

CHAPTER V

CONCLUSION DISCUSSION AND RECOMMENDATION

According to study of coral reef zoning for supporting sustainable tourism activities in Koh Tao, Suratthani province which aimed to evaluate coral condition, be a data base for zoning utilization and analyzing on critical problems that cause by tourism activities. It could be concluded and discussed in next following topics.

5.1 Conclusion and Discussion

5.1.1 Coral Conditions

The coral conditions have been investigated since 1988, 1989, 1991 between 1995 and 1997 by using Manta tow methodology (ONEP, 2005) found that the integrity of coral at Sai Ree Bay and Koh Nang Yuan decreased. On another hands, at Thian Og Bay during 1995 and 1997 found that corals healthy were very good.

The study of coral conditions in 2010 by using Photo Belt Transect technique, 56 stations in 14 areas of Koh Tao and Koh Nang Yuan at depth 1.5-8.0 m. It revealed that the integrity of coral at Koh Tao was *fair* (The ratio of living coral to dead coral was 1:1). On the average, found that living coral coverage was 31.70%, old rubble was 26.58%, dead coral was 25.73 %, sand was 10.92 % and bedrock was 5.07 % respectively.

Areas where found coral consummate in *very good* conditions were Sai Ree Bay (Station No.1-6), Chalok Baan Kao Bay (Station No.12,16), Hin Ngam Bay (Station No. 25, 26), Leuk Bay (Station No. 29, 30), Tanote Bay (Station No. 31, 32, 35, 36), Mao Bay (Station No. 38), Hin Wong Bay (Station No. 43, 44), Mango Bay (Station No. 47,48), The Eastern of Koh Nang Yuan (Station No. 49-50) and The Western of Koh Nang Yuan (Station No. 56).

Areas where found coral consummate in *good* conditions were Leuk Bay (Station No. 27, 28) and Hin Wong Bay (Station No. 41, 42). However, areas where found coral integrity in *fair* conditions were Mae Haad Bay (Station No. 10), Sai Daeng Bay (Station No. 24), Tanote Bay (Station No. 34), Mao Bay (Station No. 39,40), Mango Bay (Station No. 45), The Western of Koh Nang Yuan (Station No. 53,54,55).

Areas where found coral consummate in *poor* conditions were Chalok Baan Kao Bay (Station No.15), Tanote Bay (Station No. 33) and Mao Bay (Station No. 37). Finally, Areas where found coral consummate in *very poor* conditions were Mae Haad Bay (Station No. 7, 8, 9), Chalok Baan Kao Bay (Station No.11, 13, 14), Taa Cha Bay (Station No.17, 18), Thian Og Bay (Station No.19, 20, 21, 22), Had Sai Daeng Bay (Station No.23) and the Eastern of Koh Nang Yuan (Station No. 51-52).

Comparing the changing of coral reefs at Koh Tao in the past, they tended to become more plentiful. Due to declaring in 1996 of Suratthani province about determination fisheries and preserving vegetation, by prohibiting fishing for all species in the western coast of island, three rocks from the mound until cape of Nang Yuan. And the coral reefs dept 4-6 m. which does not be disturbed by traveler. Apart from Thian Og Bay, coral reefs were deteriorated by severe natural disasters and caused the coral integrity decreased since 1996 until the present (Yeemin, 2006).

The range of coral diversity index at Koh Tao was between 0.5-2.5. The most of coral diversity index belonged to Hin Ngam Bay (Station No.25) following by Sai Ree Bay (Station No.6), Tanote Bay (Station No.38), was 2.62, 2.42 and 2.38, respectively. Moreover, 77 coral species were found. Hin Ngam Bay (Station No. 25, 26) was the most of coral diversity discovered 20 species. Coral Fragment was the most discovered at Sai Ree Bay (Station No. 2), could be calculate 9.87 pieces/m². Following by Chalok baan kao Bay (Station No. 12, 15), could be calculated 4.98, 4.56 pieces/m², respectively.

When calculated correlation coefficient by using percentage of coral living form (LC) and diversity index (H'), it was found that the relationship was positive. The value was 0.708. It can be said that diversity index varies depending on percentage of coral living form at 70.8% at the significance of 0.01 or reliability of 50.2% as shown in (figure 5-1). This is because the relationship of coral living form

percentage will not always vary depending on diversity index. It depends on characteristics, compositions, and types of corals in each area.

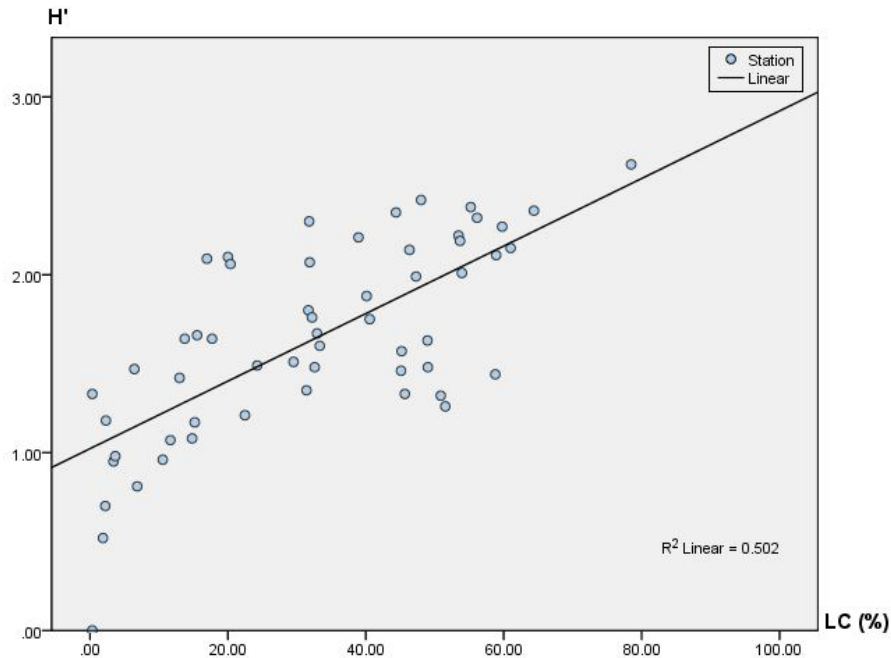


Figure 5-1 The graph showing relationship of coral living form percentage and diversity index

5.1.2 Zoning and Management Coral Reefs

The area of coral reef at Koh Tao classified by using MPACS (The Marine Protected Area Classification System) (Al-Abdulrazzak and Trombulak, 2012) could be classified as a level of protection for being Ecological Management Area (EMA). Due to in this coral area was defined as plant conservation according to General Fisheries Act B.E. 2549. Furthermore, Koh Tao was also classified as a travel industry and the utilization of coral reefs must be in accordance with the appropriate regulations, zoning and managing the multiple benefits could be done by without turning off area (no take zone). In order to prevent conflicts with stakeholder that is in the line of protected area of IUCN’s objective. According to IUCN classified this area in type VI, means protected area with sustainable use of natural resources) (IUCN, 2008).

Thus, the conceptual of zoning and management coral reef for being as sustainable tourism activities which could be divided into 1). Conservation Zone 8

sites, comprised of Sai Ree Bay, Hin Ngam Bay, Leuk Bay, Tanote Bay, Mao Bay, Hin Wong Bay, Mango Bay and Nang Yuan Island except pier, for controlling activities and reduce impact of utilization. 2). Rehabilitation Zone 6 sites, comprised of Taa Cha Bay, Thian Og Bay, Had Sai Daeng Bay and Nang Yuan's pier, in order to rehab to its original conditions or closely original condition. 3). Development Zone consisted of 2 areas where were Mae Haad's pier (Station No.7,8) and Nang Yuan's pier (Station No. 51,52) for being as Public Service.

5.1.3. Evaluating Marine Tourism Activities Issue

Considering the marine tourism activities found that SCUBA diving did not a major impact on coral reef. Because the diving course instructors inform students how to behave while they are diving in the coral reef. Moreover there are artificial coral reefs for reducing impact of utilization in natural coral reef.

Snorkeling activity uses the utilization of natural coral reef for entertaining directly in Had Sai Daeng Bay, Leuk Bay, Tanote Bay, Hin Wong Bay, Mango Bay and Eastern part of Nang Yuan's Island. In those area are surround by yellow buoy for representing the area for diving and preventing the boats come into diving area. As a result, the natural coral reef is protected. Therefore, the entrepreneurs have to inform the visitors to do not wear fins, be careful while they are diving and do not touch or pick in order to protect coral reefs. However, the tourists still ignore to wear life jacket, as a result, it take more risk that the tourists will stand and cause coral damage. Overall, in the shallow diving area such as Had Sai Daeng Bay and Had Sai Daeng Bay, the coral reef in that area was decadent. In contrast, the coral reef from another area presented in good condition.

The another coastal activities such as swimming or Sun bathing were the most found in Mae Haad Bay, Chalok baan kao Bay and Sai Ree Bay. Kayaking, Sailing, Windsurfing and Wake & Ski could be found everywhere in Koh Tao. Degradation coral reef at Koh Tao could be divided into 3 main factors, comprise of, (Figure 5-2)

(1) Developing public service, in this study showed that locations around the Mae Haad Pier and Koh Nang Yuan Pier were highly deteriorated. Especially, the construction of pier in Koh Tao at Mae Haad Pier during

August 2010, the corals covered by sediments were found. From the survey by the researcher, it was found that coral reef around Mae Haad Pier was highly deteriorated. (The ratio of living coral to dead coral was 1:3)

From the study of Weterings (2011) by using the model during 1975-2005 from the information of rainforest loss, the ground was washed out causing sediment that affects to coral reefs. This includes the expansion of tourism industry. The corals reefs around the communities include Sai Ree Bay and Mae Haad. These areas are affected by sediment that flows down. The next area is Chalok Baan Kao Bay. Moreover, there is the impact from the construction of reservoir in 2006. It caused sediment to flow down and cover Tanote Bay's coral reef (Scott, 2008). In 2009, Koh Tao managed the sediment flowing down to Tanote Bay by growing vetiver grass around the reservoir to prevent sediment from flowing down to the coast (Larpnunet al., 2011 cited in Wilkinson and Brodie, 2011). About the result of survey on coral condition around Tanote Bay by the researcher in 2010, no coral was found affected by the sediment. Except at station 33, where the corals were found deteriorated by tourism activities (detail in 5.1.3.2).

(2) Activities from marine tourism, in this study discovered that Tanote Bay was the most favorite bay that has many tourists visit and diving. According to the result, it ruined coral reef. Furthermore, the anchoring can ruin the coral reef. In Mango Bay (station No. 46) revealed that left anchor near conservative buoy could damage coral reef.

(3) Natural hazard happened in the Gulf of Thailand, was recorded in 1989. The Typhoon Gay attacked coral in southern part of Koh Tao. The coral bleaching phenomena has occurred in Taa Cha Bay, Thian Og Bay and Had Sai Daeng Bay since 1998 until the present, caused coral reef became old rubble. In addition, those places could found *Pocillopora damicornis* that use less time during metamorphose and settle (Hagedorn *et al.*, 2006). The coral reef degradation in Chalok Baan Kao Bay and Mao Bay caused by flag coral communities, resulting coral bleaching phenomena.

Management marine tourism activities, mainly handle by private sector. Since the establishment recognizes the importance of resources to operate their businesses. Such as, do not wear fins while diving in order to prevent tourists stand on

the coral reef. Term the diving and swimming area (OMCRC, 2011). The Snorkeling Area in Had Sai Daeng Bay, Leuk Bay, Hin Wong Bay, Mango Bay and Nang Yuan's island were the most favorite swimming and snorkeling area and the coral reef were found in good conditions except coral reef in Had Sai Daeng Bay was ruined by natural hazard.

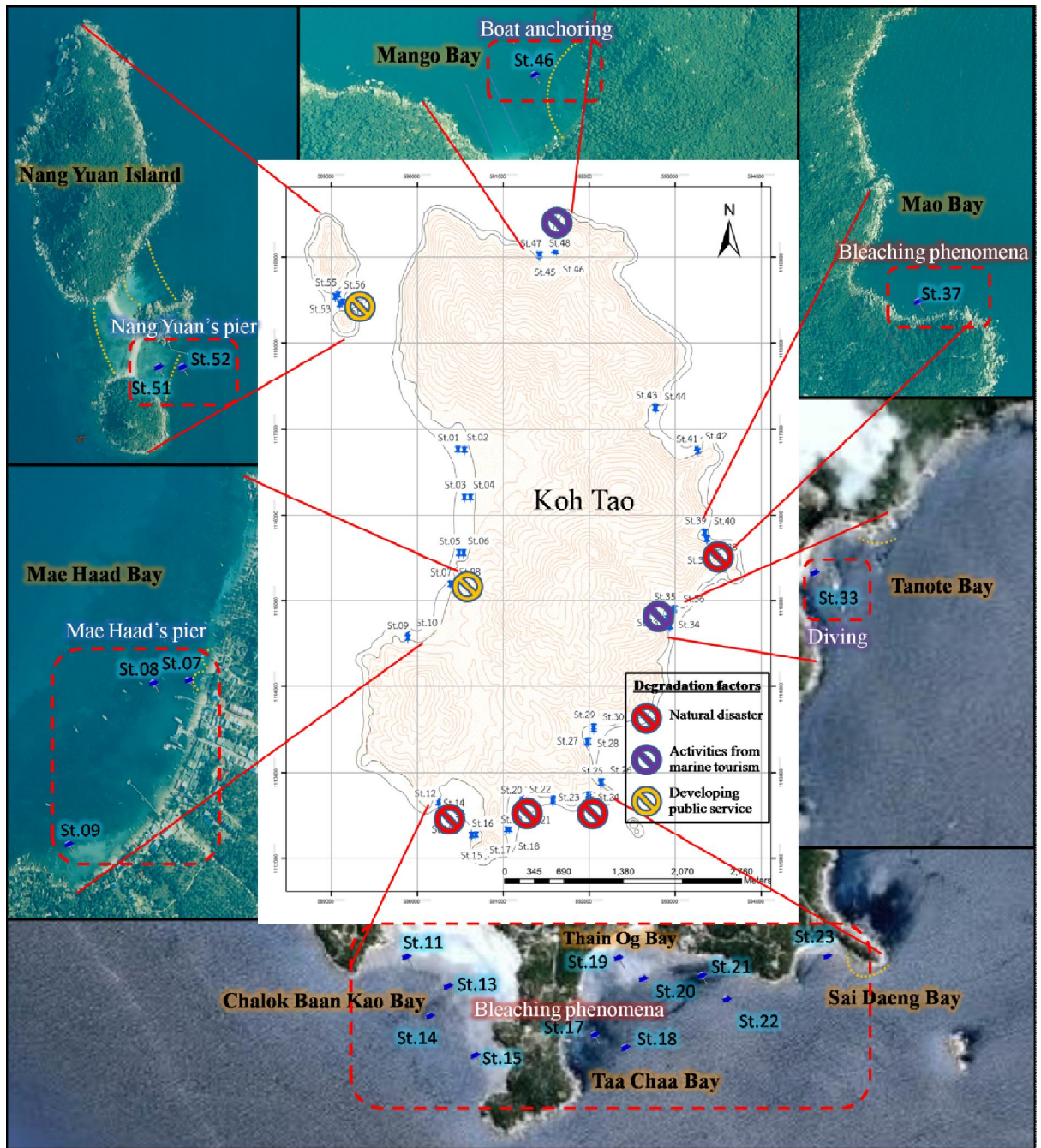


Figure 5-2 Map showing impact from degradation of coral reefs

5.1.4 Guideline for coral reef zoning to handle tourism activities

From the exploration on coral reef condition and marine tourism activities, including the interview with relevant persons, the researcher is able to determine the guideline for Koh Tao coral reef management to handle tourism activities. This will make the management effective. The conservation is concurrent with the development for sustainable utilization (figure 5-3). The detail is as follows.

(1) Non-utilization areas should be included in Strict Nature Reserve Zone in order to preserve them as coral breeding areas. Maintain their condition to support ecological processes according to the regulation of utilization area determination of OMCRC in 2009, namely Cape Nam Tok Area, Kluay Thuen Bay, and Mao Bay. The researcher agrees to reserve these 3 areas. However, it is possible that businesspersons might come to build near shore residence. Therefore, they must be informed in order to avoid utilizing the areas around Mao Bay's coral reef. In addition, the study showed that the coral condition of Hin Ngam was very good. And it has the highest coral diversity index among every explored station. Therefore, this area should be restricted too (no take zone).

(2) In conservation area where still does not have prevention such as Mao Bay and Sai Ree Bay should place buoy for defining swimming and snorkeling area. To become a protected area and can be controlled utilization in this area.

(3) Should be increase mooring buoy in Mango Bay and Nang Yuan's island because it found the massively use in this area and maintenance of the buoy in swimming and snorkeling area at Sai Ree Bay.

(4) In restoration of natural areas should focus on building under the water in the sand without coral reefs area in order to attract tourists for taking advantage of the benefits provided for in the status of coral reef degradation and leave the area to restore itself naturally.

(5) Shallow reef in Tanote Bay should determine pathway go to the beach for avoiding tourists overrun coral reef.

(6) Mae Haad Bay's pier (Station No. 7, 8) and Nang Yuan Island's pier (station No. 51, 52) should be assigned development zone for

transporting passengers and goods only. It should not have activities in this area to ensure safety for tourists.

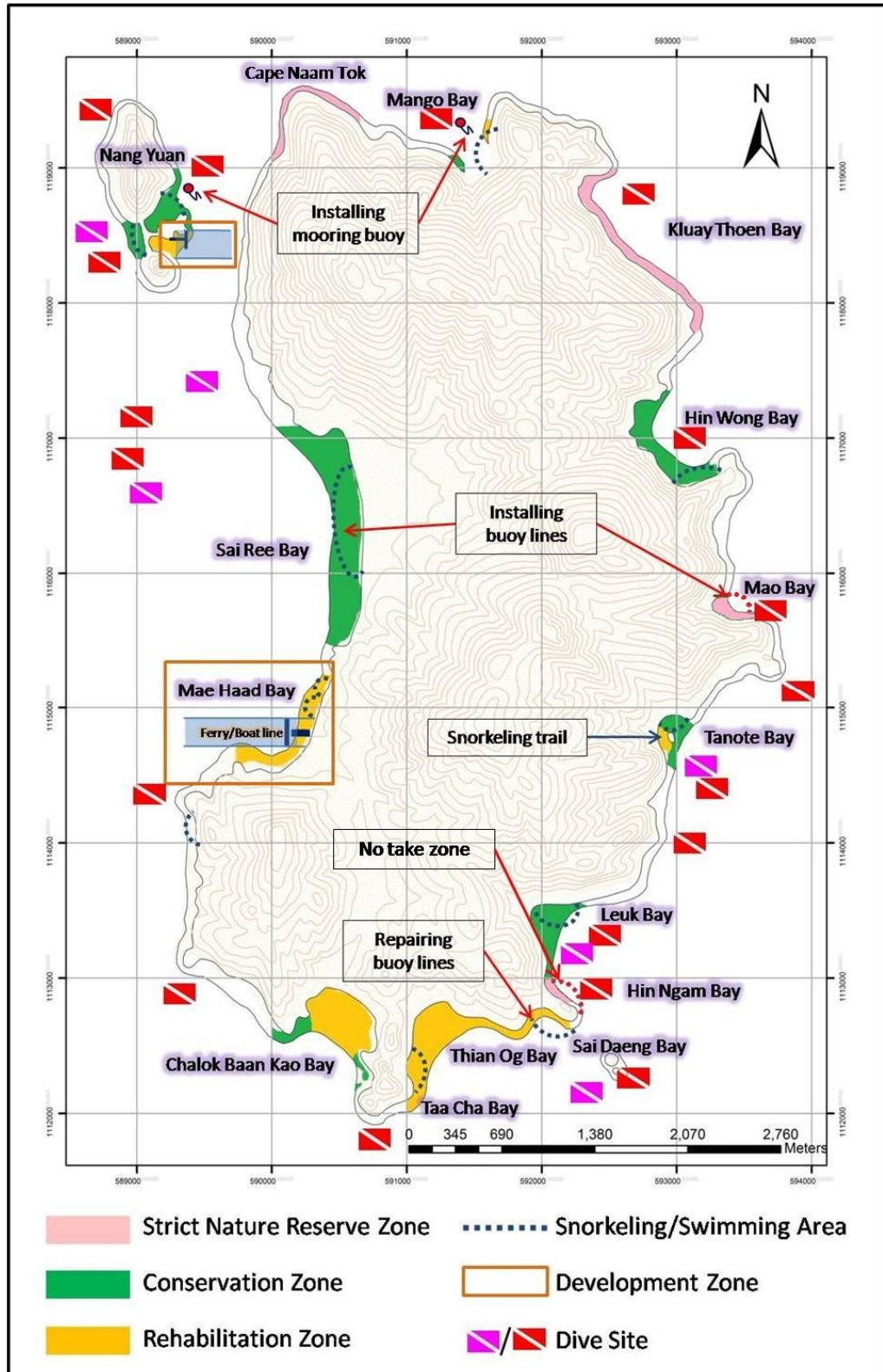


Figure 5-3 Koh Tao coral reefs management guideline

5.2 Recommendation

5.2.1 In this study, the survey was conducted on the areas used for tourism purpose only. Thus, it lacks of information from other areas. Besides, due to limitation regarding of time, budget and manpower, every area around the island should be further explored or studied in order to determine the guideline for zoning more diversely.

5.2.2 The Primitive Zone should be arranged by conducting further study in the part of fish species (reef fish), flora and fauna in the areas, which are fertile and diverse, suitable to be conserved as breeding area. The utilization must not affect to the changes of the environment, for example, arranging natural sightseeing trail with certain control and restriction. Primitive Zone will act as buffer area for Strict Nature Reserve Zone.