

Fig. 2: Composition of the fishes obtained by vertical Handline fishing in the eastern part of the Andaman Sea in February 1973.

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### A Study of the Catch Data of the JURONG in the South China Sea in 1971 and 1972

by

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#### Abstract

The semi-commercial bottom trawl fishing by the training vessel JURONG in the South China Sea in 1971 and 1972 was confined to three areas at its south western portion. The positively skewed frequency distributions of catch per hour assumed approximately the shape of a normal curve when the yield was transformed logarithmically. Sample statistics from these transformed values form the basis of discussion of the yields for 1971 and 1972 in relation to fishing seasons and types of nets used.

Yield records from JURONG showed that the catch in waters off Trengganu (northeast coast of West Malaysia) was poorer than that of Tioman and Sarawak. These yields were briefly discussed together with values obtained by the R/V CHANGI. In the area off Sarawak, the Engel II net obtained much better catches than the four seam net.

The percentage composition of dominant fish categories from Tioman and Sarawak are also discussed.

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#### 1. INTRODUCTION

For the purpose of providing shipboard training for the fishing technician trainees of the Fisheries Training Centre a joint Singapore FAO/UNDP project, the training vessel JURONG carried out bottom trawl operations in known fishing grounds in the South China Sea from 1971. The vessel tended to fish in grounds where good catches were anticipated and to continue fishing in grounds where good catches were obtained. The catches could therefore be regarded as semi-commercial in nature and probably good indicators of the conditions at the time the areas were fished.

A study of these catch data, made available to the Marine Fisheries Research Department, Southeast Asian Fisheries Development Center (SEAFDEC), is presented in this paper.

## 2. BACKGROUND OF DATA

The JURONG, maintained by the Fisheries Training Centre weighs about 210 G.T. and has a 750 h.p. engine.

Fourteen fishing cruises were made to the south western part of the South China Sea in 1971 and 1972 as shown in Table I and Fig. 1. These were to the north of Sarawak, the area around Pulau Tioman and in waters off the northeast coast of West Malaysia (Trengganu). All fishing operations were performed during the day.

During all cruises to off Sarawak in 1972 two types of nets were used the so-called four seam (headrope length 51.5 m) and Engel II (headrope length 75.5 m) nets. These nets were trawled at similar speeds and durations. At all other times and areas only the four seam net was used.

When the catch was landed on deck, the fish were sorted into various categories and weighed separately.

## 3. RESULTS & DISCUSSION

### 3.1 Mean catch and variation

The frequency distribution of the catch (in kg/hr) was obtained for each of the groups of cruises of Table I, and their frequency histograms are shown in Fig. 2. They are far from normal in shape. Since the magnitude of the variances,  $s^2_x$ , were much greater than that of their means and tended to increase with the mean catch (Table II), a logarithmic transformation (using  $\log(x+1)$ , where  $x$  is the catch in kg/hr) was carried out. The frequency distributions thus obtained appeared to be more normal in shape (Fig. 3) and the variances were stabilised.

The means and variances were calculated for the transformed data and used for deriving the expected frequency distributions of normal curves with the corresponding

numbers of samples, means and standard deviations (Fig. 3). The corresponding observed and expected frequency distributions were compared by the chi-square test. It was found that in each case, the transformed frequency distributions were good fits with the expected at 95% probability level. Hereafter, the transformed data will be used. A logarithmic transformation (using  $\log(x+1)$ , where  $x$  is the catch in kg/hr) was carried out. The frequency distributions thus obtained appeared to be more normal in shape (Fig. 3) and the variances were stabilised.

#### 3.1.1 Sarawak

In the area to the north of Sarawak the mean catch in 1971 was lower than that in 1972. The variance of the catch in 1971 was not significantly different from that of either nets in 1972, but the mean catch was very highly significantly ( $P < 0.001$ ) lower than that of both the four-seam and Engel II nets in 1972 although the fishing grounds were similar.

The better mean catch in 1972 could be due to the longer fishing season in this year. Table II shows that the variance in the 1972 four-seam net catches were larger than that in the 1971 catches. The catch in 1972 was spread over a period of approximately six months (late March through late September) as compared to about three months (late July through early October) in 1971 (Table I). The transformed ( $\log(x+1)$ ) mean catch of the cruises in July and September, 1971 (63 hauls) was 2.0127 (antilog = 103.0 kg/hr) while that of the same months in 1972 (41 hauls) was 2.0869 (antilog = 122.2 kg/hr). Their 68% catch ranges were between 58 and 178, and between 53 and 276 kg/hr respectively; there was therefore quite considerable overlap. The mean catch of all other earlier cruises in 1972 (47 hauls) was 2.3611 (antilog = 229.7 kg/hr) and gave a 68% catch range of 130 to 410 kg/hr; this was much better than that during July and September of both 1971 and 1972, and contributed greatly towards the higher mean catch in 1972.

Table I. The cruises and hauls of the JURONG in the South China Sea in 1971 and 1972

| Area & Year         | Net      | Fishing Dates      | No. of hauls |
|---------------------|----------|--------------------|--------------|
| off Sarawak, 1971   | 4-seam   | July, 20-27        | 24           |
|                     |          | Sept. 9-20         | 39           |
|                     |          | Oct. 7-9           | 9            |
| off Sarawak, 1972   | 4-seam   | Mar., 16-20        | 8            |
|                     |          | Apr., 14-20        | 28           |
|                     |          | May, 12-18         | 11           |
|                     |          | July, 16-23        | 26           |
|                     |          | Sept., 23-27       | 15           |
| off Sarawak, 1972   | Engel II | Mar., 16-20        | 9            |
|                     |          | Apr., 14-20        | 1            |
|                     |          | May, 12-18         | 19           |
|                     |          | July, 16-23        | 9            |
|                     |          | Sept., 23-27       | 5            |
| off Tioman, 1971    | 4-seam   | Mar., 31 - Apr., 7 | 35           |
|                     |          | Apr., 21-29        | 39           |
|                     |          | July, 18-19        | 7            |
|                     |          | Aug., 7-10         | 15           |
| off Tioman, 1972    | 4-seam   | Mar., 28-31        | 18           |
|                     |          | Apr., 28 - May, 1  | 17           |
|                     |          | June, 27 - July, 1 | 8            |
| off Trengganu, 1972 | 4-seam   | June, 28-30        | 11           |

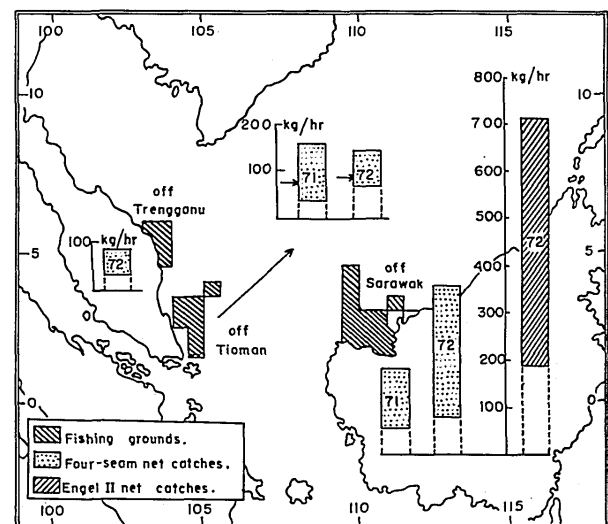


Fig. 1 Areas of fishing by the JURONG in the South China Sea and the histograms of 68% catch ranges (1971 & 1972). The horizontal arrows indicate the geometric mean catch.

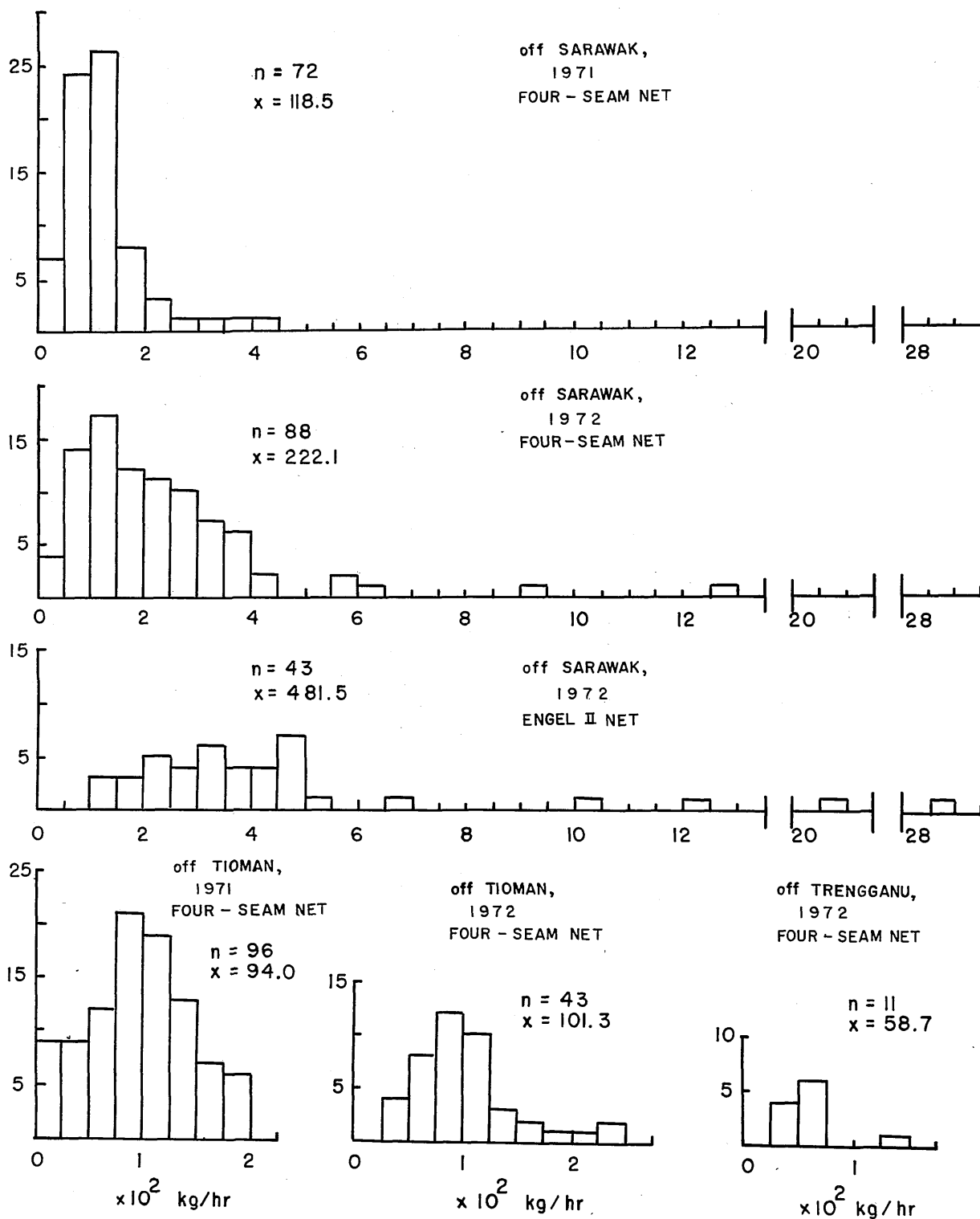


Fig. 2 Observed frequency distributions of catch in untransformed values.

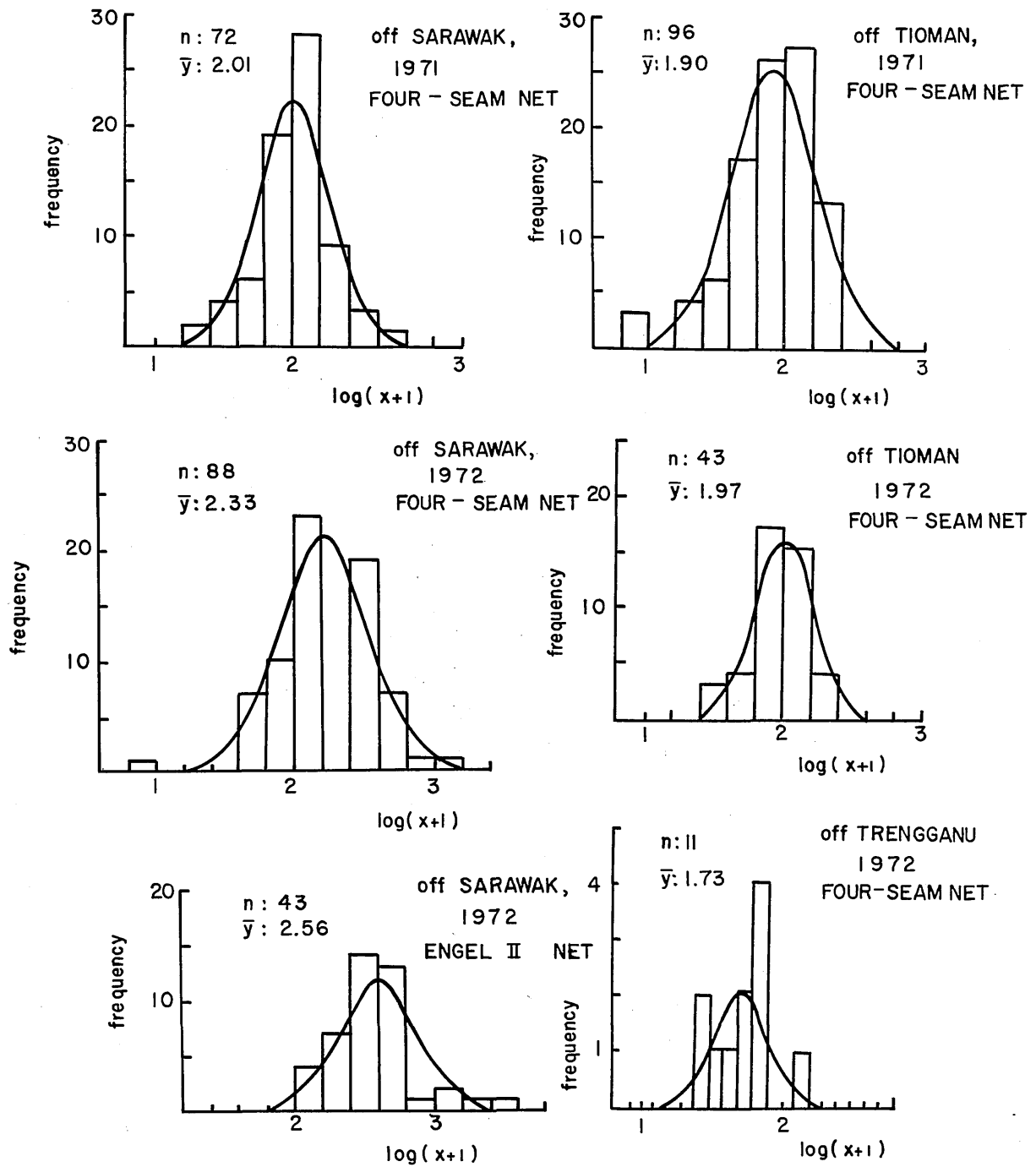


Fig. 3 Observed and expected frequency distributions of catch in logarithmic values.

We can see from Table I that the four-seam and Engel II nets were used in every cruise in 1972 to the north of Sarawak. The variances between the catches by the two nets were not significantly different. But the mean catch between the two nets was very highly significantly ( $P < 0.001$ ) different.

A study of a similar area by Minh (1972) of bottom trawl catches of the research vessel CHANGI of the Research Department, SEAFDEC, using a similar method of analysis gave a geometric mean catch of 113.2 kg/hr. The 68% and 95% catch ranges were between 47 and 270 and between 20 and 645 kg/hr respectively. These values were obtained from 86 hauls taken over two cruises in April and May, 1970 and one cruise in October, 1971 and spread over a much wider area. Moreover, the approach was not similar to that of the JURONG, but was designed to sample from as many locations as possible in a given time. With due consideration to the fact that values obtained from two different vessels are not directly comparable nevertheless it can be seen that the values from the CHANGI can easily be accommodated between the catch ranges of the JURONG taken by the four seam net in 1971 and 1972 (Table II) in approximately the same monsoon season.

### 3.1.2 Tioman

The catches in the Tioman area in the same years were poorer than those from off Sarawak (Table II; Fig. 1). When the mean catch and variances from the two years were compared it was found that although the difference between the means was not significantly different, the difference between the variances was highly significant ( $P < 0.01$ ).

When the JURONG began fishing in 1971, its first cruise was to the Tioman area. Naturally, the experienced fishermen had to get used to the ship and gear, and simultaneously train the almost completely green crew in bottom trawl fishing. The catch of the first few hauls in the first cruise was poor, and was a source of the comparatively large variance in 1971 as compared to 1972 (Table II). The variance of the first cruise was 0.0953. This was reduced to 0.0256 in the second cruise. The variance

of the fourth cruise to the area was even lower at 0.0109. However, during the third cruise the variance was again high ( $=0.1184$ ), but could have been due to other factors such as species composition (see later).

When fishing was confined to an area about 45 nautical miles square within the Tioman area under discussion, the CHANGI caught an average of 172 kg/hr (geometric mean), with a 68% catch range between 91.9 and 321.0 kg/hr (Anon., 1972). The narrow strip of ground was covered systematically by 99 hauls between late 1971 and early 1972 and again in October 1972. With reference to the JURONG's 68% catch range in Table II, the CHANGI had much better catches and much wider catch range, though it may not be strictly proper to compare directly, since the CHANGI fished in the restricted area during the northeast monsoon while the JURONG visited during the southwest.

### 3.1.3 Trengganu

In the lone fishing cruise to the area off Trengganu in late July, 1972 the average catch was poorer than that from around Tioman in 1972. To a large measure this was due to the type of fishing – the fishing off Trengganu was highly exploratory, covering in the eleven hauls an area approximately more than half that covered around Tioman with 43 hauls in 1972 (see Fig. 1; Table I). However, the transformed mean ( $= 1.7266$ ) was not significantly different from that taken off Tioman ( $= 1.8529$ ) during the same cruise (8 hauls). Nor were the differences between their variances significantly different. It may, however, be highly suspect to draw inferences from such a small sample size from this area.

## 3.2 Species composition

### 3.2.1 Sarawak

The species composition of fish caught off Sarawak was studied to see if the differences in mean catch between 1971 and 1972 were related to various fish categories and to see whether the nets used showed any selectivity.

In Table III, the percentage composition by weight of fish categories caught off Sarawak is shown. Thirty-two groups of fish were recorded in 1971. In 1972 thirty-seven

Table II. Summary of statistics of trawl catch by the JURONG in the South China Sea during 1971 and 1972.

| Item                       | Area: |               | off Sarawak |          | off P. Tioman |        | off Trengganu |
|----------------------------|-------|---------------|-------------|----------|---------------|--------|---------------|
|                            | Year  | 1971          | 1972        | 1972     | 1971          | 1972   | 1972          |
|                            | Net   | Four-seam net |             | Engel II | Four-seam net |        | Four-seam net |
| Number of hauls, n         |       | 72            | 88          | 43       | 96            | 43     | 11            |
| Arithmetic mean, $\bar{x}$ |       | 118.5         | 222.1       | 481.5    | 94.0          | 101.3  | 58.7          |
| variance, $s_x^2$          |       | 5352.1        | 3444.1      | 259311.2 | 2104.0        | 2330.8 | 965.8         |
| Transformed mean, $y$      |       | 2.0067        | 2.2334      | 2.5649   | 1.9020        | 1.9664 | 1.7266        |
| [long (x+1)] $s_y^2$       |       | 0.0638        | 0.1081      | 0.0834   | 0.0905        | 0.0389 | 0.0476        |
| Sy                         |       | 0.2526        | 0.3288      | 0.2888   | 0.3008        | 0.1972 | 0.2181        |
| Derived values:            |       |               |             |          |               |        |               |
| Geometric mean             |       | 100.6         | 170.2       | 366.2    | 78.8          | 91.6   | 52.3          |
| Catch ranges:              |       |               |             |          |               |        |               |
| 68% (Lower Limit           |       | 58.8          | 79.3        | 187.8    | 38.9          | 57.8   | 31.3          |
| (Upper Limit               |       | 180.7         | 364.0       | 713.1    | 158.5         | 144.7  | 87.0          |
| 95% (Lower Limit           |       | 30.7          | 36.7        | 96.1     | 19.0          | 36.3   | 18.5          |
| (Upper Limit               |       | 324.0         | 777.0       | 1388.0   | 317.8         | 228.5  | 144.5         |

**Table III. Percentage composition by weight (untransformed values) of major fish categories caught by JURONG off SARAWAK in 1971 and 1972.**

| Categories of fish | 1971   | 1972   |          |
|--------------------|--------|--------|----------|
|                    | 4-seam | 4-seam | Engel II |
| Red snapper        | 24.3   | 9.5    | 4.7      |
| Threadfin snapper  | 7.5    | 1.3    | 8.9      |
| Thick-lip grunt    | 5.2    | 0.5    | 0.1      |
| Slender shad       | —      | 12.9   | 15.1     |
| Shark              | 5.9    | 4.9    | 3.0      |
| Trash              | 29.3   | 35.9   | 41.4     |

groups were recorded for the four-seam net catch and thirty-six for the Engel II catch. The table shows arbitrarily only those fish categories which amounted to or exceeded 5% of the catch in any one set of data, as they are most likely to influence the total catch.

In 1971 there was greater occurrence of red snapper and thick lip grunt but a lower proportion of trash fish than in 1972; no catch of slender shad was recorded in 1971. The catch in the CHANGI indicated that slender shad was caught in waters with much coastal influence (Anon., 1972), and indeed in 1972 the JURONG tended to fish nearer the coast, where catches were also usually better. In 1971, about 25% of the hauls were taken off coastal waters, whereas in 1972 this increased to about 80%.

In 1972, the Engel II net caught 8.9% of threadfin snapper by weight but only 1.3% was recorded in the four seam net's catch. The four seam net caught 7.5% of the fish in the same area in 1971 and had good catches of threadfin snapper in the Tioman area in 1971 and 1972. Apart from this the catch by the four-seam and Engel II nets were not sufficiently different to suggest selectivity of dominant fish categories in this area conducted at the time, and it appeared that the Engel II net was capable of producing a higher yield.

### 3.2.2 Tioman

The catch composition from around Tioman was studied in relation to the differences in the variances (transformed values) between 1971 and 1972. Thirty groups of fishes were recorded in 1971, but seven of these groups whose occurrence was more than 5% of the catch in either year, as shown in Table IV, occupied 71.2% of the total

catch. In 1972 there were only three groups (out of a total of 31 recorded) of fishes which occupied more than 5% of the catch, and these groups constituted 45.6% of the total catch.

The areas fished in 1971 and 1972 were almost the same, and the percentage by weight of red snapper and triggerfish were very similar. However, the percentage occurrence of all other groups, except threadfin snapper, were much larger in 1971 than 1972 (Table IV).

The variation of catch from haul to haul was calculated for each of the fish categories occurring in more than 5% of the total catch. The variances for triggerfish and threadfin snapper were larger in 1971 than 1972, in spite of the larger proportion of these fishes in the catch in 1972. There were also other fairly large sources of variations in the catch from the other four major fish categories. Therefore the effect of the larger variation of the catch of red snappers in 1972 (as compared to that of 1971) was easily suppressed in the total variation: the variance (transformed values) of the combined weights of fish categories listed in Table IV was 0.1505 in 1971 and 0.0759 in 1972.

Although no observations were made it may be possible to regard the differences in the variation of catch from haul to haul in the two years as possibly due to the behaviour or distribution of fish schools in the area.

## 4. CONCLUSION

The JURONG fished in three south western areas of the South China Sea during 1971 and 1972. Most of the fishing was in the south west monsoon. However, there is insufficient information for conclusions of more than a tentative nature regarding these areas and their yields in terms of sample statistics and not of population parameters. It appears that the yield from off Sarawak was better than that from off Tioman, which in turn was better than that from off Trengganu. But the intensive fishing by the CHANGI during the north east monsoon season indicated that the yield from off Tioman could be similar to that from that off Sarawak in the south west monsoon.

The yield off Tioman in 1971 and 1972 was very similar. But the yield off Sarawak in 1972 was higher than 1971. The higher mean catch by the four-seam net off Sarawak in 1972 over that in 1971 was largely due to higher catches in the earlier parts of 1972 and its concentrated effort in coastal waters. There was substantial agreement in the mean catch of the CHANGI which sampled

**Table IV. Percentage composition by weight (untransformed values) and variances in catch (logarithmic values) of major fish categories caught by JURONG off Pulau Tioman in 1971 and 1972**

| Fish Categories       | 1971                   |                    | 1972                   |                    |
|-----------------------|------------------------|--------------------|------------------------|--------------------|
|                       | Percentage composition | Variance ( $s^2$ ) | Percentage composition | Variance ( $s^2$ ) |
| Red snapper           | 21.9                   | 0.3528             | 22.0                   | 0.4259             |
| Naked headed seabream | 5.7                    | 0.3552             | 1.7                    | —                  |
| Triggerfish           | 7.4                    | 0.3763             | 8.8                    | 0.1711             |
| Threadfin snapper     | 10.9                   | 0.6499             | 14.8                   | 0.6279             |
| Bigeye snapper        | 8.7                    | 0.4658             | 0.8                    | —                  |
| Shark                 | 8.0                    | 0.5267             | 3.8                    | —                  |
| Trashfish             | 8.6                    | 0.5926             | 2.5                    | —                  |

over a much wider area and time span in the same monsoon season. When it was used, the Engel II net caught more fish off Sarawak than the four-seam net in 1972, and appears to be more effective for fishing in this area; it was not tested in other areas. It is likely that the net will be experimentally tested in the near future.

The variation in the catch from haul to haul in the Tioman area was greater in 1971 than in 1972. Part of this was due to the poor catch of the first few practice hauls with the new boat and also partly due to the larger variation of catch of many more dominant fish categories, possibly as a consequence of differences in fish schooling behaviour.

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## The Demersal Resources of the South China Sea

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### Abstract

Based on the catch statistic derived from the official returns which were offered from all Taiwan paired trawlers operated in the South China Sea, dating from 1969 to 1971, the author made an investigation on the species composition, the seasonal changes of the demersal fishes appeared in their catches. The magnitude and potential of the demersal fish resources in these areas have also been assessed.

### 1. TOPOGRAPHY

As defined here, the northern boundary running to the north of Taiwan (25°N. 124°E), the western and southern boundaries are the mainland coast of Asia and the Malay Peninsula to 100°E, thence south to the equator, and along the equator to 117°E.

The region may be divided into seven sub-areas: the Taiwan Strait, the shelf of the Chinese south coast, the Gulf of Tongking, the Gulf of Thailand, the shelf off the Vietnam coast, the shelf off the Eastern coast of Malay Peninsula, the shelf off the northern coast of Borneo (Fig. 1).

The region includes a narrow continental shelf in the eastnorthern part and a wide area of continental shelf in the westsouthern part. These are given in Table 1 (with approximate areas in KM<sup>2</sup> to the 200 m contour).

Niino and Emery (1961, 1963), Emery (1969) made a general distribution map of sediments in the continental shelf of the South China Sea, Taiwan Strait and the Gulf of Thailand (Fig. 2). Sands are predominant distribution in the central portions of Taiwan Strait, the shelf off the South Vietnam coast, and some narrow sandy areas are

## 5. ACKNOWLEDGEMENTS

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present on the outer half off the Chinese south coast, northern coast of Borneo, and central east coast of Malay Peninsula.

Muds occur along Taiwan and the Chinese southeast coast to the inner shelf off the South China and the Gulf of Tongking, are predominantly distributed in the Gulf of Thailand, the shelf between Malay Peninsula and Borneo. Rocks are common on the irregular narrow shelf off Vietnam, southeast part of the Gulf of Thailand adjacent to Cambodia Coast, around the Natuna islands, around the Penghu islands in Taiwan strait, and outer shelf South of Hong Kong.

Table I. Areas of shallow water in the South China Sea (under 200 m)

| Area                              | km <sup>2</sup> |
|-----------------------------------|-----------------|
| Taiwan Strait (Region 3)          | 131,000         |
| Chinese south coast (Region 4)    | 217,000         |
| Gulf of Tongking (Region 5)       | 202,000         |
| Gulf of Thailand (Region 6)       | 332,000         |
| Coast of South Vietnam (Region 7) | 245,000         |
| East Coast of Malaysia (Region 8) | 378,000         |
| North coast of Borneo (Region 9)  | 249,000         |