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AERIAL SURVEYS OF ENDANGERED WHALES IN THE BEAUFORT
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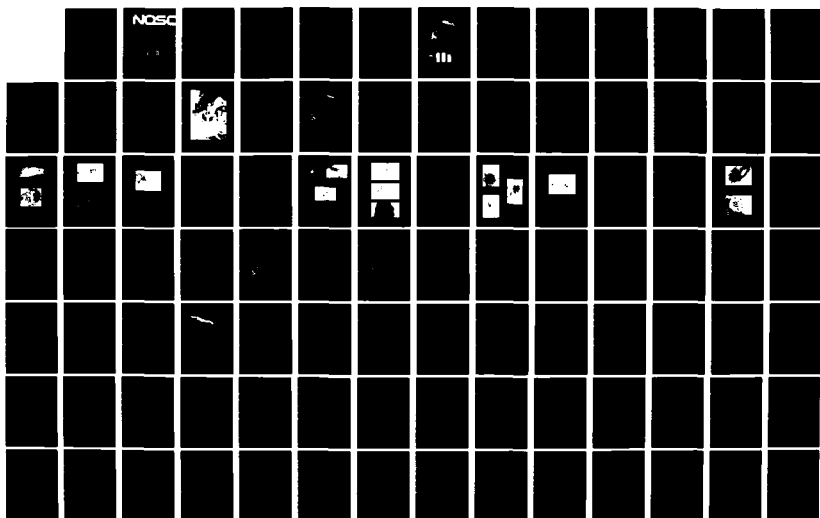
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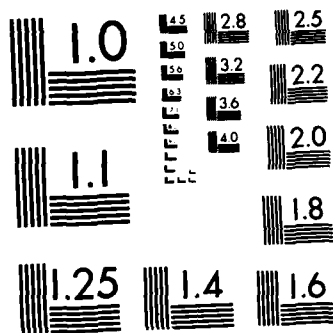
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**AERIAL SURVEYS OF ENDANGERED
WHALES IN THE BEAUFORT, CHUKCHI,
& NORTHERN BERING SEAS**

DK Ljungblad
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DR Van Schoik
CS Winchell

March 1982

Final Report: April–October 1981
Prepared for Bureau of Land
Management, Department of Interior

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Aerial surveys and acoustic recordings of bowhead whales and other endangered whales were made from April to October 1981 in the Beaufort, Chukchi, and Bering Seas. Bowhead whales were observed in the northern Bering Sea in large concentrations prior to their northward spring migration. Most whales were involved in social activity, including apparent copulation. Many bowhead sounds were recorded during these observations. The bowhead migration was followed through the Beaufort Sea from Pt. Barrow to Herschel Is. along a migration corridor centered at 71°30'N latitude. The summer survey efforts concentrated on gray whale distribution in the Chukchi and northern Bering Sea and delineated a high-density feeding area between St. Lawrence Island and		

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the Bering Strait. During these surveys normal gray whale behaviors were observed in the presence of seismic sounds. The fall nearshore bowhead migration through the Beaufort Sea moved slowly to the west along the 20-m contour line. Feeding behavior was noted most often. This report describes all results of 1981 surveys and summarizes the spring and fall migrations of the bowhead whale through the Beaufort Sea for 1979, 1980, and 1981.

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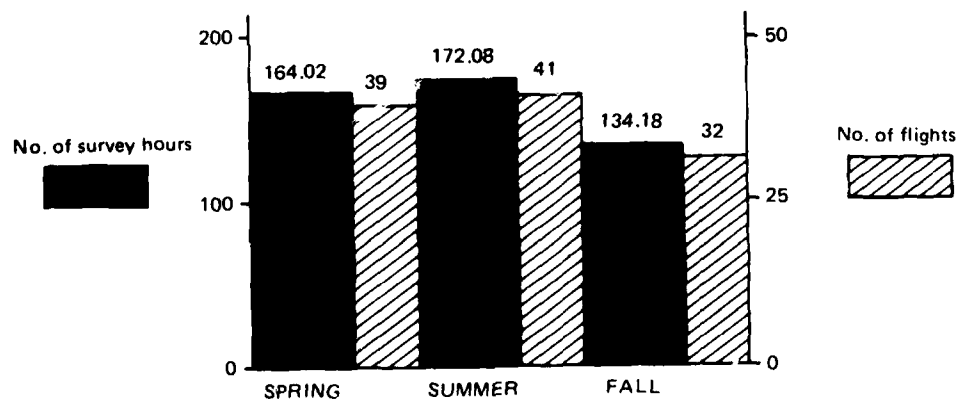
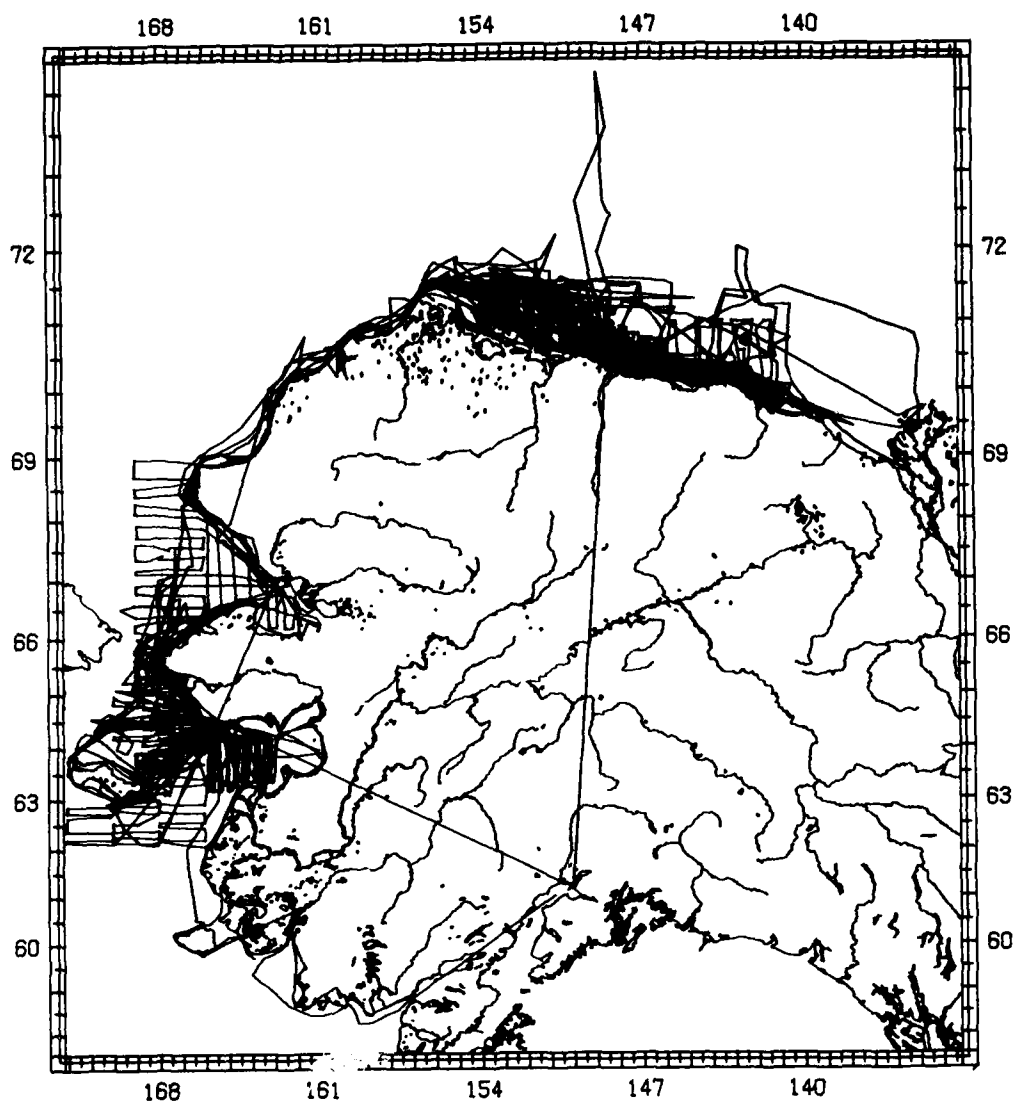
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INTRODUCTION

The bowhead whale, Balaena mysticetus, is a large baleen whale that lives in or near icy polar waters. The largest population of bowheads migrates from the Bering Sea in the spring (April, May, early June) through the Chukchi Sea to the eastern Beaufort Sea (MacKenzie Delta-Banks Island - Amundsen Gulf area). In the fall (early September and October) they return west along the Canadian and Alaskan coast into the Chukchi Sea, then south into the Bering Sea. These migrations are largely dependent upon ice conditions (Burns et al, 1980). The migrations take the bowheads through or near areas on the outer continental shelf of Alaska that are currently being assessed as potential sources of mineral and oil resources.

The bowhead whale was abundant before commercial whaling (mid 1800's), with populations estimated at 14,000 to 26,000 (Breiwick, Mitchell and Chapman, 1980). An estimate of the present population is 2264 (Braham et al, 1979). Because of its rare status, the bowhead whale is protected by the Endangered Species Act as well as the Marine Mammal Protection Act. Aboriginal whaling continues on a quota system. There is concern that resource-related development may have an effect on the bowhead whale population.

Since 1979 the Bureau of Land Management, Department of Interior, has funded the Naval Ocean Systems Center, San Diego, to determine occurrence, distribution, and relative abundance of bowhead whales in the proposed Federal and Joint State-Federal oil lease areas in the Beaufort Sea (Ljungblad et al, 1980; Ljungblad, 1981). This area is collectively called the Diapir Basin and will be referred to as the Beaufort Sea study area throughout this report. In 1981, the task was expanded to include surveys for all marine mammals, particularly endangered whales, in the Beaufort, Chukchi, and northern Bering Seas, and to assess, to the extent possible, any change in bowhead behavior related to oil development and exploration. This report is a summary of 1981 field results. The overall survey effort is portrayed in Figure 1. A flight track/sighting chart and descriptive caption for each flight are presented in Appendix A. A three-year summary of endangered whale aerial survey effort and density calculations is presented in Appendix B.



Spring (April, May) = Chukchi and northern Bering Sea = 25
Beaufort Sea = 14

No. Flights/SEASON Summer (June, July, August) = Chukchi and northern Bering Sea = 34
Beaufort Sea = 7

Fall (September, October): Beaufort Sea = 32 flights

Figure 1. Overall survey effort summary, 1981.

OBJECTIVES

The objectives during 1981 were to:

1. "Determine and describe characteristics of the seasonal distribution, relative abundance, and habitats of endangered whales of the northern Bering, Chukchi, and Beaufort Seas (U.S. Waters)."
2. Monitor ice conditions (Aerial Ice Reconnaissance, 1956) and correlate with whale migration patterns,
3. Determine distribution of marine mammals north of Cape Romanzof, using aerial survey techniques,
4. Obtain and analyze recordings of endangered whale sounds during all seasons,
5. Observe behaviors to assess any disturbance by oil development and seismographic exploration activity,
6. Record all beachings of marine mammals on coastline of Alaska above the Yukon River.

METHODS

The aircraft used in this study was a Grumman Turbo Goose provided by the Office of Aircraft Services, Department of Interior, Anchorage. It was equipped with a Global Navigation System (GNS), which has 0.37-km/hr precision. It provided continuous position updating and transect turning point programming. Surveys were planned to be flown at 153 m altitude, but, on occasion, weather forced the aircraft down as low as 30 m and as high as 336 m to maximize visibility. Airspeed varied between 222 and 296 km/hr.

The year was divided into three seasons:

Spring - April, May

Summer - June, July, August

Fall - September, October.

The bases of operations were:

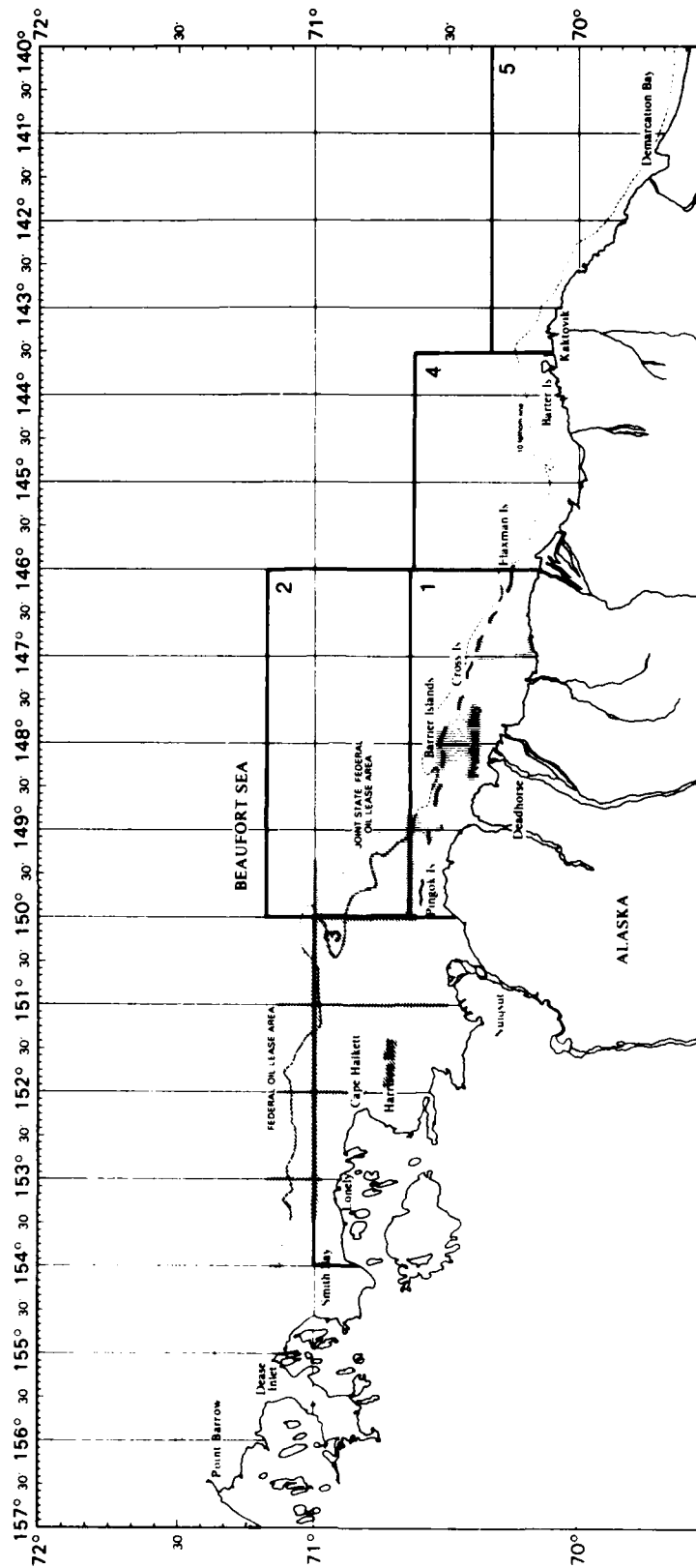
Nome - early spring and summer, Bering Sea

Deadhorse - late spring and fall, Beaufort Sea

Kotzebue - summer, Chukchi Sea.

Three types of aerial surveys were flown. Transect surveys in predetermined blocks (Figures 2 and 3) with randomly determined turning points were flown to determine distribution and estimate relative density. Coastal surveys were flown to locate and, if possible, investigate beached cetaceans by water landings near them. Lastly, search surveys were flown into areas in which there was a maximum probability of sighting whales in order to observe behavior, especially in Blocks 4 and 5 (Figure 2). The exact routes of search surveys were dependent upon weather, sea state, ice conditions, and previous patterns of whale sightings (ie, number, headings, swim speed).

Search rather than transect surveys were conducted in the spring in order to follow the bowhead migration. On the basis of past experience and a knowledge of ice conditions, (see Ljungblad et al, 1980 and 1981), it was



BEAUFORT SEA OVERALL STUDY AREA

Figure 2. Preplanned blocks of the proposed Federal and State Federal lease areas in the Beaufort Sea. Transect surveys with randomly determined turning points were flown in blocks No. 1 and No. 3. Block No. 2 was used as a weather alternate. Blocks No. 4 and No. 5 were behavior study blocks.

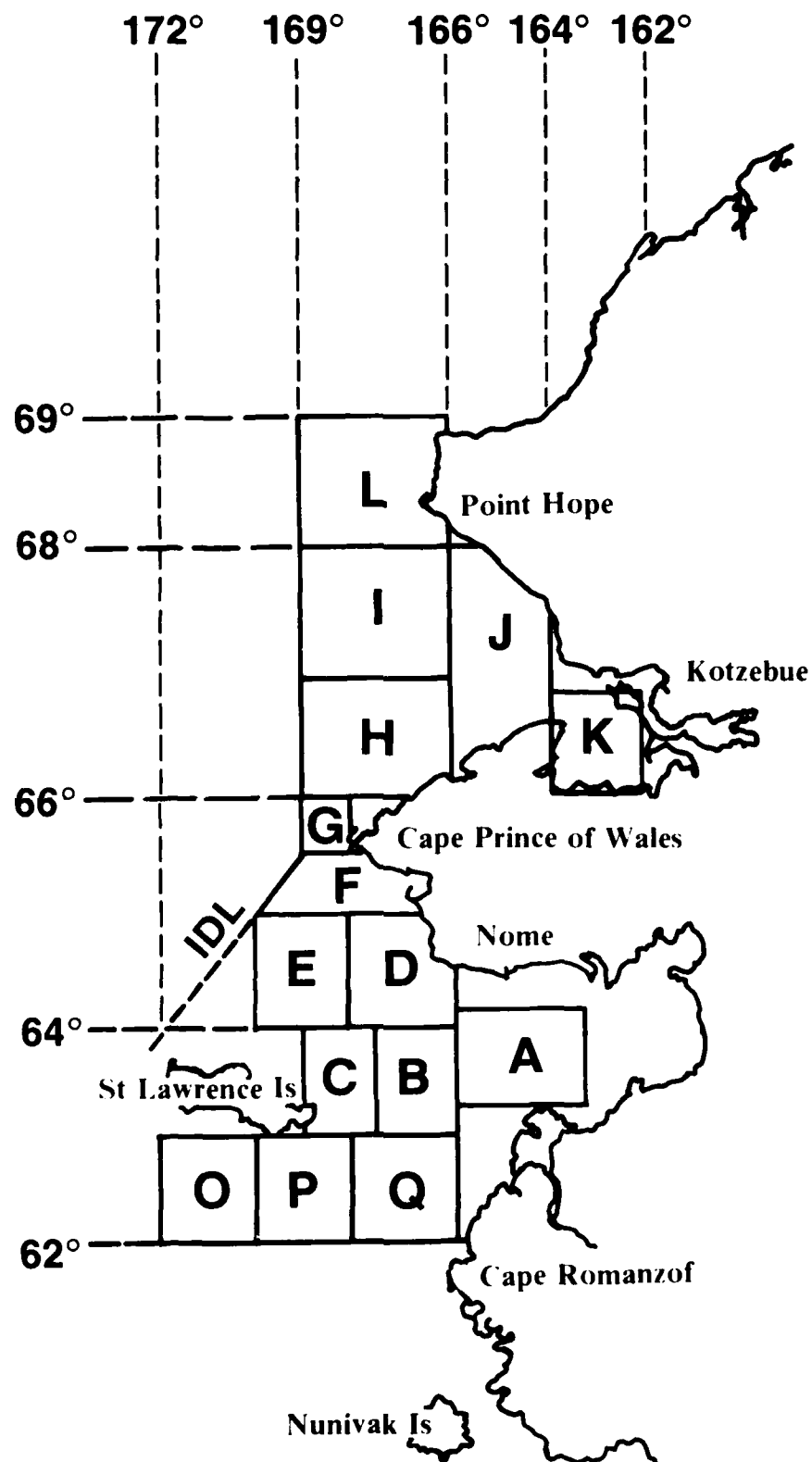


Figure 3. Preplanned transect blocks of areas surveyed in the Chukchi Sea And Bering Sea. Transect surveys with randomly determined turning points were flown in all blocks.

judged that flying line transects at this time would have provided many fewer observations since most of the line would be flown over 10/10 ice cover. By conducting searches over the major open-water leads, we were able to monitor the distribution and activity of bowhead whales in the Bering Strait and along the north slope throughout the migration period. Table 1 depicts the survey effort accomplished in each area by season.

Poor weather, poor visibility, high winds, or sea states greater than 6 on the Beaufort scale prevented flying on 48 days (see Table 1). Typical weather conditions during flights were cloudy or overcast but clear below ceilings that usually were 150 to 450 m. above sea level. Winds were usual below 30 km/hr. The temperature was cool (10-20° C). Patchy fog occasionally required that a leg of a transect or the survey in an entire block be cut short or cancelled.

The sightability of animals was affected by such factors as rain, snow squalls, fog, haze, glare, and sea state. The percentage of ice coverage may also affect sightability. Water clouded by silt or surge probably reduced sightability near rivers and shorelines. For example, for 20 km around the Yukon River delta, the water was so muddy that sightings were extremely difficult to make even when it was known, through acoustic monitoring via sonobuoys, that beluga whales were present. Currently we assume that problems of sightability are smoothed over time through repetitive sampling of an area, and that sightability is not a significant factor in the distributions reported herein.

The observers were positioned so that the person navigating was in the copilot's seat, with the other observers in a left-rear, right-rear seat arrangement and engaged in recording data on preplanned forms. The pilots and all observers were connected to a common communication system; the pilot acted as a limited observer. Each observer was provided with an inclinometer.

For all marine mammals sighted, the following information was recorded whenever possible: species identification, position coordinates, time, and number in the group. For whales, an inclinometer angle, used in the derivation of an index of abundance, was taken when the sighting was abeam of the

Table 1. Aircraft survey effort summary (flight hours in parentheses)

SEASON:	SPRING	SUMMER	FALL	TOTAL
Number of Hours Flown	164.02	172.08	134.18	470.28
Number of Flights	39	41	32	112
Days Down Due to Weather	12	25	11	48
Days Down Due to Maintenance	6	10	4	20
Total Days in Study Period	57	91	45	193
Surveys of Federal Lease Area	—	—	7 (24.25)	7 (24.25)
Surveys of Joint State-Federal Lease Area	—	—	7 (28.25)	7 (28.25)
Transit Flights	3	3	3	9
Flights Dedicated to Other Projects (Ringed Seal)	—	10	—	10
Survey and Dept. Int. Tour	—	17	—	17
Searches				
Bering Sea	7 (34.5)	—	—	7 (34.5)
Chukchi Sea	3 (15.0)	—	—	3 (15.0)
Beaufort Sea	14 (53.25)	5 (21.75)	9 (30.25)	28 (105.25)
Coastal Surveys				
Nome-Deadhorse	2	5	—	7
Nome-Anchorage	2	—	—	2
Norton Sound	2	3	—	5
Behavior Study*	4	—	7	11
Block Transect Surveys	7	20	—	27
A B C D E F G H I J K L O P Q	7 Apr (4.0) 16 Apr (3.25) 17 May (5.25)	12 Jul (8.25) 26 Aug (4.0)		5 (24.75)
	22 May (3.75)	2 Jul (3.75)		2 (7.5)
	20 May (4.75)	3 Jul (3.75)		2 (8.5)
	31 May (2.5)	15 Jul (3.0)		2 (5.5)
		21 Jun (3.75)		1 (3.75)
		12 Jun (3.25) 2 Jul (3.75)		2 (7.0)
		11 Jun (2.5) 20 Jul (1.5) 28 Aug (4.25)		3 (8.25)
		10 Jul (4.0) 28 Aug (4.25)		2 (8.25)
		24 Jul (5.75)		1 (5.75)
		15 Jun (4.25)		1 (4.25)
		17 Jun (3.75)		1 (3.75)
		16 Jun (4.75)		1 (4.75)
		30 Jun (2.0)		1 (2.0)
	13 Apr (5.0)	14 Jun (5.75)		2 (10.75)
		18 Jun (4.5)		1 (4.5)

*May also be block/search flight

aircraft. The altitude of the aircraft was recorded, in addition to the true heading and estimated speed of the whales. Notations were also made regarding the whales' behavior. Photographs were taken to positively identify species, to catalogue distinctive markings, and to record behavior patterns.

AN/SSQ-41A and AN/SSQ-41B sonobuoys were used successfully for recording marine mammal and geophysical boat sounds. These units have a frequency response of 10 Hz to 5 kHz and 10 Hz to 15 kHz, respectively. A sonobuoy is a passive listening system which contains a hydrophone array and a vhf transmitter. Sonobuoys are designed to be dropped from the aircraft by means of a rotochute or parachute. Once in contact with water, a seawater-activated battery energizes the unit. At this time, the parachute assembly jettisons and the hydrophone array drops to a preselected depth of 18.2 or 91.4 m (60 or 300 ft). The sounds picked up by the hydrophones are amplified and transmitted to a vhf broadband receiver on the aircraft, the output of which is coupled to a Nagra SJ recorder with a frequency response of 30 kHz.

SPRING (APRIL, MAY)

INTRODUCTION

Survey efforts began on 4 April 1981, from Nome, Alaska. Early flights concentrated on Norton Sound, waters north of St. Lawrence Island, and the Bering Strait and areas immediately north of the strait.

On 24 April the base of operations moved to Deadhorse, Alaska, via a survey flight following the near-shore lead from Norton Sound to Prudhoe Bay. This flight permitted the progress of migrating bowhead whales in the Chukchi Sea to be monitored.

Flights from Deadhorse were made along the near-shore leads in the Beaufort Sea in an effort to define ice conditions and locate migrating bowhead whales. The base of operations shifted back to Nome toward the end of the bowhead spring migration on 16 May, via coastal survey. Block-transect surveys were flown near the Bering Strait and St. Lawrence Island area from Nome.

Surveys were flown between 60 m (200 ft) and 305 m (1000 ft), at 222 km/hr (120 kt) to 296 km/hr (160 kt). Altitude averaged 153 m (500 ft) but was adjusted, as weather permitted, to maximize visibility.

ICE CONDITIONS

Satellite photographs, NOAA weather analysis, and our observations revealed that ice break-up was early this year when compared to 1979 and 1980. Strong currents, shifting winds, mild temperatures, and clear skies combined to create an early melt. The earliest possible opening of the ice to and through the Bering Strait was 24 March. Leads north past Pt. Barrow and east existed by March 29 according to satellite photographs.

Satellite photographs also showed tendrils (small leads broken in the polar gyre south to the shorefast ice) from Pt. Barrow east to the Canadian Beaufort Sea as early as 16 March. However, at that time there were no openings or leads to these tendrils from the Bering Sea through the Chukchi Sea.

The sea ice coverage in the northern Bering Sea was 9/10 to 10/10 in early April and broke to 8/10 by mid-April. There were numerous east-west leads and broken pan ice. Shorefast ice was less than 1 km wide in Norton Sound, except where the sound was shallow (such as near the Yukon river), where the ice was up to 5 km wide. Elsewhere in the northern Bering Sea it was 1 to 2 km wide. The Port Clarence area remained icebound through 20 April.

The sea ice coverage at St. Lawrence Island varied with the winds and currents. The windward side was often icebound (greater than 9/10 coverage) and the leeward side usually had large open-water leads (up to 3 km wide) between the shorefast ice and the pack ice. For example, Southeast Cape was completely open on 13 April, and there was open water to the Soviet coast by 14 April (Figure 4). The winds opened up the north, west, and south sides of the island by 20 April.

Ice coverage in the Bering Strait ranged from 7/10 to 9/10 in early and mid-April, with small open-water leads and polynas. By 24 April there were discontinuous north-south leads north of the Bering Strait. The major near-shore lead appeared to be associated with the 20-m contour between Cape Prince of Wales and Pt. Barrow, with two exceptions: at Kotzebue Sound and Icy Cape there was no apparent relationship between bathymetry and location of the nearshore lead. The nearshore lead at these locations approximated a straight north-south line, independent of bathymetric contours.

In the Beaufort Sea in late April, a major east-west lead started at Pt. Barrow on a heading between 85° and 110° T. The nearshore lead through the Chukchi Sea merged with this major lead at Pt. Barrow. Tendrils were formed by the polar gyre at approximately 149°W, widening this lead. Survey flights

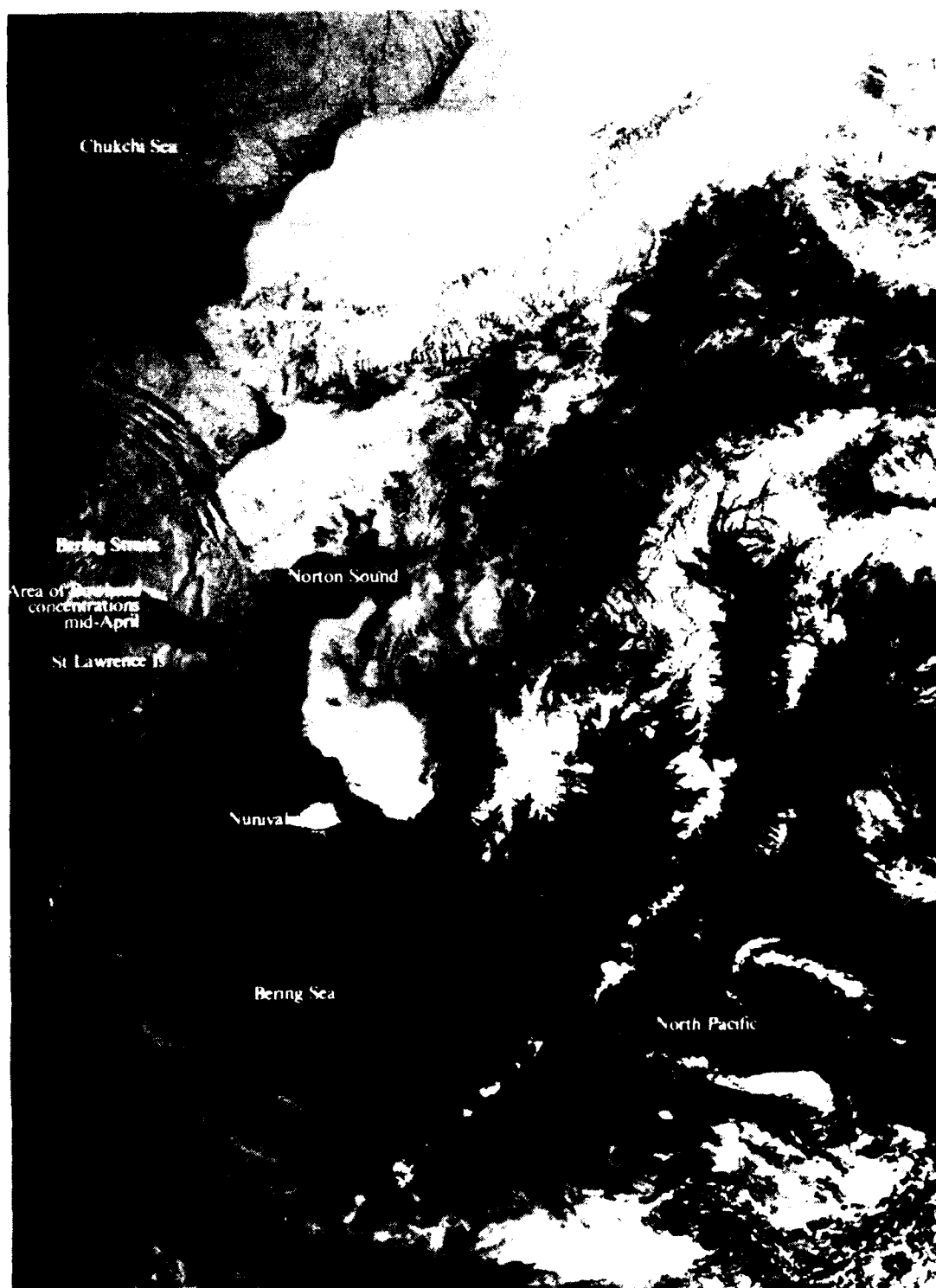


Figure 4. Satellite photograph, 14 April. Note open water and patches of ice near St. Lawrence Is., also near shore lead system along Alaska's west coast and north slope.

were made along it at approximately 71°30'N latitude between Pt. Barrow and Demarcation Point in late April and early May. Ice coverage varied between 8/10 and 9/10, with refrozen grease ice and brash ice in the lead.

SURVEY EFFORTS AND SIGHTINGS

All survey efforts and sightings for this study are summarized in Tables A-1 and A-2. Early spring survey efforts were concentrated north of St. Lawrence Island and through the Bering Strait. After 24 April, survey effort was directed along the north slope. Norton Sound was surveyed five times: three complete transect surveys of Block A (Figure 3) and two partial transects during transit flights to or from Anchorage. The overall spring survey effort representing 164.02 flight hours is portrayed in Figure 5.

The distribution of spring bowhead sightings, representing 1222 whales, is presented in Figure 6. Search surveys were conducted over all major open-water leads and polynas. Flights 4, 6, 7, 11, and 14 show that most bowheads were observed migrating around the west side of St. Lawrence Island. One bowhead was sighted heading north off the southwest end of the island on 10 April (Flight 4). Large numbers and many groups of bowhead and beluga whales were sighted north of St. Lawrence Island and south of the Bering Strait on 13 April (Figure 7a). This area was surveyed eight times from 12 April through 20 April, (see flight tracks 6-16). We assume some of the whales seen on consecutive days were resights, which lessens the accuracy of our count of bowheads but not of the relative distribution of whales in the area over this period. The number of bowheads sighted per day increased to a peak of 332 on 17 April, then decreased to 67 by 20 April.

Bowheads were also sighted north of the Bering Strait in early and mid-April. Eleven whales were seen just north of the strait on 6 April (Flight 2); 37 bowheads were sighted north of the strait, to 67°07'N latitude, on 11 April (Figure 7b). These whales were resting or swimming in small polynyas less than 100 m wide and several kilometers long. Ice further north was solid, and the whales appeared to be waiting for the ice break-up.

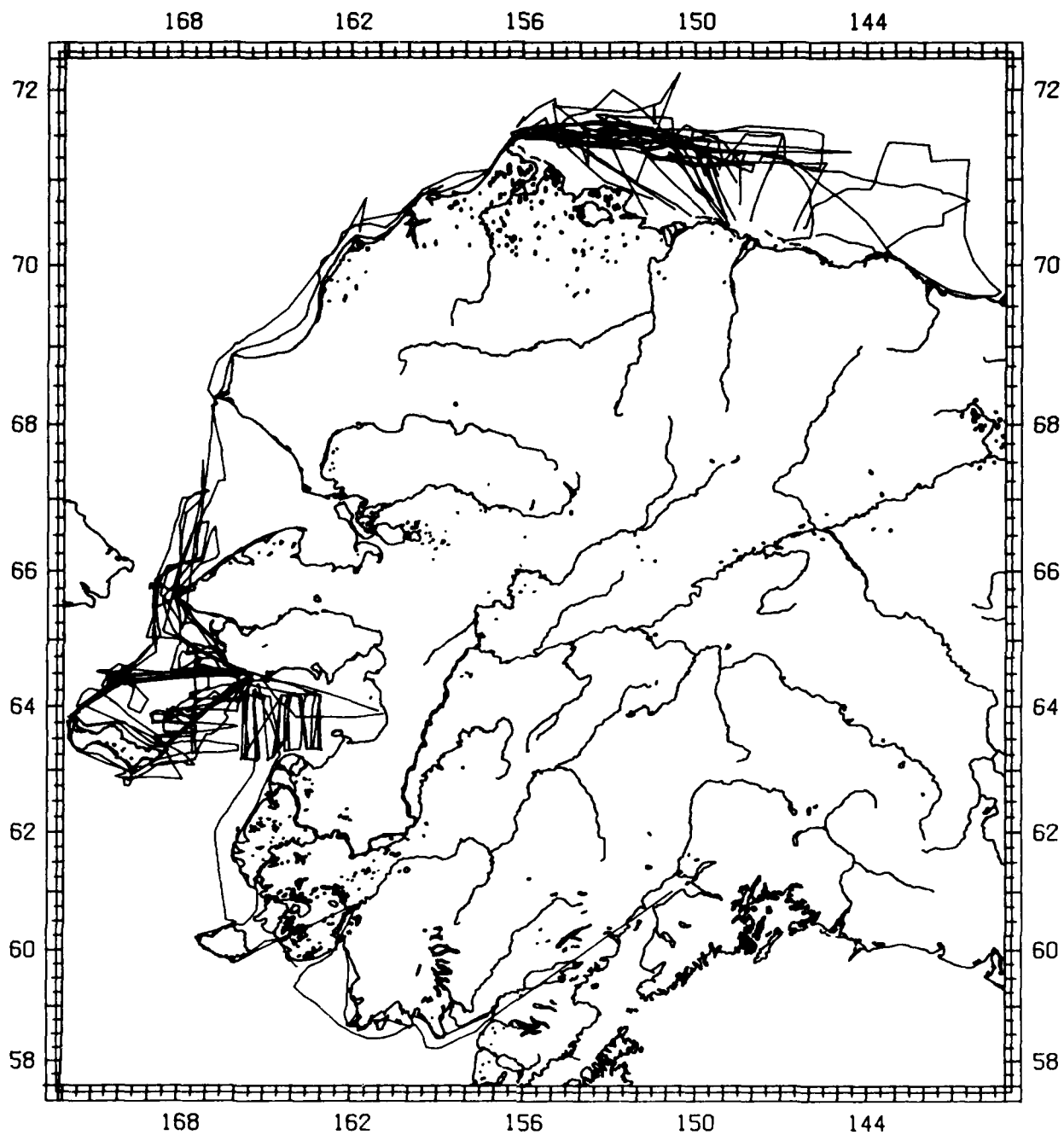


Figure 5. Overall Spring Survey effort representing 164.02 flight hours.

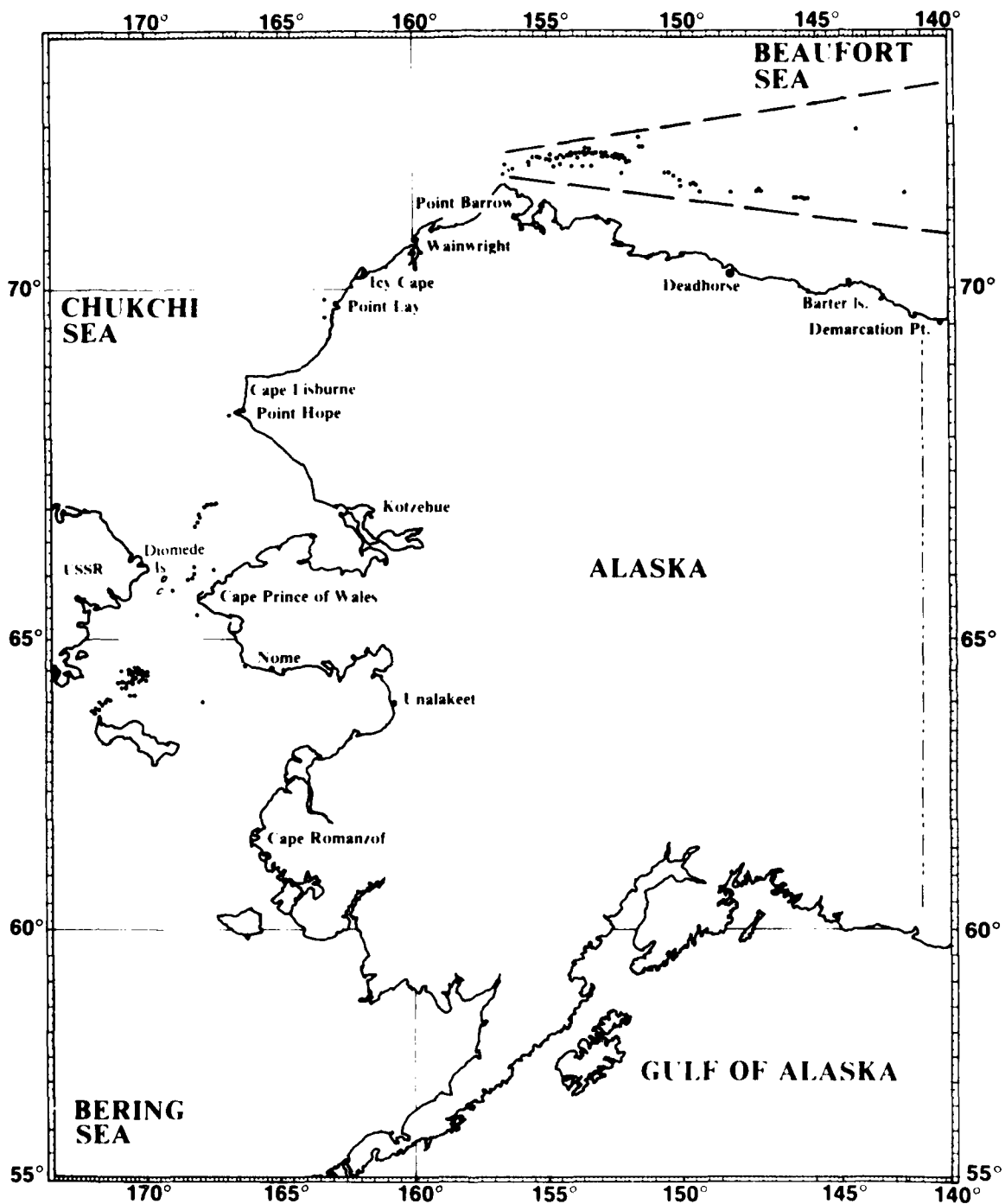
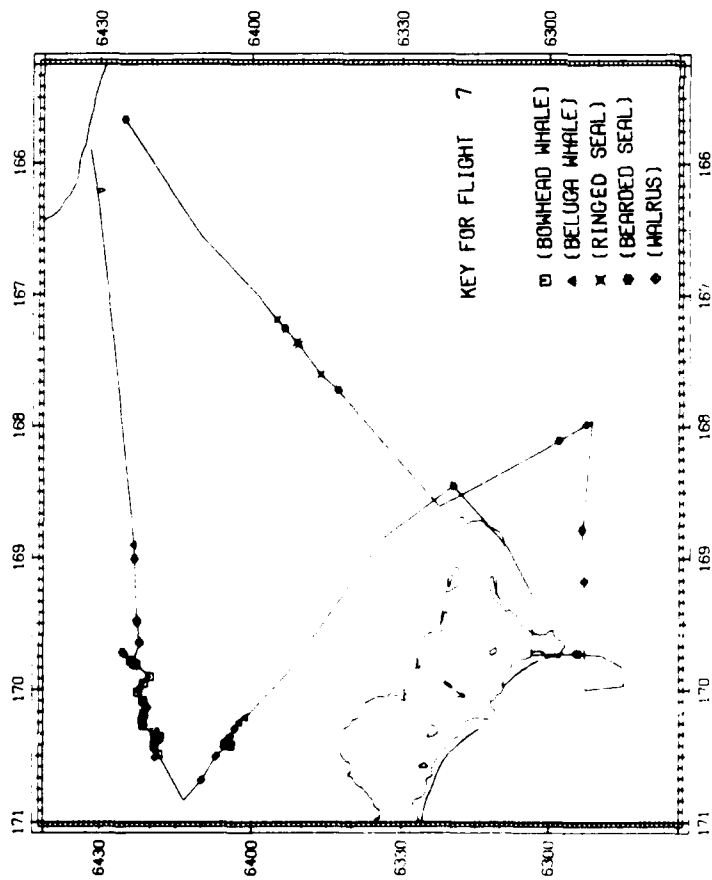
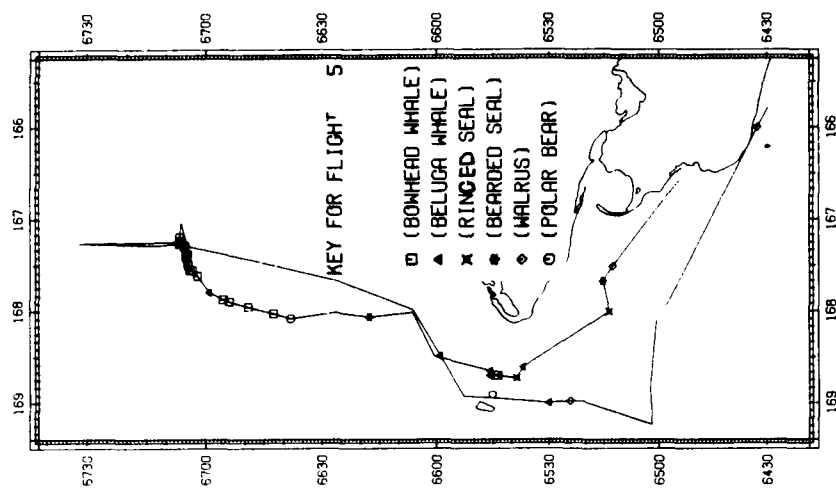


Figure 6. Distribution of spring bowhead whale sightings (n = 1222). Dashed line indicates potential migration corridor across Beaufort Sea in spring.



a) Flight track showing area of numerous bowhead and beluga whale sightings north of St. Lawrence Island, 13 April



b) Flight track showing area north of Bering Strait where bowheads were seen in early and mid-April, 11 April

Figure 7. Flight tracks.

A coastal survey of the Bering and Chukchi Seas from Nome to Deadhorse was flown on 24 April (Flight 17). Eleven bowheads were seen near Cape Lisburne, three near Icy Cape, and fourteen near Pt. Barrow. All were heading north at speeds estimated at 2 to 3 kt. A wounded bowhead was seen near Pt. Barrow. Belugas, bearded and ringed seals, and polar bears were also seen on this flight.

Survey efforts were conducted in the Beaufort Sea from 25 April to 15 May and were directed toward searching for migrating bowhead whales between Pt. Barrow and Herschel Island, south of 72°N (Flights 18 to 31). Approximately 200 bowheads were sighted from Pt. Barrow east to Herschel Island along 70°31'N latitude over the period 25 April - 7 May (Figure 8). The last eight bowheads of the spring season were sighted near Pt. Lay on a return flight to Nome on 16 May (Flight 32).

From Nome (17 to 31 May), survey efforts were directed to flying block transect surveys (Figure 3) of Norton Sound and waters of St. Lawrence Island (Flights 33 to 39). Feeding gray whales and one observation of killer whales chasing gray whales were the most significant of the sightings made in these areas. This incident is described in Ljungblad and Moore, 1983. A coastal survey from Nome to Bristol Bay was undertaken on 24 May en route to Anchorage for the aircraft's 100-hour maintenance overhaul. Eleven gray and four beluga whales were seen as well as ringed and spotted seals. Over 4000 walrus and approximately 400 Steller sea lions were seen on Round Island during this flight.

Coastal surveys from Anchorage to Nome on 30 May and from Nome to Deadhorse on 1 June were undertaken en route to ringed seal survey work in the Beaufort Sea. Seven gray and 4 beluga whales as well as 15 Dall's porpoise were seen on 30 May. Spotted seals and over 2000 walrus on Round Island were also sighted. No cetaceans were seen on the 1 June survey. Eight spotted seals, 103 ringed seals, and 7 walrus were seen.

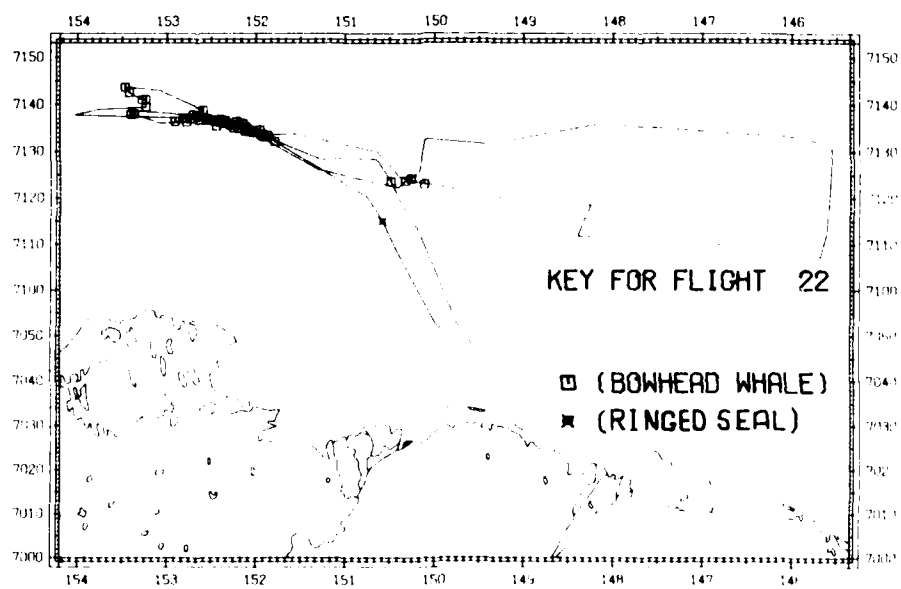
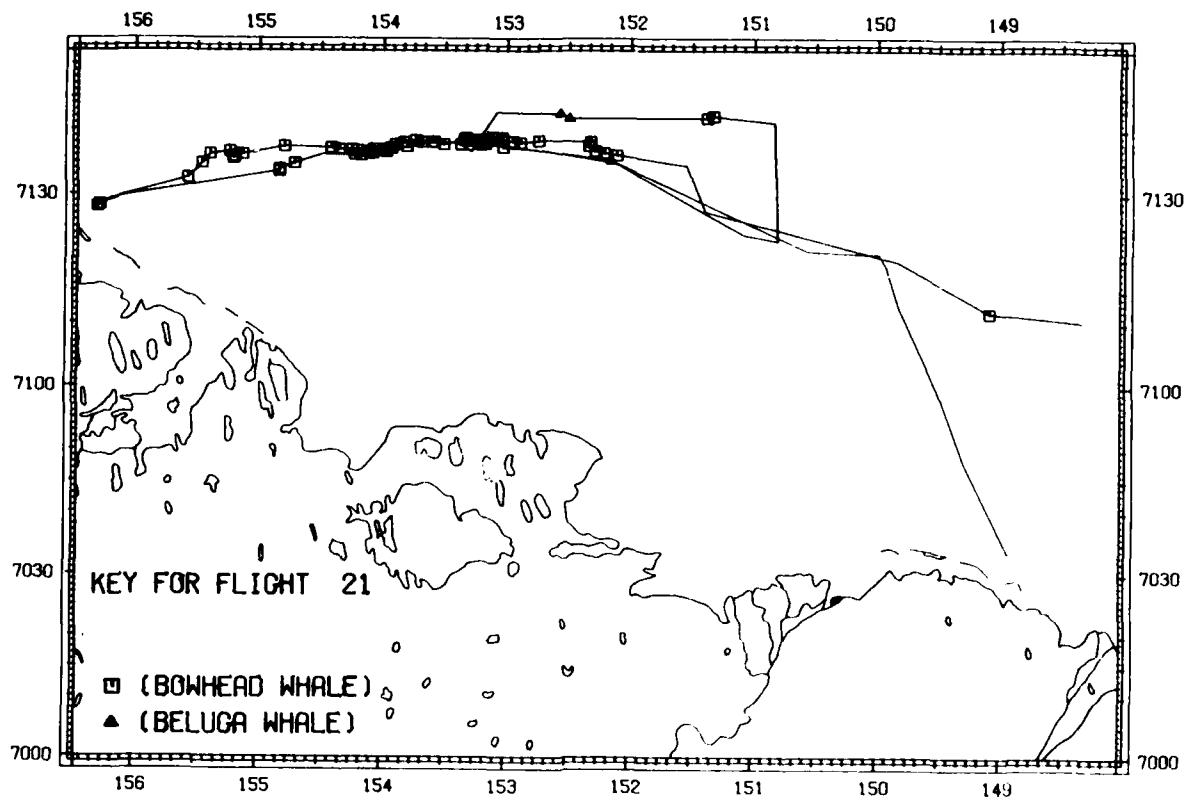


Figure 8. Flight track showing area east of Pt. Barrow where over 100 bowheads were seen on 30 April and 1 May.

MIGRATION TIMING, RELATIVE DISTRIBUTION, AND HABITAT RELATIONSHIPS

We observed the 1981 spring bowhead whale migration in two pulses, or distinct groups. The first pulse, or group, was sighted north of the Bering Strait between 6 and 11 April. Flights 2, 5, 6, and 9 show that, though search surveys were conducted south of the strait during this period, no bowheads were seen there. The bowheads observed north of the strait on Flights 2 and 5 appeared to be a separate group that was waiting for ice conditions in the Chukchi Sea to improve before proceeding northward.

The second group was sighted north of St. Lawrence Island from 12 through 20 April. These bowheads apparently migrated west of St. Lawrence Island, and waited north of the island but south of the Bering strait for several days until the ice conditions improved.

The bowheads in the second group were found in large, relatively tight aggregations of 3 to 19 whales within a 20-km-long lead oriented east to west about 75 km north of St. Lawrence Island. The lead extended across the International Date Line (IDL) along the 64°30'N latitude line beginning at 169°50'W longitude. Fifty-one whales were seen in this lead on 12 April (Flight 6). Repeated flights to this lead (Flights 11 to 14) showed an increase in the number of whales there until a peak of 332 bowheads was reached on 17 April. Whales were seen up to the IDL, and possibly similar numbers of bowheads were gathered on the Soviet side of the line. We counted whales only in USA waters.

The whales south of the strait were involved in a variety of social behaviors, with sexual behavior predominant. Movements were haphazard and averaged less than 10 km per day to the north. This second pulse of bowheads began to migrate north on 18 April. This was indicated by the whale count, which decreased from 332 whales on 17 April to 67 whales on 18 April. We believe the group of 332 bowheads represent the largest group of bowheads observed in recent history. Although it was an unusual sight for us, this gathering may be a very normal occurrence each spring somewhere south of the strait.

Apparently the bowheads were temporarily delayed prior to or after passing through the Bering Strait by heavy ice conditions. Winds and currents cause rapid ice coverage changes in the area near the strait, which may threaten survival of whales present during heavy ice conditions. Current speeds of 4 to 5 kt to the north have been reported in the strait. The whales may in fact be "pushed" through this narrow channel by such currents.

The subsequent migration route was estimated NNE to and through the Bering Strait on the Soviet side of the International Date Line (IDL). The water was more open there and no whales were sighted in the more solid pack ice north between the Diomedes and the strait. North of the Bering Strait the whales were found in narrow leads and small polynyas south of Pt. Hope.

The National Marine Fisheries Service (NMFS) reported bowhead migration occurred in two pulses in 1981, one from 11 April to 3 May and one from 19 May to 2 June (Marguette et al, 1981). Also, five bowheads were seen passing Pt. Barrow as early as 5 April. All bowheads we saw, those north of the Bering Strait on 6 and 11 April (Group 1) and those south of the Bering Strait seen between 12 and 20 April (Group 2), were probably part of the NMFS first observed pulse. The second group we saw began migrating north from the area south of the Bering Strait on 18 April. On 30 April and 1 May our surveys east of Pt. Barrow in the Beaufort Sea accounted for at least 200 bowhead whales heading due east. These bowheads were probably part of the large concentrations we observed in the Bering Sea in mid-April.

It is approximately 600 nmi to Pt. Barrow from the area where bowheads were concentrated in the northern Bering Sea prior to the northerly migration. There was an 11-day interval between the time the majority of whales apparently left the northern Bering Sea (18-20 April), and the peak sightings of bowheads in the Beaufort Sea on 30 April and 1 May. To swim the 600 nmi in 11 days the whales would have had to maintain an estimated 2.27-kt swimming speed. This swimming speed is in keeping with that estimated for migrating bowheads in previous years (Ljungblad et al, 1980, Ljungblad, 1981).

Ice conditions in the Beaufort Sea are quite variable in spring. The shorefast ice is extensive and often lasts well into the late summer months. The area in which the polar gyre causes the pack ice to meet the shorefast ice is called the shear line. The shear line is the site of massive breakup of the pack ice as it meets the shorefast ice. This breakup creates a corridor or broken ice that extends east and offshore to about 72°N latitude. Daily ice conditions along this corridor are a product of winds, movement of pack ice, surface currents and continental shelf topography. We surveyed open-water areas north and south of the shear line from 25 April to 15 May (Flights 17 to 31).

The distribution of bowhead sightings made during these flights indicates the use of a specific migration route through the Beaufort Sea (see Figure 6). In the Beaufort Sea a distinction can be made between a potential migration corridor and the migration route. The migration corridor is that area where ice conditions are usually less than 10/10 coverage and is illustrated by a dashed line in Figure 6.

The corridor is narrow at Pt. Barrow, where pack ice may be pushed into shorefast ice, creating a nearly 10/10 ice cover. The corridor becomes increasingly wider to the east as tendrils extending from the polar gyre begin to form in the Beaufort Sea near the 151°W longitude line. This potential migration corridor is relative to polar ice conditions and can, therefore, change yearly. We consider the migration route as the actual pathway in which bowhead whales were sighted. The route typically is more restricted than the corridor. Though the corridor may change yearly, the route is relatively invariant.

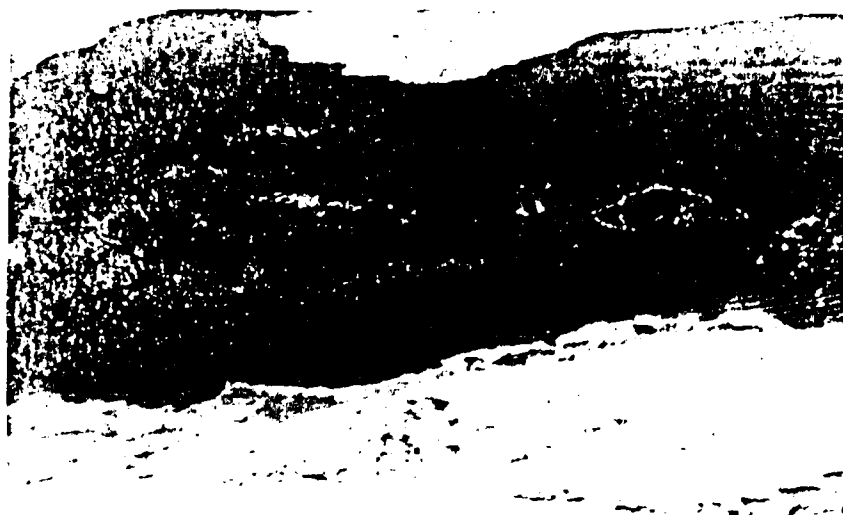
Bowheads generally assume a 55° T heading near 156°30'00 W as they approach Pt. Barrow from the south. A 55° T heading is maintained until the whales are slightly northeast of Pt. Barrow, where a nearly 90° T heading is assumed. As tendrils widen the corridor near the 151°W longitude line, the whales disperse over a wider area, maintaining headings between 90° T and 110° T. As shown in Figure 6 and Flights 18 through 31, as well as Ljungblad (1981, Figure 15), the migration route is generally maintained between

latitude 71°20'N and 71°45'N latitude independent of ice conditions. Even though there was open water this year in the northern tendrils east of 156° W, bowheads were not sighted in these waters. This year the whales seemed to prefer the larger leads, while in 1980 most bowheads were not seen in the larger leads, preferring 7/10 to 9/10 ice coverage. This suggests that bowheads use the most direct route through 7/10 to 9/10 ice or open leads, whichever may be present during their migration. The position and consistency of the migration route evidently assures the bowheads of enough icefree water for the easterly migration. The migration corridor exists over areas where changing ice conditions never completely eliminate access to open water.

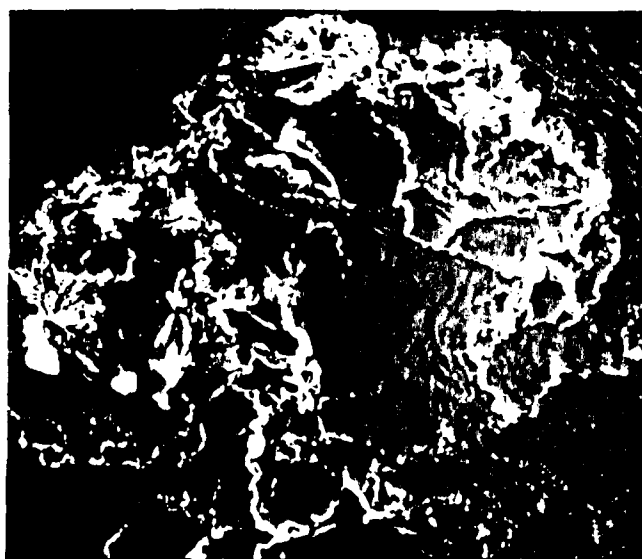
BEHAVIOR AND SOUND PRODUCTION

Eleven sonobuoys were dropped near groups of bowhead whales in the Bering Strait and northern Bering Sea. Three sonobuoys were dropped while tracking the bowhead migration through the Beaufort Sea. The bowheads were nearly silent when actively migrating in the Beaufort Sea, but produced many sounds when not migrating. Various sounds such as moans, knocks, screeches, and elephantlike trumpeting were recorded from the bowhead groups in the northern Bering Sea. The elephantlike sound was heard on two occasions in apparent response to the aircraft by individual bowheads south of the Bering Strait. This is the first time we have heard this sound type in spring. Previously the elephantlike call had been heard and recorded only in fall.

Bowheads south of the strait were in groups of 3 to 19, with some whales touching and rubbing while nearby whales were spy hopping or breaching. Single whales were usually either resting close to the lead edge, alone in small open-water pockets, or actively breaching. Pairs and groups of 3 to 9 whales were generally touching and lying horizontally or vertically, or were lying still side by side on the surface in various orientations to each other. Other whales were seen tail lobbing and probably copulating (Figure 9). Any group of whales touching was scored as involved in social behavior.



(a) Breaching bowhead whale



(b) Probable copulation in bowhead whales

Figure 9. Bowhead whale aggregations along the ice edge in spring



(c) group of 7 or more whales touching (note spyhop on left)



(d) group of three whales at surface with flipper display

Figure 9. Continued.



(c) Tail-lobbing bowhead whale

Figure 9. (Continued)

The whales engaged in social behavior were all over 12 m (40 ft). Breaching whales appeared to be smaller than solitary resting whales. Ventral-ventral postures between two whales, which we believe to be copulation, was often facilitated by at least one other whale, but could include several whales that lay under, over, or next to the apparently mating couple. On several occasions as many as three mating couples were seen in the larger groups. Of 417 bowheads observed south of the strait, 46% were engaged in social behavior, 19.9% were copulating, 20.4% were resting and 8.4% were actively swimming (Table 2).

There was no overall response to the aircraft, either behaviorally or acoustically, by bowheads south of the strait. Even flying at 60 m (200 ft) directly over the whales elicited no avoidance behavior or change in sound production except for the two occasions mentioned above.

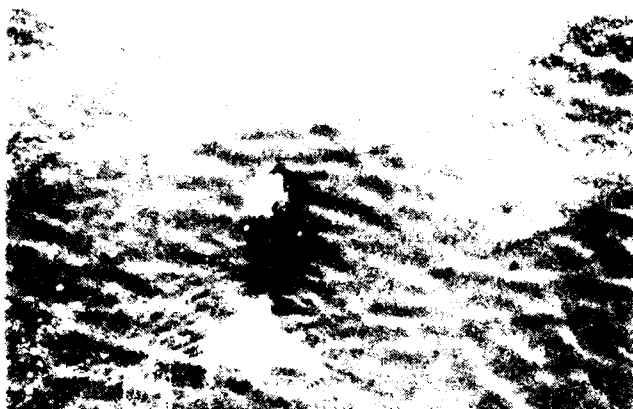
A group of about 110 bowheads was sighted in the Beaufort Sea northeast of Pt. Barrow on 30 April and again on 1 May. They traveled approximately 91 km (55 nmi) in a 24-hour period for an average speed of 2.3 kt. These migratory bowheads were in groups ranging from 2 to 6 individuals spread out over a 64 km lead oriented east to west. Swim direction followed the heading of the major near-shore easterly lead. In the absence of this lead, the swim direction assumed an average of 90° T. East of Pt. Barrow 65.8% of the whales were actively swimming, 20.3% were diving, and 6.1% were resting. Behavioral displays seen in this group included breaches (5.2%), tail slaps (2.2%) and spyhops (0.4%) (see Table 2). There were no social or mating whales seen east of Pt. Barrow. Whales were distributed nonuniformly across leads. Ninety percent (n = 110) of the whales were seen near the ice edge. Ten percent of the bowheads were seen within the center half of the lead.

DISTINCTIVE MARKINGS

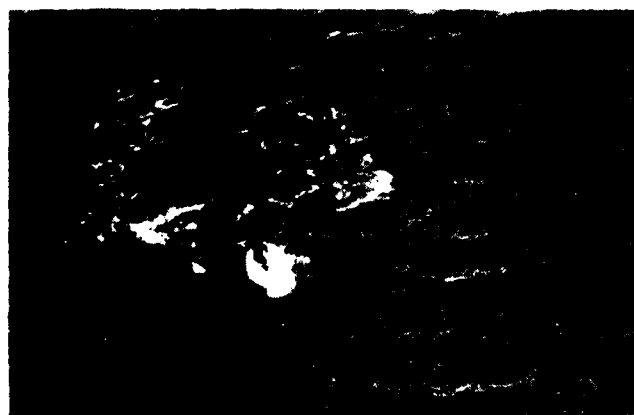
The most distinctive markings seen in the northern Bering Sea were two whales with all-white tails and two with all-white heads. Many whales had ice scars or other white markings that allowed individual identification (Figures 10 and 11).

Table 2. Spring bowhead whale behavior summary

	BEHAVIOR	SWIM	DIVE	REST	SPY HOP	MATE	BREACH	SOCIAL	TAIL SLAP	TOTAL
North Bering and South Chukchi Seas April 5 - 17	No. sightings	18	2	24	3	5	2	29	0	85
	No. animals	35	2	85	5	83	5	192	0	417
	Percent of total No. animals	8.4	.4	20.4	1.2	19.9	1.2	46.0	0	-
	Average group size	1.9	1.0	3.5	1.7	16.6	2.5	0.6	0	-
Pt. Barrow and Beaufort Sea April 18 - May 15	No. sightings	81	34	8	1	0	7	0	2	133
	No. animals	152	47	14	1	0	12	0	5	231
	Percent of total No. animals	65.8	20.3	6.1	.4	0	5.2	0	2.2	-
	Average group size	1.9	1.4	1.7	1.0	0	1.7	0	2.5	-



(a) All-white tail



(b) All-white head

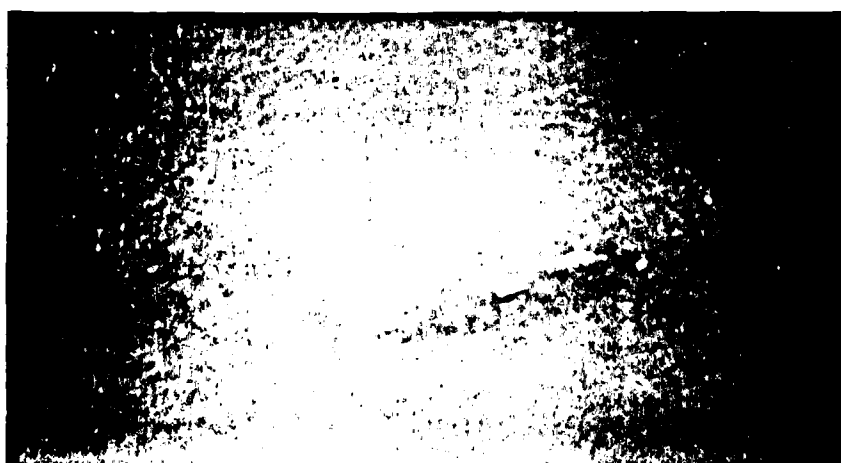
Figure 10. Bowhead distinctive white markings.



(a) tow scars on back



(b) scar forward of tail, plus white on fluke



(c) scar right side of back, small chin patch

Figure 11. Bowhead whales distinctively marked by ice scars and possible wounds.

Several types of distinctive marks were seen on whales sighted in the Beaufort Sea. Distinctive white markings on the tail stock and flukes and distinctive scars allowed at least 10 whales to be positively identified.

Approximately 8 percent of the 110 bowheads seen on 30 April and 1 May had coloration patterns, that were quite different from the basic black. Some of these whales had white colorations on the top of the head, sometimes extending back past the blowhole (Figure 12). Other whales appeared to be more brown than black. Recent photographic evidence,* obtained in the Eastern Canadian Beaufort now indicate that these coloration variants may be due to skin sloughing. There seemed to be no special relationship between these whales and group size. A "sloughing" whale was equally likely to be seen in a group of four, in a pair, or by itself. One cow-calf pair was sighted in a group of three whales on 1 May. The cow was brownish in color, had white extending over most of its head to the blowhole, and was estimated to be 15 m long. It was closely accompanied by a smaller brownish calf estimated to be 9 m long. The third whale was a normally marked bowhead 12 m long, marked with white tail chevrons. Although the three whales were swimming together, the cow and calf were closer to each other than to the third whale.

A wounded bowhead whale was sighted on 24 April northwest of Pt. Barrow (71°29"N, 156°18"W) in the company of two other bowheads. The wounded whale had a gouge out of its back, which was apparent as it lay on the surface (Figure 13). The gouge was slightly to the right of the dorsal line and immediately behind the flipper. No blood was flowing from the wound. The behavior of the whale suggested that the wound had been sustained recently. When first seen, it was lying stationary, oriented northwest, on the surface in a small polynya. A second whale was positioned so that its head was underneath the wounded whale, just behind the blowhole on the right side. It appeared the second whale was attempting to support the wounded whale at the surface. A third whale was in the area but did not participate in this supportive behavior. A sonobuoy was dropped but no sounds were recorded.

*Personal communication (1983) from R. Davis, LGL Ecological Research Associates, Inc., 1410 Cavitt St., Bryan, TX 77801.



(a) "sloughing" whales seen near Pt. Barrow



(b) "sloughing" whale with normally marked bowhead (bottom left)

Figure 12 "Sloughing" bowhead whales



FIGURE 1. Wounded bowhead whale being supported by one of the two accompanying bowhead whales. The arrow is pointing to the wound.

NATIVE WHALING

Three bowheads were reported struck and lost by villages on St. Lawrence Island (Marquette et al, 1981). Gambell reported a whale struck and lost on 5 April and 12 April. Savoonga reported a bowhead struck and lost on 13 April.

The villages of Gambell and Savoonga each took one bowhead on 14 April. The one at Gambell was 15.5 m (51 ft) long (female). The whale at Savoonga was 16.8 m (55 ft) long (female) and fulfilled the village's quota.

Two bowheads were struck and lost on 26 April by the whaling crews at Kivalina. These strikes fulfilled the village's strike quota.

Point Hope landed four bowheads (two males and two females), and struck and lost one bowhead on 4 May. Whaling ended at Point Hope when these whales were landed.

Whaling began at Wainwright on 18 April. Three females (16.1, 17.7 m and 16.5 m) were landed on 6, 17 and 18 May, respectively.

Barrow began whaling on 15 April. One whaling crew struck and lost a bowhead on 28 April. Another crew reported a strike and loss on 1 May. Four whales were landed (3 females, 1 male) on 6, 22, 25, and 30 May.

Although there is no proof, the wounded bowhead reported in this section could be the result of whaling activities. From a check of struck and lost records for 1981, it is possible that wound resulted from a strike delivered by a whaler from either Gambell or Savoonga. Only the villages of Gambell and Savoonga on St. Lawrence Island reported struck and lost whales before our 24 April sighting.

Bowheads that sustain wounds from whaling activities may not immediately die. Wounded bowheads may continue along migration routes during the spring

whaling season (Albert, 1980). The fate of wounded bowheads is not known. It is important, therefore, to measure survival rate for extended periods of time.

OTHER SPECIES

Gray whales were sighted from Bristol Bay north to Wainwright. Many were seen with large mud plumes, indicating feeding activity. Mud plumes became a useful sighting cue, as association of these trails with gray whale sightings was approximately 80 percent during this period (Figure 14). Coastal gray whale distribution appeared spotty, probably related to patchy distribution of their amphipod prey. Feeding grays were repeatedly found along a longitudinal strip from about 168°10'W to 168°45'W, ranging from approximately 63°50'N to 65°10'N.

Belugas were sighted north and south of the bowheads that were north of St. Lawrence Island in April. They were judged to be actively migrating, as evidenced by their northerly course. They were seen in small leads and polynyas. Often when they were not moving northward it appeared that belugas were actively keeping open or enlarging small open water areas by churning the water through swimming at the surface (Figure 15). They were also observed breaking new ice.

Belugas seen in the Beaufort Sea were primarily in large groups. Some groups were so large that belugas were observed swimming across leads as a continuous flow.

In May, beluga whales were common near shore. They ranged from Bristol Bay, to Harrison Bay. Groups of mostly adults were sighted in the Beaufort Sea on mid-May surveys. Belugas were also commonly seen in Norton Sound near the Yukon River and in Kotzebue Sound near Elephant Pt.

A pod of 16 killer whales was observed approaching and chasing a group of gray whales that had been feeding approximately 30 km northeast of St. Lawrence Island on 20 May (see Ljungblad and Moore, 1983). We circled the



Figure 14. Feeding gray whale with mud plume



Figure 15. Beluga whale group hunting in open water surrounded by ice

area for over 90 min and photo-recorded the incident. A sonobuoy was dropped, but no sounds from either the killer whales or grays were detected.

A pod of 15 Dall's porpoise was seen north of Nunivak Island swimming northwest on 30 May. These animals swam and dove too rapidly to allow aerial photos.

Four, uniformly slate gray, Tursiops-size cetaceans were sighted on May to the north of Kuskokwim Bay at 59°10.6'N latitude, 163°37.8'W longitude. The animals dove too quickly to allow positive identification or photographs.

One walrus was seen on 25 April just north of Smith Bay in the Beaufort Sea. The walrus was swimming in a lead less than 1 km wide along the ice edge. Walrus were seen in great number on ice floes and shorefast ice in Norton Sound/St. Lawrence Island waters from April to mid-May. Thousands of walrus were sighted on the beaches of Round Island on 24 and 30 May. This is a traditional haul-out area for males after breeding season.

Both bearded and ringed seals were pupping during April in the Bering Sea. Blood and placentas were seen on the ice and near seals.

Ringed and bearded seals were often seen on flights from Norton Sound and to the north throughout the Chukchi and Beaufort Seas. Calving was not seen in the Chukchi or Beaufort Sea.

Steller sea lions were seen on rocky shores of Cape Newenham and Round Island on 24 May.

Numerous polar bears were sighted in the Bering, Chukchi, and Beaufort Seas. The most southerly Bering Sea sightings were of a polar bear with two cubs on April 6 just north of the Bering Strait in 9/10 pack ice. Polar bear tracks were also seen as far south as the 64°N latitude line.

FLIGHTS OF OPPORTUNITY

On 19 May a flight was made with Alaska Department of Fish and Game officials to investigate the annual walrus hunt. Photos of walrus kill sites were taken. In addition to live and dead walrus, 42 gray whales were sighted (most of them feeding), as well as one possible bowhead at the mouth of Norton Sound (63°57'N, 167°50'W). Only the head of this animal was seen; it dove immediately (Appendix A, Flight 34).

SUMMER (JUNE, JULY, AUGUST)

INTRODUCTION

Surveys during this period were based out of Nome, Kotzebue, and Deadhorse. Surveys for ringed seals inhabiting the Beaufort Sea were flown out of Deadhorse in conjunction with Alaska Fish and Game biologists from 1 June to 10 June and are discussed as flights of opportunity. Block transect surveys were flown in the Chirikov Basin out of Nome and in the Chukchi Sea out of Kotzebue from 10 June to 31 July (Figure 3). One coastal flight from Kotzebue to Barter Island was flown to evaluate ice conditions and identify and count beached cetaceans. The flight path followed the 20-m contour approximately. Three flights were made for the purpose of introducing and orienting BLM personnel to the techniques and hazards of aerial surveys for marine mammals in arctic environs. The aircraft was down from 22 June to 28 June for 100-hour inspection and maintenance in Anchorage. It was dedicated to other projects from 1 August to 14 August.

Beginning 15 August flights from Deadhorse were made along the 20-m contour in the Beaufort Sea in an attempt to locate early migrating bowhead whales and define ice conditions. Base of operations shifted back to Nome on 24 August. Block transect surveys were flown in the Chirikov Basin from Nome. Base of operations shifted back to Deadhorse on 30 August, via coastal survey.

The primary objective during the summer was to sample the preplanned transect blocks as many times as possible. This afforded some temporal distribution and relative abundance data, especially for gray whales inhabiting the area.

A secondary objective was to fly coastal surveys to record all beachings of marine mammals. During these flights the aircraft flew at 76 m (250 ft) 10 to 30 m from the shoreline.

ICE CONDITIONS

Kotzebue Sound and the north coast of Seward Peninsula from Espenberg to Shishmaref had 8/10 - 9/10 shoreline ice cover on 10 June. Ice had broken up and moved out of Kotzebue Sound by 17 June, leaving only a 1/10 to 3/10 shoreline ice cover. Shorefast ice off Cape Prince of Wales still afforded approximately 9/10 coverage, ranging to 3 km offshore on 17 June. There was no shorefast ice wider than 0.5 km, but 20-km-wide ice fields of 3/10 ice cover were located near Pt. Hope, north of Cape Lisburne, and north of Shishmaref. It seemed that ice concentrations followed bottom depth contours rather than beachline contours. River outflow, land runoff, and currents affected ice conditions, causing earlier melting in these areas.

On 25 July the ice had receded to north of Pt. Lay. One-tenth concentrations existed 10 km off Icy Cape, 2/10 coverage 5 km off Wainwright, and 3/10 coverage was present at Pt. Barrow. The lease areas had 1/10 to 3/10 ice cover with up to 3/10 ice cover north to the horizon. The ice in the lease areas was old, broken pan ice with open water everywhere. Strong winds, currents, and mild temperatures were keeping the water open.

The pack ice off Alaska's north coast was over 200 km offshore during the week of August 15-23. Sustained winds out of the southwest at 15 to 30 kt were likely responsible for this extreme northerly drift. Surveys conducted during this period along the 20-m contour from Pt. Barrow to the Mackenzie Bay found mostly open-water conditions. Ice that was encountered consisted of old pan ice and brash ice. Ice cover ranged from 1/10 to 6/10, with greatest coverage found just north of the Barrier Islands. On August 22 a survey to 387 km due north of Deadhorse encountered ice cover from 7/10 to 10/10 beginning about 290 km offshore. Most ice was pan ice, with some grease ice forming in open-water areas. Photos to document ice conditions were taken every 10 min, and to the north, south, east, and west at the northern extreme of this flight.

Patches of ice cover from 1/10 to 4/10 were encountered from Deadhorse to Pt. Barrow and south to Peard Bay on the Deadhorse-to-Nome coastal survey of 24 August. Heavy fog over the Chukchi Sea prevented any further survey.

No ice was encountered in the Norton Sound/Bering Sea areas surveyed from August 26-30.

On the return coastal survey from Nome to Deadhorse, 30 August, patchy 1/10 to 4/10 ice cover was again encountered between Barrow and Deadhorse.

SURVEY EFFORTS AND SIGHTING OVERVIEW

The overall summer survey effort representing 172.08 flight hours is presented in Figure 16. A Deadhorse-to-Nome coastal survey was completed 10 June. Fourteen gray whales were sighted approximately 1 km from shore at Wainwright. No feeding mud plumes were seen. One feeding gray was noted just south of Cape Prince of Wales. Three feeding grays were noted at this same site the following day while the aircraft was en route to a block survey.

Block transect surveys were flown around the Norton Sound and Chirikov Basin out of Nome, and in the Chukchi Sea out of Kotzebue from 11 June to 31 July. In all, 25 surveys were completed, covering all of the blocks at least once and including several coastal surveys. Feeding gray whales, five fin whales, and three minke whales were the most significant of the sightings in these areas. Survey data (area and number of sightings per species) are provided in Appendix A.

Late in the summer (15-24 August)* survey efforts in the Beaufort Sea were directed toward searching out early westward-migrating bowhead whales. Unconfirmed bowhead whale sightings by a military ice reconnaissance crew and Canadian biologists indicated bowhead whales may be in the area between Harrison Bay and Mackenzie Bay. Because the survey area was relatively ice free, we concentrated our search efforts primarily along the 20-m contour as the most likely area to find early bowhead migrants based on 1979 and 1980 data. The waters from Pt. Barrow east into the Canadian Beaufort Sea were

*Aircraft used 15-22 August was ERA Twin Otter

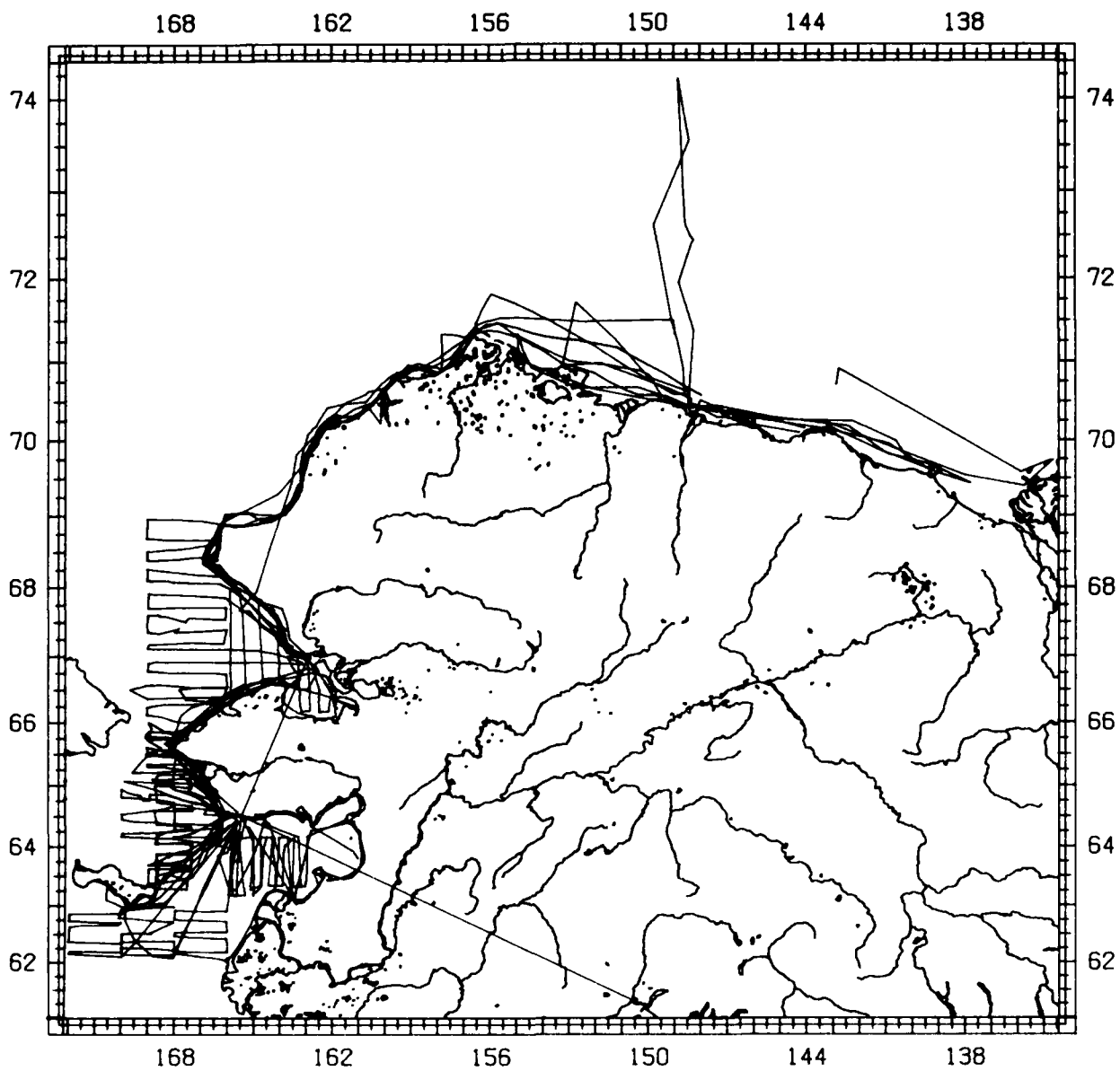


Figure 16. Overall Summer survey effort representing 172.08 flight hours.

surveyed five times between 15 and 20 August (Flights 78 to 82). Two bowheads were sighted approximately 65 km due east of Herschel Island on August 17. These whales were oriented southwest and north, but neither was actively swimming. Both whales dove and were not resighted. No other bowheads were seen during this period. An effort to fly north to the pack ice in search of bowheads was made on 22 August (Flight 83). Poor weather conditions and aircraft range forced a return to Deadhorse at a maximum northerly excursion of approximately 387 km. Pack ice was not reached. Beluga whales were sighted, but no bowheads.

A coastal survey from Deadhorse to Nome was attempted on 24 August. Gray whales, ringed seals, and bearded seals were sighted between Barrow and Wainwright before the survey was aborted due to fog.

Preplanned block transects were flown out of Nome from 26 to 29 August. Gray whales, a few walrus, and several unidentified pinnipeds were sighted.

A coastal survey from Nome to Deadhorse was completed on 30 August to re-establish a base at Deadhorse for the remainder of the fall season. Three ringed seals and four unidentified pinnipeds were sighted, along with numerous walrus and gray whale carcasses washed up on the beach.

GRAY WHALE DISTRIBUTION, HABITAT, AND BEHAVIOR

Gray whales were sighted both near shore and in offshore, pelagic waters throughout the summer. Gray whales were seen within 0.5 km of shore on both deep and shallow gradient beaches, such that they were in water from 3 m to 40 m deep. Some places were so shallow the whales were lying on the bottom. Deep-water coastal areas where grays were seen include areas just north of Cape Prince of Wales, Cape Lisburne, and Icy Cape. Grays were also sighted in pelagic waters 40-60 m deep and in up to 3/10 ice concentrations. In the Bering Sea, a concentration of gray whales was found in June north and east of St. Lawrence Island (Figure 17). Most of these whales were feeding, as evidence by mud plumes streaming from their mouths. Eighty five percent ($n = 318$) of the gray whales seen in the Chukchi and Bering Seas in June were

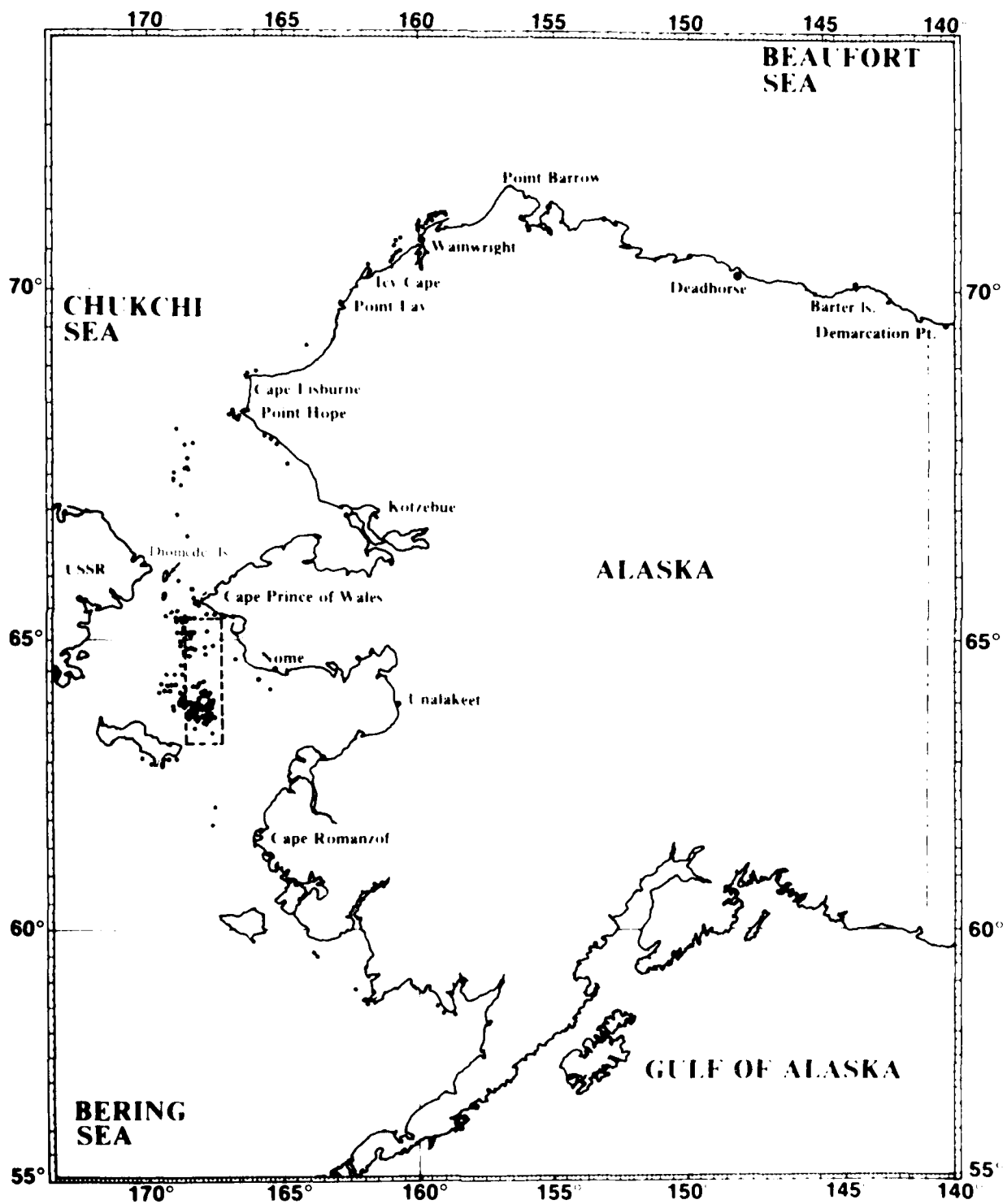


Figure 17. Distribution of gray whale sightings in the northern Bering and Chukchi Seas. The modified transect block is shown by dashed line.

feeding. Mud plumes also attract feeding birds and thus aid sightability. Since mud plumes dissociate within 5 min, they are a very temporary sighting cue.

An approximate concentration area of feeding gray whales noted in May and June was surveyed on 27 August (dashed line in Figure 17). This modified transect block was flown north of St. Lawrence Island between 65°10' N and 63°28' N latitude and 167°20' W and 168°40' W longitude (Flight 86) because we did not have time to fly Blocks B, C, D, E, and F independently. Thirty-four gray whales were seen in an area where approximately 180 grays had been counted over three surveys (Flights 35, 36, and 52) conducted in late May and June. In August, only 40 percent of the grays sighted appeared to be feeding (ie, were associated with mud plumes). This evidence of fewer whales and drop in feeding activity may indicate the termination of seasonal feeding for grays in this area.

Relative abundance and density estimates were derived for gray whales in the Chirikov Basin using strip transect, method 1 described in Estes (1978). Estimates were calculated by blocked areas (see Figure 3) to better utilize all flight effort and reduces intra-block variances. A conservative strip width of approximately 0.5 km (463 m) was used to maximize the probability that we counted all individuals within the strip boundaries. The abundance estimates ranged from a low of 0 to a high of 447 gray whales for Block F (Table 3). Note that Blocks C, E and F show the greatest abundance and density of grays.

Gray whales seen in the Chukchi Sea in July were either traveling fast (>3 kt), feeding, or resting and nursing. Five cow-calf pairs were sighted in the Chukchi Sea. Cows were feeding as well as nursing (<1% nursing). The headings of feeding whales were random, but the headings of swimming whales in pelagic waters of the Bering Sea were generally north (330° to 030° T) or south (150° to 210° T). Whales sighted near the coast were usually heading along the coast going either north or south. Tail waves, tail slaps, and head stands were observed. There was no apparent response to the aircraft even when as low as 76 m (250 ft), or to an active geophysical research boat 40 km away. No synchrony of behavior was noted, nor were distinctive markings seen.

Block	Area (nm ²)	Track survey (nm)	Gray whales counted in strip	Density (R) (no./nm ²)	Variance S ² (R)	Abundance Var (T)	Variance Var (T)	95% confidence interval around T
B	2388	50.3	0	0±0	0	0±0	0	(0-0)
C	2388	573.8	46	.049±.018	.00031	117±36.8	1357.0	(40-193)
D	3071	559.9	5	.005±.012	.00016	16±34.6	1194.4	(-54-87)
E	3071	469.9	71	.094±.033	.00106	288±92.2	8500.7	(97-478)
F	1707	400.7	131	.262±.102	.01048	447±152.9	23375.0	(117-778)
G	736	178.0	9	.028±.020	.00039	21±12.7	160.1	(-7-49)
O	3296	372.8	0	0±0	0	0±0	0	(0-0)
P	3296	341.0	2	.003±.002	.00000	10±6.0	36.6	(-4-23)
Q	3296	372.7	2	.003±.002	.00000	9±5.7	32.9	(-4-21)

Table 3. Gray whale relative abundance and density estimates for nine survey blocks in the Chirikov Basin.
Strip width used = 463 m.

OTHER SPECIES

Two fin whales were seen near Sledge Island on 15 July. Fog and poor sightability prevented photography. A group of three fin whales, including a cow-calf pair, was sighted in the southern Chukchi Sea at 67°10.5' N, 168°44.8' W along with the gray whales on 24 July (Figure 18). The cow was estimated to be 20 m long and the calf 8 m. Their swimming behavior was elusive and made photography difficult. They dove each time the aircraft approached but were resighted immediately after we passed over them. They were within 45 km of an active geological research ship (the Arctic Star) but showed no apparent response to the seismic sounds.

A group of three minke whales, including a calf, was sighted southwest of Sledge Island 15 July. The two adults were estimated to be about 10 m in length; no size estimate on the calf was obtained. These whales responded to the aircraft with short, shallow dives and were eventually lost in the fog.

Belugas were sighted in Norton and Kotzebue Sounds in June and July. Harvesting of belugas was observed at Elephant Point and Shesualek in Kotzebue Sound on 15 and 16 June. Over 100 belugas were sighted and their sounds recorded during active feeding near the mouth of the Yukon River on 12 July. Only one live beluga was seen at Pt. Lay, a traditional calving/mating area. Beluga whales were seen on two occasions during a flight out of Deadhorse in August, once in Mackenzie Bay, and once about 30 km north of Prudhoe Bay.

Two, solitary dark gray to black pilot-whale-size cetaceans were sighted in and near Norton Sound on 21 June. One animal was less than 50 m from shore in silty surge water. The second was approximately 3 to 4 m long, with a low recurved dorsal fin like that of a pilot whale. Both dove quickly, and no definitive photos were taken. It is possible that the two sightings could be of the same animal as they were made over 3 hours apart. We did not think that the animals were pilot whales because they were not seen in typical aggregations (Leatherwood et al, 1972) and no distinctive bulbous head was visible. Perhaps they were black-morph harbour porpoises.

Thousands of walrus were seen swimming and riding ice floes northward between Pt. Lay and Wainwright on 10 June. Live walrus were rarely sighted in the south Chukchi Sea or Bering Sea in late summer. Over 1350 were seen within 10 km of Pt. Barrow on 25 July. Over 500 dead walrus carcasses were seen on beaches from Cape Romanzof to Pt. Barrow. Sighting of dead walrus in the water is easy due to their white color, bloated size, and exuded oil slick.

Ringed and bearded seals were often seen on flights near Norton Sound and to the north throughout the Chukchi and Beaufort Seas. Hundreds of ringed seals were counted on the Beaufort Sea shorefast ice from 2 through 9 June. Spotted seals were most common from Kotzebue Sound south to the Kuskokwim River delta.

A solitary polar bear was sighted on the shorefast ice in Camden Bay on 8 June.

SOUNDS

Recordings were made in the summer in the following situations: a single killer whale; gray whales in the northern Bering and Chukchi Seas; over 100 beluga whales feeding in muddy water near Yukon River; minke whales near Sledge Island and gray and fin whales near a seismographic vessel. On 24 July, while conducting a transect survey in block I, we counted 36 gray whales and 3 fin whales within 68 km of the geophysical research vessel, MV Arctic Star. Most of the grays were feeding (evidenced by mud plumes) in groups of 2 to 12, with the exception of a cow and nursing calf seen resting on the surface. A 41A sonobuoy was dropped near 12 gray whales, and a second calibrated 41B sonobuoy was dropped 1.4 km from the Arctic Star (Figure 18). Loud seismic pulses were received every 12 to 14 s at both hydrophones and corresponded with visual observations of bubbles near the vessel's stern.

Spreading loss was calculated using $L = SL - 20 \log r$, where L is the received level, SL , is the source level, referenced to 1 m, which for this vessel, was 246 dB* (Gales, 1982) and r is the range in meters.

*All dB are referenced to dB re 1 μ Pa.

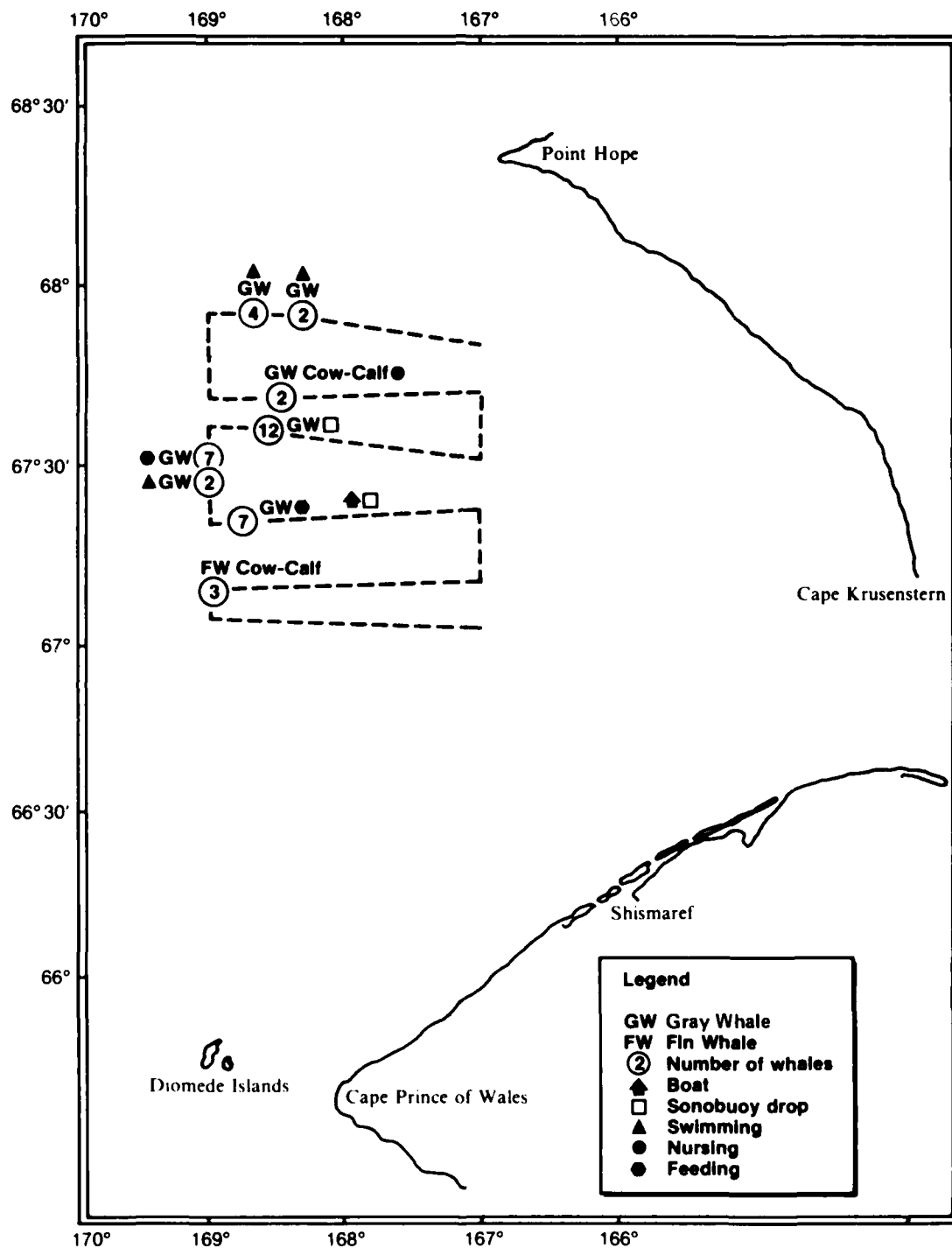


Figure 18. Location of gray whales and fin whales (including cow-calf pairs) in proximity of an active geophysical boat (Arctic Star) in the Chukchi Sea, 24 July.

The calculated received level at a range of 1.4 km was 183 dB, with a measured received level of 180 dB. The 3-dB disparity falls within the limit of the sonobuoy specifications. We used $20 \log r$ to calculate the received levels at the whales' positions. Calculated levels ranged from 154 dB at 36 km (closest grays), to 149 dB at 68 km (furthest grays). The gray and fin whale cow calf pairs were exposed to sound levels of 154 dB at 42 km, and 152 dB at 55 km, respectively. The gray whale calf continued nursing, and the fin whales were swimming slowly south in the presence of these sounds. No overt fright or flight response was evidenced by any of the 39 whales we saw.

BEACHED ANIMALS

There were 11 sightings of 14 beached animals (except walrus) and three sightings of floating whale carcasses during the summer. Three of the beached cetaceans were investigated by making a water landing near the site. Table 4 describes each of the animals. Their locations are shown in Figure 19.

Currents and ice concentrations presumably determine where animals beach. The best example of this was that of a whale carcass seen floating at $65^{\circ} 24.3'N$, $167^{\circ} 44.7'W$ on 23 July that was resighted beached in the lee of the current northeast of Cape Prince of Wales at $65^{\circ} 43.5'N$, $168^{\circ} 02.0'W$ on 20 August. This carcass was positively identified by a distinctive sunburn patch on its back. Five large whales were noted beached in this area during the summer.

FLIGHTS OF OPPORTUNITY

Surveys for ringed seals in the Beaufort Sea were conducted in conjunction with Alaska Department of Fish and Game biologists from 2 to 9 June. Nine flights were completed, covering an area from shore to about $71^{\circ} 20'N$ latitude, and from $148^{\circ} 00'$ to $158^{\circ} 00'W$ longitude. Flights were made along seismic shock lines and grid transects flown in and out of exploratory seismic areas. Detailed findings of this work have been reported in Burns et al (1981).

DATE	STATUS	SIZE	COLOR	LOCATIONS	DESCRIPTION
20 May	Dead in water	9 m	mottled gray	63°56.1'N 167°35.5'W	Gray whale carcass in presence of killer whales
6 Jul	Beached, skeleton	4 m	dark brown	Norton Bay 64°31.7'N 161°03.2'W	Identified as a Beluga on 12 July
7 Jul	Beached carcass	2 m	dark brown	Lopp Lagoon 64°44.2'N 168°00.1'W	Possible pinniped
7 Jul	Beached carcass	3 m	brown	Ikpek Lagoon 64°46.1'N 167°40.5'W	Cetacean
7 Jul	Beached carcass	11 m	brown	Shishmaref 65°55.5'N 167°12.5'W	Decomposed with yellow lines identified as a gray whale on 2 Jul 12 cm baleen taken
7 Jul	Beached carcass	7 m	brown	Shishmaref 66°04.6'N 166°49.5'W	Hunched back, thin tail, short flipper
7 Jul	Beached carcass	12 m	brown	Shishmaref 66°05.4'N 166°47.5'W	Sloughing skin probable bowhead
8 Jul	Beached	2 m	brown	67°24.2'N 163°52.0'W	Possible pinniped
8 Jul	Beached	12 m	brown	Pt. Lay 69°44.7'N 163°02.3'W	Unidentified
15 Jul 20 Jul	Dead, in water	9 m	white	SW of Sledge Is. to SE of Bering Strait 64°21.9'N 166°23.7'W	Floating tail up and head down, moved 122 km in 5 days Possible gray
23 Jul 30 Aug	Dead, in water, later beached	8 m	white with dark sunburns	SE of the Bering Strait 65°24.3'N 167°44.7'W then beached east of Cape Prince of Wales 65°43.5'N 168°02.0'W	Jaw missing and decomposed; probable gray whale
25 Jul 30 Aug	Beached	16 m	tan & brown	Cape Beaufort 64°06.1'N 163°34.1'W	Probable fin whale
29 Jul	Beached carcass	9 m	white with red stains	Cape Douglas 64°58.5'N 166°34.4'W	No baleen in mouth, probable gray whale, investigated on 30 & 31 Jul
30 Aug	Beached	11 m	white mottled	Sabine 68°52.5'N 165°13.4'W	Possible fin
30 Aug	Beached	3 m	tan	69°42.6'N 163°03.0'W 70°02.4'N 162°33.9'W	2 belugas 2 belugas

Table 4 Beached and floating cetacean and pinniped carcasses.

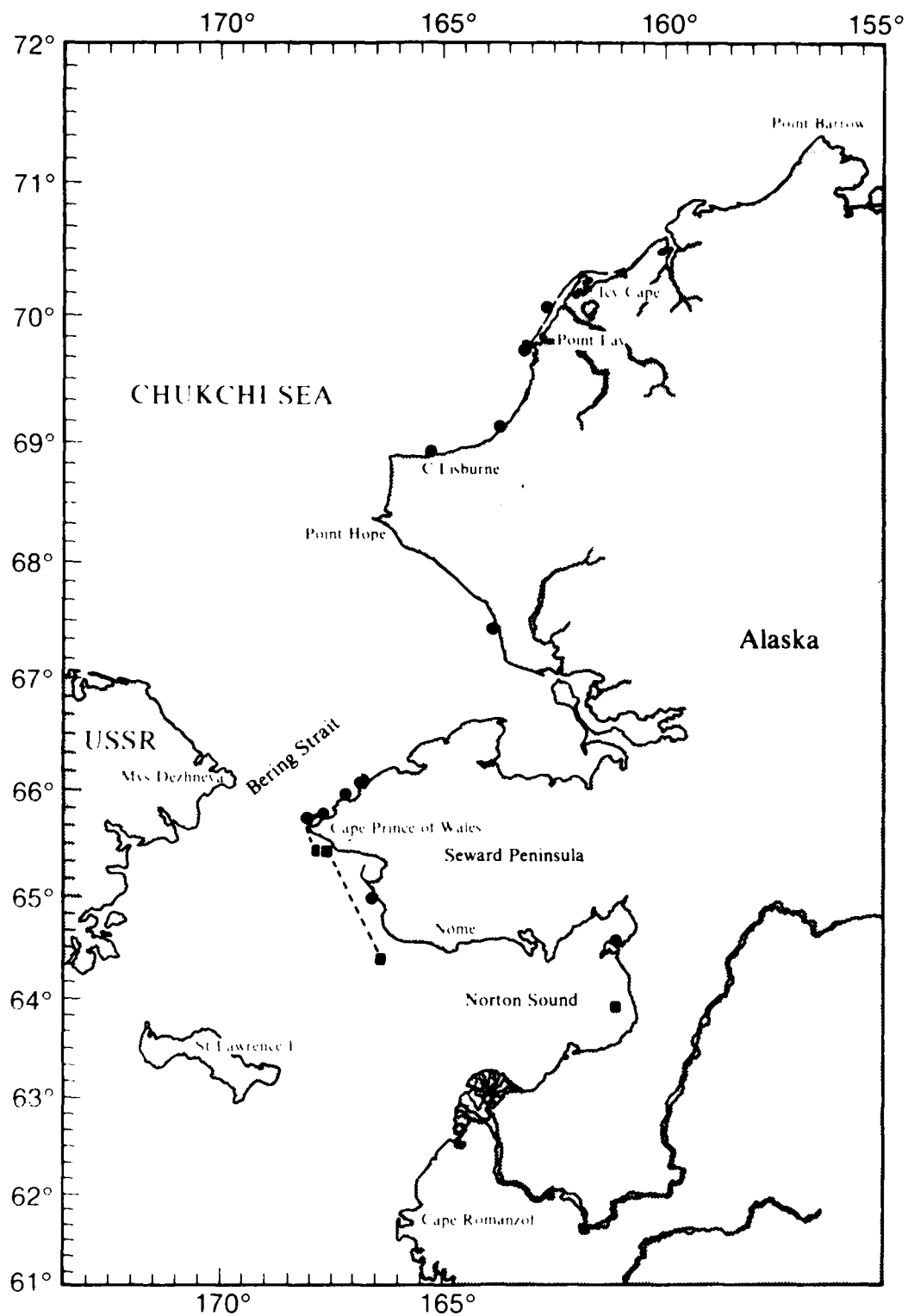


Figure 19. Sites of beached cetaceans and pinnipeds.

FALL (SEPTEMBER, OCTOBER)

INTRODUCTION

As a result of interagency consultation under Section 7, Endangered Species Act, between NMFS, BLM, and USGS, fall research efforts were directed to achieve two major objectives. A new objective was to determine if bowhead whale behavior was significantly affected by geophysical vessel activity. If relevant information was obtained, regulatory agencies (eg, USGS and/or NMFS) and vessel operators were to be notified. This objective as a priority, was a unique approach for 1981 as compared to previous seasons. Also transect surveys were to be performed to describe and characterize the relative distribution, relative abundance, habitat characteristics, and sound production of fall migrating whales in the nearshore Beaufort Sea in order to meet our original objectives. To meet these divergent needs, specific protocols were designed to effectively combine behavioral investigations with survey efforts. As an operational rule, transects were to be performed alternately with initial, daily search flights (search flights were intended to locate and assess behavioral relationships to geophysical boats). If, during a transect, behavioral interactions were observed, the transect was to be aborted in favor of behavioral investigation. Thus to a certain degree, our original sampling plan related to distributional questions was constrained by the additional demands placed upon project resources. Behavioral investigations subsequent to 21 September were performed with the participation of Mr. Mark Fraker, LGL Ecological Research Associates, Sidney, British Columbia. Additional discussions of behaviors and their relationships to summer observations are to be found in a report, presently in press, by Fraker and Ljungblad, entitled "Bowhead Whale (Balaena mysticetus) Behavior in the Presence of Geophysical Boats."

The base of operations for fall was Deadhorse. Aerial surveys generally covered the area between Smith Bay and Demarcation Bay. As mentioned above, two types of survey flights were flown: search flights to find and observe behavior and transect surveys in or near the proposed lease areas. Most

search flights focused on the eastern Alaskan Beaufort Sea, near Demarcation Bay, because the highest concentration of bowheads could be continuously found there.

In the search for bowheads, survey altitudes ranged between 153 m (500 ft) and 305 m (1000 ft). A maximum altitude of 450 m (1500 ft) was maintained, if possible, while circling bowheads and recording behaviors. Transect surveys were flown at 153 m (500 ft).

ICE CONDITIONS

Ice conditions in September ranged from open water to 5/10 coverage between the coast and the 72°N latitude line. North of 72°N latitude ice coverage varied from open to 7/10. The lease areas were covered by a maximum of 2/10 ice on the northern edges but open water was predominant. Some residual pieces of old ice were grounded and stacked up on the Barrier Islands. Sea state ranged between Beaufort 1 and Beaufort 5.

Relatively ice-free conditions persisted below the 72°N latitude line until 30 September. Freeze-up began during a storm on 1 October. By 3 October, the new ice was thick enough to support polar bears, evident by numerous track sightings. Ice cover was 9/10 grease ice south of the Barrier Islands at that time. North of the Barrier Islands and along the 20-m contour, open water prevailed, possibly the result of currents. North of this open-water strip ice cover was 5/10 to 9/10. The proposed Sale 71 and State-Federal lease areas averaged 9/10 ice cover by 4 October. Ice cover averaged 7/10 east of Flaxman Island on 4 October; coverage increased to 8/10 in this area by 7 October. By 9 October ice cover from Pt. Barrow to Demarcation Bay averaged 8/10 to 9/10 except along the 20-m contour and remained such until the end of the study period (17 October).

SURVEY EFFORTS AND SIGHTINGS

The overall fall survey effort representing 134.18 flight hours is presented in Figure 20. Thirty-four flights were completed between Smith Bay and Demarcation Bay in the fall. Seven transect surveys were flown in or near the

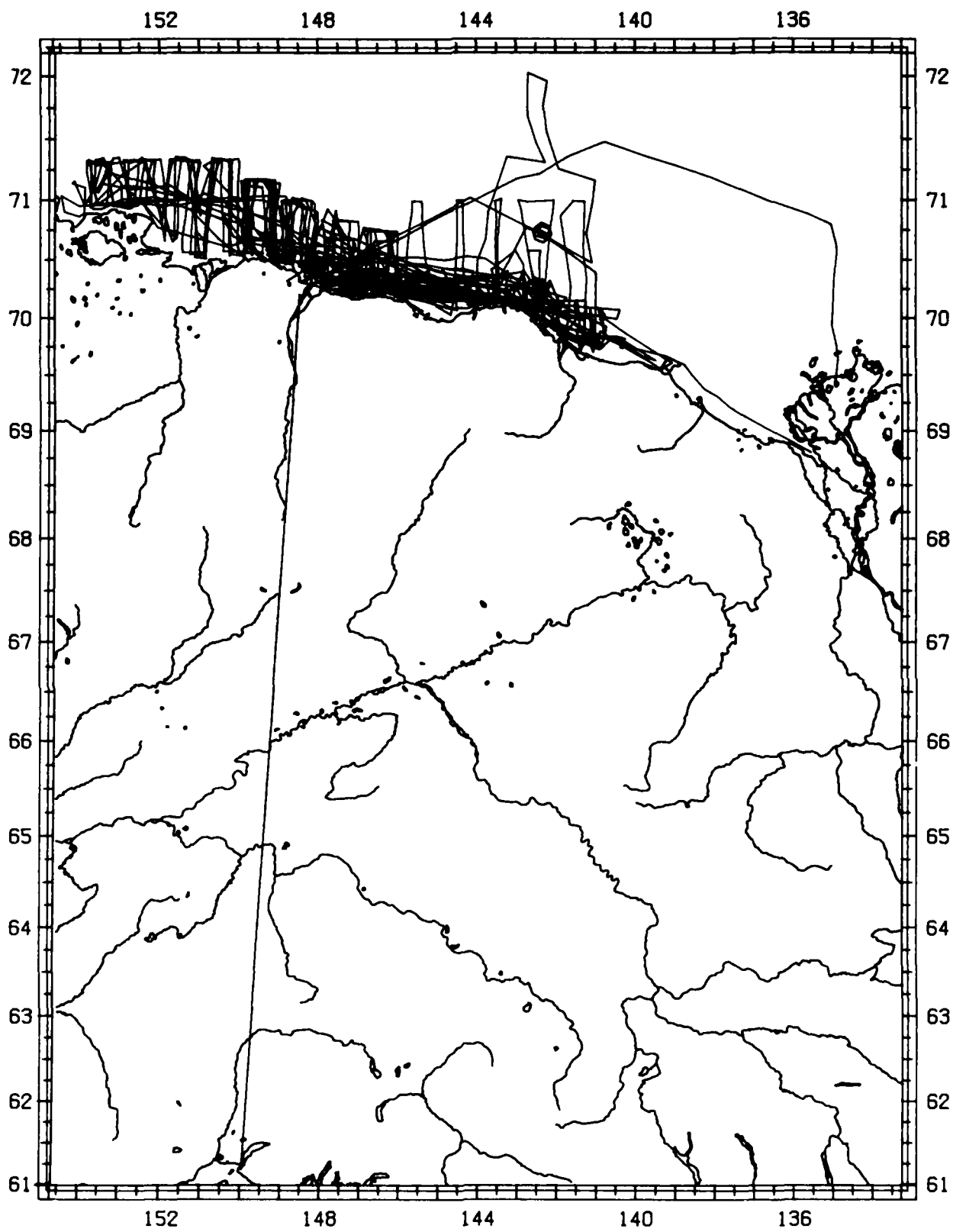


Figure 20. Overall fall survey effort representing 134.18 flight hours.

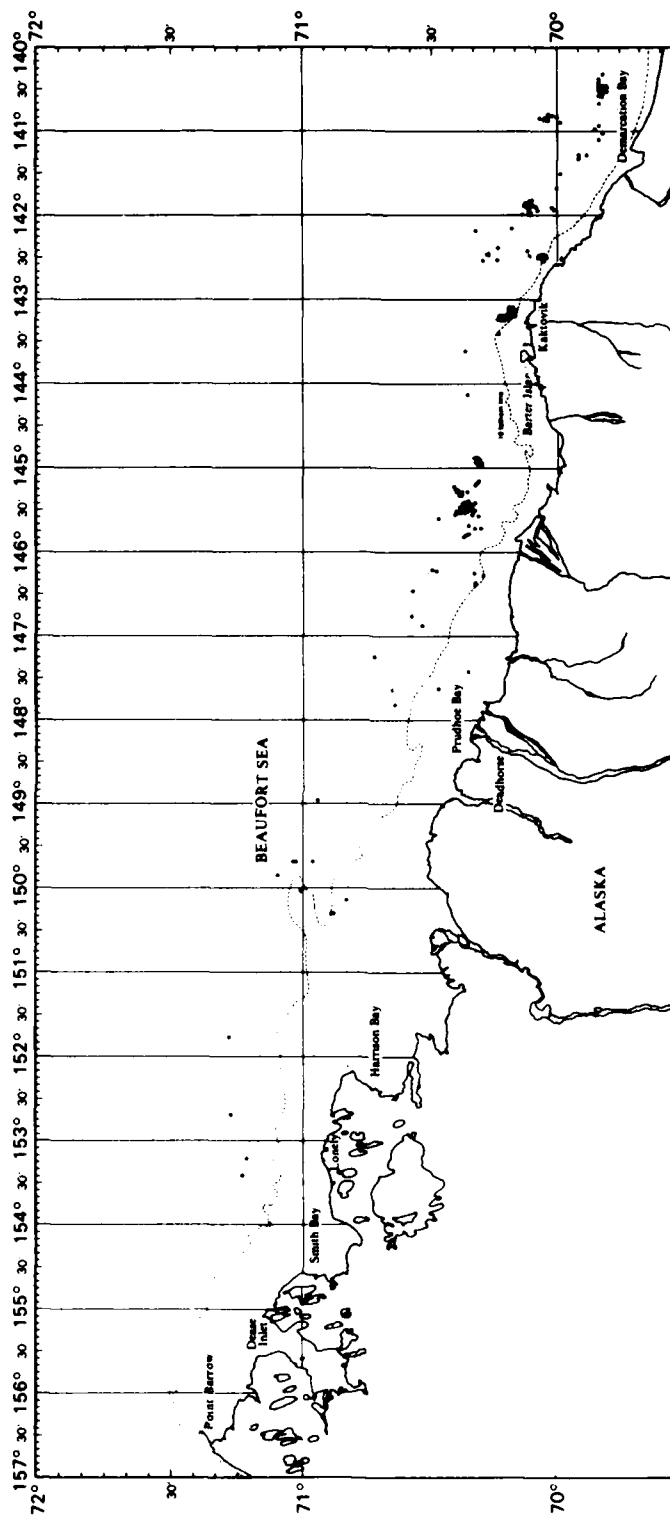
proposed Sale 71 lease area (Appendix A: Flights 98, 111, 117, 119, 122, 124, 125); seven transect surveys covered the Joint State-Federal lease area (Appendix A: Flights 99, 113-15, 117, 119, 121). Fog and icing conditions occasionally forced transect legs to be shortened or canceled on 5 of these 14 flights. Sixteen bowhead whales were sighted during these flights. Of these sightings, three bowheads were seen within the Joint State-Federal lease area, and three whales were sighted in the proposed Federal lease area. Twenty search flights were conducted to observe bowhead whale behavior. These flights were from Flaxman Island east to Demarcation Bay, generally along the 20-m contour. During these flights, 155 bowheads were sighted. Figure 21 presents all fall bowhead sightings.

MIGRATION TIMING, RELATIVE DISTRIBUTION, AND HABITAT RELATIONSHIPS

Our first fall sighting in the U.S. Beaufort Sea was on September 7, when five bowheads were seen 9 km east of Barter Island. They were heading in several directions and were engaged in feeding behavior, including diving and resting. Bowhead whales were found in greater numbers east of Barter Island than in the study areas in early fall (Flights 97 to 116).

Freeze-up began on 29 September, when most of the open water began showing a thin layer of grease ice. The general ice coverage was now estimated to range from 5/10 to 7/10. As this ice cover increased, the number of whales seen on a westerly course also increased. Their swimming speed was estimated at up to 3 kt. By 9 October, ice coverage was estimated to be 7/10 to 9/10 and remained fairly consistent throughout the remainder of the surveys.

The migration past the lease areas was assumed to begin on 28 September because this was when the first bowhead was sighted heading 270° in Block 1, which includes the State-Federal oil lease area. However, prior to that and since 12 September, whales were found on search flights near Demarcation Bay, sometimes in large numbers (up to 38 on 20 September). Whales were also found along the 20-m depth contour. However, the peak period of migration past the lease areas was between 1 October and 15 October, when 25 whales were seen on seven transect survey flights. The project was curtailed on 15 October.



BOWHEAD WHALE SIGHTINGS, FALL MIGRATION 1981

Figure 21. Fall sightings of bowhead whales.

Mechanical problems with our aircraft forced termination of the study on 15 October. Because of this we cannot fix the final day of migration, but we estimate that it was completed between 17 October to 20 October, based on the 1979 data (Ljungblad et al, 1980).

BEHAVIOR AND SOUND PRODUCTION

Behavioral data collected included surface and dive times, blow intervals and number of blows, surfacing relations to ice, and general activity. Bowheads that were observed between Barter Island and Demarcation Bay were feeding (60%), resting (40%), and producing sounds and did not appear to be migrating (Flights 97, 100, 102-107, 112, 114, 116, 118, and 120). Swimming speeds were estimated to be generally less than 0.5 kt, and many times the whales were stationary. Swimming and resting whales assumed a variety of headings, not an overall westerly heading. A detailed analysis of bowhead behavior including dive profiles is reported in Fraker and Ljungblad (1983).

On several occasions sounds were produced while whales were at or approaching the surface but would cease when the group dove. Bowhead sounds recorded in fall may be described as moans, whines, and elephantlike trumpeting. Bowheads were very active in their sound production as in 1979. Sounds produced by geophysical exploration boats were sometimes heard concurrently with bowhead sounds. The presence or absence of the boats appeared to have no effect on the types of sounds produced.

NATIVE WHALING

Three bowheads were harvested by the village of Kaktovik. A 17.3-m (57 ft) male was taken on 8 September. A second male, measuring 13.9 m (46 ft), was taken on 11 September. The final whale taken was a 17.3-m (52 ft) female on 22 September. These three whales fulfilled the native bowhead whaling quota.

OTHER SPECIES

Ringed and bearded seals were sighted on many fall flights. Pinniped sightings became more frequent as ice coverage increased.

Polar bears were sighted throughout the fall and usually reacted to the aircraft by running across the ice or diving into the water. One aggregation of 23 bears was sighted on 9 September at a bait station (established by U.S. Fish and Wildlife Service) at Demarcation Bay. Bears closest to and feeding on the bait did not react to the aircraft. Bears that were not feeding reacted to the aircraft by scattering in pairs in various directions.

DISCUSSION

Observations during 1979-81 have revealed much concerning bowhead behavior and the route of the near-shore migration that takes place each fall through the Beaufort Sea. Figure 22 shows the 469 combined 1979-81 bowhead sighting.

From these surveys it appears that one of two types of migration can be expected each fall. The type of migration that does occur seems related to the ice conditions for that season. A comparison of ice conditions and the type of migration that occurred can best be shown by looking at conditions in early to mid-September, when the migration usually begins. In September of 1979 and 1981 very little ice was present, whereas in September of 1980 the entire coastal zone of the Beaufort Sea was estimated at 7/10 to 9/10 ice coverage. For the purpose of discussion, 1979 and 1981 will be called light ice years and 1980 a heavy ice year.

In the light ice years, the migration moved very slowly to the west, with apparent feeding along the way. Groups and individuals appeared to remain in the same general area for extended periods of time. The whales were also active in respect to sound production in both years. The average group size was three to four whales, although several groups were seen that contained up to ten whales. The average dive time was 10 min with a surface time or resting period averaging 3 min.

In the light ice years, freeze-up began in early October. Even as the ice coverage increased, no immediate noticeable change occurred in the behavior of the whales. Whales were still apparently feeding in ice estimated at 5/10 to 6/10 coverage.

By mid-October of both light ice years, the ice had increased to 7/10 and 9/10 coverage. At this time, the behavior of the whales changed from feeding to a rapid movement to the west. The behavior is comparable to that seen in early September of the heavy ice year.

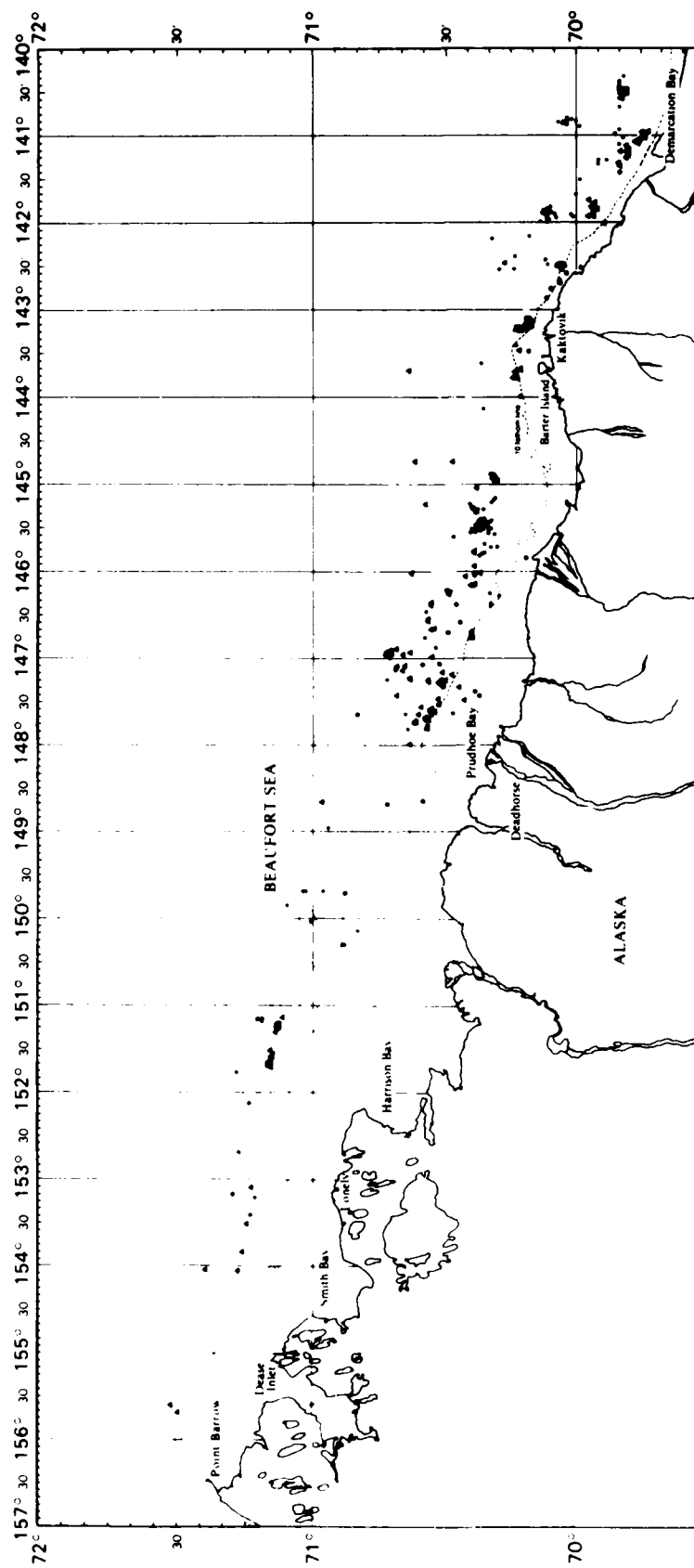


Figure 22. Combined fall bowhead sightings 1976-1981.

During the heavy ice year of 1980, nearly all bowheads seen were rapidly swimming to the west, with no feeding along the way and speeds estimated to be 3 kt. The majority of sightings were of individuals, with an occasional pair. All were sighted in small open water areas or narrow east-west leads. The sounds of the whales were recorded on only two occasions for this season even though many sonobuoys were dropped. Dive times and surface times were not obtained due to the ice conditions and swimming speeds of the whales.

Only the routes of these two types of migrations appear to be similar. This route for all three years was west along the 20-m contour. In this area open water was always present, regardless of the general ice coverage of the Beaufort Sea during September and October.

With the information obtained from these surveys it is possible to predict the type of migration that will occur during any year on the basis of ice conditions in early September of that year. If the coastal zone out to approximately 20 miles offshore is basically ice free in early September, one can expect the migration to move very slowly to the west. The first whales will appear near Demarcation Bay along the 20-m contour in early September. By mid to late September, bowheads will be distributed along the 20-m contour from Flaxman Island east to Demarcation Bay, with a higher percentage in the area from Barter Island east.

In early to mid-October, the whales will be distributed from Barter Island west to Point Barrow, with apparent feeding activity west to Harrison Bay along the 20-m contour. By mid-October, the behavior should change to that of a migratory whale, and the migration through the Beaufort should be over by late October.

In a heavy ice year, the migration is much more difficult to follow. The best approach for monitoring the migration in early September would be to fly west to east or vice versa along the 20-m contour. This area should have the majority of open water and appears to be the primary near-shore route of migration. The migration can be expected to be over by mid-October, with considerably fewer whales seen than in a light ice year (due to the heavy ice cover).

Combining the results for the past three seasons shows the distribution and the importance of the 20-m contour in respect to the near-shore migration route, regardless of the type of ice year.

Although the results of this work have provided a good understanding of the near-shore migration, there is also the strong possibility that some component of the population passes offshore in mid to late August, near the pack ice edge. Historical whaling catch records compiled by Townsend (1935) show that bowheads were taken offshore to 73°00' N in August in the western Beaufort Sea. More recent observations made by NFMFS in the western Chukchi in September of 1980 best support the possibility of an early offshore migration. This cooperative US-USSR bowhead whale survey was undertaken on board the MV Rasyashchiy from 20 September to 1 October. Bowheads were seen near the Soviet coast from 69° 30'N south to 67° 30'N (Marquette, 1981). These sightings were not only of individuals, but of large groups of 23 to 200 whales, seen on 20 and 21 September, respectively. Overall, 280 bowheads were seen from 19 September through 23 September in the western Chukchi Sea. When these sightings were made, we had not made any significant near-shore sightings in the Beaufort Sea that would account for the rather large numbers seen in the western Chukchi Sea. In accounting for the large number of bowheads present in the western Chukchi during September of 1980, two possibilities must be considered. The first is that a small resident stock of bowheads could migrate from the Bering Sea into the Chukchi Sea in the mid to late summer months. This possibility is highly unlikely, considering that very few sightings have been reported in these areas during the summer period. The second possibility, is that early offshore migration occurs from the Mackenzie Delta area through the Beaufort Sea as early as August. Considering that it is approximately 1000 nmi from the Mackenzie Delta to the western Chukchi, where these sightings were made 20 September 1980, the whales would be required to leave the Mackenzie Delta area by 7 September and swim at an average speed of 3.0 kt for a period of 13 days to arrive in the sighting area by 20 September. Based on observations of bowhead behavior and swimming speeds in light ice conditions (such as were present in August), this estimate of swimming speed is most likely high. It is more realistic to consider that they proceeded west in August at speeds of less than 1.0 kt and passed through the Beaufort Sea

offshore and nearer the pack ice edge. Our overall near-shore sightings for July and August during 1979-81 account for five bowheads.

Since our present objective is to define the distribution and occurrence of bowheads whales in or near the coastal proposed lease areas, it is impossible to direct much effort to the offshore areas. The question of an offshore migration component needs to be answered. This will require a joint survey effort, synchronized to look at both the near-shore and offshore distribution during the fall migration. At present we can only assume that we are looking at the near-shore component of the overall migration.

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APPENDIX A

AERIAL SURVEY FLIGHT RESULTS

This appendix consists of flight tracks 1 through 126, which cover surveys in the northern Bering Sea, the Chukchi Sea, and the Beaufort Sea during the period mid-April to mid-October 1981. Flight tracks and sighting information are not included for flights made in the Beaufort Sea in support of the ringed seal surveys conducted by Alaska Fish and Game (Burns et al. 1981).

Table A-1 summarizes aircraft survey efforts. Table A-2 summarizes marine mammal sightings by species and season. Table A-3 summarizes survey effort and sightings for the entire study period by flight.

Each flight is represented by a flight track/sighting chart and a descriptive caption. Each symbol on the flight track/sighting charts represents one sighting (one or more animals). The flight track captions also describe the general ice conditions observed.

The study area included the Beaufort Sea Federal Sale 71 and the Joint State-Federal proposed oil lease areas. Aircraft speed averaged 222 to 259 km/hr (120 to 140 kt) and altitude varied, depending upon the weather, from 30 to 549 m, with the average in the range of 122 to 183 m.

Table A-1. Number of marine mammals sighted by season.

SEASON	SPRING	SUMMER	FALL	TOTAL
Bowhead Whale	1222	2	171	1395
Beluga Whale	1775	382		2157
Gray Whale	153	393		546
Killer Whale	16	1		17
Fin Whale		5		5
Minke Whale		3		3
Dall's Porpoise	15			15
Unidentified Cetacean	4	6		10
Ringed Seal	270	139	139	548
Bearded Seal	161	41	17	219
Spotted Seal	8	127		135
Walrus	17305	3683		20988
Steller Sea Lion	396			396
Unidentified Pinniped	58	51	1	110
Polar Bear	17		43	60

Table A-2. Flight and sighting summary, by flight.

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBLOOY SUBJECT	SIGHTINGS											
					Bowhead whale	Gray whale	Beluga whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Seared Seal	Unidentified	Printed	Walrus	Polar Bear	OTHER
SPRING																
April 5	1	None	Transit ANC-None	-											1	
6	2	None	Search Bering Sts.	BH/Bearing St.	11	167				3	15	7			4	3
7	3	None	Block A	-		4					13				13	
8	WTHR	None	-	-												
9	WTHR	None	-	-												
10	4	None	Search St. Law. Is.	-	1					31	3				241	
11	5	None	Search Bering Sts.	BH/Bearing St.	35	134				2	2				4	1
12	6	None	Search St. Law. Is.	BH/St. Law. Is.	53	145				9	36				308	
13	7	None	Block P	BH/St. Law. Is.	80	71				6	10				495	
14	8	None	Search St. Law. Is.	BH/St. Law. Is.	74	87					15				824	TR
15	9	None	Search Bering Sts.	BH/St. Law. Is.	68	114					19				129	1
16	10	None	Block A	BS/Norton S.							1				10	
17	11	None	Search Bering Sts.	BH/St. Law. Is.	332	79					1				415	
18	12	None	Search St. Law Is.	BH/St. Law. Is.	97	57				3					559	
19	13	None	Search Bering St.	BH/St. Law. Is.	90	51									198	

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Mattus	Polar Bear	OTHER
April	20	Nome	Search St. Law. Is.	BH/St. Law. Is.	67	111					4		1634		
	21	Nome	Transit Nome-Anc.	-		17					3				
	22	Maint.	-	-											
	23	Nome	Transit ANC-Nome	-											
	24	Nome	Coastal Nome-DH	BH/Bering St.	28	213					4			2	
	25	Deadhorse	Search DH-Pt. Barrow	BH/Beaufort	12	6			15		5		1	3	
	26	WTHR	Deadhorse	-	-										
	27	WTHR	Deadhorse	-	-						1				
	28	19	Deadhorse	Search DH-Pt. Barrow	-										
	29	20	Deadhorse	Search DH-Pt. Barrow	-	14									
May	1	21	Deadhorse	Search DH-Pt. Barrow	-										
	2	22	Deadhorse	Search Beaufort Sea	BH/Beaufort	110	178				1				
2	WTHR	Deadhorse	-	-											
3	WTHR	Deadhorse	-	-											
4	23	Deadhorse	Search Barter Is.-Pt. B.	-	16										
5	24	Deadhorse	Search DH-Pt. Barrow	BH/Harrison	7										

Legend: BH bowhead
 BS bearded seal
 GW gray whale
 BE beluga whale
 ME minke
 FW fin whale
 D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Walrus	Polar Bear	OTHER
May 6	25	Deadhorse	Search DH-Pt. Barrow	-	3	72				3	3				
7	26	Deadhorse	Search DH-Herschel Is.	-	2										
8	WTHR	Deadhorse	-	-											
9	27	Deadhorse	Search DH-Pt. Barrow	-	9	7				1	1			1	
10	28	Deadhorse	Search DH-Pt. Barrow	-		2								1	
11	WTHR	Deadhorse	-	-											
12	WTHR	Deadhorse	-	-											
13	29	Deadhorse	Search DH-Pt. Barrow	-	5	116			3					4	
14	30	Deadhorse	Search Beaufort Sea	-		23			10		1				
15	31	Deadhorse	Search Beaufort Sea	-					8	1				1	
16	32	Nome	Coastal DH-Nome	-	8	79			94	34			43	1	
17	33	Nome	Block A	-		5						56	1124		
18	WTHR	Nome	-	-											
19	34	Nome	Flight of Op.	-	1	42						1	1545		
20	35	Nome	Block C	Orca/GW/ St. Lawrence Is.	56					2			3040		16 Orca
21	WTHR	Nome	-	-											

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS											
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacean	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Mattus	Polar Bear	OTHER	
SUMMER June 1 2-9 10 11 12 13 14 15 16	May 22	Nome	Block B	-	32									1000		
	23	Nome	-	-												
	24	Nome	Coastal Nome-ANC	-	11	4	4	8	51					4015		393 Sea Lion
	25-29	Maint	Anchorage	-												
	30	Nome	Coastal ANC-Nome	-	7	4	4	8						2004		15 Dall
	31	Nome	Block D	-										6		
	40	Nome	Coastal Nome-DH	-				8	103					7		
	41-49	Deadhorse	Ringed Seal Survey	-												
	50	Nome	Coastal DH-Nome	-	15	14		20	12	3	1	2126				
	51	Nome	Block G	-	5			9			2	4				
	52	Nome	Block F	-	91				1	1	2	114				
	53	Nome	-	-	-									6		
54	Nome	Block P	-	-	3											
55	Nome	Block J	-	-			99	11	3	25	5	9				
		Kotzebue	Block L	-	2	37		35	5	3	6	46				

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS												
					Bonhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Mattus	Polar Bear	OTHER		
June 17	56	Kotzebue	Block K	-				42					1	2/1D	6		
18	57	Nome	Block Q	-	1												
19	WTHR	Nome	-	-													
20	WTHR	Nome	-	-													
21	58	Nome	Block E	-	34		2								2		
22	59	Nome	Coastal Norton S.	-			12						2		2		
23-28	Maint	Anchorage	-	-													
29	60	Nome	Transit ANC-Nome	-													
30	61	Nome	Block O	-	1												
July 1	WTHR	Nome	-	-													
2	62	Nome	Block F	Orca	8		2								130		1 Orca
3	63	Nome	Block C	GW/St. Law. Is.	35										4/52D		
4	WTHR	Nome	-	-													
5	WTHR	Nome	-	-													
6	64	Nome	Block B	-			10	2					2			180	1 Skeleton/1 Carcass
7	65	Nome	Coastal Nome-Kotz	-	4		3								179D	4 Carcass	

Legend: BH
BS
GW
BE
ME
FW
D

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Walrus	Polar Bear	OTHER
July 8	66	Kotzebue	Coastal Kotz-Pt. Lay	GM Feeding/ Pt. Hope	29	1/330						6	1140		
9	WTHR	Kotzebue	-	-											
10	67	Kotzebue	Block H (CNX)	-	1							1	40		3 Carcass
11	WTHR	Nome	-	-											
12	68	Nome	Block A	BE Feeding											
13	WTHR	Nome	-	-											
14	WTHR	Nome	-	-											
15	69	Nome	Block D	ME/FW/Sledge Is.											
16	WTHR	Nome	-	-											
17	WTHR	Nome	-	-											
18	WTHR	Nome	-	-											
19	WTHR	Nome	-	-											
20	70	Nome	Block G (CNX)	-	2										
21	WTHR	Nome	-	-											
22	71	Nome	Demonstration	GW/Bering Sea	3	10								30	50

Legend: BH bowhead
 BS bearded seal
 GW gray whale
 BE beluga whale
 ME minke
 FW fin whale
 D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetaceae	Sporad Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Mattus	Polar Bear	OTHER
July 23	72	Nome	Demonstration	-	34								2	10	3 Carcasses
23	73	Nome	Coastal Nome-Kotz	-	10								14	3/50	3 Fin
24	74	Kotzebue	Block I	GW Feeding/ Geo boat	36										
25	75	Kotzebue	Coastal Kotz-DH	-	34	1/10				1			1	1350/ 260	1 Carcass
26	WTHR	Nome	-	-											
27	WTHR	Nome	-	-											
28	WTHR	Nome	-	-											
29	76	Nome	Special Block	-											1 Carcass
30	WTHR	Nome	-	-											
31	WTHR	Nome	-	-											
Aug 1	77	Nome	Transit Nome-ANC	-											
2-14	Maint/Other Project	Anchorage	-	-											
15	78	Deadhorse	Search, DH-Mackenzie Bay	-											1
16	WTHR	Deadhorse	-	-											

D = Dead

Legend:

BH	bowhead
BS	bearded seal
GW	gray whale
BE	beluga whale
ME	minke
FW	fin whale
D	dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Beluga Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Mattus	Polar Bear	OTHER
Aug 17	79	Deadhorse	Search DH-Mackenzie Bay	-	2		45								
18	80	Deadhorse	Search DH-Barter Is.	-											
19	81	Deadhorse	Search DH-Barter Is.	-											
20	82	Deadhorse	Search DH-Pt. Barrow	-						5			1		
21	WTHR	Deadhorse		-									10		
22	83	Deadhorse	Search Beaufort Sea	-			26								
23	WTHR	Deadhorse	-	-											
24	84	Deadhorse	Coastal DH-Nome	-		6				6	9				
25	WTHR	Nome	-	-											
26	85	Nome	Block A	-											
27	86	Nome	Special Block	-		34						1			
28	87	Nome	Block G & H	-		5/2D		1				2	19D		
29	88	Nome	Block P	-		10						1	3/1D		
30	89	Nome	Coastal Nome-DH	-			40			3		4	3D		2 Carcass
31	WTHR	Deadhorse	-	-											

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS									
					Bowhead whale	Gray whale	Beluga whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified pinniped	Walrus	Polar Bear
AUTUMN Sept	1	Deadhorse	Transit DH-INUVIK	-	1					1				
	2	Deadhorse	Coastal INUVIK-DH	-						4	1			
	3	Deadhorse	-	-										
	4	Deadhorse	Search, DH-Barter Is.	-										
	5	Deadhorse	State/Fed Lease Area	-										
	6	Deadhorse	-	-										
	7	Deadhorse	Search, Barter Is.	BH/Barter Is.	5									
	8	Deadhorse	Transit, DH-ANC	-										
	9 & 10	Anchorage	-	-										
	11	Deadhorse	Transit, ANC-DH	-										
	12	Deadhorse	Barter Is./Federal Lease Area	BH/Barter Is.	11					4	4			
	13	Deadhorse	State/Federal Lease Area	-						3	2			
	14	Deadhorse	Search Herschel Is.	BH/Geo boat	15									2
	15	Deadhorse	-	-										

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS										
					Bowhead Whale	Gray Whale	Unidentified Cetacea	Spotted Seal	Ringed Seal	Bearded Seal	Unidentified Pinniped	Walrus	Polar Bear	OTHER	
Sept 16	101	Deadhorse	Search Herschel Is.	BH/Herschel Is.	2										
17	102	Deadhorse	Search Herschel Is.	BH/Herschel Is.	11										
18	103	Deadhorse	Search Demarcation	Geo boats											
19	WTHR	Deadhorse	-	-											
20	104	Deadhorse	Behavior Study	BH/Beaufort Sea	38						3				
21	105	Deadhorse	Behavior Study	BH/Beaufort Sea	3										
22	106/107	Deadhorse	Behavior Study	BH/Beaufort Sea	8									2	
23	108/109	Deadhorse	Federal Lease Area	-											
24	Maint	Anchorage	-	-											
25	Maint	Anchorage	-	-											
26	110/111	Deadhorse	Federal Lease Area	-											
27	WTHR	Deadhorse	-	-											
28	112/113	Deadhorse	State-Fed Lease Area Behavior Study	BH/Beaufort Sea	14										
29	114	Deadhorse	State-Fed Lease Area	BH/Baufort Sea	17										
30	WTHR	Deadhorse	-	-											

Legend: BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

Table A-2. (Continued)

DATE	FLIGHT NO.	BASE OF OPERATIONS	FLIGHT EFFORT	SONOBUOY SUBJECT	SIGHTINGS									
					Bowhead whale	Gray whale	Beluga whale	Unidentified Cetacean	Spotted Seal	Ring Seal	Bearded Seal	Unidentified Pinniped	Walrus	Polar Bear
Oct 1	115	Deadhorse	State-Fed Lease Area	BH/Beaufort Sea	2							1		
2	116	Deadhorse	Behavior Study	BH/Beaufort Sea	12									
3	117	Deadhorse	State-Fed Lease Area	-	5				32	6				
4	WTNR	Deadhorse	-	-										
5	118	Deadhorse	Behavior Study	BH/Beaufort Sea	7									
6	119	Deadhorse	State-Fed Lease Area	BH/Beaufort Sea	3				68					3
7	120	Deadhorse	Behavior Study	BH/Beaufort Sea	5									
8	WTNR	Deadhorse	-	-										
9	121	Deadhorse	Search	-	6				6	1	6			23
10	122	Deadhorse	State-Fed Lease Area	-	2				7					
11	123	Deadhorse	Search Beaufort Sea	-	2				5					12
12	WTNR	Deadhorse	-	-										
13	WTNR	Deadhorse	-	-										
14	124	Deadhorse	Federal Lease Area State-Fed Lease Area	BH/Beaufort Sea					2					
15	125	Deadhorse	Federal Lease Area	BH/Beaufort Sea	5				7					1
16	WTNR	Deadhorse	-	-										2WT
17	126	Deadhorse	Transit DH-ANC	-										

Legend:

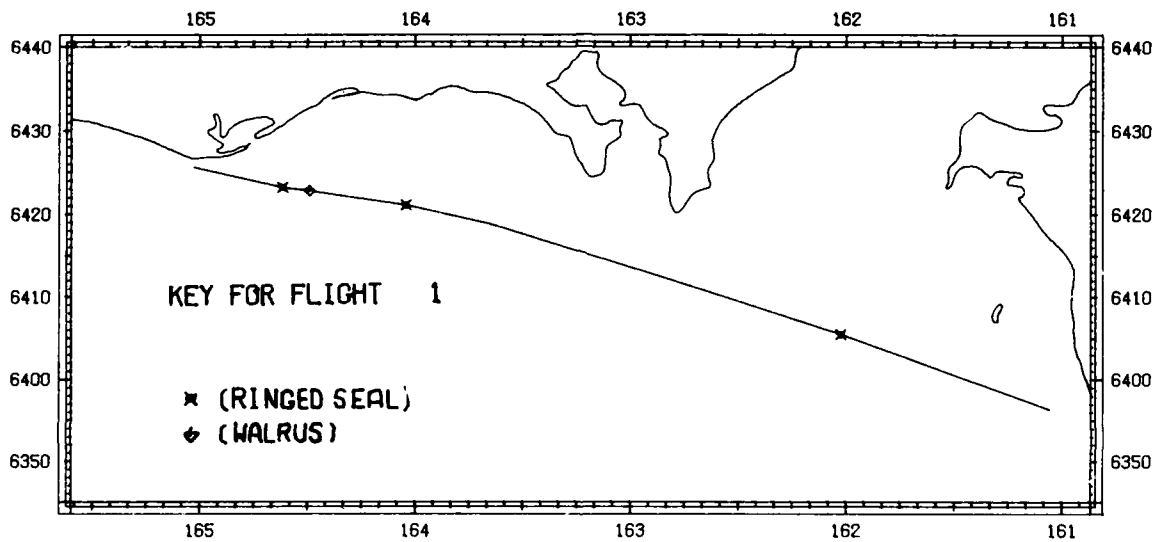
BH bowhead
BS bearded seal
GW gray whale
BE beluga whale
ME minke
FW fin whale
D dead

No Bowhead Sightings for Flight 1, April 5, 1981

FLIGHT TRACKS AND CAPTIONS

FLIGHT NUMBER 1, APRIL 5, 1981

Flight was a transit from Anchorage to Nome and included a short transect of Norton Sound. Weather was clear and ice conditions were 9/10 to 10/10 grease and pan ice. Three ringed seals and 1 walrus were sighted.

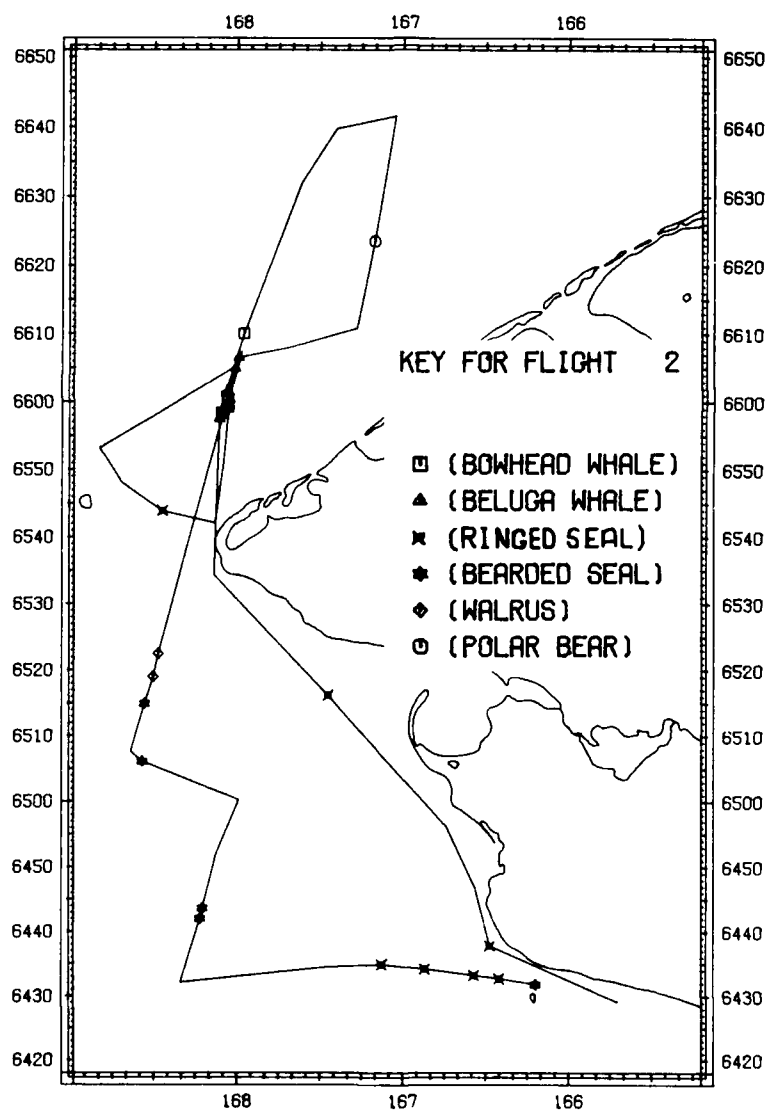


Bowhead Whale Sightings for Flight 2, April 6, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
3	168 05.7	65 58.4	305	9/10	B1	swimming
6	168 03.6	66 00.8	305	0/0	B1	social
1	168 03.3	65 59.3	305	0/0	B1	
1	167 57.6	66 10.0	305	9/10	B1	size 45 ft

FLIGHT NUMBER 2, APRIL 6, 1981

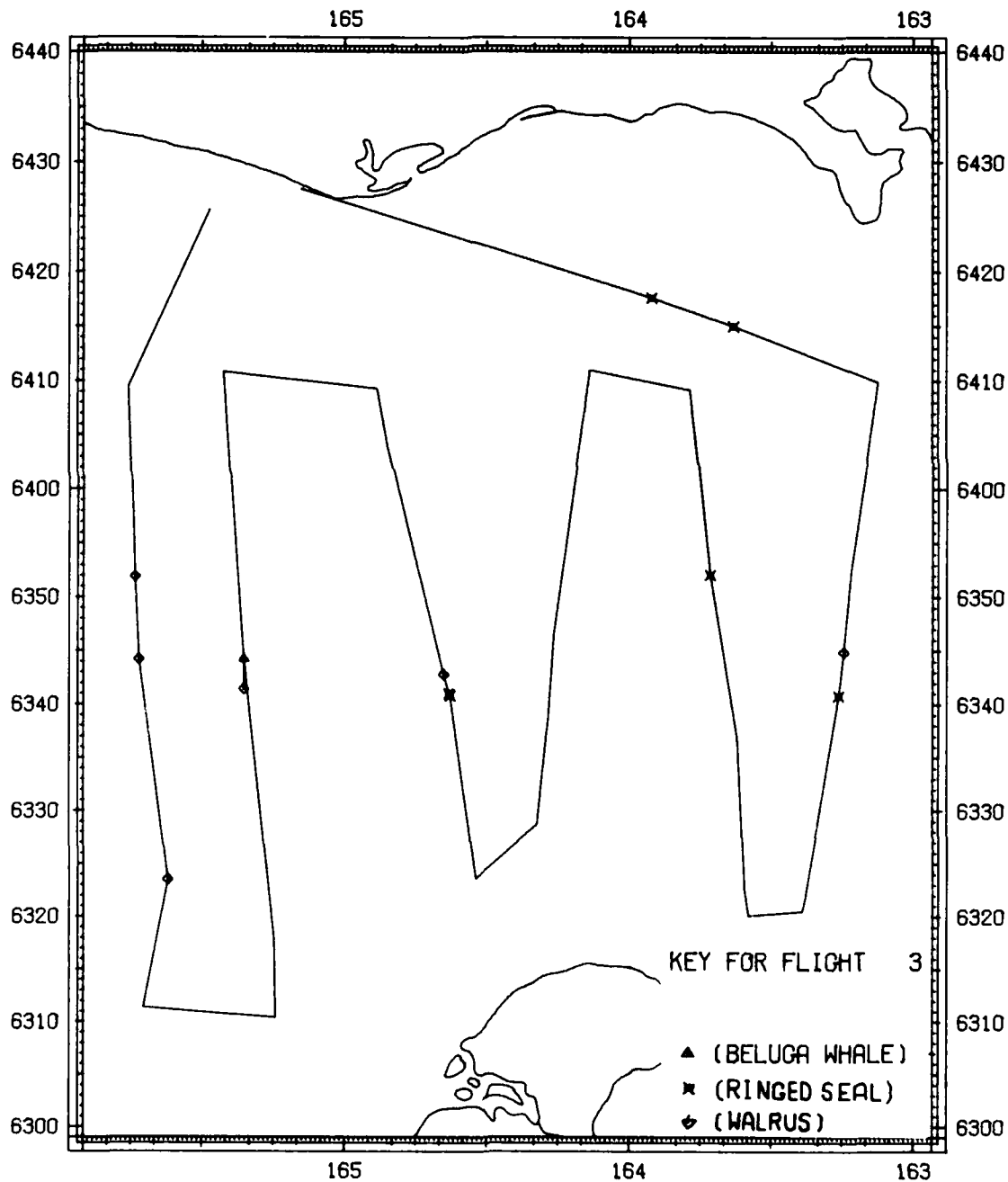
Flight was a search to and through the Bering Strait to determine ice coverage and presence of whales. The weather was partly foggy and ice coverage was 9/10 pack. Eleven bowheads were sighted north of Cape Prince of Wales. One hundred and sixty-seven beluga, including cow-calf pairs, and 15 ringed seals including cow-pup pairs were sighted in addition to 7 bearded seals, 4 walrus, and 3 polar bears. One sonobuoy was dropped.



No Bowhead Sightings for Flight 3, April 7, 1981

FLIGHT NUMBER 3, APRIL 7, 1981

Flight was a block transect survey of Norton Sound. The weather was overcast and sea state Beaufort 1. Ice conditions were reduced in some places to as little as 3/0 coverage by easterly winds, currents or water temperature. Four beluga whales, including 1 young, 13 walrus, and 13 ringed seals were sighted.

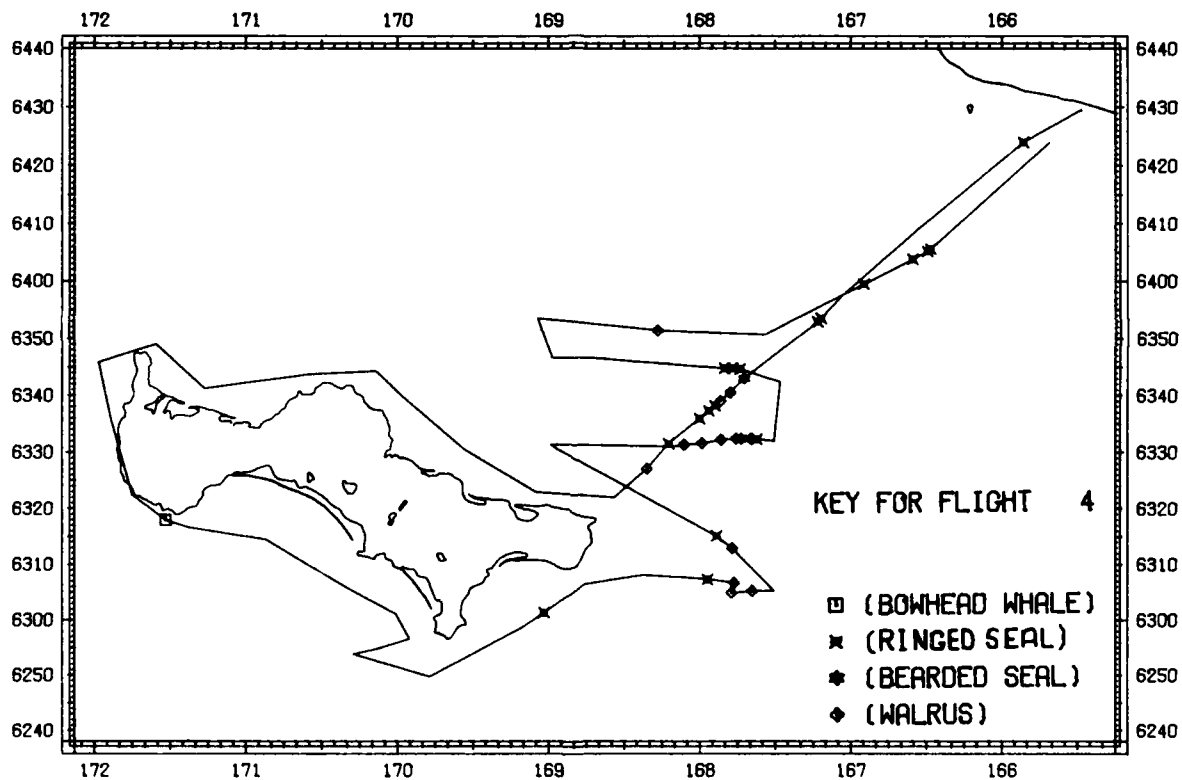


Bowhead Whale Sightings for Flight 4, April 10, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	171 31.8	63 17.9	213	8/10 B1	dove under ice

FLIGHT NUMBER 4, APRIL 10, 1981

Flight was a search around St. Lawrence Island and a partial transect survey east of the island to determine ice coverage and presence of whales. The weather was stormy and ice coverage nearly 10/10 except for a lead system between the island shorefast ice and the pack ice. One bowhead was sighted, heading north, southwest of St. Lawrence Island. Thirty-one ringed seals, including a pup, 241 walrus, and 3 bearded seals were also sighted.

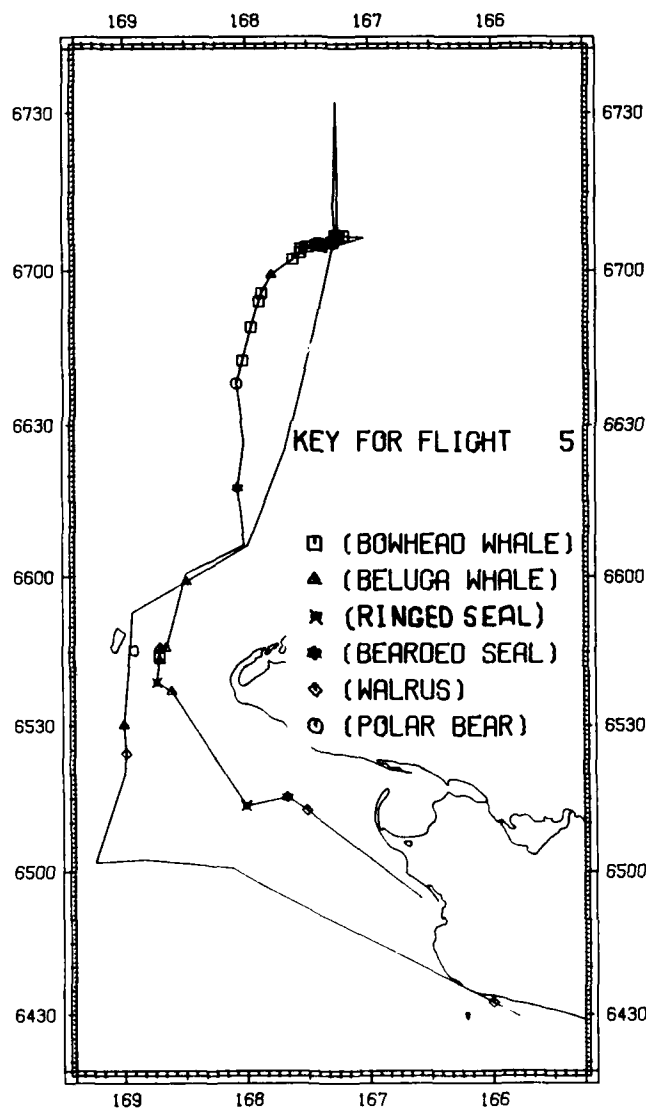


Bowhead Whale Sightings for Flight 5, April 11, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
9	167 11.7	67 06.6	335	9/10 B1	40 ft, social
2	167 14.6	67 06.2	305	9/10 B1	
2	167 15.8	67 06.7	762	9/10 B1	
4	167 17.3	67 05.3	152	9/10 B1	social
2	167 12.5	67 06.0	152	9/10 B1	
1	167 23.4	67 05.1	152	9/10 B1	
1	167 25.0	67 04.8	213	9/10 B1	
1	167 29.6	67 04.5	244	9/10 B1	
1	167 33.0	67 04.1	244	9/10 B1	
3	167 33.2	67 03.4	274	9/10 B1	30 ft social
1	167 36.9	67 02.1	305	9/10 B1	
2	167 52.4	66 55.6	366	9/10 B1	
2	167 53.7	66 53.9	335	9/10 B1	
2	167 57.2	66 49.0	335	9/10 B1	
2	168 01.5	66 42.5	366	9/10 B1	
2	168 42.1	65 43.8	305	9/10 B1	45 ft, swimming

FLIGHT NUMBER 5, APRIL 11, 1981

Flight was a search north of the Bering Strait to check the bowhead migration. The weather was overcast, and ice coverage was 8/10 pack. Thirty-five bowheads were sighted just north of the 67°N latitude line. They were in small leads with solid ice coverage north of them preventing further migration. One hundred and thirty-four belugas, 4 walrus, 2 ringed and 2 bearded seals, and 1 polar bear were also sighted.

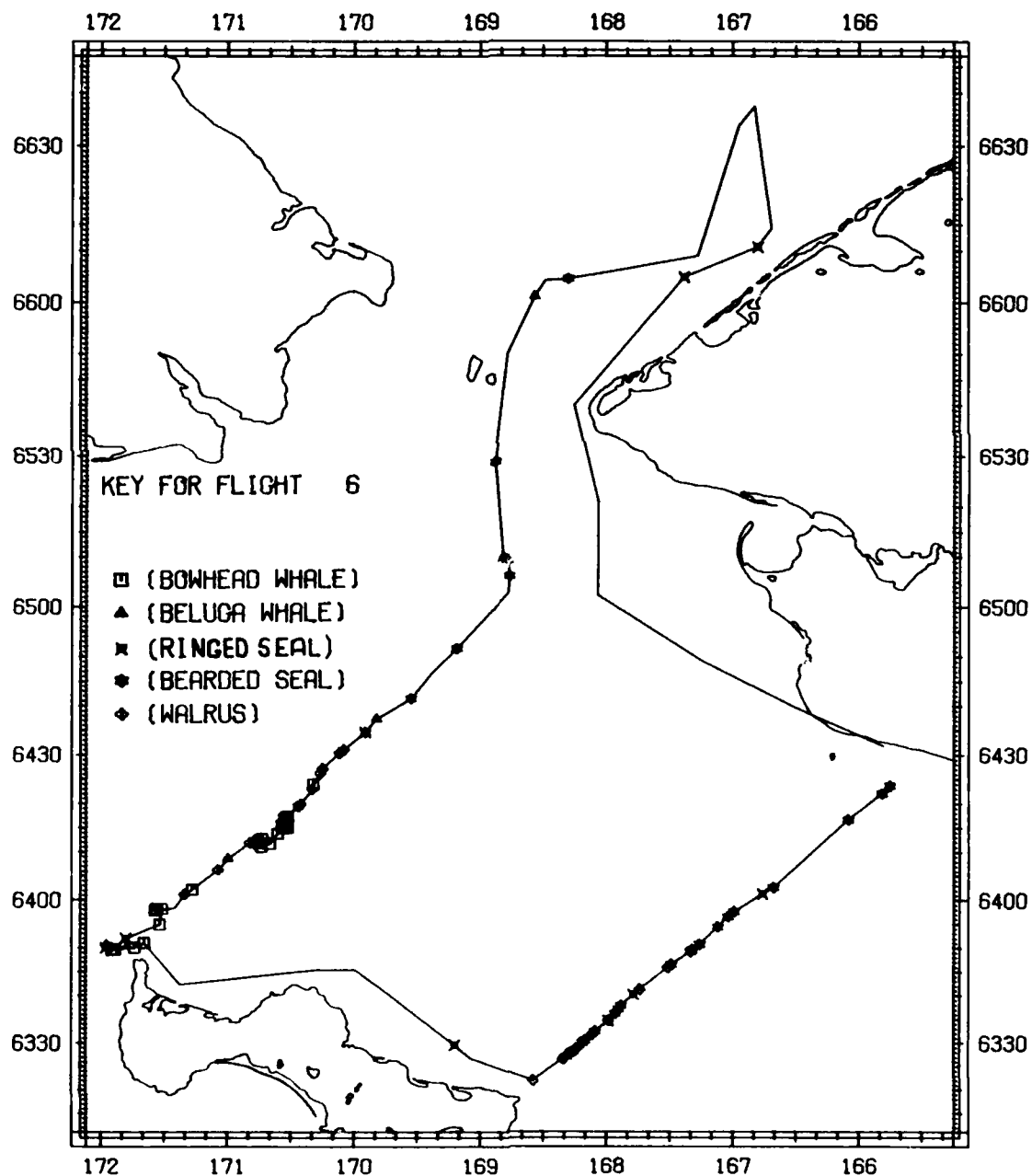


Bowhead Whale Sightings for Flight 6, April 12, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	171 39.4	63 51.0	122	0/0 B1	
1	171 44.0	63 50.0	122	0/0 B1	spy hop
1	171 53.3	63 49.6	122	0/0 B5	
3	171 53.6	63 49.7	122	0/0 B5	social
2	171 54.6	63 49.5	91	0/0 B5	mating
2	171 32.0	63 54.9	122	0/0 B5	
2	171 31.0	63 58.2	152	0/0 B5	
2	171 33.5	63 58.2	152	0/0 B5	
5	171 34.3	63 57.8	152	0/0 B5	milling
3	171 16.6	64 02.2	305	0/0 B5	40 ft, mating
3	170 43.4	64 12.7	152	0/0 B5	resting
1	170 44.8	64 1.18	91	0/0 B5	50 ft, resting
1	170 43.9	64 11.1	91	0/0 B5	30 ft
3	170 39.7	64 11.7	91	0/0 B5	50 ft, social
3	170 36.0	64 13.8	91	0/0 B5	social
4	170 33.1	64 15.0	91	0/0 B5	40 ft, social
2	170 32.7	64 15.6	91	0/0 B5	40 ft
2	170 31.2	64 15.0	91	0/0 B5	40 ft
1	170 34.1	64 15.5	91	0/0 B5	
4	170 32.9	64 16.8	91	0/0 B5	resting, social
3	170 31.8	64 17.2	91	0/0 B5	social
3	170 31.3	64 17.3	91	0/0 B5	social
1	170 19.0	64 24.0	91	0/0 B5	

FLIGHT NUMBER 6, APRIL 12, 1981

Flight was a search north of St. Lawrence Island and through the Bering Strait to determine distribution of bowhead whales. The weather was partly cloudy, ice coverage was 9/10 pack. Fifty-three bowheads were sighted north of St. Lawrence Island. Some social behavior was noted. One hundred and forty-five belugas, 36 bearded seals, 9 ringed seals, and 308 walrus were also sighted. One sonobuoy was dropped.

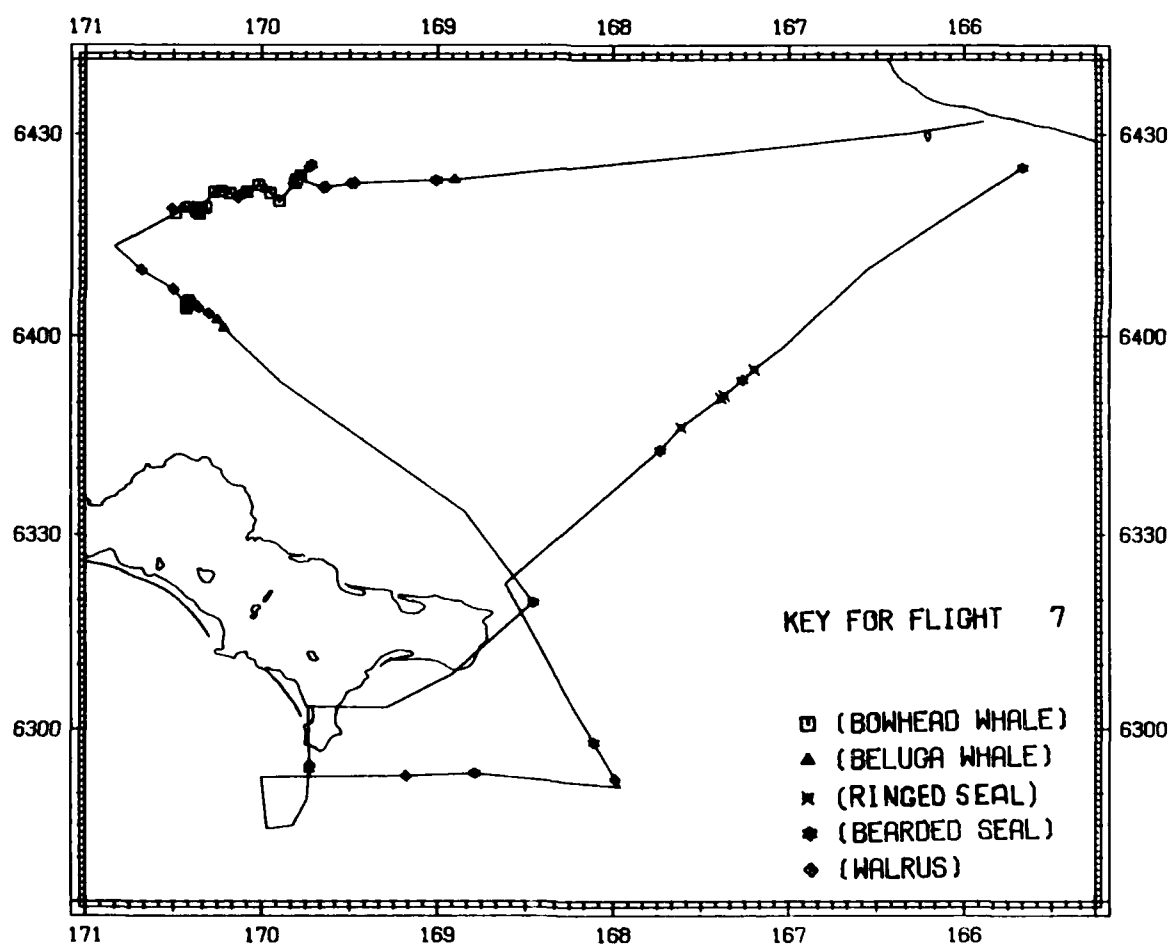


Bowhead Whale Sightings for Flight 7, April 13, 1981

No of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	170 24.9	64 05.3	305	8/10 B1	resting
1	170 25.6	64 04.4	305	8/10 B1	40 ft
2	170 25.4	64 04.1	152	8/10 B1	spy hop
2	170 25.3	64 04.6	152	8/10 B1	
2	170 29.4	64 18.3	305	9/10 B1	35 ft, breaching
10	170 24.8	64 19.2	152	9/10 B1	mating
22	170 19.0	64 19.2	152	9/10 B1	mating, spy hop
4	170 21.8	64 19.1	518	9/10 B1	40 ft
17	170 21.3	64 18.2	366	9/10 B1	social
1	170 25.5	64 18.5	305	9/10 B1	
5	170 16.3	64 21.5	305	9/10 B1	milling
3	170 13.7	64 21.6	305	9/10 B1	milling
6	170 10.9	64 21.3	305	9/10 B1	social
2	170 05.1	64 21.5	305	9/10 B1	
1	170 01.1	64 22.5	305	9/10 B1	
5	169 57.1	64 21.3	305	9/10 B1	social
2	169 54.0	64 20.1	305	9/10 B1	
2	169 48.7	64 22.8	305	9/10 B1	
3	169 48.2	64 23.3	305	9/10 B1	social
1	169 46.9	64 23.9	305	9/10 B1	

FLIGHT NUMBER 7, APRIL 13, 1981

Flight was a search to check the distribution and behavior of bowhead whales sighted previously north of St. Lawrence Island. The weather was patchy fog, so a preplanned transect survey south of the island was discontinued due to low visibility. Eighty bowheads were sighted in a lead in 9/10 ice coverage. Solid ice was noted from 10 km north of their location all the way to the Bering Strait. Obvious social behavior was observed. Seventy-one belugas, 10 bearded seals, 6 ringed seals, and 495 walrus were also sighted. One sonobuoy was dropped.



Bowhead Whale Sightings for Flight 8, April 14, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
3	169 59.6	64 20.0	122	9/10 B1	45 ft, waiting
15	170 13.2	64 29.2	183	8/10 B1	45-50 ft, social
8	170 13.5	64 30.9	152	8/10 B1	social
2	170 16.7	64 31.2	91	8/10 B1	social
2	170 14.8	64 31.4	91	8/10 B1	social
2	170 16.3	64 30.9	91	8/10 B1	social
2	170 17.8	64 31.3	91	8/10 B1	social
4	170 17.3	64 31.1	91	8/10 B1	social
5	170 14.7	64 31.4	91	8/10 B1	social
8	170 18.0	64 30.6	122	8/10 B1	social
4	170 16.2	64 30.8	122	8/10 B1	social
1	170 12.8	64 29.8	122	8/10 B1	swimming
1	170 12.9	64 29.9	122	8/10 B1	swimming
1	170 15.7	64 28.8	183	8/10 B1	
12	170 13.5	64 29.7	152	9/10 B1	social
8	170 14.4	64 29.7	152	9/10 B1	social
8	170 17.4	64 30.0	152	9/10 B1	social
4	170 09.3	64 30.2	152	8/10 B1	social
2	170 11.5	64 30.5	152	8/10 B1	
7	170 16.4	64 30.1	152	8/10 B1	social
3	170 05.3	64 29.5	152	8/10 B1	social
7	109 53.2	64 27.7	152	8/10 B1	social
1	169 48.7	64 28.1	152	9/10 B1	

AD-A126 542

AERIAL SURVEYS OF ENDANGERED WHALES IN THE BEAUFORT
CHUKCHI & NORTHERN BERING SEAS(U) NAVAL OCEAN SYSTEMS
CENTER SAN DIEGO, CA D K LJUNGBLAD ET AL. MAR 82

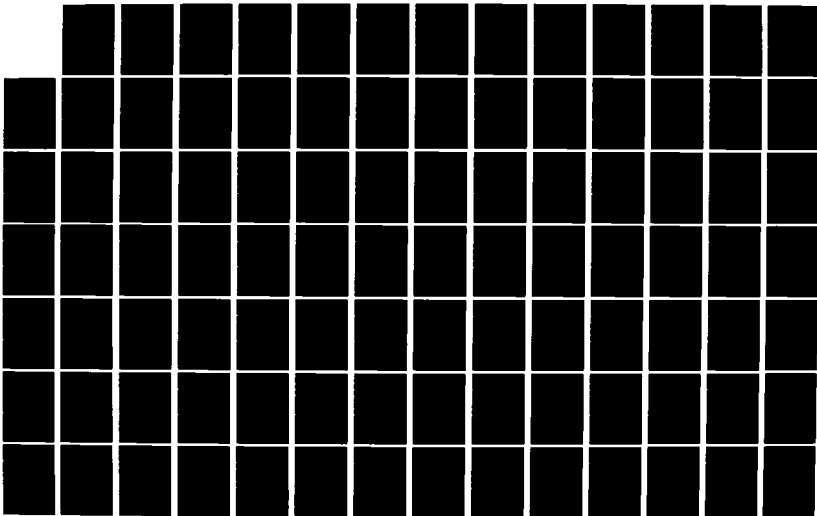
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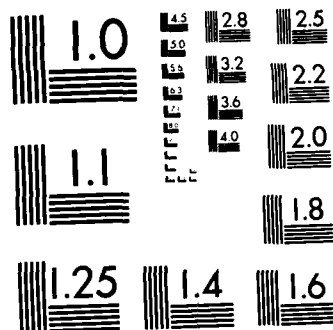
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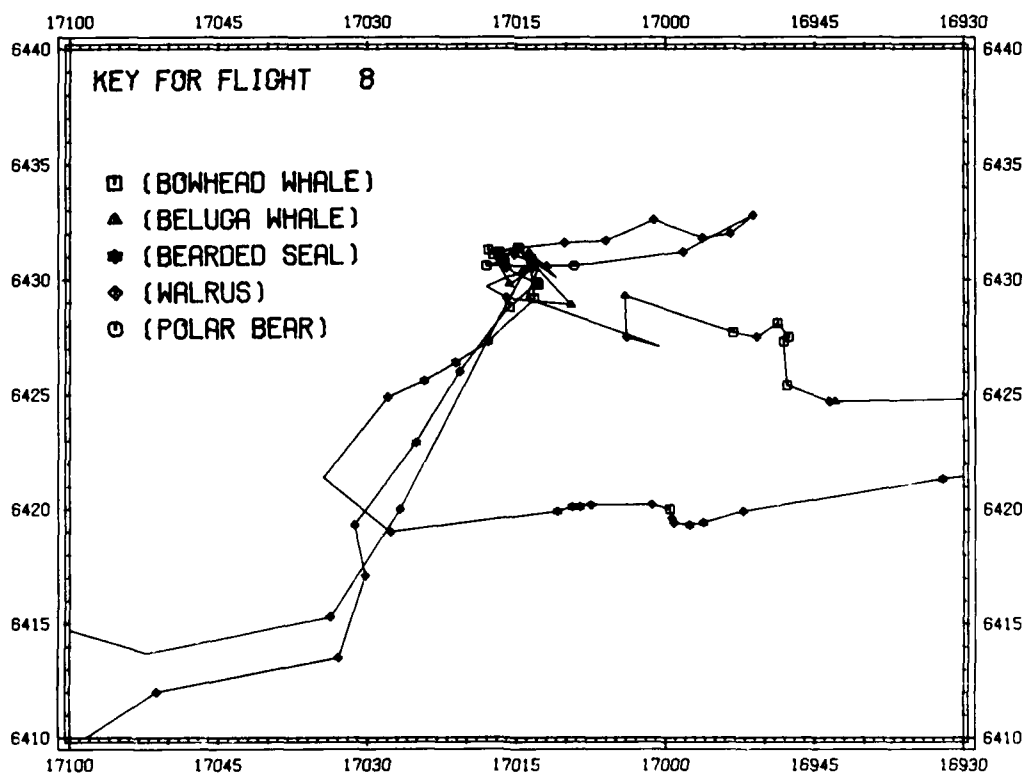
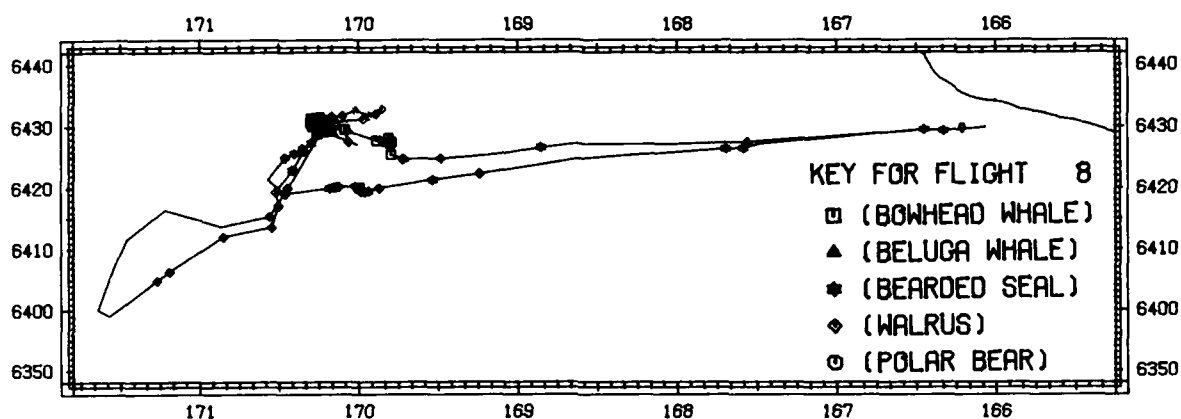
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Bowhead Whale Sightings for Flight 8, April 14, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	169 47.6	64 27.5	152	9/10 B1	
2	169 48.1	64 27.3	152	9/10 B1	
1	169 47.8	64 25.3	152	9/10 B1	

FLIGHT NUMBER 8, APRIL 14, 1981

Flight was a search to investigate distribution and behavior of bowheads sighted previously north of St. Lawrence Island. The weather was overcast, visibility was good. Ice coverage was 9/10 pack. Seventy-four bowheads were sighted in one lead, they were engaged in social behavior or resting. Eighty-seven belugas, 824 walrus, and 15 bearded seals were sighted. Polar bear tracks were noted. Two sonobuoys were dropped.



Bowhead Whale Sightings for Flight 9, April 15, 1981

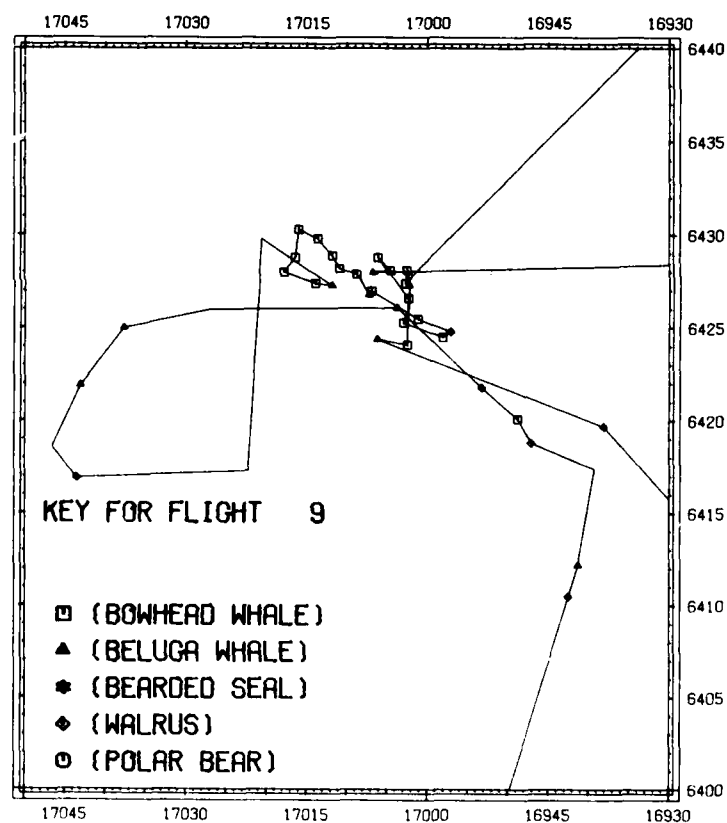
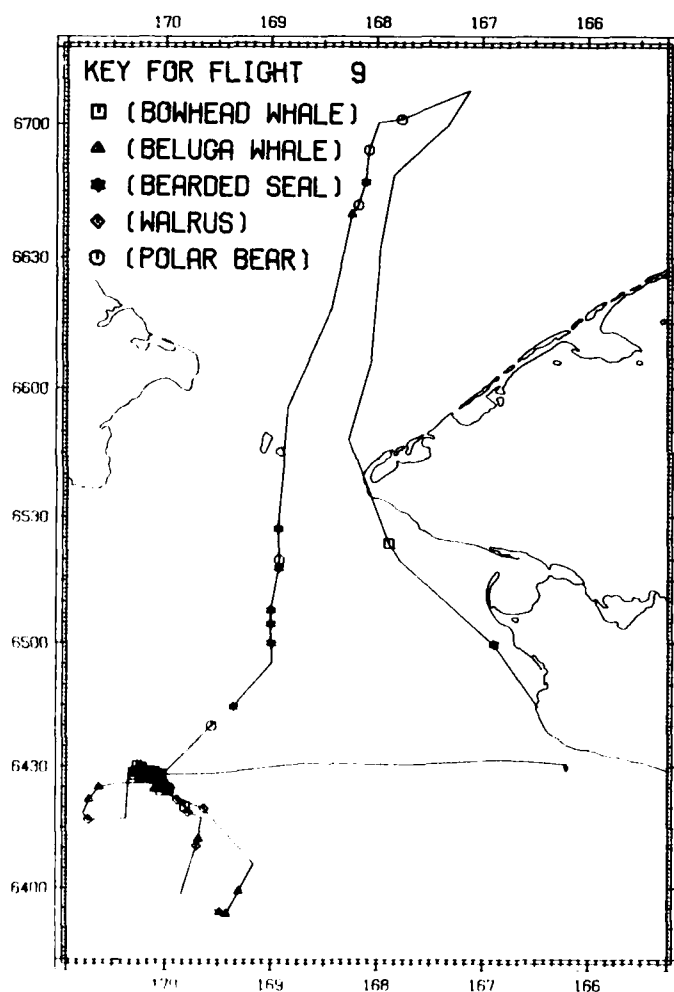
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	167 53.1	65 23.7	457	9/10 B1	35 ft, dove under ice
11	170 02.8	64 27.4	352	8/10 B1	social
6	170 02.5	64 28.1	213	8/10 B1	social
3	170 03.0	64 25.3	183	8/10 B1	social
5	169 58.1	64 24.5	183	8/10 B1	45 ft, social
1	170 01.2	64 25.5	183	8/10 B1	
2	170 07.0	64 27.0	213	8/10 B1	
1	170 08.0	64 27.9	305	8/10 B1	
7	170 10.9	64 28.2	305	8/10 B1	social
1	170 11.8	64 28.9	305	8/10 B1	
8	170 13.6	64 29.8	305	8/10	social
3	170 16.0	64 30.3	305	8/10 B1	social
10	170 16.4	64 28.8	305	8/10 B1	45 ft, group mating
6	170 17.8	64 28.0	305	8/10 B1	social
4	170 14.0	64 27.4	305	8/10 B1	social
3	169 57.0	64 24.2	305	7/10 B1	social
5	169 48.8	64 20.1	305	7/10 B1	social
3	169 57.7	64 24.5	305	9/10 B1	social
4	170 02.5	64 27.6	305	8/10 B1	social
5	170 10.0	64 28.9	305	8/10 B1	social
3	170 11.5	64 28.0	305	8/10 B1	social
3	170 02.5	64 24.1	305	8/10 B1	social, swimming
1	170 02.4	64 26.6	305	8/10 B1	

Bowhead Whale Sightings for Flight 9, April 15, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
4	170 06.1	64 28.8	305	8/10 B1	social
4	170 04.6	64 28.1	305	8/10 B1	social

FLIGHT NUMBER 9, APRIL 15, 1981

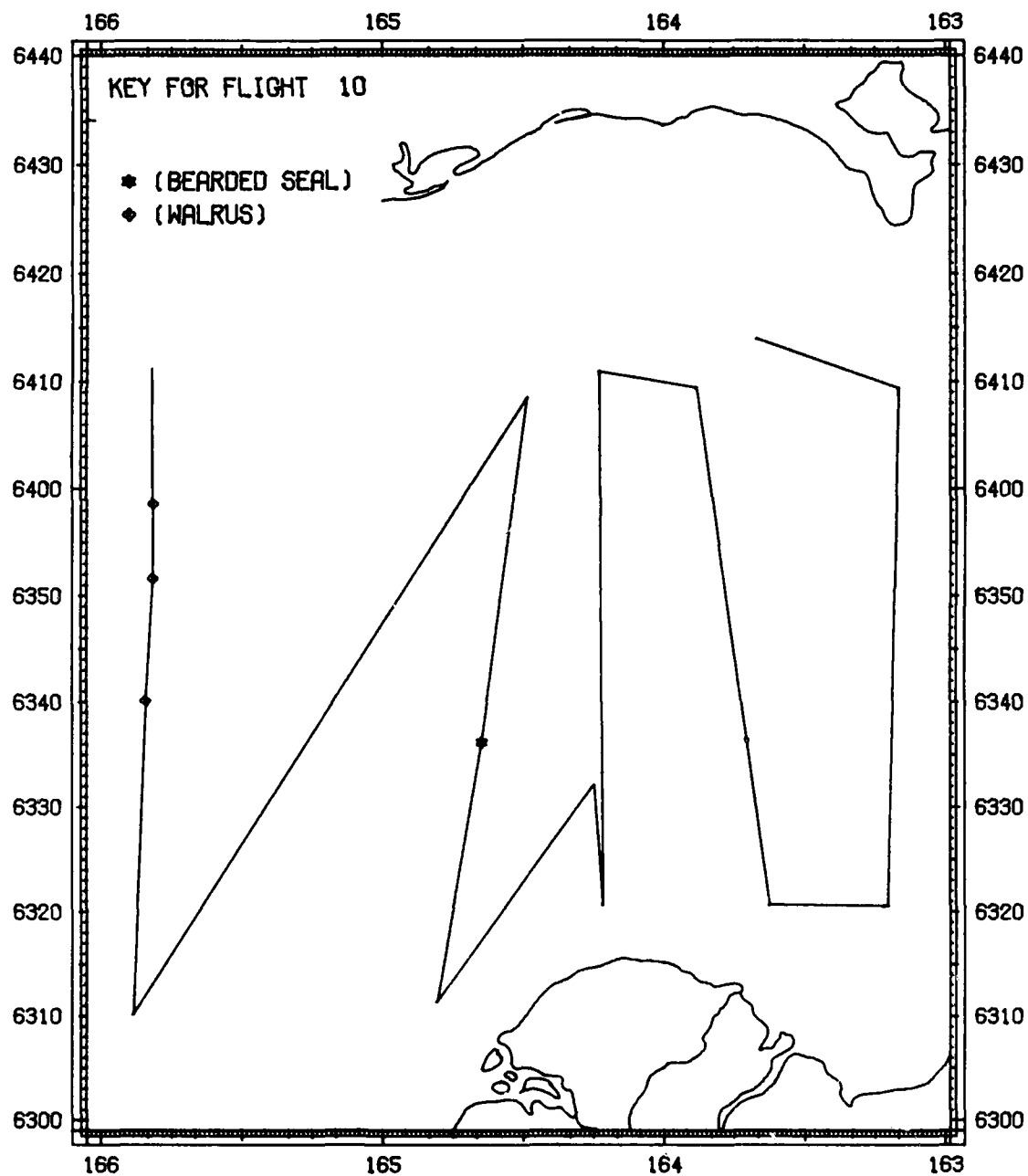
Flight was a search to look for migrating bowhead whales north of the Bering Strait and north of St. Lawrence Island. The weather was clear and visibility good. Ice coverage was 9/10 pack. Sixty-eight bowhead whales were sighted south of the solid pack ice north of St. Lawrence Island. One polar bear, 114 belugas, 19 bearded seals, and 129 walrus were also sighted. One sonobuoy was dropped.



No Bowhead Sightings for Flight 10, April 16, 1981

FLIGHT NUMBER 10, APRIL 16, 1981

Flight was a block transect of Norton Sound. The weather was partly cloudy, visibility was good. Ice cover varied from 9/10 grease and pan in shallow areas to open water. Ten walrus and one bearded seal were sighted and recorded by sonobuoy.

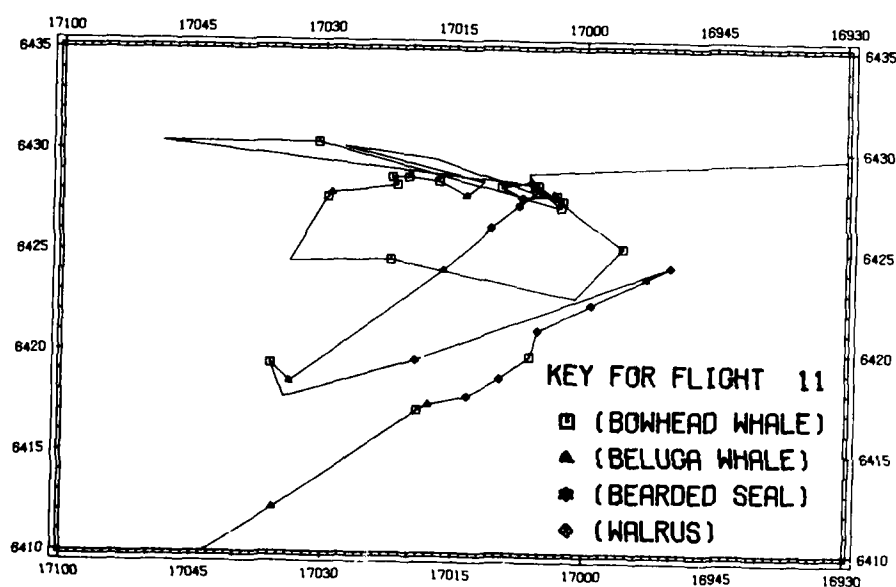
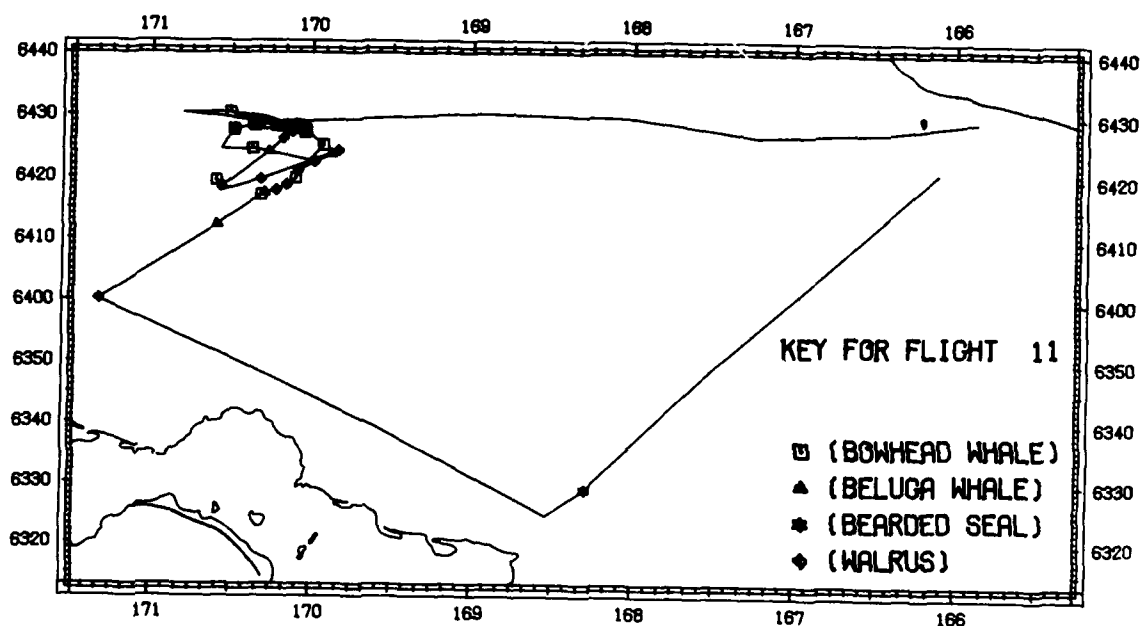


Bowhead Whale Sightings for Flight 11, April 17, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	170 19.2	64 17.1	305	9/10 B1	
2	170 06.3	64 19.8	305	9/10 B1	swimming
4	170 36.0	64 19.4	305	8/10 B1	resting, social
13	170 05.7	64 28.0	305	7/10 B1	social
7	170 02.6	64 27.5	305	7/10 B1	social
5	170 03.4	64 27.8	305	7/10 B1	social
13	170 09.7	64 28.2	305	7/10 B1	social
1	170 02.8	64 27.2	305	7/10 B1	
215	170 30.7	64 30.4	305	7/10 B1	social
30	170 05.5	64 28.3	305	7/10 B1	social
6	169 55.8	64 25.2	305	7/10 B1	social
2	170 22.4	64 24.6	305	8/10 B1	
8	170 29.6	64 27.7	305	8/10 B1	social
1	170 21.7	64 28.3	305	8/10 B1	
14	170 22.3	64 28.7	305	8/10 B1	social
5	170 20.4	64 28.7	305	8/10 B1	social
5	170 16.9	64 28.5	305	8/10 B1	social

FLIGHT NUMBER 11, APRIL 17, 1981

Flight was a search to check the location and activity of bowheads north of St. Lawrence Island. The weather was overcast and visibility was nearly unlimited. Ice coverage was 8/10 to 9/10. Three hundred and thirty-two bowheads were sighted in an east-west lead 1 km wide and 36 km long, 20 nmi NE of St. Lawrence Island. Seventy-nine belugas, 415 walrus, and 1 bearded seal were also sighted. Three sonobuoys were dropped.

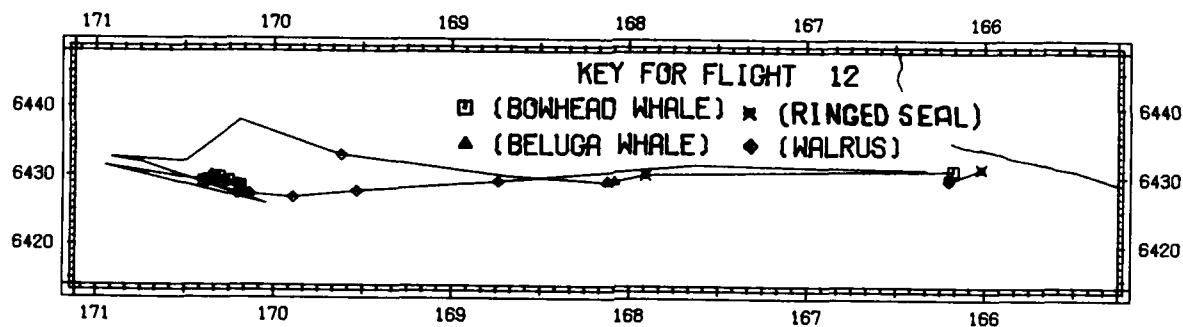


Bowhead Whale Sightings for Flight 12, April 18, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
7	170 23.7	64 29.2	610	7/10 B1	social
7	170 21.9	64 29.3	366	8/10 B1	social
10	170 18.4	64 29.8	305	8/10 B1	social
12	170 15.3	64 29.2	305	8/10 B1	social
60	170 11.4	64 28.5	305	8/10 B1	social
1	166 10.6	64 31.0	549	8/10 B1	45 ft, swimming

FLIGHT NUMBER 12, APRIL 18, 1981

Flight was a search to check the activity and location of bowheads north of St. Lawrence Island. The weather was overcast, visibility unlimited. Ice coverage was 9/10 pack. Ninety-six bowheads were sighted in one lead near St. Lawrence Island, and 1 bowhead was seen near Norton Sound. Fifty-seven belugas, 559 walrus, and 3 ringed seals were also sighted. One sonobuoy was dropped.

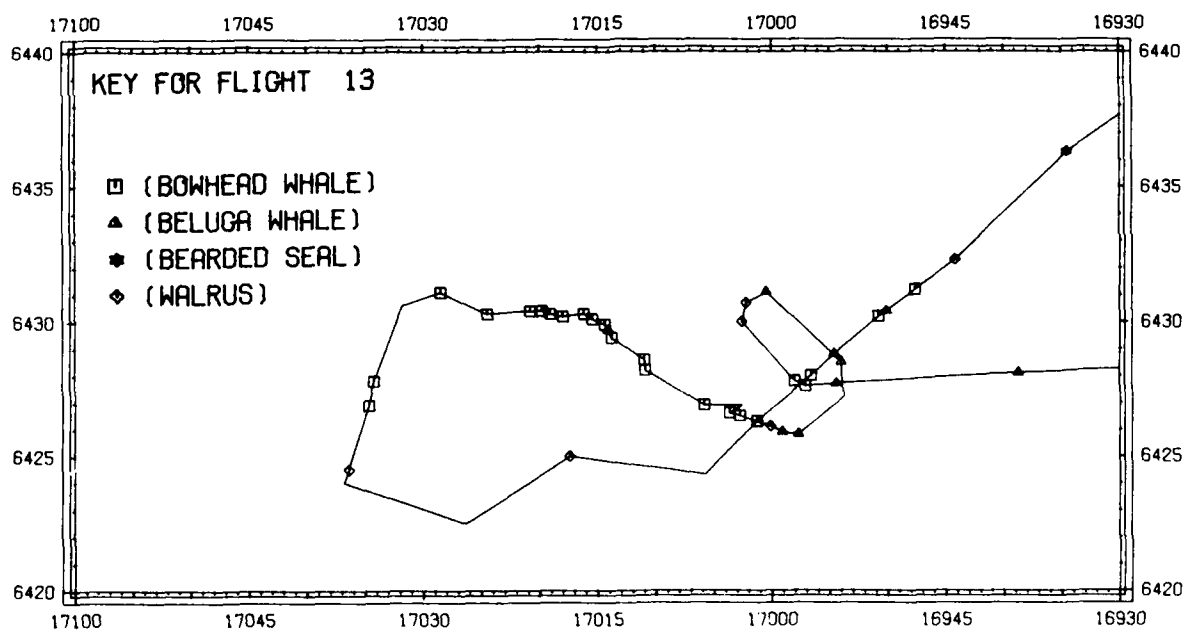
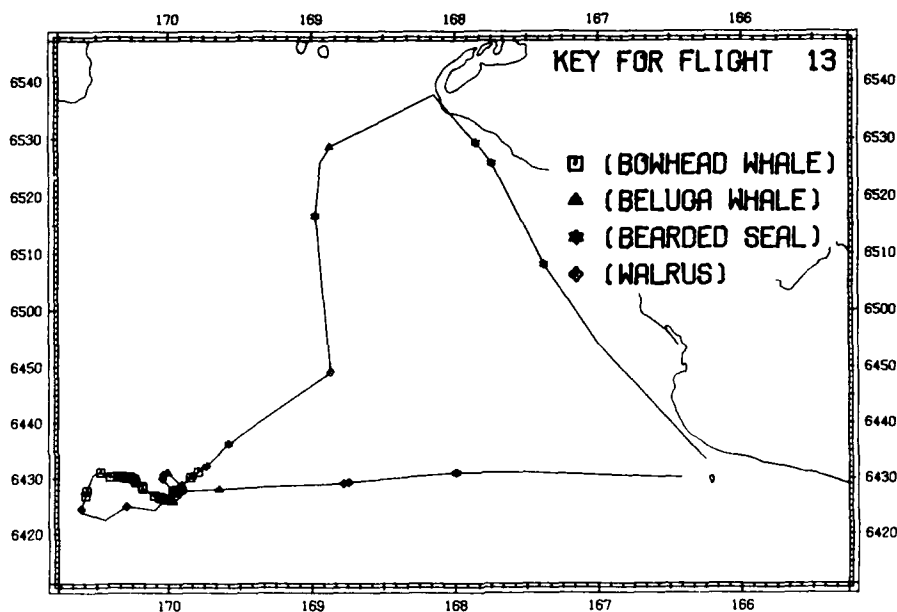


Bowhead Whale Sightings for Flight 13, April 19, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	169 57.1	64 27.6	152	8/10 B1	swimming
4	169 58.0	64 27.8	152	8/10 B1	social
6	170 02.8	64 26.5	305	8/10 B1	social
10	170 03.7	64 26.6	305	8/10 B1	social
2	170 05.9	64 26.9	305	8/10 B1	resting
2	170 10.9	64 28.2	305	8/10 B1	resting
3	170 11.0	64 28.6	305	8/10 B	social
2	170 13.8	64 29.4	305	8/10 B1	swimming
12	170 14.4	64 29.9	305	8/10 B1	social
3	170 15.5	64 30.1	305	8/10 B1	social
3	170 16.2	64 30.3	305	8/10 B1	social
9	170 18.0	64 30.2	305	8/10 B1	social
2	170 19.1	64 30.3	305	8/10 B1	
1	170 19.8	64 30.4	305	8/10 B1	
1	170 20.8	64 30.4	305	8/10 B1	
5	170 24.5	64 30.4	305	8/10 B1	social
2	170 28.5	64 31.1	305	8/10 B1	swimming
4	170 34.2	64 27.8	305	8/10 B1	social
2	170 34.7	64 26.9	305	8/10 B1	swimming
11	170 01.3	64 26.3	305	7/10 B1	social
2	169 56.6	64 28.0	305	7/10 B1	swimming
1	169 50.8	64 30.2	305	7/10 B1	resting
3	169 47.6	64 31.2	305	9/10 B1	social

FLIGHT NUMBER 13, APRIL 19, 1981

Flight was a search to check the bowhead migration from St. Lawrence Island north to the Bering Strait. The weather was overcast, visibility was unlimited, ice coverage 9/10 pack. Eighty bowheads were sighted as well as 51 belugas, 198 walrus, and 10 bearded seals. One sonobuoy was dropped.

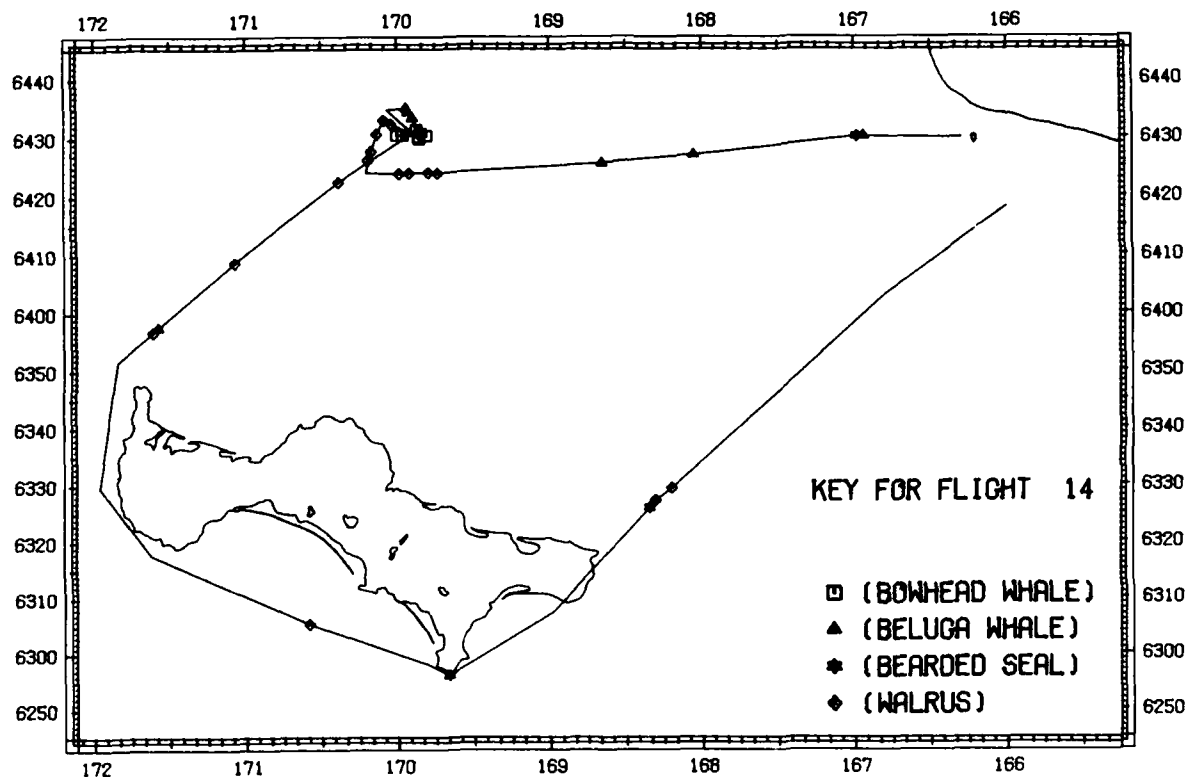


Bowhead Whale Sightings for Flight 14, April 20, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	169 51.6	64 30.2	152	9/10 B1	swimming
29	169 51.3	64 29.9	152	8/10 B1	social
16	169 52.4	64 31.4	152	8/10 B1	social
12	169 57.8	64 30.5	152	8/10 B1	social
1	170 00.1	64 30.5	152	8/10 B1	swimming
7	169 48.4	64 30.4	152	8/10 B1	social

FLIGHT NUMBER 14, APRIL 20, 1981

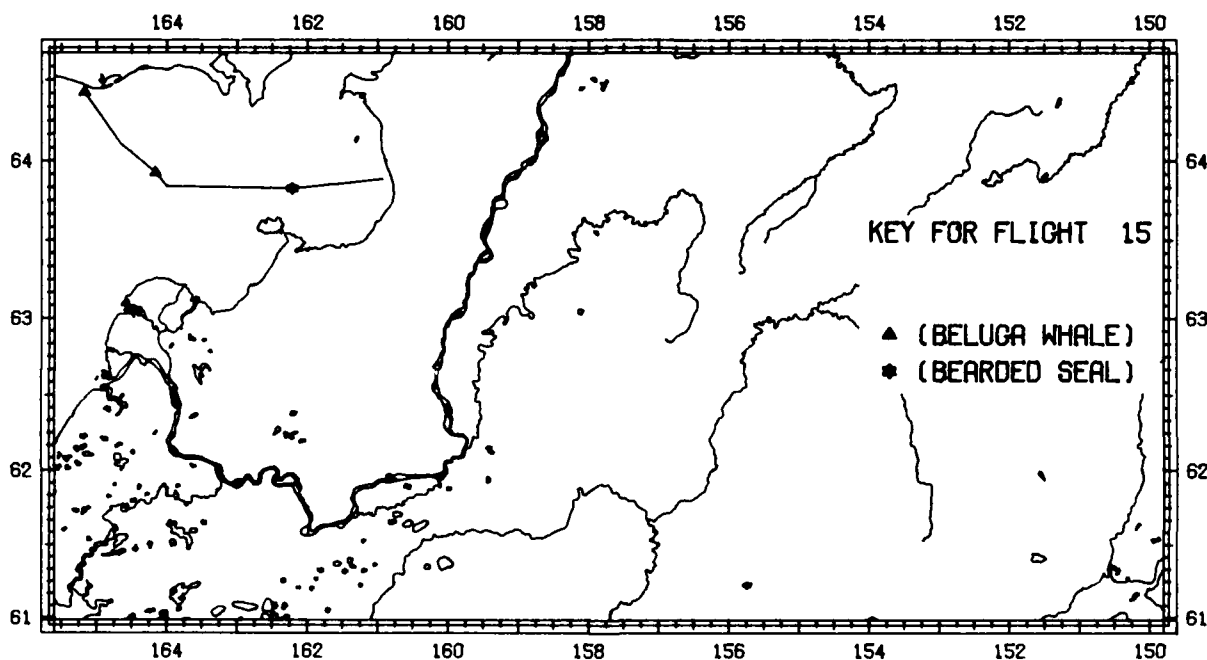
Flight was a search around St. Lawrence Island. The weather was overcast with patchy fog, which reduced visibility in places. Open water surrounded the island except on the east end, which had 6/10 ice cover. Sixty-seven bowheads were sighted north of the island. One hundred and eleven belugas, 1634 walrus and 4 bearded seals were sighted. One sonobuoy was dropped.



No Bowhead Sightings for Flight 15, April 21, 1981

FLIGHT NUMBER 15, APRIL 21, 1981

Flight was a transit from Nome to Anchorage and included a short transect survey of Norton Sound. Weather and visibility were good. The ice coverage averaged 3/10. Seventeen beluga whales and 3 bearded seals were sighted.



FLIGHT NUMBER 16, APRIL 23, 1981

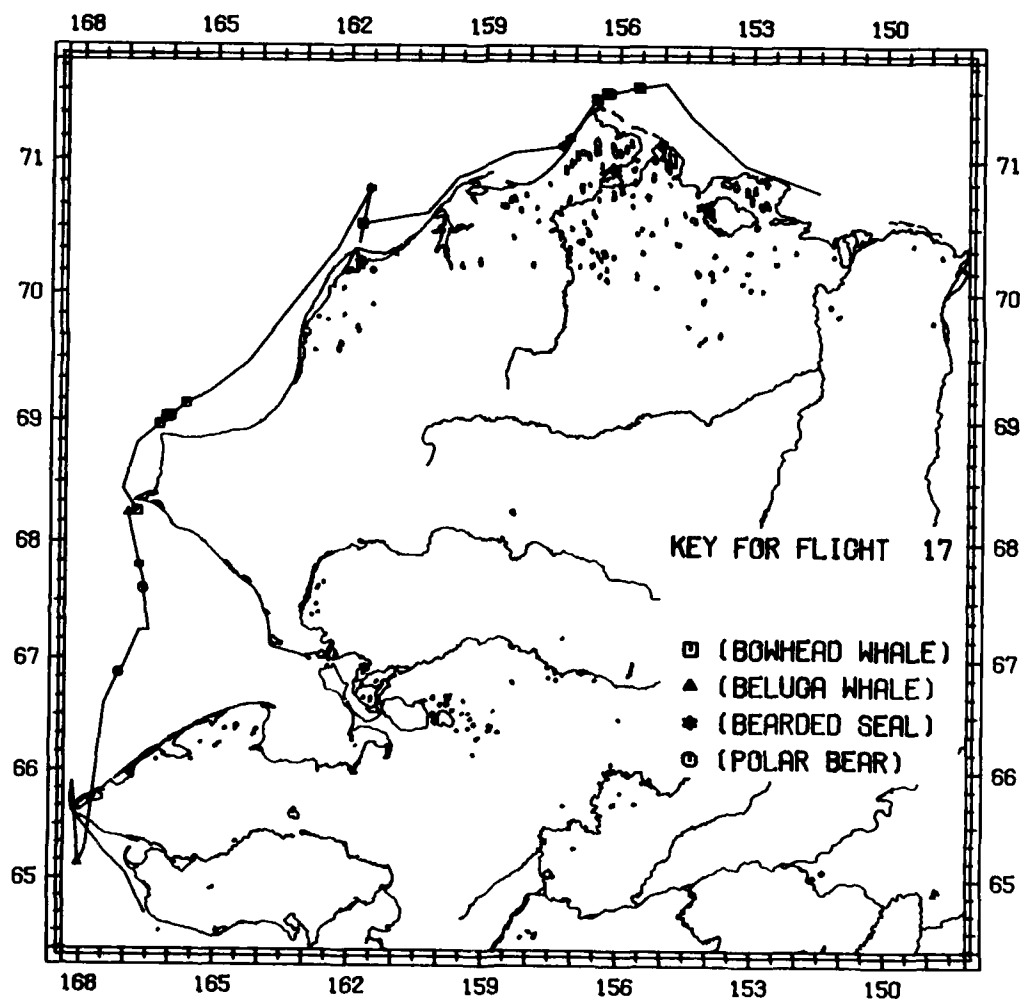
Flight was a transit from Anchorage to Nome.

Bowhead Whale Sightings for Flight 17, April 24, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	166 45.2	68 15.6	305	9/10 B1	swimming
3	166 15.9	68 58.3	305	9/10 B1	swimming
6	166 07.0	69 02.2	152	9/10 B1	swimming
1	166 05.5	69 01.5	137	9/10 B1	swimming
1	166 01.0	69 02.3	128	9/10 B1	diving
1	165 40.7	69 08.4	98	9/10 B1	diving
3	161 44.7	70 31.7	122	5/19 B1	resting
1	156 31.5	71 26.6	91	9/10 B1	diving
3	156 18.3	71 29.6	85	9/10 B1	resting
2	156 16.1	71 29.6	55	9/10 B1	swimming
3	156 13.7	71 29.2	140	9/10 B1	breaching
1	155 35.6	71 31.9	64	9/10 B1	swimming
1	155 33.7	71 31.7	61	9/10 B1	swimming

FLIGHT NUMBER 17, APRIL 24, 1981

Flight was a coastal survey from Nome to Deadhorse following the major open-water lead system north of Nome to Pt. Barrow and west of Pt. Barrow to Harrison Bay. Weather was clear, with unlimited visibility over the Bering and Chukchi Seas. Weather was overcast over the Beaufort Sea, with visibility less than 12 km. Ice conditions were 9/10 to 10/10 pan ice and leads. Twenty-eight bowhead whales were sighted, including 1 wounded bowhead. Two hundred and thirteen beluga whales, 4 bearded seals, and 2 polar bears were also seen. One sonobuoy was dropped near the wounded whale.

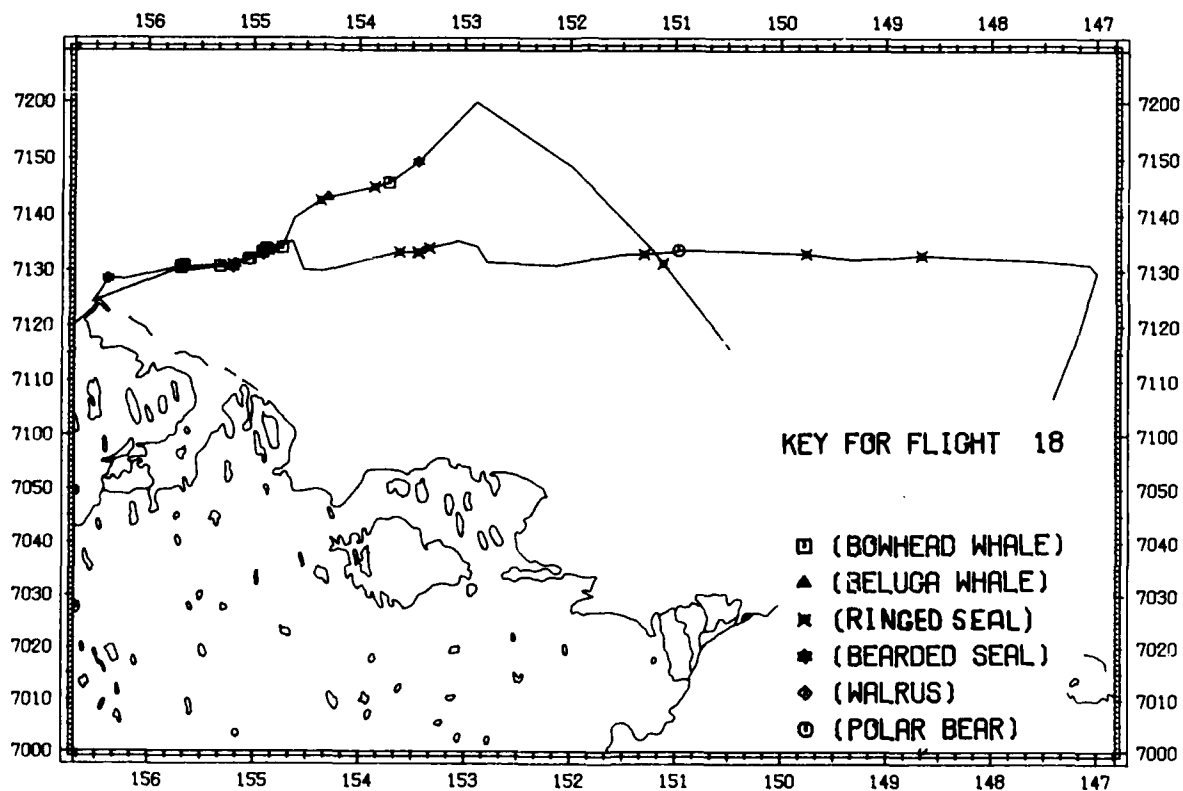


Bowhead Whale Sightings for Flight 18, April 25, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	154 54.8	71 33.3	207	9/10 B1	40 ft, resting
1	154 52.7	71 33.9	152	9/10 B1	40 ft, resting
1	155 41.3	71 30.4	152	9/10 B1	35 ft, swimming
1	155 41.5	71 30.7	152	9/10 B1	30-40 ft, swimming
1	155 39.5	71 30.8	166	9/10 B1	35 ft, swimming
1	155 19.2	71 30.7	152	9/10 B1	35 ft, dove
1	155 02.1	71 32.0	152	9/10 B1	45 ft, dove
1	155 03.0	71 32.0	152	9/10 B1	dove
1	154 43.4	71 34.1	91	9/10 B1	35 ft
2	153 43.0	71 45.7	104	9/10 B1	dove

FLIGHT NUMBER 18, APRIL 25, 1981

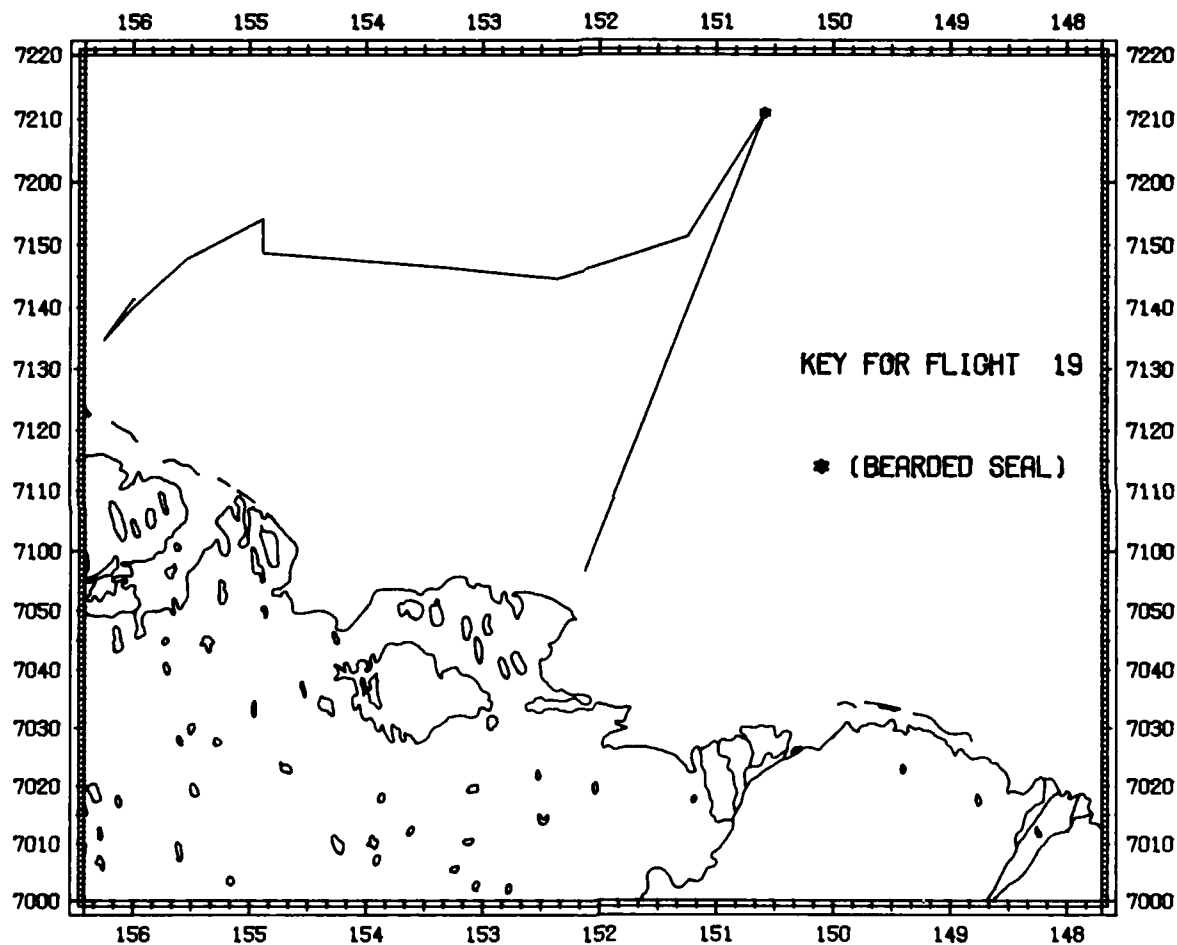
Flight was a search to survey ice conditions and presence of bowheads in the Beaufort Sea west of Prudhoe Bay to Pt. Barrow. Weather conditions were overcast, limiting visibility to less than 32 km. Ice conditions were 9/10 to 10/10 coverage. Refrozen east-west leads near Point Barrow and open north-south leads north of Lonely were noted. Twelve bowhead whales were sighted. Six beluga whales, 1 walrus, 15 ringed seals, 5 bearded seals, and a polar bear with 2 cubs were also seen. Two sonobuoys were dropped.



No Bowhead Sightings for Flight 19, April 28, 1981

FLIGHT NUMBER 19, APRIL 28, 1981

Flight was a search between Prudhoe Bay and Pt. Barrow for migrating bowheads. Weather was overcast with less than 8-km visibility. Ice coverage averaged 9/10, with leads and small cracks. No bowhead whales were sighted. One bearded seal was seen.

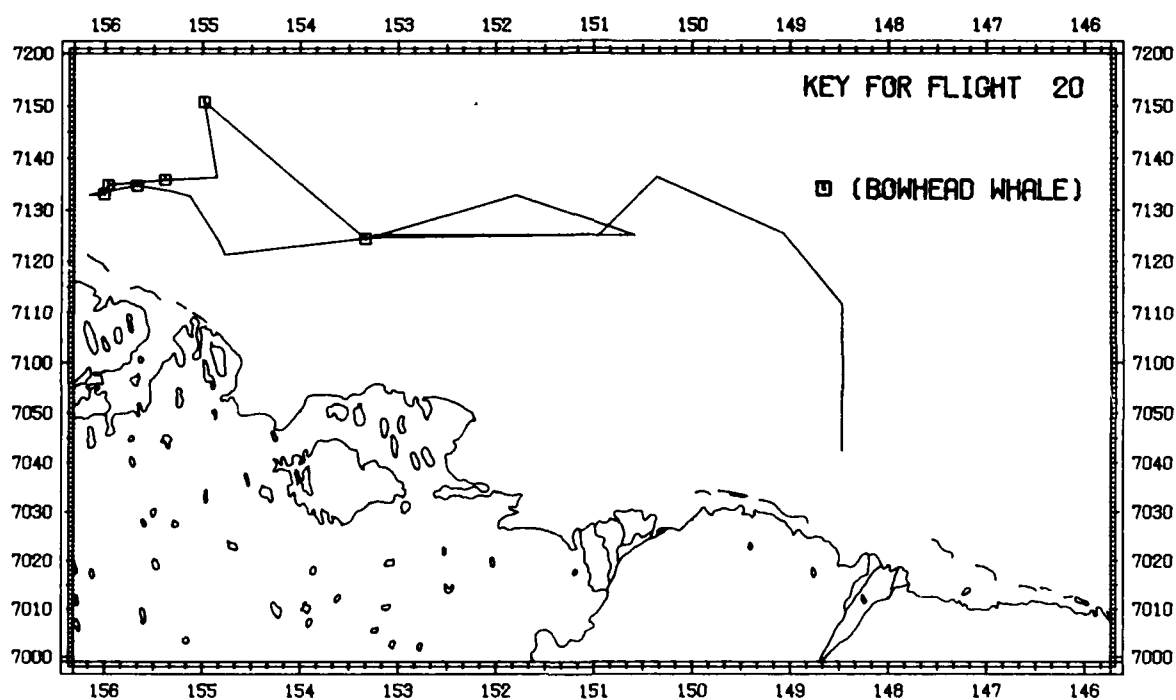


Bowhead Whale Sightings for Flight 20, April 29, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
2	155 40.1	71 34.8	220	8/10	B1	40 ft, swimming
2	155 40.1	71 34.8	220	8/10	B1	30-50 ft, swimming
1	155 00.3	71 33.1	152	8/10	B1	dove
2	155 57.8	71 34.9	146	8/10	B1	swim
1	155 23.0	71 39.9	152	8/10	B1	dove
5	154 58.8	71 50.8	152	8/10	B1	swim
2	153 19.9	71 24.4	152	8/10	B1	20-40 ft, swimming

FLIGHT NUMBER 20, APRIL 29, 1981

Flight was a search for migrating bowheads east of Pt. Barrow and north of Lonely. Weather was overcast to partly cloudy; visibility was generally less than 9 km. Ice coverage ranged from 8/10 to 10/10, with large leads up to 16 km wide. Fifteen bowhead whales were sighted. One group of 5 whales was resting near the ice edge and slapping their flippers on the water surface. No other marine mammals were sighted.



Bowhead Whale Sightings for Flight 21, April 30, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
3	153 01.8	71 37.3	305	8/10 B1	30-40 ft, swimming
1	153 02.2	71 38.8	305	8/10 B1	40 ft, swimming
3	153 08.8	71 38.4	259	8/10 B1	40 ft, dove
2	153 12.5	71 38.4	191	8/10 B1	45 ft, resting
2	153 19.8	71 38.7	252	8/10 B1	30-40 ft
1	153 20.5	71 38.4	252	8/10 B1	30-45 ft, swimming
1	153 19.3	71 38.5	98	8/10 B1	swimming
2	153 30.5	71 37.7	152	8/10 B1	40 ft, swimming
2	153 36.1	71 38.1	183	8/10 B1	30-45 ft, swimming
1	153 36.1	71 38.1	183	8/10 B1	30-40 ft, swimming
1	153 44.1	71 38.3	183	8/10 B1	30-40 ft, dove
2	153 49.8	71 38.0	183	8/10 B1	30-40 ft, swimming
2	153 55.9	71 37.2	183	8/10 B1	30 ft, swimming
1	153 59.6	71 36.9	160	8/10 B1	30 ft, swimming
2	154 05.0	71 36.4	160	8/10 B1	swimming
1	154 07.4	71 36.6	160	8/10 B1	swimming
3	154 10.8	71 36.1	160	8/10 B1	30-45 ft, swimming
2	154 13.7	71 36.2	152	8/10 B1	30-45 ft, dove
2	154 42.7	71 34.8	274	8/10 B1	30 ft, swimming
1	154 49.8	71 33.9	122	8/10 B1	
1	154 50.1	71 33.6	122	8/10 B1	swimming
2	154 50.0	71 33.6	130	8/10 B1	dove
2	156 17.3	71 28.4	305	8/10 B1	40 ft, dove
2	156 18.5	71 28.1	244	8/10 B1	

Bowhead Whale Sightings for Flight 21, April 30, 1981 (Continued)

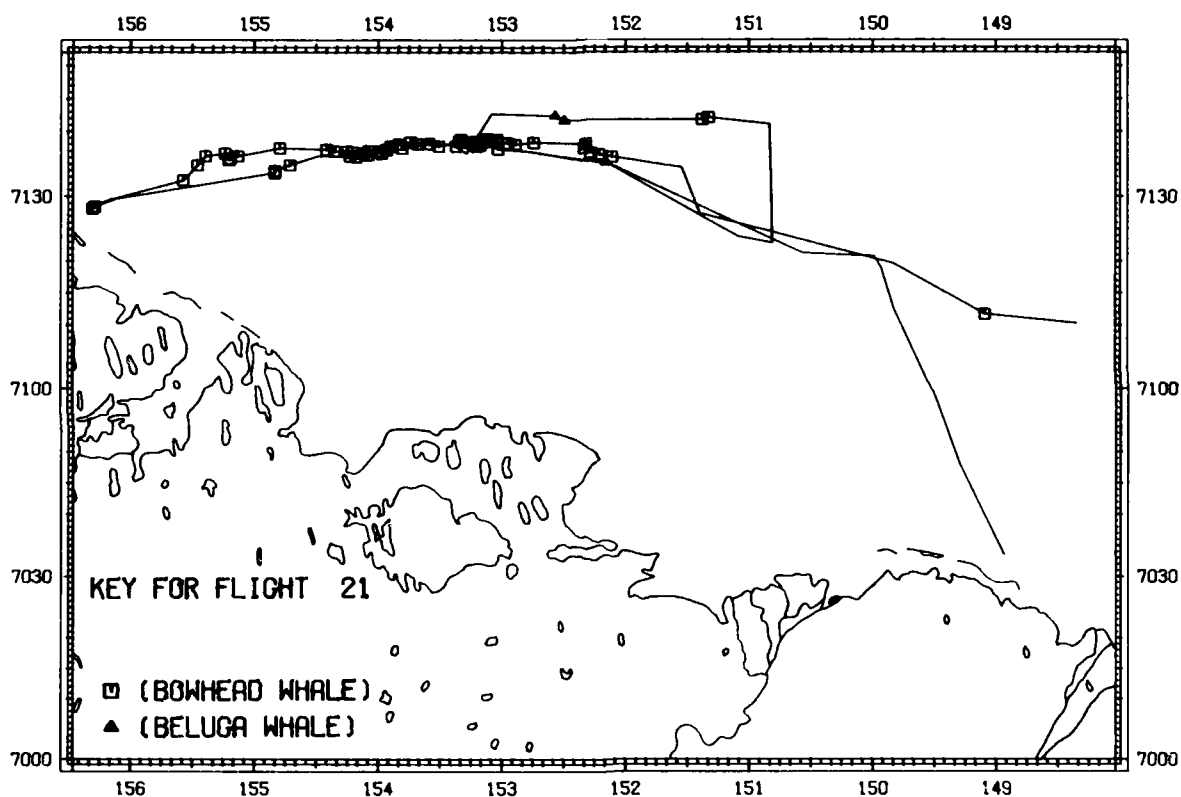
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	155 34.3	71 32.5	311	8/10 B1	
2	155 27.4	71 34.8	305	8/10 B1	swimming
1	155 23.5	71 36.2	305	8/10 B1	35 ft, diving
4	155 14.0	71 36.6	305	8/10 B1	35 ft, tail slap
1	155 11.7	71 35.8	111	8/10 B1	swimming
1	155 12.3	71 35.6	107	8/10 B1	25 ft, dove
1	155 07.7	71 36.2	305	8/10 B1	30-40 ft, dove
2	154 47.4	71 37.4	335	8/10 B1	dove
2	154 24.8	71 37.2	305	8/10 B1	swimming
2	154 20.8	71 36.9	305	8/10 B1	swimming
3	154 14.8	71 36.9	305	8/10 B1	swimming
1	154 12.1	71 36.8	305	8/10 B1	
3	154 04.1	71 37.0	305	8/10 B1	swimming
1	153 58.0	71 36.6	305	8/10 B1	swimming
1	153 53.5	71 37.7	305	8/10 B1	
3	153 40.8	71 38.1	305	8/10 B1	
2	153 48.1	71 37.4	305	8/10 B1	swimming
1	153 35.0	71 38.1	305	8/10 B1	spy hop
3	153 12.1	71 37.7	305	8/10 B1	swimming
2	153 10.3	71 37.9	305	8/10 B1	swimming
2	153 10.3	71 37.9	305	8/10 B1	swimming
1	151 19.4	71 42.1	335	8/10 B1	swimming
2	151 22.7	71 41.8	305	8/10 B1	under ice
4	153 22.0	71 37.7	305	8/10 B1	swimming

Bowhead Whale Sightings for Flight 21, April 30, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
2	153 15.2	71 38.3	305	8/10	B1	swimming
1	153 06.6	71 38.9	305	8/10	B1	swimming
3	153 01.8	71 38.3	305	8/10	B1	swimming
1	152 57.0	71 38.3	305	8/10	B1	45 ft, swimming
1	152 53.3	71 38.0	305	8/10	B1	45 ft, swimming
1	152 44.4	71 38.3	305	8/10	B1	30 ft, swimming
1	152 19.1	71 38.1	305	8/10	B1	40 ft, dove
2	152 19.9	71 37.5	305	8/10	B1	40 ft
3	152 16.7	71 36.7	305	8/10	B1	40 ft
1	152 12.5	71 36.4	305	8/10	B1	40 ft
3	152 06.4	71 36.1	395	8/10	B1	40 ft
2	149 05.4	71 11.7	305	8/10	B1	20-45 ft, swimming

FLIGHT NUMBER 21, APRIL 30, 1981

Flight was a search for bowheads west of Prudhoe Bay to Pt. Barrow. Weather conditions were overcast with unlimited visibility. Ice coverage averaged 9/10 with large east-west leads. One hundred and nine bowhead whales were sighted. Brown bowhead whales were sighted with normally colored whales. One hundred and seventy-eight beluga whales were also seen.



Bowhead Whale Sightings for Flight 22, May 1, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
3	151 55.0	71 33.2	335	7/10	B1	45 ft, swimming
2	152 07.2	71 34.3	311	5/10	B1	45 ft, swimming
2	152 11.5	71 34.9	311	5/10	B1	45 ft
1	152 15.3	71 35.0	305	5/10	B1	dove
3	152 26.7	71 35.4	305	5/10	B1	swimming
4	152 26.7	71 35.4	305	5/10	B1	swimming
1	152 54.6	71 36.4	305	5/10	B1	swimming
1	152 46.9	71 36.3	305	5/10	B1	swimming
1	153 22.2	71 38.0	305	5/10	B1	
1	153 24.2	71 37.9	305	5/10	B1	swimming
1	152 24.2	71 36.7	305	5/10	B1	swimming
2	152 21.2	71 36.6	305	5/10	B1	swimming
2	152 13.0	71 36.4	305	5/10	B1	swimming
4	152 09.0	71 36.0	305	5/10	B1	swimming
5	151 57.4	71 34.6	305	5/10	B1	swimming
3	151 55.8	71 33.6	152	5/10	B1	35 ft, swimming
1	151 56.8	71 33.5	152	5/10	B1	swimming
1	150 07.1	71 23.1	305	7/10	B1	
1	150 16.0	71 24.2	305	9/10	B1	
1	150 20.0	71 23.7	305	9/10	B1	
2	152 04.3	71 34.5	305	9/10	B1	
3	152 05.4	71 34.5	305	9/10	B1	
3	152 06.1	71 34.6	305	9/10	B1	
2	152 07.5	71 34.8	305	9/10	B1	

Bowhead Whale Sightings for Flight 22, May 1, 1981 (Continued)

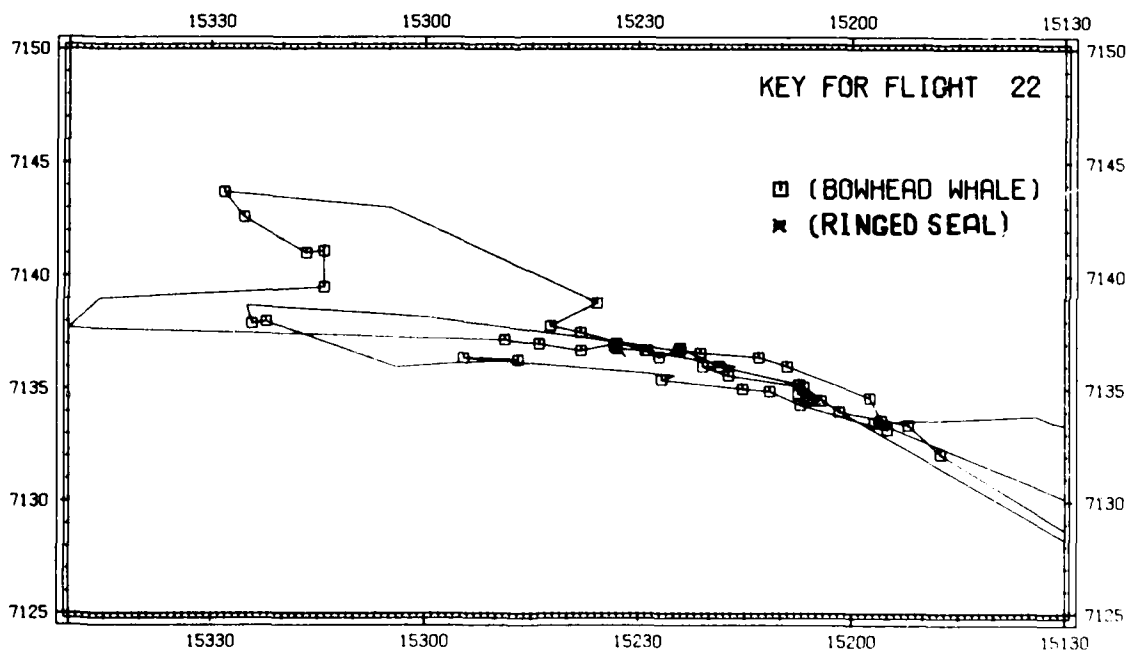
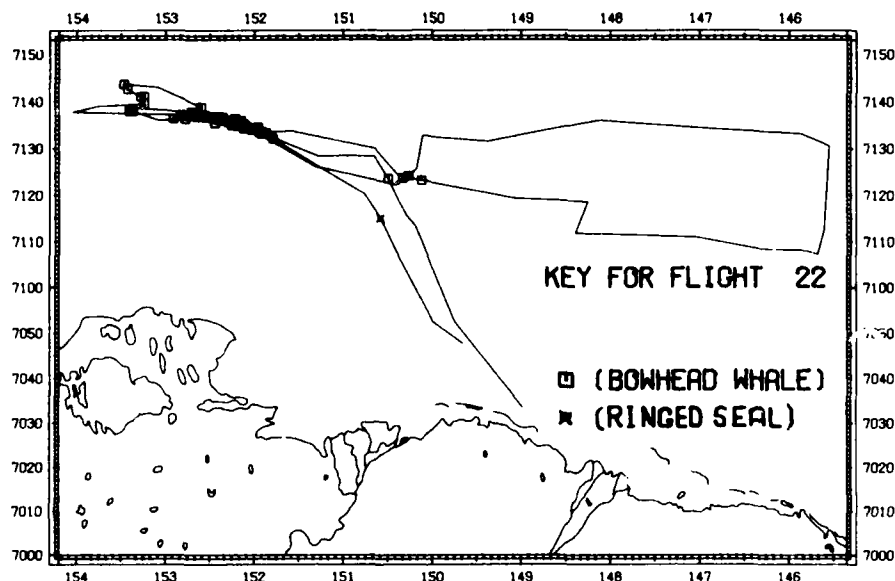
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	152 06.7	71 35.1	305	9/10 B1	
1	152 17.3	71 35.6	305	9/10 B1	
1	152 20.9	71 36.0	305	9/10 B1	
1	152 28.7	71 36.7	305	9/10 B1	35 ft
2	152 33.0	71 36.8	305	9/10 B1	40 ft
3	152 33.3	71 36.9	305	9/10 B1	40 ft
3	152 33.0	71 37.0	305	9/10 B1	50 ft
1	152 38.0	71 36.7	305	9/10 B1	45 ft
1	152 43.9	71 37.0	244	9/10 B1	45 ft
2	152 48.8	71 37.2	244	9/10 B1	
1	153 14.2	71 39.5	335	9/10 B1	dove
5	153 14.2	71 41.1	335	9/10 B1	40 ft, dove
1	153 16.7	71 41.0	335	9/10 B1	45 ft
3	153 25.4	71 42.6	320	9/10 B1	
2	153 28.2	71 43.7	335	9/10 B1	
1	152 35.7	71 38.8	335	9/10 B1	
1	152 42.3	71 37.8	335	9/10 B1	
2	152 38.0	71 37.5	335	9/10 B1	
3	152 28.9	71 36.7	335	9/10 B1	
6	152 27.0	71 36.4	335	9/10 B1	
5	152 24.0	71 36.8	335	9/10 B1	
2	152 18.5	71 36.0	335	9/10 B1	
5	152 07.3	71 35.2	335	9/10 B1	

Bowhead Whale Sightings for Flight 22, May 1, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	152 01.7	71 34.0	335	9/10 B1	
1	151 52.0	71 33.4	335	8/10 B1	
3	151 47.5	71 32.1	335	8/10 B1	40 ft, swimming

FLIGHT NUMBER 22, MAY 1, 1981

Flight was a search for bowheads north and west of Prudhoe Bay. Weather conditions were partly cloudy to overcast, with unlimited visibility. Ice coverage was 9/10 pan ice with leads. One hundred and ten bowhead whales were sighted, including several brown bowheads. A yearling bowhead was seen in a group of 5 whales. One ringed seal was sighted.

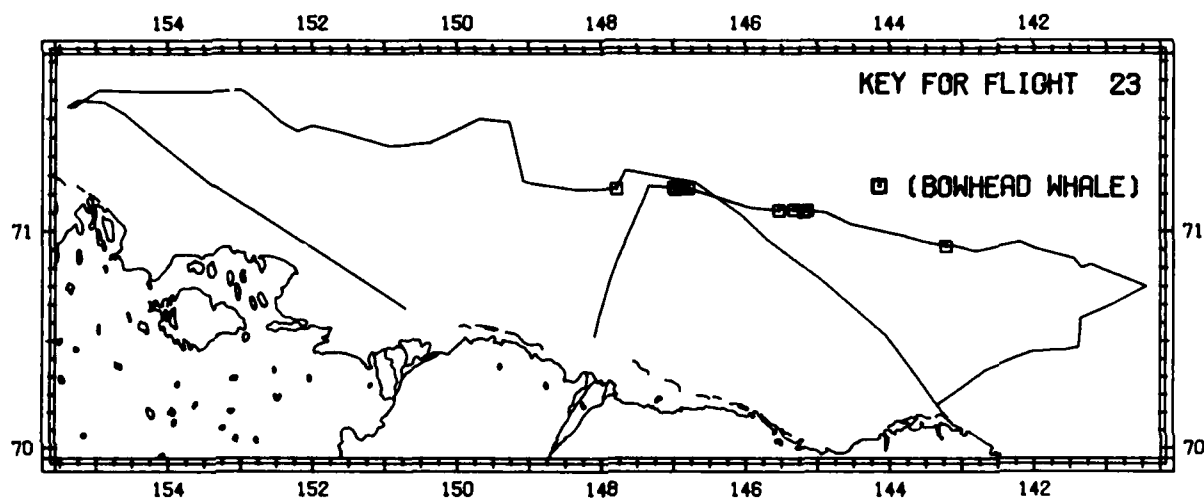


Bowhead Whale Sightings for Flight 23, May 4, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
1	146 59.4	71 11.6	366	9/10	B1	swimming
2	146 54.6	71 12.1	198	8/10	B1	40 ft, swimming
1	146 58.2	71 11.2	229	8/10	B1	dove
2	146 51.3	71 11.8	229	8/10	B1	under ice
1	146 47.3	71 11.4	213	8/10	B1	dove
1	145 31.8	71 05.5	152	8/10	B1	40 ft, under ice
2	145 19.5	71 05.6	152	8/10	B1	40 ft, under ice
1	145 11.0	71 05.1	168	8/10	B1	40 ft, swimming
2	145 08.3	71 05.5	160	8/10	B1	40 ft, swimming
1	143 13.1	71 55.8	183	8/10	B1	45 ft, resting
2	147 47.0	71 11.3	366	8/10	B1	45 ft, swimming

FLIGHT NUMBER 23, MAY 4, 1981

Flight was a search for bowheads migrating between Pt. Barrow and Barter Island. Weather conditions were partly cloudy, with unlimited visibility. Ice coverage averaged 8/10 with small cracks and leads running northeast. Sixteen bowhead whales were sighted.

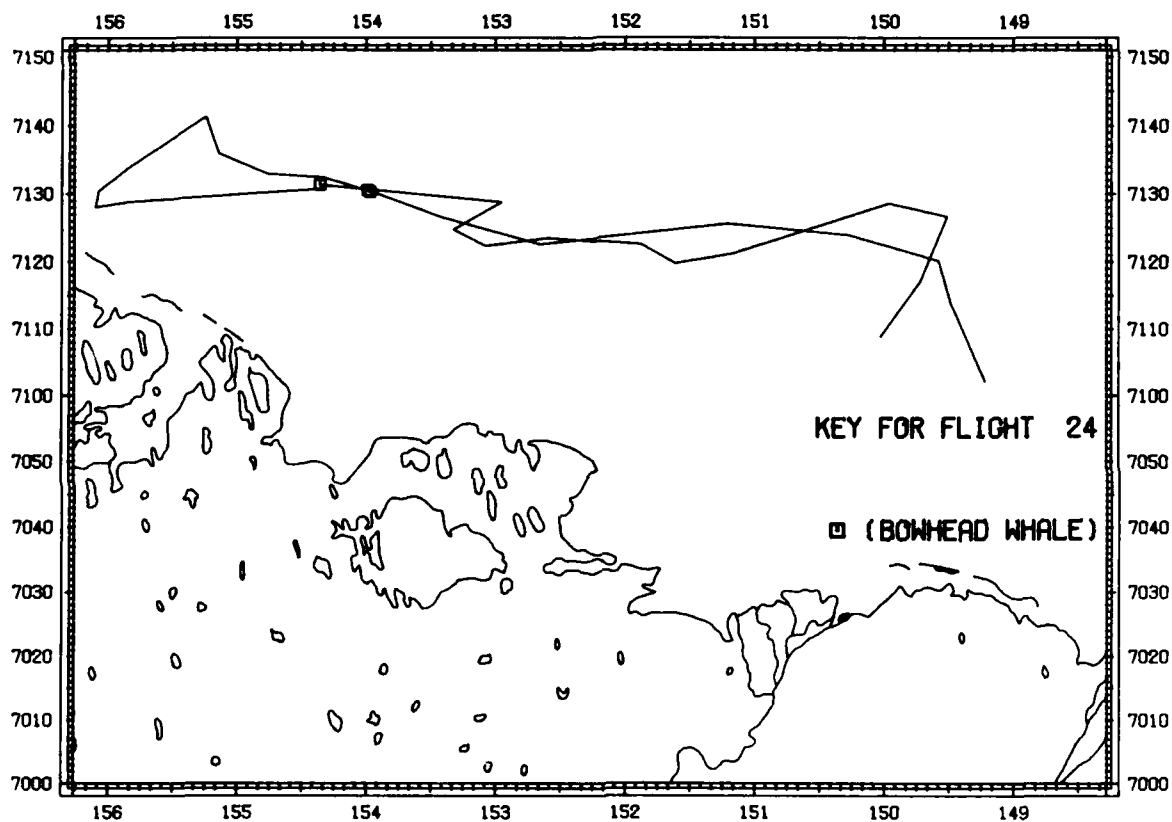


Bowhead Whale Sightings for Flight 24, May 5, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	154 21.6	71 31.3	152	8/10 B1	swimming
3	153 58.4	71 30.3	152	3/10 B1	40 ft, swimming
3	153 59.5	71 30.5	152	3/10 B1	swimming

FLIGHT NUMBER 24, MAY 5, 1981

Flight was a search for bowheads between Pt. Barrow and Prudhoe Bay south of latitude 72°. Weather was overcast to clear, with unlimited visibility. Ice coverage averaged 7/10 with large leads. Seven bowhead whales were sighted. One sonobuoy was dropped; only bearded seals were recorded.

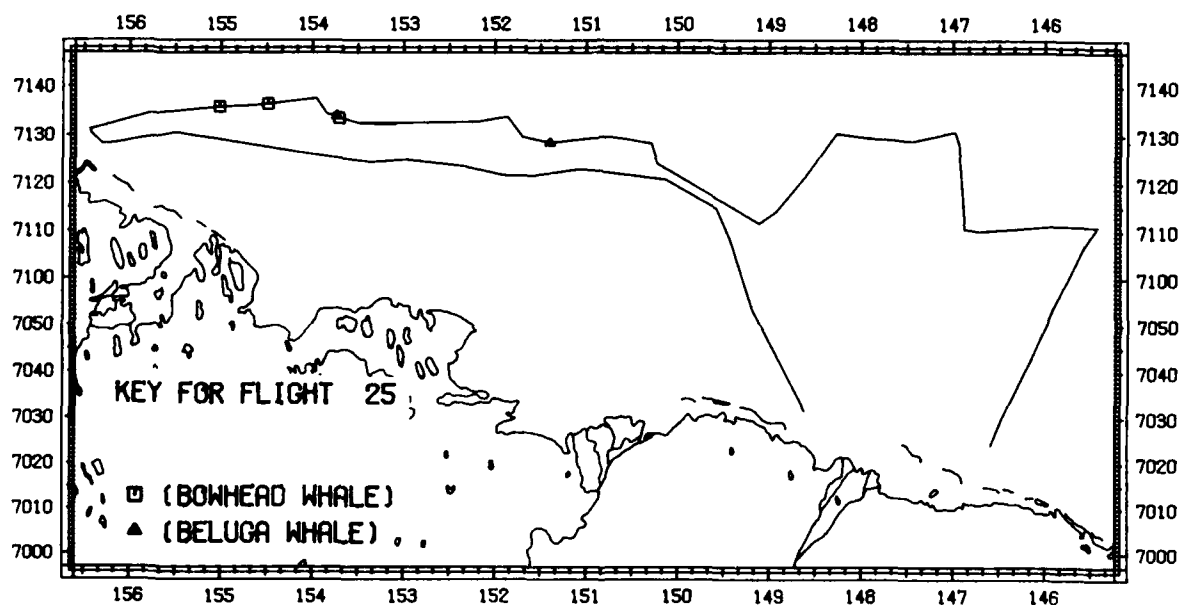


Bowhead Whale Sightings for Flight 25, May 6, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	155 01.2	71 35.9	259	8/10 B1	dove
1	154 29.2	71 36.5	271	8/10 B1	dove
1	153 42.7	71 33.6	305	8/10 B1	dove

FLIGHT NUMBER 25, MAY 6, 1981

Flight was a search for bowheads between Pt. Barrow and Prudhoe Bay. Weather was partly cloud and visibility was unlimited. Ice coverage ranged from 7/10 to 9/10. A large lead bordered the northern edge of the shorefast ice with numerous small cracks to the north of this lead. Three bowhead whales were sighted. Two groups (a total of 72) of beluga whales with calves were also seen.

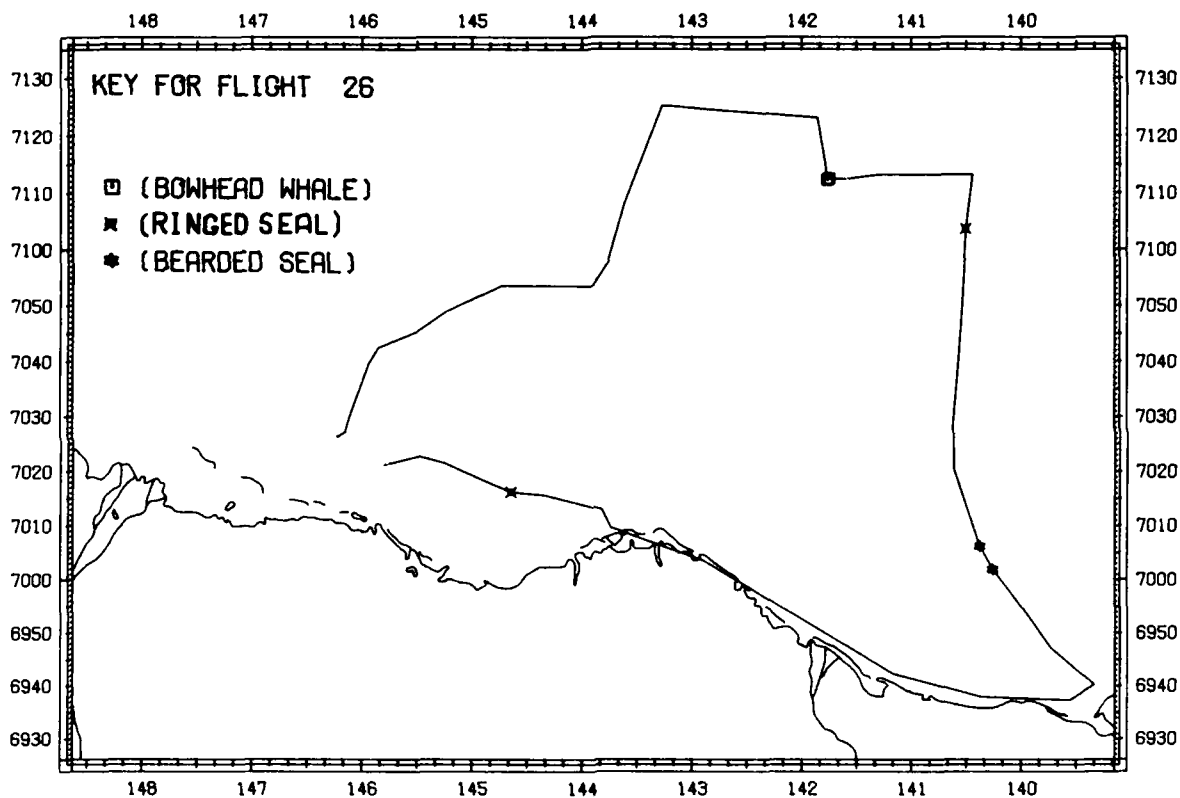


Bowhead Whale Sightings for Flight 26, May 7, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	141 46.1	71 12.3	396	8/10 B1	50 ft, resting
1	141 45.1	71 12.5	122	8/10 B1	45 ft, resting

FLIGHT NUMBER 26, MAY 7, 1981

Flight was a search for bowheads migrating between Prudhoe Bay and Herschel Island. Weather was partly cloudy overcast, with unlimited visibility. Ice coverage was 8/10 to 9/10. Three distinct east-west lead systems were mapped. Two bowhead whales were sighted. Three ringed seals and 3 bearded seals were also seen.

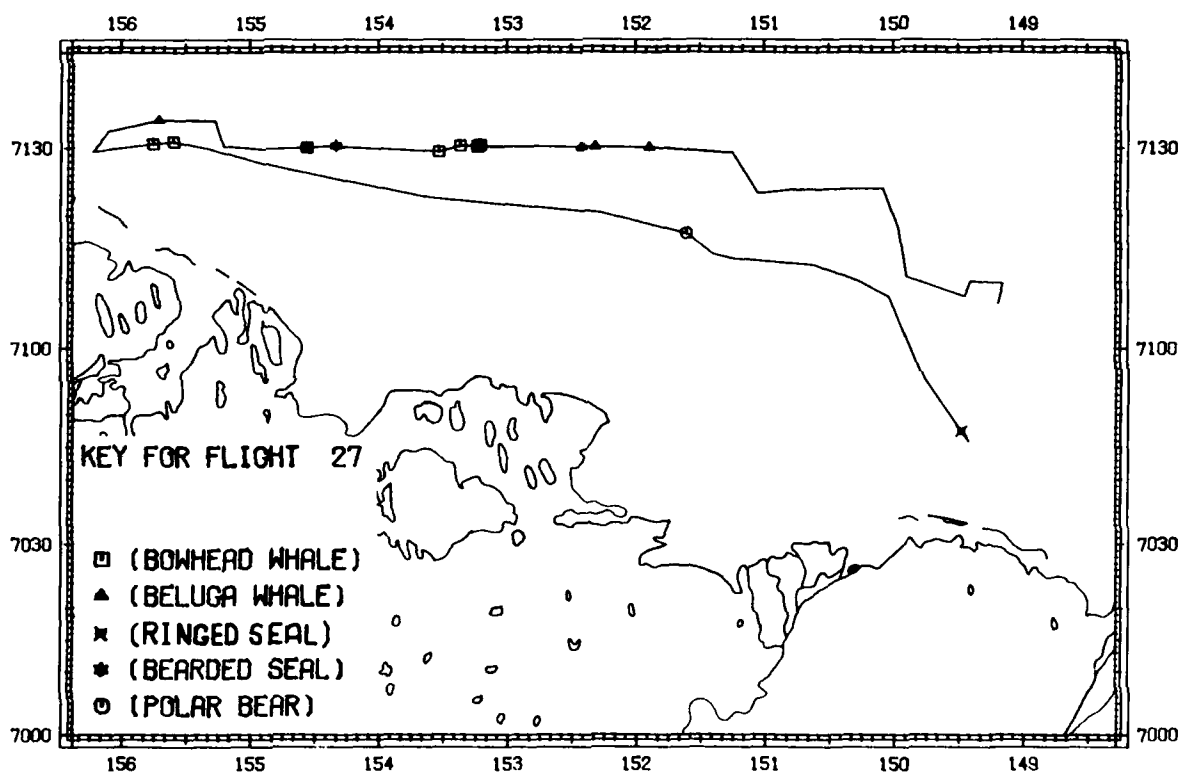


Bowhead Whale Sightings for Flight 27, May 9, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	155 36.0	71 30.9	152	8/10 B1	35 ft, swimming
1	155 45.5	71 30.6	152	8/10 B1	50 ft, swimming
1	154 33.6	71 30.0	135	8/10 B1	50 ft, dove
2	153 32.1	71 29.4	152	8/10 B1	40 ft, swimming
1	153 22.2	71 30.3	122	8/10 B1	swimming
1	153 13.6	71 30.3	152	8/10 B1	
1	153 12.9	71 30.4	152	8/10 B1	40 ft, swimming
1	153 14.1	71 30.2	152	8/10 B1	40 ft, dove

FLIGHT NUMBER 27, MAY 9, 1981

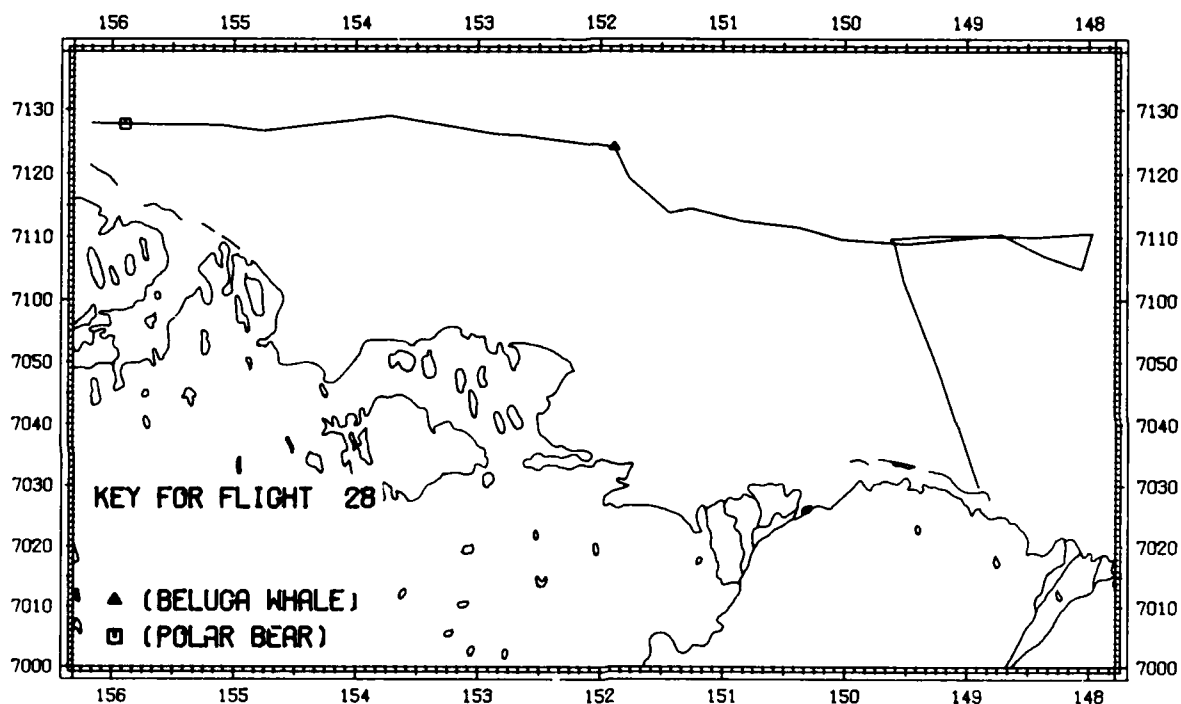
Flight was a coastal survey between Pt. Barrow and Prudhoe Bay to determine the rate at which bowhead whales were entering the Beaufort Sea. Weather was foggy, creating a low ceiling and visibility of less than 9 km. Ice coverage ranged between 7/10 and 10/10. Nine bowhead whales were sighted. Seven beluga whales, 1 polar bear, 1 ringed seal, and 1 bearded seal were also sighted.



No Bowhead Sightings for Flight 28, May 10, 1981

FLIGHT NUMBER 28, MAY 10, 1981

Flight was a search to record ice conditions and the number of bowheads migrating past Pt. Barrow. Weather was overcast, with visibility less than 9 km. Ice coverage ranged from 6/10 to 10/10 with leads filled with brash and pan ice. No bowhead whales were sighted. Two beluga whales and 1 polar bear were seen.

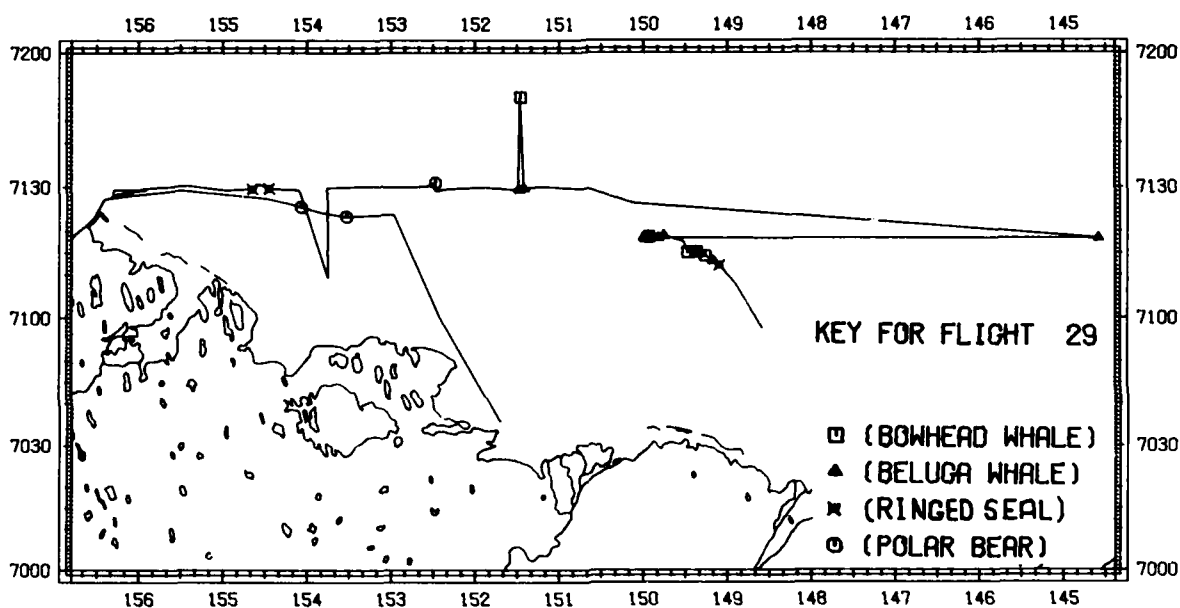


Bowhead Whale Sightings for Flight 29, May 13, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	151 27.6	71 50.2	137	8/10 B1	45 ft, resting
1	149 55.6	71 18.7	152	9/10 B1	40 ft, tail slap
1	149 28.1	71 15.1	152	9/10 B1	40-45 ft, under ice
1	149 21.8	71 15.2	152	9/10 B1	45 ft
1	149 15.5	71 14.3	137	9/10 B1	

FLIGHT NUMBER 29, MAY 13, 1981

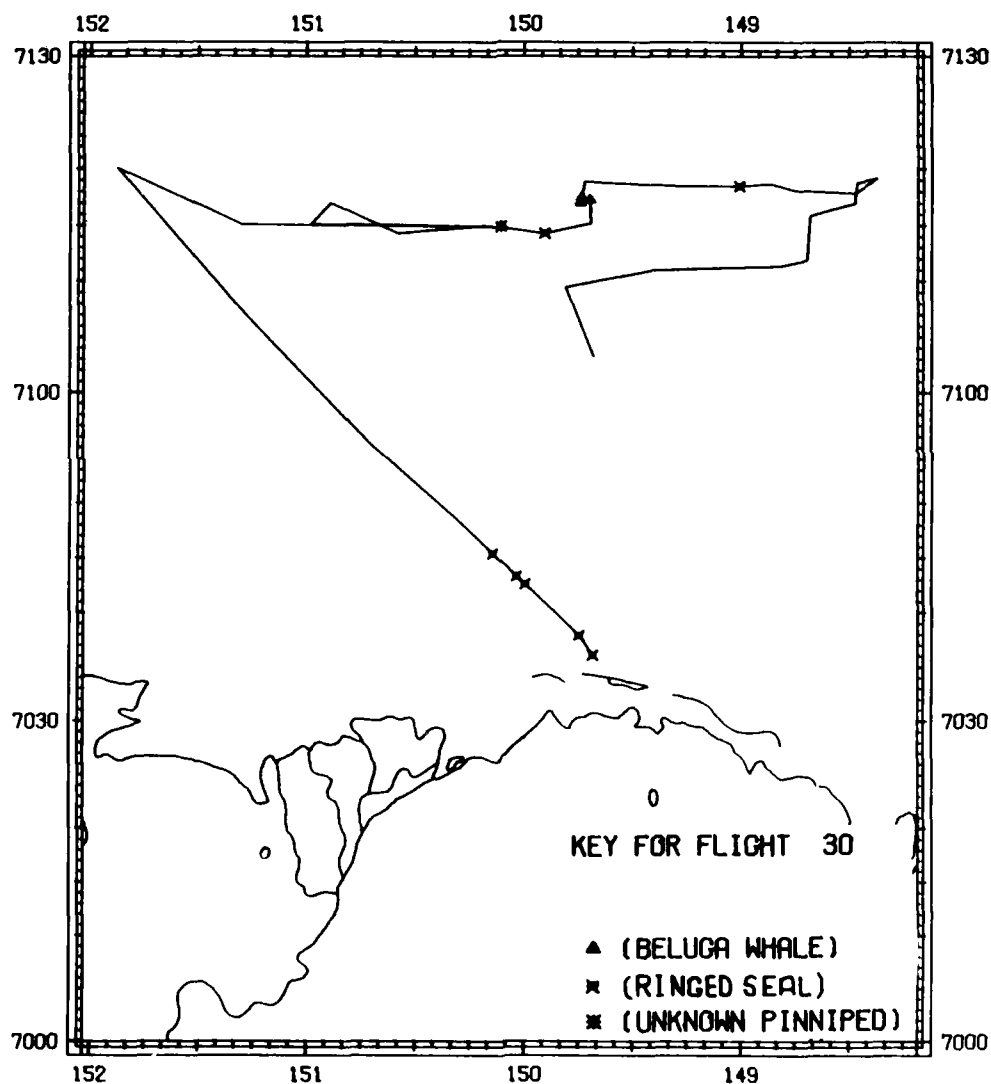
Flight was a search from Deadhorse to Pt. Barrow and return, along the lead system at about 71° 30'N. Weather was overcast with about 1-km visibility. Ice coverage averaged 9/10, forming leads and small cracks. Five bow-head whales were sighted. One hundred and sixteen beluga whales, 3 ringed seals, and 4 polar bears were also seen.



No Bowhead Sightings for Flight 30, May 14, 1981

FLIGHT NUMBER 30, MAY 14, 1981

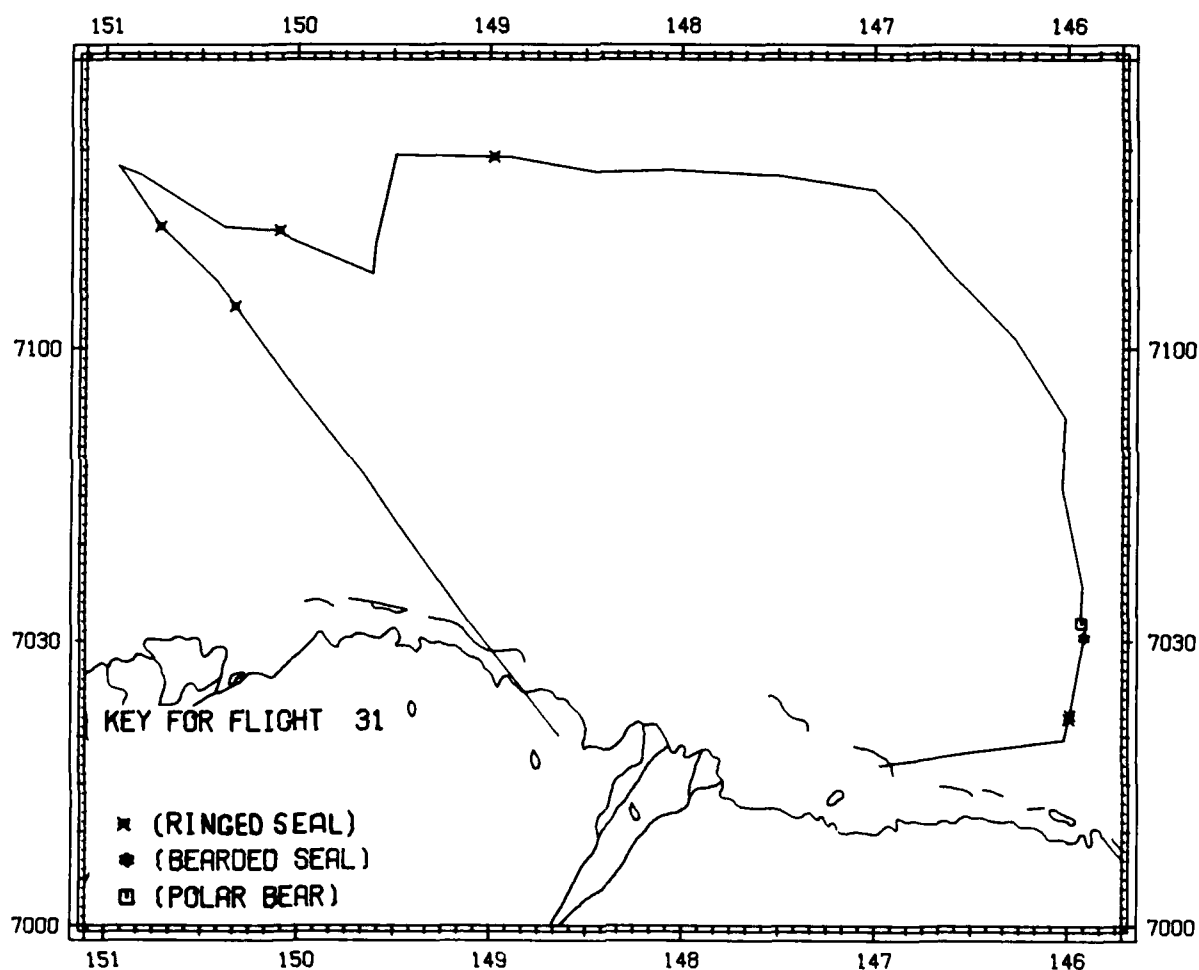
Flight was a search for migrating bowhead whales north and east of Prudhoe Bay. Weather was overcast. Visibility was about 10 km. Ice coverage averaged 9/10, forming leads and small cracks. No bowhead whales were sighted. Twenty-three beluga whales, 10 ringed seals, and 1 unidentified pinniped were sighted.



No Bowhead Sightings for Flight 31, May 15, 1981

FLIGHT NUMBER 31, MAY 15, 1981

Flight was a search to survey ice conditions and search for migrating bowheads to the east and west of Prudhoe Bay. Weather was clear with some patchy fog; visibility was unlimited. Ice conditions averaged 9/10, with small cracks and leads. No bowhead whales were sighted. One polar bear, 8 ringed seals, and 1 bearded seal were sighted.

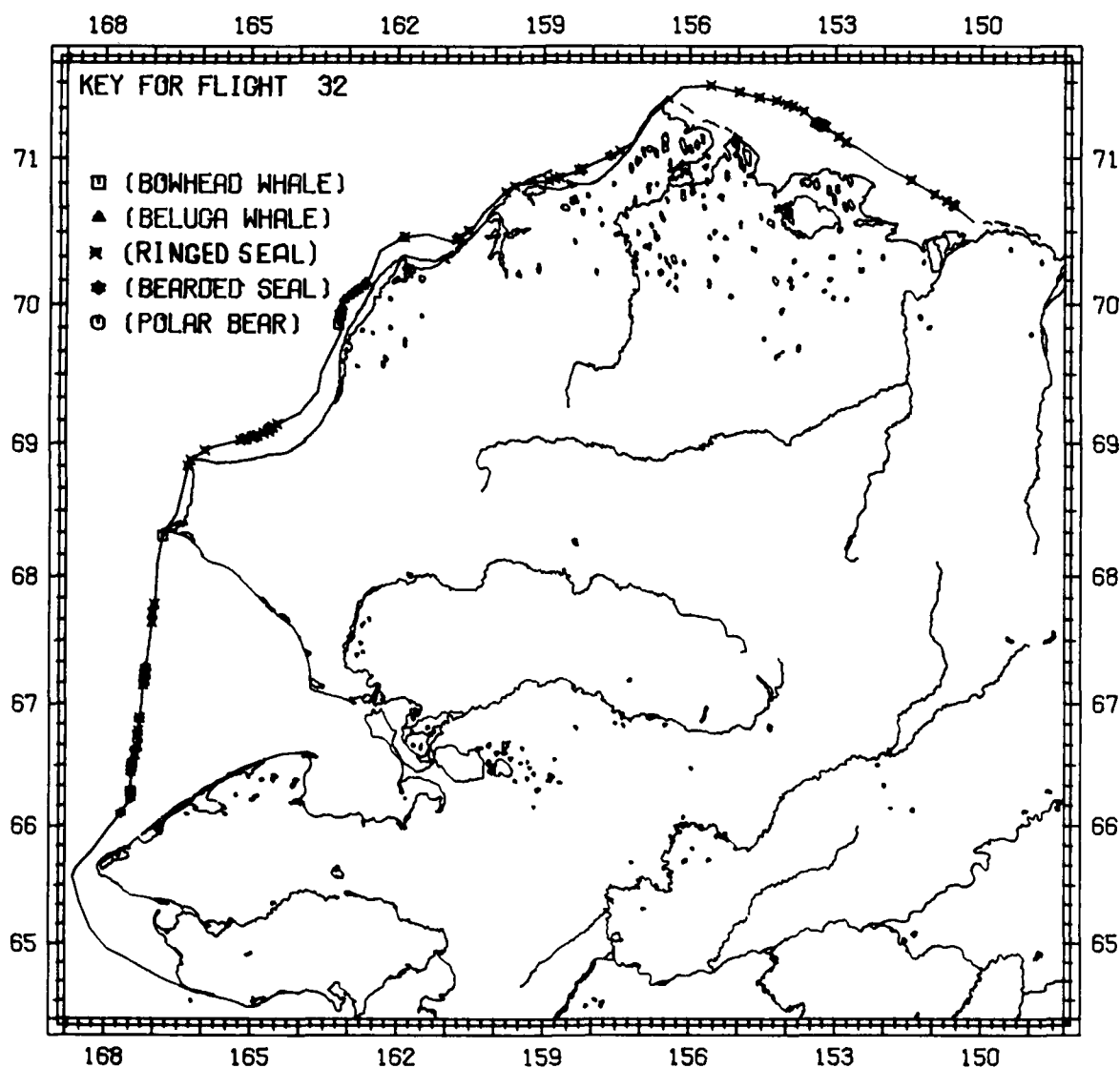


Bowhead Whale Sightings for Flight 32, May 16, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	163 10.5	69 55.7	305	7/10 B1	40 ft, swimming
5	163 12.6	59 51.6	305	7/10 B1	social
2	166 48.8	68 18.6	305	7/10 B1	40 ft, swimming

FLIGHT NUMBER 32, MAY 16, 1981

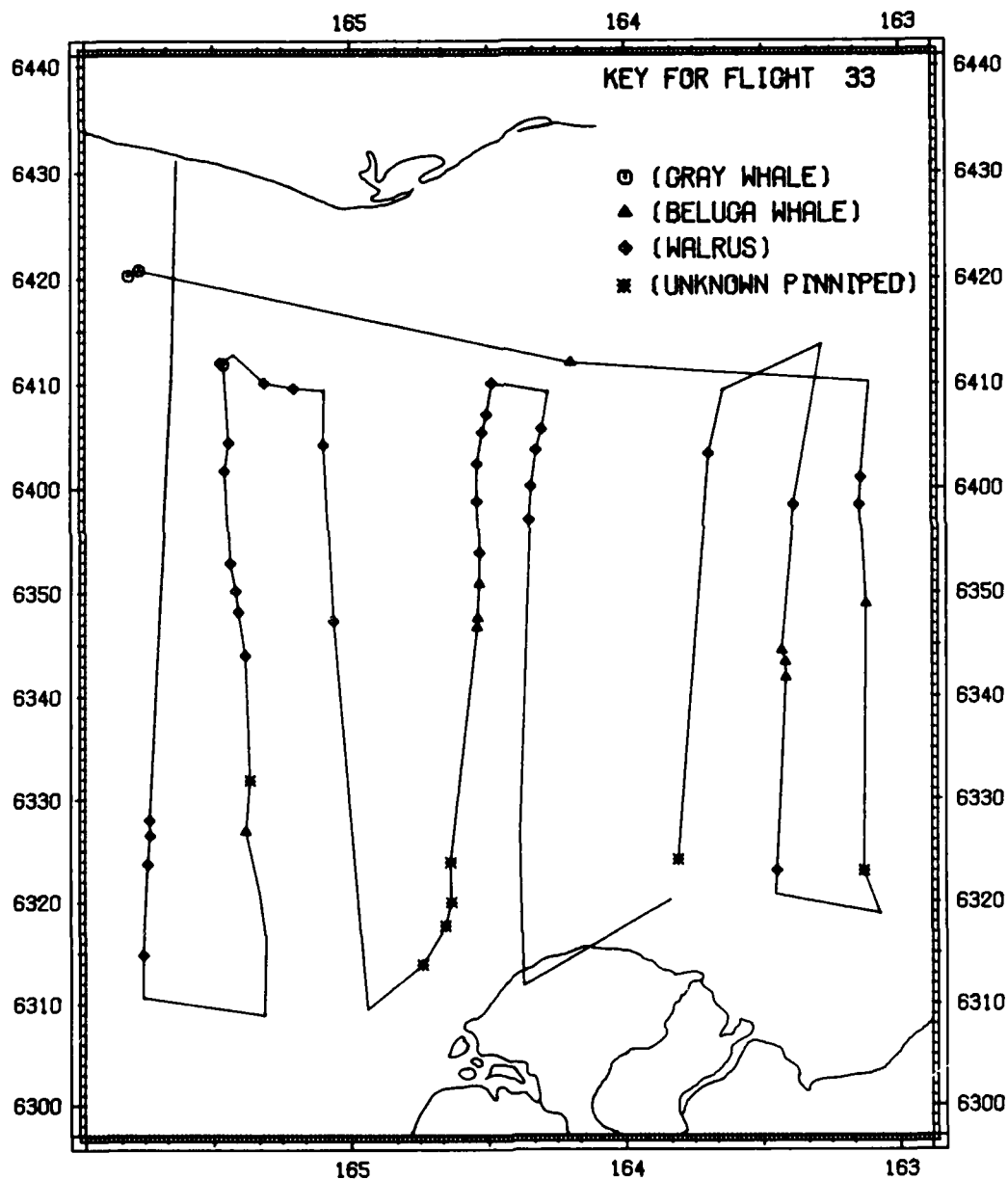
Flight was a coastal survey from Deadhorse to Nome to investigate the status of the bowhead whale migration. Weather was clear, with small areas of patchy fog; visibility was generally unlimited. Eight bowhead whales were sighted. Seventy-nine beluga whales, 94 ringed seals, 34 bearded seals, 43 walrus, and 1 polar bear were also sighted.



No Bowhead sightings for Flight 33, May 17, 1981

FLIGHT NUMBER 33, MAY 17, 1981

A transect survey was flown in Block A. Weather was clear, visibility unlimited. Sea state ranged from Beaufort 1 to 3. Five gray whales were sighted. Thirty-four beluga whales, 1124 walrus, and 56 unidentified pinnipeds were also seen.

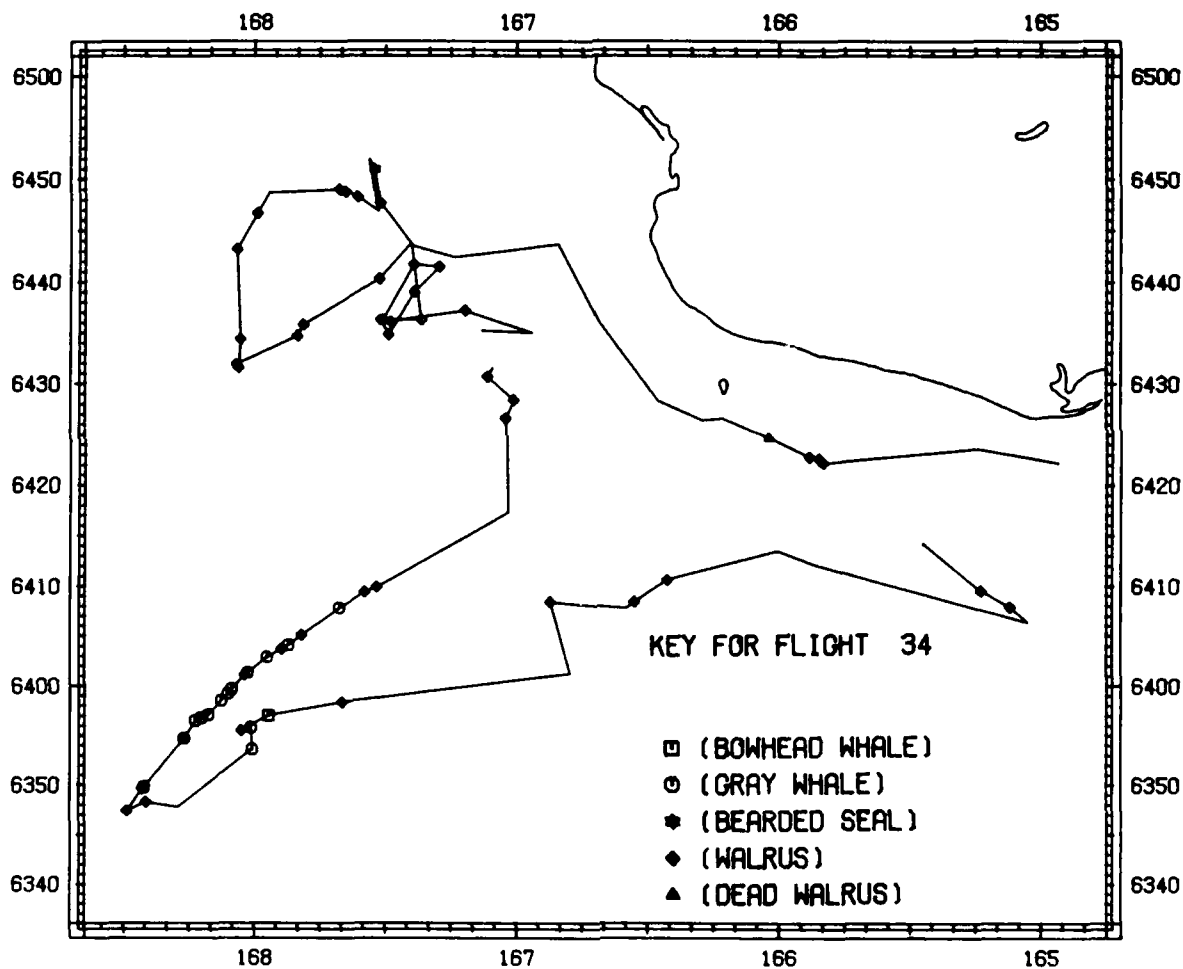


Bowhead Whale Sightings for Flight 34, May 19, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	167 56.8	63 57.0	152	B1	swimming

FLIGHT NUMBER 34, MAY 19, 1981

Flight was a search to look for walrus kills near St. Lawrence Island with Alaska Fish and Game biologists. Weather ranged from clear to overcast, with an average visibility of 20 km. Sea state ranged from Beaufort 2 to 3. One unconfirmed bowhead whale sighting was made. Forty-two gray whales, 1545 walrus, and 1 unidentified pinniped were sighted.

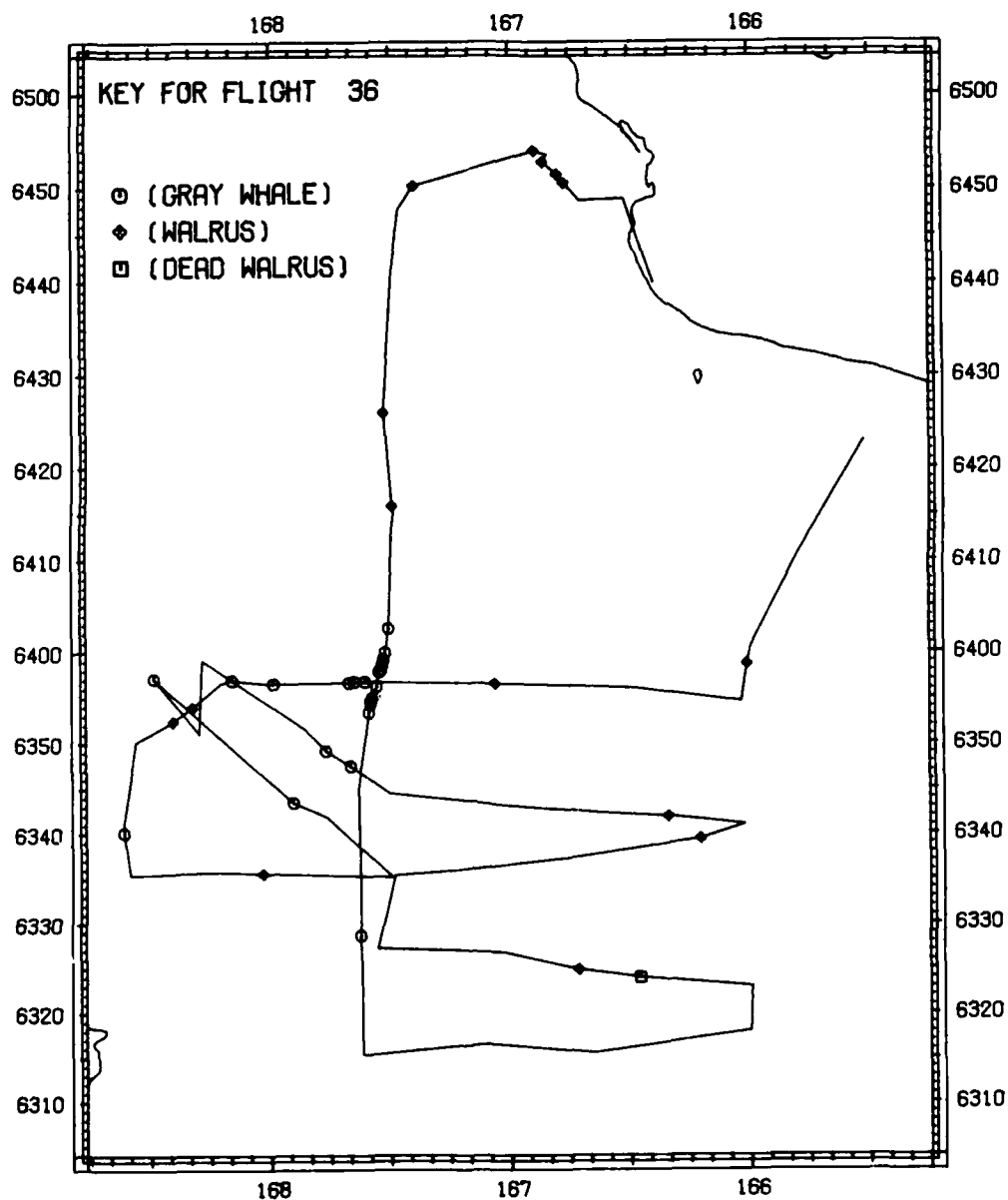


A transect survey was flown in Block C. Weather was clear, visibility unlimited. Sea state ranged from Beaufort 1 to 3. Fifty-six gray whales, 16 killer whales, 3040 walrus, and 2 ringed seals were sighted. An area containing gray whales and killer whales was circled for 90 min in order to record behavioral data.



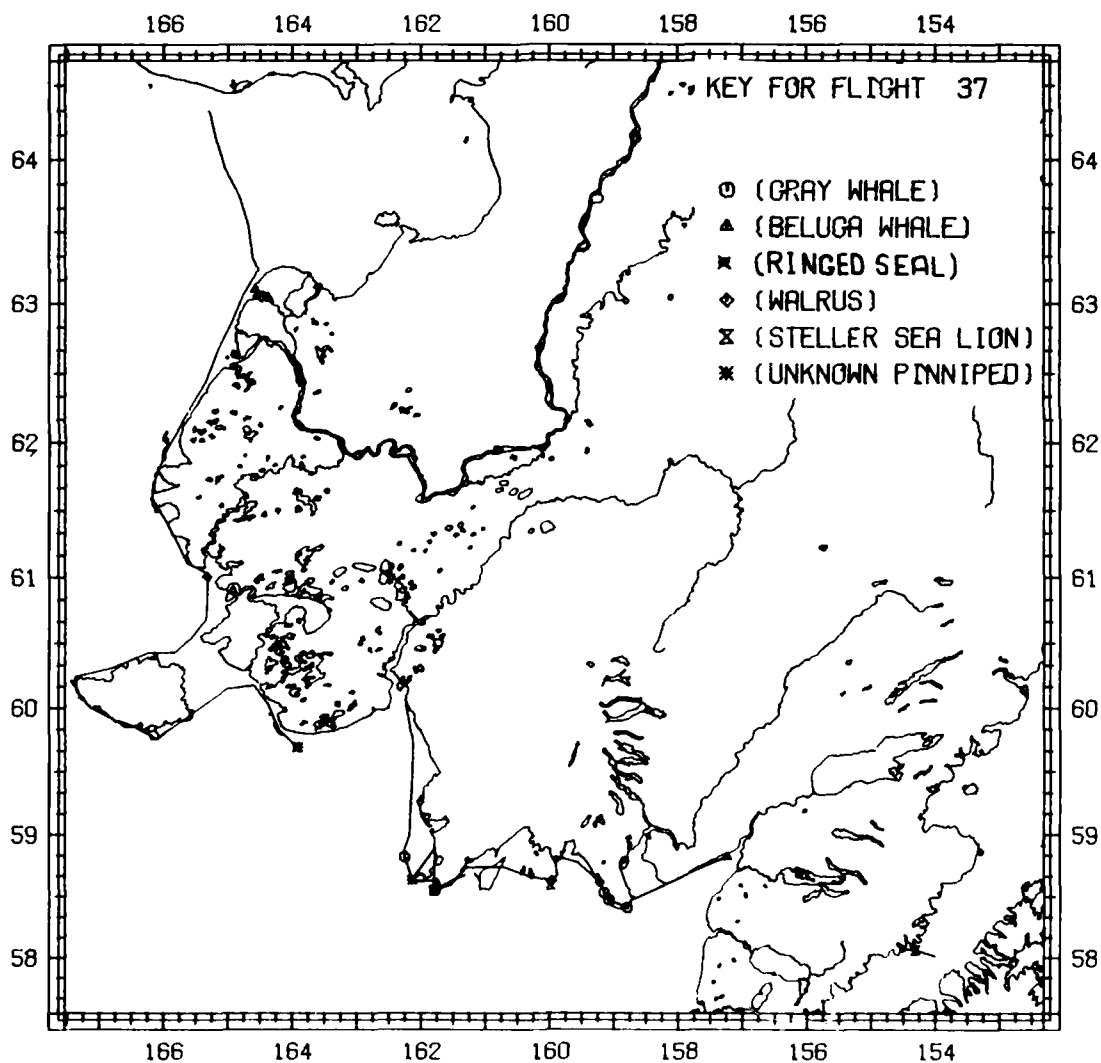
FLIGHT NUMBER 36, MAY 22, 1981

A transect survey was flown in Block B. Weather was clear with some patchy fog; visibility was limited to less than 2 km. Sea state ranged from Beaufort 2 to 3. Thirty-two gray whales and over 1000 walrus were sighted. Floating dead walrus were also seen.



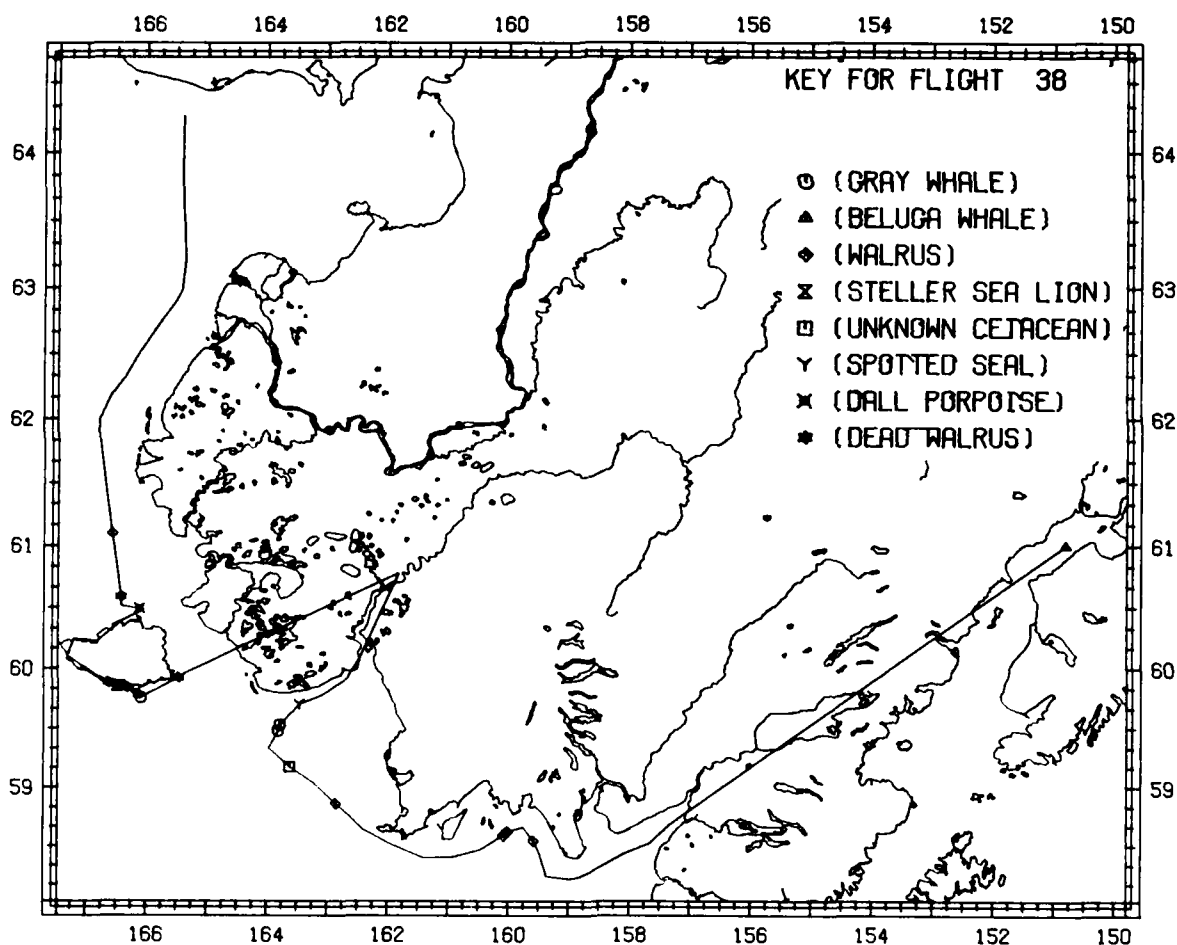
FLIGHT NUMBER 37, MAY 24, 1981

Flight was a coastal survey from Nome to Kodiak. Weather conditions ranged from clear to overcast with rain squalls, visibility from about 7 km to unlimited. Sea state ranged from Beaufort 1 to 4. Eleven gray whales, 4 beluga whales, 51 ringed seals, 393 Steller sea lions, 4015 walrus were sighted and approximately 500 unidentified pinnipeds were seen.



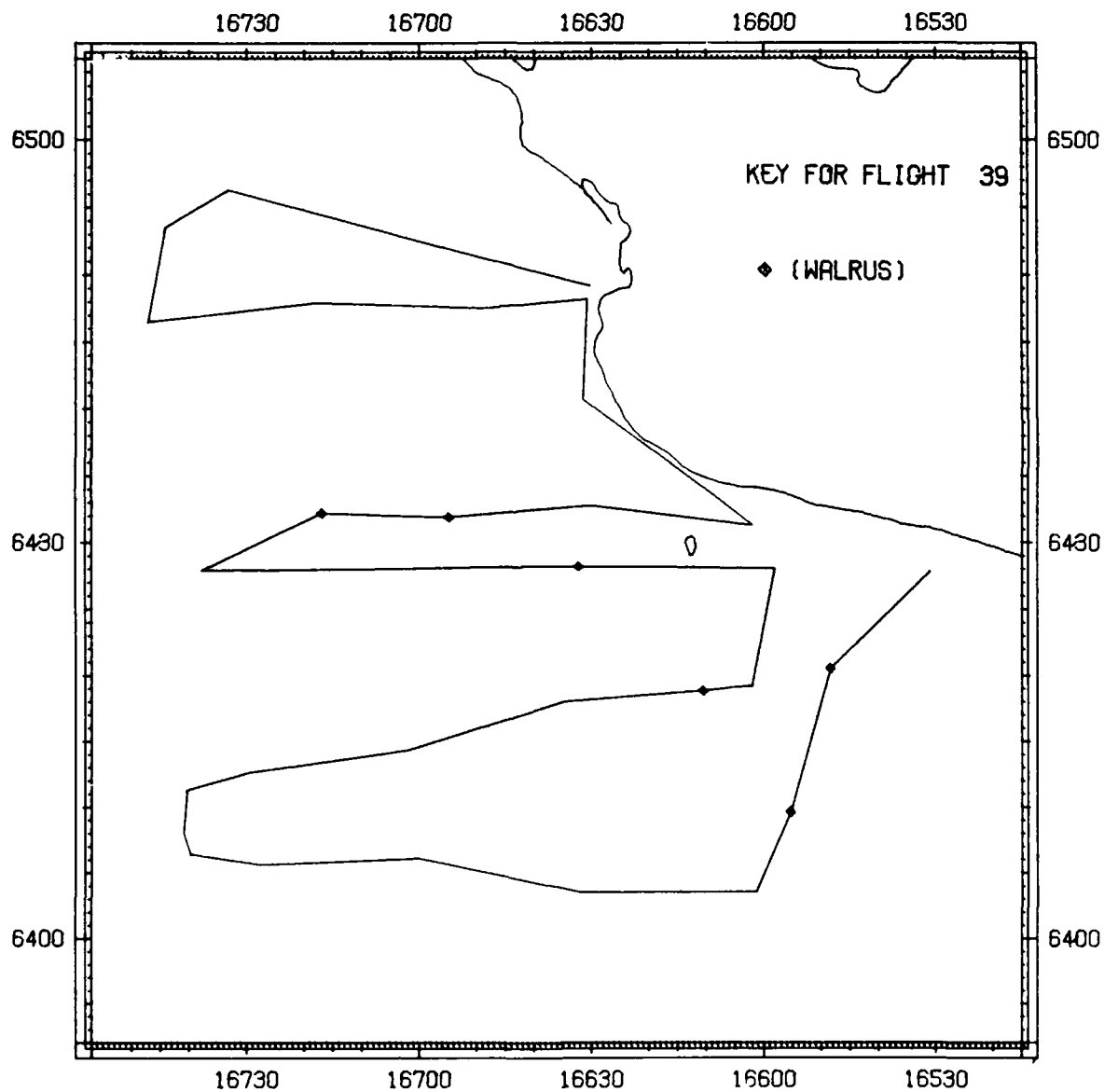
FLIGHT NUMBER 38, MAY 30, 1981

Flight was a coastal survey from Anchorage to Nome. Weather ranged from cloudy to clear, visibility from 20 km to unlimited. Sea state ranged from Beaufort 1 to 4. Seven gray whales, 4 beluga whales, 15 Dall's porpoise, 4 unidentified cetaceans, 3 Steller sea lions, 8 spotted seals, and 2004 walrus were sighted. Dead walrus were also seen.



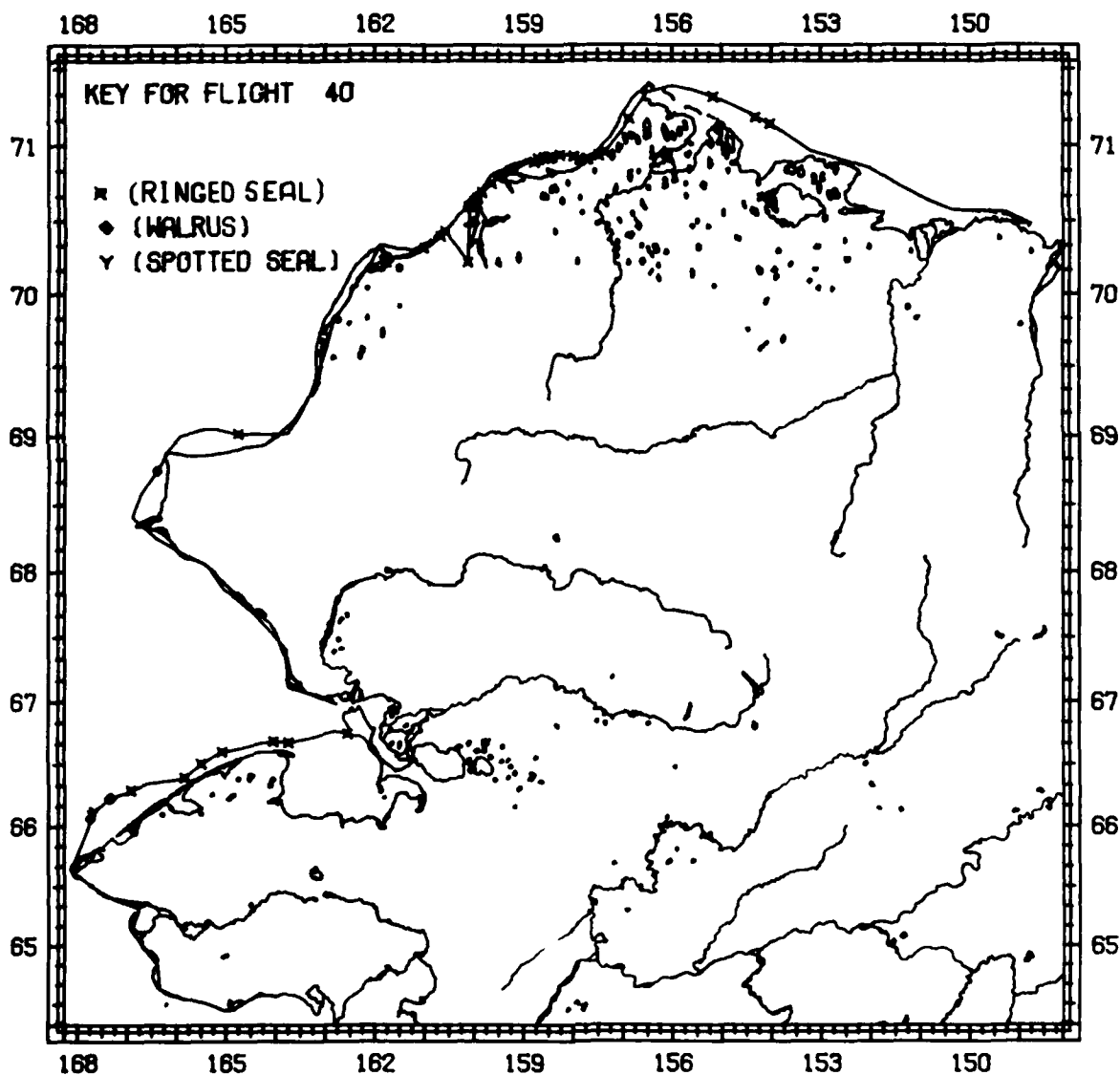
FLIGHT NUMBER 39, MAY 31, 1981

A transect survey was flown in Block D. Weather was mostly clear and sunny with some patchy fog, necessitating the truncation of some transect legs. Visibility ranged from unlimited to less than 0.5 km. Sea state ranged from Beaufort 1 to 3. Six walrus were sighted.



FLIGHT NUMBER 40, JUNE 1, 1981

Flight was a coastal survey from Nome to Deadhorse. Weather conditions ranged from clear to foggy, visibility from unlimited to less than 0.5 km. Sea state ranged from Beaufort 1 to 4; ice conditions from 1/10 to 10/10 coverage. One hundred and three ringed seals, 8 spotted seals, and 7 walrus were sighted.

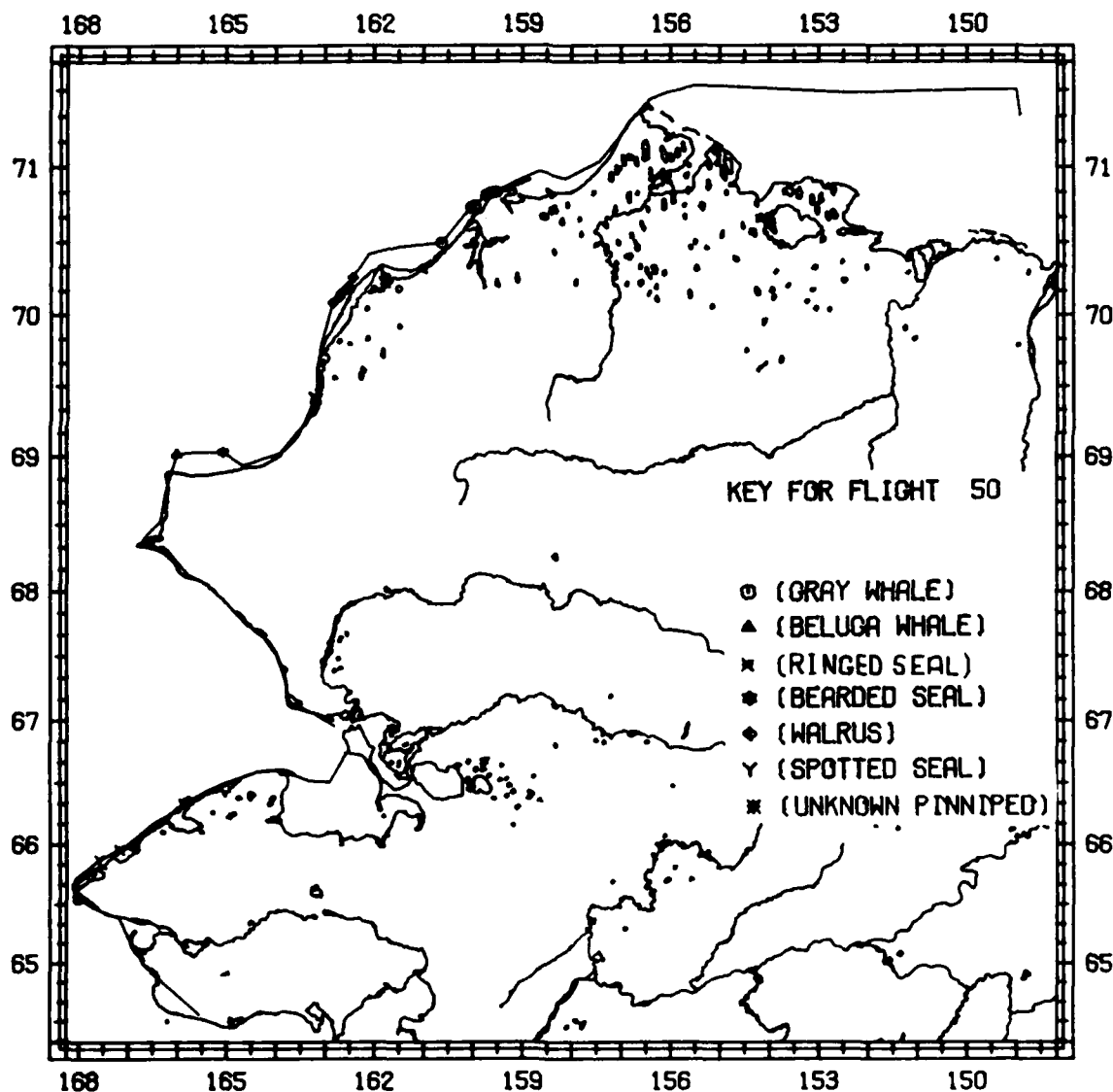


FLIGHTS NUMBER 41-49, JUNE 2-9, 1981

These flights were made to survey the ringed seal population in the Beaufort Sea in cooperation with Alaska Fish and Game biologists.

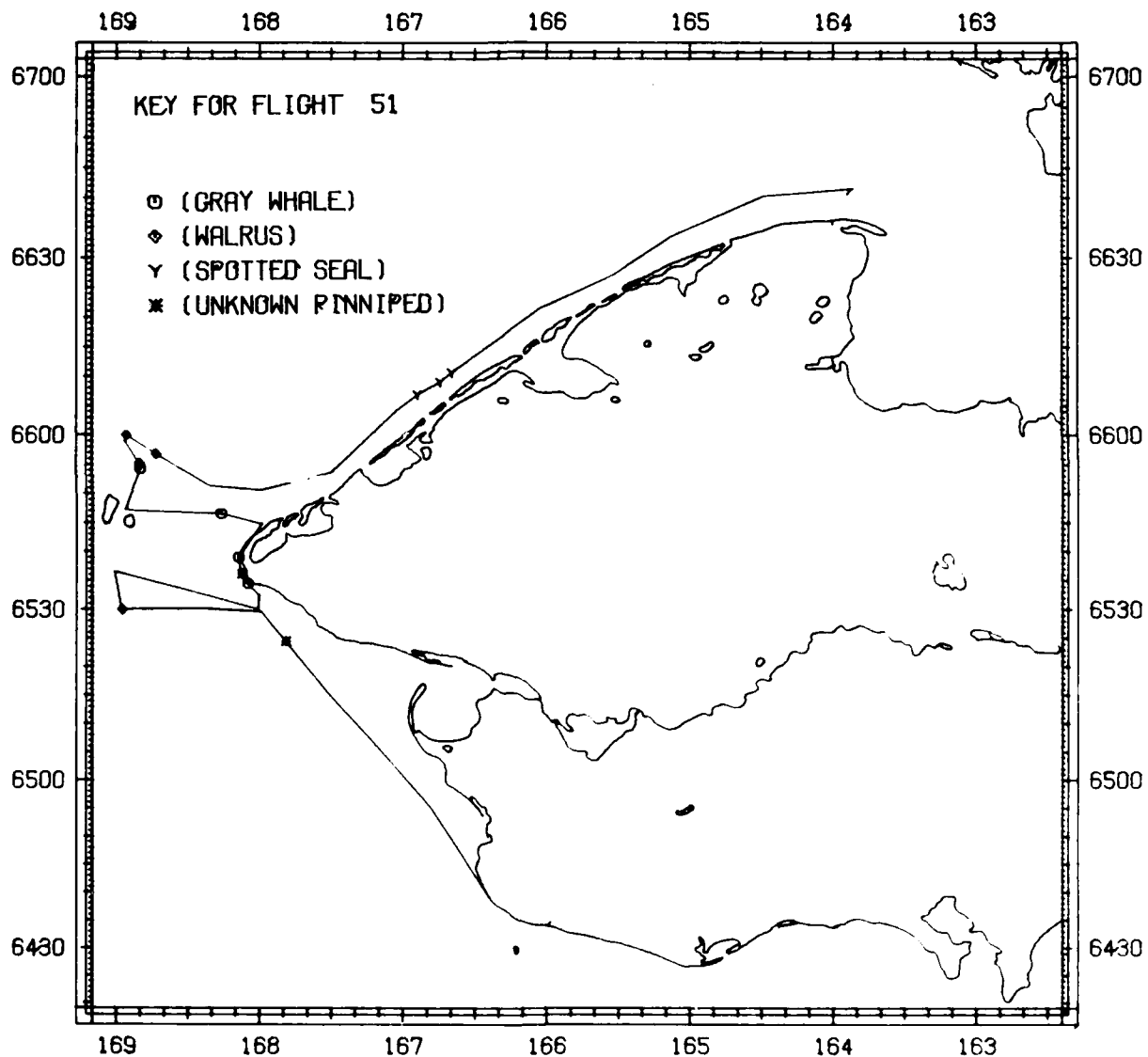
FLIGHT NUMBER 50, JUNE 10, 1981

Flight was a coastal survey from Deadhorse to Nome. Weather ranged from heavy overcast to clear, visibility from less than 0.5 km to unlimited. Beaufort Sea conditions averaged 9/10 with small cracks and leads. Sea state south of Barrow ranged from Beaufort 1 to 2. Fifteen gray whales, 14 beluga whales, 12 ringed seals, 3 bearded seals, 20 spotted seals, 2126 walrus, and 1 unidentified pinniped were sighted.



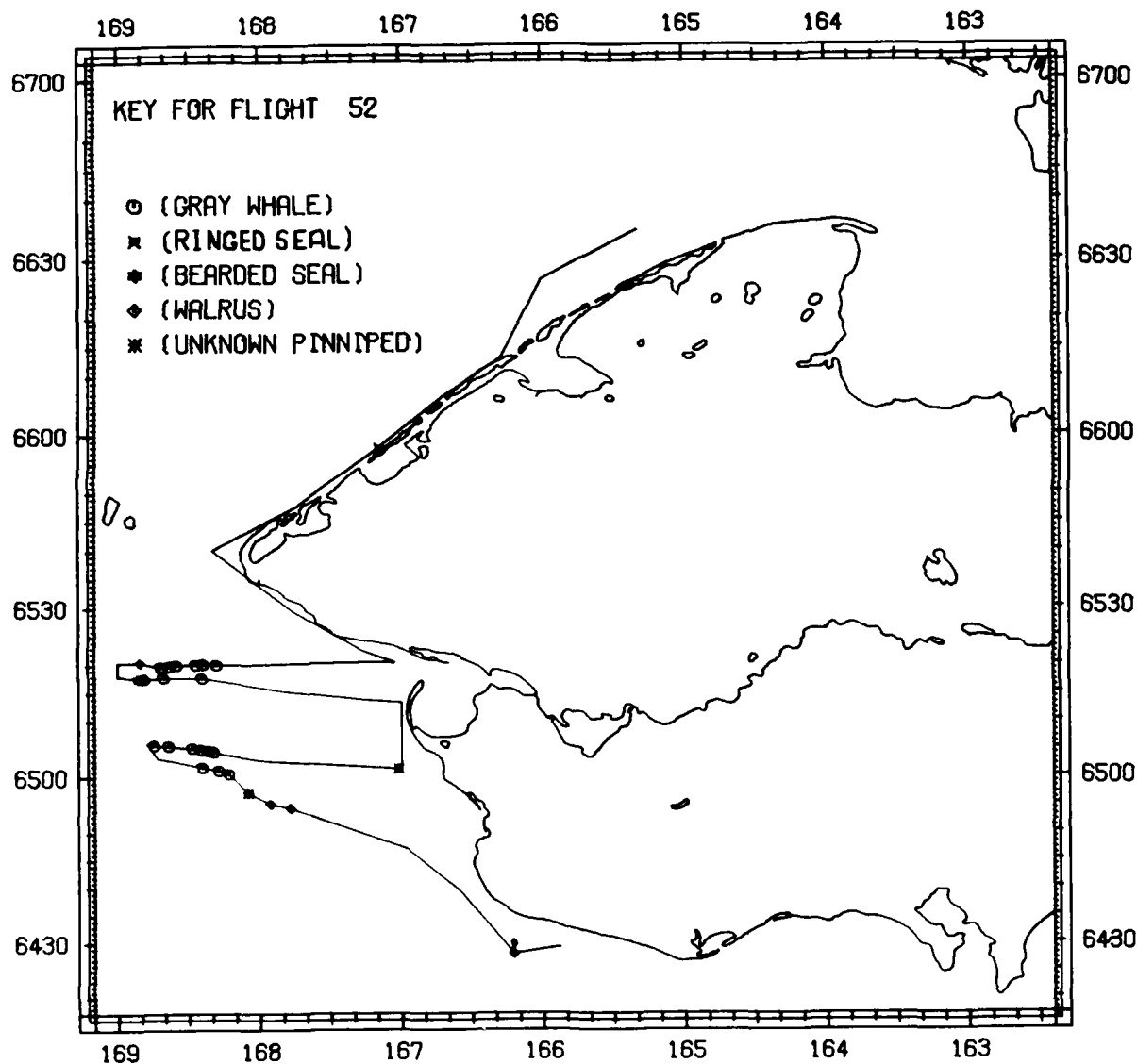
FLIGHT NUMBER 51, JUNE 11, 1981

A transect survey was flown in Block G. Weather was clear, visibility unlimited. Sea state ranged from Beaufort 2 to 3. Five gray whales, 9 spotted seals, 4 walrus, and 2 unidentified pinnipeds were sighted.



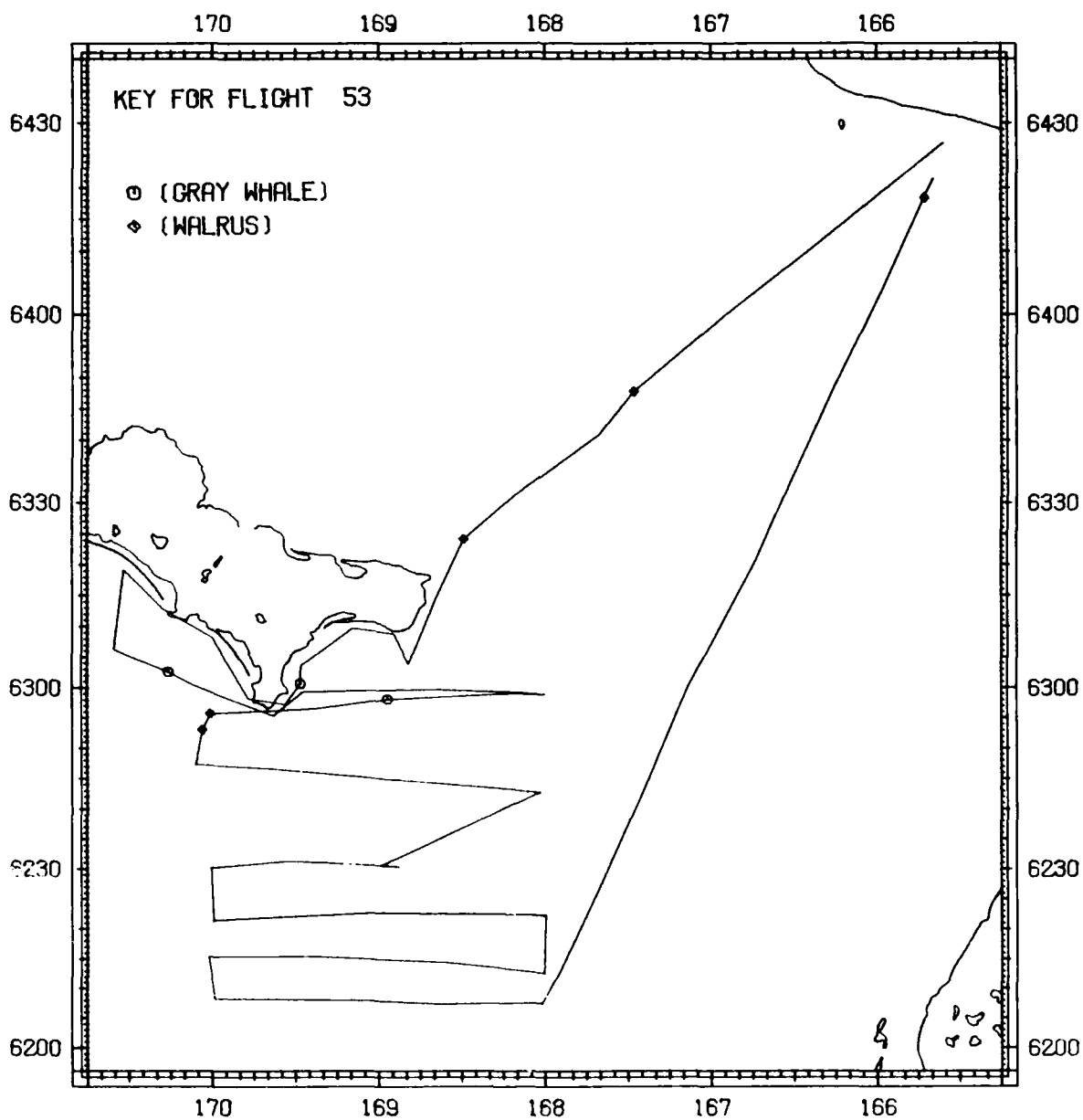
FLIGHT NUMBER 52, JUNE 12, 1981

A transect survey was flown in Block F. Weather was high overcast with patchy fog; visibility ranged from 0.5 km to 30 km. Sea state ranged from Beaufort 2 to 3. Ninety-one gray whales, 1 bearded seal, 1 ringed seal, 2 unidentified pinnipeds, and 114 walrus were sighted.



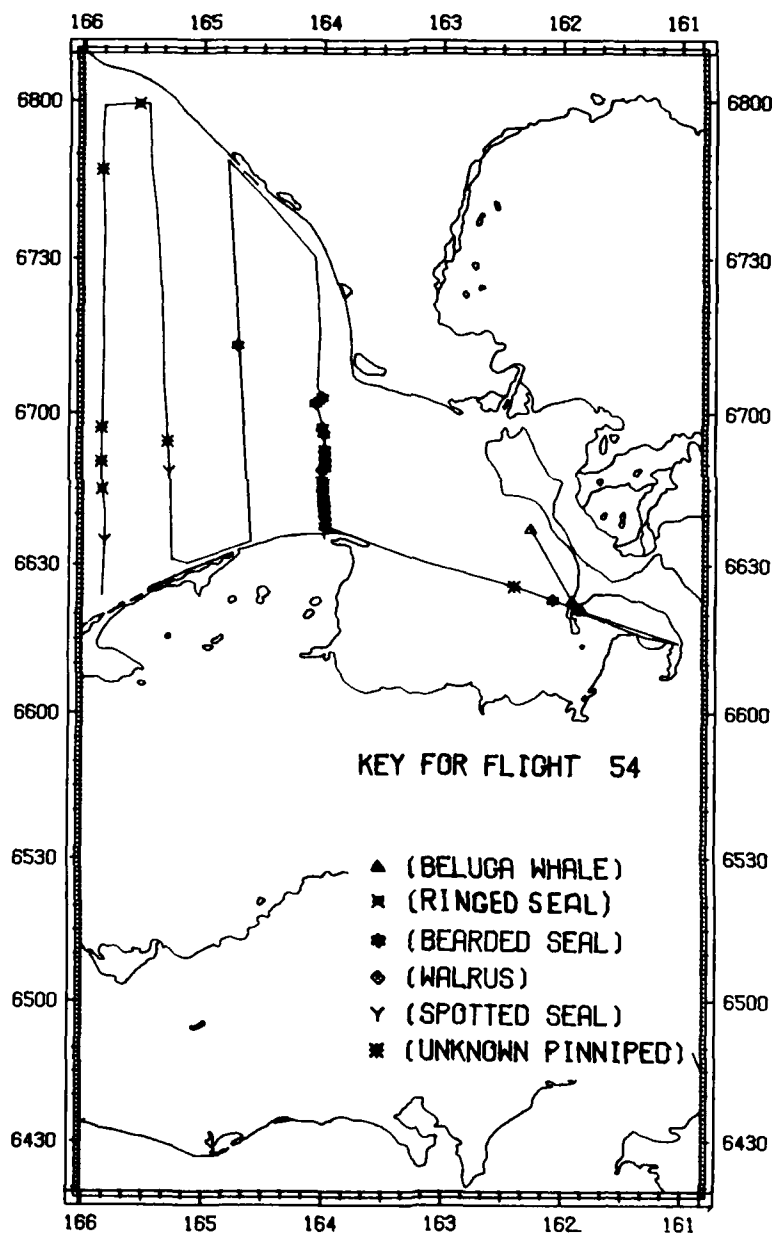
FLIGHT NUMBER 53, JUNE 14, 1981

A transect survey was flown in Block P. Weather was cloudy, with an average visibility of 20 km. Sea state ranged from Beaufort 2 to 4. Three gray whales and 6 walrus were sighted.



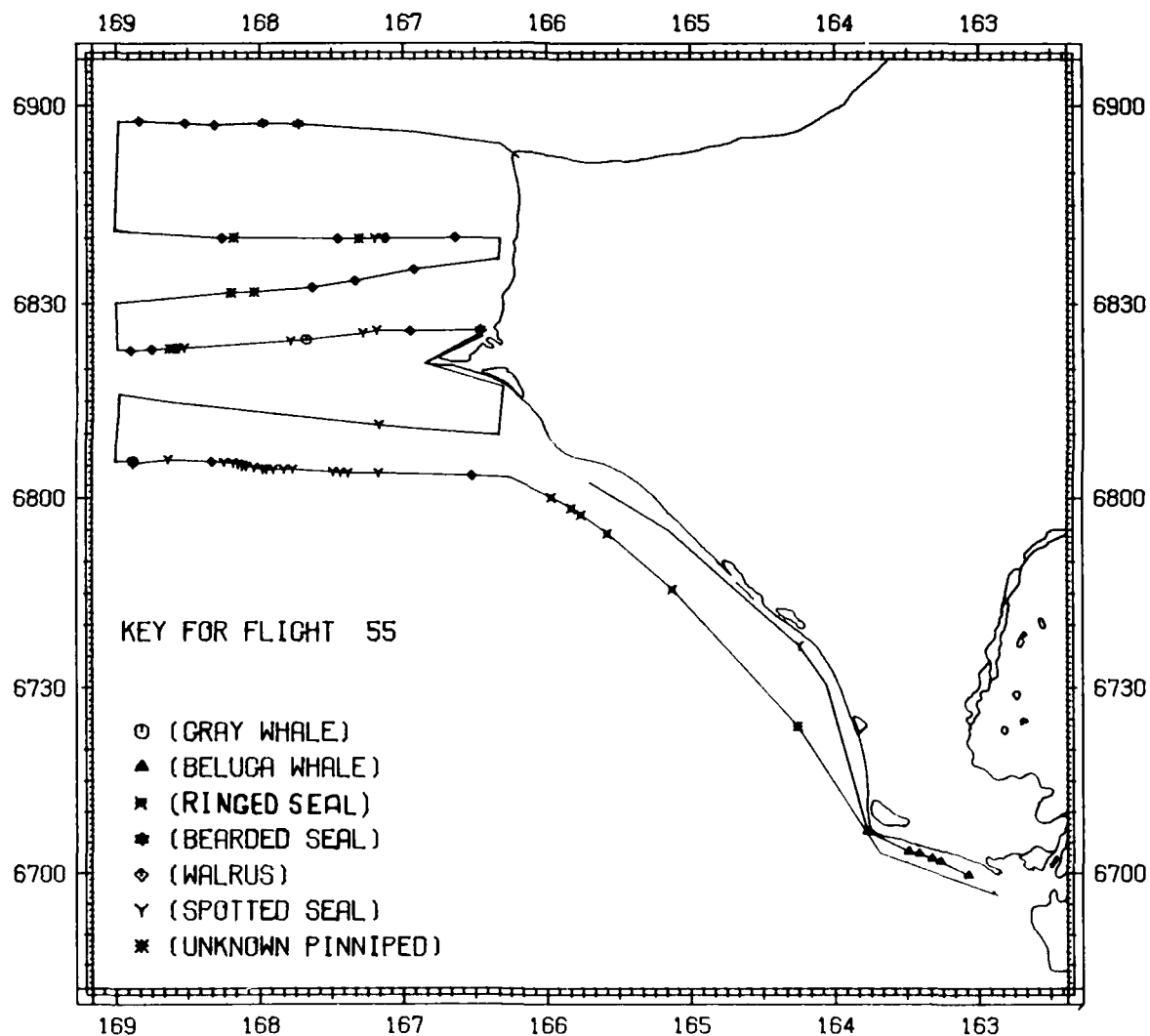
FLIGHT NUMBER 54, JUNE 15, 1981

A transect survey was flown in Block J in and near Kotzebue Sound. Weather was clear with some high clouds, visibility unlimited. Sea state was Beaufort 1; ice conditions near shore ranged from 1/10 to 8/10. Ninety-nine beluga whales, 11 spotted seals, 3 ringed seals, 25 bearded seals, 9 walrus, and 5 unidentified pinnipeds were sighted.



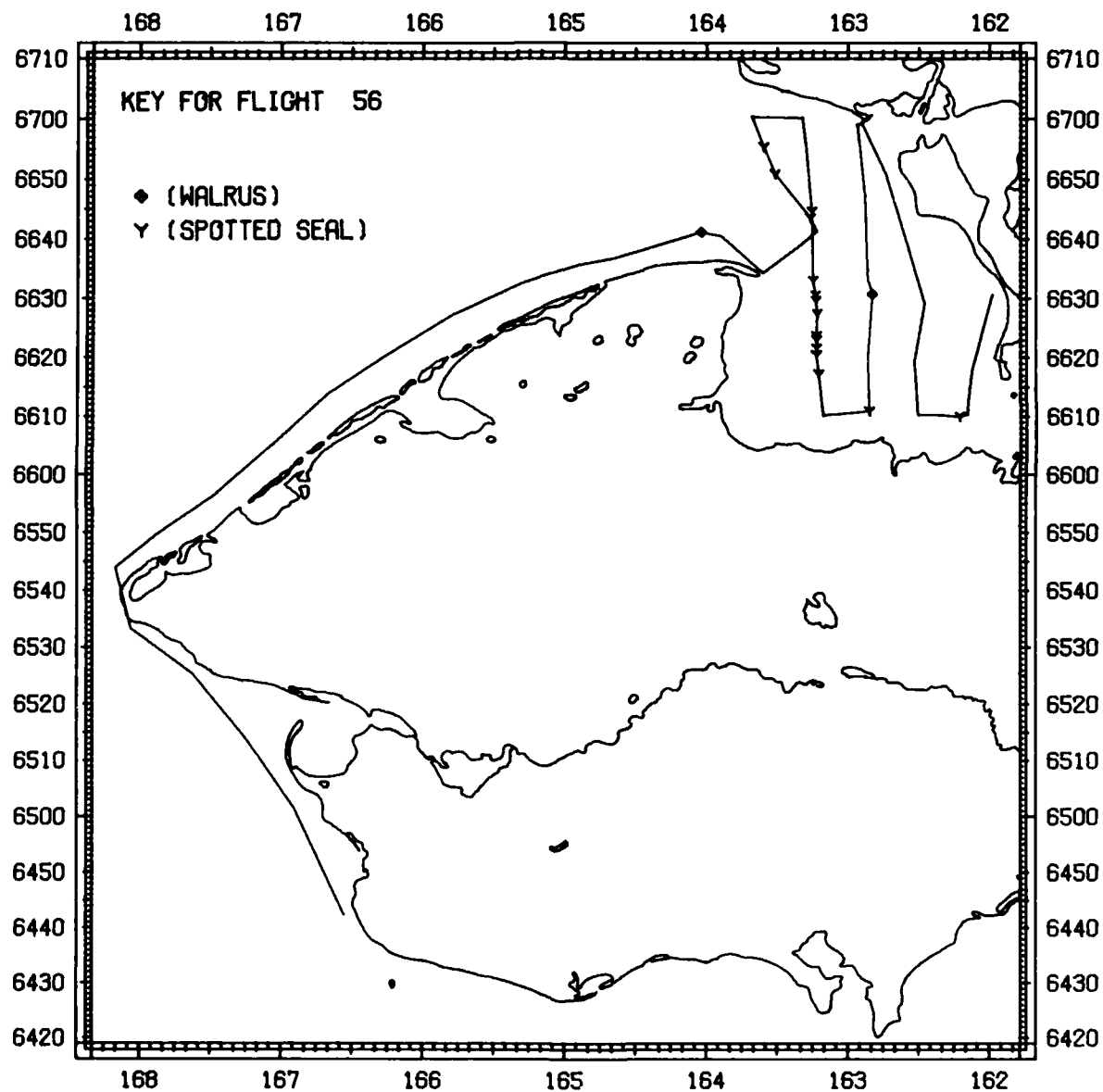
FLIGHT NUMBER 55, JUNE 16, 1981

A transect survey was flown in Block L. Weather was clear, visibility unlimited, and the sea state a Beaufort 1. Two gray whales, 37 beluga whales, 35 spotted seals, 5 ringed seals, 3 bearded seals, 46 walrus, and 6 unidentified pinnipeds were sighted.



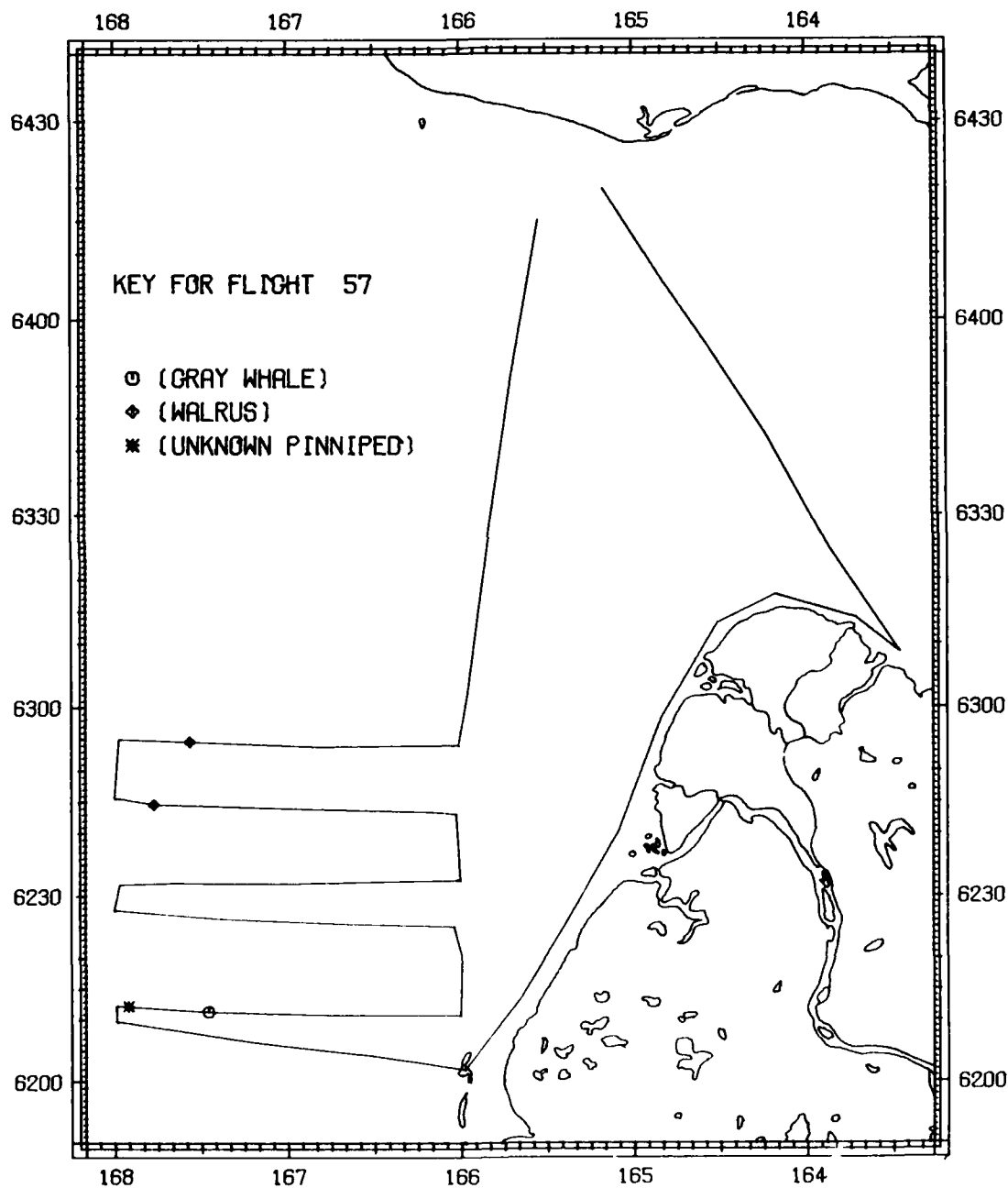
FLIGHT NUMBER 56, JUNE 17, 1981

A transect survey was flown in Block K. Weather was clear with some high clouds, visibility unlimited. Sea state ranged from Beaufort 1 to 3. Near-shore ice ranged from 1/10 to 3/10 coverage. Forty-two spotted seals and 6 walrus were sighted.



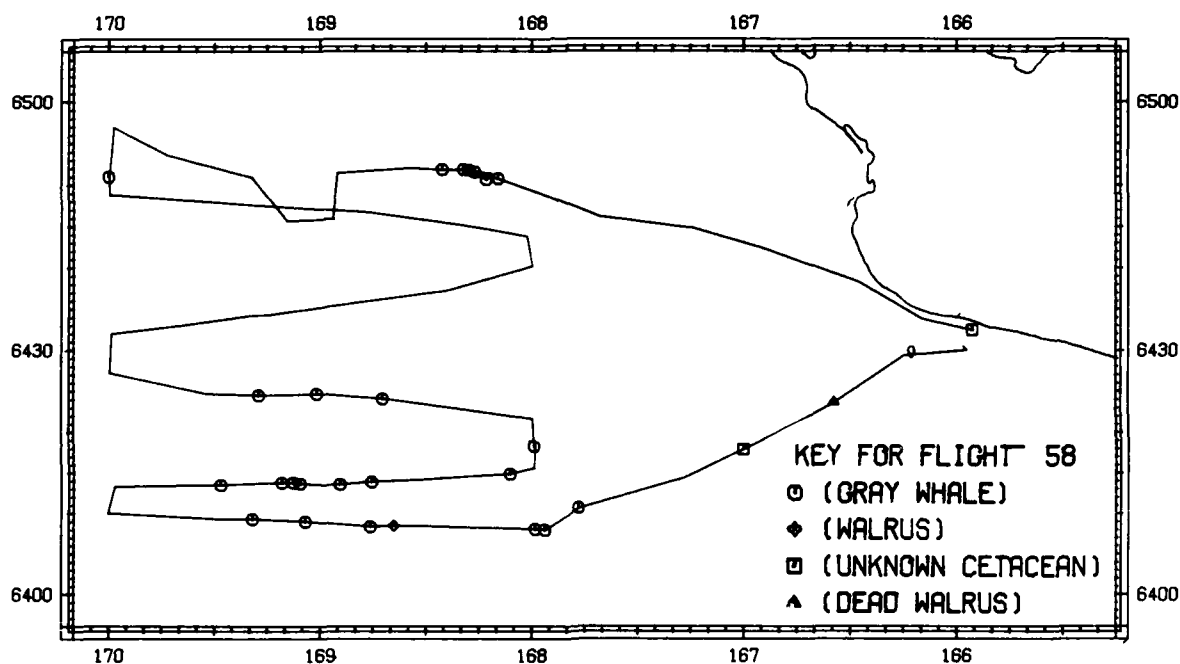
FLIGHT NUMBER 57, JUNE 18, 1981

A transect survey was flown in Block Q. Weather was clear, visibility unlimited. Sea state ranged from Beaufort 2 to 4. One gray whale, 2 walrus, and 1 unidentified pinniped were sighted.



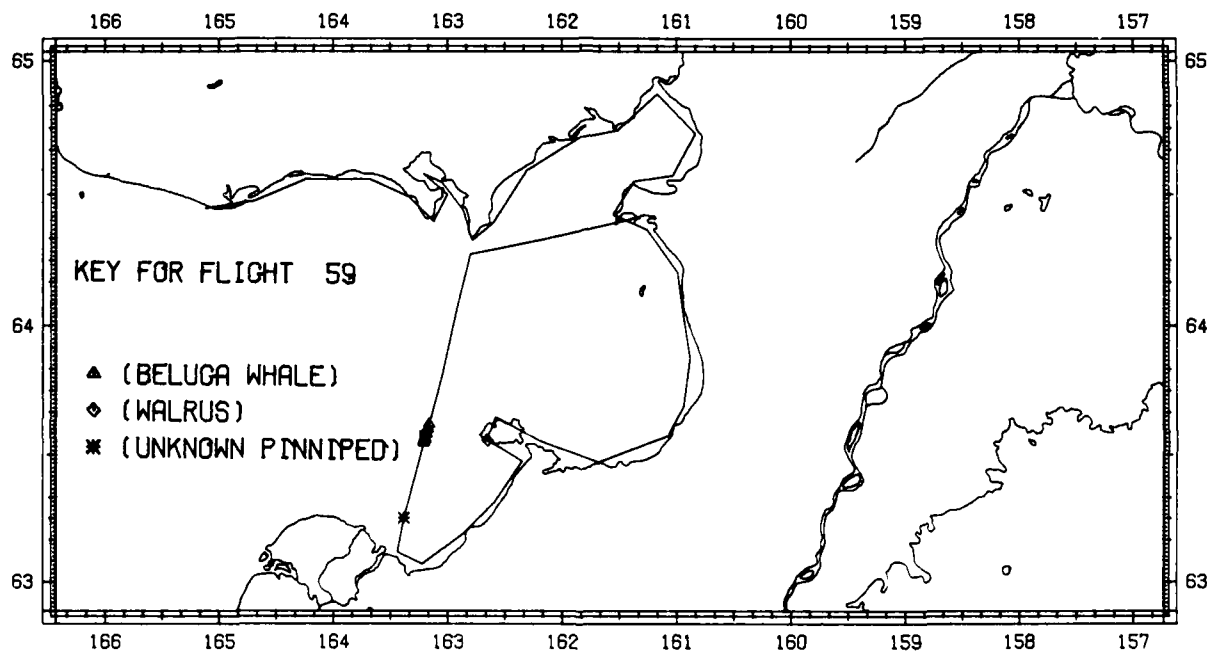
FLIGHT NUMBER 58, JUNE 21, 1981

A transect survey was flown in Block E. Weather ranged from partly cloudy to overcast with fog, visibility from less than 0.5 km to unlimited. Sea state ranged from Beaufort 2 to 3. Thirty-four gray whales, 2 walrus, and 2 unidentified cetaceans were sighted.



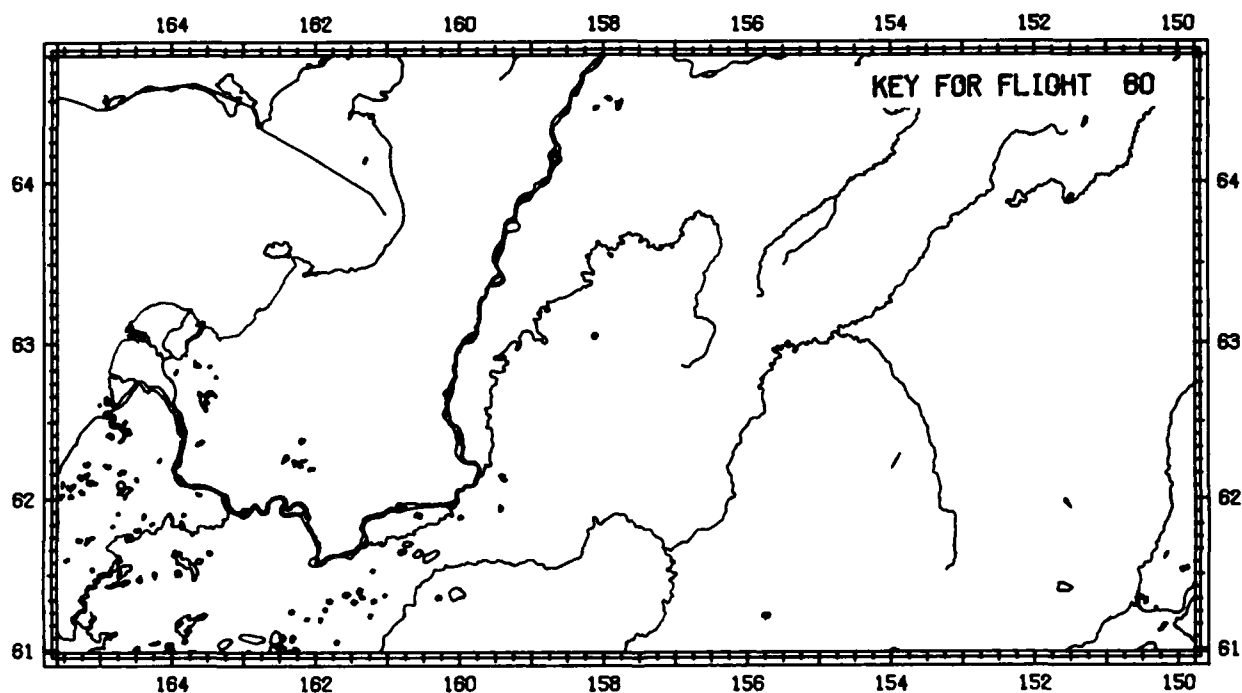
FLIGHT NUMBER 59, JUNE 22, 1981

Flight was a coastal survey around Norton Sound, then a transit overland to Anchorage for aircraft maintenance. Weather was high overcast with unlimited visibility. Sea state averaged Beaufort 2. Twelve beluga whales, 2 walrus, and 2 unidentified pinnipeds were sighted.



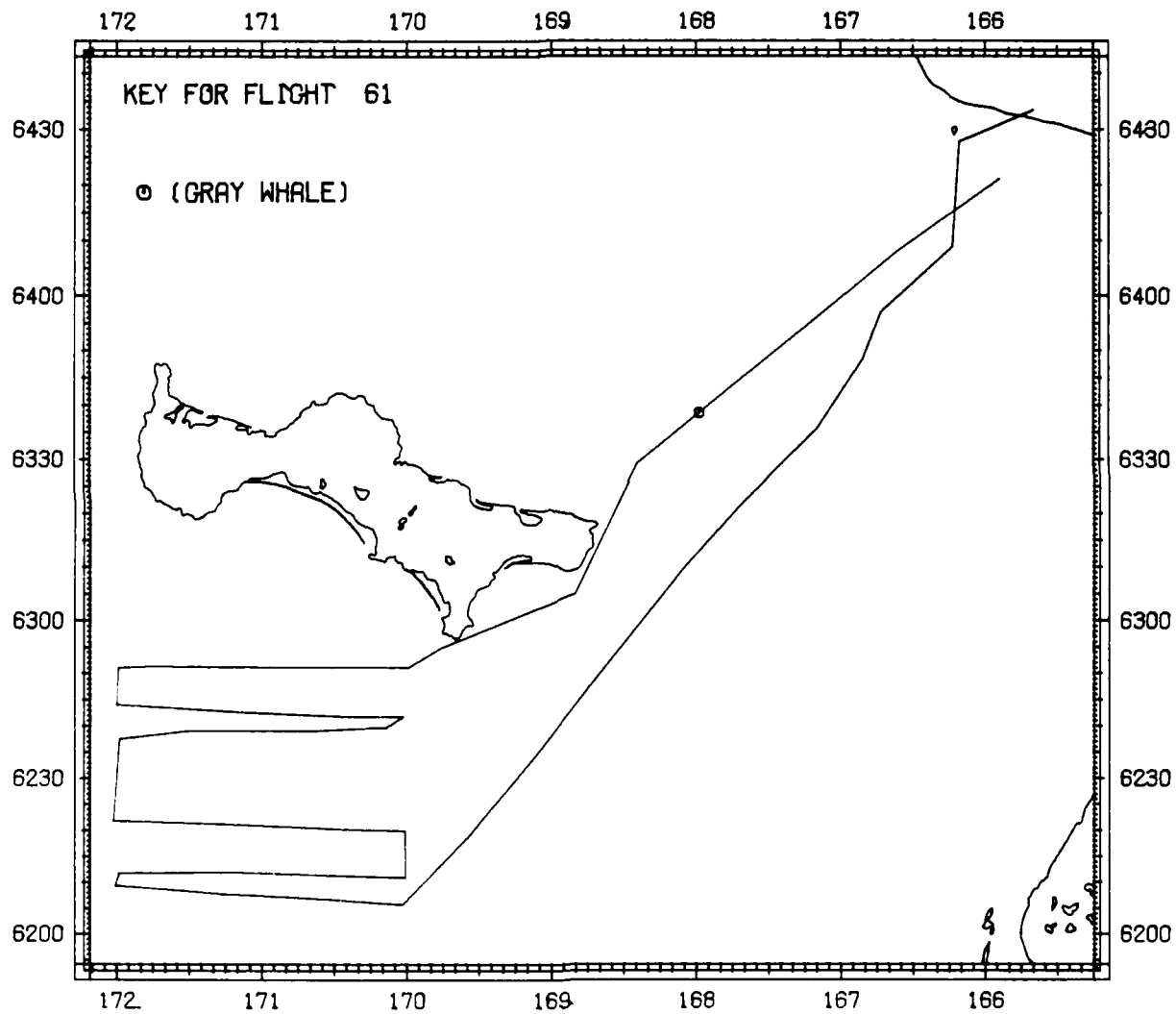
FLIGHT NUMBER 60, JUNE 29, 1981

Flight was a transit from Anchorage to Nome. No marine mammals were sighted.



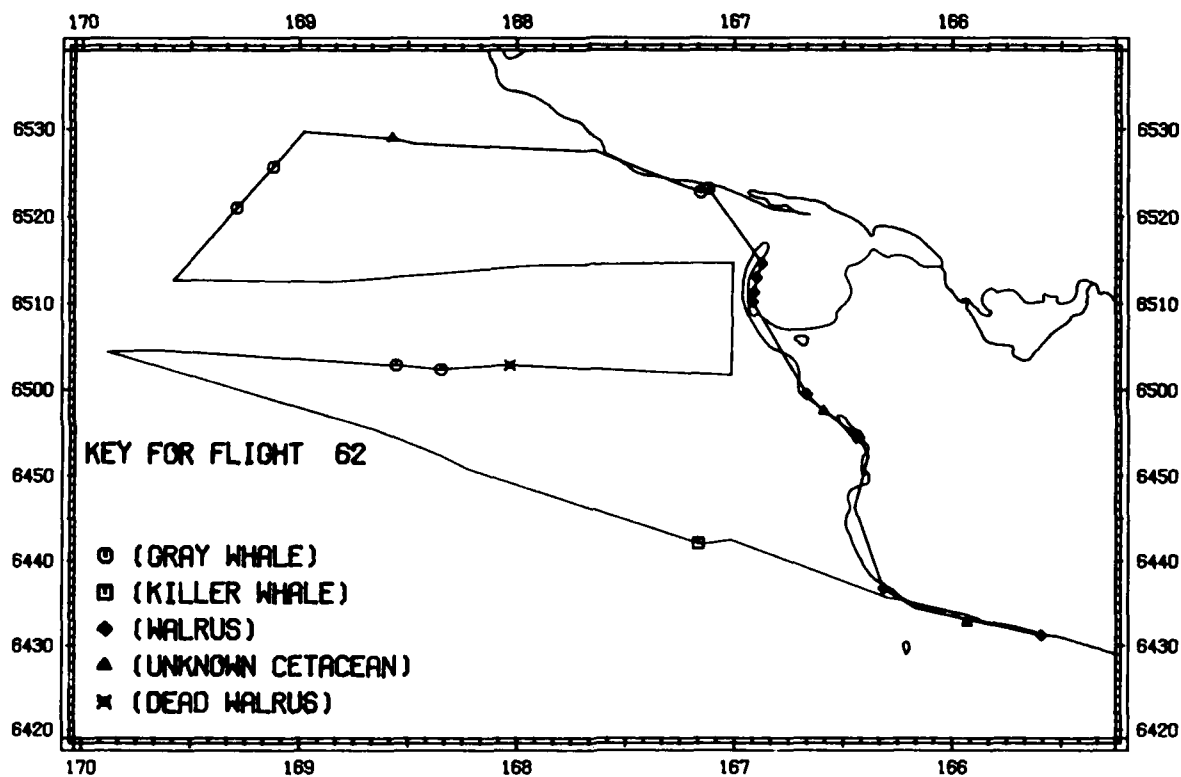
FLIGHT NUMBER 61, JUNE 30, 1981

A transect survey was flown in Block O. The weather was clear, visibility unlimited. The sea state was Beaufort 1. One gray whale was sighted.



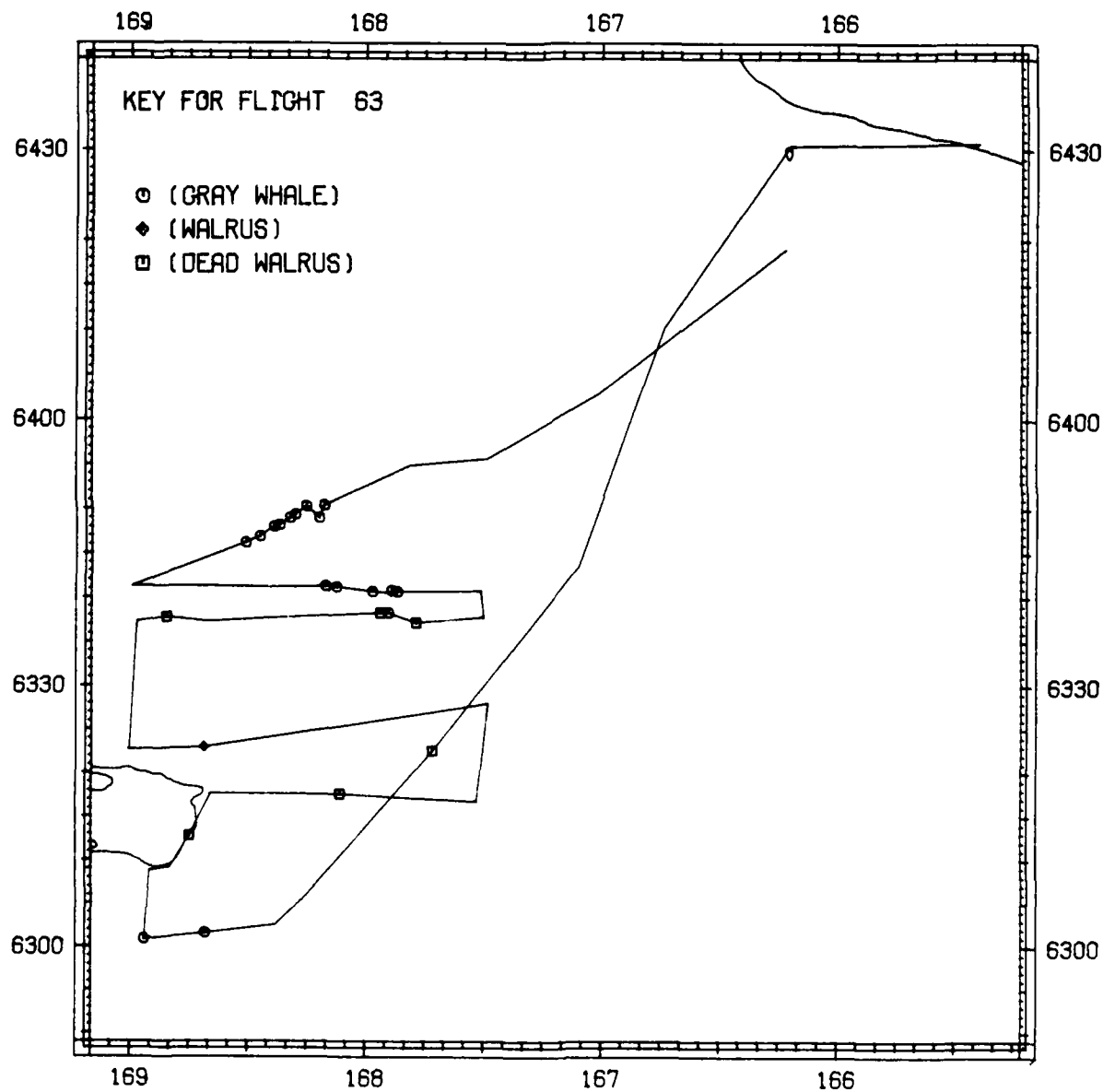
FLIGHT NUMBER 62, JULY 2, 1981

A transect survey was flown in Block F. Weather was partly cloudy with unlimited visibility. The sea state rose from Beaufort 2 to Beaufort 4 as winds increased to over 20 kt at Cape Prince of Wales. Eight gray whales, 1 killer whale, 2 unidentified cetaceans, and 13 dead walrus were sighted. Sonobuoys were dropped near the gray whales and the killer whale.



FLIGHT NUMBER 63, JULY 3, 1981

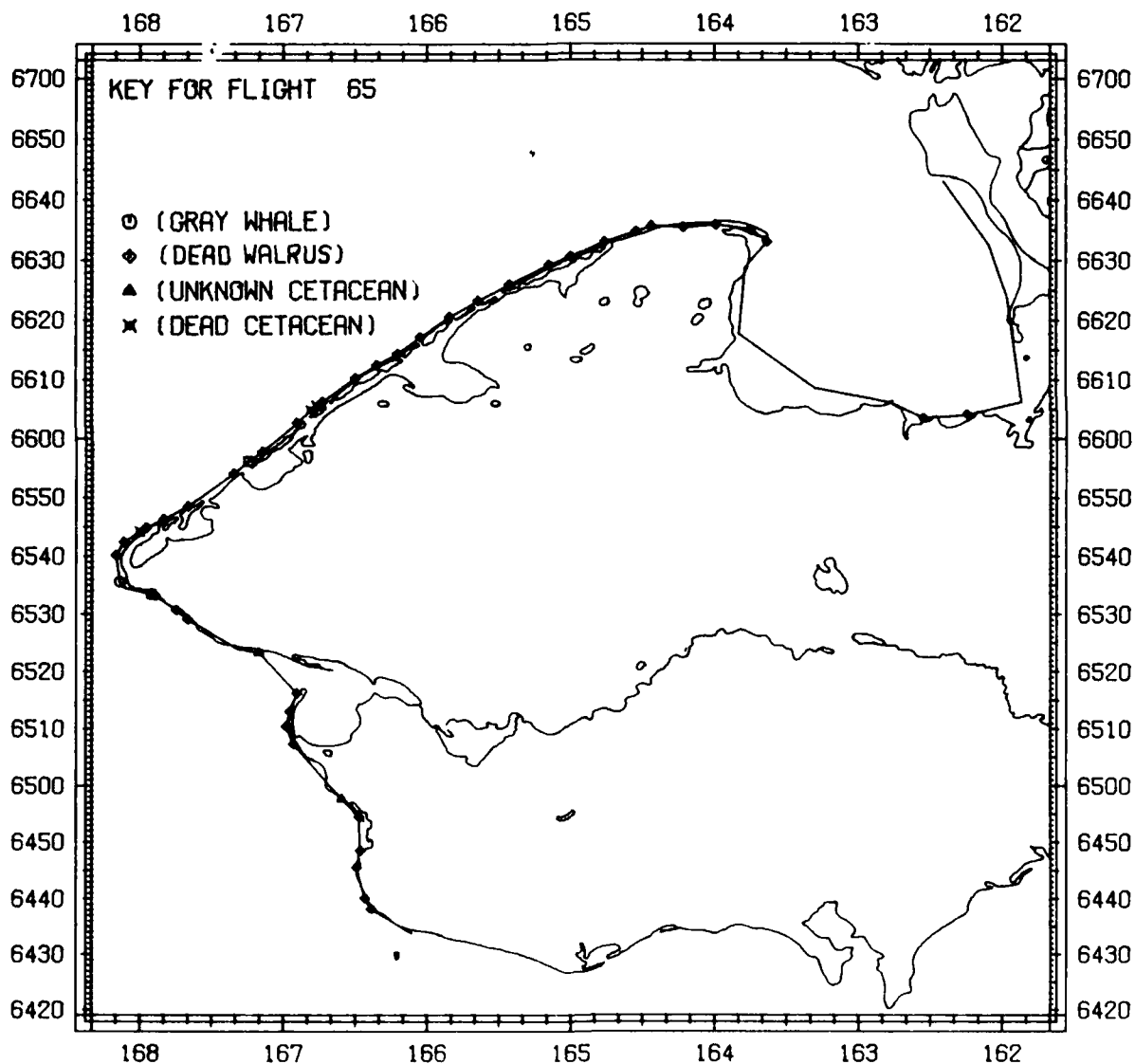
A transect survey was flown in Block C. The weather was clear, visibility unlimited, and the seas calm. Thirty-five gray whales were sighted and sonobuoys dropped near them. Four live and fifty-two dead walrus were also sighted.





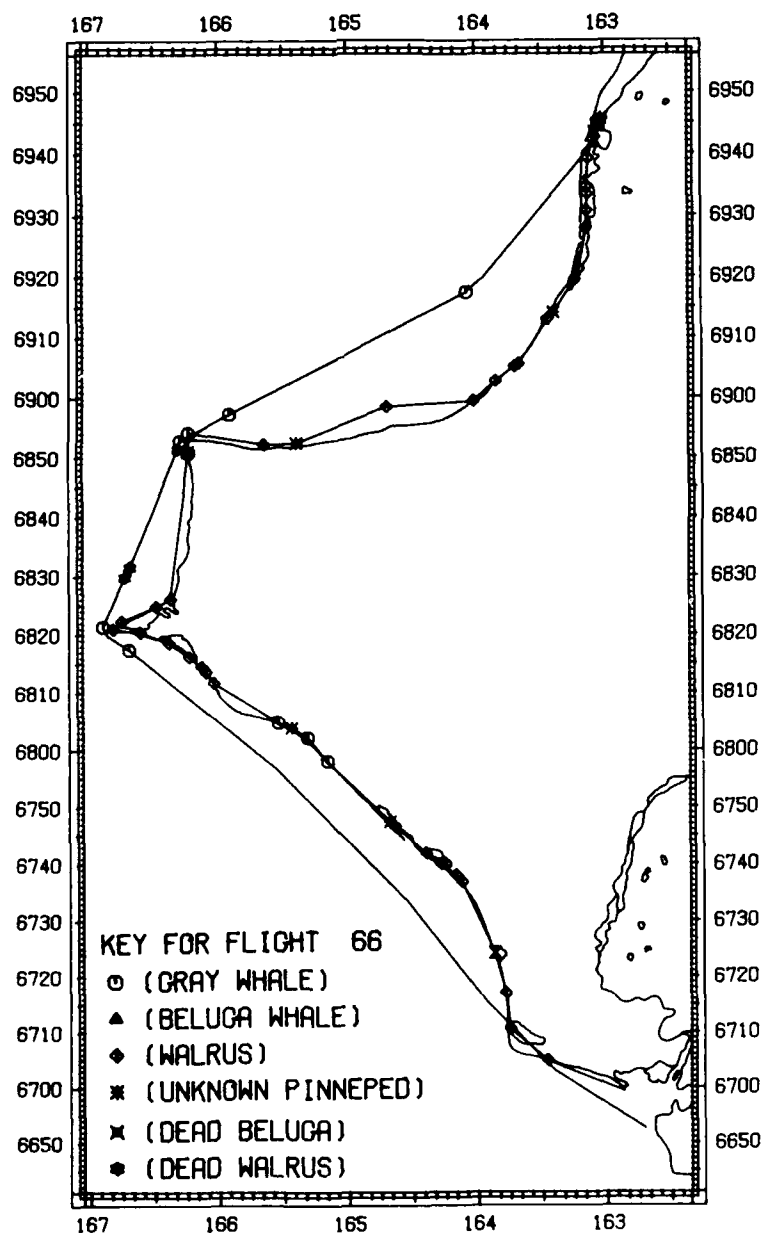
FLIGHT NUMBER 65, JULY 7, 1981

Flight was a coastal survey from Nome to Kotzebue. The weather was overcast but visibility was unlimited. The sea state was Beaufort 2, but the water was often muddy or cloudy. Four gray whales and 3 unidentified cetaceans were sighted. Four unidentified whale carcasses and 179 dead walrus were sighted on the beach.



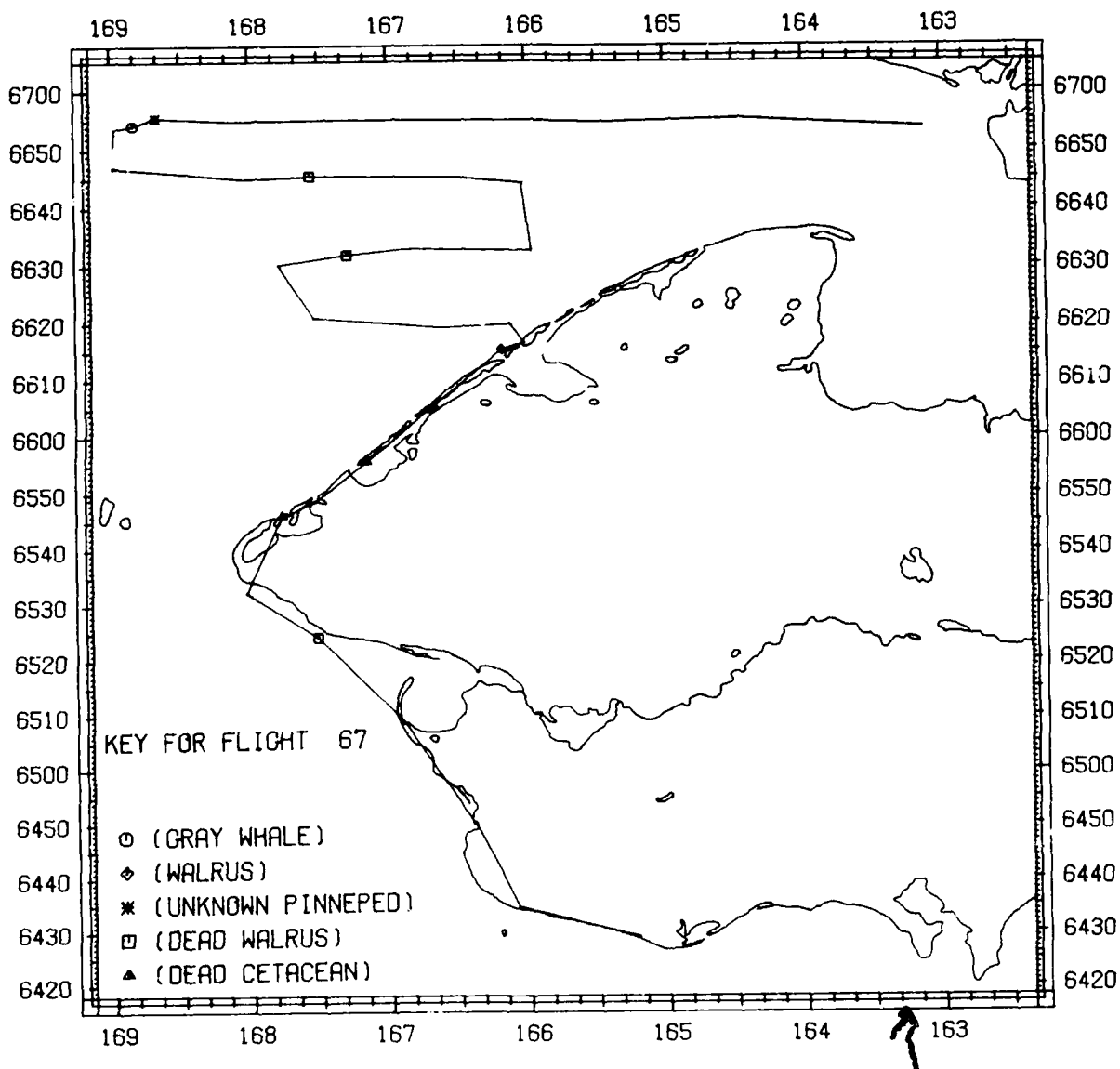
FLIGHT NUMBER 66, JULY 8, 1981

Flight was a coastal survey from Kotzebue to Pt. Lay. Weather was clear and visibility unlimited. Sea state was Beaufort 1 to 2. Twenty-nine gray whales, 1 live beluga whale and 6 unidentified pinnipeds were sighted. One hundred and fourteen dead walrus and 33 dead beluga whales were sighted on the beach. Feeding gray whales near Pt. Hope, including 3 cow-calf pairs, were recorded.



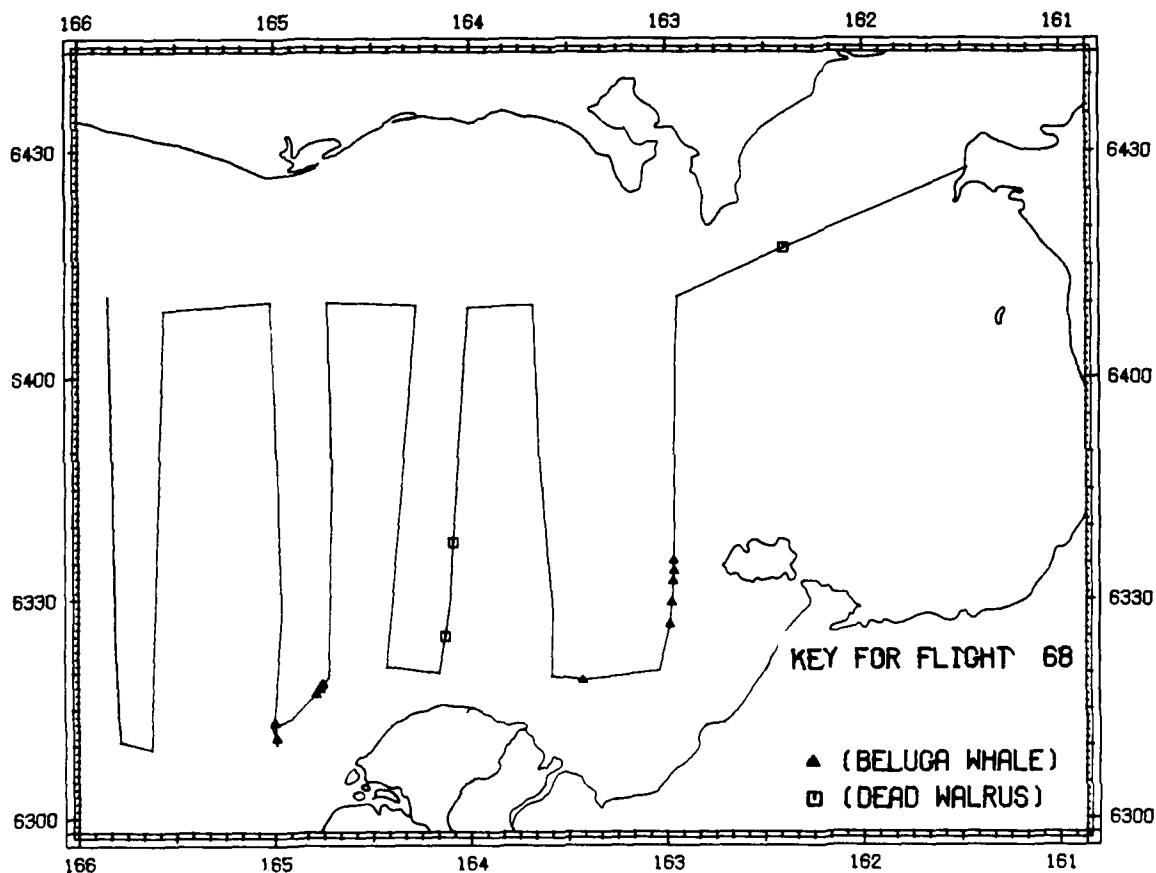
FLIGHT NUMBER 67, JULY 10, 1981

A transect survey in Block H was cancelled due to fog. Weather was mixed, as was visibility. Sea state was Beaufort 1 to 2. One gray whale and 1 unidentified pinniped were sighted. Four dead walrus and 3 unidentified whale carcasses were resighted on the beach.



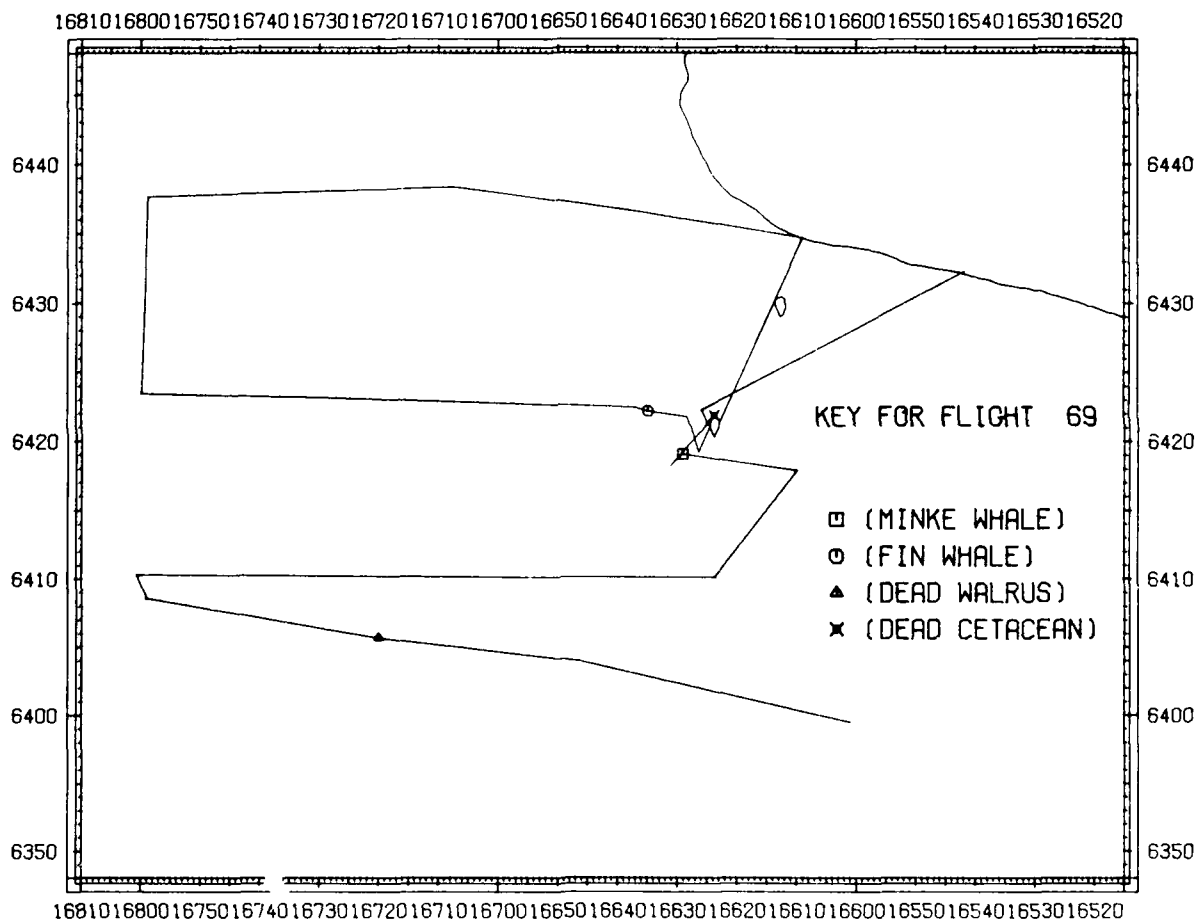
FLIGHT NUMBER 68, JULY 12, 1981

A transect survey of Block A was flown. Weather was overcast, visibility unlimited, and sea state Beaufort 2. One hundred and thirty-seven beluga whales and 3 dead walrus were sighted. A sonobuoy recorded over 100 beluga vigorously feeding in shallow, muddy water near the Yukon River delta.



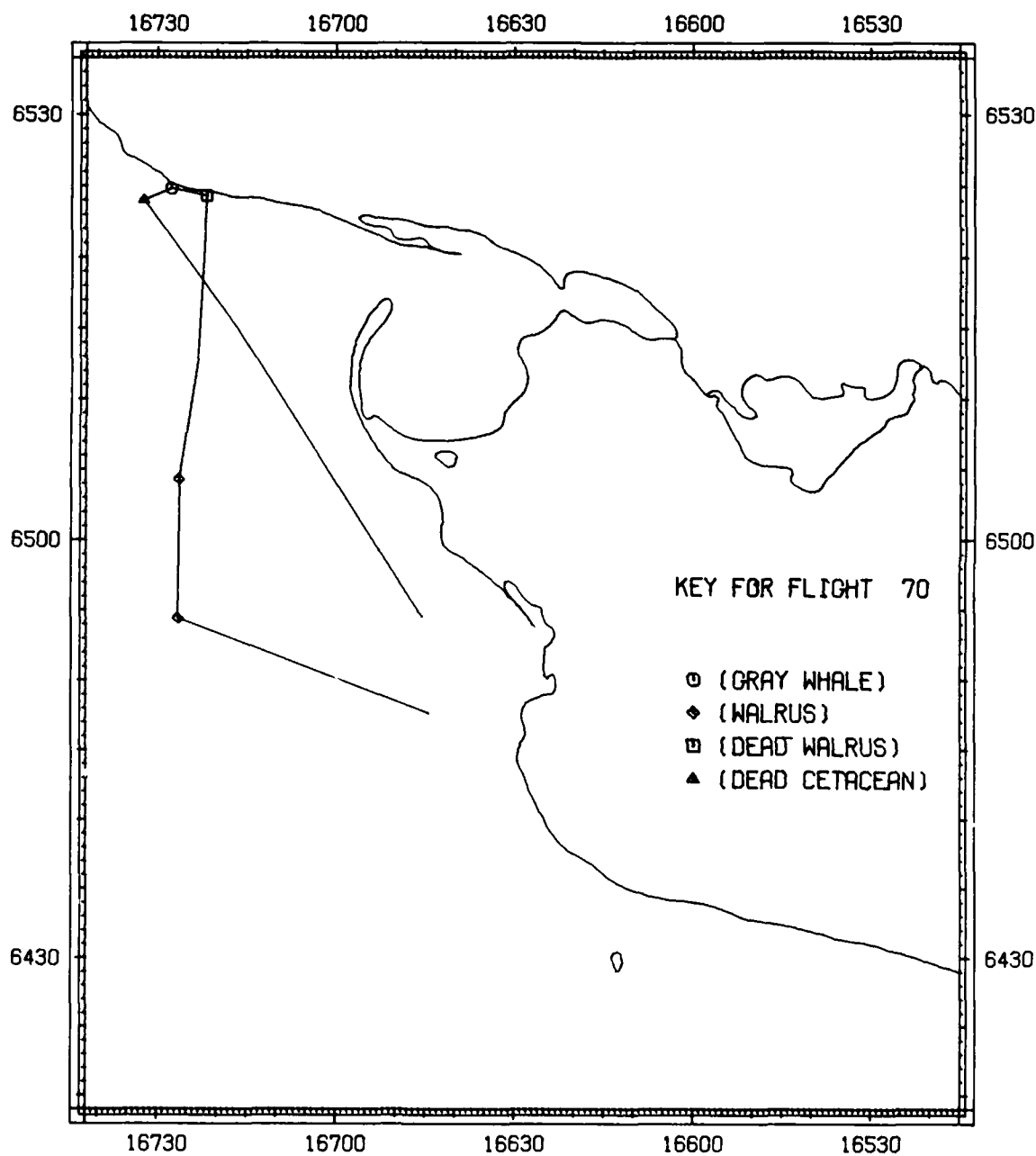
FLIGHT NUMBER 69, JULY 15, 1981

A transect survey in Block D was begun but later cancelled. The weather was overcast and foggy, which reduced visibility in some areas. Sea state was Beaufort 2. Three minke and 2 fin whales were sighted as well as a white cetacean carcass floating head down. One dead walrus was also seen. One sonobuoy was dropped near the fin whales.



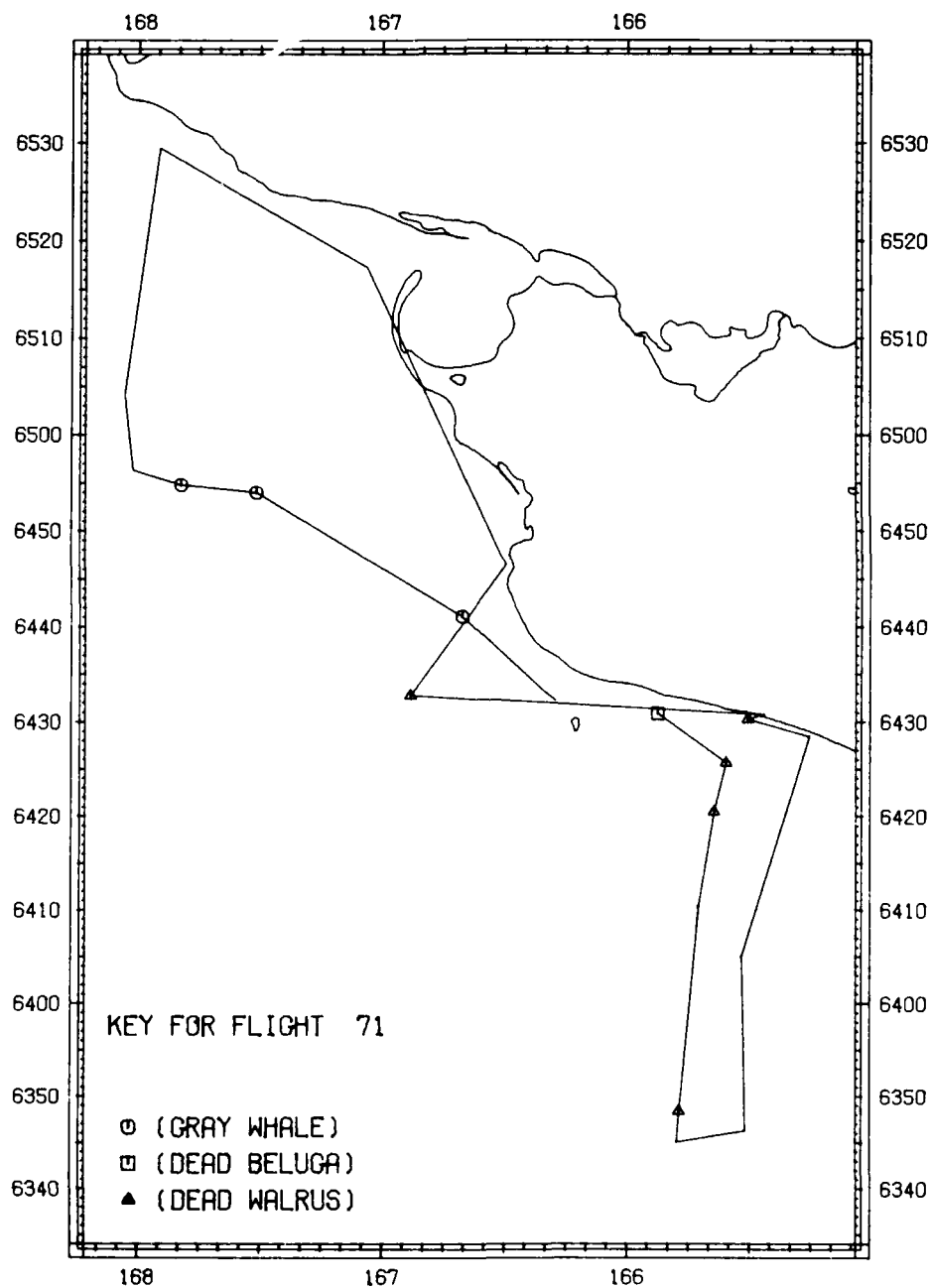
FLIGHT NUMBER 70, JULY 20, 1981

A transect survey was cancelled due to fog. Sea state was Beaufort 1. Two gray whales were sighted. Three dead walrus and 1 dead whale (same as flight 69) were also seen.



FLIGHT NUMBER 71, JULY 22, 1981

A special transect survey was flown to introduce BLM personnel from Washington, D.C., to marine mammal aerial survey work. The weather was over-cast, but visibility was unlimited. Three gray whales, 1 dead beluga whale and 5 dead walrus were sighted in the water. A sonobuoy was dropped near the gray whales.

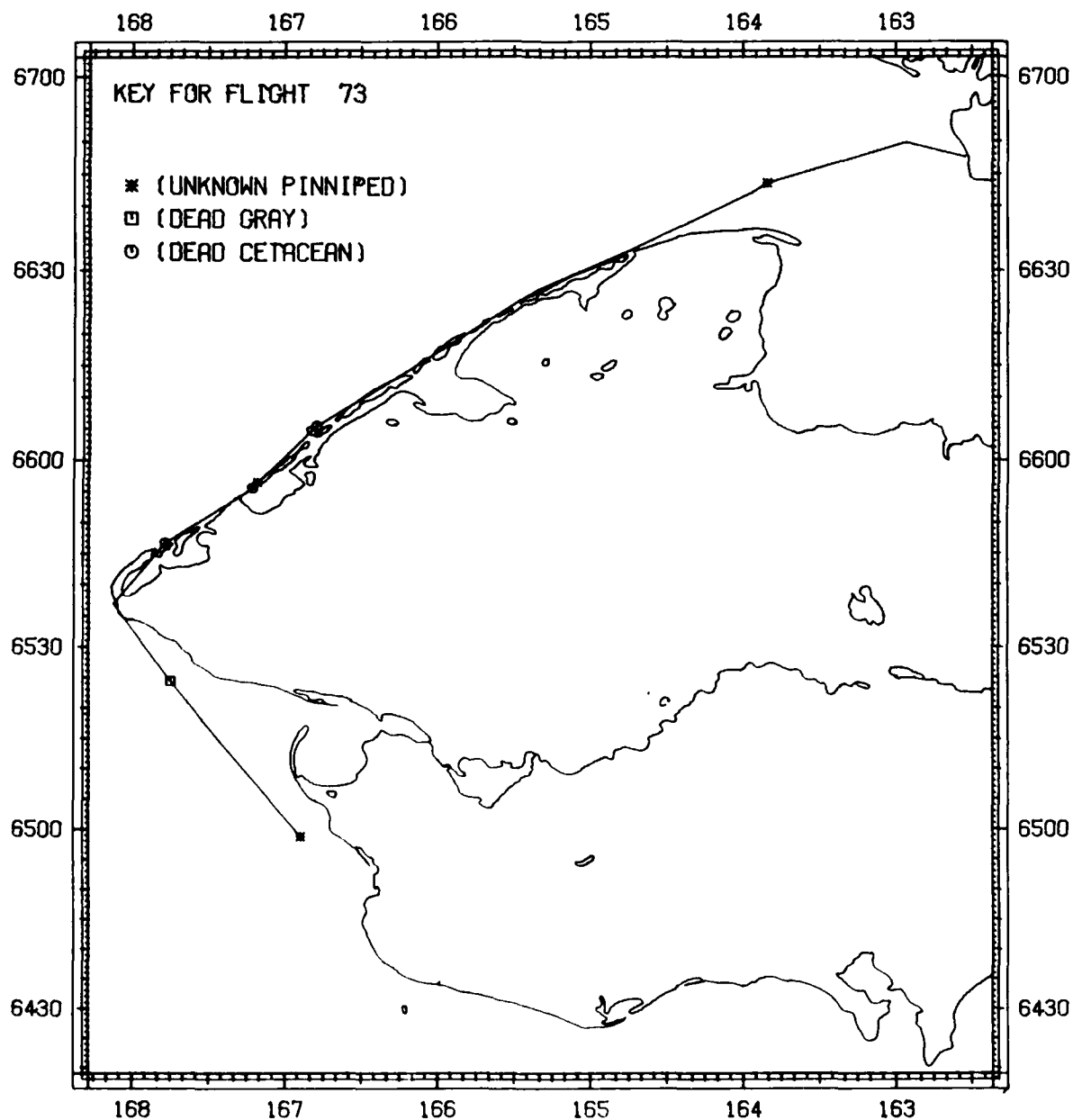


A special transect survey was flown to introduce BLM personnel from Washington, D.C., to marine mammal aerial survey work. The weather was clear, visibility unlimited, and sea state Beaufort 1. Thirty-four gray whales and 1 dead walrus were sighted.



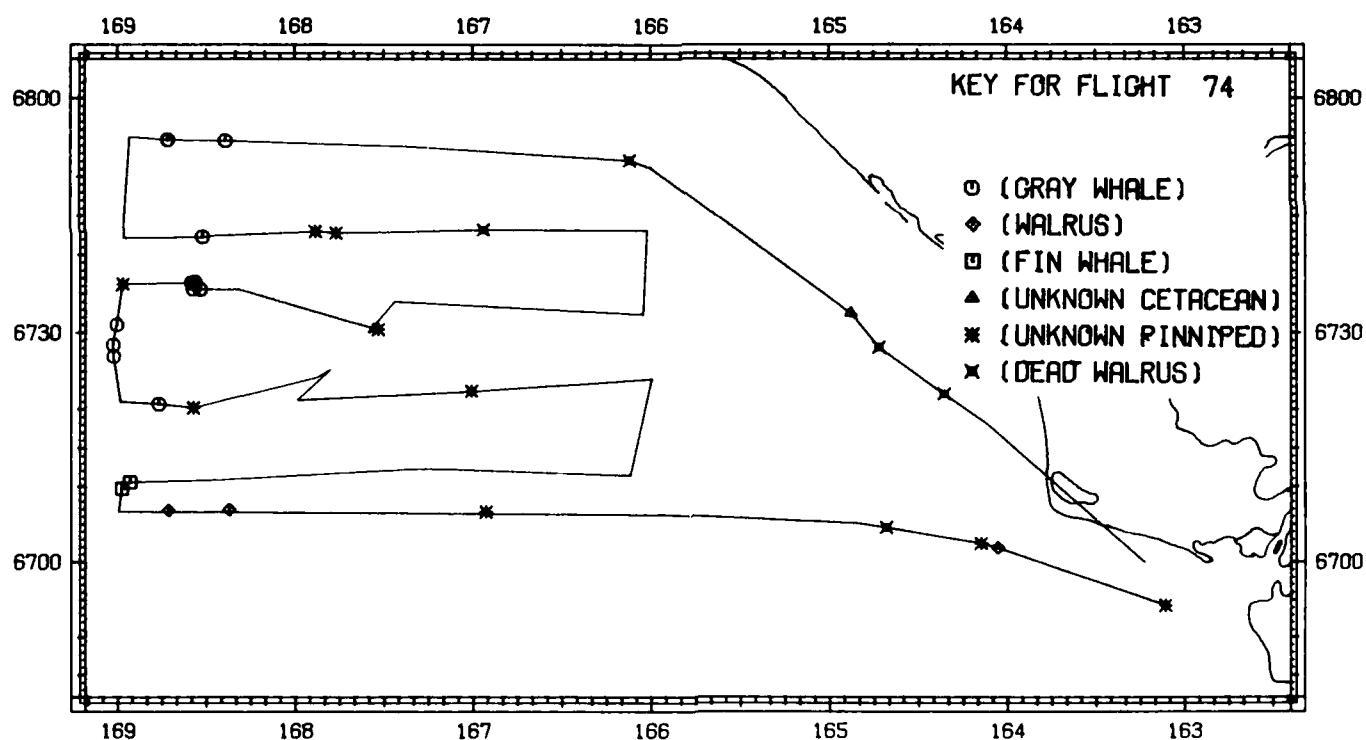
FLIGHT NUMBER 73, JULY 23, 1981

Flight was a coastal survey from Nome to Kotzebue. The weather was clear, visibility unlimited, sea state Beaufort 2. Three unidentified whale carcasses were sighted on the beach and 1 dead gray whale in the water with its jaw missing. Two unidentified pinnipeds were also sighted.



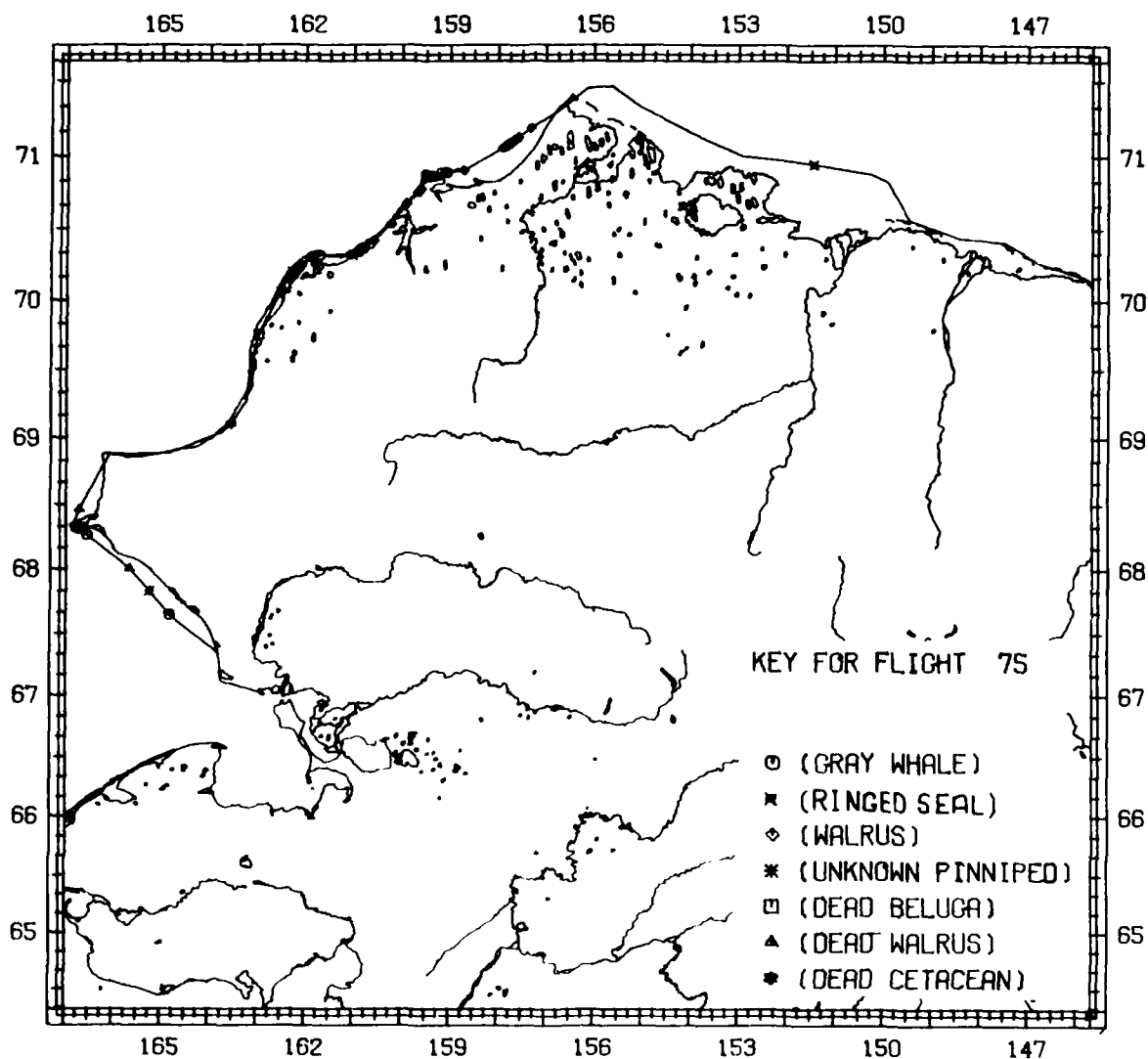
FLIGHT NUMBER 74, JULY 24, 1981

A transect survey in Block I was flown. Weather was clear, visibility unlimited, and sea state calm. Thirty-six gray whales, 3 fin whales, 8 walrus (3 live and 5 dead), and 14 unidentified pinnipeds were sighted. One sonobuoy was dropped near gray whales in 20-m water and recorded seismic sounds in addition to whale sounds. Another sonobuoy was dropped near the Arctic Star, a geophysical research ship, in order to calculate source levels on the seismic sounds and boat noise (see Figure 18 for sonobuoy and boat positions).



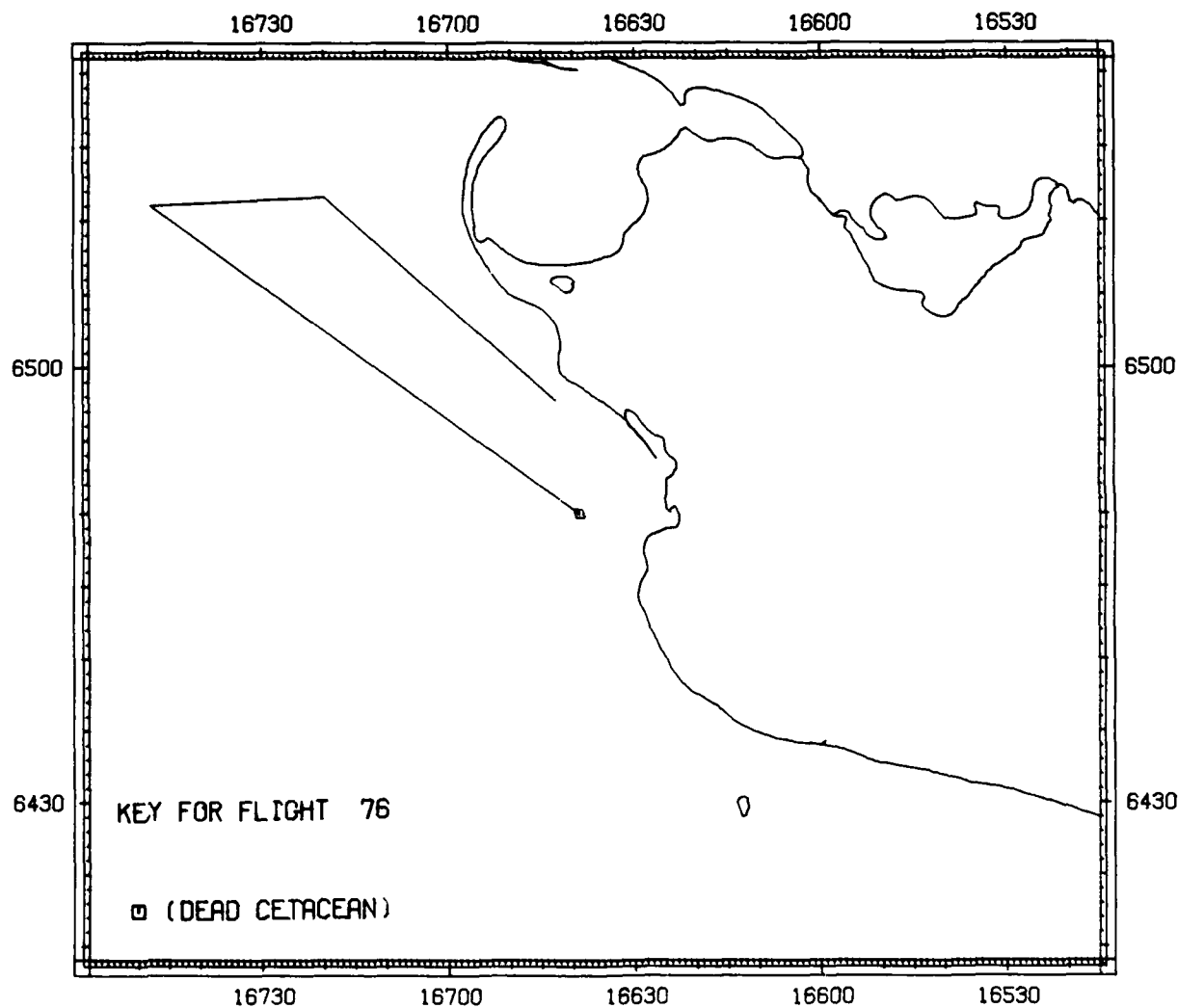
FLIGHT NUMBER 75, JULY 25, 1981

Flight was a coastal survey from Kotzebue to Pt. Barrow then along the 20-m contour through the oil lease areas. The weather was clear, visibility unlimited, sea state Beaufort 2. Thirty-four gray whales, 1 beluga whale, 1350 walrus, 1 ringed seal, and 1 unidentified pinniped were sighted. One unidentified whale carcass, a dead beluga, and 26 dead walrus were sighted on the beach. The lease area was covered with from 1/10 to 2/10 old pan ice. There was no shorefast ice. Up to 3/10 old pan and new ice was observed north of the lease area. Open-water areas were prevalent.



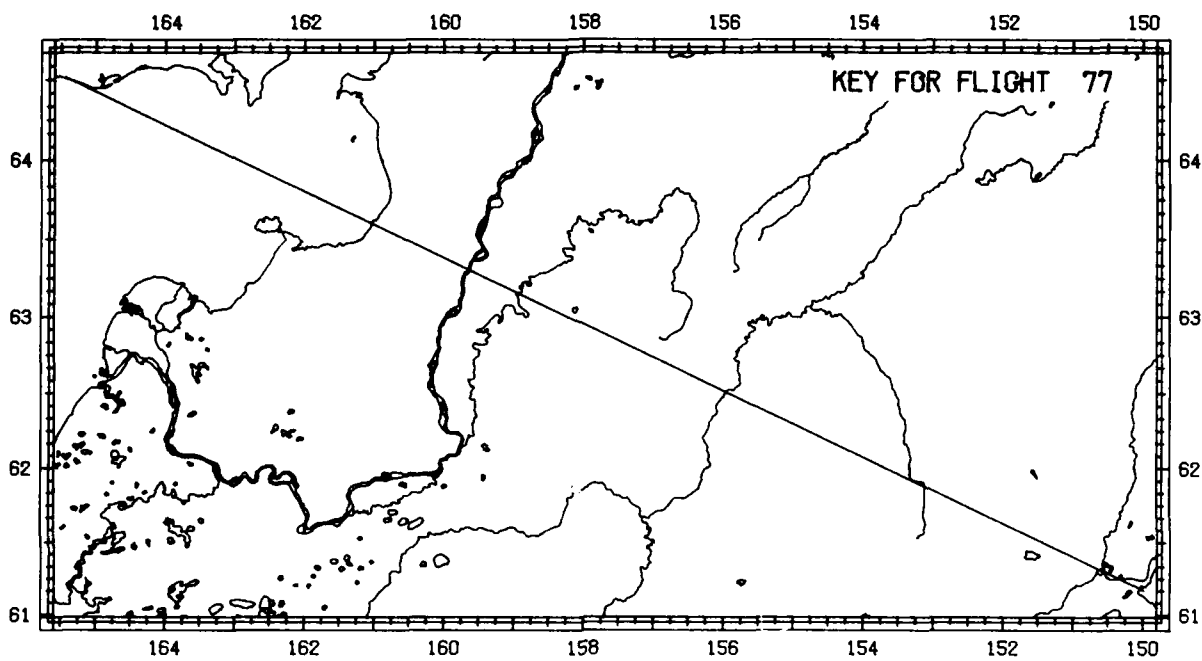
FLIGHT NUMBER 76, JULY 29, 1981

A block transect survey was cancelled due to low visibility in fog. Sea state was Beaufort 2. One unidentified whale without teeth or baleen was sighted on the beach near Cape Douglas.



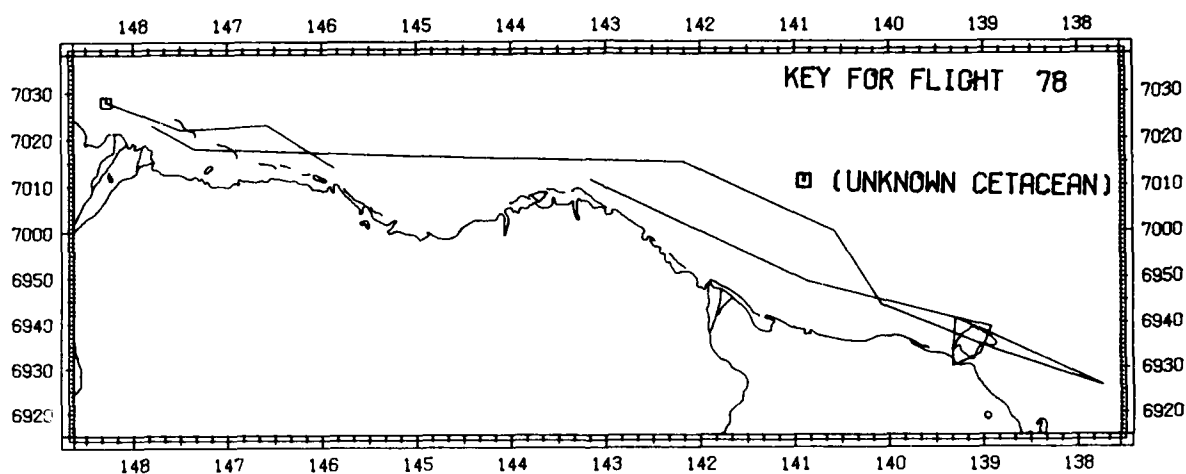
FLIGHT NUMBER 77, AUGUST 1, 1981

Flight was a transit from Nome to Anchorage for maintenance.



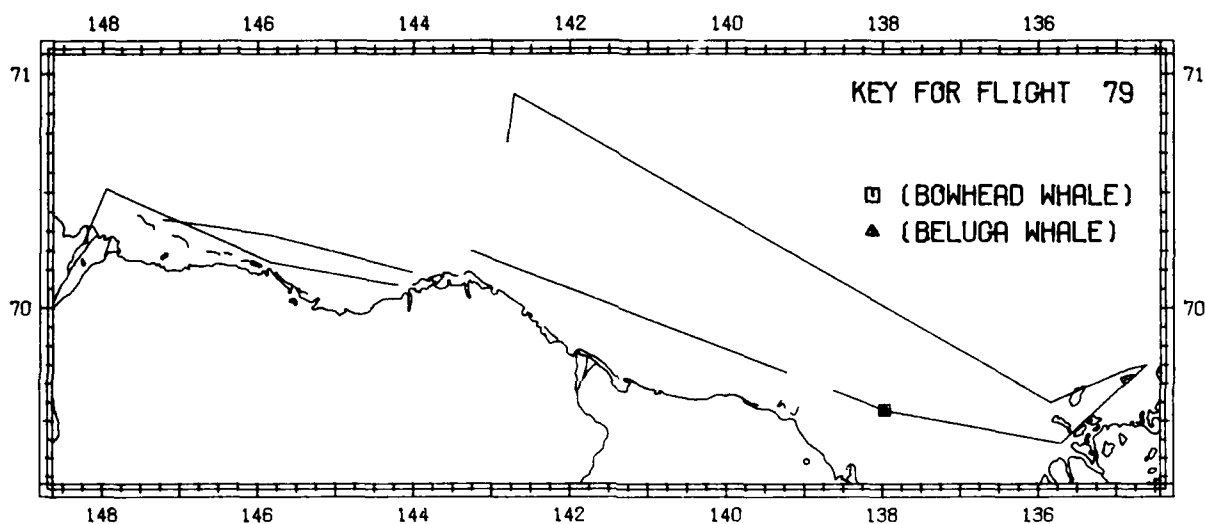
FLIGHT NUMBER 78, AUGUST 15, 1981

Flight was a search from Deadhorse to Mackenzie Bay and back to Deadhorse along the 20-m contour. Weather was cloudy, with occasional fog and rain. Visibility ranged from unlimited to less than 1 km. Sea state was Beaufort 1 and ice coverage 1/10 to 5/10 pan ice. One unidentified cetacean was sighted inside Prudhoe Bay.



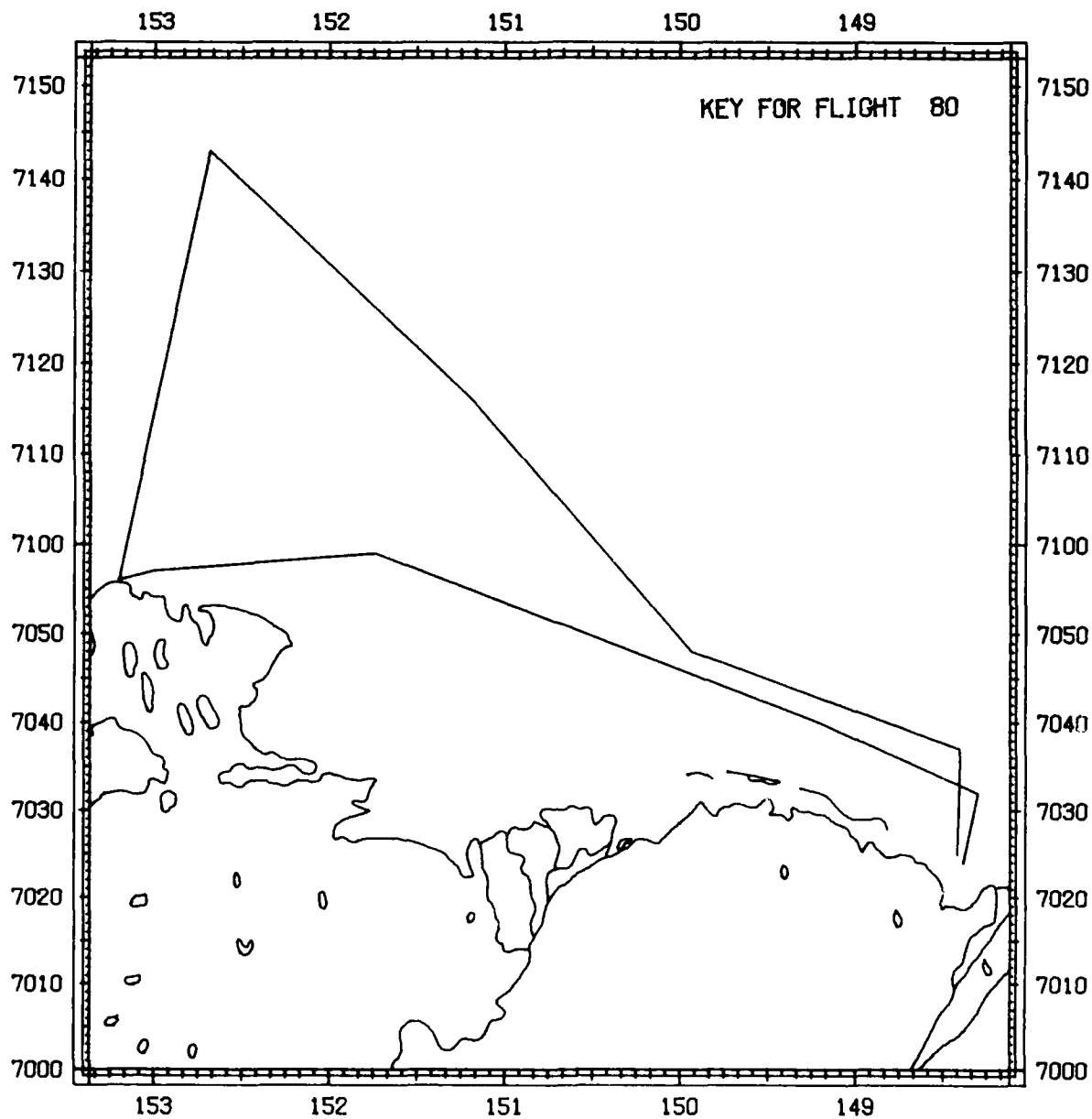
FLIGHT NUMBER 79, AUGUST 17, 1981

Flight was a search from Deadhorse east to Pelley Island and back to Deadhorse along the 20-m contour. Weather was overcast to partly cloudy. Visibility ranged from unlimited to less than 1 km. Sea state was between Beaufort 2 and 3, with ice coverage up to 6/10 in some areas. Two bowhead whales were sighted in Mackenzie Bay, along with 45 beluga whales.



FLIGHT NUMBER 80, AUGUST 18, 1981

Flight was a search for early migrating bowheads from Deadhorse west to Lonely, then north 83 km and back to Deadhorse. Weather was cloudy and rainy. Visibility ranged between 20 and 55 km. Sea state was Beaufort 3, with 2/10 ice coverage present over the northern extremities of the flight track. No marine mammals were sighted.



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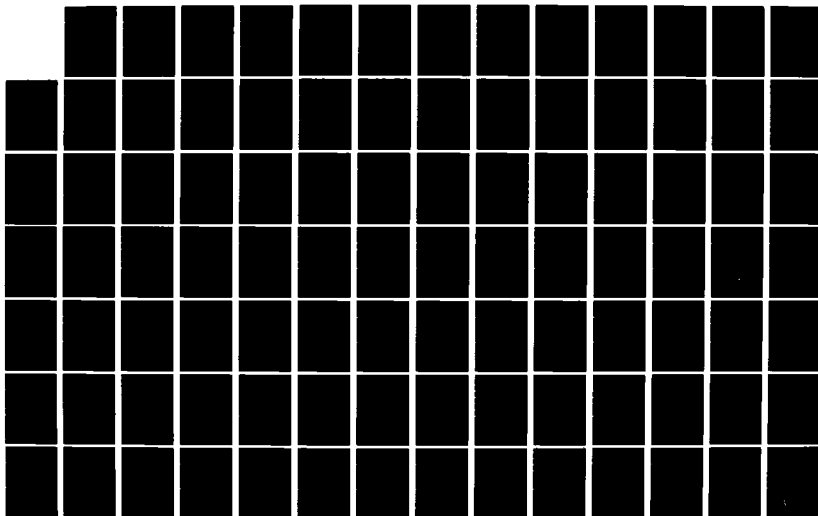
AERIAL SURVEYS OF ENDANGERED WHALES IN THE BEAUFORT
CHUKCHI & NORTHERN BERING SEAS(U) NAVAL OCEAN SYSTEMS
CENTER SAN DIEGO CA D K LJUNGBLAD ET AL. MAR 82
NOSC/TD-486

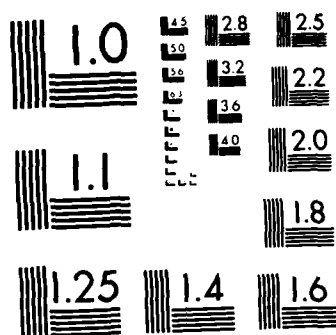
3/4

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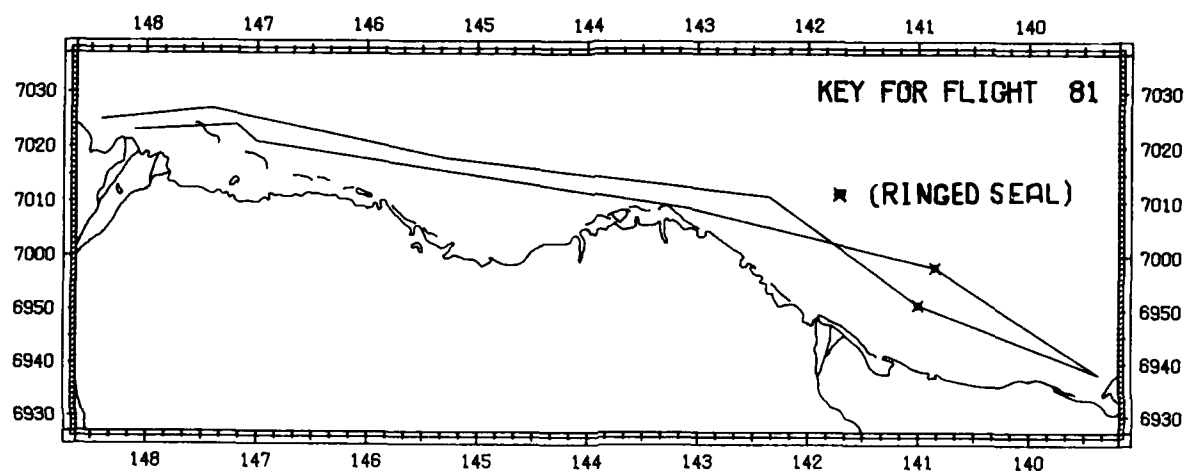




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

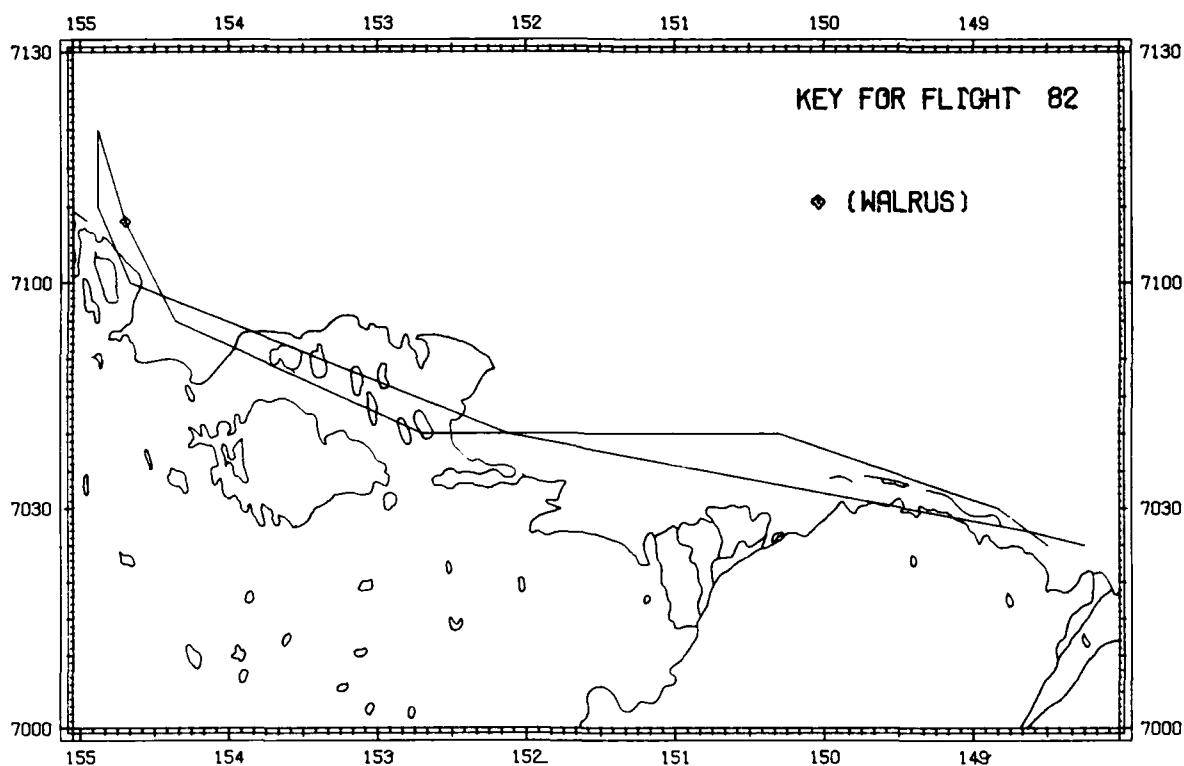
FLIGHT NUMBER 81, AUGUST 19, 1981

Flight was a search for bowheads from Deadhorse east to Herschel Island and back to Deadhorse along the 20-m contour. Weather was partly cloudy or overcast. Visibility was unlimited. Sea state was Beaufort 1. The west side of Herschel Island had 6/10 pan ice coverage. No bowhead whales were sighted. Five ringed seals were sighted.

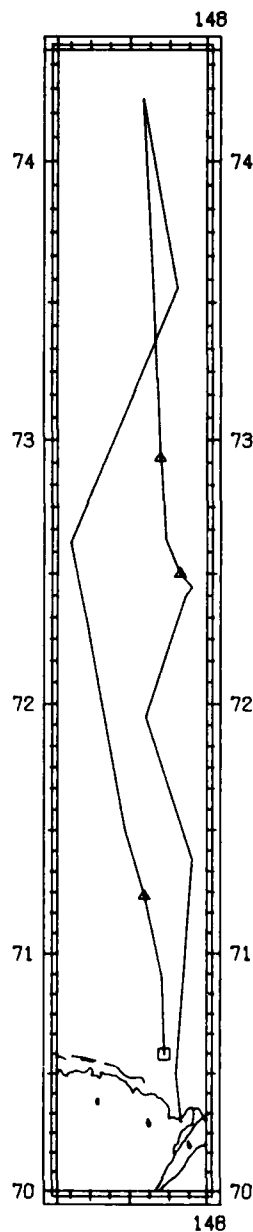


FLIGHT NUMBER 82, AUGUST 20, 1981

Flight was a search for early migrating bowhead whales from Deadhorse west to Pt. Barrow, along the 10-m contour and back to Deadhorse, paralleling the 20-m contour 10 km to the north. Weather was foggy or overcast; visibility was less than 3 km to unlimited. Sea state was Beaufort 1 or 2. Ice coverage ranged between 1/10 and 6/10, and 6/10 occurring near Pt. Barrow. No bowhead whales were sighted. One walrus was sighted north of Pt. Barrow.

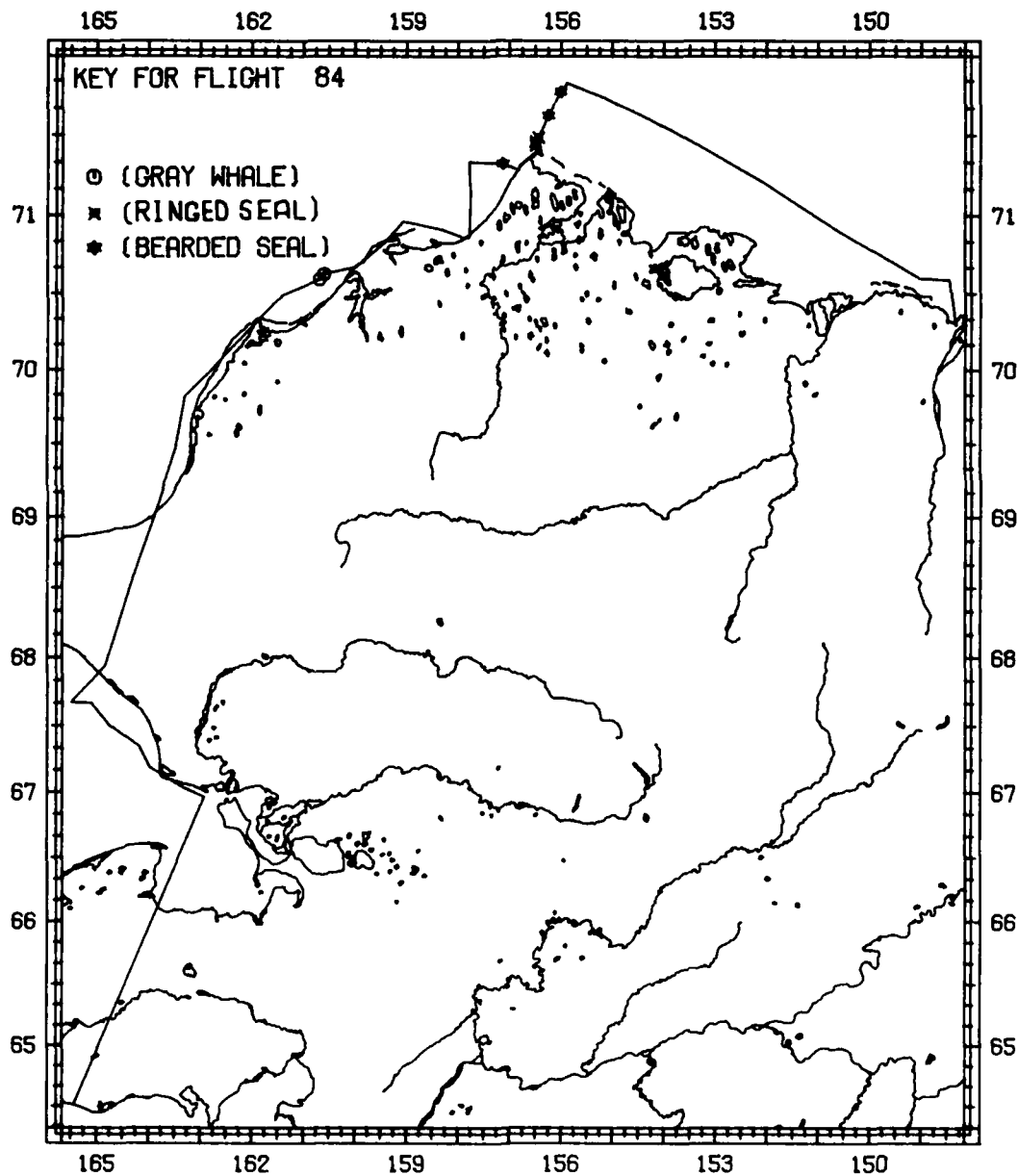


Flight was a search from Deadhorse north approximately 370 km to plot ice conditions north of Prudhoe Bay. Weather was overcast and visibility was unlimited. Ice conditions ranged from 0/10 to 9/10 coverage. Sea state was Beaufort 1 to 2. No bowhead whales were sighted. Twenty-six beluga whales were sighted. One dead walrus was sighted on an ice flow.



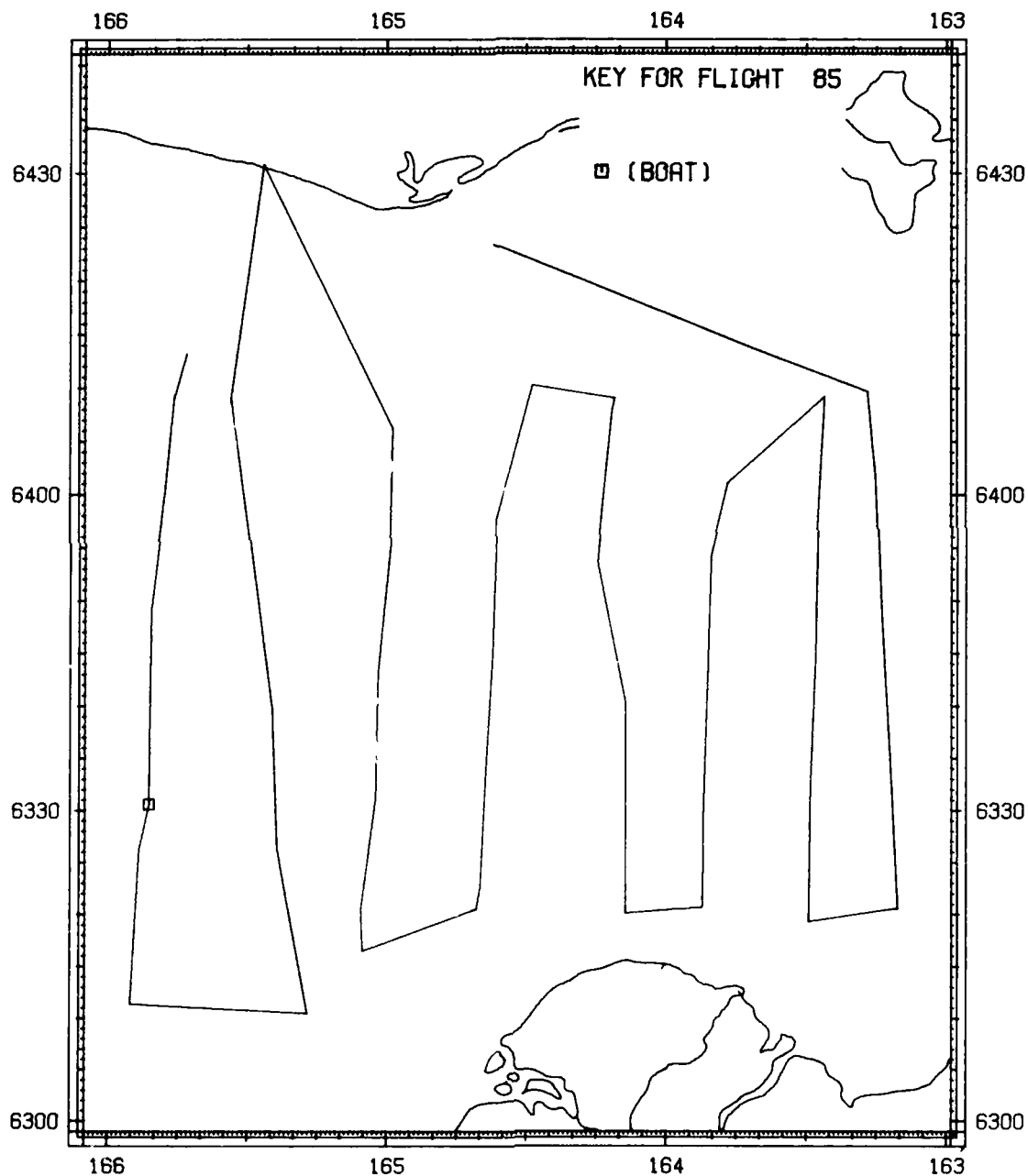
FLIGHT NUMBER 84, AUGUST 24, 1981

Flight was a coastal survey from Deadhorse to Kotezebue and a transit to Nome. Weather was partly cloudy to foggy; respective visibility was unlimited to less than 1 km. Sea state was Beaufort 1. Ice coverage was 0/10 to 4/10. Six gray whales, 6 ringed, and 9 bearded seals were sighted.



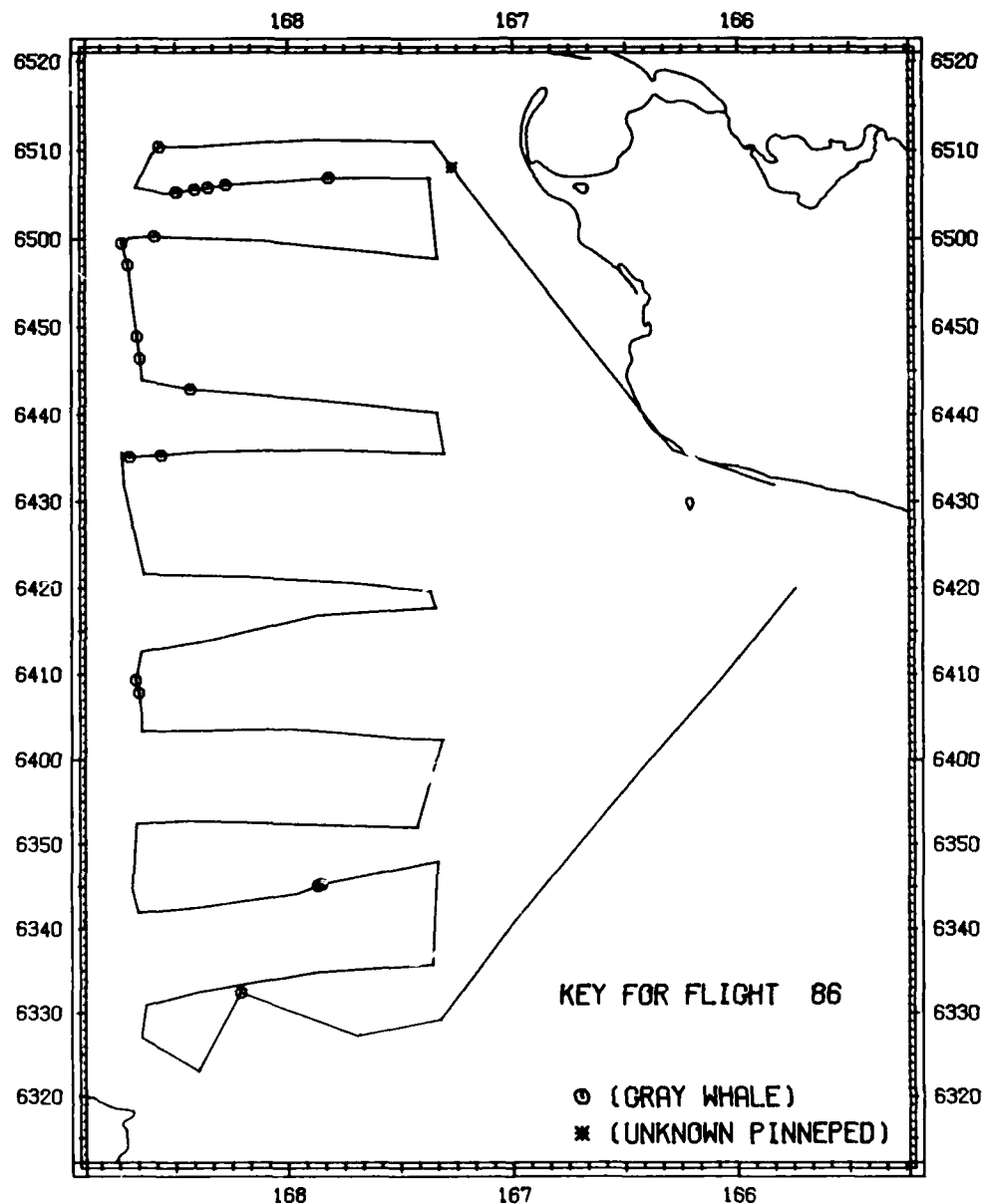
FLIGHT NUMBER 85, AUGUST 26, 1981

Flight was a transect survey of Block A. Weather was partly cloudy to cloudy. Visibility was unlimited. Sea state was Beaufort 1. No marine mammals were sighted. One geophysical boat was sighted.



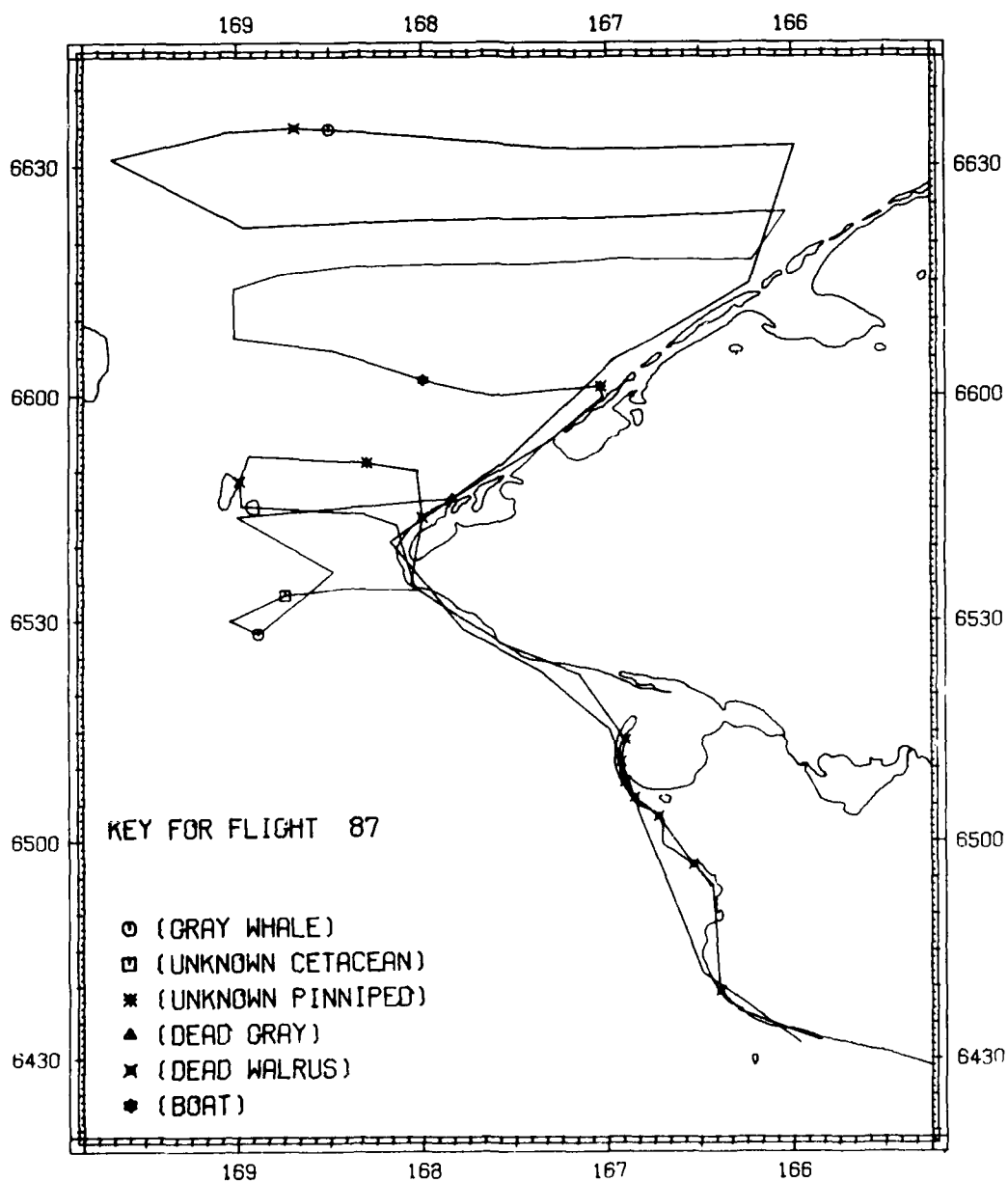
FLIGHT NUMBER 86, AUGUST 27, 1981

Flight was a transect survey between King Island and St. Lawrence Island. Weather was partly cloudy to overcast. Visibility ranged from unlimited to less than 1 km. Sea state was Beaufort 1 or 2. No ice was in the area. Thirty-four gray whales were sighted in the survey block. One unidentified pinniped was sighted while the aircraft was en route to the survey block.



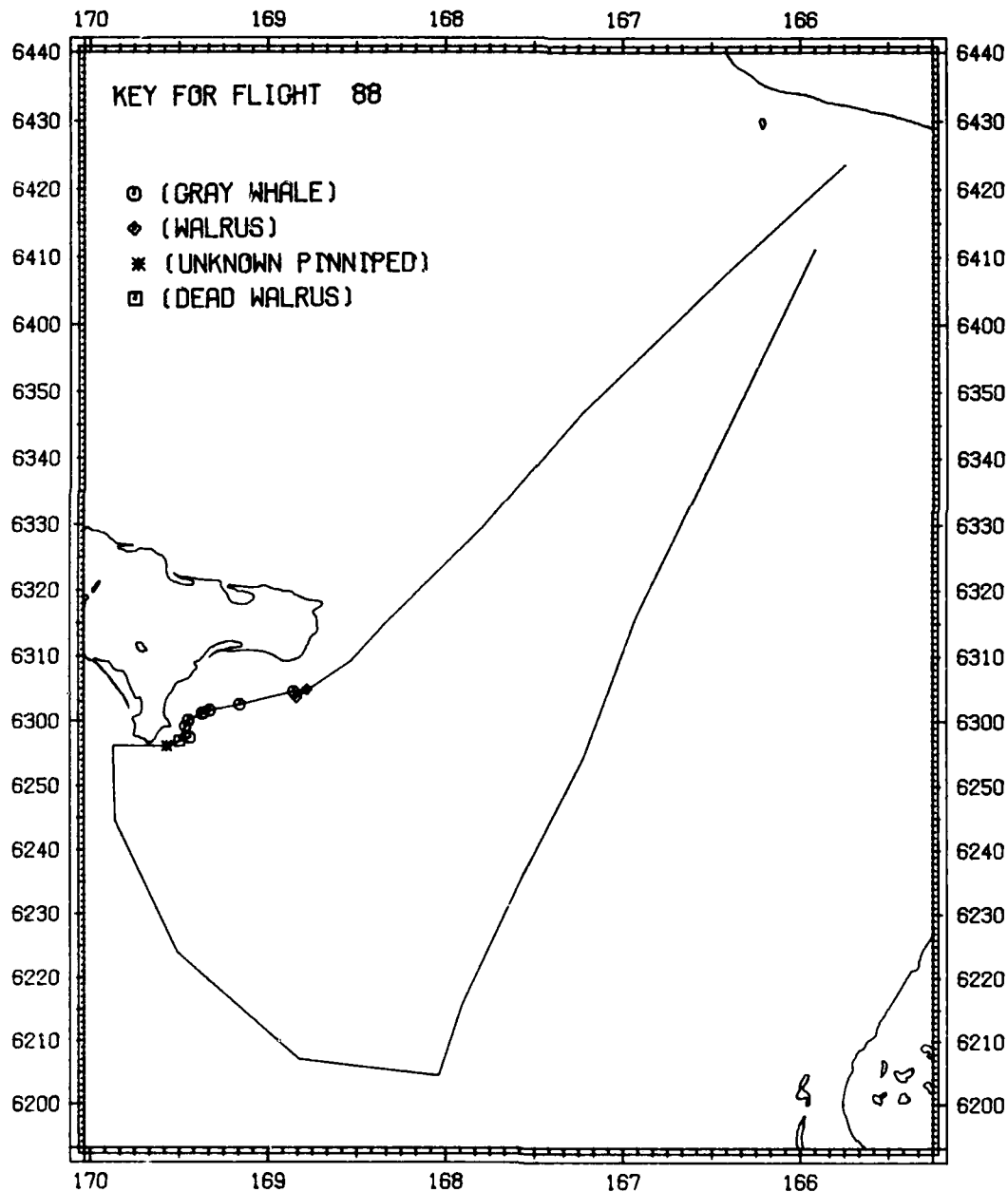
FLIGHT NUMBER 87, AUGUST 28, 1981

Flight was a transect survey of Block G and the southern half of Block H. Weather was partly cloudy or clear, resulting in unlimited visibility. Sea state ranged from Beaufort 1 to Beaufort 3. Five gray whales, one unidentified cetacean and 2 unidentified pinnipeds were sighted. Two dead gray whales and 19 dead walrus were noted on the beach.



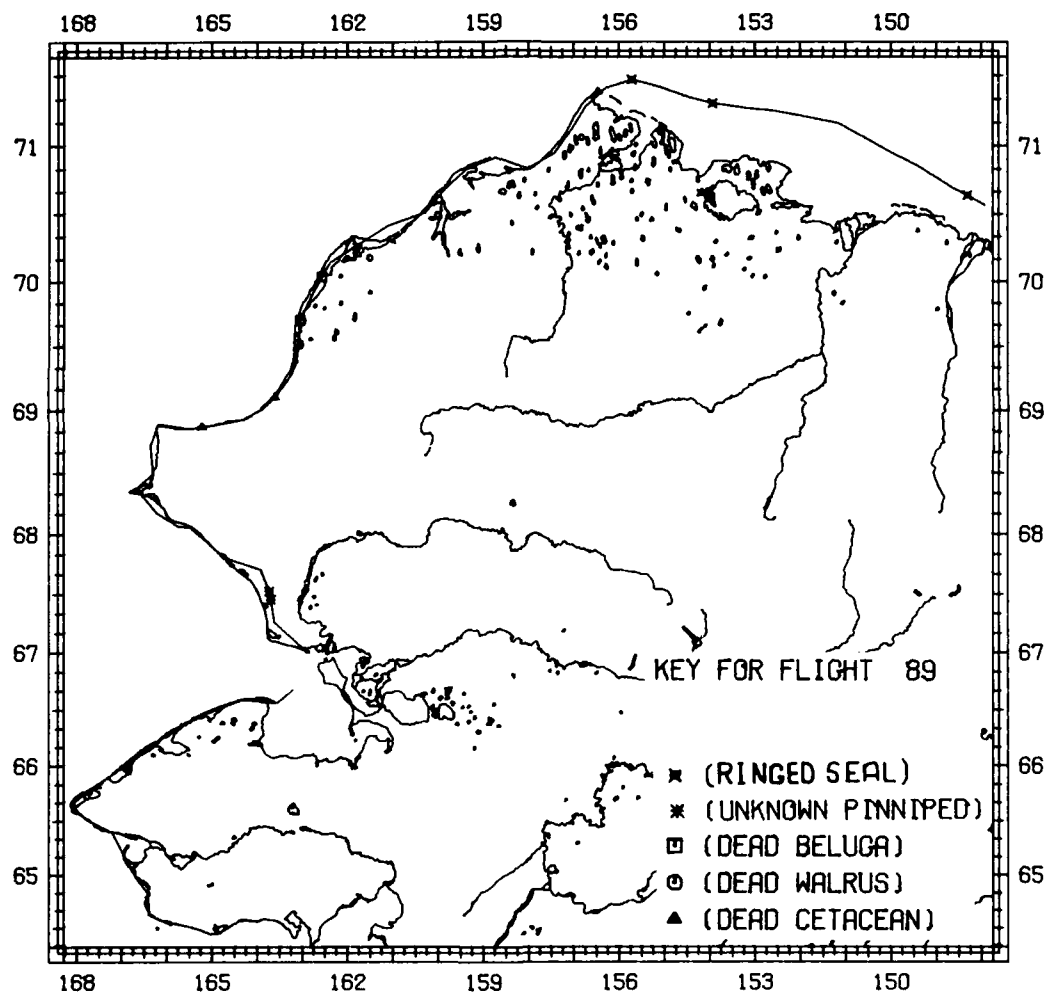
FLIGHT NUMBER 88, AUGUST 29, 1981

Flight was a transect survey of Block P. Weather was overcast to foggy, which precluded the survey. Sea state was Beaufort 1 to Beaufort 3. Ten gray whales were sighted northeast of Block P. Three live and one dead walrus were seen on Punik Island. One unidentified pinniped was seen.



FLIGHT NUMBER 89, AUGUST 30, 1981

Flight was a coastal survey from Nome to Pt. Barrow, then along the 20-m contour to Deadhorse. Visibility was unlimited except for a fog patch near Wainwright. Ice coverage was 1/10 to 2/10 in both lease areas. Three ringed seals and 4 unidentified pinnipeds were sighted. Sightings of dead beached animals included 2 unidentified whales (1 each near Cape Prince of Wales and Cape Sabine), 4 belugas at Pt. Lay, and 3 walrus.

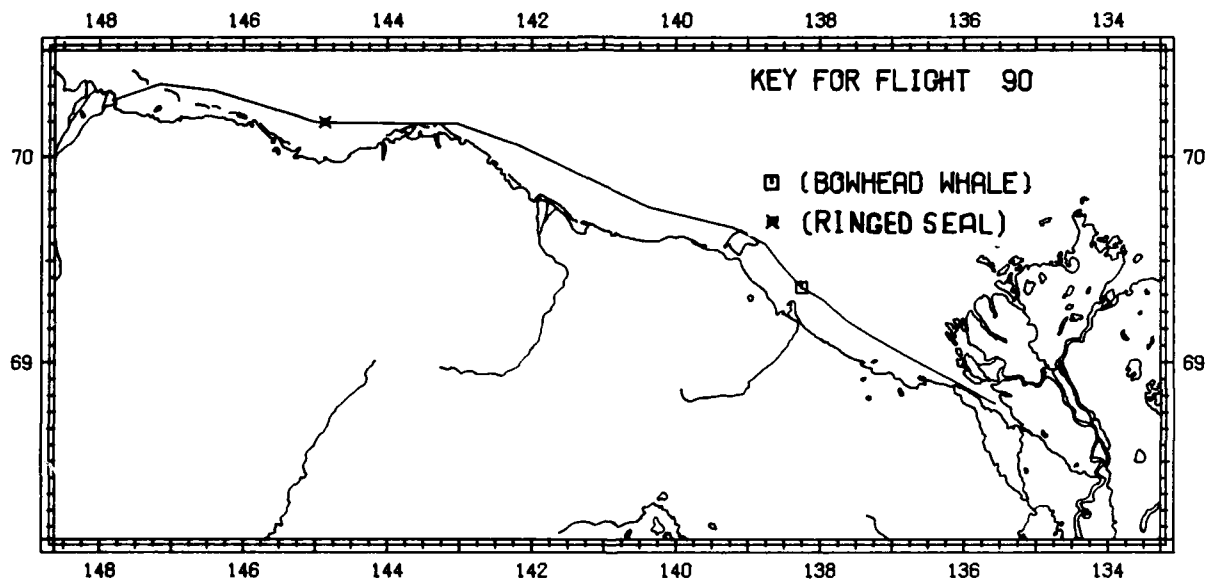


Bowhead Whale Sightings for Flight 90, September 1, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state		Behavior and observations
1	138 16.0	69 22.1	152	2/10	B1	30 ft swimming

FLIGHT NUMBER 90, SEPTEMBER 1, 1981

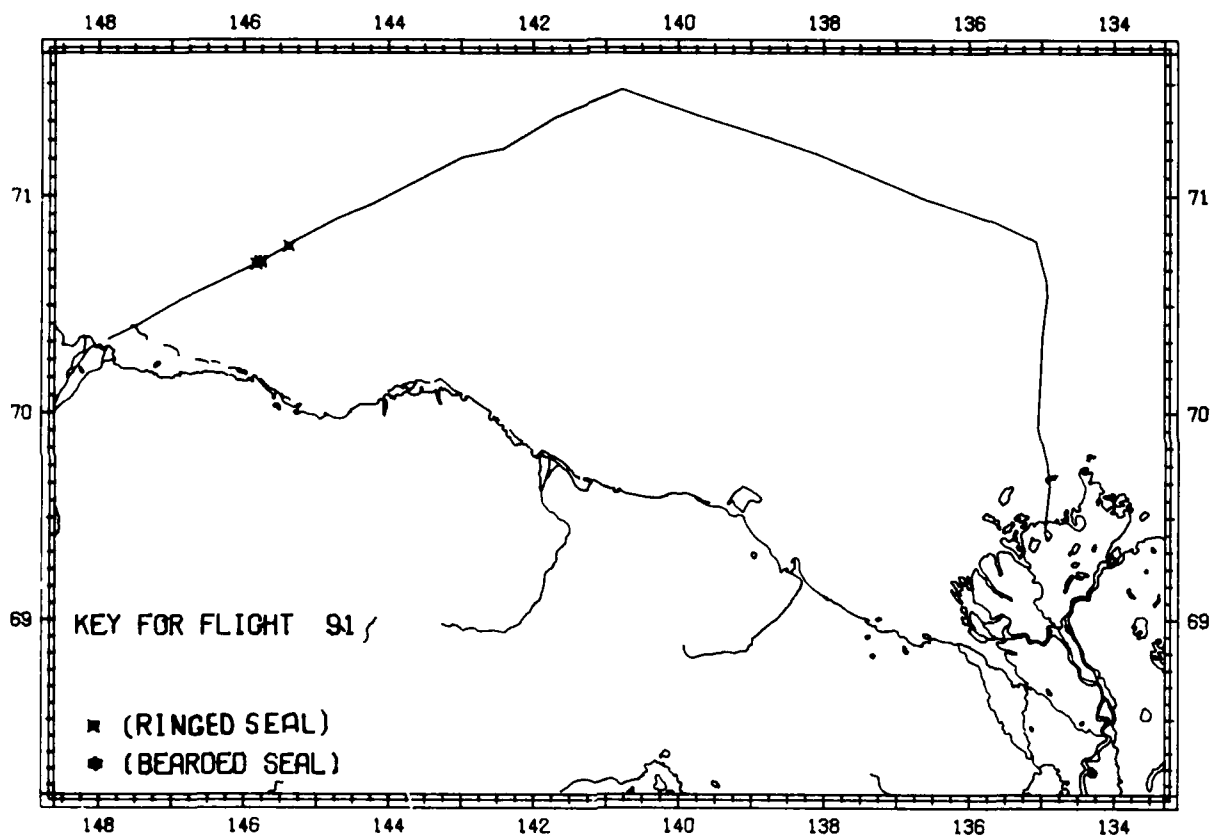
Flight was from Deadhorse to Inuvik, Canada, along the 20-m contour. The weather was overcast and the ceiling low. Visibility was below 10 km in most places. The sea state averaged Beaufort 2. Ice coverage was no greater than 3/10. One bowhead was seen east of Herschel Island. One ringed seal was also sighted.



No Bowhead Sightings for Flight 91, September 2, 1981

FLIGHT NUMBER 91, SEPTEMBER 2, 1981

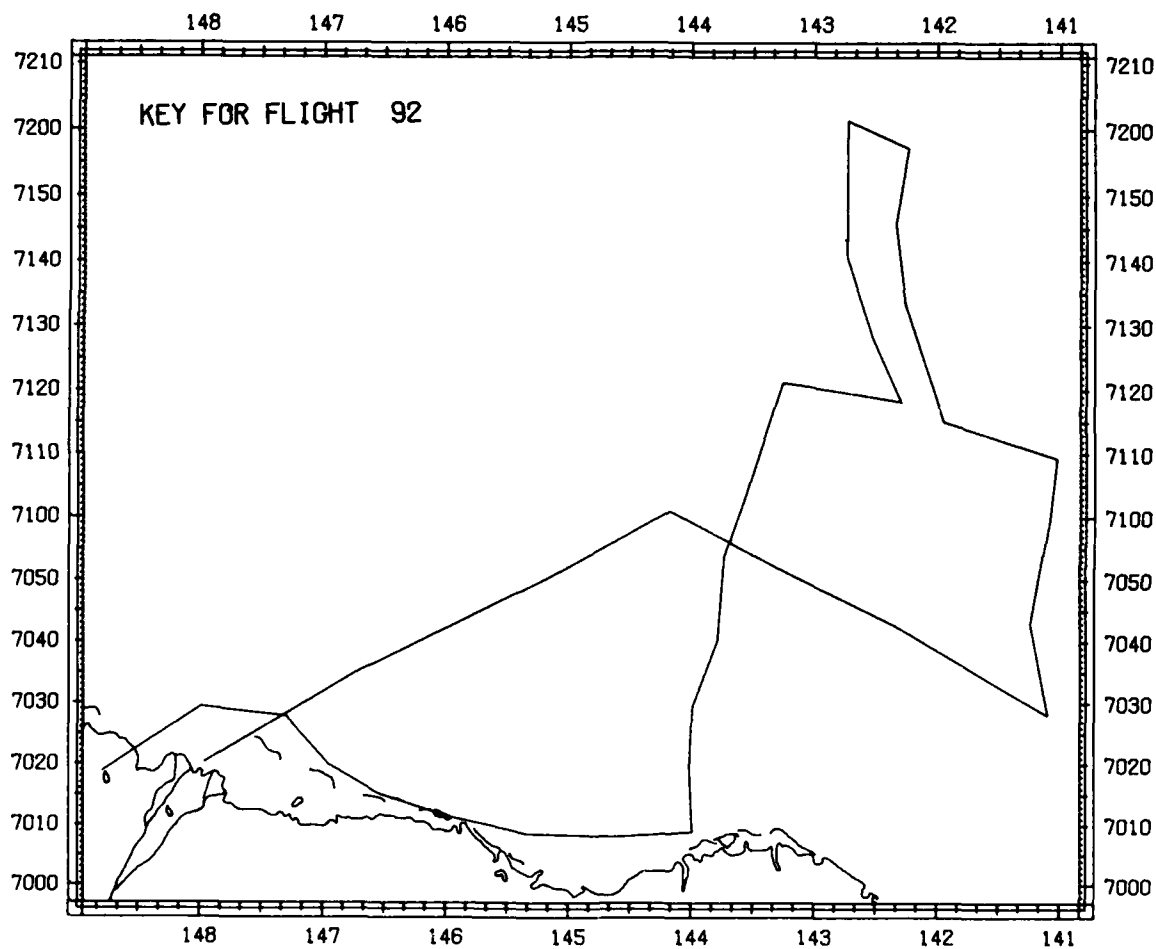
Flight was a search north to 71°0'N from Inuvik, Canada, to evaluate the ice then west to Deadhorse. The weather was foggy, reducing visibility to below an average of 5 km. Ice patches with up to 5/10 coverage were seen. Four ringed seals and 1 bearded seal were sighted.



No Bowhead Sightings for Flight 92, September 4, 1981

FLIGHT NUMBER 92, SEPTEMBER 4, 1981

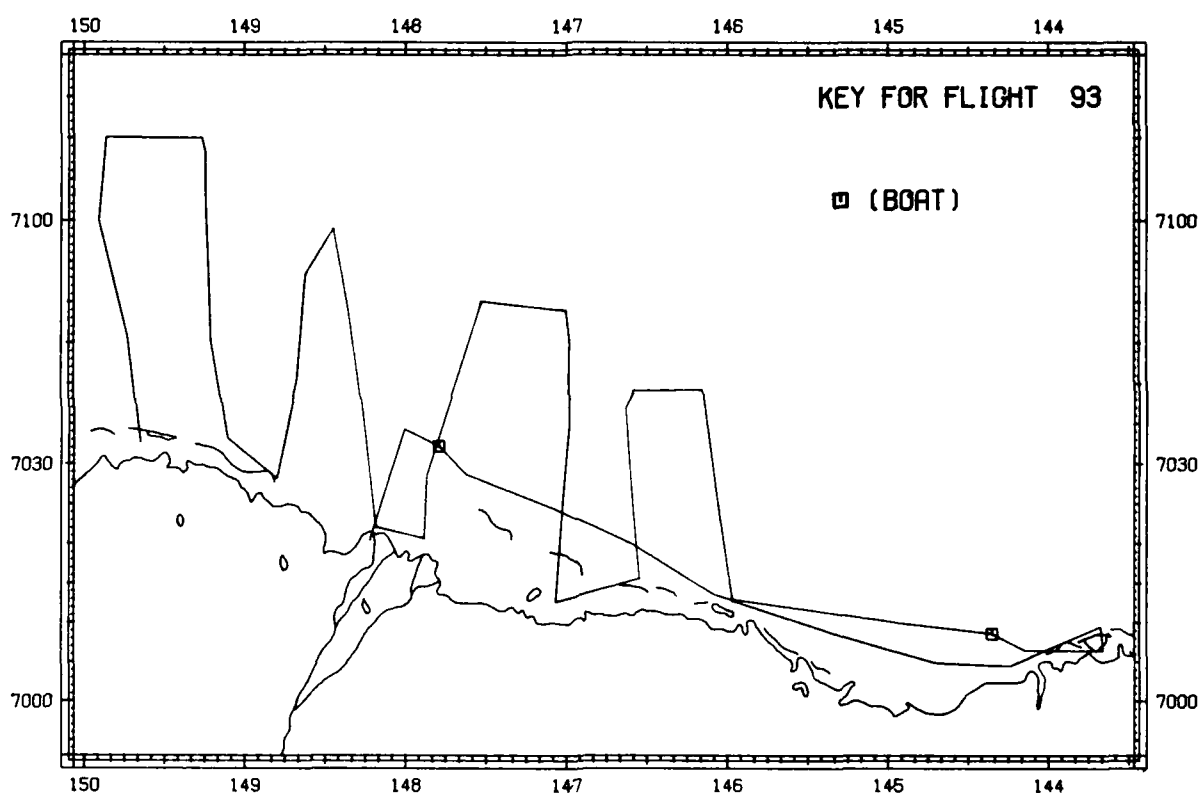
Flight was a search north to the 72°N line to evaluate the ice. The weather was overcast and visibility was variable. The sea state ranged from Beaufort 1 to 4 with patchy ice coverage up to 7/10; mostly large, old pans. No geophysical research boats were active. No marine mammals were sighted.



No Bowhead Sightings for Flight 93, September 5, 1981

FLIGHT NUMBER 93, SEPTEMBER 5, 1981

Flight was a search east around Barter Island and a preplanned survey of the State-Federal lease area. The weather was overcast and visibility varied. The sea state ranged from Beaufort 1 to 2 and the ice coverage peaked at 2/10 coverage on the northern edge of the survey. No marine mammals were sighted.

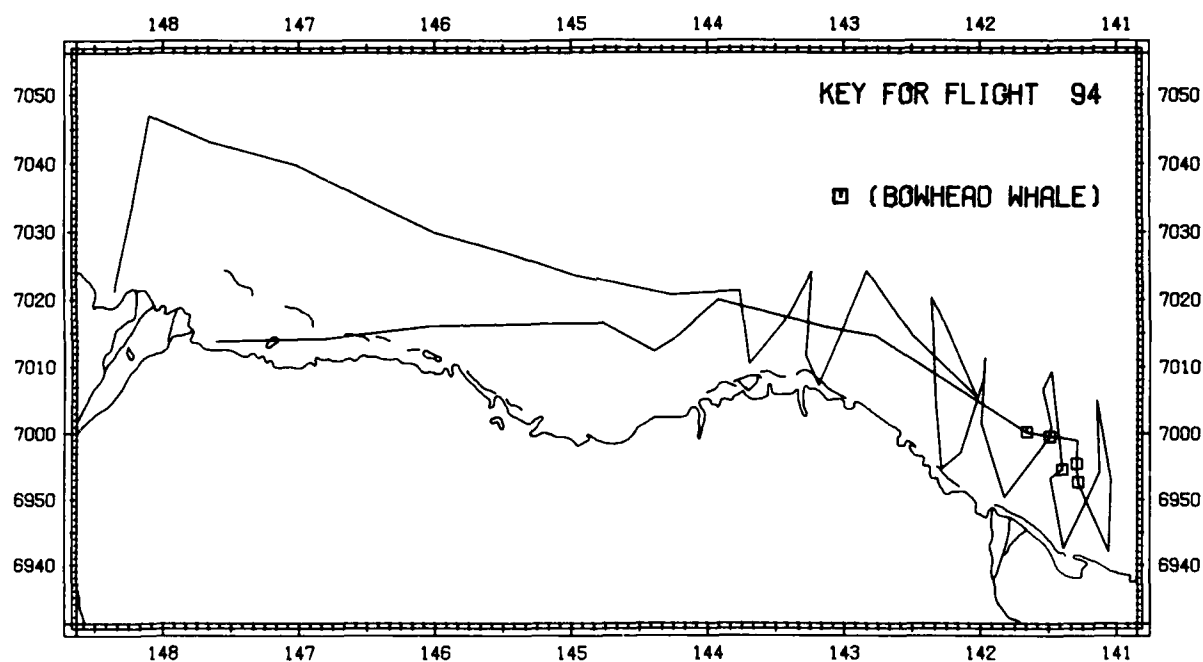


Bowhead Whale Sightings for Flight 94, September 7, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	141 29.6	69 59.5	152	1/10 B1	40 ft, swimming
1	141 24.1	69 54.5	122	1/10 B1	50 ft, swimming
1	141 17.2	69 52.6	335	1/10 B1	dove
1	141 17.7	69 55.4	335	1/10 B1	swim
1	141 39.7	70 00.2	305	1/10 B1	resting

FLIGHT NUMBER 94, SEPTEMBER 7, 1981

Flight was a search east to Barter Island along the 40-m curve, then a transect survey east to the Canadian border. The weather was partly foggy, reducing visibility below 10 km in places. The sea state was Beaufort 2, and ice coverage was rarely 1/10 or over. Five bowheads were sighted east of Barter Island in over 40-m-deep water. They were milling and could have been feeding. A sonobuoy was dropped, but no animal or geophysical research sounds were heard.



FLIGHT NUMBER 95, SEPTEMBER 8, 1981

Flight was a transit to Anchorage from Deadhorse for maintenance.

FLIGHT NUMBER 96, SEPTEMBER 11, 1981

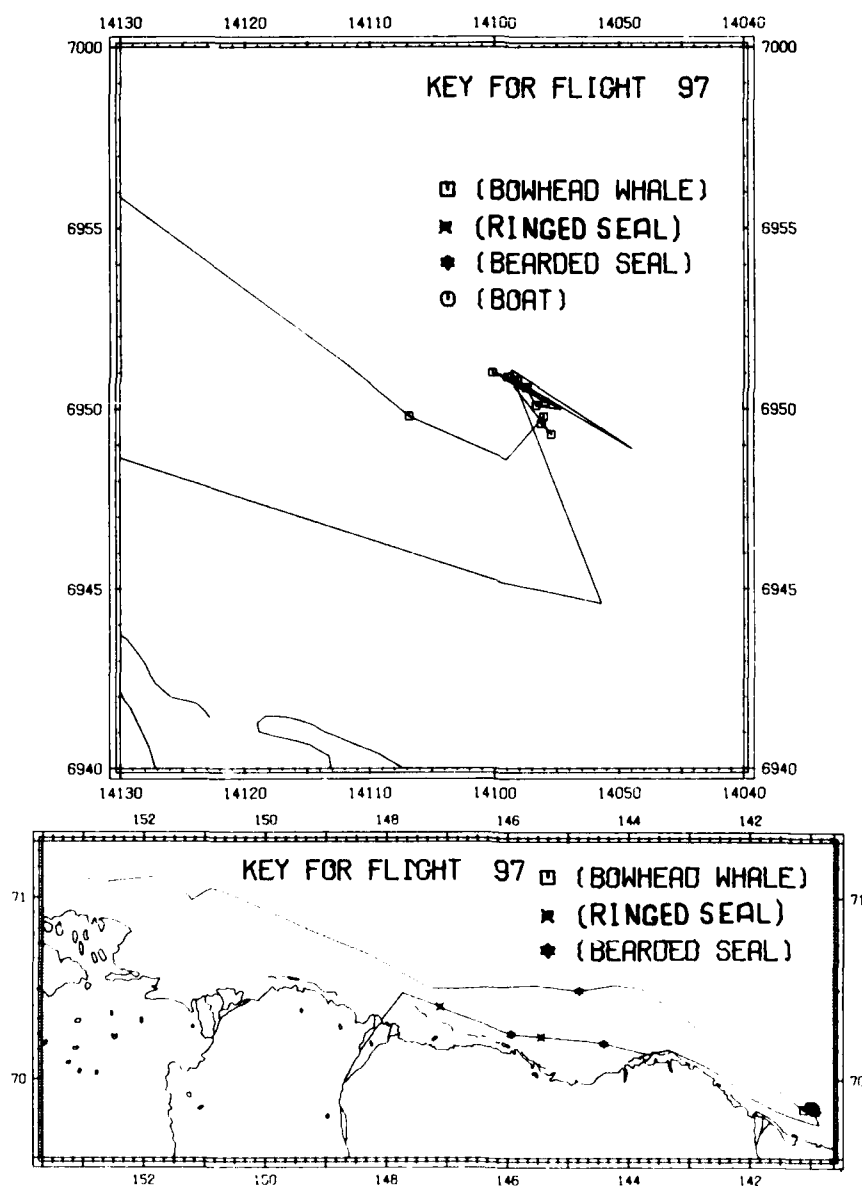
Flight was a transit from Anchorage to Deadhorse.

Bowhead Whale Sightings for Flight 97, September 12, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	140 58.2	69 50.8	305	1/10 B2	resting
1	140 58.2	69 50.8	305	1/10 B2	resting
1	140 58.2	69 50.8	305	1/10 B2	resting
1	140 58.2	69 50.8	305	1/10 B2	resting
1	140 58.2	59 60.8	305	1/10 B2	resting
1	141 00.2	69 51.0	457	1/10 B2	30 ft, swimming
1	141 00.2	69 51.0	457	1/10 B2	dove
1	141 00.2	69 51.0	457	1/10 B2	dove
1	141 00.2	69 51.0	457	1/10 B2	dove
11	140 56.6	69 50.1	457	1/10 B2	resting
1	140 57.4	69 50.6	457	1/10 B2	dove
1	140 55.9	69 50.2	457	1/10 B2	dove
2	140 59.0	69 50.9	457	1/10 B2	dove
6	140 56.5	69 49.2	457	1/10 B2	dove
7	140 56.6	69 48.8	457	1/10 B2	resting
1	140 55.9	69 50.4	457	1/10 B2	dove
7	140 54.2	69 50.2	457	1/10 B2	resting
4	140 55.4	69 49.3	610	1/10 B2	dove
1	140 56.2	69 49.6	610	1/10 B2	dove
7	140 57.6	69 49.0	610	1/10 B2	
1	140 56.0	69 49.8	610	1/10 B2	swimming
5	141 06.8	69 49.8	610	1/10 B2	25 ft, swimming

FLIGHT NUMBER 97, SEPTEMBER 12, 1981

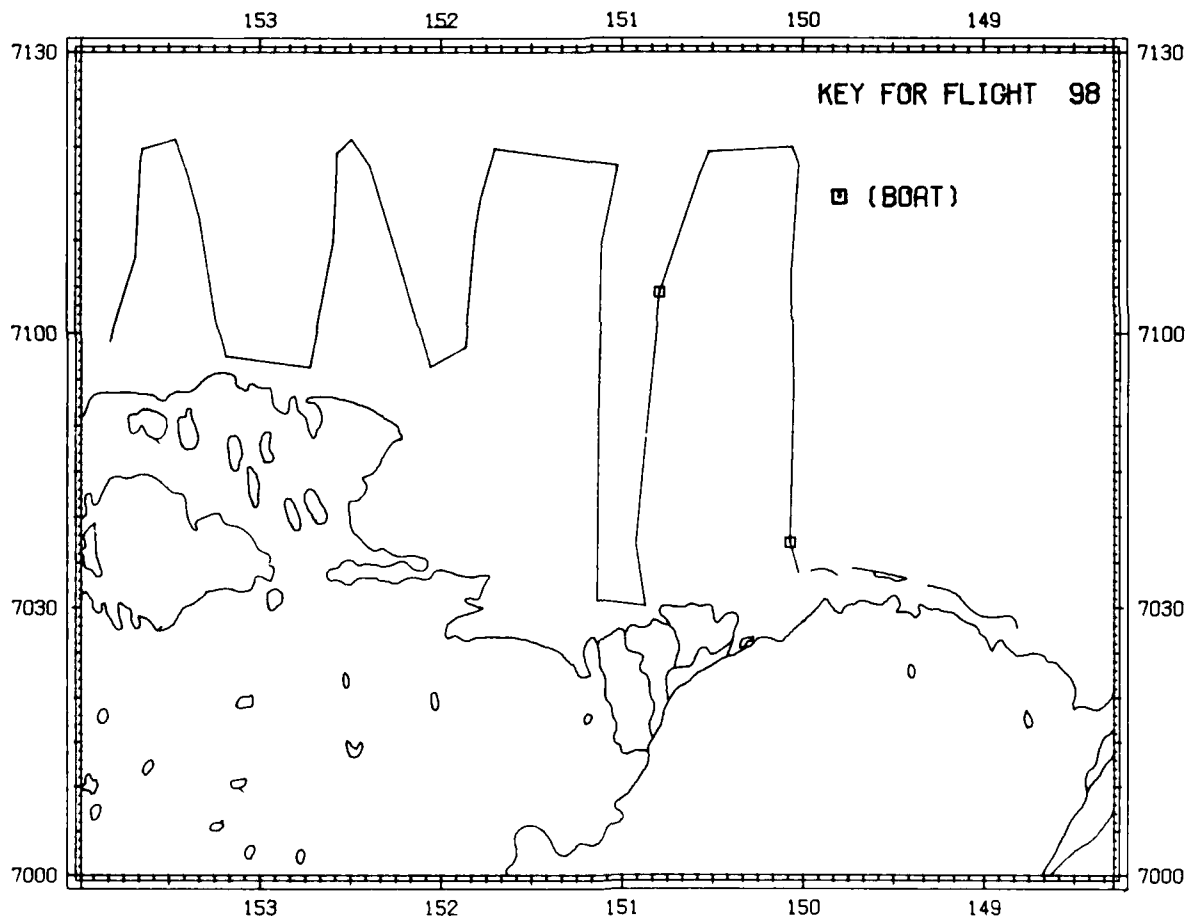
Flight was a search east from Deadhorse to Barter Island then west to Lonely along 20-m contour. Weather was partly cloudy or overcast; visibility was unlimited. Sea state varied between 0/10 to 1/10 ice coverage, with Beaufort 1 seas. Fifty-eight behavioral observations were made on a minimum of 11 bowheads. Four ringed and 4 bearded seals were sighted also. Two active geophysical boats were seen. Two sonobuoys were dropped. Bowhead whale sounds and geophysical exploration sounds were recorded.



No Bowhead Sightings for Flight 98, September 12, 1981

FLIGHT NUMBER 98, SEPTEMBER 12, 1981

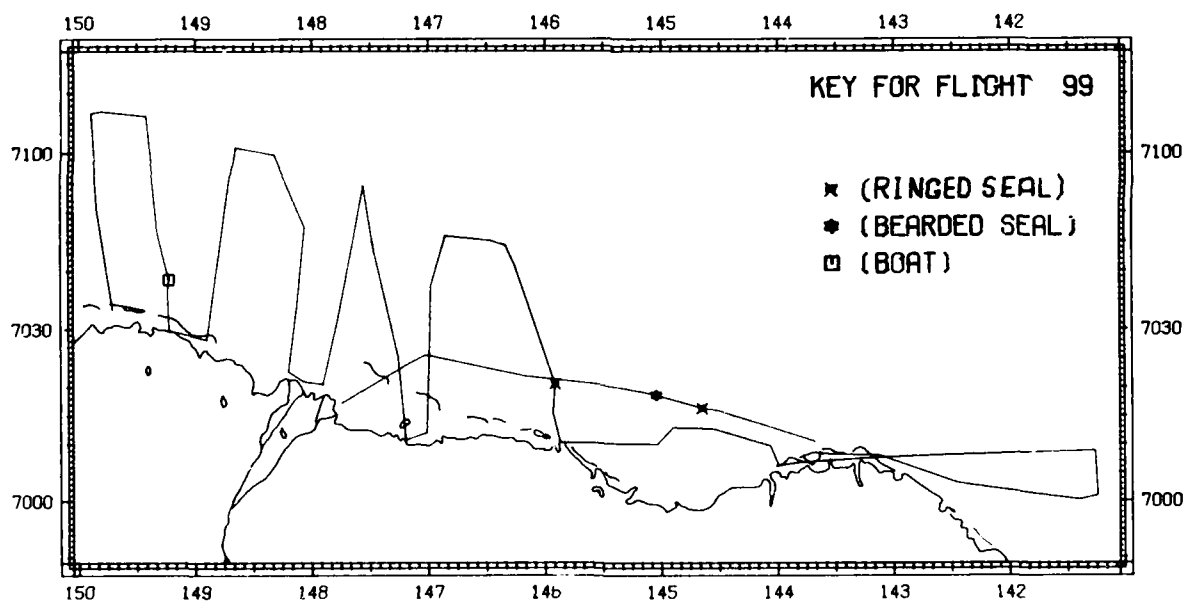
Flight was a west-to-east transect survey of the Federal lease area. Weather was partly cloudy or overcast; visibility was unlimited. Sea state Beaufort 1. There was a northern 3-km-wide strip which had 2/10 ice coverage. This strip of pan ice began abruptly and continued to the horizon. No marine mammals were sighted. Two active geophysical boats were sighted. One sonobuoy was dropped. Geophysical exploration sounds were recorded. No marine mammal sounds were recorded.



No Bowhead Sightings for Flight 99, September 13, 1981

FLIGHT NUMBER 99, SEPTEMBER 13, 1981

Flight was a seach east from Deadhorse to Barter Island, then a transect survey of the Joint State-Federal oil lease area. Weather was foggy east of Flaxman Island, resulting in visibility of less than 9 km. West of Flaxman Island the weather was partly cloudy, and visibility was unlimited. Sea state was Beaufort 1 near the Barrier Islands and 1/10 ice coverage north of the Islands. No bowhead whales were sighted. Three ringed and 2 bearded seals were sighted. One geophysical boat was seen. A sonobuoy was dropped; no sounds produced by marine mammals were recorded.



Bowhead Whale Sightings for Flight 100, September 14, 1981

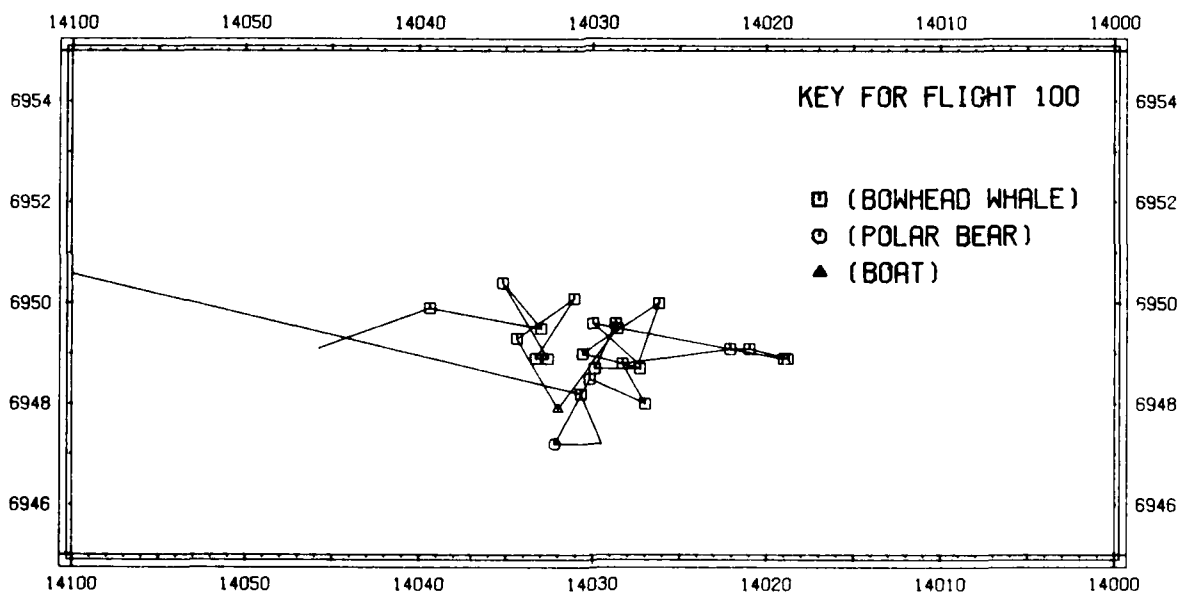
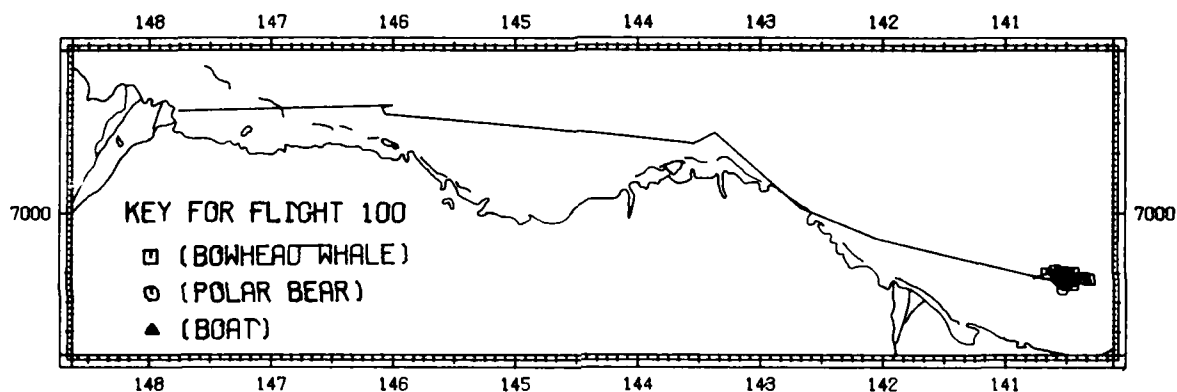
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	140 30.7	69 48.2	213	1/10 B2	55 ft
2	140 27.7	69 48.1	152	1/10 B2	25 ft, swimming
2	140 30.2	69 48.5	427	1/10 B2	50 ft, swimming
1	140 27.0	69 48.0	518	1/10 B2	swimming
2	140 28.3	69 48.8	518	1/10 B2	swimming
1	140 22.1	69 49.1	518	1/10 B2	swimming
1	140 21.0	69 49.1	518	1/10 B2	swimming
1	140 18.8	69 48.9	518	1/10 B2	swimming
1	140 19.0	69 48.9	518	1/10 B2	35 ft, swimming
2	140 28.3	69 47.5	549	1/10 B2	55 ft, swimming
1	140 30.0	69 49.6	488	1/10 B2	swimming
1	140 27.9	69 47.8	488	1/10 B2	55 ft, swimming
1	140 26.2	69 50.0	503	1/10 B2	40 ft, swimming
1	140 30.6	69 49.0	503	1/10 B2	40 ft, swimming
1	140 27.3	69 48.7	488	1/10 B2	35 ft, swimming
2	140 30.4	69 48.0	488	1/10 B2	55 ft, swimming
1	140 29.9	69 48.7	488	1/10 B2	45 ft, swimming
2	140 28.7	69 49.6	509	1/10 B2	swimming
2	140 28.6	69 49.5	509	1/10 B2	swimming
2	140 30.6	69 48.5	509	1/10 B2	swimming
1	140 34.4	69 49.3	549	1/10 B2	swimming
1	140 31.1	69 50.1	563	1/10 B2	swimming
1	140 33.3	69 48.9	549	1/10 B2	swimming
1	140 32.6	69 48.4	503	1/10 B2	

Bowhead Whale Sightings for Flight 100, September 14, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	140 33.9	69 49.1	480	1/10 B2	55 ft, swimming
1	140 35.2	69 50.4	465	1/10 B2	55 ft, swimming
1	140 33.0	69 49.5	472	1/10 B2	swimming
3	140 39.4	69 49.9	396	1/10 B2	40 ft, swimming
2	140 34.4	69 49.1	393	1/10 B2	45 ft, dove

FLIGHT NUMBER 100, SEPTEMBER 14, 1981

Flight was a search from Deadhorse to Herschel Island following the 20-m contour. The purpose of the flight was to locate bowheads for behavioral observations and record the bowheads' migratory status. Weather was foggy, yielding visibility less than 1 km until 140.30'W. At this location visibility became unlimited, with clear skies. There was 1/10 ice coverage. Forty-three behavioral observations were made on a minimum of 15 bowhead whales. Two polar bears were also seen. One geophysical boat was sighted. Two sonobuoys were dropped. Sounds were recorded from bowheads and the geophysical boat.

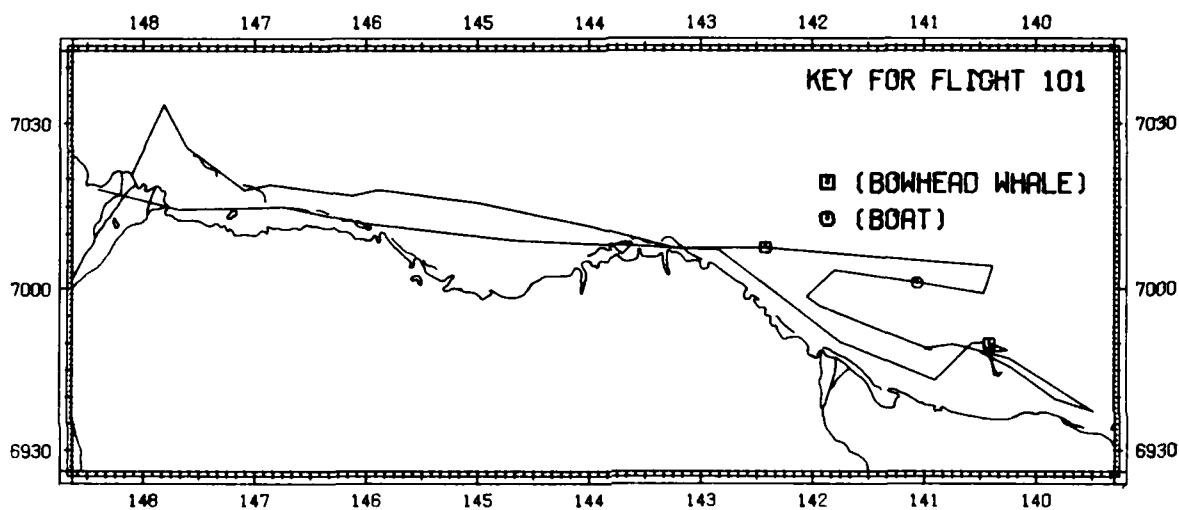


Bowhead Whale Sightings for Flight 101, September 16, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	140 24.8	69 49.9	122	1/10 B3	50 ft, resting
1	142 25.4	70 07.6	152	1/10 B3	45 ft, swimming

FLIGHT NUMBER 101, SEPTEMBER 16, 1981

Flight was a search from Deadhorse east to Herschel Island and back to Deadhorse along the 20-m contour. Weather was overcast, with low ceilings. Visibility ranged from less than 2 km to unlimited. Sea state was Beaufort 5, with 1/10 ice coverage. Two bowhead whales were sighted swimming west. One inactive geophysical boat was sighted.

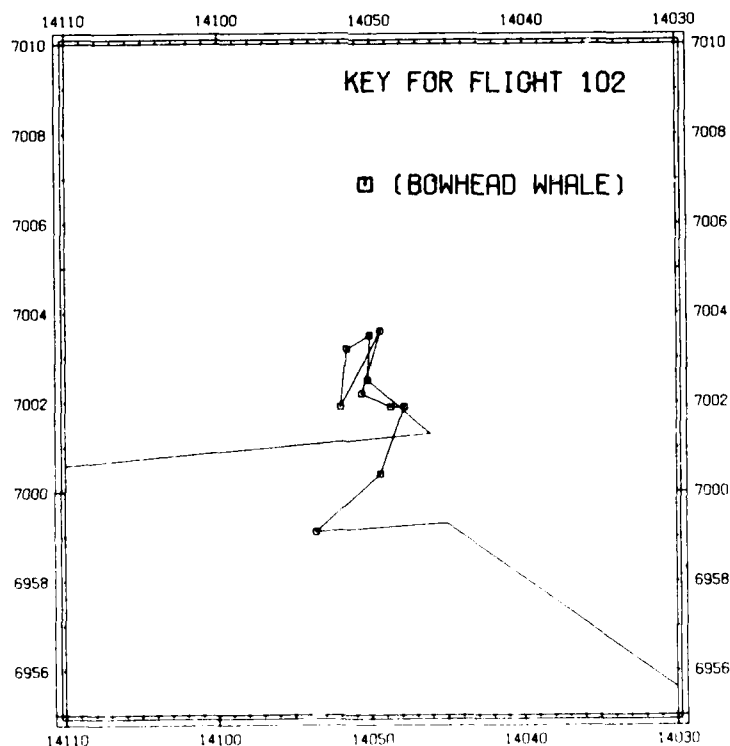
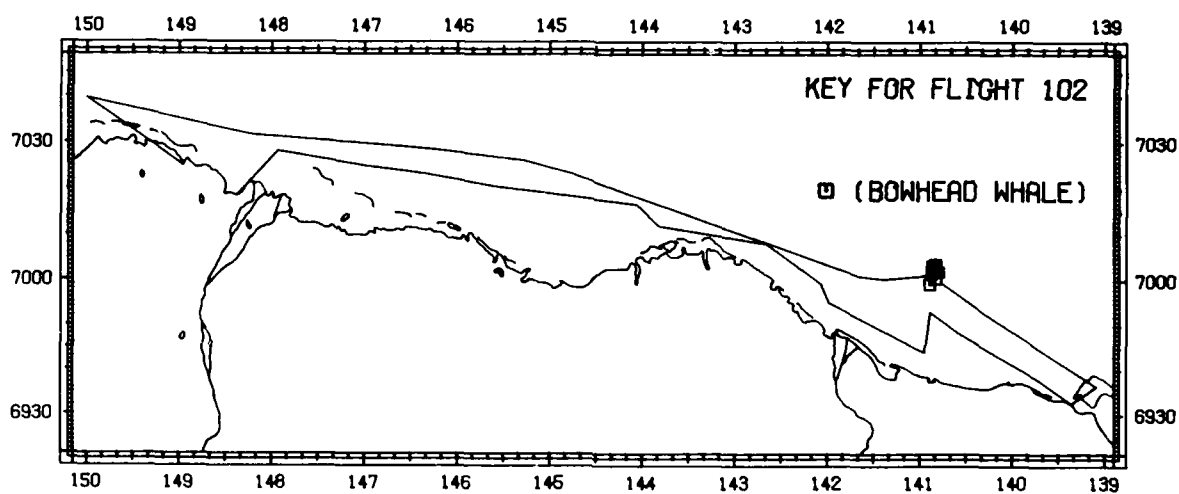


Bowhead Whale Sightings for Flight 102, September 17, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
4	140 53.6	69 59.1	274	1/10 B2	45 ft, resting
1	140 49.4	70 04.4	427	1/10 B2	45 ft, resting
1	140 47.8	70 01.9	472	1/10 B2	
1	140 48.7	70 01.9	472	1/10 B2	
1	140 50.6	70 02.2	457	1/10 B2	
1	140 49.4	70 03.6	480	1/10 B2	45 ft, resting
2	140 52.0	70 01.9	579	1/10 B2	
1	140 51.6	70 03.2	488	1/10 B2	40 ft, swimming

FLIGHT NUMBER 102, SEPTEMBER 17, 1981

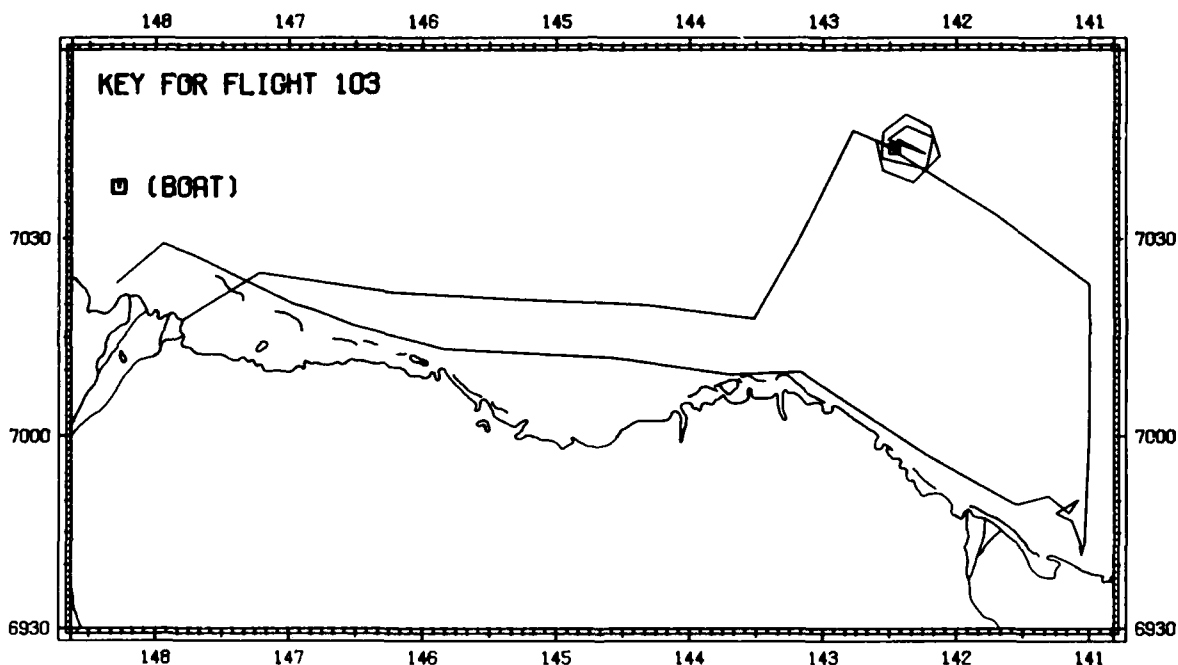
Flight was a search from Deadhorse to Herschel Island and back to Deadhorse, along the 20-m contour. The objective was to observe whale behaviors. Weather was overcast, partly cloudy, foggy and snowy. Visibility ranged from zero to unlimited. There was no good visibility east of Barter Island. Sea state was Beaufort 2 and 1/10 ice coverage. Twelve behavioral observations were made on 11 bowhead whales.



No Bowhead Sightings for Flight 103, September 18, 1981

FLIGHT NUMBER 103, SEPTEMBER 18, 1981

Flight was a search from Deadhorse east to the Canadian border and back to Deadhorse via the Barrier Island chain. The objective was to record geophysical exploration sounds and search for migrating bowhead whales. Weather was low overcast with fog. Visibility was less than 20 km. Sea state was Beaufort 4, with patches of 1/10 ice coverage. No bowhead whales were sighted. One geophysical boat was sighted. Two sonobuoys were dropped and sounds from the geophysical boat were recorded at different locations.



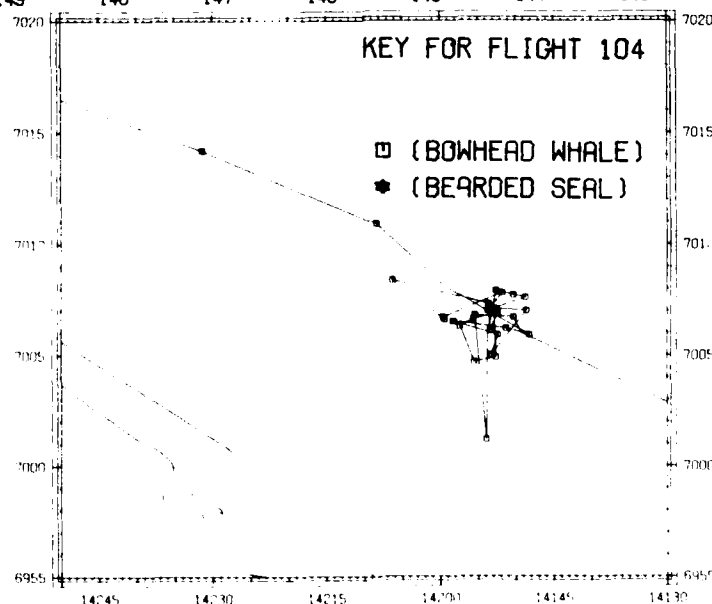
Bowhead Whale Sightings for Flight 104, September 20, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	141 50.3	70 06.7	183	1/10 B4	dove
1	141 55.4	70 06.8	18	1/10 B4	swimming
1	141 53.9	70 01.2	183	1/10 B4	resting
3	141 52.6	70 07.9	305	1/10 B4	swimming
1	141 50.3	70 07.7	305	1/10 B4	swimming
1	141 48.7	70 07.6	305	1/10 B4	40 ft, swimming
1	141 53.7	70 07.0	305	1/10 B4	resting
1	141 51.8	70 07.8	305	1/10 B4	40 ft, swimming
2	141 59.6	70 06.7	305	1/10 B4	resting
1	141 59.4	70 06.6	305	1/10 B4	45 ft, swimming
2	142 06.3	70 08.4	305	1/10 B4	dove
1	141 53.6	70 07.3	305	1/10 B4	swimming
1	141 53.4	70 06.1	305	1/10 B4	swimming
1	141 52.5	70 07.2	305	1/10 B4	swimming
1	141 52.4	70 06.9	305	1/10 B4	swimming
1	141 55.6	70 06.6	244	1/10 B4	
1	141 55.0	70 00.6	244	1/10 B4	
1	141 57.4	70 06.3	244	1/10 B4	
1	141 55.5	70 04.7	250	1/10 B4	swimming
1	141 52.6	70 04.9	277	1/10 B4	
4	141 52.9	70 07.1	265	1/10 B4	40 ft, resting
1	141 48.6	70 07.0	259	1/10 B4	
1	141 52.4	70 06.8	220	1/10 B4	resting
1	141 53.2	70 05.0	250	1/10 B4	dove

Bowhead Whale Sightings for Flight 104, September 20, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	141 52.4	70 05.9	244	1/10 B4	
3	141 52.1	70 06.1	244	1/10 B4	resting
1	141 51.3	70 06.8	259	1/10 B4	swimming
1	141 58.3	70 06.5	220	1/10 B4	swimming
1	141 58.2	70 06.5	220	1/10 B4	swimming
1	141 51.3	70 06.2	229	1/10 B4	45 ft, swimming
1	141 51.8	70 07.0	220	1/10 B4	
2	141 48.2	70 05.9	271	1/10 B4	resting
4	141 50.4	70 06.1	274	1/10 B4	resting
2	142 08.4	70 10.9	274	1/10 B4	45 ft, swimming
2	142 31.3	70 14.2	183	1/10 B4	swimming

Flight was a search from Deadhorse west to Oliktok, then east along the 20-m contour to Barter Island and Demarcation Bay, and back to Deadhorse, following the Barrier Island chain. The objective was to check the bowheads' migration along the 20-m contour and to continue the behavioral study in the Demarcation Bay area. Weather was foggy to overcast, with visibility ranging from less than 2 km to 40 km. Sea state was Beaufort 1, with occasional patches of 1/10 ice coverage. Thirty-eight bowheads were sighted in the Demarcation Bay area. Thirty-five behavioral observations were recorded on these bowheads. Three bearded seals were sighted along the 20-m contour. Two sonobuoys were dropped, and bowhead sounds were recorded.

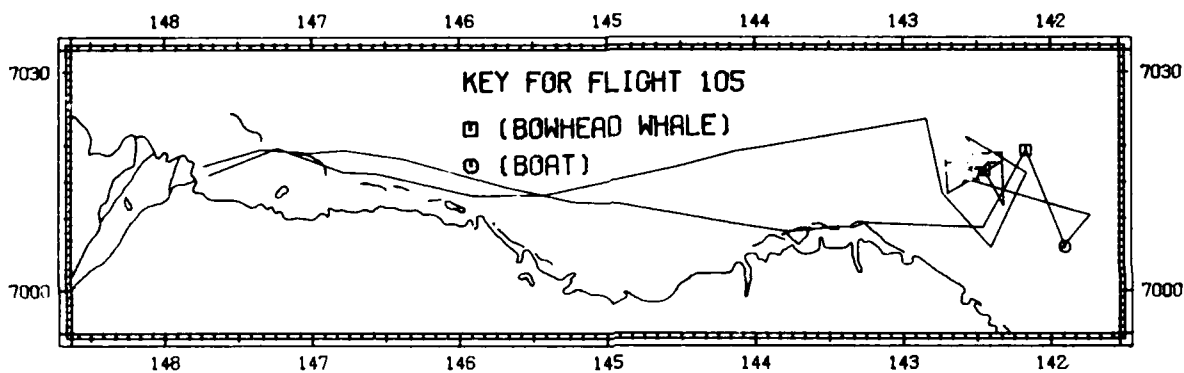


Bowhead Whale Sightings for Flight 105, September 21, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	142 10.0	70 19.3	160	3/10 B2	swimming
1	142 32.1	70 17.9	163	4/10 B2	swimming
1	142 26.7	70 16.6	271	4/10 B2	45 ft, swimming

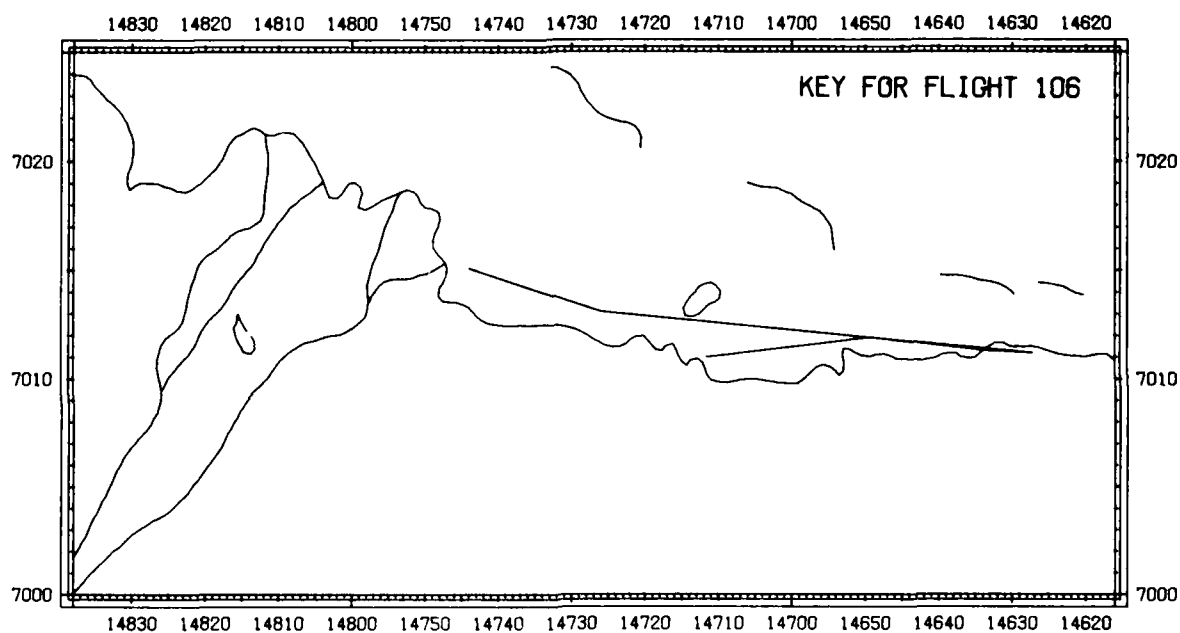
FLIGHT NUMBER 105, SEPTEMBER 21, 1981

Flight was a search from Deadhorse to northeast of Barter Island along the 20-m contour. The objective was to study bowhead whale behaviors. Weather was overcast with some fog. Visibility ranged from 40 km to less than 7 km. Sea state was Beaufort 3 to 4, with occasional 1/10 ice coverage. Five behavioral observations were made on three bowhead whales. One inactive geophysical boat was sighted. A sonobuoy was dropped, but no sounds were recorded.



FLIGHT NUMBER 106, SEPTEMBER 22, 1981

Flight was a transect survey of the State-Federal lease areas. Heavy fog north of the Barrier Islands forced the survey to be aborted.

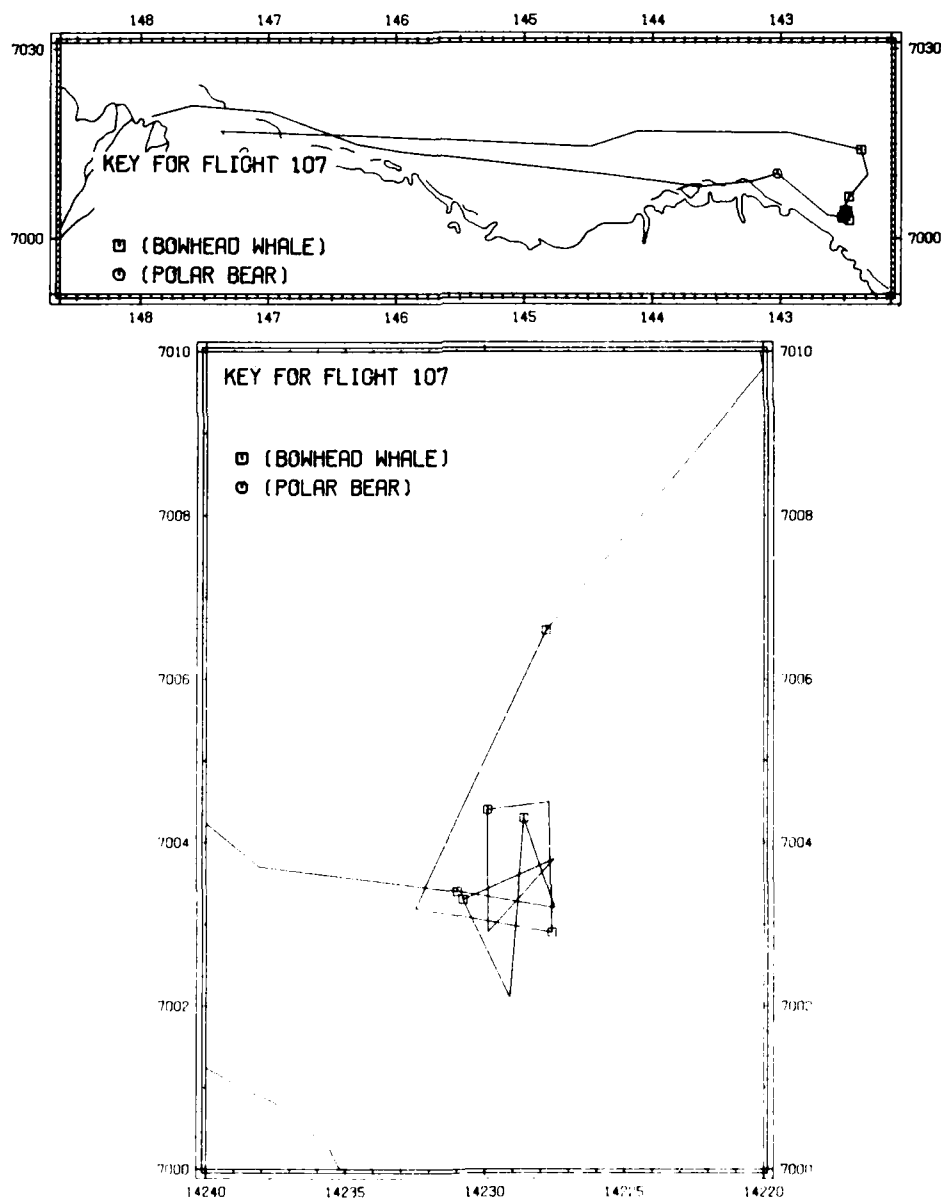


Bowhead Whale Sightings for Flight 107, September 22, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	142 31.0	70 03.4	213	1/10 B3	swimming
1	142 28.6	70 04.3	457	1/10 B3	swimming
1	142 30.8	70 03.3	366	1/10 B3	35 ft, swimming
1	142 29.9	70 04.4	579	1/10 B3	swimming
1	142 27.6	70 02.9	564	1/10 B3	40 ft, swimming
1	142 27.8	70 06.6	549	1/10 B2	resting
1	142 22.2	70 14.1	305	1/10 B2	swimming

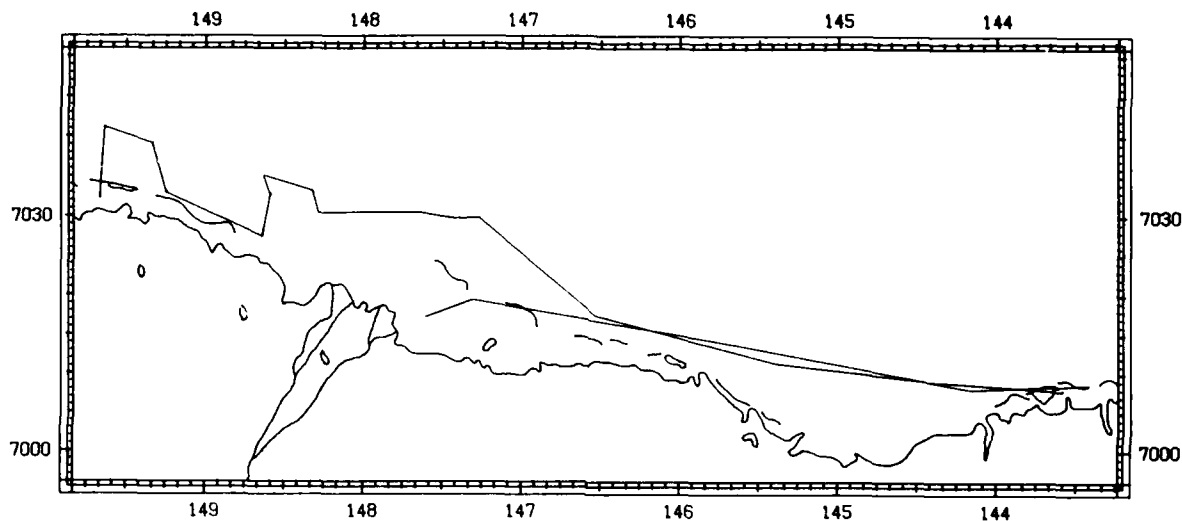
FLIGHT NUMBER 107, SEPTEMBER 22, 1981

Flight was a search from Deadhorse to east of Barter Island and back to Deadhorse along the 20-m contour. The objective was to study bowhead whale behaviors. Weather was foggy to partly cloudy, with visibility ranging from less than 7 km to 35 km. Sea state was Beaufort 2, with 1/10 ice coverage near the beach east of Barter Island. Fourteen behavioral observations were made on 7 bowhead whales. Two polar bears were sighted also. A sonobuoy was dropped, and bowhead sounds were recorded.



FLIGHT NUMBER 108, SEPTEMBER 23, 1981

Flight was a transect survey of the Federal lease area, but poor weather terminated the survey. A second objective was the bowhead behavioral study. Weather was foggy, and visibility rarely was greater than 3 km. No marine mammals were sighted.



FLIGHT NUMBER 109, SEPTEMBER 23, 1981

Flight was a transit from Deadhorse to Anchorage for repairs.

FLIGHT NUMBER 110, SEPTEMBER 26, 1981

Flight was a transit from Anchorage to Deadhorse.

No Bowhead Sightings for Flight 111, September 26, 1981

Flight was a transect of the Federal lease area. Weather was overcast or foggy, with visibility ranging from unlimited to less than 15 km. Sea state was Beaufort 4 to 5. The northern portion of the lease area had 1/10 pan ice coverage. No marine mammals were sighted. A ship in tow was sighted.



Bowhead Whale Sightings for Flight 112, September 28, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 27.5	70 20.8	122	110 B3	45 ft, swimming
1	145 25.1	70 19.9	122	1/10 B3	40 ft, swimming
1	145 25.8	70 21.6	122	1/10 B3	swimming
1	145 25.3	70 22.6	152	1/10 B3	dove
1	145 26.3	70 22.1	152	1/10 B3	
1	145 25.1	70 22.3	152	1/10 B3	dove
1	145 26.4	70 21.6	186	1/10 B3	dove
1	145 27.4	70 21.7	186	1/10 B3	dove
1	145 28.0	70 22.0	244	1/10 B3	swimming
1	145 26.2	70 22.1	244	1/10 B3	swimming
1	145 25.4	70 21.3	229	1/10 B3	dove
2	145 27.2	70 22.0	229	1/10 B3	swimming
1	145 27.3	70 21.6	160	1/10 B3	swimming
1	145 27.9	70 21.5	160	1/10 B3	swimming
1	145 28.7	70 21.2	160	1/10 B3	swimming
1	145 25.3	70 21.3	198	1/10 B3	dove
1	145 26.9	70 22.0	198	1/10 B3	swimming
1	145 27.8	70 21.8	195	1/10 B3	swimming
1	145 28.4	70 22.1	206	1/10 B3	45 ft, swimming
1	145 26.8	70 22.0	206	1/10 B3	40 ft, swimming
1	145 28.5	70 21.9	183	1/10 B3	40 ft, swimming
1	145 27.5	70 20.4	183	1/10 B3	resting
1	145 25.6	70 20.8	183	1/10 B3	swimming
1	145 24.0	70 21.5	183	1/10 B3	swimming

Bowhead Whale Sightings for Flight 112, September 28, 1981 (Continued)

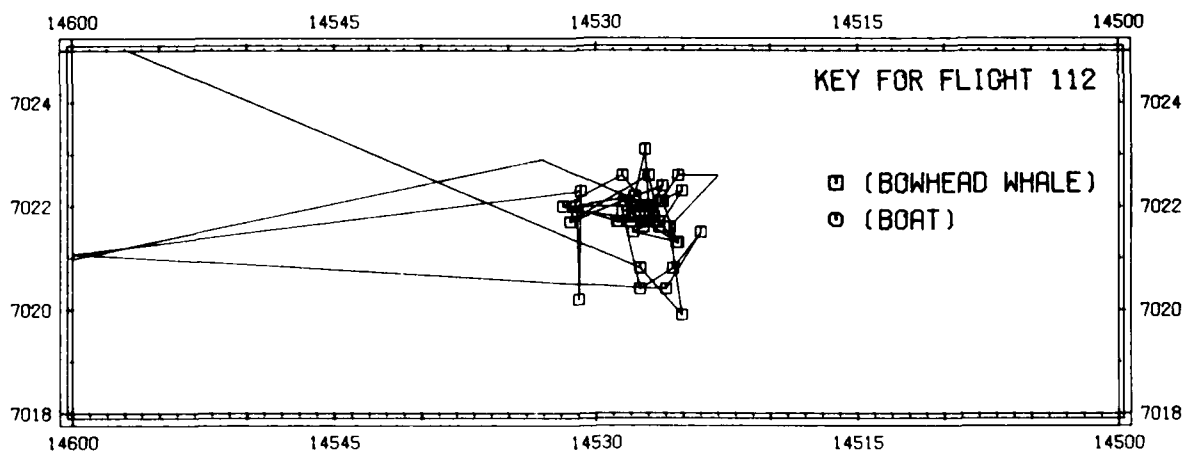
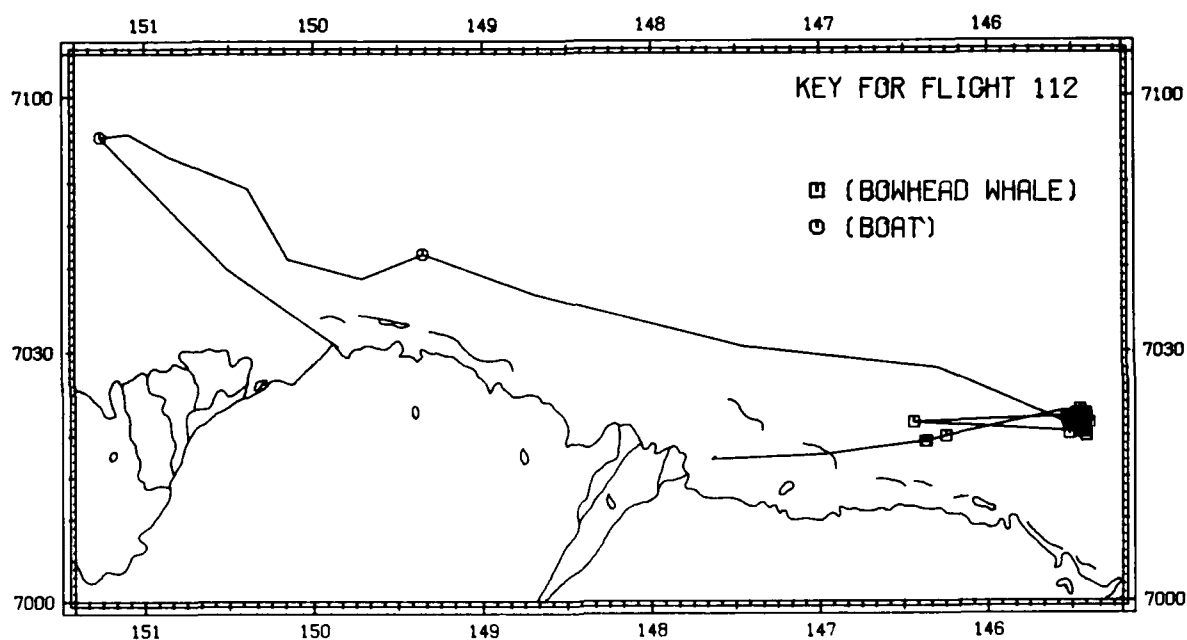
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 26.0	70 20.4	183	1/10 B3	swimming
1	145 27.7	70 22.8	183	1/10 B3	swimming
1	145 26.6	70 21.6	168	1/10 B3	swimming
1	145 30.9	70 22.3	168	1/10 B3	dove
1	145 31.0	70 20.2	168	1/10 B3	resting
2	145 29.1	70 22.1	148	1/10 B3	swimming
1	145 29.2	70 22.3	148	1/10 B3	swimming
1	145 31.1	70 21.9	148	1/10 B3	40 ft, swimming
1	145 26.4	70 21.7	198	1/10 B3	swimming
1	145 27.0	70 22.6	183	1/10 B3	swimming
1	145 31.5	70 21.7	183	1/10 B3	swimming
2	145 26.2	70 22.4	183	1/10 B3	
1	145 27.2	70 21.7	183	1/10 B3	
3	145 26.9	70 22.7	152	1/10 B3	swimming
2	145 28.8	70 21.7	152	1/10 B3	resting
2	145 26.7	70 21.8	142	1/10 B3	dove
1	145 28.5	70 22.6	133	1/10 B3	resting
1	145 28.4	70 22.8	155	1/10 B3	swimming
1	145 31.9	70 22.0	152	1/10 B3	dove
1	145 26.8	70 22.2	133	1/10 B3	swimming
1	145 28.7	70 21.7	135	1/10 B3	dove
1	145 27.7	70 22.0	143	1/10 B3	
1	145 31.2	70 22.0	183	1/10 B3	
1	145 27.8	70 22.2	183	1/10 B3	swimming

Bowhead Whale Sightings for Flight 112, September 28, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 28.2	70 22.2	183	1/10 B3	swimming
3	145 30.5	70 21.9	183	1/10 B3	swimming
1	145 27.2	70 23.1	148	1/10 B3	resting
1	145 27.7	70 23.0	183	1/10 B3	swimming
1	145 27.0	70 22.0	186	1/10 B3	
1	146 15.1	70 19.9	167	1/10 B3	swimming
1	146 22.0	70 19.3	149	1/10 B3	swimming
1	146 22.6	70 19.3	149	1/10 B3	swimming

FLIGHT NUMBER 112, SEPTEMBER 28, 1981

Flight was from Deadhorse to northeast of Flaxman Island and back to Deadhorse. The objective was to study bowhead whale behavior in relation to geophysical boat activity. Weather was overcast. Visibility was generally 35 km. Sea state was Beaufort 3, and there was no ice. Sixty-three behavioral observations were conducted on a minimum of 13 bowhead whales. One active geophysical boat was sighted. A sonobuoy was dropped, and sounds produced by the bowheads and the geophysical boat were recorded.

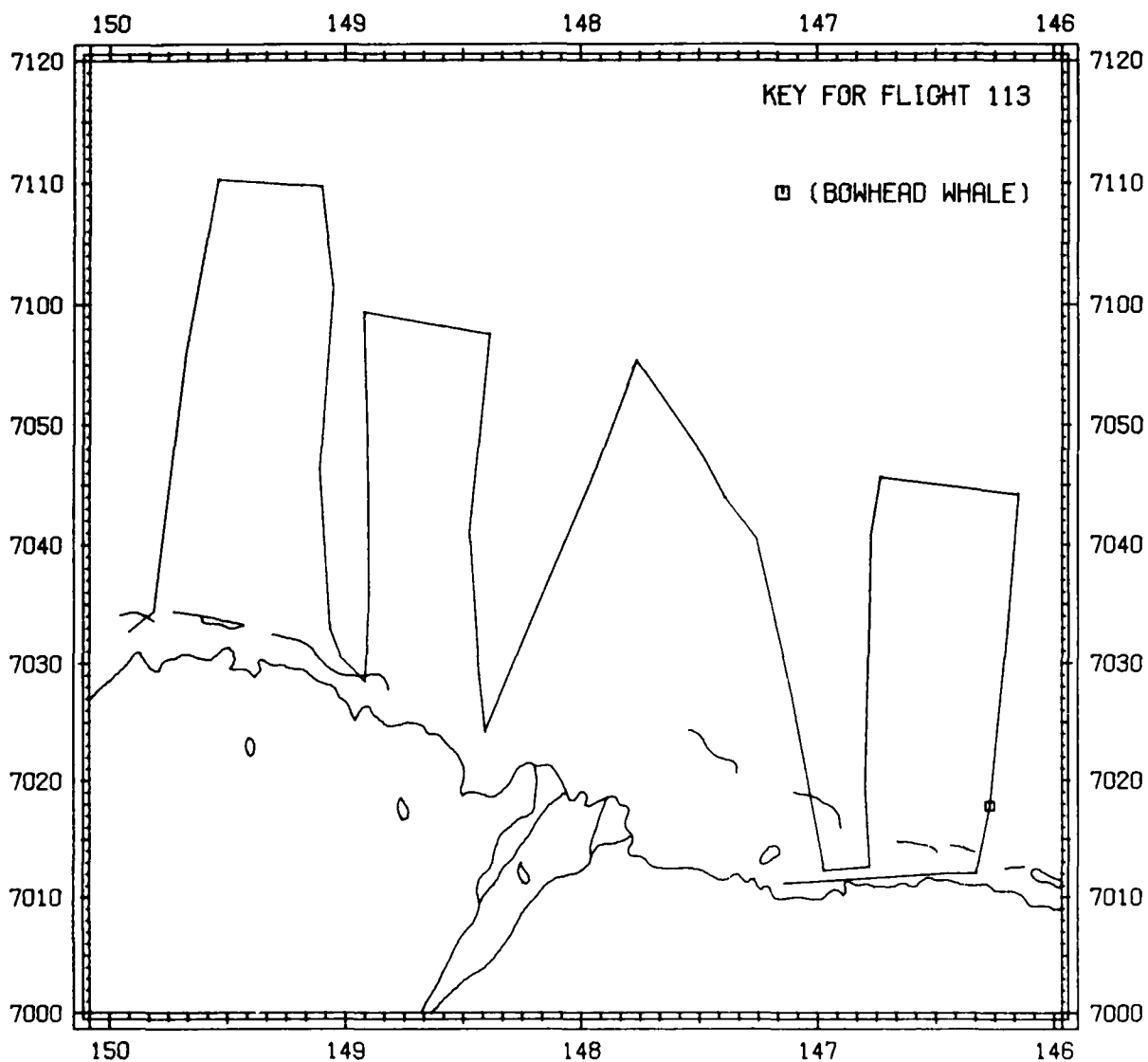


Bowhead Whale Sightings for Flight 113, September 28, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	146 16.3	70 17.8	133	1/10 B3	swimming

FLIGHT NUMBER 113, SEPTEMBER 28, 1981

Flight was a transect survey of the State-Federal lease area. Weather was overcast. Visibility was 35 km. Sea state was Beaufort 3, with 1/10 to 4/10 pan ice covering the northern portion of the lease area. One bowhead whale was sighted.



Bowhead Whale Sightings for Flight 114, September 29, 1981

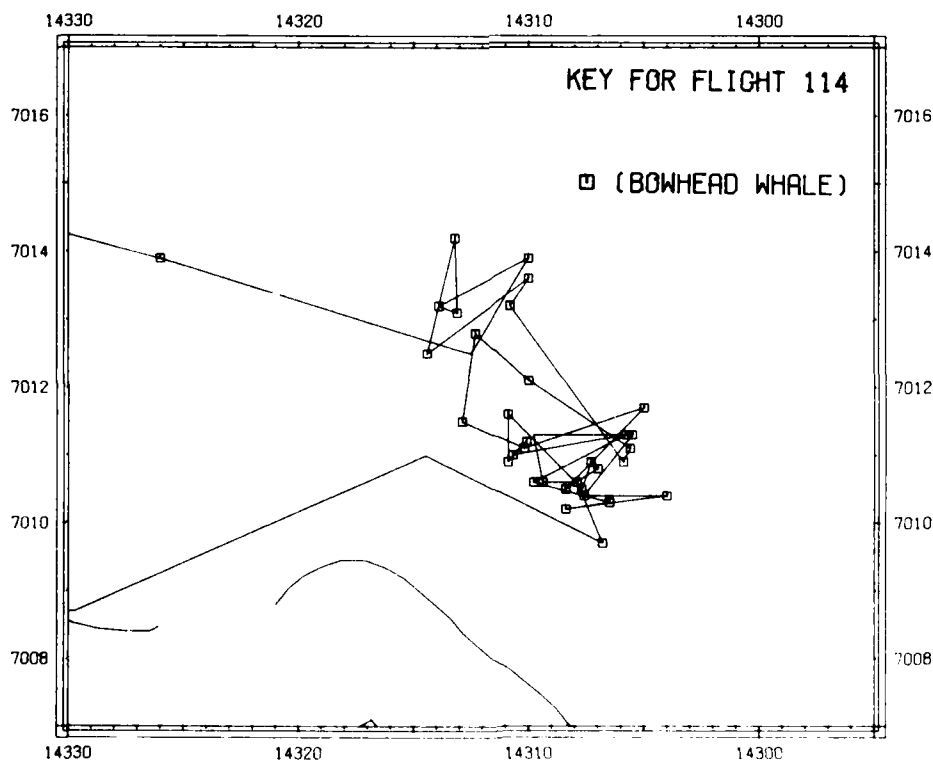
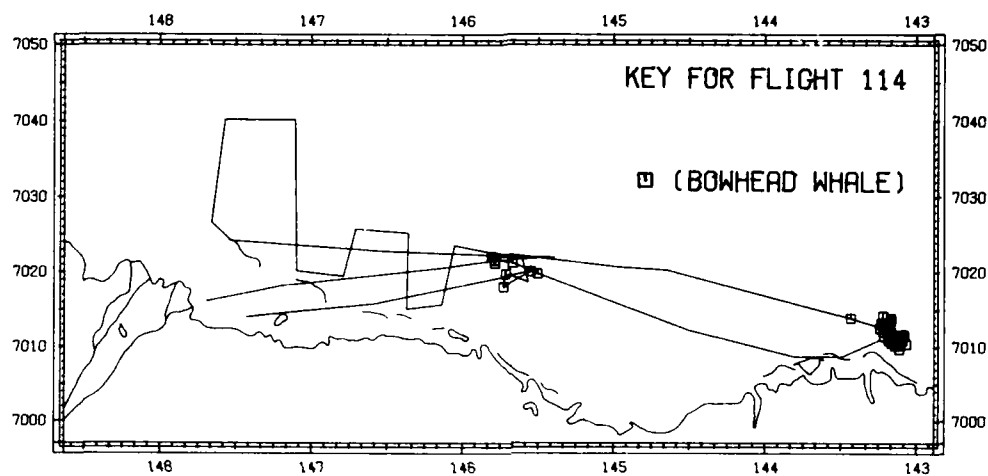
No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 47.1	70 21.6	305	1/10 B2	dove
1	145 48.4	70 22.1	305	1/10 B2	dove
1	145 47.1	70 21.2	396	1/10 B2	45 ft, resting
1	145 40.1	70 21.2	375	1/10 B2	swimming
1	145 30.2	70 19.8	351	1/10 B2	swimming
1	143 06.8	70 09.7	244	1/10 B2	swimming
1	143 07.9	70 10.6	271	1/10 B2	swimming
2	143 09.4	70 10.6	244	1/10 B2	resting
1	143 05.5	70 11.3	244	1/10 B2	
1	143 07.6	70 10.4	419	1/10 B2	dove
1	143 04.0	70 10.4	419	1/10 B2	40 ft, swimming
1	143 08.4	70 10.2	396	1/10 B2	
1	143 06.5	70 10.3	427	1/10 B2	
2	143 09.8	70 10.6	405	1/10 B2	
1	143 05.8	70 11.3	408	1/10 B2	resting
1	143 10.7	70 11.0	427	1/10 B2	dove
1	143 10.1	70 11.2	427	1/10 B2	40 ft, swimming
1	143 10.9	70 10.9	436	1/10 B2	40 ft, swimming
1	143 10.9	70 11.6	436	1/10 B2	dove
1	143 07.7	70 10.5	408	1/10 B2	
2	143 07	70 10.9	408	1/10 B2	40 ft, resting
2	143 07.0	70 10.8	390	1/10 B3	40 ft, swimming
2	143 08.4	70 10.5	390	1/10 B3	dove
1	143 05.0	70 11.7	411	1/10 B3	40 ft, swimming

Bowhead Whale Sightings for Flight 114, September 29, 1981 (Continued)

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	143 10.2	70 11.1	411	1/10 B3	40 ft, swimming
1	143 12.9	70 11.5	420	1/10 B3	dove
1	143 12.3	70 12.8	396	1/10 B3	
1	143 10.8	70 11.5	366	1/10 B3	
1	143 10.0	70 12.1	366	1/10 B3	
1	143 05.6	70 11.1	393	1/10 B4	
1	143 05.9	70 10.9	393	1/10	
1	143 11.1	70 12.9	372	1/10	
1	143 10.8	70 13.2	372	1/10	
1	143 13.1	70 12.1	381	1/10	
1	143 10.0	70 13.6	381	1/10	
1	143 14.4	70 12.5	381	1/10	swimming
1	143 13.2	70 14.2	381	1/10	swimming
2	143 13.1	70 13.1	381	1/10	
1	143 13.9	70 13.2	366	1/10	
1	143 10.0	70 13.9	305	1/10	dove
1	143 26.0	70 13.9	381	1/10	swimming
1	145 42.8	70 19.8	305	1/10	35 ft, swimming
1	145 43.7	70 18.1	302	1/10	dove
1	145 33.0	70 20.1	305	1/10	

FLIGHT NUMBER 114, SEPTEMBER 29, 1981

Flight was a search from Deadhorse to east of Barter Island and back along the 20-m contour, then a preplanned transect survey of the State-Federal lease area. Weather was overcast. Visibility was unlimited. Sea state ranged from Beaufort 3 to 4. Forty-six behavioral observations were recorded on a minimum of 17 bowhead whales. Two sonobuoys were dropped, and bowhead sounds were recorded.

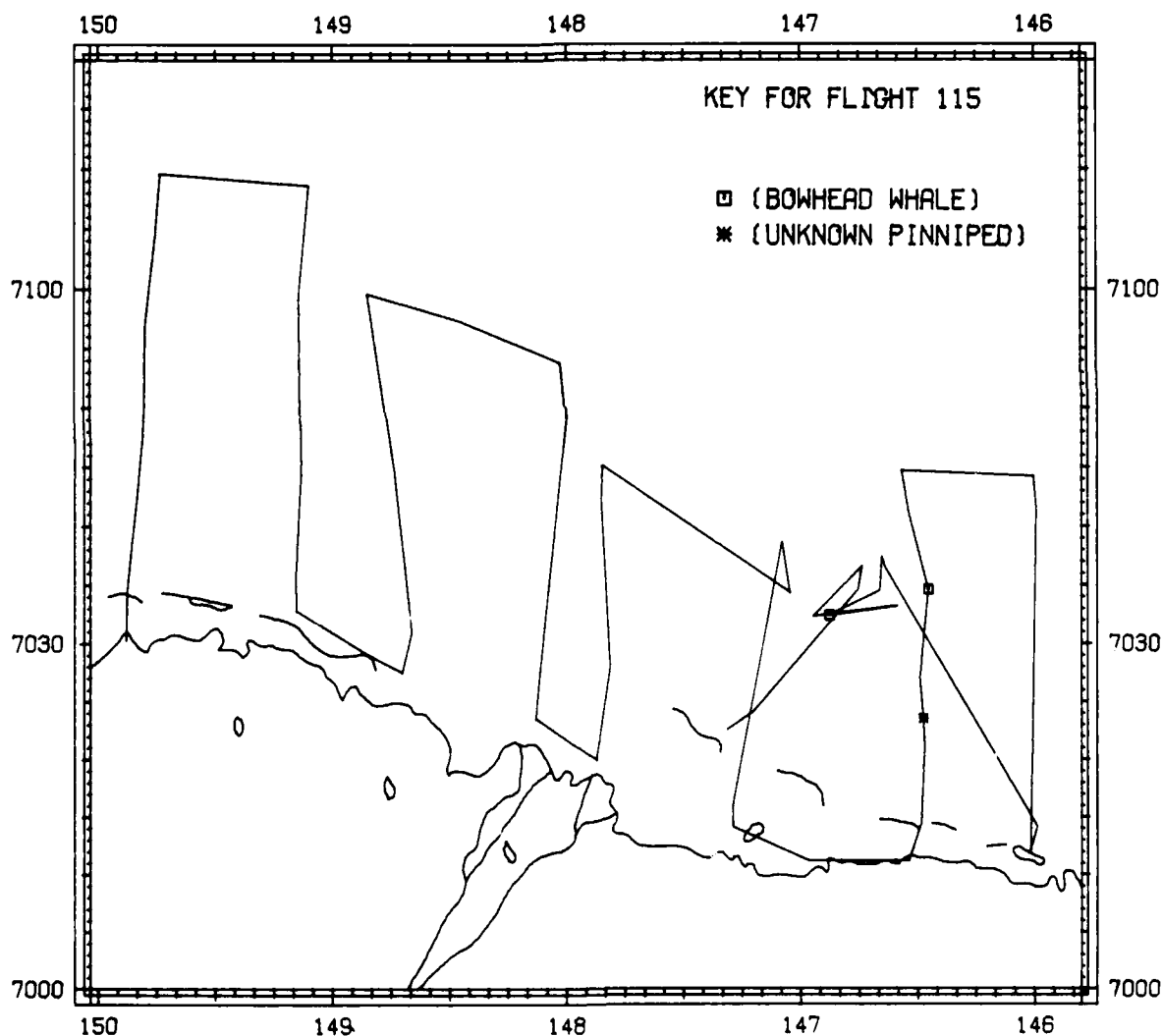


Bowhead Whale Sightings for Flight 115, October 1, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	146 27.2	70 34.6	183	1/10 B2	swimming
1	146 52.6	70 32.4	183	1/10 B3	40 ft, swimming

FLIGHT NUMBER 115, OCTOBER 1, 1981

Flight was a transect survey of the Joint State-Federal lease area. Weather was overcast. Visibility was less than 30 km. Sea state was Beaufort 3, and new ice was forming. Various combinations of grease ice and pan ice covered the area as much as 9/10. Two bowhead whales and 1 unidentified pinniped were sighted. Two sonobuoys were dropped, and bowhead sounds were recorded.

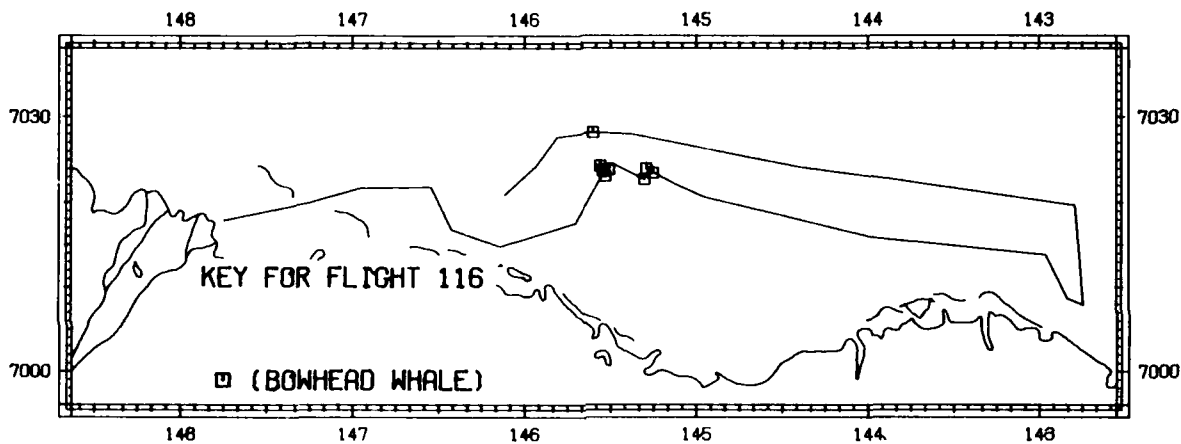


Bowhead Whale Sightings for Flight 116, October 2, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 31.7	70 23.1	137	3/10 B3	
1	145 33.4	70 24.3	152	3/10 B3	resting
2	145 32.5	70 23.8	137	3/10 B3	45 ft, dove
1	145 30.4	70 23.9	143	3/10 B3	40 ft, swimming
4	145 18.0	70 22.7	137	2/10 B3	55 ft, resting
1	145 15.1	70 23.5	137	2/10 B3	
7	145 18.6	70 23.1	213	2/10 B3	resting
3	145 17.2	70 23.4	220	2/10 B3	swimming
5	145 17.2	70 22.8	241	2/10 B3	resting
3	145 15.8	70 23.8	244	2/10 B3	
2	145 15.0	70 24.1	244	2/10 B3	swimming
1	145 17.3	70 24.0	244	2/10 B3	
3	145 17.9	70 22.8	244	2/10 B3	
2	145 36.0	70 28.2	152	2/10 B3	55 ft, swimming

FLIGHT NUMBER 116, OCTOBER 2, 1981

Flight was from Deadhorse to east of Barter Island and back to Deadhorse along the 20-m contour. The objective was to continue the behavior study on migrating bowhead whales. Weather was overcast. Visibility ranged from 40 km to less than 5 km. Sea state was Beaufort 5, with occasional patches of pan ice. Maximum ice coverage was 3/10. Thirteen behavioral observations were made on a minimum of 12 bowhead whales. Two sonobuoys were dropped, and bowhead sounds were recorded.

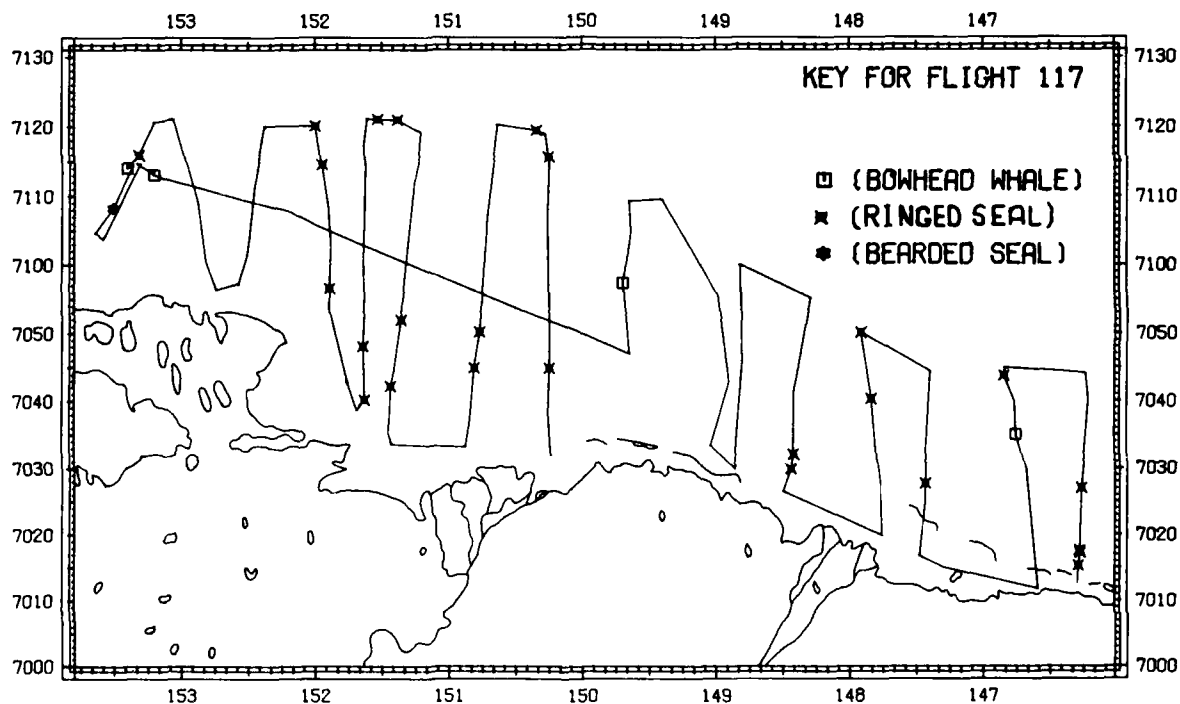


Bowhead Whale Sightings for Flight 117, October 3, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	153 24.3	71 14.1	116	8/10 B4	
1	153 12.3	71 13.1	213	8/10 B4	55 ft, swimming
1	149 41.7	70 57.4	163	8/10 B4	55 ft, swimming
1	146 45.1	70 35.0	152	8/10 B3	55 ft, swimming

FLIGHT NUMBER 117, OCTOBER 3, 1981

The flight was a transect survey of the Federal and Joint State-Federal lease areas. Weather was mainly overcast, with occasional patches of fog. Visibility was good. Sea state was variable as freeze-up was beginning. Grease ice, pan ice, and small lead systems covered the areas. Ice coverage ranged from 2/10 to 10/10. Five bowhead whales were sighted, including 1 cow-calf pair. Bowhead whale tracks in the ice were also seen. Thirty-two ringed seals and 6 bearded seals were also sighted.

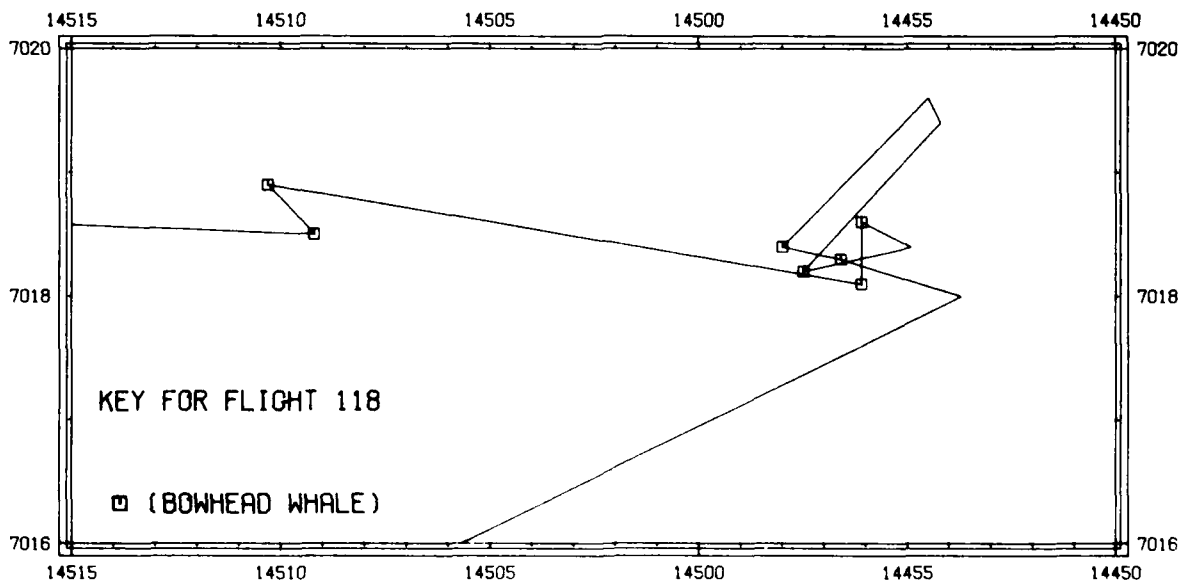
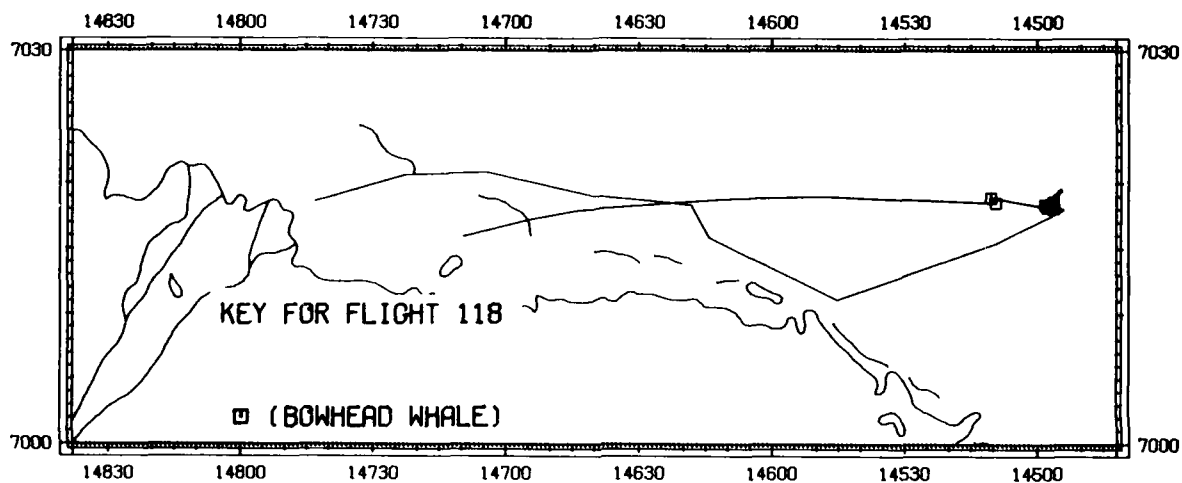


Bowhead Whale Sightings for Flight 118, October 5, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	144 56.6	70 18.3	152	5/10 B3	45 ft, resting
1	144 58.0	70 18.4	152	5/10 B3	45 ft, resting
1	144 56.9	70 18.5	244	5/10 B3	resting
1	144 56.1	70 18.2	244	5/10 B3	resting
1	144 57.5	70 18.2	244	5/10 B3	45 ft, resting
1	144 53.8	70 18.3	213	5/10 B3	resting
1	144 53.7	70 18.7	213	5/10 B3	
1	144 52.2	70 18.7	213	5/10 B3	resting
1	144 52.4	70 19.3	213	5/10 B3	swimming
1	144 54.9	70 19.2	198	5/10 B3	resting
1	144 55.5	70 18.6	183	5/10 B3	
1	144 56.1	70 18.6	183	5/10 B3	dove
1	144 55.6	70 17.9	183	5/10 B3	
1	144 56.1	70 18.1	183	5/10 B3	resting
1	144 10.3	70 18.9	122	5/10 B3	dove
1	145 09.2	70 18.5	105	5/10 B3	dove

FLIGHT NUMBER 118, OCTOBER 5, 1981

Flight was from Deadhorse to northeast of Flaxman Island and back to Deadhorse along the 20-m contour. The objective was to study bowhead whale behavior. The weather was foggy and overcast. Visibility was less than 8 km. Sea state was newly formed pan ice, averaging 5/10 coverage. Sixteen behavioral observations were recorded on 7 bowhead whales. Two sonobuoys were dropped, and bowhead sounds were recorded.

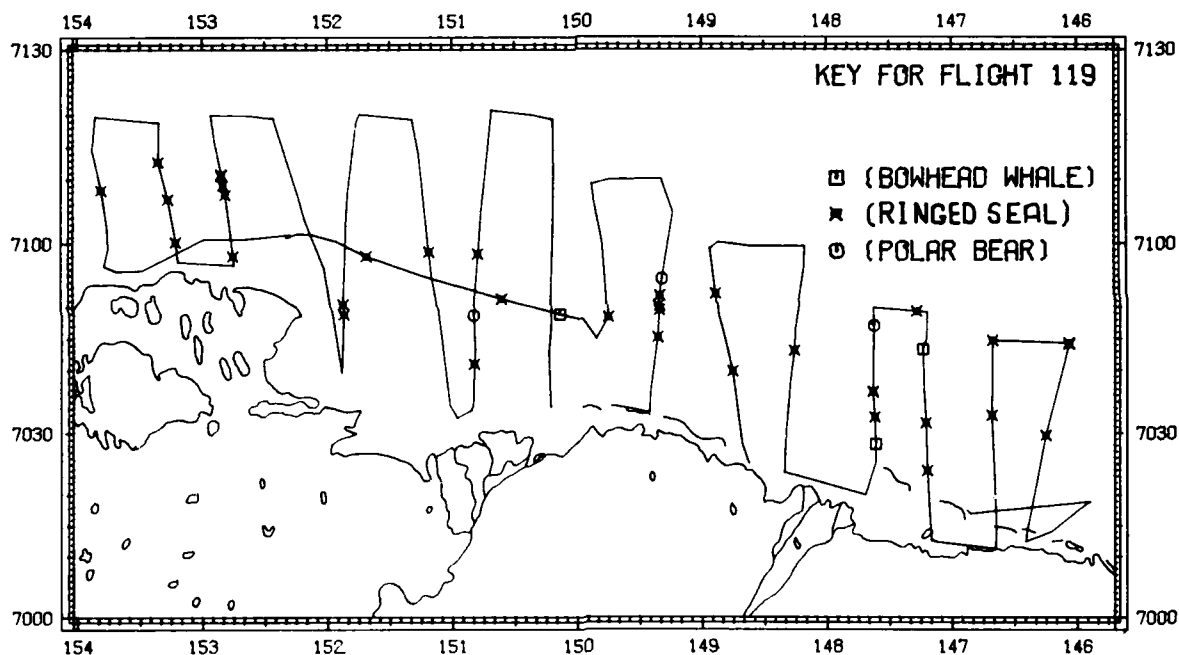


Bowhead Whale Sightings for Flight 119, October 6, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	150 08.4	70 48.9	183	8/10 B1	dove
1	147 36.8	70 28.2	155	7/10 B1	dove
1	147 14.1	70 43.3	146	9/10 B1	45 ft, resting

FLIGHT NUMBER 119, OCTOBER 6, 1981

Flight was a transect survey of the Federal lease area and Joint State-Federal lease area. Visibility was as far as 50 km in some portions of the lease areas. Ice coverage generally ranged between 7/10 and 9/10 of pan ice and grease ice. Three bowhead whales were sighted. Nine bowhead whale tracks in the ice were sighted. Sixty-eight ringed seals and 3 polar bears were also sighted. Two sonobuoys were dropped, and bowhead sounds were recorded.

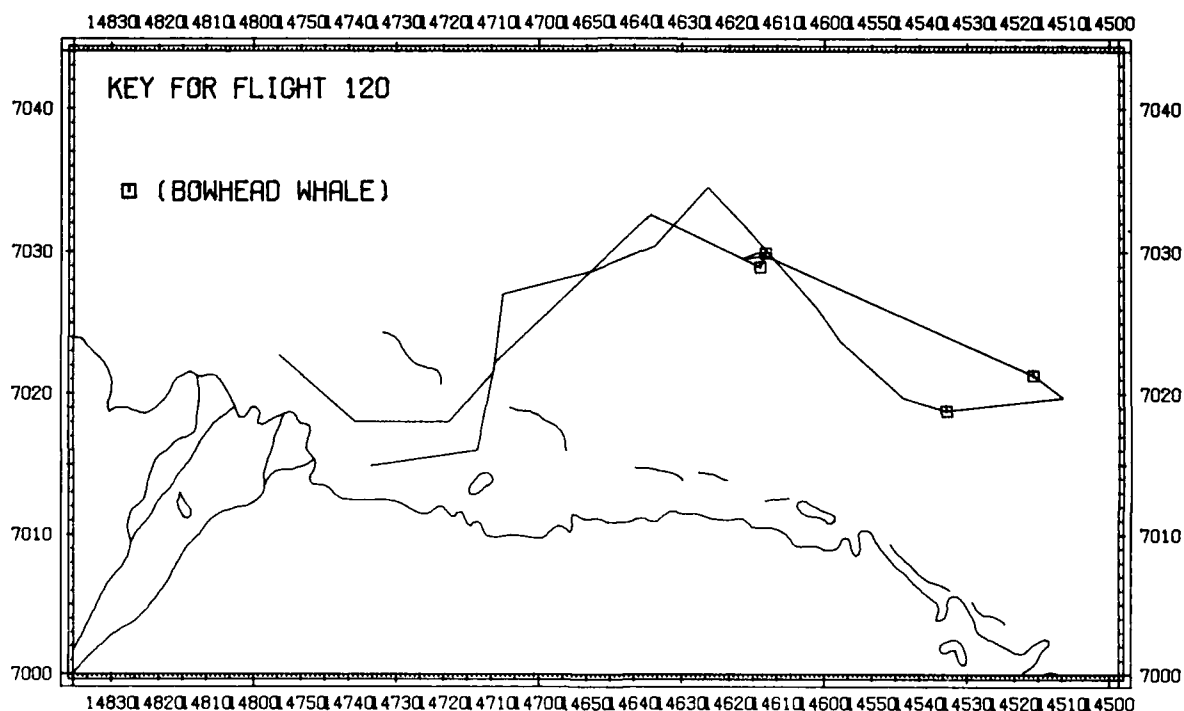


Bowhead Whale Sightings for Flight 120, October 7, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	146 13.4	70 28.9	152	7/10 B1	swimming
2	146 12.3	70 29.9	152	7/10 B1	50 ft, swimming
1	145 16.0	70 21.3	122	7/10 B1	swimming
1	145 34.3	70 18.8	119	7/10 B1	

FLIGHT NUMBER 120, OCTOBER 7, 1981

Flight was a search from Deadhorse to north of Flaxman Island and back to Deadhorse. The objective was to continue the behavioral study of migrating bowhead whales. Weather was overcast and freezing rain, which caused the survey to be terminated. Visibility never exceeded 20 km. Five bowhead whales were observed. Two sonobuoys were dropped, and bowhead sounds were recorded.

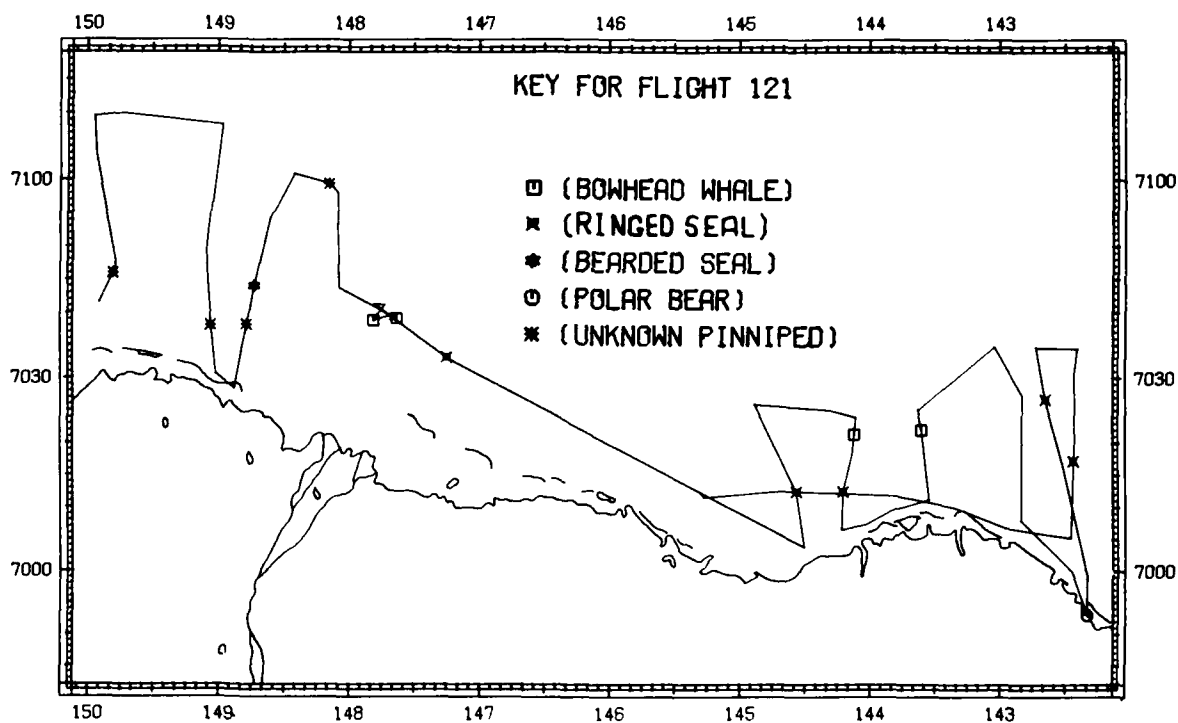


Bowhead Whale Sightings for Flight 121, October 9, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
3	147 37.9	70 39.1	488	8/10 B1	40 ft, swimming
1	147 48.6	70 38.8	518	8/10 B1	45 ft, swimming
1	144 07.2	70 21.3	174	6/10 B1	dove
2	143 36.1	70 22.0	186	8/10 B1	50 ft, swimming

FLIGHT NUMBER 121, OCTOBER 9, 1981

Flight was a transect survey of the Joint State-Federal lease area (cancelled due to fog), then east to Barter Island and returning to Deadhorse. Weather was foggy. Visibility was 30 km or less. Ice coverage ranged between 7/10 and 10/10. Seven bowhead whales were sighted. Six ringed seals, 1 bearded seal, and 6 unidentified pinnipeds were seen. Twenty-three polar bears were sighted at a bait station at Demarcation Bay. One sonobuoy was dropped, and bowhead whale sounds were recorded.

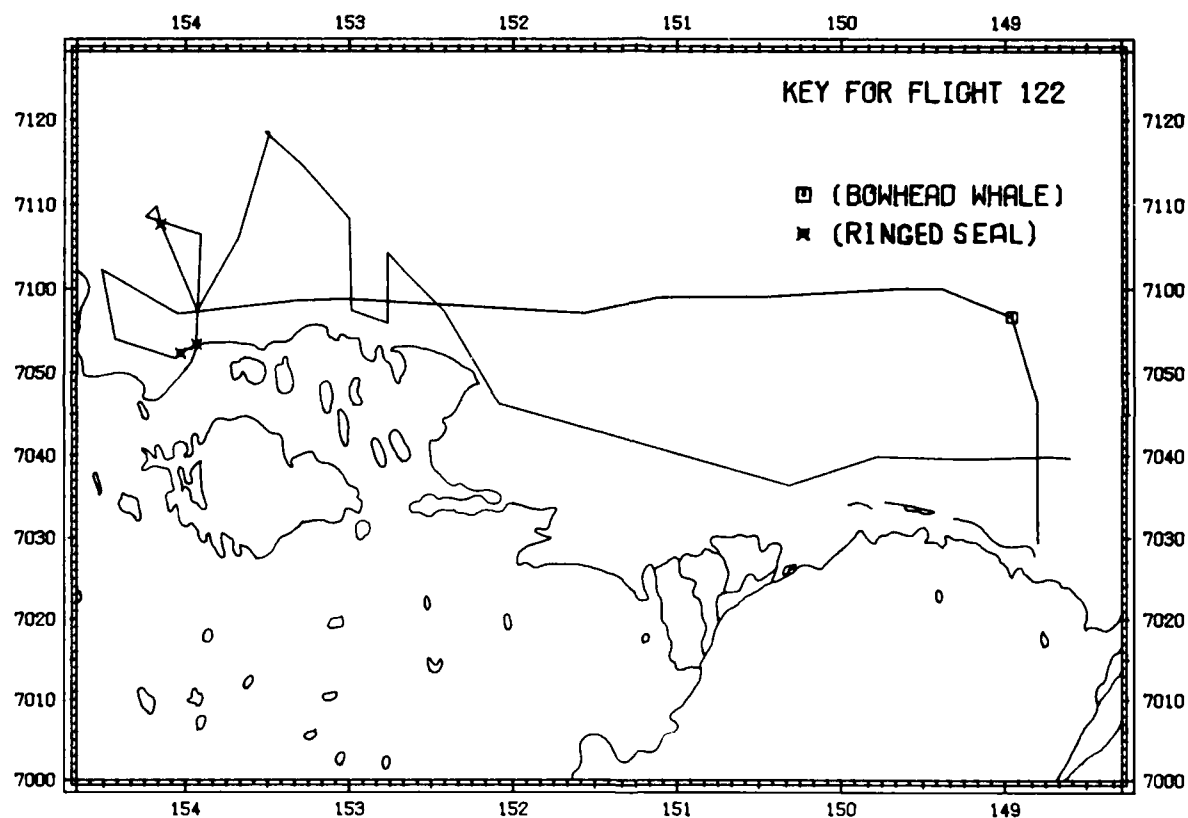


Bowhead Whale Sightings for Flight 122, October 10, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
2	148 57.4	70 56.7	183	9/10 B1	resting

FLIGHT NUMBER 122, OCTOBER 10, 1981

Flight was a search along the 71.00°N latitude line west to Smith Bay, and a preplanned transect survey of the Federal lease area. Line transects were aborted due to fog. Ice coverage was 8/10 to 10/10, mostly new pan ice and grease ice. Two bowhead whales were sighted in the Joint State-Federal lease area while the aircraft was en route to Smith Bay. Seven ringed seals were seen near Smith Bay.

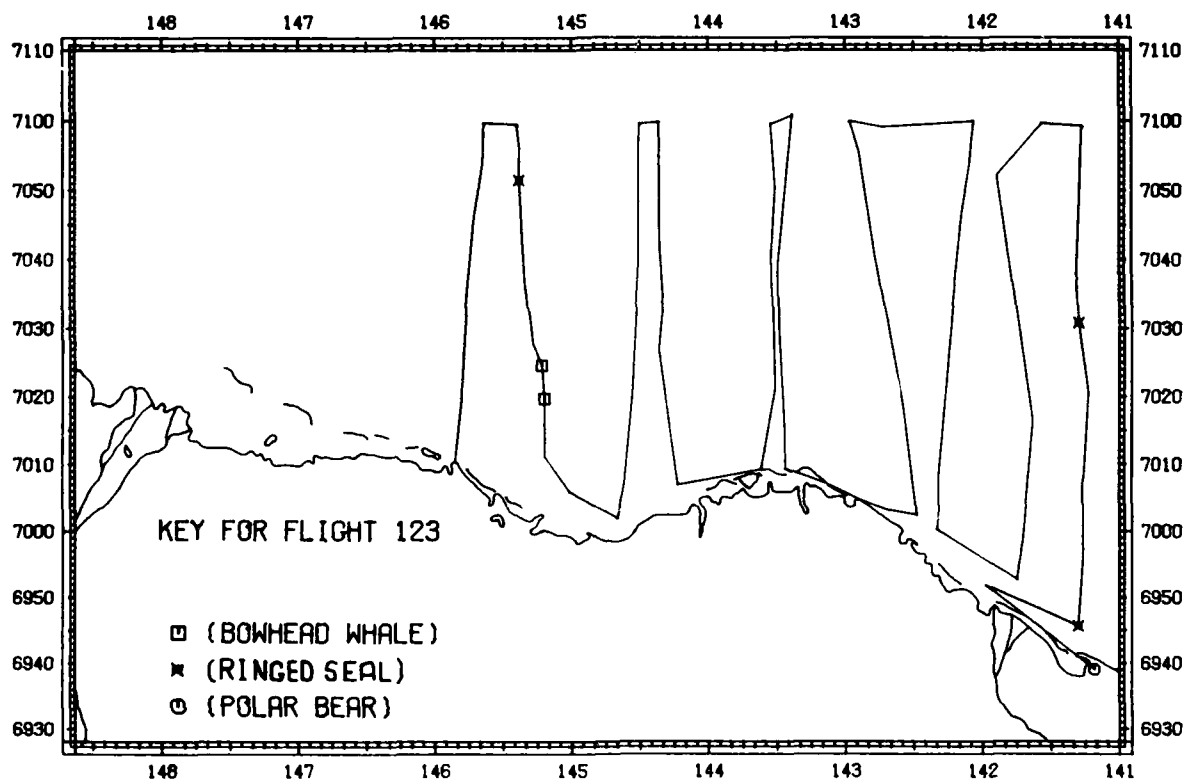


Bowhead Whale Sightings for Flight 123, October 11, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	145 13.1	70 24.6	149	8/10 B1	45 ft, swimming
1	145 11.9	70 19.7	152	8/10 B1	

FLIGHT NUMBER 123, OCTOBER 11, 1981

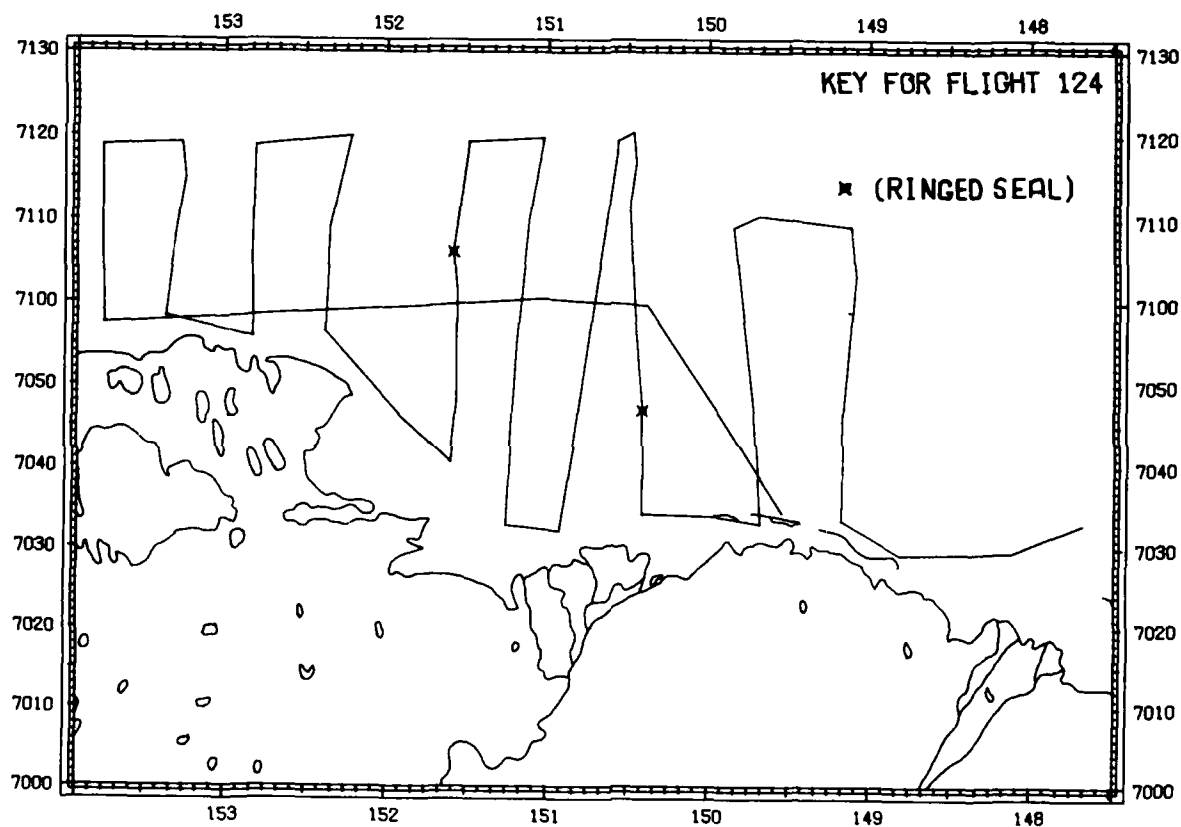
Flight was a transect survey between Camden Bay and Demarcation Bay, extending north to the 71°N line. Weather was partly cloudy, the fog in the northern section of the survey area. Visibility ranged from unlimited to less than 1 km. New ice was forming over the area, ranging from 4/10 to 10/10 coverage. Ice coverage decreased near shore and to the east. Two bowhead whales were sighted. Five ringed seals were sighted also. Twelve polar bears were sighted at a bait station at Demarcation Bay.



No Bowhead Sightings for Flight 124, October 14, 1981

FLIGHT NUMBER 124, OCTOBER 14, 1981

Flight was a transect survey of the Federal lease area and part of the Joint State-Federal lease area. Ice coverage ranged from 8/10 to 10/10. No bowheads were sighted. Two ringed seals were seen in the Federal lease area.

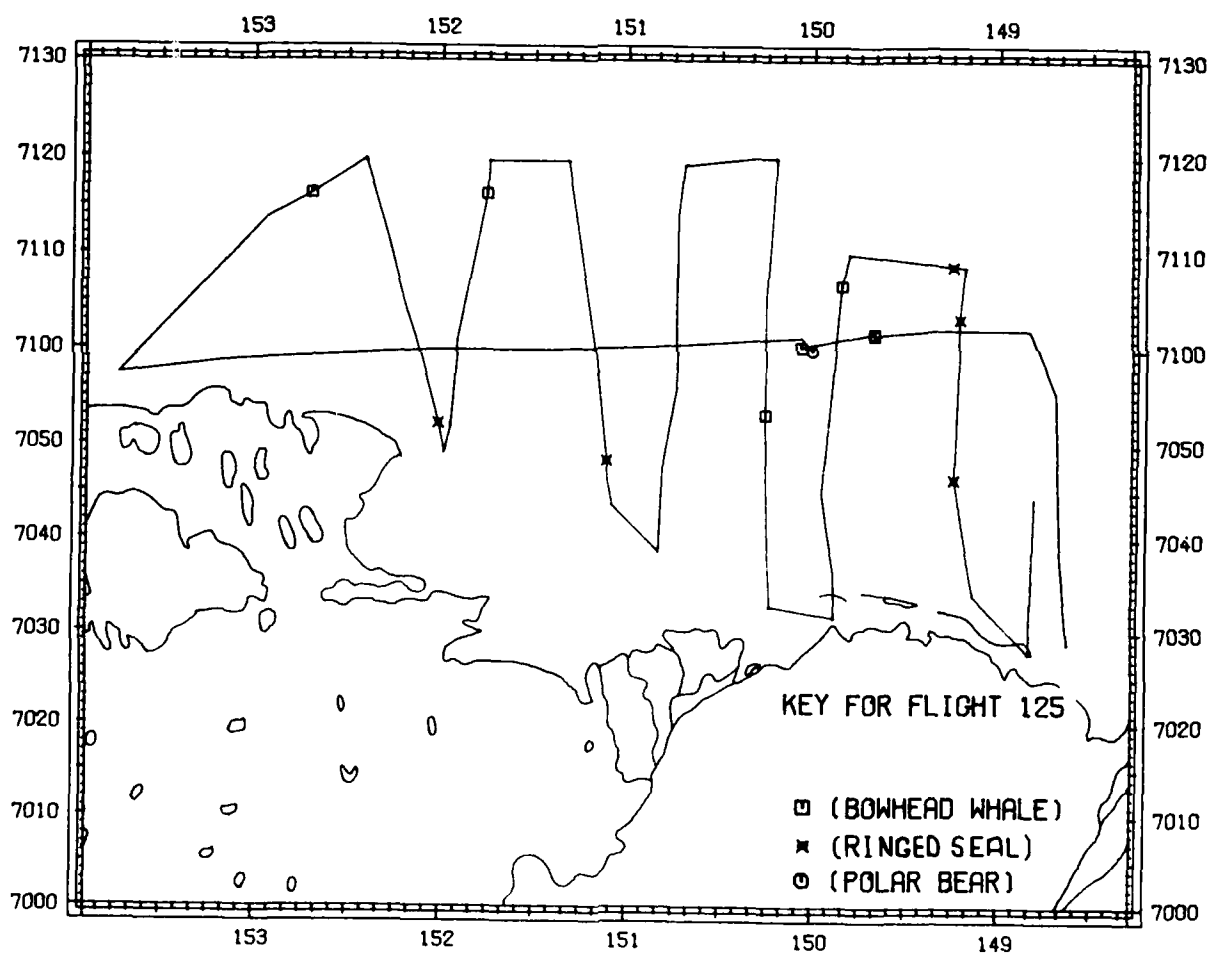


Bowhead Whale Sightings for Flight 125, October 15, 1981

No. of Whales	W. Long.	N. Lat.	Alt. m	% ice/ sea state	Behavior and observations
1	149 40.2	71 01.6	168	8/10 B2	
1	149 40.2	71 01.8	168	8/10 B2	
1	150 03.9	71 00.3	171	8/10 B2	dove
1	152 41.8	71 16.2	152	8/10 B1	
1	151 45.4	71 16.2	145	8/10 B1	swimming
1	150 15.6	70 53.2	160	8/10 B1	dove
1	149 50.7	71 06.8	183	8/10 B1	

FLIGHT NUMBER 125, OCTOBER 15, 1981

Flight was a partial transect of the Federal lease area from Deadhorse to Harrison Bay, east to Prudhoe Bay, and back to Deadhorse. Poor weather and visibility restricted the areas which could be surveyed. Weather was overcast to foggy with occasional patches of heavy snow. Visibility was less than 20 km. Ice coverage ranged between 7/10 to 10/10, forming leads and pan ice. Seven bowheads were sighted. Seven ringed seals and 1 polar bear were also sighted. Two sonobuoys were dropped, but sounds were not recorded.



APPENDIX B

DISTRIBUTION OF SURVEY EFFORT

AND

OBSERVED DENSITIES OF BOWHEAD AND GRAY WHALES

IN THE BEAUFORT, CHUKCHI AND BERING SEAS

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INTRODUCTION

The following section presents an analysis of aerial survey data collected from 1979 to 1981. The objectives of the analysis were to determine distribution and density of bowhead whales in the Beaufort, Chukchi and Bering Seas, and distribution and density of gray whales in the Bering and Chukchi Seas. An important component of this analysis was determination of the distribution of survey effort.

The Beaufort Sea was treated as one study area; the Bering and Chukchi Seas were treated as the another. Both study areas were subdivided for the purpose of more precise illustration of survey effort and density of animals.

Distribution of survey effort and density of bowhead whales in the Beaufort Sea study area were examined during Spring (April-May) and Summer (June-August) and again during Fall (September-October). In the Bering and Chukchi Seas, distribution of survey effort and density of bowhead whales was examined during Spring. Distribution of survey effort and density of gray whales in the Bering and Chukchi Seas were examined during Summer (June-August).

METHODOLOGY

Map Preparation

Maps were prepared using the computer program AMP, A Mapping Package, consisting of FORTRAN subroutines which can be used for customized plotting applications. AMP was used to plot aerial survey data which resided on file as a series of geographic coordinates (latitude and longitude) associated with time and sightings of whales. Land masses are part of the AMP data base. Depth contours were plotted by reading a separate file of data points prepared for this analysis.

Depth contours were digitized using several reference maps. It was necessary to use more than one map because not all contours were available on any one map. The U.S. Geological Survey map "Open - File 76 - 823, Sheet 1 or 2" was used to digitize the 50m and greater depth contours, plus all contours shown in the Chukchi Sea except for the 30m depth contour off the Soviet coastline. The 30m depth contour off the Soviet coastline and in the Bering Sea was taken from U.S. Department of Commerce map "514, 4th Ed., Apr. 11/81." In the Beaufort Sea, the 10m, 20m, and 30m depth contours were taken from two maps labeled "Data from: Geophysical Corp. of Alaska, 1975, NOAA, Dept. of Commerce Charts, U.S.G.S. Dept. of Interior Charts" which were additionally labeled as "Eastern Beaufort Sea" and "Western Beaufort Sea."

When the depth contours were merged onto a single data file and plotted, some inconsistencies became apparent. For example, a 30m depth contour from one map file crossed over the 50m depth contour from another map file. When this situation occurred, a portion of one of the depth contours was "clipped" to resolve the inconsistency. Note that portions of the 20m and 30m depth contours were clipped near Point Barrow, Alaska, and that the 50m depth contour was clipped near Saint Lawrence Island in the Bering Sea.

Data Processing and Quality Control

A computer program was written to screen for bad data values. The chronological order of time was checked. Aerial survey data files were screened for obvious errors in geographic position by plotting separately the course of each daily aerial survey. A computer program was used to calculate flight speeds and distances on a point to point basis, and listings of these values were scanned for suspiciously slow or fast speeds. The listings and maps were compared; errors were flagged and edited; and the process was repeated until data files were error-free with respect to these conditions.

Definition of Areas and Methodological Limitations

The total study area was divided from east to west based on proximity to oil lease sites (Figure B-1). Region A is west and adjacent to the lease areas extending from 153°30'W to 157°00'W longitude. Region B extends from 150°00'W to 153°30'W longitude, representing the western lease area. Region C extends from 146°00' to 150°00'W longitude, representing the eastern lease area. And, Region D is east and adjacent to the lease area extending from 141°00'W to 146°00'W longitude.

Depth contours (Figure B-2) were used to stratify the Beaufort Sea from north to south corresponding to water depth. Preliminary analysis of survey data indicated that there was a relationship between water depth and distribution of bowhead whales. Depth contours of 10m, 20m, 50m, 200m and 2000m were selected (Figure B-3, Figure B-4).

The stratum from the coastline to 10m corresponded closely to the area inside the barrier islands (A1, B1, C1, D1A, and D1B). Area D1 was divided into D1A and D1B at 143°30'W, which marked the boundary between two areas previously defined for behavioral studies (Figure B-5).

The shelf area was stratified from 10m to 20m, 20m to 50m, and 50m to 200m. Areas A2, B2, C2, D2A, and D2B corresponded to the 10m to 20m strata. Area D2 was divided similarly to D1. Areas A3, B3, C3, and D3 corresponded to the 20m to 50m stratum. Areas A4, B4, C4, and D4 corresponded to the 50m to 200m stratum.

Offshelf strata were defined from 200m to 2000m and deeper than 2000m. Areas A5, B5, C5, and D5 corresponded to the 200m to 2000m strata. Areas B6, C6 and D6 corresponded to the deeper than 2000m strata.

The comparatively shallow Bering and Chukchi Seas were not subdivided on the basis of depth contours; rather, regions (Figures B-56, B-57) were determined based on survey effort and animal distributions.

The digitizer was used to trace region boundaries, which led to a boundary problem termed "splinter error". The technique used to digitize each region was to circumscribe it by tracing the boundary of the region. Thus, when two regions were adjacent, the common boundary would be digitized twice. In fact, a boundary was often digitized more than twice. For example, the boundary between regions A1 and B1 was digitized four times because it served not only as a boundary between A1 and B1 but also between the larger regions A and B. A splinter error occurred when one set of points defining a common boundary did not exactly match the second, third or fourth set of points used to define the same boundary for other regions.

Because of this splinter error problem, a very small percentage of the total area may be shared by two regions or may be left out of a region. For example, because of overlap, a small portion of the Beaufort Sea may have been shared during the analysis of two adjacent regions. Conversely, if two sets of points defining a common boundary diverged slightly, a small portion of the Beaufort Sea could have been left out of the analysis.

The implications of the splinter error problem in relation to this study are small. Statistics reported for each sub-region, region and the total study area are valid, but there may be small discrepancies when the values of sub-regions are summed and compared to the values reported for larger regions, e.g., number of survey hours flown, listed in the tables as Survey Time.

This problem is slightly compounded in two other respects. First, current system limitations require that a maximum of 100 vertices can be used to define an area. Since so many points were required to digitize coastline boundaries, the splinter error problem became somewhat greater when the boundary for the Beaufort Sea total study area was defined. Only about one of every three points used to define the coastal sub-regions was selected to define the coastline for the total area. The total study area for the Bering-Chukchi Sea was not defined because of this limitation.

Statistics Presented in Tables

Region Area nmi^2 - Areas were approximated by straight line integration which contributed to discrepancies between the summation of sub-region areas and areas calculated for larger regions. Area calculations are accurate to within about 1 percent of the true area.

Percent of Total Area - The percent of total area was calculated as the region area divided by the sum of all sub-region areas; this quantity was then multiplied by 100.

Percent of Area Surveyed - The percent of area surveyed is a relative measure of survey effort expended per survey region. Strip width was defined as one nautical mile. Therefore, the total number of miles flown equalled the total number of square nautical miles surveyed. The percent of total area was calculated as the number of nautical miles surveyed divided by the region area; this quantity was then multiplied by 100.

This technique did not account for overlapping aerial survey strips which result in double counting the area surveyed. Therefore, some areas surveyed may show more than 100 percent coverage.

Survey Time HR:MIN - The time in hours and minutes spent surveying an area. Because of splinter errors and rounding errors, the values reported for time spent surveying sub-regions did not always equal those reported for larger regions.

Percent of Total Time - The time in hours and minutes spent surveying a region divided by the sum of survey times reported for each sub-region.

Number of Transects Flown (=n) - Transects or flight legs were defined as units of survey effort by the aerial survey team. The beginning and ending of transects were further defined by the survey region boundaries. A portion of an aerial survey leg passing over a region was treated as a transect relative to that region. Thus, one transect could be broken into several transects with respect to sub-region analyses. For this reason, the sum of the transects based on sub-regions was greater than the total number of transects reported for the total region.

Number of Bowheads Observed - The number of bowhead whales observed within one half nautical mile of either side of the aircraft. In contrast, whale sightings depicted on maps include all whales sighted, regardless of their distance from the aircraft. Because of splinter errors, small discrepancies may occur between the sum of the number of whales observed in each sub-region versus the number reported for larger regions.

Density as Number per nmi², Variance and Confidence Range -
 Calculation of density statistics for each stratum followed the method
 employed by Krogman et. al. (1979), which was based on the technique
 described in Estes and Gilbert (1978):

$$(1) \hat{R} = \sum y_i / \sum x_i$$

where $\hat{R}$ = observed density of whales per square nautical mile

y_i = number of whales observed in the i th strip transect

x_i = area of the i th strip transect

$$(2) S_{\hat{R}}^2 = [\sum (y_i^2 / x_i) - \hat{R} \sum y_i] / (n-1) (\sum x_i)$$

where $S_{\hat{R}}^2$ = variance of R

n = number of strip transects

The confidence interval was calculated as:

$$(3) \text{C.I.} = \hat{R} \pm t_{.05(2)V} \sqrt{V(\hat{R})}$$

The notation $t_{.05(2)V}$ refers to the critical value of t where

$\alpha (\infty) = .05$ ($1 - = .95$) based on a two tailed test with V degrees of
 freedom. Degrees of freedom were calculated as the total number of
 transects minus one.

Presentation of Figures and Tables

Results are presented by species, area, season and year. Each presentation consists of:

- 1) Figure depicting aerial survey tracklines, sightings and region boundaries.
- 2) Figure depicting whale sightings, depth contours and/or region boundaries.
- 3) Table of statistics associated with each region.
- 4) Figure depicting percent aerial survey coverage for each region.
- 5) Figure depicting observed density of whales for each region.

Please refer to the table of contents for order of presentation of aerial surveys results. Figures and tables are intended to be self explanatory.

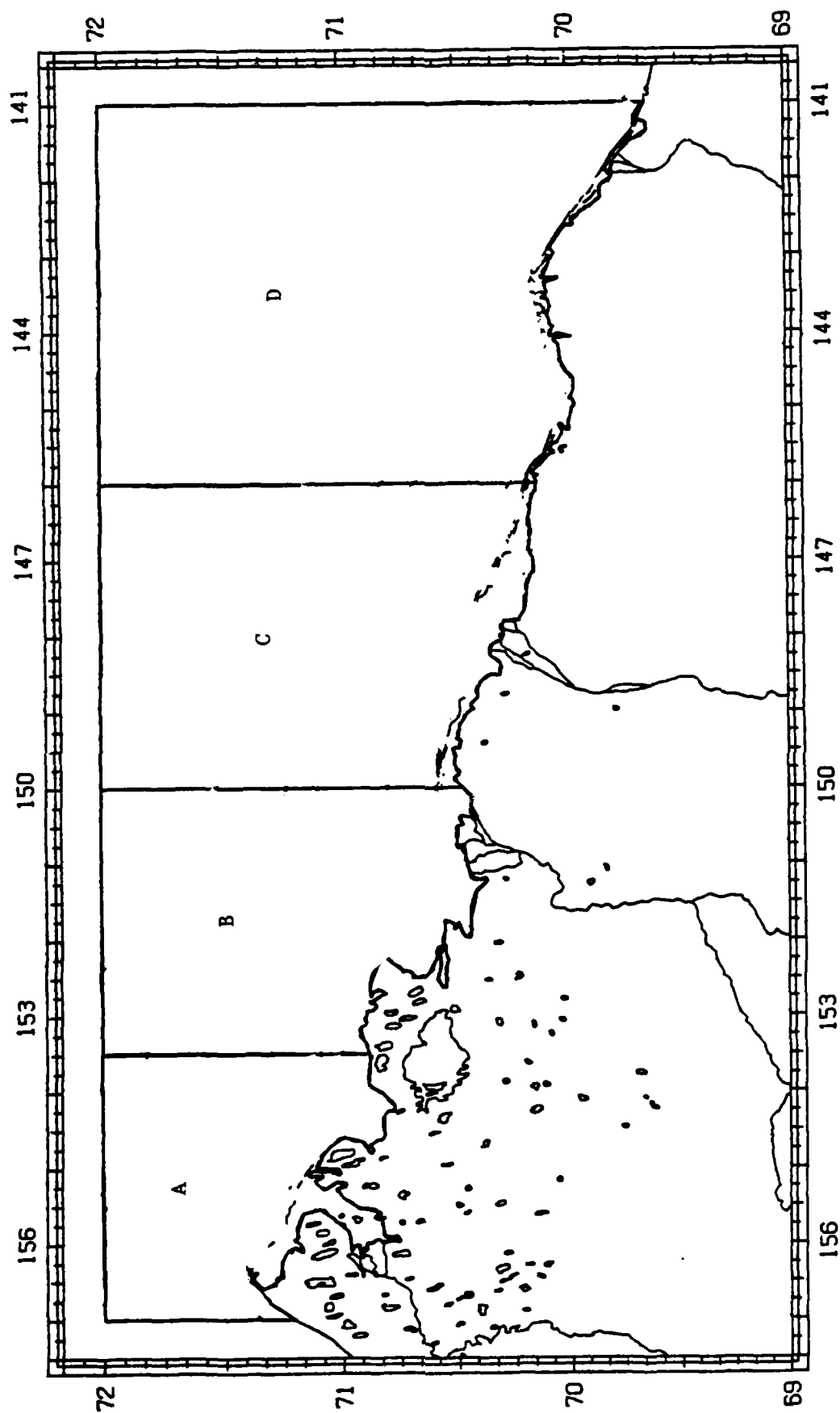


Figure B-1. The Beaufort Sea study area was divided into four regions A, B, C and D.

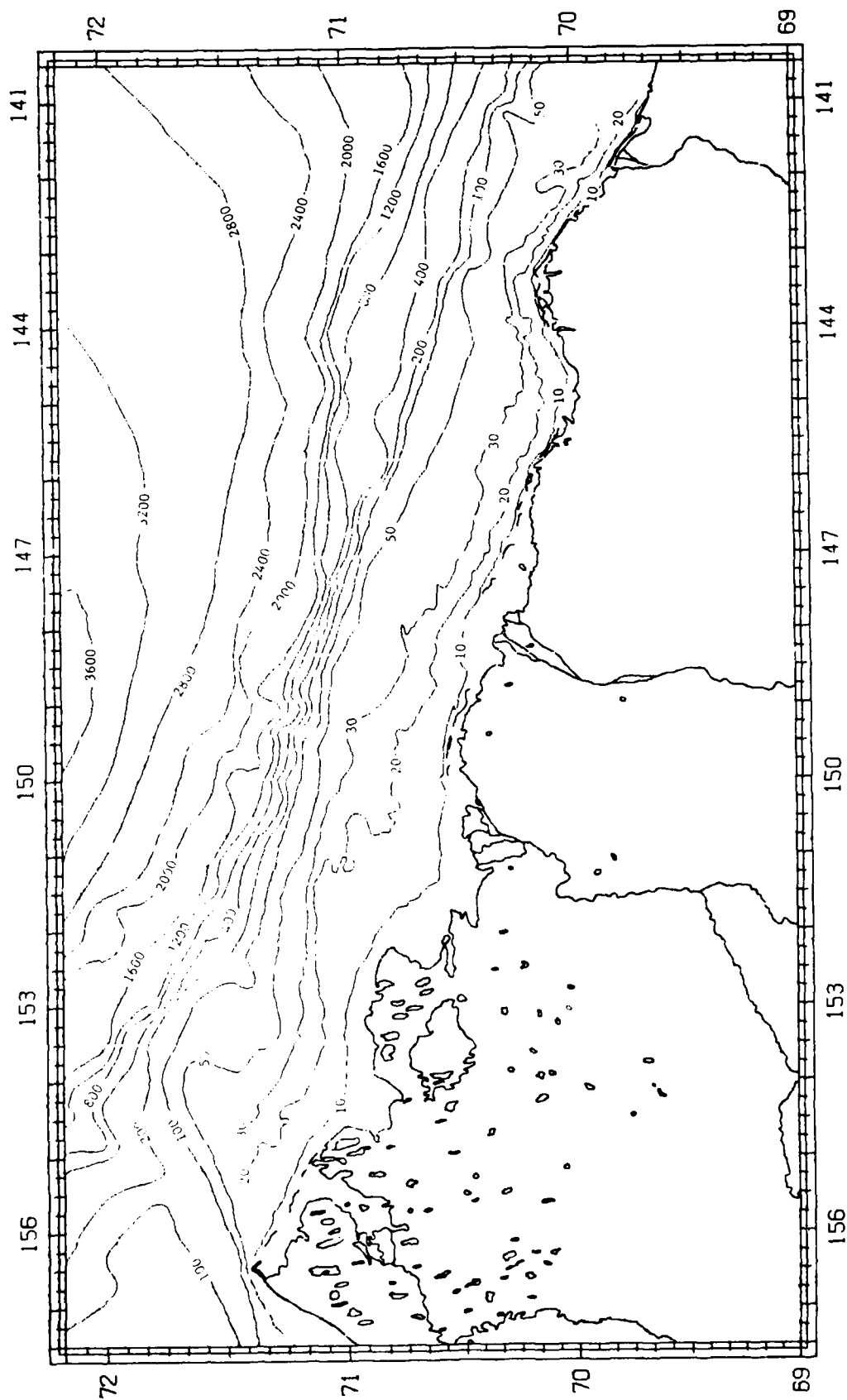


Figure B-2. Beaufort Sea depth contour lines, in meters.

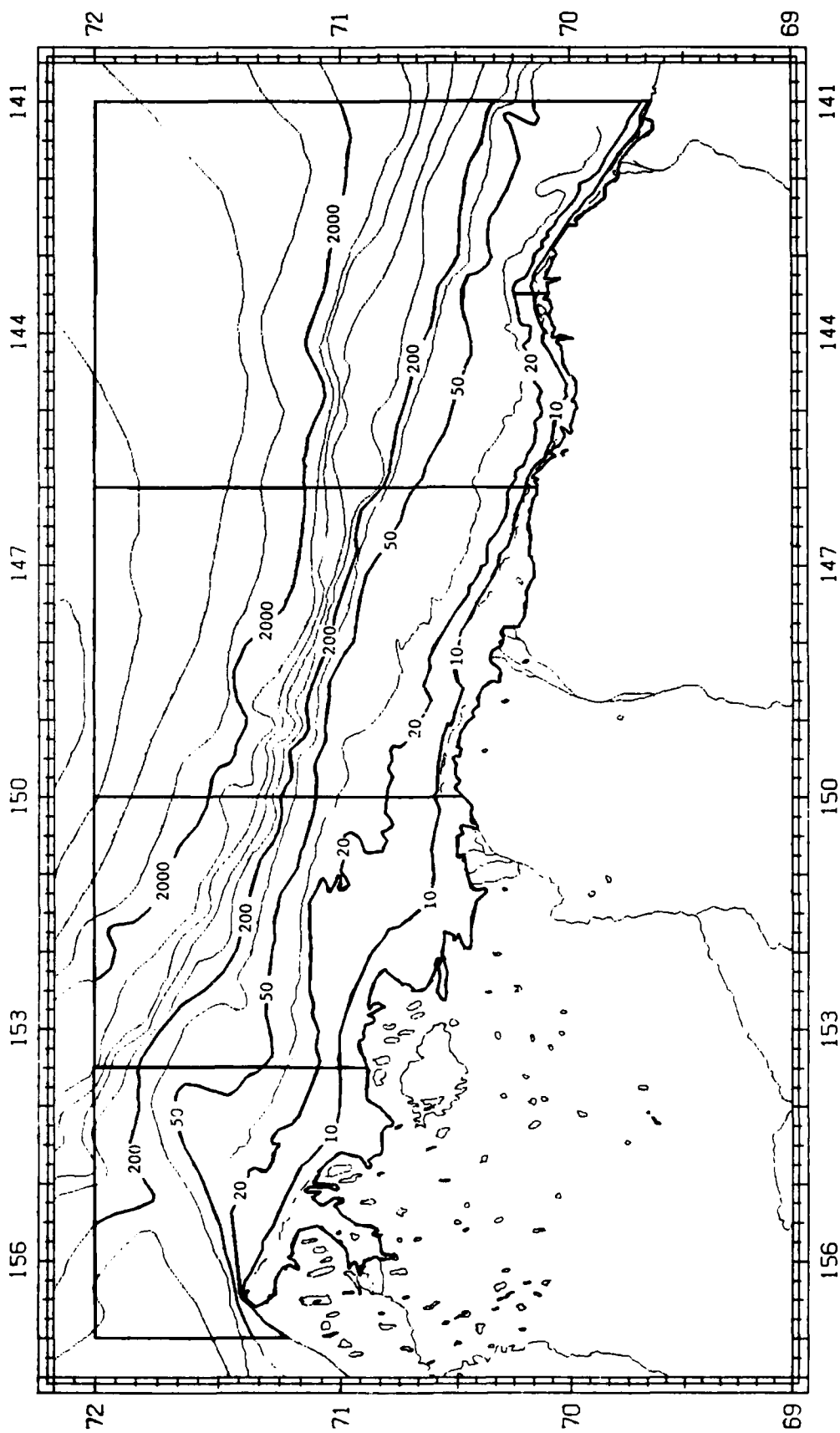


Figure B-3. Map depicting the survey regions in the Beaufort Sea after stratification by contour intervals of 10m, 20m, 50m, 200m, and 2000m.

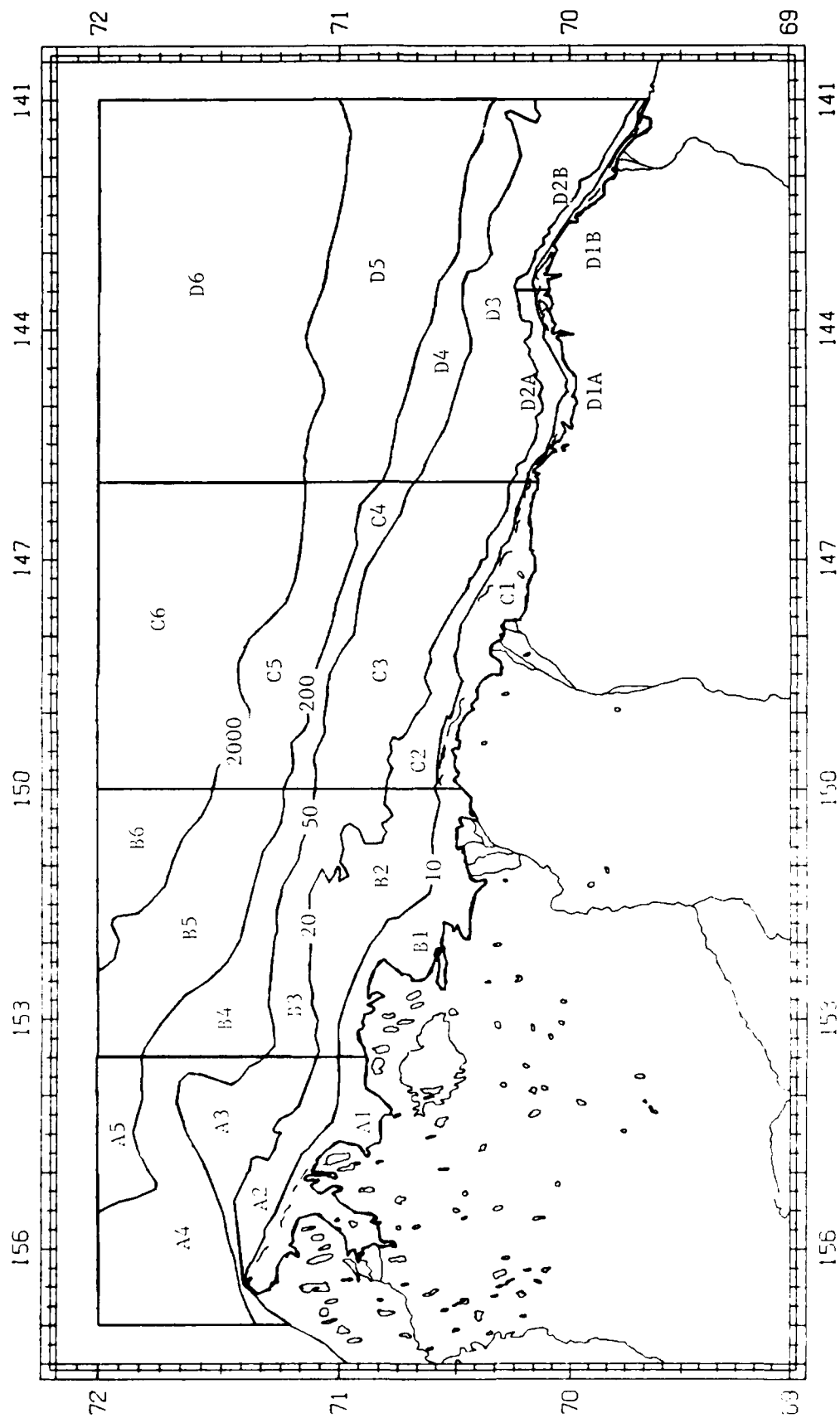


Figure B-4 . Map depicting Beaufort Sea stratum names. Strata A1, B1, C1, D1A and D1B extended from the coast out to the 10 meter depth contour. Strata A2, B2, C2, and D2A, and D2B fell between the 10 and 20 meter depth contours; A3, B3, C3, and D3 fell between the 20 and 50 meter depth contours; etc. Strata D1A, D1B, D2A and D2B are enlarged in Figure B-5.

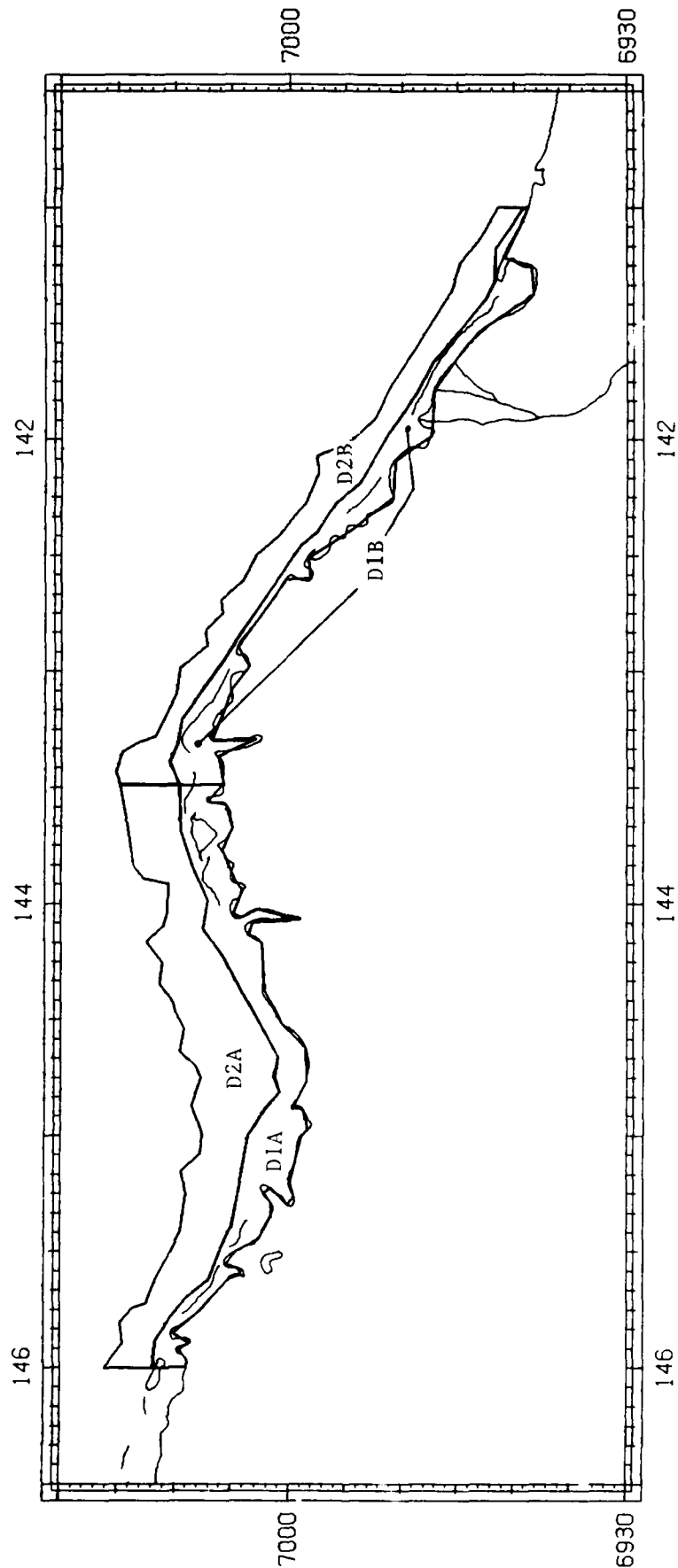


Figure B-5. Map depicting Beaufort Sea strata D1A, D1B, D2A, and D2B. Regions D1A and D1B extended from the coast out to the 10 meter depth contour. Regions D2A and D2B extended from the 10 meter to the 20 meter depth contour.

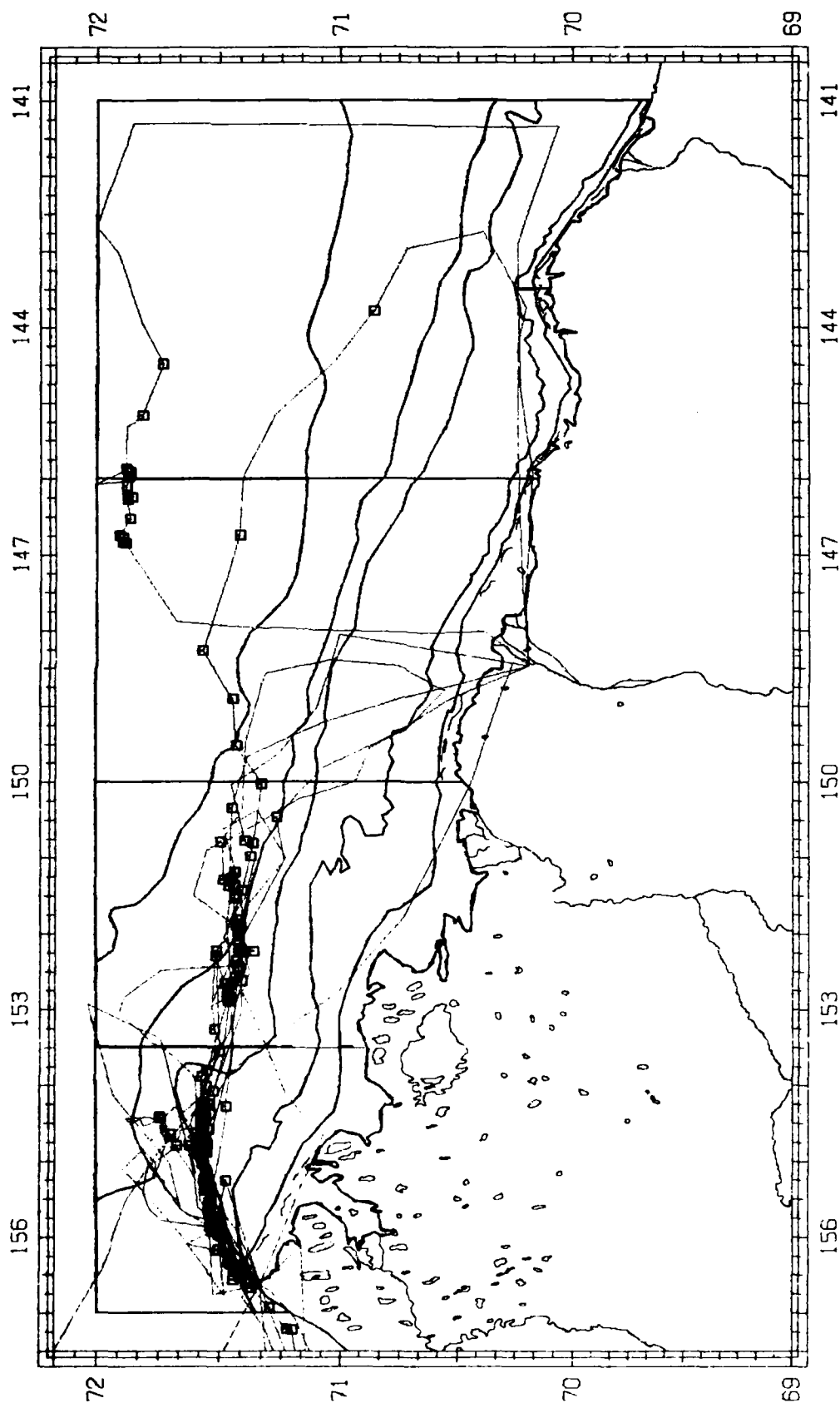


Figure B-6. Plot of aerial survey tracklines and bowhead whale sightings made during the April-May 1980 aerial survey of the Beaufort Sea.

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AERIAL SURVEYS OF ENDANGERED WHALES IN THE BEAUFORT
CHUKCHI & NORTHERN BERING SEAS(U) NAVAL OCEAN SYSTEMS
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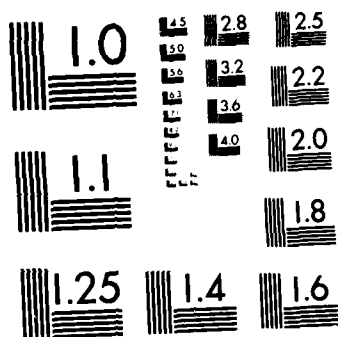
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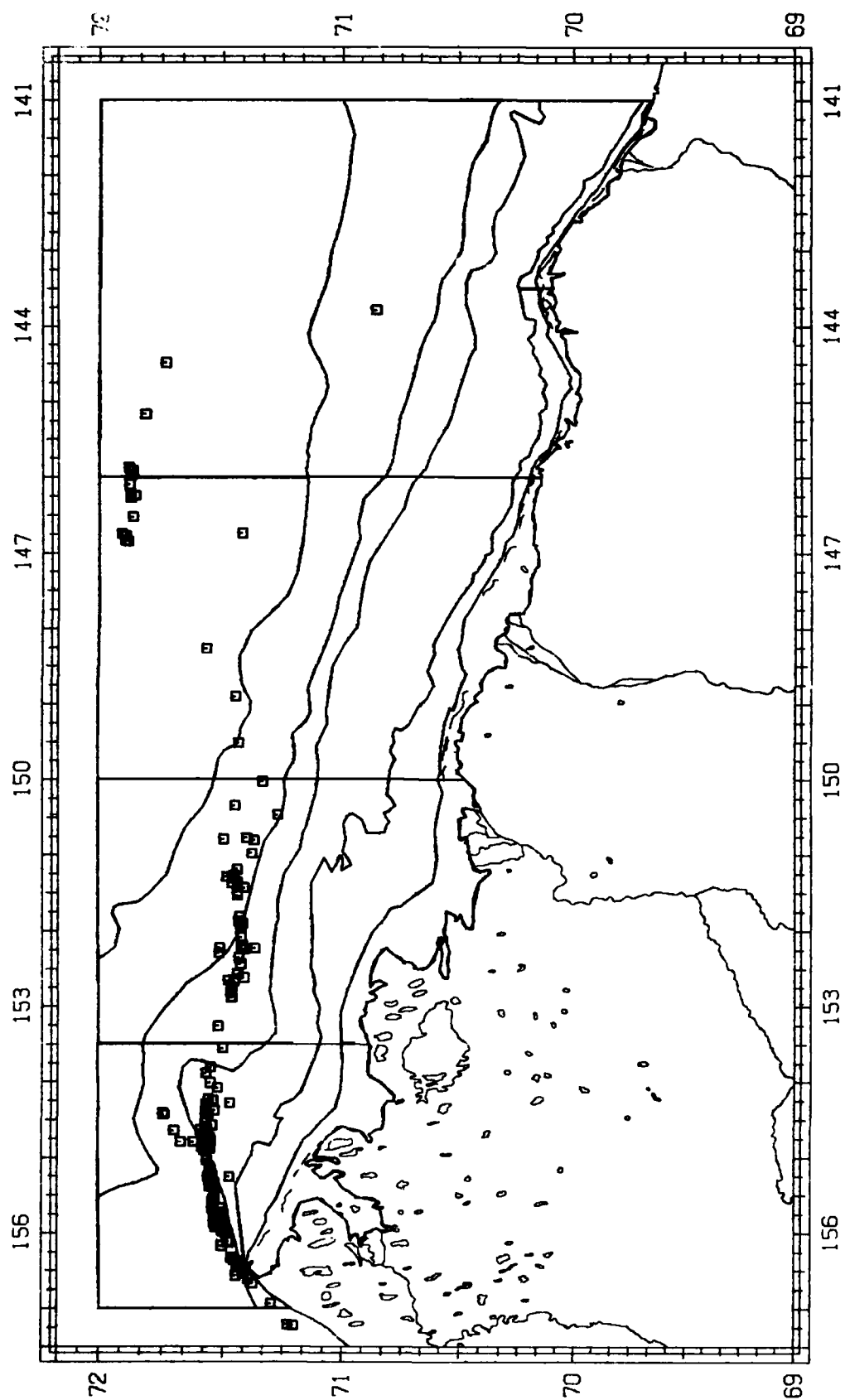


Figure B-7. Plot of bowhead whale sightings made during the April-May 1980 aerial survey of the Beaufort Sea.

Table B-1. Statistics from aerial survey of bowhead whales conducted April-May 1980 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nm². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 30 hours and 35 minutes.

Region Name	Region Area nm ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (±n)	Number of Bowheads Observed	Density as Number per nm ²	Variance	Confidence Range of Density
Total	28,609	100.	11.18	31:30	100.00	28	268	0.084	>0.0	0.053 - 0.114
A	3,792	13.	36.05	14:45	48.23	26	175	0.128	0.001	0.078 - 0.178
A1	654	2.25	12.68	0:42	2.29	15	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	7.13	0:15	0.82	9	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	47.12	4:28	14.60	35	58	0.156	0.001	>0.088 - 0.224
A4	1,516	5.22	54.49	8:51	28.94	36	117	0.141	0.001	0.076 - 0.207
A5	384	1.32	12.81	0:24	1.31	6	0	0.0	0.0	0.0 - 0.0
B	5,569	19.	14.40	7:31	24.58	11	58	0.072	0.001	0.008 - 0.137
B1	739	2.54	6.12	0:10	0.54	2	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	2.35	0:09	0.49	2	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	3.06	0:06	0.33	3	0	0.0	0.0	0.0 - 0.0
B4	893	3.07	42.80	3:39	11.93	15	25	0.065	0.001	>0.0 - 0.131
B5	1,463	5.03	22.15	3:13	10.52	11	33	0.102	0.001	0.020 - 0.184
B6	659	2.27	0.00							
C	7,701	27.	7.28	5:13	17.06	11	24	0.043	>0.0	>0.0 - 0.089
C1	584	2.02	14.90	0:33	1.80	6	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	10.64	0:25	1.36	7	0	0.0	0.0	0.0 - 0.0
C3	1,910	6.57	5.76	0:49	2.67	7	0	0.0	0.0	0.0 - 0.0
C4	486	1.67	13.77	0:22	1.20	5	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	9.13	1:01	3.32	6	1	0.009	>0.0	>0.0 - 0.039
C6	3,079	10.55	4.66	1:50	5.99	4	23	0.161	0.006	>0.0 - 0.416
D	11,625	41.	4.07	3:59	13.02	4	11	0.023	0.004	>0.0 - 0.230
D1A	156	0.55	2.31	0:01	0.05	1	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	0.00							
D2A	257	0.88	8.50	0:07	0.38	4	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	2.33	0:01	0.05	2	0	0.0	0.0	0.0 - 0.0
D3	1,397	6.87	7.30	0:51	2.78	4	0	0.0	0.0	0.0 - 0.0
D4	1,118	3.50	1.64	0:06	0.34	2	0	0.0	0.0	0.0 - 0.0
D5	2,309	9.66	3.16	0:39	2.13	2	1	0.011	>0.0	>0.0 - 0.128
D6	5,303	18.24	3.65	1:53	6.16	4	10	0.052	>0.010	>0.0 - 0.367

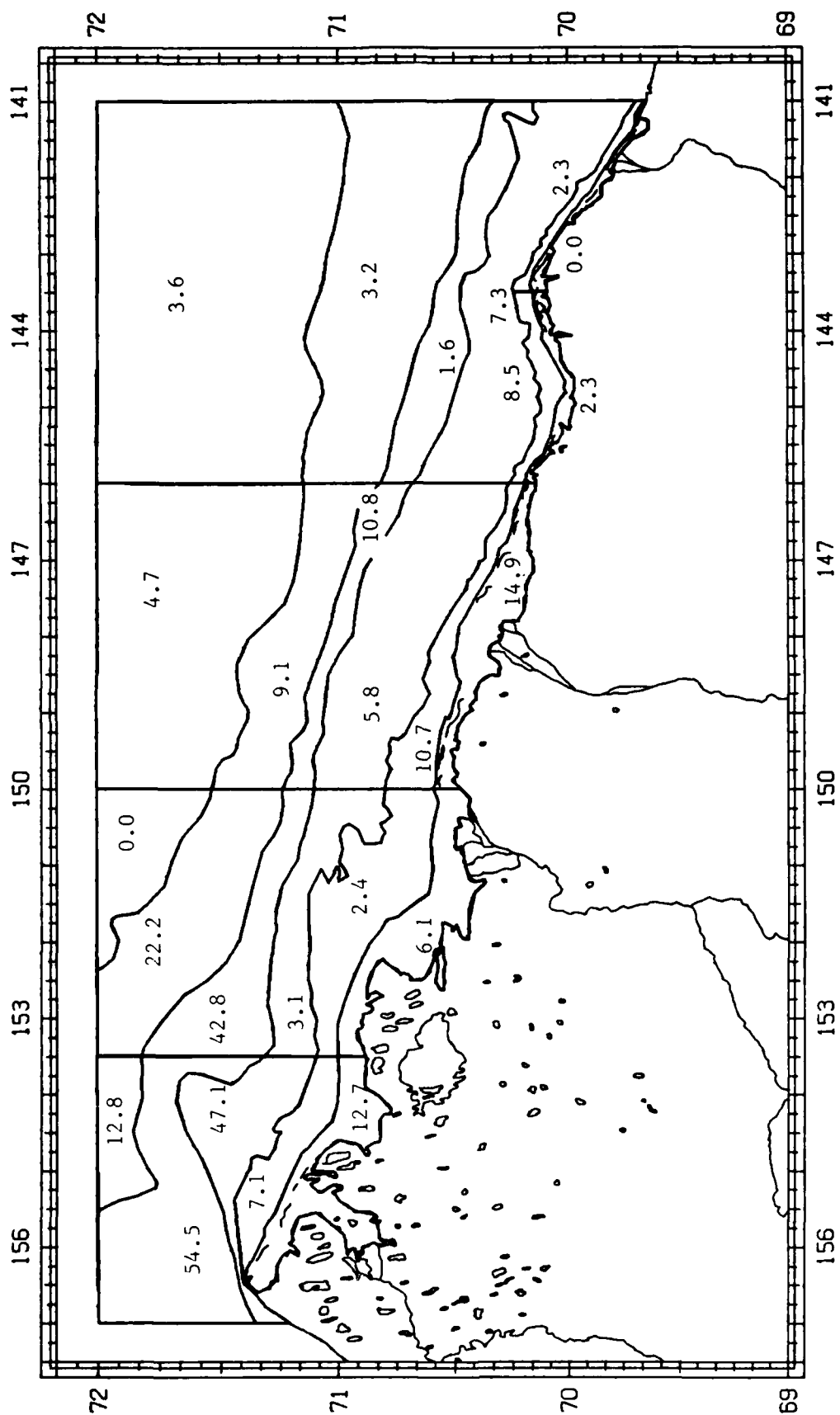


Figure B-8. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each sub-region. Data are based on the April-May 1980 Beaufort Sea aerial surveys.

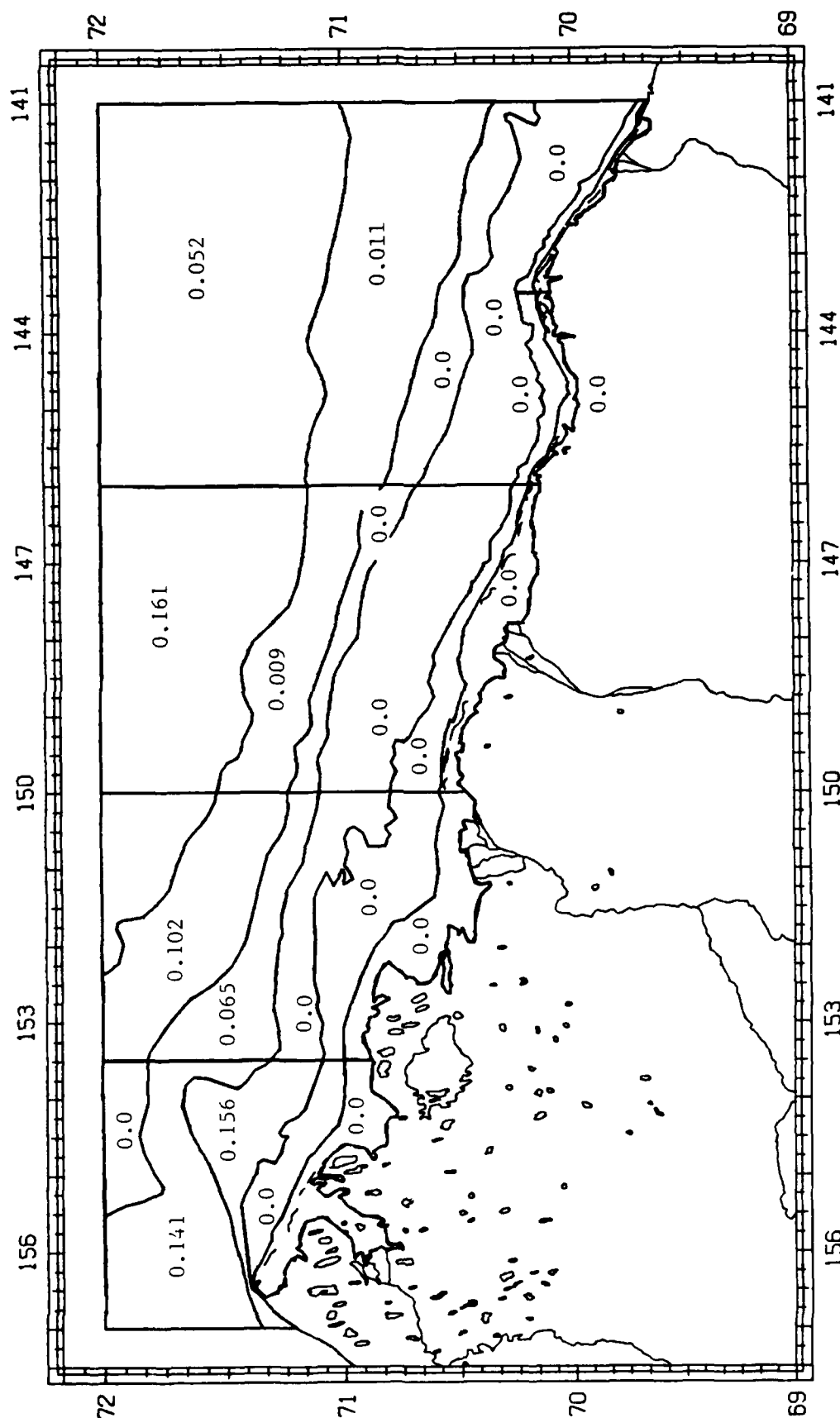


Figure B-9. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during April-May 1980.

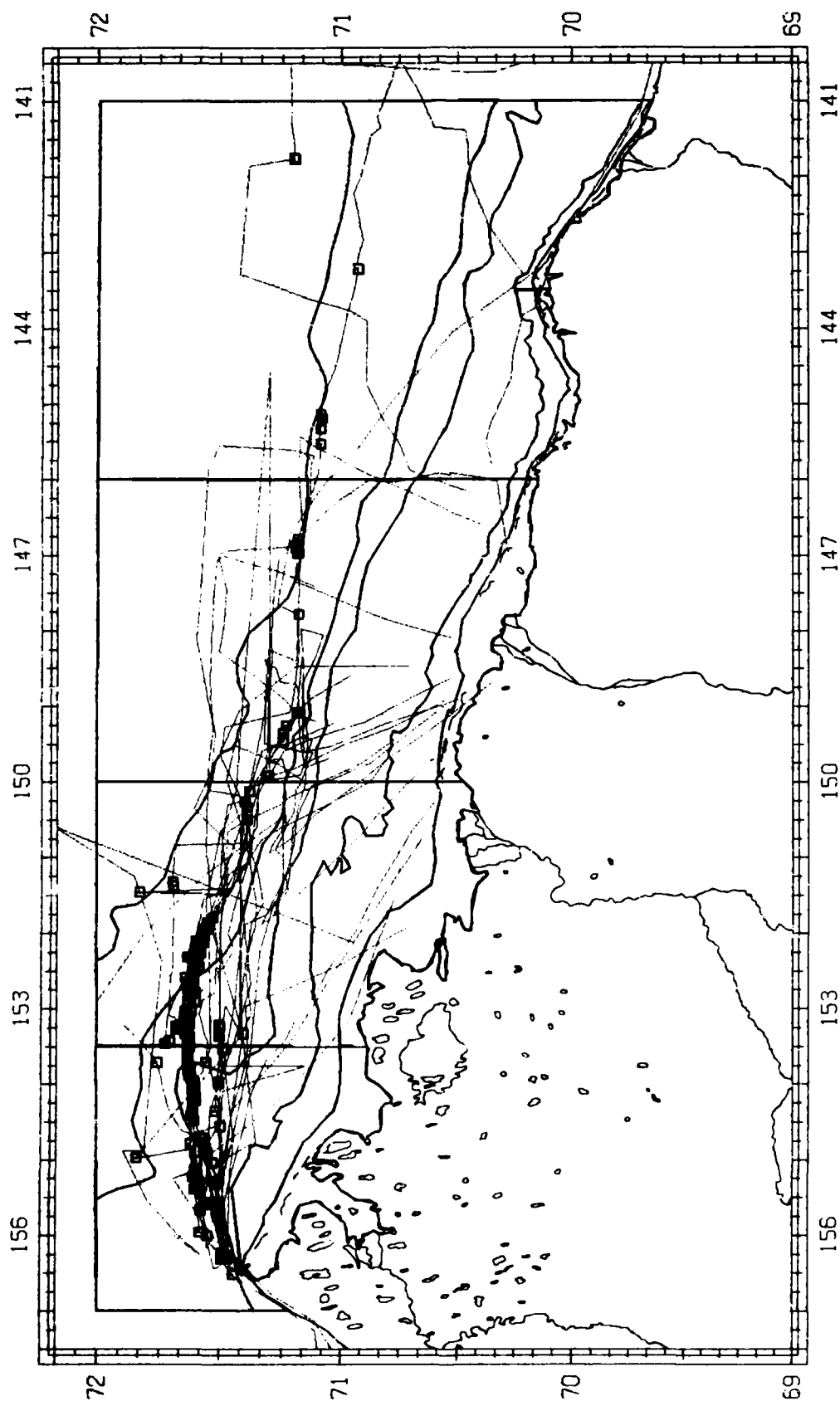


Figure B-10. Plot of aerial survey tracklines flown during April-May 1981 in the Beaufort Sea. Squares represent bowhead whale sightings.

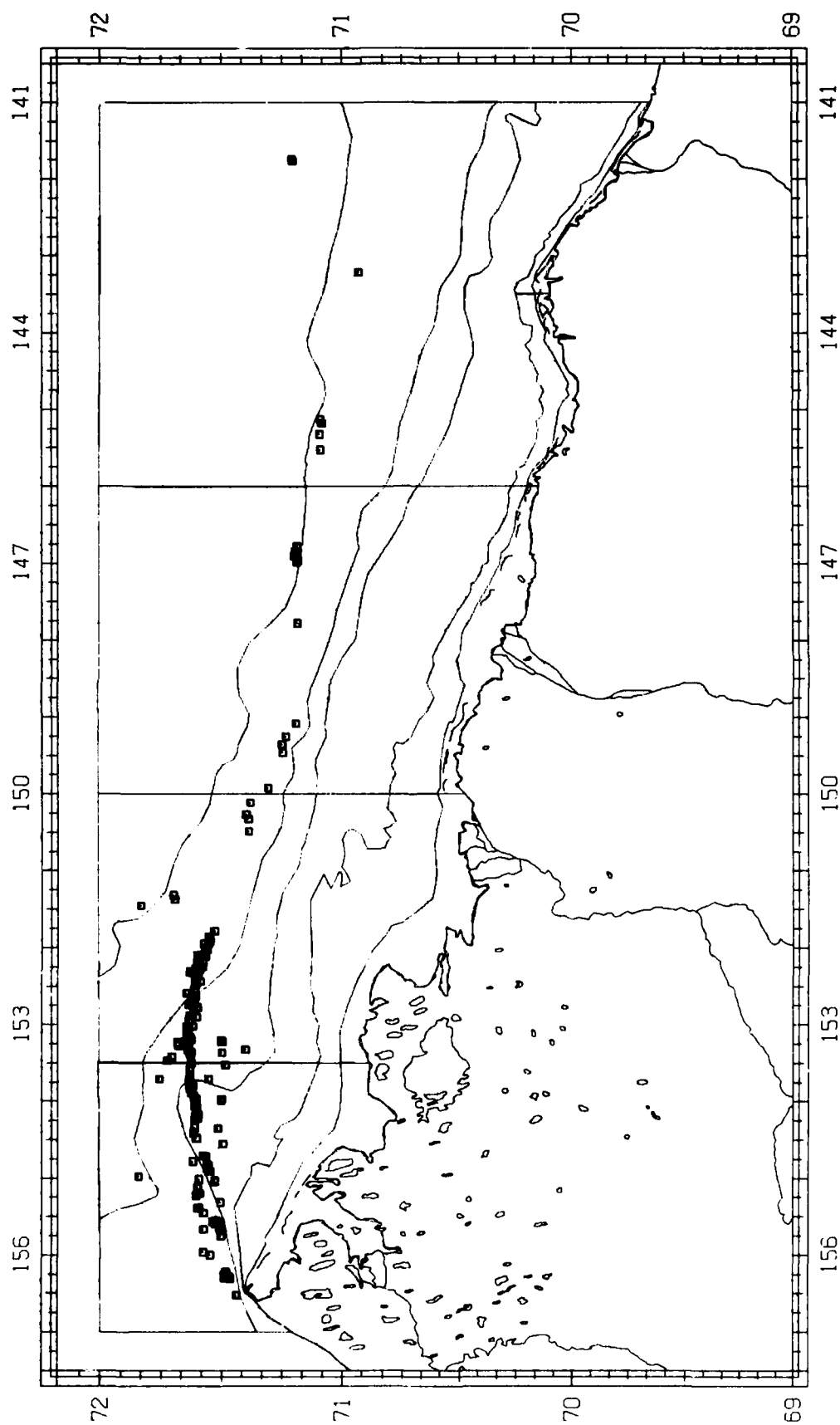


Figure B-11. Plot of bowhead whale sightings made during the April-May 1981 aerial surveys of the Beaufort Sea.

Table B-2. Statistics from aerial survey of bowhead whales conducted April-May 1981 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nmi². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 40 hours and 49 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of Total Time	Number of Transects Flown (±n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
Total	28,609	100.00	19.27	41:35	100.00	22	271	0.049	>0.0	0.018 - 0.081
A	3,792	13.3	33.51	11:04	27.11	15	100	0.079	0.001	0.007 - 0.151
A1	654	2.25	0.74	0:01	0.04	2	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	1.39	0:03	0.12	2	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	83.77	5:05	12.45	25	42	0.064	0.001	>0.0 - 0.129
A4	1,518	5.22	38.24	5:48	14.21	35	53	0.091	0.001	0.029 - 0.154
A5	384	1.32	5.07	0:08	0.33	2	5	0.256	0.177	>0.0 - 5.602
B	5,569	19.5	38.25	16:05	39.40	26	150	0.070	>0.001	0.022 - 0.119
B1	739	2.54	7.57	0:15	0.61	2	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	15.60	1:11	2.90	9	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	16.74	0:53	2.16	14	0	0.0	0.0	0.0 - 0.0
B4	893	3.07	87.22	5:51	14.33	14	56	0.072	0.001	0.017 - 0.127
B5	1,463	5.03	68.10	7:53	19.31	23	93	0.093	0.001	0.019 - 0.168
B6	659	2.27	5.33	0:08	0.33	4	1	0.028	0.001	>0.0 - 0.147
C	7,701	27.0	19.38	9:46	23.93	26	13	0.009	>0.0	>0.0 - 0.018
C1	584	2.02	2.64	0:02	0.08	3	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	15.41	0:30	1.22	9	0	0.0	0.0	0.0 - 0.0
C3	1,910	6.57	12.67	1:38	4.00	15	0	0.0	0.0	0.0 - 0.0
C4	486	1.67	26.95	0:54	2.20	16	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	50.94	4:12	10.29	27	6	0.010	>0.0	0.001 - 0.018
C6	3,070	10.56	12.90	2:13	5.43	13	7	0.018	>0.0	>0.0 - 0.067
D	11,625	41.0	5.37	4:21	10.66	11	8	0.013	>0.0	>0.0 - 0.030
D1A	156	0.55	2.96	0:01	0.04	1	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	12.26	0:04	0.16	4	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	2.11	0:03	0.12	1	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	24.88	0:06	0.24	3	0	0.0	0.0	0.0 - 0.0
D3	1,997	6.87	4.79	0:47	1.92	6	0	0.0	0.0	0.0 - 0.0
D4	1,018	3.50	5.26	0:20	0.82	4	0	0.0	0.0	0.0 - 0.0
D5	2,809	9.66	8.32	1:45	4.29	7	7	0.030	0.001	>0.0 - 0.112
D6	3,303	18.24	3.34	0:58	2.37	5	1	0.006	>0.0	>0.0 - 0.015

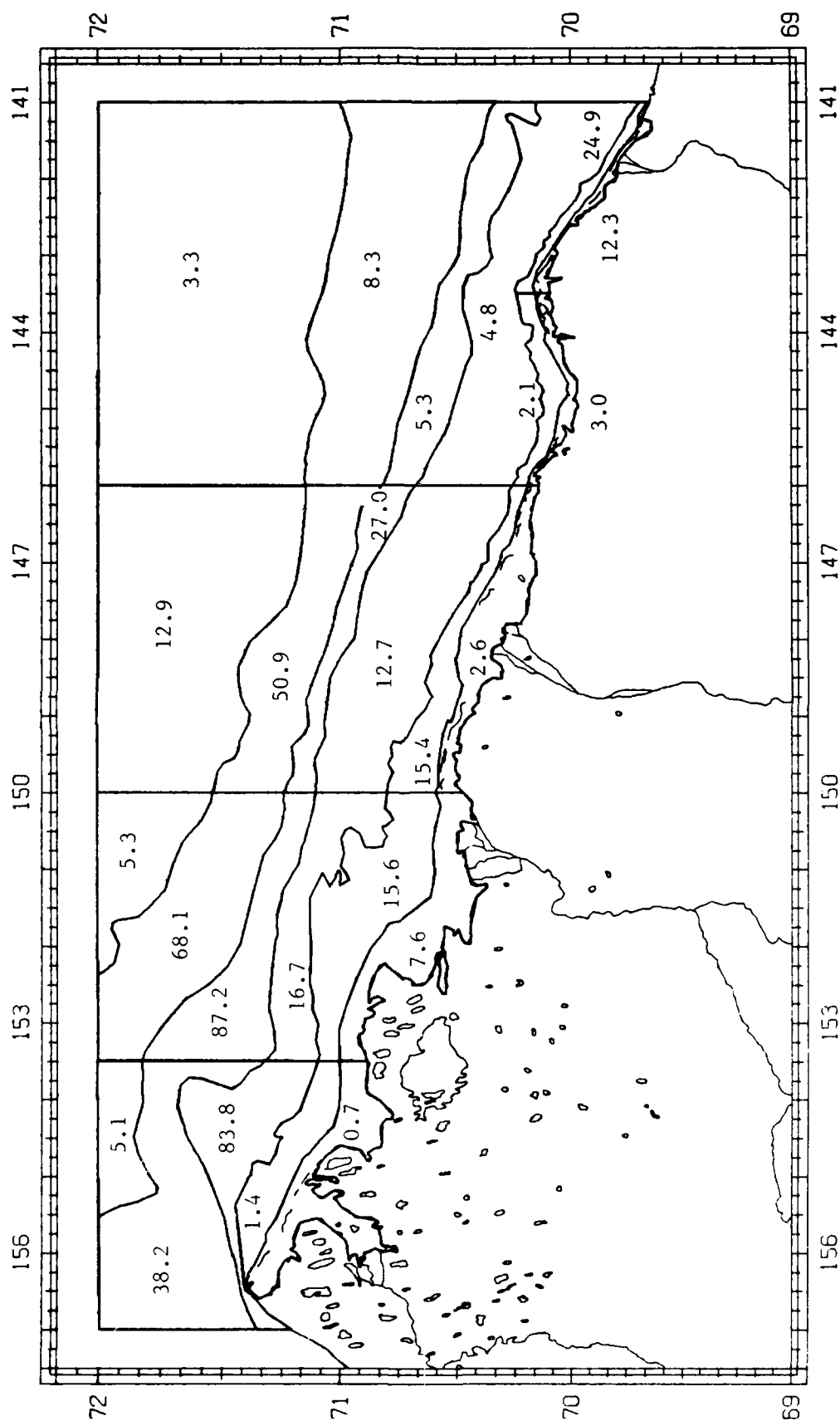


Figure B-12. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each sub-region. Data are based on the April-May 1981 Beaufort Sea aerial surveys.

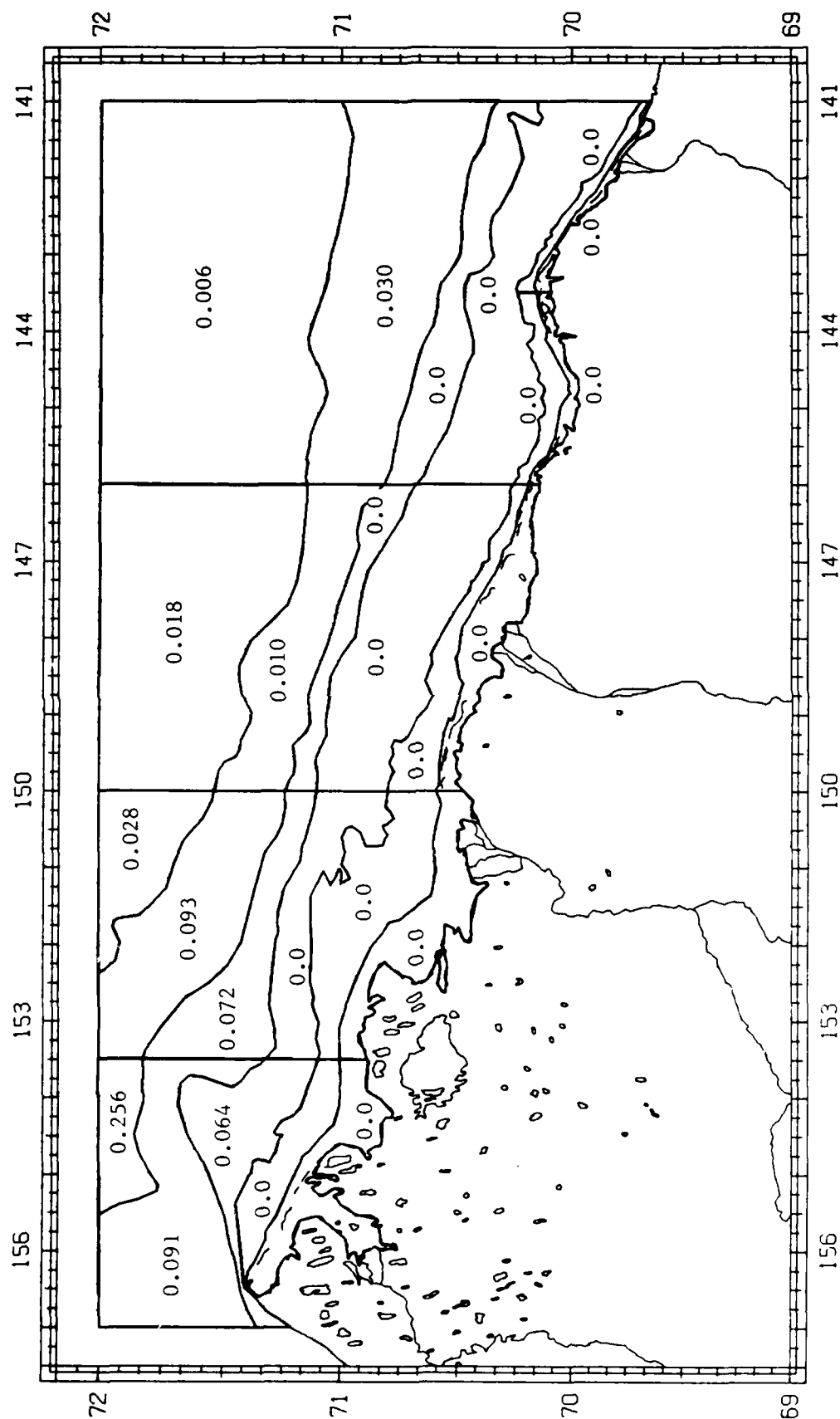


Figure B-13. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during April-May 1981.

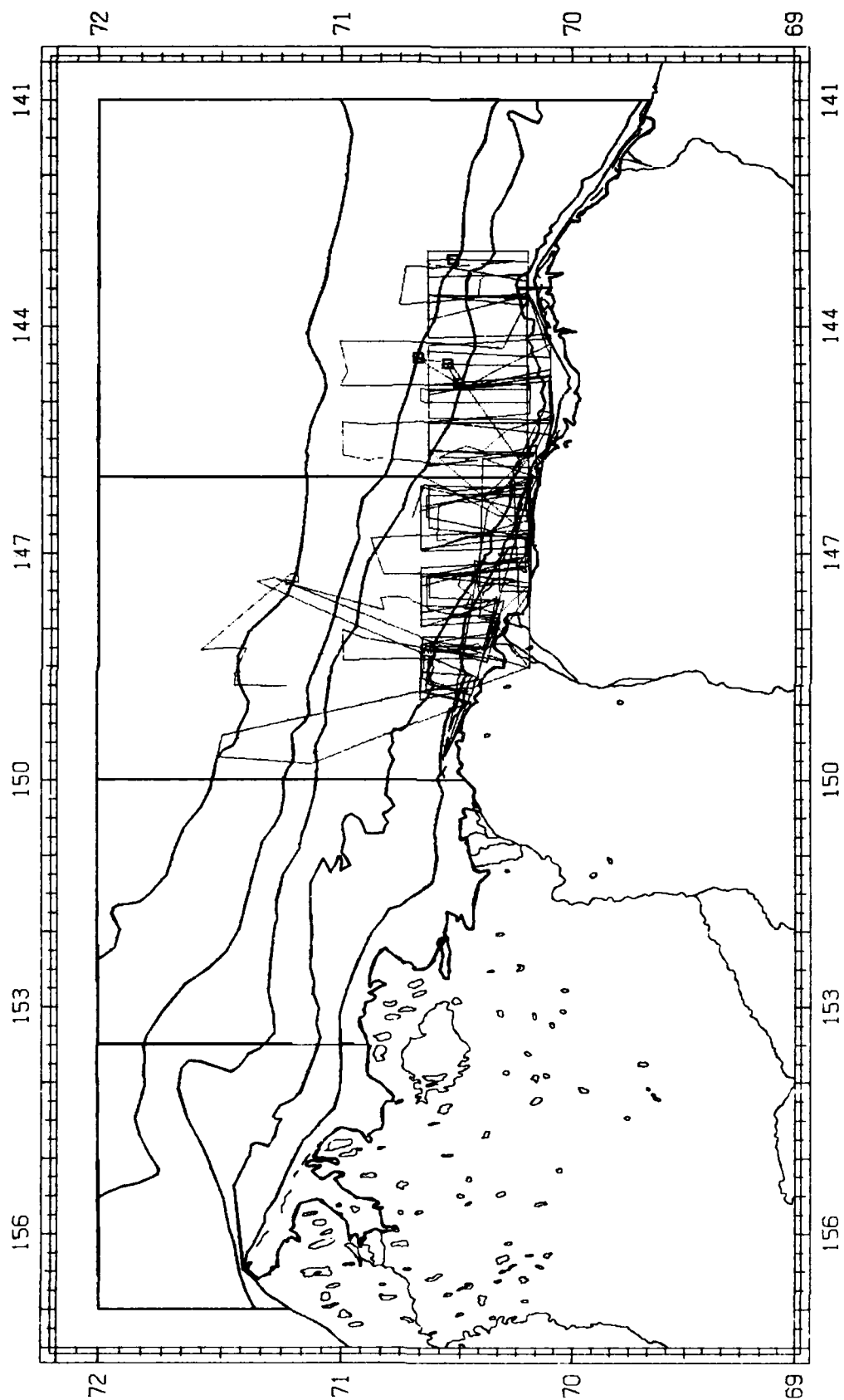


Figure B-14. Plot of aerial survey tracklines flown during August 1979 in the Beaufort Sea. Squares represent bowhead whale sightings.

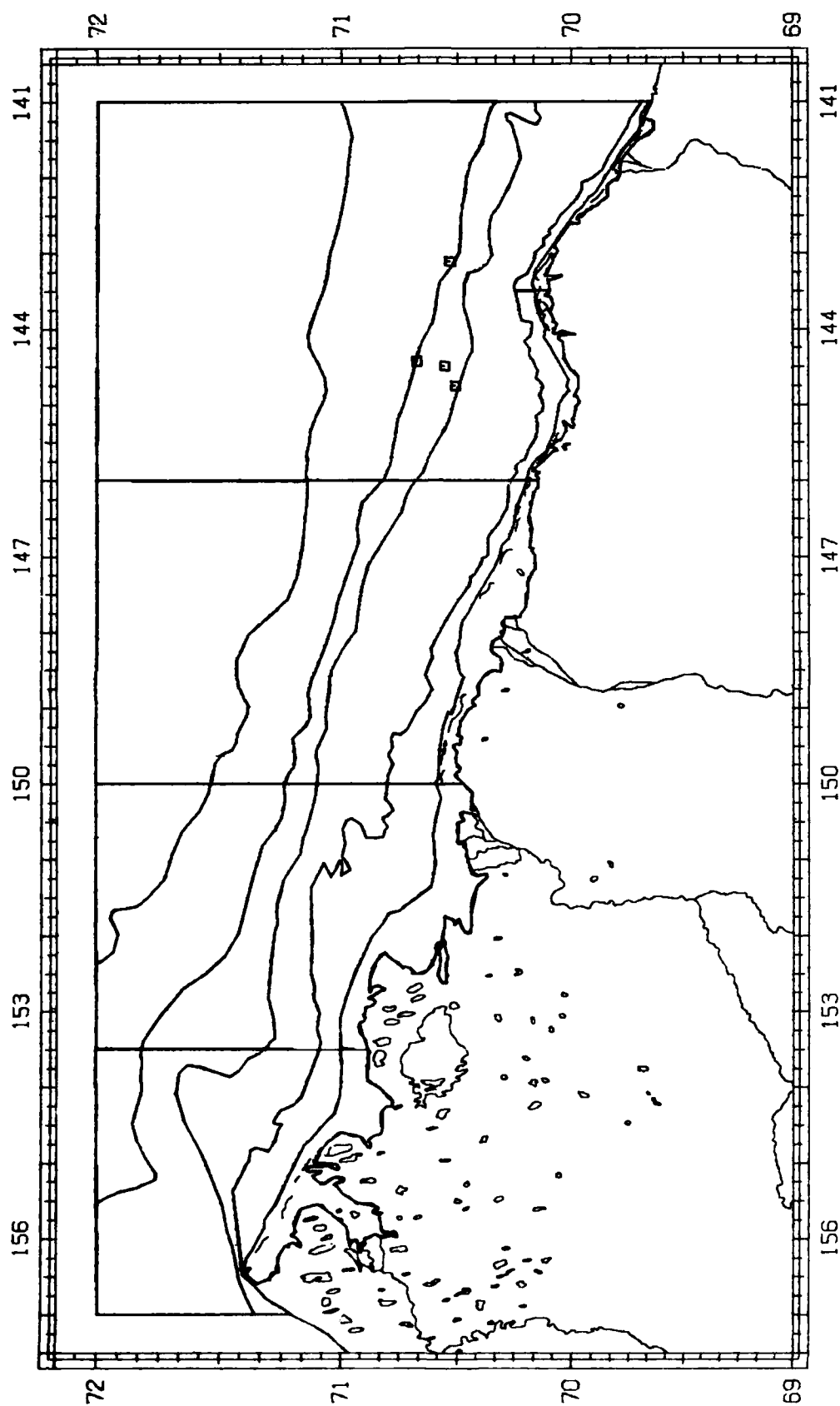


Figure B-15. Plot of bowhead whale sightings made during the August 1979 aerial surveys of the Beaufort Sea.

Table B-3. Statistics from aerial survey of bowhead whales conducted August 1979 in the Beaufort Sea. Values for each region were the summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nmi². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 40 hours and 49 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (±n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
Total	28,639	100.	14.43	44:21	100.00	25	7	0.002	>0.0	0.001 - 0.004
A	3,792	13.	0.00							
A1	654	2.25	0.00							
A2	473	1.65	0.00							
A3	789	2.71	0.00							
A4	1,518	5.22	0.00							
A5	384	1.32	0.00							
B	5,569	19.	0.00							
B1	739	2.54	0.00							
B2	1,079	3.71	0.00							
B3	793	2.73	0.00							
B4	893	3.07	0.00							
B5	1,463	5.03	0.00							
B6	659	2.27	0.00							
C	7,701	27.	30.37	26:58	61.94	23	0	0.0	0.0	0.0 - 0.0
C1	584	2.02	134.72	9:49	22.55	49	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	69.03	3:13	7.39	68	0	0.0	0.0	0.0 - 0.0
C3	1,910	6.57	54.49	9:00	20.67	42	0	0.0	0.0	0.0 - 0.0
C4	486	1.67	8.73	0:27	1.03	7	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	7.82	3:21	7.70	8	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	2.58	1:08	2.60	5	0	0.0	0.0	0.0 - 0.0
D	11,625	41.	15.40	16:56	38.90	19	7	0.004	>0.0	>0.0 - 0.008
D1A	156	0.55	15.04	0:12	0.47	11	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	0.00							
D2A	257	0.88	112.04	3:27	7.92	34	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	9.68	0:06	0.23	3	0	0.0	0.0	0.0 - 0.0
D3	1,497	6.87	44.53	7:12	16.54	46	0	0.0	0.0	0.0 - 0.0
D4	1,318	3.50	31.73	3:45	8.61	24	4	0.012	>0.0	>0.0 - 0.027
D5	2,834	9.66	7.65	1:52	4.29	8	3	0.015	>0.0	>0.0 - 0.057
D6	5,353	19.24	0.00							

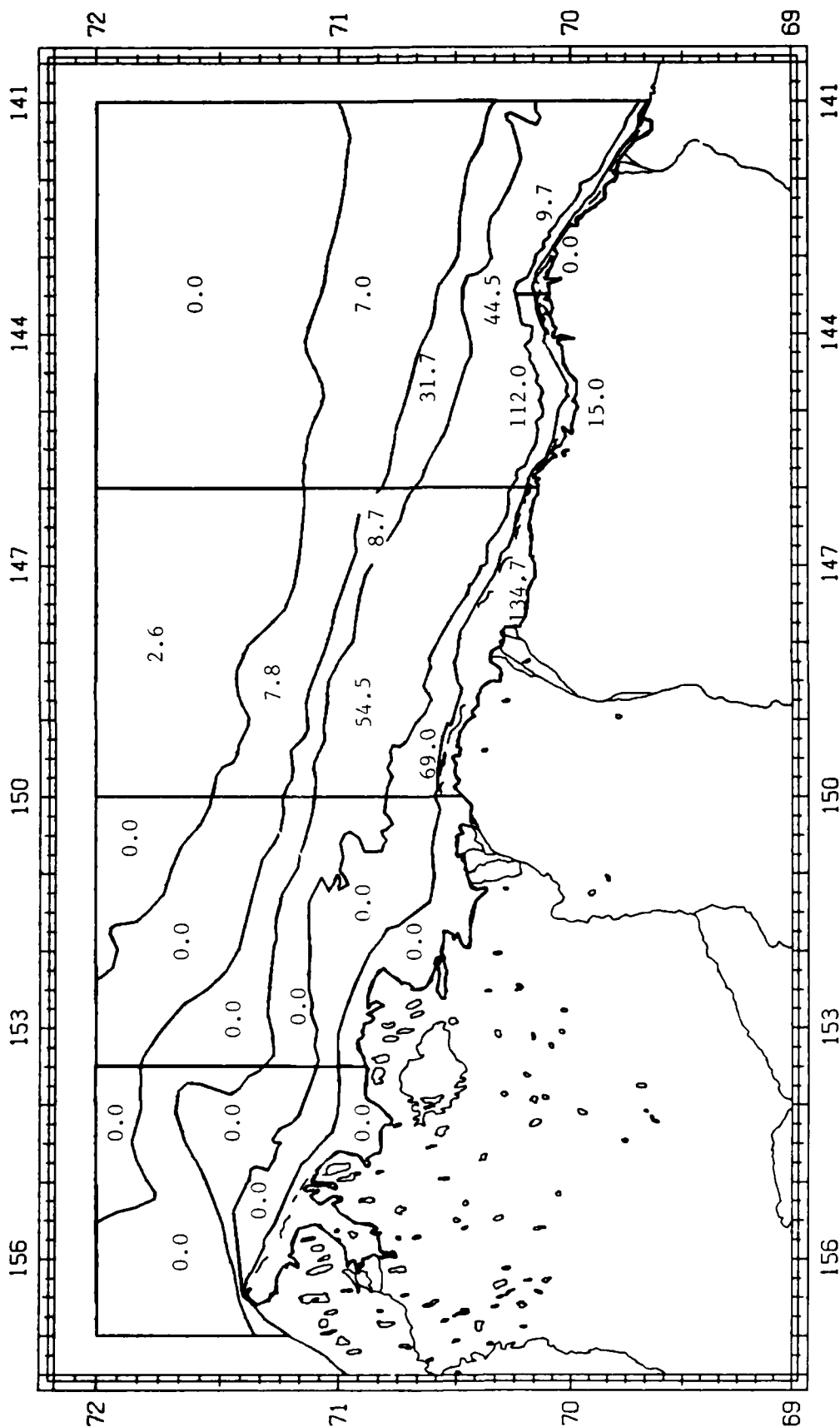


Figure B-16. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Values exceeding 100 percent resulted when the total number of nautical miles surveyed was greater than the region, indicating that some locations were overflown more than once. Data are based on the August 1979 Beaufort Sea aerial surveys.

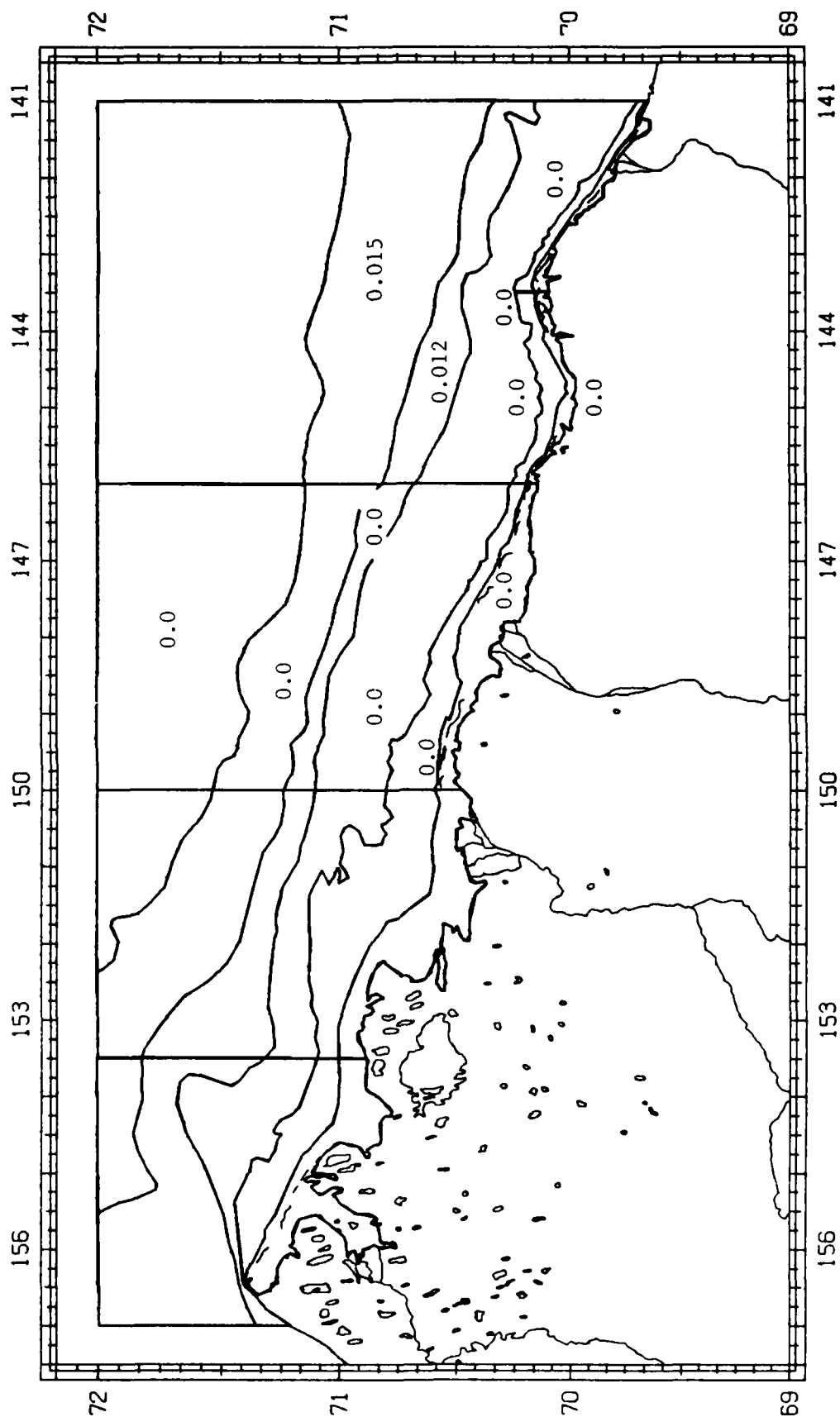


Figure B-17. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during August 1979.

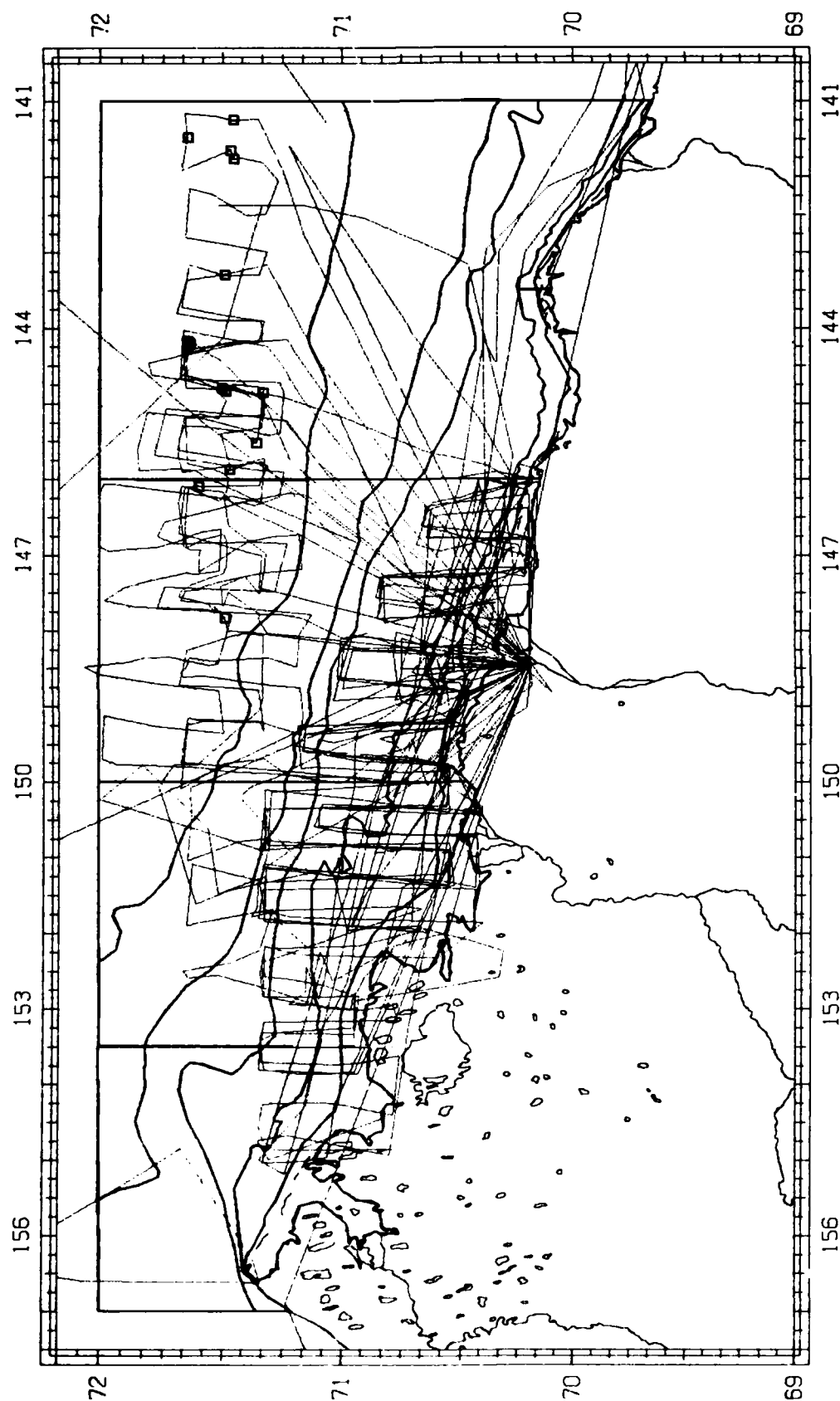


Figure B-18. Plot of aerial survey tracklines flown during June-August 1980 in the Beaufort Sea. Squares represent bowhead whale sightings.

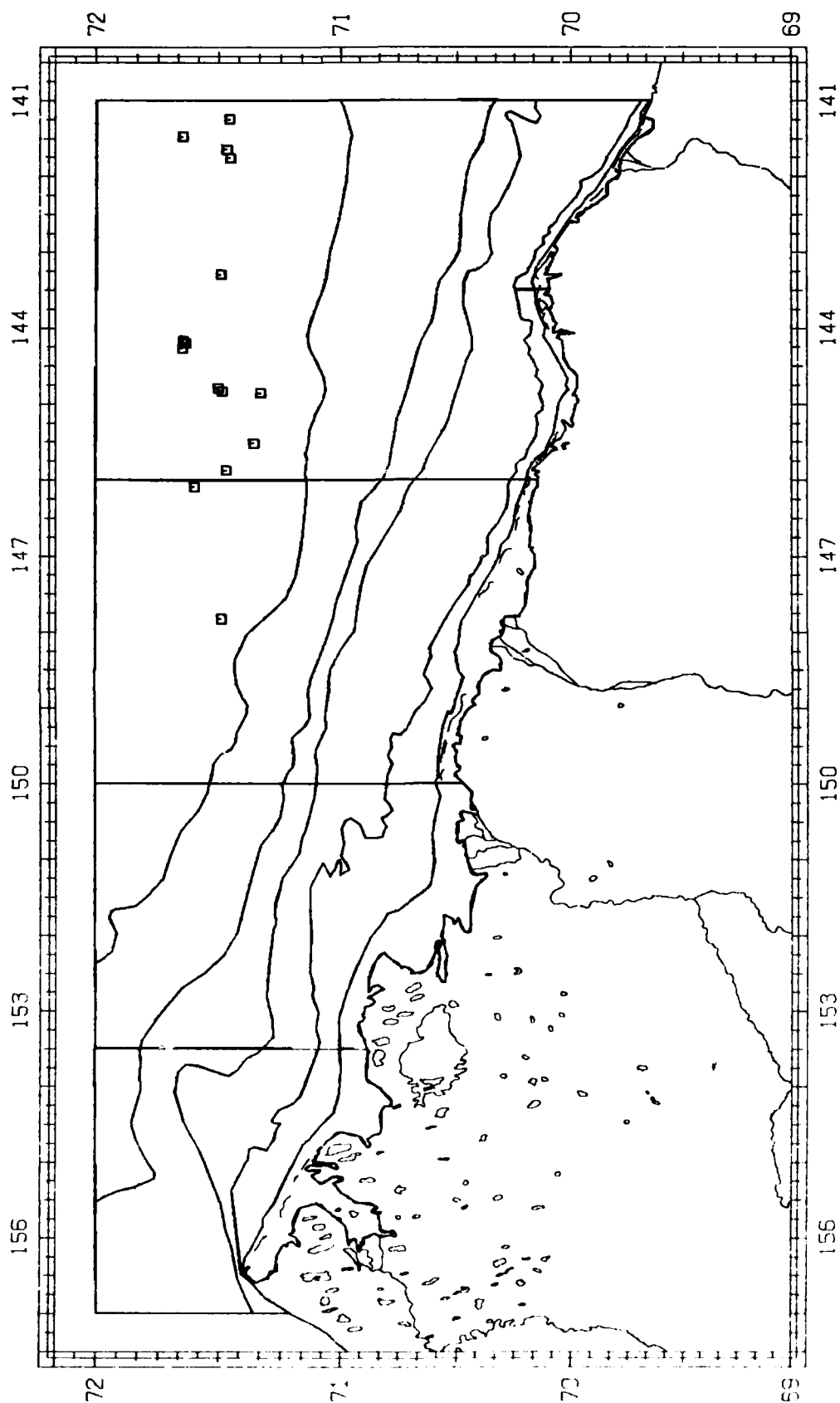


Figure B-19. Plot of bowhead whale sightings made during the June-August 1980 aerial surveys of the Beaufort Sea.

Table B-4. Statistics from aerial survey of bowhead whales conducted June-August 1980 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nm². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 88 hours and 41 minutes.

Region Name	Region Area nm ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of Total Time	Number of Transects Flown (±n)	Number of Bowheads Observed	Density as Number per nm ²	Variance	Confidence Range of Density
Total	28,609	100.	38.74	89:34	100.00	78	16	0.001	>0.0	0.001 - 0.002
A	3,792	13.	12.57	3:19	3.74	14	0	0.0	0.0	0.0 - 0.0
A1	654	2.25	19.22	0:48	0.90	14	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	31.93	1:00	1.13	12	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	14.70	0:56	1.05	12	0	0.0	0.0	0.0 - 0.0
A4	1,518	5.22	4.44	0:30	0.56	5	0	0.0	0.0	0.0 - 0.0
A5	384	1.32	4.15	0:02	0.04	1	0	0.0	0.0	0.0 - 0.0
B	5,569	19.	50.87	21:05	23.77	50	0	0.0	0.0	0.0 - 0.0
B1	739	2.54	88.56	4:45	5.36	54	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	92.33	7:29	8.44	52	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	64.90	3:33	4.00	47	0	0.0	0.0	0.0 - 0.0
B4	893	3.07	35.46	2:40	3.01	25	0	0.0	0.0	0.0 - 0.0
B5	1,463	5.03	17.12	1:51	2.09	11	0	0.0	0.0	0.0 - 0.0
B6	659	2.27	15.09	0:28	0.53	6	0	0.0	0.0	0.0 - 0.0
C	7,701	27.	71.90	45:45	51.59	64	2	>0.0	>0.0	>0.0 - 0.001
C1	584	2.02	154.26	11:57	13.47	76	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	173.56	6:38	7.48	99	0	0.0	0.0	0.0 - 0.0
C3	1,910	6.57	104.06	14:50	16.73	76	0	0.0	0.0	0.0 - 0.0
C4	486	1.67	44.53	1:22	1.54	29	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	35.00	3:06	3.50	27	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	35.08	7:44	8.72	21	2	0.002	>0.0	>0.0 - 0.004
D	11,625	41.	19.29	19:15	21.71	23	14	0.006	>0.0	>0.002 - 0.010
D1A	156	0.55	13.76	0:06	0.11	4	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	11.15	0:07	0.13	4	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	5.57	0:07	0.13	5	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	14.25	0:13	0.24	4	0	0.0	0.0	0.0 - 0.0
D3	1,997	6.87	25.49	4:03	4.57	16	0	0.0	0.0	0.0 - 0.0
D4	1,018	3.50	7.32	0:32	0.60	7	0	0.0	0.0	0.0 - 0.0
D5	2,809	9.66	10.14	1:56	2.18	11	0	0.0	0.0	0.0 - 0.0
D6	5,303	18.24	24.51	11:58	13.49	11	14	0.011	>0.0	0.003 - 0.019

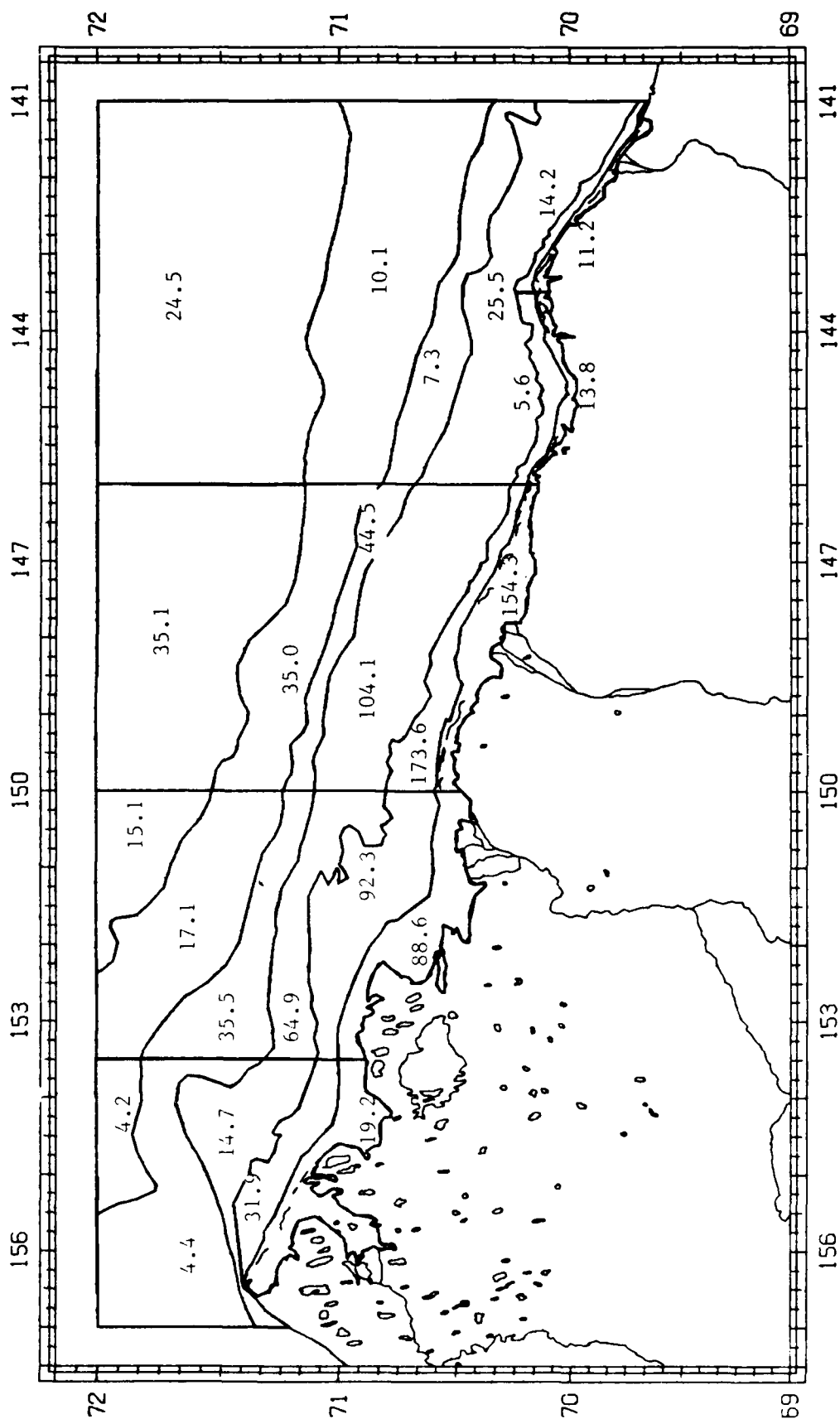


Figure B-20. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Values exceeding 100 percent resulted when the total number of nautical miles surveyed was greater than the region, indicating that some locations were overflown more than once. Data are based on the June-August 1980 Beaufort Sea aerial surveys.

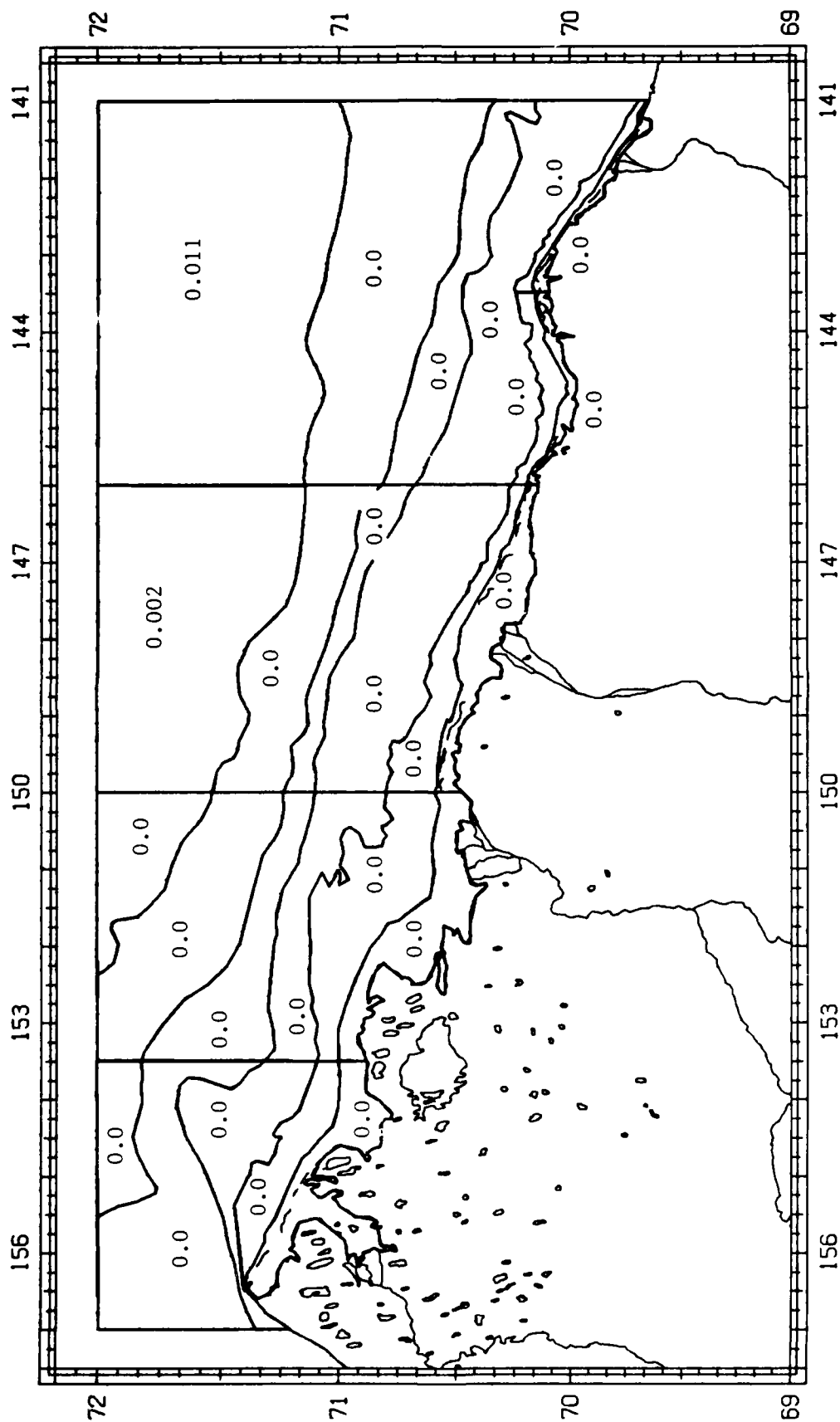


Figure B-21. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during August 1980.

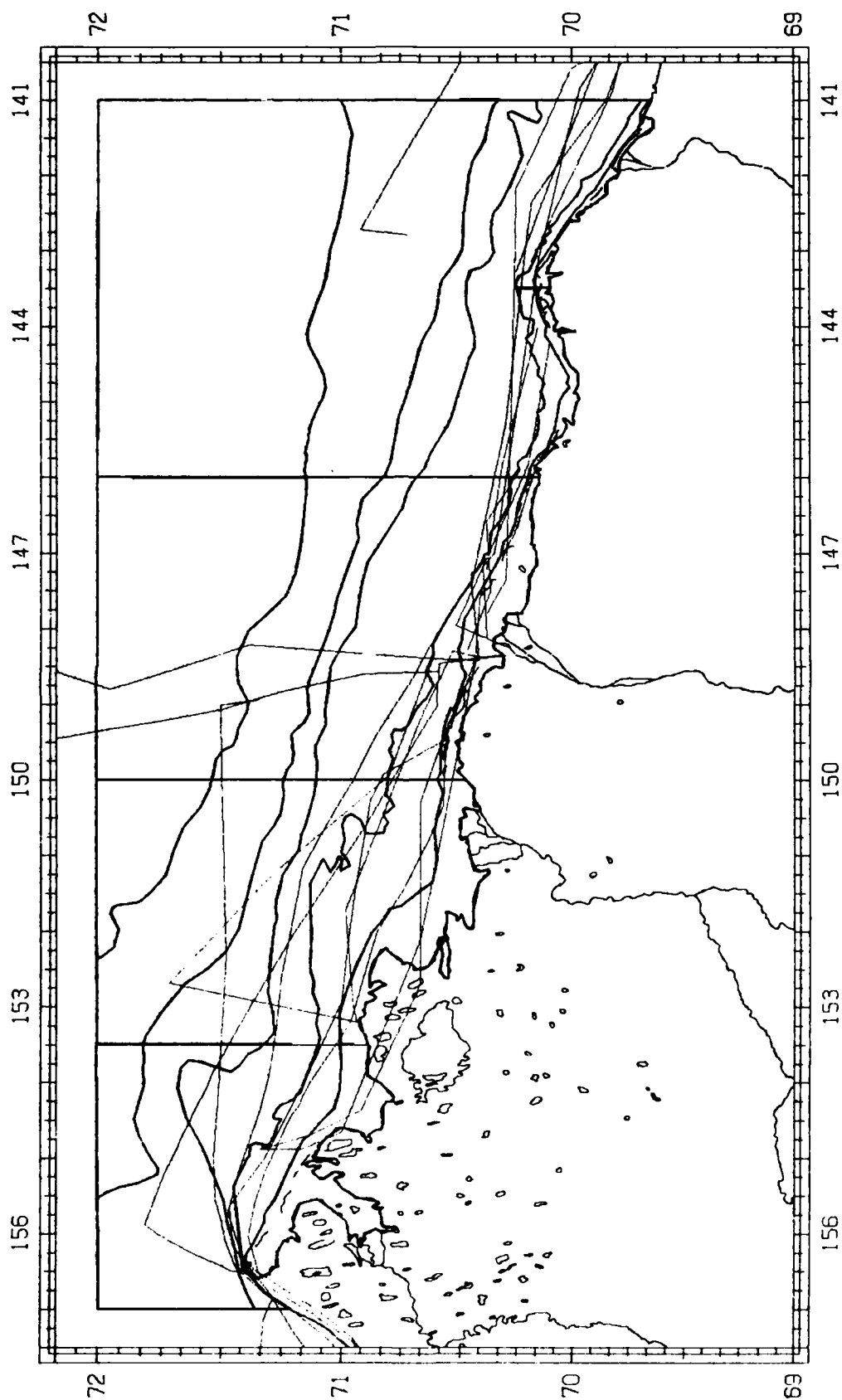


Figure P-22. Plot of aerial survey tracklines flown during June-August 1981 in the Beaufort Sea. No bowhead whales were observed during these surveys.

Table B-3. Statistics from aerial survey of bowhead whales conducted June-August 1981 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nmi². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 17 hours and 10 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (±n)	Number of Bowheads Observed	Density as Numbr per nmi ²	Variance	Confidence Range of Density
Total	28,609	100.	8.67	18:08	100.00	27	0	0.0	0.0	0.0 - 0.0
A	3,792	13.	11.26	3:09	18.	12	0	0.0	0.0	0.0 - 0.0
A1	654	2.25	10.28	0:36	3.50	8	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	26.51	0:49	4.76	7	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	18.01	1:05	6.31	12	0	0.0	0.0	0.0 - 0.0
A4	1,518	5.22	6.13	0:40	3.88	5	0	0.0	0.0	0.0 - 0.0
A5	384	1.32	0.00							
B	5,569	19.	11.69	4:10	24.	8	0	0.0	0.0	0.0 - 0.0
B1	739	2.54	17.55	0:53	5.15	6	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	17.97	1:23	8.06	12	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	21.41	0:56	5.43	9	0	0.0	0.0	0.0 - 0.0
B4	893	3.07	9.32	0:23	2.23	4	0	0.0	0.0	0.0 - 0.0
B5	1,463	5.03	5.07	0:17	1.65	2	0	0.0	0.0	0.0 - 0.0
B5	659	2.27	0.00							
C	7,701	27.	11.02	7:17	42.	19	0	0.0	0.0	0.0 - 0.0
C1	584	2.02	45.51	2:20	13.59	16	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	44.85	2:32	14.76	18	0	0.0	0.0	0.0 - 0.0
C3	1,910	6.57	10.29	1:25	8.25	13	0	0.0	0.0	0.0 - 0.0
C4	486	1.67	2.06	0:01	0.10	2	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	3.73	0:15	1.45	4	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	3.05	0:31	3.01	3	0	0.0	0.0	0.0 - 0.0
D	11,625	41.	4.74	3:18	13.	10	0	0.0	0.0	0.0 - 0.0
D1A	156	0.55	1.79	0:01	0.10	1	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	3.93	0:01	0.10	1	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	17.43	0:16	1.55	8	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	7.29	0:03	0.29	4	0	0.0	0.0	0.0 - 0.0
D3	1,947	6.87	21.83	2:35	15.05	12	0	0.0	0.0	0.0 - 0.0
D4	1,318	3.50	0.00							
D5	2,859	9.66	1.84	0:08	0.78	1	0	0.0	0.0	0.0 - 0.0
D6	5,333	18.24	0.00	0:00	0.00	0	0	0.0	0.0	0.0 - 0.0

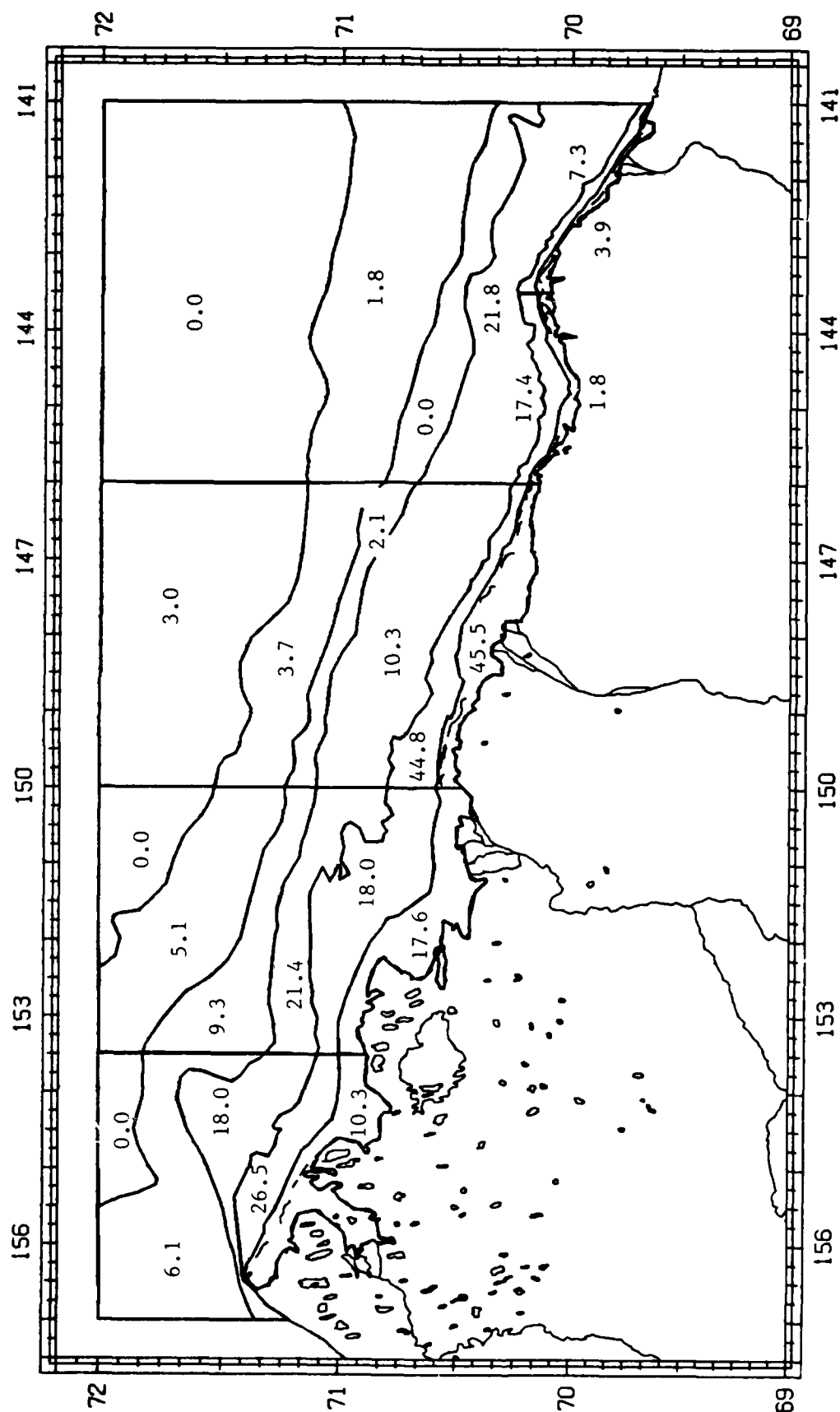


Figure B-23. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Data are based on the June-August 1981 Beaufort Sea aerial surveys.

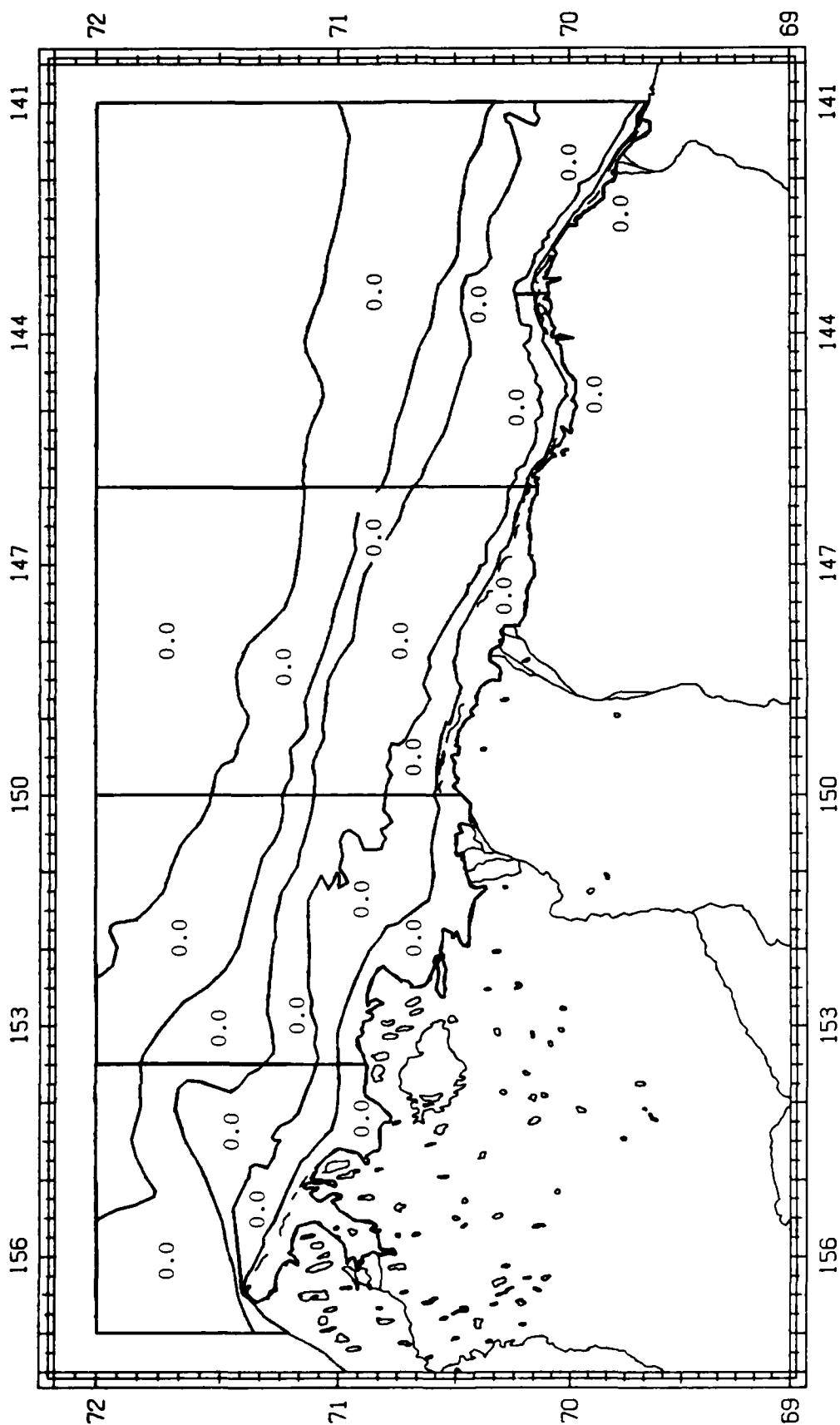


Figure B-24. Values shown are observed densities of bowhead whales as determined from aerial survey flown in the Beaufort Sea during June-August 1981.

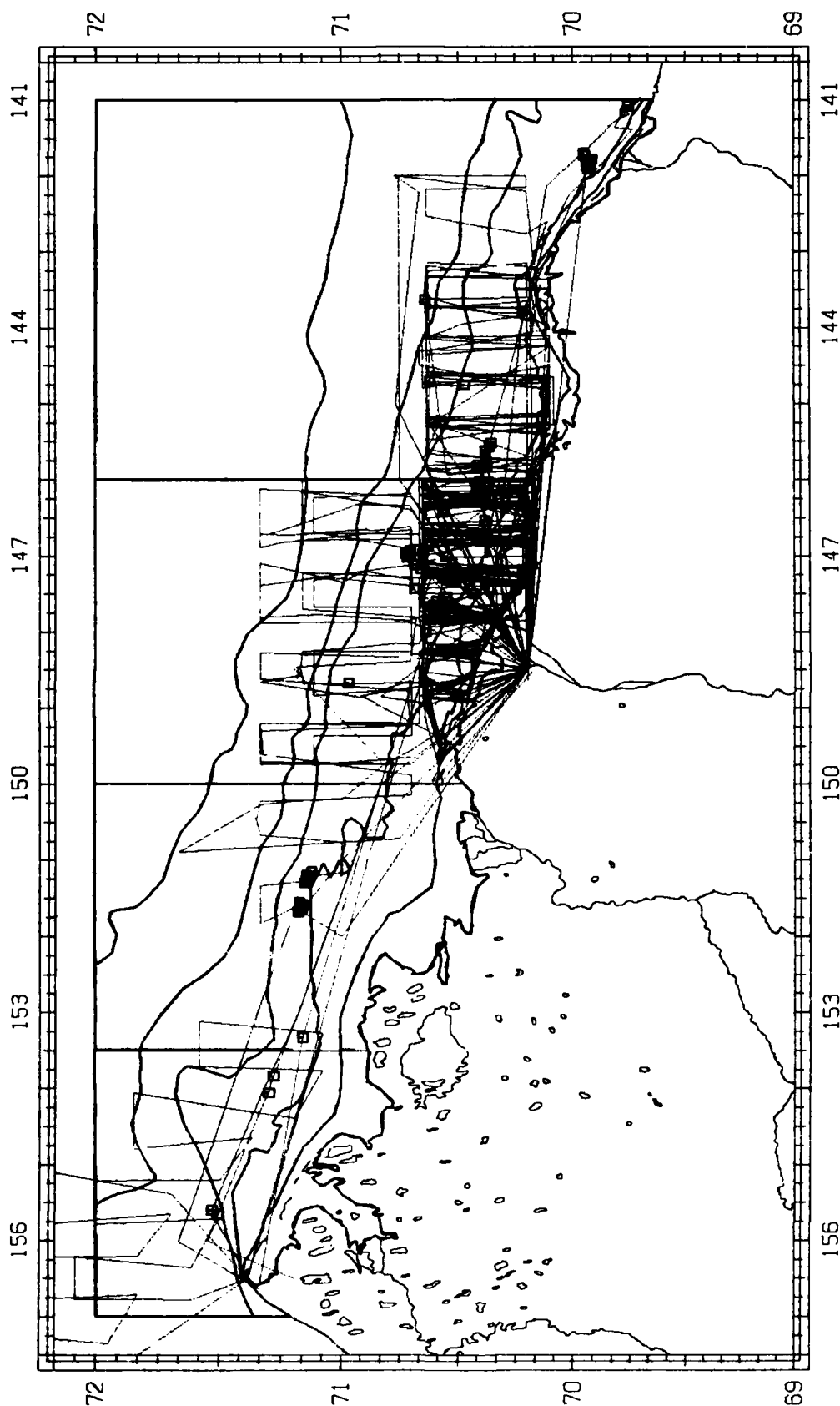


Figure B-25. Plot of aerial survey tracklines flown during September-October 1979 in the Beaufort Sea. Squares represent bowhead whale sightings.

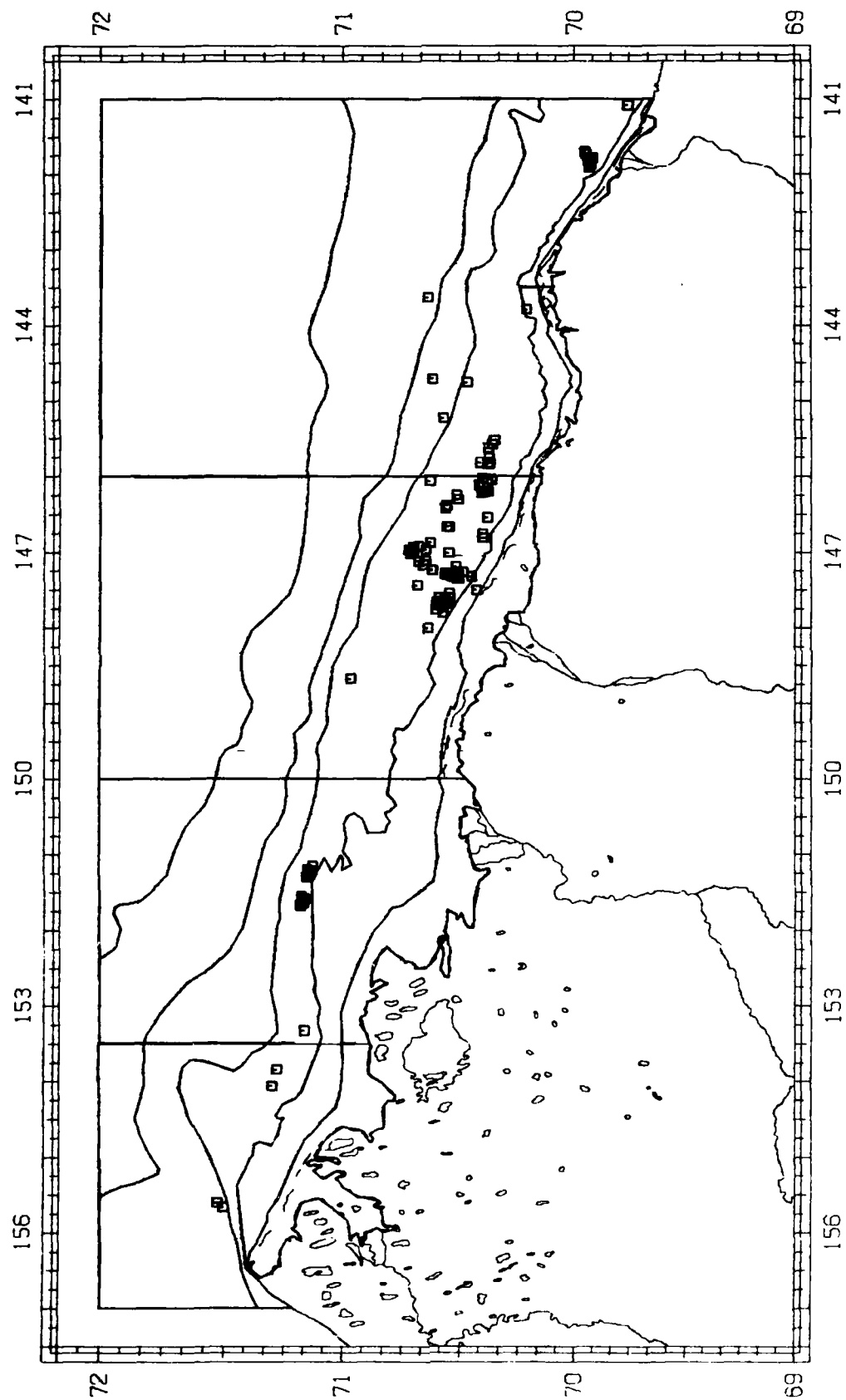


Figure B-26. Plot of bowhead whale sightings made during the September-October 1979 aerial surveys of the Beaufort Sea.

Table B-6. Statistics from aerial survey of bowhead whales conducted September-October 1979 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nmi². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. Total time spent surveying was approximately 131 hours and 38 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (=n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
Total	28,609	100.	42.86	132:48	100.00	75	150	0.012	>0.0	0.005 - 0.020
A	3,792	13.	20.91	8:43	6.62	16	5	0.006	>0.0	>0.0 - 0.014
A1	654	2.25	8.53	0:40	0.51	11	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	26.61	1:20	1.01	9	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	28.37	2:04	1.57	15	1	0.004	>0.0	>0.0 - 0.010
A4	1,518	5.22	22.69	3:33	2.70	15	4	0.012	>0.0	>0.0 - 0.032
A5	384	1.32	10.70	0:15	0.19	4	0	0.0	0.0	0.0 - 0.0
B	5,569	19.	13.12	7:43	5.86	8	41	0.056	0.001	>0.0 - 0.131
B1	739	2.54	0.69	0:02	0.03	2	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	28.85	2:50	2.15	17	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	32.31	2:56	2.23	23	41	0.160	0.006	0.001 - 0.319
B4	893	3.07	10.49	0:45	0.57	7	0	0.0	0.0	0.0 - 0.0
B5	1,463	5.03	4.45	0:59	0.75	2	0	0.0	0.0	0.0 - 0.0
B6	659	2.27	0.00							
C	7,701	27.	101.23	86:20	65.59	86	83	0.011	>0.0	0.004 - 0.017
C1	584	2.02	397.71	25:52	19.65	156	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	216.68	11:58	9.09	202	6	0.005	>0.0	>0.0 - 0.015
C3	1,910	6.57	192.90	42:44	32.46	129	77	0.021	>0.0	0.009 - 0.033
C4	486	1.67	45.43	1:48	1.37	34	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	34.49	3:55	2.98	23	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	3.97	1:01	0.77	6	0	0.0	0.0	0.0 - 0.0
D	11,625	41.	25.59	30:14	22.97	43	21	0.007	>0.0	>0.0 - 0.027
D1A	156	0.55	43.67	1:14	0.94	26	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	24.23	0:20	0.25	6	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	186.88	4:35	3.48	51	1	0.002	>0.0	>0.0 - 0.007
D2B	155	0.53	47.89	0:43	0.54	17	0	0.0	0.0	0.0 - 0.0
D3	1,997	6.87	68.67	14:18	10.86	76	19	0.014	>0.0	>0.0 - 0.035
D4	1,018	3.50	52.64	5:02	3.82	38	0	0.0	0.0	0.0 - 0.0
D5	2,809	9.66	11.30	2:43	2.06	13	1	0.003	>0.0	>0.0 - 0.011
D6	5,303	18.24	0.02	0:01	0.01	1	0	0.0	0.0	0.0 - 0.0

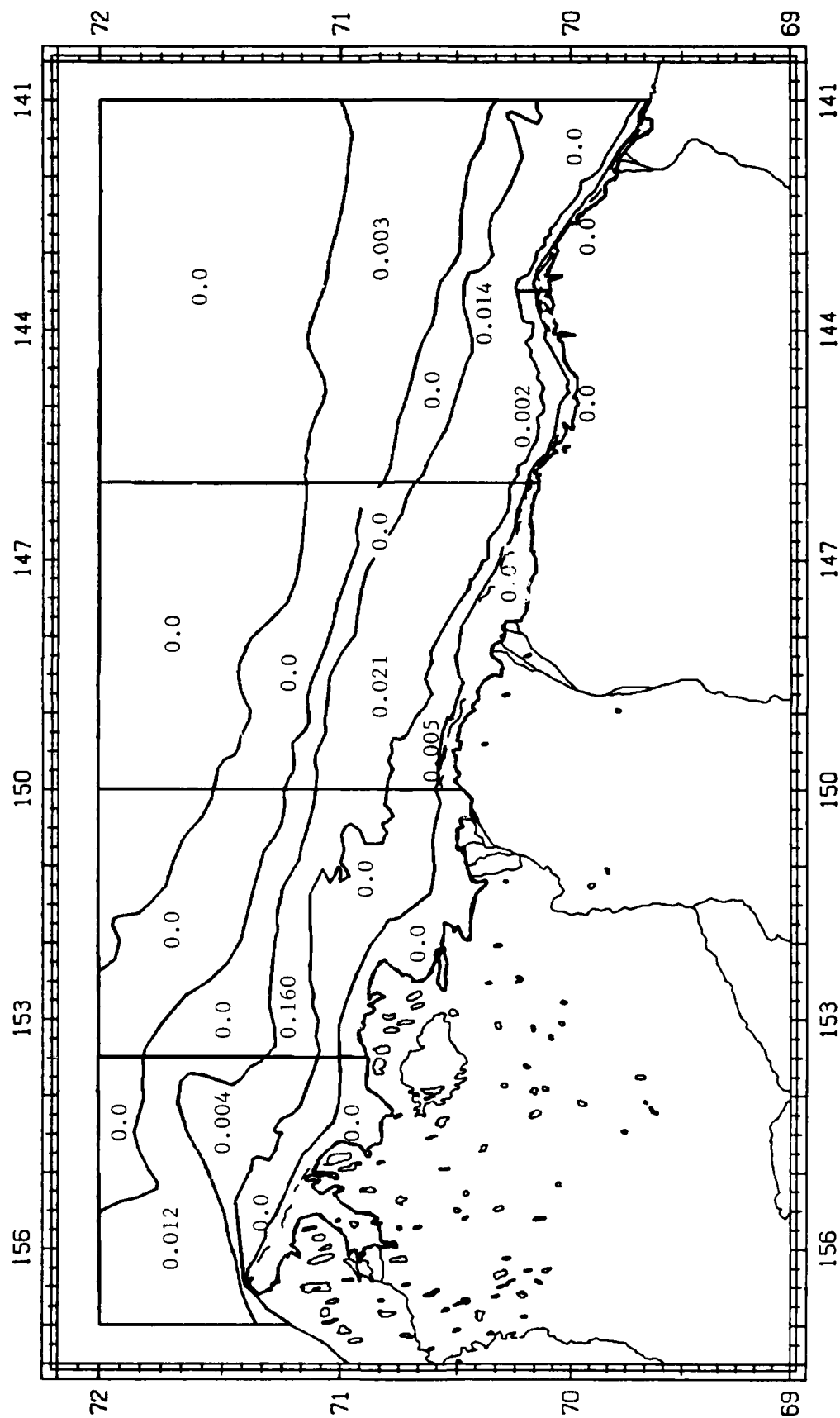


Figure B-28. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during September-October 1979.

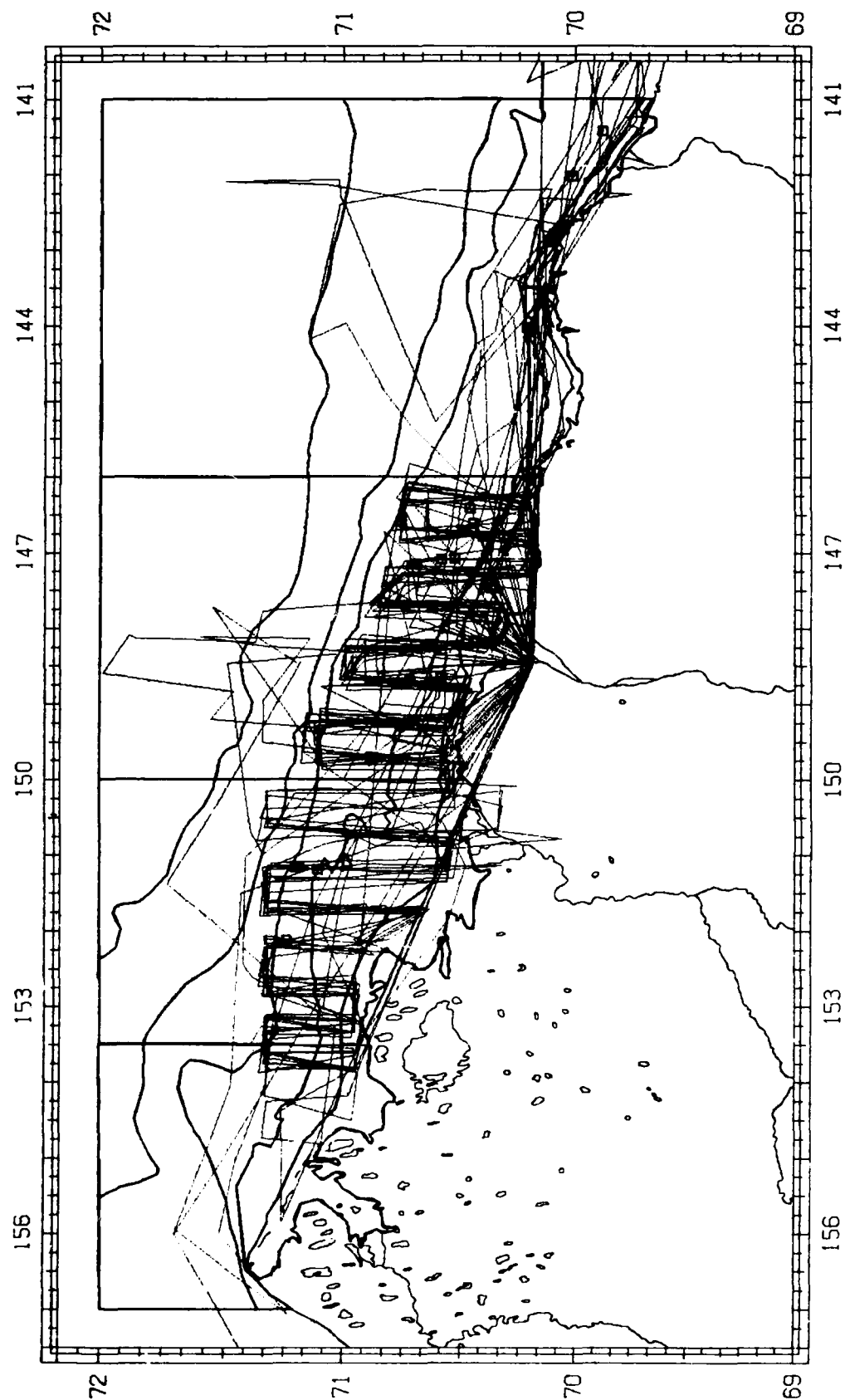


Figure B-29. Plot of aerial survey tracklines flown during September-October 1980 in the Beaufort Sea. Squares represent bowhead whale sightings.

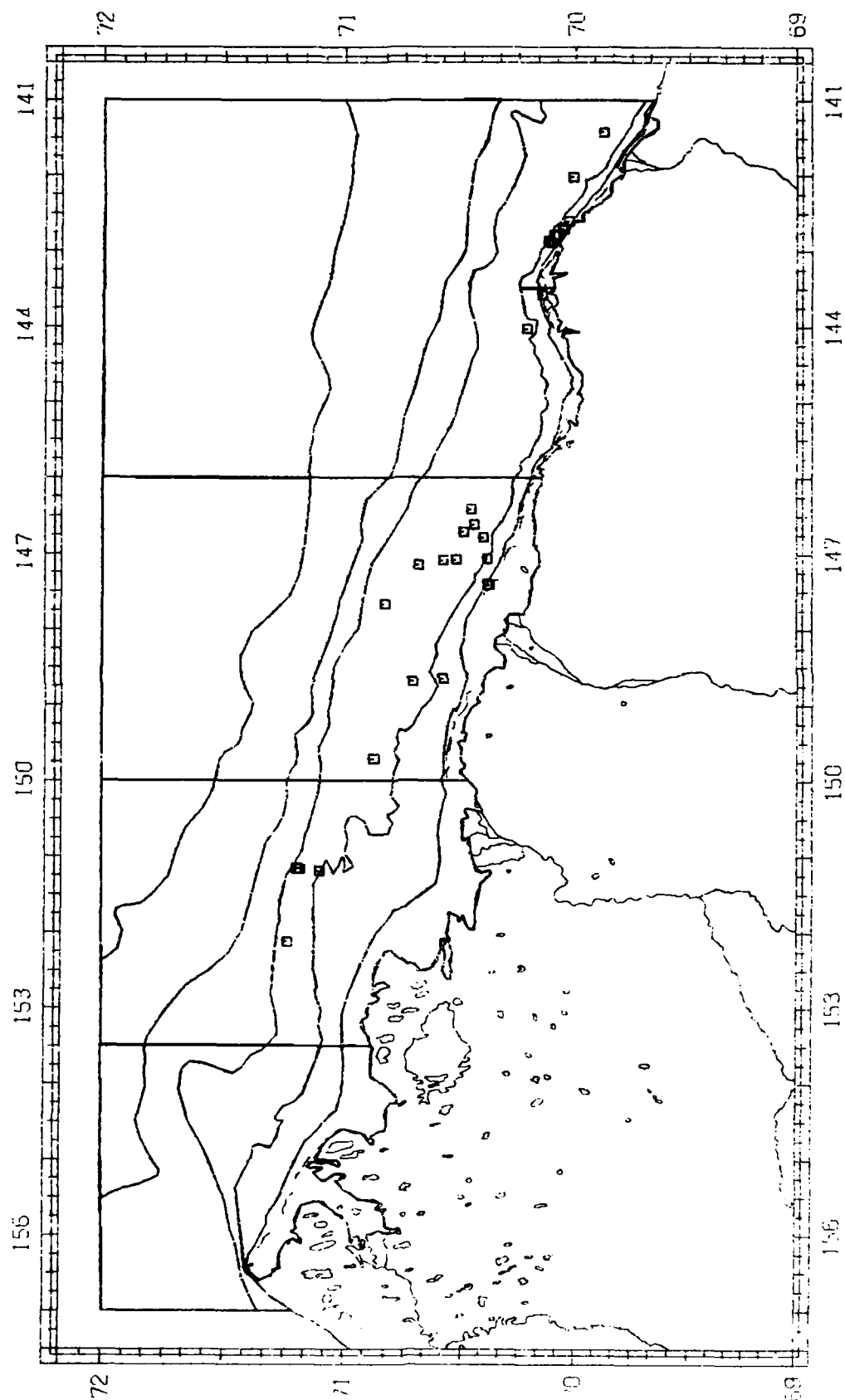


Figure B-30. Plot of bowhead whale sightings made during the September-October 1980 aerial surveys of the Beaufort Sea.

Table B-7. Statistics from aerial survey of bowhead whales conducted September-October 1980 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure . The total area of all regions was approximately 29,070 nmi². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. The total time spent surveying was approximately 125 hours and 48 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (=n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
Total	28,609	100.	50.41	127:10	100.00	84	20	0.001	>0.0	0.001 - 0.002
A	3,792	13.	19.96	6:22	5.06	15	0	0.0	0.0	0.0 - 0.0
A1	654	2.25	25.95	1:46	1.40	15	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	34.23	1:21	1.07	18	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	40.20	2:13	1.76	19	0	0.0	0.0	0.0 - 0.0
A4	1,518	5.22	7.29	0:47	0.62	13	0	0.0	0.0	0.0 - 0.0
A5	384	1.32	0.00							
B	5,569	19.	72.68	34:00	27.03	46	4	0.001	>0.0	>0.0 - 0.002
B1	739	2.54	123.32	11:20	9.01	70	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	129.31	10:12	8.11	99	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	114.31	6:31	5.18	99	4	0.004	>0.0	>0.0 - 0.014
B4	893	3.07	70.15	5:11	4.12	50	0	0.0	0.0	0.0 - 0.0
B5	1,463	5.03	12.59	1:21	1.07	10	0	0.0	0.0	0.0 - 0.0
B6	659	2.27	0.00							
C	7,701	27.	92.57	61:44	49.07	70	9	0.001	>0.0	>0.0 - 0.002
C1	584	2.02	283.90	16:08	12.82	133	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	231.45	10:05	8.02	176	1	0.001	>0.0	>0.0 - 0.001
C3	1,910	6.57	186.97	30:04	23.90	125	7	0.002	>0.0	>0.0 - 0.003
C4	486	1.67	53.40	1:50	1.46	37	0	0.0	0.0	0.0 - 0.0
C5	1,224	4.21	17.93	1:44	1.38	12	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	5.48	1:20	1.06	5	0	0.0	0.0	0.0 - 0.0
D	11,625	41.	21.31	24:08	19.18	39	7	0.003	>0.0	>0.0 - 0.005
D1A	156	0.55	70.00	2:29	1.97	25	1	0.009	>0.0	>0.0 - 0.031
D1B	123	0.42	83.12	2:00	1.59	20	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	129.63	2:59	2.37	44	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	120.95	3:34	2.84	32	3	0.016	>0.0	>0.0 - 0.034
D3	1,997	6.87	71.26	10:42	8.51	62	2	0.001	>0.0	>0.0 - 0.003
D4	1,018	3.50	6.74	0:31	0.41	7	0	0.0	0.0	0.0 - 0.0
D5	2,809	9.66	5.55	1:05	0.86	4	0	0.0	0.0	0.0 - 0.0
D6	5,303	18.24	1.78	0:35	0.46	2	0	0.0	3.0	0.0 - 0.0

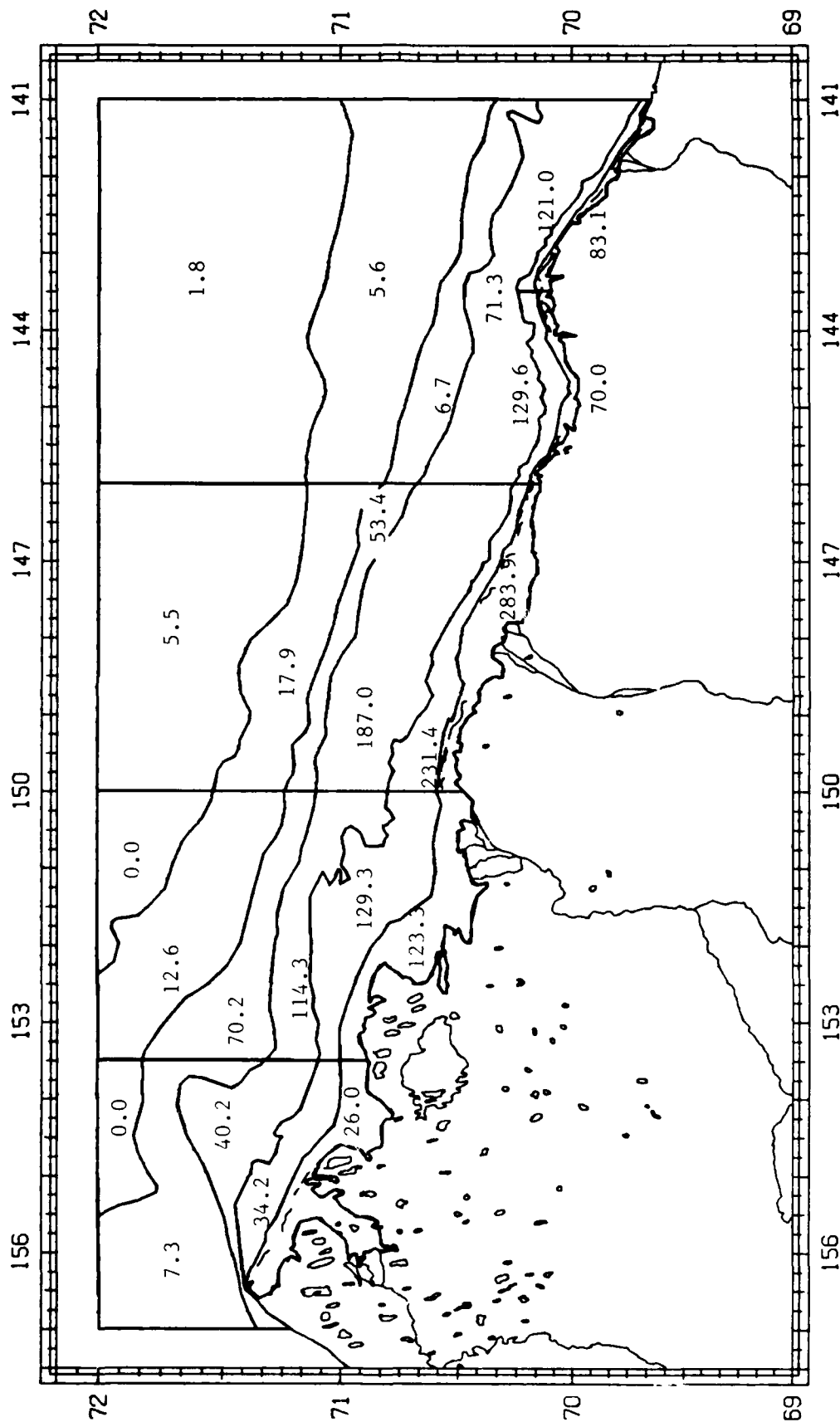


Figure R-31. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Values exceeding 100 percent resulted when the total number of nautical miles surveyed was greater than the region, indicating that some locations were overflown more than once. Data are based on the September-October 1980 Beaufort Sea aerial surveys.

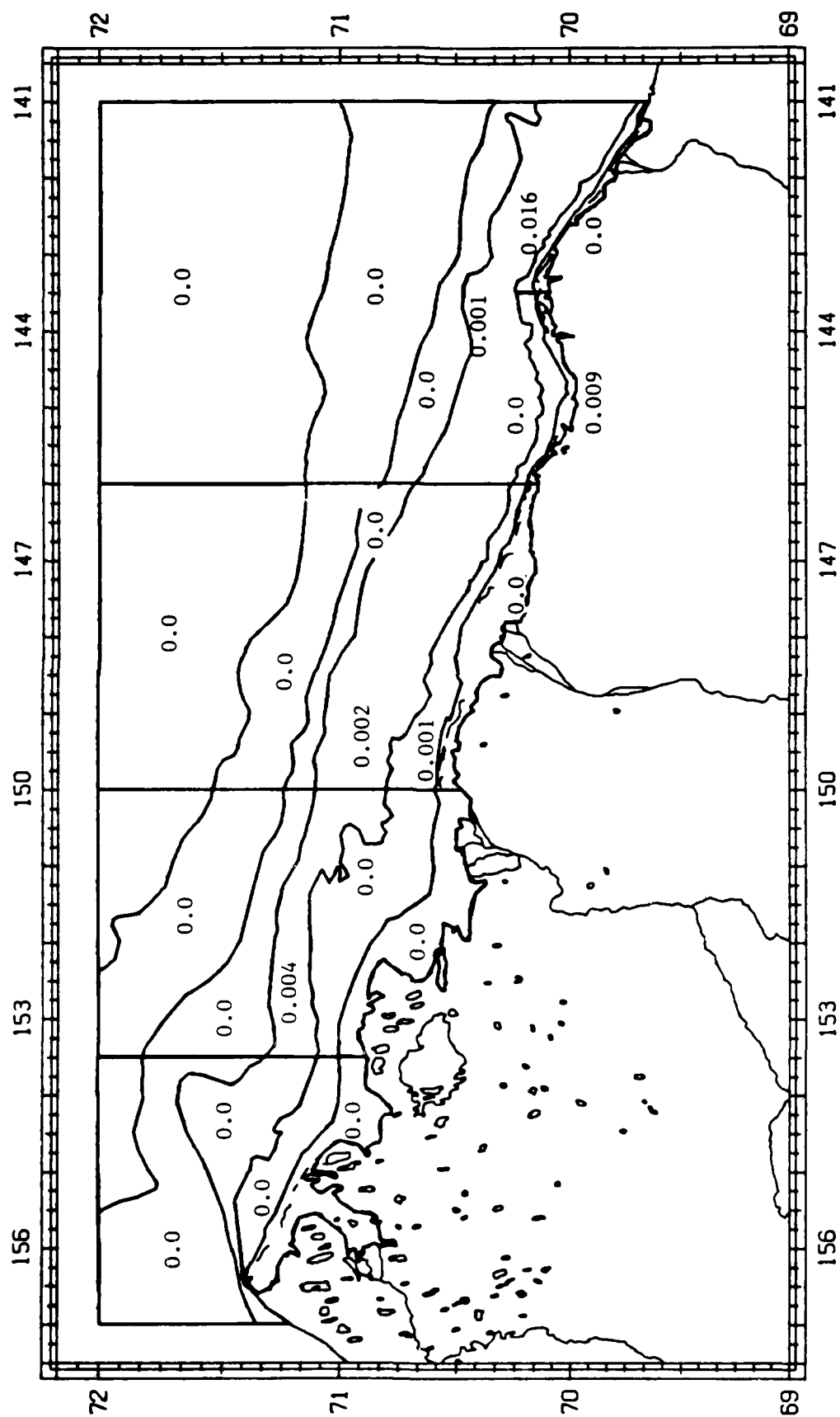


Figure B-32. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during September-October 1980.

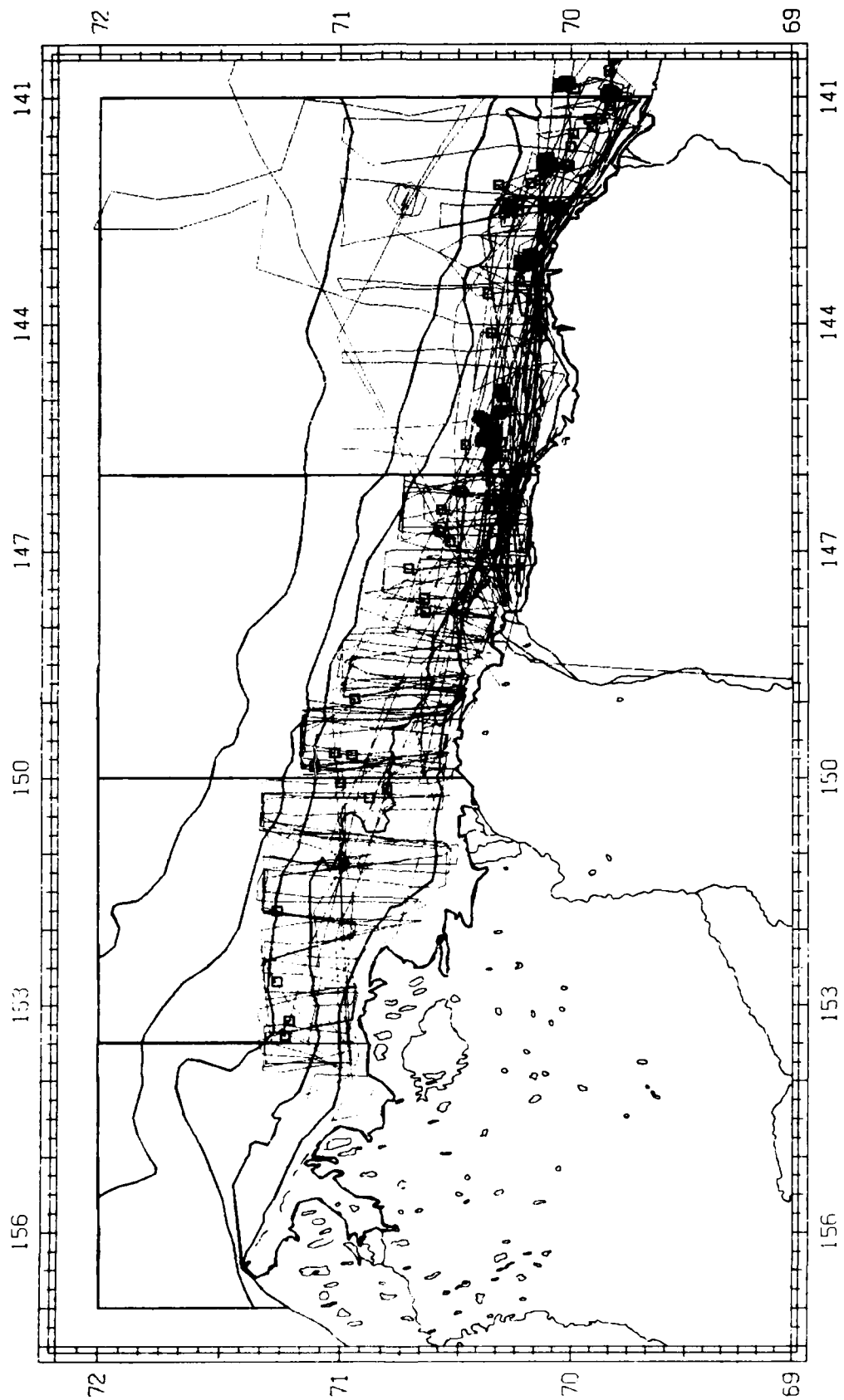


Figure B-33. Plot of aerial survey tracklines flown during September-October 1981 in the Beaufort Sea. Squares represent bowhead whale sightings.

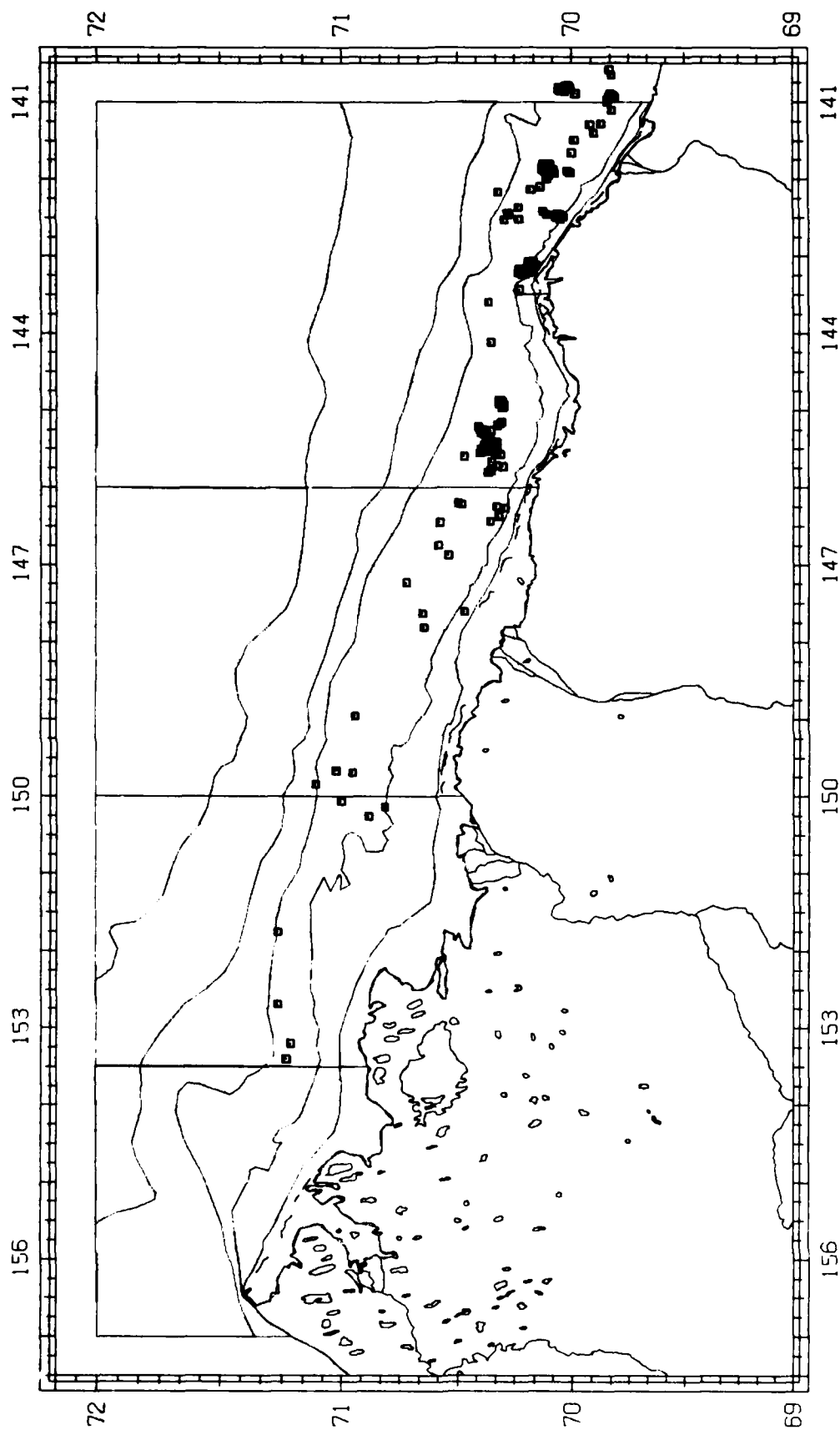


Figure B-34. Plot of bowhead whale sightings made during the September-October 1981 aerial surveys of the Beaufort Sea.

Table B-8. Statistics from aerial surveys of bowhead whales conducted September-October 1981 in the Beaufort Sea. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-4. The total area of all regions was approximately 29,070 nm². Areas were approximated by straight line integration and thus minor discrepancies exist between the summation of areas of sub-regions and the area calculated for the total region. Total time spent surveying was approximately 99 hours.

Region Name	Region Area nm ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transsects Flown (±n)	Number of Bowheads Observed	Density as Number per nm ²	Variance	Confidence Range of Density
Total	28,639	100.	42.93	99:22	100.00	259	204	0.017	>0.0	0.004 - 0.030
A	3,792	13.	6.41	1:45	1.77	17	0	0.0	0.0	0.0 - 0.0
A1	654	2.25	13.31	0:33	0.55	10	0	0.0	0.0	0.0 - 0.0
A2	479	1.65	14.76	0:32	0.54	9	0	0.0	0.0	0.0 - 0.0
A3	789	2.71	10.78	0:38	0.64	13	0	0.0	0.0	0.0 - 0.0
A4	1,518	5.22	0.06	0:01	0.02	1	0	0.0	0.0	0.0 - 0.0
A5	384	1.32	0.00							
B	5,569	19.	42.60	17:22	17.54	89	8	0.003	>0.0	>0.0 - 0.007
B1	739	2.54	39.26	2:07	2.14	47	0	0.0	0.0	0.0 - 0.0
B2	1,079	3.71	92.89	6:58	7.04	76	0	0.0	0.0	0.0 - 0.0
B3	793	2.73	87.10	5:20	5.39	76	8	0.012	>0.0	0.002 - 0.021
B4	843	3.07	34.86	2:15	2.27	55	0	0.0	0.0	0.0 - 0.0
B5	1,463	5.03	5.26	0:35	0.59	16	0	0.0	0.0	0.0 - 0.0
B6	659	2.27	0.00							
C	7,701	27.	60.99	35:08	35.49	164	21	0.004	0.0	0.002 - 0.007
C1	584	2.02	163.69	6:48	6.87	123	0	0.0	0.0	0.0 - 0.0
C2	528	1.82	216.20	8:20	8.42	140	1	0.001	>0.0	>0.0 - 0.003
C3	1,910	6.57	125.28	18:31	18.70	132	19	0.008	>0.0	0.004 - 0.012
C4	486	1.67	40.09	1:22	1.38	41	1	0.005	>0.0	>0.0 - 0.017
C5	1,224	4.21	0.90	0:06	0.10	7	0	0.0	0.0	0.0 - 0.0
C6	3,070	10.56	0.00							
D	11,625	41.	42.75	45:00	45.45	73	175	0.035	0.0	>0.0 - 0.090
D1A	156	0.55	81.25	1:01	1.03	24	0	0.0	0.0	0.0 - 0.0
D1B	123	0.42	107.31	0:54	0.91	24	0	0.0	0.0	0.0 - 0.0
D2A	257	0.88	157.59	2:53	2.91	62	0	0.0	0.0	0.0 - 0.0
D2B	155	0.53	159.02	2:37	2.64	45	5	0.017	0.002	>0.0 - 0.100
D3	1,397	6.87	146.74	29:22	29.66	104	167	0.057	>0.0	>0.0 - 0.097
D4	1,518	3.50	22.32	1:44	1.75	28	1	0.004	>0.0	>0.0 - 0.016
D5	2,809	9.66	22.42	4:48	4.85	23	0	0.0	0.0	0.0 - 0.0
D6	5,403	18.24	4.28	1:35	1.50	8	0	0.0	0.0	0.0 - 0.0

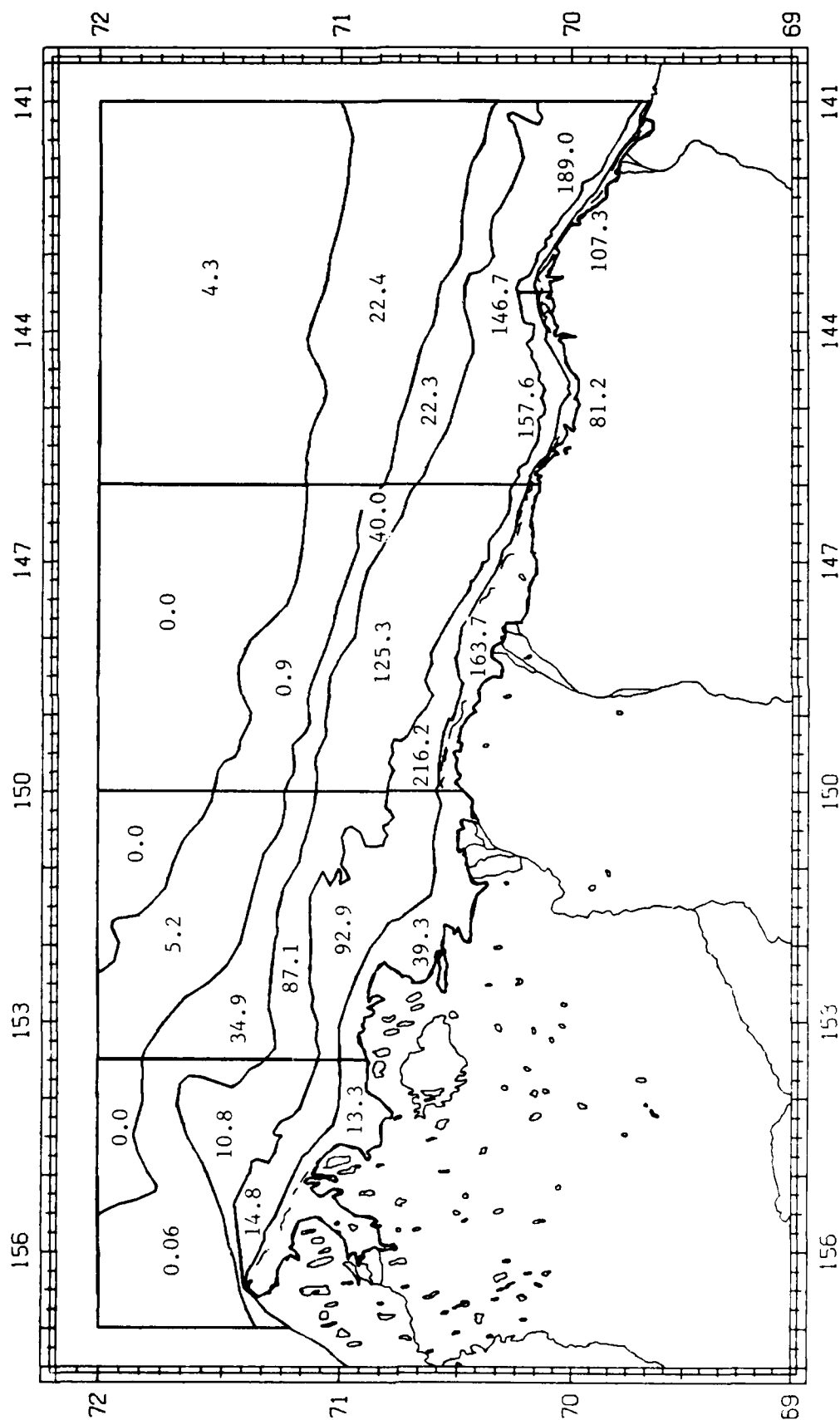


Figure B-35. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Values exceeding 100 percent resulted when the total number of nautical miles surveyed was greater than the region, indicating that some locations were overflown more than once. Data are based on the September-October 1981 Beaufort Sea aerial surveys.

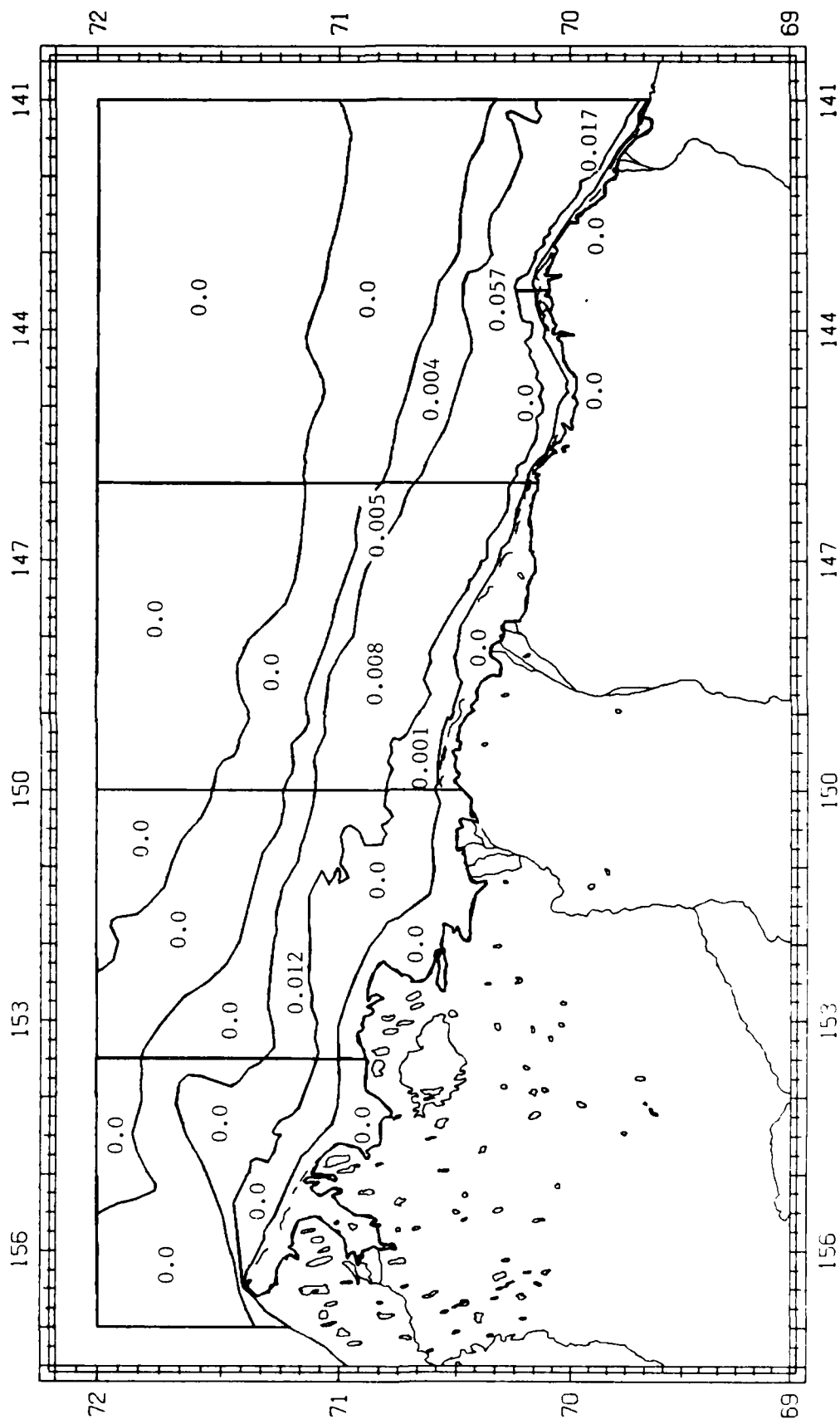


Figure B-36. Values shown are observed densities of bowhead whales as determined from aerial surveys flown in the Beaufort Sea during September-October 1981.

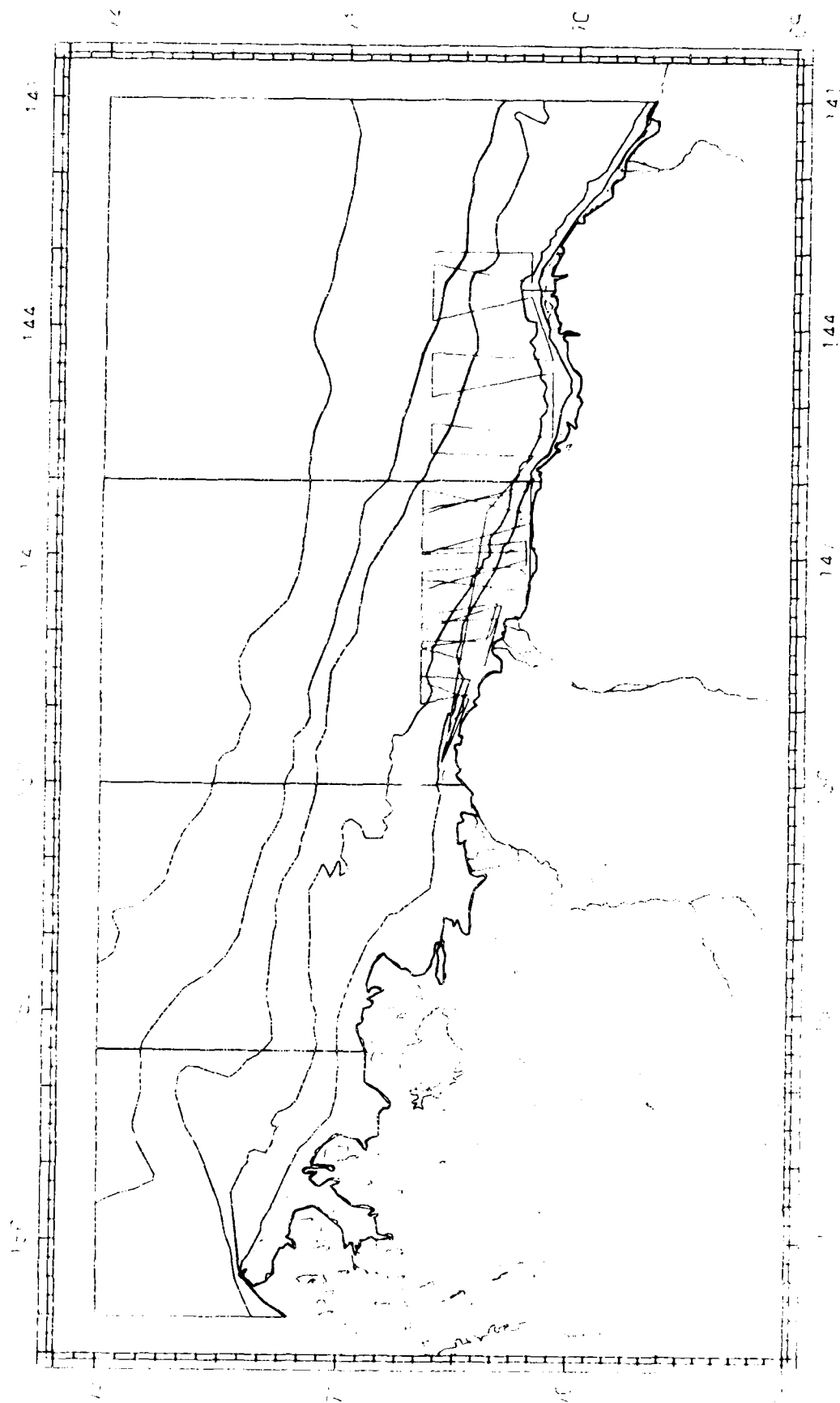


Figure B-37. Plot of aerial survey tracklines flown during 1-15 August 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

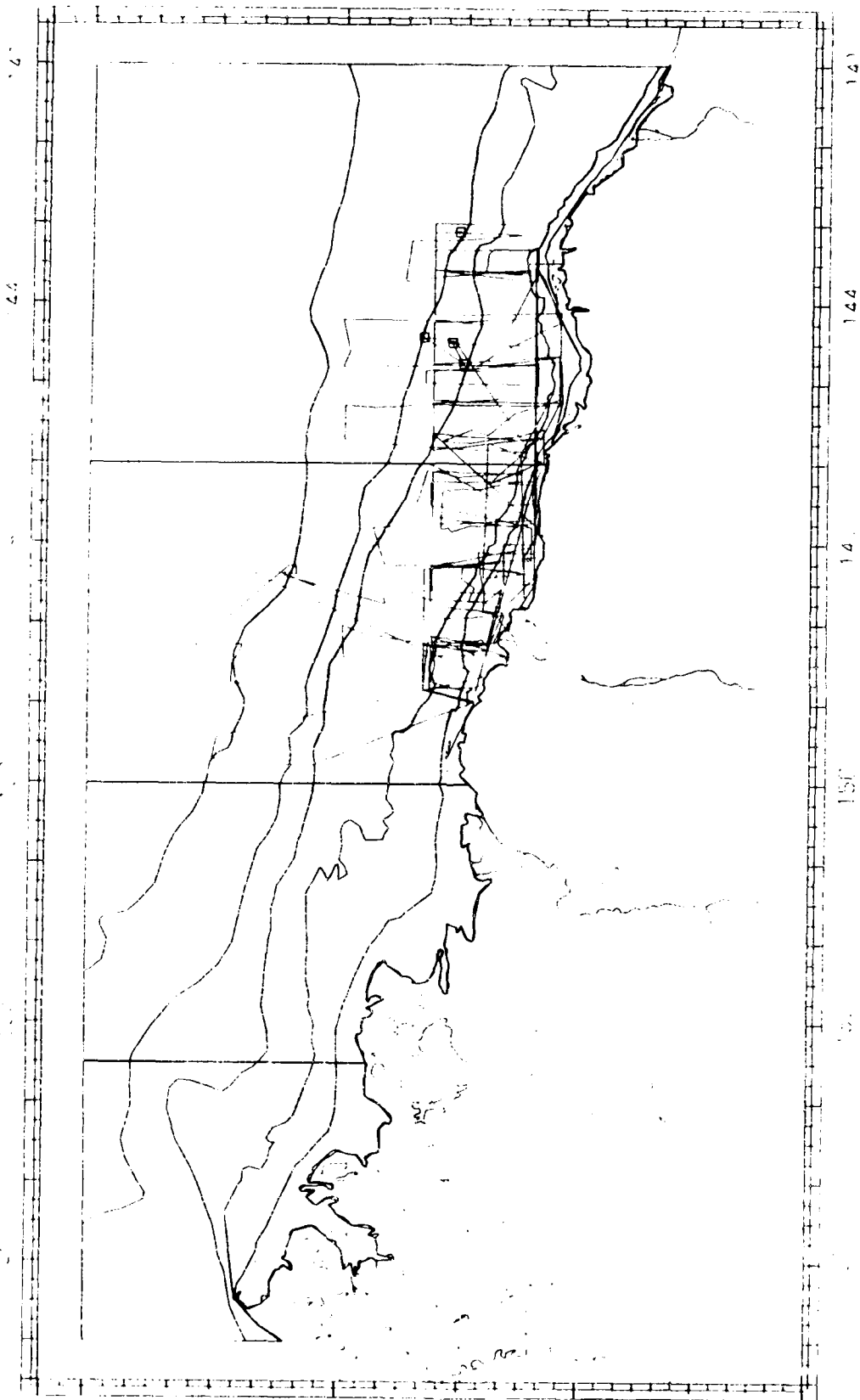


Figure 8-38 Plot of aerial survey tracklines flown during 16-31 August 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

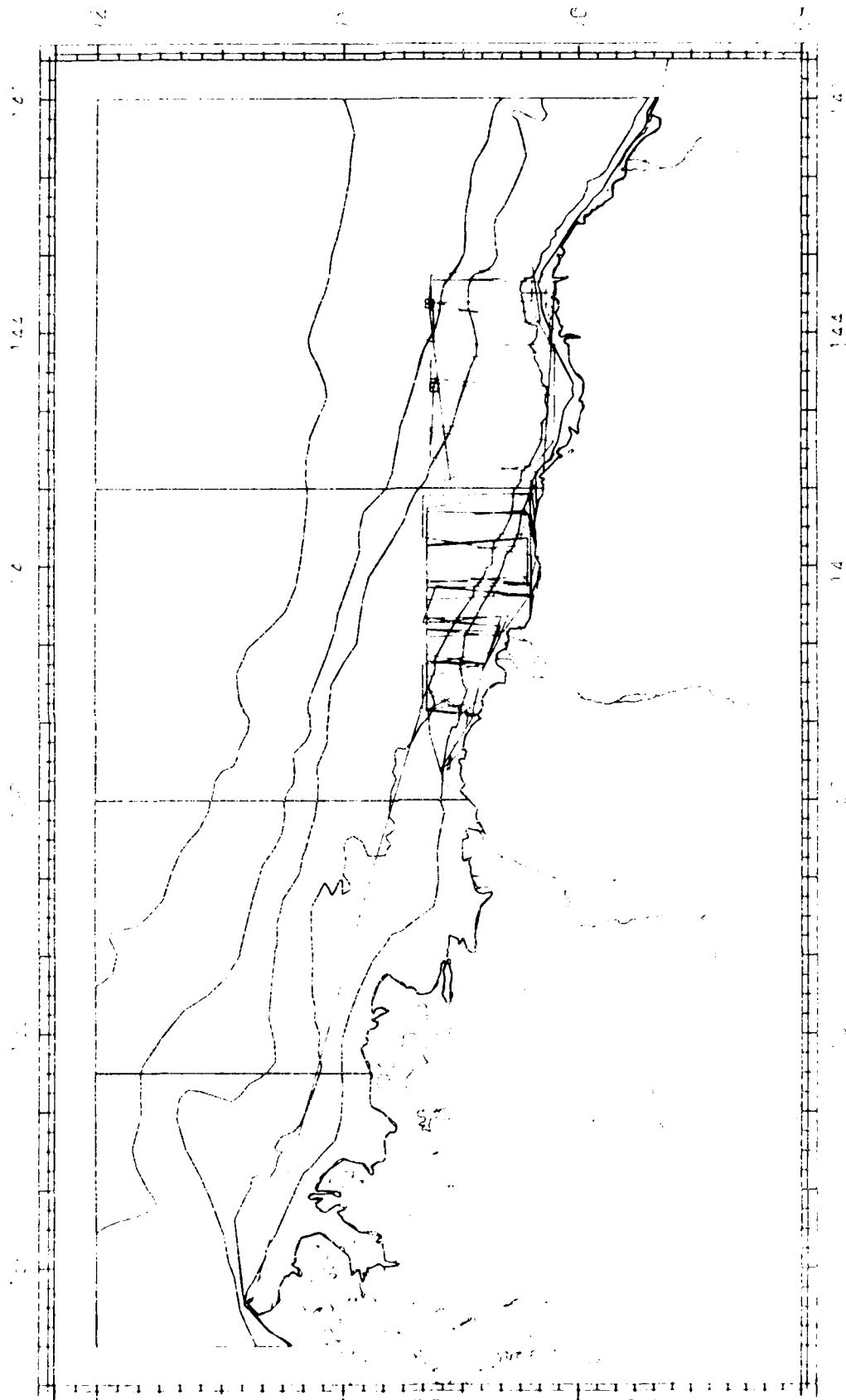


Figure B-19. Plot of aerial survey tracklines flown during 1-15 September 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

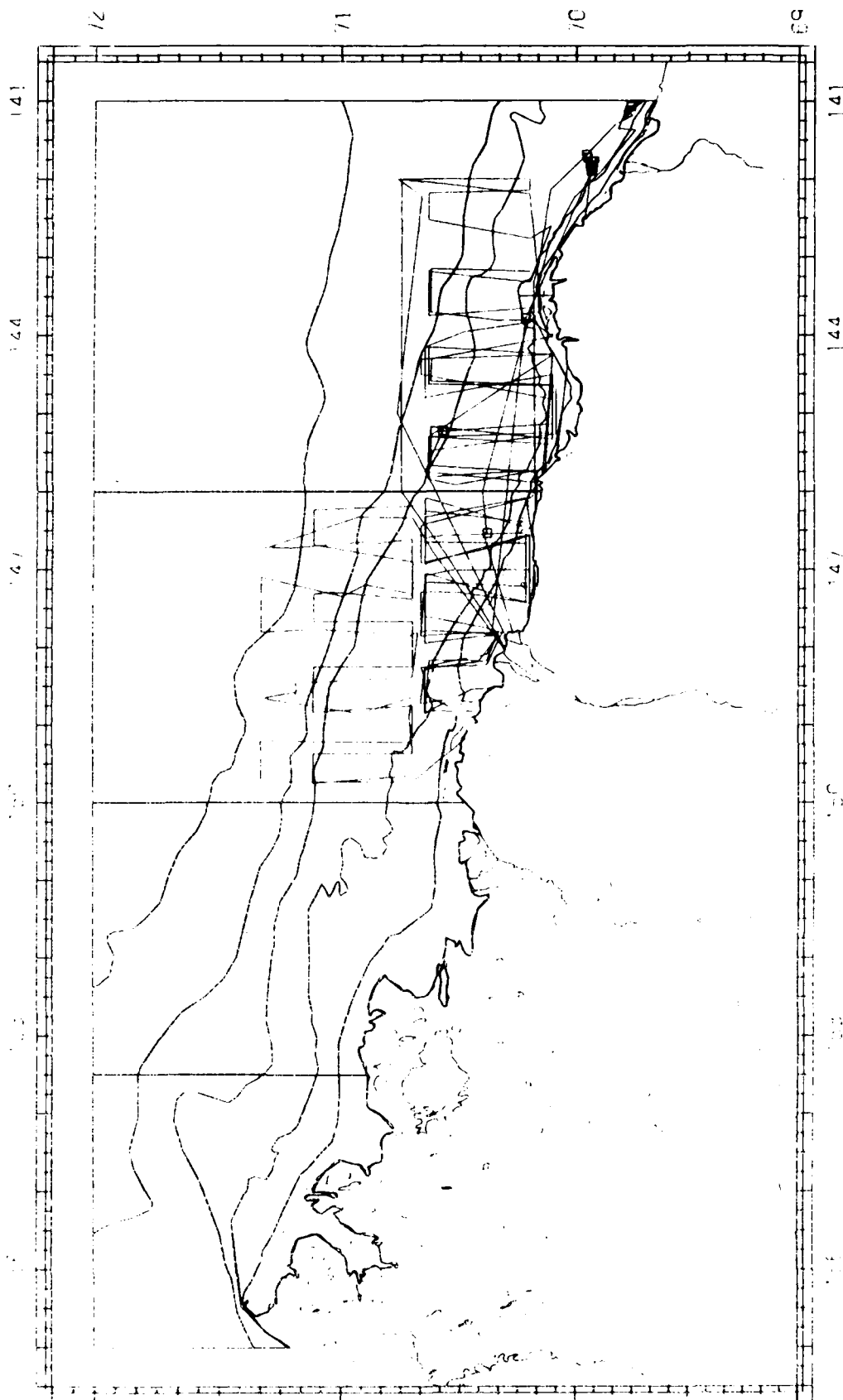


Figure B-40. Plot of aerial survey tracklines flown during 16-30 September 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

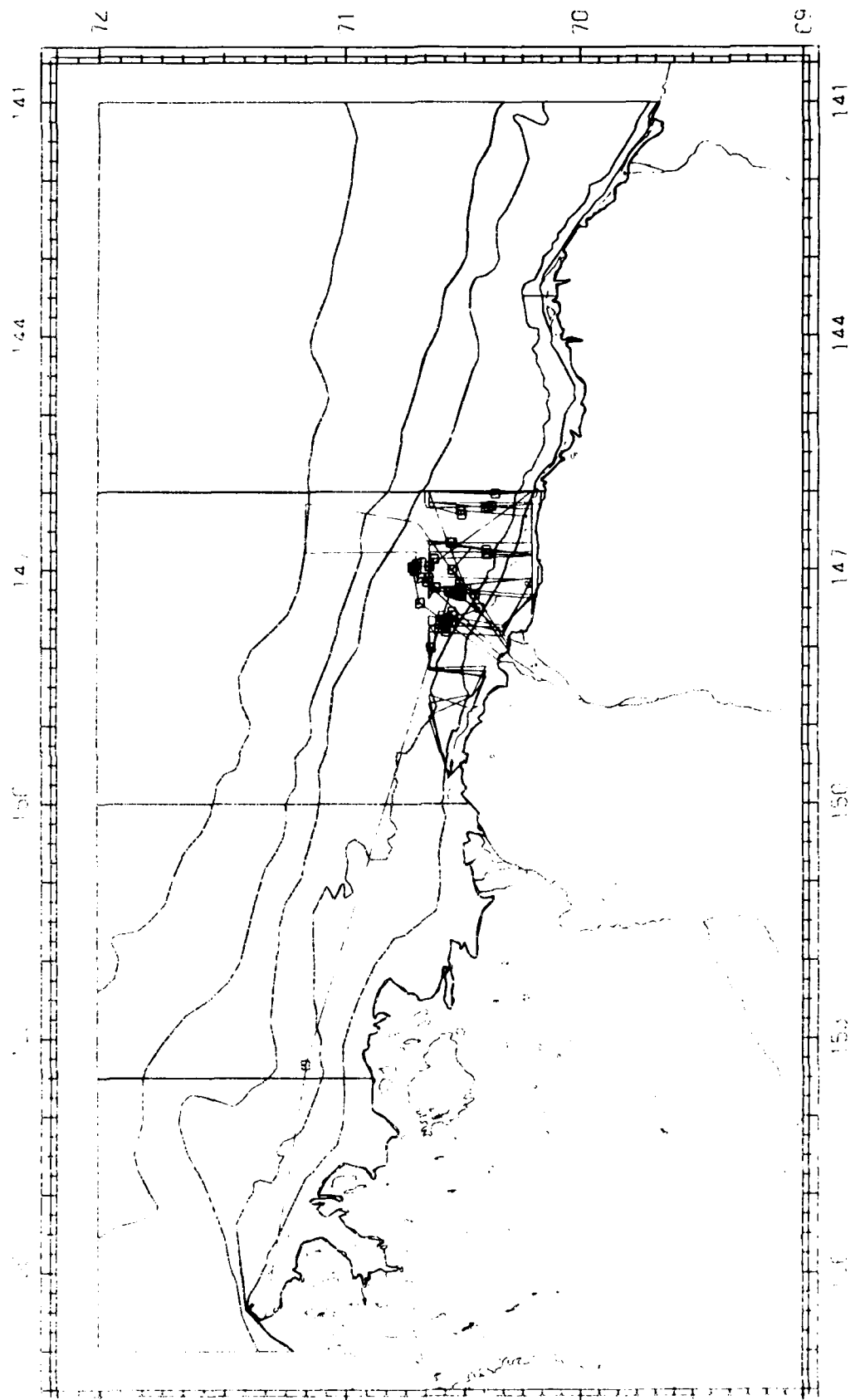


Figure B-41. Plot of aerial survey tracklines flown during 1-15 October 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

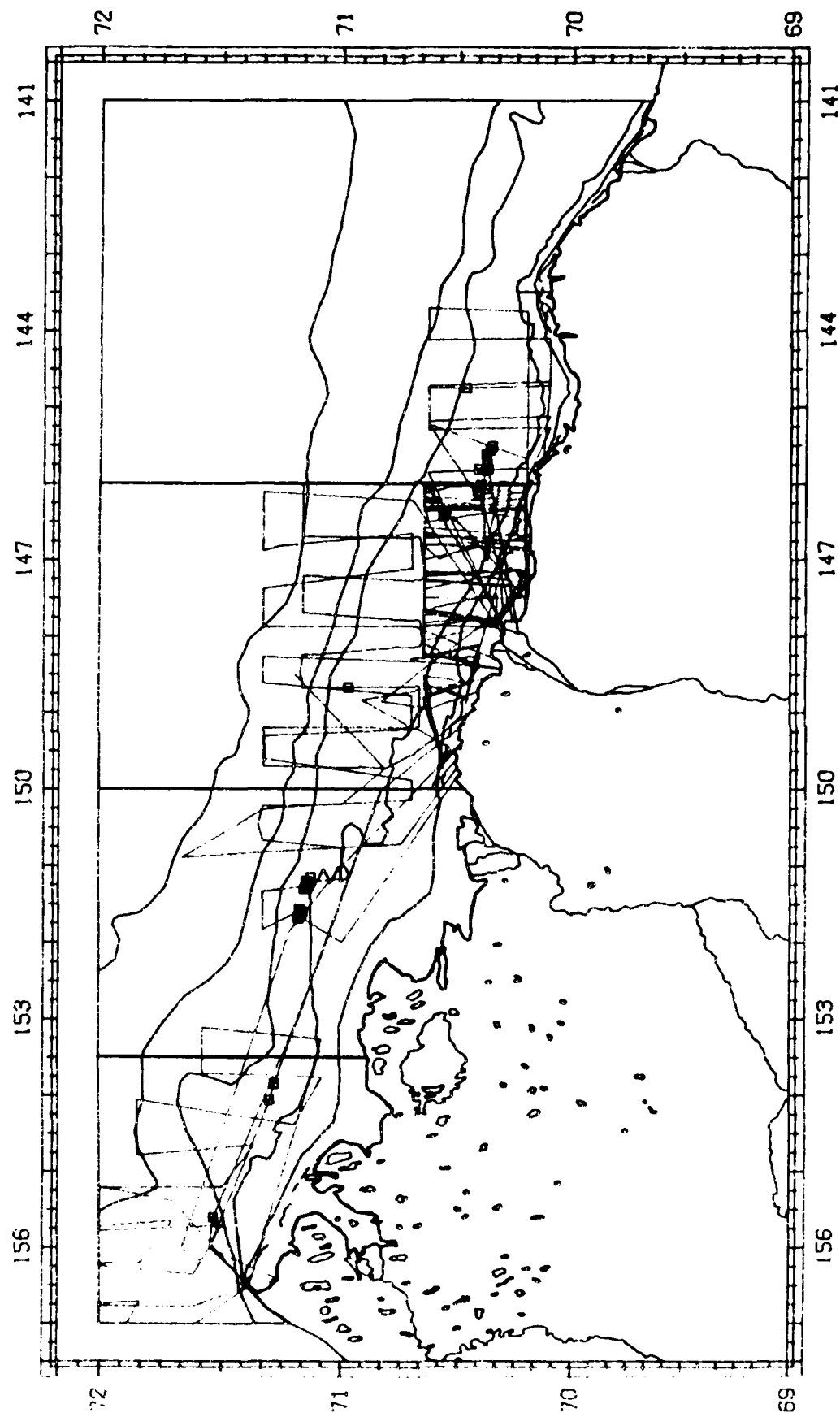


Figure B-42. Plot of aerial survey tracklines flown during 16-31 October 1979 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

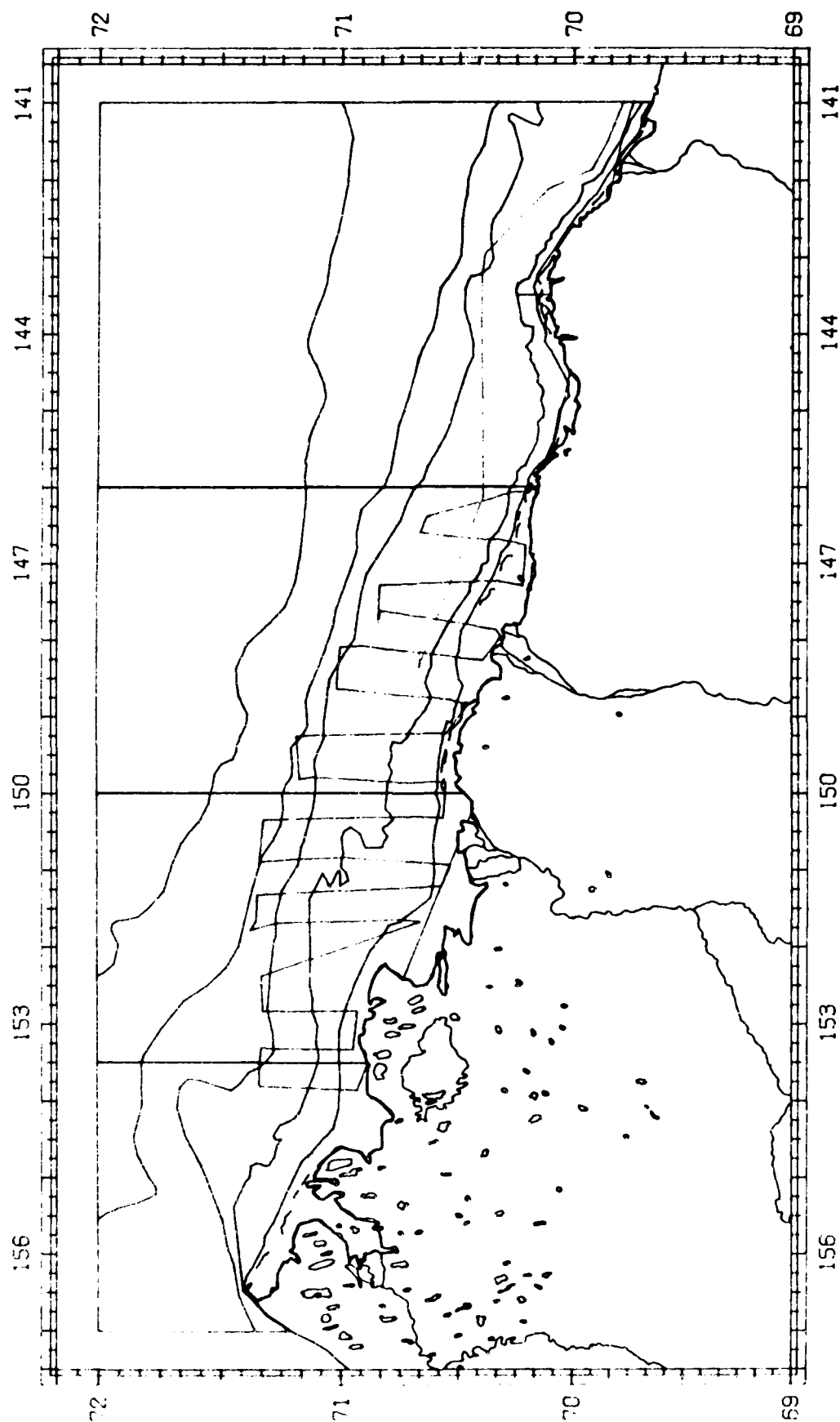


Figure B-43. Plot of aerial survey tracklines flown during 1-15 August 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

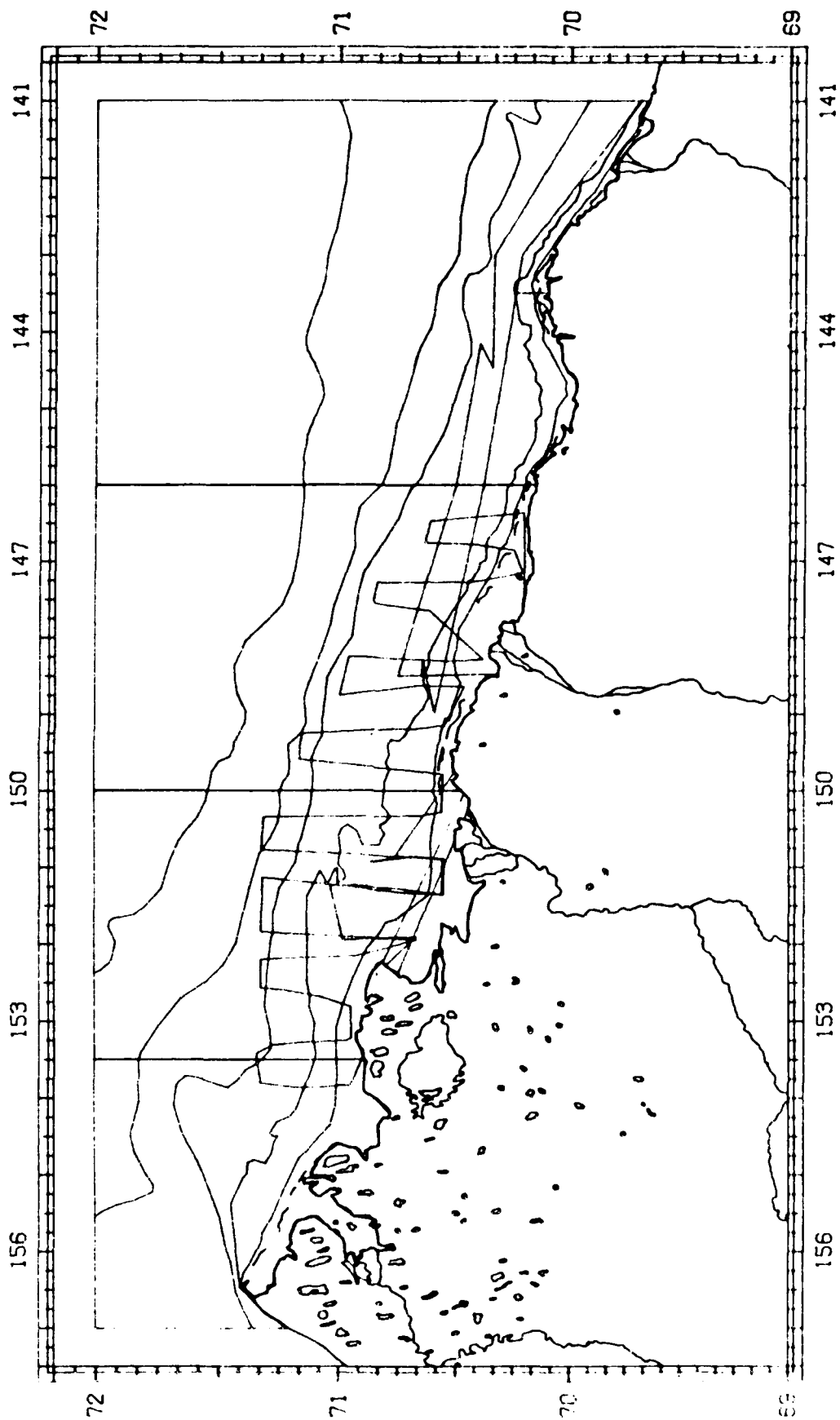


Figure B-44. Plot of aerial survey tracklines flown during 16-31 August 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

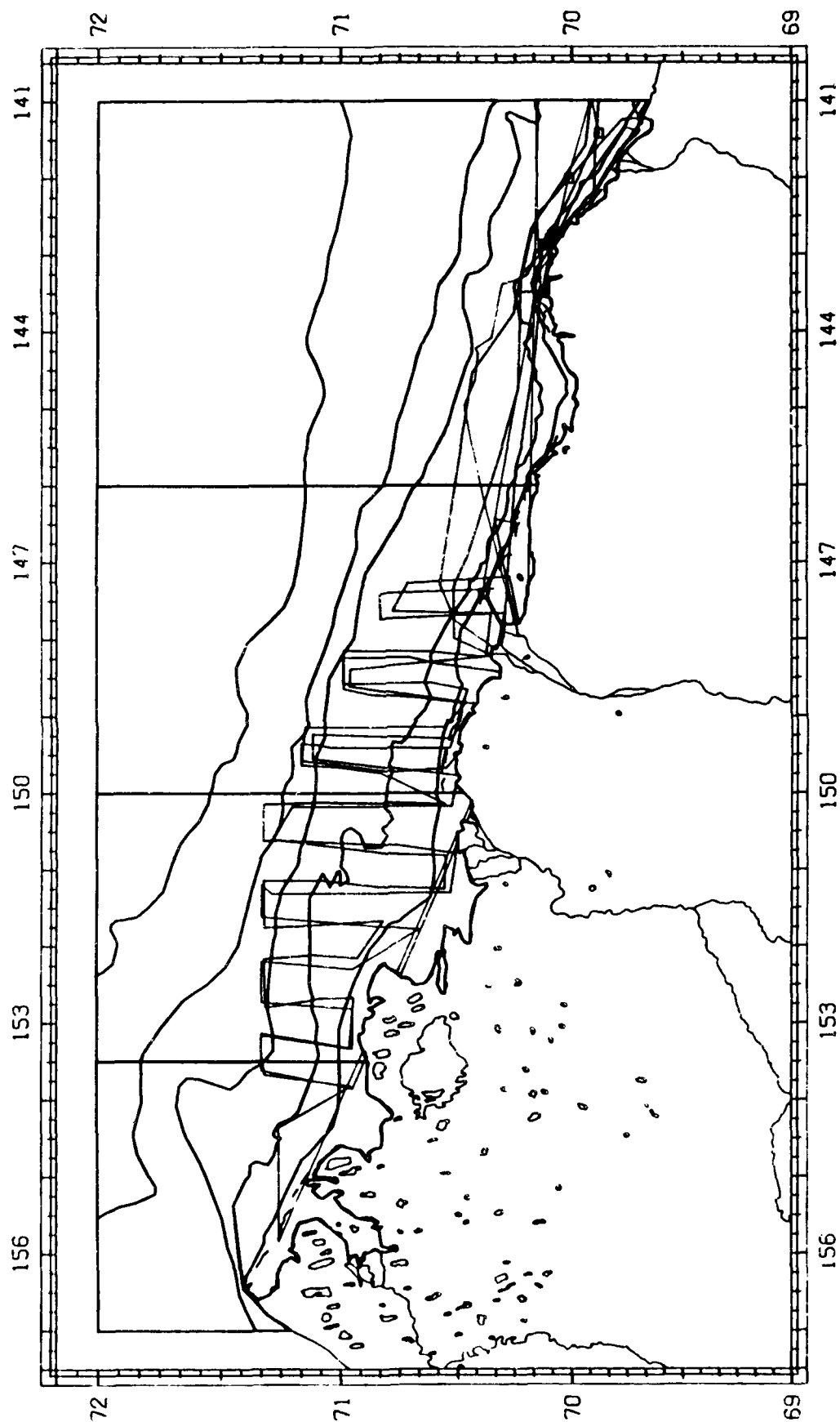


Figure B-19. Plot of aerial survey tracklines flown during 1-15 September 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

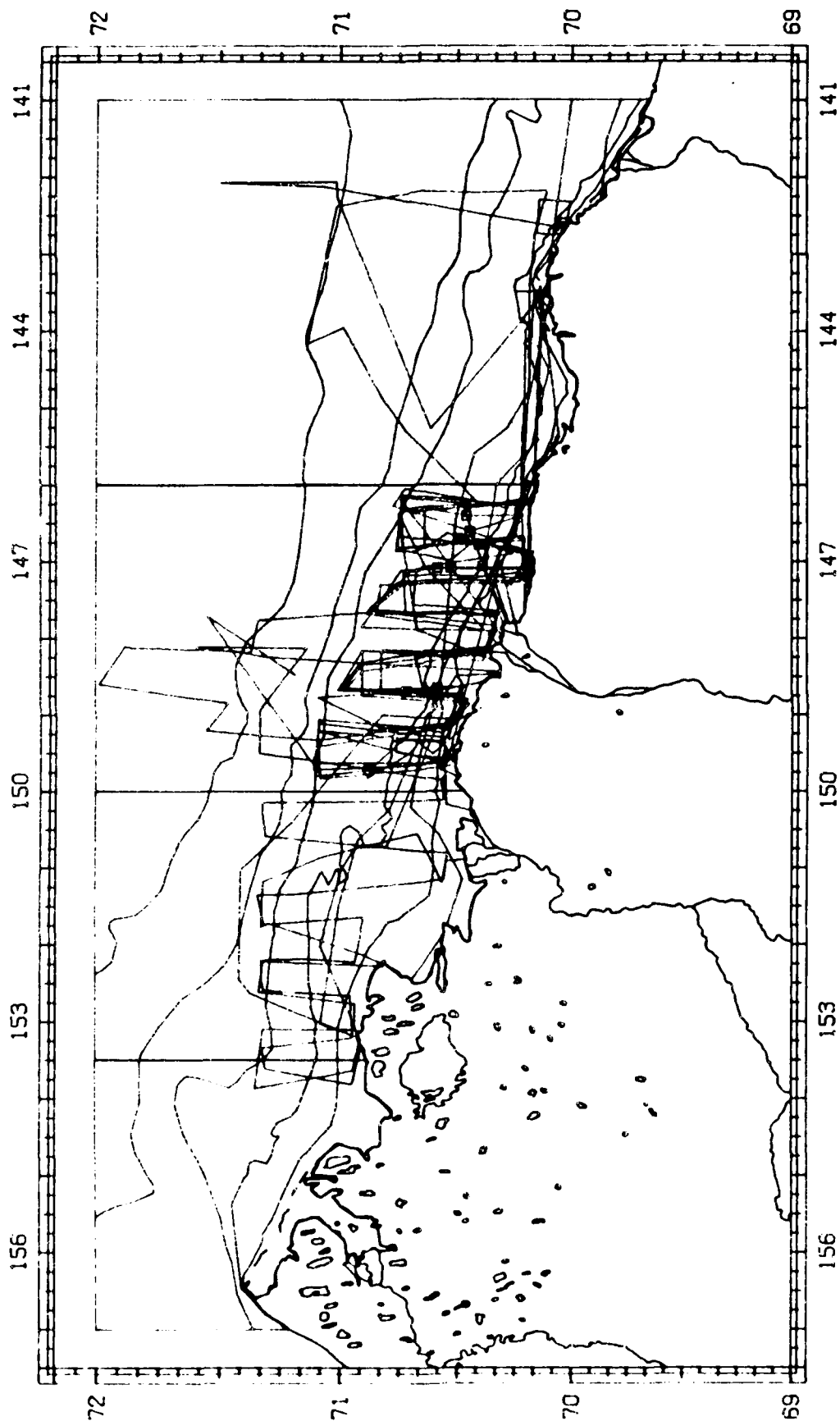


Figure B-60. Plot of aerial survey tracklines flown during 16-30 September 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

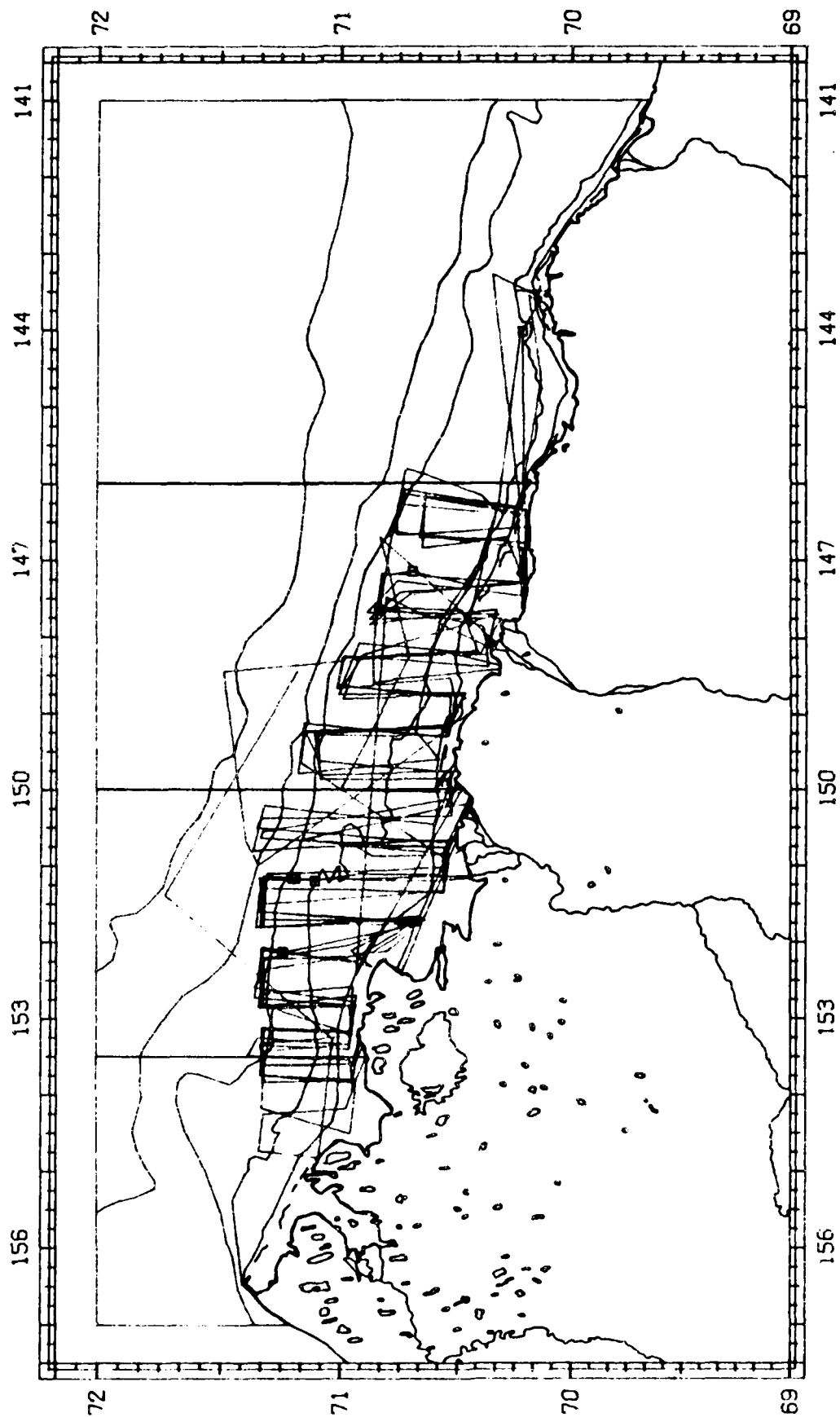


Figure B-47. Plot of aerial survey tracklines flown during 1-15 October 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

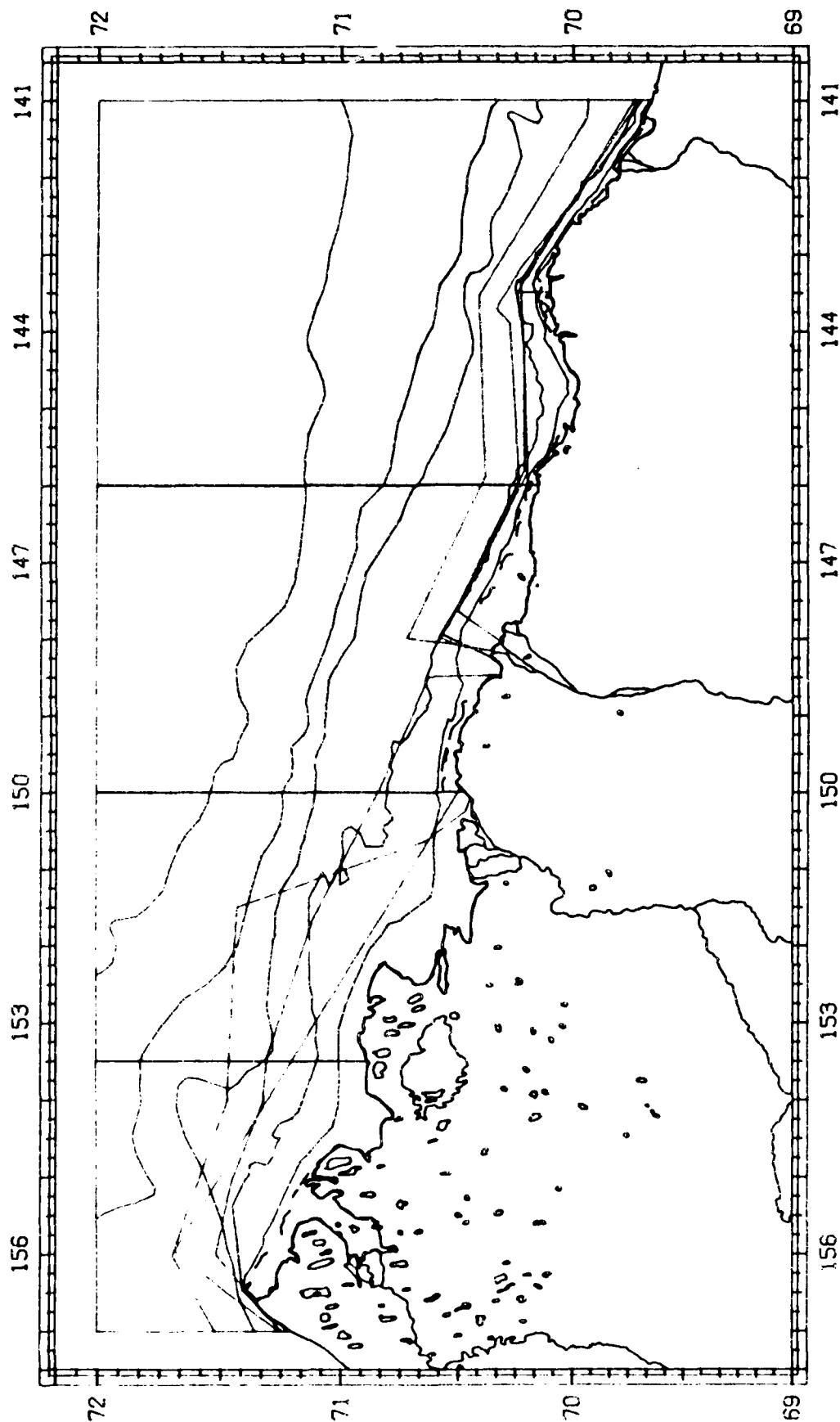


Figure B-48. Plot of aerial survey tracklines flown during 16-31 October 1980 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

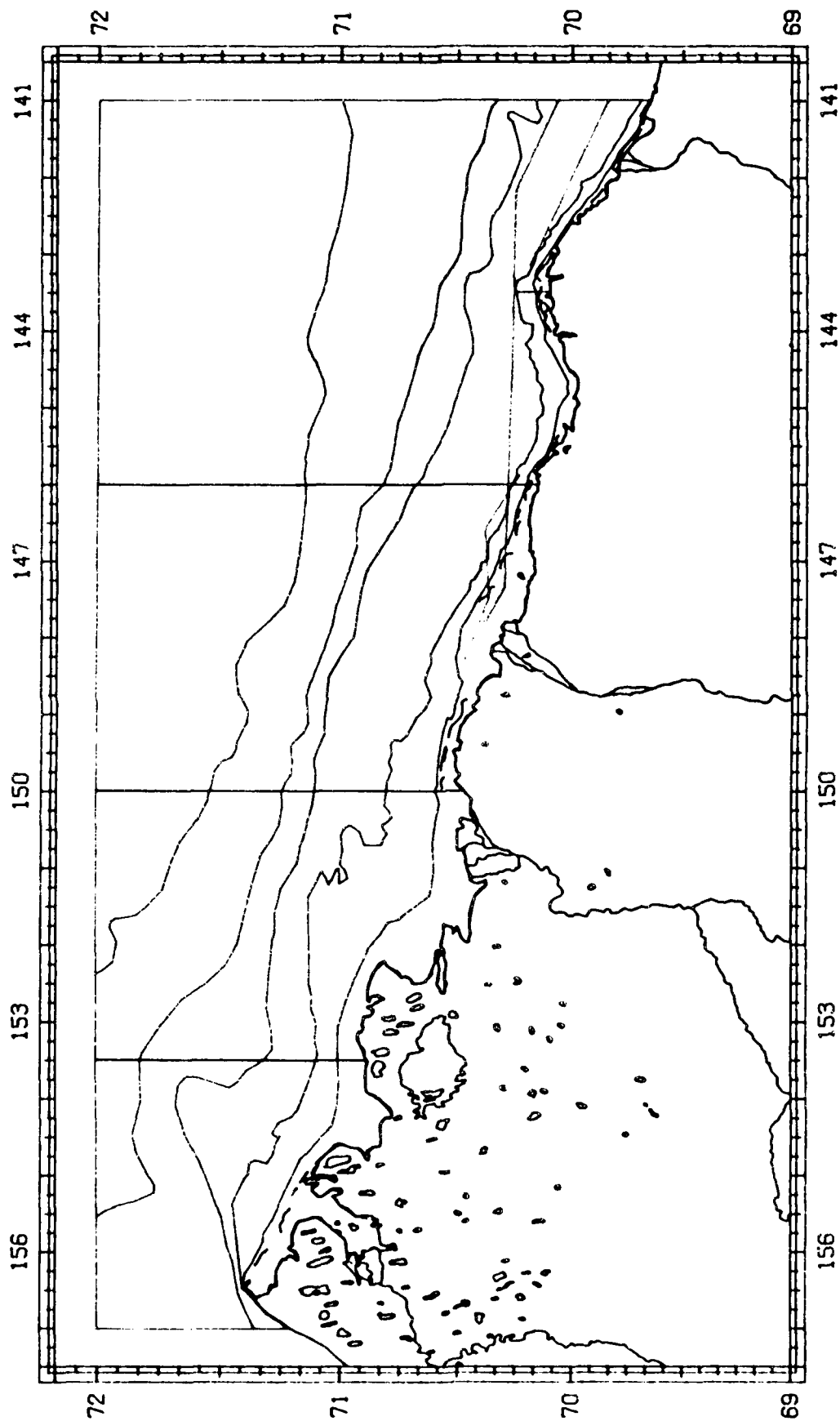


Figure B-49. Plot of aerial survey tracklines flown during 1-15 August 1981 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

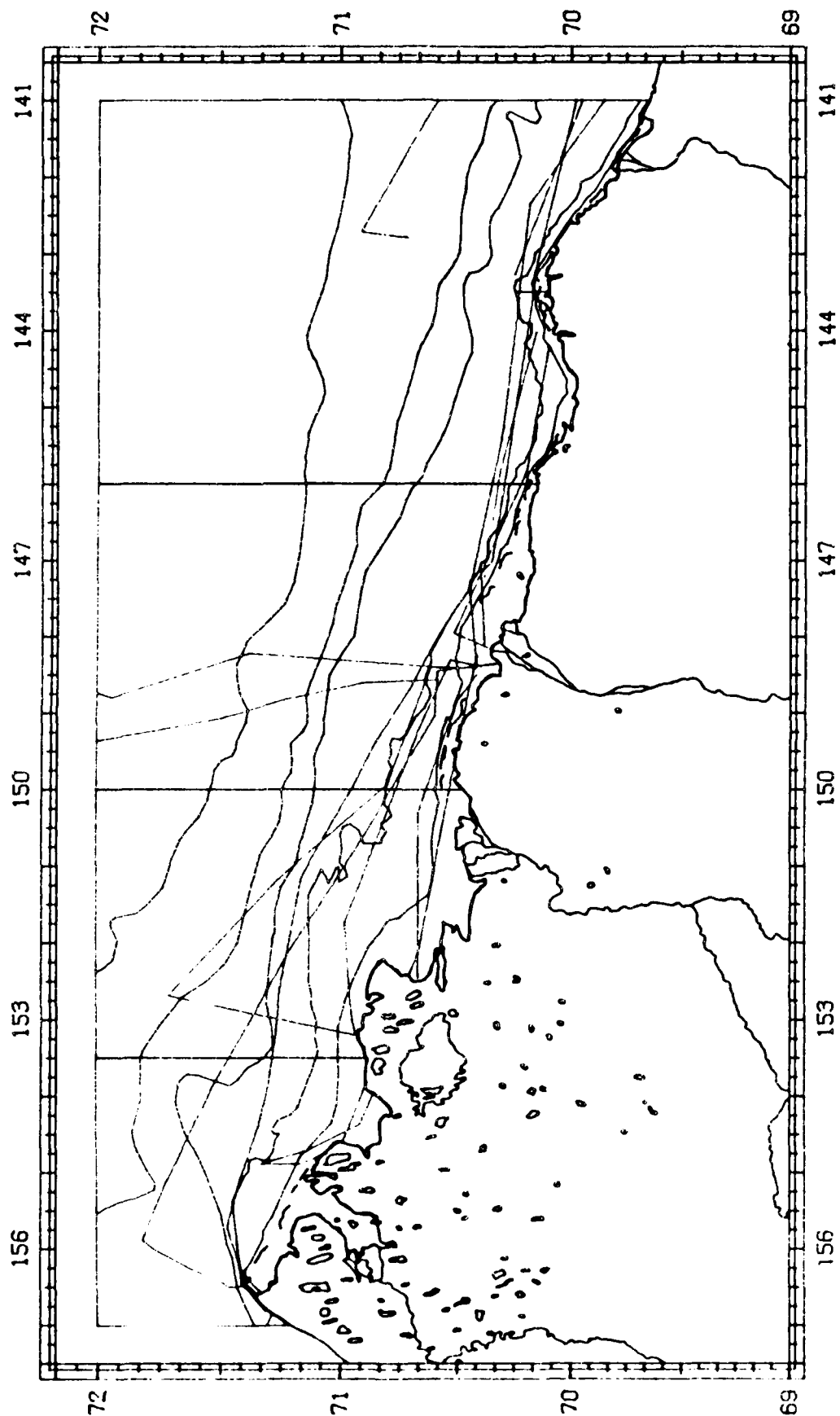


Figure B-90. Plot of aerial survey tracklines flown during 16-31 August 1981 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

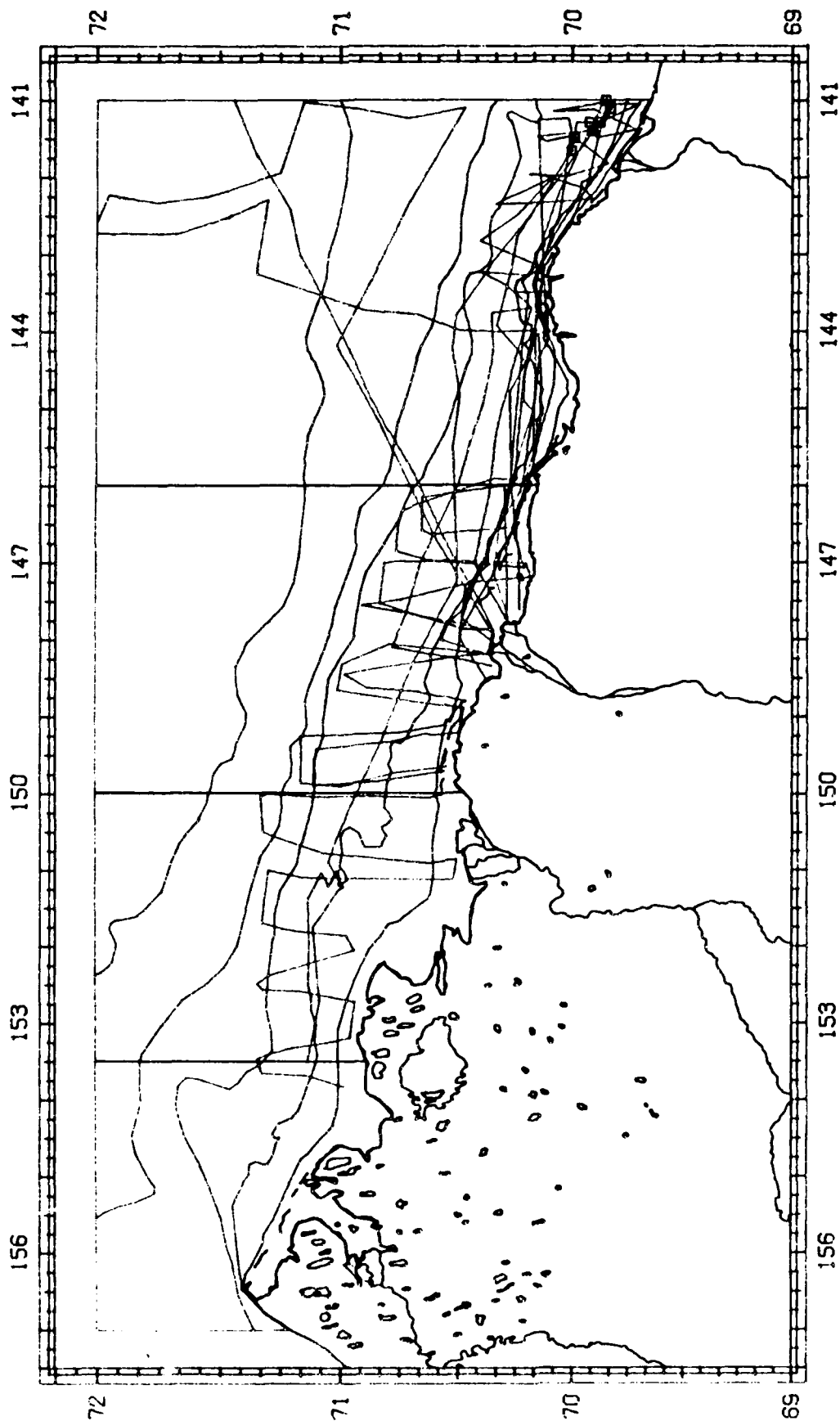


Figure B-51. Plot of aerial survey tracklines flown during 1-15 September 1981 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

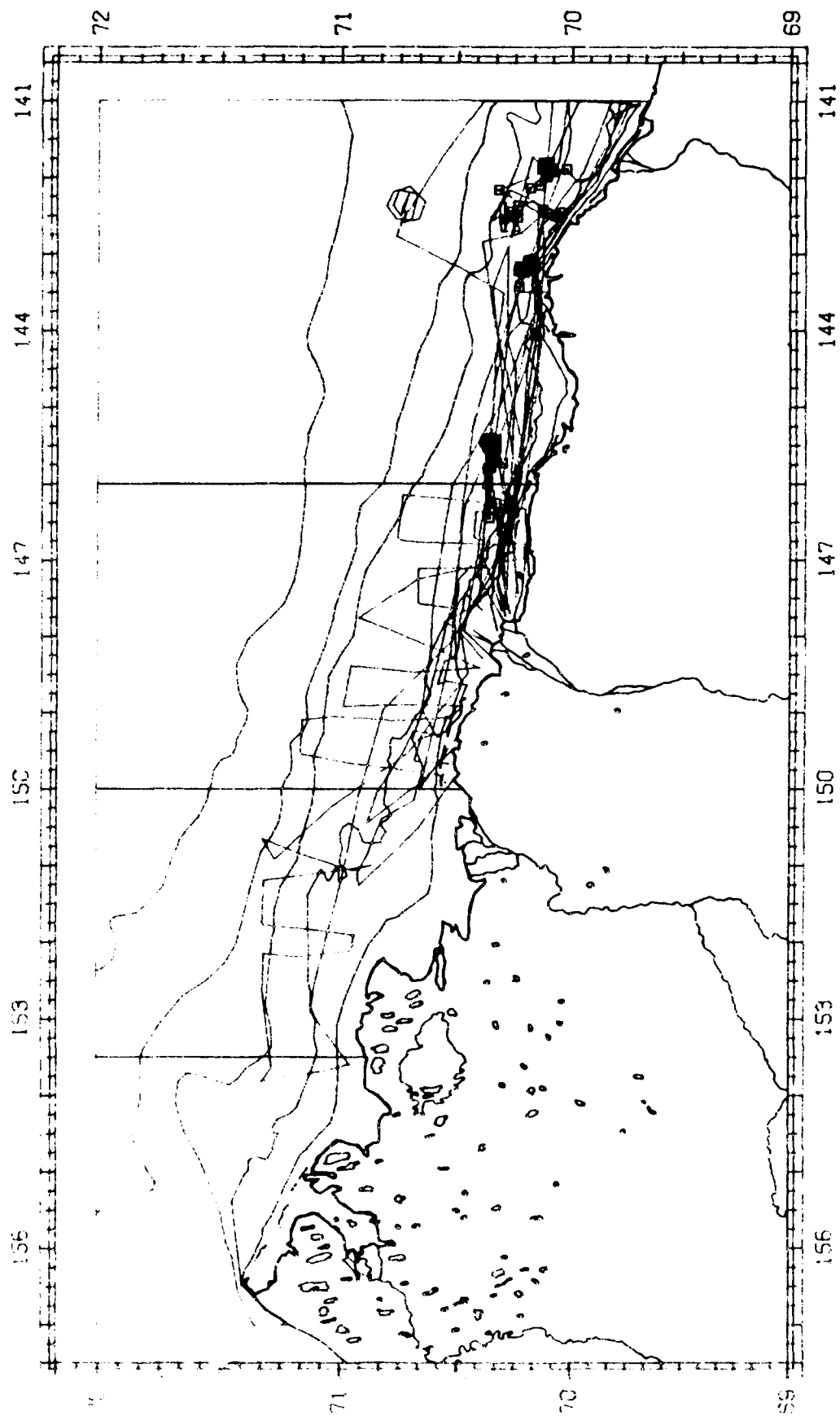


Figure 10-2. Plot of aerial survey tracklines flown during 16-30 September 1981 in the Beaufort Sea. Study area region boundaries are blue, tracklines are red, and black squares represent bowhead whale sightings.

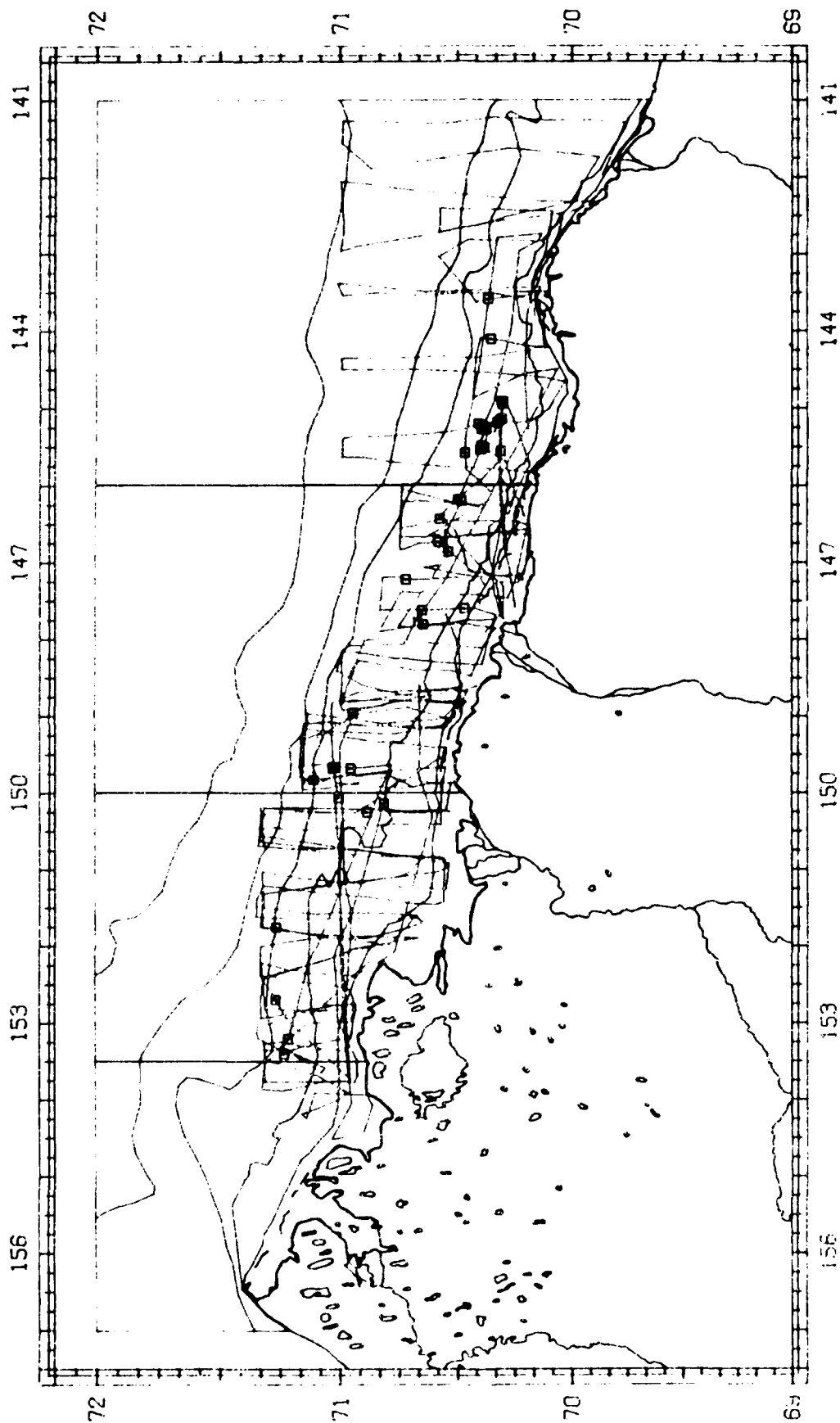


Figure 1-11. Plot of aerial survey tracklines flown during 1-15 October 1981 in the Reaumont Sea. Study area region boundaries are blue, tracklines are red, and black squares represent potential whale sightings.

Table H-9. Statistics from aerial survey of bowhead whales conducted August-October 1979-81 in the Beaufort Sea. Statistics apply to the total Beaufort Sea study area. The total study area was approximately 29,070 nm².

Year	Period	Percent of Area Surveyed	Survey Time HR:MIN	Number of Transects Flown (=n)	Number of Bowheads Observed	Density as Number per nm ²	Variance	Confidence Range of Density
1979	Aug. 1-15	3.74	11:14	5	0	0.0	0.0	0.0 - 0.0
	Aug. 16-31	10.69	33:00	20	7	0.002	0.0	>0.0 - 0.005
	Sep. 1-15	7.23	19:22	14	1	>0.0	>0.0	>0.0 - 0.001
	Sep. 16-30	11.61	31:33	22	4	0.001	>0.0	>0.0 - 0.003
	Oct. 1-15	5.29	23:02	9	77	0.051	>0.0	0.017 - 0.085
1980	Oct. 16-31	18.73	58:36	30	68	0.013	>0.0	>0.0 - 0.026
	Aug. 1-15	3.58	13:15	9	0	0.0	0.0	0.0 - 0.0
	Aug. 16-31	4.65	10:10	7	0	0.0	0.0	0.0 - 0.0
	Sep. 1-15	9.33	26:36	20	6	0.002	>0.0	>0.0 - 0.005
	Sep. 16-30	18.85	50:17	34	7	0.001	>0.0	>0.0 - 0.002
1981	Oct. 1-15	17.95	40:01	21	8	0.002	>0.0	>0.0 - 0.003
	Oct. 16-31	4.28	9:44	9	0	0.0	0.0	0.0 - 0.0
	Aug. 1-15	0.85	1:36	3	0	0.0	0.0	0.0 - 0.0
	Aug. 16-31	5.82	12:14	19	0	0.0	0.0	0.0 - 0.0
	Sep. 1-15	11.46	23:04	53	13	0.004	>0.0	>0.0 - 0.056
	Sep. 16-30	13.77	34:37	46	145	0.037	>0.0	0.018 - 0.056
	Oct. 1-15	17.70	41:37	160	46	0.009	>0.0	0.006 - 0.012
	Oct. 16-31	0.00						

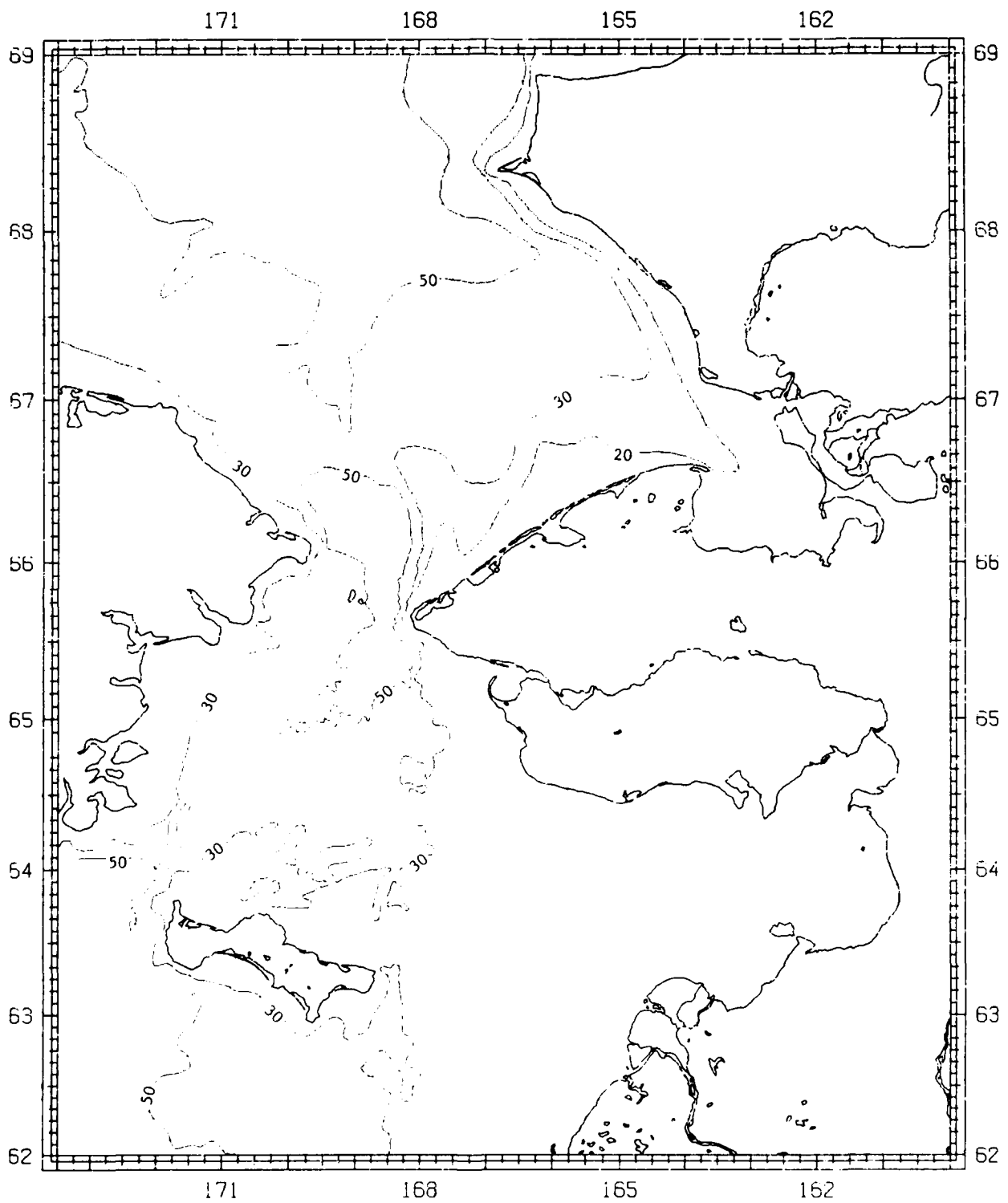


Figure B-54. Bering and Chukchi Seas depth contour lines in meters.

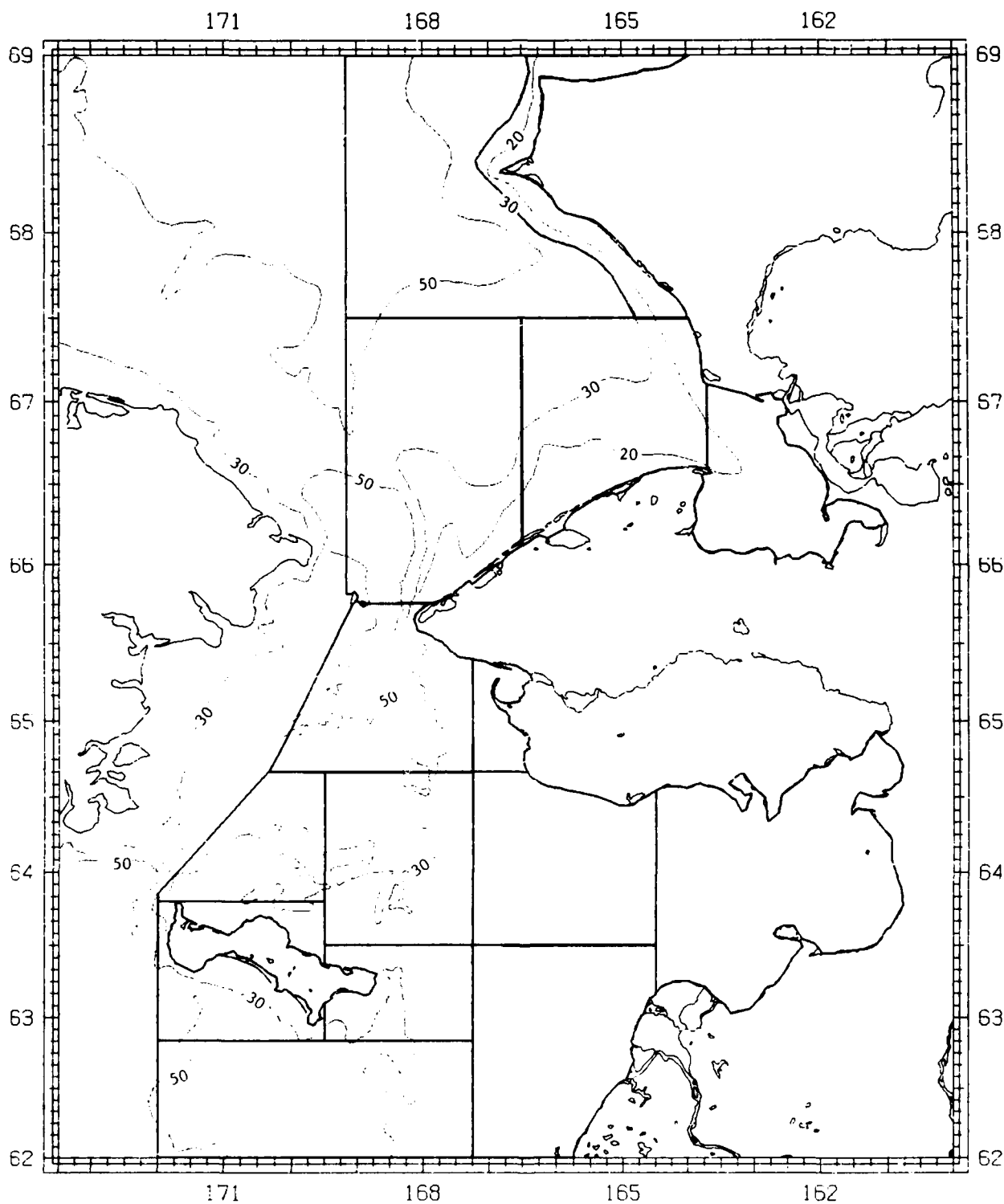


Figure B-55. Map depicting survey areas in relation to depth contours in the Bering and Chukchi Seas.

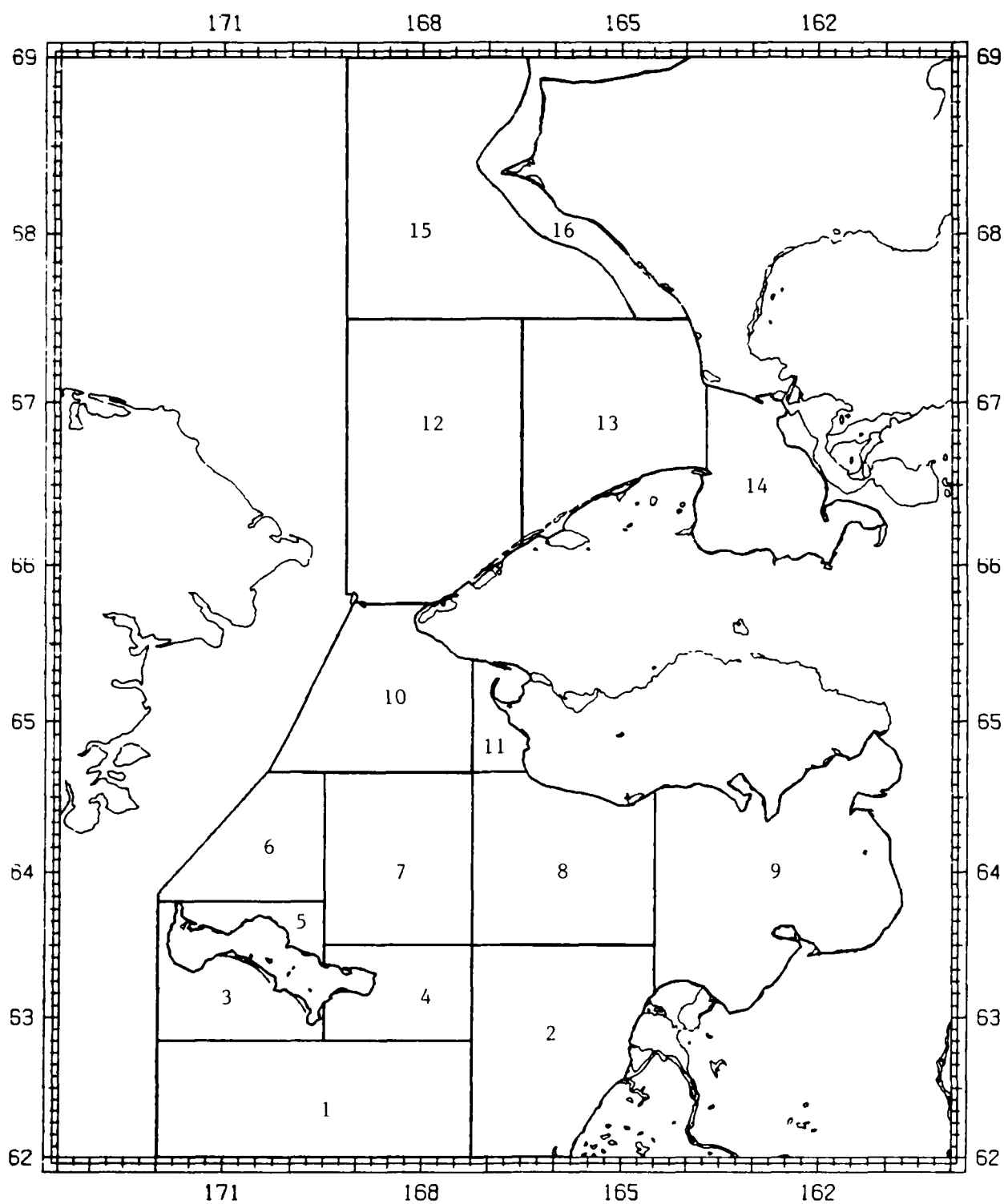


Figure B-56. The Bering and Chukchi Seas were divided into 17 regions. Region 17 is depicted in Figure B-57.

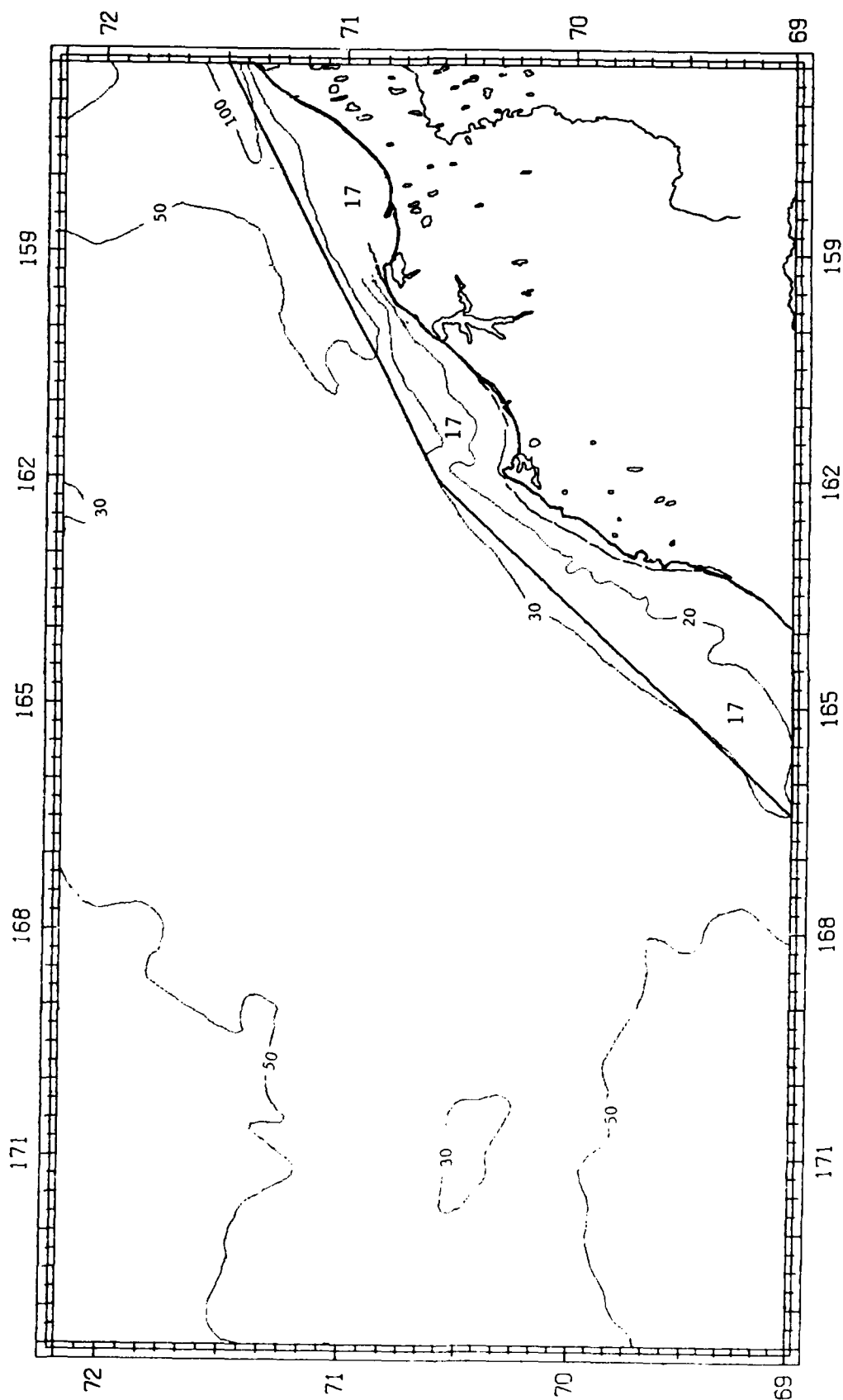


Figure B-57. Map depicting the survey area 17 in relation to depth contours in the Chukchi Sea.

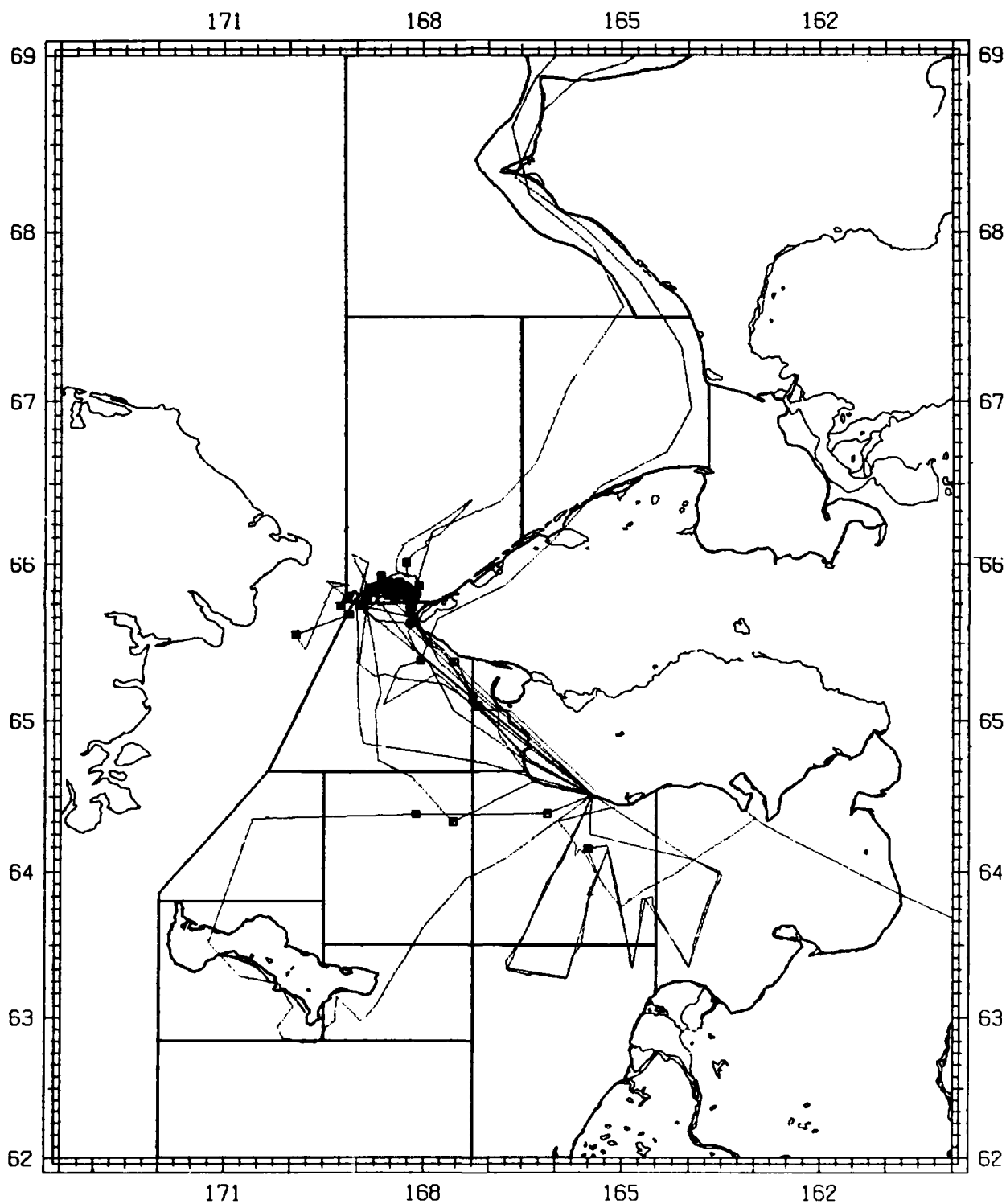


Figure B-58. Plot of aerial survey tracklines flown during April-May 1980 in the Bering and Chukchi Seas, regions 1-16. Squares represent bowhead whale sightings.

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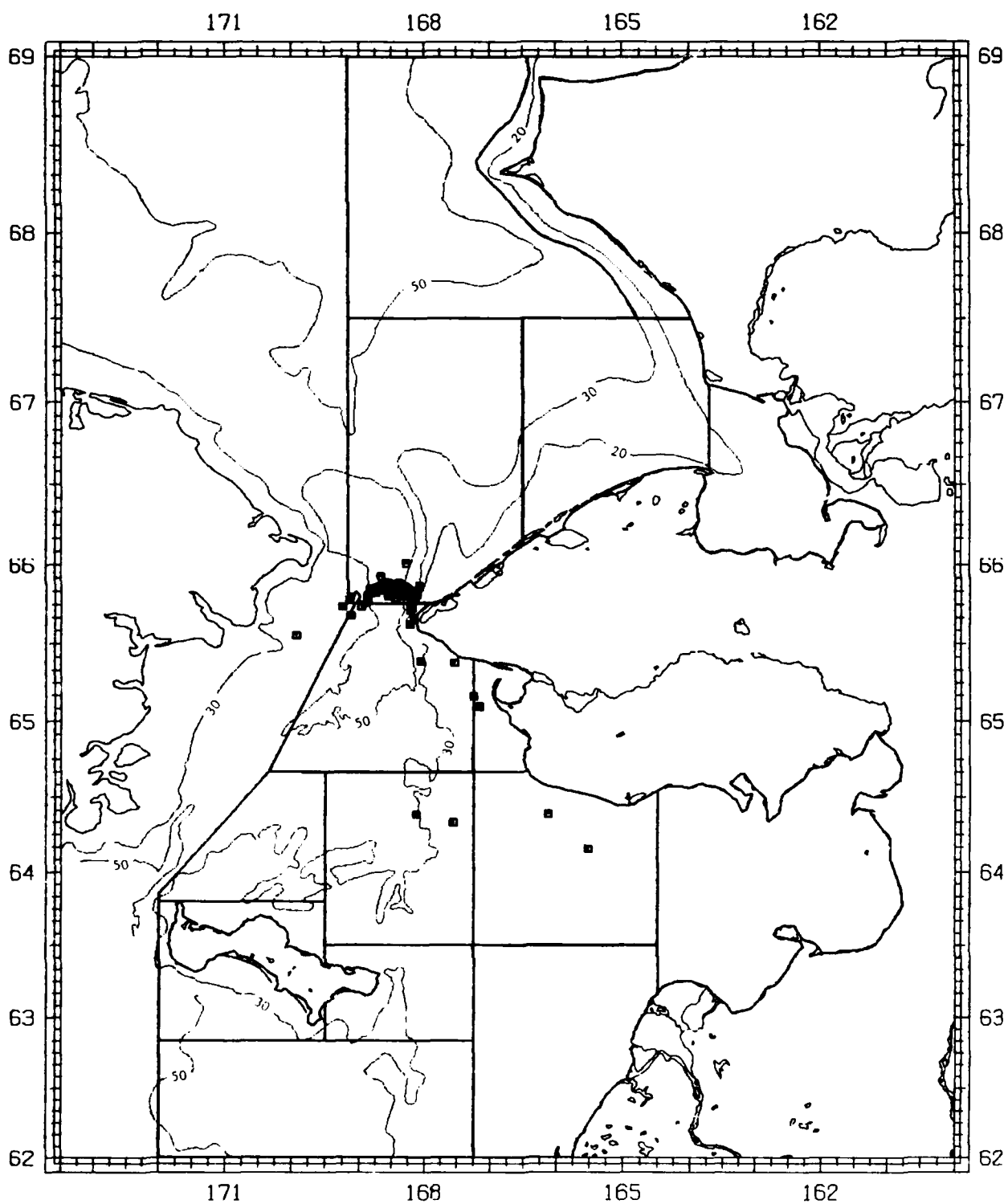


Figure B-59. Plot of bowhead whale sightings made during the April-May 1980 aerial survey of the Bering and Chukchi Seas, regions 1-16.

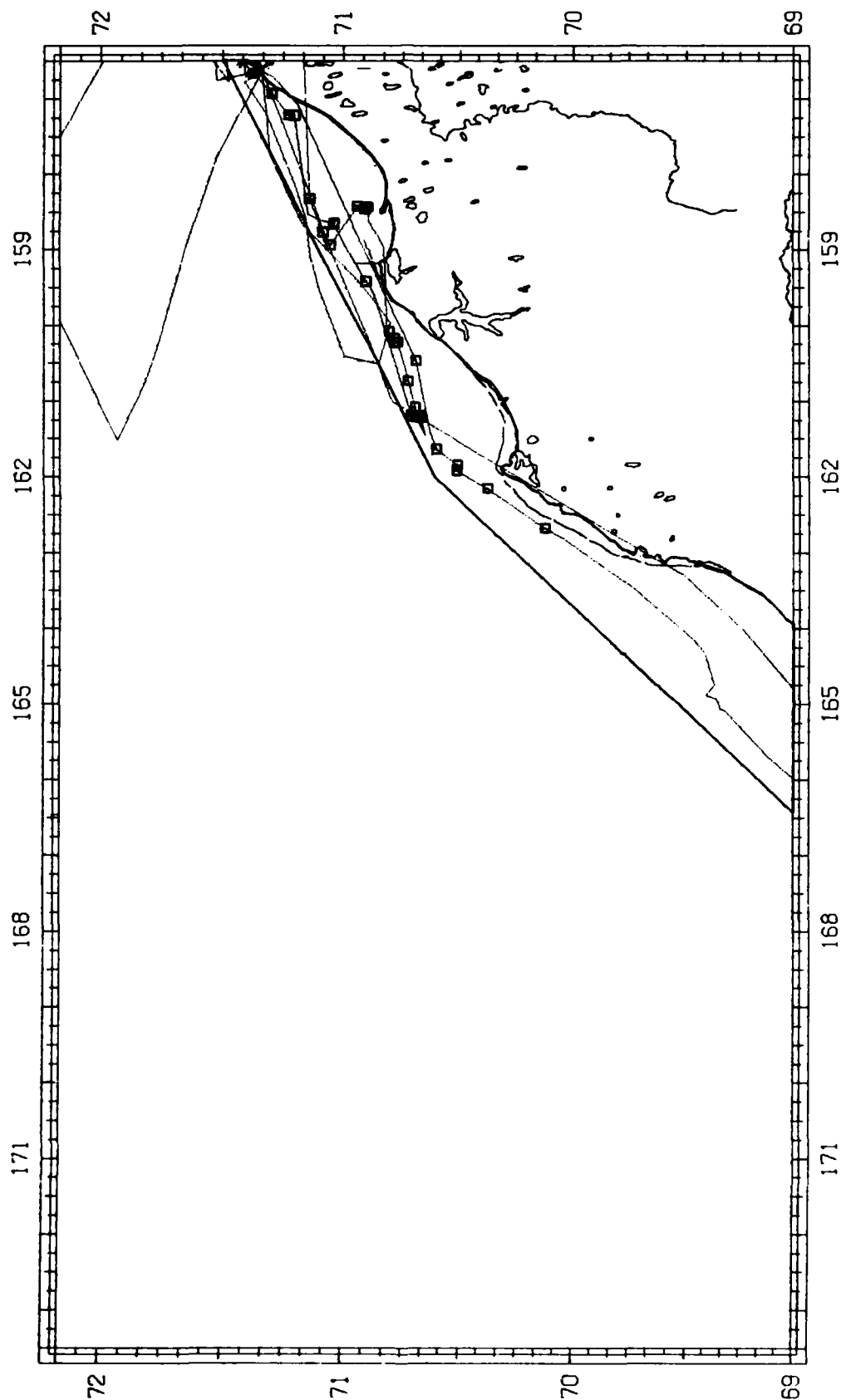


Figure B-60. Plot of aerial survey tracklines flown during April-May 1980 in the Chukchi Sea, region 17. Squares represent bowhead whale sightings.

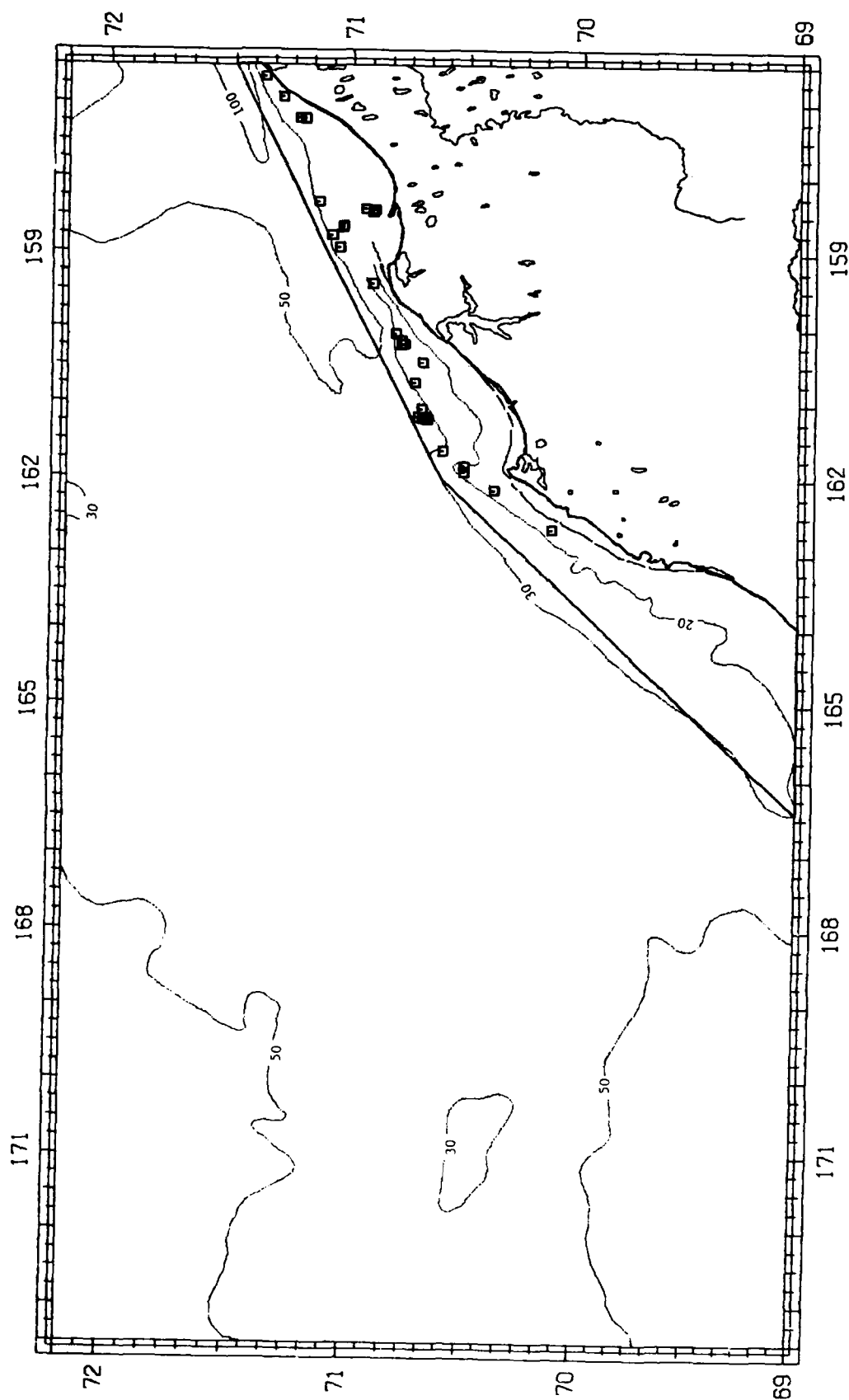


Figure B-61. Plot of bowhead whale sightings made during the April-May 1980 aerial survey of the Chukchi Sea, region 17.

Table B-10. Statistics from aerial survey of bowhead whales conducted April-May 1980 in the Bering and Chukchi Seas. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-56. The total study area was approximately 64,871 nmi². Total time spent surveying was approximately 34 hours and 34 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (=n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
1	6,542	10.08	0.16	0:03	0.14	1	0	0.0	0.0	0.0 - 0.0
2	5,550	8.56	2.68	1:10	3.38	4	0	0.0	0.0	0.0 - 0.0
3	2,011	3.10	2.97	0:21	1.01	3	0	0.0	0.0	0.0 - 0.0
4	2,211	3.41	3.12	0:33	1.59	1	0	0.0	0.0	0.0 - 0.0
5	724	1.12	1.64	0:01	0.05	1	0	0.0	0.0	0.0 - 0.0
6	2,313	3.56	2.73	0:35	1.69	1	0	0.0	0.0	0.0 - 0.0
7	4,088	6.30	3.27	0:34	1.64	3	4	0.030	>0.0	>0.0 - 0.092
8	4,566	7.04	14.78	5:29	15.86	15	2	0.003	>0.0	>0.0 - 0.006
9	7,262	11.19	4.31	1:56	5.59	3	0	0.0	0.0	0.0 - 0.0
10	3,676	5.67	20.24	5:31	15.96	23	11	0.015	>0.0	>0.0 - 0.042
11	767	1.18	35.84	1:43	4.97	13	2	0.007	>0.0	>0.0 - 0.020
12	6,185	9.53	7.57	7:26	21.50	11	312	0.666	0.036	0.244 - 1.089
13	4,140	6.38	3.74	0:52	2.51	3	0	0.0	0.0	0.0 - 0.0
14	2,469	3.81	0.00							
15	5,767	8.89	0.35	0:02	0.10	1	0	0.0	0.0	0.0 - 0.0
16	1,504	2.32	12.78	1:10	3.38	5	0	0.0	0.0	0.0 - 0.0
17	5,096	7.86	16.01	7:08	20.64	16	49	0.060	>0.0	0.019 - 0.102

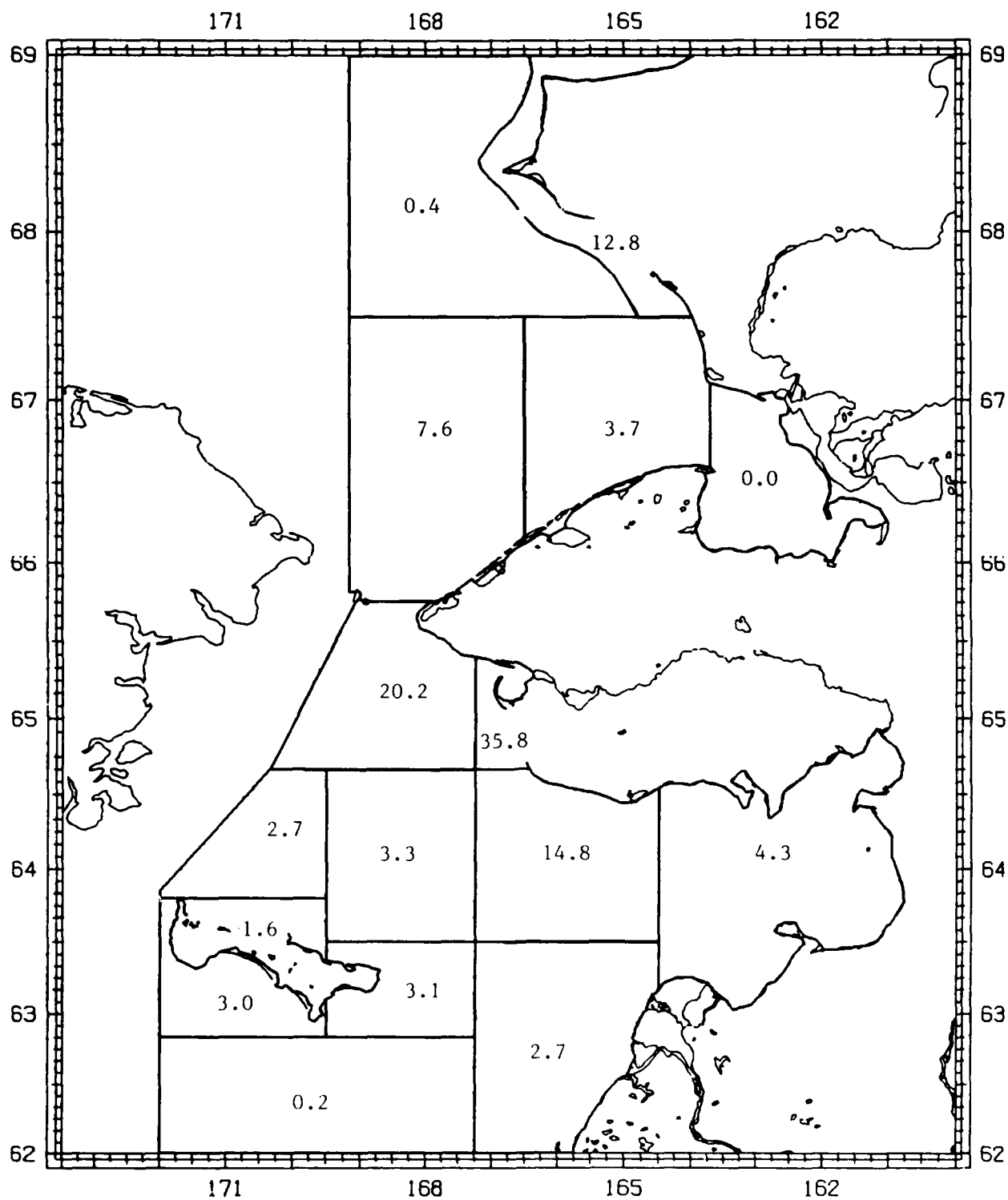


Figure B-62. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Data are based on the April-May 1980 Bering and Chukchi Seas aerial surveys. Percent coverage of Chukchi Sea region 17, not shown, was 16.0.

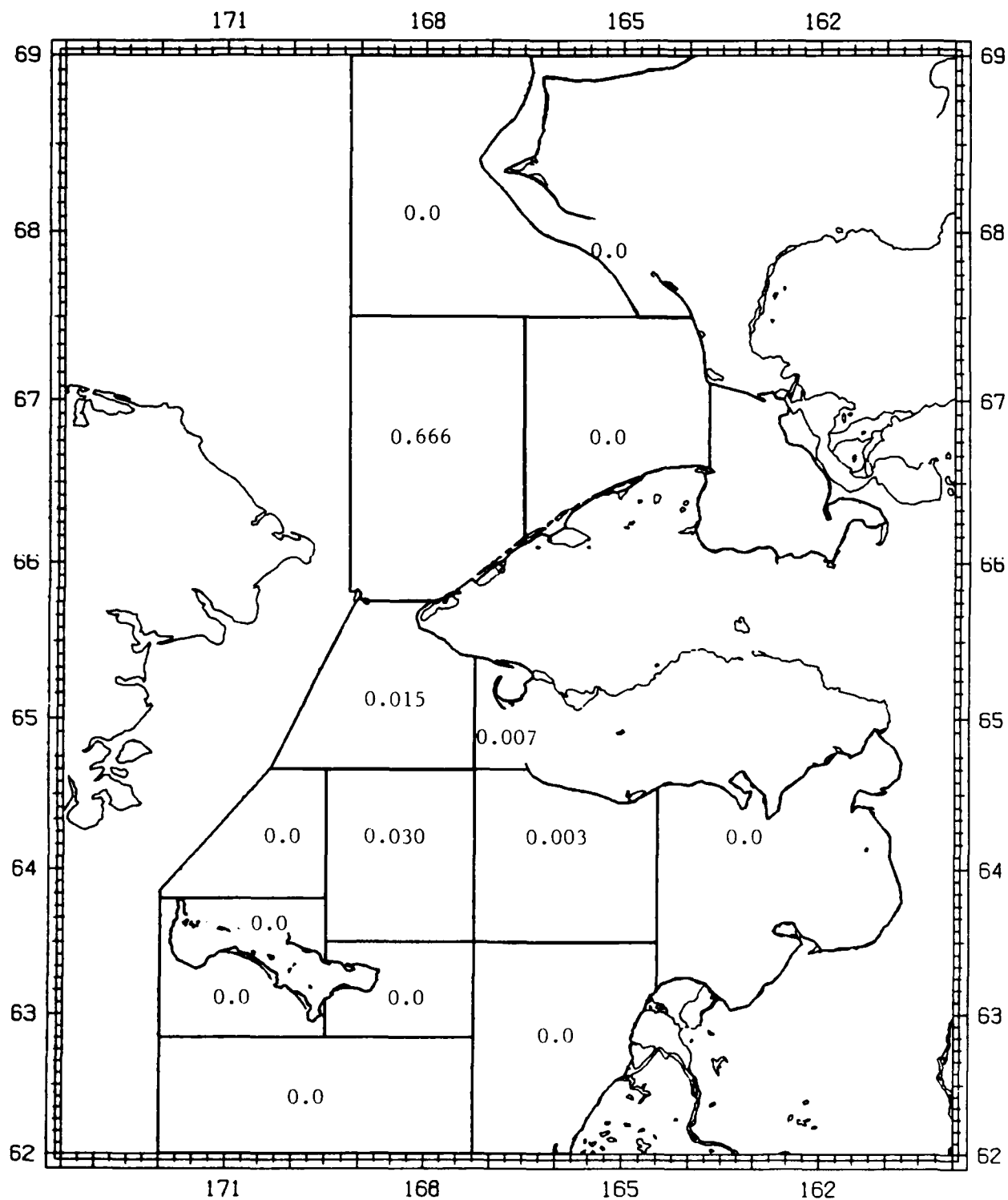


Figure B-63. Values shown are observed densities of bowhead whales as determined from aerial survey flown in the Bering and Chukchi Seas during April-May 1980. Observed density in Chukchi Sea region 17, not shown, was 0.043.

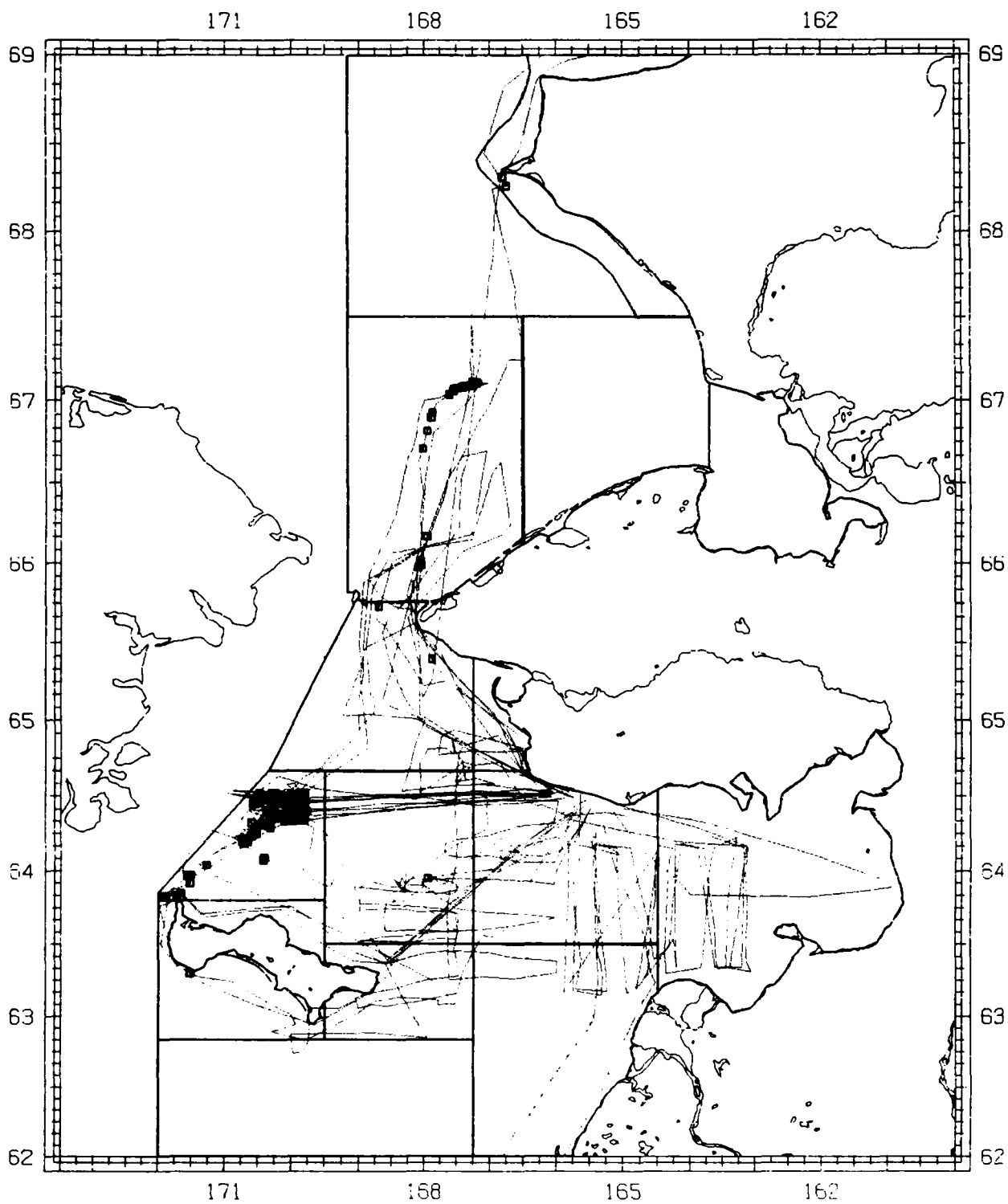


Figure B-64. Plot of aerial survey tracklines flown during April-May 1981 in the Bering and Chukchi Seas, regions 1-16. Squares represent bowhead whale sightings.

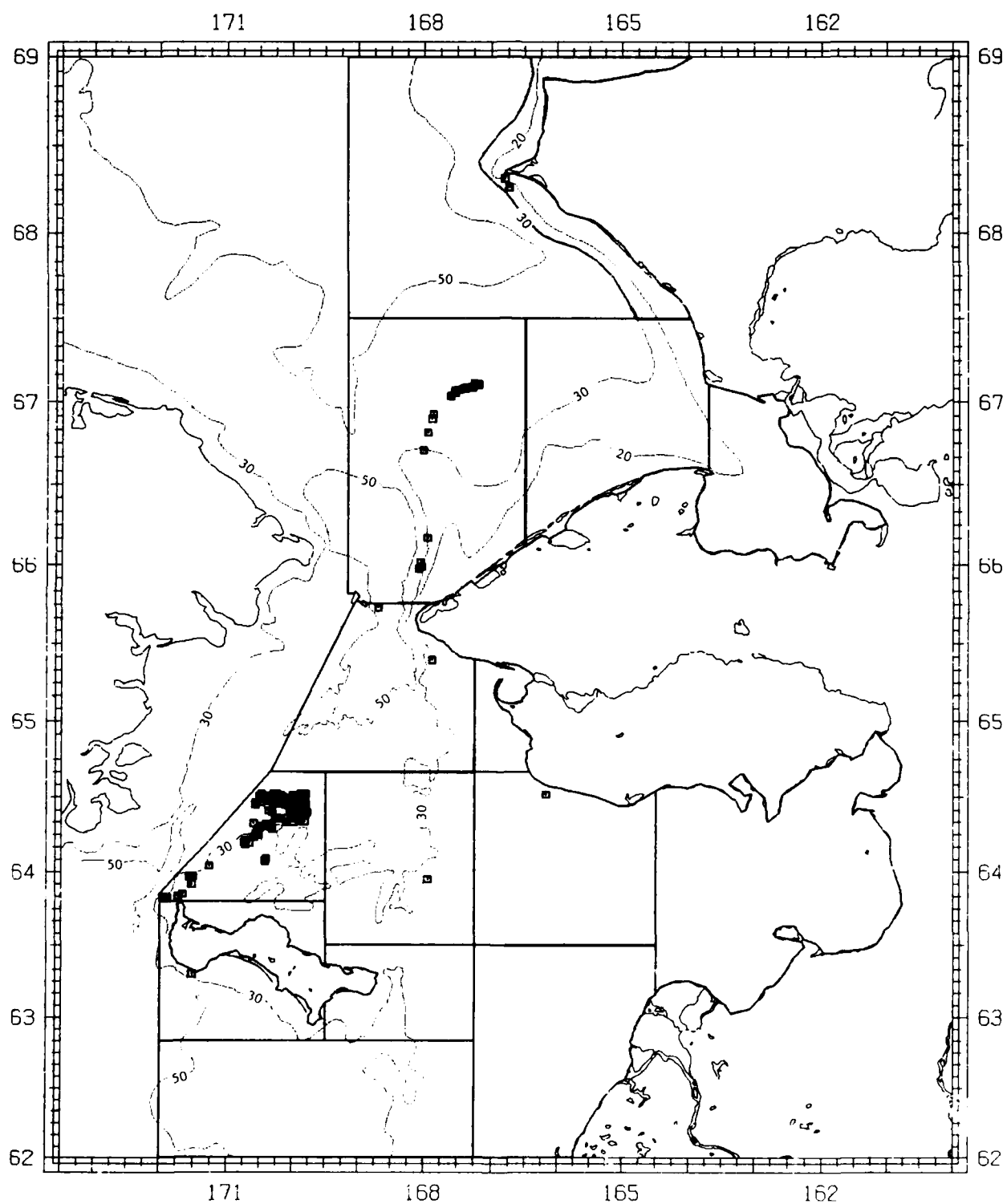


Figure B-65. Plot of bowhead whale sightings made during the April-May 1981 aerial survey of the Bering and Chukchi Seas, regions 1-16.

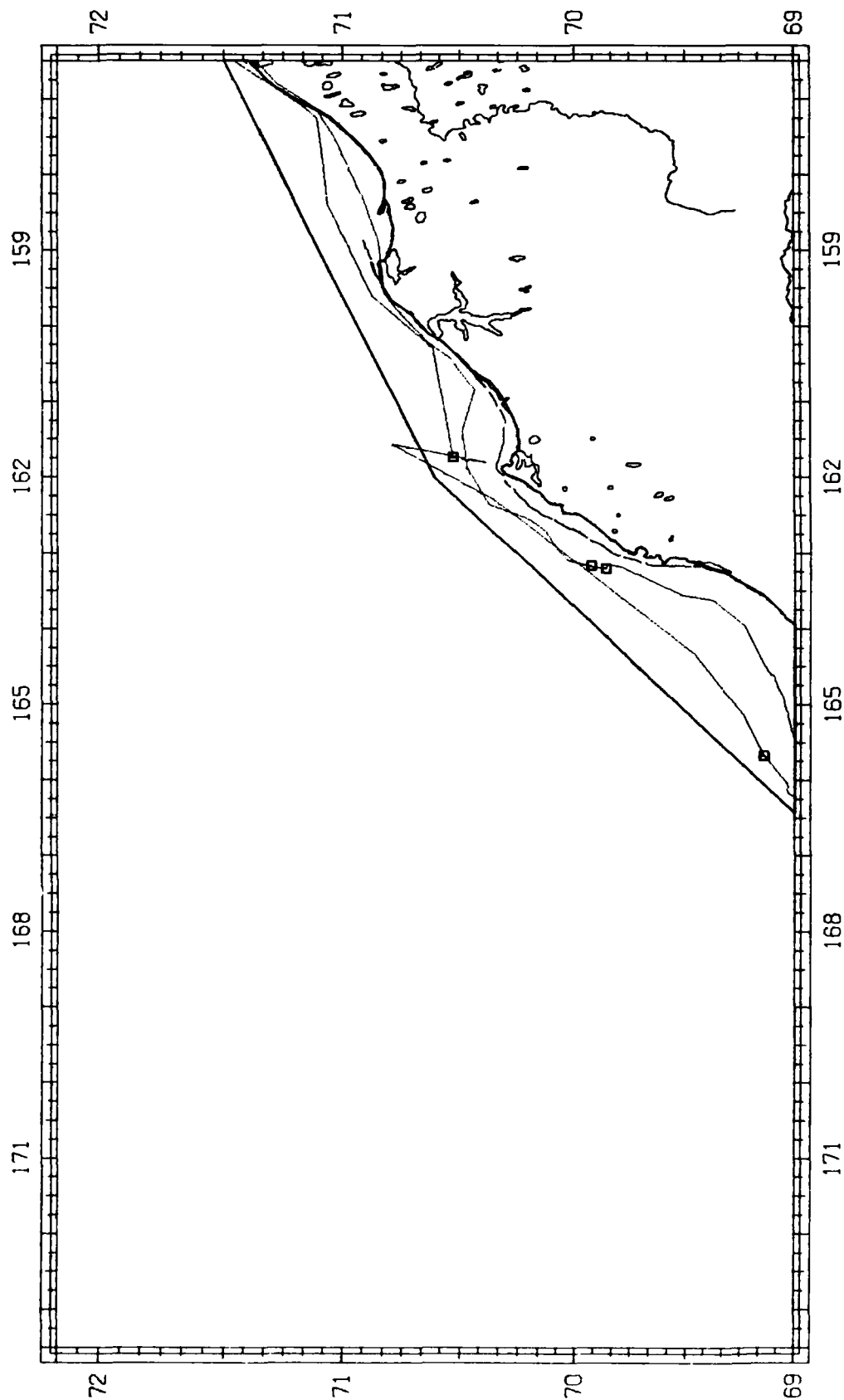


Figure B-66. Plot of aerial survey tracklines flown during April-May 1981 in the Chukchi Sea, region 17. Squares represent bowhead whale sightings.

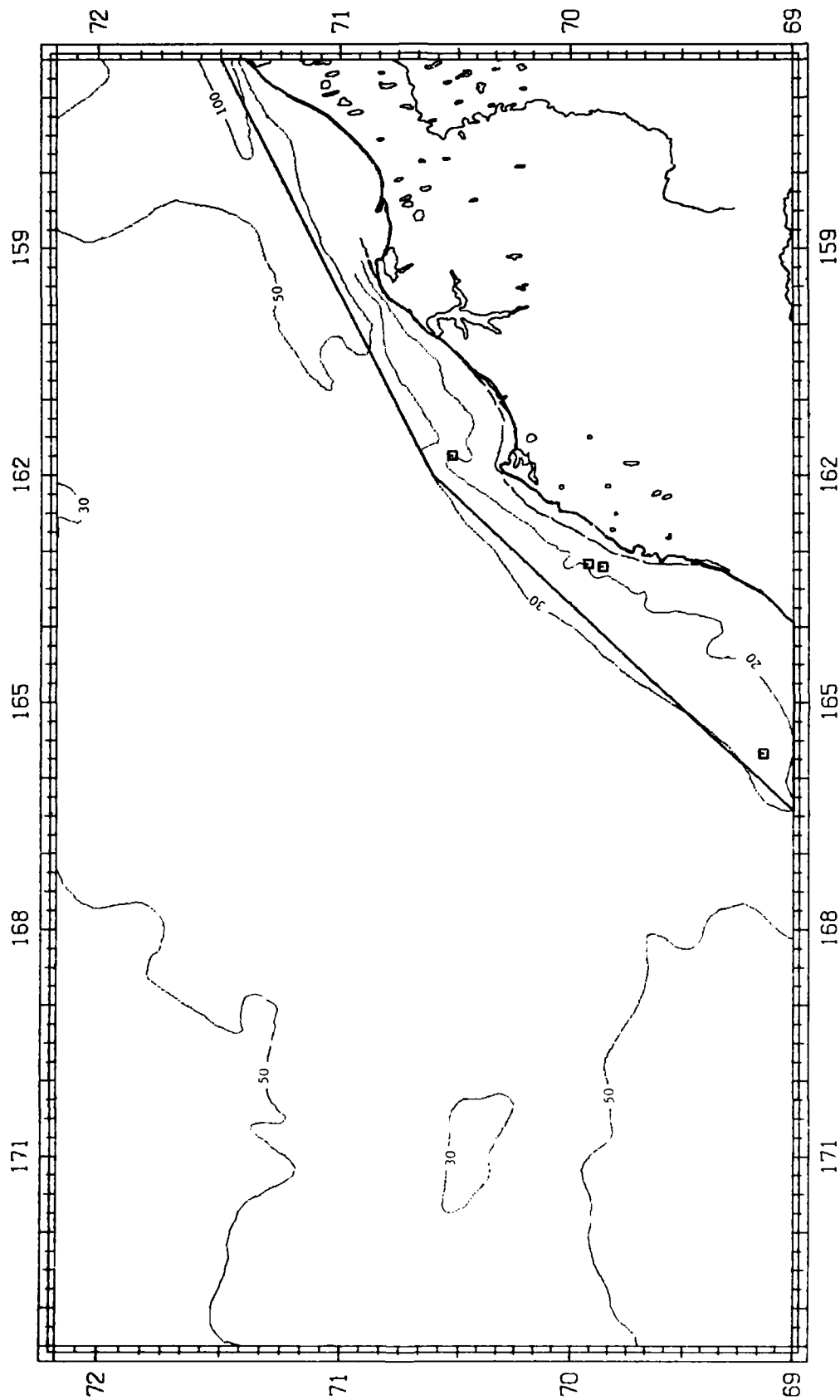


Figure B-67. Plot of bowhead whale sightings made during the April-May 1981 aerial survey of the Chukchi Sea, region 17.

Table B-11. Statistics from aerial survey of bowhead whales conducted April-May 1981 in the Bering and Chukchi Seas. Values for each region are summed where appropriate. Region numbers refer to areas depicted in Figure B-56. The total study area was approximately 64,871 nmi². Total time spent surveying was approximately 81 hours and 1 minute.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (=n)	Number of Bowheads Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
1	6,542	10.08	0.26	0:08	0.17	2	0	0.0	0.0	0.0 - 0.0
2	5,550	8.56	9.18	3:36	4.44	15	0	0.0	0.0	0.0 - 0.0
3	2,011	3.10	11.83	1:53	2.32	8	0	0.0	0.0	0.0 - 0.0
4	2,211	3.41	25.45	4:02	4.98	19	0	0.0	0.0	0.0 - 0.0
5	724	1.12	20.68	0:56	1.15	4	0	0.0	0.0	0.0 - 0.0
6	2,313	3.56	49.56	15:08	18.68	14	828	0.722	0.022	0.404 - 1.041
7	4,088	6.30	38.68	12:17	15.16	40	0	0.0	0.0	0.0 - 0.0
8	4,566	7.04	42.19	14:02	17.32	55	0	0.0	0.0	0.0 - 0.0
9	7,262	11.19	12.28	5:52	7.24	20	0	0.0	0.0	0.0 - 0.0
10	3,676	5.67	25.77	6:35	8.13	25	2	0.002	>0.0	>0.0 - 0.006
11	767	1.18	39.38	2:07	2.61	13	0	0.0	0.0	0.0 - 0.0
12	6,185	9.53	17.33	9:13	11.38	10	28	0.026	>0.0	>0.0 - 0.061
13	4,140	6.38	0.10	0:01	0.02	1	0	0.0	0.0	0.0 - 0.0
14	2,469	3.81	0.00	0:53	1.09	4	0	0.0	0.0	0.0 - 0.0
15	5,767	8.89	2.22	0:33	.58	4	5	0.063	0.007	>0.0 - 0.322
16	1,504	2.32	5.31	3:45	4.63	6	18	0.035	>0.0	0.016 - 0.054
17	5,096	7.86	10.18							

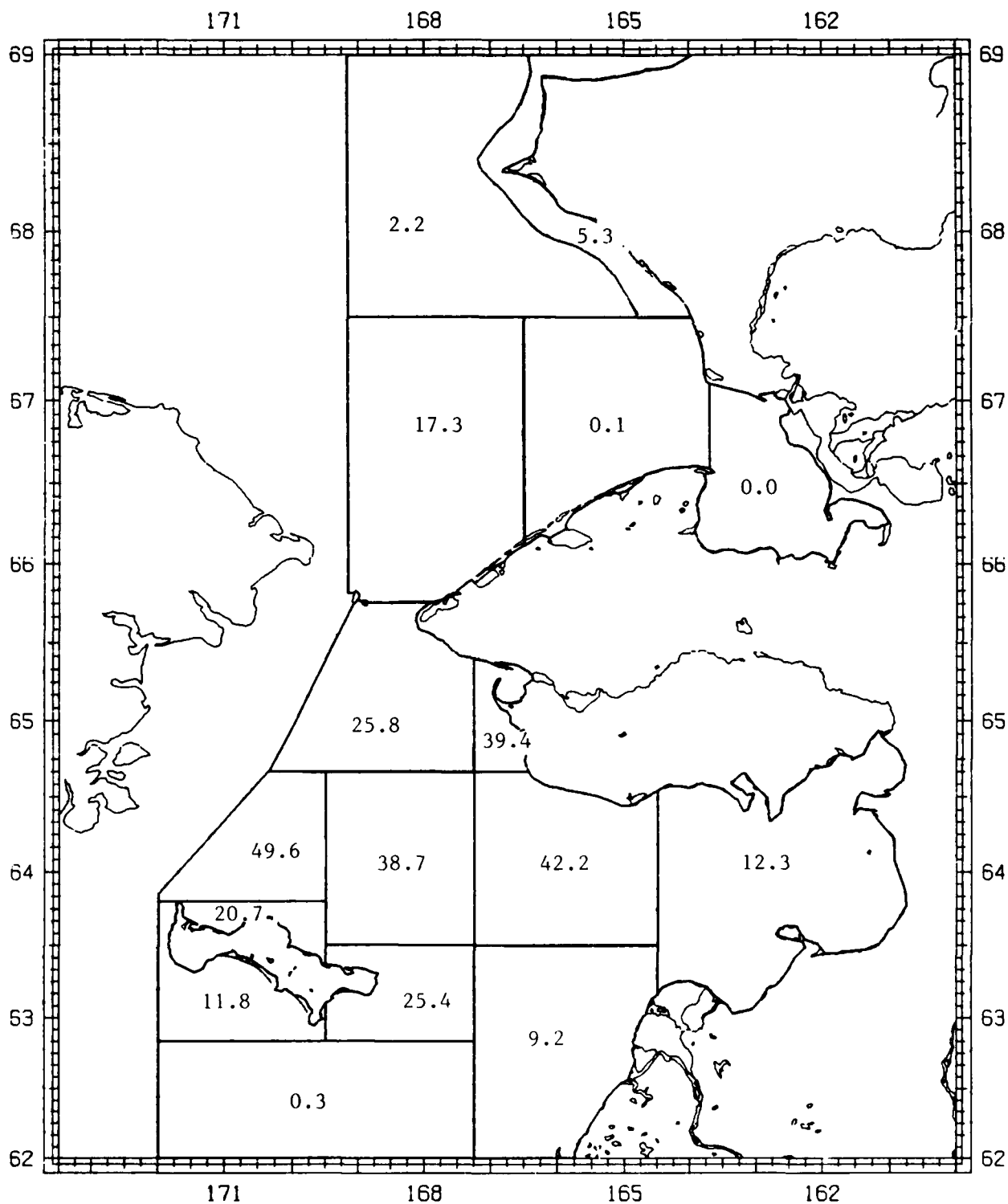


Figure B-68. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Data are based on the April-May 1981 Bering and Chukchi Seas aerial surveys. Percent coverage of Chukchi Sea region 17, not shown, was 10.2.

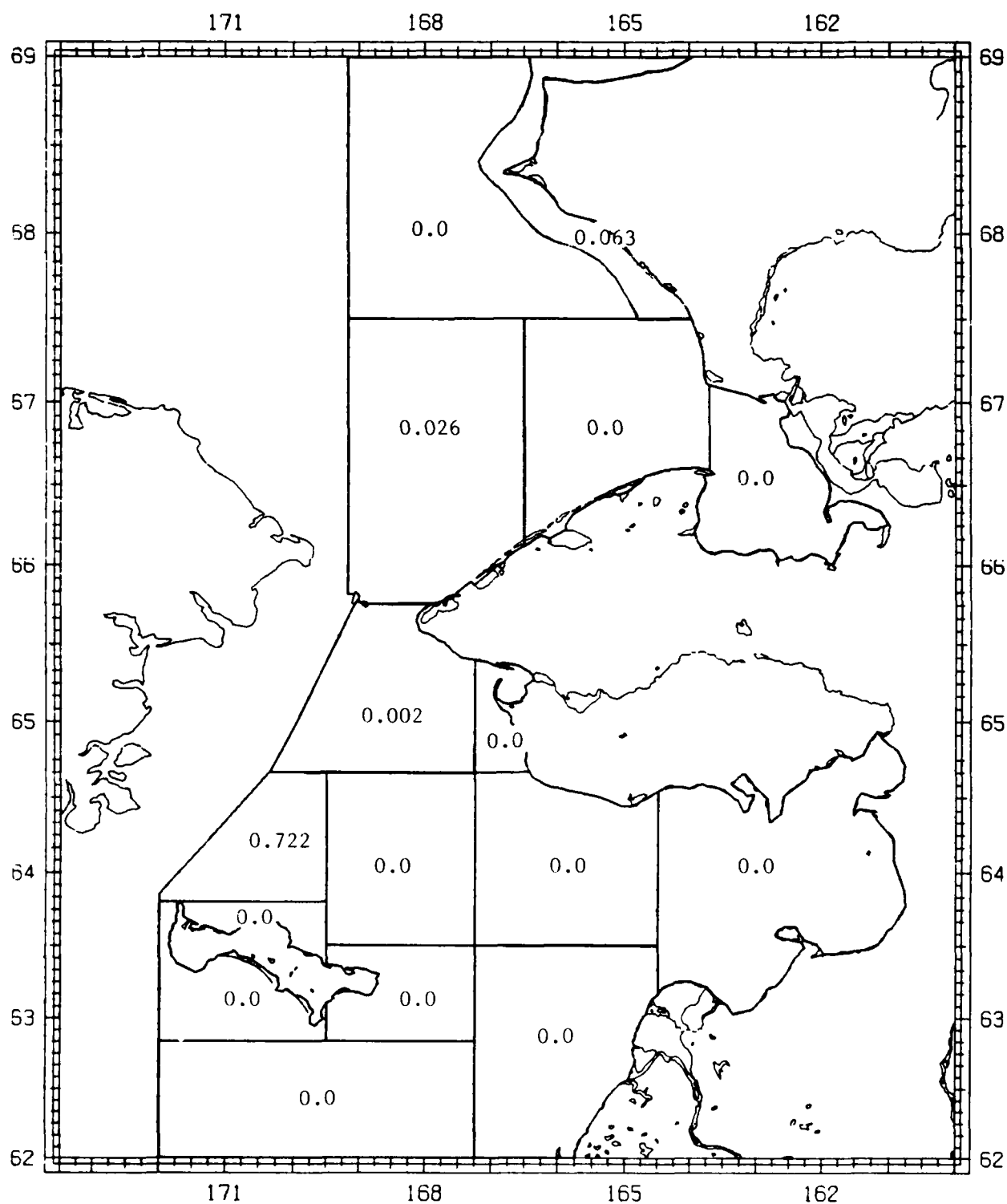


Figure B-69. Values shown are observed densities of bowhead whales as determined from aerial survey flown in the Bering and Chukchi Seas during April-May 1981. Observed density in Chukchi Sea region 17, not shown, was 0.035.

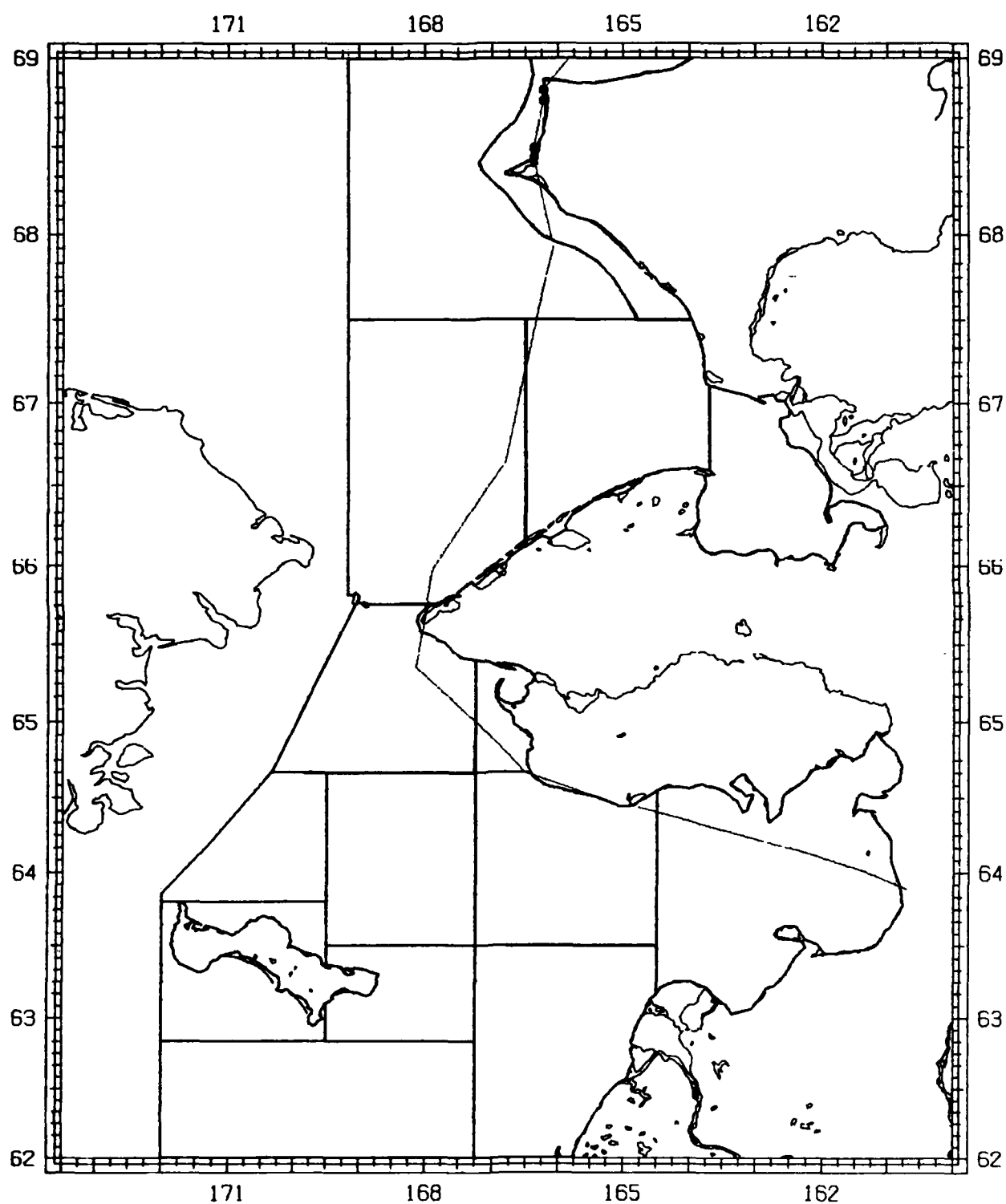


Figure B-70. Plot of aerial survey tracklines flown during June-August 1980 in the Bering and Chukchi Seas, regions 1-16. Circles represent gray whale sightings.

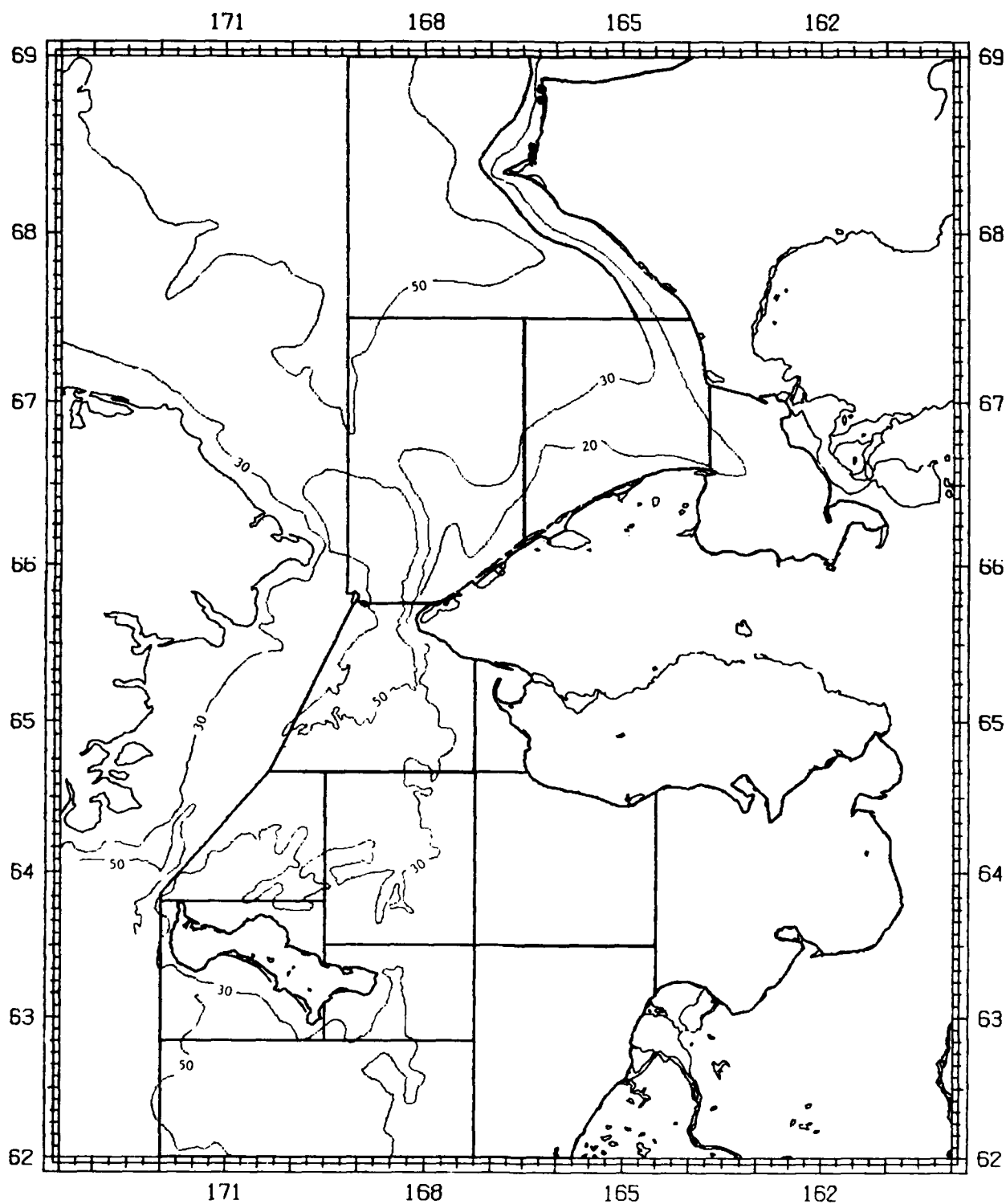


Figure B-71. Plot of gray whale sightings (circles) made during the June-August 1980 aerial survey of the Bering and Chukchi Seas, regions 1-16.

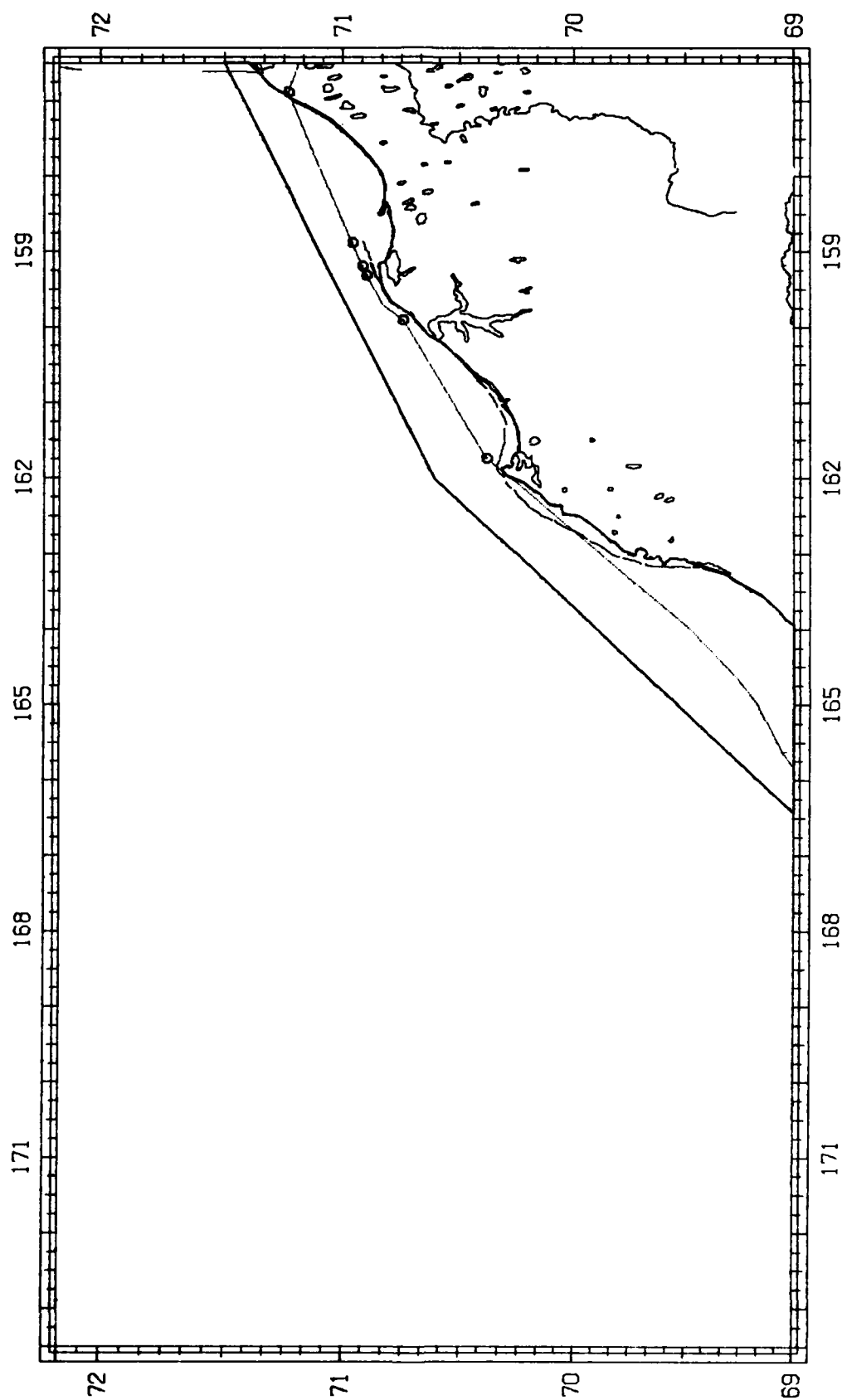


Figure B-72. Plot of aerial survey tracklines flown during June-August 1980 in the Chukchi Sea, region 17. Circles represent gray whale sightings.

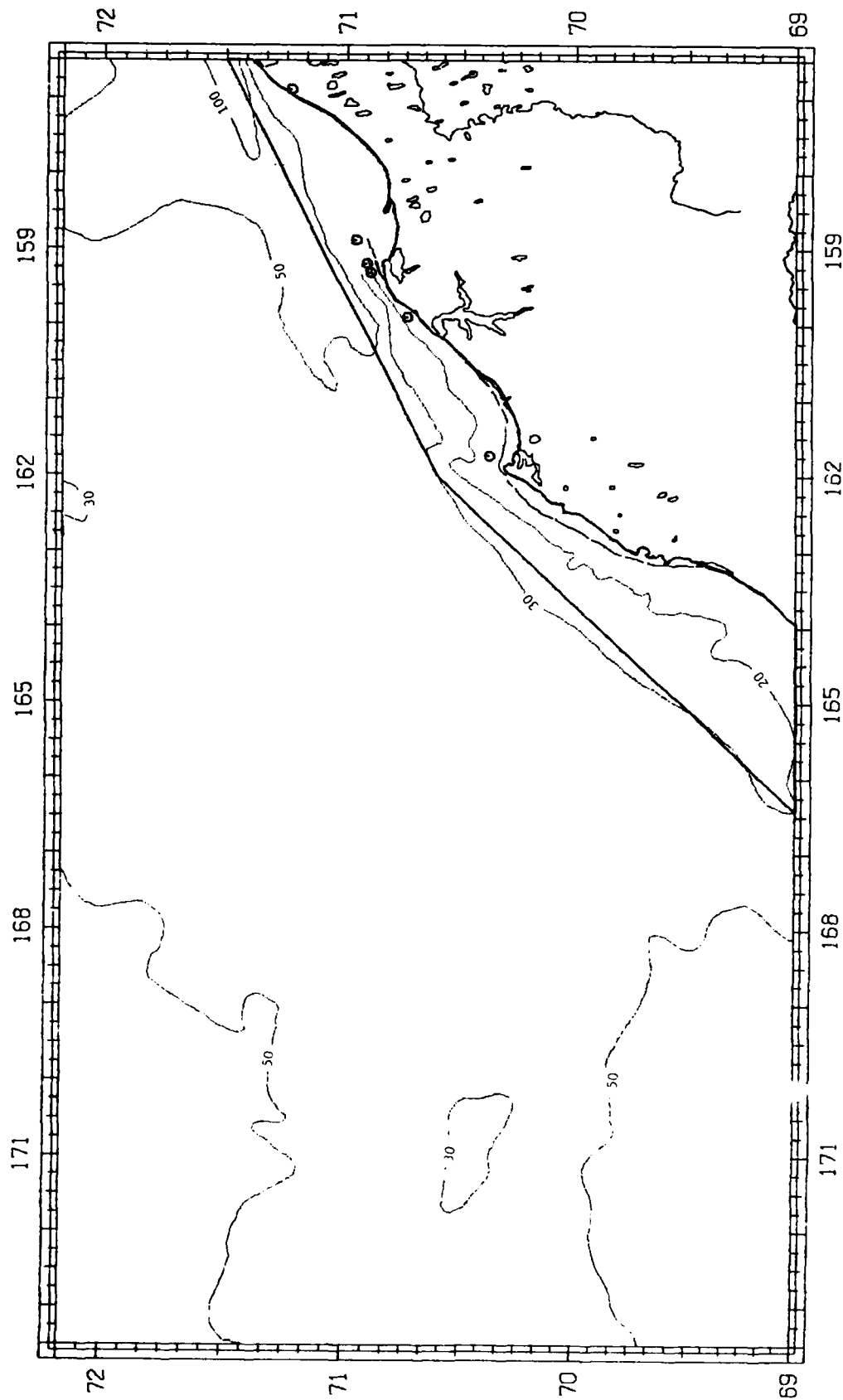


Figure B-73. Plot of gray whale sightings (circles) made during the June-August 1980 aerial survey of the Chukchi Sea, region 17.

Table B-17. Statistics from aerial survey of gray whales conducted June-August 1980 in the Bering and Chukchi Seas. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-56. The total study area was approximately 64,871 nm². Total time spent surveying was approximately 4 hours and 21 minutes.

Region Name	Region Area nm ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of total Time	Number of Transects Flown (=n)	Number of Grays Observed	Density as Number per nm ²	Variance	Confidence Range of Density
1	6,542	10.08	0.00							
2	5,550	8.56	0.00							
3	2,011	3.10	0.00							
4	2,211	3.41	0.00							
5	724	1.12	0.00							
6	2,313	3.56	0.00							
7	4,088	6.30	0.00							
8	4,566	7.04	0.22	0:05	1.92	2	0	0.0	0.0	0.0 - 0.0
9	7,262	11.19	1.39	0:39	14.94	1	0	0.0	0.0	0.0 - 0.0
10	3,676	5.67	1.23	0:28	10.73	2	0	0.0	0.0	0.0 - 0.0
11	767	1.18	3.69	0:13	4.98	1	0	0.0	0.0	0.0 - 0.0
12	6,185	9.53	1.52	0:44	16.86	1	0	0.0	0.0	0.0 - 0.0
13	4,140	6.38	0.48	0:01	0.38	1	0	0.0	0.0	0.0 - 0.0
14	2,469	3.81	0.00							
15	5,767	8.89	0.50	0:13	4.98	1	0	0.0	0.0	0.0 - 0.0
16	1,504	2.32	3.52	0:33	12.64	3	4	0.076	0.003	0.0 - 0.327
17	5,096	7.86	3.86	1:25	32.57	3	4	0.020	>0.0	>0.0 - 0.073

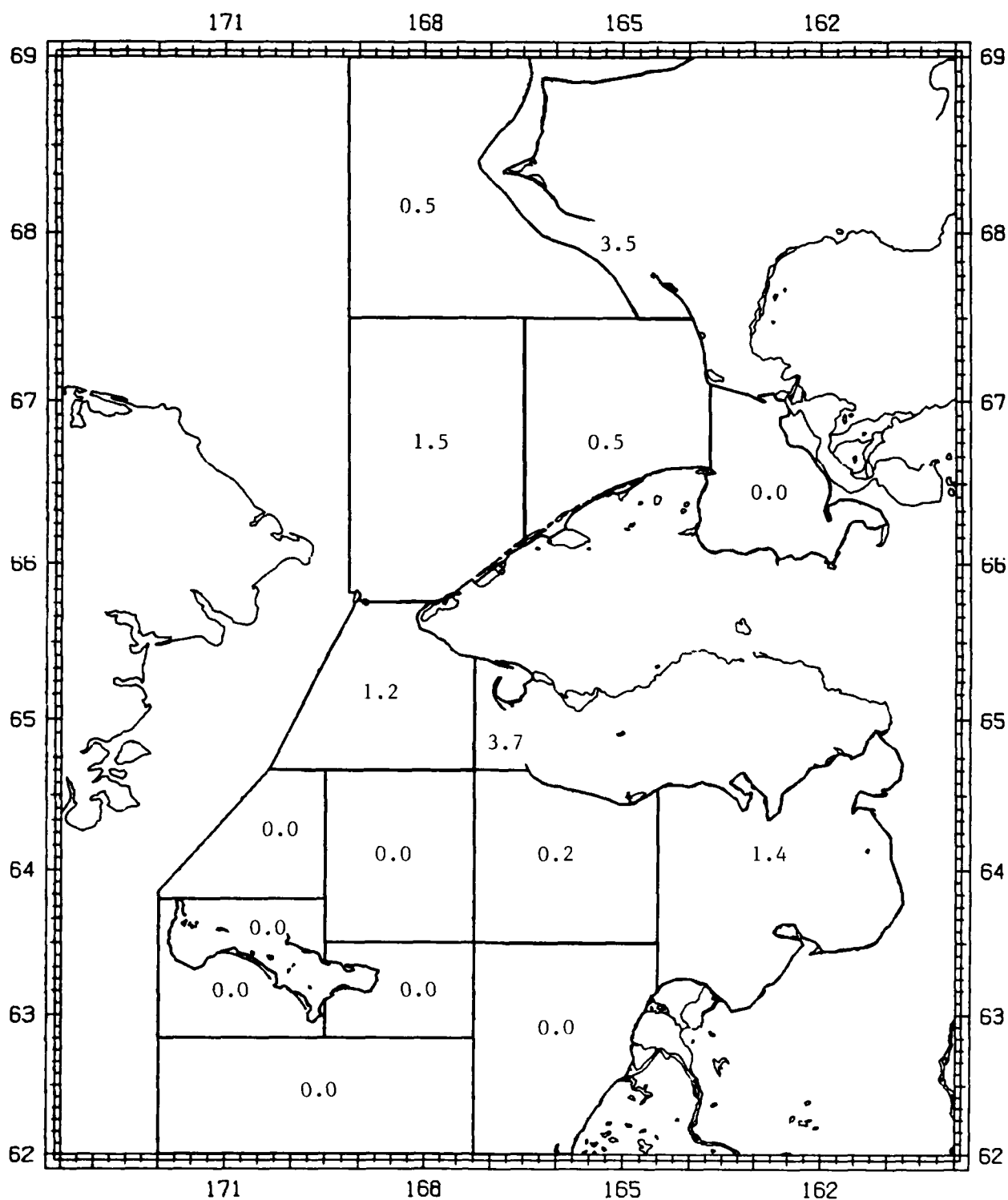


Figure B-74. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Data are based on the June-August 1980 Bering and Chukchi Seas aerial surveys. Percent coverage of Chukchi Sea region 17, not shown, was 3.9.

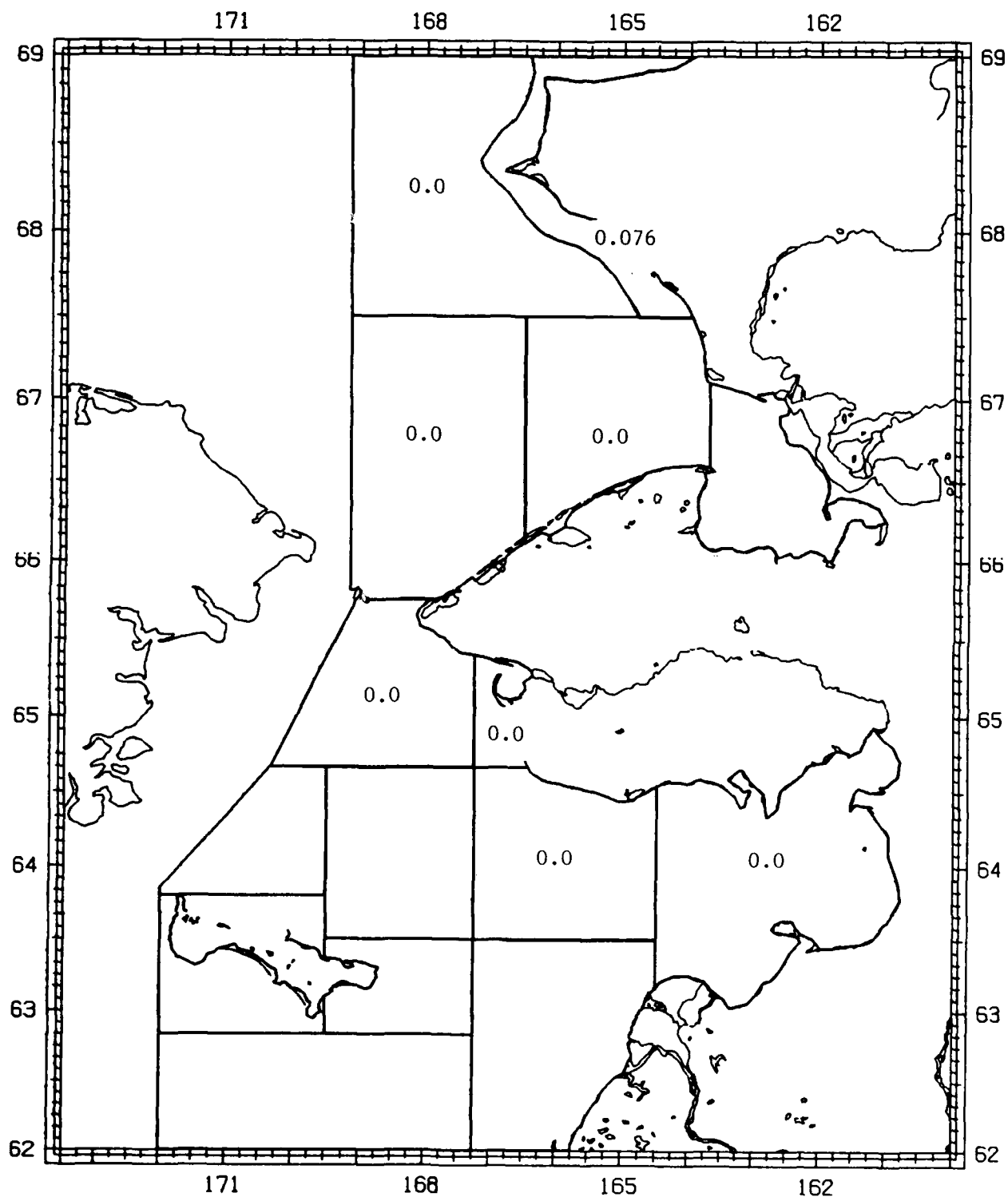


Figure B-75. Values shown are observed densities of gray whales as determined from aerial survey flown in the Bering and Chukchi Seas during June-August 1980. Observed density in Chukchi Sea region 17, not shown, was 0.020.

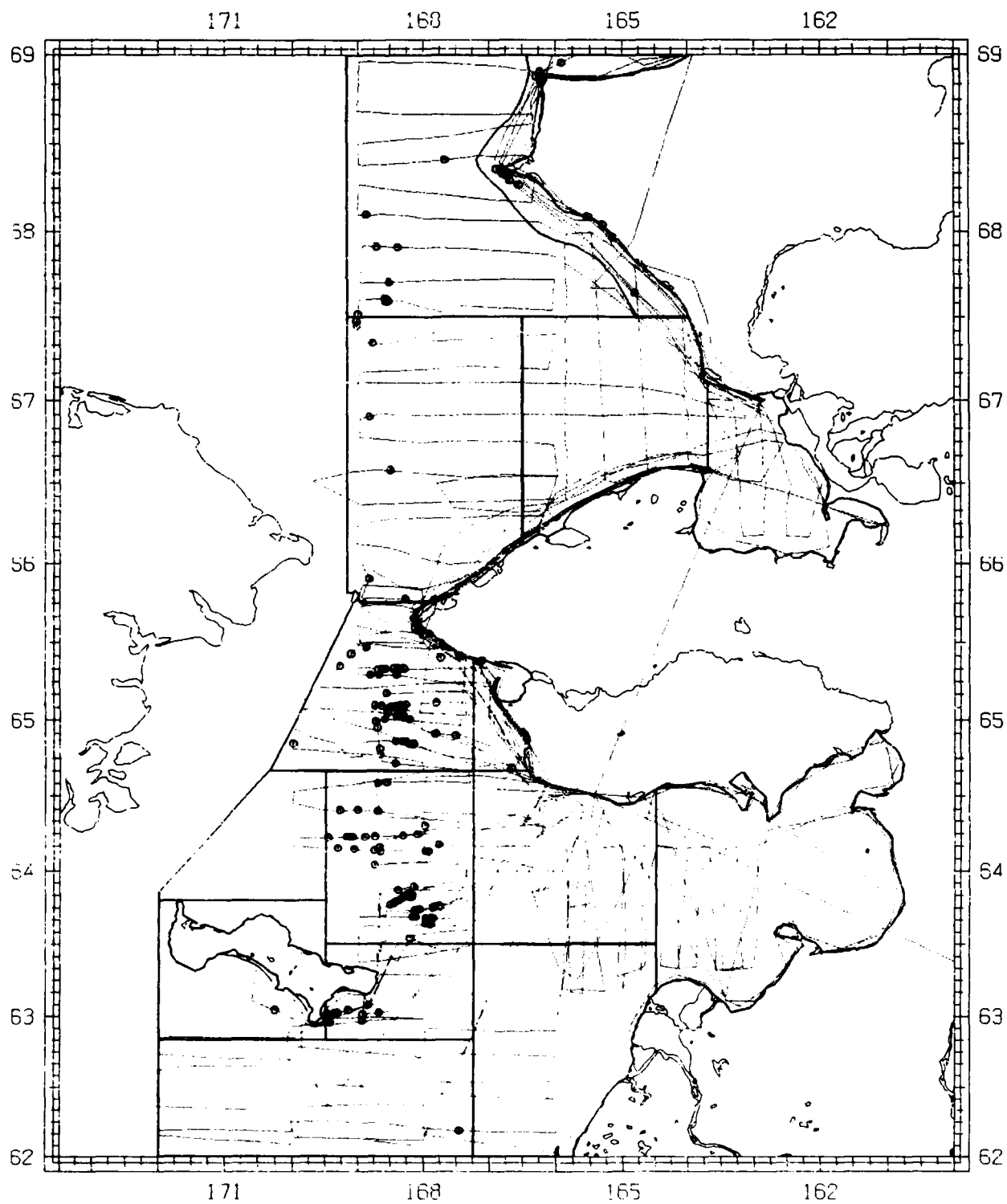


Figure B-76. Plot of aerial survey tracklines flown during June-August 1981 in the Bering and Chukchi Seas, regions 1-16. Circles represent gray whale sightings.

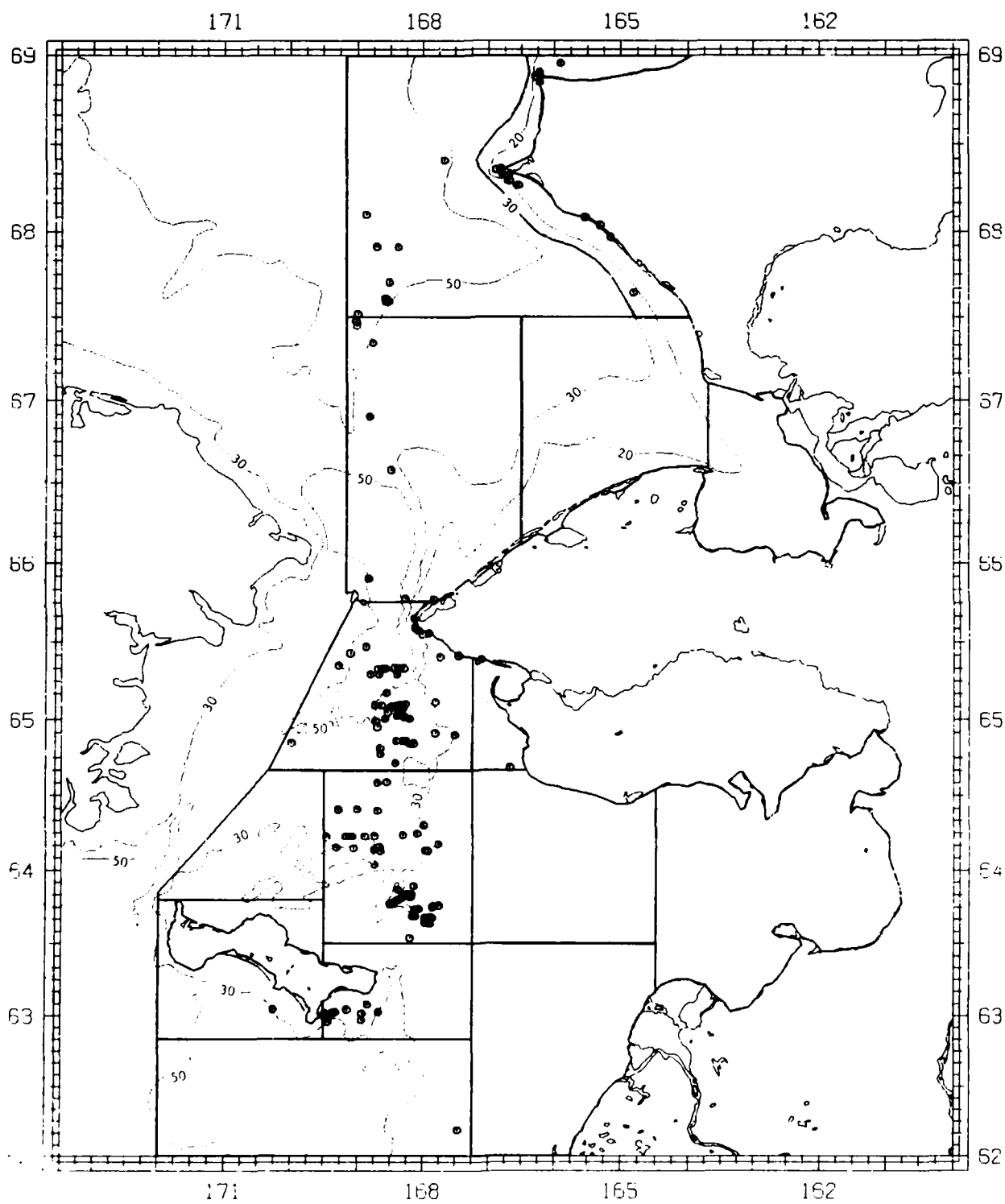


Figure B-77. Plot of gray whale sightings (circles) made during the June-August 1981 aerial survey of the Bering and Chukchi Seas, regions 1-16.

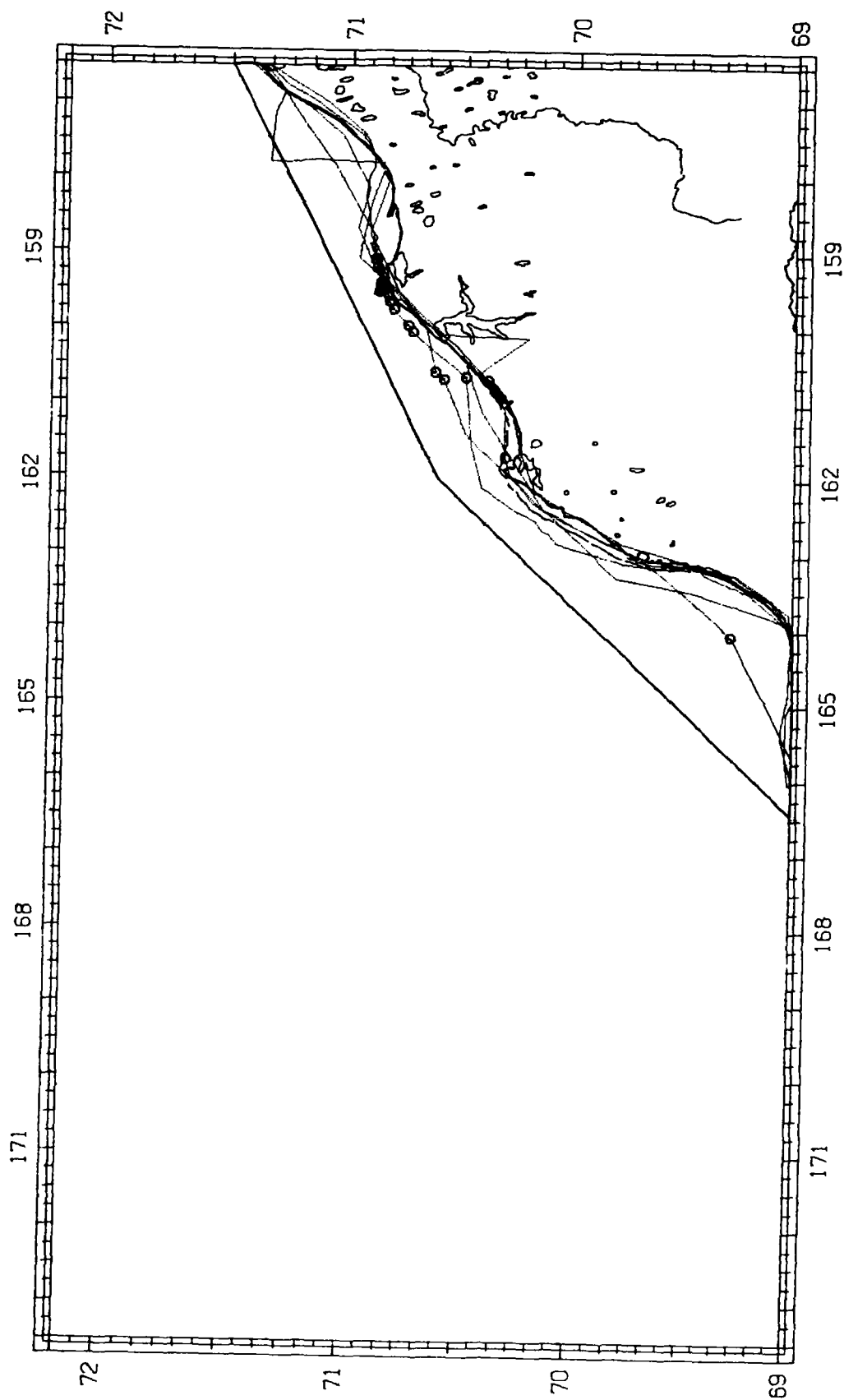


Figure B-78. Plot of aerial survey tracklines flown during June-August 1981 in the Chukchi Sea, region 17. Circles represent gray whale sightings.

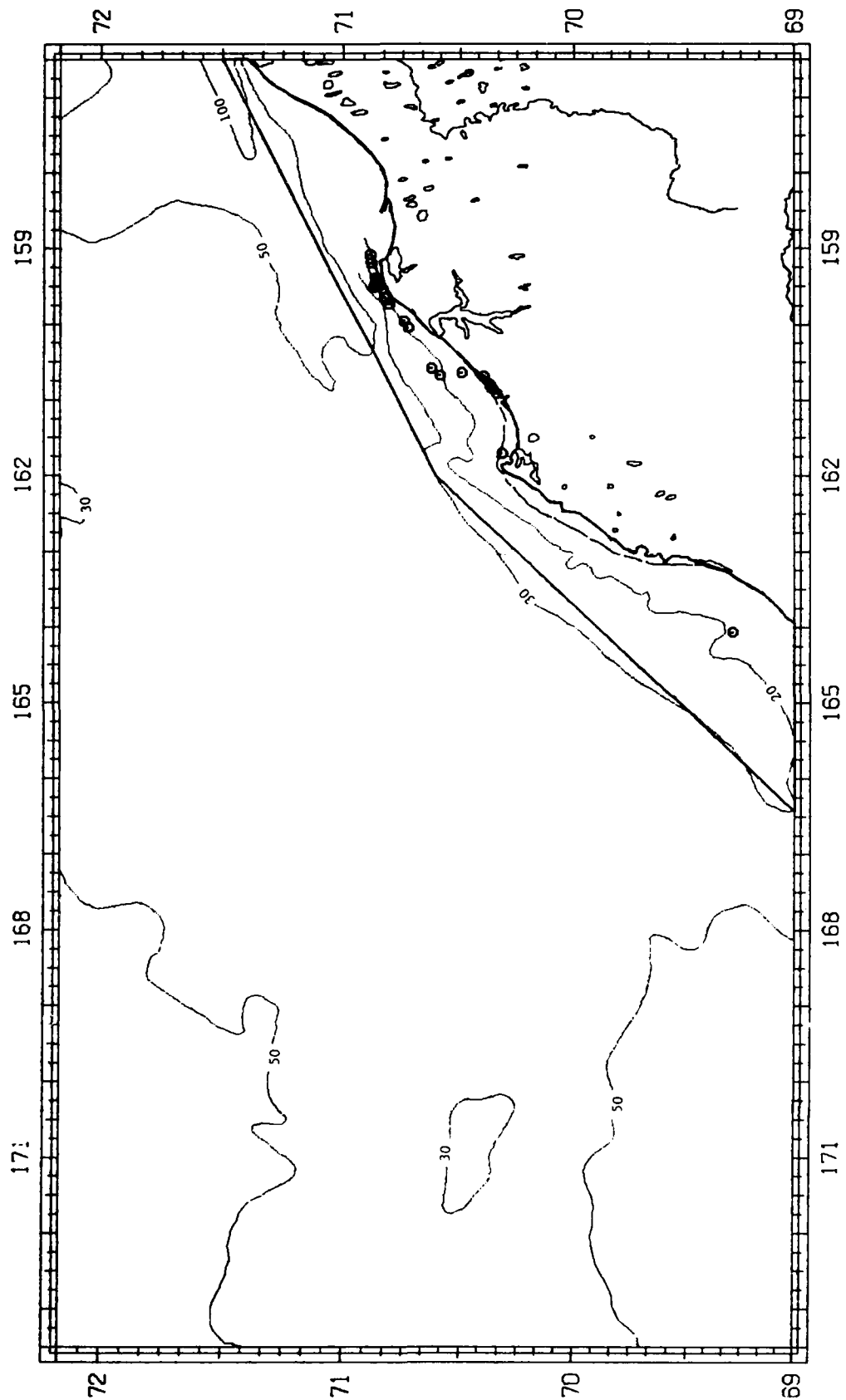


Figure B-79. Plot of gray whale sightings (circles) made during the June-August 1981 aerial survey of the Chukchi Sea, region 17.

Table B-11. Statistics from aerial survey of gray whales conducted June-August 1981 in the Bering and Chukchi Seas. Values for each region were summed where appropriate. Region numbers refer to areas depicted in Figure B-56. The total study area was approximately 64,871 nmi². Total time spent surveying was approximately 105 hours and 16 minutes.

Region Name	Region Area nmi ²	Percent of Total Area	Percent of Area Surveyed	Survey Time HR:MIN	Percent of Total Time	Number of Transects Flown (=n)	Number of Grays Observed	Density as Number per nmi ²	Variance	Confidence Range of Density
1	6,542	10.08	14.68	6:27	6.13	29	1	0.001	>0.0	>0.0 - 0.004
2	5,550	8.56	11.66	4:37	4.39	25	0	0.0	0.0	0.0 - 0.0
3	2,011	3.10	9.32	1:18	1.23	9	1	0.005	>0.0	>0.0 - 0.012
4	2,211	3.41	25.27	4:05	3.88	21	11	0.020	>0.0	>0.0 - 0.040
5	724	1.12	0.00	0:00	0.00	0	0	0.0	0.0	0.0 - 0.0
6	2,313	3.56	2.56	0:20	0.32	6	0	0.0	0.0	0.0 - 0.0
7	4,088	6.30	25.50	7:09	6.79	41	81	0.078	>0.0	0.044 - 0.111
8	4,566	7.04	36.33	11:59	11.38	63	0	0.0	0.0	0.0 - 0.0
9	7,262	11.19	20.77	10:58	10.42	51	0	0.0	0.0	0.0 - 0.0
10	3,676	5.67	36.87	10:28	9.95	70	155	0.114	>0.0	0.057 - 0.172
11	767	1.18	82.07	5:05	4.83	55	5	0.008	>0.0	>0.0 - 0.020
12	6,185	9.53	18.20	9:07	8.66	35	16	0.014	>0.0	>0.004 - 0.025
13	4,140	6.38	28.98	8:40	8.23	41	0	0.0	0.0	0.0 - 0.0
14	2,469	3.81	28.42	5:04	4.81	32	0	0.0	0.0	0.0 - 0.0
15	5,767	8.89	11.94	5:07	4.86	19	14	0.020	>0.0	0.003 - 0.038
16	1,504	2.32	65.54	7:26	7.06	47	28	0.028	>0.0	0.014 - 0.043
17	5,096	7.86	18.58	7:26	7.06	36	41	0.043	>0.0	0.015 - 0.072

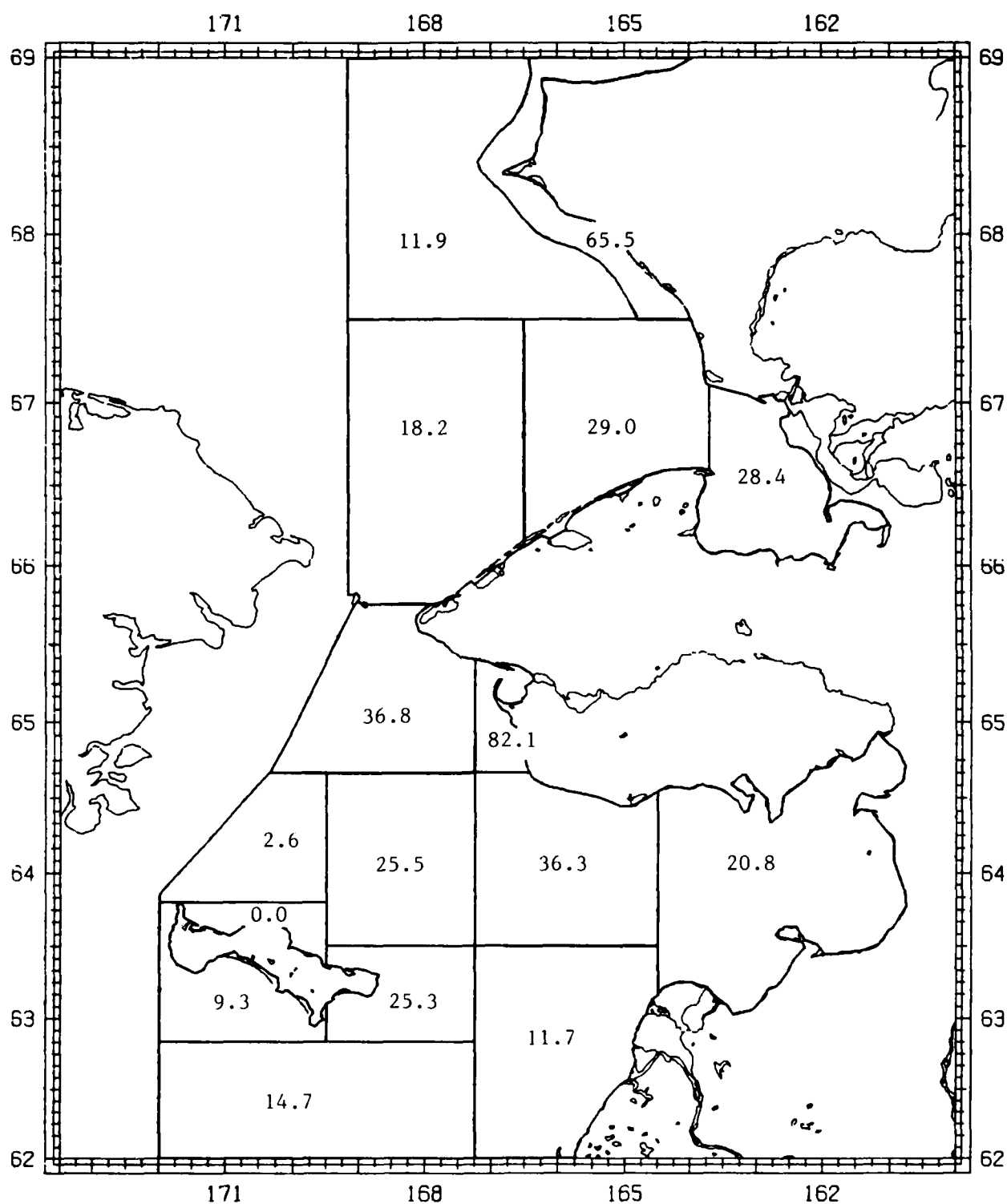


Figure B-80. Values shown are percentages expressed as total number of survey track miles flown divided by the area of each region. Data are based on the June-August 1981 Bering and Chukchi Seas aerial surveys. Percent coverage of Chukchi Sea region 17, not shown, was 3.9.

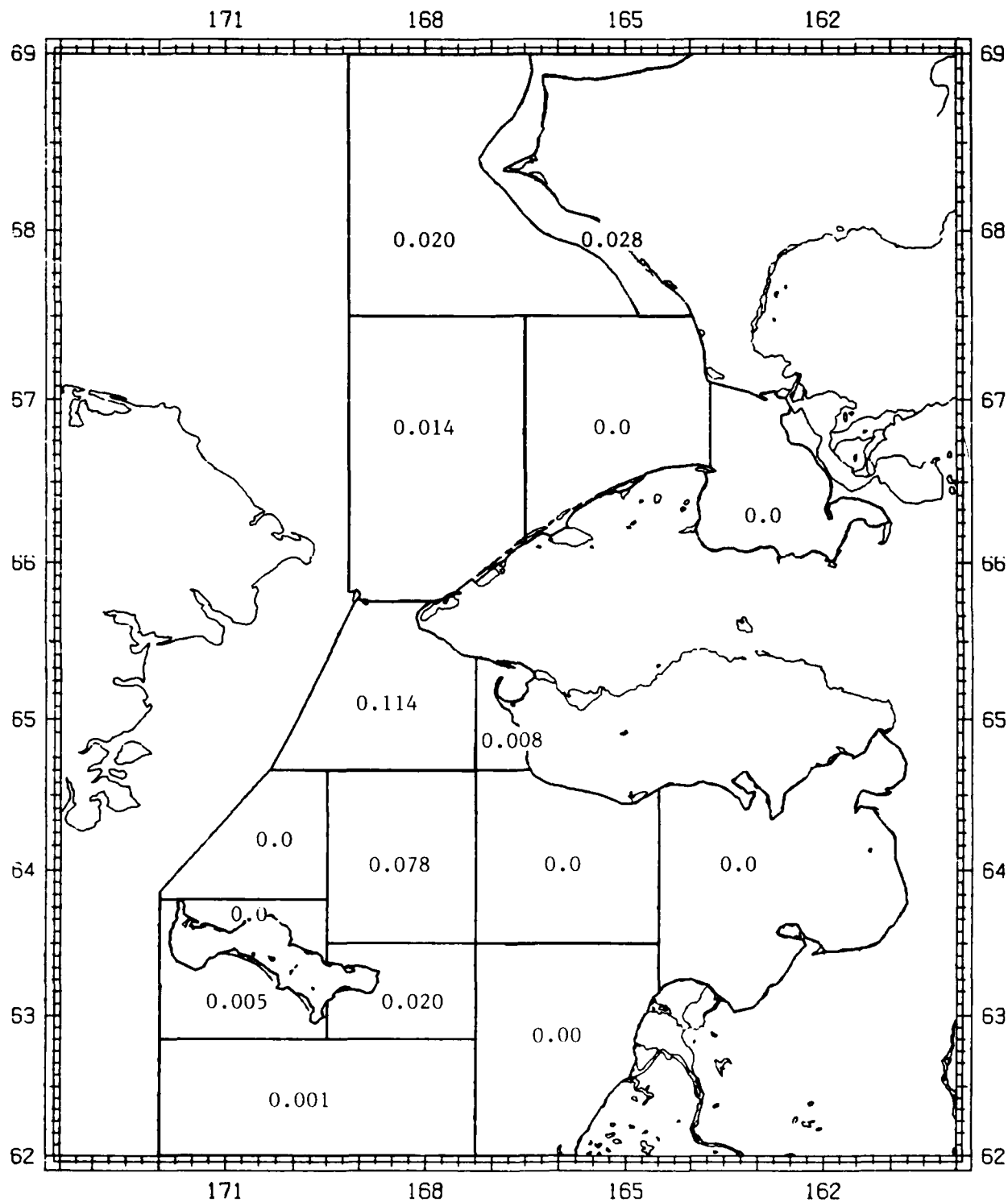


Figure B-81. Values shown are observed densities of gray whales as determined from aerial survey flown in the Bering and Chukchi Seas during June-August 1981. Observed density in Chukchi Sea region 17, not shown, was 0.020.

Literature Cited

- Estes, J. A., and J. R. Gilbert. 1978. Evaluation of an aerial survey of Pacific walruses (Odobenus rosmarus divergens). J. Fish. Res. Board Can. 35: 1130-1140.
- Krogman, B. D., H. W. Braham, R. M. Sonntag, and R. G. Punsley. 1979. Early spring distribution, density, and abundance of the Pacific Walrus (Odobenus rosmarus) in 1976. Outer Continental Shelf Environmental Assessment Program Research Unit 14 Final Report, No. R7120804.

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