Trawl catch and bycatch survey in Samar Sea, Philippines

2016

Strategies for trawl fisheries bycatch management project

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Strategies for trawl fisheries bycatch management
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Abstract

Two major fish landing points were identified namely: Catbalogan Fish Port and Calbayog Fish Port for commercial trawl and Barangay Burabud, Santa Margarita as secondary trawl landing port for municipal trawl fisheries. Standardized National Stock Assessment Program (NSAP) forms were used to collect data on trawl, both commercial and municipal trawl. For the purpose of segregating municipal trawl for shrimp and fish, we further classified municipal trawl as municipal trawl medium (engine powered by automotive diesel engines like (4DR5, 6D14, 6BB1 etc.) while municipal small are those small trawl for shrimp powered by 16 hp gasoline engine or sometimes single piston diesel engines. Aside from the landing survey, researchers also conducted on-board observation on trawl operation for commercial and small shrimp trawl. Total catch and towing time was recorded including the cruise track to determine the fishing ground. This study recorded a total of 107 species of finfish during the sampling months. Five species of commercially important shrimps were caught by trawl namely: Penaeus merguiensis, P. japonicus, P. latisulcatus, P. monodon and P. semisulcatus. A total of 40 commercial trawl and 753 municipal trawl were recorded operating in Samar Sea and vicinity. The commercial trawl catch in Calbayog City has 35 % and medium trawl had contributed 7% while the municipal medium trawl in Catbalogan City contributed 44 % and the municipal small gasoline trawl catch in Catbalogan and Brgy. Burabud Sta. Margarita was 14 %. The bycatch in commercial trawl was 2 % with use of JTEDs in Calbayog City while the municipal medium trawls got 62 % bycatch in Catbalogan City and for the municipal small gasoline in Catbalogan City and Sta. Margarita it was 16 %. Catbalogan City medium trawler (4DR5) do not use JTEDs due to the revision of the local ordinance.

1. Introduction

Samar Sea has remained a traditional demersal fishing ground and its multi-species fisheries is exploited by a wide range of fishing gears, majority of which are demersal fishing gears. Most of the studies conducted in Samar Sea focused on stock assessment on demersal stocks starting with the work on Warfel and Manacop (1950), Villoso (1980), Armada (1984), Silvestre (1986); Abdurahman (1988) and Mines (1995). In 1950, the Theodore N. Gill otter trawl survey operated near Catbalogan, Samar; from the six completed drags made, the average catch per hour was 92 pounds (42 kg) of marketable fish. The highest yield was 248 pounds (112 kg) in one hour, obtained on the 20 fathom contour. In 1979, the mean biomass was found to be 1.52t/km2 found in all depths according to Saeger (1981). In Southeast Asia, the biomass of virgin or untapped fishing grounds ranges generally between 5.0 and 6.0t/km2 in the continental region. According to Yasaki (1983), and Pauly (1980a) 4.0 t/km2 is considered as virgin stock for the water depths down to 70m.

Legasto, del Mundo and Carpenter (1976) conducted a trawling experiment near Maqueda Bay and reported that 50 minutes of dragging caught 3.19 kg catch with glass fishes, squids, grunts, slipmouths, shrimps, and crabs as common catch. In 1976, approximately 27,000 metric tons of fish and other fishery products were landed from this area, about 22% of this quantity from commercial vessels (BFAR, 1976). Villoso and Hermosa (1980) have identified a total of 226 species, belonging to 132 genera and 82 families from demersal trawl survey. Abdurahman (1988) made a study on the fishing ground as well as Danish seine test fishing which gained popularity thereafter .It contributed to a more overfished Samar Sea brought about by more effective operation of modification of scaring device on its full rope and use of tom weight with iron hoop later termed as “zipper seining”.

The project “Strategies for trawl fisheries bycatch management” (REBYC-II CTI) – will contribute to the more sustainable use of fisheries resources and healthier marine ecosystems in the Coral Triangle and Southeast Asia waters by reducing bycatch, discards and fishing impact by trawl fisheries. The unaccounted mortality of bycatch and discard by trawl fishery in the area is scanty and not properly documented. Although previous studies on Juvenile and Trash Excluder Devices (JTEDS) were successful in the area, yet the most trawlers did not install the prescribed excluder device, hence this study is made. Result of the study will serve as baseline information for the formulation of management measures like those included in the Samar Sea Fisheries Management Plan (SSFMP).

Objective of the study

- Determine the trawl good catch and bycatch by volume and weight.
- Identify dominant species caught by trawl.
- Collect biological parameters necessary for the formulation of policy.
- Provide a scientific basis for the Ecosystem Approach of Fisheries Management (EAFM).

2. Materials and methods

2.1. Data collection and catch and bycatch assessments

Two major landing ports of Samar were selected considering the volume of catch landed by trawl fishery: the Catbalogan City fish port and Calbayog City fish landing port. Proximity and accessibility of the area and the willingness of the fishermen to cooperate were the criteria. Fish landing in these sites was monitored every two days, including Saturday, Sunday and holidays from July to December 2014. Sampling time coincided with landing time early in the morning and afternoon around 3 pm. Two enumerators were assigned in each landing site to collect information. Inventory of the boat operating, volume of catch of trawl, length measurement of species of fish and invertebrates caught, using standard National Stock Assessment Program (NSAP) forms were the information collected.

2.2. Analysis of data

2.2.1. Standing stock and extraction rate

The mean trawlable biomass (B) was estimated via the swept area using the following expressions:

$$\mathbf{D} = \frac{\mathbf{C}}{\mathbf{X_1 * X_2 * L * HL}} \tag{1}$$

and

$$\mathbf{B = D * A} \tag{2}$$

where D is the mean stock density, C is the mean catch per unit effort (CPUE). X_1 is the escapement factor (0.5), X_2 is the ratio expressing the effective width of the head rope (0.5), HL is the length of the head rope, L is the distance swept by the trawl, and A is the area of the bay.

The annual extraction rate (F) or rate of fishing is expressed as a ratio between the total annual yield and standing biomass:

$$\mathbf{F = Y / B} \tag{3}$$

where Y and B are the annual yield standing biomass, respectively.

2.2.2. Index of relative importance

In addition to the relative abundance by weight, the species caught by trawl were ranked according to their relative importance. The index of relative importance (IRI), described in Pinkas *et al.* (1971), was used since it combines the different measures of abundance, namely, number, weight and frequency of occurrence. This was defined by the following expression:

$$\mathbf{IRI_i = F_i \, (N_i + W_i)} \tag{4}$$

where IRI_i is the index relative importance of the species I, F_i is the relative frequency of occurrence of species i, N_i is the percentage of number of species i, and W_i is the percentage of weight of species i:

2.2.3. Length-weight relationship

Length of fish (cm) and corresponding fresh weight (gram) were recorded to establish the length-weight relationship for each particular species. The relationship is defined by the expression:

$$\mathbf{W = a \, L^b} \tag{5}$$

where W is the weight of the fish (gram), L is the fork length (cm), a is the constant, and b is the coefficient.

2.2.4. Sex ratio and stages of maturity

To determine the spawning seasons of the dominant species, maturity stages of both male and female were determined and recorded. From the same set of collected data, the sex ratio between male and female of each major species were determined. Simplified five-point scale was used to determine the stages of maturity:

Table 1: Five points scale used in determining the stages of maturity

Stages maturity	Classification
Stage I	Immature, virgin
Stages II	Developing/maturing
Stage III	Mature/develop
Stage IV	Gravid and spawning
Stage V	Spent or resting

2.2.5. Population parameters

Using the collected length frequency data growth parameters (L_∞, k) of the von Bertalanffy equation: total (Z), natural (M) and fishing (F) mortality coefficients; exploitation ratio (E); and recruitment patterns of dominant and economically important species were estimated using the ELEFAN (Electronic Length Frequency Analysis) routines of the FiSAT (FAO ICLARM stock assessment tools) software package (Gayanilo et al., 1996).

The parameters of the von Bertalanffy (1938) growth equation are derived from the following expression:

$$\mathbf{l_t = L\infty[\, l^{-e^{-k(t-t_0)}}]} \qquad (6)$$

where l_t is the length of the fish at age l_t, L∞ is the asymptotic length of the mean size at which fish would grow if they were allowed to live and grow indefinitely, e is the base of Naperian logarithm, k is the growth coefficient, and t_0 is the hypothetical age the fish would attain at length zero, if it has always grow in a manner as describe by the von Bertalanffy equation.

The exponential decay process was described by Beverton and Holt (1957), in the following equation:

$$\mathbf{N_t = N_0\, e^{-Zt}} \qquad (7)$$

where N_t is the number of surviving fishes in the population or cohort at time t, N_0 is the initial number of fishes in the cohort or population at time t=0, Z is the instantaneous total mortality coefficient and t is the time interval (year) between N_0 and N_t. The function describes the decrease of the number of individuals belonging to the same cohort overtime. The components of the instantaneous total mortality are shown in the following expression.

$$\mathbf{Z = M + F} \qquad (8)$$

Where, M is the instantaneous natural mortality coefficient or death caused by predation, old age, pollution, etc.; and F is the instantaneous fishing mortality coefficient or death caused by fishing. M is estimated from Pauly's (1980) empirical formula:

$$\log M = 0.654 \log k - 0.28 \log L\infty + 0.463 \log T \quad (9)$$

where $L\infty$ and k are the von Bertalanffy growth parameters and T is the average temperature of the fishing ground.

These mortality components are also expressed in the form of an index to determine the rate of exploitation, i.e.

$$E = F / Z \quad (10)$$

where E is the exploitation rate, and F and Z are fishing and total mortality coefficients.

3. Results and discussion

The survey covered a grand total of 811,700 kg for six months (October 2013 to March 2014) from Catbalogan City fish port and Calbayog City fish landing port. The commercial trawl catch in Calbayog City had contributed 35 %; "4DR5" has contributed 7% while the municipal 4DR5 in Catbalogan City has 44 % and for the municipal small gasoline trawl catch in Catbalogan and Brgy. Burabud Sta. Margarita were 14 %. For operational definition "4DR5" an automotive engine used by medium trawl with a gross tonnage ranging from 3.1 to 14 GT considered as commercial under R.A 8550 otherwise known as Fisheries Code of the Philippines of 1998.

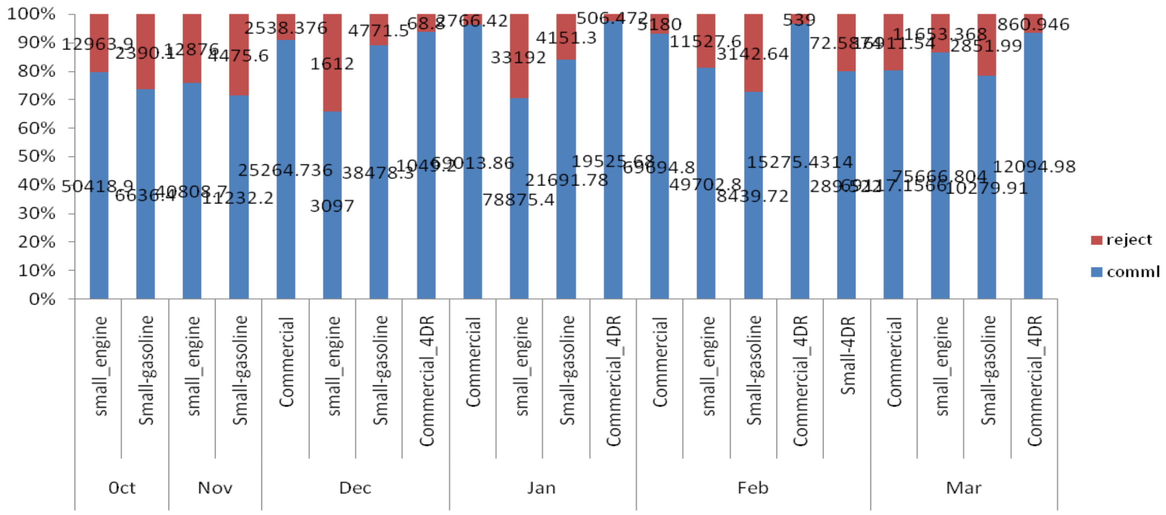

Figure 1: Good catch and bycatch in commercial and municipal trawl total catch landing in the selected landing centres in Samar Sea

"Reject" refers to bycatch. "Small municipal trawl" are trawl with outrigger powered by 16 hp gasoline or diesel engines. For the whole Samar Sea, the total count for commercial trawl was 40 and 753 medium and small trawl.

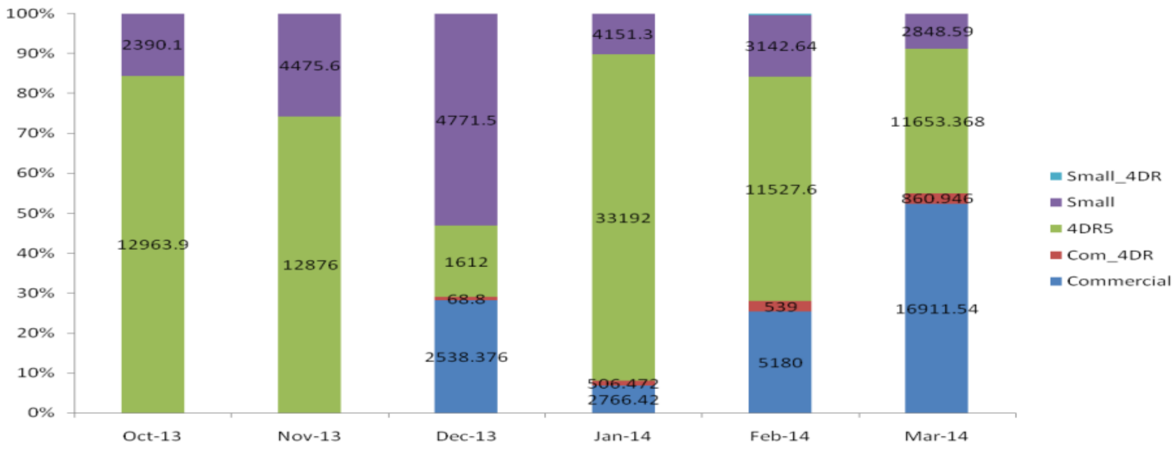

Figure 2: Bycatch in commercial and municipal trawl catch landing in the selected landing centres of Samar Sea

A total of 135,052 kg of bycatch was reported from both sampling areas together. The bycatch in commercial trawl was 2 % with use of JTEDs in Calbayog City while the municipal 4DR5 got 62 % in Catbalogan City and the municipal small gasoline in Catbalogan City and Sta Margarita was 16 %. Catbalogan City medium trawlers (4DR5) do not use JTEDs due to the revision of the local ordinance. This amounts to a total of 676,653 kg of good catch for six months. Catbalogan City 4DR5 contributed about 44% of the catch landing followed by commercial trawl in Calbayog City which contributed about 35%, while the small engine and 4DR5 in Sta. Margarita contributing 14% and commercial 4DR5 contributing about 7%.

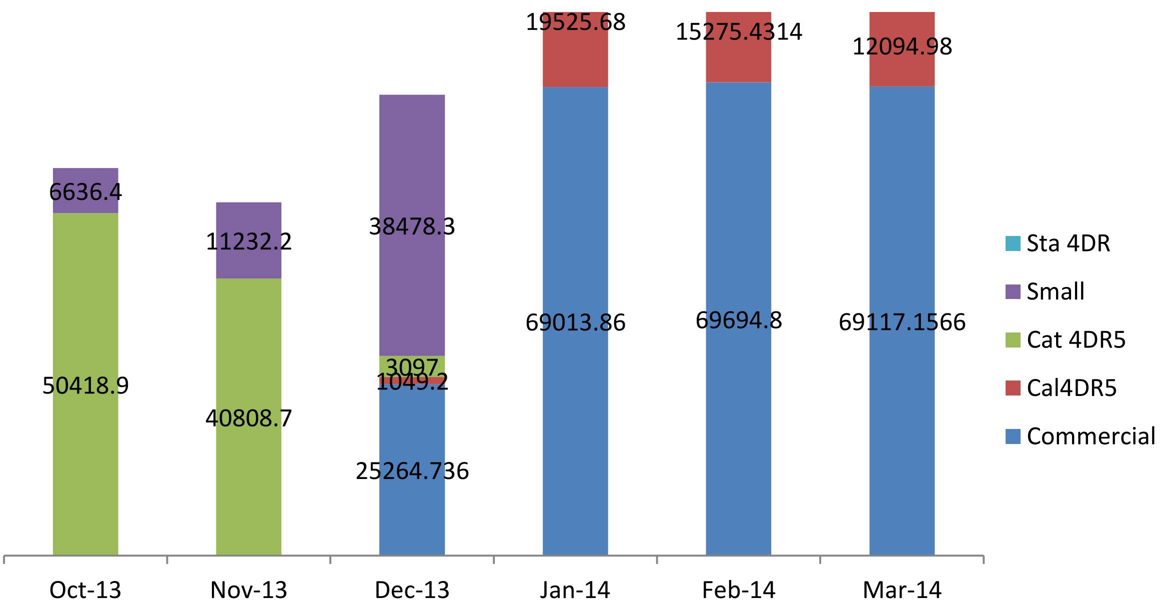

Figure 3: Good catch of trawl fishery in Samar Sea

For Calbayog City there was no commercial trawl operation due to fuel price escalation of diesel from October to November 2013, while in December they only landed 11% due to super typhoon "Haiyan".

January 2014 landed 29% while February and March 30% (April, May, June, and July are closed season).

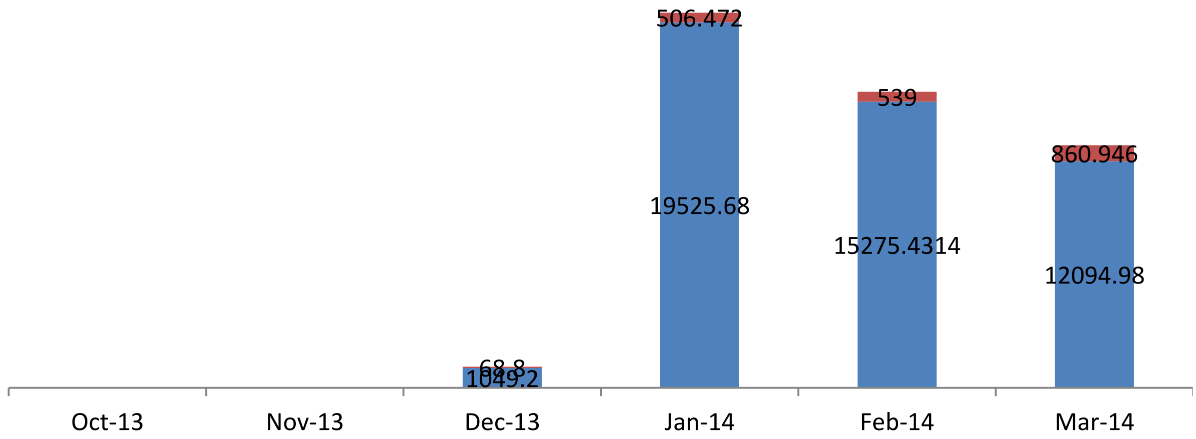

Figure 4: Catch landing of 4DR5 medium size trawl in Calbayog City

A total of 298,481 kg of demersal fish caught by trawl were recorded in the months of October 2013 to March 2014. For Catbalogan City medium trawl (4DR5), bycatch was ranging from 2 to 40%. In October and November 2013 the bycatch was 15% for both months while in January 2014 they got the highest bycatch (about 40%) and for the months of February and March 14% of bycatch were recorded consisting of juveniles of commercially important fin fishes.

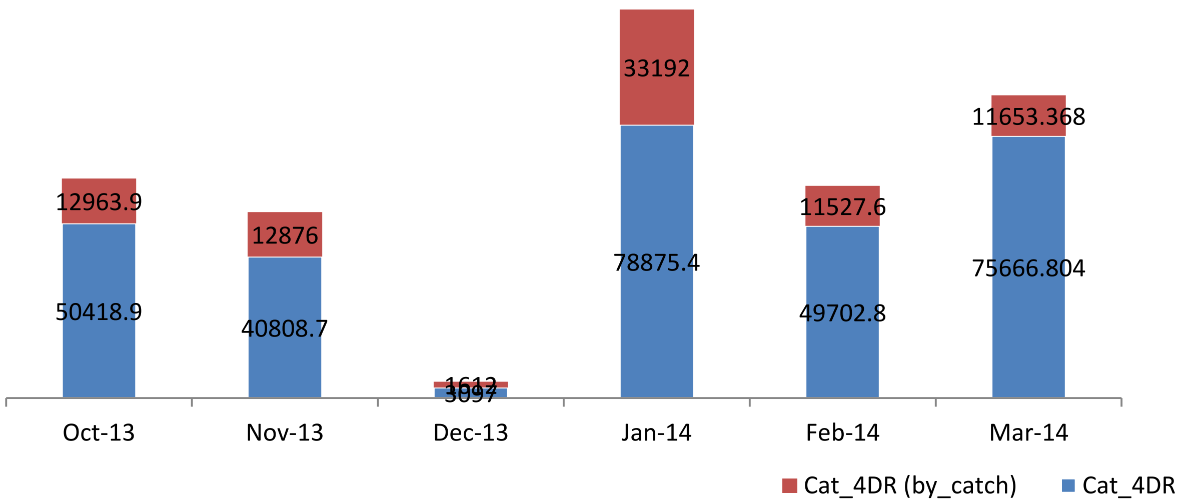

Figure 5: Municipal 4DR5 and bycatch landing in Catbalogan City

A total of 108,112 kg of demersal fish caught by trawl was recorded during the months of October 2013 to March 2014, Catbalogan and Brgy. Burabud Sta. Margarita. October recorded 74% of good catch and 26% of bycatch; Novembere recorded 72% of good catch and 28% of bycatch; December has 91 % of good catch and 9% of bycatch; January has 84% of good catch and 16% of bycatch; February has 73% of good catch and 27% of bycatch; March has 78% of good catch and 22% of bycatch.

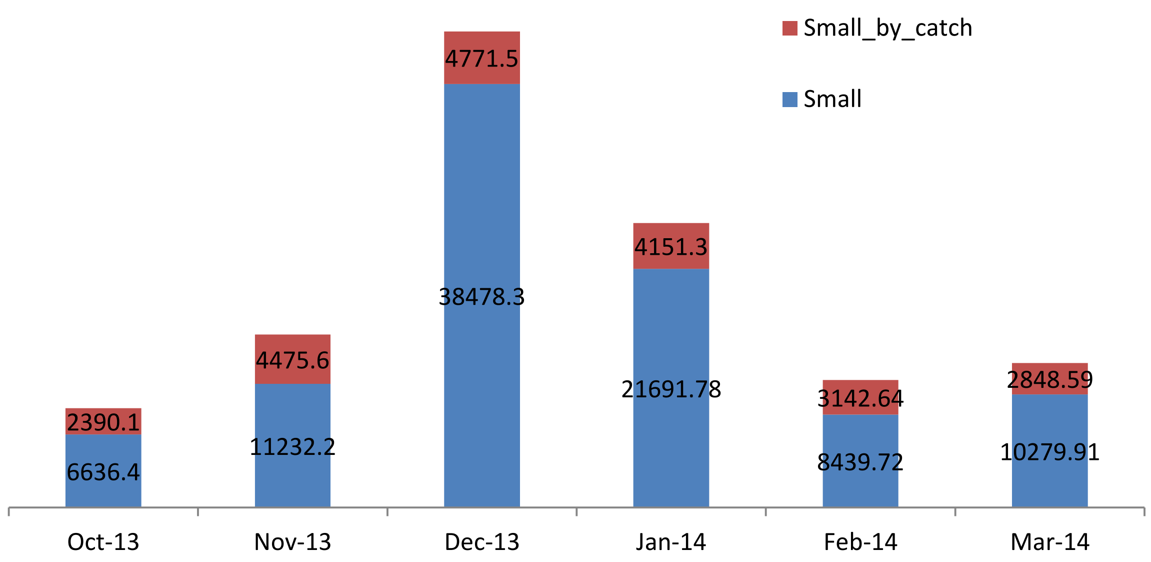

Figure 6: Municipal small trawl catch and bycatch in Samar Sea

A total of 107 species of fin fish were recorded during the six sampling months. This are comparatively less species than that of the Samar Sea Trawl Survey 1980 by University of the Philippines in the Visayas (UPV) with German technical cooperation (GTZ) which recorded 226 species (Villoso *et al.*,1980). **Table 2** shows the list of dominant species and their relative abundance by commercial trawl and also small medium trawl (4DR5). Common slipmouth ranks highest (25.1%) among the demersal stock. Five species of commercially important shrimps were caught by trawl namely: *Penaeus merguiensis*, *P. japonicus*, *P. latisulcatus*, *P. monodon and P. semisulcatus.*

Table 2: Relative abundance (by weight) of the 20 most common fish species caught by commercial trawl in Samar Sea, 2013-2014

	Species	**%**
1	*Leiognathus splendens*	25.1
2	*Trichiurus lepturus*	12.2
3	*Saurida tumbil*	8.5
4	*Rastrelliger brachysoma*	7.1
5	*Upeneus sulphureus*	6.6
6	*Priacanthus tayenus*	6.3
7	*Stolephorus indicus*	6.1
8	*Leiognathus equulus*	5.8
9	*Sardinella fimbriata*	4.2
10	*Nemipterus hexodon*	3.2
11	*Lutjanus lutjanus*	2.1
12	*Rastrelliger faughnii*	2.0
13	*Decapterus macrosoma*	1.8
14	*Secutor insidiator*	1.8

15	*Rastrelliger kanagurta*	1.7
16	*Sardinella longiceps*	1.5
17	*Scolopsis taeniopterus*	1.2
18	*Lutjanus monostigma*	1.1
19	*Selar crumenophthalmus*	0.9
20	*Selaroides leptolepis*	0.8

Table 2 shows the list of top 20 species of fishes landed in two major fish ports in Calbayog City and Catbalogan City by commercial trawl and medium fish trawl.

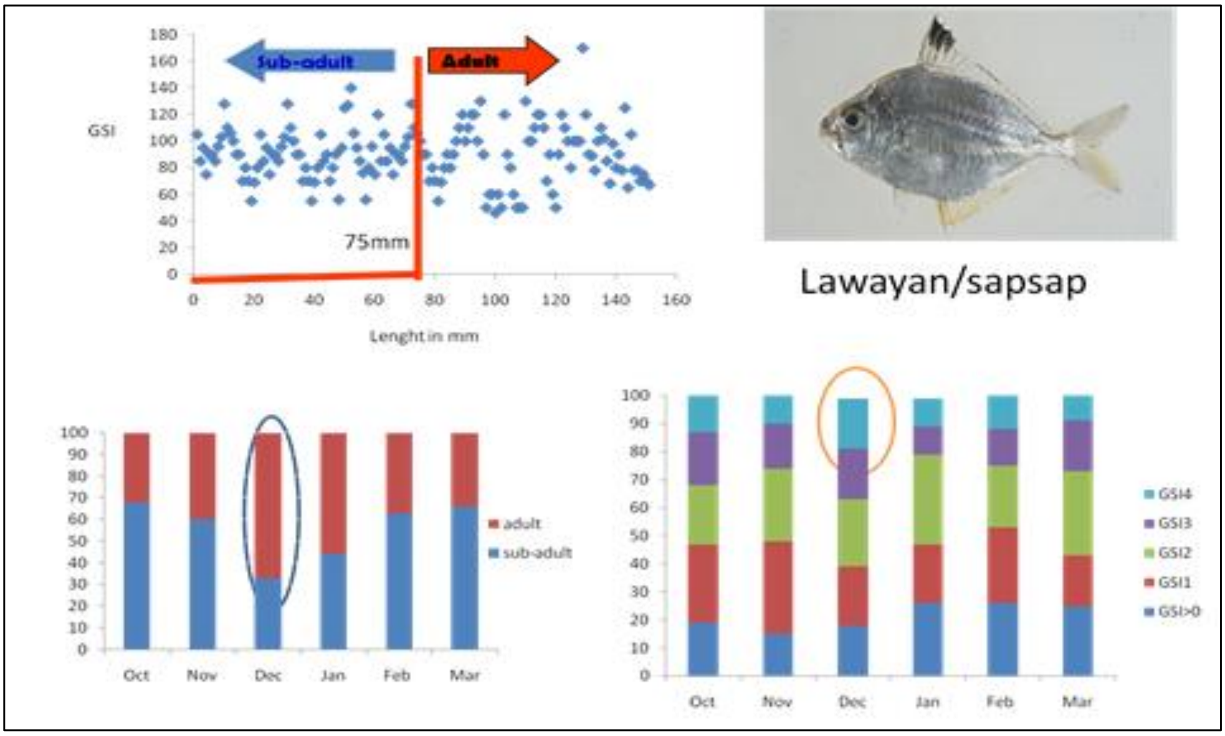

Figure 7: Maturity of slipmouth

Figure 7 shows maturity of the common slipmouth (*Leiognathus splendens),* length of first maturity was 75mm. Adult and gravid individuals at stage IV were caught in December.

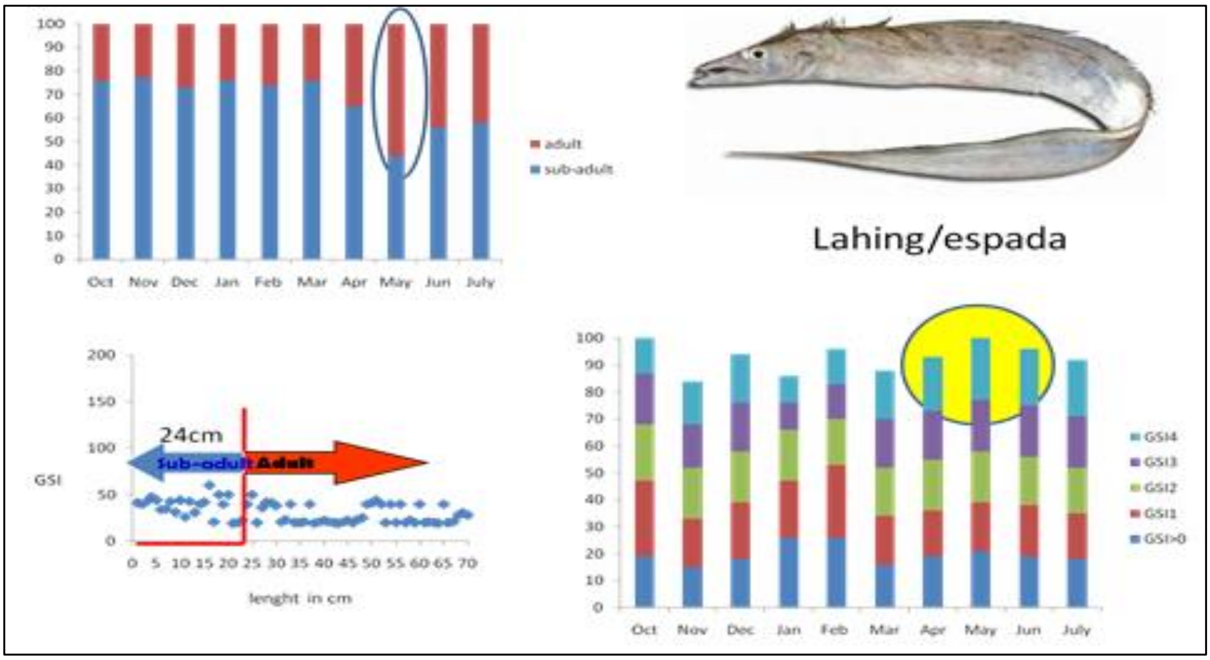

Figure 8: Maturity of hairtail

Figure 8 shows maturity of the second dominant fish caught by trawl in Samar Sea, the hairtail (Trichiurus lepturus). Adult individuals were caught in May and reach the length of first maturity at 240 mm.

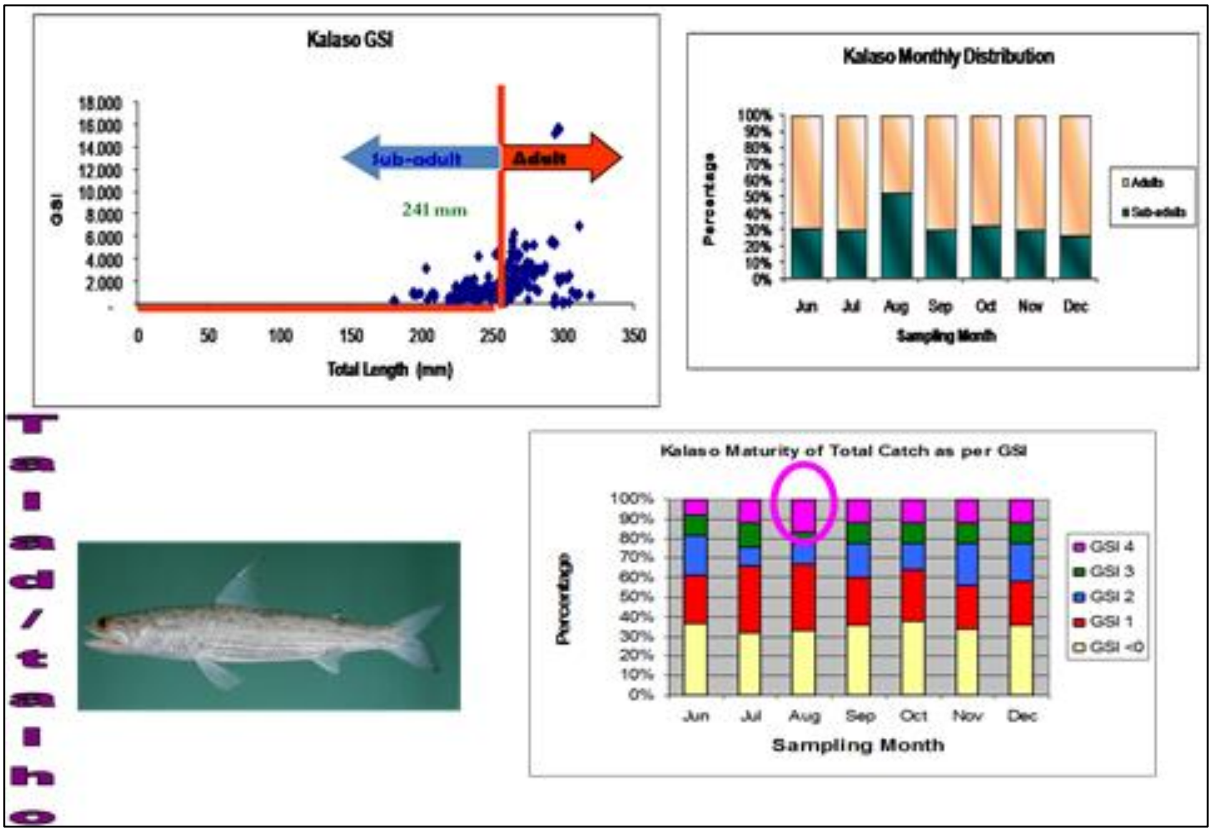

Figure 9: Maturity of lizard fish

The third dominant species was the lizard fish (*Saurida tumbil*) which reached the length of first maturity at 241 mm and were caught with stage IV egg maturity (**Figure 9**).

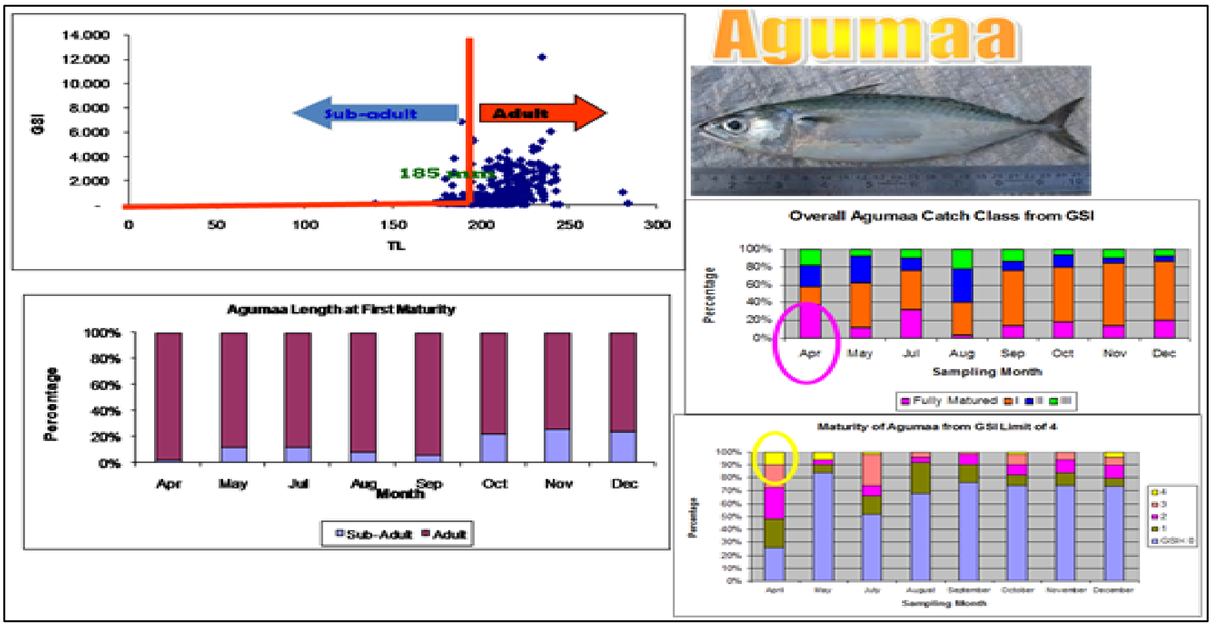

Figure 10: Maturity of chub mackerel

Three species of mackerel including the commercially important chub mackerel were caught throughout the year in Samar Sea (**Figure 10**). The island mackerel (*Rastrelliger faughni*) reach the length of first maturity at 185 mm and were caught in April with gravid stage IV adult. While in Indian mackerel (*Rastrelliger kanagurta*) the length at first maturity is 199mm and these were caught during April, May, and June as adult (**Figure 11**). The short bodied mackerel (*Rastrelliger brachysoma*) attain their first length of maturity at 170mm and were abundantly caught from February to May; also at stage IV for their eggs (**Figure 12**).

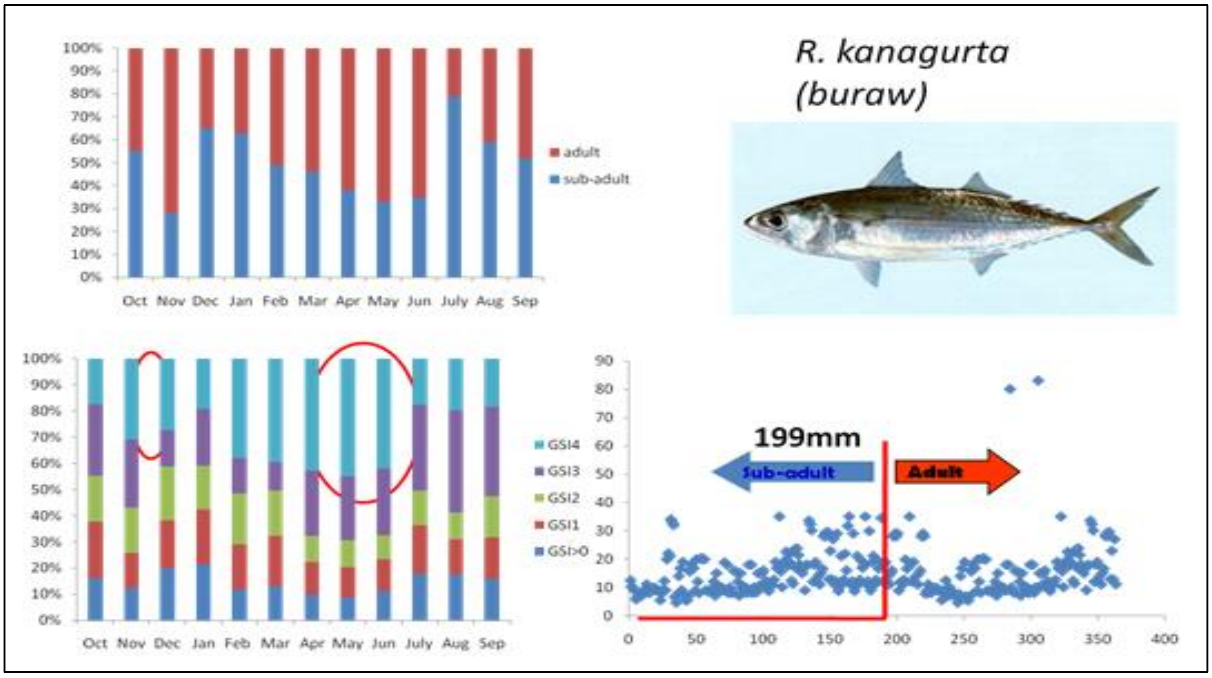

Figure 11: Maturity of Indian mackerel

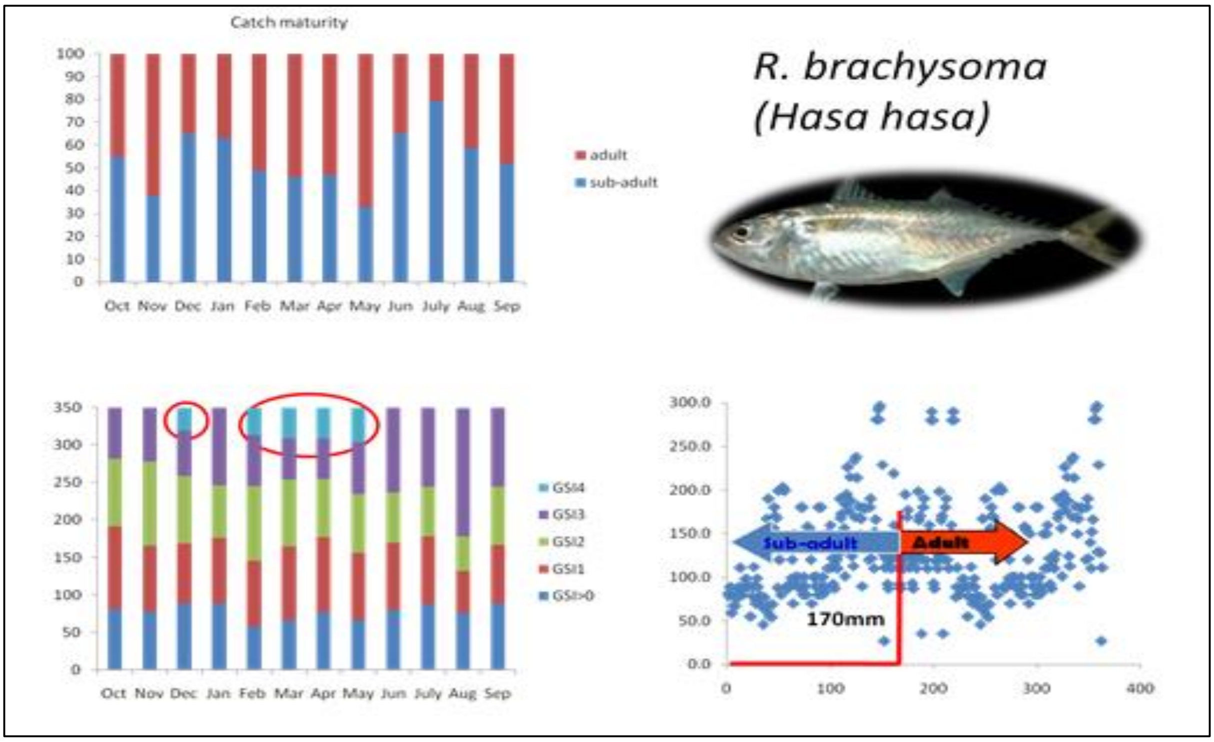

Figure 12: Maturity of short bodied mackerel

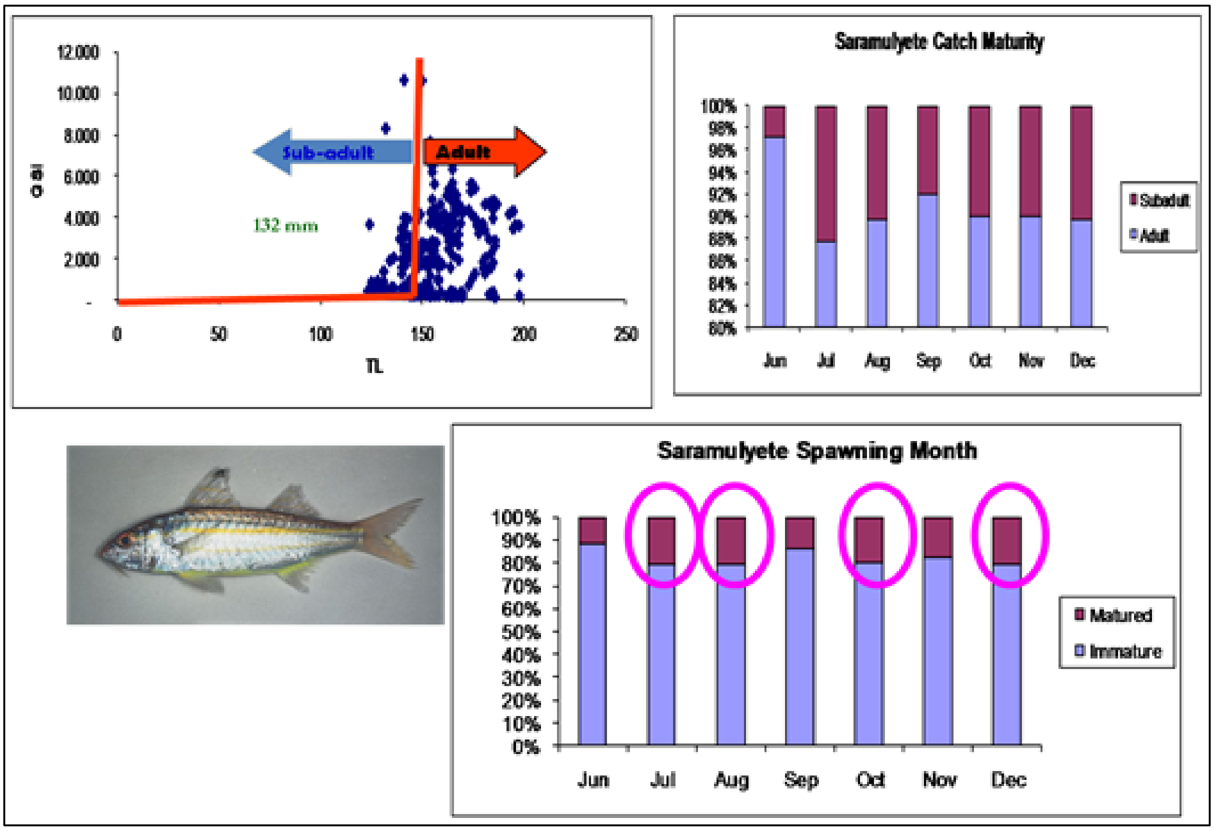

Figure 13: Maturity of goat fish

The length of first maturity of goat fishes (*Upeneus sulphureus*) was 132mm. There were four spawning months in a year i.e., July and August, October and December. Adults were caught abundantly in June and July (**Figure 13**). Rank six in the most dominant species was purple-spotted bigeye (*Priacanthus tayenus*) with 290 mm as the first length of maturity and they were caught by trawl abundantly during April and May, while matured stage IV gravid specimens were observed in April and July (**Figure 14**).

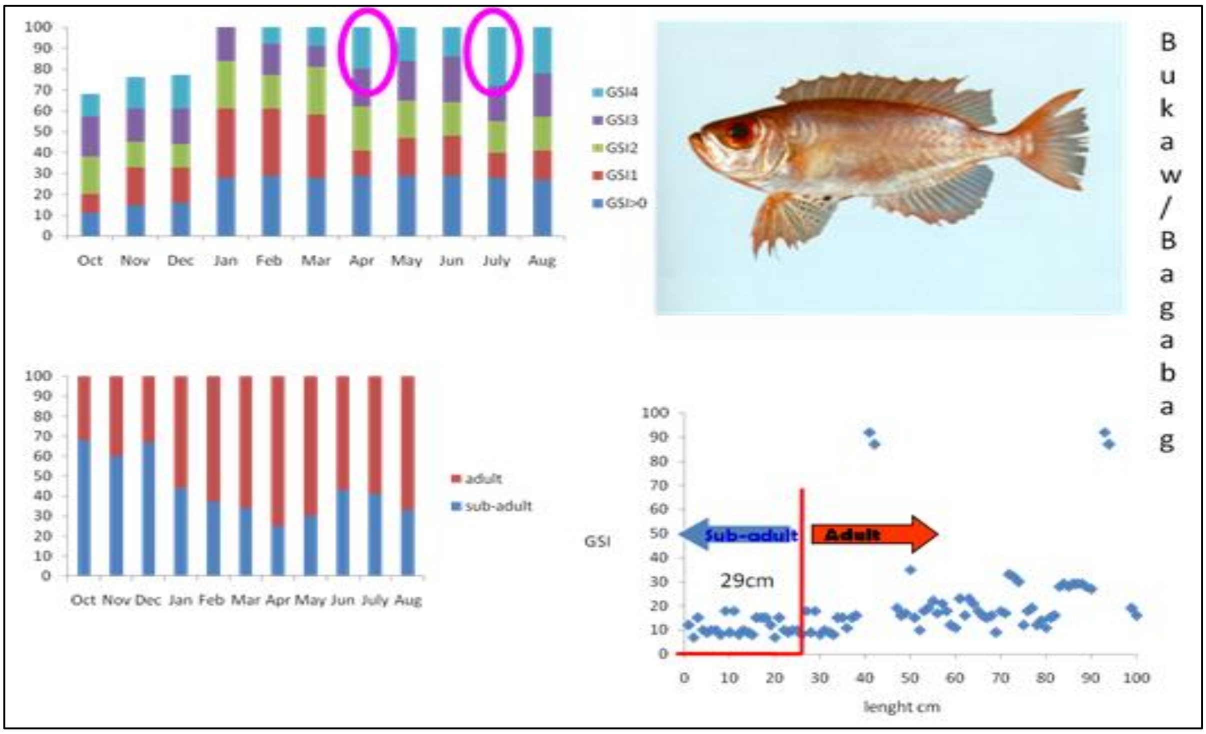

Figure 14: Maturity of purple-spotted bigeye

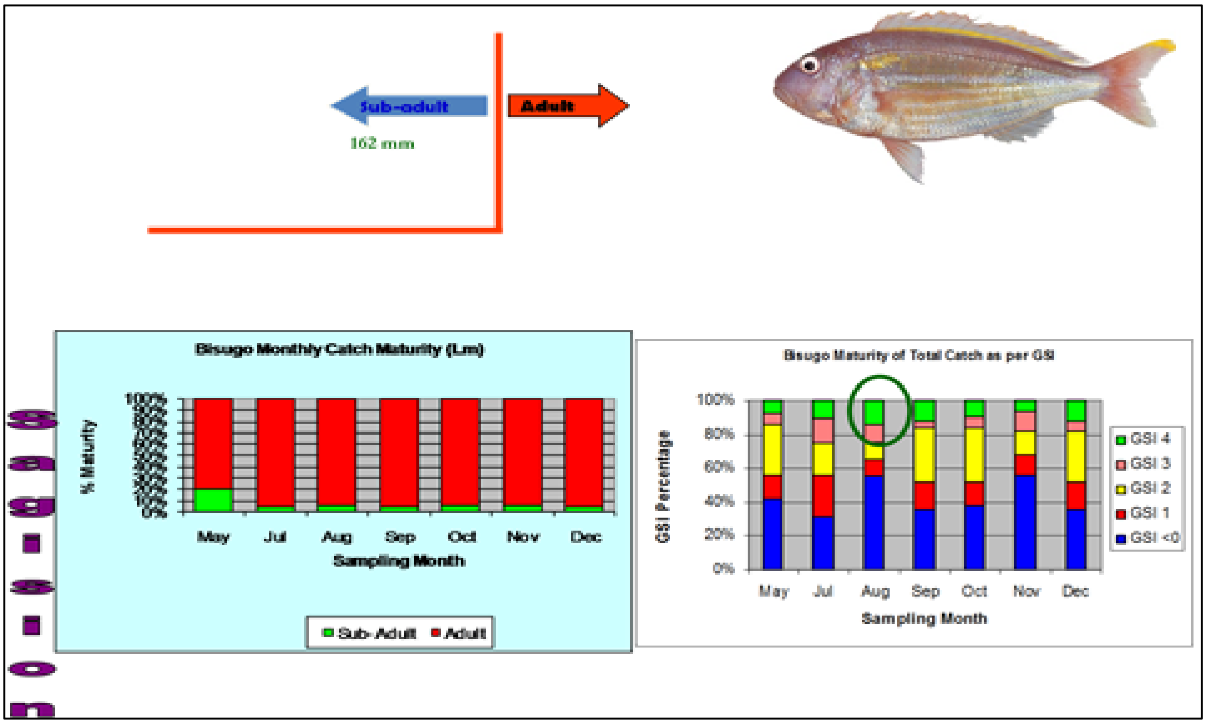

Figure 15: Maturity of threadfin breams

The length at first maturity of the threadfin breams (*Nemipterus hexodon*) was 162 mm and these were caught gravid at stage IV in the months August and September. The adult nemipterids were caught in almost all months except for May when they were sub-adult (**Figure 15**).

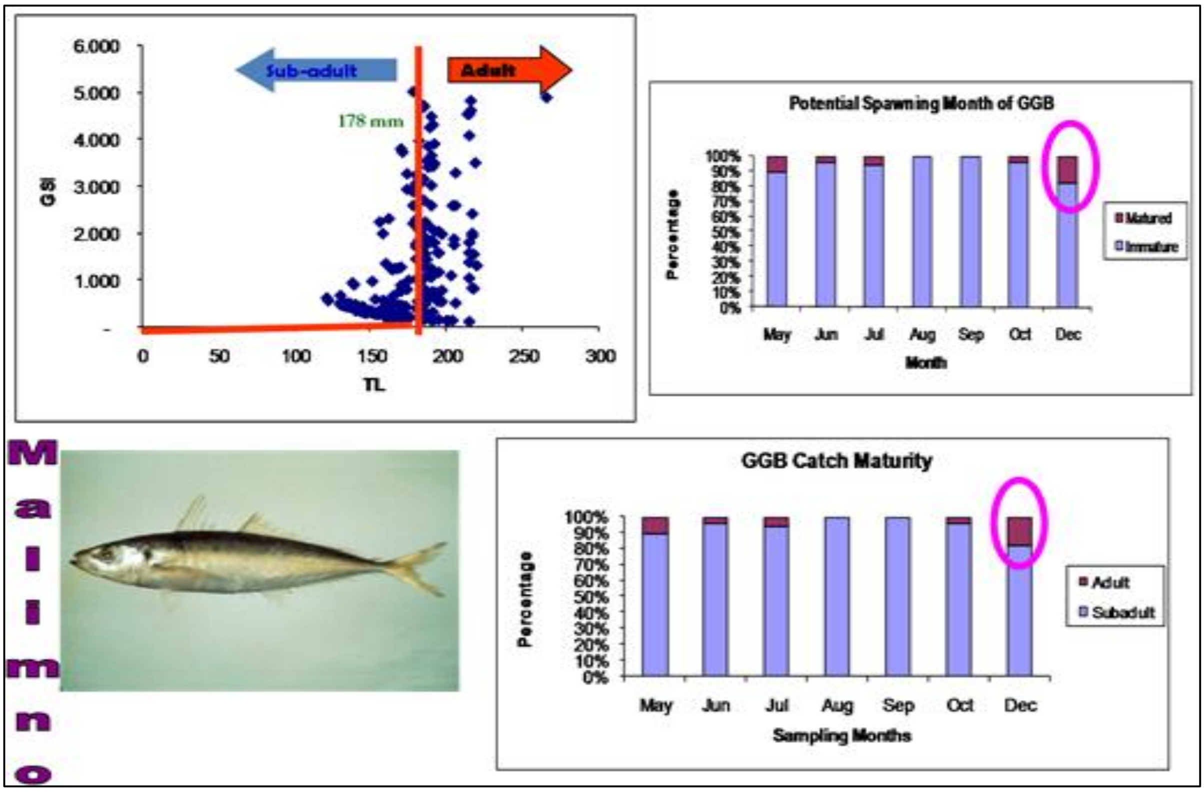

Figure 16: Maturity of roundscad

Roundscad (*Decapterus macrosoma*) was one of the dominant species that were caught by demersal trawl in Samar Sea. The first length of maturity was 178 mm and they were mostly caught as adult in December (**Figure 16**).

Table 3: Population parameters of dominant species caught by trawl in Samar Sea (2013-2014)

Species	a	b	r^2	L_∞	k	Z	M	F	E
Leiognathus splendens	0.036390	2.89	0.98	13.50	1.00	5.66	2.25	3.41	0.60
Trichiurus lepturus	0.000150	3.43	0.93	78.00	0.50	11.13	7.81	3.32	0.29
Saurida tumbil	0.003920	3.32	0.98	34.19	0.82	2.79	1.52	1.26	0.45
Rastrelliger brachysoma	0.010000	3.23	1.00	21.20	0.96	3.20	1.44	1.76	0.55
Upeneus sulphurous	0.002219	2.95	0.96	16.25	0.78	3.00	1.53	1.47	0.49
Priacanthus tayenus	0.030000	2.70	0.86	29.00	0.65	4.71	1.31	3.40	0.72
Stolephorus indicus	0.006700	3.23	0.95	13.00	0.50	4.65	1.00	3.15	0.68
Leiognathus equulus	0.033510	2.96	0.99	22.25	0.80	4.08	1.69	2.39	0.59
Sardinella fimbriata	0.045100	2.58	0.93	13.80	0.75	3.21	1.45	1.76	0.55
Nemipterus hexodon	0.023840	2.94	0.97	22.75	1.09	4.74	2.06	2.68	0.57
Lutjanus lutjanus	0.023500	2.80	0.89	27.60	0.50	4.23	2.14	2.09	0.49

Rastrelliger faughni	0.014100	3.00	0.93	26.50	1.30	4.44	1.60	2.84	0.63
Decapterus macrosoma	0.005640	3.17	0.88	28.10	2.00	4.71	1.57	3.14	0.67
Secutor insidiator	0.018700	3.08	0.85	11.00	1.30	5.09	2.06	3.03	0.60
Rastrelliger kanagurta	0.014100	3.20	0.93	28.40	1.31	7.84	1.89	5.86	0.75
Sardinella longiceps	0.008570	3.00	0.74	21.00	0.60	8.62	2.70	5.92	0.69
Scolopsis taeniopterus	0.027370	2.85	0.98	21.50	0.62	2.54	1.45	1.09	0.43
Lutjanus monostigma	0.022180	2.91	0.97	55.00	0.22	4.96	1.77	3.19	0.64
Selar crumenophthalmus	0.011400	3.23	0.96	28.50	1.70	4.01	2.23	1.78	0.56
Selaroides leptolepis	0.014500	3.08	0.99	15.75	0.60	3.84	1.54	2.30	0.60

Table 3 shows population parameters of the top 20 species caught by trawl in Samar Sea. Almost all species have high exploitation rate (E) except for a few like the hairtail (*Trichiurus lepturus)* and breams (*Scolopsis taeniopterus*). Recent trawl survey by M/V DA-BFAR revealed that the estimated standing stock biomass of Samar Sea was 2.88 t/km^2; higher than that of the adjacent fishing ground like San Pedro Bay with 1.7t/km^2 (Armada,1996) and also the Visayan Sea. But in terms of biodiversity, Samar Sea was lower than the adjacent fishing grounds probably brought about by overfishing. Samar Sea has been ovefished since the early 1980's. 1n 1979, the mean biomass was found to be 1.52t/km^2 found in all depth according to Saeger, 1981. In Southeast Asia, the biomass of virgin or untapped fishing grounds ranges generally between 5.0 and 6.0t/km^2 in the continental region

Daniel Pauly (1993) has defined 'Malthusian overfishing' as a situation where small-scale fishers in developing countries engage in 'wholesale resource destruction' in their efforts to maintain their incomes. On the north coast of Java, small-scale fishers experienced a serious decline of catches and some were forced to leave fishing as the numbers of commercial trawlers grew in the 1970s (Bailey, 1986; Bailey, 1987; Bailey, 1988). With the imposition of a trawl ban in 1980, there was a remarkable recovery of demersal fish stocks. The ban of commercial trawl in Samar Sea in 1979-1980 showed a 100% recovery of biomass in 19-50m depth range (Saeger, 1981). It also showed a positive increase in biomass in partial closure of Malampaya Sound in 1973. This is an example of fishery management tool (through BFAR) that recieved recognition from sectors due to rehabilitation of the depleted resource.

4. Conclusion

A total of 107 species of finfish were recorded during the sampling months. The BFAR NSAP program is still going including other gears operated in Samar Sea. Our result during onboard commercial trawl showed that the top 20 dominant species caught were sexually mature in the months of April, - July (which was now declared as closed season for commercial trawl by the Samar Sea Alliance) although for some species it extends to August.

Fisheries management in tropical developing countries would be well served by a cogent theory of overfishing focussing on the human dimension or the other way. For lack of such a theory, we run the risk of treating symptoms as causes and of not getting at the root of the problem. In order to create a well-grounded theory, research must be conducted on the relative significance of social and economic factors leading to overfishing, and on the causal relationships among these factors (Sunderlin,1994). With the introduction and adoption of the Ecosystem Approach to Fisheries Management (EAFM) it would allow to balance the ecological aspect and human well being, unlike the previous fishery management tools that were ineffective because it was not supported by science base and local knowledge. EAFM mandates to generate and collate scientific information and sensitise, and educate policy makers and decision makers on science based factual assessment. There is need to provide policy makers with appropriate information regarding the ecosystem impact and other significant effects of trawl fisheries. Continuous study on bycatch for other gears apart from trawl which includes study on fish larvae (ichthyoplankton) before and after establishment of closed season for commercial fishing are needed to provide rationale and science based information.

5. References

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