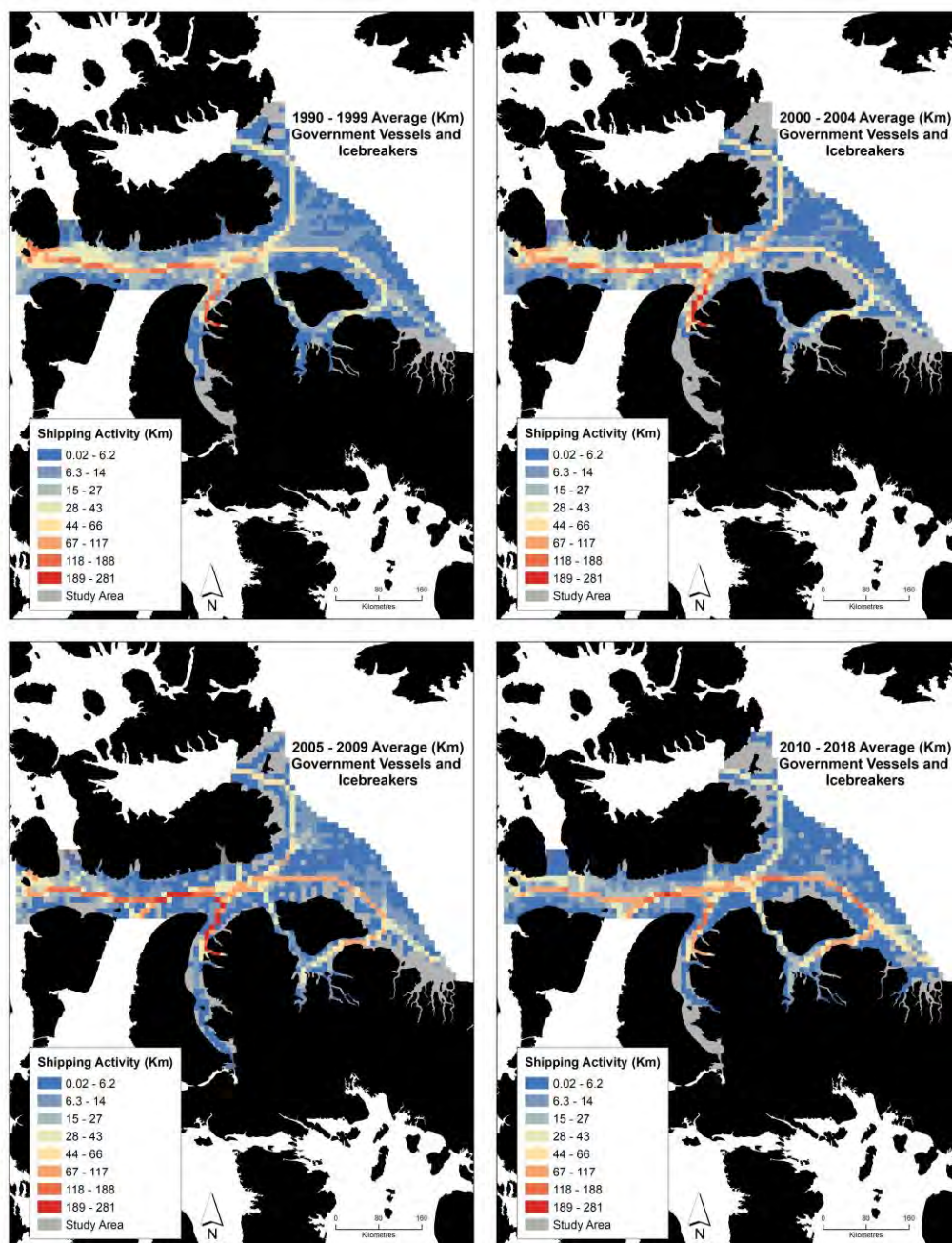


**Figure 9: Annual Average Kilometres Travelled by General Cargo, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**



## Government Vessels and Icebreakers

Government vessels and icebreakers include all Canadian Coast Guard vessels, research vessels and private, research and government icebreakers. Government vessels and icebreakers in Tallurutiup Imanga have consistently high shipping activity throughout the baseline and the three phases. They have the highest shipping activity in this region. All four periods show high concentration of vessel traffic throughout the central region as well as the locations near the communities.

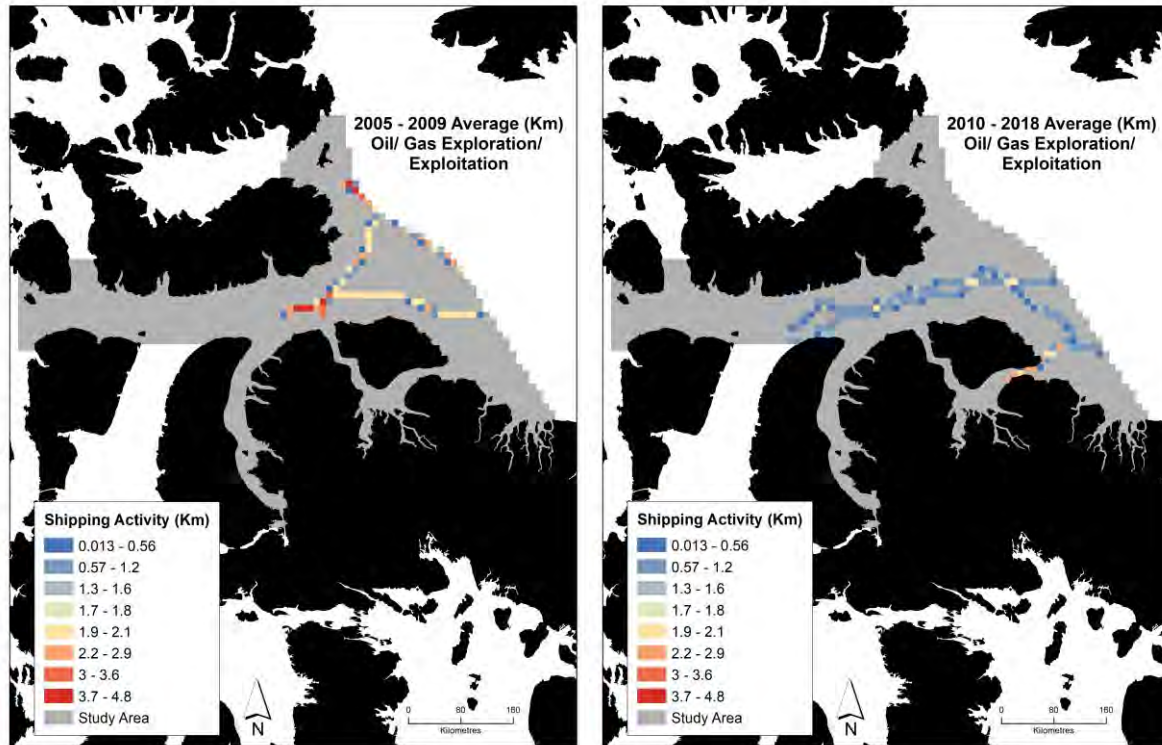


**Figure 10: Annual Average Kilometres Travelled by Government Vessels and Icebreakers, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**



## Oil/Gas Exploration Vessels

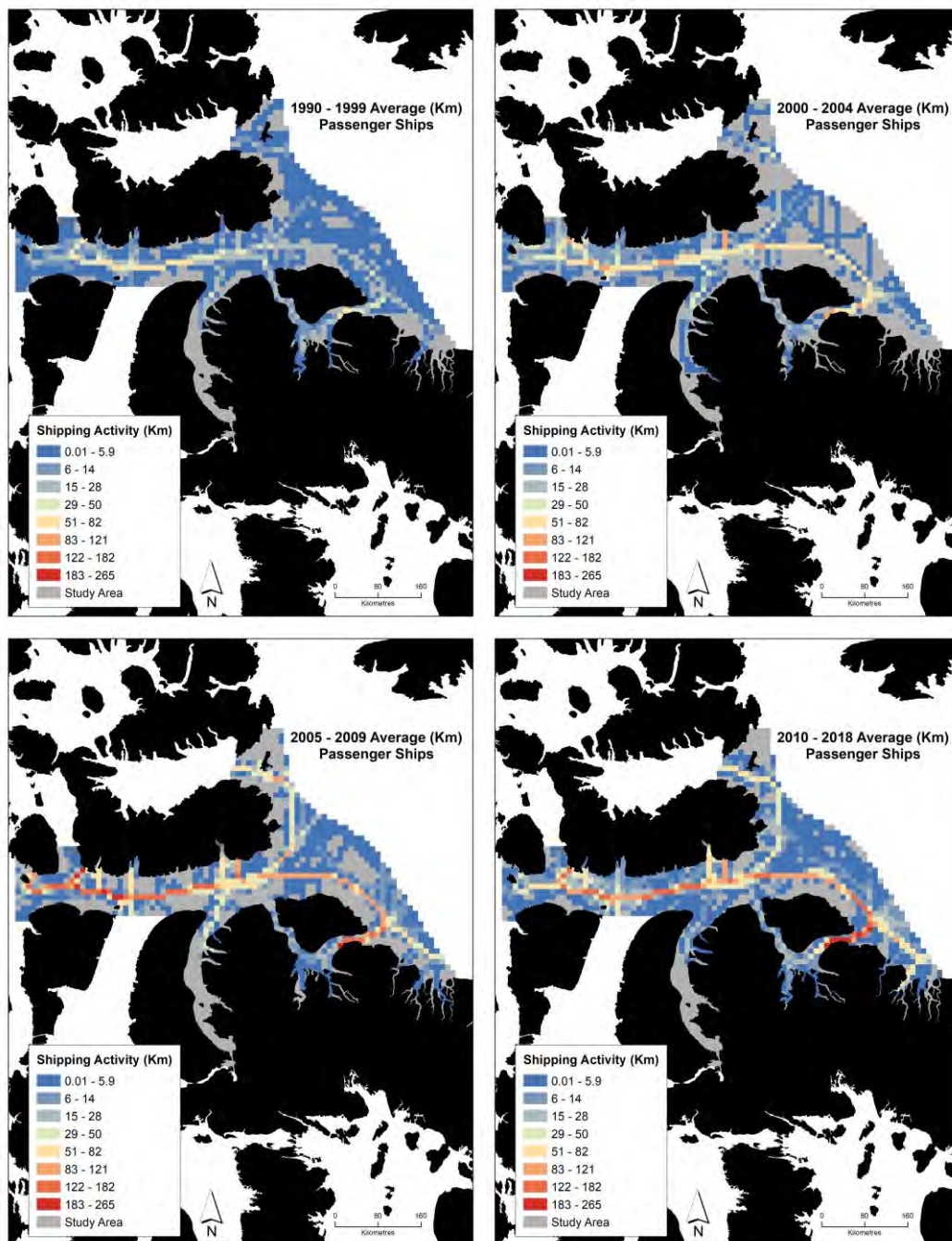
Oil and gas exploration and exploitation vessels include vessels for seismic, oceanic and hydrographic surveys, oil drilling and storage, offshore re-supply and portable oil platform vessels. Oil and gas vessels have the lowest shipping activity in Tallurutiup Imanga. In phase 2, there was one oil and gas vessel travelling in the north, to the east of Devon Island. While in phase 3, there was only one vessel present as well, travelling to the south of Bylot Island and in the middle of Parry Channel.



**Figure 11: Annual Average Kilometres Travelled by Oil/Gas Exploration/Exploitation Vessels, Phase 2 (left), Phase 3 (right).**

## Passenger Ships

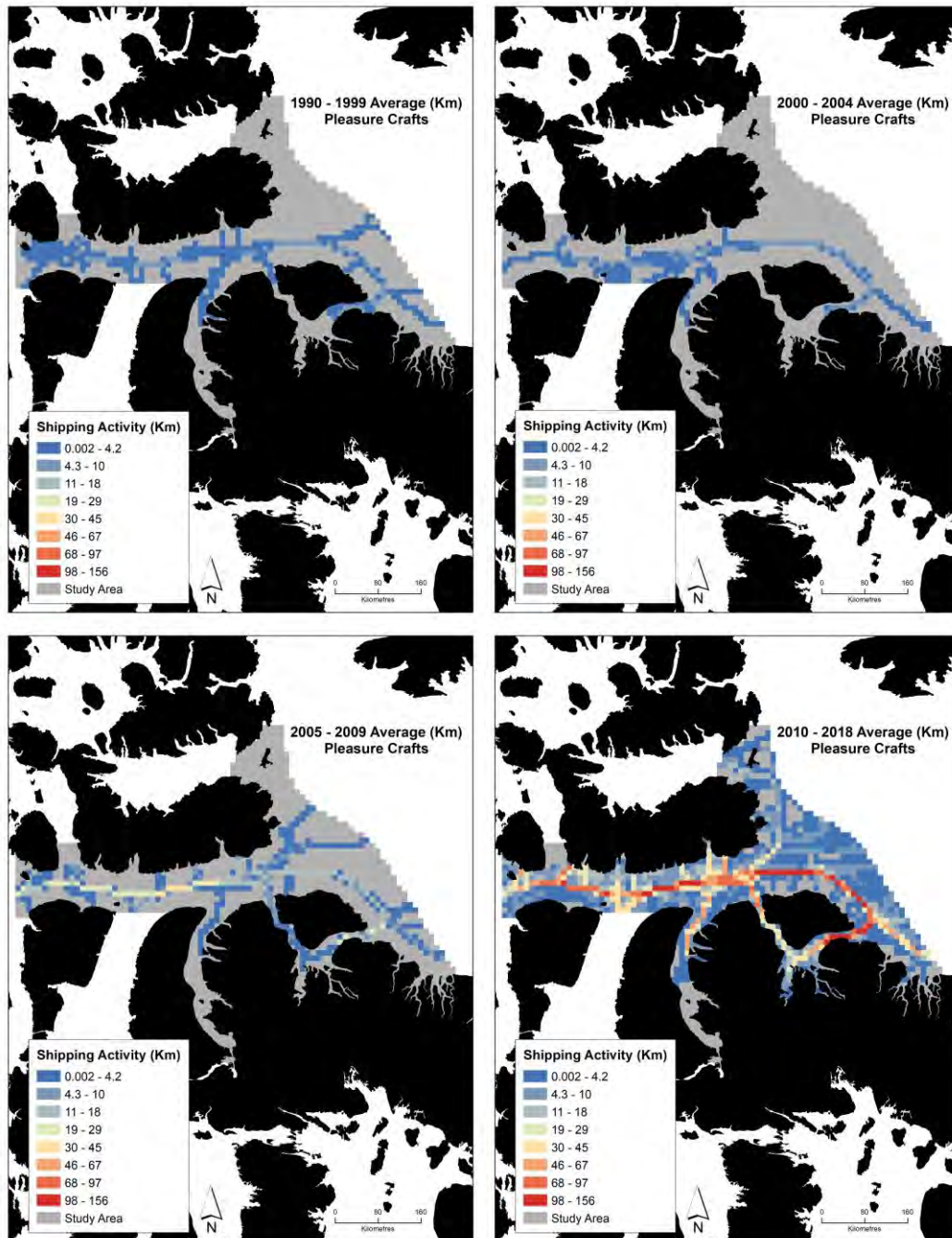
Passenger ships are vessels that carry passengers for remuneration and include vessels like cruise ships and ferries. Passenger ships have stayed consistent and concentrated all throughout Tallurutiup Imanga; they are one of the vessel types with the highest shipping activity in this region. Shipping activity is high in the central channel as well as to Pond Inlet and Beechy Island on Devon Island. There is also some notable vessel activity in the small inlets on Devon Island.



**Figure 12: Annual Average Kilometres Travelled by Passenger Ships, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**

## Pleasure Crafts

Pleasure crafts are vessels that are non-commercial such as motor yachts, sailboats and rowboats. From the baseline to phase 2, pleasure crafts had low shipping activity and were only concentrated in the central Parry Channel and towards the communities. In phase 3, the shipping activity increased significantly and has spread throughout the region. Areas of high activity include Beechy Island, Pond Inlet and some inlets on the southern side of Devon Island.

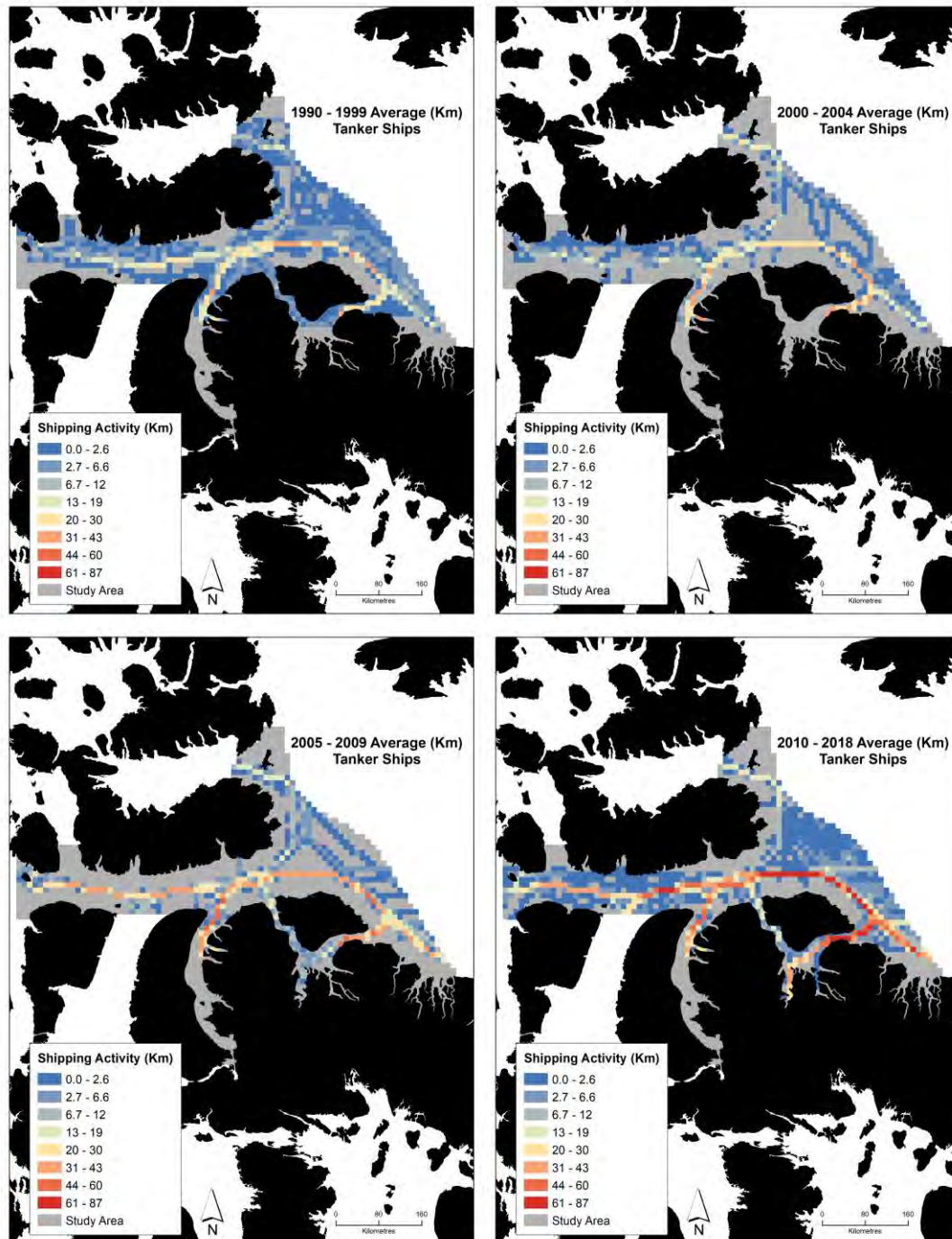


**Figure 13: Annual Average Kilometres Travelled by Pleasure Crafts, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**



## Tanker Ships

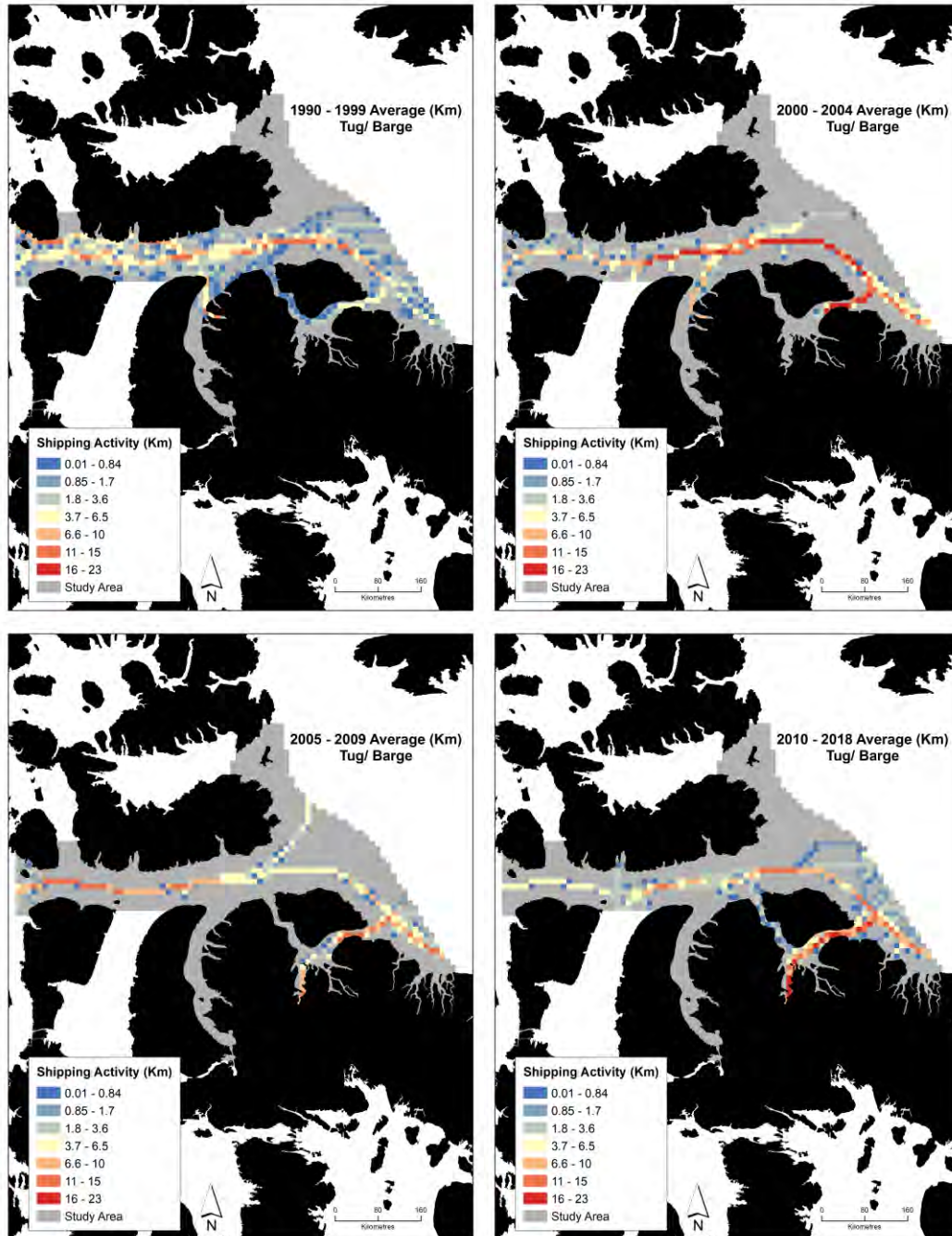
Tanker ships carry bulk liquids or compressed gases. Tanker ships were widely spread throughout Tallurutiup Imanga during the baseline period. Spatial distribution slightly decreased in phases 1, 2 and 3; however, the concentration of shipping traffic in phase 3 increased around Bylot Island, down to Arctic Bay and throughout the central channel of Tallurutiup Imanga.



**Figure 14: Annual Average Kilometres Travelled by Tanker Ships, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**

## Tug/Barge

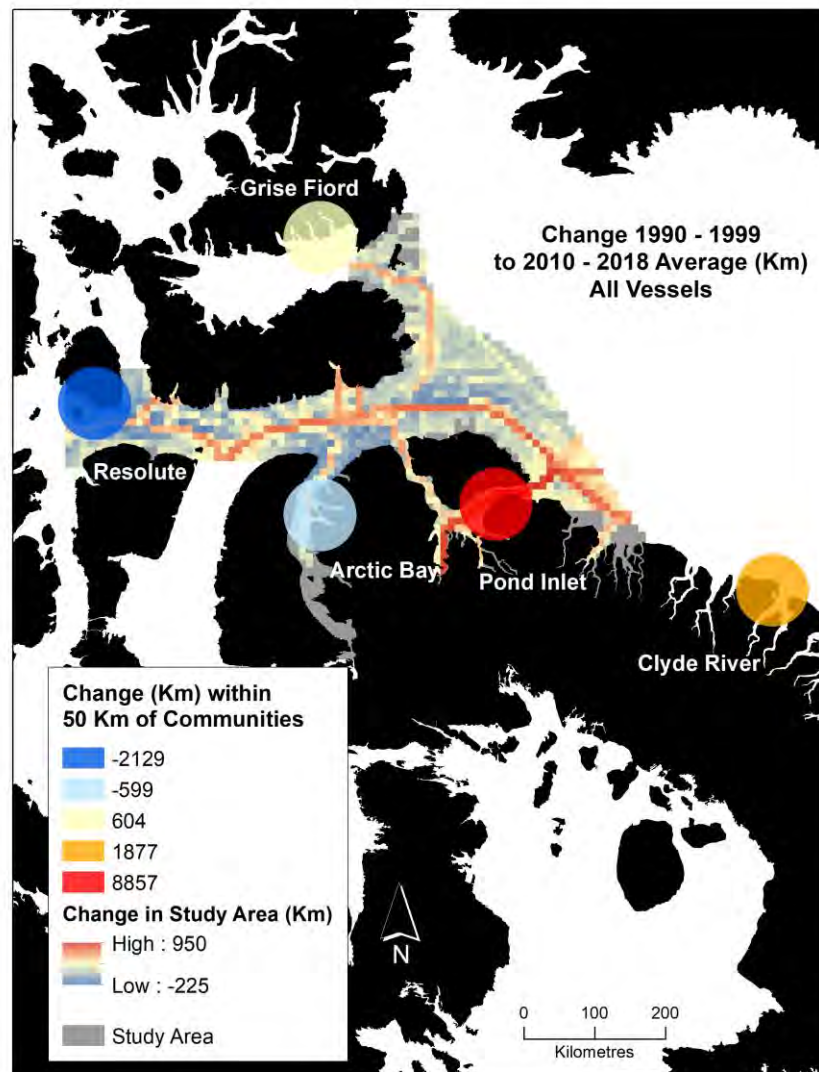
Tugs are designed for towing and pushing while barges are designed for carrying bulk or mixed cargo. Tugs and barges were one of the vessel types with low shipping activity. They were the most spatially distributed in the baseline period and the most concentrated in kilometres travelled in phase 1 around Bylot Island. Spatial distribution and general shipping activity decreased in phases 2 and 3.



**Figure 15: Annual Average Kilometres Travelled by Tugs/Barges, Baseline Period (top left), Phase 1 (top right), Phase 2 (bottom left), Phase 3 (bottom right).**

## VESSEL TRAFFIC NEAR COMMUNITIES AROUND TALLURUTIUP IMANGA

Figure 16 shows the overall spatial change in vessel traffic from the baseline period (1990-1999) to phase 3 (2010-2018). It also displays the proportional changes in vessel traffic encountered within 50 kilometres of each community near Tallurutiup Imanga. The dots that are royal blue and light blue represent communities where the change in shipping activity decreased (Resolute and Arctic Bay respectively). The yellow, orange and red dots represent the communities that experienced an increase in shipping activity (Grise Fiord, Clyde River and Pond Inlet respectively). Pond Inlet has experienced the greatest increase in shipping activity in Tallurutiup Imanga and in the whole Canadian Arctic, most likely attributed to increases in tourism vessels, bulk carriers, and tanker traffic associated with mining in the Mary River Mine (Dawson et al., 2018).



**Figure 16: Change in Vessel Traffic (Km) within 50 Km of Communities, from 1990-1999 Average to 2010-2018 Average and Changes in Overall Vessel Traffic During the Same Period.**

## CONCLUSION

This report summarized the temporal and spatial trends in ship traffic in Tallurutiup Imanga, Nunavut, Canada from 1990 to 2018. Overall, the total annual kilometres travelled by ships in the region has increased over the 29-year time period. The types of vessels that have consistently made up the greatest portion of traffic in the region are government vessels and icebreakers, passenger ships and general cargo. Over the last 10 years of the study period, pleasure craft vessels have increased at the greatest rate in terms of total proportions of overall vessel traffic in the region. Bulk carriers experienced decreases in total kilometres travelled around 2003 but have since increased over the last 4 years (2015 - 2018). Other vessel types, such as oil and gas exploration vessels as well as fishing vessels, and tugs and barges have remained relatively low throughout the study period.

The spatial distribution of the vessel traffic in Tallurutiup Imanga has been relatively consistent. Most vessels navigate in the middle of the main Parry Channel. Vessel types like passenger ships, pleasure crafts, tankers and general cargo are concentrated around communities. Pleasure crafts and passenger ships also tend to visit inlets on the southern coast of Devon Island.



## REFERENCES CITED

Dawson, J., Copland, L., Johnston, M., Pizzolato, L., Howell, S., Pelot, R., Etienne, L., Matthews, L., & Parsons, J. (2017a). Climate Change Adaptation Strategies and Policy Options for Arctic Shipping in Canada. A report prepared for Transport Canada. Ottawa, Canada.

Dawson, J., Copland, L., Mussells, O., & Carter, N. (2017b). Shipping trends in Nunavut from 1990-2015: A report prepared for the Nunavut General Monitoring Program. Ottawa, Canada and Iqaluit, Nunavut.

Dawson, J., Pizzolato, L., Howell, S., Copland, L., & Johnston, M. E. (2018). Temporal and spatial patterns of ship traffic in the Canadian Arctic from 1990 to 2015. *ARCTIC*, 71(1), 15-26.

Ghosh, S., & Rubly, C. (2015). The emergence of Arctic shipping: issues, threats, costs, and risk-mitigating strategies of the Polar Code. *Australian Journal of Maritime & Ocean Affairs*, 7(3), 171-182.

Government of Nunavut (2016). Population Estimates. Retrieved from:  
<https://www.gov.nu.ca/eia/information/population-data>

Parks Canada (2018). National Marine Conservation Areas: Introduction. Retrieved from:  
<https://www.pc.gc.ca/en/amnc-nmca/introduction>

Pizzolato, L., Howell, S. E., Derksen, C., Dawson, J., & Copland, L. (2014). Changing sea ice conditions and marine transportation activity in Canadian Arctic waters between 1990 and 2012. *Climatic change*, 123(2), 161-173.

Pizzolato, L., Howell, S. E., Dawson, J., Laliberté, F., & Copland, L. (2016). The influence of declining sea ice on shipping activity in the Canadian Arctic. *Geophysical Research Letters*, 43(23), 12,146-12,154.

Smith, L. C., & Stephenson, S. R. (2013). New Trans-Arctic shipping routes navigable by midcentury. *Proceedings of the National Academy of Sciences*, 110(13), E1191-E1195.

Stephenson, S. R., Smith, L. C., Brigham, L. W., & Agnew, J. A. (2013). Projected 21st-century changes to Arctic marine access. *Climatic Change*, 118(3-4), 885-899.



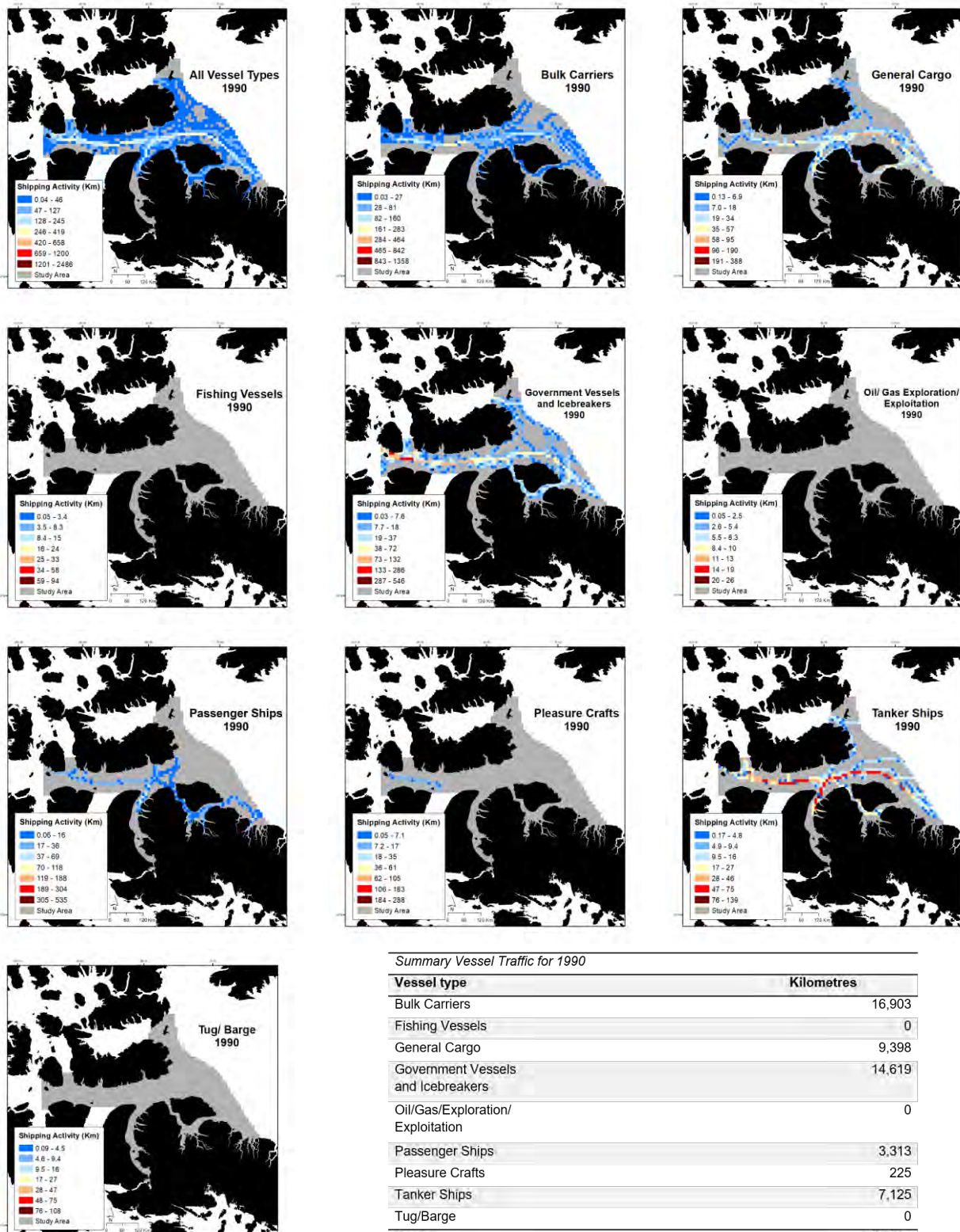
## APPENDIX A: ANNUAL KILOMETRES TRAVELLED BY VESSEL TYPE (1990 – 2018)

Year	Bulk Carriers	Fishing Vessels	General Cargo	Government Vessels and Icebreakers	Oil/Gas/ Exploration/ Exploitation	Passenger Ships	Pleasure Crafts	Tanker Ships	Tug/Barge	Grand Total
<b>1990</b>	16,903	0	9,398	14,619	0	3,313	225	7,125	0	51,584
<b>1991</b>	16,811	0	13,786	17,145	0	2,396	1,612	6,109	2,800	60,658
<b>1992</b>	20,849	0	7,942	16,670	0	2,502	852	4,741	645	54,201
<b>1993</b>	17,348	0	8,489	23,818	0	2,005	69	5,216	0	56,945
<b>1994</b>	19,193	790	11,381	24,246	0	6,494	3,344	4,127	1,674	71,251
<b>1995</b>	17,667	0	10,419	23,618	0	11,122	590	3,473	8,758	75,647
<b>1996</b>	16,254	0	9,260	20,163	0	10,018	0	4,503	1,468	61,666
<b>1997</b>	17,845	0	10,702	27,944	0	9,096	0	2,442	1,181	69,208
<b>1998</b>	13,980	0	11,579	20,667	0	15,647	0	4,161	0	66,034
<b>1999</b>	18,693	0	14,528	29,147	0	14,741	0	2,594	2,267	81,969
<b>Baseline Average</b>	17,554	79	10,748	21,804	0	7,733	669	4,449	1,879	64,916
<b>2000</b>	16,081	0	11,205	30,049	0	13,439	1,343	3,900	0	76,017
<b>2001</b>	13,478	0	16,783	25,717	0	7,418	410	2,942	3,457	70,206
<b>2002</b>	11,335	0	7,722	19,921	0	11,669	0	3,861	1,918	56,426
<b>2003</b>	1,706	0	6,044	20,224	0	11,579	742	3,334	4,348	47,978
<b>2004</b>	0	0	5,135	18,607	0	15,411	1,071	4,192	0	44,416
<b>P1 Average</b>	8,520	0	9,378	22,904	0	11,903	713	3,646	1,945	59,006
<b>Change from Baseline</b>	-9,034	-79	-1,370	1,100	0	4,170	43	-803	65	-5,908

<b>2005</b>	0	0	7,787	21,183	0	16,763	1,481	4,305	479	51,999
<b>2006</b>	0	0	7,137	22,322	0	22,239	0	4,266	1,617	57,582
<b>2007</b>	425	0	7,443	22,894	0	20,611	798	6,989	3,006	62,166
<b>2008</b>	2,797	0	10,746	25,636	772	23,059	5,586	7,226	932	76,753
<b>2009</b>	0	0	9,670	24,326	0	18,172	5,038	5,577	0	62,783
<b>P2 Average</b>	644	0	8,557	23,272	154	20,169	2,581	5,673	1,207	62,257
<b>Change from Baseline</b>	-16,910	-79	-2,192	1,469	154	12,435	1,911	1,224	-672	-2,660
<b>2010</b>	0	0	11,055	20,867	0	21,537	6,565	10,217	2,325	72,567
<b>2011</b>	0	1,250	9,858	26,320	0	9,225	12,304	12,543	1,572	73,073
<b>2012</b>	0	0	12,888	18,348	0	10,073	17,105	8,410	1,337	68,160
<b>2013</b>	731	843	15,931	24,282	403	15,126	16,846	9,340	0	83,502
<b>2014</b>	1,204	2,025	17,906	26,483	0	18,829	27,990	9,018	643	104,098
<b>2015</b>	8,989	4,107	13,823	10,655	0	27,290	16,024	7,669	1,556	90,114
<b>2016</b>	25,571	2,811	13,315	26,328	0	25,886	22,622	6,708	1,453	124,693
<b>2017</b>	41,583	5,573	20,572	24,744	0	27,750	25,420	10,656	1,522	157,820
<b>2018</b>	51,184	1,873	12,645	12,272	1,257	33,690	12,225	8,134	3,831	142,111
<b>P3 Average</b>	14,362	2,054	14,333	21,589	184	21,045	17,456	9,188	1,582	101,793
<b>Change from Baseline</b>	-3,192	1,975	3,584	-215	184	13,312	16,786	4,739	-297	36,877

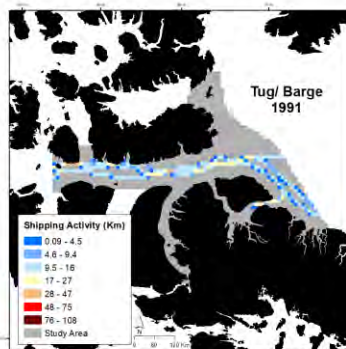
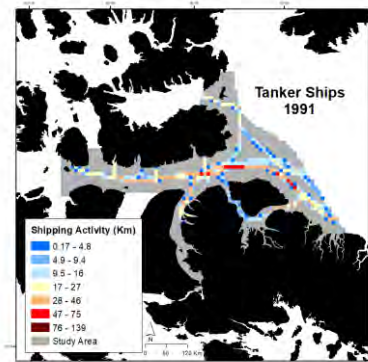
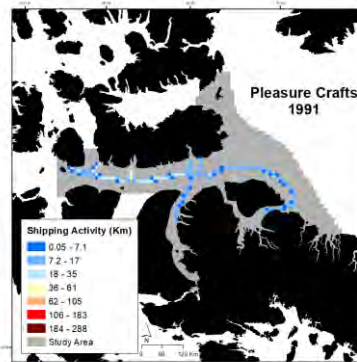
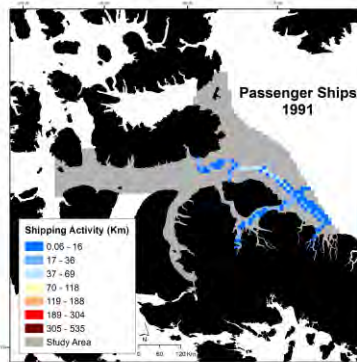
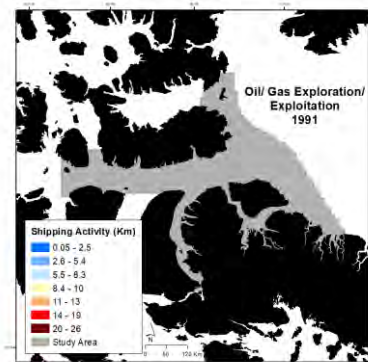
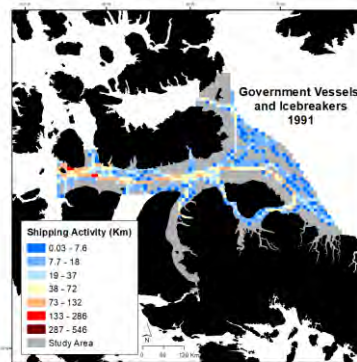
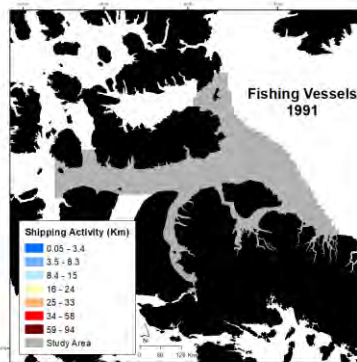
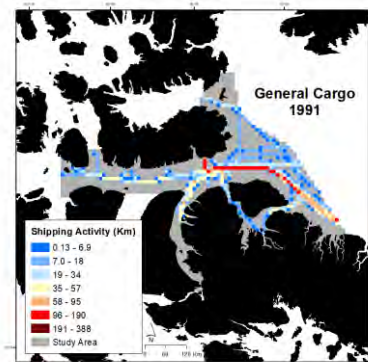
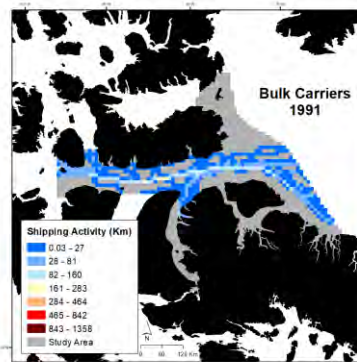
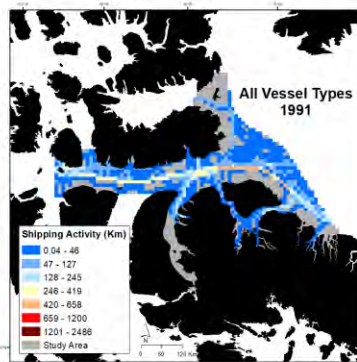
## APPENDIX B: VESSEL TYPE TRENDS BY YEAR (1990 – 2018)

1990





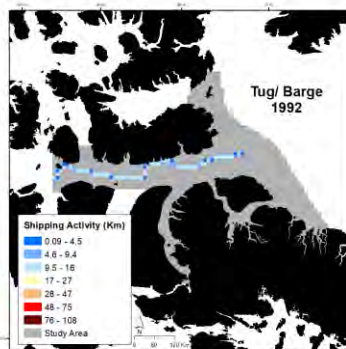
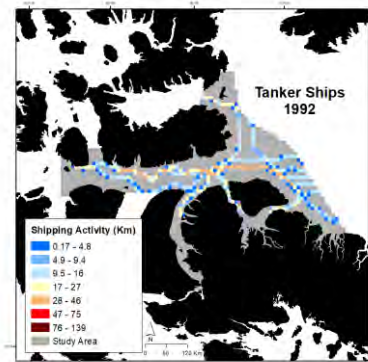
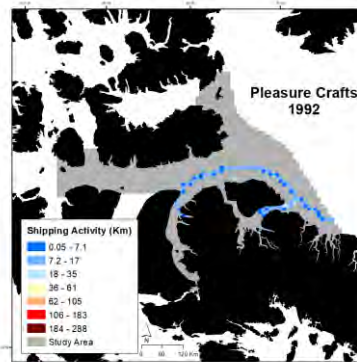
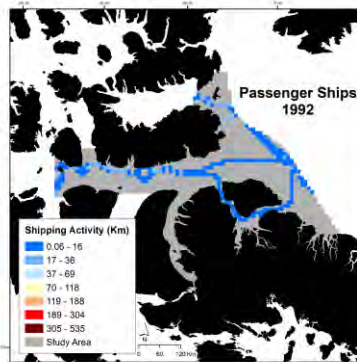
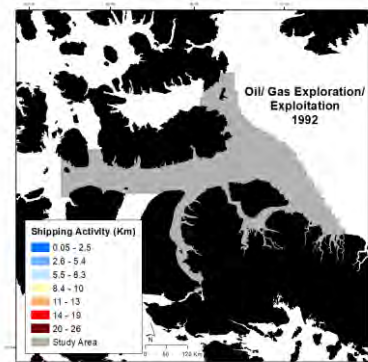
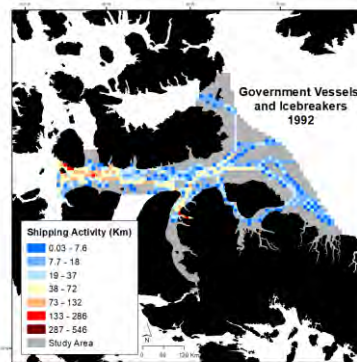
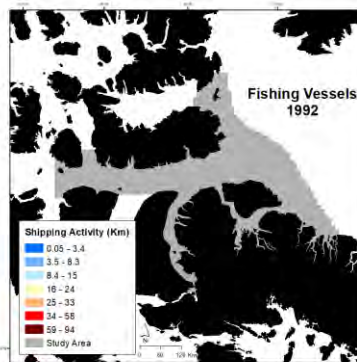
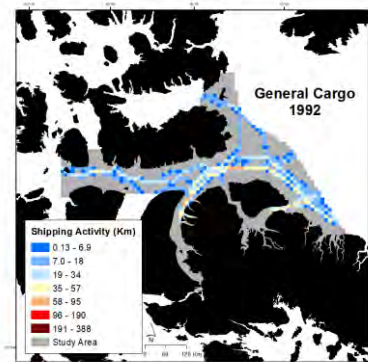
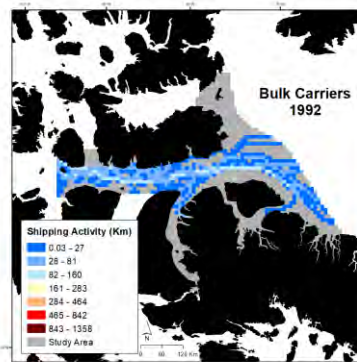
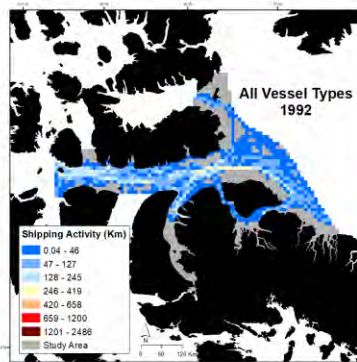
1991



Summary Vessel Traffic for 1991

Vessel type	Kilometres
Bulk Carriers	16,811
Fishing Vessels	0
General Cargo	13,786
Government Vessels and Icebreakers	17,145
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	2,396
Pleasure Crafts	1,612
Tanker Ships	6,109
Tug/Barge	2,800
<b>Total</b>	<b>60,658</b>

1992

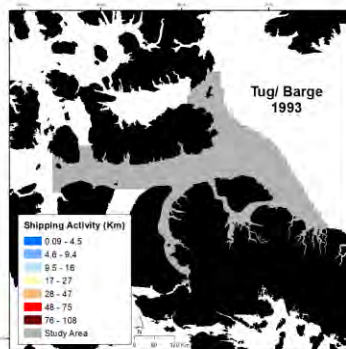
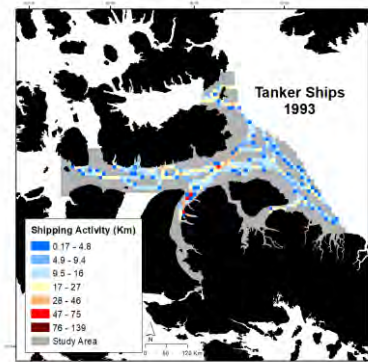
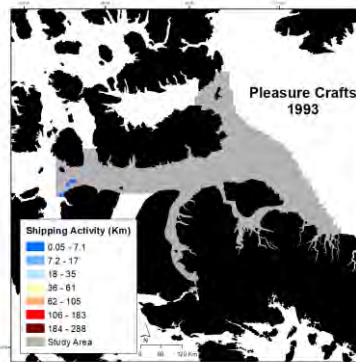
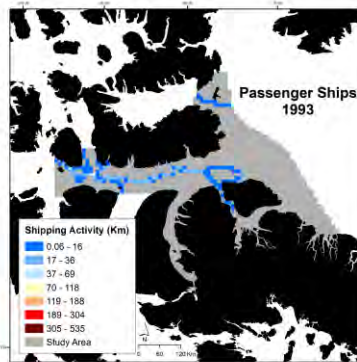
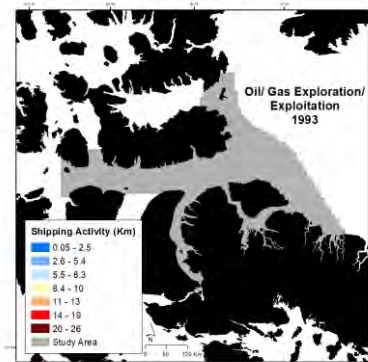
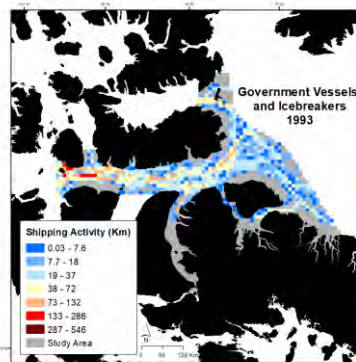
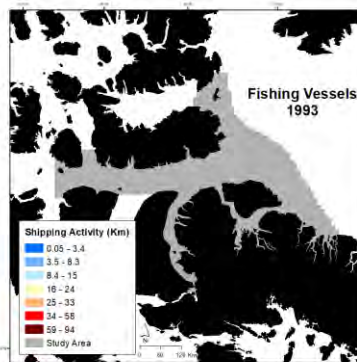
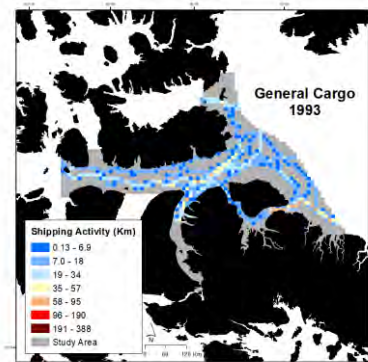
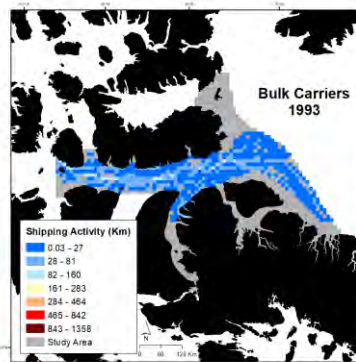
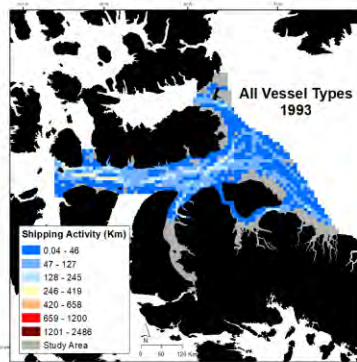


Summary Vessel Traffic for 1992

Vessel type	Kilometres
Bulk Carriers	20,849
Fishing Vessels	0
General Cargo	7,942
Government Vessels and Icebreakers	16,670
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	2,502
Pleasure Crafts	852
Tanker Ships	4,741
Tug/Barge	645
<b>Total</b>	<b>54,201</b>



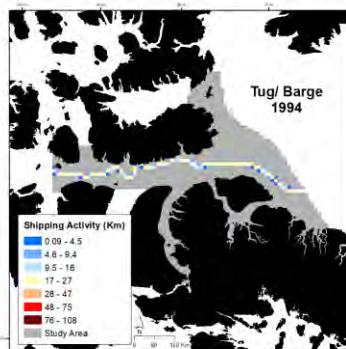
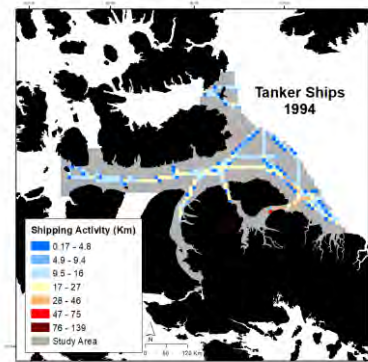
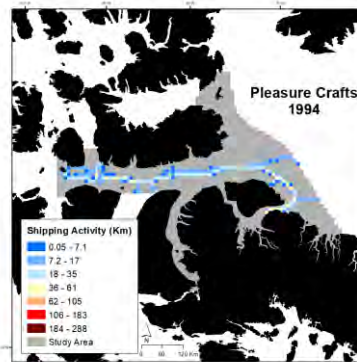
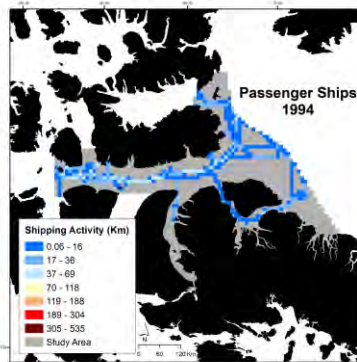
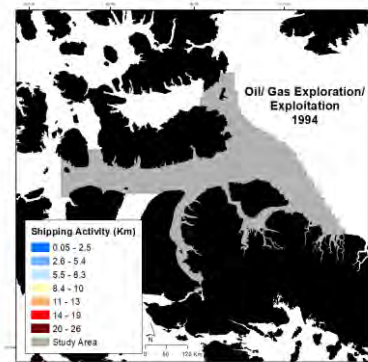
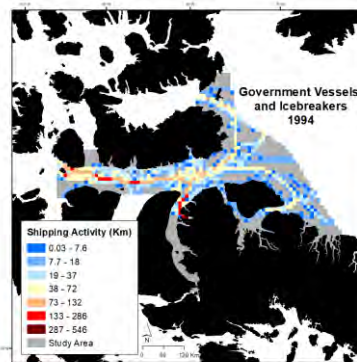
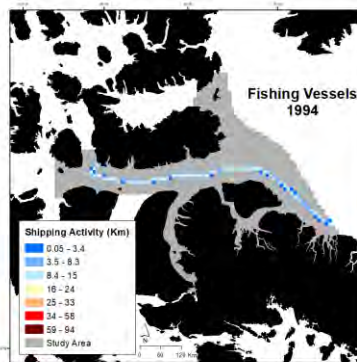
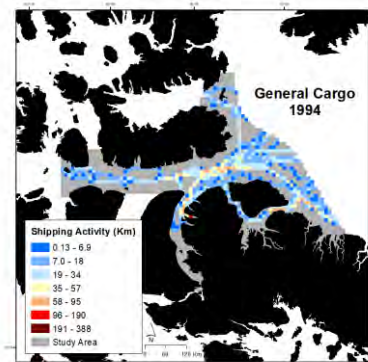
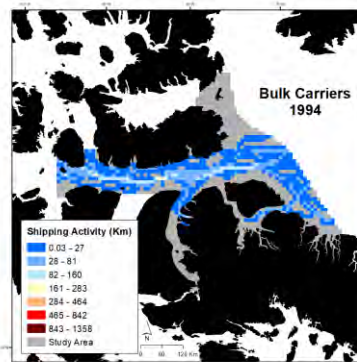
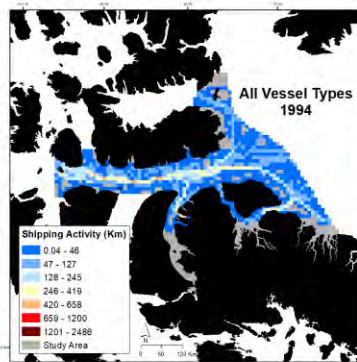
1993



Summary Vessel Traffic for 1993

Vessel type	Kilometres
Bulk Carriers	17,348
Fishing Vessels	0
General Cargo	8,489
Government Vessels and Icebreakers	23,818
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	2,005
Pleasure Crafts	69
Tanker Ships	5,216
Tug/Barge	0
<b>Total</b>	<b>56,945</b>

1994

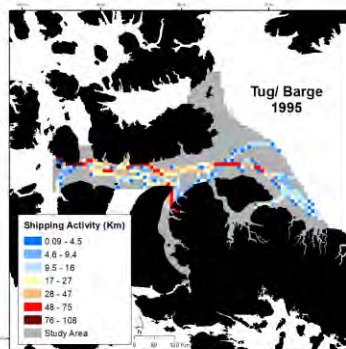
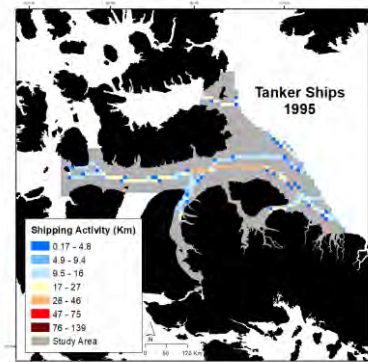
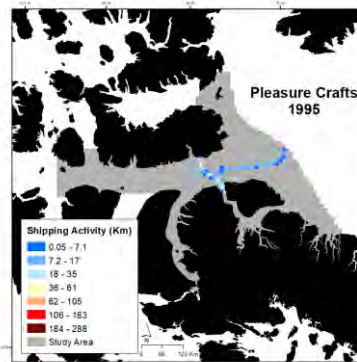
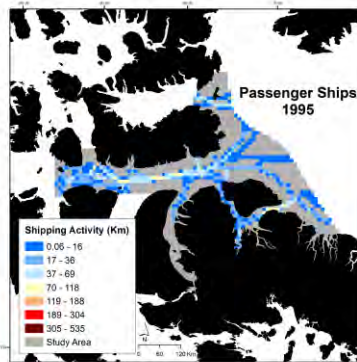
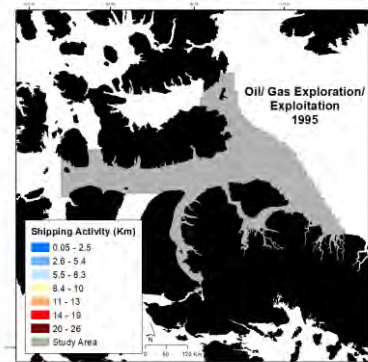
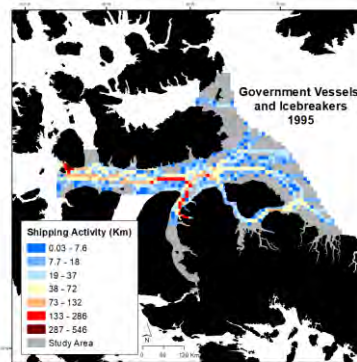
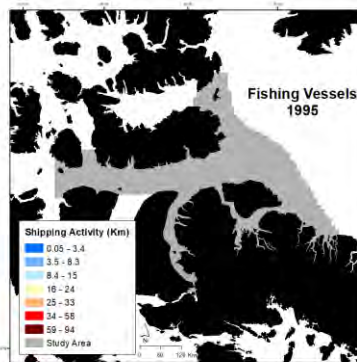
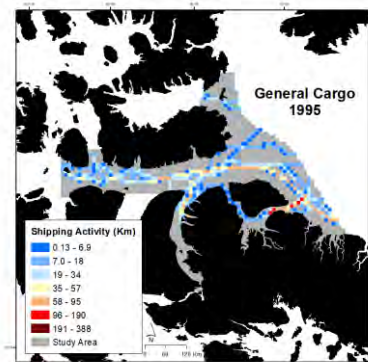
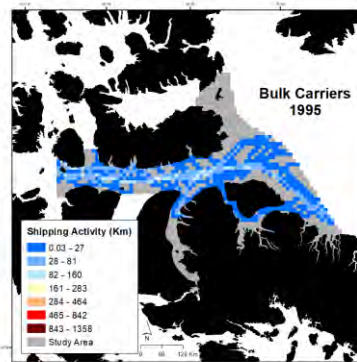
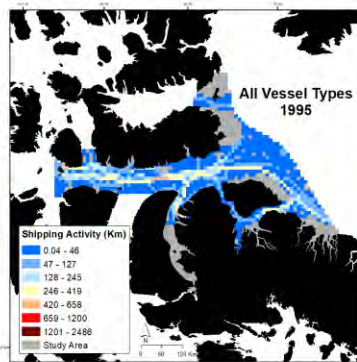


Summary Vessel Traffic for 1994

Vessel type	Kilometres
Bulk Carriers	19,193
Fishing Vessels	790
General Cargo	11,381
Government Vessels and Icebreakers	24,246
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	6,494
Pleasure Crafts	3,344
Tanker Ships	4,127
Tug/Barge	1,674
<b>Total</b>	<b>71,251</b>



1995

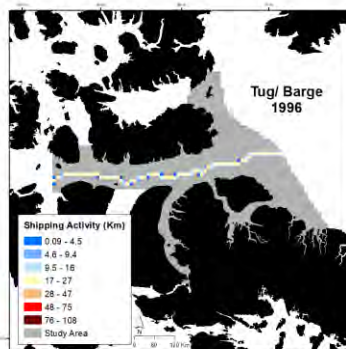
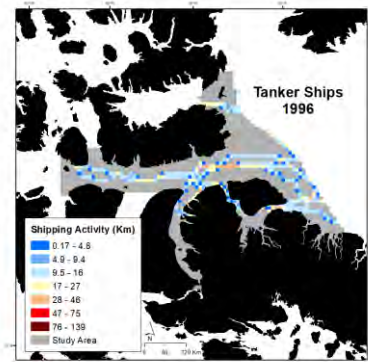
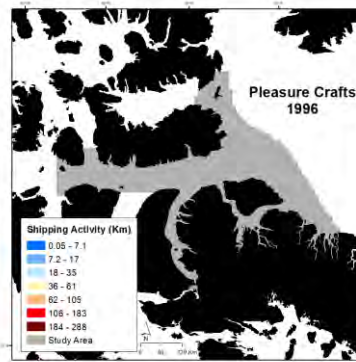
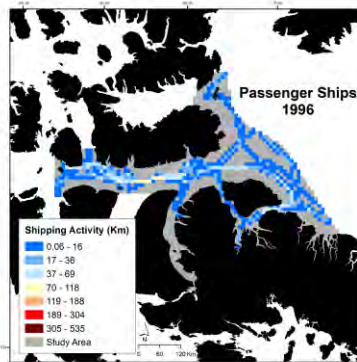
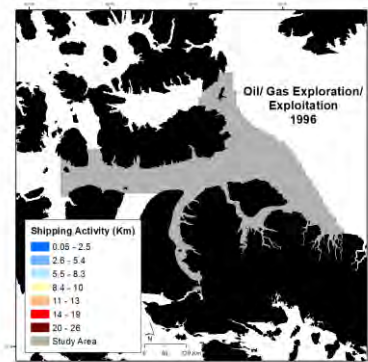
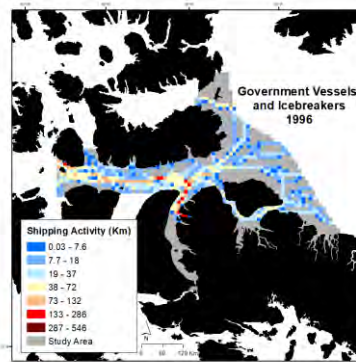
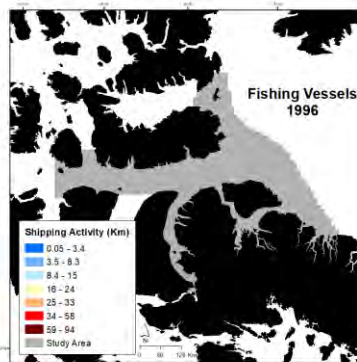
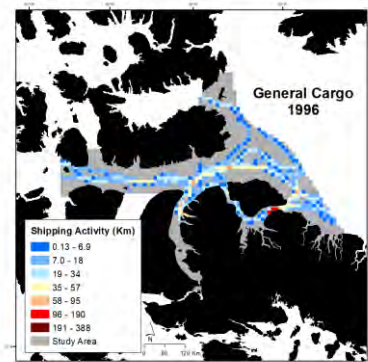
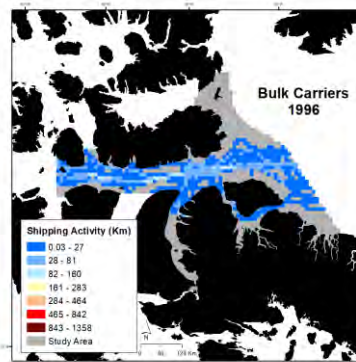
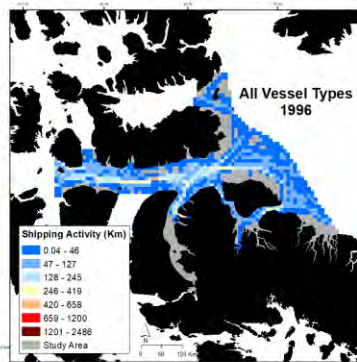


Summary Vessel Traffic for 1995

Vessel type	Kilometres
Bulk Carriers	17,667
Fishing Vessels	0
General Cargo	10,419
Government Vessels and Icebreakers	23,618
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	11,122
Pleasure Crafts	590
Tanker Ships	3,473
Tug/Barge	8,758
<b>Total</b>	<b>75,647</b>



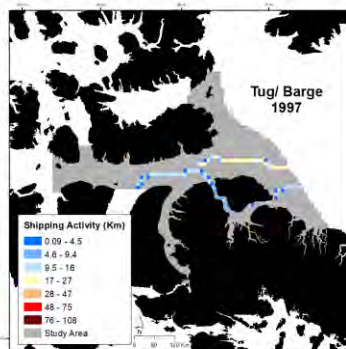
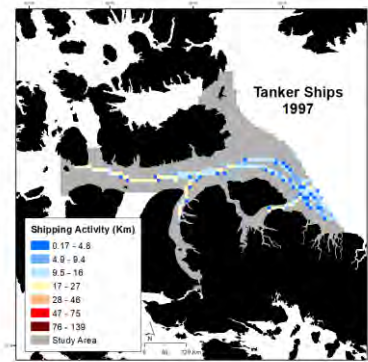
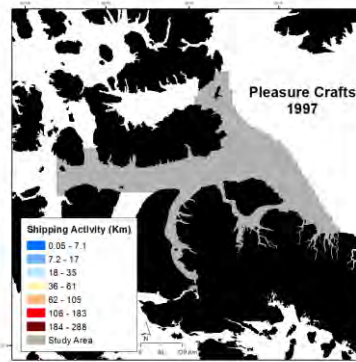
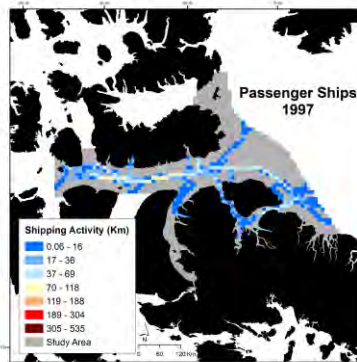
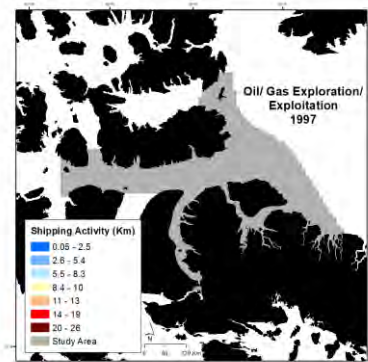
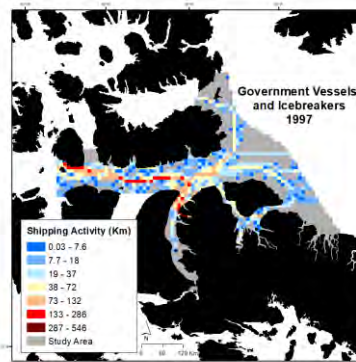
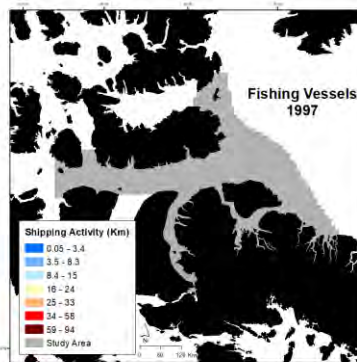
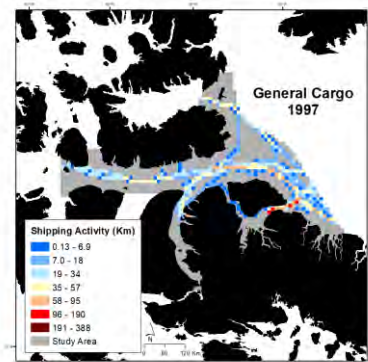
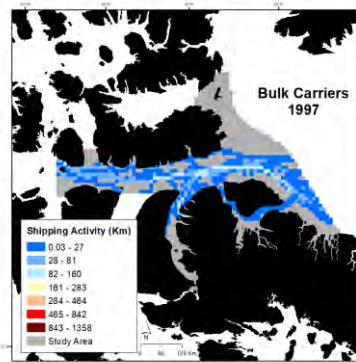
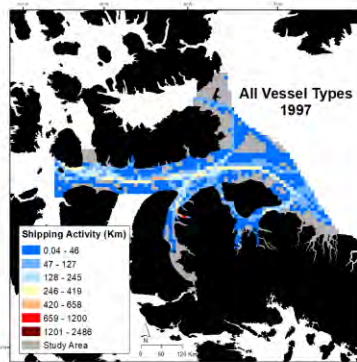
1996



Summary Vessel Traffic for 1996

Vessel type	Kilometres
Bulk Carriers	16,254
Fishing Vessels	0
General Cargo	9,260
Government Vessels and Icebreakers	20,163
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	10,018
Pleasure Crafts	0
Tanker Ships	4,503
Tug/Barge	1,468
<b>Total</b>	<b>61,666</b>

1997

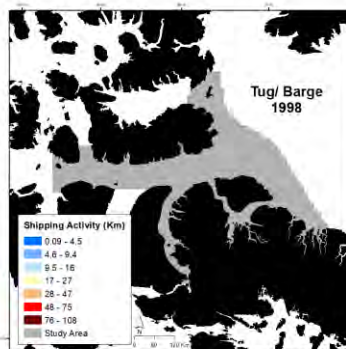
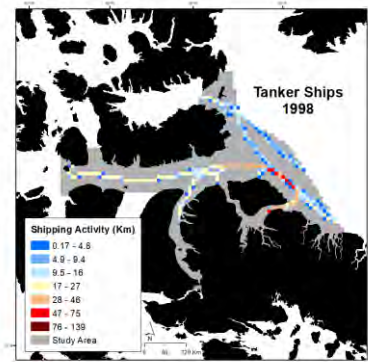
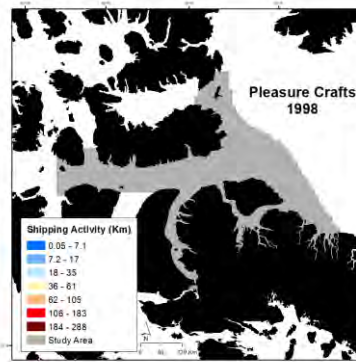
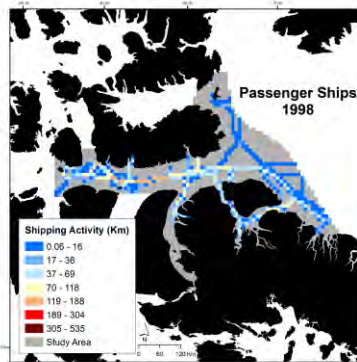
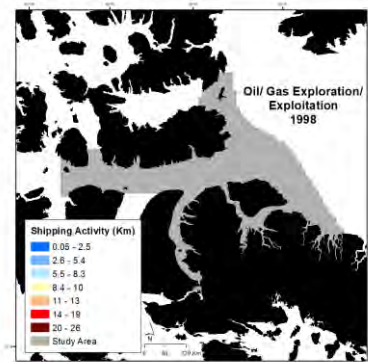
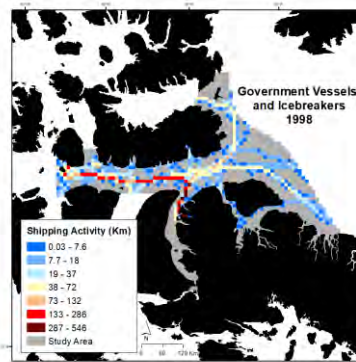
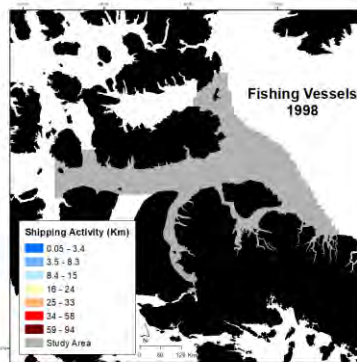
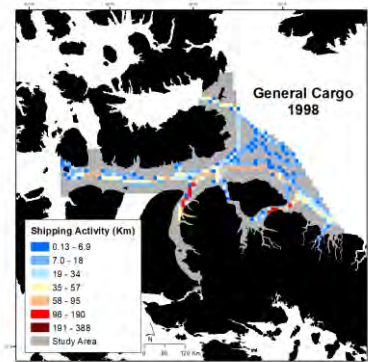
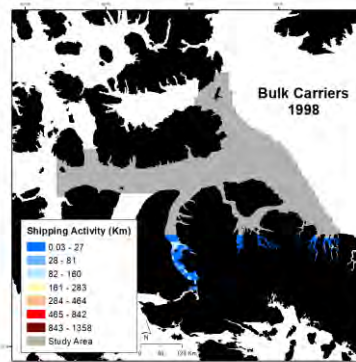
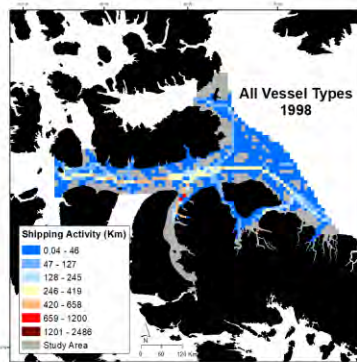


Summary Vessel Traffic for 1997

Vessel type	Kilometres
Bulk Carriers	17,845
Fishing Vessels	0
General Cargo	10,702
Government Vessels and Icebreakers	27,944
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	9,096
Pleasure Crafts	0
Tanker Ships	2,442
Tug/Barge	1,181
<b>Total</b>	<b>69,208</b>



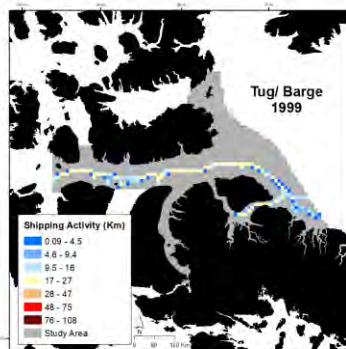
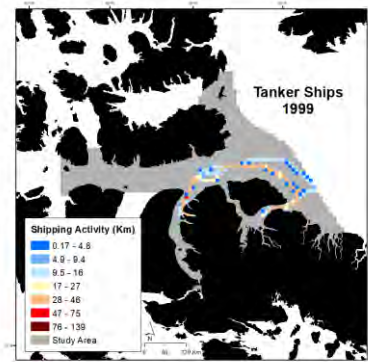
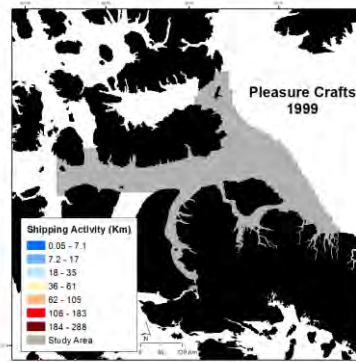
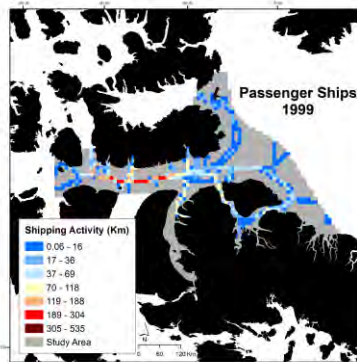
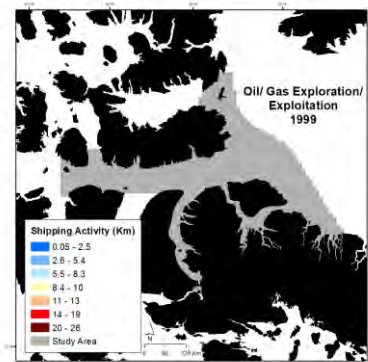
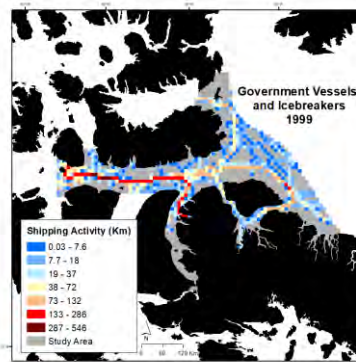
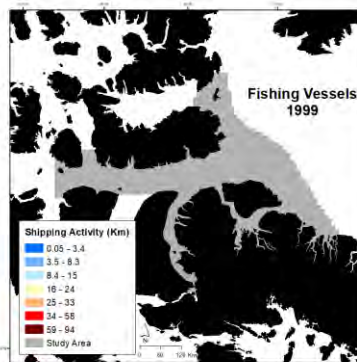
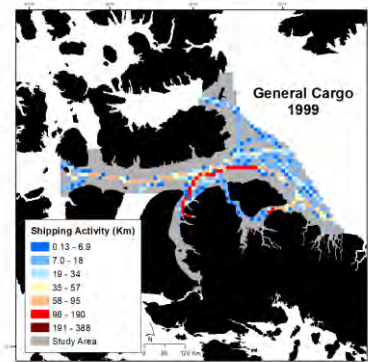
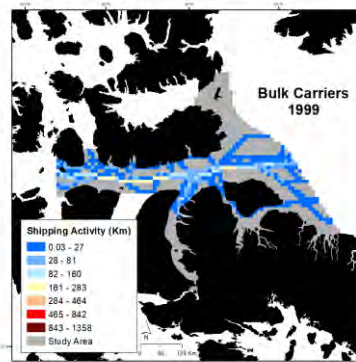
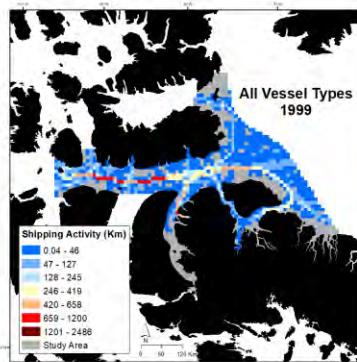
1998



Summary Vessel Traffic for 1998

Vessel type	Kilometres
Bulk Carriers	13,980
Fishing Vessels	0
General Cargo	11,579
Government Vessels and Icebreakers	20,667
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	15,647
Pleasure Vessels	0
Tanker Vessels	4,161
Tug/Barge	0
<b>Total</b>	<b>66,034</b>

1999

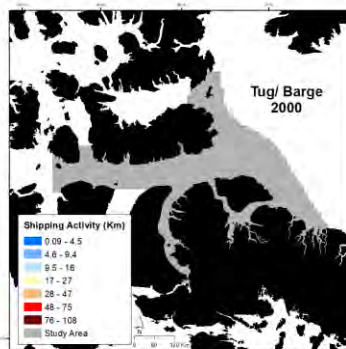
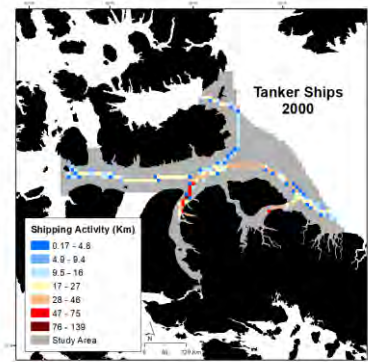
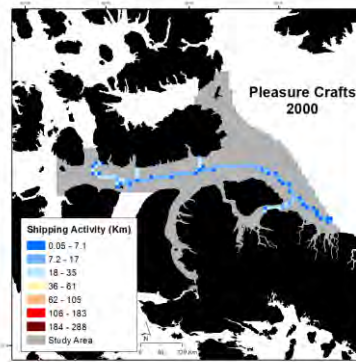
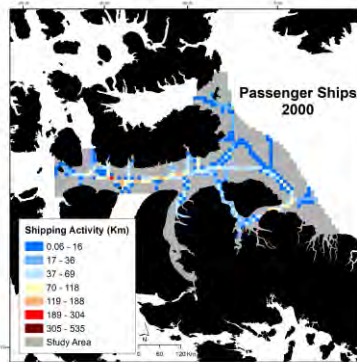
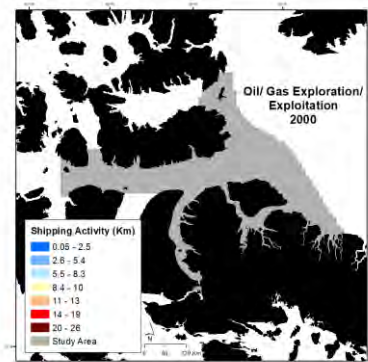
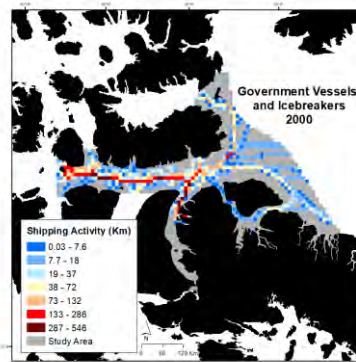
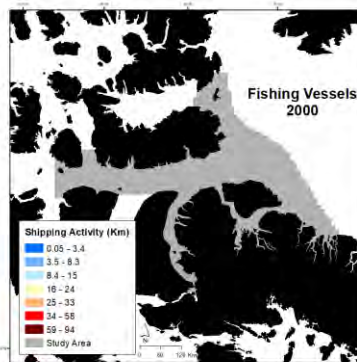
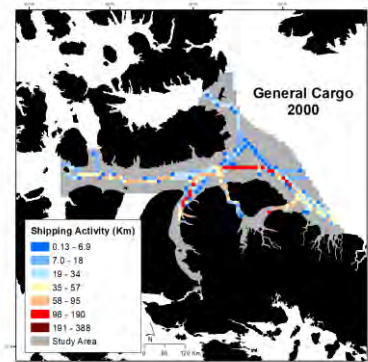
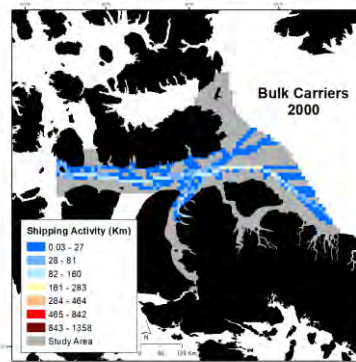
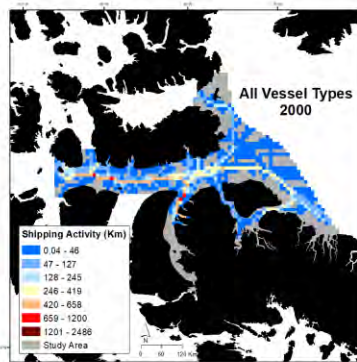


Summary Vessel Traffic for 1999

Vessel type	Kilometres
Bulk Carriers	18,693
Fishing Vessels	0
General Cargo	14,528
Government Vessels and Icebreakers	29,147
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	14,741
Pleasure Vessels	0
Tanker Ships	2,594
Tug/Barge	2,267
<b>Total</b>	<b>81,969</b>



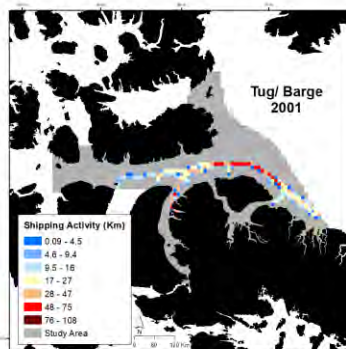
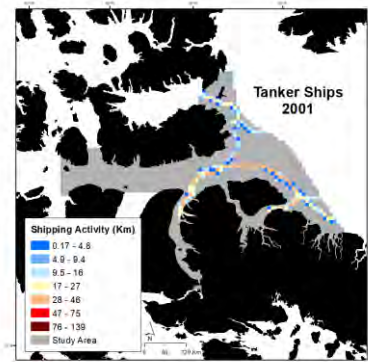
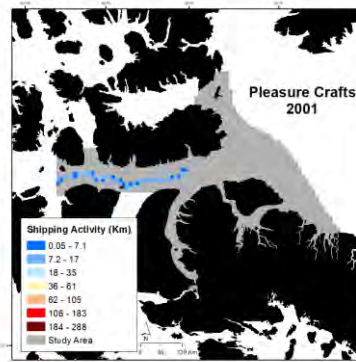
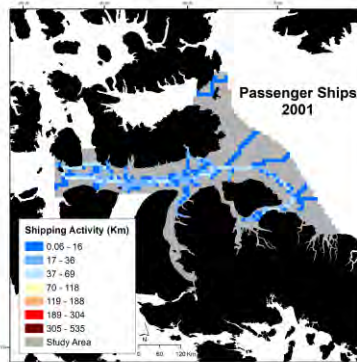
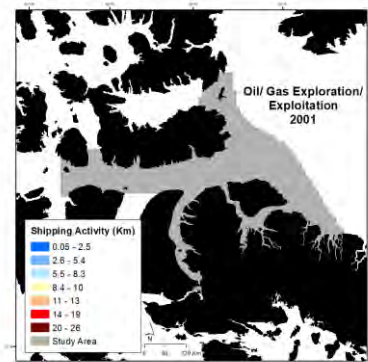
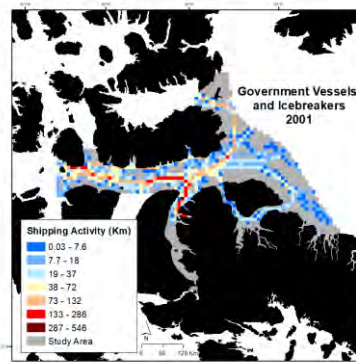
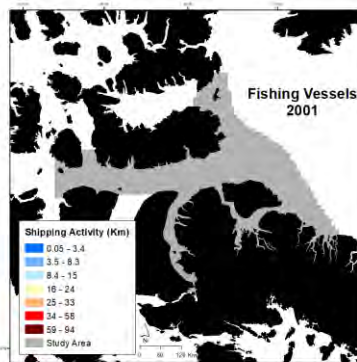
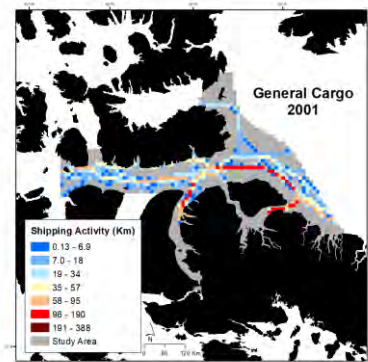
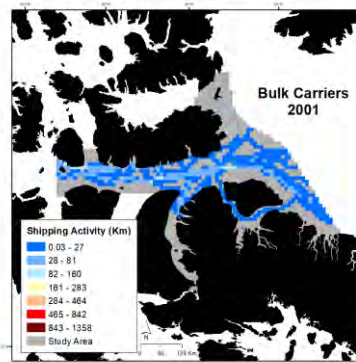
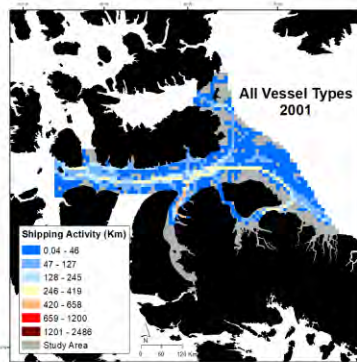
2000



Summary Vessel Traffic for 2000

Vessel type	Kilometres
Bulk Carriers	16,081
Fishing Vessels	0
General Cargo	11,205
Government Vessels and Icebreakers	30,049
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	13,439
Pleasure Crafts	1,343
Tanker Ships	3,900
Tug/Barge	0
<b>Total</b>	<b>76,017</b>

2001

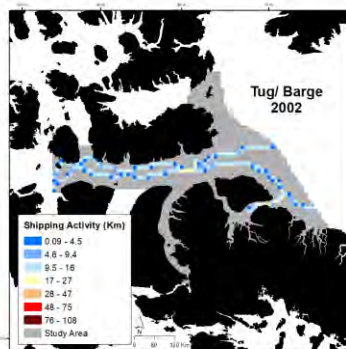
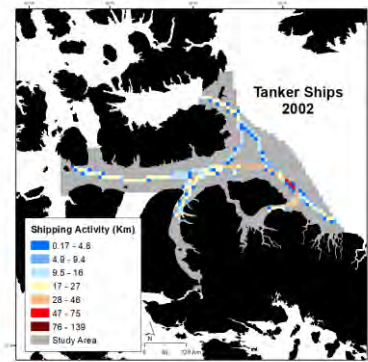
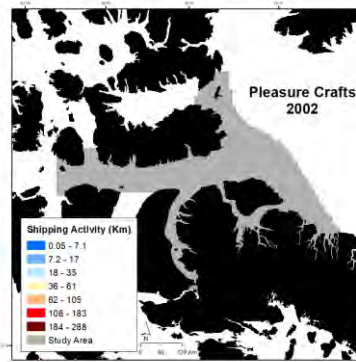
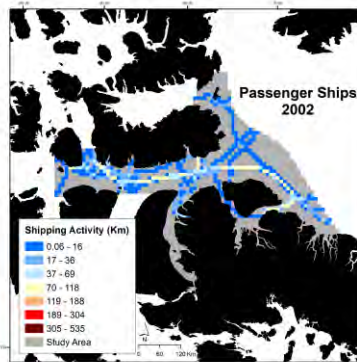
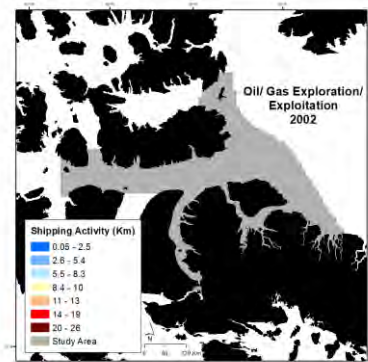
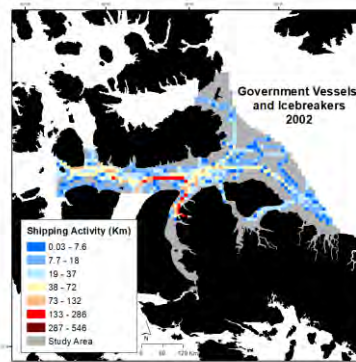
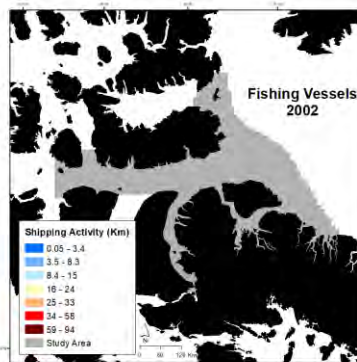
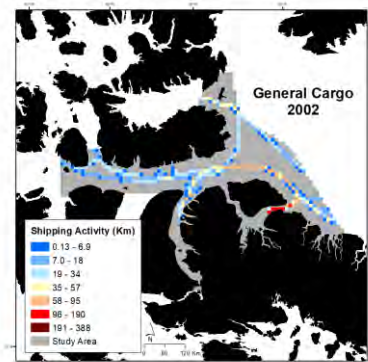
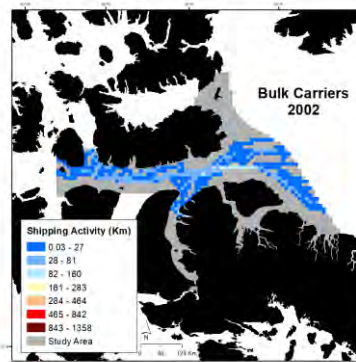
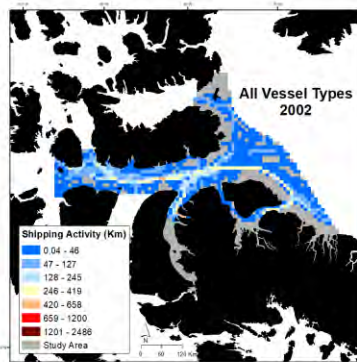


Summary Vessel Traffic for 2001

Vessel type	Kilometres
Bulk Carriers	13,478
Fishing Vessels	0
General Cargo	16,783
Government Vessels and Icebreakers	25,717
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	7,418
Pleasure Crafts	410
Tanker Ships	2,942
Tug/Barge	3,457
<b>Total</b>	<b>70,206</b>



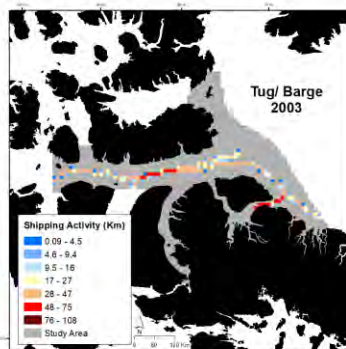
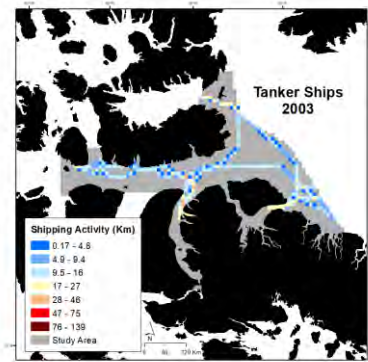
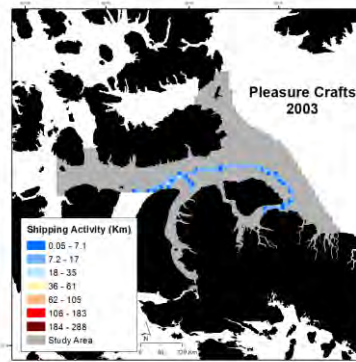
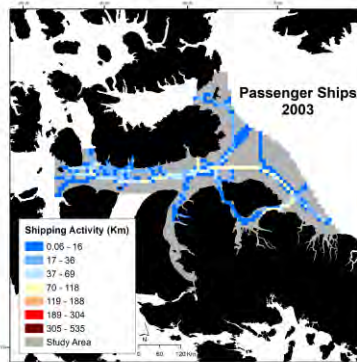
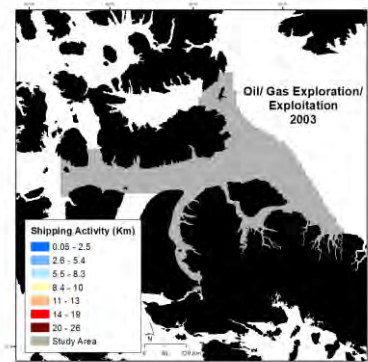
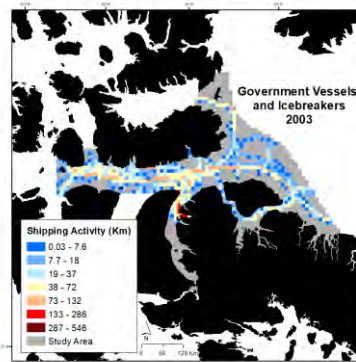
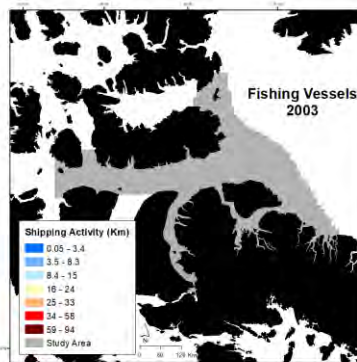
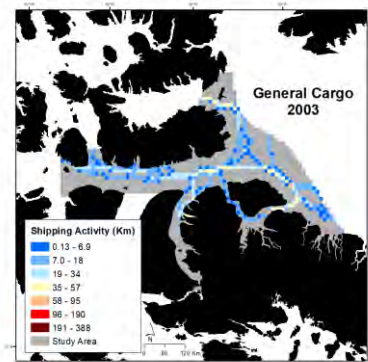
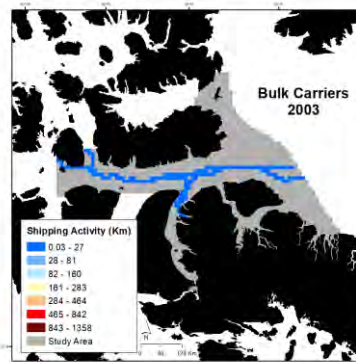
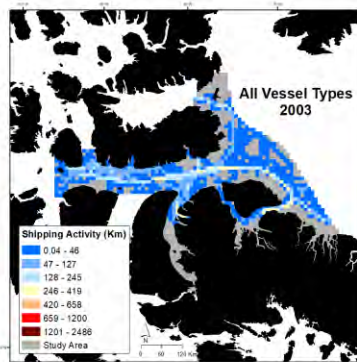
2002



Summary Vessel Traffic for 2002

Vessel type	Kilometres
Bulk Carriers	11,335
Fishing Vessels	0
General Cargo	7,722
Government Vessels and Icebreakers	19,921
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	11,669
Pleasure Crafts	0
Tanker Ships	3,861
Tug/Barge	1,918
<b>Total</b>	<b>56,426</b>

2003

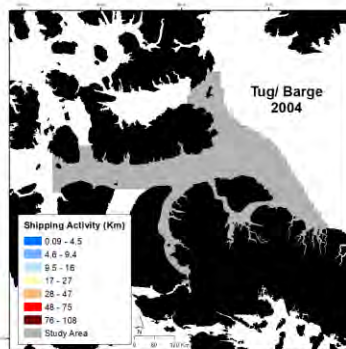
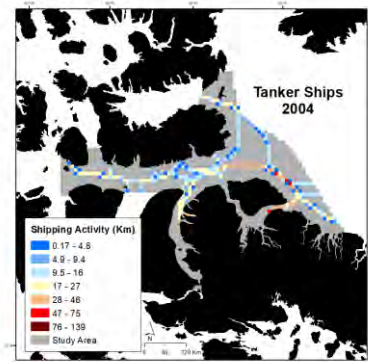
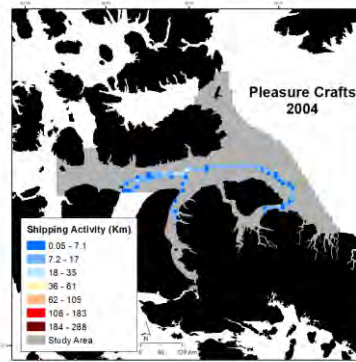
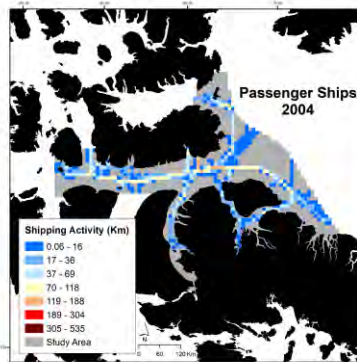
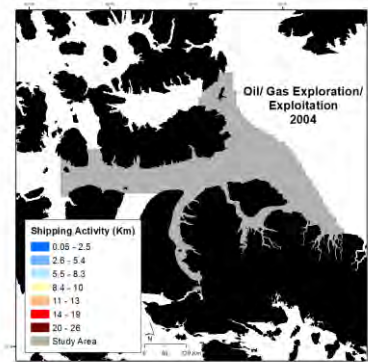
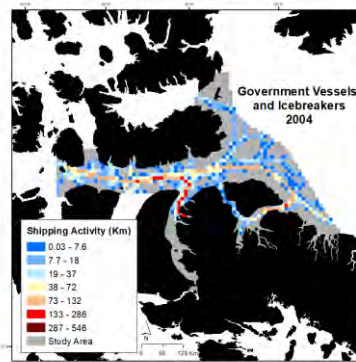
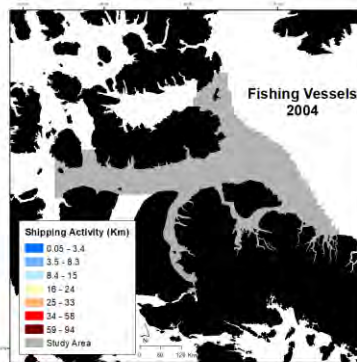
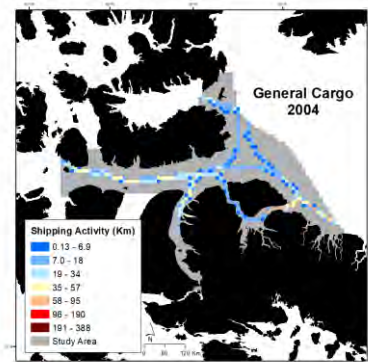
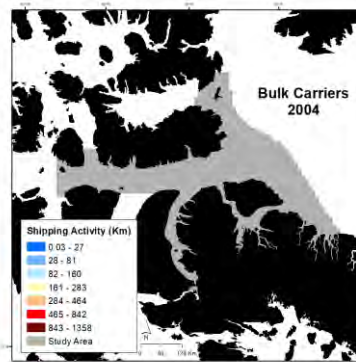
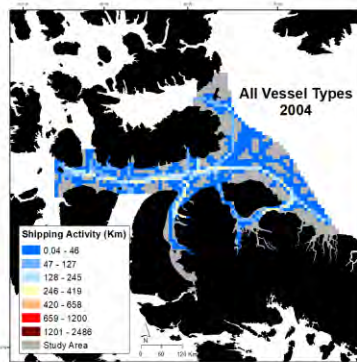


Summary Vessel Traffic for 2003

Vessel type	Kilometres
Bulk Carriers	1,706
Fishing Vessels	0
General Cargo	6,044
Government Vessels and Icebreakers	20,224
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	11,579
Pleasure Crafts	742
Tanker Ships	3,334
Tug/Barge	4,348
<b>Total</b>	<b>47,978</b>



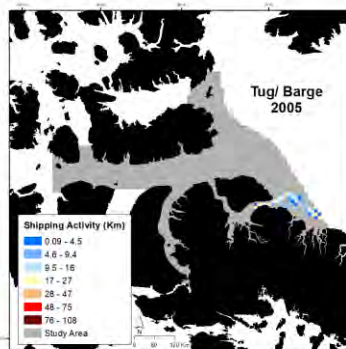
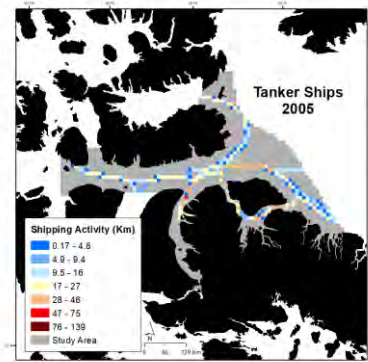
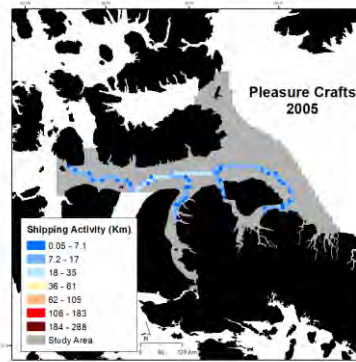
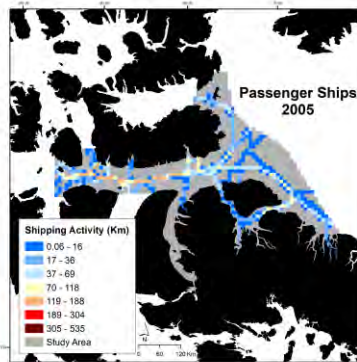
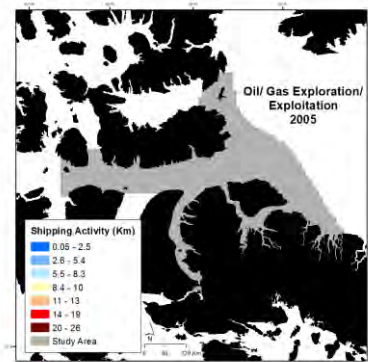
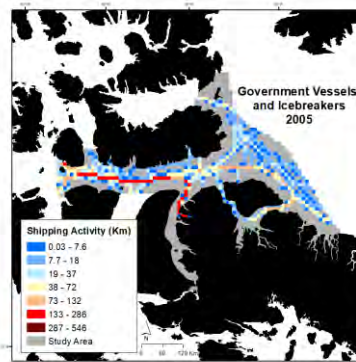
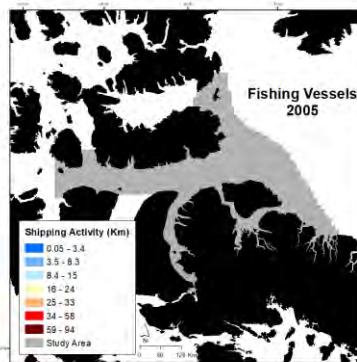
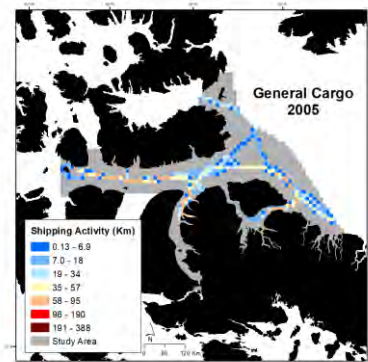
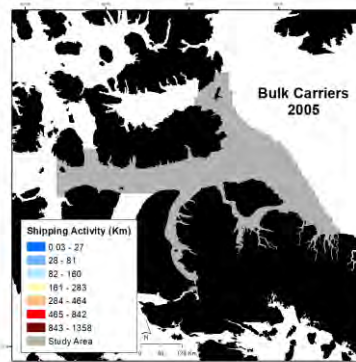
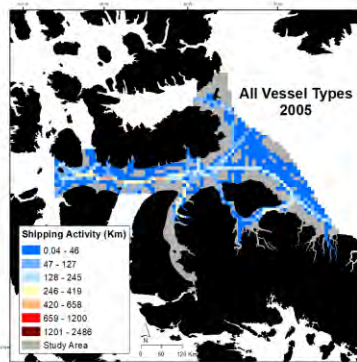
2004



Summary Vessel Traffic for 2004

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	5,135
Government Vessels and Icebreakers	18,607
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	15,411
Pleasure Crafts	1,071
Tanker Ships	4,192
Tug/Barge	0
<b>Total</b>	<b>44,416</b>

## 2005

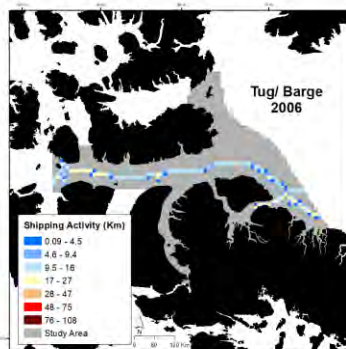
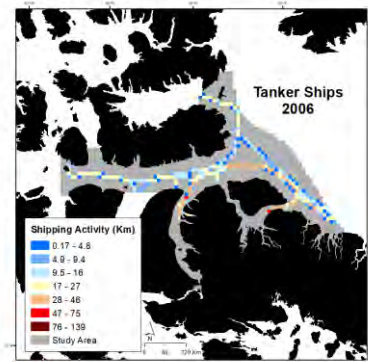
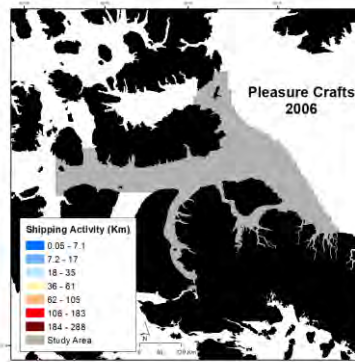
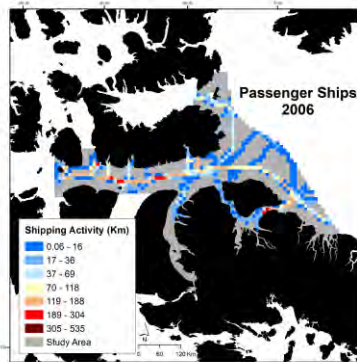
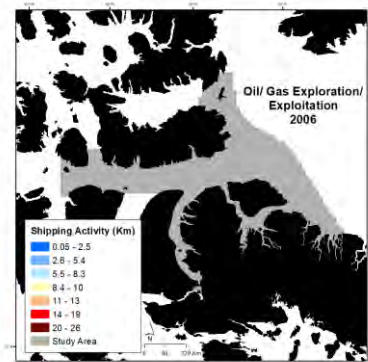
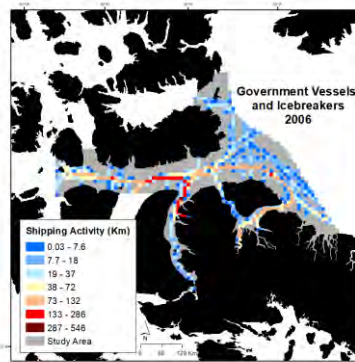
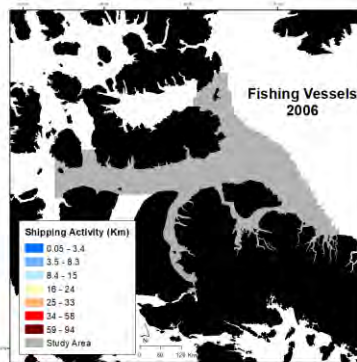
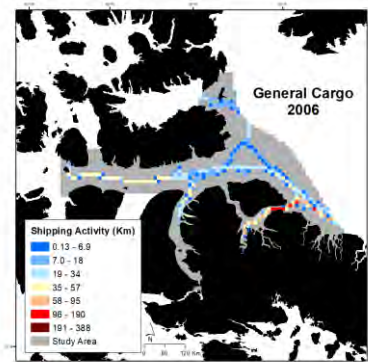
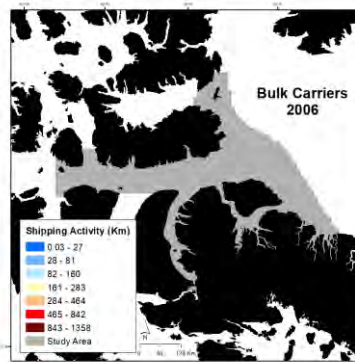
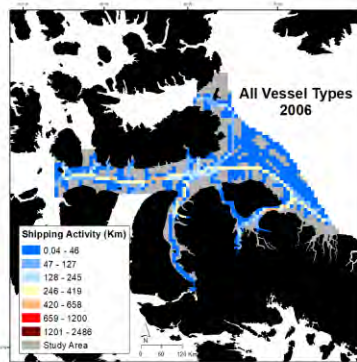


Summary Vessel Traffic for 2005

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	7,787
Government Vessels and Icebreakers	21,183
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	16,763
Pleasure Vessels	1,481
Tanker Ships	4,305
Tug/Barge	479
<b>Total</b>	<b>51,999</b>



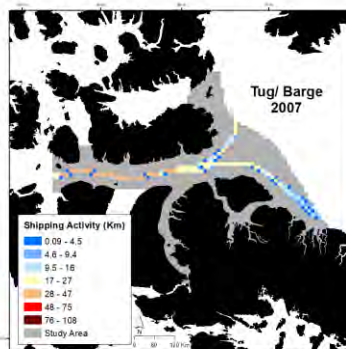
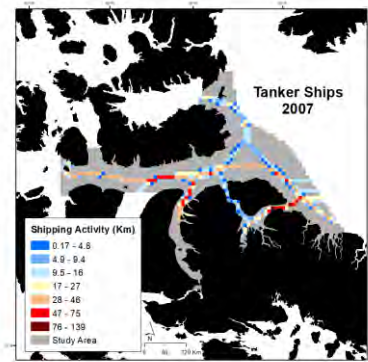
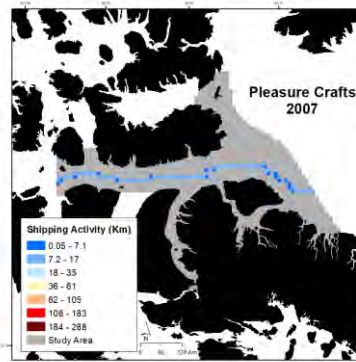
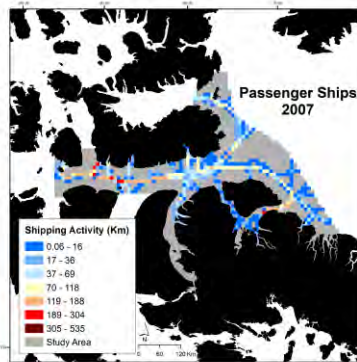
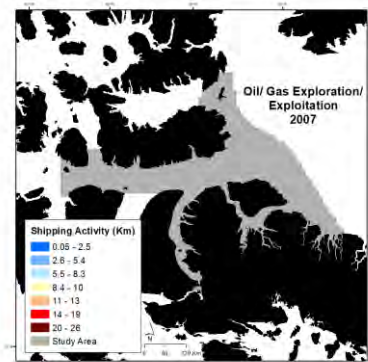
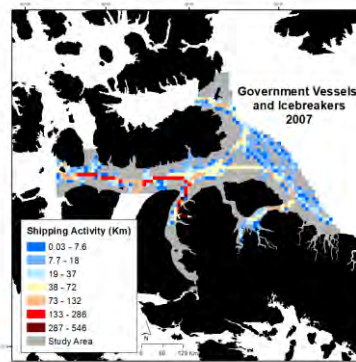
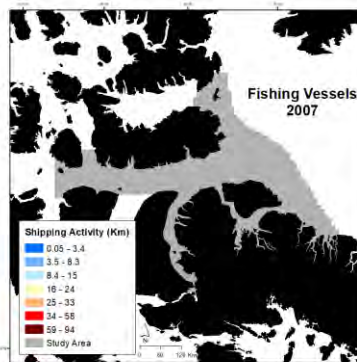
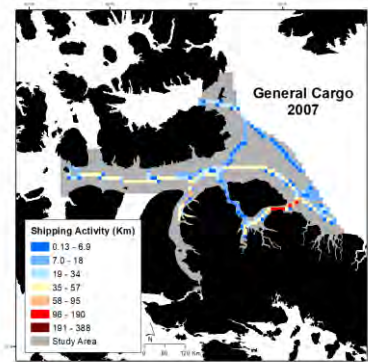
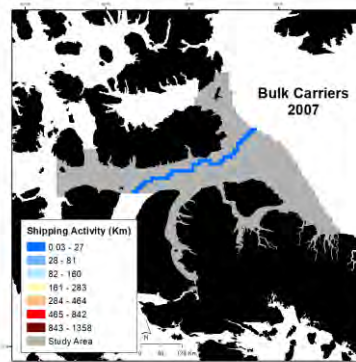
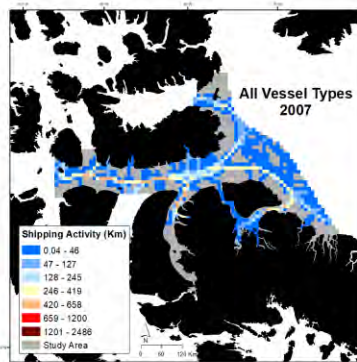
2006



Summary Vessel Traffic for 2006

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	7,137
Government Vessels and Icebreakers	22,322
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	22,239
Pleasure Crafts	0
Tanker Ships	4,266
Tug/Barge	1,617
<b>Total</b>	<b>57,582</b>

2007

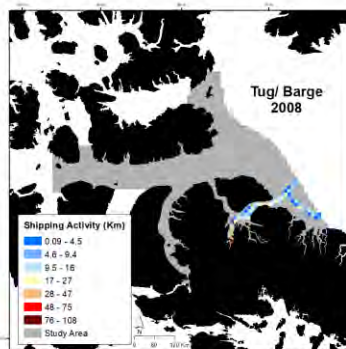
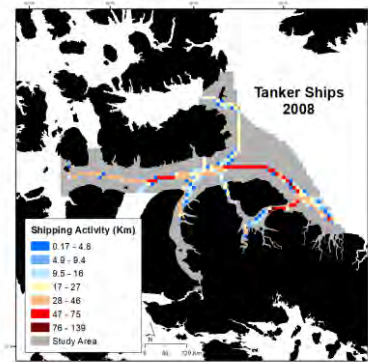
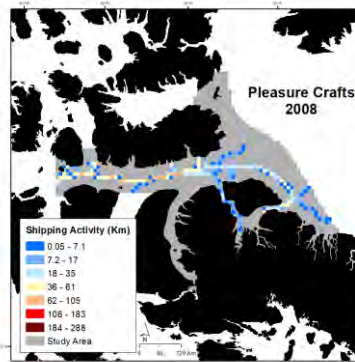
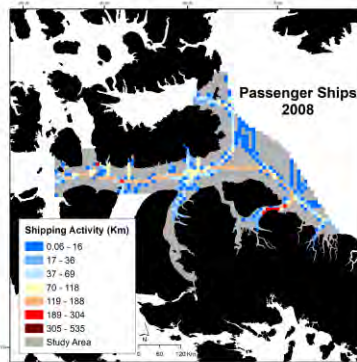
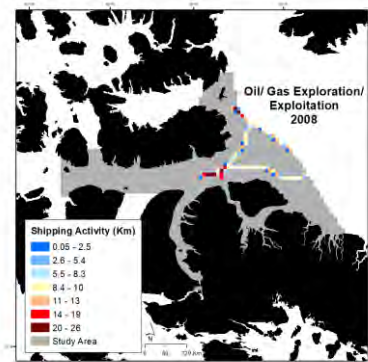
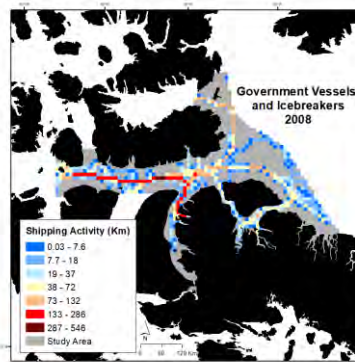
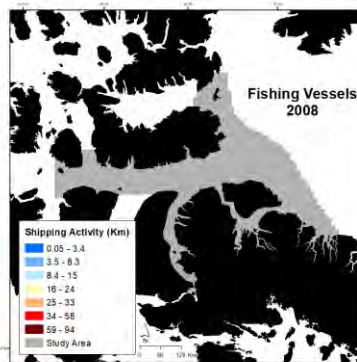
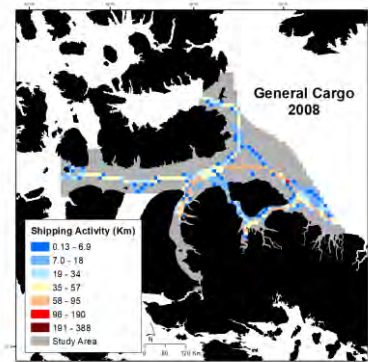
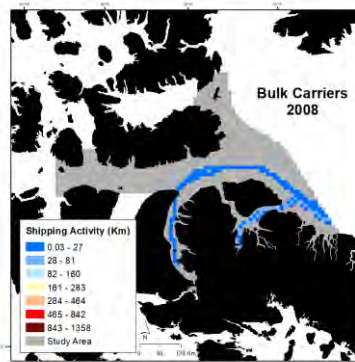
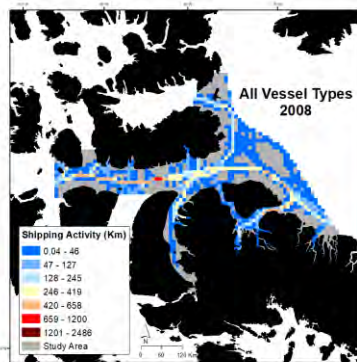


Summary Vessel Traffic for 2007

Vessel type	Kilometres
Bulk Carriers	425
Fishing Vessels	0
General Cargo	7,443
Government Vessels and Icebreakers	22,894
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	20,611
Pleasure Crafts	798
Tanker Ships	6,989
Tug/Barge	3,006
<b>Total</b>	<b>62,166</b>



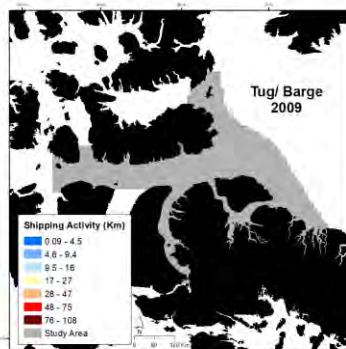
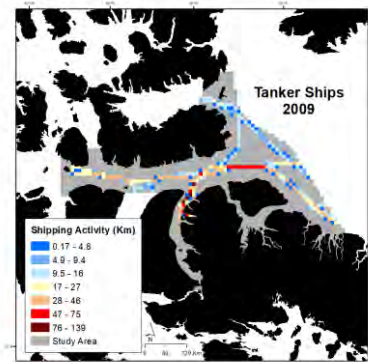
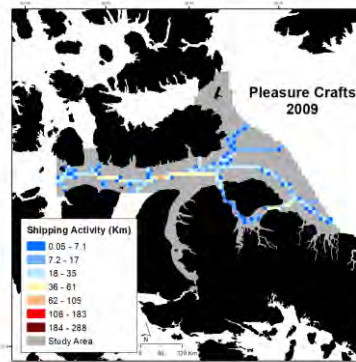
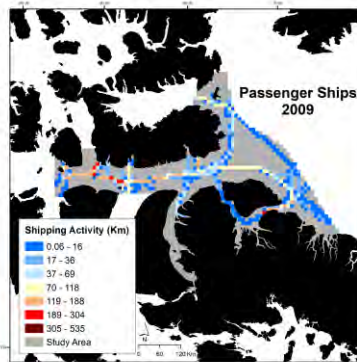
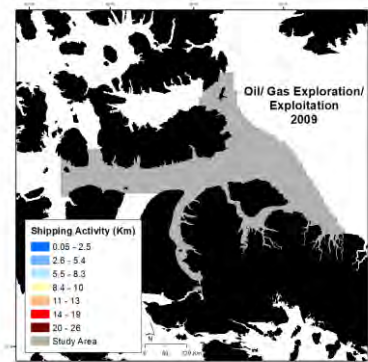
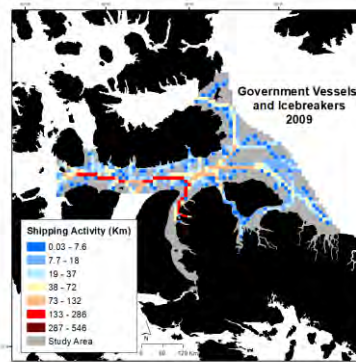
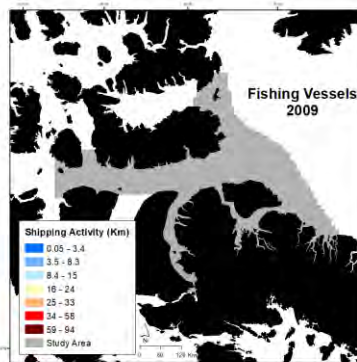
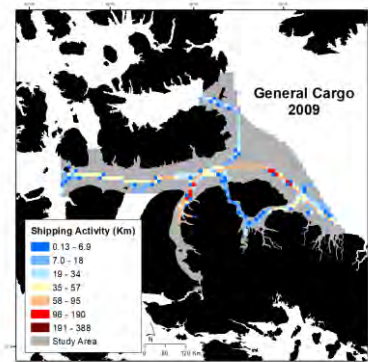
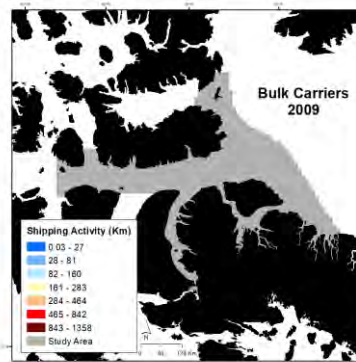
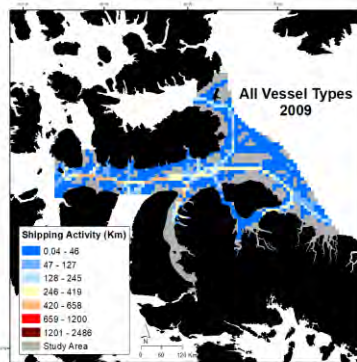
2008



Summary Vessel Traffic for 2008

Vessel type	Kilometres
Bulk Carriers	2,797
Fishing Vessels	0
General Cargo	10,746
Government Vessels and Icebreakers	25,636
Oil/Gas/Exploration/Exploitation	772
Passenger Ships	23,059
Pleasure Crafts	5,586
Tanker Ships	7,226
Tug/Barge	932
<b>Total</b>	<b>76,753</b>

2009

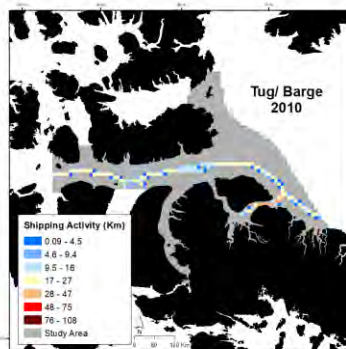
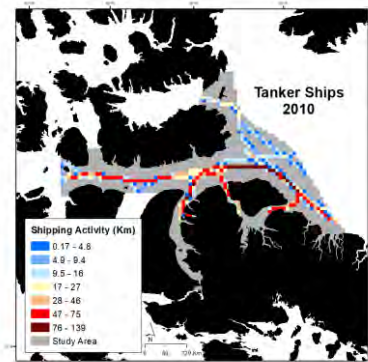
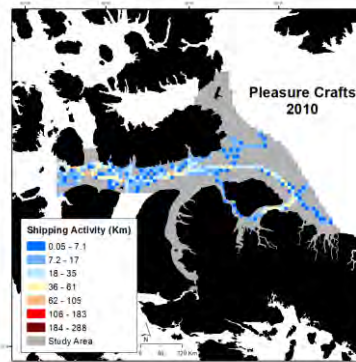
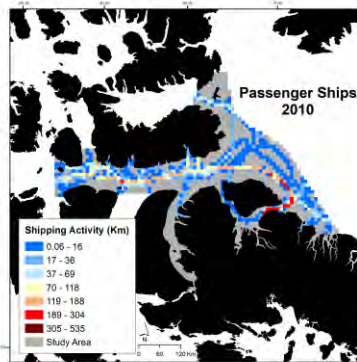
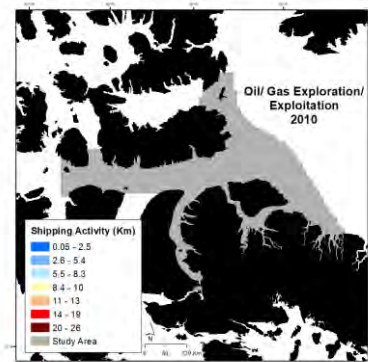
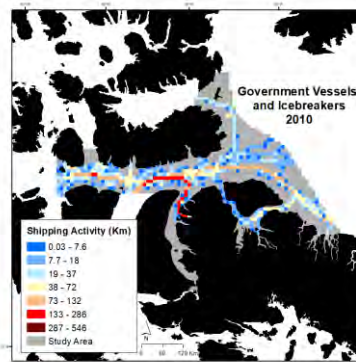
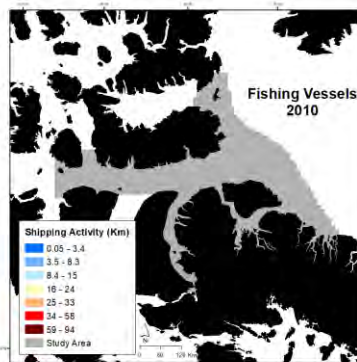
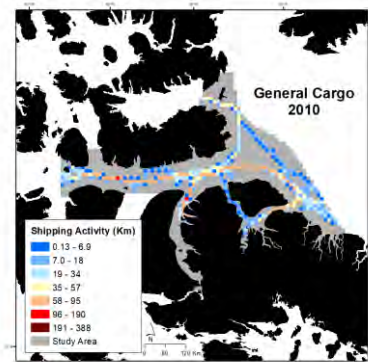
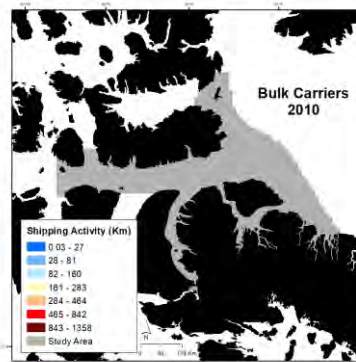
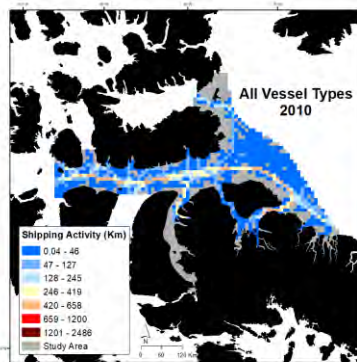


Summary Vessel Traffic for 2009

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	9,670
Government Vessels and Icebreakers	24,326
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	18,172
Pleasure Vessels	5,038
Tanker Ships	5,577
Tug/Barge	0
<b>Total</b>	<b>62,783</b>



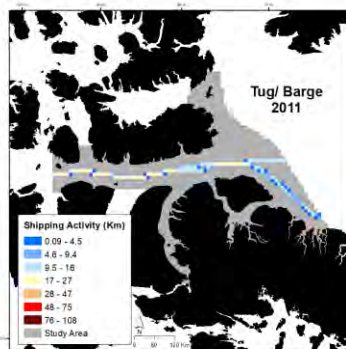
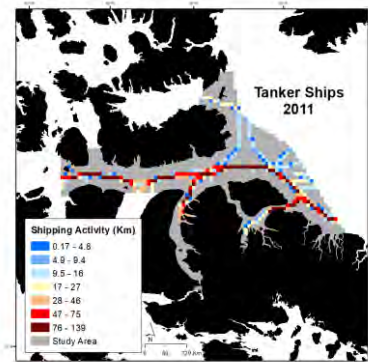
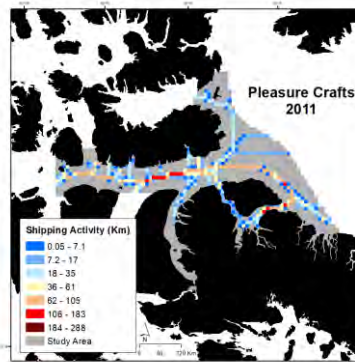
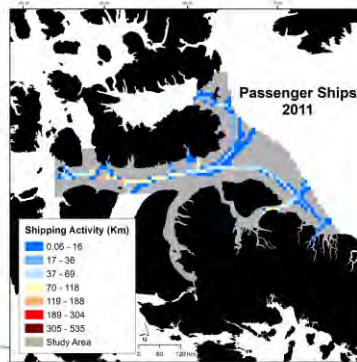
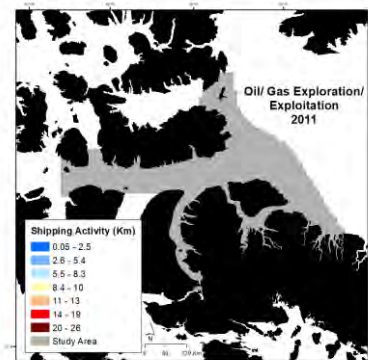
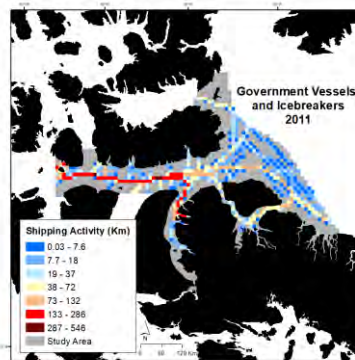
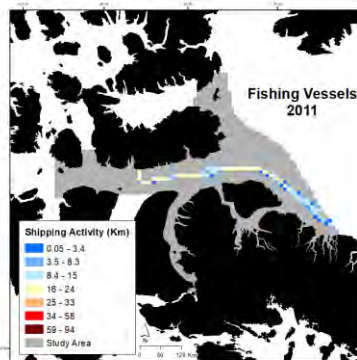
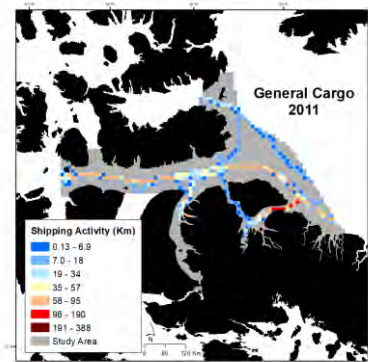
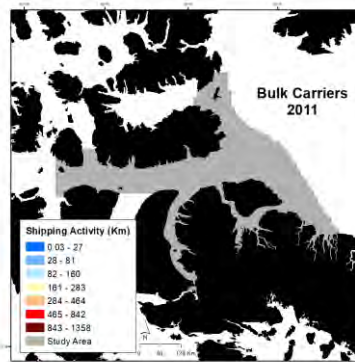
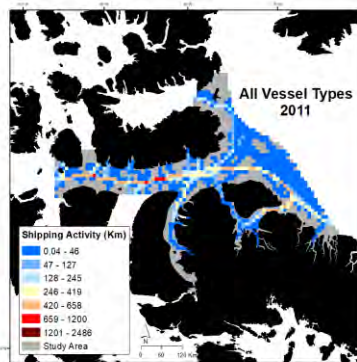
2010



Summary Vessel Traffic for 2010

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	11,055
Government Vessels and Icebreakers	20,867
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	21,537
Pleasure Vessels	6,565
Tanker Ships	10,217
Tug/Barge	2,325
<b>Total</b>	<b>75,567</b>

2011

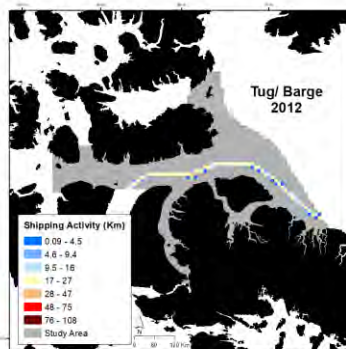
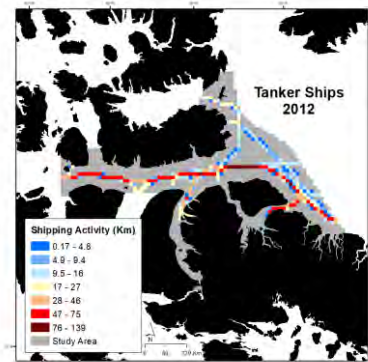
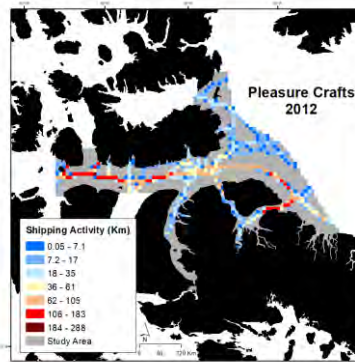
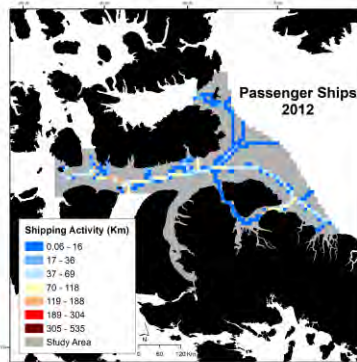
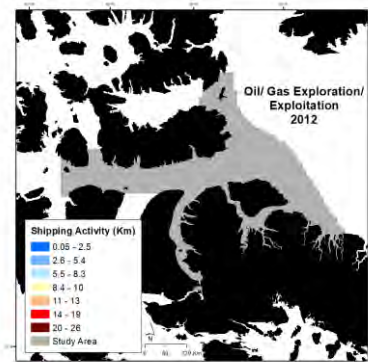
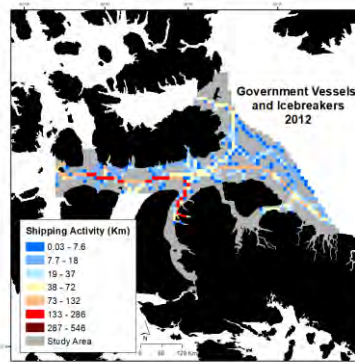
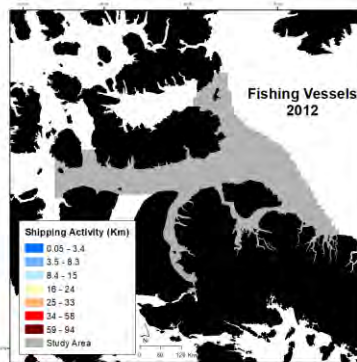
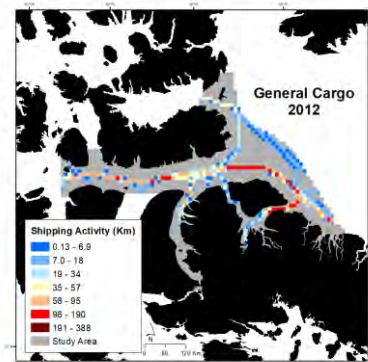
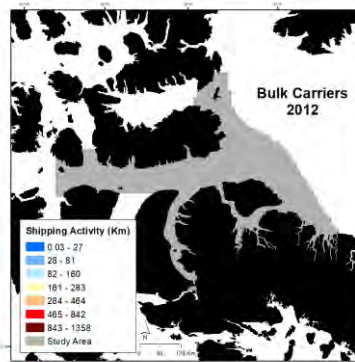
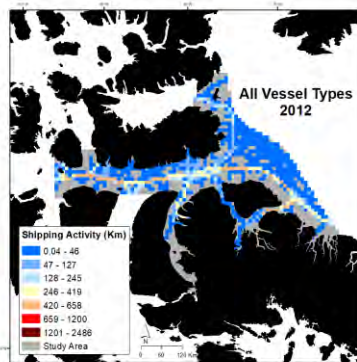


Summary Vessel Traffic for 2011

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	1,250
General Cargo	9,858
Government Vessels and Icebreakers	26,320
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	9,225
Pleasure Vessels	12,304
Tanker Ships	12,543
Tug/Barge	1,572
<b>Total</b>	<b>73,073</b>



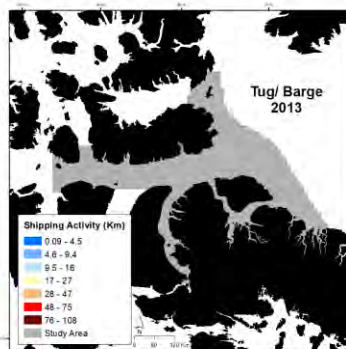
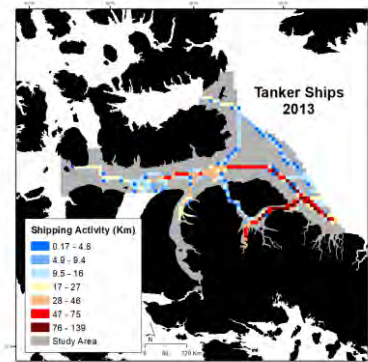
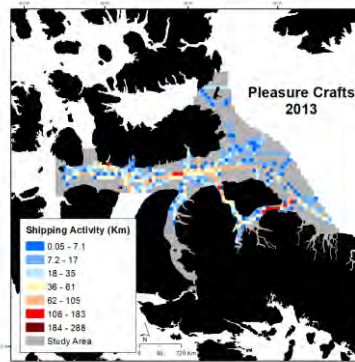
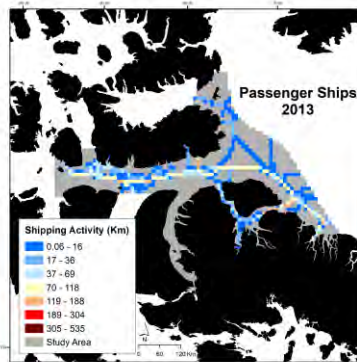
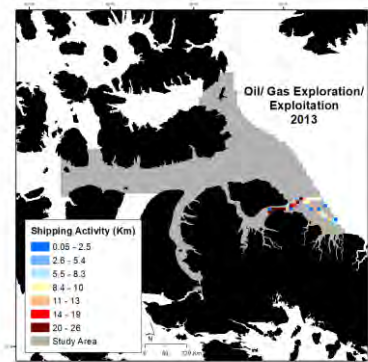
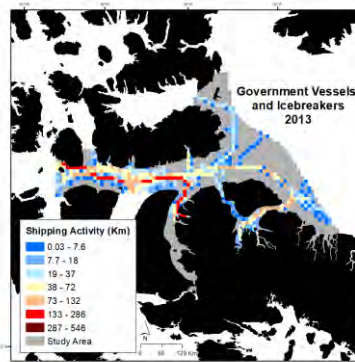
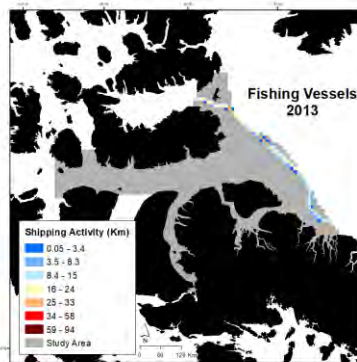
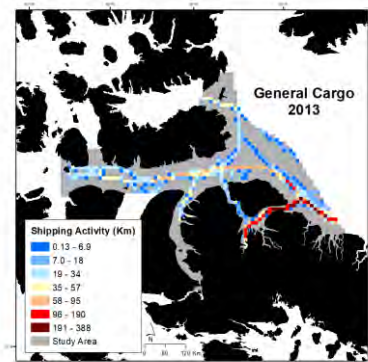
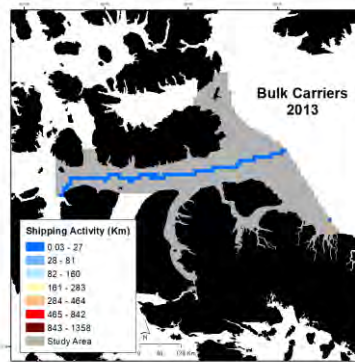
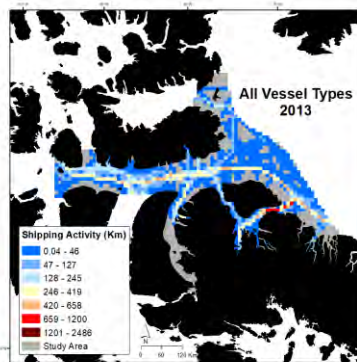
2012



Summary Vessel Traffic for 2012

Vessel type	Kilometres
Bulk Carriers	0
Fishing Vessels	0
General Cargo	12,888
Government Vessels and Icebreakers	18,348
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	10,073
Pleasure Crafts	17,105
Tanker Ships	8,410
Tug/Barge	1,337
<b>Total</b>	<b>68,160</b>

2013

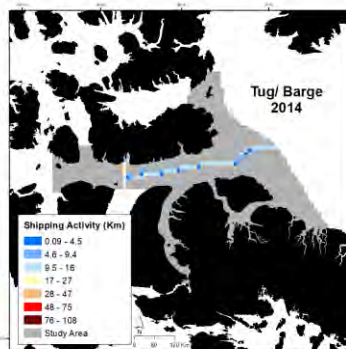
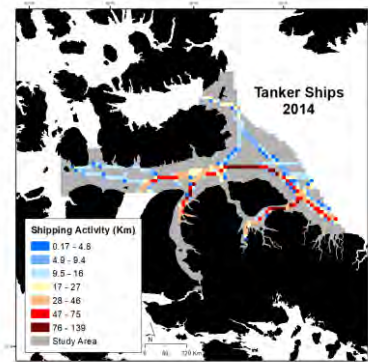
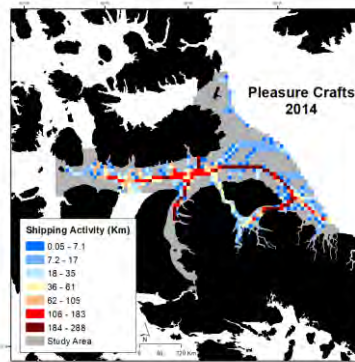
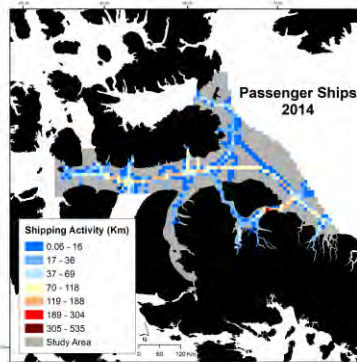
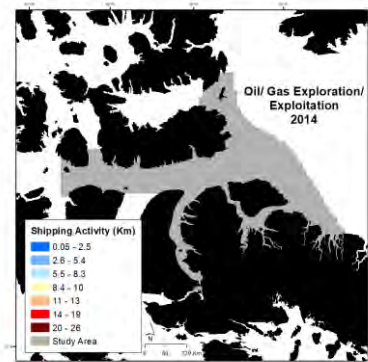
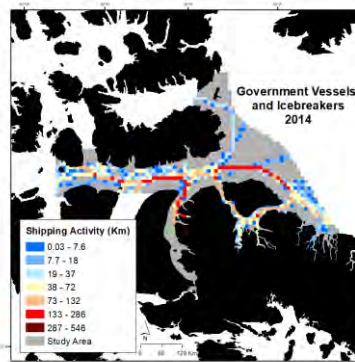
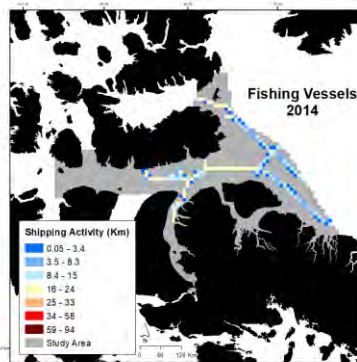
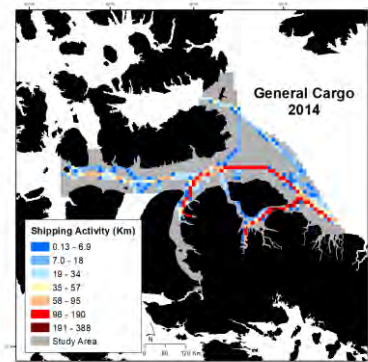
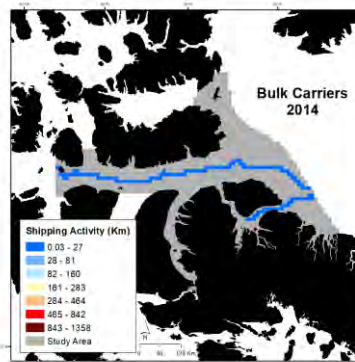
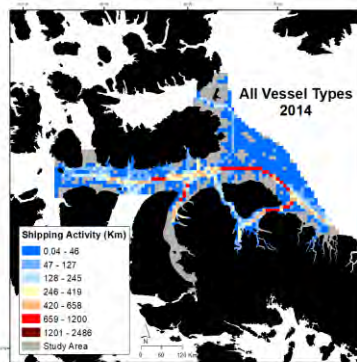


Summary Vessel Traffic for 2013

Vessel type	Kilometres
Bulk Carriers	731
Fishing Vessels	843
General Cargo	15,931
Government Vessels and Icebreakers	24,282
Oil/Gas/Exploration/Exploitation	403
Passenger Ships	15,126
Pleasure Crafts	16,846
Tanker Ships	9,340
Tug/Barge	0
<b>Total</b>	<b>83,502</b>



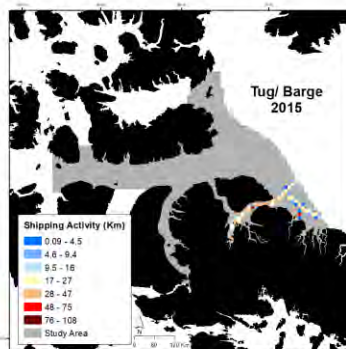
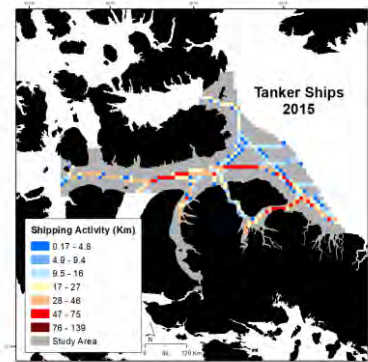
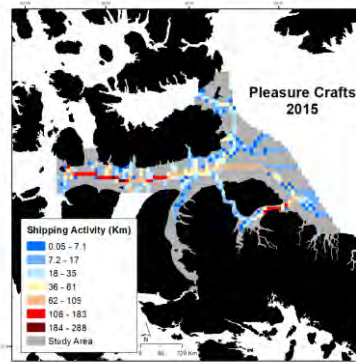
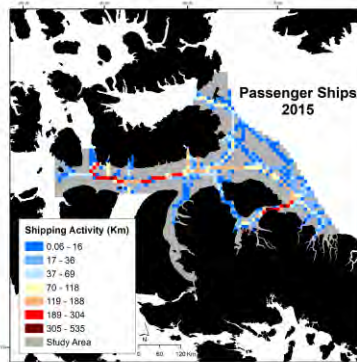
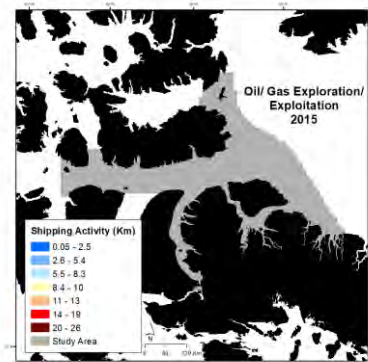
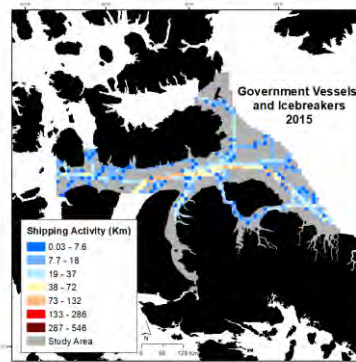
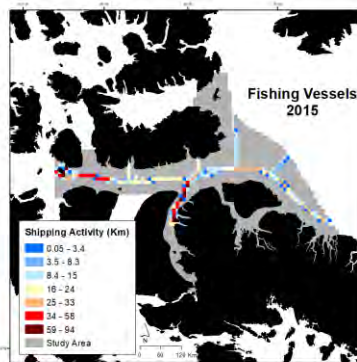
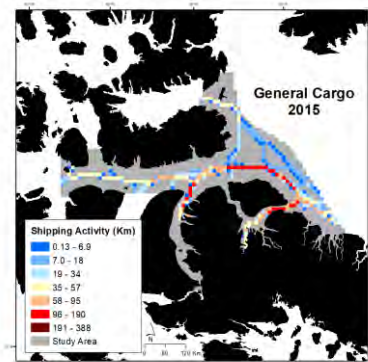
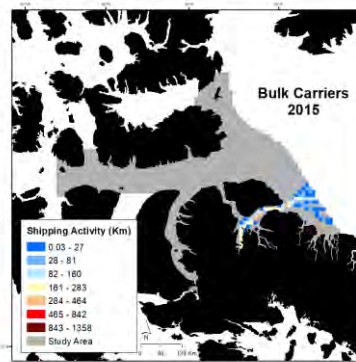
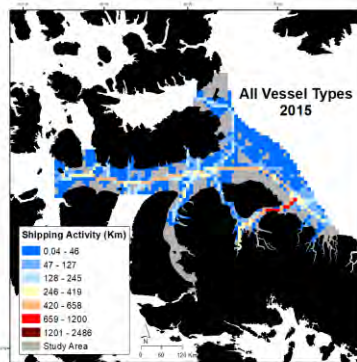
2014



Summary Vessel Traffic for 2014

Vessel type	Kilometres
Bulk Carriers	1,204
Fishing Vessels	2,025
General Cargo	17,906
Government Vessels and Icebreakers	26,483
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	18,829
Pleasure Crafts	27,990
Tanker Ships	9,018
Tug/Barge	643
<b>Total</b>	<b>104,098</b>

2015

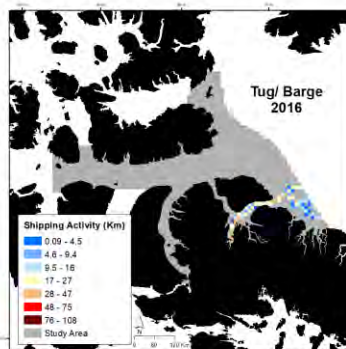
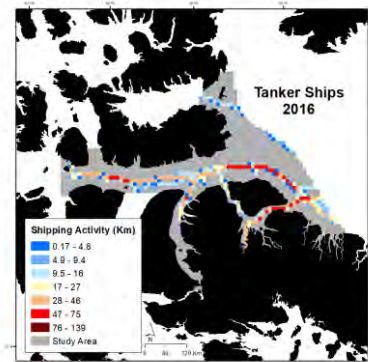
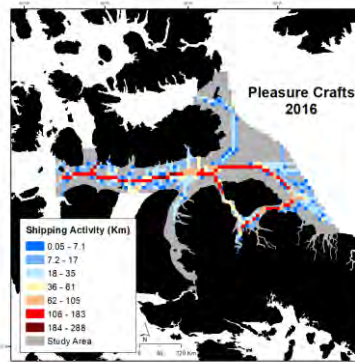
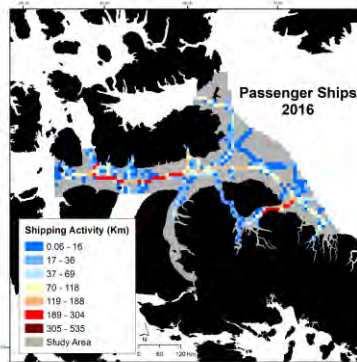
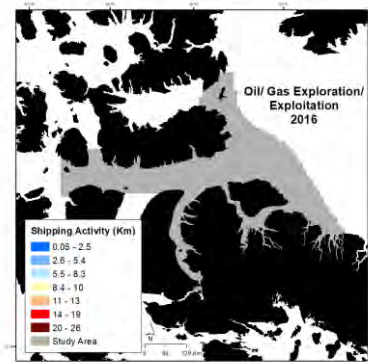
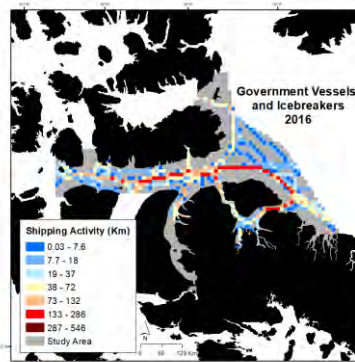
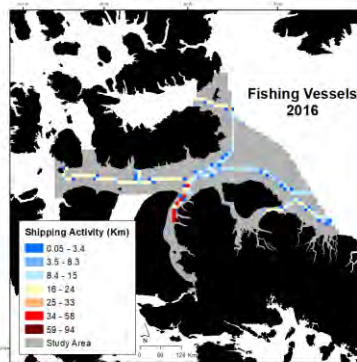
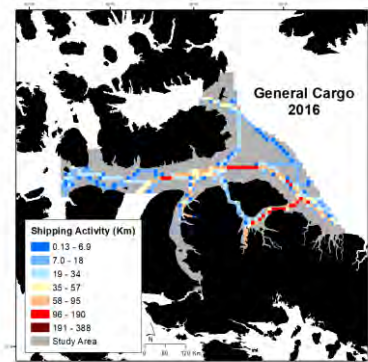
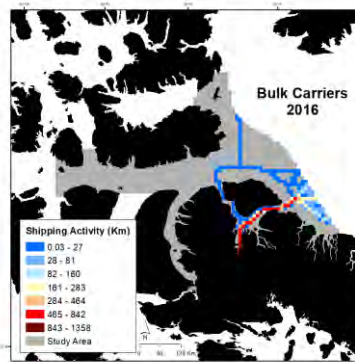
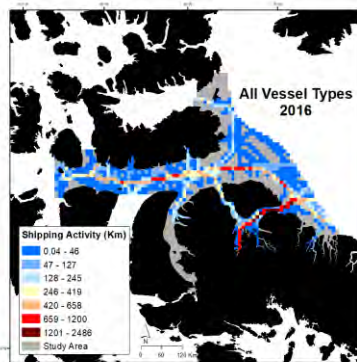


Summary Vessel Traffic for 2015

Vessel type	Kilometres
Bulk Carriers	8,989
Fishing Vessels	4,107
General Cargo	13,823
Government Vessels and Icebreakers	10,655
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	27,290
Pleasure Crafts	16,024
Tanker Ships	7,669
Tug/Barge	1,556
<b>Total</b>	<b>90,114</b>



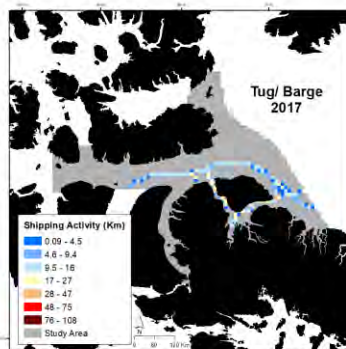
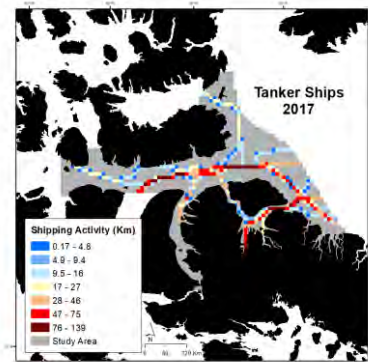
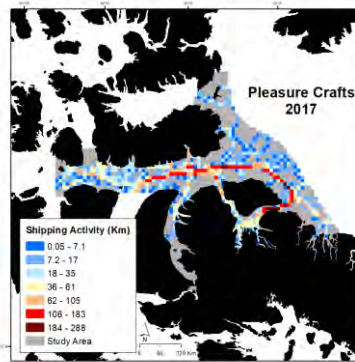
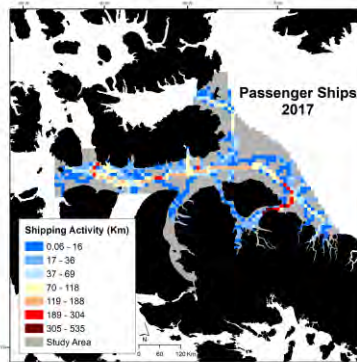
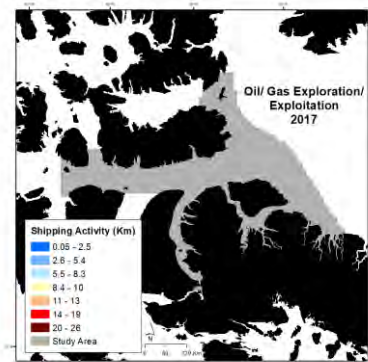
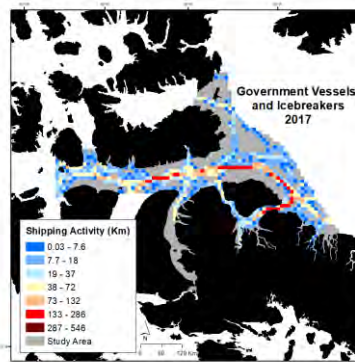
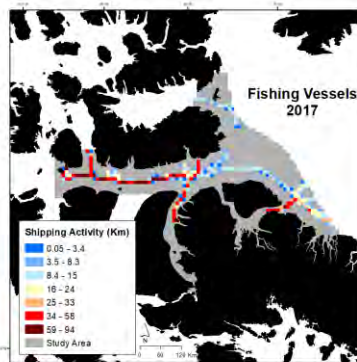
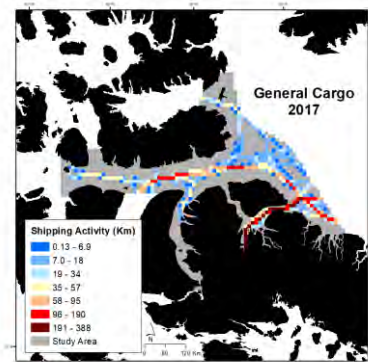
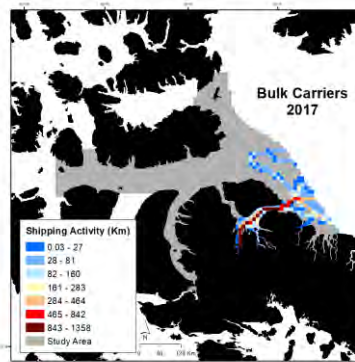
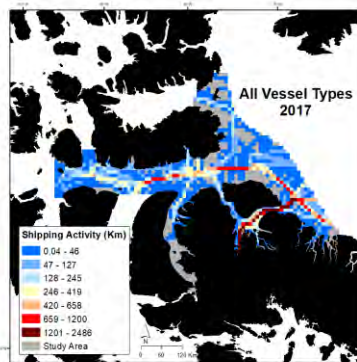
2016



Summary Vessel Traffic for 2016

Vessel type	Kilometres
Bulk Carriers	25,571
Fishing Vessels	2,811
General Cargo	13,315
Government Vessels and Icebreakers	26,328
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	25,886
Pleasure Crafts	22,622
Tanker Ships	6,708
Tug/Barge	1,453
<b>Total</b>	<b>124,693</b>

2017

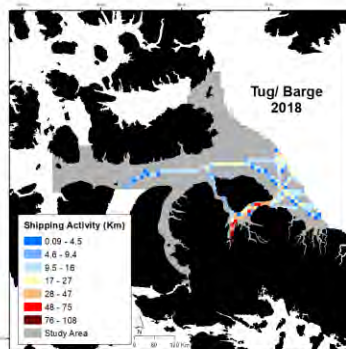
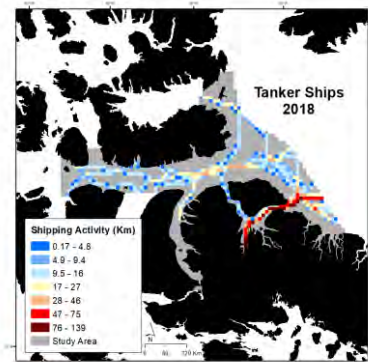
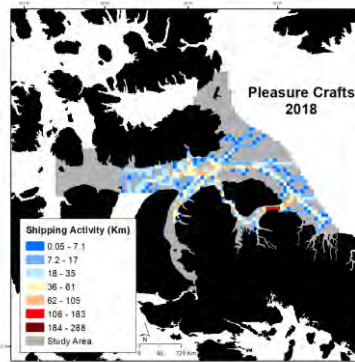
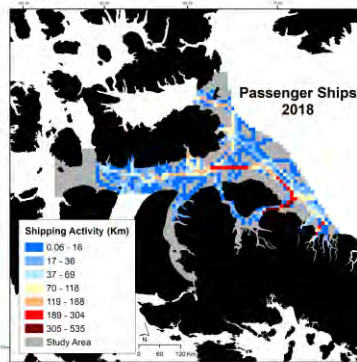
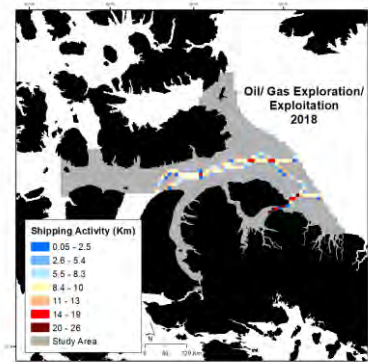
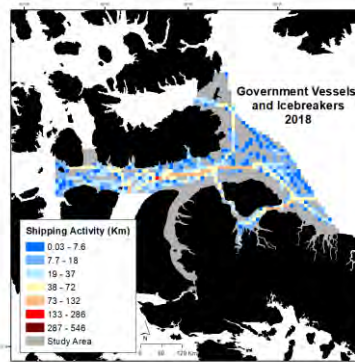
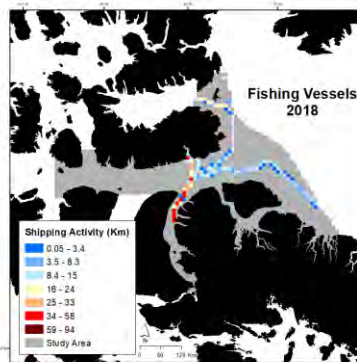
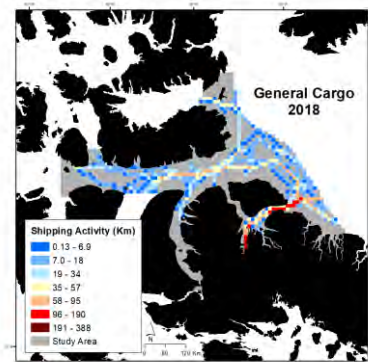
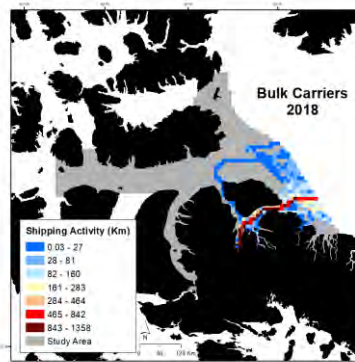
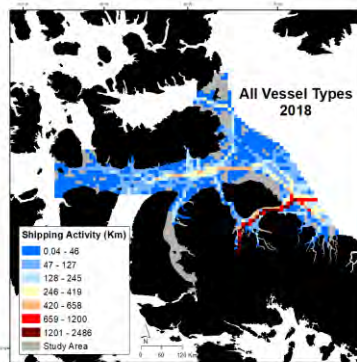


#### Summary Vessel Traffic for 2017

Vessel type	Kilometres
Bulk Carriers	41,583
Fishing Vessels	5,573
General Cargo	20,572
Government Vessels and Icebreakers	24,744
Oil/Gas/Exploration/Exploitation	0
Passenger Ships	27,750
Pleasure Crafts	25,420
Tanker Ships	10,656
Tug/Barge	1,522
<b>Total</b>	<b>157,820</b>



2018



Summary Vessel Traffic for 2018

Vessel type	Kilometres
Bulk Carriers	51,184
Fishing Vessels	1,873
General Cargo	13,645
Government Vessels and Icebreakers	16,272
Oil/Gas/Exploration/Exploitation	1,257
Passenger Ships	33,690
Pleasure Crafts	12,225
Tanker Ships	8,134
Tug/Barge	3,831
<b>Total</b>	<b>142,111</b>