

PROJECT REPORT NO. 23

A COMPARISON OF WEATHER ON THE ICE PACK TO THAT OF COASTAL STATIONS IN THE ARCTIC ISLANDS

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TORONTO, JULY 1976.

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1. Introduction

In areas such as the Arctic Islands, where climate is severe, a knowledge of the local weather is necessary for the planning of most types of operations. In the case of the Arctic Islands, this need for weather information has increased substantially since the beginning of a major program of oil and gas exploration. In the case of this type of program, information regarding conditions inland, at coastal locations and off-shore is needed. Relatively long series of weather observations are presently available from Atmospheric Environment Service (AES) stations located at coastal sites, however little usable data from inland or off-shore stations have been collected and analysed. Since weather conditions are influenced by local topography, it is to be expected that the data from AES coastal sites will not be entirely representative of other areas. The objective of this study is to provide some information on how weather off-shore over the ice pack differs from that at the nearest AES stations.

This study is based on a comparison of offshore observations made between November 1974 and April 1975. Because of this short period of record, the results should be considered as preliminary in nature. In addition, they are presented to illustrate differences between the two types of sites, and do not necessarily represent average weather conditions at any particular site.

2. Sources of data

Hourly observations, taken by Panarctic Oils Limited at East Drake 1-55 (Lat. $76^{\circ}24'39''$, Long. $107^{\circ}48'55''$, see Figure 1) from November 23, 1974 to April 19, 1975, were used in this study. It should be noted that the station was operated in support of their offshore drilling program, consequently the observational program was not on a 24-hour basis, but varied from day-to-day as Panarctic's operational demands warranted. For comparative purposes, hourly observations corresponding to those taken at the drilling site, were abstracted for Rea Point and Resolute Bay. It would have been desirable to abstract data for Isachsen and Mould Bay as well, however, these stations have a three-hourly observing program, and were therefore inadequate for the purpose of this study.

3. Method of analysis

The total number of observations collected at East Drake was 3118. This amount of data was insufficient for monthly analysis; therefore, it was decided to group the data, and analyse the results as being representative of the winter drilling season. Rea Point and Resolute Bay data were similarly grouped.

A computer program was prepared to compute the number of occurrences of various meteorological parameters. Tables displaying the frequency and relative frequency of visibilities, weather contingencies by wind speed classes,

ice fog, blowing snow, temperature, wind speeds and wind-chill, were prepared for all three stations. The results of the drilling site and land stations were compared, and the prominent features outlined.

4. Results

4.1 Winds

Table 1 displays the percentage frequency of wind speed classes and Table 2 displays the directional average wind speed. The directional percentage frequency of all winds is given in Figure 2, and of those at or exceeding 20 mph in Figure 3. Finally, the cumulative percentage frequency of wind speeds is given in Figure 4.

The higher percentage frequency of lower wind speeds at East Drake (90.5% for winds 00-19 mph, compared to 68.8% and 76.1% for Rea Point and Resolute Bay respectively) is reflected by the lower overall average wind speed: 10.2 mph at East Drake, compared to 14.6 mph at Rea Point and 12.7 mph at Resolute Bay.

The predominant northwesterly direction at all three stations for all winds as illustrated in Figure 2, appears to be the same for winds ≥ 20 mph (Figure 3).

4.2 Frequency of temperature classes

Table 3 displays the percentage frequency of temperature classes

whereas Figure 5 shows the cumulative percentage frequency of temperature. Over 30% of the cases occurred between -30°F and -39°F at East Drake, whereas the same percentage is observed at temperatures between -20°F and -29°F at Rea Point and Resolute Bay; .3% of the cases occurred in the -60 to -69°F temperature range at East Drake while none occurred in this range at either Rea Point or Resolute Bay. Figure 5 shows the relatively colder temperatures observed at East Drake, and exhibits as well the similarity between Rea Point and Resolute Bay.

4.3 Ceilings and visibilities

The lower visibilities observed at East Drake are evident in Table 4. The percentage frequency of all threshold values are consistently higher at East Drake than Rea Point or Resolute Bay. Tables 5 and 6 display the various weather contingencies by wind speed classes. It should be pointed out however, that these contingencies are not mutually exclusive. The percentage frequency of all three contingencies at East Drake (Table 5) exhibits a maximum at winds between 10 and 19 mph, whereas at Rea Point this maximum is shifted to 20-29 mph. This is partly due to the higher frequency of ice fog at East Drake in this wind speed class (see section 4.5). Table 6 exhibits an increasing trend of the relative percentage frequency of all contingency classes as the wind speed increases through the 30-39 mph class. This trend is more pronounced at East Drake, where the relative percentage frequency of ceilings ≤ 200 feet or visibility $\leq \frac{1}{2}$ mile increases from 22.8% for 10-19 mph to 87.7 for 20-29 mph. Blowing snow is the major factor in reducing visibilities at these latitudes, and an inspection of East Drake

in Table 8, indicates that the relative percentage frequency of blowing snow jumps from 15.0% for winds between 10-19 mph to 88.0% for winds between 20-29 mph.

4.4 Blowing snow

The close relationship between wind speed and blowing snow is quite apparent in Tables 7 and 8; however, the likelihood of blowing snow occurring at a given wind speed class is greater at East Drake than Rea Point or Resolute Bay (Table 8). For instance, the relative percentage frequency of blowing snow at East Drake for winds 20-29 mph is 88%, whereas it is only 29.4% and 40.2% at Rea Point and Resolute Bay respectively. From Tables 9 and 10, there appears to be no preferred temperature class for blowing snow at East Drake; however, the relative percentage frequency decreases to 2.2% for the -40 to -49°F temperature class. This is due to the weak anticyclonic circulation with which cold temperatures are usually associated.

Tables 11 and 12 display the percentage frequency and the relative percentage frequency of blowing snow by wind directions. An inspection of Table 12 and Table 2 indicates that there exists a close relationship between the relative frequency of blowing snow and the directional average wind speed. In general, it appears that for East Drake, a wind direction with an average wind speed ≥ 10 mph is the same direction for which the relative percentage frequency of blowing snow is $\geq 20.0\%$. No such pattern was observed for Rea Point or Resolute Bay.

4.5 Ice Fog

In analysing ice fog, all observations in which ice fog was reported were tabulated, and the frequency and relative frequency of ice fog by temperature classes, wind speed and wind direction were prepared in Tables 13 to 18. From these tables the following observations could be made:

- (a) the relative percentage frequencies of ice fog by temperature classes (Table 14) were consistently higher at East Drake than Rea Point or Resolute.
- (b) the decline of the relative percentage frequency at -60 to -69°F at the East Drake (Table 14) is unrepresentative because of the small number of occurrences of these temperatures.
- (c) A peak observed in the -30 to -39°F temperature range at East Drake and Resolute Bay (Table 13) occurs in the -20 to -29°F temperature range at Rea Point.
- (d) At East Drake in Table 16 the relative percentage frequency of ice fog exhibits a strong peak for winds from the NNW (73.3%) followed by the NW (63.5%).

Finally, in Table 18, the relative percentage frequency of ice fog for winds between 0 and 9 mph is higher at East Drake than Rea Point or Resolute Bay. Table 18 indicates as well that generally the relative percentage frequency of ice fog increases as wind speed increases; and for winds between 30 and 39 mph it is as high as 42.9%, 72.3% and 43.5% for East Drake, Rea Point and Resolute Bay respectively.

The observed high relative frequency of ice fog at strong winds, at all three stations, and the pronounced peak noted in part (d) above, were examined further. Obstructions to vision, as defined in Manobs (ref. 4), are reported only when the prevailing visibility is 6 miles or less, however all obstructions to vision are reported if more than one occur during an observation. In cases of strong winds and the simultaneous occurrence of blowing snow and ice fog, the predominant obstruction to vision is blowing snow; furthermore, in cases of strong winds, ice fog could be mistakenly reported because of the glittering effect of snow; therefore only those cases where occurrence of ice fog was reported, but not ice fog and blowing snow, were prepared in Tables 19 to 24. These tables should reflect a more realistic relationship between ice fog, temperature, wind speed and wind direction. An inspection of tables 19 to 24 reveals the following:

- i) The pronounced peak observed in (d) is no longer present in Table 20. There is an indication however, that ice fog favours a south-westerly or a northwesterly direction of the wind at the drilling site.
- ii) The relative percentage frequency of ice fog by temperature classes at East Drake in Table 22 (graphical representation in Figure 6) is still consistently higher than Rea Point or Resolute Bay.
- iii) The relative percentage frequencies of ice fog by wind speed classes in Table 24 (graphical representation in Figure 7), peaks at 10-19 mph at East Drake and decreases for higher wind speeds. This peak is observed to occur at 20-29 mph at Rea point and Resolute Bay, but decreases for stronger winds. However, it should be noted that

in most cases of wind speed greater than 29 mph, blowing snow is reported (Table 8). At this value the exposed areas of flesh will freeze in less than one minute for the average individual) while values

4.6 Wind-chill

The rate of cooling of the exposed human skin increases as the temperature decreases. However, when cold temperatures combine with winds, exposed human skin could freeze in a dangerously short time, the cumulative frequency of selected wind-chill values were therefore prepared in Table 26. The tables reflect again the high wind-chill values experienced at East Drake, and its poorer visibilities.

In computing the wind-chill, the following equation was used:

$$H = (10\sqrt{V} - V + 10.45) (33 - T)$$

The difference between the percentage frequencies at East Drake and Sea Point or Resolute Bay becomes more pronounced for the higher wind-chill values and lower visibilities.

where H is the wind-chill in kilocalories per square metre per hour of exposed skin surface, V is the wind speed in metre per second, and T is the air temperature in °C.

In discussing the polar ice in the Arctic, the Oceanographic Atlas of the Polar Seas (ref.2) indicates that winds, currents and other stresses produce openings of various sizes as well as hummocks and ridges that may be lifted 40 feet or more above the surface of the water by gale force winds.

Langbehn (ref.3), corroborates by reporting higher roughness lengths over rough ice. The mechanical turbulence, resulting from pressure ice, and the colder temperatures seemed to be the dominant factor in the above equation. The cumulative frequency of wind-chill at East Drake is considered lower winds at East Drake.

sistently higher than Rea Point or Resolute Bay. It was as high as 21.5% for wind-chill $>2000 \text{ Kcal/m}^2/\text{hr.}$, (at this value the exposed areas of flesh will freeze in less than one minute for the average individual) while values this high did not occur at Rea Point or Resolute Bay.

Since poor visibilities may affect the safety of the drilling operations, and wind-chill the safety of the personnel, the percentage frequency of wind-chill and visibilities were prepared in Tables 27 to 29. These tables reflect again the high wind-chill values experienced at East Drake, and its poorer visibilities.

The difference between the percentage frequencies at East Drake and Rea Point or Resolute Bay increases progressively and becomes most pronounced for the higher wind-chill values and lower visibilities.

5. Discussion

In discussing the polar ice in the Arctic, the Oceanographic Atlas of the Polar Seas (ref.2) indicates that winds, currents and other stresses produce openings of various sizes as well as hummocks and ridges that may be lifted 40 feet or more above the surface of the water by onshore winds. Langleben (ref.3), corroborates by reporting higher roughness length over rough ice. The mechanical turbulence, resulting from pressure ice, and the possible local effects at Rea Point and Resolute Bay, may explain the observed lower winds at East Drake.

Despite the lower winds at East Drake, there is no significant difference between the frequency of occurrence of blowing snow at the drilling site and the weather stations.

When cases of simultaneous occurrence of ice fog and blowing snow were deleted, the frequency of ice fog at East Drake was more than double that of Rea Point or Resolute Bay. Open leads, and release of water vapour at the drilling site probably account for most of the difference.

The higher relative frequency of ice fog at wind speeds between 0 and 9 mph at East Drake, as a result of the release of moisture; and the higher relative frequency of blowing snow at higher wind speeds, may account for the poorer ceilings and visibilities at the drilling site.

The colder temperatures and poorer visibilities resulted in the higher percentage frequencies of wind-chill-visibility contingencies at East Drake.

6. Summary and Conclusions

The object of this study was to attempt to establish the relationship between the weather at an offshore drilling site and nearby land stations.

The results suggest that winter temperatures at the offshore site are somewhat colder than the nearby land stations, and perhaps because of the mechanical turbulence induced by pressure ice, winds appeared to be lower at the drilling site. The most outstanding feature was the high occurrence of ice fog at the drilling site. The relatively high incidence of ice fog at light wind speed, the occurrence of blowing snow in strong winds, resulted in the lower ceilings and visibilities that could in turn affect the safety of offshore operations and their tactical support.

Due to the short period of record, and the limited number of observations, the results of this study are by no means representative of "normal" climate of an offshore site, nor are they applicable to the whole Arctic. They do suggest the possible differences that may exist between land and offshore conditions and emphasise the need for more data collection and further studies.

TABLE 1

References

1. Siple P.A. and Passel C.F. 1945. Measurements of dry atmospheric cooling in sub-freezing temperatures. Proceedings, American Philosophical Society Vol. 98, 177-199.
2. U.S. Hydrographic Office. Oceanographic Atlas of the polar seas. 1958.
3. N.P. Langleben. A study of the roughness parameters of sea ice from wind profiles. Journal of Geophysical Research Vol. 77 No. 30, 1972.
4. Environment Canada, Manual of standard procedures for surface weather observing and reporting.

TABLE 2

	East Drake	Rea Point	Resolute Bay
C	0.0	0.0	0.0
N	12.1	12.6	12.3
ENE	7.4	13.7	14.4
NE	3.3	8.8	18.1
ENE	6.0	10.8	18.5
E	9.1	10.6	17.0
ESE	10.9	10.5	20.1
SE	10.0	14.2	15.4
SSE	8.4	15.3	14.2
S	11.3	11.3	14.2
SSW	7.5	8.0	10.3
SW	6.9	6.8	11.0
WSW	6.1	7.6	10.3
W	8.1	13.7	8.4
WNW	11.0	17.6	9.1
NW	12.5	19.0	10.6
NNW	14.0	18.4	13.0
Over all average wind speed	10.2	14.6	12.7

TABLE 1

Percentage Frequency of Wind Speed Classes

	W I N D S P E E D (M. P. H.)							
	00-09	10-19	20-29	30-39	40-49	≥ 20	≥ 30	≥ 40
East Drake	48.8	41.7	9.1	.2	.1	9.5	.4	.1
Rea Point	31.6	37.2	26.5	4.4	.3	31.2	4.7	.3
Resolute Bay	47.3	28.8	17.2	6.1	.7	23.9	6.8	.7

TABLE 2

Directional Average Wind Speed (M.P.H.)

	East Drake	Rea Point	Resolute Bay
C	0.0	0.0	0.0
N	12.1	12.6	12.2
NNE	7.4	13.7	14.4
NE	5.3	8.8	16.1
ENE	6.0	10.8	18.5
E	9.1	10.6	17.0
ESE	10.9	10.5	20.1
SE	10.0	14.2	15.4
SSE	8.4	15.1	14.2
S	11.3	11.3	14.2
SSW	7.5	8.0	10.3
SW	6.9	6.8	11.0
WSW	6.1	7.6	10.5
W	8.1	13.7	8.4
WNW	11.0	17.6	9.1
NW	12.5	19.0	10.6
NNW	14.0	18.4	13.0
Over all average wind speed	10.2	14.6	12.7

TABLE 3

Percentage Frequency of Temperature classes

	TEMPERATURE CLASSES (°F)							
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10
East Drake	.3	7.2	16.3	33.6	22.7	11.5	8.4	.1
Rea Point		.5	13.1	22.4	33.5	20.0	10.5	
Resolute Bay		.4	8.6	28.6	33.5	17.9	10.0	.1

TABLE 4

Percentage frequency of visibility at or below specified values

	Visibility (miles)			
	$\leq \frac{1}{2}$	≤ 1	≤ 3	≤ 5
East Drake	18.1	26.8	41.1	52.8
Rea Point	13.8	19.5	26.7	31.7
Resolute Bay	5.9	10.3	26.3	34.8

Table 5

Percentage Frequency of Ceilings and Visibilities by Wind Speed Classes

	Ceiling \leq 200 feet or visibility $\leq \frac{1}{2}$ mile						Ceiling \leq 500 feet or visibility \leq 1 mile						Ceiling \leq 1000 feet or visibility \leq 3 miles					
	0-9	10-19	20-29	30-39	40-49	All winds	0-9	10-19	20-29	30-39	40-49	All winds	0-9	10-19	20-29	30-39	40-49	All winds
East Drake	.4	9.5	8.0	.2	.1	18.2	1.2	16.6	8.7	.2	.1	26.8	6.7	26.0	8.0	.2	.1	42.0
Rea Point		1.4	8.6	3.5	.3	13.8	.7	2.7	12.3	3.8	.3	19.8	2.6	6.7	14.2	3.9	.3	27.7
Resolute Bay	.1	.1	1.8	3.3	.6	5.9	.8	.9	3.8	4.5	.7	10.7	5.5	5.6	9.1	5.6	.7	26.5

Table 6

Relative Percentage Frequency of Ceilings and Visibilities by Wind Speeds Classes

	Ceiling \leq 200 feet or visibility $\leq \frac{1}{2}$ mile					Ceiling \leq 500 feet or visibility \leq 1 mile					Ceiling \leq 1000 feet or visibility \leq 3 miles				
	0-9	10-19	20-29	30-39	40-49	0-9	10-19	20-29	30-39	40-49	0-9	10-19	20-29	30-39	40-49
East Drake	.8	22.8	87.7	100.0	100.0	2.5	39.8	95.8	100.0	100.0	13.8	82.5	98.6	100.0	100.0
Rea Point	.1	3.7	32.8	79.6	100.0	2.1	7.3	46.3	86.9	100.0	8.2	18.0	53.7	89.1	100.0
Resolute Bay	.3	.4	10.4	54.5	86.4	1.6	3.0	22.2	73.8	95.5	11.7	19.5	53.1	92.7	100.0

TABLE 7

Percentage Frequency of Blowing Snow by Wind Speed Classes

	W I N D S P E E D S (M . P . H .)					All winds
	00-09	10-19	20-39	30-39	40-49	
East Drake		6.3	8.0	.2	.1	14.6
Rea Point		.6	7.8	3.9	.3	12.6
Resolute Bay		.3	6.9	5.2	.7	13.1

TABLE 8

Relative Percentage Frequency of Blowing Snow by Wind Speed Classes

	W I N D S P E E D S (M . P . H .)				
	00-09	10-19	20-29	30-39	40-49
East Drake	.1	15.0	88.0	100.0	100.0
Rea Point		1.7	29.4	89.1	100.0
Resolute Bay		1.0	40.2	85.3	100.0

TABLE 9

Percentage Frequency of Blowing Snow by Temperature Classes

	T E M P E R A T U R E (°F)								All Temp.
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10	
East Drake			.4	6.4	3.8	2.1	2.0		14.7
Rea Point			.4	2.1	6.7	2.8	.6		12.6
Resolute Bay				1.2	4.9	3.4	3.5		13.0

TABLE 10

Relative Percentage Frequency of Blowing Snow by Temperature Classes

	T E M P E R A T U R E (°F)						
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0 1-10
East Drake			2.2	18.9	17.0	18.6	23.4
Rea Point			3.4	9.3	20.0	14.3	5.5
Resolute Bay		.4	.2	3.7	21.8	29.7	41.8

TABLE 11

Percentage Frequency of Blowing Snow by Wind Direction

	WIND DIRECTION																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
East Drake		1.7	.1			.2	.5	.6	.5	1.1	.1	.1		.2	1.2	5.1	3.2
Rea Point		.6	.1					.1	.3	.5				.2	1.1	4.9	4.9
Resolute Bay		1.3	1.0	.3	.6	1.1	2.6	2.7	.8	.3	.1					.3	1.8

TABLE 12

Relative Percentage Frequency of Blowing Snow by Wind Direction

	WIND DIRECTION																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Last Drake		25.4	2.1		2.6	12.0	24.3	20.2	13.5	25.4	2.3	2.1		3.5	8.4	20.9	25.7
Rea Point		7.5	1.9					4.8	12.3	7.9				4.3	6.9	23.0	29.1
Resolute Bay		16.2	31.3	9.1	17.4	38.9	38.4	22.0	21.8	19.6	4.5	2.6			.6	2.2	7.3

TABLE 13

Percentage Frequency of Ice Fog by Temperature Classes

	TEMPERATURE (°F)							
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10 all temperatures
East Drake	.1	2.3	5.6	16.0	13.1	5.3	4.5	4.6
Rea Point		.1	2.7	5.3	10.3	4.6	2.9	25.9
Resolute Bay		.1	1.8	8.0	7.9	2.4	2.6	22.8

TABLE 14

Relative Percentage Frequency of Ice Fog by Temperature Classes

	TEMPERATURE (°F)							
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10
East Drake	20.0	32.3	34.8	47.5	57.9	45.8	54.0	
Rea Point		17.6	20.8	23.7	30.8	22.9	28.1	
Resolute Bay		14.3	21.5	28.1	23.4	13.3	24.2	

TABLE 15

Percentage Frequency of Ice Fog by Wind Direction

	W I N D D I R E C T I O N																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
East Drake	1.2	2.3	.4	.2	.3	.7	.8	.6	1.3	1.7	1.7	1.3	1.0	1.7	6.8	15.8	9.2
Rea Point	.9	1.7	.6		.2	.1	.1	.9	.6	1.1	.4	.2	.1	.7	2.7	7.8	7.9
Resolute Bay	1.4	2.2	1.0	.2	.4	.5	1.6	1.3	.7	.2	.2	.1	.1	.5	1.6	3.0	7.9

TABLE 16

Relative Percentage Frequency of Ice Fog by Wind Direction

	W I N D D I R E C T I O N																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
East Drake	18.0	34.4	13.5	16.7	20.5	42.0	37.1	21.3	31.7	39.6	42.2	41.5	40.0	30.4	48.1	63.5	73.3
Rea Point	12.4	19.5	17.5	6.7	20.6	14.8	18.8	45.2	30.8	17.2	9.2	8.3	4.3	12.9	16.4	36.7	47.5
Resolute Bay	22.4	26.2	33.3	8.0	12.2	17.8	23.1	10.9	17.6	8.9	11.4	7.9	5.4	24.6	31.9	23.3	31.9

TABLE 17

Percentage Frequency of Ice Fog by Wind Speed Classes

	W I N D S P E E D (M. P. H.)					all winds
	00-09	10-19	20-29	30-39	40-49	
East Drake	11.9	28.7	6.2	.1		46.9
Rea Point	3.0	6.5	13.0	3.2	.3	26.0
Resolute Bay	7.8	5.5	6.5	2.6	.3	22.7

TABLE 18

Relative Percentage Frequency of Ice Fog by Wind Speed Classes

	W I N D S P E E D (M. P. H.)				
	00-09	10-19	20-29	30-39	40-49
East Drake	24.4	68.8	68.0	42.9	
Rea Point	9.5	17.6	48.9	72.3	100.0
Resolute Bay	16.5	19.2	38.0	43.5	50.0

TABLE 19

Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by Wind Direction

	W I N D D I R E C T I O N																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
East Drake	1.2	1.5	.4	.2	.2	.5	.5	.6	1.0	1.2	1.7	1.2	1.0	1.6	5.8	11.8	6.1
Rea Point	.9	1.4	.6		.2	.1	.1	.8	.5	.7	.4	.2	.1	.6	2.0	4.2	4.0
Resolute Bay	1.4	1.1	.3	.2	.3	.3	.8	.8	.6	.1	.2	.1	.1	.5	1.6	2.8	6.2

TABLE 20

Relative Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by Wind Direction

	W I N D D I R E C T I O N																
	C	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
East Drake	18.0	22.5	13.5	16.7	17.9	30.0	24.3	20.2	23.8	26.9	41.4	40.4	40.0	28.7	41.1	47.6	48.3
Rea Point	12.4	16.9	17.5	6.7	20.6	14.8	18.8	40.3	26.2	10.8	9.2	8.3	4.3	11.0	12.1	19.6	23.9
Resolute Bay	22.4	13.8	8.1	5.7	7.0	8.9	11.1	6.5	15.1	7.1	11.4	7.9	5.4	24.6	31.3	21.8	25.2

TABLE 21

Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by temperature classes

	T E M P E R A T U R E (^o F)								
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10	all temperatures
East Drake	.1	2.3	5.4	11.6	9.9	3.8	3.4	3.4	36.5
Rea Point		.1	2.3	3.6	5.5	2.9	2.5		16.9
Resolute Bay		.1	1.8	6.9	5.0	1.7	1.6		17.1

TABLE 22

Relative Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by temperature classes

	T E M P E R A T U R E (^o F)							
	-69-60	-59-50	-49-40	-39-30	-29-20	-19-10	-9-0	1-10
East Drake	20.0	32.3	32.9	34.4	43.7	33.1	40.2	
Rea Point		17.6	17.4	15.9	16.4	14.6	23.5	
Resolute Bay		14.3	21.5	24.1	15.0	9.6	14.6	

TABLE 23

Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by wind speed classes

	W I N D S P E E D (M . P . H .)					
	00-09	10-19	20-29	30-39	40-49	all winds
East Drake	11.9	23.5	1.0			36.4
Rea Point	3.0	6.3	7.4	.1		16.8
Resolute Bay	7.8	5.4	3.4	.5		17.1

TABLE 24

Relative Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by wind speed classes

	W I N D S P E E D (M . P . H .)				
	00-09	10-19	20-29	30-39	40-49
East Drake	24.4	56.4	10.9		
Rea Point	9.5	16.9	28.0	2.2	
Resolute Bay	16.5	18.9	19.8	8.4	

TABLE 26

Cumulative Percentage Frequency of Wind-chill

TABLE 25

Stages of relative human comfort and environmental effects of atmospheric cooling (after Siple, 1945)

East Drake	99.4	93.2	91.8	86.3	81.3	71.2
Res Point	92.5	92.0	84.4	67.5		
Resolute Bay	93.9	85.3	72.4	52.8		

Wind-chill (Kcal/m ² /hr)	Degree of comfort
600	Considered as comfortable when dressed in wool underwear, socks, mitts, ski boots, ski headband, and thin cotton windbreaker suits, and while skiing over level snow at above 3 mph. (Metabolic output about 200 Kcal/m ² /hr.)
1200	Considered unpleasant for travel on foggy and overcast days.
1200	Considered unpleasant for travel on clear sunlit days.
1400	Freezing of exposed human flesh begins, depending upon degree of activity, amount of solar radiation, character of skin, and circulation. Travel, or living in temporary shelter, becomes disagreeable.
2000	Travel, or living in temporary shelter, becomes dangerous. Exposed areas of flesh will freeze within less than 1 minute for the average individual.
2300	Exposed areas of flesh will freeze within less than ½ minute for the average individual.

TABLE 26

Cumulative Percentage Frequency of Wind-chill

	WIND CHILL ($\text{kcal/m}^2/\text{hr}$)					
	>600	>1000	>1200	>1400	>2000	>2200
East Drake	99.4	93.2	91.8	86.5	21.5	3.2
Rea Point	92.5	92.0	84.4	67.5		
Resolute Bay	93.9	88.2	77.4	52.8		

TABLE 27

EAST DRAKE

Percentage Frequency of Visibility at or below
Specified values or wind-chill at or above specified values

Wind-chill ($\text{Kcal/m}^2/\text{hr}$)	Visibility (miles)			
	1/4	1/2	1	3
600	99.4	99.5	99.5	99.5
1000	93.2	93.3	93.3	93.5
1200	91.8	91.9	91.9	92.3
1400	86.5	86.6	86.7	87.4
2000	24.9	26.8	31.4	43.3
2200	10.9	14.8	22.1	35.8

TABLE 28

REA POINT

Percentage Frequency of Visibility at or below
Specified value or wind-chill at or above specified values

Wind-chill (Kcal/m ² /hr)	Visibility (miles)			
	1/4	1/2	1	3
600	92.5	92.5	92.5	92.9
1000	92.0	92.0	92.0	92.4
1200	84.8	84.8	84.8	85.6
1400	67.6	67.6	67.7	68.9
2000	7.9	11.2	16.7	24.0
2200	7.9	11.2	16.7	24.0

TABLE 29

RESOLUTE BAY

Percentage Frequency of Visibility at or below specified
values or wind-chill at or above specified values

Wind-chill (Kcal/m ² /hr)	Visibility (miles)			
	1/4	1/2	1	3
600	93.9	93.9	94.0	94.3
1000	88.2	88.3	88.4	88.9
1200	77.4	77.4	77.6	78.8
1400	52.8	52.8	53.2	55.9
2000	1.3	4.2	8.8	21.0
2200	1.3	4.2	8.8	21.0

FIGURE 1. BLACKENED TABLETS INDICATE POSITIONS OF DRILLING HOLES AND OBSERVING STATIONS

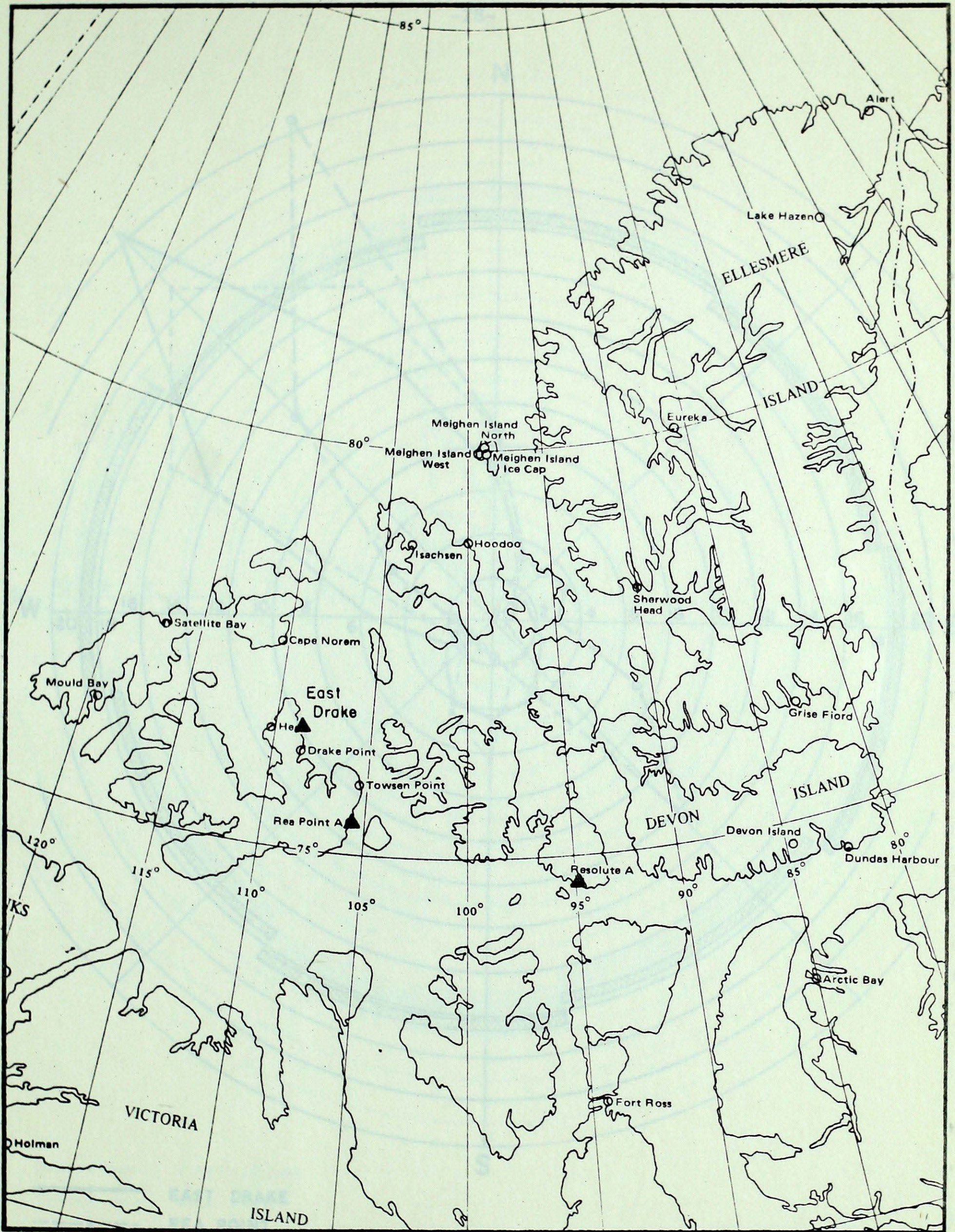


FIGURE 1: BLACKENED TRIANGLES INDICATE POSITIONS OF DRILLING SITE AND OBSERVING STATIONS.

Figure 2: Directional Percentage Frequency of all winds

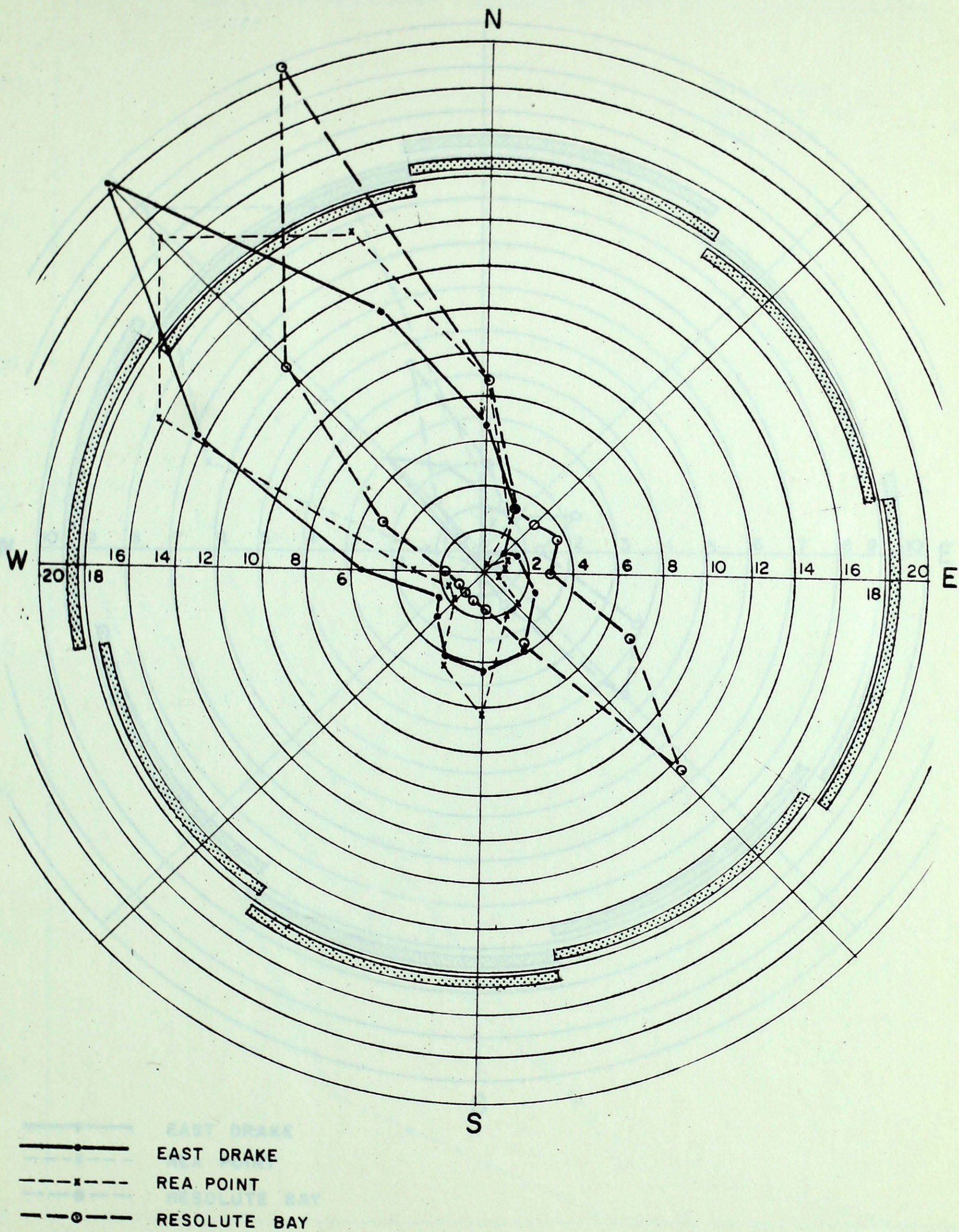


Figure 2 : Directional Percentage Frequency of all winds.

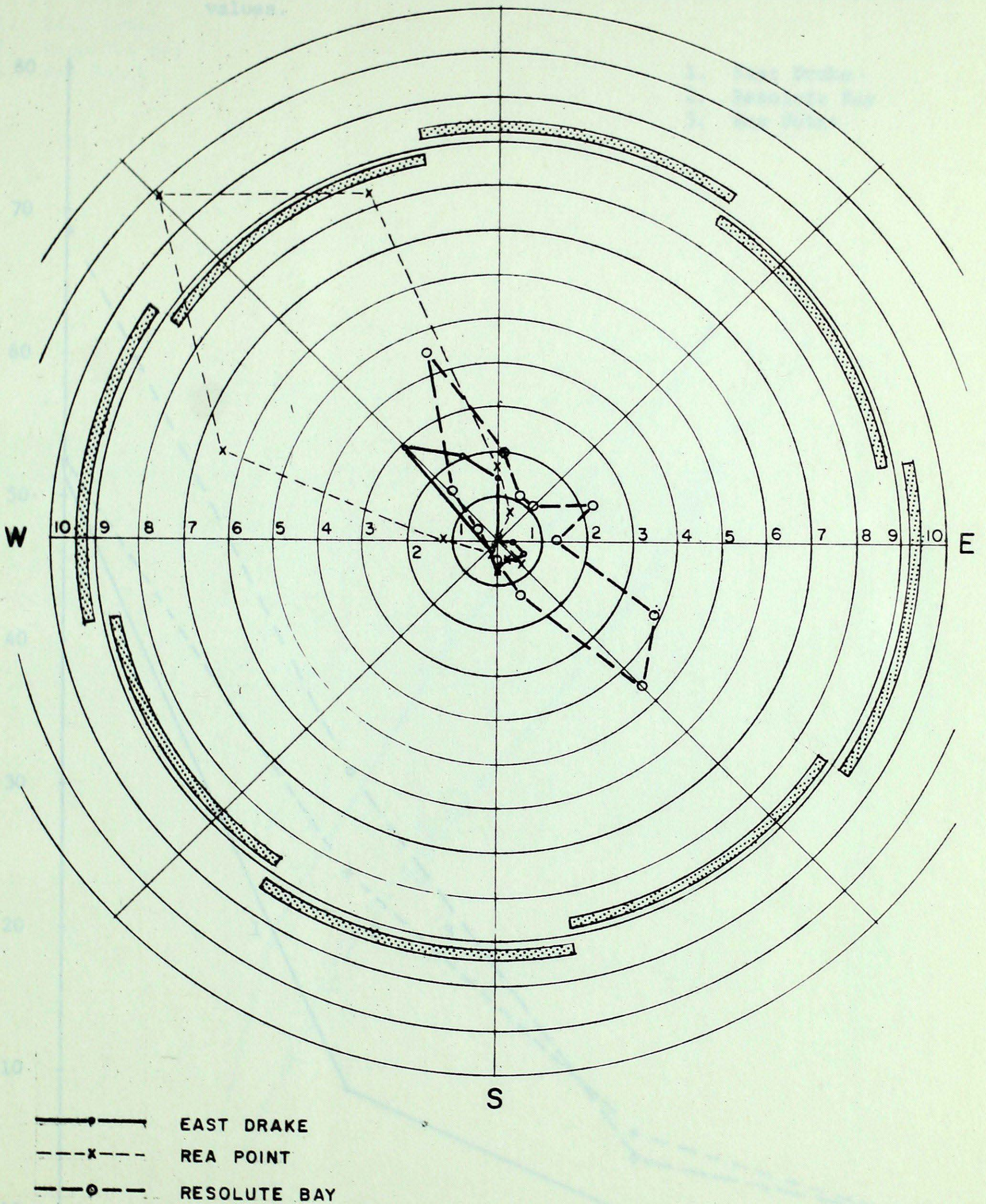


Figure 3 : Directional Percentage Frequency of winds 20 mph

Figure 4. Cumulative percentage frequency of winds at or above specified values.

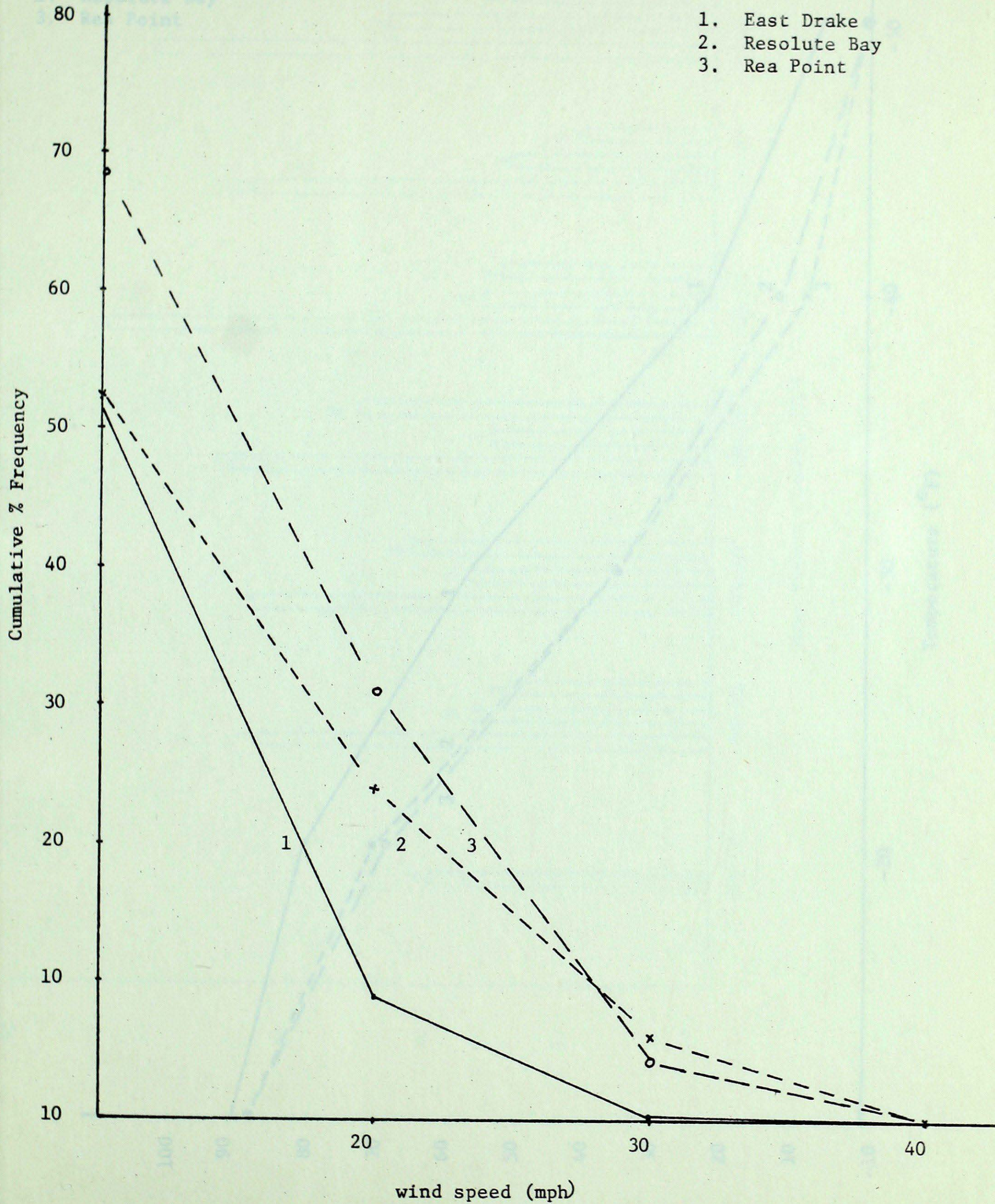


Figure 5. Cumulative Percentage Frequency of Temperatures at or below specified values.

1. East Drake
2. Resolute Bay
3. Rea Point

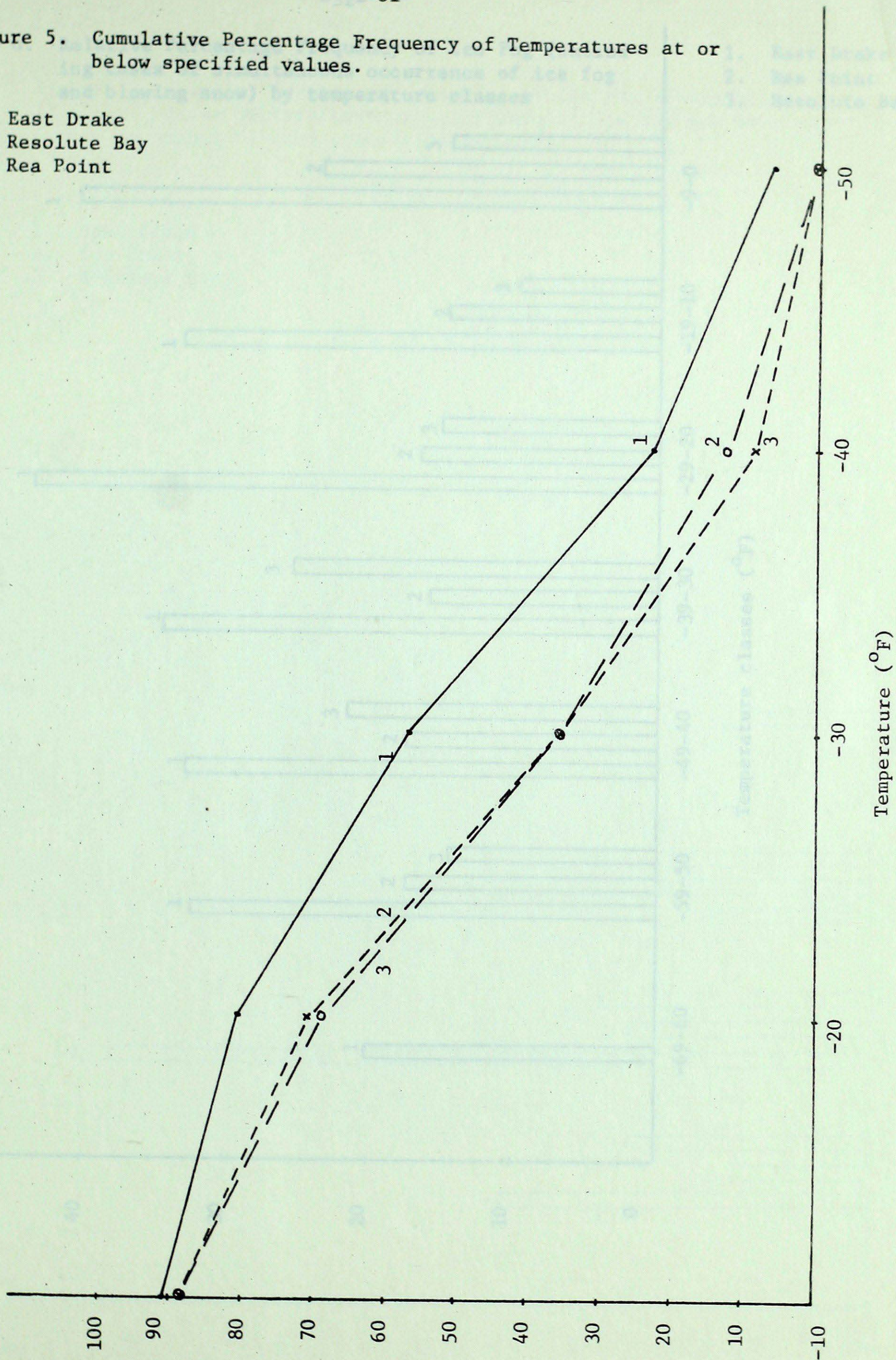


Figure 6. Relative Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by temperature classes

1. East Drake
2. Rea Point
3. Resolute Bay

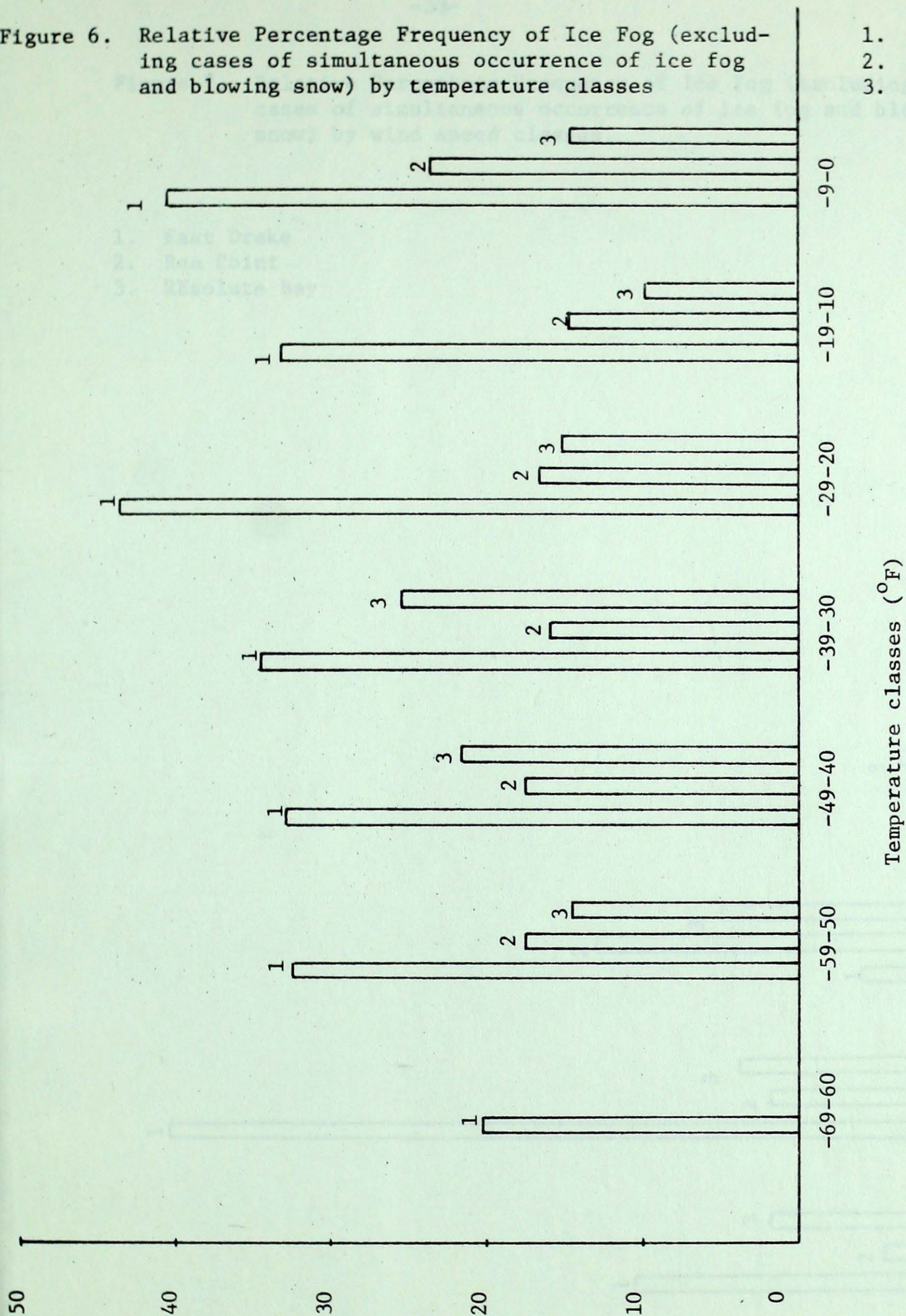


Figure 7. Relative Percentage Frequency of Ice Fog (excluding cases of simultaneous occurrence of ice fog and blowing snow) by wind speed classes.

- 1. East Drake
- 2. Rea Point
- 3. REsolute Bay

