Evaluating the effectiveness of co-management in Nui Chua National Park Marine Protected Area Ninh Thuan Province, Vietnam

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Master Thesis in Fisheries and Aquaculture
Management and Economics FSK-3911
(30 ECTS)

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May 2012

Abstract

Although Nui Chua National Park MPA is considered as an effective MPA of Vietnam, especially in the involvement of community in management process, an overall assessment of biodiversity, socioeconomic and governance could help managers continue developing the advantages and overcome mistakes. By using relevant indicators, this study stated that abundance of species is somewhat increased, the conservation objective of Nui Chua MPA has been achieved. The livelihood of local communities slightly improved and the tourism provides some alternative livelihoods for households around the MPA. In addition, there is a small reduction in the dependence of fishermen on marine resources due to the rising profits of vessel affected by Nui Chua MPA. Community plays an important role in decision making, monitoring and enforcement in the MPA management. However, the law, policy and responsibilities of stakeholders have been not clear and little support for community's activities. Those results explain for the necessary of the change and improvement of the management in Nui Chua MPA in future to be more successful.

Key words: Nui Chua, MPA, co-management, effectiveness, abundance, occupation, profit, communities.

ACKNOWLEDGEMENTS

First of all I would like to express my deep and sincere gratitude to my supervisors, Professor Clair Armstrong and Doctor Quach Thi Khanh Ngoc for their understanding, patience, supports and guidance. I am sure that without their helps, I cannot complete my work as well as it now;

I am deeply grateful to Mr. Pham Trong Yen – Director of Sustainable Livelihood in and around Marine Protected Areas Component and Associate Professor. Nguyen Thi Kim Anh, who gave me the opportunity to participate in this master program and encouraged me during study period; I would like to thank to Norwegian Fishery College, Tromsø University and Nha Trang University for all the coordination, lectures and other supports that I and my classmates in Noma 4 received during nearly 2 years.

I also wish to thank Mrs. Doan Thi Thanh Ha, Mr. Nguyen Hoang Linh and other colleagues in LMPA component for their encouragement and useful comments for my research ideas.

I wish to express my warm and sincere thanks to Mr. Nguyen Van Xiem, the manager of Environmental Education Office, Nui Chua National Park Management Board and Mr. Pham Vu Diep for providing me important data and reports related to Nui Chua MPA. I also want to thank to Mr. Pham Anh Dung and Mr. Le Tue, the staffs of Nui Chua MPAMB and Ms. Ngoc Tuoi, a student of Faculty of Environmental Science, Ho Chi Minh City University of Science with the great support on collecting data. Many thanks to Ms. Ngoc Suong for sharing her accommodation with me on nearly 3 weeks when I conducted my survey in Nui Chua MPA. Also thanks to other staffs in Nui Chua National Park for their warmly welcome.

I would like to thank to Mrs. Pham Thi Thu Hien – English teacher of Ha Noi University for English revision of my thesis.

Finally, my deepest gratitude for my family, especially my parents, my brother and sister in law, my cousin, and my close friends who always beside me, have been encouraging me and together with me solving all difficulties not only during my master study but also in all our life time.

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ABBREVIATIONS

CPUE	Catch Per Unit of Effort
FAO	Food and Agriculture Organization
GPS	Global Positioning System
GSO	General Statistics Office
IUCN	International Union for Conservation of Nature
LMPA	Sustainable Livelihood in and around Marine Protected Areas
MB	Management Board
MCD	Center for Marine life Conservation and Community Development
MPAs	Marine Protected Areas
NC	Nui Chua
NGOs	Non-Government Organizations
NP	National Park
UNEP	United Nations Environment Programme
USD	United State Dollard
VND	Viet Nam Dong
WB	World Bank
WCPA	World Constitution and Parliament Association
WWF	World Wild Fund

1. INTRODUCTION

The number of newly established Marine Protected Areas (MPAs) is increasing worldwide from 4,435 MPAs in 2008 (MPA New 2008) to 5880 ones in 2010 (Toropova et al. 2010). As a matter of fact, MPAs are not only considered as instruments for natural resource protection but tools of fishery management as well (Protect 2006).). It is proven by the researchers of UNEP that to manage an MPA effectively, the governance approach and framework should be a good combination of different instruments (Jones et al. 2011). Specifically, in MPA management, top-down, bottom-up and market incentives are three approaches that are involved in collaborative management with the participation of all stakeholders from the state to communities (Jones et al. 2011).

In Vietnam, there are six official MPAs: Nha Trang Bay MPA – Khanh Hoa Province (2001), Cu Lao Cham MPA – Quang Nam Province (2003), Nui Chua National Park MPA – Ninh Thuan Province (2003), Phu Quoc MPA – Kien Giang Province (2007), Con Co MPA – Quang Tri Province (2010), Cu Lao Cau MPA – Binh Thuan Province (2010). In the coming time, the number is expected to increase in conjunction with the Planning for Marine protected areas system which was approved on Decision No. 742/QĐ TTg of Vietnamese Ministry on May 26th, 2010. Accordingly, this plan is divided into two phases. First, in the period from 2010 to 2015, 16 MPAs will be founded and start operating; simultaneously, the Plan for running MPAs will be carefully reviewed and adjusted. More data system will be built and policies as well as legal related documents for MPAs will also be supplemented. After that, in the second phase from 2016 to 2020, the government will try to expand the MPAs system; build the detailed plan and operate some new MPAs; monitor aquatic resources, biodiversity and ecosystems; develop co-management model for local communities, domestic and international organizations and individuals to participate in building and managing MPAs with the target of exploiting and using MPAs effectively to protect the marine ecological environment and improve economic condition for local communities.

While five other MPAs are set on islands, Nui Chua National Park MPA is the only one located in coastal area. Its natural forests and marine protected areas are widely known as in need of most protection. Additionally, the system of marine organisms in Nui Chua MPA is rich, regarding the coral coverage, diversity in fish species, seaweed and benthic algae. This place is also ranked in the second position in Vietnam as a sanctuary where many sea turtles

come to nest and lay their eggs. Since Nui Chua MPA was established in 2008, the system of management has been implemented directly under co-management principles and successfully attained much heart-inspiring results. Under careful protection, the number of sea turtle and coral reef has been non-stoppingly expanded, thus, the economic condition of local people has been greatly improved. More importantly, the local communities are also willing to directly participate in almost all decisions and management activities of the MPA. However, in recent time, a question has been raised about the real effectiveness of management in Nui Chua MPA. Besides separate studies about biodiversity of researchers from Nha Trang Institute of Oceanography (Tuan et al. 2008, Long 2012) and the natural, socio-economic assessment report of villages around Nui Chua MPA (Trung et al. 2008), there has been hardly any research conducted to evaluate the effectiveness of co-managing this MPA. While there are many studies that assessed and evaluated MPAs management in Viet Nam such as assessing co-management in Nha Trang Bay MPAs (the first MPA of Viet Nam) (Anh 2010 and Hong 2010) and effectiveness evaluating of Cu Lao Cham MPA (the successful MPA model) (Nhung 2010). Hence, it is of great necessity to conduct an evaluation the effectiveness of co-management in Nui Chua MPA, especially when Vietnamese Government has intention to expand MPAs system, improve the force of policies and legal document and apply co-management model into all of MPAs nationwide.

In this thesis, the effectiveness of Nui Chua MPA management will be assessed in three aspects, including biodiversity, socio-economics and the involvement of community in management process. The methodology chosen in this study is based on the wide range of indicators that were suggested by Pomeroy et al. (2004) and Armstrong and Ngoc (2011)

Three objectives in this paper are as followed:

- Evaluate whether Nui Chua MPA can generate the expected benefits (for both biodiversity and socioeconomic aspects) as anticipate in the plan design.
- Define the profit of vessels operating around Nui Chua MPA.
- Assess the involvement of local community in management process.

The questions should be answered to clarify those objectives are: How is the change in amount of species before and after the introduction of Nui Chua MPA?; What have happened with the catches of fishermen around Nui Chua MPA?; Is there any new job created and what is the new structure of occupation? Have the income of local people increased and how is the

dependence of their life onto fishery?; What is the costs and earnings of vessel fishing around Nui Chua MPA? And how do the local communities participate on decision making and implement protection and relevant activities in the MPA?

The thesis includes six (6) parts. The first is introduction part with general information about Nui Chua MPA and the objectives of this paper. The second part, Background, explains the detail of biodiversity, fishery and co-management system of Nui Chua MPA. Literature Framework of part 3 will present some concepts of Marine protected area, co-management, and case studies of co-management in fisheries and MPAs. Part 4 provides the data collection and measurable methodology with suggested indicators of Pomeroy et al. (2004), Armstrong and Ngoc (2011). Results of the research are explained in the next part. Discussion from the results and the conclusion are in the final chapter of the paper.

2. BACKGROUND

2.1. Overview of Nui Chua MPA inside Nui Chua National Park, Ninh Thuan Province

Ninh Thuan is a province of South Central Coast of Vietnam. The North of this province shares border with Khanh Hoa province, it also borders with Binh Thuan province to the South, Lam Dong province is next to the Western and the East is East Sea. Ninh Thuan has a coastline of 105 kilometres; the fishing ground located in upwelling region that has rich and diversified marine resources with over 500 species of sea products. There is also an abundant and varied coral reef ecosystem with over 120 species and some rare and precious sea turtles. Coastal region of Ninh Thuan is a large area with many bays and lagoons, especially Nui Chua National Park, which includes not only reserved activities but also tourism and fishery economics development.

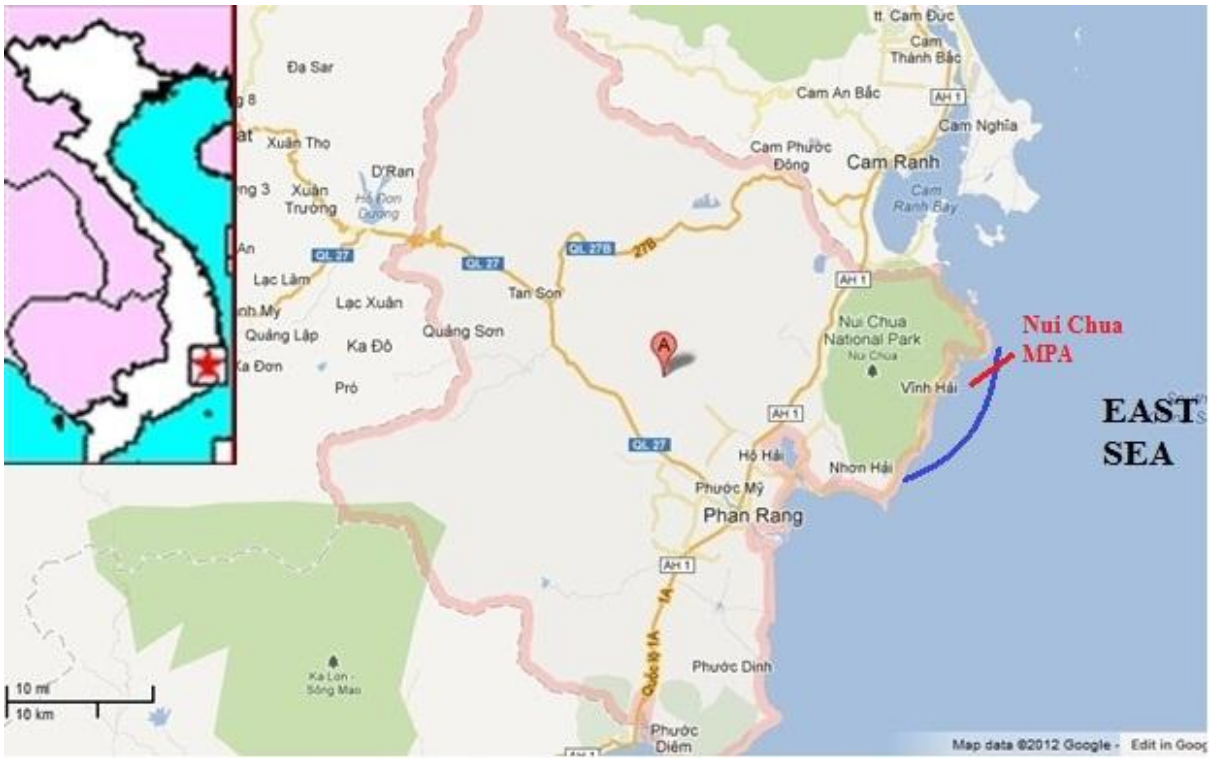


Figure 1: The location of Nui Chua National Park, Vietnam

(Source: Google map and Department of Survey and Mapping Vietnam)

Nui Chua National Park, Ninh Hai district, Ninh Thuan province is located in a tropical monsoon climate with dry and rainy season in a year, the humidity and average rainfall level is lowest in the country. This park has the main type of terrain which is low and middle hills,

valleys and delta areas, coastal sandy platform. Forest vegetation of Nui Chua is varied with six (6) types including 1,265 species of vascular plants. There are about 35 rare plant species that need to be strictly protected. Animal system in Nui Chua is quite abundant with 306 species of vertebrate wildlife. Nui Chua sea site has high biodiversity with coral reef and sea-grass beds. There are also spawning grounds of marine turtles.

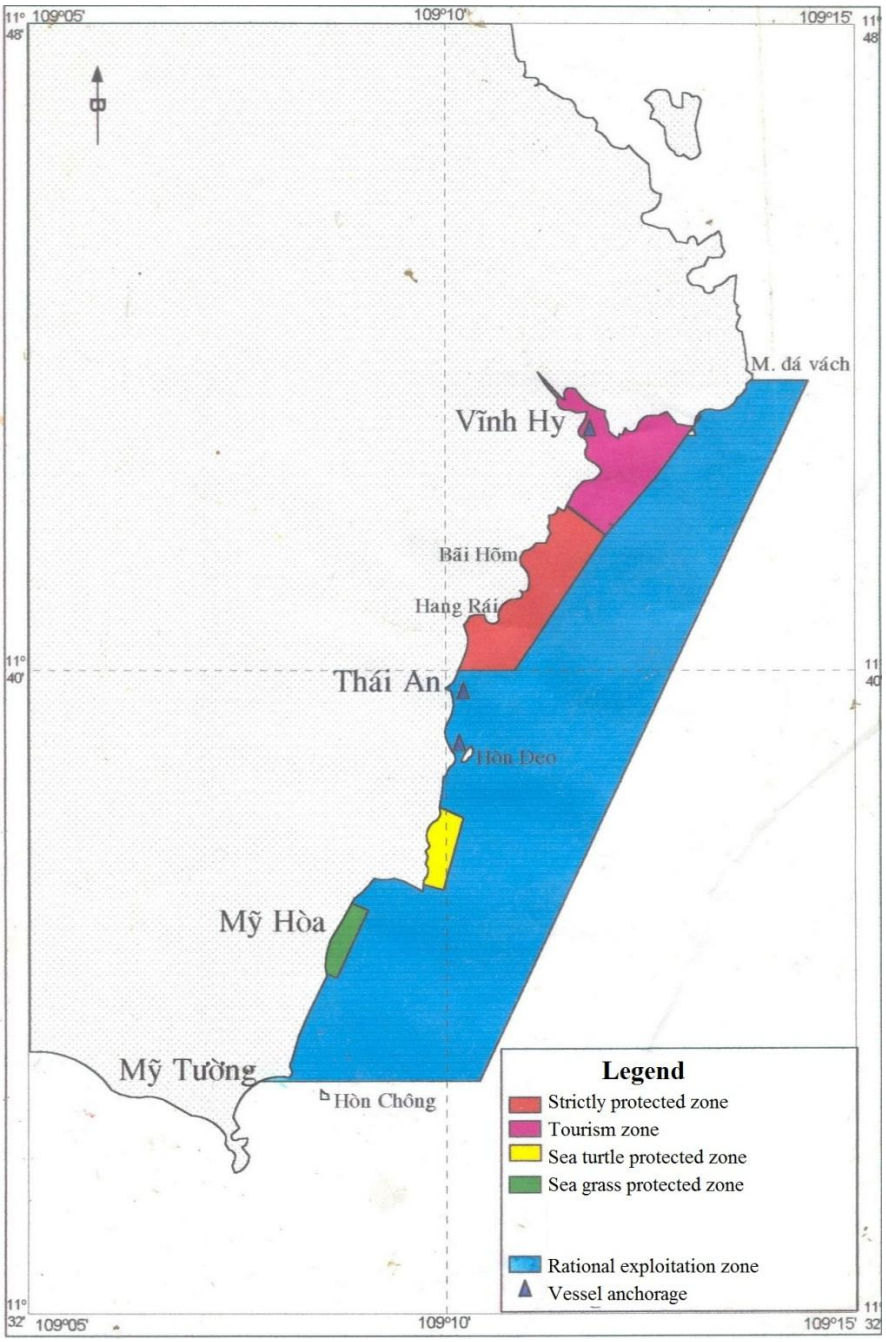


Figure 2: Functional areas in Nui Chua MPA, Ninh Thuan province

(Source: Nui Chua National Park Management Board)

Nui Chua National Park, once called Nui Chua Natural conservation area, was established on 9th July 2003 by the Decision No.134/2003/QĐ-TTg of the Prime Minister. Before 2003, Nui Chua Natural conservation used to be the area of only forest; however, up to now it covers an area of 29,865 ha and contains both forest and marine protected areas. Terrestrial area includes 16,087 ha of strictly protected forest, 6,421 ha of ecological restoration forest and 5 ha of administrative service zone. The marine component, which could be called Nui Chua MPA, contains 568 ha of strictly protected zone, 99 ha of sea turtles protected zone, 84 ha of sea-grass protected zone, 6,299 ha of rational exploitation zone and 329 ha of marine ecotourism zone. The north of Nui Chua MPA is Wall Stone Cape and the south is Chong Island. The length of coastline is 24.96 kilometres (See figure 2). Nui Chua MPA are aimed at: (1) Protecting biodiversity, especially the species which are in the danger of extinction; (2) Developing sustainable fisheries, eco-tourism and other activities without negative impacts on habitats, natural resources and marine environment; (3) Serving scientific research, environment education and international cooperation of natural conservation. (Ninh Thuan People's Committee 2010).

According to the report of LMPA (2008), Nui Chua MPA has been impacted from 7 villages where the life of communities is relying on marine resources. These villages include Khanh Hoi, My Hiep, My Tan 1, My Tan 2, My Hoa, Thai An, Vinh Hy with a total population of approximately 14,000, among which 3,370 people are fisher (Kien 2004; Trung et al. 2008). People in Vinh Hy, My Tan 1, My Tan 2 and My Hiep village are almost dependent on fishing due to the lack of agricultural land while in Khanh Hoi, Thai An and My Hoa agricultural activities are more important than fishing. The educations of people in these villages are low. Only about 10% people graduate from high school and upper level, nearly 90% have lower education (Trung et al. 2008). Moreover, female have higher education than male because after finishing the secondary school, most of male have no interest in study and prefer going fishing or find the other jobs such as servicer, hired labour to earn their living.

2.2. Biodiversity in Nui Chua MPA

The sea of Nui Chua National Park is on the zone of tidal exchange from the North down and from the South up and also influenced by upwelling effect. Therefore, biological resources of Nui Chua MPA are not only rich and varied in species but also rare and valuable for science, genetic conservation and other economic benefits (Ngan 2004). According to Long 2012,

marine resources in Nui Chua MPA include coral reef, reef fish, molluscs, polychaetes, crustacean, echinoderm, sea turtle and sea grass.

Coral reef

Up to now, the scientists have found 334 species of coral, in which 15 families with 59 genus and 308 species creating reef, 16 species of soft coral, 6 species of horn coral, 3 species of coral polyps and 1 Zoanthid (Long 2012). Reef structure is mostly typical reef rim form. Its distribution in coastal area of Thai An, My Hoa, My Tan. At low tide, the coral reefs in these areas are exposed to a tidal flat, which can be extended to 500-800 metres. Reef morphology is relatively complex and abundant with a number of coral groups that distribute from low tide level to the depth of over 20 metres. The total estimated are of coral reefs in 2011 is up to 2330 ha. Hard coral coverage ranged from 19.7% to 59.7%, average 40.2%. (Long 2012)

Reef fish

Reef fish in Nui Chua MPA is also quite varied with 260 species of 104 genuses, 28 families (Long 2012). In which, *Labridae* (30 species), *Belontidae* (24 species), *Chaetodontidae* (18 species), *Scaridae* (11 species) and *Acanthuridae* (8 species) are the most abundant families. Density of coral fish ranging from 75.1 to 263.4 fishes/100m^2. There are mostly small fish with length of 1-10 cm and 11-20 cm, belong to *Acanthuridae, Siganidae, Mullidae, Nemipteridae,* etc. (Long 2012)

Molluscs

Molluscs of reef have 115 species of 65 genuses, 34 families with 3 classes of *Gastropoda* (83 species), Two-piece shells (31 species) and *Chitons* (1 species). *Conus, Turbinidae, Strombidae, Cypraeidae, Muricidae, Trochidae* are the families that have the large number of species. (Long 2012)

Crustaceans

Crustaceans include 24 species of 19 genuses, 13 families. Lobster and doctor shrimp are two target species in Nui Chua area. The density of extremely low from 0 to 0.2 individual/100m^2 (Long 2012)

Echinoderm

Echinoderm includes 23 species of 14 genuses, 10 families. While density of urchin is quite higher (1.7 – 4.2 individual/100m^2), densities of sea cucumber and thons starfish are low (<0.3 individual/100m^2) (Long 2012).

Sea turtle

Nui Chua MPA is the second-place of Vietnam raking in sea turtle (following Con Dao National Park) with 3 species Chelonia, Lepidochelys olivines, Eretmochelys imbricate. In 2010, turtle came to nest and laid their eggs 21 turns. Total amount of eggs is 657, hatched eggs is 534 and 523 young turtle ran back to the sea. (Kim 2011)

Sea grass

Sea grass in Nui Chua MPA include 188 species of 4 orders, 32 families and 86 genus in which Red seaweed Rhodophyta is the most abundant order (79 species). On coral reef of Mui Thi – My Hoa, seagrass grow on the sandy bottom together with dead coral and make eco-link with coral reef. (Tuan et al. 2008)

2.3. Fishery in Nui Chua MPA

Fishing activities of 7 villages in Nui Chua MPA are almost inshore and quite diversified. Hook and line, squid net, push net, sinker net, lobster seeding net and gill net are operated seasonably while lobster trap, purse seine (day), trammel net and trap are operated all time of year. Target species are exploited directly on coral reef are *Serranidae, Lutianidae, Siganidae*. Fishing capacity could be 100 – 200kg/night/vessel. Lobster seed exploitation is mainly on My Tan and My Hiep village on the southwest monsoon period (March-May and July-September). The number of exploited lobsters may be up to 50-100 lobster/vessel/day. The exploitation of seaweed, oyster, snail and fish at tide flat also brings the significant income for poor people in Nui Chua MPA. The catches of pelagic fish such as anchovy (*Engraulidae*), scad (*Decapterus*), and mackerel (*Scombridae*) are also high, in which anchovy accounted for 60% of total production (Tuan et al. 2012).

In Vinh Hy village, almost of households have no or limited agriculture land, therefore their life mainly depend on fishing. In 2008, the amounts of fishing households are 265 with 58 engine boats and 80 basket boats (Trung et al. 2008). Fishing ground is 1 mile away from the shore and along the coast. Two important fishing activities in this village are push net and gill

net. Vinh Hy is also in tourism development zone, therefore, there is a huge amount of fisher moving to tourism activity or work for Nam Nui Chua Joint Stock Company (A tourism company which has been building an eco-tourism zone in development project)

Thai An village has the large agriculture land, therefore, income of people almost come from grape, garlic, onion and raising sheep, goat and cow. This village also has the large area of coral reef, sea grass and spawning grounds of turtle. About 19% of population in Thai An go fishing and the main gear is trammel net. (Trung et al. 2008)

In My Hoa village, there are only 16% of population working in fishing field. The fishing scale is very small with 17 basket boats and the fishers mainly walk along the beach to fish. (Trung et al. 2008)

Life of community in My Tan 1 village mainly depends on fishing. They have 172 engine boats, 35 basket boats and 5 small capacity canoes. Push net, lift net with strong light and sinker net are the most common fishing gears in this village. There are 50 households using push net to fish anchovy and most of fishing boats have fish hunter machine. Anchovy and mackerel are the target species of gill net set up around the sea of My Tan 1 village. (Trung et al. 2008)

My Tan 2 village has 91 engine boats and 20 basket boats. The people also attend to aquaculture activity for livelihood with two products sweet snail and lobster seed. (Trung et al. 2008)

In My Hiep village, the large amounts of local people go fishing with 43 engine and basket boats. Fishing activity is quite diversified. The main activity is squid hook and lines at night in 1 km far from the coastline area. There are about 100 households diving (night and day time) for lobster seedlings, snail and fish. The fishers using push net also have fish hunter machine on their boats. Protected area in My Hiep village has 15 ha of sea grass and coral reef. (Trung et al. 2008)

Khanh Hoi is the village that has 25% fisher with about 58 engine boats and 80 basket boats. Sinker net is the most common activity in this village (46%), followed by lift net with strong light (8%). Another main job is producing salt (Trung et al. 2008).

2.4. Co-management system in Nui Chua MPA

Although Nui Chua MPA was established in 2003 by the government however it still was not listed in MPAs Network Planning of Vietnam until May 2010. About the financial and technical issue, Nui Chua MPA received a wide range of supports from international organisations and projects. They also created opportunities for local community to participate directly in marine resources management process. From 2000 to 2006, when Nui Chua MPA was Natural Conservation Area, WWF-Indochina Programme in Vietnam annual funded for sea turtle protected activities, in which, communication activities to raise awareness of local people and training courses on sea turtle rescue were emphasized. A volunteering sea turtle protected group was born and up to now it has 8 members. In 2003, two volunteering coral reef protected groups were also born with 6 members of each. They are the result of coordination of Nui Chua MPA Management Board with Ninh Thuan Department of Fisheries Resources Protection and People's Committee of two communes Vinh Hai and Nhon Hai, which have 7 villages affected by the MPA, in disseminating the benefit of protection coral reef to local community. (Kien 2004)

There are several stakeholders attending to manage Nui Chua MPA such as local community, People's Committee of communes in and around the MPA, Nui Chua National Park Management Board, Departments of Agriculture and Rural Development, Natural Resources and Environment, Science and Technology, Police, Military of Ninh Thuan province and other organisations. The relationships among them are showed in the Figure 3.The stakeholders at higher level provide policy, decision, etc. to the others at lower level; in opposite, the stakeholder at lower level provide their opinion, suggestion, etc. to the others at higher level on management process. All of stakeholders have been playing their own important roles that were specified on Partitioning and Management Regulation of Nui Chua MPA that was approved by the Chairman of People's Committee of Ninh Thuan province in 2010. To detail:

Nui Chua National Park Management Board:

Mission:

+ Take responsibility on managing and protecting the MPA under regulations and law provisions;

+ Conduct research and boundary adjustment for functional areas of the MPA, mapping and mark on the field;
+ Organize the management and conservation activities for animal species, aquatic plants and maintain the natural ecosystem in the MPA.
+ Implement pollution prevention measurements, monitoring and preventing harming activities to the MPA.
+ Periodical monitoring and reporting to competent authorities about the status of biodiversity and environment quality within the MPA.
+ Educate and raise awareness of environmental protection and biodiversity conservation to stakeholders and communities living in and around MPA.
+ Propose mechanisms and policies to competent authorities and implement activities to improve the livelihoods of communities.
+ Develop and implement the Management Plan annually, 5 years, 10 years, etc.

Authorities

+ Patrol, monitor and make the records of violent activities in the MPA, then transfer to functional agencies to handle according to government laws and regulations.
+ Sign joint ventures with domestic and foreign individuals and organizations in implementing legal tourism and service activities in MPA.
+ Directly collect, manage and use the marine conservation fees under regulations of People's Committee of Ninh Thuan Province.
+ Organize all activities of international cooperation to protect and develop conservation value under current laws.

Local community: fishermen of volunteer groups directly attend to activities of patrolling, supervision and protection marine resources: coral reef, sea turtle, etc. They daily are at protection station in the beach and boating to coral reef areas. They can make records of administrative violations of people who used electric shocks, poisons, explosives for fishing or exploring, surveying, mining, purchasing, transport and processing illegal coral; temporarily seizing material evidences such as boats, generators and power grids; transfer the records and material evidences to People's committee of communes or inspectors of department of fishery resources protection. Moreover, they themselves build operation plan and implement activities for their groups; and coordinate with Commune People's committee in propaganda knowledge of marine resources to other people in community. Volunteer

groups also participated in the meeting to gather idea for building Partitioning and Management Regulation of Nui Chua MPA.

Commune People's committee: supporting and coordinating with Nui Chua National Park Management Board and other relevant agencies to implement regulations and law provisions relating to all activities in the MPA.

Departments of Agriculture and Rural Development; Natural Resources and Environment; Science and Technology; Culture, Sports and Tourism; Police, Military of Ninh Thuan: coordinate with Nui Chua National Park Management Board in implementing, monitoring and handling illegal activities in the MPA based on functional authorities of each agencies.

Other organizations and projects (such as WWF, LMPA, and MCD): have been playing important role in management process of Nui Chua MPA. They support finance and technology for managing the MPA.

The advantage of co-management in Nui Chua MPA is that the good coordination among stakeholders such as Nui Chua MPA Management Board, Departments of Agriculture and Rural Development; Natural Resources and Environment, Military of Ninh Thuan, Non-Government Organizations (NGOs), People Committee, especially local communities. Local communities participate directly not only on decision-making process and patrolling, monitoring and protection marine resources (volunteer groups) but also other activities such as building pier, toilet and waste management. (Kim 2011)

Beside the advantages, there are also some problems of this management in Nui Chua MPA. Law system and legend documents related to Nui Chua MPA management are incomplete. The mission of relevant agencies are also overlapped (Kim, 2011), such as the overlapped mission between Department of Fishery Resource Department and Natural Resource and Environment, between Military of Ninh Thuan and Nui Chua MPA Management Board. It may cause the decline of their responsibilities on management process. One more problem is that the lack of staffs in Nui Chua MPA Management Board. The people who are working in marine conservation are also the staff of Nui Chua National Park. They have to separate their working time for both missions: marine conservation and forest protection. The limitation of their management capacity and the lack of necessary equipment are the difficulties in management process.

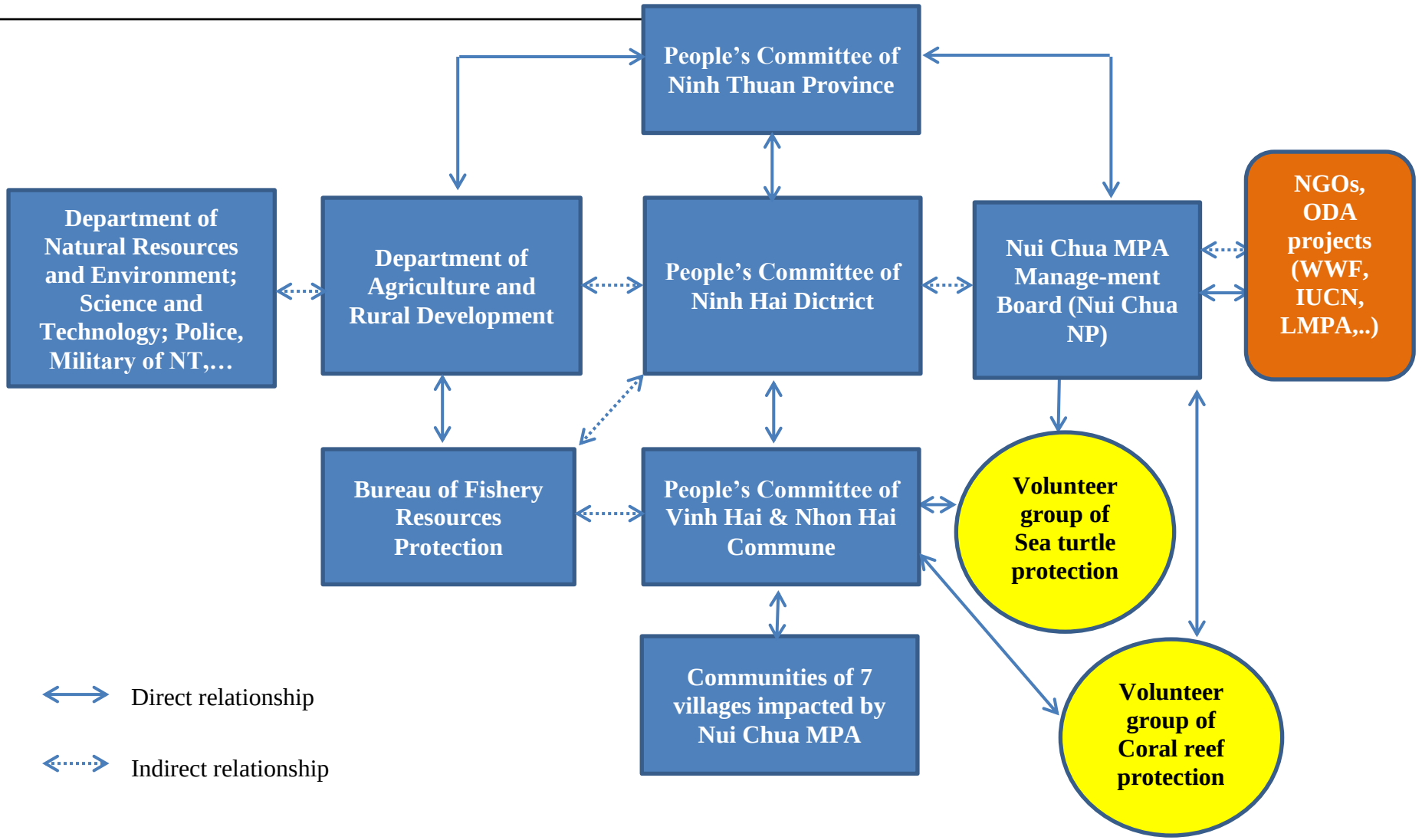


Figure 3: Co-management system in Nui Chua MPA

3. LITERATURE FRAMEWORK

3.1. Marine Protected Area

MPAs are considered as a tool for ecosystem conservation and fisheries management (Protect 2006). According to IUCN (The International Union for Conservation of Nature), an MPA is "Any area of intertidal or sub-tidal terrain, together with its overlaying waters, and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part of all of the enclosed environment". MPAs could include both marine and terrestrial resources (WCPA 1999). They are the geographical areas in which human activities are limited to protect natural and/or cultural resources. MPAs are established for a large range of objectives, including protecting marine species and habitats, conserving marine biodiversity, restoring fisheries stocks, managing tourism activities, improving livelihoods, education value and minimizing conflicts among resource users (Protect 2006; Armstrong and Ngoc 2011).

Objectives above can be achieved when the use of MPAs are planned and evaluated carefully (Hilborn et al. 2004). Hilborn et al. also suggested that the "bottom-up" form should be supported for any management measure in MPAs system as an effective way. It may because of the communities are the people who understand clearly which and how the species or habitats need to be protected are. However, in the technical report "Governing Marine Protected Area" of UNEP in 2011, the authorities said that in natural resource governance, including protected area, co-management could be applied with combining three approaches: "top-down", "bottom-up" and "market incentives". In which, "top-down" is the control of the state through law and other regulations, "bottom-up" is community-based approach that local people are involved in decision-making process and "market incentives" approach attaches economic value to biodiversity and property rights to environmental resource to provide balanced decisions.

With the rapid development of the amount of MPAs over the world (since 2003, it has increased 150% and got 5880 MPAs in 2010) (Toropova 2010) and the variety in management methodologies, many people question that whether an MPA and its management has been successful or not. Therefore, all of them need to be monitored and accessed. In MPA management, monitoring is an integral component. It provides the result of implementation

process such as the changes of biodiversity, social and economic data from time to time (Houde et al. 2001). Many studies of worldwide scientists were published and applied to evaluate the effectiveness of MPAs. A report of Leverington et al. 2008 shown out a checklist of important methodologies and approaches that were used to access the management effectiveness in protected areas. Most of methodologies used in five (5) continents for MPAs based on IUCN-WCPA Framework. On the group of International Methodologies, they listed six (6) studies include: Rapid assessment and prioritization of protected area management (RAPPAM); Management effectiveness tracking tool (METT); Enhancing our heritage; How is your MPA doing? Conservation action planning (TNC) and WWW-World Bank MPA score card; in which two (2) studies especially for evaluating MPAs. They are *How is your MPA doing?(Pomeroy et al. 2004)* and *WWF-World Bank MPA score card (WWF-WB, 2004).* In this paper, I apply the methodology of the study ***How is your MPA doing? (Pomeroy et al. 2004)***. Further more information about this methodology will be presented on Methodology part.

3.2. Co-management

Co-management is defined as the sharing of responsibility and/or authority between the government and local resource users/community to manage the fishery or resource (e.g. coral reef, mangrove shoreline habitat) (Pomeroy and Williams 1994). Co-management involves various degrees of delegation on management responsibility and authority between the local level (resource user/community) and the state level (national, provincial, municipal government) (Pomeroy and Williams 1994) or between full community-based management and full government-based management. Nowadays, more dynamic partnership using capacities and interest of local fishers and communities, complemented by the state's abilities to provide enabling legislation, enforcement and other assistance. The form of management "top – down" is also shifted away from centralized to new strategies. There are more involvements of fishers on fisheries management process with the government. (Berkers et al. 2001)

According to Carlsson and Berkes (2004), co-management is a logical approach to solving resource management problems by partnership. Local users alone can hardly manage most natural resources. They need the help of their partners at higher levels. Thus, co-management is very important. Firstly, it seems to be the allocation of tasks, brings together a variety of

different capacities and comparative advantages. Secondly, there is the sharing of resources between partners in co-management system, such as information about harvesting volumes or status of the resource at local groups and technology, scientific expertise, and a diversity of information at State level. Thirdly, co-management is a means of linking different types and levels of organization. They coordinate their activities in relation to a specific area or resource system. Co-management also has the important role in reducing transaction costs and sharing risks. Because, co-management is a system with a large number of actors, transaction costs and risks can be shared for all actors, as compared to relying on one actor for their accomplishment. One more important role of co-management is that it reduces conflicts and might even function as a more long-term problem solving mechanism (Carlsson and Berkes 2004)

As I presented above, co-management could combine three approaches: "top-down", "bottom-up" and "market incentives". While "top-down" approach emphasizes the role of the state on identifying most of protected areas and deciding who, how and why local people should participate on management process (Cooke and Kothari 2001; Jones et al. 2011), "bottom-up" approach seems to be a community-based approach. It enhances the sharing of power between the state and local people and the improvement of the power of local people and other organizations on decision-making process (Jones et al. 2011). "Market incentive" is the argued issue between advocates of "top-down" and "bottom-up" approaches. It is important to provide the benefit from tourism and other economic development opportunities for local people, following the point view of advocates of "bottom-up" approach. The property rights of local resources of local people should be increased and they should play the role of responsible stewards (Hayes and Ostrom 2005; Jones et al. 2011). Advocates of "top-down" approach argued that a fund could be transferred from more economically developed countries (MEDCs) to less economically developed countries (LEDCs) to support biodiversity conservation through measures such as setting up and capacity building to conserve protected areas. However, advocates of bottom-up incentives suspect whether such financial supports are transferred to local people who are directly affected by protected area restrictions, etc (Jones et al. 2011). Therefore, each MPA can apply adopted point view depending on the aim and reality of that MPA.

Katon et al., 1997 identified thirteen characteristics of successful co-management institutions:

1. Existence of a resource availability problem.
2. Specification and enforcement of property rights.
3. Influence of fishers on project planning and participation by those affected.
4. Supportive local leadership and cooperation among fishers.
5. Knowledge of project objectives.
6. Positive attitude toward rules.
7. Presence of legal and policy support.
8. Community cooperation.
9. Job satisfaction of fishers.
10. Dependence on fishing as the most important source of total household income.
11. Tangible benefits from co-management arrangements.
12. Built-in monitoring and evaluation schemes.
13. Reinforced incentives to collaborate.

Brown et al. (2005) identified four main pillars for the successful co-management of fisheries:

1. An enabling policy and legal framework;
2. The participation and empowerment of communities (and other users);
3. Effective linkages and institutions; and
4. Resources – a resource worth managing and the people and money to do it.

3.3. Case studies of co-management for fisheries and marine reserves

Co-management is now common in over the world. In the field of fisheries, co-management principles are implemented quite widely. In some places, co-management plays a very important role to create the success to achieve some goals. However, in some other places, due to several existed mistakes, co-management could be fail. Studying and learning from both successful and fail experiences to understand the reason why they can achieve their objective, why not, is good lessons in management process. Katon et al. (1997); Lopes et al. (2003); Gray (2008); Poonian et al. (2008) and many other scientists have studied and analyzed the success of the implementation co-management for fisheries in normal places or fisheries in MPAs. The table 1 below shows four case studies of both successful and un-successful co-management with some important information.

Table 1: Case studies of Co-management in some fisheries/MPAs

Place	Evaluating Person	Number of fishermen /family	Goals	Regulation/ Monitoring	Co-management form	Result and Reason of success or failure
San Salvador – Philippines (380 ha)	Katon et al., 1997	*1,620 people, 284 families * 64% residents have income from fishing	- Actual imposition of sanctions against violators of fishery-related laws - Higher rule compliance - Reduced incidence of community conflicts.	Focused on the enforcement of the sanctuary and reserve's regulation	**Top-down** **Bottom-up** Powers and responsibilities were transferred to local government	**Successful** Legal and policy support with vigorous enforcement
Kwirikwidge fishing villages, Angoche District, Nampula Province, Mozambique (3,500km^2)	Lopes and Gervasio, 2003	* 1260 people, 260 families, * 700 fishermen Fishing is the main income source (98%)	- Reduce the conflicts of stakeholders - Control artisanal fishing activities	There is a limitation of fishermen each fishing season (40) Ministry of Agriculture and Fisheries organize and planning	**Top-down** From 1997, a fishing resources community management committee and a district co-management committee were created.	**Un-successful** The role of co-management inter-district committee is not clear – lack of validity of the decision

Gladden Spit and Silk Cayes Marine Reserve, Belize (11000 ha)	Gray, 2008	Over 3,200 fishers	Marine resource management and conservation (support multiple interpretations of knowledge and environmental problems at both the local and regional level)	Friend of Nature plans and monitors regulation of zoning and responsibilities of users	A network of social relations in which actors engage in politics of scale (Fisheries Department of Belize and locally-based NGO, Friend of Nature, fishers, tour guide, village councils)	**Successful** - Combination of scientific and local knowledge - Effective enforcement through local legitimacy
Mohéli Marine Park, Comoros Islands (404 km^2)	Poonian et al., 2008	*10 villages * 3,800 residents	Deliver effective conservation and development outcomes for communities and their marine resources.	* Is a National Park however people have to follow the regulation of villages * "Ecoguards" are fishermen who were chosen to raise awareness and monitor.	**Bottom-up** A committee composed of representatives assembled from ten local villages, government, police and tourism operators	**Un-successful** - Lack of sustainability (alternative livelihood) - Inequitable distribution of benefits - Exclusion of women - Lack of enforcement of regulations.

There are two first case studies of San Salvador, Philippines and Kwirikwidge fishing villages, Mozambique. They both have the huge number of fishermen and their life almost depend on fishing activities. The managers of these two areas also have the same objectives which are controlling the fishing activities and reducing conflicts between stakeholders. However, the types of their co-management are different. While basing on two approaches "top-down" and "bottom-up", the management of San Salvador have been successful with the real power and responsibilities belong to local government. Managers in Kwirikwidge fishing village issued some regulations in which only 40/700 fishermen were allowed to fish on each fishing season. This "top-down" regulation was not concurred by a large amount of fishermen. The management was fail due to the lack of validity of decision.

The next to case studies are marine reserves. The same as the other MPAs, protecting marine resources is the main purpose of those areas. Gladden Spit and Silk Cayes Marine Reserve, Belize has a quite strange co-management when the main responsibilities belong to Friend of Nature (FON) - a Non-Government Organization. With the effective enforcement and the combination of scientific and local knowledge, that marine reserve reached their goals successfully. In opposite situation, with several of mistakes such as lack of alternative livelihood, inequitable distribution of benefits, exclusion of women and lack of enforcement of regulations, Mohéli Marine Park were un-successful with the type of co-management is "bottom-up".

4. METHODOLOGY AND DATA

4.1. Methodology

The methodology in this paper bases on field methods, the approach that was suggested by Pomeroy et al (2004) in the book "How is your MPA doing?" and suggested indicators of Armstrong and Ngoc (2011) in assessing marine protected areas in Vietnam. "Field methods" is an absolutely useful tool for people who conduct fieldwork. It combines both qualitative and quantitative methods to analysis a wide range of specific field data (Sage journal, Protect, 2006). In assessing the effectiveness of marine reserves, field methods could include the studies in marine ecosystems and biodiversity (e.g. Roberts and Polunin 1991; Garcia-Charton and Pérez-Ruzafa 1999; Protect 2006), socioeconomic and governance (e.g. Philmore James 2007; Mangora. M. M and Shalli, M. S 2012). The study would analyze indicators related to these aspects above and be developed from suggested indicators group of Armstrong and Ngoc (2011). (See Table 2)

Table 2: Indicators for evaluating the co-management effectiveness of Nui Chua MPA, Ninh Thuan, Vietnam

Natural science knowledge	The abundance of the species
	Composition and structure of communities
	Fishing effort and catch per unit of effort
Social science knowledge	Perception of availability of the fish
	Household income
	Household occupational structure
	Conflicts between resource users
	Costs and earnings of the vessels affected by MPAs
Governance	Level of stakeholders participation and satisfaction in management process and activities
	Degree of interaction between managers and stakeholders
	Level of stakeholder involvement in surveillance, monitoring and enforcement

(Source: Developed from Armstrong and Ngoc 2011)

4.1.1. Analyze indicators in group Natural science knowledge

The abundance of the species

As presented in Background part, biodiversity in Nui Chua MPA is not only rich but also variety with several of species. One of the objectives of Nui Chua MPA is to protect some target species such as sea turtle, coral reefs and reef fish. From 2003 up to now, researchers annually conducted a large amount of activities to calculate or estimate the number of individuals with using some technological methods such as marking badge (for sea turtle), GPS, echo sounders and scuba diving reef check. Almost studies were carried out by scientists from Institute of Oceanography, Nui Chua MPA Management Board, WWF, etc. Collected data normally include coverage of living coral, population size, density and the length of fish, number of turtle and their eggs, etc. With fishes, they divided into groups based on the length (1-10cm, 10-20cm, 20-30cm, >30cm). The change of fish lengths and density or population size express the change of species abundance in Nui Chua MPA. By comparing the change of species abundance through the years, we can predict the available of some target species in the future and assess whether Nui Chua MPA achieved the biodiversity objective or not (Armstrong and Ngoc 2011).

Composition and structure of communities

While the species abundance indicator requires general information of all species, composition and structure of communities needs detail data of each kind, including the frequency, density and size of each individual checked and the position in the water column where the individual is checked (Armstrong and Ngoc 2011). Those data in Nui Chua MPA were collected at the same time with the data for above indicator by the same methods.

In observing and recording process, the discovery of new species or the disappearance of any species should be carried out carefully (Armstrong and Ngoc 2011). Besides comparing the change through the years (from 2003 to 2011) of each species, we can rank and compare the abundance of all species within each community to examine what is the major contributor of abundance at Nui Chua MPA.

Fishing effort and catch per unit of effort

Fishing effort seems to be the real impact of fishing activities into marine resource. It can be the number of fishing hours or days on boat, the number of hook used per night (for long-line fishing) or the distance of nets used, etc. In Vietnam, the easiest and most common way to collect information of fishing effort is collect the number of fishing hours/days in a month or a year through interview fishermen because they can remember or note in their fishing diaries to provide information for logbook program of MPA Management Board. Catch per unit of effort (CPUE) is considered as an indirect measure of the abundance of species. A fishery will be overexploitation if its CPUE is decreasing (Pablo and Richard 2004). Therefore, an unchanged CPUE or an increasing CPUE, the signal of spill-over effect, is expected with an effective MPA (Pablo and Richard 2004, Armstrong and Ngoc 2011). To compute catch per unit of effort, the formula can be used is:

$$\text{CPUE} = \frac{H}{E}$$

where: CPUE is the catch per unit of effort (kg/day)

H is the total weight of the harvest (kg)

E is the fishing effort (day)

With the purpose of planning a sustainable fishery development base on understanding the catches, efforts, fishing activities, etc., a log-book program were conducted in Nui Chua MPA and supported by LMPA component from the beginning of 2010. The log-books were provided to 20 households living around the MPA and focus on 4 main types of gears, which are three grids trawl, squid hook and line, lobster trap and diving. The data were collected monthly base on the guidance of Pomeroy et al (2004), include: The kind of fishing gear, the engine power, the number of crew, the number of fishing day,

4.1.2. Analyze indicators in group Social science knowledge

Perception of availability of the fish

Based on the general perception of fishermen about availability of target species, this indicator could help the find out how is the change of harvested amount and composition compared to earlier period and in which species; and if the harvest increasing (the impact of

spill-over effect from a well-managed MPA) or not (Pomeroy et al. 2004, Armstrong and Ngoc 2011). The fishermen and other local people (housewife, agriculture farmer, etc.) were required to compare the change in amount of fish catch at present with the period before Nui Chua MPA was established through an individual survey on 2012. With the people who are not fishermen (or wife of fishermen), it can be the change of fish available in the local market.

Household income

Household income is the income of all members in family. The importance is that the manager should understand the source of income in each household; which livelihood activities create the highest income and the change of income before and after the introduction of MPA. Then they can assess the effect of the MPA to the livelihood of community is positive or negative (Armstrong and Ngoc 2011).

Villages around Nui Chua MPA have different natural and geographic condition therefore the livelihoods and the sources of income are different as well. The new jobs created after the appearance of the MPA in those villages are also not the same. The creation of new jobs/alternative livelihoods in community not only lead to the change of income source of households but also show the proportion of income from fishing activities shifted to the other activities. It is used to evaluate the effect of the MPA to income of households. The information was collected from the community before (on 2003 by Department of Fisheries Resources Protection of Ninh Thuan) and after (survey on 2012) the creation of the MPA.

Household occupational structure

In the process of collecting data used for analysing household income, we also know the occupational structure through source of income. In addition, the socio information of age, gender and education level; and the identification of the main job (primary income) and the extra job (secondary income) of each household should be taken to determine the range of household income (Armstrong and Ngoc 2011). The analysis of this indicator also shows us the change of occupational structure by comparing the information that were collected on 2008 and the other on 2012.

Conflicts between resource users

As other coastal areas, there are several stakeholders using marine resource in and around Nui Chua MPA: fishermen using static gear (hook and line, gill net), mobile gear (trawl, push net, lift net), aquaculture farmer, people working in tourism, service, etc. Conflicts between them are inevitable. To understand those conflicts, a relevant question for resource users was asked together with other questions on the individual survey on March 2012.

Costs and earnings of the vessels affected by MPAs

Costs and earnings of the vessels should be collected before and after the establishment of the MPA. According to Armstrong and Ngoc (2011), the information of fishing ground, time and distance from port to fishing ground are also extremely important for the management to examine whether the change of those data increased operation costs of fishermen or not; or the creation of MPA affected positively or negatively on earning of fishermen from fishing activities.

The information used for analyzing this indicator was collected through log-book program in 2010, 2011. They include: revenue (earnings from fishing), fixed cost, variable cost per year of a vessel of four main gears operating around Nui Chua MPA. The gross income from fishing activities is calculated following the equation:

$$\text{Gross income} = \text{Revenue} - \text{Total cost}$$

$$\text{Total cost} = \text{Fixed cost} + \text{Variable cost}$$

The most importance is that whether the vessel is profitable or not. Profit margins should be used to examine that. It shows us the percentage of profit in revenue. When profit margin is positive, the owner of vessel has benefit. The higher profit margin is, the more benefit he can get. It is calculated following the equation:

$$\text{Profit margin} = \frac{Net\ profit}{Revenue} \times 100\%$$

4.1.3. Analyze indicators in group Governance

Level of stakeholder participation and satisfaction in management process and activities

The role of community in management process of Nui Chua MPA always emphasized. While the participation of other stakeholders almost is obligation and responsibility to execute their work, the participation of local community seems to be volunteer activities. They are affected directly and in a wide range of job, income, habit, etc. Analyzing this indicator to examine how much the community care about the development of their life at the present and in the future, examine whether the kind of management in Nui Chua MPA is really based on community. The data were collected through individual survey on March 2012 with the questions: "How many times do you participate on the meetings for implementing activities in Nui Chua MPA?", "Do manager of Nui Chua MPA or local government ask your idea about general policy and decision?", "Have your idea been attended by MPA management unit or local government?"

Degree of interaction between managers and stakeholders

This indicator is used to assess the degree of providing ideas or suggestions of stakeholders/communities on decision making to choose the best way to implement one activity in Nui Chua MPA. The question were asked on the survey is "Do manager of Nui Chua MPA or local government ask your idea about general policy and decision?" and "Have your idea been attended by MPA management unit or local government?

Level of stakeholder involvement in surveillance, monitoring and enforcement

Collecting the data of what are the activities of 7 volunteer fishermen (6 ones from coral reef protection group and 1 person from sea turtle group) in surveillance, monitoring and enforcement and why they want to involve in the management process in Nui Chua MPA. They also provided the financial support per person per month from Nui Chua MPA Management Board.

4.2. Data

4.2.1. Secondary data

Secondary data were collected from "Sustainable Livelihood in and around marine protected area" (LMPA) component, Nui Chua National Park Management Board, Statistical Yearbook of Ninh Thuan Province, Demonstration of Sustainable Management of Coral Reef Resources

in the Coastal Waters of Ninh Hai District, Ninh Thuan Province, Institute of Oceanography. They include:

- Monitoring of coral reefs in coastal waters of Vietnam: 1994-2007 – Institute of Oceanography;

- Assessment of natural, environmental and socio-economic conditions of villages around marine protected area of Nui Chua National Park (2008) – LMPA;

- Logbook data (2010, 2011) – LMPA & Nui Chua National Park Management Board;

- Biodiversity in coastal zone of Ninh Hai District, Ninh Thuan province, Viet Nam (2012);

- Gear, catch, revenue data of fishery communities in coastal zone of Ninh Hai District, Ninh Thuan Province, Viet Nam (2012).

Those secondary data are to analysis natural science indicators (The abundance of the species, Composition and structure of communities and Fishing effort and Catch per unit of effort (E& CPUE) as the suggestion of Armstrong and Ngoc (2011)

4.2.2. Primary data

The survey was conducted in five villages named Vinh Hy, Thai An, My Hoa, My Hiep, My Tan which are affected directly by Nui Chua National Park MPA. 65 questionnaires were completed with the answers of 65 people in those five villages by interview face-to-face. They are fishermen, wives of fishermen, other people whose life are depended on the ocean and product of ocean, farmers, etc. However, they are not only information of 65 people, information of 65 households with 245 people were collected.

The primary data not only were gathered to analysis social science indicators as suggestion of Armstrong and Ngoc (2011) but also for some indicators of Governance part on the Guidebook of Pomeroy et al, (2004) such as Level of stakeholders participation and satisfaction in management process and activities, Level of stakeholder involvement in surveillance, monitoring and enforcement. All information needed for this study is showed in full questionnaire in the Appendix

5. RESULTS

5.1. Analyze indicators in group Natural science knowledge

5.1.1. The abundance of target species in Nui Chua MPA

Located within Nui Chua National Park, Nui Chua MPA has a variety biodiversity with a wide range of species which have high biological value and are the living environment of fishes (for instance: sea turtles, coral reefs, sea grass, etc.) or have economic value and are sources of livelihood of communities around the MPA (For example: reef fishes, Molluscs, Crustacean, etc.). In the past, the sea of this location was open access; people used several means, even explosives and chemicals, to exploit those species for their living. Thus, the ecosystem was destroyed seriously, especially coral. In three years from 1999 to 2003, local government detected that 13.83 tonnes coral had been exploited (Kien 2004). However, after Nui Chua MPA was established, those exploitation activities have been banned in strictly protected zone, fishery is allowed in rational exploitation zone and other activities can be operated in other zones outside the strictly protected zone. A large number of awareness raising programmes regarding national resource and environment protection for tourists, school pupils and local people, especially fishermen, also have been implemented (Kim 2011). In addition, two volunteer groups were founded to protect sea turtles and coral reefs with all members are fishermen who living in villages around Nui Chua MPA and might caught turtles, corals and fishes in the past. Therefore, to assess whether the natural resource management in Nui Chua MPA is efficient or not, the consideration of target species abundant changing is extremely important.

Sea turtle

Protection for sea turtle is the first purpose when Nui Chua MPA was established in 2003. However, the record of them has only been detail since LMPA component supported to this MPA in 2008 (see Table 3). From 2008 to 2011, the data of the number of turtles turn up beach, number of turtle nest seem to be constant excepted in 2009, those data significantly increased, from 21 to 39 turtles turns up beach and from 8 nets to 12 ones.

Table 3: Abundance of sea turtle in Nui Chua MPA

No.	Record of sea turtle	2008	2009	2010	2011
1	Number of turtles turn up beach a year	21	39	21	19
2	Number of turtles turn up twice	2	3	2	2
3	Number of nests	8	12	8	8
4	Total of turtle eggs	608	1010	657	
5	Number of hatched eggs	450	958	534	
6	Number of live juvenile turtle	411	927	523	
7	Number of dead juvenile turtle	39	31	8	
8	Percentage of juvenile turtle coming back sea/turtle eggs (%)	67.6	91.78	79.6	

(Source: Kim 2011)

After the first time laying eggs at beach, the technical staffs of Nui Chua MPA Management Board and the volunteers mark label for turtles to monitor the amount of turtles which turn up beach second time (a year). That number increases from 2 turtles (in 2008) to 3 ones (in 2009), then fall down to 2 turtles in 2010 and 2011. Therefore, the number of eggs were laid and hatched in 2009 is highest, 1010 and 958 eggs, respectively. Year 2010 has the decreasing numbers of eggs compared with year 2009, however they were still much more than year 2008 (657 laid eggs and 534 hatched eggs compared with 608 and 450 hatched eggs). The number of dead juvenile turtle is absolutely reduced, from 39 turtles in 2008 to 32 ones in 2009 and reach the lowest number in 2010, 8 turtles. All live juvenile turtles were helped to come back sea, the percentage were increased from 67.6% in 2008 to 79.6% in 2010 per total turtle eggs. The amount of turtle's eggs increase could be the result of improvement on technic of people who are the volunteer protecting sea turtle in Nui Chua MPA.

Coral

It can be seen from Figure 4 below, in the comparison with 2003, the coverage of coral in 2011 was declined. However, the change of coral cover in Nui Chua MPA was divided two periods. In the period 2003 - 2007, the coverage of living coral significantly decreased (from 30.5% to 21.8%). In the period 2007 – 2011, the coverage gradual climbed up and reached 28.9% in 2011, in which, hard coral was 20.2% (2007) up to 25.5% (2011) and soft coral was

from 1.6% to 3.3%. The coverage of recently killed coral is lower than 1.2%, except in 2010, it was 3.6%.

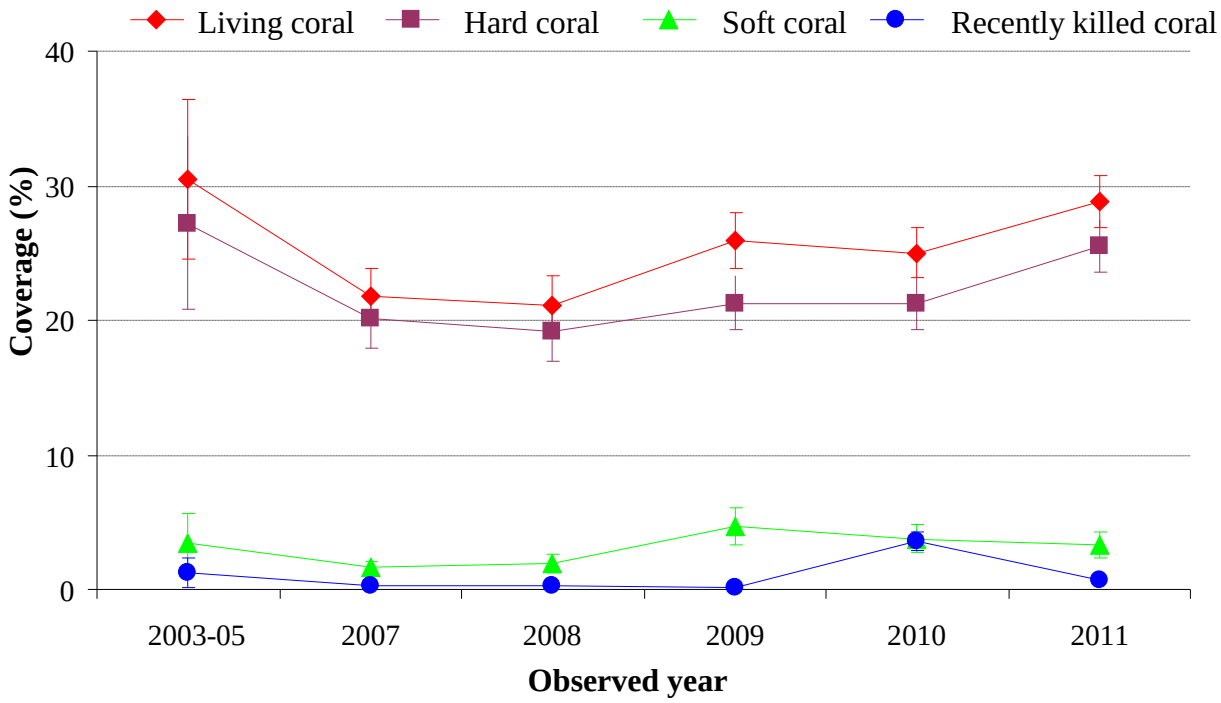


Figure 4: Coverage of coral in Nui Chua MPA through years

(Source: Long 2012)

Reef fish

As presented in Background part, reef fish in Nui Chua MPA is varied with 260 species of 104 genuses, 28 families (Long 2012). The average density of reef fish is 80.0 – 222.6 individual/100m^2, mainly on small fish group 1-10cm and 11-20cm. Big fished sized 21-30cm and > 30cm have extremely low density, under 0.7 individual/100m^2 (See figure 5)

It can be seen from two graphs below that the abundance of reef fish increased immediately in four years after the MPA was established, from 78.7 in period 2003-2005 to 119 individual/100m^2 in 2007, especially density of fishes sized 21-30cm rise from 0.03 to 0.44 individual/100m^2. However, it had slightly declining trend in three following years, then suddenly increased sharply in 2011 on group 1-10cm and 21-30cm. The density of reef fish, especially 1-10cm and 21-30m fishes are from 87.5, 72.1 and 0.1 individual/100m^2 in 2010 to 222.6, 200.1 and 0.65 individual/100m^2 in 2011, respectively. The upward trend of reef fish seems to appropriate with the increase of coral coverage recently.

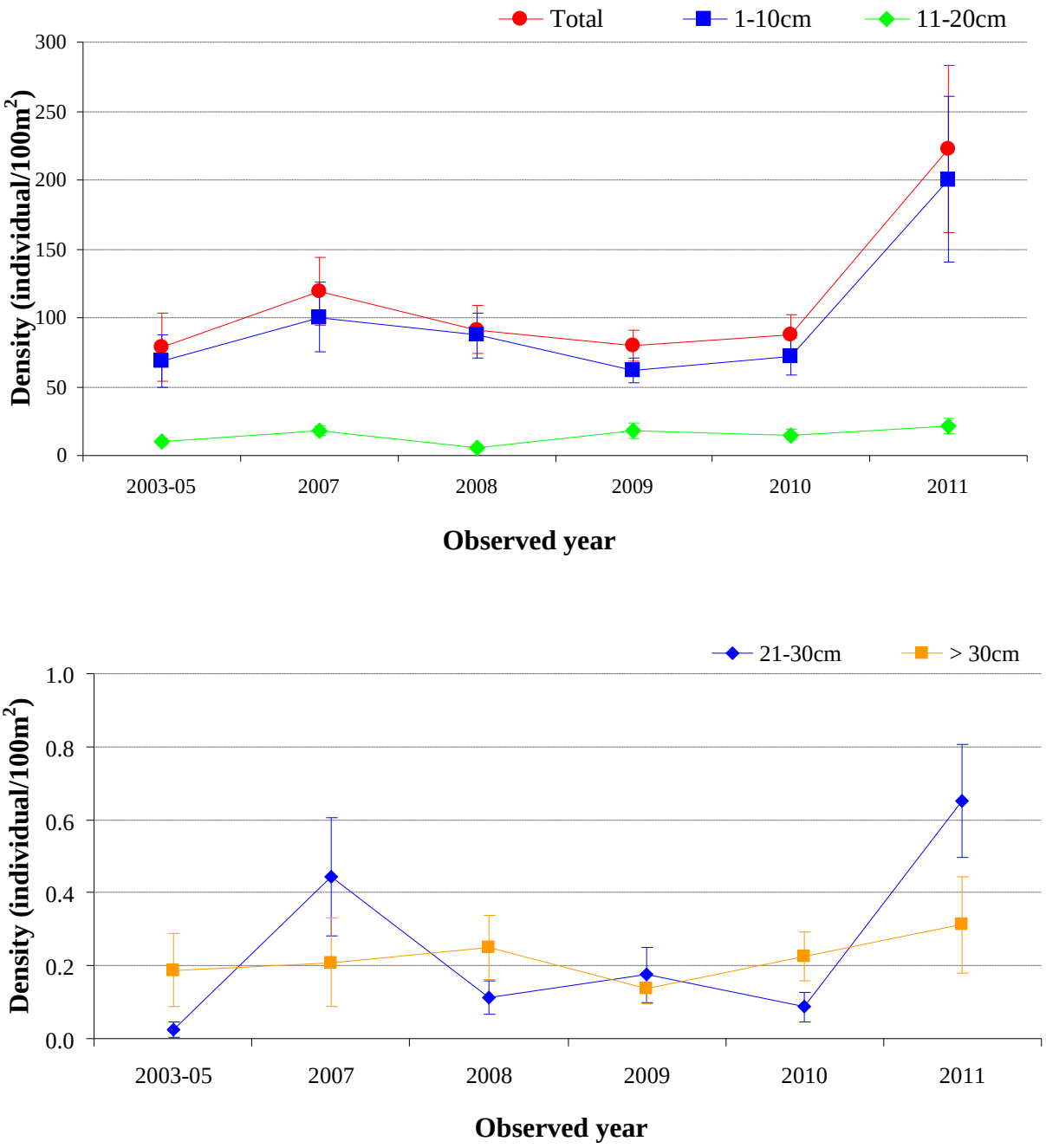


Figure 5: Density (+ s.d.) of reef fish in Nui Chua MPA
(Source: Long 2012)

Molluscs

The graph below shows the variation of density of molluscs in Nui Chua MPA. The density of molluscs is low almost years from 2003 to 2011. The highest density of dune snail is 0.9 individual/100m^2 and giant clamp is 0.3 individual/100m^2 in 2007. The same as density variation of reef fish, molluscs also had the increasing trend after the MPA was created,

however decreased up to 2011. In 2011, there is a raised number of dune snails (0.2 individual/100m^2) compared with 0 individual in 2003-2005 and a declined number of giant clamp from 0.3 in 2003-2005 to 0.1 individual/100m^2.

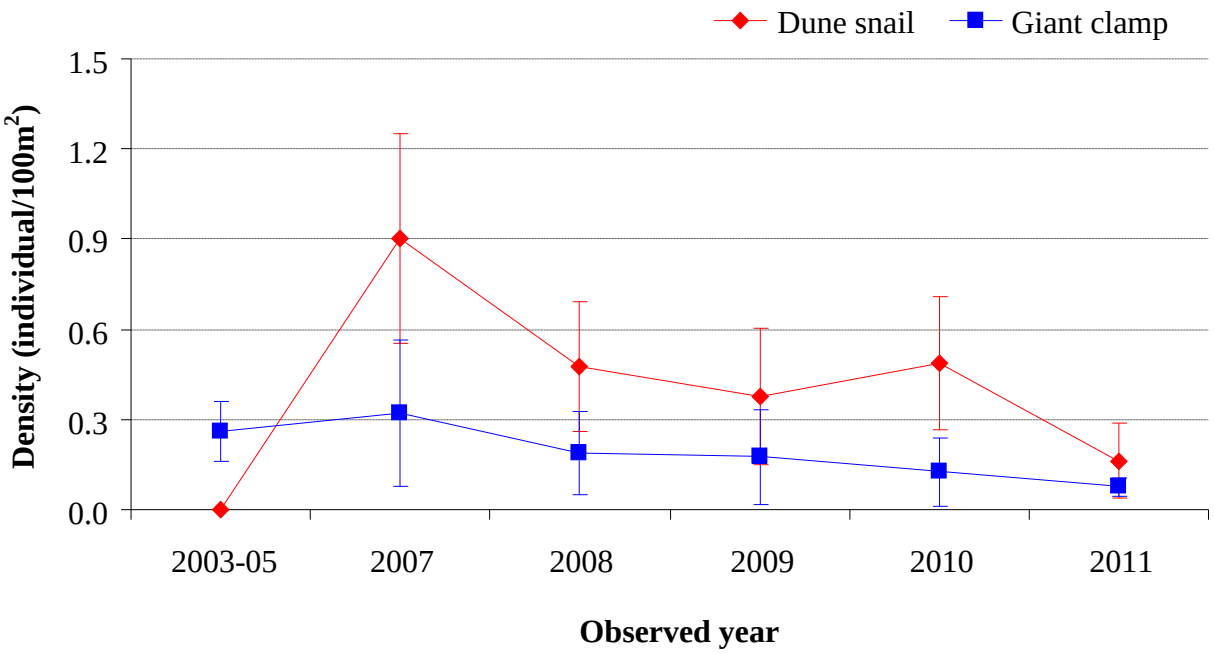


Figure 6: Density (+ s.d.) of molluscs in Nui Chua MPA
(Source: Long 2012)

Crustacean

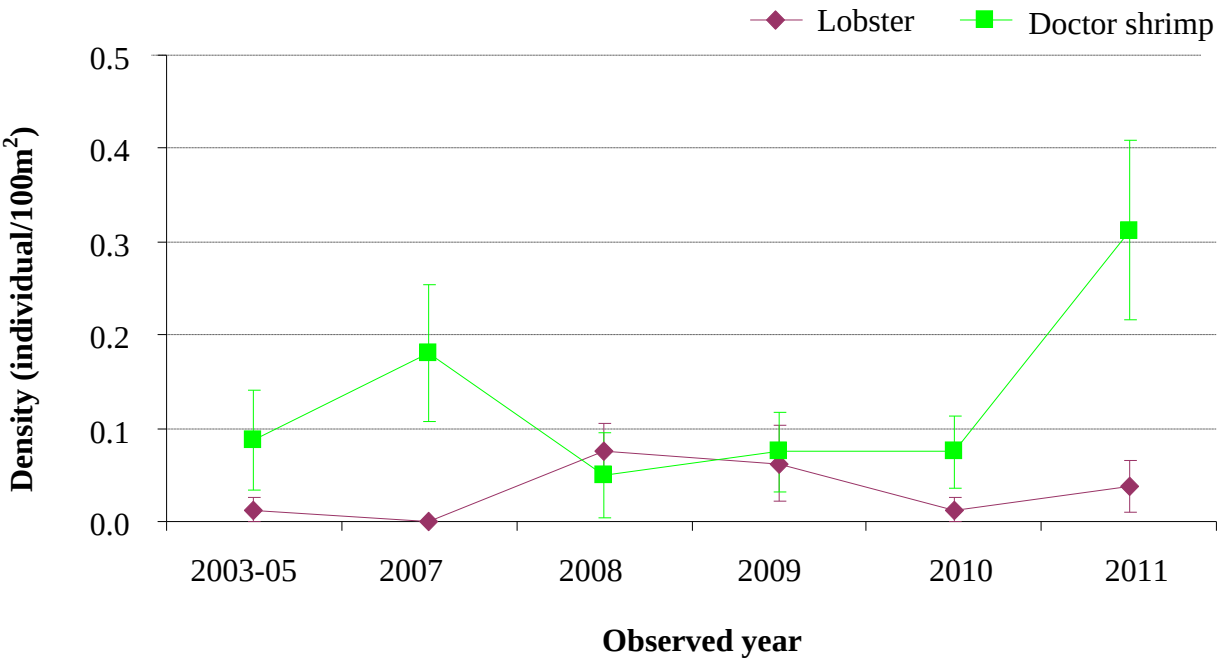


Figure 7: Density (+ s.d.) of Crustacean in Nui Chua MPA
(Source: Long 2012)

Crustacean has lowest density in Nui Chua MPA (<0.32 individual/100m^2) and the changing trend is not steady. In which, the density variation of doctor shrimp is similar to reef fish. It slightly increased after the effect of MPA from 0.08 in 2003-2005 to 0.18 individual/100m^2 in 2007, then decreased up to 2010 (0.075 individual/100m^2) and increase again in 2011 with 0.31 individual/100m^2. The change of lobster is different. It reached the highest number in 2008 (nearly 0.1 individual/100m^2). That number fell down to 0.0375 in 2011, however it still higher than 0.0125 in 2003-2005 (see Figure 7)

5.1.2. Composition and structure of fish in Nui Chua MPA

In general, the density of some target fish families in Nui Chua MPA in 2011 increased compared with 2003. (See Table 4) However, it could not be said that it is the result from well management of this MPA due to the uncertain trend of density variation from 2003 to 2011. Fish families in Table 4 belong to food group and aquarium group. Labridae and Pomacentridae seem to have the highest abundance in Nui Chua MPA years through years. However, Siganidae suddenly increased significantly in 2011 (from 3.4 individual/100m^2 in 2010 to 123.2 individual/100m^2) and reached the highest position in abundance of reef fish.

Table 4: Abundance of some fish families in Nui Chua MPA from 2003 to 2011

Unit: individual/100m^2

	2003-2005	**2007**	**2008**	**2009**	**2010**	**2011**
Labridae	19.7	26.9	19.0	16.2	21.1	43.7
Pomacentridae	25.1	44.6	37.5	37.1	35.4	24.1
Siganidae	1.7	8.2	1.2	0.3	3.4	123.2
Acanthuridae		5.8	8.8	9.7	9.8	9.0
Scaridae	4.6	10.9	1.9	4.3	11.2	4.8
Chaetodontidae	2.2	2.3	3.6	2.2	2.2	3.4
Serranidae	0.3	2.2	1.0	0.6	0.2	0.2
Pomacanthidae	0.1	0.2	0.1	0.2	0.2	0.1
Haemulidae	0.1	0.1	0.1	0.1	0.2	0.1
Lutjanidae	0.0	0.0	0.1	0.5	0.0	0.2

(Source: Long 2012)

We can see the uncertain variation of fish families from the figure 8 below. Most of them increase after four years the MPA was established and then decrease in the next year.

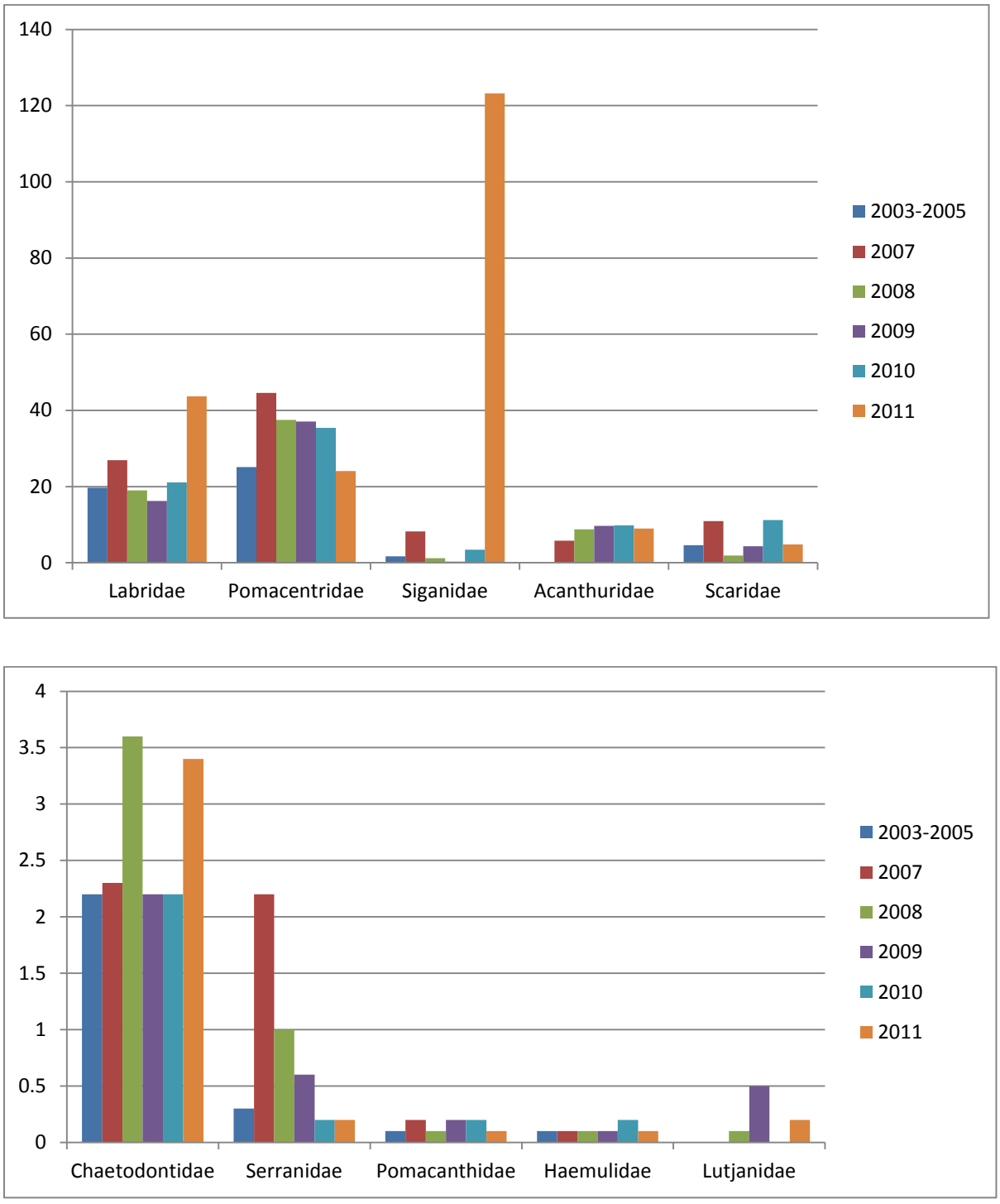


Figure 8: The variation of abundance of some fish families in Nui Chua MPA from 2003 to 2011

While Pomacentridae and Serranidae keep the downward trend until 2011, their abundance in 2011 reduce slightly compared with the period 2003-2005; the density of remain fish families

become higher. Labridae, Siganidae and Chaetodontidae have the marked increase in 2011 with at least double volume. The others have lowest abundance in Nui Chua MPA (around 0.3 individual/100m^2). The difference of them through years is not substantial, for example: Pomacanthidae, Haemulidae, etc.

5.1.3. Fishing effort and catch per unit of effort of vessels operation around Nui Chua MPA

The fishery of villages around Nui Chua MPA is small scale and the operation is almost in shore. Five villages have total 2089 households (Tuan et al. 2012) and about 600 vessels including basket boat, basket boat with engine power (under 12CV) and engine boat (12CV-25CV).

(Photo: Basket boat and engine power boat at Vinh Hy Bay –
*Taken by author on March, 2012***)**

Number of engine boat is a half of total vessel, in which My Tan 1 village has the most (150 vessels). My Hoa village has the less number of vessel compared with four other villages and there is no engine boat here. The number of basket boat in Vinh Hy village is highest (120 basket boats without engine power and 30 basket boats with engine power). Vinh Hy is also

the second village which has the most number of vessels in this area (240 vessels), following My Tan (250 vessels) (See table 5).

Table 5: Capacity of vessels around Nui Chua MPA

STT	Kind of vessels	Number of vessel				
		Vinh Hy	**Thai An**	**My Hoa**	**My Tan 1**	**My Hiep**
1	Basket boat without engine	120	40	10	100	20
2	Basket boat with engine (under 12CV)	30		5		
3	Engine boat (12 - 25CV)	90	20		150	50
	Total	240	60	15	250	70

(Source: Tuan et al. 2012)

The caught target species of local fishermen are broad squid, lobster, sea cucumber, anchovy, sepia, etc., and the main gear used is squid hook and line, diving, lobster trap and three grids trawl (the net has three layers with small mesh size). There is a huge amount of fishermen who diving (410 persons), in which 200 persons come from My Hiep village, 100 persons from Vinh Hy and 100 persons from Thai An village. There is no fisherman from My Hoa live by diving (See Table 6). Hook and line is also used to catch broad squid with total of basket boat is 330. Again, lobster trap is a popular gear in My Hiep village with 200 vessels (per 280 ones in total). However this village only have 30 vessels using three grids trawl, while My Hoa uses the most number of trawl (40 vessels) in 102 one of the total.

According to Hydrometeorological Center of Viet Nam, the average annual rainfall in Ninh Thuận Province is lowest, 700-800mm/year and the coastal zone (include Nui Chua MPA) is rarely impacted by storms. Local fishermen thus go fishing nearly almost of days in year. It is their only answer when they were asked in the self-survey on Mach 2012. Nui Chua MPA log-book data shows that the average operating days per year of lobster trap vessels are the most, 322 days. Hook and line boats catches squid on 300 days. 262 and 245 days are fishing efforts of three grids trawl and diving in areas around the MPA.

Table 6: Number of fishing fleet and caught species of some main gears around Nui Chua MPA

Gear	Caught species	Operating days at sea (day/year)	Number of vessels or person					Total
			Vinh Hy	Thai An	My Hoa	My Tan 1	My Hiep	
Hook & line	Broad squid	300	150	60	15	100	5	330
Three grids trawl	anchovy, broad squid, sepia, Siganus spp., cobia, lobster	262	20		40	12	30	102
Diving	Lobster, Parrotfishes, sea cucumber	245	100	100		10	200	410
Lobster trap	Lobster	322	50			30	200	280

(Source: Tuan et al. 2012, log-book data)

Based on the data collected from log-book program of Nui Chua MPA in 2010 and 2011, the catches per unit effort of four main gears were computed as Table 7. In general, the CPUE of all gears increase from 2010 to 2011. Average CPUE of three grids trawl is the largest number, 72.97 kg/day, while lobster trap, diving and squid hook and line only caught 3.69 kg/day, 5.34 kg/day and 0.93 kg/day, respectively.

Table 7: CPUE of four main gears around Nui Chua MPA

Unit: kg/day

	Three grids trawl	Lobster trap	Diving	Squid hook&line
2010	65.37	3.01	4.86	0.89
2011	80.56	4.37	5.81	0.97
Average	**72.97**	**3.69**	**5.34**	**0.93**

(Source: Nui Chua MPA log-book data)

With only two observed years, it seems to be absolutely difficult to evaluate the effective of Nui Chua MPA by using CPUE due to the lack of information. However, management capacity of the MPA management board could be indirectly assessed through this omission.

5.2. Analyze indicators in group Social science knowledge

5.2.1. Community's perception of availability of the fish around Nui Chua MPA

The local people who were asked in a self-survey about the change in amount of fish catch are fishermen, wives of fishermen, agriculture farmers, etc. 86% of them think that the catch in 2012 is more than the period before the Nui Chua MPA creation. 12% of residents, in opposite, believe that, the catch was decreased. Only 2% think that there is no change in fish catch in their sea area. (See figure 9)

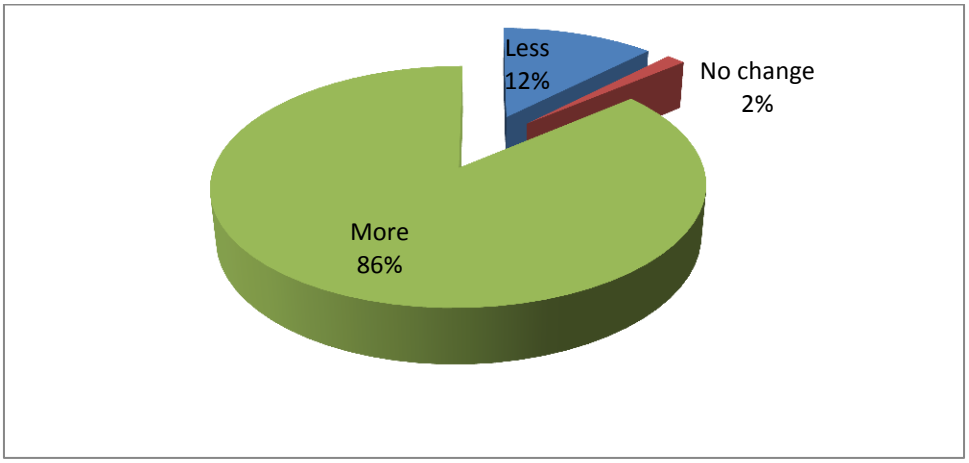


Figure 9: Perception of local people regarding fish catch amount compared with before Nui Chua MPA established

Almost people explained that the harvest increased due to the vessel and equipment is more modern. In addition, they believe that the reduction in exploitation used explosives and chemicals is a reason of protecting coral reef – the living environment of fish; therefore, the amount of fish increase, the catch increase. The species were caught frequently are squid, tuna, mackerel, discus and anchovy.

5.2.2. Household income of people living around Nui Chua MPA

According to the Statistical Yearbook (General Statistic Office of Vietnam 2011), the average monthly income per capita in Vietnam increases year through year. (See table 8) In 2004, it

was 484 thousand VND in whole country, 815 thousand VND in urban area and 378 thousand VND in rural area. Monthly income of residents around Nui Chua MPA in 2004 is about 1.3 million VND (Kien et al. 2004); higher than both whole country and urban area. In 2010, monthly income of Viet Nam is 1387 thousand VND, in which, 2130 thousand VND from urban area and 1071 thousand VND from rural area. It is stated in Prime Ministry's Decision No. 170/2005/QĐ-TTg dated 8 July 2005, poverty level in period from 2006 to 2010 in rural area is lower than 200 thousand VND/month/capita. Therefore, it can be seen that income in the villages around Nui Chua MPA is absolute higher than poverty level.

Table 8: Average monthly income per capita of Viet Nam

Unit: 1000 VND

	1999	**2002**	**2004**	**2006**	**2008**	**2010**
Whole country	**295**	**356**	**484**	**636**	**995**	**1387**
Urban area	517	622	815	1058	1605	2130
Rural area	225	275	378	506	762	1071

(Source: GSO 2011)

Beside information of average income, up to now, there has not been any socio-economic survey create the detail of sources of income in Nui Chua MPA to evaluate the importance of those jobs with local people life. In the self-survey conducted on March 2012, several information regarding to occupation and income of 65 households in 5 villages around Nui Chua MPA was collected and computed. The average income per month of a household is 19,218 thousand VND (See table 9). With the number of total people in 65 households is 245, the average member of a household is 3.77. Thus, monthly income per capita is 5,097 thousand VND which is the result of 19,218 thousand VND divided by 3.77.

There are several of income sources of households: fishing, agriculture (growing grape, apple, onion and garlic; raising goat, sheep, etc.), aquaculture (mainly focus on lobster farming), small business (for example: sell goods for local people, etc.), tourism and hired job (work for government office or other companies). They could be main source of income or extra income depending on how many jobs household members have and how much people earn from these jobs. For example: in a household of Vinh Hy village, the husband could be a

fisherman and his income is from going fishing while the wife is worker of a local company and her income is one quarter of her husband's income. Thus, it can be said that main income of their family comes from fishing or in other words, their life depend on fishery.

Table 9: Average monthly income per household regarding to other sources in the villages around Nui Chua MPA

Unit: 1000 VND (1USD=20,828VND)

Income source	Average income per household	%	In which			
			Main income	%	Extra income	%
Fishing	12,880	67.0	12,324	95.7	555	4.3
Agriculture	3,937	20.5	3,750	95.3	187	4.7
Aquaculture	720	3.7	720	100.0	0	0.0
Small business	575	3.0	548	95.4	27	4.6
Tourism	73	0.4	20	27.2	53	72.8
Hired jobs	1,033	5.4	930	96.1	40	3.9
Total	**19,218**	**100**				

(Source: self – survey, 2012)

It can be seen from table 9 that fishery plays the most important role in creating monthly income for a household, reach 67%; in which 95.7% income from fishery is main income. It is followed by agriculture with 20.5% in total income source. Aquaculture brings 3.7 % to household income of this area; while tourism brings very small percentage of income to household, 0.4%. Small business and hired job contribute 3.0% and 5.4% in household income of 5 villages around Nui Chua MPA.

5.2.3. Household occupational structure of villages around Nui Chua MPA

The occupations are mainly mentioned in this analysis are fishing, agriculture, aquaculture, small business, tourism and hired labour. The others could be house work, student, old people, etc. The villages around Nui Chua MPA have different natural condition; thus, the occupation structures are also different and change years through years. However, it seems to be no detail reports regarding to social-economic condition in those villages except report of

LMPA in 2008 before Nui Chua MPA was received supports from that component. Therefore, the comparison here seems to be relatively due to the source of information is not heterogeneous. Household occupation structure in 2008 comes from report of LMPA; while information in 2012 comes from self-survey.

In My Hiep village, the percentage of fishermen decreases, from 75% in 2008 to 36% in 2012. The pie chart in 2008 does not show the proportion of people who work in small business, tourism and hired labour areas; however, in 2012 they are 12%, 5% and 5%, respectively. In 42% of other occupations, there could be include the people who are housewives, students, old people, aquaculture farmers, etc.

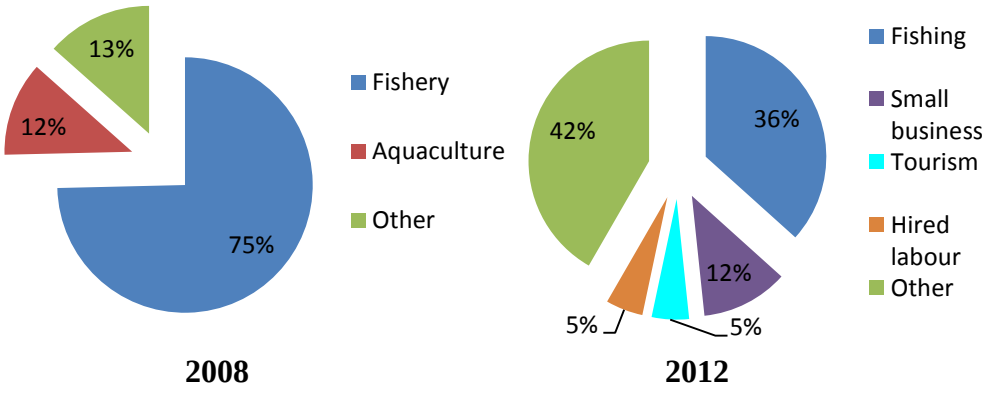


Figure 10: Occupational structure in My Hiep village in 2008 and 2012
(Source: Trung et al. 2008 and self-survey 2012)

My Hoa is a village which has high ratio of person who work as agriculture farmer, 58% in 2008 and 63% in 2012. (See Figure 11) The fishermen are also increase may be due to beside the time they spend on field, they can go fishing as an extra job to improve their life.

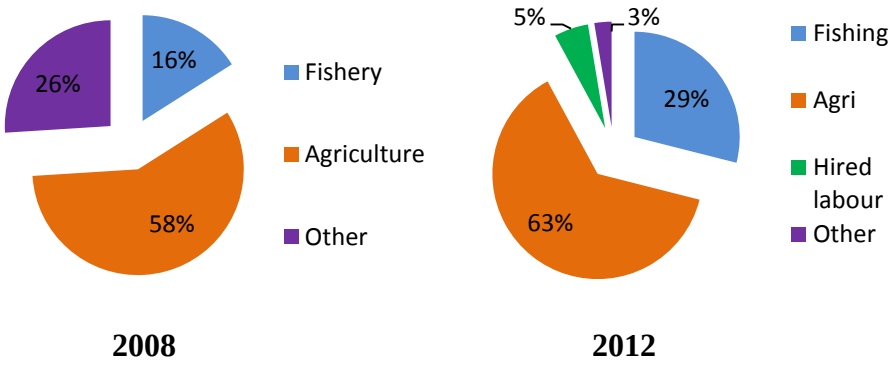
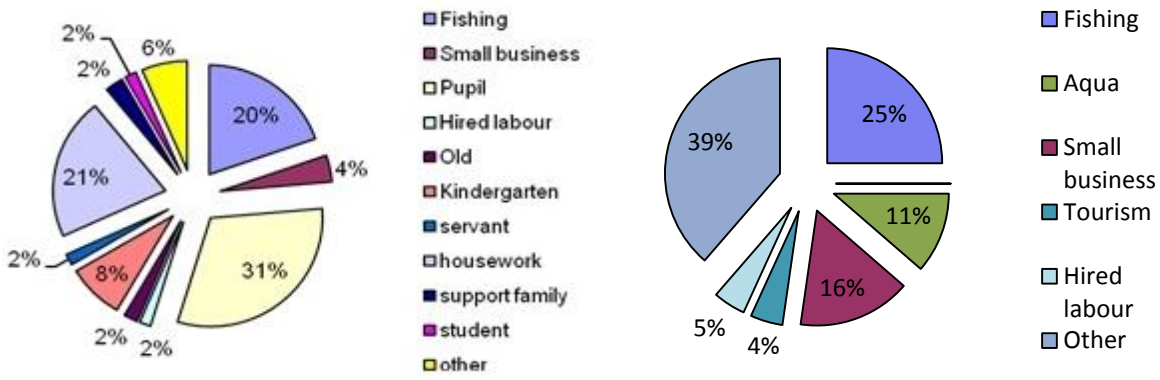


Figure 11: Occupational structure in My Hoa village in 2008 and 2012

(Source: Trung et al. 2008 and self-survey 2012)

Vinh Hy, located in Vinh Hai commune, is the village on tourism development area of Nui Chua MPA. However, in 2008 tourism was not important occupation and was not mentioned in the left pie chart of Figure 12; while in 2012, more people worked in that area with the percentage is 4%. In 2008, there was also no record of aquaculture and small business on Vinh Hy's occupation structure. Therefore, they have been 11% and 16%, respectively, in 2012. Almost wives of fishermen in Vinh Hy stay at home; the proportion in 2008 is 21%. In 2009, Ninh Thuan Province approved to Nam Nui Chua Joint Stock Company of creating an eco-tourism zone in development area of Nui Chua Nation Park, located in Vinh Hai commune. Therefore, several people in Vinh Hy have been hired to work as mason, gardener, etc. Becoming a worker of this company seems to be a new job for fishermen or house wives in Vinh Hy village.



2008 **2012**

Figure 12: Occupational structure in Vinh Hy village in 2008 and 2012

(Source: Trung et al. 2008 and self-survey 2012)

5.2.4. Conflicts between resource users around Nui Chua MPA

Almost people around Nui Chua MPA who were interviewed in the survey believe that marine resource are common property, any person who has fishing ability can fish. The pie-diagram below shows that 89% residents answered that there is no conflict in their community. 5% of other people think that huge and modern vessels from other provinces (for instance: Khanh Hoa, Binh Thuan) came and competed with local vessels. However it is not much because almost of vessel in Nui Chua operate near coastline and the outside vessels mainly exploit farther. 3% is the conflicts between fishery and aquaculture and 1% is between tourism and aquaculture. The complaint may come from aquaculture farmers due to the activities of fishing boats and tourism boats effect to quality of lobster in aqua-farm.

Waste fuel, rubbishes from fishing boats and tourism boats daily excrete into the water leading to water for aquaculture become more and more polluted. The percentage of people who do not care about the conflicts is 2% and there is no one thinks that the activities of fishermen using mobile gear impact to the activities of static gear. The explanation for that could be there are clear borders between the activities conducted around Nui Chua MPA.

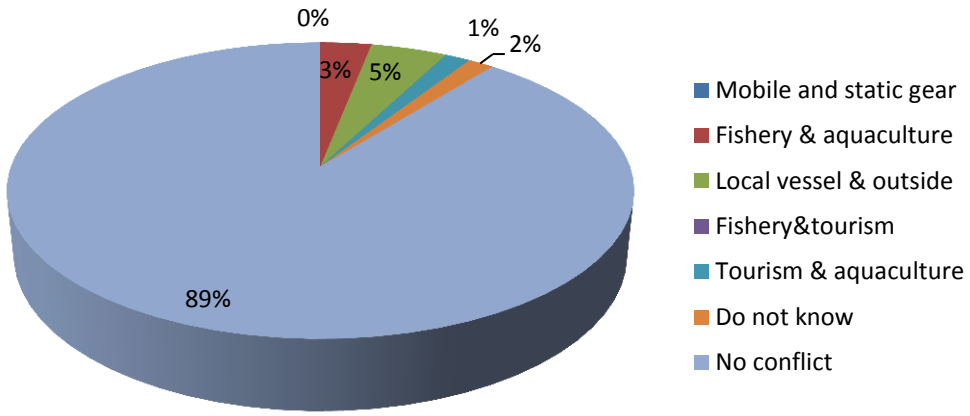


Figure 13: Conflicts between resource users in Nui Chua MPA
(Source: Self-survey, 2012)

5.2.5. Costs and earnings of the vessels affected by MPAs

Fishermen in villages around Nui Chua MPA do not have to pay tax or insurance, therefore, costs of vessels operating in this area include: investment cost and repair/maintenance cost. These costs cannot be separated on smaller cost, for example, investment cost covers the cost of vessel, engine power and gear. Fishermen only remember the total costs and they were indicated in Table 10 below.

Although the vessels using three grids trawl have the highest average investment cost, however its economic life is long, thus, the depreciation per year is lower than vessels for diving (1365.625 compared with 1894.444 thousand VND). The vessels of squid hook and line have the smallest depreciation due to lowest investment cost (3 million VND) and short economic life (4 years). Repair and maintenance costs are estimated 5.1 million VND for a vessel of three grids trawl, 1.585 million VND for lobster trap, 3.3 million VND for diving vessel and only 580 thousand VND for basket boat of hook and line. From those data, the total fixed cost could be calculated as the table 10.

Table 10: Annual fixed cost of a vessel operating around Nui Chua MPA

Unit: 1000 VND (1USD=20,828VND)

	Investment cost (1)	Economic life (year)(2)	Depreciation (1)/(2)	Repair cost	Total fixed cost
Three grids trawl	43700	32	1365.625	5100	**6465.625**
Lobster trap	8000	6	1333.333	1585	**2918.333**
Diving	34100	18	1894.444	3300	**5194.444**
Squid hook&line	3000	4	750	580	**1330**

(Source: Nui Chua MPA log-book data, self-survey 2012)

Total fixed cost of vessel using three grids trawl is highest, 6465.625 thousand VND. It could be due to that vessel exploit farther and intensity of using is more than others. In addition, the gears of that vessel are always torn and have to be repaired. Thus, its repair/maintenance cost is also highest. Squid hook and line normally use basket boat with low investment cost and repair/maintenance cost, therefore the average fixed costs is smallest, 1,330 thousand VND/year.

Table 11: Average variable cost and revenue per vessel toward four main gears around Nui Chua MPA

2010	Operating days at sea (day/year)	Variable cost/day (1000 VND)	Variable cost /year (1000 VND)	Revenue /day (1000 VND)	Revenue /year (1000 VND)
Three grids trawl	300	75.847	22754.03	97.867	29360.08
Lobster trap	262	35.663	9343.627	387.201	101446.8
Diving	245	200	49000	874.286	214200
Squid hook&line	322	18.546	5971.845	84.915	27342.54
2011					
Three grids trawl	300	33.684	10105.26	219.741	65922.23
Lobster trap	262	55.406	13962.23	380.104	99587.23
Diving	245	78.849	19317.91	522.045	127900.9
Squid hook&line	322	13.438	4327.258	119.723	38550.95

(Source: Nui Chua MPA log-book data)

Variable costs were collected in log-book program include the payment for fuel, foods, ice and crews, etc. The ratio of profit per trip between owner and crews is 50:50. The owner keeps 50% profit after subtracting the expense of fuel, foods and ice, etc. The rest 50% is equally shared to crews, include the owner if they also participate on fishing. The number of crews in vessels using three grids trawl is from 2 to 6 and in vessels of diving is from 2 to 3 depend on horse power of vessel. Lobster trap and squid hook and line only need one person. That may be the reason of two lowest variable costs and highest revenues of lobster trap and squid hook and line in 2010 and 2011 (see table 11).

With the information of average number operating days at sea in log-book and variable cost and revenue per day, the variable costs per year can be calculated by multiplying variable costs per day by number operating days at sea. Revenues per year are calculated with the same way, multiplying revenue per day by number operating days at sea.

Table 12: The average profit per vessel of four main gears operating around Nui Chua MPA in 2010 and 2011

Unit: 1000 VND (1USD = 20,828 VND)

2010	Total fixed cost (1)	Variable cost (2)	Total cost (3) = (1)+(2)	Revenue (4)	Net profit (5) = (4)-3	Profit margins (%) = (5)/(4) * 100%
Three grids trawl	6465.625	22754.03	29219.658	29360.08	140.426	0.48
Lobster trap	2918.333	9343.627	12261.960	101446.8	89184.874	87.91
Diving	5194.444	49000	54194.444	214200	160005.556	74.70
Squid hook & line	1330	5971.845	7301.845	27342.54	20040.695	73.29
2011						
Three grids trawl	6465.625	10105.26	16570.884	65922.23	49351.343	74.86
Lobster trap	2918.333	13962.23	16880.566	99587.23	82706.661	83.05
Diving	5194.444	19317.91	24512.354	127900.9	103388.586	80.83
Squid hook & line	1330	4327.258	5657.258	26698.33	21041.072	78.81

(Source: Nui Chua MPA log-book data)

Total cost per year of a vessel is the sum of total fixed cost and variable cost. Net profit is equal to revenue minus cost. Profit margins are necessary ratios to understand the percentage of profit in revenue.

It can be seen from table 12 above that all profit margins of four gears in 2010 and 2011 are positive; that means fishing activities of all vessels are profitable. Profit margin of three grids trawl in 2010 is very small, 0.48%. However, it increased to 74.86% in 2011 due to higher revenue and lower cost compared with 2010. Lobster trap has the highest profit margins, 87.91% in 2010 and decreased to 83.05% in 2011. The profit percentages of profit in revenue of diving and squid hook and line were rising from 2010 to 2011. They are 74.70% and 80.83% for diving; and 73.29% and 78.81% for squid hook and line.

5.3. Analyze indicators in group Governance

5.3.1. Level of Nui Chua communities' participation and satisfaction in management process and activities

There are 28 people/65 interviewees (43.1%) answered that they were invited to the meeting of community to collect the idea about general policy and decision. Most of them are leaders of inhabitant groups in five villages around Nui Chua MPA, leaders of autonomy groups, the volunteers of protected sea turtle group and coral reef group, etc. Among the participants, 29% people come only 1-2 times, 11% and 14% are the degrees of "some time" and "usually" participants, respectively, and 46% participate frequently (no absent) (See Figure 14).

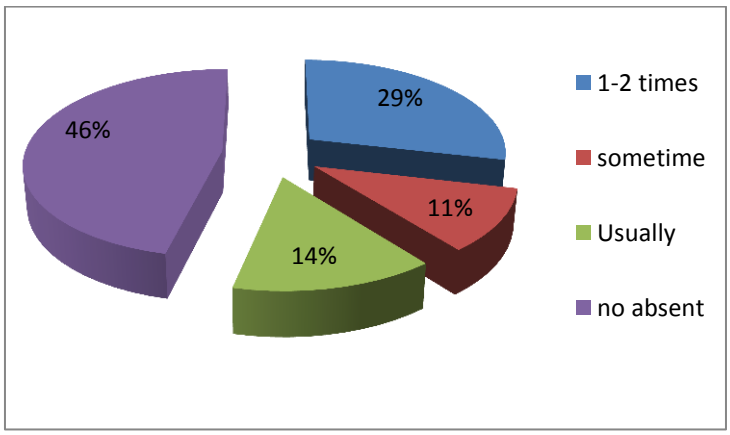


Figure 14: The participation of residents on meetings for managing

Nui Chua MPA *(Source: self-survey, 2012)*

5.3.2. Degree of interaction between managers and stakeholders in Nui Chua MPA

41.5% people believed that the authority always ask their ideas to manage the MPA more efficiency, and 75% people think that their comments and suggests were attended by the authority (self-survey, 2012). General meetings, which include the managers of Nui Chua MPA and other stakeholders, were organized once each three months or when there are important activities needed to be conducted. The activities of autonomy and volunteer groups are different. They meet each other monthly to access their operations then record to the managers. There is an example in reality, when LMPA component supported to build a pier in 2011 in Vinh Hy village, which located in tourism development zone of Nui Chua MPA, the residents were asked about the size and material that the pier should have (Nui Chua MPA Management Board, 2011 and self-survey, 2012).

5.3.3. Level of communities' involvement in surveillance, monitoring and enforcement

As presented in Background part, there are two volunteer groups in Nui Chua MPA which started their activities from 2003, after the MPA was introduced. They daily are at protection station in the beach to monitor and protect see turtles or boating to coral reef areas by their own boat. With the illegal activities in protected areas, they can make records of administrative violations, temporarily seizing material evidences such as boats, generators and power grids then transfer the records and material evidences to People's committee of communes or inspectors of department of fishery resources protection. Each volunteer is received the support 150,000 VND per month from Nui Chua Management Board. 100% fishermen, who were asked on the self-survey on March 2012, said that they volunteer to protect marine resources because they love the nature, want to have relaxed time at beautiful places and want to directly help turtles come back to their habitat. 7/10 people think that they want to help the managers on patrolling, supervision and protection in management process.

6. DISCUSSION AND CONCLUSION

6.1. Discussion

The results of this paper show that the introduction of Nui Chua MPA and the management implementation here generated several benefits for both biodiversity at this coastal zone and livelihood of local people. From analyzing the biological indicators, it can be seen that the abundance of almost species inside the MPA is somewhat stable and increased. Sea turtles, for which the protection is the main reason of the creation of Nui Chua MPA, have stable amount. Although there is no exact evidence in number of sea turtle from 2003 to 2007 and the change of them from 2008 to 2011 in the table 3 is not upward trend, according to Nui Chua MPAMB, the recent amount of them has been increased compared with before the creation of the MPA. The second most important creature is coral reef. Despite the smaller coverage than 2003-2005, living coral in this area has been increased from 2007, in which there is a substantial increasing trend of hard coral, a slightly reduction of soft coral and extremely small coverage of recent killed coral (lower than 1.2%). Besides there has been a gradual fall in molluscs, unstable change of several reef fishes and lobster, density of reef fish also rises, especially from 2009, common in the fish sized 1-10cm and 11-20cm. Compared with the downward trend of fish abundance in Nha Trang MPA (Armstrong and Ngoc 2011), biodiversity of Nui Chua MPA is more improved.

CPUE of some main fishing gears operating around Nui Chua MPA all increases from 2010 to 2011. While the CPUE of several fishing gears in Nha Trang MPA have both trends upward and downward (Armstrong and Ngoc 2011). CPUE of three grids trawl in Nui Chua MPA has the largest difference from 65.37kg/day in 2010 to 80.56 kg/day in 2011. It is possibly the improvement in amount of fish in two years. However, the observed period is extremely short and there is no data of biodiversity outside the MPA. It is difficult to conclude that is the effect of spillover in this area. Several continuing researches should be carried out both inside and outside the MPA to compare and control the change of biological indicators.

Around Nha Trang MPA, 69% of the residents believed that the catch in 2009 has reduced compared with the period before the MPA creation (Armstrong and Ngoc 2011). There is an absolute opposite perception of 89% community around Nui Chua MPA that the catch in 2012 has increased. This result may also explain for the increase of species' abundance in

Nui Chua MPA. Other socioeconomic indicators mention regarding to livelihood of local people around the MPA. Monthly income per capita in this area is higher than not only poverty threshold but in the whole country. Although agriculture is very important in this area and contributes about 20% to income source of local households, fishery still is their most critical livelihood with 67%. The tourism development brings several new occupations to local people, especially to households living base on marine resources. The pressure on marine resource may simultaneously reduce. Nevertheless, the percentage income people earn from tourism is only 0.4%. Because the tourism area is small and mainly located in Vinh Hy village in which there is Vinh Hy Bay. While the occupational change in Nha Trang MPA was evaluated basing on gender (husband and wife) (Armstrong and Ngoc 2011), this study shows the changes in occupation vary from village to village. Because the natural condition of all villages is absolutely different and there is not the same trend in those villages. For instant: in Thai An and My Hoa village, there are several large fields of grape, apple, garlic and onion. Those products are not only famous in Ninh Thuan province but also in Vietnam and have high economic value. Therefore, not only fishermen but also wives of fishermen may become farmers or hired labors on agriculture fields when the fishing ground has been limited after the establishment of the MPA. Developing eco-tourism is one of objectives of Nui Chua MPA, thus, in the villages, which have beautiful view or protected species such as Vinh Hy (Vinh Hy Bay, coral reef), Thai An (coral reef, sea turtle) and My Hiep (coral reef), the percentage of residents who work in tourism and aquaculture field has been increased due to more and more tourists come to Nui Chua MPA.

On the assessment of costs and earnings of vessels affected by the MPA, there is no comparison in gross income per fishing day of some fishing gear in Nha Trang MPA between main season and other season as in the study of Armstrong and Ngoc (2011). However, not only net profits but also profit margins per vessel in Nui Chua MPA were computed and compared in two year 2010 and 2011. The results show that benefits from fishing activities by using four main gears to exploit fish are high. It may be the explanation for the high percentage of people (89%) who think there is no conflict in their living area due to the fishing activities are still profitable, they do not need to “cross the border” into other ones’ areas. Vessels using three grids trawl, diving and squid hook and line have increasing profit margins, only lobster trap has created decreasing profit margins from 2010 to 2011. This reduction comes from the rise in variable cost and the slight decrease in revenue of lobster

trap vessel. However, its CPUE still increases in two year, thus the decrease in revenue may come from the fall of lobster's price in the market.

The role of stakeholders is very important in management process in Nui Chua MPA. They directly or indirectly created the improvement of local people from the awareness about the MPA to their real activities. Communities are the people whose daily lives happen around the MPAs. They understand both natural and socioeconomic conditions here clearly; their opinions in managing the MPA thus should be considerable. In fact, 70% of residents believe that the managers of Nui Chua MPA followed their comments and suggestion. For example: the volunteer groups proposed time and methods to monitor sea turtles and coral reefs in Thai An and My Hiep villages then it is approved by the authority; community of Vinh Hy village suggested the size and material of the pier which was built in 2011 and they themselves directly collect the using fee from fishing and tourism boats, monitor and control the activities of vessels in the pier's place; etc. Daily supervision of volunteer groups is the reason of reducing the number of fishing operations which have negative impact in protected area, leads to the increase of marine resources.

Nui Chua MPA Management Board has the highest responsibility in management process in Nui Chua MPA. By sharing the missions and benefits with the communities and other stakeholders, the managers have generated the improvement in awareness of local communities about the importance of Nui Chua MPA and the participation voluntary in management activities. Achieved results somewhat reflect several positive impacts of the MPA and the management into biodiversity in this coastal area and livelihood of local communities. Therefore, that responsibility sharing can be seen as a good point in Nui Chua MPA management process and should be considered by other MPA Management Board.

To conduct management activities, even collecting data for studying purpose, the managers need a huge budget which is not the easy issue for Nui Chua MPA Management Board. Although the MPA was created in 2003, it still was not listed in MPAs Network Planning of Vietnam until May 2010. All supports from government are extremely limited. Up to now, the MPA have been received a large range of financial and technical support of Non-Government Organizations (NGOs) or Official development assistance (ODA) projects such as WWF, IUCN, LMPA component. However, all of those supports are also limited and the using purposes have to depend on the objectives of projects, do not only provide for the MPA's objectives. Hence a certain budget for annual management and assessment should be

considered and created in general management plans. For example: a part of benefits from tourism companies of leasing land to open eco-tourism zone inside the MPA, from the entrance fees of tourists, etc.

Besides the careful preparation in financial issue, completing the law system and legend documents related to marine resources conservation in Nui Chua MPA and separating clearly detail missions of each agency is necessary. The addition of specialized skillful staff for Nui Chua MPA Management Board is extremely important to manage the MPA more effectively; etc.

The limitation of this study is lack of some important data. The observed period for evaluating socioeconomic is extremely short. It is difficult to compare the exact change in CPUE or profits of vessels around Nui Chua MPA at recent years with the period before the MPA creation without data in the past. The occupational data collection is also different between year 2008 and 2012. One is a wide range of survey which was supported by LPMA component with large number of sample and the participation of several experts. One is the private survey with smaller sample and limited capacity and financial condition. Those problems could be solved by continuing collecting fishing diary from fishermen for log-book data program at least two more years; conducting a general survey in all biological, socioeconomic and governance aspects with large sample as the one in 2008.

6.2. Conclusion

It can be said that the management in Nui Chua MPA is the combination of two approaches "top-down" and "bottom-up" with the key role of communities. After analysing biological, socioeconomic and governance indicators in Nui Chua MPA, it can be concluded that collaborative management of this MPA seems to be somewhat successes. Despite several of problems in related to presented policy, financial and human force aspect, etc., there is still a small increase in biodiversity and substantial improvement livelihood of local communities. The high benefit from fishing activities around Nui Chua MPA could be the motivations for fishermen continue exploiting marine resources. Thus, a more strictly management should be implemented in this area to ensure that the conservations and activities of fishermen still follow the regulation of the managers.

However, any change of natural, socioeconomic and governance conditions could impact not only to Nui Chua MPA but also the management. Assessment of management effectiveness seems to be an important part of management process (Armstrong and Ngoc 2011). Therefore, conducting the regular evaluations will help all managers have timely adjustments to reduce the negative impacts on marine resources to the lowest level or have the solutions to create sustainable livelihoods for the communities around the MPA. The data and information for analysing those three group indicators should be collected in next uninterrupted periods to evaluate more detail and exactly.

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APPENDIX

Questionnaire

Section 1: General information

1. **Gender**: Male/Female
2. **Village**:……
3. **Age**:……
4. **Level of education**:……

☐ Under Elementary ☐ Elementary ☐ Secondary ☐ High school

☐ Other:…….

5. **How many people in your family?**.....

Section 2: Occupation and livelihood

6. **Your family's average income per year**:……

7. **To compare with 5 years ago, your family's income:**

☐ Increasing ☐ Decreasing ☐ Unchanged

Member	Age	Gender	Level of education	Main job (Average income per month)	Second job (Average income per month)	Third job (Average income per month)
1)						
2)						
3)						
4)						
5)						
6)						
7)						

8. **Do you participate in volunteer groups?** ……..……
   Which one?

   ☐ Protect coral reef ☐ Protect ocean turtle

9. **Do you think that your participation in volunteer groups is helpful for protecting marine resource and managing the MPA?**

   ☐ Yes ☐ No

10. **Why do you participate in volunteer group?**

    ☐ For fun

    ☐ Want to receive financial support from MPA management unit

    ☐ Love the nature and want to directly protect ocean turtle/coral

    ☐ Want to help MPA management unit, local government

    ☐ Other reason:……..

11. **Have you been received financial support from MPA management unit? If yes, how much per month?**

    ☐ Yes…….. ☐ No

Section 3: Perceptions of local people towards Nui Chua MPA

12. **Do you know the Strictly Protected area in Nui Chua MPA?**

    ☐ Yes ☐ No

13. **If yes, from which way did you know that?**

☐ Flyers, posters

☐ Communication performance

☐ TV, radio, local radio, newspaper

☐ Community meetings

☐ Other:……..……

14. What do you think about the number of fish in the sea in Nui Chua?

☐ Less ☐ No change ☐ More

Especially which kind of species?.....

Why do you think that?

☐ The catch is decreasing/unchanged/increasing

☐ Number of fishermen and boats are increasing/unchanged/decreasing

☐ Many fishermen outside MPA come

☐ The number of aquaculture farm increases

☐ Fishing has been banned in strictly MPA area

☐ Other reasons:…….**.....**

15. Is there any conflict around your living area?

☐ Between fishermen using mobile gear (trawls, purse seine) and static gear (gillnet)

☐ Between fishery and aquaculture

☐ Between local fishermen and others from different places

☐ Between fishery and tourism development

☐ Other

16. Do you like the introduction of Nui Chua MPA? Why?

☐ Yes. Because: (choose some reasons)

- The beach is more beautiful
- Ocean turtle and coral reef are protected
- More and more tourists come -> can sell fish or local gift
- Some kinds of fish are protected

- Household income increase
- Children were trained to work for tourism (cook Asia and European food, make baker, etc)
- Livelihood is supported
- Other reason:……

☐ No. Because: (choose some reasons)

- Have to go farther to fish
- Income from fishing decreases
- Other reason:……

Phần 4: Level of participation in MPA management

17. Do manager of Nui Chua MPA or local government ask your idea about general policy and decision?

☐ Yes ☐ No

18. Do you participate in the meeting for implementing activity in NC MPA?

☐ Yes ☐ No

If yes, how many time per year?

☐ 1-2 times

☐ Sometimes (absent 4-5 times)

☐ Usually (absent 1-2 times)

☐ No absent

19. Have your idea been attended by MPA management unit or local government?

☐ Yes ☐ No