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## **Fisher's Participation in Environmental Monitoring: The case of coral reef monitoring in Tingloy, Batangas**

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### **Abstract**

The five-island municipality of Tingloy is known for its coral reefs. However, these reefs are being threatened by man-made stresses and natural disturbances. Thus, a methodological framework was developed through the integration of scientific and indigenous knowledge in determining and assessing the present status of coral reef ecosystem. This study aimed to facilitate and encourage fishers' participation in the development process of the integrated methodological framework. The framework was conceived by the combined efforts of fishers and the different institutions in the area. The fishers were interviewed, and a smaller group from them was trained and they participated in monitoring the coral reef environment for the whole year. The developed methodological framework was applied and the condition of the coral reef ecosystem was determined. The data gathered served as the baseline information of the coral reef environment in the area, while the monitoring framework developed can serve as an overall guide for monitoring activities in the future.

### **Introduction**

The Philippines is blessed with one of the most diverse coral reef ecosystems in the world as it lies in the region known as "The Coral Triangle". However, the Philippine coral reefs are increasingly threatened ecosystems, as manifested by rapidly decreasing coral cover, low fish populations, and reef productivity which has dropped by one-third during the last decade (Jameson et al.1995). The damage that occurs to coral reefs is usually the result of natural and man-made interference. Typhoon damage, blast fishing, sedimentation and pollution are threats to this ecosystem. Added to that, social and economic problems: poverty, over-population, low fisheries yield, overfishing, uneven

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distribution of wealth, low levels of environmental and social consciousness, and lack of law enforcement, all contributed to the deterioration and exploitation of marine resources (Gomez et al. 1994; Uychiaoco & Aliño 1995; Pomeroy & Carlos 1997; Westmacott et al. 2000).

For the past 20 years, much has been done on coastal management in the country. Efforts on coastal resource management involve government, non-government organizations, local communities and resource users with emphasis on communities' participation in the rehabilitation and conservation programs (Gutierrez et al. 1996; Subade et al. 1998; Fernandez et al 2000; White & Vogt 2000). There has been an increasing level of participation by local communities and resource users, particularly the fishers in coastal management across the country, as evidenced by several cases such as the stories of Apo Island, Banate Bay (Fernandez et al. 2000) and others. In most of those projects, coastal management and monitoring has been done mainly by scientists, and focused on biophysical and chemical aspects. Moreover, the scientists also determined most of the monitoring guidelines and techniques. This situation makes it difficult for fishers to be actually involved in monitoring activities. This is understandable because of the lack of scientific training of these fishers. Thus, local participation would usually be limited to patrolling while monitoring would be largely done by the scientists.

Therefore, there is a need of encouraging participation down to the grassroots level for monitoring and assessment since it is through this, one could determine the status of the coral reef ecosystem and the effectiveness of a policy, a programme, or management activity being implemented. This study aimed to facilitate and encourage community participation in the development process of the integrated methodological framework for environmental monitoring of coral reefs in Tingloy, Batangas. It also integrated scientific and indigenous knowledge in determining and assessing the present status of coral reef, reef fish and water quality in the area. The framework developed could also serve as an overall guide for the monitoring activities to be undertaken by coastal communities.

### ***Conservation Measures in Tingloy, Batangas***

Luzon, one of the most extensive coral reef ecosystems, and a favorite destination of scuba divers is found along the municipality of Tingloy, Mabini and its vicinity. Tingloy is located in Maricaban Island, Batangas, 120 km south of Manila. Tingloy is situated in the southern coast, and the coral reefs are found along the western and southwestern parts of Batangas Bay and in Maricaban Strait. The western side of Tingloy

(e.g. Sepoc point., Sombrero and Caban islands), is considered one of the best diving sites in the area (Uychiaoco & Aliño 1995). The coral communities of Mabini and Tingloy are said to have traditionally supported rich near-shore fishing and in recent years, a growing tourism industry. In the early 80's however, several factors began to threaten the ecosystems of these areas (White & Vogt 2000). These factors are increased fishing effort using destructive methods, uncontrolled coastal development, increased visitation by scuba divers and day-trippers and increased pollution.

Due to the above threats, the Marine Parks/Reserve Development Inter-Agency Task Force officially declared the Sombrero Island as a marine park and issued rules and regulations to ensure its safety and protection from destructive human activities. Various activities have been done for the improvement of the reef areas but these were not sustained. Later, various organizations of the community, government agencies and Non-government organizations have exerted efforts in the protection and management of Anilao's reefs (Uychiaoco & Aliño 1995).

The WWF (World Wide Fund for Nature)-Philippines, locally called Kabang Kalikasan ng Pilipinas (KKP) has been implementing conservation activities in Mabini and Tingloy since 1998. It started by setting up community based, multi-sectoral, inter-municipal council, the Mabini-Tingloy Coastal Area Development Council (MATINGCADC), which it envisions as the one which will eventually manage the area's rich marine resources. To further ensure this, the project strengthened the coastal law enforcers "Bantay Dagat" that the local council has organized. "Bantay Dagat" patrols the municipal waters of Mabini and Tingloy every night until broad daylight to increase the safety level and protection of the area from illegal fishers. Presently, the Bantay Dagat of the two municipalities, which have passed a sisterhood agreement to enhance collaboration in the conservation of their coastal natural resources, organized themselves into a composite enforcement team which focuses on enforcing fishery laws and ordinances. With the success in the enforcement efforts of Tingloy to curb illegal and destructive fishing activities, members of the municipal council, Sangguniang Bayan who are also members of MATINGCADC, are now considering on identifying and declaring certain areas within their political jurisdiction as community-managed municipal marine reserves (Dumaop 2000).

Establishing a community-based methodological framework on environmental monitoring supports the WWF-Philippines project's goal of community empowerment. In addition, the methodology and other data that were gathered from this study could provide input to the coastal and fishery resources management plan, which was being developed for the two municipalities of Mabini and Tingloy. Likewise,

it may also provide input to the establishment of marine reserves in Tingloy.

### Conceptual Framework

This study was conducted in the five islands of Tingloy, Batangas involving the community and different institutions for the rehabilitation and conservation of marine resources. The framework could be viewed as a system with several components, interacting to come up with an integrated methodological framework for environmental monitoring (Fig.1). The first component is the community, which is composed of the fishers, who are the main residents, and the local government unit (LGU) in the area. The data gathered through interviews with the fishers was incorporated in the framework. The LGU constitutes the level of policymaking, governance and law enforcement that authorized and supported community-level institutional and organizational management. The second component comprises the institutions, which were equally important such as the Provincial Government Environment and Natural Resources Office (PGENRO), the academic institution and the KKP or the WWF-Philippines. The PGENRO and the academe provided the scientific knowledge in the environmental assessment while the role of KKP-WWF was measured through its past and present efforts as well as future plans for the sustainable management of the aquatic ecosystem.

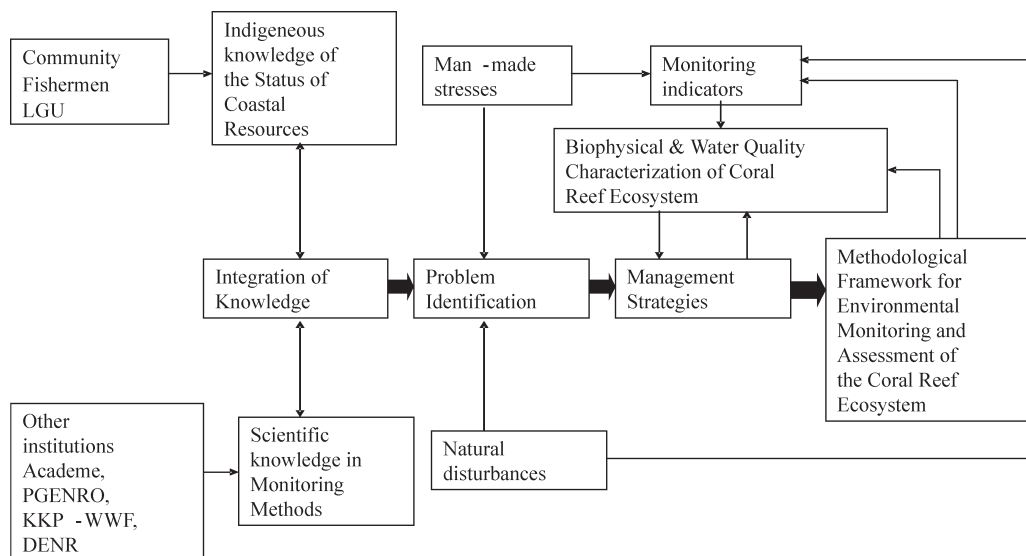


Figure 1. Conceptual framework of the Study.

The third component is the coastal environment specifically the extensive coral reef ecosystem. The coral reef ecosystem of Tingloy becomes one of the most favourite destinations of scuba divers; however, these were subjected to dynamite and cyanide fishing in addition to oil spill and garbage in the coastal waters. The effects of these

human activities cannot be determined due to lack of information on the present status of the coral reef ecosystem. Thus, a monitoring framework was developed to assess the condition of its coastal environment. In addition, the site was chosen as a study area because of the growing concern of the community and WWF-Philippines for the conservation of its marine resources. It is envisioned that the local community themselves will eventually manage the area's rich marine resources.

### Methodology and Research Process

The methodological processes for the development of the framework were shown in Figure 2. Secondary data and other relevant information from journal articles, published and unpublished materials were used to triangulate primary data derived from the study. Some data were taken from research studies on coral reefs and reef fishes of Tingloy, Sombrero Island and Calumpan Peninsula by Marine Science Institute of U.P. Diliman. Based on this secondary information, the interview questions were refined to enable the researcher to validate data gaps and further explained observations from literature. Sources of secondary data were from school libraries, PGENRO, and KKP.

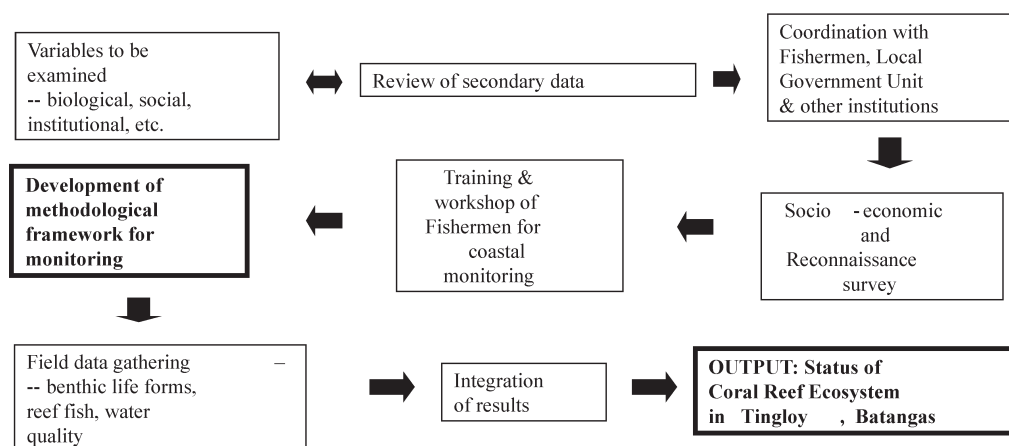


Figure 2. The research process for the development of the framework

Initial coordination with different sectors was undertaken to find out what is the most needed in coastal/ coral reef management, identify data gaps, and request for assistance from appropriate institutions. This was done through consultation with KKP officials and local government officials. The study was also presented to PGENRO officials. They were asked to assist in the water quality analysis of coastal waters in Tingloy in order to determine the coastal water quality and classification.

Prior to other tasks such as the bio-physical survey and water quality assessment, the mapping of the benthic community was undertaken following the methods done by

Nievaes (1997). This was done once during the preliminary stage of the study using the manta tow technique (English et al.1994) to make an approximate estimation of the extent covered by the coral reefs as well as its distribution in the identification of the sampling sites.

The individual survey was conducted over a five-week period from June to July 2001 in Tingloy, Batangas. To gather the needed data, a structured and open-ended interview schedule was administered to the fishers after it was translated to Tagalog and pre-tested in Barangay Sulo, Mabini. The questionnaire consisted of 10 pages divided into the following five sections: 1) demographic and socio-economic characteristics of fishers, 2) fishing and resource management practices, 3) knowledge, 4) perception, and 5) attitude. In the last part of the questionnaire, the fishers were asked if they were willing to participate in monitoring of coastal resources and the reason for their answers.

The data from the social survey provided input in the identification of the major problems to be addressed in monitoring. Out of the 26 problems identified, six major problems were identified with the fishers for environmental monitoring.

Two-day training on coastal monitoring was conducted for the fishers. Out of the 109 fishers interviewed, eight participated in the training-workshop. The five criteria for the selection of participants in fishers's training are: 1) willingness to volunteer without payment in the monitoring, 2) have at least a total score of 100 out of 128 points (on the perception, attitude and knowledge questions), 3) agree or strongly agree to the establishment of marine reserves, 4) physically fit, and 5) able to read and write.

Based on the results of the reconnaissance conducted, five sampling sites were identified for coral cover, reef fish and water quality assessment of the study. The five sites selected can give a representative estimate of the status of the coral reef ecosystem in Tingloy, Batangas. The criteria for the selection of the sites are as follows: 1) serve as a site of baseline data of the status of coral reefs in Tingloy 2) serve as one of the major sites for future monitoring activities 3) serve as one of the possible sites for the establishment of marine reserve and 4) serve as one of the possible sites for protection and rehabilitation programs. Fishers' preferences of the sites as a fishing ground and where oil spill was observed were also considered. The results of manta tow survey were integrated in the focus group discussion to finalize the selection of sampling sites and appropriate sampling time for the wet and dry season of various physical, biological and chemical parameters of the study.

Coral and reef fish surveys were done during the month of March. Two fishers were assigned for each site for the coral and reef fish survey. A line-intercept technique and snorkel survey were used by the divers and fishers, respectively in the assessment of coral reef and reef fish. Based on [Gomez & Alcala \(1978\)](#) studies, coral cover was categorized as Excellent (75-100%), Good (50-74.9%), Fair (25-49.9%), and Poor (0-24.9%).

Water sampling of coastal waters was quarterly scheduled in the months of August, November, February and June. Sample collection for each month was carried out by two fishers for all the five sites over a one day period. Microbial, physical and chemical attributes of the coastal water were determined with assistance from PGENRO.

## **Results and Discussion**

### ***Methodological Framework for Monitoring***

The framework was developed through the participation of the community particularly the fishers and various institutions; LGU, the non-government organization as represented by the KKP, the PGENRO and the academe (Table 1). Coordination with the fishers and institutions provided information of what must be done to the coastal resources of Tingloy especially from the point of view of the community. Through this, the KKP provided financial, logistics, and personal support for the development and implementation of the study. The municipal government assisted in information dissemination.

A feedback from the municipality was that there might be difficulty in conducting a survey due to lack of barangay profile and one has to go to each barangay to gather the needed data. The only means of transportation in the area was the use of boat otherwise one has to walk for hours to reach other barangays. The Commission on Election (COMELEC) officials provided the voter's list to ease the recollection of names of fishers in each barangay. The fishers provided vital information on issues that affect the coral reefs in Tingloy while the PGENRO agreed to analyze the coastal water of Tingloy free of charge.

After the whole process of development was discussed and approved by the community, a general survey of marine resources was agreed upon. A map was prepared and the data collected during the reconnaissance was used as basis for the identification of sampling sites. The personnel of KKP who were fishers in the area, assisted in the preparation of the map. A total of 160 tows were done in the five islands of Tingloy in a span of three days. About 91.25% have reef formation and only 8.75% have very low reef formation and primarily a sandy area.

Table 1. Integrated methodological framework for environmental monitoring of coral reefs ecosystem and social system in Tingloy, Batangas.

| ISSUE OR PROBLEM                                                | CAUSES                                                                                                                                                                        | POSSIBLE INDICATORS                                                    | MANAGEMENT STRATEGIES                                                                                                                                                                                                                                   | WHERE TO MONITOR                                                                      | WHEN TO MONITOR                          | MONITORING METHOD                                                                                                                                   | PERSON(S)/ INSTITUTION INVOLVED                                    |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Poverty or low income of municipal fisherfolks*<br>Overfishing* | Too many fishermen, overexploited resources, low catch, management practices<br>Changes in fishing effort, natural disturbances, changes in coral cover, management practices | Income*, no. of fishers*, health condition<br>Fish sizes and abundance | Alternative livelihood* fishing regulation through licensing<br>Harvest regulations (MPA/Zoning, seasonal closure, gear restriction, species restriction), patrolling and enforcement*                                                                  | Per municipal barangay<br>Inside and outside MPA, representative sites of the Tingloy | Once a year<br>Wet and dry season        | Social survey<br>Fish visual census                                                                                                                 | LGU, Academe, NGO, DENR<br>Fishermen, Academe, NGO                 |
| Habitat Degradation*                                            | Increase in fishing effort, management practices like MPA enforcement<br>Destructive fishing methods, natural disturbances, management practices like MPA                     | Fishing effort; catch per unit effort*<br>Coral cover*                 | Education campaign, patrolling & enforcement*, harvest regulations (MPA, seasonal closure, gear restriction, species restriction)<br>Waste management (proper disposal system), Patrolling and enforcement*, Information campaign for proper sanitation | Per municipal barangay<br>Inside and outside MPA, representative sites of Tingloy     | At least once a month<br>Once a year     | Fish catch monitoring<br>Manta tow, snorkel survey                                                                                                  | Fishermen, Academe, LGU, NGO<br>Fishermen, Academe, NGO            |
| Pollution (solid waste and sewage)*                             | Waste disposal practices, management practices<br>Lack of toilet facilities, management practices                                                                             | Garbage*<br>Cases of diarrhea                                          |                                                                                                                                                                                                                                                         | Representative sites of Tingloy                                                       | Every quarter of the year                | Water quality analysis particularly on ammonia, nitrogen, phosphate, DO and BOD<br>Water quality analysis particularly on Total and Fecal Coliforms | Fishermen, PGENRO, Academe, NGO<br>Fishermen, PGENRO, Academe, NGO |
| Pollution (oil spill)*                                          | Industry and ships oil spill, management practices                                                                                                                            | Oil spill*                                                             | Lobbying for waste reduction from oil refineries and ships*, patrolling and enforcement                                                                                                                                                                 | Representative sites of Tingloy especially Sto. Tomas site                            | Every quarter of the year                | Water quality analysis particularly on Oil and Grease<br>Manta tow, snorkel survey                                                                  | Fishermen, PGENRO, Academe, NGO<br>Fishermen, PGENRO, Academe, NGO |
| Pollution (sedimentation)                                       | Loss of mangrove areas, deforestation, management practices<br>Same as above                                                                                                  | Coral cover<br>Siltation                                               | Mangrove reforestation, replanting of trees or vegetation in the upland                                                                                                                                                                                 | Representative sites of Tingloy especially Sto. Tomas<br>Same as above                | Once a year<br>Every quarter of the year |                                                                                                                                                     | Fishermen, PGENRO, Academe, NGO<br>Fishermen, PGENRO, Academe, NGO |
| Storms and/or global warming*                                   | Natural disturbances, increasing CO <sub>2</sub> level                                                                                                                        | Coral cover*                                                           | Reduce man -made stress to enable the environment to recover more easily                                                                                                                                                                                | Representative sites of Tingloy particularly Bonito                                   | Once a year                              | Water quality analysis especially TSS<br>Manta tow, snorkel survey                                                                                  | Fishermen, PGENRO, Academe, NGO<br>Fishermen, PGENRO, Academe, NGO |

Legend: \* - identified by fishermen

However, a sampling frame is necessary to determine the identity and number of fishers to be interviewed in Tingloy. Thus, the names of all fishers from each barangay were enumerated upon request from their barangay captains. At least a week was given for the Barangay captains to submit to the Chairman for the Committee of Agriculture and Fisheries of Tingloy the list of all fishers in their barangay. Only seven out of 15 barangay captains were able to submit their list. A follow-up was done by going into each barangay captains who were not able to submit their list. A copy of the municipal voter's list from the local COMELEC was brought to ease the recollection of the names of the fishers. Once the final list was completed, a stratified random sampling was used to select the fishers to be interviewed. A total of 130 fishers were scheduled for interview. In July 2001 personal interviews of sampled fishers were conducted in all barangays except for Barangay Maricaban.

In Barangay Maricaban, the Barangay Captain informed the enumerators that the fishers do not want to be interviewed because they have conflict with the local government unit, with FRAVELLE (owners of the newly-built fish cages in their barangay), and with non-government organizations (e.g. Haribon and KKP). The objectives of the study were presented and explained to the Brgy. Captain, and he was told that the results of the interviews will be given to the municipality. The enumerators were then allowed to interview the fishers but were given cold responses by the latter. Moreover, because of uneasiness and possible threat for the enumerators, the interview for this barangay was called off and the sampled fishers were not included in the study. Thus, only a total of 109 fishers were interviewed for the whole municipality of Tingloy, not including the Maricaban fishers. Most of the respondents are residents of Brgy. San Isidro, Brgy. Sto. Tomas, and Brgy. San Juan.

During the two-day training-workshop, results of the social survey were presented to the fishers on the first day and they were asked to discuss the problems and issues identified and to provide solutions for these. Monitoring indicators, sampling sites and sampling time were also agreed upon during the workshop. A presentation about coral reef ecosystem was also made to them. On the second day, methods on snorkel survey of coral and fishes and water sampling were discussed with them. They were then trained on how to do actual snorkel survey and water sampling. One of the limitations in the number of participants is the limited fund considering that the activity only provided food and transportation expenses and no extra allowance was given.

One of the important steps in the development process of the monitoring framework is the identification of problems or issues. Each of the respondents in the social survey was asked to determine problems in the coral reef ecosystem in Tingloy and to provide management solutions to address these problems. The result was discussed during the focus group discussion with the participants. The coral reef ecosystem of

Tingloy is affected by both environmental and social problems. The six major problems identified were poverty or low income among the municipal fisherfolks, overfishing or overexploitation of resources, habitat degradation due to dynamite and cyanide fishing, pollution due to the presence of considerable amount of garbage and oil in the coastal waters, and storms or typhoon. Fishers identified all the seven issues or problems except sedimentation. The problem of sedimentation was only realized based on the results of the benthic life forms and total suspended solids readings of all sites. Different management strategies were provided to solve these problems, which are caused by anthropogenic and natural disturbances.

Monitoring indicators were identified during the focus group for each environmental problem. Indicators were variables that change due to one or combinations of factors or human actions. They are likely to change due to changes in the environment or management. Indicators selected must be in accordance with the needs or interest of the coastal community. Moreover, things or organisms in the coastal environment, which need to be observed in several sites through time, were selected, per recommendation or concurrence by the fishers. Possible monitoring indicators for poverty could be the number of fishers and their health condition. Fish catch per unit effort is another indicator identified by fishers for overfishing but this was not monitored in the study due to time constraint. Additional physico-chemical parameters such as pH, temperature, salinity, lead and mercury level were also included.

Five sampling sites were identified for coral cover, reef fish and water quality assessment of the study. The five sites selected for monitoring were the Caban reef, Macawayan reef, Bonito reef, Pisa reef and Sto. Tomas reef. Fishers preferences of the sites as a fishing ground and where oil spill was observed were also considered. The results of manta tow survey was integrated in the focus group discussion to finalize the selection of sampling sites and appropriate sampling time of various physical, biological and chemical parameters of the study. Coral reef areas in Balahibong Manok, Sombrero and Maricaban were not considered as sampling sites. There are strong currents in the first two areas while there is conflict with the residents in Maricaban.

Finally, sampling method and sampling period were finalized with the involvement of fishers and various institutions in the actual monitoring. Fishers were primarily involved in different aspects of monitoring. In summary, the contributions of key institutions are as follows:

The LGU assisted in organizing and encouraging the municipal fisherfolks to participate. The municipal government arranged activities with the fishers for their interview, training-workshop, and actual monitoring. They also provided assisting personnel to enable the researcher to familiarize themselves with the locality and the

environment of Tingloy. The barangay captains of all the 15 barangays also assisted by providing the lists of all their fishers, informing the selected respondents of their interview schedule, as well as informing the participants of their monitoring schedule.

The Department of Environment and Natural Resources (DENR) through its field office, the PGENRO has been regularly monitoring the water quality in Batangas Bay. It is only in this study that the PGENRO started monitoring the coastal waters in Tingloy. However, their analysis of marine waters have been limited and constrained to a few parameters due to lack of necessary facilities and equipment in their laboratory.

The KKP provided the financial, personnel and logistics support. They gave personnel assistance in going into each barangay and during the physico-bio-chemical survey of the coral reefs ecosystem. Logistics support such as staff house, boat, and diving equipments were also provided.

The most important contribution of the academe for the resource management of Tingloy is the scientific method of monitoring. The academe together with the fishers conceptualized the development process of the methodological framework for monitoring of coral reef ecosystem in Tingloy, Batangas. They serve as facilitator in the study especially in the integration of indigenous and scientific knowledge. The academe was also the lead institution in the training-workshop of the fishers.

### ***Status of Coral Reef Ecosystem***

After its conceptualization and finalization, the methodological framework was then applied to determine the status of the coral reef ecosystem in Tingloy, Batangas.

### ***Coral Cover***

A coral reef assessment using the line intercept method by divers and snorkel survey by fishers were made. [Gomez & Alcala \(1978\)](#) categorization was used. All five sites (Caban reef, Macawayan Reef, Bonito Reef, Pisa Reef and Sto Tomas Reef) were categorized in fair condition by the fishers survey. On the other hand, diver's survey showed only two sites, Caban reef and Makawayan reef in good condition with a 50-74.9% coral cover while the rest of the sites were in fair condition (Table 2). Both sites had high live hard coral cover among the selected sites thus it can be said that areas in Caban reef and Makawayan reef are recommended sites for establishment of marine reserves. However, some fishers are not in favor of the establishment marine reserves and some will only allow it if alternative livelihood are provided for them. Considering the sensitivity of the issue, it is better to conduct further consultation with the community to arrive at a more acceptable plan for a marine reserve.

Table 2. Benthic lifeforms in five different sites, Tingloy, Batangas, 2001

| Benthic Lifeforms          | Bonito reef<br>% Cover | Caban reef | Macawayan reef | Pisa reef | Sto. Tomas<br>reef |
|----------------------------|------------------------|------------|----------------|-----------|--------------------|
| Live hard corals           | 27.46                  | 60.6       | 53.23          | 8.09      | 36.17              |
| Dead corals                | 47.86                  | 19.42      | 30.67          | 24.24     | 17.10              |
| Algae                      | 7.1                    | 2.52       | 4.36           | 0.51      | 1.04               |
| Other Fauna                | 16.68                  | 11.3       | 6.88           | 64.89     | 14.94              |
| Abiotic reef<br>components | 0.9                    | 6.16       | 4.84           | 2.27      | 30.78              |

Though there are some discrepancies in the results of fishers's survey with the divers' survey, the skills of the former could be improved through further training. The discrepancies are understandable for the fact that different techniques were used. Fishers also need more training in the identification of benthic life forms using the snorkel survey method.

### **Reef Fishes**

Reef fish visual census of the diver's could estimate the number, abundance and biomass of fish in an area. This technique counts individual fish and estimates their total lengths in order to determine the standing stock and population size structure of specific species. On the other hand, snorkel survey of fishers could only estimate the number and abundance of fish.

### **Fish Biomass**

Among the five sites, Caban reef (59428.21g) has the highest fish biomass while Pisa reef (12,372.34g) has the lowest. Other reef areas are as follows; Bonito reef (49900.34g), Makawayan reef (36222.93g) and Sto. Tomas reef (25183.46g). Fish biomass could not be determined from the fishers survey because it requires that fish be identified at the species level.

### **Fish Abundance**

The divers in all the five sites recorded about 31 families while the fishers identified 25 families. Diver's survey showed that Makawayan reef has the highest fish abundance, followed by Caban reef. Pisa reef and Sto. Tomas reef has the lowest fish abundance. By family, Pomacentridae had the largest contribution to the mean biomass, accounting for more than 30% of the total biomass for each site. It is also the most numerous fish group per individual counts for all sites. Fishers's survey on fish abundance per individual counts was also highest for Pomacentridae. Pomacentridae is a very large family ([White 1987](#)) and considered as the most abundant in reefs ([Manthachitra & Sudara 1991](#)) thus

their dominance in abundance and biomass is typical. The high biomass and abundance of herbivorous grazers particularly that of Pomacentridae and Acanthuridae have keep the algae population to a minimum and enhance the survival of coral recruits ([Huston 1985 as cited in Nybakken 1993](#)).

The difference in the result of the diver's and the fishers's survey might be due the difficulty in identifying the scientific and English name of fishes recorded by fishers in Tingloy. There were some fish whose English name cannot be identified. There are also fishes recorded by fishers that cannot be found in the diver's survey such as fishes that belongs to the family of Anguillidae whose individual is the largest fish recorded. The family of tuna, Scombridae was also recorded by the fishers, but none by the divers. It is suggested that a survey be conducted on the list of all fishes in Tingloy with its common name, English name and scientific name identified so that there will be uniformity in reef fish identification.

Another reason for the discrepancy in the results was the difference in the methods used for sampling. Some fishers commented that there was difficulty for them to identify small sizes of fish using snorkel survey thus they did not include those they could not clearly identify. Unlike with the reef fish visual census used by the divers wherein proximity with the fish is nearer thus identification and size approximation is easier.

### ***Coastal Waters of Tingloy, Batangas***

Based on their training, the fishers collected water from the different five stations and the samples were analyzed by PGENRO except for microbial and heavy metals analysis, which were done by the Department of Science and Technology and the National Science and Research Institute, respectively.

In general, the water quality of coastal waters of Tingloy was still within the DENR standard for Class SA coastal and marine waters except for some areas in the total and fecal coliforms standard. Bonito reef and Sto Tomas reef are way beyond the maximum DENR standard for coliforms. All sites have high total suspended solids value for all quarters, which indicate the degree of sedimentation in Tingloy. Among the five sites, the coastal waters in Sto. Tomas reef exceeds the allowable limit for Class SA marine water. Sto. Tomas reef has the highest readings in oil and grease, Biological Oxygen Demand, and fecal coliforms. It also has a high reading in total suspended solids and total coliforms. The level of oil and grease in Sto. Tomas reef showed that Tingloy was not spared from oil spill in Batangas. With these results, resort establishment is not advisable along the coast of Sto. Tomas.

### **Conclusion and Recommendations**

The development of methodological framework for environmental monitoring involved the participation of coastal communities (i.e. fishers) and its institutions. The fishers identified the reef fishes through their common name, which is a contribution in coastal monitoring. Some of the names of the reef fishes are only known in Tingloy and could not be found in other coastal communities. They were also able to describe other marine organisms in the area.

Fish catch was identified by fisher's as an important indicator in determining fish abundance in the area. However, fish catch monitoring was not included in the study due to time constraint. The fishers suggested that a fish landing area be established in Tingloy so that fish stocks can be monitored and the price of fish can be regulated.

Snorkel survey method used by the fishers could provide a general estimate of the benthic lifeforms in coral reef areas in Tingloy. However, snorkel survey is limited to depth of 20 meters and identification is only until the benthic life form category of corals. Identification at genera level and coral growth estimation were difficult using the snorkel survey considering the distance of the fisher to the corals surveyed.

Reef fish visual census by the fishers was also limited to depth of 20 meters. Very small fishes could no longer be identified at that depth. Reef fish identification by fishers was only until the family level in estimating fish sizes and abundance. Fish sizes were also estimated by inches by the fishers because they were more familiar with the measurement. Results of fish sizes were converted to centimeters.

However, based on a careful analysis, it appears that the fishers need more practice for biological survey of benthic lifeforms as well familiarization with the scientific description of these substrate covers. In addition, consultation with the fishers is necessary to improve the existing method or in trying another method like the point-intercept transect, which ever suits their capability.

In retrospect, the benefits in the development of the methodological framework are the following:

1. The community and institutions are given a chance to participate and share their indigenous and scientific knowledge.
2. The fishers are empowered in the development process of the framework.
3. The baseline characterization of the coral reef ecosystem is determined through the combined efforts of the community.
4. The framework could serve as a guide that can be applied by other coastal communities. Modifications may be made due to differences in human activities in the area.

On the other hand, the limitations are as follows:

1. Its application in other areas may be limited by the capacity of the fishers in the area. Thus training of these fishers should be considered.
2. Its application would require going into the different components of the framework and this would entail time and money. However, this framework could give a starting point for the development of other methodological framework in other communities.
3. Not all indicators were monitored due to time and financial constraint.
4. In this study, some local names of reef fishes were not identified. It is therefore recommended that a study be conducted for a uniform identification of reef fishes with its local name, English name, and scientific name.
5. It was a desire to include all resource users and institutions from the community. However, only few cooperated.

Finally, it is recommended for the municipality of Tingloy that water quality analysis should include other parameters to characterize industrial waste. To reduce sedimentation, individual families should plant trees. To facilitate establishment of marine reserves, it needs an extensive study particularly focusing on what can be advantageous to the fishers. Further training of fishers in monitoring with the use of other indicators such as income, fish catch and fishing effort can be conducted and led by Barangay Captains with assistance from the fishers and other sectors in the community. Because each locality is unique by itself in terms of community resources, indicators, sectors and human activities, the developed methodological framework can be used as a guide in the development of other communities' methodological framework. The community needs to go through the same process and identify its unique features. Training of fishers and other participants is very important.

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