30472

OCS Study MMS 92-0020

STABLE ISOTOPE ANALYSIS OF 1987 - 1991 ZOOPLANKTON SAMPLES AND BOWHEAD WHALE TISSUES

by

Donald M. Schell, Principal Investigator
Institute of Marine Science
University of Alaska
Fairbanks, Alaska, 99775

for

U. S. Minerals Management Service
Contract no. 14-35-0001-30472

March 1992

30472

OCS Study MMS 92-0020

STABLE ISOTOPE ANALYSIS OF 1987 - 1991 ZOOPLANKTON SAMPLES AND BOWHEAD WHALE TISSUES

by

Donald M. Schell, Principal Investigator
Institute of Marine Science
University of Alaska
Fairbanks, Alaska, 99775

for

U. S. Minerals Management Service
Contract no. 14-35-0001-30472

March 1992

OCS Study MMS-92-0020

STABLE ISOTOPE ANALYSIS OF 1987 - 1991 ZOOPLANKTON SAMPLES AND BOWHEAD WHALE TISSUES

by

Donald M. Schell, Principal Investigator
Institute of Marine Science
University of Alaska
Fairbanks, Alaska, 99775

for

U. S. Minerals Management Service

March 1992

This study was funded by the Alaska Outer Continental Shelf Region of the Minerals Management Service, U. S. Department of the Interior, Anchorage, Alaska under Contract no. 14-35-0001-30472

The opinions, findings, conclusions or recommendations expressed in this report are those of the author and do not necessarily reflect the views of the U. S. Dept. of the Interior, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use by the Federal Government.

ABSTRACT

This report describes the results of the stable isotope analyses of bowhead whale tissue samples and bowhead whale prey organisms collected by the principal investigator and the North Slope Borough over the years 1987 to 1991. The goal of the study was to provide detail on previous findings regarding the isotope ratio gradients evident in the zooplankton and to verify previous findings regarding the growth rates and age determination techniques developed for bowhead whales. By virtue of four opportunities to sample zooplankton in Russian waters off the Chukotka Peninsula and in the Gulf of Anadyr, we now have data from areas where bowheads feed on the return migration and from most of their overwintering range. We also have collected additional samples from the U.S. side of the Chukchi Sea on several cruises and have statistically analyzed these data. The years in which sampling occurred offer an opportunity to investigate the effects of marked variation in physical environment--1987 and 1989 were very light ice years whereas 1988 was one of the heaviest ice years on record in the Chukchi and northern Bering seas. The Bering Sea did not become totally ice-free at any time in the summer of 1988.

Our findings support the initial conclusions (Saupe et al, 1989) that the zooplankton of the western Beaufort, Bering and southern Chukchi seas are enriched in ^{13}C relative to the eastern Beaufort Sea. We also confirmed that euphausiids are enriched in ^{13}C relative to copepods, first reported by Schell et al. (1987). On the ecosystem scale, the zooplankton sampled in 1987 are approximately one part per thousand enriched in ^{13}C relative to the same taxa sampled in 1988 and 1989. Statistical tests on the isotope ratios from subregions in the Bering, Chukchi and Beaufort seas indicate that the carbon isotope ratios in zooplankton are the same in the Bering and Chukchi seas but are significantly depleted in ^{13}C progressing eastward across the Beaufort Sea.

The analysis of baleen from bowhead whales taken between 1987 and 1990 continues to support the findings regarding both feeding and growth rates of the whales as reported in Schell et al. (1989a,b). Bowhead whales are slow-growing (-0.5 m/yr) and the young animals between year one and about 6 - 7 years of age undergo a period of little or no linear growth. We estimate that bowheads require 15 - 17 years to reach the length of sexual maturity, i.e. 13 - 14 m,

By comparing the baleen isotope ratios from the adult whales sampled (n = 17) we have constructed a 20 year record of the isotope ratios in the phytoplankton of the northern Bering and Chukchi seas, assuming that the baleen accurately reflects the carbon isotope ratios of the primary producers. This long-term record was compared with the temperature anomalies in surface waters of the Bering Sea and we find that the $\delta^{13}C$ of the zooplankton is inversely correlated with temperature. These findings have considerable importance in that they test current models attempting to relate ocean temperature, and atmospheric carbon dioxide levels with the $\delta^{13}C$ of ocean sediment organic matter. Our data indicate that the models do <u>not</u> correctly predict the $\delta^{13}C$ of primary production and that dissolved carbon dioxide concentrations do not govern $\delta^{13}C$ of phytoplankton.

Comparison of bowhead whale and right whale baleen from the. northern hemisphere with right whale baleen from the southern hemisphere shows that northern hemisphere zooplankton are much more enriched in ^{15}N and ^{13}C than

zooplankton from the same latitudes in the S. Atlantic and Southern oceans growing under similar physical conditions. These data indirectly support the "iron limitation" hypothesis for the Southern Ocean and indicate that isotope ratios in marine phytoplankton are governed primarily by algal growth rates and not by either temperature or the size of the dissolved carbon dioxide pool [CO_2(aq)]. These findings have implications with regard to paleoclimate records in sediments and predicting the effects of climatic warming and atmospheric carbon dioxide increases. This work is currently being completed and will be reported in the near future.

PROJECT ORGANIZATION AND ACKNOWLEDGEMENTS

This report describes the findings on field and laboratory work conducted by the Principal Investigator through the auspices of the . Institute of Marine Science and the Institute of Northern Engineering, Water Research Center, University of Alaska Fairbanks. This report integrates the initial studies on baleen and bowhead whale natural history with later work on zooplankton isotope ratios. The latter focus was made when the opportunity arose for access to Russian waters began in 1988.

Project personnel for field work on this study included the Principal Investigator and the following:

Susan Saupe, technician
Norma Haubenstock, technician
Bruce Barnett, graduate research assistant
Kimberly Vinette, graduate research assistant

Laboratory preparation of samples and mass spectrometry were the responsibility of Norma Haubenstock and Kimberly Vinette under the supervision of the PI. Graduate research assistant, Yu Wu Zhang also assisted with the preparation of samples in the laboratory.

We are grateful for the support provided by J. Montague and C. Cowles of the Minerals Management Service. We appreciate the continued support by Carol Pease of NOAA for both time and space on NOAA ships on several cruises in the Bering and Chukchi seas. Most of the samples from east of the dateline were obtained on these NOAA-supported cruises with the exception of cruises on the AKADEMIK KOROLEV and the THOMAS WASHINGTON which were funded by the NSF supported ISHTAR program. We are grateful to T. Albert and C. George of the Department of Wildlife Management, North Slope Borough for the collection of whale tissue samples under permit from the National Marine Fisheries Service, NOAA. They have also supplied many helpful insights into the natural history of the bowhead whales.

We are grateful to the Water Research Center for support of analytical work on right whale baleen and other samples which have proved valuable in interpreting the observed isotopic data obtained from this study.

This report was prepared by D. M. Schell and N. Haubenstock. The statistical analyses and comparison with long-term temperature anomalies in the Bering Sea were done by Kimberly Vinette with the supervision and assistance of Dr. Edward Murphy, Inst. of Arctic Biology, University of Alaska Fairbanks.

TABLE OF CONTENTS

Page

ABSTRACT 2

PROJECT ORGANIZATION AND ACKNOWLEDGEMENTS 4

TABLE OF CONTENTS. 5

LIST OF FIGURES. 7

LIST OF TABLES 9

EXECUTIVE SUNMARY 10
Zooplankton Sampling. 10
Carbon Isotope Ratios in Zooplankton. . . 10
Baleen Sampling 11
Long-term Cycles in Zooplankton Carbon Isotope Ratios 11
$\delta^{13}C$ as an Indicator of Paleotemperature and Productivity in the Marine Environment. . . 12

INTRODUCTION 13
Background . . . , ... 13
Isotope Ratios in Food Web Studies. 13

OBJECTIVES. 15

NETNODS 15
Isotope Samples 15
Zooplankton Sampling 15
Baleen Samples 16
Muscle and Fat Samples 16
Total Dissolved Carbon Dioxide 22
Isotope Ratio Analysis 22
Statistical Analyses, ... 22
Statistical Treatment of Data. 22
Regional Areas 22

DATA MANAGEMENT.. 23
Quality Assurance and Control 23
In-house Quality Assurance and Control 23
Data Management 24
In-house Data Management 24
Data Archiving Program 24

RESULTS. 25
Carbon Isotope Ratio Data 25
Total seawater Carbon Dioxide $\delta^{13}C$ 25
Zooplankton Isotope Ratios 25
Copepods. 25
Euphausiids. . . . . , ... 28
Chaetognaths . . . . . , ... 29
Isotopic Data on Bowhead Whale Growth 30

Bowhead Whale Baleen Isotope Ratios. 30

TABLE OF CONTENTS (Continued)

Environmental Control of Carbon Isotope Ratios . 46
Bering Sea Surface Temperature Anomalies 47

DISCUSSION. 50
Carbon Isotope Gradients. . . . . , . . . 50
Latitudinal Gradients in Carbon Isotope Ratios . 50
Seasonal and Interannual Variation in Zooplankton $\delta^{13}C$ 50
Nitrogen Isotope Ratios in Baleen 51
Environmental Monitoring with Baleen. 51
Csrbon Isotope Ratio Trends in Baleen. 51

LITERATURE CITED... 56

APPENDICES. 58
Appendix 1. $\delta^{13}C$ and $\delta^{15}N$ values for zooplankton samples. 58
Appendix 2. $\delta^{13}C$ and $\delta^{15}N$ values for bowhead whale tissues. 76

LIST OF FIGURES

Page

Figure 1. Station locations for zooplankton stable isotope samples, SU87 (left) and TH87 (right). . . 17

Figure 2. Station locations for zooplankton stable isotope samples, IE88 (left) and TW88 (right). . . 18

Figure 3. Station locations for zooplankton stable isotope samples, AK88 (left) and SU88 (right). . . 19

Figure 4. Station locations for zooplankton stable isotope samples, SU89 (left) and SU90 (right). . . 20

Figure 5. Station locations for zooplankton stable isotope samples, SU91 . . . , ... 21

Figure 6. Geographic subregions for statistical comparison of zooplankton isotope ratios. 23

Figure 7, Carbon isotope ratios for total dissolved carbon dioxide samples from the Bering and Chukchi sea. . 26

Figure 8. Average copepod isotope ratios for the subregions in Figure 6 . . . . . , ... 26

Figure 9. Average euphausiid isotope ratios for the subregions in Figure 6. 28

Figure 10. Average chaetognath isotope ratios for the subregions in Figure 6 29

Figure 11. Baleen carbon isotope ratios for three plates . . . 34

Figure 12. Baleen carbon isotope traces for all whales 35

Figure 13. Body length and estimated ages for subadult whales. 48

Figure 14. Baleen length and estimated age of bowhead whales. . 48

Figure 15 The $\delta^{13}C$ and $\delta^{15}N$ traces for whale 88B10 49

Figure 16. Temperature anomalies and average baleen isotope ratios for the northern Bering Sea 52

Figure 17. Correlation analysis between baleen isotope ratios and temperature anomalies. . . . . , ... 52

Figure 18. Zooplankton carbon isotope ratios by cruise for copepods and euphausiids. 53

Figure 19. Zooplankton carbon isotope ratios by cruise for chaetognaths. . . . . , ... , . 53

LIST OF FIGURES (Continued)

Figure 20. Carbon isotope ratios of phytoplankton and fauna from the northern Bering and southern Chukchi seas. . 54

Figure 21. Nitrogen isotope ratios for phytoplankton and fauna from the northern Bering and southern Chukchi seas. . 54

LIST OF TABLES

Page

Table 1. Cruises from which zooplankton were collected for this study, 1987 - 1991. 16

Table 2. Averages, standard deviations, range and number of zooplankton $\delta^{13}C$ determinations 27

Table 3. Carbon and nitrogen isotope ratios for baleen and other tissues from whales 31

Table 4. Bowhead whale (*B. mysticetus*) growth rate data from $\delta^{13}C$ analyzed baleen plates 33

This work is a continuation of a study begun in 1985 as a subcontractor to LGL Ecological Research Associates on the importance of the eastern Beaufort Sea to the feeding of bowhead whales. At that time we undertook a comparison of the carbon isotope ratios ($\delta^{12}C$) in bowhead whale baleen plates with the $\delta^{13}C$ values of zooplankton from around the range of the whales. The results were very encouraging and the study was expanded in 1986. From the isotope data were were able to conclude that the whales fed primarily in the Bering and Chukchi seas and that the growth rates of the animals were much slower than reported rates for right whales (*Eubalaena glacialis*). The findings were reported in the Final Report for MMS Study 87-0037.

The conclusions that we presented (Schell et al. 1987) based on this past data were criticized by a review panel convened by the North Slope Borough (1987). They felt there were too few data regarding (1) the zooplankton from around the range of the bowhead, and (2) the lack of data regarding the cause of the purported isotopic shift between the southwestern and northeastern segments of the migratory range. We recognized these shortcomings well before the review and sought to collect the necessary samples to fill the data gaps using ships of opportunity. This report presents the results of the stable isotope analysis of the samples collected over the following years.

Zooplankton Sampling

The political events of the past few years have contributed profoundly to the success of this study. The major criticism that no zooplankton sampling had been conducted in the waters on the Russian (ne' Soviet Union) side of the dateline has been completely removed through four sampling trips in waters of the western Bering Sea and the western Chukchi Sea covering virtually all of the known range of the western Arctic population of bowhead whales. Overall, more than 200 stations were occupied on ten cruises and opportunistically collected samples from other research programs in the region were analyzed when available.

Carbon Isotope Ratios in Zooplankton

Analysis of zooplankton $\delta^{13}C$ from the above cruises has shown that there is little or no statistically significant difference (at the <0.05 level) between the Chukchi and Bering seas. This is not unreasonable in that transport of water northward through the Bering Strait tends to displace the Bering Sea zooplankton community. The primary isotopic gradient in Alaskan waters occurs across the Alaskan Beaufort Sea with $\delta^{13}C$ of copepods and euphausiids approximately 3.5 - 4 ‰ lighter near the Alaska-Canada border than in the Chukchi Sea west of Point Barrow. Statistical analysis of $\delta^{13}C$ values between cruises and interannually also showed little difference within the same region. Analysis of isotope ratios of copepods and euphausiids collected on subsequent cruises revealed some small interannual differences but these differences were often masked by a large range of $\delta^{13}C$ values with samples from each cruise. As noted by Saupe et al. (1989), euphausiids are enriched in ^{13}C relative to copepods by approximately 1,5°/00.

The new data confirm the findings we presented in Saupe et al. (1989) that there is a persistent isotopic gradient across the winter-summer range of the bowhead whale. The feeding by the whales on zooplankton across this gradient imparts the marked oscillations in $\delta^{13}C$ evident in the baleen plates.

Baleen Sampling

Through cooperation between the Alaska Eskimo Whaling Commission and the North Slope Borough Department of Wildlife Management, baleen plates have been obtained from most of the whales killed between 1987 and 1990. Although no MMS funding was available for analyzing the 1989 and 1990 samples we have sought to keep the isotopic record continuous over these years by analyzing as many plates as feasible with support from the UAF. This has enabled the long-term analyses of temperature records and provided support to obtain additional information on baleen growth in right whales. The right whale data are still being processed and will be reported in the open literature at a later date.

The isotopic data collected further confirms the findings which have been reported in Schell et al. (1989a,b) regarding the feeding and growth rates of bowhead whales. These whales are slow growing and undergo a period of little or no growth of body length of 4 - 6 years duration following weaning during which time their baleen continues to lengthen. We interpret this as a period in which the whales are undergoing the necessary morphological change to become efficient filter feeders.

Long-term Cycles in Zooplankton Carbon Isotope Ratios

The long-term (decade) $\delta^{13}C$ values of zooplankton in the Bering-Chukchi seas were determined by averaging the $\delta^{13}C$ values from the baleen plates that were laid down while the whale was feeding in the Bering-Chukchi region. The whales, by virtue of integrating multi-ton quantities of zooplankton over both space and time, provide a much better average for the zooplankton $\delta^{13}C$ than can be obtained by net sampling from ships on a limited time basis. The plates from 17 adult and subadult whales were analyzed in this manner and the baleen values from each given year were averaged. For 1990, only two plates were used, since only a limited effort has been made to analyze baleen since 1988.

Temperature. anomalies from the Bering Sea were obtained from long-term sea surface temperature data assembled by Scripps Oceanographic Institution. These data, when plotted on 9 month and five-year running means revealed that there is an inverse relationship between $\delta^{13}C$ and sea surface temperature on a decadal time scale but there is no apparent shift in response to a marked -2.5 yr temperature cycle of similar amplitude in Bering Sea. A 19-year cycle of about 1°C in average sea surface temperature is reflected in $\delta^{13}C$ by a cycle of 1°/oo. Correlation analysis of the two curves reveals that $\delta^{13}C$ lags sea surface temperature by approximately 1 - 2 years. This is reasonable given the time constraints between fixing carbon and passing it up the food chain and the seasonal migrations of the whales.

$\delta^{13}C$ as an Indicator of Paleotemperature and Productivity in the Marine Environment.

Recent models (Rau and DesMarais 1991, 1992 ;Rau et al. 1989) argue that the isotope ratios of plankton in the world oceans vary in response to changes in the size of the dissolved carbon dioxide pool [CO_2(aq)]. The models explain the progressive decrease in plankton $\delta^{13}C$ toward the polar regions as a response to the increasing [CO_2(aq)] associated with colder water. Through the use of our isotopic data on the bowhead whales and additional data from our analyses of right whale baleen plates from the South Atlantic, we find that these models are not accurate predictors of trends in $\delta^{13}C$. The whale data indicate that 1) the northern hemisphere is characterized by ^{13}C-enriched zooplankton relative to similar latitudes and temperatures in the southern hemisphere and that 2) $\delta^{13}C$ increases with decreasing temperature in the Bering Sea, exactly opposite to model predictions. Nitrogen isotope data indicate that the phytoplankton of the southern ocean are growing slowly in excess nutrients and this low growth rate is associated with increased discrimination for the lighter isotope. Since temperature, [CO_2(aq)] and light regimes are similar in both hemispheres at high latitudes, these variables are unlikely to be the source of the reduced growth rates. Our findings are not inconsistent with the hypohtesis that the "iron limitation" associated with low inputs of aeolian dust may be responsible for the low rates of phytoplankton productivity and consequent low $\delta^{13}C$ of plankton in the Southern Ocean.

INTRODUCTION AND OBJECTIVES

Background

This project sought to acquire information on the natural history and habitat requirements of bowhead whales (*Balaena mysticetus*) in arctic Alaska. The technique employed uses the abundances of the stable isotopes of carbon as natural tracers of food intake from various environments in which the whales feed. The long baleen plates of bowhead whales serve as feeding records in that the stable isotopes are incorporated into the protein at the time of feeding and remain unchanged thereafter. Since the isotope abundances in the plates must be matched with prey from the differing geographic regions in which the animals feed, zooplankton samples were collected using ships of opportunity at locations throughout the Bering and Chukchi seas. Bowhead whale tissue samples were obtained from harvested whales in 1987 - 1990 through cooperation of the North Slope Borough. The analysis and interpretation of the stable isotope data from these samples constituted the tasks of this project.

Isotope Ratios in Eood Web Studies

Ecosystem studies involving biochemical systems usually depend upon two approaches. One approach is to construct budgets or mass balances of a key element and attempt to determine which fluxes dominate these budgets. The second approach measures the key rates or processes within the system and then attempts to relate the findings to the overall goal. Although ideally the two approaches should be complementary and finally coalesce into a better understanding of the ecosystem, this goal is usually difficult to attain. There may be mismatches between time and space scales of the two approaches or processes which can not be determined to the required accuracy. Many of these quandaries are evident in any attempt at estimating the feeding requirements of bowhead whales. Because stable isotope ratios can contribute both source (tracer) information and process information, they are ideally suited for the measurement of elemental movements--in this case carbon.

The field of stable isotope tracers has steadily expanded and a wealth of information on terrestrial and aquatic applications is now available. Fry and Sherr (1984) and Peterson and Fry (1987) review these applications and discuss the strengths and weaknesses of the many studies. Rundel et al. (1989) present a series of papers on various applications including several multiple isotope tracer studies.

The fidelity of consumers to the isotopic compositions of diet underlies all natural abundance studies. DeNiro and Epstein (1978) plotted diet vs. consumer isotope ratio and found that the transfer was conservative with regard to the whole animal. A small enrichment occurs of about one ‰ per trophic step, typically slightly larger with herbivores and less with carnivores. This has been documented in both field and laboratory studies (see review by Peterson and Fry 1987, McConnaughey and McRoy, 1979). Jones et al. (1981) documented the change in isotope ratios of cattle fed C-3 plants then changed to C-4 plants, then switched back again. Within 70 days, newly grown hair had reached equilibrium with the

new diet after each change. Since the hair required several days to reach the surface of the skin prior to being shaved, actual response was faster than the isotope ratios in the shavings indicated. In a similar study, Boutton et al. (1988) showed that the milk produced by dairy cows very rapidly approached the isotopic composition of a new diet. The milk precursor pool in the cow was estimated to have a half-life of 0.9 day and a mass of 7 kg indicating an efficient conversion of food into blood proteins and then to milk.

Within organisms, the complex pathways of biosynthesis can alter the isotope ratios in the end products relative to starting materials. The distribution of carbon isotopes has been studied by several authors (Tieszen et al. 1983; DeNiro and Epstein 1978; Jones et al. 1981; Mizutani and Wada 1988). Muscle tissue tends to closely approximate diet whereas keratinous proteins--hair, feathers, and hooves--are typically enriched by 2-3°/oo relative to diet. Schell et al. (1989b) found that keratin in baleen averaged about one ‰ heavier than muscle which in turn was about 6°/oo heavier than lipids. Polar bears, (*Ursus maritimus*) which are 1 - 2 trophic levels above bowhead whales, also show an enrichment in keratin $\delta^{13}C$ of 1-2°/oo relative to the whales. As more and more studies are performed on ecosystem processes, the usefulness of stable isotope ratios as tracers has become increasingly evident.

Natural history investigations of the large baleen whales present formidable problems due to the difficulties in observing the animals in their natural environments. Attempts to determine growth rates of whalesthrough aerial photogrammetry (Koski et al. 1991) has proved very difficult and only ten resightings of <10 m whales have been reported. Recently we have shown (Schell et al. 1989a, b) however, that bowhead whales (*Balaena mysticetus*) have marked annual oscillations in stable carbon and nitrogen isotope abundances along the length of the baleen plates in the mouth. These oscillations result from the annual migration of the animals from wintering grounds in the Bering Sea to the summering areas of the Canadian Beaufort Sea. Zooplankton along the migrational path have differing isotopic abundances of carbon and nitrogen which are reflected in the composition of the keratin in the continuously growing baleen plates. Since up to 20 years feeding record may be present in the plates of a large bowhead whale, considerable insight may be gained on the natural history of the whales and their habitat usage. Saupe et al. (1989) reported on the isotopic abundances in zooplankton prey which produce the large variations in *B. mysticetus*, and Schell et al. 1989b) presented a revised growth rate for *B. mysticetus*, determined through isotopic aging techniques.

The isotope ratios in the baleen and especially in the muscle and visceral fat of animals killed in the spring compared to those killed in fall show that the greatest abundance of points along the traces from *B. mysticetus* correspond to isotopic abundances typical of prey species in the western and southern areas of the migratory range. The average ^{13}C isotopic abundance in visceral fat and muscle tissue from spring-killed *B. mysticetus* was enriched by 2.1 ‰ relative to two fall-killed animals implying that a major fraction of the total carbon of the animal was derived from the western and southern parts of their annual range. Although at this time it is impossible to accurately estimate the relative amounts of food that the whales obtain from the Beaufort versus Chukchi versus Bering seas, these data contrast with previous feeding scenarios

which suggested that bowheads feed more heavily in the summer in the eastern Beaufort Sea and relied almost entirely on stored reserves for the winter (Lowry and Frost, 1984; Lowry et al. 1987).

OBJECTIVES

Our overall goal is to use the isotopic gradients in the zooplankton of the Bering-Chukchi-Beaufort seas as natural tracers to determine the habitat dependencies and feeding strategies of the bowhead whale. The objectives of this study are listed as specific tasks below:

1. Complete isotopic analysis on the baleen and bowhead whale tissue samples collected over the 1987 and 1988 Inupiat whaling seasons.

2. Complete isotopic analysis on zooplankton collected from the Bering and Chukchi seas during 1987 - 1991. The samples obtained span almost the entire range of the western population of bowhead whales including the critical northern Bering - southern Chukchi region for which very little data were previously available and the U.S.S.R. waters of the Anadyr Gulf and off the Chukotka peninsula.

3. Collect and analyze samples of water column total carbon dioxide to test whether [CO_2(aq)] isotope ratios were one of the mechanisms causing the geographic shift in isotopic abundances. Although stripping and mass spectrometry of these sample yields the $\delta^{13}C$ of total carbon dioxide, the relatively uniform temperature regimes allow approximation of the $\delta^{13}C$ of the [CO_2(aq)]. These samples were collected concurrently with the zooplankton sampling on some of the cruises noted below.

4. Interpret and synthesize new data in context with past findings to confirm or deny current interpretations of bowhead whale natural history with special reference to the role of the eastern Alaskan Beaufort Sea as feeding habitat. Data were tested statistically to obtain seasonal and geographic patterns which may be applied toward estimating the food acquired by bowhead whales from the various habitats occupied over the seasonal migration. Details of the statistical treatments are described in Methods, below.

These samples provide a comprehensive assessment of bowhead whale prey over most of the range of the animals and comparative samples from adjacent waters such as the eastern half of the Bering Strait. Fortuitously, the sampling also occurred at the extremes of ice conditions. Year 1987 was one of the lightest ice years ever recorded and 1988 was the heaviest ice year recorded since satellite imagery has been available. This contrast may have affected primary productivity regimes over the summer season and contributed to differing isotope ratios in the resulting food chain.

METHODS

Isotope Samples

Zooplankton Sampling -- Samples of zooplankton were collected on the cruises listed in Table 1 and shown in Figure 1 - 5 with the use of bongo

nets in open water or ring nets in areas of broken pack ice. Typically, oblique tows were conducted through the water column to within 5 - 10 m of the bottom. Multiple tows were taken until sufficient sample size was obtained to provide enough biomass to allow isotopic analysis on the major taxa present. Samples were sorted on board as soon as possible, to the species level if feasible, or at least to general taxon. Sorted samples containing greater than 200 mg C wet weight were acidified with 10 percent HCl to remove carbonates and dried to constant weight. A subsample of approximately 15 mg was then ground with copper oxide and placed in a 9 mm x 200 mm quartz tube. The tubes were loaded on a vacuum manifold and evacuated to <5 mTorr, then sealed with a torch for combustion. Samples were combusted at 870° for 2 hr and allowed to cool overnight. At this point the sample had been converted to carbon dioxide, nitrogen, water and sulfur dioxide. The tubes were opened onto the vacuum manifold and the nitrogen and carbon dioxide separated by cryogenic distillation. The purified gases were collected in short lengths of 6 mm glass tubing for later mass spectrometry.

Table 1. Cruises from which zooplankton samples were collected for this study, 1987 - 1991. Station locations are shown in Figs. 1 - 5.

R/V Alpha Helix	HX87	7 - 18 June 1987
R/V Thomas G. Thompson	*TH87*	12 - 30 August 1987
R/V Surveyor	*SU87*	16 September - 7 October 1987
R/V Alpha Helix	*IE88*	25 April - 15 May 1988
R/V Akademik *Korolev*	AK88	24 July - 3 September 1988
R/V Thomas Washington	*TW88*	9 - 29 September, 1988
R/V Surveyor	SU88	19 September - 14 October 1988
R/V Surveyor	*SU89*	19 September - 9 October 1989
R/V Surveyor	SU90	27 September - 24 October 1990
R/V Surveyor	SU91	22 September - 11 October 1991

Baleen Samples -- Specimens of the longest baleen plates from the whales listed in Table 3 were collected by personnel of the North Slope Borough Department of Wildlife Management. Upon receipt, plates were cleaned of adhered gum tissue and then scrubbed with steel wool to remove surface films of algae and other foreign matter. A strip of adhesive tape marked off in centimeters was placed along the length and the baleen sampled at 2.5 cm intervals using a flexible shaft engraving tool. The fine powdered baleen was collected and stored in a vial until treated and combusted as described above.

Muscle and Fat Samples -- The samples of frozen soft tissue were trimmed while frozen to remove possible surface contaminants and then a subsample of approximately five grams of muscle or fat was dried at 70° to constant weight. Muscle tissue was converted to a hard solid by drying, but the fatty tissues were rendered to a clear or yellowish oil. Subsamples of muscle were treated similarly to the baleen. The oil from fats was subsampled with a micropipette and approximately 15 mg placed onto a piece of precombusted glass fiber filter paper. This was then ground with copper oxide and treated as above. No nitrogen samples were collected from the oil due to the extremely low N content.

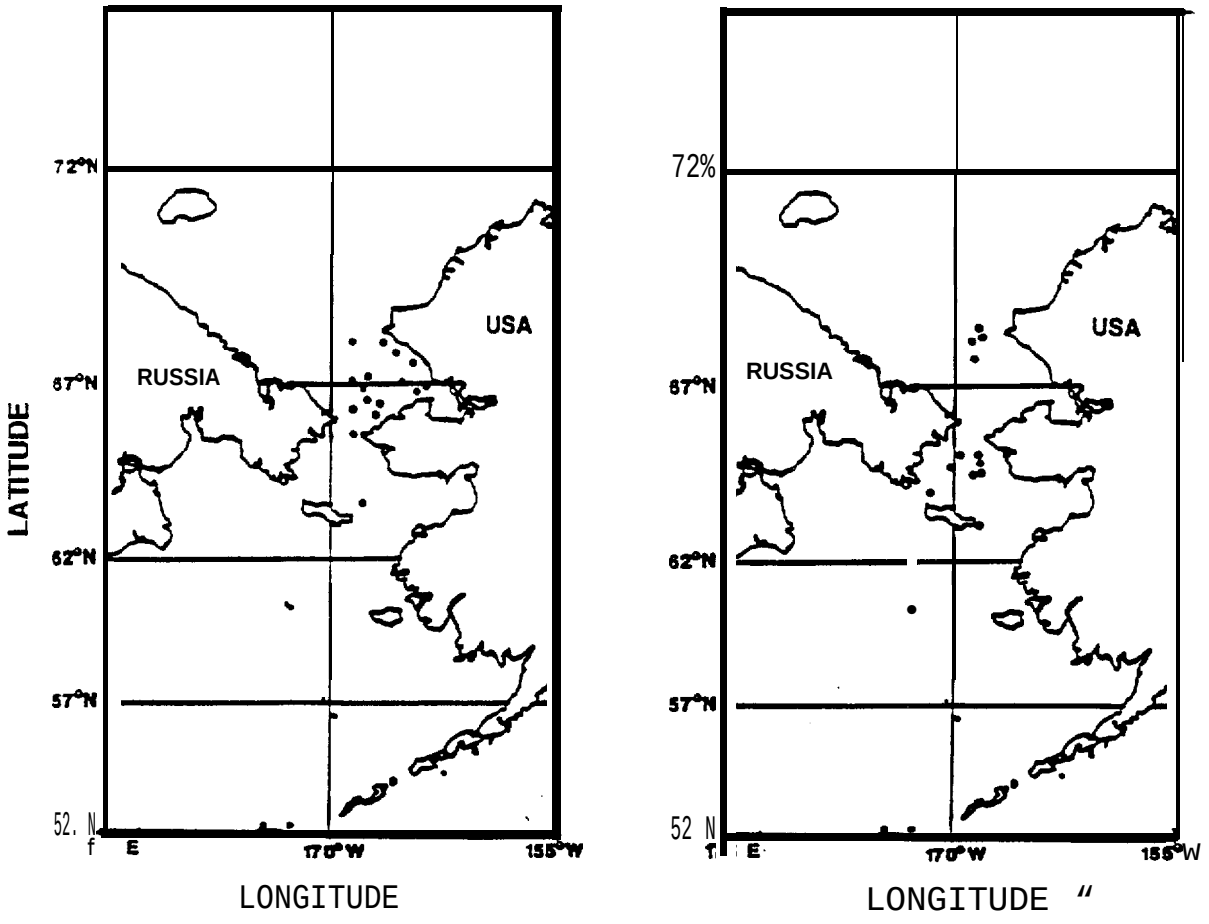

Figure 1. Station locations for zooplankton stable isotope samples, SU87 (left) and TH87 (right).

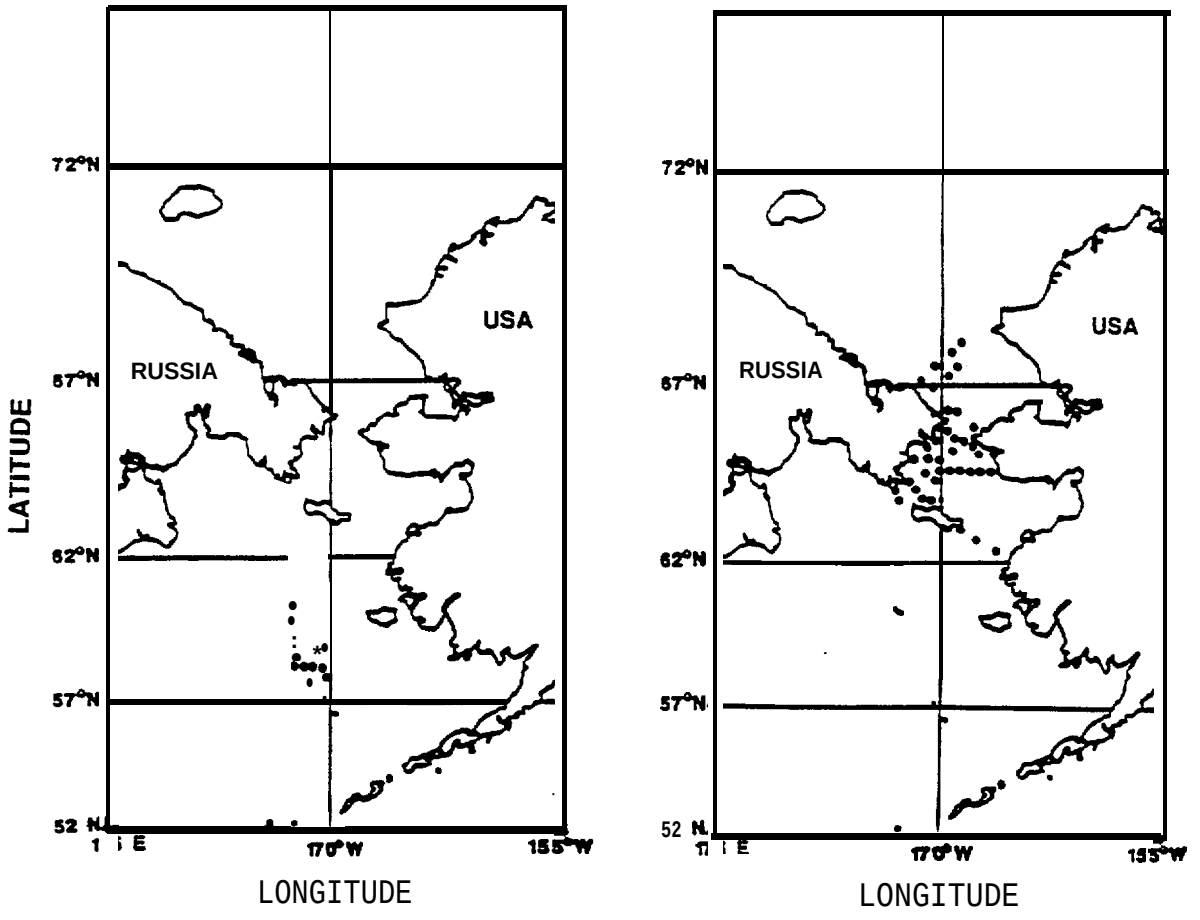

Figure 2. Station locations for zooplankton stable isotope samples, IE88 (left) and TW88 (right).

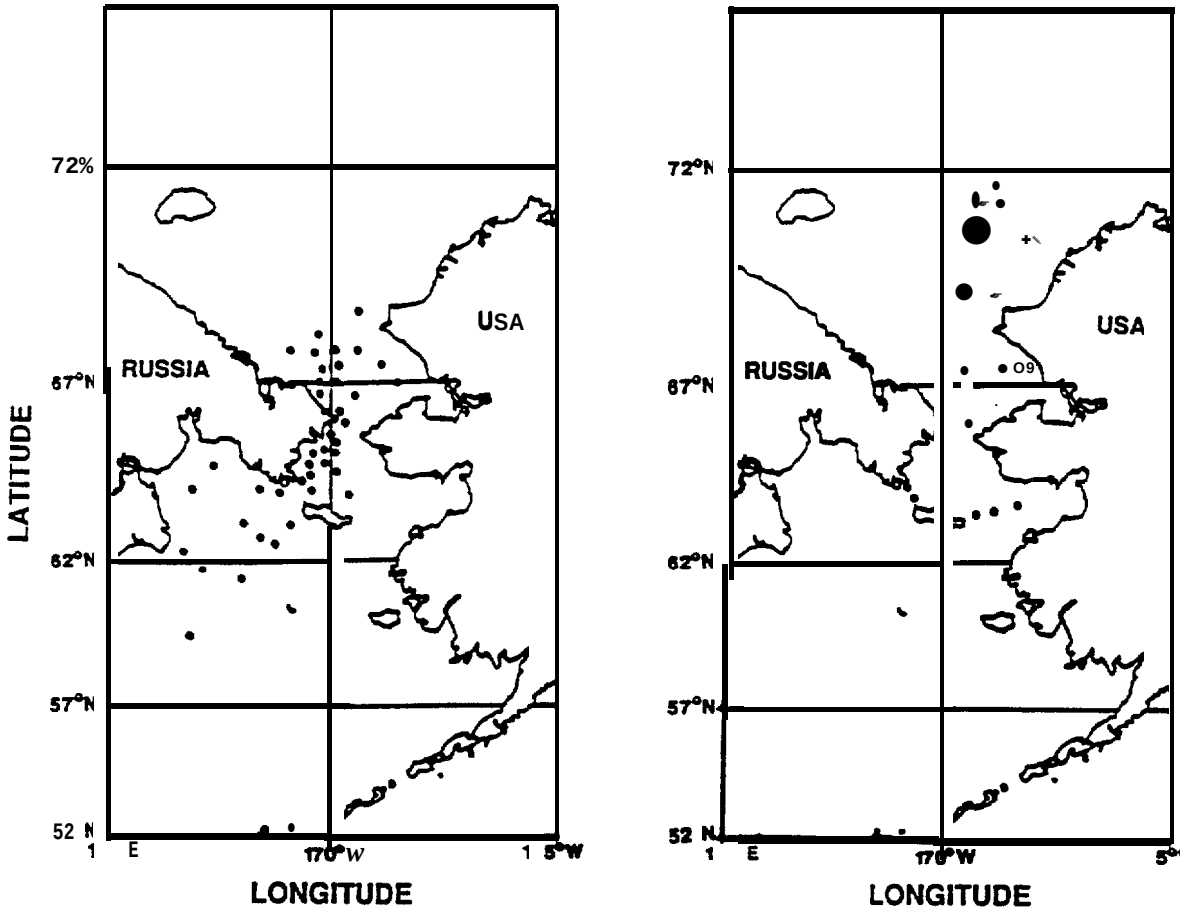

Figure 3. Station locations for zooplankton stable isotope samples, AK88 (left) and SU88 (right).

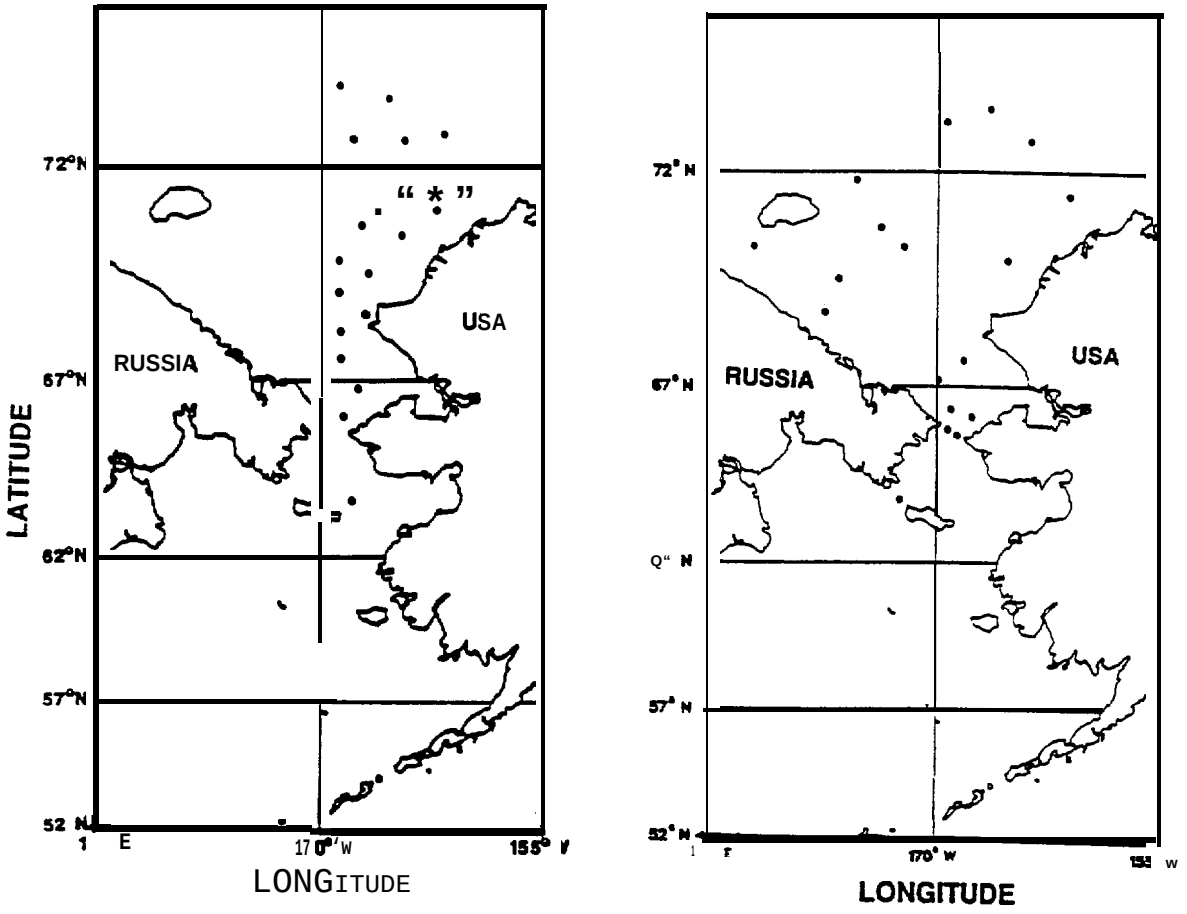

Figure 4. Station locations for zooplankton stable isotope samples, SU89 (left) and SU90 (right).

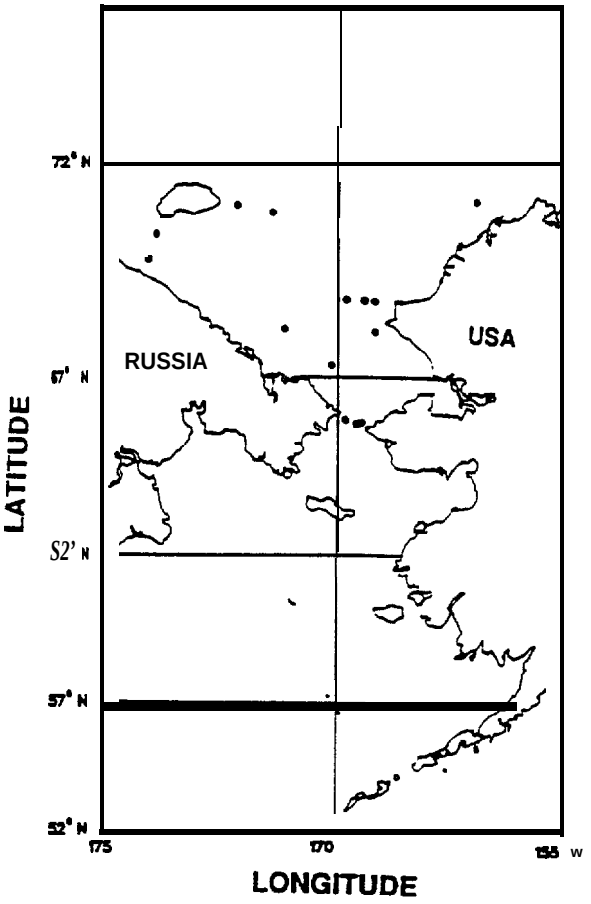

Figure 5. Station locations for zooplankton stable isotope samples, SU91.

Total Dissolved Carbon Dioxide -- Water samples were collected from two cruises for analysis of the $\delta^{13}C$ of the total dissolved carbon dioxide. Samples of 150 ml of seawater were transferred to a flask containing 4 ml of concentrated phosphoric acid on the vacuum line. The carbon dioxide was then stripped with a stream of oxygen gas under reduced pressure and collected in a tube cooled with liquid nitrogen. After cryogenic distillation from water, the gas was sealed into short lengths of glass tube. The carbon dioxide was later run for $\delta^{13}C$ on the mass spectrometer. Data from two cruises showed that the $\delta^{13}C$ values were typical of seawater CO_2 (Kroopnick, 1973), and no further samples were obtained until the final cruise in the summer of 1991.

Isotope Ratio Analysis -- Mass spectrometry was performed using a VG Isogas mass spectrometer. Machine reproducibility was typically better than $\pm$0.05 ppt on split samples and overall sample reproducibility was better than $\pm$0.2 ppt on replicates carried through the entire process.

Statistical Analyses

Statistical Treatment of Data -- Kruskal-Wallis non-parametric tests were used to identify significant differences among locations for major taxonomic groups (Conover 1980, Zar 1984). If the Kruskal-Wallis test was significant ($p<0.05$), we used Tukey's multiple comparison procedure (e.g., Zar 1984) to examine all possible pairwise differences between locations. Using a SAS/GLM computer statistical package, a two-way ANOVA on the ranked data was also employed to test for significant differences between the isotope ratios of taxonomic groups at given locations as well as between isotope ratios of each taxonomic group among locations (Conover and Iman, 1981). Major groups included copepods, euphausiids, and chaetognaths. Significant differences between cruises were also tested for major taxa groups.

Regional Areas -- The study area was divided into the following regions for statistical analysis:

Canadian Beaufort Sea	(130.46-138.46 "W, 69.00-71.95 'N)
Eastern Alaskan Beaufort Sea	(139.47-143.70 'W, 69.00-71.95 "N)
Central Alaskan Beaufort Sea	(144.02-149.90 'W, 69.00-71.95 'N)
Western Alaskan Beaufort Sea	(152.65-156.50 "W, 69.00-71.95 'N)
Northern Chukchi Sea	(156.51-179.85 "W, 70.00-71.50 'N)
Eastern Chukchi Sea	(160.00-168.99 'W, 66.35-69.99 "N)
Western Chukchi Sea	(169.00-180.00 'W, 66.35-69.99 'N)
Eastern Bering Sea	(163.00-168.99 "W, 63.00-66.27 "N)
Central Bering Sea	(169.00-175.00 'W, 63.00-66.27 "N)
Western Bering Sea	(175.00 'W-179.85 E, 53.93-67.00 "N)
Southern Bering Sea	(170.67-172.86 "W, 57.47-60.00 'N)

These regions are depicted in Figure 6. In a second analysis, the Canadian, Eastern Alaskan, Central Alaskan and Western Alaskan Beaufort seas were combined into the region Beaufort Sea. The Eastern and Western Chukchi seas were combined to form the Chukchi Sea. The Eastern, Central and Western Bering seas were combined into the Bering Sea, but not the Southern Bering Sea. The Northern Chukchi Sea region and the Southern Bering Sea region remained as in the previous analysis.

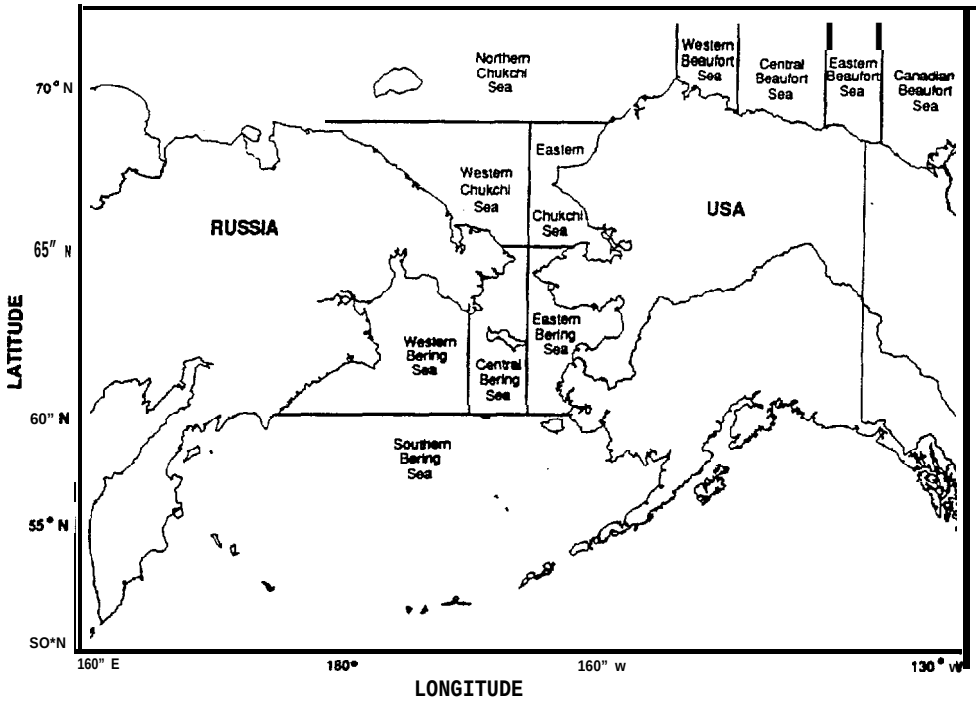

Figure 6. Geographic subregions for statistical comparison of zooplankton isotope ratios.

DATA MANAGEMENT

Quality Assurance and Control

In-house Quality Assurance and Control -- sample processing and mass spectrometry results are incorporated into a rigorous in-house quality control and assurance program. Baleen is subsampled from plates collected and identified as to animal and date by personnel of the North Slope Borough Dept. of Wildlife Management. Baleen plates are engraved with an identifying number to preclude loss of attached identifiers during cleaning and subsampling. The subsamples are stored in labeled vials. Both baleen plates and vialed subsamples are available for resampling in case of handling mishaps. During collection of carbon dioxide and nitrogen from combusted samples, gas samples are split to provide exact replicates to test mass spectrometer replicability.

Laboratory standards consist of organic carbon standards provided by

the National Bureau of Standards. We also maintain secondary working standards of tank gases and a bowhead whale baleen standard that has been calibrated in our laboratory and at the University of Texas and the Marine Biological Laboratory, Woods Hole, Massachusetts. Baleen standards are carried through the entire analytical procedure at regular intervals and whenever new reagents are used or any change in procedure occurs.

Internal consistency and replicability was tested by running two plates from opposite sides of the mouth from the same whale (87B3-A,B). The traces from these plates are shown in Fig. 12 (RESULTS). The very close conformation of the two analyses is strong indication that the isotopic compositions of the baleen plates are identical at temporally equivalent locations along the longitudinal axes. To test if all plates in one side of the baleen rack gave the same isotopic trace, three plates were collected from whale 89B1. One plate came from the distal portion, one from the middle of the rack and one from the proximal portion. All plates gave almost identical traces with the middle plate showing a slightly faster growth rate and longer total length (Figure 11, RESULTS).

Data Management

In-house Data Management -- Data are recorded in three forms. (1) Samples are identified in laboratory books and the isotope ratios recorded in hard copy. (2) The mass spectrometer computer prints out a machine record of the sample and the statistics of the analysis; and (3) all data are stored on computer files (Lotus 1-2-3) with periodic back-up.

Data Archiving Program -- No specific format has been established by the National Oceanographic Data Center for stable isotope ratio data. The Principal Investigator will provide raw data in either spreadsheet format or hard copy for interested users upon request.

Carbon Isotope Ratio Data

Total Seawater Carbon Dioxide $\delta^{13}C$ -- The seawater samples stripped of total carbon dioxide showed that the range of values found in the Bering and Chukchi seas were typical for the range found in high latitudes by Kroopnick (1973). No significant differences were found in the $\delta^{13}C$ of total carbon dioxide between years or cruises. The range of values is over 4 ‰ and probably reflects the high primary productivity in the region but these values cannot account for the gradients evident in the zooplankton since the values are essentially the same as in the eastern Alaskan Beaufort Sea. Here, Dunton (pers. comm.) found values ranging from 0.70 - 1.06; avg. = 0.91. The data obtained are shown in Figure 7.

Zooplankton Isotope Ratios -- Mass spectrometer results of $\delta^{13}C$ for zooplankton by taxa and region were compiled and compared to determine statistically significant differences. Table 2 lists the $\delta^{13}C$ averages, standard deviations, maximum and minimum values by cruise. Regional differences are shown in Figures 8 - 10 and described below.

Copepods -- Copepods typically comprised over 50% of the total number of organisms from each net tow. Species included the following calanoid copepods: *Calanus marshallae, Pseudocalanus minutus, Eucalanus bungii bungii, Metridia lucens, Neocalanus plumchrus, Neocalanus cristatus.* Initially, *Metridia lucens*, a non-calanoid species, was not included in statistical comparisons as a separate species since they are carnivorous and were anticipated to be slightly enriched in ^{13}C. Later analysis showed, however, that their $\delta^{13}C$ values were essentially the same as calanoid copepods (averages for cruises HX87 and AK88, -19.39 and -22.53 for *Metridia*; -21.02 and -22.41 for calanoid copepods, respectively. For cruises where identification to species was impractical, calanoid copepods were divided into size categories of small, medium and large. For statistical purposes, copepods were combined together for each station and an average $\delta^{13}C$ value determined,

Figure 8 shows the average $\delta^{13}C$ values and sample size for copepods by region. Copepod $\delta^{13}C$ values from 193 stations had significant differences among the eleven geographical areas (ANOVA on ranked values, $F_{10,182}$ = 22.54, $P<0.0001$). Pairwise comparison showed significant differences between regions. Copepods from the Eastern Beaufort Sea were significantly depleted relative to copepods from all other regions except the other Beaufort Sea regions. The Canadian Beaufort Sea copepods were significantly depleted relative to the Central Bering, Eastern Bering, Western and Eastern Chukchi seas. The Central Beaufort Sea copepods were depleted relative to those of the Western and Eastern Chukchi seas. The copepods from the Southern Bering Sea were significantly enriched relative to copepods from all other regions except the Western Chukchi Sea. This one instance may be misleading, however, since the Southern Bering samples were collected in June and may not be temporally comparable. Western Chukchi copepods were enriched relative to those of the Northern Chukchi Sea and the Central Bering Sea.

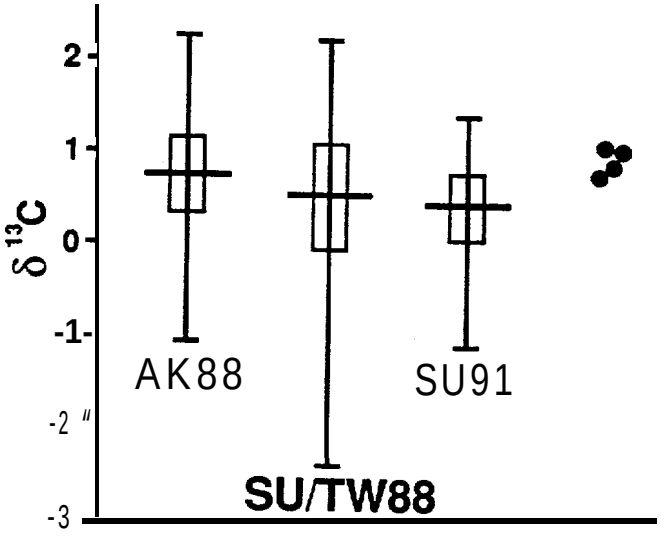

Figure 7. Carbon isotope ratios ($\delta^{13}C$) for total dissolved carbon dioxide samples from the Bering and Chukchi sea (n = 88). Alphanumerics denote cruises (Table 1) from which samples were collected. Individual points are from the eastern Beaufort Sea (70°31'N, 142°07'W) (K. Dunton, pers. comm.).

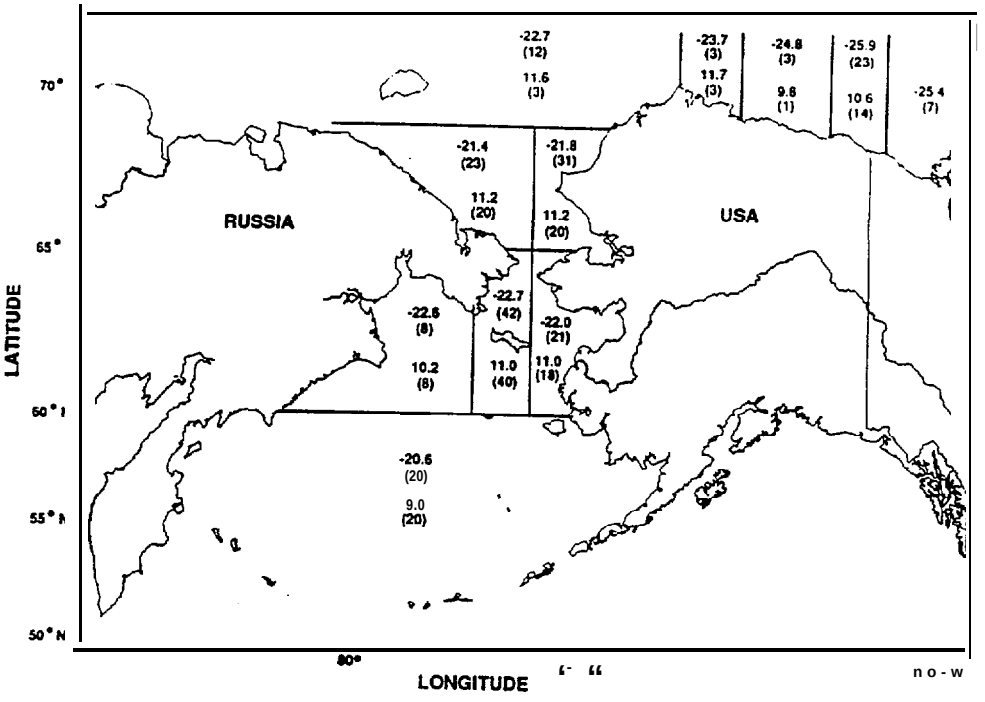

Figure 8. Average copepod isotope ratios for the subregions in Figure 6. Upper values in each area are $\delta^{13}C$ and sample number in parentheses; lower values are $\delta^{15}N$ and sample number In parentheses.

Table 2. Averages, standard deviations, range and number of zooplankton $\delta^{13}C$ determinations for copepods, euphausiids and chaetognaths collected from the Bering and Chukchi seas, 1987 - 1991.

		Copepods	Euphausiids	Chaetognaths
R/V Thomas Thompson 1987 (TH87)				
(southeastern	mean	-21.22	-19.42	-20.04
Chukchi and	sod.	0.63	0.67	0.23
northern Bering	maximum	-19.92	-18.40	-19.70
seas)	minimum	-22.42	-20.27	-20.24
	n	32	33	14
R/V Surveyor 1987 (SU87)				
(Kotzebue Sound and	mean	-21.66	-20.22	-20.58
northern Bering)	s.d.	1.29	0.83	0.42
	maximum	-19.74	-18.47	-20.10
	minimum	-24,42	-21.76	-21.43
	n	32	11	14
R/V Helix 1988 (IE88)				
(northern central	mean	-20.20	-20.08	-19.42
Bering Sea)	s.d.	0.46	0.40	0.40
	maximum	-19.41	-19.58	-19.42
	minimum	-21.14	-20.79	-20.87
	n	13	8	16
R/V Akademik Korolev 1988 (AK88)				
(northern Bering	mean	-22.18	-20.72	-21.24
and southern	s.d.	0.98	1.11	0.94
Chukchi seas)	maximum	-20.54	-17.73	-19.92
	minimum	-25.25	-22.65	-23.99
	n	31	24	21
R./V Thomas Washington 1988 (TW88)				
(southern Chukchi	mean	-21.83	-21.16	-21.13
and northern	s.d.	1.23	0.97	1.28
Bering seas)	maxi mum	-19.58	-19.86	-18.65
	minimum	-24.12	-22.89	-23.94
	n	37	17	18
R/V Surveyor 1988 (SU88)				
(eastern Chukchi	mean	-23.46	-21.40	-20.77
and northern	s.d.	0.56	0.74	0.69
Bering seas)	maximum	-22.36	-20.07	-19.68
	minimum	-24.58	-22,45	-22.04
	n	19	13	14
R/V Surveyor 1989 (SU89)				
(eastern Chukchi	mean	-22.40	-21.18	-20.59
Sea)	s.d.	1.08	0.76	0.68
	maximum	-18.90	-19.83	-19.60
	minimum	-24,72	-22.62	-21.86
	n	39	28	21

Table 2. (Continued)

		Copepods	Euphausiids	Chaetognaths
R/V Surveyor 1990 (SU90)				
(Chukchi Sea)	mean	-22.65	-20.69	-19.90
	sod.	0.98	1.37	0.98
	maxi mum	-20.70	-18.29	-18.29
	minimum	-24.38	-22.98	-21.54
	n	17	12	19
R/V Surveyor 1991 (SU91)				
(Chukchi Sea)	mean	-22.46	-21.04	-20.00
	s.d.	1.23	1.24	0.36
	maximum	-20.63	-19.41	-19.26
	minimum	-25.32	-23.08	-20.62
	n	18	16	16

Euphausiids -- Euphausiids were initially sorted Into small, medium and large sizes, but no differences in $\delta^{13}C$ were evident by size and the data were pooled for regional comparisons. Species were determined for cruises HX87, AK88, and SU88. Species present included *Thysanoessa raschii* and *T. inermis*. Figure 9 shows $\delta^{13}C$ values and sample size for euphausiids by region. Euphausiid $\delta^{13}C$ values for 127 stations had significant differences among the eleven geographical areas (ANOVA on ranked values, $F_{10,116} = 7.81$, $P<0.0001$). For euphausiids, pairwise comparison showed significant differences among regions. Euphausiids from the Canadian,

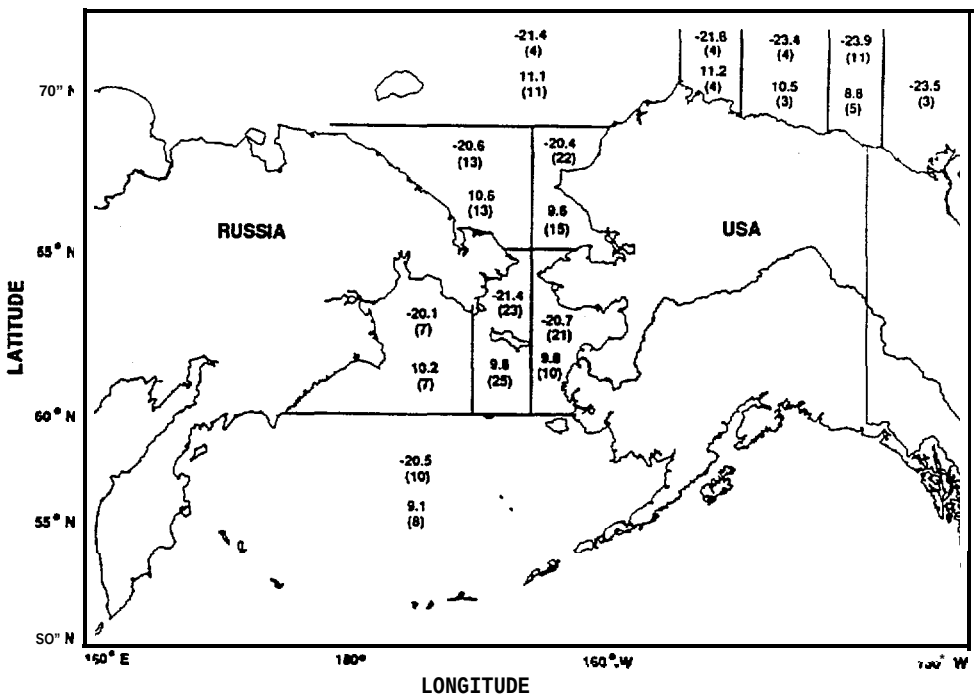

Figure 9. Average euphausiid isotope ratios for the subregions in Figure 6. Upper values in each area are $\delta^{13}C$ and sample number in parentheses; lower values are $\delta^{15}N$ and sample number in parentheses.

Central Alaskan and Eastern Alaskan Beaufort Sea regions were significantly depleted relative to those from the Southern Bering, Western Bering, Eastern Bering, Western Chukchi and Eastern Chukchi Sea regions. In addition, euphausiids from the Eastern Beaufort Sea region are significantly different from those of the Central Bering Sea, the most ^{13}C-depleted samples south of the Bering Strait.

Chaetognaths -- Chaetognaths are the principal predator of copepods and were abundant in almost all samples collected. Their carbon isotope ratios reflected the $\delta^{13}C$ of copepods from the same waters and were approximately 0.5 - 1 ‰ more enriched as anticipated from their trophic position. Figure 10 shows $\delta^{13}C$ values and sample size for chaetognaths by region. Chaetognath $\delta^{13}C$ values for 122 stations had significant differences among ten geographical areas (ANOVA on ranked values, $F_{9,112}$ = 5.65, P= <0.0001). Pairwise comparisons showed significant differences between chaetognaths from several of the regions. Chaetognaths from the Eastern Bering Sea are significantly different from those of the Southern Bering Sea. Chaetognaths from the Western Bering Sea are significantly different from those of the Northern, Eastern, Western Chukchi Sea and Southern Bering Sea regions.

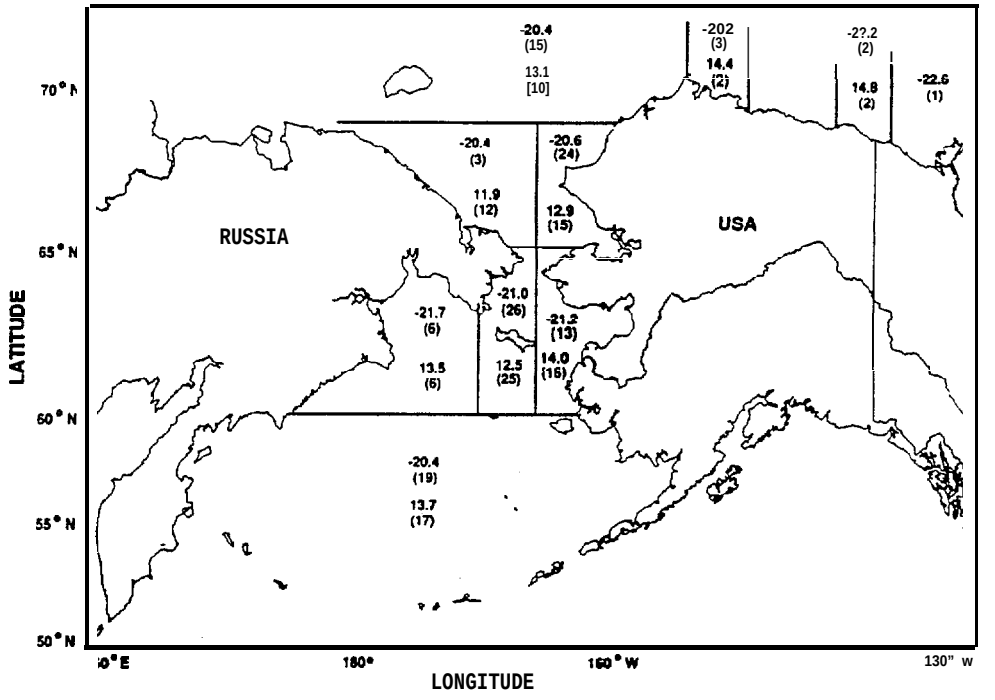

Figure 10. Average chaetognath isotope ratios for the subregions in Figure 6. Upper values in each area are $\delta^{13}C$ and sample number in parentheses; lower values are $\delta^{15}N$ and sample number in parentheses.

Saupe et al. (1989) reported an average value of $\delta^{13}C = -20.9^{o}/_{oo}$ for samples collected in June 1987 from the northern Bering Sea. As with the copepods, the chaetognaths collected in late summer and fall showed a slightly depleted average $\delta^{13}C$ relative to 1987 samples from the same time period. The $\delta^{13}C$ of copepods, euphausiids and chaetognaths collected from the SURVEYOR in 1989 (SU89) were in turn slightly enriched compared to the previous year.

Isotopic Data on Bowhead Whale Growth

Bowhead Whale Baleen Isotope Ratios -- Average $\delta^{13}C$ values for muscle, fat, and baleen are listed in Table 3 and individual $\delta^{13}C$ values for the baleen plates from the whales analyzed to date are shown in Figure 12. The traces encompass ages ranging from a near-term fetus (87B5F) to adults in excess of 23 years of age. All whales showed evidence of isotopic changes of the same magnitudes and periods as reported by Schell et al. (19871. Yearling whales all had distinctive natal notches near the tips of the baleen plates and several of these animals had been identified as "ingutuks" by Inupiat whalers, supporting the conclusion of Nerini et al. (1984), that this morphological variant is a recently weaned yearling.

An alternate hypothesis has been posed to account for the sometimes small and variable $\delta^{13}C$ peaks found in baleen from small whales (Withrow, et al. 1991). Their basic presumption is that growth is continuous and rapid following weaning and the peaks are hypothesized to correspond to individual bouts of feeding and fasting by young whales and are not a reflection of annual cycles. We do not accept this hypothesis for the following reasons: First, the primary cycles in even small whales all occur at approximately the same positions on the baleen In whales killed at similar times, regardless of year. Secondly, fall-killed small whales show peak locations and overall patterns consistent with growth over the summer months in a region of $\delta^{13}C$ depletion. Third, the progression of peaks along a plate of moderate length shows a decrease in cycle length consistent with a slowing in the growth of baleen. Superpositioning of the traces from the small whales identified as ages 1 - 4 in Figure 12 actually reveals a very remarkable similarity in all of the $\delta^{13}C$ traces over the first few years of life. Finally, the premise of rapid growth in small whales recently has been contraindicated by aerial photogrammetric data showing very slow growth rates In small whales (Koski, et al. 1991),

By measuring the incremental changes in baleen growth rates between isotopic cycles along the plates, ages were determined for the subadults using the technique described in Schell et al. (1987, 1989b). The findings, reported in Table 4, have been incorporated into the body length versus age and the baleen length versus age curves reported by Schell et al. (1989b). Beyond age four, the growth in body length in subadults is nearly linear vs. age with a slope of 0.49 m/year. Projecting this growth rate to the assumed age of sexual maturity at 13 - 14 m yields ages between 15 - 17 years (Figure 13). These estimates are less than the previous estimates of 18 - 20 years (Schell et al., 1989b).

Baleen length remains the best indicator of age in young whales. The data acquired in this study have been plotted with the data from Schell et al. (1989b) and the modified curve is shown in Figure 14. The best-fit

Table 3. Carbon and nitrogen isotope ratios for baleen and other tissues from whales analyzed in this study. Missing points indicate no sample. Age is estimated from isotopic dafa on baleen, N = number of samples from baleen plate.

WHALE	KILL DATE (ddmmyy)	SEX	BODY LENGTH (m)	AGE (years)	AVERAGE BALEEN $\delta^{13}C$ (‰)	BALEEN LENGTH (cm)	N	VISCERAL FAT	BLUBBER	MUSCLE	OTHER
								($\delta^{13}C$ (‰))			
66B1 +	10105166	M	9.7	9	-18.68	175	63				
8601	27/04/86	M	6.2	4	-16.61	118	43			-19.4	
66B2	27104166	M	8.7	1	-16.74	52	28		-25.8	-20.1	
8603	30104166	F	8.9	7	-19.09	160	52			-20.6 (2)	
66B4	01105186	M	8.9	7	-16.77	130	52			-19.6	
66B5	04105186	M	6.1	2	-16.23	85	53	-24.4		-19.1	
6606	05105166	F	12.3	>15	-19.30	230	81	-25.7		-19.7	
86B7	06105166	M	10.7	11	-19.07	201	49	-24.7		-20.0 (3)	
86KK1	10/09/86	F	7.6	3.5	-19.10	130 (right)	49	-27.6 (2)	-26.0 (3)	-21.4	
86KK2	17/09/86	F	17.1	>23	-17.81	360	165	-25.0	-25.4	-19.1	-16.4 (collagen)
66KK3	26109186	M	10.4	7.5	.19.30	165	50	-26.5	-26.5	-21.4	-16.2 (collagen)
86WW1	05105166	M	15.9	>20	-17.26	269	133	-24.9		-18.6	
86WW2	10/05/86	F	17.7	>23	-17.73	310	200		-25.8	-19.4	
87B1	01/05/88	M	9.3	6	-19.45	168	38				
67B2	02105167	F	6.9	8	-18.50	150	60				
67B3-A	04105167	M	11.0	>13	-16.99	195	76				
87B3-B	04105187	M	11.0	>13	-19.05	195	79				
67B4	20105167	F	16.6	>20	-16.43	295	118				
67B5	15/06/87	F	15.7	>19	-18.46	300	120				
87B5F	15/06/87	fetus	4.0		-16.19	15	14		-19.5	-16.9	
67B6	22110167	F	15.7	>21	-17.97	315	105	-23.6	-24.7 (24)	-19.2 (2)	-15.6 (2) (tendon)
67B7	29110107	M	6.5	1.5	-18.60	85	34	-25.5	-26.1 (14)	-20.6	-20.7 (tendon)
67G2	24104167	F	16.8	>22	-18.23	345	138				
67H4	26105167	M	7.8	1	-16.40	66	27				
87N1	05110187	F	15.2	>17	-18.74	330	132		-25.6 (71)	-20.9 (2)	
87WW2	06105187	M	13.5	>14	-18.90	215	86				
87WW3	15/05/87	F	6.2	1	-16.91	65	72				
6801	24104168	F	6.9	2	-18.56	98	39	-25.0(2)		-20.2	
86B2	25/04/88	M	6.8					-24.4	-25.6	-19.4	
88B3	25104166	F	7.6					-25.3		-19.2	
88B4	25104/88	F	9.0	3	-18.63	130	52			-19.3 (2)	-17.3 (tendon)
88B5	25104166	M	6.9							-19.4	
88B6	02105108	F	8.3					-25.3 (C. V. F.) •		-20.0 (2)	-19.5 (tendon)
88B6	02/05/88	F	6.3					-25.7 (R.V.F.)•			

Table 3. Cent'd.

WHALE	KILL DATE (ddmmyy)	SEX	BODY LENGTH (m)	AGE (years)	AVERAGE BALEEN $\delta^{13}C$ (‰)	BALEEN LENGTH (cm)	N	VISCERAL FAT	BLUBBER	MUSCLE	OTHER
								(δ "c (o/m)			)
88B6	02/05/88	F	8.3								-19.6 (liver)
88B7	05105180	F	8.2	1	-16.86	78	31	-25.7 (R.V.F.)•		-20.3	-21.1 (liver)
8887	05105168	F	8.2	1							-19.7 (tendon)
88B8	06105168	F	'7.5	4	-16.67	130	52	-21.4 (C.V.F.)•		-19.5	-16.7 (tendon)
6808	06105186	F	7.5	4				-25.6 (R.V.F.) '			-20.2 (liver)
88B9	15/09/88	M	14.6	>18	-16.64	257					
88B10	17/09/88	M	15,1	>21.5	-16.74	302	132				
88811	17/09/88	F	15.6	>22.5	-18.17	320	137				
88G1	16/04/88	F	15.7	>18	-18.44	295					
88G2	25104180	F	15.3	>18	-18.41	275				-19.1	
88KK1	24109180	F	14.9	>19.5	-18.61	297	102				
88WW1	25104166	F	7.9	1	-16.27	77	30				
88WW2	26104188	M	9.1	2	-16.91	96	39				
88WW3	06105166	M	13.4	>14	-19.66	207	83				
89B1	23104169	F	8.9	2	-16.52	90 (proximal)	37				
8981	23104169	F	8.9	2	-18.51	103 (medial)	41				
89B1	23104169	F	6.9	2	-18.55	87 (distal)	36				
6909	25110169	M	8.2	1.5	-18.49	965 (right)	38				
69B9	25110189	M	6 2	1.5	-18.51	96.5 (left)	38				
89B10	28110189	F	6.1	5 5	-19.69	152 (left)	63				
89B10	28110169	F	8.1	5.5	-19.55	155 (right)	64				
89KK3	27109189	M	12.6	>14	-19.55	220	91				
9005	23/05/90	F	15.9	>19	-18.00	279	125				
90B7	01/10/90	F	8.4	3.5	-18.77	140	56				
90B8	02110190	M	12.9	>13.5	-18.93	243	101				
90G4	07105190	F	15.2	>20	-16.29	300	119				

• C.V.F. = Cardiac visceral fat; R.V.F. = Renal visceral fat

+ B. Barrow, G - Gambell, H. Point Hop, KK = Kaktovik, N - Nuiqsut, WW = Wainwright

Table 4. Bowhead whale (B. *mysticetus*) growth rate data from $\delta^{13}C$ analyzed baleen plates. "Estimated age" represents actual age of the animal assuming birth occurred in spring. "Baleen Growth Increments" are the number of $\delta^{13}C$ cycles in the given length range, progressing from the tip of the plate toward the jaw. Asterisks indicate missing increments lost through erosion from tip.

Whale[a]	(sex)	(season taken)	Body Length (m)	Baleen Length (m)	No. of Baleen Growth Increments (cm/yr) >45	35-45	27-35	<27	Estimated Age (years)
† 87B5F	(Fetus)	Spring	4.0	0.15					
86B2	Female	Spring	8.7	0.65	1				1
† 87WW3	Female	Spring	8.2	0.60	1				1
† 87H4	Female	Spring	7.8	0.65	1				1
† 88B7	Female	Spring	8.2	0.77	1				1
† 88WW1	Female	Spring	7.9	0.77	1				1
† 87B7	Male	Fall	8.5	0.85	1				1.5
† 89B9	Male	Fall	8.2	0.96	1				1.5
86B5	Female	Spring	8.1	0.95	1	1			2
† 88B1	Female	Spring	8.9	0.97	1	1			2
† 88WW2	Male	Spring	9.1	0.95	1	1			2
† 89B1	Female	Spring	8.9	1.03	1	1			2
† 88B4	Female	Spring	9.0	1.30	1	1	1		3
† 90B7	Female	Fall	8.4	1.40	1	1	1		3.5
86KK1	Female	Fall	7.6	1.45	2	1			3.5
† 88B8	Female	Spring	7.5	1.30	1	1	1	1	4
86B1	Male	Spring	8.2	1.35	1	1	1	1	4
86B4	Male	Spring	8.9	1.50	•	1	1	4	7
86B3	Female	Spring	8.9	1.70	*	1	1	4	7
86KK3	Male	Fall	10.4	1.85	*	1	1	4	7.5
† 87B1	Male	Spring	9.3	1.62	*	1		6	8
† 87B2	Female	Spring	8.9	1.72	*	1	1	5	8
66B	Male	Spring	9.7	1.75	*	1	1	6	9
86B7	Male	Spring	10.7	1.90	*	*	1	8	11
† 87B3	Male	Spring	11.0	1.95	*	*	*	10	≥13
† 90B8	Male	Fall	12.9	2,43		*	*	10	≥13.5
† 87WW2	Male	Spring	13.5	2.15	•	*	*	11	≥14
† 88WW3	Female	Spring	13.4	2.07	*	*	*	11	≥14
86B6	Female	Spring	12,3	2.40	•	*	*	12	≥15
† 87N1	Female	Fall	15.2	3.25	*	*	*	14	>17
† 88B9	Male	Fall	14.6	2.57	*	*	*	15	>18
† 88G2	Female	Spring	15.3	2.75	•	*	*	15	>18
† 90B5	Female	Spring	15.9	2.79	*	*	*	16	>19
† 87B5	Female	Spring	15.7	3.00	•	*	*	16	>19
† 88G1	Female	Spring	15.7	2.95	*	*	*	16	>19
† 88KK1	Female	Fall	14.9	2.97	*	*	*	16.5	>19.5
† 90G4	Female	Spring	15.2	3.00	*	*	*	17	>20

Table 4 (Continued).

Whale[a]	(sex)	(season taken)	Body Length (m)	Baleen Length (m)	No. of Baleen Growth Increments (cm/yr)				Estimated Age (years)
† 87B4	Female	Spring	16.8	2.75	•	*	*	17	>20
86WW1	Male	Spring	15.9	3.15	*	*	*	17	>20
† 87B6	Female	Spring	15.7	3.15	*	*	*	18	>21
† 88B10	Male	Fall	15.1	3.02	*	*	*	18.5	>21.5
† 87G2	Female	Spring	16.8	3.45	•	*	*	19	>22
† 88B11	Female	Fall	15.6	3.20	*	*	*	19.5	>22.5
86KK2	Female	Fall	17.1	3.80	*	*	*	20	>23.5
86WW2	Female	Spring	17.7	3.75	*	*	*	20	>23

a. Indicates year, location and sequential number of kill. B = Barrow; G = Gambell; H = Point Hope; N = Nuiqsut; WW = Wainwright; KK = Kaktovik.

† Whales analyzed for this study. Other data from Schell et al. (1987).

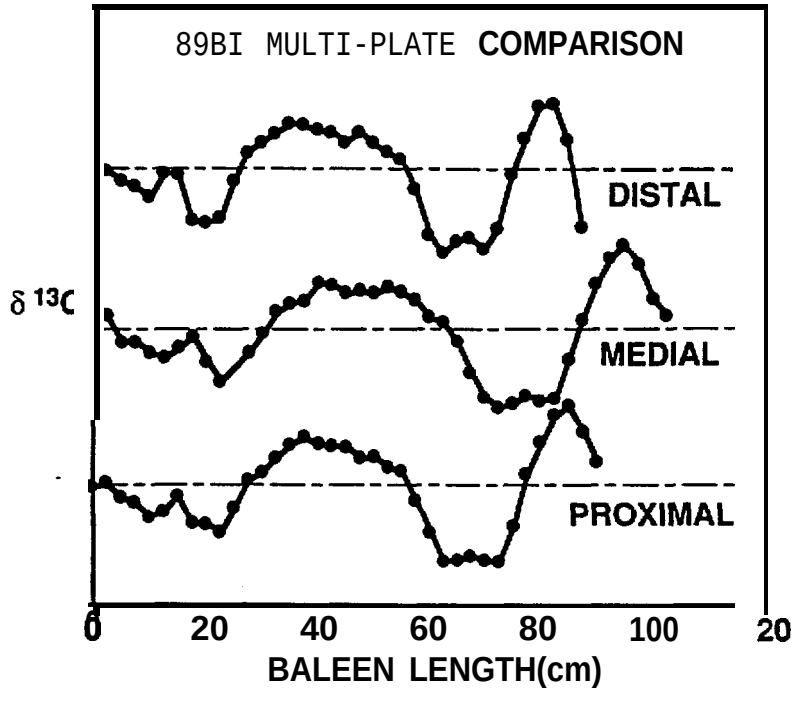

Figure 11. Baleen carbon isotope ratios for three plates from distal, medial and proximal locations in the baleen rack of whale 89B1. Vertical scale is the same for all plates. See also whale 88B9, Figure 12.

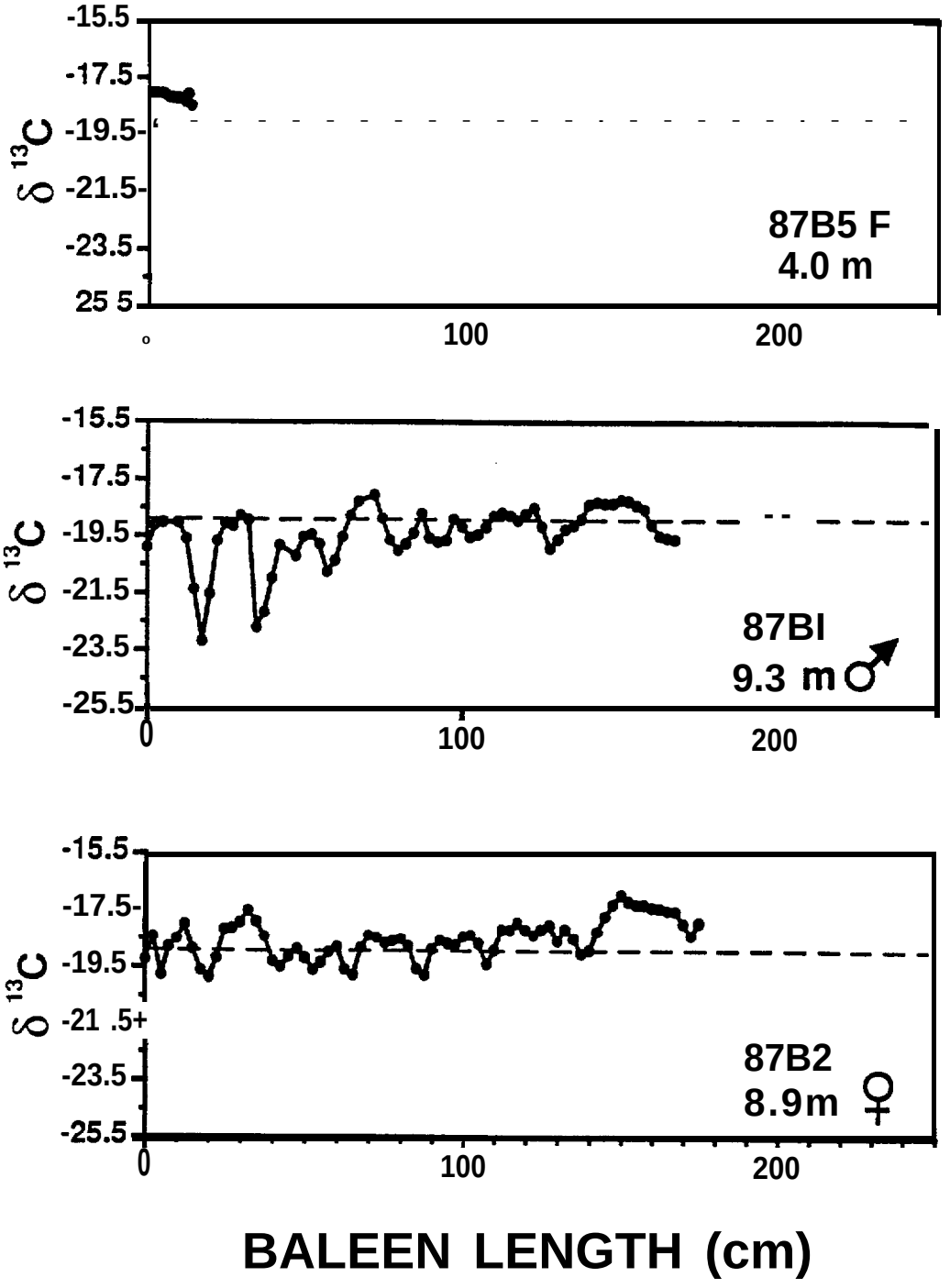

Figure 12. Baleen carbon isotope ratio traces for all whales sampled in this study. Estimated ages are listed in Table 4.

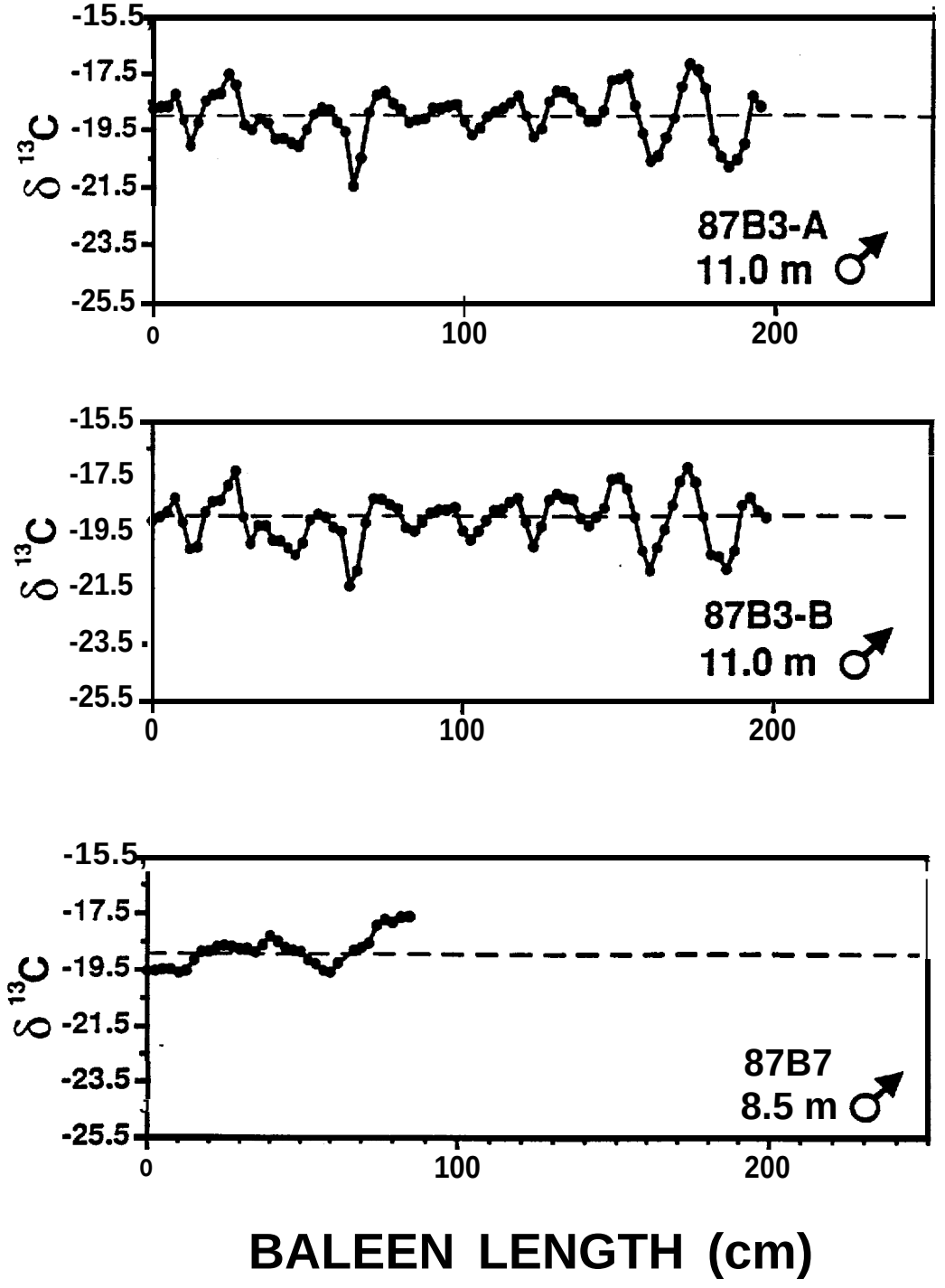

Figure 12. (cent'd)

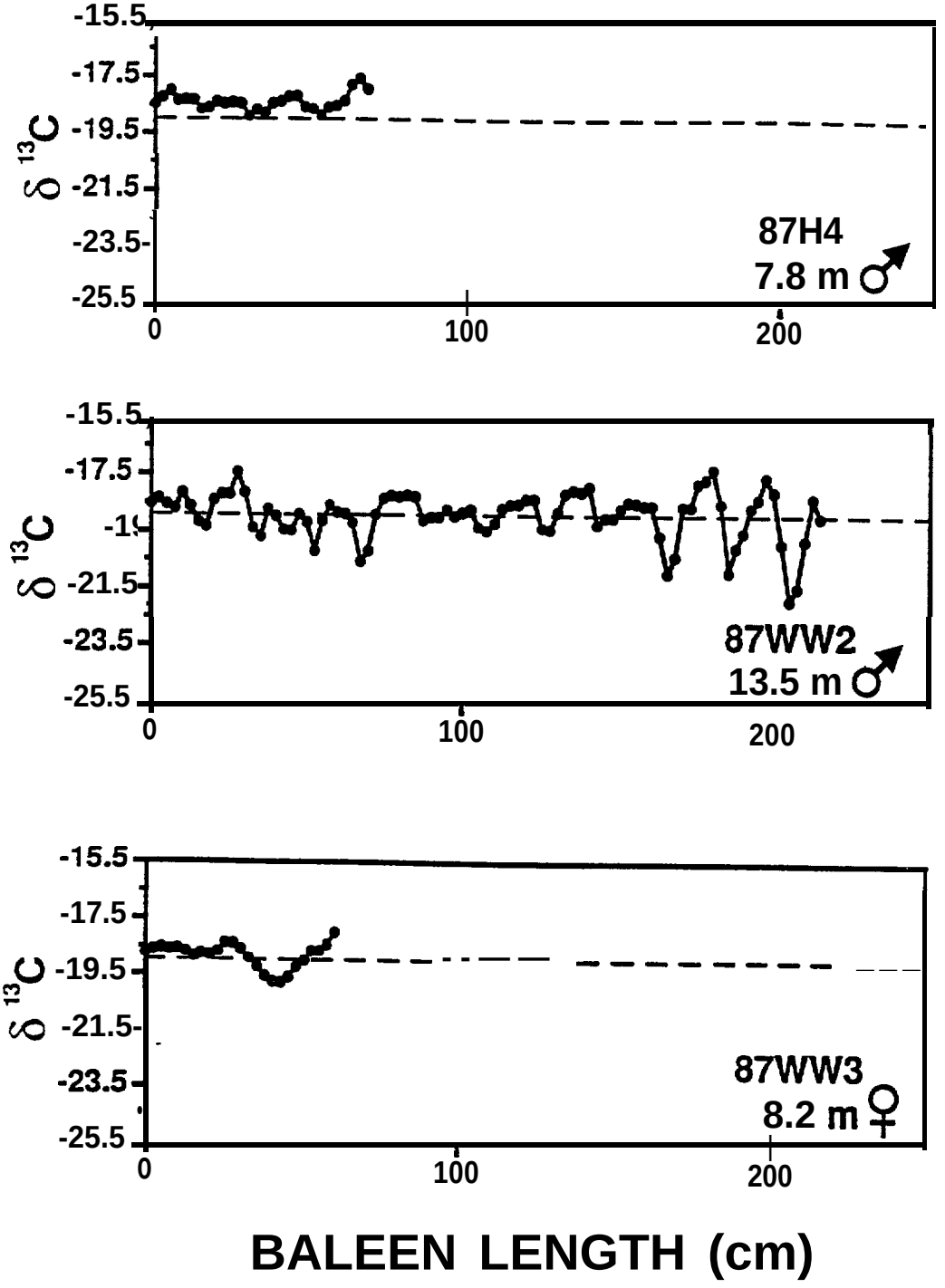

Figure 12. (cent'd)

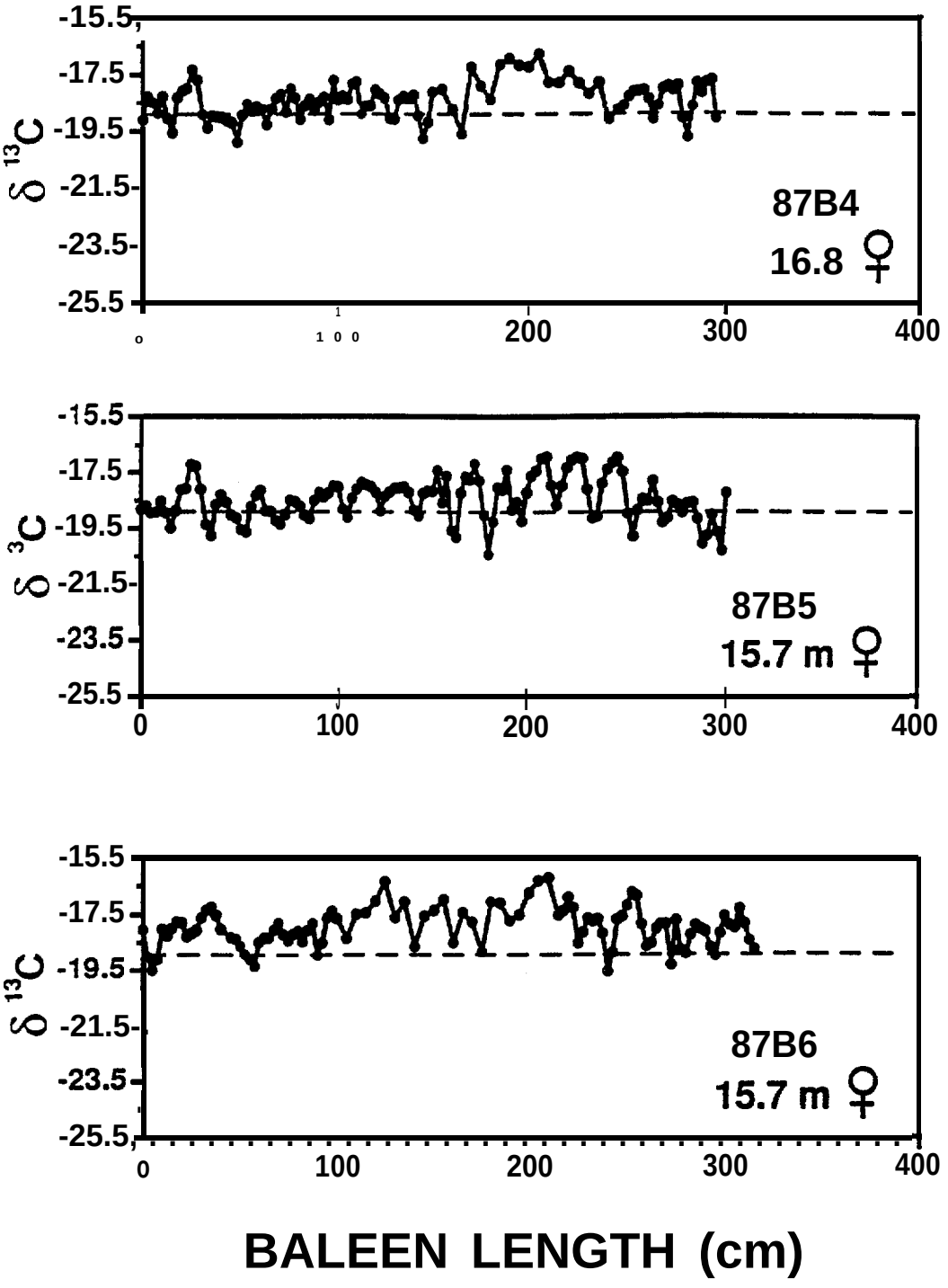

Figure 12. (cent'd)

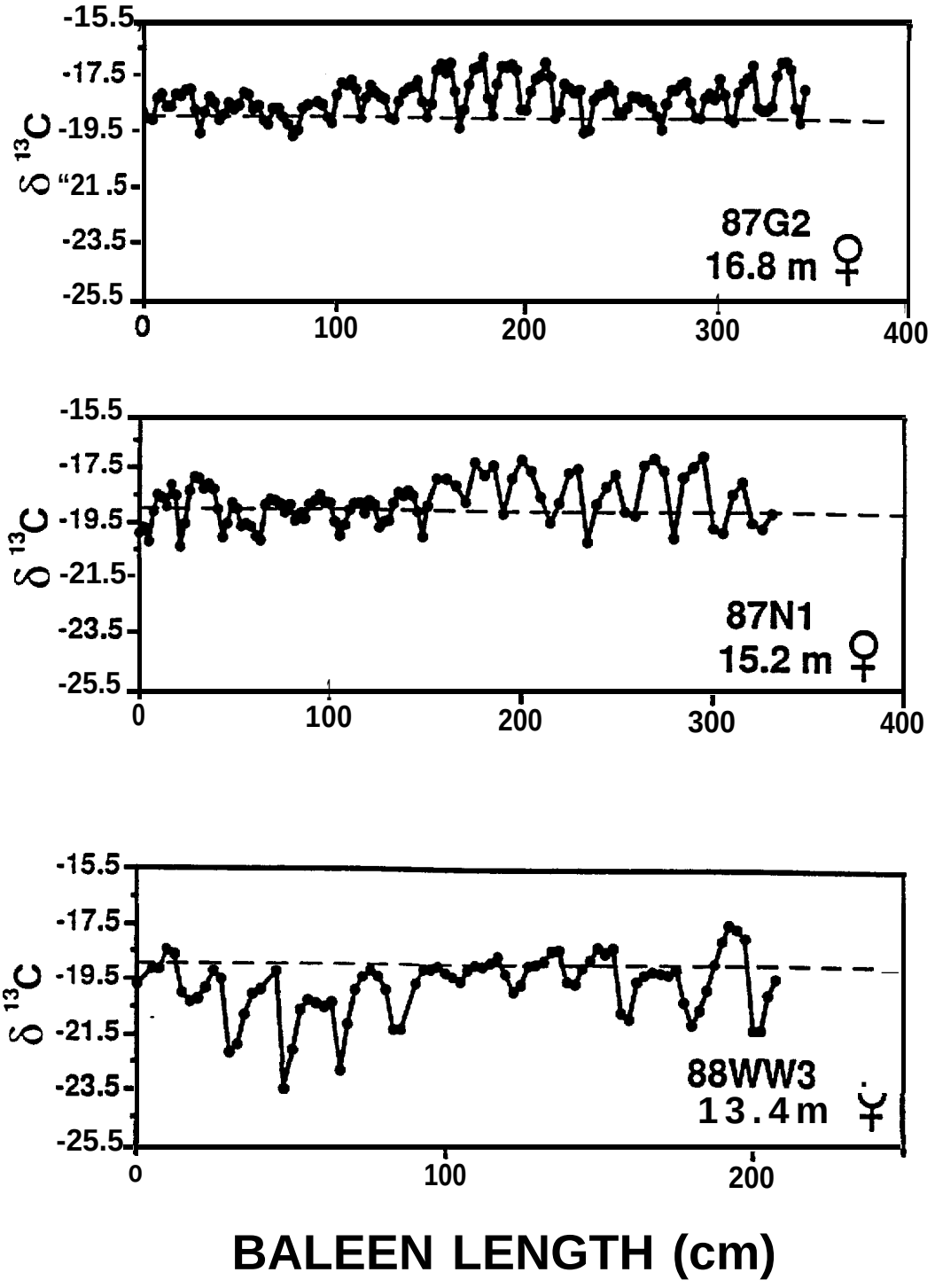

Figure 12. (cent'd)

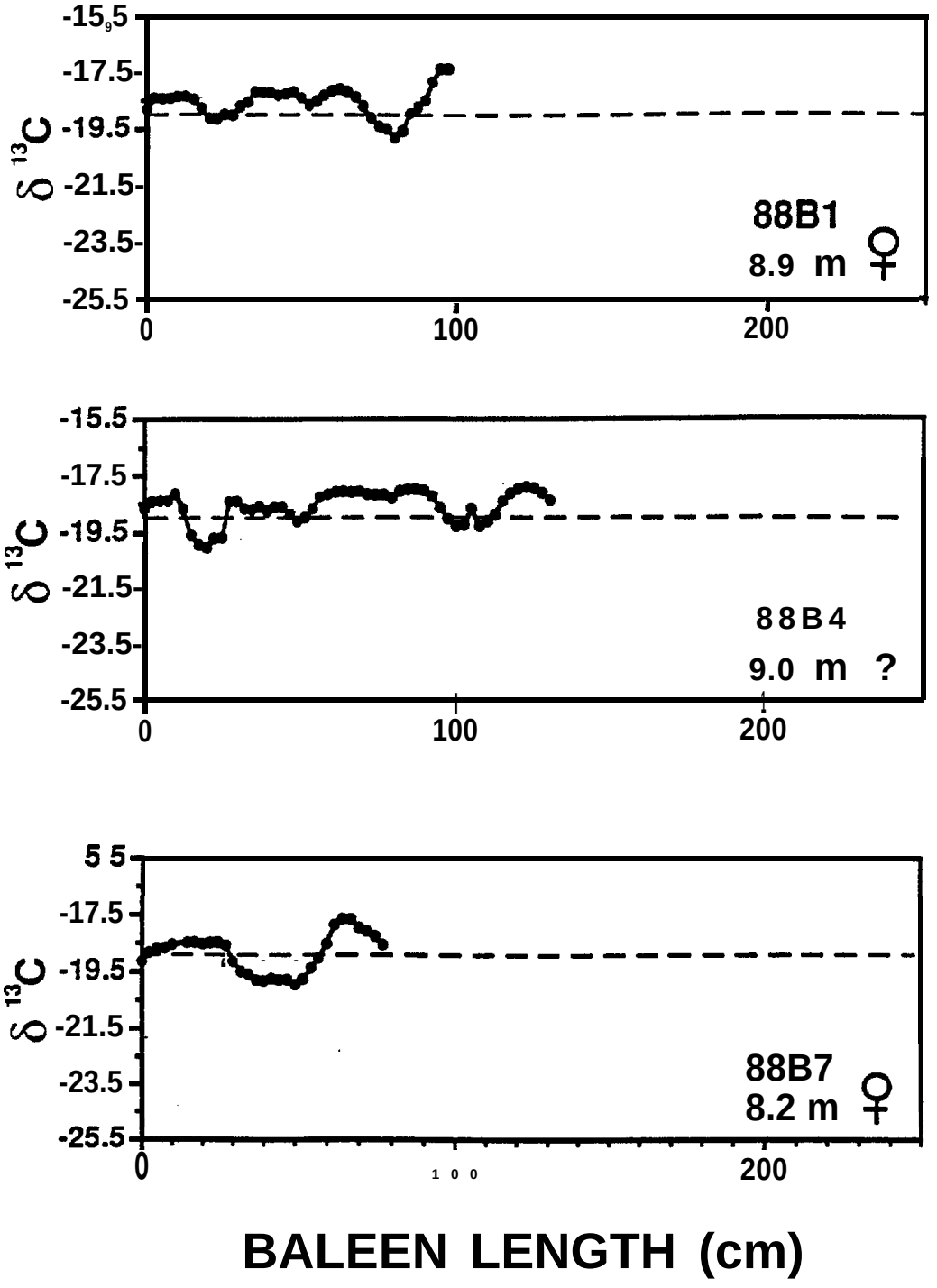

Figure 12. (cent'd)

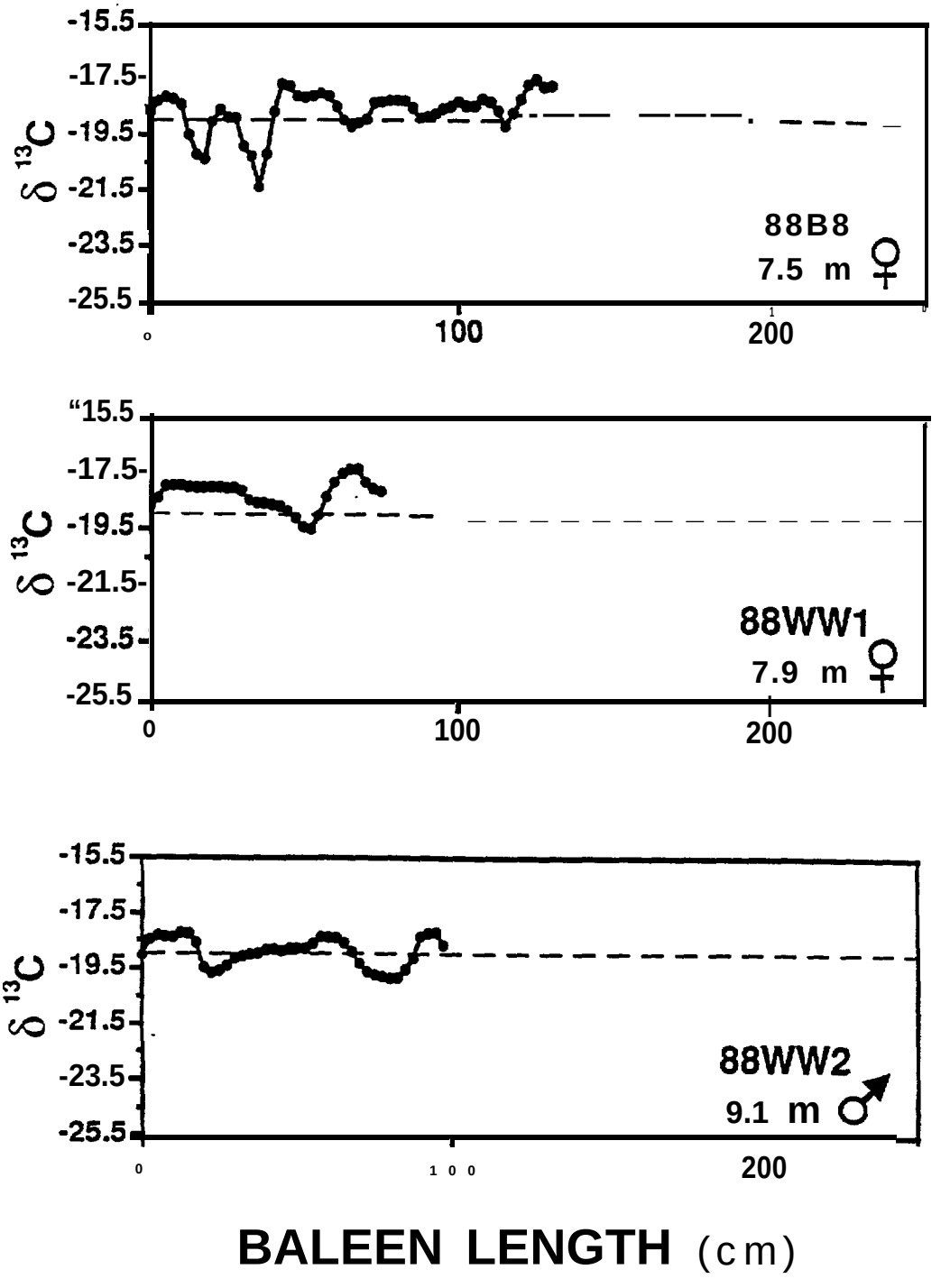

Figure 12. (cent'd)

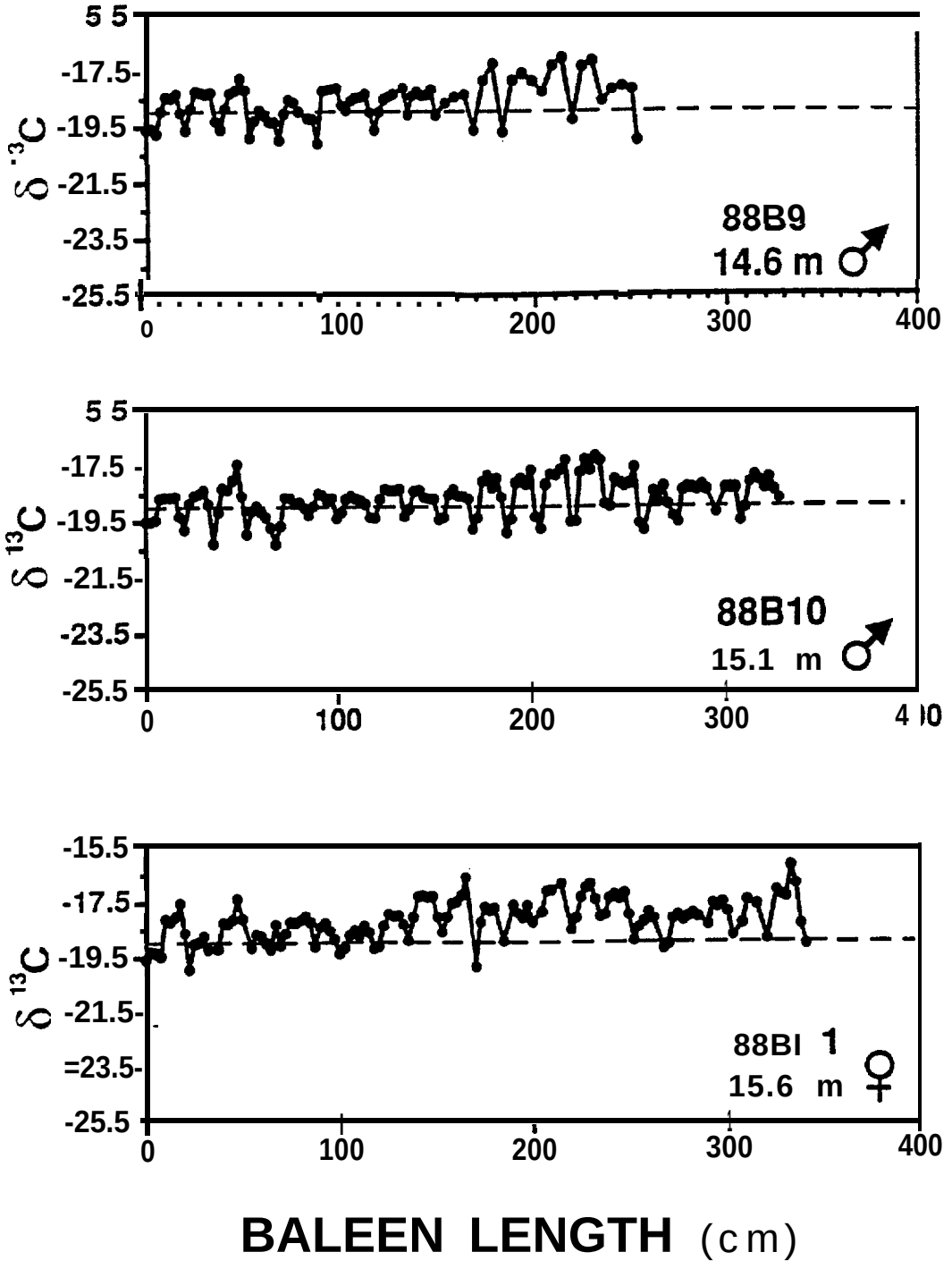

Figure 12. (cent'd)

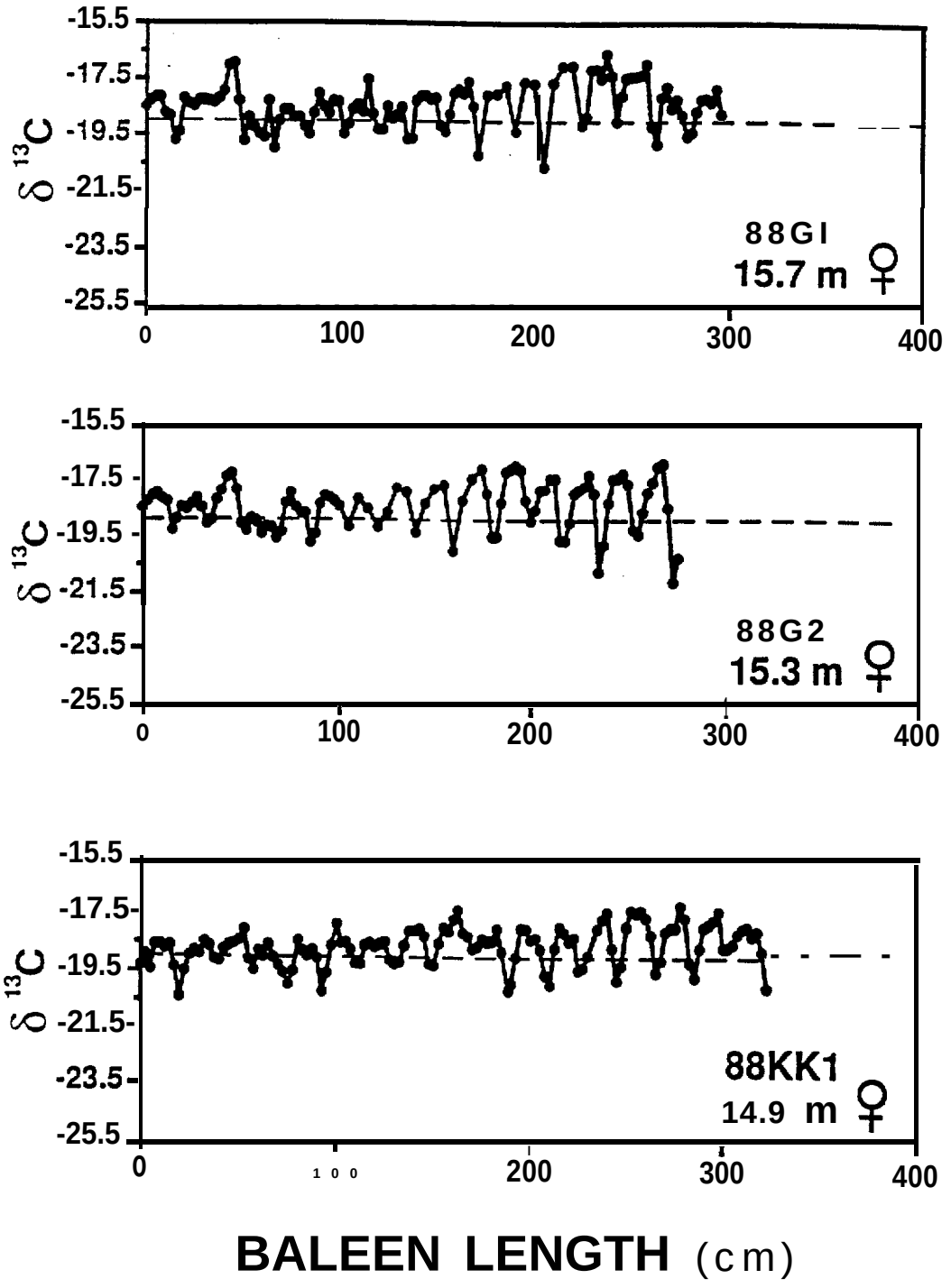

Figure 12. (cent'd)

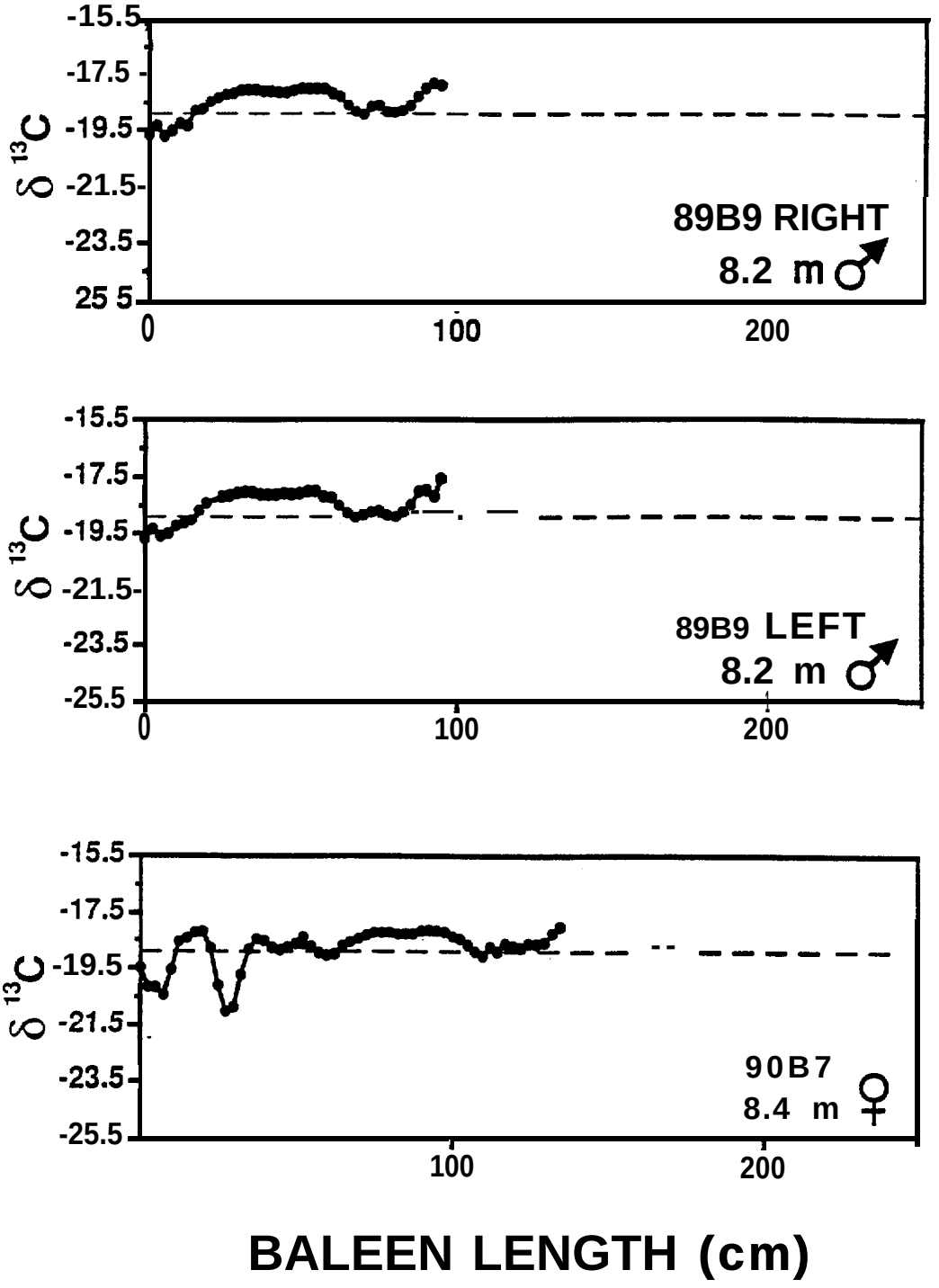

Figure 12. (cent'd)

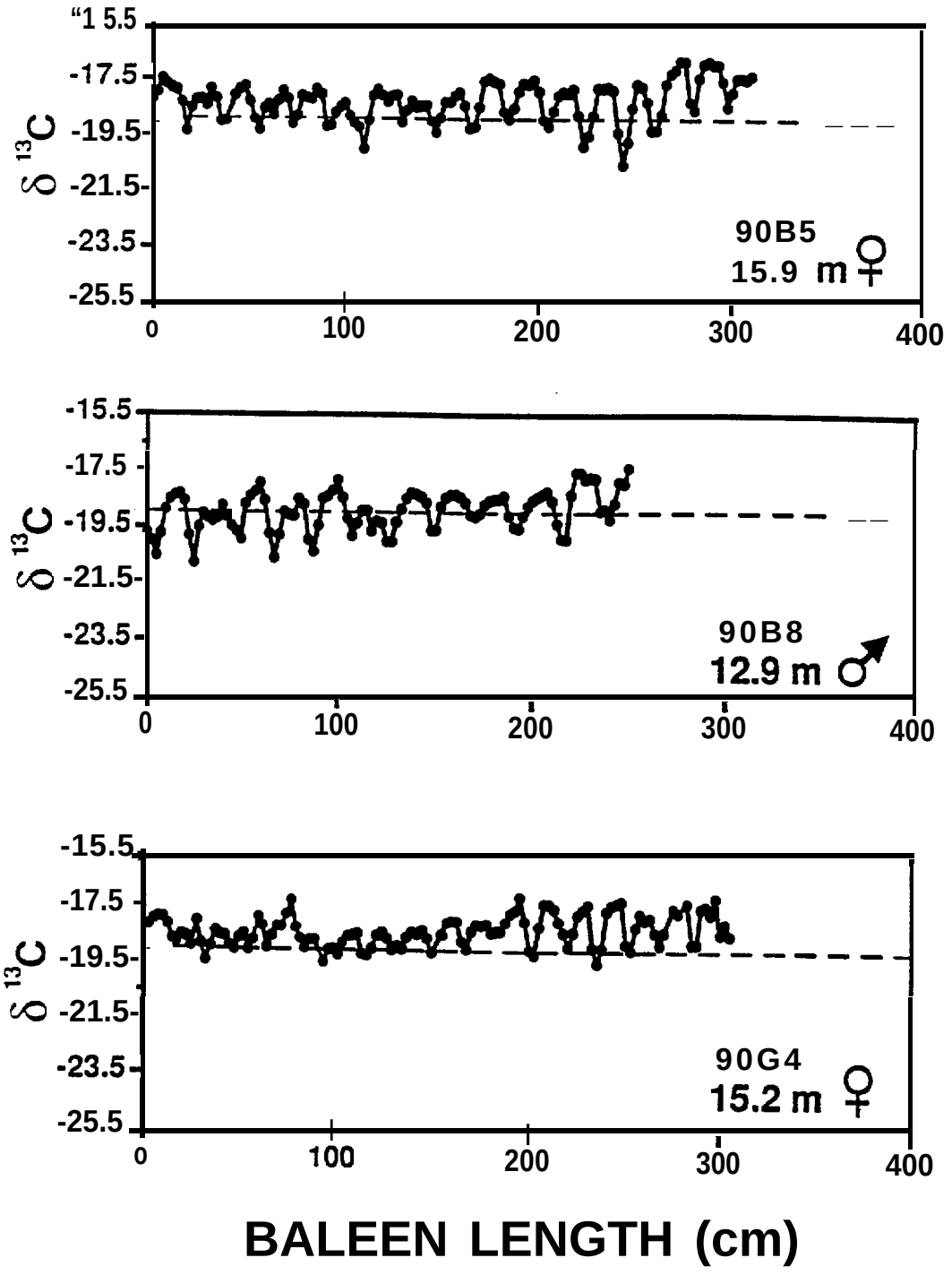

Figure 12. (cont'd)

power curve for baleen length versus age is now:

$$X = 2.14\ Y^{2.271} \quad r^2 = 0.97$$

where X = age in years and Y = baleen length in meters. The points for whales 87B3, 90B8, 87WW2, 88WW3, and 86B6 are "best estimates" and the uncertainty is greater than that for younger whales. The incremental changes in baleen growth rates are indiscernible in these whales due to wear off the distal end of the plates. The age estimates assume a loss of three years baleen growth from the tip of the plate. It is theoretically possible to calculate a wear rate from the data on the change in body length versus the incremental growth of baleen plates. We did not feel this is valid in the present case, however, because the plates we analyzed were not always from same position in the rack. As the multiple plate analysis for whale 89B1 shows, it is possible to get the same age from any of the longer plates in the baleen rack, but there is a slight difference in growth rates depending on position in the rack. The plates in the center of the rack are slightly longer and grow slightly faster than those at more proximal or distal positions. It would be important for maximum accuracy in aging of the animals to collect the plates from the same location in the racks.

Following weaning, there is a period of little linear body growth which persists for several years. Whale 88B8 was estimated at 4 years of age and had a body length of 7.5 m. This was shorter than any of the yearlings analyzed to date although the baleen, at 1.3 m in length, was almost double the length of the yearlings (see Table 3). Observers of the whale noted that the animal was very thin and had a relatively thin layer of blubber. Whale 87B2, with an estimated age of 8 years, was 8.9 m in length, well within the same length range as yearlings and two-year olds. The baleen in this whale was 1,72 m in length. Figure 13 illustrates this diapause or near cessation in growth very clearly.

Environmental control of carbon isotope ratios -- Closer examination of the isotope records in the baleen from large whales reveals that on a multi-year basis, the winter $\delta^{13}C$ values undergo year-to-year changes and often show trends of either increasing or decreasing ^{13}C content over periods up to 5 or 6 years. Comparison of the isotope records between large whales also shows that the trends usually, but not always correlate, indicating that the source of the variability is probably in the food consumed from the winter environment.

Figure 15 shows the carbon and nitrogen isotope ratio traces of an adult whale (88B10). The trace spans the period 1969 to 1988. The boxes show the isotope ratio values presumed to be derived from fall-winter feeding in the Bering/Chukchi seas. Whales harvested in the spring have new baleen enriched in $\delta^{13}C$ indicating previous feeding during the fall and/or winter in the Chukchi/Bering seas. Whales killed in the fall have new baleen growth depleted as the baleen reflects the relatively ^{13}C-depleted prey of the Beaufort Sea summer feeding grounds. It would be expected that if the whale fed only in the summer, the $\delta^{13}C$ values of the tissues would reflect only the $\delta^{13}C$ values of the Beaufort Sea zooplankton prey. The annual $\delta^{13}C$ oscillations reveal, however, that the depleted region is less than one-third of the yearly baleen growth and

is equivalent to the fraction of the year the whales reside in the Beaufort Sea. This indicates that baleen growth continues through the fall and winter at an approximately constant rate.

These fall-winter values display multi-year trends of changing isotope ratios punctuated by years showing sharp shifts. These trends are evident in the baleen of all of the adult whales sampled (17 whales). From the traces of stable isotope values along the baleen plates, fall/winter baleen values were listed by year for 17 adult and subadult whales and averaged. These data were then plotted for the years 1973 to 1990.

Bering Sea Surface Temperature Anomalies - Figure 16 shows the isotope ratio values from baleen plate records for fall-winter feeding by all whales between 1973 and 1990. With the exception of isotope ratios in 1985-1986, the trend follows a relatively smooth pattern of ^{13}C-depletion from 1975 to 1985 and increasing enrichment in recent years. Also shown in Figure 16 are the sea surface temperature anomalies for the Bering Sea over this same period. Fall/winter isotope averages are plotted opposite nine-month and five-year running mean Bering Sea surface temperature anomalies recorded at 55 degrees North and 175 degrees West. Although a pronounced 2.4 year temperature cycle is evident in warm years, as shown by the 9-month running mean, the isotope record reflects only the inverse of the long-term trend as evident in the five year running mean, Since the temperature record might be biased by unusual winter temperatures and the primary production season occurs during the spring-summer months, the five-year running mean sea surface temperature anomalies for the spring and summer months (April-September) were compared to the fall/winter baleen averages. The assumption is that isotope ratios in spring/summer phytoplankton are incorporated into the zooplankton over the course of the summer and fall and then into the whales when they return from the Arctic in the late fall. Cross-correlation analysis between these spring/summer sea surface temperature anomalies and Bering-Chukchi isotopic data indicate an inverse correlation close to the 93?! confidence level (Figure 17) and an approximately one - two year lag behind sea surface temperature changes. This confidence level is probably inflated because of the use of the running anomaly averages but the apparent correlation of the isotope ratios with the longer term changes in temperature is interesting. The lag behind temperature may reflect delayed responses by phytoplankton assemblages and consequent changes in $\delta^{13}C$. Temperature changes of this small magnitude alone would be expected to have little effect on $\delta^{13}C$ but may be a proxy for the other physical and chemical effects altering the environmental quality for phytoplankton.

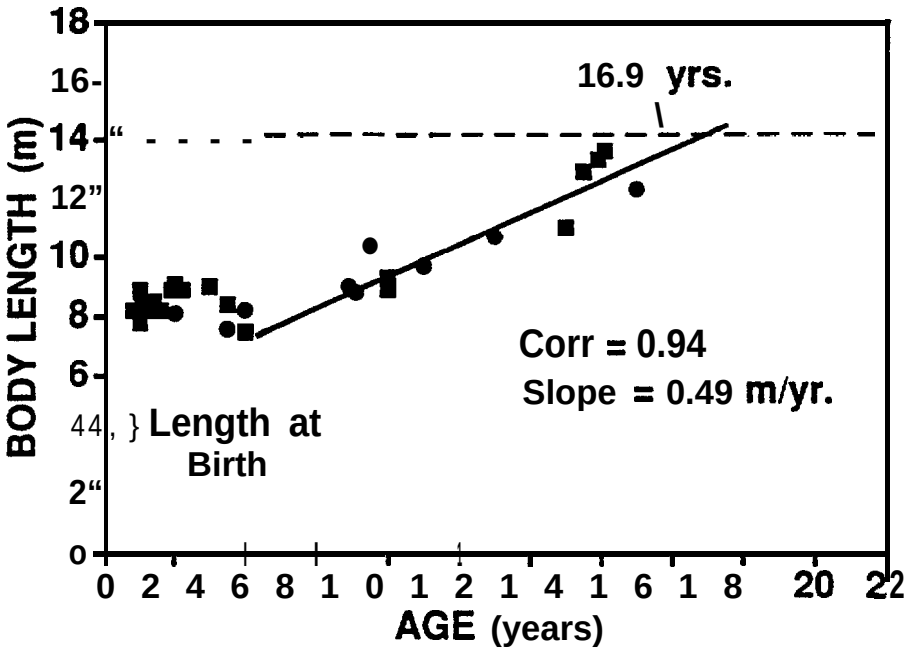

Figure 13. Body length and estimated ages for subadult whales. The regression line is for data from age four; the intercept at 14 m is the estimated age for sexual maturity. Circles are data from Schell et al. (1989) ; squares are data from this study.

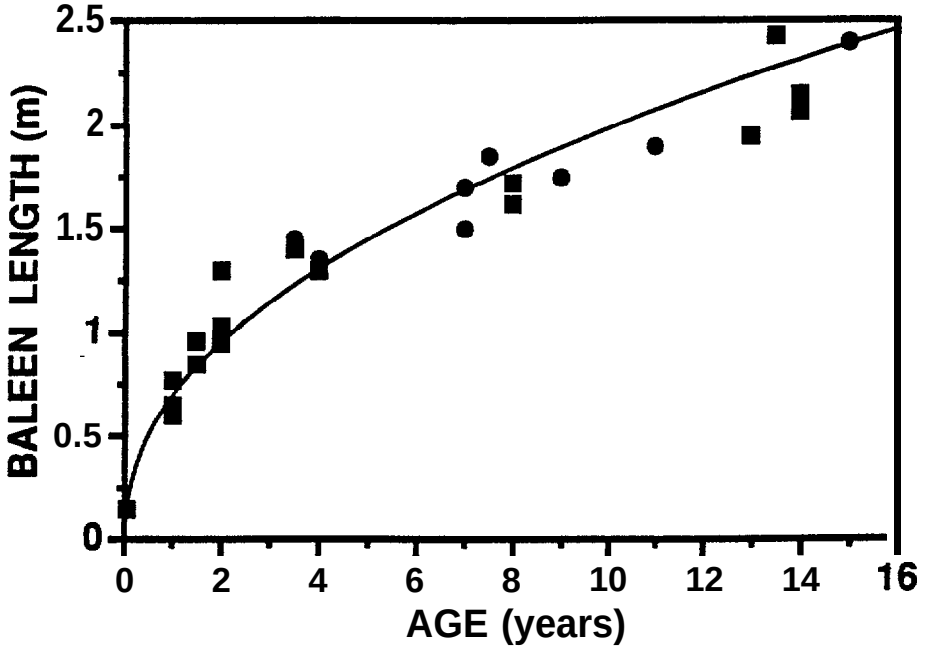

Figure 14. Baleen length and estimated age of subadult bowhead whales. Circles are data from Schell et al, (1989); squares are data from this study.

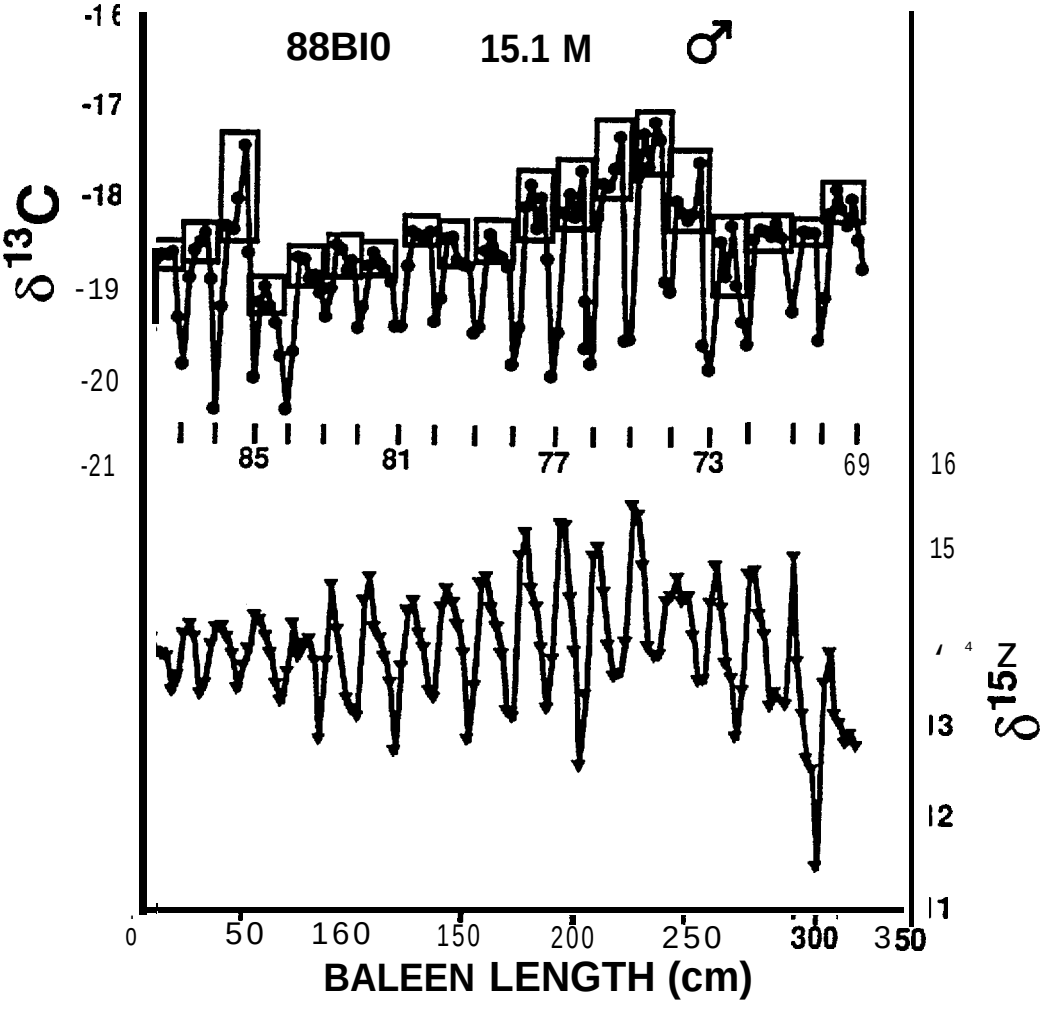

Figure 15. The $\delta^{13}C$ and $\delta^{15}N$ traces for whale 88B10. Points enclosed in boxes represent baleen laid down during feeding in the Bering and Chukchi seas. These data were averaged for each year and used with similar data from other adult and subadult whales to calculate interannual shifts in zooplankton $\delta^{13}C$.

DISCUSSION

Carbon Isotope Gradients

Latitudinal Gradients in Carbon Isotope Ratios -- The results of the statistical analyses concur with the Saupe et al (1989) findings of trends in zooplankton enrichment from the Beaufort Sea to the Chukchi/Bering seas. The Canadian, Eastern Alaskan and Central Alaskan Beaufort seas zooplankton are the most ^{13}C-depleted and the Western Beaufort, Chukchi and Bering seas tend to be the most enriched. Comparisons of $\delta^{13}C$ values for zooplankton species between the Beaufort Sea and Chukchi/Bering seas indicate significant differences between these regions. This evidence further supports the latitudinal trend of ^{13}C-depletion at higher latitudes and enrichment at lower latitudes although on the local scale the gradient is most pronounced in n east-west direction. However, due to the small sample size in the Western Beaufort Sea, the differences listed between the Western Beaufort and Eastern, Canadian and Central Beaufort seas may not be as solid as indicated. It is also important to recognize that no synoptic sampling of zooplankton occurred in the Beaufort Sea concurrent with sampling of the Chukchi and Bering seas. The conclusion that the Beaufort Sea zooplankton are depleted in ^{13}C relative to western and southern samples is based on the facts that no zooplankton have been collected from the latter regions with $\delta^{13}C$ values as low as the Eastern Beaufort Sea. Although the baleen isotope ratios also indicate that the differences persist from year to year, an opportunity to synoptically sample all regions in the same season would be most useful in confirming the magnitude of the $\delta^{13}C$ gradient.

Seasonal and interannual variation in zooplankton $\delta^{13}C$ -- Zooplankton collected on cruises in 1988 showed a seasonal trend in ^{13}C depletion from early spring to late summer and fall. In 1988, copepods, euphausiids and amphipods collected on the spring ice-edge cruise (May) were significantly ^{13}C-enriched relative to those collected in late summer and early fall (July-October). Again, however, no synoptic sampling of the other regions has been undertaken early in the season so temporal variation cannot be separated from geographic. Several Chukchi/Bering sea cruises taken from September to October 1987-1991, within the same general geographic regions, show a very weak trend of ^{13}C-depletion in zooplankton between years 1987 - 1988 with slight enrichment in 1989 - 1991 (Figures 18 and 19). This trend is too weak to be construed as an indication of interannual change in zooplankton $\delta^{13}C$, but the baleen isotope data indicate this may be true (see below).

The small variability between years in zooplankton $\delta^{13}C$ may be driven by physical parameters, including temperature changes and nutrient supply. Changes in $\delta^{13}C$ of phytoplankton stocks could be accompanied by changes in algal species composition associated with ice-retreat and bloom stages. These changes might also be reflected in seasonal differences in $\delta^{13}C$ of zooplankton as well as zooplankton biomass diversity. Although the change in euphausiid or copepod $\delta^{13}C$ would require a change in phytoplankton $\delta^{13}C$, a change in baleen $\delta^{13}C$ from a given region could arise solely from a shift in fractional biomass abundance between copepods and euphausiids. The magnitude of the observed shift in baleen $\delta^{13}C$ would require, however, almost an exclusive shift between total copepod to total euphausiid diet. Euphausiids are typically one ‰ enriched relative to copepods.

Nitrogen Isotope Ratios in Baleen

In contrast to the pronounced gradient in $\delta^{13}C$ for zooplankton in Alaskan waters, no such gradient is evident for $\delta^{15}N$. The data in Figures 8 - 10 illustrate that the nitrogen isotope ratios for both copepods and euphausiids are statistically the same for virtually all regions tested and only euphausiids in the eastern Alaskan Beaufort Sea are significantly lighter than in other regions. The small sample sizes for the eastern Beaufort Sea make even its slight difference questionable. With both copepods and chaetognaths, no trends in $\delta^{15}N$ are evident across the geographic regions. We would anticipate, therefore that the baleen isotope ratios would show only a very small or no annual oscillation in $\delta^{15}N$. This is not the case. The nitrogen isotope ratios shown in Figure 15 undergo seasonal oscillations of equal or greater magnitude than $\delta^{13}C$ in very close synchrony usually lagging $\delta^{13}C$ by a few months. The period of maximum enrichment occurs while the whales are in the Bering Sea assuming that the maximum in $\delta^{13}C$ occurs in late Fall as estimated above. Since the enrichments in $\delta^{15}N$ are of 1 - 3 ‰, an important change in feeding behavior must be occurring that is not arising from geographic isotope gradients.

Figures 20 and 21 illustrate the faunal isotope ratios in the Bering-Chukchi seas through all trophic levels from phytoplankton to polar bears. $\delta^{13}C$, being conservative with diet, remains little changed through all trophic levels with a small enrichment of <1°/00 across each level. Figure 21, nitrogen data, illustrates the >3°/oo trophic enrichment found in $\delta^{15}N$ from the same samples. The bowhead whale data are from muscle tissue and the $\delta^{13}C$ values are a match for feeding entirely in the Bering-Chukchi-western Beaufort seas. The $\delta^{15}N$ values are, however, anomalously enriched for a secondary consumer (compare with chaetognaths) and very similar to those for pelagic and demersal fishes. This may reflect a significant dietary change during the late winter months. Although we have no stomach content data on bowhead whales feeding on the Bering outer continental shelf or over the Bering Basin, we hypothesize that the whales may be shifting their major prey species during winter to a higher trophic level. Candidate species might include small schooling fishes such as juvenile pollock or sand lance that a slow-moving whale could capture, jellyfish, or perhaps aggregations of carnivorous zooplankton such as *Metridia* spp. Feeding on prey such as these would be required to produce the $\delta^{15}N$ isotope ratios evident in the whales. At present, this hypothesis of a major shift in winter diet to a higher trophic level is based solely on the isotopic data. Also, based upon the observation that there are often large interannual variations in the amplitude of the $\delta^{15}N$ oscillations, the dietary shift may not be as pronounced in some winters. Alternatively, fasting in late winter might also cause enrichment in $\delta^{15}N$ values of baleen, although this should also be reflected in the muscle tissue. No enrichment in $\delta^{15}N$ is evident in muscle of spring versus fall-killed whales.

Environmental Monitoring with Baleen

Carbon Isotope Ratio Trends in Baleen -- Since changes in $\delta^{13}C$ within a food chain are the result of fractionation caused by metabolism within the organism and are usually small (<1 0/00), the carbon isotope

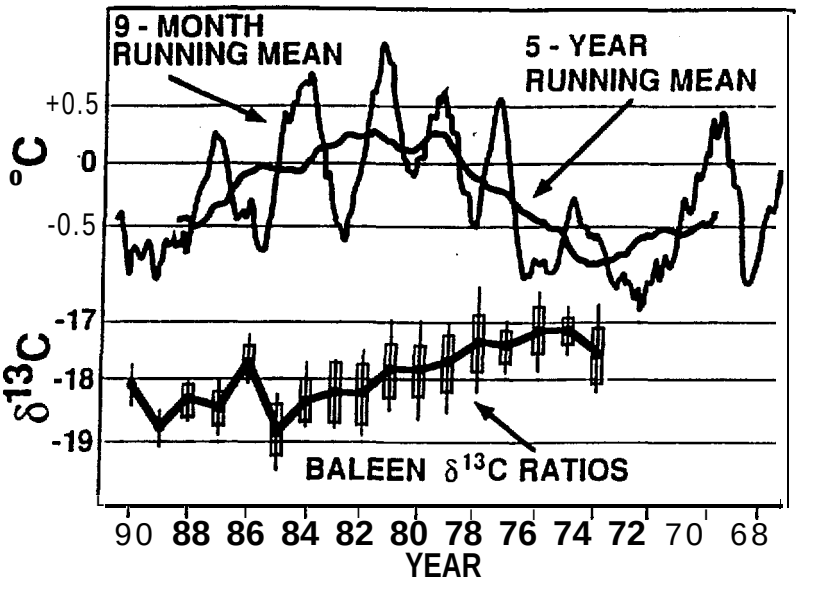

Figure 16. Temperature anomalies and average baleen isotope ratios for the northern Bering Sea. Temperature curves are for the 9-month and 5-year running means. Isotope ratio data are for baleen laid down while feeding in the Bering and Chukchi seas (n = 17 whales).

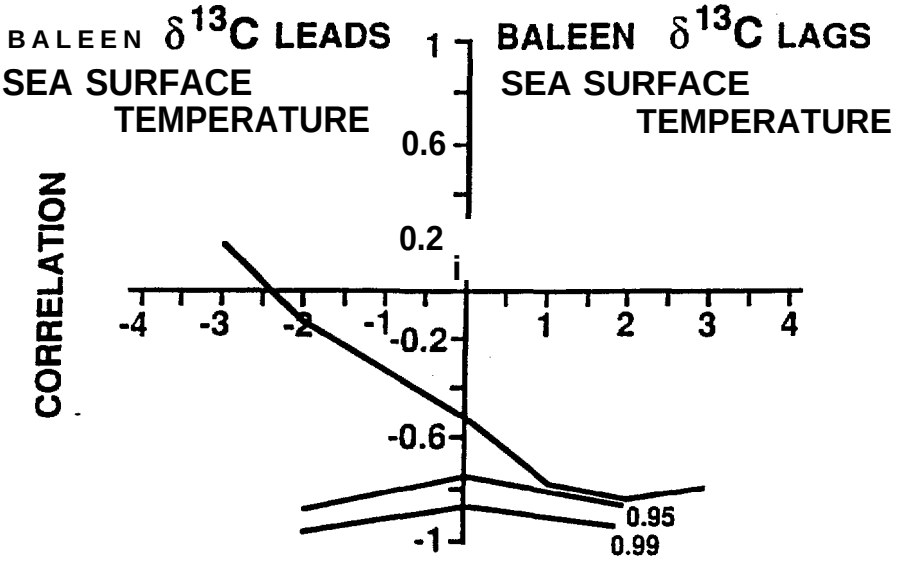

Figure 17. Correlation analysis between baleen isotope ratios from Bering sea feeding and temperature anomalies (April - September) from the northern Bering Sea.

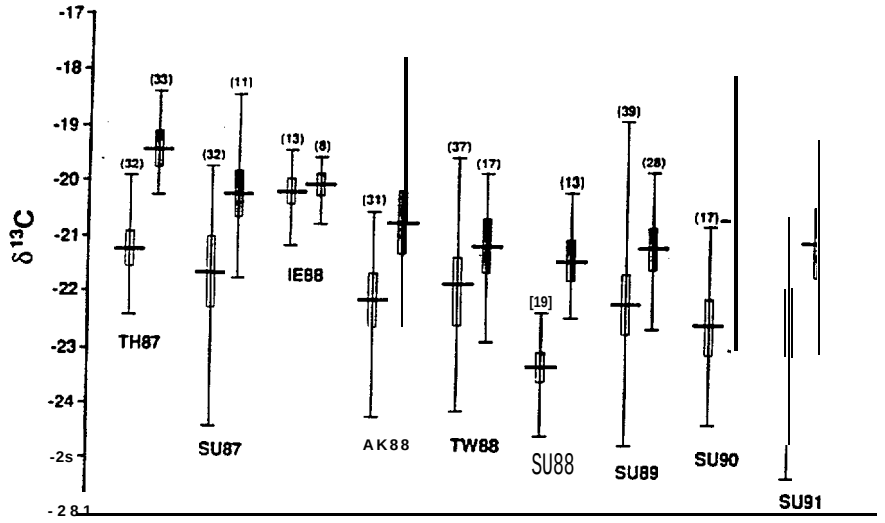

Figure 18. Zooplankton carbon isotope ratios by cruise for copepods and euphausiids. Vertical line is range; box, standard deviation; number of samples in parentheses.

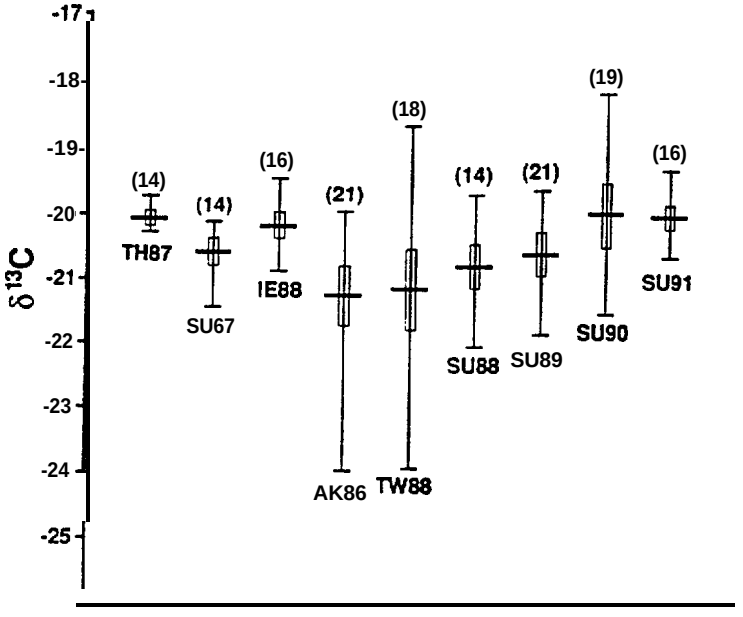

Figure 19. Zooplankton carbon isotope ratios by cruise for chaetognaths. Vertical line is range; box, standard deviation; number of samples in parentheses.

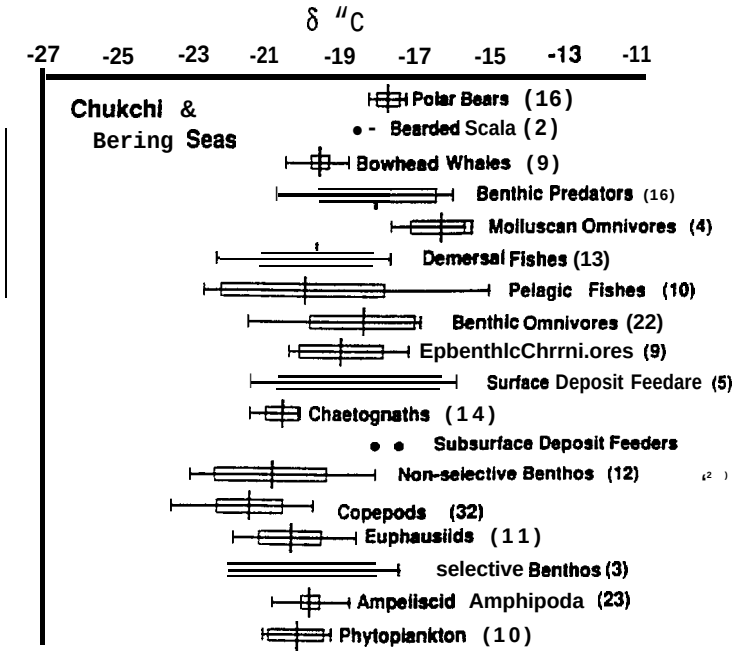

Figure 20. Carbon isotope ratios of phytoplankton and fauna from the northern Bering and southern Chukchi seas (from Schell 1990).

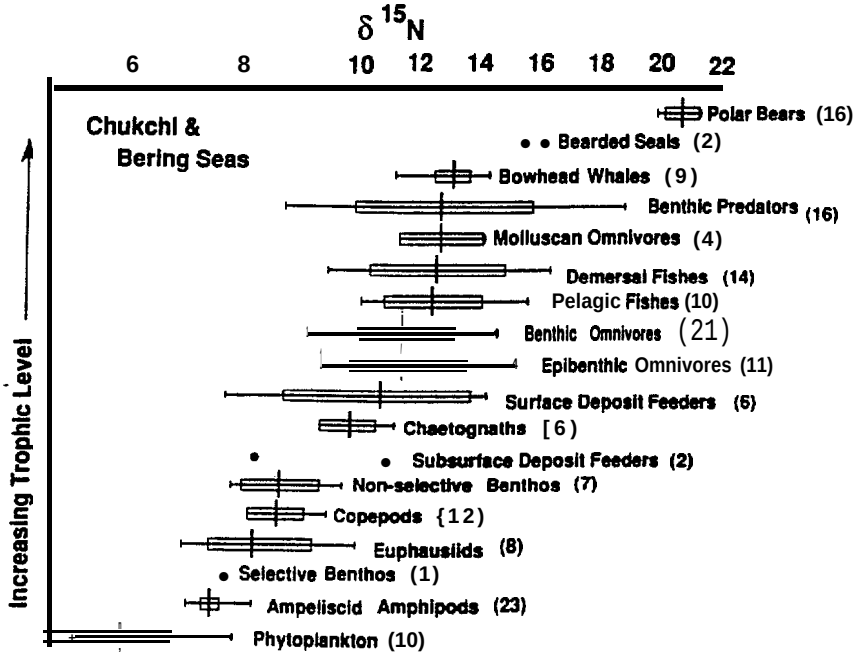

Figure 21. Nitrogen isotope ratios for phytoplankton and fauna from the northern Bering and southern Chukchi seas (from Schell 1990).

composition of the bowhead whale can be viewed as a surrogate for isotopic composition of the primary production in areas where the animal feeds. The Bering/Chukchi seas are the sources of most of the food supporting bowhead whales.

The carbon isotope data in baleen reflect the integrated isotope ratios in the zooplankton which in turn reflects the integration of isotope ratios in the phytoplankton on which the zooplankton fed. Since a large whale consumes zooplankton at the rate of over a ton a day in feeding bouts, they are incontestably the most efficient sampler devised (Thomson, 1987). If the correlation between $\delta^{13}C$ and primary productivity can be quantified for the Bering Sea, baleen would offer a simple and easily reproducible means of separating top-down from bottom-up controls on ecosystem productivity. Since samples are readily available and a baleen plate from a large whale can span over twenty years, a continuous record could be maintained with a modest analytical program. Long-term cycles evident in the isotope ratios would allow forecasting of ecosystem changes and the hindcasting would enable correlations to be established for anomalous years.

The fall/winter baleen $\delta^{13}C$ averages have a trend in ^{13}C-depletion between 1973 and 1984. In following years, baleen $\delta^{13}C$ appears to begin a weak trend in ^{13}C-enrichment (1985 to 1990) with an anomalous increase in ^{13}C-enrichment in 1985. Our data contradict the hypothesis of Rau et al. (1989) regarding the role of $[CO_2aq)]$ In controlling $\delta^{13}C$ values of plankton. We also find that in reviewing the intra-seasonal trends of $\delta^{13}C$ for copepods and euphausiids, they are most enriched at the start of the season when water temperatures are coldest and carbon dioxide concentrations would be expected to be higher. The cruises for 1988 span the period June through October. We feel, therefore, that until the floristics of the phytoplankton successions have been studied as well as the physical characteristics of the water masses wherein the primary production occurs, the mechanisms for the observed changes in $\delta^{13}C$ remain uncertain.

Although the tasks involved in quantifying the correlations between baleen $\delta^{13}C$ and primary productivity might seem formidable, the analogous situation exists in the North Atlantic. Here, however, the long-term records of phytoplankton and zooplankton abundances have already been established and correlated with the productivity of higher trophic levels. Only the isotope ratios remain to be run. Although no baleen sources equivalent to the bowhead whale are available, the collections of fin whale and sei whale baleen plates from the Norwegian and Icelandic fisheries could provide the needed samples. It is reasonable to predict that analyses of these samples will offer expanded insight into the processes governing the productivity of the world oceans.

LITERATURE CITED

Boutton, T.W., H. F. Tyrell, B. W. Patterson, G. A. Varga and P. D. Klein. 1988. Carbon kinetics of milk formation in holstein cows in late lactation. J. Anim. Sci. 66:2636-2645.

Conover, W. J. 1980. Practical nonparametric statistics. John Wiley, N.Y.

Conover, W. J. and R. L. Iman. 1981. Rank transformations as a bridge between parametric and nonparametric statistics. Am. Statistician 35:1224-1229.

DeNiro, M. J., and S, Epstein, 1978. Influence of diet on the distribution of carbon isotopes in animals. Geochimica et Cosmochimica Acts 42: 495-506.

Feder, H. M., A.S. Naidu, M. Baskaran, K. Frost, J. M. Hameedi, S. C. Jewett, W. R. Johnson, J. Raymond, and D. M. Schell. 1990. Bering Strait-Hope Basin: habitat utilization and ecological characterization. Final Report RU690, NOAA-Ocean Assessment Division (Anchorage, Alaska) 465 pp.

Fry, B., and E. Sherr, 1984. $\delta^{13}C$ measurements as indicators of carbon flow in marine and freshwater ecosystems. Contributions in Marine Science 27:13-47.

Jones, R. J., M. M. Ludlow, J. H. Troughton, and C. G. Blunt. 1981. Changes in the natural carbon isotope ratios of the hair from steers fed diets of C_4, C_3 and C_4 species in sequence. Search 12:85-87.

Koski, W.R., R.A. Davis, G.W. Miller and D. E. Withrow. 1991. Growth rates of bowhead whales as determined from low-level aerial photogrammetry. Int'l. Whaling Comm SC/43/PS23, Reykjavik Iceland, 1991.

Kroopnick, P. M. 1985. The distribution of ^{13}C in the world oceans. Deep Sea Res. 32:57-84.

Lowry, L. F., and K, Frost. 1984. Foods and feeding of bowhead whales in western and northern Alaska. Sci. Rep. Whales Res. Inst. 35:1-16.

Lowry, L. F., K.J. Frost , J.C. George and K. Coyle. 1987. Feeding ecology of bowhead whales: prey spectrum and seasonal and regional feeding patterns. Abstr. T6 In: Abtracts 4th Conferenc Biol. Bowhead Whale, 4 - 6 March 1987, Anchorage AK. North Slope Borough, Barrow AK.

McConnaughey T., and C.P. McRoy. 1979. Food-web structure and the fractionation of carbon isotopes in the Bering Sea. Marine Biology 53: 257-262.

Mizutani, H., and E. Wada. 1988. Nitrogen and carbon isotope ratios in seabird rookeries and their ecological implications. Ecology 69(2): 340-349.

Nerini, M.K., H. W. Braham, W. R. Marquette, and D. J. Rugh. 1984. Life history of the bowhead whale, *Balaena mysticetus* (Mammalia:Cetacea). Journal Zoology, London. 204:443-468.

North Slope Borough Science Advisory Committee. 1987. A review of the report "Importance of the eastern Alaskan Beaufort Sea to feeding bowhead whales, 1985-86". Report NSB-SAC-OR-109. North Slope Borough Dept. of Wildlife Management, Barrow, Alaska, 99723. 53 pp.

Peterson, B.J., and B. Fry. 1987. Stable isotopes in ecosystem studies. Annual Reviews of Ecological Systems 18:293-320.

Rau, G. H. and D. J. DesMarais. 1991. A model relating plankton $\delta^{13}C$ to CO_2 supply and demand. Eos 72:65.

Rau, G. H. and D. J. Des Marais. 1992. Marine plankton $^{13}C/^{12}C$ as a function of CO_2 supply and demand. (Abstr.) Amer. Sot. for Limnol. and Oceanogr. , Santa Fe, New Mexico, 9 - 14 February 1992.

Rau, G. H., T. Takahashi, and D. J. DesMarais. 1989. Latitudinal variations in plankton $\delta^{13}C$: implications for CO_2 and productivity in past oceans. Nature 341:516-518.

Rundel, P., J. R. Ehleringer, and K. Nagy. 1989. Stable isotopes in ecological research. Ecol. Studies 68, Springer-Verlag, New York, 512 pages.

Saupe, S. M., Schell, D.M., Griffiths, U. B. 1989. Carbon isotope ratio gradients in western arctic zooplankton. Marine Biology 103: 427-432.

Schell, D.M., S, M. Saupe, and N. Haubenstock. 1989a. Natural isotope abundances in bowhead whale (*Balaena mysticetus*) baleen: markers of aging and habitat usage. Ecological Studies 68:260-269.

Schell, D. M., S. M. Saupe and N. Haubenstock. 1989b. Bowhead whales (*Balaena mysticetus*) growth and feeding as estimated by $\delta^{13}C$ techniques. Marine Biology 103:433-443.

Schell, D. M., S. M. Saupe, and N. Haubenstock. 1987. Bowhead whale feeding: allocation of regional habitat importance based on stable isotope techniques. Pages 369-415 in W. J. Richardson, ed. ***Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 198S-86.*** By LGL Ecological Research Associates, Inc., for U.S. Minerals Management Service. Available from: National Technical Information Service, Springfield, VA 22161 as PB88-150271/AF, 547 pp.

Thomson, D. H. 1987. Energetic of bowheads. Pages 417-448 in U. J. Richardson, ed. ***Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead*** Whales, 1985-86. By LGL Ecological Research Associates, Inc., for U.S. Minerals Management Service. Available from: National Technical Information Service, Springfield, VA 22161 as PB88-150271/AF, 547 pp.

Tieszen, L.L., T. W. Boutton, K. G. Tesdahl, N. A. Slade. 1983. Fractionation and turnover of stable carbon isotopes in animal tissues: implications for $\delta^{13}C$ analysis of diet. Oecologia (Berlin) 57:32-37.

Withrow, D., R. Burke Jr., L. Jones and J. Brooks. 1991. Variations in $\delta^{13}C$ carbon isotope ratios in bowhead whale baleen plates used to estimate age. International Whaling Comm. SC/43/PS11. Reykjavik, Iceland, May 1991.

Appendix 1. $\delta^{13}C$ and $\delta^{15}N$ values for zooplankton samples.

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (ppt)	DEL N15 (PPt)
R/V SEQUEL, SEPTEMBER 1643		u							
AMPHIPOD	Parathemisto libellula	CA85	10		69.00	136.00	09/85	-26.20	
COPEPOD		CA85	1		69.00	136.00	09/85	-27.60	
COPEPOD		CA85	2		69.00	136.00	09/85	-27.40	
COPEPOD		CA85	3		69.00	136.00	09/85	-26.50	
COPEPOD		CA85	4		69.00	136.00	09/85	-26.60	
COPEPOD		CA85	5		69.00	136.00	09/85	-26.00	
COPEPOD		CA85	6		69.00	136.00	09/85	-25.60	
EUPHAUSIID		CA85	7		69.00	136.00	09/85	-23.70	
EUPHAUSIID		CA85	8		69.00	136.00	09/85	-24.10	
EUPHAUSIID		CAS5	9		69.00	136.00	09/85	-24.10	
RN ANNIKA MARIE, SEPTEMBER 16S5		AM							
AMPHIPOD	Parathemisto libellula	AM85	10		70,50	143.10	09/85	-27.05	
AMPHIPOD	Parathemisto libellula	AM85	11		70.10	142.70	09/85	-26.87	
AMPHIPOD	Parathemisto libellula	AM85	12		70,20	142.70	09/85	.25.81	
COPEPOD		AM85	1		70.30	142.70	09/65	-20.05	
COPEPOD		AU45	2		70.20	142.70	09/85	-26.19	
COPEPOD		AU66	3		70.10	142.70	09/85	-25.76	
COPEPOD		AM85	4		69.70	141.00	09/85	-27.23	
COPEPOD		AM85	5		70.20	142.70	09/85	-24.66	
COPEPOD		AM85	6		7050	143.10	09/65	-25.38	
COPEPOD		AM85	7		70.10	142.70	09/85	.26.03	
EUPHAUSIID	Thysanoessa raschii	AM85	6		70,20	142.70	09/85	-19.67	
EUPHAUSIID	Thysanoessa raschii	AU45	9		60,70	141.00	09/85	-23.58	
R/V ANNIKA MARIE, SEPTEMBER 1SSS		AM							
AMPHIPOD	Gammarid	AM86	25	T4-4	70.12	140.87	09/86	-2473	9.10
AMPHIPOD	Large	AM86	108	T4-2	69.75	141.20	09/s6	-23.48	7.69
AMPHIPOD	Large	AM86	64	12	69.83	141.40	09/86	-24.33	8.84
AMPHIPOD	Large	AM86	17	T3-3	70.03	141.82	09/88	-25.5S	S.25
AMPHIPOD	Large	AM86	66	T3-3	70.03	141.82	09/86	.26.s8	8.84
AMPHIPOD	Large	AM86	10s	T1-1	70,15	143.67	09/86	.21.17	799
AMPHIPOD	Large	AM86	76	13.4	70.22	141.70	09/86	-25.15	6.9S
AMPHIPOD	Large	AU24	60	T1-3	70,35	143.s0	09/86	-21.09	8.91
AMPHIPOD	Large	AM86	83	13.s	70,40	141 53	09/86	-23.14	7,26
AMPHIPOD	Large	AU54	74	T1-5	70.5s	143.5s	09/86	-23.53	10.94
AMPHIPOD	Large	AM86	88				09/86		794
AMPHIPOD	Medium-Small	AM86	75	T4-2	69.75	141.20	09/86	-26 83	6.99
AMPHIPOD	Medium-Small	AU44	20	T3-3	70.03	141 42	09/86	-25.13	690
AMPHIPOD	Medium-Small	AM86	18	T2-1	70.06	142.60	09/86	-2007	S.20
AMPHIPOD	Medium-Small	AM86	314				09/86		620
AMPHIPOD	Parathemisto libellula	AM86	73	T3-2	69.90	141 63	09/86	-24.06	8.49
AMPHIPOD	Parathemisto libellula	AM86	28	14.4	70.12	140.87	09/86	.27.03	7s0
AMPHIPOD	Pa rathemisto libellula	AM86	36	T2-2	70.13	S42,32	09/86	-23.54	7.45
AMPHIPOD	Parathemisto libellula	AM86	39	T2-2	70.13	142.82	09/86	-24.13	849
AMPHIPOD	Parathemisto libellula	AM86	23	T2-5	70.53	142.45	09/86	-24.19	11.24
AMPHIPOD	Small	AM86	27	TA.2	69.68	13047	09/86	-27.44	737
AMPHIPOD	Small	AM86	3	T4-1	69.70	141.28	09/86	-22.34	
AMPHIPOD	Small	AU85	4	5	69.83	14187	06186	-22.34	
AMPHIPOD	Small	AM86	92	12	66.63	141.60	09/86	-24.04	690
AMPHIPOD	Small	AM86	10	T4-3	60,62	14002	09186		604
AMPHIPOD	Small	AU.%	*7	T4-4	70.12	140.87	0s/66	-25.81	404
AMPHIPOD	Small	AM86	76				09/66	-24.14	4 94
AMPHIPOD		AM86	31	1A-2	69.68	139.47	09/86	-22. S6	
AMPHIPOD		AM86	64	T3-1	69,6S	142.03	09/86	.21.27	8 S5
AMPHIPOD		AM86	110	13	69.85	141.55	09/86	.2644	12 19
AMPHIPOD		AM86	66	T2-2	70.00	140.00	09/86	-23.79	6'62
AMPHIPOD		AM86	63	T3-3	70.03	141.S2	09/86	-24.2S	745
AMPHIPOD		AM86	86	T3-3	70.03	141.82	09/86	-25.69	
AMPHIPOD		AM86	62	T1-1	70.15	143.67	09/86	-22.26	8 39
AMPHIPOD		AM86	82	T3-4	70.22	141.70	09/86	-24.14	776
AMPHIPOD		AM86	06	T3-4	7022	14170	09/86	-25.81	6'42
AMPHIPOD		AM86	23	T2-5	70.53	142.4S	09/86		8 55
COMPOSITE		AM86	123	T3-1	69 85	142.03	09/86	-2667	
COMPOSITE		AU.%	52	T3-2	69.90	141.95	09/86	-25.34	10 22
COMPOSITE		AM86	23	T2-5	70.53	142.45	09/86		10 22
COMPOSITE		AM86	107				06/66	-25.62	10 72
COPEPOD	Large	AU6S	19	TA-2	66.60	13e.47	09/86	-25.24	10 50
COPEPOD	Large	AU6S	2	5	69,33	141.87	0S/86	-2524	10 50
COPEPOD	Large	AU26	6	T3-3	70.03	t 43.50	09/86	-2506	
COPEPOD	Large	AU34	54	T3-3	70.03	141.82	06186	-2540	10 50
COPEPOD	Large	AU66	9	T4-4	70.12	140.67	09/86	-25.13	11 20
COPEPOD	Large	AM86	36	12.2	70.13	14222	09/86	-2500	10 80
COPEPOD	Large	AM86	26	T2-2	70.13	142.62	09/86	-2586	9 17
COPEPOD	Small	AU64	51	2	69.68	139.47	09/86	-2715	11 48
COPEPOD	Small	AM86	41	T4-1	69.70	141 28	09/86	-27.19	12 71
COPEPOD	Small	AM86	42	T4-1	66,70	141.28	09/86	-2774	12 71
COPEPOD	Small	AM86	44	T4-1	69.70	141.2S	09/86	-22.24	11 94
COPEPOD	Small	AM86	5	5	69.83	141.87	09186		11 48
COPEPOD	Small	AM86	43	5	69.85	141.90	09/86	-26.76	11 57
COPEPOD	Small	AU44	4s	T4-3	69.92	140.62	09/86	-25.09	1157
COPEPOD	Small	Au24	111	T4-3	6662	140.92	09/66	-26.92	640
COPEPOD	Small	AU6S	47	T3-3	70,03	141.82	09/86	-23.63	13 33

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	M T E (MM/YY)	DEL C13 (ppt)	DEL N15 (PP6)
	Small	AM86	46	T2-1	70.08	[illegible]	[illegible]	[illegible]	10.64
COPEPOD	Small	AM86	46	12-1	70 08	142,60	09/86		13.33
COPEPOD	Small	AM86	40	12.2	70.13	142.42	09/86	-2439	10.29
COPEPOD	Small	AM86	109	T1-3	70. 35	143.60	09/86	-26.05	10.26
COPEPOD		AM86	52	11	69.65	140.88	09/86	-23.95	
COPEPOD		AM86	55	11	69.65	140.88	09/86	-28 51	10.81
COPEPOD		AM86	58	11	69.65	140.88	09/86	-28 04	
COPEPOD		AM86	115	14.1	60.70	141.28	09/86	-27 S6	11.72
COPEPOD		AM86	114	T4-2	69.75	141.20	09/86	-2799	12.32
COPEPOD		AM86	53	12	69.83	141. 60	09/86	-27 28	10.07
COPEPOD		AM86	120	12	W 83	141 60	09/86	-26 02	9.79
COPEPOD		AM86	56	5	69.W	141.90	09/86	-28 00	11.02
COPEPOD		AM86	57	5	69.85	141,20	09/86	-28 24	10.30
COPEPOD		AM86	116	T3-3	70. 03	141.82	09/86	-25 28	10.40
COPEPOD		AM86	103	12-1	70.08	142.60	09/86	-25.29	9.54
COPEPOD		AM86	104	12-2	70.13	142.52	09/66	-25 88	7.97
COPEPOD		AM86	50	T1-1	70.15	.*43.67	09/86	-2632	10.W
COPEPOD		AM86	: :	T1-[illegible]	[illegible]	143.67	09/66	-2s 7:	11 64
COPEPOD		AM86	118	T3-4	7022	141.70	09/86	-25.66	9.68
COPEPOD		AM52	102	T1-2	70.23	143.65	09/86	-25 6a	
COPEPOD		AM86	112	T1-2	70.23	143.66	09/86	-25 33	13.81
COPEPOD		AM86	119				09/86		922
EUPHAUSIID	Small	AM86	1	T4-3	69.62	140. S2	09/66	-2362	703
EUPHAUSIID	Small	AM86	24	T2-5	70.53	142.45	09166	-23 52	703
EUPHAUSIID	Thysanoessa raschii	AM86	3s	TA-2	60. 68	130.47	09/86	-2505	7.12
EUPHAUSIID	Thysanoessa raschii	AM86	12	T4-1	69.70	141,20	09/66	-2595	724
EUPHAUSIID	Thysanoessa raschii	Ak454	14	T4-1	66 70	141 26	06/66	-26 42	4.88
EUPHAUSIID	Thysanoessa raschii	AM86	96	T4-2	69.75	141.20	09/86	-25 30	b 04
EUPHAUSIID	Thysanoessa raschii	AM86	:	T3-[illegible]	[illegible]	[illegible] 82	09/66	-24 46	
EUPHAUSIID	Thysanoessa raschii	AM86	34	T4-4	70.12	140.87	09/66	-25.44	6.98
EUPHAUSIID	Thysanoessa raschii	AM86	32	12.2	70.13	142.82	09/66	-2413	703
FISH		AM.%	85	11	69.65	140,6.6	09/86	-26.01	694
FISH		AM86	33	TA-2	6S.6S	13s,47	09/66	-27 13	
FISH		AM86	21	7'4.1	69.70	141.26	00166	-27.68	7 3s
FISH		AM86	87	:	[illegible]	[illegible],20	09/86	-27 58	9.97
FISH		AM86	117	13	69.6s	141.55	09/86	-26.54	10.52
FISH		AMs5	72	T3-2	69.S0	141.95	09/66	.24.76	10.38
FISH		AM86	16	T4-3	69.92	140.92	09/86	-26.02	8.72
FISH		AM86	7	13.3	70.03	143.50	0s/66	-2s 37	6.50
FISH		AM86	70	13.4	70.22	141.:70	09/86	-25.16	10.46
FISH		AM86	81	T3-4	70.22	141.70	[illegible]	[illegible]	[illegible]
FISH		AM86	94	T3-4	70.22	[illegible]	[illegible]	[illegible]	9.65
FISH		AM86	100	T3-5	?0.40	141.53	09/86	.26.70	10.91
FISH		AM86	67	11.4	70.4s	143,57	00/66	-2446	13.10
FISH LARVAE		AM86	29	T4-4	70.12	140.87	06/66	-26 99	862
FISH LARVAE		AM86	??	T2-[illegible]	70.13	142.s2	09/86	-2425	0.72
HYDROZOAN		AM86	76	T4-3	69.92	140.92	09/86	-26.51	10.49
HYDROZO		AM86	77	T1-1	70.15	143.67	09/86	-2506	14.22
HYDROZO		[illegible]6	65	T1-4	70.46	[illegible]	09/86	-24 [illegible]	[illegible] 39
MYSIDACEA		AM86	61	I t	69.65	140.88	09/86	-25.41	8.21
MYSIDACEA		AM86	15	TA-2	69.68	139.47	09/86		9.30
MYSIDACEA		AM86	91	T4-1	69.70	141.28	09/86	-26.96	7.72
MYSIDACFA		AM86	90	12	69.83	141.60	09/86	-25.95	
MYSIDACEA		AM86	93	12	69.83	141.60	09/86	-26 74	8.02
MYSIDACEA		AM86	95	T3-1	69.85	142.03	09/86	-25 12	9.10
MYSIDACEA		AM86	71	T3-2	69.90	141.95	09/86	-24 29	6 66
SHRIMP LARVAE		AM86	13	s	69,83	141.87	09/66		645
SHRIMP LARVAE		AM86	37	T2-2	70.13	142.52	09/86	-21 94	8 45
R/V TULLY 1986		TA							
AGLANTHA	Aglantha digitalis	TA24	26	52	70.15	131.4s	09/86	-21 70	
AGLANTHA	Aglantha digitalis	TASS	66	60	70.70	132.87	09/86	-2420	
CHAETOGNATH	Sagitta sp.	TA86	128	61	69.S6	1 33.97	09/86	-23 00	
COPEPOD	Limnocalanus grimaldii	TA5[illegible]	118	61	69.S2	133.167	09/86	-26 70	
FISH, ARCTIC COD	Boreogadus saida	TA66	122	61	69.88	1 33.97	09/86	-23 W	
AMPHIPOD	Parathemisto libellula	TA26	186	70	70.67	134.83	09/86	-2410	
AMPHIPOD	Parathemisto libellula	TAM6	464	5	69.27	137.33	09/86	-26.00	
CHAETOGNATH	Sagitta sp.	TAM8	37t	85	70.72	133.97	09/86	-22.40	
COPEPOD	Calanus glacialis	TA86	205	68	70.17	134.90	09/86	-2310	
COPEPOD	Calanus hyperboreus	TA86	244	76	70.29	130.77	09/86	-25 50	
COPEPOD	Calanus hyperboreus	TA86	329	so	70.W	130.77	09/86	-25 40	
COPEPOD	Calanus hyperboreus	TA26	460	32	69.77	1[illegible]4.07	09/86	-2450	
COPEPOD	Calanus hyperboreus	TAM8	549	22	69.63	138.77	06/66	-23 60	
CTENOPHORE	Beroe cucumis	TA46	184	70	70.62	134.s2	09/66	-2270	
CTENOPHORE	Beroe cucumis	TA88	306	77	70.38	130.77	09/86	-2300	
CTENOPHORE	Beroe cucumis	TA88	456	30	69. S7	136.77	09/86	-2440	
EUPHAUSIID	Thysanoessa raschii	TA36	45s	s	69.27	147.33	09/86	-23 4a	
EUPHAUSIID	Thysanoessa raschii	TA86	210	66	70.17	134.83	09/86	-2320	
FISH, ARCTIC COD	Boreogadus saida	TA86	370	65	70.72	133.97	09/86	-23.50	
FISH, ARCTIC COD	Boreogadus saida	TA86	376	65	70.72	123.07	09/86	-2320	
MYSIDACEA	Mysis sp.	TA46	22s	67	70.W	134.83	09/86	-23.70	
MYSIDACEA	Mysis sp. (25mm)	TA86	217	67	70.00	134.s2	09/86	-2330	
MYSIDACEA	Mysis sp. (25mm)	TA86	471	4	69. 20	t 37.50	09/86	-2380	
PTEROPOD	Limacina helicina	TA86	360	65	70. 72	133.97	09/86	-2420	
PTEROPOD	Limacina helicina	TA86	42S	62	70.05	133.97	09/86	-23.20	
USCGS POLAR STAR OCTOBER 1986		PS							
AMPHIPOD	Gammarus wilkitzkii	PS86	57	A-6	71,76	152.95	10/86	-20.0s	946
AMPHIPOD	Gammarus wilkitzkii	PS86	85	B-7	70.93	146.76	10/86	-21 01	1073
AMPHIPOD	Hyperia sp.	PS86	6a	s-7	70,93	146.7a	10/86	-18.21	
AMPHIPOD	Hyperia sp.	Psaa	119	0.10	70.72	14065	10/86	-2232	

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	OA7E (MM/YY)	DEL C13 (ppt)	DEL N15 (ppt)
AMPHIPOD	Hyperia sp. (10-20 mm)	PS86	5	W-14	71 82	1 3s.50	10/86	-20.96	13 46
AMPHIPOD	Onsimus nansen (20mm)	PS26	95	S.7	70.93	146,76	10/66	-2093	12.48
AMPHIPOD	Parathemisto abyssorum (5mm)	PS86	70	B-10	71.15	146.60	1 0/88	-23.11	11.80
AMPHIPOD	Parathemisto abyssorum (5mm)	PSS3S	118	D-Io	70.72	140.95	10/S6	-23.60	12.26
AMPHIPOD	Parathemisto abyssorum (5mm)	PSS2	133	D-12	70.45	142.85	10186	-25.38	
AMPHIPOD	Parathemisto libellula	PS34	23	A-10	71.95	152.65	1 0/66	.21.65	11 63
AMPHIPOD	Parathemisto libellula	PS86	32	A-10	71.95	152.6S	10/86	-20.82	11 97
AMPHIPOD	Parathemisto libellula	PSS6	46	A-10	71.95	152.65	10/86	.22.52	12.76
AMPHIPOD	Parathemisto libellula	PSS6	7?	B-7	70.93	146.76	10166	-20.74	
AMPHIPOD	Parathemisto libellula	PS66	07	B-7	70.93	146,76	1 0)66	-24.35	12.75
AMPHIPOD	Parathemisto libellula	PS34	143	E-7	71.42	149.60	1 0/66	-22.95	12.73
AMPHIPOD	Parathemisto libellula (20mm)	PS66	130	C-5	70.55	144.03	1 0/66	-22.S6	
AMPHIPOD	Parathemisto libellula (5-1 0mm)	PSS6	14	W-14	71.82	156.50	10/S6	-20.80	11.1s
AMPHIPOD	Parathemisto libellula (5-1 0mm)	PS86	24	A.1O	71 95	S52.65	10/86	-2056	11 72
AMPHIPOD	Parathemisto libellula (5-10mm)	PS86	25	A-10	71.95	152.65	10/S6	-20 65	12.71
AMPHIPOD	Parathemisto libellula (7.1 0mm)	PS66	132	D-12	70.45	142.65	1 0/S6	-25.37	
AMPHIPOD	Parathemisto libellula (2-3mm)	PSS6	1s	W-14	71 S2	156.60	101S6	-21.36	1113
ANEMONE		PS86	30	A-10	71.95	152,6S	1 0/66	-20.29	12.27
CHAETOGNATH	Sagitta sp.	PS86	33	A-10	71.05	152,65	10/6s	-19.91	1450
CHAETOGNATH	Sagitta sp.	PS86	3s	A-10	71.95	152,6S	10/6S	-20.12	
CHAETOGNATH	Sagitta sp.	PS86	55	A-8	71.75	152.95	10/86	-19.98	15.03
CHAETOGNATH	Sagitta sp.	PS86	60	A-8	71.75	52.95	10/S6	-2036	1324
CHAETOGNATH	Sagitta sp.	PS86	65	A-5	71.50	153.17	1 0/66	-2050	
CHAETOGNATH	Sagitta .	K466	104	C-10	71.02	143.5s	10/86	-22.52	14.91
CHAETOGNATH	Sagitta sp.	PS6S	116	D-10	70.72	140.95	1 0/66	.21.62	1461
CHAETOGNATH	Sagitta w.	PS86	s	W-14	71,62	156.50	1 0/66		14.35
CHAETOGNATH	Sagitta sp.	PS86	61	A-8	71,75	152.95	10/86	-20.28	13.24
COPEPOD	(2-4mm)	PS86	112	D-10	70.72	140.65	10/S6	-24.75	10.16
COPEPOD	(3-4mm)	PS86	91	B-7	70.93	146.7s	101s6	-24.34	9.40
COPEPOD	(3mm)	PS26	56	A-8	71.75	152.95	10/86	-22,73	11.77
COPEPOD	(4mm)	PSS6	26	A-10	71.95	152.65	10/86	.22.46	11.64
COPEPOD	(5-7mm)	PS46	63	B-7	70.63	146.7s	1 0/66	-25.15	10.12
COPEPOD	(6-8mm)	PS86	44	A-10	71 .s5	152.65	1 0/66	-23.01	13.43
COPEPOD	Calanus 5p.	PS86	138	c-5	70.55	144.03	10/S6	-25.16	
COPEPOD	Calanus sp.	PS86	163	c-Io	71.02	143.55	10/86	-25.94	6.04
COPEPOD	Calanus sp.	PS86	13	W-14	71.S2	16s.60	1 0/66	-24.22	11.22
COPEPOD	Calanus sp. (3-4mm)	PSS4	121	D-1 1	70.32	141,55	10/86	-26.38	6.54
COPEPOD	Calanus 6p. (5-7mm)	PS36	120	D-11	70.32	141.55	10/86	-25.26	0.15
COPEPOD	Calanus sp. (5mm+)	PSS4	114	D-Io	70. ?2	140.65	10/86	-25.06	
COPEPOD	Paraeuchaeta sp.	PS86	1 0s	C-10	71.02	143.55	1 0166	.25.S2	12.06
COPEPOD	Paraeuchaeta sp.	PS86	113	D-1 o	70.72	140.s5	1 0/66	-24.91	12.30
COPEPOD		PS86	45	A.1O	71.65	1S2.65	10/s6	-21.98	11.08
COPEPOD		PS86	146	E-7	71.42	146.60	1 0)66	.25.11	
COPEPOD		PS86	150	E-7	71.42	149. s0	10{s6	-23.93	10 16
EUPHAUSIID	(10-15mm)	PS86	22	A-10	71,95	152,65	1 0/66	-20.76	11 30
EUPHAUSIID	(10-20mm)	PS86	42	A-10	71.95	152,65	1 0/66	-21.38	103s
EUPHAUSIID	(10-20mm)	P966	115	D-10	70.72	140,95	1 0/66	-23.01	1100
EUPHAUSIID	(10-25mm)	PS86	92	B-7	70 93	146.78	10/S6	-2354	10.20
EUPHAUSIID	(10mm)	PS86	46	A-6	71.75	162.9S	1 0/66		10.35
EUPHAUSIID	(10mm)	PS86	52	. . .	71 75	152.6S	1 0/66	-20.55	12.15
EUPHAUSIID	(10mm)	PS86	53	A-6	71.75	152.95	10/S6	-21.45	11.51
EUPHAUSIID	(10mm)	PS86	58	A-6	71.7s	152.05	1 0/66	.21.02	11.s4
EUPHAUSIID	(10mm)	PS86	59	A-8	71,7s	152.06	10/86	-21.06	9.72
EUPHAUSIID	(10mm)	PS3S	78	B-7	70.63	146.76	10/S6	-23.47	9.31
EUPHAUSIID	(10mm)	PS86	34	S-7	70.63	146.78	1 0/66	-23.13	0.12
EUPHAUSIID	(17-25mm)	PS66	2	w-t4	71 .s2	15s.50	20/S6	-23.29	11 30
EUPHAUSIID	(18-25mm)	PS86	81	s-7	70,93	146. ?S	10/S6	-23.38	13,49
EUPHAUSIID	(20-25mm)	PS86	75	B-7	70.93	146.76	10166	-23,31	1167
EUPHAUSIID	(20mm)	PS86	21	A-10	71.95	t 52.65	20/S6	-21.90	12.17
EUPHAUSIID	(20mm)	PS86	47	A-6	71.75	152.95	10/86	-22.75	10.10
EUPHAUSIID	(20mm)	PS64	50	A-O	71.75	1S2.65	1 0/66	-21 67	1203
EUPHAUSIID	(25-30mm)	PS3s	4!	A-10	71.95	152.65	1 0/66	-21 69	12.57
EUPHAUSIID	(25mm)	PS86	20	A-10	71,65	132.66	10/86	-22.21	10.76
EUPHAUSIID	(-20mm	PS86	36	A-10	71.95	152.65	10/86		12.55
EUPHAUSIID	(-20mm)	PS2S	97	S-4	70.65	147.25	10/86	-22.92	11.17
EUPHAUSIID		PS86	92	A-10	[illegible]	[illegible]	10/86	-22.61	14.43
EUPHAUSIID		PS3s	51	A-4	71.75	152.6S	10/86	-20.26	10. IS
EUPHAUSIID		PS86	64	A-5	71.60	153.17	1 0/66	-24.65	11.31
EUPHAUSIID		PS3S	66	B-10	71,15	146,60	10/86	-22.90	11.39
EUPHAUSIID		PS86	t 23	O t t	70.32	141.35	10/86	-22.41	11.53
EUPHAUSIID		PS3S	129	0-12	70, 4s	142.SS	1 0/86	-22.76	11.81
EUPHAUSIID		PS86	144	E-7	71.42	146.S0	10/86	-24.07	11.03
EUPHAUSIID		PS86	[illegible]	E-7	71.42	149.90	1 0/66	-24.23	6S2
EUPHAUSIID		PS86	64	A-5	71.50	153.17	10/86	-21.00	11 24
EUPHAUSIID		P9s2	3	W-14	71. S2	15s.50	t0/86	-22.88	9.86
FISH, COD	(40-45mm)	PS86	36	A-10	71.95	152.65	10(S6	-19.84	12. s6
FISH, COD	(45-55mm)	PS86	90	B-7	70.93	146.78	1 0/S6	-21.10	12.17
FISH, COD	(45mm)	PS86	10s	0.10	70.72	140.65	10/86	-22.47	13.02
FISH, COD		PSss	2s	A-10	71.95	152.65	10/86	-21.19	1314
FISH, COD		PS62	34	A-10	71.95	152.S6	1 0/66	-21.2s	13.13
FISH, COD		PSS6	142	E.?	71,42	146. SO	1 0/66	-20.39	1304
FISH, COD		PS86	12	W-14	71.62	156.50	10/86	-21.14	11 79
FISH, COD		PS66	1	W-14	71.82	156.50	10/66	-19.01	12.79
FISH, SAND LANCE	Ammodytes hexapterus	PSS6	63	A-5	71.50	153.17	10/86	-20.5S	12.63
FISH, SAND LANCE	Ammodytes hexapterus	PS86	0	W-14	71 82	156.50	10/86	.20 3a	12.73
FISH, SAND LANCE	Ammodytes hexapterus (50 mm)	PS86	27	A-10	71.65	152.65	10/86	-20.24	12.6s
FISH, SAND LANCE	Ammodytes hexapterus (60 mm)	PS86	t 00	s-4	70. 6S	147.25	10/s6	.20.02	1267
JELLYFISH	Cyanea capulata	PS86	127	D-11	70.32	141.55	1 0/66	-2364	12.41
MYSIDACEA	(25-30mm)	PS86	99	B-4	70.6S	147,25	1 0/66	-21.2s	10.36
MYSIDACEA	(25mm)	S86			1.75	152.95	101S6	-16.77	12.10
MYSIDACEA	(30mm	S86	74	s-7	70.63	146.78	10166	-21.21	1224
MYSIDACEA	(30mm	S32	60	B-7	70. 93	146.78	10/86	-20. w	11 2s
MYSIDACEA		Sss	29	A-to	71. 95	152.65	1 0/66	F .21 04	

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE	LONGITUDE	DATE (MM/YY)	DEL C13 (ppt)	DEL N1 S (ppt)
MYSIDACEA		PS86	10	W-14	71.82	156.50	10/86	-20.02	1 2.%
PTEROPOD	Clione limacina	PS86	117	D-1o	7072	140.95	10/86	-23.42	9.*7
SHRIMP		PS86	11	w-1 4	71 82	156.50	10/86	.19.07	14.81
ALPHA [illegible]									
AMPHIPOD	Ampelisca birulai	HX87	2	4	64.18	168.85	06/87	-19.89	8.08
AMPHIPOD	Ampelisca birulai	HX87	7	13	64.92	169.87	06/87	-20.71	7.66
AMPHIPOD	Ampelisca birulai	HX87	28	11	64.78	168.72	06/87	-19.28	7.83
AMPHIPOD	Ampelisca birulai	HX87	141	9	64.12	168.18	06/87	-19.92	12.64
AMPHIPOD	Ampelisca eschrichti	HX87	73	13	64.62	169.87	06/87	-20.13	6.71
AMPHIPOD	Ampelisca eschrichti	HX87	92	24	64.28	169.33	06/87	-20.00	7.13
AMPHIPOD	Ampelisca eschrichti	HX87	91	9	64.12	168.18	06/87	-19.91	7.58
AMPHIPOD	Ampelisca macrocephala	HX87	14	24	64.28	169.33	06/87	-19.14	7.80
AMPHIPOD	Ampelisca macrocephala	HX87	21	11	64.78	168.72	06/87	-19.46	7.99
AMPHIPOD	Ampelisca macrocephala	HX87	29	24	64.28	169.33	06/87	-19.66	7.75
AMPHIPOD	Ampelisca macrocephala	HX87	32	24	64.28	169.33	06/87	-19.79	8.41
AMPHIPOD	Ampelisca macrocephala	HX87	68	13	64.92	169.87	06/87	-20.26	8.45
AMPHIPOD	Ampelisca macrocephala	HX87	74	3	64.67	168.60	06/87	-19.89	7.68
AMPHIPOD	Ampelisca macrocephala	HX87	77	8	64.06	169.48	06/87	-19.06	9.38
AMPHIPOD	Ampelisca macrocephala	HX87	78	8	64.08	169.48	06/87	-19.24	8.31
AMPHIPOD	Ampelisca macrocephala	HX87	83	8	64.06	169.48	06/87	-18.96	8.31
AMPHIPOD	Ampelisca macrocephala	HX87	86	3	64.67	168.60	06/87	-19.85	7.67
AMPHIPOD	Ampelisca macrocephala	HX87	95,86	3	64.67	168.60	06/87	-20.10	8.72
AMPHIPOD	Ampelisca macrocephala	HX87	[illegible]	13	64.92	169.87	06/87	-20.06	7.88
AMPHIPOD	Ampelisca macrocephala	HX87	115	11	64.7a	168.72	06/87	-19.40	8.72
AMPHIPOD	Ampelisca macrocephala (lg)	HX87		13	[illegible]	169.87	06/87	-19.66	7.98
AMPHIPOD	Ampelisca macrocephala (lg)	HX87	5	5	64.97	169.27	06/87	-18.79	8.05
AMPHIPOD	Ampelisca macrocephala (lg)	HX87	157	9	64.12	168.18	06/87	-20.17	9.44
AMPHIPOD	Ampelisca macrocephala (med)	HX87	3	5	64.97	169.27	06/87	-19.69	7.88
AMPHIPOD	Ampelisca macrocephala (med)	HX87	20	11	64.78	168.72	06/87	-19.65	8.35
AMPHIPOD	Ampelisca macrocephala (med)	HX87	88	13	64,92	169.87	06/87	-20.86	7.84
AMPHIPOD	Ampelisca macrocephala (med)	HX87	106	3	64.67	168.60	06/87	-19.66	8.47
AMPHIPOD	Ampelisca macrocephala (sm)	HX87	4	5	64.97	169.27	06/87	-20.13	7.91
AMPHIPOD	Ampelisca macrocephala (sm)	HX87	112	9	64.12	168.18	06/87	-19.99	8.91
AMPHIPOD	Ampelisca macrocephala (v. sm)	HX87	113	[illegible]	64.12	168.18	06/87	-18.59	8.70
AMPHIPOD	Anonyx sp.	HX87	18	20	64.27	168.68	06/87	-19.60	12.06
AMPHIPOD		HX87	140	9	64.12	168.18	06/87	-19.26	12.72
AMPHIPOD	Byblis gaimardi	HX87	1	9			06/87	-20.14	10.71
AMPHIPOD	Byblis sp.	HX87	60	13	64.92	169.87	06/87	-20.35	7.79
AMPHIPOD	Byblis sp.	HX87	66	3	64.67	168.60	06/87	-19.86	7.46
AMPHIPOD	Byblis sp.	HX87	69	3	64.67	168.60	06/87	-20.09	9.35
AMPHIPOD	Byblis sp.	HX87	79	13	64.92	169.87	06/87	-20.75	8.07
AMPHIPOD	Byblis sp.	HX87	80	13	64.92	169.87	06/87	-20.60	8.70
AMPHIPOD	Byblis sp.	HX87	84	3	64.67	168.60	06/87	-19.97	9.24
AMPHIPOD	Byblis sp.	HX87	90	9	64.12	168.18	06/87	-20.89	
AMPHIPOD	Byblis sp. (large)	HX87	27	11	64.78	168.72	06/87	-19.75	8.87
AMPHIPOD	Byblis sp. (large)	HX87	96	9	64.12	168.18	06/87	-21.27	9.69
AMPHIPOD	Byblis sp. (medium)	HX87	97	9	64.12	168.18	06/87	-20.76	9.95
AMPHIPOD	Byblis sp. (small)	HX87	26	11	64.78	168.72	06/87	-20.47	
AMPHIPOD	Gammarid	HX87	119	11	64.78	168.72	06/87	-19.32	10.81
AMPHIPOD	Grandiforus sp.	HX87	52	24	64.28	169.33	06/87	-17.66	13.93
AMPHIPOD	Grandiforus sp.	HX87	105				06/87	-16.67	14.70
AMPHIPOD	Haploops sp.	HX87	142	9	64.12	168.18	06/87	-21.04	
AMPHIPOD	Limbos sp.	HX87	51	11	64.78	168.72	06/87	-18.31	9.46
AMPHIPOD	Limbos sp.	HX87	96	13	64.62	169.87	06/87	-18.18	8.35
AMPHIPOD	Parathemisto libellula	HX87	11	13	64.92	169.87	06/87	-18.90	8.49
AMPHIPOD	Parathemisto libellula	HX87	12	13	64.92	169.87	06/87	-19.91	8.92
AMPHIPOD	Parathemisto libellula	HX87	24	11	64.78	168.72	06/87	-21.67	9.68
AMPHIPOD	Parathemisto libellula	HX87	39	8	64.08	169.48	06/87	-19.26	8.98
AMPHIPOD	Parathemisto libellula	HX87	42	24	64.28	169.33	06/87	-19.23	
AMPHIPOD	Parathemisto libellula	HX87	43	24	64.28	169.33	06/87	-19.05	9.00
AMPHIPOD	Parathemisto libellula	HX87	89	20	64.27	166.66	06/87	-19.26	9.95
AMPHIPOD	Parathemisto libellula	HX87	101	13	44.92	166.87	06/87	-19.04	8.64
AMPHIPOD	Parathemisto libellula	HX87	123	11	64.78	168.72	06/87	-20.02	10.18
AMPHIPOD	Parathemisto libellula	HX87	151	9	64.1[illegible]	[illegible]	06/87	-19.45	10.77
AMPHIPOD	Parathemisto libellula	HX87	152	3	64.67	168.60	06/87	-19.49	9.93
AMPHIPOD	Pontoporia femorata	HX87	139	9	64.12	168.18	06/87	-19.12	
AMPHIPOD	Protomedeia sp.	HX87	8s	13	64.92	169.87	06/87	-19.81	
AMPHIPOD	Protomedeia sp.	HX87	26	11	64.78	168.72	06/87	-19.76	9.12
AMPHIPOD	Protomedeia sp.	HX87	149	9	64.12	168.18	06/87	-18.77	10.71
AMPHIPOD		HX87	50				06/87	-17.41	14.09
AMPHIPOD		HX87	70				06/87	-18.48	11.13
AMPHIPOD		HX87	[illegible]				[illegible]/87	-17.46	13.07
AMPHIPOD		HX87					06/87	-18.68	12.85
BIVALVE		HX87	127	9	64.12	168.18	06/87	-16.40	10.73
BIVALVE		HX87	131	9	64.1[illegible]	168.18	06/87	-18.62	8.87
BIVALVE		HX87	96	13	64.92	169.87	06/87	-16.95	8.25
BIVALVE		HX87	129	11	64.78	168.72	06/87	-16.07	8.08
BIVALVE		HX87	130	13	64.92	169.87	06/87		8.11
CHAETOGNATH	Sagitta sp.	HX87	22	6	64.08	169.48	06/87		13.28
CHAETOGNATH	Sagitta sp.	HX87	37	24	64.28	169.33	06/87	-20.95	13.80
CHAETOGNATH	Sagitta sp.	HX87	103	13	64.92	169.87	06/87	-20.78	12.76
CHAETOGNATH	Sagitta sp.	HX87	110	0	64.12	168.18	06/87	-20.45	15.95
CHAETOGNATH	Sagitta sp.	HX87	116	11	64.78	168.72	06/87	-21.02	14.61
CHAETOGNATH	Sagitta sp.	HX87	64	20	64.27	168.68	06/87	-21.42	13.74
CHAETOGNATH	Sagitta sp.	HX87	14a	3	64.67	168.60	06/87	-20.76	15.50
COPEPOD	Calanus sp.	HX87	67,6	13	[illegible]	169.87	06/87	-21.46	8.66
COPEPOD	Calanus sp.	HX87	19	8	64.08	169.48	06/87	-20.48	
COPEPOD	Calanus sp.	HX87	38	24	64.28	169.33	06/87	-20.67	8.36
COPEPOD	Calanus sp.	HX87	40	24	64.28	169.33	06/87	-20.15	7.61
COPEPOD	Calanus sp.	HX87	41	6	64.08	169.48	06/87	-21.11	8.91
COPEPOD	Calanus sp.	HX87	67	20	64.27	168.68	06/87	-21.04	7.40

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (ppt)	DEL N15 (PPt)
COPEPOD	Calanus sp.	NX47	133	11	64.78	16372	06/87	-21.90	7.27
COPEPOD	Calanus 3p. (large)	HX87	10	13	64.92	169.87	06/87	-20.46	7.79
COPEPOD	Calanus 3p. (large)	HX37	16	13	64.92	169.87	06/87	-21.50	7.20
COPEPOD	Calanus sp. (large)	HX87	111	3	64.67	168.60	06/87	-19.69	8.46
COPEPOD	Calanus sp. (medium)	HX87	5'4	20	64.27	168.68	06/87	-21.28	7.27
COPEPOD	Calanus sp. [medium-small)	HX87	6	13	64.92	169.87	06/87	-20.42	7.99
COPEPOD	Calanus 3P. (medium-small)	HX87	121,122	11	64.78	168.72	06/87	-21.54	8.02
COPEPOD	Calanus 3P. (medium-small)	HX87	134	11	8478	168.72	06/87	-19.71	7.33
COPEPOD	Eucalanus sp.	HX87	9	13	64.62	169.87	06/87	-20.85	7.14
COPEPOD	Eucalanus sp.	HX87	23	24	64.28	169.33	06/87	-20.96	
COPEPOD	Eucalanus sp.	HX87	85	8	64.08	169.48	06/87	-20.62	7.44
COPEPOD	Eucalanus sp.	HX87	75	20	64.27	168.68	06/87	-20.52	7.15
COPEPOD	Eucalanus 4p.	HX87	136	11	64.78	1s473	06/87	-22.92	6.12
COPEPOD	Eucalanus 30.	HX87	107	3	6467	168.60	06/87	-22.74	8.26
COPEPOD	Large	HX87	143	9	64.12	168.18	06/87	-21.42	10.66
COPEPOD	Metridia sp.	HX87	124,128	11	64.78	168.72	06/87	-19.50	10.67
COPEPOD	Metridia sp.	NX37	49	24	64.28	169.33	06/87	-19.41	10.14
COPEPOD	Metridia sp.	HX87	53	8	64.08	169.48	06/87	-19.28	8.74
COPEPOD	Metridia w.	NX27	104	13	64.92	169.87	06/87	-19.07	7.97
COPEPOD	Metridia sp.	NX67	108	3	6467	168.60	06/87	-19.43	10.29
COPEPOD	Metridia 8p.	HX87	126	11	64.76	168.72	06/87	-19.50	10.00
COPEPOD	Metridia sp.	HX67	153	9	64S2	168.18	06/87	-19.53	10.43
CRAB	Hyas lyratus	HX87	46	11	64.76	168.72	06/87	-15.97	
CRAB		HX87	55	3	64. s7	168.60	06/87		10.65
CRAB MEGALOPS		HX87	4	13	64.92	169.87	06/87	-21.83	
CRAB ZOEA	Small	HX87	136	11	64.76	168.72	06/87		9.92
EUPHAUSIID	Thysanoessa inermis	HX87	36	11	6478	168.72	06/87	-20.09	9.62
EUPHAUSIID	Thysa— raschii	HX87	8	13	6462	169.87	06/87	-19.24	9.37
EUPHAUSIID	Thysanoessa raschii	HX87	17	20	6427	168.68	06/87	-19.10	8.69
EUPHAUSIID	Thysanoessa raschii	HX87	30	20	64.27	168.68	06/87	-19.85	8.46
EUPHAUSIID	Thysanoessa raschii	HX87	31	20	64.27	168.68	06/87	-18.53	8.97
EUPHAUSIID	Thysanoessa raschii	HX87	132	3	6467	168.60	06/87	-19.78	11.07
EUPHAUSIID		HX87	156	9	64.12	168.18	06/87	-18.78	11.03
FISH	Eelpout	HX87	114	11	64.76	168.72	06/87		16.16
FISH LARVAE		HX87	63	20	64.27	168.68	06/87	-19.08	14.15
FISH LARVAE		HX87	117	11	64.78	168.72	06/87		14.24
FISH LARVAE		HX87	144	3	64.67	168.60	06/87	-18.80	13.87
FISH LARVAE		HX87	147	9	64.12	168.18	06/87		15.45
GASTROPOD	Polinices pallida (MOM Snail)	HX87	126	9	64.12	168.18	06/87	-17.57	10.98
ISOPOD		HX87	45	11	64.76	168.72	06/87	-13.73	
POLYCHAETE	Ampharetidae	HX87	48	11	6476	168.72	06/87	-20.92	9.39
POLYCHAETE	Nephtys sp.	HX87	62	9	6412	168.18	06/87	-15.97	13.77
POLYCHAETE		HX87	15	24	44.26	169.33	06/87	-18.13	11.31
POLYCHAETE		HX87	57	3	64.67	168.60	06/87	-18.03	12.17
POLYCHAETE		NX27	58	4			06/87	-16.83	13.44
POLYCHAETE		HX87	61	8	64.06	169.48	06/87	-18.13	13.73
POLYCHAETE		HX87	62	8	6406	169.48	06/87	-16.28	11.66
POLYCHAETE		HX87	61	13	64.62	169.87	06/87	-17.26	13.35
POLYCHAETE		HX87	87	8	64.02	169.48	06/87	-18.11	13.51
POLYCHAETE		HX87	102	3	3467	168.60	06/87	-17.95	14.39
POLYCHAETE		HX87	109	9	64,62	168.18	06/87	-18.57	13.62
PTEROPOD	Clione limacina	HX87	2s	20	64.27	168.68	06/87	-22.84	
PTEROPOD		HX87	25, 13	13	[illegible]	[illegible]	06/87	-23.18	11.23
PTEROPOD		HX87	33	11	64.78	168.72	06/87	-23.87	10.87
SHRIMP	Pandalus 4p.	HX87	47	1 1	64.78	168.72	06/87	-17.47	12.44
SHRIMP		HX87	5	13	64.92	169.87	06/87	-17.76	11.74
SHRIMP LARVAE		IX87	44	24	64.28	169.33	06/87		8.90
SHRIMP LARVAE		IX87	145	9	64.12	168.18	06/87	-18.83	10.12
SHRIMP LARVAE		IX87	155	9	64.12	168.18	06/87		10.04
RV THOMAS G. * — -	AUGUST 1987	TH							
AMPHIPOD	Ampelisca macrocephala	TH87	34	40	6401	169.87	08/87	-2097	
AMPHIPOD	Ampelisca macrocephala	TH87	36	40	64.61	169.87	08/87	.2013	
AMPHIPOD	Byblis sp.	TH87	35	40	64.01	169 67	08/87	.20 88	
AMPHIPOD	Parathemisto."libellula	TH87	55	15	63.30	171 63	08/87	-19.41	
AMPHIPOD	Parathemisto libellula	TN87	43	29	44.33	168.97	06/67	-19.58	
AMPHIPOD		TH87	6	156	ad. 30	168.65	08/87	-19.38	
AMPHIPOD		TN47	60	12	62.02	168.66	08/87	-19 61	
CHAETOGNATH	Sagitta sp.	TN47	3	154	66.20	16863	08/87	-16.70	12.35
CHAETOGNATH	Sagitta sp.	TH67	10	156	68.00	168.91	08/87	-19.48	
CHAETOGNATH	Sagitta 6p.	TNd7	16	144	67.50	168.25	08187	.20.24	9.58
CHAETOGNATH	Sagitta 3p.	TN37	30	84	64,67	16456	08/87	-20.16	
CHAETOGNATH	Sagitta 6P	TH87	52	25	6455	17063	08/87	-20.15	s 81
CHAETOGNATH	Sagitta 3P:	TNd7	42	12	62.62	168.66	08/87	-20.16	
CHAETOGNATH	Sagitta sp.	TH87	10	156	66.00	168.91	08/87	-19 93	13.43
COMPOSITE		TH87	49	25	64.55	170.52	08/87	-20.65	Q 55
COPEPOD	Large	TH87	24	50	64.77	16. 62	08/87	-20.24	9.37
COPEPOD	Small	TH87	[illegible]	144	67 50	166.36	08/87	.21 25	8.51
COPEPOD	Small	TH87	61	12	62.43	168.66	08/87	.22.02	9 69
COPEPOD		TNA7	4	154	68.30	12646	08/87	-21.06	1020
COPEPOD		TH87	8	[illegible]	68.00	168.91	08/87	-21.18	
COPEPOD		TH87	11	156	68.00	168.91	08/87	-21 09	11.06
COPEPOD		TH87	18	144	67.60	168.25	08/87	.20. 84	8.38
COPEPOD		TN37	21	151	66.07	165.57	08/87	-21.29	9.02
COPEPOD		TH87	20	50	64.77	168.63	08/87	-21.38	
COPEPOD		TH87	28	50	64.77	16862	08/87	-20.74	
COPEPOD		TN37	32	84	64.67	16366	08/87	-21.72	9.26
COPEPOD		TH87	[illegible]	33	[illegible]	168.57	08/87	-21 12	
COPEPOD		TH67	42	29	6423	146.67	08/87	-21.79	8.99
COPEPOD		TH87	50	35	64.55	170 6a	08/87	-20.4a	9.34
COPEPOD		TH87	53	25	4455	170.52	08/87	-21 59	
COPEPOD		TH87	[illegible]	15	66.60	in . n	08/87	-22.*2	9 53

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (ppt)	DEL N15 (ppt)
CRAB MEGALOPS		TH87	28	50	64.77	168.63	08/87	-20.32	
CRAB MEGALOPS		TH87	39	32	64.40	168.57	08/87	-20.76	
CRAB MEGALOPS		TH87	57	15	63.80	171.83	08/87	-20.03	
EUPHAUSIID		TH87	6	156	68.30	168.65	08/87	-18.44	7.08
EUPHAUSIID		TH87	15	144	67.50	168.25	08/87	-18.59	
EUPHAUSIID		TH87	22	151	68.07	168.57	08/87	-18.92	7.60
EUPHAUSIID		TH87	25	50	64.77	168.63	08/87	-19.72	
EUPHAUSIID		TH87	31	84	64.67	168.58	08/87	-19.95	
EUPHAUSIID		TH87	44	29	64.33	166.97	08/87	-20.27	
EUPHAUSIID		TH87	1	154	68.30	168.65	08/87	-19.11	
GASTROPOD		TH87	26	50	64.77	168.63	08/87	-20.71	
PTEROPOD		TH87	2	154	68.30	168.65	08/87	-21.12	
PTEROPOD		TH87	[illegible]	29	64.33	166.97	08/87	-21.09	
SHRIMP		TH47	5	156	68.30	168.65	0s/87	.17.83	
R/V NOAA 544P SURVEYOR, SEPTEMBER-OCTOBER 1987		SU							
[illegible]	Hyperiid	SU87	67	SU27	[illegible]	[illegible]	09/87	-20.62	
AMPHIPOD		SU67	111	SU8	67.03	16.S.23	09/87	.21.22	
CHAETOGNATH	Sagittasp.	SU87	22	KS5	67.54	1s5.30	09/87	-20.13	11.76
CHAETOGNATH	Sagittasp.	SU87	91	Xsa	67.54	166.20	09/87	-20.13	12.55
CHAETOGNATH	Sagitta sp.	SU87	113	SU8	67.03	166.23	09/87	-20.47	
CHAETOGNATH	Sagitta sp.	SU47	103	SW	46.63	166.92	09/87	-20.85	
CHAETOGNATH	Sagitta sp.	SU37	41	SU11	67,07	165.73	09/87	-20.40	
CHAETOGNATH	Sagitta sp.	SU47	29	SU12	6s.75	168.25	09/87	-21 43	
CHAETOGNATH	Sagitta sp.	SU87	92	SU13	67.07	168.02	09/87	-20.61	11.76
CHAETOGNATH	Sagitta sp.	SLM7	20	KS15	67.04	163.s0	09/87	-20.69	
CHAETOGNATH	Sagitta sp.	SU87	66	SU27	43.12	169.00	09/87	-2013	11.76
CHAETOGNATH	Sagitta sp.	SLS7	64	KS17	67.63	164.87	09/87	-20.10	
COMPOSITE		SU87	114	SU8	67.03	166,23	09/87	-20.61	10.70
COPEPOD	Calanus sp.	SU87	108	SU8	67.03	168.23	09/67	-21.16	6.72
COPEPOD	Calanus sp.	SU87	42	SU11	67.07	165.73	09/67	-20.40	9.87
COPEPOD	Calanus sp.	SU87	93	SU13	67.07	168.02	09/67	-20.80	
COPEPOD	Calanus sp.	SU87	62	KS17	67.63	164.87	09/67	-20.40	11.49
COPEPOD	Calanus sp. (lar	SU87	26	SU12	26.75	14s.2s	09/87	-21.06	9.81
COPEPOD	Calanus sp. (small)	SU87	68	SU27	6S.12	169.00	09/87	-21.96	10.25
COPEPOD	Eucalanus sp.	SU87	77	SU5	67,03	166.02	09/87	-21.82	9.71
COPEPOD	Eucalanus sp.	SU87	69	SU27	22.12	169.00	09/87	-2 1 65	
COPEPOD	Large	SU87	45	KS4	67.74	14s.02	09/67	-21.07	
COPEPOD	Large	SU87	30	KS5	67.54	166.20	09/67	-22.32	
COPEPOD	Small	SU87	76	SU5	67.03	160.02	09/87	.19.74	
COPEPOD	Small	SU87	107	SU8	67.03	1S3.23	09/67	-19.64	
COPEPOD	Small	SLm7	99	SU13	67.o7	166.02	09/87	-21.61	
COPEPOD		SU87	101	SU9	as. 54	154.92	09/87	-20.73	
CRAB MEGALOPS		SU87	24	KS5	67,54	166.20	06/67	-20.46	
CRAB MEGALOPS		SU87	104	SU9	62.44	16s.02	06/67	-20.46	
CRAB MEGALOPS		SU87	63	SU27	42.12	166.00	09/87	-19.92	
EUPHAUSIID	Large	SU87	106	SU9	66.68	15S.62	09/87	-20.15	12.27
EUPHAUSIID	Medium	SU87	105	SU9	66ss	166.92	09/87	-20.30	9.57
EUPHAUSIID		SU87	[illegible]	KS4	67.74	16s.03	09/87	-18 47	
EUPHAUSIID		SU87	23	KS5	67.56	166.20	09/87	-19.67	9.38
EUPHAUSIID		SU87	[illegible]	SU8	66.45	167.20	09/67	-2066	0.04
EUPHAUSIID		SU67	112	SU8	67.03	166.23	09/67	-20.6S	7.62
EUPHAUSIID		SU87	32	SU12	66.75	168.25	06/67	.21.76	
EUPHAUSIID		SU87	66	SU13	67.o7	168.02	09/s7	-2001	8.60
EUPHAUSIID		SU87	70	SU27	68.12	169.00	09/87	-2039	0.46
CHAETOGNATH	Sagitta sp.	SU87	72	SU2	65.67	162.33	10/67	.20.63	11.35
CHAETOGNATH	Sagitta sp.	SU87	7	SU21	68.12	166.58	10/67	.20 21	
CHAETOGNATH	Sagitta sp.	SU67	52	KS24	64,76	165.03	! 0/67	-20.79	13.16
CHAETOGNATH	Sagitta sp.	SU47	*O	KS106	66.35	1S4,63	10/67	-21.05	
COPEPOD	Calanus sp.	SU87	71	SU2	65.67	1s4.33	10/87	-20 80	11.01
COPEPOD	Calanus sp.	SU87	85	SU5	65.67	168.83	10/67	-22.81	
COPEPOD	Calanus sp.	SU87	54	KS24	66.78	165.03	10/87	-20.41	
COPEPOD	Calanus sp.	SU87	1	KS27	66.08	167.S0	10/87	-21 98	
COPEPOD	Calanus sp. (large)	SU87	57	KS6	66.35	1s3.s3	10/87	.2217	9.4a
COPEPOD	Eucalanus sp.	SU67	56	KS24	66.78	165.03	10/67	-21.10	9.41
COPEPOD	Eucalanus sp.	SU87	81	KS106	44,35	1s6,s3	10/87	-2161	S.52
COPEPOD	Small	SU87	35	SU5	65.67	163.s3	10/67	-21.29	
COPEPOD	Small	SU87	47	SU5	6S,67	168.83	10187	-23.54	
COPEPOD	Small	SU87	55	KS24	46,76	1s5,03	10/67	-21 46	10.83
COPEPOD	Small	SU87	84	KS106	66.35	168.83	10/87	-20.87	10.03
EUPHAUSIID		SU87	90	SU5	65.67	168.83	1 0/67	-2026	t o w
EUPHAUSIID		SU87	5a	KS6	66.35	1ss.s3	10/87	-19.72	
PHYTOPLANKTON		SU87	12	SU21	68.12	14s.s4	10/67	-21.95	
SHRIMP	Pandalus goniurus	SU87	8	SU21	68.12	1ss,s5	1 0/67	-19.46	
RN ALPHA HELIX, APRIL-MAY 1988									
CHAETOGNATH	Sagitta sp.	IE88	18	18	58.41	170.71	[illegible]	[illegible]	[illegible]
CHAETOGNATH	Sagitta sp.	IE88	12	12	57.47	170.43	04/66	-19 69	13.97
CHAETOGNATH	Sagitta sp.	IE62	23	23	56.23	171,33	04/66	-19 96	13,31
CHAETOGNATH	Sagitta sp.	IE88	26	26	52,26	171.42	04/66	-20.08	1573
CHAETOGNATH	Sagittagitta	IE88	33	33	58.32	171.42	04/88	-19.52	
COPEPOD		IE88	33	33	52.32	171.62	04/66	-19.85	9.63
COPEPOD		IE88	18	18	58.41	170.71	04/88	-19 94	10.40
COPEPOD		IE88	23	23	56.23	171.32	04166	-19.90	8.56
COPEPOD		IE88	16	16	58.50	170.67	04/88	-2030	It. 58
COPEPOD		IE88	23	23	56.23	171 32	04/88	-20.15	9.44
COPEPOD		IE88	1	1	60.03	149.24	04/88	-25.5a	6.02
COPEPOD		IE88	26	26	58.26	171.42	04186	-20.32	7.s0
COPEPOD		IE88	12	12	57.47	1710.s2	04/88	-19.77	8.90
COPEPOD		IE88	31	31	5S.27	171.41	04/88	-19.85	6.S2
COPEPOD		IE88	22	22	57.76	171.87	04/66	-21.14	721

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (n)	LONGITUDE (W)	DA7E (MM/YY)	DEL C13 (ppl)	DEL N15 (ppl)
EUPHAUSIID		IE88		1	60.03	140,25	04/88	-20.79	7,71
ICE ALGAE		IE88	23	23	56.23	171 32	04/88	-2378	
JELLYFISH		IE88	15	15	58.4a	170.70	04/ss	-20.11	
PHYTOPLANKTON		IE88	23	23	58.23	171.32	04/88	-20.33	4.23
PHYTOPLANKTON		IE88	12	12	57.47	170.52	04/88	-20.19	
PHYTOPLANKTON		IE88	23	23	58.23	171.32	04/88	-20.29	5.32
PHYTOPLANKTON		IE88	12	12	57.47	170.62	04/88	-20.48	8.72
PTEROPOD		IE88	12	12	57.47	170.42	04/88	-19.80	
SALP		IE88	18	18	58.41	170.71	04/88	-19.82	13.s1
AMPHIPOD		IE88	64	64	59.1?	172,83	05/88	-19.85	1405
CHAETOGNATH	Sagitta sp.	IE88	88	88	5673	172.76	05/88	-20.57	16.30
CHAETOGNATH	Sagitta 4p.	IE88	16	16	58.50	170.67	05/88	-19,61	15.82
CHAETOGNATH	Sagitta sp.	IE88	31	31	58.27	171.41	05/88	-1952	
CHAETOGNATH	Sagitta sp.	IE88	22	22	57.7a	171.67	05/6a	-20.71	12.33
CHAETOGNATH	Sagitta sp.	IE88	55	55	59.21	171 19	05/88	-19.03	1420
CHAETOGNATH	Sagitta 4p.	IE88	76	7a	59.47	172.70	05/88	-20.24	14.51
CHAETOGNATH	Sagitta sp.	IE88	83	83	59.52	172.86	05/88	-20.43	1435
CHAETOGNATH	Sagitta 8p.	IE88	56	59	58.38	172.73	05/88	-20 87	12.42
CHAETOGNATH	Sagitta sp.	IE88	83	.33	59.52	172. 86	05/88	-20.49	
CHAETOGNATH	Sagitta sp.	IE88	46	46	58.28	171.94	05/88	-20.39	12.92
CHAETOGNATH	Sagitta sp.	IE88	63	63	58.95	172,78	05/88	-20.17	1402
CHAETOGNATH	Sagitta sp.	IE88	3a	3a	58.33	171.65	05/88	-2021	1411
CHAETOGNATH	Sagitta sp.	IE88	64	64	59.17	172.83	05/88	-20.40	1450
COPEPOD		IE88	64	64	59.17	172.83	05/88	-20.49	754
COPEPOD		IE88	61	51	58.32	172.55	05/88	-20.15	8,24
COPEPOD		IE88	59	59	58.26	172.73	05/88	-20.73	7.37
COPEPOD		IE88	46	46	58.28	171.94	05/88	-19.78	8.03
COPEPOD		IE88	83	83	56.52	172.86	05/8a	-19.85	11,27
COPEPOD		IE88	36	38	52..33	t?! 65	05/88	-20.96	7.85
COPEPOD		IE88	88	88	59.73	172.76	05/88	-20.55	11.13
COPEPOD		IE88	7a	7a	59.47	172.79	05/88	-19.72	10.17
COPEPOD		IE88	63	63	58.95	t 72.7a	05/88	-20.03	7.87
COPEPOD		IE88	55	55	59.21	171.19	05/88	-19.41	12.81
EUPHAUSIID		IE88	63	63	58.95	172.78	05/88	-19.97	8.37
EUPHAUSIID		IE88	4a	46	58.28	171. w	05/88	-20.04	
EUPHAUSIID		IE88	7.	78	59.47	172.79	05/88	.19.a7	9.17
EUPHAUSIID		IE88	83	63	59.52	172.66	05/88	-20.33	10.17
EUPHAUSIID		IE88	88	88	5*.73	172.76	05/88	-20.40	12.28
EUPHAUSIID		IE88	64	64	5s.17	172.13	05/88	-19.58	8.24
EUPHAUSIID		IE88	51	51	58.32	172.55	05/88	.10.69	7.5a
EUPHAUSIID		IE45	59	59	58.38	172.73	05/88	-19.98	8.88
ICE ALGAE		IE88	46	46	58.28	171. 94	05/88	-18.66	
PHYTOPLANKTON		IE55	89	89	59.25	172,73	05/88	-19.75	6.81
PHYTOPLANKTON		IE88	3a	38	58.33	171.65	05/88	-19.48	505
PHYTOPLANKTON		IE88	92	92	58.05	172.7a	05/88		10.01
PHYTOPLANKTON		IE88	88	66	59.73	172.76	05/88	-20.41	5,24
PHYTOPLANKTON		IE88	93	93	58.05	[illegible]	05/88	.19. 95	5.91
PHYTOPLANKTON		IE88	59	59	58.38	172.73	05/88	-19.13	5.44
PHYTOPLANKTON		IE88	55	55	59.21	171 19	05/88	-20,67	
PHYTOPLANKTON		IE88	36	36	55.33	171.65	05/88		5.2a
PHYTOPLANKTON		IE88	55	55	59.21	171.19	05/88	-20.80	10.95
SALP		IE88	55	55	59.21	171.19	05/88	[illegible]	
RN AKADEMIC KOROLEV, JULY-AUGUST 1988		AK							
CHAETOGNATH	Sagitta sp.	AK88	1	20	62.58	178.06	08/88	-22.26	15.49
CHAETOGNATH	Sagitta sp.	AK88	2	6	59.50	179.50	08/88	-22.22	11.33
CHAETOGNATH	Sagitta sp.	AK88	3	11	61 53	178.65	08/88	-21.30	11.01
CHAETOGNATH	Sagitta sp.	AK88	4	110	53.93	176.00	08/88	-23.99	
CHAETOGNATH	Sagitta sp.	AK88	5	95	64.67	169.98	08/88	-20.50	12.68
CHAETOGNATH	Sagitta	AK88	6	9	61.34	176.10	08/88	-21.58	15.13
CHAETOGNATH	Sagitta sp.	AK88	7	13	62.18	179.85E	08/88	-21.16	12.86
CHAETOGNATH	Sagitta sp.	AK88	8	3	64.00	175.00	08/88	-21.36	14.84
CHAETOGNATH	Sagitta sp.	AK88	9	107	64.38	171.65	08/88	-21.29	9.96
CHAETOGNATH	Sagitta sp.	AK88	10	2 2	63.00	176.00	08/88	-22.63	11.98
CHAETOGNATH	Sagitta sp.	AK88	11	87	65.41	170.36	08/88		11.39
CHAETOGNATH	Sagitta sp.	AK88	12	60	67.26	170.83	08/88	-20.73	
CHAETOGNATH	Sagitta sp.	AK88	13	61	67.33	169.75	08/88	-20.19	11.16
CHAETOGNATH	Sagitta sp.	AK88	[illegible]	[illegible]	[illegible]	171.35	08/88	-20.33	12.58
CHAETOGNATH	Sagitta sp.	AK88	15	32	64.00	175.00	08/88	-21.61	9.96
CHAETOGNATH	Sagitta sp.	AK88	16	56	67.74	169.93	08/88	-21.27	8.84
CHAETOGNATH	Sagitta sp.	AK88	17	47	68.10	170.88	08/88	-20.74	12.82
CHAETOGNATH	Sagitta sp.	AK88	18	64	67.30	166.71	08/88	-22.17	10.78
CHAETOGNATH	Sagitta sp.	AK88	19	19	62.42	174.01	08/88	-20.67	11.93
CHAETOGNATH	Sagitta sp.	AK88	20	38	63.92	173.58	08/88	-21.24	11.65
CHAETOGNATH	Sagitta sp.	AK88	21	50	68 66	168.33	08/88	-20.22	11.20
CHAETOGNATH	Sagitta sp.	AK88	23	72	66.55	174.17	08/88	-19.92	13.53
CHAETOGNATH	Sagitta sp.	AK88	24	85	65.83	169.17	08/88	-20.92	10.70
CHAETOGNATH	Sagitta sp.	AK88	[illegible]	[illegible]	[illegible]	169.38	08/88	-20.40	10.94
CHAETOGNATH	Sagitta sp.	AK88	26	66	65.08	170.73	08/88	-21.45	
CHAETOGNATH	Sagitta sp.	AK88	27	11	61.58	178.65	08/88	-21.71	9.21
COPEPOD	Neocalanus cristatus	AK88	2a	13	62.18	179.85E	08/88	-21.87	10.12
COPEPOD	Neocalanus cristatus	AK88	2a	27	64.72	177.60	08/88	-20.63	8.27
COPEPOD	Neocalanus cristatus	AK88	30	3a	63,92	173.58	08/88	-21.30	9.01
COPEPOD	Neocalanus cristatus	AK88	31	32	64.00	175.00	08/88	-21.05	8.57
COPEPOD	Neocalanus cristatus	AK88	32	25	6 400	179.33	08/88	-20.67	8.93
COPEPOD	Neocalanus cristatus	AK88	33	[illegible]	59.50	179.50	08/88	-22.91	7.52
COPEPOD	Neocalanus cristatus	AK88	34	1 1 0	53.93	176.00	08/88	-26.77	5.51
COPEPOD	Neocalanus cristatus	AK88	36	107	64.38	171.65	08/88	-21.46	10.22
COPEPOD	Neocalanus cristatus	AK88	37	61	67,22	169.75	08/88	-21.20	9.11
COPEPOD	Neocalanus cristatus	AK88	38	76	65.97	169.58	08/88	-22.18	
COPEPOD	Neocalanus cristatus	AK88	30	97	64.73	171.18	08/88	-21.73	11.57
COPEPOD	Neocalanus cristatus	AK88	[illegible]	[illegible]	65.41	170.36	08/88	-20.88	9.90

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION.	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	SALINITY (ppt)	WEIGHT (wt)
COPEPOD	Neocalanus cristatus	AK88	43	85	6533	169.17	08/88	-22,40	0.55
COPEPOD	Neocalanus cristatus	AK88	44	40	64.13	172.50	08/88	-22.39	9.75
COPEPOD	Calanus sp.	AK88	45	27	347[illegible]	177.80	08/88	-20.82	8.10
COPEPOD	Calanus sp.	AK88	46	38	63.92	173.5a	08/88	-22.31	10.73
COPEPOD	Calanus sp.	AK88	47	32	64.00	175.00	08/88		9.78
COPEPOD	Calanus sp.	AK88	4a	25	3400	179.33	08/88	-20.44	0.46
COPEPOD	Metridia sp.	AK88	[illegible]	97	[illegible]	171.18	08/88	-22.42	3.44
COPEPOD	Metridia sp.	AK88	50	6	5950	17m.30	08/88	-22.87	5.77
COPEPOD	Metridia sp.	AK64	[illegible]	67	[illegible]43	165.83	08/88	-22.29	14.18
COPEPOD	Eucalanus sp.	AK88	52	95	64.00	179.33	08/88	-21.7a	6.93
COPEPOD	Eucalanus sp.	AK88	53	3a	63,62	173.58	08/88	-22.s9	6.55
COPEPOD	Eucalanus sp.	AK88	54	61	6732	169.75	08/88	-22.13	11.21
COPEPOD	Eucalanus sp.	AK88	55	32	64.00	175.00	08/88	-22.6a	6.69
COPEPOD	Eucalanus sp.	AK88	56	95	64.97	169.98	08/88	-23.85	
COPEPOD	Eucalanus sp.	AK88	57	11	61.66	17a.65	08/88	.23.20	
COPEPOD	Eucalanus sp.	AK88	58	6	59.40	179.50	08/88	-22.16	7.67
COPEPOD	Eucalanus sp.	AK88	59	97	8473	171.18	08/88	.23.29	7,46
COPEPOD	Eucalanus sp.	AK88	60	107	64.38	171.65	08/88	.23.34	8.07
COPEPOD	Eucalanus sp.	AK88	61	40	44t3	172.50	08/88	.23.13	a.37
COPEPOD	Eucalanus sp.	AK88	62	68	65.35	166.96	08/88	-23.71	
COPEPOD	Eucalanus sp.	AK88	[illegible]	[illegible]	[illegible]	169.17	08/88	-22.61	6.57
COPEPOD	Eucalanus sp.	AK88	64	27	64.72	177.80	08/88	-22.07	7.28
COPEPOD	Eucalanus sp.	AK88	65	70	66.92	169.92	08/88	-23.22	
COPEPOD	Eucalanus sp.	AK88	[illegible]	[illegible]	[illegible]	169.21	08/88	.22.85	
COPEPOD	Eucalanus sp.	AK54	67	86	6534	169.38	08/88	-23.12	7.39
COPEPOD	EIXdsp.	AK88	6a	110	5293	176,00	08/88	-2S.27	5.00
COPEPOD	Eucalanus sp.	AK88	69	42	63.92	172.07	08/88	-22. s0	
COPEPOD	Eucalanus sp.	AK88	70	72	66.55	174.17	08/88	-22.60	
COPEPOD	Eucalanus sp.	AK88	71	87	65.41	170.36	08/88	-22.83	
COPEPOD	Calanus sp.	AK88	72	22	63.00	176.0	08/88	-24.25	10.s6
POLYCHAETE		AK88	73	39	64.23	172.66	08/88		14,72
POLYCHAETE		AK88	74	110	[illegible]	176.00	08/88	-23.98	5.62
POLYCHAETE		AK88	75	6	59.50	176.50	08/88	-22,42	9.36
AMPHIPOD	Parathemisto pacifica	AK54	76	13	62.18	169.85	06/66	-21.68	11.03
AMPHIPOD	Parathemisto pacifica	AK53	77	9	61.34	176.10	08/88	-22.36	12.01
AMPHIPOD	Parathemisto pacifica	AK53	78	11	61.54	178.65	06/86	.20.61	11.56
AMPHIPOD	Parathemisto pacifica	AK88	79	a	59.30	170. %	08/88	-21.71	8.20
AMPHIPOD	Parathemisto pacifica	AK88	80	3a	63.92	173.58	06/66	.21,62	6.54
AMPHIPOD	Parathemisto pacifica	AK56	81	104	63.65	169.21	08/88		9.54
AMPHIPOD	Parathemisto pacifica	AK35	82	107	44.34	171.65	08/88	-22.01	
AMPHIPOD	Parathemisto pacifica	AK65	83	88	65.34	169.6S	08/88	-23.22	
AMPHIPOD	Parathemisto pacifica	AK55	84	40	44.1"	172.50	08/88	-22.85	9.90
AMPHIPOD	Parathemisto pacifica	AK53	85	86	65.94	169.38	08/88	-23.75	
AMPHIPOD	Parathemisto pacifica	AK34	87	65	44.97	169.98	08/88	-21.60	11,23
AMPHIPOD	Parathemisto libellula	AK44	88	32	64.00	175.00	08/88	-22.19	9.65
AMPHIPOD	Parathemisto libellula	AK55	89	20	62.56	178.06	08/88	-23.66	
AMPHIPOD	Parathemisto libellula	AK54	90	22	63.00	176.00	08/88	-24.62	11.57
AMPHIPOD	Parathemisto sp.	AK53	91	110	52.53	176,00	06166	-24.37	
AMPHIPOD	Parathemisto pacifica	AK46	92	74	64.55	168.60	08/88	-23.16	
AMPHIPOD	Parathemisto libellula	AK33	93	27	84.72	177.30	08/88	-21,23	9.66
AMPHIPOD	Gammmarid	AK63	94	2s	44.00	t 7s.33	08/88	-19.99	6.50
AMPHIPOD	Gammmarid	AK88	95	45	67.73	172.83	08/88	-19.60	
EUPHAUSIID	Small	AK88	96	3a	63.62	173.58	08/88	-20.77	8.28
EUPHAUSIID	Small	AK88	97	40	64.13	172.50	08/88	-20.21	9.41
EUPHAUSIID	[illegible]	AK88	98	11	61.58	178.65	08/88	-20.63	6.51
CRAB, ZOEA		AK63	99	11	61.53	178.65	08/88	-20.38	10.62
CRAB	Brachy	AK88	100	3a	43.as	173.58	08/88	-19.9a	a.73
CRAB	Anomura	AK88	101	6	61.34	176.10	08/88	-23.32	12.40
CRAB LARVAE		AK88	102	22	43.00	176.00	08/88	.22.4a	660
SHRIMP LARVAE		AK88	103	47	66.63	165.63	08/88	-19.80	11.24
SHRIMP LARVAE		AK88	104	a	56.50	179.50	08/88	-20.51	
SHRIMP LARVAE		AK88	105	86	65,64	166.35	08/88	-19.96	8.65
SHRIMP		AK88	106	104	63.85	166.21	08/88	-17.70	13.27
SHRIMP LARVAE	Pandalid	AK88	107	50	68.66	6a.33	08/88	-19.93	11.21
SHRIMP LARVAE	Pandalid	AK88	108	104	63.85	169.21	08/88	-20.66	9.87
SHRIMP LARVAE	Pandalid	AK88	[illegible]	95	[illegible]	169.98	08/88	-20.16	8.96
SHRIMP LARVAE	Pandalid	AK88	110	97	54.73	171.18	08/88		6.65
SHRIMP LARVAE	Hippolytid	AK88	111	64	67.20	166.71	08/88	.20.59	
SHRIMP LARVAE	Hippolytid	AK88	112	107	64.38	171.66	08/88	-19.12	8.87
SHRIMP LARVAE	Hippolytid	AK88	113	99	64.53	170.02	08/88	.19. 83	10.04
SHRIMP LARVAE	Hippolytid	AK88	114	3a	63.92	173.36	08/88		8.95
SHRIMP LARVAE	Hippolytid	AK88	115	42	63.62	172.07	08/88	-20.54	
SHRIMP LARVAE	Hippolytid	AK54	116	5s	67.[illegible]	168.44	08/88	-19.04	0.54
SHRIMP LARVAE	Hippolytid	AK88	117	7a	65.97	169.53	08/88	-20,63	S.64
COMPOSITE		AK88	118	96	65.05	170.73	08/88	-22.04	11.33
COMPOSITE		AK88	119	22	63.00	176.00	08/88		11 04
COMPOSITE		AK88	120	47	68.10	[illegible].46	08/88	-21.61	
COMPOSITE		AK45	121	42	63.32	172.07	08/88	-22.55	8 . 6 6
COMPOSITE		AK88	122	58	67.51	172.19	08/88	-16.86	8.32
COMPOSITE		AK66	123	78	65.35	169.22	08/88	-21.77	9.69
COMPOSITE		AK88	124	40	4413	t 72.50	08/88	-21.99	9.89
COMPOSITE		AK88	125	106	ad 23	170 91	08/88	.22.60	9.91
COMPOSITE		AK88	126	64	67.30	166.71	08/88	-20,67	9.05
COMPOSITE		AK88	127	67	66.92	165.83	08/88	-20.65	10.68
COMPOSITE		AK88	126	50	68.66	168.33	08/88	-21.45	11.68
COMPOSITE		AK88	129	110	53.63	176.00	08/88	-25.87	5.50
COMPOSITE		AK88	130	86	65.94	169.38	08/88	-20.85	10,44
COMPOSITE		88	131	38	63.92	173.58	08/88	.21.40	
COMPOSITE		AK88	132	35	63.00	173.00	08/88	-23.34	12.12
COMPOSITE		AK88	133	98	64.72	170.87	08/88	-22.24	6S4
COMPOSITE		AK88	134	20	62.[illegible]	176.04	08/88		11.76
COMPOSITE		AK88	135	57	67.71	171.35	08/88	-21.13	8.96
COMPOSITE		AK88	136	95	4 467	169.66	08/88	-22.68	10.44

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE	LONGITUDE	DATE	DEL C13	DEL N15 (ppt)
COMPOSITE		AK88	138	32	64.00	175.00	08/88	-23.38	9.92
COMPOSITE		AK88	139	6	59.50	179.50	08/88	-22.62	7.07
COMPOSITE		AK46	140	6	61.34	176.10	08/88	-24,16	10.17
COMPOSITE		AK56	141	11	61.58	178.65	06/66	-23.45	106B
COMPOSITE		AK66	142	13	62.16	179.45E	08/88	-23.09	10.20
COMPOSITE		AK56	143	13	62.18	179.45s	06/66	-22.98	10,70
COMPOSITE		AK56	144	2s	64,00	179.22	08/88	-18.92	8,76
COMPOSITE		AK88	145	27	64.72	177.80	08/88	-19.32	8.61
COMPOSITE		AK44	146	36	63.92	173.58	06/66	-20.80	9.15
COMPOSITE		AK88	147	70	66.92	169.92	08/88	-19.54	8.73
COMPOSITE		AK88	148	72	66.55	174.17	08/88		9.69
COMPOSITE		AK54	140	85	65..s3	169.17	08/88	-22.14	10.40
COMPOSITE		AK88	150	87	65.41	170.36	08/88	.20.52	9 2a
COMPOSITE		AK88	151	26	65,34	169.99	06/66	-20.245	10, S6
COMPOSITE		AK88	152	97	64.73	171.18	06/66	-21.45	6 41
COMPOSITE		AK88	153	: :	64.53	170.02	06/66	-21.19	10.50
COMPOSITE		AK88	154	.04	63.85	169,21	08/88	.21.52	10.72
COMPOSITE		AK88	155	; ";	64.38	171 65	06/66	.20.30	10.29
COPEPOD	C. marshallae, N plumchrus	AK6S	156	110	53.93	176 00	06/86	-25.55	547
COPEPOD	C. marshallae, N. plumchrus	AK44	157	13	62.16	17s.654s	08/88	-22.21	12.15
COPEPOD	C. marshallae, N. plumchrus	AK55	156	6	59,60	179.50	06/66	-23.99	8.17
COPEPOD	C. marshallae, N. plumchrus	AK88	159	9	61.34	176.10	08/88	.24,16	1062
COPEPOD	C. marshallae, N. plumchrus	AK64	160	8	59.30	179.50	08/88	-23.66	8 66
COPEPOD	C. marshallae, N. plumchrus	AK54	162	19	62.42	17401	08/88	-22.69	14.88
EUPHAUSIID	Small	AK88	163	32	64.00	175.00	08/88	.16,91	8.97
EUPHAUSIID	Small	AK88	164	27	64.72	177.80	08/88	-17,73	7.81
EUPHAUSIID	Small	AK88	165	11	61.58	17645	08/88	-20.74	10.77
EUPHAUSIID		AK88	166	6	59 so	179 50	08/88	-21,52	8.09
EUPHAUSIID		AK64	167	22	63.00	176.00	08/88	-20.46	10.64
EUPHAUSIID		AK88	168	13	62.18	17945s	08/88	-21.53	10,64
EUPHAUSIID		AK88	t 60	25	64.00	17623	06/66	-18.71	6,43
EUPHAUSIID	Large	AK88	170	27	64.72	17750	08/88		8.83
EUPHAUSIID	Large	AK64	171	20	62.35	176.04	08/88	-21.94	13.50
PHYTOPLANKTON		AK64	1 ?3	24	63.71	176.44	08/88	-19 01	717
PHYTOPLANKTON		AKS6	174	20	62.58	176.04	08/88	-24.12	11.80
COPEPOD	Small	AK55	175	25	64.00	17622	08/88	-1 S.25	10.5s
COPEPOD	Calanus sp.	AK63	176	20	62.58	176.0S	08/88	-23.57	13.34
EUPHAUSIID	Large	[illegible]	[illegible]	[illegible]	[illegible]	179.50	08/88	-21.68	a.76
COPEPOD	C. marshallae, N plumchrus	AKS2	176	11	61.58	178.65	08/88	-23.53	10.54
COPEPOD	C. marshallae, N plumchrus	AK88	17*	6	59.50	979.50	06166	-24.70	6.32
PHYTOPLANKTON		AK65	160	44	67.40	173.36	06168	-21.69	6.66
PHYTOPLANKTON		AK65	161	55	67.74	168.44	06166	-18.71	7.22
PHYTOPLANKTON		AK88	143	76	65,97	169.58	08/88	-22,46	8.70
PuvTcPu"–		AK88	165	45	67.73	172.52	06166	-21.90	6.36
BRYO20A		AK44	166	106	64.23	170.91	08/88	-19.80	8.49
BRYO20A		AK56	167	106	64.23	170.91	08/88	-20.17	6.66
BRYO20A		AK66	169	32	44.00	176.00	08/88	-18.19	9.72
BRYO20A		AK88	[illegible]	102	64.08	167.39	08/88	-1660	12.43
BRYO20A		AK6a	161	72	66.55	174.17	06)66	-18.74	6.03
SEA CUCUMBER		AK88	192	73	[illegible]	169.33	08/88		13.46
SEA CUCUMBER		AK64	193	45	67,73	172.43	08/88		13.73
SEA CUCUMBER		AK88	[illegible]	81	67.33	169.75	08/88	-17.00	11.96
SEA CUCUMBER		AKa5	195	6a	67.00	106.73	08/88	-18.21	
SEA SQUIRT	Archidistoma sp.	AKaa	19a	106	64,23	170.61	08/88	-20.27	10.26
BIVALVE	Nucula belloti	AKM	198	18	62.00	175.04	08/88	-18.73	10.02
BIVALVE	Nucula belloti	AK64	199	45	67.73	172.83	08/88	-18.07	798
BIVALVE	Nucula belloti	AK64	200	35	63,00	173.00	08/88	-20.06	9 68
BIVALVE	Nucula belloti	AK55	201	69	67.00	146,73	08/88	-18.12	9.35
BIVALVE	Nucula belloti	AK88	202	59	67.15	173.00	08/88	.16.20	9.53
BIVALVE	Nuculana fossa	AK64	203	18	62.00	175.04	08/88	-18.83	9.5A
BIVALVE	Nuculana fossa	AK65	204	45	67.73	172.52	08/88	.17 95	
BIVALVE	Nuculana fossa	AK66	205	59	67.15	173.00	08/88	.17. 96	9.53
BIVALVE	Nuculana fossa	AK64	206	55	67.74	168.44	08/88	-17.00	8.05
BIVALVE	Nuculana fossa	AK23	207	61	67.33	169.75	08/88	-18.27	a19
BIVALVE	Nuculana fossa	AK64	208	53	67,74	168.44	08/88		7.75
BARNACLE		AK65	209	104	63,43	168.21	08/88	-16.10	10.63
FISH		AK88	210	81	65.83	164.23	08/88	-21 08	12.66
FISH, WALLEYE POLLOCK	Theragra chalcogramma	AK88	211	4	58.52	174.49	08/88	-19.57	11.17
FISH, SCULPIN		AK88	212	[illegible]	[illegible]	[illegible]	08/88	-17 56	15,72
FISH, SCULPIN		AK64	213	41	44.03	172.21	08/88	-17.86	16. 95
FISH, SCULPIN		AK88	214	100	64.38	169.18	08/88	-17.62	14.57
FISH, SCULPIN	Gymnocanthus galeatus	AK88	215	72	66.55	174 17	08/88	-18 31	13.72
SCAPHOPOD	Dentalium sp.	AK88	21a	35	63.00	173.00	08/88	-19.34	
BIVALVE		AK8a	217	16	62.00	175.04	08/88	-18.15	10.93
BIVALVE	Macoma calcaria	AK4S	21a	69	67.00	168.73	08/88	.1a 86	8.82
BIVALVE	Macoma calcaria	AK36	219	56	67.15	17300	08/88	-1754	a 81
BIVALVE	Macoma calcaria	AK64	220	35	63.00	173.00	08/88	-18.56	946
BIVALVE	Macoma calcaria	AK88	22*	37	63.66	172.62	08/88	-17.65	9.05
GASTROPOD	Polinices sp. (Moon Snail)	AK546	222	61	67.33	169.75	08/88	-15.94	11.04
GASTROPOD	Polinices sp. (Moon Snail)	AK8a	223	69	67.00	16473	08/88	-16 81	
GASTROPOD	Bittium schfiehtii	AK648	224	18	62.00	175.04	08/88	-17,40	10 53
AMPHIPOD	Ampelisca sp.	AK56	225	69	67.00	164.73	08/88	-19.16	9.3a
AMPHIPOD	Ampelisca sp.	AK4S	226	al	67.33	166.75	08/88		8.58
BIVALVE	Yoldia scissurata	AK44	227	5a	67.15	173.00	08/88	-17.85	8.62
SHRIMP LARVAE	Pandalidae	AK54	22a	41	64.03	172.2?	08/88	-19 44	76S
SHRIMP	Sclerocrangon boreas	AK4S	22a	104	63.85	169.21	08/88		13.18
SHRIMP	Sclerocrangon boreas	AK8a	230	102	64.08	167.36	08/88	-19.97	14.61
CRAB, LYRE	Hyas lyratus	AK84	231	92	64.43	167.68	08/88	-18.89	1544
CRAB, LYRE	Hyas lyratus	AK88	232	100	64.38	169.1a	08/88	-20.33	11.65
CRAB, LYRE	Hyas lyratus	AK64	233	104	63.85	169.21	08/88	-S770	13.79
CRAB, LYRE	Hyas lyratus	AKs4	234	102	64.08	167.39	08/88	-21.11	15.25
CRAB, LYRE	Hyas lyratus	AK44	235	96	65.06	170.72	08/88	-18 55	12 14
CRAB, LYRE	Hyas lyratus	AKaa	23a	106	64.23	170 91	08/88	-19.17	11 84

SAMPLE	DESCRIPTION	CRUISE	SAMPL610	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (ppt)	DEL N15 (PPt)
CRAB, SPIDER		AK66	237	72	66.55	174. 17	08/88	-17.32	1344
CRAB, SPIDER		AK88	239	53	67.63	165.73	08/88	1 -21.01	13.6S
CRAB, TANNER	Chionocetes opilio	AK88	240	104	63.6S	169.21	08/88	-20.94	13.49
CRAB, TANNER	Chionocetes opilio	AK88	242	72	66.55	174.17	08/88	-20.52	11.32
CRAB, TANNER	Chionocetes opilio	AK88	243	106	64.23	170.61	08/88	-17.74	11.27
CRAB, TANNER	Chionocetes opilio	AK88	244	64	67.30	166.71	08/88	-19.16	13.62
CRAB, TANNER	Chionocetes opilio	AK88	245	65	67.34	164.97	08/88	-39.63	13.55
CRAB, TANNER	Chionocetes opilio	AK88	246	96	65. 08	170.73	06/66	-21.04	11.47
CRAB, HERMIT	Labidocherus splendescens	AK88	247	53	67.63	165.73	08/88	-19.77	12.4a
CRAB, HERMIT	Labidocherus splendescens	AK88	248	96	65.08	170.73	08/88	.21 .43	11.60
CRAB, HERMIT	Labidocherus splendescens	AK66	249	100	64.3a	169.18	08/88	-18.29	12.25
CRAB, HERMIT	Labidocherus splendescens	AK88	250	72	66.55	174.17	08/88	-16.45	11.19
BRITTLESTAR	Ophiura sarsi	AKaa	252	65	67.34	164.67	08/88	.12 21	
BRITTLESTAR	Ophiura sarsi	AK88	253	61	67.33	169.75	08/88	-13.99	12.67
BRITTLESTAR	Ophiura sarsi	AK88	254	64	67.30	166.71	06/86		13.52
BRITTLESTAR	Ophiura sarsi	AK88	255	35	63.00	173.00	08/88	-14 88	
SEASTAR	Henricia sp	AK66	258	72	66.55	174.17	06/64	-1453	11.73
URCHIN		AK88	259	40	64.13	172.50	08/88	-21 34	
ANEMONE		AK88	260	61	67.33	169.75	08/88	-1715	t 2.54
SPONGE		AK88	261	83	65.67	168.50	08/88	-16, 85	
SPONGE		AK88	262	41	64.03	172.21	08/88	-18.77	12.24
CORAL, SOFT RED		AK88	263	92	64.68	167.68	08/88	.1983	13.04
CORAL, SOFT RED		AK66	264	83	65.67	168.50	06166	-19.64	11.31
CORAL, SOFT RED		AK88	265	102	6406	167.39	08/88	-19.97	12,60
TUBEWORMS		AK88	266	106	64,23	170 91	06/68	-19.56	10.83
AMPHIPOD	Anonyx 3p.	AK88	267	5'4	67.15	173.20	08/88	.17.66	13.47
AMPHIPOD	Anonyx sp.	AK88	268	100	64.36	166.16	08/88		12.27
AMPHIPOD	Anonyx sp	AK88	269	61	67.33	166.75	08/88	-17 76	12.16
AMPHIPOD	Anonyx sp.	AK88	270	100	64.3a	169.18	08/88	.20.22	8.17
EUPHAUSIID		AK88	271	61	67.33	169.75	08/88	-20.18	9.26
EUPHAUSIID	I-hysanoeesa inermis (large)	AK88	272	50	68.66	1 6 6 , 33	08/88	.21.00	
EUPHAUSIID		AK88	273	70	66.92	166. 92	08/88	-20.75	8.42
EUPHAUSIID		AK88	274	110	53.93	176.00	08/88	-23.41	
EUPHAUSIID		A K56	275	72	66.55	174,17	08/88	-20.06	9.44
EUPHAUSIID	Large	AK46	27a	76	65.97	169.58	08/88	-21 .57	8.64
EUPHAUSIID		AK6a	277	99	54.53	170.02	08/88	.20.13	10.87
EUPHAUSIID		A Kaa	276	55	67.74	168.44	08/88	-19 63	9.04
EUPHAUSIID		AK88	280	85	65.63	169.17	08/88	-21.03	8.95
EUPHAUSIID		AK88	2a2	50	68.66	168.33	08/88	-21.09	9.55
EUPHAUSIID		AK88	263	104	63.85	169.21	08/88	-22.65	8.84
EUPHAUSIID		AK88	2a4	t 07	64.3a	171.65	08/88	-21.97	
EUPHAUSIID		AK88	285	88	65.00	169.66	08/88	-21.50	8.94
EUPHAUSIID		AKa6	266	67	66.93	t 65.22	08/88	-20.95	9.18
EUPHAUSIID		AK6a	2a7	42	63.92	172,07	08/88		8.12
EUPHAUSIID		AK6a	288	64	67.30	166.71	08/88	-20.92	8.62
EUPHAUSIID		AKaa	269	87	65.41	170.36	08/88	-19.64	8.54
EUPHAUSIID		AK88	290	95	64.97	1 69.9a	08/88	-21.11	8.99
EUPHAUSIID		AK64	201	9a	64.72	170.87	08/88	-22.44	12.28
EUPHAUSIID		AKaa	292	86	65.94	169.36	08/88	-20.32	6.55
COPEPOD	Medium	AK66	263	35	63.00	173.00	08/88	-23.61	12.27
COPEPOD	Medium	AK56	294	104	63.85	169.21	08/88	-22.79	10.47
COPEPOD	Neocalanus plumchrus	AKaa	295	110	53.93	176.00	06/66	-25.63	
COPEPOD	Pseudocalanus minutus	AK88	296	60	67.26	170. 53	08/88	-21.12	13.50
COPEPOD	Pseudocalanus minutus	AK66	297	60	67.26	170.83	08/88	-21 07	
COPEPOD	c. marshallae, Metridia sp.	AKaa	298	50	66.99	168.33	08/88	-21.98	12.47
COPEPOD	C. marshallae, Metridia sp.	AK66	300	97	64.73	171.18	08/88	-22.12	11.80
COPEPOD	C. marshallae, N. plumchrus	AK88	301	88	65,35	169.99	08/88	-23.22	
COPEPOD	C. marshallae, N. plumchrus	AKaa	302	60	67.2a	170.53	08/88	-20,59	11.02
COPEPOD	C. marshallae, N. plumchrus	AK65	303	74	66.55	169.20	08/88	-21.76	10.87
COPEPOD	C. marshallae	AK88	304	107	64.3a	171.65	08/88	-21.67	12.50
COPEPOD	C. marshallae	AK88	305	70	66.92	169.92	08/88	-22.08	15.00
COPEPOD	C. marshallae	AKaa	306	42	63.92	172.07	08/88	-23.62	
COPEPOD	C. marshallae	AK6a	307	45	67.73	172.62	08/88	-20.98	10.50
COPEPOD	C. marshallae	AKaa	308	55	67.74	156.44	08/88	-21.25	10 63
COPEPOD	C. marshallae	AKaa	300	47	68.10	170. 55	08/88	-20.62	10.73
COPEPOD	C. marshallae	A K66	310	[illegible]	[illegible]	169.93	08/88	-21.16	10.66
COPEPOD	C marshallae	AK2a	311	64	67.30	165.71	08/88	-22.12	13.95
COPEPOD	G: marshallae	AK65	312	85	25. 83	169.17	08/88	-23.64	10.72
COPEPOD	C. marshallae	AKaa	314	5a	67.51	172.16	08/88	-20.61	10.78
COPEPOD	C. marshallae	AK6a	315	5a	67.15	173.00	08/88	-21.60	10.43
COPEPOD	C. marshallae, N. plumchrus	AK5a	31a	96	65,03	170.72	08/88	-22.34	11.77
COPEPOD	C. marshallae, N plumchrus	AKaa	317	67	65.41	1 70.3a	08/88	-21.35	10.51
COPEPOD	C. marshallae, N. plumchrus	AK88	318	61	67.33	169.75	08/88	-21.58	11.41
COPEPOD	C. marshallae, N. plumchrus	AK88	310	76	65.97	169.58	08/88	-22.30	11.14
COPEPOD	C. marshallae, N. plumchrus	AK88	320	95	64.97	169.98	08/88	-22.60	10 59
COPEPOD	C. marshallae, N. plumchrus	AK88	321	57	67.71	171 3S	08/88	-20.73	10.34
COPEPOD	C. marshallae, N. plumchrus	AK88	322	86	6S.94	169.38	08/88	-20 86	10.72
PHYTOPLANKTON		AK55	323	72	66.55	174. 17	08/88	-20.52	5.92
COPEPOD	Neocalanus cristatus	AK64	327	40	64.13	172.50	08/88	-21.9a	10.25
R/V THOMAS WASHINGTON, SEPTEMBER 1988		TW							
AGLANTHA	Aglantha digitalis	TW88	02	02	62.20	166.87	09/88		14.95
AGLANTHA	Aglantha digitalis	TW88	26	26	65.15	168.08	09/88	-21.09	11.81
AGLANTHA	Aglantha digitalis	TW88	26	26	65.15	168.08	09/88	-20.87	
AGLANTHA	Aglantha digitalis	TW88	29	29	65.15	168.27	09/88		10.11
AGLANTHA	Aglantha digitalis	TW88	50	50	67.03	196.88	09/88		10.44
AGLANTHA	Aglantha digitalis	TW88	62,92	62	66.27	169.08	09/88	-21.15	11.23
AGLANTHA	Aglantha digitalis	TW88	63	63	66.18	169.52	09/88	-20.72	8.87
AGLANTHA	Aglantha digitalis	TW88	67	67	65.77	169.45	09/88	-20.33	9.70
AGLANTHA	Aglantha digitalis	TW88	66	56	65.67	-169.15	09/88		10.26
AGLANTHA	Aglantha digitalis	TW88	71	71	65.67	168.75	09/88		11.31
AGLANTHA	Aglantha digitalis	TW88	73	73	65.67	168.42	09/88	-22.60	11.42

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE	DEL C13	DEL N1 (ppt)
AGLANTHA -	Aglantha digitalis	TW88	75,87	7 5	65.67	168.18	09/88	-22.10	12.62
AGLANTHA	Aglantha digitalis	...	9s	24	64.15	1 ?2. 55	09/88	-21 75	loos
AGLANTHA	Aglantha digitalis		63	63	66.18	16S.52	09/88		9.37
AMPHIPOD	Parathemista pacifica		62.50	62	46.27	169.08	09/88	.21.77	10.75
AMPHIPOD	Parathemisto pacifica	T	108.101 90	108	64.05	17312	09/88	.2484	12.28
AMPHIPOD	Parathemisto pacifica	TW88	26,29, 19	26	65.15	166,06	09/88	-21 86	12.18
AMPHIPOD		TW88	105	105	63.S5	171.60	09/88	-25.58	
AMPHIPOD		TW88	37	37	68.00	168.92	09/88	-18.73	9.32
AMPHIPOD		TW88	73	73	65.67	166.42	09/66	-23.05	15.13
AMPHIPOD		TW88	81	81	65.15	169,67	09/88	-21.67	6s4
AMPHIPOD		TW88	23	63	65,26	170.28	09/88	-21.19	11.44
AMPHIPOD		TW88	97	27	44.3s	172.77	09/88	-1988	6 51
BIVALVE	Acila castrensis	TW88	40	40	67.72	16970	06/.s6	-16.65	6.45
CHAETOGNATH	Sagitta sp	TW88	101	101	64.05	172.33	09/88	-21.95	1372
CHAETOGNATH	Sagitta sp	7W52	10J	103	63. SS	172.12	09/88	-23.56	14.77
CHAETOGNATH	Sagitta Y?	TW88	14	14	64.62	166.00	09/88	-23.94	14.71
CHAETOGNATH	Sagitta sp	TW88	26	32	65.15	1 66,06	09/88		12.42
CHAETOGNATH	Sagitta sp	TW88	29	2P	6S. t5	968,27	09/88		12.24
CHAETOGNATH	Sagitta sp	TW88	4s	42	6663	170.48	06/66	-20.61	12.46
CHAETOGNATH	Sagitta sp.	TW88	50	50	6?,03	196.88	09/88	.20.67	12.93
CHAETOGNATH	Sagitta sp.	TW88	52	52	67.25	169.23	06/66	-21.46	13.05
CHAETOGNATH	Sagitta sp.	TW88	62,75	62	s6,27	169.08	09/88	-20 7s	13.2.7
CHAETOGNATH	Sagittn sp.	TW88	23	43	3618	160.52	09/88	-21 31	13.29
CHAETOGNATH	Sagittn sp.	TW88	67	67	6S.77	169.45	09/88	-21 65	11.79
CHAETOGNATH	Sagitta 4P.	TW88	6S	66	6567	169,15	09/88	-21.28	12,36
CHAETOGNATH	Sagitta sp.	TW88	71	71	65.67	186.7S	09/88		13.00
CHAETOGNATH	Sagitta sp.	TW88	73	73	65.67	168.42	09/88	-22.42	14.68
CHAETOGNATH	Sagitta sp	TW88	81	61	65.15	169.67	09/88	-20.58	13.81
CHAETOGNATH	Sa itta sp	TW88	22	32	65.26	170.28	09/88	-19.66	15.76
CHAETOGNATH	Sagitta sp.	TW88	85,60	05	65.42	170.67	06/66		12.51
CHAETOGNATH	Sagitta 8P.	TW88	52	66	84.73	779. 57	09/88		11.14
CHAETOGNATH	Sagitta sp.	TW88	87	37	24.67	171.22	09/88	.20.67	13.05
CHAETOGNATH	Sagitta sp.	TW88	M	94	64.42	171.33	09/88	.20.36	1339
CHAETOGNATH	Sagitta 2p.	TW88	97	97	24.25	172.77	09/88	.2002	13.41
CHAETOGNATH	Sagitta 2p.	TW88	99	22	54.15	t 72.5S	09/88	.20.66	13.01
CNIDARIA		TW88	40	40	67.73	169.70	09/88	-17.86	11, s4
CNIDARIA		TW88	52	52	67.2S	1 66.23	09/88	-18.09	12.2s
CNIDARIA		TW88	73	73	65.67	168.42	09/88		15.03
COMPOSITE		TW88	0s	0s	62.63	168.97	09/88	-24.21	
COMPOSITE		TW88	17	17	44.62	1 66.05	09/88	-21.56	13.05
COMPOSITE		TW88	37	37	6s. 00	166.62	09/88	-24.S6	
COMPOSITE		TW88	37	37	4s.00	168.92	09/66	.21.71	11,04
COMPOSITE		TW88	37	3?	45.2a	168.92	09/88	-19.26	
COMPOSITE		TW88	3s	38	67.62	169.13	09/88	-20.90	14.30
COMPOSITE		TW88	06	04	62.52	145.00	09/88	-23.68	
COMPOSITE		TW88	101,102	101	64.05	172.23	09/66	-23,56	6S5
COMPOSITE		TW88	2,15	2	22.20	1 46,67	09/66	-20.53	13.54
COMPOSITE		TW88	21	21	4463	16676	09/88	-24.14	
COMPOSITE		TW88	46,50	46	45.s3	170.46	09/88		1100
COMPOSITE		7W22	67	67	66.77	169.45	09/88	-21.38	9.49
COMPOSITE		TW88	71	71	6S.67	145.75	09/88		10.48
COMPOSITE		TW88	66,s3,s4	66	44.73	171.67	09/88	.21.04	
COPEPOD	Large	7W45	3s	3s	65.15	168.27	09/88	-20.59	1059
COPEPOD	Small	TW88	4s	4s	6s. s2	170,48	00/66	-20.88	1254
COPEPOD	Small	TW88	52	53	67.26	169.23	09/88	-21,77	11 10
COPEPOD	Small	7WS3	7s	75	63.67	166.16	09/88	-24.09	13 89
COPEPOD		TW88	101	101	64.05	172.33	09/88	-26.57	1400
COPEPOD		7W2S	102	103	63.95	172.12	09/88	-23.66	1145
COPEPOD		TW88	105	105	63.26	171.90	09/88	-25.64	13 08
COPEPOD		TW88	126	105	44.05	173.12	09/88	-25.62	12 94
COPEPOD		TW88	14	14	4443	168.00	09/88	-21.27	13 19
COPEPOD		TW86	15	1s	44.43	966.30	09/88	-22.22	12.00
COPEPOD		TW86	19	16	64.38	169.33	09/88	-22.41	10 43
COPEPOD		TW88	2s	34	65,15	166,06	09/88	-22.53	14 73
COPEPOD		TW88	29	3s	65.15	t 66.2?	09/88	-21.20	11 21
COPEPOD		TW88	37	37	4s.00	168.92	09/88		15 13
COPEPOD		TW88	40	40	67.73	169.70	09/66	-21.13	15 22
COPEPOD		TW88	u	u	67.28	170.78	09/88	-21 02	12 79
COPEPOD		TW88	47	47	67.26	170.78	09/88	-20.46	10 51
COPEPOD		7W66	46	46	56.52	170.48	09/88	-20.52	13 02
COPEPOD		TW88	50	60	67.03	16s. ss	09/88	-20.67	11 22
COPEPOD		TW88	52	52	67.2S	169.23	09/88	-21.98	14 80
COPEPOD		TW88	42	22	4S.27	160.0S	09/88	-21.06	14 31
COPEPOD		TW88	62,02	62	S6.27	1 69.06	09/88		11 84
COPEPOD		TW88	62	43	66.18	169.52	09/88	-21.13	10 44
COPEPOD		TW88	44	65	65.67	169.78	09/88	-22.05	10 35
COPEPOD		TW88	67	6?	6S.77	169.4S	09/88	-2296	
COPEPOD		TW88	66	69	65.67	169.15	09/88	-22.26	1052
COPEPOD		TW88	71	71	45.67	168.75	09/88		10 90
COPEPOD		TW88	73	73	65.67	166.42	09/88	-23.21	13 48
COPEPOD		TW88	75	75	65.67	168,16	09/88	-22.37	1376
COPEPOD		TW88	61	61	65.15	169.67	09/88	-23.77	12 36
COPEPOD		TW88	43	53	65.28	1 70.28	09/88		12 92
COPEPOD		TW88	85	45	65.42	17067	09/88	-19 S6	12 43
COPEPOD		TW88	24	54	2473	171.57	09/88	-2322	12 52
COPEPOD		TW88	67	87	44.67	171.22	09/88	-24 12	14 36
COPEPOD		TW88	60	90	64.62	170.13	09/88	-26 49	13 60
COPEPOD		TW88	92	63	6425	170.75	09/88		12 45
COPEPOD		TW88	64	64	64.42	171.33	06/s6	-2165	12 22
COPEPOD		TW88	97	67	64.25	172,77	09/88	-21 40	12 33
COPEPOD		TW88	96	26	44.15	172.55	09/88		12 23
CRAB		7WS2	02	03	42.30	1 56.67	09/88	-24.26	452
CRAB		TW88	101	101	64.05	1 72.33	09/88	-23.23	11 03

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE	LONGITUDE	DATE	DEL C13 (DPI)	DEL N15 (PPI)
CRAB		Twda	103	103	63.95	172.12	00/66	-22.44	11,00
CRAB		TW88	105	105	63.85	171. W	09/88	-23.13	1s.4s
CRAB		7WS6	106	104	64.05	173.12	09/88	-2304	11.13
CRAB		I-wad	110	110	63.72	173.10	09/88	-23.07	1454
CRAB		TW88	15	Is	64.62	168.30	09/88	-21.88	11.7s
CRAB		Twaa	19	19	64.38	169.33	09/88	.20. s2	9.65
CRAB		TW88	3s	23	65.15	168.27	09/88		0.45
CRAB		TW88	40	40	67.72	169.70	09/88		10.81
CRAB		TW88	44	44	67.28	170.78	09/88	-21.04	11.47
CRAB		TW88	52	52	67.25	160.23	09/88	-21.05	10.64
CRAB		TW88	61	61	86.35	168.95	09/88	-20.85	
CRAB		TW88	62	62	66.27	169.06	09/88	-20.52	10.89
CRAB		TW88	43	63	66,16	169.52	09/88		9.49
CRAB		TWS6	46	63	65.67	160.78	09/88	.20.48	11.16
CRAB		TW88	46	5s	65.67	169.76	09/88	-20.36	
CRAB		TW88	69	69	65.67	169.15	09/88	-21.64	10.92
CRAB		Twda	81	81	65.15	169.67	09/88	-17.67	12.64
CRAB		TW53	83	63	65.28	170.28	09/88	-20.47	11.31
CRAB		TW88	55	85	65.42	170.87	09/88		9.82
CRAB		Twsd	66	64	64.73	171.57	09/88		10.13
CRAB		TW88	92	22	64,26	170.75	09/88	-21.33	
CRAB		TW88	M	34	64.42	171.33	09/88	-21.87	0.89
CRAB		TW88	97,02,52	97	44.25	172.77	09/88	-20.26	12.16
CRAB		I-wad	99	2a	64.15	172.55	09/88	-22.10	10.35
EUPHAUSIID		Twaa	101	101	6405	172.33	09/88	-25,54	11.04
EUPHAUSIID		Twda	108	105	64.05	173.12	09/88	-25.80	11.11
EUPHAUSIID		TW88	14	1*	64.62	168.00	09/88	-21.61	12.44
EUPHAUSIID		TW88	15	15	[illegible]	168.30	09/88	-21.32	11.54
EUPHAUSIID		TW26	19,3S.29,65,9S	19	64 3a	16S.33	09/88	-20.68	10.67
EUPHAUSIID		TW88	37	37	68.00	168.92	09/88	-21.83	1360
EUPHAUSIID		TW88	40	40	67.72	169.70	09/88	-19,46	12.10
EUPHAUSIID		TW88	44	44	67.2a	170.76	09/88		11.1!
EUPHAUSIID		TW88	47	47	67.2a	170.78	09/88	-19.86	12.76
EUPHAUSIID		Tw6a	48	48	62	170.48	09/88	-21.65	14.s4
EUPHAUSIID		TW88	50	50	67.02	1ss.5s	09/88	-20.53	12.63
EUPHAUSIID		Twda	s?	62	67.25	169.23	09/88	-19.94	9.10
EUPHAUSIID		TW88	43	62	66.27	169.08	09/88	.20.62	11.39
EUPHAUSIID		TW88	63	as	66.18	169.52	09/88		10.58
EUPHAUSIID		Twaa	6a	6a	65.67	169.15	09/88	-22.44	10.41
EUPHAUSIID		Twaa	71	71	65.67	168.75	09/88	-22.60	10.71
EUPHAUSIID		Twdd	73	73	65.67	168.42	09/88	-21,09	10.06
EUPHAUSIID		TW88	81	61	65.15	169.67	09/88	-21.86	12.04
EUPHAUSIID		Twaa	65	55	65,42	170.87	09/88	-20.22	9.02
EUPHAUSIID		TWS5			[illegible]	171.57	09/88	-20.54	13.11
EUPHAUSIID		TW88	60	90	64.S2	170.13	09/88	-22.89	11.12
FISH, FLATFISH		TW88	60	m	64.62	170.13	09/88	-23.68	10.05
FISH		TW88	69,75,94	69	65.67	169.15	09/88	-19.60	11 20
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	06	06	62.S3	1ss.00	09/88	.22 63	15.26
FISH, WALLEYE POLLOCK	Theragra chalcogramma	Twsa	15	15	64.62	138.30	09/88	-22.83	13.89
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	16	16	64.62	16mar	09/88	-22.08	
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	66	46	66.82	170.4a	09/88		12.58
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	·		[illegible]	196.88	09/88	-21.78	13.12
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	62	62	66.27	169.08	09/88		14.34
FISH, WALLEYE POLLOCK	Theragra chalcogramma	7W55	71	71	65.67	166.75	09/88	-22.56	13.23
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	73	73	65.67	165.42	09/88	-22.1a	13.2a
FISH, WALLEYE POLLOCK	Theragra chalcogramma	TW88	85	85	65.42	170.a7	09/88	-2021	12.56
JELLYFISH		TW88	05	05	62.52	167.75	09/88	-21 64	15.28
JELLYFISH		Twaa	38	38	67.92	169.13	09/88	-21.39	13.87
JELLYFISH		TW88	50	50	67.03	196.88	09/88	-20.42	11 65
JELLYFISH		TW88	65	65	65.87	169.78	09/88	-21 67	
JELLYFISH		TW88	73	73	65.67	168.42	09/88	-22.02	15.07
JELLYFISH		TW88	83	63	65.26	170.28	09/88	-20.40	13.1S
POLYCHAETE		TW88	61,83	61	66.35	168.95	09/88		12-.s3
PTEROPOD	Clione limacina	TW88	29,44s2	26	65.15	168.27	09/88	.22.3a	10.50
PTEROPOD	Clione limacina	TWM	62, S3,72	62	66.27	169.08	09/88	-22.22	10.79
PTEROPOD	Clione limacina	Twaa	7S,61	75	65.67	168.18	09/88	-21.42	10.44
PTEROPOD	Clione limacina	TW88	07.101,100,73	67	64.67	171.22	09/88	-22.74	11.13
SHRIMP LARVAE	Pandalus sp.	Twda	69	6a	65.67	169.15	09/88	-20.41	10. s2
SHRIMP LARVAE	Pandalus sp.	Twad	72	73	65.67	168.42	09/88	-20.4a	10.74
SHRIMP LARVAE	Pandalus sp	TW88	6s,75,36 ,14	85	65.42	170.87	09/88	.20.4a	6.22
SHRIMP LARVAE	Pandalus sp.	TW88	90,94,105	90	64.62	170.13	09/88	-22,02	7 87
URCHIN		TW88	42	52	66.27	169.08	09/88	-19.80	10.71
R/V NOAA SHIP SURVEYOR, SE... OCTOBER, 19[illegible]		S1							
ALGAE		SU88	17a	PG5	63.41	167.14	10/88	.32.73	
AMPHIPOD	Gammarid	SU88	134	PG9	63.30	165.65	10/88	-20,43	1777
AMPHIPOD	Gammarid	SU88	135	PZ1	70.35	162.43	10/88	-21.26	10.46
AMPHIPOD	Gammarid	sins	136	PU6	71. s0	166.82	10/88	-17.57	9.75
AMPHIPOD	Gammarid	SU88	137	PZ11,PT1,PY5	70.34	166.05	10/88	-18.55	10 89
AMPHIPOD	Hyperiid	SU88	138	PE1	64 05	172,42	10/88	-23.87	6.26
AMPHIPOD	Parathemisto libellula	Sims	139	PE3	63.25	171.89	10/88	.23.2a	10, s6
AMPHIPOD	Parathemisto pacifica	SU88	140	PE5	63.26	171.89	1 o/6a	-23.59	a.46
AMPHIPOD	Parathemisto pacifica	SU88	141	PD5	65 73	168.78	10/88	.2a at	10 39
AMPHIPOD	Parathemisto pacifica	SU88	142	PC11	67.24	164.83	10/88	-22.05	13 92
AMPHIPOD	Parathemisto pacifica	SU88	143	PU6	71.s0	1s4.s6	10/88	-20.90	13.27
AMPHIPOD	Parathemisto pacifica	SU88	144	PP27,PU1	70.32	168.97	10/88	.2321	
AMPHIPOD	Parathemisto pacifica	SU88	14s	PD3,FC13	65.87	168. U	10/88	-22. 16	13.38
AMPHIPOD		SU88	133	PU1	71.16	167.87	10/88	-21.31	10.04
CHAETOGNATH	Sagitta sp.	SU88	2a	PA1 B	68.90	166.67	10/88	-21.94	
CHAETOGNATH	Sagitta sp	SU88	[illegible]	[illegible]	63.66	171.89	10/88	-20.7a	13,14

SAMPLE	DESCRIPTION	CRUISE	SAMPLEID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (PPI)	DEL N15 (PDI)
CHAETOGNATH	Sagitta sp.	SU88	38	PE1	64.05	172.42	10/88	-21.44	13.15
CHAETOGNATH	Sagitta sp.	SU88	40	PD3	65.67	168.44	10/88	-20.68	14.34
CHAETOGNATH	Sagitta sp.	SU88	43	PC7	67.25	166.49	10/88	-20.82	15.82
CHAETOGNATH	Sagitta sp.	SU88	44	PG9	63.50	165.65	10/88		16.61
CHAETOGNATH	Sagitta sp.	SU88	45	PC1	67.25	168.98	10/88	-20.88	13.70
CHAETOGNATH	Sagitta sp.	SU88	46	PG2	63.36	168.26	10/88	-20.94	14.69
CHAETOGNATH	Sagitta sp.	SU88	47	PT1	71.34	166.78	10/88	-19.83	13.77
CHAETOGNATH	Sagitta sp.	SU88	48	PP27	70.32	168.97	10/88	-20.89	13.49
CHAETOGNATH	Sagitta sp.	SU88	49	PU1	71.16	167.87	10/88	-20.12	
CHAETOGNATH	Sagitta sp.	SU88	50	PC11	67.24	164.83	10/88	-20.40	16.01
CHAETOGNATH	Sagitta sp.	SU88	51	PD5	65.73	168.78	10/88	-22.04	11.77
CHAETOGNATH	Sagitta sp.	SU88	53	PZ11	70.34	166.05	10/88	-19.68	
CHAETOGNATH	Sagitta sp.	SU88	185	PZ1	70.35	163.43	10/88	-20.42	
CHAETOGNATH	Sagitta sp.	SU88	186	PU6	71.50	166.82	10/88	-20.68	13.28
COMPOSITE		SU88	146	PZ1	70.35	163.43	10/88	-22.33	
COMPOSITE		SU88	148	PA1B	68.90	166.67	10/88	-23.83	
COMPOSITE		SU88	150	PY5	70.62	166.21	10/88	-22.18	11.20
COMPOSITE		SU88	151	PW9	71.17	166.58	10/88	-22.37	
COMPOSITE		SU88	152	PG5	63.41	167.14	10/88	-21.42	13.48
COMPOSITE		SU88	153	PW8	71.16	166.60	10/88	-22.61	11.04
COMPOSITE		SU88	154	PG9	63.50	165.65	10/88	-22.12	13.27
COMPOSITE		SU88	156	PP34	69.16	168.97	10/88	-22.27	10.97
COMPOSITE		SU88	158	PW8	71.16	166.60	10/88	-23.95	
COMPOSITE		SU88	160	PD5	65.73	168.78	10/88	-23.37	10.05
COMPOSITE		SU88	161	PC11	67.24	164.83	10/88	-21.70	12.52
COMPOSITE		SU88	162	PE5	63.86	171.89	10/88	-23.54	9.51
COMPOSITE		SU88	163	PE1	64.05	172.42	10/88	-23.72	
COMPOSITE		SU88	164	PE5	63.86	171.89	10/88	-23.64	9.75
COMPOSITE		SU88	165	PE1	64.05	172.42	10/88	-23.72	10.18
COMPOSITE		SU88	166	PC7	67.25	166.49	10/88	-21.97	11.29
COMPOSITE		SU88	167	PT1	71.34	166.78	10/88	-24.98	11.63
COMPOSITE		SU88	168	PD3	65.67	168.44	10/88	-23.86	10.74
COMPOSITE		SU88	170	PP27	70.32	168.97	10/88	-25.26	10.98
COMPOSITE		SU88	171	PG2	63.36	168.26	10/88	-22.24	12.42
COMPOSITE		SU88	183	PW9	71.17	166.58	10/88	-21.16	8.42
COMPOSITE		SU88	187	PW9	71.17	166.58	10/88	-25.18	
COMPOSITE		SU88	147	PZ11	70.34	166.05	10/88	-22.24	
COMPOSITE		SU88	149	PD3	65.67	168.44	10/88	-23.76	
COPEPOD	C. marshallae, N. plumchrus	SU88	21	PC7	67.25	166.49	10/88	-23.32	12.35
COPEPOD	Calanus marshallae	SU88	6	PA1B	68.90	166.67	10/88	-23.64	12.69
COPEPOD	Calanus marshallae	SU88	8	PD3	65.67	168.44	10/88	-24.16	10.17
COPEPOD	Calanus marshallae	SU88	9	PP34	69.16	168.97	10/88	-23.13	
COPEPOD	Calanus marshallae	SU88	10	PG9	63.50	165.65	10/88	-24.19	
COPEPOD	Calanus marshallae	SU88	12	PG2	63.36	168.26	10/88	-23.93	12.84
COPEPOD	Calanus marshallae	SU88	13	PW8,9	71.16	166.59	10/88	-23.01	11.32
COPEPOD	Calanus marshallae	SU88	14	PE1	64.05	172.42	10/88	-23.45	
COPEPOD	Calanus marshallae	SU88	15	PC11	67.24	164.83	10/88	-22.97	11.26
COPEPOD	Calanus marshallae	SU88	18	PY5	70.62	168.21	10/88	-22.36	11.52
COPEPOD	Calanus marshallae	SU88	20	PP27	70.32	168.97	10/88	-23.59	11.64
COPEPOD	Calanus marshallae	SU88	22	PG5	63.41	167.14	10/88	-23.53	13.52
COPEPOD	Calanus marshallae	SU88	23	PU1	71.16	167.87	10/88	-23.23	11.96
COPEPOD	Calanus marshallae	SU88	24	PU6	71.50	166.82	10/88	-23.24	12.16
COPEPOD	Calanus marshallae	SU88	175	PZ11	70.34	166.05	10/88	-23.35	11.53
COPEPOD	Calanus marshallae	SU88	181	PT1	71.34	166.78	10/88	-22.53	11.55
COPEPOD	Calanus marshallae	SU88	184	PC1	67.25	168.98	10/88	-23.58	12.01
COPEPOD	Calanus marshallae	SU88	189	PE5	63.86	171.89	10/88	-24.58	
COPEPOD	Calanus sp.	SU88	7	PZ1	70.35	163.43	10/88	-22.73	11.90
COPEPOD	Eucalanus sp.	SU88	31	PE1	64.05	172.42	10/88	-22.29	9.24
COPEPOD	Eucalanus sp.	SU88	32	PD5	65.73	168.78	10/88	-23.75	9.25
COPEPOD	Eucalanus sp.	SU88	33	PC7	67.25	166.49	10/88	-21.03	10.65
COPEPOD	Eucalanus sp	SU88	35	PE5	63.86	171.89	10/88	-21.99	9.09
COPEPOD	Eucalanus sp.	SU88	36	PC1	67.25	168.98	10/88	-22.80	9.83
COPEPOD	Neocalanus cristatus	SU88	26	PG5,PD3,PD5	65.73	168.78	10/88	-21.83	8.75
COPEPOD	Neocalanus cristatus	SU88	30	PE1	64.05	172.42	10/88	-21.44	8.24
COPEPOD	Neocalanus cristatus	SU88	192	PE5	63.86	171.89	10/88	-21.71	9.31
COPEPOD	Neocalanus plumchrus	SU88	3	PE5	63.86	171.89	10/88	-24.77	10.30
COPEPOD	Neocalanus plumchrus	SU88	4	PD3	65.67	168.44	10/88		10.46
COPEPOD	Neocalanus plumchrus	SU88	5	PE1	64.05	172.42	10/88	-24.04	10.61
COPEPOD	Neocalanus plumchrus	SU88	179	PE1	64.05	172.42	10/88	-23.14	
COPEPOD	Pseudocalanus minutus	SU88	1	PD5	65.73	168.78	10/88	-24.44	9.83
COPEPOD	Pseudocalanus minutus	SU88	2	PC13	67.26	164.03	10/88	-22.48	11.57
CRAB	Lithodes maja	SU88	111	PP27	70.32	168.97	10/88	-22.17	10.97
CRAB	Lithodes maja	SU88	112	PW8-9	71.16	166.59	10/88	-21.41	
CRAB	Lithodes maja	SU88	113	PT1	71.34	166.78	10/88	-21.97	10.66
CRAB	Lithodes maja	SU88	114	PZ11	70.34	166.05	10/88	-21.19	10.42
CRAB	Lithodes maja	SU88	115	PA1B	68.90	166.67	10/88	-25.18	9.24
CRAB	Lithodes maja	SU88	116	PU6	71.50	166.82	10/88	-22.02	11.10
CRAB	Lithodes maja	SU88	117	PY5	70.62	166.21	10/88	-21.89	
CRAB LARVAE	Labidocherus splendescens	SU88	108	PA1B	68.90	166.67	10/88	-22.84	11.66
CRAB LARVAE	Labidocherus splendescens	SU88	109	PT1	71.34	166.78	10/88	-21.50	11.40
CRAB LARVAE	Labidocherus splendescens	SU88	110	PU6	71.50	166.82	10/88	-21.29	11.69
CRAB ZOEA	Brachura	SU88	125	PT1	71.34	166.78	10/88	-20.72	11.13
CRAB ZOEA	Brachura	SU88	126	PW8-9	71.16	166.59	10/88	-21.95	
CRAB, TANNER	Chionocetes opilio	SU88	119	PZ11	70.34	166.05	10/88	-21.06	10.85
CRAB, TANNER	Chionocetes opilio	SU88	120	PD5	65.73	168.78	10/88	-20.16	9.51
CRAB, TANNER	Chionocetes opilio	SU88	121	PD3	65.67	168.44	10/88	-24.14	11.21
CRAB, TANNER	Chionocetes opilio	SU88	122	PE5	63.86	171.89	10/88	-21.84	
CRAB, TANNER	Chionocetes opilio	SU88	124	PE1	64.05	172.42	10/88	-20.88	
CRAB, TANNER	Chionocetes opilio	SU88	127	PP34	69.16	168.97	10/88	-21.64	10.61
CRAB, TANNER	Chionocetes opilio	SU88	128	PC7	67.25	166.49	10/88	-20.65	10.24
CRAB, TANNER	Chionocetes opilio	SU88	129	PG2	63.36	168.26	10/88	-21.46	11.05
CRAB, TANNER	Chionocetes opilio	SU88	130	PU6	71.50	166.82	10/88	-21.05	10.67
CRAB, TANNER	Chionocetes opilio	SU88	131	PP27	70.32	168.97	10/88	-21.94	10.83

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (w t)	DEL N15 (ppt)
CRAB, TANNER	Chionoecetes opilio	SU88	132	PU1	71.16	16.7.87	1 0/88	-21.10	11.14
CRAB, TANNER	Chionoecetes opilio	SU88	162	PC1	67.25	168.66	10/88	-21.64	14.22
EUPHAUSIID	Small	SU88	55	PCI	67.25	158.25	10/88	-20.51	11.04
EUPHAUSIID	Small	SU88	61	PT1	71.24	166.76	10/88	-21.86	11.62
EUPHAUSIID	Small	SU88	74	PU6	71 50	166.s2	10/88	-21.88	10.s9
EUPHAUSIID	T raschii, T, inermis	SU88	58	PC1	67.25	168.66	10/88	-20.57	11.20
EUPHAUSIID	Thysanoessa inermis	SU26	63	PA1B	68. 90	166.67	10/88	-21.57	11. s2
EUPHAUSIID	Thysanoessa inermis	SU88	64	PE1	64.0S	172.42	10/88	-22.13	10.30
EUPHAUSIID	Thysanoessa inermis	SU88	65	PZ1 1	70.34	16s 05	10/88	-21.90	11.33
EUPHAUSIID	Thysanoessa inermis	SU88	66	PU1	71.16	167 87	1 o/6a	-22.45	
EUPHAUSIID	Thysanoessa inermis	SU88	67	PP27	70.32	16697	10/88	-22.45	11.34
EUPHAUSIID	Thysa— inermis	SU88	6a	PC1	67.25	166.66	10/88	-20.91	11.80
EUPHAUSIID	Thysanoessa inermis	SU56	69	PU6	71 50	166.s2	1 0/66	,21.74	
EUPHAUSIID	Thysanoessa inermis	SU88	70	PZ1	70.35	163.43	10/88	.21.63	11.60
EUPHAUSIID	Thysanoessa inermis	SU88	71	PP27	70.32	166.67	10/88	-20.43	12.05
EUPHAUSIID	Thysanoessa inermis	SU88	72	W o o	71 16	166.59	10166	-21,30	
EUPHAUSIID	Thysanoessa raschii	SUS6	60	PT1	71,34	168. 7a	1 0/66	-20.87	11.46
EUPHAUSIID		SU88	54	PC7	67.25	165.49	10/88	-20.07	
EUPHAUSIID		SU88	56	PD2	65.67	16644	10166	,21.28	10.51
EUPHAUSIID		SIMS	57	PE5	63. 5S	171.89	10/88	-21.67	9.66
EUPHAUSIID		SU88	62	PD5	65.?3	168.7.s	10186	,21.67	9.69
EUPHAUSIID		SU88	76	PG5,PG9	63.41	167.14	10/88	-22.02	13.00
EUPHAUSIID		SU88	186	PG2	63.2S	168.26	10/88	-21.07	
FISH, FLATFISH		SU88	76	PP27,PD3	70.32	168.97	1 0/66	-22.95	11.71
FISH LARVAE		SU88	80	PC13	6726	16403	10168	-21.28	11.63
FISH, SAND LANCE	Ammodytes hexapterus	SU88	77	PYs	7062	166.21	10/88	-21.64	12.94
JELLYFISH		SU88	95	PW8-9	71,76	166.59	10/66	-21.19	5.49
MYSIDACEA	Hemimysis lamornae	SU88	81	PC13	67.26	164.03	10/88	,21.70	12.20
MYSIDACEA	Hemimysis lamornae	SU88	63	PG5	63.41	167,14	10/88	,21.66	13.25
MYSIDACEA	Hemimysis lamornae	SU88	as	PG9	6350	1s5.65	10/88	-21.78	t 3,77
MYSIDACEA	Hemimysis lamornae	SU88	62	PG5	63 41	167.14	10/88	-21.31	
PHYTOPLANKTON		SU45	176	PU6	71 50	166.82	10/88	-24.00	
PHYTOPLANKTON		SU88	177	PZ11	7034	166.05	10166	-24.74	ass
PTEROPOD	Clione limacina	SU88	86	PD2	65.67	168.44	10/88		9.4a
PTEROPOD	Clione limacina	SU88	67	PE5	63.86	171.89	10/88	-23.53	9.78
PTEROPOD	Clione limacina	SU88	88	PD3	65.73	166.76	10/88	-22,74	9.33
PTEROPOD	Clione limacina	SU88	69	PZ11	70.34	766.05	10/88	-21.92	10.05
PTEROPOD	Clione limacina	SU88	90	PZ1	70.35	163.43	1 0188	-23.58	10.21
PTEROPOD	Clione limacina	SU88	91	PE1	64.05	172.42	10/88	-23.12	10.13
SHRIMP	Hippolytid	SU88	96	PD5,PC13			1 0/66	-20.26	11.53
SHRIMP	Hippolytid	SU88	105	PG9	63.5P	165.65	10/88	-20.35	13.55
SHRIMP	Hippolytid	SUS6	106	PC1	67,25	168.98	10/88	-19.89	11.90
SHRIMP	Hippolytid	SU88	107	PP27	70.32	168.97	10/88		12.31
SHRIMP	Pandalus sp.	SU88	10s	PU6	71.50	166.82	1 0/66	-20.75	103s
SHRIMP	Pandalus 3p.	SU88	104	PU1	71.16	167.87	1 o/6a	-20.43	10.07
SHRIMP	Pandalus sp.	SU88	700	PE5	63. 5S	171.89	70166	-22.10	
SHRIMP	Pandalus 3p.	SU88	101	PP34	6S 16	1s5.97	10/88	-20.5a	9.99
SHRIMP		SU88	98	PZ1	70.35	163,43	1 0/66	-20,46	1502
SHRIMP		SU88	97	PW8,9	71.16	166.59	10166		10.2s
SHRIMP		SU56	99	PD2	6S.67	168.44	10/88	-1 9.6S	9.90
TUNICATE	Oikopleura 3p,	SUS6	172	PG2	63.3S	146.26	10/88	-22.46	11 59
TUNICATE	Oikopleura 3p.	SU88	173	PP24	69.16	168.97	10/88	-23.23	731
TUNICATE	Oikopleura sp.	SU88	174	PW8,9;PU6;PZ11	71.50	1ss52	10/88	-2332	10 66
R/V NOAA SHIP SURVEYOR, SEPTEMBER-OCTOBER 1989		SU							
AMPHIPOD	Gammarid	SU89	5	ANADYR89	64.05	172.22	10/89	-17.79	12.36
AMPHIPOD	Gammarid	SU89	6	ANADYR89	64.05	172.22	10/89	-17.84	11 28
AMPHIPOD	Gammarid	SU89	7	ANADYR89	64.05	172.22	10/89	-16.71	8 56
AMPHIPOD	Gammarid	SU89	16	QD5	65.73	168.67	10/89	-18.82	9 13
AMPHIPOD	Gammarid	SU89	51	QQ12	72.33	164.73	10/89	-21.15	12 15
AMPHIPOD	Gammarid	SU89	53	QQ13E	73.15	165.85	10/89	-21.29	11 92
AMPHIPOD	Gammarid	SU89	54	QQ13E	73.15	165.85	10/89	-19.83	12 16
AMPHIPOD	Gammarid	SU89	71	QP14G	73.37	168.95	10/89	-20.56	11 84
AMPHIPOD	Gammarid	SU89	73	QP14G	73.37	168.95	10/89	-18.87	10 80
AMPHIPOD	Gammarid	SU89	47	QQ3	70.83	162.50	10/89	-20.72	11 84
AMPHIPOD	Hyperiid	SU89	19	HANNA TROUGH	70.52	167.47	10/89	-20.60	11 45
AMPHIPOD	Hyperiid	SU89	58	QQ14	71.98	164.97	10/89	-20.94	13 01
AMPHIPOD	Hyperiid	SU89	135	QC9	67.25	165.67	10/89	-21.97	15 69
AMPHIPOD	Parathemisto libellula	SU89	1	ANADYR89	64.05	172.22	10/89	-20.69	11 11
AMPHIPOD	Parathemisto libellula	SU89	15	QD5	65.73	168.67	10/89	-21.82	10 74
AMPHIPOD	Parathemisto libellula	SU89	80	QJ17	71.63	168.38	10/89	-19.70	11 08
AMPHIPOD	Parathemisto libellula	SU89	102	QAA6	68.90	169.00	10/89	-21.50	10 99
AMPHIPOD	Parathemisto libellula	SU89	110	QB7	67.98	169.00	10/89	-20.31	10 58
AMPHIPOD	Parathemisto libellula	SU89	127	QB2	68.28	167.25	10/89	-21.84	12 03
AMPHIPOD	Parathemisto libellula	SU89	128	QC9	67.25	165.67	10/89	-21.01	
AMPHIPOD	Parathemisto libellula	SU89	161	QEE1	64.05	172.42	10/89	-21.74	9 40
AMPHIPOD	Parathemisto libellula	SU89	169	QG2	63.37	168.30	10/89	-22.67	13 03
AMPHIPOD	Parathemisto libellula	SU89	93	QL4	69.35	167.17	10/89	-22.30	10 34
AMPHIPOD	Parathemisto libellula (large)	SU89	148	QC1	67.25	169.00	10/89	-22.70	11 26
AMPHIPOD		SU89	146	QC1	67.25	169.00	10/89	-20.07	8 45
AMPHIPOD		SU89	98	QP31	69.67	168.97	10/89	-20.92	13 38
AMPHIPOD		SU89	138	QC1	67.25	169.00	10/89		8 30
CHAETOGNATH	Sagitta sp	SU89	4	ANADYR89	64.05	172.22	10/89	-21.13	10 90
CHAETOGNATH	Sagitta sp	SU89	14	QD5	65.73	168.67	10/89	-21.27	12 24
CHAETOGNATH	Sagitta sp	aU89	20	HANNA TROUGH	70.52	167.47	10/89	-19.76	11 87
CHAETOGNATH	Sagitta sp	sU89	22	ICY CAPE	70.32	164.87	10/89	-20.68	13 86
CHAETOGNATH	Sagitta sp	sU89	30	QR4	71.30	160.20	10/89	-20.67	13 80
CHAETOGNATH	Sagitta sp	aU89	32	QR6	71.90	161.25	10/89	-20.60	12 87
CHAETOGNATH	Sagitta sp	sU89	40	QQ3	70.83	162.50	10/89	-20.44	14 03
CHAETOGNATH	Sagitta sp	sU89	42	QQ3	70.83	162.50	10/89	-20.50	13 36
CHAETOGNATH	Sagitta sp	sU89	52	QQ12	72.33	164.73	10/89	-19.88	10 96
CHAETOGNATH	Sagitta sp.	SU89	65	QQ20	71.00	164.98	10/89	-19.98	11 99

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE MM/YY)	DEL C13 (ppt)	DEL N15 (ppt)
CHAETOGNATH	Sagitta sp.	SU89	72	OP14G	73.37	[illegible]	[illegible]	[illegible]	[illegible]
CHAETOGNATH	Sagitta sp.	SU89	81	QJ11	70.83	166,70	1 0/89	-19.99	11 62
CHAETOGNATH	Sagitta sp.	SU89	95	OP31	69.67	168.S7	1 0/80	-20.50	12. s6
CHAETOGNATH	Sagitta sp.	SU89	107	QAA6	68.60	160.00	10/89	-19.66	11.71
CHAETOGNATH	Sagitta sp.	SU89	12s	OB2	68 28	167.2S	10/s9	-20.59	13.-
CHAETOGNATH	Sagitta sp.	SU89	132	QC9	67.25	185.67	10/s9	-21.51	14.09
CHAETOGNATH	Sagitta sp.	SU89	130	QC1	67.25	169.00	10/89	-20.00	
CHAETOGNATH	Sagitta sp.	SU89	145	QC1	67,25	169.00	10/89	-19.94	11 2s
CHAETOGNATH	Sagitta sp.	SU89	150	QCD4	66.42	167.88	10/89	-21.86	15.02
CHAETOGNATH	Sagitta sp.	SU89	155	QDD5	6S.73	168.75	1 o/8*	-21.39	13 49
CHAETOGNATH	Sagitta sp.	SU89	t 57	QEE1	64.05	172.42	10/89	-20.47	10.76
CHAETOGNATH	Sagitta sp.	SU89	168	QG2	63.37	t 66,30	10/89	.21.52	13.89
CHAETOGNATH	Sagitta sp.	SU89	88	QL4	69.35	167.17	10/89	-20.16	11 92
CHAETOGNATH	Sagitta sp.	SU89	119	OB7	67.98	166,00	1 0/89	-16.60	11.24
CHAETOGNATH	Sagitta sp.	SU89	'41	QL4	69.3S	167.17	10/89		12.00
CHAETOGNATH	Sagitta sp.	SU89	112	OB7	67.98	169.00	10/89	-20.10	10.58
COMPOSITE		SU89	123	OB7	67.98	169.00	10/89	-21.54	9.26
COMPOSITE		SU89	171	OG2	63.37	16s.30	10/89	-24.54	
COMPOSITE		SU89	12	ANADYR89	64.05	172.22	10/s9	-22.89	s 74
COMPOSITE		SU89	26	ICY CAPE	70.32	164.87	10/89	-22.45	12.36
COMPOSITE		SU89	3!	OR4	71 so	160.20	10/89	-22,13	11 99
COMPOSITE		SU89	77	OP14G	73.37	16s.65	1 0/89	-22.09	
COMPOSITE		SU89	78	OP14G	73.37	168.95	101S6	-22.19	
COMPOSITE		SU89	94	OL4	69.35	167.17	10/89	-22.41	
COMPOSITE		SU89	108	QAA6	68.60	169.00	10/89	-20.13	
COMPOSITE		SU89	106	QAA6	63.s0	160,00	10/89	.20.21	
COMPOSITE		SU89	146	QC1	67.2S	169,00	10/89	-23.06	10.29
COMPOSITE		SU89	164	OEE1	64.05	172.42	10/89	-20.68	
COMPOSITE		SU89	44	a n	70.83	162, S0	10/89	-20.99	
COMPOSITE		SU89	45	QC3	70.53	162, S0	10/89	-22.39	
COPEPOD	Calanus sp.	SU89	141	QC1	67.25	160. 00	10169	-22.69	8 99
COPEPOD	Calanus sp.	SU89	147	ccl	67.25	169.00	10/89	-22.76	666
COPEPOD	Calanus sp.	SU89	61	QC20	71.00	164.98	10/86	-22.57	10,63
COPEPOD	Calanus sp.	SU89	124	OB2	45.26	167.25	10/89	.21.66	11 17
COPEPOD	Calanus sp.	SU89	! 29	QC9	67,25	165,67	10/89	-21.62	11 64
COPEPOD	Calanus sp	SU89	1 S6	OEE1	34.05	172.42	10/89	-22.60	8.23
COPEPOD	Calanus sp	SU89	165	OG2	63.37	168.30	10169	-24.72	11 36
COPEPOD	Calanus sp.	SU89	67	OL4	69.35	167.17	10/s9	.22.63	9.71
COPEPOD	Calanus sp.	SU89	121	OB7	67.63	169.00	1 0/66	-22.41	6,12
COPEPOD	Calanus sp	SU89	3	ANADYR89	64.05	172.22	1 0/66	.22.66	6.04
COPEPOD	Calanus sp	SU89	13	QD5	65.73	168.67	10/89	.21.72	10.s2
COPEPOD	Calanus sp	SU89	23	ICY CAPE	70.32	164.87	10/89	-24.30	1142
COPEPOD	Calanus sp	SU89	27	OR4	71.30	160.20	10/89	-22.87	
COPEPOD	Calanus sp	SU89	39	QC3	70,83	162,50	10/89	-23.62	11 64
COPEPOD	Calanus sp.	SU89	41	QC3	70.83	162.50	10/89	-23.59	12.26
COPEPOD	Calanus sp.	SU89	151	QCD4	66.42	167. 88	! 0/66	-23.04	1320
COPEPOD	Calanus sp.	SU89	113	OB7	67.98	169.00	1 0/66	.21.67	10 06
COPEPOD	Calanus sp.	SU89	90	OL4	69.36	167.17	10/89	.23. S7	9 85
COPEPOD	Calanus sp.	SU89	1 03	QAA6	45.60	169.00	10/6S	.21.75	8 06
COPEPOD	Eucalanus sp.	SU89	10	ANADYR89	64,05	172.22	10/89	-20.s0	
COPEPOD	Eucalanus sp	SU89	126	OB2	45.26	167.25	10/89	-22.71	8.68
COPEPOD	Eucalanus sp	SU89	133	QC9	67.25	165.67	10/89	-21 42	11 15
COPEPOD	Eucalanus sp	SU89	140	QC1	67.25	169.00	1 0/66	-22.08	
COPEPOD	Eucalanus sp	SU89	142	QC1	67.2S	169.00	10/69	-22.44	8 61
COPEPOD	Eucalanus sp.	SU89	156	OEE1	64.05	172.42	10/s9	-2050	7 34
COPEPOD	Eucalanus sp	SU89	65	OL4	66.35	167.17	10/s0	-221 s	
COPEPOD	Eucalanus sp	SU89	101	QAA6	66.60	169.00	10/s0	-22.83	789
COPEPOD	Eucalanus sp	SU89	! 22	OB7	67.98	169.00	10/89	-22 24	8 71
COPEPOD	Eucalanus sp	SU89	104	QAA6	68.90	169,00	1 0(86	-22.62	732
COPEPOD	Eucalanus sp.	SU89	116	OB7	67.98	169.00	1 0166	-22.16	
COPEPOD	Large	SU89	43	o n	70.63	162. S0	10180	-23 85	1345
COPEPOD	Medium-Large	SU89	74	OP14G	73.37	166,95	10169	-23.58	1043
COPEPOD	Neocalanus sp.	SU89	8	ANADYR89	64.05	172,22	1 0/89	-21.95	72s
COPEPOD	Neocalanus sp.	SU89	160	OEE1	64.0s	172.42	10/89	-20.49	7 43
COPEPOD	Small	SU89	66	OP12	72.35	167.95	10/89	-18 90	10 42
COPEPOD		SU89	70	OP14G	73.37	166.9s	1 0/66	-22.24	11 46
COPEPOD		SU89	130	QC9	67.25	165.67	10/89	-21.60	1343
CRAB LARVAE		SU89	60	QC20	71.00	164. S6	10169	-21.84	10 43
CRAB LARVAE		SU89	66	OP12	72,35	167.25	10/8s	-21.13	10 56
CRAB LARVAE		SU89	7*	QJ17	71.63	166,3S	10:80	-20.11	10 18
EUPHAUSIID	Large	SU89	24	ICY CAPE	70.32	154.67	1 eta*	-21 68	11 19
EUPHAUSIID	Large	SU89	29	OR4	71.30	160.20	1 0/89	.21.61	12 16
EUPHAUSIID	Large	SU89	143	QC1	67.2S	169.00	70/8s	.29.96	11 34
EUPHAUSIID	Large	SU89	120	OB7	67.98	169.00	10169	-22.36	10 77
EUPHAUSIID	Large	SU89	105	QAA6	23.60	166,00	10/89	-2220	10 92
EUPHAUSIID	Large	SU89	114	w	67.98	169.00	1 0/66	-21 43	10 67
EUPHAUSIID	Medium	SU89	18	HANNA TROUGH	70.52	167.47	10/8s	-21.41	11 01
EUPHAUSIID	Medium-Large	SU89	75	OP14G	73.37	166.65	10/89	-21 35	12 43
EUPHAUSIID	Small	SU89	17	HANNA TROUGH	70,52	167.47	10/89	-20.44	19 67
EUPHAUSIID	Small	SU89	2s	ICY CAPE	70,32	164.67	10/89	-21.44	10 67
EUPHAUSIID	Small	SU89	26	OR4	71.20	160.20	10/89	-20.47	9 66
EUPHAUSIID	Small	SU89	35	OR9D	72.42	162.05	10/89	-20.92	11 66
EUPHAUSIID	Small	SU89	82	QJ11	70.63	146.70	1 0/66	-20.56	9 36
EUPHAUSIID	Small	SU89	t 44	QC1	67.25	1 66,00	10/89	-21 62	10 19
EUPHAUSIID	Small	SU89	84	OL4	6635	167.17	10/89	-20.40	9 46
EUPHAUSIID	Small	SU89	92	OL4	69.35	167.17	10/89	-20.00	10 21
EUPHAUSIID	Small-Medium	SU89	76	OP14G	73.37	168.95	10169	-21.92	12 44
EUPHAUSIID	Small-Medium	SU89	163	OEE1	64.05	172.42	10166	.1983	646
EUPHAUSIID	Small-Medium	SU89	167	OG2	63.37	168.30	10/89	.22.25	9 57
EUPHAUSIID	Small-Medium	SU89	116	OB7	67.65	166,00	10/89	-21 28	627
EUPHAUSIID	Small-Medium	SU89	137	QC1	67.25	166.00	1018s	-20.99	9 09
EUPHAUSIID	Small-Medium	SU89	106	QAA6	64.60	1 6S.00	1 0/89	-20.89	6 51
EUPHAUSIID	Small-Medium	SU89	11s	0s7	6763	16600	10/89	-20.56	8 95

SAMPLE	DESCRIPTION	CRUISE	SAMPLE 10	STATION	LATITUDE (N)	LONGITUDE (W)	DATE MM/YY)	DEL C13 (DPt)	DEL N15 (PPt)
EUPHAUSIID		SU89	9	ANADYR89	64.05	172,22	10/89	-20.30	7.81
EUPHAUSIID		SU89	49	CC12	72.33	164.73	10/89	-22.01	11.67
EUPHAUSIID		SU89	59	CC20	7100	764.98	10/89	-20.83	10.78
EUPHAUSIID		SU89	134	CC9	67.2S	165.67	10/89	-21.39	11.56
EUPHAUSIID		SU89	152	CCD4	66.42	167.64	10/89	.22..32	11.57
EUPHAUSIID		SU89	100	CAA6	66.20	169.00	t 0/89	-20.73	8.71
FISH	Eelpout	SU89	66	CC20	71 00	1s4.66	10169	-21.19	12.01
FISH		SU89	170	CC2	63.37	168.30	1 0/89	-21.75	13.62
FISH, SAND LANCE	Ammodytes hexapterus	SU89	21	HANNA TROUGH	70.52	167.47	1 0/89	-10.26	11.29
FISH, SAND LANCE	Ammodytes hexapterus	SU89	34	CR8	71,60	161.25	10/89	-21.46	12.70
FISH, SAND LANCE	Ammodytes hexapterus	SU89	36	CR9D	7242	162.05	1 0/89	-19.78	11ss
FISH, SAND LANCE	Ammodytes hexapterus	SU89	46	CC3	70,83	162.50	10/89	-21.73	13.52
FISH, SAND LANCE	Ammodytes hexapterus	SU89	50	CC12	72.33	164,73	1 0/89	-19.61	12.22
FISH, SAND LANCE	Ammodytes hexapterus	SU89	57	CC14	71 66	164.97	10/89	-20.16	11 54
FISH, SAND LANCE	Ammodytes hexapterus	SU89	64	CC20	71 00	15498	1 0/89	-20.06	12.05
FISH, SAND LANCE	Ammodytes hexapterus	SU89	111	CB7	67. 6S	169.00	1 0/89	-19.09	10.72
MYSIDACEA	Large	SU89	136	CC9	67.25	165.67	10169	-21.58	13. Ed
MYSIDACEA	Small-Medium	SU89	131	CC9	6725	165.67	10/89	-20.68	13.36
MYSIDACEA		SU89	156	CCD5	63.73	168.75	10/89	21 78	14.24
MYSIDACEA		SU89	166	CC2	63.37	168.30	10/s9	-22.00	14.38
PHYTOPLANKTON		SU89	37	CR9D	72.42	162.05	10160	.25.25	
PHYTOPLANKTON		SU89	36	CR9D	72.42	162.05	1 0/69	-25.07	
POLYCHAETE		SU89	33	CR8	71.60	161.25	1 0/s9	-18.69	12.40
SHRIMP	Crangon	SU89	153	CCD4	66.42	167.66	1 0/s0		14.2S
SHRIMP LARVAE		SU89	8	CJ11	70.83	166.70	1 0/89	-20.99	9.93
SHRIMP LARVAE		SU46	56	CC13E	73.15	165.65	1 0/66	-21,04	12.14
SHRIMP LARVAE		SU89	62	CC20	71,04	164.98	10180	-21,09	9.53
SHRIMP, HUMPBACK	Pandalus goniurus	SU89	154	CCD4	66.42	167.88	1016'4	-19.14	12.1!
SHRIMP, HUMPBACK	Pandalus goniurus	SU89	162	CEE1	64.05	172.42	10/89	-18.99	10.13
SHRIMP, HUMPBACK	Pandalus goniurus (large)	SU89	2	ANADYR89	64.05	172.22	10/89	-19.34	10,25
SHRIMP, HUMPBACK	Pandalus goniurus (small)	SU89	11	ANADYR89	64.05	172.22	10/89		10.41
R/V NOAA SHIP SURVEYOR, SEPTEMBER-OCTOBER 1990		SU							
AMPHIPOD	Parathemisto libellula	SU90	12	RA07	65.72	14S.61	10/s0	-23.01	
AMPHIPOD	Parathemisto libellula	SU90	21	RB03	67.43	169.64	1 0/90	-19.57	
AMPHIPOD	Parathemisto libellula	SU90	69	RF04	70.60	173.49	1 0/90	-20.30	9.87
AMPHIPOD	Parathemisto libellula	SU90	47	RJ06	70.47	165.49	1 0/90	-22.61	11.73
AMPHIPOD	Parathemisto sp.	SU90	3	REE2	63.65	172,15	1 0/90	-22.34	
CHAETOGNATH	Sagitta sp.	SU90	76	BUOY 1	69.70	176.01	1 0/90	.10.22	11.52
CHAETOGNATH	Sagitta sp.	SU90	9	RA03	65.07	169.31	10/90	-19.09	10.66
CHAETOGNATH	Sagitta sp.	SU90	14	RA07	65,72	168.61	1 0/90	-20.67	11.66
CHAETOGNATH	Sagitta 3p.	SU90	24	RB03	67.43	169.55	10/s0	-18.29	11.20
CHAETOGNATH	Sagitta sp.	SU90	27	RB05	67.87	155.22	10160	-16.77	11.40
CHAETOGNATH	Sagitta sp.	SU90	34	RCD02	66.32	167.04	10/90	-18.33	10.57
CHAETOGNATH	Sagitta 6p.	SU90	30	RCD05	66.59	160.27	10/s0	.20.65	13.61
CHAETOGNATH	Sagitta sp.	SU90	3a	RD03	69.23	176.68	1 0/90	-19.27	11.54
CHAETOGNATH	Sagitta 8p,	SU90	76	RE04	70.s0	173.42E	10/90	-19.74	11.95
CHAETOGNATH	Sagitta sp.	SU90	6	REE2	63.95	172.15	10100	-21.06	13.05
CHAETOGNATH	Sagitta sp.	SU90	70	RF04	70.50	173.46	1 0/90	-20.19	10.64
CHAETOGNATH	Sagitta sp.	SU90	71	RG04	72.02	174.74	10/90	-19.40	11.76
CHAETOGNATH	Sagitta sp	SU90	65	RH04	73.33	169.03	1 0/90	-21.53	12.22
CHAETOGNATH	Sagitta sp.	SU90	63	RI03	73.30	166.02	10/90	-20.01	13.85
CHAETOGNATH	Sagitta sp.	SU90	44	RJ01	70 %	170.46	1 0/s0	-19.87	12.40
CHAETOGNATH	Sagitta sp.	SU90	49	RJ06	70.47	165.40	1 0/90	-21.54	12.33
CHAETOGNATH	Sagitta 2p.	SU90	63	RK03	71.60	1s0.74	10/90	-16.44	12.17
CHAETOGNATH	Sagitta sp.	SU90	56	R K 0 7	72.60	162.81	1 0/90	-20.06	13.76
CHAETOGNATH	Sagitta sp.	SU90	17	RN06	66.80	12610	1 0/00	-20.76	11.70
COMPOSITE		SU90	36	RCD02	66.22	167.04	1 0/90	-10.37	9.24
COMPOSITE		SU90	41	RD03	69.23	176.68	1 0/90	-20.95	10.s4
COMPOSITE		SU90	1	REE2	63.65	172.15	1 0/90	-22.16	9.s4
COMPOSITE		SU20	54	RK03	71.40	120.74	1 0/90	21.45	11.79
COPEPOD	C marshallae	SU90	6	RA02	65.07	169.31	10/90	-22.41	1012
COPEPOD	C marshallae, N. plumchrus	SU90	5	REE2	63. s5	172.15	1 0/90	-23.45	960
COPEPOD	C. marshallae, N. plumchrus	SU90	20	RN06	66.80	168.10	1 0/90	-23.36	10.4s
COPEPOD	Calanus sp.	SU90	79	BUOY 1	69.70	176.01	10/90	-22.34	10.73
COPEPOD	Calanus 3p.	SU90	22	RS03	67.43	169.S4	10160	21.25	10.14
COPEPOD	Calanus 3p.	SU90	33	RCD02	66.22	167.04	10/90	-20.70	6.62
COPEPOD	Calanus sp.	SU90	29	RCD06	66.59	169.27	1 0/90	-21.56	12.20
COPEPOD	Calanus sp.	SU90	40	Roo2	46.23	176.56	1 0/90	.2330	ass
COPEPOD	Calanus sp.	SU90	75	RE04	70.s0	173.46s	1 0/90	-22.34	11.64
COPEPOD	Calanus sp.	SU60	67	RF04	70.60	173,46	10/90	-22.07	10.28
COPEPOD	Calanus sp.	SU90	73	RG04	72.o5	174.74	10/90	.22.53	10.32
COPEPOD	Calanus sp.	SU90	64	RH04	73.23	169.03	10160	-24.15	11.14
COPEPOD	Calanus sp.	SU90	61	RI03	73.50	166.02	10100	-24.38	10.69
COPEPOD	Calanus 8p.	SU90	42	RJ01	70.56	170.49	10/60	-22.72	11.12
COPEPOD	Calanus sp.	SU90	50	RJ06	70.47	165.49	10100	-22.16	11.26
COPEPOD	Calanus 2p.	SU90	51	RK03	71.60	1 so. 74	10190	-23.54	11.30
COPEPOD	Calanus sp.	SU90	5s	RK07	72.60	162.81	1 0/s0	-22.84	11.45
COPEPOD	Eucalanus bungii	SU90	60	BUOY 1	69.70	176.01	10/90	-22.95	0.51
COPEPOD	Eucalanus bungii	SU90	10	RA03	65.07	169.31	10190	-22.46	623
COPEPOD	Eucalanus bungii	SU90	13	RA07	65.72	1S5.61	101s0	-22.64	9.13
COPEPOD	Eucalanus bungii	SU90	23	RB03	67.43	166.46	1 0/90	-22.17	6.07
COPEPOD	Eucalanus bungii	SU90	35	RCD02	66.32	167.06	10190	-20.06	6.27
COPEPOD	Eucalanus bungii	SU90	31	RCD06	66.56	16627	10/90	-21.11	10.44
COPEPOD	Eucalanus bungii	SU90	37	RD03	69.23	176.65	t 0/90	-23.59	9.53
COPEPOD	Eucalanus bungii	SU90	4	REE2	63.95	172.15	10/90	-22.09	6.35
COPEPOD	Eucalanus bungii	SU90	66	RF04	70.80	173.46	10160	-24.84	6.20
COPEPOD	Eucalanus bungii	SU90	72	RG04	72.04	174.74	10160	-22.94	6.S6
COPEPOD	Eucalanus bungii	SU90	45	RJ01	70.56	170.49	10/90	-23.22	11.01
COPEPOD	Eucalanus bungii	SU90	48	RJ06	70.47	165.49	10/90	-22.30	10.23
COPEPOD	Eucalanus bungii	SU90	18	RN06	4S.60	168.10	10160	-22.26	S.22
COPEPOD	Neocalanus cristatus	SU90	2	REE2	63 S5	172.13	1 0/s0	23.12	

SAMPLE	DESCRIPTION	CRUISE	SAMPLE 10	STATION	LATITUDE (N)	LONGITUDE (W)	DATE MM/YY)	D EL C13 (ppt)	DEL N15 (PPt)
COPEPOD		SU90	2a	RB05	67.87	168.33	1 0/90	-21.82	9.65
CRAB ZOEA		:U90	52	RK03	71.60	160.74	t 0/90	.21.27	11 W
EUPHAUSIID	Thysanoessa sp.	SU90	11	RA03	65.07	169.31	1 0/90	-20.10	9.14
EUPHAUSIID	Thysanoessa sp.	SU90	15	RA07	65,72	168.61	1 0/90	-20,49	
EUPHAUSIID		SU90	77	BUOY 1	60.70	176.01	10/90	-20.12	9.49
EUPHAUSIID		SU90	2s	RS03	67.43	169.66	10100	-18.53	8.40
EUPHAUSIID		SU90	26	RB05	67,87	168.33	10/90	-19.86	9.21
EUPHAUSIID		SU90	32	RCD02	66.32	167.06	10/90	-18.30	.6.48
EUPHAUSIID		SU90	39	$6003	69.23	176.68	10/90	-21.04	9.4a
EUPHAUSIID		SU90	7	REE2	63.95	172.15	10/s0	.21. 97	9.27
EUPHAUSIID		SU90	74	RG04	72.08	174.74	1 0/s0	-20.94	8.84
EUPHAUSIID		SU90	60	RI03	73.50	166.02	10/90	-22.98	
EUPHAUSIID		SU90	43	RJ01	70,54	170.49	10/90	.20. 87	11,54
EUPHAUSIID		SU90	46	RJ06	70,47	165.49	1 0/90	-21.44	12.37
EUPHAUSIID		SWo	57	RK07	72.80	162.al	10/90	-21.86	
EUPHAUSIID		SU90	19	RN06	66.80	168.10	10100	-20.40	10.53
MYSIDACEA		U90	1a	RN06	66.80	168.10	1 0/90	-19.44	13.o2
MYSIDACEA		SU90	56	RK07	72. 80	162,al	1 0/90	-21.17	
SHRIMP LARVAE		SU90	66	RH04	73.33	169.03	10/90	-21.07	684
SHRIMP LARVAE		U90	62	RI03	73.30	166.02	1 0/90	-20.36	9.86
SHRIMP LARVAE		SU90	56	RK07	72.80	162.81	10/90	-16.14	
R/V NOAA SHIP SURVEYOR, SEPTEMBER-OCTOBER 16s1		SU							
AMPHIPOD	Gammarid	SU91	7	SA07	65.73	1 68.63	1 0(61	-19.83	7,03
AMPHIPOD	Gammarid	SU91	04	SA03	65.90	169.31	10/91	-20.12	74a
AMPHIPOD	Hyperiid	SU91	23	SK3A	71 15	159.65	1 0/91	.20.42	14.37
AMPHIPOD	PW1OUMIUO sp.	SU91	2	SA07	65.73	1 6863	10101	-20.91	10.59
AMPHIPOD	Parathemisto sp.	SU91	54	SC02B	60.10	17760	10/91	-20.22	9.63
AMPHIPOD	Parathemisto 3p.	SU91	70	SC09	66.93	167.99	10/91	.20.7.S	10,07
AMPHIPOD	Parathemisto sp.	SU91	43	SE04	70.49	170.49s	10/91	.20.05	12.55
CHAETOGNATH	Sagitta sp.	SU91	38	SE04	70.40	178.49E	10/91	-20,17	13.29
CHAETOGNATH	Sagitta sp.	SU91	5	SA07	65,73	168.63	10/91	-19.54	11.25
CHAETOGNATH	Sagitta sp.	SU91	13	SC08B	68.94	168.49	10/91	-19.93	12.02
CHAETOGNATH	Sagitta sp.	SU91	20	SKSA	71.15	159 95	10/91	-20.62	12.70
CHAETOGNATH	Sagitta sp.	SU91	26	sF04	70.81	173.49	10/91	.20.60	12.01
CHAETOGNATH	Sagitta sp.	SU91	34	SF08	71.11	176.50	10/91	-20.03	13,8s
CHAETOGNATH	Sagitta 3p.	SU91	4s	SE01	69.88	177.88E	10191	.19.a4	15.06
CHAETOGNATH	Sagitta sp.	SU91	52	SC02B	68.10	177.60	1 0/91	-19.77	11.37
CHAETOGNATH	Sagitta sp.	SU91	57	SC04	68.40	172.24	10/91	-19.26	11,20
CHAETOGNATH	Sagitta sp.	SU91	67	SC09	68.93	167.36	10/91	-20.09	12.44
CHAETOGNATH	Sagitta sp.	SU91	7a	SS07	68.34	166.89	10/91	-20,04	11.91
CHAETOGNATH	Sagitta sp.	SU91	80	SS02	67.22	170,34	10/91	-19.75	t 0.?6
CHAETOGNATH	Sagitta sp.	SU91	88	SA03	65.60	166.31	10/91	-20.23	10.84
CHAETOGNATH	Sagitta sp.	SU91	91	SA07	65,73	168.62	1 0/91	-20,36	12.55
CHAETOGNATH	Sagitta sp.	SU91	49	SE01	69.88	177.aaE	10/91	-19.85	15.44
CHAETOGNATH	Sagitta sp.	SU91	40	SE04	70.40	178.49E	10/91	-20.00	14.55
COPEPOD	Calanus sp.	SU91	29	SF04	70.81	173.46	10/91	-25.32	1353
COPEPOD	Calanus sp.	SU91	35	sF06	71,11	176.50	10/91	-23.71	10.46
COPEPOD	Calanus sp.	~W I	82	S602	67.22	170.34	10/91	.21.51	9.52
COPEPOD	Calanus sp.	SU91	a	SA07	65.73	168.63	10/91	-21 53	8.92
COPEPOD	Calanus sp.	SU91	14	SC08B	68.94	t 68.49	10/91	-23.62	11.02
COPEPOD	Calanus sp.	SU91	19	SK3A	71.15	15005	10/91	-24.39	10.97
COPEPOD	Calanus sp.	SU91	37	SE04	70.46	t 78.49E	10/91	-22.82	10.86
COPEPOD	Calanus 8p.	SU91	46	SE01	69.88	177.88E	10/91	-22a!	11.09
COPEPOD	Calanus sp.	SU91	53	SC02B	68.10	177.60	10/91	-21.92	10.65
COPEPOD	Calanus sp.	SU91	60	SC04	68.40	172.24	10/91	-21,07	956
COPEPOD	Calanus sp.	SU91	66	SC09	68.93	167.99	10/91	-21 81	10. s4
COPEPOD	Calanus 3p.	SU91	86	SA03	65,60	169.31	10/91	-22.32	8.80
COPEPOD	Calanus sp.	SU91	09	SA07	65.73	168.62	10/91	-23.05	1S.86
COPEPOD	Calanus sp.	SU91	74	SS07	68.34	!6606	10/91	.21.47	9.59
COPEPOD	Calanus sp.	SU91	10	SA07	65.73	168.63	10/91	-20,63	10.29
COPEPOD	Calanus 6P.	SU91	25	SK2A	71.15	150.45	10/91	-23.12	12.13
COPEPOD	Calanus sp.	SU91	4a	SE01	69.66	177.88E	10/91	-21.90	12.20
COPEPOD	Calanus 6p.	SU91	42	SE04	70.49	17.s.46s	10/91	-21.54	11. 57
COPEPOD	Eucalanus bungii	SU91	59	SCM	68 40	172.24	10/91	-23.47	7,66
COPEPOD	Eucalanus bungii	SU91	3	SA07	65.73	168.63	10/91	-21.45	a.27
COPEPOD	Eucalanus bungii	SU91	16	SC08B	6s.66	t 66.46	10/91	-20.65	
COPEPOD	Eucalanus bungii	SU91	51	SC02B	64.10	177.80	10/s1	-27.23	8.16
COPEPOD	Eucalanus bungii	SU91	77	SS07	68.34	166.89	10/91	-21.90	9.03
COPEPOD	Eucalanus bungii	SU91	81	SB02	67.22	170.34	10/91	-21.44	8.27
COPEPOD	Eucalanus bungii	SU91	85	SA03	05. s0	169.31	10/91	-20.59	8.60
COPEPOD	Eucalanus bungii	SU91	90	SA07	65,73	168.62	10/91	.22.3S	1 62
COPEPOD	Eucalanus bungii	SU91	6S	SC09	68.93	167.99	10/91	-20.67	9.06
COPEPOD	Neocalanus cristatus	SU91	1	SA07	65.73	168.63	10/91	-20.02	0.72
COPEPOD	Neocalanus cristatus	SU91	18	SC08B	68.94	168.49	10/91		12.34
COPEPOD	Neocalanus cristatus	SU91	63	SC04	60.40	172.24	10/s1	-22. 18	0.69
COPEPOD	Neocalanus cristatus	SU91	69	SC09	68.63	167.66	10191	-21.86	10.34
COPEPOD	Neocalanus cristatus	SU91	76	SS07	68.34	166.89	1 0/91	-21.62	9.s3
COPEPOD	Neocalanus cristatus	SU91	83	SS02	67.22	170.34	10/91	-21 2a	
COPEPOD	Neocalanus cristatus	SU91	93	SA07	65.73	-168.62	10/91	-18 29	
CTENOPH		SU91	: :	SF04	[illegible]	173.40	1 0/91		
EUPHAUSIID		SU91	9	SA07	65.73	168.63	10/91	-20.28	11.30
EUPHAUSIID		SU91	5s	SC02B	68.10	177.60	t0/91	-23.04	0.56
EUPHAUSIID		SU91	S6	SC02B	68.10	177.60	t 0/91	-23,06	6.93
EUPHAUSIID	Furcillia	SU91	32	SF05	71.11	175,50	10/91	-21.47	3.62
EUPHAUSIID	Furcillia	SU91	27	SF04	70.81	173.40	10/91	.21 .s4	9.19
EUPHAUSIID	Medium	SU91	11	SC08B	68.94	168.49	10/91	-20.78	11.05
EUPHAUSIID	Small	SU91	12	SC08B	68.94	168.49	1019 1	-19.64	8.50
EUPHAUSIID		SU91	13	SB07	68.34	166.89	10/91	-20,36	10.47
EUPHAUSIID		SU91	4	SA07	65.73	168.63	10/01	-21.04	10. 73
EUPHAUSIID		SU91	21	SK3A	71 15	159.95	10/91	-22.74	12.24
EUPHAUSIID		SU91	5a	SC04	60.40	172.24	10/91	-19.95	9 10

SAMPLE	DESCRIPTION	CRUISE	SAMPLE ID	STATION	LATITUDE (N)	LONGITUDE (W)	DATE (MM/YY)	DEL C13 (ppt)	DEL N15 (ppt)
EUPHAUSIID		SU91	64	SC09	68.93	167.99	10/91	-19 S7	*.12
EUPHAUSIID		SU91	79	Sso2	47.22	170.34	10/91	-19.41	8,SS
EUPHAUSIID		SU91	67	SA03	65.s0	169.31	10191	-20.76	9.19
EUPHAUSIID		SU91	92	SA07	65.73	168.52	10/91	.20.46	11.03
EUPHAUSIID		SU91	50	SC02B	6a.10	177. W	10!s1	-22,50	6S4
CEA	Large	SU91	41	SEo6	70.49	17a.46E	10/91	-18.57	12.24
MYSIDACEA		SU91	94	SA07	65.73	168.52	10/91	.22.10	12.05
MYSIDACEA		SU91	17	SC06B	68.94	1 S6.49	10/91	.20.99	11.62
SHRIMP LARVAE		SU91	s	SA07	65.73	166.42	10/91	.18. 17	9 49
SHRIMP LARVAE		SU91	1s	SC06B	68.94	168.49	1 01*1	-1s S2	10.14
SHRIMP LARVAE		SU91	22	SK3A	71.15	159.95	10!01	.20.64	11.19
SHRIMP LARVAE		SU91	: :	SF04	70.81	173.49	10/91	-22.47	10.44
SHRIMP LARVAE		SU91	33	SF08	71.11	176.50	101s1	-21,01	10.43
SHRIMP LARVAE		SU91	66	SC09	68.93	167.99	10/91	-20.67	9.91

Appendix 2. $\delta^{13}C$ and $\delta^{15}N$ values for bowhead whale tissues.

WHALE - 8681		
DATE KILLED - 27 APRIL 1986		
LOCATION - BARROW, ALASKA		
SEX - MALE		
BODY LENGTH = 8.2 m		
BALEEN LENGTH = 1.2 m		
AVERAGE DEL C13 = -18.81		
TISSUE	DEL C13 (PPt)	DEL N15 (PPt)
MUSCLE	-19.43	1S.24
BALEEN LENGTH (cm)	DEL C13 (PPt)	OEL N15 (ppt)
0.0	-18.64	
2.5	-18.50	
5.0	-18.54	
?.5	-1 S,4'4	
10,0	-1s,34	
12.5	-18.84	
15.0	-19.73	
17.5	-1 S,77	
20.0	-19.35	
22.5	-18 83	
25.0	.1 S.S3	
27.5	-19.09	
30.0	.19.02	
32.5	-1 S.95	
35,0	-19.24	
37.5	-19.53	
40,0	.19.89	
42.5	.19, 66	
45.0	-19.06	
47,5	.18.41	
50,0	.18.27	
52.5	-18.39	
55.0	-18.45	
60.0	-18.47	
65,0	-1 S.40	
70,0	-18.89	
75.0	-18.s6	
60,0	-1s.31	
85,0	-18.37	
90.0	.17. s8	
95,0	-18.41	
100,0	.1s.35	
105.0	-18.24	
110.0	-18.68	
11s.0	-18.89	
120.0	.1s.72	
125.0	-19.14	
130.0	-19.09	
13s.0	-19.02	

WHALE - 86B2		
DATE KILLED - 27 APRIL 1986		
LOCATION - BARROW, ALASKA		
SEX - MALE		
BODY LENGTH - 8.7 m		
BALEEN LENGTH - 0.52 m		
AVERAGE DEL C13 = -18.74		
AVERAGE DEL N15 = 15.82		
TISSUE	DEL C13 (ppt)	OEL N15 (ppt)
BLUBBER	-25.81	
MUSCLE	-20.10	14.S3
BALEEN LENGTH (cm)	OEL C13 (ppt)	DEL N15 (PPt)
0,0	-19.16	15.80
2 s	-1.s.s7	16.76
5.0		15.74
7.s	.18,2s	15.04
10.0	-1 S.31	15.10
12.5	-16.62	15.67
15.0	-18.46	1 5.73
17, S	-18.73	15.36
20.0	-18.51	15.64
22.s	-18.50	15.99
25.0		15.79
27.5	-18.56	16.s0
30.0	-19.01	
32.S	-19.31	15.59
33. s	-19.70	15.65
37.s	-19.80	14.79
400	-19.45	16.01
42.s	.19.5S	17.48
450	-19 48	16 6S
47.5		
50.0	-19.11	15.42
52.5		15.16
55.0	-16 16	16 24
57.s	-17.69	16.00
60.0	-17 94	15 51
62.S	-17.80	1s 05

WHALE . 66s3		
DATE KILLED - 30 APRIL 1986		
LOCATION - BARROW, ALASKA		
SEX - FEMALE		
BODY LENGTH = 8.9 m		
BALEEN LENGTH = 1.6 m		
AVERAGE DEL C13 = -19.09		
AVERAGE DEL N15 = 14.42		
TISSUE	DEL C13 (ppt)	OEL N15 (DPt)
MUSCLE	-20.56	1264
BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (PPt)
0.0	-19.32	1s.09
2.5	-16.90	14.52
5.0	-19.10	14.51
. .	-18.93	14.70
10.0	-16. 80	14.14
12. s	-20.s0	
1s.0	-22,22	12.92
17.5	.22.30	13.30
20.0	.20.77	13.94
22.s	.19.76	14.80
25.0	-1946	15.45
27.5	-19. 51	14.87
30.0	.19.67	14,32
32.5	-19.44	13.7a
3s.0	-19.60	13.9s
37.s	.20.3S	13.14
39,0	-21.14	13.13
42.5	-19.47	14.01
45.0	-18. 50	1444
47.s	-18.46	14.18
50.0	-18.61	1482
52.5	-18 6S	14,62
55.0	.18.69	14● s
57.5	-18.86	14.30
60.0	.19.09	13,49
62,S	-20.23	12.99
65,0	-19.34	14.07
67.S	-18.73	1472
70,0	-1s,61	1491
72. S	-18.92	14 59
7s.0	-18.89	13.90
60.0	-19.19	13.56
85.0	.1 S.44	13.52
900	-18.86	1422
95.0	-18.29	14 86
100,0	-18.53	150S
10s.0	.1s.65	14.18
110.0	-18.99	13.70
115.0	-18.66	13.70
120.0	-17.67	15.53
125.0	-17 so	
130.0	-17.92	14.65
135.0	-17.67	14 98
140.0	-18.04	15.49
145.0	-18.23	15.57
150.0	-18.48	15.57
155.0	-18.29	14.33
160.0	-18.10	16.27
165.0	-17 98	15.58
170.0	-18.03	15.06

WHALE - 86B4		
DATE KILLED - 1 MAY 1986		
LOCATION - BARROW, ALASKA		
SEX - MALE		
BODY LENGTH = 8.9 m		
BALEEN LENGTH = 1.3 m		
AVERAGE DEL C13 = -18.77		
AVERAGE DEL N15 = 14.68		
TISSUE	DEL C13 (ppt)	DEL N15 (PPt)

MUSCLE	-19.55	1556
BALEEN LENGTH	DEL C13	DEL N15
(cm)	(ppt)	(ppt)
0.0	-la.in	1620
2 5	-18.50	1462
5.0	-18.09	1408
7 5	-18.78	14 39
10.0	-19 62	13.97
12.5	-1994	15.22
150	-19.42	15.19
1?5	.19 3.S	14.69
20,0	-19.63	15.15
22.5	-19.70	14.72
25.0	-21.73	13.63
27.5	-22.05	12.39
30.0	-19 72	1425
32.5	.16.63	14.S7
35.0	-18.36	1475
375	-18.49	15.12
400	-18 65	14.60
425	-18 68	1391
45.0	-20,35	14 75
47.5	-20.70	
50.0	-19.54	13.27
52.5	-16.70	1479
55.0	1846	15.53
57.5	19.06	1489
60.0	-18.65	14.97
62.5	-18.70	14 12
65.0	-18.73	13.64
67.5	.16. S9	12.73
70.0	-1906	14.00
[illegible]	-18.21	
75.0	-18.06	15.15
77.5	-18.35	15.31
80.0	-18.54	14.40
82.5	-18.17	15 OS
85.0	-18.32	14 57
87.5	-18.71	13,76
90.0	-19.17	13.90
92.5	.16.76	13.65
95.0	-18.42	
97.5	-17.60	15.62
100.0	-17.50	15.56
105.0	-17.71	15.46
110.0	-17.54	15.28
115.0	-17.89	15.23
120.0	.18.73	14 2?
125.0	-18.12	1s.05
130.0	-17.65	15.16
135.0	-17,23	16.30
140.0	-17.54	16.19
145.0	-17.85	15.76
150.0	-18.58	14.19
WHALE : 8685		
DATE KILLED - 4 MAY 1986		
LOCATION - BARROW, ALASKA		
SEX - MALE		
BODY LENGTH = 8.1 m		
BALEEN LENGTH = 0.85 m		
AVERAGE DEL C13 = -18.23		
AVERAGE DEL N15 = 15.67		
TISSUE	DEL C13	DEL N15
	(ppt)	(ppt)
MUSCLE	-19.10	14.42
VISCERAL FAT	-24.42	
BALEEN LENGTH	DEL C13	DEL N15
(cm)	(ppt)	(ppt)
0.0	-18.76	17.80
2.5	-18.24	16.66
5.0	-18.07	16.22
7.5	-18.07	16.18
10.0	-18.08	15.84
12.5	-18.18	
15.0	-17.86	15.97
175	-18.01	15.68
20.0	-18.15	16.20
22.5	.18.41	16.06
25.0	-18.62	16.10
27.5	-18.59	16.08
30.0	-18.19	16.24
32.5	-18.23	16.22
35.0	-17.98	15.97
37.5	-18.08	16.40
40.0		16.06

42.5	-18.03	15.90
[illegible]	-18.06	16.26
47.5	-18.28	15.70
50.0	-18.23	15.72
52.5	-18.33	15.95
55.0	-18.27	15.68
57.5	-18.48	
60.0	-18.46	15.59
62.5	-18.73	
65.0	-18.80	15.30
67.5	-18.71	15.68
700	-18.79	15.47
72.5	.1s.84	16.42
75.0	-18.81	16.00
775	-18 70	15.82
80.0	-18.67	15.11
82.5	[illegible]	15.18
85.0	-18.11	14.82
87.5	-18.31	14.97
90.0	-17.29	14.86
02.5	-17 02	14.91
95.0	-1706	13.93
97.5	-17.20	1362
100.0		12.88
WHALE . 8686		
DATE KILLED - 5 MAY 1986		
LOCATION - BARROW, ALASKA		
SEX - FEMALE		
BODY LENGTH = 12.3 m		
BALEEN LENGTH = 2.3 m		
AVERAGE DEL C13 = -19.30		
AVERAGE DEL N15 = 13.63		
TISSUE	DEL C13	DEL N15
	(ppt)	(ppt)
MUSCLE	-19.68	12.82
MUSCLE	-19.73	13.39
MUSCLE	-19.77	13.69
VISCERAL FAT	-25.89	
BALEEN LENGTH	DEL C13	DEL N15
(cm)	(ppt)	(ppt)
0.0	-18.40	14.30
2.5	-18.37	14.16
5.0	-16.44	14.71
7.5	-18.38	14.11
10.0	-19.94	13.94
12.5	-19.95	13.47
15.0	-20S6	13.72
17.5	-19.113	13.83
20.0	.19.48	14.14
22.5	-19.79	13.76
25.0	-19.82	1405
27.5	-20.24	13.45
30.0	.1991	1203
32.5	-20.80	12.84
35.0	-19 94	1355
37.5	.19,21	13.37
40.0	-18 51	13.69
42.5	-18.73	13.64
45.0	-1a 87	13.89
47.5	-19.20	13.34
50.0	-20.19	13.13
52.5	-20.29	13.25
55.0	-19.39	13.34
57.5	.1s.s0	13.s9
50.0	-18.33	14.10
62.5	-18.46	13.23
65.0	-18.81	13.37
67.5	.19.14	1201
700	-19.26	12.52
?2.5	-19.40	12.76
75.0	-19 20	1320
77.5	-19.10	14.24
50.0	-18.96	1400
82.5		14 09
85.0	-18.60	13 61
a7.5		13.56
60.0	-16 14	13.18
92.5	-19.33	12.79
95.0	-19.25	12.93
97.5		13.77
100.0	-19.11	13.89
102.5		13.75
105.0	-18.74	13.51
107.5		13,77
110.0	-19,6a	13 2a
112.5		12.34
115.0	-1997	12 86

117.5	-18.86	14.51
120.0	-17.65	14.61
125.0	-18.33	14.16
130.0	-19.55	13.45
135.0	-19.55	12.97
140.0	-19.11	14.76
145.0	-18.42	13.97
147.5		14.70
150.0	[illegible]	13.75
155.0	-20.83	12.31
160.0	-19.02	14.01
162.5		15.56
165.0	-18.85	14.98
170.0	-19.23	13.70
[illegible]	-21.[illegible]	12.41
180.0	-20.04	13.47
185.0	-18.89	14.62
190.0	-19.01	14.08
195.0		11.29
200.0	-19.82	13.54
205.0	-18.[illegible]	14.48
210.0	[illegible]	[illegible]
215.0	-21.18	12.55
220.0	-19.81	13.24
225.0	-18.30	14.74
230.0	-20.41	13.85
235.0	-20.59	12.86
240.0	-19.45	13.99

WNALE - 86B7

DATIE KILLED - 6 MAY 1986
LOCATION - BARROW / ALASKA
SEX : MALE
BODY LIENGTH = 10.7 m
BALEEN LENGTH = 2.0 m
AVERAGE DEL (C13 = -19.07
AVERAGE DEL N15 = 13.87

TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
MUSCLE	.20.25	15.s0
MUSCLE	-19.97	
VISCERAL FAT	-24.67	

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (DDt)
0.0	-19.30	15.30
2.5	-19.22	13.61
5.0	-19.09	14.48
7.5	-19.16	14.72
10.0	-18.58	14.59
12.5	-19.21	13.87
15.0	-20.18	14.05
17.5	-20.39	13.65
20.0	-19.90	14.10
22.5	-19.83	14.57
25.0	-19.99	14.79
27.5	-19.98	13.89
30.0	-22.25	13.16
32.5	-21.95	13.30
35.0	-19.80	13.51
37.5	-19.05	13.94
40.0	-18.60	13.89
45.0	-18.59	14.47
50.0	-18.72	14.17
55.0	-19.54	13.39
60.0	-18.07	14.11
65.0	-18.79	14.10
70.0	-19.17	13.49
75.0	-19.42	12.75
80.0	-18.81	14.46
85.0	-19.02	14.31
90.0	-18.92	13.55
95.0	-19.47	12.92
100.0	-18.54	13.98
105.0	-18.49	13.59
110.0	-18.28	12.59
115.0	-18.95	12.32
120.0	-18.48	13.83
125.0	-18.00	14.97
130.0	-18.06	14.53
135.0	-18.78	13.53
140.0	-18.79	12.71
145.0	-18.38	14.59
150.0	-17.55	14.16
155.0	-17.93	14.37
160.0	-19.99	13.33
165.0	-19.05	13.01
170.0	-17.45	14.61
175.0	-17.18	
180.0	-18.78	13.53
1s5.0	-19.57	12.92
190.0	-19.23	14.12

WNALE . 86KK1

DATE KILLED - 10 SEPTEMBER 1986
LOCATION - KAKTOVIK, ALASKA
SEX . FEMALE
BODY LENGTH = 7.6 m
SALEEN LENGTH = 1.3 m for right and left plates
AVERAGE DEL C13 (RIGHT) - -19.10
AVERAGE DEL C13 (LEFT) . - l a w
AVERAGE DEL N15 (RIGHT) . 14.00
AVERAGE DEL N15 (LEFT). 14.57

TISSUE	DEL C13 (PPt)	DEL N15 (ppt)
BLUBBER	-25.99	
BLUBBER	-26.06	
BLUBBER	.26.02	
MUSCLE	-21 45	13.91
VISCERAL FAT	-27.69	
VISCERAL FAT	-26.60	
VISCERAL FA7	-27.63	

BALEEN LENGTH (em)	DEL C13 (PPt)	DEL N15 (OPt)
86KK1 RIGHT		
00	.20 5s	13.02
5.0	-20.01	14.04
10 o	-18 SS	14.17
15 o	-18.14	14.47
20.0	-19.44	13.78
2s.0	-18 7s	14.29
[illegible]		14.90
35.0	-19.51	13.67
400	-21.19	12.92
45.0	-18 66	12.26
50.0	-18.06	14.61
55.0	-18.55	14.48
50.0	.18.32	14.79
65.0	[illegible]	14.87
86KK1 LEF7		
0 0	.20.6S	13.21
5.0		13.91
10.0	-18.34	14.59
15.0	-18.07	14.28
20.0	-19.44	13.64
25.0		14.17
30.0	-18.39	14.83
35.0	-19.65	14.26
40.0	-21.54	13.27
45.0	-18.14	13.26
50,0	-1S.03	1447
550	-18.69	14.38
SOo	-18.28	12,23
65 o	-18.29	15.29
[illegible]		14.34
750	-18.69	14.S2
80.0	-18.89	14.59
85.0	-19.21	14.37
[illegible]	[illegible]	14.14
S s o	-1s.34	15.53
100.0	-1S.42	16.47
105,0	-1s.49	16.54
110.0	.18.59	16.22
115.0	-is, s7	15.92
120.0	.16.49	1S.43
125.0	-16.64	15.18
130.0	-19.30	14.77
135.0	-19.27	14.61
140.0	-19.11	14.54
146.0		14.55

WHALE - 86KK2

DATE KILLED - 17 SEPTEMBER 1986
LOCATION - KAKTOVIK, ALASKA
SEX - FEMALE
BODY LENGTH = 17.1 m
BALEEN LENGTH = 3.8 m
AVERAGE DEL C13 = -17.80
AVERAGE DEL N15 = 14.39

TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
BLUBBER	-25.35	
COLLAGEN	-16.39	
COLLAGEN	-18.48	16.06

MUSCLE	-19.01	13.80
MUSCLE	-19.05	13.90
MUSCLE	-18.96	
MUSCLE	-19.46	13.89
VISCERAL FAT	-25.02	

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-18.43	15.12
2.5	-18.45	
5.0	-18.95	
7.5	-18.15	
10.0	-18.08	15,30
12.5	-18.07	15,41
15.0	-17.35	14.66
17.5	-17.36	14.43
20.0	.18.45	15,12
22.5	-18.88	14.99
25.0	-18.38	1528
27.5	-18.09	14.80
20.0	-18.40	15.06
32.5	-18.73	14.96
26.0	-1888	14 36
37.5	-18.57	1420
40.0	-19.23	14 10
42.5	-18.10	14.36
45.0	-17.31	14 47
47.5	-18.39	1424
50.0	-18.27	14.74
52.5	-18.02	1529
55.0	-17.74	1478
57.5	-17.74	14.86
60.0	-18.83	1427
62.5	-17.97	1550
65.0	:17,44	15.26
67.5	-18.42	1546
70.0	-18.42	1480
72.5	-18.23	13.72
75.0	-19.08	1359
77.5	-17.79	13 W
20.0	-18.15	14.91
62.3	.17.94	15.05
85.0	-18.09	1440
87.5	-17 16	14.34
40.0	-17. 92	13.38
92.5	-18.77	13.36
45.0		12.88
975	-18.75	1360
100.0		14.22
102.5	-17.87	1459
105.0	-17.95	14.51
107.5	-16.22	14.44
110.0	-17.84	
112.5	-18.25	13.26
115.0	-1794	13 00
117.5	-1791	14.95
120.0	-17.66	15.11
122.5	-17.57	14 45
125.0	-17.69	1437
127.5	-17.38	1433
130.0	-18.78	1345
132.5	-1626	
135.0	-18. 90	1370
137.5		1378
140.0	-17.82	13.13
147.5	-1769	1431
150,0	-17,39	1310
152.5	.18.48	13,22
155.0	.19,46	13.21
157, s	-16.39	1345
160.0	-18.16	13.39
162, S	-16.21	16.08
165,0	.16. 96	13,36
167, S	-1701	1515
170.0	-17.01	13,75
172.5	.1s.26	1412
17s.0	-16.67	
177.5	-19.04	14,71
180.0	-17.31	15,97
182.5	-17.21	1603
185.0	-17.10	1463
187.5	-1764	14.14
190.0	-19.73	13 33
192.5	-19.33	1305
195.0	-16.25	14 49
197.5	-17.40	16.21
200,0	-1596	15.01
202.5	.17.22	15.32
205.0	-16 15	
207.5	-17.92	13.17
210.0	-1826	1406
215.0	-16.81	16.16
220.0	.1663	1407
225.0	-18.14	13.98
230.0	-17.43	15.37
235.0	-16.53	15.05
240.0	-16.67	13.63
245.0	-19.19	12.85
250.0	-17.74	15.03
255.0	-16.81	13.89
260.0	-19.05	13.46
265.0	-16.77	14.12
270.0	-17.95	15.68
275.0	-18.07	13.51
280.0	-18.23	
285.0	-16.47	11.78
290.0	-17.51	14.19
295.0	-17.89	13.50
300.0	-16.61	14.76
305.0	-17.77	13.65
310.0	-17.80	14.55
315.0	-18.96	14.14
320.0	-17.16	13.68
325.0	-16.27	15.51
330.0	-15.58	14.12
335.0	-16.24	14.18
340.0	-17.78	14.78
345.0	-16.45	16.14
350.0	-16.83	14.53
355.0	-16.23	14.74
360.0	-16.23	14.91
365.0	-15.96	14.75
370.0	-15.23	14.11
375.0	-16.04	14.21
380.0	-16.03	15.83

WHALE . 86KK3

DATE KILLED - 26 SEPTEMBER 1986
LOCATION - KAKTOVIK, ALASKA
SEX - MALE
BODY LENGTH = 10.4 m
BALEEN LENGTH = 1.9 m
AVERAGE DEL C13 = -19.30
AVERAGE DEL N15 = 14.45

TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
BLUBBER	-26.53	
COLLAGEN		14.96
COLLAGEN	-16.23	15.79
MUSCLE	-21.33	12.74
MUSCLE	-21.43	17.19
VISCERAL FAT	-26.95	
VISCERAL FAT	-26.08	

BALEEN LENGTH (cm)	DEL C13 (VPt)	DEL N15 (PPt)
0.0	.21.92	13.48
2,5	-21.86	13.00
5.0	-20.65	13.85
7.5	-19.88	14.00
10.0	-19.72	14.11
12.5	-19.73	14.28
15.0	-19.26	14.94
17.5	-19.17	14.73
20.0	-19.09	14.34
22.5	-21.41	13.53
25.0	-21.92	12.94
27.5	-20.92	12.83
30.0	-19.77	13.95
32.5	-19.20	14.86
35.0	-19.20	15.22
37.5	-19.49	14.96
40.0	-19.47	14.48
42.5	-19.57	13.98
45.0	-19.64	12.34
47. s	-20.14	13.42
50.0	-19.84	13.72
55.0	-18.56	14.81
60.0	-18.32	14.71
65.0		14.35
70.0	-19.59	13.26
75.0	-19.58	13.94
80.0	-18.75	
85.0	-18.72	14.77
90.0	-18.98	13.93
95.0	-19.29	13.46
100.0	-19.16	13.59
105.0	-18.65	15.01
110.0	-18.56	15.35
115.0	-18.15	14.19
120.0	-19.03	14.37
125.0	-19.25	

130.0	-18.76	14.27
135.0	-18.19	15.21
140.0	-18.27	15.64
145.0	-18.28	15.30
150.0	-18.32	15.63
155.0	-18.58	15.24
160.0	-18.94	15.16
165.0	-18.63	15.26
170.0	-18.46	16.23
175.0	-18.27	15.86
180.0	-18.38	15.88
185.0	-18.30	15.32
190.0	-18.46	15.54

WHALE . 86WW1

DATE KILLED - 5 MAY 1986
LOCATION - WAINWRIGHT, ALASKA
SEX - MALE
BODY LENGTH = 15.9 m
BALEEN LENGTH = 2.69 m
AVERAGE DEL C13 = -17.26
AVERAGE DEL N15 = 14.01

TISSUE	DEL C13 (PPt)	DEL N15 (PPt)
MUSCLE	-18.84	14.38
VISCERAL FAT	-24,96	
VISCERAL FAT	-24.86	

BALEEN LENGTH (cm)	DEL C13 (PPt)	OEL N15 (PPt)
0.0	-18. 3	14. 1
2.5	-18. 1	14. 4
5.0	-17. 1	14. 3
7.5	-17. 7	14 4
10.0	-17. 6	13. 10
12.5	-18. 4	13. 7
15,0	-18. 0	14, 9
17,5	-18. 4	14. 5
20.0	-18. 16	14. 1
22.5	-18, 6	14. 7
25.0	-18. 9	15. 6
27,5	-18. 6	14, 6
20,0	-19. 6	14. 6
32,5	.17, 2	12. 5
35,0	-17. 3	13. 9
37,5	-17. 8	14. 7
40.0	-17. 5	13. 9
42.5	-17, 3	14, 7
45,0	-18. 15	13. 4
47,5	-18. 8	14. 1
50.0	-17. la	12. 9
52,5	-16. 6	13. 7
55.0	-17. 0	
57.s	.17. 7	13 1
60.0	.17, 10	13. 7
62.5	-16. 4	13. 2
65.0	.17. 6	14. la
67.5	.17. 5	14. 6
70,0	-17. 6	14. 3
72.5	-17. 5	13, 5
75.0	-17. 3	13. 6
715	-la, 5	13. o
80.0	-17. 1	13. 3
82.5	-17. 2	14. 10
85.0	-17. 8	14. 1
87.5	-17. 1	12. 1
00.0	-17. 8	13. 7
42.5	-18. 2	13. 0
95.0	-17. 4	14. 7
*7.5	-17, 0	14, 6
100.0	-17. 9	14. 1
102.5	-16. 6	14 5
105.0	-17. 0	13. 3
107.5	-18. 1	14 0
110.0	-18. 2	14 7
112.5	-17. 9	14. 3
115.0	-17. 6	
117.5	-17, o	14. 4
120.0	-16. 6	13. 1
122.5	-16. 7	13. 4
125.0	-19. 10	12. 7
127.5	-16. 4	14. 1
1 30.0	-16. 13	15. 2
1 32.5	-16. 8	15. 1
135. o	-17. 1	14 9
137.5	-17. 8	14. 1
140.0	-16. 9	14. 9
1 42.5	-16. 8	13. 6
145.0	.17 0	15 7

147.5	-17.21	15.52
150.0	-17.31	14.17
152.5	-17.45	13.65
155.0	-18.14	13.95
157.5	-18.47	13.23
160.0	-17.62	12.48
162.5	-17.22	14.05
165.0	-16.99	14.30
167.5	-17.02	13.20
170.0	-17.22	13.47
172.5	-18.57	13.69
175.0	-17.62	13.19
177.5	-17.14	14.24
180.0	-17.40	13.30
185.0	-16.29	13.97
190.0	-17.24	13.80
195.0	-16.69	14.74
200.0	-16.89	13.81
205.0	-16.41	13.81
210.0	-16.89	15.22
215.0	-16.72	13.26
220.0	-17.70	12.30
225.0	-17.46	14.92
230.0	-17.57	14.59
235.0	-17.55	13.89
240.0	-18.29	13.61
245.0	-17.19	14.89
250.0	-17.33	13.16
255.0	-16.43	13.56
260.0	-17.61	
265.0	-17.42	13.94
270.0	-17.17	13.95
275.0	-17.07	
280.0	-16.50	14.92
285.0	-16.41	14.33
290.0	-18.85	13.83
295.0	-16.63	14.86
300.0	-16.92	13.40
305.0	-17.80	13.98
310.0	-16.81	14.78
315.0	-16.48	13.70

WHALE - 86WW2

DATE KILLED - 10 MAY 1986
LOCATION - WAINWRIGHT, ALASKA
SEX - FEMALE
BODY LENGTH = 17.7 m
BALEEN LENGTH = 3.1 m
AVERAGE DEL C13 = -17.73
AVERAGE DEL N15 = 14.20

TISSUE	DEL C13 (PPt)	OEL N15 (PPt)
BLUBBER	-25.77	
MUSCLE	-19 3s	13.62

BALEEN LENGTH (cm)	DEL C13 (PDt)	DEL N15 (PPt)
0.0	-1s.21	15.21
2.5	-18.15	13.63
5.0	-18.08	14.48
7.5	-17.94	14 S7
10,0	-17.76	1495
12,5	-17.34	14,S6
15,0	-17.74	1429
17.5	-17.4*	1425
20.0	-10.02	1488
22.5	-1s.s4	14.20
25,0	-18.33	13.53
27.5	-18.48	14.50
30.0	-18. so	14.77
32.5	-19.01	14.09
35.0	-19.09	13.49
37.5	- l a w	13.70
40.0	-1s.14	13.16
•2.5	-17.59	13.e 1
4s.0	-17 98	13.36
47.5	-17.80	12.S5
50.0	-18.05	14.9a
52.5	-17,78	14,34
55.0	.17.61	14.09
575	-1602	13.88
60.0	-18.26	14.23
62.5	-17.56	13.26
65.0	-17.50	14.78
67,5	-18.09	14.29
70.0	-19.19	13.80
72.5		13.33
75.0	-18.61	135S
77.5	-1?.S7	12.69

80.0	-17 72	15,27
82.5	-17.87	14.90
85.0		15.09
87.5	-17.58	13.96
90.0	-17.51	13.87
92.5	-17.87	15.20
95.0	-18.39	13.39
97.5	-17.94	12.24
[illegible]	-17.40	14.21
102.5	-17.39	14.81
1 05.0	-17 34	14.36
107.5	-17 19	13.25
110.0	-1761	13.70
112.5	-18.53	
11s0	-1704	12.45
1175	-17.91	11.68
120.0	.1749	14.61
122.5	.1753	14.14
125.0	-17.48	13.62
127.5	-18.28	13.35
130.0	-18.86	13.35
132,5	-1708	14.43
135,0	-17.56	13.08
137.5	-17.25	13.45
140.0	-1706	14.70
142.5	-16.78	1539
145.0	-17.37	1357
147 5	-18.07	13.35
150,0	-18 02	1364
152.5	-16 62	1400
1s5.0	.16.57	1595
157 5	-16.41	1495
180.0	-16 16	15.50
162.5	-16.49	13.68
165.0	-17,32	13.36
187.5	-18.10	13.29
170.0	-17.47	
172.5	.1726	15.68
175.0	-17 58	16.37
177.5	-17.77	14.90
180.0		13.42
182.5	-18.57	1409
185.0	-18.63	13.42
187.5	-[illegible].39	12.02
190.0	-18.33	12.84
192.5	-17.11	14 45
1950	-17.3a	15,42
197 5		13.67
200.0	-17,06	14 12
202.5	-18.34	1427
205.0	-17.49	15.44
207.5	-17.05	15.83
210.0	-17 03	15.25
212.5	.17.22	14.15
215.0	-16,62	14.10
217.5	-1742	13.56
220.0	-18.38	14.21
222.5	.17.51	14.54
225.0	-1734	15.26
227.5	-17.78	15.08
230.0	-17 93	14.35
232.5	-17.67	14.55
235.0	-19.55	14.06
237.5	-20.12	13.S7
240.0	-1843	15.15
242.5	-17.32	15.93
245.0	-1735	15,23
247,5	-17,45	15.86
250,0	-17.32	16.33
252.5	-16.82	13.08
255.0	-17.08	12,64
257.5	-18.34	13.62
260.0	-18.53	14.20
262.5	.17.75	14.97
265.0	-17.63	16 15
267.5	-18.03	15.90
270.0	-17.96	15.16
272.5	.18.05	12.63
275.0	-17.76	13.33
277.5	-18.26	13.51
280.0	-18.75	13.52
282.5	-17.48	12.98
285.0	-17.40	13.03
287.5	-17.57	13.08
290.0	-17.62	12.74
292.5		13.62
295.0	-18.62	14.01
297.5	-19.08	13.88
3000	-18.10	14.55
302.5		15.53
305.0	-16.38	15.24
307.5	-17.[illegible]	15.10
310.0	.17.61	14.25
312.5	.17 61	1393

k

315.0	-18.89	13.74
317.5	-19.54	13.11
320.0	-17.81	14.10
322.5	-16.86	15.14
325.0	-16.60	15.39
327.5	-16.83	14.74
330.0	-16.28	14.00
332.5	-15.96	12.85
335.0	-16.74	13.93
337.5	-17.66	14.72
340.0	-16.95	13.42
342.5	-16.89	14.13
345.0	-16.42	15.77
347.5		14.84
350.0	-16.75	13.53
352.5	-16.98	13.51
355.0	-17.91	14.08
357.5	-18.20	13.97
360.0	-18.84	14.92
362.5	-17.11	15.10
365.0	-16.46	14.34
367.5	[illegible]	[illegible]
3700	.17.61	14.75
372.5	-17.78	14.25

WHALE - 87B1

DATE KILLED - 1 MAY 1987
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 9.3 m
BALEEN LENGTH = 1.68 m
AVERAGE DEL C13 = -19.45
AVERAGE DEL N15 = 13.72

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-19.92	15.01
2.5	-19.14	15.02
5.0	-19.03	14.65
7.5		14.62
10.0	-19.03	13.54
12.5	-19.62	13.21
15.0	-21.38	12.42
17.5	-23.18	12.06
20.0	-21.52	13.35
22.5	-19.68	13.87
25.0	-19.07	13.78
27.5	-19.16	14.13
20.0	-18.78	13.91
32.5	-18.[illegible]04	13.56
35.0	-22.68	12.78
37,5	-22.14	12.30
40.0	-20.97	12.34
42.5	-19.82	13.61
45.0		14.12
47.5	-20.20	14.06
50.0	-19.53	13.79
52.5	-19.44	13.71
55.0	-19.79	13.47
57.5	-20.75	12.61
60.0	-20.35	12.70
62.5	-19.53	13.53
65.0	-18.77	13.94
67.5	-18.27	13.25
70.0		13.31
72.5	-18.05	13.98
75.0	-18.87	13.94
77.5	-19.64	13.13
80.0	-20.00	12.67
82.5	-19.77	13.08
85.0	-19.38	13.47
87.5	-18.69	14.40
90.0	-19.56	14.57
92.5	-19.70	14.35
95.0	-19.63	13.80
97.5	-18.89	13.13
100.0	-19.16	12.86
102.5	-19.51	12.85
105.0	-19.42	12.89
107.5	-19.16	13.42
110.0	-18.76	14.08
112.5	-18.65	14.60
1160	-18.75	14.50
117.5	-18.93	14.21
120.0	-18.68	13.95
122.5	-18.47	13.61
125.0	-19.13	13.48
127.5	-19.89	13.19
130.0	-1658	12.88
132.5	-19.23	12.97

135.0	-19 09	13.01
137.5	-16.55	13.4s
140.0	-18 34	14.S0
t 42, S	-18.27	14.73
14s.0	-18.31	14.61
147. s	-1832	14.99
150.0	-18 17	15.08
152,5	-18.23	15.18
t 55,0	-18.40	14.98
t 57.5	-18.55	14.95
160.0	-19.06	13.89
162.5	-19.46	13.35
165.0	-19.55	13.41
167.5	-19.60	13.59

WHALE 87B2		
DATE KILLED - 2 MAY 1987		
LOCATION - BARROW, ALASKA		
SEX - FEMALE		
BODY LENGTH = 8.9 m		
BALEEN LENGTH = 1.75 m		
AVERAGE DEL C13 = -18.50		
AVERAGE DEL N15 = 14.11		
BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-19 24	15.80
2.5	-18 42	15.62
5.0	.1976	1506
7,5	.1660	15.27
10.0	-18.49	14.71
12,3	-18.00	14.01
15.0	-18.87	1367
17.5	.16.60	13.44
20.0	-19.86	
22.3	-19.19	14.30
2s.0	-18.16	14.26
27.5	-18.11	14.91
30.0	-17.90	13.99
32.5	-17 46	13.50
35.0	-1787	13.09
37.5	-18.42	13.30
too	-19.27	14.01
42.5	.19.47	14.05
45.0	-19.12	14.34
47.5	-18.84	14.76
30.0	-19 16	14,39
52.5	-19.56	1441
55,0	-19.32	13.97
57.5	-18 63	13.87
8oo	-18.78	14.18
62.5	-19.56	13,52
65.0	-19.76	13, 19
67.5	-18.82	13.48
70.0	-16.37	13.44
72.5	-18 44	12.s0
75.0	-18 65	13.95
77.5	-18.57	13.91
80.0	.18.47	
82.5	-18.76	13.77
85.0	-19.54	12,72
87.5	.19.75	13.10
160.0	-18.85	13.77
92.5	.18.54	1437
95.0	-18.85	14.04
97.5	-18.70	13.s7
100.0	-18 36	13.18
10 2 . 5	-18.34	13.95
105.0	-16.66	13.32
107.s	.19,37	13.36
110.0	-18.89	13.49
112.5	-18.14	14.21
115.0	-18.18	14.68
117.5	-17 92	14.45
120.0	-18.16	14,62
122.5	-18.33	14.30
125.0	-18 14	14.52
127.5	-17.99	13.92
130.0	-18.57	13.29
132.5	-18.15	13.42
135.0	-18.43	13.14
137.5	-19.02	12.65
140.0	-18.89	12,90
142.5	-16.22	13.42
145.0	-17.69	14 al
147,5	-17.26	15.07
150,0	-1603	13.32
152.5	-17 16	15,64
155.0	-1728	15.23
157.5	-17.20	14.67

160.0	-17.39	14.80
162.5	-17.42	14.41
165.0	-17.51	15.36
167.5	-17.53	15.37
170.0	-17.95	14.16
172.5	-18.37	13.83
175.0	-17.92	14.13
WHALE - 87B3A		
DATE KILLED - 4 MAY 1987		
LOCATION - BARROW, ALASKA		
SEX - MALE		
BODY LENGTH = 11.0 m		
BALEEN LENGTH = 1.95 m		
AVERAGE DEL C13 = -18.99		
AVERAGE DEL N15 = 13,7S		
TISSUE	DEL C13 (PPt)	DEL N15 (PPt)
MUSCLE		13.003
BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0	-18.74	15.50
2.5	-18.88	15.04
5.0	-18.65	14.44
7.5	-18.22	13.72
10.0	-19.14	13.62
12.5	-20.05	13.35
15.0	-19.25	14.68
17.5	-18.46	15.06
20.0	-18.25	15.10
22.5	-18.18	15.04
25.0	-17.51	13.28
27,5	-17.89	13.66
30.0	-19.32	13.76
32.5	-19.52	14.23
35.0	-19.09	14.54
37.5	-19.27	14.80
40.0	-19.83	14.73
42.5	-19.81	14.17
45.0	-19.99	13.37
47.5	-20.09	13.07
50.0	-19.52	13.83
52.5	-18.94	13.97
55.0	-18.72	13.17
57.5	-1s.82	14.08
60.0	-19.24	14.22
62.5	-19.60	14.15
65.0	-21.47	12.83
67.5	-20.49	15.15
70.0	-18.89	13.71
72.5	-18.26	14.23
75.0	-18.16	14.18
77.5	-18.56	13.37
80.0	-18.80	13.49
82.5	-19.25	13.16
85.0	-19.15	12.71
87.5	-19.09	13.58
90.0	-18.73	14.23
92.5	-18.72	14.05
95.0	-18.63	13.85
97.5	-18.57	14.26
100.0	-19.20	13.46
102.5	-19.68	13.02
105.0	-19.43	12.61
107.5	-19.01	12.99
1 too	-18.81	13.74
112.5	-18.68	14.06
113.0	-18.49	13.64
117.5	-18.26	13.50
120.0	-18.99	14.62
122.5	-19.72	12.75
125.0	-19.44	12.40
127.5	-18.47	14.60
130.0	-18.09	14.52
132.5	-18.11	14.34
135.0	-18.34	14.04
137.5	-18.79	13.97
140.0	-19.16	13.29
142.5	-19.16	12.43
145.0	-18.78	12.85
147.5	-17.71	13.28
150.0	-17.66	13.92
152.5	-17.51	13.59
155.0	-18.61	14.23
157.5	.19.62	1419
160.0	-20.56	1333
162.5	-20.40	12.90
163.0	-19 74	13.08

167.5	-19.07	13.71
170.0	-17.97	13.90
172.5	-17.17	13.24
175.0	-17.40	13.27
177.5	-18.06	13.36
180.0	-19.90	13.35
182.5	-20.45	12.87
185.0	-20.80	12.88
187.5	-20.56	12.91
190.0	-20.02	13.14
192.5	-18.31	16.08
195.0	-18.69	14.88

WHALE - 87B38

DATE XII-LED -4 MAY1987
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 11.0 m
BALEEN LENGTH = 1.96 m
AVERAGE DEL C13 --19.03
AVERAGE DEL N15 = 13.65

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-19.11	15.12
2.5	-18.95	13.63
5.0	-16.77	14.00
7.5	-16.29	13.44
10.0	-19.14	13.38
12.5	-20.10	13.52
150	-20.00	13.78
17.5	-18.77	14.53
20.0	-18.40	14.95
22.5	-18.36	15.46
25.0	-17.83	13.63
27,5	-17.32	13.52
30.0	-18.95	13.59
33.5	-19.89	14.39
36.0	-19.26	14.48
37,5	-19.25	14.43
40,0	-10.76	14.86
42.5	-19.80	13,75
45,0	-20.06	13.89
47.5	-20.31	13.13
60.0	-19.87	13,43
52.5	-19.06	13.93
55.0	-18.84	13.42
57.5	-18.97	13.56
50.0	-19,33	14.17
52.5	-19.48	14.14
65.0	-21 42	12.89
67.5	-20.68	12.75
70.0	-19.16	13.65
72.5	-1630	14.39
75.0	.16.32	14 00
77.5	-16.52	13.56
80.0	-18.67	15.25
62.5	.19.33	13,06
85.0	19,47	12.67
87.5	-10.12	13.19
40.0	-18.81	14.19
92,5	-18.70	13.67
95.0	.18.70	13.83
07,5	-18.60	13.76
100.0	-19.45	13.07
102.5	-19.76	12,94
105.0	-19.45	12.60
107.5	-19.07	12.69
1 too	-18.71	13.77
112.5	-18.65	13.72
115.0	-18.41	13.54
117,5	-18.26	13.23
1 20.0	-19.13	13.23
122.5	-19.99	12.60
125.0	-19.29	12.73
127.5'	-18.34	14.27
130.0	-18.11	14.25
132.5	-18.26	14.39
135.0	-18.32	1 4.04
137.5	-18.98	
140,0	-19.26	12.66
142.5	-18.94	12.29
145.0	-1a 62	12.96
147,5	-17.60	13,29
150.0	-17,54	1400
152.5	-17.93	
155.0	-18.95	13.95
157.5	-20.15	
160.0	-20.87	13.04
162.5	-20.03	12.80

165.0	-19.39	1331
167.5	-1.s.53	1406
170.0	-1760	13.68
172.5	-17.19	12.99
175.0	.17. 72	13.25
177.5	-18.96	
180.0	-20.30	13.16
182.5	-20.38	12.35
185.0	-20.84	12.65
167.5	-20.17	1347
190.0	-16.55	
1 a2.5	-18.27	15.85
195.0	-18.75	1301
1'47.6	-18.96	13.51

WHALE - 87B4

DATE KILLED - 29 MAY 1987
LOCATION - BARROW ALASKA
SEX - FEMALE
BODY LENGTH = 116.8 m 1
BALEEN LENGTH = 2.95 m
AVERAGE DEL C13 -18.43
AVERAGE DEL N15 = 14.05

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-19 12	
2 5	-18.28	15.50
5.0	-18 49	
7 5	.16.67	1530
10.0	-18.29	14.13
12.5	.19.06	13.60
15,0	.19,5a	13.s1
17.5	-18.31	14.79
20.0	-18.07	15.04
22.5	-17.98	
25.0	-17.35	13.73
27,5	-17.70	14.22
30,0	-18.91	
32.5	-19.38	14.03
35.0	-18.96	14.92
37.5	-19.00	13.75
40.0	.19,03	14.33
42.5	-19,15	
45.0	-19, 21	
47.5	-19.88	1401
50.0	-18.93	14.23
52.5	-18.57	
55,0	-18.80	13.83
57.5	-18.86	14.30
60.0	-18.77	14.25
62.5	-1a 27	13.53
850	-18.73	13.3a
67.5	.16.3S	
70.0	.1.6.21	14.19
72.5	-18.84	14.34
75.0	-18.02	
77.5	.18.34	1357
80.0	-19.10	13.63
82.5	-18.60	14.7a
85.0	-18.38	14 68
87.5	-18.76	1474
90.0	.1.s.60	14.59
92.5	-16,2S	13.88
95.0	-19.11	13.41
97.5	-17.72	
100.0	-18.42	13.04
102.5	-18.26	
105.0	-18.40	14.34
107.5	-17.87	14 09
110.0	-17.78	
112.5	-18.89	13,32
115.0	-16.63	12.94
117.5	-18.81	
120.0	-18.06	14.39
122.5	-18.20	14,45
125,0	-18.34	13.86
127.5	-19 07	13.33
130.0	-19.10	13.15
132.5	-18.42	14. 13
135.0	-18.28	13.76
137.5	-18.38	14.0S
140.0	.16.23	14 52
142.5	-18.97	13.89
145.0	-19.77	13.50
147.5	-19.20	13.80
150.0	-18.12	15.60
155.0	-18.03	15.14
160.0	-18.74	13.90
165.0	-19.59	14.09
170.0	-17 26	14 32

175.0	-17.91	13.14
180.0	-18.41	13.32
185.0	-17.17	1410
190.0	-16.96	13.79
10s.0	-17.22	12.s2
200.0	-17.26	12.14
205.0	-16.80	14.05
210.0	-17.78	13.66
215.0	-17.81	15.27
220.0	.17.40	14.05
225.0	-17.82	14.26
230.0	-18.20	13.10
235,0	-17.79	
240.0	-19,09	13.25
245.0	.16.77	14.00
247.5	-16.62	14.11
2s0.0	-16.29	14.63
252.5	.18.11	15.34
255.0	-16.09	15,03
257.5	-16.06	13.74
260.0	-18.36	13.49
262.5	-19.09	13.62
265.0	-18.61	14.18
267.5	-18.00	14.09
270.0	-17.91	13.90
272.5	-18.06	14.38
275.0	-17.89	13.32
277.5	-19.07	13.59
280.0	-19.72	12.97
282,5	-18.65	14.30
285.0	-17.81	15.84
267.5	-18.17	15.77
290.0	-17.77	1432
292.5	-17.70	14.18
20s.0	-19.08	13.64

WHALE - 87B5		
DATE KILLED - 15 JUNE 1987		
LOCATION - BARROW ALASKA		
SEX - FEMALE		
BODY LENGTH = 15.7 m		
BALEEN LENGTH = 3.0 m		
AVERAGE DEL C13 - -18.88		
AVERAGE DEL N15 - 13.44		
BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (ppt)
0.0	-18.83	14.26
2.5	-15,71	12.65
3.0	-15,96	12.88
7.s	-18.94	14.16
10.0	.18.54	13.77
12.5	-18.97	13.19
15.0	-19.49	13,56
17. S	.16,66	13.94
20.0	.18.15	13.27
22.5	-18.09	1328
25.0	-17.25	13.29
27.5	-17.32	13.32
30.0	-18.12	13.76
32.5	-19.37	13.76
36.0	-19.76	13.56
37.5	-16.66	13,51
40.0	.16.34	14.10
42.5	.16.58	14.66
45.0	-19.05	13.44
47.5	-19.14	13.14
60.0	-19.55	13.17
62.5	-19.63	1343
55.0	.16.74	14.05
57.5	.16.33	14,21
40.0	-18.17	14.04
62.5	-18.88	14,13
66.0	-18.92	13.62
67.5	.19.24	13.23
70.0	-19.35	13.22
7 2 . 5	-19,02	13.73
75,0	-18.51	13.25
77.5	-18.56	13.24
40.0	-18.73	13.67
82.5	.1s.05	13.88
85.0	-19.17	13.64
87,5	-18.51	14,04
40.0	-16.24	14,63
92.5	-18.38	14.55
95.0	-18.26	14.40
97.5	-18.01	13.56
100.0	-18.04	13.51
102.5	-18.82	12.91
105.0	-19.10	12,76
107.5	.16.43	13.37

110.0	-18.11	13.70
112.5	-17.87	13.74
115.0	-17.95	13.89
117.5	-18.03	13.53
120.0	-18.24	13.90
122.5	-18.89	12.67
125.0	-18.38	13.39
127.5	-18.22	13.87
130.0	-18.07	13.72
132.5	-18.06	13.50
135.0	-18.03	13.76
137.5	-18.23	12.87
140.0	-18.85	12.73
142.5	-19.05	13.27
145.0	-18.27	1445
147.5	.16.16	13.69
150.0	-18.17	13.57
1512.5	.17.43	13.47
155.0	-18.50	13.13
157.5	-17.86	13.43
160.0	-19.57	12.86
162.5	-19.82	13.28
165.0	-16.24	1449
167.5	-17.67	14.92
170.0	-17.77	14.62
172.5	-17.22	13.83
175.0	-17.81	1350
177.6	-19.03	9.05
180.0	-20.43	12.46
152.5	-19.26	1347
185.0	-18.06	1446
187.5	-18.13	14 14
lee. o	-17.42	13,39
192.5	-16.62	13.05
195.0	.18.57	13 09
197.5	-19.23	12,75
200.0	-18,23	t 2.05
202.5	-17.64	12.57
205,0	-17.44	13.28
207.5	-17.01	12.97
210.0	-16.94	12.89
212.5	-17.97	12.75
215.0	-15.65	13.20
217.5	-17.9s	12.98
220.0	-1734	12.29
222.5	-17.07	13.18
225.0	-16.96	13.59
227.5	-17.02	1324
230.0	-18 11	13.50
232.5	-19.12	1382
235.0	-19.05	13,9s
237.5	-17.90	13.60
240.0	-17.40	1407
242.5	-17.17	13.21
245.0	-16.99	12.s9
247.5	-17.50	1278
250.0	-18.96	130S
252.5	-1979	1324
255.0	-18.85	1333
257.5	.16.52	13,77
257,5	.16.47	1396
260.0	-18.51	13.75
2s2. 5	-17.81	13.0S
265.0	-18.58	13.20
267.5	-19.29	12.38
270.0	-19.13	13.47
272.5	-16.54	14.0
275.0	-18.67	13.41
277.5	-1803	13.98
280.0	-18.62	1411
262.S	-1s.59	12 73
26S.0	-19.18	12.28
287.5	.20.04	1299
290.0	.19. 76	1103
292.5	.19.05	12 83
295.0	.19.63	1194
297.5	-20.28	1275
300.0	-18.25	1241

WHALE - 87B5F		
DATE KILLED - 15 JUNE 1987		
LOCATION - BARROW, ALASKA		
FETUS		
BODY LENGTH = 4.23m		
BALEEN LENGTH = 14 cm		
AVERAGE DEL C13 = -18.19		
AVERAGE DEL N15 = 13.59		
TISSUE	DEL C13 (OPt)	DEL N15 (ppt)
BLUBBER	-19 so	1402

MUSCLE	-1 S.44	1423
BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (DPl)
t.0	-18.05	1404
2.0	-18.04	14.09
3.0	-18.05	14.01
4.0	-18.07	1376
5.0	-18.07	13.85
6.0	-18.15	13.78
7.0	-18.23	13.56
8.0	-18.22	11.88
9.0	-1826	13.54
10.0	-1 S.24	13.45
110	-18.27	13.4s
12.0	-18.38	13.62
13.0	-18.10	13.67
14.0	-18.51	1362

WHALE -87B6		
DATE KILLED - 22 OCTOBER 1987		
LOCATION - BARROW, ALASKA		
SEX - LACTATING FEMALE		
BODY LENGTH = 15.7 m		
BALEEN LENGTH = 3.15 m		
AVERAGE DEL C13 = -17.97		
AVERAGE DEL N15 = 13.74		
TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
MUSCLE	-19.20	13.27
SMOOTH MUSCLE	-18.76	13.24
TENDON	-15.75	16.53
VISCERAL FAT	-23.56	
BLUBBER	-24.67	
MOUTH BLUBBER	-23.96	
BLUBBER:		
B-L1	-25,16	
B-u	-25.57	
B-L3	-24.58	
B-L4	-24.40	
B-L5	-24.58	
B-L6	-24.55	
B-L7	-24.60	
B-L8	-25.12	
B-LB	.24.54	
B-L10	-24.49	
B-W1	-23.93	
B-w2	-24.59	
B-W3	-24.58	
B-W4	-24.59	
MOUTH BLUBBER:		
BM-L1	-24.06	
BM-L2	-24.14	
BM-L3	-24.02	
BM-L4	-23.6S	
BM-L5	-24,07	
BM-L6	-24.00	
BM-L7	-23.04	
BM-L8	-24.32	
BM-L9	-24.33	
BM-L10	-24.29	
BM-W1 -	-23.80	
BM-W2	-23.63	
BM-W3	-23,75	
BM-W4	-23.76	
BM-W5	-23.97	
BM-W7	-24.12	
BM-W8	-24.02	
BM-W9	-24.00	
BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-18.05	15.38
2.5	-19.00	14.24
5.0	-19.61	13.15
7.5	-19.11	14.22
10.0	-18.02	14.66
12.5	-18.25	15.27
15.0	-17.99	14.75
17.5	-17.77	13.98
20.0	-17.80	13.83
22.5	-18.29	13.85
25.0	-18.17	14.25
27.5	-18.05	14.12
30.0	-17.62	13.65
32.5	-17.36	14.85
35.0	-17.25	1456
37.5	-17.53	14.08
40.0	-18.02	14.18
42.5		13.82
45.0	-18.31	13.45
47.5	-18.38	14.34
So. o	-18.62	14.30
52.5	-18.92	13.79
55.0	-19.10	13.74
57.5	-19.34	13.46
60.0	-18.46	13.43
62.5	.18.22	13.55
65.0	-18.31	13.87
67.S	-18.04	1387
70.0	-17.41	13.64
72,5	-18.20	13.25
75.0	-18.43	12.79
77.5	-18.19	12.61
80.0	-18.10	13.55
62.5	-18.45	1448
85.0	-18.05	14.13
87.5	.17 83	1331
60.0	-18.65	13.22
92.5	-18.51	13.78
95.0	-17.81	14.6a
97.5	-17.39	1500
100.0	-17.65	14.73
105.0	-18.34	13.34
1 too	.17.50	13.57
115.0	-1744	1451
120.0	-17.04	13,57
125.0	-16.37	11.62
130,0	-17.61	12.19
135.0	-17.07	14.44
140.0	-18.64	13.04
145.0	-17.57	13.29
150.0	-17.36	14.09
155.0	-16.98	13.70
160.0	-18.50	13.74
165.0	-17.43	14.36
170.0	-17.78	13.80
175.0	-16.82	13.49
180.0	-17.08	14.54
185.0	-17.11	13.98
190.0	-17.73	13.32
195.0	-17.52	11.97
200.0	-16.75	14.34
205.0	-16.33	12.94
210.0	-16.23	10.87
215.0	-17.53	13.77
217.5	-17.37	
220.0	-16.91	14.00
222.5	-17.27	13.75
225.0	-18.52	13.74
227.5	-18.12	12.27
230.0	-17.65	15.30
232.5	-17.73	14.80
235.0	-17.67	13.25
237.5	-18.17	14.47
240.0	-19.55	12.49
242.5	-18.85	13.71
245.0	-17.69	11.91
247.5	-17.57	14.86
250.0	-17.20	15.45
252.5	-16.76	13.49
255.0	-16.86	12.97
257.5	-17.86	12.89
260.0	-18.63	13.24
262.5	-18.52	13.53
265.0	-18.02	14.58
267.5	-17.85	15.52
270.0	-17.85	14.66
272.5	-19.30	13.36
275.0	-17.71	12.60
277.5	-18.76	13.44
280.0	-18.91	13.15
282.5	-18.23	11.85
285.0	-17.90	13.71
287.5	-18.02	13.45
290.0	-18.12	13.39
292.5	-18.65	12.62
295.0	-18.99	13 38
297.5	-18.19	14 19
300.0	-17.58	
302.5	-17.88	15.77
305.0	-17.97	14.84
307.5	-17.32	13.23
310.0	-17.83	13.01
312.5	-18.43	12.34
315.0	-18.74	12.12

WHALE -8707

DATE KILLED - 29 OCTOBER 1967
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 8.5 m
BALEEN LENGTH = 0.85 m
AVERAGE DEL C13 = -18.80
AVERAGE DEL N15 = 15.19

TISSUE	DEL C13 (PPt)	DEL N15 (PPt)
MUSCLE	-20.83	13.85
TENDON	-20.65	14.23
VISCERAL FAT	.25.50	
BLUBBER	-26.00	
BLUBBER:		
B-L1	-25.97	
B-L2	-26.09	
B-L3	-26.17	
B-L4	-26.14	
B-L5	-26.06	
B-L7	-26.58	
B-W1	-25.93	
B-W2	.26.10	
B-W3	-24.36	
B-W4	-26.15	
B-W5	-26.08	
B-W6	-26.16	
B-W7	-26.19	

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (PPt)
0.0	-1[illegible].54	15.32
2.5	-1[illegible].53	15.22
5.0	.1[illegible].47	
7.5	-1[illegible].47	14.02
10.0	-1[illegible]1.62	14.91
12.5	-1[illegible].53	15.12
15.0	-1[illegible].13	15.82
17.5	-1[illegible].85	15.98
20.0	-1[illegible].82	16.20
22.5	-1[illegible].67	16.24
2s.0	-1[illegible].61	16.23
27.5	-1[illegible].66	16.19
30.0	-1[illegible].75	16.03
32.5	-1[illegible].73	15.71
35,0	-1[illegible].86	15,06
37.5	.1[illegible].58	15.27
40.0	-1[illegible].27	15.oe
42.5	-1[illegible].46	15.06
45.0	.1[illegible].69	14.91
47.5	-1[illegible].79	14.96
50.0	-1[illegible].84	14.67
52,5	-1[illegible].12	14.52
55.0	-1[illegible].27	14,46
57.5	.1[illegible].51	14.45
60.0	-1[illegible].58	14.45
62.5	-1[illegible].24	14.60
65.0		14.79
67.5	-1[illegible].79	14.99
70.0	-1[illegible].69	14,94
72.5	-1[illegible].52	15,20
75.0	-1[illegible].91	15,56
77,5	-1[illegible].69	15.26
60.0-	-1[illegible].81	15.02
82.5	-1[illegible].62	15.17
65.0	-1[illegible].60	14.41

WHALE - 87G2

DATE KILLED - 24 APRIL1967
LOCATION - GAMBELL, ALASKA
SEX - FEMALE
BODY LENGTH = 16.8 m
BALEEN LENGTH = 3.45 m
AVERAGE DEL C13 = -18.23
AVERAGE DEL N15 = 14.20

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-1[illegible].78	14.83
2.5	-1[illegible].01	14.65
5.0	-1[illegible].06	14.63
7.5	-1[illegible].30	13.95
10.0	-1[illegible].14	13.09
12.5	-1[illegible].57	13.52
15.0	-1[illegible].56	14.07
[illegible]	[illegible]	[illegible]
20.0	-18.20	14.75
22.5	-18.00	14.90
25.0	-17.97	13.74
27.5	-18.70	13.42
30.0	-19.53	13.65
32.5	-18.78	14.32
35.0	-18.26	14.57
37.5	-18.46	14.88
40.0	-19.05	14.34
42.5	-18.86	13.71
45.0	-18.45	13.03
47.5	-18.64	13.37
50.0	-18.51	14.48
52.5	-18.09	14.69
55.0	-18.15	14.03
57.5	-18.65	13.93
60.0	-18.54	14.24
62.5	-19.08	13.91
65.0	-19.21	12.92
67.5	-18.65	14.07
70.0	-18.64	14.25
72.5	-18.94	13.38
75.0	-19.21	13.55
77.5	-19.61	13.56
80.0	-19.42	13.66
82.5	-1s 63	14.62
85.0	-18.52	15.11
87.5		13,31
90.0	-18.40	14.03
92.5	-18.50	13.79
95.0	-18.95	14.85
97.5	-19.16	1225
100.0	-18.16	13.75
102.5	-17.75	14.50
105.0	-1780	14,41
107.s	-17.65	1345
110.0	-17.96	13,44
112.5	-18.98	12.70
115.0	-18.25	1319
117.5	-17.82	13.99
120.0	-18.06	14,05
122.5	-18.19	13.70
125.0	-16.30	13.65
127.5	-18.94	13.36
130.0	.19.01	1344
132.5	.18.37	1405
135.0	-18.04	14.11
137.5	-17.88	14.10
.40.0	-1782	14.44
142.5	-17.61	14.15
14s.0	-16.34	13.65
147.5	-18.69	13.01
150.0	-18.42	14.03
152.5	-17.24	15.83
155.0	-17.01	1513
157.5	-17.32	1556
160.0	-16.90	1410
162.5	-17.97	1379
165.0	-19.27	13.22
167.5	-18.60	14.51
170.0	-17.72	1556
172.5	-17.18	1615
175.0	.17.10	1377
177,5	-16.77	1435
180.0	-18.17	1403
182.5	-18.81	13.64
185.0	-17.70	15.20
187.5	-17.08	16.01
190.0	.17.08	16.25
192.5	.17.02	1463
195.0	-17.20	13.49
197.5	-18.58	13.14
200.0	-18.59	13.96
202.5	-17.95	15.02
205.0	-17,51	15.73
207.5	-17.40	15.44
210.0	.16.94	1420
212.5	-1743	13.63
215.0	-18.90	13.87
217.5	-18.85	14.26
220.0	-17.71	13.98
222.5	-17.85	13.83
225.0	-17.99	14.10
227.5	-17.91	14.17
230.0	-19.40	13.71
232.5	-19.32	13.98
235.0	-18.27	14.81
237.5	-18.07	15.32
240.0	-18.02	15.93
242.5	-17.73	15.0:
245.0	-17.93	14.09
247.5	-18.67	13.79
250.0	-18.77	13.99
252.5	.18.51	14.76

2 s 5 0	-18	4	1531
2S7.5	-18	7	15.85
260.0	-18	8	15 29
262.5	-16	4	13 15
265.0	.18	0	13.76
2675	-18	3	14 44
270.0	.19	10	13,79
272. S	.18	la	14.41
27S.0	-17	1	1502
277.5	.17	9	15.31
280.0	.17	2	14.17
282.5	-17	3	12.93
285.0	-18	1	12.89
287.5	-18	6	1337
290.0	.18	10	13 40
2'22.5	.18	7	15.2S
295.0	.18	14	1S.S4
207.S	-18	1	15.68
300.0	-17	3	13.77
302.5	-18	8	13.91
305.0	-18	12	13.08
307.5	-19	12	13.08
310.0	-17	18	14.S9
312.S	-17	Is	15.19
31s.0	.17	la	1532
317S	.17	Is	14.29
320.0	.18	0	1401
322.5	.18	1	1372
325.0	-18	9	13.83
327.5	-18	6	1333
330.0	-17	8	13.89
332.5	-16	3	1521
335.0	-16	10	1420
337,s	-17	5	12.81
340.0	-18	9	1376
342,5	-19	4	14.56
345.0	-17	Is	14.8s

WHALE 87144

DATE KILLED - 28 MAY 1987

PE, ALASKA

= 7.8 m

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-16.46	16.34
2.5	-16.22	15.66
5.0	-17.99	16.00
7.5	-16.34	15.82
10.0	-16.31	15.73
12.5	.18,33	15.65
15.0	.1866	15.56
17.5	-16 S6	15.45
20,0	.18,37	1s 40
22.5	-16.44	15.08
25.0	-16.40	15.21
27.5	-16.45	15.09
*0. o	-18. ss	1s.34
33.s	.18 66	15.09
35.0	-18.78	15.05
37.5	-16.42	15.17
40.0-	-18.3?	1s.44
42.5	-16.16	
4s.0	.14.16	15.16
47.5	-18. s6	1s.00
50.0	-16.65	15.13
52.5	-16.86	1484
55.0	-16.57	1506
57.5	-16.51	1512
60.0	-16.32	1S.17
62.5	.17.77	15.09
65.0	.17.56	15.02
67.5	-17.94	13.89

WHALE - 87N1

DATE KILLED - 5 OCTOBER 1987
LOCATION - NUIQSUT, ALASKA
SEX - FEMALE (PREGNANT-165 cm FETUS)
BODY LENGTH = 15.2m
BALEEN LENGTH = 3.3 m
AVERAGE DEL C13 = -18.74
AVERAGE DEL N15 = 13.67
AVERAGE DEL C13 BLUBBER: A: -25.70, B: -25.6
C: -25.63, D: -25.60

TISSUE	DEL C13 (PPt)	DEL N15 (ppt)
MUSCLE-A	-21.05	12.87
MUSCLE-B	-20.s5	12.90
BA-L1	-25.76	
BA-L2	-25.64	
BA-L3	-25.91	
BA-L4	-25.82	
BA-L5	-25.69	
BA-L6	-25.69	
BA-L7	-25.84	
BA-L8	-25.69	
BA-L9	-25.60	
BA-W1	-25.66	
BA-W2	.25.54	
BA-W3	-2S,57	
BA-W4	-25.64	
BB-L1	-2S 69	
BB-L2	-25.71	
BB-L3	-25.64	
BB-L4	-25.57	
BB-L5	-25.47	
BB-L6	-25.63	
BB-L7	-2S.74	
BB-W1	-25 64	
BB-W2	-25.69	
BB-W3	-2S.86	
BB-W4	-2S.60	
BC-L1	-25.72	
C-L2.2	.25.66	
BC-L3	-25.75	
BC-L4	-25.57	
BC-L5	-25.42	
BC-L6	-25.53	
BC-L7	-25. 80	
BC-L8	-25.67	
Be-W1	-25.45	
BC-W2	-25.74	
BC-W3	-25.74	
BC-W4	-25.64	
BC-W5	-2S.69	
BC-W6	-25.68	
BD-L1	-2 5.88	
BD-L2	-25.68	
BD-L3	-25.69	
BD-L4	-25.64	
BD-L5	-25.66	
BD-L6	-24.60	
BD-L7	-25.62	
BD-L8	-25.57	
BD-L9	.2s.ss	
BD-W1	-25.68	
BD-W2	-25.67	
BD-W3	-2s.76	
BD-W4	-25.7s	
BD-W5	-25.73	

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-19.89	13.67
2.5	-19.70	13.77
5.0	-20.20	13.59
7.5	-19.11	13.98
10.0	-18.49	13.21
12.5	-18.60	13.01
15.0	-18.90	14.53
17.5	-18.14	14.42
20.0	-18.51	13.50
22.5	-20.37	13.86
25.0	-19.53	13.62
27.5	-18.33	13.91
30.0	-17.64	13.05
32.5	-17.89	13.17
35.0	-18.24	14.31
37.5	-18.11	13.95
40.0	[illegible]	14.04
42.S	-19.01	13.82
45.0	-20.02	13.59
47.5	-19.51	13.67
50.0	-18.77	13.26
52.5	-18.99	14.16
55.0	-19.62	14.92
57.5	-19.53	13.93
60.0	-19.63	14.37
62.5	-19.97	13.93
65.0	-20.13	13.62
67.5	-18.83	13.25
70.0	-18.63	13.34
72.5	-18.88	13.14
75.0	-18.80	13.49
77.5	-19.10	13.73

4 0 . 0	-16.84	14.19
82.5	-19.40	14.26
46.0	-19.17	12.63
87.5	-19.34	13.35
50.0	-16.80	13,41
92.s	-16.69	13.10
65.0	-16.47	13.42
97.5	-16.74	13.95
100.0	-16.76	13.71
102.5	-19.44	14.26
10s.0	-19.96	13,34
107.5	-19.57	13,27
110.0	-19.01	13.82
112.5	.16.77	14.89
115.0	-16.76	15.67
117.5	-19,13	13.71
120.0	.18.87	14.11
122.5	-1552	13.60
125.0	-19.64	12.60
127.5	-19.42	13,67
130.0	-19.36	12 64
132.5	-18.73	12.95
135.0	-16.36	12.64
137.5	-16.46	13.42
140.0	-16.29	13.03
142.5	-16.45	13.65
145.0	-19.04	13.85
147.5	-19.95	12.83
150.0	-16.82	12.57
155.0	.17.54	13.88
160.0	.17,54	14.05
165.0	.15.09	13.52
170.0	.16.67	13.10
175.0	-17.23	13.41
180.0	-17.69	13.43
185.0	-17.33	13.92
190.0	-19.07	13.21
195.0	-17.79	13.53
200.0	.17.11	14.97
205.0	.17.51	14.43
210.0	.15.44	13.50
215.0	-19.38	13,25
220.0	-15.67	13.03
225.0	-17.58	14,80
230.0	-17.42	13.28
235.0	-20.07	13.15
240.0	-16.70	13.31
245.0	-16.08	13.85
250.0	-17.64	14.17
255.0	-18.97	13.65
260.0	-19.11	14.06
265.0	-17.29	14.58
270.0	-17.05	14.26
275.0	.17.50	14.19
2s0.0	-19.93	13,71
285.0	-17.74	13.40
260.0	.17.35	13.28
265,0	-16.98	13,70
300,0	-19.58	14,3S
305.0	-19.74	13.30
310.0	-18.35	13.41
315.0	-17. 91	13.53
320,0	-19.39	12.79
325.0	-19.60	13.12
330.0	-19.03	13.20

WHALE 87WW2

DATE KILLED - 6 MAY 1987
LOCATION - WAINWRIGHT, ALASKA
SEX - MALE
BODY LENGTH = 13.5 m
BALEEN LENGTH = 2.15 m
AVERAGE DEL C13 = -18.90
AVERAGE DEL N15 = 13.52

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-15.55	15.25
2.5	-15.36	14.74
5.0	.15.57	15.04
7.5	-18.71	1482
10.0	-16.15	13.43
12.5	-18.83	13.99
15.0	-19.18	14.63
17.5	-10.34	1367
20.0	-18.40	14.12
22.5	-18.19	1416
25.0	-18.19	14.52
37.5	.1744	12.81
30.0	.16.13	13.28
32.5	-19 37	13 74
35.0	-19 69	t357
37.5	.1.6.72	1372
40.0	-18 97	1372
42,5	-19 44	14 46
45,0	-19.48	13.73
47.5	-16.90	13 31
50.0	-19.17	13.62
52.5	-20.16	13 47
55.0	-19.12	13 46
57.5	-16.59	13.25
60,0	.16.62	13.10
62.5	-18.87	1352
65,0	-19.20	13.48
67.5	-20.54	13.32
70.0	-20 1s	12.61
72.5	-18.90	1327
75,0	-16 33	1396
77.5	.16.23	1396
500	-18.28	13.69
82.5	.16.21	13.32
85.0	-18.28	12.85
67.5	-1910	12.27
90.0	-18.99	12.60
02.5	.18,39	13.63
95.0	-18.72	14.18
07.5	-15.S5	1412
100.0	-18.82	14 29
102.5	.16.70	13 32
105.0	-19.34	1 3 0 0
107.5	-19.47	12.82
110.0	-19. 17	12.37
112.5	-18.66	1352
115.0	-15.52	1336
117.5	-18.50	1323
120.0	-18.33	1320
122.5	-18.34	13.11
125.0	-19.36	12.72
127.5	-19.43	1221
130.0	-18.79	13.15
132,5	-18.13	14.04
135,0	-18.02	13.79
137.5	-18.09	13.69
140.0	-17.90	13.45
142,5	-19.23	12,56
145.0	-18.99	12.03
147,5	-18.98	12.72
150,0	.16.67	13.88
152.5	.18.44	1324
155,0	-18,47	13.81
157.5	-18.56	13.65
160.0	-16,57	13 06
162.5	-19.64	13 18
165.0	-20,94	12.70
167.5	-20.35	12.25
170.0	-18.60	13.13
172.5	-18.60	13.66
175.0	[illegible]	13.28
177.5	-17.63	12.96
180.0	-17 30	13 19
182.5	-18.48	13.40
185.0	-20.88	12.47
187.5	-20.05	12.66
190.0	-19.51	13.92
192.5	-18.63	14.37
195.0	-18.31	15.23
197.5	-17.58	13.62
200.0	-18.[illegible]	13.27
202.5	-19.90	12.94
205.0	-21.87	12.35
207.5	-21.43	12.41
210,0	-19.80	13.56
212.s	-18.20	1537
215.0	-18.97	15.23

WHALE - 87WW3

DATE KILLED -15 MAY 1987
LOCATION - WAINWRIGHT, ALASKA
SEX - FEMALE
BODY LENGTH = 8.2 m
BALEEN LENGTH = 0.6 m
AVERAGE DEL C13 = -18.91
AVERAGE DEL N15 = 15.41

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0,0	.16.73	1707
2.5	-14.62	16.09
5.0	-18.55	15.51
7 5	.16.61	15.74
10.0	-18.58	1664
12.5	-18.71	16 57

15.0	-18.27	16.51
17.5	-18.75	16.37
20.0	.18. s0	16.03
22.5	-18.69	15,36
2s.0	-18.37	15.12
27.5	-18,3s	15.19
30.0	-18.59	1523
32.5	-18.92	14.s5
35.0	-19.21	14.ee
37.5	.;..:55	14.64
40.0	-19.74	14.53
42.5	-19.78	14.44
45.0	-19.58	14.56
47.5	-19.21	15.14
60.0	-19.01	15.03
52.5	-18.65	14.60
55.0	-18.66	15.26
57.5	-18.42	15.40
60.0	-18.00	14.98
62.5		15.22
65,0		14.76

WHALE - 8881

DATE KILLED - 24 APRIL 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.9 m
BALEEN LENGTH = 0.88 m
AVERAGE DEL C13 = -18.56
AVERAGE DEL N15 = 15.32

TISSUE	DEL C13 (DPt)	DEL N15 (DPt)
MUSCLE	.20.16	14.55
VISCERAL FAT	-24.99	

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-18.81	16.27
2.5	-18.41	15,93
5.0	-18.43	16.00
7.5	-1 S.42	15.89
10.0	.18.35	16.08
12.5	.18.35	16.02
15.0	-18.48	15.51
17.5	.18.76	15.36
20.0	.19.13	14.26
22.5	.19. 16	14.66
25.0	-18.66	15.20
27.5	.19.01	15.20
30.0	-18.70	15.46
32.s	.18.54	15.87
35.0	-18.19	16.35
37.5	-18.21	15.61
40.0	-18.23	15.43
42.5	-18.32	15.16
45.0	-16.26	15.54
47.5	-18.18	15.31
50,0	-18.42	15,52
52.5	-18.66	15,94
55.0	-16.52	16.07
57.5	-18.31	15.81
60.0	-18.15	15.32
62.5	-18.09	15.04
65.0-	-18.19	15.23
67.S	-18.39	15.20
70.0	-18.69	15.12
72.5	.16.11	14.85
75.0	-10,36	14.57
77.5	-19.50	1416
50.0	-19.80	14.23
42.5	-19.57	14 63
05.0	-16.64	15.12
07.5	-16.72	15,00
20.0	-16.46	15.26
02.5	-1783	15.13
95.0	-1736	13.54
97.5	-1737	1453
100.0		14.12

WHALE -4382

DATE KILLED - 25 APRIL 1988
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 8.8 m

TISSUE	DEL C13 (9Dt)	DEL N15 (ppt)
MUSCLE	-19.43	14.80
VISCERAL FAT	-24.45	
AVERAGE BLUBBER	-25.65	
BLUBBER (BL2)	[illegible]	
BLUBBER (BW4)	-25.64	
BLUBBER (BW6)	-25 0[illegible]	
BLUBBER (BL4)	-25.63	
BLUBBER (BL5)	-25.6[illegible]	
BLUBBER (BL6)	-25.50	
BLUBBER (BW1)	-25.60	
BLUBBER (BW2)	-25. 5[illegible]	
BLUBBER (BW3)	-25.6[illegible]	
BLUBBER (BW5)	-25.6[illegible]	
BLUBBER (BL2)	-25.63	
BLUBBER (BL1)	-25.65	

WHALE - 8883

DA7E KILLED .25 APRIL 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 7.8 m

TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
MUSCLE	-19.24	
VISCERAL FAT	.25.2a	

WHALE - 8884

DATE KILLED - 25 APRIL 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 9.0 m
BALEEN LENGTH = 1.30 m
AVERAGE DEL C13 = -18.63
AVERAGE DEL N15 = 15.02

TISSUE	DEL C13 (ppt)	DEL N15 (PPt)
MUSCLE	-19.28	14.54
TENDON	-17.34	16.68

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-18.67	16.38
2.5	-18.40	15.45
5.0	-18.36	14.66
7.5	-18.39	14,78
too	-18.14	13.63
12.5	-18.70	14.11
15.0	-19.60	13.85
17.5	-19.92	13,65
20.0	.20.03	13.56
22.5	-19.70	14.08
25.0	.12.67	14.66
27.5	-18.42	15.56
20.0	-18.39	15 94
32.5	-18.68	15 89
35.0	-18.71	15,96
37.5	.16.60	15.62
40.0	-18.75	15.09
42.5	.18.62	15.14
45.0	-18.62	15.83
47.5	-18.87	15.36
50.0	.19.13	14.91
52.5	-18.99	15.00
55.0	-18.69	15.30
57.5	-18.26	15.71
50.0	-18.15	15.71
62.5	-18.07	15.60
65.0	-18.04	15.70
67.5	-18.08	15.23
70.0	-18.05	15.02
72.5	-18.16	15.34
75.0	-18.19	15.50
77.5	-18.17	15.32
80.0	-18.32	15.42
32.5	-18.03	15.07
85.0	-17.96	14.82
87.5	-17.98	15.51
90.0	-18.03	14.69
92.5	-18.25	15.09
95.0	-18.64	14.92
97.5	-19.04	14.57
100.0	-19.28	14.84
102.5	-19.23	14.86

105.0	-18.68	
107.5	-19.28	15.15
110.0	-19.11	14.97
112.5	-18.87	15.11
115.0	-18.39	15.23
117.5	-18.12	15.04
120.0	-17.96	14.76
122.5	-17.89	14.72
125.0	-17.94	14.79
127.S	-18.12	14.03
130.0	-18.56	13.70

WHALE-8885

DATS . 25 APRIL 1S42
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 8.9 m

TISSUE	DEL C13 (ppt)	OEL N15 (ppt)
MUSCLE	-19.43	13.80

WHALE-8886

OATS KILLED - 2 MAY 1s26
LOCATION - BARROW, AK
SEX . FEMALE
BODY LENGTH = 8.3 m

TISSUE	DEL C13 (ppt)	DEL N15 (PPt)
LIVER	-19.82	16.25
VISCERAL FAT (RENAL)	-25.69	
VISCERAL FAT (CARDIAC	-25.34	
VISCERAL FAT (CARDIAC	-25.18	
MUSCLE	-19.97	14.30
MUSCLE	-19.91	
TENDON	-19.49	16.54

WNALE - 8887

DATE KILLED - 5 MAY 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.2 m
BALEEN LENGTH = 0.78 m
AVERAGE DEL C13 = -18.86
AVERAGE DEL N15 = 14.91

TISSUE	DEL C13 (PPt)	DEL N15 (PPt)
MUSCLE	.20.30	14 43
VISCERAL FAT (RENAL)	-25.71	
LIVER	-21.11	16.23
TENDON	-19.72	15 91

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-19.14	16.01
2.s	-18.83	15.73
5.0	-16,60	15.98
7.5	-18.66	16.07
10.0	.12.S3	15.44
12.*		
15.0	-16.46	14.[illegible]
17.5	.18,47	14.68
20.0	-18.54	14.287
22.5	-18.48	14,74
25.0	-18.46	14.95
27.S	-18.60	14.79
30.0	-19.14	15.00
32.5	-19.46	14.92
35.0	-19.59	14.93
37.5	-19.79	14.29
40.0	-19.82	14.50
42.5	-19.74	14.72
45.0	-19.79	14.39
47.5	-19.77	14.79
50.0	-19.97	14.68
52.5	-19.75	14.78
55.0	-19.37	14.44
57.5	-19.01	15.14
60.0	-18.52	15.13
62.5	-17.86	16.05
65.0	-17.64	15.59
67.5	-17.65	15.60
70.0	-17.96	14.85
72.5	-18.08	14.38
75.0	-18.25	13.78
77.5	-18.56	14.78

WNALE - 8888

DATE KILLED - 6 MAY 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 7.5 m
BALEEN LENGTH = 1.3 m
AVERAGE DEL C13 = -18.67
AVERAGE DEL N15 = 15.42

TISSUE	DEL C13 (ppt)	DEL N15 (PPt)
MUSCLE	-19.52	13.97
VISCERAL FAT (RENAL)	-25.49	
LIVER	-20.22	15.20
TENDON	-18.66	16.90
VISCERAL FAT (CARDIAC	-21.44	

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL NIS (ppt)
0.0	-18.69	15.39
2.5	-18.30	14 87
5.0	-18.16	14.83
7.5	-18.22	1293
10.0	-18.44	13,0'2
12.5	-19.51	1346
15.0	-20.21	13.09
17.5	-20.38	13,56
20.0	-19.03	1s.2s
22.5	-18.61	15.88
25.0	-18.89	15.93
27.S	-11s.92	1s.33
30.0	-19.92	13.67
32.S	-20.27	13.82
3s.0	-21.37	13.20
37.s	-20.20	13.62
40.0	-18.68	15.29
42.5	-1?.70	1S.32
45.0	-17.81	14.9s
47.5	-18.15	1s,50
50.0	-la. 20	16.49
S2.5	-18.12	16.06
55.0	-1s.03	1S27
57. s	.1s.1s	15.54
60.0	.18. s1	1620
62.S	-18.98	1s.70
65.0	-19.23	15.82
67.s	.19.09	15 58
70.0	-18.95	1613
72.5	-18.37	1679
75.0	-18.32	1712
77.5	-1S .26	1699
60.0	-18.27	1669
82.5	-16.2s.	1664
85.0	.18. ss	16.34
87,5	-16. S0	16.02
90.0	-18.84	16.74
92.s	-18.73	16.03
95.0	-16 S4	15.51
97.5	-18.46	15.72
100.0	-18.30	15.41
102.5	-18.45	15.50
105.0	-18.46	15.56
107.5	-18.17	15.78
110.0	-18.30	15.98
112.5	-18.63	16.25
115.0	-19.18	16.16
117.5	-18.70	16.44
120.0	-18.20	15.45
122.5	-17.70	14.66
125.0	-17.50	14.95
127.5	-17.77	15.25
130.0	-17,7S	14.79

WHALE - 55ss

EPTEMBER 1988
BARROW, ALASKA
TL - 14.6 m
2.53 m
= -18.64

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
	-19.62	13.27
	-19.55	13.02
	-19.78	12.96
7.5	-18.95	14.08
10.0	-18.44	14.29
12.5	-18.47	13.75
15.0	-18.31	12.16
17.5	-19.02	13.50
20.0	-19.63	13.71
22.5	-18.87	14.31
25.0	-18.22	14.50
27.5	-18.28	14.49
30.0	-18.33	13.37
32.5	-18.28	13.00
35.0	-19.31	13.27
37.5	-19.62	13.82
40.0	-18.66	14.40
42.5	-18.30	14.42
45.0	-18.19	13.88
47.5	-17.74	13.63
50.0	-18.17	14.13
52.5	-19.91	13.97
55.0	-19.31	14.04
57.5	-18.93	14.05
60.0	-19.11	14.08
62.5	-19.34	11.41
65.0	-19.36	13.59
67.5	-19.98	13.28
70.0	-19.06	13.74
72.5	-18.55	13.58
75.0	-18.65	13.70
77.5	-18.96	13.95
80.0		14.02
82.5	-19.24	13.86
85.0	-19.26	13.31
87.5	-20.11	13.92
90.0	-18.23	14.24
92.5	-18.18	13.89
95.0	-18.14	13.43
97.5	-18.10	13.41
100.0	-18.76	13.08
102.5	-18.94	13.30
105.0	-18.60	13.86
107.5	-18.48	13.93
110.0	-18.44	13.92
112.5	-18.33	13.60
115.0	-19.01	13.62
117.5	-19.65	13.27
120.0	-18.99	13.14
122.5	-18.54	14.07
125.0	-18.41	13.97
127.5	-18.33	13.94
130.0		13.23
132.5	-18.11	13.46
135.0	-19.10	13.25
137.5	-18.41	14.22
140.0	-18.27	14.33
142.5	[illegible]	14.08
145.0	-18.36	13.97
147.5	-18.76	13.74
150.0	.19.12	13.30
155.0	-18.69	13.92
160.0	.1s.43	13.91
165.0	-18.34	
170.0	-19.65	13.12
175.0	-17.84	14.68
180.0	-17.27	14.06
185.0	-19.72	13.43
187.5	-19.14	13.92
190.0	-17.84	15.14
195.0	-17.59	14.04
200.0	-17.87	13.89
205.0	-18.27	13.86
210.0	-17.32	12.88
212.5	-17.27	13.74
215.0	-17.07	12.87
420.0	-19.28	13.42
225.0	-17.36	14.91
230.0	-17.17	13.7a
235.0	-18.60	13.62
240.0	-18.18	14.95
245.0	-18.06	14.07
250.0	-18.17	
252,5	-20.01	13.20

WHALE - 88810		
DATE KILLED - 17 SEPTEMBER 1988		
LOCATION - BARROW, ALASKA		
SEX - MALE		

BODY LENGTH = 15.1 m		
BALEEN LENGTH = 3.28 m		
AVERAGE DEL C13 = -18.74		
AVERAGE DEL N15 = 15.32		

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-19.50	14.08
2.5	-19.50	13.04
5.0	-19.43	13.18
7.5	-18.67	13.96
10.0	-18.52	13.60
12.5	-18.62	13.78
15.0	-18.58	13.75
17.5	-19.30	13.36
20.0	-19.80	13.53
22.5	-18.87	14.01
25.0	-18.57	14.11
27.5	-18.49	13.98
30.0	-18.38	13.32
32.5	-18.88	13.46
35.0	-20.29	13.88
37.5	-19.17	14.07
40.0	-18.30	14.10
42.5	-18.35	13.97
45.0	-18.02	13.78
47.5	-17.44	13.40
50.0	-18.58	13.67
52.5	-19.95	13.85
55.0	-19.12	14.22
57.5	-18.96	14.17
60.0	-19.17	14.00
62.5	-19.35	13.79
65.0	-19.72	13.46
67.5	-20.30	13.25
70.0	-19.67	13.59
72.5	-18.63	14.13
75.0	-18.66	13.76
77.5	-18.86	13.91
80.0	-18.83	13.96
82.5	-19.03	13.72
85.0	-19.29	12.83
87.5	-18.96	13.70
90.0	-18.50	14.57
92.5	-18.56	14.05
95.0	-18.77	
97.5	-18.66	13.30
100.0	-19.40	13.18
102.5	-19.19	13.08
105.0	-18.72	14.39
107.5	-18.58	14.66
110.0	-18.71	14.10
112.5	-18.78	13.97
115.0	-18.90	13.77
117.5	-19.38	13.47
120.0	-19.39	12.70
122.5	-18.73	13.86
125.0	-18.35	14.29
127.5	-18.40	14.38
130.0	-18.41	14.02
132.5	[illegible]	[illegible]
135.0	-19.34	13.38
137.5	-19.08	13.32
140.0	-18.43	14.33
142.5	-18.41	14.53
145.0	-18.66	14.37
147.5	-18.71	14.14
150.0	-18.72	13.82
152.5	-19.45	12.84
155.0	-19.38	13.45
157.5	-18.55	14.59
160.0	-18.38	14.68
162.5	-18.60	14.33
165.0	-18.61	14.12
167.5	-18.72	13.81
170.0	-19.79	13.17
172.5	-19.39	13.10
175.0	-18.08	14.91
177.5	-17.84	15.18
180.0	-18.30	14.56
182.5	-17.97	14.34
185.0	-18.64	13.86
187.5	-19.92	13.21
190.0	-19.43	13.77
192.5	-18.14	15.27
195.0	-17.95	15.26
197.5	-18.18	14.45
200.0	-17.68	13.85
202.5	-19.36	12.56
205.0	-19.77	13.36
207.5	-18.19	14.92
210.0	-17.82	15.01
212.5	-17.86	14.51

215.0	-17.66	13.91
217.5	-17.32	13.57
220.0	-19.52	13.60
222.5	-19.51	13.96
225.0	-17.76	15.48
227.5	-17.26	15.38
230.0	[illegible]	14.80
232.5	-17.15	13.91
235.0	-17.34	13.80
237.5	-18.69	13.82
240.0	-18.99	14 [illegible]
242.5	.18.00	14
245.0	-18.13	14
247.5	.18.22	14
250,0	-18.16	14
252,5	-17.5s	14
255,0	-19.58	13
257.S	-19. 83	13
260.0		14
262,5	-18.44	14
265.0	-18.80	14
267.5	-18.27	13
270,0	-18. 91	13
272.5	.19,32	12
275.0	-19.56	13
277.5	-18.41	14
280.0	-18.30	14
282.5	-18.32	14
285.0	-18,37	14
287.5	-18.24	13
290.0	-18,39	13
292.3		
245.0	-19.19	13
297.5		14.[illegible]
30[illegible].0	-18.33	13.75
30[illegible].5	-18.34	13.15
30[illegible].0	-18.34	12.65
30[illegible].5	-19.51	12.53
31[illegible].0	-19.04	11.47
31[illegible].5	-18.13	13.50
31[illegible].0	-17.87	13.86
31[illegible].5	-18.07	13.15
32[illegible].0	-18.33	13.05
32[illegible].5	-17.97	12.83
32[illegible].0	-18.42	12.93
32[illegible].5	-18.73	12.79

WHALE -64611

DATE KILLED - 17 SEPTEMBER 1988
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 15.6 m
BALEEN LENGTH = 3.2 m
AVERAGE DEL C13 = -18.17
AVERAGE DEL N15 = 14.41

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (PPt)
0.0	-19.[illegible]	13.73
2.5	-19.30	13.03
	1.34	12.95
7.5	-19.45	13.48
10.0	-18.11	15.19
12.5	-18.20	14.35
15.0	-18.02	13.98
17.5	-17.53	13.47
20.0	-18.63	14.54
22.5	-19.93	14.03
25.0	-19.04	15.04
27.5	-18.96	15.10
30.0	-18.77	14.50
32.5	-19.22	14.28
35.0		13.90
37.5	-19.20	14.41
40.0	-18.25	15.22
42.5	-18.29	15.15
45.0	-18.12	15.18
47.[illegible]	-17.[illegible]	14.25
50.0	-18.10	14.21
52.5		14.38
55.0	-19.15	14.74
57.5	-18.69	14.87
60.0	-18.75	14.80
62.5	-18.98	14.33
65.0	-19.22	13.23
67.5	-18.33	13.15
70.0	-19.06	13.90
72.5	-18.64	14.62
75.0	-18.21	14.45
77.5	-18.24	13.85
40.0	.15..14	14 11

82.5	-18.01	14 52
85.0	-18.23	13.52
67,5	-19 12	1366
900	-18.42	14 S5
92.5	-1828	1408
05.0	-16.56	1343
97.5	-18.88	13.60
100,0	-19.37	13.48
102,5	-19.19	1410
105,0	.18.74	14.37
107.5	-18.54	15.02
1 10.0	.1 S.76	14.98
112. s	.10..37	14.47
115.0	-18 61	14.32
117. s	.19.20	13.36
120,0	-19.13	13.39
122.5	-18.36	14.58
125,0	-17 94	14.80
127.5	-18.03	14.60
130,0	-17.99	1405
132.5	-18.33	13.74
13s.0	-18.92	12.89
137.5	-18.06	14.18
140.0	.17.29	15.20
1 42.5	-17.26	14.74
145.0	-17 31	14.76
147,5	.17.29	14.20
150.0	-18.03	14.57
152. S	-18.62	14.56
155.0	-18.04	14.03
157.s	-17,54	14.94
160.0	-17 4a	14.92
162.5	-17.24	14.60
165.0	.1a 61	13.66
167.5		
170.0	-19.62	1351
172,5	-18.23	15S3
175,0	-17 66	15.66
177.5	-17 81	14.32
180.0	-17 70	14.29
182.5		
185.0	-18.93	14,19
187.5		
190.0	-17.59	18.44
192.5	-17.89	16.68
195,0	-18.08	15.85
197.5	-17.62	14 89
200,0	-16.23	14,34
202.5	-18 86	13.98
205.0	-17 84	1502
207.5	-17.11	16.10
210,0	-17.07	1607
212.5		
215.0	-16.83	13.62
217.5		
220,0	-18.51	14.02
222.5	-1808	15.26
225.0	.17.3!	15.74
227,5	-16.90	15.74
230.0	-16.84	14,71
232,5	-17.41	14.27
235.0	.1 S.03	1398
237.5	-17.46	1523
240.0	-17.36	16.26
242.S	-17.22	1654
245.0	-17.37	15.50
247.5	-17.17	1434
260.0	-17.96	13.90
232.5	-18.92	14,03
255.0	-18.42	15,37
257.5	-18.20	1540
360.0	-17.45	1540
262.5	-16.10	14 49
265.0		
267.5	.10.20	13.60
270.0	-19.07	13.76
272.5	-18 10	15.26
275.0	-17.96	15.51
277.5	-18.16	1600
280.0	-16.02	1439
282.5	-1789	13,47
265.0	-1803	13.33
287.5		
290.0	-18.34	14.41
292.5	-17 56	15.53
245.0	-17 66	1467
247a	-17.50	13 45
300.0	.17.66	12.86
302.5	.18.75	13.93
305.0		13.78
30?.5	-16.26	13.3a
310.0	-s7 4a	14.28
312.5		
315.0	-17 59	13 4a

317.5		
320.0	-18.66	12.78
325.0	-17.10	
327.5	-17.25	14.68
330.0	-17.31	14.22
332.5	-16.22	12.54
335.0	-16.86	13.05
337.5	-18.32	13.79
340.0	-19.08	13.57

WHALE - 88G1

DATE KILLED - 16 APRIL 1988
LOCATION - GAMBELL, ALASKA
SEX - FEMALE
BODY LENGTH = 15.7 m
BALEEN LENGTH = 2.95 m
AVERAGE DEL C13 = -18.44
AVERAGE DEL N15 = 13.83

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (DPt)
0.0	-18.47	13.91
2.5	-18.27	13.33
5.0	-10.16	12.59
7.s	-18 15	12.50
10.0	-18.72	12.99
12.5	-18 82	13.26
15.0	-19.70	13,2S
17.5	-1939	12.95
20.0	-18.22	
22.5	-18.39	13.37
25.0	.18,.46	13 92
27.5	-18.27	13.56
30.0	-18.26	
32.5	.18.28	13.12
35.0	.18.34	13.S3
37.5	-18.18	15.09
40.0	-17 93	14.05
42.5	-17.01	13.39
45.0	-16,63	13.09
47.5	-18.29	13.48
50. o	-19,72	13.46
52.5	-18.87	14.61
55.0	-19.21	14.53
57.5	-19.45	14.82
60.0	-19.57	12.54
62.5	-18.28	12.00
65.0	-19.95	13.28
67.5	-18.99	13.86
70.0	-18.61	13.29
72.5	-18.60	13.08
75.0	-18.86	13.55
77.5	-18.87	13.90
80.0	-19.18	14.22
82.5	-19.46	13.07
85.0	-18.71	14.42
87.5	-18.04	14.55
90.0	-18.48	14.26
92,5	-18.73	13.85
95.0	-18.28	13.26
97.5	-18.31	13.05
100.0	-19.45	12.84
102.5	-19.10	13.15
10s.0	.1s.57	15.26
107.s	-18.40	14.67
110.0	-18.65	14.86
112.5	-17.52	14.40
115.0	-18.74	13.S2
117.5	-19.29	12.71
120.0	.19.29	12.40
122a	-18.48	13.16
125.0	-14.90	13.72
127.5	-15.75	13.39
130.0	-18 451	13.05
132.5	-19.61	
135.0	-19.58	12.66
137.5	-18.25	13.66
140.0	-18.09	14.25
142.5	-18.08	14,00
145.0	-18 19	14.46
147,5	-18.16	13.93
150,0	-19.12	13.38
152.5	-19.34	13.01
15s. o	-18 73	13.97
157.s	-17 97	14.79
160.0	-17 84	14.42
162.5	-17.99	14.58
165,0	-17.59	13.84
167.5	-18.45	13.60
170.0	-20.14	13.11
175.0	-18 06	14.62
180.0	-18.01	11.90
185.0	-17.73	13.84
190.0	-19.32	13.20
195.0	-17..57	16.05
200.0	-17.65	15.24
205.0	-20.56	13.10
210.0	-17.61	15.45
215.0	-17.02	15.62
220.0	-17.00	12.95
225.0	-19.12	13.01
227,5	.18.50	14.26
230,0	-17 15	16.16
232.5	-17.12	15.82
235.0	.17.46	14.25
237.5	-16.60	13.08
240.0	.17.38	14.49
242.5	.1.5.96	14.28
245.0	-18.08	14.28
247.5	.17.45	1s.5!
250.0	.17 3a	16.1 1
252.5	-17.37	15.94
255.0	.1?.32	
257.S	-16.95	13.42
2s0.0	-19.17	13.25
262.5	-19.75	
265.0	-18.13	15.2a
267.5	.17.77	15.37
270.0	-18.50	13.63
272,5	-18.21	13.46
275.0	-18.74	13.36
277.5	-19.49	12.70
280.0	-10.3s	12.84
282.5	-18.63	13.85
265.0	-18.20	
287.5	-18.15	14.70
290.0	-1 S.26	14.67
2S2.5	-17.84	
295.0	-18.71	12.81

WHALE -4622

DATE KILLED - 25 APRIL 1988
LOCATION - GAMBELL, ALASKA
SEX - FEMALE
BODY LENGTH = 15.3 m
BALEEN LENGTH = 2.75 m
AVERAGE DEL C13 = -18.41
AVERAGE DEL N15 = 14.34

TISSUE	DEL C13 (ppt)	DEL N15 (ppt)
MUSCLE	-10.06	13.90

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-18 49	14.95
2.5	-18.26	14 2S
5.0	-18.04	14.44
7.5	.17.95	14.49
10.0	-18.17	14.07
12.5	-18.27	1426
15.0	-19.28	14.09
17.5	-18.89	14.66
20.0	-18.47	15.04
22.5	-18.55	15.27
25.0	-18.34	15.13
27,5	-18.18	14.57
30.0	-18.51	1s.22
22.5	-19.05	14.95
35.0	-18.91	14.73
37a	.18.20	14.42
40.0	-17.87	14.63
42.5	-17.40	13.69
45.0	-17.27	13.51
47,5	-17.43	13.6a
60,0	-19.05	14.11
52,5	-19.30	14.28
56,0	-18.88	14.23
57.5	-18.98	14.83
50.0	-19.39	14.60
62.5	-19.18	14.08
65.0	-19.19	14.0*
67,5	-19.66	13.92
70.0	-19.34	14.2a
72.5	-18.30	15.17
75.0	-17.94	14.68
77.5	-18.48	
80.0	-18.66	14.04
82.5	-16 6a	14 20
520	-19.70	%4 .62
87.5	-19 41	14.06

90.0	-18.35	14 33
92.5	-18.04	13.95
95.0	-18.12	14.57
97.5	-18.23	14.24
100.0	-18.43	13.s5
105.0	-19.16	13.22
110.0	-18.17	15,53
115.0	-18.54	14.00
120.0	-19.17	13.62
12s.0	-18.65	13.57
130.0	.1777	14.S4
135.0	-17.92	13.95
140.0	-19,34	13.10
145.0	-18.31	1409
150.0	-17.78	14.20
155.0	-17.65	14 36
160.0	-19.96	13.29
165.0	.18.21	14.40
170.0	-17 41	14.67
175.0	.17.08	14.15
t 77.5	[illegible]	14.33
180.0	-19.50	13 16
182.5	-19.47	13.35
185.0	-18.28	14.79
187.5	-17.16	15.58
190.0	-17.06	1466
192.5	-16.97	13.55
195.0	-17.11	14.12
197.5	-18.19	14.72
200.0	-18.93	14.09
202.5	-18.54	14.93
205.0	.17 84	16.13
207,5	-17.78	1622
210.0	-17.40	14.59
212.5	-17.42	14.33
215.0	.19.59	13.51
217.5	-19.60	13.46
220.0	-18.97	14 02
222.s	.17. *3	15.54
225.0	-17.61	16 00
227.5	-17.69	15,21
230.0	-17.29	13.64
232.5	-17.94	14.07
235.0	.20.72	12.62
237.5	-19.76	13.76
240.0	-18.26	15.29
242.5	-17.44	15.15
245.0	-17.36	15.19
247.5	-17.23	14.23
250.0	-17.61	14.23
252.5	-19.23	14.30
255.0	-19.40	14.07
257.5	-18.63	14.54
260.0	-17.90	15.02
262.5	[illegible]	[illegible]
265.0	-17.00	13.59
267.5	-16.90	13.62
270.0	-18.47	13.92
272.5	-21.09	12.87
275.0	-20.24	13.55

WHALE - 88MKK1

DATE KILLED : 2[illegible] SEPTEMBER 1[illegible]

LOCATION : IKAKTOVIK ALASKA

SEX - FEMALE

BODY LENGTH = 14.9 m

BALEEN/LENGTH = 2.97 m

AVERAGE DEL C13 = -19.61

AVERAGE DEL N15 = 13.52

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-19. 32	
2.5	-18.92	12.76
5.0	.10.45	12.74
7,5	-18.61	12.9s
10,0	-18.57	13.76
12.5	-1 S,72	14.28
15.0	-16.62	13 S4
17.5	-19.38	13.33
20.0	-20.41	12.64
22. s	.19.53	13.s5
25.0	-18.97	14.30
27.5	-18. S0	13.92
30.0	-18.88	14.24
32.s	-18.47	13.76
35.0	-16,63	13.74
37.5	-19.06	13.97
40.0	-19.15	14 06
42.5	.18.75	13.82
4s.0	-18.59	13.63
47,5	.1 S,50	1409
50.0	-18 40	14.15
52.5	.1s04	13.ss
5s.0	-19 09	13.06
57.5	.19.46	13.66
60.0	-167$	14 04
62.5	-16.98	14 01
6S.0	-16.57	14,21
67.5	-10.02	14.43
70.0	-192s	13.s4
72.5	-19.55	13.30
75.0	-19.94	[illegible]
77.5	-19.50	13.12
80.0	-18.42	13.09
82.5	-18.76	12.69
85.0	-18.97	13.59
67.S	-18.75	13.89
90.0	-19.04	13.84
92.5	-20.20	13.39
95.0	-19.56	13.31
97.5	-18.59	13.09
100.0	-17.65	12.88
102.5	-18.48	13.27
105.0	-18.47	13.24
107.5	-18.75	13.32
110.0	-19.21	13.23
112.5	-19.24	12.66
115.0	-18.60	13.60
117.5	-18.51	14.53
120.0	-18.64	14.71
122.5	-18.54	14.27
125.0	-18.45	13.77
127.5	-19.08	13.31
130.0	-19.25	13.01
132.5	-19.18	12.54
135.0	-18.60	13.32
137.5	-18.09	14.05
140.0	-18.07	13.80
142.5	-17.99	13.54
145.0	-18.27	13.54
147.5	-19.22	12.39
150.0	-19.26	12.57
152.5	-18.51	13.36
155.0	-17.94	14.01
157.5	-18.08	13.94
160.0	-17.67	13.79
162.5	-17.31	13.84
165.0	-18.14	13.46
167.5	-18.25	12.82
170.0	-18.68	12.47
172.5	-18.59	13.28
175.0	-18.33	13.08
177.5	-18.44	13.76
180.0	-18.40	14.03
182.5	-17.98	13.69
185.0	-18.78	13.89
187.5	-20.12	13.06
190.0	-19.88	12.93
192.5	-18.96	13.23
195.0	-17.96	14.10
197.5	-18.00	14.68
200.0	-18.34	14.47
202.5	-18.30	13.87
205.0	-18.67	13.55
207.5	-19.58	12.95
210.0	-19.91	13.02
212.5	-18.62	14.66
215.0	-17.91	15.69
217.5	-18.10	15.26
220.0	-18.40	14.30
222.5	-18.28	14.07
225.0	-19.40	13.62
227.5	-19.31	13.33
230.0	-18.90	13.55
232.5	-17.84	14.14
235.0	-17.95	14.71
237.5	-17.83	14.39
240.0	-17.37	13.59
242.5	-18.63	13.46
245.0	-19.76	13.20
247.5	-19.25	13.14
250.0	-17.89	13.07
252.5	-17.30	13.61
255.0	-17.41	14.18
257.5	-17.32	14.06
260.0	-17.57	13.71
262.5	-18.18	13.57
265.0	-19.47	13.44
267.5	-19.07	14.34
270.0	-18.07	15.23
272.5	-17.92	14.69
275.0	-17.89	14.12
277.5	[illegible]	[illegible]
280.0	.175S	13.30

282.5	-1 1 6	13 12
285.0	-1 82	1294
287.5	-1 .63	1337
290.0	-1 90	1383
292.5	-1 79	14 82
295.0	-1 64	
297.5	-1 3 5	1303
300.0	-1 61	
302.5	-1 1.s9	11S7
305.0	-1 48	12.25
307.5	-1 14	1349
310.0	-1 97	1320
312.5	-1 8 9	1434
315.0	-1 2 0	14 12
317.5	-1 0 6	1234
320.0	-1 .74	12.78
322.5	-1 1.99	12.25

WHALE - 88WW1

DATE KILLED - 25 APRIL 1988
LOCATION - WAINWRIGHT, ALASKA
SEX - FEMALE
BODY LENGTH = 7.9 m
BALEEN LENGTH = 0.77 m
AVERAGE DEL C13 = -18 27
AVERAGE DEL N15 = 15.45

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-18.71	1639
2.5	-18.42	1634
5.0	-17.99	1804
7.5	-17.96	15 47
10.0	-17 94	15.11
12.5	-18.02	15.03
15.9	-18.04	150a
17.5	-18.03	1543
20,0	-18.02	15.16
22,5	-18.01	1509
25.0	-18.06	1502
27.5	-18.03	15 00
20.0	-18.16	1545
32.5	-18 45	1557
35,0	-18.58	1563
37.5	-18.58	15.63
40.0	-18 63	1561
42.5	-18 69	1541
45.0	-18.65	1522
47. 5	-1909	15.13
60.0	-19 40	15 15
52.5	-19.47	1486
55.0	-18.97	15 18
57.5	-18.34	
60.0	-17.82	1569
62.5	-17 50	1600
65.0	-17 34	16 10
67.5	-17 35	1556
70.0	-17.82	
72,5	-18 06	1521
75.0	-18.15	1530

WHALE - 88WW2

DATE KILLED - 26 APRIL 1988
LOCATION - WAINWRIGHT, ALASKA
SEX - MALE
BODY LENGTH = 9.1 m
BALEEN LENGTH = 0.98 m
AVERAGE DEL C13 = -18.91
AVERAGE DEL N15 = 14.91

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-1 03	1 67
2.5	-1 4 6	1 72
5.0	-1 S.34	1 53
7.5	-1 .39	1 13
10.0	-1 .40	1 72
12.5	-1 .22	1 16
15.0	-1 .25	1 32
17.5	-1 .61	1 62
20.0	-1 4 8	1 54
22.5	-1 67	1 63
25.0	-1 1.59	1 40
27.5	-1 4 0	1 97
30.0	-1 .14	1 53
32.5	-1 .05	1 997
35.0	-1 98	1 21
37.5	-1 9 6	1 45

400	-18 85	16.01
42.5	-1.2.80	
45,0	.1.3.87	15.86 .
47.5	-18.79	15.98
60.0	-18 78	15 64
52.5	-18.78	15 49
55.0	-18.51	15 01
57.5	-18.39	14.69
60.0	-18.40	14 73
62.5	-18.42	14,50
65.0	-18 61	15.13
67.5	-15. s!	14.50
700	-19.34	14.50
72.5	-19.63	14.19
75.0	-19.73	14.04
77.5	-19.60	1403
80.0	-19.67	14.19
82.5	-19.84	14.26
95.0	-19.52	14.34
17.5	.19.12	1462
90.0	-18.36	15.01
92.5	-18.25	14.66
95.0	-18.21	14.61
97.5	-19.07	

WHALE - 88WW3

DATE KILLED - 6 MAY 1988
LOCATION - WAINWRIGHT, ALASKA
SEX - MALE
BODY LENGTH = 13.4 m
BALEEN LENGTH = 2.1 m
AVERAGE DEL C13 = -19.66
AVERAGE DEL N15 = 13.82

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (PPt)
0.0	-19.73	
2.5	-18.85	14.84
5.0	-19.10	14.30
7.5	-19.13	14.24
10.0	-18.46	13.53
12.5	-18.63	13.13
15.0	-20.01	13.30
17.5	-20.32	14.18
20.0	-20.21	14.48
22.5	-19.82	15.08
25.0	-19.16	14.60
27.5	-19.48	13.71
30.0	-22.16	12.88
32.5	-21.87	12.86
35.0	-20.77	14.10
37.5	-20.04	14.68
40.0	-19.86	14.43
42.5	-19.34	14.80
45.0	-19.19	14.10
47.5	-23.46	12.51
50.0	-22.05	13.10
52.5	-20.60	14.37
55.0	-20.24	14.77
57.5	-20.36	14.68
60.0	-20.50	14.72
62.5	-20.32	13.91
65.0	-22.79	13.19
67.5	-21.09	13.41
70.0	-19.67	1426
72.5	-19.38	14 16
75.0	-19.14	14.31
77.5	-19.36	14,02
20.0	-19.87	14.13
62.5	-21,27	13.62
55.0	-21.24	12.65
87.5	-19.72	13.21
90.0	-19.63	13.37
92.5	-19.10	15.11
95.0	-19.11	14.43
97.5	-18.98	13.86
100.0	-19.25	13.65
102.5	-19.38	13.56
105.0	-19.56	12.93
107.5	-19.11	13.47
110.0	-18.94	13.78
112.5	-18.97	14.34
115.0	-18.84	14.12
117.5	-18.64	13.61
120.0	-19.26	13.48
122.5	-19.89	13 20
125.0	-19.64	12.63
127.5	-18.94	13.47
130.0	-18.89	14.11
132.5	-18.77	14 16

1315.0	-18.41	13 84
137.5	-18.38	13.36
140.0	-19.52	13.09
142.5	-19.62	12.52
145.0	-19.01	13.70
147.5	-18.74	14.36
1 50.0	-18.30	14.80
152.5	-18.49	14.81
155.0	-18.32	13.91
157. s	.20.64	13.29
160.0	-20.S4	12.67
162.5	-10, 53	12.88
165.0	-19.29	14 08
167.5	-19.16	14.46
170.0	.19.21	14.46
172.5	-19.29	14.14
175.0	-19.06	14.07
177.5	-20.25	13.87
180.0	-21.05	13.23
182.5	-20.53	13.00
185.0	-19.80	13.22
187.5	-18.87	14.60
190.^	-18.05	15.32
192.5	-17.45	13.84
19s.0	-17.61	13.49
197,5	.17.93	13,73
200.0	-21.24	12.95
202.5	.21.21	13.15
205.0	-19.98	12.85
207.5	-19.41	14.40

WHALE - 8981 DISTAL

DATE KILLED - 23 APRIL1989
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.9 m
BALEEN LENGTH = 0.87 m
AVERAGE DEL C13 = -18.55
AVERAGE DEL N15 = 15.05

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (PDt)
0.0	-18.48	15.84
2,5	-18.51	15.56
5.0	-18.64	14,50
7.5	.1s.71	15.17
too	-18.84	14.56
12.5	-18.54	14.85
15.0	-18.55	15.00
‡7,5	-19.14	14.64
20.0	-19.16	14.11
22.5	-19.10	14.01
25.0	-18.64	14.s7
27.5	-18.27	15.5S
30.0	-18.14	15.99
32.5	-18.03	15.66
35.0	-17.90	15,06
37.5	-17.92	15.06
40.0	-17.99	15.16
42.5	-18.01	15.19
45.0	-18.14	14.95
47.5	-18.01	14.89
50.0	-18.15	14,51
52.5	-16.27	14.80
55.0	-18.36	15,27
57.5-	-1s.74	1s.31
50.0	-16.31	15,67
52.5	-16,55	14.45
55.0	-19,40	1477
67.5	-19.35	1s.13
70.0	-19.49	14.93
72.5	-19.24	14.96
75.0	-16,56	15.36
77.5	-16,10	15.64
50.0	-17.99	15.30
52.5	.17.66	15.14
25.0	-18.33	15.08
57,5	-19.23	14.92

WHALE - 8981 MEDIAL

DATE KILLED - 23 APRIL1989
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.9 m
BALEEN LENGTH = 1.03 m
AVERAGE DEL C13 = -18.51
AVERAGE DEL N15 = 14.93

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (DPt)
2.5	-18.33	15.57
5.0	-18 6?	15.10
7.5	-18 S7	15.07
0.0	-18.81	14.70
2.5	-18 67	14.66
5.0	-18.74	15,43
[illegible]	[illegible]	14 66
[illegible]	[illegible]	1451
22.5	-19.17	14.26
25.0		13.63
27.5	-18.80	14.59
30.0	.16 5S	15.16
32.5	-18.29	15.78
3s.0	-18.18	15.60
37.5	-18.14	15.66
40.0	-17.92	15.09
42.5	-17.95	14.91
45.0	-18.27	15.27
47.5	-18.02	14.82
50.0	-18.05	14.78
52.5	-17.97	14.86
55.0	-18.04	14 79
57.5	-18.13	14.78
60.0	-18.35	14.73
62.5	-18.41	14.61
65.0	-18.66	14.94
67.5	-19.05	14.84
70.0	-19.36	14.70
72.5	-19.49	14.73
75.0	-19.45	15.00
77.5	-19.35	14.79
80.0	-19.41	14.89
82.5	-19.36	14.84
85.0	-18.89	14.96
87.5	-18.37	15.33
90.0	-17.93	
92.5	-17.60	15.43
95.0	-17.43	15.45
97.5	-17.68	15.15
100.0	-18.12	14.42
102.5	-18.32	14.11

WHALE - 8981 PROXIMAL

DATE KILLED - 23 APRIL1989
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.9 m
BALEEN LENGTH = 0.98 m
AVERAGE DEL C13 = -18.52
AVERAGE DEL N15 = 15.04

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (PPt)
0.0	-18.51	15.51
2.5	-18.47	15.30
5.0	-16,64	15.25
7,5	-16.71	15.00
10.0	.15.65	1450
12.5	-18.82	14.53
15.0	-18.82	15.1S
17.5	-18.67	14.66
20.0	-18.98	14.46
22.5	-19.08	14.21
25.0	-18.78	14.77
27.5	-18.43	15.36
30.0	-18 32	15.62
32.5	-18.14	15.65
35.0	-17.96	15.41
37.5	-17.89	15.10
40.0	-17 97	14.99
42.5	-17.96	14.96
45.0	-18.01	14.98
47, s	-18.15	14.66
50,0	-18 13	14.73
52.5	-18.26	15.51
55,0	-18.32	14.66
57.5	-18.68	15.09
50.0	-19.09	14.96
62.5	-19.44	14.73
65.0	-19.42	15.15
67.5	-19.37	15.02
70.0	-19.43	14.91
72.5	-16.45	14,67
75.0	.16.01	15.00
77.5	-16.35	15.32
80.0	-17.6S	15.46
62.5	-17.61	15.39
85.0	-S748	1s43

87. s	-17.81	15.33
20.0	-18.19	14.72

WHALE - 8989 LEFT

DATE KILLED - 25 OCTOBER 1989
, ALASKA

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (ppt)
0.0	.19.70	14.34
2.5	-19.36	14.66
5.0	-19.50	14.77
7,5	-19 so	14.80
too	.19.23	15.27
12. s	-10 14	15.26
15.0	-19.03	15.45
17. S	-18.66	15.85
20.0	-18.40	16.03
25.0	-18.18	16.38
27,5	-18.15	15.97
30.0	-18.05	15.77
32.5	-18.02	15.43
35.0	.18.03	15.74
37.5	-18.13	15.16
40.0	-18.13	15.35
42.5	-18.11	15.03
45,0	-18.08	15.32
47.5	.18,11	15.47
50.0	-18.06	15.31
52.5	-18.00	15.36
55.0	-17.99	15.39
57.5	-18.19	15.72
60.0	-18.24	15.33
62.5	-18.50	15.22
65.0	-18.78	15.06
67.5	-18.95	14.73
70.0	-18.86	15.00
72.5	-18.74	14.82
75.0	-18.69	14.97
77.5	-18.88	14.91
80.0	-18.93	14.95
82.5	-18.74	15.19
85.0	-18.46	15.00
87.5	-18.02	15.26
90.0	-17.97	14.84
92.5	-18.18	13.85
95.0	-17.57	13.84

WHALE - 8989 RIGHT

DATE KILLED - 25 OCTOBER 1989
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 8.2 m
BALEEN LENGTH = 0.97 m
AVERAGE DEL C13 = -18.49
AVERAGE DEL N15 = 15.37

BALEEN LENGTH [cm) -	DEL C13 (PPt)	DEL N15 (ppt)
0.0	-1 1.67	14.48
	1.34	14.75
5.0	-1 1.?2	14.46
7.5	-1 1.52	15.15
10.0	-1 .24	
12.5	-1 .33	15.34
15.0	-1 .60	15.38
17.5	-1 .70	15.77
20.0	-1 .46	16.05
22.5	-1 .31	16.41
25.0	-1 .20	16.42
27.5	-1 .15	16.31
30.0	-1 .04	16.13
32.5	-1 .01	15.67
35.0	-1 .02	15,53
37.	. .09	15,42
40.0	-1 .10	15.38
42.5	-1 .13	15.37
45.0	-1 .12	
47.5	-1 .04	15.49
50.0	-1 .97	15.36
52.5	-1 .98	15,32
55.0	-1 .99	1551
57.5	-1 .00	15 58
60.0	-18.16	15.66
62.5	-18.29	15.61
65.0	-18.60	15.29
67.5	-18.85	15.16
70.0	-18.95	15.14
72.5	-18.64	15.34
75.0	-18.60	15.19
77.5	-18.67	15.12
80.0	-18.69	15.56
82.5	-18.62	15.10
85.0	-18.59	15.07
87.5	-18.26	15.06
90.0	-17.98	15.27
92.5	-17.79	14 56
95.0	-17. 86	13.97

WHALE . 89B10 LEFT

DATE KILLED - 28 OCTOBER 1989
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.1 m
BALEEN LENGTH = 1.5 m
AVERAGE DEL C13 = -19.69
AVERAGE DEL N15 =

BALEEN LENGTH (cm)	DEL C13 (PPt)	DEL N15 (ppt)
0.0	.22.24	
2.5	-24.42	
5.0	-23.11	
7,5	-20.68	
10.0	-19.22	
12,5	-19.23	
15.0	-19.61	
17.5	-19.12	
20.0	-21.07	
22.5	-21.1?	
25.0	-20,20	
27.5	-19.18	
30,0	-18.42	
32.5	-18.44	
35,0	-18.48	
37,5	-18.60	
40.0	-19.99	
42.5	-21.00	
45.0	-20.04	
47.s	-19,44	
50.0	-19.00	
52.5	-19.39	
55.0	-19.21	
57.5	-20.21	
60.0	-22.18	
62.5	.22.01	
65. o	-20.00	
67.5	-18.59	
70.0	-18.39	
72. S	-18.50	
75.0	-18.50	
77,5	-18.35	
80.0	-18.08	
82.5	-18.18	
65.0	-18.95	
87.5	-19.2s	
90.0	-19.19	
92.5	-19.11	
95.0	-19.08	
97.5	-22.3a	
100.0	-19.14	
102.5	-19.00	
105.0	-19.00	
107.5	-19.18	
110.0	.19.06	
112.5	.19.13	
115.0	-19.18	
117.5	-19.06	
t 20.0	-19.12	
122.5	-19.25	
125.0	-19.23	
127.5	-19.34	
130.0	-19.63	
132.5	-19.56	
135.0	-19.65	
137,5	-19.66	
140.0	- w a s	
142.5	-19.65	
145.0	-19.68	
147,S	.19.66	
150.0	-20.01	
152.S	-19.97	
155.0	-19.47	

WHALE . 89810 RIGHT

DATE KILLED - 28 OCTOBER 1989
LOCATION - BARROW, ALASKA
SEX - FEMALE
BODY LENGTH = 8.1 m
BALEEN LENGTH = 1.5 m
AVERAGE DEL C13 = -19.55
AVERAGE DEL N15 = 14.72

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-22.68	13.70
2.5	-24.32	12.09
5.0		11 76
7.5	-21.38	12.86
10.0	.19.47	14.44
12.5	-19.10	14.78
15.0	-19.50	14.25
17.5	-19.24	13.93
20.0	-19.96	13.96
22.5		13.14
25.0	-20.70	12.29
27.5	-10.67	13.50
30.0	-18.76	14.S2
32,5	-18.50	15.24
35,0	.10.57	14.72
37.5	.18.62	14.00
40.0	-19.45	13.48
42.5	-20.s1	12.68
45.0	.21.17	13.10
47,5	-19.87	14 61
50.0	-19.25	15.69
52.5	-19.10	15.98
55.0	-19.12	14.98
57.5	-19.75	14.44
60.0		13.34
62.5	-22.23	12.35
65.0	-21.06	13.16
67.5	-18.67	
70.0	-18.39	15.83
72.5	.1s.40	15.80
75.0	-18. s!	15.84
77.5	.10.36	15.61
80.0	-18.16	15.27
02.5		1490
85.0	-18.41	14.96
87.5		15.19
90.0	-19.19	15.65
02.5	-18.16	
95.0		15.78
97,5	-19.06	16.06
100,0	-18.97	16.21
102,5	-18.98	16.23
105.0	-18.90	16.26
107.5	-18.93	16.24
110.0	-18.98	15 60
112.5	-19.04	16.00
115.0	-19.20	16.21
117.5	-to. 15	16 13
120.0	-19.18	15.97
122.5		15.38
125.0	-19.18	15.13
127.5	-19,25	15.21
130.0	.19.50	15.20
132.5 .	-19.58	1537
135.0	-19.68	15.06
137.5	-19.69	14.66
140.0	-19.87	14.76
142.5	-1S.93	14.45
145.0	-19.88	14,33
147.5	-19.95	14.42
150.0	-20,03	14 66
152.5	-19.84	14.50

WHALE - 89KK3

DATE KILLED - 27 SEPTEMBER 1989
LOCATION - KAKTOVIK, ALASKA
SEX - MALE
BODY LENGTH = 12.6 m
BALEEN LENGTH = 2.2 m
AVERAGE DEL C13 = -19.55
AVERAGE DEL N15 =

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0.0	-22.17	13, S6
2.5	-21 91	1351
5 0	-21.65	12.72
7 5	-19.40	14.02
100	-19 31	1421
12.5	-19.47	14 14
15.0	.10. 90	14.47
17.5	-19.09	1327
20.0	-19 17	13.36
22.5	-19.88	12.87
25.0	-20 14	12.52
27.5	.19. s0	13.55
30.0	-16. S2	14.27
32.5	-18.48	13.71
35.0	-18 18	12.99
37.5	-18.77	13.20
40.0	-20.10	13.13
42.5	-20.91	13.07
45.0	-20.57	13.99
47.5	.19. 99	1453
50.0	-19.49	15.09
52.5	-19.54	15 37
55.0	-18.99	14.55
57.5	-20.10	13,32
60.0	-21.61	12.57
62.5	-21.72	
65.0	-20.54	14.21
67.5	-19.82	14.44
70.0	-19.59	14.66
72.5	-19.40	1449
75.0	-20.21	13.74
775	-23.64	1220
80.0	-22.55	12.60
82,5	-20.49	14.14
65,0	-20.08	1466
87.5	.20.05	14.81
90.0	-20.30	14 40
92.5	-20.04	13.88
95.0	.21.22	13.51
97.5	-22.21	12.83
100.0	-20.65	
102.5	-20.13	13.87
105.0	-18.06	13.99
107.5	-16.75	1405
t 10.0	.19.03	14.31
112.5	-19.36	1429
115.0	-20.18	13.76
117.5	-21.44	12.86
120.0	-20.76	13.24
122.5	.19.44	1417
125.0	.19.07	15.01
127.5	-19.55	1542
130.0	-19.44	14.83
132.5	-18.84	13.92
135.0	-19.14	13.64
137.5	-19,39	13,27
140.0	-19.62	1277
142.5	.19.20	12.94
145.0	-18.76	
147.5	-18.74	14.00
150.0	-1856	
152.5	-1860	13,74
155.0	-18.37	
157.5	-18.86	13.3s
160.0	-19.26	13.10
162.5	-19.36	12,s0
165.0	-19.21	12.62
167.5	-16.92	
170.0	-18.78	14.11
172.5	-18.55	
175.0	-18.51	
177.5	-18.31	13.44
180.0	-18.85	
182.5	-19.79	12.55
185.0	-19.77	12.32
157.5	-18.81	
t 90.0	-15.12	14.25
102.5	-17.91	14.25
195.0	-18.09	14.51
197.5	-16.26	1447
200,0	-16.55	13..35
202.5	-20.11	13.24
205.0	-20.54	12.S6
207.5	-19.51	
210.0	-18.85	13.06
212.5	-18.18	
215.0	-17.86	13.34
217.5	-17.14	13.02
220.0	-17.29	
222.5	-18.40	12.65

wNALE-sees

DATE KILLED - 2334AY1SW
LOCATION - BARROW, ALASKA

SEX - FEMALE		
BODY LENGTH = 15.9 m		
BALEEN LENGTH = 2.79 m		
AVERAGE DEL C13 . -18.00		
AVERAGE DEL N15 -		
BALEEN LENGTH	DEL C13	DEL N15
(cm)	(ppt)	(ppt)
0.0	-18.21	
2.5	-17 97	
5.0	.1751	
7.s	-17.70	
10.0	-17 81	
12.5	.1700	
15.0	-18.34	
17,5	-19.39	
20.0	-18.55	
22.5	-18.25	
25.0	-18.23	
27.5	-18.45	
20.0	-17.87	
22.5	-18.20	
35.0	.1904	
.37 s	-18.99	
40.0		
42.5	-18.08	
45.0	-17.87	
47.5	.1777	
50.0	.18. 30	
52.5	-18.94	
55.0	.10..33	
57.3	-18.57	
60,0	-18.42	
62.5	-18.50	
65.0	-18.27	
67. s	.17.95	
70.0	-18.22	
72.5	-19.11	
75.0	-18.83	
77.s	-18.12	
80.0	-18.19	
S2.5	-18.22	
85.0	17.87	
87.5	-18.04	
60.0	-19.22	
92.s	-19.17	
95.0	-18.71	
07.5	-18.52	
100.0	-18.35	
102.5	-18 83	
105.0	-19.07	
107.5	-19.24	
110.0	-19.99	
112.5	-18.97	
115.0	-18.09	
117.5	-17.87	
120.0	-18 09	
122.5	-18.31	
125.0	.18.10	
127.5	-18.05	
130.0	-19.05	
132.5	-18.58	
135.0	-18.28	
137.5	-18.48	
140.0	-18.44	
142.5	.18.43	
145.0	-18.98	
147.5-	-10.3s	
150.0	-18.85	
152.5	-18.30	
155.0	-18.29	
157.5	-18.06	
160.0	-17.93	
162.5	-18.42	
165.0	-19.24	
167.5	-19.17	
170.0	-18.47	
172.5	-17.56	
175.0	-17.45	
177.5	-17.55	
180.0	-17 64	
182.5	-18 64	
185.0	-18 91	
187.5	-18 48	
190.0	-17.91	
192.5	-17,63	
195.0	-17.66	
197.5	-1749	
200,0	-17 90	
202,5	.18.93	
206.0	-19.16	
207.5	-18 61	
2100	-18 06	

212.5	.17.93	
215.0	-17.99	
217.5	-17.82	
230.0	-18.74	
232.5	-19.85	
225.0	-19.51	
227.5	-18.77	
230.0	-17.79	
232.5	-17.79	
235.0	.17.74	
237.5	-17.57	
240.0	.19.30	
242.5	-20.54	
245.0	-19.72	
247,5	-18.49	
250.0	-17,54	
252,5	-17 74	
255.0	-18.27	
257.5	-19 30	
250.0	-1030	
282.5	-1874	
25s.0	-17 84	
267. s	-17.29	
270.0	-17.15	
272.5	.16.55	
275.0	-16.86	
277.5	-18.29	
280.0	-18.56	
282.5	.17.45	
285.0	-16.95	
287.5	-16.86	
240.0	-16.98	
222.5	.16.65	
295.0	-17.57	
227.5	.15.46	
300.0	-17.94	
202.5	-17,46	
305.0	.1744	
307.5	-17.49	
310,0	-17.35	
WHALE -4067		
DATE KILLED -1 OCTOBER 1620		
LOCATION - BARROW, ALASKA		
SEX - FEMALE		
BODY LENGTH = 8.4 m		
BALEEN LENGTH = 1.40 m		
AVERAGE DEL C13 = -18.77		
AVERAGE DEL N15 =		
BALEEN LENGTH	DEL C13	DEL N15
(cm)	(ppt)	(ppt)
0.0	-19.48	
2.5	-20.15	
5.0	-20.17	
7.5	-20.42	
10	-19.55	
12.5	-18.58	
15.0	-18.43	
17.5	-18.24	
20.0	-18.20	
22.5	-18.80	
25.0	-20.10	
27.5	-21.00	
30.0	-20.85	
32.5	-19.73	
35.0	-18.83	
37.5	-18.47	
40.0	-18.54	
42.5	-18.78	
45.0	-18.87	
47.5	-18.76	
50.0	-18 64	
52.5	.16.38	
52.5	.16.64	
5s.0	-18.74	
57.5	-18.98	
60.0	-10.04	
42.5	-19.01	
55.0	-16.71	
67.5	-18.57	
70.0	-la,,44	
72.5	-18.32	
75.0	-18.24	
7.5	-18.23	
20.0	.16.24	
22.5	-18.30	
55.0	-18.28	
87.5	-18.2a	
40.0	-10.16	
32.5	-18.15	

95.0	-1 .17	
97.5	-1 .24	
100.0	-1 .40	
102.5	-1 .48	
105.0	-1 .70	
107.5	-1 .93	
110.0	-1 .08	
112.5	-1 .76	
115.0	-1 .92	
117.5	-1 .63	
120.0	-1 .73	
122.5	-1 .79	
125.0	-1 .63	
127.5	-1 .65	
130.0	-1 .59	
132.5	-1 .28	
135.0	-1 .03	

WHALE - 9088

DATE KILLED - 2 OCTOBER 1990
LOCATION - BARROW, ALASKA
SEX - MALE
BODY LENGTH = 12.9 m
BALEEN LENGTH = 2.43 m
AVERAGE DEL C13 = -18.93
AVERAGE DEL N15 =

BALEEN LENGTH (cm)	DEL C13 (ppt)	OEL N15 (ppt)
0,0	-19.72	
2.5	.20.01	
5.0	-20.52	
7.5	-19.75	
10.0	-18, 91	
12.5	-18.53	
15,0	-18.39	
17.5	-18.34	
20.0	-18.61	
22.5	-19.83	
25.0	-20.78	
27.5	-19.53	
30.0	-19.05	
32.5	.16,18	
35.0	-10.30	
37.5	-19.20	
40.0	.16.77	
42.5	-19.14	
45.0	-19.50	
47.5	-19.66	
50.0	.19,93	
52.5	-16.70	
55.0	-16,42	
57.5	-1 S,26	
60.0	-17.96	
62.5	-18.58	
65.0	-19.73	
67.5	-20.58	
70.0	-19.80	
?2.s	-18.97	
75.0	-19.06	
77.5	-19.12	
80.0	-16.52	
82.5	-18.72	
85.0	-19.96	
87.5	-20.37	
90.0	-19.45	
92.5	-18.51	
95.0	-18.41	
97.5	-18.23	
100.0	.17 .66	
102.5	-18.47	
105.0	-19.20	
107.5	-19.81	
110.0	-19.36	
112.5	-16.93	
115.0	-18.93	
117.5	-19.63	
120.0	-19.30	
122.5	-19.36	
125.0	-20.00	
127.5	-20,00	
130.0	-19.31	
132.5	-16.66	
135.0	-18.49	
137.5	-18.28	
140.0	-18.34	
142.5	-18.42	
145.0	-18.63	
147.5	-19.59	
150.0	-19.58	
152.5	-18.75	
155.0	-18.46	
157,5	-18 34	
160.0	-18.35	
162.5	-18 44	
165.0	-18 62	
167.5	-19 05	
170.0	.19.13	
172.5	-19.00	
175,0	-18.70	
177.5	-1656	
160.0	-1650	
182.5	-18 49	
185.0	-18.38	
167.5	-19.09	
1s0.0	-19.47	
162.5	-19.52	
195.0	-1906	
197.5	-18.74	
200,0	-18.54	
202,5	-18.43	
205.0	-1.2.32	
207.5	-18.23	
210.0	-18.56	
212.5	-19.34	
215.0	-19 68	
217.5	-1969	
220.0	-18.32	
222.5	-17.54	
225.0	-17.56	
227.5	-1776	
230.0	-17.74	
232.5	-1776	
235.0	-18.91	
237.5	-18.64	
240.0	-19.19	
242.5	-18.63	
245.0	-17 69	
247.5	-17.95	
250.0	-17 37	

WHALE - 90G4

OA7E KILLED. 7 MAY 1990
LOCATION - GAMBELL, ALASKA
SEX-FEMME
BODY LENGTH = 15.2 m
sALEEN LENGTH = 3.0m
AVERAGE DEL C13 - -16.2S
AVERAGE OEL N15 -

BALEEN LENGTH (cm)	DEL C13 (ppt)	DEL N15 (ppt)
0,0	-16.77	
2.5	-18.13	
5.0	-17.93	
7.5	-17 65	
10.0	-17.85	
12.5	-18.12	
15.0	-18 63	
17.5	-18.78	
20.0	-18.48	
22.5	-18.56	
25.0	-18.88	
27.5	-97.99	
30.0	-18.75	
32.5	-19.38	
35.0	-18.90	
37.5	-18.33	
40,0	-1s.47	
42.5	.16.52	
45.0	.16.64	
47.5	-19.00	
30.0	-18.59	
52.5	-18.43	
55.0	-19.01	
57.5	-18.65	
60.0	-17.42	
62.5	-18.14	
2.5.0	.16.S0	
67.5	.16.49	
70.0	-18.15	
72.5	.1 S.15	
75.0	-17.72	
77.5	-17.22	
80.0	-18.19	
82.5	-18.59	
85.0	-18.93	
67.5	-18.65	
90.0	-18.66	
95.0	-19.43	
97.5	-18.95	
100.0	-18.96	

102.5	-19.17	
105.0	-18.73	
107.s	-18.51	
110.0	-18.45	
112.5	-18.41	
115.0	-19.13	
117.5	-19.18	
120.0	-18.93	
122.5	-18.48	
125.0	-18.35	
127.5	.1.2.56	
130.0	-18.97	
132.5	-18.82	
135.0	-18.92	
137.5	-18.53	
140.0	-18.34	
142.5	-18.39	
145.0	-18.25	
147.5	-18.57	
150.0	-19.05	
155.0	-18.41	
157.5	-17.98	
160.0	.17.93	
162.5	.17.95	
165.0	-18.65	
167.5	-18.92	
170.0	-18.30	
172.5	-18.05	
175.0	-18.07	
177.5	-18.03	
180.0	-18.34	
182.5	-18.29	
185.0	-18.26	
187.5	.17.94	
190.0	-17 63	
192.5	-17.53	
195.0	-17.04	
197.5	-17.02	
2a0.0	-18.92	
2a2.5	-19.11	
205.0	-18.10	
207.5	-17.28	
210.0	-17.29	
212.5	-17.45	
215.0	-17.91	
217.5	-18.31	
220.0	-18.82	
222.5	-18.31	
225.0	-17. s7	
227.5	-1750	
230.0	-17.29	
232.s	-18.65	
235.0	-19.39	
237.5	-18.85	
240.0	-17.52	
242.s	-17.31	
245.0	-17.25	
247.5	-17.17	
250.0	-18.71	
252.5	.18.93	
255.0	-18.11	
2s7.5	-17.63	
260.0	-17.86	
262.5	-17.77	
265.0	-1s.30	
267.5	-18.73	
270.0	-18.30	
272.5	-17.43	
277.5	-17.57	
282.5	-17.24	
285.0	-16,72	
287.5	-18.71	
290.0	-17.44	
232.5	.17.35	
265.0	.17.64	
2s7.5	.17.05	
200.0	-18.36	
202.5	-17.97	
205.0	-18.42	