UNITED STATES

AMLR ANTARCTIC MARINE LIVING RESOURCES PROGRAM

AMLR 1992/93 FIELD SEASON REPORT

Objectives, Accomplishments and Tentative Conclusions

Edited by
Jane Rosenberg

MAY 1993

ADMINISTRATIVE REPORT LJ-93-08

Antarctic Ecosystem Research Group

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center
P.O. Box 271
La Jolla, California 92038

The U.S. Antarctic Marine Living Resources (AMLR) program provides information needed to formulate U.S. policy on the conservation and international management of resources living in the oceans surrounding Antarctica. The program advises the U.S. delegation to the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), part of the Antarctic treaty system. The U.S. AMLR program is managed by the Antarctic Ecosystem Research Group located at the Southwest Fisheries Science Center in La Jolla.

Inquiries should be addressed to:

Chief, Antarctic Ecosystem Research Group
Southwest Fisheries Science Center
P.O. Box 271
La Jolla, California, USA 92038

Telephone Number: (619) 546-5600

TABLE OF CONTENTS

BACKGROUND

The long-term objective of the U.S. Antarctic Marine Living Resources (AMLR) field research program is to describe the functional relationships between krill, their environment, and their predators. The field program is based on two working hypotheses: (1) krill predators respond to changes in the availability of their food; and (2) the distribution of krill is affected by both physical and biological aspects of their habitat. In order to refine these hypotheses, a study area was established in the vicinity of Elephant Island (Figure 1). A seasonal field camp was established at Seal Island, off the northwest coast of Elephant Island, where reproductive success and feeding ecology of seal and penguin breeding colonies are monitored. A complementary series of shipboard observations was initiated to describe both within and between season variations in the distributions of nekton, zooplankton, phytoplankton, and water types. In addition, research on the ecology of Adelie penguins is conducted at Palmer Station each year during the austral summer.

SUMMARY OF 1993 RESULTS

Six surveys were conducted between mid-January and mid-March, 1993. As in past seasons, two major water types were easily identified (Drake Passage and Bransfield Strait). Current flow was generally from southwest to northeast across the AMLR study area, with meanders seen northeast of Elephant Island. Similar to last year, phytoplankton biomass, as measured by chlorophyll-a concentrations, decreased markedly from Leg I to Leg II. Preliminary analysis of net plankton samples during Leg I showed a predominance of diatoms in all stations. Early in the season, krill were most abundant northwest of Elephant Island, between Elephant and Clarence Islands, and to the west between Elephant and King George Islands. Krill densities found during Leg II's large-area survey were low compared to that of Leg I, although comparable to a similar survey conducted at the same time last year. The overall krill length frequency distributions and maturity stage composition from this year's large-area surveys differed considerably compared to last year. In particular, a distinct juvenile mode was absent, suggesting poor spawning and/or larval survival from the 1991/92 season. Also, a relatively abundant intermediate size mode (around 35mm) suggests the apparent success of the 1990/91 krill year class. Salps were the overall dominant component of zooplankton samples collected. This season was a very good year for recruitment of chinstrap penguins, with increased numbers of birds attempting to breed on Seal Island. Despite this, only 72% of eggs present upon the field team's arrival hatched. In contrast, breeding success for chinstraps (chicks surviving to creche) was high at 92%. Total survivorship was comparable to past seasons at 67%, except for the 1990/91 season which was 59%. Breeding success of macaroni penguins was the highest recorded compared to all past seasons. Fur seal pup production on the island was very similar to last season. At Palmer Station, Adelie penguins enjoyed high breeding success this season, although not significantly higher relative to last year (1.46 vs 1.39 chicks creched/pair).

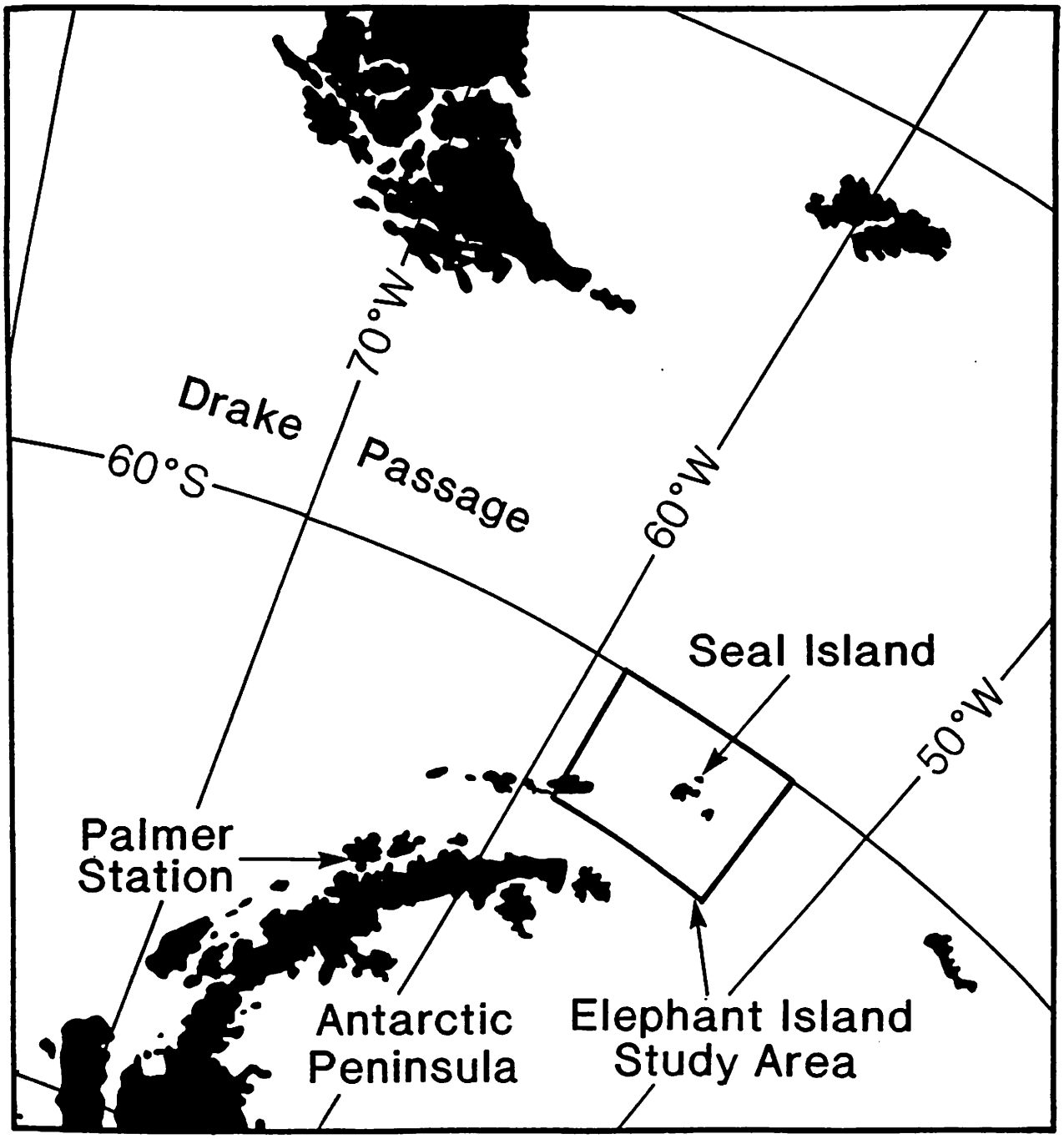

Figure 1. Locations of the U.S. AMLR field research program: Elephant Island Study Area, Seal Island, and Palmer Station.

OBJECTIVES

Shipboard Research:

1. Map meso-scale (10's to 100's of kilometers) features of water mass structure, phytoplankton biomass and productivity, and zooplankton constituents (including krill) in the area around Elephant Island.

2. Estimate the abundance of krill in the area around Elephant Island.

3. Delineate the hydrographic and biological features across the expected front north of Elephant Island.

4. Map the micro-scale (1-10's of kilometers) features of the distribution, density, and abundance of krill immediately north of Elephant Island, within the foraging range of krill predators breeding at Seal Island.

5. Provide logistic support to the Seal Island field camp.

6. Conduct pelagic seabird and marine mammal observations along the Central and South American coast during the Southbound transit, as well as in the AMLR study area during Legs I and II.

7. Conduct observations of seabird foraging patterns in relation to prey distribution in the AMLR study area during Legs I and II.

8. Determine effects of diel changes of krill behavior and orientation of survey transects on the description of krill distribution patterns.

9. Measure acoustic target strength of krill as a function of animal size, gender, and sexual maturity.

10. Investigate acoustic signatures of selected zooplankton species using multi-frequency technology and directed MOCNESS sampling.

Land-based Research:

<u>Seal Island</u>

1. Monitor pup growth rates and adult female foraging of antarctic fur seals according to CCAMLR Ecosystem Monitoring Program (CEMP) protocols.

2. Conduct directed research on pup production, female foraging behavior, diet, abundance, survival, and recruitment of fur seals.

3. Monitor the abundance of all other pinniped species ashore.

4. Evaluate an automatic direction-finding system for determining the offshore foraging areas of fur seals.

5. Monitor the breeding success, fledgling size, reproductive chronology, foraging behavior, diet, abundance, survival, and recruitment of chinstrap and macaroni penguins according to CEMP protocols.

6. Examine penguin chick growth and condition for intra- and inter-seasonal comparisons.

7. Conduct directed research on seasonal and diel patterns in the diving behavior of chinstrap penguins in order to assess changes in foraging patterns and effort as physical and biological components change through the breeding season.

8. Examine intra-seasonal changes in penguin chick provisioning contemporaneously with foraging effort.

9. Test an automatic direction-finding system for monitoring the locations of offshore foraging areas of chinstrap penguins.

10. Assess the reproductive success, survival, and recruitment of cape petrels.

Palmer Station:

1. Determine Adelie penguin breeding success.

2. Examine how present and past indices of Adelie penguin breeding success relate to a true measure of breeding success.

3. Obtain information on Adelie penguin diet composition and meal size.

4. Determine Adelie penguin chick weights at fledging.

5. Determine the amount of time breeding adult Adelie penguins need to procure food for their chicks.

6. Band a representative sample (1000 chicks) of the Adelie penguin chick population for future demographic studies.

7. Determine adult Adelie penguin breeding chronology.

8. Continue exploring the feasibility of adding more of the Standard Methods to the suite of data now be collected at Palmer Station.

Fraser / Trivelpiece
AMLR

12. Seabird research undertaken as part of the NMFS/AMLR ecosystem monitoring program at Palmer Station, 1992-1993; submitted by William R. Fraser and Wayne Z. Trivelpiece.

12.1 Objectives: Palmer Station is one of two sites on the Antarctic Peninsula where long term monitoring of seabird populations is being undertaken in support of U.S. participation in CEMP. Our objectives during 1992-93, the sixth season of field work at Palmer Station, were:

1. To determine Adelie penguin breeding success,

2. To examine how present and past indices of Adelie penguin breeding success relate to a true measure of breeding success,

3. To obtain information on Adelie penguin diet composition and meal size,

4. To determine Adelie penguin chick weights at fledging,

5. To determine the amount of time breeding adult Adelie penguins need to procure food for their chicks,

6. To band a representative sample (1000 chicks) of the Adelie penguin chick population for future demographic studies,

7. To determine adult Adelie penguin breeding chronology, and

8. To continue exploring the feasibility of adding more of the Standard Methods to the suite of data now being collected at Palmer Station.

12.2 Accomplishments: Field work at Palmer Station was initiated on 6 October 1992 and terminated on 1 April 1993. The early start date was again aided by joint funding from the National Science Foundation's (NSF) Division of Polar Programs. NSF recently chose Palmer Station as a Long Term Ecological Research (LTER) site, and it has committed long-term funding and logistics support to an ecosystem study in which Adelie penguins represent one of two key upper trophic level predators selected for research. As a result of this cooperative effort between the National Marine Fisheries Service (NMFS) and NSF, field season lengths at Palmer Station now cover the entire 5-month Adelie penguin breeding season.

Until last season, breeding success in Adelie penguins had been estimated by using indices based on chick production per colony, the number of active nest sites in early January, and the ratio of 1-and 2-chick broods (see below). A true measure of breeding success, that is, the number of chicks reaching creche age per breeding pair, had not been previously obtained due to the late start of the field season and the subsequent inability to determine the number of breeding pairs and the fate of their eggs and chicks

early in the season. This season we again followed a 100-nest sample on Humble Island from clutch initiation to creche. Adelie penguins again exhibited high reproductive success, creching 1.46 chicks per pair.

As in past seasons, two indices of breeding success were also examined. On 6 January, the proportion of 1 and 2 chick broods was assessed at 54 colonies in 5 different rookeries; on 26 January these and other colonies were censused to assess chick production. Production at these colonies totaled 7319 chicks, of which a sample of 2687 active territories fledged 4534 chicks. This suggests a per-pair productivity of 1.69 chicks, 0.23 chicks more than the more accurate measure of breeding success obtained above. This difference, which is consistent with figures obtained last season, is not large enough to negate the potential usefulness of these breeding success indices. This season, 60.2% of the territories examined contained 2-chick broods, a decrease of 10.3% over last season.

Diet studies were initiated on 11 January and terminated on 19 February. During each of the 8 sampling periods, 5 adult Adelie penguins were captured and lavaged (stomach pumping using a water off-loading method) as they approached their colonies to feed chicks on Torgersen Island. All birds (N=40) were subsequently released unharmed. The resulting diet samples were processed at Palmer Station. A nearly complete absence of all prey other than krill (*Euphausia superba*) characterized the 1992-93 samples. These krill were smaller than in previous seasons, averaging 35-40mm in length.

Adelie chick fledging weights (N= 322) were obtained between 5-23 February at beaches near the Humble Island rookery. Peak fledging occurred on 13 February, 6 days prior to last season; the average fledgling weight was 3.2kg.

Radio receivers and automatic data loggers were deployed at the Humble Island rookery between 13 January and 13 February to monitor presence-absence data on 40 breeding Adelie penguins instrumented with small radio transmitters. These transmitters were glued to adult penguins feeding 10-14 day old chicks. Analysis of the data has not yet been accomplished due to the size of the databases obtained. These results will be presented as part of the final report being delivered at a later date.

One-thousand Adelie penguin chicks were banded on 3 February as part of long-term demographic studies at AMLR colonies on Humble Island. The presence of birds banded in previous seasons was also monitored during the entire field season on Humble Island as part of these demographic studies.

A 100-nest sample was established on Humble Island to assess the chronology of breeding events, with relevant data being obtained every 1-3 days as weather permitted from 6 October to 1 April. Relative to last season, peak activity in a variety of breeding events occurred 6-10 days earlier. Variability between colonies was again evident and appeared to be correlated with snow cover present early in the breeding season.

Because of the longer field seasons being undertaken at Palmer Station, great potential exists for adding more of the CEMP Standard Methods to the suite of data being collected. In 1991-92, we successfully added Procedure B (chicks raised per breeding pair) to Standard Method A6.2 (breeding success). Procedure B, perhaps the most labor intensive of all the Standard Methods, was continued during 1992-93 to complement data being obtained with Procedure A (chick counts) and the proportion of 1- to 2-chick broods. This was also true of Standard Method A3.2 (breeding population size). Due to early season problems with access to the rookeries due to wind and pack ice, we again found it impossible to implement Procedure C (chicks raised per colony) and Standard Method A2.2 (duration of the first incubation shift). Data collection was again expanded to incorporate the months of October, November and December, which included weather and other environmental data as well.

12.3 Disposition of the Data: No diet samples were returned to the U.S. for analysis as all work was successfully completed at Palmer Station. All other data relevant to this season's research is currently on diskettes in our possession and will be made available to the Antarctic Ecosystem Research Group coincident with the final report on this season's activities due in July.

12.4 Tentative Conclusions: Adelie penguin breeding success was again high during 1992-93, but not significantly higher relative to the 1991-92 season (1.46 vs. 1.39 chicks creched/pair). Although the number of 2-chick broods present decreased, on average, by 10.3%, the overall number of chicks produced at 54 sample colonies was 7319, a 14.5% increase over last season. The factors responsible for this change are currently not known and must await further analysis of our data. As last year, the predominant component in the diets of Adelie penguins was the krill *Euphausia superba*. However, unlike last season, more krill in the smaller size classes dominated the diet samples (35-40mm vs. 45-50mm). We currently cannot provide any information on the relative availability of krill between seasons based on the telemetry data used to estimate the length of foraging intervals; analysis of these data is currently beyond the scope of this report due to the large size of the pertinent databases.

Mean Adelie penguin chick fledging weights did not differ significantly from those evident last season (3.20 vs. 3.20kg.). As last year, the fledging period again encompassed a 3-week interval (5-23 February), with peak fledging occurring on 13 February (vs. 19 February during 1991-92). The 6-day difference in peak activity of this breeding event was typical of the chronology of other breeding events this season, suggesting an earlier timing of breeding chronology. Compared to last season, 1992-93 was in general characterized by lighter than normal snowfall and pack ice.

12.5 Problems, Suggestions and Recommendations: This season was generally problem-free at Palmer Station. Minor problems with the telemetry equipment were again repaired on site, thus allowing this aspect of the research to achieve a potential comparable to last season. Although it is clear that some new Standard Methods can be added to the data being collected, predictable access to AMLR colonies due to weather

and pack ice, which tend to limit small boat (Zodiac) operations, continues to be a problem. As a result, Standard Methods that depend on predictable and consistent access to study sites are not likely to be successfully implemented at Palmer. We are continuing to investigate ways of obtaining data relevant to CEMP within the constraints imposed on us by Palmer's unique working environment, and will report potentially new alternatives to NMFS as they are found.

ACKNOWLEDGEMENTS

The entire scientific party is very grateful to Captain Frederick Jones and the officers and crew of the *Surveyor* for maintaining an atmosphere of cooperation and camaraderie throughout the cruise. Our success was due, in large measure, to their enthusiasm, professional competence, and attention to detail.

All departments contributed to our success. The electronic technicians helped to set up the CTD and underway data logging systems and kept the electrons flowing in the right direction; they helped the rest of us with our computers, printers, communications equipment, and just about anything that had a battery, wire, or silicon chip. The deck department helped us rig our nets, set up the acoustic tows, and ferry cargo. They also carefully deployed our equipment, lashed down our stray gear, and even spotted birds and whales that escaped our attention. The engineering department helped us fabricate a second towed body. The stewards adeptly handled our extra demands in an over-crowed wardroom. The survey department helped us sort plankton when we unexpectedly found ourselves shorthanded. They also worked tirelessly in conducting salinity calibrations. The officers provided a professional atmosphere and operated the ship in a safe manner.

Even more important was the cordial atmosphere aboard ship that was maintained throughout the cruise. The scientific party welcomed the friendship extended to them by the crew, many of whom offered welcome words of encouragement when times were difficult. Good shipboard atmosphere and communications contributed directly to our productivity.

One individual deserves special recognition: LT John Humphrey. As the *Surveyor's* field operations officer, he skillfully orchestrated the ship's resources to accomplish our goals. His attention to detail, his tolerant manner, and his quick smile contributed a great deal to the success of the cruise.