although the young are reported to feed on shrimps and small fishes, and occasionally on squids.

The diet of other species of *Lutjanus* such as *L. bohar* (Forskål), *L. gibbus* (Forskål), *L. vaigiensis* (Quoy et Gaimard), *L. kasmira* (Forskål), *L. monostigmus* (Cuvier et Valenciennes), *L. griseus* (Linné) and *L. argentiventris* (Peters) from various areas of the tropical Pacific, Indian and Atlantic Oceans has been reported (Longley et al. 1925; Londley & Hilgebrand, 1941; Randall, 1955; Randall & Brock, 1960; Hiatt & Strassburg, 1960; Talbot, 1960; Hobson, 1965; Helfrich et al. 1968). The diet of most of these species is also mainly composed of fishes, crabs, stomatopods and molluscs. Helfrich et al. (1968) classified *L. bohar* and *L. gibbus* in the Line Islands as a euryphagous roving carnivore and a roving, unspecialized carnivore, respectively. Among the food organisms of *L. bohar* in the Line Islands, decapod crab megalops formed the dominant item of crustaceans, especially from November through May, and gastropods made up a larger part of molluscs. These two groups, megalops and gastropods, scarcely occurred in the stomachs of both *L. sanguineus* and *L. sebae.*

Significance of ascidians as a food item has not yet been reported for *Lutjanus* species, although tunicates were important food items for some species of West Indian reef and inshore fishes (Randall & Hartman, 1968).

In the present study, no evidence of cannibalism among *L. sanguineus* or *L. sebae* was found. The present authors have also carried out the study on the feeding habit of 11 other species including several piscivorous fises such as *Saurida tumbil* (Bloch), *S. undosquamis* (Richardson) and *Rachycentron canadum* (Linne). Neither *L. sanguineus* nor *L. sebae* was found in their stomachs. Therefore, the natural mortality of both species due to the predatory activity of enemies seems to be rather low. Cannibalism does not seem to take place also among lutjanids in the Line Islands. Out of 1790 *L. bohar*, only 2 individuals were found ingesting some unknown species of lutjanid. A possible predator of lutjanids is grouper, since one specimen out of 14 *Epinephelus hexagonatus* (Bloch et Schenider) examined in the Line Islands contained the remains of a *Lutjanus* species (Helfrich et al., 1968).

Summarizing, it may be said that the feeding habits of both *L. sanguineus* and *L. sebae* are well suited for a demersal life, and both species occupy the highest niche in the bottom ichthyofauna in the South China Sea.

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Trawl Fishing Grounds in North Andaman Sea

by
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Abstract

Experimental trawl operations in north Andaman Sea were carried out by three vessels, T/V JURONG from the Singapore Fisheries Training Center, T/V PAKNAM and R/V CHANGI from SEAFDEC, from 1971 to 1973.

The results of catch analysis show that the fishing ground is promising. Means of catch per hour ranged from260 to 690 kg. for the 8 survey cruises, among which 3 cruises yielded more than 500 kg/hr. Croaker, catfish,

jacks and scad, shad, golden snapper, grunter and white pomfret usually constituted about 70% of total catch. However, catch per hour and species composition varied, sometimes extremely, from haul to haul, suggesting patchy distributions of fish schools.

Good fishing grounds were usually found in shallow waters of 30–40 metres deep, and means of catch per hour decreased with depth. Nevertheless the mean of catch per hour in the deepest waters surveyed (60–80 metres) was at the same level as those observed in the good fishing grounds in the South China Sea. On the other hand, fluctuation of catch per hour was much higher in shallow waters than in deeper waters.

1. INTRODUCTION

The FAO/UNDP Fisheries Training Center, a joint project with Singapore, carried out trawl surveys in north Andaman Sea in December 1971 and January 1972. The results were promising. In order to study the fishing ground in greater detail a joint survey between the two departments of the Southeast Asian Fisheries Development Center (SEAFDEC) and the Fisheries Training Centre was carried out at the end of 1972. The training and research vessels involved were T/V JURONG of the Fisheries Training Centre, T/V PAKNAM of the Training Department and R/V CHANGI of the Marine Fisheries Research Department. Another joint survey was also carried out by JURONG and CHANGI in January 1973.

2. VESSELS AND FISHING GROUNDS

2.1 Vessels and trawl nets

Table I shows the details of vessels and trawl nets used in the survey. As shown in the table JURONG is smaller in both size of boat and power of main engine than the other two vessels, while the net used by her is much larger than the others. However, this difference was not taken into account in analysis of the catch. As the average trawling time by CHANGI was shorter, the catch of each haul by all three vessels was converted into catch per hour before any further calculation.

2.2 Fishing grounds

The areas surveyed by all three training and research vessels are enclosed by longitude 14–16°N and latitude 94°–97°30'E. However, the trawl operations were concentrated in a few localities, as shown in Fig. 1. For convenience of analysis of the catch data, the fishing grounds were divided into 4 areas (a, b, c, d) in this report.

Table I. Details of the vessels and trawl nets used in the servey

	T/V Jurong	T/V Paknam	R/V Changi
Size of boat (tons)	213.3	386.8	386.6
Power of main engine (HP)	750	1000	1000
Type of net	4 seamed	4 seamed	4 seamed
Size of net in length of head rope (m)	51.5	34.4	36
Trawling speed (knots)	3.5	4	3.5
Trawling time/haul (hrs)	2	2	1.5

3. RESULTS

3.1 Catch per hour

During the period from December 1971 to January 1973, the three vessels made 8 survey cruises and 165 trawl hauls in north Andaman Sea. Because of the prevailing monsoons the most suitable time for operations in these waters is at the beginning and the end of a year. Hence operation surveys were conducted from November to January.

Table II shows the date, the number of hauls and the catch of the trawl operations in north Andaman Sea.

During the survey cruises by JURONG in December 1971 and January 1972, the high total catch and mean catch per hour (more than 650 kg/hr) were obtained, indicating a rich and well matured fishing ground. Although subsequent joint operations carried out in the same areas by the three vessels in December 1972 did not produce such good results, the catches were still high

Table II. Trawl catch by cruise in the fishing ground in north Andaman Sea Both arithmetic and geometric means are shown.

Cruise number	1	2	3	4	5	6	7	8
Month, year	Dec. 71	Jan. 72	Nov./ Dec. 72	Dec. 72 I	Dec. 72 II	Dec. 72 III	Jan. 73 I	Jan. 73 II
Name of boat	J	J	J	J	C	P	J	C
No. of haul	15	20	15	25	13	34	19	24
Total catch (ton)	21.8	27.7	14.0	12.5	6.3	17.1	19.3	13.9
Arith. mean of catch/hr (kg)	656.1	691.2	459.4	258.7	360.7	272.1	548.3	398.2
Coefficient of variation (%)	134	108	69	61	77	61	88	100
Geom. mean of catch/hr (kg)	445.0	448.2	393.3	210.0	259.5	210.4	360.9	301.1
70% confidence limits								
Upper limit	773.8	568.7	455.3	243.4	322.2	239.9	460.8	349.4
Lower limit	255.9	353.3	339.7	181.1	209.1	184.5	282.7	259.6

Abbreviation for name of boat: J: T/V Jurong, C: R/V Changi, P: T/V Paknam compared to standard catch from the South China Sea (Senta, et al. 1973).

It can be seen from Table II that the coefficient of variations exceeded 100% in 3 cruises (cruises 1, 2 and 8), indicating great fluctuations in catch while the coefficient of variations for the remaining cruises were rather moderate, being almost at the same level as those observed in the South China Sea (Lit. cit.).

From the geometric means of catch per hour and their 70% confidence limits in Table II, it is seen that cruise 2 yielded the best catch, with the lower limit of confidence well above the upper limits of confidence for cruises 4, 5, 6 and 8. On the other hand, values for catch per hour in cruises 4 and 6 were very poor, with the upper confidence limits of geometric mean well below the lower confidence limits for all other cruises. Still, the values for catch per hour for these two cruises were much higher than those for any areas in the South China Sea as surveyed by CHANGI.

3.2 Species composition of catch

3.2.1 Species composition in general

TAble III shows that croaker was the predominant fish caught, comprising more than 23% in weight of the catch. Catfish, jacks and scads, shad and grunter were usually abundant although a certain degree of fluctuation in the catch of these fishes was observed. Golden snapper, white pomfret and spanish mackerel also constituted an important part of the catch although they were caught rather sporadically. In contrast to the catch from the South China Sea where red snappers were predominant, their percentage in the catch in this area was less significant. Also of less importance are threadfin snapper and goatfish which comprised less than 5% of the catch.

3.2.2 Species composition by cruise

Except for one cruise, croaker was by far the most abundant fish caught in this area, especially when the catch per haul exceeded 1 ton. The catch of croaker showed little fluctuation by cruise. However, a certain degree of fluctuation occurred in the catch of catfish, jacks and scad, shad and grunter, although these fishes were caught in nearly every cruise. Golden snapper, white pomfret and spanish mackerel were only caught in some of the cruises. The catch of golden snapper was especially variable. During the January 1973 cruise by JURONG (cruise 7) one haul had a catch of 2.9 tons of golden snapper, while the remaining 5 hauls on the same day yielded only 25–65 kg of the fish.

The fluctuation in catch of white pomfret, a fish of economical importance, was also remarkable. This fish occupied 11.3% and 8.2% of total catch in cruises 3 and 4 while in cruise 7 and 8 their catch was negligible. The distribution of white pomfret must be very contagious, because the fish catch usually fluctuated from haul to haul even within the same area and the same day. For instance, on December 7, 1972 the pomfret caught in each haul ranged from 20 kg to 325 kg.

The occurrance of red snapper in the catch was rather infrequent, and only occurred where operations were carried out in depths of more tan 40 metres. This could indicate that red snapper had a different distribution pattern from the other fishes dominant in this area.

Table III. Percentage in weight of major species in total trawl catch by cruise

Cruise Number	1	2	3	4	5	6	7	8
Species* / Month/year	Dec. 71	Jan. 71	Nov./ Dec. 72	Dec. 72 I	Dec. 72 II	Dec. 72 III	Jan. 73 I	Jan. 73 II
1. Croaker	27.8	27.9	39.2	23.6	39.8	23.3	24.2	23.4
2 Catfish	28.2	12.6	11.2	21.3	5.6	15.7	3.1	9.2
3 Jacks & scad	1.0	3.5	3.4	13.9	11.6	8.8	4.4	10.7
4 Shad	12.3	4.1	12.9	1.3	11.4	1.0	4.9	6.6
5 Golden snapper	–	12.5	–	–	0.2	1.3	22.7	14.5
6 Grunter	3.5	21.4	1.6	10.1	1.1	–	7.8	8.0
7 White pomfret	1.4	4.1	11.3	8.2	6.5	2.7	–	0.1
8 Red snapper	2.7	–	1.8	3.7	3.1	3.7	–	–
9 Spanish mackeral	1.6	4.6	0.8	2.6	–	0.3	3.6	0.5
10 Hairtail	1.8	–	0.5	5.1	0.3	2.8	1.5	2.6
11 Lizardfish	0.4	–	–	–	5.9	4.0	0.9	4.1
12 Dorab	0.7	1.4	0.1	1.7	–	0.1	0.8	0.4
13 Conger eel	–	0.7	0.3	1.0	0.6	0.3	0.4	1.4
14 Threadfin snapper	0.6	–	–	2.3	2.8	5.1	–	1.3
15 Mackerel	0.4	0.3	–	–	–	3.3	4.8	–
16 Goatfish	–	1.4	–	–	1.0	3.5	–	1.4
17 Chorinemus	–	–	–	1.2	2.1	0.3	1.3	2.9
18 Seabream	3.0	–	–	–	0.2	–	–	–
19 Barracuda	–	–	–	0.1	–	0.8	–	1.0
20 Sharks & ray	4.1	3.0	5.2	3.7	4.8	6.2	1.8	8.3
21 Other fishes & squid	8.5	2.5	11.7	0.2	3.0	16.8	17.8	3.6

* 1: sciaenids, 2: *Tachysurus*, 3: carangids, 4: *Pellona & Ilisha*, 5: *Lut janus johni*, 6: *Pomadasys*, 7: *Pampus argenteus*, 8: large-sized lutjanid other than 5, 9: *Scomberomrus*, 10: *Trichiurus*, 11: *Saurida*, 12: *Chirocentrus dorab*, 13: *Muraenesox talabon*, 14: *Nemipterus*, 15: *Rastrelliger*, 16: mullids, 17: *Chorinemus*, 18: *Gymnocranius*, 19: *Sphyraena*.

3.3 Catch by area and by depth

Most of the hauls of the surveys were concentrated in areas b and c, especially in shallow waters (Fig. 1). Only 3 hauls each were made in areas a and d. Table IV shows the number of hauls by depth in each area.

The catch per hour distribution in each area is given in Fig. 2. This figure shows clearly that the distribution pattern of the catch per hour in areas b and c are quite similar. Both areas showed a wide range of fluctuation, ranging from about 50 kg/hr to 3500 kg/hr. Area c seems to be slightly better in terms of higher value of catch/hr. However, any difference in the mean catch per hour may be superficial as the number of hauls in each area varies considerably. As there were only 3 hauls each in areas a and d, it is difficult to compare these two areas with area b and c.

Catch per hour as well as species composition varied with depth. As shown in Table V, the highest mean value of catch per hour (509.3 kg) was obtained in depth of 30–40 metres, almost twice that of 40–50 m depth (285.9 kg/hour). In the depth range of 60–80 metres, the catch per hour was only about one-third that of 30–40 metres depth. However, in the waters of depth 30–40 metres, the coefficient of variation was 108%, indicating greater degree of fluctuation than the other depth ranges. The fluctuation of catch per hour decreased greatly as the depth increased.

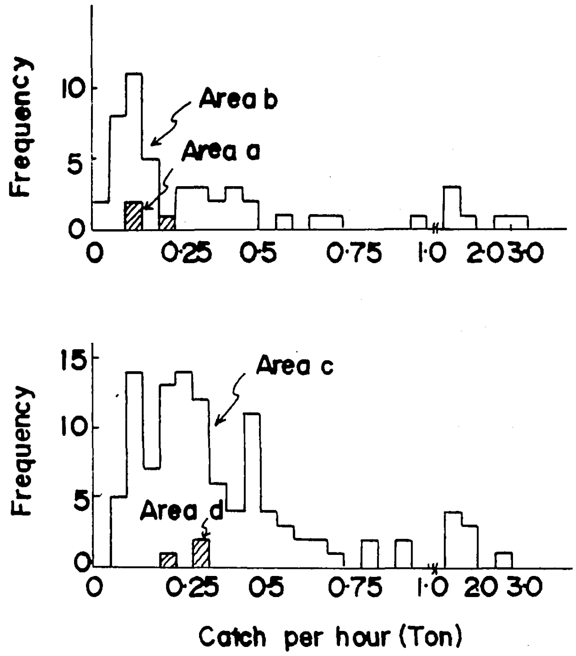

Fig. 2 Catch per hour frequency distribution by area.

Table IV. Number of hauls by depth and by area

Depth (m) / Area	30–40	40–50	50–60	60–70	70–80
a			1	1	1
b	33	16	4		
c	75	28	3		
d			2	1	
Total	108	44	10	2	1

Table V. Trawl catch by depth. Data for cruise 1 to cruise 8 are combined

Depth (metres) / Items	30–40	40–50	50–60	60–80
No. of hauls	108	44	10	3
Mean of catch/hr (kg)	509.3	285.9	222.3	168.4
C.V. (%)	108	73	55	20
Geometric mean catch/hr (kg)	354.0	208.9	191.5	165.6
70% C.L.				
Upper L.	381.1	238.2	232.8	196.8
Lower L.	328.8	183.2	157.4	139.3

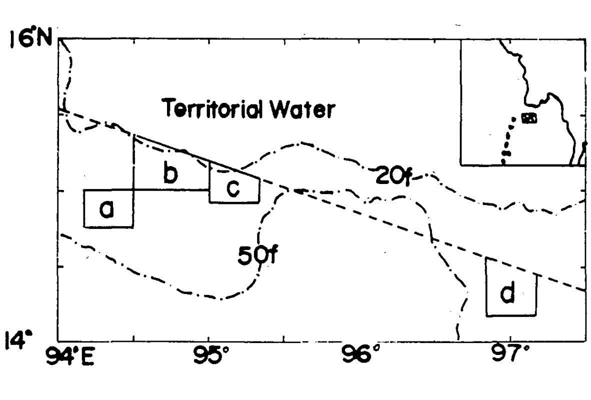

Fig. 1 Map to show the surveyed areas and depth contours in the north Andaman Sea.

4. DISCUSSION AND CONCLUSION

The data collected so far has indicated that the waters in north Andaman Sea are a comparatively rich and exploitable fishing ground, with species composition very different from those of the trawl catch in the South China Sea. The species composition however varied according to depth. In shallow waters, croaker, catfish, golden snappers, shad, jacks and scads were the dominant species. White pomfret also occurred in shallow waters. In deeper waters, red snappers, lizardfish and threadfin snappers were relatively more abundant. In this respect, areas a and d and areas b and c therefore gave a different species composition, the former two areas being deeper than the latter. Usually good catches in areas b and c were associated with good catches of croaker and golden snapper which, at times, consistuted more than 50% of the catch per haul. However, the catch of golden snapper, white pomfret, and mackerel were rather sporadic. This may be due partly to the bahaviour and distribution pattern of the fish, and partly to seasonal of tidal conditions.

Although the species composition of trawl catch in this fishingg ground was remarkably different from those of most areas in the South China Sea, a high similarity in species composition was observed between the catch of the present surveys and that obtained from waters off Sarawak in November 1972. During the latter trip, CHANGI operated only in shallow waters (26–48 m), and about 50% of total catch was occupied by croaker, catfish, shad, golden snapper, and jacks and scad, although red snappers also showed high percentage of 12.9% (in preparation). It appears therefore that the depth and bottom topography are factors which may determine the differences or similarities in species compositions of the two areas.

The trawl surveys were restricted to the months of December and January, and therefore, it is difficult to determine if seasonal fluctuation affects the species composition. However, it may be noted that white pomfret was caught in substantial amounts in the four cruises in December 1972 but was negligible in January 1973.

The differences in catch per hour and species composition have been shown to be related to depth. It seems that the good fishing grounds are distributed in the shallow waters of not more than 40 metres deep. However even within the shallow waters, the catch per hour varied considerably, indicating a rather patchy distribution of good fishing localities. The deeper waters, especially those at a depth of 6–80 metres yielded comparatively poor catch. Nevertheless, the mean value for catch per hour (168 kg) in such waters were at the same level as those in the good fishing grounds in the South China Sea.

The formation of good fishing grounds in the shallow water may not be attributed to the depth itself. A rich supply of nutrient salts, less saline water masses, and muddy bottoms caused by the discharge of Irrawaddi and Sittang Rivers may be supporting the high productivity thereby creating suitable environments for coastal demersal fishes in this region.

The fishing ground in north Andaman Sea is promising and has economic potential. However, more surveys need to be carried out to study the fluctuation of catch and the distribution pattern of the fishing ground.

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Demersal Fish Resources in Untrawlable Waters, Viewed through Vertical-Line Fishing

by
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Abstract

Rocky reefs (80–120 m. in depth) along shoulders of steep continental slope in the South China Sea and the Andaman Sea often provide potentially good fishing grounds. Demersal fish resources in these reefs, having quite different species composition from those in trawl fishing grounds, have been scarcely exploited so far.

The results of the recent surveys by Japanese research vessels and by R/V CHANGI revealed that vertical line fishing is promising in such untrawlable fishing grounds. The daily catch often exceeded one ton and was composed mainly of white snapper, gold-lined sea bream, grouper, pigface, trevally and jobfish.

The catch and species composition in different areas did not vary much provided that the above mentioned bottom feature and oceanic environment were present. Daily catch may fluctuate considerably the above men-