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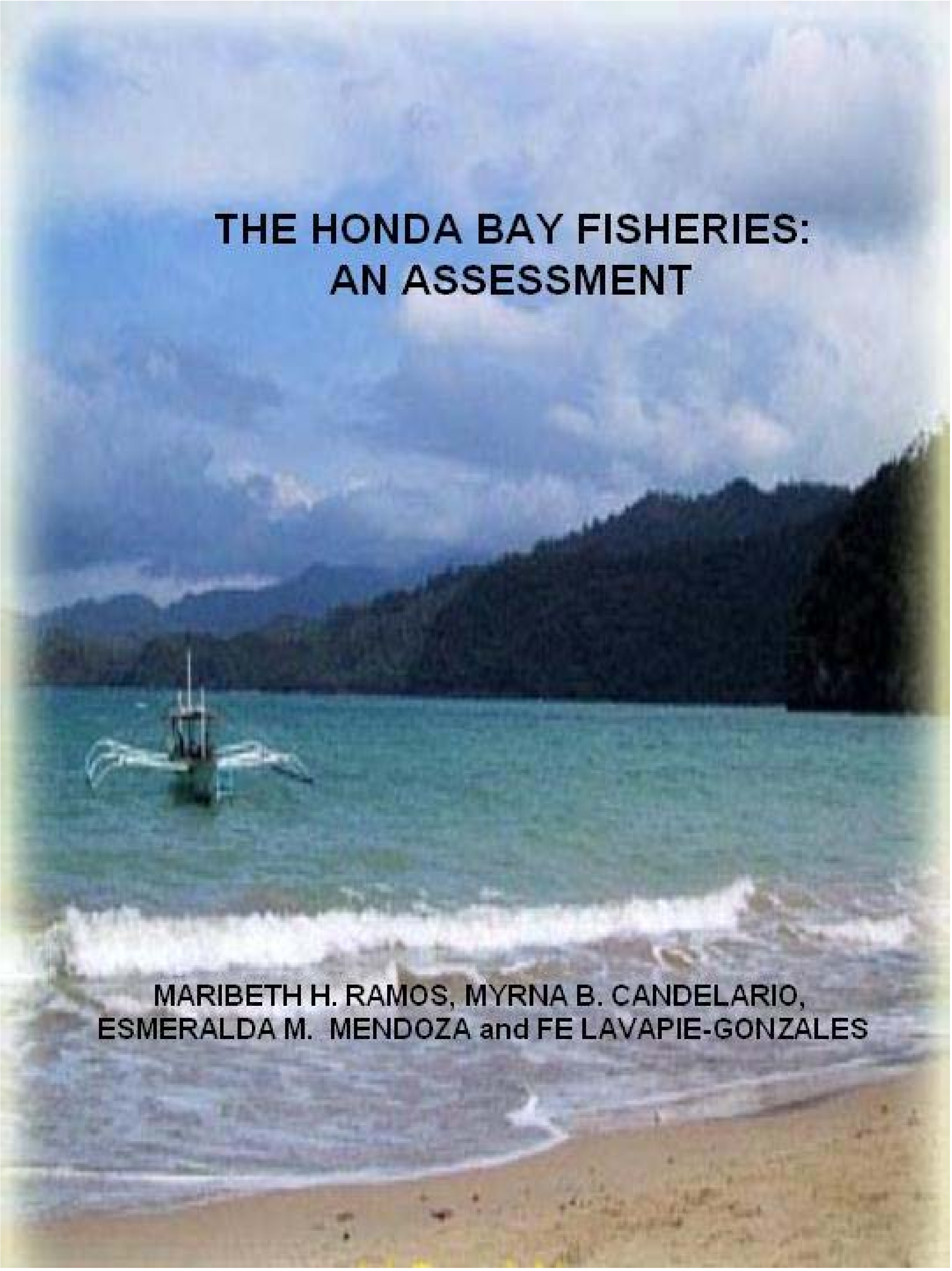
National Stock Assessment Program



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ABBREVIATIONS, ACRONYMS AND SYMBOLS

a	-	intercept
Am.	-	American
b	-	slope
BAS	-	Bureau of Agricultural Statistics
BFAR	-	Bureau of Fisheries and Aquatic Resources
BGN/BSGN	-	bottom gillnet/set gillnet
BIMP-EAGA	-	Brunei Indonesia Malaysia Philippines – East Asian Growth Area
BSLL	-	bottom set longline
Bull.	-	bulletin
CBCRM	-	community-based coastal resource management
CMO	-	City Mayor’s Office
Coll.	-	college
Comm.	-	Commission
COMM Program	-	Community Analysis Program
Comp.	-	computerized
Conf.	-	conference
CPUE	-	catch per unit of effort
CRM	-	coastal resource management
Dept.	-	department
e	-	exponent
E	-	exploitation rate
ECAN	-	Environmentally Critical Areas Network
ed./eds.	-	editor/s
EGN	-	encircling gillnet
ELAC	-	Environmental Legal Assistance Center
ELEFAN	-	Electronic LEngth Frequency ANalysis
Eopt	-	optimum exploitation rate
f	-	effort
F	-	instantaneous rate of fishing mortality
FAO	-	Food and Agriculture Organization of the United Nations
FC	-	fish corral
Fig.	-	figure
Fish.	-	fisheries
FISAT	-	FAO-ICLARM stock assessment tools
Fopt	-	optimum fishing mortality
FRMP	-	Fisheries Resource Management Program
FSP	-	Fishery Sector Program
GT	-	gross ton/tonnage
ha	-	hectare
HL	-	hook and line
ICLARM	-	International Center for Living Aquatic Resources Management
IMFO	-	Institute of Marine Fisheries and Oceanology
Info.	-	information
Int’l.	-	international
J.	-	journal

K	-	curvature parameter of the VBGF
kg	-	kilogram
LGU	-	local government unit
L∞	-	asymptotic length, *i.e.*, the (mean) length the fish of a given stock would reach if they were to grow forever
M	-	natural mortality
Mar.	-	marine
MCS	-	monitoring, control and surveillance
MHL	-	multiple hook and line
M.Sc.	-	Master of Science
mt	-	metric ton
NGA	-	non-government agency
NGO	-	non-government organization
NRP	-	number of recruitment pulses
NSAP	-	National Stock Assessment Program
p./pp.	-	page/s
Pap.	-	paper
PCAMRD	-	Philippine Council for Aquatic Marine Research and Development
PESO	-	Public Employment Service Office
Ph.D.	-	Doctor of Philosophy
Philipp.	-	Philippines
PhP	-	Philippine peso
PIADP	-	Palawan Integrated Area Development Project
PPC	-	Puerto Princesa City
Proc.	-	proceedings
PY	-	potential yield
Res.	-	research
RN	-	ringnet
Sci.	-	science
SEARCA	-	Southeast Asian Regional Center for Research and Graduate Study in Agriculture
Ser.	-	series
SGN	-	surface gillnet
SLN	-	stationary liftnet
Soc.	-	society
SZOPAD	-	Special Zone for Peace and Development
T	-	mean annual habitat temperature, in °C
Tech.	-	technical
Trop.	-	Tropical
TWINSPAN	-	Two-Way INdicator SPecies ANalysis
Univ.	-	university
UPV	-	University of the Philippines in the Visayas
VBGF	-	von Bertalanffy growth function, either in original or seasonally oscillating form
Vol.	-	volume
Z	-	instantaneous rate of total mortality
Ø’	-	growth performance index
<	-	less than
>	-	more than

ACKNOWLEDGMENTS

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Above all, we acknowledge the help of our ALMIGHTY GOD, for His grace of wisdom and strength, and guidance in the realization of the project.

ABSTRACT

This paper discusses the results of a fishery assessment of Honda Bay, conducted by the BFAR Region IV for a period of five years, from October 1997 to September 2002.

The entire five-year production showed fluctuating catches. The highest catch (1,095.6 mt) was attained in 2000. In 2002, the total production was 838.012 mt, a reduction of 23.5 percent from the 2000 production.

The potential yield (PY) and maximum potential effort were determined using the Schaeffer and Fox models. Results obtained using the Schaeffer model showed a PY of 975.03 mt at an optimum effort of 378.8 gross tonnage (GT), while those obtained using the Fox model, a PY of 977.2 mt at an optimum effort of 37.8 GT. The production in 2000, *i.e.,* 1,095.6 mt, is an indication that catch in Honda Bay has reached its maximum level for 2000, since the present PY is 977 mt (using the Fox formula) and 975 mt (using the Schaeffer formula). However, for 2002, the annual catch decreased to 838 mt.

Most of the important types of artisanal gear showed declining catch rates (CPUE), such as bottom set gillnet (16 to 14), stationary liftnet (54 to 34.2), surface gillnet (30.56 to 17), bottom set longline (11 to 8), hook and line (8 to 3.5), spear gun (23 to 7.8), and fish corral (36.5 to 7.7).

The average exploitation rate of all the species analyzed is 0.57, which indicates that heavy fishing is already occurring in the bay.

Based on the income per gear, six types of gear provide incomes above the minimum daily wage of PhP 150.00. The rest of the gear give incomes below the minimum wage, to as low as PhP 14.00/fisher/day.

INTRODUCTION

Proper utilization, conservation, protection, development and management of the country's capture fishery resources require vital information of the fisheries, including biological status of major species by area. Basically, these information require standard methods and regular data collection. Hence, the Bureau of Fisheries and Aquatic Resources (BFAR) conceptualized in 1998, and has implemented since then, the National Stock Assessment Program (NSAP) thru all the BFAR Regional Offices. The NSAP was instituted pursuant to Sections 7, 8 and 9 of Republic Act 8550 (or the Philippine Fisheries Code of 1998) which stipulate that resource assessment has to be done in order to obtain such vital information.

Under the NSAP, the study area of the BFAR Region IV is Honda Bay in Palawan. The bay is one of the 12 bays initially identified as overfished, and has therefore been given management focus under the Fishery Sector Program (FSP). The FSP is a fisheries management program implemented in 1990-1995 with the main goal of instituting the principle of community-based coastal resource management (CBCRM).

This paper discusses the results of a five-year assessment (1998-2002) of the fisheries of Honda Bay. The data were collected by the BFAR Region IV to augment existing information as basis for appropriate management measures.

Objectives of the Study

Generally, this assessment was conducted to formulate sound policies/measures for the management and conservation of the country's marine resources for the attainment of sustainable production in marine fisheries.

Specifically, this study aimed to (1) determine the number of fishing gear and craft; (2) map fishing areas and identify fish landing sites; (3) determine current levels of production and effort and their relationship; (4) estimate population parameters of major fish resources in Honda Bay; (5) understand recruitment patterns of dominant fish species; (6) complement the Bureau of Agricultural Statistics (BAS) in the generation of better fishery statistics in Honda Bay; (7) identify fishery issues and conflicts; and (8) formulate a set of recommendations on appropriate management options for the coastal waters of Honda Bay that would lead to formulation of appropriate policies.

MATERIALS AND METHODS

Secondary information about Honda Bay especially on the demographic, labor force, and employment data were collected, compiled and supplied in this study. The rest of the data were collected from primary sources. For the current information about the resources, sampling landing sites were identified and standard methods of sampling and data processing were followed (using the NSAP suggested methodology). Fish landing surveys were undertaken in these landing sites: Tagburos, Sta. Lourdes, Human and Katumbal in Lucbuan, Anilawan and Barimbing in Babuyan (Fig. 1). Sampling covered a five-year period starting in October 1997 until September 2002. The five-year fisheries and biological data collected were compiled and analyzed.

Fishing boat and gear inventory was conducted by the enumerators for 15 days in 19 barangays along Honda Bay, in coordination with the local barangay officials. The inventory was part of the assessment to determine the amount of fishing in Honda Bay, including the estimation of production.

Survey results, raised per month by gear by landing center, were summed up to obtain the annual yield from the six landing centers and then raised to the whole bay by using the information on gear counts.

For the purpose of standardization of effort and catch per unit effort, all data were transformed into Bottom Set Gillnet (BSGN) units, one of the dominant types of gear used in Honda Bay. The average CPUE of BSGN was divided by the annual estimated yield to determine the total annual effort in terms of the number of boat landings of BSGN.

An estimate of the present potential yield (PY) was done using the Schaeffer and Fox Models:

Schaefer $Y = af + bf^{2}$

Fox $Y = f e^{(a + bf)}$

where
Y = yield
a = intercept
b = slope
f = effort

and e stands for exponent.

Effort used in the estimation of PY is the total of gross tonnage of all fishing boats operating in the bay.

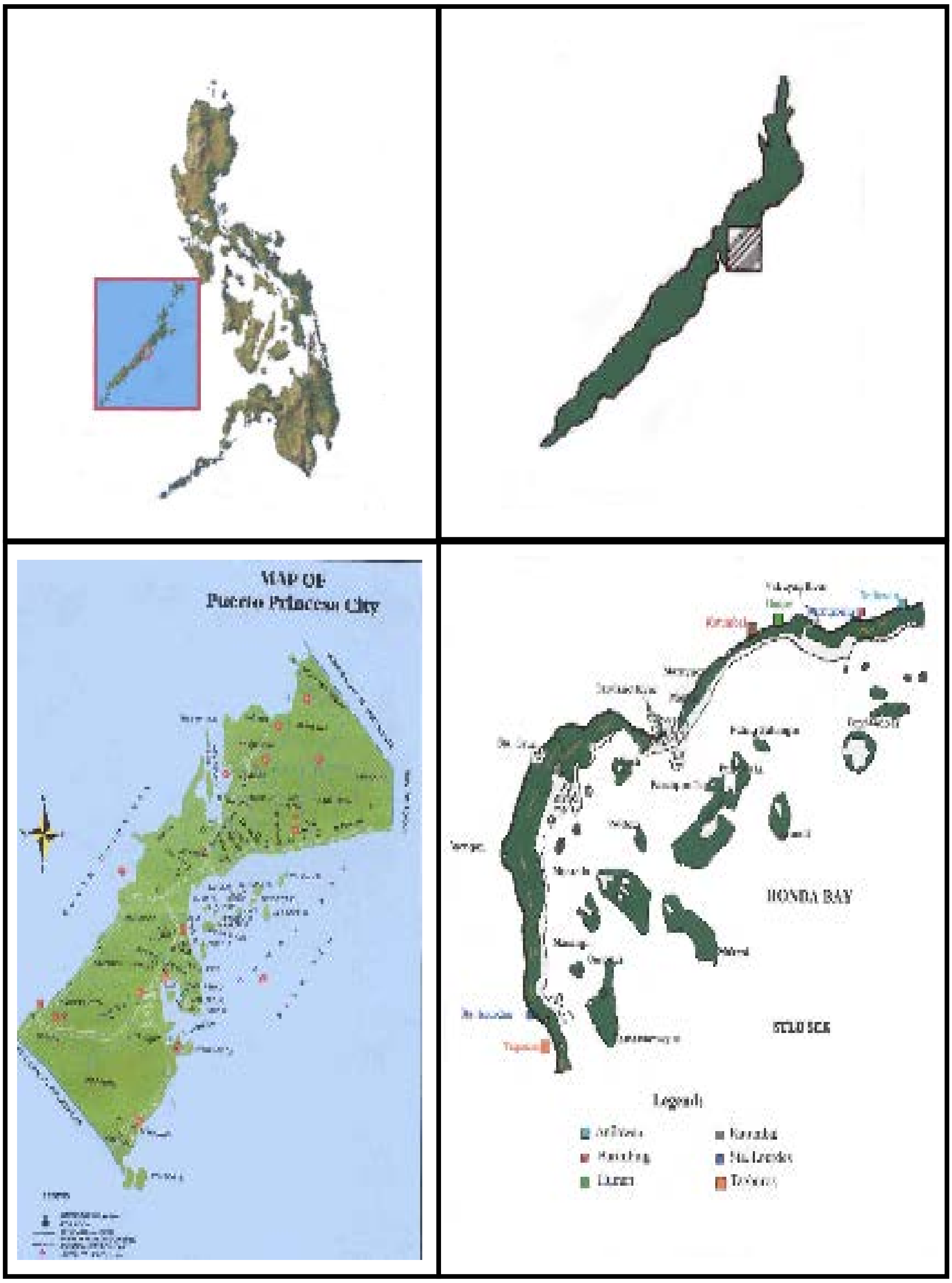


Figure 1. Maps showing the location of fish landing sites at Honda Bay where sampling for this study was regularly undertaken.

Population parameters were estimated using the FAO ICLARM Stock Assessment Tool or FISAT (Gayanilo *et al.* 1996). This tool was also used to analyze the length frequency data of some selected dominant species found in Honda Bay. Some file manipulations, like running average of three and adjustment of class intervals, were used to emphasize the modes and increase the number of points to be used. The Powell Wetherall's Plot (Powell 1979, Wetherall 1986) was used to estimate the mean asymptotic length (L_∞); the extreme value theorem (Formaccion *et al.* 1991), to estimate the $L_{max.}$ The curvature parameter (K) of the VBGF, when L_∞ is given, was estimated using the K-scan and curve fitting by eye routines of the ELEFAN I methodology (Pauly and David 1981).

Using the estimates of the growth parameters, L_∞ and K, an analysis of the seasonal recruitment pulse was performed using the Recruitment Pattern methodology as proposed by Pauly (1984) through reverse projection of the restructured data thru the time axis.

Natural mortality (M) was estimated using Pauly's empirical equation (Pauly 1980), *i.e*.,

$$\log(M) = -0.0066 - 0.27 \log(L_\infty) + 0.6543 \log(K) + 0.4634 \log(T)$$

where L_∞ (in cm) is the asymptotic length, K is the curvature parameter of the VBGF, and T is the mean annual habitat temperature taken as 28.O^{o}C. The length converted catch curve (Pauly 1984, Edralin *et al.* 1988) was employed to estimate total mortality (Z), where the fishing mortality (F) of the fully-exploited length groups can be deducted (*i.e*., M = Z – F); and exploitation rate (E) was obtained by dividing F by Z computed for each species (Beverton and Holt 1956, Pauly 1984, Pauly and Soriano 1986, Silvestre *et al*. 1991).

The growth performance index $Ø' = \log_{10}K + 2\log_{10}L_\infty$ (Pauly and Munro 1984) was used to compare the growth performance of species studied with previous estimates contained in "Fish Base" (Froese and Pauly 1998).

RESULTS AND DISCUSSION

Overview of the Study Area

Honda Bay is one of the major fishing grounds within the West Sulu Sea in Palawan, the island province known for its rich coral reef areas and its bountiful coral reef fishes. It is situated on the eastern side of mainland Palawan north of Puerto Princesa City, the center of trade and development and identified as one of the growth centers of the Brunei Indonesia Malaysia Philippines East Asian Growth Area (BIMP-EAGA) and the Special Zone for Peace and Development (SZOPAD).

Honda Bay, consisting of 18 coastal barangays, has an approximate area of 28,000 hectares with 13 charted islands. These islands are emergent portions of reef flats that give substrates the ideal environment to grow resource bases, such as coral reefs, mangroves and seagrasses that are critical ecosystems on which Honda Bay's fisheries depend (PIADP 1990).

Fondeado Island comprises the largest area with 139 ha, followed by Meara Marina Island Resort (41 ha) and Cañon Island (31.25 ha). Kalungpang Island is the smallest area.

In the past, Honda Bay had been the focus of development activities where mining activities were undertaken. A number of biological/resource assessment studies have been made, such as the preliminary study on the size and maturity of commercially important fishes in Honda Bay (Schroeder 1979), rapid rural system appraisal on Honda Bay and associated catchments (PIntegrated Area Development Project 1990), and resource and ecological assessment (ICLARM 1996) – all supporting the goals of CBCRM as part of the Honda Bay Fisheries Co-Management Project. In February 2000-2001 resource and ecological assessment, and socio-economic assessment were conducted by SEARCA and ICLARM, the results of which stated that Honda Bay is experiencing excessive fishing pressure and overexploitation (Lachica-Aliño *et al*. 2001).

Management Interventions

The perceived decline in catch since 1980 has triggered a major concern on the marine resources of the country. Additional measures, programs and activities were implemented on a nationwide scale. In Honda Bay, four fish sanctuaries were established in Barangays Manalo, Tanabag, Babuyan and Binduyan with a total area of 182 ha. From 1989 to 2003, a total of 310 ha were planted with mangroves in Barangays Manalo, Babuyan and San Jose, all in Puerto Princesa City. It was envisioned that these areas would provide a wider growing and feeding haven for young recruits as well as for their protection/sanctuary.

Aggressive enforcement of existing fishery laws was put in place as more apprehensions were recorded. Administratively, the City Government implemented Bay Watch which is a collaborative effort of the national government agencies (NGAs), local government units (LGUs) and non-government organizations (NGOs) to intensify the campaign against all forms of illegal fishing. Haribon Palawan and the Environmental Legal Assistance Center (ELAC) led in undertaking community organizing and providing livelihood projects for the fisherfolks, also in support to the CBCRM program.

Resource management awareness was also done by the BFAR in coordination with the LGUs which are geared towards fisherfolk empowerment program. Fisheries and Aquatic Resources Management Councils (FARMCs) were organized and further strengthened through various training programs. The stress was on value formation and capability building, prerequisites for stakeholders to better manage their bay's resources.

Moreover, the monitoring, control and surveillance (MCS) program also conducted law enforcement training to spur cooperation among concerned agencies. These agencies aim to provide effective deterrent actions to discourage violations of fishery laws and regulations by both foreign and domestic fishers.

To enhance the socio-economic welfare of the coastal communities and to sustain the resource, BFAR-FRMP and the LGU of Puerto Princesa initiated the integration of coastal resource management initiatives of various agencies and entities through the Honda Bay Integrated Coastal Resource Management Plan. This plan then serves as a guide in the implementation of baywide management activities leading to a holistic effort to solve the problems and issues affecting the bay.

Figure 2 shows a map of Honda Bay showing the location of various CRM interventions of different agencies and organizations in the area.

Fishery Demographics

As of 1996, there were a total of 5,991 households within the Honda Bay area, with more than 75 percent engaged in fishing either as a primary or alternative source of income (CMO, PPC 1998). The resource and social assessment household survey conducted by SEARCA/ICLARM in 2001, which covered 175 fisherfolks of Honda Bay, showed that 98 percent of the respondents are male and 88 percent are married. More than one-third (35 percent) belong to the 36-50 age bracket, and majority (67 percent) are long-time residents having lived in the area since birth or for more than 10 years. However, only around one-fifth (18 percent) are native Palaweños or Cuyonin, with a greater percentage (60 percent) originating from the Visayan provinces. Educational attainment is low, with only 60 percent having attained elementary education. Nearly one-fourth (23 percent) reached high school only.

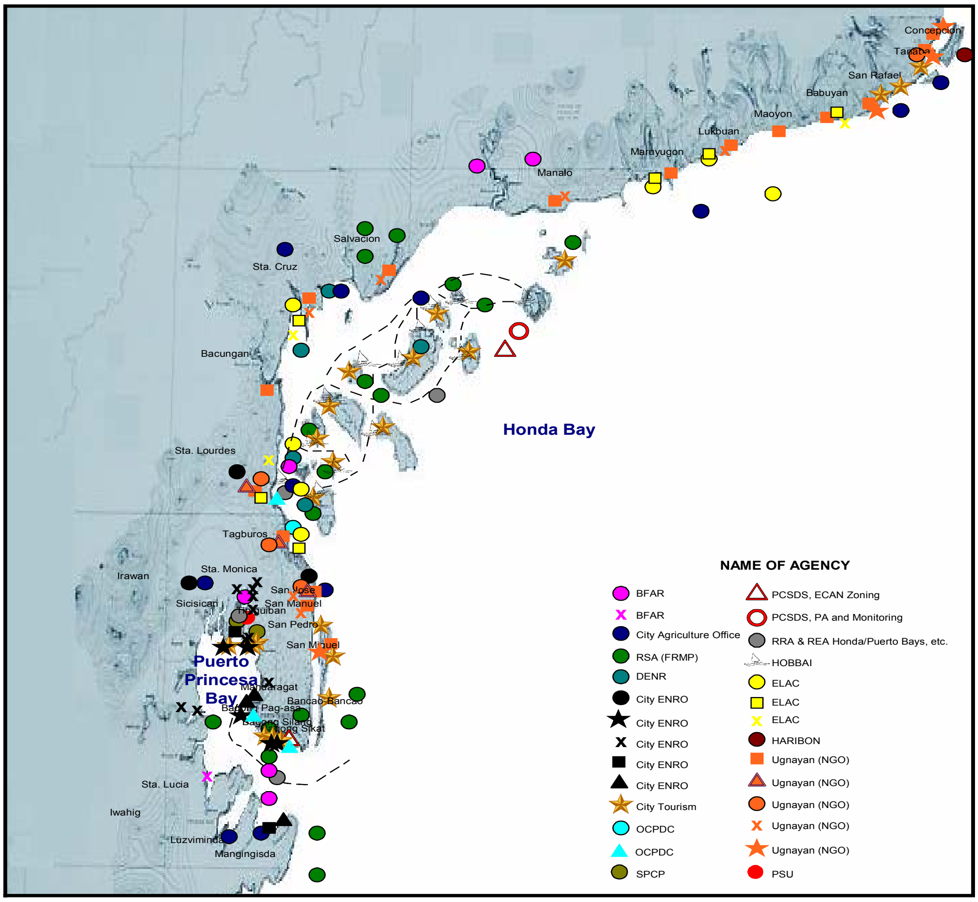


Figure 2. Map of Honda Bay showing the locations of various CRM interventions (in shape code) of different agencies and organizations in the area.

SHAPE CODE:

- ○ Resource-based conservation measures (critical habitats, spawning grounds, fish sanctuaries, mangrove reforestation, etc.)
- △ Infrastructure (pier, wharf, fisheries complex, slaughter house and landfill)
- ☆ Tourism (dive spots, resorts, beach parks, other water sports)
- □ Socio-economic (CO works, barangay-based livelihood project)
- ╳ Mariculture activities (fishponds, seaweeds, fish pens, hatchery)
- – Others (navigational lanes, not mentioned above)

A typical fisher of Honda Bay supports a household of five and most of them have their own motorized boats with at least two fishing gear. About 70.3 percent of the respondents are full-time fishers, while 29 percent are engaged in other income-generating activities (Fellizar, Jr. and Bernardo 2001).

Based on the survey conducted by the BFAR in October 2003, a total of 1,719 fishermen are residing along the coast of Honda Bay. Tagburos and

Sta. Lourdes have the most number of fishermen with 249 and 200, respectively; while San Miguel had the least number of fishermen.

Data on the number of fishermen, gear and craft give an approximate scenario of the fishing industry; while density indices depict a picture of the intensity of fishing activities of any particular area (Ingles 1998). Figure 3 shows the density of fishers per kilometer of coastline at the barangay level. For the whole bay, the average density is 17. Barangays Tagburos and Sta. Lourdes have high densities of 48 and 32 fishermen per kilometer, while Bacungan has the lowest with three fishermen per km. This index is not applicable in Barangay Maoyon since it is landlocked. Fishermen from this area share the coastline of Barangays Lucbuan and Babuyan with a high density value of 30.

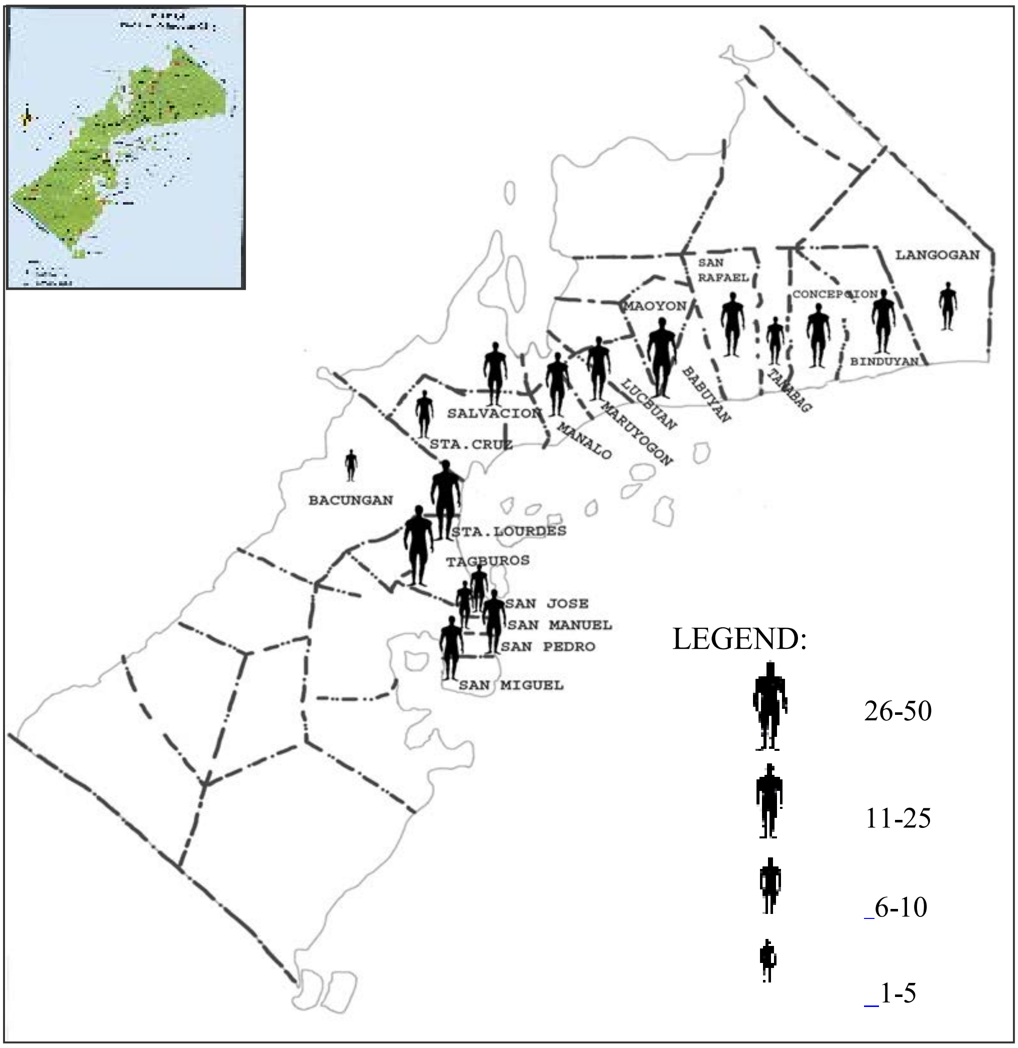


Figure 3. Density of fishers per barangay at Honda Bay.

The estimate of 17 fishers/km of coastline is relatively low compared to estimates for other major fishing grounds, like Lingayen Gulf with 78 (Silvestre *et al*. 1988), Ormoc Bay with 22 (Ingles 1992), and the whole of Guimaras

Strait with 98/km of coastline (Padilla *et al*. 1990, as cited by Lachica-Aliño *et al*. 2001). This is also lower than the density (26 fishers) obtained in the study of Lachica-Aliño *et al*. (2001).

The category of Honda Bay in 1980 was "lightly fished" area, with fisher density of around three fishers per km. In 2001, Lachica-Aliño *et al.* classified the bay as "moderately fished" area, based on the definition of Fox of a "moderately fished" area with 20-70 fishers/km of coastline.

The average fisher to banca ratio is 3.16 for every small-scale fishing boat, and 15 fishers for every commercial vessel. The 3.16 fishers to banca ratio operating within the bay is higher than the computed ratio in the study of Lachica-Aliño *et al.* (2001). This is also relatively higher than the ratios obtained in other traditional fishing grounds of the country, such as Lingayen Gulf with 1.8 in 1998 (Silvestre *et al*. 1998) and San Pedro Bay with 1.9 in 1995 (Armada 1996).

The number of boats within the bay is 543, with 558 fishing gear being operated by 1,719 fishermen. However, an inventory conducted by Lachica-Aliño *et al.* (2001) showed that the number of boats is 1,509, with 21 types of fishing gear operated by 1,065 fishermen. Barangay Sta. Lourdes has a higher fisher to boat ratio due to the operation of ringnet which is a commercial gear in the area. In the case of the artisanal fisheries (municipal, <3 GT), the average of three fishers to a boat was observed in Tagburos, Lucbuan, Tanabag and Langogan.

Historical Fishery Production

Before 1976, the fishery statistics reflected the production of about 48 bays and gulfs, but only for commercial fisheries, *i.e.*, catch by boat of more than 3 GT. In the case of Honda Bay, fish production (26 mt caught by bagnet) was reported only in 1964. There was no entry in the succeeding years as production from the bay might have been lumped with the catch from Sulu Sea during the fishery statistic survey.

Improvement in the collection and publication of fishery statistics spearheaded by the Food and Agriculture Organization (FAO) in 1975 included a systematic collection both in the artisanal (municipal, < 3 GT) and commercial (> 3 GT) fisheries, and accounted separately. The improvement also merged/fused adjacent areas to become one statistical area on the assumption that a common resource exists in nearby waters. Hence, the long list of bays became 24 statistical areas only (Fig. 4). Honda Bay was then included in statistical area No. 7 for which its production was added to four other bays beginning 1977. Since the record of publication by bay is no longer published, biologists are at a loss in getting a time-series production data by specific study area. Even without these production data, however, studies show that all traditional fishing areas especially the bays of the country are overfished – a problem seeking responsible management efforts of all concerned.

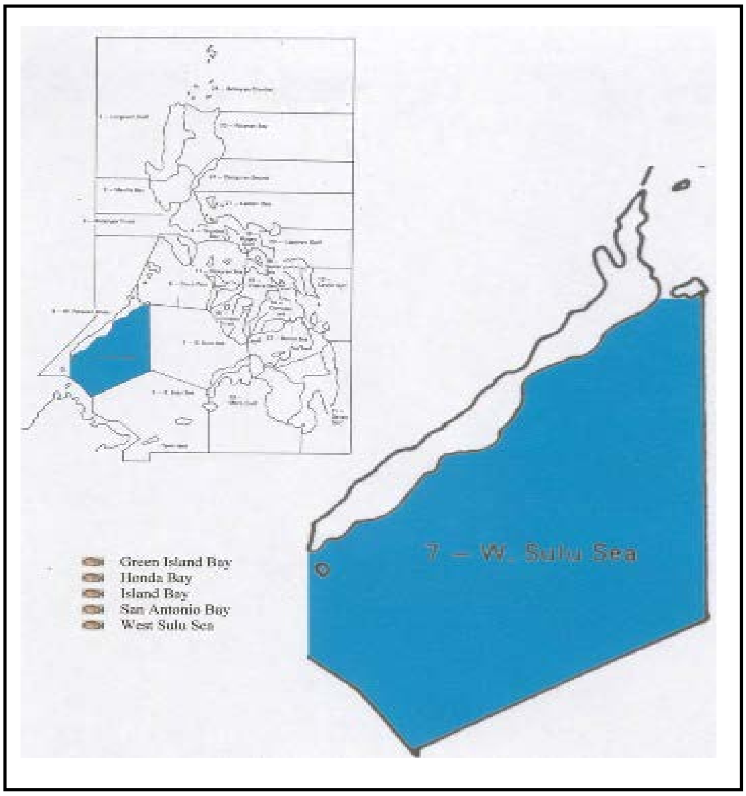


Figure 4. Statistical fishing areas and marine fishing ground of West Sulu Sea.

This assessment study thus gives an idea of the current status of the fish resources of Honda Bay and its contribution to total production. The data in this study can be used by the BAS in providing production information in this part of Palawan where it has no data gathering at all.

Fishing Ground Characterization

Reef Area

Numerous small islands are scattered in the bay, all of which are encircled by fringing reefs with extensive reef flats. The coral reef benthos is primarily structured according to its differential wave exposure and relative susceptibility to siltation. This is manifested in its benthic cover attributes such as the proportion of live hard cover, soft coral and dead coral with algae. Generally, the reefs are considered fair (Gomez *et al.* 1981). Honda Bay's reefs are relatively better than those in Puerto Princesa Bay, based on condition index (Gomez *et al*. 1994).

Seagrass Beds

Diverse community of seaweeds is found in Honda Bay. Tagburos has the highest recorded number of species, and Sta. Lourdes has the lowest. In terms of frequency and cover, Tagburos has the highest occurrence and abundance of seaweed species, and Cowrie Island the lowest. Seagrass species common to the area are *Enhalus acoroides, Thalassia hemprichii and Halophila ovalis*. The highest seagrass density was recorded in Fondeado Island, while the lowest was found in Sta. Lourdes (Roleda *et al.* 2001).

Mangrove Area

In 1979, the entire province of Palawan was declared as a mangrove swamp forest reserve under Presidential Proclamation No. 5152 (Zamora 1980). However, some mangrove forests have been destroyed by human interventions. Based on the ECAN Map of 1998, the total mangrove area of Honda Bay is 1,190.7 ha.

A resource and ecological assessment conducted in June and November 2000 showed that the dominant mangrove species of Honda Bay are *Rhizophora apiculata*, *R. stylosa*, *Bruguiera gymnorrhiza, Ceriops tagal and R. mucronata* (Aliño *et al.* 2001). A total area of 182 ha was declared as sanctuaries, and 310 ha in the Puerto Princesa shoreline.was planted with mangroves.

Soft-Bottom Habitat

The soft-bottom communities of Honda Bay have received little attention, although these are an integral part of the bay's ecology and nutrient cycle. A study by Ticzon and Montaño (2001) showed that Fondeado Island has the densest concentration of soft-bottom fauna, while Bush Island has few organisms.

Climate

Based on the Modified Corona Climate Clasification System, Palawan can be classified as having two climatic zones. The northwest coast of Puerto Princesa City and the extreme north and southern portions of the province have a Type I climate, *i.e.*, characterized by two pronounced seasons. A dry season prevails for six months, from November to April; and a wet season from May to October, the latter corresponding to the passage of the southwest monsoon. The heaviest rains are recorded in September, while the lowest or driest month occurs in February. The average annual rainfall is 3,000 mm.

The remaining portions of the province of Palawan and Puerto Princesa City have a Type III climate, which is characterized by lack of a pronounced maximum rain period and a short dry season lasting from one to three months. This dry period occurs from January to April. The average rainfall is 1,600 mm (as cited by Fellizar and Bernardo 2001). In general, Puerto Princesa and Palawan have a uniform temperature throughout the year with average monthly temperatures ranging from 27.0 ^{o}C to 28.6^{o}C. The warmest months are March, April and May; while the coolest months are November, December, January and February. Likewise, the city has more or less uniform relative humidity, ranging from 79 to 86 percent, with an annual mean of 84 percent (CMO, PPC 1998).

Fishing Boat and Gear

Fishing boat. Boats in Honda Bay are more or less 60 percent motorized (Fig. 5). An inventory showed an increase of 27 percent in the number of motorized boats within the period of three years, while non-motorized boats increased by 59 percent. This is due to the high demand for octopus in the international market which has made it a lucrative business venture.

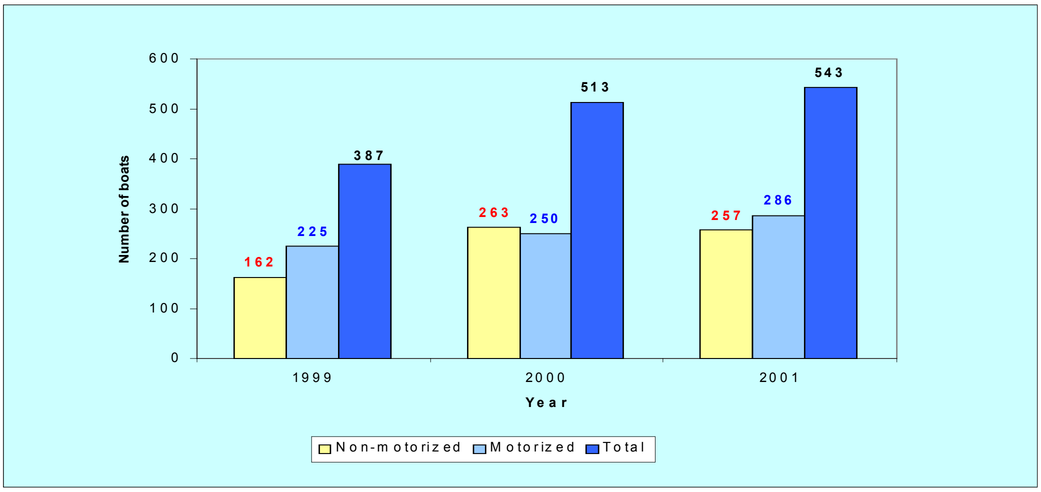


Figure 5. Number of non-motorized and motorized boats in Honda Bay (1999-2001).

Fishing gear. Sixteen kinds of gear were used by fishermen in 1999, 20 in 2000, and 23 in 2001. Lines, which are the major gear used in the area, consist of bottom set longline, hook and line, jigger, longline and multiple hook and line. Nets are composed of bottom set gillnet, drift gill net, manual push net, ringnet, surface gillnet, and stationery liftnet. Traps and barriers consist of fish corral and crab pot, while hand instruments include spear gun and spear gun with compressor. In 2000, additional gear were noted – troll line in line category, fish corral with compressor, and "hibas-hibas" to barriers and traps, and gathering tools to hand instruments. Likewise, an inventory in 2001 showed that additional gear were used, such as beach seine, crab lift net, encircling gillnet, and fish lift net. In 2002, no actual inventory on boat and gear was conducted; thus, the data for 2001 were used as basis for the estimation of effort. The number of gear per category is shown in Fig. 6.

The annual set of boat/gear data showed that there was an increase of 16 percent in the number of fishing gear, particularly hook and line, and 40 percent in the number of fishing boats operating within Honda Bay. The increase was due to gear type diversification, *i.e.*, using several types of gear in one fishing trip/operation to augment income or maximize fishing activity. As such, the catch landed by a fishing boat is from two gear types (*e.g.*, stationary liftnet and multiple hook and line, stationary liftnet and bottom set gillnet). Another likely explanation for this increase is the proliferation of more effective small-scale fishers as a reaction to the loss of opportunities for trawlers to operate within the bay (Aliño *et al.* 2001). The total number of gear was 405 in 1999, 528 in 2000, and 558 in 2001.

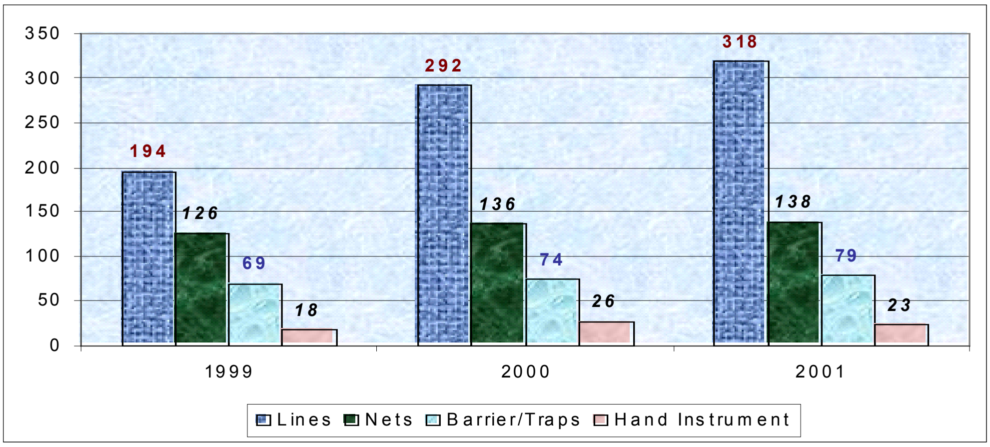


Figure 6. Number of gear per category (1999-2001).

Catch contribution by gear. The production of Honda Bay is contributed mostly by ringnet, bottom set gillnet, fish corral, stationery liftnet, and hook and line (Fig. 7).

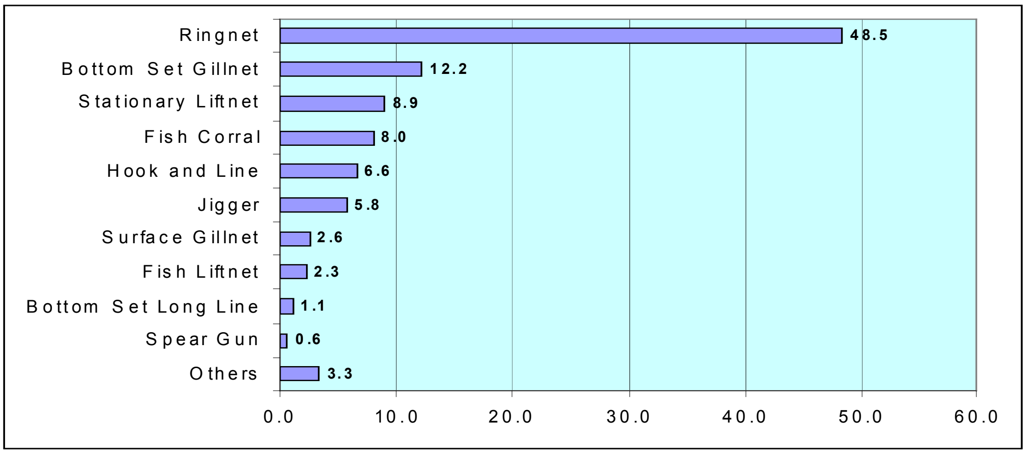


Figure 7. Average share of different types of gear to the total fish production in Honda Bay (1998-2002).

Ring net gave the highest annual yield (48.5 percent), followed by bottom set gillnet (12.2 percent), stationery liftnet (8.9 percent), and fish corral (8 percent). Minor gear include surface gillnet (2.6 percent) and fish liftnet (2.3 percent).

The seasonality of fishing gear is not pronounced in the area as almost 42 percent of the gear surveyed operate year-round. The same was observed by Luistro *et al.* (1998) and Aliño *et al*. (2001).

Annual Production

Based on this assessment, the annual production (October 1998-September 2002) ranged from 838.2 mt to 1,095.6 mt (Fig. 8). It showed an increasing trend from 1998 to 2000, and a decreasing trend from 2000 to 2002. By gear, ringnet (a commercial fishing gear) had an annual catch range of 355-610 mt with the highest annual catch obtained from October 1997 to September 1998; stationary liftnet, 53-119 mt; jigger, 9-103 mt; bottom set gillnet, 78-165 mt; fish liftnet, 10-51 mt; and fish corral, 54-100 mt. Other gear, *i.e.*, bottom set longline and surface gillnet, showed an annual catch range of 4-17 mt and 8-48 mt, respectively.

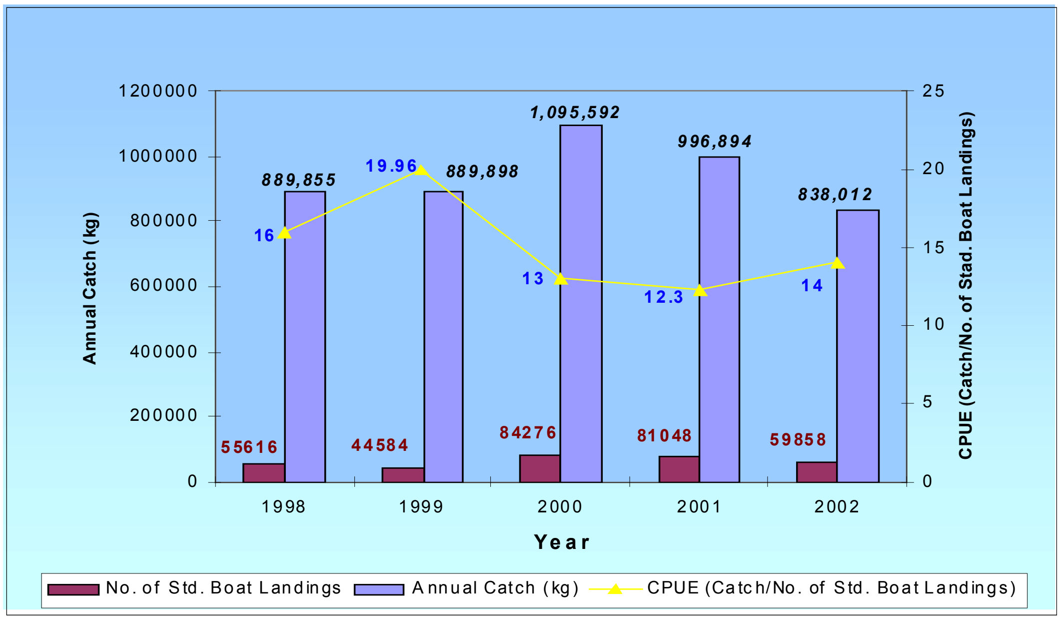


Figure 8. Catch and effort relationship in Honda Bay (1998-2002).

Effort. The number of boat landings of all gear ranged from 9,382 (1998) to 82,338 (2000) annually. For the purpose of correlating it to the annual production, it was standardized using the bottom set gillnet (BSGN) unit. As such, the corresponding annual estimated effort in terms of boat landing by BSGN ranged from 44,584 to 84,276 (Fig. 8).

Catch and effort relationship. The trend of catch, effort and catch per unit effort (CPUE), from 1998 to 2002, showed that an increased number of (standard) boat landings gives only an increment in catch but with a low CPUE. It also showed that the effort level of 44,584-84,276 boat landings can sustain the maximum level of production so far estimated from the observation (see Fig. 8).

Catch per unit effort by gear. Data on CPUE of some of the most used gear in Honda Bay showed a decreasing trend. A decrease in annual catch per boat landing was noted in the stationary liftnet (54 kg in 1998 to 34 kg in 2002), surface gillnet (30 kg in 1999 to 17 in 2002), bottom set longline (11 kg in 1998 to 8 kg in 2002), hook and line (8 kg in 1998 to 3.5 kg in 2002), and fish corral (36.5 kg to 7.7 kg). On the other hand, an increasing trend in CPUE was observed in gear for commercial operation: fish liftnet (235 kg per boat landing to 505 kg in 2002) and ringnet (297 kg to 689.5 kg in 2002).

Almost all of the artisanal gear experienced a decreasing catch rate.

Seasonality of catch. Figure 9 shows greater catches from August to September (1998-1999), May to September (2000-2001), and April to June (2002). Seasonality of fishing operation for municipal fisheries for the past five years was not pronounced.

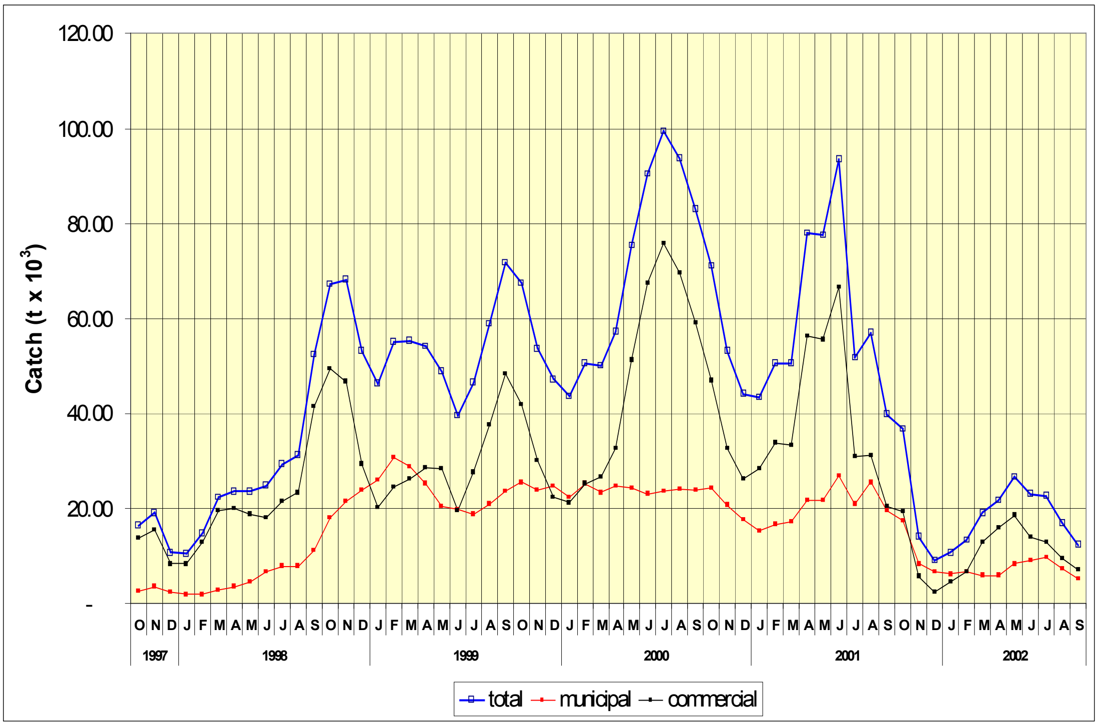


Figure 9. Monthly catch (using running average of three), Honda Bay (1998-2002).

On commercial fisheries, the trend of production may be influenced by the southeast and northeast monsoons. The five-year data showed high production during the southwest monsoon or “habagat” (from June to October). The lean season was observed during the northeast monsoon or “amihan” (from November to January).

Catch Composition

A total of 334 species of fish belonging to 54 families (Fig. 10), and 16 species of invertebrates belonging to seven families (Fig. 11) were identified from six sampling sites in Honda Bay in 1998. Compared to the list for the same months in 1999, the number of fish species decreased by 15 percent

(283 species of fish belonging to 61 families), while the invertebrate species increased by six percent (17 species belonging to eight families).

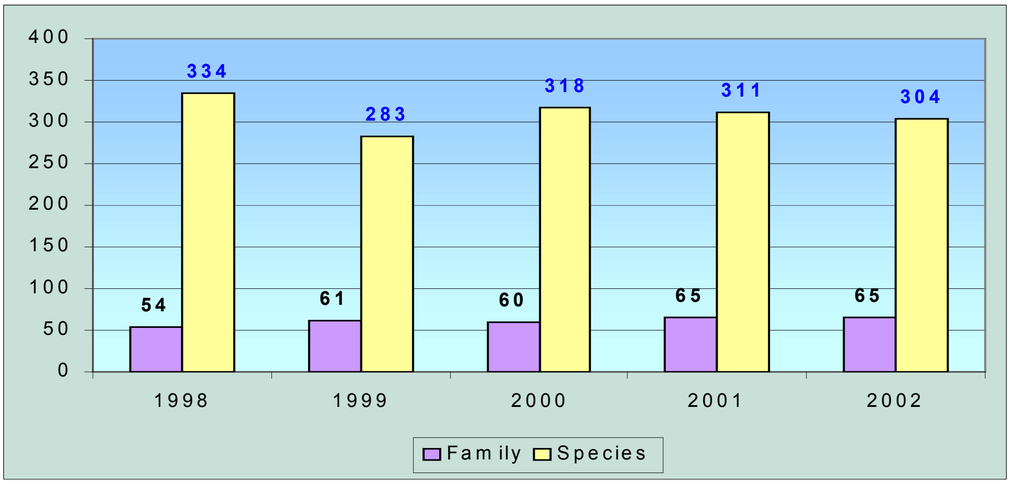


Figure 10. Comparison of the number of fish families and species identified in Honda Bay (1998-2002).

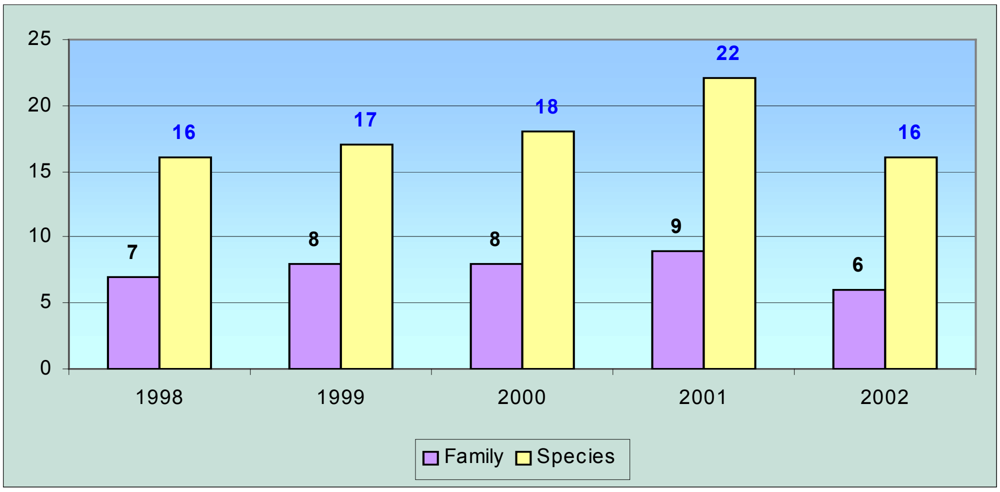


Figure 11. Comparison of the number of invertebrate families and species identified in Honda Bay (1998-2002).

In 2001, a total of 311 species of fish belonging to 65 families and 22 species of invertebrates belonging to nine families were identified in six landing sites of Honda Bay. Compared to the data of the previous year, the number of fish species decreased by two percent, while the number of fish families increased by eight percent. The invertebrate species and families increased by 22 percent and six percent, respectively. In 2002, a total of 304 fish species belonging to 65 families, and 16 species of invertebrates belonging to six families were identified. Compared to the number of fish species in the previous year, there was a decrease of two percent in species composition.

An increase in the catch of *Octopus dollfusi* was noted; it ranked second among the species caught in 2002. This is mainly due to an increased demand for octopus in the international market leading to purposive fishing.

Overall, there was a decrease in the number of fish species observed in five years, from 334 to 304 (average). Some families, however, showed an increase in the number of species probably due to the improvement in the capability to identify, which may not have been efficient during the first year. This is also true for the invertebrate species.

A decrease in the number of species or disappearance of some species in the catch means overexploitation. Previous studies showed that a more obvious effect of excessive fishing is manifested by a decrease in the species composition of catch. Increase in fishing effort might not lead to a decline in catch rates but instead result in a change in species composition, as shown by Armada (1999) in Manila Bay. The most noticeable of such changes is the increase in squid abundance in relation to fish biomass, as shown by Pauly (1979) in the Gulf of Thailand and Silvestre *et al*. (1988) in Lingayen Gulf.

Relative abundance by family. In terms of the number of species by family, Carangidae comprised 11 percent of the species caught in Honda Bay from 1998 to 2002, with an average number of 24 species. This was followed by Lutjanidae (seven percent), Nemipteridae (seven percent) and Serranidae (six percent) (Fig. 12).

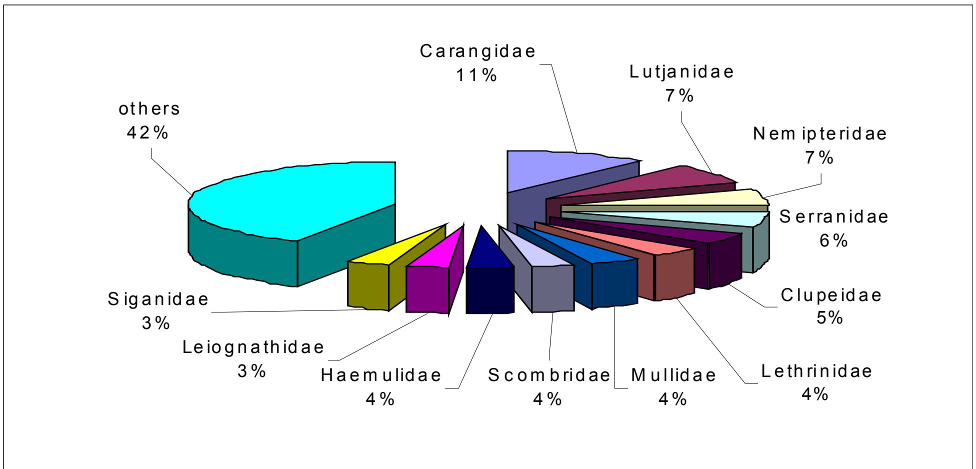


Figure 12. Relative abundance of fish species (by family) caught in Honda Bay (1998-2002).

Comparing the number of species 20 years ago (based on the study of Schroeder 1980), there was a slight reduction in terms of the number except in unimportant species like Acanthuridae (surgeon fishes), Apogonidae (cardinal fishes), Holocentridae (soldier fishes), Labridae (wrasses), Pomacentridae (damsel fishes) and Scaridae (parrot fishes). Among the valued fish species, Lutjanidae (snappers) and Serranidae (groupers) showed considerable reduction.

For the invertebrate species, majority of the identified species were Penaeidae which comprised 24 percent of the total enumeration (Fig. 13). This was followed by Portunidae (19 percent), Loliginidae (17 percent), Sepiidae (12 percent) and Panuliridae (eight percent).

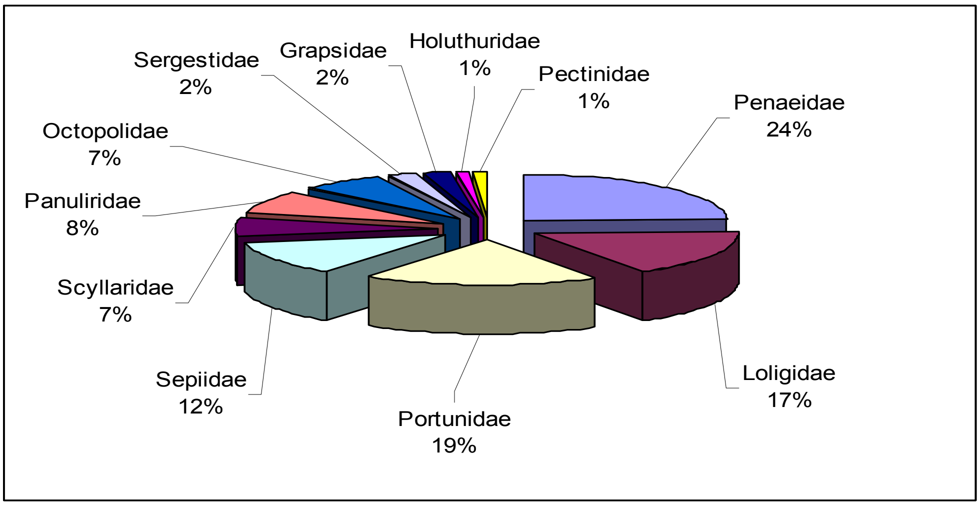


Figure 13. Relative abundance of invertebrate species (by family) caught in Honda Bay (1998-2002).

Pelagic, demersal and reef fishes. Based on the five-year data, pelagic fishes dominated the catch with an average percentage of 76.72 percent, while ground fishes and reef fishes accounted for 15.7 percent and 7.58 percent, respectively (Fig. 14). The increase in demersal species may be accounted to the banning of trawl fishing in the area. On the other hand, the decrease in reef catch is due to overfishing in the reefs, and probably also to the slow recovery of protected reefs or continued deterioration of fish biomass in reef areas.

Most abundant species in Honda Bay. Most of the commercially exploited fish species in Honda Bay are small pelagic species (Fig. 15). Demersal fish species as well as reef fishes also contribute to the commercial production of Honda Bay, although in small quantities only. In general, the bay's catch composition consists mainly of carangids and scombrids, which may be attributed to the gear used. Ringnet is a pelagic gear which has a percentage contribution of approximately 50 percent of the annual yield of the bay.

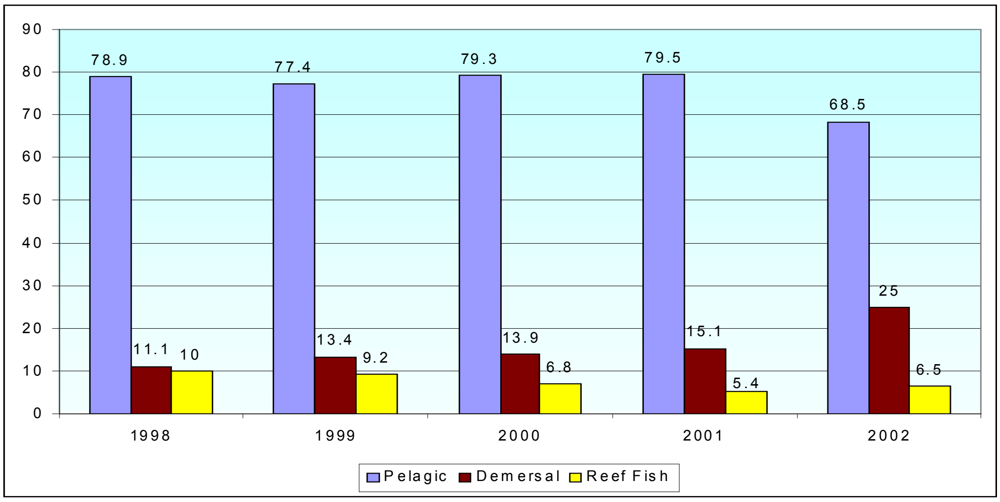


Figure 14. Percentage composition of pelagic, demersal and reef fishes caught in Honda Bay (1998-2002).

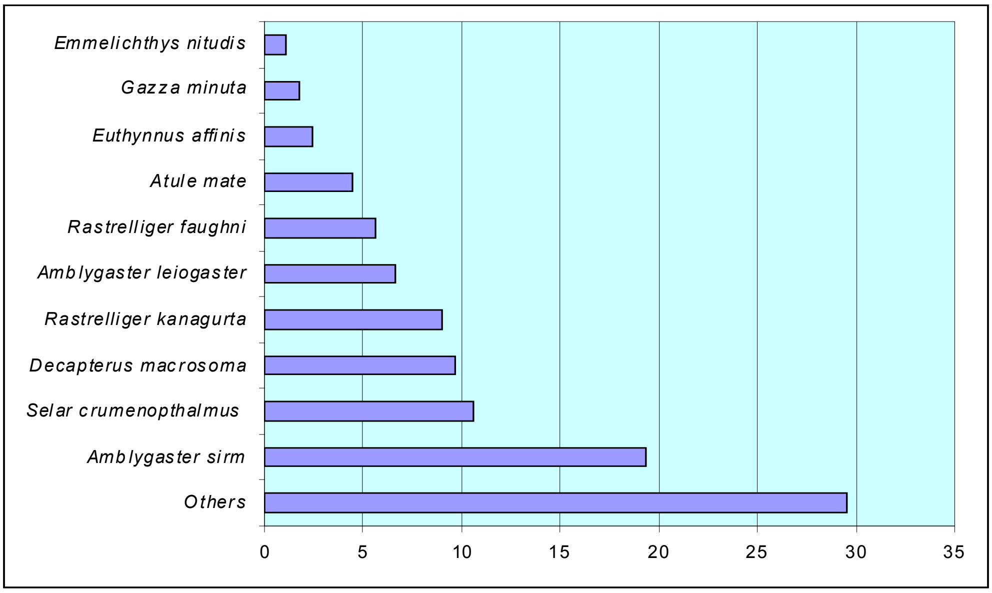


Figure 15. Most abundant commercial fish species caught in Honda Bay.

As to the artisanal (municipal) catch, the most abundant species is *Octopus dollfusi*, followed by *Sardinella fimbriata* and *Gazza minuta* (Fig. 16). The species composition of the municipal catch is similar to that of the commercial catch, both consisting mostly of pelagic species. Only *Gazza minuta*, which is a demersal species, showed a high percentage catch.

Species composition of the major types of gear. The relative abundance of the species per fishing gear showed variation in species composition in the five-year study.

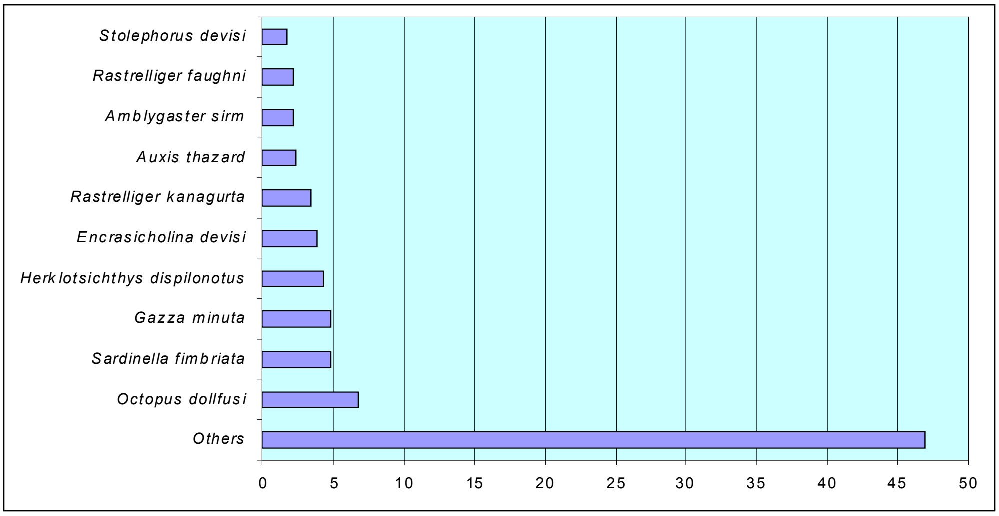


Figure 16. Most abundant species comprising the municipal catch in Honda Bay.

For the stationary liftnet, clupeids, sardines and other small pelagics were abundant from 2000 to 2002. This might have been due to the decrease or disappearance of species that feed on nekton/larvae, such as *Caranx* sp., *Sphyraena* sp. and *Rastrelliger* sp., which were present in the first two years of the study.

For the surface gillnet, small pelagics (such as the *Sardinella* species which were present in 1999) were predominated by large pelagics from 2000 to 2002. The abundance of large pelagics triggered the decrease of small pelagics which feed on nekton or larvae. The same is true in the species composition of ringnet and bottom set gillnet. An increase in the nekton-feeding species (*Decapterus* sp., *Selar* sp.) resulted to a decrease of leiognathids which are plankton feeders.

In general, the fishery resource in terms of species composition showed an increasing number of species belonging to a higher trophic level. Fox (1986) stated that a general shift in species composition with increase in fishing intensity is often accompanied by an increase in the proportion of low-valued trash fish species. There is also some evidence that squid and *Acetes* become more abundant in heavily fished onshore waters. This is probably due to the disappearance of predatory species that feed on squid and shrimp larvae.

Size (length) of fish species caught by different types of gear**.** Based on the data (2001-2002), nets (*i.e.*, encircling gillnet, floating liftnet, bottom set gillnet and ringnet) generally catch a higher number of small-sized fishes as compared to other types of gear targeting the same species.

For *Siganus guttatus*, small sizes were mainly caught by encircling gillnet, while larger sizes were caught by bottom set gillnet and fish corral (Fig. 17).

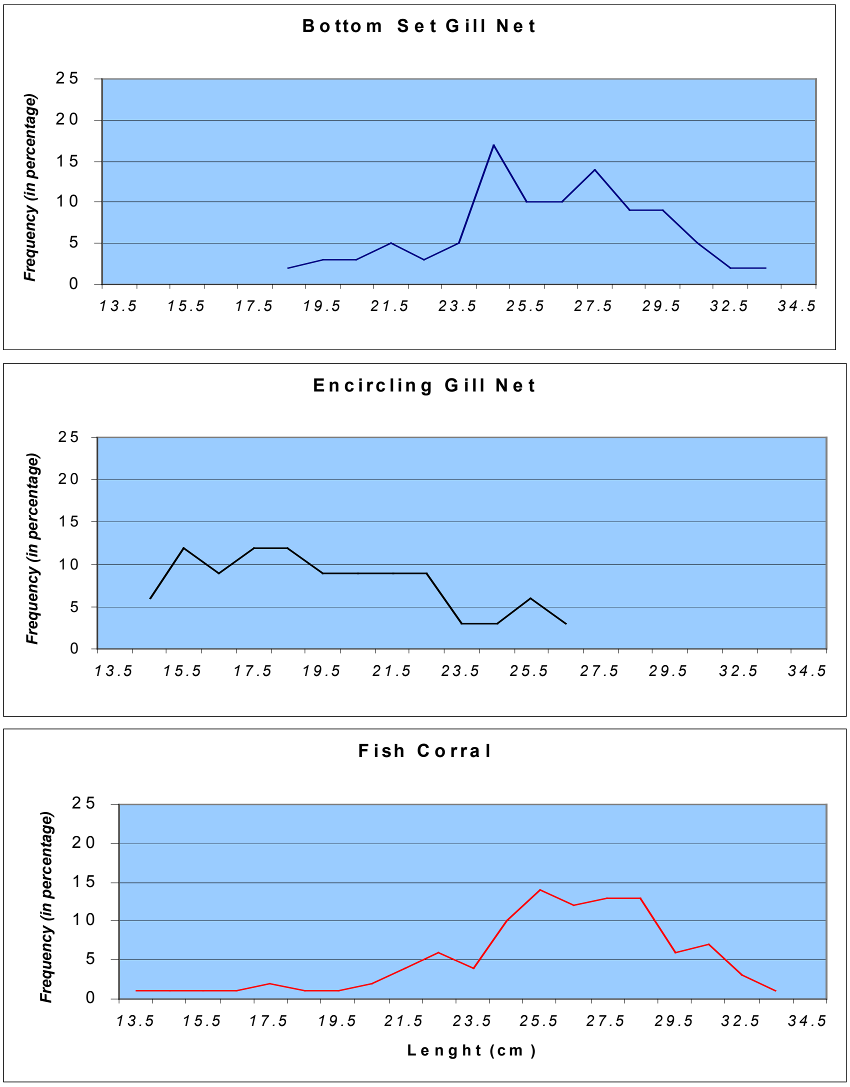


Figure 17. Length frequencies of *Siganus guttatus* caught by different types of gear in Honda Bay (2001-2002).

A high percentage of small-sized *Selar crumenopthalmus* was caught by floating liftnet; the bottom set gillnet and ringnet caught more of the larger sizes (Fig. 18).

In the case of *Rastrelliger kanagurta*, both bottom set gillnet and ringnet caught bigger fishes as compared to the catch of fish corral (Fig. 19). For *R. faughni*, small-sized fishes were mainly caught by ringnet, while the larger sizes by bottom set gillnet (Fig. 20).

For *Lutjanus fulviflamma*, both fish corral and bottom set gillnet targeted small sizes of the species, while the bottom set longline caught more of the larger sizes (Fig. 21).

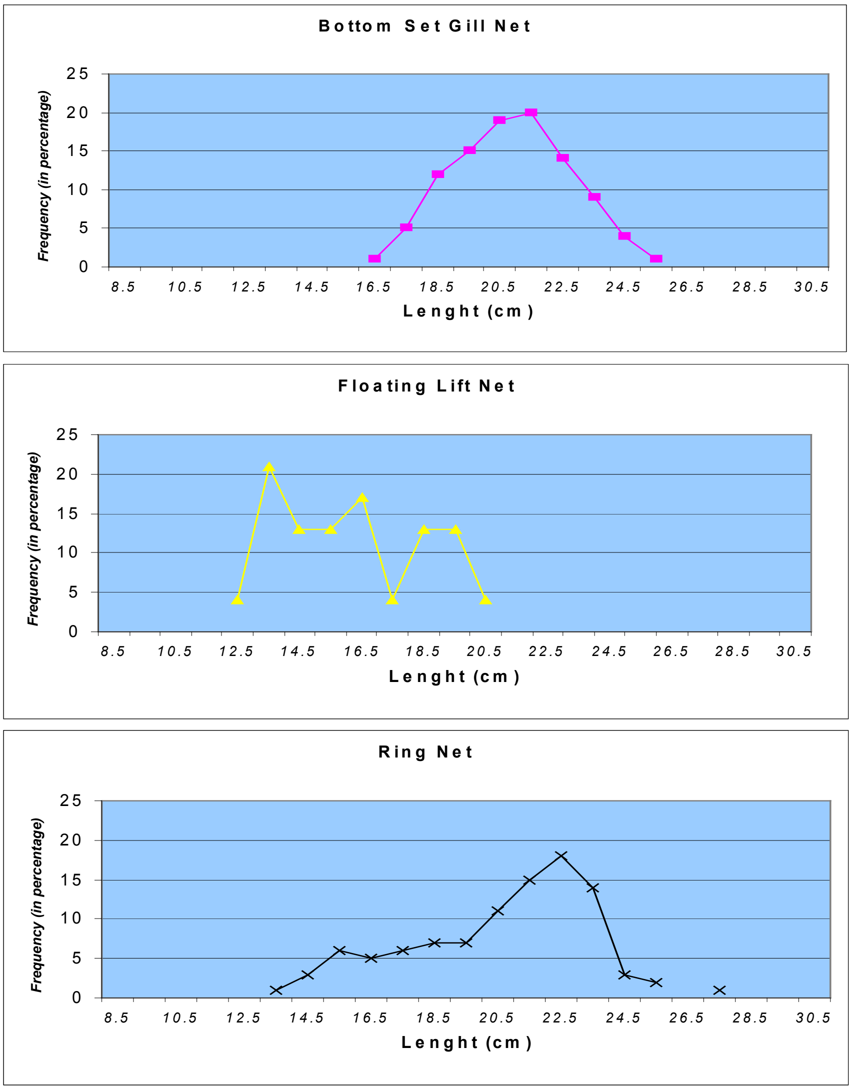


Figure 18. Length frequencies of *Selar crumenopthalmus* caught by different types of gear in Honda Bay (2001-2002).

Population Parameters

Other than the analysis of catch and effort, an analysis of the biological parameter coefficients of important species was also done. This component of stock assessment gives information on the values of the species parameters which, when compared to standard values, give the status of a particular resource. Optimum fishing mortality and optimum size of capture can be predicted, just as potential yield and optimum effort are determined in the analysis of catch and effort component.

For instance, one of the standard values referred to for a stock that is optimally exploited is: fishing mortality (F) is about equal to natural mortality (M) or Fopt = M and exploitation rate, Eopt = 0.5 (Gulland 1971).

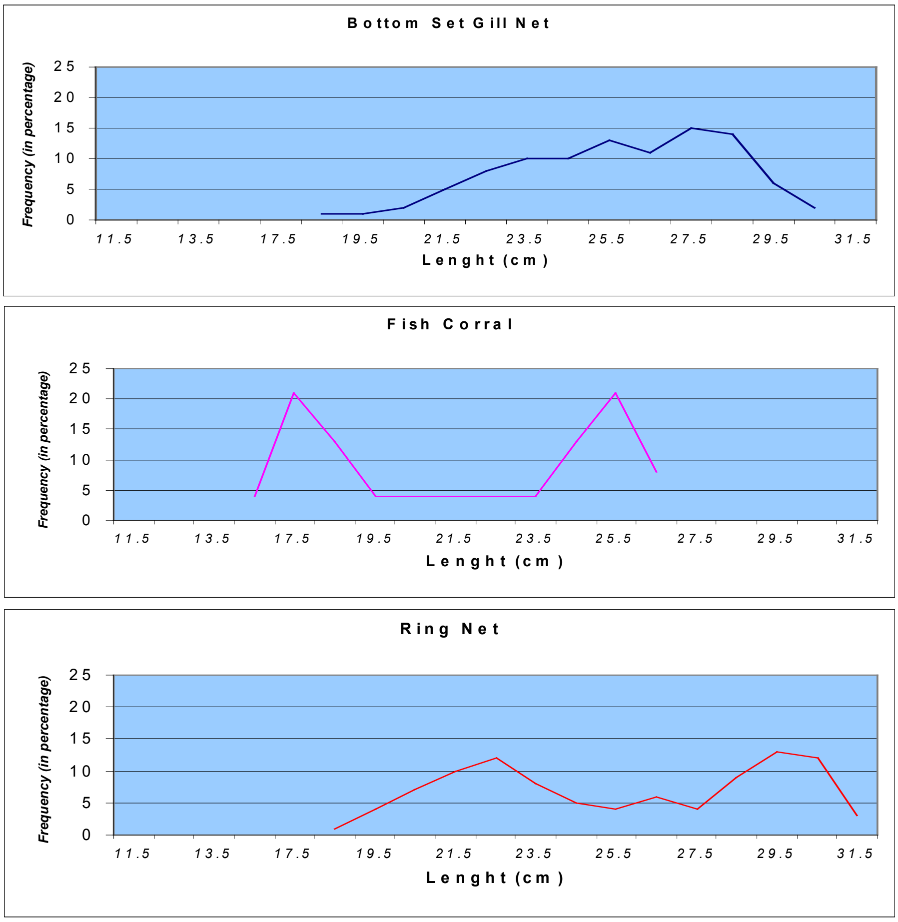


Figure 19. Length frequencies of *Rastrelliger kanagurta* caught by different types of gear in Honda Bay (2001-2002).

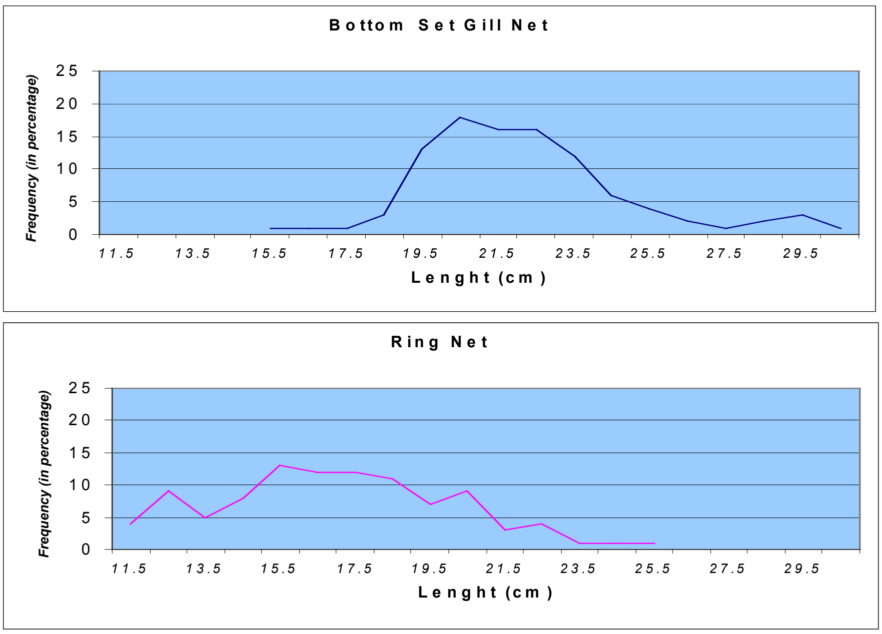


Figure 20. Length frequencies of *Rastrelliger faughni* caught by different types of gear in Honda Bay (2001-2002).

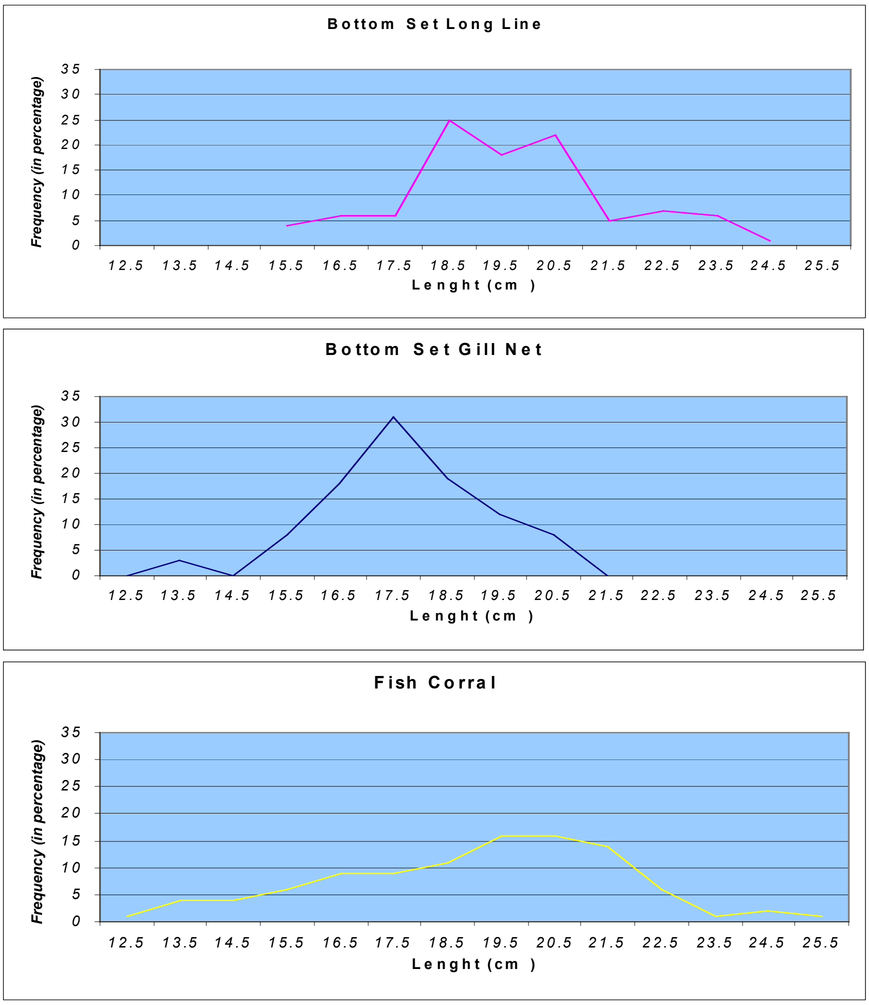
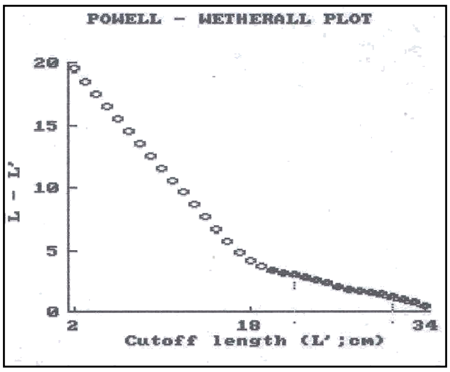


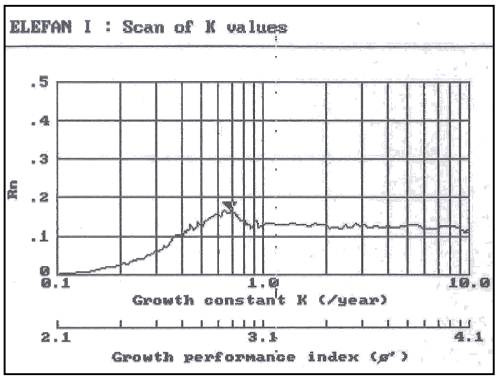
Figure 21. Length frequencies of *Lutjanus fulviflamma* caught by different types of gear in Honda Bay (2001-2002).

Eighteen pelagic and demersal (soft-bottom and reef) species were analyzed. The pelagic species were *Amblygaster sirm, A. leiogaster, Rastrelliger kanagurta (RN & BGN), R. faughni, Decapterus macrosoma, Selar crumenophthalmus, S. boops, Atule mate, Leiognathus splendens (RN & BGN), Stolephorus indicus*, and *Encrasicholina devisi.* The demersal species were *Gazza minuta, Nemipterus hexodon, N. furcosus, Siganus guttatus, S. canaliculatus, Lutjanus fulviflamma and L. vitta.* Sample analysis for *Atule mate* is shown in Fig. 22. The summary of the population parameter values is given in Table 1.

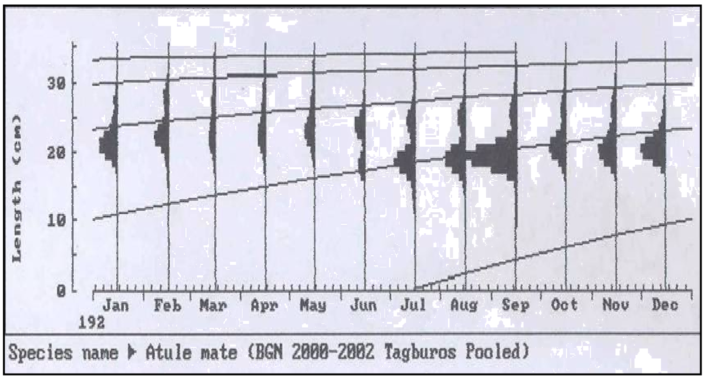
a. Powell- Wetherall Plot



b. Scan of K



c. Histogram



d. Length Converted Catch Curve

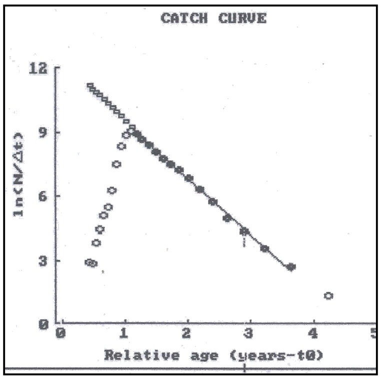


Figure 22. Plot of estimates of population parameters of *Atule mate* in Honda Bay (2000-2002).

Growth. Growth parameter (K) is a relative index of the rate of growth, usually between values of 0.4 and 2.0, which describes the species to be fast growing (more than 1.0) or slow growing (less than 1.0). Based on this, most of the species analyzed are relatively fast growing, with K values of more than 1.0. The rest, with values less than 1.0, are slow-growing species (Table 1).

Values of growth performance index (ǿ), which is the function of L_∞ and K of the individual species analyzed, are within the range of values reported in other Philippine studies. These studies include those on *Amblygaster sirm, Rastrelliger kanagurta, Decapterus macrosoma, Selar crumenopthalmus and Leiognathus splendens* (Lavapie-Gonzales *et al*. 1997, Corpuz *et al.* 1985, Ingles and Pauly 1984, and Silvestre 1986). For *Amblygaster leiogaster, Selar boops, Encrasicholina devisi, Gazza minuta, Siganus guttatus,* and *Lutjanus vitta,* the results are the second record for these species, while those on *Nemipterus furcosus and Lutjanus fulviflamma* are the first record in the Philippines.

Table 1. Summary of growth (L_∞ and K) and mortality (Z, M and F) parameters, exploitation ratios and number of recruitment pulses (NRP) for selected species exploited in Honda Bay (1998-2002).

Species	Gear	Year	L_∞ (cm)	K (yr^{-1})	Z (yr^{-1})	M (yr^{-1})	F (yr^{-1})	E (F/Z)	NRP
Amblygaster leiogaster	*RN*	00-01	25.6	1	3.38	1.87	1.51	0.45	2
Amblygaster sirm	*RN*	00-02	29.54	1	5.7	1.79	3.91	0.69	2
Atule mate	*BGN*	00-02	36.454	0.69	2.64	1.33	1.31	0.5	1
Decapterus macrosoma	*RN*	98-02	24.76	1.3	5.64	2.24	3.4	0.6	2
Encrasicholina devisi	*SLN*	2002	9.613	1.2	5.59	2.76	2.83	0.51	2
Gazza minuta	*RN*	98-00	17.82	1.5	6.5	2.69	3.81	0.59	2
Leiognathus splendens (BGN)	*BGN*	99-02	16.54	0.79	4.17	1.81	2.36	0.57	1
Leiognathus splendens (RN)	*RN*	1998	15.04	0.75	2.55	1.79	0.76	0.3	1
Lutjanus fulviflamma	*FC*	01-02	31.44	1	5.24	1.76	3.48	0.66	2
Lutjanus vitta	*BGN*	99-02	33.019	0.79	3.54	1.49	2.05	0.58	2
Nemipterus furcosus	*BGN*	00-02	28.474	1.6	6.08	2.46	3.62	0.6	2
Nemipterus hexodon	*BGN*	00-02	28.23	1.8	7.48	2.67	4.81	0.64	2
Rastrelliger faughni	*RN*	99-01	25.75	1.4	5.43	2.32	3.11	0.57	2
Rastrelliger kanagurta (BGN)	*BGN*	00-02	33.49	1.6	6.56	2.36	4.2	0.64	2
Rastrelliger kanagurta (RN)	*RN*	00-02	32.4	1.5	5.91	2.28	3.63	0.61	2
Selar boops	*RN*	98-00	27.69	1.4	5.41	2.28	3.13	0.58	1
Selar crumenophthamus	*BGN*	00-02	30.601	0.97	5.19	1.78	3.41	0.66	2
Siganus canaliculatus	*FC*	99-02	33.419	0.97	4.42	1.7	2.72	0.62	1
Siganus guttatus	*FC*	99-01	35.78	2.2	5.52	2.85	2.67	0.48	2
Stolephorus indicus	*SLN*	99-02	11.57	1.3	5.05	2.77	2.28	0.45	1

The L_∞ and K values estimated for *Rastrelliger faughni* from the computed phi prime are very close to those obtained by Jabat and Dalzell (1988). Likewise, the values estimated for *Atule mate* are close to those obtained by Lavapie-Gonzales *et al.* (1997). For *Stolephorus indicus,* the values are comparable with those reported by Ingles and Pauly (1984). The K value for *Siganus canaliculatus* is the third record in the Philippines, which is very close to the K value reported by Pauly (1978).

Fishing mortality and natural mortality. Estimates of fishing mortality (F) and natural mortality (M) showed that 15 species have F values greater than M values. This indicates full exploitation/overexploitation of these species: *Rastrelliger kanagurta (*BSGN, 4.2; RN, 3.63)*, R. faughni* (3.11)*, Decapterus macrosoma* (3.4)*, Selar crumenophthalmus* (3.41)*, Selar boops* (3.13)*, Gazza minuta* (3.81)*, Leiognathus splendens*-BGN (2.36)*, Nemipterus hexodon* (4.81)*, Nemipterus furcosus* (3.62)*, Siganus canaliculatus* (2.72)*, Lutjanus fulviflamma* (3.48) *and Lutjanus vitta* (2.05), *Encrasicholina devisi* (2.83), *Nemipterus hexodon* (4.81) and *Amblygaster sirm* (3.91).

Exploitation rate. The formula used in computing the exploitation rate (E) is: E = F/M + N or E = F/Z. The standard E value is 0.5. If the value obtained is less than 0.5, the resource is still underexploited. However, if the value is more than 0.5, the resources/stocks are being exploited beyond their optimum yield. Based on this, *Rastrelliger kanagurta* and *R. faughni* (mackerels), *Decapterus macrosoma* (roundscads), *Selar crumenophthalmus* and *Selar boops* (big-eye scads), *Gazza minuta* and *Leiognathus splendens* (slipmouths), *Siganus canaliculatus* (siganids), *Nemipterus hexodon* and *N. furcosus* (threadfin breams) and *Lutjanus fulviflamma* (snappers), which all exhibited E values exceeding 0.5, are overexploited. The rest had E values within the standard value of less than 0.5 (Figs. 23 and 24, Table 1).

Figures 23 and 24 show that 25 percent of the species analyzed had estimated E values which are within the optimum values, and 75 percent beyond the maximum E value as suggested by Gulland (1971). This is an indication that the fishery resources of Honda Bay are fully exploited. This conforms with the result of a study by Lachica-Aliño *et al*. (2001) which showed that majority of the species (except *Gerres abbreviatus*) subjected for analysis had high E values, ranging from 0.41 to 0.77. A mean E value of 0.57 indicates that heavy fishing pressure is occurring in the bay.

Recruitment. Recruitment refers to the entry of young batch of fishes to the population. It is important to have an idea of how many times within a year young batches of fishes become available to the fishing ground by species. It is a vital information that can be deduced from the length data. Of the 18 species analyzed, 12 species exhibited bimodal recruitment, while six species (*Selar boops, Atule mate, Gazza minuta, Stolephorus indicus, Siganus canaliculatus* and *Leiognathus splendens*) exhibited unimodal recruitment.

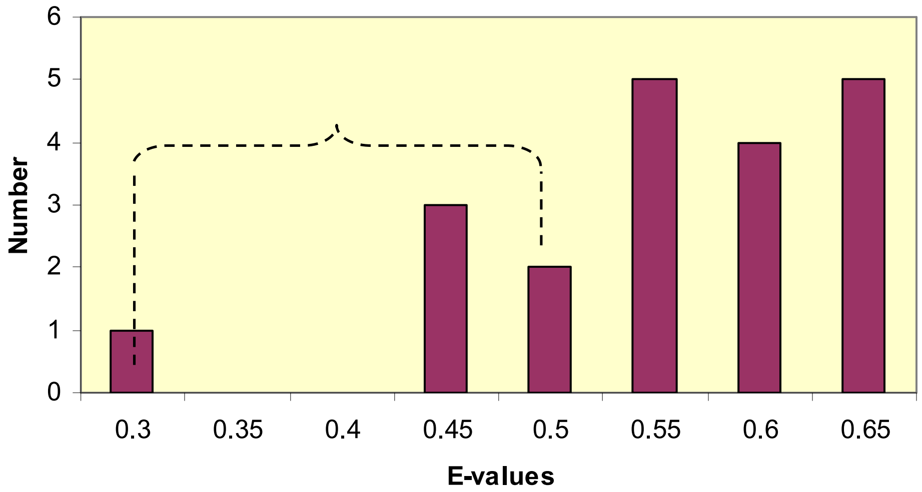


Figure 23. Distribution of exploitation ratio (E) of 18 species analyzed in this study.

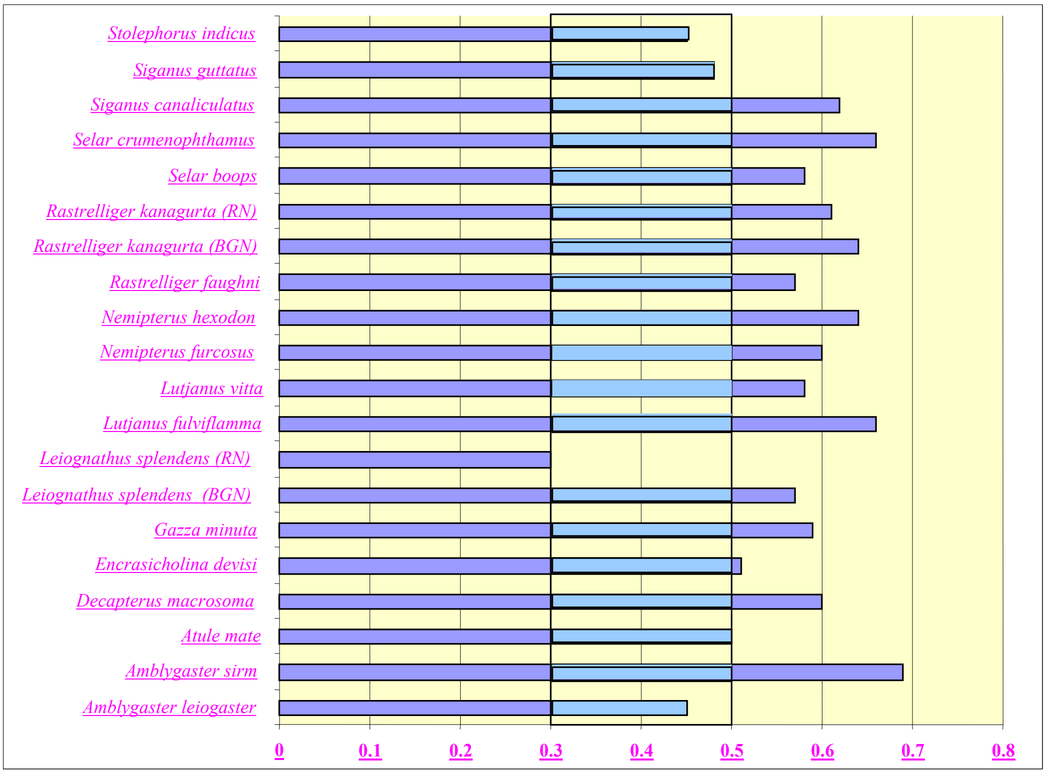


Figure 24. Estimated exploitation ratio (E) of species from L-F analysis.

Mean length and size at first maturity of dominant species. Table 2 shows that most of the important fish species caught in Honda Bay have a mean size bigger than their length at first maturity. This indicates that these species have at least contributed to the recruitment process of their stocks before these are caught.

Assessment

Potential yield. Preliminary estimates, using the standard Schaeffer model for computation of potential yield (PY), show that the present PY that can be harvested in Honda Bay is about 975.03 mt at an optimum effort of 342.1 GT. Using the Fox model, the PY is about 977.2 mt at an optimum effort of 378.8 GT. The values obtained using the Schaeffer and Fox models confirmed that both catch and effort in Honda Bay are at their maximum level. The theoretical downward trend after the maximum value has been reached is shown by the decreasing trend of production after the highest production in 2000 (Fig. 25).

Economics of fishing. The economic approach was also used in the assessment of earnings and the extent to which the resource benefits are shared between different gear and beneficiaries.

Table 2. Mean length and size at first maturity of dominant species caught in Honda Bay (2002).

Species	Gear	Mean Length (cm)	Size at 1st Maturity (cm)
Amblygaster sirm	RN	19.52	15.1
Decapterus macrosoma	RN	14.18	19.3
Selar crumenophthalmus	BSGN	25.60	34.1
	FC	23.45	
	RN	23.46	
Rastrelliger kanagurta	BSGN	25.60	15.3
	FC	23.45	
	RN	23.46	
Rastrelliger faughni	BSGN	22.15	15.5
	RN	17.04	
Atule mate	BSGN	21.33	19.5
	FC	19.50	
	RN	18.64	
Lutjanus fulviflamma	BSGN	17.68	17.9
	BSLL	19.63	
	FC	19.09	
Nemipterus hexodon	BSGN	19.25	15.3
	BSLL	17.82	
	EGN	19.44	
	HL	17.24	
	SLN	17.50	
	MHL	16.79	
Siganus canaliculatus	FC	16.03	19.9

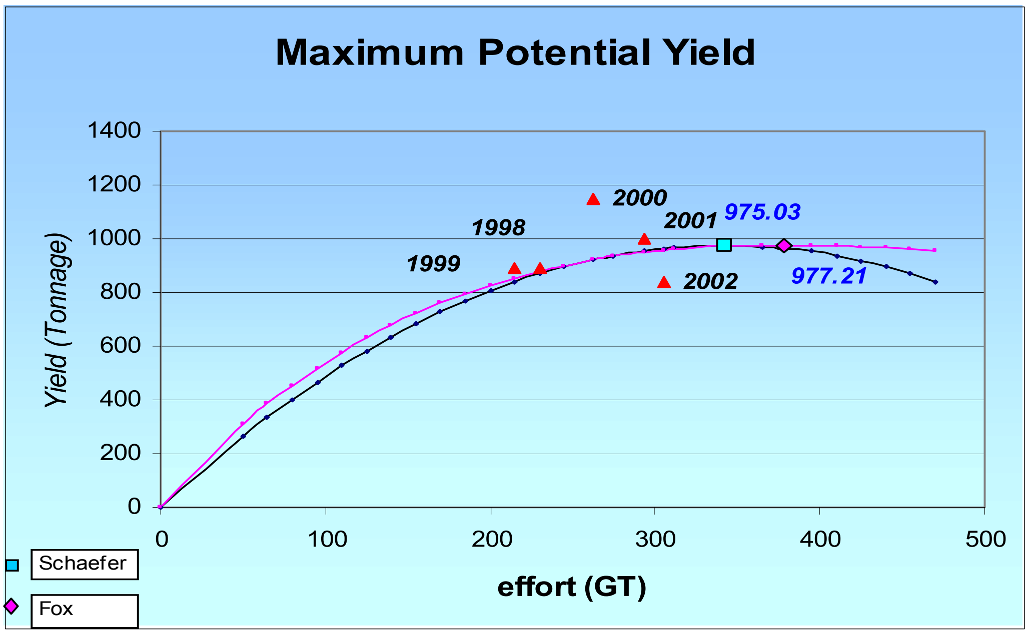


Figure 25. Potential yield (PY) of Honda Bay, Palawan.

Labor force and employment. A total of 72,061 individuals, or 45 percent of Puerto Princesa City's population of 160,088, are engaged in gainful occupations as private employees (14.85 percent), traders/ businessmen (eight percent), fishermen (five percent), government employees (four percent), farmers (four percent), and as hired laborers and peddlers (nine percent) (CMO, PPC 1998). The remaining 55 percent are engaged in non-income earning or non-gainful activities; these include students, housekeepers, and retirees which account for 31 percent, 14 percent, and one percent, respectively. According to the PESO definition of terms and concepts, those that fall under this category include those who are below employment age, unemployed but employable, and unemployed but not employable.

The socio-economic assessment conducted by SEARCA/ICLARM in 2001 showed that fishing is the primary source of income of the respondents. Other occupations include labor and services, farming and livestock production, sales and marketing, art and craft making and employment. About 70.3 percent are full-time fishers, while 29.7 percent are engaged in other income-generating activities. Around six percent of the housewives earn from fishing and other related activities, such as fish trading and processing.

Employment in fishing is informal since there are no written contracts, nor any health and retirement benefits. Compensation therefore depends on fisher's catch, although most of the small-scale fishing gear are owned by the fishers themselves (Ingles and Babaran 1998). Operators of commercial fishing gear, such as ringnet and fish liftnet, employ around 20-25 fishers. However, only the pilot and mechanic are hired as regular employees, and the rest of the crew are on temporary/seasonal basis.

Investments**.** Investments in fishing in Honda Bay vary according to the fishing gear and target species, from as high as PhP 2.7 million for ringnet to as low as PhP 2,650.00 for "pataw-pataw"/hook and line (Table 3).

The total investment for commercial fishing gear is PhP 3.0 million, and PhP 700,000 for municipal fishing gear. The values do not include adjustments for inflation rate but they reflect the investment cost given by the fishers at the time of their investment.

Income derived from fishing**.** *Municipal fishing* – The annual gross revenue ranges from PhP 30,095.00 (for hook and line) to PhP 509,106.00 (for encircling gillnets). Municipal fishing gear are categorized into nets, lines, hand instruments, and traps and barriers. Nets realize a high annual revenue of PhP 1,234,237.00, while hand instruments with a low revenue of PhP 139,612.74. It should be noted that 21.6 percent of the line gear are non-motorized. The net profit for each gear shows that the annual net income (of multiple hook and line and encircling gillnet) is over PhP 400,000.00, while that of "pataw-pataw"/hook and line is less than PhP 15,000.00.

Table 3. Fixed costs of the different fishing gear in Honda Bay.

Gear Type	Boat	Motor	Gear	Others	Total	Dep. cost 10%
Municipal						
A. Nets						
Beach Seine	7,000	20,000	12,000	3,000	42,000	4,200
Bottom Set Gillnet	22,000	28,000	36,000		86,000	8,600
Crab Liftnet	2,500	nm	1,000		3,500	350
Encircling Gillnet	22,000	28,000	6,000		56,000	5,600
non-motorized	4,000		6,000		10,000	1,000
Stationary Liftnet	30,000	28,000	35,000	12,000	105,000	10,500
Surface Gillnet	20,000	28,000	48,000		96,000	9,600
B. Lines						
Bottom Set Longline	5,000	28,000	500		33,500	3,350
Hook and Line	2,500	nm	500		3,000	300
Jigger	2,500	nm	300		2,800	280
Multiple Hook and Line	5,000	15,000	500		20,500	2,050
Pataw-pataw (H & L)	2,500	nm	150		2,650	265
C. Hand Instrument						
Spear Gun with Compressor	22,000	28,000	17,000	5,000	72,000	7,200
D. Traps and Barriers						
Crab Pot/Trap	2,500	15,000	2,500		20,000	2,000
Fish Corral	22,000	28,000	15,000	1,200	66,200	6,620
Commercial						
A. Nets						
Fish Liftnet	80,000	60,000	136,000	3,260	279,260	27,926
Ringnet	947,000	150,000	1,600,000	65,000	2,762,000	276,200

The use of gross income may give a clear performance of each gear, but may not necessarily project a clear image of the income earned by each fisher. This is so, because of the variable number of fishers operating a particular gear or some gear are used seasonally (Ingles and Babaran 1998).

Commercial fishing operation – Ringnet and fish liftnet are the two types of commercial fishing gear operating in Honda Bay. The annual gross income from commercial fishing operation is PhP 3.0-4.0 million. In terms of profit, ringnet earns PhP 4.4 million; fish liftnet, PhP 1.5 million. For large fishing boats, the computation of income follows a sharing system wherein 50 percent of the net profit is shared by the crew. The resulting annual share per fisher is PhP 87,530.00, for ringnet; PhP 25,092.00, for fish liftnet.

It is estimated that the daily income of a fisher on board a ringnetter is PhP 239.80. For fish liftnet fishers, the daily income is only PhP 96.14 which is below the minimum wage and inadequate to support a household of five.

Fishing is a profitable business. However, profits vary according to the gear used. Profit from fishing using motorized vessels is higher than that using only non-motorized boats, although a higher profit would be realized if the boat and gear are both owned by the fisher. The multiple hook and line and encircling gillnet are the most profitable municipal fishing gear. Ringnet gives a higher profit than other commercial fishing gear. The operation of fish liftnet in Honda Bay, having low income, had been transferred to San Vicente in 2003.

Figure 26 shows the average earnings of each fisher per fishing day. Only six (out of 17) types of gear (*i.e.*, ringnet, multiple hook and line, encircling gillnet, surface gillnet, crab liftnet, crab pot) provide incomes higher than the minimum daily wage of PhP 150.00.

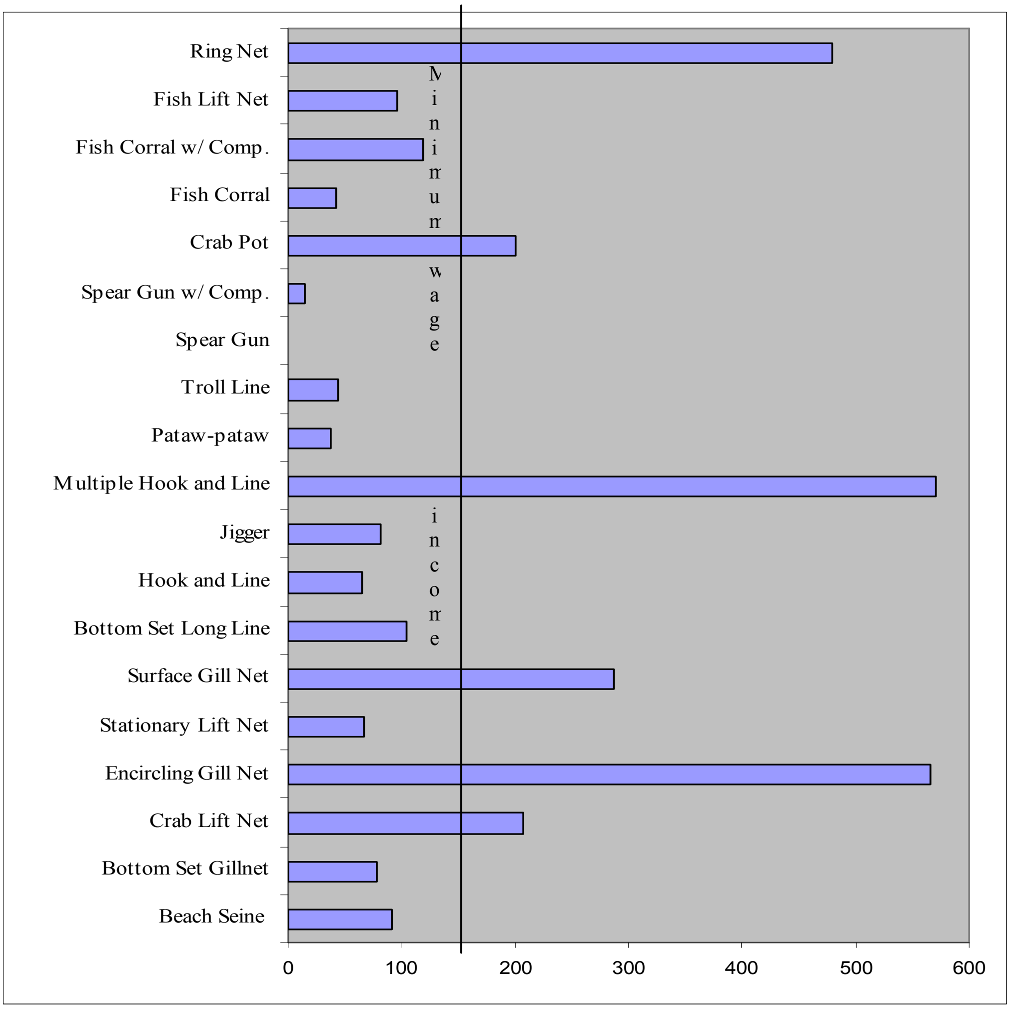


Figure 26. Income per fishing day of the different fishing gear used in Honda Bay. (Line drawn across the histogram represents the minimum daily wage of PhP 150.00.)

Community Analysis

Analysis on species composition and gear used was achieved through the use of the COMM Program. The program determines the similarity of species and stations (gear). Table 4 shows the results of the analysis.

Table 4. Two-way table on fish family composition and gear used in Honda Bay (1999-2001).

Family	SG	EGN	HL	BSLL	RN	FLN	SLN	BSGN	FC	SGN
Carangidae	2.4	2.8	1.1	13.2	38.6	31.3	6.1	22	25.1	9.1
Clupeidae					30.6	32.3	57.3	2.2	9.2	
Scombridae			.9	.3	22.4	11.7	2.5	36.2	4.6	87.7
Leiognathidae		.1			2.1	3.5	15.1	16.6	17.4	
Sphyraenidae		.1	.1	1.5	2.4	1.4	.4	4.3	13.1	3.1
Engraulidae					.7	13.5	17.4		3.2	
Emmelichthyidae					1.7	2.9	.4		.2	
Loliginidae					.8	.8	.1		.1	
Mullidae	6.6	.1		.1	.5	.9	.5	4.4	1.2	
Portunidae				.2				3.5	.3	
Lethrinidae	1.2	11.4	1.1	32.3				1	.9	
Lutjanidae	1.2	.3	.9	12.4				1	1.7	
Nemipteridae	6.9	1.1	95.8	40				8.2	10.1	.1
Siganidae	81.8	84.2		.1	.2	1.8	.3	.6	12.1	

Encircling gillnet, hook and line, bottom set longline and spear gun fishing activities are predominantly undertaken in coral reefs or near coral reef areas as evidenced by their catch composition, such as siganids, nemipterids, lethrinids and lutjanids. On the other hand, ringnet, fish liftnet and stationary lift are operated in the presence of schooling fishes, particularly pelagics (carangids, clupeids and scombrids). In the case of fish corral, bottom set gillnet and surface gillnet, species composition varies because their operation depends on trapping fishes that come across the gear.

Fishes of the families Carangidae, Clupeidae and Scombridae have similar characteristics that justify why these were formed in the same group. Fish species under these families are found in the vicinity of the water column's surface and are thus classified as pelagic. Small species of carangids and scombrids inhabit coastal waters, while the larger species are out far offshore or conduct transoceanic migrations. Most of the gear used by fishermen in the bay catch a high percentage of small species. On the other hand, the large ones are caught by ringnet, floating liftnet and stationary liftnet which are operated offshore.

Small pelagics are species belonging to the family Leiognathidae, Engraulidae, Sphyraenidae, Clupeidae and Carangidae which inhabit shallow coastal waters. These are mostly schooling species.

Species of the families Emmelichthyidae and Loliginidae are found near the bottom or at coastal and continental shelf areas at a depth of 100-400 m. Some of these species are found in shallow waters.

Mullidae and Portunidae are found in sandy or muddy bottoms or substrates. Both inhabit shallow waters.

Lethrinidae, Lutjanidae, Nemipteridae and Siganidae are bottom-dwelling species usually found on sandy substrates. These are also found in rocks, coral reefs, mangroves, estuaries and brackishwater areas. High percentage of species belonging to these families are caught by spear gun, encircling gillnet, hook and line, and bottom set longline. These gear are operated at the bottom/near bottom of shallow areas.

Results of the TWINSPAN analysis conducted by Aliño *et al*. (2001) indicated that the fish community in Honda Bay is basically grouped due to an embayment effect and/or exposure to monsoon seasons. There is an inner group composed of sites Bush, Meara and Snake, and an outer or exposed group composed of sites Areeciffe, Cowrie, Fondeado and Starfish. Furthermore, these groupings are characterized by a particular species group. The inner group is characterized by denuding herbivores (*Siganus vulpinus* and *S. virgatus*) and pelagic planktivores (*Chromis alphareus* and *Amblyglyphidodon* sp.). On the other hand, the outer or exposed group is characterized by denuding herbivores (*Plectroglyphidodon lacrymatus, Pomacentrus molluccensis*, *Neoglyphidodon melas, Halichoeres melanochir, Cheilinus chlorourus* and *Ctenochaetus striatus*).

In terms of practical application in management, the cluster analysis clearly shows which gear type targets the shallow water – mostly pelagic portion of the resource and those targeting reef-associated resources. Concerns or issues pertaining to specific portions of the resource may therefore be addressed by focusing on these sets of gear. Fish corral and bottom set gillnet catches cut across all the major fish groups, and their regulation would affect the entire resource.

SUMMARY AND CONCLUSION

From 1998 to 2002, there was an increase of six percent in the number of fishing gear and 40 percent in the number of fishing boats operating within the bay, particularly hook and line. This increase was due to gear type diversification, using several types of gear in one fishing trip/operation to augment income or maximize fishing activity. Thus, the catch landed by a fishing boat is from two different types of gear. Moreover, there has been a proliferation of more effective small-scale fishers as a reaction to the loss of opportunities for trawlers to operate within the bay (Lachica-Aliño *et al*. 2001).

The seasonality of fishing operation for municipal fishers is not pronounced as almost 42 percent of the different gear surveyed operate year-round. On the other hand, the trend of production from commercial fishing operation is influenced by the southeast and northwest monsoons.

The trend of catch, effort and catch per unit effort (CPUE) during the five-year period showed that an increased number of boat landings translates only to an increment in catch but with a low CPUE. It also showed that the effort level of 44,584-84,276 boat landings can sustain the maximum level of production so far estimated from the observation.

Some of the municipal gear used had a decreasing trend of CPUE, while others showed an increasing trend. A decrease in annual catch per boat landing was noted in the stationary liftnet, surface gillnet, bottom set longline and fish corral. This shows that almost all of the artisanal gear are experiencing a decreasing catch rate, while commercial fishing operation shows an increasing trend of CPUE.

In terms of the number of species by family, there was a considerable reduction among the high-valued species, *e.g.*, Lutjanidae (snappers) and Serranidae (groupers).

Catch composition for five years was dominated by pelagic fishes (76.72 percent), while demersal or ground fishes and reef fishes contributed 5.7 percent and 7.58 percent, respectively. The increase in demersal species was probably due to the ban on trawl, and the decline in reef catch was possibly caused by overfishing in the reefs or by a decline of fish biomass in reef areas.

Most of the fishes exploited both by municipal and commercial fishing are small pelagics. This may be attributed to the gear used in the bay. The ban on the use of trawl led to an increase in demersal species. The decline in reef catch may be due to overfishing in the reef areas and slow recovery of protected reefs.

The fishery resource in terms of species composition showed an increasing number of species belonging to a higher trophic level, *e.g.*, *Decapterus* sp. and *Selar* sp.

Twenty-five percent of the species analyzed have estimated E values within the optimum range, while 75 percent have E values beyond the maximum level. This is an indication that the resources of Honda Bay are experiencing full exploitation.

Data on mean length and size at first maturity of dominant species caught in the bay showed that their mean sizes are much bigger than their length at first maturity. This indicates that most of the species have at least contributed to the recruitment process of their stocks before these are caught.

Estimates on potential yield (PY) showed that both catch and effort in Honda Bay are at the maximum level. The theoretical downward trend after the maximum level has been reached is shown by the decreasing production trend after the highest production was reached in 2000.

Of the 17 different types of gear analyzed, only six (*i.e*., ringnet, multiple hook and line, encircling gillnet, surface gillnet, crab liftnet and crab pot) provide incomes higher than the minimum wage of PhP 150.00 per day.

RECOMMENDATIONS

Resource assessment should go beyond the collection of resource information. It should include the collection of information on the status of the implementation of CRM. The assessment must provide sufficient explanation on factors that enhance resources of a managed fishing ground. Ideally, LGUs could initiate moves for a total ban on dynamite and cyanide fishing, and coastal polluting industries as these all promote wastage. A successful ban will then improve the sustainability of the coastal marine resources.

The use of gear that are "environment-friendly" and provide high net income, such as multiple hook and line, encircling gillnet, surface gillnet, crab lift net and crab pot, should be encouraged.

The present level or amount of fishing in Honda Bay is already at the maximum; the potential yield of 977 mt has been reached, as estimated using the Fox model. Estimates of exploitation rate of different fish species point out to heavy fishing pressure on the bay's resources. The hope, therefore, of increasing or maintaining the present production lies on the implementation of management measures by the sectors concerned.

It is interesting to note that with the present level of exploitation in Honda Bay, most of the important species are able to reproduce and replenish their stocks before these are caught. Honda Bay is not so overfished as to have a discouraging situation, but it should be sustained by strict implementation of all recommendations contained in the management plans.

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