RINGED SEAL MONITORING : relationships of distribution, abundance, and reproductive success to habitat attributes and industrial activities.

PROGRESS REPORT

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Ringed Seal Monitoring: Relationships of Distribution, Abundance, and Reproductive Success to Habitat Attributes and Industrial Activities

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I. Introduction and Objectives

Most studies of distribution and abundance of ringed seals have been based on extrapolations of counts made from aerial surveys conducted during the spring molt (e.g., Burns and Harbo 1972; Smith et al. 1978, Stirling et al. 1981a, b). Results indicate that densities of hauled out seals vary geographically, annually, and in relation to ice type. In Alaska, higher densities have been reported in the Chukchi Sea than in the Beaufort Sea, on shorefast ice than on moving pack ice (Burns and Eley 1978), and in areas of 40% or less ice deformation (Burns and Kelly 1982).

Factors limiting the abundance of ringed seals are poorly known. Polar bears (Ursus maritimus), arctic foxes (Alopex lagopus) and humans are their major predators (Johnson et al. 1966, Smith 1976, 1980). Habitat attributes such as food availability and ice conditions undoubtedly affect ringed seal numbers and productivity, but the actual mediating factors are far from clear (Stirling et al. 1977, Lowry et al. 1980, Smith and Hammill 1981). Human activities such as those associated with exploration and development of offshore oil and gas reserves may also influence ringed seal numbers. Recent studies conducted in the Alaskan Beaufort Sea (Burns et al. 1981, Burns and Kelly 1982) suggest that on-ice seismic exploration results in some localized displacement of seals but that the overall effect is not significant. The probable effects of other development-related activities are not known.

An understanding of patterns of ringed seal abundance and distribution, and the factors that influence observed patterns, is essential to understanding ecological processes and interactions in waters of northern Alaska. This research project was designed to address those questions. Specific objectives are to:

1. Develop and implement a monitoring protocol for long-term studies on abundance of ringed seals in Alaskan coastal waters.

2. Quantify population parameters of ringed seals in areas subjected to industrial activities and in appropriate "control" areas.

3. Identify temporal and spatial trends in ringed seal abundance and relate these to current and historic population status.

4. Assess factors influencing ringed seal abundance and productivity and, where appropriate, make recommendations for mitigating adverse effects of industrial activities.

II. Field and Laboratory Activities

In the period covered by this report, historical data were re-analyzed, an aerial survey protocol was finalized, and the first season of aerial surveys was successfully completed (Table 1).

During the first half of 1985, all historical data from ringed seal aerial surveys conducted by ADF&G in 1970-1984 were reviewed, checked, tabulated, and plotted. These data now provide an organized and accessible data base with which to compare results of 1985 and future surveys.

The principal investigators met with personnel from OCSEAP (Paul Becker and George Lapiene) and Minerals Management Service (Steve Treacy) in January 1985 to discuss and finalize the protocol to be used for aerial surveys of ringed seals hauled out on the fast ice of the Chukchi and Beaufort seas. The discussions covered logistical needs, basic design of the surveys, distribution of survey effort in relation to on-ice industrial activities, and the rationale for additional studies that may be needed to assess the impacts of industrial activities on ringed seals. A final protocol for aerial survey design was submitted to OCSEAP in early February.

Aerial surveys of ringed seals hauled out on the fast ice from Kotzebue Sound to Barter Island were conducted between 20 May and 14 June 1985. Surveys in the Chukchi Sea were flown from 21-30 May and in the Beaufort Sea from 30 May-13 June.

Table 1. Field and laboratory activities, December 1984-July 1985.

Activity	Dates	Personnel
Verification and re-entry of historical aerial survey data	Dec-March	Frost, Venable, Lowry
Meeting with OCSEAP/MMS discuss protocol	24 Jan	Lowry, Frost, Burns
Preparation of aerial survey protocol	27 Jan-8 Feb	Lowry, Frost
Diapir field update meeting-OCSEAP/MMS	4-15 March	Frost
Bering Sea information exchange meeting - OCSEAP/MMS	30 May	Burns
Aerial surveys - Chukchi	20-30 May	Frost, Golden, Gilbert
Aerial surveys - Beaufort	30 May-14 June	Frost, Golden, Hills
Computerize 1985 aerial survey data - Chukchi	24 June-15 July	Frost
Computerize 1985 aerial survey data - Beaufort	ongoing	Frost

III. Methods

Re-analysis of Historical Data

Ringed seal aerial survey data collected by ADF&G prior to 1985 were reviewed and checked in order to provide an organized data base for comparison to future aerial surveys. Methodology used in those surveys is summarized in Table 2. The tracklines for surveys were replotted and legs checked for correct beginning and ending points, reasonable air speeds and leg lengths. Legs when survey conditions were questionable (e.g., obscured visibility, wind greater than 20 knots, or poor ice conditions) were deleted from the data base, as were those when navigational questions could not be resolved. (Many of the early surveys were flown without GNS navigation.) Computerized sighting data were verified against the original field data sheets. Ice and environmental records were verified and updated as necessary to reflect the most recent coding requirements.

Aerial Surveys

Surveys were conducted using a NOAA Twin Otter fixed-wing aircraft equipped with bubble windows, radar altimeter, and GNS-500 navigation system. All surveys were flown at an airspeed of approximately 120 knots. In the Chukchi Sea survey altitude was 500 ft; in the Beaufort Sea ice conditions and low ceilings necessitated a lower survey altitude of 300 ft. Three scientific personnel participated in each survey: a navigator who sat in the co-pilot's seat and recorded weather, ice conditions, and navigational information, and two observers stationed one on either side of the aircraft just forward of the wings. Surveys were flown from 1000-1600 true local time to coincide with the time of day when maximal numbers of seals haul out.

Each observer counted the seals in the strip on his or her side of the aircraft. Strip width varied according to altitude and was determined by inclinometer angles which were also indicated by marks on the windows. At 500 ft, the transects began 1/8 nm out from the centerline and extended out to 1/2 nm for an effective width of 3/8 nm (2,250 ft). At 300 ft, the inclinometer angles remained the same and the effective track width was reduced to 1,350 ft (Figure 1). Each observer recorded the time of sighting (by one-minute intervals), number of individuals, number of pups, and whether the seals were at breathing holes or along cracks. In addition, notations were made of any evidence of on-ice human activity (snowmachine tracks, seismic lines, artificial islands, or drill rigs), and of other marine mammals such as whales or polar bears.

An on-board data recording system supplied by NOAA, which was linked to the GNS-500 and radar altimeter, was used to mark beginning and ending time, altitude, latitude, and longitude of each transect, and to mark other positions of interest.

The Beaufort/Chukchi study area was divided into 11 sectors that corresponded to those used in previous surveys and reports (Figure 2). Within sectors, transects were flown along lines of latitude in the Chukchi Sea and longitude in the Beaufort Sea from just offshore to the edge of shorefast ice. In some instances, it was difficult to determine the edge

Table 2. Methodology for ringed seal aerial surveys conducted by ADF&G, 1970-1984 in the Chukchi and Beaufort seas.

	1970	1975	1976	1977	1978	1981	1982	1984
Aircraft	C180/ C185	C180/ Otter	C180/ Otter	C180/ Otter	C172/ C180	Grumman Goose	Bell 204 Helicopter	C180
Track width (nm)	0.87	0.87	0.87	0.87	0.87	1.0	1.0	1.0
Altitude (ft)	500	500	300-500	300	300	300-500	500	500
Navigation[1]	DR	DR or On Trak	DR or On Trak	DR	DR	GNS	GNS	DR
Left & right separate	no	no	yes	yes	yes	yes	yes	yes
Inner/outer separate	no	no	no	no	no	yes	yes	no
Centerline offset	no	no	no	no	no	yes	no	no
Clinometer used	no	no	no	no	no	yes	yes	yes
Ice deformation recorded	no	no	yes	yes	yes	yes	yes	yes

[1] DR = Dead-reckoning using known landmarks.
GNS = Global Navigation System Model 500.

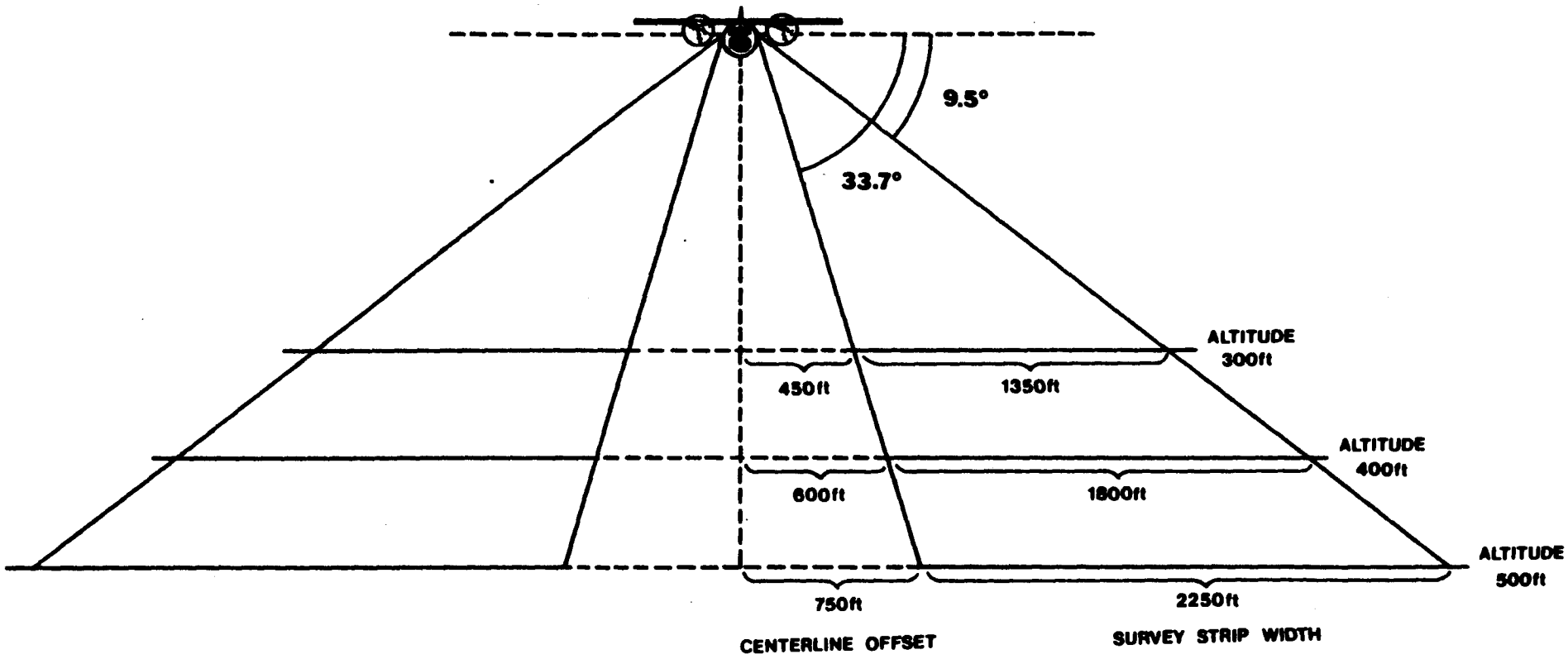

Figure 1. Diagram showing inclinometer angles, centerline offsets, and survey strip widths for ringed seal surveys.

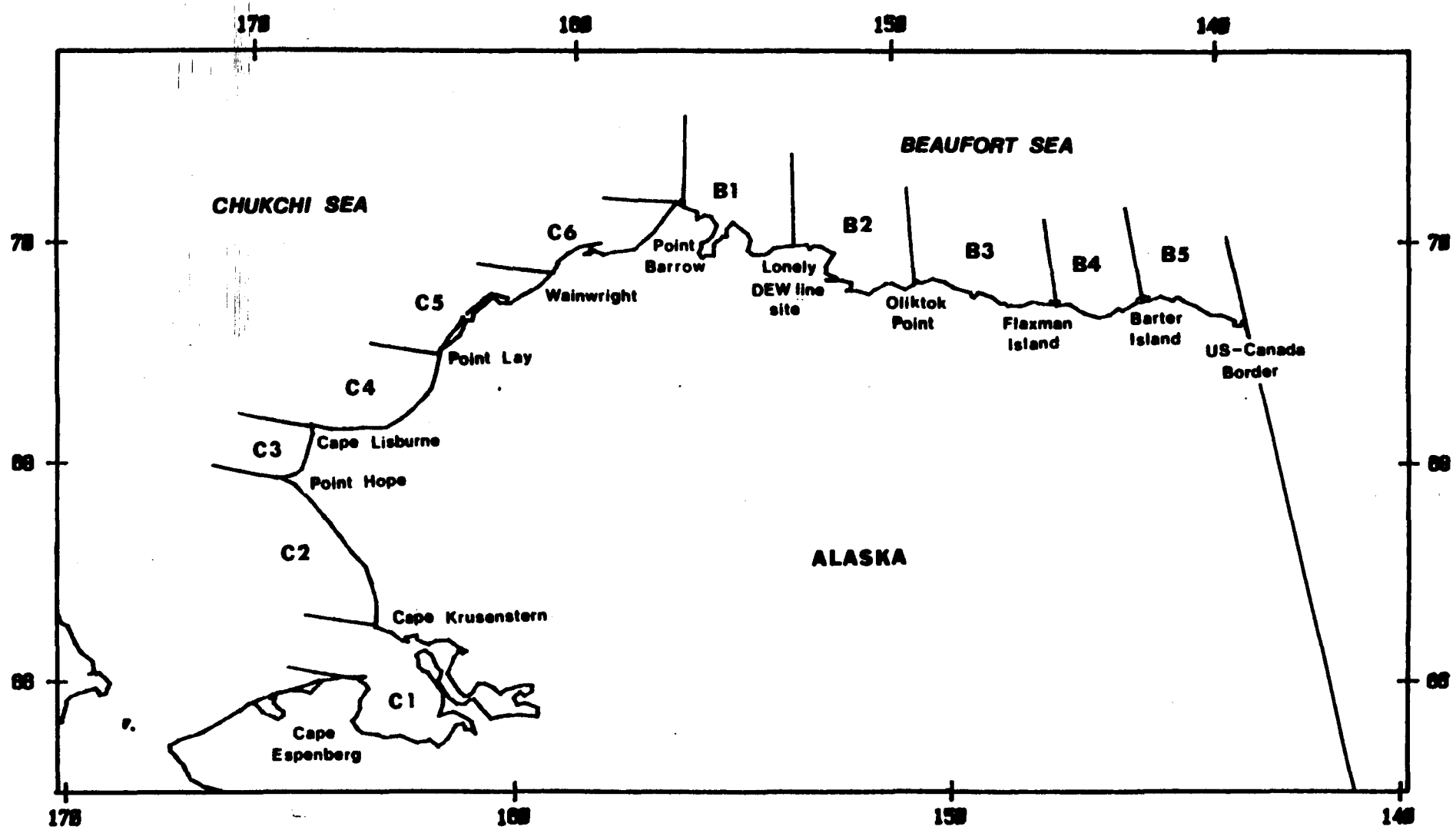

Figure 2. Map of northern Alaska showing sectors used for the design and analysis of ringed seal aerial surveys conducted by ADF&G.

of the fast ice, in which case lines were flown to an arbitrary end point offshore. The edge of the fast ice will be determined based on satellite photographs taken during the same time period and the data will be coded accordingly.

Transect lines were spaced approximately 2 nm between centerlines (2 minutes of latitude, 6 minutes of longitude); within each sector, 60% of the possible transects were randomly selected and flown. In two sectors in the Beaufort Sea where on-ice industrial activity is greatest (B2, Lonely to Oliktok and B3, Oliktok to Flaxman Island) coverage was increased to 90%. In addition, a 10-mile grid of lines spaced one mile apart was flown around the artificial island, Seal Island.

Data Entry and Analysis

Data are currently being entered into an IBM-PC computer using a data entry program that converts field data to NODC codes. Accuracy of data is checked both manually and by range checks built into the data entry program.

IV. Data Collected or Analyzed

Historical data from over 11,000 linear miles of trackline (7,800 nm^2 of survey area) were verified, reanalyzed, and plotted (Tables 3 and 4, and Appendix A). Coverage in the Beaufort Sea was almost double that in the Chukchi Sea. The two most heavily industrialized sectors, B2 and B3, have received the most intensive survey effort, with approximately 2,500 nm of usable trackline in each sector. In the Chukchi Sea over 70% of the usable data are for the northernmost sectors, C5 and C6. Coverage was most extensive (2,040 nm of trackline) in the Chukchi Sea in 1976, the only year in which all six sectors were flown. In the Beaufort Sea, coverage was greatest in 1981 when 2,884 linear miles of trackline were surveyed.

In spring 1985 aerial surveys were flown over the fast ice from Kotzebue Sound to Barter Island. The NOAA Twin Otter picked up scientific personnel in Fairbanks on 20 May and flew to Kotzebue, which served as an operations base until 24 May. Sectors C1 and C2 were completed during that time. Because the fast ice was very narrow in sector C2, transects were extended over pack ice to approximately 10 nm offshore. Operations were moved to Cape Lisburne on 24 May. Sector C4 was completed, but due to extremely limited fast ice and high winds, sector C3 was not flown. From 26 May until 2 June surveys were staged out of Barrow and sectors C5, C6, and parts of B1 and B2 were completed. On 2 June, operations were moved to Deadhorse and we operated from there until the end of the project on 14 June. All Beaufort Sea sectors were completed except B5, where only a few transects were flown.

Approximately 86 hours of flight time were expended in the successfully completed sectors. The aircraft flew an estimated 10,320 nm during survey flights, of which approximately 5,400 nm were on survey trackline (Table 5). Coverage was greatest in sectors B2 and B3 in the Beaufort Sea.

Table 3. Ringed seal survey effort in the Chukchi Sea, 1970-1984.

	C1	C2	C3	C4	C5	C6
1970						
Track miles (nm)					127	163
Area surveyed (nm^2)					91	124
Number of legs					9	10
1975						
Track miles (nm)					264	257
Area surveyed (nm^2)					230	222
Number of legs					17	18
1976						
Track miles (nm)	606	215	39	79	298	803
Area surveyed (nm^2)	526	187	34	69	260	342
Number of legs	27	11	3	4	19	42
1977						
Track miles (nm)					171	179
Area surveyed (nm^2)					149	156
Number of legs					13	14
1978						
Track miles (nm)					169	182
Area surveyed (nm^2)					147	157
Number of legs					13	13
1984						
Track miles (nm)	121	158				
Area surveyed (nm^2)	121	122				
Number legs	8	7				

Table 4. Ringed seal survey effort in the Beaufort Sea, 1970-1982.

	B1	B2	B3	B4
1970				
Track miles (nm)	379	365	315	101
Area surveyed (nm^2)	325	317	274	88
Number of legs	17	16	13	6
1975				
Track miles (nm)	490	385	254	90
Area surveyed (nm^2)	412	344	202	78
Number of legs	35	22	17	5
1976				
Track miles (nm)	342	232	145	102
Area surveyed (nm^2)	167	151	126	89
Number of legs	14	11	5	4
1977				
Track miles (nm)	155	87	82	95
Area surveyed (nm^2)	131	76	72	83
Number of legs	6	7	3	5
1981				
Track miles (nm)	221	1,257	1,143	263
Area surveyed (nm^2)	110	628	554	130
Number of legs	18	104	98	21
1982				
Track miles (nm)	218	188	515	96
Area surveyed (nm^2)	106	94	243	47
Number of legs	23	14	48	9

Table 5. Dates, estimated flight hours, percent coverage, and preliminary estimate of track miles flown for each sector during the 1985 ringed seal surveys conducted by ADF&G from 20 May-14 June. All or parts of sectors B1-B4 were flown more than once.

Sector	Dates	% of transects flown	Area	Hours	Track miles(nm)
C1	21, 23 May	60	Kotzebue Sound	10.9	767
C2	22 May	60	Cape Krusenstern-Pt. Hope	5.5	220
C3	-	0	Pt. Hope-Cape Lisburne	0	0
C4	24, 25 May	60	Cape Lisburne-Pt. Lay	5.5	202
C5	27 May	60	Pt. Lay-Wainwright	4.5	183
C6	27, 30 May	60	Wainwright-Barrow	4.0	157
B1	30 May, 13 June	60	Barrow-Lonely	9.0	573
B2	28 May, 1, 2, 11, 13 June	90	Lonely-Oliktok	16.5	1,241
B3	7, 9, 11, 12 June	90[1]	Oliktok-Flaxman	20.0	1,482
B4	3, 12 June	60	Flaxman-Barter	8.0	492
B5	12 June	22	Barter-Demarcation	2.2	121

[1] Additional transects were flown in the vicinity of Seal Island.

Ice and weather conditions were excellent in the Chukchi Sea, with only one in ten days lost due to weather. In the Beaufort Sea, we were able to survey on only 8 of 13 days due to fog, wind, or both.

V. Results and Discussion

Historical Data

Results of aerial surveys conducted from 1970-1984 are summarized in Table 6. Some of the densities presented differ from previously reported values for several reasons. During the re-analysis of data we resolved navigational problems, and used more strict requirements regarding suitable survey conditions in order to ensure that the historical data are comparable to that being collected in the present monitoring program.

Most earlier surveys were conducted using dead-reckoning navigation. Determination of the exact location of survey tracklines was difficult, particularly when flying more than a few miles from shore or when shoreward visibility was restricted. If fog or snow terminated a transect part way between identifiable geographic points, it was necessary to extrapolate transect end points based on course heading, elapsed time, and estimated ground speed, a process further complicated by variable wind conditions that affected both course heading and speed.

Earlier density calculations sometimes used point-to-point, straight-line distances for coastal transects rather than taking into account curvature of the shoreline. Recalculation of those densities necessitated replotting tracklines with additional way points in order to reconcile track length and ground speed.

Between 1978 and 1981, primary means of navigation changed from dead-reckoning to the GNS-500. Under the dead-reckoning system, strip widths, and sometimes track lengths, were measured in statute miles. With the advent of the GNS, measurements were made in nautical miles. During preliminary analysis of data for some years, confusion arose in conversion from one unit to the other, particularly in surveys when track width was measured in statute miles (which could be calibrated on an airstrip) and track length in nautical miles (which were stepped off a chart or calculated from beginning and ending latitudes and longitudes).

Other changes made during re-analysis of historical data included recoding of ice type, primarily reclassification of some ice as pack ice rather than fast ice. Parts of some transects were deleted because of marginal weather conditions. In the Beaufort Sea, slight alterations were made in the boundary between sector B3 and B4 which influenced densities in those sectors.

Despite the changes resulting from recalculation of densities, the overall pattern in ringed seal abundance remained the same: densities of ringed seals were usually highest in the northeastern Chukchi Sea, from Point Lay to Barrow, and lowest in the Beaufort Sea. Within the Beaufort Sea, there was considerable annual variability in which region had the highest observed density of seals. For example, sector B4 from Flaxman to Barter

Table 6. Summary data on the observed density of ringed seals in the Chukchi and Beaufort seas, 1970-84, from aerial surveys flown by the Alaska Department of Fish and Game.

Sectors	1970	1975	1976	1977	1978	1981	1982	1984
CHUKCHI SEA								
C1			0.93					1.80
C2			2.89					2.87
C3			1.21					
C4			6.64					
C5	6.95	3.50	2.78	4.47	5.27			
C6	5.54	7.08	4.96	3.42	2.32			
BEAUFORT SEA								
B1	2.16	3.73	1.53	1.29		1.42	1.31	
B2	1.52	1.72	1.13	0.61		1.44	1.68	
B3	1.99	0.96	2.03	0.75		1.51	1.79	
B4	4.15	3.03	0.53	1.66		1.68	1.11	

Island had the highest density of seals in three years and the lowest in two years. Each sector had the lowest density in at least one year, and three of four sectors had the highest density in at least one year.

Statistical re-analysis of these data will be ongoing through the remainder of 1985 to determine whether useful comparisons can be made between 1970-1984 data and results of the 1985 surveys.

1985 Surveys

Entry of 1985 aerial survey data into an IBM-PC computer is ongoing. All Chukchi Sea sectors have been entered, checked, and edited and are ready for analysis. Beaufort Sea data are currently being coded for ice characteristics. In the Chukchi Sea, the boundary between fast and pack ice was easily recognizable; the two areas were usually separated by an open water lead. In the Beaufort Sea, distinguishing between fast and pack ice was considerably more difficult. Field data are presently being compared to satellite photos of the ice in order to provide the most accurate location of the fast ice/pack ice boundary.

Upon completion of 1985 field work, a debriefing session was held with field personnel to discuss survey methodology. The Twin Otter fitted with bubble windows was considered by all to be an extremely satisfactory survey aircraft. A survey altitude of 500 ft was considered workable in the Chukchi Sea due to relatively flat ice and excellent weather. In the Beaufort Sea, survey altitude was reduced to 300 ft in order to avoid persistently low cloud ceilings and fog, and to compensate for difficult sighting conditions caused by extensive meltwater and dirty ice. All observers considered 500 ft to be unsatisfactory for detecting seals under the ice conditions that prevailed in the Beaufort Sea in June 1985.

Survey tracks were offset 34° from the center line in 1985 (1/8 nm at 500-ft altitude) to compensate for obscured downward visibility, the more rapid passage of seals and therefore greater likelihood not counting them close to the centerline, and the increased chance that seals directly under the plane might dive and not be counted. All observers were satisfied with the offset inner track boundary and believed their counts to be more accurate by not having to guard the center line. Diving seals were not considered to be a significant problem with the centerline offset.

VI. Problems/Recommended Changes

A copy of the field operations report submitted to George Lapiene, Alaska Office, NOAA Ocean Assessments Division on 1 July 1985 is attached (Appendix B). That report discusses suggestions for minor modifications to the aircraft and for changes in the on-board data recording system to make it more useful for seal surveys.

No major problems were encountered during the 1985 field season. Analysis of survey data and preparation of the annual report are expected to proceed on schedule and be complete by December 1985.

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Appendix A. Plots of ringed seal sightings in the Chukchi and Beaufort seas, 1970-1984.

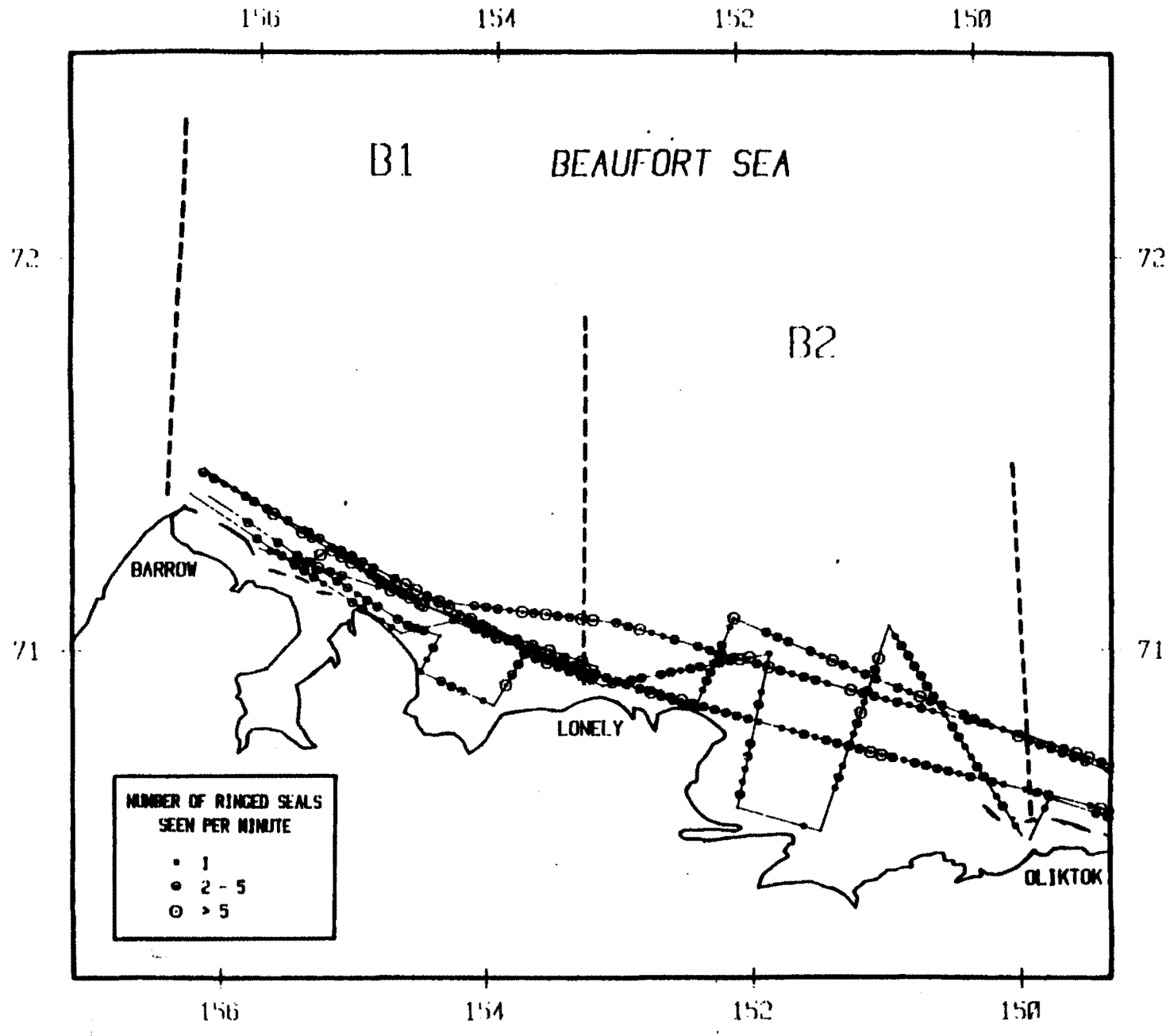

Figure A-1. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 8-13 June 1970.

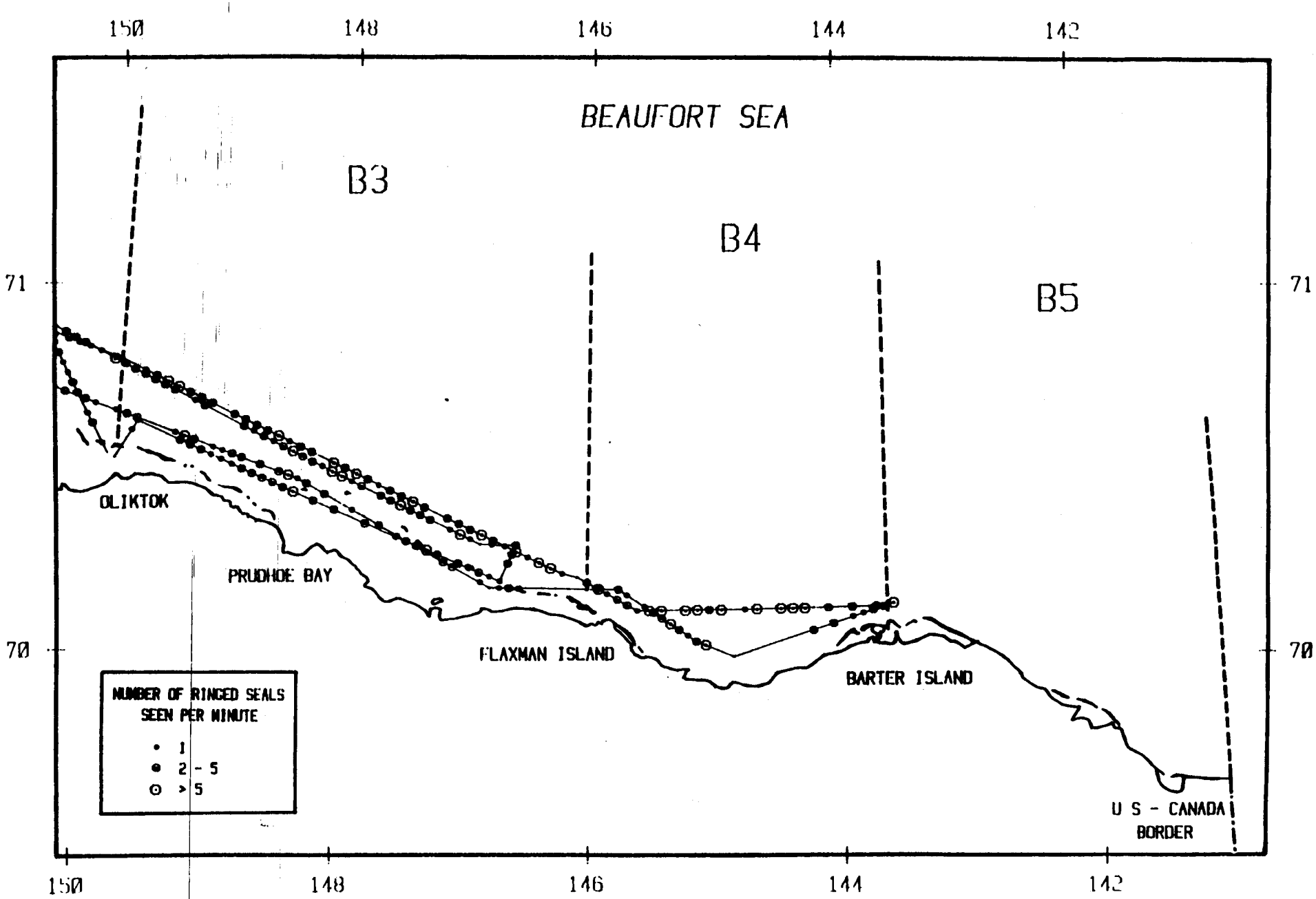

Figure A-2. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 9-13 June 1970.

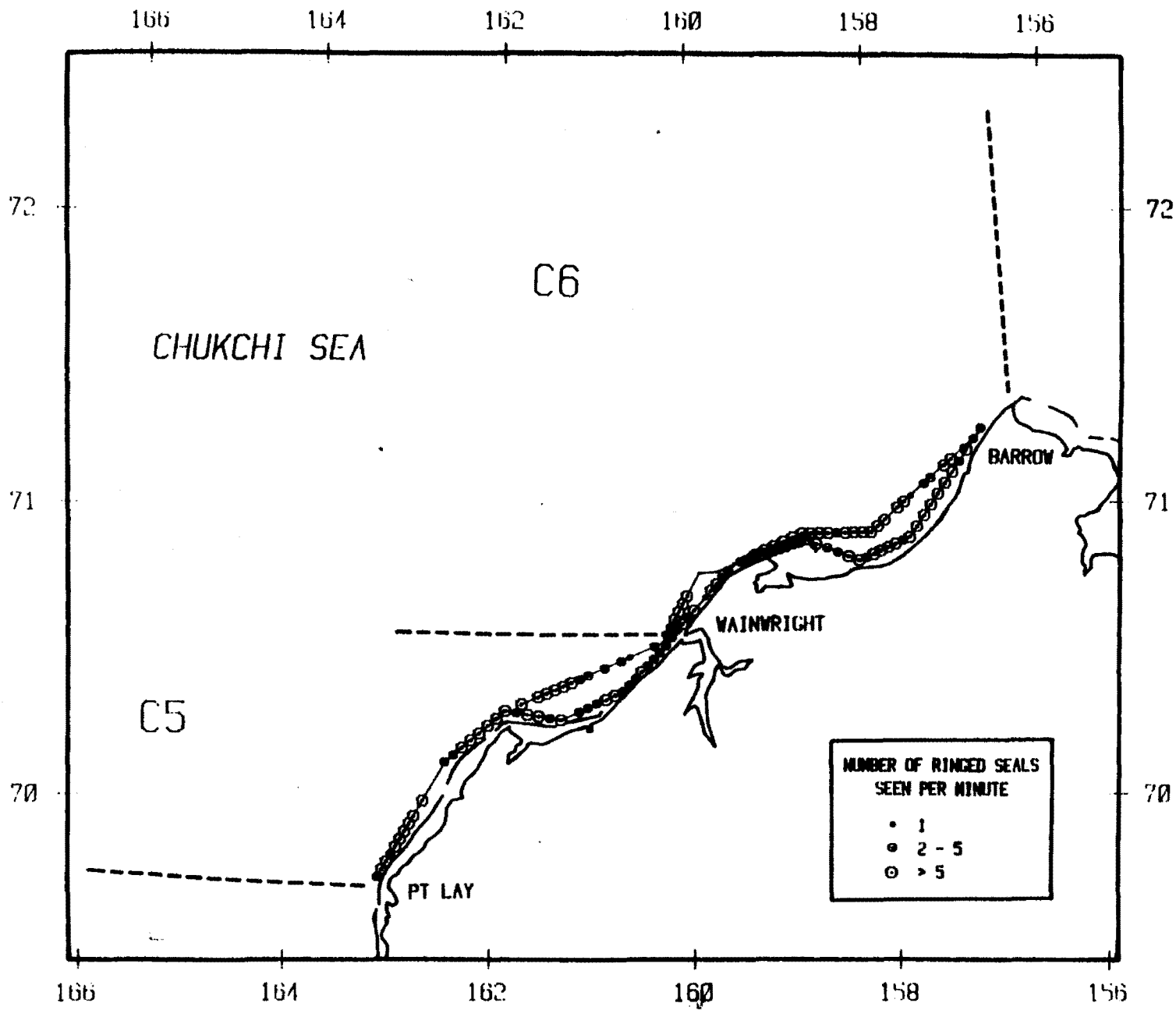

Figure A-3. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C5 and C6, Chukchi Sea, 8 June 1970.

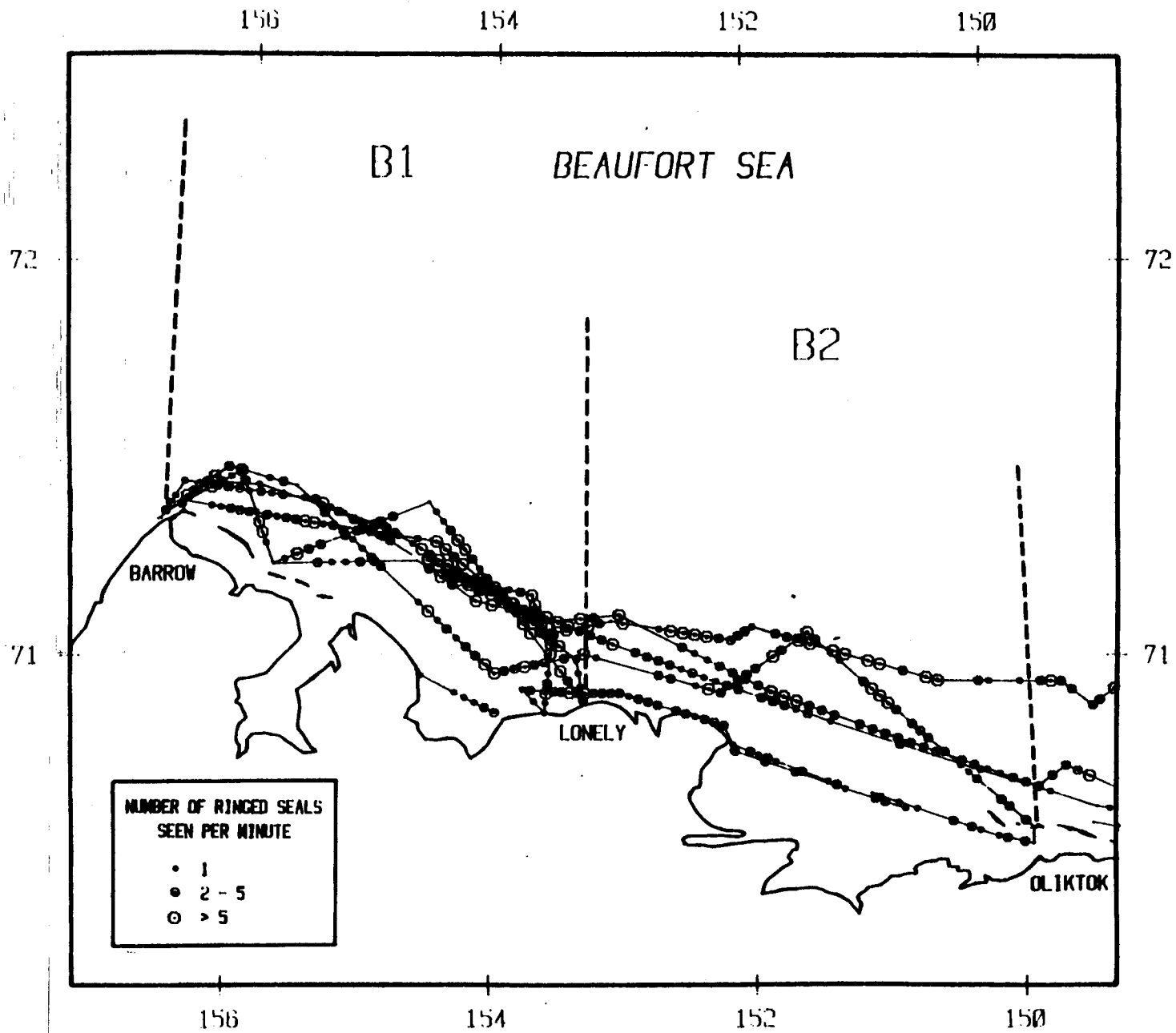

Figure A-4. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 10-17 June 1975.

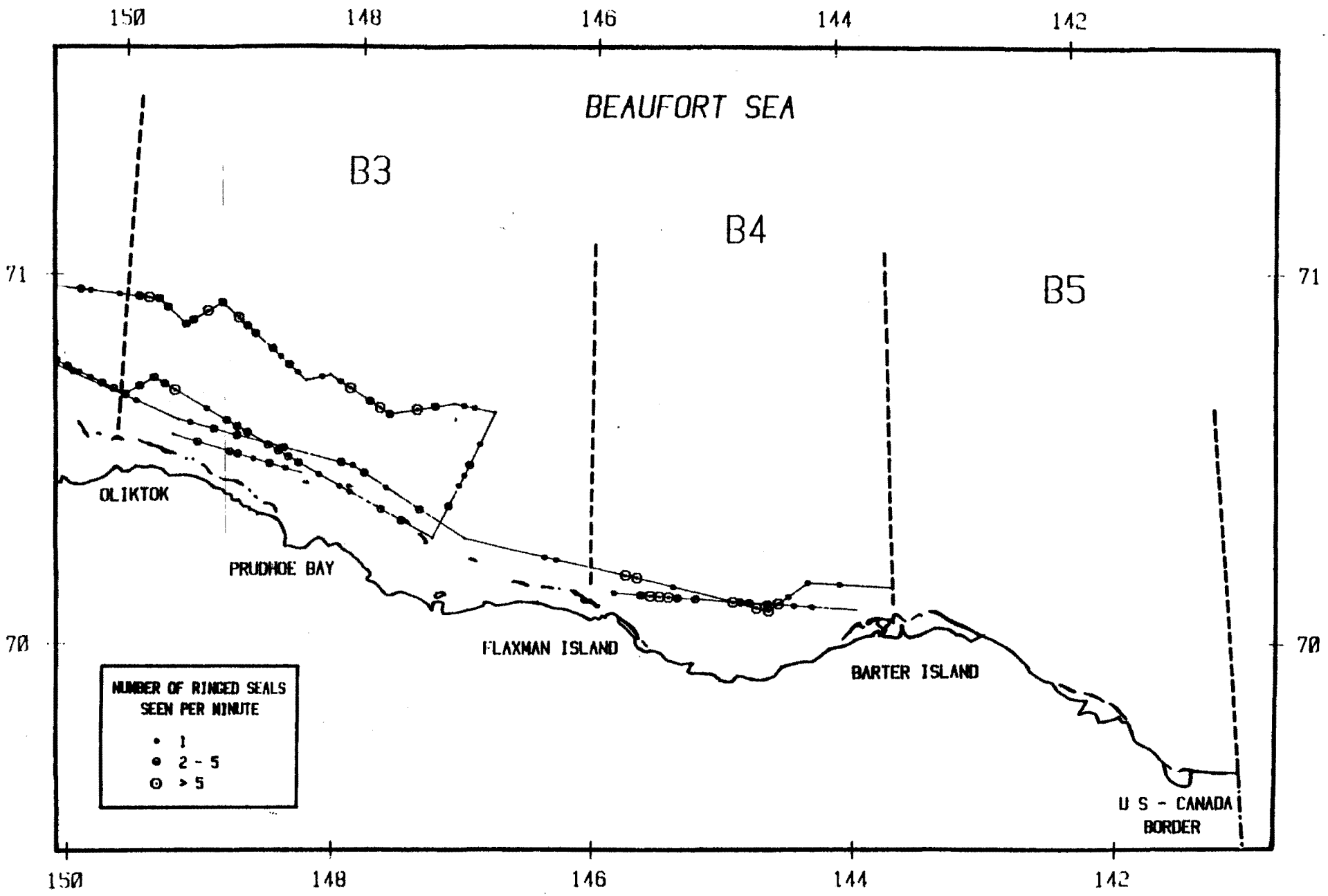

Figure A-5. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 10-13 June 1975.

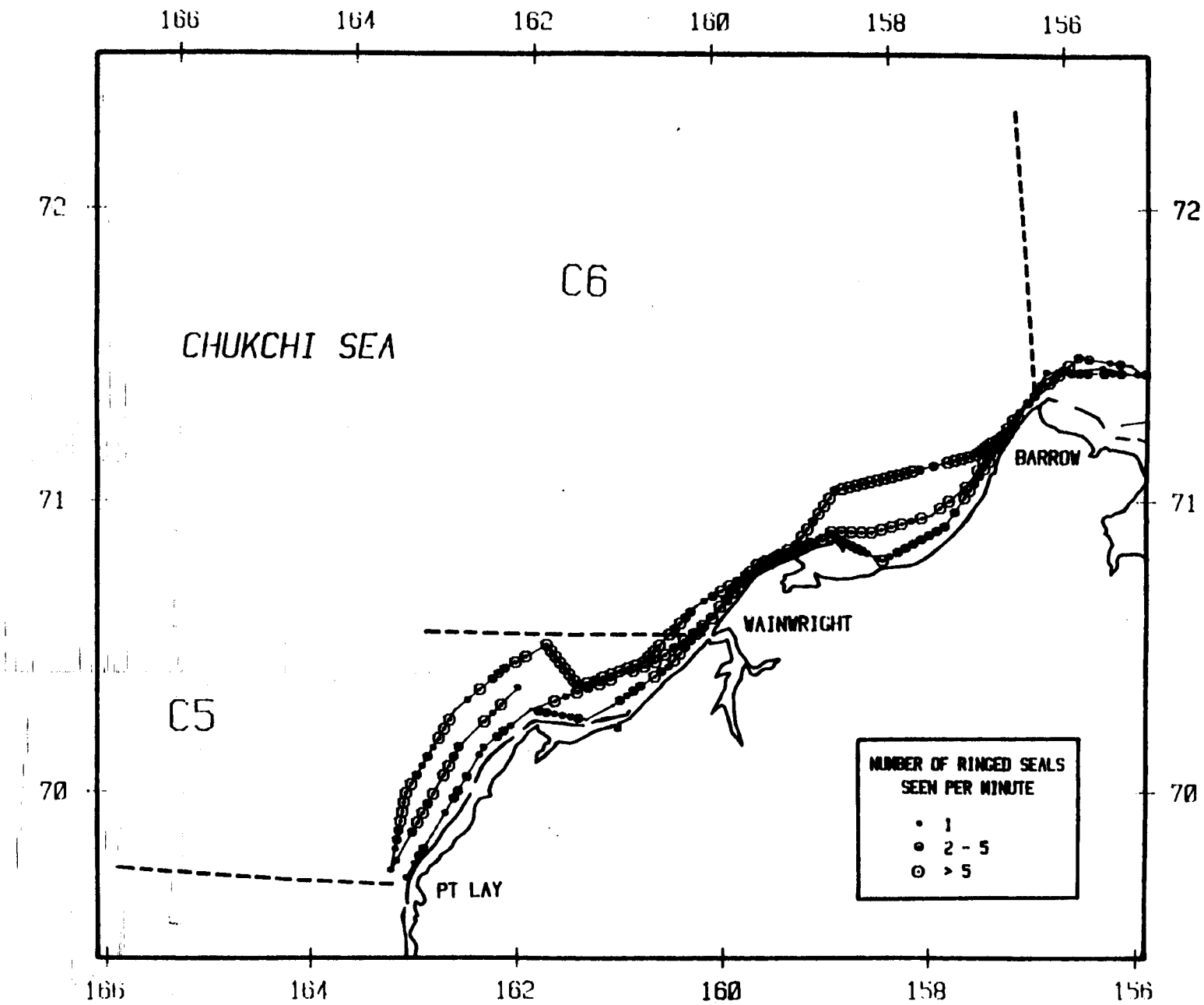

Figure A-6. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C5 and C6, Chukchi Sea, 10-18 June 1975.

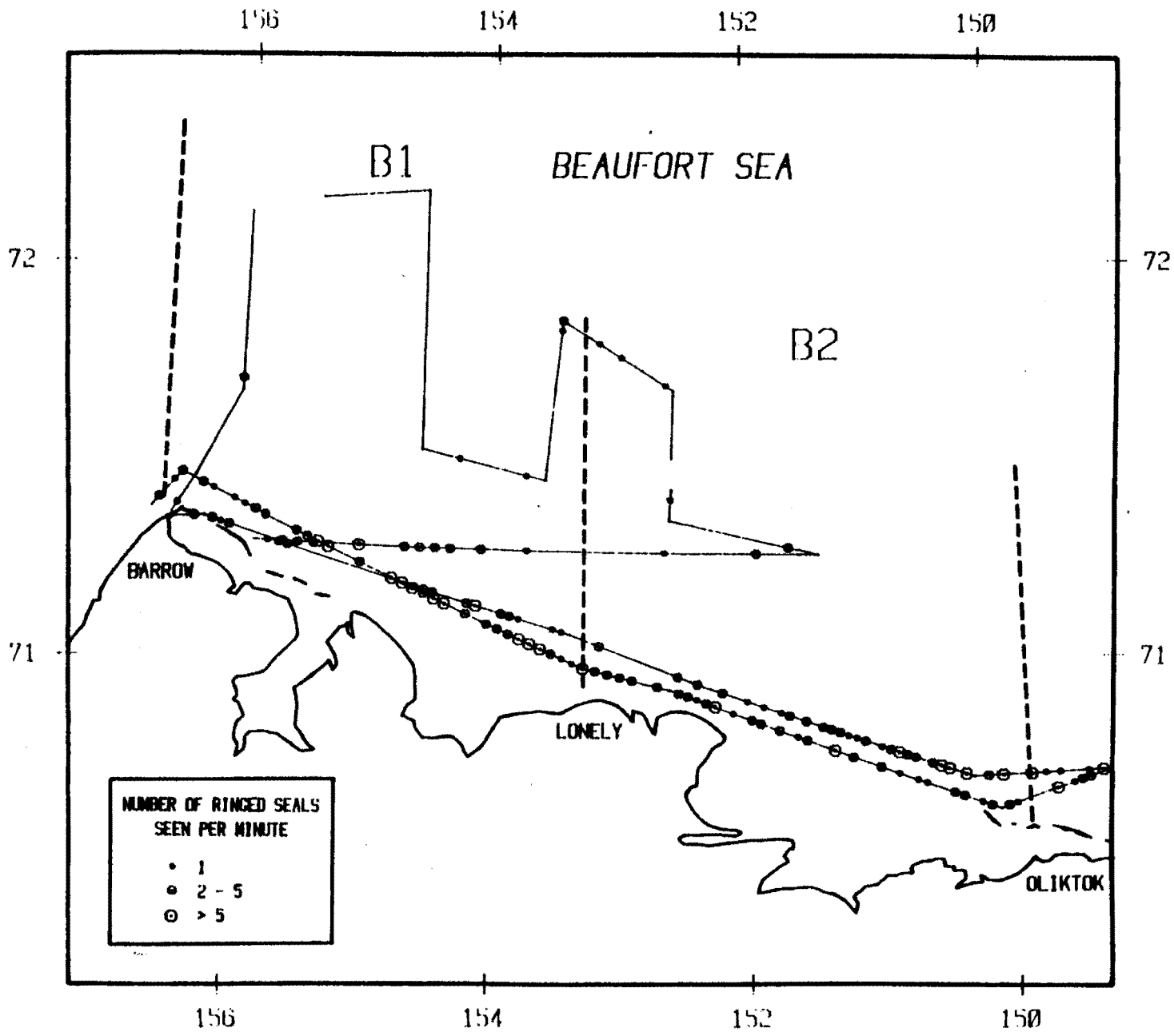

Figure A-7. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 12-15 June 1976.

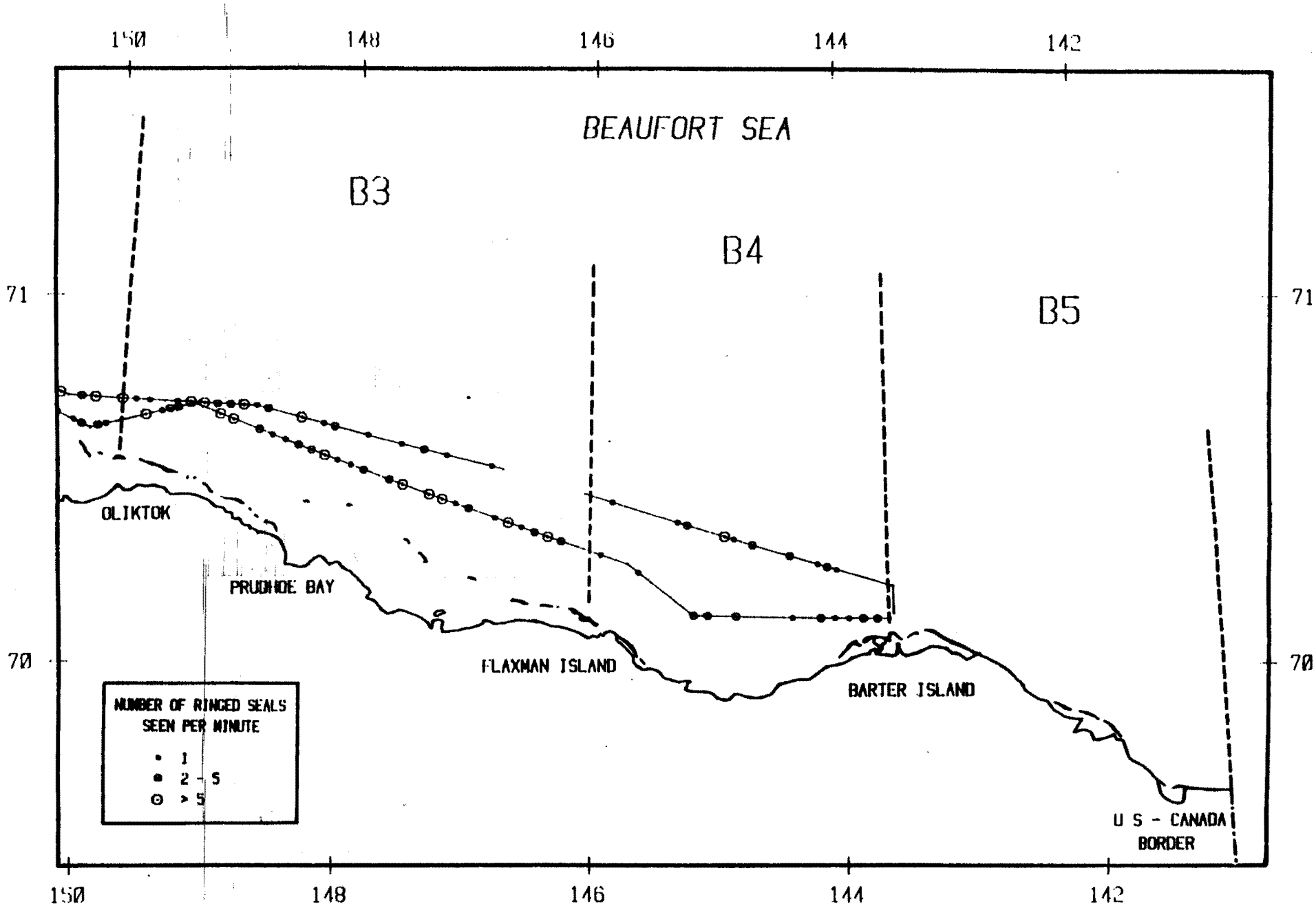

Figure A-8. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 15 June 1976.

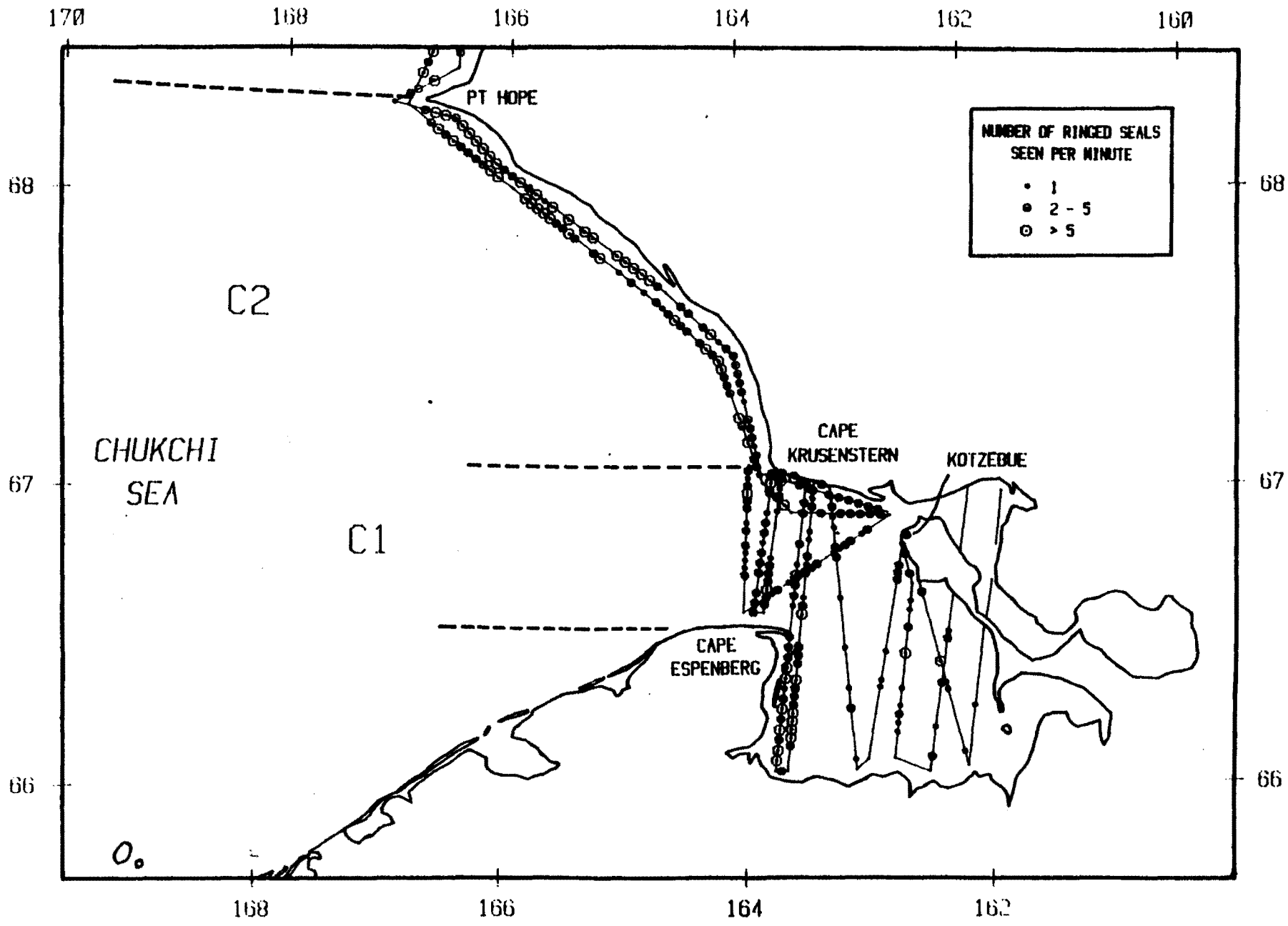

Figure A-9. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C1 and C2, Chukchi Sea, 10-12 June 1976.

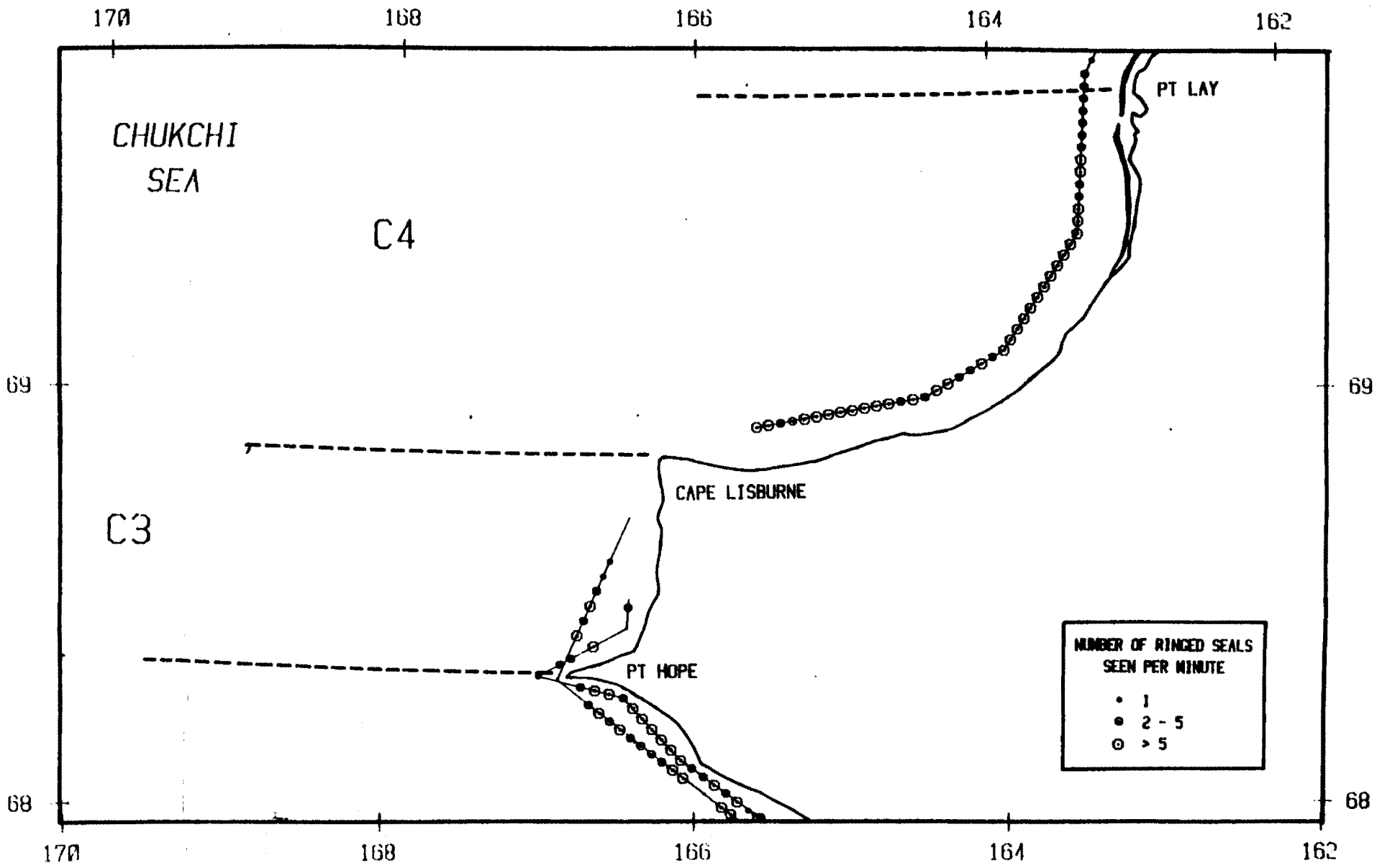

Figure A-10. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C3 and C4, Chukchi Sea, 10-12 June 1976.

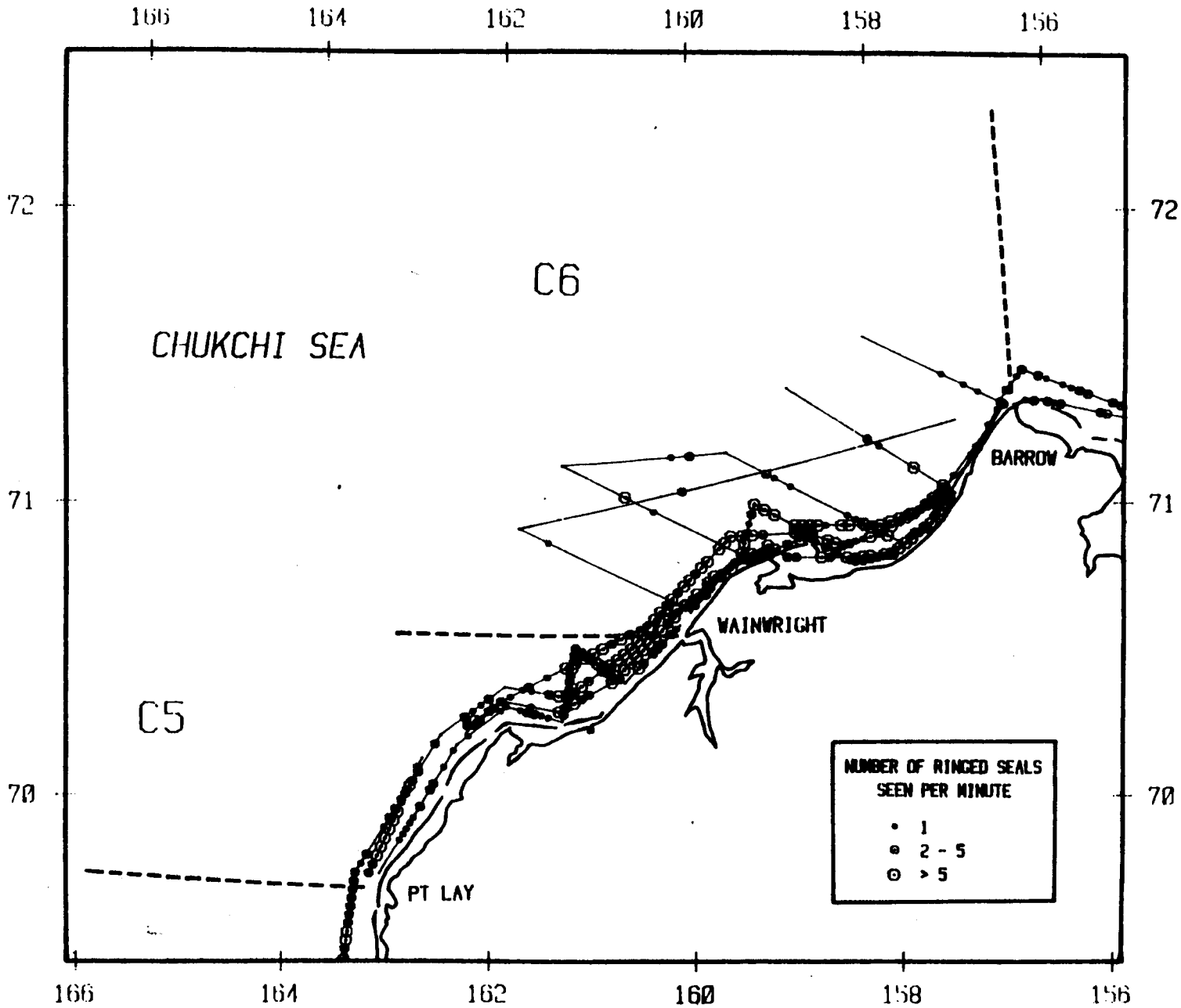

Figure A-11. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C5 and C6, Chukchi Sea, 10-16 June 1976.

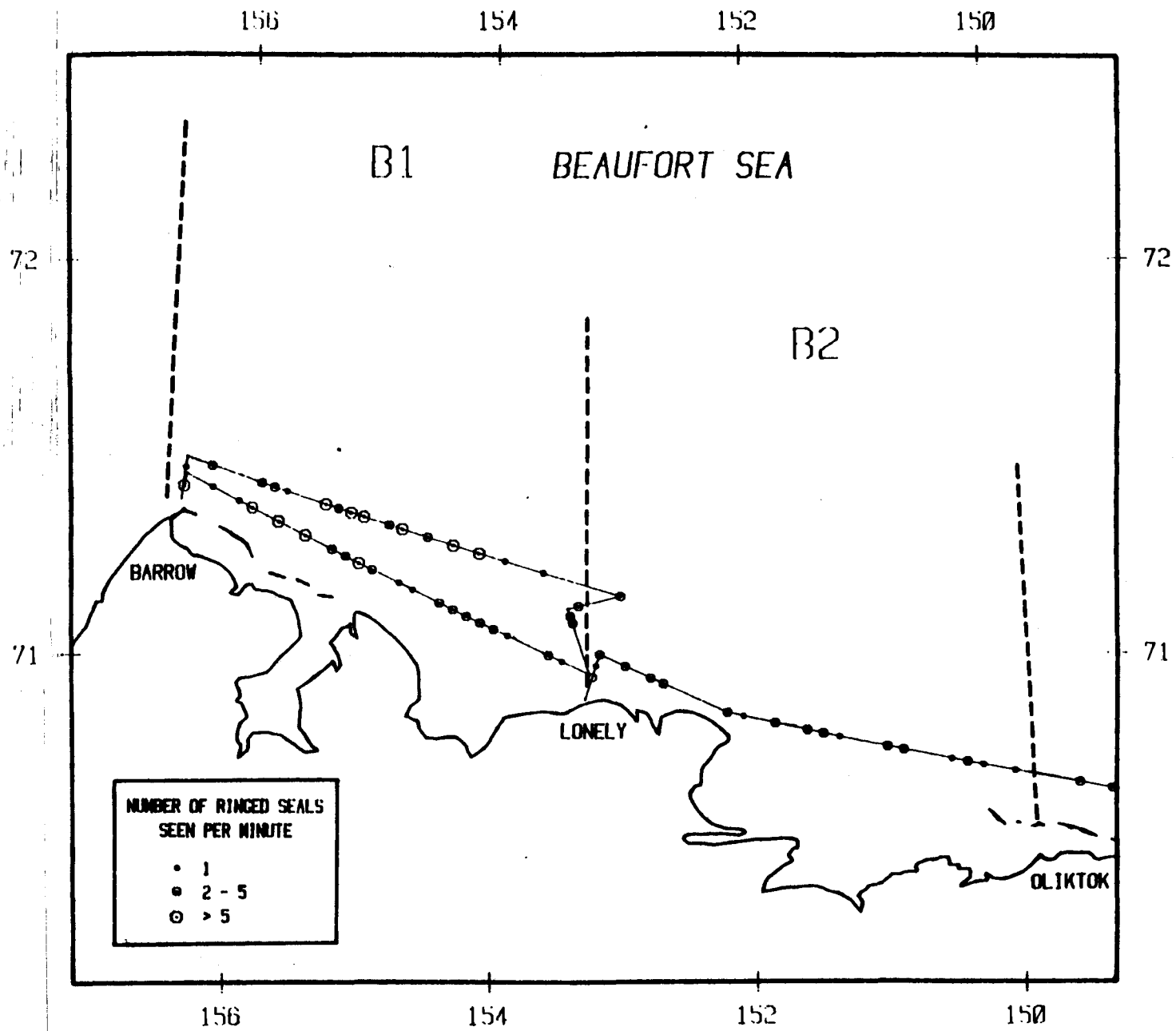

Figure A-12. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 14-16 June 1977.

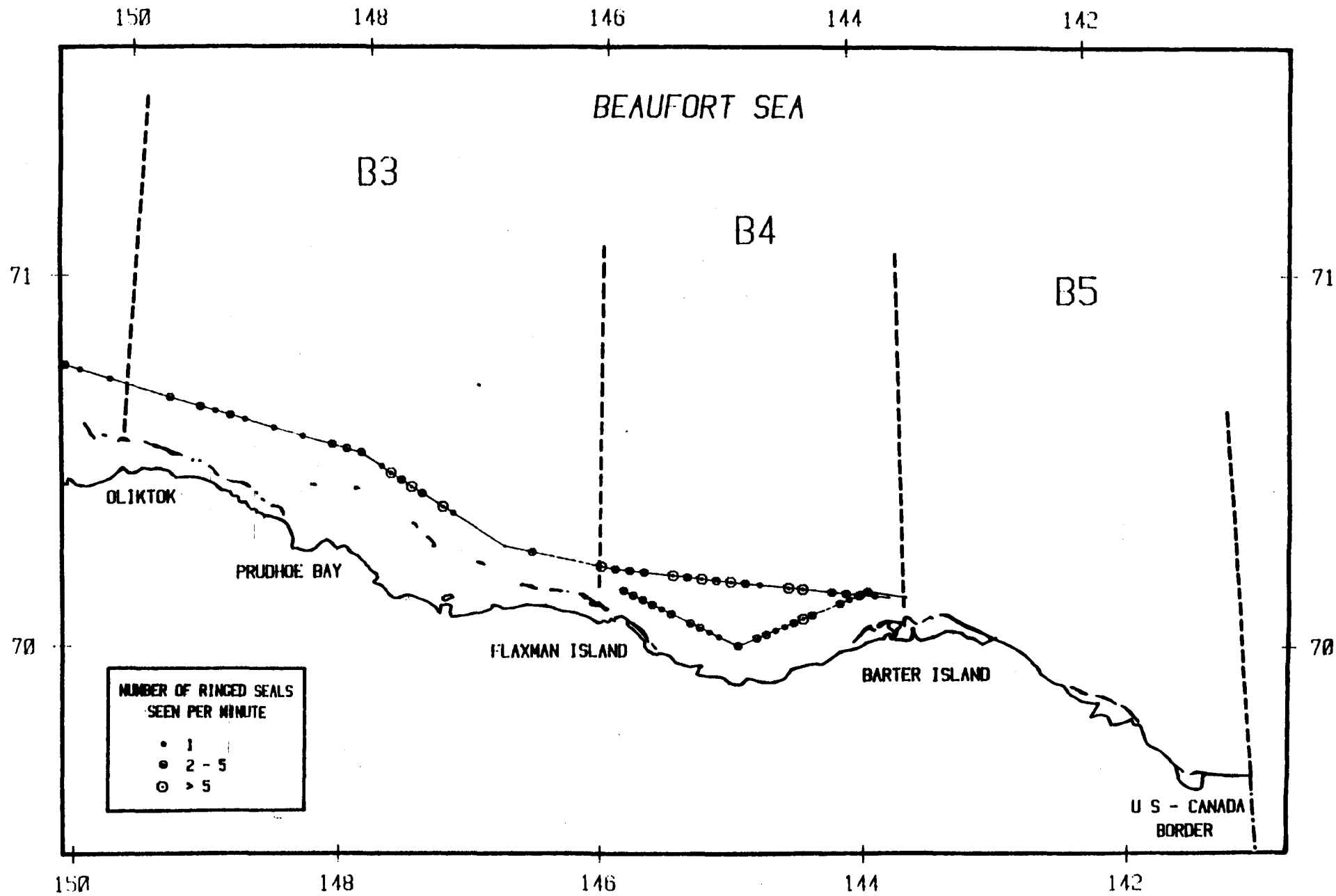

Figure A-13. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 14 June 1977.

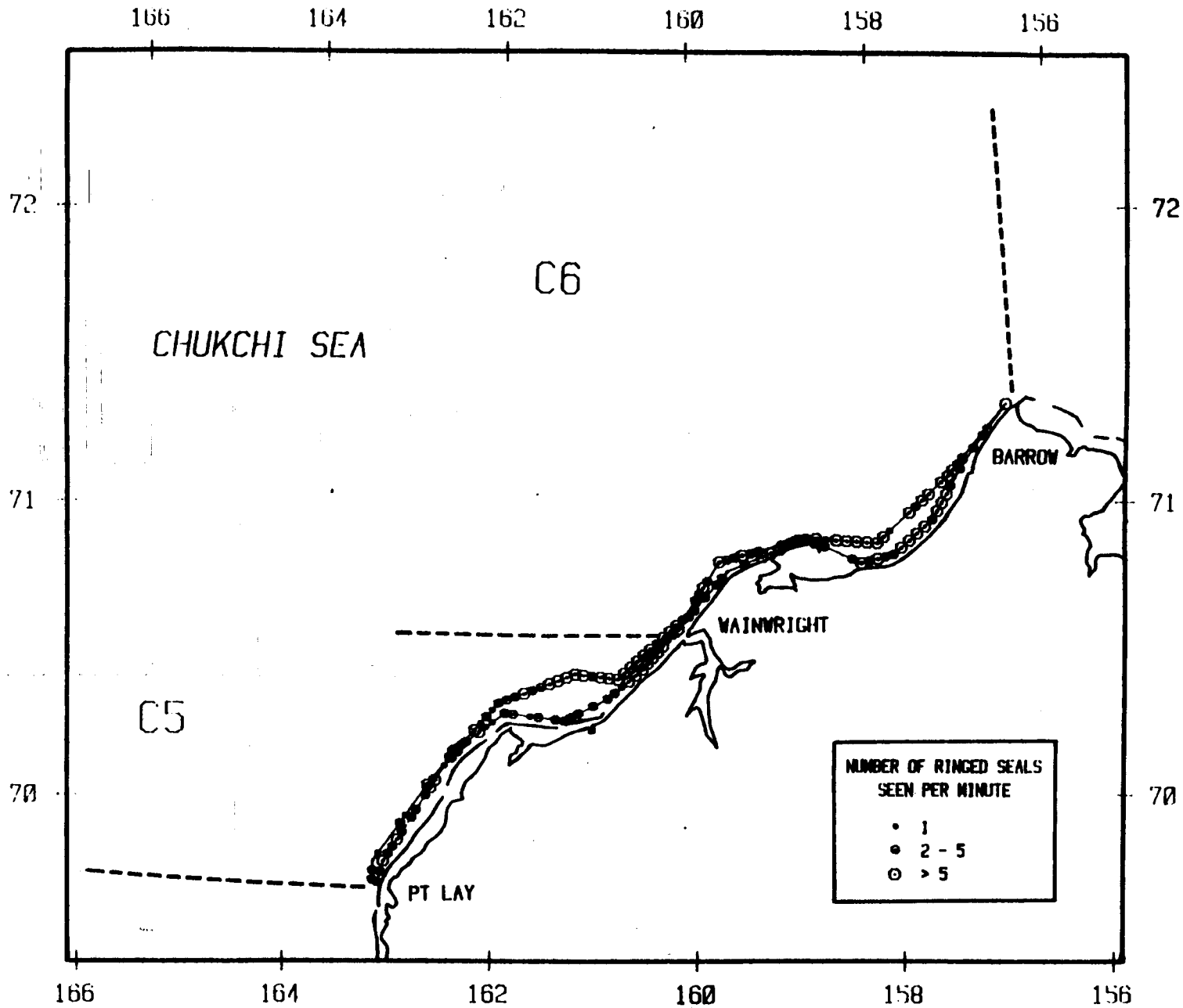

Figure A-14. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C5 and C6, Chukchi Sea, 13 June 1977.

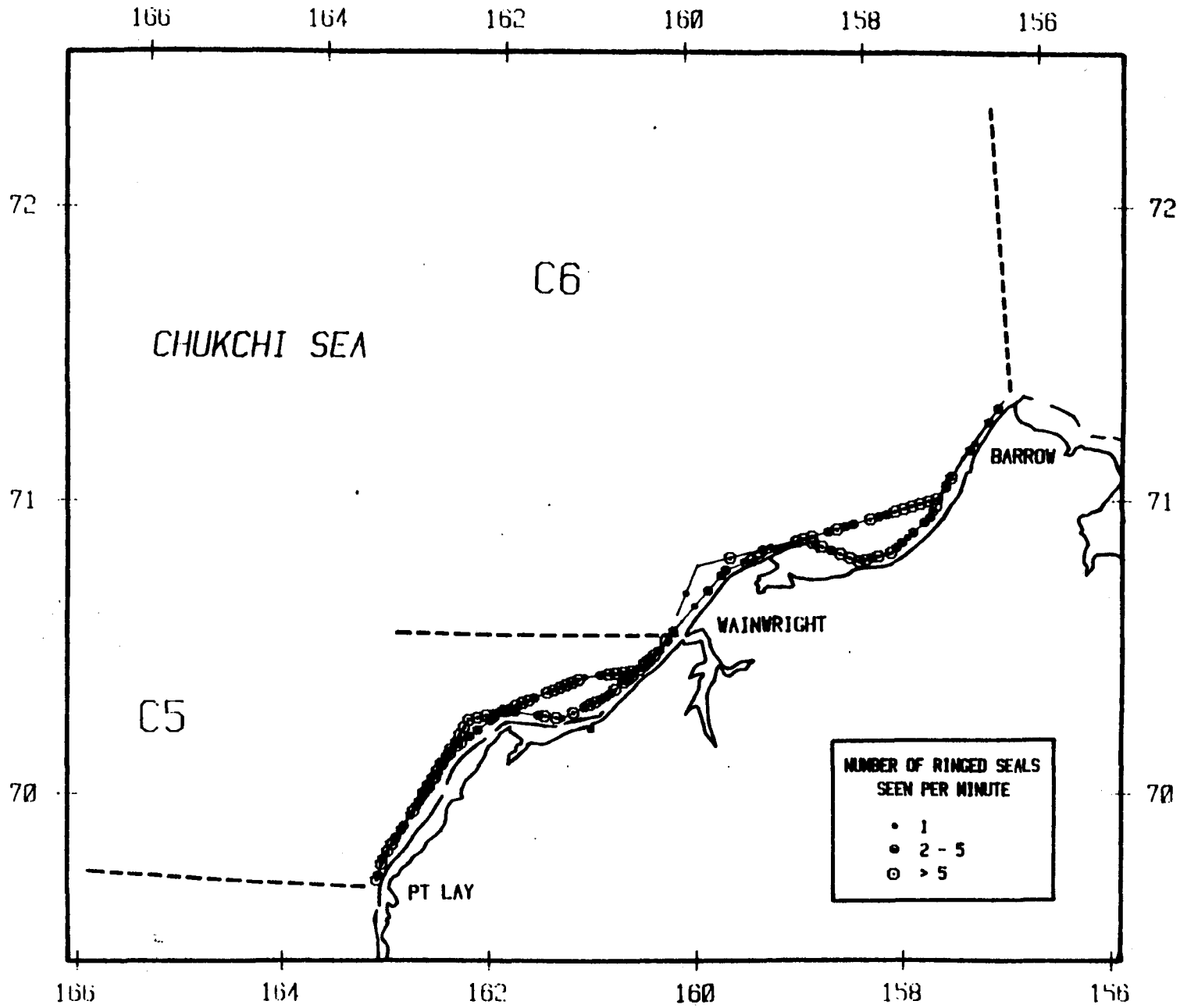

Figure A-15. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C5 and C6, Chukchi Sea, 6 June 1978.

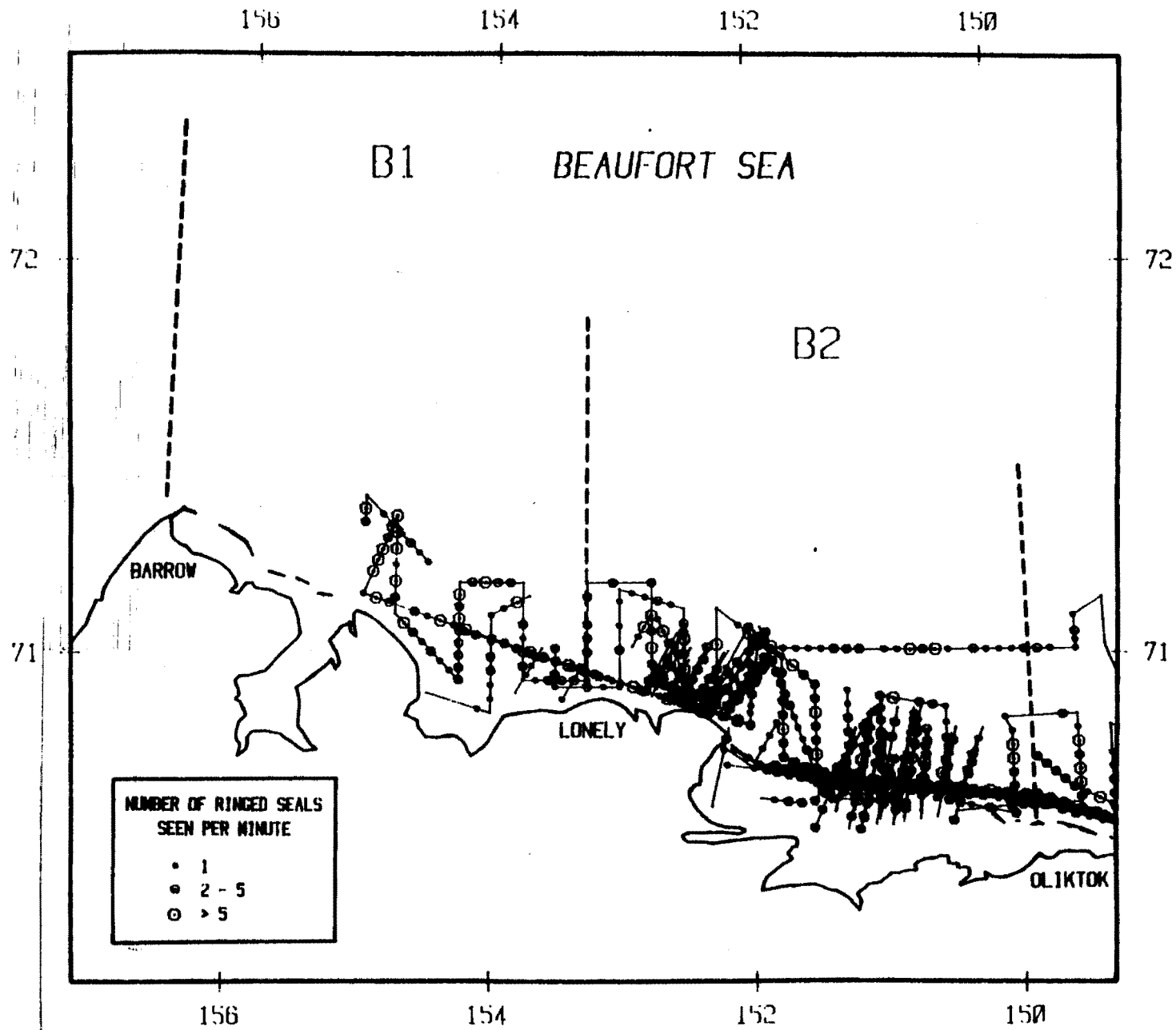

Figure A-16. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 2-9 June 1981.

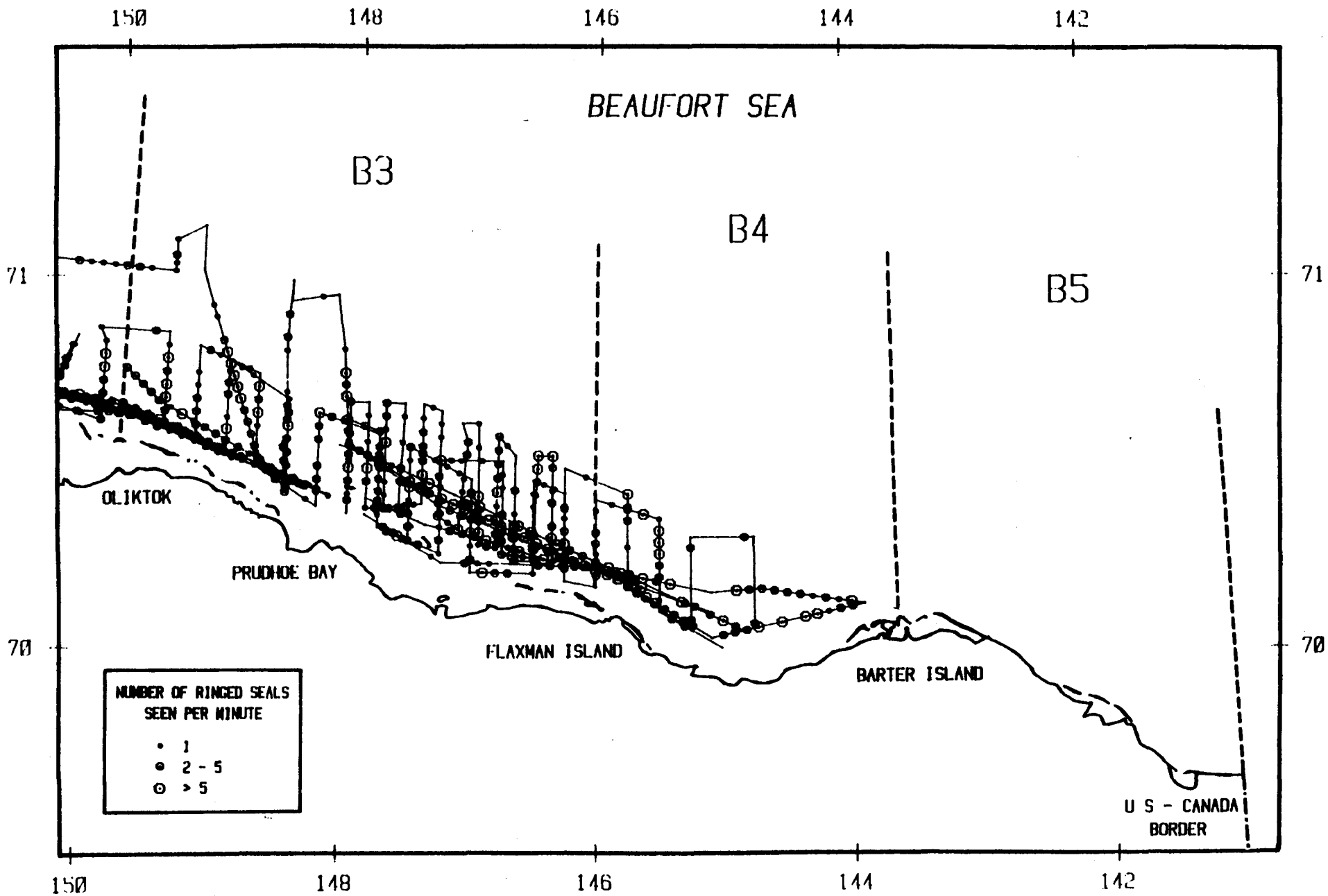

Figure A-17. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 2-9 June 1981.

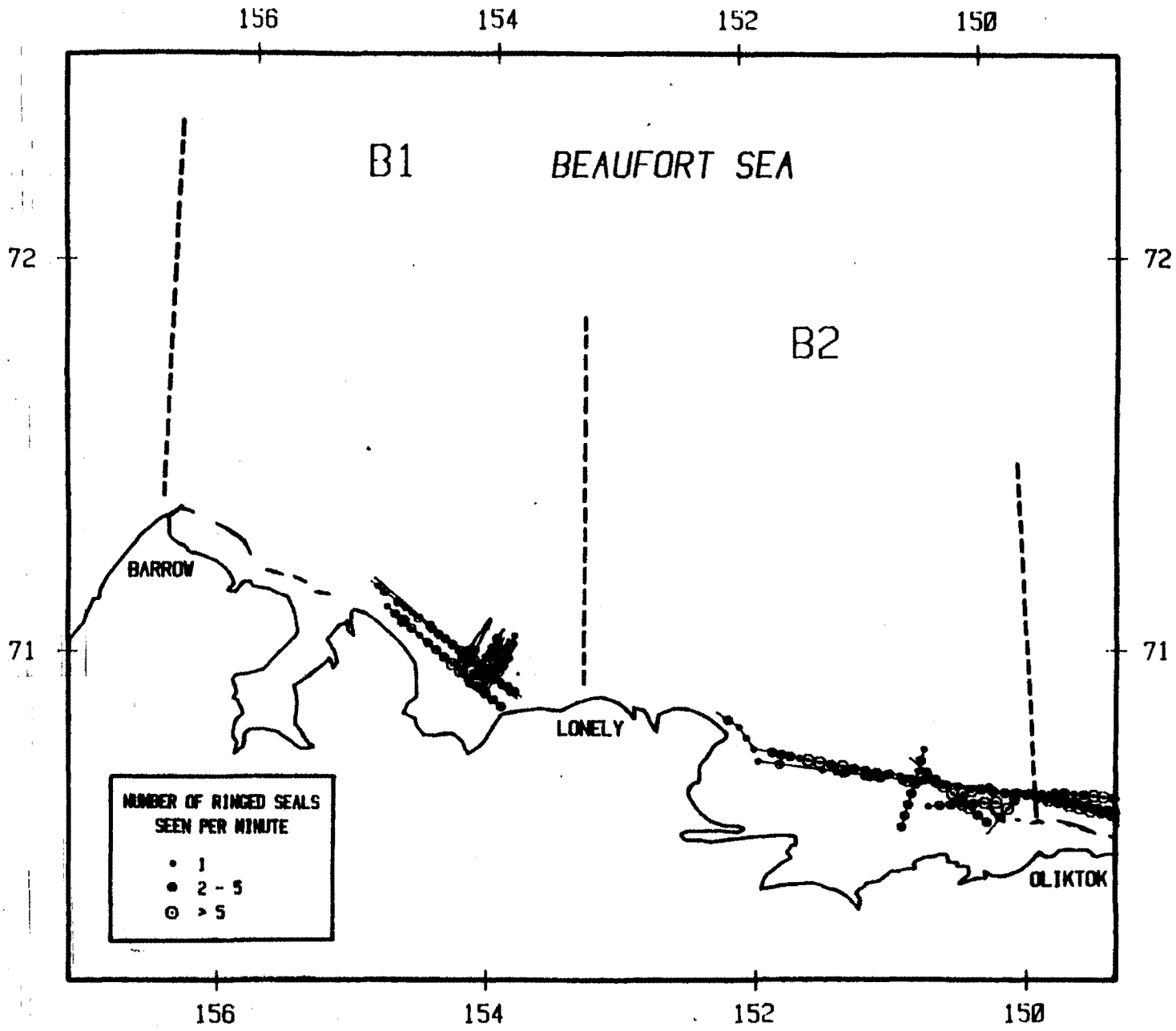

Figure A-18. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B1 and B2, Beaufort Sea, 25 May-3 June 1982.

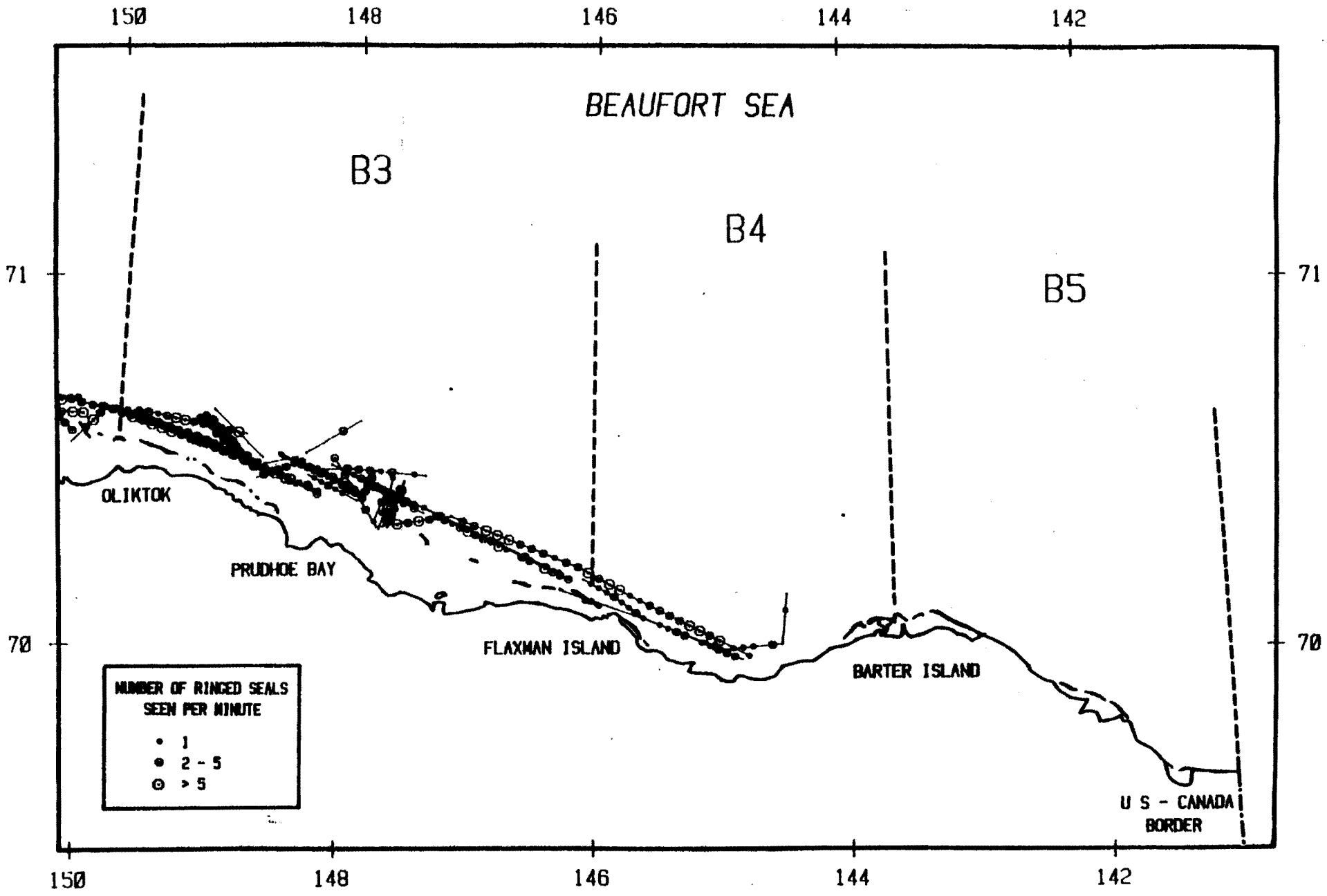

Figure A-19. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors B3 and B4, Beaufort Sea, 25 May-4 June 1982.

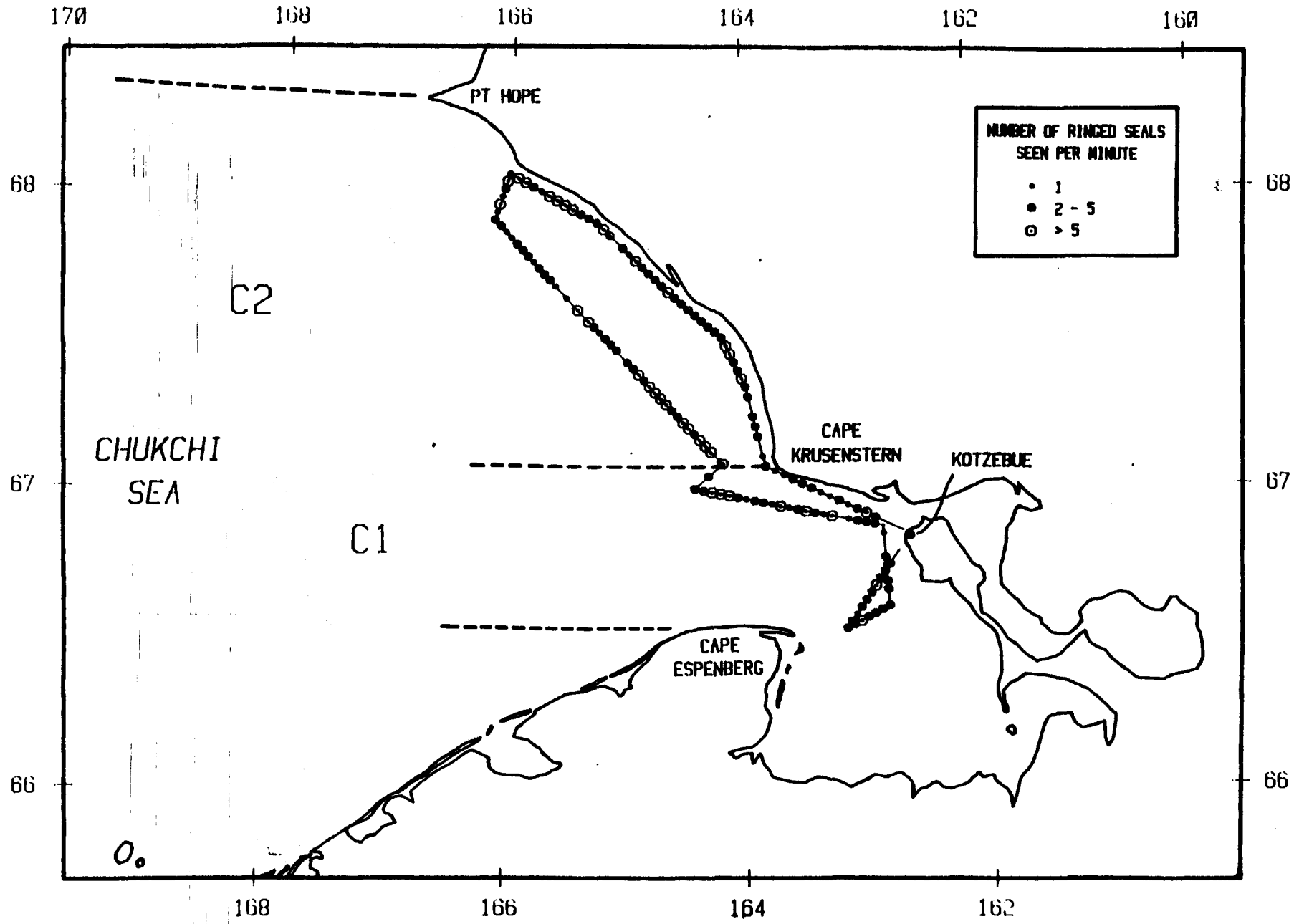

Figure A-20. Plot of ringed seal sightings from aerial surveys flown by ADF&G in sectors C1 and C2, Chukchi Sea, 16 May 1984.

Appendix B

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

BILL SHEFFIELD, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701

July 1, 1985

George Lapiene
NOAA/Ocean Assessments Division
Alaska Office
701 C Street
P.O. Box 56
Anchorage, AK 99513

Dear George:

According to our contract for the ringed seal project, RU #667, I'm supposed to submit a field operations report to you upon completion of OCSEAP-provided logistics support. I have forwarded to you under separate cover a copy of the letter written to Moran concerning the flight crew. As stated in that letter, we were able to complete virtually all aspects of the survey, which included over 5,400 miles of actual on-track survey lines, largely because of the cooperation and competence of the chief pilot, Dan Eilers. Mr. Eilers did not simply fly the aircraft, but also paid attention to the scientific design and objectives of the project and made constructive comments about how best to use the aircraft to achieve the desired end.

The NOAA Twin Otter was highly satisfactory as a survey aircraft. The GNS functioned well throughout the trip and the ICS was adequate. For future surveys I would suggest that the plane be equipped with several spare microphones for the David Clark headsets, and at least one additional headset. It would also probably be a good idea to modify the ICS so that the pilot and co-pilot have the option to talk privately between themselves without being overheard by the rest of the aircraft. The current setup allows for isolation of the rear observers from the cockpit, but not for the reverse. The bubble windows worked well, but for colder weather surveys bleed air to prevent fogging would be necessary. While in Barrow Eilers, Crona, and myself inspected the bleed-air, anti-fogging system on the Otter under charter to the NMFS whale crew. Crona indicated that it should be a straightforward modification for the NOAA Otter.

Ground accommodations arrangements were entirely satisfactory. As you know, ADF&G was able to arrange for housing in Kotzebue and we should be able to do so again in future years. The flight crew would also be welcome to stay there if they so desired. The Cape Lisburne facility, as in previous years, was extremely cooperative. Fueling was a minor inconvenience as the pumping system to transfer fuel to and from the 200-gallon tank was not adequately vented. NARL is an excellent base of

operations particularly if arrangements can be made with the DEW site for use of hanger space to do maintenance.

The on-board computer system has great promise but this year was of limited use for ringed seal surveys. Because we didn't know about the system more than a week or two in advance, there was inadequate time to develop appropriate software. Hardware capabilities are excellent, and the existing software written by Bennet is well-designed for whale surveys. Pinniped surveys, however, entail numerous sightings within one-minute intervals as well as a variety of environmental information, also recorded every few minutes; the software requirements for entry of such data are considerably different than for whale data. We did find the system very useful this year for marking begin and end points of legs and for marking positions of things such as polar bears, belukhas, seismic lines, artificial islands, shear zones, and the edge of the shore lead.

Prior to next year's survey it will be necessary to write software specific to seal surveys (it should also be useful for walrus surveys). I anticipate using the on-board system for real-time recording of environmental data, beginning and ending coordinates of legs, and for marking other positions of interest. Ideally, additional software will also be written for later (nights or weather days) entry of seal sightings, which can then be merged with the real-time data set. Since our office does not own or use an HP it will be necessary to borrow an HP85 from OCSEAP in order to write the software, or to contract someone else to do it. Additionally, it will be necessary to transfer data from the HP system to an IBM PC for analysis. If the NOAA/OCSEAP office in Anchorage had the appropriate hardware link between the two systems it should be very easy to copy data from an HP to an IBM PC in your office.

I have enclosed a table with the dates, sectors, and approximate number of hours and miles on transect flown during the May-June ringed seal surveys. We were able to complete all sectors except C3 (Point Hope to Cape Lisburne), where ice conditions were inappropriate for survey, and B5 (Barter to Demarcation) where we ran out of flight hours.

Thank you for the many logistical arrangements you made that contributed to the success of the project. As always, it has been a pleasure to work with you. I look forward to using the NOAA Twin Otter again in the future.

Sincerely,

Kathy Frost
Marine Mammals Biologist
Division of Game
(907)456-5156

Enclosure

cc: Paul Becker
Dan Eilers

Table 1. Miles on track and hours flown during ringed seal aerial surveys, 20 May-14 June 1985.

Date	Sector	Area	# Hours	# Miles on Track
21 May	C1	Kotzebue Sound	5.5	498
22 May	C2	Cape Krusenstern - Pt. Hope	5.5	220
23 May	C1	Kotzebue Sound	5.4	269
24 May	Commute	Kotzebue - Cape Lisburne	1.0	-
24 May	C4	Cape Lisburne - Pt. Lay	3.7	154
25 May	C4	Cape Lisburne - Pt. Lay	1.8	48
26 May	Commute	Cape Lisburne - Barrow	1.8	-
27 May	C5, C6	Pt. Lay - Wainwright - Barrow	6.3	317
28 May	B2	Lonely - Oliktok	6.0	341
30 May	C6, B1	Wainwright - Barrow - Lonely	6.5	387
1 June	B2	Lonely - Oliktok	3.5	176
2 June	B2	Lonely - Oliktok	5.1	374
3 June	B4	Flaxman - Barter	4.6	231
5 June	B3	Abort due to weather	1.0	-
7 June	B3	Oliktok - Flaxman	6.2	451
8 June	B3	Abort due to weather	1.3	-
9 June	B3	Oliktok - Flaxman	5.8	493
10 June	B4	Abort due to weather	1.2	-
11 June	B2, B3	Oliktok - Flaxman	7.1	628
12 June	B3, B4	Oliktok - Flaxman -		
	B5	Barter - Demarcation	6.7	461
13 June	B1, B2	Barrow - Lonely - Oliktok	6.8	390
		Totals	92.8	5,438