การใช้ทรัพยากรประมง และแนวทางการจัดการที่หมู่เกาะอาดัง-ราวี-หลีเป๊ะ อุทยานแห่งชาติตะรุเตา และเกาะบุโหลน อุทยานแห่งชาติหมู่เกาะเภตรา[1]

FISHERY RESOURCE USES AND MANAGEMENT INTERVENTION AT ADANG-RAWI-LIPE ISLANDS, TARUTAO NATIONAL PARK , AND BULHON ISLANDS, MU KO PHETRA NATIONAL PARK

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บทคัดย่อ

อุทยานแห่งชาติตะรุเตาและอุทยานแห่งชาติหมู่เกาะเภตราถูกกำหนดให้เป็นเขตสงวนสภาพธรรมชาติเนื่องจากพื้นที่บริเวณดังกล่าวมีความหลากหลายทางชีวภาพสูงและมีระบบนิเวศของแนวปะการังที่กว้างใหญ่ ทำให้อุทยานแห่งชาติทั้งสองแห่งนี้ได้รับการคุ้มครองตามพระราชบัญญัติอุทยานแห่งชาติซึ่งห้ามกระทำการที่เป็นอันตราย การล่า และการเก็บหาพืชและสัตว์ภายในพื้นที่ อย่างไรก็ตาม ไม่ได้มีการบังคับใช้กฎหมายในการประกอบอาชีพประมงพื้นบ้านขนาดเล็กของชนพื้นเมืองที่พึ่งพิงทรัพยากรแถบแนวปะการัง การศึกษานี้ใช้วิธีการเก็บข้อมูล 3 วิธี ได้แก่ 1. การทำแบบสอบถามครัวเรือน 2. การพูดคุยอย่างไม่เป็นทางการกับผู้ให้ข้อมูลหลัก และ 3. การสังเกตโดยตรง จากการเก็บข้อมูลพบว่าครัวเรือนส่วนใหญ่ในชุมชนอาศัยการประมงเป็นหลักในการดำรงชีพ แต่เมื่อตลาดมีความต้องการผลผลิตทางทะเลในปริมาณที่สูงขึ้น ประกอบกับคนในท้องถิ่นมีการติดต่อกับแผ่นดินใหญ่มากขึ้นนำมาสู่ความต้องการสิ่งอำนวยความสะดวกในชีวิตประจำวัน ตลอดจนการมีมาตรฐานในการดำรงชีวิตที่สูงขึ้นทำให้มีค่าใช้จ่ายมากขึ้นตามมาด้วย นอกจากนั้นแล้ว อุทยานแห่งชาติถือได้ว่ามีความสำคัญทางเศรษฐกิจและสังคมในแง่ของการเป็นจุดหมายของนักท่องเที่ยวและเป็นแหล่งของกิจกรรมนันทนาการที่เกี่ยวข้องกับธรรมชาติ ซึ่งดึงดูดนักท่องเที่ยวจากทั่วโลก ส่งผลให้เกิดความเสื่อมโทรมของของทรัพยากรแนวปะการังอันเนื่องมาจาการพัฒนาการท่องเที่ยว ดังนั้น มีความจำเป็นที่จะต้องวางแผนกลยุทธ์ในการจัดการที่ดีขึ้นเพื่อสร้างความสมดุลระหว่างความจำเป็นในการอนุรักษ์และปกป้องคุ้มครองทรัพยากรธรรมชาติกับ

การทำประมงอย่างยั่งยืนของชาวเลที่เกาะหลีเป๊ะและคนในท้องถิ่นที่เกาะบุโหลน การปรับปรุงการบริหารจัดการควรจะมุ่งไปที่สาเหตุที่เป็นรากของปัญหาเพื่อการบริหารจัดการอุทยานแห่งชาติในระยะยาว

คำสำคัญ: การจัดการอุทยานแห่งชาติ, ชุมชนพื้นเมืองชายฝั่งทะเล, ประมงพื้นบ้าน, เกาะหลีเป๊ะ, เกาะบุโหลน

Abstract

Tarutao National Park and Mu Ko Phetra National Park are designated conservation areas due to their high biodiversity and extensive coral reef ecosystems. They are protected by the National Park Act which bans the harming, hunting or harvesting of flora and fauna. However, its provisions have never been enforced on the small-scale artisan type fishing activities of the indigenous population, who depend on reef resources. Data collection was based on three main techniques; household questionnaires survey, informal discussion with key informants, and direct observation. The majority households in these communities depend greatly on fishing as their essential livelihood. Market demand for fresh marine produce has increased and greater contact with the mainland has led to a demand for modern conveniences and a rise in living standards requiring more money. In addition, national parks are considered economically and socially important in terms of being tourist destinations and providing nature-related recreational activities, which attract tourists from all over the world. This has resulted in an over exploitation of coral reef resources and the deterioration of coral reef from tourism development. Better planning and management strategies are needed where the requirements of the sea gypsies on Lipe island and the local villagers on

Bulhon islands to sustainable harvest fish is balanced with the need to conserve and protect these important natural resources. The intervention will target to the rooted causes of the problem for the long term management of these national parks.

Keywords: marine park management, coastal indigenous communities, indigenous fisheries, Lipe island, Bulhon islands

1. Introduction

Thailand has two major coastlines, the 1,870 km long coastline bordering the Gulf of Thailand and the 800 km long Andaman coastline in the Indian Ocean. Both are rich in natural resources supporting many small local fishing communities and the rapidly expanding tourism industry. The Andaman coast of Thailand has extensive coral reefs along its length and is home to numerous communities operating small-scale fisheries on the reefs as well as large fishery operators. Coral reefs are recognized as highly diverse ecosystems of utmost importance both environmentally and economically. The reefs of Thailand are among the most diverse in the world but are under threat and have been seriously degraded by human activity and natural causes. Over-fishing, destructive fishing practices (notably explosive blast fishing), coastal development, tourism, crown of thorns starfish infestations, strong storms, a mass bleaching event in 1997 and the tsunami in 2004 have all taken their toll on the health of coral reefs along Thailand's Andaman coast. At present more than 50% of Thailand's coral reefs are protected but illegal fishing is common and natural disasters cannot be prevented.

Research studies have shown that many reef species have become depleted over the last few decades due to increasing fishing pressure and habitat loss. However, it is unclear to what extent small-

scale fisheries have a responsibility for this and there has been little effort to monitor, manage and regulate them. At present there is very little data on small-scale fisheries, their effects on coral reefs and the dependence of indigenous fishing communities on these fisheries. Often there is a conflict of interest between the fishers and the need to preserve certain areas rich in diversity and marine life. One such instance is the Chao Lay community inhabiting Lipe Island, and local villagers of Bulhon islands, Satun province, Southern Thailand.

Adang-Rawi and Lipe Islands are part of the Tarutao National Park which covers a total area of 1,490 km^2 of which 1,264 km^2 is sea and encompasses 51 islands. This area is typical of Thailand's island marine habitats with extensive coral reefs, high biodiversity and clear waters. It is a popular tourist destination, providing visitors with clean beaches and high quality snorkeling and diving. The majority of the local population depend on income from the tourist industry and fishing, and therefore are highly reliant on the sea. Meanwhile, Bulhon islands are a group of islands located within Mu Ko Phetra National Park, which has 22 islands with an area of 494.38 km^2 of which 468.38 km^2 is marine. These islands are located close to the mainland. The islands are not popular tourist destination compared to Lipe island. The majority of local population is dependent on income from fishing. These two national

parks were set up in recognition of the unique and high biodiversity contained within and that there was distinct threat to this biodiversity from fishing and coastal development.

For many years, life on Lipe Island has revolved around the coral reefs of Lipe, Adang and Rawi Islands while the life on Bulhon islands are around the coral reefs, mangrove and pinnacles within Mu Ko Petra National Park. Traditionally, women and children collect shellfish from the intertidal reef flats, while men and older boys fish and dive in the deeper reef slope areas. Through their experience, the Chao Lay have acquired extensive knowledge about marine life, from which they have developed a variety of methods for harvesting the abundant natural resources in the area. They have a deep and broad understanding of the behavioral patterns of different fish species and found the best time and methods to catch them. They have learnt to read the environment to provide clues to the best places to catch fish (Map 1).

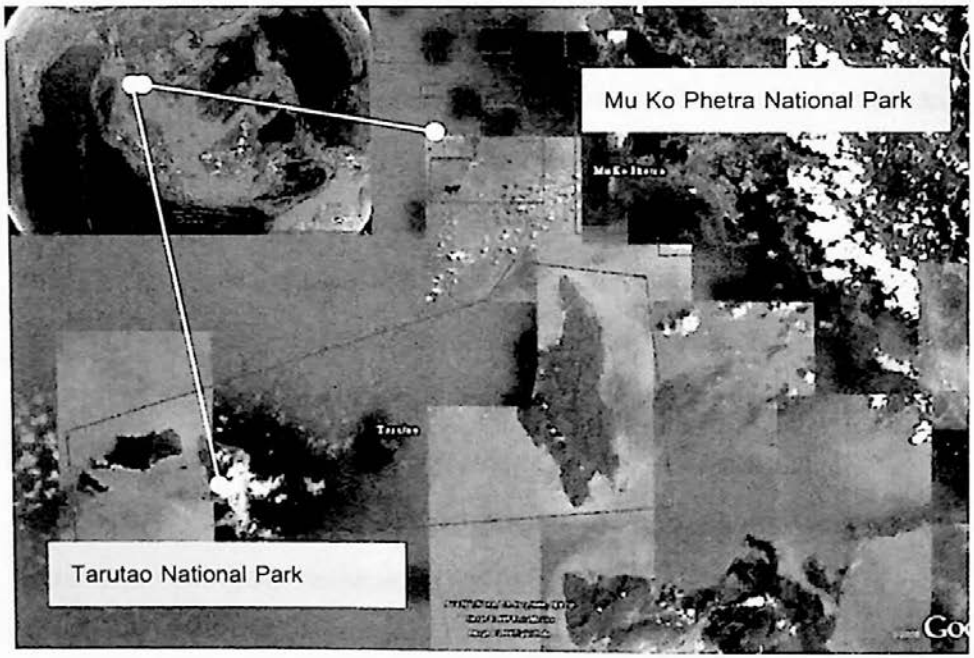
Fish and other marine organisms comprise the majority of the Chao Lay's diet and are their primary source of protein and vitamins. Relatively more sea food is consumed by the Chao Lay than in any other part of Thailand. They have also found many other uses for marine life,

for example sea cucumbers are used for medicinal purposes, and shells as water containers, trumpets and ornaments.

The Chao Lay at Lipe Island and the local fishermen on Bulhon islands excel at reading nature and their observations enable them to find signs of fish and search the sky for signs of changing weather. Experience tells them where to fish, what fish are present, and which baits and methods to use. They learned to navigate by using 'natural signposts' in the sea, such as the direction of waves and currents, water temperature and color, and the positions of stars. This knowledge was traditionally passed from generations to generations.

At present there is a lack of quantitative data on the effects the growing fishing industry is having on the reef system and especially on the population and abundance of target species and the community structure of reef fishes. This article presents the results from collecting fishery data to identify target fishery species, surveying and monitoring these target species and examining the dependence of the local communities on the reef fisheries. The data will show the extent of the fishing pressure being placed on the reef and the importance of the reefs' resources to the Chao Lay. It will enable better planning and management strategies to be implemented where the requirements of

the Chao Lay to harvest fish in a sustainable fashion is balanced with the need to conserve and protect these important resources.



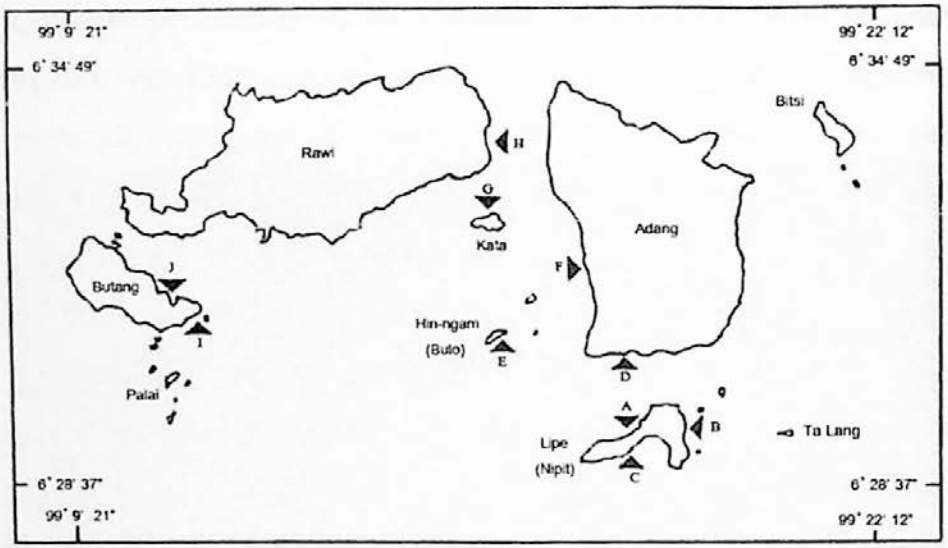
Map 1: Mu Ko Phetra National Park and Tarutao National Park.

2. Methodology

Data collection in the study was based on three main techniques; household questionnaires survey, informal discussion with key informants, and direct observation. A household questionnaires survey was employed for investigating socio-economic characteristics of members of the village community, bio-physical conditions of

fisheries resources and their changes occurring overtime, based on perceptions of community members. The informal discussion with key informants is used mainly for investigating historical, socio-cultural and technical perspectives. The application of direct observation was used as a supporting technique in making qualitative inquiries with respect to both physical and social attributes of the community. Informal discussions with key informant and direct observation were undertaken by the staff of Coral Reef and Benthos Research Unit and the staff of Mu Ko Phetra National Park.

During April 2006, the household questionnaires were used to investigate the general information about the reef fish fisheries in Adang Rawi islands and Bulhon islands. The income, type of fishing gears, fishing boat, fishing sites, target fish, by-catches, and tourism involvement were asked. A total of 116 samples were obtained from Li Pe island, the major fishing communities in Adang-Rawi islands, Tarutao National Park, and another 75 samples were obtained from Bulhon islands (Bulhon Lay island and Bulhon Don island) in Mu Ko Phetra National Park (Map 2).



Map 2: Adang-Rawi and Lipe Islands -- part of the Tarutao National Park.

3. Results

3.1 Socioeconomic data

The data are derived from 116 households and 75 households sampled from Lipe island and Bulhon islands respectively.

Lipe island

All interviewees are men. The average age of those interviewees was 35 years old. The age range was 16-70 years old. The education background of the interviewees was at primary school level 1-4 (42%) followed by junior high school level 1-3 (3%), and high school level 4-6

(1 %). The illiterate group composed of 16% of the sampling group. About 67 percent are fishermen as their main occupation. Thirty-nine percent of the population has only one occupation which is fishery. The others have at least two main occupations. Other occupations were resort owners, tour boats, commerce, boat drivers, resort and restaurant's employees. The average yearly income was Baht 41,000, ranging from Baht 12,000-120,000, yearly. (Figure 1)

Bulhon islands (Bulhon Don and Bulhon Lay)

Most of interviewees were the head of each household. The average age of the interviewees was 39 years old, ranging from 21-78 year old. Eighty-seven percent of the interviewees are men. The education background of most people interviewed was at primary level grade 1-4 (44%), grade 5-6 (27%), junior high school level 1-3 (1%). The illiterate group is very high composed of 28% of the samplers. About 83% of the interviews have the fishery as their main occupation. Sixty-two percent have only fishery as their solely occupation. Other occupations are related to tourism which are resort owner, tour boat, merchant, tour guide, and resort and restaurant's employees. The average yearly income was Baht 40,000, ranging from Baht 10,000-120,000, yearly. (Figure 1)

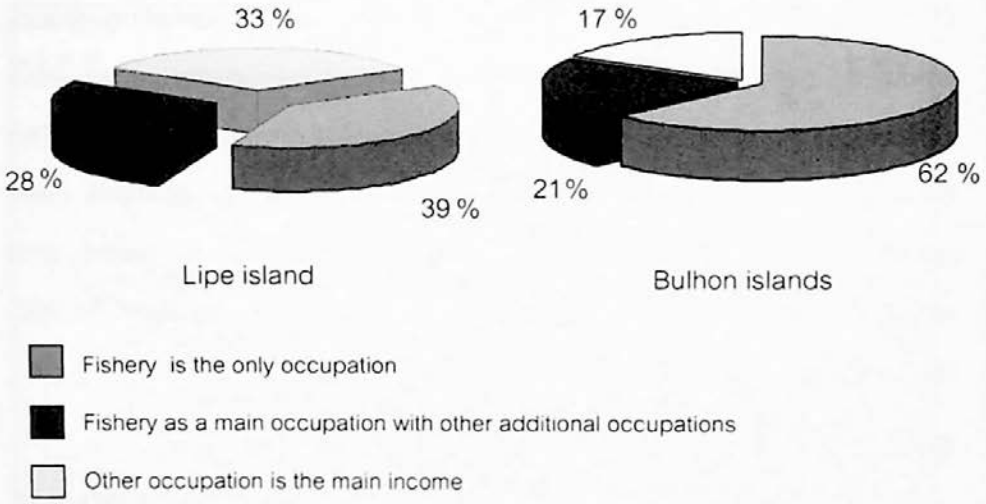


Figure 1: Occupation of the Lipe island and Bulhon islands communities.

In general, the overall educational attainment of household members in these two communities is very low. However, there has been much improvement among young members. Fishing is not the only occupation available for members of these two communities. Some households have their members engaged in other occupations including trading, rubber production, wage work and hired labor in commercial fishery, resort and restaurant. Among these secondary occupations, resort and restaurant employee was the most important. However, the majority households which were involved in fishing regard fishing as their most important occupation. Other types of occupations are less significant.

Overall, it is clear that the majority households in these communities depend greatly on fishing as their important livelihood. The scarcity of other economically productive resources makes fishery resources crucially important to them, both as the main source of cash income and as food for household consumption, particularly as the main source of protein in their daily diet.

3.2 Fisheries characteristics

Many different species of marine organisms are taken by the Chao Lay community on Lipe island and local community on Bulhon islands. Daily activities include women and children gleaning shellfish along the seashore. Baited hand-lines or spears are used to catch small fish. Men often go fishing from boats on the coral reef or submerged rocks at a favorite or secret place. Sometimes the community will fish cooperatively in groups. Hundreds of men, women and children use bamboo sticks to herd fish into the surrounding nets.

Many different methods are used in artisan fishing. Some methods are very simple, such as gleaning shellfish from rocks at low tide. Some are complicated and require skill and many people, for example the group fish drives involving the whole village. Different kinds of fishing boat are used depending on the distance to be traveled, the sea conditions and local seafaring traditions. Small boats are often used

for inshore fishing on coral reefs when seas are calm. In general, the length of fishing boat in Lipe island (11-12 meters) is longer than those in Bulhon islands (9-10 meters). Sometimes sails are used to travel to more distant fishing grounds. (Figure 2)

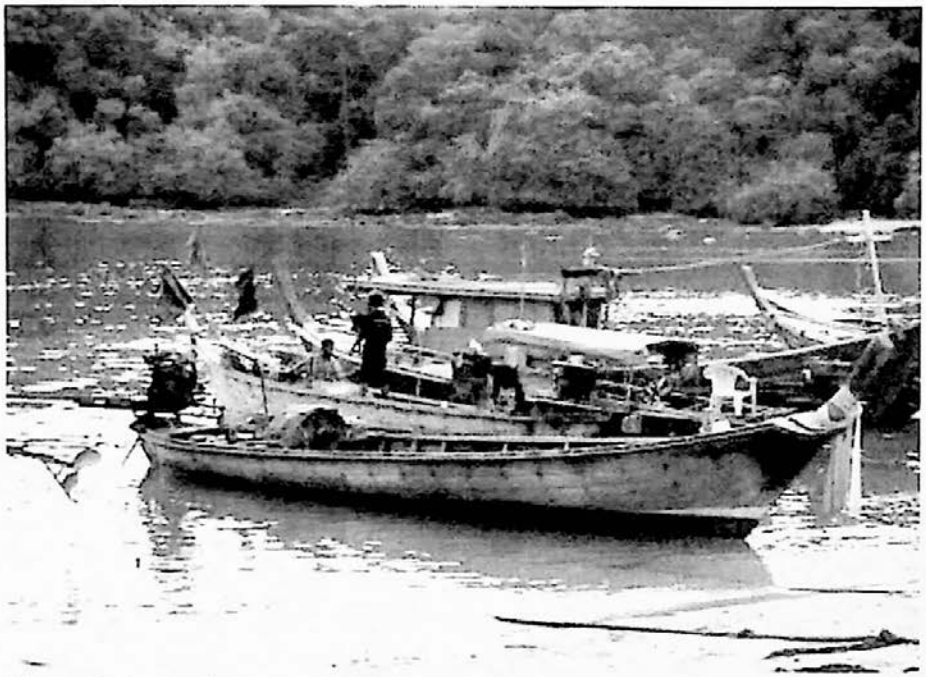


Figure 2: Local fishing boats. (photo by author)

The majority of fishing boats today are powered by long-tail motors. They are comparatively expensive and require fuel supplies from the mainland. More intensive commercial fisheries have replaced the traditional artisan fisheries. These may involve small-scale, family

operations or be a part of a large-scale company-owned operation employing many ships and hundreds of workers. Commercial fishers use more efficient fishing gears and methods than artisan fishers taking much larger catches. The anchovies, groupers, tunas, mackerel, squids, prawns and crabs are the main target for these commercial fisheries.

Like other fishing communities in southern Thailand the Chao Lay at Lipe Island and local communities on Bulhon islands have small-scale fisheries based on long tail motor boats operating near the coral reefs. They are faster and can go further and carry more than the small traditional boats. Fishers commonly used line fishing, gill nets and fish traps, which catch many fish including many non-target species (Table 1). The fish is then kept fresh in an ice box to be sold at market. Large carnivore fish species like sea bass and grouper are in high demand on the mainland and Langkawi Island in Malaysia, and are sold in local markets and at restaurants on the islands during the tourist season. Some of the invertebrates found on coral reefs are also valuable. Giant clams, lobsters and sea cucumbers are much sought after by local restaurants and overseas markets. (Figure 3-6)

Most of the catch for selling in these communities is food fish and sold as fresh fish at the local market or to fish dealers who live in the community. There is no food processing activities undertaken for

commercial purposes. However, sea cucumber processing activities are found on Bulhon islands and some remote bays in Rawi island. (Table 1)

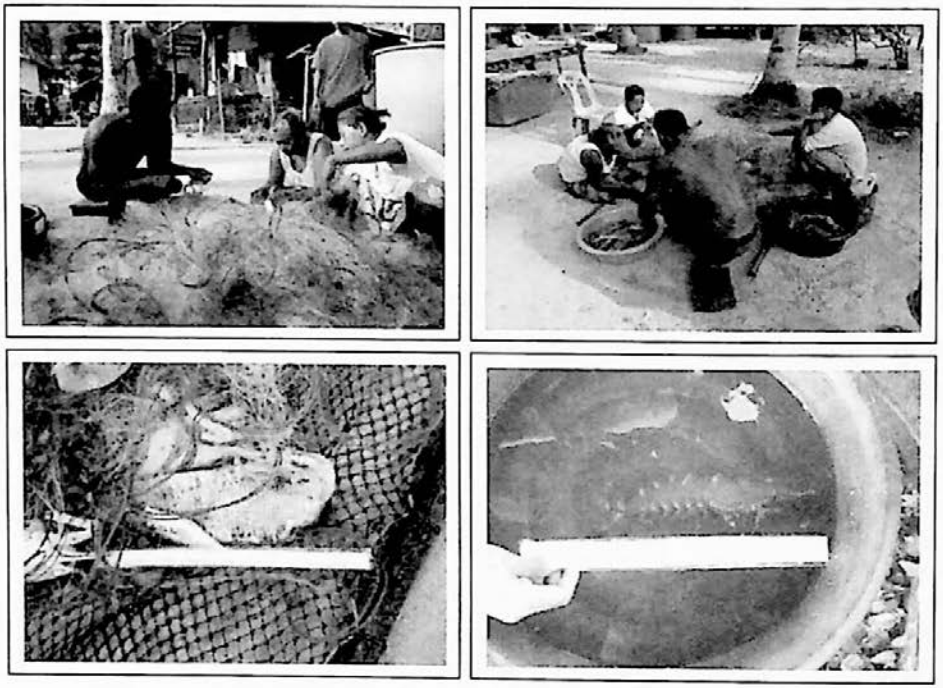


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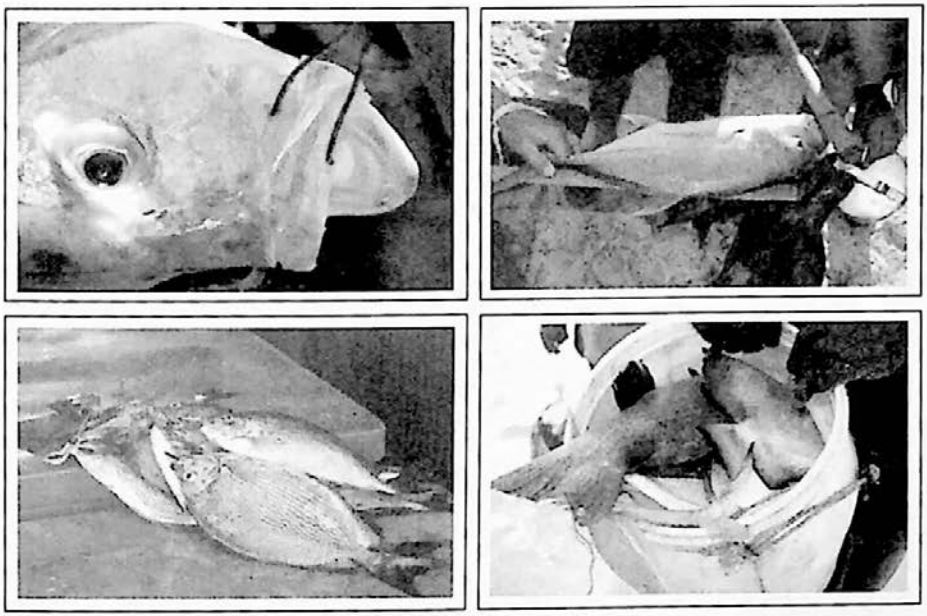
Figure 3-6: Gill net target species. (photos by author)



7	8
9	10

Figure 7-10: Hand line fishing and fish trap. (photos by author)

Table 1: The primary fishery target for main fishing gears.

	Lipe island		Bulhon island	
	Target species	Fishing duration*	Target species	Fishing duration*
Line fishing	squid, barracuda, grouper, king mackerel, longtail-tuna, eastern little tuna, two-spot red snapper, trevally	1 day	squid, grouper, two-spot red snapper, trevally, emperor, swordfish, King mackerel,	1-5 days
Fish trap	fusiliers, rabbit fish, trevally, grouper, emperor	7-15 days**	Squid, blue swimming crab, trevally, rabbit fish, grouper, rock cod	1 days**
Gill net	trevelly, queenfish, tuna, rabbit fish, fusiliers, emperor, black banded kingfish	1 day***	Blue swimming crab, shrimp, king mackerel, indo-pacific mackerel, trevally	1–7 days***

* Fishing duration counts from setting out to sea to coming back to shore with marine catch.

** For fish trapping, fishers usually go out to sea to deploy their traps, then come back home and go out again in a few days to check their traps and bring back the catch.

*** For gill netting, fishers can either deploy their net and wait on the spot, or leave their net and return to fetch their catch.

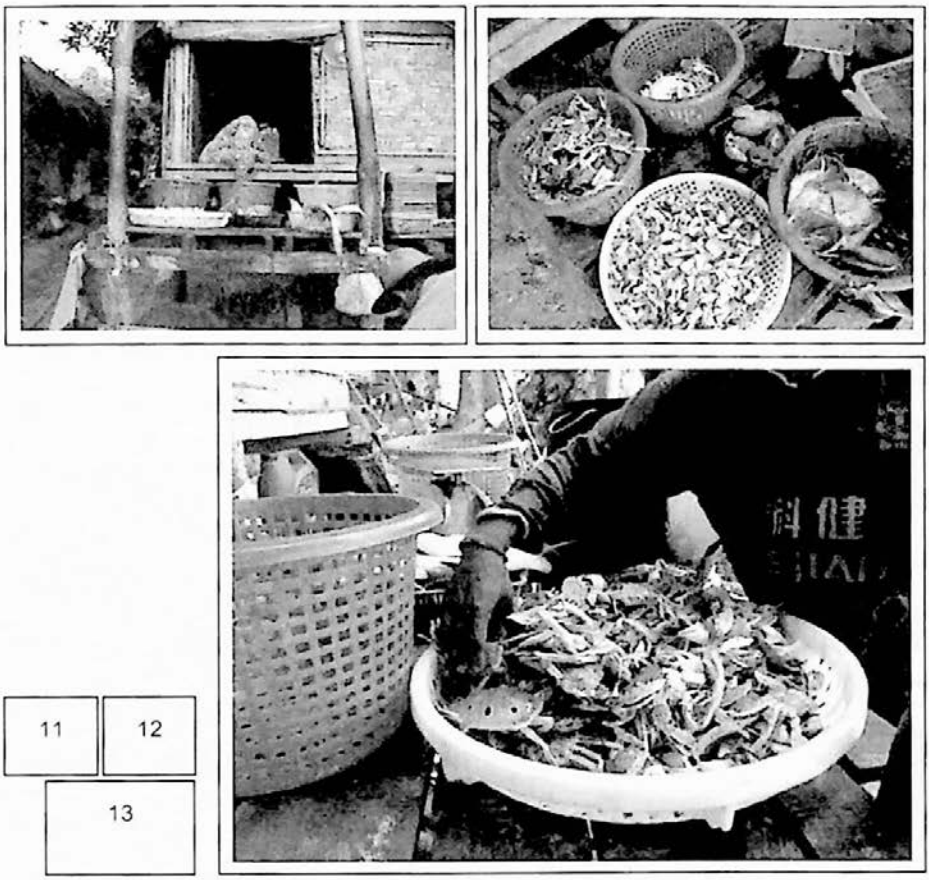


Figure 11-13: Marine life are sold to the collector on the island and sent to mainland market. (photos by author)

There is no significant price variation offered by different fish dealers. However, some kinds of bond do exist between fishers and each fish dealer. The most common arrangement is that fishers who are provided with credits, either in kind or catch, rice, can food, fishing gears, and boat will sell their fish to the credit providing dealer. By doing so, the dealer can deduct his loans from the value of catch each fisher has with him (Figure 14).

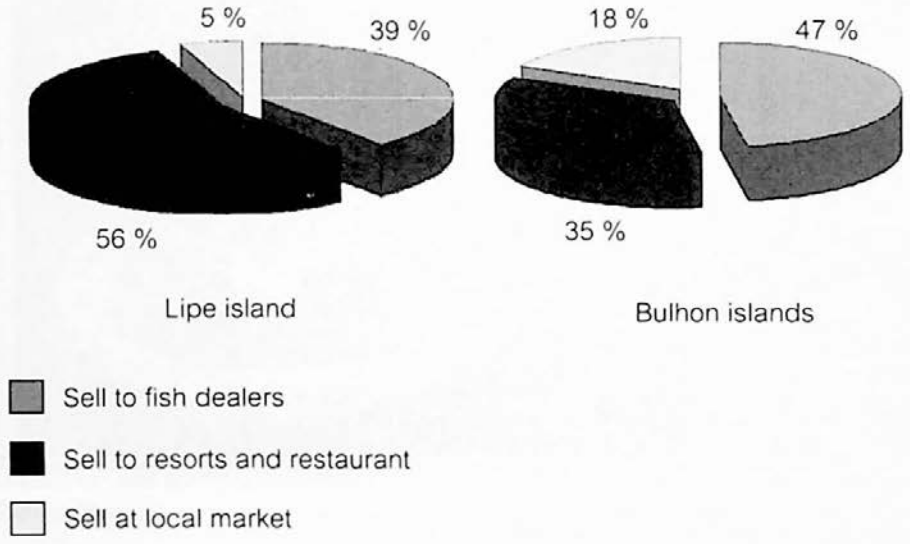


Figure 14: Percentage of surplus fish and other marine fauna sold to middle man, resorts and restaurants, and local market.

4. Discussion

The primary aims of the Thailand's marine parks are to conserve and protect these areas from human exploitation and activity, conduct research and monitoring programs to gain knowledge about the natural processes, and recreation. This type of protected area plays significant roles in maintaining ecological stability and preserving biological diversity (Sethapun, 2000). They also aim to educate the local people about safe and sustainable marine use. National Parks provide members of the local community with employment, especially with the increase in tourism requiring boat operators and guides. Revenue is generated by charging tourists and stakeholders to use the area, this money is used to pay staff, maintain the park, fund research and 5% is invested back into local community projects. National Parks are protected by National Park Act 1961 prohibiting the harming, harvesting or hunting of all organisms, yet at present unregulated and unmonitored fishing occurs daily within both national parks.

When Tarutao national park was set up, it contained small populations of Chao Lay, an ethnic group whose life style and culture is closely linked to the sea. These indigenous populations are traditionally nomadic but for political reasons were given the islands of Ko Lipe to permanently inhabit early last century. Rather than relocate these people

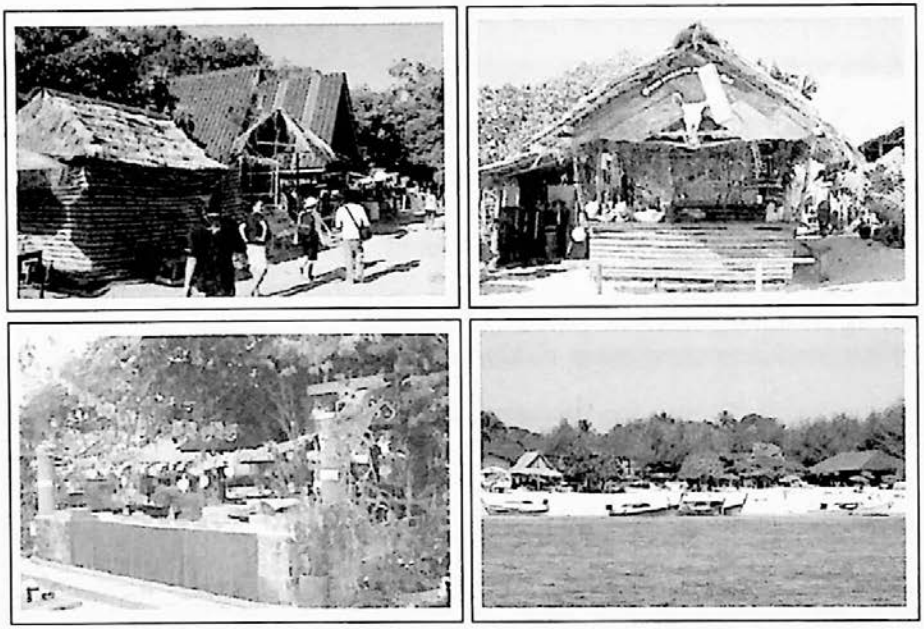
outside of the national park as in normal circumstances, they were allowed to stay and continue their traditional way of life which involves non-destructive small-scale subsistence fisheries. Traditional fishing methods include hand lines, trolling, fish traps, spears and small nets and have minimal detrimental impacts on the reefs.

In the past, the coral reef fishery could be described as sustainable. This was particularly important in a small community such as at Lipe Island where land and coral reef resources were limited. Fishing communities developed special ways of managing the fish stocks and learned to value and conserve these resources. For example, it was customary to return undersized fish and other by-catch to the sea.

Traditionally, local fishermen did not catch more fish than they needed or could consume. In general, sharing is fundamental to their culture and usually the catch of fish is distributed among the villagers. This was a reminder that the seas should not be overused and a balance was maintained for many generations. Due to lack of refrigeration in many areas, the catch was generally eaten the day it was caught. Sometimes surplus fish were sundried, smoked or salted and stored. This was then eaten when rough seas prevent fishing. Sometimes a family member will take part of the catch to market and the proceeds are used to buy rice, sugar, tinned food and other produce

not available on the island. These products are cheap and easy to store but are not as nutritious as the traditional fresh food.

Prior to the rapid development in the last 30 years, the demands on marine resources were not excessive. The Chao Lay communities were much smaller than they are today as they grew rapidly as a result of modern welfare and the tourism industry. The arrival of urbanization, tourism and commercialism has had a massive impact on their culture and customs. During the tourism season (November to May) the extra people staying on the island requiring additional natural resources greatly increases the pressure placed on the limited land and coral reef fish resources. Rapid population growth, limited resources and space, and development pressures are issues commonly encountered in most fishing community villages in Thailand where tourism has been introduced. Often the land and marine resources surrounding the village cannot support large populations forcing the young and the educated to migrate to the mainland. The local community has grown rapidly from a small fishing village into a famous tourism destination attracting many investors. Some women and children work in the resorts as cooks and cleaners or displaying their cultural heritage to the tourists and many of the men ferry tourists around the islands. (Figure 15-18)



15	16
17	18

Figure 15-18: Tourism development on Lipe island. (photos by author)

Fishing pressure has increased in recent decades due to a number of reasons placing greater strain on the reef ecosystem. Even though many Chao Lay families have diversified there incomes, the majority catering for the growing tourist industry, there is evidence of over-fishing on the reefs. The island is closed for half the year due to the

monsoon so the only source of income at this time is through fishing. Local fishermen have commented on a decrease in catches and a smaller average size of fishes and previous research studies. Satapoomin (2002) and Nootmorn et al., (2002) have shown a decrease in the abundance of fishes, in particular species targeted by the fishery, with reductions in both yield and catch per unit effort (CPUE). Both papers conclude a change in management strategy and regulation is required to prevent fish stocks becoming depleted and avoid further deterioration of the reef.

Much of the land, fishing gear and boats on Lipe Island have been bought by a few Thai businessmen who now control the fishery and use the Chao Lay to collect reef resources. Only then did they start to use destructive fishing methods to catch more fish. Destructive fishing which includes not only dynamite and cyanide fishing, but also illegal trawling at some sites, though these activities are becoming less of a threat as tourism becomes heavier. In addition, collection of other marine resources (particularly seashells) as tourist souvenirs and for export, sea cucumbers, giant clam, and aquarium fish are still occurred.

Market demand for fresh marine produce has increased and greater contact with the mainland has led to a demand for modern conveniences and a rise in standards of living that require more money.

This has resulted in a change of lifestyle moving away from their traditional culture towards a more urbanized style. A sustainable fishery where fish are consumed and traded locally no longer exists, but has become a profit driven industry with the majority of fish caught being exported to Langkawi Island in Malaysia (Satapoomin, 2002). The Chao Lay also traditionally collect endangered species such as turtles to eat and cut down trees for houses and boats creating conflicts between the Chao Lay and the park rangers who are trying to protect the reefs and other park resources.

Over-exploitation of some coral reefs around Adang-Rawi islands and Bulhon islands has depleted many important reef fish and invertebrates and the villagers now have to import large quantities of cheap canned fish, meat, vegetables and rice from the mainland. Locally caught fish and invertebrates are often too expensive for local inhabitants and are sold to restaurants providing for the tourists. The rapid development of the tourism industry has led to a decline in water quality and increased pollution with un-treated sewage seeping into the sea. Catches of reef fish and invertebrates are declining and as a result they are becoming more expensive at local markets.

The main reasons for the declines in coral reef fisheries are summarized here:

1) Increased demand for fish

Limited coral reef resources have had to support increasing tourism and market demands. A sustainable fishery where fish are consumed and traded locally no longer exists, but has grown to become a profit driven industry with the majority of landings sold to local restaurants or exported to the mainland and Langkawi Island, Malaysia.

Some marine species which have supported the Chao Lay for hundreds of years are now in serious decline. Coral reef resources can be viewed as a renewable resource that will recover over time. However, if exploitation levels are too great, natural recruitment cannot produce enough young to replace those caught and the system declines.

2) Improved fishing methods

More efficient technology and improved fishing gear have increased catch size to unsustainable levels. For example, modern nylon fishing lines, fish traps, nylon gill nets, underwater breathing apparatus, bigger boats, depth sounders and freezers have all resulted in higher landings.

3) Destructive fishing techniques

In the past, dynamite fishing was commonly used on coral reefs. These methods are indiscriminate and kill target and non-target species. In addition dynamite causes massive damage to the coral reef habitat resulting in low diversity, unproductive environments. Nowadays, dynamite fishing is much less common due to improved education and better enforcement. Previously impacted areas may take decades to recover to pre-exploitation levels.

4) Increased commercial fisheries

The traditional artisan fishery at Lipe Island has become a commercial enterprise. The prospect of wealth and a high demand for fresh fish to support tourism has driven fishers to fully exploit the local natural resources. Improved transport to the mainland and the use of storage freezers by local fish collectors has led to greater efficiency and fishing capacity. Much of the fishing gear and boats on Lipe Island are controlled by a few Thai businessmen who employ the Chao Lay to harvest reef resources, consequently if they don't catch fish they won't get paid. Only when pressures to exploit reef resources grew did the Chao Lay start to use destructive and higher technology fishing methods. Greater contact with the mainland has led to a demand for modern conveniences and a raise in living standards resulting in a

lifestyle change away from their traditional culture towards a more urbanized style.

5) Decline in traditional conservation

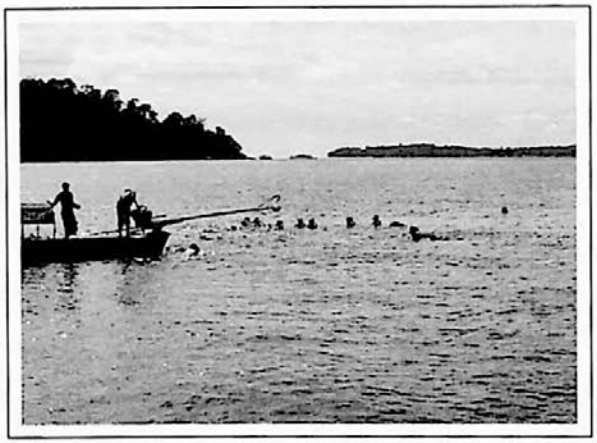
Traditional methods of conserving fish stocks, such as resource ownership, have been lost as the fishery resources became common property of the nation allowing access to all. Other traditions have declined under pressure from commercial fisheries. Conflict between artisan and commercial fishers has increased as they often fish the same species.

6) Loss of fisheries habitat

Large areas of coral reef in the area have been degraded from natural and anthropogenic[3] disturbances. Intact habitat is essential for species to complete their lifecycles. Many environmental problems arose from unplanned and illegal tourism developments (Figure 19-20). Some of the effects have been summarized here: i) The number of resorts on the island is growing rapidly, ii) Poor land management has caused severe erosion of hill slopes and increased sea turbidity and sedimentation on the reefs, iii) The commercial fishing boats anchor within the protected area and wash their fishing gear, iv) Discarded

[3] Caused by human activities.

fishes are thrown on to the reef, v) Unmanaged and inappropriate behavior of visitors to the coral reefs. The coral reef degradation has led to declines in fish abundance affecting the local fishery.



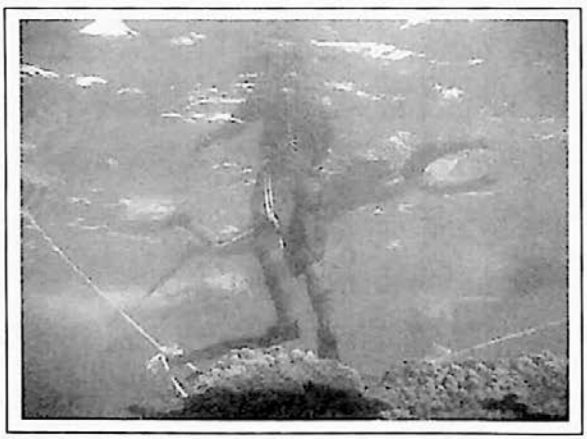


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Figure 19-20: Examples of possible environmental damages from tourism development. (photos by author)

7) Water Pollution

Tourism is possibly the biggest culprit in causing water pollution. The majority of tourism developments were poorly planned and none of the resorts have sufficient waste water treatment. Sewage and other waste waters are discharged into swamps or underground where they seep out into the surrounding sea and may harm the coral reef ecosystem through eutrophication[4].

Piers are essential for marine transport and the tourism industry but pollution surrounding piers can be very high due to human activity and they cause coastal erosion. Oil is often spilt from ships when they load or unload fuel. The phytoplankton is always blooming during the summer season.

8) Ineffective national park management

The national park has little control over the Chao Lay fishery inside the park boundaries. Tarutao National Park and Mu Ko Phetra Naional Park are designated conservation areas due to their high biodiversity and extensive coral reefs. They are protected by the National Park Act which banning the harming, hunting or harvesting of marine organisms. However, small-scale artisan fishing by the Chao Lay has been allowed. The Chao Lay rightly view the natural resources as

[4] Over enrichment of nutrients in the water which may cause problems like algae bloom.

their property, culture and heritage. In addition, there is no appropriate management plan for tourist development.

A compromise between resource exploitation and conservation is urgently required where fishing is allowed in a controlled manner through the implementation of an effective fishery management strategy of the area both inside and outside the park boundaries. Environmental friendly tourism activities should be encouraged.

9) Environmental perturbations

Although somewhat protected by the Sumatran peninsula, the islands of Adang and Rawi were greatly impacted by the recent tsunami of the year 2004. Initial observations indicated that some areas had experienced greater destruction than others; damage to reefs varied from normal everyday expected levels to whole coral beds totally destroyed leaving masses of coral rubble in the shallow water. Having surveyed a variety of sites around the Adang-Rawi islands, it appears that most damage occurred in the sandy, shallow bay areas as opposed to deeper rocky shores where the coral is more robust.

Several large coral bleaching events have occurred during El Nino years at Ko Lipe and the surrounding reefs causing widespread coral mortality. A combination of 2004 tsunami and the 1997 El Nino Southern Oscillation has decimated some areas resulting in a reduce of

coral cover. This loss of habitat through natural events combined with chronic anthropogenic activity has greatly impacted the local environment.

5. Management interventions

The causal chain analysis (Figure 21) was used in the identification of the rooted cause of change in environmental state, the level or scale of threats at a particular site, and the alternative points of intervention, along the chain of cause. The analysis was based on several visits during December 2004–December 2006. The loss of coral reef and associated animals is the primary problem. The five main immediate causes or direct threats were identified as heavy tramping damage, an increasing of sedimentation from the islands' development, waste water discharge from tourism development, fishing boats and tourism boats, deteriorated fishing activities and over-fishing, and natural phenomena. Under each direct threat, the root causes were describe as: lacking knowledge on coral reef ecology and its importance, ignoring attention-grabbing of stakeholders according to the first threat, lacking of public participation in development projects, weakness of law enforcement and fishery pressure (small scale and large scale).

Carefully thought out management strategies are required to balance the needs of the Chao Lay and tourism business for the protection and conservation of the reefs biodiversity. Given the root causes for coral reef degradation, the proposed interventions for management of coral reef in Adang-Rawi and Bulhon islands can be summarized into 6 categories as follows (Figure 22):

1) **Promote local self-organization** and improve the ability of the government sector to properly manage the coral reef ecosystems.

2) **Support integrated research programs** pertaining to the management of the coral reef.

3) **Provide knowledge, guidelines and promote awareness** pertaining to the values and importance of the coral reef ecosystem to the local communities, visitors and government personnel.

4) **Enforce legal measures and zoning plan** for the protection of coral reef and the environment.

5) **Rehabilitate the degraded coastal ecosystems.**

6) **Encourage alternate occupation** and sources of income to reduce fishery activities on coral reefs.

Furthermore, a compromise between fishing pressure and conservation of the reef is needed where fishing is allowed in a controlled manner either through the use of licenses or the implementation of

protected 'no-take' areas. This strategy has previously been employed in other areas and has been shown to increase yield and CPUE. Satapoomin (2002) suggests several sites in the Adang-Rawi area that could be set up as reserves based on their high diversity of fishes and corals encompassing the greatest range of fish and coral species present in the area and their ease of regulation being sited near the park head quarters. However, reserves or 'no-take' areas frequently require strong regulations focused on prohibiting harvest of marine life. On the other hand, such restrictions may be support through the voluntary support and cooperation of stakeholders. Proper zoning can also help to minimize conflict between uses of the coral reefs, such as recreation, tourism, and fishing. No-take or no-intrusion areas may represent possible zone types, as well as recreational areas or resource harvest locations.

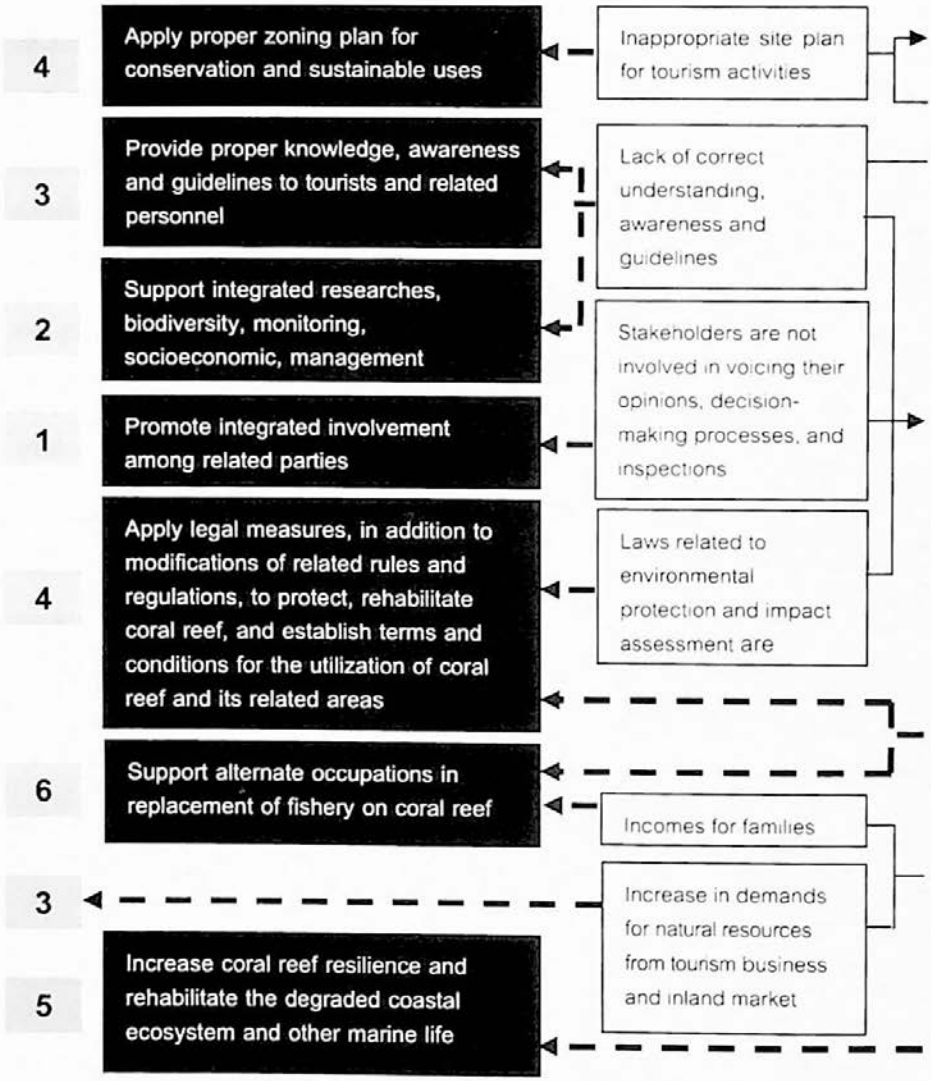
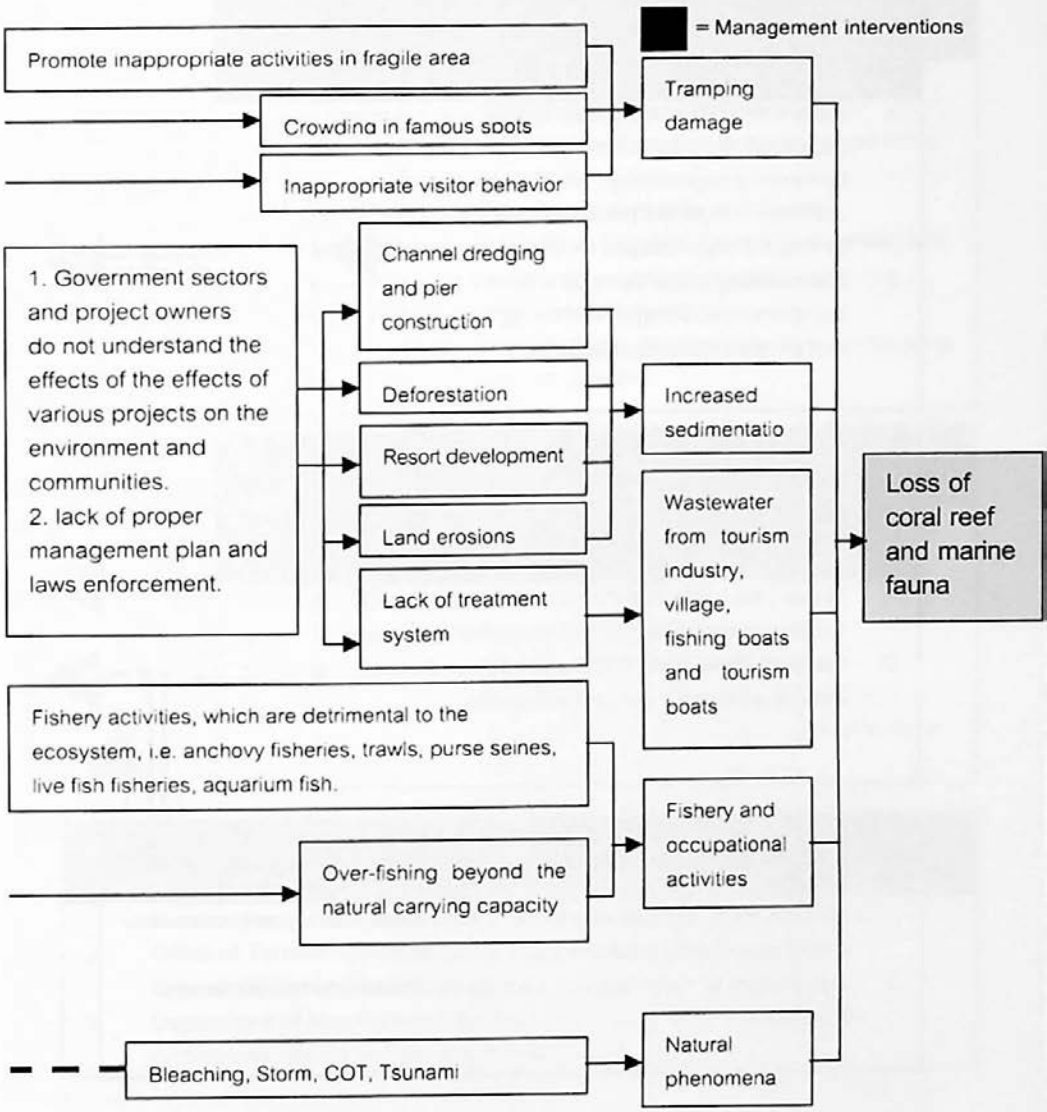


Figure 21: Causal Chain Analysis and management intervention for protecting coral reef of Adang-Rawi islands and Bulhon islands.


= Management interventions
Promote inappropriate activities in fragile area
Crowding in famous spots
Inappropriate visitor behavior
Tramping damage
1. Government sectors and project owners do not understand the effects of the effects of various projects on the environment and communities.
2. lack of proper management plan and laws enforcement.
Channel dredging and pier construction
Deforestation
Resort development
Land erosions
Lack of treatment system
Increased sedimentatio
Wastewater from tourism industry, village, fishing boats and tourism boats
Loss of coral reef and marine fauna
Fishery activities, which are detrimental to the ecosystem, i.e. anchovy fisheries, trawls, purse seines, live fish fisheries, aquarium fish.
Over-fishing beyond the natural carrying capacity
Fishery and occupational activities
Bleaching, Storm, COT, Tsunami
Natural phenomena

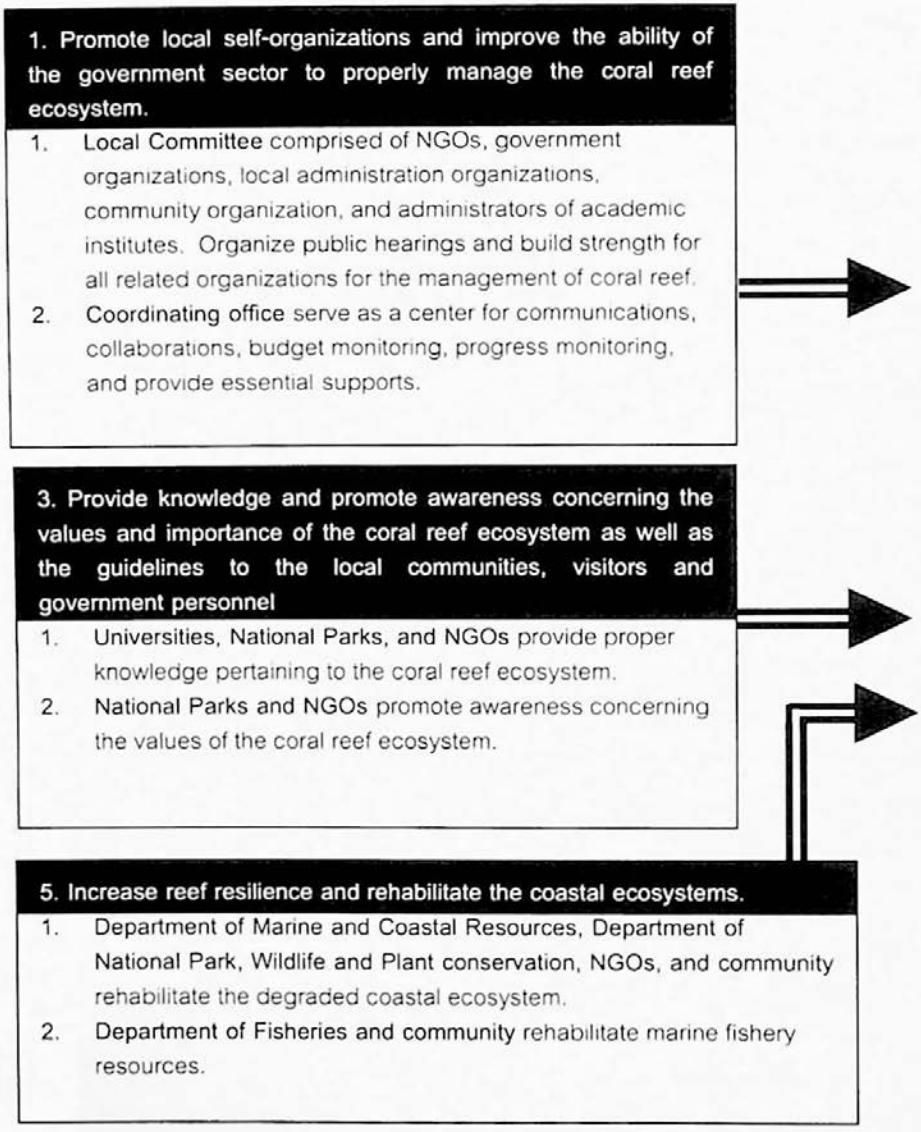
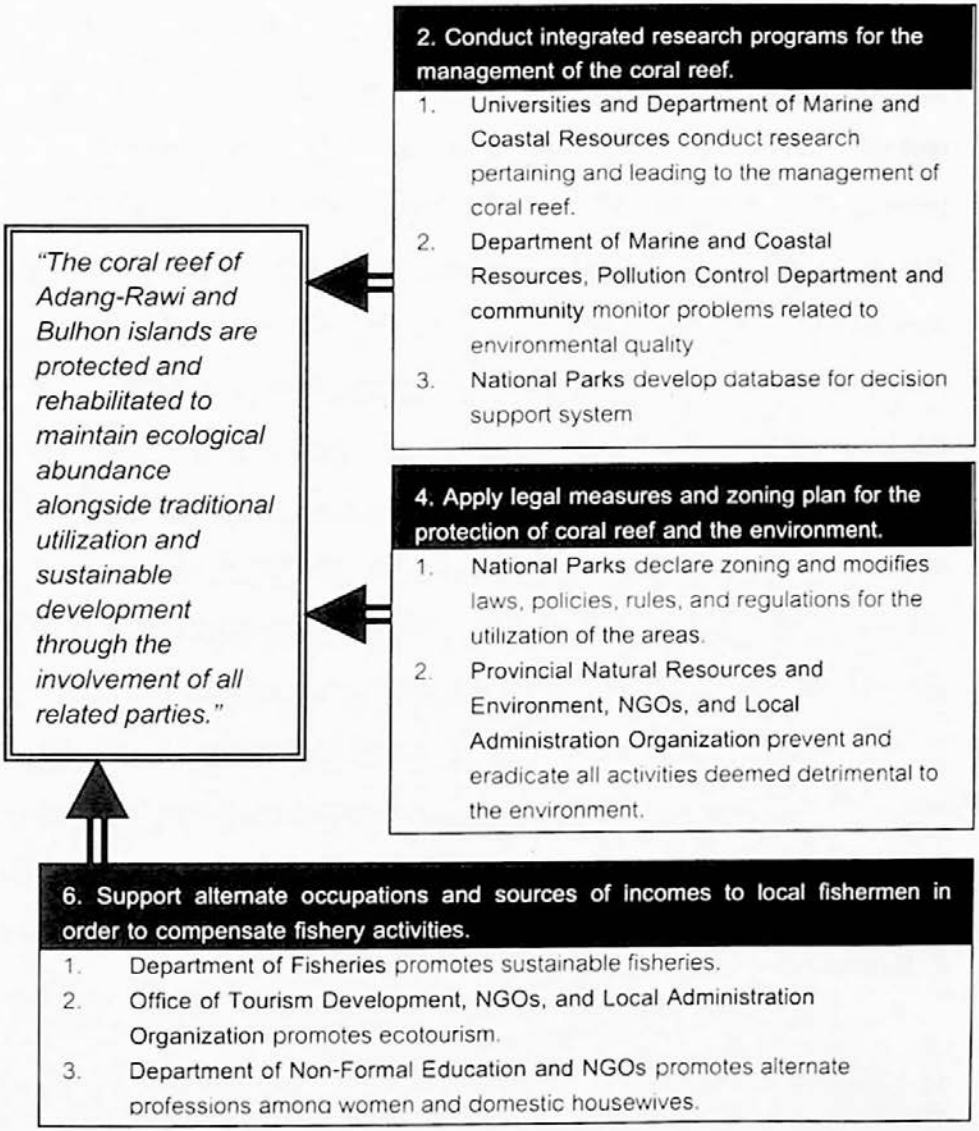


Figure 22: Protocols to achieve the desired outcomes regarding the management of coral reef in Adang-Rawi and Bulhon islands.


2. Conduct integrated research programs for the management of the coral reef.
1. Universities and Department of Marine and Coastal Resources conduct research pertaining and leading to the management of coral reef.
2. Department of Marine and Coastal Resources, Pollution Control Department and community monitor problems related to environmental quality
3. National Parks develop database for decision support system
"The coral reef of Adang-Rawi and Bulhon islands are protected and rehabilitated to maintain ecological abundance alongside traditional utilization and sustainable development through the involvement of all related parties."
4. Apply legal measures and zoning plan for the protection of coral reef and the environment.
1. National Parks declare zoning and modifies laws, policies, rules, and regulations for the utilization of the areas.
2. Provincial Natural Resources and Environment, NGOs, and Local Administration Organization prevent and eradicate all activities deemed detrimental to the environment.
6. Support alternate occupations and sources of incomes to local fishermen in order to compensate fishery activities.
1. Department of Fisheries promotes sustainable fisheries.
2. Office of Tourism Development, NGOs, and Local Administration Organization promotes ecotourism.
3. Department of Non-Formal Education and NGOs promotes alternate professions among women and domestic housewives.

6. Recommendations for further studies

Further studies are need to assess the impacts of indigenous reef fisheries on coral reefs at two sites situated within the boundaries of these two national parks, Bulhon islands in Mu Ko Phetra National Park and Adang-Rawi Islands in Tarutao National Park. The study should collect data on the fishing methods used, species targeted for fishing, the dependence of the local populations on the coral reefs and the status of coral and fish populations within the marine parks. It will provide baseline data and crucial information on the effects of small-scale reef fisheries enabling marine park managers to formulate and implement better strategies taking into account the needs of the Chao Lay and the protection of the reef resources. It is of utmost importance that the local community is involved and the aim of the research is clearly explained to them as without their cooperation catch data will be impossible to obtain.

7. Summary

Today, many of the traditional methods utilized by the Chao Lay to conserve their natural resources are no longer in use. The social responsibility to look after the sea and protect its resources has been replaced by the prospect of wealth and a belief that it should be exploited for money. Traditional knowledge of the sea held by the

Chao Lay is in danger of disappearing altogether as it is not passed on to the next generation. Interest from the younger generations in their heritage is declining as they adopt a more westernized lifestyle accelerated by their exposure to tourists and Thais. Traditional knowledge has accumulated over hundreds of generations and is very valuable. There is a need to record the oral histories of older community members, it is important to do this before it is lost forever.

Nowadays, tourism rights are guaranteed, but the traditional ownership of the sea is not accepted. Marine resources are 'the common property of nation' allowing commercial fishers to catch as much fish as they want. The demand for fresh fish is increasing as is the price. Many commercial fishers believe that if they do not catch the fish, somebody else will, causing a race to exploit the limited resources.

These two marine parks contain extensive highly diverse coral reef systems hosting a multitude of rare and unique species. Coral reefs act as a nursery and a refuge for many species, including economically important fishing species and many small communities depend on coral reefs to provide income through fishing or tourism. However, National Park regulations are poorly regulated and enforced. Reefs in these national parks are currently under threat from over-fishing and destructive fishing practices, tourism, coral bleaching and

sedimentation from coastal development. New and more efficient fishing practices have been introduced increasing the rate of exploitation and tourism has increased the demand for fresh fish. Electricity, freezers and better marine transport allow the excess catch to be preserved and transported to mainland for sale in the markets.

The protection, understanding of natural processes and management of these coral reefs is essential in the conservation of this important ecosystem and resource. Several meeting with key stakeholders should be organized to discuss on the draft version of causal chain analysis and its management interventions. The details of each management intervention will be obtained.

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