

**THE USE OF ALTERNATIVE SCENARIOS FROM
AN ECOSYSTEM-BASED MODEL SIMULATION OF THE DANAJON BANK
MUNICIPAL FISHERIES AS INPUT TO EVALUATING FISHERIES
MANAGEMENT OBJECTIVES IN A CHOICE EXPERIMENT**

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The Use of Alternative Scenarios from an Ecosystem-based Model Simulation of the Danajon Bank Municipal Fisheries as Input to Evaluating Fisheries Management Objectives in a Choice Experiment

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ABSTRACT

Fisheries management is undertaken in pursuit of economic, social, and ecological objectives. Although underpinning interactions occur between the objectives, their seemingly divergent outcomes highlight more their conflicts. The lack of understanding that fisheries is an integral part of a larger ecosystem reinforces these differences. The Policy Search Routine in the Ecopath with Ecosim (EwE) software was used to investigate the type and levels of trade-offs that are necessary when maximizing each of the management objectives. Predator fish groups seem to suffer the most when the economic objective is maximized. On the other hand, maximization of the social objective incurs major reductions in both prey and fish biomasses, as well as decreases in overall profits. Maximizing the ecological objective plus emphasis on rebuilding the predator fish biomasses results in positive increments for both predator and prey fish biomasses, but negative increments for the rest of the variables. These reference parameters served as attributes to characterize the alternative scenarios in a choice experiment survey, which aimed to evaluate the choice decisions of the fishers in Danajon, northwestern Bohol, the Philippines. The results showed significant difference in the proportions of respondents preferring three discrete policy scenario outcomes and their implied economic, social, and ecological fisheries management objectives ($\chi^2 = 64.391$, $p < 0.001$). Further, segmented logistic regression models of the respondents revealed that their choice for a specific scenario was influenced by some of their socio-economic and fisheries characteristics. The models for economic objective/scenario preference, social objective/scenario preference, and ecological objective/scenario preference were overall significant at $p < 0.01$, $p < 0.001$, and $p < 0.002$, respectively. Furthermore, a logistic regression model for evaluating the policy attributes as potential determinants of choice proved significant at $p < 0.001$. It demonstrated high probabilities of choice when a policy/scenario promotes the increase in effort of fishing gear types perceived to be least harmful to the marine ecosystem, improves overall fisheries harvest, promotes employment security for the majority, and increases the biomass of blue crabs (*Portunus pelagicus*), locally known as “lambay”.

CHAPTER 1

INTRODUCTION

1.1 Rationale

Costanza *et al.* (1999) describes fisheries management as a form of natural resource governance that operates on the interdependency of the socio-economic and ecological dimensions of a fisheries system. The ecological dimension supports the human activities through flows of goods and services. At the same time, human activities impact the ecological structure. The term 'fisheries' implies human action of taking fish and other fishery resources from an aquatic ecosystem. The degree and rate at which fish and fishery resources are taken from the ecosystem result in corresponding impacts to the ecosystem. If this rate of *taking from* the ecosystem should interfere significantly with its natural dynamics, the flows of goods and services will be affected correspondingly, thereby reducing the overall value that the ecosystem can provide to human society. In this context, an effective fisheries management aims for the sustainability of the interactions between the socio-economic and ecological dimensions of fisheries ecosystems.

Owing to the complexity of not only the dynamics within an aquatic ecosystem, but also, that of the components of human society, fisheries management requires multiple disciplines and information on the characteristics of the ecosystem, of human activities, and of the interactions between the two, in order to address both the ecosystem and societal objectives. Thus, the FAO's *A Fisheries Manager's Guidebook* (Cochrane 2002) prescribes a working definition for fisheries management as:

"The integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued

productivity of the resources and the accomplishment of other fisheries objectives.”

The definition can be divided into two parts, the first consisting of methods directed to achieve fisheries objectives, while the second part connotes the objectives themselves. Explicit in the definition is a societal objective, *the continued productivity of the resource*, which implies the fisheries catch that will satisfy consumptive demands of society. The fisheries catch should subsequently refer to corresponding fishing activities that will generate profits and employment. Implicitly, ecosystem objectives go parallel with the socio-economic objectives since the condition of the ecosystem affects the productivity of the resource. In the actual conduct of fisheries management, conflicts between the ecosystem and socio-economic objectives may arise, and trade-offs will have to be made depending on the needs and preferences of stakeholders, who in this study will be considered as both users and managers of the fisheries resources. Taking on a conservationist's perspective, the pursuit of ecosystem objectives, such as maintenance of biodiversity, *should take precedence over maximizing fisheries yields*, with the argument that *...loss of biodiversity is irreversible and represents potentially huge opportunity costs in the future* (Agardy 2000). However, from a typical fisher's perspective, sustaining poorly understood ecosystem dynamics may be less relevant compared to ensuring the provision of basic daily food requirements of the family. This is where the first part of the FAO definition of fisheries management comes into play. Users-managers and policy makers interaction is eminent to identify priority fisheries management objective/s. Equally crucial are systematic researches to identify, describe, and assess the ecosystem characteristics upon which the fisheries activities depend. These steps are aimed to generate as much relevant information as possible, necessary for linking ecosystem and socio-economic fisheries objectives (see Lane and Stephenson 1995 for a more detailed discussion) in order to develop fisheries management strategies that are appropriate, effective, and sustainable.

The Danajon fisheries system is deemed an ideal setting to examine the interplay of socio-economic and ecosystem objectives of fisheries management. Danajon is a rich fishing ground that supports an important part of the municipal fisheries sector of Central Visayas, Philippines (Figure 1-1), covering an estimated surface area of 2,476 km² (Green *et al.* 2004). Seventeen coastal municipalities share jurisdiction over the natural resources of the Danajon ecosystem. Fishing in the area occurs throughout the year, and is dominated by the municipal fisheries sector, which is characterized by multiple gear types that exploit multiple fish and invertebrate species. Blue crabs (*lambay*), squids (*nokos*), rabbitfish (*danggit*), garfish (*bawo*), anchovy (*bolinao*), roundscads (*tamarong*), and mackerel scads (*anduhaw*) are among the important fisheries resources in Danajon (Armada *et al.* 2004).

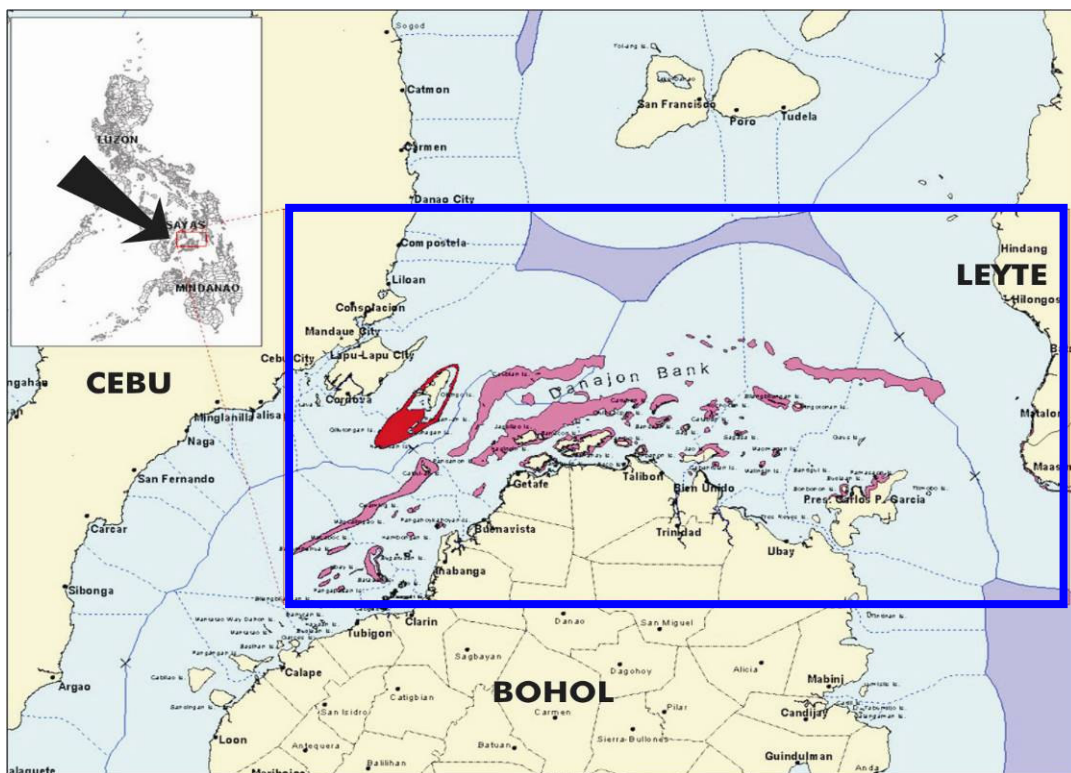


Figure 1-1. Map of the Danajon ecosystem (boxed). Source: FISH Project-GIS

In Bohol Province alone, ten out of twenty-nine coastal municipalities form part of the Danajon fisheries system. Although comprising only one-third of the coastal municipalities of the Bohol Province, these municipalities already represent over 50% of the municipal fishers and fishing boats for the entire

province (Armada *et al.* 2004). This clearly reflects the importance of the Danajon system to the municipal fisheries production in the area. In addition to the harvest and employment benefits, Danajon is a possible significant source of non-marketed ecosystem benefits, such as biodiversity, aesthetic values, and cultural values. In Danajon, there can be found a double barrier reef, a unique geological formation which has developed over a span of 6,000 years of coral growth (Pichon 1977). Thus, it will be particularly interesting to determine whether societal or ecosystem objectives are preferred by the stakeholders of Danajon, to investigate at the same time how the stakeholders make trade-offs between these varying, and at times, seemingly conflicting objectives.

1.2 Review of Literature

Benefits generated from a marine ecosystem include goods and services that are either traded or not traded in the market. Marketed goods and services from a marine ecosystem usually refer to fisheries benefits such as, but not limited to, the landed catch or fish harvests, and the direct and indirect employment generated in the pre-harvest, actual harvest, and post-harvest activities. Annual reports from the Bureau of Fisheries and Aquatic Resources (DA-BFAR 1951-1987, 1997, 2000, 2002, 2003, 2004) and Bureau of Agricultural Statistics (BAS 1988-2002, 1992-2001, 2001, 2002) contain production results that estimate the market benefits generated from the fisheries sector in the Philippines. These reports are limited to the estimation of marketed fisheries benefits of the contemporary generation only. However, there are many non-marketed inter-generational benefits that fisheries systems accrue to society. These include maintenance of genetic, species, and ecosystem biodiversity, recycling of nutrients, energy transport, supply of aesthetic values, and supply of recreational activities (Holmlund and Hammer 1999), to mention a few. These benefits are measured using non-market valuation techniques, which can be divided into two main streams: the revealed preference (RP) methods and the stated preference (SP) methods (Adamowicz *et al.* 1998a, Alpizar *et al.* 2001, Hicks 2002). Revealed preference methods use observations on actual choices made by individuals

to infer the value of a good. Popular RP methods are the hedonic pricing method and the travel cost method (Braden and Kolstad 1991). Stated preference methods, on the other hand, evaluate values of goods and services by using individuals' stated behavior or preferences in a hypothetical setting. Adamowicz *et al.* (1998a) identified conjoint analysis, contingent valuation method (CVM), and choice experiments as examples of techniques under the SP method. In early transport and marketing literature, the terms stated preference, conjoint analysis and choice experiment were often used interchangeably owing to the high similarity in their experimental design, methodology, and analysis. Sanko (2001) further stated that although sometimes the differences between these methods are discussed, the differences are "dubious and clear definition is difficult." Hence, economic models, experimental designs, and analytical tools devised for the different stated preference techniques shall be adopted.

A detailed comparison of the advantages and disadvantages of using SP and RP techniques is outlined in the valuation literature (Adamowicz *et al.* 1998a, Sanko 2001, Hicks 2002). Stated preference techniques likewise share the same limitations and inherent constraints of valuation methods in general (Hufschmidt *et al.* 1983). An obvious weakness is its reliability, that is, since individuals state their preferences under a hypothetical situation, there is a possibility that the expressed preferences will not be consistent with their actual behavior. Morikawa (1989) introduced a method combining stated and revealed preference data to overcome this problem. Several studies have tested its application (Adamowicz *et al.* 1994, Hanley *et al.* 2000, Dosman and Adamowicz 2002), thus giving the combined SP and RP method general acceptance in non-market valuation. As the name implies, combined SP and RP require two data sets for analysis. The collection of which will require longer time and more money than collecting just one data set for either method.

Choice experiment, also known as discrete choice method (Hanemann 1984, Ben Akiva and Bierlaire 1999), is a popular technique used to measure consumer preferences about the characteristics or attributes of a product or

service, hence to develop effective product design. The technique is based on a theory of value (Lancaster 1966) which states that individuals derive utility from the characteristics of the goods rather than directly from the goods themselves. Applied to non-market valuation, the choice experiment allows for the evaluation of not only an ecosystem's value as a whole, but the implicit values of its attributes as well (Hanley *et al.* 1998, Bateman *et al.* 2003, Birol *et al.* 2005). This makes the choice experiment method appropriate for evaluating benefits generated by the multiple services and functions of ecosystems. An in depth analysis of the application of choice experiments in non-market valuation is provided by Boxall *et al.* (1996), Bateman and Willis (1999), Adamowicz *et al.* (1998b), Hanley *et al.* (1998), Layton and Brown (1998), Louviere *et al.* (2000), Alpizar *et al.* (2001), and Louviere (2001).

Prior to the application of choice experiments in non-market valuation, the method had already been used widely in the field of transportation (Ben-Akiva and Lerman 1985, Morikawa 1989, Hensher 1994, Ben Akiva and Bierlaire 1999) and commodity marketing (Louviere and Hensher 1982, Louviere and Woodworth 1983, Hanemann 1984, Louviere 1993, Unterschultz *et al.* unpubl.). The first study to apply choice experiments to non-market valuation was Adamowicz *et al.* (1994). The method was then soon applied extensively in both market and non-market valuation studies, such as to examine preferences in health services (Ryan and Hughes 1997, Ratcliffe and Buxton 1999, Ryan and Farrar 2000, Ryan *et al.* 2001), urban planning (Davies *et al.* 2000), recreation (Train 1998, Hanley *et al.* 2000, Haider 2004); marine water quality (Eggert and Olsson 2003), biodiversity (Frör 2003, Birol *et al.* 2004) and service standards in urban water (MacDonald *et al.* 2005), among many others.

In fisheries literature, the early application of choice experiments was limited to recreational fishing (Olsen *et al.* 1991, Hicks 2002a) and hobbyists' preference for ornamental fish (Alencastro 2004). Not until recently had the method been used to evaluate, not specific fisheries goods and services, but fisheries management programs. Layton *et al.* (1999) applied a stated preference technique to rate alternative programs aimed to conserve and/or

rehabilitate fish populations in Washington state waters, while Hicks (2002b) applied the technique to investigate a species-specific management strategy. The significance of these studies was in their recognition of the various sources of human societal factors that impact the fisheries ecosystem, thus reflecting the rationale of the present study. A work most relevant to the present study was carried out by Wattage *et al.* (2005) wherein a choice experiment was used to evaluate multiple objectives in fisheries management. The preference structure of stakeholders, i.e. both users and managers of fisheries resources, was deemed important to be able to identify more efficient and more sustainable fisheries management strategies. A similar assumption for the present study is that components of a fisheries management policy affect stakeholders' perception of that policy, thereby influencing their decisions to whether or not support related management activities.

1.2.1 The economic model

The basic theoretical foundation of the choice experiment approach is traditional microeconomic theory, which assumes that individuals choose to consume a specific good in quantities that maximize his/her utility subject to specific constraints (e.g. budget). The characteristics theory of value (Lancaster 1966) proposes that individuals derive discrete utilities from the different characteristics or attributes that make up a good or service. The choice experiment approach combines these theories and links them with the random utility theory (Thurstone 1927, McFadden 1974, Manski 1977), which posits that the choices that individuals make can be modeled as a function of the goods' attributes. That is, on the assumption that individuals derive utility from the characteristics or attributes of a good rather than from the good itself, a change in one of the good's characteristics, therefore, may result in a discrete switch from one good to another rather than in a continuous change in the quantity demanded.

Ideally, the model should try to identify and capture all possible attributes that influence choice behavior. However, this may not be possible. To capture these unknown influencing factors, a random variable is incorporated in the

individual's utility function expressed in a formula (McFadden 1974, Train 1986, Adamowicz *et al.* 1998a):

$$U_i = V_i + \varepsilon_i$$

where U_i is the overall utility for any one alternative i , V_i is the systematic or known component of the utility, and ε_i is the stochastic or random component. The systematic component of the utility may be described as that attribute that makes a product 'attractive' (Adamowicz *et al.* 1998a). The presence of the random component allows for the computation of probabilities that an individual will choose one alternative over another, depending on the relative sizes of their systematic components. Therefore, for any two alternatives i and j , for example, the probability that an individual will choose alternative i over j is:

$$Pr ob\{i Chosen\} = prob\{V_i + \varepsilon_i > V_j + \varepsilon_j; \forall j \in C\}$$

where C is the set of all possible alternatives.

In sum, choice experiment studies are based around respondents selecting between alternative bundles of attributes. Conventionally, the development of these bundles of attributes involves qualitative investigation, such as focus groups and interviews (Hydeⁱ, *pers.comm.*). Hyde *et al.* (2002) presents a development work for a choice experiment, essentially proposing a rigorous method of identifying the attributes to be used in the statistical model and the levels of those attributes.ⁱⁱ The painstaking and laborious nature of such

ⁱ Dr. Tony Hyde is an econometrist whose work is focused in modeling choice behavior, latent class analysis, and random utility modeling. He is currently a professor at the University of Wales Aberswyth.

ⁱⁱ The method used a program (software) called NVivo, which allows coding and grouping of crucial statements from spoken or written word, from interviews, focus groups, or open-ended questions in a questionnaire. Another paper of relevance is Kaplowitz and Hoehn (2001).

method provided the imperative to use ecosystems modeling and simulation to identify the key attributes for the construction of alternative scenarios in a choice experiment. Focus groups may then be employed simply for validation.

1.2.2 The ecosystem model

Ecopath is a software used to construct a mass-balanced trophic model and to calculate network characteristics of an ecosystem. Its foundations can be traced back to Odum's invaluable works on ecosystem development and fundamentals of ecology (Odum 1969, Odum 1971), and to the early works on modeling marine ecosystems energy and biomass flows (Caddy 1975, Sheldon *et al.* 1977, Polovina 1984, Ulanowicz 1984, 1986). Thereafter, Ecopath underwent several developmental stages from the basic Ecopath II (Christensen and Pauly 1992) to the current Ecopath, Ecosim, Ecospace (EwE) package (Christensen *et al.* 2000, Christensen *et al.* 2004). While Ecopath allows for the modeling of a defined ecosystem, Ecosim is a time-dynamic simulation tool designed for investigating fisheries effects and policy exploration, and Ecospace is a tool that is both spatial and time-dynamic intended primarily to examine impact and placement of marine protected areas and spatial effort allocation. In its entirety, the EwE software package is very useful with its applications to *address ecological questions, evaluate ecosystem effects of fishing, explore management policy options, evaluate impact and placement of marine protected areas, and evaluate the effect of environmental changes* (Christensen *et al.* 2000). Detailed reviews of the methods, capabilities, and limitations of EwE are available in Walters *et al.* (1997), Pauly *et al.* (2000), and Christensen and Walters (2004a).

Literature on the application of EwE to a range of marine ecosystem scales continues to grow, from large marine ecosystems and ocean systems (Pauly and Christensen 1993, Cox *et al.* 2002), to bay, coast, lagoon, reef, and gulf fisheries systems (Silvestre *et al.* 1993, Christensen 1998, Okey and Pauly 1998, Zetina-Rejon *et al.* 2001, Pitcher *et al.* 2002, Arreguin-Sanchez *et al.* 2004), to inland lake (Kitchell 2000, Moreau 2001) and aquaculture systems (Delos Reyes 1993), and even boreal forest systems (Ruesink *et al.* 2002).

Ecopath models of the Bolinao Reef (Aliño *et al.* 1993), Lingayen Gulf (Guarin 2001), San Miguel Bay (Bundy and Pauly 2001, Bundy 2004), San Pedro Bay (Campos 2003) and Sapián Bay (Armada and Bacalso 2004) represent the few published models of marine fisheries systems in the Philippines. For a more comprehensive reading on EwE application, three important edited volumes devoted to aquatic ecosystems modeling are those of Christensen and Pauly (1993), Pitcher and Cochrane (2002), and the special volume of *Ecological Modeling* Journal (Vol. 172, 2004) which contained issues that addressed the dynamics of marine resource interactions and management mechanisms.

Of high relevance to the research are the works contained in Pitcher and Cochrane (2002), the work of Christensen and Walters (2004b), and the study of Bundy (2004), which applied ecological theory to explore the interactions between fishing and the ecosystem of San Miguel Bay, Philippines. These researches made use of the *Policy Search Routine* in Ecosim to test a range of fisheries management strategies. In brief, this application is a non-linear search procedure known as the Davidson-Fletcher-Powell (DFP) method used to iteratively search for optimum fishing patterns over time. The fishing patterns refer to combinations of fishing rates, i.e. the relative fishing efforts of the various fishing gears of the Ecopath model. These fishing rates result in corresponding impacts on the biological community structure and fishery yields of the system. The optimum fishing patterns will vary depending on the user-defined performance measures or objective functions for fisheries management, specifically, *net economic value* (total fishing profits), *social value* (employment), and *ecosystem structure* or '*health*'. For example, if a high weight is assigned to *net economic value*, the routine simulates a fishing strategy that maximizes production of those species that are most profitable to the harvest. Alternatively, a high weight on *social value* will result in a scenario that maximizes production of fishing operations that employ the most people. Lastly, a high weight on the *ecosystem structure* criterion causes the routine to search for a fishing pattern that maximizes the biomass of long-lived organisms, maintains biodiversity and ensures against ecological instability. A recent addition to the set of objective functions is the *mandated rebuilding*

of species (Christensen *et al.* 2004). This objective function was incorporated to test for possible outcomes of policies aimed to preserve or rebuild populations of a given species in an area. The user may prioritize one objective over the others, or assign equal weights for all objectives to search for what is referred to as a 'compromise scenario' in Ecosim policy simulation, implying the trade-offs to be made in pursuing any or a combination of the objectives in fisheries management.

1.3 Objectives

The overall aim of the study is to evaluate stakeholders' preferences for different fisheries management objectives in an ecosystem-based fisheries context. To this end, the study addresses the following specific objectives:

1. To search for fishing strategies for the Danajon municipal fisheries system that will maximize each of the fisheries management objectives identified;
2. To identify key socio-economic characteristics of stakeholders that are likely to influence their preference;
3. To identify key attributes relating to the fisheries management objectives that are likely to influence stakeholders' choice decisions; and
4. To gather information that may be used in developing future fisheries management strategies, or in modifying/reinforcing current fisheries management policies in place.

The key attributes characterized the pursued fisheries management objectives. The policy search routine in ecosystems modeling and simulation, coupled with key informants interviews, helped identify these attributes. The simulated optimum fishing patterns and corresponding biological community structure of the Danajon municipal fisheries system defined the alternative scenarios of fisheries management in the choice experiment. Stakeholders' preference for the *economic*, *social*, and *ecological* objectives were then evaluated.

1.4 Hypotheses

In evaluating the three specific fisheries management objectives – economic, social, and ecological objectives – the study intends to find out whether the stakeholders are likely to prefer one objective over the others. The choice experiment shall yield from an n random sample of fisheries stakeholders estimates of population proportions that will favor either economic objective, social objective, or ecological objective, with probabilities p_1 , p_2 , and p_3 , respectively. To decide whether the stakeholders have a preference for any one objective, the study tests the null hypothesis that these objectives are preferred equally by the stakeholders:

H_{o1} : Ecological Obj., $p_1 =$ Economic Obj., $p_2 =$ Social Obj., $p_3 = 1/3$

against the alternative hypothesis that one objective is preferred:

H_{a1} : At least one of the proportion exceeds $1/3$.

Specific variables such as the stakeholders' socio-economic and fisheries characteristics, and the attributes or elements of the alternative fisheries management policies may influence stakeholders' decisions. Accordingly, the study investigates whether certain socio-economic and fisheries characteristics of the stakeholders (e.g. gender, educational attainment, type of fishing operation, etc.) determine their preferences for alternative fisheries management policies and objectives:

H_{o2} : The socio-economic and fisheries characteristics of the stakeholders have no significant influence over their choices

against the alternative hypothesis that

H_{a2} : At least one of the socio-economic and fisheries characteristics of the stakeholders is likely to influence significantly their choice decisions.

Furthermore, the study explores the probabilities that certain attributes or elements of the alternative fisheries management policies under specific fisheries management objectives influence the stakeholders' choice decisions:

H_{o3} : No one attribute of the fisheries policy scenarios is likely to influence significantly the choices made by the stakeholders

against the alternative hypothesis that

H_{a3} : At least one attribute of the fisheries policy scenarios is likely to influence significantly the stakeholders' choice decisions.

1.5 Conceptual Framework

Fisheries management is undertaken in pursuit of three objectives: the economic objective, social objective, and ecological objective. For this study, these objectives reflect the outputs of the ecosystem model simulations. Following Christensen *et al.* (2004), the economic objective refers to the fisheries rent based on calculating fisheries profits as the value of the catch ($= \text{volume of landings} \times \text{price, by species}$) less the cost of fishing ($= \text{fixed} + \text{variable costs}$). The social objective refers to the employment supported by the various fishing gear types operating in the Danajon area. This employment benefit is calculated as the number of jobs relative to the catch value, which is specific for each gear type or fishing operation. The ecological objective refers to the ecosystem structure or health after E.P. Odum's description of ecosystem 'maturity' (Odum 1971). The components that characterize the ecological objective are limited to biomass indicators of selected fish and invertebrate groups depicting the overall trophic level of the system.

The pursuit of any or a combination of the objectives in fisheries management implies trade-offs in the levels of their characteristic components. The choice of a priority objective should reflect the needs of the stakeholders of the fishery, as well as their level of insight of what 'fisheries' is when placed in an

ecosystem context. Understanding these elements will help fisheries managers and policy makers develop appropriate fisheries management strategies that will be more effective and more sustainable. A schematic diagram of the conceptual framework of the study is presented in Figure 1-2.

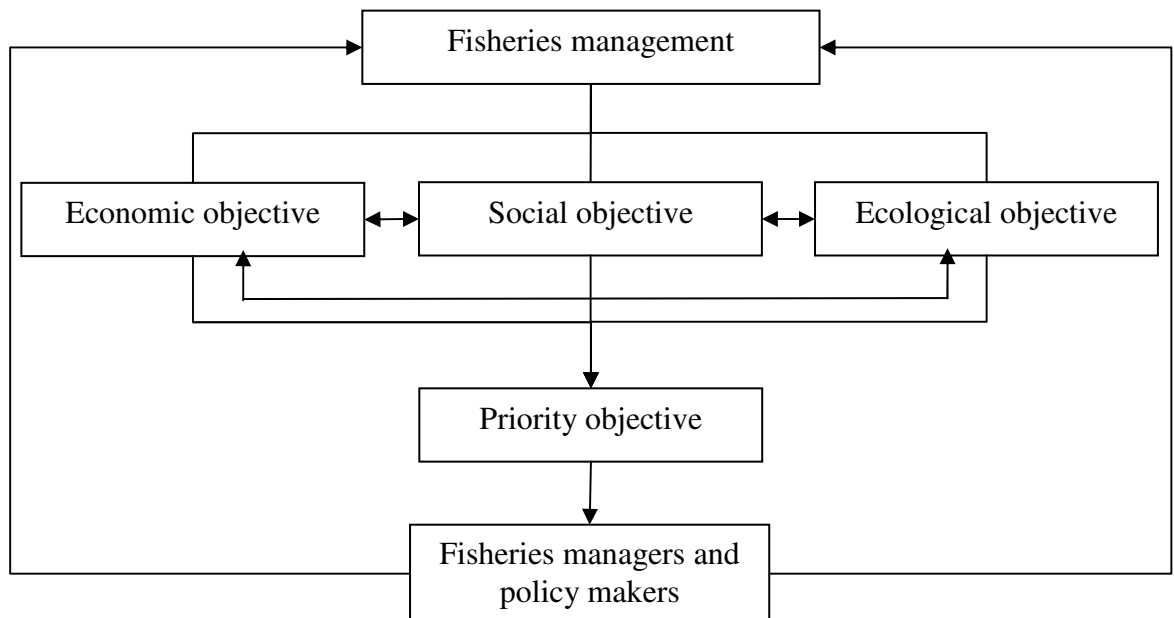


Figure 1-2. Conceptual framework for evaluating fisheries management objectives in a choice experiment study

1.6 Limitations of the Study

The study involved the integration of two otherwise independent methods applied to the multi-disciplinary framework of fisheries management science (Lane and Stephenson 1995): *ecosystems modeling* and evaluation of fisheries management objectives through a *choice experiment*. Following are the limitations and relevant biases in each method, and the means by which these could possibly be overcome in the study. General limitations are likewise enumerated.

1.6.1 Limitations of fisheries modeling and simulation

An Ecopath model is simply a representation of ecosystem conditions averaged over an annual period. Considering not only the complex interrelationships of an ecosystem's living components, but also the variable physiological and thermodynamic constraints, the constructed model for the Danajon municipal fisheries system is just one of the many possible representations of the actual dynamics of the system. Another contributory factor to uncertainties in the model is the source of data inputs. That is, the model construction has a heuristic value in which the representation of ecosystem structure and interactions is highly dependent on the data origins. Models constructed from purely on-site and current data are rare. For this study, the 2006 Ecopath model of the Danajon fisheries system served as the basic foundation for the simulation of alternative fisheries management scenarios. The model made use of parameter inputs that were a combination of primary data and modified value estimates from secondary sources, such as published fisheries assessment studies, fisheries biology investigations, and Ecopath models of similar or comparable ecosystems.

The researcher had access to recent fisheries profiles for all the municipalities of Bohol and Cebu provinces with jurisdiction over the municipal waters comprising the Danajon ecosystem. However, other relevant fisheries data such as catch rates and catch composition of gear types, and information on the current conditions of important micro-systems in Danajon were limited to the municipalities of Talibon, Bien Unido, Ubay, and Carlos P. Garcia only. Consequently, the Danajon Ecopath model and its simulations are representative of the fisheries conditions of only these four municipalities.

Lastly, the analysis in Ecosim is limited to direct fisheries outputs (i.e. harvest), direct market utility (i.e. profits) and direct employment (fisher groups) only. The choice experiment is hoped to capture the hidden values of the stakeholders in evaluating alternative fisheries management objectives and scenarios.

1.6.2 Limitations of the choice experiment

Adamowicz *et al.* (1998a), Swait and Adamowicz (1996), Mazotta and Opaluch (1995), and Bradley (1988) analyzed the specific problems that exist in choice experiment design and strategy. Too many alternative choices in the experiment design may lead to task complexity, which arises when the effort demanded from the respondents in choosing their preferred alternative may be so taxing that it compromises their ability to select their preferred option. Further, learning and fatigue effects may arise with too many alternatives that result in very long experiments. Furthermore, there is a danger for trivial questions and highly improbable scenarios to cause the respondents to not take the experiment seriously. These issues were addressed by limiting the number of alternative scenarios and by screening the responses before data analysis.

The choice experiment design, sample size selection, and survey methods were largely dependent on the budget constraints of the researcher. The allotted timeframe for the conduct of a masters' thesis in the University was another important consideration. In view of these constraints, the respondents for the choice experiment were limited to the direct users of the Danajon municipal fisheries system, specifically, the fishers only. Although a limitation, this was not a major set-back in evaluating fisheries management objectives since fishers were the main interest group of the study. Of the four municipalities included in the model construction, Talibon has the highest total number of fishing vessels with 1,490 motorized and 750 non-motorized vessels, and leads the record for total fishing gears inventoried (Armada et al. 2004). It likewise has a fair representation of the various fishing gear types and operations in the Danajon areaⁱ. Thus, to limit the scope of the experiment taking into consideration budgetary and time constraints, only the fishers from the municipality of Talibon comprised the set of fishers from which survey respondents were selected.

ⁱ Appendix A

CHAPTER 2 METHODOLOGY

The study is divided into two major parts: first, the search for alternative fisheries management scenarios, and second, the choice experiment survey. A schematic diagram (Figure 2-1) summarizes the steps undertaken to complete the study.

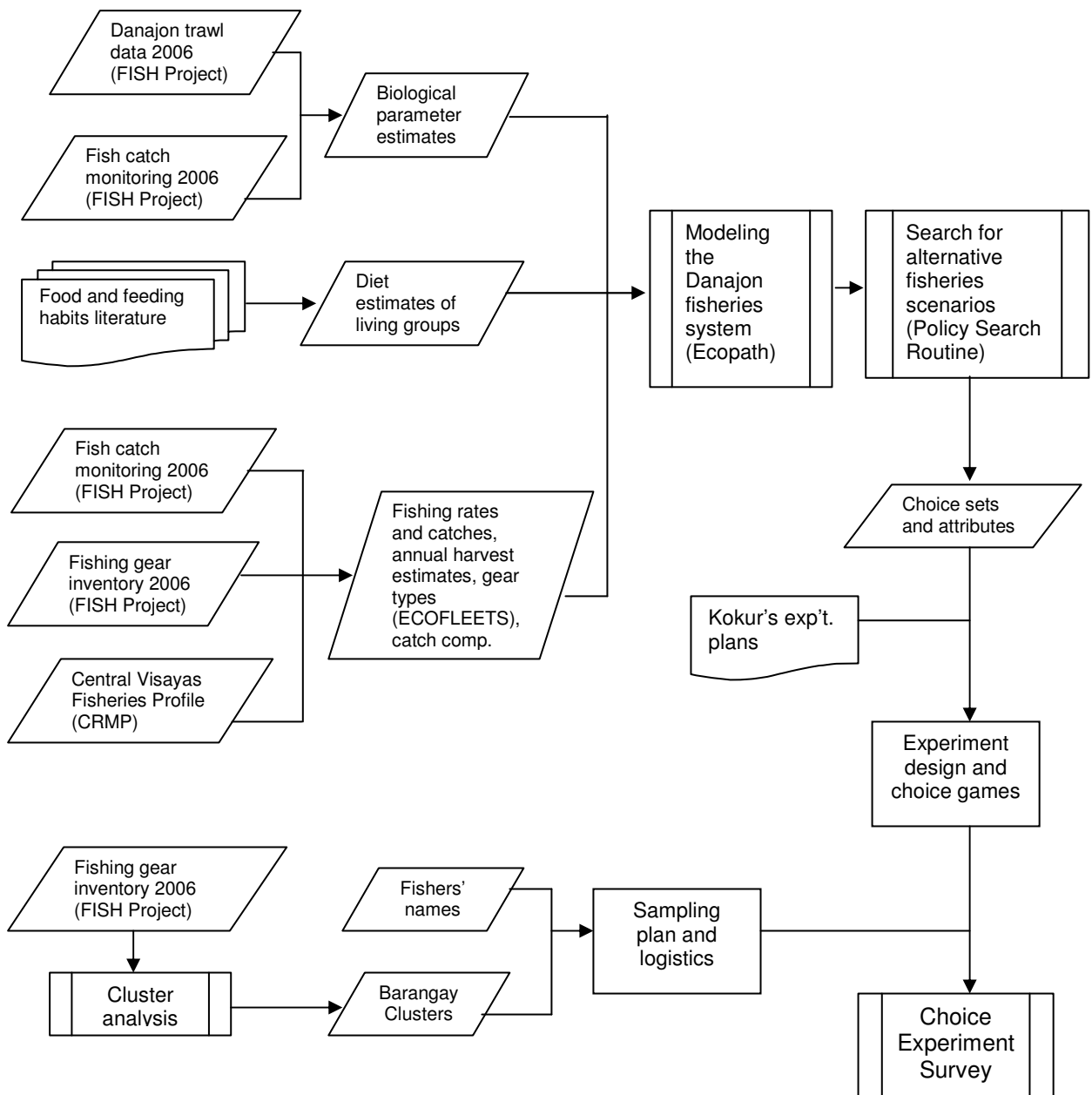


Figure 2-1. Schematic diagram of the study methodology

2.1 Simulating alternative management scenarios for the Danajon fisheries system

The Danajon ecosystem modelⁱ constituted the basic foundation of the fisheries policy simulations. It incorporated the municipal waters of Talibon, Bien Unido, Ubay, and Carlos P. Garcia (Figure 2-1). This area covers an estimated total 1,227 km², and a reef area of about 198 km². Trawl surveys in 2004 estimated the demersal biomass density in this part of Danajon at 0.45 tons/km² (FISH Project 2005). Follow-up surveys conducted in 2006 showed a doubling in demersal biomass density (FISH Project, unpublished).

Alternative fisheries management policies under specific management objectives were explored using the Policy Search Routine function in the EwE software. In addition to the 2006 Ecopath model of the Danajon fisheries system, other inputs include an updated list of fish prices (i.e. price of landed catch)ⁱⁱ and the fixed and variable costsⁱⁱⁱ of the various gear types and activities operating in Danajon. These information were collected via key informants interview, particularly, with fishers representative of the major fisheries activities in the area.

Three fisheries policy scenarios aimed at maximizing one or a combination of the specific management objectives were simulated: 1) Scenario A, maximizing the economic objective; 2) Scenario B, maximizing the social objective; and 3) Scenario C, maximizing the ecological objective with a mandated rebuilding of predator fish biomasses.

The policy search simulations were run for a span of 20 years under different vulnerability settings (0.2, 0.4, 0.6) to check for model sensitivities to strong fluctuations in trophic flow control. Due to the absence of empirical data to suggest any reliable estimates of trophic control in the system, the simulations

ⁱ Appendix B

ⁱⁱ Appendix C

ⁱⁱⁱ Appendix D

under 0.4 vulnerabilities were used assuming a mixed top-down and bottom-up control in the ecosystem. A discount rate of 4% (default value) was used in the policy search. All simulated strategies indicated that the system had stabilized within a 10-year period. Thus, the tenth year for each simulation was used as end state upon which reference parameters were compared to the base scenario (i.e. the 2006 Danajon model).

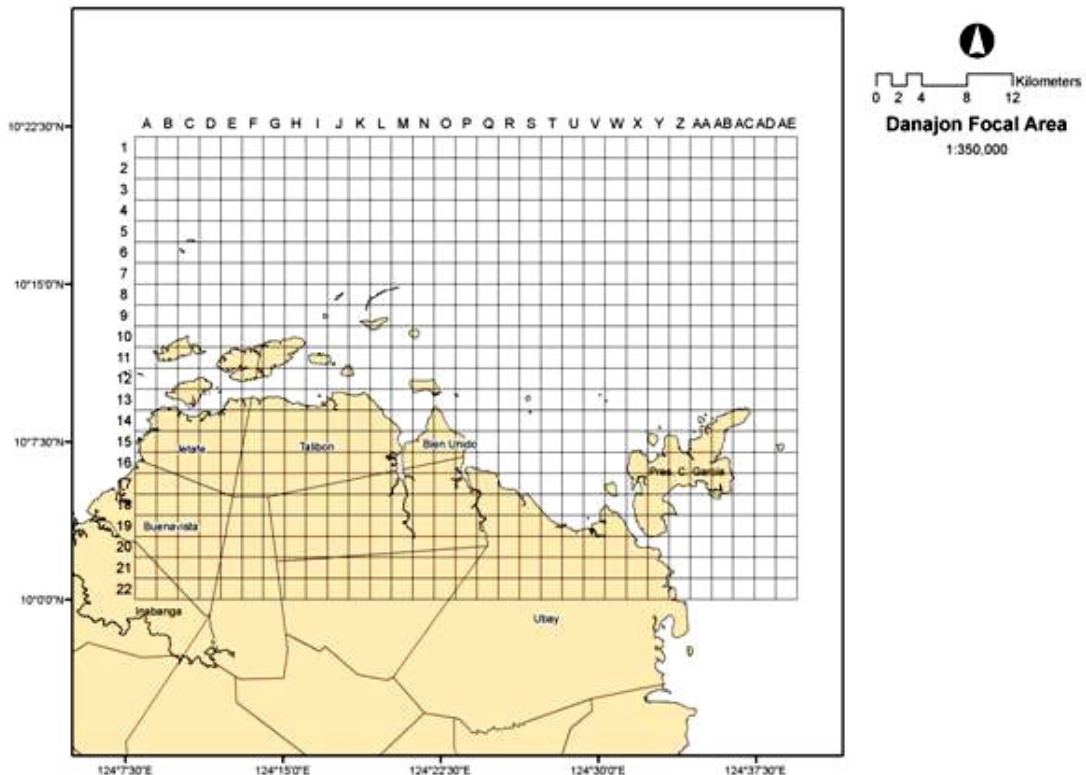


Figure 2-2. Grid map of Danajon municipal waters included in the Ecopath model.
Source: FISH Project-GIS

2.2 Choice experiment

The simulated alternative scenarios of the EwE Policy Search Routine formed the bases for the creation of alternative fisheries scenarios in the choice experiment. In the survey, respondents were asked to choose between these alternatives, each corresponding to a fisheries policy simulation that maximized one or a combination of fisheries management objectives. In order to examine the influence of the attributes or specific elements that comprised a scenario, choice games consisting of random pairs of choice sets

and attribute levels were constructed. In each choice game, the respondents were asked to choose only one of two alternatives in order to prompt the respondents to act as “consumers” whereby the fisheries scenarios are the “goods” or “services”. Invoking the random utility theory, we expect that the scenario with the attributes or a combination of attributes that the respondents find more “attractive” (i.e. that which they believe will maximize their utility) will be chosen. A questionnaire to elicit respondents’ attitudes and perception of relevant fisheries management topics and issues, as well as their overall perception of selected fishing gear types and activities concluded the survey.

2.2.1 Defining choice attributes and levels

Reference parameters from the policy search simulations were selected to serve as attributes or variables comprising the choice scenarios. The attributes included in the choice experiment were selected based on their relevance to and adequate representation of the management objectives being tested. A further consideration in the choice of attributes was that these had to be common enough indicators that the target respondents (i.e. the fishers) can relate to. For instance, the ecological objective could have been represented using a wide range of reference parameters such as those that characterize ecosystem health, species biodiversity, biological productivity, trophic levels, etc. However, these could be subject matters unfamiliar to an average fisher. A brief focus group with fishers revealed that fish groups common in the catch can serve as proxy indicators of ecosystem conditions. That is, abundance of long-lived predator species were considered as indicators of a system in pristine state, while dominance of generally small-sized fishes in the catch were considered as indicators of an over-exploited or overfished system. For this experiment, biomass of predator fishes (i.e. sharks, selected reef-associated carnivorous fishes, and selected pelagic carnivorous fishes), biomass of prey fishes (i.e. small, typically soft-bottom dwelling zoobenthos feeders), and biomass of blue crabs served as biological reference parameters. Blue crabs biomass was included to represent the invertebrate groups, and additionally to determine its influence over the respondents’ choice decisions, considering that blue crabs are among the

highly exploited fisheries resources in Danajon. Total annual harvests and total annual profits served as economic reference parameters. Total number of fishers employed in the fishery served as social reference parameters. Lastly, fishing gears and activities reflect the fisheries fleets that were recommended by the policy search to increase their overall effort under the different management strategies simulated.

The levels for each attribute were defined based on the relative change in the end state (i.e. after 10 years of simulation) in each management strategy. For the biological parameters, the levels of change were simply stated as whether the biomass for a particular group has increased or decreased relative to the baseline scenario. For the economic parameters, percentage change from the baseline scenario was used instead of absolute values since the former was found to depict change more effectively. On the other hand, absolute numbers, rounded of to the nearest 500, were used to characterize the levels of the social parameters since we are dealing with numbers of fishers in this case. Fishing gear types and activities recommended for significant increases in their overall effort were enumerated to represent gear groups that define the levels for this last reference parameter.

2.2.2 Development of choice experiment design

The purpose of this step was to generate different combinations of attributes and attribute levels to create hypothetical alternative scenarios for use in the experiment. An experimental design consists of several choice games where in each choice game a respondent is presented with at least two alternative scenarios from which he or she must choose one.

For this study, a two-level experiment was administered. The first experiment consisted of only one choice game with three alternative scenarios. Table 2-1 outlines the attributes and attribute levels of the alternative scenarios. These scenarios represented the different fishing strategies generated by the Policy Search Routine. Specifically, Scenario A represented the results of the simulated strategy that maximized the economic objective (i.e. net profits),

Scenario B for the simulated strategy that maximized the social objective (i.e. employment or total number of fishers engaged in the fishery), and Scenario C for the simulated strategy that maximized the ecological objective with a mandated rebuilding of predator fish biomasses. The respondents were asked to choose only one scenario given that they had only these three alternatives to choose from. The responses derived from this experiment were used to determine the respondents' preference for a specific fisheries management scenario and its implied objective.

Table 2-1. Attributes and attribute levels characterizing the alternative scenarios in Choice Experiment 1

Attributes	Level 1	Level 2	Level 3
Predator fish biomass	increase from baseline	decrease from baseline	
Prey fish biomass	increase from baseline	decrease from baseline	
Blue crabs biomass	increase from baseline	decrease from baseline	
Total annual catch	increase by 250%	increase by 100%	decrease by almost 100%
Total annual profits	increase by 350%	decrease by 50%	decrease by 150%
Employment, number of fishers engaged in the fishery	55,000	65,000	1,500
Fishing gears types recommended for increase	Jigs Danish seines Compressor fishing Surface gillnets Hook and lines Crab fishing gears Fish corrals	Trawl Surface gillnets Danish seines Compressor fishing Blast fishing Beach seine Round haul seine Stationary liftnet	none (fishing effort of all gear types and activities must reduce)

A second experiment was designed to trigger the respondents to reveal which among the set of attributes (independent variables) and their levels comprising the choice scenarios have strong influence over their choices (dependent variable). For this experiment the biological, economic, and social attribute levels were reduced into two levels only, simply signifying either increase or decrease from the baseline scenario. The fishing gear types were reclassified into four levels. The first level consisted of the Danish seine (*liba-liba*), trawl (*palakaya*), and beach seine (baling). These gears generally represent the prohibited or illegal fishing gears due to their active operation and use of fine mesh netting. The second level consisted of the fishing gear

types generally considered to be most “friendly” to the marine ecosystem due to their passive nature of operation. These include the hook and lines (*pasol*), gillnets (*pukot*), and squid jigs (*pangnokos*). The third level consisted of fishing gear types that technically are passive fishing gears, but are considered “controversial” because of their use of fine mesh netting. These include the Round-haul seines (*lawag*), the fish corrals (*bungsod*), and the stationary liftnet (*bintol*). The fourth and last level of the fishing gear type attribute consists of the fishing gears that exclusively target blue crabs. These are the crab gillnets (*pukot panglambay*), crab pots (*panggal*), and crab liftnets (*sapyaw panglambay*). These attributes and levels along with their codes for the regression analysis are summarized in Table 2-2.

Table 2-2. Attributes, levels and coding for Choice Experiment 2

	Attributes	Levels	Codes
1	Predator Fish Biomass	decrease	0
		increase	1
2	Prey Fish Biomass	decrease	0
		increase	1
3	Blue Crabs Biomass	decrease	0
		increase	1
4	Total Landed Catch	decrease	0
		increase	1
5	Overall Profits	decrease	0
		increase	1
6	Total Fishers (Employed)	decrease	0
		increase	1
7	Fleet Types Allowed to Increase	liba-liba, palakaya, baling	0
		pamukot, pasol, pangnokos	1
		bungsod, lawag, bintol	2
		panglambay (pukot panglambay, panggal, sapyaw)	3

To test the effects or influence of the variables stated above, the design for the second experiment consisted of a number of choice games to facilitate statistical identification of the underlying preference functions (Adamowicz *et al.* 1998a). The number of choice games depended on the number of alternative scenarios, which in turn was subject to the number of attributes and attribute levels used. A full factorial design for this experiment wherein six of the attributes had only two levels and one attribute had four levels, yielded a total of $2^6 * 4^1 = 256$ hypothetical scenarios. Random pairing of the alternative scenarios would have resulted in 128 choice games, which would

still have been too taxing and unrealistic to fully administer considering the learning and fatigue effects of long experiments.

To facilitate the task of constructing the second experiment, the experimental plans provided in Kocur et al. (1981) were consulted. These plans are fractional factorial designs which consist of a selection of points from the full factorial design, assuming that some of the interactions of variables are negligible. Since for this study, only the main effects (i.e. the effect on the decision of going from one level of the variable to the next given that the remaining variables remain constant) will be examined and no interactions of the variables will be analyzed, the fractional design robustly suffices.

In the end, the experimental design for the second experiment consisted of eight choice games comprising the different artificial combinations of the attribute levelsⁱ. Each choice game consisted of two alternative scenarios. For each choice game, the respondents were tasked to choose only one scenario given that they have only the two scenarios to choose from. The experimental results were analyzed to evaluate the statistical significance of the independent variables and estimate their effects.

2.2.3 Experiment questionnaires

Each respondent was tasked to complete a three-part questionnaireⁱⁱ. The first part consisted of the single choice card of Choice Experiment 1. The second part consisted of eight choice cards representing the eight choice games of Choice Experiment 2. The third questionnaire was designed to obtain demographic, socio-economic, and fishing practices information of the respondents, their general attitudes, perception, and understanding of some issues and topics relevant to fisheries management, and their overall perception of ecosystem “friendliness” of selected fishing gears. The design

ⁱ Appendix E

ⁱⁱ Appendix F

of the third part of the questionnaire was roughly patterned after the guidelines outlined in Bunce and Pomeroy (2003).

As in any form of research survey, a series of pre-tests of the questionnaires were conducted involving at least 30 respondents. The general impression obtained from the respondents after the pre-surveys was that the task of choosing their preferred scenarios seemed to be manageable and could be accomplished within an hour. However, items especially under the attitudes/perception section of the survey needed to be expounded for most respondents in order for them to truthfully reveal their agreement or disagreement of the issues. Further, the pre-test also revealed that the respondents were rarely punctual and so the surveys had to be administered to groups consisting of an average 3-5 respondents, and that a schedule for a morning survey usually lasts the whole day. Thus, survey schedules had to be adjusted accordingly.

2.2.4 Sampling and logistics

2.2.4.1 Determining the sample size, n

The required sample size n was determined using the formula (Blalock 1979):

$$n = \left[\frac{z_{1-\alpha/2} \cdot s}{d} \right]^2$$

Where:

n = the sample size

$z_{1-\alpha/2}$ = the z-value of the standard normal curve at significance α

s = the standard deviation for the variable being considered

d = the desired accuracy or confidence interval

For this study a 95% confidence level was used as is customary in most research, and the corresponding z-value was 1.96. Since the survey generally involves testing the significance of categorical data (i.e. choices),

the standard deviation was estimated conservatively at 0.5 to yield the largest possible value of n results (Watson et al. 1986). The confidence interval was 0.05. Thus, at 95% confidence level and a confidence interval of 0.05, we have the following values: $z_{1-\alpha/2} = 1.96$, $s = 0.5$, and $d = 0.05$. Substituting these values into the sample size formula, a sample size of $n = 384$ was required for the survey.

2.2.4.2 Sampling type and sample distribution

In choice experiments, possible sampling strategies include a simple random sample, a stratified sample, or a choice-based sample (Alpizar *et al.* 2001). For this experiment, a stratified-random sampling was undertaken. A total of sixteen coastal barangays from both the island and mainland Talibon were identified (Table 2-3)ⁱ. The pre-determined sample size was initially stratified to include all barangays shown in order to represent adequately the demographic distribution of fishers in the municipality. However, administering the survey in all these barangays may prove overly expensive and time consuming. Thus, a cluster analysis was first performed to group the barangays based on the similarity of their fishing gear types and activities. Single-barangay clusters were automatically selected for inclusion, whereas representative barangays were selected at random from large-sized clusters.

Table 2-3. Island and mainland coastal barangays of Talibon, Bohol whose fishing activities occur within the modeled Danajon ecosystem

Island Barangays	Coastal Barangays in the Mainland
Busalian	Bagacay
Calituban	Burgos
Cataban	Poblacion
Guindacpan	San Francisco
Mahanay	San Isidro
Nocnocan	San Pedro
Sag	Sto. Niño
Suba	Tanghaligue

ⁱ Coastal barangays Balintawak and San Agustin which were located along the river mouth further inland were excluded.

A list of fishers' names (both registered and unregistered) from each of the representative barangays were then obtained in order to construct the sample frame for the survey. To facilitate this task, the assistance of the Municipal Agricultural Office (MAO), the Talibon Coastal Resource Management (CRM) Office, the Barangay Captains, and community organizers was solicited.

2.2.4.3 Survey administration

A central group technique, which is essentially a modified personal interview method that involves carrying out the survey in person to groups of at most fifteen respondents (Kokur et al. 1981) was adopted. Randomly selected fishers from the representative barangays were sent written communications which served as both letters of introduction and invitation to participate in a choice survey to be conducted within the premises of their respective barangays, on a specified date and timeⁱ. The letters were coursed through the Talibon community organizer and the respective barangay councils. Accordingly, the Barangay Captains of these barangays were sent introductory letters and a request to schedule for the survey interviewsⁱⁱ.

2.2.4.4 Model estimation

The choice experiment data were first analyzed using a multinomial test. Specifically, a chi-square test of homogeneity of k proportions was administered for the responses from Choice Experiment 1 in order to test the hypothesis that the alternative scenarios representing the three fisheries management objectives are equally preferred by the respondents. To test the hypothesis that the characteristics of the respondents have no influence over their choice decisions, a binomial logistic regression was performed for the respondents, segmented according to their preferred scenario. Data from Choice Experiment 2 were likewise analyzed via binomial logistic regression to test the hypothesis that the attributes of the alternative management

ⁱ Appendix G

ⁱⁱ Appendix H

scenarios have no influence over the respondents' choice decisions. Where statistical significance was established, the probabilities of choice were estimated.

Binomial logistic regression was used in this study since the dependent variable is categorical and dichotomous (i.e. 'to choose' = 1, 'not to choose'=0) and the independent variables (i.e. the attributes characterizing the respondents and the alternative scenarios) are a mix of continuous and categorical variables. To estimate the probability of choice, the logistic regression model for the choice experiment applies maximum likelihood estimation after transforming the choice variables into logits (or the natural log of the odds of the dependent occurring or not). That is,

$$\ln(ODDS) = \ln\left(\frac{\pi}{1-\pi}\right) = a + bX$$

where π is the predicted probability of the choice, $1-\pi$ is the probability of the alternative decision (i.e. not to choose), and X is a predictor variable. The odds were converted into estimated probabilities with the formula:

$$\pi = \frac{ODDS}{1 + ODDS}$$

where the values of the probabilities are contained between 0 and 1.0. Data analysis was performed using SPSS (version 9.0).

CHAPTER 3

RESULTS AND DISCUSSION

3.1 Fisheries Scenarios

Three alternative fisheries policy scenarios were developed using the Ecopath with Ecosim (EwE) Policy Search Routine. The models represented no compromise or “extreme” management strategies, each maximizing one of the three fisheries management objectives: Scenario 1 simulates maximization of the economic objective in fisheries (i.e. total annual profits); Scenario 2 simulates maximization of the social objective in fisheries (i.e. total number of jobs/employment in the fishery); and Scenario 3 simulates maximization of the ecological objective in fisheries with a mandated rebuilding of predator fish biomasses. Predator fish biomass, prey fish biomass, and blue crabs biomass serve as biological reference parameters. Total annual harvests and total annual profits serve as economic reference parameters. Total number of fishers employed in the fishery serve as social reference parameter. The units of fishing gears and activities represent the allocation of fisheries effort. Figures 3-1 to 3-3 illustrate the relative changes of the first six selected parameters while Tables 3-1 to 3-3 provide summaries of the percentage change of fishing gear units under each alternative fisheries management policy.

Fisheries scenario A (maximizing the economic objective) resulted in relative increases in total annual profits, total number of fishers, total annual catch, prey fish biomass, and blue crabs biomass, while the predator fish biomass is reduced. To maximize the economic objective, the Policy Search Routine suggested increases in relative fishing effort of fishing gears and activities that yield the highest profits with reference to their fixed and variable costs. In this case, substantial increases in the overall effort of jigs, followed by Danish seines, compressor fishing, surface gillnets, and handlines, longlines and trolls were recommended. In the 2006 Ecopath model of Danajon fisheries, the jigs target almost exclusively cephalopods, primarily squids and

occasionally octopus, the former commanding a consistently high price in the market. On the other hand, Danish seines were found to exploit a variety of fish and invertebrate groups, most importantly the small- and intermediate-sized soft-bottom zoobenthos feeders (yellowstripe scad, goatfishes, threadfin breams), the reef-associated carnivorous Carangid fishes (jacks and trevallies), carnivorous reef fishes (barracudas), and squids/cuttlefish groups. While the prices of these fish range from low (≤ 30 per kilo) to high (≥ 100 per kilo), the invariably high catch rates make the Danish seine one of the fishing activities that yields the highest net profits. Compressor fishing activities target primarily the reef-associated fishes, from reef grazers (parrot fishes, rabbitfish) to the carnivorous reef fishes (sweetlips, snappers, groupers) that likewise command high prices in the market. The surface gillnets target predominantly small schooling pelagics such as sardines, anchovies, and halfbeaks. While the price per kilo of these fish is low, they more than make up for it in bulk. Lastly, while handlines, longlines and trolls have relatively low CPUEs, net profits are high relative to the low cost of inputs.

Scenario A: Maximizing Economic Objective

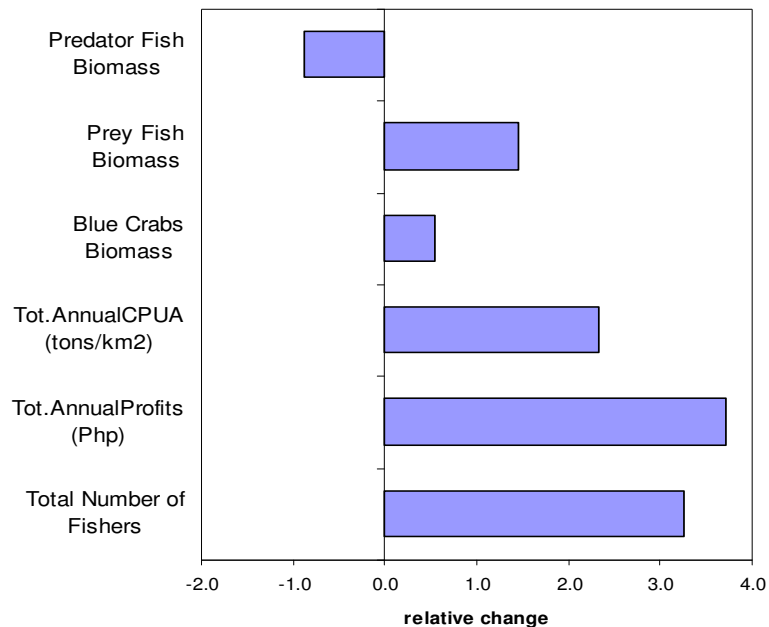


Figure 3-1. Resulting changes in biological, economic, and social reference parameters under policy scenario A

Scenario B: Maximizing Social Objective

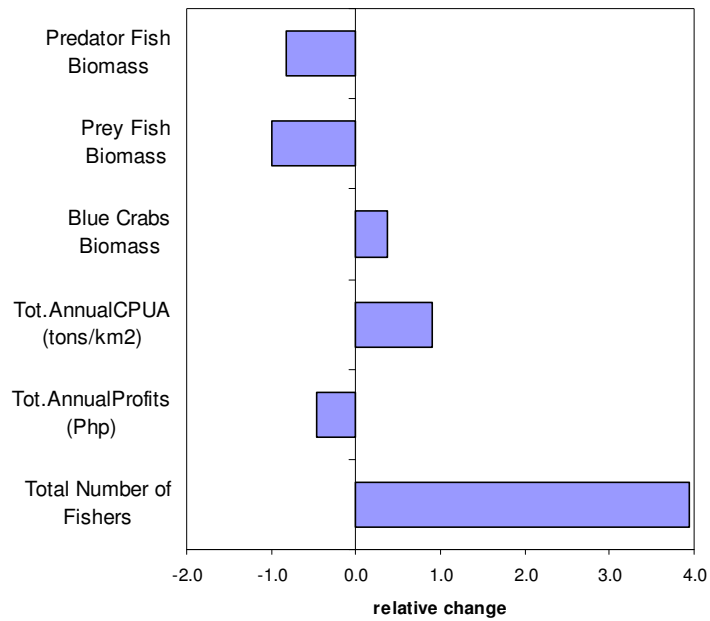


Figure 3-2. Resulting changes in biological, economic, and social reference parameters under policy scenario B

Scenario C: Maximizing Ecological Objective with Mandated Rebuilding of Predator Fish Biomass

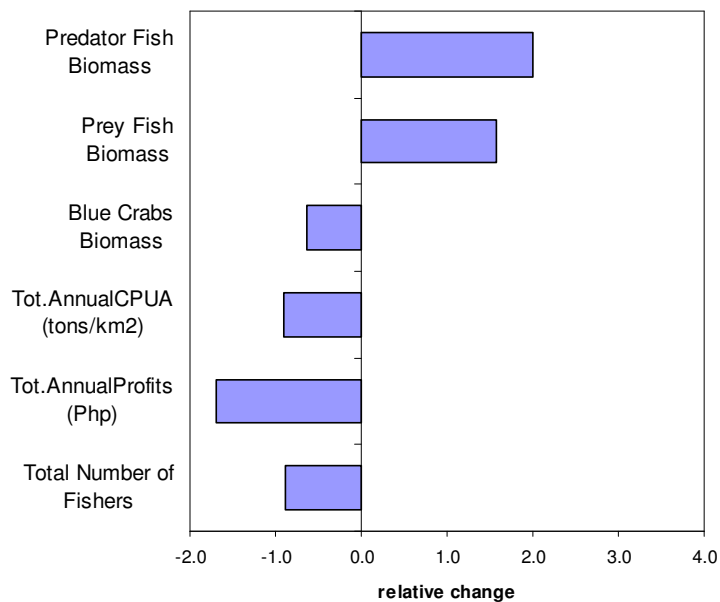


Figure 3-3. Resulting changes in biological, economic, and social reference parameters under policy scenario C

Table 3-1. Percentage change in overall number per fishing gear type or activity in the Danajon Bank ecosystem under Scenario A:
Maximizing the Economic Objective

Ecopath Fleet Name	%Change
Jigs	28.58
Danish seine	6.27
Spear w/ compressor	2.62
Surface gillnets	1.54
Handlines, longlines and trolls	0.42
Crab fishing gears	0.31
Barrier nets and traps	0.26
Beach seine	-0.30
Otter trawl	-0.37
Simple spears and harpoons	-0.79
Blast fishing	-0.86
Pots	-0.92
Fish aggregation using light	-0.93
Scoopnets & Scissornets	-0.93
Set gillnets & trammel nets	-0.98



Table 3-2. Percentage change in overall number per fishing gear type or activity in the Danajon Bank ecosystem under Scenario B:
Maximizing the Social Objective

Ecopath Fleet Name	%Change
Otter trawl	59.00
Surface gillnets	33.54
Danish seine	17.54
Spear w/ compressor	2.46
Blast fishing	1.31
Beach seine	0.36
Fish aggregation using light	0.01
Crab gears	-0.07
Scoopnets & Scissornets	-0.27
Simple spears and harpoons	-0.55
Set gillnets & trammel nets	-0.56
Jigs	-0.71
Pots	-0.87
Barrier nets and traps	-0.99
Handlines, longlines and trolls	-0.99

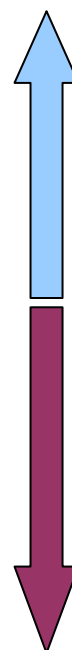



Table 3-3. Percentage change in overall number per fishing gear type or activity in the Danajon Bank ecosystem under Scenario C: Maximizing the Ecological Objective with mandated rebuilding of predator fish biomasses

Ecopath Fleet Name	%Change
Beach seine	-0.210
Otter trawl	-0.425
Jigs	-0.548
Blast fishing	-0.740
Fish aggregation using light	-0.822
Crab gears	-0.827
Scoopnets & Scissornets	-0.859
Barrier nets and traps	-0.883
Simple spears and harpoons	-0.925
Surface gillnets	-0.925
Set gillnets & trammel nets	-0.959
Spear w/ compressor	-0.961
Pots	-0.969
Danish seine	-0.970
Handlines, longlines and trolls	-0.988



In fisheries scenario B (maximizing the social objective), the most significant result was the considerable increase in total number of fishers engaged in the fishery. This likewise resulted in an increase in overall harvests, but not necessarily total profits. While predator fish and prey fish biomasses decreased, blue crabs biomass increased. A substantial increase in the overall effort of trawls, surface gillnets, and Danish seines were recommended, as well as increases for compressor fishing, blast fishing, beach seine, and fish aggregation with light. All these gears have relatively high catch rates, and apparently, employ more people per unit weight of landing. Further, since the aggregate catch composition of these gears show abundance of both prey and predator fish groups, their increased fishing effort logically explains the reduction of the fish biomasses. Furthermore, without effective predators and competitors, the blue crabs ended up benefiting in this scenario.

Fisheries scenario C (maximizing the ecological objective with a mandated rebuilding of predator fish biomasses) resulted in relative increases in both predator and prey fish biomasses, but reductions in all economic and social reference parameters. The model likewise forced a reduction in the effort of all fisheries activities. The top five fishing gears and activities required to make the most reductions in effort were handlines, longlines and trolls, Danish seines, fish pots, compressor fishing, and the bottom gillnets, and understandably so since these gears exploit the carnivorous reef and carnivorous soft-bottom fish groups (i.e. the major predator groups) in the system. The recommended overall reduction in fishing pressure likewise appear to provide a reasonable degree of ecosystem stability since the resulting biomass distribution across the food web is more balanced under this scenario as compared to the other two scenarios wherein a few groups strongly dominate and several groups essentially drop out of the system (Figures 3-4 to 3-6).

These simulated scenarios formed the bases for the creation of alternative fisheries scenarios in the choice experiment. The selected reference parameters served as attributes or variables comprising the choice scenarios. These were tested as potential determinants of choice behavior.

Scenario A: Maximizing Economic Objective



Figure 3-4. Resulting changes in the biomasses of functional groups of the Danajon marine ecosystem under fisheries policy scenario A

Scenario B: Maximizing Social Objective

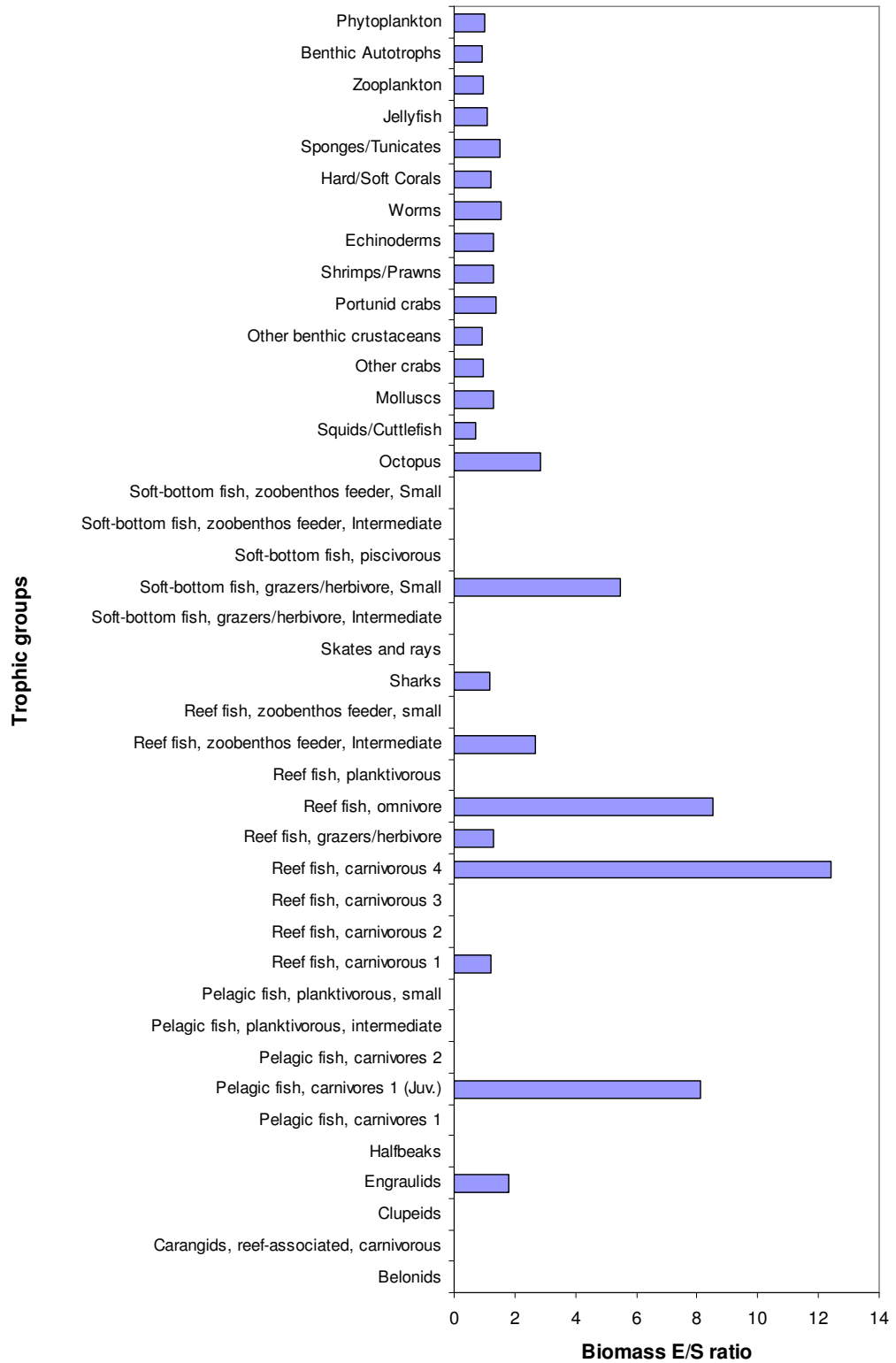


Figure 3-5. Resulting changes in the biomasses of functional groups of the Danajon marine ecosystem under fisheries policy scenario B

Scenario C: Maximizing Ecological Objective with Mandated Rebuilding of Predator Fish Biomass

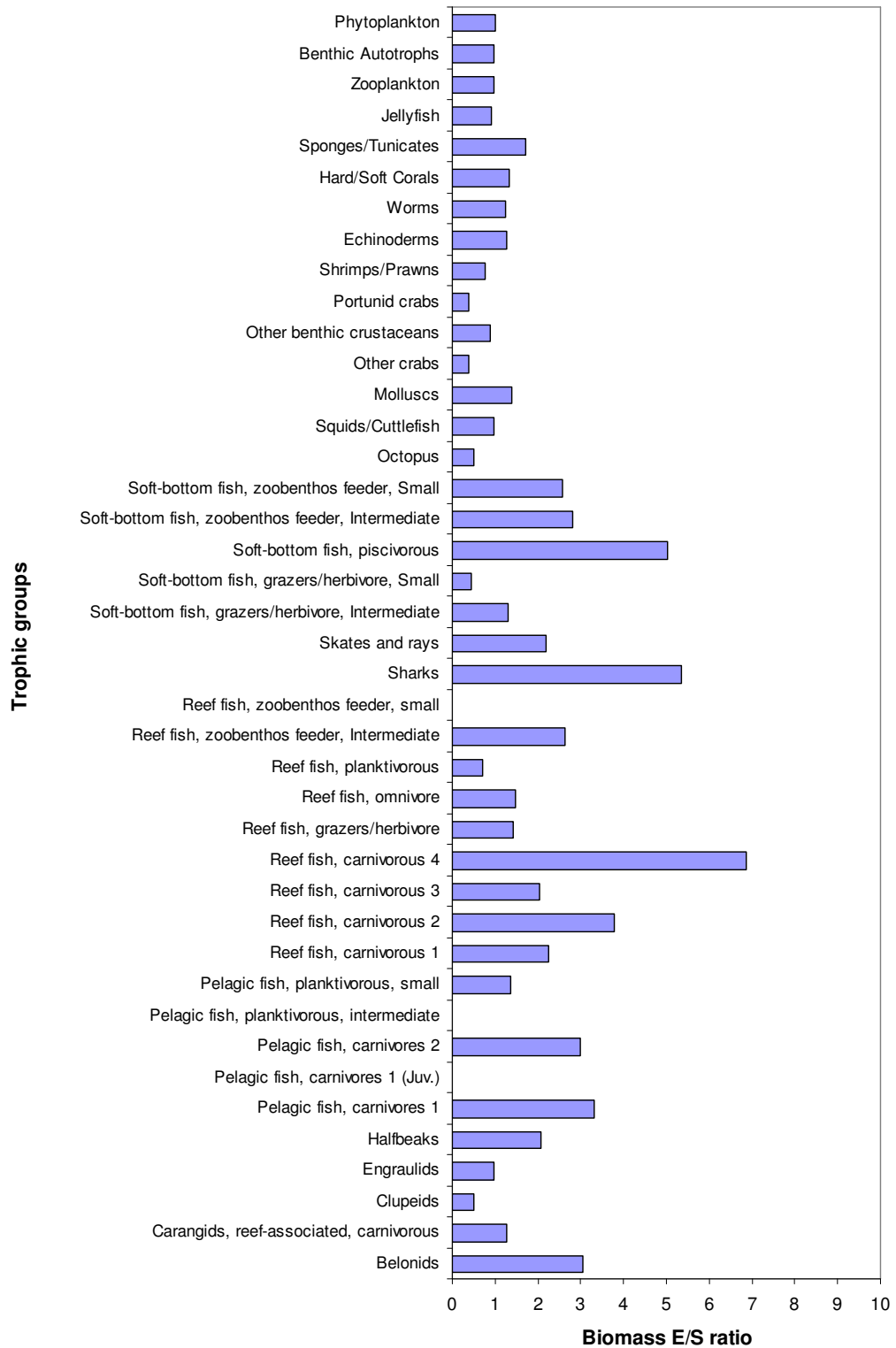


Figure 3-6. Resulting changes in the biomasses of functional groups of the Danajon marine ecosystem under fisheries policy scenario C

3.2 Survey Results

3.2.1 Demographic distribution of the sample, *n*

The cluster analysis yielded seven clusters of barangays with fairly similar types of fishing activities (Figure 3-7)¹. Specifically, these consisted of five coastal barangays from the mainland and another 5 island barangays. They comprise the representative barangays of Talibon for the choice experiment. The final stratified distribution of the required survey sample is shown in Table 3-4.

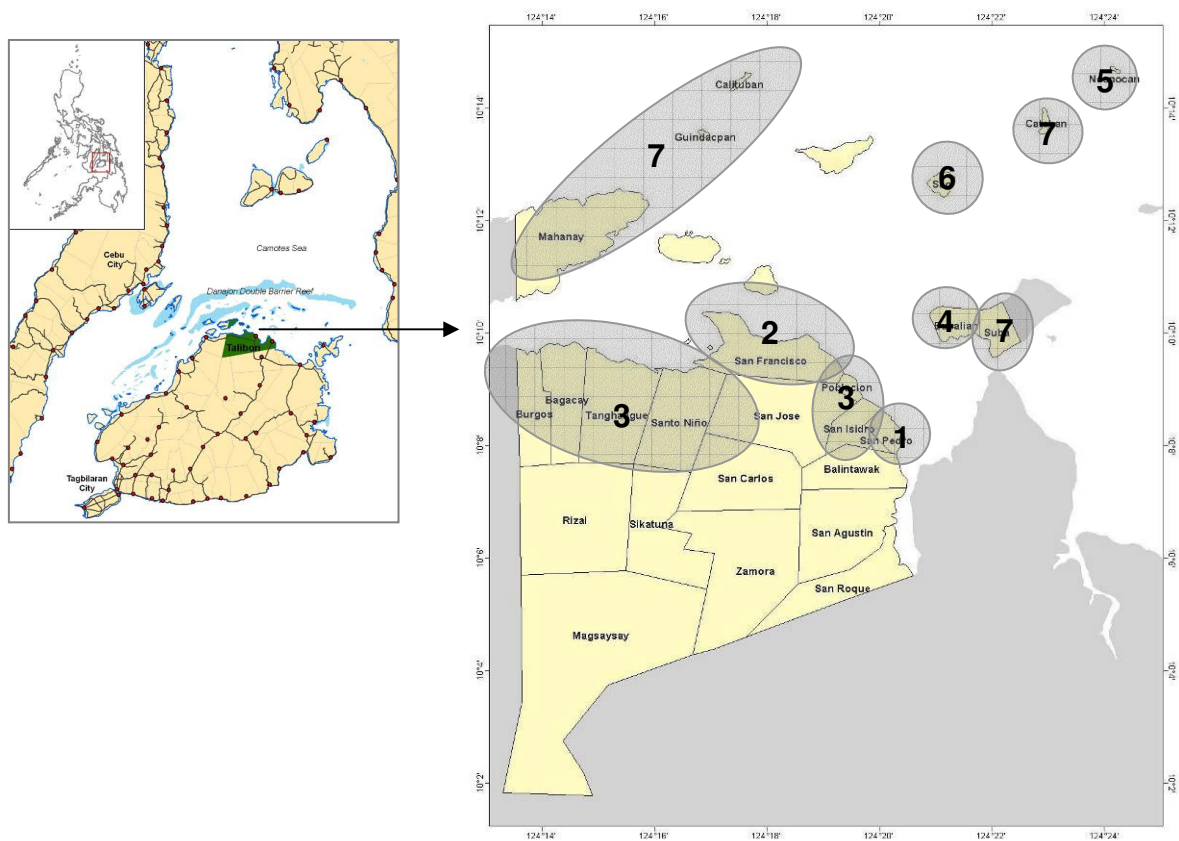


Figure 3-7. Map of Talibon showing barangays clustered based on types of fishing gears and activities operated

¹ See Appendix I for SPSS output of cluster analysis

Table 3-4. Survey clusters, estimated population, and required sample size *n*

Location	Cluster, Barangays	Dominant and unique gear types (based on 2006 gear inventory)	Est. fishers pop'n.	Percent to total	<i>n</i> (95% Conf., .05 accuracy)
Mainland coastal barangays	Cluster 1 San Pedro	Barrier nets and traps, Crab fishing gears, and Pots	102	2.94%	11
	Cluster 2 San Francisco	Handlines, longlines and trolls, Jigs, and Crab fishing gears	113	3.25%	13
	Cluster 3 Burgos Bagacay* Tanghaligue* Sto. Niño San Isidro Poblacion*	Handlines, longlines and trolls, Set gillnets and trammel nets, Barrier nets and traps	369	10.63%	41
Island barangays	Cluster 4 Busalian	Handlines, longlines and trolls, Jigs, and Crab fishing gears; only cluster with reported use of Trawls and Danish seines	300	8.64%	33
	Cluster 5 Nocnocan	Compressor fishing, Spear fishing, Handlines, longlines and trolls, and Pots	454	13.08%	50
	Cluster 6 Sag	Pots, Handlines, longlines and trolls, and Crab fishing gears	138	3.97%	15
	Cluster 7 Mahanay Cataban Guindacpan* Calituban* Suba	Crab fishing gears, Gleaning, Diving for marine invertebrates and Compressor fishing	1,996	57.49%	221
TOTAL			3,472	100%	384

*representative barangays for the cluster

3.2.2 Response rates

Acknowledging the 50% non-response rate estimated during the pilot survey, 192 additional letters to the initial 384 letters of invitation to participate in the choice survey were proportionately distributed among the representative barangays. During the course of the survey, 22 unopened letters were returned as the intended recipients were either already deceased or had transferred residence to another barangay. New fishers' names had to be selected randomly from the list in order to replace them. There were also several fishers who were not able to attend because they had to fish during the scheduled survey and sent their wives to attend instead. Although the act of going out to sea in order to fish is not absolutely exclusive to males, the extent of involvement or familiarity of the female respondents who came to represent their husbands with the actual fishing operation of their husbands were nonetheless verified. As with the male respondents, the female respondents were given a brief overview of the purpose of the survey and explanations on how to answer the questionnaires. Majority were confident that they could answer the questions and proceeded to do so. However, there were a few who admitted that they would rather have their husbands answer them and thus, did not participate.

All in all 422 number of fishers out of the 598 invitations actually participated in the survey for an overall response rate of 70.6%. This higher than expected response rate may be attributed to the diligent effort to collaborate with the respective barangay councils both prior to and during the scheduled survey dates. Letters of invitation were coursed through the barangay office and, where applicable, were delivered by the *kagawad* assigned for each *purok* at least one week before the scheduled survey. Invited fishers who failed to show up at the survey venue during the appointed schedule were followed-up at a later hour or date, with the kind assistance of the barangay *kagawads* and other local contacts.

Collected survey questionnaires were screened for partial responses. That is, questionnaires with at least one section left completely unanswered were

excluded from the analysis. In the end, a total of 411 completed survey questionnaires were used.

3.2.3 Representativeness

The distribution of the actual survey respondents were compared against the demographic distribution of the Talibon fishers across the seven pre-defined survey clusters (Table 3-5).

Table 3-5. Distribution of required and actual *n* number of responses used in the survey

Survey Cluster	Required <i>n</i> (95% CI, .05 error)	<i>n</i>
1	11	12
2	13	16
3	41	51
4	33	38
5	50	45
6	15	23
7	221	226
Total	384	411

A Chi-square goodness-of-fit test was administered to test a null hypothesis that the demographic distribution of the survey respondents does not differ significantly from the overall distribution of fishers in Talibon. Since the computed chi-square value of 6.504 does not exceed the critical value $\chi^2_{(6,0.05)} = 12.59$, there is not enough evidence to reject the null hypothesis. Therefore, the respondents are fairly representative of the distribution of fishers in Talibon across the 7 survey clusters.

3.2.4 Respondents' Socio-Economic and Socio-Civic Profile

Age. The overall mean age of the respondents is 41.4 years (n=404). The youngest fisher interviewed was 15 years of age and the oldest was 77 years old. Table 3-6 shows the average age of respondents across the 7 survey clusters.

Table 3-6. Age of respondents (*mean, range, sd*) shown by cluster

	Survey Clusters						
	1	2	3	4	5	6	7
Responses	11	16	50	37	43	21	226
Mean Age	47.3	45.1	46.0	46.2	36.4	43.6	39.9
Min	31	23	17	26	15	31	16
Max	69	73	77	72	64	63	74
s.d.	13.7	13.2	13.0	12.6	10.8	7.9	12.2

Gender. Overall, 88 percent of the respondents were male and 12 percent were female. A consistent majority of male against female respondents was observed across the survey clusters, with the exception of Cluster 6 (Barangay Sag) where close to half of the respondents were female (Figure 3-8). While some of the female respondents do not actually go out to fish, others do assist their husbands occasionally in fishing. However, female involvement in actual fishing was somewhat limited to nearshore fishing activities such as gleaning, fish corrals, some gillnets, and the operation of crab pots and crab liftnets.

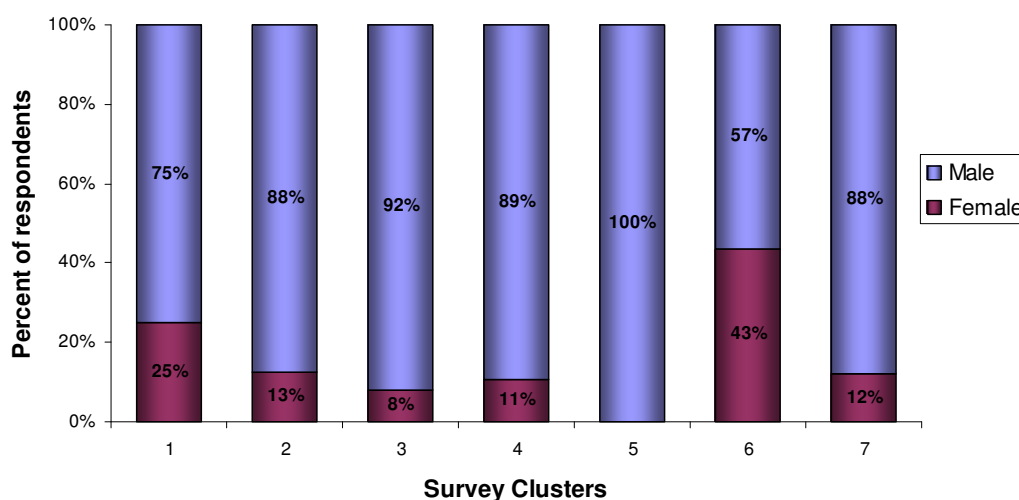


Figure 3-8. Distribution of respondents by gender across the survey clusters (n=411)

Apparently agreeing to this preliminary observation was the exclusively male participation from Cluster 5 (Barangay Nocnocan) where the main fishing activity of the island is compressor fishing – an activity carried out by male fishers. With a fair representation of females in the overall survey, their

influence or non-influence in the general survey responses was worth investigating.

Civil Status, Number of Children, Household Size. Majority of the respondents were married (86.6%). The rest were either still single (10.8%), widowed (1.7%) or divorced (1%). These overall percentages are reflective of the distribution within the individual survey clusters (Figure 3-9).

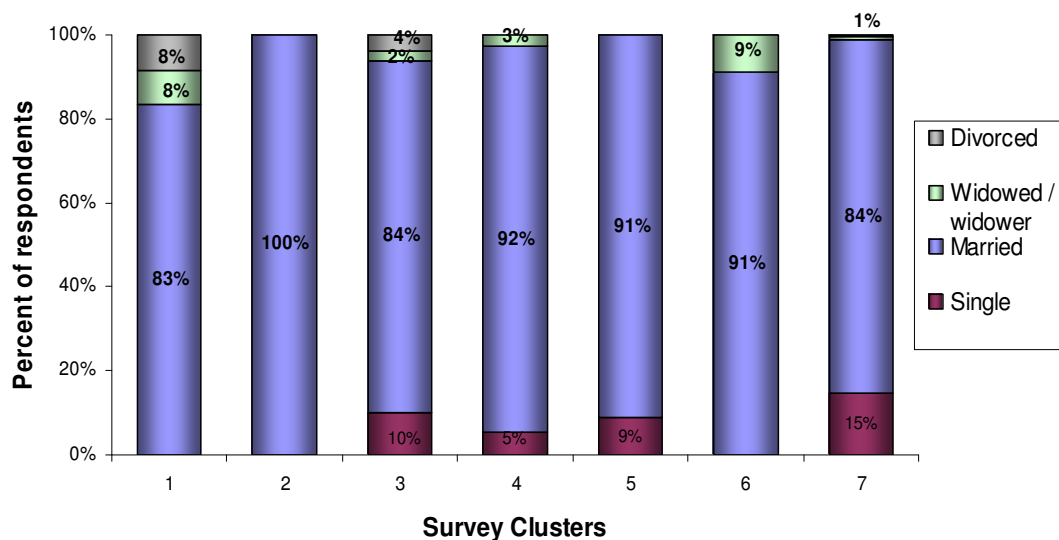


Figure 3-9. Distribution of respondents by civil status across the survey clusters (n=409)

Overall average number of children is 4.8 while the average household size is 6.1. The largest value registered for number of children was 18 (Table 3-7) from an elderly hook and line fisherman in Barangay Sag who recalled proudly how he was able to support his entire family solely on fishing. He doubts, however, whether somebody can do the same nowadays. His exact words were, “*Lisod na ang panagat karon ikumpara sauna.*” Nonetheless, households with ten or more members are still present in these fishing communities, as shown in Table 3-8. These preliminary observations could be an indication of the size of the population directly and indirectly dependent on the fisheries resources for their daily survival.

Table 3-7. Number of children (*mean, range, sd*) shown by cluster

	Survey Clusters						
	1	2	3	4	5	6	7
Responses	11	16	49	38	45	22	224
Average number of children	6.5	5.4	5.1	5.3	4.0	6.2	4.6
Min	1.0	1.0	0.0	0.0	0.0	2.0	0.0
Max	14.0	9.0	13.0	12.0	12.0	17.0	13.0
s.d.	4.2	2.3	3.3	2.7	3.3	3.3	3.1

Table 3-8. Number of residents per household (*mean, range, sd*) shown by cluster

	Survey Clusters						
	1	2	3	4	5	6	7
Responses	9	16	48	38	45	22	221
Average household size	6.0	7.1	5.9	5.7	5.8	7.2	6.1
Min	3.0	2.0	2.0	2.0	2.0	3.0	1.0
Max	10.0	11.0	14.0	11.0	11.0	11.0	18.0
s.d.	2.2	2.7	2.3	2.7	2.2	2.2	2.6

Education. Majority of the respondents (72.7%) had attained at least some level of elementary education. The remaining had graduated or at least had some level of high school education (16.7%), had graduated or at least had some level of college education (4.9%), or had no formal education at all (5.7%). Figure 3-10 shows the percentage share of the respondents' educational attainment across the survey clusters.

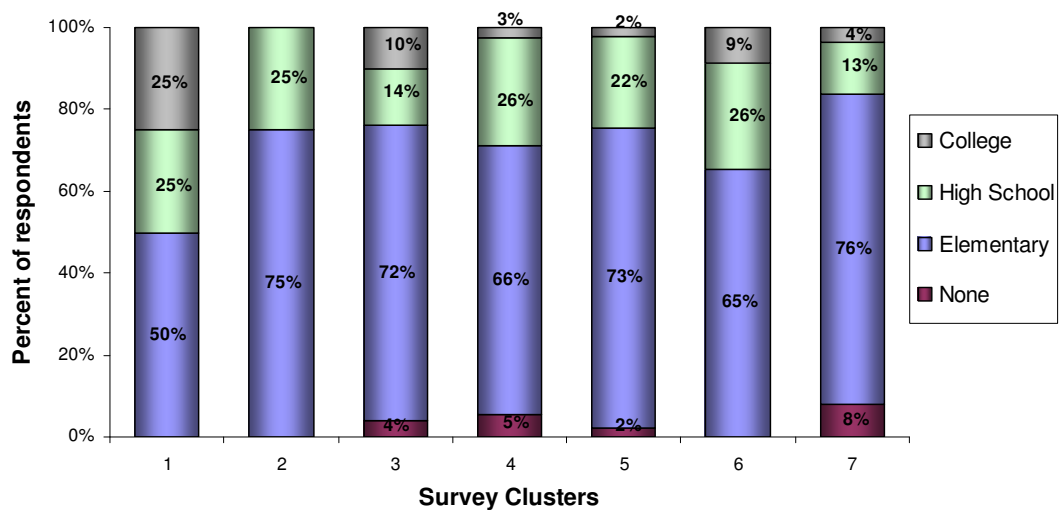


Figure 3-10. Educational attainment of respondents compared across survey clusters (n=407)

Incomes. Estimated monthly incomes of the respondents are shown in Figure 3-11. Majority of the respondents (83.6%) reported average monthly incomes under 5 thousand pesos. This figure agrees well with Green et al. (2000) who estimated that over 60% of coastal inhabitants in northwestern Bohol live below the poverty line of 6 thousand pesos monthly income for a family of 5 to 6 members.

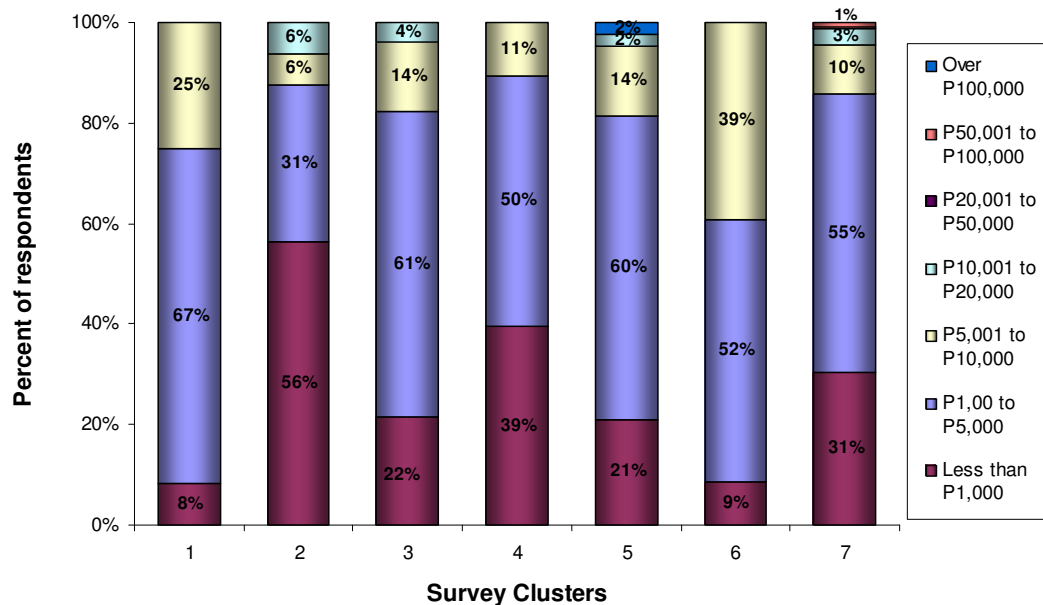


Figure 3-11. Distribution of reported monthly incomes of the respondents by survey cluster (n=409)

The respondents were asked whether or not they had other (non-fishery) income sources. Only 25.3% of the respondents had income sources other than fishing activities while for the other 74.7% fishing is the only form of livelihood and sole source of income. As shown in Figure 3-12 all survey clusters reflect this trend except for Cluster 3, which is represented by three coastal barangays from mainland Talibon. Livelihoods and sources of income are arguably more varied in the mainland than in island barangays. Availability of land allows for farming and raising livestock. Relatively closer to the town center, opportunities for business and employment are likewise more readily available in the mainland than in the island barangays. Figure 3-13 shows the other types of livelihood that the respondents are engaged in.

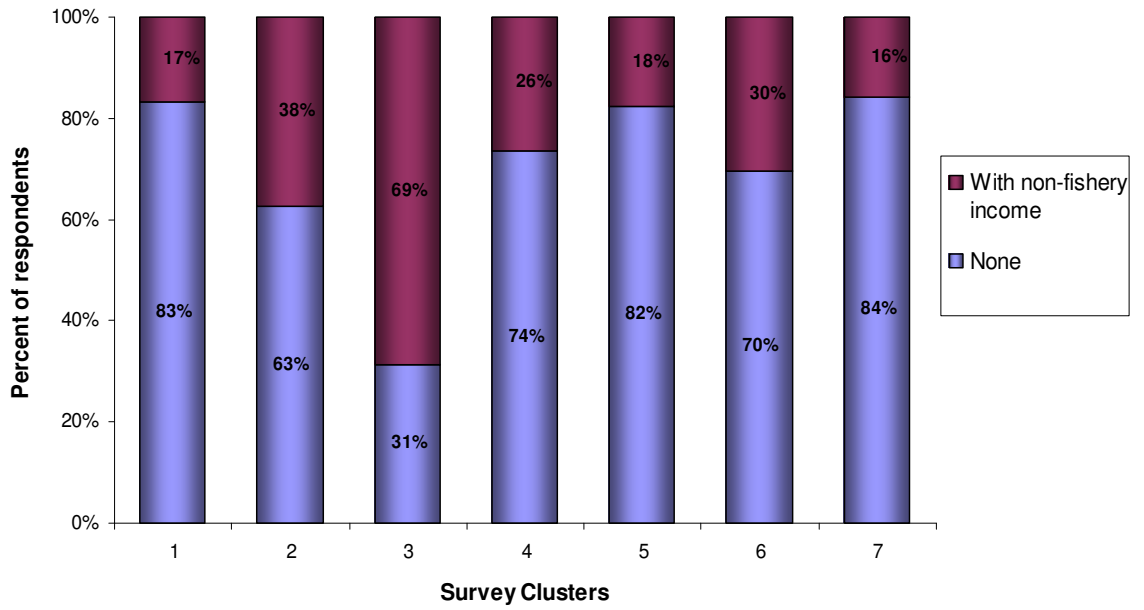


Figure 3-12. Percentage share of respondents with and without alternative or supplemental (non-fishery) income sources, shown by survey cluster (n=411)

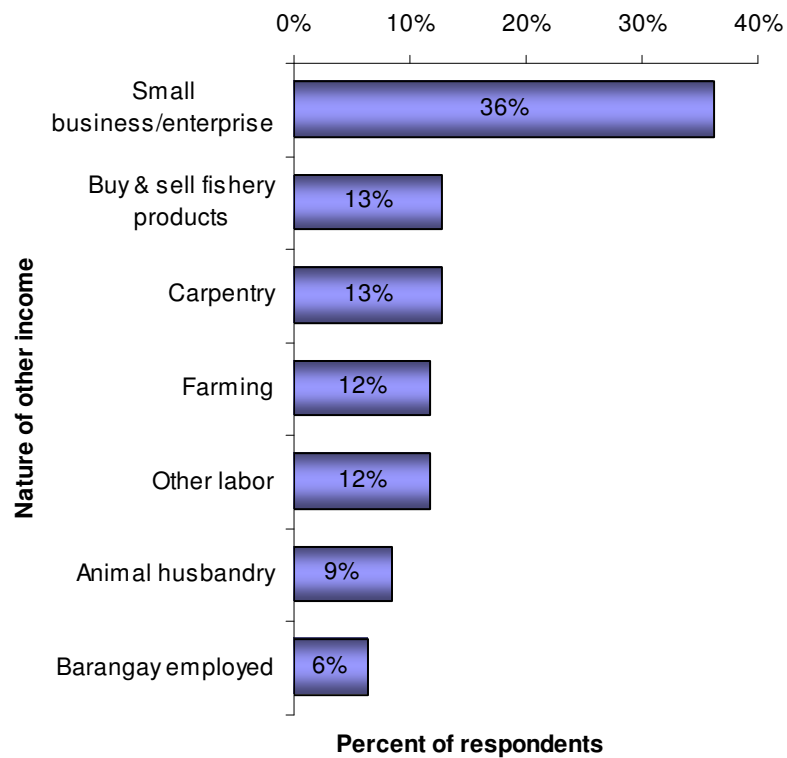


Figure 3-13. Other forms of livelihood and sources of income of respondents (n=94)

Socio-civic involvement. Only 20 percent of the respondents showed involvement in socio-civic organizations in their locality. These organizations are primarily fisherfolk organizations, religious associations (i.e. charismatic group), organized women’s groups, and local cooperatives. Of the 7 survey clusters, the respondents from Clusters 1 and 6 appear to violate the trend (Figure 3-14). Correspondingly, these clusters boast of active fisherfolk organizations and women’s groups.

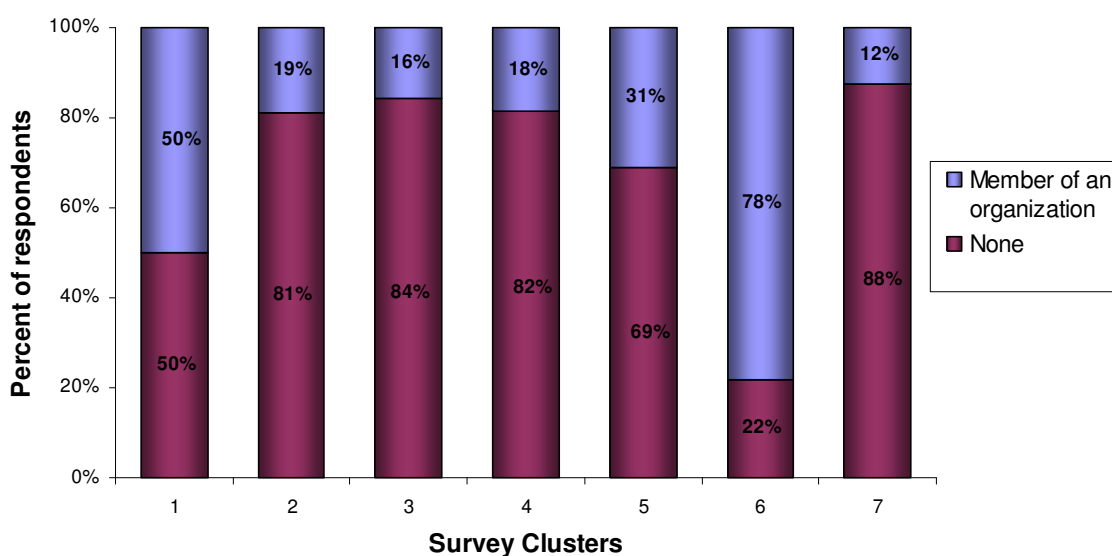


Figure 3-14. Percentage share of respondents with and without involvement or membership in a local organization (n=411)

Trainings and/or seminars attended. A respondent’s level of appreciation and understanding of environmental, fisheries, and coastal resource management related issues may be attributed to whether or not he/she has attended some trainings or seminars relevant to these topics. Overall, only 27.3 percent of the respondents had attended any training or seminar. As shown in Figure 3-15, only respondents from Cluster 6 show a higher percentage for attendance in some local trainings or seminars. It would be interesting to find out whether or not this has any significant bearing on their preference for fisheries management objectives. Figure 3-16 shows the nature of the types of trainings or seminars attended by some of the

respondents. These are predominantly Fisheries- or CRM-related trainings or seminars. Other types include livelihood trainings, religious seminars, and other local seminars conducted by community organizers and social workers on topics such as health, sanitation, finance, reproductive health, etc.

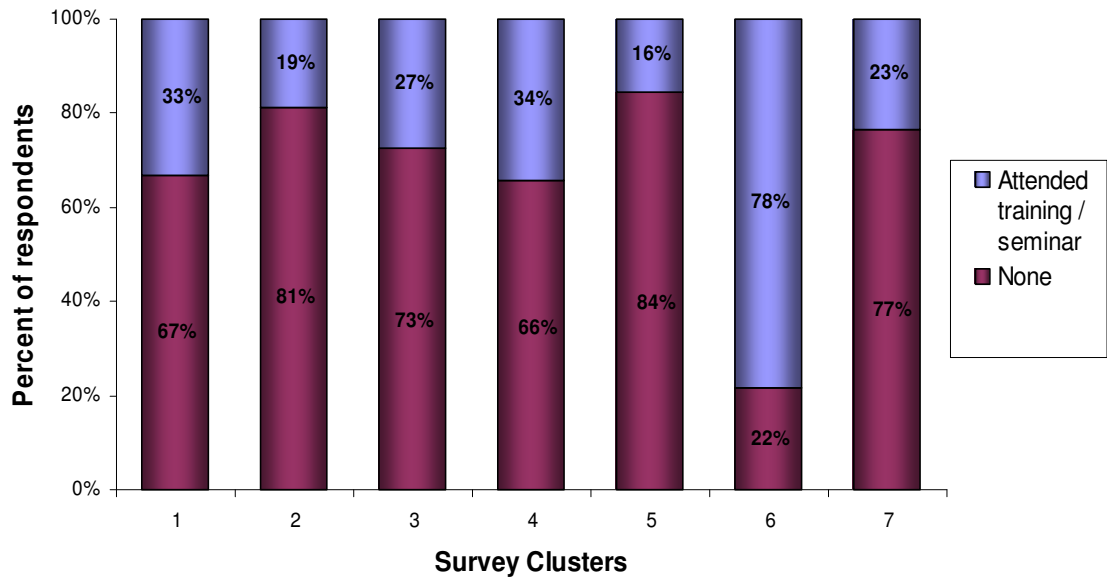


Figure 3-15. Percentage share of respondents that have attended local trainings and/or seminars, shown across the survey clusters (n=411)

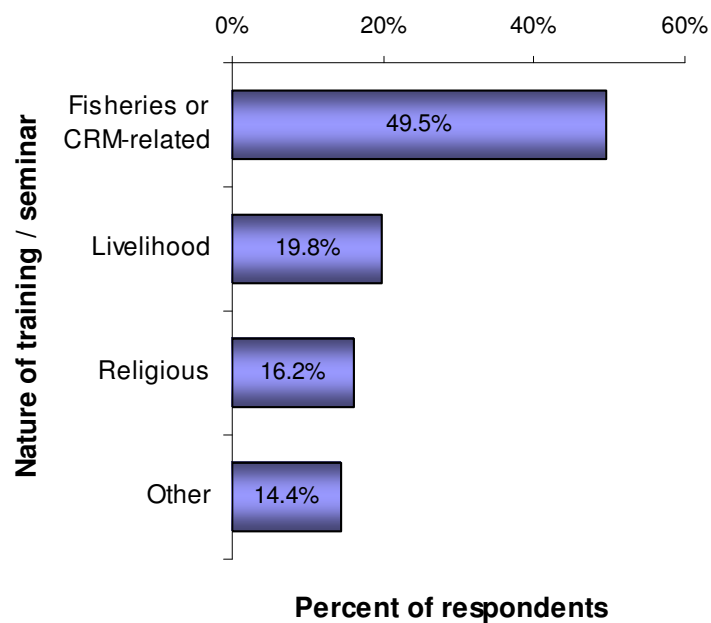


Figure 3-16. Types of trainings and/or seminars attended by the respondents (n=111)

3.2.5 Respondents' Fisheries Profile

Fisheries Registration. Fisheries registration in Talibon as of survey date requires all fishers with fishing vessels to register their boats at the Municipal Agriculturists' Office (MAO) for a specified fee in addition to a corresponding fee for the type of fishing gear operated. Fishers who do not own a fishing vessel, therefore, do not necessarily appear in this municipal fisheries registry. However, regular inventories of fishers conducted through the barangay councils enlist both the registered and unregistered fishers.

In this survey, majority of the respondents (60.76%) had some form of registration through either their fishing vessel or fishing gear (Figure 3-17). The rest (39.24%) who do not appear in the fishery registry of Talibon were mostly fishers categorized as “*mangabay*” or fishers who do not own the fishing gears and vessels they operate. Customarily, these fishers work together with other fishers in fishing operations that require several numbers of fishers, such as the Danish seines, round-haul seines, trawls, compressor fishing, and some gillnet operations. While the “*mangabay*” are non-owners of fishing gears and vessels, they nonetheless are regarded as full-time fishers who consider fishing as their primary means of livelihood.

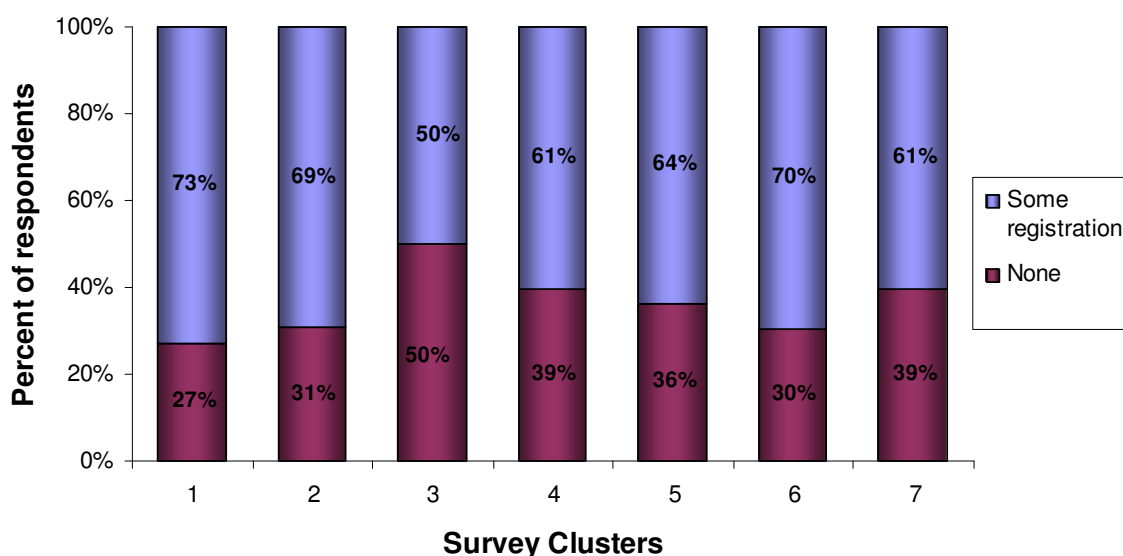


Figure 3-17. Percentage share of respondents who have had some form of fisheries registration, shown across the survey clusters (n=395)

Years fishing. The average numbers of years fishing for the respondents across the survey clusters are compared in Table 3-9. Overall, the estimated number of years that the respondents had been engaged in fishing is 21.8 years. Not surprisingly, children as young as 7 or 8 assist their parents in fishing operations, and depending on the nature of the fishing, may already seriously take part in it at age 15.

Table 3-9. Number of years fishing (*mean, range, sd*) shown by cluster

	Survey Clusters						
	1	2	3	4	5	6	7
Responses	10	15	50	35	42	23	222
Average number of years fishing	17.2	25.9	14.3	25.3	17.7	27.7	23.0
Min	5.0	5.0	0.5	1.0	2.0	6.0	1.0
Max	49.0	62.0	50.0	57.0	43.0	45.0	63.0
s.d.	12.6	19.0	13.0	13.2	10.5	9.7	12.6

Fishing gears and activities. On the average, a fisher may engage in three types of fishing activities throughout a year. Ordinarily, a primary fishing activity is maintained while supplemental fishing activities are undertaken depending on the seasons and availability of fish and/or other fishery resources. Figure 3-18 shows the relative importance of fishing gear types and activities based on the number of respondents who identified them as either their primary or supplemental fishing activities. Considering only the primary fishing gears identified, crab fishing gears (21.9%), compressor fishing (17.8%), and set gillnets and trammel nets (12.6%) were the three most important fishing gears and activities of the respondents. For the supplemental fisheries activities, hook and line fishing (15.1%), crab fishing gears (12.9%), and seaweeds culture (10.2%) were found to be the most important. Overall, the key fisheries activities that the fishers in the survey depend on, in one way or another, are crab fishing gears (48.4%), handlines, longlines and trolls (42.8%), and set gillnets and trammel nets (30.9%).

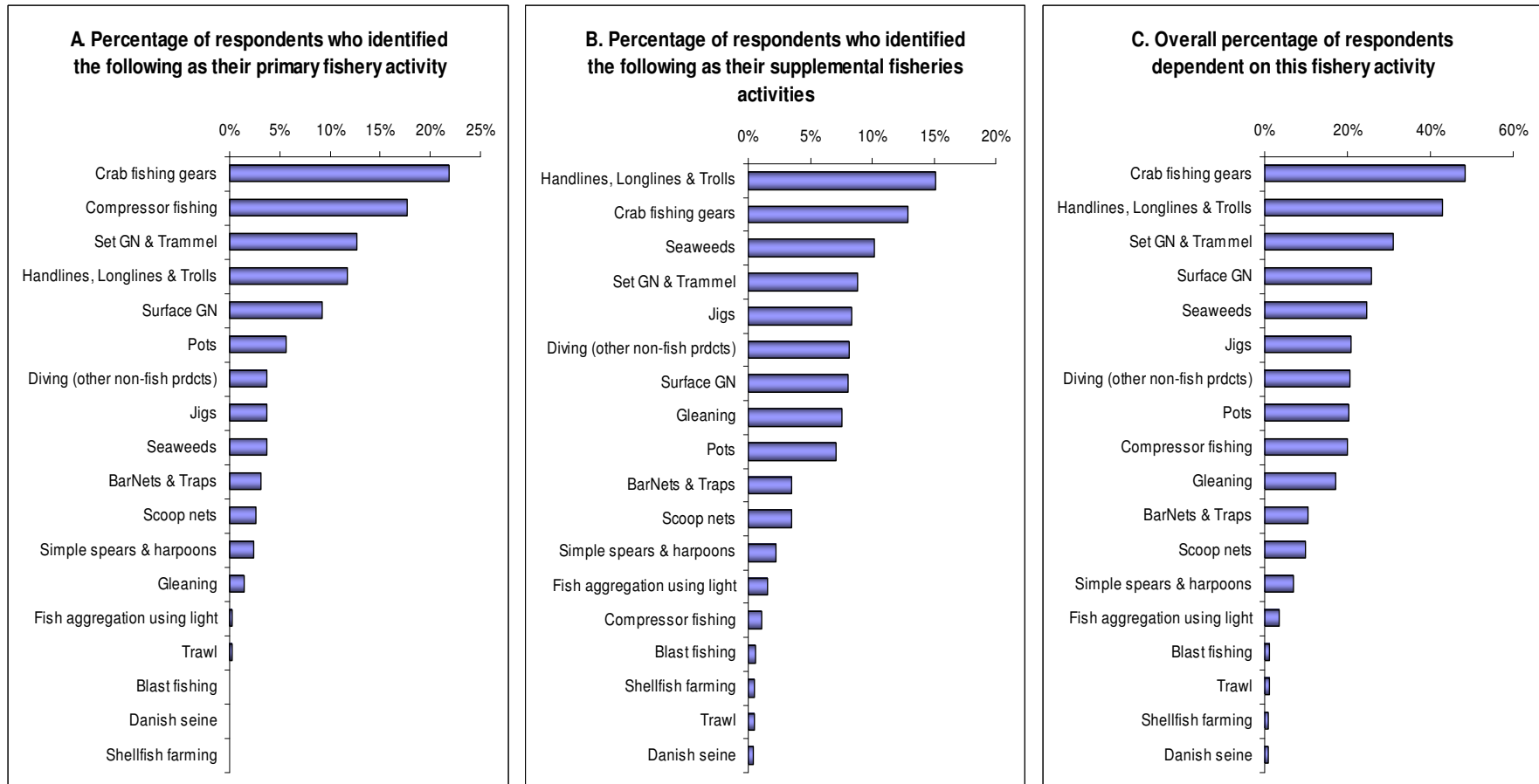


Figure 3-18. Relative importance of the fishing gears and activities of the respondents

Fishing effort (hours spent fishing). Overall, the average number of hours that the fishers in the survey spend fishing is 6.8 hours (sd=3.5). Cluster 1 (Barangay San Pedro), where fisheries activities are predominantly nearshore activities (i.e. fish corrals, crab liftnets and crab pots) has the smallest estimated average fishing hours. On the other hand, the highest estimated average value is for Cluster 5 (Barangay Nocnocan) where the dominant fishing activity is compressor fishing (Figure 3-19). One way ANOVA test for comparison of means showed that at least one of the survey clusters' mean fishing duration differs significantly from the rest of the clusters ($F=18.703$, $p < 0.001$). Multiple pairwise comparison of means revealed that the mean fishing duration of Cluster 5 differs significantly from all other clusters ($p < 0.001$), while Cluster 1 mean fishing duration differs significantly only from Cluster 3 ($p < 0.005$) and Cluster 4 ($p < 0.05$), in addition to Cluster 5.

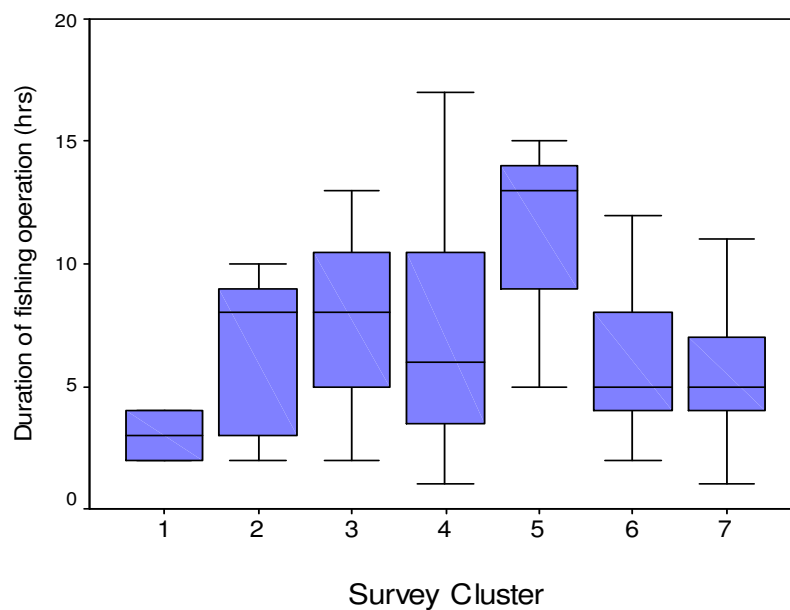


Figure 3-19. Comparison of fishing duration of respondents across the survey clusters (n=345)

Weight of catch (kg) per fishing operation. More than half of the respondents estimate their average fish catch per fishing operation (primary fishing gear) to be no more than 5 kilograms (Figure 3-20). Of these, 33 percent are crab fishers and another 16 percent operate hook and line fishing gears. On the other hand, highest average harvest rates come from seaweeds culture. Seaweeds culture is a unique case as harvest frequency

is only 1-2 times a month. Other than for seaweeds, the highest reported CPUE comes from respondents operating surface gillnets that target primarily schooling small pelagics such as engraulids (*bolinao*), sardines (*mangsi*), halfbeaks (*swasid*), and garfishes (*bawo*). Compressor fishing, gillnets, fish pots, and scoopnets are the fishing gear types and activities that dominate the middle ranges of estimated average catch. Figure 3-21 shows the distribution of catch rates of the primary fishing gear types and activities of the respondents.

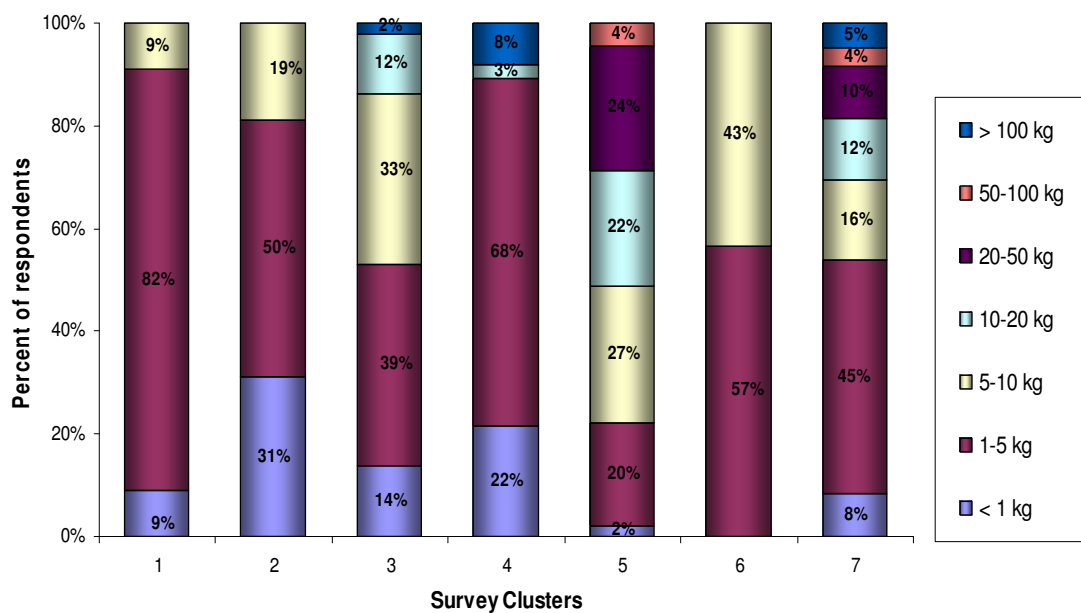


Figure 3-20. Percent distribution of reported weights of catch of the respondents (n=408)

When compared with the initial estimates of catch rates for selected fishing gears and operations in the municipality of Talibon for the year 2006 (FISH Project, unpublished), some of the revealed catch rates agree with the 2006 estimates while others differ. For example, 85% the respondents reported catch rates under 5 kilograms while crab fishing gears in the 2006 estimate also reflect the low catch rates with a weighted mean of 2.31 kilos per fishing trip. However, while the 2006 estimated weighted average CPUE of handlines, longlines and trolls is 11.6 kilograms, only 4.2% of the respondents reported catch rates above 10 kilograms. Table 3-10 shows a comparison of the selected catch rates of the survey respondents with the 2006 estimates of CPUEs.

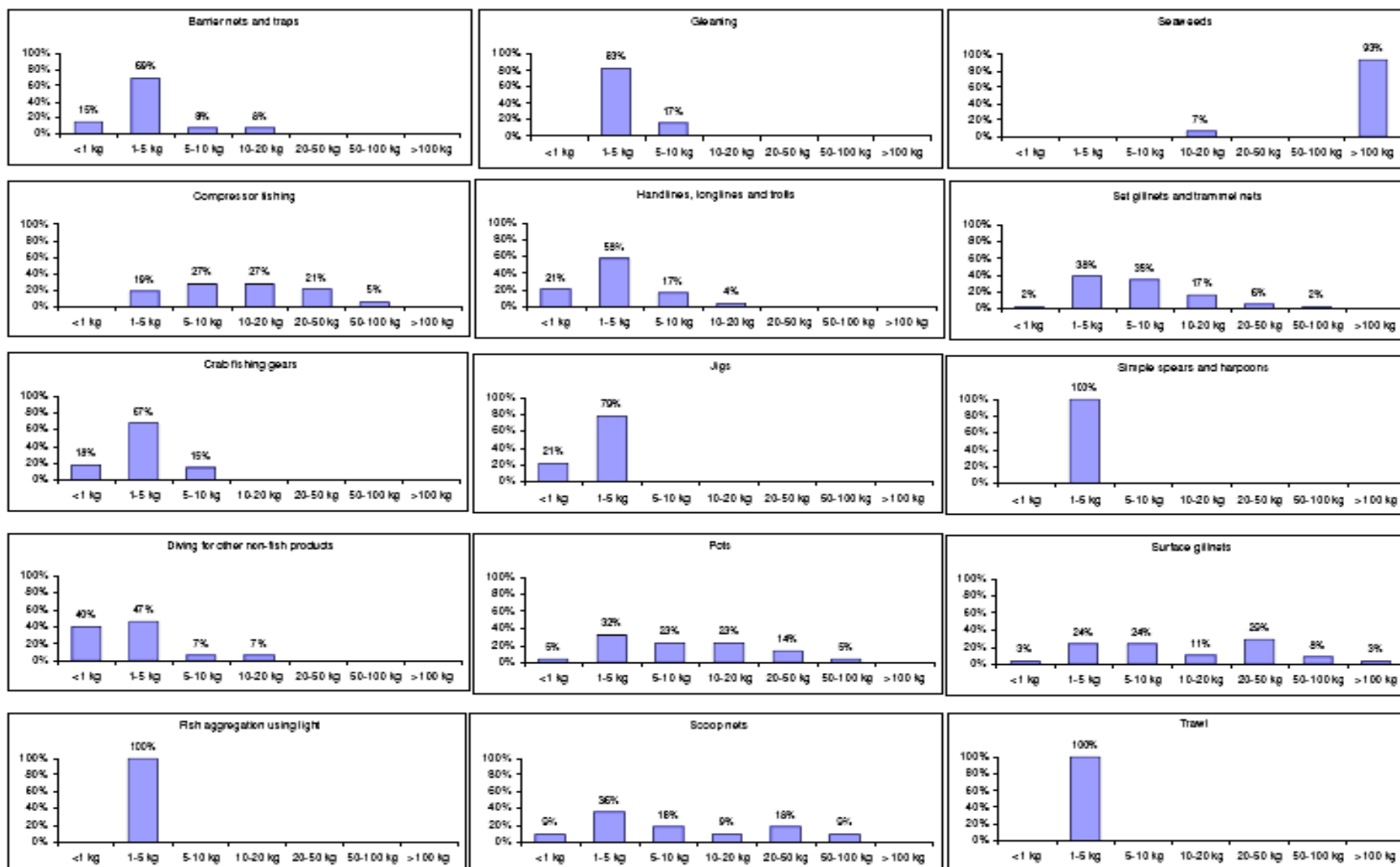


Figure 3-21. Percent distribution of reported weights of catch of respondents per fishing operation

Table 3-10. Initial estimates of CPUE for the year 2006 and reported catch rates of respondents

Fishing gear	FISH 2006 estimates	Catch rates (% of respondents)
Barrier nets and traps	7.85 kg	< 5 kg (84.6%)
Compressor fishing	23.22 kg	10-20 kg (27.4%) 20-50 kg (20.5%)
Crab fishing gears	2.31 kg	< 5 kg (85.4%)
Handlines, longlines and trolls	11.04 kg	< 10 kg (95.8%)
Jigs	2.44 kg	< 5 kg (100%)
Pots	18.99 kg	10-20 kg (22.7%)
Scoopnets	21.70 kg	> 20 kg (27.3%) 20-50 kg (20.5%)
Set gillnets and trammel nets	9.96 kg	1-10 kg (73.1%)
Surface gillnets	17.70 kg	5-10 kg (23.7%) 10-20 kg (10.5%) 20-50 kg (28.9%)

Fishing vessels. Majority of the respondents (78.3%) are owners of fishing vessels. This statistic mirrors the situation in all survey clusters except for Cluster 5 (Barangay Nocnocan) wherein 55.6 percent of the respondents do not own a fishing vessel. These respondents were mostly “*mangabay*” for compressor fishing operations.

Fishing vessels may be either non-motorized or motorized. Survey respondents own either one or both types as shown in Figure 3-22. Also evident is the bias for motorized fishing vessels in the survey clusters composed of island barangays far from the mainland (Clusters 5, 6 and 7). On the other hand, non-motorized fishing vessels remain widely used in the survey clusters composed of coastal barangays in the mainland (Clusters 1, 2

and 3) and island barangays relatively near the mainland (Cluster 4). These preliminary observations may be an indication of the nature of the respondents' fishing operations across survey clusters and the locations of their fishing grounds.

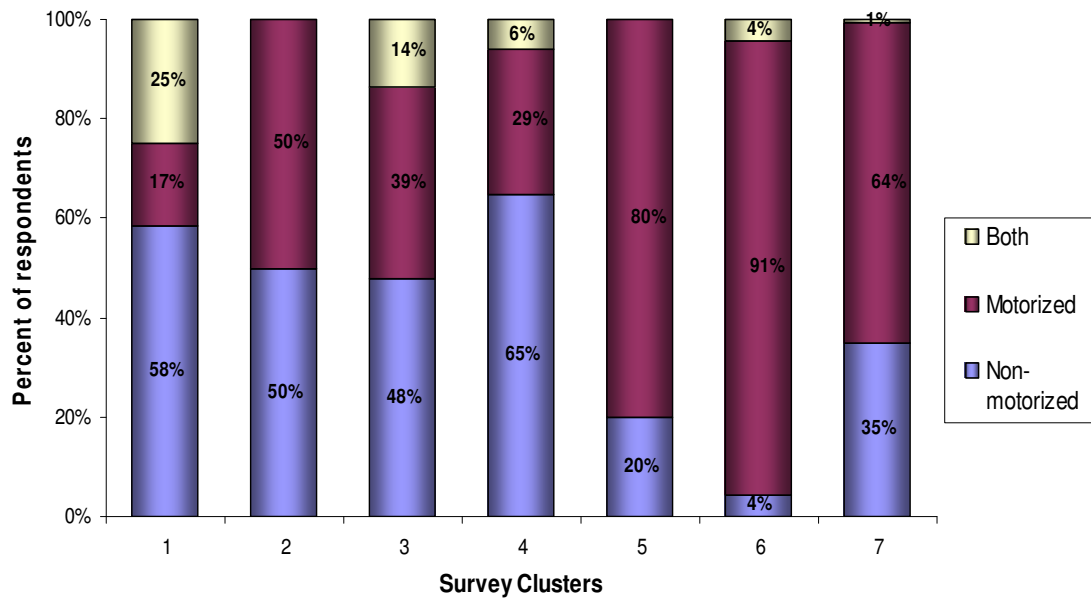


Figure 3-22. Types of fishing vessels owned by respondents across survey clusters (n=318)

Fishing ground. A huge majority of the respondents (83.9%) reported their fishing grounds to be within Talibon waters only. The rest of the respondents revealed that they sometimes fish in waters outside the jurisdiction of Talibon either occasionally (8.8%) or as a norm (7.3%). As shown in Figure 3-23, the latter group are respondents from Cluster 5 (Barangay Nocnocan) whose effective fishing ground for compressor fishing covers reef areas in the adjacent municipalities of Bien Unido and Getafe, and up to as far as the reef areas of Sta. Rosa (Olango Island), Cebu.

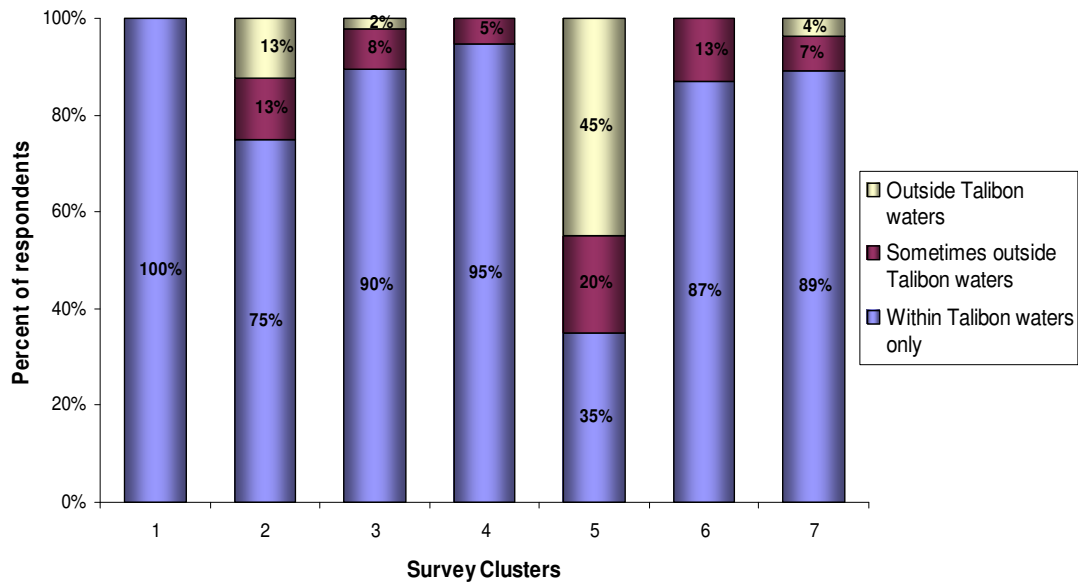


Figure 3-23. Percent distribution of respondents by survey clusters on the location of their fishing grounds (n=398)

3.2.6 Respondents' attitudes and perceptions to selected issues and topics relevant to fisheries management

This section presents the findings of Part III of the questionnaire that consisted of fourteen statements which were designed to elicit the respondents' attitudes and perceptions regarding various issues and topics relevant to the management of fisheries in the Danajon Bank, particularly in the municipality of Talibon. The statements relate to these six basic topics and issues: 1) value of protected ecosystems; 2) dynamics of marine ecosystems; 3) overfishing; 4) control mechanisms in fisheries management; 5) fisheries enforcement; and 6) integrated management of the Danajon fisheries. The respondents were asked to mark on a Likert-type scale from one to five, to which extent they agreed or disagreed with each statement (1=Strongly disagree; 2=Disagree; 3=No opinion; 4=Agree; 5=Strongly agree). In the analysis, scores for marks 1 and 2 and marks 4 and 5 were pooled to represent general disagreement and agreement of the statements, respectively. The results are shown in Figures 3-24 to 3-29.

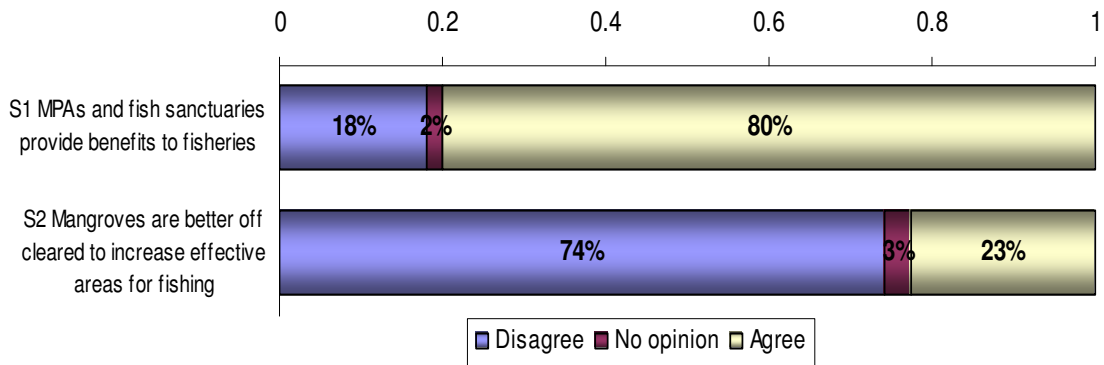


Figure 3-24. Respondents' perception of value of selected protected marine ecosystems in Danajon

Statements 1 and 2 were to draw out the respondents' general perception of the benefits of establishing protected areas. Statement 2 concerning mangroves was phrased negatively. Overall, majority of the respondents seem to appreciate the importance of fish sanctuaries and mangrove systems as protected areas, hence, as no-take areas. Respondents who appear not entirely convinced of the significance of establishing fish sanctuaries (18%) and protecting mangrove forests (22.6%) argued that their fishing grounds have been reduced because of these. The respondents whose traditional fishing grounds used to be where the fish sanctuaries are now located expressed very strong opposition. Respondents who agreed to clear mangroves in order to increase effective areas for fishing generally were from island barangays where there is little or no mangrove growth. Perhaps, the lack of appreciation for protecting mangroves stems from this circumstance.

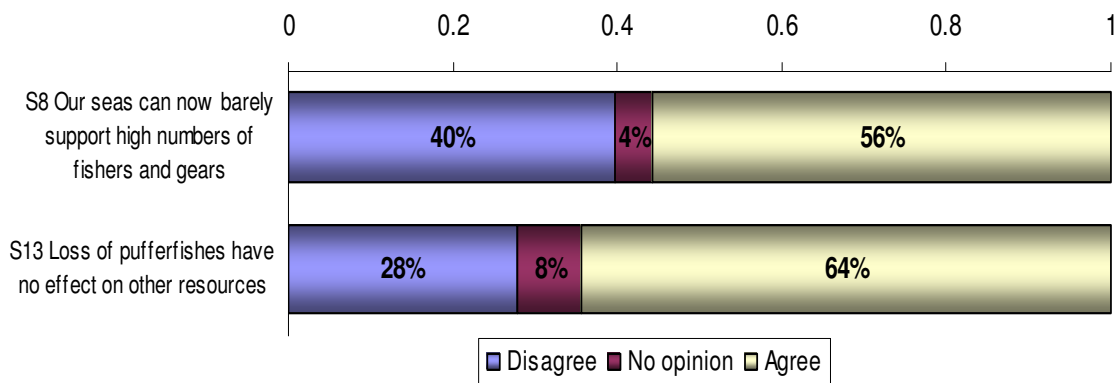


Figure 3-25. Respondents' perception and understanding of some aspects of marine ecosystem dynamics in the Danajon fisheries setting

Respondents' perception and general understanding of some ecosystem dynamics were elicited through Statements 8 and 13, which dealt with the concepts of carrying capacity or ecosystem limits, and interrelatedness of ecosystem components, respectively. More than half of the respondents (56%) agreed that there are indeed too many fishers sharing limited resources in a limited area. However, still quite a considerable percentage of respondents (40%) did not agree to the statement. When asked why, a common explanation of these respondents roughly referred to the 'cycle of things', and found it only natural to have occasions when fish are abundant and when fish are scarce. Therefore, reduced fish catch is not necessarily attributed to the Danajon ecosystem's incapacity to support the fisheries activities.

On the interrelatedness of ecosystem components, the pufferfish was used as an example since pufferfishes, "*botete*" or "*buriring*" in the local dialect, are generally not valued as food fish primarily because they can cause poisoning when consumed. Only 27.8 percent of the respondents disagreed with the statement that the loss of pufferfishes in the ecosystem has no effect at all on other resources. They explained that even though "*botete*" has minimal value to humans, they may be important as food for other fishes in the marine ecosystem.

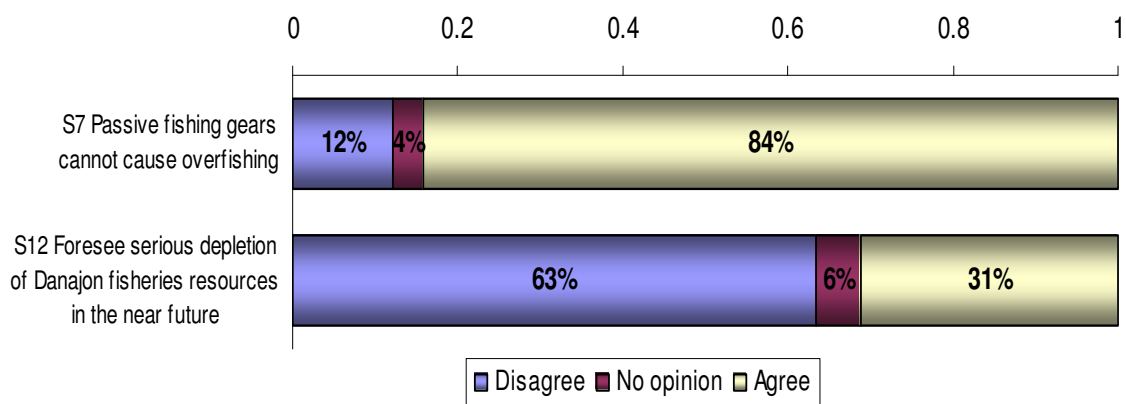


Figure 3-26. Respondents' perception and understanding of potential causes and effects of overfishing in the Danajon fisheries setting

The respondents' depth of understanding of the possible causes of overfishing was tested with Statement 7 which basically says that passive fishing gears cannot cause overfishing. Overfishing can still result even when all fishing gears in a fishery remain passive. Increase in number, increased fishing effort and modifications in gear configuration can all effectively increase total removals of both target and non-target species and sizes, resulting in overfishing. Only a meager 12 percent of the respondents were able to reflect on this for their answer. Interestingly, majority (63%) of the respondents did not believe that there will come a time when the Danajon ecosystem will experience losses and serious depletion of fishery resources (Statement 12). They argued that fishing has been going on since before the generation of their grandparents, and the seas never ran out of fish! Therefore, as they saw it, even if they may experience reduced fish catch at times, they doubt that serious depletion will ever occur. Others even possessed a seemingly philosophical attitude, reasoning that God will not abandon them when they are in need.

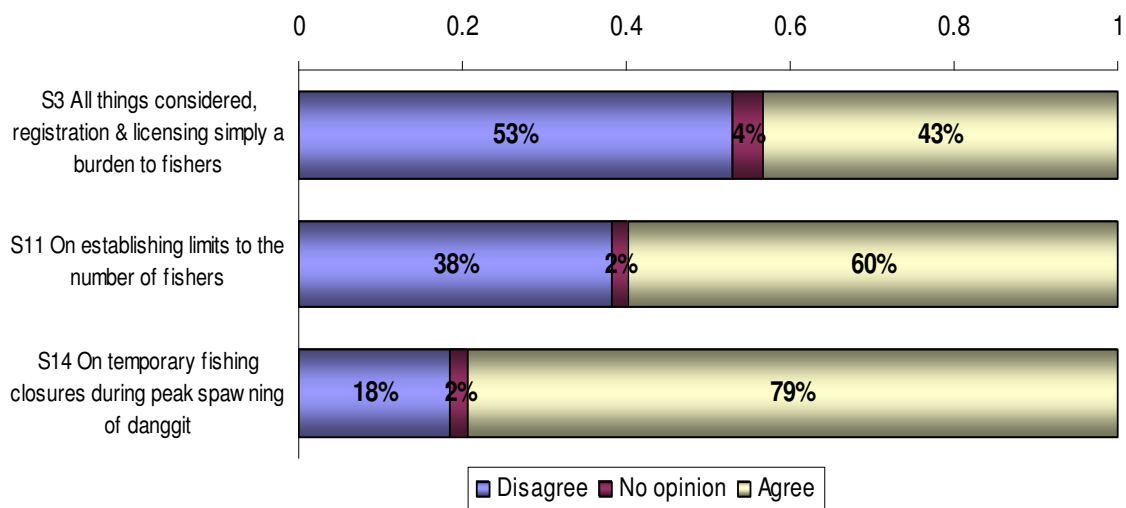


Figure 3-27. Respondents' attitudes towards some control mechanisms in the management of Danajon fisheries resources

On the control mechanisms in fisheries (Statements 3, 11, and 14), the respondents (at least 50% of the time) agreed to measures aimed to regulate overall fishing effort. Fifty-three percent of the respondents did not see

fisheries registration and licensing as nothing more than just a burden, rather it was perceived as a necessary measure to ensure that Talibon fishers will be given priority in fisheries benefits allocation. Likewise, 60 percent of the respondents agreed to establish limits to the number of fishers allowed to fish in Talibon, not necessarily as a measure against possible overfishing, but more of ensuring that only Talibon fishers can fish within the municipal waters of Talibon. Further, majority of the respondents (79%) were in favor of the temporary fishing closure in seagrass areas during the 4th, 5th, and 6th nights of the new moon of every month, when peak spawning activity of seagrass rabbitfish (*danggit*) occurs. They appreciated the importance of allowing the fish to spawn in order to restore their populations and ensure sustainability of the catch. However, the 18 percent who expressed opposition to this policy were the fishers whose fishing activities were generally confined in the seagrass areas, and the gillnet fishers who traditionally timed their fishing activities to catch the schools of *danggit* that aggregate nearshore during peak spawning events.

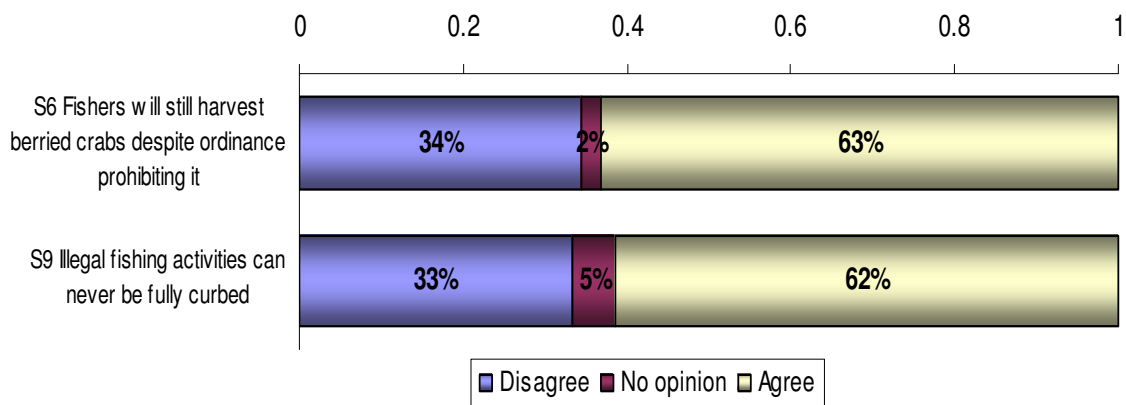


Figure 3-28. Respondents' perceptions of compliance to and enforcement of fisheries policies or laws in Danajon

Statements 6 and 9 were designed to draw out the respondents' perception of the enforceability of fisheries laws in Talibon. Overall, at least 60 percent of the respondents showed lack of faith in some aspects of fisheries law enforcement. As with the case of the current ban on the harvest of berried blue crabs, 63 percent of the respondents believed that the fishers will

continue to catch berried blue crabs whenever they can get away with it. Likewise, 62 percent of the respondents did not believe that the current law enforcement can completely eradicate illegal fishing activities in the area. This lack of faith in the effective implementation of fishery laws is important to note as this may be reflective of their overall commitment, or lack thereof, in participating in and supporting fisheries management policies and initiatives in the municipality of Talibon and the Danajon Bank in general.

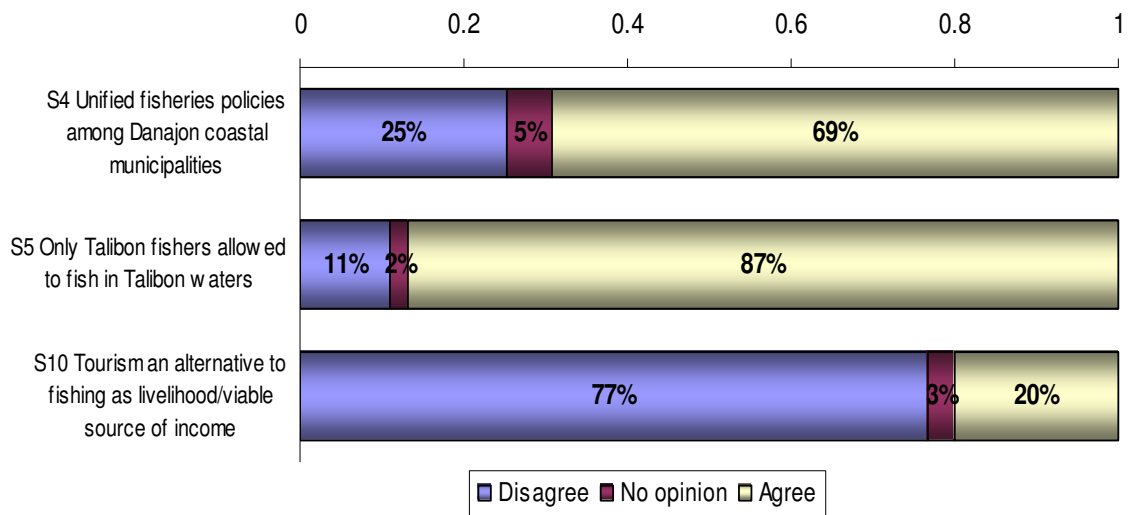


Figure 3-29. Respondents' attitudes towards some current and future policies for the integrated management the Danajon fisheries

Majority of the respondents (69.2%) expressed agreement to the unification of fisheries policies among the Bohol coastal municipalities that are within the Danajon Bank ecosystem (Statement 4). For a fisheries manager's perspective, this arrangement is ideal to facilitate the implementation of fisheries laws within a shared body of water and to likewise foster cooperation among municipalities in the management of their fisheries. On the side of the fishers, many of the respondents favored the notion of comprehensive fisheries policies across Danajon in order to fully eliminate illegal fishing activities, particularly the Danish seine (*liba-liba*) that continue to operate in neighboring municipalities. On the other hand, the respondents whose current fishing activities are firmly prohibited (e.g. compressor fishing) in the other municipalities were apprehensive of such arrangement and decidedly disagreed.

The statement that fishing in Talibon should be exclusive to Talibon fishers (Statement 6) was supported by an overwhelming 87 percent of the respondents. This result is in agreement with the motivation of the respondents who favored establishing limits in the number of fishers (Statement 11) to ensure that Talibon fishers should first and foremost be given priority access to fisheries resources in Talibon.

Lastly, tourism as a possible alternative to fisheries as livelihood was explored in Statement 10. Majority of the respondents (77%) did not see tourism as a viable livelihood alternative to fisheries. This result is important to consider for the local government policy makers and planners who intend to promote marine tourism in Talibon, as projects in that direction may not get the necessary support from the fisherfolk sector.

In addition, the respondents were asked to state which, in their opinion, should be the priority objective for managing fisheries. The choices essentially correspond to the implicit objectives of the alternative scenarios in Part I of the choice experiment. Percentage distribution of the responses is shown in Figure 3-30. The management objective that gained top priority was the objective to protect marine ecosystems and the resources therein, followed by the objective to increase fish catch and profits, and lastly the objective to ensure overall employment security. It will be interesting to note whether or not the respondents' preferences in the choice experiment are consistent with their stated priority fisheries management objective.

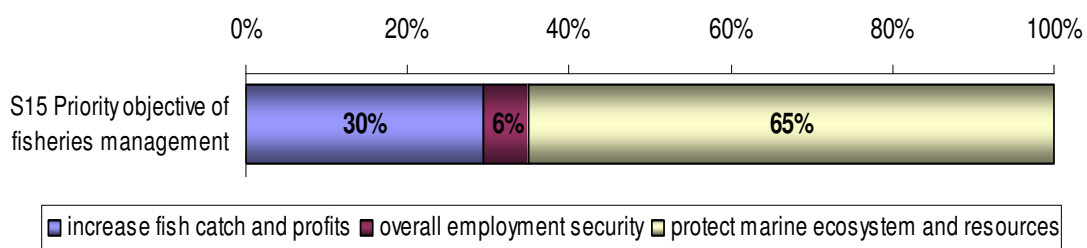


Figure 3-30. Respondents' stated priority objective in fisheries management

To sum up, the results of the attitude, perception, and knowledge survey of the respondents concerning several topics relating to the fisheries ecosystem and fisheries management reveal that majority of the respondents do have an appreciation of the benefits that can be derived out of protected areas in the marine environment and in implementing control or regulatory mechanisms in fisheries. This was reflected in the overall agreement or support of the respondents to statements that focused on these topics. However, results from the statements concerning ecosystem dynamics and overfishing showed that the respondents only have minimal understanding of these concepts. Interestingly, the corresponding reasons behind the replies imply the respondents' strong religious faith and reliance in the Creator. On the other hand, this may also reflect an attitude that is likely to attribute manifestations of overfishing and other disturbance in the balance of the marine ecosystem to supernatural factors rather than probable anthropogenic causes. With regards to fisheries law enforcement, the expressed lack of confidence applies to both the law enforcers and to fellow fishers. Understandably, fisheries laws that lack enforceability are not taken seriously. Lastly, the results have shown that while majority of the fishers favor unified fisheries policies across Danajon coastal municipalities, ownership and exclusivity of use of resources remains important. Fisheries is indeed an integral part of the Danajon ecosystem and a policy aimed to bring major changes that may affect this source of livelihood is not likely to receive a warm welcome, as in the case of tourism. Overall, these results may help us understand the possible motivations behind the respondents' stated preferences in the choice experiment.

3.2.7 Perception of fishing gears and activities

The concluding section of the questionnaire asked the respondents of their general perception of the ecosystem "friendliness" of some twenty fishing gear types and fishing activities. The respondents were instructed to check whether a fishing gear or activity is relatively benign (*dili makadaot*) or harmful to the marine ecosystem (*makadaot*). The responses of the respondents are summarized in Figure 3-31. The top three fishing gears that the respondents

(at least 90%) perceived as harmful to the marine ecosystem are the Danish seine (*liba-liba*), bottom trawl (*palakaya*), and beach seine (*baling*). Common to all these three fishing gears is their active mode of operation, their use of seine nets with fine mesh netting, and they are all prohibited for use within the municipal waters of Talibon. The rest of the fishing gears and activities that the respondents (at least 50% of the time) perceived as harmful to the marine ecosystem are pushnets (*sudsud*), trammel nets (*triple net* or *3-net*), round haul-seine (*lawag*), and compressor fishing. *Sudsud* was considered a harmful gear primarily because of the perceived disturbance it causes as it “plows” through the muddy and seagrass bottoms nearshore. Shells, shrimps, juvenile fish and invertebrates, fish eggs and fish larvae can all be caught using *sudsud* depending on the location and season it is operated. Trammel nets were alleged harmful due to the effective mesh size that results from the clever construction of three overlapping net panels. Reduced size selectivity causes both large-size and small-size fish to become enmeshed in the netting. Further, trammel nets have become more frequently used for *dumbol* fishing, or fishing with the use of a plunger-like contraption that is pounded onto the water in order to scare and drive the fish into the awaiting net. As for round-haul seines, there were only an estimated five *lawag* fleets operating in the municipality of Talibon after the 2006 fishing gear inventory. Fishing relies mainly on the use of lights to attract schools of fish into a seine net about 25 meters in diameter. The entire operation usually involves 2-3 light boats and one large boat where the net and catch are loaded. Although technically not an active fishing gear, its high catching efficiency coupled with poor size-selectivity in the catch (FISH Project, 2004) makes *lawag* relatively harmful to the marine ecosystem. Lastly, compressor fishing is generally perceived as one of the more harmful types of fishing activities as it is often associated with the use of toxic substances such as *tuble*, *kuskus*, and cyanide that causes the death of living coral. Even without the use of toxins, indiscriminate and high overall harvest of reef fishes still destroys the reef. Some fishers also said it was unfair that these fishes caught by compressor fishing do not necessarily end up in Talibon markets; rather, the catch goes directly to buyers and contractors from Cebu City. Increasing harvest of aquarium fish and sea cucumbers via compressor fishing is also an issue.

Fishing gears perceived by the respondents (at least 90% of the time) as relatively not harmful to the marine ecosystem are crab pots (*panggal panglambay*), seaweeds culture (*pangguso*), bottom-set longline (*kitang*), simple hook and line (*pasol/bira-bira*), and crab gillnet (*pukot panglambay*). These gears can all be classified as passive fishing gears. However, “stationary” fishing gears (i.e. anchored to the seabed) such as the fish corral (*bungsod*), stationary liftnet (*bintol* or *new look*), and filter/fyke net (*sanggab*) were not wholly perceived as “friendly” to the marine ecosystem despite their passive mode of operation. According to the respondents who decided that these gears were harmful, the fine mesh netting used in their construction causes these gears to catch non-target juvenile species of fish. Likewise, at least one third of the respondents considered crab liftnet (*sapyaw panglambay*) as harmful for similar reasons. Among the three crab fishing gears, *sapyaw* is operated nearest to shore in seagrass and muddy bottoms where blue crabs spend the juvenile phase of their life cycle.

In the choice experiment, we shall determine whether or not the respondents’ perception of the different fishing gear types and activities have an influence in their choice decisions.

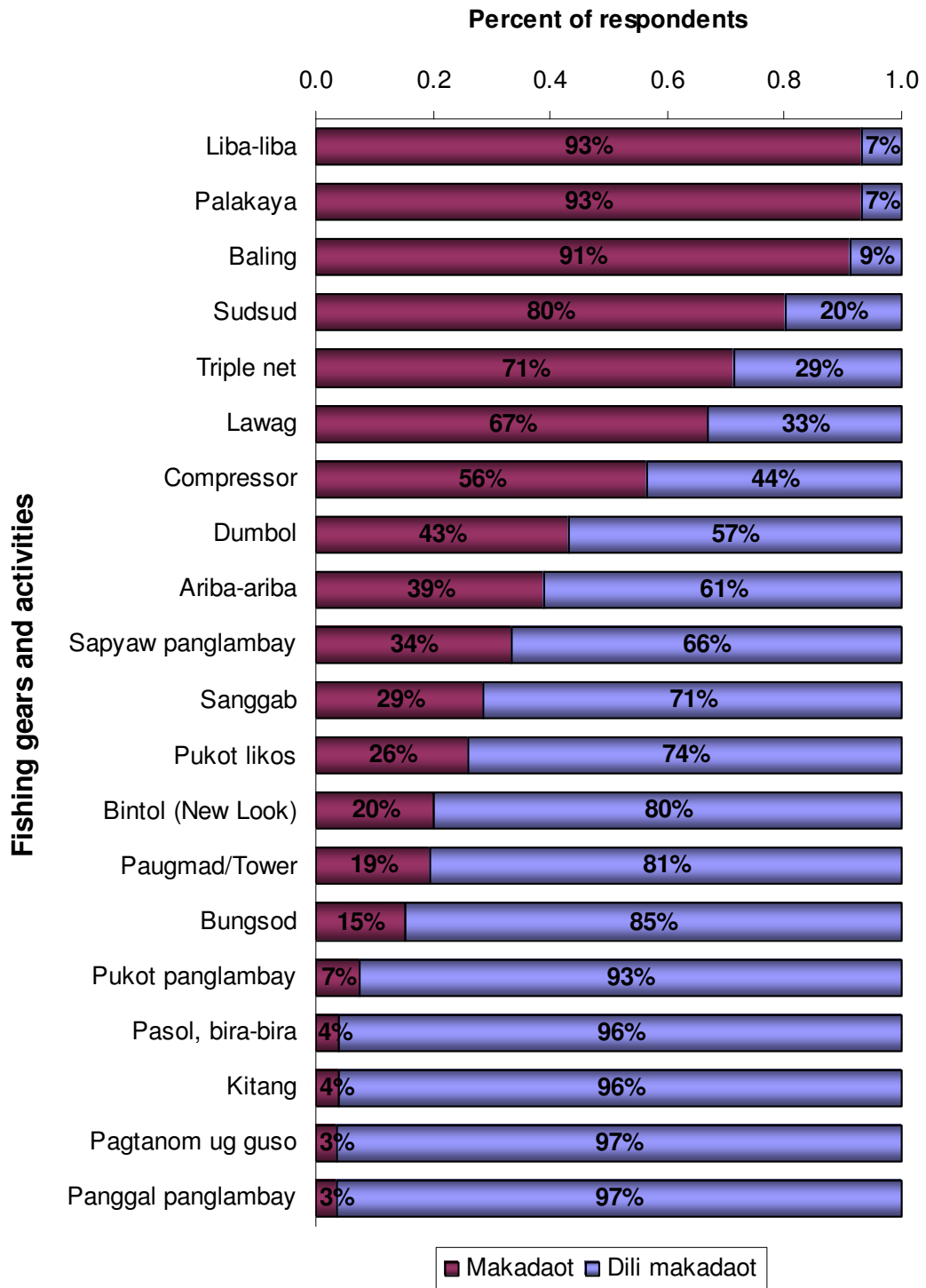


Figure 3-31. Respondents' general perception of ecosystem effects of selected fishing gears types and activities in Danajon Bank.

3.3 Choice Experiment

3.3.1 Preferred scenario

The results of the first part of the choice experiment are based on responses from 409 individual respondents. The proportion of respondents who chose Scenario A (maximizing the economic objective), Scenario B (maximizing the social objective), and Scenario C (maximizing the ecological objective with emphasis on rebuilding predator fish biomass) were 0.49, 0.16, and 0.35 respectively. A Chi-square test was administered to test the null hypothesis that the respondents equally preferred the three scenarios. The computed chi-square value $\chi^2 = 64.391$ is statistically significant at $p < 0.001$, and thus the null hypothesis was rejected. In other words, there is evidence at 0.001 level to indicate that the respondents do have a preference for at least one choice scenario. It appears that Scenario A is most preferred and Scenario B is least preferred.

Since the sample size was deemed sufficiently large and normal approximation is reasonable^{*}, a 95% confidence interval for the true proportion[†] of Talibon fishers who are likely to prefer Scenarios A, B, and C were approximated. The results are summarized in Table 3-11.

Table 3-11. Approximated true proportion of the Talibon fishers choosing scenarios A, B, and C at 95% confidence interval

Scenario	\hat{p}	95% C.I. for p
A Maximize economic objective	0.487	0.438, 0.535
B Maximize social objective	0.164	0.128, 0.199
C Maximize ecological objective, rebuilding of predator fish biomasses)	0.350	0.303, 0.396

^{*} The sample size $n=409$ was checked to be sufficiently large and that the normal distribution provides a reasonable approximation for the proportion of respondents preferring each scenario over the others (binomial proportion) using $(\hat{p} \pm 3\sigma_{\hat{p}})$. All intervals satisfied the criterion of being wholly contained in the interval (0,1).

[†] $\hat{p} \pm z_{\alpha/2} \sigma_{\hat{p}}$

Based on these results, we can be 95% confident that the percentage of Talibon fishers who are likely to support a policy that maximizes the economic objective (i.e. total profits) in fisheries management, is between 43.8 and 53.5 percent. On the other hand, only about 12.8 and 19.9 percent of the Talibon fishers are likely to support a policy that maximizes the social objective (i.e. number of fishers engaged in the fishery), while between 30.3 and 39.6 percent are likely to support a policy that maximizes the ecological objective with emphasis on rebuilding predator fish biomasses.

Comparing these results with the respondents' stated priority objectives in Section 3.2.5, only the social objective is consistently preferred the least in both surveys. Given that the alternative scenarios in the choice experiment were not labeled, the respondents had to base their decisions on one or a combination of the scenario elements or attributes to determine which scenario provided them with the most benefits (utility maximizing behavior). On the other hand, the explicitly stated objectives in the attitudes/perception survey may have triggered the respondents to form a strategic bias for the objective which they may have believed to be the "ideal" – *to protect the marine ecosystem and the resources therein*. Therefore, the results from the choice experiment should be more reliable than the outcome of the stated priority objective survey.

3.3.2 Respondents' profile: Determinants of choice?

Specific characteristics or attributes of the respondents may influence their preferred choice scenarios. A binomial logistic regression model was drawn for each proportion of the respondents who chose either Scenario A, Scenario B, or Scenario C. Socio-economic and fisheries characteristics from the respondents' profile, as well as their perception and attitudes towards some fisheries management topics and issues were selected as potential determinants of choice. Socio-economic variables included in the model were *location, age, gender, civil status, number of children, household size, education, income level, alternative income, fisherfolk organization*, and

fisheries trainings/seminars. Fisheries characteristics included *fisher registration, primary fishing gear type, catch rates, duration of fishing, ownership of fishing vessel, and fishing ground*. Primary fishing gear types were reclassified as not harmful (*dili makadaot*) or harmful (*makadaot*) to the marine ecosystem based on the respondents' perception of ecosystem friendliness of a fishing gear or activity. A gear was classified as either not harmful or harmful if at least 50 percent of the respondents rated their fishing gears as such in Section 3.2.6. For the respondents' general attitudes and perception towards fisheries management topics or issues, *priority objective* variable refers to the respondents' stated priority fisheries management objective in the survey. The variable *protect* refers to the respondents' attitudes towards protected areas in the marine ecosystem. Respondents' understanding of interrelatedness of marine species as part of the marine ecosystem dynamics is reflected in the variable *ecosystem dynamics*. *Overfishing* variable reflects the respondents' belief in the possibility of serious depletion of marine resources in the near future due to overfishing. *Control mechanisms* variable represents the respondents' attitude towards fisheries registration and licensing, to establishing limits to the number of fishers, and to the temporary closures in the harvest of *danggit* during spawning seasons. The variable *enforcement* represents the respondents' overall perception or faith in fisheries law enforcement. Lastly, the respondents' attitudes towards the proposed unification of fisheries policies across Danajon coastal municipalities is represented by the variable *unified policy*. A summary of the socio-economic, fisheries, and attitudes/perception variables are shown in Table 3-12 together with the levels and codes assigned to them for the logistic regression.

The results of the logistic regression model segmented by choice are reported in Table 3-13. The hypothesis that all coefficients are equal to zero (i.e. all variables have no influence over choices made) was tested. The chi-square values 67.53, 91.16, and 75.71 for models of the respondents who preferred Scenario A, Scenario B, and Scenario C, respectively, were all significant at

Table 3-12. Socio-economic, fisheries and attitudes/perception variables and levels

Variables	Levels	Codes
Socio-economic		
<i>Location</i>	Cluster 1	0
	Cluster 2	1
	Cluster 3	2
	Cluster 4	3
	Cluster 5	4
	Cluster 6	5
	Cluster 7	6
<i>Age</i>	(continuous variable)	
<i>Gender</i>	female	0
	male	1
<i>Civil status</i>	single	0
	married	1
	widowed/widower	2
	others	3
<i>Number of children</i>	(continuous variable)	
<i>Household size</i>	(continuous variable)	
<i>Education</i>	none	0
	elementary	1
	high school	2
	college	3
<i>Monthly income levels (Php)</i>	<1,000	0
	1,000 to 5,000	1
	5,000 to 10,000	2
	10,000 to 20,000	3
	>20,000	4
<i>Alternative income</i>	none	0
	with income other than fisheries	1
<i>Organization</i>	non-member	0
	member of a fisherfolk organization	1
<i>Trainings/seminars</i>	none	0
	attended fisheries- or CRM-related	1
	training/seminar	
Fisheries		
<i>Fisher registration</i>	not registered	0
	registered	1
<i>Primary fishing gear type</i>	not harmful (dili makadaot)	0
	harmful (makadaot)	1
<i>Catch rates</i>	< 1 kg	0
	1-5 kg	1
	5-10 kg	2
	10-20 kg	3
	20-50 kg	4
	50-100 kg	5
	> 100 kg	6
<i>Duration of fishing</i>	(continuous variable)	
<i>Own fishing vessel</i>	does not own a fishing vessel	0
	owns at least 1 fishing vessel	1
<i>Fishing ground</i>	within Talibon waters only	0
	sometimes outside Talibon waters	1
	outside Talibon waters	2
Attitudes/Perception		
<i>Priority fisheries management objective</i>	increase fishers catch and incomes	0
	security in employment for majority	1
	protect the marine/fisheries ecosystem and resources	2
<i>Protect</i>	not in favor to either or both MPA establishment and mangroves protection	0
	positive attitude to both MPA and mangroves protection	1
<i>Ecosystem dynamics</i>	pufferfishes have no importance	0
	pufferfishes have importance	1
<i>Overfishing</i>	serious depletion unlikely	0

Table 3-12. Socio-economic, fisheries and attitudes/perception variables and levels

Variables	Levels	Codes
<i>Control mechanisms</i>	serious depletion a possibility	1
	negative attitude towards control mechanisms	0
	positive attitude to least 2 of the control mechanisms	1
<i>Enforcement</i>	negative perception of fisheries law enforcement and overall compliance	0
	positive perception of fisheries law enforcement and overall compliance	1
	negative attitude towards unification of fisheries policies	0
<i>Unified policy</i>	positive attitude towards unification of fisheries policies	1

$p < 0.01$, $p < 0.001$, and $p < 0.002$. The null hypothesis was thus rejected. Therefore, there is enough evidence at at least 0.01 level to indicate that some of the independent variables do influence the choices made by the respondents. In the individual models, variables were considered significant at 0.05 level. The estimated correlation between the error terms (Nagelkerke's R^2) for all three models fall within the ranges reported in most logistic regression models, which are between 0.2 and 0.5. Overall success rate of prediction is highest for the Scenario B model, followed by the model for Scenario C, and then the model for Scenario A.

All coefficients for *location* (Clusters) were not significant at 0.05 level. In other words, all things being equal, one cannot predict the respondents' choice of a scenario by their location alone. Similarly, coefficients for the variables *age* and *gender* all fall short of significance. Nonetheless, if it has any indication, the negative signs of the *age* coefficients under the models for Scenarios A and B, and the positive *age* coefficient under the model for Scenario C may imply that the older the respondents get, they tend to favor more Scenario C, that which maximizes the ecological objective and increases the predator fish biomass, over the other two alternative scenarios. Although the evidence for *gender* is likewise not reliable, if it has any indication at all, the negative coefficient under the Scenario A model and the positive coefficients under the Scenario B and C models may imply that females tend to favor the economic objective while males tend to prefer more either the social or ecological objective.

Looking at the variable *civil status*, where the singles serve as reference group, only the coefficient for the married respondents under the Scenario B model is significant. The negative sign implies a lower likelihood for married respondents to select this alternative.

Table 3-13. Respondents' characteristics as determinants of choice for fisheries scenarios

Predictor Variables	Levels	Scenario A		Scenario B		Scenario C	
		coefficient	<i>P</i>	coefficient	<i>P</i>	coefficient	<i>P</i>
Socio-economic							
<i>Location</i>	Cluster 1	0		0		0	
	Cluster 2	-10.704	0.677	-1.858	0.981	6.439	0.775
	Cluster 3	-12.583	0.624	6.964	0.898	7.723	0.732
	Cluster 4	-12.995	0.612	7.699	0.887	7.479	0.740
	Cluster 5	-12.517	0.626	7.725	0.997	6.746	0.765
	Cluster 6	-13.002	0.612	5.423	0.921	8.226	0.715
	Cluster 7	-12.657	0.622	5.930	0.913	8.334	0.712
<i>Age</i>		-0.003	0.830	-0.003	0.886	0.006	0.717
<i>Gender</i>		-0.750	0.078	1.059	0.228	0.538	0.248
<i>Civil status</i>	single	0		0		0	
	married	0.351	0.528	-2.558	0.001	0.961	0.150
	widowed/ widower	-5.992	0.724	-2.539	0.107	2.318	0.106
	others	7.009	0.846	-6.015	0.954	-6.468	0.862
<i>Children</i>		-0.013	0.852	0.112	0.214	-0.066	0.365
<i>Household size</i>		-0.024	0.727	-0.068	0.483	0.088	0.232
<i>Education</i>	none	0		0		0	
	elementary	0.151	0.793	0.437	0.582	-0.255	0.672
	high school	0.570	0.401	-1.341	0.173	0.002	0.997
	college	0.976	0.292	-9.214	0.787	-0.008	0.994
<i>Income levels (Php, monthly)</i>	<1,000	0		0		0	
	1,000 to 5,000	0.429	0.182	0.861	0.066	-0.816	0.018
	5,000 to 10,000	0.102	0.844	-0.502	0.579	-0.058	0.913
	10,000 to 20,000	-1.014	0.458	3.641	0.018	-1.020	0.464
	>20,000	-0.899	0.516	4.171	0.033	-7.187	0.836
<i>Alternative income</i>		0.475	0.182	0.219	0.688	-0.562	0.160
<i>Fisheries organization</i>		0.827	0.061	-2.959	0.002	0.121	0.800
<i>Fisheries training/seminar</i>		-0.988	0.020	0.936	0.123	0.513	0.252
Fisheries							
<i>Fisher registration</i>		-0.350	0.227	0.552	0.208	0.139	0.656
<i>Primary fishing gear type</i>		1.181	0.006	-0.177	0.766	-1.281	0.007
<i>Catch rates</i>	< 1 kg	0		0		0	
	1-5 kg	-0.249	0.619	0.383	0.614	0.165	0.767
	5-10 kg	-0.264	0.647	-0.438	0.646	0.480	0.449
	10-20 kg	-1.589	0.019	1.289	0.166	0.976	0.165
	20-50 kg	-1.033	0.137	-0.155	0.876	1.331	0.077
	50-100 kg	-0.810	0.449	-9.859	0.845	1.443	0.209
	> 100 kg	-0.814	0.342	-7.452	0.878	1.338	0.150
<i>Duration of fishing</i>		0.051	0.280	-0.031	0.651	-0.039	0.455

Table 3-13. Respondents' characteristics as determinants of choice for fisheries scenarios

Predictor Variables	Levels	Scenario A		Scenario B		Scenario C	
		coefficient	<i>P</i>	coefficient	<i>P</i>	coefficient	<i>P</i>
<i>Own fishing vessel</i>		0.676	0.068	-0.738	0.151	-0.420	0.278
<i>Fishing ground</i>	within Talibon waters only	0		0		0	
	sometimes outside Talibon waters	-0.535	0.330	0.579	0.416	0.209	0.718
	outside Talibon waters	-0.542	0.402	0.802	0.340	0.143	0.862
<i>Attitudes/Perception</i>							
<i>Priority</i>	catch and profits	0		0			
<i>objective</i>	employment	-0.555	0.448	1.099	0.228	-0.126	0.882
	ecosystem and resource protection	-0.736	0.020	-0.332	0.474	0.992	0.005
<i>Protect</i>		-0.227	0.438	0.673	0.126	0.011	0.972
<i>Ecosystem dynamics</i>		0.422	0.193	0.598	0.201	-0.653	0.071
<i>Overfishing</i>		-0.126	0.686	-0.551	0.253	0.454	0.172
<i>Control mechanisms</i>		0.140	0.640	-0.419	0.342	-0.023	0.943
<i>Enforcement</i>		0.013	0.975	-1.355	0.073	0.434	0.302
<i>Unified policy</i>		-0.069	0.834	0.205	0.667	0.035	0.921
Intercept		12.805	0.618	-7.322	0.893	-10.233	0.651
<i>Number of cases</i>		308		308		308	
<i>-2Log-likelihood (intercept only):</i>		426.511		285.965		396.552	
<i>-2Log-likelihood:</i>		358.985		194.806		320.845	
<i>Model Chi-square:</i>		67.526		91.159		75.707	
		(df=43, <i>p</i> <0.010)		(df=43, <i>p</i> <0.000)		(df=43, <i>p</i> <0.002)	
<i>Pseudo R²</i>		0.263		0.424		0.301	
<i>Overall Success rate</i>		65.58%		88.31%		73.05%	

For the variables *children*, *household size*, and *education*, the models were unable to present any reliable evidence that these characteristics do affect the respondents' choice for a fisheries scenario. It is interesting to note, however, the relatively high negative coefficients for the high school and college groups under the Scenario B model. Although inconclusive, if it has any indication at all, the negative coefficients may imply that the more educated respondents tend not to favor this alternative.

The *income level* variable (least income group serves as reference group) presents some interesting results. Comparing the coefficients across the income levels, low income groups (respondents with monthly incomes under ten thousand pesos) tend to prefer Scenario A as indicated by the all positive

coefficients under the Scenario A model. However, the coefficients are not significant from a statistical point of view. On the other hand, the same group had all negative coefficients under the Scenario C model, with the coefficient for income range 1,000 to 5,000 proving significant at 0.05 level. Proceeding to the higher income ranges (monthly incomes ten thousand pesos and above), both the coefficients under the Scenario B model were positive and remarkably high at 0.05 level of significance. Based on these results, we can say that lower income groups have reduced probability of choosing the scenario prioritizing the ecological objective (Scenario C), while higher income groups have significantly higher probabilities of choosing the scenario prioritizing the social objective (Scenario B) over other alternatives. However, having an *alternative income* or income source other than fisheries shows non-significant results.

Looking at the variables reflecting the respondents' socio-civic involvement, members of fisherfolk organizations tend not to choose Scenario B as indicated by the negative coefficient that is highly significant at 0.005 level. Although not significant, corresponding positive coefficients for Scenarios A and C imply that these alternatives are rather preferred. On the other hand, respondents who have participated in fisheries or CRM-related trainings or seminars show a significant negative coefficient under the Scenario A model, indicating a reduced probability of choosing this alternative over the others. Although inconclusive statistically, the positive coefficients for both the *fisherfolk organization* and *fisheries trainings/seminars* variables under the Scenario C model may still be noteworthy. If it has any indication, increased involvement in fisherfolk groups and trainings may increase the probabilities of favoring Scenario C, which maximizes the ecological objective.

As for the fisheries variables, we cannot predict the choice for a fisheries scenario using information on whether or not the respondents are registered fishers, whether or not the respondents own a fishing vessel, the duration of fishing activities, and fishing ground. The *primary fishing gear type* variable, however, showed important results. A significant positive coefficient under the Scenario A model indicates that respondents whose primary fishing gears

or activities are classified as harmful or “*makadaot*” tend to prefer Scenario A (maximizing economic objective). On the other hand, a significant negative coefficient under the Scenario C model indicates that the respondents whose primary fishing gears or activities are classified as not harmful or “*dili makadaot*” have a tendency to prefer Scenario C (maximizing the ecological objective). What is most noteworthy of these results is the implied agreement of the respondents’ actual behavior (based on current fishing gear type) and their stated preference (based on choice scenario and the corresponding fisheries management objective). In other words, the respondents’ current fishing gear types and activities may already reflect their motivations in selecting, ergo potentially supporting, present and future fisheries management undertakings.

Catch rates variables show statistically insignificant coefficients, except for the 10-20 kg group under the Scenario A model. Taken together with the other *catch rates* coefficients under this model, the observation that all coefficients are negative and that groups with higher catch rates tend to show higher negative coefficients may imply that the respondents who consistently catch more, ironically, tend not to prefer Scenario A. Comparing these coefficients with the other models, we can see that coefficients under Scenario C are all positive, and that groups with higher catch rates have correspondingly higher positive coefficients. These results may imply that respondents who consistently catch more tend to prefer Scenario C. Overall, these results somehow agree with the outcome of the policy search routine simulations, which showed that abundance in catch does not necessarily translate into economic benefits (i.e. increased net profit); rather, it is more a reflection of improved ecosystem state coupled with methods of fisheries exploitation. Therefore, the increasingly positive coefficients of *catch rates* under Scenario C (maximizing the ecological objective) may be a reflection of the respondents’ appreciation of the importance of maintaining general health of the marine ecosystem in order for them to have consistently high catch rates.

Moving on to the attitudes/perception variables, *priority objective* variables essentially correspond to the objectives maximized by individual choice

scenarios. With “increased catch and profits” as reference, those who prioritized “protect the marine ecosystem and resources therein” showed a significant negative coefficient under the Scenario A model ($p < 0.05$) and a significant positive coefficient under the Scenario C model ($p < 0.005$), showing agreement of their stated priority objective and preferred fisheries management scenario. Although statistically not significant, those who prioritized “overall employment security” nonetheless exhibited the same agreement of their stated objective and choice scenario as indicated by the positive coefficient under the model for Scenario B (maximizing the social objective) only.

The rest of the variables failed to exhibit any statistically significant result. If they have any indication, however, the signs of their coefficients may be used as basis for some speculation. That is, positive coefficients imply increased probability of choosing a particular scenario, while negative coefficients imply the opposite. For the respondents who stated positive attitudes towards protection of marine ecosystems (*protect*), a positive coefficient under the Scenario C model does reflect agreement of their attitude and choice. Ironically, respondents who showed fair understanding/appreciation of the interrelatedness of ecosystem components (*ecosystem dynamics*) yielded a negative coefficient for Scenario C but positive coefficients for Scenarios A and B, both of which simulated trophic models wherein species groups dropped out of the system. For those who believed that serious depletion of resources in the Danajon ecosystem is a possibility as a result of *overfishing*, they tend to favor Scenario C over Scenarios A and B. That is, all variables held constant, awareness of causes and effects of overfishing may motivate respondents to support policies that protect ecosystems and increase biological productivity (using fish biomass as proxy). Further, respondents who showed a general positive attitude towards *control mechanisms* in fisheries, tend to show preference for Scenario A, as indicated by its positive coefficient. Recalling that the respondents’ overall motivation for supporting fisheries regulations is ensuring priority access to resources by Talibon fishers, somehow explains the preference for Scenario A. Limiting the number of

fishers in a defined area, in this case the municipal waters of Talibon, reflects a rational economic motivation whereby limited players means less competition, and therefore higher individual net benefits. Another variable whose positive and negative coefficients reflect some rational economic motivation is belief in fisheries law enforcement (*enforcement*). The respondents who perceived positively the conduct of fisheries law enforcement and in the overall compliance yielded positive coefficients under the models for Scenarios A and C but a negative coefficient under the Scenario B model. Recall that Scenario B recommends increasing the effort of mostly the harmful types of fishing activities. Logically, if the respondents do not believe that regulations aimed at either protecting marine ecosystems or increasing overall net incomes can be fully implemented, then they would rather support the alternative scenario which they perceive to be most realistic. That is, it would seem irrational to support a fisheries policy that calls for overall reduction in fishing effort when they believe that other fishers will continue to violate the restrictions due to perceived poor fisheries enforcement. Lastly, a negative coefficient for the *unified policy* variable under Scenario A model may imply that the respondents who showed a positive attitude towards unification of fisheries policies across the Danajon coastal municipalities have stronger socially- and/or ecologically-relevant motivations behind their decisions.

3.3.3 Scenario attributes: Determinants of choice?

A logistic regression was performed to test the individual elements of the choice scenarios (main effects only) as potential determinants of choice. That is, by presenting the respondents with sets of hypothetical choice scenarios wherein the levels of the scenario attributes were varied randomly, the study examined which attribute significantly influenced the decisions of the respondents to choose one scenario over another. The results of the logistic regression model* are based on 381 individuals and a total of 5,838

* Four alternative models were constructed: Model 1 or the complete model where all responses were considered; Model 2 where lexicographic replies were rejected; Model 3 where lexicographic responses and choices for choice game 6 were screened for irrational

observations. This was after unanswered choice games, “lexicographic” behavior (i.e. employing a simplifying decision rule by always choosing either Card A or Card B in all eight choice games) and irrational choices (i.e. choosing Card A over Card B for choice game six, where card A clearly is the scenario that yields the lesser benefits of the two) were screened out. A test of the full model versus the restricted model (intercept only) yielded a chi-square value of 1029.031 which is significant at $p < 0.001$. The hypothesis of all coefficients being equal to zero was thus rejected. Therefore, there is evidence at 0.001 level to indicate that some elements of the choice scenarios influence the respondents’ choice decisions. Overall, the model was able to correctly classify the choices 70.20 percent of the time.

Table 3-14. Logistic regression predicting decision from biological, economic, and social predictor variables

Predictor variables	Coefficient (B)	s.e.	χ^2	p	Exp(B)	95% CI for Exp(B)	
						Lower	Upper
Predator Fish Biomass	-0.743	0.059	161.526	<0.0001	0.476	0.424	0.534
Prey Fish Biomass	-0.179	0.058	9.462	0.0021	0.836	0.746	0.937
Blue Crabs Biomass	0.342	0.058	34.850	<0.0001	1.407	1.256	1.576
Total Annual Catch	0.666	0.058	130.480	<0.0001	1.946	1.736	2.182
Total Annual Profits	-0.733	0.058	159.461	<0.0001	0.480	0.429	0.538
Total Number of Fishers	0.395	0.058	46.985	<0.0001	1.485	1.326	1.663
Fishing gear type							
<i>Pamukot, pasol, pangnokos</i>	1.368	0.087	247.577	<0.0001	3.928	3.312	4.658
<i>Bungsod, lawag, bintol</i>	0.214	0.085	6.328	0.0119	1.239	1.048	1.464
<i>Panglambay</i>	1.391	0.084	273.006	<0.0001	4.020	3.408	4.741
<i>Liba-liba, palakaya, baling</i>	0	--	--	--	--		
Intercept	-0.632	0.096	43.327	<0.0001			
Number of cases included in the analysis	5838						
-2 Log-likelihood (intercept only):	8093.19						
-2 Log Likelihood:	7064.16						
Model Chi-Square:	1029.03	(df=9, p<0.001)					
Pseudo R ²	0.22						
Overall Success rate:	70.20%						

As shown in Table 3-14, all parameters have remarkably high statistical significance, and therefore have considerable influence over the respondents’

responses; and Model 4 where lexicographic replies and choice game 6 were rejected all together. Model 3 showed the best parameters of model fit with the most significant Chi-square value. The alternative models are shown in Appendix J.

choice decisions. However, some variables have a higher influence than others in the choices made by the respondents. Of all biological, economic, and social predictor variables, *blue crabs biomass*, *total annual catch*, and *total number of fishers* appear to be the more important considerations of choice. That is, when holding all other variables constant, a scenario recommending an increase of these variables is more likely to be chosen over any alternative. Negative coefficients for the *predator fish biomass*, *prey fish biomass*, and *total annual profits* could be an indication of the respondents' willingness to trade off these elements or attributes in exchange for increases in the levels of the more preferred attributes.

The fishing gear type was a categorical variable with four levels: 1) *liba-liba*, *palakaya*, and *baling* to represent the highly destructive fishing gears; 2) *pamukot*, *pasol*, and *pangnokos* to represent the least destructive fishing gears; 3) *bungsod*, *lawag*, and *bintol* to represent the "controversial" fishing gears; and 4) *panglambay* to represent the different gear types that target specifically the blue crabs. To proceed with the logistic regression, k-1 variables needed to be set up wherein one of the fishing gear groups had to serve as reference group to which each of the other groups were compared. The group considered to be most harmful to the marine ecosystem (i.e. *liba-liba*, *palakaya*, and *baling*) served as reference. The results show that the respondents favored significantly more a scenario that recommended an increase in either the crab fishing gears or the hook and lines, gillnets, and jigs group over an alternative scenario showing an increase in the harmful gear types. By looking at the odds ratios (ExpB), we can say that for any two choice pairs, the odds for choosing a scenario recommending an increase in *panglambay* were four times higher than for an alternative scenario recommending an increase in *liba-liba*, *palakaya*, and *baling*. Likewise, the odds for choosing a scenario recommending an increase in *pamukot*, *pasol*, and *pangnokos* were 3.9 times higher than the alternative recommending an increase in *liba-liba*, *palakaya*, and *baling*. Albeit of lesser significance, a scenario showing an increase in the gear types considered to be "controversial" because of their use of fine mesh netting (i.e. *bungsod*, *lawag* and *bintol*) was also 1.2 times more likely to be favored over the scenario

showing an increase in the harmful fishing gear types. Based on these results, we can say that *liba-liba*, *palakaya*, and *baling* as a level of the fishing gear type attribute is a significant deterrent of choice.

The odds ratios for each variable were further converted into estimated probabilities in order to define more sensibly the degree of influence of these predictor variables. As shown in Table 3-15, our model predicts that all other variables being constant, a scenario is chosen approximately 68 percent of the time if it recommends an increase in fishing effort of the least harmful fishing gear types. On the other hand, a scenario proposing an increase in “controversial” fishing gears is chosen only 39.7 percent of the time.

Table 3-15. Summary of estimated probabilities

Predictor variables	Probabilities
Biological, economic, and social	
<i>Total Annual Catch</i>	0.509
<i>Total Number of Fishers</i>	0.441
<i>Blue Crabs Biomass</i>	0.428
<i>Prey Fish Biomass</i>	0.308
<i>Total Annual Profits</i>	0.203
<i>Predator Fish Biomass</i>	0.202
Fishing gear type	
<i>Panglambay</i>	0.681
<i>Pamukot, pasol, pangnokos</i>	0.676
<i>Bungsod, lawag, bintol</i>	0.397

As for the biological, economic, and social predictor variables, a scenario showing an increase in total annual catch, followed by an increase in total number of fishers, and then an increase in blue crabs biomass have 50.9%, 44.1%, and 42.8% probabilities of being chosen, respectively, over an alternative scenario. The stronger influence of *total annual catch* over *total annual profits* in the respondents’ choice decisions imply that for an average Talibon fisher, profits are of lesser importance than catch. Considering that over 80 percent of the respondents reported average monthly incomes less than 5 thousand pesos, and therefore are living below the poverty line, a hand-to-mouth existence explains the higher priority for the catch, which answers the immediate and basic food needs of the fishers and their families.

Important consideration for *total number of fishers* implies that the respondents do consider employment as an important factor in making their choices, and that they made their decisions within a broader context (i.e. the society) than solely maximizing their individual gains (private utility). This was not made apparent in Choice Experiment 1, where among the three fixed scenarios representing the results of the different objective-maximizing policies, the scenario maximizing the social (i.e. employment) objective was least preferred by the respondents. With the results of the logistic regression for the individual scenario attributes, we may be able to attribute the very low preference for the employment maximizing scenario to the highly destructive types of fishing gears and activities that that particular scenario recommended for increase. The significant deterrence of choice of the harmful fishing gear types as proven in the logistic regression may have remarkably come into play in Choice Experiment 1, and eclipsed the positive influence of the increase in employment, thus causing the social objective maximizing scenario to be least preferred.

Lastly, the stronger influence of *blue crabs biomass* over *predator fish biomass* and *prey fish biomass* validates the importance of this resource to the fisheries of Talibon. This result is consistent with the results from the respondents' profile which showed that overall, nearly half of the respondents depend on fishing gears and activities that exploit the blue crabs resource. Importantly, the blue crabs as a fisheries resource are among the abundant and highly marketable commodities in Danajon Bank. Thus, many fishers are able to take advantage of this resource as a source of income and livelihood, directly satisfying the economic and social objectives of the fisheries in Danajon. Moreover, the fishing gears used specifically to catch blue crabs are generally perceived to have a relatively low negative impact on the marine ecosystem, thus further adding to its positive appeal to the fishers.

Further relating the results of the logistic regression with the results in Choice Experiment 1, we can see that the highly important economic, social, and biological predictor variables (i.e. *annual catch*, *total number of fishers*, and *blue crabs biomass*) all increased in the scenario that maximized the

economic objective (Scenario A). This scenario also recommended for the increase of only two fishing gears perceived by the respondents as “harmful” – the Danish seine (*liba-liba*) and the compressor fishing – and the rest of the fishing gears were the perceived “not harmful” gear types. On the other hand, while the employment maximizing scenario (Scenario B) likewise showed an increase in *annual catch*, *total number of fishers*, and *blue crabs biomass*, it recommended for an increase in the effort of mostly the perceived “harmful” fishing gear types and activities. As for the ecology maximizing scenario (Scenario C), it recommended for a reduction in the effort of all fishing gear types and activities, and at the same time showed significant decreases in the *annual catch*, *total number of fishers*, and *blue crabs biomass*, leaving only the biomasses of fish groups to increase. Thus, for all 3 policy scenarios, Scenario A presented increases in 5 of the 6 predictor variables, including the top 3 important variables as shown in the logistic regression, and most importantly perhaps, the highest increase in overall annual catch, with mostly the “not harmful” fishing gear types recommended for increase in effort. Therefore, the higher preference of the respondents for Scenario A over Scenarios B and C were indeed based on the positive influence of most of the significant elements characterizing the scenario. Correspondingly, the lesser influence of the increase in fish biomasses did not make up for the decrease in the more important elements of *annual catch*, *total number of fishers*, and *blue crabs biomass*, and explains the lower preference for Scenario C. Finally, the highly negative influence of the increase in perceived harmful fishing gear types and activities was evidently more significant than any other element, thus explaining the least preference for Scenario B despite it showing increases in the other economic and social variables.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

On the search for alternative fisheries strategies

The Policy Search Routine function in the Ecopath with Ecosim (EwE) software proved to be a powerful tool in simulating alternative fisheries management strategies in pursuit of defined economic, social, and ecological objectives. Maximization of the objectives produced extreme or “no compromise” scenarios that revealed which economic, social, biological and overall ecological reference parameters are likely to increase or decrease under each policy. The simulations demonstrated that simple realignment of individual units of fishing effort can bring about significant changes in the fisheries system. These results are key to further highlighting fisheries as an integral part of the ecosystem, and that the varying levels of exploitation of multiple species groups affect not only the biological community structure, but also the socio-economic conditions of the fishers who are dependent on them. Needless to say, fisheries management should be undertaken within an ecosystem-based framework taking into account the interplay of socio-economic and ecological components of the ecosystem. Although the simulations represented extreme cases, they nonetheless can serve as basis for discussion among the managers and stakeholders of a fisheries system to outline a policy that is representative of a more realistic and acceptable compromise of management objectives in order to make optimal use of fisheries resources in a responsible and sustainable manner.

The simulated policy scenarios provided empirical bases for the creation of alternative scenarios in the choice experiment. Unlike the conventional FGD method of determining choice attributes and levels, the reference parameters selected from the simulations adequately provided for choice attributes that were more representative of the objectives being maximized.

On the key socio-economic characteristics of the respondents that influence their choice decisions

Talibon fishers who have attended fisheries- or CRM-related trainings/seminars tend not to support a policy that maximizes the economic objective. However, fishers whose fishing gears or activities lean more towards the “harmful” type, and whose catch rates are relatively low, tend to support such a policy scenario. Further, fishers who are likely to support the economic policy scenario tend to have a low priority for protecting the marine ecosystem and the resources therein.

Married fishers and fishers who are members of fisherfolk organizations tend to be highly averse to a policy that maximizes the social objective. However, fishers with the highest income levels tend to significantly favor this type of policy.

Fishers belonging to the lower income-level groups tend not to support a policy that maximizes the ecological objective. If their current fishing gear types are more ecosystem-friendly, however, they have a higher likelihood of supporting this policy. This behavior also appears to be consistent with their stated priority fisheries management objective, which is the protection of the marine ecosystem and its resources.

On the key attributes characterizing the fisheries management scenarios that significantly influence the respondents’ choice decisions

Overall, the economic objective appears to be the strongest motivation of Talibon fishers in making their decisions. However, immediate catch, and not profits, was shown to be the more significant variable. The fishers are evidently willing to trade-off long term economic gains to satisfy the more pressing needs of day-to-day survival. Correspondingly, fisheries policies that promote the increase of fisheries harvests have a high probability of gaining fishers’ support, even if this means reduction in overall profits and lowered fish biomasses in the marine ecosystem. Further, policies that are predicted

to result in the increase of employment have high probabilities of being supported by the fishers on the condition that harmful fishing gear types are eliminated. Furthermore, policies that favor the blue crabs resource and the blue crabs fishing industry have significantly high probabilities of being supported, reflecting the current importance of the blue crabs fisheries in Danajon.

Finally, Talibon fishers are conscious of the ecosystem effects of their fishing gears and activities, and this awareness significantly influences their choice decisions. Fisheries policies that promote the use of fishing gears perceived as least harmful to the marine ecosystem, such as crab fishing gears, handlines, longlines and trolls, gillnets, and jigs have a high likelihood of gaining support from the fishers. On the other hand, policies that promote the increase of “controversial” and especially the harmful fishing gears are more likely to be rejected.

On the practicable and effective management strategy for the Danajon Bank fisheries

Therefore, if the municipality of Talibon intends to pursue any particular fisheries management strategy, this study recommends that the components of that strategy must promote the improvement of fisheries catches, secure fisheries employment, eliminate harmful fishing gears, and ensure the sustainability of the blue crabs resource to gain majority support from the stakeholders. Apparently, fisheries- and CRM-related trainings/seminars, as well as support to building and strengthening fisherfolk organizations, remain as wise investments for the municipality as these were shown to develop among the fishers a more holistic and more ecosystem-based perspective of their fisheries and marine resources. While the fishers generally appreciate the benefits of establishing protected areas and regulating fishing effort through various control mechanisms, compliance wanes due to the partial and perceived poor enforcement of fisheries laws and regulations. Improvements in the conduct of fisheries law enforcement, therefore, are likewise necessary. The results of an effective fisheries law enforcement will provide the fishers a

sense of community resource ownership and the security that they themselves will reap the benefits of the judicious and sustainable exploitation of their fisheries resources. Thus, this will further increase their compliance to fisheries laws and policies. Critical segments of the population are the low income groups who comprise majority of the fishers in Talibon. Motivations for their choice decisions are essentially the immediate and basic needs for their daily survival. This causes them to willingly trade-off future profits and improvements in the resource base, which ironically they are highly dependent upon.

Moreover, the local fisheries managers together with representatives from the different fisher groups, non-government organizations and similar entities assisting the Danajon coastal municipalities in the conduct of fisheries management, can utilize the Policy Search Routine in say, scenario planning exercises, as a practical tool to explore a range of other possible strategies to optimize the fisheries resources in Danajon Bank. In this way, the participants representing the different sectors can immediately predict, based on empirical evidence, the likely outcomes of specific gear and effort controls and other fisheries strategies, thus reducing uncertainty and likely conflicts that arise from misconceptions. However, the study still strongly states caution in the use of the Policy Search Routine and other predictive models, especially in the absence of updated on-site biological and socio-economic data. This stresses the importance of regular and timely fisheries monitoring surveys to adequately provide the necessary information to represent realistically the different elements that characterize the fisheries and fisheries management of Danajon Bank.

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APPENDIX A. FISHING GEARS AND ACTIVITIES IN THE DANAJON BANK

Inventory of fishing gears and activities in the four coastal municipalities included in the 2006 Danajon Ecopath model

Fishing gears and activities		Municipality				Grand Total
Major classification	Variations	Talibon	Bien Unido	Ubay	CPG	
Barrier Nets and Traps	Barrier net	3	8	5		16
	Filter net	13	24			37
	Fish corral	141	48	16	10	215
	Miracle hole	1				1
Beach seine	Beach seine	4	7	4		15
Blast fishing	Dynamite	18	7	8		33
Compressor fishing	Spear w/compressor	117		32	1	150
Crab fishing gears	Crab gillnet	271	146	100	189	706
	Crab liftnet	117	26	66	38	247
	Crab pot	100	12	23	10	145
Danish seine	Danish seine	2	85			87
Diving	Diving for crabs/shells/sea cucumbers	106	5	29		140
Fish aggregation using light	Round-haul seine	5				5
	Stationary liftnet	7		16		23
Gleaning	Gleaning	163			8	171
Handlines, longlines & trols	Bottom-set longline	30	48	117	268	463
	Hook and line w/float	54	7	44	104	209
	Multiple handline	39	27	170	467	703
	Simple hook & line	484	301	523	611	1919
	Surface-set longline (Hemiramphus)		2			2
Jigs	Troll for hemiramphus/belonids	19	14	7	267	307
	Fish jig	17				17
	Octopus jig	4				4
	Squid jig	114	7			121
	Squid jig (troll)	199	148	340	459	1146
Pots	Eel Pot	3		1		4
	Fish pot	224	40	32	21	317
	Shrimp pot	20		11		31
	Squid pot			22		22
Pushnets	Scissor nets / Pushnets	1	16			17
Scoopnets	Scoopnets	89	11			100
Set gillnets and trammel nets	Barrier gillnet	2		7		9
	Bottom-set gillnet	129	60	82	147	418
	Set gillnet w/ plunger	32	83	60		175
	Trammel net	74	5	10		89

Inventory of fishing gears and activities in the four coastal municipalities included in the 2006
Danajon Ecopath model

Fishing gears and activities		Municipality				Grand Total
Major classification	Variations	Talibon	Bien Unido	Ubay	CPG	
Simple spears & harpoons	Handspear, spear gun, harpoon	135	96	53	39	323
Surface gillnets	Drift gillnet	52	100	67	208	427
	Drive-in gillnet	29	66	5	2	102
	Encircling gillnet	2	5		2	9
	Squid gillnet	45	3	1	5	54
Trawl	Trawl	7	24	3		34
Grand Total		2872	1431	1854	2856	9013

APPENDIX B. DANAJON BANK 2006 ECOPATH MODEL SUMMARY

Input and estimated parameters of the living groups in the
2006 Danajon Ecopath model

Group name	Trophic level	Biomass (t/km ²)	PB (/year)	QB (/year)
1 Belonids	4.30	0.26	3.13	7.36
2 Carangids, reef-associated, carnivorous	3.73	0.19	4.22	8.52
3 Clupeids	3.21	1.50	4.06	15.42
4 Engraulids	3.23	2.85	5.46	19.72
5 Halfbeaks	3.15	0.05	4.02	16.61
6 Pelagic fish, carnivores 1	4.45	0.19	2.01	8.00
7 Pelagic fish, carnivores 1 (Juv.)	3.95	0.03	1.69	24.09
8 Pelagic fish, carnivores 2	4.18	0.02	3.70	8.90
9 Pelagic fish, planktivorous, intermediate	3.18	0.10	7.00	17.22
10 Pelagic fish, planktivorous, small	3.18	0.56	6.24	21.04
11 Reef fish, carnivorous 1	3.63	0.03	1.97	6.88
12 Reef fish, carnivorous 2	3.71	0.10	3.30	7.52
13 Reef fish, carnivorous 3	4.60	0.29	2.56	7.64
14 Reef fish, carnivorous 4	3.42	0.12	3.14	13.61
15 Reef fish, grazers/herbivore	2.00	0.16	4.28	28.61
16 Reef fish, omnivore	2.66	0.06	3.55	17.32
17 Reef fish, planktivorous	3.16	0.03	3.55	13.05
18 Reef fish, zoobenthos feeder, Intermediate	3.52	0.20	2.85	8.99
19 Reef fish, zoobenthos feeder, small	3.40	0.06	4.85	13.16
20 Sharks	4.29	0.09	0.60	7.08
21 Skates and rays	3.44	0.35	0.62	5.76
22 Soft-bottom fish, grazers/herbivore, Intermediate	2.22	0.02	3.65	17.75
23 Soft-bottom fish, grazers/herbivore, Small	2.03	0.09	4.41	35.90
24 Soft-bottom fish, piscivorous	4.07	0.07	3.96	10.22
25 Soft-bottom fish, zoobenthos feeder, Intermediate	3.55	0.15	5.50	11.85
26 Soft-bottom fish, zoobenthos feeder, Small	3.14	0.85	6.01	14.24
27 Octopus	3.36	0.16	2.08	7.30
28 Squids/Cuttlefish	3.75	2.84	3.10	16.64
29 Molluscs	2.14	18.03	2.80	11.73
30 Other crabs	2.37	0.79	4.17	14.00
31 Other benthic crustaceans	2.52	8.58	2.65	33.40
32 Portunid crabs	2.94	0.44	5.06	14.00
33 Shrimps/Prawns	2.40	1.68	6.30	28.94
34 Echinoderms	2.52	13.26	2.05	4.95
35 Worms	2.55	7.99	5.20	24.00
36 Hard/Soft Corals	2.71	61.00	1.09	9.00
37 Sponges/Tunicates	2.24	18.43	1.70	4.02
38 Jellyfish	3.26	0.96	5.01	25.05
39 Zooplankton	2.18	46.20	40.00	133.33
40 Benthic Autotrophs	1.00	76.63	13.25	-
41 Phytoplankton	1.00	25.00	231.00	-

Estimated catch (t/km²/yr) and aggregate trophic level of the catch of fishing gear operations grouped by fleet classifications used in the 2006 Danajon Ecopath model.

EcoFleet Classification	Annual landings	Trophic level of the Catch
Barrier nets and traps	0.22	3.13
Beach seine	0.01	2.60
Blast fishing	0.05	3.01
Crab gears	0.54	2.94
Danish seine	1.01	3.59
Fish aggregation using light	0.20	3.38
Handlines, longlines and trolls	2.18	3.58
Jigs	0.24	3.75
Otter trawl	0.02	2.40
Pots	0.79	3.25
Scoopnets and scissornets	0.29	3.14
Set gillnets and trammelnets	1.16	3.17
Simple spears and harpoons	0.08	2.60
Compressor fishing	0.54	2.99
Surface gillnets	1.22	3.45
Total catch	8.56	3.36

APPENDIX C. RANGE OF FISH PRICES USED AS INPUT INTO THE POLICY SEARCH SIMULATIONS, COLLECTED VIA KEY INFORMANTS INTERVIEWS

Price list of fish and invertebrate groups in the 2006 Danajon Ecopath Model
(price reflect landing price, Php per kilo)

ECOPATH MODEL GROUP	Average*	Min	Max
Belonids	58.75	30	90
Carangids, reef-associated, carnivorous	61.25	30	90
Clupeids	35.56	30	50
Engraulids	30.00	30	30
Halfbeaks	70.00	70	70
Molluscs	45.00	45	45
Octopus	60.00	60	60
Other benthic crustaceans	35.00	35	35
Other crabs	20.00	20	20
Pelagic fish, carnivores 1	67.31	50	110
Pelagic fish, carnivores 1 (Juv.)	30.00	30	30
Pelagic fish, carnivores 2	41.84	25	80
Pelagic fish, planktivorous, intermediate	54.68	35	70
Pelagic fish, planktivorous, small	20.00	5	30
Portunid crabs	63.64	20	90
Reef fish, carnivorous 1	60.67	50	70
Reef fish, carnivorous 2	85.45	30	150
Reef fish, carnivorous 3	56.67	50	80
Reef fish, carnivorous 4	35.24	15	70
Reef fish, grazers/herbivore	77.62	50	100
Reef fish, omnivore	30.25	15	70
Reef fish, planktivorous	57.50	10	90
Reef fish, zoobenthos feeder, Intermediate	38.94	15	70
Reef fish, zoobenthos feeder, small	29.12	15	50
Sharks	72.50	50	80
Shrimps/Prawns	100.00	60	120
Skates and rays	50.83	30	80
Soft-bottom fish, grazers/herbivore, Intermediate	42.86	30	60
Soft-bottom fish, grazers/herbivore, Small	59.12	15	65
Soft-bottom fish, piscivorous	40.83	20	60
Soft-bottom fish, zoobenthos feeder, Intermediate	46.23	15	60
Soft-bottom fish, zoobenthos feeder, Small	33.11	15	50
Squids/Cuttlefish	101.82	80	130
Total	49.66	5	150

*weighted according to length-frequency composition of catch

APPENDIX D. ESTIMATED FIXED AND VARIABLE COSTS INCURRED BY FISHING OPERATIONS IN DANAJON AS INPUT INTO THE POLICY SEARCH SIMULATIONS, COLLECTED VIA KEY INFORMANTS INTERVIEWS

Estimated Fixed Costs of Ecopath Fleets

Ecopath Fleet Name	Gear Variation	No. units	DaysOperation		Fixed costs				
			Ave.Days Operat/yr	WtdAve. Days Oper/yr	Gear+ Access. +Labor	Boat + Motor	Others	Annual Fixed costs/Unit	Total Annual Fixed costs
Barrier nets and traps	Barrier net	16	159		20,000.00	24,000.00	2,200.00	46,200.00	739,200.00
	Filter net	37	115		12,000.00	2,500.00	725.00	15,225.00	563,325.00
	Fish corral	215	221		25,000.00	2,500.00	1,375.00	28,875.00	6,208,125.00
	Miracle hole	1	25		1,500.00	2,500.00	200.00	4,200.00	4,200.00
		269		202					7,514,850.00
Beach seine	Beach seine	15	137		5,000.00	2,500.00	375.00	7,875.00	118,125.00
		15		137					118,125.00
Blast fishing	Dynamite	33	57			24,000.00	1,200.00	25,200.00	831,600.00
		33		57					831,600.00
Crab gears	Crab gillnet	706	239		9,000.00	24,000.00	1,650.00	34,650.00	24,462,900.00
	Crab liftnet	247	208		3,000.00	2,500.00	275.00	5,775.00	1,426,425.00
	Crab pot	145	224		1,062.00	3,000.00	203.10	4,265.10	618,439.50
	Diving for crabs	140	192		3,500.00	2,500.00	300.00	6,300.00	882,000.00
		1238		226					27,389,764.50
Danish seine	Danish seine	87	180		12,000.00	80,000.00	4,600.00	96,600.00	8,404,200.00
		87		180					8,404,200.00
Fish aggregation using light	Round-haul seine	5	240		210,000.00	300,000.00	25,500.00	535,500.00	2,677,500.00
	Stationary liftnet	23	232		50,000.00	24,000.00	3,700.00	77,700.00	1,787,100.00
		28		233					4,464,600.00
Handlines, longlines and trolls	Bottomset longline	463	213		800.00	2,500.00	165.00	3,465.00	1,604,295.00
	Hook and line (simple)	1919	237		60.00	2,500.00	128.00	2,688.00	5,158,272.00
	Hook and line w/float	209	173		300.00	24,000.00	1,215.00	25,515.00	5,332,635.00
	Multiple handline	703	205		300.00	2,500.00	140.00	2,940.00	2,066,820.00
	Surface-set longline (Hemiramphus)	2	216		300.00	2,500.00	140.00	2,940.00	5,880.00
	Troll (for hemiramphus)	307	122		100.00	2,500.00	130.00	2,730.00	838,110.00
		3603		214					15,006,012.00

Estimated Fixed Costs of Ecopath Fleets

Ecopath Fleet Name	Gear Variation	No. units	Days Operation		Fixed costs				
			Ave. Days Operat/yr	Wtd Ave. Days Oper/yr	Gear+ Access. +Labor	Boat + Motor	Others	Annual Fixed costs/Unit	Total Annual Fixed costs
Jigs	Octopus jig	4	50		100.00	2,500.00	130.00	2,730.00	10,920.00
	Squid jig	121	90		250.00	2,500.00	137.50	2,887.50	349,387.50
	Squid jig (troll)	1146	137		250.00	4,780.00	251.50	5,281.50	6,052,599.00
		1271		132					6,412,906.50
Otter trawl	Otter trawl	34	120		15,000.00	50,000.00	3,250.00	68,250.00	2,320,500.00
		34		120					2,320,500.00
Pots	Eel Pot	4	196		800.00			800.00	3,200.00
	Fish pot	317	150		2,700.00	49,000.00	2,585.00	54,285.00	17,208,345.00
	Squid pot	22	167		2,000.00	49,000.00	2,550.00	53,550.00	1,178,100.00
		343		152					18,389,645.00
Scoopnets & Scissornets	Scoopnets	117	165		3,500.00		175.00	3,675.00	429,975.00
		117		165					429,975.00
Set gillnets & trammel nets	Bottomset gillnet	418	223		35,000.00	49,000.00	4,200.00	88,200.00	36,867,600.00
	Set gillnet (with plunger)	175	248		7,000.00	12,000.00	950.00	19,950.00	3,491,250.00
	Trammel net	89	217		15,000.00	24,000.00	1,950.00	40,950.00	3,644,550.00
		682		228					44,003,400.00
Simple spears and harpoons	Handspear, spear gun, harpoon	323	189		3,500.00	2,500.00	300.00	6,300.00	2,034,900.00
		323		189					2,034,900.00
Spear w/ compressor	Spear w/compressor	150	192		60,000.00	49,000.00	5,450.00	114,450.00	17,167,500.00
		150		192					17,167,500.00
Surface gillnets	Drift gillnet	427	210		30,000.00	55,000.00	4,250.00	89,250.00	38,109,750.00
	Drive-in gillnet	102	215		12,000.00	55,000.00	3,350.00	70,350.00	7,175,700.00
	Encircling gillnet	9	175		12,000.00	55,000.00	3,350.00	70,350.00	633,150.00
	Squid gillnet	54	229		12,000.00	55,000.00	3,350.00	70,350.00	3,798,900.00
		592		212					49,717,500.00

Estimated Variable Costs of Ecopath Fleets

Ecopath Fleet Name	Gear Variation	No. units	Days Operation		Variable Costs					
			Ave. Days Oper./yr	Wtd. Ave. Days Oper/yr	Fuel	"Gas", Light	Food + Other Consum.	Bait	Annual Var Costs/Unit	Total Annual Var Costs
Barrier nets and traps	Barrier net	16	159		80.00		60.00		22,325.33	357,205.33
	Filter net	37	115					0.00	0.00	0.00
	Fish corral	215	221					0.00	0.00	0.00
	Miracle hole	1	25					0.00	0.00	0.00
		269		202						357,205.33
Beach seine	Beach seine	15	137						0.00	0.00
		15		137						0.00
Blast fishing	Dynamite	33	57		200.00		100.00	200.00	28,500.00	940,500.00
		33		57						940,500.00
Crab gears	Crab gillnet	706	239		80.00		30.00		26,284.06	18,556,543.56
	Crab liftnet	247	208				30.00	25.00	11,458.33	2,830,208.33
	Crab pot	145	224				30.00	25.00	12,319.31	1,786,300.31
	Diving for crabs	140	192			39.00	60.00		19,014.88	2,662,082.50
		1238		226						25,835,134.71
Danish seine	Danish seine	87	180		760.00		90.00		153,000.00	13,311,000.00
		87		180						13,311,000.00
Fish aggregation using light	Round-haul seine	5	240						840,000.00	4,200,000.00
	Stationary liftnet	23	232		40.00	240.00	30.00		71,920.00	1,654,160.00
		28		233						5,854,160.00
Handlines, longlines and trolls	Bottomset longline	463	213					40.00	8,533.25	3,950,894.19
	Hook and line (simple)	1919	237					20.00	4,744.12	9,103,963.93
	Hook and line w/float	209	173					20.00	3,461.19	723,388.81
	Multiple handline	703	205					20.00	4,096.77	2,880,027.42
	Surface-set longline (Hemiramphus)	2	216					20.00	4,320.00	8,640.00
	Troll (for hemiramphus)	307	122						0.00	0.00
		3603		214						16,666,914.35
Jigs	Octopus jig	4	50						0.00	0.00
	Squid jig	121	90						0.00	0.00
	Squid jig (troll)	1146	137		32.00	10.00	30.00		9,845.45	11,282,887.11
		1271		132						11,282,887.11
Otter trawl	Otter trawl	34	120		800.00		90.00		106,800.00	3,631,200.00

Estimated Variable Costs of Ecopath Fleets

Ecopath Fleet Name	Gear Variation	No. units	Days Operation		Variable Costs					
			Ave. Days Oper./yr	Wtd. Ave. Days Oper/yr	Fuel	"Gas", Light	Food + Other Consum.	Bait	Annual Var Costs/Unit	Total Annual Var Costs
Pots	Eel Pot	4	196	120				20.00	3,920.00	15,680.00
	Fish pot	317	150		80.00			20.00	14,995.75	4,753,653.86
	Squid pot	22	167		80.00			20.00	16,666.67	366,666.67
		343								5,136,000.53
Scoopnets & Scissornets	Scoopnets	117	165	152		10.00			1,648.10	192,827.14
		117		165						192,827.14
Set gillnets & trammel nets	Bottomset gillnet	418	223	228	120.00	10.00	60.00		42,294.28	17,679,007.41
	Set gillnet (with plunger)	175	248		80.00	5.00			21,046.00	3,683,050.00
	Trammel net	89	217		80.00	10.00	60.00		32,500.00	2,892,500.00
		682								24,254,557.41
Simple spears and harpoons	Handspear, spear gun, harpoon	323	189	189		30.00	30.00		11,316.67	3,655,283.33
		323								3,655,283.33
Spear w/ compressor	Spear w/compressor	150	192	192	80.00		60.00		26,874.17	4,031,125.00
		150								4,031,125.00
Surface gillnets	Drift gillnet	427	210	212					0.00	0.00
	Drive-in gillnet	102	215		400.00	10.00	100.00		109,473.31	11,166,277.76
	Encircling gillnet	9	175						0.00	0.00
	Squid gillnet	54	229						0.00	0.00
		592								11,166,277.76




APPENDIX E. RANDOMLY-PAIRED CHOICE SCENARIOS (LEVELS CODED) TO CREATE THE EIGHT CHOICE GAMES FOR CHOICE EXPERIMENT 2

Attributes	Choice sets															
	1		2		3		4		5		6		7		8	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Predator Fish Biomass	1	0	0	1	0	1	1	0	1	0	0	0	1	1	1	0
Prey Fish Biomass	0	0	1	0	1	1	1	1	1	0	0	1	0	1	0	0
Portunid Crabs Biomass	1	0	1	1	1	0	0	1	0	0	0	1	1	0	1	0
Total Landed Catch	1	1	1	0	0	0	1	0	0	1	0	1	0	1	1	0
Overall Profits	1	1	1	0	0	0	1	1	1	0	0	0	1	0	0	1
Total Fishers (Employed)	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	1
Fleet Types Allowed to Increase	0	3	2	3	1	2	1	3	0	1	0	0	1	3	2	2

**APPENDIX F. THREE-PART QUESTIONNAIRE FOR THE CHOICE
EXPERIMENT SURVEY (IN CEBUANO)**

PART 1




Asa sa ining tulo ka sitwasyon (A, B, C) ang imong napaboran?

ELEMENTO ↓	A	B	C
DAGKONG ISDA 	↓	↓	↑
GAGMAYNG ISDA 	↑	↓	↑
LAMBAY 	↑	↑	↓
TOTAL CATCH	+250%	+100%	-100%
ABOT o KITA SA PANAGAT	+350%	-50%	-150%
EMPLEYO / KADAGHANON SA MANANAGAT	55,000	65,000	1,500
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> •Pagnokos •Liba-liba •Compressor •Pukot lutaw •Pasol •Panglambay •Bungsod 	<ul style="list-style-type: none"> •Palakaya •Pukot lutaw •Liba-liba •Compressor •Tiro •Baling •Lawag ug Bintol 	WALA

Palihug check sa napilian →

PART 2. Card No. 1




Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↑	↓
GAGMAYNG ISDA 	↓	↓
LAMBAY 	↑	↓
KINATIBUK-ANG KUHA (TOTAL CATCH)	↑	↑
ABOT o KITA SA PANAGAT	↑	↑
EMPLEYO / KADAGHANON SA MANANAGAT	↓	↓
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Liba-liba • Palakaya • Baling 	<ul style="list-style-type: none"> • Panglambay (Pukot, Panggal, Sapyaw)

Pali hug check sa napilian →

PART 2. Card No. 2




Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↓	↑
GAGMAYNG ISDA 	↑	↓
LAMBAY 	↑	↑
KINATIBUK-ANG KUHA (TOTAL CATCH)	↑	↓
ABOT o KITA SA PANAGAT	↑	↓
EMPLEYO / KADAGHANON SA MANANAGAT	↓	↓
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Bungsod • Lawag • Bintol (New Look) 	<ul style="list-style-type: none"> • Panglambay (Pukot, Panggal, Sapyaw)

Pali hug check sa napilian →

PART 2. Card No. 3




Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↓	↑
GAGMAYNG ISDA 	↑	↑
LAMBAY 	↑	↓
KINATIBUK-ANG KUHA (TOTAL CATCH)	↓	↓
ABOT o KITA SA PANAGAT	↓	↓
EMPLEYO / KADAGHANON SA MANANAGAT	↓	↓
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Pamukot • Pamasol • Pangnokos 	<ul style="list-style-type: none"> • Bungsod • Lawag • Bintol (New Look)

Pali hug check sa napilian →

PART 2. Card No. 4


Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↑	↓
GAGMAYNG ISDA 	↑	↑
LAMBAY 	↓	↑
KINATIBUK-ANG KUHA (TOTAL CATCH)	↑	↓
ABOT o KITA SA PANAGAT	↑	↑
EMPLEYO / KADAGHANON SA MANANAGAT	↓	↑
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Pamukot • Pamasol • Pangnokos 	<ul style="list-style-type: none"> • Panglambay (Pukot, Panggal, Sapyaw)

Pali hug check sa napilian →

PART 2. Card No. 5



Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↑	↓
GAGMAYNG ISDA 	↑	↓
LAMBAY 	↓	↓
KINATIBUK-ANG KUHA (TOTAL CATCH)	↓	↑
ABOT o KITA SA PANAGAT	↑	↓
EMPLEYO / KADAGHANON SA MANANAGAT	↑	↑
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Liba-liba • Palakaya • Baling 	<ul style="list-style-type: none"> • Pamukot • Pamasol • Pangnokos

Pali hug check sa napilian →

PART 2. Card No. 6




Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↓	↓
GAGMAYNG ISDA 	↓	↑
LAMBAY 	↓	↑
KINATIBUK-ANG KUHA (TOTAL CATCH)	↓	↑
ABOT o KITA SA PANAGAT	↓	↓
EMPLEYO / KADAGHANON SA MANANAGAT	↓	↑
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Liba-liba • Palakaya • Baling 	<ul style="list-style-type: none"> • Liba-liba • Palakaya • Baling

Pali hug check sa napilian →

PART 2. Card No. 7




Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↑	↑
GAGMAYNG ISDA 	↓	↑
LAMBAY 	↑	↓
KINATIBUK-ANG KUHA (TOTAL CATCH)	↓	↑
ABOT o KITA SA PANAGAT	↑	↓
EMPLEYO / KADAGHANON SA MANANAGAT	↑	↑
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Pamukot • Pamasol • Pangnokos 	<ul style="list-style-type: none"> • Panglambay (Pukot, Panggal, Sapyaw)

Pali hug check sa napilian →

PART 2. Card No. 8

Asa sa ining duha ka sitwasyon (A o B) ang imong napaboran?

MGA ELEMENTO	A	B
DAGKONG ISDA 	↑	↓
GAGMAYNG ISDA 	↓	↓
LAMBAY 	↑	↓
KINATIBUK-ANG KUHA (TOTAL CATCH)	↑	↓
ABOT o KITA SA PANAGAT	↓	↑
EMPLEYO / KADAGHANON SA MANANAGAT	↑	↑
KLASE SA PANAGAT NGA PWEDE PADAGHANON	<ul style="list-style-type: none"> • Bungsod • Lawag • Bintol (New Look) 	<ul style="list-style-type: none"> • Bungsod • Lawag • Bintol (New Look)

Pali hug check sa napilian →

Part 3

Respondent No.: _____	DATE: _____	BARANGAY: _____
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Palihug tubag sa matinud-anon.

PERSONAL

1) NA REGISTRO BILANG MANANAGAT? <input type="checkbox"/> Oo <input type="checkbox"/> Wala		2) PILA NA KA TUIG NANAGAT? _____	3) PANUIGON o IDAD? _____
4) GENDER <input type="checkbox"/> Lalaki <input type="checkbox"/> Babaye	5) CIVIL STATUS <input type="checkbox"/> Single <input type="checkbox"/> Widowed/ Widower <input type="checkbox"/> Married <input type="checkbox"/> _____	6) PILA KABUOK ANAK? _____	7) PILA KA MAMUMUJO SA PANIMALAY? _____
8) GRADO o LEVEL SA PANG-ESKWELA? <input type="checkbox"/> Wala kaeskwela <input type="checkbox"/> Elementary <input type="checkbox"/> High School <input type="checkbox"/> College <input type="checkbox"/> Masteral/Post-graduate			

SOCIO-ECONOMIC

1) ABOT o KITA SULOD SA USA KA BUWAN <input type="checkbox"/> Ubos sa P1,000 <input type="checkbox"/> P5,001 to P10,000 <input type="checkbox"/> P20,001 to P50,000 <input type="checkbox"/> sobra sa P100,000 <input type="checkbox"/> P1,000 – P5,000 <input type="checkbox"/> P10,001 to P20,000 <input type="checkbox"/> P50,001 to P100,000			
2) DUNAY PANGITA GAWAS SA PANAGAT o PANGISDA? <input type="checkbox"/> Oo. <i>palihug sulat unsa kini</i> 1) _____ 2) _____ <input type="checkbox"/> Wala			

SOCIO-CIVIC

1) ORGANISASYON NGA NASAKUPAN	POSISYON
2) MGA NATAMBONGANG TRAINING o SEMINAR	

KABAHIN SA PANGISDA o PANAGAT

1) ADUNAY KAUGALINGONG SAKAYANG PANDAGAT? <input type="checkbox"/> Oo <input type="checkbox"/> Wala	2) KLASSE SA SAKAYAN <input type="checkbox"/> Bugsay/Baroto <input type="checkbox"/> De-motor/De-makina
--	---

Para sa imong prinsipal na panagat:

3) ORAS SA PANAGAT _____ <i>hasta</i> _____	4) KASAGARANG GIDAGHANON NGA MAKUHA <input type="checkbox"/> ubos sa 1 kilo <input type="checkbox"/> 1-5 kilo <input type="checkbox"/> 5-10 kilo <input type="checkbox"/> 10-20 kilo <input type="checkbox"/> 20-50 kg <input type="checkbox"/> 50-100 kilo <input type="checkbox"/> sobra sa 100 kilo
---	---

Sunod/padayon →

(...padayon) **KABAHIN SA PANGISDA o PANAGAT**

5) LUGAR PANAGATAN			
<input type="checkbox"/> Sulod lamang sa kadagatan sa Talibon		<input type="checkbox"/> Usahay gawas sa kadagatan sa Talibon	
		<input type="checkbox"/> Gawas sa kadagatan sa Talibon	
6) KLASA SA PANAGAT (<i>palihug check as tanan nga klase nga panagat gigamit, butangi ug guhit ang prinsipal na panagat gigamit</i>)			
BARRIER NETS AND TRAPS		CRAB FISHING GEARS	
<input type="checkbox"/> Sanggab		<input type="checkbox"/> Pukot panglambay	
<input type="checkbox"/> Bungsoy pahubas		<input type="checkbox"/> Panggal panglambay	
<input type="checkbox"/> Paugmad/Tower		<input type="checkbox"/> Sapyaw panglambay	
<input type="checkbox"/> Amatong o "Miracle Hole"		<input type="checkbox"/> Panawm ug lambay	
<input type="checkbox"/> Lukob		<input type="checkbox"/> Uban pa _____	
POTS		JIGS	
<input type="checkbox"/> Bubo sa isda		<input type="checkbox"/> Undak sa nokos	
<input type="checkbox"/> Bubo sa nokos		<input type="checkbox"/> Uwang-uwang/Ullang-ullang	
<input type="checkbox"/> Bantak		<input type="checkbox"/> Subid sa kugita	
<input type="checkbox"/> Uban pa _____		<input type="checkbox"/> Uban pa _____	
SET GILLNETS & TRAMMEL NETS		HANDLINES, LONGLINES & TROLLS	
<input type="checkbox"/> Pukot palunod/pataan		<input type="checkbox"/> Pasol/bira-bira/labyog	
<input type="checkbox"/> Panayming		<input type="checkbox"/> Kitang/palangre	
<input type="checkbox"/> Pukot panglabayan		<input type="checkbox"/> Undak/cha-cha	
<input type="checkbox"/> Pukot dumbol		<input type="checkbox"/> Pasol pangmangsi	
<input type="checkbox"/> Pukot Triple		<input type="checkbox"/> Palagdas, panagpo	
<input type="checkbox"/> Uban pa _____		<input type="checkbox"/> Subid sa bawo	
		<input type="checkbox"/> Kitang pangsasa	
		<input type="checkbox"/> Uban pa _____	
SURFACE GILLNETS		FISH AGGREGATION WITH LIGHT	
<input type="checkbox"/> Ariba-ariba/Pamanban/Pambawo/Pangsasa		<input type="checkbox"/> Lawag	
<input type="checkbox"/> Pukot lutaw/paanod		<input type="checkbox"/> Bintol/New Look	
<input type="checkbox"/> Pukot pangmangsi		<input type="checkbox"/> Uban pa _____	
<input type="checkbox"/> Pukot likos/Paninsin			
<input type="checkbox"/> Yab-yab		SPEAR FISHING	
<input type="checkbox"/> Pukot pangnokos		<input type="checkbox"/> Pamana (mano-mano, pinusil, salapang)	
<input type="checkbox"/> Uban pa _____		<input type="checkbox"/> Pana-Compressor/Boso	
<input type="checkbox"/> Paniro	<input type="checkbox"/> Panubli	<input type="checkbox"/> Panawm ug bat	<input type="checkbox"/> Sikpaw/Panulo
<input type="checkbox"/> Pangguso	<input type="checkbox"/> Panginhas	<input type="checkbox"/> Uban pa _____	

Sunod/padayon →

Unsay imong opinyon, pagbati, o panan-aw sa ining mga aspeto sa pagdumala sa panagatan?

1) <i>Ang Marine Protected Area (MPA) ug mga Fish Sanctuary makahatag ug dakong benepisyo sa mga mananagat.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
2) <i>Mas maayong hagbason o hawanon ang mga mangroves para mas molapad ang mahimong mapanagatan.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
3) <i>Pabug-at lamang sa mga mananagat ang pagparehistro ug paglukat ug lisensya sa pangisda.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
4) <i>Mas maayong magkapareho ang mga balaod, regulasyon, bayranan, ug uban pang polisiya sa panagat o pangisda ang mga lungsod nga nasakop sa ecosystema sa Danajon.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
5) <i>Angay nga ang kadagatan sakop sa lungsod sa Talibon para lamang sa mga mananagat sa Talibon.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
6) <i>Walay kasiguraduhan nga ang bidhang lambay nga akong ibalik o i-uli sa dagat mosanay kay kuhaon raman gihapon ni sa ubang mananagat.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
7) <i>Ang mga naila nga 'passive fishing gears' sama sa pasol, pukot, bubo, ug bungsod dili maka resulta sa 'overfishing'.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>
8) <i>Sa pagkakaran, dili na makasarang ang atong kadagatan tungod sa kadaghan sa mga mananagat ug sa nagkalain-laing klase sa panagatan.</i>				
Panghingusganong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingusganong naka-uyon <input type="checkbox"/>

Sunod/padayon →

9) <i>Maski unsaon pa, dili gyud hurot nga masanta ang mga ilegal na klase sa panagat.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
10) <i>Mahimong pulihan sa turismo ang pangisda isip prinsipal nga pangita o panginabuhian sa mga mamulupyo sa Talibon ug katibuk-ang Danajon Bank.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
11) <i>Kinahanglan na gyud nga ma control ang kadaghanon sa mananagat sa Talibon ug katibuk-ang Danajon Bank.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
12) <i>Dili magdugay, mahurot-hurot gyud ang isda sa Danajon Bank.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
13) <i>Walay epekto sa ubang klase sa isda sa dagat kung mahurot o mawala na ang mga butete.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
14) <i>Angay nga mahatagan ug higayon nga makayagyag sa ilang mga itlog ug similya ang mga danggit pamaagi sa usa ka 'close-season' o dili pagpanagat sa kalusayan kada ika-upat, ika-lima ug ika-unom nga subang sa kada buwan.</i>				
Panghingu sg anong wala maka-uyon <input type="checkbox"/>	Wala maka-uyon <input type="checkbox"/>	Walay opinyon o pagbati <input type="checkbox"/>	Naka-uyon <input type="checkbox"/>	Panghingu sg anong naka-uyon <input type="checkbox"/>
15) <i>Kinahanglan nga ang pangunahong katuyuan sa pagdumala sa pangisda o panagatan kay ang:</i>				
<i>pagpalambo o pagpadaghan sa kinatibuk-ang kuha ug kita/ginansya sa mga mananagat</i> <input type="checkbox"/>		<i>seguridad sa trabaho o empleyo para sa kadaghanan</i> <input type="checkbox"/>		<i>pag-amping sa kadagatan ug sa nagkalain-laing matang sa isda ug mananap sulod niini</i> <input type="checkbox"/>

Sunod/padayon →

Palihug tubag sa matitud-anon. Walay sakto o sayop nga tubag ini.

<i>Sa imo lamang panan-aw, makadaot ba sa kinaiya ug ecosystema sa dagat ang paggamit ining mga klase sa panagat?</i>	MAKADAOT	DILI MAKADAOT
1) 3-Net / Triple Net	<input type="checkbox"/>	<input type="checkbox"/>
2) Ariba-ariba/Pangbawo	<input type="checkbox"/>	<input type="checkbox"/>
3) Baling	<input type="checkbox"/>	<input type="checkbox"/>
4) Bintol (New Look)	<input type="checkbox"/>	<input type="checkbox"/>
5) Bungsod	<input type="checkbox"/>	<input type="checkbox"/>
6) Compressor	<input type="checkbox"/>	<input type="checkbox"/>
7) Dumbol	<input type="checkbox"/>	<input type="checkbox"/>
8) Kitang	<input type="checkbox"/>	<input type="checkbox"/>
9) Lawag	<input type="checkbox"/>	<input type="checkbox"/>
10) Liba-liba	<input type="checkbox"/>	<input type="checkbox"/>
11) Pagtanom ug guso	<input type="checkbox"/>	<input type="checkbox"/>
12) Palakaya	<input type="checkbox"/>	<input type="checkbox"/>
13) Panggal panglambay	<input type="checkbox"/>	<input type="checkbox"/>
14) Pasol, bira-bira	<input type="checkbox"/>	<input type="checkbox"/>
15) Paugmad/Tower	<input type="checkbox"/>	<input type="checkbox"/>
16) Pukot likos	<input type="checkbox"/>	<input type="checkbox"/>
17) Pukot sa lambay	<input type="checkbox"/>	<input type="checkbox"/>
18) Sanggab	<input type="checkbox"/>	<input type="checkbox"/>
19) Sapyaw sa lambay	<input type="checkbox"/>	<input type="checkbox"/>
20) Sudsud	<input type="checkbox"/>	<input type="checkbox"/>

DAGHANG SALAMAT SA IMONG PAGKAMATINUD-ANON, SA PAGGAHIN UG ORAS, UG SA IMONG KOOPERASYON!

APPENDIX G. SAMPLE LETTERS TO RANDOMLY-SELECTED FISHERS TO PARTICIPATE IN THE CHOICE SURVEY (IN VISAYAN)

Dear Sir/Madam,

Maayong adlaw. Ako si Regina Therese M. Bacalso, usa ka estudyante sa Master of Science in Environmental Studies sa University of the Philippines (U.P.), Cebu City. Para sa akong pagahimuong Masteral Thesis, buot nakong mahibaw-an ang nagkalain-laing mga hinuna-hunaan o opinyon sa mga mananagat sa Talibon, Bohol kabahin sa pagdumala sa pangisda o panagat sa tibuuk nga Danajon Bank. Usa sa mga kinaiyanhong bahandi nga gahatag ug dakong garbo sa Talibon ug sa iyang mga silingang lungsod ang gibantog nga Danajon Bank *ecosystem*. Maingon usab, ang Danajon Bank gahatag ug dili lamang panginabuhian o serbisyo pang ekonomiya sa mga taga Talibon gumikan sa pangisda, kung dili usab ang uban pang mga serbisyo para sa katilingban ug mga serbisyo pang ekolohiya. Mao nga ang mga katuyuan sa pagdumala sa panagat nasibo sa mga serbisyo nga makuha gikan niini: Pang Ekonomiya, Pang-Katilingban, ug Pang-Ekolohiya. Bisan pa, dili malikayan nga usahay maingon nga adunay mga kasumpakian o komplikto sa mga katuyuan sa pagdumala sa panagat. Pinaagi sa usa ka survey, akong tinguha nga masayran kung sa tulo ka mga katuyuan sa padumala sa panagat/kadagatan, aduna bay usa nga gipalabi ang mga mananagat sa Talibon, ug unsa pud ang mga nagkalain-laing hinungdan niini.

Pinaagi sa pagbunot-bunot o *draw lots*, usa ikaw sa mga napiliang mananagat sa _____, nga akong giimbitahan mosalmot sa akong pagahimuong survey interview sa

Adlaw: _____
Oras: _____
Lugar: _____

Hinaot unta nga dili kamo mapakyas sa pagtambong niini. Ang survey interview kay mahuman sa sulod sa usa ka oras lamang. ***Pagmasaligon usab nga konpidensyal ang mga resulta sa survey, ug walay laing paggamitan sa inyong mga katubagan kung dili para sa akong thesis lamang.***

Sa inyong mga pangutana o dugang klaripikasyon, tawag o text sa numero: 0917-2044428. Magkita-kita ta puhon!

Kanimo matinuuron,

Regina Therese M. Bacalso
MSc Environmental Studies
Natural Sciences and Mathematics Division
U.P. in the Visayas,
Lahug Cebu City

APPENDIX H. INTRODUCTORY LETTERS FOR THE BARANGAY CAPTAINS OF REPRESENTATIVE BARANGAYS

Dear _____,

My name is Regina Therese Bacalso, a student pursuing the degree MSc in Environmental Studies at the University of the Philippines in the Visayas (Cebu Campus). For my thesis, I am carrying out a study on the Talibon fishers' attitudes with regards to fisheries resource management. The fisheries of the Municipality of Talibon occurs within the famous Danajon Bank ecosystem, which not only provides for the economic and social needs of the Danajon fishers, but also supplies biological and ecological services to the inhabitants of Danajon. Hence, my study, which particularly aims to identify fishers' preferences for specific elements pertaining to the different objectives of fisheries resource management, namely, *Biological/Ecological Objectives*, *Economic Objectives*, and *Social Objectives*, will hopefully aid in a more holistic and successful implementation of fisheries laws, projects, and other similar fisheries management undertakings in the area.

Through a random sampling (draw-lots method), Barangay _____ was among the ten coastal and island barangays chosen to represent the fishing communities of Talibon for my thesis survey. Again by draw-lots, _____ number of fishers residing in your barangay were selected randomly to participate in the survey. Attached herewith is a list of their names. I hope that as *Punong Barangay* of _____, you will grant me permission to conduct my survey interview on the following schedules:

Date: _____
Time: _____
Venue: _____

In a scientific study like this, it is important that complete and truthful information will be used. ***Rest assured that the information that shall be generated from the survey will be treated confidentially and will be used for no other purpose than for my thesis alone.***

If you have any questions about the study, please do not hesitate to contact me by telephone 0917-2044428, by email: regina.bacalso@gmail.com, or by written communication.

Respectfully yours,

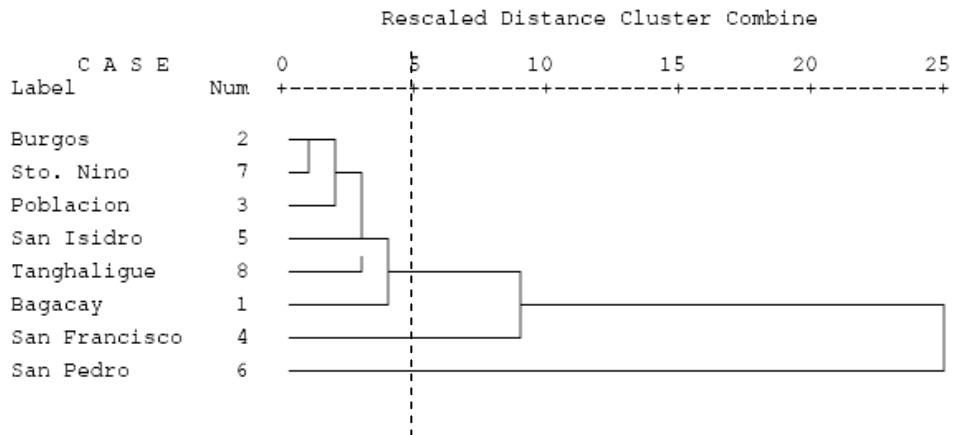
Regina Therese M. Bacalso
MSc Environmental Studies
Natural Sciences and Mathematics Division
University of the Philippines in the Visayas
Lahug, Cebu City

APPENDIX I. SPSS CLUSTER ANALYSIS OUTPUT FOR TALIBON COASTAL BARANGAYS, SIMILARITY OF FISHING GEAR TYPES AND OPERATIONS

Coastal barangays in the Mainland: 3 Clusters

***** H I E R A R C H I C A L C L U S T E R A N A L Y S I S *****

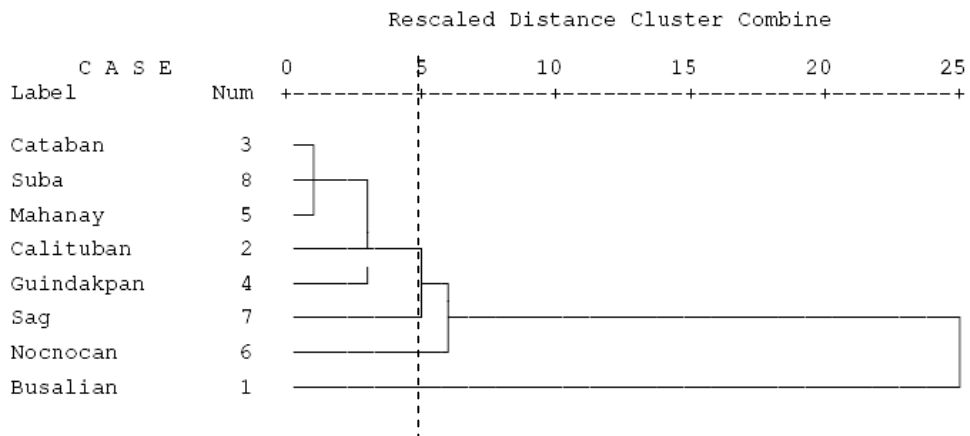
Dendrogram using Average Linkage (Between Groups)



Island barangays: 4 Clusters

***** H I E R A R C H I C A L C L U S T E R A N A L Y S I S *****

Dendrogram using Average Linkage (Between Groups)



APPENDIX J. ALTERNATIVE LOGISTIC REGRESSION MODELS EVALUATING SCENARIO ATTRIBUTES AS DETERMINANTS OF CHOICE

Alternative model 1: All responses considered for analysis

Predictor variables	Coefficient (B)	s.e.	χ^2	p	Exp(B)	95% CI for Exp(B)	
						Lower	Upper
Biological							
<i>Predator Fish Biomass</i>	-0.686	0.054	158.683	<0.001	0.504	0.453	0.561
<i>Prey Fish Biomass</i>	-0.265	0.054	23.837	<0.001	0.768	0.690	0.854
<i>Blue Crabs Biomass</i>	0.175	0.054	10.521	0.0012	1.191	1.072	1.324
Economic							
<i>Total Annual Catch</i>	0.480	0.054	78.369	<0.001	1.616	1.453	1.797
<i>Total Annual Profits</i>	-0.678	0.054	156.477	<0.001	0.508	0.457	0.565
Social							
<i>Total Number of Fishers</i>	0.254	0.054	22.190	<0.001	1.289	1.160	1.432
Fishing gear type							
<i>Pamukot, pasol, pangnokos</i>	1.2383	0.0795	242.5755	<0.001	3.450	2.9521	4.0316
<i>Bungsod, lawag, bintol</i>	0.2101	0.0773	7.3794	0.0066	1.234	1.0603	1.4357
<i>Panglambay</i>	1.3079	0.0771	287.9693	<0.001	3.698	3.1798	4.3013
<i>Liba-liba, palakaya, baling</i>	0	--	--	--	--		
Intercept	-0.3389	0.0835	16.4619	<0.001			
Number of cases included in the analysis							
-2 Log-likelihood (intercept only):	6558						
-2 Log Likelihood:	8908.33						
Model Chi-Square:	8003.10						
Pseudo R ²	905.23	(df=9, p<0.001)					
Overall Success rate:	0.18						
	67.57%						

Summary of estimated probabilities	
Predictor variables	Probabilities
Biological, economic, and social	
<i>Total Annual Catch</i>	0.535
<i>Total Number of Fishers</i>	0.479
<i>Blue Crabs Biomass</i>	0.459
<i>Prey Fish Biomass</i>	0.354
<i>Total Annual Profits</i>	0.266
<i>Predator Fish Biomass</i>	0.264
Fishing gear type	
<i>Panglambay</i>	0.725
<i>Pamukot, pasol, pangnokos</i>	0.711
<i>Bungsod, lawag, bintol</i>	0.468

Alternative model 2: Lexicographic responses rejected

Predictor variables	Coefficient (B)	s.e.	χ^2	p	Exp(B)	95% CI for Exp(B)	
						Lower	Upper
Biological							
<i>Predator Fish Biomass</i>	-0.742	0.057	167.603	<0.001	0.476	0.426	0.533
<i>Prey Fish Biomass</i>	-0.304	0.057	28.498	<0.001	0.738	0.660	0.825
<i>Blue Crabs Biomass</i>	0.207	0.057	13.320	0.000	1.229	1.100	1.374
Economic							
<i>Total Annual Catch</i>	0.529	0.057	86.277	<0.001	1.698	1.518	1.898
<i>Total Annual Profits</i>	-0.732	0.057	165.308	<0.001	0.481	0.430	0.538
Social							
<i>Total Number of Fishers</i>	0.259	0.057	21.045	<0.001	1.296	1.160	1.447
Fishing gear type							
<i>Pamukot, pasol, pangnokos</i>	1.3673	0.0843	263.1883	<0.001	3.925	3.327	4.6294
<i>Bungsod, lawag, bintol</i>	0.2264	0.0813	7.7456	0.005	1.254	1.0693	1.4708
<i>Panglambay</i>	1.3892	0.0809	294.7321	<0.001	4.012	3.4234	4.7013
<i>Liba-liba, palakaya, baling</i>	0	--	--	--	--	--	--
Intercept	-0.3659	0.0873	17.5761	<0.001			
Number of cases included in the analysis	5978						
-2 Log-likelihood (intercept only):	8287.27						
-2 Log Likelihood:	7330.04						
Model Chi-Square:	957.23	(df=9, p<0.001)					
Pseudo R ²	0.20						
Overall Success rate:	68.58%						

Summary of estimated probabilities	
Predictor variables	Probabilities
Biological, economic, and social	
<i>Total Annual Catch</i>	0.541
<i>Total Number of Fishers</i>	0.473
<i>Blue Crabs Biomass</i>	0.460
<i>Prey Fish Biomass</i>	0.339
<i>Total Annual Profits</i>	0.250
<i>Predator Fish Biomass</i>	0.248
Fishing gear type	
<i>Panglambay</i>	0.736
<i>Pamukot, pasol, pangnokos</i>	0.731
<i>Bungsod, lawag, bintol</i>	0.465

Alternative model 4: Lexicographic responses rejected, Game 6 removed

Predictor variables	Coefficient (B)	s.e.	χ^2	p	Exp(B)	95% CI for Exp(B)	
						Lower	Upper
Biological							
<i>Predator Fish Biomass</i>	-0.732	0.070	109.344	<0.001	0.481	0.419	0.552
<i>Prey Fish Biomass</i>	-0.661	0.064	108.556	<0.001	0.516	0.456	0.585
<i>Blue Crabs Biomass</i>	-0.157	0.063	6.164	0.013	0.855	0.756	0.968
Economic							
<i>Total Annual Catch</i>	0.170	0.063	7.335	0.0068	1.186	1.048	1.341
<i>Total Annual Profits</i>	-0.721	0.070	107.198	<0.001	0.486	0.424	0.557
Social							
<i>Total Number of Fishers</i>	-0.109	0.063	2.946	0.0861	0.897	0.792	1.016
Fishing gear type							
<i>Pamukot, pasol, pangnokos</i>	1.3889	0.1198	134.4375	<0.001	4.011	3.1713	5.0718
<i>Bungsod, lawag, bintol</i>	0.2676	0.1239	4.6619	0.031	1.307	1.025	1.6661
<i>Panglambay</i>	1.4351	0.1247	132.4257	<0.001	4.200	3.2894	5.3632
<i>Liba-liba, palakaya, baling</i>							
Intercept	0.323	0.1689	3.6571	0.0558			
Number of cases included in the analysis							
	5274						
-2 Log-likelihood (intercept only):							
	7311.32						
-2 Log Likelihood:							
	6370.78						
Model Chi-Square:							
	940.53	(df=9, p<0.001)					
Pseudo R ²							
	0.22						
Overall Success rate:							
	66.86%						

Summary of estimated probabilities	
Predictor variables	Probabilities
Biological, economic, and social	
<i>Total Annual Catch</i>	0.621
<i>Total Number of Fishers</i>	0.553
<i>Blue Crabs Biomass</i>	0.541
<i>Prey Fish Biomass</i>	0.416
<i>Total Annual Profits</i>	0.402
<i>Predator Fish Biomass</i>	0.399
Fishing gear type	
<i>Panglambay</i>	0.853
<i>Pamukot, pasol, pangnokos</i>	0.847
<i>Bungsod, lawag, bintol</i>	0.644

ACKNOWLEDGEMENTS

This study would not have been realized without the kind and generous cooperation of the people of Talibon, Bohol. First and foremost, I would like to express my sincerest and utmost gratitude to the fishers of Talibon who participated in the study survey. I thank them for their time, their openness, and their sense of humor! I am much indebted to the families who welcomed me into their homes, who provided me with a place to sleep, and who fed me the freshest *lambay* and *kinilaw na bolinao*. On a parallel note, I would also like to thank the staff of Watergate Pension who did not mind opening their doors for me, even at 2 o' clock in the morning.

Many thanks to the Talibon CRM Office staff who provided me with the much needed background data at the onset. Special thanks to the barangay captains and council members of the island and mainland coastal barangays where I conducted my survey for their invaluable assistance. I am much thankful to the former FISH enumerators and now close friends – Vanessa, Adelyn, Nong Saturnino, and Sabino – whose assistance during the surveys allowed me to accomplish much in a day's work. I wish to thank the Orevillo family, most especially Mr. Victor Orevillo, community organizer of the FISH Project in Talibon, Bohol, who helped me get in touch with key persons to interview, facilitated the distribution of the letters of communication, helped me with the surveys on occasion, and practically did most of the initial legwork to make the survey proceed as smoothly as possible. Other FISH Project staff worth acknowledging are Jessie Floren and Rafael Martinez, our GIS specialists, who provided me with the necessary maps and charts. Most importantly, I would like to thank Prof. Nygiel Armada, who for the past six years has been my mentor, advisor, and dependable source of constructive criticism. Much of what I know now I learned from him. To my academic advisors Prof. Florence Evacitas, Prof. Yuleta Orillo, and Dr. Jesus Juario, thank you for the expressed confidence in me and in my independent study. Because you believed, I did. Lastly, to my batch mates in the MSES Program, loopy nights were and always will be a welcome respite from our constant *pursuit of excellence!* So now that all has been said and done, let's get it on...