Distribution Ratio of Useable/Trash Fish Caught by Long-Line Fishing

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Abstract

The present survey was conducted to find out the distribution ratio of useable/trash fish caught by long-line fishing. The purpose of the survey was to obtain fundamental data for examining the homeostatic ecosystem in the ocean, as an application of microcosmology.

The long-line fishing was repeated 8 times in June 1980 in the East Indian Ocean by the Kagoshima Maru (1038 t) of Kagoshima University. The operations were carried out by 7042 hooks, consisting of 3200 hooks with synthetic squids and 3842 hooks with frozen saury.

The total number of fish caught was 166 individuals. Therefore, the fishing rate was calculated to be 2.4%. Tuna and horse mackerel were classified into the "useable fish", and shark and similar fish were shorted into the "trash fish". The distributions of useable and trash fish were estimated to be: 66.1 to 33.9% in body weight, and 54.8 to 45.2% in fish number, respectively.

INTRODUCTION

For the most part of the fisheries history, trash fish have been disregarded as an animal resource from the oceans. Many biologists have concentrated their study on the ecology and physiology of commercial species only. The trash fish, however, are not negligible from the ecological point of view, since they comprise an important part of the consumer group in the aquatic ecosystem (CLARK, 1969). The trash fish for mankind are not trash for all the other organisms in natural waters. Similarly, the term "useable fish" is one of economic derivation, and is not based on an ecological point of view. In this paper, these terms are employed only for convenience.

The fishermen remove the useable fish from the sea to the land. Population densities of the useable fish sometimes gradually decreased due to over fishing. On the contrary, most of the trash fish show a strange shape, and are immediately thrown away from the fishing boat into the sea. Therefore, we could not find any trash fish in the fish market. A boarding of the fishing boat is the only way to study the ecology of trash fish.

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The present survey was then conducted to obtain the fundamental data for examining the homeostatic ecosystem in the ocean (ODUM, 1971). The distribution ratio of the useable/trash fish caught by a long-line fishing boat in the East Indian Ocean is presented in this paper. The results are discussed as an application of microcosmology in the rotifer culture (HIRATA & YAMASAKI, 1980).

METHODS

The ling-line fishing was repeated 8 times between the 14th and 21st of June, 1980, in the East Indian Ocean on board the Kagoshima Maru of Kagoshima University. The operation stations, St. 1-8, were located between N 1°50′-S 3°10′ and E 90°50-E 91°45′, as shown in Fig. 1. The fishing was done by 7042 hooks with 3842 frozen

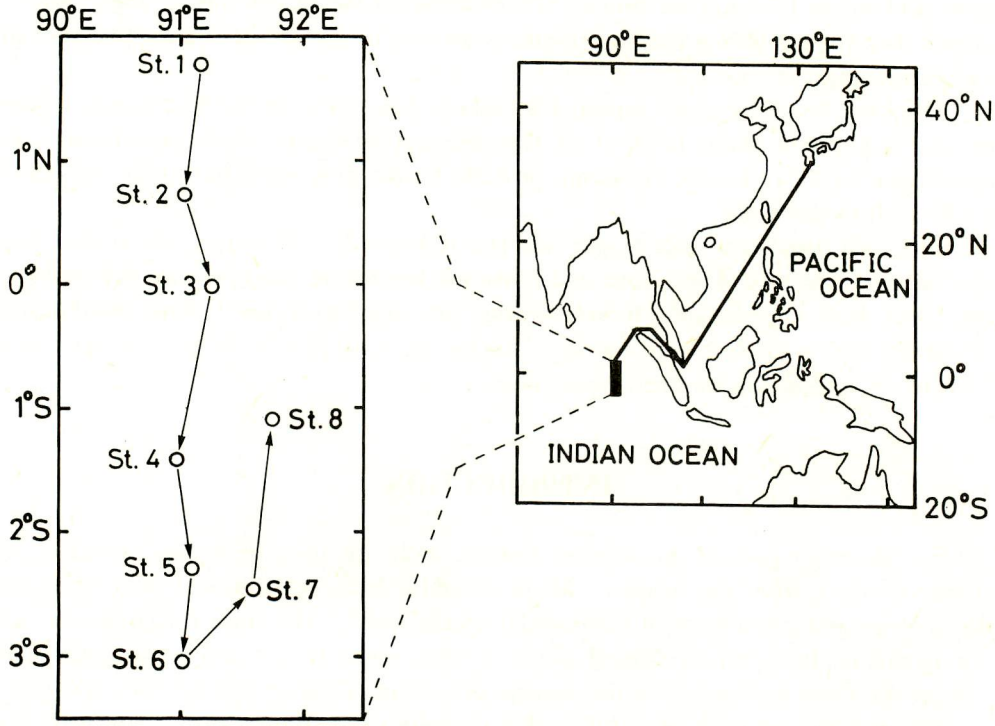

Fig. 1 Location map of the long line fishing survey.

saury and 3200 synthetic squids (products of Yamashita Tuna Bait Co. Ltd., Type No. 5.5-11.0). The lines were set in the early morning between 5 and 8 a.m., and taken up in the evening around 4 to 9 p.m.

During the period of operations, vertical variations of: water temperature, salinity, pH, and dissolved oxygen content at each station were observed by routine methods (Japan Meteorology Society, 1972). The water depth over the fishing grounds ranged from about 4000 to 5000 m. The water samples were collected by Nansen bottoles between 0 and 1000 m depth.

All fish caught by the lines were identified into species or familiy, and measured for body length and weight on board. The head and viscera of the tuna were immedi-

ately removed, and weighed, in order to determine the distribution ratio of useable/unuseable parts of the fish.

RESULTS

During the operations, 114 fish of 15 families, 17 species, and 5 unknown species were caught. They were broadly divisible into two categories; useable and trash fish. The classification was based on their marketable value from an economical point of view. Kihada *Neothunus albacora*, Makajiki *Makaira mitsukurii*, Mebachi *Parathunnus sibi*, Basho-kajiki *Histiophorus orientalis*, Kurokawa-kajiki *Istiomax indicus*, Sawara *Scomberomorus niphonius*, Shiira *Coryphaena hippurus*, and Aburasokomutsu *Lepidocybiun flavobrunneum* were classified as useable fish. On the contrary, Yoshikiri *Prionace glaucus*, Yogore *Carcharchinus longimanus*, Hiragashira *C. gangetticus*, Onaga-zame *Alopias profundus*, Shumoku-zame *Sphyraena lewini*, Mizuuo *Alepisaurus borealis*, and Ei Rajiformes spp. were divided into the trash fish group. Common names mentioned above are presented in Japanese.

Distribution ratios in each group with regard to number and weight are represented in Fig. 2-A and -B, respectively. The ratios of useable/trash fish were calculated to be about 55/45 in fish number, and 66/34 in body weight. Here, the residues of useable fish shared 5.5 parts of total body weight, and were sorted into the trash fish as shown in Fig. 2-B.

Species compositions of the useable and trash fish are illustrated in Fig. 3, especially the trash fish in Table 1. The dominant species of useable fish was Kihada *N. albacora*

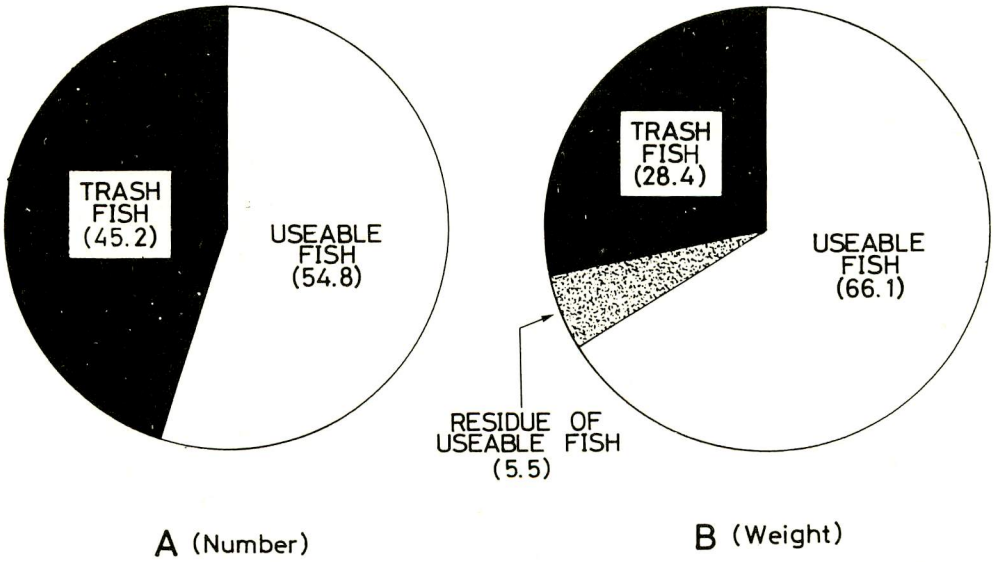

Fig. 2 Compositions of useable and trash fish in number and body weight.

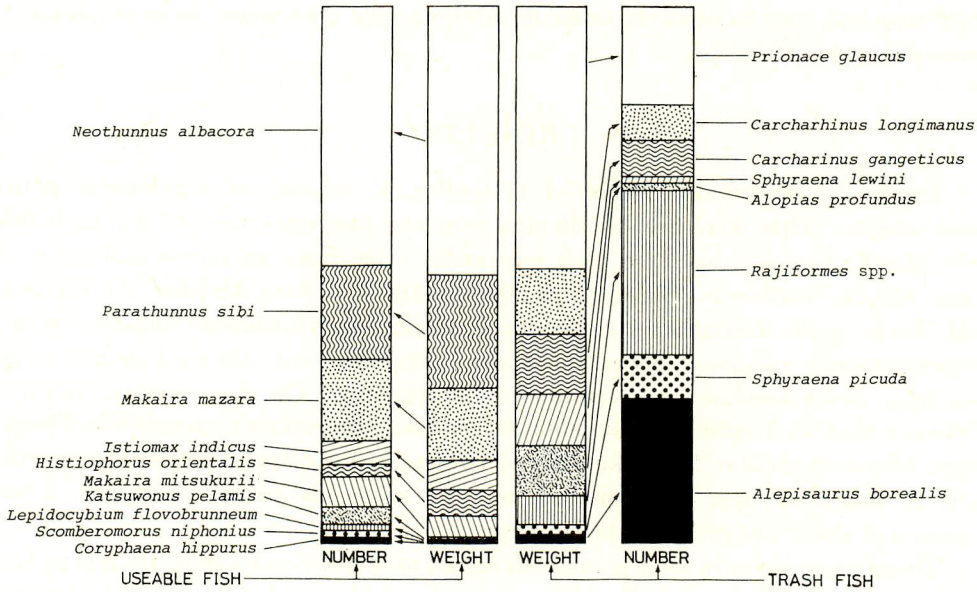

Fig. 3 Compositions of useable and trash fish in number and body weight.

Table 1. Species composition and total weight of trash fish during the survey.

Species	Fish caught	
	Number	Weight (kg)
Alepisaurus borealis	20	14.7
Sphyraena picuda	6	22.6
Alopias profundus	1	110.0
Carcharhinus longimanus	5	145.0
Chrcharhinus gangeticus	5	132.0
Prionace glaucus	14	582.5
Sphyraena lewini	1	113.0
Rajiformes spp.	23	65.3
Total	75	1185.1

in both number and weight. In case of the trash fish group, Yoshikiri *P. glaucus* was highly dominant in body weight; not in the fish number. Many Mizuuo *A. borealis* and Ei Rajiformes spp. were caught, but their body weights were lighter than the sharks.

The results of oceanographic observation were represented in Fig. 4. The surface water generally extended to a depth of 100 to 200 m. Average water temperatures in 0 and 1000 m depth were 29.6 and 6.8 ℃, respectively.

Discussion

In this survey, the distribution ratio of useable/trash fish was approximately 66/34

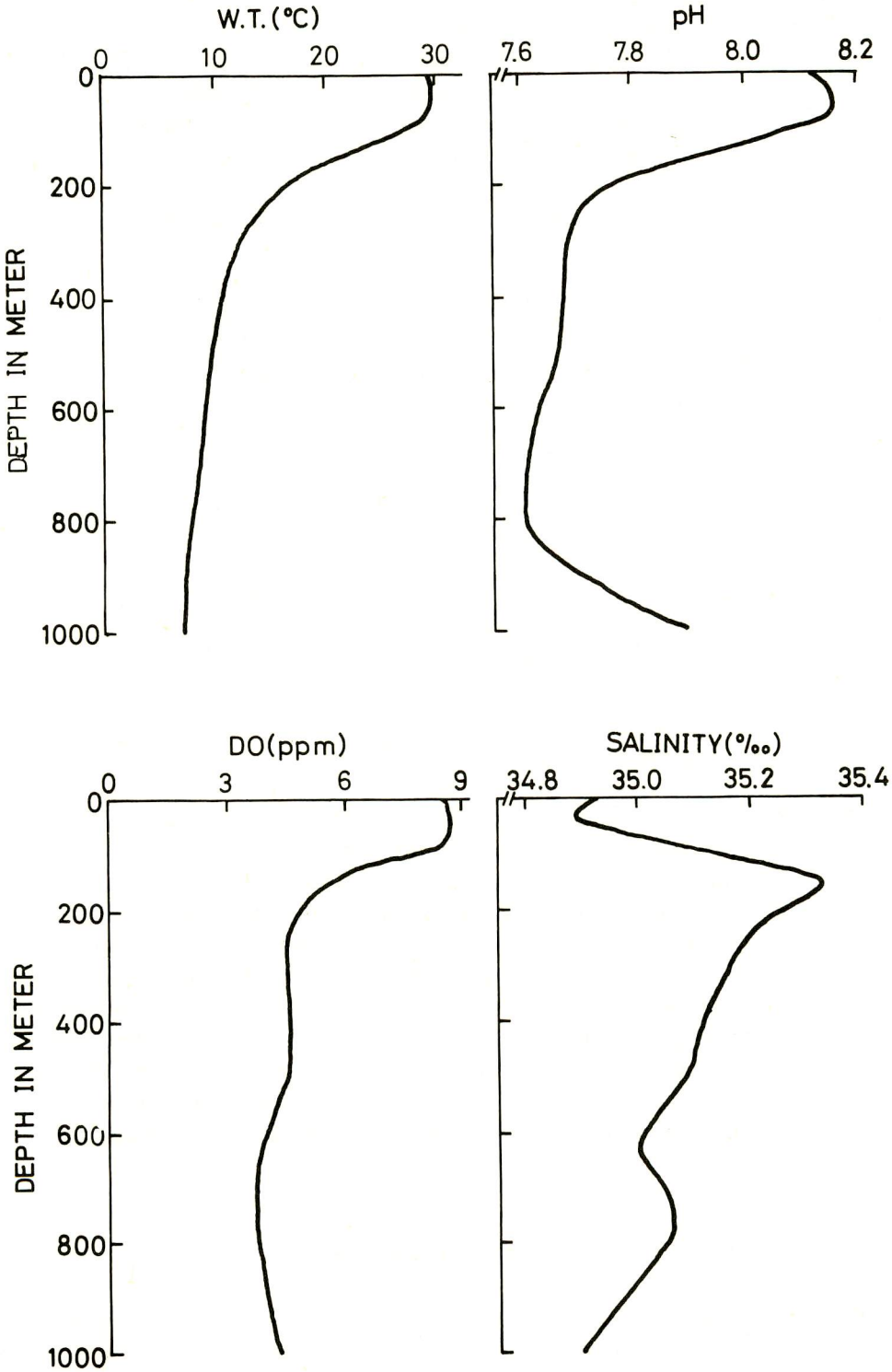

Fig. 4 Average vertical profiles of : water temperature, pH, dissolved oxygen and salinity at the fishing stations (St. 1-8).

in their body weight. This ratio was probably the first calculation by the longline fishing method, since most of the trash fish are usually immediately thrown away from the boat. The resources of trash fish have not been examined before this present time.

According to the statistic report of the Japanese fisheries industry (Statistics and Information Department, 1980), average annual catch of tuna by long-line fishing was 302,300 tons over the last ten years (Table 2). The average annual amount of

Table 2. Annual variation of tuna catch by long-line fishing (after Statistics and Information Department, 1980).

Year	Nomber of boat	Amount of tuna catch (× 1000 t)
1969	2558	326
70	2443	304
71	2443	282
72	2347	287
73	2455	299
74	2028	294
75	2136	290
76	2221	295
77	2154	320
78	2149	326*
Mean	2292.5	302.3

*200 t in deep sea areas, 101 t in near-sea areas, and 28 t in coastal waters.

trash fish could be estimated to be 155,730 tons (= 302,300 × 34/66). Those trash fish, however, accumulated on the bottom of the ocean year by year.

The water temperatures observed in this survey were 28.3-29.7 ℃ in the surface water, and 6.3-7.9 ℃ in 1000 m deep. The water depth in the present fishing ground, however, ranged from 4000 to 5000 meters. The temperature at the bottom of the deep sea is usually about 3-4 ℃ (SVERDRUP, et al ; 1972). The decomposition and mineralization under such low temperatures are extremely decelerated. This results in the reduction of energy flow in the oceans, and thus, is a serious problem from the ecological point of view (WATT ; 1968). A sort of bioconversion system (SLESSER & LEWIS ; 1979) based on microcosmology (HIRATA ; & YAMASAKI ; 1980), and a study of ecosystem including the trash fish are neccessary for promoting the energy flow in the oceans.

ACKNOWLEDGEMENTS

We wish to express our thanks to Captain Professor Mr. S. UEDA and Chief Engineer Mr. T. YAMAGUCHI, Kagoshima Maru of Kagoshima University, for providing the oportunity of the present survey, and to Mr. W. NAGATA, graduate student of our laboratory, for helping in the preparation of the English text.

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