Sustainability Assessment of the Live Reef-Fish for Food Industry in Palawan Philippines

Article · January 2003

CITATIONS
29

READS
383

6 authors, including:

Samuel S. Mamauag
Marine Environment and Resources Foundation, Inc., Marine Science Institute
23 PUBLICATIONS **500** CITATIONS
SEE PROFILE

Alvin Morales
Asian Development Bank
1 PUBLICATION **29** CITATIONS
SEE PROFILE

SUSTAINABILITY ASSESSMENT OF THE LIVE REEF-FISH FOR FOOD INDUSTRY IN PALAWAN, PHILIPPINES

2003

Jose E. Padilla
Samuel Mamauag
Gilbert Braganza
Nilo Brucal
Dennis Yu
Alvin Morales

Contents

Executive Summary

Attempts to achieve a balance between and among trade, developmental and environmental objectives often revolve around questions concerning economic gains from trade liberalization *vis a vis* eroding social and environmental capital. These concerns include the erosion of biodiversity, the depletion of natural resources, increasing pollution in a number of developing countries, along with growing gaps between the rich and poor, and declining per capita incomes. In response to these and other concerns, WWF launched its Sustainability Assessment (SA) of Trade-Related Policies Project (SA Project) in 1999. The SA Project emphasizes the importance of evaluating the impacts of a trade policy on the economy, environment and society in the context of multistakeholder consultations. Results generated by an effective SA can help ensure that the potential benefits from trade are realized and any negative impacts are mitigated, by instituting appropriate trade and non-trade related policies at the local, national and international levels.

The sustainability assessment of the live reef-fish for food industry (LRFFI) in the Philippines has been undertaken as part of the WWF SA Project. The LRFFI is exclusively driven by international trade that emerged in response to international demand for live fish for food, primarily in Hong Kong and China. While it is a relatively small export sector, it is significant in environmental and social circumstances. The commodity is primarily collected from coral reefs – one of the most productive yet sensitive marine ecosystems. This export-oriented industry is being encouraged by the government to generate valuable foreign currency at the same time provide fishermen with a better source of income compared to traditional fishing. However, it is generally perceived now that the fish stocks that support the export industry are now largely overfished and their habitats have been generally degraded. This will have implications for the economic viability of the sector but more importantly, will have harmful effects on the sustainability of fishermen's livelihoods.

Objectives

This study was conducted to demonstrate the usefulness of SA in looking at the environmental, social and economic impacts of a trade-driven activity with the end in view of reforming trade decision-making processes towards a more favorable sustainable and equitable development. Specifically, the study on the LRFFI attempts to:

a. Characterize the LRFFI by describing the major players involved and the relationships existing among them;
b. Provide an analysis of the economic, social and environmental impacts of the industry; and
c. Formulate policy and institutional arrangements that would effectively govern the industry.

Implementation

The Calamianes Group of Islands in the northern part of Palawan was chosen for the study because of the prevalence of live fish trading in the area. Palawan has been a major supplier of live fish, accounting for as much as 55% of total exports.

A technical team composed of social and biophysical scientists was mobilized to undertake the assessments. First, the team developed a sustainability assessment framework that is appropriate for LRFFI. Second, the team implemented the framework by collecting primary and secondary data during the second quarter of 2002. Participatory consultations with major stakeholders of the industry were also conducted during the same period. The team interviewed fishermen, traders, exporters, and local government officials, among others, in the islands and in Manila. The team also undertook coral reef assessments in several sites to assess the impact of the collection of live fish and gathered time series catch and effort data. Finally, this information was processed and analyzed to provide quantitative assessments of the economic, environmental and social impacts of the industry. This document contains the assessment framework and the results from its application..

Along with the technical team, a multistakeholder Technical Working Group (TWG) was formed to set the direction of the study and to serve as a forum for discussing the progress and the results of the study. The TWG is composed of representatives from government agencies, NGOs and people's organizations (POs), and the private sector[1].

Findings

Evolution of LRFFI

In the Philippines, the collection of live fish for food originated at the southern tip of Samar Island in the 1980s. From there, it spread to other parts of the Philippines, including the study site in the Calamianes. The economic potential of the industry brought traders to the islands together with fishermen from other provinces. The higher price for live fish was the most significant incentive in the emerging industry. From a small initial group of 30 pioneers, the number grew to 500 and bloated to almost a thousand collectors in 1992. Majority of the fishermen come from other provinces and most have since settled in the islands. By the late 1990s, it was estimated that about 60 to 70 per cent of the local fishing communities were engaged in live reef-fish collection.

Changes in catching methods were also observed over time. Hook-and-line was introduced replacing the less efficient fish traps. However, the most common method used in catching live fish was the use of cyanide, which is squirted on the corals to stun

[1] The members of the TWG are: National Economic Development Authority; Department of Agriculture and the Bureau of Fisheries and Aquatic Resources; Department of Environment and Natural Resources; Palawan Council for Sustainable Development Staff; Department of Trade and Industry, Department of Foreign Affairs; International Marinelife Alliance – Philippines; PAMALAKAYA; WWF Philippines; and representatives of LRFFI.

the fish to make collection easier. Cyanide fishing has been traced as far back as the 1960s, starting with the ornamental fish industry and carried over to the LRFFI. The reports of massive cyanide use prompted the provincial government to impose a ban on the catching of live fish in the province of Palawan. The ban was lifted, however, after the fishermen and traders protested and agreed to police their own ranks to stop the use of cyanide. The lifting of the ban on the live fish trade opened the industry once again and encouraged the further entry of more firms.

Today, the LRFFI in the Calamianes is characterized by dynamic arrangements between and among fishermen, traders/middlemen, boat owners/operators, financiers (*amo*), and exporters. The transactions take place in four geographical stages - in the islands, Coron town, Manila, and Hong Kong. A complicated system of patronage characterizes the relationships in this industry. Fishermen and most middlemen are based in the islands with the latter financing the operations of the former – boat, fishing implements, gasoline, and other provisions, including loans for basic family needs especially during off-season. The agreement is verbal – built on trust and a promise that fish will be sold exclusively to the financier. The fish collected by the middleman are taken to "buying stations" owned mostly by exporters in Coron town who maintain sophisticated holding tanks to keep the fish alive. The live fish are then transported by air to Manila-based exporters through chartered flights using small planes. Finally, the fish are transported on commercial flights to Hong Kong and other destinations.

Indicators

The assessment framework that was developed focused on the identification and the quantification of appropriate indicators using primary and secondary data as well as information provided by stakeholders. The indicators are summarized below.

The biological and ecological indicators suggest that the industry is "mining" and degrading its resource base that has greatly compromised its present and future regenerative capacity. Catches have been declining in recent years and any short-term increase in catch is coming from fishing grounds outside the Calamianes. Fishermen have gone in search of more productive fishing grounds and have been spending more time at sea. The mean size of fish collected is getting smaller and exploitation rates indicate serious overfishing.

The economic indicators present similar results. Income from fishing has been dissipated by declining catches brought about by overfishing and the swelling number of fishermen in a regime of open access. Likewise, the returns from capital and labor have been greatly diminished over time. This has occurred despite an increase in the price of fish in nominal peso terms. Fishermen remain in the industry primarily because of a lack of alternative non-fishing employment in the remote islands.

The existing social and political institutions are not adequately equipped to address the worsening ecological and economic status of LRFFI. Moreover, these institutions have not adequately responded to the emerging problem despite past policy pronouncements.

Recently, local institutions have expressed some resolve to address the problem before the situation becomes irreversible. A necessary and sufficient approach to improve the situation of LRFFI in Calamianes is through a multistakeholder commitment to do their respective roles in managing the industry. The social and political situation, however, does not currently appear to support such strategy.

Sustainability Indicators of the LRFFI

Sustainability Indicators	Results in the Calamianes Islands Using Primary and Secondary Data
Catch	• Live fish catch (in kilogram weight) predominantly of *P. leopardus*, decreased from 1998 to 2001.
Catch per Unit Effort (CPUE)	• Absence of benchmark does not allow trend analysis • Present estimate of CPUE in the harvest of live fish was higher relative to estimates found elsewhere in the tropics
Fishing distance and duration	• Respondents travel farther than in the past in search of newand productive fishing grounds, resulting in longer fishing trips/duration
Species composition	• *P. leopardus* remains the most dominant species
Fish body size	• Mean body size of *P. leopardus* decreased from 1998 to 1999. • There was also a reduction of the ratio of total weight (in kilogram) to total number of individuals in the catch (abundance) of live fish from 2000 to 2001. • Both results suggest growth over-fishing
Size/age at sexual maturity	• Live fish trade targets size range (28 - 32 cm total length) which are young and sexually immature to maturing individuals • High catch rates of these small-sized individuals may lead to recruitment over-fishing
Fishing mortality rates	• High, preliminary estimates of mortality rates for *P. leopardus* are relatively higher than those in the Great Barrier Reef, Australia.
Exploitation rates/yield per recruit	• MSY is exceeded; stocks of *P. leopardus* in the Calamianes are overfished
Habitat degradation due to cyanide exposure	• No significant spatial effect, estimate of habitat degradation was small but dead coral cover was greater than live coral cover on cyanide-impacted areas compared to non-impacted areas
Price	• Increased significantly over a 10-year period
Catch per unit of effort	• No earlier data but must have decreased significantly due to decline in catch and increase in number of fishers
Employment	• No time series data but current number is estimated at over 1,000 artisanal fishers which constitute primarily of migrants
Investment	• As the number of fishers has increased so did investments. While no census data exists, considering fishermen-boat ration of 3 persons, there should be at least 300 boats engaged in the industry,
Labor productivity	• Average annual gross profits amounted to over PhP 25,000 in 2001. This is lower than legal minimum wage rates. Fishermen remain in the industry as they may not have employment alternatives outside fishing.

Capital productivity	• In fishing, the boat is considered a sunk investment. The engine may have other uses. Returns of investment are very low on the average.
Income distribution	• Quite a number of fishers are already losing • Inequitable distribution of benefits – those who have greater access and control of the finances reap the benefits while ordinary fishermen continue to incur debt year round
Government capacity and capability	• Weak due to absence of strategic management plan and lack of resources to do this for appropriate resource management • Perceived presence of vested interests by local financial and political elites. No real decisions are made since they also control local government structures, to include enforcement agencies. • Barangay government is regarded significant and relevant in terms of facilitating the participation of fisherfolk. • Coordination among government agencies is constrained by cross-cutting jurisdictional issues, ambiguous working relationships, and lack of institutional accountability • Perceived prevalence of irregularities in the enforcement of regulations and the ineffectiveness of concerned government agencies both at the national and local levels.
Self-reliance and empowerment	• Absence of substantive multi-sectoral consultations and multistakeholders dialogues and other relevant consensus building activities in all levels or resource management use (at the fisherfolk level, LGU level, policy level, etc.).
Gender – complementing roles and functions	• Gender roles have shifted in terms of achieving equal levels of significance in keeping economic stability within the family • Uncertainties of income from LRFFI led women to assume more economically significant roles
Access to basic social services	• Absence of key service infrastructures at the barangay level (especially in the islands where fishing communities are located) • Presence and concern from government are only felt during election time
Food security	• Perceived uncertainties of communities on the provision and acquisition of food due to inequitable trade dynamics and lack of service delivery from concerned government agencies • CGI start to show indications of resource depletion due to unregulated exploitation of resource coupled by the unabated illegal and destructive fishing practices
Cultural stability	• Weak cultural cohesion and constructive awareness among the indigenous people • Unstable working relationships between migrants and indigenous peoples

Recommendations

It is clear from the above indicators that the fishery is overfished, in both biological and economic terms, and there is a sense of urgency to reverse the unsustainable path of the industry. This is an age-old situation not only in the Calamianes but in the entire country. Countless efforts have been undertaken and enormous resources have been spent yet overexploitation of fisheries continues if not worse. What are needed are new approaches.

Sustainability assessment provides a different approach to fisheries management, which is being implemented in the LRFFI in the Calamianes. Considering the economic, environmental and social aspects of the international trade-driven industry, solutions should address these three considerations at the same time. Therefore, what is emphasized in SA is the multistakeholder approach not only in managing the industry, but more importantly, in making relevant and responsive decisions. The stakeholders – the direct fishermen, traders, financiers, exporters, among others – should arrive at the appropriate decisions about the direction of the industry through consultations among themselves. This approach is a departure from the top-down prescriptive policy formulation and implementation and represents an extension of the community-based management approach.

Following this approach, the study suggests a process involving these activities:

a) Presentation of the results of the study to the local stakeholders in Calamianes Islands.

b) Conduct of dialogues and consultations among the stakeholders themselves to decide on specific measures to be undertaken to reverse the unsustainable path of the industry. Dialogues and consultations will be aided by the project technical team for scientific inputs and by the local government officials for legal and administrative inputs.

c) Formulation of specific measures that will be arrived at by the stakeholders that are necessary and sufficient to ensure the sustainability of the industry. The project technical team will: a) assess if the measures proposed by the stakeholders constitute the "minimum" to reverse the trend; b) recommend additional measures if called upon by the stakeholders. The set of measures should address the economic, environmental and social issues of the LRFFI.

d) Identification of the roles and responsibilities of each stakeholder group in ensuring the sustainability of LRFFI, which are mutually agreed upon by them, thus acceptable and doable. The stakeholders will ensure that not one group is "free riding" on the others. The local government will certify if the roles are within legal bounds, easily monitored and administratively feasible.

e) Implementation, monitoring and evaluation of the management of the industry by all stakeholders, including the local government units with technical and scientific

support for monitoring and evaluation. It should be recognized that the management scheme is adaptive allowing for periodic adjustments along the way to adjust to unforeseen circumstances and the effectiveness of each measure.

The recommended roles of the local government units (PCSD, provincial, municipal and barangay levels) include the following:

a) Enabling the conduct of multistakeholder dialogues and consultation. Government should basically agree to industry self-regulation subject to a minimum set of acceptable targets that will be sufficient to ensure sustainable LRFFI.

b) Enacting the required ordinances to provide for the formal implementation of the set of measures formulated and agreed upon by the stakeholders.

c) Monitoring and evaluation of the implementation of the agreed upon measures.

d) Facilitating continuing dialogues and consultations to "fine-tune" the measures in the context of adaptive management.

ACKNOWLEDGEMENTS

This report is the result of multi-stakeholder cooperation among those who share similar concerns about the future of the Live Reef-Fish for Food Industry (LRFFI). Special thanks are extended to the stakeholders in the Calamianes Islands in Palawan – the fishermen particularly from the islands of Coron, Delian, Kanipo, Nangalao and Panlaitan, traders, exporters and others who are directly engaged in the trade – for generously allowing us a glimpse of the activities as part of the research. The brief but very precious opportunities provided to our team led to the writing of this report.

The insights and candid views provided by the following are recognized: Hon. Alfredo Enriquez, Municipal Mayor of Coron; Mr. Arnulfo Vicentino, Municipal Planning and Development Officer of Coron; Municipal Councilors Patrick Matta and Jing Astor; Congressman Brown Sandoval; Ms. Nora Labrador, Mr. John Pontillas and Atty. Joselito Alisuag of the Palawan Council for Sustainable Development Staff; officers and members of the Calamianes Fishermen's Association, particularly Ms. Miniani Baylosis and Mr. Jing Astor; Saragpunta Foundation; and Environmental Legal Assistance Center. The assistance to the research team of Mr. Al Linsangan and Mr. Melchor, both residents of Coron, Palawan, was very valuable in navigating the Calamianes waters.

The members of the project Technical Working Group have provided general directions to the project and also comments on the preliminary results of the study. The chair and members of the project TWG include the following: National Economic Development Authority; Department of Agriculture and the Bureau of Fisheries and Aquatic Resources; Department of Environment and Natural Resources; Palawan Council for Sustainable Development Staff; Department of Trade and Industry, Department of Foreign Affairs; International Marinelife Alliance – Philippines; PAMALAKAYA; WWF Philippines.

Finally, thanks are extended to WWF-International, the Department of Agriculture and WWF Philippines for believing in what the project hopes to achieve.

List of Acronyms and Abbreviations

AFMA	Agricultural and Fisheries Modernization Act
APEC	Asia-Pacific Economic Cooperation
BFAR	Bureau of Fisheries and Aquatic Resources
BPR	Biomass Per Recruit
CGI	Calamianes Group of Islands
CI	Conservation International
CPUE	Catch-Per-Unit Effort
ECAN	Environment Critical Action Network
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organization
FISAT	FAO-ICLARM Stock Assessment Tool
GBR	Great Barrier Reef
ICLARM	International Center for Living Aquatic Resource Management
ILP	Import Liberalization Program
IMA	International Marinelife Alliance
IPRA	Indigenous Peoples Rights Act
LGC	Local Government Code
LGU	Local Government Unit
LIT	Line Intercept Transects
LRFFI	Live Reef Fish for Food Industry
MSY	Maximum Sustainable Yield
OECD	Organization for Economic Cooperation and Development

PAG-ASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PCSD(S)	Palawan Council for Sustainable Development (Staff)
PNP	Philippine National Police
SA	Sustainability Assessment
SEP	Strategic Environment Plan
SCUBA	Self Contained Underwater Breathing Apparatus
TRP	Tariff Reform Program
TWG	Technical Working Group
UNEP	United Nations Environmental Program
VBGF	Von Bertalanffy Growth Function
WTO	World Trade Organization
WWF	World Wide Fund for Nature
YPR	Yield-Per-Recruit

List of Tables

List of Figures

Part I
Background

1. Introduction

Achieving development is the basic tenet that gave impetus to globalization. With increasing interaction among people from different parts of the globe, it is believed that wealth creation and sharing of benefits across borders (Lam 2001) will prop up the economies of developing countries to address national goals such as poverty alleviation, economic growth and environmental protection. One of the significant components of globalization is trade liberalization, which involves the gradual but steady removal of trade barriers among countries. This has encouraged greater movement of goods across national boundaries, enhancing efficiency in production and in the provision of services and paving the way for substantial cross border flows of capital. Proponents of more liberal trading regimes suggest that these flows of goods, capital and investment will help many countries solve problems related to sustainable development.

Recently, however, some governments point to deficiencies in the global trading system. Since the formation of the World Trade Organization (WTO) in 1994 that ushered a faster pace in trade liberalization process, many countries have experienced growing trade deficits and falling growth rates (UNEP 2001). Other countries have cited failures in achieving a balance between the pursuit of economic gains and efforts to protect the environment. They argue that trade liberalization has damaged certain natural resource-based sectors with attendant substantial social costs. Studies, particularly in the forestry sector, seem to support this along with other assessments such as those looking at shrimp aquaculture and certain agricultural products that are internationally traded.

Indeed, based on early and emerging literature, what seems to be coming out is that the environmental and social costs of trade liberalization have started to outweigh the economic benefits to some countries. Biodiversity has been eroded, natural resources have been depleted, pollution has increased in many parts of the world, particularly in developing countries, the gap between the rich and the poor has widened, and per capita income has declined in a large number of countries. Critical questions have been raised that seek clarification on the economic gains from trade in light of the eroding social and environmental capital.

One concrete tool available to ensure that the environmental considerations are given due weight in sensitive projects and increasingly in policy formulation is environmental impact assessment (EIA). The Philippines has institutionalized EIA but lately, some sectors have called for the broadening of these assessments beyond their exclusive focus on the environment. The WWF's SA Project being implemented in the Philippines in collaboration with a multistakeholder group fills this gap as SA focuses not only on environmental assessment but also equally on economic and social considerations.

The WWF project in the Philippines is part of a global program on SA focusing on trade policies. SA emphasizes a multistakeholder-oriented approach to assess the impacts of trade policies on the economy, environment and society as a whole. This is done through rigorous and thorough scrutiny of relevant data and information on trade. The goal of SA is to maximize the benefits from trade by enhancing its positive impacts and mitigating its negative economic, environmental and social impacts. This may be achieved through a range of local and national policies (and possibly international agreements) formulated through highly analytical assessments and extensive consultations among stakeholders.

The WWF effort was launched in the context of other initiatives related to SA. The United Nations Environment Programme (UNEP) spearheaded an effort to promote integrated assessments when it released its *Reference Manual for the Integrated Assessment of Trade-Related Policies* (UNEP 2001). The manual serves as a guide for governments and policymakers in assessing trade policies towards achieving a synergy among economic, environmental and social goals. National governments have also made commitments to undertake environmental assessments or reviews of trade policy. For example, the government of Canada has released a framework for Strategic Environmental Assessment aimed at ensuring that environmental considerations are taken into account when negotiating trade agreements. Likewise, trade negotiations in the United States are subject to environmental reviews further to Executive Order 13141, which was signed in 1999 which aimed to ensure that the careful environmental review of potential impacts of trade negotiations.

The Philippine Case Study

In April 2001 at a workshop in Manila, WWF launched the Philippine case study on the SA of trade policies. Participants agreed to conduct a SA in the Philippines given the scarcity of information on the social, economic and environmental impacts of trade liberalization. Further, participants at the workshop identified the fisheries sector as a priority area because of its tremendous importance to the Philippine economy in terms of contribution to domestic product and employment.

The choice of the fisheries sector assumed further significance in light of the ongoing and contentious Tariff Reform Program (TRP), which is now on its 4th and final phase. The TRP is a policy initiative that was started over 20 years ago in 1981 to improve the country's international competitiveness. The TRP also addressed the international commitments following the "reply and offer" principle, which called for the presentation of a set of offers and counteroffers by the Philippines when negotiating with other countries. The program has gone through four stages with each stage marked by reduction in tariffs of a number of commodities. Along with the Import Liberalization Program (ILP), the TRP, by abolishing high levels of protectionism over time, has engaged the Philippines in liberal trading arrangements with the hope of enhancing the country's competitiveness and productivity.

Following the Manila workshop, a project team was mobilized to undertake the SA. Along with the technical team, a multistakeholder Technical Working Group (TWG) was

formed to serve as a forum for setting the direction of the project and its evaluation. In addition to considering the TRP, the TWG recommended the assessment of the country's export-oriented trade policy in terms of its economic, environmental and social impacts. A specific subsector was chosen to demonstrate how SA works. The live reef-fish for food industry (LRFFI) was selected because it is an export-oriented industry that is claimed to have important environmental and social impacts in addition to the significant economic impacts in terms of foreign exchange. The case study was conducted in the Calamianes Group of Islands in Palawan because it accounts for 65 per cent of the country's total exports of grouper, the major group of species species in the LRFFI in terms of volume and value.

The case study highlights the importance of the wider geographical context. The province of Palawan is reputed to be the Philippines' remaining frontier of pristine and unspoiled natural resources. The province's forest and coastal areas are recognized to contain many endemic and rare animal and plant species. It is this unique environmental beauty that has lured people to the province to commune and enjoy its natural richness. At the same time, these natural resources have served as a magnet for migration that led to overexploitation, which in certain instances included destructive techniques.

Concerns over the sustainability of the LRFFI were echoed worldwide when cyanide was detected in most live reef fish tested under a program carried out by the International Marinelife Alliance (IMA). At the same time, coral reef is destroyed by continued cyanide use. In 1997, APEC hosted the Workshop on the Impacts of Destructive Fishing Practices on the Marine Environment in Hong Kong to address this issue (TRAFFIC 1999). The workshop yielded a number of steps agreed upon by the participants to protect the coral reef ecosystems from destructive fishing methods including the use of cyanide.

The conduct of SA focusing on the LRFFI in Coron is deemed timely as concerned national and local government agencies, and the stakeholders, are in the process of developing appropriate policies to address the declining industry. The SA approach involving an integrated analysis of social, economic, and environmental impacts of the live reef-fish industry could bring to the fore substantive basis for addressing the problem at various geopolitical levels. Furthermore, the multi-stakeholder SA process provides for the participation of all stakeholders and the requisite openness and transparency that encourages the stakeholders to be more responsive, thus ultimately arriving at acceptable courses of action to address their situation.

2. Objectives of the Study

The study was conducted to demonstrate the usefulness of SA in assessing the environmental, social and economic impacts of an internationally trade-driven activity with the end in view of reforming trade decision-making processes to promote sustainable development. Specifically, the study attempts to:

a. Characterize the LRFFI by describing the major players involved and the relationships existing among them;

b. Provide an assessment of the economic, social and environmental impacts of the industry;

c. Formulate policy and institutional arrangements that govern the industry; and

d. Initiate measures to institutionalize SA in the Philippines.

3. The Evolution of the Live Reef-Fish for Food Industry

As in other countries, the LRFF industry in the Philippines is driven primarily by international demand from Hong Kong and China. It originated in the 1970s in South East Asia when live food fish collection began in the waters of Hong Kong (Pratt, et al 1998). Since then, the trade has proven to be a lucrative business posting an estimated retail value of US$ 1 billion (Pratt, et al 1998). Given the expanding market demand in China, the figure is projected to increase by 60 to100 per cent in 2003 from the 1997 level.

In the Philippines, the collection of live fish for food originated in the 1980s in Guiuan[2] located at the southern tip of Samar Island. . From there, it spread to other parts in the Philippines, including the study site – the Calamianes Group of Islands in the northern part of Palawan (**Figure 1.1**). The Calamianes is composed of the municipalities of Coron, Busuanga, Cullion and Linapacan (*refer to Map of the Calamian Group of Islands*). There are a total of 47 barangays covering a total land area of about 194,700 hectares (Coron being the largest) with a total human population of over 71,100 (of the four municipalities, Coron is the most populous). The geophysical characteristic of the area is of low, rugged, and rolling terrain with occasional wide plains and pasture areas. The land is generally used for agriculture with the best tracts of land owned and maintained by a few wealthy landowners. Communities have a significant level of dependency on the natural assets both in the uplands and coastal areas. Fishing, particularly the catching of live reef-fish remains the main source of income and livelihood of the people living in the Calamianes. .

Fig. 1. 1 Map of the Calamianes Group of Islands (Philippine mapinset)

[2] It is reported in Guiuan that the commercial collection of live reef-fish no longer exists due to overexploitation and destructive fishing in the past.

A local businessman is recognized as the pioneer of live reef-fish for food collection and trade in the Calamianes. It appears that in the late 1980s, traders based in Hong Kong approached the businessman to establish such industry in the area. Sensing the economic potential of the business, he accepted financial and technical support from foreign partners and started the collection of live fish for food in the islands of Panlaitan and Kanipo. Today, the areas where live reef fish catching is prevalent are distributed over the Calamianes and in other areas of Palawan. Depending on the season and weather conditions, specific fishing grounds are preferred. The islands where most live reef fish are sourced from are Delian and Kanipo in Coron, Demipac and Panlaitan in Busuanga, Binudac in Culion, and Nangalao in Linapacan. Of late, the intrusion of large-scale fishing vessels from neighboring and distant provinces as well as the prevalent use of destructive fishing methods have forced the locals to move further outside the vicinity of these two islands. New fishing grounds are being visited as far southeast as Amanpulo.

During the initial phase, fishermen from distant provinces of Surigao, Bohol and Leyte were brought to the area to fish and train the locals in techniques for catching live fish. The activity and practice slowly grew among the fishing communities and it was not long before fish replaced lobster as the main live aquatic product in trade. By the late 1990s, it was estimated that about 60 to 70 per cent of fishing communities engaged in live reef fish collection.

Given the delicate nature and character of the fish, the fishermen were trained in proper handling techniques. The fish were kept alive at sea by ingenious methods. Fishermen built mini "aquariums" or holding tanks into the hull of their boats where a fish is released right after capture. The "aquariums" allow seawater to flow in and out freely that create an environment that kept the fish alive until sold to the traders who in turn maintain sophisticated holding tanks.

Changes in catching methods have been observed over time. Hook-and-line was introduced replacing the less efficient fish traps. However, the most common method used to catch live fish is with cyanide, which is squirted to stun the fish to make collection easier. Cyanide fishing has been traced back to the 1960s (Pratt et al date). The technique was initially used in the ornamental fish industry and then applied to live reef-fish for food industry. It is estimated that about 65 tons of cyanide each year is squirted on Philippine coral reefs to catch live fish for food and for ornaments.

The reports of massive cyanide use prompted the provincial government to impose a ban on the catching of live fish in the province of Palawan. The ban was lifted, however, after the fishermen and traders agreed to police themselves to stop the use of cyanide. For continued compliance, local and national laws were formulated governing destructive fishing.

The lifting of the ban on the live fish trade opened the industry once again and encouraged the further entry of more firms. From a small group of 30 pioneers, the number grew to 500 and bloated to almost a thousand collectors in 1992. In the mid 1990s, operators, exporters and traders owned by Manila-based Chinese businessmen

associated with Hong Kong-based traders and restaurants, which then made up the web of major players of the industry.

Undoubtedly, the enormous financial returns in the early years of the industry motivated fishermen to shift their concentration to the catching reef-fish live. The higher price for live fish was the most significant incentive in the emergence industry. The price in 1992 of a kilo of a good size (0.5 to 1 kilo) grouper or '*suno*' sold to the exporters was just PhP50.00. By the late 1990s, a good-sized grouper could be sold for as much as PhP300.00 per kilo.

The LRFF Industry in 2002

Today, the LRFFI in the Calamianes is characterized by dynamic arrangements between and among fishers, traders and exporters (**Figure 1.2**). The main transactions take place in the town of Coron, which is the central trading site for all live reef fishes because of its proximity to the islands and other towns and the presence of an airport for easy and fast transport of the product to Manila.

The major players in the LRFFI in the Calamianes are the fishermen, traders/middlemen, boat owners/operators, financiers (*amo*), and exporters. There are about 1000 fishermen-collectors of live reef fish scattered in the small islands in Calamianes although other estimates put the number much higher. Up to three middlemen stay in these islands providing *banca* or engine to fishermen who usually pay on installment with no interest in exchange for a marketing agreement. The fishermen take their catch to the middleman and sell it at the prevailing price. When catch is low, or during lean periods the middlemen provide for the basic necessities and other household needs, also on credit. Payments – partial or full, depending on the amount - are made in the subsequent fishing expeditions until the debt is fully paid. As conditions become dire, the more indebted the fishermen become. This situation often leave them in debt all year round and subsequently fully dependent on income from LRFFI to pay off debts.

There are no papers or legal instruments governing middleman-fisherman arrangements, but trust is strictly observed. A fisherman who loses the trust of the middleman often finds himself divested of everything he has been provided with, including the boat, engine and other fishing equipment. Some studies have noted that in informal lending agreements, the absence of binding commitments between the lender and the borrower accounts for the excessive interest rates. This is due to the high risks involved in unsecured lending such as those between the traders and fishermen.

The price of live reef fish in the islands is usually lower by PhP100 than the price in Coron town center. A small number of financially independent fishermen bypass the middlemen by traveling all the way to Coron to get a higher price. The price varies depending on the species and the classification of fish. *Plectropomus leopardus* or coral trout is the most popular based on exporters' requirements and therefore fetches the highest price. A coral trout with a *good size* classification - .5 to 1kg – gets the prevailing maximum rate which can go over PhP2000 around the Chinese New Year and other

special events. The *undersized* fish - .4 kg and below – gets the lowest price while that for *oversized* fish is pegged at prevailing maximum and no additional value is assessed for weights exceeding 1 kg. Regardless of the size and the species, the amount drastically drops to 10 per cent of the prevailing price when imperfections such as slight discoloration or damage on the scales are observed.

Island-based middlemen immediately transport the live fish to buying stations associated with their financiers or *amo,* to minimize rejects and mortalities that result from long period of stocking or poor handling. The *amo* are based in Coron and financethe operation of middlemen in the islands. They maintain fish cages for growing juvenile fishes purchased at PhP20/pc, which are sold to buying stations when desired weight/size is reached.

While the arrangements are not clear, the *amo* reportedly gets PhP100 from the buying station for every fish regardless of size. The links between the *amo* and the buying stations are not exclusive. The *amo* can go to, and strike deals with, other buying stations in search of better deals.

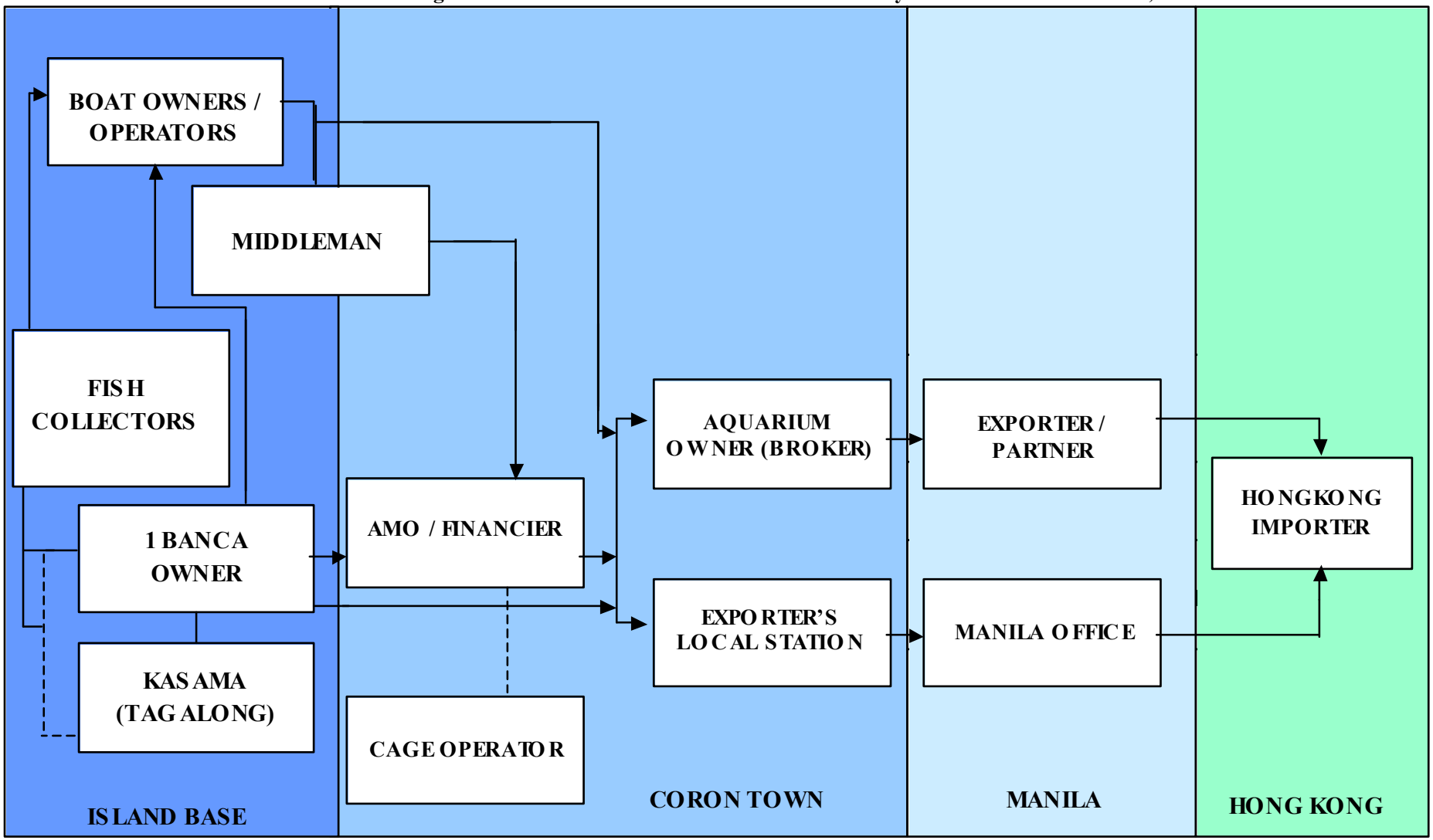
There are five exporters and buying stations located in the Coron area – Sea Dragon, Kenneth Aquamarine, Great Ocean, Yuki Aquamarine, and Kos Aquamarine. Of the five buying stations, three are local offices of exporters based in Manila – Sea Dragon, Great Ocean and Kenneth. The other two, Yuki Aquamarine and Kos, are brokers for Manila-based exporters. Among them, Sea Dragon has managed to firmly establish a stronghold in Coron by striking a partnership with one of the bigger *amos,* who are both politically and economically influential. The residents of Coron acknowledge this person as the most influential player in the LRFFI given his present economic status and his wide network of contacts. The partnership seems to work for Sea Dragon as it has managed to register the highest volume of live reef fish transported from Coron based on the PCSDS records.

Traders transport live fish to Manila in oxygenated plastic bags and loaded on styropor boxes. Two hours before airlifting, the fish is induced to sleep by letting it stay in cold water to minimize movements during the travel and to assure that it arrives Manila in good condition. The local government charges PhP0.50 per kg on gross weight. The cost of airfreight is fixed at PhP18,000 for 23 boxes and PhP36,000 for 43 boxes, depending on the capacity of the plane.

Major Exporters of Live Food Fish

The four major export firms based in Manila registered as fully owned by Philippine nationals, at least on paper, are the three names mentioned in the previous section and Furdelon Seafood Products. On the average, the firms have been in the LRFFI for at least 7 years while they have been in the export of other marine products for at least 9 years. All firms are also into the export of other marine products, which may include lobsters, sea/sand/mud crabs, eel, and tropical aquarium fishes.

Figure 1.2. The Live Reef-Fish for Food Industry In Calamianes Islands, Palawan



The exporters (except Furdelon) operate buying stations at different parts of the country. Some of the areas include Cuyo Islands and Taytay in Palawan, Surigao, Tacloban, Samar and Albay. Marketing arrangements vary depending on local conditions or situation. The immediate destination of the exported fish is the Hong Kong market.

In the Calamianes Islands, two of the four exporters forged tie-ups with established local buyers to ensure their supply of LRFF. For instance, the local buyer sells LRFF exclusively to an exporter. The arrangements can also include sharing on operating costs or the exporter solely takes care of the operating costs. The remaining two firms with their own established facilities in the area buy directly from middlemen, fishers, or people who directly sell their LRFF to the buyer or exporter of their choice.

In terms of forward marketing channels, three of the four firms sell their LRFF to their respective importers from Hong Kong while one firm deals with three different importers to spread the risks and possibly obtain better prices.All firms are self-financed. Capitalization ranges from PhP1.5 to PhP9 million pesos. The disparity is attributed to the scale of operations measured by the number of buying stations in the source islands. Three of the four exporters also maintain stations in different areas of the Philippines where LRFF is being conducted. The operating costs of exporters are difficult to estimate. However, transport costs are easily verifiable. Airfreight from Manila to Hong Kong ranges from US$0.60 – 0.70 per kilogram (gross weight). Exporters must secure export commodity clearance, export declaration, and an export permit. Insurance, referred as Security Service Charge, and an Airway Bill Fee are also paid for each export transaction. Taxes are not assessed for the live fish exports.

Part II
Ecological Sustainability Assessment[3]

1. Introduction

The live reef food fish trade in the Calamianes Islands in northern Palawan, Philippines is the focus of this ecological assessment. The assessment aims to identify attributes (variables and indicators) in the biology and ecology of the trade in the area and carry out analysis to determine the status and conditions of the traded commodity (live fish stocks) as well as their ecological habitats.

In particular, the ecological assessment integrates into the SA, the physical and biological elements of the trade. It specifically identifies key attributes of the bio-physical elements and examines them through systematic and scientific approach. Ecological assessment eventually provides the findings to allow synthesis of the trade's impacts on the bio-physical elements and how these relate to and strike a balance among other essential elements of the trade such as the economic and social aspects.

2. Variables and Indicators of Ecological Impacts

Ecological sustainability assessment utilizes bio-physical attributes of an ecosystem to characterize the conditions of an ecological resource in the context of sustainable fishery. Maximum sustainable yield (MSY) is one important concept for this assessment because it presents a measure of the critical level of fishery harvest and the ecological consequences of exceeding that level (i.e. carrying capacity). Another key element of sustainability assessment is the establishment of the ecological impacts on the ecosystem by anthropogenic (e.g, cyanide- fishing) and natural causes (e.g., algal dominance) driven by the economic dynamics of the resource.

Ecological sustainability assessment of the LRFFI in the Calamianes involves two broad sets of indicators. First is the fishery resource aspect in the trade. This fishery resource will be identified and assessed qualitatively (for example, biology) and quantitatively (such as stock assessment) to show the status and dynamics of the resource as influenced by the trade. Second is the resource habitat. The condition and the amount of the impacted reef habitats of the resource will be illustrated and any negative impacts by the trade on these features will be highlighted. The ecological assessment component, therefore, will provide the general overview of the fishery resource dynamics (such as economic, growth, recruitment, ecosystem and "Malthusian" overfishing) (Russ 1991) and the ecological consequences on the resource habitats (Saila et al. 1993, Roberts 1995, Mous et al. 2000).

The variables identified in this assessment are over-fishing (Pauly 1984) and habitat-degradation mainly through cyanide-fishing (Barber and Pratt 1997).

[3] This section is written by S. Mamauag

2.1 Indicators of Over-fishing

Fisheries worldwide have been heavily exploited (Pauly et al. 1998). Fisheries will collapse if unabated over-exploitation continues. The LRFFI in Coron is no exception as present levels of live fish catch suggest over-exploitation (Mamauag et al. 2002). Over-fishing is further elucidated in several forms, namely, economic, growth, recruitment, ecosystem and "Malthusian" over-fishing (Russ 1991). Economic over-fishing occurs when cost of fishing (effort) exceeds that of the yield (catch). Growth over-fishing is represented by the reduction of mean body size and faster growth rate for a certain age of fish due to intense fishing. Fisheries approach recruitment over-fishing when fishing pressure on fish populations is so high that it diminishes potential recruitment of larvae due to severe reduction of moderate to large-sized sexually mature fish affecting reproductive output. Further increase in exploitation levels results to ecosystem over-fishing when depletion of target species leads to changes in fish assemblages (Russ and Alcala 1989) and its subsequent effect ("cascading" effect) on the reef community structure as a whole (Roberts 1995). Finally, the fishery results to "Malthusian" over-fishing when fishermen resort to destructive fishing practices (such as blast-fishing or cyanide-fishing) to compete for fish catch and/or earn profits amidst declining stocks.

Preliminary assessment revealed that most of the targeted coral reef fish in the LRFFI in the Philippines are groupers (*lapu-lapu*) (Family Serranidae) (Pratt et al. 2000). Groupers worldwide are highly susceptible to over-fishing due to their slow growth, maximum longevity and low rates of natural mortality (Ralston 1987), moderate-scale migration (Zellar 1998), spawning aggregation behavior (Shapiro 1987, Samoilys 1997), and sequential hermaphroditism (Shapiro 1987, Sadovy 1994).

a. Catch and fishing effort

Long time-series data (over several years) on fishery catch and effort can be used to examine any trend in catch or catch rates (such as declining stocks or catch per unit effort, CPUE) (Pauly 1984, Russ 1991), which can initially address the issue of economic over-fishing. Catch data include species composition and their total weights (in kilograms or tonnes) while effort data are number of fishermen, number of fishing vessels, types of fishing gear used, fishing duration (such as hours or days) and area of fishing. However, collection of CPUE data is not an easy task. Problems often arise such as absence of data in some months and years, difficulty of data collection up to the level of species (multi-species fishery), variation in the type of fishing vessel or gear used among areas, spatial variation of fishing grounds, differences of catch data from the landing and collection sites, and unreported catch data (Russ 1991). Nonetheless, some studies have assessed fisheries using catch and effort data. Alcala and Russ (1990) reported a significant decrease of CPUE (from 1.98 kg man^{-1} $trip^{-1}$ to 0.99 kg man^{-1} $trip^{-1}$), after protective management of a coral reef marine reserve in Sumilon Island, Philippines, broke down.

b. Travel distance and duration of fishing

Any increase or expansion in the distance of travel by fishermen to fishing grounds indicates that stocks may be declining (Sullivan et al year). As a consequence, an increase of time of fishing also occurs.

c. Maximum Sustainable Yield (MSY) and Yield-Per-Recruit (YPR)

Knowledge of MSY primarily ascertains the status of the fishery whether present fishing levels are sustainable or not. MSY can be determined from catch and effort data. In the absence of these types of data due to the limitations enumerated above, a different approach to gain an idea of a sustainable yield (though not exactly an estimate of MSY) and also provide exploitation status is the Yield-Per-Recruit procedure. YPR estimates the yield that would be obtained from a given number of recruits (late fish larval stage about to settle or enter the adult habitat) and a given fishing regime. An estimate of yield based on catch and effort data can be generated by using the Surplus-Production model of Schaefer (in Pauly 1984) while the YPR model of Beverton and Holt (1957) and Thompson and Bell (1934) uses fish size- and age-based growth parameters to predict yield estimates. Gayanilo and Pauly (1997) created a computer programme FISAT (FAO-ICLARM Stock Assessment Tool) to perform fish stock analysis, which includes estimation of yields in various models. If collection of primary data is not possible secondary data could be used for analysis of which results are dependent on some limitations discussed above.

d. Variation in species composition in the fishery

Any change in the species composition in the fishery will suggest a shift of target species due to depletion of the dominant species in the fishery (Russ 1991). This has cascading effects on the reef community structure, which may adversely affect the stability of the community (Roberts 1995).

e. Fish population growth rate and reduced mean size

Information on fish growth is essential to stock assessment (Brothers 1982, Longhurst and Pauly 1987). Growth of fish can be derived from size-at-age data, among others (Pauly 1984). In this study, only size-at-age or age data will be used since it is the most appropriate data to determine growth in slow-growing, long-lived species (Pauly 1984) such as the groupers (Ferreira and Russ 1994). Age of fish is determined from visible growth rings in calcified or bony structures in fish such as the otoliths or "ear bones" (Panella 1971, Brothers 1984). Validated annuli or annual rings have been observed in otoliths of most grouper species for which information is available (Ferreira and Russ 1994, Mamauag 1997). To describe growth of fish, the non-linear Von Bertalanffy Growth Function, $L_t = L_\infty (1\text{-}e^{-K(t\text{-}to)})$ (Pauly 1984) will be employed.

f. Fish mortality rates

Fish mortality rates (*Z* and *M*) are established mainly with age and growth data (Pauly 1984). Total mortality, *Z*, is derived from the descending plot of the regression of the age

and the number of fish per age group or what is generally known as the age-based catch curve analysis (Beverton and Holt 1957, Chapman and Robson 1960). Natural mortality *M*, of grouper stocks can be determined from the equation of Ralston (1987): $M = 0.0189 + 2.06\ K$, which was derived from the relationship between *K* and *M* of 17 stocks of groupers and snappers (Family Lutjanidae). Fishing mortality, *F*, can simply be generated from the equation $Z = M + F$ (see Pauly 1984). Exploitation ratio or rate, *E*, of a fish stock can be estimated from the equation $E = F/Z$ (see Pauly 1984). Yield or *MSY* estimates of fish stock can be estimated from the Yield-per-Recruit model. The analysis for the Yield-per-Recruit will be done using FISAT.

g. Fish reproductive biology

High fishing pressure affects reproductive patterns of fish populations. McGovern et al. (1998) showed a reduction of size (and age) at sexual maturity (indicator) of the Atlantic grouper *Mycteroperca microlepis* after a long exposure to high levels of exploitation. In addition, sexually mature groupers aggregate to spawn (Samoilys 1997) which is induced by the behavior of the population (Ferreira 1995). Groupers were also reported to show high fidelity on previously selected aggregation sites (Samoilys 1997, Zellar 1998). However, previous reports on spawning aggregation sites revealed over-exploitation in some grouper species (Colin 1992, Beets and Friedlander 1998) as the fidelity of fish to these sites increases their vulnerability to over-exploitation through fishing.

Reduced size at sexual maturity can be determined based on the size, age and reproduction data of fish in a population (stock). Data on reproduction include sex and sexual transition and gonad development status (for example, female and male immature, maturing, ripening, ripe, spawning, spent and resting gonads), which are ascertained from histological sections. Data on these aspects will be gathered from a previous study on the reproduction of *P. leopardus* collected from Calamianes Islands (Mamauag 1997).

2.2 Indicators of Cyanide-fishing

It has been reported that sodium cyanide has been used to collect live fish since the establishment of the LRFFI in the Philippines (Barber and Pratt 1997). Cyanide is a poisonous substance which specifically impairs respiratory and photosynthetic activities in organisms (Jones and Hoegh-Guldberg 1999) and smaller concentrations of which can stun fish for easier capture and handling during transit and keep fish alive before it is consumed (Bentley 1998). It has been reported also that cyanide-collectors use crowbars to rip reef features apart to collect stunned fish. Hook-and-line is the traditional fishing gear to collect live fish yet some fishermen have been observed to resort to cyanide-fishing due to minimal fishing effort with high catches (Robinson 1996, Bentley 1998). Increasing demand in the fishery resource drives escalating supply levels and may lead to over-exploitation of stocks if harvest exceeds MSY (Pauly 1984).

Equally important, the ecological risk to reef habitats from the reported use of cyanide in the LRFFI is high. Loss of, or changes in, habitats may affect the community structure on coral reefs and subsequently altering fish groupings (Saila et al. 1993). In addition,

target and non-target fish species as well as invertebrates are also either damaged or killed by cyanide exposure (Hall and Bellwood 1995, Barber and Pratt 1997, Lind et al. 1977, Burke et al. 2002).

a. Coral bleaching and its spatial extent of damage

Anecdotal reports contend that patches of coral colonies have been adversely affected by exposure to cyanide from cyanide fishing (Barber and Pratt 1997). In laboratory experiments, Jones and Stevens (1997) and Jones and Hoegh-Guldberg (1999) found substantial evidence of coral bleaching due to cyanide exposure. Loss of the symbiotic algae (*zooxanthellae*) was observed from experimental coral colonies due to impairment in their respiration and photosynthesis. Subsequent dissociation in the coral-algal symbiosis led to discoloration or "bleaching" in the affected corals.

Bleaching of coral reefs, however, can be attributed to a range of factors including climate change (Wilkinson 1998), sedimentation and pollution (Burke et al. 2002), and predation by starfish *Acanthaster planci* (Wilkinson 2000) and other sea urchin species which affect the complexity of reef substrates (Carpenter 1986). Some studies have singled out the effect of cyanide on impacted reefs. Studies in Indonesia, for example, have demonstrated minimal effect (Erdmann and Pet-Soede 1996, Pet and Pet-Soede 1999, Mous et al. 2000).

Although bleaching is not necessarily an indicator of reef degradation exclusively brought about by cyanide fishing, these studies have provided insights on the approaches and mechanisms to understand the many variables in cyanide-impacted areas. Mous et al. (2000) closely monitored cyanide fishers at Supermonde Archipelago and Komodo National Park in Indonesia to determine estimates of reef degradation (in %-points loss per year). The estimate was based on the area of reef destroyed (1 m^2) per fish caught with cyanide. This was multiplied with an estimate for the total number of fish caught with cyanide per square kilometer per year. The estimate for the total number of fish caught per year was based on three independent variables: production and yield of fish, fishing effort and CPUE, and volume of fish in the LRFFI of Indonesia. For the yield variable the estimate used was based on average yield of groupers in other coral reefs, which was 1000 kg/km^2 per year (Russ 1991, Jennings and Polunin 1995). The calculated amount of area (in square kilometres) in each independent variable was then divided by the total surface area of coral cover to express percent cover change (%-points loss).

b. An estimate of damage in coral cover

It is possible to study signs of the impact of destructive fishing (such as cyanide) on the health of coral reef areas. Sampling sites can be identified based on prior knowledge of the frequency of cyanide use by fishers. This information can be generated from a questionnaire/survey on the fishing community's perception of cyanide-use or from secondary data or literature. Underwater surveys by SCUBA can be carried out in these areas. In particular, line intercept transects (LIT) (English et al. 1994) can determine benthos cover on cyanide-impacted areas. Variation in the percentage of coral cover

(such as live coral, dead coral, dead coral with algae) (English et al. 1994) among selected sites can also be assessed.

3. Methodologies for Estimating Indicators

This study has undertaken an ecological assessment of the LRFFI in Calamianes. Initial steps involved a compilation of related literature and past information on fisheries and coral reef conservation initiatives in Calamianes.

Over-fishing

Fishery data of the LRFFI in the Calamianes (major fish landing site) such as species composition, fish production in the form of catch landings in kilogram weight, date and area of collection, fishing gear used, and age and reproduction data were gathered from the database of IMA-Philippines. Until recently, IMA has been monitoring the fishery of the live fish caught in the LRFFI. In particular, IMA research has been more focused on determining and generating age data of the dominant grouper species in the LRFFI, the coralgrouper *Plectropomus leopardus* (Figure 2.1), collected from several areas in the Philippines including the Calamianes in which Coron is the major "landing site" of live fish. These size-at-age data were used for stock assessment purposes.

Fig. 2.1. The coralgrouper, *Plectropomus leopardus*, the most dominant species in the LRFFI in the Calamianes Islands. (Source: Pratt et al. 2000).

To gather information on the socio-economic and bio-physical attributes of the LRFFI, a rapid assessment was conducted by the reasearch team in the Calamianes Islands between 9 and 20 April 2002, using a survey questionnaires. For the bio-physical component, information on species composition, fish production, catch per unit effort per species, location of fishing habitats, fishing gears used, destructive fishing practices and grouper spawning aggregations were asked in the questionnaires. Questions pertaining to the fishers' perception on the difference of various indicators such as diminishing catch, declining income, increasing distance and time spent in fishing, within the past five years

were also emphasized. The survey sampled 120 respondents from three major areas in the Calamianes Islands,--Coron, Linapacan and Nangalao– where LRFFI is the major source of livelihood. The sampling protocol for the survey is discussed at length in the socio-political and economic sections of this SA.

Additional fishery data were collected from the Municipal Agricultural Office of Coron, from the Palawan Council for Sustainable Development (PCSD-Coron), and from the Bureau of Fisheries and Aquatic Resources (BFAR) office in Coron. Pertinent data were also collected from the Conservation International (CI), which has produced substantial reports regarding environmental management and conservation issues in Coron.

To determine the fishery status of the live fish caught in the LRFFI on a temporal scale (temporal variation) stock analysis was undertaken, based primarily on the FAO-ICLARM Stock Assessment Tool (FISAT; Gayanilo and Pauly 1996). Virtually no secondary data of long time-series of catch and effort were available, owing to the difficulty in collecting and monitoring these types of data in the LRFFI. An estimate of CPUE was derived from the information gathered from the survey questionnaires.

In the absence of catch and effort data, yield (per recruit) was estimated from size-at-age data of a dominant grouper species in the LRFFI (*P. leopardus*) using the "knife-edge selection" of the Yield-Per-Recruit Analysis (Relative YPR) in FISAT. The Biomass-Per-Recruit Analysis (Relative BPR), as well, was also determined. Growth rate parameters (K, L_∞, t_o, L_c) were derived using the generalized form of the Von Bertalanffy Growth Function (VBGF) in FISAT. Total mortality, Z, was calculated using the age-based catch curve analysis (Beverton and Holt 1957, Chapman and Robson 1960). Natural mortality, M, was estimated employing Ralston (1987) mortality equation: $M = 0.0189 + 2.06\ K$). Fishing mortality, F, was computed from the equation $Z = M + F$. The Exploitation rate, E, ($E = F/Z$) for *P. leopardus* was also determined. E_{max} (exploitation level which maximizes yield per recruit), $E_{0.5}$ (exploitation level which will result in a reduction of the unexploited biomass by 50%) and $E_{0.1}$ (level of exploitation at which the marginal increase in yield per recruit reaches 1/10 of the marginal increase computed at a very low value of E) were all provided in the YPR analysis of FISAT.

Secondary data on *P. leopardus* reproductive biology were used to determine sequential hermaphroditism for the species, size (and/or age) at first reproduction and at sex transition, and, finally, spawning periodicity (gonado-somatic index; Shapiro 1987) to corroborate timing of spawning aggregations. Some of these data were derived from Mamauag (1997) and some were gathered from the IMA database.

Cyanide-fishing

Estimates of reef degradation (indexed as %-points loss in live coral cover) due to cyanide fishing were determined following Mous et al. (2000). An important assumption for this estimate is that a square-meter of coral reef area is destroyed for every one live fish (*P. leopardus*) collected by cyanide fishing and the total impacted area is the product of the total number of fish caught by cyanide per square kilometer per year multiplied by

1 square meter. The total number of fish caught with cyanide per unit area per unit time was derived from a) potential production and yield of live fish (e.g., *P. leopardus*), b) fishing effort and CPUE (if available) and c) volume of the trade (for *P. leopardus* only). The computed value of each variable was then divided by the total surface area of coral cover and expressed as the percentage loss in live coral cover. The estimate of total coral cover in the Calamianes reef areas was gathered from secondary data.

In order to correlate cyanide exposure to coral bleaching in the Calamianes reefs, it was important to identify and consider a range of intervening variables that might contribute to the "bleaching" process. Site selection was crucial for this assessment. Results from the survey on the perception of the respondents with regard to the frequency of cyanide fishing per area were assessed. Informal interviews were conducted with former cyanide-users with an emphasis on the specific sites they had visited more than once. Secondary data and literature on cyanide fishing in Coron (such as those from Conservation International) were also examined in conjunction with the survey results. Based on these criteria, three major sites in the Calamianes Islands group were identified: Tempel reefs, Cabugao reefs and Siete Pecados Island. (Figure 1.1)

The first site, Tampel reefs, is about xxx miles from the coastal town of Coron but relatively close to the municipality of Culion. This site has been purportedly visited by cyanide-users because it is relatively far from any inhabited town or baranggay in the Calamianes with anti-cyanide monitoring enforcement groups (such as the Philippine National Police-Maritime Police). The second major site is Cabugao reefs. These reefs have been impacted by cyanide. They lie approximately xxx miles from Coron and are located at the eastern side of the sparsely inhabited Coron Island. The third major site selected, Siete Pecados Island, is a pristine site which has informally been designated as a protected area by diving shops in Coron to boost local diving tourism. This informal designation means that no destructive fishing practices are allowed and only minimal fishing activity. Siete Pecados Island is located less than a mile from Coron and a small fishing village is found nearby. This relatively pristine area was included in the sampling for comparative purposes.

Manta tows were carried out at the outset of each sampling to reconnoiter the selected site (English et al. 1994). Two replicate 50-meter transects was made at each site, except for Cabugao reefs which was sampled with only one transect (N = 5). Line-Intercept Transect technique was performed in all replicate transects. Life-form attributes such as live coral, dead coral, algae, abiotic and others, were assessed and taken into account in percentages during each underwater census of a transect.

Sampling was also tried to eliminate other factors that may obscure the effect of cyanide on impacted areas. Although 2002 has been identified as an El Nino year (PAG-ASA), recent trends in the climate suggest that the force of the present El Nino may not be as strong as those in 1982-83 or 1997-98. It is hoped that the proposed sampling period in 2002 may eliminate any interveneing effect of climate change on bleaching of coral reefs. Selection of sites for sampling also took into account sedimentation and pollution factors. The sites were located with no significant source of sediment and pollution loading (both

from adjacent and distant sources). In terms of the predatory effect of *Acanthaster planci*, the major sites selected were known to have very low abundance of the crown-of-thorns.

4. Results and Discussion

4.1 Overfishing

a. Catch trends

Catch of fish for the LRFFI in the Calamianes Islands, has decreased. Figure 2.2 shows the trend in catch (in kilogram weight) between 1994 and 2001. Catch data from 1994 to 1996 appear to be relatively low compared with later years. There was no record of any data in 1997. Catch levels peaked in 1998 and having been dropping off since then. The differences in the magnitude of volume of data were attributed to the variation of data sources and their sampling strategies. Data from 1994 to 1999 were collected by IMA but sampling was more intensified in 1998 and 1999. Data from 2000 and 2001 were collected from PCSD.

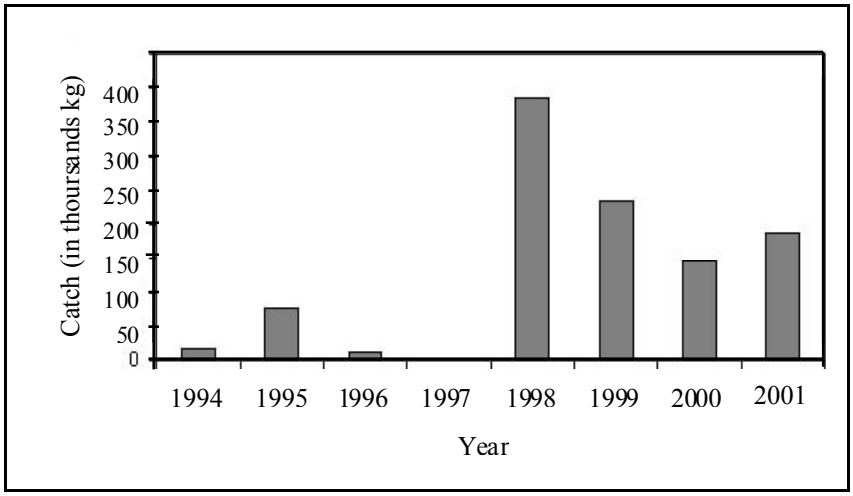


Fig. 2.2. Catch of live fish in kilogram weight in the Calamianes Islands from 1994 to 2001. (Source: PCSD and IMA).

The LRFFI in Calamianes started in the mid 1980s but data was scarce prior to 1994. Despite the differences, the decreasing trend in the catch was consistent with the trend of the export of live fish collected from several areas in the Philippines (Figure 2.3). Data was collected independently by the Fisheries Quarantine Service-BFAR (1999). There was a high of almost 4000 mt in 1995 but gradually declined to 1500 mt in 1999. No data was collected after 1999. These trends reflect the initial effect of over-exploitation on fishery stocks. Russ (1991) has described the effect of high fishing pressure on the abundance of a species or a stock and has suggested that its subsequent reduction is a direct effect of such pressure.

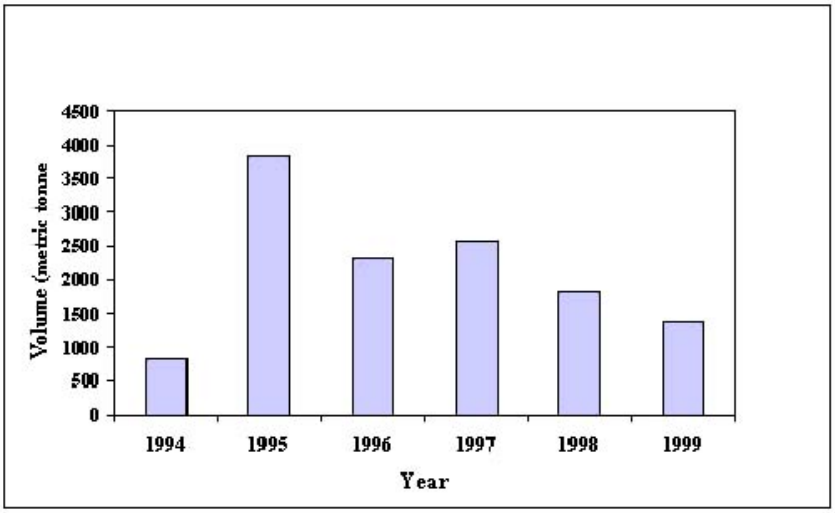


Fig. 2.3. Volume of live fish in the Philippines exported from 1994 to 1999. (Source: BFAR-Fisheries Quarantine Service).

b. Catch per unit effort (CPUE)

No data on fishing effort in the LRFFI were available. This is probably due to the difficulty in monitoring live fish collectors around the large expanse of the Calamianes reefs, a lack of initiatives on the part of the concerned local government agencies to require fishers to collect fishing effort data, and cyanide-fishing which has never been totally eradicated, remains a clandestine and undocumented activity. Long time-series data (i.e. years) of fishing effort could provide information such as status of fisheries and yield estimates in light of achieving sustainability, to improve management

An estimate of the mean catch per unit effort (CPUE) in the LRFFI, of which hook-and-line was the most commonly-used, is shown in Table 2.1. This estimate is based on the knowledge of fishers of several attributes of fishing effort (such as number of boats, fishers per boat, fishing hours per day or year, and fishing gears used) and amount of catch per unit time (day/month/year) derived from the survey. The mean CPUE (1.52 kg man^{-1} hr^{-1}), although generated through an indirect and less systematic approximation, provides an initial CPUE value for the LRFFI and was observed to be relatively high. Russ et al. (1998) gave CPUE estimates for *P. leopardus* in the Great Barrier Reef (GBR), Australia, which ranged from 0.41 to 0.89 fish man^{-1} hr^{-1} mainly using hook-and-line. If initial CPUE for the LRFFI were converted into number of fish instead of total weight (number of fish = total number of kilograms/mean individual body weight, 0.8 kg) then mean CPUE in the LRFFI (1.90 fish man^{-1} hr^{-1}) (Table 2.1) is indeed higher than those in the GBR.

Table 2.1. Catch-per-unit effort of the LRFFI in the Calamianes based on the survey

Area	# of boats w/ 2 fishers	# of kg	# of fish	# of hrs	CPUE kg/man hr	CPUE fish/man hr

Canipo	20	1458.00	1822.50	98	0.7439	0.9298
Coron	2	57.50	71.88	12	2.3958	2.9948
Delian	28	1338.00	1672.50	121	0.3949	0.4937
Nangalao	142	6590.00	8237.50	611	0.0760	0.0949
Panlaitan	42	2129.00	2661.25	193	0.2626	0.3283
Poblacion	2	62.00	77.50	8	3.8750	4.8438
Bgy 1	4	337.00	421.25	29	2.9052	3.6315
mean					1.5219	1.9024

This does not necessarily mean, however, that there is higher yield and biomass of *P. leopardus* in the Philippines than in Australia. In fact, the opposite is true, and this suggests that there are less unexploited reefs in the Philippines than in the GBR. The other possible reason for this is that Philippine reefs such as in the Calamianes Islands are under severe fishing pressure while most reefs in the GBR ranged from lightly- to moderately fished (Russ 1991). The high CPUE estimate for the LRFFI also raises the possibility that cyanide-fishing plays a major role due to its potential to yield high catches with minimal fishing effort.

c. Fishing travel distance and duration

Results of the survey indicate that a large proportion of respondents (78 per cent) believe that desired fishing areas are farther away in 2002 than they were five years ago (Figure 2.4a). This suggests that stocks in the Calamianes reefs for the LRFFI have been declining due to high fishing pressure and fishermen, trying to meet the increasing demand of the trade, are traveling farther distances to unexploited areas. Associated with increase in distance is an increase in the duration of over-all fishing activity. Many respondents (58 per cent) believed that it now takes longer to reach areas with fish than it did five years ago. This indicates a drop in the abundance of stocks in areas where they used to fish (Figure 2.4b).

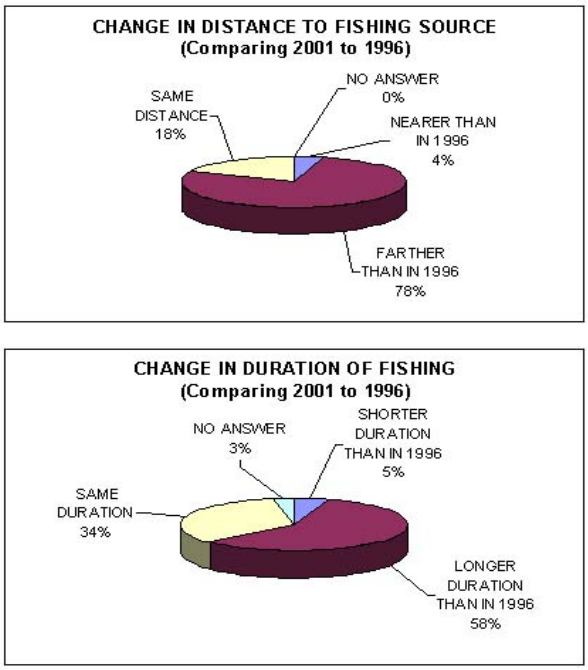


Fig. 2.4. Perception of survey respondents on the difference of fishing (a) travel distance and (b) duration between 2001 and 1996 (from survey data).

d. Species composition and dominant species in the LRFFI in Calamianes

The coralgrouper *Plectropomus leopardus*, was observed to be the most dominant species in the fishery with some close relatives with less than considerable catches (Pratt et al. 2000). Table 2.2 provides a list of species in the LRFFI over the entire Philippines. Species caught in the Calamianes Islands are particularly noted. Owing to the dominance of *P. leopardus*, it appears that the LRFFI in the Calamianes may be a single species fishery.

Examination of catch data from the IMA database indicates that the majority of the catch at any time is of *P. leopardus*. Although some closely associated species (particularly the Napoleon wrasse *Cheilinus undulatus*) were observed in the catch landings, their almost consistent absence in the catch and low abundance did not allow analysis such as those of *P. leopardus*. It was, therefore, not possible to detect any changes in species composition in the fishery. Unlike in some areas of the LRFFI in the Philippines, such as Guiuan for example, a number of species of coral reef fish were as abundant as *P. leopardus*, including *P. areolatus*, *Epinephelus fuscoguttatus* and *E. polyphekadion*. The monitoring of the LRFFI in Guiuan, however, was discontinued by IMA due to logistical problems. Resumption of monitoring LRFFI in the Philippines and addressing research gaps such as variation in species composition can provide insights on effects on the community structure of reef systems where populations of apex predators like *P. leopardus* are depleted by exploitation.

Table 2.2. List of species collected in the live reef fish food industry in the Philippines (Pratt et al. 2000)

Species	Common name
Family Serranidae	
Plectropomus leopardus ¶	Leopard coral trout
Plectropomus areolatus ¶	Squaretail coral trout
Plectropomus maculatus ¶	Spotted coral trout
Plectropomus laevis ¶	Blacksaddled coral trout
Plectropomus oligacanthus ¶	Highfin coral trout
Epinephelus bleekeri *	Duskytail grouper
Epinephelus coioides *¶	Orange-spotted grouper
Epinephelus malabaricus *	Malabar grouper
Epinephelus fuscoguttatus ¶	Brown-marbled grouper
Epinephelus polyphekadion	Camouflage grouper
Epinephelus fasciatus	Blacktip grouper
Epinephelus lanceolatus	Giant grouper
Epinephelus ongus	White-streaked grouper
Epinephelus cyanopodus	Speckled blue grouper
Cromileptes altivelis ¶	Humpback grouper
Cephalopholis miniata	Coral hind
Anyperodon leucogrammicus	Slender grouper
Family Labridae	
Cheilinus undulates ¶	Napoleon humphead wrasse
Family Scaridae	
Scarus sp.	Parrotfish
Family Lutjanidae	
Lutjanus sebae	Snapper
Family Scorpaenidae	
Synanceia sp.	Scorpionfish
Family Panuliridae	
Panulirus sp.	Lobster
Parribacus sp.	Flat Lobster

¶ Species collected in the LRFFI in the Calamianes Islands.

- Also traded as fry or fingerlings

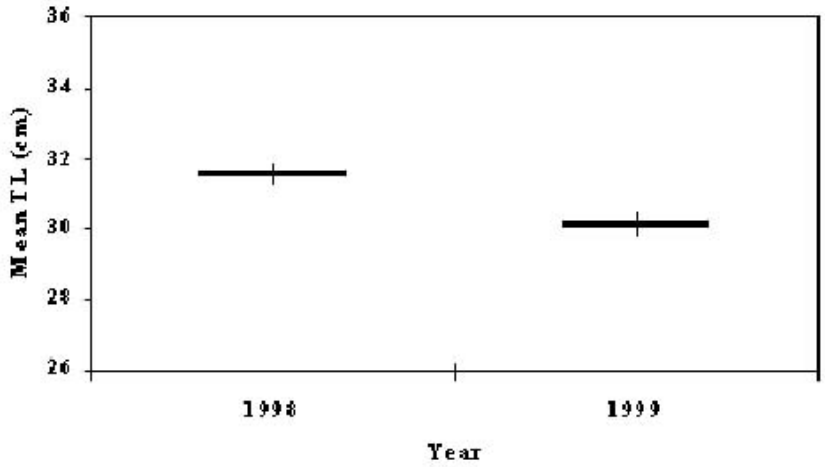


Fig. 2.5. (a) Mean size (total length in cm) of *P. leopardus* in the Calamianes in 1998 and 1999. (Source: Mamauag et al. in press).

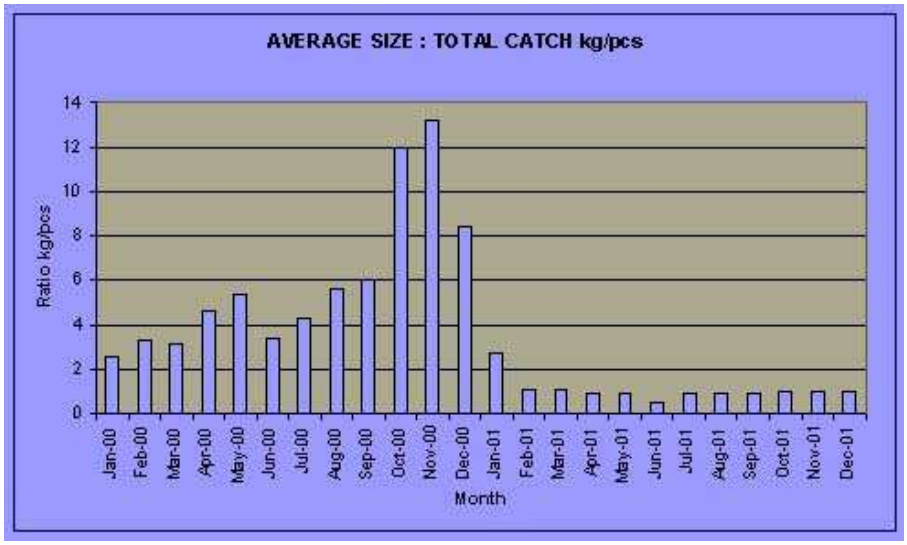


Fig. 2.6. The ratio of total catch (kg) and abundance of *P. leopardus* in Calamianes between 2000 and 2001. (Source: PCSD)

e. Reduction of mean body size

There was a reduction of mean size of *P. leopardus* in the Calamianes. Figure 2.5 shows the difference of mean size of *P. leopardus* in 1998 and 1999 while Figure 2.6 presents the decrease in the ratio of total catch (kg) and abundance of *P. leopardus* in 2000 and 2001. The reduction in mean size of the fish reflects the effect of high levels of fishing

pressure on fish populations. This elucidates a compensatory mechanism in the population whereby in response to pressure from fishing, juveniles and young adults in the population increase their growth rates to offset diminishment of larger-sized adults that are targeted selectively by fishing (size selection) (Gulland 1957).

f. Size, age and growth of P. leopardus in the Calamianes

Figure 2.7 shows the size-at-age data and the estimated growth curve for *P. leopardus* collected from the Calamianes Islands. The technique used to generate age was through otoliths otoloiths. Age was based on the periodic marks observed in the otoliths (annual rings or annuli).

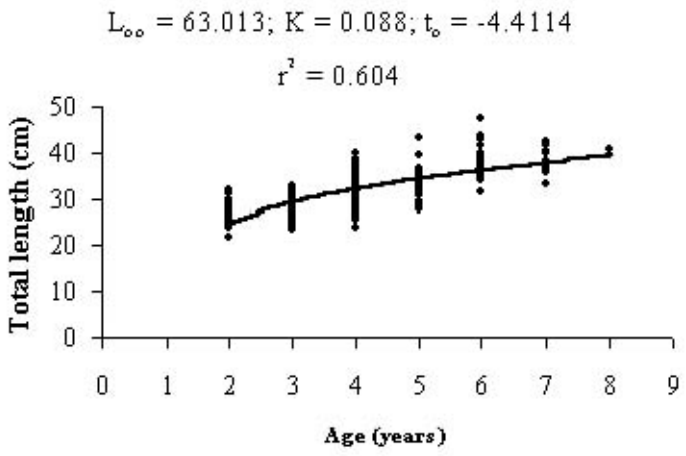


Fig. 2.7. Size-at-age data and growth curve estimate for *P. leopardus* in the Calamianes Islands. (Source: Mamauag et al. in press).

The age range of the catch was between two and eight years-old with a corresponding size range of between 24.0 and 47.0 cm total length. The growth curve which was engendered by fitting the non-linear Von Bertalanffy Growth Function into the size-at-age data provided an estimate of growth coefficient K at 0.088, length at infinity L_{∞} at 63 cm total length (this is the mean length the fish of a given stock would reach if they were to grow indefinitely or what is known as the asymptotic length) and t_0 at –4.411 (the age of fish at zero length following the growth curve). The estimated growth coefficient for *P. leopardus* in the LRFFI appear to be slower when compared with those from the Australian stocks. Ferreira and Russ (1994, 1995) reported growth rates for *P. leopardus* which ranged from 0.101 to 0.321. The growth rate for the local stocks, however, suffered from incomplete age representation. Since fishing harvested only 2 to 8 year old fish, stock analysis disregarded 0+ and 1 year-old fish which were reported to exhibit fast growth rates (Ferreira and Russ 1994) and hence K was underestimated (Mulligan and Leaman 1992). Inclusion of these fast- growing individuals in estimating growth rate of the Calamianes populations should therefore reveal a faster rate than the one detected in this study, based on the theory that size selection enhances rates of growth (Gulland

1983). Although *K* may be underestimated, this result indicates that using age data to determine growth rate for the commercially targeted *P. leopardus* in the Philippines is possible. This provides more reliable estimates than using length frequency data for stock assessment.

g. Size selection in the LRFFI in the Calamianes and its biological implications

The age and size distributions of *P. leopardus* in the catch (1998 data) were between two and eight years-old and between 24.0 and 47.0 cm total length, respectively. This indicates that there are important biological implications as it appears that the fishery has been targeting, not only the large-sized adults but the young, sexually immature to maturing individuals as well. Mamauag (1997) has provided initial data on the reproductive biology of *P. leopardus* collected from the Calamianes Islands. Figure 2.8 presents the gonadal status of various reproductive stages of female, male and transitional individuals of *P. leopardus* and Figure 2.9 is the size frequency distribution of these sexual developmental stages. Size (range) at sexual maturation or first reproduction, which is determined from the size class distribution at which 50 per cent are mature females (Ferreira 1995) was between 28-32 cm total length (Figure 2.9). If this size range is compared with the size frequency distribution of the catch in the LRFFI in the year 1998 (Figure 2.10), it is clear that the fishery has been targeting those individuals that are approaching maturity or at first reproduction. This further suggests recruitment overfishing as expounded by Russ (1991) in that the fishing pressure is so high that it greatly affects recruitment due to reduction of the abundance of spawning individuals.

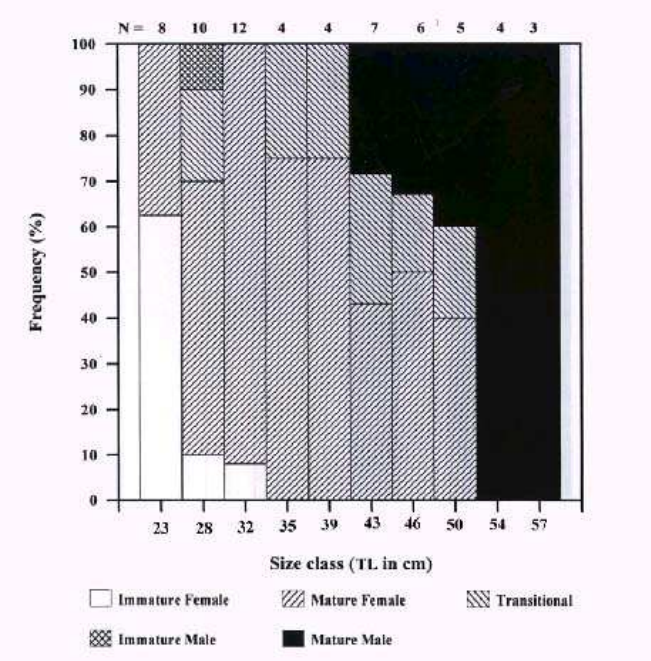


Fig. 2.8. Gonadal status of various reproductive stages of an immature female (top, left), mature female (top, right), transitional individual (bottom, left) and young male (bottom, right) of *P. leopardus*. (Source: Mamauag 1997).

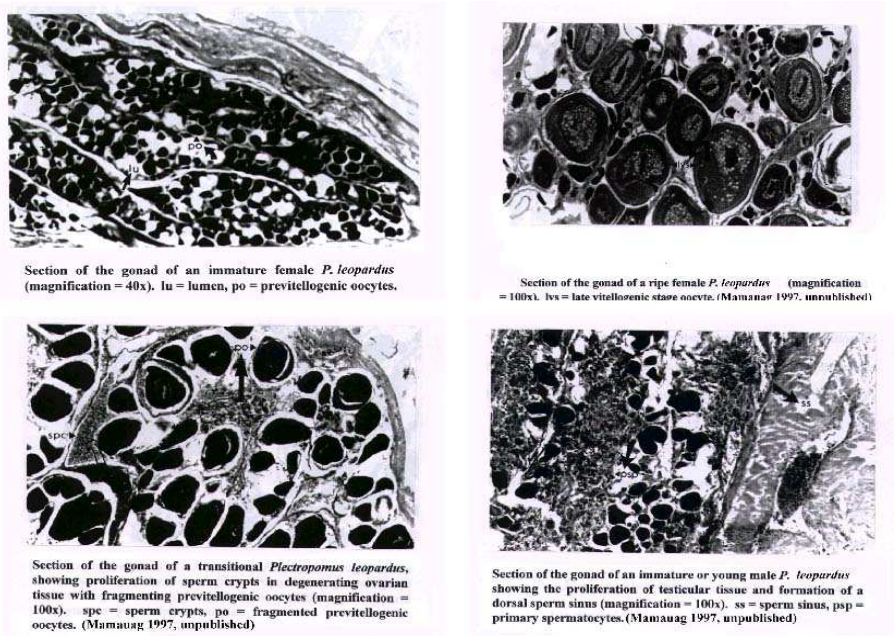


Fig. 2.9. Size frequency distribution of sexual developmental stages of *P. leopardus*. (Source: Mamauag 1997).

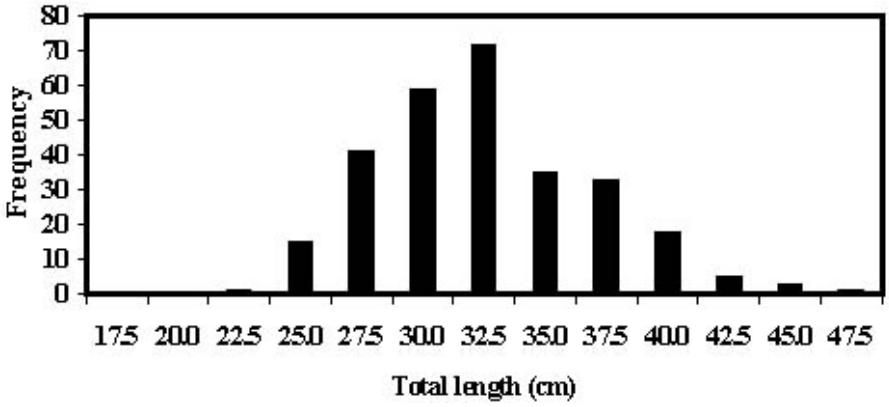


Fig. 2.10. Size frequency distribution of *P. leopardus* in the LRRFT in the Calamianes Islands in 1998. (Source: Mamauag et al. in press).

The age and size distributions of *P. leopardus* in the LRFFI are also highly influenced by the pricing dynamics. Table 2.3 shows the price of live *P. leopardus* in the LRFFI in the Calamianes Islands. It appears that price is maximum at more than 1 kilogram body weight of live fish and any additional weight does not receive any value. This prompts fishers to collect many fish with weight not exceeding 1 kg to increase profits, although this is not always the case.

In addition, it has been widely recognized that *P. leopardus* and other species of groupers for which information is available, form aggregations to spawn (Shapiro 1987, Sadovy 1994, Samoilys 1997, Zellar 1998). This phenomenon is highly influenced by the behavior in fish populations to enhance reproductive success (i.e. natural selection).
It has also been observed that aggregating fish, *P. leopardus* in particular, show high fidelity on previously selected aggregation sites (Samoilys 1997, Zellar 1998). However, reports have shown that sites of spawning aggregations have been over-fished and wiped out (for example in the Caribbean region,Bannerot et al. 1987, Beets and Friedlander 1992) as the fidelity of fish to these sites increases their vulnerability to over-exploitation through fishing.

h. Mortality and exploitation rates

Estimated mortality (*Z*, *F*, *M*) and exploitation rates of *P. leopardus* in the LRFFI are shown in Table 2.3. Rates of total mortality *Z* and, thus, fishing mortality *F* are high. Russ et al. (1998) provided mortality rates for *P. leopardus* from the Great Barrier Reef, Australia, using figures generated by previous studies and these ranged from 0.12 to 0.68 covering from the lightly-fished to moderately-fished areas. The results for the local stocks in Calamianes, however, are only preliminary due to the absence of some age classes in the population and small sample size for some age classes in the analysis, thus should be taken with caution. Nevertheless, these results should be able to provide a close approximation of mortality rates for *P. leopardus* in the Philippines.

Coral reefs in the Philippines are more exploited than those in the GBR (Munro and Williams 1987, Russ 1991), so mortality rates for *P. leopardus* in the Philippines are indeed elevated, especially for the live food fish trade where demand is always high (Barber and Pratt 1997). This led to a high estimate of exploitation rate (E), which was slightly greater than the E_{max} (Table 2.3) suggesting that stocks of *P. leopardus* in the LRFFI are over-exploited. This should pave the way to providing measures to address depletion of stocks due to unsustainable catch levels.

Table 2.3. Mortality and exploitation rates of *P. leopardus* in the LRFFI in Calamianes. (Adapted from Mamauag et al. in press)

Total Mortality, Z	0.932 (± 0.157)
Natural Mortality, M	0.200
Fishing Mortality, F	0.732
Exploitation rate, E	0.785
E_{max}	0.684
E_{10}	0.564
E_{50}	0.338

i. Relative Yield-Per-Recruit and Biomass-Per-Recruit

Estimates for the relative YPR and BPR with their corresponding exploitation rates (E) of P. leopardus in the Calamianes are provided in Table 2.4. Relative YPR was highest at 0.024 (the proportion of yield per recruit since number of recruits is not known), which was observed to be between rates of exploitation from 0.60 to 0.80. This implies that YPR for the present exploitation rate (E = 0.785) did not differ with YPR for the E_{max} (0.684). Relative BPR values, however, decreased at that range of E, indicating that despite the similarities in yield per recruit, there was reduction of fish biomass as exploitation levels increased.

Table 2.4. Exploitation levels with their corresponding relative yield-per-recruit and biomass-per-recruit values of *P. leopardus* in Calamianes, using the FISAT software

E	Y/R	B/R
0.10	0.007	0.836
0.20	0.012	0.686
0.30	0.017	0.548
0.40	0.020	0.425
0.50	0.023	0.317
0.60	0.024	0.224
0.70	0.024	0.146
0.80	0.024	0.083
0.90	0.023	0.035
0.99	0.021	0.003

j. Cyanide-fishing

An estimate of reef degradation due to cyanide exposure

Table 2.5 presents the sensitivity analysis for values estimated as degraded reefs due to cyanide-fishing. Following Mous et al. (2000), only two independent variables were used in the estimation (based on yield and volume). There was no information on the unit of fishing effort in cyanide-fishing (e.g., number of bottle or amount of cyanide) available to allow estimation of reef degradation. Both variables provided best estimates which ranged from 0.094 to 0.11%-points loss yr^{-1}, which were small hence, less significant.

Table 5. Results of the sensitivity analysis for the estimation of reef degradation in the Calamianes Islands, expressed as loss of live coral cover in %-points per year, caused by the LRFFT.

	best	conservative	worst case
area of live coral cover lost per fish caught (m^2)	1	0.3	3
Variable			
yield (kg km^{-2} yr^{-1})	750	563	1000
mean weight (kg)	0.8	1.2	0.4
reef degradation (%-points loss yr^{-1})	0.094	0.014	0.75
total volume (mt)	190	127	285
mean weight (kg)	0.8	1.2	0.4
reef degradation (%-points loss yr^{-1})	0.11	0.014	0.963

An estimate of reef degradation mainly through coral census

Figure 2.11 gives the results in percent coral cover of the underwater survey of cyanide-impacted and non-impacted areas in the Calamianes. The results showed that live coral cover in non-impacted areas were relatively higher than in impacted areas. In the same token that there were higher proportions of dead coral presumably due partly to long cyanide exposure in impacted than in non-impacted areas. This also suggests that although dying, dead or bleached portions of coral colonies were present in both types of areas, impacted reefs showed more visible bleached corals than non-impacted ones. It was particularly noted in impacted reefs that visible but small portions of bleached corals (e.g., branching *Acropora*) were found in patch-like conditions and not in large spatial scales. This may have resulted from the manner cyanide is being used on reef corals. Barber and Pratt (1997) and Mous et al. (2000) reported that cyanide-users select coral heads, patches, and crevices to pursue fish taking refuge under or inside these coral features. These results, however, are far from conclusive. Other major damage-causing factors, such as blast-fishing may have played a role in the reef conditions. After death, affected coral colonies have been known to recover depending on the type of species, duration and amount of disturbance. In this regard, it is difficult to assume that all "dead corals" were in fact caused by cyanide. There is a need, therefore, to carry out further investigations with a more refined resolution. Blast-fishing results to coral fragmentation that should be particularly taken into account in future research. Also, fragmentation due

to blast fishing bleaching due to poison (e.g., cyanide) and coral recovery rates may be species-specific that observations should be based on species.

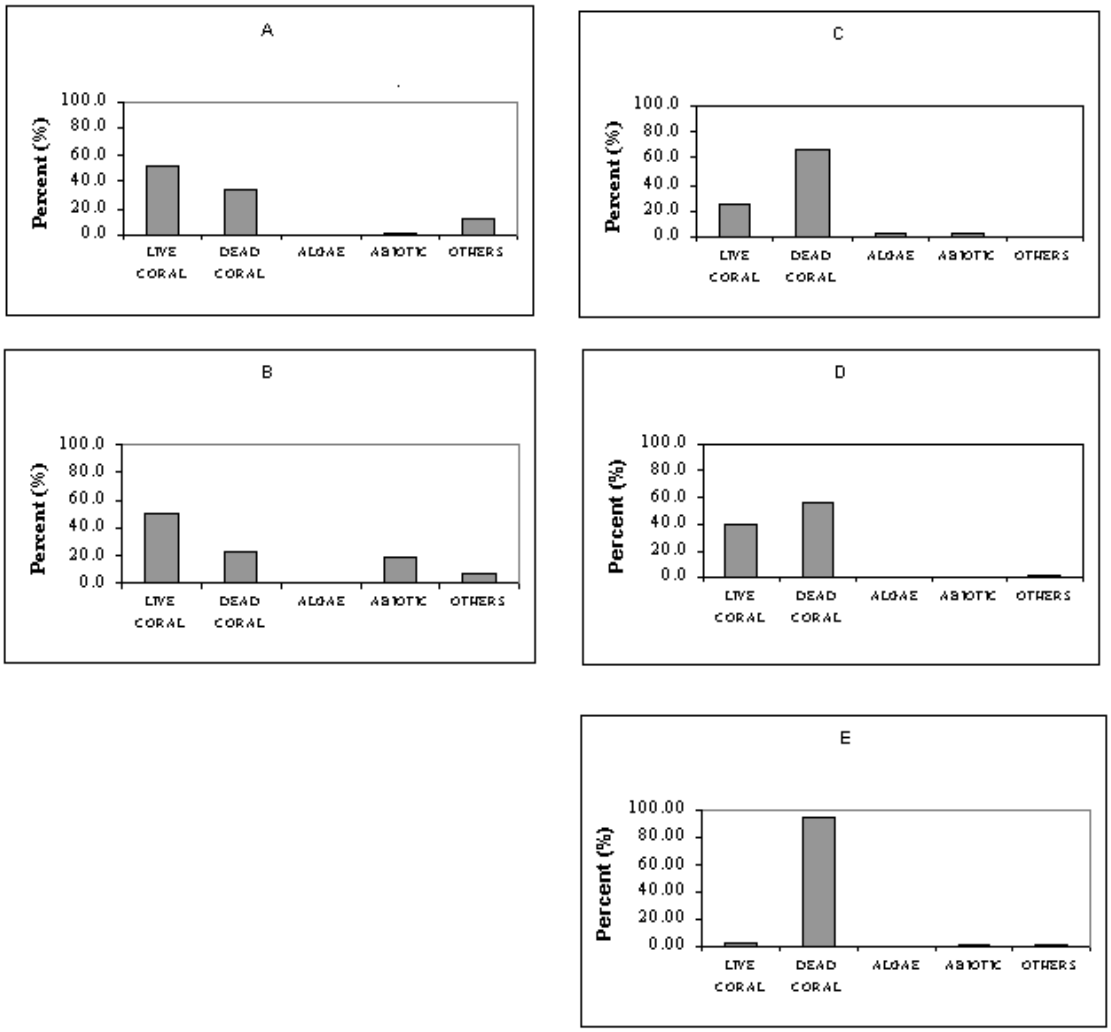


Fig. 2.11. Percent coral cover of non-impacted areas (A, B) and cyanide-impacted areas (C, D, E).

5. Summary and Conclusions

The coralgrouper *P. leopardus*, the most dominant species in the live reef food fish trade in the Calamianes, is over-fished. Catch as well as export records have recently been declining It also appears that there is reduction of mean size of *P. leopardus,* which is indicative of "growth" over-fishing. This is confirmed both from the yield-per-recruit analysis which further showed corresponding decrease in biomass with present exploitation levels, and from the survey results. However, absence of historical series data of fishing effort in the LRFFI precluded an estimate of the MSY. The results for the relative YPR implied that a proportion of a sustainable yield (per recruit) was a function of the exploitation ratio (E) hence fishing mortality (F) and that present exploitation

levels exceeded the maximum proportion of yield per recruit. Also, data on some age and size classes were deficient and limited sample sizes for the analysis of growth, mortality and exploitation rates were noted. Inclusion of extreme age and size classes in the population through fishery-independent sampling scheme will improve parameter estimation. Monitoring and sampling for these assessments should be a routine work, which should also include data on fishing effort, among others. The survey-engendered estimate for catch per unit effort in this study was quite high. This may appear counter-intuitive as over-fished stocks should reflect decreasing, thus, small CPUE (Russ 1991). The large catch with high fishing effort, however, may be due to the expansion in spatial scale of the LRFFI fishery in the Calamianes. Anecdotal reports revealed that fishermen collect live fish as far south as the Cuyo Island. Fishermen may be presently fishing distant unexploited reefs. This may also reflect the apparent increase in catch from 2000 to 2001. At the rate live fish are being caught, however, these stocks will virtually become over-fished and the fishery may collapse. Absence of historical data did not permit analysis of variation of species composition. The LRFFI in the Calamianes seems to be a single-species fishery. Although very few other species are captured, the fishery is predominated by the coralgrouper *P. leopardus*. Unsustainable catch, however, will deplete their stocks and it is expected that other close relatives of grouper species will replace *P. leopardus* and so on so forth indicating cascading effects or fishing-down-the-food-web phenomenon (Pauly et al. 1998).

Although population parameters estimated for *P. leopardus* are preliminary, present age and size distributions in the LRFFI catch, in tandem with data on reproductive biology, nevertheless, suggest "recruitment" over-fishing. Most of the individuals in catch are sexually immature to maturing individuals. Like most grouper species for which information is available, *Plectropomus leopardus* is a protogynous hermaphrodite (Ferreira 1995, Mamauag 1997). This means that fish changes sex from being a functional female to a functional male at some stage of its life cycle. This sex transition is induced by the behavior of the population wherein the reproductive success of a female increases if it were a male (Warner 1975). In addition, Ferreira (1995) believed that size selectivity in the *P. leopardus* in the GBR resulted to depletion of large-sized males in the population and thus could have induced timing of sex reversal. Although complicated, management of the sequential hermaphrodite *P. leopardus* can still be predicted (Bannerot et al. 1987). In the LRFFI in the Calamianes, either the populations are composed of smaller-sized individuals with presumably faster growth rates (i.e. growth over-fishing) or that the fishery is highly size selective but biased towards small to moderately-sized individuals as influenced by the pricing dynamics. This, however, differs from the scenario in the GBR. There is, therefore, a need to understand better the implications of these emerging trends in the LRFFI catch. On the other hand, these results are not uncommon and indicative of exploited stocks of grouper species worldwide due largely to their long life span, slow-growth and low rates of natural mortality (see Ralston 1987).

Detecting effects of cyanide on coral reefs at Calamianes has been difficult. A number of factors may be inter-acting to override and mask the sole effect of cyanide. The approach to zero in on this sole effect on reef fish habitats has provided tangible results but these

were either less significant or preliminary. Underwater surveys have documented several localized "bleached" coral colonies among the "cyanide-impacted sites" the reason why these sites had higher proportions of dead corals as opposed to "non-impacted sites". Whether or not cyanide-fishing has actually degraded these reef substrates, however, awaits further investigation. On the other hand, the results which initially showed less significant effect of cyanide imply that cyanide impact may have been reduced due to efforts of intervention by certain monitoring groups such as the International Marinelife Alliance (IMA-Philippines) to abate cyanide-fishing in the LRFFI in Calamianes. Barber and Pratt (1997) enumerated the initiatives to lessen the actual use and effect of cyanide-fishing in the LRFFI. These include random cyanide-detection test among live fish samples, increased enforcement of regulations in cyanide-fishing, education and training in local fishing communities where destructive fishing has been practiced, strengthening the legal basis for monitoring the LRFFI, and promoting reforms in export and import trade policies.

A need to undertake an immediate management intervention for the LRFFI exists. Economic policies for a sustainable trade should consider the ecological issues emergent in this study. In particular, the inclusion of small individuals in the present size distribution (24.0 – 47.0 cm Total Length) of the catch poses ecological risks for the stocks or populations of the vulnerable *P. leopardus*. It is, thus, recommended to increase size limit in the catch to at least 35.0 cm TL (Figs. 8&9), at which size sex transition has been detected and that some fish may have presumably undergone several spawning activities. This size also appears to fetch a near maximum price in the market.

The fishing effort (CPUE) is high. As a consequence, present exploitation rate is beyond sustainable catch. To revert back to a level which approaches maximum yield, exploitation rate should be lessen by reducing effort (see Russ 1998). High fishing effort did not reflect low CPUE but rather high catches because fishermen travel to distant unexploited areas. It could be that these areas are spawning aggregation sites. Spawning sites of *P. leopardus* in Australia have been determined (Samoilys 1997, Zellar 1998). Aggregation sites, however, are at risk of over-exploitation and decimation (Beets and Friedlander 19xx). It is, thus, crucial that spawning sites for the local stocks be identified and should be protected. Protective management on these sites must rely on the knowledge on the seasonality and periodicity of spawning aggregation of *P. leopardus* or any grouper species captured for the LRFFI. Routine assessment, therefore, should also include reproductive biology such as sex, gonado-somatic index (GSI) and gonad developmental stage of fish through gonad histology to infer timing and periodicity of spawning, thus, an idea of temporal formation of aggregations. Aside from the temporal scale, it is also necessary to determine the spatial scale of spawning aggregations (i.e the area of these aggregations) and whether spawning is single-site or multi-sites. High exploitation levels, hence, over-fishing may be avoided if management schemes for sustainable fishery will include closure seasons or reduction of fishing effort during spawning and at these aggregation sites.

Initiatives to lessen cyanide-fishing in the LRFFI such as random cyanide-detection test among live fish samples, increased enforcement of regulations in cyanide-fishing,

education and training in local fishing communities on non-destructive and traditional fishing techniques, strengthening the legal basis for monitoring the LRFFI, and promoting reforms in export and import trade policies, must continue. Albeit the inadequate pieces of evidence of environmental impact of cyanide-fishing, it is nonetheless risky to ignore it since cyanide is a broad spectrum poison and its long-term effect is not known. It is, therefore, also recommended that more refined research sampling protocol to flesh out cyanide effect on reef habitats from among other factors should be prioritized in future investigations. Furthermore, assessment of coral reef habitats showed various extent of damage and cyanide-fishing may be liable. Blast-fishing is also a major cause for reef degradation (McManus et al. 1997), although it is recognized that this particular destructive fishing practice is not used in the LRFFI. One important management initiative is the establishment of marine protected areas (MPA) in the LRFFI. This reduces stress factors (e.g., cyanide exposure, over-fishing) on the reef biota and allows degraded coral habitats to recover mainly through population replenishment by way of larval dispersal and recruitment to areas both inside and outside of MPAs (e.g., Russ and Alcala 1992).

It is also imperative that in order for the aforementioned management initiatives to be successful, participatory approach (i.e. community-based) (Salm and Clark 2000) in the implementation of the initiatives among stakeholders in the LRFFI such as the local government (e.g., provincial, municipal), fishing communities, national government agencies (e.g., BFAR, PNP), traders, exporters, etc., should be adopted. Finally, these groups should undergo capacity-building on social, legal, technical, and scientific aspects of management.

Table 2.5. Summary of biological and ecological indicators and results

Indicator	General trend	Study results
Catch	Decreasing	• Live fish catch (in kilogram weight) in the Calamianes, predominantly by *P. leopardus*, decreased from 1998 to 2001. • Export of live fish also decreased from 1994 to 1999.
CPUE	absence of previous data did not provide any trend	• Present estimate of CPUE in the harvest of live fish was higher relative to estimates found elsewhere in the tropics.
Fishing travel distance	increasing	• Respondents in the survey believed that they travel farther to fish than in the past.
Fishing travel duration	increasing	• Respondents also affirmed that they spent longer periods reaching fishing grounds now compared in the past.
Species composition	no shift in the catch composition was observed	• *P. leopardus* remain the most dominant species in the live fish trade at Calamianes.

Fish body size	Reduced	• Mean body size of *P. leopardus* decreased from 1998 to 1999. • There was also a reduction of the ratio of total weight (in kilogram) to total number of individuals in the catch (abundance) of live fish from 2000 to 2001. • Both results suggest growth over-fishing.
Fish growth rate	no significant change in the growth rate was observed	• The present estimate of growth rate for *P. leopardus* in the Calamianes was low and similar to other conspecific stocks in the tropics. • The estimate of growth rate was preliminary due to absence of the fast growing 0+ and 1 year old individuals in the analysis. Their incorporation into the analysis may presumably reveal a relatively higher rate.
Size/age at sexual maturity	Reduced	• Live fish trade targets size range of 28.0 cm TL – 32.0 cm TL which are young and sexually immature to maturing individuals (inferred from a previous study on the reproduction of *P. leopardus* also in Calamianes). Size at maturity of *P. leopardus* from the Great Barrier Reef in Australia was greater than 32.0 cm TL. • High catch rates of these small-sized individuals in the stocks may lead to recruitment over-fishing.
Fishing mortality rates	High	• Although estimates are preliminary, mortality rates for *P. leopardus* in the Calamianes are relatively higher than those in the Great Barrier Reef, Australia.
Exploitation rates/yield per recruit	Exceeded "maximum yield"	• Results suggest that stocks of *P. leopardus* in the Calamianes are over-fished.
Habitat degradation due to cyanide exposure	no spatial significant effect	• Estimate of habitat degradation was small. • However, dead coral cover was greater than live coral cover on cyanide-impacted areas and vice versa on non-impacted areas

Although population parameters estimated for *P. leopardus* are preliminary, present age and size distributions in the LRFFI catch, in conjunction with data on reproductive biology, nevertheless, suggest "recruitment" overfishing. Most of the individuals in catch are sexually immature to maturing individuals. Size (and age) at sexual maturity of *P. leopardus* in the LRFFI is smaller compared to P. leopardus in Australia. In the LRFFI in the Calamianes, either the populations are composed of smaller-sized individuals with presumably faster growth rates (growth overfishing) or the fishery is highly size selective but biased towards small to moderately-sized individuals as influenced by the pricing dynamics. These results are not uncommon and are indicative of exploited stocks of

grouper species worldwide due largely to their long life span, slow-growth and low rates of natural mortality (Ralston 1987).

Detecting effects of cyanide on coral reefs at Calamianes has been difficult. A number of factors may be inter-acting to override and mask the isolated effects of cyanide. The approach to zero in on this sole effect on reef fish habitats has provided tangible results but these were either less significant or preliminary. Underwater surveys have documented several localized "bleached" coral colonies among the "cyanide-impacted sites" the reason why these sites had higher proportions of dead corals as opposed to "non-impacted sites".

Whether or not cyanide-fishing has actually degraded these reef substrates deserves further investigation. The results which initially showed less significant effect of cyanide imply that cyanide impact may have been reduced due to efforts of intervention by certain monitoring groups such as the IMA-Philippines to abate cyanide-fishing in the LRFFI in Calamianes. Barber and Pratt (1997) enumerated the initiatives to reduce the use and effect of cyanide-fishing in the LRFFI. These include random cyanide-detection test among live fish samples, increased enforcement of regulations in cyanide-fishing, education and training in local fishing communities where destructive fishing has been practiced, strengthening the legal basis for monitoring the LRFFI, and promoting reforms in export and import trade policies.

Part III
Economic Sustainability Assessment[4]

1. Introduction

One of the pillars of sustainability in the live reef fish trade sector is the ability of the resources to provide a long-term source of income to the industry stakeholders. These include the fishers, traders, exporters and others directly or indirectly dependent on the industry for livelihood. This report presents a conceptual derivation of economic sustainability indicators, attempts to estimate the values of these indicators, and formulates a set of recommendations to improve on the economic sustainability of the fishery.

2. Indicators of Economic Sustainability

We use basic economic tools to derive appropriate indicators of economic sustainability. Figure 3.1 shows a supply-demand curve for a typical fishery on a price-output axes. The demand curve has the usual downward slope. The supply curve for the fishery is "backward bending"[5] which means that the output (catch) from a fishery first increases with price, reaches a maximum and eventually decreases at a threshold price. The bioeconomic derivation of the fishery supply curve indicates that the ascending part of the supply curve corresponds to a fish biomass (or stock) closer to the unexploited biomass while the backward bending part corresponds to a depleted fish biomass. The backward bending fishery supply curve is due to the biophysical characteristics of the fishery whereby sustainable catch (output) first increases with the level of fishing effort, reaches a maximum (the maximum sustainable yield or MSY) and eventually decreases. In other words, there is a limit to the regenerative capacity of the fish stock.

It is conceivable that the supply curve for the fishery could shift given changes in parameters that affect the regenerative capacity of the fish stock such as environmental variables. Habitat degradation from pollution, sedimentation and loss of habitats reduces the capacity of the environment to support any form of aquatic life thus decreasing sustainable yields and shifting the supply curve to the left, say from S_0 to S_1.

Focusing on the curves S_0 and D_0, the equilibrium price and quantity for the fishery are respectively P_0 and Q_0 at point A. It is noted that the equilibrium is on the backward bending part of the supply curve. Further, the same level of output would have been forthcoming at a lower supply price, which is a point on the ascending part of the supply curve S_0. The significance of this lies in the management regime for the fishery. Under open access where there is no control on entry and exit of fishing vessels, the equilibrium level of fishing is where economic rent is zero. If economic rent exists, fishing continues to expand until fully dissipated.

[4] This section is written by J. Padilla and D. Yu. A. Morales conducted the field survey.
[5] The derivation of the backward-bending supply curve may be found in Copes (1972).

The exposition thus far indicates that the open access equilibrium is characterized by overcapacity and depletion of fish stocks relative to what the fishery could potentially generate in terms of economic rents and the maximum sustainable yield. In the Philippines and in most fisheries in developing countries, the institutional regime for fisheries is similar to, if not actually open access. This points to the importance of instituting regulation of the fishery through command-and-control, economic instruments or a combination thereof to correct the situation. Without an effective regulatory framework, the fishery will always gravitate to the open-access equilibrium with too many boats and fishers, where rents are fully dissipated and catches are low.

International trade may be represented in the model by a shift in the demand curve from D_0 to D_1. The outward shift in the demand curve means that a higher output is needed for every price level. How far the demand curve shifts to the right depends on the importance of the fishery to the local and international market it serves and on the magnitude of the international market. If the fishery serves a huge international market then the demand curve is expected to move far to the right. Using the same assumption (an open-access regime of exploitation), the new equilibrium will settle in a point where S_0 and D_1 intersect. The new equilibrium price will behigher and output lower. The pressure from higher demand due to international trade will worsen conditions in the fishery. Thus, a simple analysis shows the negative impact of trade if there are no effective controls on entry to and exit from the fishery.

This model can also be used to identify indicators to assess the impact of trade policies on the fisheries sector. These indicators as identified by Padilla et. al (1995) are also called "stress indicators" (Table 3.1). In the fishery, the context of sustainability involves several dimensions, which include physical or biological, economic and social components. These dimensions indicators are adopted in the sustainability assessment of trade-related fisheries policies and used to identify indicators. Each economic indicator is discussed below.

Output/Catch

As in the preceding discussions, trade is a primary vehicle for increasing effort in the fisheries, particularly if the barriers to trade were relaxed. Long-run impacts indicate that catches would decline as a consequence of increased effort and deteriorating ecosystem for an exporting country under an open-access regime. Figure 3.1 exhibits the decline in catches from Q_o to Q_1. Trend in catches for the fishery, specifically species for export, can be determined. The surplus yield model can be used as basis to verify if the Maximum Sustainable Yield (MSY) has been exceeded for stocks exploited over time.

Price

The price of fish for the exporting country should increase due to the increase in demand on account of bigger international market and the resulting decline in catches. The change in price is shown in the movement from P_o to P_1, placing the new equilibrium price at

Point B from the initial condition, Point A. From a society's viewpoint, a positive price increment benefits a fisher or the exporting country. However, the social impacts are detrimental to the society or people from the exporting country in general.

Investments and Employment

Open access fisheries are characterized by the unregulated entry of labor and capital in the fishery. The increase in prices would drive up profits in the fishery thus attracting more investments to come in. If investment flows are liberalized as in the case of the Philippines, it is conceivable that foreign investment would start to flow into the country.

In terms of employment, if capital investments increase, a corresponding rise in employment is expected where the magnitude depends on the labor-capital requirements of fishing technology. Marginalized domestic fishing labor is expected to enter the fishery especially if macroeconomic conditions are unfavorable.

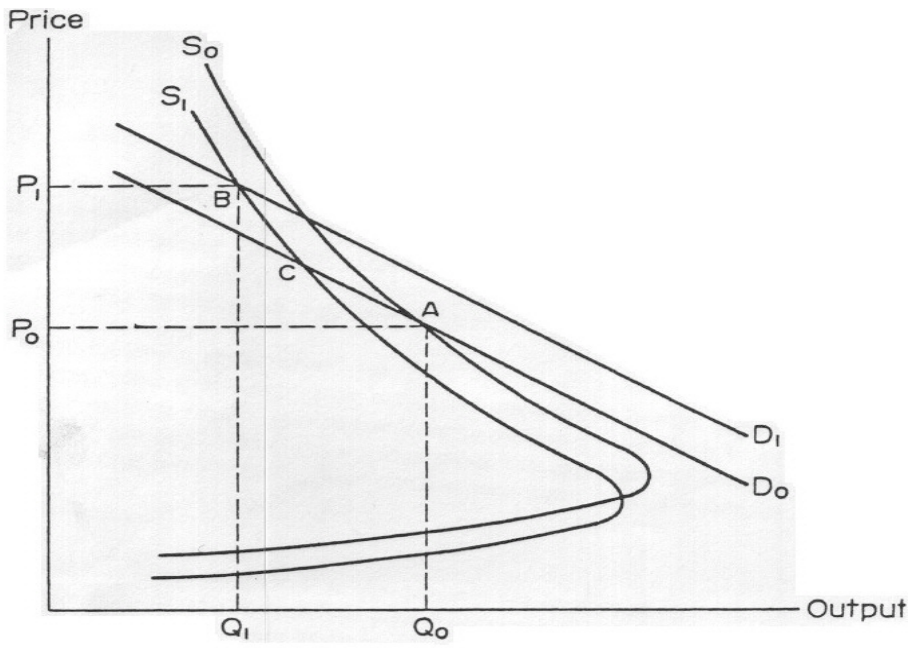


Figure 3.1. The supply and demand curve for a typical fishery (from Copes 1972).

Table 3.1. Summary of bioeconomic indicators of stress on an open-access fishery

Indicator	Relationship to Model	Qualitative Behavior Under Stress	Data Requirement
Output (Catch)	Direct	Decrease (critical as soon as decline is evident)	Secondary catch data
Price	Direct	Increase	Secondary data on ex-vessel prices
Catch per unit of effort (CPUE)	Direct	Decrease (critical when 50 per cent of initial level)	Secondary data (should be verified with primary survey data)
Employment	Direct	Increase	Secondary data (no. of fishers)
Investment	Direct	Increase	Secondary data (no. of vessels)
Labor productivity	Indirect	Decrease (critical when less than opportunity cost of labor)	Secondary data (should be verified with primary survey data)
Capital productivity	Indirect	Decrease (critical when less than opportunity cost of capital)	Secondary data (should be verified with primary survey data)
Income distribution	Indirect	Increase (positive skew)	Primary survey data

Source: from J. Padilla et al (1995)

Catch Per Unit Effort, Capital and Labor Productivity

Increased effort and declining catches in the fisheries would result in the decrease in the productivity of the factors of production such as the catch per unit effort (CPUE), an indicator of fishing performance. Based on the Schaefer model, a 50 percent decline in the CPUE indicates that excess effort has been expended in obtaining MSY. As trade is likely to increase fishing intensity, CPUE declines particularly under open-access conditions where the entry of fishermen is unregulated. Consequently, the productivity would also decline.

Income distribution

Smith (1990) observed that in majority of fisheries where stocks are scarce, catch distribution, and hence fishing incomes, is skewed in favor of larger and more efficient producers. The latter are more adept at hunting fish, able to move to other fishing grounds and in general more adaptable to changing conditions. The competition for more harvests will ease-out inefficient fishers in the long-run as those with more sophisticated technologies will likely get a higher share of catch from declining catches.

3. Methodology

This study makes use of both secondary and primary data. Secondary data were sourced from records maintained by the province of Palawan through the Palawan Council for Sustainable Development Staff, the municipalities in the Calamianes Group of Islands, the Bureau of Fisheries and Aquatic Resources, and non-government organizations such as the International Marinelife Alliance. Most of the data presented here, however, came from a sample survey of fishermen, traders and exporters conducted as part of this project. The survey is described below.

Sampling

At least 120 fishers are covered by the study and are distributed as follows: Linapacan (71); Coron (28); and Busuanga (21). The distribution of the sample reflects the geographic distribution of fishers in CGI. Although Culion was not covered due to time constraint, the remaining municipalities are representative of the entire island group. Information of the distribution of fishers was based on a rapid assessment cum site reconnaissance visits. Consultations with the stakeholders during this trip led to prioritization of members of the newly formed Calamianes Live Fish Operators Association for the interview of fishers.

Most traders based in the islands were interviewed. All exporters/traders (4) based in Manila were covered in the study. The exporters chosen were operating in 2001.

Primary Data Collection and Processing

A questionnaire in the Philippine national language (*Pilipino*) was developed particularly for the fishermen-respondents (Attachment _) on April 8-25, 2002. The questionnaire was first pre-tested in the islands and subsequently finalized. To facilitate data gathering, the project employed the assistance of four enumerators from Coron who underwent a one-day orientation workshop on the objectives of the survey and on some of the basic techniques in interviewing. The survey of exporters based in Manila was conducted in May 2002.

Details of operations of fishers, traders and exporters for 2001 were collected in the surveys. As this was a recall survey, the most recent year was covered. The implicit assumption is that 2001 is a representative year for the industry in terms of operations.

The survey data was encoded wherein each variable represented answers to questions in the survey. Answers that were drawn out came in the form of either numerical values or string values, which are non-numeric in nature. Some of the numerical values represent either a volume or monetary amount while others represent an answer (e.g. 1=Yes; 2=No) or a perception (e.g. 1=Agree; 2=Not sure; 3=Don't Agree; among others). String values

on the other hand represented non-numeric answers in nature wherein suggestions, titles, names, and the like were elicited by the questions (e.g. species of live fish caught, seminars attended, etc.).

Secondary Data Collection

An extensive review of existing literature and the initiatives being carried out by other groups that are either similar or complementing this study was made to further validate the data and to figure out the projections being made in terms of the future of the LRFFI.

Profile of Respondents

Of the 120 respondents, majority (60%) had come from the town of Linapacan. 21 on the other hand had come from Busuanga while 28 or 23.3 per cent of the respondents had come from the town of Coron. 71 also had come from the sitio of Nangalao while the rest had come from other sitios such as Barangay 1, Canipo, Coron, Dellian, Planlaitan, and Poblacion. About 86 per cent or 103 of the respondents had also indicated that they had been living in their current location for the past five years while 14 per cent are recent migrants although a large number have settled in the area for than five years. Most of the migrants originated from Cebu and other places in the Visayas such as Leyte and Masbate.

The average respondent has been engaged in the collection of live reef fish for food for 5 years although there are those that have been in the industry much longer and some are recent entrants. Majority had indicated that they spend about a day out in the sea (92 or 77%) where a day of fishing is roughly equivalent to 9 hours.

All of the respondents belong to various Christian religions and sects.

4. Results and Discussion

Most of the discussions of the indicators are based from the survey data, supplemented by available secondary data. It is noted that some indicators are discussed in both the ecological and economic sustainability assessment reports and these are cross-referenced where applicable.

Output/Catch

The collection of data on live fish production in the Calamianes Group of Islands (CGI) has not been consistent over the years. Hence, the time-series data presented in Figure 2.2 shows no production in some years. However, it is clear in recent years that the production has been declining and this trend is actually validated by the survey. Ninety (90) per cent of the respondents indicated that the volume of live fish caught declined significantly between 1996 and 2001, a five-year period.

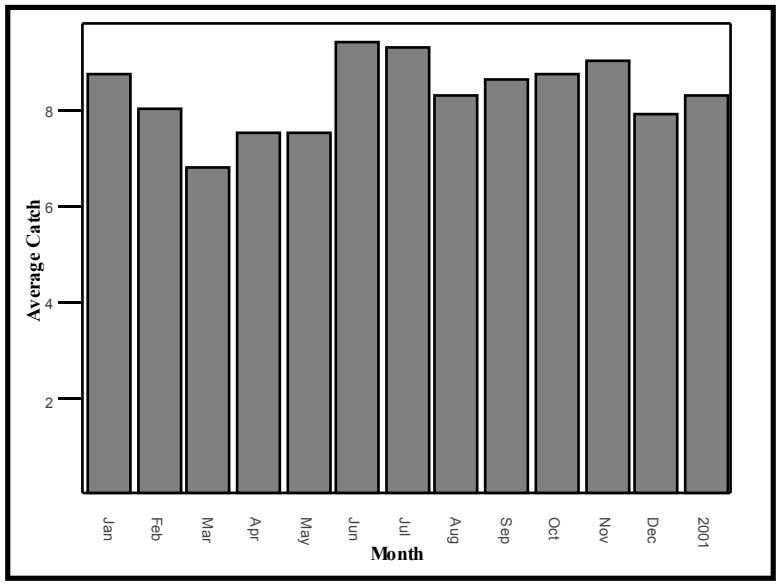


Figure 3.2. Monthly catches of sample fishers, 2001 (survey data).

For 2001, average annual catch was almost 100 kg or equivalent to over 8 kilos per month (Figure 3.2). As demand is relatively higher around the Chinese New Year, it is expected that catches would peak around December to February. However, this is not shown by the monthly catch data indicating that fishers are primarily hunters and catch fish whenever they find one. The variation may be more a function of weather as shown by the frequency of trips (Figure 3.3) and biological factors such as the spawning season of groupers at which time they aggregate and are more vulnerable to fishing.

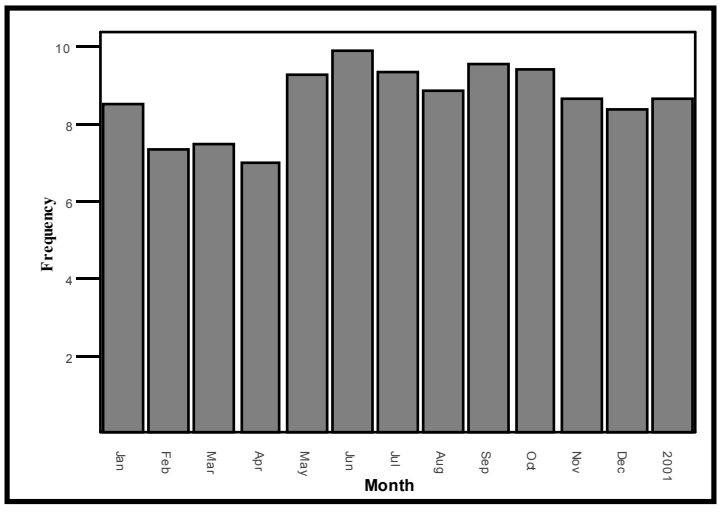


Figure 3.3. Average number fishing trips per month in 2001 (survey data).

Average total catch for the year 2001 is about 100 kg and the distribution of the sample is shown in Figure 3.4. Most of the fishers are clustered around the lower catch levels but

there are a few outliers. The situation has gotten dire among those surveyed. Almost 80 per cent stated that they had to go to more distant fishing grounds in search of fish. This signifies that they have already overfished fishing grounds around their residences. The study also revealed that fishing trips (about 60 per cent) are taking longer on account of longer travel and search time. Frequency of fishing trips in 2001 was about 8 per month. This could be less frequent compared to previous years because of the longer fishing trips as discussed earlier.

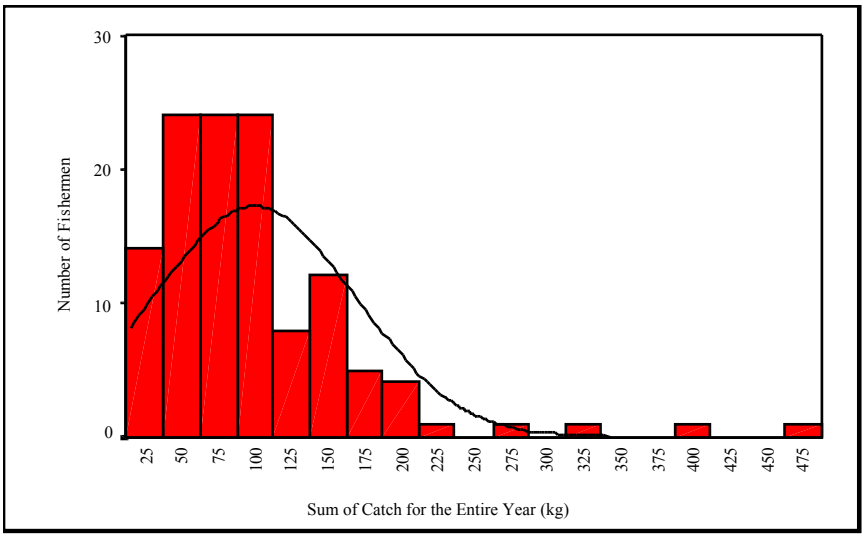


Figure 3.4. Distribution ofrespondents in terms of total annual catch.

Prices

Based on interviews of exporters, traders, and the fishermen, demand had indeed increased. Such increase, coupled with the decline in production (at least in CGI and presumably elsewhere) must have put an upward pressure on prices. Indeed, the perceptions of those surveyed indicated that demand increased between 1996 and 2001. With 68 respondents stating that they were earning more in 2001 compared to 1996, the decline in volume of production was more than offset by the increase in prices. This comparison, however, is in nominal terms.

The above perception is supported by time series price data (Table 3.2) with prices increasing more than ten-fold over a 10-year period. The information in the table also shows significant price difference according to size of fish. The preferred size is from 500 g to 1 kg, which commands a premium. Undersized fish is priced much lower but still higher than fresh or frozen fish. These are grown in cages to marketable size. In Table 3.2, the price of oversize fish is higher because the data includes prices for all fish species. Some grouper species are more expensive than others regardless of size.

Prices received by the sample fishers varied within the year. As shown in Figure 3.5, prices start to increase towards the end of the year with a peak in December although prices are still high in January and February during the Chinese New Year.

Table 3.2. Average prices of live fish, Calamianes Island Municipalities

Year	Prices by size/weight (PhP / kg)		
	Undersize 300 grams - 499 grams	Good Size 500 grams to 1 kilo	Oversize 1 kilo and above
1994	70	90	90
1995	80	90	100
1996	250	1,000	1,100
1997	200	800	900
1998	250	900	1,000
1999	300	1,100	1,200
2000	300	1,200	1,300
2001	350	1,400	1,300
2002	300	1,150	1,050

Source of data: PCSDS

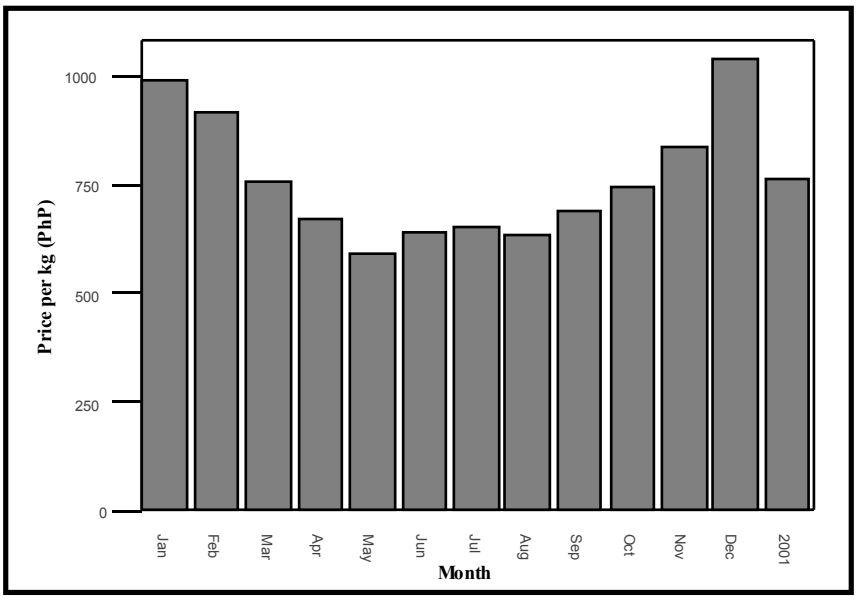


Figure 3.5. Average monthly prices of live red grouper in 2001 (survey data).

Employment and Investments

The perception of fishermen is that their ranks increased over the years. This is verified in the earlier discussion on migration of fishers. Part of the increase is from the migration of about 14 per cent of the respondents into the CGI mainly because of the availability of work and because of the perception of abundance of target fish species. Not only did the number of fishermen increase, but the number of exporters and traders.

Over half of the respondents mentioned that the availability of work was the main reason why most of the respondents had transferred and decided to reside in Calamianes. Other reasons for migration include the opportunity to improve their quality of life and the presence of relatives in the area that would have assisted them in finding employment. Some were random seekers who tagged along with friends looking for fishing-related work upon the advice of "recruiters". These were the years of the rapid expansion in LRFFI where fishermen were brought in the CGI from other provinces.

The increase in the number of fishermen must have brought about a corresponding increase in investments in fishing equipment. Average investment for a fishing unit, consisting of the boat and engine suitable for the fishery amounted to PhP36,600 although bigger boats with more powerful engines could cost as much as PhP96,000.

The increase in employment and investments was triggered by the financial assistance extended by traders and exporters, responding to increasing demand for live food fish in their export markets. Aside from the cost of fishing equipment, exporters and traders would also lend working capital to fishermen to cover fishing expenses.

Catch per Unit Effort, Capital and Labor Productivity

As mentioned in the previous sections, there has been an increase in the number of fishermen that have been employed in the LRFF trade. In addition to this, there has been an improvement in the technologies that are now being used to catch these fishes. The trend in these two indicators would provide sufficient evidence that there has been an increase in the catch in the short term from higher fishing intensity. This is shown by the production data over time, particularly from the 1990s.

Over time, with sustained increase in fishing intensity, total production eventually declined as was observed starting in 2000 onwards. This then brings about a decline in productivity for all the fishermen and also for the traders and exporters involved in the industry. For the fishermen, they have responded by spending longer search time for fish and traveling to distant fishing grounds. All these resulted in the deterioration of fishing operations as indicated by the perceptions of the fishermen.

Table 3.3 below shows the catch per unit of effort expressed in kilogram per hour of fishing. It is noted that fishing hours do not include travel time. While no time series data exist, it may be concluded that CPUE has gone down significantly over the years on account of declining catches and the increase in the number of fishers. However, given the high prices of live fish, the revenue per hour of fishing is still attractive, on the average. There is a significant difference in CPUE across sites but this is because fishermen in Panlaitan and Coron have already moved to more productive fishing grounds far from their residences.

Table 3.3. Catch per unit effort by municipality, 2001 (survey data)

Municipality	Boats (no.)	Catch (kg)	Fishing Days	Hours	CPUE (kg/hr)
Coron	28	3,252.5	51.3	268	0.4334
Nangalao	71	6,590.0	67.1	611	0.1519
Panlaitan	21	2,129.0	36.0	193	0.5253
All Sites					0.3702

Table 3.4. Average revenues and costs (survey data)

	Per Annum	Per Fishing Trip
Gross Revenues	96,288	2,227
Live Fish	82,770	2,097
Other Catch	13,718	130
Variable Cost	71,057	672
Net Revenue	25,431	1,555

Level of Income and its Distribution

The computation of the annual profits each fisherman made during the year 2001 involves the subtraction of the annual revenues of each fisherman from the costs incurred during his fishing activities for the whole year. Annual revenue was computed by multiplying the average fish caught in kilos from January to December of 2001, with the corresponding average price per kilo. The resulting values of each month were then totaled to come up with the fishermen's annual revenue for 2001.

The yearly maintenance costs of each fishermen on their boats, engines, hook and line, and other equipment used as well as their variable costs on fishing gear such as gasoline, kerosene, engine oil, ice, bait, rent on the boat and engine, repair fees, commissions of workers, food, and other materials that were purchased for their fishing endeavors were converted to yearly values so as to be consistent with the data needed to compute for annual values. The depreciation values for boats and engines were also computed. All these elements of cost were then totaled to come up with a value for the fisherman's annual costs. Performance was computed annually and on a per trip basis.

The figures are in Table 3.4 and the distribution of the sample in terms of annual revenues is in Figure 3.6. Annual revenues of the fishermen reached as much as PhP417,000. The average annual revenues was P82,770 for live fish and P13,718 for by catches. On the other hand, the highest annual total costs for 2001 was P240,430 while the average was P71,000. Average annual profit from their operations came out to over PhP25,000. However, it is noted that 52 of the 120 fishermen lost money in 2001.

One reason why some fishermen are more efficient than others is the more advanced technologies and techniques they used in teir operations. Some fishermen from the survey had indicated that they had undergone trainings on the correct ways of catching fishes, thus giving them a comparative advantage over fishermen who have not attended the same training.

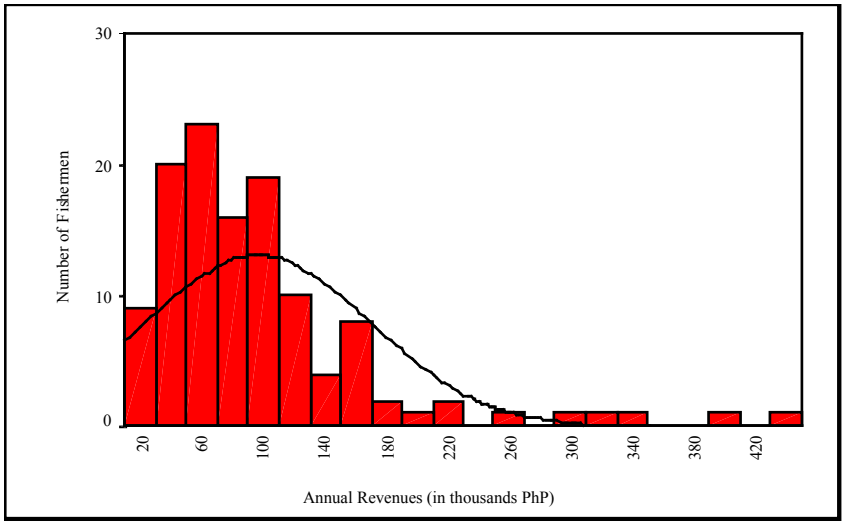


Figure 3.6. Distribution of respondents in terms of annual revenues (survey data)

The same reasoning could be applied to those who have more advanced fish-catching equipment than those who rely on ordinary techniques. Further information and knowledge on locations of spawning aggregations also contribute to this difference in the distribution of income. Again, those with inside knowledge of where fishes are plentiful will have a comparative advantage over those who rely on luck. This is evident in the outliers who earned as much as PhP316,104 within a year, as shown in Figure 3.7.

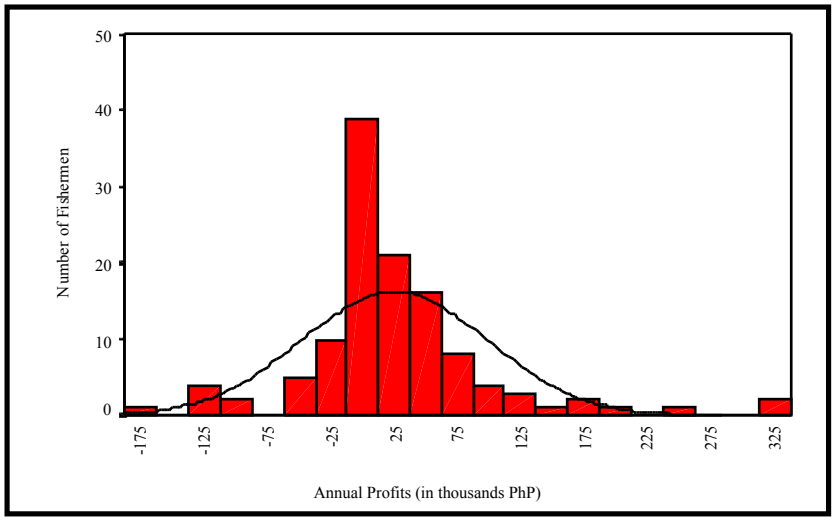


Figure 3.7. Distribution of respondents in terms of annual profits (survey data)

The profits are net of cash expenses in the fishing operations. Expenses do not include fixed costs as well as the cost of time of the fishermen. If investments in fishing equipment are considered "sunk", the profits would represent payment for labor which amounts to about PhP 2,000 per month. Indeed the earnings from the fishery of the average fisherman in 2001 was small even relative to prescribed minimum wages.

5. Summary and Conclusions

This paper focused primarily on the assessment of the performance of fishers in the LRFF industry using primary survey data. The indicators identified in Table 3.1 of section 2 are summarized below (Table 3.5) and the survey data results are compared with the qualitative behavior under stress.

The summary below indicates that the fishery is no longer economically sustainable and the situation is expected to worsen in the coming years unless something is done to the industry.

Table 3.5. Behavior of economic sustainability indicators from survey data

Indicator	Qualitative Behavior Under Stress	Survey Data Results (2001)
Output (Catch)	Decrease	Declined significantly over the time
Price	Increase	Increased significantly over a 10-year period
Catch per unit of effort	Decrease	No earlier data but must have decreased significantly due to decline in catch and increase in number of fishers
Employment	Increase	No time series data but current number is estimated at over 1,000 artisanal fishers which constitute primarily of migrants
Investment	Increase	As the number of fishers has increased so did investments. While no census data exists, considering fishermen-boat ration of 3 persons, there should be at least 300 boats engaged in the industry,
Labor productivity	Decrease (critical when less than opportunity cost of labor)	Average annual gross profits amounted to over PhP 25,000 in 2001. This is lower that legal minimum wage rates. Fishermen remain in the industry as they may not have employment alternatives outside fishing.
Capital productivity	Decrease (critical when less than opportunity cost of capital)	In fishing, the boat is considered a sunk investment. The engine may have other uses. Returns of investment are very low on the average.
Income distribution	Increase (positive skew)	Quite a number of fishers are already losing. Data on benefits derived by traders is not available at this point.

Part IV
Community and Social Sustainability Assessment[6]

1. Introduction

Recently, there has been growing concern over the increase in exploiting live reef food fishes for export especially that the Calamianes Islands have the most number of fishers that engage in live reef fishing. Although relatively a recent development in resource exploitation, live reef fishing communities have significantly multiplied in numbers over the last 5 years as well as observed increase in the number of fishing vessels from neighboring provinces and islands engaging in live reef fishing. Hence, the enormous pressure placed on a fragile resource. The emergence of trade-related policies relevant to the fisheries sector has consequently led to perceived overexploitation of the resources and the resulting adverse impacts on communities. Accompanied by factors such as domestic governance and local development agendas, there is thus a need to carefully look into the issue in an objective manner, especially within a sustainable development context. It is therefore appropriate that a social impact assessment is developed and applied in order to contribute to a greater understanding of forces that impinge on social, economic, and environmental sustainability.

The primary objective of the community and social impact assessment is to provide a means of determining how a particular economic activity have or may have affected a community's way of living and their struggle to achieve a comfortable quality of life. As such, social impact assessments are ways by which there may be a greater understanding of the relationship between economic activities, such as live reef fishing, and its social nuances especially at the community level where these impacts may have conspicuous manifestations and which may have a bearing on sustainability.

2. Social Impact and Sustainability Indicators

This social impact assessment on the live reef fish trade in Northern Palawan will look into four main social sustainability areas namely socio-institutional, socio-economic, gender, and quality of life. These areas will provide a basis for determining whether the current practice of live reef fishing in the area is socially sustainable.

Socio-institutional – This social sustainability area refers to the capacity and capability of key institutions and agencies in ensuring the proper administration or conduct of live reef fishing activities. In other words, it is important to determine whether services and assistance from government agencies is being properly provided such as the enforcement of agreed policies and regulations. This may be determined addressing the following key questions: *Which groups and agencies are directly or indirectly related to the administration and proper conduct of live reef fishing? Do these groups and agencies*

[6] This section is written by G. Braganza.

have the appropriate manpower, budget and office to develop and implement policies and programs that would ensure the proper administration of live reef fishing activities? How are the activities of these groups and agencies perceived by the communities in terms of effectively providing support and assistance? Moreover, stable socio-institutional relationships are also important in determining over all institutional impact. Unless there is clarity in the roles, functions, working relationships and arrangements between these groups and institutions, sustainability may remain challenging. It is therefore important to ask the following key questions: *What level of coordination and relationships are there between the major live reef fish trade actors? Has there been any conflict, overlap, or gaps in terms of functions and roles? What mechanisms have been put in place to ensure proper coordination and complementation? What are the different property rights regimes and who is responsible for what?* Hence, it is important that for live reef fishing activities to be socially sustainable, it must have, or is capable of enabling institutional stability, that which is determined by functional clarity and capability, between and among the major agencies and offices such as local government, national government agencies and civil society groups.

Socio-economic – This social sustainability area refers to the complex trade and market relations and processes that define how key stakeholders relate to each other. The socio-economic area focuses on the relationship between the key stakeholders in terms of their economic significance and determine whether these relationships enable local fisherfolk a sense of empowerment and whether these socio economic relations provide equitable distribution of the benefits. These are understood by asking the following key questions: *Do local and ordinary fisherfolk have access and venues by which they contribute to decision making process critical to the live reef fish trade? Are there interventions or occasions through which local fishers participate in the development of policies pertinent to live reef fishing? Have communities been actively and effectively enforcing live reef fishing rules and regulations? How are the benefits, such as income, shared among the stakeholders? Do the local fisherfolk feel that current live reef fish trade arrangements are potentially beneficial to them? Does the fisherfolk community have tenurial security or actual property rights over the resource?* Therefore it is important that for live reef fishing to be socially sustainable, it must have the capacity to motivate local fisherfolk towards greater self-reliance and self-determination by ensuring that there is access to greater decision-making and that the benefits are appropriately distributed. Therefore, key ingredients of social sustainability are those which are determined by the active involvement of the community in decision-making processes and the security provided by balanced or equitable distribution of benefits.

Gender – This social sustainability area refers to the social roles and responsibilities that are either being practiced or are adjusting given the demands and conditions exerted by major economic activities and institutional forces. It mainly tries to understand how social capital undergoes changes in order to cope with certain economic and social limitations and potentials. If particular roles and functions are capable of working with certain constraints and thus undergo a process of adjustment, then a sense of gender balance and complementation is achieved. Gender balance and complementation is expressed through perceived changes in specific roles and functions such that these

provide a clearer opportunity to achieve a degree of social sustainability. In the case of live reef fishing it would be interesting for example to note how the activities related to the industry have contributed to achieving a gender based coping mechanism such that there is relative ease in responding to related demands and challenges (i.e., since males have to travel farther to fish, females increasingly take over the domestic and economic duties of males or females increasingly acquire greater responsibility over key economic decisions of the household).

Quality of Life – This broad social sustainability area refers to the cultural stability, food security, and the access and use of basic social services. It is suspected that a peoples' way of life is greatly affected by the introduction of new technology that accompanies new patterns of income generation such as that of live reef trade fishing, which is relatively a recent introduction in these islands. The extent and significance of live reef fishing undoubtedly places a significant toll on the peoples' culture and local relations. The socio-cultural make up of the Calamianes Islands where live reef fishing thrive presents a very challenging context. It is thus important to determine, in terms of cultural stability, how the various socio cultural groups relate to each other: *How are decisions in the community reached? What impact do the indigenous cultural communities have on the over-all decision making processes within the community? Who prevails and in what context? How are conflicts managed? Who is mainly responsible for overall coordination and collaboration?* In terms of food security, some of the main points that need to be addressed are: *Do the fisherfolk feel that they are able to provide food for their families all year round? Does the live reef fish activity provide constant food on their table? What alternative activities have been undertaken in order to ensure that food is provided at the time most needed?* Finally, with regards to access and use of basic social services, the key questions that need to be addressed are: *Have government agencies been able to provide communities basic services such as education (e.g., provision of teachers, construction of schools, etc.) and health (e.g., appointment of rural health workers, provision of medical supplies, construction of health centers, etc.)? How do communities perceive government? What groups and institutions have been able to provide assistance and support?* Hence, for live reef fishing to be socially sustainable, it is imperative that respect and relevance are placed on cultural values or that avenues are provided and used to work with cultural communities; that there is a degree of security in terms of providing access to food or that communities feel assured that there is a sense of certainty in terms of where and how they can sustain access to food; and that communities actually enjoy basic social services that should be provided for by government and other related agencies and organizations.

The Social Impact Assessment Framework (Table 4.1) presents how these sustainability areas are further understood and applied and the tools used in determining whether live reef fish activities may be assessed as socially sustainable. Impact and sustainability indicators for each sustainability area are presented to enable greater application and determination of how sustainability areas may be assessed. Impact indicators provide the basis to determine whether live reef fishing is providing positive or negative social impact and whether it is socially sustainable. How these indicators are behaving and manifested are further presented by its operational dimensions, which are objective and

verifiable expressions of specific sustainability area. A framework of broad social sustainability areas and its indicators provide a sense of manageability and practicality to a potentially overwhelming task. By organizing and presenting an analytical strategy based on such framework enables decision makers and planners to gain a clearer understanding of whether economic activities such as live reef fishing is socially sustainable.

3. Results and Discussion

The results of the study are presented in three major discussions. Firstly, there is a brief presentation of the history and development of live reef fish trade in the Calamianes Islands. The discussion traces the early beginnings of the trade noting the rapid level of resource exploitation, the accompanying levels of technology, and the consequent effect of marked and immediate economic benefits. Secondly, resource management initiatives relative to the live reef fish trade in the area is discussed. This section focuses on the various resource management initiatives undertaken at various institutional levels and how the desire to address a potentially ecologically damaging economic activity is facing enormous challenges. Lastly, a discussion on the social impact of the live reef fish activity in the Calamianes Islands based on the study results present initial social sustainability assessment of live reef fishing in the Calamianes Islands.

3.1 Resource Management Initiatives: Policy Issues and Concerns

Live reef fish catching primarily employs the use of simple hook, lines, and PVC pipes, but the prevalent and increasing use of ecologically destructive and illegal fish catching methods have led to serious concern over the future of live reef fish trade in the area and its impact on the well being of its fishing communities. Of late, the increasing awareness to actively respond to these concerns as well as the need to protect the fragile ecosystem where groupers thrive and sustainably manage the depleting resource has consequently led to efforts towards a need to understand resource management options and how more concrete resource management steps as well as institutional relations may be undertaken.

Resource management initiatives, especially directly linked to the live reef fish trade are present at various institutional levels. On the national level, there is Presidential Decree 704 (1975), which was, for a long period of time, the premiere law governing the whole fish trade industry. The landmark Republic Act 7160 (1991) or more popularly known as the Local Government Code (LGC), facilitated greater decentralization of resource management functions to local governments making these units more responsible and accountable over the use and maintenance of their natural resource. At the local government level, resource management initiatives are expectedly contained in specific local development plans, ordinances and resolutions. The Agricultural and Fisheries Modernization Act (AFMA) further built upon emerging development directions towards sustainable management of resources by identifying potential agricultural and fisheries development zones was not fully developed. Another national level initiative that has impact on local resource management is the Indigenous Peoples Rights Act (IPRA),

which primarily enables indigenous communities to determine and apply resource management practices, that are culturally based and ecologically sound.

Table 4.1. Social Impact and Sustainability Assessment Framework

SOCIAL SUSTAINABILITY AREAS	IMPACT AND SUSTAINABILITY INDICATORS	OPERATIONAL DIMENSIONS	TOOLS/APPROACHES/ METHODOLOGY	INFORMATION SOURCE
Socio-Institutional	• National government's capacity and capability to respond to changes brought about by live reef fishing • The ability and effectiveness of various government units and agencies to coordinate their activities and programs • The level and quality of coordination between government and civil society groups	• Who are the key decision makers in the local government • What particular office(s) is (are) tasked to handle trade-related/ development activities • How many staff are involved in this office • How much budget is allotted for this office • What is the staffing and budget characteristics and concerns of offices tasked to provide basic services	1. Focus group discussions (issues and concerns mapping, institutional relations diagram, etc.) 2. Key Informant Interview	• Local government officials • PO members • Community members • Fisherfolk • Fish traders • Market vendors • NGO members
Socio-Economic	• the benefits brought about by the economic activity is equitably distributed • Empowerment and self reliance of fishers over certain local trade related linkages	• How are fisherfolk and traders related? • What are the f activities that allow stakeholders participation • What are the relations and linkages involved between the levels of activities • What are the financial and social benefits and costs of such linkage and how are these distributed • What are the emerging economic and social concerns	1. Focus group discussion (resource mapping, issues and concerns mapping, problem tree analysis, conflict mapping, etc.) 2. Key Informant Interview	• Local government officials • PO members • Community members • Fisherfolk • Fish traders • Head of household • NGO members
Gender	• Current, expected, and emerging roles and responsibilities that compliment demands and challenges •	• What roles and responsibilities were commonly practiced • What were the changes and adjustments • What were the effects of such changes in terms of economic and social aspects	1. Focus group discussions (gender mapping, problem and issues tree analysis, etc.) 2. Key Informant Interview	• Women groups • Heads of household • PO members • NGO members
Quality of Life	• Communities' access to and utilization of basic social services • People and communities have adequate supply of food all year round • Participation of indigenous cultural communities in local decision making through active collaboration with other local residents	• What are the relationships between cultures • What office or organization is assisting in terms of cultural stability • What are the issues that affect culture and social relations • What basic services are available/lacking • What are the other forms of economic activity	1. Focus group discussions (social issues mapping, conflict mapping, problem tree analysis, etc.) 2. Key Informant Interview	• Fisherfolk • Heads of household • Women's groups • PO members • NGO members

At the provincial level, Republic Act 7611 (1991) or known as the Strategic Environment Plan (SEP) for Palawan was an innovative undertaking directed towards enabling the provincial government of Palawan to lead resource management and development efforts. This enabled the establishment of the Palawan Council for Sustainable Development (PCSD) which is tasked to ensure that local development initiatives are consistency with the province's development agenda. This coordinative body is further operationalized at the municipal level through the Environment Critical Action Network (ECAN) which is expected to work closely with municipal governments with regards to ensuring sustainable management of local resource.

In the context of live reef fish trade in the area, a number of specific ordinances are in place and have impressed a degree of impact on how communities are coping especially in terms of their relationship with institutions and agencies. These are mainly regulatory and are directed towards controlling over exploitation. For example, PCSD AO No. 3 comprises guidelines for the Accreditation, Regulation, and Monitoring of live fish catching, culture, transport and trading in the whole province of Palawan. In addition, pursuant to this Provincial Ordinance No. 2 came out in 1993 prohibiting the catching, gathering of certain live reef fish species.[7] This ordinance created much discussion among live reef fish traders and operators which initiated moves towards getting an exemption. Pressures from the live reef fish sector groups in Coron prompted a revisit of this ordinance which eventually led to PO JO 29 amending PO No 2 which exempts certain species of fish but prescribed a system of compliance for its shipping and transporting by creating a municipal-based Community Fisheries Board (PO 29 Municipal Ordinance No. 4) which is composed of representatives from civil society groups (e.g., local NGOs, religious sector, youth and peoples organizations), and local government unit officials. But the board did not have either the capacity or capability to perform its mandated functions (e.g., conduct of studies and consultations to determine the maximum allowable yield from accredited fishing operators and fishermen, determine a system of accreditation, and determine spawning period to ensure the adequate stock, etc.). Finally, PCSD Resolutions No. 98-118, 98-124, 99-142 was passed which required all live reef fish catchers, fish cage operators, traders and carriers in Palawan to obtain permit or accreditation from PCSD. This move led to the establishment of the Calamianes Fishermen's Association, a government accredited organization, which facilitated accreditation and permit processing for fisherfolks, traders, and operators.

In effect, the overall policy and institutional make up governing live reef fish trade in the Calamianes has been regulatory in nature and direction. Yet, despite this foundation, illegal fishing practices are prevalent as well as uncontrolled incursions of large-scale fishing vessels into municipal waters. This reflects two key issues: lack of capacity to enforce policies and the absence of a pro-active sustainable resource management strategy.

---

[7] …. 1. Family: Scaridae (Mameng), 2. Ephinephelus Fasciatus (Suno), 3. Cromileptes Altivelis (Panther or Senorita, lobster below 200 grams and spawning), 4. Tridacna Gigas (Giant Clams or Taclobo and other species), 5. Pictada Margaritifera (Motehr Pearl Oysters), 6. Penaeus Monodon (Tiger Prawn – breeders size or mother), 7. Epinephelus Suillus (Loba or Green Grouper) and, 8. Family: Balistidae (Tropical Aquarium Fishes) for a period of five years in and coming from Palawan Waters.

3.2 The Social Impact and Sustainability Issues of Live Reef Fish Industry

Based on the findings from focus group discussions, interactions with key stakeholders, various participatory appraisal activities, and the socio economic survey, the following discussion on social sustainability areas is presented. This discussion provides an initial understanding for determining the level of social sustainability of live reef fishing and may potentially indicate what possible levels and areas of response and strategic intervention may be undertaken to ensure the overall sustainability of the trade.

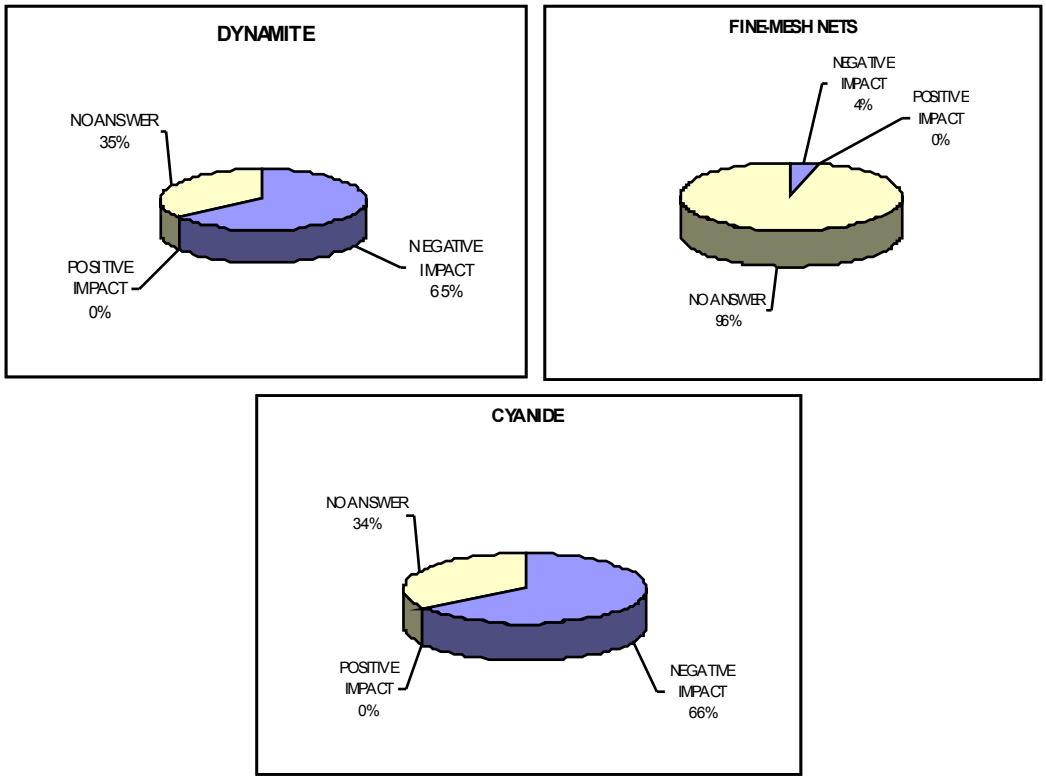


Figure 4.1. Perceptions on destructive fishing practices on fishing operations (survey data).

The introduction of live reef fishing in the islands has certainly provided much economic benefits to stakeholders. It has also motivated greater competition among the fisherfolk which has led to exploring new fishing grounds and the unfortunate use of various methods that result in substantial damage to the ecosystem. Among those surveyed, there is generally a negative perception of the use of destructive and illegal fishing practices on live reef fishing operations (Figure 4.1) despite the felt benefits of such use in terms of catch abundance and its consequently large financial returns. This negative perception is mainly due to the observed impact of such practices on the habitat of the fishing grounds and the broader ecosystem where the fish thrive. In many fishing grounds identified as those where cyanide is used, corals are bleached while dynamite used areas are where destroyed corals are found scattered and scarred. Since groupers feed and propagate in good coral environment, the consequences of recent use of dynamite and cyanide fishing on the coral ecosystem significantly depleted the live reel fish resource as well as other organisms that have links on the growth and propagation of live reef fish. Fisherfolks

perceive that, compared to present experiences, there is a favorable regard for live reef fishing at the time it was beginning to be practices in the islands (Figure 4.2). This is because the use of destructive fishing methods was not yet that prevalent then. In essence, there seems to be a relatively significant and growing awareness of the impact of live reef fish trade in terms of how practices and methods have accommodated illegal and destructive means and how these in effect have resulted in environmental destruction.

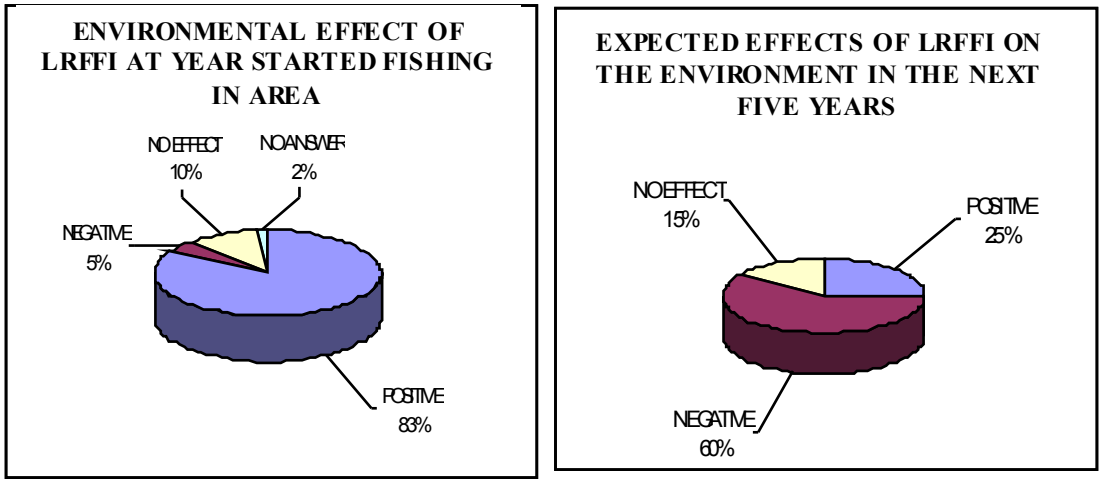


Figure 4.2. Perceived environmental effect of live reef fish industry (survey data).

Furthermore, the survey also show that the recent use of destructive and illegal fishing methods and the intrusion of large fishing vessels coming from other provinces have been observed to impact on the volume of catch, earnings, fish source distance and fishing time of fisherfolk directly involved in live reef fish catching In terms of changes in fish catch, it was observed by the fishers surveyed that the catch in 2001 was much less than when the trade started sometime in the mid-90's (Figure 4.3). But despite the marked decrease in fish catch, it was perceived that earnings from live reef fish catching

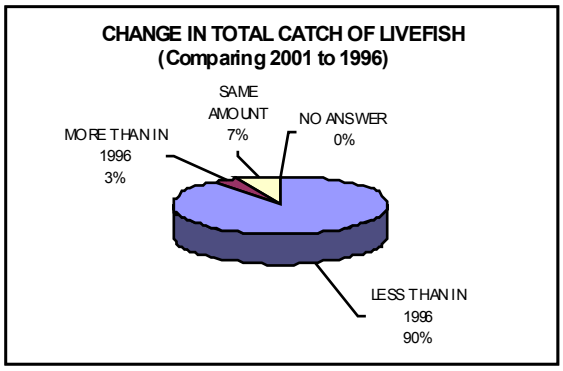


Figure 4.3. Perceived change in total catch of livefish (survey data).

increased since the time it was introduced in the islands (Figure 4.4). This is so since the price of live reef fish has increased more than a thousand (a good-sized grouper was valued at P50.00 in the early 90's as compared to the current average value of P1,000.00

for the same weight and size). Hence, even with a limited catch, fisherfolks gain relatively high-income return from the sales of a few live reef fish. But the catching practice has not been easy and there is a marked perception of how difficult live reef fish catching has become. In terms of distance, it was observed that fishing grounds for live reef fish is farther than when it started (Figure 4.5). Fisherfolk engaged in live reef fishing need to travel a farther distance to be able to gain a greater assurance of catching live reef fish. This is because many of the nearby fishing grounds have either been

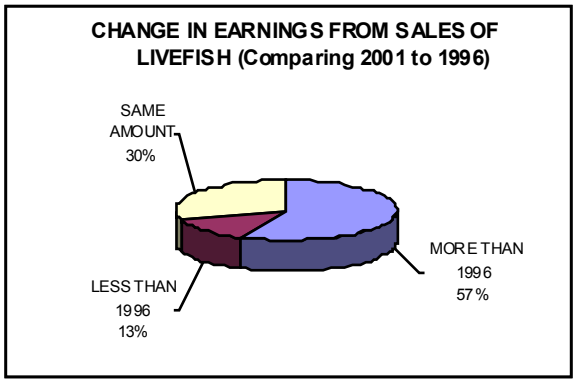


Figure 4.4. Perceived change in earnings from sales of livefish (survey data).

affected by illegal and destructive fishing practices or the presence of 'other' fisherfolk has made the catching more competitive. Many local fisherfolk have identified relatively well-stocked areas but these are situated farther that the usual areas (refer to Community Map of Live Reef Catch Areas: Delian and Kanipo and Map of Location and Abundance of Live Reef Fish). As a result of these identification of distant fishing grounds and the consequent movement of fisherfolks towards these areas, the duration needed to catch a

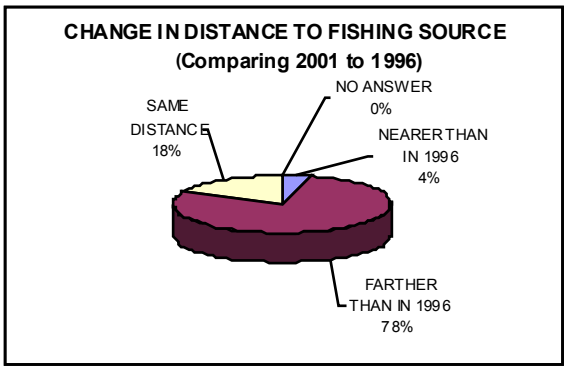


Figure 4.5. Perceived change in distance to fishing source (survey data).

substantial yield has become greater. It was observed that live reel fishing entails a longer time compared to when it started. In the mid-90's the time needed to travel and catch a substantial yield only took less than a day whereas current catch duration will take as long as three to five days (Figure 4.6).

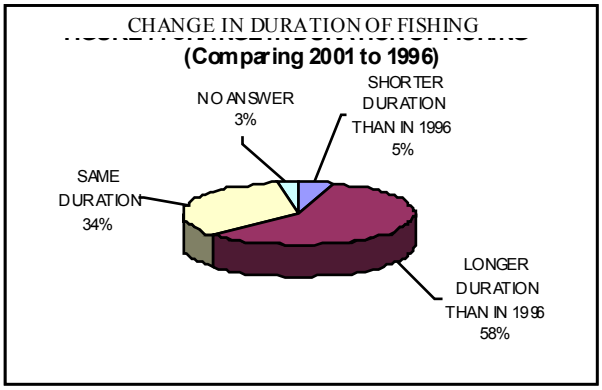


Figure 4.6. Perceived change in duration of fishing (survey data).

3.2.1 Socio Institutional

There are a number of agencies and institutions that are involved in the live reef fish trade although the degree of their work and relevance varies depending n their levels and scope of significance. Most prominent among the various institutions and agencies directly involved in the live reef fish trade are the Palawan Council for Sustainable Development (PCSD), the national line agencies such as the Department of Agriculture (specifically the Bureau of Fisheries and Aquatic Resources or BFAR) and the Department of Environment and Natural Resources, and the municipal governments. The PCSD is mandated by law to provide the development policy and program framework for the province and hence is responsible for coordinating development and natural resource management initiatives and ensuring that these are consistent to sustainable development principles. The government's line agencies are expected to provide the strategic and technical assistance to local governments and communities in terms of servicing and responding to local needs. Municipal governments are looked upon as the key implementors of development and resource management initiatives taking into careful consideration contextual concerns and capabilities. Given these levels of scope of involvement, it is therefore critical that these institutional levels perform consistently and are in coordination with each other for it to provide maximum impact. Unfortunately, this has not been so.

Weak institutional significance and coordination - It was observed that key sectors in the broader community have very low regard of formal government agencies and institutions (refer to Diagram 4.1, 4.2 and 4.3 - Womenfolk, Fisherfolk, and Indigenous Peoples Perception Diagrams of Relevant Institutions and Agencies). The diagrams presenting the level of significance various agencies and institutions have in relation to local concerns and issues show how 'distant' they are in terms of felt significance they have vis-à-vis with the communities. It is interesting to note that agencies and institutions commonly regarded as those that have direct relations to the live reef fish trade are those that are not providing the strategic interventions and assistance needed to respond to local issues and

concerns especially those which concern enforcement of laws and the apprehension of those using illegal and destructive fishing methods. Although there is an appreciation of local government in terms of relating to communities, this is mainly determined by access and immediacy. Hence it is the barangay local government is most regarded as that which has a degree of significance and potential relevance compared to the municipal and provincial local governments. It is those agencies and institutions that do not have direct links to the live reef fish trade but respond to basic social services that are perceive to be providing the most help.

Yet, despite the felt presence of institutions and agencies tasked to ensure the sustainability of development and natural resource management both in the provincial and local levels many stakeholders consistently feel that pressures on the delicate resource base and inequitable economic arrangements persist and may potentially impact on the sustainable practice of live reef fishing in the area. Interestingly, stakeholders indicate the ineptitude of these institutions and the lack of a clear working relationship among and between themselves to appropriately regulate illegal activities and strictly enforce policies and rules. For example, the local governments and the PCSD have been perceived by communities to be ineffective especially regarding enforcement against illegal fishing practices and the intrusion of 'other' fishing vessels which has led to the influx of materials and ingredients used for illegal and destructive fishing methods. Furthermore, in the municipality of Busuanga, their enforcement agency has only 2 personnel assigned, a boat and a limited supply of fuel. Hence, it is no wonder that live reef fishers have a very low regard for local government. Clearly, communities do not view relevant government agencies as having the capability and capacity to enforce appropriate regulations as well as the qualities needed to coordinate among themselves.

Lack of institutional capabilities - Also, from the diagram drawn by stakeholders, only the cultural communities are aware of the PCSD despite it being an institutional body at the provincial government level actively responsible for the overall supervision of the natural resource management initiatives of the province, including the live reef fish trade. Also, from the diagram, stakeholders have very little felt support and assistance from line agencies that are expected to provide needed service. Instead, it is the agencies indirectly involved in natural resource management, in particular the live reef fish trade, that are regarded as more relevant to communities. On the other hand, stakeholders indicate that municipal governments have been considered as responsive but if further qualified in terms of its potential rather than actually providing assistance. Survey results indicate that stakeholders have very little regard for local governments because of officials' vested interests and control from local financial and political elites. These observations have been shared by stakeholders based on their experiences regarding the continuing use of illegal fishing methods which has greatly damaged much of the major fishing grounds and the unabated increase in the number of fisherfolk engaged in the trade that has placed enormous pressure on the resource. Clearly, with all of these agencies and institutions working on similar scopes and agendas, much is desired in terms of coordination and collaboration. This is pronounced on the issue of property rights regimes in terms of access to live reef fish resource and management. In the context of the live reef fish trade, the most evident role of the PCSD has been that of providing accreditation to fisherfolks

and organizations wishing to engage in the trade. But municipal governments are also providing accreditation and are trying to seek a level of greater responsibility over the access and management of its resources. What merges then is a multi layered bureaucratic procedure, highly regulatory without clear accountabilities. Except for cultural communities' claim over recognized ancestral domain (terrestrial, coastal and water), there is very little municipal governments can do beyond their boundaries. Although the PCSD works at the municipal government level through the Environment Critical Action Network (ECAN), the function of such body has in some instances conflicted with local development agendas and has thus had limited impact on sustainable management of local resources.

Interestingly, from the diagram of institutional and agency relations with communities, live reef fishers recognize the significance of local government's role, but there is hardly a felt impact of local government in terms of providing support and assistance to communities and ensuring that the sustainability of their economic activity. Communities are essentially marginalized from the whole decision making process since it is believed that local political and financial elites have virtual control over the decision making process. Although those interviewed have indicated almost an inconclusive perception of the local government's effectiveness in stopping illegal fishing activities, this may also be viewed as communities' uncertainty with regards to how local governments' should respond to local concerns and needs. Nowhere is this disturbing perception more evident in how communities regard law enforcement agencies. From the diagram of institutional relations, the police is situated farthest from the community which indicates the very low level of significance enforcement agencies have on communities. During focus group discussions, it was shared that the reason why illegal activities persist is the strong links unscrupulous traders and operators have established with law enforcement agents. This was further stressed by the survey results when respondents were asked about the LGUs effectiveness in responding to the illegal fishing activity issue (Figure 4.7). Although the results are not conclusive, it highlights the mixed, if not indifferent view of communities on the impact and enforcement function of the local government.

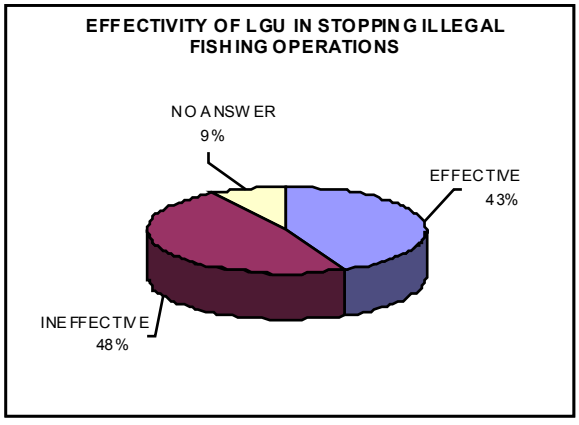


Figure 4.7. Perceived effectivity of local government units in stopping illegal fishing operations (survey data).

3.2.2 Socio Economic

The live reef fish trade in the Calamianes has become a very sophisticated and relatively highly beneficial economic activity. This has greatly affected how people and communities are relating among themselves and what they are beginning to consider in terms of their survival. It is very apparent that much has changed in the last few years and these changes has brought forth key concerns that mainly pertain to the socio-economic lives of the communities – their sense of empowerment as expressed by their role in decision making processes and the level of equity or that which allows them to enjoy the optimal benefits of their labor. In these two instances, the study shows that there in much that needs to be addressed.

Absence of empowering mechanisms - Generally, fisherfolk have very little regard of their role in the overall decision-making process and dynamics and their relations with local government units regarding the live reef fish trade. In terms of the decision making process, most fisherfolk believe that only the local and financial elite have the capacity to mak Yet, despite the felt presence of institutions and agencies tasked to ensure the sustainability of development and natural resource management both in the provincial and local levels many stakeholders consistently feel that pressures on the delicate resource base and inequitable economic arrangements persist and may potentially impact on the sustainable practice of live reef fishing in the area. Interestingly, stakeholders indicate the ineptitude of these institutions and the lack of a clear working relationship among and between themselves to appropriately regulate illegal activities and strictly enforce policies and rules. For example, the local governments and the PCSD have been perceived by communities to be ineffective especially regarding enforcement against illegal fishing practices and the intrusion of 'other' fishing vessels which has led to the influx of materials and ingredients used for illegal and destructive fishing methods.

Summary of Responses from Survey Regarding Decision Making Processes

DECISION MAKING
- Only a few people : local elite
- Not enthusiastic
- Pessimistic about getting/reaching consensus
- Not informed on issues and organizations

LOCAL GOVERNMENT
- LGU (Municipal) responsibility
- Local government makes organization response difficult : Barangay

Furthermore, in the municipality of Busuanga, their enforcement agency has only 2 personnel assigned, a boat and a limited supply of fuel. Hence, it is no wonder that live reef fishers have a very low regard for local government. Clearly, communities do not

view relevant government agencies as having the capability and capacity to enforce appropriate regulations as well as the qualities needed to coordinate among themselves.e significant decisions hence the lack of enthusiasm and motivation to participate in decision making activities. Even in terms of relating to fishing communities and reaching a consensus among the fisherfolk is perceive to be difficult and in many instances a prevailing sense of pessimism. These negative perceptions on the local fisherfolk decision making is attributed to the lack of opportunity for them to understand and articulate their issues and concerns as well as the limited information they have of organizations and institutions that may provide support and assistance. In effect, fisherfolk communities are marginal from the whole decision making process as well as from potential access to support. Their relative negative, if not indifferent, impression of the effectiveness of local governments in terms of stopping illegal fishing operations indicates that communities do not see anyone taking effective responsibility over the issues pertaining to the trade. Although there is an awareness of the critical role of local government since communities still regard the municipal local government as the unit most responsible in terms of responding to issues concerning live reef fishing, this awareness ahs not been translated into concrete actions and impacts. But enabling local government's active involvement requires the commitment and initiative of the barangays in ensuring the conduct of localized decision making processes. Unfortunately, communities do not have positive experiences working with barangay officials since conflicting interests have made organization and decision making processes difficult.

Inequitable distribution of benefits and the growing sense of dependence - From the web diagram of issues and concerns related to live reef fishing (refer to Diagram 4.4: Web Diagram of Local Concerns and Issues), it was evident that the fishers perception of how the trade and market relations and processes define the dynamics and arrangements among the various actors involved show a cycle of dependency. This is evident in the relationship between fisherfolk and the financiers especially in terms of valuing the resource and the provision of access or support to sustainably engage in the business. The level of live reef fishing has reached a degree of sophistication and intense competition. This requires fisherfolk to constantly seek a level of security if not the appropriate arrangement to sustain their livelihood. Hence, poor fisherfolk, especially those who have lately just engaged in the trade incur debts and enter into working relationships that thrives on patronage and loyalty. This is further encouraged given the extreme difficulty and risk that accompanies the catching of live reef fish. Fisherfolk need to travel long distances and stay long periods of time just to be able to catch an adequate supply. In most cases, there is no catch. Fisherfolk will need to enter into debts just to be able to provide his family food while he is away. The returns are uncertain hence, costs are compounded and the debts increase. Just to ensure that support is needed, loyalty to certain operators is established and a vicious cycle of dependence is perpetuated. In effect, fisherfolk become increasingly unempowered and marginalized.

Given the growing level of dependency of ordinary fisherfolk to those that have the technology and financial resources, as a consequence, it appears that benefits, particularly profits from fish catch are inequitably distributed. Results from the survey strengthens this observation since it shows that for the for the year 2001 in terms of annual profits

earned, about 56% of those interviewed were able to gain earnings while the rest incurred losses which eventually translated to further debts. Although this may be attributed to efficiency, there is an underlying concern as to who has access to resources and technology as well as the information that determine efficiency and how these are accessed. Clearly, the comparative edge may be found among those whose social and economic arrangements have reached a level of sophistication such that it ensures optimal profits. However, as a consequence, ordinary fisherfolk who are left out of this dynamics will continue to experience losses and hence sustain a relationship based on debt and indebtedness.

3.2.3 Gender

The live reef fish trade has greatly affected the domestic and economic roles of females in fishing communities. Based on the interactions with community members, it was expressed that the current difficulties being experienced by fisherfolk in struggling to earn a living through live reef fishing has led to adjustments in domestic activities such as time spent on child care and home management. What has overtaken common domestic activities are those that are more economically oriented in terms of engaging in income earning ventures. Despite the large income gained from live reef fishing, the inconsistency and uncertainty of fish catch consequently forced women in these fishing communities to seek other means of providing alternative sources of income to be able to ensure that there is constant influx on financial resource. This adjustment in the role and function of women in fishing communities has resulted further rationalizing the critical contribution women provide in ensuring domestic stability. Unfortunately, these emerging adjustments are not being optimized in terms of enabling greater social and economic stability within the communities. It would be an opportune moment to enable a process whereby there is a means of articulating local social and economic issues which may lead to greater local response. Now that there is a sense of balance between the genders in terms of equal levels of significance on the overall economic stability within the family, there is a need to seek opportunities that may lead to overcoming the difficulties associated with live reef fishing.

3..3 Quality of Life

Live reef fishing has become the major and economic activity for most of the communities in the Calamianes Islands, hence, it is no wonder that much of the local concerns and issues are centered on their experience in the live reef fish trade especially that which revolve around the quality of life.

Food security being threatened – The issues web diagram has in its center the issue of lack of income which is explained as caused by a number of factors but mainly concerning the uncertainties brought about by live reef fish catching and the trade. Concerns such as low yield or few catch due to illegal fishing and intrusion of other fisherfolk, quality of catch and weather conditions affects the amount of income. Due to lack of income, there is the inability to send children to school, failure to acquire basic necessities, indulgence in vice, and the increase preference to enter into debt. The

consideration to acquire debts in turn either leads to alleviate current dire conditions or further the debt situation which consequently perpetuates a vicious cycle. By doing so, there emerges a deep social and economic gap between those who have the financial resources and those who do not have. As a result of this inequitable economic dynamics and social relationships, food security is thus threatened and made more uncertain by the lack of proper response from concerned agencies.

Limited access to basic social service - One of the key issues presented in the institutional relations diagram is how certain government line agencies have been providing basic social services to fishing communities. Although it is shown that a number of government line agencies, focused on providing basic social care and service, appear to be most relevant and appreciated, the reason being is because they have been visible to the communities and not necessarily because they are able to deliver the needed service. For communities, social service is associated with presence and visibility and not so much their impact. The lack of needed social service and forms of support that may potentially contribute to improving the communities' quality of life is evidenced by the absence of key service infrastructures such as health centers and primary school establishments in the island barangays and fishing communities. More importantly, community members note the lack of information regarding alternative livelihood opportunities and skills and capacity development trainings, which they regard as valuable inputs in potentially allowing them to improve their current economic and social status. Interestingly, communities note that it is only during election periods that both presence and concern from national government is felt.

Weak cultural cohesion and stability - In less than a decade, the live reef fish trade has exceptionally evolved from a simple but high risk-high return economic activity to a multi level sophisticated and highly complex socio-economic trade dynamics. This quantum-like leap has placed great pressure on the social dimension such that tensions and areas of social instability are felt. This is evident on how local residents relate to migrants and indigenous peoples. At present, there is a social and cultural equilibrium but this has been observed as fragile and unstable. For example, in the island of Delian, local residents and communities are trying to negotiate with the indigenous community for them to allow the construction of a school building on the island. The indigenous community has consistently rejected the proposal believing that such establishments may potentially weaken their traditional and cultural fiber hence increasing social tension in the area. Local NGOs are aware of this concern but have not yet fully been able to respond since there is a limited understanding of local cultural dynamics as well as inadequate capacity to work on a clearer and collaborative level of assistance. Nowhere is this more apparent in the relationships involving those engaged in live reef fishing especially in light of emerging constraints in terms of access to catch areas, use of proper fishing technology and responsibility over the care and maintenance of identified fishing grounds.

4. Summary and Conclusions

In determining the social impact of the live reef fish trade in the Calamianes Islands, four social sustainability areas were used which were further developed and measured by their impact indicators: Socio-Institutional (capability and capacity, and coordination); Socio-Economic (empowerment and equity); Gender (balance and complementation); and Quality of Life (cultural stability, food security, and access/utilization of basic services). To further determine the overall usefulness of these indicators, a matrix presenting how effect areas affect these indicators, was used. In the matrix, the sustainability areas were further qualitatively assessed in terms of how they link up with various effects (i.e., scale, technology and regulatory) brought about by the live reef fish trade. Adopting an approach and model used by OECD determining the link between trade and environment, a summarized presentation of determining social sustainability is presented.

The Matrix of Social Impact of Live Fish Trade presents how impacts brought about by the economic activity is linked with identified social sustainability indicators (Table 4.2). The effect of scale refers to the changes in intensity, frequency, or number of specific characteristics brought about by the trade. The technology effect presents the level of sophistication or technical applications that are related to the trade. Finally, the regulatory effects are those which pertain to policies and guidelines that refer to the conduct of the economic activity in the area. In the table, each of the effects will or may have corresponding impact on certain social sustainability indicators, whether positive – that which contributes to its significance, or negative – that which constrains or hinders attention to it. The table shows that the effect of the current state and practice of the live reef fish trade economy in the Calamianes Islands is socially unsustainable.

This conclusion is further explained by the following key insights based on the study conducted. First, despite the abundance of national and local policies governing live reef fish trade dynamics, there is a lack of a pro-active and sustainable resource management policy that takes into account local social capital such as local knowledge and skills. It is evident during the social assessment exercises and survey that communities are much aware of the need to work with government in order to establish a sustainable resource management strategy. The acknowledgement by communities of the growing difficulties and risks associated with current fishing practices, the intrusion illegal fisherfolk and the increasing use of destructive methods highlight the opportunity to seek ways whereby communities are provided greater responsibility and accountability over local resource management. This is where NGOs can provide the most effective support. It is important that community organizing efforts are directed towards increasing awareness of the biophysical character of the trade as well an awareness to establish collaborative arrangements between government and communities.

Second, it is apparent that policies are not matched by strong and able institutional capabilities particularly in matters concerning enforcement and responsive governance. This is mainly an indication of an unempowered local government and is symptomatic of top heavy development initiatives. What is needed is to re-orient provincial involvement as becoming more facilitative rather than regulatory. This may be achieved if municipal

governments are provided strategic technical and financial assistance in first, gaining a full understanding of the state of their resources which may eventually lead to concrete responses such as enabling greater enforcement capabilities. This may enable municipal governments to undertake a process of that leads to a responsive-oriented form of governance.

Finally, there is a significant level of social instability manifested by dependency arrangements, inequitable distribution of benefits, and weak socio-cultural cohesion. Present stakeholders relations are clearly based on the efficiency given the stiff competition over scarce resource hence requiring means of gaining competitive advantage. As such, this need leads to access the needed technology and resource through debts and patron-based relations. But uncertainties of the trade only lead to further debt and indebtedness hence perpetuating dependency relations. This consequently results to the inequitable distribution of benefits since only those who own the resources that enable efficient fish catch are those who gain the most. Hence, fisherfolk who wish to ensure substantial catch will enter into arrangements with those who can provide the needed technology, adding costs for the fisherfolk and lower economic benefits.

The perpetuating cycle of dependency and lower net benefit communities are experiencing is in turn affecting local socio-cultural relations. Fishing communities continue to expand and lack of provision of social services from government line agencies have created tensions over resource access and use. This is more conspicuous in matters involving relationships between indigenous communities and local residents given disparate resource management regimes and responsibility over these resources. Therefore, given the unstable nature of social relationships at the community level, it is critical that efforts are programmed to establish social cohesion and stability upon which may be built socially responsive resource management strategies.

Table 4.2. Matrix of Social Sustainablity Impacts

EFFECT	RELATED SOCIAL FACTORS	SOCIAL SUSTIANABILITY INDICATORS								
		Socio-Institutional			Socio-economic		Gender	Quality of life		
		Gov't capacity and capability	Gov't agency coordination	Civil society-gov't coordination	Equitable distribution of benefits	Self reliance and empowerment of fishers	Complimenting roles and functions	Access to basic social services	Food security	Cultural stability
Scale	Increased number of fisherfolk	– –	–	–		– – –	+ +	– –	– – –	– – –
	Movement/shift to farther fishing grounds					– – –	+ + +		– – –	
	Increased number of fisherfolk from other areas	– – –	– – –		– –	–	+		– – –	– –
Technology	Increased use of hook and line method								+ + +	+ + +
	Increased use of cyanide and dynamite fishing methods								– – –	– – –
Regulation	Required Provincial accreditation	+ +	+ + +	+ + +					+	
	Required Municipal permit	+ +		+ +						
	Unclear property rights regimes	– –	– – –	– – –		– – –				– – –
	Absence of resource management strategy	– –	–	– –	–	–			– –	

+ + + : Very high positive impact – – – : Very low negative impact

Part V
Conclusions and Recommendations

1. Conclusions

The biological/ecological, economic and social/community indicators are summarized below (Table 5.1). It is clear that LRFFI, as indicated by the assessments of the *P. leopardus* fishery in the Calamianes, is treading an unsustainable path.

The biological and ecological indicators suggest that the industry is "mining" and degrading its resource base that has greatly compromised its present and future regenerative capacity. Catch have lately been declining and any short-term increase in catch is coming from fishing grounds outside the Calamianes. Fishermen have been in search for more productive fishing grounds and have been spending more time at sea. The mean size of fish collected is getting smaller and exploitation rates indicate serious overfishing.

The economic indicators essentially present the same results. Income from fishing has been dissipated by declining catches brought about by overfishing and the swelling number of fishermen in a regime of open access. Likewise, the returns from capital and labor have been greatly diminished over time. This, despite the increase in the price of fish, at least in nominal peso terms. The reason why fishermen remain in the fishery is primarily the lack of non-fishing employment alternatives in the remote islands.

Unfortunately, the social and political institutions are not adequately equipped to address the declining ecological and economic state of LRFFI. Moreover, these institutions have not adequately responded to arrest the emerging problem despite the past policy pronouncements. More recently, however, the local institutions are showing resolve to address the problem before the situation becomes irreversible. A necessary and sufficient approach to improve the situation of LRFFI in Calamianes is through a multistakeholder commitment to do their respective roles in managing the industry. The social and political situation, however, does not currently appear to support such strategy.

Table 5.1. Summary Results of the Ecological, Economic and Social/Institutional Indicators Sustainability of LRFFI

Sustainability Indicators	Results in the Calamianes Islands Using Primary and Secondary Data
Catch	• Live fish catch (in kilogram weight) predominantly of *P. leopardus*, decreased from 1998 to 2001.
Catch per Unit Effort (CPUE)	• Absence of benchmark does not allow trend analysis but must have declined significantly due to decrease in catch and increase in number of fishers • Present estimate of CPUE in the harvest of live fish was higher relative to estimates found elsewhere in the tropics

Fishing distance and duration	• Respondents travel farther than in the past in search of new and productive fishing grounds, resulting in longer fishing trips/duration
Species composition	• *P. leopardus* remains the most dominant species
Fish body size	• Mean body size of *P. leopardus* decreased from 1998 to 1999. • There was also a reduction of the ratio of total weight (in kilogram) to total number of individuals in the catch (abundance) of live fish from 2000 to 2001. • Both results suggest growth over-fishing.
Size/age at sexual maturity	• Live fish trade targets size range (28 - 32 cm total length) which are young and sexually immature to maturing individuals • High catch rates of these small-sized individuals may lead to recruitment over-fishing
Fishing mortality rates	• High, preliminary estimates of mortality rates for *P. leopardus* are relatively higher than those in the Great Barrier Reef, Australia.
Exploitation rates/yield per recruit	• MSY is exceeded; stocks of *P. leopardus* in the Calamianes are overfished
Habitat degradation due to cyanide exposure	• No significant spatial effect, estimate of habitat degradation was small but dead coral cover was greater than live coral cover on cyanide-impacted areas compared to non-impacted areas
Price	• Increased significantly from 1994 to 2002, in nominal Philippine
Employment	• No time series data but current number is estimated at over 1,000 artisanal fishers which constitute primarily of migrants
Investment	• As the number of fishers has increased so did investments. While no census data exists, considering fishermen-boat ration of 3 persons, there should be at least 300 boats engaged in the industry,
Labor productivity	• Average annual gross profits amounted to over PhP 25,000 in 2001. This is lower than legally prescribed minimum wage rates. Fishermen remain in the industry as they may not have employment alternatives outside fishing.
Capital productivity	• In fishing, the boat is considered a sunk investment. The engine may have other uses. Returns of investment are very low on the average
Income distribution	• Quite a number of fishers are already losing • Inequitable distribution of benefits – those who have greater access and control of the finances reap the benefits while ordinary fishermen continue to incur debt year round
Government capacity and capability	• Weak due to absence of strategic management plan and lack of resources to do this • No real participatory decisions are made since local government structures including enforcement agencies are controlled by local financial and local elite • Barangay or village-level government is regarded significant and relevant in terms of facilitating the participation of fishermen • Coordination among government agencies is constrained by cross-cutting jurisdictional issues, ambiguous working relationships, and lack of institutional accountability • Perceived prevalence of irregularities in the enforcement of regulations and the ineffectiveness of concerned government agencies both at the national and local levels

Self-reliance and empowerment	• Absence of mechanisms for substantive multi-sectoral consultations and multi- stakeholder dialogues and other relevant consensus building activities at all levels or resource management use (at the fishermen level, LGU level, policy level, etc.).
Gender – complementing roles and functions	• Gender roles have shifted in terms of achieving equal levels of significance of both genders in keeping economic stability within the family • Uncertainties of income from LRFFI led women to assume more economically significant roles
Access to basic social services	• Absence of key service infrastructures at the barangay (village) level (especially in the islands where fishing communities are located) • Presence and concern from government are only felt during election time
Food security	• Perceived uncertainties by communities on the provision and acquisition of food due to inequitable trade dynamics and lack of service delivery from concerned government agencies • Resource depletion may be attributed to unregulated exploitation of fish stocks coupled by the unabated illegal and destructive fishing
Cultural stability	• Weak cultural cohesion and constructive awareness among the indigenous people • Unstable working relationships between migrants and indigenous peoples

2. Recommendations

It is clear from the above indicators that the fishery is overfished, in both biological and economic terms, and there is a sense of urgency to reverse the unsustainable path of the industry. This is an age-old situation not only in the Calamianes but in the entire country. Countless efforts have been undertaken and enormous resources have been spent yet overexploitation of fisheries continues if not worse. What are needed are new approaches.

Sustainability assessment provides a different approach to fisheries management, which is being implemented in the LRFFI in the Calamianes. Considering the economic, environmental and social aspects of the international trade-driven industry, solutions should address these three considerations at the same time. Therefore, what is emphasized in SA is the multistakeholder approach not only in managing the industry, but more importantly, in making relevant and responsive decisions. The stakeholders – the direct fishermen, traders, financiers, exporters, among others – should arrive at the appropriate decisions about the direction of the industry through consultations among themselves. This approach is a departure from the top-down prescriptive policy formulation and implementation and represents an extension of the community-based management approach.

Following this approach, the study suggests a process involving these activities:

f) Presentation of the results of the study to the local stakeholders in Calamianes Islands.

g) Conduct of dialogues and consultations among the stakeholders themselves to decide on specific measures to be undertaken to reverse the unsustainable path of the industry. Dialogues and consultations will be aided by the project technical team for scientific inputs and by the local government officials for legal and administrative inputs.

h) Formulation of specific measures that will be arrived at by the stakeholders that are necessary and sufficient to ensure the sustainability of the industry. The project technical team will: a) assess if the measures proposed by the stakeholders constitute the "minimum" to reverse the trend; b) recommend additional measures if called upon by the stakeholders. The set of measures should address the economic, environmental and social issues of the LRFFI.

i) Identification of the roles and responsibilities of each stakeholder group in ensuring the sustainability of LRFFI, which are mutually agreed upon by them, thus acceptable and doable. The stakeholders will ensure that not one group is "free riding" on the others. The local government will certify if the roles are within legal bounds, easily monitored and administratively feasible.

j) Implementation, monitoring and evaluation of the management of the industry by all stakeholders, including the local government units with technical and scientific support for monitoring and evaluation. It should be recognized that the management scheme is adaptive allowing for periodic adjustments along the way to adjust to unforeseen circumstances and the effectiveness of each measure.

The recommended roles of the local government units (PCSD, provincial, municipal and barangay levels) include the following:

e) Enabling the conduct of multistakeholder dialogues and consultation. Government should basically agree to industry self-regulation subject to a minimum set of acceptable targets that will be sufficient to ensure sustainable LRFFI.

f) Enacting the required ordinances to provide for the formal implementation of the set of measures formulated and agreed upon by the stakeholders.

g) Monitoring and evaluation of the implementation of the agreed upon measures.

h) Facilitating continuing dialogues and consultations to "fine-tune" the measures in the context of adaptive management.

References

Alcala A, Russ G. 1990. A direct test of the effects of protective management on abundance and yield of tropical marine resources. J. Cons., Cons. Int. Explor. Mer. 46:40-47.

Bannerot S, Fox W Jr, Powers J. 1987. Reproductive strategies and the management of snappers and groupers in the gulf of Mexico and the Caribbean. *In* Polovina, J.J. and Ralston, S. (eds.), Tropical Snappers and Groupers: Biology and Fisheries Management, Westview Press, Boulders, Colorado. pp. 561-603.

Barber C, Pratt V. 1997. Sullied Seas: Strategies for combating cyanide fushing in Southeast Asia and beyond. World Resources Institute (WRI) Report. Washington, D.C., USA. 64 p.

Beets J, Friedlander A. 1992. Stock analysis and management strategies for red hind Epinephelus guttatus, in the U.S. Virgin Islands. Proc. Gulf Carib. Fish. Inst. 42:66-79.

Bentley N. 1998. The exploitation and trade of live reef fish in Southeast Asia. International Marinelife Alliance Report, Manila, Philippines.

Beverton R, Holt S. 1957. On the dynamics of exploited fish populations. Fish. Invest. Minist. Agric. Fish. Food (G.B.), Ser. 2(19), 533 p.

Brothers E. 1982. Aging reef fishes. NOAA natn. mar. Fish. Serv. Tech. Memo., U.S. Dept. Commerce NMFS-SECF-80:3-23.

Burke L, Selig E, Spalding M. 2002. Reefs at risk in Southeast Asia. World Resources Institute. Washington, D.C. USA.

Carpenter R. 1986. Partitioning herbivory and its effects on coral reefs algal communities. Ecological Monographs. 56:345-363.

Chapman D, Robson D. 1960. The analysis of a catch curve. Biometrics. 16:354-368.

Colin P. 1992. Reproduction of the Nassau grouper, Epinephelus striatus, and its relationship to environmental conditions. Env. Biol. Fish. 34:357-377.

Copes, P. 1972. Factor rents, sole ownership and the optimum level of fisheries exploitation. Manchester School of Economics and Business Studies 40(2): 233-259.

Environment and Trade – A Handbook; UNEP; 2000.

Erdmann M, Pet-Soede L. 1996. How fresh is too fresh? The live reef food fish trade in Eastern Indonesia. NAGA, the ICLARM Quarterly. 19:4-8.

Ferreira B.1995. Reproduction of the common coral trout *Plectropomus leopardus* (Serranidae: Epinephelinae) from the central and northern Great Barrier Reef, Australia. *Bull. Mar. Sci.* 56(2):653-669.

Ferreira B, Russ G. 1994. Age validation and estimation of growth rate of the coral trout, Plectropomus leopardus (Lacepede 1802) from Lizard Island, Northern Great Barrier Reef. *Fish. Bull.*, U.S. 92:46-57.

FQS 1999. "Data on live fish trade export from shipment records". Fisheries Quarantine Service – BFAR – Dept. of Agriculture. Nayong Pilipino, Pasay City, Philippines.

Gayanilo F, Pauly D. 1997. FAO-ICLARM Stock Assessment Tool (FISAT) – Reference manual. FAO computerized information series (fisheries) #8. Rome, Italy.

Gulland J. 1983. Fish stock assessment. A manual of basic methods. Wiley and Sons, New York, USA.

Jennings S, Polunin N. 1995. Comparative size and composition of yield from six Fijian reef fisheries. J. Fish Biology. 46:28-46.

Jones R, Steven A. 1997. Effects of cyanide on corals in relation to cyanide fishing on reefs. Mar. Freshwater Res. 48:517-522.

Jones R, Hoegh-Guldberg O. 1999. Effects of cyanide on coral photosynthesis: implications for identifying the cause of coral bleaching and for assessing the environmental effects of cyanide fishing. 177:83-91.

Longhurst A, Pauly D. 1987. Ecology of tropical oceans. Acad. Press, San Diego, CA. 407 p

Mamauag S. 1997. Age, growth and reproduction of *Plectropomus* spp. (Serranidae: Epinephelinae) in Northern Palawan, Philippines. MSc thesis. Dept. of Marine Biology, James Cook University, Qld., Australia.

Mamauag S, Donaldson T, Pratt V, McCullogh B. in press. Age and size structure of the leopard coralgrouper *Plectropomus leopardus* in the live reef fish trade of the Philippines. Proc. 9th International Coral Reef Symposium, Bali, Indonesia. Oct. 22, 2000.

McGovern J, Wyanski D, Pashuk O, Manooch C, Sedberry G. 1998. Changes in sex ratio and size at maturity of gag, Mycteroperca microlepis, from the Atlantic coast of the southeastern United States during 1976-1995. Fish. Bull. 96:797-807.

McManus J, Reyes R, Nanola C. 1997. Effects of some destructive fishing methods on coral cover and potential rates of recovery. Environ. Management. 21(1):69-78.

Mous P, Pet-Soede L, Erdmann M, Cesar H, Sadovy Y, Pet J. Cyanide fishing on Indonesian coral reefs for the live food fish market – what is the problem. InCesar H (ed.) Collected essays on the economics of coral reefs. CORDIO, Kalmar University, Sweden. 244 pp.

Mulligan T, Leaman B. 1992. Length-at-age analysis: can you get what you see? Can. J. Fish. Aquat. Sci. 49:632-643.

Munro J, Williams D. 1985. Assessment and management of coral reef fisheries: Biological, environmental and socio-economic aspects. Proc. 5th Inter. Coral Reef Symposium. 4:545-581.

Natural Resources, International Trade, and Sustainable Development Series No.1: Fish for Thought; IUCN.

Padilla, J. and P. Copes 1994. Bioeconomic Analysis of Management Options for Tropical Fisheries Using a Bicriteria Programming Model. Marine Resource Economics. 1994 Vol. 9 pp.47-66.

Padilla, J., G. Silvestre and M. Dalusong. 1995. "Bioeconomic Stress Indicators for Fisheries: Conceptual Exposition and Preliminary Applications" in A. Menez and G. Newkirk (eds.) Philippine Coastal Resources under Stress. Canada: Dalhousie University and Philippines: University of the Philippines

Padilla, Jose E. and A. Morales. 2002. Towards a Sustainability Assessment Framework for Trade-Related Fisheries Policies in the Philippines (Draft).

Padilla, J. and A. Morales. 1999. Economics of Fishpen and Fishcage Operations in Lingayen Gulf, Philippines. Environmental and Natural Resources Accounting Project (ENRAP). Department of Environment and Natural Resources (DENR). Quezon City, Philippines.

Pannella G. 1971. Fish otoliths: daily growth layers and periodical patterns. Science. 173:1124-1128.

Pauly D. 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud. Rev., Manila, Philippines. 8, 325 p.

Pauly D, Christensen V, Dalsgaard J, Froese R, Torres F Jr. 1998. Fishing down marine food webs. Science. 279:860-863.

Philippine Poverty Assessment, Volume 1: Main Report, World Bank, May 2001.

Pet J, Pet-Soede L. 1999. A note on cyanide fishing in Indonesia. SPC Live Reef Fish Information Bulletin. 5:21-22.

Pratt V, Mamauag S, Alban J, Parfan E, Donaldson T. 2000. Status report on the Philippine live reef fish trade and strategies to combat its destructive fishing practices. Report on the Status of Coral Reefs in the Philippines, Marine Science Institute, University of the Philippines, Diliman, Quezon City. February 2000.

Ralston S. 1987. Mortality rates of snappers and groupers. In Polovina, J.J. and Ralston, S. (eds.), Tropical snappers and groupers. Biology and Fisheries Management. Westview Press, Inc., Boulder, Colorado. 659 p.

RAP Bulletin of Biological Assessment. 2000. A rapid marine biodiversity assessment of the Calamianes Islands, Palawan Province, Philippines. Conservation International. Dept. of Conservation Biology, Washington D.C., USA.

Reference Manual for the Integrated Assessment of Trade Related Policies, UNEP, 2001.

Roberts C. 1995. Effects of fishing on the ecosystem structure of coral reefs. Conserv. Biology. 9(5):988-995.

Robinson S. 1986. Palawan's live "lapu-lapu/mameng" trade: Raising the stakes in the cyanide controversy. Report submitted to the Philippine Dept. of Agriculture (then Ministry), Task Force on Illegal Fishing. Manila, Philippines.

Rubec P, Pratt V. 1984. Scientific data concerning the effects of cyanide on marine fish. *Freshwater and Marine Aquarium*. 7(5):4-6, 78-80, 82-86, 90-91.

Russ G. 1991. Coral reef fisheries: effects and yields. In Sale, P.F. (ed.), The ecology of fishes on coral reefs. Academic Press, Inc., San Diego, CA. 754 p.

Russ G, Alcala A. 1989. Effects of intense fishing pressure on an assemblage of coral reef fishes. Mar. Ecol. Prog. Ser. 56:13-27.

Russ G, Lou D, Higgs J, Ferreira B. 1998. Mortality rate of a cohort of the coral trout Plectropomus leopardus, in zones of the Great Barrier Reef Marine Park closed to fishing. Mar. Freshwater Res. 49:507-511.

Saila S, Kocic V, McManus J. 1993. Modelling the effects of destructive fishing practices on tropical coral reefs. Mar. Ecol. Prog. Ser. 44(1):51-60.

Sale P.F. 1991. The ecology of fishes on coral reefs. San Diego, California: Academic Press, Inc. 754 p.

Sadovy Y, Rosario A, Roman A. 1994. Reproduction in an aggregating grouper, the red hind, E. guttatus. Env. Biol. Fish. 411:269-286.

Samoilys M. 1997. Periodicity of spawning aggregations of coral trout *Plectropomus leopardus* (Pisces: Serranidae) on the northern Great Barrier Reef. Mar. Ecol. Prog. Ser. 160:149-159.

Shapiro D. 1987. Reproduction in groupers. *In* Polovina, J.J. and Ralston, S. (eds.),Tropical snappers and groupers. Biology and Fisheries Management. Westview Press, Inc., Boulder, Colorado. 659 p.

Sustainability Impact Assessment Study, Phase One and Two Reports; WTO New Round.

Towards the Institutionalization of Sustainability Assessment Process in the Philippines – A Focus on Trade-Related Policies: A Proposal; SEAP, WWF-Philippines; 2002

Warner R. 1975. The adaptive significance of sequential hermaphroditism in animals. Am. Nat. 109:61-82.

Wilkinson C. 1998. Status of coral reefs of the world: 1998. Australian Institute of Marine Science.

Wilkinson C. 2000. Status of coral reefs of the world: 2000. Australian Institute of Marine Science. P. 127.

Zellar D. 1998. Spawning aggregations: patterns of movement of the coral trout Plectropomus leopardus (Serranidae) as determined by ultrasonic telemetry. Mar. Ecol. Prog. Ser. 162:253-263.