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Stock Assessment by Swept Area Method in the Darvel Bay, Sabah Malaysia

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Abstract: The assessment survey for the fisheries had been done in Darvel Bay, Sabah, Malaysia within Sulu Sulawesi Marine Ecology region. The trawler vessels are used in this survey, trawler towing by boat with 20 GRT experiments extensive held 2003 to 2006. Tow duration was 4 hours by engine 1100 rpm at 3 knots speed, the samples were taken in vessel with the code end size are 38 mm. A total of hundred twenty eight hauls were conducted at depth ranging 9-60 meters depth, the trawl able fishing are 834.55 km square, The total catch 20032.9 kg with 156.5 kg mean catch per hauls. The study shown that, the total potential resources are 1293723.93 kg and estimated of density for this area for every one km square at 3,639.53 kg or 3.6 metric tones per square kg, average catches per hours are 39.12 kg.

Key words: Stock · Demersal fish · Trawler · Haul · Biomass

INTRODUCTION

Fish stock assessment survey has often focused on obtaining point estimate of the key parameter of the biological system [1]. The stock survey is part of the fisheries management in Darvel Bay to ensure sustainable exploitation at the optimum level. Conservation and protection, the integration of environmental and economic consideration, in which will encourage the optimum use of resources without unhearing its long run potential production.

Darvel Bay is a large bay on the east side of Sabah on the island of Borneo. It is the largest semi-enclosed bay on the east coast of Borneo and faces the Sulawesi Sea [2]. Within Sulawesi Sulu Marine Ecology (SSME) covered Lahad Datu and Kunak district with area approximately 834.55 km^2 lying within the boundaries of Latitude 5° 0′ to 4° 40′ North with Longitude 118° 10′ East to Longitude 118° 40′ East as in Figure 1 and it has a long coastline and shallow fresh waters flowing from Silabukan, Sapagaya, Tingkayu River that provide a large amount of habitat of marine resources, covered with 9-60 m depths, generally mangroves and mudflats and also highly productive fish species [3]. Darvel Bay is important to the local as source of food as well as to get cheap protein. Fish as preferred as part of local and traditional recipes [4].

The commercial fishing gear had increased demersal fish landing in this area. Figures were obtained from statistical annually data which was collected in Lahad Datu and Kunak district. In 1990 the marine fish landing was 13761 tons [5] and this amount increase to 53051.36 tons after 10 years [6]. The increasing of landing was due to the increasing of fishermen and fishing gears. The catch trend increases by quantity every year because of increase in effort fishing gear.

The objective of this study to estimate the biomass. The data provided as a basis for assessing the magnitude of the resources and its resilience to fishing pressure especially demersal fishes in this area as well as in Sabah generally in the future.

MATERIALS AND METHODS

The map of Darvel Bay Nautical chart No. 1680 produced by Superintendent of Rear Admiral, United Kingdom was used during the survey and the area as in Figure 1.

A 20 GRT trawler was used in the trial to collect fish samples. Data collection was conducted started from January 2003 to December 2006. The tow duration was 4 hours by an engine 1100 rpm at 3 knots speed. The transects were cruised throughout day only. The samples were taken on board with the code end mesh sizes were

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Fig. 1: Location of the study which is around Darvel Bay, Sabah, Malaysia (adapted from http:// www.asianinfo.org/ asianinfo/countries_map/map-picture/malaysia_pol98.jpg [7])

38 mm with mount opening 2 meters. A total of 128 trawl sampling were conducted within the area ranging between 9-60 meters depth. Data of total weight catch were recorded for each haul.

Global Position Sensory (GPS) was used to identify the location of 128 stations that involved in trawling. The trawler net was used to estimate the mean catch in the fishing area at all station. The size of stock or total stock weight or biomass was the mean catch per area being swept by trawl (a) multiplied by the stock area (A). A towed trawl net in fact the fish sample in an area which is equivalent to a long rectangular sampling unit with an area [8]. King [9] estimated as:

a = W * TV * D

(M/n Mile). (M/Hr). (Hr)=M Sq

W = HL/N ml (1852 metres))*TV*Duration

Where;

W = The effective width of the trawl
HL = Head line (Meter)
N ml = Nautical Mile, where's1 N mile=1852 Nautical meters
TV = The velocity (M/hr)
D = Duration of the tow (hour)

The weight or stock biomass of fish in the area is obtained by multiplying the biomass of the fish in the path of the trawl by the ratio of the stock area to the trawl area:

B = Cw/v * (A/a)

Where;

B = Biomass or stock siz
Cw = Mean catch per tow
v = Vulnerability (Fish above 5 cm Vulnerability with mesh size 38 mm)
A = Total area occupied by the stock
a = The area covered by the standard trawl

With assumption fish below 5 cm escape from the net 38 mm diamond shape. The selectivity of the net is considered to be the fish length at which 50 percent of the fish are retained in the cod end of a trawl [10]. The data for Swept Area Method as in Table 1.

RESULTS

A total of 128 hauls were conducted for biomass estimation within the survey in the Darvel Bay duration from January 2003 to December 2006. These were shown in Table 2 Using Swept Area Method, the total survey area was estimated at 834.55 Km sq. The fish resources estimation is only limited coastal waters at the shallower than 60m in depth. In general observation, Lat 4° 57' N Long 118° 23' E, the lowest catch with only 95 kg and the high Lat 4° 53' N Long 118° 16' E was 247 kg.

The estimation potential fish resources 1034979.15 kilograms with fish density was 3,639.53 kg/km^2 and the result estimated in Table 3. The fish density is calculated based on assumptions the doors and sweeps are effectively herding fish into the path of the net.

Table 1: Information Data for Swept Area Method

1 nautical Mile	1852.00	Meters
Towed distance	22204.00	Meters
Fishing area	834.55	Km.sq
Headline	2.00	Meters
Towed velocity	6.08	Km/hrs
Time	4.00	Hrs

Table 2: The catch from hundred twenty eight stations

No	Position	Total weight
1	Lat 4° 50' N Long 118° 24' E,	140.0
2	Lat 4° 53' N Long 118° 14' E,	142.0
3	Lat 4° 58' N Long 118° 25' E	181.0
4	Lat 4° 53' N Long 118° 15' E,	170.0
5	Lat 4° 57' N Long 118° 26' E,	182.0
6	Lat 4° 52' N Long 118° 16' E,	216.0
7	Lat 4° 57' N Long 118° 27' E,	208.4
8	Lat 4° 52' N Long 118° 15' E,	216.5
9	Lat 4° 57' N Long 118° 25' E,	171.0
10	Lat 4° 52' N Long 118° 16' E,	182.0
11	Lat 4° 56' N Long 118° 26' E,	185.0
12	Lat 4° 51' N Long 118° 14' E,	200.0
13	Lat 4° 55' N Long 118° 12' E,	173.0
14	Lat 4° 47' N Long 118° 13' E,	161.0
15	Lat 4° 48' N Long 118° 14' E,	134.0
16	Lat 4° 54' N Long 118° 15' E,	146.0
17	Lat 4° 47' N Long 118° 14' E,	148.0
18	Lat 4° 53' N Long 118° 13' E,	152.0
19	Lat 4° 46' N Long 118° 16' E,	125.0
20	Lat 4° 54' N Long 118° 12' E,	138.0
21	Lat 4° 48' N Long 118° 18' E,	119.0
22	Lat 4° 53' N Long 118° 11' E,	145.0
23	Lat 4° 55' N Long 118° 24' E,	137.0
24	Lat 4° 57' N Long 118° 33' E,	142.0
25	Lat 4° 59' N Long 118° 26' E,	127.0
26	Lat 4° 52' N Long 118° 32' E,	150.0
27	Lat 4° 56' N Long 118° 23' E,	158.0
28	Lat 4° 53' N Long 118° 35' E,	149.0
29	Lat 4° 23' N Long 118° 53' E,	115.0
30	Lat 4° 52' N Long 118° 34' E,	135.0
31	Lat 4° 53' N Long 118° 23' E,	156.0
32	Lat 4° 52' N Long 118° 32' E,	122.0
33	Lat 4° 58' N Long 118° 23' E,	124.0
34	Lat 4° 53' N Long 118° 30' E,	95.0
35	Lat 4° 57' N Long 118° 23' E,	143.0
36	Lat 4° 52' N Long 118° 30' E,	108.0
37	Lat 4° 56' N Long 118° 23' E,	217.0
38	Lat 4° 54' N Long 118° 30' E,	221.0
39	Lat 4° 55' N Long 118° 23' E,	201.0
40	Lat 4° 55' N Long 118° 30' E,	226.0
41	Lat 4° 54' N Long 118° 23' E,	154.0
42	Lat 4° 55' N Long 118° 31' E,	165.0
43	Lat 4° 57' N Long 118° 22' E,	187.0
44	Lat 4° 51' N Long 118° 14' E,	199.0
45	Lat 4° 56' N Long 118° 22' E,	211.0
46	Lat 4° 50' N Long 118° 13' E,	192.0
47	Lat 4° 56' N Long 118° 22' E,	155.0
48	Lat 4° 54' N Long 118° 15' E,	165.0
49	Lat 4° 52' N Long 118° 22' E,	159.0
50	Lat 4° 53' N Long 118° 13' E,	170.0
51	Lat 4° 53' N Long 118° 22' E,	141.0
52	Lat 4° 54' N Long 118° 12' E,	161.0
53	Lat 4° 57' N Long 118° 21' E,	128.0
54	Lat 4° 55' N Long 118° 14' E,	150.0
55	Lat 4° 56' N Long 118° 21' E,	153.0
56	Lat 4° 57' N Long 118° 14' E,	141.0
57	Lat 4° 55' N Long 118° 21' E,	130.0
58	Lat 4° 52' N Long 118° 14' E,	151.0
59	Lat 4° 54' N Long 118° 21' E,	169.0
60	Lat 4° 53' N Long 118° 13' E,	158.0
61	Lat 4° 53' N Long 118° 21' E,	117.0
62	Lat 4° 53' N Long 118° 14' E,	128.0
63	Lat 4° 53' N Long 118° 20' E,	150.0
64	Lat 4° 52' N Long 118° 14' E,	126.0
65	Lat 4° 57' N Long 118° 23' E,	123.0
66	Lat 4° 53' N Long 118° 14' E,	115.0
67	Lat 4° 58' N Long 118° 23' E,	141.0
68	Lat 4° 53' N Long 118° 15' E,	133.0
69	Lat 4° 56' N Long 118° 23' E,	200.0
70	Lat 4° 52' N Long 118° 16' E,	231.0
71	Lat 4° 55' N Long 118° 23' E,	210.0
72	Lat 4° 53' N Long 118° 16' E,	247.0
73	Lat 4° 54' N Long 118° 23' E,	160.0
74	Lat 4° 52' N Long 118° 16' E,	171.0
75	Lat 4° 56' N Long 118° 22' E,	220.0
76	Lat 4° 55' N Long 118° 14' E,	240.0
77	Lat 4° 55' N Long 118° 12' E,	203.0
78	Lat 4° 47' N Long 118° 13' E,	190.0
79	Lat 4° 48' N Long 118° 14' E,	155.0
80	Lat 4° 54' N Long 118° 12' E,	168.0
81	Lat 4° 47' N Long 118° 14' E,	153.0
82	Lat 4° 53' N Long 118° 13' E,	175.0
83	Lat 4° 46' N Long 118° 16' E,	150.0
84	Lat 4° 53' N Long 118° 12' E,	162.0
85	Lat 4° 48' N Long 118° 18' E,	131.0
86	Lat 4° 53' N Long 118° 11' E,	159.0
87	Lat 4° 55' N Long 118° 24' E,	155.0
88	Lat 4° 57' N Long 118° 13' E,	148.0
89	Lat 4° 59' N Long 118° 26' E,	107.0
90	Lat 4° 52' N Long 118° 13' E,	136.0
91	Lat 4° 56' N Long 118° 23' E,	140.0
92	Lat 4° 53' N Long 118° 14' E,	142.0
93	Lat 4° 23' N Long 118° 53' E,	135.0
94	Lat 4° 52' N Long 118° 14' E	148.0
95	Lat 4° 53' N Long 118° 23' E,	148.0
96	Lat 4° 52' N Long 118° 13' E,	125.0
97	Lat 4° 56' N Long 118° 25' E,	134.0
98	Lat 4° 55' N Long 118° 14' E,	118.0
99	Lat 4° 54' N Long 118° 24' E,	115.0
100	Lat 4° 56' N Long 118° 15' E,	143.0
101	Lat 4° 54' N Long 118° 27' E,	136.0
102	Lat 4° 56' N Long 118° 16' E,	200.0
103	Lat 4° 56' N Long 118° 26' E,	161.0
104	Lat 4° 57' N Long 118° 15' E,	178.0
105	Lat 4° 56' N Long 118° 26' E,	130.0
106	Lat 4° 51' N Long 118° 16' E,	143.0
107	Lat 4° 56' N Long 118° 25' E,	164.0
108	Lat 4° 51' N Long 118° 12' E,	181.0
109	Lat 4° 50' N Long 118° 14' E,	176.0
110	Lat 4° 43' N Long 118° 14' E,	184.0
111	Lat 4° 47' N Long 118° 13' E,	141.0
112	Lat 4° 47' N Long 118° 14' E,	144.0
113	Lat 4° 54' N Long 118° 15' E,	134.0
114	Lat 4° 46' N Long 118° 16' E,	144.0
115	Lat 4° 53' N Long 118° 13' E,	145.0
116	Lat 4° 48' N Long 118° 18' E,	132.0
117	Lat 4° 54' N Long 118° 12' E,	118.0
118	Lat 4° 55' N Long 118° 24' E,	130.0
119	Lat 4° 53' N Long 118° 11' E,	148.0
120	Lat 4° 59' N Long 118° 26' E,	154.0

Table 2: Continued

121	Lat 4° 57' N Long 118° 33' E,	115.0
122	Lat 4° 56' N Long 118° 23' E,	142.0
123	Lat 4° 52' N Long 118° 32' E,	152.0
124	Lat 4° 55' N Long 118° 53' E,	173.0
125	Lat 4° 21' N Long 118° 35' E	125.0
126	Lat 4° 51' N Long 118° 32' E,	134.0
127	Lat 4° 54' N Long 118° 34' E,	167.0
128	Lat 4° 53' N Long 118° 31' E,	130.0
Total (kg)		20032.9
Average catch per haul		156.5
Average catch per hr		39.1
STDEV		30.7
Variance		943.9

Table 3: The Result from Swept Area Method

Total area	834.55	Km sq
Average catch	156.50	Kg per haul
Estimated resources	1034979.15	Kg
Fish Density	3,639.53 kg	Kg per square km
Effective width (W)	0.1393	N km Sq

DISCUSSIONS

The fishes were totally vulnerable. One vulnerability was the most conservative estimate of stock biomass [9]. Fishing selectivity is defined as ability to target and capture fish by size and species during harvest operation [10]. Targets might be some wanted species of certain size-ranges, often above a pre-set minimum whereas the non-targets will consist of all other species and size-ranges that are incidentally caught. The selectivity process, interaction between the behaviour of living organisms and the moving gear is the key factor in any selection process. Some organisms, however, have the capability to sense parts of the approaching gear and will react in various ways. The most common reaction fish will tend to swim away from the net rather than being caught [11]. This behaviour, also known as herding, is seen in different parts of the gear and will normally result in a separation of organisms with different swimming capabilities, e.g. large and small individuals of the same species. Another behaviour pattern typical for some organisms is that they can sense escape holes that they will try to penetrate when in a frightening situation as in the cod end. When organisms become more densely packed than they commonly are in their natural environment, some will become frightened and react with panic. The resulting behaviour is vigorous flight in all directions, a reaction often seen in the aft belly of trawls when the cross section of the trawl has been reduced to a fraction of what it is at the entrance.

The estimated biomass density of the area where the potential resources 3,639.53 kg/km^2 or 3.6 metric tons/km^2. In comparison with the estimated biomass of demersal resources along the West Coast of Sabah in 1972, the fish density was about 4.97 metric tons /km^2 by KK Penyelidik [12], 7.74 metric tons/km^2 in 1987 by RV Rastrelliger [13] and 3.14 metric tons/km^2 in 1993 by KK Manchong [14].

In conclusion, Darvel Bay among the riches fishing ground situated in East Coast Sabah. Intensive trawled in that area the fishery resources may be removed with high-effort of trawler trawling and removes the resources. The removal of fishery resources is subjected to the density of the resources in that area.

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