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Original Paper

STANDING STOCK OF DEMERSAL FISH ASSESSMENT IN SOUTHERN PART OF SOUTH CHINA SEA

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ABSTRACT

Demersal fish assessment is prerequisite for optimal fishing. In this paper, standing stock of demersal fish in southern part of South China Sea was determined by swept area method. The research was carried out by research vessel SEAFDEC on 18 – 30 June 2005. The catch of fish was obtained from 18 in-situ station use bottom trawl. There were found 154 species and 38 563 individual, respectively. The Leiognathus bindus was dominant species at fishing operation. Catch per unit area (CPUA) was ranged from 62.99 to 748.57 kg km^{-2} and averaged 420.32 kg km^{-2}. The overall catch rate ranged 5.6 to 121.97 kg hr^{-1} and averaged 50.54 kg hr^{-1}. The standing stock of demersal fish in survey area was 124 560 ton.

Key words*: Biomass ; demersal fish ; South China Sea ; standing stock ; swept area*

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INTRODUCTION

South China Sea (SCS) is an area that has significant biological diversity. The waters is an area in the western Indo-Pacific oceans have long been known as a center of shallow marine waters in the world, and it was the region with biological diversity in tropical regions (UNEP 2001). As a center of biological diversity shallow marine waters of the world, the SCS is an advocate of world fisheries is very significant to the importance of food security, and as a source of export revenue for countries around the waters.

SCS fishery resources as the main contribution is very important at the local, regional and international levels to food and income. Total production in SCS about 5 million tons of catch annually, or about 10% of the total world catch. Five of the eight world-famous shrimp producers are from countries around the SCS (first, Indonesia, second, Viet Nam; third, China; sixth, and eighth Thailand and Philippine). These countries are also producing countries of the world tuna catch by 23%, and the world's canned tuna fish, almost 75% of the countries in the region of this SCS (Alino, 2001).

Waters of the Southern South China Sea (EEZ and territorial waters of Indonesia) is categorized as a relatively shallow waters neritik continent with an average depth of 70 m and is one potential area of marine fisheries (Atmaja, *et al.*, 2001). Potential held annually about 1.25 million tons, with a utilization rate of 20% (Boer *et al.,* 2001). In other words, the region still has a chance in the development of marine fisheries, especially in the utilization of marine resources.

After the enactment of Presidential Decree No.39/1980 on the prohibition of trawling, most of the trawl is used for research purposes. Its use is also limited by the partial and discontinuous at the study area.

The rate of catch or catch per unit effort (catch per unit effort, CPUE) can be considered as an index of stock abundance in the waters (Gulland, 1983). Changes the value of stock abundance index in the waters indicate changes in fish populations in the waters under the influence arrests.

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Especially in tropical areas like the SCS, the studies on demersal fish is very complex because of its multi-species, size and inhabits diverse habitats of different base. In addition, studies on the existence of demersal fish in the waters of Indonesia are still very rare. Research demersal fish in the waters of the SCS from 1975 to 2001 only three new study as reported by Martosubroto and Pauly 1976; Sudradjat & Beck 1978; PRPT and P2O-LIPI 2001 in Sumiono *et al*. 2003. So, how much of potential, deployment and complexity of demersal fish are not well understood. In an effort to optimize the utilization of demersal fishes in the SCS on an ongoing basis, the necessary scientific information about the distribution, density, abundance and potential of demersal resources, so it can be used as a basis for policy making in the management of demersal fish of the waters.

According to Boer *et al.,* (2001), the potential of demersal fish in the waters of the SCS (not including ZEEI) amounted to 655,650 tons / year. While the production by 82,460 tons / year or in other words, the utilization rate is still about 12.58%. While the results of research conducted in these waters before, shows that the condition of demersal fish stocks are declining in 1975 for 677,320 tons, amounting to 516,600 tons in 1978 and 2001 amounted to 166,460 tons (Martosubroto & Pauly 1976; Sudradjat and Beck 1978; PRPT & P2O-LIPI 2001 in Sumiono *et al.,* 2003). While Widodo (2003) says that in general the condition of demersal fish resources in waters LCS Indonesia region already at the level of "fully exploited". If fishing effort continues at the level of 'fishing effort' by both the Indonesian fishing vessels and illegal fishing by foreign vessels at this time, it can be presumed that the existence of stocks of demersal fish resources in the CSF would not be sustainable.

MATERIALS AND METHODS

To find out the availability of demersal fish resources, especially fish in Indonesian waters of CSF, acoustic surveys, oceanographic and fishing operations by using a bottom trawl were carried out. The survey was conducted from June 12th to 2nd July, 2005, collaboration with SEAFDEC PRPT-DKP. Survey sites were in a position approximately 00 ° -03 ° N and 105 ° - 109 ° east.

Demersal fish biomass estimation was done using a method sweep or swept area by Sparre and Venema (1998). This method was based on the area sweep trawl (a), the length of the flow sweep (D) and wing trawl opening (H), which is mathematically expressed as:

$$a = D * H \quad \text{……..(1)}$$

The catch per unit area CPUA) obtained through the formula:

$$\frac{\frac{Cw}{t}}{\frac{a}{t}} = \frac{Cw}{a} \quad kg/km^2 \quad \text{……(2)}$$

If the fraction of the biomass of fish caught in the grooves effectively painted the trawl is X1, and $\overline{Cw/a}$ is the average catch per unit area of all attraction, then the total biomass of demersal fish in the waters surveyed in the SCS waters km2 of area A is:

$$B = \frac{\left(\overline{Cw/a}\right) * A}{X_1} \quad \text{……(3)}$$

X1 value is usually chosen between 0.5 and 1.0. For trawling in Southeast Asia are usually value X1 = 0.5 (Isarankura 1971; Saeger, Martosubroto and Pauly 1980 in Sparre and Venema 1999).

RESULTS AND DISCUSSION

Catch composition and rate

The arrest was made at 18 stations with varying water depths, from 21-77 m. During the capture operation, it was obtained 154 species of fish, consisting of 134 demersal fish species and 14 species of pelagic fish, a type of lobster (*Panulirus pencillatus*), prawns (shrimp), squid (*Loligo endulis*), squid and crab.

The composition of the catch ever (tail) during the arrest operation were *Leiognathus bindus* (Leiognathidae) of 75.44%, and five other species by the number of> 1.00% of *Pentaprion longimanus* (Pentaporidae) of 3.80%, respectively of the family Mullidae *Upeneus luzonius* (2.29%), *U. sundaicus* (1.68%) and *U. sulphureus* (1.61%) and *Scolopsis taneniopterus* (Nemipteridae) of 1.14%, while the catch of other demersal fish species was less than 1%.

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Overall of catches of demersal fish caught with the highest percentage during the study was the fish of the family Leiognathidae (76.49%), Mullidae (8.93%), Pentaporidae (4.34%), Nemipteridae (2.13%) and Synodontidae (1.67%). When compared with the results of a survey in the waters of western Kalimantan in May 2002 using a fish net, the catch for fish obtained from the family Leiognathidae (11.8%), Nemipteridae (12.8%), Synodontidae (9.9%), Ray (8.4%) and Mullidae (3.7%) (Wagiyo & Nurdin 2002 *in* Sumiono *et al*, 2003). Species from family Leiognathidae, Mullidae and Pentaporidae increased, while the fish of the family Nemipteridae, Synodontidae and Ray tend to decline. While the results of trawl surveys in 2001 acquired five very dominant fish families namely Mullidae, Nemipteridae, Leiognathidae, Synodontidae and Ray (PRPT and P2O LIPI, 2001).

Under the category of fish size (weight) for 134 species of demersal fish caught during fishing operations, 100 species were small-sized fish (small fish food) which is sized by weight <200 g/fish. While the other 24 species of demersal fish measuring ≥ 200 g/fish, 14 types of measuring <1 kg/head and 10 types obtained with an average weight of more than 1 kg/head. Types are among *Amboeneusis* sp. (62.5 kg), Raja sp (7.05 kg), *Himantura gerrardi* (4.36 kg), *Pletropomus maculates* (4.33 kg), *Lutjanus johnii* (3.69 kg), *Lutjanus argentimaculatus* (3.40 kg), *Platax batavianus* (1.70 kg), *Plectorhynchus argyreus* (1.50 kg), *Scomberomorus commerson* (1.30 kg) and *Uppius Orbis* (1.10 kg).

Table 1. The catch, catch rate, CPUA and demersal fish biomass in the SCS, parts of Indonesia.

St.	Depth (m)	Substrate	Number of		Catch (kg)	Catch Rates (kg/ hour)	CPUA (kg/km²)	Biomass (kg)
			Sp.	Ind.				
1	21.0-33.4	S/M	27	994	40.53	38.60	350.29	2.402.93
2	43.0-44.7	SC	26	288	51.69	49.23	434.34	2.979.45
3	52.5-55.5	S/SC	34	199	21.33	20.98	153.09	1.050.15
4	44.10	M/S	23	1.232	29.72	29.23	257.92	1.769.25
5	28.70	SC	34	450	32.4	32.40	324.58	2.226.52
6	31.5-33.0	SC	40	585	80.82	80.82	685.72	4.703.92
7	36.0-40.0	SC	20	105	5.6	5.60	62.99	432.13
8	27.50	SC	32	251	41.74	41.74	352.10	2.415.33
9	65.0-66.0	S/M	34	179	86.35	86.35	633.24	4.343.89
10	52.0-54.0	M/SC	35	348	25.01	26.80	216.44	1.484.73
11	57.5-59.0	S/SC	45	910	122	121.97	999.67	6.857.57
12	74.00	S/M	34	916	22.78	22.78	173.29	1.188.74
13	56.5-60.5	M	28	3.103	37.99	37.99	306.25	2.100.85
14	51.00	S/M	41	497	54.69	51.27	393.81	2.701.44
15	31.5-34.0	SC	41	761	111.2	111.19	1.001.63	6.871.00
16	62.00	S/M	38	2.566	34.04	34.04	261.83	1.796.07
17	75.0-77.0	S/M	31	2.779	26.47	26.47	210.06	1.440.99
18	72.70	S/M	29	19.462	93.87	92.33	748.57	5.135.05

S = Sand; M = Mud; SC = Soft Coral

Trawl fishing operations carried out by the speed of the pull between 3.2 to 4.0 knots with an average of 3.6 knots, and the length of time withdrawal between 0.93 to 1.07 hours, or an average time of the pull of an hour. Of the catch obtained (**Table 1**), for demersal fish catch rate during the study ranging from 5.6 kg/hour (station 7) to 121.97 kg/hour (station 11). The average catch rate of 50.54 kg/hour or 88.16% of the amount of trawl catch rate of 57.33 kg/hour. The catch rate of shrimp and squid were 0.13 kg/hour (0.23%) and 2.39 kg/hour (4.17%). The squid was caught around the fishing stations, except station 1, with most

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catches at stations 17 and 18, each 406 heads (3.60 kg) and 205 tails (4.50 kg). Shrimp caught in trawl operations only at station 1 with water depths between 21 to 33.4 m (1 individual) and 10 stations (56 individuals) with a depth between 52-54 m. Basic types of waters that are favored by the penaeid shrimp by Penn (1984) is a sandy mud and waters at a depth of 10-30 m and are still influenced by the mass of fresh water. But the catch is made, more shrimp obtained at 10 stations away from the beach and its waters have the basic types of mud with a soft coral (M/SC). So it can be said that the distribution of shrimp is strongly influenced by the type of bottom waters (muddy) and not influenced by the depth of the waters.

Distribution and Density

The highest abundance of demersal fish species during the study encountered at station 11 by 45 species and dominated by many as 278 individual Chrysozoma pterocaesio (4.60 kg), whiles the lowest at station 7 and was dominated by *Lutjanus lutjanus* as many as 64 individuals (1.50 kg). Abundance distribution of the catch (individual) ever been found at station 18 as many as 19.700 people with water depth of 72.70 m. *Leiognathus blindus ever* discovered on this station is 18.980 individuals (65.00 kg) or 96% of the total catches in this station. While the station 9 at a depth of 65-66 m has the smallest number of catches (251 individuals) and *Pentaprion longimanus* dominates the catches on these stations as many as 38 individuals (1.10 kg). Beside that also found *Loligo endulis* as many as 65 individuals (1.60 kg) or 26% of the total catch.

Fish with a large measure of weight were generally obtained in very small amounts such as *Amboeneusis* sp. (1 tail, 62.5 kg) at station 9, *Raja* sp. (2 tail, 34.5 kg) and *Plectorhynchus pictus* (1 tail, 5.4 kg) at station 11. While the types of fish with smaller weights were mostly found in groups such as *Leiognathus bindus* found in some stations with more than 100 individuals, and that most of the were stations 18980 individuals (65.0 kg).

Demersal fish density obtained for the location of the survey area of 0.42 kg/km². Fish density per unit area (CPUA) the highest found in station 15 of 1001.63 kg/km². While the lowest density at station 7 at 432.13 kg/km². Distribution of demersal fish density was seen representing the two water depths, the waters close to shore with a depth of 31.5 to 34 m for stations 6 and 15, and the waters of both the deep water with a depth of 57.5 to 59.0 m and 72.7 m at stations 11 and 18.

At both stations near the coast, the number of fish species that are found almost the same and the basic types of soft coral waters. Family Mullidae (*Upeneus sundaicus* and *U. sulphureus*) was species dominated catches. While the station is far from the coast, *Leiognathus bindus* (Leiognathidae) was dominated the catches both locations. The catch from the station in located near the beach is hardly found *L. bindus* except at station 15 as many as 22 individuals. This indicates that the species of fish inhabit the waters in and away from the beach.

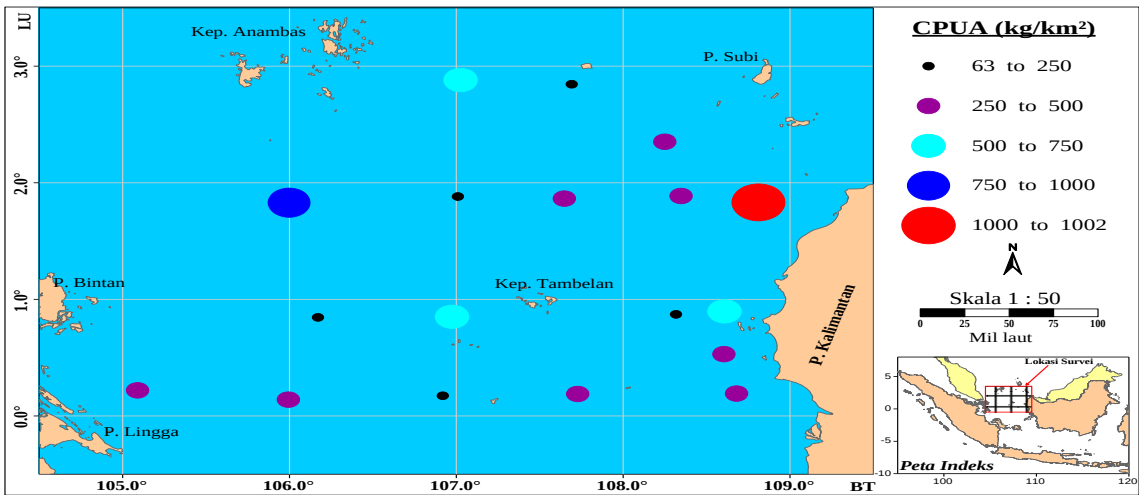

Fig.1. CPUA distribution of demersal fish in the CSF region of Indonesia.

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Standing stock

The catch per hour or the rate of capture can be assumed as an index value that is proportional to the biomass of demersal fish in the survey area. In accordance with the opinion of Gulland (1983), then the abundance of stocks or catch per unit area (CPUA) can be used to estimate the magnitude of the potential of demersal fish resources in the survey area. The average stock density CPUA or obtained from the catch in trawl fishing station 18 for 0.42 tons/km². The surveyed area of 148,171.85 km ² and if the fraction of the biomass of demersal fish on the effective path swept trawl (X1) of 0.5 used in the calculation of the estimated potential of on-site survey, then the amount of standing stock in the SCS of 124 560 tones.

The amount of standing stock values were compared with results of previous studies in the same location (**Table 2**), shows that the potential of demersal fish resources declining from year to year. According to the Marine and Fisheries Statistics 2005, the magnitude of the potential of demersal fish in the SCS was 334 800 tons for 2002. This potential was greater than the potential of the previous year. As for 2005, its potential is smaller (down) or only 63% of potential in 2002.

If the calculation of the potential of demersal fish in 2002 based on the same area (287,000 km²) for the three previous studies, and the area was also used to estimate potential for 2005 then the value of standing stock or the potential of demersal fish amounting to 241,265 tons, or decreased by 31% from 2002.

Table 2. Comparison of catch rates, stock density and standing stock of demersal fish resources in the SCS, parts of Indonesia.

Year	Area (km²)	Catch Rates (kg/jam)	Stock Density (ton/km²)	*Standing stock* (ton)	References
1975	287,000	156.0	2.36	677,320	Matosubroto & Pauly (1976)
1978	287,000	119.0	1.80	516,600	Sudradjat & Beck 1978
2001	287,000	66.9	1.00	166,460	PRPT and P2O-LIPI 2001
2002				334,800	Statistic Data of DKP
2005	148,171.85	50.54	0.42	124,560	Result

The amount of demersal fish production in 2002 was 54,690 tons / year. If the value of production is used as a reference to the year 2005 with the value of the potential that exists, then the rate of production of demersal fish resources by the year 2005 by 44%. If the number of allowable catches (JBT) is 80% of the existing potential, then the rate of utilization of demersal fish resources were still about 55% by 2005 from JTB amounting to 99,648 tons / year. By comparing between potential and production of fish landing the highest ever achieved in the CSF in 2002, was the potential of the available fish resources have not been utilized optimally. The potential of demersal fish resources in the SCS was statistically has decreased. But with today's conditions, still provides an opportunity and challenge to develop the fisheries sub-sector to reach JTB future production through increased productivity and efficiency of the arrest.

In general, the condition of demersal fish resources in the SCS region of Indonesia was already at full utilization (fully exploited). However, if viewed from the production per-year data released by DKP, it can be concluded that the exploitation of fish resources is mostly done by the fishermen / foreign boats fishing illegally in Indonesian territory SCS.

CONCLUSION

1. Standing stock (potential) of demersal fish resources based on trawl catches was 124,560 tones. The potential of fish resources have declined from year to year. The rate of utilization of demersal fish resources in 2005 reached 55%.
2. Catch rate of demersal fishes in the CSF was 50.55 kg / km², while the density of stocks or catch per unit area (CPUA) was 0.42 tones / year. Referring to the results of several previous studies, it appears that the

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rate of catch and demersal fish density in CSF experienced a real decline.

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