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ASSESSMENT OF THE STOCK CONDITION OF PELAGIC ARMORHEAD ON SOUTHEAST HANCOCK SEAMOUNT

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ABSTRACT

The relative abundance of pelagic armorhead, Pseudopentaceros wheeleri, was assessed by using bottom longlines during six research cruises to the Southeast Hancock Seamount between January 1985 and August 1987. Abundance neither increased nor decreased continuously during this period and instead showed large fluctuations, which were due to the irregular recruitment of fish to the seamount and their subsequent rapid mortality. The sustained low catch rates of the commercial trawl fishery since 1978 suggest that insufficient brood stock was maintained and the armorhead stock would probably benefit from greater protection than that afforded by the 1986 fishing moratorium on the Hancock Seamounts.

INTRODUCTION

The trawl fishery for pelagic armorhead, Pseudopentaceros wheeleri, on the mid-Pacific seamounts began with an exploratory venture by the Soviets in 1967. This early effort was expanded, and by 1972, the armorhead stock supported a full-scale commercial fishery, which included both Soviet and Japanese vessels. The fishery soon had a pronounced effect on the armorhead stocks, as evidenced by the Japanese trawlers' catch rates, which plummeted on the Hancock Seamounts from nearly 80 metric tons (t)/h in 1972 to less than 1 t/h in 1978 and remained at less than 1 t/h through 1984 (Fig. 1). This 100-fold decrease in catch per unit effort (CPUE) indicated that the armorhead stock was severely stressed and prompted a 6-yr moratorium, beginning in 1986, on all commercial fishing activities for armorhead within the U.S. Exclusive Economic Zone surrounding the Hancock Seamounts.

With the termination of the Japanese fishery and its record of CPUE on the Hancock Seamounts, continued monitoring of the armorhead stock required an ongoing research stock assessment program. Although fishery research on the Hancock Seamounts had been conducted by the Honolulu Laboratory of the National Marine Fisheries Service (NMFS) since 1976, research using standardized assessment techniques to collect a time series of stock abundance data was not initiated until 1985. The new measures of stock abundance used for this time series, however, cannot be standardized against Japanese trawl CPUE until a fishery resumes. Consequently, current estimates of stock abundance cannot be compared to the historical Japanese CPUE record.

The new time series was based on data obtained with Kali[1] longlines (Shiota 1987), rather than bottom trawls, because the research vessel used by the Honolulu Laboratory is not well suited for trawling and because bottom trawls cannot sample armorhead inhabiting the steep sides of the seamount. Initially, we used the average catch per hook from the longlines as a measure of stock abundance, but after two cruises, it became clear that this measure could be biased because armorhead density was so high that, upon retrieval of the gear, few hooks remained unoccupied and baited. When such gear saturation occurs, catch per hook will cease to increase with armorhead abundance and will diminish with the catch of other species that compete with armorhead for hooks.

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

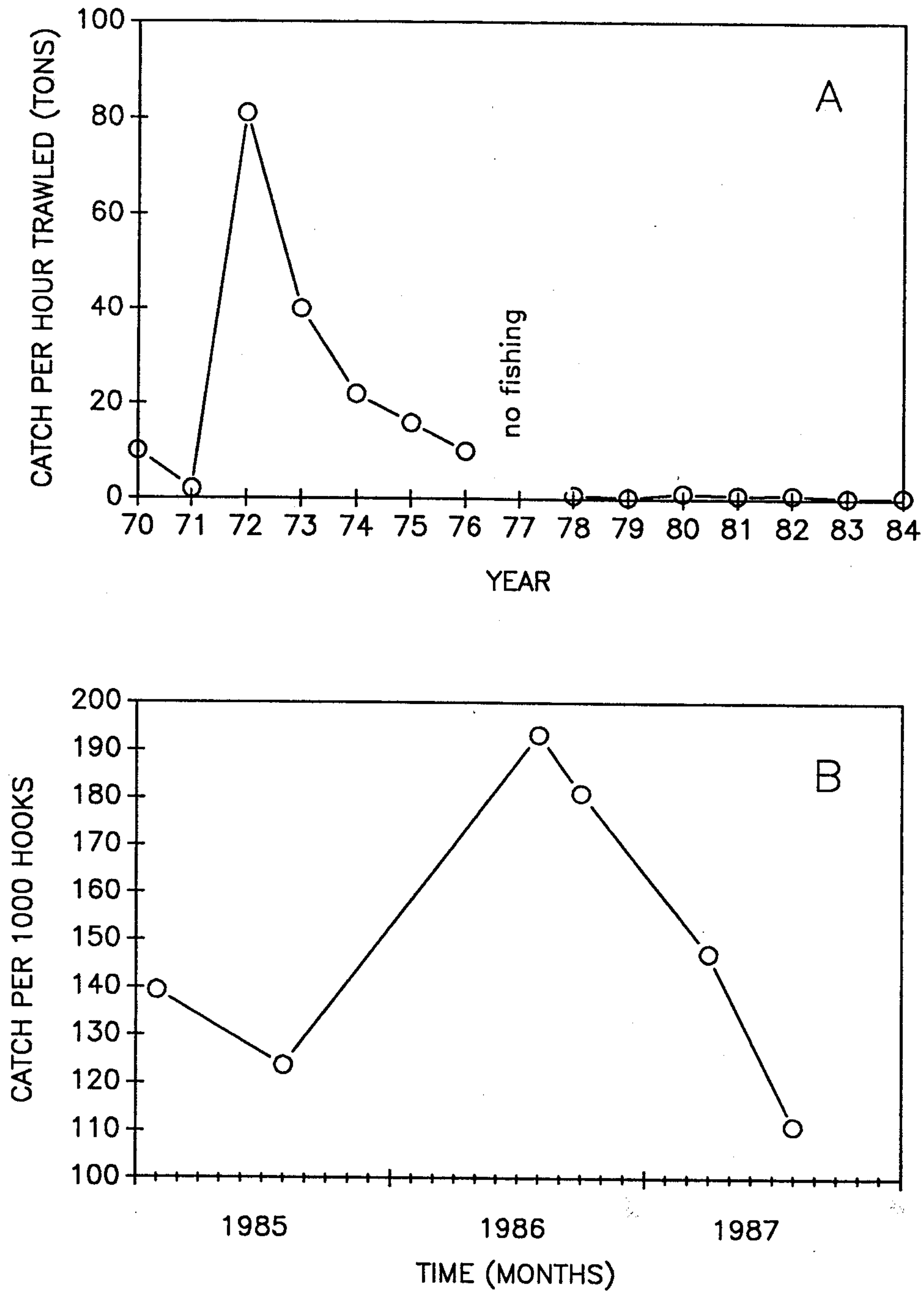

Figure 1.--(A) Catch per hour of the Japanese trawlers fishing the Hancock Seamounts. Data for years up to 1981 were obtained in Uchida and Tagami (1984); data for subsequent years were compiled from U.S. foreign observer reports on file at the Honolulu Laboratory. (B) Research longline catch per hook on Southeast Hancock Seamount for the six stock assessment cruises in 1985-87.

This problem led to a search for other ways of using longlines for stock assessment. One approach that showed promise was the use of small timers attached to each hook and activated when a fish strikes (Somerton et al. in review). The time to capture of each fish on a longline can then be used to compute an index of abundance that, unlike CPUE, is unaffected by gear saturation and interspecific competition for hooks. Hook timers have been used on three of the longline stock assessment cruises, and a report dealing with this method of stock assessment is forthcoming (Somerton in prep.). Here, I will consider only the time series of armorhead catch per hook (CPUE).

METHODS

The Southeast Hancock Seamount was sampled with longlines six times; the dates of the sampling and the effort, expressed as the number of hooks, are shown below:

Date	Hooks
2-26 February 1985	2,016
20 June-15 July 1985	2,718
11 August-8 September 1986	6,711
31 October-11 November 1986	2,948
12-27 April 1987	3,636
16-24 August 1987	4,534

Armorhead abundance was initially measured in terms of catch per 1,000 hooks, but this measure was modified to minimize two potential sources of bias. First, longlines with hook timers have a lower CPUE than longlines without timers when both types of gear are fished side by side (Somerton et al. in review). Hook timers were used on one-half of the hooks on the August and October 1986 cruises, on all of the hooks on the August 1987 cruise, and on none of the hooks on the remaining cruises; therefore, one of the gear types had to be adjusted for the difference in catchability to create a coherent time series. Because hook timers became the standard gear, the CPUE of hooks without timers was corrected for the presence of timers by using the CPUE ratio of the two gear types in the side-by-side comparisons.

Second, preliminary studies indicated that the depth distribution of armorhead might change over time and that such a change could produce variation in CPUE unrelated to the variation in armorhead abundance. This was minimized by separating the seamount into four depth strata, determining the CPUE within each stratum, then calculating the weighted average CPUE by using strata areas as the weighting factors.

RESULTS AND DISCUSSION

The longline CPUE's for the first six stock assessment cruises to the Southeast Hancock Seamount are in Figure 1. Over this 3-yr period, the CPUE's have neither increased nor decreased continuously and instead have shown relatively large fluctuations: CPUE's increased by 60% from 1985 to 1986 and decreased by 27% from 1986 to 1987. This fluctuation has occurred because armorhead arrive at the seamounts sporadically and subsequently die rapidly.

Knowledge of several aspects of the life history of armorhead are crucial to understanding the evidence supporting the above explanation of armorhead fluctuations. Armorhead spend 1.5 to 2.5 yr in the epipelagic zone of the northeast Pacific before returning as adults to the mid-Pacific seamounts where they spawn and remain until they die (Boehlert and Sasaki 1988; Humphreys et al. in press). When armorhead arrive at the seamounts; they are very fat, but because of the rigors of spawning and their apparent inability to obtain sufficient prey, they lose weight and eventually become quite emaciated. Since the beginning of the stock assessent cruises, this change in weight has been monitored with an index of fatness (body depth divided by length). Provided that the fatness index (FI) is the same for all armorhead when they arrive at the seamounts and that it decreases continuously and uniformly with time, then it can be used as a measure of time since arrival.

Frequency histograms of FI for the six stock assessment cruises (Fig. 2) each have two or three distinct humps or modes. This pattern indicates that the arrival of armorhead at the Hancock Seamounts was concentrated over relatively short time periods that were followed by periods with little or no recruitment. These modes represent groups of fish, or cohorts, that can be followed from one histogram to the next as they progressively decrease in fatness. In January 1985, two modes were present, one at 0.19 FI and the other at 0.22 FI. In June 1985, the same two modes were present as well as a new mode at 0.29 FI. The histograms for the subsequent four cruises were each dominated by a single mode, which decreased from 0.27 FI in August 1986 to 0.24 in August 1987. The most likely interpretation of this pattern is that the fat fish first seen in June 1985 were the forerunners of a large recruitment of fish that apparently was completed by August 1986. Little or no recruitment occurred between October 1986 and August 1987. Comparing the recruitment pattern (Fig. 2) to the longline CPUE's (Fig. 1), it is clear that armorhead abundance on the seamount increased markedly with the arrival of a single group of recruiting fish.

High recruitment variability is not the sole cause of the observed changes in armorhead abundance, because it does not explain the rapid decline in abundance after recruitment. The rapid decline is likely due to a high mortality rate. Mortality rate of armorhead was estimated by using the histograms of FI in conjuction with the longline CPUE's to follow the abundance of individual cohorts over time (Somerton and Kikkawa in prep.). For two cohorts, the estimate of annual natural mortality rate was about 0.70, which is an exceptionally high value for fish as large as armorhead

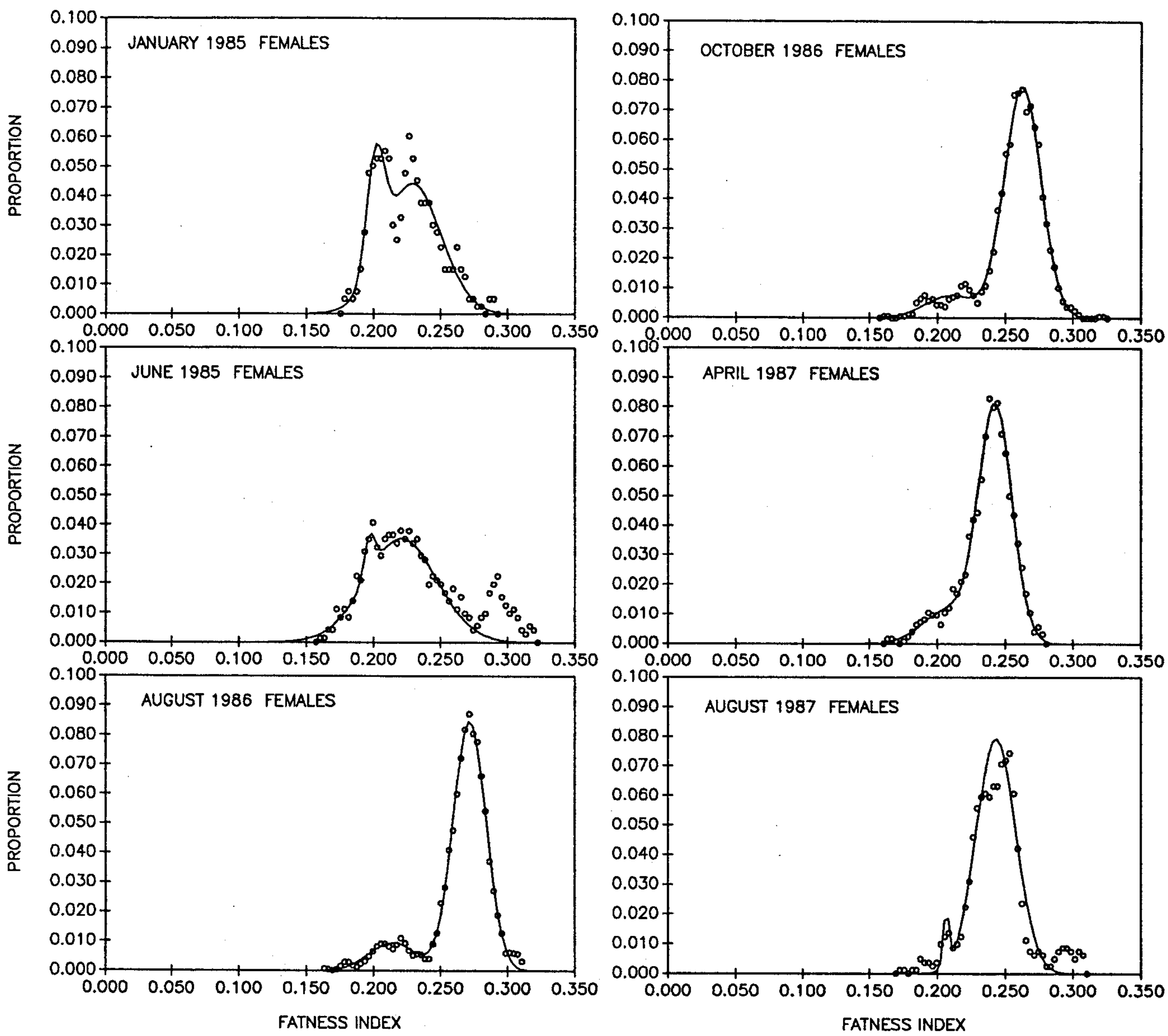

Figure 2.--Frequency histograms of fatness index for female armorhead on the six stock assessment cruises in 1985-87. A line delineating the composit fatness distribution of two fully recruited cohorts is also shown for each cruise. This line is used to statistically define the groups and is described more fully in Somerton and Kikkawa (in prep.).

(by comparison, the natural moratality rate of opakapaka is 0.31, less than one-half as high (Ralston and Kawamoto 1988)). Without a fishery, roughly 50% of a recruited cohort will die each year, and few armorhead live beyond 2 yr after recruitment.

If an armorhead fishery were to begin on the Hancock Seamounts, the already high variability in armorhead abundance would become higher still as fewer fish survived to their second year after recruitment. This means that the armorhead fishery is inherently targeted on recruiting fish and that successful management strategies must deal with the problem of preserving sufficient brood stock. The fishing moratorium on the Hancock Seamounts was an attempt to preserve a brood stock, but fishing has not occurred for nearly 4 yr, and no sustained increase in recruitment has occurred. One problem is that all available evidence (Borets 1979) indicates that the progeny of Hancock Seamount armorhead commingle during their juvenile phase with the young armorhead from other seamounts and that recruitment of an individual to a particular seamount is probably a random event unrelated to the seamount of origin. Considering that, historically, only 10% of the armorhead stock occurred within the U.S. Exclusive Economic Zone, the moratorium likely is insufficient protection to rebuild the stock, and some form of international management will be required.

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