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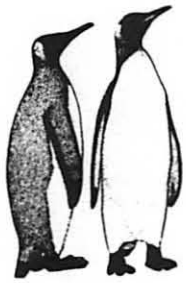

UNITED STATES
AMLR ANTARCTIC MARINE LIVING RESOURCES PROGRAM

AMLR 1995/96 FIELD SEASON REPORT

Objectives, Accomplishments and Tentative Conclusions

Edited by
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Southwest Fisheries Science Center
Antarctic Ecosystem Research Group

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BACKGROUND

The long-term objective of the U.S. AMLR field research program is to describe the functional relationships between krill, their predators, and key environmental variables. The field program is based on two working hypotheses: (1) krill predators respond to changes in the availability of their food source; 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 designated in the vicinity of Elephant, Clarence, and the eastern end of King George Islands, hereinafter called the AMLR study area (Figure 1). A field camp was established at Seal Island, a small island off the northwest coast of Elephant Island.

Shipboard studies have been conducted in the AMLR study area for eight consecutive austral summers to describe variations within and between seasons in the distributions of nekton, zooplankton, phytoplankton, and water types. Complementary reproductive and foraging behavior studies on breeding seals and penguins have been accomplished each austral summer at Seal Island. However, because Seal Island was recently found to be geologically unstable and possibly unsafe due to landslide hazards, research at the field camp was significantly abbreviated during the 1996 season. Research on the ecology of Adelie penguins has been conducted at Palmer Station during each austral spring and summer.

SUMMARY OF 1996 RESULTS

Shipboard surveys were conducted during two 30-day legs in the AMLR study area between mid-January and mid-March 1996. Two major water types were identified: Drake Passage and Bransfield Strait. A prevailing southwest to northeast water flow was seen across the AMLR study area. The flow was intensified in three zones: north of Elephant Island, roughly following the topographic trend of the shelf-break; in a narrow band paralleling the northern boundary of the Bransfield Strait south of King George Island; and a more northerly trend between Elephant and Clarence Islands. High phytoplankton biomass values were found in waters over the continental shelf northeast of Elephant Island during Leg I, while during Leg II the richest areas were found east of King George Island. Relatively high phytoplankton biomass was found south of Elephant Island during both legs. The lowest phytoplankton concentrations were found in the northwest portion of the study area, in Drake Passage waters. During both legs, areas of high krill density were mapped in wide bands along the north side of King George and Elephant Islands where water depth was greater than 200m. The mean krill abundance value from the Elephant Island area in January 1996 was the highest observed there since March 1983 and is mostly due to the large numbers of juvenile krill. The krill recruitment index, based on the relative proportion of total krill comprised by the 1-year old age group during Leg I's survey, was 0.622 (s.e. = 0.849). This value was one of the highest recorded over the past 18 years and indicates strong recruitment of the 1994/95 year class. Strong recruitment results from good spawning success and survival of early stages spawned during the previous year. This was associated with large proportions of advanced female maturity stages during January-March 1995 and extensive sea-ice conditions in the Antarctic Peninsula region during winter 1995. These results support hypothesized relationships between krill recruitment success, krill spawning seasonality, and winter sea-ice conditions. Similar to 1995, salp abundance was relatively low

this year, which seems to be correlated with the extensive sea-ice cover of the previous winter. On Seal Island, the highest count of male fur seals hauled out was substantially larger than the number recorded during the same period in the previous season. Fur seal pup production was considerably higher compared to the previous season. Breeding numbers of chinstrap penguins this season were lower than average. Estimates from this year may indicate the lowest breeding population recorded. However, penguins that nested produced chicks whose survival and growth appeared to be normal. The macaroni penguin population appeared to be near normal compared to historical averages. At Palmer Station, most of the measured parameters related to breeding biology of Adelie penguins exhibited a slight decrease between the 1994/95 and 1995/96 seasons, including breeding population size, percent two-chick broods, total chick production, and chick fledging weights. The exception to this trend was breeding success, which exhibited an increase.

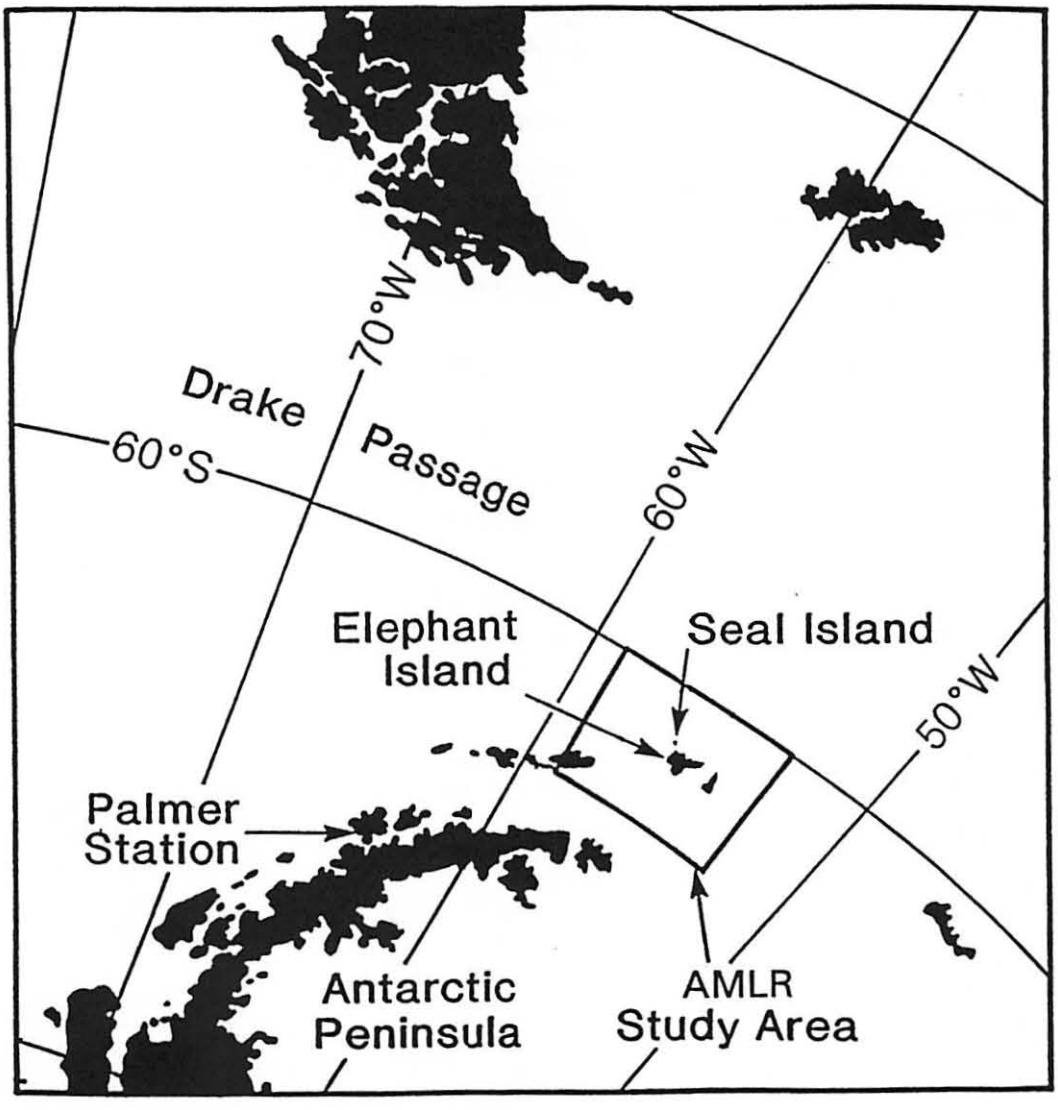

Figure 1. Locations of the U.S. AMLR field research program: AMLR study area, Seal Island, and Palmer Station.

2. Record presence of known-aged and previously instrumented or handled pinnipeds and seabirds.

3. Weigh Antarctic fur seal pups at a standard time during the field season.

4. Weigh and measure fledging chinstrap penguin chicks.

5. Dismantle and remove camp structures no longer in use.

Palmer Station

1. Determine Adelie penguin breeding population size.

2. Determine Adelie penguin breeding success.

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

4. Determine Adelie penguin chick weights at fledging.

5. Determine adult Adelie penguin foraging trip durations.

6. Band 1000 Adelie penguin chicks for future demographic studies.

7. Determine Adelie penguin breeding chronology.

Fraser, et. al.

AMLR

9. Seabird research undertaken as part of the NMFS/AMLR ecosystem monitoring program at Palmer Station, 1995/96; submitted by William R. Fraser, Donna L. Patterson, Eric J. Holm, Karen M. Carney, and John Carlson.

9.1 Objectives: The AMLR program of the National Marine Fisheries Service (NMFS) provides information needed to formulate U.S. policy on the conservation and management of resources living in the oceans surrounding Antarctica. The program is in support of U.S. participation in the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), which established a program for managing the living resources of the Antarctic ecosystem through international cooperation. The AMLR program emphasizes directed research undertaken for the express purpose of providing for the effective conservation of the marine living resources of the Antarctic ecosystem, which is the primary goal of CCAMLR.

The main objective of U.S. directed research is to provide information needed to detect, monitor, and predict the effects of fishing and associated activities on target, dependent, and related species of the Antarctic marine ecosystem. A key component of this effort involves monitoring seabird populations at Palmer Station, which is one of two sites on the Antarctic Peninsula where long-term research has been undertaken in support of U.S. participation in the CCAMLR Ecosystem Monitoring Program (CEMP). Objectives during 1995/96, the ninth season of field work at Palmer Station on Adelie penguins (*Pygoscelis adeliae*), were:

1. To determine Adelie penguin breeding population size,

2. To determine Adelie penguin 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 adult Adelie penguin foraging trip durations,

6. To band 1000 Adelie penguin chicks for future demographic studies, and

7. To determine Adelie penguin breeding chronology.

9.2 Accomplishments: Field work at Palmer Station was initiated on 10 October 1995 and terminated on 27 March 1996. The early start date was aided by joint funding from the National Science Foundation's (NSF) Office of Polar Programs. In 1990, NSF selected Palmer Station as a Long Term Ecological Research (LTER) site, and 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 NMFS and NSF, field season duration at Palmer Station now covers the entire five month Adelie penguin breeding season.

Breeding Biology and Demography.

Adelie penguin breeding population size was determined by censusing the number of breeding pairs at 54 sample colonies during the peak egg-laying period (21-23 November 1995). These colonies contained 5457 pairs, which is a 2.4% decrease in population relative to the 5591 breeding pairs censused 29 November - 2 December 1994.

Breeding success was determined by following a 100-nest sample on Humble Island from clutch initiation to creche. A slight increase in breeding success was recorded this season, with birds creching 1.61 chicks per pair, or 0.12 chicks more than were creched per pair last season. As in past seasons, two other indices of breeding success were also determined. The proportion of one and two chick broods was assessed at 49 sample colonies between 5-6 January 1996. Of the 2844 broods censused, 63.5% (N=1805) contained two chicks, a slight decrease from the 66.5% reported in January 1995.

Chick production was determined by censusing chicks on 18 and 20 January 1996 at 54 sample colonies when approximately 2/3 of them were in the creche stage. Production at these colonies totaled 6532 chicks, a decrease of 2.3% from January 1995 when 6685 chicks were censused.

Chick fledging weights were obtained between 4-23 February 1996 at beaches near the Humble Island rookery. Peak fledging occurred on 10 February, which is one day earlier than in February 1995. Compared to February 1995, the average fledgling weight of the 263 Adelie chicks sampled decreased by less than 50g (2.96 vs 2.92kg). Data specific to the chronology of other breeding events are still under analysis and will be reported later.

As part of continued demographic studies, 1000 Adelie chicks were banded on 4 February 1996 at selected 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 studies.

Foraging Ecology.

Diet studies were initiated on 11 January 1996 and terminated on 17 February 1996. During each of the eight sampling periods, five adult Adelies were captured and lavaged using a water off-loading method as they approached their colonies to feed chicks on Torgersen Island. All birds (N=40) were released unharmed and the resulting diet samples processed at Palmer Station. The early samples contained a mix of prey items dominated by the presence of the euphausiids *Thysanoesa macrura* and *Euphausia superba*. Of these, only the krill *E. superba* was prevalent in the diets later in the season; fish were also noted in 50% of the diet samples, a marked increase relative to last season. The distribution of krill size-classes was bimodal, with very large (46-55mm) and very small (16-25mm) krill characterizing the samples. This distribution was significantly different from the one observed last season when only large krill were the dominant component of the diet.

Radio receivers and automatic data loggers were deployed at the Humble Island rookery between 9 January 1996 and 24 February 1996 to monitor presence-absence data on 33 breeding Adelie penguins carrying 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.

9.3 Tentative Conclusions: The 1995/96 season was characterized by the persistence of heavy winter/spring pack ice until December, conditions nearly identical to those encountered last season. Most of the measured parameters related to the breeding biology of Adelie penguins in the Palmer Station vicinity exhibited a slight decrease between the 1994/95 and 1995/96 seasons. This included changes in breeding population size (5591 vs. 5457 pairs), percent two-chick broods (66.5% vs. 63.5%), total chick production at sample colonies (6685 vs. 6532 chicks), and chick weights at fledging (2.96 vs. 2.92kg). The exception to this trend was breeding success, which exhibited an increase (1.49 vs. 1.61 chicks creched per pair). As suggested last season, there is continued evidence that using a 100-nest sample to determine breeding success, as suggested by the CEMP protocols, may not adequately reflect real trends in this parameter from season to season that may be due to changes in the marine environment. The long-term data sets accumulated at Palmer Station are suggesting that breeding success is colony specific, with year-to-year variability within and between colonies being largely determined by environmental features specifically associated with the terrestrial nesting habitat. Variability in snow accumulation, for example, appears to "swamp" the potential effects of changes in the marine system, at least as measured by a 100-nest sample. This continues to suggest that breeding success needs to be measured by including both more nest sites and more colonies to fully account for the effects of changes in the marine system. Despite similar winter/spring pack ice conditions, last season was characterized by a 2-week delay in the timing of the January blooms, a feature not observed during the 1995/96 season.

Relative to last year, changes in the foraging ecology of Adelie penguins during 1995/96 included shorter foraging trip durations (24 vs.13 hours, based on a partial analysis of the data), a bimodal distribution in krill size classes present in the diet samples, and an increased presence of fish in the diets. This pattern exhibits close correspondence with features observed during the 1991/92 season, which also followed a heavy ice year (1990/91) and included relatively "normal" conditions in the timing of the January blooms. These data continue to support the hypothesis that interactions between winter/spring sea ice conditions and the timing of blooms may be the key variables affecting the abundance and distribution of prey in the foraging environment of Adelie penguins in the Palmer Station area. Aspects and implications of this hypothesis are currently being examined in a series of analyses and publications that are either in press or submitted, and which summarize AMLR, LTER and related data for the Palmer area since 1974.

9.4 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 are currently on diskettes at the Antarctic Ecosystem Research Group.

9.5 Problems, Suggestions and Recommendations: As suggested last season, it is becoming more apparent that environmental variables such as sea ice extent and snow deposition, among others, may be key determinants of at least some aspects of the annual variability inherent in some of the monitored parameters. However, at the moment, there is no formal requirement in effect by which to standardize the collection and reporting of environmental data. It is our opinion that the development of such standards would greatly aid our interpretive potential within and between CEMP monitoring sites. It is also apparent that some of the CEMP protocols, as they are currently being implemented, may lack the sensitivity to provide the type of information being requested by CEMP. This would argue that these protocols need to be updated, an effort that was instituted at Palmer Station in 1995/96 by a developing a series of experiments to contrast results obtained by using older vs. newer methodologies. This effort is expected to continue next season.