Progress report on

Marine and coastal resources monitoring capacity building program for Thailand MPA staff

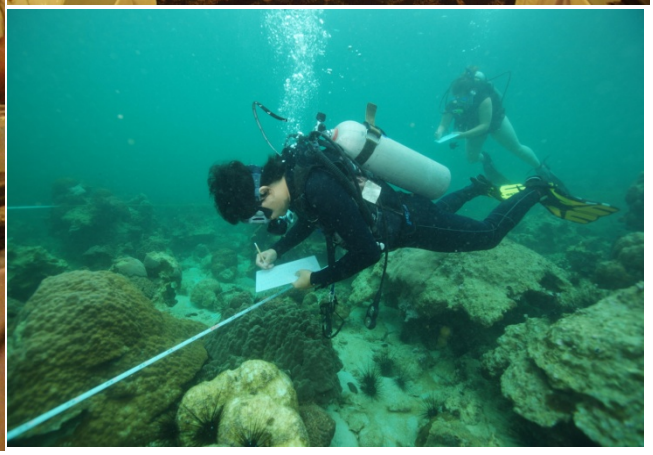

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Table of content

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Rational of assignment

Thailand's marine and coastal resources, like many others around the world, are coming under increasing environmental and anthropogenic pressures. While conserving marine and coastal resources is the responsibility of many government agencies in Thailand, many areas are protected and managed by the Department of National Parks, Wildlife and Plant Conservation (DNP). However, in the past, one of the greatest constraints on effective management of natural resources was the lack of information on the drivers of resources decline. Also lacking were integrated research and monitoring programmes. Scientific studies and surveys had been conducted sporadically throughout Thailand's national parks with little consistency in methodology or large-scale experimental design.

Although there have been many scientific studies of the marine and coastal resources, limited funding and in some cases a lack of interest mean that few areas have been studied continually. Repeated study is needed to evaluate the health of marine and coastal resources, and to allow MPA managers to adapt to changing circumstances. However, the gap in regular scientific surveying can and will be filled by long-term monitoring by park staff.

Generally, surveyors use several methods in combination to suit particular interests. If the objective is to measure the effectiveness of management approaches by examining change in resources condition, monitoring methods should permit comparison of site conditions over time. Frequently used survey techniques for monitoring biological changes are aerial photography and remote sensing for general types of resources. For coral reefs and underwater habitat and organism monitoring, common techniques include manta tow rapid survey,

swimming survey (visual or video), line intercept transects, fish census (visual or video), quadrats and photo quadrats, and circle sampling (Phongsuwan & Chansang, 1994; DMSCI, 1997; English *et al*., 1997; Worachananant & Thamrongnawasawat, 1999; RFD, 2000; Worachananant, 2000). Monitoring a large area requires more resources than a small area, so the level of monitoring will have to balance data quality with cost of collection. In addition, data from broad-scale methods tend to be more qualitative and difficult to compare unless obvious differences exist.

Data collected from one site on a reef cannot represent the entire reef and, likewise, data from one reef cannot represent the whole park. Sampling effort needs to be spread throughout the area of interest to be able to make general statements and conclusions about the area (Oxley, 1997). Thus, designing a fundamental monitoring procedure is crucial in order to facilitate an accurate monitoring programme. Data analysis and application are equally important for effective management.

The purpose of this assignment is to develop and deliver a training package for long-term monitoring of marine and coastal resources to be used in building the capacity of MPA staff in Thailand to collect and use information for increasing management effectiveness.

Objectives

The principal objectives of this assignment are:

1. Using the gap analysis from the SAMPAN workshop of 1 December 2011, develop a marine and coastal resources monitoring course, including appropriate training materials in Thai, for MPA staff.
2. Deliver the training course to selected MPA staff to test its effectiveness and obtain feedback for refining and finalising the training materials

Methodology

1. Review and analyse the current situation of monitoring practice based on findings from SAMPAN workshop.

2. Summarise reef monitoring practices being used by coral reef researchers and conduct a discussion forum with specialists and practitioners.
3. Assess key reef monitoring practices essential for enhancing management effectiveness of marine natural resources
4. Draft the course outline and prepare reef monitoring workshop manual.
5. Validate the manual with experts and key practitioners.
6. Conduct reef monitoring training workshop for 15-20 marine park staff.
7. Revise and finalise course outline and training materials, including manual from course evaluation feedback by trainees and other stakeholders

Thus, in this report, attributes one to five have been done and summary of activities, procedures outputs and deliverables is listed in table 1

Table 1 The activities, outputs and deliverables of this assignment

<table>
<tr><th>Activity</th><th>Procedures</th><th>Outputs</th><th>Deliverables</th></tr>
<tr><td>1. Review and analyse gap analysis and other outputs from SAMPAN workshop on 1 December 2011</td><td>1. Review and analyse workshop report from SAMPAN meeting and synthesise draft material for specialist and key practitioners meeting on 17th February 2012 at Bangkok</td><td>1. Gap of monitoring practice and training needs.</td><td rowspan="2">1. Overview of monitoring capacity needs,
2. training objectives,
3. relevant background materials on reef monitoring being used by researchers.</td></tr>
<tr><td>2. Summarise reef monitoring practices being used by coral reef researchers and conduct a discussion forum with specialists and practitioners.</td><td rowspan="4">2. Deliver the synthesised material on reef monitoring being used by Thai researchers and conduct a panel discussion on appropriate reef monitoring method for marine park staff.</td><td>2. Reef monitoring practices being used by coral reef researchers</td></tr>
<tr><td>3. Access key reef monitoring practices essential for enhancing management effectiveness of marine natural resources</td><td rowspan="2">3. Appropriate reef monitoring method for marine park staff</td><td rowspan="3">4. Draft course outline
5. Appropriate methods and number of collecting samples</td></tr>
<tr><td>4. Draft the course outline</td></tr>
<tr><td>5. Validate the manual with experts and key practitioners.</td><td>4. Draft course design and the appropriate sample for data collecting</td></tr>
</table>

Summary and conclusion derived by the gap analysis

Following the gap analysis from SAMPAN workshop, six priority topics on conservation monitoring as jointly identified by a group of key stakeholders within three marine parks (Mu Koh Surin, Mu Koh Similan and Mu Koh Lanta Marine National Parks) have been identified as;

1. Status of coral reef
2. Status of reef fish
3. Status of water quality
4. Status of marine endangered species
5. Level of coral bleaching and coral diseases
6. Socio-economic data especially in tourism and fisheries communities (from Mu Koh Lanta Marine National Park[1])

These priority topics were analysed and presented to the participatory workshop and summarised into main categories as, status of coral reef, status of coral reef fish, water quality information, endangered species, and Other environment parameters related to Coral bleaching.

Status of coral reef.

Status of coral reef information had been collected as well as environmental parameters overtime. Reef check, reef watch, line intercepted transect and belt transect were standard methods used among marine scientists in collecting those data. Mu koh Surin national park, in particular, has continual data overtime since 2004. Most studies were carried on in coral reef area focus on **reef structure and composition**, **coral fragmentation** and **effect of snorkelling on coral reef.** However, limited skill and understanding of field data collection resulted in constrains on some critical monitoring designs among park staff as follows;

- criteria for sampling site selection,

[1] Not in the scope of this assignment

- appropriate number of sampling site in each station,
- whether the sampling should be random or fixed site,
- validity of collected data,
- the ability to distinguish coral diseases, and
- how to integrate collected data and use that data in association with the adaptation of management plan.

Status of coral reef fish.

Data of target species in conservation program were collected using fish visual census as describe by English *et al.,* 1997. Others data were collected using reef check method and reef watch method. Target species are listed as;

- Groupers
- Snapper
- Bump head parrotfish
- Guitar fish and shovelnose ray
- Barramundi cod
- Napoleon wrasse
- Whale shark
- Ribbon eel
- Manta ray
- Sharks

Studies showed that there are some constrain limiting the effectiveness of reef fish management in National park due to illegal fishing and limited knowledge of park staff. Major problems include;

- Illegal fishing activity in park boundary,
- limited ability to assess fish population changed,
- complicated categorising system to monitor reef fish; identified target species should classified as economic species, endemic species, endanger species etc.

Water quality information

Phuket Marine Biological centre (PMBC) had been collecting water parameters in marine national park twice a year. Reports showed that excessive nutrients and low dissolved Oxygen are common problems in coral reef. Most of study collected water parameters both physical and biological such as Temperature, Turbidity, pH, Salinity, DO, BOD and total Coliform bacteria. According to SAMPAN meeting, there are problems arise from park staff including the selection of sampling sites and the limitation of instrument and the complication of analysis techniques, thus appropriated collectible parameters should be classified into two categories; **field data** which require simple technique and basic instruments and **lab data** which require complicated lab technique and advance instruments.

Endanger species

Current study only covered a survey of sea turtle in Surin National park. Problem found there is no certain agency take full responsibility on such data so; therefore, database network linked to PMBC should be established.

Other environment parameters related to Coral bleaching.

Few topics in environment parameters were raised such as beach transition, population of hermit crab and goats crab, diversity and abundance of macro algae, abundance of COT and present of coral disease.

Current reef monitoring practices being used by coral reef researchers

Standard method being used among marine scientists were compiled in "Survey manual for tropical marine resources" edited by English *et al.,* (1997). There are 6 Methods used according to objective of the study described belows.

Manta tow technique (Done *et al.*,1981)

This technique was used to evaluate a broad status of coral reef during a severed change of reef health in a broad area within a short time such as Mass coral bleaching, out brake of Crown

of Thorn Sea star (COT), Tropical storm or oil spill etc. Collected data would give brief information of reef status and be able to use as a guideline to conduct further research which focuses on specific issue. With a small motored-boat slowly tow a skilled diver attached to a manta board enables a visual assessment of large scale. A constancy speed three to five kilometre per hour and consecutively pause every two minutes to let an observer record data onto data sheet. Advantages of manta tow technique included the large coverage area of reef can be surveyed within a short time and low risk on damaging coral colony. On the other hand, disadvantages of this method are a limited data of coral reef collected, high experienced needed of an observers and cannot be conducted in poor visibility water.

Quadrat methods.

Objectives of this method are to evaluate density, distribution and variation of benthic community within the given area. Squared-sampling plot (Quadrat) made from stainless steel or PVC will be random or fix placed in study site regard as sampling area. Data will be collected by visual estimation or photographic estimation within given quadrat and reported in average proportion of each category to entire reef.

Line intercept transect.

Line intercept transect has been regarded as standard method being used worldwide. Objectives of this method are to study actual status of coral reef as well as diversity, density and community structure of coral. Data collected by this method provide more detail than Manta tow technique and applicable to different type of data such as life form, genera or specie etc. Line transects were placed on coral reef parallel to shore line, observer records transition of each benthic organism and physical composition such as sand, coral rock, coral rubble and rock underneath. According to the reports available, there are four different methods in term of length of line and number of replicate being used in Thailand; 20 meter line with five replicates, 50 meter line with replicates, 30 meter line with three replicates and 30 meter with four replicates.

Data analysis; percentage cover of each categories in proportion to reef area will be analysed. Ecological data such as abundance, species diversity and species richness can also be obtained

from recorded data. Line intercept transect are able to provide percentage cover information of every categories found in sampling line. It also needs few of basic tools; PVC line and underwater slate board. However coral life forms are difficult to distinguish in some genera.

Fixed Pointed Transect.

This method was first established by Reef Check Program (www.reefcheck.org) to monitor status of coral reef all over the world and be a simple method to volunteered divers. A 100 meter transect or four of 20 meter transect will be placed in coral reef then data of indicator species are recorded at every 0.5 m from zero to 20 meter and start another three observes at interval of five meter. Advantages of this method are being simple method for volunteered diver to collect data and gathered data is fairly acceptable. Disadvantages of this methods are difficulty of distinguish some life forms of coral.

Video Belt Transect.

Video belt transect being used to monitor change of benthic community in coral reef as well as study of distribution, diversity and community structure of coral reef. By using a wide angle video camera in auto focus mode observer need to keep distance between line transect and camera at 0.25 meter as well as to maintain horizontal position. Recording will be conducted in 50 meter line transect at swimming speed 10 meter per minute. Additional light sources might be used when conduct in low light intensity.

Data interpretation; Recorded file will be playback and paused at every 0.5 meter then data at 9 random or fixed point on screen will be collected and analysed. Using video camera can help decrease underwater time so researcher can observe more area than visual inspection. However, this method requires video camera and, in some case, artificial light source which are expensive. For this reason light intensity and suspended sediment are limiting factor in recording acceptable video file.

Photo Belt Transect.

Photo belt transect is a method modified from video belt transect using photography instead of video recording therefore, applicable to other researcher who have underwater still camera.

Using wide angle still camera in auto focus mode, observer need to take two photo of benthic community; one to the left of transect and the other to the right slightly overlap the first photo. Observer will continue taking photo every 0.5 meter along 20 meter line transect hovering at 0.3 meter above ground. Researcher can analyse data using particular software to collect benthic community data over fixed or random 9 points on screen. To conduct data analysis 40 photos per line and nine sampling points in each photo were selected. Percentage cover of each category (genera, species or life form) will be reported in proportion to entire reef. Advantages of this method are decreasing of surveying time therefore; researcher will be able to survey more area in limited time. Moreover observer only need to take photo and employ data analysis using software with applicable to people who are not coral biologist. However basic photography skill and basic computer skill are essential in employing Photo Belt Transect method.

Current monitoring practices on coral reef fish and other invertebrates being used by researchers.

Coral reef fish and invertebrates are regards as reef status index. There are techniques used to study and monitor those organisms in coral reef.

Belt Transect.

This survey method is known as Fish visual census (English *et al*., 1997). Observer will record species and abundance of fish along three replicates of 50 metre long transects with five meter belt or five replicates of 30 metre long transects with five meter belt. Belt transect method are also used to survey marine invertebrates as well.

Estimated time swim.

Researchers can also conduct fish visual census by swimming at constant speed at certain depth during given time of 30 to 60 minutes or nine replicates of five minutes swim.

Estimated distance swim.

This method is a fish visual census in constant speed at certain depth. Observer need to estimate a survey distance of 50 meter without transect line for three replicates.

According to previous research conducted by Kasetsat university and Burapha university, coral reef fish will be classified as Target species, Indicator species and Major families whilst researchers from Prince of Songkhla university and SAMPAN project have categorised coral reef fish into Target species, Indicator species, Ornamental species and Herbivorous species. However difference of each category is subject to difference of study area.

Marine invertebrates in coral reef have also been monitored and study by university and other agencies. Marine invertebrates which are target of each survey among those researchers are both common indicator in coral reef such as Crown of thorn sea star, Sea urchin, sea cucumber, *Drupella* sp., nudibranch, soft coral, sea anemone and Giant tiger clam.

Current monitoring practices on water quality

Monitoring of sea water quality is importance in observing effect of anthropogenic activities to coral reef. Up-to-date information is essential in managing use of coral reef as well as to maintain good condition of sea water. To obtain useful information, suitable physical and biological parameters and consistence of data collection are to be considered. Besides, collecting skill, water analysis skill and standard instruments are factor effecting success of data collection to marine park staff. Training of water sampling and physical data collection will increase capacity of marine park staff. Analysis of water parameters can be done by working together between marine park research centre, universities and other government agencies.

Physical parameters; Temperature, salinity, pH, turbidity, DO, nitrite, nitrate, ammonia, phosphate

Biological parameter; Fecal Coliform bacteria, total Coliform bacteria.

Draft of standard Method in long-term monitoring of marine and coastal resources.

According to the participatory meeting between marine scientists university researcher and professor, and marine park scientist and manger. Set of standard methods for marine park staff to monitor marine and coastal resources has been nominated categorising by priority research needed.

Coral reef

The Photo Belt Transect method has been considered as the most suitable standard method for marine park staff to monitor coral reef status. Study site will be selected as permanent study site for long term monitor. The methodology of photo belt transect is described below.

1. Thirty meter transect line will be placed in reef flat and reef slope with three replicates each.
2. Place two by two meter quadrat at start and end of each line.
3. Take a photo in given quadrat at the begin point of transect line.
4. Take a photo of coral colony on the right side of the line using wide angle mode camera at 0.5 meter above the transect line. Each photo should cover 0.5 meter regards to the line.
5. Take a photo in given quadrat at the end of transect line.
6. Analyse all photo using CPCe software (Coral Point Count with excel extension)

Coral reef fish

The Fish visual census is the most suitable method for coral reef fish monitoring. Surveying will be conducted on metre long transects with five meter belt using same transect used in coral reef monitoring. Target species to be observed has been classified based on trophic level into six categories.

- **Carnivorous fish** such as grouper, snapper, lion fish and moray eel.
- **Herbivorous fish** such as parrot fish, surgeonfish, tang and rabbit fish
- **Planktivorous fish** such as damsel and fusiliers

- **Common fish** such as barracudas and wrasses
- **Rare fish** such as sharks and rays
- **Ornamental fish** such as butterfly fish, frog fish, anemone fish and angle fish

Marine invertebrates

Marine invertebrates will be monitored using 30 metre long transects with two meter belt used in coral reef monitoring. Observer has to first count the number of target species on one side within one meter width of the line and return on the other side. Crown of thorn sea star, in particular, will be either monitored by manta tow technique. Soft coral will be monitored only in high abundance site. Gorgonian will be monitored by tagging selected colony and taking a photo to compare overtime.

Table 2 types of selected marine invertebrates and method used for data collection

Species	Data collection	
	filed survey	projected photo
Crown of thorn sea star	X	
Sea cucumber	X	
Drupella sp.	X	
Giant clam	X	
Cleaner shrimp	X	
Sponge		x
Macro algae		X
corallimorph		X
Sea anemone		X
Gorgonian	Tagging and take a photo	
Soft coral		Taking photo in 2 x 2 meter permanent quadrat

Water quality

Selected parameter and sampling method are listed in table 3. Data sampling are scheduled during neap tide twice a month.

Table 3 selected water quality parameter and detail of collection procedures

Parameters	Instrument	Remark	Standard value	Collector
temperature	thermometer	Field sampling	-	Park staff
salinity	Refractometer	Field sampling	29-35 ppt	Park staff
pH	pH meter	Field sampling	7.0-8.5	Park staff
Turbidity	Sechi disc	Field sampling	-	Park staff
Dissolved oxygen (DO)	DO meter	Field sampling	> 4-6 mg/L	Park staff
nitrite	Water sampling bottle or automatic meter	Field sampling and lab analysis		Park staff and Research center
Nitrate	Water sampling bottle or automatic meter	Field sampling and lab analysis	< 60 ug-N/L	Park staff and Research center
Ammonia	Water sampling bottle or automatic meter	Field sampling and lab analysis	< 70 ug-N/L	Park staff and Research center
Total nitrogen	Water sampling bottle or automatic meter	Field sampling and lab analysis	-	Water sampling bottle or automatic meter
phosphate	Water sampling bottle or automatic meter	Field sampling and lab analysis	< 15 ug-P/L	Park staff and Research center
Total Coliform bacteria	Water sampling bottle and Lab analysis	Water sampling at30 cm. depth	< 1,000 MPN/100mL	Park staff and Research center
Total fecal coliform bacteria	Water sampling bottle and Lab analysis	Water sampling at30 cm. depth	< 1,000 MPN/100mL	Park staff and Research center