

Project 730021

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## Introduction

The meteorological data presented in this report were collected during the summer months of 1974-76 in support of a research project which examined coastal processes along northern Somerset Island. The only source of continuous yearly meteorological data along Barrow Strait is from the Resolute Bay meteorological station located on southwestern Cornwallis Island (Fig. 8.1). Because climatic conditions were thought to vary with geographic position and local topography along Barrow Strait, a program to measure meteorological parameters was carried out at the field base camp at Cunningham Inlet, Somerset Island.

The base camp, located at 74°08'N, 93°53'30"W, was situated on a gravel raised beach terrace approximately 9 m above sea level on the western shore of Cunningham Inlet. The meteorological station, adjacent to the base camp, was 1.4 km inland from the northwest headland of Cunningham Inlet (Figs. 8.1, 8.2). A second anemometer was located at the northwest headland approximately 25 m above sea level; this anemometer was set up in 1975 and 1976 to provide a better indication of wind conditions along the exposed northern shore of Somerset Island. Cunningham Inlet, which is approximately 5 km wide at the mouth and 8 km long, is lined on the east and west shores by plateau slopes reaching elevations of 200 m. Because of the protection provided by these high slopes, the climate at the head of the inlet often is less severe than the climate experienced at the more exposed northern end of the inlet.

The field season and duration of observations were mainly from late June to early September, but for 1975 data are only available until August 20. The meteorological observations were collected at least four times daily at 0700, 1200, 1900, and 2300 hours CDT. Because these measurements constitute only a small part of the daily field program, however, some gaps do occur in the information. Observations during the first six hours of each day were limited to those monitored on instruments.

This report is intended as a summary of meteorological observations made during the summers of 1974 to 1976. Also, a comparison of climatic conditions at Resolute Bay and Cunningham Inlet illustrates the similarities and differences of climate at two stations located on either side of Barrow Strait. A climatic summary of daily air temperatures, precipitation, and winds for the Cunningham Inlet station has been prepared and is available upon request to the author.

## Air Temperature

Air temperature was recorded continuously on a Short and Mason weekly thermograph in 1974 and on a Bacharach Tempscribe in 1974 and 1976. The mean daily temperature at Cunningham Inlet for July and August, based on data from three summers, was 4.1°C and 3.3°C, respectively (Tables 8.1, 8.2). The maximum recorded temperature was 16.1°C on August 17, 1975, and the minimum was -3.9°C on September 12, 1974 and August 29, 1976 (Table 8.1). Figures 8.3A and 3B illustrate the highest and lowest maximum and minimum temperatures. Unfortunately no records are available for Cunningham Inlet during late August 1975, a time when below normal air temperatures were recorded at Resolute Bay. The coolest summer was 1976 when average temperatures were 1.1°C and 4.6°C below the mean temperatures recorded for July and August, respectively, during the other two summers (Table 8.1). The warmer temperatures recorded in 1974 and 1975 may be partly a function of the

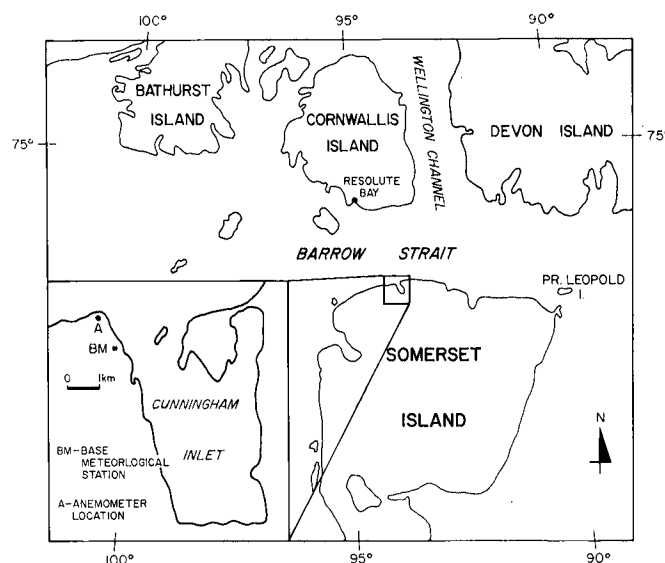


Figure 8.1. Location map.

type of screen used to house the thermometers. During the first two years an unpainted, homemade screen was used whereas in 1976 a regulation Stevenson screen (Fig. 8.2) was borrowed from Polar Continental Shelf Project at Resolute Bay. The warmest summer was in 1975 and followed a very early spring melt at the beginning of June. In 1975, summer temperatures over 10°C, were recorded on 8 days and although the minimum temperatures hovered around 0°C, the frost-free period lasted from July 1 to August 20 at Cunningham Inlet. In contrast, temperatures of 10°C or greater were recorded only on 2 days in 1976, and the longest frost-free period was 16 days from July 17 to August 2. In 1974, temperatures above 10°C were recorded on 8 days, and the frost-free period lasted from July 1 to August 12.

## Comparison with Resolute Bay

A comparison of air temperatures recorded at Cunningham Inlet and Resolute Bay (Environment Canada, 1974, 1975, 1976) (Table 8.2, Fig. 8.4) shows that mean temperatures are 1° to 2°C higher at Cunningham Inlet. This difference also may be due to the type of Stevenson screen utilized at Cunningham Inlet. The greatest difference occurs in the mean minimum temperatures at the two stations.

Figure 8.4 illustrates that warming and cooling trends are similar at both stations, and often the maximum air temperatures occur on the same date at both places. Minimum temperatures are lower and commonly occur on different days at Resolute Bay than at Cunningham Inlet. In 1974 similar temperatures were observed at both stations; in 1975 temperatures were higher at Cunningham Inlet; and in 1976 they were usually higher at Resolute Bay. Mean daily temperatures fall below 0°C more often at Resolute Bay, and the frost-free season is much shorter than at Cunningham Inlet. Maximum summer temperatures occur during the last week of July or the first week in August at both stations, with a second peak in temperature around August 15-20.

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Table 8.1

Air temperature and precipitation summaries, Cunningham Inlet, NWT, 1974-1976

No. Days of Record			TEMPERATURE (°C)							PRECIPITATION (mm)					
			Mean		Mean Daily	Max.	Date	Min.	Date	Total Amount	No. days with 2.54 mm or more	Heaviest fall in month	Date	No. days with	
			Max.	Min.										Snow	Fog
1974	July	31	6.1	2.8	4.5	10.0	12	0.3	25	20.06	9	8.00	22	3	14
	August	31	5.5	1.4	3.4	15.3	03	-2.2	29	9.67	7	3.30	17	7	12
	Sept.	13	0.4	-1.9	-0.5	3.3	01	-3.9	12	4.95*	4	2.49*	04	8	3
1975	July	31	6.4	2.6	4.5	15.6	29	0.3	17	15.14	10	5.21	31	4	12
	August	20	7.8	3.3	5.6	16.1	17	0.0	20	5.58	6	3.30	07	1	11
1976	July	31	4.9	1.8	3.4	11.1	28	-0.8	01	19.23	8	11.68	02	5	11
	August	31	2.3	-0.4	1.0	6.7	17	-3.9	29	13.93	9	6.35	19	6	12
	Sept.	10	0.1	-1.9	-0.9	1.1	01	-3.1	09	0.25*	2	0.25*	09	3	5

\* Instrument unable to measure blowing snow, therefore represents minimum value.

Table 8.2

Comparison of mean air temperatures at Cunningham Inlet and Resolute Bay, NWT (°C)

Month/Station	1974 Average			1975 Average			1976 Average			1974-76 Average		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
July Cunningham Inlet	6.1	2.8	4.5	6.4	2.6	4.5	4.9	1.8	3.4	5.8	2.4	4.1
Resolute Bay	5.8	0.6	3.2	4.9	-0.1	2.4	6.4	0.8	3.6	5.7	0.4	3.1
August Cunningham Inlet	5.5	1.4	3.4	7.8	3.3	5.6	2.3	-0.4	1.0	5.2	1.4	3.3
Resolute Bay	5.3	-0.7	2.3	4.2	-1.3	2.9	2.4	-1.6	0.4	3.9	-1.2	1.9



Figure 8.2. (A) Meteorological station located at the base camp, Cunningham Inlet (arrow locates rain gauge). (GSC 169681)



Figure 8.2. (B) Instruments housed in the Stevenson screen at the meteorological station at Cunningham Inlet. (GSC 169684).

### Precipitation

Precipitation was monitored continuously at Cunningham Inlet each season. Although the recorded values of rainfall are accurate, those of snowfall are underestimated because of the inability to catch and measure blowing snow in the small gauge (Fig. 8.2A); therefore the percentage rainfall shown in column 6 of Table 8.3 is higher than it should be for the Cunningham Inlet station.

The average amount of precipitation recorded during the months of July and August was 29.7 mm. The most precipitation fell in the summer of 1976 and the least during 1975. Measurable precipitation (2.54 mm or more) was recorded on 16 to 17 days each summer. The heaviest recorded fall of precipitation in one day was 11.68 mm on July 2, 1976. At Cunningham Inlet precipitation generally was greater for July than August.

Snow fell on twice as many days during the summers of 1974 and 1976 than 1975. At Cunningham Inlet, however, the last 10 days of August 1975, which was a period of considerable snowfall at Resolute Bay, were not monitored. Snow may fall during any summer month at Cunningham Inlet, but it does not remain on the ground for any length of time until late August or early September.

Each July and August recorded more than 10 days of fog (Tables 8.1, 8.3). These figures include all fog banks that occurred within some part of Cunningham Inlet and not necessarily just those over the meteorological station.

### Comparison of data from Cunningham Inlet and Resolute Bay

A comparison of total summer precipitation for both meteorological stations is presented in Table 8.3. On average, precipitation was 22.5 mm more each summer at Resolute Bay than at Cunningham Inlet. Some of this difference results from an inability to measure the amount of blowing snow at Cunningham Inlet. Only in 1976 were more days of rainfall recorded at Cunningham Inlet than at Resolute Bay; however, the total amount of summer precipitation was still greater at Resolute Bay. When a large low pressure system was situated over Barrow Strait and considerable precipitation fell at Resolute Bay, precipitation also would fall at Cunningham Inlet. The amount of precipitation that fell at each station, on the same date, varied as did the date on which maximum seasonal precipitation was recorded.

Columns 2 and 3 of Table 8.3 illustrate that although precipitation fell on more than half of the days on record, only 25 to 35 per cent of these days recorded measurable precipitation (2.54 mm or more). The large number of days with trace precipitation may be a function of the coastal location of both stations, where fog and drizzle often occur especially after the sea ice breaks up in Barrow Strait. Both stations had similar fog records, but Resolute Bay experienced a few more days of fog than did Cunningham Inlet during two of the three years. In fact, fog occurred at both stations on the same date an average of 17 days each summer (Table 8.3). Fog is common along the north coast of Somerset Island, but often it did not extend landward south of the weather station which was 1.4 km inland from Barrow Strait.

### Sunshine

The amount of sunshine at Cunningham Inlet was recorded only during summer 1976 using a modified Campbell-Stokes sunshine recorder. July was the sunniest month with 57 per cent of the total possible sunshine recorded. Twenty-four hours of sunshine were recorded on July 26 and 28 which were also days of maximum air temperature (Fig. 8.4C) at Cunningham Inlet. August and the beginning of September had very little sunshine, less than 16 per cent of the possible duration of sunshine (Table 8.4).

A comparison of sunshine records collected at Resolute Bay over the same period indicates that similar conditions existed at both stations in July, but differences arose during

Table 8.3

Summer precipitation at Cunningham Inlet and Resolute Bay, NWT, 1974-76

	Days of Available Data	Days with Precipitation	Days with Precipitation more than trace	Total Amount (mm)	Rainfall (mm)	Rainfall as % of Total	Maximum in one day (mm)	Date of Maximum Fall	No. Days of Fog	No. Days Fog Occurred at both stations
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1974 (July 1 - Sept. 13)	75	42	20	34.68	25.58	73.7	8.00	July 22	29	18
Cunningham Inlet										
Resolute Bay	75	54	26	63.24	45.96	72.7	15.49	July 22	31	
1975 (July 1 - August 20)	51	29	15	20.70	19.6	94.6	5.21	July 31	23	15
Cunningham Inlet										
Resolute Bay	51	40	27	46.73	42.41	90.8	7.11	Aug. 9	30	
1976 (July 1 - Sept. 10)	72	32	19	33.37	28.88	86.5	11.68	July 2	28	17
Cunningham Inlet										
Resolute Bay	72	44	12	46.23	19.81	42.8	9.65	Aug. 19	26	

Table 8.4

Amount of sunshine, Cunningham Inlet and Resolute Bay<sup>1</sup>, NWT, 1976

Location	Observation Period	Duration (hours)	Total Possible Hours	% of Possible Duration	Maximum Sunshine in one day		No. Days with no Sunshine
					Hours	Date	
Cunningham Inlet	July 3-31	394.5	744	57.8	24.0	26, 28	1
Resolute Bay		406.0		59.4	24.0	26, 27	1
Cunningham Inlet	Aug. 1-31	101.6	648	15.7	14.4	11	8
Resolute Bay		139.0		21.4	15.6	27	7
Cunningham Inlet	Sept. 1-8	18.1	126.6	14.2	6.9	01	3
Resolute Bay		46.4		36.6	11.1	05	0

<sup>1</sup> Fisheries and Environment Canada, 1976.

the rest of the season. A large, long-lasting high pressure system over the study area (Fig. 8.5) accounts for the similarity of conditions in July, and a series of high and low pressure systems caused more variable sunshine at both stations in August. In the latter case the local configuration of open water - sea ice - land with respect to the wind direction would be responsible for the cloud cover (B. Taylor-Alt, pers. comm., 1977). During August and early September, Resolute Bay received more total sunshine and had fewer days with no sunshine than did Cunningham Inlet.

### Winds

Wind direction and speed were monitored at Cunningham Inlet using two rotating cup anemometers; one was located at base camp, the other on the northwest headland of the inlet. Both were mounted on posts approximately 2 m above the ground. Wind speed was recorded continuously 24 hours a day, but wind direction was documented only when the anemometers were visited. Wind direction was determined using a large flag. Although wind speed and direction data were collected, particularly during storms, the present summary is based on measurements taken four times daily.

### Wind Direction

The prevailing wind direction recorded at Cunningham Inlet was from the west-northwest (Table 8.5); the next largest number of observations was from the northwest. Slightly more than 40 per cent of all winds recorded at Cunningham Inlet originated from these two directions.

For coastal process studies it is useful to know the direction of strong winds. Over the three summers the most frequent direction of winds 20 mph or greater was from the northwest quadrant, but when wind data for each year are examined the direction of winds greater than 20 mph varies. For example in 1975 most strong winds blew from the south, whereas in 1974 and 1976 some easterly winds were strongest.

### Wind Velocity

Wind velocity data collected over the three summers are summarized in Table 8.6. During 1974 and 1975, 75 per cent of all winds were less than 13 mph compared to 57 per cent in 1976 when winds were slightly stronger. Only 4 per cent of the winds were stronger than 20 mph; the maximum wind velocity recorded at Cunningham Inlet was 32.8 mph from the west-northwest on July 13, 1976. Occurrences of

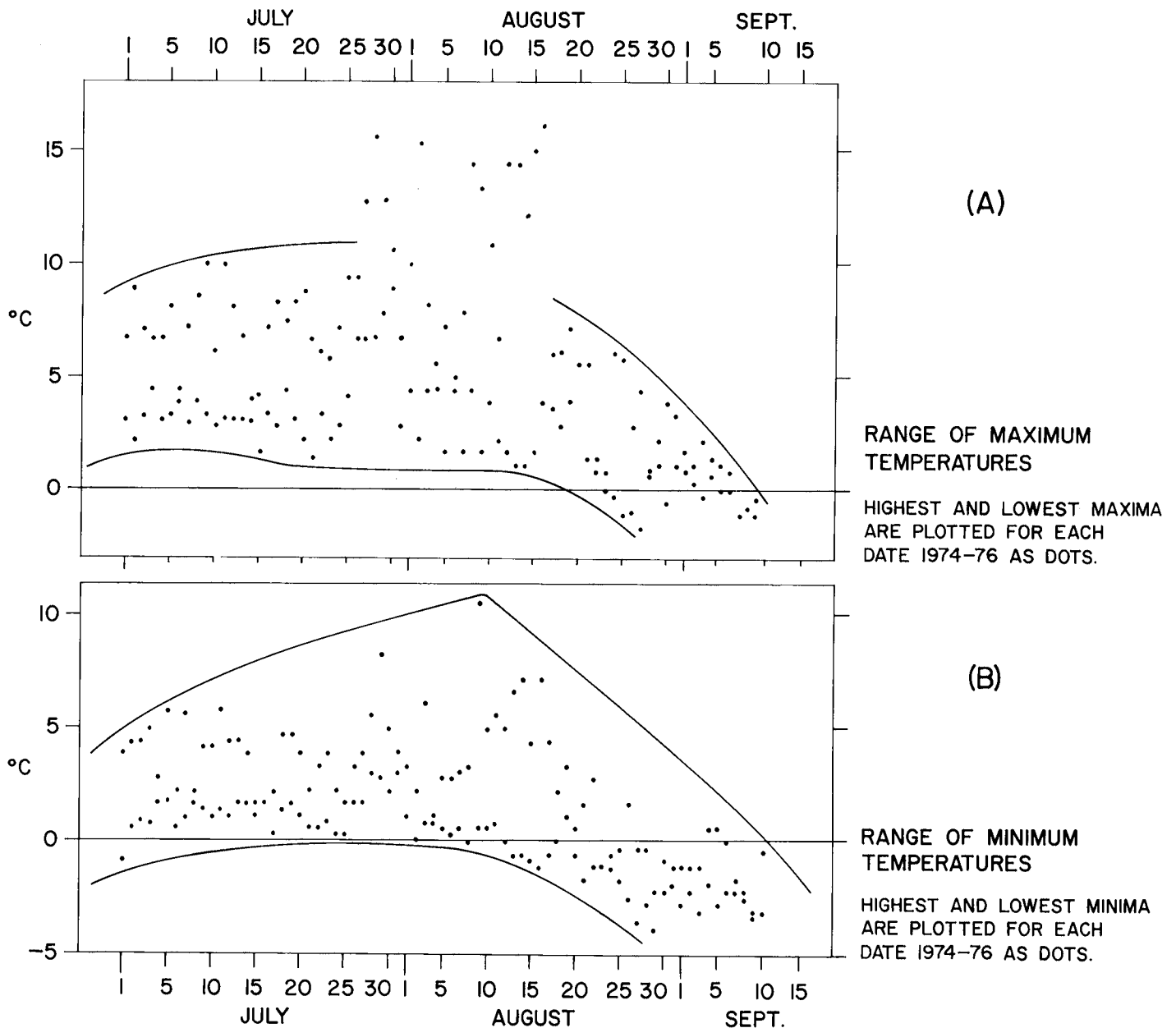


Figure 8.3. Maximum and minimum summer temperatures, Cunningham Inlet, Northwest Territories, 1974-1976.

Table 8.5

Summary of wind direction, Cunningham Inlet, NWT, 1974-1976

Year/Month	No. of Observations	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	Prevailing Wind
1974 July	124	12	1	1	-	1	1	1	3	7	4	4	11	24	28	13	10	3	WNW
August	124	9	1	2	1	3	6	3	4	10	4	1	8	15	23	17	12	5	WNW
September	52	6	3	8	4	-	-	-	-	1	-	-	-	1	6	9	10	2	Variable
% Frequency of observations		9.0	1.6	3.7	1.6	1.3	2.3	1.3	2.3	6.0	2.7	1.6	6.3	13.3	19.0	13.0	10.7	3.3	WNW
1975 July	124	10	5	3	1	3	-	-	2	11	-	3	1	21	24	29	7	4	NW
August	80	5	2	-	-	3	-	1	-	13	4	1	2	11	10	20	7	1	NW
% Frequency of observations		7.4	3.4	1.5	0.5	2.9	-	0.5	0.9	11.8	1.9	1.9	1.5	15.7	16.7	24.0	6.8	2.5	NW
1976 July	124	12	1	5	1	3	1	6	10	-	1	1	1	4	35	28	11	4	WNW
August	124	-	2	-	-	1	1	-	10	6	2	6	-	8	39	37	10	3	WNW
September	40	4	1	3	3	2	4	3	5	4	-	-	-	-	3	4	-	4	Variable
% Frequency of observations		5.6	1.4	2.8	1.4	1.7	2.9	3.1	8.7	3.5	1.0	2.4	0.3	4.2	26.7	23.9	7.3	3.8	WNW
Total number of observations		58	16	23	10	15	13	14	34	52	15	16	23	84	168	157	67	26	WNW
% Frequency of all observations (792) 1974-1976		7.3	2.0	2.9	1.3	1.9	1.6	1.8	4.3	6.6	1.9	2.0	2.9	10.6	21.2	19.8	8.4	3.3	WNW

winds of 20 mph or greater numbered 2 to 3 in July and August of 1974 and 1975 and numbered 10 in 1976. Calm conditions at Cunningham Inlet represent only 3 per cent of all observations. The average wind velocity, as a mean of the grouped data of 792 observations, was 9.7 mph.

#### Comparison of data from North Coast and Base Camp

Observations made in 1974 indicated that winds on the north coast were often much stronger than those recorded at base camp 1.4 km inland. To determine if there was a difference in velocity and if so, how much, anemometer readings were made at both locations in 1975 and 1976.

In 1975, 92 per cent of the winds were stronger at the coast; only on a few occasions were winds stronger at base camp, but the difference was less than 1 mph. The ratio of mean wind speed at the coast to that at base camp was 1.23. The differences in wind speed between the two localities were least on days of shifting winds and greatest during periods of strong winds blowing from one direction.

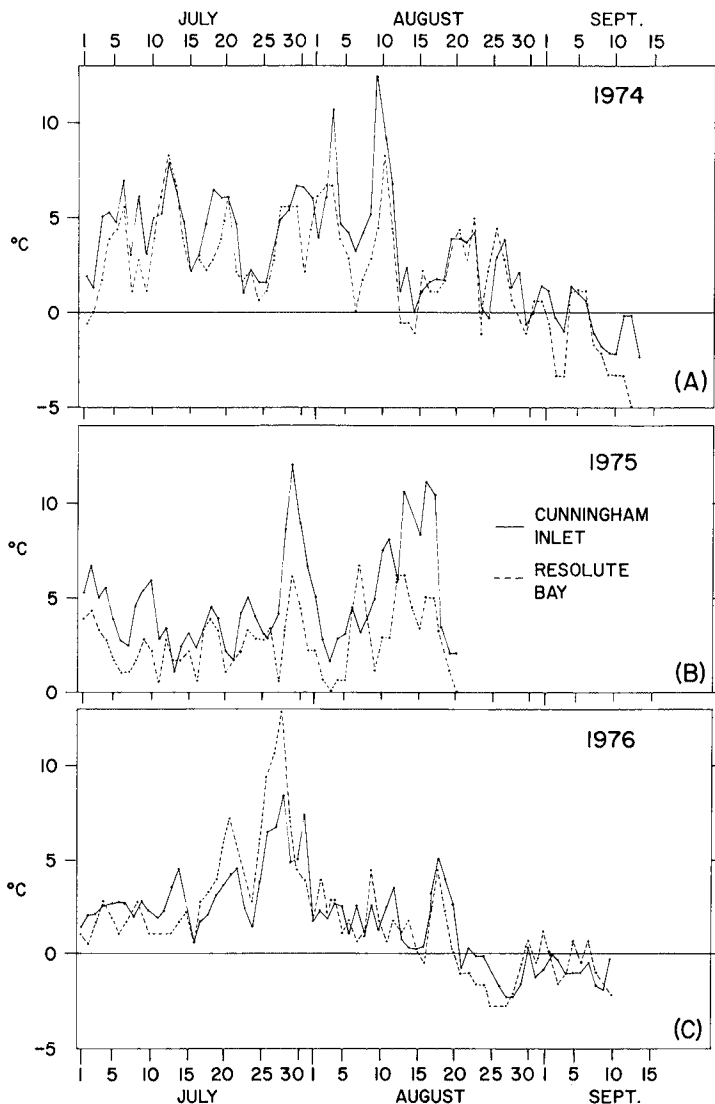


Figure 8.4. Mean daily air temperatures, at Cunningham Inlet and Resolute Bay, Northwest Territories, 1974-1976.

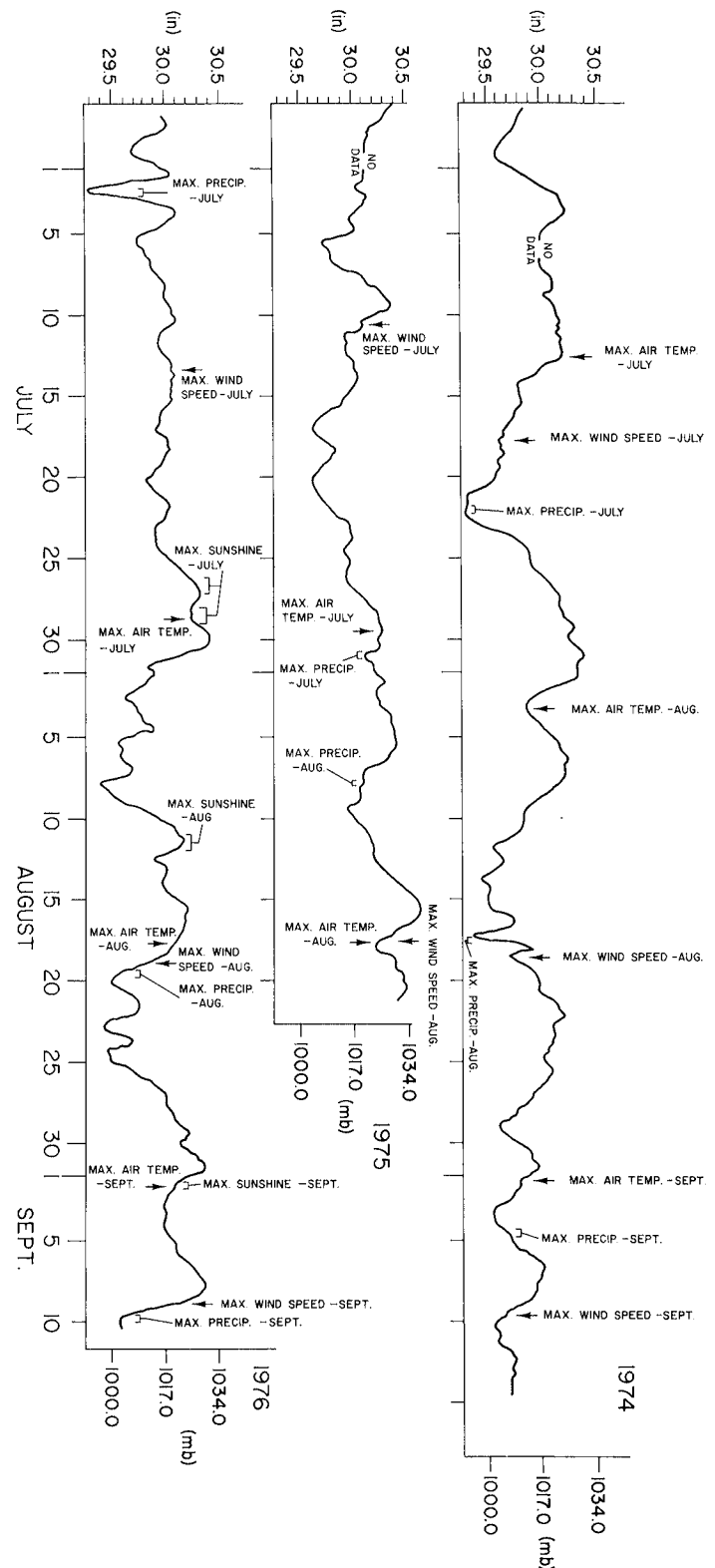


Figure 8.5. Barometric pressure and significant climatic occurrences, Cunningham Inlet, Northwest Territories, 1974-1976.

Table 8.6

Summary of wind velocity, Cunningham Inlet, NWT, 1974-1976

Year/Month	No. Observations	Velocity (mph) no. of occurrences				Monthly Mean Velocity
		Calm	1 - 12.9	13 - 19.9	20 - 39	
1974 July	124	3	97	27	3	9.2
August	124	5	100	17	2	7.9
September	52	2	34	13	3	9.7
% Frequency of observations		3.3	75.0	19.0	2.7	
1975 July	124	4	88	30	2	9.6
August	80	1	62	14	3	9.1
% Frequency of observations		2.4	73.6	21.6	2.4	
1976 July	124	3	90	21	10	9.6
August	124	4	49	62	9	13.4
September	40	4	24	8	3	8.9
% Frequency of observations		3.8	56.8	31.7	7.7	
Total number of observations (792)		26	538	192	35	
% Frequency of all observations 1974-76		3.3	68.0	24.3	4.4	

Table 8.7

Comparison of wind data for Resolute Bay and Cunningham Inlet, NWT, 1974-1976

Year/Month	Days of Available Data	Prevailing Wind Direction	Mean Monthly Velocity (mph)	Occurrence of Winds $\geq 20$ mph				Maximum Hourly Velocity		
				N	NNW-W	NNE-E	Other	Velocity	Direction	Date
1974-July										
Cunningham Inlet	31	WNW	9.2	-	1	-	2	22.5	WSW	17
Resolute Bay	31	WNW	14.5	4	7	3	15	40.0	ESE	21
1974-August										
Cunningham Inlet	31	WNW	7.9	-	-	1	1	22.8	E	18
Resolute Bay	31	SE	14.2	1	2	14	9	45.0	ESE	19
1975-July										
Cunningham Inlet	31	NW	9.6	-	2	-	4	22.5	W	10
Resolute Bay	31	WNW	11.7	7	4	3	4	37.0	N	14
1975-August										
Cunningham Inlet	20	NW	9.1	-	2	-	5	23.9	SSW	17
Resolute Bay	20	SE	11.2	-	3	2	9	31.0	ESE	11
1976-July										
Cunningham Inlet	31	WNW	9.6	-	8	-	3	32.8	WNW	13
Resolute Bay	31	N	13.2	7	6	10	4	49.0	E	02
1976-August										
Cunningham Inlet	31	WNW	13.4	-	11	-	4	28.8	SSE	18
Resolute Bay	31	WNW	16.1	13	6	10	4	47.0	NNW	03



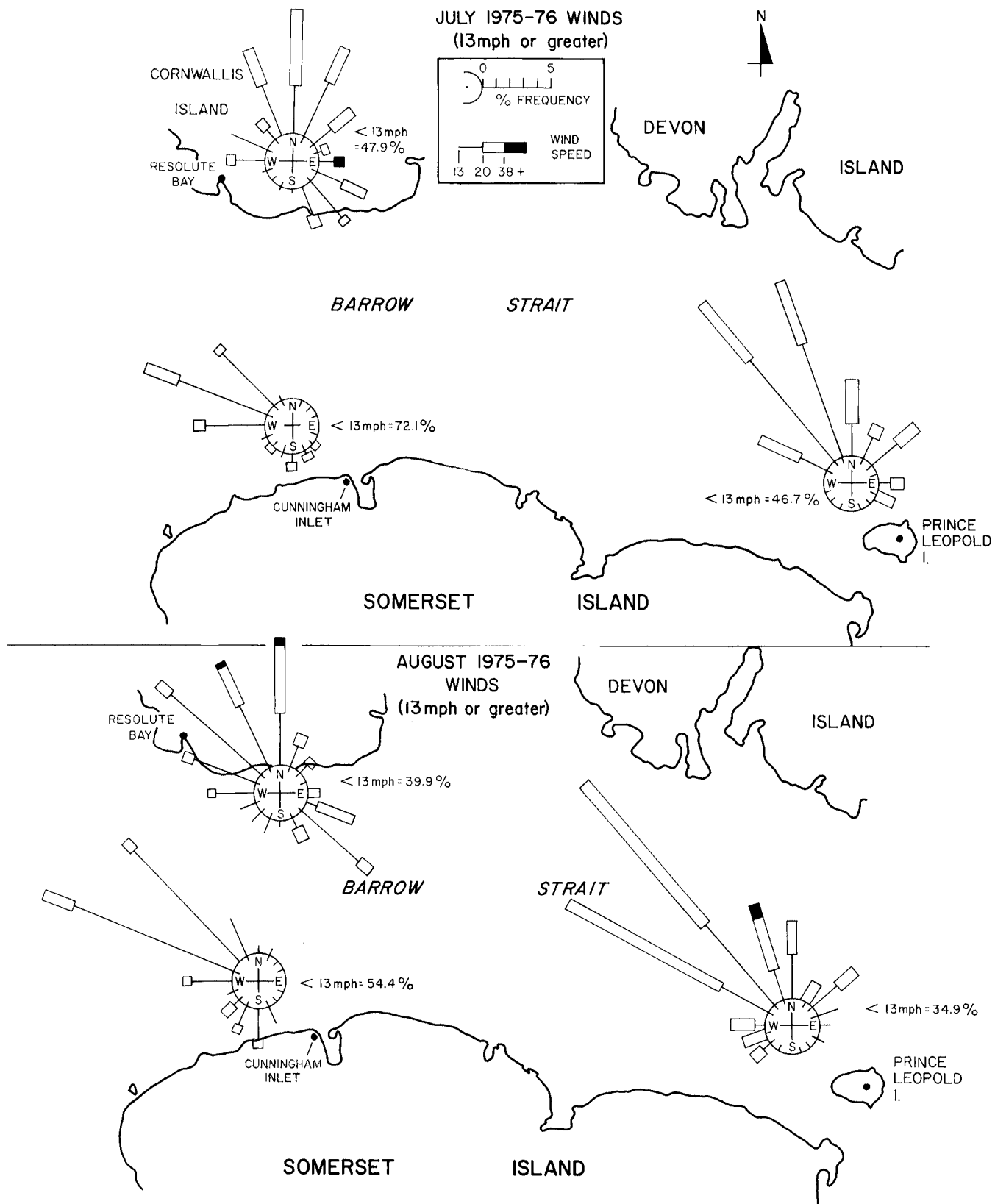


Figure 8.6. Wind rose diagrams for July and August 1975 and 1976 for three stations on Barrow Strait.

In 1976 only 66 per cent of the winds were stronger at the coast than at base camp. Furthermore wind direction differed at the two sites on two occasions, but these occurred during winds of less than 3 mph; generally wind direction seldom changed within short distances inland from the coast.

Using all the wind data collected for 1975 and 1976, the ratio of mean wind speed at the coast to that at camp was 1.10. For winds less than 20 mph the ratio was 1.08; and for winds of 20 mph or greater from the north to west direction the ratio was 1.18. Winds blowing at more than 20 mph from the south were slightly stronger at base camp than on the coast.

It is evident that even though winds are slightly stronger on the coast, the difference is only significant during periods of strong winds at which time winds on the coast could be calculated from the base camp wind data by multiplying by a constant of 1.18 to 1.23.

#### Comparison of data from Cunningham Inlet and Resolute Bay

In 1974 wind speeds, on average, were 5.8 mph greater at Resolute Bay than at Cunningham Inlet, whereas in 1975 and 1976 the winds were only 2.6 mph stronger at Resolute Bay. The larger difference in wind speed during 1974 is due to the absence of wind data from the north coast of Somerset Island, which was incorporated into the calculations for 1975 and 1976 for Cunningham Inlet. The number of occurrences of winds more than 20 mph (Table 8.7) was greater at Resolute Bay, and the maximum wind speed there each summer, except in 1975, was greater than 39 mph (Table 8.7). Some of the high winds recorded at Resolute Bay, however, are due to local conditions. Only in August 1974 did maximum wind velocity and same wind direction occur during the same storm at both stations, otherwise maximum reported winds at both stations occurred on different dates and from different directions. An examination of prevailing monthly wind direction indicates relatively similar winds from the west-northwest to northwest at both places in July but considerable differences exist for August. In August 1974 and 1975 winds were from the northwest quadrant at Cunningham Inlet and from the southeast at Resolute Bay. Wind rose diagrams for July and August 1975 and 1976 were drawn based on wind observations from three stations along Barrow Strait in order to illustrate the summer wind pattern (Fig. 8.6). The third station monitored was situated on Prince Leopold Island at approximately 250 m elevation (Nettleship, pers. comm., 1976); therefore the wind speeds are stronger than would be experienced at sea level. It is evident that of all the climatic parameters monitored at Cunningham Inlet and Resolute Bay, wind characteristics differed the most.

#### **Barometric Pressure**

A barograph was used during the three seasons to measure tendencies in air pressure and to monitor pressure systems moving through the study area and their relationship to storms experienced along the coast. The barographs used were not calibrated with barographs at the weather station in Resolute Bay, hence absolute comparisons cannot be made. The resultant barometric data for the three summers are shown in Figure 8.5 together with other related climatic occurrences.

#### **Summary and Conclusions**

Based on information collected over three summers some generalizations can be made about the climate at Cunningham Inlet. Furthermore, it is now possible to comment on the usefulness of Resolute Bay records in describing the climate on northern Somerset Island.

Summer air temperatures at Cunningham Inlet ranged from -3.9° to 16.1°C, with a mean of 3° to 4°C. The

warmest period each summer appears to occur in the last week of July or the first week of August. More than ten days of fog or precipitation occurred each month, and the average summer precipitation was 29.6 mm. The coolest, wettest summer during the period studied was in 1976, and the warmest was in 1975. On northern Somerset Island spring melt did not occur until late June to early July in 1974 and 1976, but in 1975 the rivers had peaked and the snow had melted by mid to late June.

Slightly more than 40 per cent of all winds recorded each summer at Cunningham Inlet blew from the northwest quadrant. No winds were recorded here over 33 mph, and 50 per cent to 75 per cent of all winds were less than 13 mph. Although winds more than 20 mph most frequently were from the west-northwest, it was found that these strong winds could originate from several directions. Calm periods were rare at Cunningham Inlet, occurring only 3.3 per cent of the time.

In the past, climatic records from Resolute Bay have been used by researchers to determine the climate on adjacent islands including northern Somerset Island. Warming and cooling trends in air temperature are very similar at both stations; therefore, even though temperatures averaged 1° to 2°C higher on Somerset Island, air temperature data from Resolute Bay in most cases would characterize the temperature at Cunningham Inlet. Precipitation usually falls at both stations on the same date, but the amounts are different and the date of maximum precipitation rarely coincides.

At Resolute Bay and Cunningham Inlet, wind direction is similar in July but not in August. This is not necessarily a monthly phenomenon but is thought to be related to sea ice cover and to air pressure systems over Barrow Strait. Wind speeds are much greater at Resolute Bay during the entire summer. Whereas winds over 33 mph were not observed at Cunningham Inlet (Table 8.6) winds stronger than this were experienced an average of 5 times at Resolute Bay during the summers of 1974-76 and each of the previous five summers.

It is suggested, therefore, that the above differences in wind and precipitation data should be taken into account when applying data from Resolute Bay to northern Somerset Island.

#### **Acknowledgments**

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