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NOAA TECHNICAL MEMORANDUM AR 7

U.S. DEPARTMENT OF COMMERCE
National Oceanic And Atmospheric Administration
National Weather Service

SEA ICE CONDITIONS IN THE COOK INLET, ALASKA DURING THE 1970-71 WINTER

RICHARD J. HUTCHEON
MARINE METEOROLOGIST

ALASKA REGION
Anchorage,
Alaska
October 1972

Copy to DET & CHI

These Memoranda are available from the Alaska Region Headquarters at the following address:

National Oceanic and Atmospheric Administration
National Weather Service Regional Headquarters
632 6th Avenue, Hill Building
Anchorage, Alaska 99501

ATTN: Regional Climatologist

1. Freeze-Thaw Cycle in the Coastal Arctic of Alaska - 1968.

2. Climate Along A Pipeline from the Arctic to the Gulf of Alaska - 1968.

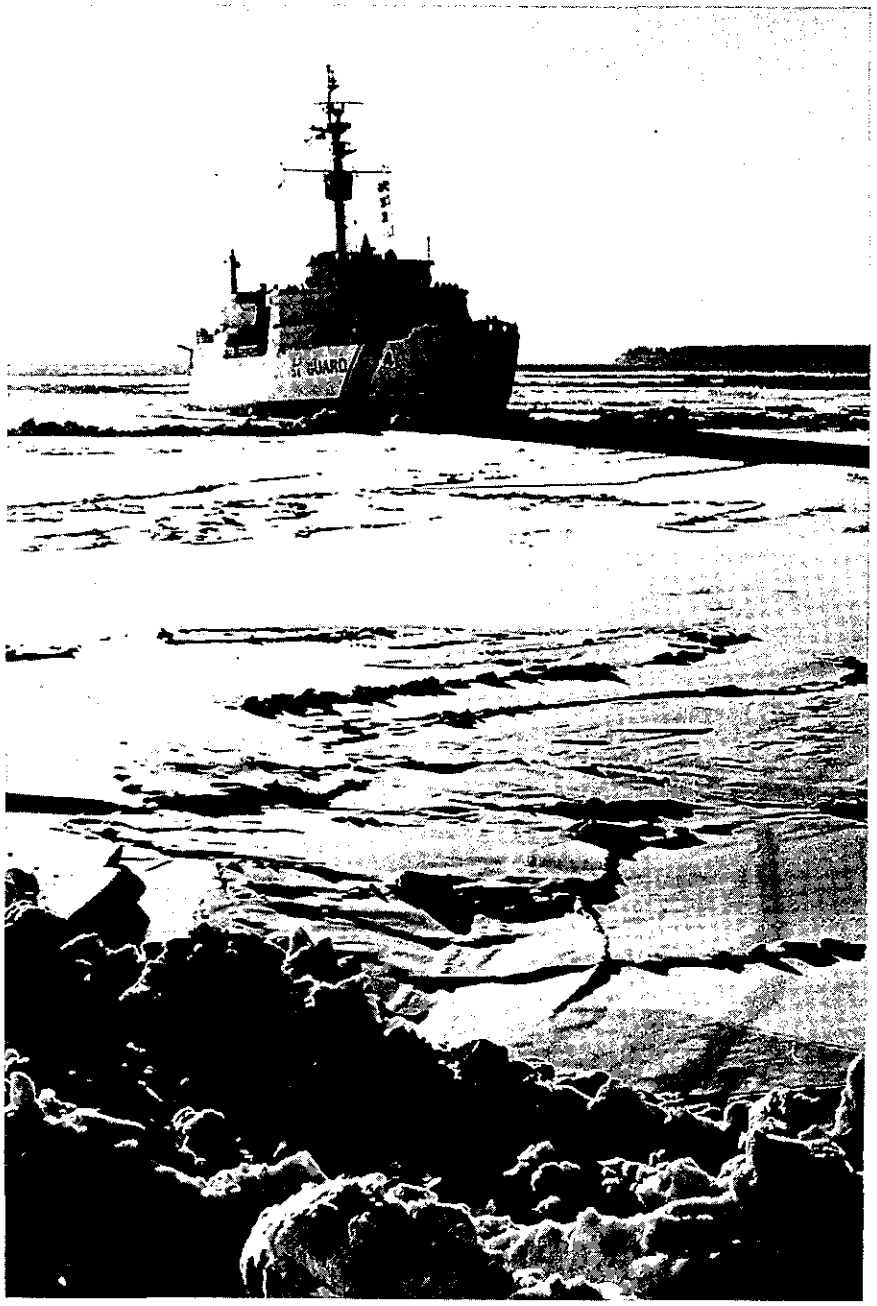
3. Coastal Weather and Marine Data Summary for Gulf of Alaska, Cape Spencer Westward to Kodiak Island - 1969.

4. Climate of the North Slope of Alaska. Harold Searby and Marcelle Hunter. February 1971.

5. Forecasting Ice in Cook Inlet, Alaska. Richard J. Hutcheon. August 1972.

6. Sea Ice Conditions in the Cook Inlet, Alaska during the 1969-1970 Winter. Richard J. Hutcheon. September 1972.

7. Sea Ice Conditions in the Cook Inlet, Alaska during the 1970-1971 Winter. Richard J. Hutcheon. October 1972.



Ice Breaker in bound to Port of Anchorage February 11, 1971. Pt. MacKenzie, in background top right.

Picture — Courtesy Anchorage Times

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

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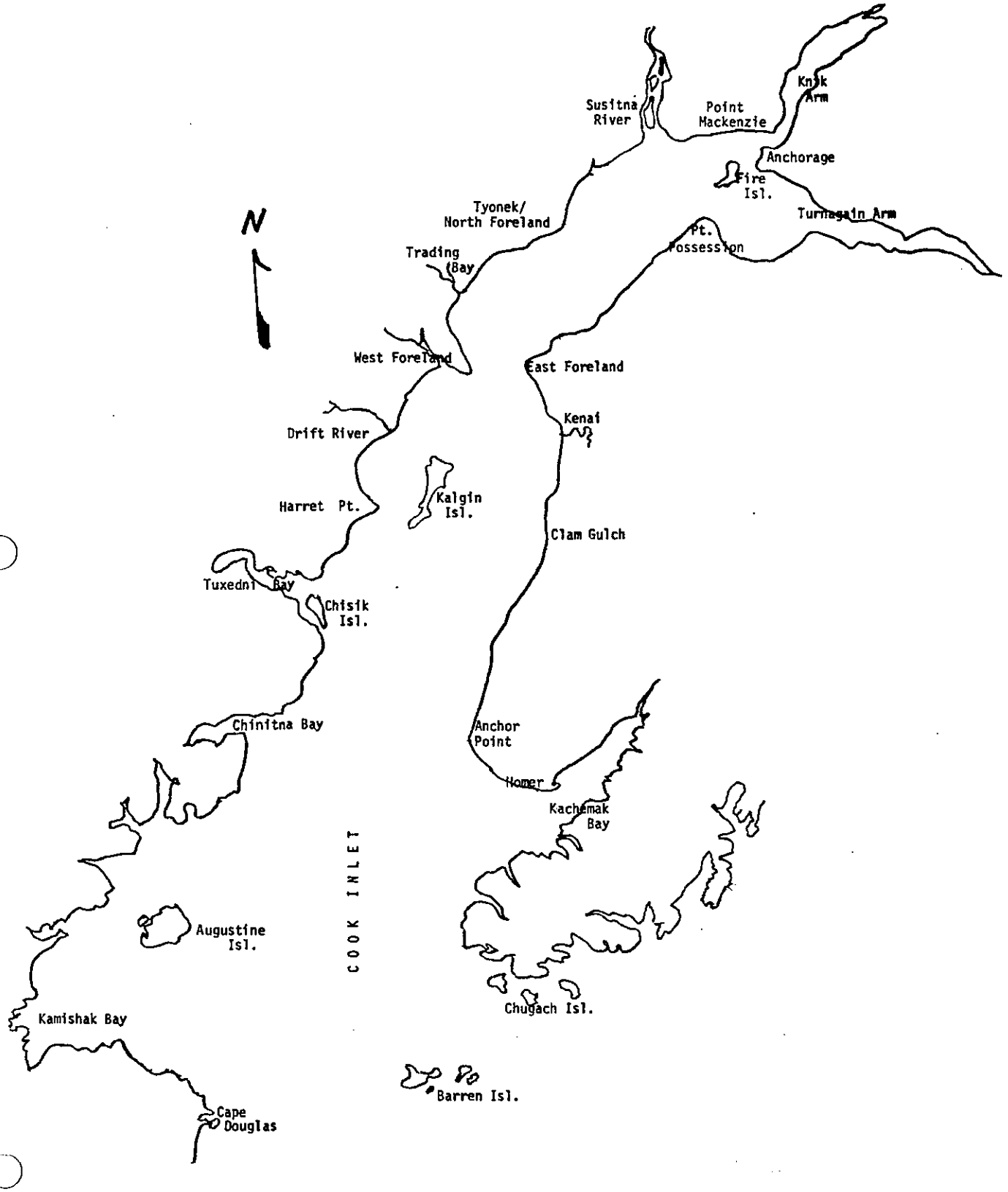

N
Susitna River
Point Mackenzie
Knik Arm
Anchorage
Fire Isl.
Turnagain Arm
Pt. Possession
Tyonek/ North Foreland
Trading Bay
West Foreland
East Foreland
Kenai
Drift River
Kalgin Isl.
Harret Pt.
Clam Gulch
Tuxedni Bay
Chisik Isl.
Chinitna Bay
Anchor Point
Homer
Kachemak Bay
COOK INLET
Augustine Isl.
Chugach Isl.
Kamishak Bay
Barren Isl.
Cape Douglas

SEA ICE CONDITIONS IN THE COOK INLET, ALASKA
DURING THE 1970 - 1971 WINTER

Ice in Cook Inlet during the winter of 1970 - 1971 was rough and persistent, The first ice was sighted on the 17th of October, and the Inlet was not ice free in the spring until the 20th of May. The ice was at its farthest extent late in January, south to Cape Douglas on the western side of the Inlet and Anchor Point on the eastern side with fast ice reported in Kachemak Bay extending up to 3 miles from the northern shore.

The extensive cold periods during the month of January and again during March (Figure 1) resulted in the development of rough ice conditions which persisted well into spring. A measure of the ice growth can be made by using cumulative frost degree days. A frost degree day is defined as a daily mean temperature 1° F below an arbitrary base of 32° F. Table 1 gives the cumulative degree days, by the month, for the winter of 1970 - 1971. Figure 2 compares the cumulative degree days during the winter of 1970 - 1971 with the average cumulative degree days, the highest 10%, and lowest 10% of cumulative degree days at Anchorage for a period of record beginning in 1923. Table 2 and 3 present other comparisons in tabular form.

Examination of these data indicates degree days accumulated at a nearly normal rate through the end of December. During the month of January, however, 919

degrees accumulated, and was exceeded only twice during any month since winter shipping began in the Inlet in 1964. Degree day accumulation during the month of February was slightly less than the normal rate, but because of the exceptionally cold January, total accumulation for the winter remained well above normal. The very cold month of March boosted the total degree day accumulation to near the highest 10% level for the entire winter.

The first ice developed on the mud flats during the latter part of October when temperatures in the Inlet dropped 20 or more degrees below normal, into the low teens. Some fresh water ice was sighted on the 17th near the mouth of the Big Susitna River and fresh water ice cakes were reported near the Anchorage dock on the 24th and 25th of October. However, this ice was of short duration as temperatures rose well above freezing during the first part of November and the Inlet water temperatures remained near 40 degrees.

Above freezing temperatures prevailed until the middle of November, when a strong ridge of high pressure developed over the western coast of Alaska bringing the Inlet under the influence of cold, Arctic air for the remainder of the month.

By the 19th of November, ice had begun forming in sheltered, shallow parts of the Inlet. Very cold temperatures on the 22nd and 23rd accelerated development of the ice with 7 to 10 tenths coverage of new ice being reported north of Fire

Island on the 23rd. By the end of November, up to 8 tenths brash and scattered floes up to 10 inches thick, had developed north and east of Fire Island and extended southward to near Moose Point, with decreasing amounts southward to the Forelands. Ice cakes up to 4 feet thick were reported near the mouths of the Susitna and Beluga Rivers. Shore ice had formed as far south as Kenai.

A gradual increase occurred in the ice concentrations during the first half of December with ice occasionally reported off Anchor Point by the middle of the month. Warmer temperatures in the latter part of December caused considerable softening of the ice and some decrease in the ice concentration. However, a rapid decrease in temperatures at the end of December began a steady increase in ice which continued through the month of January.

January was an exceptionally cold month, with the average temperature at Anchorage International Airport only 2.7 degrees above zero, more than 9 degrees below the normal monthly temperature. At Anchorage, the month of January was the coldest since 1947 and the second coldest since 1925. The 5 below zero average temperature at Kenai was the coldest in a 36 year record, while Homer had the second coldest since records began in 1943.

By the end of January, ice extended as far south as Cape Douglas on the western side of the Inlet and Anchor Point on the eastern side, with fast ice extending up to

3 miles off the northern shore of Kachemak Bay. Numerous reports were received concerning the difficulty ships had in the Inlet during the last half of January. On the 26th, an aerial reconnaissance observed a tanker frozen in the ice at the loading platform at Drift River and another having difficulty in the ice several miles off Drift River.

Because of the persistent subzero temperatures, the ice in the Inlet became very hard during the last half of January and thicknesses of the ice floes were estimated to be increasing at about 1 inch a day. In addition to the heavy ice that had formed in the Inlet, large piles of ice (Stamukhi) formed on the tidal flats and were occasionally lifted free by the tidal action.

These large chunks of ice, observed in the Inlet throughout the winter, resulted from beach ice which had broken free, been deposited higher on the mud flats, and frozen to the underlying mud. Ice floes floating toward the beach were then caught on top of this higher piece of ice and, as the tide receded, the overhanging pieces broke off, leaving a stack of layered ice with nearly straight sides. This process was repeated many times, being limited only by the height of the tides and the strength with which the original beach ice was frozen into the mud.

The coming of February brought warmer temperatures to the Inlet, averaging 20.6 degrees during the month at Anchorage International Airport, nearly 2 degrees

above normal. A gradual decrease in ice concentration and a general softening of the ice occurred during the month with up to 9 tenths brash and cakes existing south to Cape Kasilof by the end of the month and 3 to 6 tenths from Cape Kasilof to Anchor Point. During February, several reports were received of ships being damaged by striking stamukhi which had been lifted afloat by high tides. Isolated stamukhi with thicknesses greater than 40 feet were observed grounded between Moose Point and the East Foreland, and scattered chunks up to 40 feet thick were observed grounded at Middle Ground Shoal and northeastward in shallow mid-channel areas.

The relatively mild temperatures of February did not persist into March, which was exceptionally cold. The average monthly temperature at Anchorage International Airport was 14.2 degrees, more than 10 degrees below normal. The average daily temperatures at Anchorage rose above 30 degrees only once during the month.

A reconnaissance flight over the Inlet on the 23rd of March indicated concentrations generally 3 to 7 tenths north of St. Augustine Island and Clam Gulch with 6 to 9 tenths on the western side of the Inlet between Old Tyonek and the West Forelands. A similar flight one year earlier showed less than 1 tenth concentrations over the northern portion of the Inlet with only a few floes and cakes southward to Tyonek.

Temperatures in the Inlet area rose steadily during the month of April, generally rising above freezing by the middle of the month. Ice concentrations decreased markedly during the last half of the month as a result of the warm temperatures causing an increased runoff into the Inlet and creating a "flushing" effect, moving the ice southward into the warmer water with the tidal motion. By the end of April, only patches of brash and cakes, made up mostly of beach ice, existed north of the Forelands. However, a report from the Anchorage dock on the 29th indicated that a ship was nearly torn away from its moorings by the force of the ice during tidal change.

Ice concentrations continued to decrease during May, and by the 7th the Inlet was ice free except for a few chunks of beach ice and some river ice occasionally up to 4 feet thick. This ice gradually melted during the month with warmer water temperatures and increased sunshine. By the 20th of May the Inlet was ice free.

Reconnaissance of the Cook Inlet sea ice was facilitated immeasurably through the excellent cooperation of the 5040th Helicopter Squadron at Elmendorf AFB. Meteorologists from the Weather Service Forecast Office were frequent observers aboard these operational and training helicopter flights. Reconnaissance from other aircraft, though on a less regular basis, was also beneficial.

Figure 1.

AVERAGE DAILY TEMPERATURES

ANCHORAGE

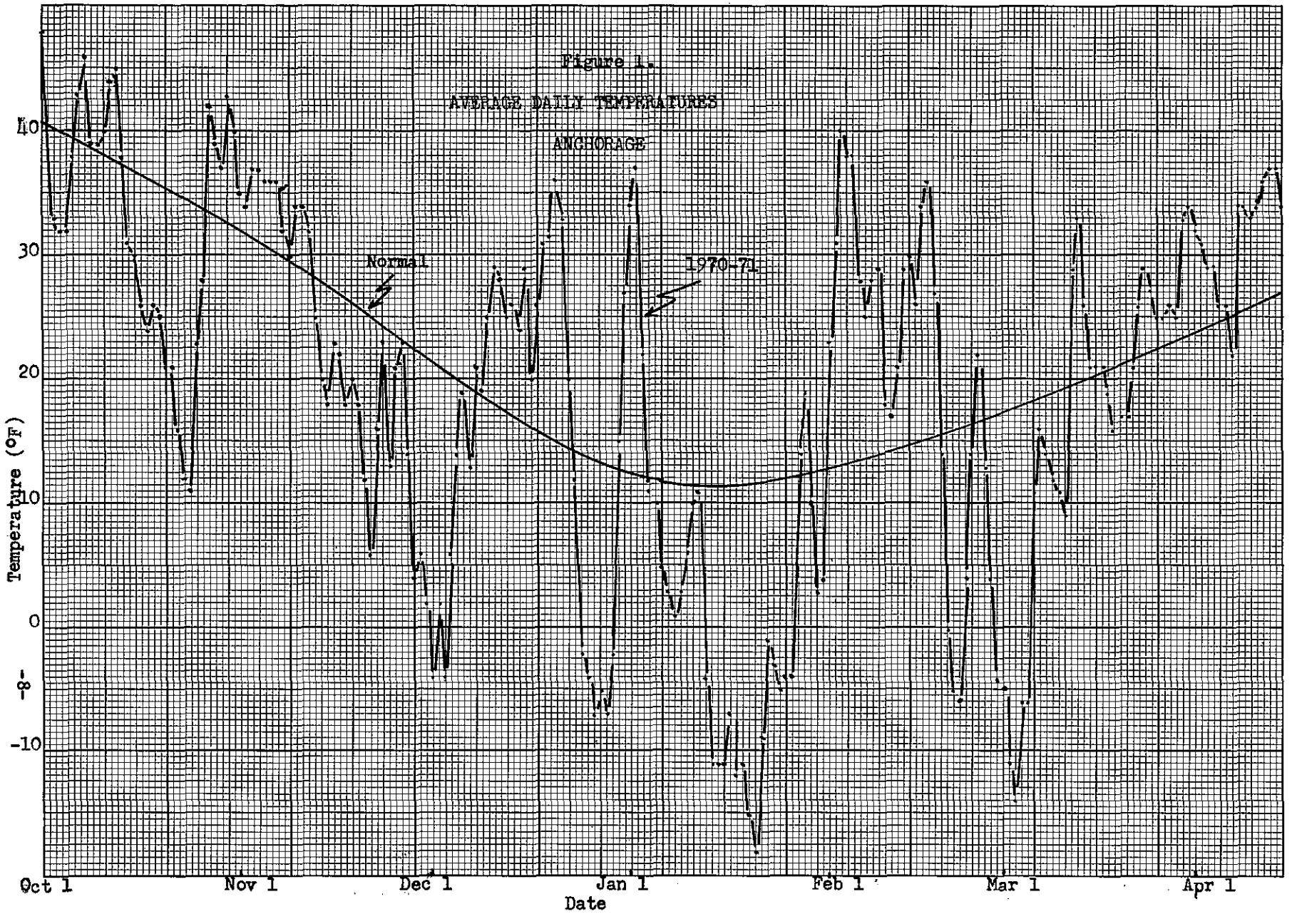


Figure 2

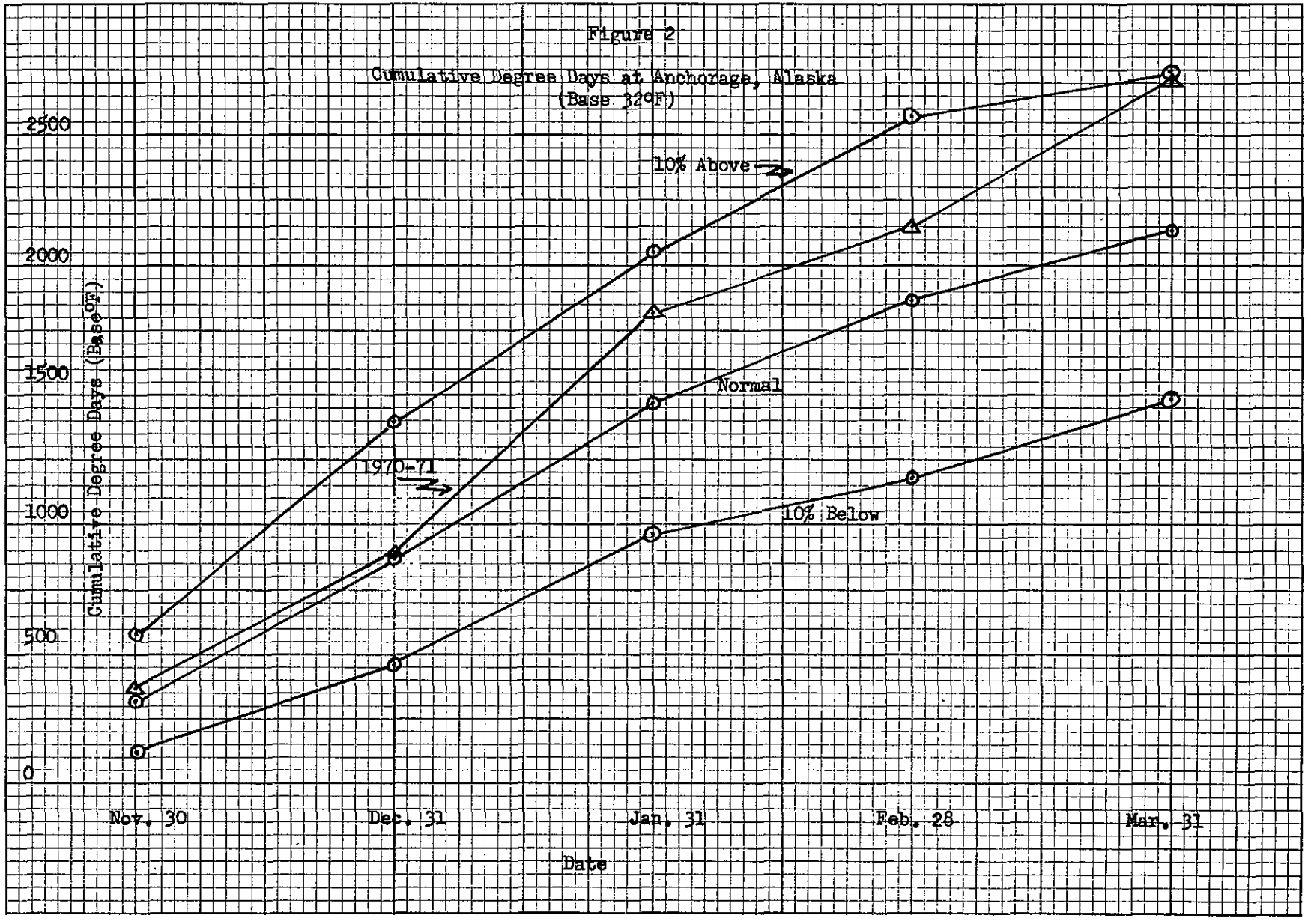

Cumulative Degree Days at Anchorage, Alaska
(Base 32°F)
2500
2000
1500
1000
500
0
Cumulative Degree Days (Base 0°F)
10% Above
Normal
1970-71
10% Below
Nov. 30
Dec. 31
Jan. 31
Feb. 28
Mar. 31
Date

TABLE 1

Cumulative Degree Days (Base 32 F) for the Winter 1970 -- 1971
Anchorage, Alaska

	By Oct. 31	By Nov. 30	By Dec. 31	By Jan. 31	By Feb. 28	By Mar. 31
Monthly	112	250	533	919	339	552
Cumulative		362	895	1814	2153	2705

TABLE 2

Cumulative Degree Days (Base 32 F) for Each of 6 Winters
at Anchorage, Alaska

Year	By Nov. 30	By Dec. 31	By Jan. 31	By Feb. 28
1964-65	313	1270	1948	2554
1965-66	338	918	1608	2086
1966-67	429	1080	1848	2335
1967-68	133	626	1228	1480
1968-69	290	1083	1929	2317
1969-70	265	369	1078	1157

TABLE 3

Climatological Summary of Cumulative Degree Days (Base 32 F.) at Anchorage, Alaska for October through March

(period of record begins with 1923-24 winter *)

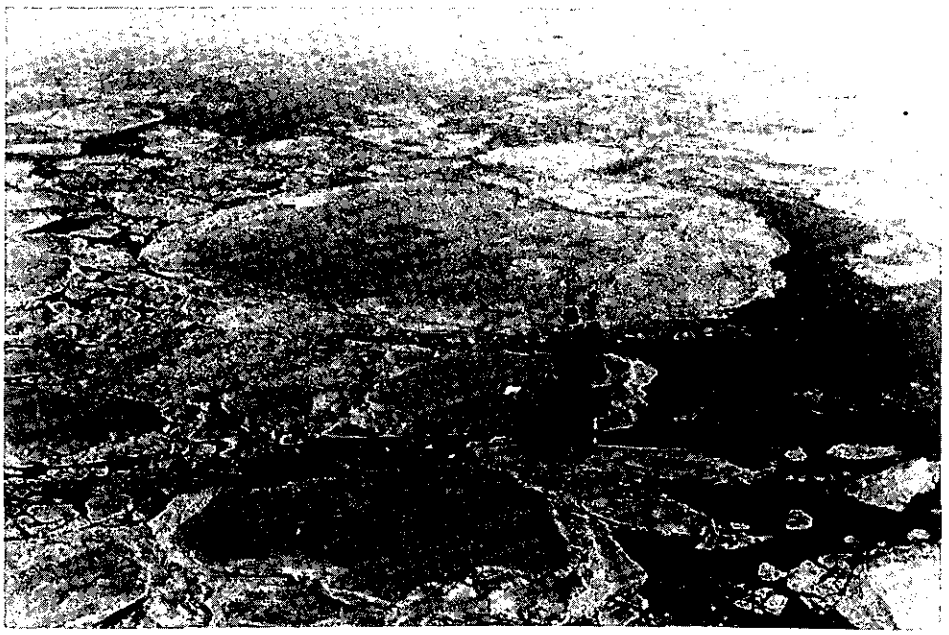
The winters of 1955-56 accumulated more degree days than any other winter since the period of record began in 1923. The winter of 1930-31 accumulated the least. The percentages listed in the left hand column indicates the percent of years which have had a greater number of degree days accumulated by the end of a particular month. For example, 90% of the time more than 906 degree days have accumulated by Jan. 31.

	By Nov. 30	By Dec. 31	By Jan. 31	By Feb. 28	By Mar. 31
1955-56	680	1415	2240	2873	3253
10% above	590	1400	2040	2560	2740
25%	500	1170	1930	2400	2580
Average	314	884	1479	1877	2146
75%	160	690	1130	1440	1690
90% above	120	460	906	1180	1490
1930-31	253	414	637	794	980

* 1925-26, 1926-27, 1928-29 missing

Kachemak Bay January 15, 1971.

Picture -- Leif Lie, Meteorologist
National Weather Service Forecast
Office, Anchorage.

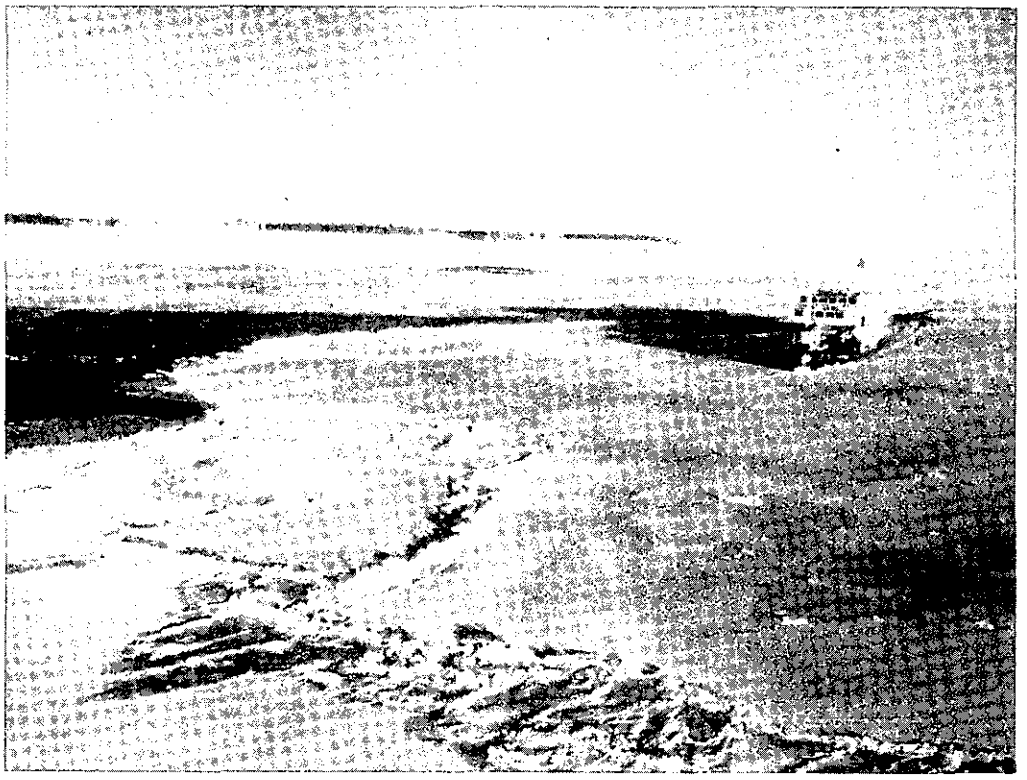


Trading Bay, January 15, 1971.

Picture — Leif Lie, Meteorologist
National Weather Service Forecast Office,
Anchorage.

From Sea-Land ship Philadelphia, near Nikiski, January 26, 1971.

Courtesy Captain B.J. Logan,
American Institute of Marine Underwriters.



Sea-Land ship Philadelphia, near Nikiski area, January 26, 1971.

Courtesy Captain B.J. Logan,
American Institute of Marine Underwriters.

Foss barge in channel below Fire Island, April 1, 1971.

Courtesy M.D. Duppenthaler, Foss Launch & Tug Co.

GLOSSARY

TERM	USUAL AGE	USUAL THICKNESS
NEW ICE	HOURS TO DAYS	LESS THAN 4 INCHES
YOUNG ICE	DAYS TO WEEKS	4 TO 12 INCHES
THIN (FIRST YEAR) ICE	WEEKS TO MONTHS	12 INCHES TO 2 FEET
MEDIUM (FIRST YEAR) ICE	MONTHS	2 TO 4 FEET
THICK (FIRST YEAR) ICE	MONTHS	OVER 4 FEET
MULTI-ICE	MORE THAN ONE YEAR	UP TO 10 FEET OR MORE

TENTHS COVERAGE	CATEGORICAL TERM
0	ICE FREE
1-3	VERY OPEN PACK ICE
4-6	OPEN PACK ICE
7-9	CLOSE PACK ICE
10	VERY CLOSE PACK ICE

TERM	FLOE SIZE (DIAMETER)
BRASH	LESS THAN 6 FEET (FRAGMENTED)
CAKES	6 TO 65 FEET
SMALL FLOES	65 TO 300 FEET
MEDIUM FLOES	300 TO 1500 FEET
BIG, VAST, GIANT FLOES	1500 FEET TO MILES ACROSS

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