BI-AK83

Semi-Annual Report
October 1983
Contract No. 83ABC00067
Research Unit No. 639

DISTRIBUTION OF LARVAL AND JUVENILE RED KING CRABS IN THE NORTH ALEUTIAN BASIN

Gregory McMurray
Allan H. Vogel

VTN Oregon, Inc.
25115 SW Parkway
Wilsonville, OR 97070

Paul A. Fishman

Environmental Consulting
Portland, OR

David Armstrong

Aquatic Research Consulting Services
Seattle, WA 98915

October 1983

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION 1.0

TASK OBJECTIVES

The purpose of the present study is to provide sufficient information on larval and juvenile red king crab distributions and associated environmental variables to reasonably describe the potential effects of oil and gas exploration and development on the crab population and its fishery. Specific objectives of the program have been developed to provide relevant data and to apply these data toward a comprehensive assessment of red king crab vulnerabilities. These objectives include:

1) Collect and measure larval red king crabs, identify them to growth stage and assess their apparent spatial distributions on the North Aleutian Shelf;

2) determine the apparent spatial distribution and changes in individual size of juvenile red king crabs (<60 mm carapace length) in the study area;

3) identify correlations between the physical environment of the North Aleutian Basin and the apparent distribution and relative abundance of larval and juvenile red king crabs; and

4) contribute to an overall understanding of OCS oil and gas development effects on red king crab populations and fisheries for this species.

SECTION 2.0

FIELD ACTIVITIES

2.1 Ship Schedule and Scientific Personnel

Three cruises were scheduled for this project; all have been completed. In addition, opportunistic sampling for decapod larvae along the 50 m isobath from Port Moller to Unimak Island was performed on 27 May 1983 during the Blue King and Korean Hair Crab cruise (RP-MF-83A, Leg 11) to the Pribilofs. The NOAA ship Miller Freeman was used for all cruises.

2.1.1 Cruise 83-1 (RP-MF-83A, Leg 1}, 18 April to 7 May 1983

Personnel: AlIan H. Vogel, VTN Oregon, Chief Scientist
Thomas Moylan, Clatsop Community College
Stephen C. Jewett, North Pacific Research
Anamaria Escofet, Aquatic Research Consulting Services

2.1.2 Cruise 83-3 (RP-MF-83A, Leg III), 2-17 June 1983

Personnel: Paul A. Fishman, VTN Oregon, Chief Scientist
Gregory McMurray, VTN Oregon
David A. Armstrong, Aquatic Research Consulting Services
Peter Hagen, International Pacific Halibut Commission
Tom Shirley, University of Alaska, Juneau
Rich Hevner, Clatsop Community College

2.1.3 Cruise 83-5 (RP-MF-83B, Leg II), 9-23 September 1983

Personnel: Allan H. Vogel, VTN Oregon, Chief Scientist
Ronald A. Simmons, VTN Oregon
Chris Rogers, Aquatic Research Consulting Services
Peggy Russel, Aquatic Research Consulting Services
Tim McGinnis, Williamson and Associates

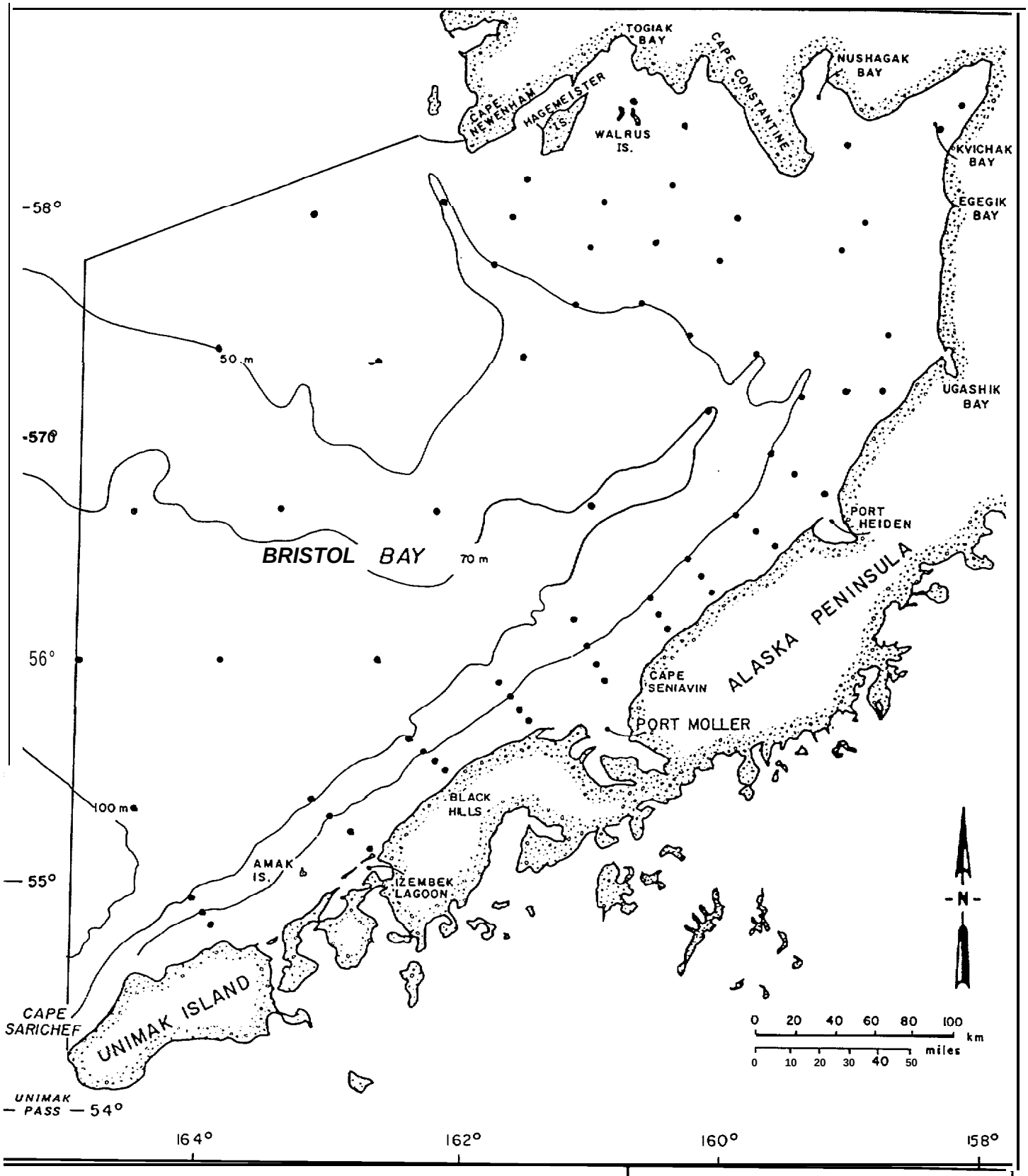
2.2 Methods

Depth-specific temperature and conductivity was collected with the Miller Freeman's CTD system. Conductivity was converted to salinity using a computer algorithm. The bottom was routinely surveyed by Simrad fathometer at each station during all three scheduled cruises. Side-scan sonar (SSS) mapping of the bottom was performed at selected stations during September in an attempt to refine the description of bottom habitat, and aid in the evaluation of juvenile crab habitat. Sediment samples were collected by Van Veen and Shipek grabs during cruises 83-1 and 83-3 for subsequent laboratory analyses. Additional Shipek samples were collected during September to "ground truth" SSS records.

Plankton samples were collected by vertically hauled, metered Bongo nets or horizontally towed Tucker trawls and neuston samples. Epifaunal samples were collected with a trynet or a modified rock dredge. The rock dredge was generally used where bottom conditions were too rough for trawling, as determined by fathometer traces or other methods. Some use of Dungeness and shrimp pot was also attempted.

2.3 Sample Locations and Data Collected

The sampling locations for the three scheduled cruises are presented in Figures 1 through 3. The types of data collected and quantities are shown in Table 1.



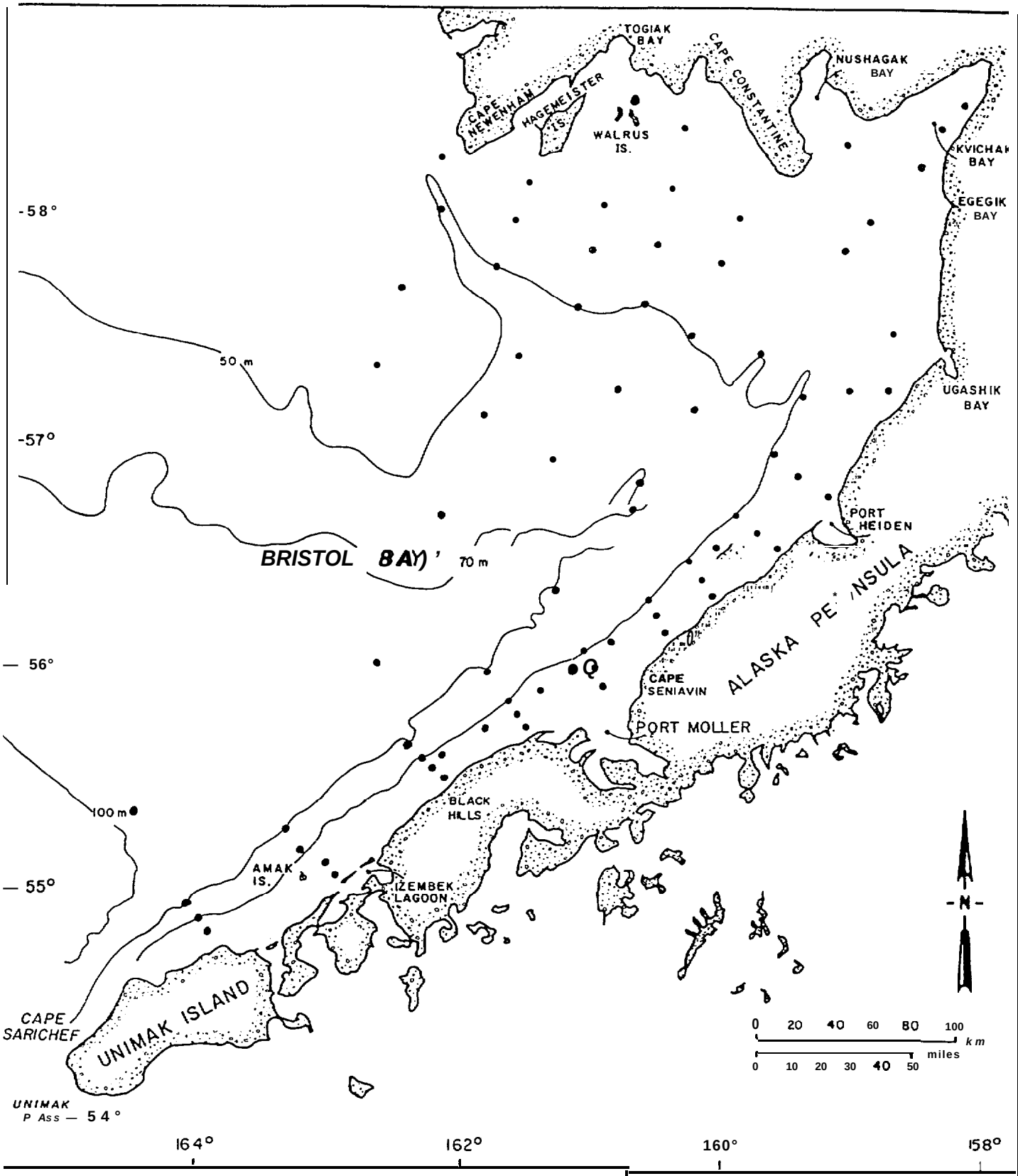
• = SAMPLING STATION

——— = STUDY AREA BOUNDARY

CRUISE 83-1 SAMPLING STATIONS

OCTOBER 1983

FIGURE 1

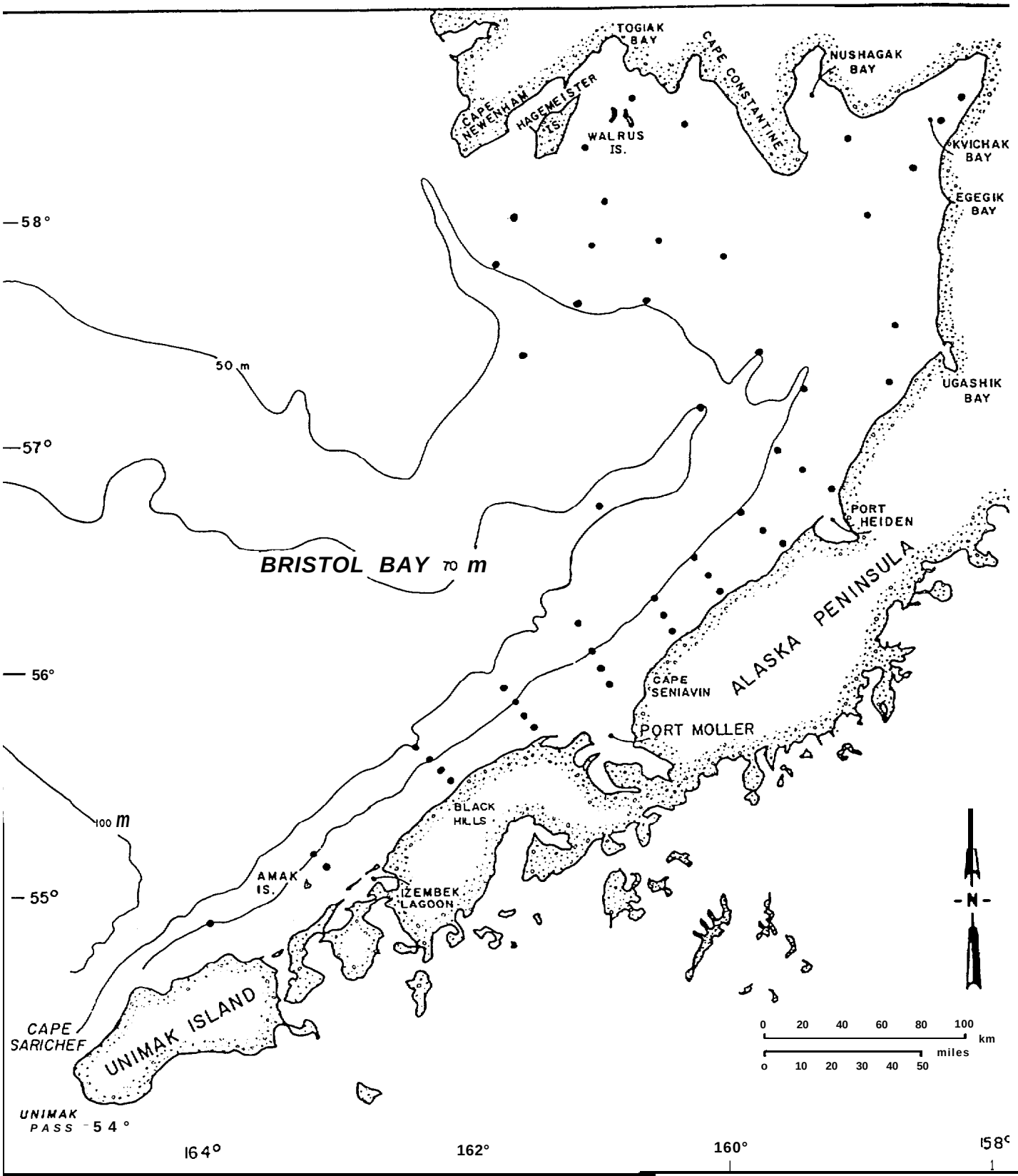


• † SAMPLING STATION

CRUISE 83-3 SAMPLING STATIONS

OCTOBER 1983

FIGURE 2



• = SAMPLING STATION

CRUISE 83-5 SAMPLING STATIONS

OCTOBER 1983 | FIGURE 3

TABLE 1

SUMMARY OF FIELD DATA COLLECTION

Cruise	83-1	83-2	83-3	83-5
Survey Stations Occupied (Planned)	69(72)	16(17)	88(64)	47(48)
CTD	76		76	47
Van Veen bottom grab	2			
Shipek bottom grab	46		20	12
Rock dredge	51		42	16
Trynet otter trawl	50		78	35
Oblique Bongo net tow	77	16	79	24
Tucker trawl	16		6	-
Sameoto Neuston sampler tow	4			
Shrimp pot	3		12	-
Crab pot			5	
Side-scan sonar surveys (hrs/nm)			-	19.6/52
Simrad fathometer surveys (hrs/nm)	12.3/-	-	16.0/97	22.0/68

SECTION 3.0

LABORATORY ACTIVITIES

3.1 Schedule

Laboratory analysis for sediment size and larval enumeration began in May and is scheduled to be completed by the end of October. Grain size analysis of the sediment samples has been completed and the resulting data are presently being coded for entry into the computerized data base. Larval and hydrographic data entry and analysis has begun. The epifaunal field coding forms have been proofed and entered onto computer floppy disc, and listings from the discs have been proofed. Final disc copies are presently being prepared and these will be read to a master tape.

3.2 Methods

Larvae. The preserved samples were first either subsampled using a Folsom plankton splitter or rough sorted for decapod larvae in their entirety. The decision of whether to sort the entire sample or to split it depended on its size and condition. The general, though subjective, rule governing this decision was that if the sample was clean and had a volume greater than 0.15 liter, it was subsampled. Samples were considered clean if the volume of gelatinous zooplankton was low and there were no large phytoplankton aggregations, both of which would interfere with splitting.

A number of the samples were replicated from each cruise to confirm the calculated level of confidence. All counted samples and splits were saved separately for any necessary future verification. Counts were recorded on the standard VTN larval decapod coding sheet. The raw counts will be converted into population density data. For the rarer

stages the conversion is merely division of the total number counted by the volume (m3) and area (m2) from which the sample was collected. Where aliquots were taken, the density values obtained are then multiplied by the reciprocal of the size of the split used.

Juveniles. The identifications of organisms in each epifaunal sample, as well as the number of individuals and total weight by taxon, were recorded on coding forms in the field. Individual lengths and weights of red king crabs and other dominant invertebrate and fish species were also recorded.

Wet weights of preserved post-larval crabs were measured in the laboratory. These animals will be archived for possible future work not funded in this project, such as stomach content analysis.

3.3 Data Analysis

The grain size data will be analyzed to produce tables of grain size distribution, and the sorting index will be calculated. Results will be displayed as tables and as plotted distributions on a study area map.

The larvae will initially be described with a set of summary tables and density maps by stage and cruise. The initial statistical treatment will be a multiple correlation analysis, producing a correlation matrix between all of the included variables, after which multiple linear regression may be run on selected variables. Prior to statistical treatment, the data will be tested for normality, and if not normally distributed, the data will be transformed in order to obtain valid statistical results. For larvae, the proposed initial list of variables will be temperature and salinity at five and 10 meters depth, time of day, time of year, station position, bottom depth and maximum depth of tow. Multiple correlation analysis was selected as the initial statistical treatment because it is a mathematically-succinct method of determining the relative magnitude of different interactions within a

1 arge set of variables. In addition to the statistical analysis of relative abundance and apparent distribution, a final , more limited anal ysis wi 11 be performed on the Tucker trawl and neuston net samples. The possible presence of larval diel vertical stratification will be tested through a mixed-factor analysis of variance (ANOVA) statistical design.

Epifaunal data, including presence-absence, numerical density and biomass, will be analyzed using similarity analysis. The distribution of similar groups will be examined and plotted on study area maps, and tables will be produced listing the frequency and abundance values for species in each similar group. The distribution of red king crabs will be examined in relation to these groups. Data for juvenile and adult red king crab size and distribution have been placed in a separate data file.

Analysis of results from side-scan sonar use will be performed as time and budget allow. SSS traces and sediment samples will be compared in an attempt to describe the bottom types recorded by sonar. The distribution of epifauna from samples obtained concurrent with sonar traces will be examined. It is hoped that the use of sonar will refine the attempts to describe bottom habitat and its distribution in future studies.

A preliminary data analysis/synthesis meeting was conducted on October 19 with all members of the scientific team; another meeting is scheduled for mid-November.

SECTION 4.0

RESULTS

4.1 Physical and Sedimentary Data

Results are not yet available in summary form.

4.2 Larval Data

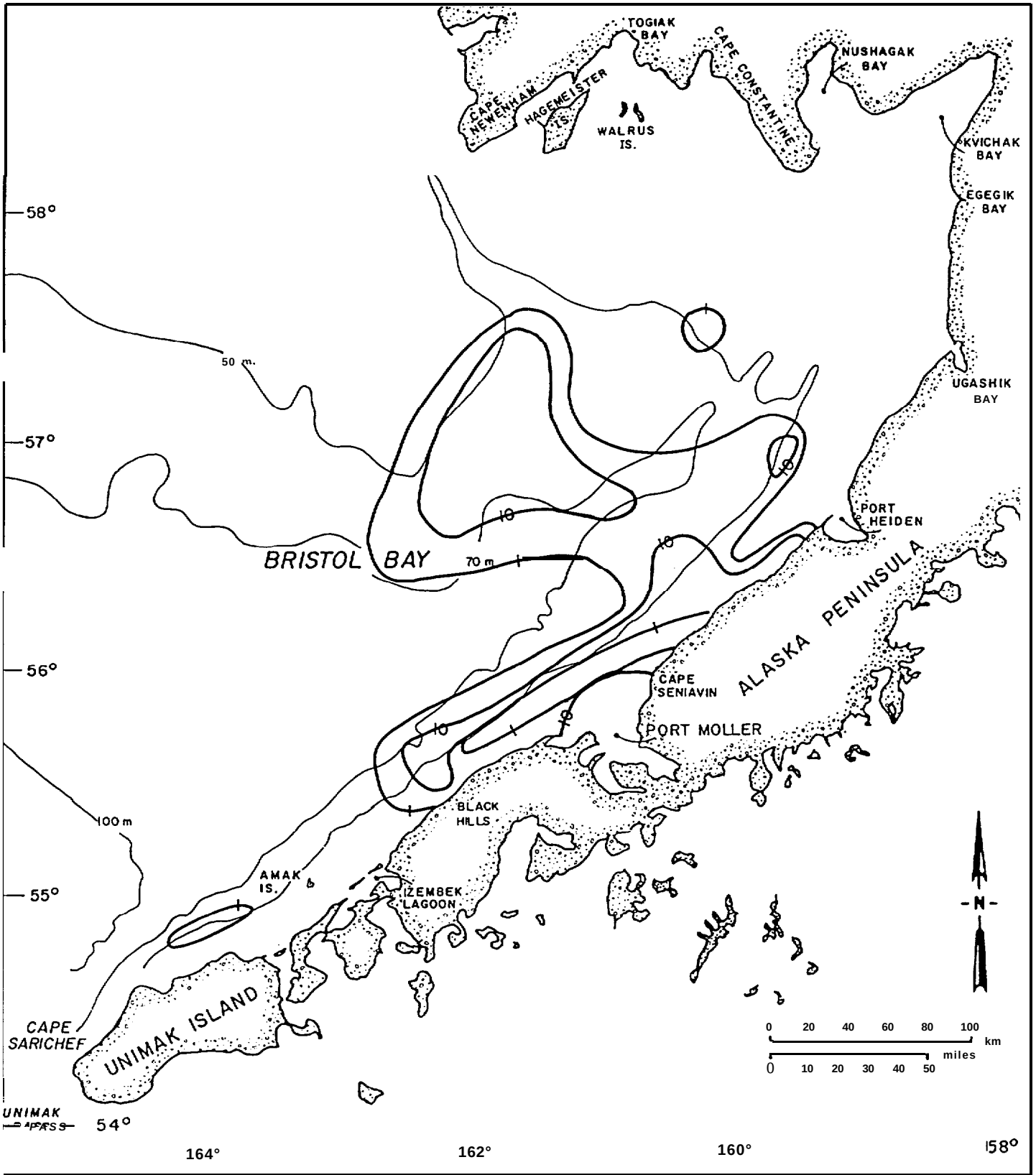
Preliminary distribution maps from the first two cruises are presented in Figures 4 and 5.

4.3 Juvenile and Adult Data

Table 2 presents a preliminary summarization of size data for juvenile and adult red king crabs. Preliminary distribution results are presented in Table 3. The distribution results for each cruise are shown in Figure 6.

4.4 Epifaunal Trawl Data

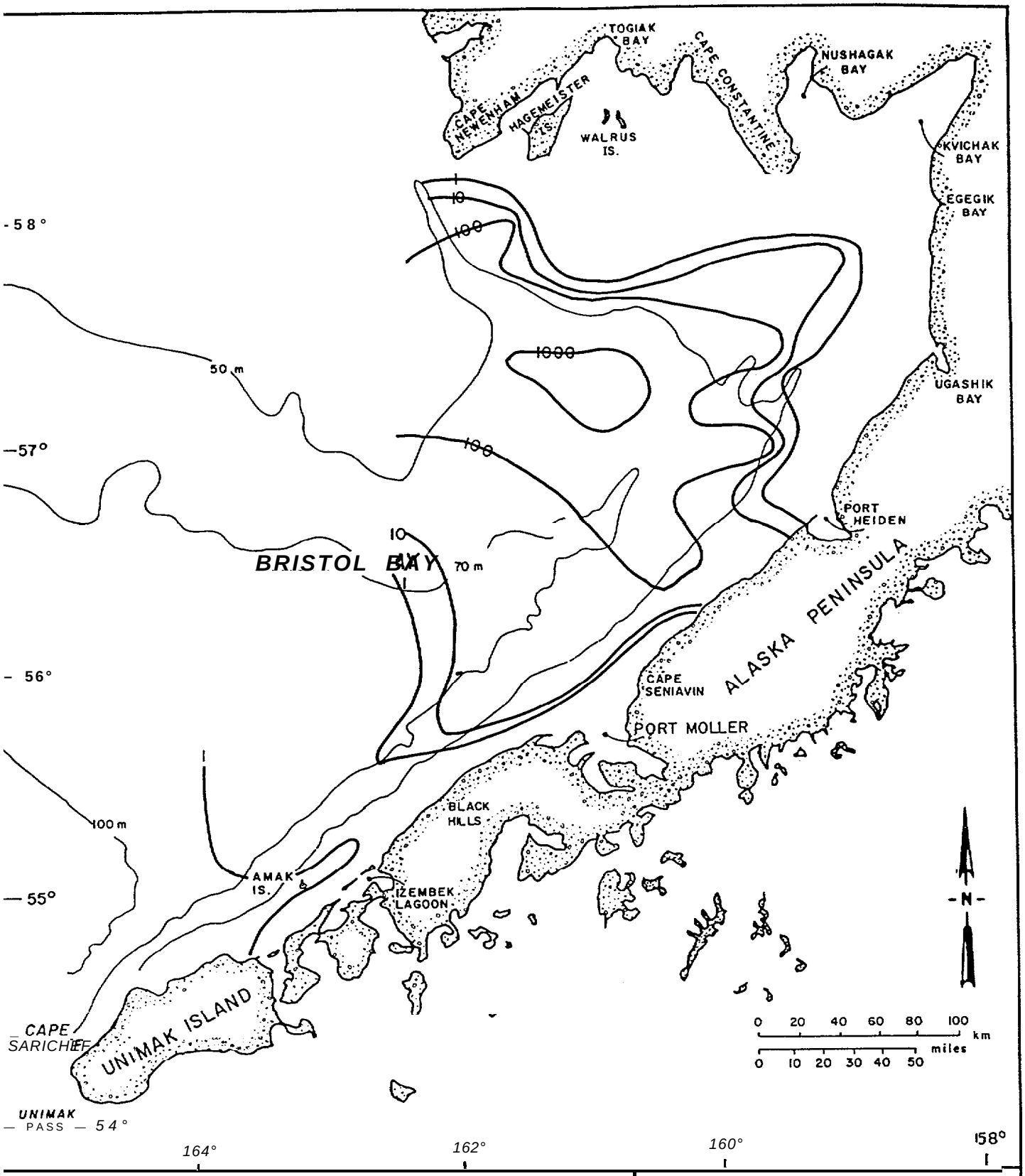
Results are not ready at this time.



—10— = NUMBERS OF RED KING CRAB LARVAE PER 1000 m^3

CRUISE 83-1 LARVAL DISTRIBUTION

OCTOBER 1983 | FIGURE 4



—10— = NUMBER OF RED KING CRAB LARVAE PER 1000 m^3

CRUISE 83-3 LARVAL DISTRIBUTION

OCTOBER 1983

FIGURE 5

TABLE 2

PRELIMINARY SUMMARY OF RED KING CRAB SIZE DATA

Sampling Date	Sex(a)	Size Range (mm)	Mean Size (mm)	Standard Deviation	Sample Size
April-May 1983 (Cruise 83-1)	M	4-133	59.13	42.42	77
	F	3-120	69.06	29.01	48
	OF	88-120	94.83	12.40	6
June 1983 (Cruise 83-3)	M	6-126	65.69	30.47	71
	F	6-120	65.05	29.46	59
	OF	92-120	103 ● 86	12.10	7
	u	3-25	7.88	7.02	8
September 1983 (Cruise 83-5)	M	3-118	8.60	13.41	78
	F	3-118	13*93	23.34	73
	OF	96-118	104.00	12.17	3
	u	3-29	5.38	4.68	32

(a) M = Male, F = Total female, OF = Ovigerous female, U = Undetermined.

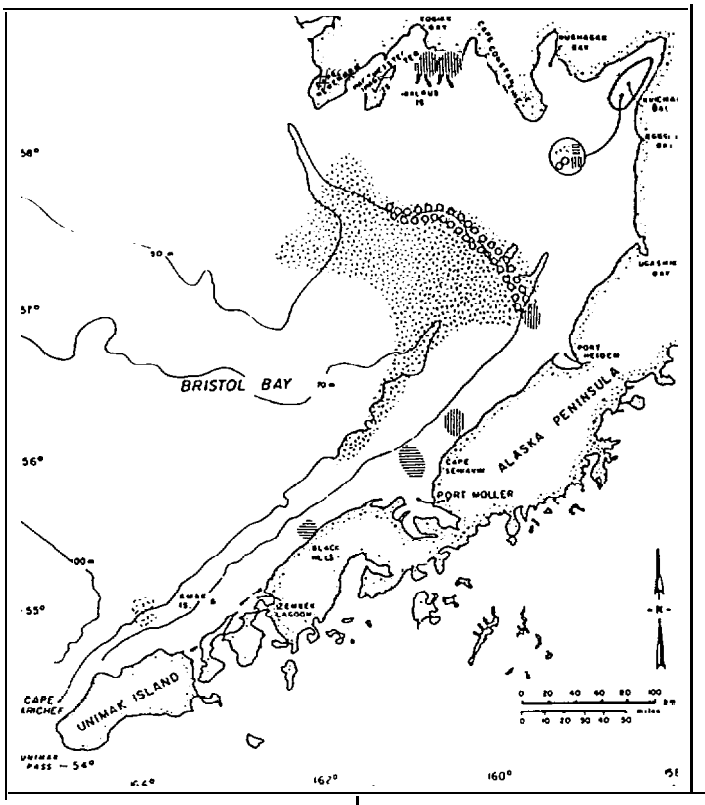
TABLE 3

PRELIMINARY SUMMARY OF APPARENT RED KING CRAB DISTRIBUTION

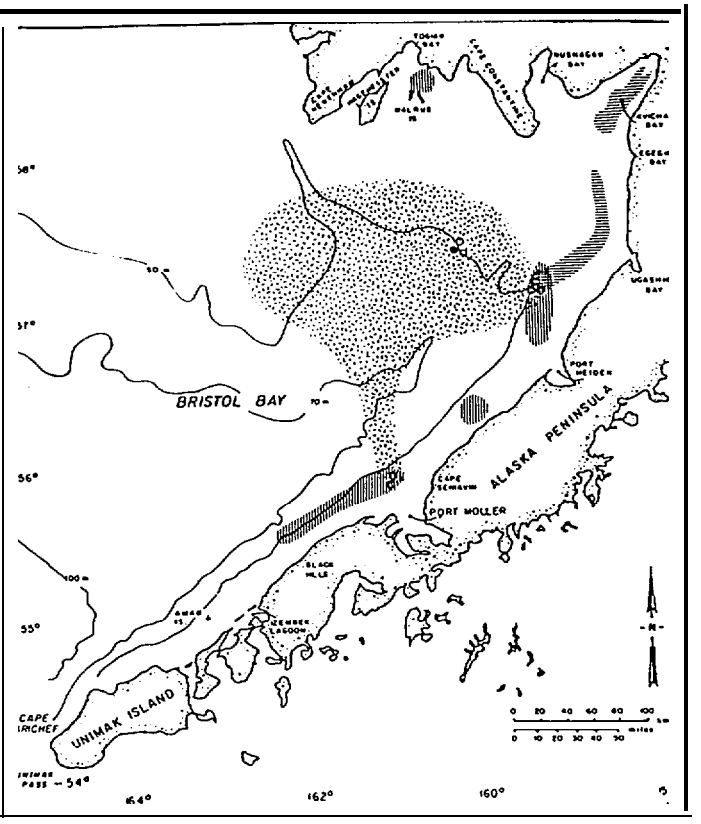
Sampling Date	Size (mm)	Distribution(a)
April-May 1983 (Cruise 83-1)	≤10	1 station off PM; 2 stations off PH; 1 station KB; 1 station WI
	>10-40	1 station BH; 2 stations off PM; several stations KB
	>40-60	4 stations offshore KB along 50 m isobath
	>60	11 stations in north-central BB at >50 m, with 1 station off PM; and 1 station off Unimak Island
June 1983 (Cruise 83-3)	≤10	6 stations in BH-PM area; 1 station between PMand PH; 2 stations off PH; 1 station WI
	>10-40	3 stations off PH-KB; several stations in KB
	>40-60	2 stations off PM; 1 station off PH at 50 m; 1 station in central BB at 50 m
	>60	North-central BB, ≥50 m, with extension toward PM
September 1983 (Cruise 83-5)	YOY(b)	1 station northeast off PM; 5 stations off PH-KB area
	>10-40	1 station off each of east and west corners of PM; 1 station off PH; stations in KB
	>40-60	None collected
	>60	4 stations along a line between PM and Cape Newenham, generally deeper than previously

(a) PM = Port Moller
PH = Port Heiden
KB = Kvichak Bay
WI = Walrus Island area
BH = Black Hills area
BB = Bristol Bay, offshore area

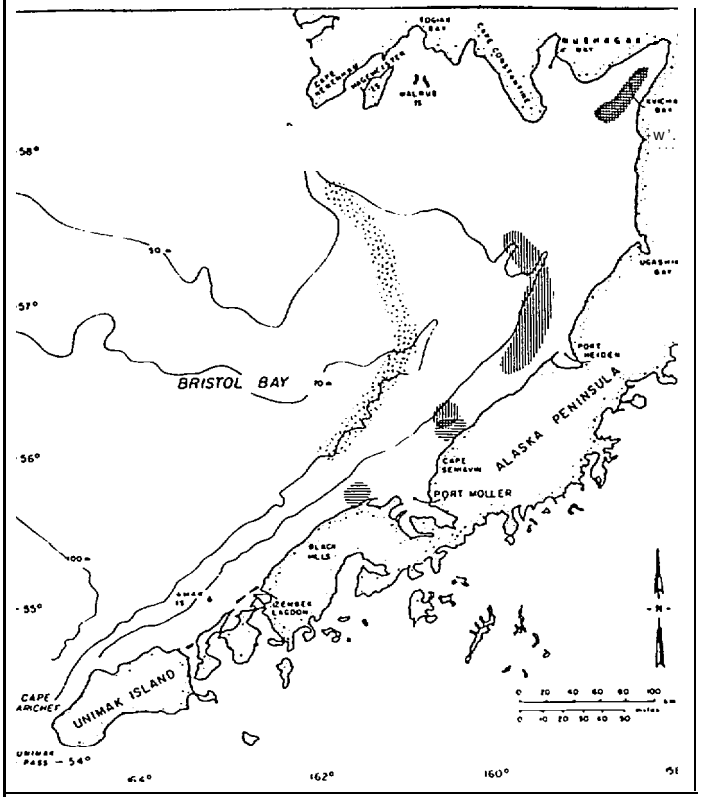
(b) YOY = Young-of-the-year crabs



CRUISE 83-1
(APR-MAY)



CRUISE 83-
(JUN)



CRUISE 83-5
(SEP)

▥ = ≤ 10 mm

▤ => 10-40 mm

⁰₀₀ => 40-60 mm

▦ = > 60 mm

DISTRIBUTION OF JUVENILE AND ADULT RED KING CRABS DURING 1983

OCTOBER 1983 | FIGURE 6

SECTION 5.0

PRELIMINARY INTERPRETATION OF RESULTS

This was a very poor year for larval reproduction compared to 1982 and earlier years (Armstrong, et al. 1981, 1983; Haynes 1974). Results have not been analyzed in sufficient detail for further interpretations to be included at this time.

SECTION 6.0

PROBLEMS ENCOUNTERED/RECOMMENDED CHANGES

The habitat occupied by early juvenile red king crabs is apparently quite rough. Consequently, repairs were frequent and at least three trynets and a rock dredge were lost during this investigation. Spare webbing, nets, doors and dredge frames are essential for any future studies in this area.

Several of the proposed stations could not be sampled due to their location. These areas were either inadequately surveyed or lacked channel markers or, in a single instance, was in a crab pot storage site. Most of these areas could be sampled from small boats during future work in Bristol Bay.

Bottom trawl surveying with both the standard fathometers onboard the Miller Freeman and the side-scan sonar used during the September cruise was very time consuming. The SSS and the fathometers frequently varied in their assessments of bottom type. More extensive SSS mapping perhaps coupled with supplemental underwater photography could be employed in future studies in conjunction with the techniques utilized during this year's cruises.

The most serious problems encountered were the poor larval production this year and the infrequency of larval sampling as there were only two suitable cruises for collecting adequate numbers of larvae. This combination limited the extent to which any general conclusions can be made from this year's data.

One minor problem was encountered during larval enumeration in the laboratory. Analysis has taken more time than expected due to a band of high phytoplankton densities spread northwest across Bristol Bay from between Cape Seniavin and Port Heiden to south of Cape Newenham. The high phytoplankton densities significantly slowed the counts.

SECTION 7.0

ESTIMATES OF FUNDS EXPENDED

The monies expended through 28 October 1983 totaled $113,053.72.