Effects of coral bleaching on the socio-economics of the fishery in Bolinao, Pangasinan, Philippines.

November 2000

Lida Pet-Soede

Acknowledgements

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Executive summary

Socio-economic effects of bleaching, if any, were estimated from literature, interviews and catch logbooks that were also used in a cost-benefit analysis of the fishery at the household level. Trends in total catch and in Catch per unit Effort (CpuE) were studied for effects of the 1998 bleaching event from catch and effort data that were collected since 1996 by the Marine Fisheries Resources Management Project (MFRMP). Perceptions of fishers on causes to changes in their fishery and on the importance of bleaching were inventoried. The status of the fishery was compared to recent changes in habitat and fish community structure.

An estimated total of 3 154 fishers are engaged in the fishery at and around the Bolinao reef area (200 km^2). A large variety of fishing gears is used and patterns in resource utilisation vary with different requirements for operation of the gear and differences in target species. Of the reef fishery gears, large-scale spear gun fishers using compressors catch most, followed by triplet nets. The *parisris* and deep-sea hook and line are most efficient catching some 6-8 kg of fish per hr. Lowest catch rates of 0.25-1 kg per hr are found for gillnets that are operated during the day, small-scale spear guns and hook and line. Logbooks confirm these average catches and show the uncertainty of the fisheries indicated by large daily variances around the average catches.

The average monthly income in 1985 for small-scale Bolinao fishers was estimated at some 470 P per month with household expenditures almost doubling the income and it was concluded that fishing does not support minimum financial needs for survival. At present however, it appears that each fisher is able to feed his family and save some money for other expenses. Prices vary at the different points in the product chain and increase sometimes as much as 300% from one level to the next. The costs of operation varies between fisheries with highest total costs for larger boats and when using expensive technology. When we use our estimates for revenue and costs average gross income for the different fisheries varied between 125 – 300 US$. For an estimate of the added value of a fishery, the opportunity costs of labour are deducted. The result shows that except for the shell collector, who would not consider another occupation as they are mostly women and children, every operation makes significantly more money fishing than if they were working as an unskilled labourer. Net incomes after deducting opportunity costs of labour vary between 680- 8840 P per month. Especially the larger scale operations, even after dividing the income over crewmembers, have significant monthly incomes. Fishers using crab pots and *lagrite* have lowest net incomes but these have often other (fishery) sources of income.

There appears little difference between catch rates in 1997 (before bleaching) and in 1999 (after bleaching) for most fishing gears. Only catch rates for *tabar* or *lambat*, a shallow water gill net operated while water beating, are clearly higher than before 1999. These fishers aim mostly at herbivores such as rabbitfish and parrotfish. Even when accounting for the level of fishing effort, again only *tabar* nets show a significant increase in CpUE at an even slightly higher level of fishing effort. Thus it appears that only this fishery benefited from changes that occurred in 1998. This could be related to the bleaching event, nevertheless from the underwater visual census data we cannot find sufficient arguments for particular shifts in the fish community that would only affect this particular fishery. When asked, most of the gill net fishers actually said that their catches had reduced over the past years, no one mentioned increasing catches.

From the interviews we found that 57% of the fishers had heard about bleaching and 53% had witnessed it personally. Of the people who had heard about or had witnessed the bleaching, 79% said that it was caused by the use of sodium cyanide in the illegal fishery for aquarium and live food fish. Only 21% said that it was caused by El Niño and most of these had probably heard the correct explanation of the phenomenon during community consultation meetings. Some thought that it caused catches to drop. When asked about their catches, 90% of the fishers said that the catch biomass had changed since 5 years ago. 8% said there is more fish now as a result of better management (stricter enforcement of the ban on destructive fishing) and 89% said that the catches had gone down mostly because of over fishing (64%) and destructive fishing (14%). Of all fishers 33% said that size in the catch has also changed, and is smaller (82%) or larger (18%) than 5 years ago. Of all fishers interviewed 43% said that the species composition has changed, and that some species cannot be caught anymore (such as cardinalfish). Most fishers (37%) suggested that strict enforcement of the recently established fishery ordinance was the best solution.

Underwater visual census data indicates that the habitat structure at Bolinao reefs has changed drastically and that this is significantly related to the 1998 bleaching event. Changes in the fish community structure from 1996 to 1999 cannot be so easily explained. Fish abundance and biomass increased after 1996 but this trend didn't change after the bleaching. Trends in catches show no clear change in the year after the bleaching except for increased catches with the small-scale gill net called *tabar*. Only if the 100% increase in catches of *tabar* fishers is indeed related to the bleaching it could be argued that the bleaching affected their income positively. None of the fishers that use this gear mentioned this increase however. It can also not be fully explained from changes in the reef fish community structure, because then other fishing gears should catch more fish as well. Therefore it is concluded from the available data that there is no evident effect of the 1998-bleaching event on the fishery in Bolinao as of yet.

The fact that Bolinao fishers appear to be depending on herbivorous fish that fetch a relatively high price at the local market presents a situation that is interesting from a scientific viewpoint. In theory the Bolinao fishers could be better off after a bleaching event, when the herbivorous fish manage to benefit from the extended algal growth following coral mortality. Nevertheless, regardless effects of bleaching, this is a clear example of a disrupted system with little scope for a healthy reef fishery.

1 Introduction

1.1 Background to the study

During the spring and summer of 1998, massive coral bleaching and subsequent mortality occurred throughout the Indo-Pacific. The start of the bleaching coincided with an exceptionally large El Niño event and a subsequent La Niña. Philippine reefs were hit hard, with coral bleaching, hurricanes and a COT-outbreak all in the same year. Wilkinson writes about Philippines in 1998*: "Massive bleaching started in mid-July, and may be still ongoing in western regions where reports are coming in from Bolinao (northwest Luzon), to Puerto Galera and southern Negros Island, central Philippines (Dumaguete, Campomanes Bay, Danjugan Island, El Nido (Bacuit Bay) and Coron Island (Palawan), and Pag-asa Island (Spratleys). Temperatures of 33-34°C degrees were reported, and bleaching went as deep as 28 m (temperatures of 30-31 °C) and completely affected soft corals and some anemones. Bleached hard corals were primarily the plating, branching and foliose forms, with up to 75% of the community bleached in some areas. Massive corals were also affected; faviids were bleached, but large Porites appeared to resist bleaching below 5 m, but not on shallow reef flats of Bolinao and Negros. Black-band disease was observed on a few bleached colonies. Mortality, however, of bleached corals appears to be low. On the well-known Apo Island, some large colonies of Galaxea fasicularlis showed some patchy bleaching. Massive bleaching also reported in Danao Bay, near Baliangao, northwest Mindanao in October 1998, with bleaching mostly affecting branching corals and significant rotting of soft corals, but fire coral (Millepora) not affected. (Jade Fraser, Fiona Gell, Gillian Goby, Rex Montebon, Laurie Raymundo, David Medio).*"

A study by Arceo et al (1999) relates of massive bleaching in various reefs throughout the Philippines. The bleaching was reported from all over Philippines starting early June until mid-november 1998. Observations coincided with the occurrence of hotspots over the regions. It was suggested that differences in the severity of the bleaching within and among reefs may be influenced by environmental conditions unique to the area such as wave exposure, tidal fluctuations and reef morphology.

Coral reef ecosystems are crucially important for coastal fisheries and tourism among other things. Therefore this bleaching event and subsequent events could have severe socio-economic impacts in tropical developing countries. However, the exact link between coral bleaching and mortality on the one hand and ecosystem services such as fisheries, tourism and coastal protection on the other hand is poorly understood. This report aims at discussing how the bleaching event has affected the socio-economic position of Philippines reef fishers or could affect this in the future.

1.2 General theory

Coral bleaching appears to have no obvious immediate and direct effect for a fishery in a reef area. This is partly caused by the fact that reef fish communities are mainly constituted by K-strategists and so do not respond very fast to environmental changes, and partly by the fact that there are hardly any fisheries that fully depend on a stretch of coral reef only. Effects that can be observed on the long-term through indirect changes in the habitat structure due to coral bleaching are more likely and follow the generally accepted theories regarding habitat-fish interactions on coral reefs.

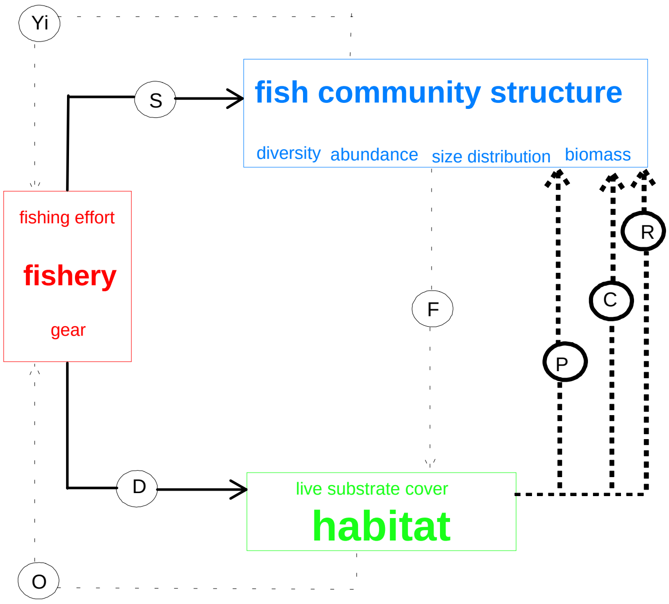

Figure 1 Relationship between habitat, fish community structure and fishery.

Apart from fishery effects, reef fish communities are structured by three ecological processes, the relative importance and validity of which remain controversial. First, competition for food and space (C) determines fish diversity and fish density. Second, recruitment patterns of juveniles (R) determine adult fish community structures. Third, predation (P) determines survival patterns, therefore adult fish density. The structural complexity of a reef habitat influences all three ecological processes (Figure 1). It has a function in providing a) niches for various species to coexist on a coral reef, b) suitable substrate for reproductive activities and larval settlement on a coral reef, and c) shelter for fish to escape predation on a coral reef, especially in the case of small fishes. Several studies showed that species diversity, density and biomass of the fish community is positively related to rugosity and that live substrate cover influences the fish community structure via feeding interactions. Dead coral structures enhance growth of algae that constitute the diet of herbivorous grazers such as parrotfish (*Scarus* spp.), but fail to contribute to the diet of fish that prey on invertebrates associated with live coral species. Grazing has a negative effect on habitat rugosity because it causes erosion of calcareous structures, but it also has a positive effect on the density of deposit- and suspension foraging invertebrates and fishes.

In a fishery that is entirely dependent on reef fish, catch rates may decrease and the catch composition may shift more towards the herbivorous species. These fish are often lower in value so as a result the economic position of fishers may deteriorate. Especially fisher communities that live at islands with little alternative sources of income will have difficulty to sustain their livelihood. A fishery that aims at catching large predatory pelagic fish that forage near the reefs may also experience lower catches when their targets move to other less destroyed areas to hunt for prey. A fishery that aims for small pelagic species that occupy a reef area or lagoon during certain phases in their life stage may also experience lower catches when reefs disappear. Most fisheries in the Philippines are of a multi-species and multi-gear character. Thus, it is more likely to assume that fishers will change their habits relatively easily when certain fish become less abundant into catching other species at other habitats rather than wait until they loose the chance to make a living. This is particularly imaginable because of the relatively long period over which a reef fish community will change. Nevertheless the question that needs answered in this study is whether the 1998 bleaching event has already affected the Bolinao fishery and if so, how?

1.3 Structure of the study

First, the fishery of Bolinao is characterized. The different boat types are described, the most commonly used fishing grounds are indicated and catch specifics for the large variety of gear types is presented. Also the economics of the fishery are presented as a cost benefit analysis at the individual household level. These data were collected from existing reports, through interviews and from catch logbooks. Second, underwater visual census data are studied for significant differences in the habitat and fish community structure before and after the 1998-bleaching event. These data were collected in the ongoing research program by UP-MSI staff. Third, trends in total catch and CpUE are studied for significant changes after the 1998 that could be related to the bleaching event. These time series have been collected by UP-MSI and MFRMP staff since 1996. Fourth, the perceptions of fishers were inventoried on causes to changes in their fishery and on the importance of bleaching are discussed. Finally, conclusions are drawn on the socio-economic effects of bleaching on the Bolinao fishery.

2 Material and methods

2.1 The study area

Bolinao municipality in Pangasinan province is one of the 18 municipalities that surround the Lingayen Gulf and has some 53 000 inhabitants (Conte 2000). These people live scattered over 30 Barangays in a total of 23 000 ha land, 47% of which is for agricultural use. Bolinao experiences two pronounced seasons: rainy season from mid June to early November and a dry season for the rest of the year. The ecology, resource exploitation and the socio-economy of Lingayen Gulf with an estimated area of some 2 100 km^2 has been elaborately studied and described by Liana McManus and Chua Thia-Eng (1990). The Lingayen Gulf fishery produced 1.5% of the total Philippine municipal fish production of 786 847 MT in 1994 (Munprasit et al 1995).

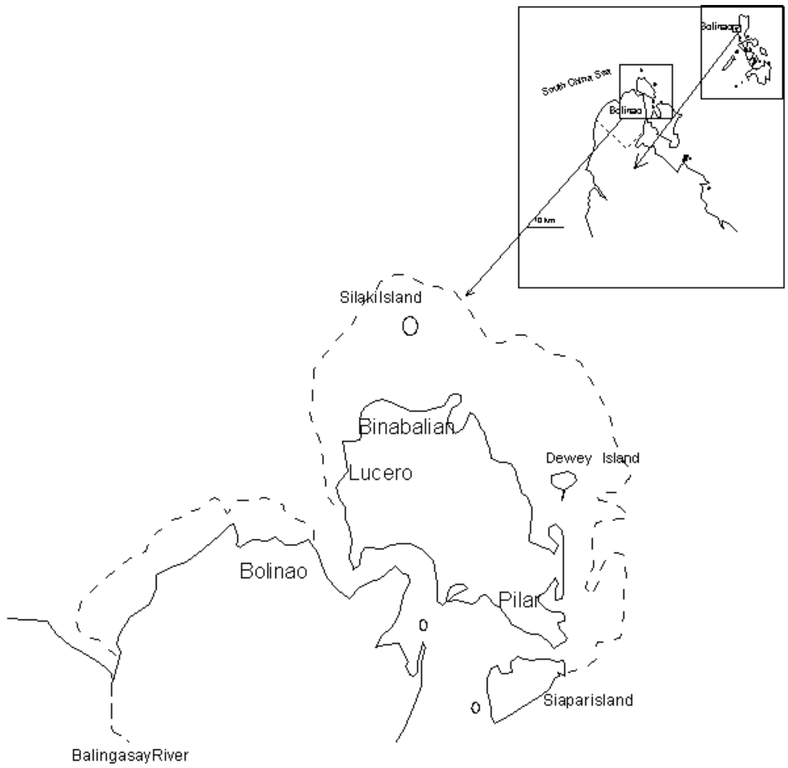

Figure 2. Study area of Bolinao municipality

Most of the Bolinao reef complex is found around Santiago island (Figure 2). The reefs enclose extensive sea grass beds and dense coral gardens. These habitats provide the basis to the fishery livelihoods of some 30% of the Bolinao inhabitants (McManus et al 1992). A large variety of fish is caught with a large variety of gears but most fishers target the relatively high-valued siganids (*Barangen*). Siganids are captured at all live stages, even the fry is used to make fish paste or *Bagoong*. Bolinao is also a major source of <u>Chanos chanos</u> (*Bangus*) in the region. Since 1997 aqua-culture for this milk-fish started to flourish. This industry depends largely on the availability of fry that is mostly gathered during the season in the area close to the Balingasay river.

2.2 Data collection

Data were collected for three purposes:

1. To find the effect of bleaching on habitat and fish community structure – Underwater Visual Census
2. To find the effect of bleaching on fisheries catch and effort – fisheries profiling
3. To find the effect of bleaching on fisheries socio-economics - valuation

2.2.1 UVC study

The UVC study by the UP-MSI team was mainly conducted at Malilnep Reef, off the coast of Santiago Island, which has an extensive reef-flat that stretches out towards the reef crest. Ten reef sites were surveyed along the reef crest, across a 5-km stretch, in June 1997 (Figure 3). Only 8 sites were resurveyed in June 1998 while all ten were revisited in June 1999. The condition of the reef before (June 1997), during (June and August 1998), and after bleaching (June 1999) was compared. To determine changes in benthic lifeform attributes, a total of 20 samples of 50-m video transect data were compared before (i.e. June 1997) and after bleaching (i.e. June 1999). In order to see temporal trends in coral community structure, 3 reef sites that were consistently surveyed from 1997 – 1999 were compared and used in the analyses.

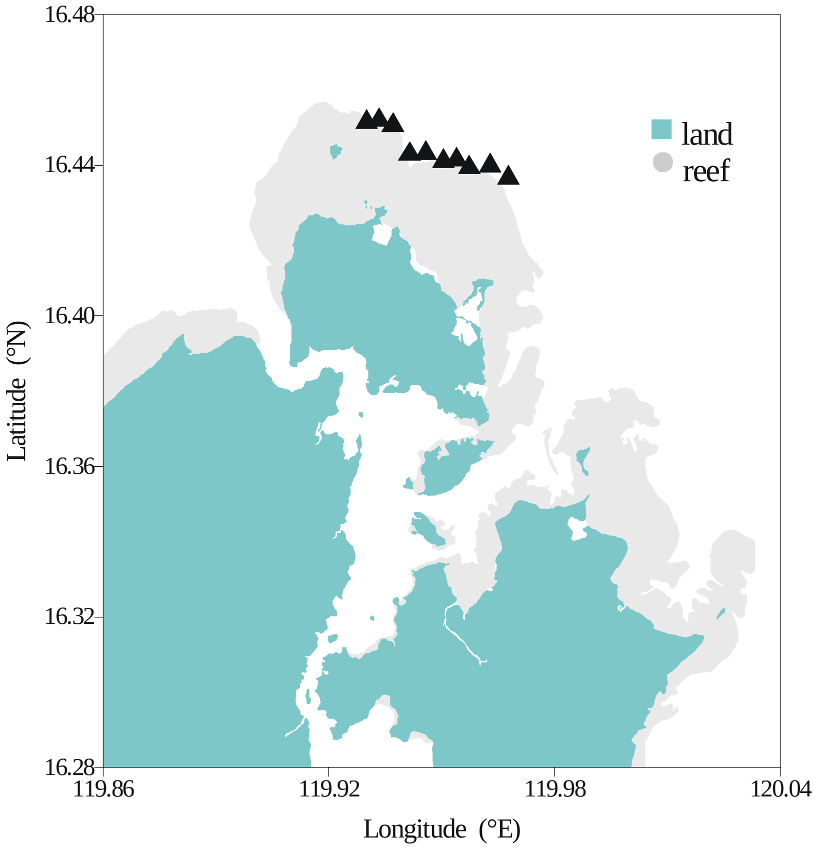

Figure 3. Location of the sampling sites for UVC work on habitat and fish.

Meanwhile, the community structure of reef fishes was also surveyed during the same periods as that of the benthic communities. UVC methods described by English et al (1997) were slightly adjusted and used. In 1997, UVC was performed by one observer and in the succeeding years by two observers. At each site, a 50-m transect line was lain along the reef crest parallel to the shore at a depth of 6-7 m. The abundance and sizes of all fish species encountered within 5 m of either side of the transect was estimated. The changes in community structure over time were then examined and analyzed.

2.2.2 Fisheries profiling

Interviews were conducted to locate major fishing grounds and learn about the different types of fishing gears used in the area. Fishers were asked to indicate their major fishing ground on a map. Catch and effort assessment data, regularly collected by MSI-staff were transcribed to study spatial and temporal patterns in the fishery input and output.

2.2.3 Socio-economic valuation

A combination of monitoring methods was used:

- Personal set interviews were conducted with representatives of all fishing gears that are commonly used in the Bolinao region. The major objective of conducting these interviews was to assess costs of operation and some estimate of average gross income. These interviews also included questions regarding the perception of fishers on the trends in their fishery and effects of the recent bleaching event. Also some of the other stakeholders that conducted reef related activities were interviewed.
- Logbooks were distributed to a selection of fishers for most gear types. The objective of distributing the logbooks was to quantify the average daily catch per fishing gear and the uncertainty around this average during one month. Fish price information was used to find an objective estimate of average daily gross income per fisher.
- Questionnaires were distributed amongst groups of fishers, buyers and other stakeholder groups. The objective of the questionnaires was to assess perceptions of fishers and other users of the Bolinao reef system on the effects of coral bleaching on their livelihoods.
- Informal discussions with source persons were held with fishers, buyers, scientists, government officials and other people. The objective of these interviews was to obtain price information, background information to area development, legislation and distribution of fishing patterns.
- Direct observations were conducted at major fish landing sites to gain some objective estimate of the total catch landed each day and its composition. Information on fish prices was collected and the marketing system was studied. The objective of these observations was to allow for an estimation of the total catch landed each day in Bolinao municipality.

2.3 Data analysis

The number of samples taken for the socio-economic study is not particularly large, which makes the application of statistical testing rather useless. The socio-economic data are used to estimate averages or rank outcomes and serve a solely descriptive purpose and are input for the cost-benefit analysis.

For the cost-benefit analysis of the fishery at individual household levels, a simple formula was used. The annual net revenue of a certain type of fishery *i*, NR_i, is calculated by subtracting the operational costs, C_{oi}, and the opportunity costs of labour, C_l, from the total gross revenues of this type of fishing, GR_i:

$$NR_i = GR_i - (C_{oi} + C_l) \quad (1)$$

The gross revenue per fisher, GR_l, is a combination of the total annual catch biomass (kg) per fish category per fisher and the average price for the fish caught (per kg). To estimate GR_l, for each gear an average daily catch was estimated based on information derived from the interviews and logbooks. The average price paid to fishers at the island was taken from interviews and observations.

Picture: Bolinao fish market

The operational costs for each fishing gear were estimated using information derived from interviews. As an estimate of the opportunity costs of labour the daily salary of unskilled labourers was inventoried from interviews and set at 120-180 P/day or a midpoint estimate of US$ 75 per month. The average monthly costs for the boat is added to the average costs for the gear to calculate operational costs per month or per trip for different fishing gears. The total operational costs are added to the opportunity costs for labour and deducted from the gross revenue.

The total value of the fishery at the society level is less straightforward to estimate. The total value of the catch must be estimated using total landed catch in the municipality multiplied with the price paid at the commercial market. An estimate of the amount and value of fish consumed by the fishers and their families must be added.

3 Characteristics of the Bolinao fishery

3.1 Technical profile

An estimated total of 3 154 fishers are engaged in the fishery at and around the Bolinao reef area of 200 km^2. A survey conducted mid 1998 resulted in some general data for the 7 *Barangay* or villages found on Santiago island (Table 1) (Anonymous 1998).

3.1.1 Boats

The municipal fisheries are officially classified as using boats of 3 gross tons or less and these boats fall in 2 categories: without or with engines. In the non-motorised category there are three types. The *balsa* or bamboo rafts, canoes with no engine and boats with a sail. In the motorised category there are 3 major types. The small boat with a 4-5 HP engine, the larger boat with the 16 HP engine that can take up to 3 fishers and the largest with 2 engines that takes some 6 fishers and is mostly used for *basnig* fishing.

Picture: bamboo raft.

3.1.2 Fishing gears

A large variety of fishing gears is used in the Bolinao municipal waters. The patterns in resource utilisation vary with different requirements for operation of the gear and differences in target species. Also the catch composition differs between gears (Table 2). Finally, also the costs and benefits for each gear differ. Some villages have specialised in one or two gears, for example at Lucero a relative large proportion of fishers use *basnig*, diving with spear guns is mostly practised by fishers from Balingasay and Dewey is frequently mentioned as the place from where dynamite fishing is initiated. Reef gleaning occurs mostly by women and children from Pilar.

Hook and line

There are three major types of hook and line operations. The large scale one is called *kawil* and operates in deep sea aiming for tuna. The others are different in that they are either operated at night or during the day and are multi-hook lines or single hook lines. During the night, the gear is operated depending on the weather but mostly some 10-12 hrs from 6 p.m.- 6 a.m. When operated during the night, a *petromax* kerosene lamp is used to attract the fish. All hook and line fishers work alone. When operated during the day the fisher starts in the morning and stays out for some 6 hrs. This is more a long line type of fishery with some 80 hooks on each line. The hook and line used in deep and open water is a single line handheld with artificial bait and the size of the hook and the type of bait depends on the fish targeted. The line is usually on a roll of 200 m. About 5-6 small motorised boats are taken by a mother boat for a 2-3 day trip and this mother ship serves as a floating safe haven and restaurant. The hook and line operators fish long hrs sometimes even during the night.

Gill net

The gill nets are mostly deployed to provide food for the family, not necessary for sale. With small buoys and small weights the net is made sure to be positioned correct. Many fishers deploy their gill nets only during the flood season when the pens flow over and many milkfish are available in the area. Some gill net fishers work together in one boat or from a bamboo raft during some 2 hrs per day only.

Fixed traps

Most of the traps that are called *pasabing* are fixed structures set in areas at some 5 m depth. *Baklad* is also a similar type of trap. With high tide the fish are floating in the trap vicinity and when the tide recedes the fish are trapped. It does not take a lot of time each day to operate the traps, the only activity is checking the catch, which takes some 30 minutes only. Often the traps are checked from a bamboo raft. Mostly the traps are checked in the morning starting at 7 am. Some use the *baklad* traps for collecting what is called *baksang*, used to make *bagoong* or fermented fish paste/sauce. Water and salt is added and then left for 3 months.

Picture: Fixed fish trap

Crab traps

The crab pots or *nasa*, are made from bamboo and tied together in groups of 30-33 each with a rope. Each day it takes some 3-4 hrs to check and empty all the pots. This is mostly done from a bamboo raft.

Shell collector

For the collection of shells, mostly women and children are involved. They need little equipment, just a bucket and what is called a *bolo* or stick to get the shells. The collecting depends on the tide, but occurs almost daily. Usually a group of 10-15 women set out to collect shells, some work the whole day but most collect some 3-5 hrs only. In the past they used to collect the expensive species only but now the catches are down they collect most species.

Spear gun

There are two major types of spear gun fishing and the difference is the size of the operation. The small-scale operations use a bamboo raft and the larger dive with 2 people using hookah compressor. Both use a petromax during the night to attract fish. The small spear gun operators fish from 7 p.m.-4 a.m. For small-scale operations minimum catch is some 1 kg but maximum can be 6-7 kg. On average catches are 3-4 kg. These include mostly rabbitfish, but also some groupers. The large-scale spear gun divers have 2 divers and one compressor operator onboard. They use flashlights underwater and dive much deeper up to 50 m. The larger operations fish mostly 3-4 days per week.

Basnig

This includes deploying a net around kerosene lamps after the schools of fish have been attracted by the light. Fishing is only at night and only at days when there is no full moon as this would affect their catchability. Depending on how much fish there is they pull the net sometimes 10 times during one night, but mostly some 5 times on average. It takes about 5-6 people on one boat. They start at 17 in the afternoon and return around 6 the next morning. During the waiting before the fish are attracted they often use hook and line and catch an extra 5-20 kg with that during one night.

Lagrite

Lagrite is also a net that is operated with lamps. It is a much smaller set-up that the *basnig*, and the boat from which it is operated has no engine. Mostly a fisher goes out at 2 am and returns around 6 am. 2 lamps are used. During the typhoon season from May-September not many of these nets are operated due to bad weather.

Compressor diving for nylon shells

This operation is very seasonal and has only recently started in Bolinao. The local fishers and buyers had little idea about these resources and now mostly fishers/divers from the Visayas come during the season to dive for the shells. They hire the boat and equipment from a local Bolinao owner and dive each day (except Sunday) during some 6 hrs for shells. These are dug up with either their hands or with a net that they stick in the mud. It takes the large group of divers only 3 weeks and then the resource is exhausted so they return to their own region. The shells are rinsed at the mainland. The divers dive with 3 people and one man stays in the boat to manage the hookah lines and compressor.

Bangus fry collectors

Fry is collected from mid April to August with a sort of seine net. The fry is collected during the day mostly. Two people pull the net with a cod-end through the shallow seagrass area.

Parisris

Depending on the season some different type of *parisris* is used, when houndsfish are the target from January-August the net is different than when flying fish is the target. The net is mostly pulled some 5-6 times per trip. Most common operation is performed with 2 boats that set out the net. Then from the two boats the net is closed by pulling the rope.

Picture: Houndsfish catch.

Triplet nets

The use of triplet nets is prohibited now, some say they can still use double nets and only in certain months of the year. These nets are mostly operated from a bamboo raft, but also boats are used when the catch is large.

3.1.3 Fishing grounds

Most fishers indicated their fishing grounds on the reef flat surrounding Santiago island or at the reef edge. These patterns were confirmed by the data collected monthly by staff from MFRMP. Most activities occurred near the reef edge (Figure 4).

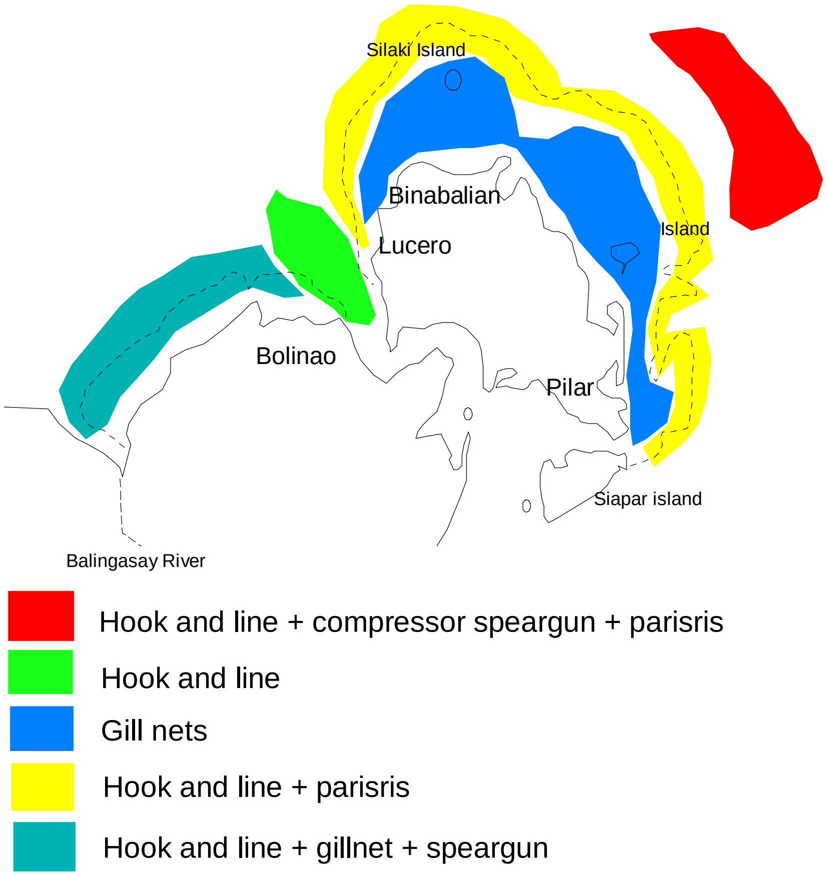

Figure 4 Spatial patterns in effort distribution for some of the most important gears.

3.2 Economics

3.2.1 Revenue from catches

Catch biomass and composition vary between gear types. The two large-scale gears that operate in the open water catching large pelagic fish such as tuna and mackerel or the smaller pelagic anchovy and squid experience the highest catch biomass on average (Table 2). Looking at the reef fisheries, the large-scale spear gun fishery where a compressor is used catches most on average, followed by triplet nets. When we look at the catch efficiency expressed in catch per hr, however, the fishery with fixed traps is most efficient as it takes only 0.5 – 1 hr per day to empty this passive fishing gear. The *parisris* and deep-sea hook and line are most efficient catching some 6-8 kg of fish per hr. With some 4-5 kg per hr, these gears are followed by compressor diving with a spear gun and the larger gillnet that is operated at night with lamps. Lowest catch rates are found for the gillnet that is operated during the day, spear gun and hook and line, that catch only 0.25-1 kg per hour on average.

The logbooks confirm these average catches, however the variance around these averages is quite high from day-to-day (Figure 5). This implies that although fishers will have a certain perception of developments in their catches, this perception must be checked with objective data.

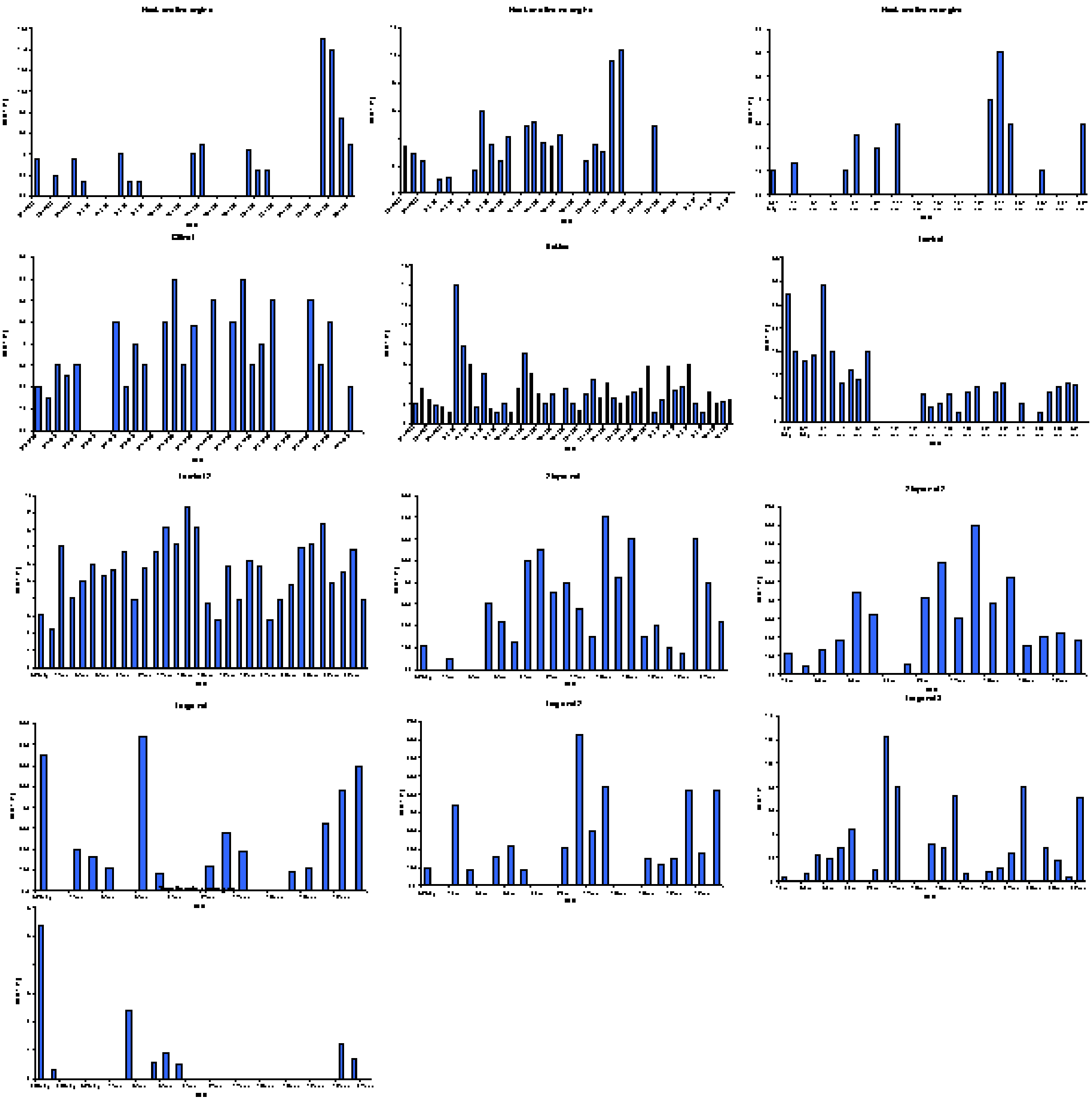

Figure 5. Day-to-day variance in catches for a number of common gears.

More important when discussing revenues for different types of fishing is the price of the fish (Table 3). Prices vary at the different points in the product chain. The price difference from one level to the next can be as much as 300%. The fisher often sells his fish to an island collector who frequently also serves as his patron or *suki*. This relation is one of mutual benefit where the patron provides the fisher with money, sometimes equipment as a loan and the fisher sells his fish to that patron only for an often lower price than at the market. The patron then brings the fish to the market between 6.00-11.00 AM where mostly women and some men buy their catch. The catches are weighed per fish category and a price is negotiated. The fishers buy ice and return home.

Picture: Tricycle.

The women take a tricycle to the market and sell their fish there during the day or bring it to other villages inland, or sell it to women that bring it inland. At the saturday morning market there are some 3 rows of concrete tables where fish is sold by some 25-30 vendors. The variety is large. Some of the fish is kept in iced water but most is on display on the tables. Categories include moray eels, catfish, parrotfish, sardines, small anchovy, dried shrimp fry, dried and fresh ponyfish. Some of the grouper is very small, 10 cm and most of the siganids are very small as well. Serranids (US$ 3.75/kg) and lobster (US$ 11.25/kg) are most expensive and cater the local tourist market. Siganids (US$ 3.50/kg), carangids and leiognatids (both US$ 2.5/kg) follow closely however and are marketed to local consumers. To compare: chicken, pork, and beef sell for US$ 1.85, 2.25, and 3 per kg respectively.

3.2.2 Costs of operation

The costs of operation also vary between fisheries. Obviously the costs of daily operation together with the depreciation costs are highest for the larger boats (Table 4). The costs of operation for the different gear types depend on the level of technology needed to operate the gear (Table 5). Thus the costs to operate a large size gear such as a fixed trap are relatively low as it only takes wood, bamboo, some rope and netting to build it. Need for maintenance of traps depends on the weather and sea conditions. The initial costs for investment and some unclear and unwritten regulations on who may own a trap however, keep some fishers from building one. The operation of the relatively small-size gear of the speargun that is operated using compressor diving is relatively expensive. This is because of the high tech equipment such as the compressor, the larger boat and the underwater flashlights.

3.2.3 Financial benefits of fishing in Bolinao – household level

The average monthly income in 1985 for the Pangasinan province was estimated at 2 530 P per family, of which 50% was for food, 10% for housing and 5-6 % for education, medical care (McManus and Thia-Eng 1990). Estimates of income for small-scale Bolinao fishers are even lower at some 470 P per month for 1985, with household expenditures almost doubling the income and it was concluded that fishing does not support minimum financial needs for survival (McManus and Thia-Eng 1990).

When we use our estimates for revenue and costs we can calculate average gross income for the different fisheries (Table 6). For a valuation of the added value of a fishery, the opportunity costs of labour are deducted. The result shows that except for the shell collector, who would never consider another occupation as they are mostly women and children, every operation makes significantly more money fishing than if they were working as an unskilled labourer. Net incomes after deducting opportunity costs of labour vary between 680- 8840 P per month. Especially the larger scale operations, even after dividing the income over crewmembers, have significant monthly incomes. Fishers using crab pots and *lagrite* have lowest net incomes but these have often other (fishery) sources of income.

Household expenses for a 4 person family include food (rice @ 500 P per month), electricity and water (@ 50 P per month), clothing, school fee and medication (@ 500 P per month). With these average expenses of 1050 P per month, each fisher is currently able to feed his family and save some money for other expenses[1].

3.2.4 The value of the fishery at the municipal/society level.

The fisheries data provided in the annual statistics of the Bureau of Fisheries and Aquatic resources do not allow detailed study of the catches of reef fish. The Philippine fishery is characterised in three sectors: aquaculture, municipal fishery (both inland and marine) and commercial. The regions that are identified are too large for detailed study. For example Bolinao municipality falls under the Pangasinan province that resides in the Ilocos region indicated in the statistical yearbooks with Region I. In the same region, catches from Ilocos Norte, Ilocos Sur, and

[1] The lowest net income after deducting 3000 P for opportunity costs is 680 P. This means that total income is 3680 minumum and that 1050 fixed costs can easily be paid from that.

La Union are combined. Also, the fish categories identified in the yearbook do not include reef fish categories. These are probably grouped under “others”, a category that makes up some 50-57% of the total municipal catches (BFAR 1994-1998). Whereas we could not obtain these data, McManus and Thia-Eng (1990) have collected data on the volume of landed coral reef fish for the total Pangasinan province. Reef catches varied between 822 – 1 318 t in the period 1983-1985, which was some 17 – 33% of the total provincial catch. Major groups are snappers, wrasses and parrotfish, garfish, rabbitfish and goatfish. The value of the total landings for the Lingayen Gulf was estimated by McManus and Thia-Eng using an elaborate method that allowed use of the highly aggregated official fisheries data. They estimated a total value in 1984 of some 113 504 000 P (McManus and Thia-Eng 1990). The value of reef fish landings was not estimated separately, however if we use 1989 prices published by McManus et al (1992) and the 1984 volume per fish category, a very rough estimate of 31 730 000 P is derived, which equals 28% of the total value for Lingayen Gulf.

During 1 hr at the landing site in Picocobuan there were about 10 fishers that landed their fish and their combined catch was some 150 kg. Landings were very diverse and included many non-reef categories: anchovy, halfbeak, milkfish, grouper, snapper, emperor, sardines, small tuna, scads, batfish, hairtail, ponyfish and live crabs. The estimates by Anonymous 1998 that are depicted in table 1 are therefore considered quite reasonable. Using the total daily landings of 1645 kg of fish at the markets (Anonymous 1998), annual landings are estimated at some 500 000 kg or 500 t (assuming average landings for 300 days per year).

When each of the estimated 3 154 fishers takes home 0.5 kg of fish per day for private consumption, the estimate of total annual catches is double that of the landings and comes at nearly 1 000 t. With an average value of 75 P per kg fish at the consumers market total annual value comes at some 75 000 000 P or US$ 1 875 000 using the current exchange rate (40 P = US$ 1).

Although we cannot compare this directly with published data from 1985 in Lingayen Gulf, considering general developments in the number of fishers and the different exchange rate, the order of size could be considered reasonable. When we roughly assume that also 28% of this is reef associated fish, the annual gross value of the reef fishery in Bolinao is some US$ 500 000.

4 Developments in the structure of habitat and fish community[2]

4.1 Coral habitat community structure

Overall, there was a significant change in live coral cover from 41% before the bleaching to 14% after the bleaching at the 10 reef sites that were sampled in Bolinao. Dead coral cover was highest (35%) in August 1998 at the height of the bleaching event. Soft coral decreased from 7% to 1% while algal cover increased from 20% to 37%. No significant changes were observed for other fauna and abiotic cover (Figure 6).

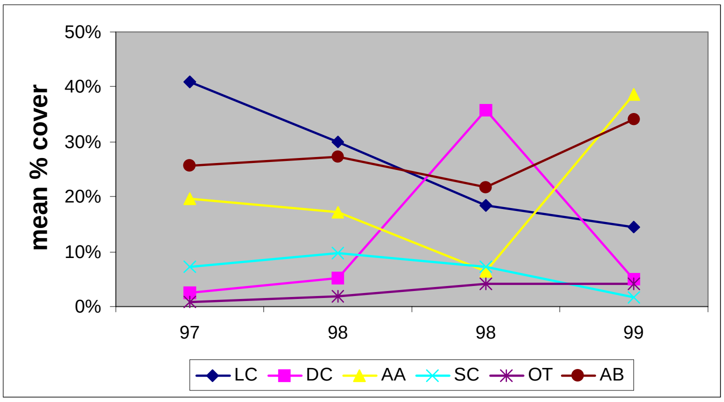

Figure 6. Trends in six major benthic lifeform attibutes in 10 reef sites in Malilinep, Bolinao, Pangasinan from 1997 to 1999 based on video surveys. Two surveys were conducted during the height of the bleaching event in 1998 (July and August). Six major lifeform attributes: LC = live coral, DC/DCA = dead coral/dead coral with algae, AA= algal assemblages, SC = soft coral, OT = other flora and fauna, AB = abiotic.

The same trends were observed for the three sites that were consistently surveyed (Figure 7). Live coral cover values was highest prior to the bleaching event in 1997 (i.e. 54%) compared to the subsequent surveys (i.e. 46%->18% ->17%). Dead coral cover was highest in August 1998 (i.e. 35%). The change in algal cover was more pronounced a year after the bleaching event (i.e. 5% in August 1998 to 32% in June 1999). The decline in soft coral cover was more pronounced (i.e. 10% change) for these three sites compared to the overall picture. Other fauna and abiotic cover showed no significant changes through time at these sites either.

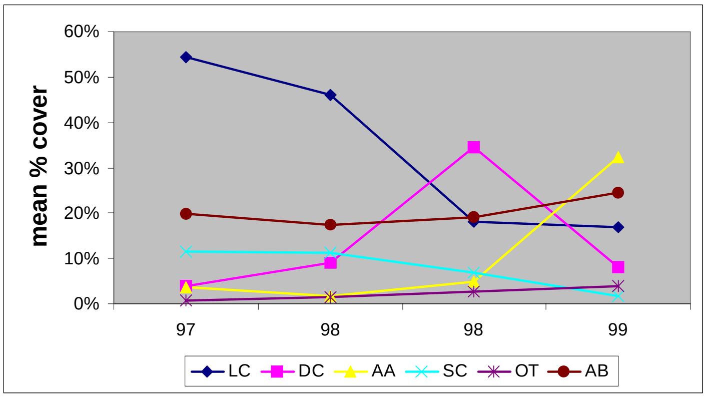

Figure 7. Trends in six major benthic lifeform attibutes in 10 reef sites in Malilinep,

[2] These results are taken from: The 1998 mass coral bleaching event in the Philippines: ecological impact assessment by Miledel Christine C. Quibilan, Hazel O. Arceo, Porfirio M. Aliño and Wilfredo Y. Licuanan to be published at the 9th ICRS Coral Reef Symposium in October 2000

Bolinao, Pangasinan from 1997 to 1999 based on video surveys. Two surveys were conducted during the height of the bleaching event in 1998 (July and August). Six major lifeform attributes: LC = live coral, DC/DCA = dead coral/dead coral with algae, AA= algal assemblages, SC = soft coral, OT = other flora and fauna, AB = abiotic.

4.2 Associated reef fish

There was a general increase in the total number of fishes in Malilnep from 1997 to 1999. Initial analyses showed that, although the total number of counts did not differ significantly from one year to the next, the increase was significant between 1997 and 1999 (Figure 8).

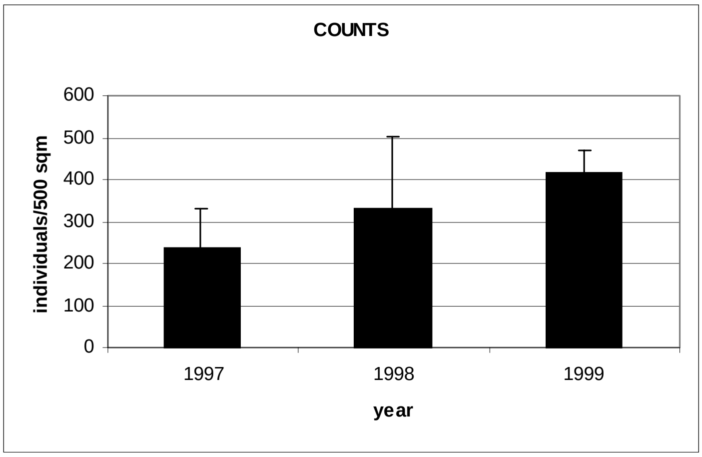

Figure 8. Trends in fish density.

The reef fish community was evidently dominated by species belonging to the families Pomacentridae, Acanthuridae, Scaridae and Pseudochromidae, and sub-family Cheilininae and Corinae (Labridae) (Tables 7a & b).

The total fish biomass also showed similar increasing trends over the 3-year period and appears to have doubled from 1997 to 1999 (Figure 9). There does not seem to be major shifts in the composition of the dominant families/subfamilies (Tables 8a & b). Though most of the fish families showed increasing trends in biomass, it is interesting to note that marked increases in biomass can be seen in scarid and acanthurid species, as well as the pomacentrid, *Plectroglyphidodon lacrymatus,* which are all herbivores. Furthermore, distinct increases are also observed in Mullidae and the subfamily, Corinae (Labridae). These are zoobenthos feeders.

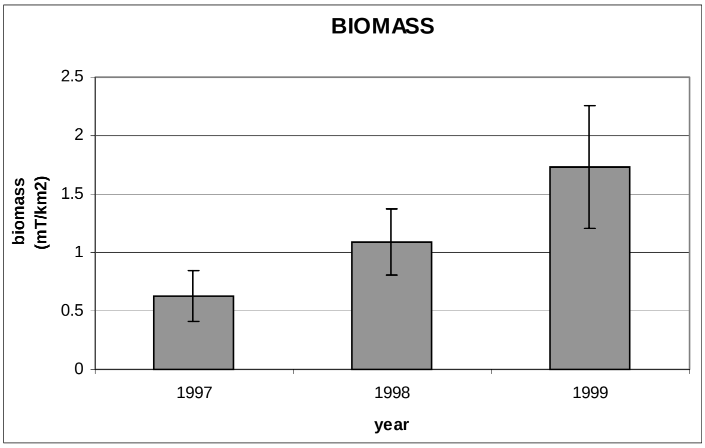

Figure 9. Trends in reef fish biomass.

Biomass of all trophic groups seems to increase but the changes are not significant (Figure 10). Only the omnivores (i.e. Balistidae, Pomacentridae, etc.) showed a significant increase. It is difficult to detect whether bleaching affected coral-feeders or corallivores (i.e. Labricthyinae and some chaetodontids) because they are very few to begin with, and trends do not show any significant results.

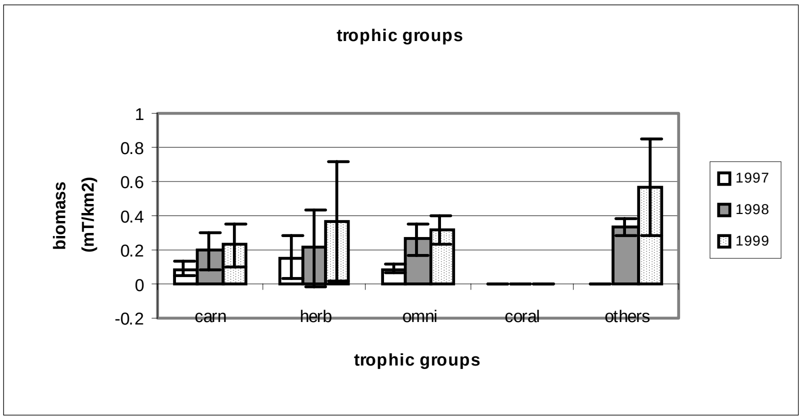

Figure 10. Differences in trophic structure over the period 1977-1999.

4.3 Theoretic implications for the fishery in Bolinao

Taking the above results from the underwater visual census, it appears that there is more fish to catch on the reefs in 1999 than in 1997. The trend in the numbers of individuals was started before the bleaching event however and although this trend might have implications for the socio-economic position of the Bolinao fishers, it is clear that such developments can not be explained from the 1998 bleaching event only. The species composition of the reef fish community has not significantly shifted. Neither has the trophic composition of the fish community. If there are differences, these are not clearly related to the bleaching as most trends already started in or before 1997 when the first data were collected. Nevertheless the obvious increases in fish abundance and biomass might have affected the reef fisheries catches.

5 Developments in the fishery

To assess developments in the catches, data were used that describe the trends in monthly catch and effort since March 1996 (MFRMP unpublished), and also perceptions of fishers and other stakeholders were summarised. Developments in fishing effort and other developments in the fishery are also described to find if these explain the trends or whether indeed the 1998 bleaching event affected the fishery.

5.1 Perceptions

Ninety percent of the fishers interviewed replied that the catch biomass had changed since 5 years ago. 8% said there is more fish now as a result of better management (stricter enforcement of the ban on destructive fishing) and 89% said that the catches had gone down mostly because of over fishing (64%) and destructive fishing (14%). Of all fishers 33% said that size in the catch has also changed, and is smaller (82%) or larger (18%) than 5 years ago. Of the fishers interviewed 43% said that the species composition has changed, and that some species cannot be caught anymore (such as cardinalfish). Most fishers (37%) suggested that strict enforcement of the recently established fishery ordinance was the best solution.

Some 82% of the fishers interviewed had an opinion on the condition of the reefs in Bolinao. Equal numbers of these fishers (31%) considered the reefs in good or bad shape. The majority of 38% said that some parts are good and others are bad. Some 55% of the fishers pointed to destructive fishing practices as the main cause for reef degradation. All fishers that considered the reefs in healthy shape said that this was a result of the stricter enforcement of the ban on illegal practices since the new mayor of Bolinao took seat in 1995. To further improve the condition of the reefs continued strict enforcement was preferred by 71% of the fishers interviewed. If the reefs would disappear altogether the majority (35%) would still fish but elsewhere, or have to find another job (47%). Most fishers expressed their hopes on a better living standard in the future, with more fish to catch and the opportunity to give their children a good education.

During ongoing community consultation by MFRMP, some fishers asked about coral bleaching. They had noticed it but didn’t know what it was. Many fishers at that meeting thought that it caused catches to drop but they said it was caused by many local threats like the waste of the fish pens etc. MSI explained the phenomena and that it happened all over the world in tropical regions. When we asked about bleaching specifically in relation to the status of the habitat, 57% had heard about it, and 53% had seen it personally. Of the people who had heard about or had witnessed the bleaching, 79% said that it was caused by the use of sodium cyanide in the illegal fishery for aquarium and live food fish. Of the remaining fishers that had witnessed bleaching, 21% said that bleaching was caused by El Niño.

5.2 Trends in catches

Catch rates for the 7 major gears show some seasonal pattern when data for the period 1996-1999 are combined and averages are calculated (Figure 11).

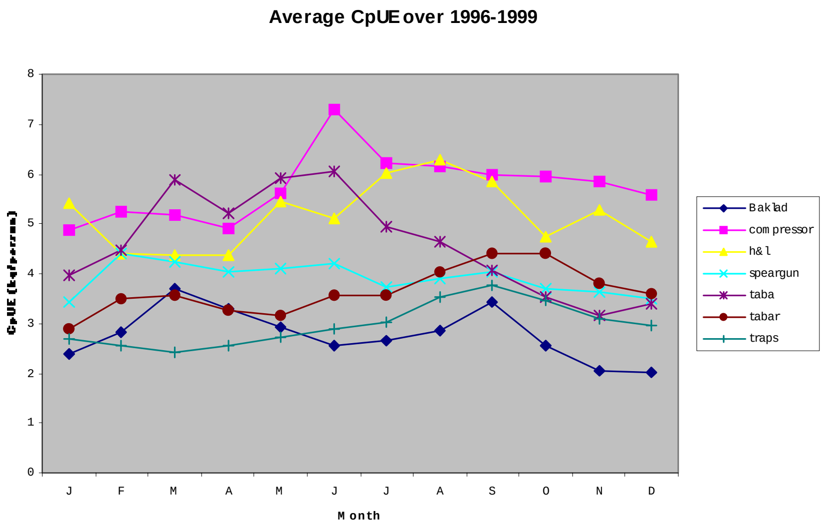

Figure 11 Average CpUE for the 7 major gears in the Bolinao fishery during 1996-1999.

Although the different fishing gears show some variation, the average overall catch rate (corrected for the relative importance of the individual fishing gears in the total fishery) appears highest around the second half of the year in July and August (Figure 12).

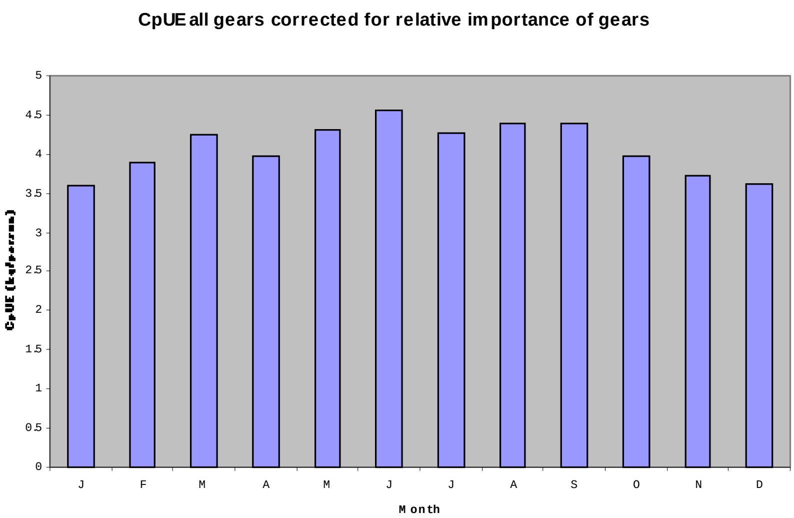

Figure 12 Seasonal patterns in average CpUE for all gears.

When studying the catch rates between years for most fishing gears there appears little difference between catch rates in 1997 (before bleaching) and in 1999 (after bleaching) (Figure 13).

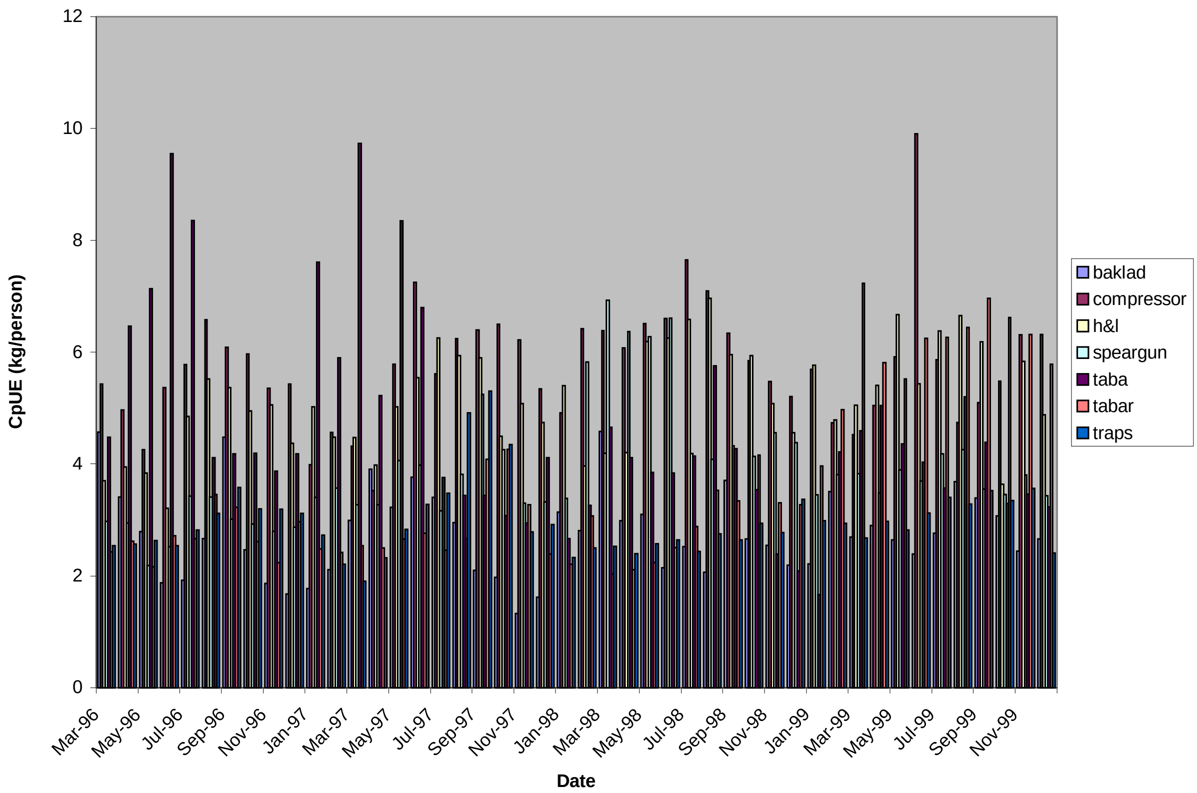

Figure 13. Developments in CpUE for 7 major gears from 1997-1999.

Only catch rates for the gear called *tabar* or *lambat*, are clearly higher than before (Figure 14). This gear is a gill net set in shallow water and operated while water beating. Fishers aim at catching herbivores such as rabbitfish and parrotfish mostly.

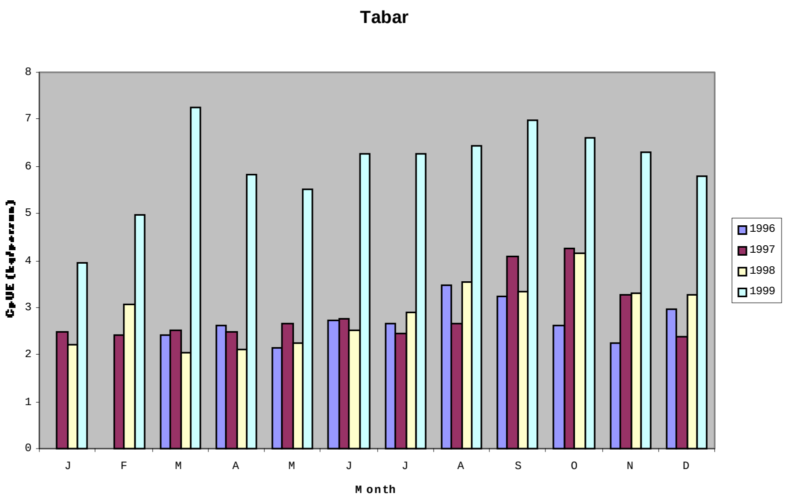

Figure 14. Annual trends in CpUE for gill nets.

When looking in more detail at the trends per fishing gear we find no clear change between after and before bleaching (Figure 15 a-f).

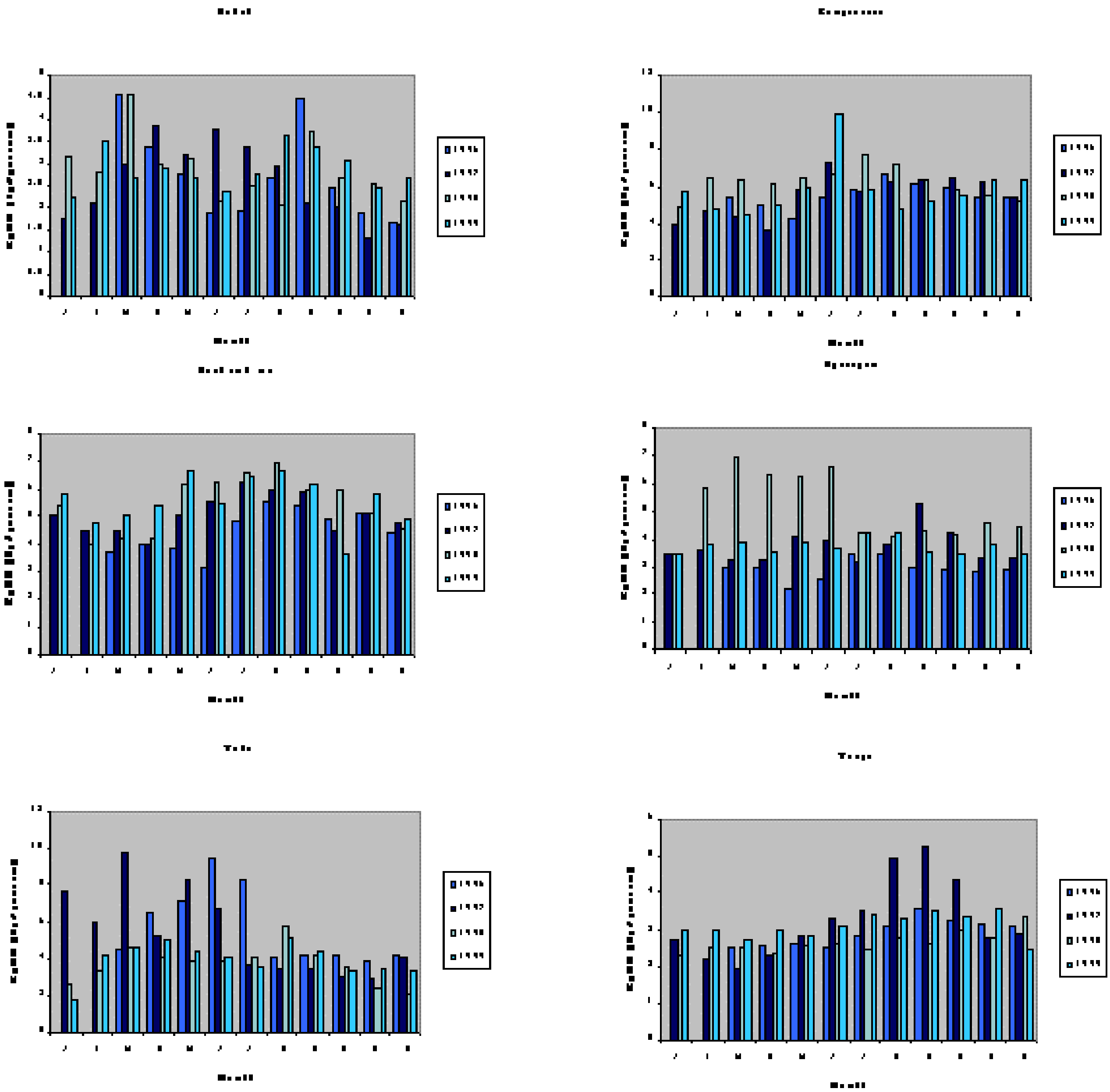

Figure 15 a-f. Annual trends in CpUE for 6 major gears.

5.3 Trends in fishing effort and other developments in the Bolinao fishery

5.3.1 Fishing effort

When we compare CpUE between years taking into account the level of fishing effort, it appears that effort for spear gun operations that use compressors and for *taba* gill nets went up since 1996, and their respective CpUE stayed constant or went down slightly (Figure 16).

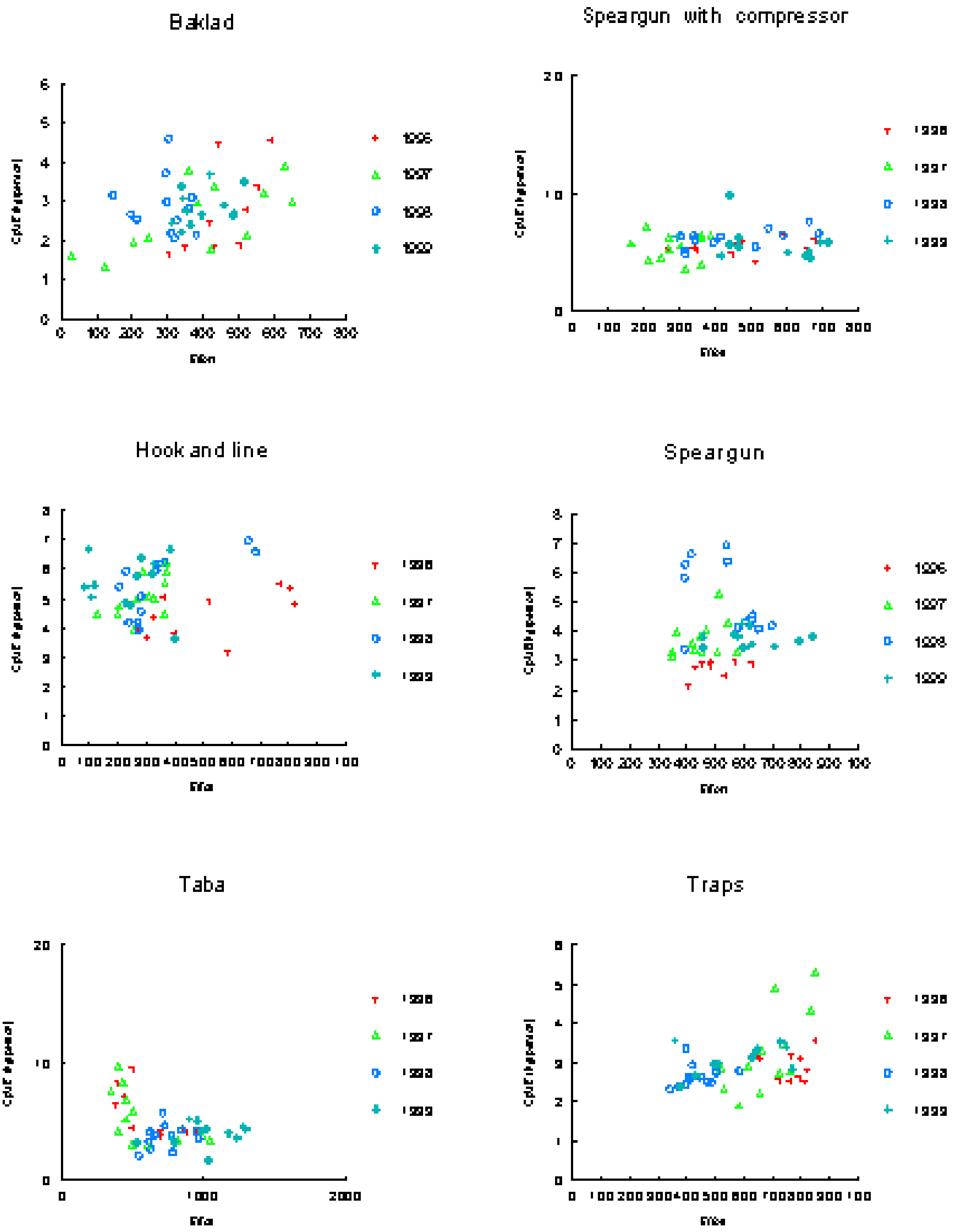

Figure 16 a-f. Relation between CpUE and effort for different years between 1996-1999.

Fishing effort for hook and line, for *baklad* and for traps went down and only the CpUE for hook and line went slightly up. Effort for small-scale spear gun stayed constant but CpUE went slightly up. Again only for the *tabar* type gill net, there appears to be a significant increase in CpUE at an even slightly higher level of fishing effort (Figure 17).

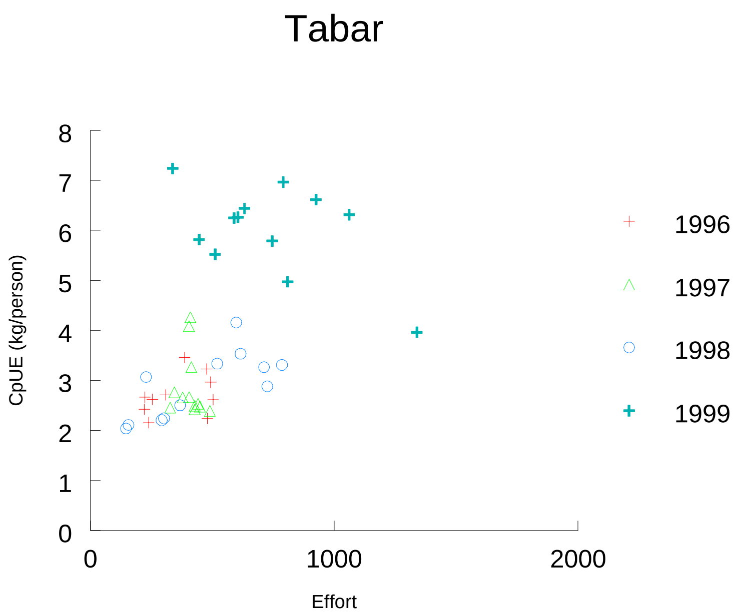

Figure 17. Relation between effort and CpUE for tabar gill net between 4 subsequent years.

Assuming these data are correct it appears that only the fishery with *taba* benefited from changes that occurred in 1998. This could be related to the bleaching event, nevertheless from the underwater visual census data we cannot find sufficient arguments for particular shifts in the fish community that would only affect this particular fishery. When asked, most of the gill net fishers said that their catches had reduced over the past years, no one mentioned a clear increase in catch.

5.3.2 Other developments in the Bolinao fishery

During the course of the long-term ongoing projects by UP-MSI and others in the region it became clear that there are a number of other developments in Bolinao region that affected the fishery input and output. These developments and their theorised effects on the fishery make it difficult to attribute changes to the bleaching event only. In the interviews with fishers some of these developments were also mentioned as causes to changes in their catches and as causes to either deterioration or improvement of the reef habitat. Factors include the developments in the operation of fish ponds, continued use of destructive fishing practices, the recent disaster caused by the oil tanker that hit Bolinao reef and spilled oil, and the establishment of the fishery ordinance.

Milkfish grow-out

The large number of fish pens that are mostly located in the Binabalian area on the eastern side are said to affect the general water quality in Bolinao municipal waters. In the entire Bolinao area some 625 fixed structures were counted, of which 153 were corrals, 108 were fish cages and 391 were fish pens (Anonymous 1999). There used to be some 3000 pens in the area. Now the number is down but the operations have become more intensive. Fish pens are mostly used for grow-out of milkfish fry. For these operations a lot of fish feed is used, much of which is thought to foul the area. Some effect of the bleaching was expected but no hard evidence is found yet.

Picture: milkfish grow-out pen

The harvest takes some 6 months. Everyday fish is scooped out of the holding pens and transported to the market where it is loaded in trucks that bring it to Manila on ice. The fish is then > 7 month and already close to 1 kg. Most of the milkfish is landed and handled at the new landing site at Picocobuan. There are 26 fish transporters in Bolinao, they collect at Arosan, Picocobuan and Balingasay. Milkfish production takes some 6 months. 1 bag of food costs 350 P for 25 kg. When fish are fully-grown and ready to harvest they need about 15 bags for the entire pen. When they are smaller the fish eat much less. Each day some 200-300 *banjara* (cages) are loaded in the truck of each some 50-60 kg so in total some 10 000-18 000 kg milkfish is transported per truck each day to Manila.

Grow-out of other marine organisms

Some pilot projects for the grow-out of siganids are started. There was always a peak in catch of siganids during the run around November, but the year after the bleaching this did not happen, so no one wants to bid for the concession now. Unconfirmed reports relate that in 1999 there were almost no siganids caught. In 2000 however it seems to be back to normal again.

Then there is a giant clam project, which is intended mostly for restocking of the natural populations. However it is also studied if this could be an economically feasible source of income for fishers. The clams that are maintained by the project were seriously hit in 1998 when the bleaching occurred and some 40% died (Gomez & Mingoa-Licuanan 1998). Major markets for clams are in Cebu and Palawan where tourists eat the clams. The source islands for Cebu market is Bantayon and Bohon and Kalituban and Talaban, where wild clams are harvested. Prices for clams in Cebu are low some 20-50 P per piece.

Picture: Clam hatchery.

Clams are transferred after some 5 months from the nursery area into the grow-out area so that the facilities can be used again for other batches or other clams. Tridacna gigas takes some 8-10 years (females) to be sexually mature and males some 5-7 years. Early 99 there were not many larvae that survived, a lot of the eggs were produced but they didn't hatch. They died after 5 days, so before transformation which is at 7/8 days. Now just this April 2000 more larvae were hatched from the eggs, but it remains to be seen how many there are left after 2 months when they become visible.

Seacucumber grow-out (smaller species) also occurs in the area as well as grouper grow-out. There is a grouper grow out project, where grouper grows during 8 months. Some 500 fish are kept in the cages and with 4 cages this makes 2000 fish. Each is fed up to 4-5 kg and then sold.

Destructive fishing practices

The use of destructive fishing practices is said to have reduced. There are some 120 active aquarium fish collectors at Binabalian. These used to be caught with cyanide but it is said that this was stopped after the mayor has issued strict regulations and patrol. The International Marinelife Alliance (IMA) has worked to train fishers in catching aquarium fish with nets. Aquarium fish is sold to island buyers and brought to the mainland market once every 3 days. Fishing with cyanide for live grouper and lobster is said to be still occurring at the reefs. Blast fishing also still continues but now the fishers (mostly from Dewey) go further away, some 200 miles, which takes some 10 hrs with their boats. There are some 10 boats and a large mother-boat. They catch some 2 000 kg of fish per day which is carried on ice by the mother-boat.

Fisheries management

Based on the study by McManus et al (1992) the implementation of a series of marine protected areas was suggested in 1992. One MPA is agreed on and the marine sanctuary has been installed since 3 years and is some 14.77 ha large. As the municipal ordinance is not yet in place in all barangays, there still is a lot of discussion about the size and location of others. There is also an ongoing discussion of local bans of the triplet gillnets.

Decentralisation authority and responsibility for fisheries resources has also started in 1992. Barangays now have legislative power. The fishery ordinance was passed in December 1999. Following the municipal office has issued an extensive survey for the Socio-Economic Profile (SEP) of Bolinao municipality, which has started already. It will take almost 1 year and data on the number of fishers and their gears will be collected. The priority at the municipal office right now is the design of the land use plan, but these plans also include making better fish storing facilities.

In the fisheries ordinance 4 zones are distinguished: I Eco-tourism, II Multiple use, III Fishery management, and IV Trade and navigation. Zone I enclosed an area where there is the issue of the milkfish fry concession. Catches are good but there are some market problems. There is quite some competition; the owners of pens in the area usually buy fry from other areas. This area has some eco-tourism initiatives going on and an installed MPA.

Zone II is for milkfish culture, there used to be some 3000 structures in 1997 with a total area of 88 ha, now the number of structures are less than 1000. The village councils have some adhoc groups that can hopefully manage issues related to the effects of these pens on the environment. Members of the villages are involved in the monitoring of water quality. The results of the monitoring and other activities are given back during regular meetings. One of the issues is to try and work on creating a better relationship between the fry catchers and the grow-out pen owners.

Zone III is very diverse; there are 4 village level groups. There is an MPA proposed (mangroves and coral reefs) and some experimental culture of siganids is taking place. One of the corrals that was used for catching siganids, is now left alone so that the siganids can stay there to grow and spawn. Establishment of the MPA is still difficult because the people cannot agree on the MPA issues, even while it is written in the fishery ordinance. In this zone there is also a mangrove rehabilitation/replanting project going on. Some 12 ha are already replanted and the villagers themselves are convincing other villages to also start such project. There are however still no groups that want to take the responsibility of the reefs as a whole.

Zone IV has not been implemented much. The health council is working on some solution for the solid waste, still in progress.

6 Conclusions

Although the changes in the reef habitat structure are evident and significantly related to the bleaching event, changes in the fish community structure cannot be so easily explained. Fish abundance and biomass increased since 1998 but there is no stronger increase after the bleaching occurred in 1998. Trends in catches show no clear change in the year after the bleaching except for catches with the small-scale gill net called *tabar*. None of the fishers that use this gear mentioned this increase however. It can also not be fully explained from changes in the reef fish community structure, because then other fishing gears should catch more fish as well. Therefore from the available data it is concluded that there is no evident effect of the 1998-bleaching event on the fishery in Bolinao as of yet.

Careless publication of such a conclusion can have serious implications especially when this conclusion is used to downplay the seriousness of bleaching. It is never intended to provide material for such use, however with the current data it is not possible to proof that there is either a positive or a negative effect on the socio-economic position of fishers. This could be caused by insufficient data as some will argue. Nevertheless the author maintains the conclusion as the data that are available have been collected to such detail and with such regularity that it seems fair to say that if these data won’t show it, no data will show a positive or negative effect of bleaching for the socio-economic position of fishers in Bolinao only two years after the event. Similar conclusions were drawn for the Kenyan coastal fishery from Mombasa (McClanahan and Pet-Soede, 2000).

It may be that it takes longer before the fishery will indeed experience changes that are causally related to the 1998 bleaching event. Within the ongoing work of the research and management projects in Bolinao, this is likely to surface but it will remain difficult to relate such changes to the bleaching only. It appears that so far the fishers in Bolinao are quite able to sustain their livelihoods even in a fishery that is ecologically “poor” in that it exploits the lowest trophic groups mostly and has little alternative fishing stocks left to turn to. However, they have little possibilities to set aside money for large investments. This means that they are stuck in the current situation. If indeed the fishery collapses in the future as a result of delayed bleaching effects, or other factors that are supposed to influence the fishery performance such as overfishing, deteriorating water quality and habitat conditions, there is little else for the fishers to do but look for income in an entirely different sector.

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8 Tables

Table 1 Characteristics of the fisheries from the 7 villages at Santiago Island (Source: Anonymous 1998).

Barangay	landing sites #	mainland landing	Avg. landed catch kg	# fishers	# of boats per type			population 1998
					basnig	motorised	non motorised	
Binabalian	5	Arosan Bolinao	175	1156	8	76	14	3161
Lucero	7	Arosan	245	631	25	58	25	2408
Goyoden	7	Arosan	245					1807
Salud	1	Dagupan	35	56	5	26	28	2258
Pilar	12	Picocobuan Baguio	420	305	5	77	3	2108
Victory	8	Picocobuan	280	150	5	12	20	1204
Dewey	7	Picocobuan Arosan	245	856	7	120	1	2108
Total	47		1645	3154	55	369	91	15054

Table 2 Average daily catch per fisher for the most common fishing gears in Bolinao based on interviews and logbooks.

gear	hrs	daily catch (kg)	logbook catch (kg)	maximum (kg)	minimum (kg)	major category	catch/hr (kg)
deepsea h&l	12	75		200	20	tuna, mackerel	6.25
lamp net large	12	50		500	0	anchovy, squid	4.17
parisris	4	30	28.8-34.1	200	0	houndsfish	7.50
compressor	8	30		40	20	lobster, grouper	3.75
shell compressor	6	20		25	15	nylonshells	3.33
triplet	8	15	30	20	10	emperor, parrot	1.88
fixed trap	0.5	10	3.2	17	3	rabbitfish, mixed	20.00
gleaning	4	7		15	5	shells	1.75
gillnet	8	7	3.4-8.5	10	5	rabbitfish, ponyfish	0.88
h&l	12	5	2.5-6.9	8	1	grouper, mixed	0.42
crab pot	3	5		8	0	crab	1.67
spear gun small	9	4	1.5	6	1	rabbitfish, squid	0.44
aquarium	5	50*		100*	20*	butterflyfish	10.00*

* Note that this is not in kg but in numbers of fish caught.

Table 3 Prices paid for fish at different points in the marketing system

fish	local name	remark	island/village	landing/buyer	market	1991*
anchovy	dilis, monamon		20-30		40	30
batfish	pinau	25-35 cm		120	130	
blue marlin	blue marlin		70			
butterfly live	saddleback butterfly	per fish		15		
crabs	barisaway, gewey		20-50	60		30
dorado	dorado		25		70	35
eel	igat			50	70	25
emperor	rogso		15-35	60	90	40
flying fish	flying fish		10		30	15
fuselier	terong		15			
fuselier	dalagangbukid		60	60	80	30
goatfish	kumyan			60		40
grouper	lapulapu	10-30 cm	100-120	120	150	60
hairtail	pinka				70	25
halfbeak	balasot		35		45	30
houndsfish	layalay		40		40	35
jack	talaketok		70-120	70	100	60
lobster	lobster	large	250	450		120
milkfish	bangus	300g	50-60	70-100	80	30-50
milkfish fry	bangus fry	per 1000	300			
mixed	sarisari	small	20-35	40		
mixed	sarisari	large	40-70	55		
mullet	burasi				70	65
parrotfish	molmol		15	20-30		20-30
parrotfish	molmolgreen			40-55		
ponyfish	sapsap		40-65		100	40
rabbitfish	barangen	small	15-30	70	80	
rabbitfish	barangen	large	35-50	70	80	50
rabbitfish	rorokan, malaga	large		100	140	60
rabbitfish	samarau, rorokan	small		65		
rabbitfish	samarau, rorokan	large		70	100	
scad	galunggong			60	50	35
shells	biatbiat	bucket	5			
shells	nylonshells			60		
shrimp	orang		100			160
siganid small	padas		30			
spmackerel	tangigi		70			50
squid	lake		55-90	40		60
squirrelfish	bayabaya			25	25	20
surgeonfish	labahita			60	45	30
tuna	tuna		40			30
unicornfish	sunayan			25	70	30
wrasse	sangitan lawin			30		20

* From: McManus et al 1992.

Table 4 Approximate costs per month for different boat types (1 US$ = 40 P)

Boat type	Value new (P)	Duration (years)	Cost per month (US$)
bamboo raft	350-400	1	0.7-0.8
canoe with no engine	3000	10	0.6
canoe with sail	2100	10	0.4
canoe with 4 HP	15000	10	3.1
canoe with 16 HP	35000-45000	10	7.3-9.4
boat wit 2 engines	80000	10	16.6

Table 5 Costs of operation per fishing gear per month (1 US$ = 40 P)

Gear type	Value new (P)	Duration	Other costs (P)	Cost per month (US$)
hook and line - nighttime	500	1-3 m	kerosene 15/night sigarettes 25/night	24
hook and line - daytime	1200	1 m	bait 15/day	38
hook and line - deepsea	150	1 m	food and gasoline 1000/3-day trip	128.75
gillnets	500-1000	3 m	kerosene 30/night	23
fixed traps	7000-10000	2-10 yr	repairs 500/yr	3.13
crab pots	750-1000	3-6 m	bait 50/day	29
shell collector	-	-	-	-
speargun - small-scale	400	5 yr	kerosene 60/night lamp + cover 1600	31.8
speargun - large-scale	400	5-10 yr	2 lamps @ 2000 compressor 10000 diesel 300/trip 4 batteries/trip	155.5
basniq	100000	> 10 yr	kerosene 150/night maintenance 100/mnt diesel 300/night	248.3
lagrite	1000	10 yr	2 lamps @ 2500 fuel 60/trip	32.3
nylon shell collector	-		rent equipment 700/day	437.5
fry collector	-	-	-	-
parisris	50000-60000	5-6 yr	gasoline 300/trip	170.8
triplet nets	5000	5 m	gasoline 60/trip	55
seaweed gatherer	1500	3-8 yr	-	0.4

Table 6 Estimate of average net income in US$ per fishing operation per month for different gear types (1 US$ = 40 P).

Gear type	Operational costs	Opportunity costs of labour	Gross revenue	Net income per month (US$)
nylon shell collector	438 (437.5)	75	3750	3312[1]
speargun - large-scale	165(164.9)	75	2625	2460[1]
basniq	265 (264.9)	75	1600	1335[1]
hook and line - deepsea	139 (138.85)	75	1410	1271[1]
parisris	187 (187.4)	75	600	413[1]
fixed traps	4 (3.9)	75	300	221
triplet nets	58 (58.1)	75	300	167
gillnets	26 (26.1)	75	260	159
fry collector	-	75	187.50	112.5[2]
hook and line - nighttime	27 (27.1)	75	160	58
hook and line - daytime	41 (41.1)	75	160	44
speargun - small-scale	35 (34.9)	75	140	30
lagrite	33 (32.9)	75	125	17[2]
crab pots	30 (29.8)	75	125	20
shell collector	-	75	10	-65[3]

[1] Note that this is the net income of the boat, a sharing system is applied to divide this to crewmembers. [2] Note that this is a seasonal extra activity. [3] Note that this is performed by women and children for whom there is no need to calculate opportunity costs of labour so net income is actually 10 US$ per month.

Table 7a. Top ten dominant species in Malilnep Reef, Bolinao, Pangasinan (individuals/500sqm)

1997		1998		1999	
1 *Siganus argenteus*	55.2	1 *Plotosus lineatus*	87.5	1 *Parupeneus multifasciatus*	56
2 *Siganus spinus*	24.8	2 *Chromis margaritifer*	27.1	2 *Halichoeres nebulosus*	33.6
3 *Chromis margaritifer*	16.4	3 *Pomacentrus philippinus*	14.8	3 *Plectroglyphidodon lacrymatus*	27.7
4 *Halichoeres nebulosus*	14.1	4 *Parupeneus multifasciatus*	14.4	4 *Chromis vanderbilti*	21
5 *Pomachromis richardsoni*	13.1	5 *Chromis vanderbilti*	14.3	5 *Pomacentrus bankanensis*	19.9
6 *Plectroglyphidodon lacrymatus*	11.2	6 *Scarus sordidus*	11.8	6 *Chromis margaritifer*	13.2
7 *Pomacentrus bankanensis*	10.7	7 *Plectroglyphidodon lacrymatus*	11.1	7 *Thalassoma hardwickii*	11.8
8 *Pomacentrus lepidogenys*	10.6	8 *Chromis weberi*	10.1	8 *Chromis sp.*	9.9
9 *Pomacentrus chrysurus*	8.6	9 *Chromis sp.*	8.5	9 *Pseudocheilinus hexataenia*	9.9
10 *Macropharyngodon meleagris*	7.1	10 *Labracinus cyclophthalmus*	7.9	10 *Scarus sordidus*	9.5
Total no. of species	**103**		**161**		**177**
Total counts	**273.7**		**391.5**		**423.6**

Table 7b. Top ten dominant families/subfamilies in Malilnep Reef, Bolinao, Pangasinan (individuals/500sqm)

1997		1998		1999	
1 Pomacentridae	94.2	1 Pomacentridae	134.4	1 Pomacentridae	145.6
2 Siganidae	80.3	2 Plotosidae	87.5	2 Corinae (Labridae)	73.3
3 Corinae (Labridae)	41.1	3 Corinae (Labridae)	33.0	3 Mullidae	66.0
4 Acanthuridae	15.3	4 Acanthuridae	23.9	4 Scaridae	31.1
5 Scaridae	6.7	5 Mullidae	17.9	5 Acanthuridae	26.7
6 Chaetodontidae	6.0	6 Scaridae	16.3	6 Cheilininae (Labridae)	18.6
7 Cheilininae (Labridae)	5.9	7 Cheilininae (Labridae)	10.9	7 Pseudochromidae	7.5
8 Pseudochromidae	4.3	8 Pseudochromidae	9.9	8 Pempheridae	6.9
9 Cirrhitidae	3.5	9 Chaetodontidae	9.6	9 Cirrhitidae	6.2
10 Lethrinidae	2.8	10 Siganidae	7.3	10 Chaetodontidae	6.1
Total No of. Families	**28**		**30**		**27**

Table 8a. Top ten dominant species in Malilnep Reef, Bolinao, Pangasinan (biomass in mt/sqkm)

	1997			1998			1999	
1	*Siganus argenteus*	0.1448	1	*Scarus sordidus*	0.0612	1	*Parupeneus multifasciatus*	0.1506
2	*Halichoeres nebulosus*	0.0357	2	*Parupeneus multifasciatus*	0.0603	2	*Plectroglyphidodon lacrymatus*	0.1113
3	*Ctenochaetus binotatus*	0.0306	3	*Plectroglyphidodon lacrymatus*	0.0559	3	*Scarus schlegeli*	0.0887
4	*Thalassoma quinquevittatum*	0.0272	4	*Ctenochaetus striatus*	0.0552	4	*Hipposcarus longiceps*	0.0876
5	*Plectroglyphidodon lacrymatus*	0.0265	5	*Thalassoma hardwickii*	0.0487	5	*Halichoeres nebulosus*	0.0862
6	*Pomachromis richardsoni*	0.0249	6	*Labracinus cyclophthalmus*	0.0483	6	*Thalassoma hardwickii*	0.0784
7	*Thalassoma hardwickii*	0.0247	7	*Ctenochaetus binotatus*	0.0371	7	*Labracinus cyclophthalma*	0.0644
8	*Macropharyngodon meleagris*	0.0218	8	*Halichoeres nebulosus*	0.0290	8	*Ctenochaetus striatus*	0.0613
9	*Pomacentrus bankanensis*	0.0200	9	*Pomacentrus chrysurus*	0.0274	9	*Scarus sordidus*	0.0544
10	*Scarus sordidus*	0.0195	10	*Dascyllus trimaculatus*	0.0262	10	*Ctenochaetus sp.*	0.0540
Total biomass		**0.7068**			**1.1432**			**1.8872**

Table 8b. Top ten dominant families in Malilnep Reef, Bolinao, Pangasinan (biomass in mt/sqkm)

	1997			1998			1999	
1	LabCorinae	0.1628	1	Pomacentridae	0.2379	1	LabCorinae	0.3145
2	Siganidae	0.1583	2	LabCorinae	0.1812	2	Scaridae	0.3084
3	Pomacentridae	0.1307	3	Acanthuridae	0.1811	3	Acanthuridae	0.2768
4	Acanthuridae	0.0997	4	Scaridae	0.0885	4	Pomacentridae	0.2614
5	Holocentridae	0.0238	5	Mullidae	0.0757	5	Mullidae	0.1806
6	Scaridae	0.0218	6	Pseudochromidae	0.0565	6	Holocentridae	0.1065
7	Chaetodontidae	0.0178	7	Chaetodontidae	0.0533	7	Pseudochromidae	0.0806
8	LabCheilininae	0.0156	8	Holocentridae	0.0384	8	Chaetodontidae	0.0792
9	Pseudochromidae	0.0114	9	LabCheilininae	0.0364	9	LabCheilininae	0.0566
10	Mullidae	0.0087	10	SEpinephelinae	0.0338	10	Balistidae	0.0524

9 Appendices

Appendix I - Abstract for the 9th ICRS.

FIRST EVALUATION OF THE 1998 CORAL BLEACHING EVENT TO FISHERIES AND TOURISM IN THE PHILIPPINES.
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The impact of the 1998 mass coral bleaching event on the fishery and tourism sectors was studied from two cases. The case studies focused on Bolinao, Pangasinan, where local communities are highly dependent on reef fisheries and in El Nido, Palawan, which is not only a renowned destination for reef-related tourism, but also supports a considerable fishing community. Declining fish catches in Bolinao seem related to the event and have a relatively large impact on the fishers as there profits were already marginalized and at the subsistence level. According to local tourism operators, the number of tourists that have visited El Nido has also declined since 1998. Besides coral bleaching, other factors such as the Asian financial crisis, El Niño and the passage of major tropical cyclone are deemed to have contributed to the decline in tourism in the area. Considering the difficulty of differentiating between the causative factors, costs of the bleaching event to the Bolinao and El Nido local society are estimated.

Appendix II List of questions used during personal interviews

Household finances fishers

Major fishing area (per season) use map

1. Date
2. Village
3. Fishing gear
4. Private ❑ Borrowed ❑
5. Type of boat
6. Private ❑ Borrowed ❑
7. Full-time ❑ Part-time ❑
8. Age
9. Fishing since
10. Family size
11. Day fishing per week
12. Hrs fishing per day
13. Costs of gear new
14. Duration of gear in years
15. Costs of boat new
16. Duration of boat in years
17. Other costs per day
18. Average catch per day in kg
    Maximum
    Minimum
19. Major species in catch
20. Average price per species
21. Other income sources sorted by importance

Perception fishers

1. Did your catch change over the past 5 years? Yes ❑ No ❑
2. How? More ❑ Less ❑ Same ❑
3. What about composition?
4. Why this change?
5. Have you heard about coral bleaching? Yes ❑ No ❑
6. What is coral bleaching?
7. What is the cause of bleaching?

Explain what bleaching is with picture.

8. Have you seen it? Yes ❑ No ❑
9. Where? Use map.
10. What is condition of the reefs? Use map.
11. Why this condition? Name major threat/cause.
12. What must be done about that?
13. What is the function of reefs for fisheries?
14. What will you do when reefs disappear?
15. What is your personal wish for future?

Appendix III Questionnaires that were distributed

1. Petsa _____________
2. Barangay _________________
3. Ano ang ginagamit nyo sa panghuhuli ng isda? ____________________
4. Personal na kagamitan ❑ Hiniram ❑
5. Anong uri ng bangka ang ginagamit ninyo sa panghuhuli ng isda? __________________
6. Personal na kagamitan ❑ Hiniram ❑
7. Madalas ba kayong manghuli ng isda ❑ Paminsan-minsan ❑
8. Edad _______________
9. Kailan kayo nagsimulang mangisda? ______________
10. Ilan kayo sa pamilya? _________________
11. Ilang beses sa isang linggo kayo nangingisda? ________________
12. Ilang oras sa loob ng isang araw kayo nangingisda? _______________
13. Madalas ilang kilo ng isda ang nahuhuli ninyo? _________
14. Pinakamarami ________
15. Pinakamababa ________
16. Anong uri ng isda ang madalas ninyong mahuli?
17. Karaniwan, magkano ang presyo bawat uri ng isda?
18. Maliban sa pangingisda, may iba pa ba kayong uri ng hanapbuhay?
19. Sa loob ng 5 taon, may nabago pa sa nahuhuli ninyong isda? Yes ❑No ❑
20. Sa paanong paraan? Mas marami ❑ Kakaunti ❑ Pareho ❑
21. Nabago ba ang klase ng isda na inyong nahuhuli?
22. Ano-anong uri ang mga isdang ito?
23. Ano sa palagay ninyo ang mga dahilan ng pagbabago?
24. Narinig o naobserbahan ba ninyo ang tungkol sa pamumuti ng mga corals? Yes ❑ No ❑
25. Ano ang pamumuti ng mga corals?
26. Ano sa inyong palagay ang dahilan ng pamumuti ng mga corals?
27. May mga nakita na ba kayo? Oo ❑ Hindi ❑
28. Saan? Ituro sa mapa.
29. Sa inyong palagay o obserbasyon, ano ang kasalukuyang kalagayan ng mga bahura natin ngayon? Maraming napinsala ❑ Walang napinsala ❑ Maaring ituro sa mapa.
30. Ano ang maaaring dahilan nito? Magbigay ng ilang halimbawa.
31. Ano ang maaari nating gawin upang maiwasan ito?
32. Ano ang gagawin ninyo kapag nawala na ang mga yamang-dagat na ito tulad halimbawa ng mga bahura kung saan pinamumugaran ng mga isda?
33. Sa inyong palagay, gaano kahalaga ang bahura sa pangisdaan?
34. Ano ang nais o pangarap ninyo balang araw sa ating pangisdaan?