Environment and Climate Change Canada
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SEA ICE IN CANADA

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

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February 2021

Table of contents

List of Figures

List of Tables

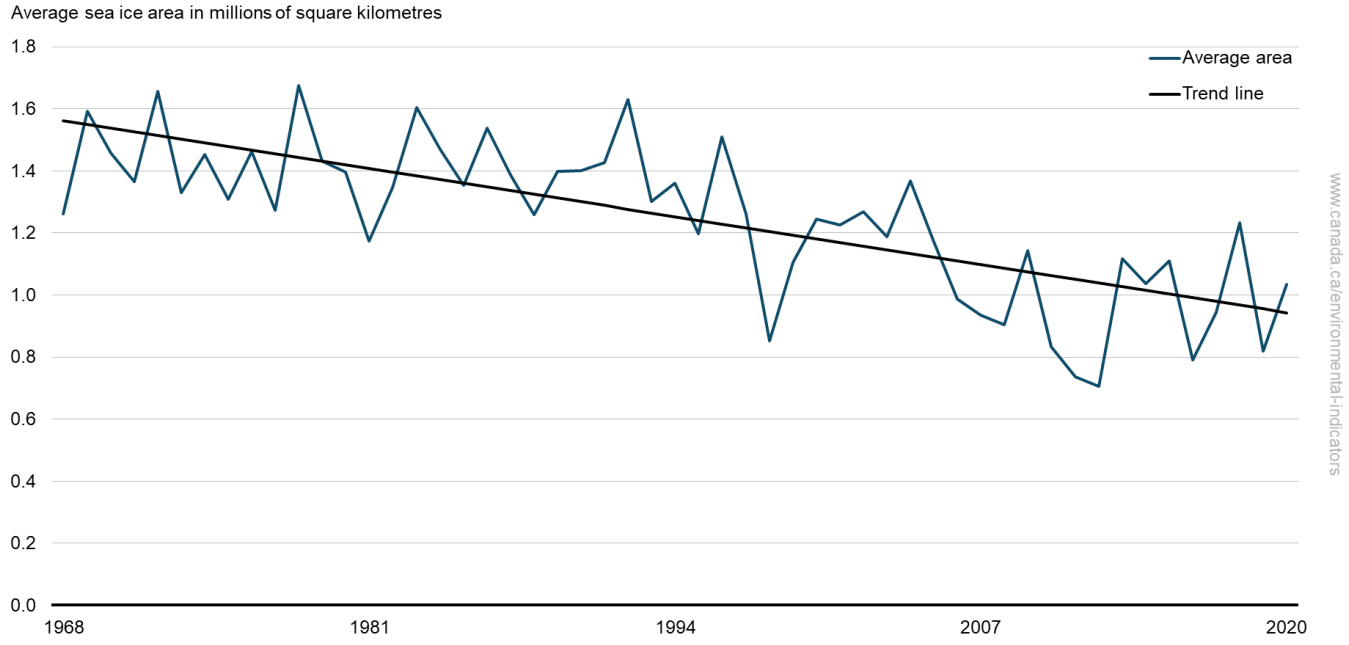
Sea ice in Canada

Sea ice is a prominent feature in the Northern Canadian Waters.[1] It consists of seasonal ice that forms and melts each year (referred to as first-year ice) and ice that is present all-year round (referred to as multi-year ice). The amount and type of sea ice present, and the total minimum area it covers during the summer season,[2] impacts human activity and biological habitat.

Key results

- In 2020, the sea ice area in the Northern Canadian Waters reached 1.04 million square kilometres (km^2), representing 27.6% of the total area
- The lowest sea ice area occurred in 2012, with 0.70 million km^2
- Between 1968 and 2020, summer sea ice area in the Northern Canadian Waters declined at a rate of 7.5% per decade

Figure 1. Average sea ice area, Northern Canadian Waters, 1968 to 2020



Data for Figure 1

Note: A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Sea ice area decline in the Northern Canadian Waters is the result of a combination of factors. Human-induced warming from greenhouse gas emissions and climate variability has resulted in an unprecedented loss of sea ice over the last 50 years.

Arctic sea ice is very sensitive to climate change because of the sea ice-albedo feedback that influences how much solar radiation is absorbed into the sea ice-ocean system. As sea ice area declines due to warming temperatures, more dark ocean surfaces that readily absorb sunlight (solar radiation) are exposed, in turn causing more sea ice to melt. This feedback cycle is an important factor in amplifying Arctic temperatures. Research has

[1] Northern Canadian Waters are comprised of the Canadian Arctic domain and the Hudson Bay domain.

[2] Sea ice area is measured during the summer season. The summer season is defined as the period from June 19 to November 19 for the Hudson Bay domain and from June 25 to October 15 for the Canadian Arctic domain.

shown that the loss of Arctic sea ice is a very significant contributor to the recent amplification of Arctic temperature change compared to the global average.

Changes in the amount of sea ice, the location of ice edges and the timing of seasonal ice formation and melt have complex, cascading ecosystem impacts. Sea ice declines result in a loss of wildlife habitat, as it serves as hunting platforms for polar bears and as resting grounds and nursery areas for walruses and seals. Algae that grow on the underside of sea ice are also important to the marine food supply.

These changes also have an impact on the safety of northerners who use sea ice as a transportation route or platform for hunting and fishing. More than ever, decisions on whether to go out on the ice must be made on the basis of weather and sea ice condition reports, as northerners can no longer rely on traditional knowledge of when it is safe to venture out on the ice.

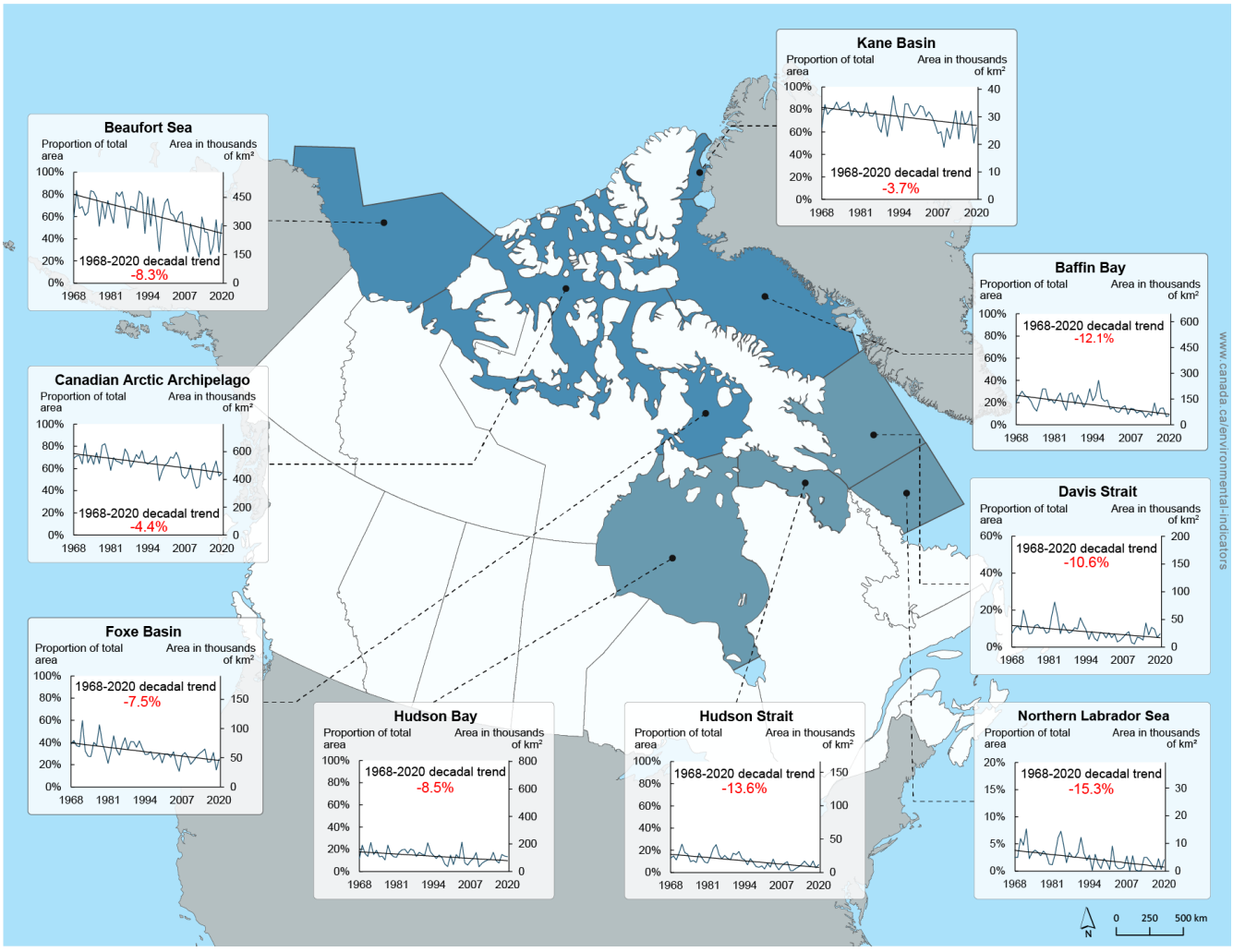
Regional sea ice

In the Northern Canadian Waters, the summer sea ice area varies by sub-region. Five (5) sub-regions make up the Canadian Arctic domain (Kane Basin, Foxe Basin, Baffin Bay, the Beaufort Sea and the Canadian Arctic Archipelago) and 4 sub-regions comprise the Hudson Bay domain (Hudson Bay, Hudson Strait, Davis Strait and the Northern Labrador Sea).

Key results

- The Canadian Arctic Archipelago, Beaufort Sea and Kane Basin sub-regions usually remain covered by ice in the summer because they contain a mix of multi-year and first-year ice
- The 4 sub-regions of the Hudson Bay domain (Hudson Bay, Hudson Strait, Davis Strait and Northern Labrador Sea) are typically free of sea ice in summer because they are first-year ice regions
- All sub-regions exhibit statistically significant decreasing trends in summer sea ice area over the 1968 to 2020 period, ranging from a 3.7% decrease per decade in the Kane Basin to a 15.3% decrease per decade in the Northern Labrador Sea

Figure 2. Sub-region sea ice area trends, Northern Canadian Waters, 1968 to 2020



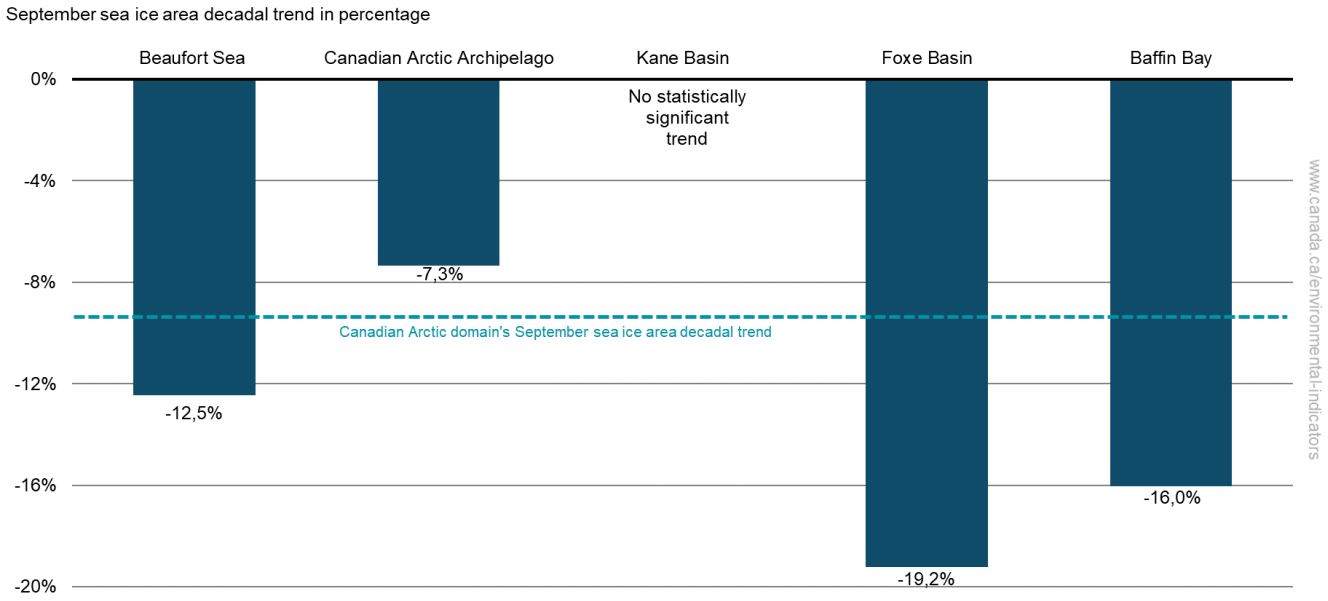
Data for Figure 2

Note: A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

In absolute terms, the largest summer sea ice area loss over the 1968 to 2020 period has occurred in the Beaufort Sea sub-region, where approximately 204 000 km^2 of sea ice was lost (which corresponds to almost 3 times the land area of New Brunswick). The Canadian Arctic Archipelago, Baffin Bay and Hudson Bay sub-regions also lost a large amount of sea ice area over the same period, of approximately 137 000 km^2, 110 000 km^2 and 64 000 km^2, respectively.

Each year, the minimum sea ice area is observed during the month of September. At this time of the year, all the sea ice in the Hudson Bay domain has melted. The Canadian Arctic domain's sub-regions present statistically significant decreasing trends in average September sea ice area over the 1968 to 2020 period, except for the Kane Basin where no statistically significant trend was reported. In the Canadian Arctic, a decrease of 9.4% per decade has been observed for the September sea ice area, which is lower than the 13.1% decadal decrease observed for the entire Arctic.[3,4]

Figure 3. Sub-region September sea ice area decadal trends, Canadian Arctic domain, 1968 to 2020



Data for Figure 3

Note: The trends presented correspond to the decadal trend over the period from 1968 to 2020. The September sea ice area trend is calculated based on the average sea ice area during the month of September for each year from 1968 to 2020. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Climate projections suggest that a nearly sea ice-free summer is possible for the Arctic Ocean by the middle of the 21st century, although sea ice may persist longer in the Canadian Arctic Archipelago region.[5]

[3] National Snow and Ice Data Center (2020) Arctic sea ice news and analysis - October 2020. Retrieved on November 20, 2020.

[4] Note that the Canadian Arctic domain trend was calculated using data for the period from 1968 to 2020, whereas the data from the National Snow and Ice Data Center for the entire Arctic cover the period from 1979 to 2020.

[5] Derksen C *et al.* (2019) Changes in snow, ice, and permafrost across Canada; Chapter 5 in Canada's Changing Climate Report, (ed.) E. Bush and D.S. Lemmen; Government of Canada, Ottawa, Ontario, p.194–260. Retrieved on November 20, 2020.

Multi-year sea ice

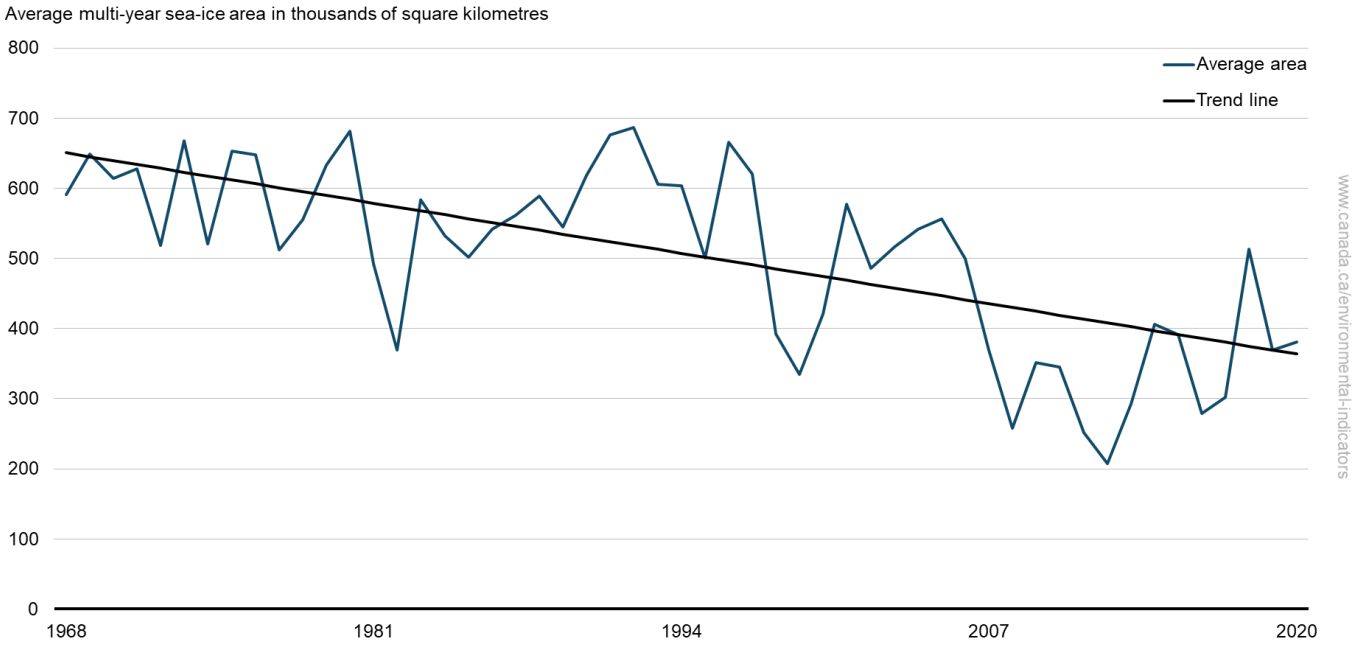
Multi-year sea ice corresponds to ice that has survived at least one summer's melt. Multi-year sea ice contains less salt and is usually thicker than first-year sea ice, making it harder and more difficult for icebreakers to navigate and clear. Considering that the sub-regions from the Hudson Bay domain are first-year ice regions that are free of multi-year ice during summer, the indicators on multi-year sea ice focus on the Canadian Arctic domain.[6]

Key results

In the Canadian Arctic domain:

- Between 1968 and 2020, multi-year ice made up between 26% to 50% of the total sea ice area
- The multi-year sea ice area has declined by 8.3% per decade over the period from 1968 to 2020
- In 2020, the average multi-year sea ice area reached 381 000 square kilometres
- The lowest multi-year sea ice area occurred in 2012, with 207 000 km^2

Figure 4. Average multi-year sea ice area, Canadian Arctic domain, 1968 to 2020



Data for Figure 4

Note: A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

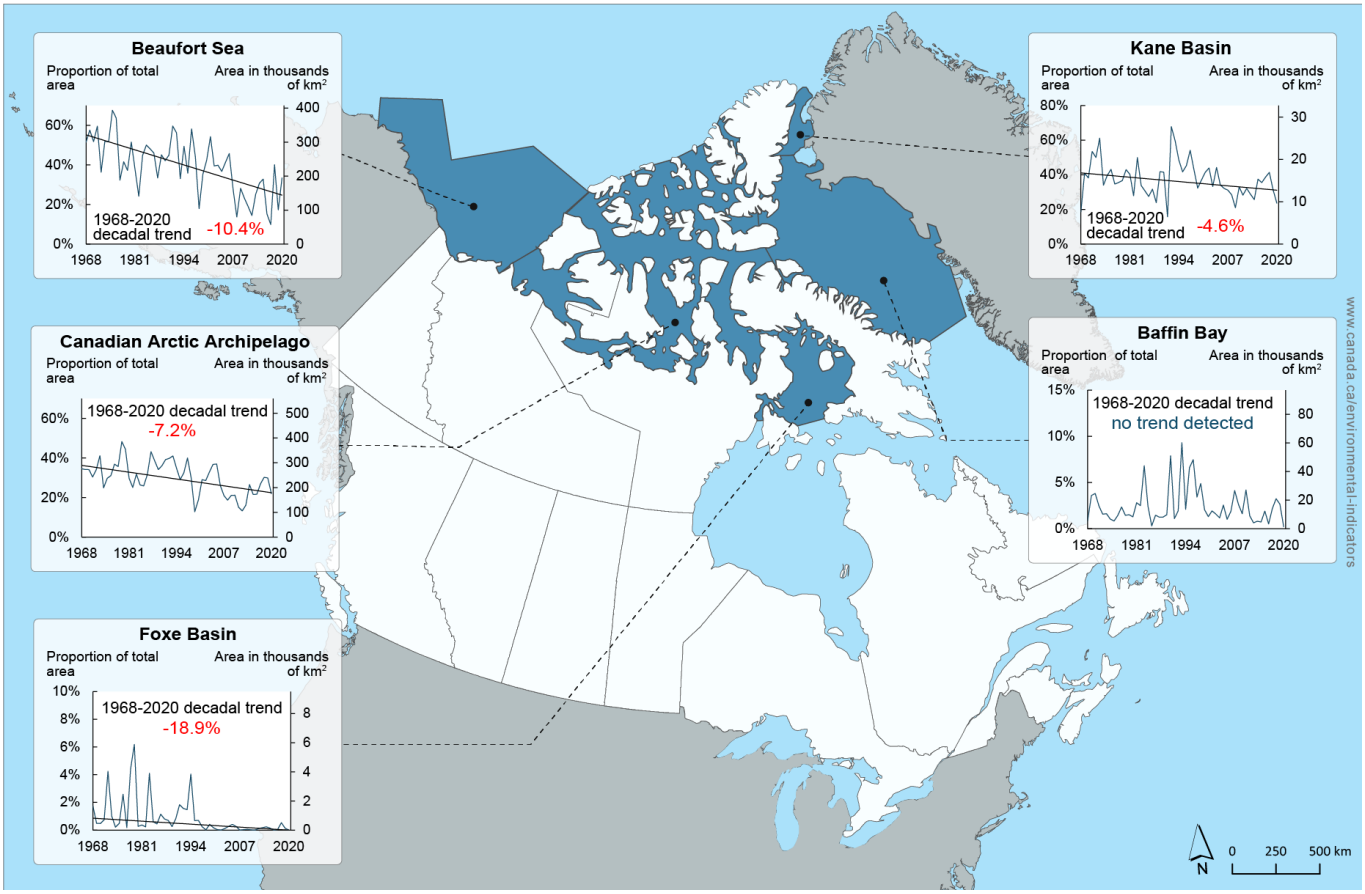
[6] Multi-year sea ice area is measured during the summer season. For the Canadian Arctic domain, the summer season is defined as the period from June 25 to October 15.

Regional multi-year sea ice

Key results

- In the Canadian Arctic domain, statistically significant decreasing trends in the average multi-year sea ice during the summer season, were found for the Foxe Basin, Kane Basin, Beaufort Sea and Canadian Arctic Archipelago sub-regions
- The Baffin Bay sub-region showed no trend from 1968 to 2020

Figure 5. Sub-region multi-year sea ice area trends, Canadian Arctic domain, 1968 to 2020

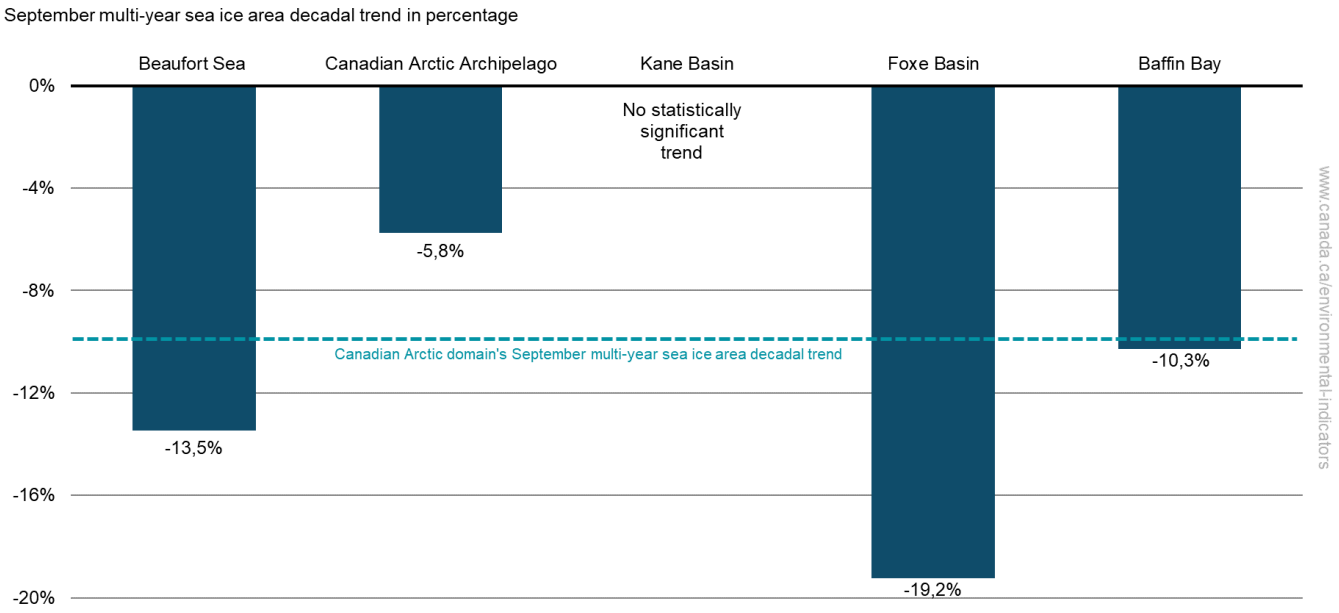


Data for Figure 5

Note: A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

The decrease in average September multi-year sea ice in the Northern Canadian Arctic from 1968 to 2020 is 9.9%. The sub-regions of the Canadian Arctic domain exhibited statistically significant decreasing trends in average September multi-year sea ice area over the 1968 to 2020 period in all regions except Kane Basin.

Figure 6. Sub-region September multi-year sea ice area decadal trends, Canadian Arctic domain, 1968 to 2020



Data for Figure 6

Note: The trends presented correspond to the decadal trend over the period from 1968 to 2020. The September multi-year sea ice area trend is calculated based on average multi-year sea ice area during the month of September for each year from 1968 to 2020. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.

Source: Environment and Climate Change Canada (2020) Climate Research Division.

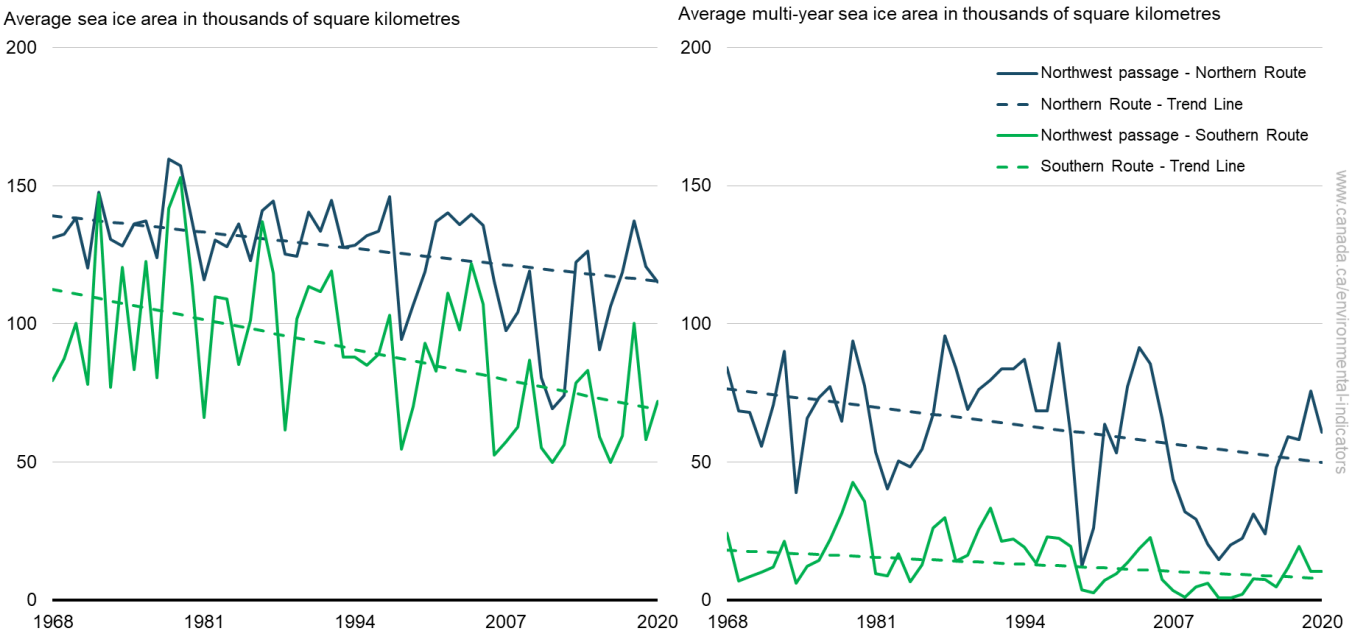
Sea ice area in Canada's Northwest Passage

Canada's Northwest Passage is a system of gulfs, straits, sounds and channels in the Canadian Arctic Archipelago that connects the Beaufort Sea in the west with Baffin Bay in the east. There are 2 main navigation paths through the Northwest Passage: a northern route and a southern route.

Key results

- Over the 1968 to 2020 period, statistically significant decreasing trends were detected for both the total sea ice and multi-year sea ice areas
    - Decreases of 3.2% and 7.3% per decade were detected for the sea ice areas of the northern and southern routes of the Northwest Passage, respectively.
    - For multi-year sea ice, a decreasing trend of 6.6% per decade was detected for the northern route, while a decreasing trend of 10.7% per decade was detected for the southern route.
- The lowest sea ice area was observed in 2011 for the northern route and in 2016 for the southern route
- The lowest multi-year sea ice area occurred in 1999 for the northern route and in 2012 for the southern route

Figure 7. Average total and multi-year sea ice area, Canada's Northwest Passage, 1968 to 2020



Data for Figure 7

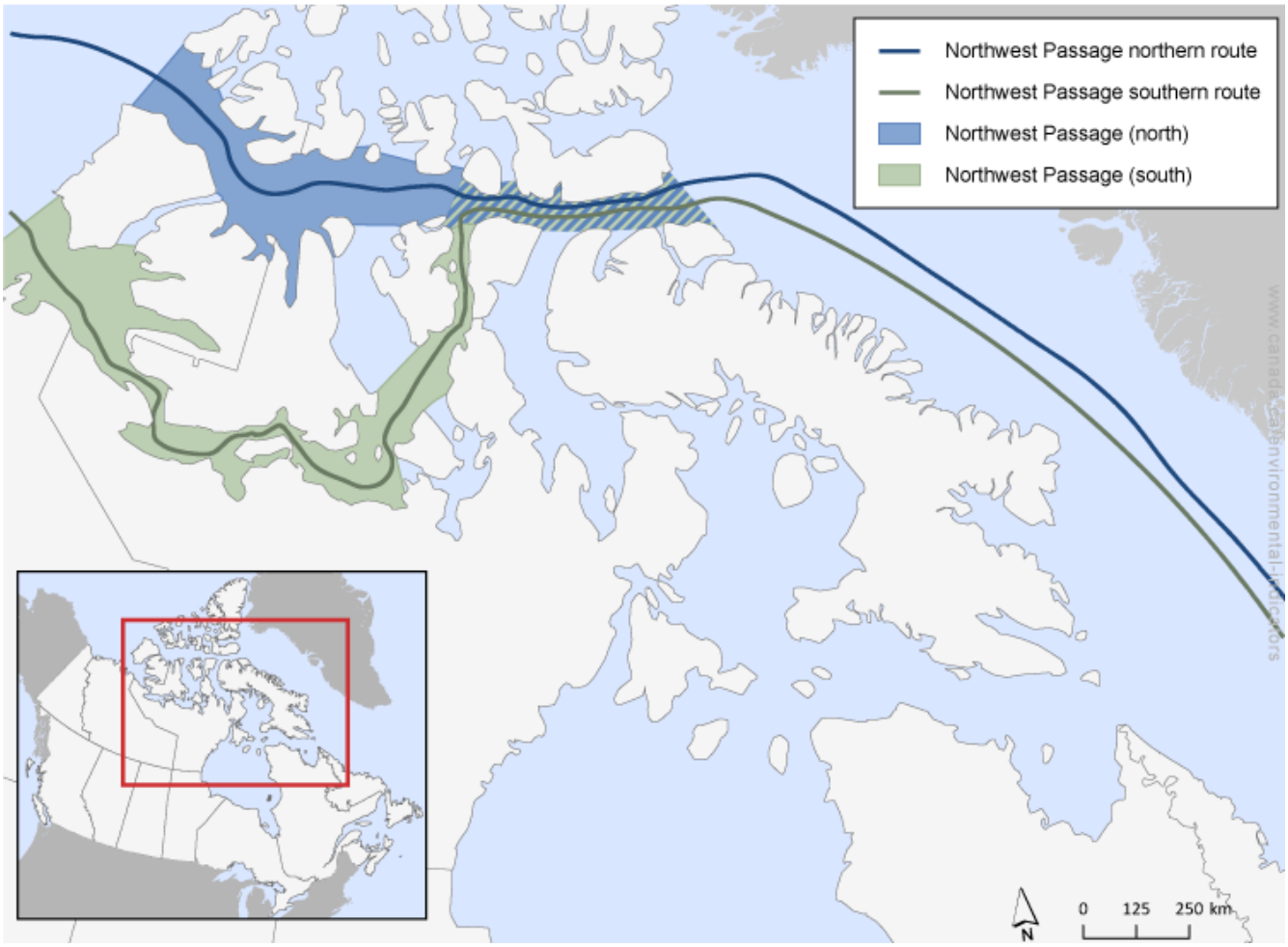
Note: Sea ice area is measured during the summer season. For the Canadian Arctic domain, the summer season is defined as the period from June 25 to October 15. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.

Source: Environment and Climate Change Canada (2020) Climate Research Division.

Canada's Northwest Passage

Canada's Northwest Passage presents a potential deep-water Arctic shipping route between the northern Pacific and Atlantic regions that is much shorter than routes through the Panama or Suez canals. The Northwest Passage is covered by sea ice for most of the year, making it a navigation obstacle for ice-breaking ships and a safety hazard for non-ice-strengthened ships.

Figure 8. Canada's Northwest Passage



Source: Environment and Climate Change Canada (2018) Climate Research Division

Reduced sea ice is increasing opportunities for shipping, tourism, resource exploration and industrial activities in the North. However, these activities bring new risks of marine accidents from a changing sea ice cover that can put people and ecosystems at risk and place additional stress on limited search and rescue and disaster response capacity.

About the indicators

What the indicators measure

The Sea ice in Canada indicators provide information on the area of sea in Canada covered by ice during the summer season. Sea ice area represents the portion of marine area covered by ice. The area is evaluated using the Canadian Ice Service Digital Archive and is expressed in thousands or millions of square kilometres. The Sea ice in Canada indicators are provided for the Northern Canadian Waters, by sub-region and for the Northwest Passage. The indicators also present trends in total sea ice area and multi-year sea ice area. Multi-year sea ice is defined as sea ice that has survived at least one summer's melt.

Why these indicators are important

Sea ice is an indicator of how the climate is changing. It is a critical component of our planet because it influences the Arctic and global climate, ecosystems, and people who live in the polar regions. Sea ice influences the climate through the sea ice–albedo feedback effect (or reflectivity of the Earth's surface). Changes in sea ice can also affect ocean currents and the exchange of heat and water vapour from the ocean to the atmosphere.
Sea ice affects marine transportation, commercial fishing, offshore resource development, the hunting and fishing patterns of Indigenous peoples, and tourism and recreation. Understanding how Canada's climate is changing is important for developing adaptive responses. The Sea ice in Canada indicators provide a way to communicate to Canadians how the coverage of Canada's Arctic sea ice has changed.

The Intergovernmental Panel on Climate Change and the World Meteorological Organization use sea ice, among several other variables, to assess long-term changes in climate. Sea ice is considered by the World Meteorological Organization's Global Climate Observing System to be an Essential Climate Variable.

Effective action on climate change

These indicators support the measurement of progress towards the following 2019 to 2022 Federal Sustainable Development Strategy long-term goal: A low-carbon economy contributes to limiting global average temperature rise to well below 2 degrees Celsius and supports efforts to limit the increase to 1.5 degrees Celsius.

In addition, the indicators contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. They are linked to Goal 13, Take urgent action to combat climate change and its impacts.

Related indicators

The Temperature change in Canada indicator measures yearly and seasonal surface air temperature departures in Canada, while the Precipitation change in Canada indicator measures annual and seasonal precipitation departures.

The Snow cover indicators provide information on spring snow cover extent and annual snow cover duration in Canada.

Data sources and methods

Data sources

Sea ice data used in these indicators were provided by Environment and Climate Change Canada's Climate Research Division. The sea ice area data were computed from the weekly sea ice charts (Canadian Ice Service Digital Archive) produced by Environment and Climate Change Canada's Canadian Ice Service.

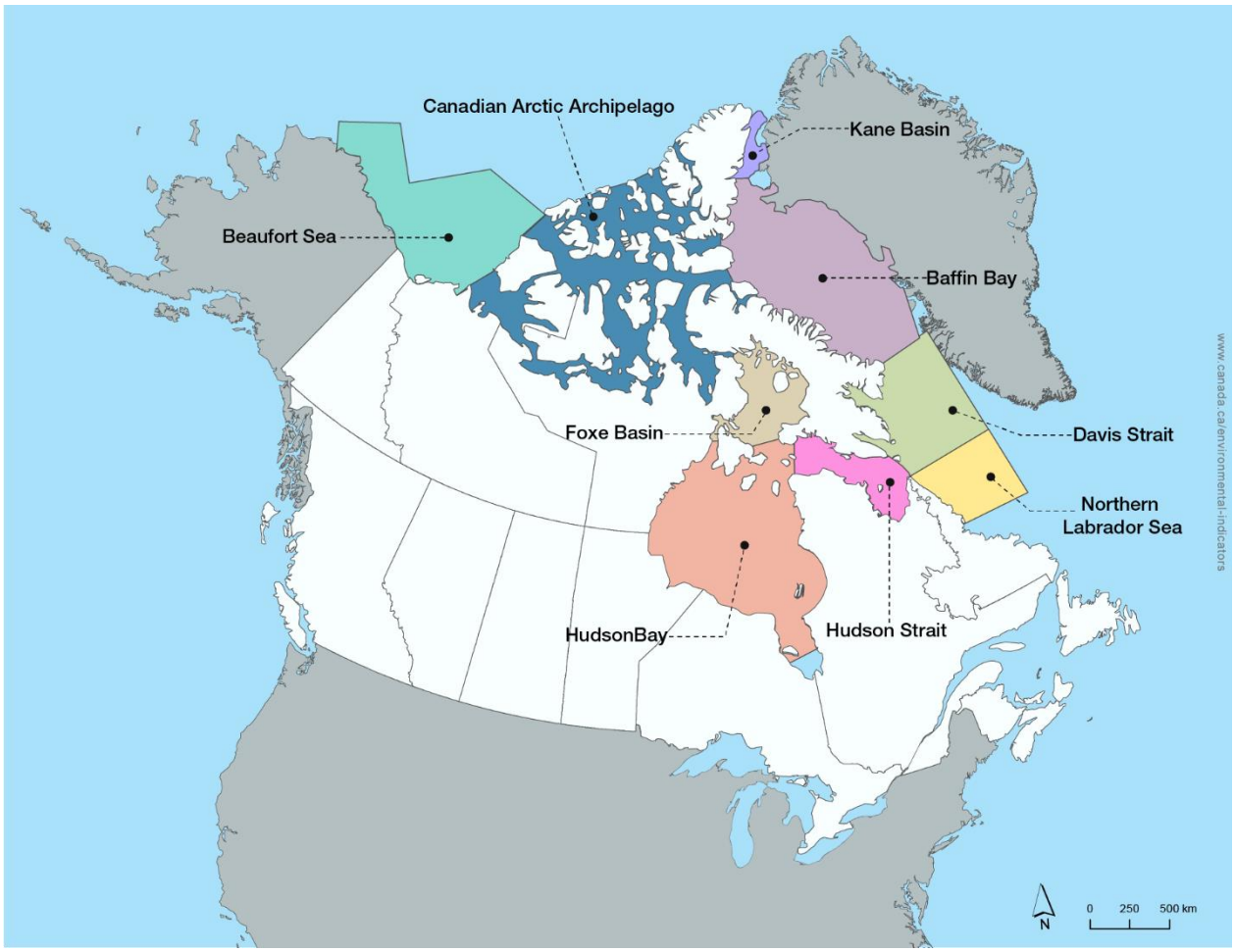
More information

Spatial coverage

The indicators provide coverage for the Northern Canadian Waters which are comprised of the Canadian Arctic domain and the Hudson Bay domain. Five (5) sub-regions make up the Canadian Arctic domain

(Kane Basin, Foxe Basin, Baffin Bay, the Beaufort Sea and the Canadian Arctic Archipelago) and 4 sub-regions comprise the Hudson Bay domain (Hudson Bay, Hudson Strait, Davis Strait and the Northern Labrador Sea).

Figure 9. Sea ice sub-regions of the Northern Canadian Waters



Source: Environment and Climate Change Canada (2018) Climate Research Division

Temporal coverage

The indicators are calculated using data for the summer sea ice season for the years 1968 to 2020. The summer sea ice season is defined as the period from June 25 to October 15 for the Canadian Arctic domain and from June 19 to November 19 for the Hudson Bay domain. These intervals correspond to the summer shipping season of each domain, a period during which the Canadian Ice Service produces weekly regional sea ice charts.

Data completeness

The data for these indicators are compiled by the Canadian Ice Service and grouped into time series by the Climate Research Division to ensure comparability. The data incorporate information from many different sources such as satellite data, surface observations, airborne and ship reports, and model results, along with the expertise of experienced ice forecasters. The Canadian Ice Service provides the authoritative Canadian record for sea ice in Canada.

Data timeliness

The data used in the Sea ice in Canada indicators are current up to 2020.

Methods

The Sea ice in Canada indicators are based on the sea ice area data provided by Environment and Climate Change Canada's Climate Research Division.

For each region and sub-region, an average sea ice area is calculated from the summer season weekly sea ice charts for each year, from 1968 to 2020.

A statistical analysis is carried out using the Mann-Kendall and Sen's methods (Kendall-tau) to identify the presence of statistical linear trends at the 95% confidence level.

More information

The Sea ice in Canada indicators use the weekly sea ice charts produced by the Canadian Ice Service. Weekly sea ice charts are primarily produced using imagery from RADARSAT-1 (since 1996) and RADARSAT-2 (since 2008) satellites. Other remote sensing data sources are also used, such as the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer and Moderate-Resolution Imagine Spectrometer imagery. Where possible, the interpretation of satellite data is verified using observations from the Canadian Ice Service specialists onboard dedicated aircraft and Canadian Coast Guard ships.[7]

The Canadian Ice Service ice charts indicate the ice concentration in tenths[8] and its stage of development. They also list the mean and normal 1981 to 2010 temperatures of some of the region's stations, which give an indication of one of the factors contributing to current ice conditions. Ice information is presented using the World Meteorological Organization's terminology. For more information about how the Canadian Ice Service produces weekly sea ice charts and maps, consult the Regional Ice Charts or the Manual of Standard Procedures for Observing and Reporting Ice Conditions.

The weekly sea ice charts are compiled into time series by the Climate Research Division for each region and sub-region. The sea ice area for a given year corresponds to the average area calculated from the weekly sea ice charts of the summer season.

The summer season was chosen because it represents the time when the sea ice reaches its minimum area, which is widely utilized within the scientific community as a measure of climate variability. It is also the time period when the most visible changes in sea ice occur. Historically, sea ice charts have been generated to support the shipping season, which is most active during the summer.

Non-parametric statistical tests were carried out on temporal sea ice area data to detect the presence of a linear trend and, if present, to determine the orientation (positive or negative) and magnitude of the rate of change (slope). The standard Mann-Kendall trend test was used to detect trend presence and orientation, while the Sen's pairwise slope method was used to estimate the slope. A trend was reported when the Mann-Kendall test indicated the presence of a trend at the 95% confidence level.

Caveats and limitations

Care should be taken when using these indicators as proxies of the actual sea ice area change in specific locations. Sea ice area change could vary considerably within a sub-region, the smallest unit of analysis in these indicators.

Resources

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[8] Ice concentration describes the relative amount of area covered by ice, compared to a reference area and can be reported in tenths (0/10 to 10/10) or as a percentage.

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Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Average sea ice area, Northern Canadian Waters, 1968 to

Year	Northern Canadian Waters (millions of square kilometres)
1968	1.26
1969	1.59
1970	1.46
1971	1.37
1972	1.66
1973	1.33
1974	1.45
1975	1.31
1976	1.46
1977	1.27
1978	1.67
1979	1.43
1980	1.40
1981	1.17
1982	1.35
1983	1.60
1984	1.47
1985	1.35
1986	1.54
1987	1.39
1988	1.26
1989	1.40
1990	1.40
1991	1.43
1992	1.63
1993	1.30
1994	1.36
1995	1.20
1996	1.51
1997	1.26
1998	0.85
1999	1.11
2000	1.24
2001	1.23
2002	1.27
2003	1.19
2004	1.37
2005	1.17
2006	0.99
2007	0.93
2008	0.90
2009	1.14
2010	0.83
2011	0.74
2012	0.70
2013	1.12
2014	1.04
2015	1.11
2016	0.79
2017	0.94
2018	1.23
2019	0.82
2020	1.04

Note: Sea ice area is measured during the summer season. For the Northern Canadian Waters, the summer season is defined as the period from June 19 to November 19 for the Hudson Bay domain and from June 25 to October 15 for the Canadian Arctic domain. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.2. Data for Figure 2. Sub-region sea ice area trends, Northern Canadian Waters, 1968 to

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Hudson Bay (thousands of square kilometres)	Hudson Strait (thousands of square kilometres)	Davis Strait (thousands of square kilometres)	North Labrador Sea (thousands of square kilometres)
1968	73	26	130	337	551	94	21	25	5
1969	79	35	168	486	569	191	25	34	5
1970	71	31	196	392	570	130	19	38	12
1971	69	32	171	402	512	109	30	31	9
1972	114	33	160	355	659	211	42	67	15
1973	62	35	137	372	520	123	30	46	5
1974	52	33	100	485	570	154	27	24	7
1975	52	34	80	479	509	107	16	25	8
1976	76	34	136	449	593	111	18	38	7
1977	71	35	209	298	514	84	15	41	6
1978	106	30	208	422	646	191	29	34	7
1979	75	33	139	337	657	127	22	36	6
1980	60	32	146	433	575	108	15	25	2
1981	40	30	125	367	465	103	14	27	2
1982	61	31	157	314	557	140	24	57	6
1983	88	35	185	476	532	158	36	81	12
1984	64	31	123	455	525	161	42	56	14
1985	55	30	84	480	511	133	27	24	10
1986	72	32	178	407	620	163	21	42	3
1987	84	26	186	288	583	155	26	32	7
1988	64	24	120	403	487	109	21	25	5
1989	78	31	174	398	526	139	19	28	5
1990	77	23	143	382	579	125	29	35	7

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Hudson Bay (thousands of square kilometres)	Hudson Strait (thousands of square kilometres)	Davis Strait (thousands of square kilometres)	North Labrador Sea (thousands of square kilometres)
1991	68	30	103	483	550	120	27	33	12
1992	79	38	140	466	608	208	31	53	6
1993	67	31	210	261	524	141	21	41	4
1994	56	29	140	454	510	116	19	31	6
1995	56	25	169	299	529	94	12	14	0
1996	61	35	258	446	536	119	21	28	6
1997	47	35	156	319	570	101	15	16	3
1998	52	32	138	166	391	53	9	11	1
1999	57	30	143	344	457	36	8	26	5
2000	41	32	91	420	502	119	10	25	3
2001	56	34	102	442	519	50	5	17	1
2002	57	34	77	368	562	122	14	26	9
2003	51	30	73	357	553	97	8	17	2
2004	60	32	101	320	596	213	20	24	1
2005	40	30	111	359	548	63	10	9	1
2006	27	27	61	376	432	46	4	12	1
2007	54	24	96	244	407	76	10	18	5
2008	59	25	91	163	435	93	14	23	0
2009	52	19	69	313	504	137	16	28	6
2010	39	26	79	237	406	34	3	8	0
2011	44	22	73	192	337	59	3	6	0
2012	51	26	43	135	351	73	6	18	0
2013	57	32	67	347	501	84	9	17	5
2014	60	22	52	268	519	86	12	13	5

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Hudson Bay (thousands of square kilometres)	Hudson Strait (thousands of square kilometres)	Davis Strait (thousands of square kilometres)	North Labrador Sea (thousands of square kilometres)
2015	65	32	127	265	417	139	17	43	3
2016	42	27	57	149	399	79	12	22	2
2017	43	28	96	199	472	61	9	36	0
2018	59	32	98	333	533	123	17	33	4
2019	29	20	47	162	424	112	7	17	1
2020	48	26	56	313	445	108	12	24	4
1968 to 2020 decadal trend	-7.5%	-3.7%	-12.1%	-8.3%	-4.4%	-8.5%	-13.6%	-10.6%	-15.3%

Note: Sea ice area is measured during the summer season. For the Northern Canadian Waters, the summer season is defined as the period from June 19 to November 19 for the Hudson Bay domain and from June 25 to October 15 for the Canadian Arctic domain. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.3. Data for Figure 3. Sub-region September sea ice area decadal trends, Canadian Arctic domain, 1968 to 2020

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Canadian Arctic domain (thousands of square kilometres)
1968	31	19	31	273	455	809
1969	13	31	66	474	437	1021
1970	22	26	76	341	428	892
1971	10	32	30	342	329	743
1972	60	31	67	255	568	981
1973	16	34	29	276	373	728
1974	8	30	10	416	414	878
1975	1	33	17	512	396	959
1976	30	30	17	376	464	917
1977	21	37	73	200	403	734
1978	53	28	50	294	557	982
1979	19	29	18	208	545	819
1980	6	28	7	434	470	945
1981	0	25	14	289	322	650
1982	7	33	41	222	414	716
1983	56	34	57	465	330	941
1984	10	27	15	393	392	838
1985	5	31	3	429	334	802
1986	15	31	34	305	494	879
1987	41	25	29	254	434	783
1988	14	20	4	362	390	791
1989	19	32	26	298	360	735
1990	28	30	27	316	483	884
1991	27	24	9	461	394	916
1992	33	37	37	413	509	1030
1993	24	34	91	169	388	707
1994	5	27	19	383	362	795
1995	6	26	34	231	456	754
1996	8	35	107	401	427	977
1997	3	35	33	206	508	785
1998	4	35	19	107	171	335

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Canadian Arctic domain (thousands of square kilometres)
1999	6	31	41	196	246	521
2000	1	33	17	273	295	619
2001	10	32	18	302	374	737
2002	5	32	14	218	388	657
2003	1	32	9	274	450	766
2004	11	30	14	226	488	769
2005	1	27	11	273	396	709
2006	0	24	11	270	266	571
2007	5	22	16	136	218	396
2008	7	25	12	105	268	417
2009	1	29	10	249	337	626
2010	0	29	16	132	240	418
2011	2	16	4	113	146	282
2012	5	22	3	19	150	199
2013	4	36	16	248	362	666
2014	5	18	4	197	385	608
2015	11	34	27	103	202	377
2016	0	26	7	32	238	303
2017	1	32	18	115	340	505
2018	11	30	16	222	398	677
2019	0	13	2	95	260	371
2020	0	25	4	201	294	525
1968 to 2020 decadal trend	-19.2%	No trend	-16.0%	-12.5%	-7.3%	-9.4%

Note: The trends presented correspond to the decadal trend over the period from 1968 to 2020. The September sea ice area trend is calculated based on average sea ice area during the month of September for each year from 1968 to 2020. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.4. Data for Figure 4. Average multi-year sea ice area, Canadian Arctic domain, 1968 to 2020

Year	Canadian Arctic domain (thousands of square kilometres)
1968	591
1969	648
1970	615
1971	628
1972	518
1973	667
1974	520
1975	653
1976	648
1977	512
1978	555
1979	633
1980	681
1981	492
1982	369
1983	583
1984	532
1985	502
1986	542
1987	561
1988	589
1989	545
1990	619
1991	676
1992	687
1993	606
1994	603
1995	501
1996	666
1997	620
1998	392
1999	335
2000	421
2001	577
2002	486
2003	516
2004	542
2005	557
2006	499
2007	370
2008	257
2009	351
2010	345
2011	252
2012	207
2013	292
2014	406
2015	391
2016	279
2017	302
2018	513
2019	370
2020	381

Note: Multi-year sea ice area is measured during the summer season. For the Canadian Arctic domain, the summer season is defined as the period from June 25 to October 15. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.

Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.5. Data for Figure 5. Sub-region multi-year sea ice area trends, Canadian Arctic domain, 1968 to 2020

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)
1968	1.66	8	6	300	276
1969	0.46	17	23	335	273
1970	0.46	16	25	302	272
1971	0.72	22	16	347	243
1972	4.04	20	10	212	272
1973	0.96	25	10	303	329
1974	0.20	14	7	301	198
1975	0.46	16	5	394	237
1976	2.46	18	9	371	248
1977	0.16	14	15	188	294
1978	4.18	15	9	242	285
1979	5.88	15	10	217	385
1980	0.26	18	8	300	355
1981	0.35	16	18	220	237
1982	0.22	11	16	141	200
1983	3.91	20	44	261	254
1984	0.57	14	16	292	210
1985	0.43	13	2	280	206
1986	1.09	11	9	268	252
1987	0.77	13	8	195	345
1988	0.66	10	8	263	308
1989	0.24	17	10	245	273
1990	0.79	17	51	262	288
1991	1.74	6	7	348	313
1992	1.49	28	12	327	318
1993	1.41	24	60	193	327
1994	3.85	20	13	288	278
1995	0.65	17	43	209	232
1996	0.67	19	48	339	259
1997	0.23	22	22	257	319
1998	0.02	18	32	104	239
1999	0.40	13	13	206	102
2000	0.16	15	8	247	150

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)
2001	0.03	17	12	316	232
2002	<0.01	18	10	230	228
2003	0.11	14	8	232	263
2004	0.25	18	16	214	293
2005	0.39	14	7	241	295
2006	0.25	13	12	266	208
2007	0.00	13	27	163	167
2008	0.03	12	17	80	149
2009	0.06	9	10	164	168
2010	0.02	14	27	135	169
2011	0.00	12	9	111	120
2012	0.10	13	4	84	106
2013	0.17	12	5	146	129
2014	0.22	11	5	179	212
2015	0.13	15	12	191	172
2016	<0.01	15	3	88	173
2017	0.04	16	14	57	215
2018	0.51	17	21	234	241
2019	0.13	13	17	101	239
2020	0.00	10	1	195	175
1968 to 2020 decadal trend	-18.9%	-4.6%	No trend	-10.4%	-7.2%

Note: Multi-year sea ice area is measured during the summer season. For the Canadian Arctic domain, the summer season is defined as the period from June 25 to October 15. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.

Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.6. Data for Figure 6. Sub-region September multi-year sea ice area decadal trends, Canadian Arctic domain, 1968 to 2020

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Canadian Arctic domain (thousands of square kilometres)
1968	0.01	3	6	258	245	513
1969	0.73	17	38	366	262	685
1970	0.04	11	25	283	234	553
1971	1.09	17	11	313	198	540
1972	0.00	18	8	184	208	418
1973	0.61	27	13	259	215	514
1974	0.29	11	6	296	182	495
1975	0.56	18	2	466	190	677
1976	0.22	15	7	356	219	597
1977	0.05	16	21	187	262	486
1978	0.15	11	7	231	250	499
1979	0.39	21	12	178	352	563
1980	0.00	15	3	333	312	662
1981	0.16	12	7	259	205	484
1982	0.08	18	21	131	182	352
1983	1.15	23	45	263	225	557
1984	1.00	15	11	244	183	453
1985	0.00	14	1	282	173	470
1986	0.00	11	6	231	220	468
1987	0.00	10	11	241	311	572
1988	0.29	8	1	267	276	552
1989	0.06	26	17	221	257	521
1990	0.00	23	24	238	257	542
1991	1.95	5	3	373	306	689
1992	0.00	24	17	329	282	651
1993	0.52	31	80	151	279	540
1994	0.04	22	14	302	271	610
1995	0.61	18	19	201	256	494
1996	0.39	21	29	363	280	693
1997	0.33	24	11	185	321	542
1998	0.00	21	13	94	146	273

Year	Foxe Basin (thousands of square kilometres)	Kane Basin (thousands of square kilometres)	Baffin Bay (thousands of square kilometres)	Beaufort Sea (thousands of square kilometres)	Canadian Arctic Archipelago (thousands of square kilometres)	Canadian Arctic domain (thousands of square kilometres)
1999	0.23	13	15	165	107	300
2000	0.00	17	8	210	154	389
2001	0.13	16	10	286	239	551
2002	0.01	14	5	173	224	415
2003	0.02	14	2	224	283	523
2004	0.11	17	6	156	297	476
2005	0.76	13	6	236	256	512
2006	0.36	15	9	222	210	457
2007	0.00	15	13	107	161	296
2008	0.00	13	8	60	144	224
2009	0.00	11	8	154	167	340
2010	0.03	17	10	96	156	278
2011	0.00	11	2	72	90	175
2012	0.00	10	0	16	97	124
2013	0.00	13	8	125	135	281
2014	0.04	11	3	163	194	370
2015	0.00	15	16	83	121	235
2016	0.00	14	3	17	184	218
2017	0.00	16	12	50	182	260
2018	0.01	17	8	187	226	438
2019	0.00	9	1	63	187	260
2020	0.00	9	1	154	178	342
1968 to 2020 decadal trend	-19.2%	No trend	-10.3%	-13.5%	-5.8%	-9.9%

Note: The trends presented correspond to the decadal trend over the period from 1968 to 2020. The September multi-year sea ice area trend is calculated based on average sea ice area during the month of September for each year from 1968 to 2020. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

Table A.7. Data for Figure 7. Average total and multi-year sea ice area, Canada's Northwest Passage, 1968 to 2020

Year	Northwest Passage northern route total sea ice area (thousands of square kilometres)	Northwest Passage southern route total sea ice area (thousands of square kilometres)	Northwest Passage northern route multi-year sea ice area (thousands of square kilometres)	Northwest Passage southern route multi-year sea ice area (thousands of square kilometres)
1968	131	79	84	24
1969	133	87	68	7
1970	138	100	68	9
1971	120	78	56	10
1972	148	147	71	12
1973	130	77	90	21
1974	128	120	39	6
1975	136	83	66	12
1976	137	123	73	14
1977	124	80	77	22
1978	160	142	65	31
1979	157	153	94	43
1980	137	114	77	36
1981	116	66	54	10
1982	130	110	40	9
1983	128	109	50	17
1984	136	85	48	7
1985	123	101	55	13
1986	141	137	67	26
1987	144	118	96	30
1988	125	62	84	14
1989	125	102	69	16
1990	140	113	76	26
1991	134	112	80	33
1992	145	119	84	21
1993	128	88	84	22
1994	129	88	87	19
1995	132	85	69	13
1996	133	89	69	23
1997	146	103	93	22
1998	94	55	60	19
1999	107	70	12	4

Year	Northwest Passage northern route total sea ice area (thousands of square kilometres)	Northwest Passage southern route total sea ice area (thousands of square kilometres)	Northwest Passage northern route multi-year sea ice area (thousands of square kilometres)	Northwest Passage southern route multi-year sea ice area (thousands of square kilometres)
2000	119	93	26	3
2001	137	83	64	7
2002	140	111	53	10
2003	136	98	77	14
2004	140	122	91	19
2005	136	107	86	23
2006	115	53	66	7
2007	98	57	44	4
2008	104	63	32	1
2009	119	87	29	5
2010	81	55	20	6
2011	69	50	15	1
2012	74	56	20	1
2013	122	79	22	2
2014	126	83	31	8
2015	91	59	24	7
2016	106	50	48	5
2017	119	59	59	12
2018	137	100	58	19
2019	121	58	76	10
2020	115	72	61	10
1968 to 2020 decadal trend	-3.2%	-7.3%	-6.6%	-10.7%

Note: Sea ice area is measured during the summer season. For the Canadian Arctic domain, the summer season is defined as the period from June 25 to October 15. A statistically significant trend is reported when the Mann-Kendall test indicates the presence of a trend at the 95% confidence level.
Source: Environment and Climate Change Canada (2020) Climate Research Division.

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