Fish and Invertebrate Yields of the Coral Reefs of Selinog Island in the Mindanao Sea and Hulao-hulao in Panay Gulf, Philippines*

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ABSTRACT. The fish and invertebrates caught at the reefs of Selinog Island in the Mindanao Sea and Hulao-hulao in Panay Gulf were studied from April 1982 to August 1984. The fish and invertebrate yield of Selinog was estimated at 5.88 m t/yr/sq km and that of Hulao-hulao at 5.0 m t/yr/sq km. In addition to reef fishes, the harvest included fishes of the families Carangidae, Belonidae, Scombridae, Sphyraenidae and some cartilaginous fishes such as rays and sharks.

Selinog reef has an area of about 126.3 ha, while Hulao-hulao reef is about 50 ha. Both reefs have been dynamited and subjected to fishing with **muro ami**. Live coral cover was approximately 29% for Seiinog and 27% for Hulao-hulao. Selinog reef is bordered by "dropoffs" at certain points; in contrast, Hulao-hulao is generally flat.

The income of the 120 Selinog fishermen, who fished for cash, was variable, ranging from ₱0.13 to ₱35.00 per man-hour. The value of the fish catch of the 60 Hulao-hulao fishermen, who fished only for home consumption, was much lower—about ₱0.12 to ₱13.71 per man-hour.

This paper is the third in a series of reports on coral reef fisheries, the other two dealing with reef fish yields of the central Visayan islands of Sumilon (Alcala 1981) and Apo (Alcala and Luchavez 1981). The present paper extends our knowledge of reef fish yields to the Mindanao Sea (Selinog Island) and Panay Gulf (Hulao-hulao Reef).

The relevant literature on fish yields of coral reefs has been reviewed in the two papers mentioned above and by Martin and Polovina (1982). The interested reader is referred to them.

As in the previous studies, the objectives of the present study were to determine the quantity of the fish and invertebrates caught by fishermen and to correlate quantity and quality of the fish yield to certain characteristics of the reefs.

Study Areas

Selinog Island Reef.

Selinog Island, which belongs politically to Dapitan City, Zamboanga del Norte, lies in the Mindanao Sea, about 15 km from Tagolo Point on the Mindanao mainland. It is a 90-hectare, flat coralline island with a population of about 620, including 120 fishermen. Fishing is the main

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source of income for the inhabitants. Income from coconuts, banca building, and making mats from leaves of *Pandanus* grown on the island supplements income from fishing for some families.

The island is roughly spindle-shaped, its long axis oriented north-south (Fig. 1). Sandy beaches form most of its coastline, except for parts of the eastern and western sides, which are rocky. A sand spit is found at the southern tip. The prevailing current during the northeast monsoon months flows southward.

A 126.3-ha fringing reef extending to the 30-meter isobath practically surrounds the island (Fig. 1). Live coral cover, in general, was low (28.63%), with a relief of approximately 10 to 100 cm. About 71% of the reef surface area was coral rubble, dead corals and sand. Dominant hard coral genera include *Acropora, Porites, Pocillopora, Turbinaria, Millepora, Favia Heliopora, Galaxea, Montipora* and *Seriatopora*. Soft corals were also present. A fairly good diversity of fish, invertebrates (such as octopi, lobsters, gastropod shells, sea cucumbers and sea urchins) and various species of algae compose the benthic biota. The red algae were the most abundant, including *Laurencia* spp., *Hypnea* spp., *Chondria* spp., *Gracilaria* spp., *Spyridia, Champia, Mastophora and Rhodymania*. A few species of green and brown algae were also present. These algae grow abundantly on dead corals and coralline bedrock. Patches of dead standing corals seen among thriving colonies probably resulted from predation by the Crown-of-Thorns starfish (*Acanthaster*) and other coral predators. Damage to hard corals on the reef "drop-offs" must have been inflicted by dynamite fishermen, boat anchors, *muro-ami* fishing, fish traps and storms.

Fishing on the reef occurred throughout the year, being limited only by strong current and rough seas brought about by typhoons and monsoon winds. The fishermen used non-motorized, dug-out canoes and motorized outrigger bancas. Their fishing gear included bamboo traps, spearguns, handlines, gill nets and bottom lines.

Hulao-hulao Reef.

Hulao-hulao reef is a small barrier reef located off Calaogao Sitio, Cauayan, Negros Occidental, in Panay Gulf. It is 250 meters from the shoreline, separated from mainland Negros by a 10 m deep channel. The reef appears to be rising, presumably as a result of tectonic movements in the volcanic arc of the Negros arc-trench system.

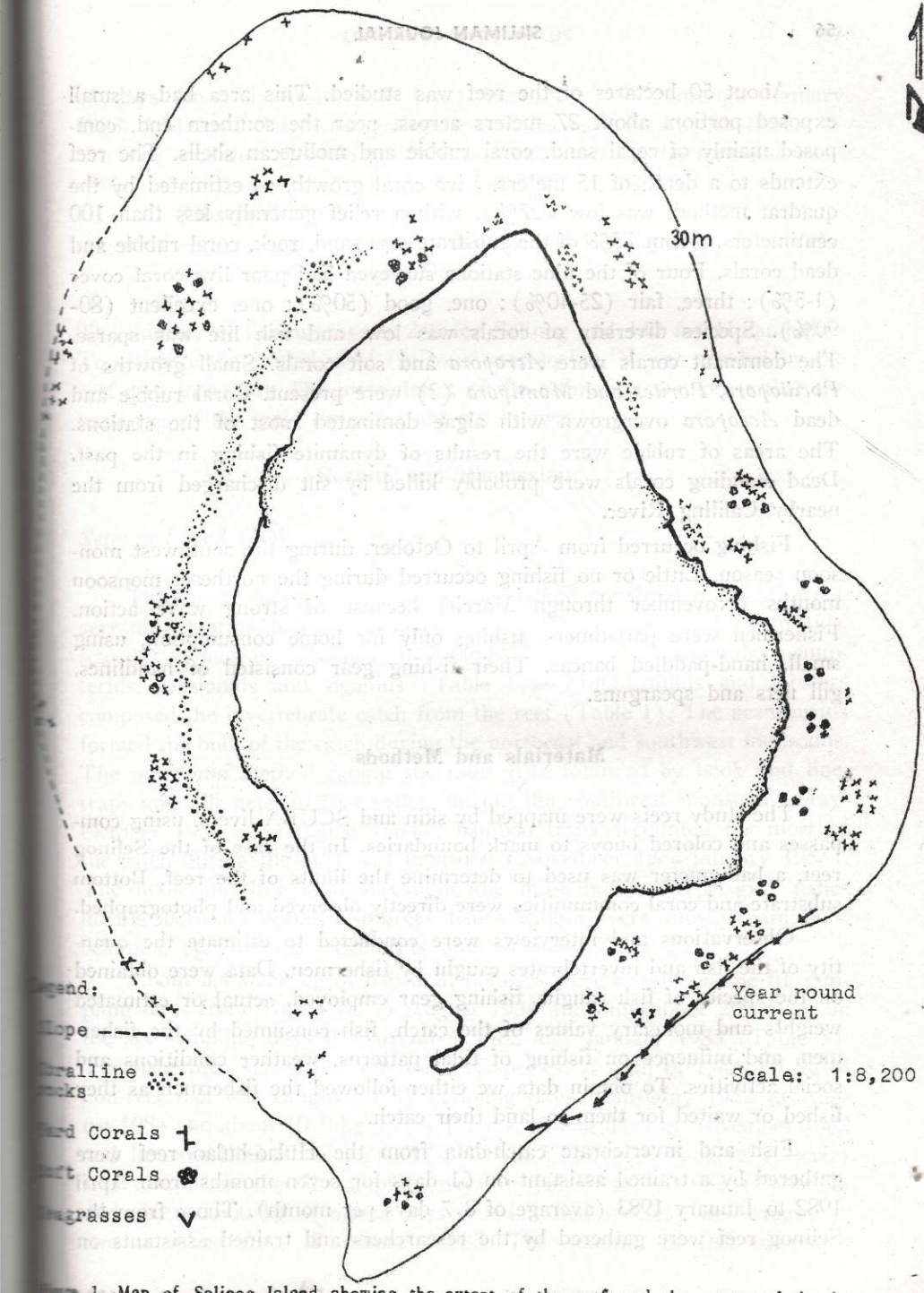

Figure 1. Map of Selinog Island showing the extent of the reef and the nature of the bottom.

About 50 hectares of the reef was studied. This area had a small exposed portion, about 27 meters across, near the southern end, composed mainly of coral sand, coral rubble and molluscan shells. The reef extends to a depth of 15 meters. Live coral growth, as estimated by the quadrat method, was low (27%), with a relief generally less than 100 centimeters. About 73% of the substrate was sand, rock, coral rubble and dead corals. Four of the nine stations surveyed had poor live coral cover (1-5%); three, fair (25-40%); one, good (50%); one, excellent (80-90%). Species diversity of corals was low, and fish life was sparse. The dominant corals were *Acropora* and soft corals. Small growths of *Pocillopora, Porites* and *Montipora* (?) were present. Coral rubble and dead *Acropora* overgrown with algae dominated most of the stations. The areas of rubble were the results of dynamite fishing in the past. Dead standing corals were probably killed by silt discharged from the nearby Caliling River.

Fishing occurred from April to October, during the southwest monsoon season. Little or no fishing occurred during the northeast monsoon months (November through March) because of strong wave action. Fishermen were part-timers, fishing only for home consumption, using small, hand-paddled bancas. Their fishing gear consisted of handlines, gill nets and spearguns.

Materials and Methods

The study reefs were mapped by skin and SCUBA livers, using compasses and colored buoys to mark boundaries. In the case of the Selinog reef, a bathymeter was used to determine the limits of the reef. Bottom substrate and coral communities were directly observed and photographed.

Observations and interviews were conducted to estimate the quantity of the fish and invertebrates caught by fishermen. Data were obtained on the species of fish caught, fishing gear employed, actual or estimated weights and monetary values of the catch, fish consumed by the fishermen, and influence on fishing of tidal patterns, weather conditions and social activities. To obtain data we either followed the fishermen as they fished or waited for them to land their catch.

Fish and invertebrate catch-data from the Hulao-hulao reef were gathered by a trained assistant on 61 days for seven months from April 1982 to January 1983 (average of 8.7 days per month). Those from the Selinog reef were gathered by the researchers and trained assistants on

61 days (monthly mean, 8.7 days) from May 1982 through January 1983. Additional data were gathered on three days in August 1984.

The total fish yield in kg (Y) was estimated by the formula:

$$Y = \frac{\text{Observed Catch (kg)}}{\text{Number of Sampling Days}} \times \text{Number of Fishing Days in a Year.}$$

The number of fishing days is 240 for Selinog and 140 for Hulao-hulao. To estimate the annual yield (in tons) per sq km, Y was divided by the reef area in sq km. The main defect of the estimation method is that the variances of the yield estimates are not known.

Results and Discussion

Selinog Island Reef.

The "reef" fishes caught at Selinog Island consisted of acanthurids, serranids, labrids, balistids, pomacentrids, mullids, holocentrids, lethrinids, scarids, kyphosids, lutianids, muraenids, plotosids, synodontids, nemipterids, caesionids and siganids (Table 1). Octopi, squids and lobsters composed the invertebrate catch from the reef (Table 1). The acanthurids formed the bulk of the catch during the northeast and southwest monsoons. The *muro-ami* method caught the most fish, followed by hook and line, traps and gill nets, in that order, during the southwest monsoon (May-October 1982 and August 1984); bamboo traps accounted for most of the catch during the northeast monsoon (November 1982-January 1983). The hook and line method caught the most non-reef (pelagic) fishes during both monsoons. Non-reef fishes caught were mostly carangids, belonids, sphyraenids, scombrids and elopids (Table 2).

About 3,460.57 kg of fish and molluscs were caught on the 61 sampling days from May 1982 to August 1984 and only about 299.1 kg on the six sampling days in November 1982 and January 1983 (Table 5). The fishermen also fished for non-reef species. A total of 1,400.65 kg of non-reef fish was caught on 31 sampling days from May 1982 to August 1984 and about 10.9 kg on the three sampling days in November 1982 and January 1983 (Tables 2 and 6). About 5,120 kg of mackerel (*Auxis*) was caught on the 61 sampling days in July-October 1982 (Table 7) and about 2,300 kg of manta rays (unidentified species) was caught on two sampling days in January 1983. The quantity of fish consumed

Table 1. Groups of reef fishes and invertebrates caught at Selinog in 1982–83 and 1984

Taxonomic Group	Weight (kg)	% Total
1. Assorted species (acanthurids, labrids, caesionids, scarids, mullids, small serranids, and **Abudefduf**)	1,872.75	54.12
2. Acanthuridae (**Naso** and **Acanthurus**)	894.3	25.84
3. Serranidae (**Epinephelus** and other genera)	137.85	3.98
4. Molluscs (squids and octopi)	120.85	3.5
5. Scaridae (**Scarus**)	108.25	3.13
6. Kyphosidae (**Kyphosus**)	106.25	3.07
7. Nemipteridae	67.85	1.96
8. Labridae	44.3	1.3
9. Lutjanidae	28	0.81
10. Lethrinidae	20.4	0.59
11. Balistidae	14.5	
12. Pomacentridae	13.52	
13. Mullidae	12.2	
14. Holocentridae	9.15	
15. Muraenidae	8.05	
16. Crustacea (lobsters)	0.9	
17. Caesionidae	0.6	
18. Plotosidae	0.4	
19. Synodontidae	0.3	
20. Siganidae	0.05	
TOTAL	3,460.57	98.3

Table 2. Groups of non-reef fish caught at Selinog in 1982–83 and 1984

Taxonomic Group	Weight (kg)	% Total
1. Carangidae	1,006.15	71.83
2. Belonidae	292.2	20.86
3. Sphyraenidae	47.1	3.36
4. Scombridae	33.5	2.39
5. Elopidae	11.6	0.83
6. Dussumieridae (?)	10	0.71
7. Mugilidae	0.1	
TOTAL	1,400.65	99.98

Table 3. Groups of reef fish and invertebrates caught at Hulao-hulao reef in 1982

Taxonomic Group	Weight (kg)	% Total
1. Assorted reef species	970.15	88.77
2. Molluscs (octopi, squids, shellfish)	92.3	8.45
3. Serranidae (**Epinephelus** and other genera)	14.25	1.30
4. Balistidae (**Balistoides** and allied species)	9	0.82
5. Crustacea (lobsters)	2.5	0.22
6. Dasyatidae (**Dasyatis**)	2	0.18
7. Plectorhynchidae (**Plectorhynchus**)	1	
8. Mullidae (**Parupeneus** and **Upeneus**)	1	
9. Scaridae (**Scarus**)	0.6	
10. Siganidae (**Siganus**)	0.05	
TOTAL	1,092.85	97.74

(sampled for nine days) was 33.1 kg of small reef fish and 295 kg of sharks.

The reef fish yield was computed as follows: A total of 1,343.57 kg, exclusive of the 2,126 kg caught with *muro-ami* in May 1982, was caught by fishermen on 61 fishing days, or an average of 22.02 kg per fishing day. This was multiplied by 240, the total number of fishing days in one year (average of 20 days per month), to obtain an estimate for one year, 5,286.17 kg. To this figure was added the *muro-ami* catch of 2,126 kg, giving the total caught in one year during the period of sampling as 7,412.17 kg. If this is divided by 1.26 sq km, the reef area, the annual yield is 5.88 tons/sq km/yr.

The data show that more fish were caught during the southwest monsoon than during the northeast monsoon. Two reasons could account for this finding. One is that the northern and northeastern portions of the reef, which are shielded from the southwest monsoon, are the more productive parts of the reef. The productivity during the southwest monsoon is further enhanced by a three-month shift (July through September) from reef fishing to offshore fishing for mackerel and manta rays. The other reason is that there are more calm days favorable for fishing during the southwest monsoon months. As mentioned earlier, these reef portions have the most extensive live coral cover.

The monetary value of the 3,469.57 kg of reef fish and invertebrates caught on 61 sampling days was ₱10,943.93 (Table 5) and that of the 1,400.65 kg of non-reef fish caught on 34 sampling days was ₱5,794.00 (Table 6). The income of the fishermen from reef fish and invertebrates was variable, ranging from ₱0.13 to ₱10.53 per man per hour (Table 5); that from non-reef fish was also variable, but generally higher, ranging from ₱0.16 to ₱35.00 per man per hour (Table 6). (A fisherman spent about five hours fishing per day, on the average.) These estimates do not include the value of fish the fishermen consumed. As can be gleaned from Tables 5 and 6, the selling price of fish at Selinog during the time of study was low—₱2.00-₱5.00 per kg.

Pelagic fish harvested outside the reef by Selinog fishermen during the sampling period included mackerel (*Auxis* spp.), manta rays and hammerhead sharks. Mackerels were harvested during four months (July to October) and manta rays during two months (December to January). Manta rays were sold on the nearby island of Siquijor for a good price, ₱100.00 to ₱800.00 per fish, while sharks (and occasionally dolphin) were either consumed or given away. The meat of sharks and dolphins

Table 4. Groups of non-reef fish caught at Hulao-hulao reef in 1982

Taxonomic Group	Weight (kg)	% Total
1. Belonidae	280.5	95.6
2. Carangidae (Scomberoides)	7	2.4
3. Scombridae (Rastrelliger)	6	2.0
TOTAL	293.5	100.0

Table 5. Biomass and value of reef fish and invertebrates caught at Selinog in 1982–83 and 1984

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
6–20 May – 2 June, 1982	8	2,212	6,276.00	0.14 – 6.43
3–31 July 1982	11	436.87	1,510.37	0.26 – 0.43
1–23 August 1982	12	116.2	494.85	0.31 – 1.26
2–27 September 1982	8	49.7	178.45	0.37 – 3.20
6–18 October 1982	14	255	934.00	1.17 – 10.53
19–21 November 1982 – 25 January 1983	6	299.1 – ca 9 l*	803.16 22.50	0.13 – 1.74 0.42
19–20 August 1984	2	91.7	724.60	0.60 – 8.57
TOTAL	61	3,469.57	10,943.93	

* Gonads of sea urchins (**Tripneustes gratilla**) consumed by residents are valued at ₱2.50 per liter.

Table 6. Biomass and value of non-reef fish caught at Selinog in 1982–83 and 1984

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
6 May – 2 June 1982	10	608	2,240.00	1.09 – 33.33
7 – 31 July 1982	9	468.6	2,051.30	0.67 – 7.73
2–10 August 1982	4	57.2	314.30	1.22 – 26.58
5–9 September 1982	2	158	632.00	8.00 – 13.07
10–19 October 1982	4	76	319.00	2.80 – 35.00
19–21 November 1982	2	2.4	8.80	0.16 – 25.00
25–January 1983	1	8.5	51.00	
19–20 August 1984	2	21.95	177.60	0.50 – 6.75
TOTAL	34	1,400.65	5,794.00	

was not saleable and, like small acanthurids, abrids and pomacentrids, was mainly consumed at home.

The catch per unit effort (c/f) of the Selinog Island fishermen was generally low. The one exception was when *muro-ami* was used during the southwest monsoon for a very high c/f of ₱51.55 kg/man-hour. The c/f for gill netting, hook and line and speargun was higher during the southwest monsoon (8.70 kg/man-hour, 2.91 kg/man-hour and 2.55 kg/man-hour, respectively) than during the northeast monsoon (4.77 kg/man-hour, 1.18 kg/man-hour, 1.16 kg/man-hour, respectively), but that for bamboo traps was lower during the southwest monsoon (0.114 kg/man-hour) than during the northeast monsoon (0.23 kg/man-hour). The c/f from mackerel fishing was 2.48 kg/man-hour.

Hulao-hulao Reef.

The reef fish at Hulao-hulao included serranids, balistids, dasyatids, hacmulids, mullids, scarids and siganids; pelagic species were belonids, carangids and scombrids. The invertebrates included octopi, squids, shellfishes and lobsters (Table 3). Among these groups, the belonids, which were caught in gill nets, composed most of the catch (Table 4).

Tables 8 and 9 show that about 1,386.35 kg of fish and molluscs were caught from the reef on 61 sampling days from April to October 1982. The annual yield was estimated as follows: The reef fish caught in seven months weighed 1,092.85 kg for 61 days, or 17.42 kg per fishing day. On this basis, the total yield expected for 140 fishing days in one year would be 2,508.2 kg. If this is divided by 0.5 sq km, the annual yield comes to about 5.02 tons/sq km/yr. There was no fishing during the northeast monsoon, as the reef is inaccessible, being exposed to the strong winds.

There is no question that the Hulao-hulao reef is now relatively unproductive. The junior author remembers that this reef teemed with fish and other forms of marine life 30-40 years ago. The low yield of the reef is due to the combined effects of dynamite-fishing and overexploitation. As already stated, most of the area has been damaged by blast fishing and is now being colonized by algae and soft corals. Overexploitation is indicated by the smaller sizes of the fish caught there, compared with those taken at Selinog (Table 10).

Tables 8 and 9 further show the Philippine peso value of the fish catch of the Hulao-hulao fishermen, which ranged from ₱0.12 to ₱17.25 for reef fish and invertebrates and from ₱0.10 to ₱13.71 for non-reef

Table 7. Biomass and value of non-reef fish *(Auxis sp.)* caught with multiple hook and line off Selinog Island in 1982

Date	No. of sampling days	Catch (kg)	Value in pesos	Income/man/trip* in pesos	
				Range	Mean
2–30 July	22	1,824.8	6,386.80	2.72– 99.00	39.56
1–31 August	16	1,494.5	5,230.75	9.45– 94.50	45.01
11–30 September	18	1,371.9	4,801.65	8.75–119.63	43.58
1–5 October	5	428.8	1,500.80	7.88– 82.47	41.12
TOTAL	61	5,120.00	17,920.00		

*Fishing trip takes about 5 hours.

Table 8. Reef fish and invertebrates caught at Hulao-hulao in 1982

Date*	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
April	10	92.5	375.00	0.25 – 11.20
May	10	281.3	1,132.50	0.17 – 10.67
June	10	539.4	2,180.00	0.50 – 1.67
July	6	14	192.50	1.33 – 4.00
August	10	88.6	384.90	0.44 – 17.25
September	10	55.8	227.30	0.12 – 2.33
October	5	21.25	89.50	0.56 – 3.67
TOTAL	61	1,092.85	4,581.70	

*Reef not accessible to fishermen during northeast monsoon–November to March (5 months).

Table 9. Non-reef fish caught at Hulao-hulao in 1982

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour (Range)
April	2	121.5	486.00	0.64 – 13.71
July	3	35	132.00	4.00 – 6.00
August	2	7	28.00	0.10 – 1.60
September	7	33	132.00	1.11 – 2.67
October	7	99	396.00	0.95 – 3.56
TOTAL	21	295.5	1,174.00	

Table 10. A comparison of sizes (total length in cm) of fish caught at Hulao-hulao and Selinog reefs, April through November 1982. Fish were caught with gill nets, spears, fish traps and handlines

Family	Hulao-hulao			Selinog		
	Number	Range	Mean – SD	Number	Range	Mean – SD
Acanthuridae	58	8.9–38.1	18.1±6.5	75	8.0–64.0	32.1±15.3
Serranidae	40	4.0–40.5	14.6±5.9	30	22.0–62.0	31.9± 9.7
Scaridae	68	7.0–33.4	19.5±6.2	3	18.0–31.0	24.7± 6.5
Labridae	10	10.2–27.9	16.4±5.7	17	8.0–40.0	18.3± 9.4
Mullidae	17	10.2–25.4	17.3±5.0	7	18.0–32.0	23.4± 4.8

fish per man-hour. It must be emphasized that these fishermen fished only for home consumption, in contrast to their Selinog counterparts, who fished for cash.

The catch per unit effort of the Hulao-hulao fishermen was quite low except for gill netting (2.81 kg/man-hour) and for *muro-ami* (141.64 kg/man-hour). The c/f for handline and speargun were 1.25 kg/man-hour and 0.99 kg/man-hour, respectively.

Comparisons and Conclusions

Selinog reef has a silghtly higher fish production than Hulao-hulao reef, and with more intensive fishing it could yield more. This difference is most likely due to the larger extent of deeper water and the presence of "drop offs" at Selinog. Hulao-hulao reef, in contrast, is shallow and lacks "drop offs". Our previous experience at Sumilon indicates that "drop offs" may contribute to a high production. Both reefs have been subjected to blast fishing and *muro-ami,* and both have about the same live coral cover. Hulao-hulao appears to be overfished, as indicated by the smaller size of the fish species caught.

There is a significant quantity of caesionids at Selinog reef. However, our catch data are limited because our sampling periods did not coincide with the time for catching *Caesio*. At Selinog, *Caesio* are mainly caught in gill nets, unlike at other reefs where *Caesio* are caught in traps. The mesh size of traps at Selinog is too large for *Caesio*.

In terms of annual yields per sq km, the Selinog Island reef has lower productivity than the Apo Island reef, which yields about 11.4-11.5 m t, and the Sumilon reef, which produces from 14 to 24 m t. The fish yield of Philippine reefs appears to range from a low of about 5 to a high of 24 m t/yr/sq km. This variability would seem related to such factors as intensity of fishing, type of bottom configuration and quality of coral cover. The relative contributions of these factors to fish yield remains to be quantified.

The low peso value of the fish catch of the fishermen at the two reefs studied confirms the findings of Smith et al. (1980) that municipal fishermen in the Philippines fall into the low income groups of the Philippine population.

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International Food Problems: A Multidisciplinary Perspective

George W. Beran

Each of us, whether of high or low estate, whether poor or rich or in the large range in between, needs to consider for himself what is most important to his life. The list of items to consider would probably include many of the following:

Faith in God	Economic security
Spouse and family	Clean air, quiet and beautiful surroundings
Health: a strong body	Friends and coworkers
Food—adequate or even more	Work and responsibility
Education	Art, literature and music
Home and land	Freedom to develop my own life

Which one of these would you choose as most important to you if you had to give up all the others? "Of course," you will say, "without food or health there is no life, and of what importance are all the others?" Yet this question must be asked because all of these items can be taken away or lost; the quality of your life depends on where you place your emphases.

It is widely held today that food should be placed as the number one priority, over all other aspects of life, and that it should receive the primary attention of governments throughout the world. Such would be a "Food First Policy." I do not at this time speak as an advocate of "food first" but I do place considerable emphasis on the "World Food Issue." The present world food situation is not a cause for optimism, not even cautious optimism.

World food production is currently increasing at about 2.4% per year. Approximately 60% of the world's people live in food deficit countries, and this situation, while fluctuating, is showing no basic improvement.

The world population is increasing approximately 2.1—2.2% per year. This is down from about 2.3—2.4% in 1970. This decrease may sound like a ground for optimism but unfortunately it is not. The countries with significant downward trends in population growth have been those in Europe, those in North America, plus Japan, China and Taiwan,