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THE FREQUENCY AND PERCENT COVERAGE
OF SEA ICE IN THE ST. GEORGE BASIN

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The Frequency and Percent Coverage
of Sea Ice in the St. George Basin

Introduction and Background

The St. George Basin lies between the **Pribiloff** Islands and the Alaska Peninsula and is generally the region of the southern limit of yearly oceanic ice in eastern Bering Sea. With the advent of offshore petroleum leasing in these waters, questions have arisen concerning the extent and coverage of annual sea ice here.

In order to address some of these questions, the accompanying maps have been compiled showing these parameters on a monthly basis for that region.

Methods

The U.S. Navy Fleet Weather Facility, **Suitland**, Maryland, compiles and publishes weekly sea ice charts of world-wide sea ice conditions. These charts are produced largely by means of satellite imagery, but direct aircraft observations are also utilized for verification purposes. In particular, aircraft with highly accurate positional navigational equipment are used to monitor the ice edge. We have utilized these charts to compile the maps presented here.

Because sea ice statistics tend **to** be more sensitive to latitude than longitude, the region of interest was divided into cells of one degree latitude by five degrees of longitude. The Navy sea ice charts from **1972** to present were **scaled** for presence of ice in each cell and the average concentration reported for the **cell**. These numbers were then averaged on a monthly basis.

The monthly maps attached as part of this report show both these parameters for each cell. From left to right within each cell the first number gives the frequency with which ice was found within that cell during a particular calendar month and the second number gives an average of concentration over those occasions when ice had been present. Hence, for the **cell** containing the lower half of **Nunivak** Island whose upper left-hand corner is located at 60° latitude 165° longitude, there was ice present during 67% of the Novembers between 1972 and 1980 and the average of the concentrations on those occasions was six tenths.

Results

Figures 1 through 8 give the results of this analysis during the eight months starting in November when oceanic ice is found in this region. The cells containing the St. George Basin Lease Area have been indicated by an asterisk. The following observations were made from these charts:

November By this month ice appears as far south as 57°N with a frequency of 33%. It is interesting to note that for a given latitude the frequency and coverage appear to be greater in **cells** adjacent to land than in cells removed from land. No ice appears yet in the St. George Basin.

December Now ice appears as far south as 56° about 22% of the time. However, the average coverage is only 20%. Again there is a tendency for frequency and coverage to be greater in cells adjacent to shore. Another interesting feature on this map is the appearance of cells

which have had a 100% frequency of the occurrence of **ice**, two of which have had an average of 90% coverage. The northern cell containing the St. George Basin now has an ice frequency of 14% with an average coverage of 20%.

January Ice appears no further south than in December. However, the frequency of occurrence in each cell tends to be greater. Of the five **cells** which have 100% frequency, three also have 100% coverage. The tendency for cells adjacent to land to contain ice more frequently and with greater coverage continues. Again only the northern **cell** containing the St. George Basin Lease Area has a **non-zero** probability of containing ice.

February Ice **still** appears no further south than 56°N . However, the frequency and coverage are generally greater than in January. The tendency for cells adjacent to land to contain more **ice** than cells not adjacent to land appears to break down and reverse in some cases. The northern cell containing the St. George Lease Area now has a 56% frequency of containing ice with an average coverage of 30%.

March This is the month of greatest ice extent. Ice now appears as far south as 55°N . It is interesting to note that while in previous months many cells contained ice on 100% of all observed occasions, these cells now have only contained ice between 90% and 60% of the years of observation. Furthermore, the earlier tendency for cells adjacent to shore to contain ice more frequently than cells removed from shore has completely disappeared. This is the only month during

which both cells containing the St. George Basin have a non-zero history of containing ice. Although the frequency is 20% in both cells the average coverage on those occasions is 90% in the northern cell and 30% in the southern cell.

April The average extent of ice begins to recede during this month. The maximum ice edge has retreated to **56°N**. In addition, the frequency and coverage **in all cells** is reduced from the previous month. Only the northern **cell** containing the St. George Basin has ice during this month (20% of all Aprils) and the average coverage on those occasions is 40%.

May The maximum edge of ice remains at 56° during this month. However, the frequency of ice and average coverage tend to decrease generally in the area. (No **cell** contains ice during more than 40% of **all Mays**). The cell containing the northern portion of the St. George lease area **still** contains ice 20% of the time with an average concentration of 20%. **At** this time there is a general tendency for cells not adjacent **to** land to contain ice approximately twice as frequently as those adjacent to land.

June Ice **is** absent from nearly the entire study area. The small amount of ice remaining could **well** be fast ice grounded on shoals in **near-**shore waters.

Conclusions with respect to oil and gas leasing

in the St. George Basin

There are two main blocks of leases being considered in the St. George Basin. One of these lies roughly in the northern cell discussed above and the other in the southern cell. Although both cells statistically contain ice during the winter, the frequency and coverage is much greater in the northern cell. The southern cell lies in the statistical southern limit of Bering Sea ice. The results for these two lease blocks are summarized **below**:

Month	Lease Block	Frequency	Average Coverage
December	north	14%	20%
	south	0	0
January	north	11%	20%
	south	0	0
February	north	56%	30%
	south	0	0
March	north	20%	20%
	south	20%	20%
April	north	20%	40%
	south	0	0

Thus, between December and April the northern lease tract has a finite chance of ice each month between December and April while the southern lease block only has had ice during March. During that month, the probability of ice in the northern block is nearly 60%.

Pease (1980) has shown for late winter there is reason to believe that at times, at least, the Bering Sea acts as a "conveyor belt," transporting thick ice grown in the northern Bering Sea---or possibly even the **Chukchi** Sea---to the region of the ice edge.

These results show that the entire St. George Lease Area lies within the extreme ice edge. The "conveyor belt" concept suggests that fairly thick floes (**vlm**) may be transported to this ice edge. Certainly the design of structures and operating procedures related to offshore petroleum exploration and development in the St. George Basin should take **this** possibility into consideration.

ACKNOWLEDGEMENTS

This work was supported by the Bureau of Land Management through an interagency agreement with the National Oceanic and Atmospheric Administration, under which a multi-year program responding to an environmental assessment of petroleum development on the Alaskan Continental Shelf is being performed. Specifically, Contract 03-5-022-55, Research Unit 267, supported the work described here.

REFERENCES:

Pease, C.H., 1980 Eastern Bering Sea Ice Dynamics and Thermodynamics. in The Eastern. Bering Sea, its Oceanography and Resources. OCSEAP (Outer Continental **Shelf** Environmental Assessment Program), NOAA Field Office, **P.O.** Box 1808, Juneau, Alaska 99802

FIGURE 1: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for November. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY NOVEMBER

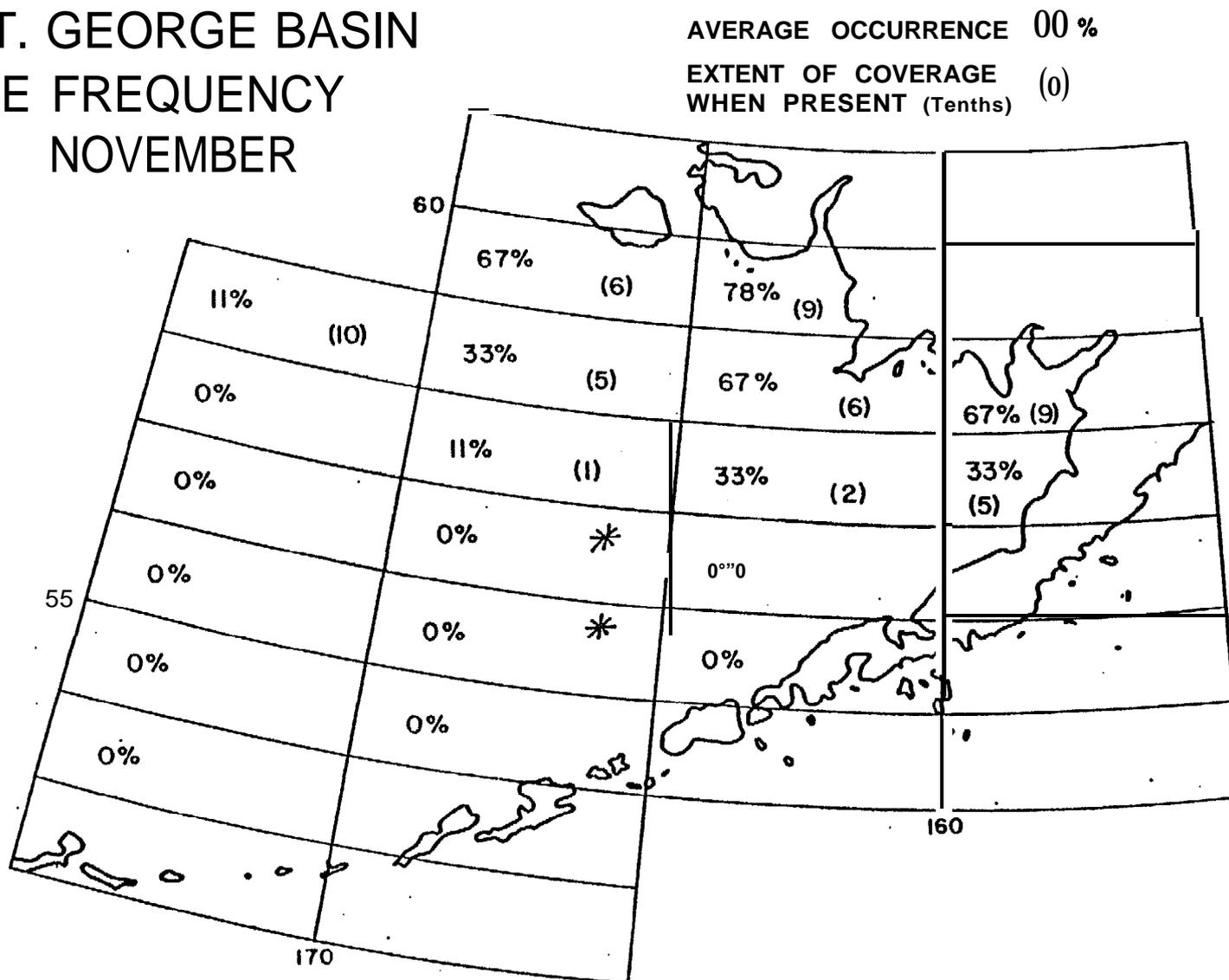


FIGURE 2: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for December. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY DECEMBER

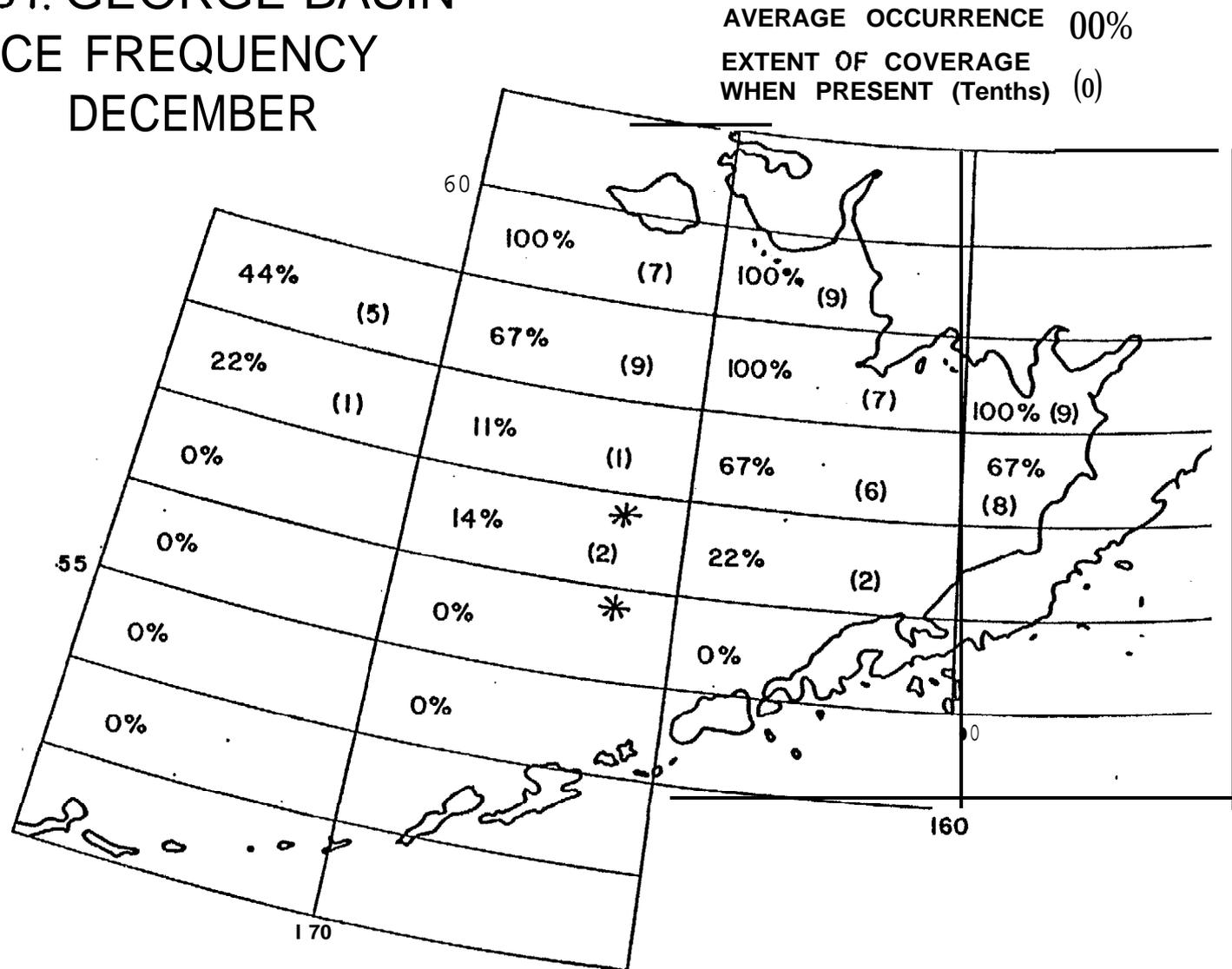


FIGURE 3: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for January. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY JANUARY

AVERAGE OCCURRENCE 00 %
EXTENT OF COVERAGE (0)
WHEN PRESENT (Tenths) (0)

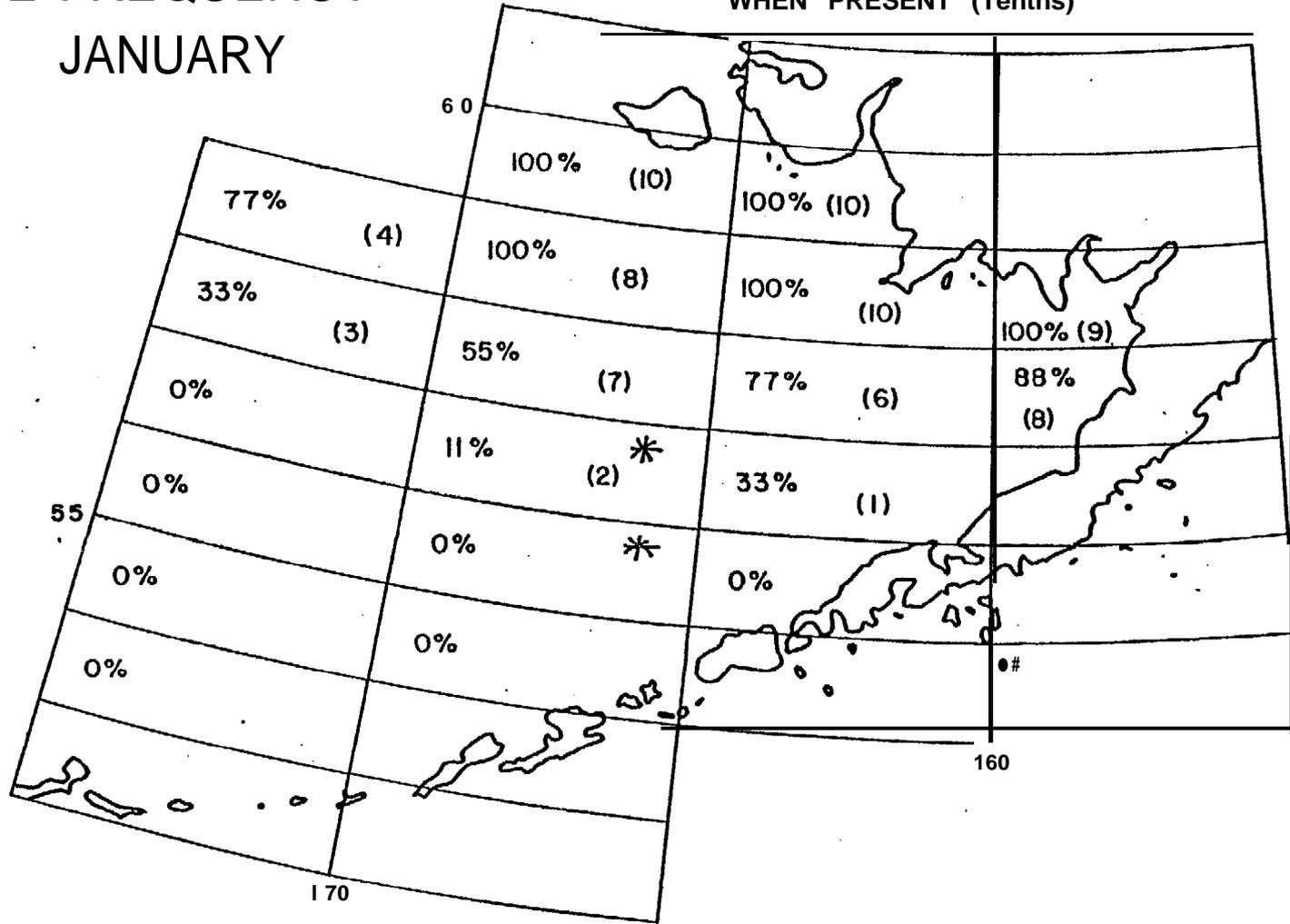


FIGURE 4: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for February. **Data** cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN'

ICE FREQUENCY

FEBRUARY

AVERAGE OCCURRENCE 00%
 EXTENT OF COVERAGE
 WHEN PRESENT (Tenths) (0)

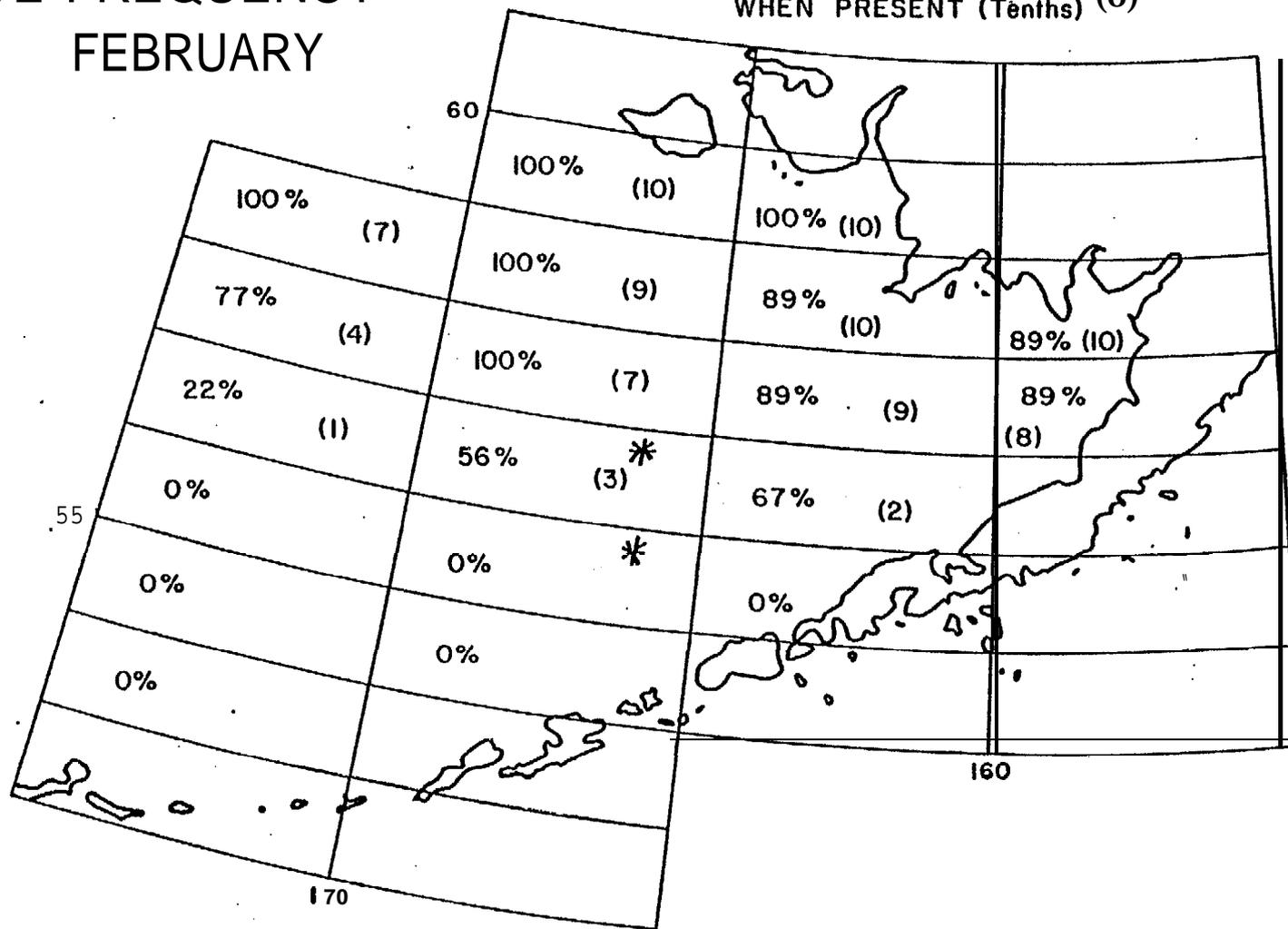


FIGURE 5: Average yearly frequency of ice occurrence and **extent** of ice coverage when ice is **present** in the region of the St. George Basin Petroleum Lease Area for March. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY .MARCH

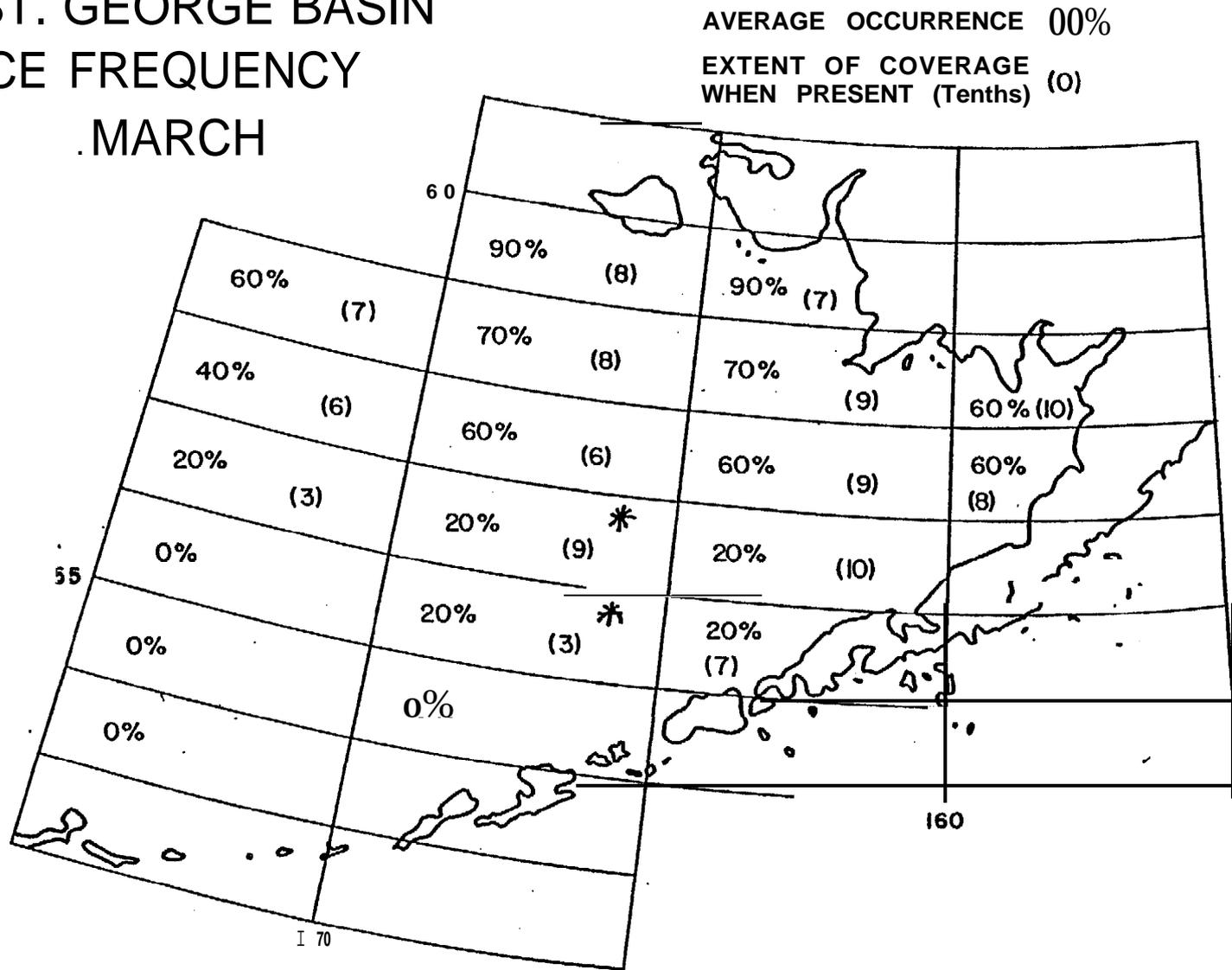


FIGURE 6: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for April. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY "APRIL

AVERAGE OCCURRENCE 00%
EXTENT OF COVERAGE
WHEN PRESENT (Tenths) (0)

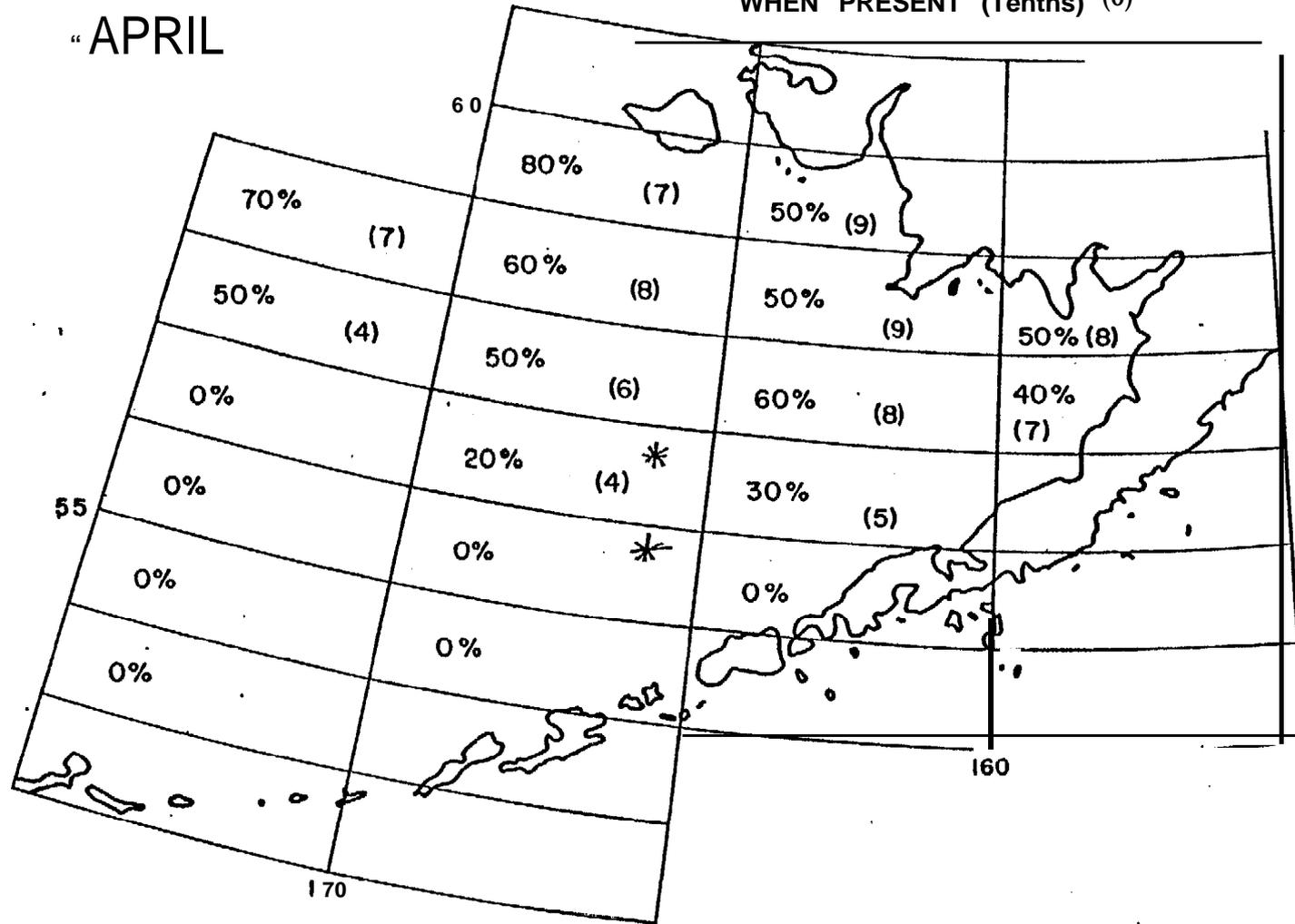


FIGURE 7: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for May. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN . ICE FREQUENCY MAY

AVERAGE OCCURRENCE 00%
EXTENT OF COVERAGE
WHEN PRESENT (Tenths) (0)

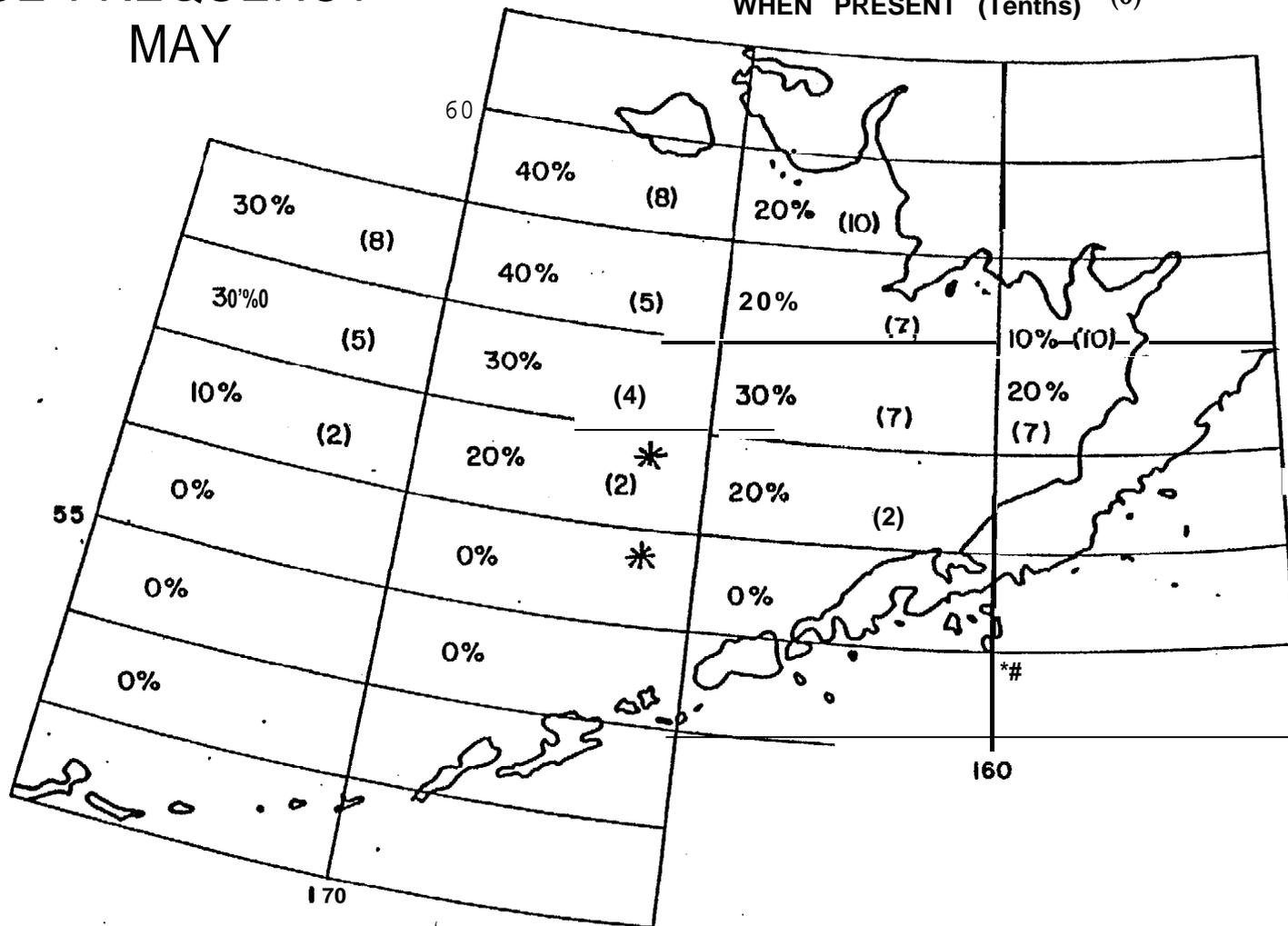


FIGURE 8: Average yearly frequency of ice occurrence and extent of ice coverage when ice is present in the region of the St. George Basin Petroleum Lease Area for June. Data cells containing an asterisk (*) contain potential petroleum leasing tracts.

ST. GEORGE BASIN ICE FREQUENCY JUNE

AVERAGE OCCURRENCE 00%
EXTENT OF COVERAGE (Tenths) (0)

