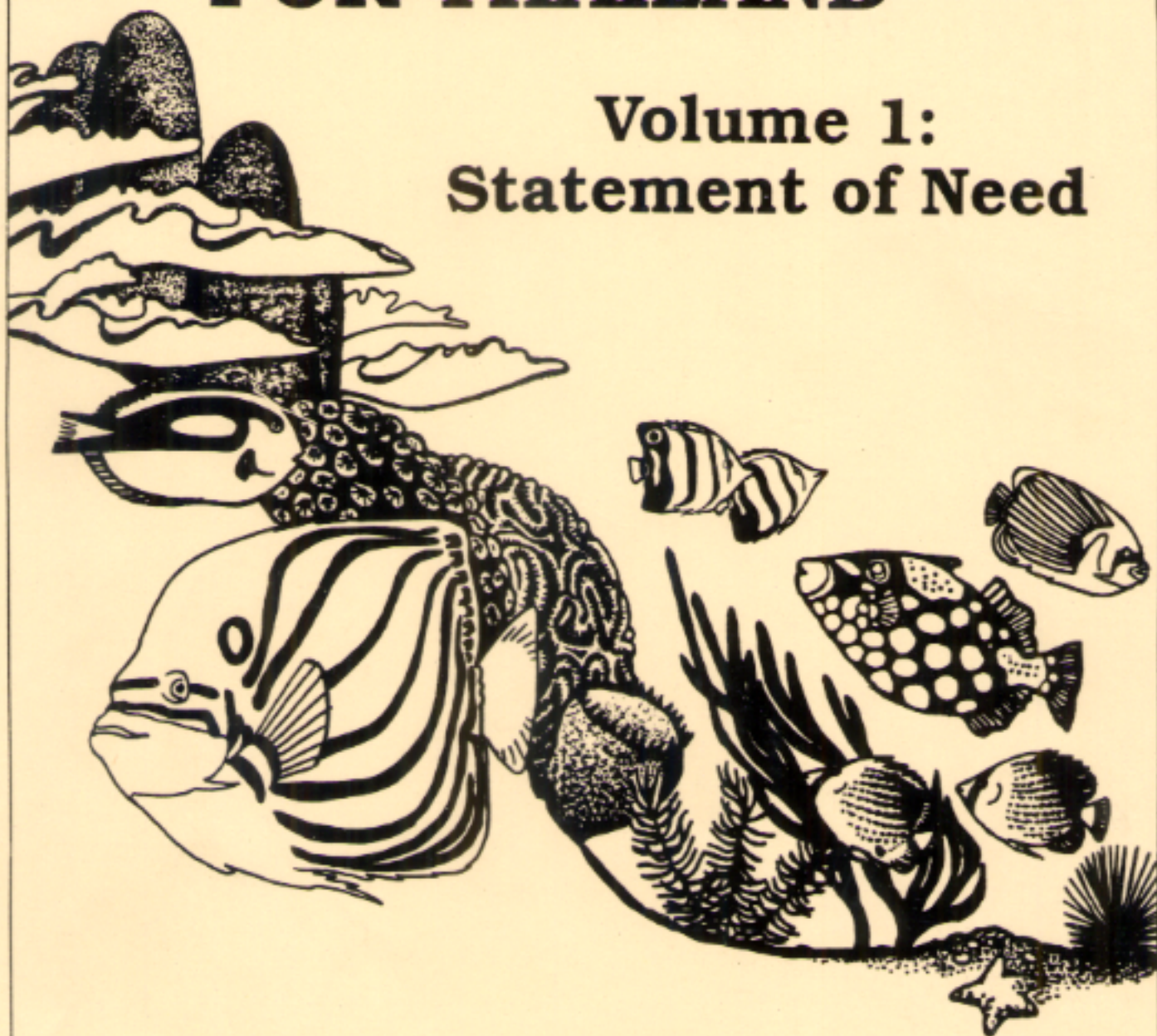


A NATIONAL CORAL REEF STRATEGY FOR THAILAND

Volume 1: Statement of Need



Thailand Coastal Resources Management Project

A NATIONAL CORAL REEF STRATEGY FOR THAILAND

**Volume 1:
Statement of Need**

January 1991



THAILAND COASTAL RESOURCES MANAGEMENT PROJECT

Office of the National Environment Board

The University of Rhode Island

Department of Technical and Economic Cooperation

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The opinions, findings, conclusions, and recommendations expressed in this report are those of the authors and do not necessarily reflect the official view of the Agency for International Development.

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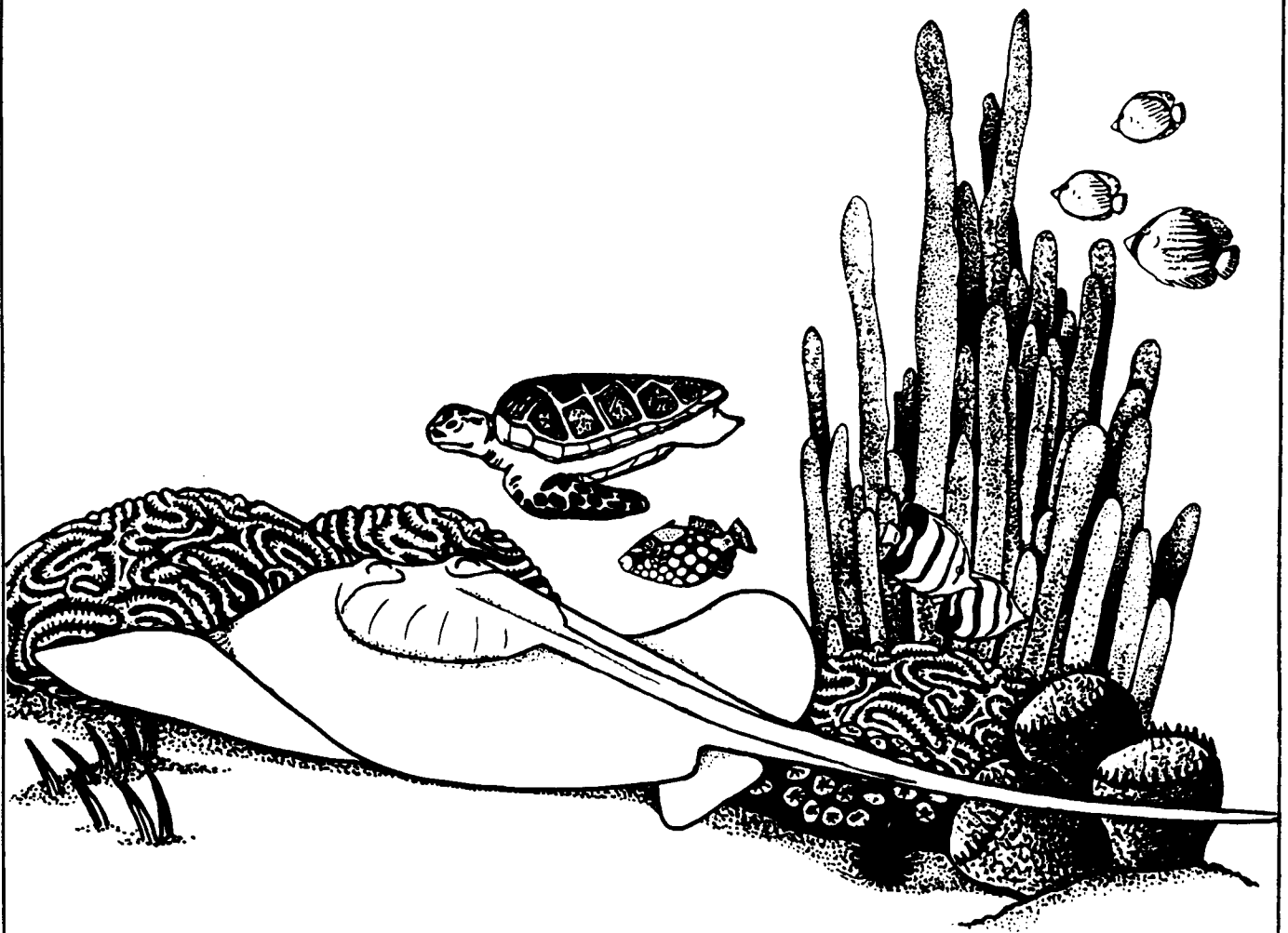
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PREFACE

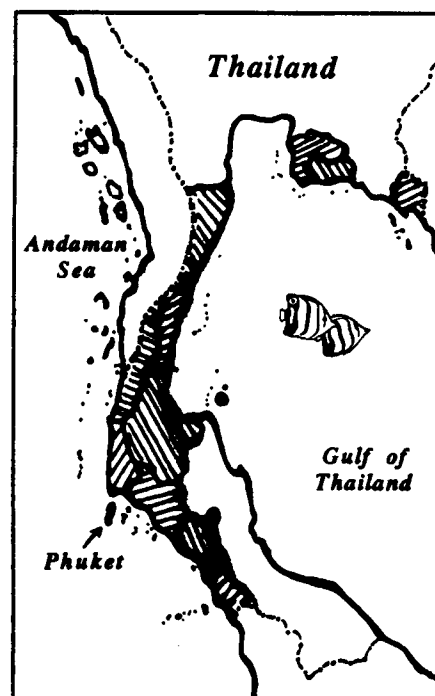
Coral reefs are underwater communities found in tropical marine areas where the water is warm, shallow and clear such as in the lower Gulf of Thailand and the Andaman Sea. Like mangroves, lagoons, beaches, and seagrass beds, coral reefs are diverse and productive ecosystems that support a range of human activities. Coral reefs are one element of the natural resource base that has led to robust economic development in Thailand's coastal zone. Major reef groups are found in twelve of Thailand's twenty-three coastal provinces (Map 1).

While healthy reefs are an asset to the national economy and natural heritage, degraded or destroyed reefs represent an important loss. Baseline studies undertaken in 1988 confirm that Thailand has lost extensive and valuable coral reefs during the last two decades. Should they continue, these trends will have serious negative implications for fisheries and tourism in many coastal communities.

The Government of Thailand has recently undertaken several projects in an attempt to reverse trends in coral reef degradation. These have included a nation-wide baseline study and community-based reef management activities in Phuket, Surathani and other coastal provinces. If Thailand is to maintain its coral reefs, conservation and management efforts must be expanded to include all major reef groups in the twelve provinces where significant reefs are present.

Volume 1: Statement of Need is the first step in a process aimed at developing a National Coral Reef Strategy for Thailand. The document establishes the need for a National Strategy, defines the key problems it must address, and sets forth attainable objectives. The findings contained in this report are based on information and experience from both government and the private sector.

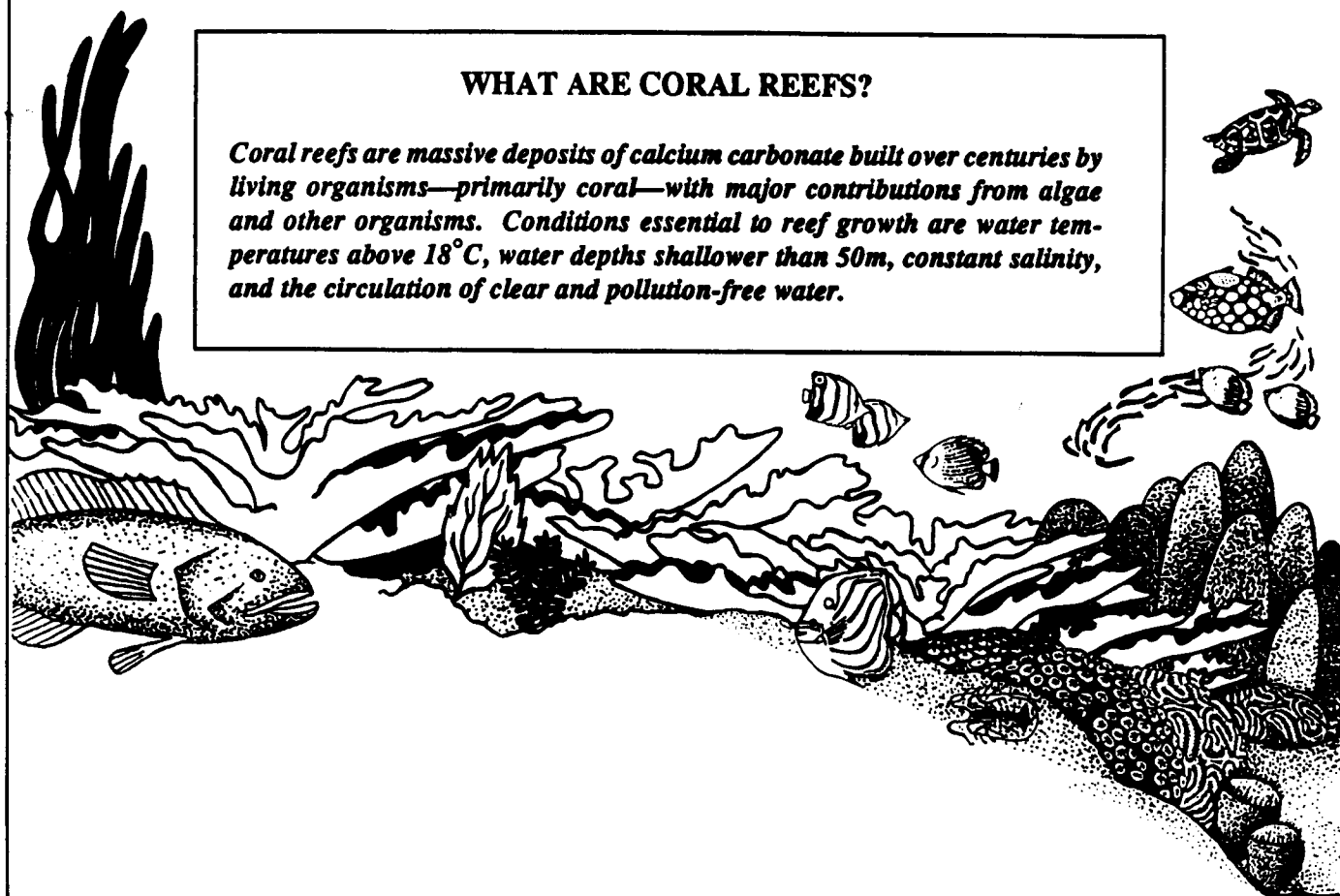
The policies, measures and actions needed to meet the challenge of sustainable reef use will be set forth in an accompanying document, **Volume 2: Policies and Action Plan**, to be released in late 1991. Implementation of this national coral reef strategy will require unprecedented cooperation among national and local government, and among government, the private sector and resource users. There is broad support for such an initiative. We must, however, proceed with purpose and urgency if Thailand is to maintain its coral reefs.



MAP 1.
COASTAL PROVINCES
WITH CORAL REEFS

WHAT ARE CORAL REEFS?

Coral reefs are massive deposits of calcium carbonate built over centuries by living organisms—primarily coral—with major contributions from algae and other organisms. Conditions essential to reef growth are water temperatures above 18°C, water depths shallower than 50m, constant salinity, and the circulation of clear and pollution-free water.



THAILAND NEEDS A CORAL REEF MANAGEMENT STRATEGY

There are three compelling reasons for adopting and implementing a coral reef management strategy for Thailand without delay.

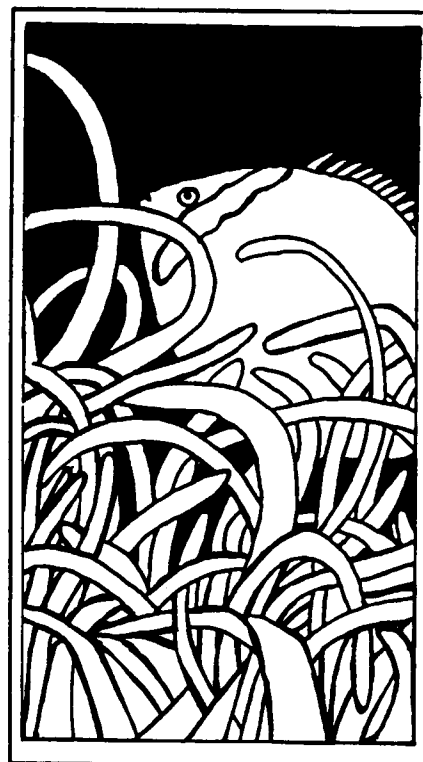


1. Thailand's coral reefs are important to the national economy, to maintaining local lifestyles and as an essential part of southeast Asia's natural heritage. An effective management strategy can ensure that all Thai people, including future generations, will continue to benefit from these reefs.

In the 1980's coral reefs became an important feature of international tourism in many provinces including Phuket, Krabi, Surathani and Trang. Tourism is Thailand's biggest source of foreign exchange and healthy coral reefs, with their scenic and recreational values, are an attraction that draws visitors to Thailand.

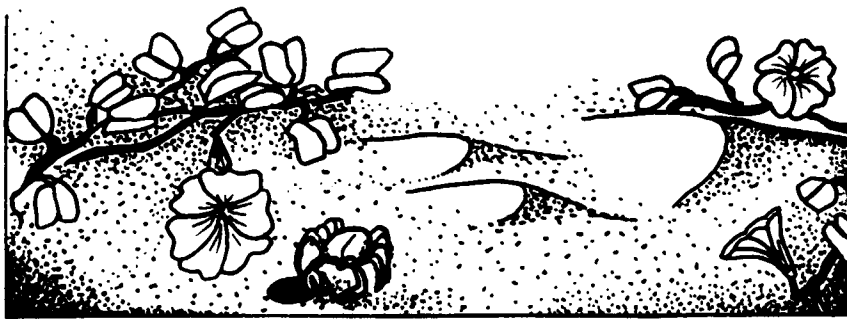
Coral reefs offer tourism development opportunities which produce increased employment and revenues for coastal provinces. Many businesses in the coastal zone now depend directly or indirectly on revenues generated by the utilization of healthy coral reefs. In some locations, increased recreational use of coral reefs has provided poor, small-scale fishermen with an alternative source of income.

Thailand's coral reefs provide food and shelter for fish and shellfish of high commercial value including grouper, snapper, and lobster. These reef species are often an important source of revenue for traditional fishermen. While small compared to the total catch and value of Thailand's industrial fisheries, reef fisheries are a primary source of income and food for many coastal communities.



CORAL REEFS BENEFIT THE PEOPLE OF THAILAND BY:

- Providing recreational opportunities;
- Providing habitat for commercially important fish;
- Protecting shorelines from severe erosion during heavy storms and monsoons;
- Nourishing beaches with coral-derived sand;
- Producing products for medicinal and pharmaceutical purposes; and
- Providing habitat for rare and threatened species.



Coral reefs serve as a nursery for juvenile fish during their early growth. Many of these fish eventually migrate to join the offshore stocks that are so important to Thailand's industrial fisheries.

Thailand's coral reefs are a natural heritage of international significance. Thailand is near the center of highest coral diversity in the world. The diversity of species is remarkable, with 210 species of coral and over 100 species of fish already identified. Rare species are present on remote reefs and new species are still being identified. Like tropical forests, Thailand's coral reefs are an important reservoir of biological diversity.

Many of Thailand's reefs have been placed within Thailand's Marine National Parks—one of the most extensive networks of marine protected areas in the ASEAN region. These coral reefs are destined to play an important role in research, marine environmental education and the testing of innovative marine conservation techniques.

As development continues to boom along Thailand's coasts, the demands placed on coral reefs for fisheries production, tourism, and research will all increase and conflicts will intensify. Unfortunately, the benefits derived from coral reefs are too easily overlooked in the coastal development process. A National Strategy offers a mechanism whereby values and opportunities linked to Thailand's reefs are recognized and incorporated in the process of making decisions concerning coastal land use, fisheries management and tourism development.



2. Thailand's coral reefs are deteriorating at an accelerating rate. Yet, there remain many unspoiled reefs of great significance.

Coral reefs in Thailand are affected by:

- Increasing coastal sedimentation and pollution brought by changing land use within coastal watersheds;
- Reef blasting, other destructive fishing practices and anchoring on reefs;
- Overharvesting of fish and shellfish; and
- Storm damage and crown-of thorns infestations.

Today, over sixty percent of Thailand's coral reefs are either in poor or fair condition, a dramatic change from just a decade ago. Deteriorating conditions could lead to the permanent destruction of coral reefs in some areas.

The causes of deteriorating reef conditions vary from one location to another, as do the social and economic significance of the problems. A National Strategy will help sort problems in order of priority, and examine the social, economic and technical dimensions of each problem.

While the challenge of conserving Thailand's reefs is considerable, it is not insurmountable. There are still many reefs in either good or very good condition particularly in the offshore waters of Trad, Trang, and Chumporn provinces. Thailand also possesses a complete and current data base on the status of its coral reefs, enabling the Government to make informed management decisions.

This National Coral Reef Strategy provides a unique and timely opportunity for the Kingdom to address an important environmental issue. A combination of coordinated immediate actions and long-term measures is needed to maintain those reefs that are still productive and to reverse trends in habitat degradation. Thailand has the opportunity to become among the first countries in Southeast Asia to formulate an effective national program.





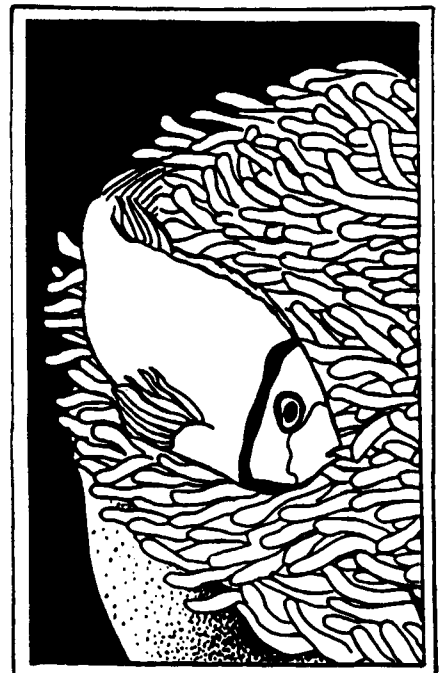
3. Thailand currently has few policies, laws or programs that recognize the importance of coral reefs. A strong national commitment and a management strategy are needed to ensure that coordinated and effective national and local actions are taken to encourage the sustainable use of coral reefs.

To date, attempts to control sources of damage such as pollution, overfishing and blasting have been fragmented and ineffective. This is in large part due to the legal and institutional framework governing the use of coral reefs in Thailand. Indeed, Thailand's existing laws and regulations do little to encourage wise use of valuable coral reefs. In most cases, the laws that do exist cannot be enforced.

There have recently been local initiatives, supported by national government, aimed at better management and conservation of Thailand's coral reefs. These small pilot projects have demonstrated the necessity of community participation in habitat management. They have also shown that government can work in close partnership with reef users and the private sector in solving specific problems such as anchor damage and littering. While these projects are a positive step, such efforts have been small and isolated when compared to the magnitude of the problems affecting coral reef habitat in Thailand.

Development and management decisions that affect coral reefs are made by a number of government departments as well as the private sector. Among them are the Department of Fisheries, the Tourism Authority of Thailand, the Royal Forestry Department and Provincial governments. Their decisions are usually based on objectives other than habitat protection and the values of coral reefs are often overlooked.

A coordinated and more harmonious approach to managing Thailand's coral reefs is now imperative. A National Strategy enables all concerned agencies to agree on priorities for action. It creates mechanisms for inter-agency cooperation and encourages all levels of government to solve problems in partnership with local communities and the private sector. Above all, a strategy heralds a strong national commitment for coral reef protection.



DEVELOPING THE STRATEGY

The Royal Thai Government has initiated the formulation of a National Coral Reef Strategy based on a sequence of activities that have yielded the scientific information, practical experience and broad support required for effective management.

Formulation of the National Strategy is being undertaken in three phases.

PHASE 1: Preparation and Distribution of Findings on the Status and Significance of Coral Reefs;

PHASE 2: Formulation and Discussion of Policies, Measures and Actions; and

PHASE 3: Cabinet and Agency Approval.

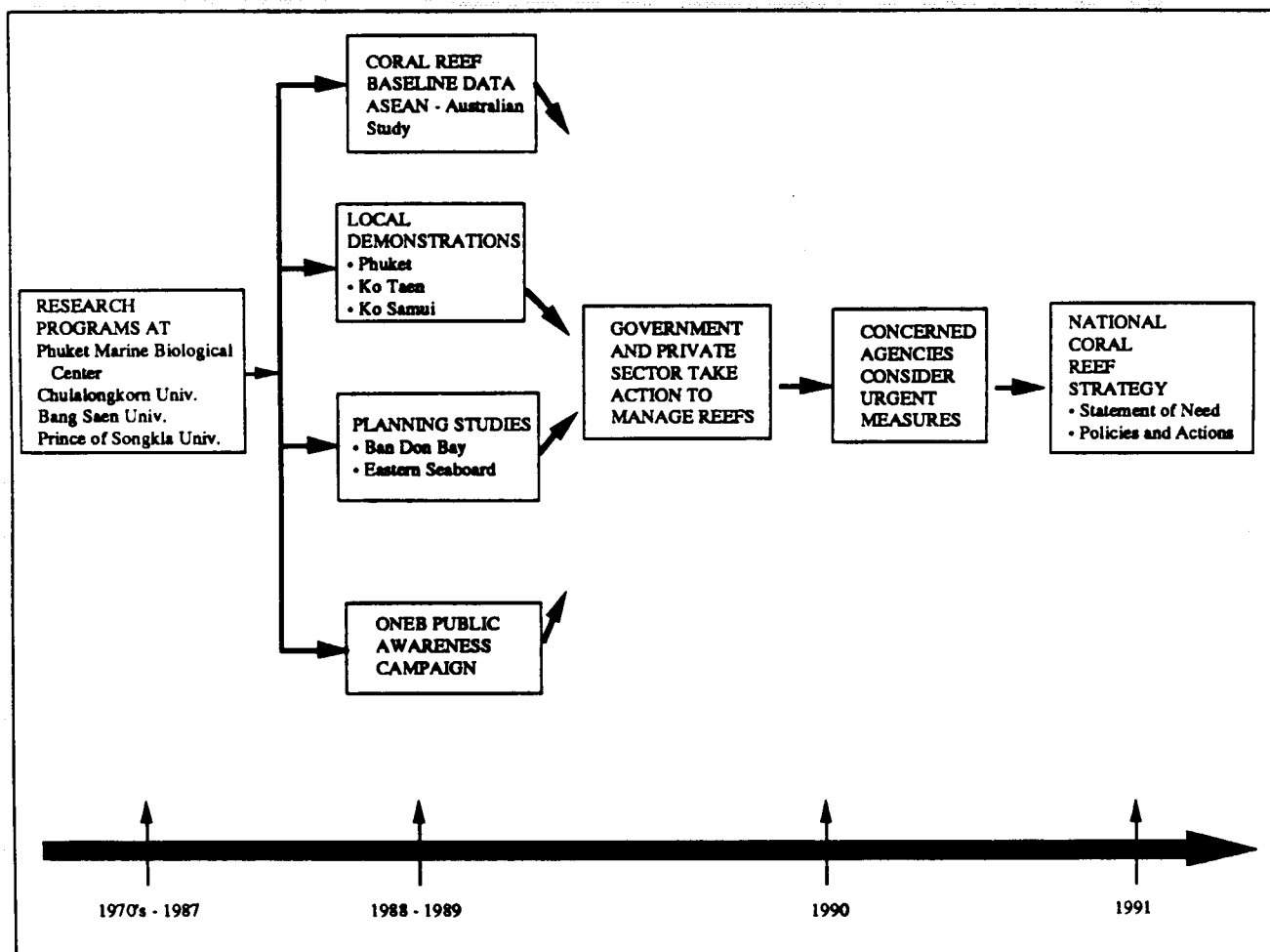
This document marks the completion of Phase 1. Participation from a wide cross-section of reef users, scientists, business interests, and concerned management agencies is an integral part of each phase. This consultation is crucial to ensuring that the best available information on reef condition and use is considered and that the strategy balances local and national priorities for the development and protection of coral reef resources.

The National Coral Reef Management Strategy must also complement and reinforce other environmental management efforts and programs in effect in Thailand's coastal areas. Foremost among these are the following:

- Provincial natural resource and environmental management plans in the twelve provinces where coral reefs are an important natural resource;
- Other environmental management measures including the Office of the National Environment Board's environmental impact assessment procedures and water quality standards;
- Marine national park management plans and the national marine park system plan currently under preparation; and
- National coastal policy formulation efforts underway as other elements of the Coastal Resources Management Project.



RECENT EVENTS IN CORAL REEF MANAGEMENT



Phase 1 of the National Coral Reef Management Strategy was initiated in early 1990. Three sets of activities have been crucial to this first phase:

- Analysis and validation of baseline information, including reef condition data from the ASEAN-Australian Cooperative Program on Marine Science and socio-economic data collected as part of the Coastal Resources Management Program (CRMP);
- Review of lessons learned from national and local demonstration projects in coral reef management; and
- Interagency and public consultation on the priority issues that should be addressed by a National Strategy.

This **Statement of Need** reflects the common understanding shared by reef users, scientists and resource managers of priority issues and opportunities for coral reef management in Thailand.

THAILAND'S CORAL REEFS

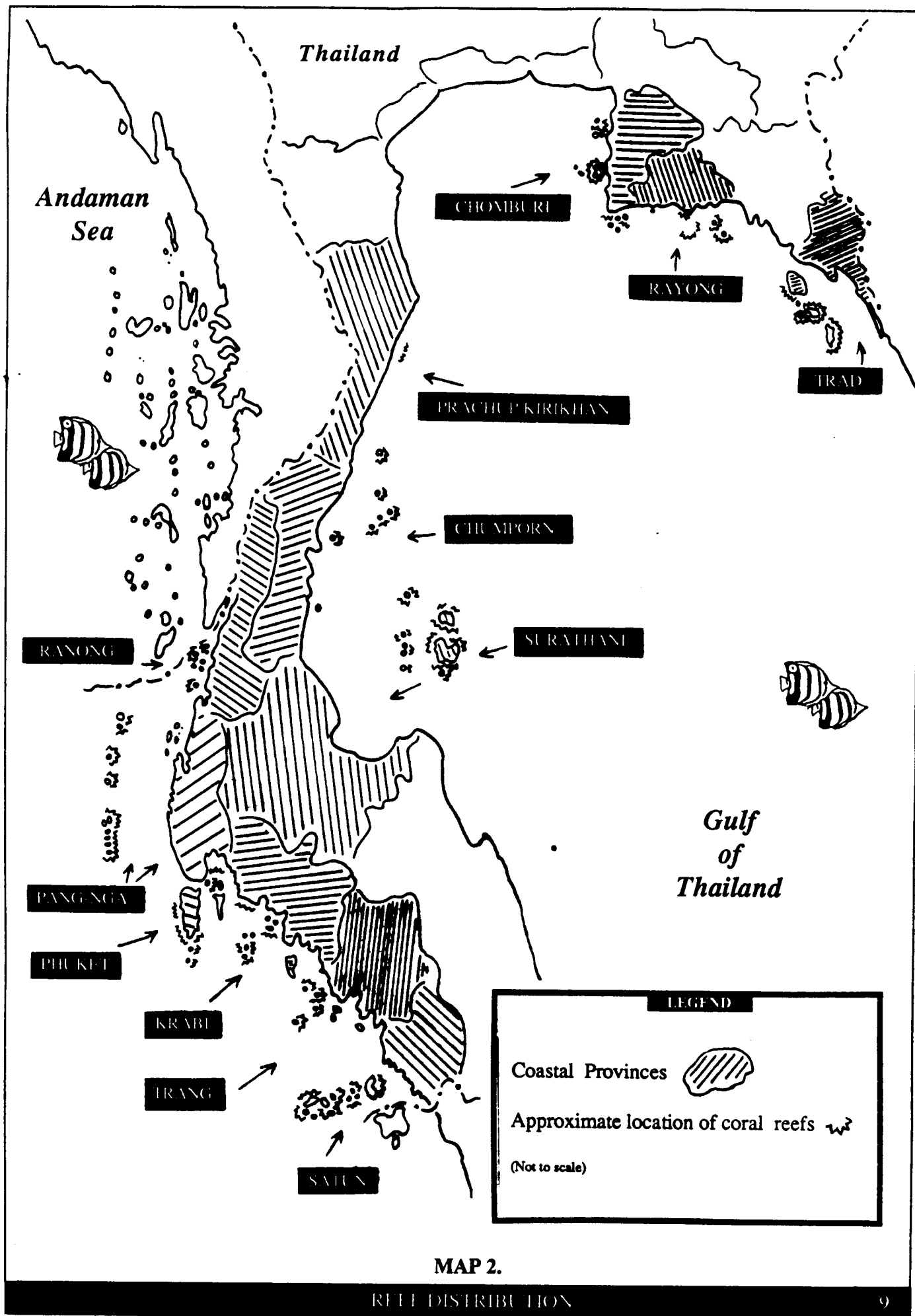
Located between 6°N and 13°N, Thailand's coastal waters offer good conditions for coral reef growth. There are over 300 major reef groups in Thailand, covering an estimated area of 12,000 km² (Map 2). Based on reef extent, Thailand ranks third in total reef area among the countries of southeast Asia, following the Philippines and Indonesia.

Coral reefs are among the most productive marine habitats in tropical regions. They support an abundance and diversity of fish and invertebrates. Recent surveys conducted in the Andaman Sea recorded 210 species of coral and over 100 species of reef fish from 30 genera and 15 families.

The majority of the reefs in Thailand are either fringing reefs or coral communities growing on substrates other than a limestone reef such as granite cliffs and boulders. There are rare occurrences of patch reefs, barrier reefs and atolls, mainly in the Gulf of Thailand.

There are marked climatic and oceanographic differences between the Andaman Sea and the Gulf of Thailand which affect coral reefs. Reefs in the Andaman Sea are subject to semi-diurnal tides and are exposed to predominant southwest monsoons from May to October. Reefs in the Gulf of Thailand are more affected by cyclonic weather and are subject to diurnal tides. Natural sedimentation is greater in the Gulf of Thailand due to its shallow depths and large river discharges. Coral diversity is thought to be higher in the Andaman Sea with the highest species diversity of hard corals (140 species) reported for the Adang-Rawi coral reef group in Satun.

Effective management of Thailand's coral reefs depends on an understanding of the ecology, significance, uses and condition of these habitats as well as the human activities resulting in reef degradation. Thailand is fortunate in that it now has a nation-wide baseline of information on reef resources, the result of the ASEAN-Australian Cooperative Program on Marine Science. The overview on reef condition provided here is based on the results of that study as well as decades of research conducted by Thai universities and the marine research centers of the Department of Fisheries. Information on reef use and management efforts was collected by the Office of the National Environment Board in 1990 and is based on interviews with Provincial officials, dive clubs, business leaders, and reef users.



MAP 2.



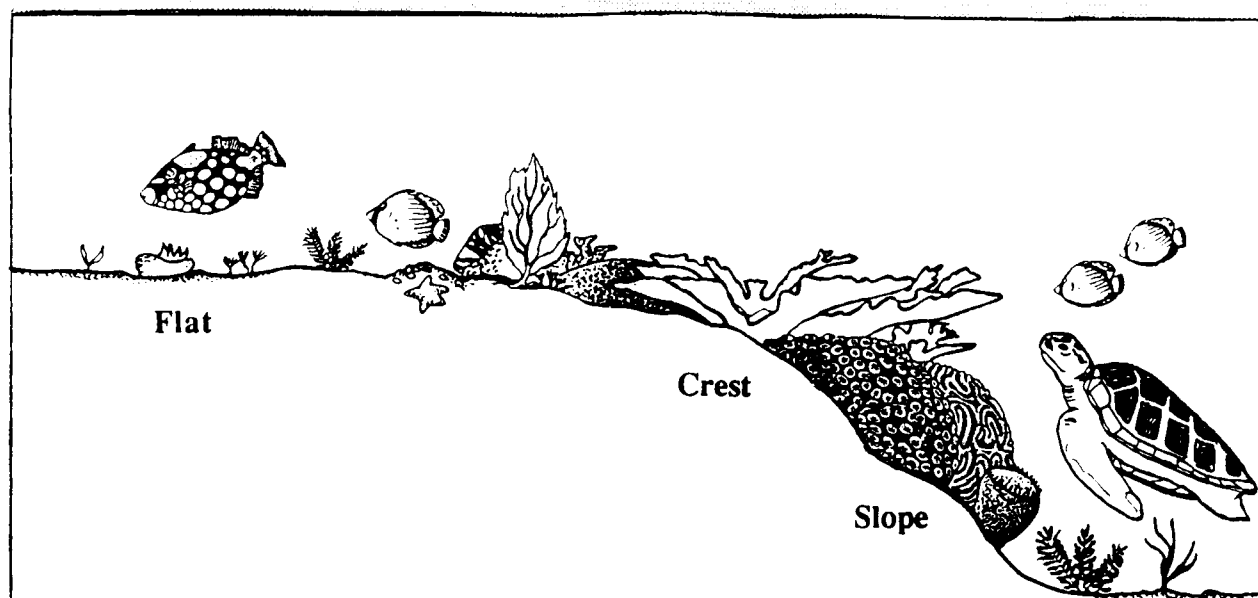
REEF DISTRIBUTION

Andaman Sea. Approximately 55% of Thailand's major coral reefs groups occur in the Andaman Sea. Within this region, there are marked differences in reef species composition and morphology. Reef conditions and coral cover tend to vary with the degree of exposure to the monsoon, currents, substrate and distance from the mainland. Fringing reefs predominate, with the reefs in the Adang-Rawi group a classic example (see drawing opposite). Other reefs in the Andaman Sea are coral communities growing on rocky shores and vertical granite walls where there is no substantial limestone reef development. This is the case for the Similan Islands and the Mu Ko Phi Phi group.

Scientists consider the most extensive, pristine and perhaps best developed reefs in Thailand to be those in the Surin Islands group (e.g., Pachumba and Stok islands). Other coral reefs of major ecological significance in the Andaman Sea Region include Ko Kradan and Ko Ngai in Trang province; and Ko Damhok, Damkwan, and Yong in Krabi province.

Western Gulf of Thailand. Approximately 20% of Thailand's major coral reef groups occur at shallow depths in the western Gulf of Thailand. Chumporn and Surathani are the only two provinces in this region with major reef groups. Poorly developed reefs are also found in the province of Prachup Kirikhan.

Eastern Gulf of Thailand. Approximately 25% of Thailand's major coral reef groups are in the eastern Gulf of Thailand. While generally not as developed as coral reefs in the Andaman Sea, several reefs in the Gulf of Thailand including Ko Tao and Ko Kradat are considered of particular ecological significance.



REEF DISTRIBUTION

PROVINCE	NO. REEF GROUPS	MAJOR REEFS
<i>Andaman Sea</i>		
Pang-nga	21	Surin
Satun	14	Adang-Rawi
Trang	15	Ko Rok
Phuket	12	Raja, Ko Hae
Krabi	7	Phi Phi
Ranong	4	Ko Chang
<i>Western Gulf of Thailand</i>		
Surathani	19	Ang Thong, Tao
Chumporn	18	Ko Chorakhe
Prachup Kirikhan	5	Ko Rat
<i>Eastern Gulf of Thailand</i>		
Trad	19	Ko Chang, Kradat
Rayong	13	Samet, Thalu, Man
Chomburi	25	SiChang, Pattaya

CORAL REEF USE

The coral reefs of Thailand support a variety of activities that can be grouped as tourism and recreation; fisheries-related uses; and other uses including research and education. The nature and intensity of utilization varies considerably from reef to reef as shown in Map 3.

In the last decade, there have been significant changes in reef use patterns, as small-scale or traditional fisheries have gradually been replaced by tourism-dependent activities. Local fishermen have converted their boats into small tour boats and placed more emphasis on shell collection for the souvenir trade. This shift in coral reef use is most notable in Trad, Pang-nga, Trang, and Surathani provinces.



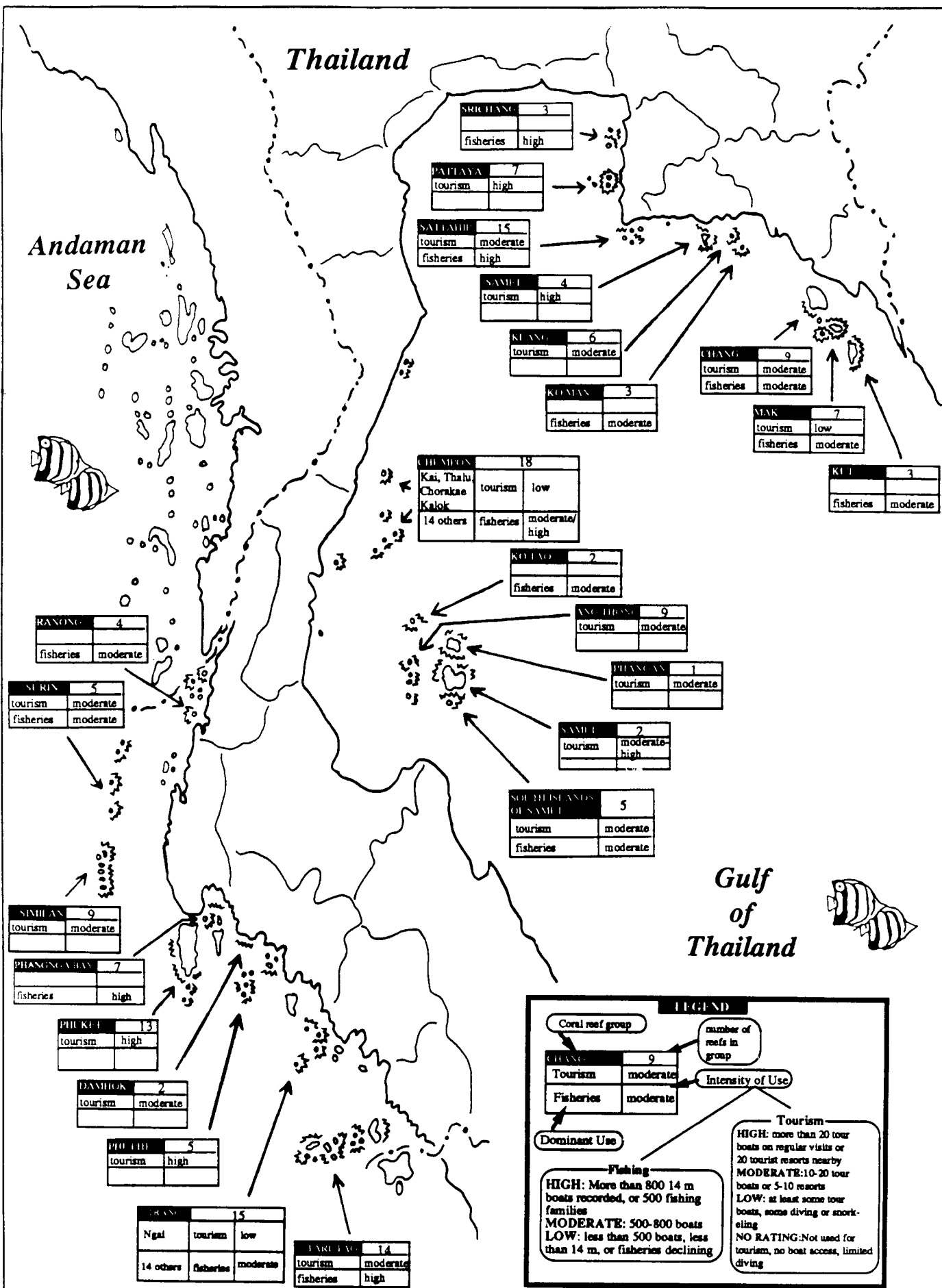
TOURISM AND RECREATION

Tourism and recreation uses include diving and underwater photography, snorkeling, sightseeing from glass-bottom vessels, and sport fishing.

Reefs close to beach resorts along the mainland or on major islands are often used intensively for tourism-related activities. In 1989, tourism-related activities were the predominant use of 40% of all major reefs in Thailand. Provinces where tourism and recreation are the most important reef use include Chomburi, Rayong, Phuket and Krabi. Approximately half of all reefs located in Surathani and Pang-nga provinces are also used primarily for tourism. Reefs receiving the heaviest tourism use include those in the vicinity of Patong and Ko Hae in Phuket Province, and the reefs off Pattaya, Ko Samui and Ko Samet.

SCUBA divers use coral reefs for training, sport diving, and underwater photography. Spearfishing is still uncommon in Thailand although it does occur. Divers are predominantly foreign visitors although the number of Thai divers has increased over the last few years. Sport fishing is primarily hook and line fishing done by Thai tourists for barracuda and grouper. Sightseeing from glass-bottom boats is a popular activity among both foreign and Thai tourists to Phuket and Pattaya.





MAP 3.

Coral reef-dependent recreational uses are seasonal. Rough seas during both monsoons greatly reduce access to the offshore islands where most major reefs occur. There are, nonetheless, a few year-round tourist destinations used for snorkeling and diving such as Patong and Ko Hae in Phuket.

Several coastal provinces (including Surathani, Trad, Phuket, Krabi and Pang-nga) are experiencing a rapid and steady growth in tourism with dramatic increases in reef-dependent recreational activities. The tourism growth experienced in these coastal areas in the last decade has heralded a new dependence of local businesses on coral reefs. There were, in 1990, an estimated 5,000 small tour boat operators and dive shops dependent on the recreational uses of coral reefs. In addition, many hotel resorts and large tour companies benefit indirectly from the scenic and recreational values of coral reefs. Data from Phuket from 1987 on the number of small businesses and shops that depend on the area's reefs provide an indication of the economic importance of these habitats for the tourism sector.

REEF DEPENDENT AND REEF RELATED BUSINESSES IN PHUKET

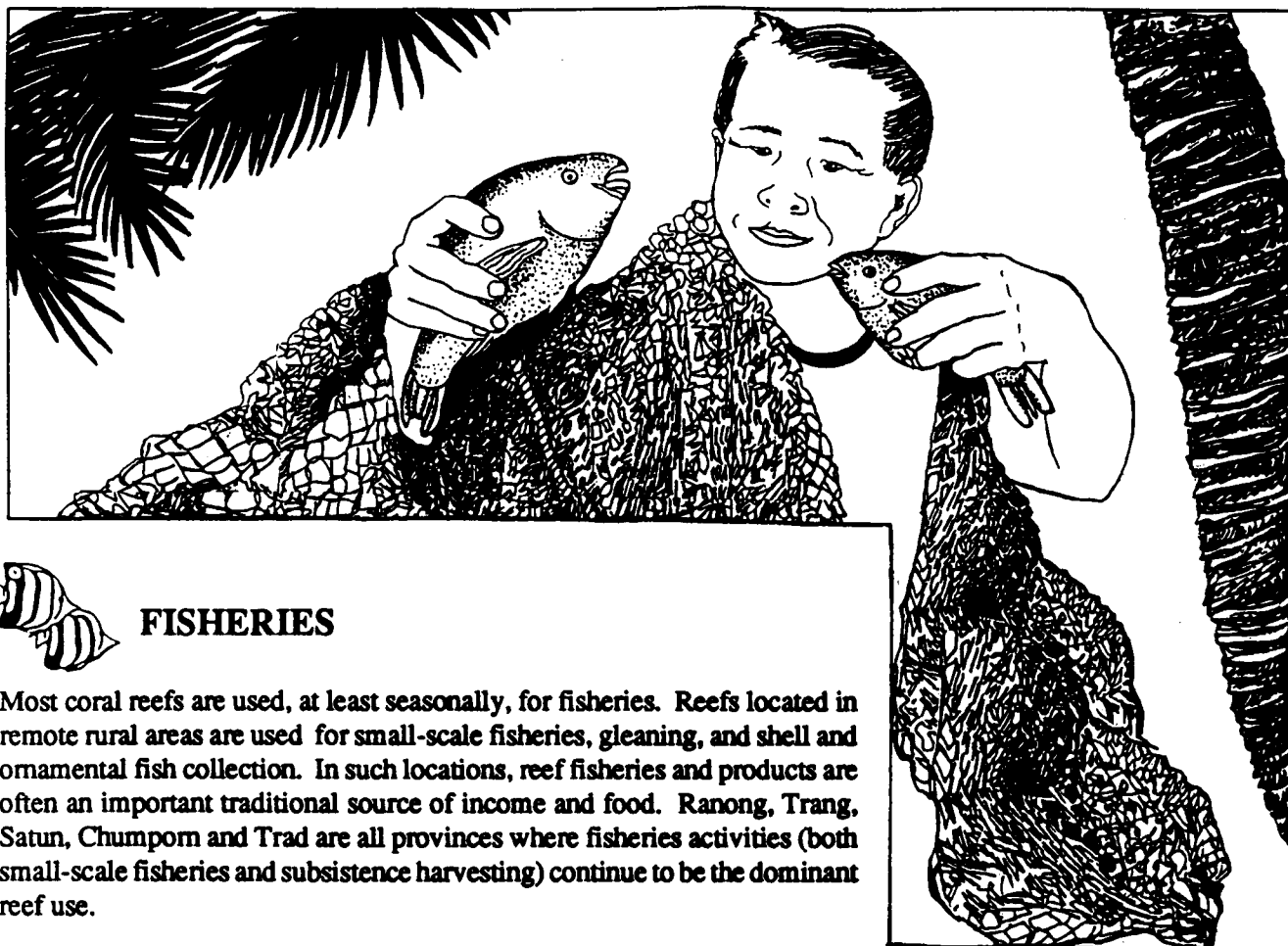
<i>BUSINESSES</i>	<i>NO. OF OPERATORS*</i>	<i>REVENUES*</i>
Tour boat operators	12	40 million baht
Tour companies	32	75 million baht
Dive shops	18	10 million baht
Souvenir shops	100+	no data
Shell/coral shops	40	2 million baht
Beach resorts/hotels	100+	no data
Seaside restaurants	100+	no data

* Estimated (1988)

In order of importance, the provinces with the most tourism revenues related to reefs include:

- Chomburi;
- Phuket;
- Surathani;
- Krabi;
- Pang-nga;
- Satun.

While revenues associated with recreational diving and snorkeling are still relatively low in Trad, Chumporn and Trang, these provinces have just been "discovered" as diving destinations. Most experts are predicting rapid increases in tourist resorts and services aimed at divers and snorkelers in these three provinces in the next five to ten years.



FISHERIES

Most coral reefs are used, at least seasonally, for fisheries. Reefs located in remote rural areas are used for small-scale fisheries, gleaning, and shell and ornamental fish collection. In such locations, reef fisheries and products are often an important traditional source of income and food. Ranong, Trang, Satun, Chumporn and Trad are all provinces where fisheries activities (both small-scale fisheries and subsistence harvesting) continue to be the dominant reef use.

Fisheries activities are the predominant use in approximately 45% of all coral reefs in Thailand. This estimate is conservative, simply because it is more difficult to record fishing and subsistence use than tourism use.

Local people in rural coastal areas depend on reef products as a source of protein in their diet. It is difficult to estimate how many people depend on coral reefs for subsistence but it is known that the traditional sea people and other inhabitants of small coastal communities glean reefs for small fish, mollusks, and other invertebrates.

Other major user groups dependent on reef fisheries include small-scale fishermen, shell and ornamental fish collectors and wholesale shell and ornamental fish dealers. Inshore small-scale fisheries are an important source of supplementary income in the provinces of Trad and Chumporn. Coral reef habitat also supports the fisheries sector by functioning as recruitment and nursery areas for stocks important to offshore fisheries.



OTHER USES

Coral reefs are being used more frequently for outdoor education programs, especially in Marine National Parks. They also serve as outdoor marine biology laboratories for Thai universities. Several universities including Chulalongkorn, Bang Saen, and Prince of Songkla have had on-going research programs at selected reefs for decades.

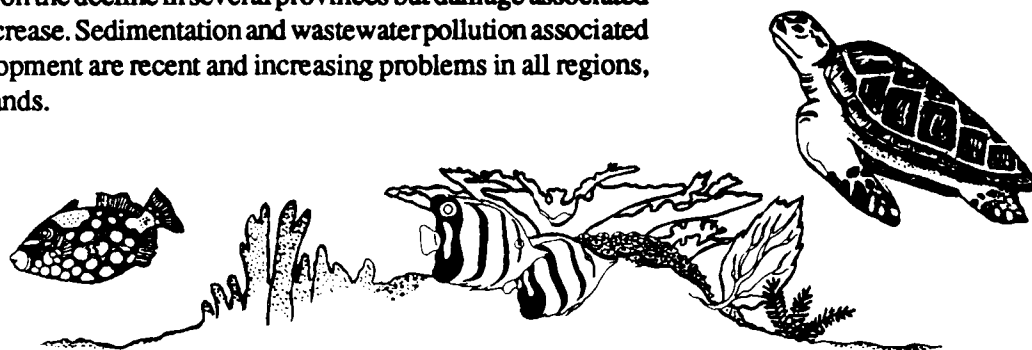
CORAL REEF CONDITION AND MANAGEMENT ISSUES

The condition of coral reefs in Thailand ranges from very good to very poor (Map 4). Over 60% of all major reef groups in Thailand are either in poor or fair condition. Less than 36% are in good or very good condition. The widespread deterioration of coral reefs in Thailand is a recent event associated with the introduction of bottom-trawlers and the use of explosives in the early 1960's, and the expansion of beach resorts in the late 1970's.

The coastal provinces that still have significant areas of reef in good and very good condition are: Trad, Trang and Pang-nga. The coastal provinces where reef degradation is most severe due to human-related activities are: Chomburi, Satun, Rayong, Phuket and Surathani.

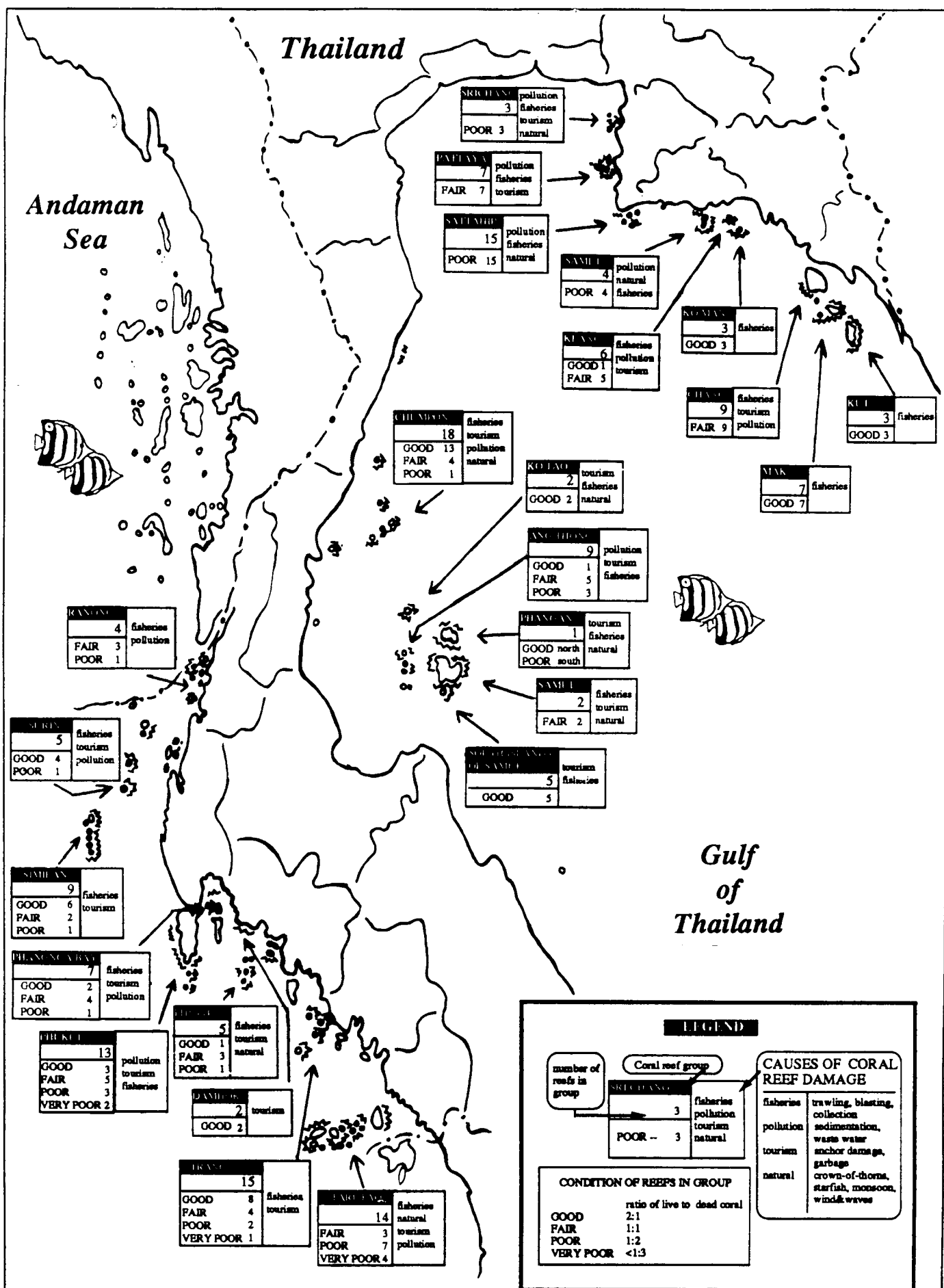
Geographic patterns in coral reef deterioration reflect patterns of use. Thus, reefs used heavily for tourism and in proximity to large beach resorts are affected primarily by pollution and anchor damage. This is the case for the reefs along the west coast of Phuket and those offshore from Pattaya. Reefs in remote or predominantly rural areas, such as in Chumporn and Satun provinces, are being damaged primarily by reef blasting and trawling.

Dominant causes of reef deterioration are shifting in many provinces. Reef blasting is reported to be on the decline in several provinces but damage associated with trawling is on the increase. Sedimentation and wastewater pollution associated with rapid coastal development are recent and increasing problems in all regions, even along offshore islands.



REEF CONDITION BY REGION

<i>CONDITION</i>	<i>WEST GULF</i>	<i>EAST GULF</i>	<i>ANDAMAN SEA</i>	<i>ALL THAILAND</i>
Good/very good	58 %	24 %	34 %	36 %
Fair	29 %	37 %	32 %	33 %
Poor/very poor	13%	39 %	32 %	30 %



MAP 4.

CONDITION OF THAILAND'S CORAL REEFS

WHAT ARE THE MAJOR CAUSES OF REEF DETERIORATION?

Fisheries

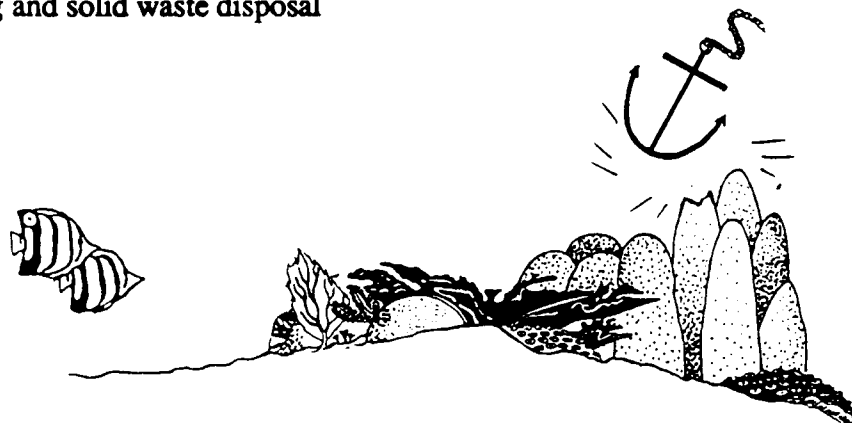
- Dynamite fishing
- Trawling over reefs
- Overharvesting
- Other illegal fishing techniques (chemicals, muro-ami)

Pollution and sedimentation

- Sedimentation and stormwater runoff from coastal areas
- Wastewater discharges from coastal developments
- Offshore sources of sedimentation (dredging, tin mining)

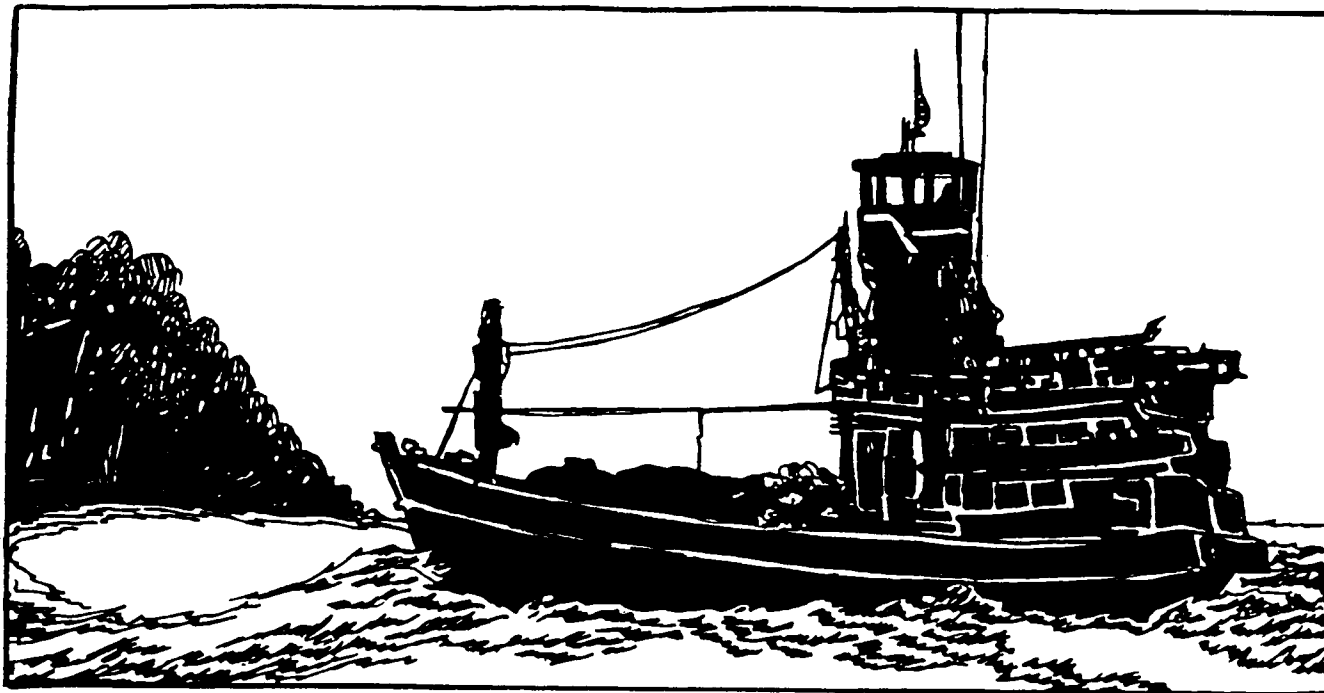
Tourism

- Anchor damage
- Groundings
- Trampling
- Souvenir collection and trade
- Littering and solid waste disposal



DOMINANT CAUSES OF REEF DAMAGE BY REGION

CAUSES	WEST GULF	EAST GULF	ANDAMAN SEA	ALL THAILAND
Fisheries damage	46%	87%	67%	71%
Pollution damage	30%	12%	27%	14%
Tourism damage	24%	1%	6%	14%



IMPACTS RELATED TO FISHERIES

Dynamite fishing has caused damage in 65% of Thailand's coral reefs and is the predominant cause of damage in 51% of the reefs. Provinces where reef blasting is extensive and a dominant cause of damage are Ranong, Pang-nga, Trang, Satun and Chumpom and to a lesser extent in Trad and Rayong. Dynamite fishing occurs mainly in offshore locations where enforcement is difficult such as Ko Tao, the Similan Islands, and the outer islands of Tarutao.

Dynamite fishing results in severe and extensive damage to coral reefs. The explosive charges can uproot coral heads, indiscriminately kill adult and juvenile fish and other reef organisms, and increase turbidity. Reefs that have been blasted are no longer productive for fisheries and their recreational value is greatly reduced.

Dynamite fishing is a relatively recent phenomena, beginning in the early 1960's. The possession and use of explosives has been banned by law since 1964 but enforcement of the ban has been only partly successful. Dynamite fishing appears to be on the decline in several locations because of the shift in employment towards bottom-trawling and tourism. Persistence of the problem is attributed to the lack of alternative local sources of income for fishermen, lack of knowledge and access to alternative fishing technologies, and a severe decline in coastal fisheries.

Trawling is a cause of damage in 79% of Thailand's coral reefs and it is the predominant cause of damage in 20% of the reefs. Rayong, Satun, Trad and Surathani are all provinces where bottom-trawling is a predominant cause of reef damage. The destructive effects of trawling over reefs have been observed in both inshore and offshore locations.

Bottom-trawlers dragging their nets over reefs disturb the fragile substrate and increase turbidity. Trawlers also use fine mesh nets that capture all fish, including young juveniles. This practice, although not as damaging as dynamite fishing, reduces reef productivity and diversity. Other damaging fishing techniques such as the use of chemicals and muro-ami are reported in Thailand, but these practices are not common.

There is little information available for estimating the extent and severity of overharvesting coral reef organisms. Catch data are not collected for most reef fisheries nor are there catch, size or season limits for any reef finfish or marine invertebrates. There is evidence that spiny lobster populations are depleted in some areas including Phuket. Commercial stocks of snapper and grouper are also probably depleted in the Gulf of Thailand. Several invertebrates, such as cowries, cone shells, and giant clams are becoming rare due to heavy collection pressure in heavily utilized areas such as Phuket and Ko Samui. There is also selective overharvesting of ornamental species of fish, which can be sold for high prices in the international aquarium fish trade. A number of species have become locally rare because of this fishery.

Persistent overharvesting of reef fisheries can have significant economic and social implications for the rural coastal areas of Thailand. Depleted reefs cannot provide a reliable source of edible products for coastal communities. People can no longer supplement their income with the sale of shells for the souvenir trade if reefs are overharvested. Overharvested reefs also lose their appeal to divers and snorkelers.





POLLUTION

Coastal water pollution currently affects over 60% percent of Thailand's coral reefs and is rapidly becoming the predominant long-term threat to reef health. Of primary concern are impacts associated with sedimentation and wastewater discharges.

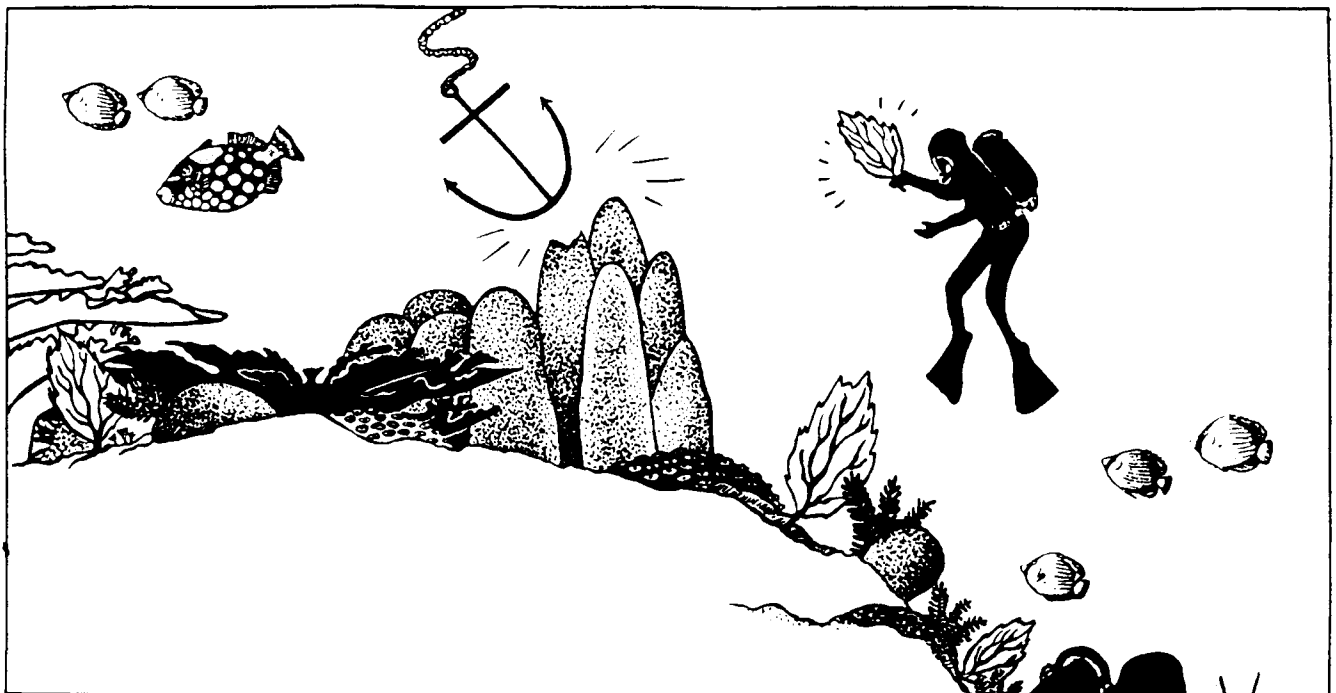
Sedimentation is a problem for 51% of Thailand's coral reefs and is the predominant cause of damage in 14% of the reefs. Provinces where sedimentation is a significant problem include Chomburi (reefs in the Pattaya area), Surathani (Ang Thong group), Phuket (Patong Bay, Bang Tao and Ko Hae) and Prachup Kirikhan. Sedimentation threatens most reefs located in shallow inshore waters close to mainland developments.

The ecological effects of sedimentation on coral reefs range from a temporary slow-down in coral growth to gradual die-off and permanent changes in community structure and species diversity. Persistent sedimentation can reduce the potential of reefs for both recreation and fisheries.

The most severe sedimentation problems are associated with extensive removal of vegetation and construction in coastal watersheds. Formerly, sedimentation was primarily associated with clearing for agriculture. More recently, increased sedimentation is most often linked to cut and fill operations for road construction, quarrying for fill material, gullyng along steep roads, and filling of lowland areas. Such activities increase sediment discharges into shallow coastal waters resulting in higher turbidities. The extent of reef sedimentation is affected by currents; hence the actual source of land-based sediment pollution may be several kilometers from the affected reefs.

Sedimentation is also associated with land and offshore tin mining in the provinces of Ranong, Pang-nga and Phuket. Offshore dredging operations along the northern coast of the Andaman Sea and in Pang-nga Bay cause resuspension of bottom sediments and increased turbidity, which affects coral growth. Follow-up observations indicate that coral recovery does take place once dredging operations are stopped.

Pollution associated with excessive wastewater discharges in coastal waters is a cause of damage of 10% of Thailand's coral reefs. It is an important cause of damage in Pattaya, Ko Samet, Phi Phi Don and Patong Bay. In these locations, beach resorts and seaside communities are discharging wastewater directly into coastal bays in amounts that exceed the natural dilution capacity of coastal waters. Wastewater pollution can cause eutrophication—excessive algal growth, reduced oxygen levels, and increased turbidities—which in time reduce coral growth and lead to the decline of some species. Eutrophication of reefs reduces their tourism and recreational potential and if severe, can also cause a public health threat for water-based sports.



IMPACTS RELATED TO TOURISM

While the impacts of recreational activities such as anchor damage are still localized, their significance is expected to increase over the next decade as coastal tourism continues to grow. Dramatic increases are projected for provinces such as Trang, Krabi, and Surathani.

Anchor damage, a major problem associated with tourism and recreational use, is reported as a cause of damage in 56% of Thailand's coral reefs and is the predominant cause of damage on 14% of the reefs. Provinces with anchor damage problems are Surathani, Krabi, Phuket and Satun. Anchor damage occurs on most reefs located in protected bays close to large beach resorts. These reefs are regular destinations for tour boats carrying divers, snorkelers and other tourists.

The ecological impacts of anchor damage include breaking coral heads, and abrasion caused by the anchor line. In time, anchor damage can reduce the diving and recreational value of the most popular and accessible reefs. This tends to shift tourism pressure to reefs further offshore. Anchor damage occurs mainly because boat operators are not aware of the damage they are causing and of the long-term consequences of poor navigation practices.

Other problems associated with heavy recreational use of coral reefs include trampling, littering, and the casual collection of reef organisms. As with anchor damage, these problems indicate a lack of environmental awareness among both boat operators and tourists.





NATURAL DISTURBANCES

Coral reefs are exposed to many natural events that bring about significant changes in their structure and species composition. In Thailand, the major natural causes of coral reef damage are storms and monsoons which can uproot coral heads and break delicate coral branches. Reefs can take several years to recover from the damage caused by a strong storm. Extreme low tides, another natural phenomena, may expose corals directly to sunlight and cause massive die-offs.

The crown-of-thorns starfish feeds on live coral and can destroy large areas of reef during infestations. Localized outbreaks of the crown-of-thorns have been reported in the Gulf of Thailand and there has been a significant increase in outbreaks in the Andaman Sea since 1982.



CORAL REEF MANAGEMENT TODAY

Coral reef management in Thailand rests on laws and regulations that apply to all coral reefs and additional measures applicable only to marine protected areas. In recent years, central agencies, provincial governments and the private sector have undertaken non-regulatory actions aimed at improving coral reef conditions through restoration, preventive measures and education (Map 5).



LAWS AND REGULATIONS

Three laws are used to protect coral reefs in Thailand: the Fisheries Law of 1947, the National Park Act of 1961, and the Enhancement and Conservation of National Environmental Quality Act (NEQA) of 1975.

The Fisheries Act establishes the regulations governing marine fisheries in Thailand's coastal and offshore waters. The Act establishes four types of waters: Protected Areas (also referred to as Fisheries Sanctuaries), Reserved Areas, Leased Areas and Public Areas.

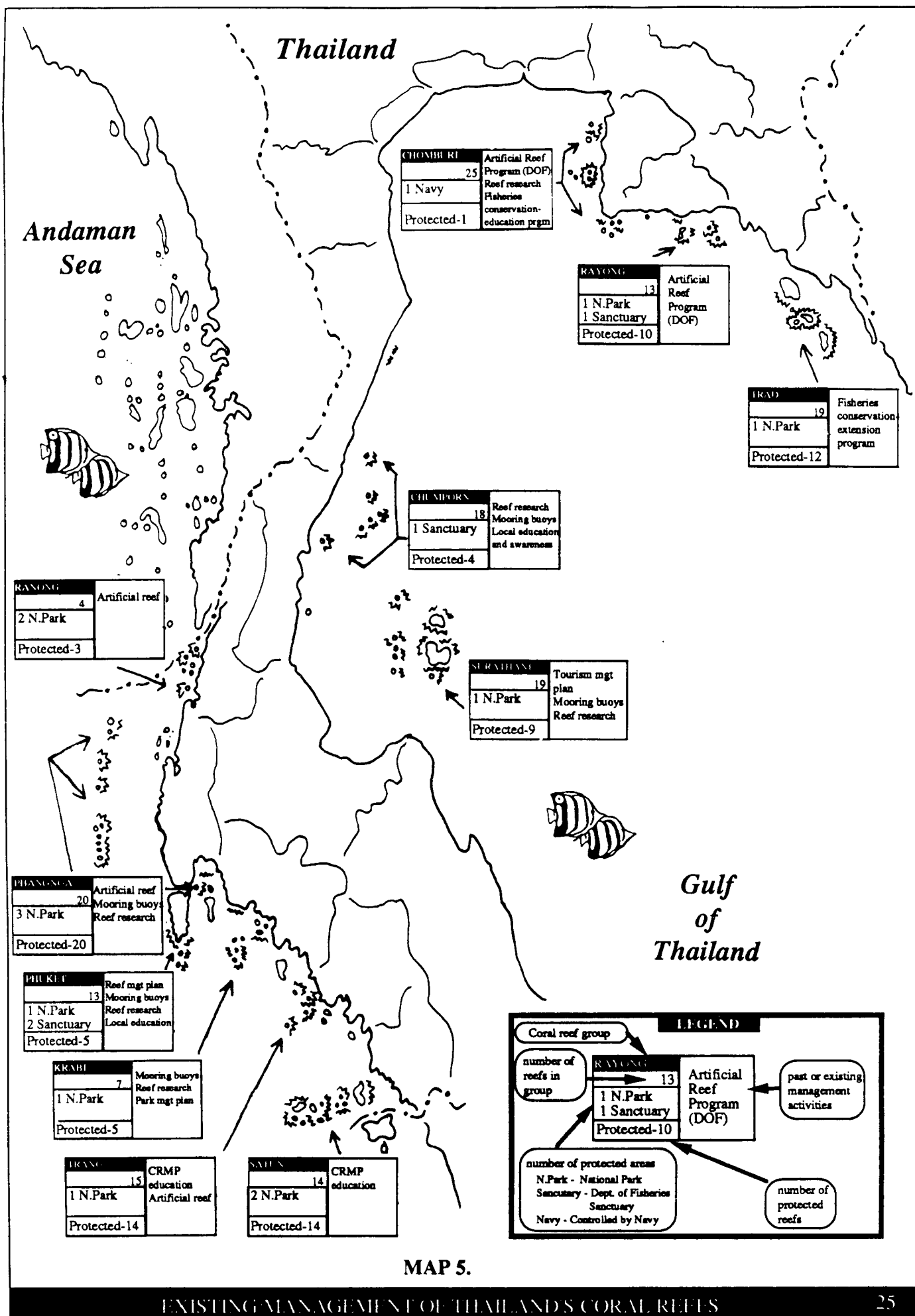
All coral reefs in Thailand are either classified as Public Areas or Protected Areas. The latter are sanctuaries where fishing or any activity likely to disturb fisheries habitat are prohibited. There are four such small sanctuaries containing approximately 2000 km² of coral reefs.

Several Ministerial Regulations and Notifications have been issued pursuant to the Fisheries Act including:

- Prohibition of the possession or use of explosives, toxic substances or electricity for fishing;
- Prohibition of sale of fish caught by illegal practices;
- Prohibition of the collection or export of corals;
- Prohibition of the collection of sponges;
- Prohibition of the collection of sea turtles eggs or sea turtles except by permit; and
- Prohibition of trawling and push-net operations within 3 km from shore.

These regulations are enforced by the Department of Fisheries (DOF) which has officers at 20 shore-based locations. The Department is currently establishing a new offshore patrol base in the Western Gulf of Thailand. There are plans for similar patrol bases in the Andaman Sea and the Eastern Gulf.

There have been problems in enforcing coral reef protection regulations. First, the language of the law and the subsequent regulations are often unclear or incomplete. Most notably, domestic sale of coral and the use



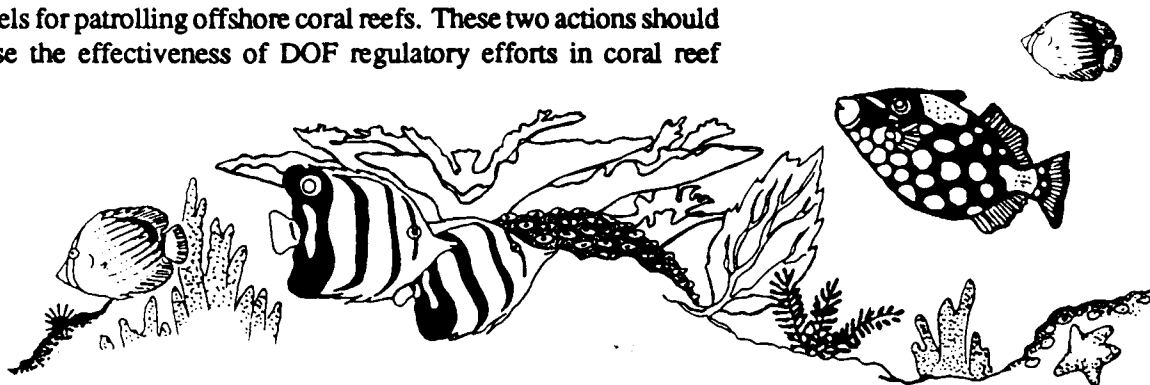
MAP 5.

of spearguns or muro-ami are not specifically prohibited by regulation. This makes it difficult to pursue violators and impose penalties. Second, the area over which these regulations apply is large when compared to the manpower and equipment available for enforcement. Third, the Department of Fisheries has had to focus its surveillance and enforcement activities on commercial offshore fisheries rather than inshore fisheries because of limited personnel and patrol boats.

There are no size, catch or season limits in effect for reef fisheries. Such limits have been recommended in the past for the spiny lobster fishery. New regulations for the protection of several reef invertebrates and ornamental fish are now under consideration by the Department of Fisheries.

There is also evidence that awareness and acceptance of fisheries regulations among small-scale fishermen is low. Fisheries extension programs in rural areas have not been used effectively to address habitat conservation issues.

An urgent measure recently approved by Cabinet authorizes Navy personnel to enforce fisheries regulations pursuant to the Fisheries Act (see box below). As part of the same resolution, Cabinet approved the acquisition of several vessels for patrolling offshore coral reefs. These two actions should help increase the effectiveness of DOF regulatory efforts in coral reef protection.



URGENT MEASURES FOR CORAL REEF PROTECTION

(Approved in 1990 by Cabinet)

MEASURE #1

Determine proper mooring sites and install mooring buoys at coral reefs that are frequently used by tour boats.

MEASURE #2

Increase the effectiveness of measures aimed at reducing coral reef destruction through enhanced enforcement efforts and public education.

MEASURE #3

Direct the Navy and the Harbor Department to support urgent measures for coral reef management and to prevent and control coral reef destruction along Thai coastal waters. The Ministry of Agriculture will assign authority to Navy and Harbor Department staff to act as enforcement officers for the Fisheries Act.

Nine of the 15 Marine National Parks in Thailand include significant reef areas (see box below). Most of the parks containing reefs have been designated in the Andaman Sea with only three sites designated in the Gulf of Thailand. Together with the Fisheries Protected Areas, approximately 60% of Thailand's significant coral reefs are included within a protected area.

MARINE NATIONAL PARKS ARE PROTECTING CORAL REEF HABITAT

<i>Marine National Park</i>	<i>Sea Area (ha)</i>	<i>Region</i>
Tarutao	126,000	Andaman
Mu Ko Ang Thong	8,400	West Gulf
Mu Ko Surin	10,205	Andaman
Hat Nai Yang	8,000	Andaman
Khao Laem Ya- Mu Ko Samet	12,000	East Gulf
Mu Ko Similan	9,300	Andaman
Mu Ko Chang	4,480	East Gulf
Mu Ko Phi Phi	32,900	Andaman
Mu Ko Lanta	10,850	Andaman

Several institutional and operational constraints have, however, limited the effectiveness of Thailand's network of protected areas in preserving coral reef habitat. These include:

- The size of the areas designated and the boundaries have been too broad or have not corresponded to resource protection priorities;
- There have been serious conflicts between park designation and traditional uses of marine resources, particularly fisheries;
- Local economic and social priorities have been overlooked in the park management and development process;
- Jurisdiction over marine resources is unclear and there have been apparent conflicts with fisheries regulations; and
- The emphasis of marine park management has been on accommodating visitor use rather than on resource protection, marine interpretation and enforcement.

Under NEQA, the Office of the National Environment Board (ONEB) has published "Coastal Water Quality Guidelines" for the west coast of Phuket. Special restrictive guidelines have been set for several coral reef areas for preservation and conservation purposes. These guidelines have not, however, been adopted by any implementing agencies or been used to affect development patterns. Also under NEQA, Environment Impact Assessments are required for selected major developments that have the potential to significantly affect Thailand's natural environment. While this tool could be used to identify potential impacts on coral reefs and suggest mitigation measures, it has not, as yet, been used for this purpose.



NON-REGULATORY MEASURES

Public support for coral reef management increased dramatically in the late 1980's. This support has come in part from the extensive media coverage of both the beauty and degradation of the Kingdom's coral reefs. Commitment to coral reef conservation has also grown in response to direct action taken at both the national and local levels to reverse trends in coral reef degradation. These actions have largely been voluntary—they depended on individuals, businesses and government agencies working together to solve problems. Such voluntary efforts are called "non-regulatory measures."

Non-regulatory measures can include education and scientific activities as well as direct management actions such as mooring buoy installation. ONEB has led the effort to increase public awareness about the importance of coral reefs, the human activities that are leading to their degradation and actions that can be taken to conserve this valuable habitat. This campaign has reached most of Thailand's newspapers. More intensive education efforts are ongoing in Chomburi, Chumporn, Phuket, and Satun provinces.

The ONEB, the Tourism Authority of Thailand and volunteer associations of divers and tour boat operators have cooperated to educate boat pilots and escort guides in coral reef ecology and ways to avoid damaging reefs. The results of such efforts have been impressive in terms of changed behavior and increased commitment to conservation. The National Park Division is beginning to include coral reef information in its Park interpretive programs; and the Department of Fisheries, through its extension program, has offered conservation education to reef fishermen. The Royal Forestry Department has completed management plans for Tarutao and Mu Ko Phi Phi Marine National Parks, both of which include specific measures for reef conservation and management.

Cooperation among coral reef scientists in Thailand has been extensive and is essential to the National Strategy formulation process. Researchers have worked together to document reef condition in Thailand through the ASEAN-Australian baseline study.



Communities are experimenting with techniques for reef protection. A community-based habitat protection program began in Phuket in 1987 as part of the Thailand Coastal Resources Management Project. It brought together local, provincial and national government officials and the private sector to formulate and implement a strategy for reef protection. Implementation of the Phuket coral reef protection strategy has focused on projects that address on-site damage caused by tourism-related activities (see inset box). Similar projects were undertaken at Ko Samui as part of the Upper South Coastal Management Project.

The results of these demonstrations have been reported in both local and national media. By 1989, local efforts to protect coral reefs were extended beyond the demonstration areas to Krabi and Chumpom provinces. The Office of the National Environment Board continues to provide technical assistance to local volunteer groups interested in installing mooring buoys on coral reefs.

There is much that can be accomplished with non-regulatory measures. While not sufficient to halt reef degradation altogether, such measures do reduce on-site damage. More importantly, they help generate the support required to achieve compliance with the laws and regulations that must be effectively applied and enforced if Thailand is to maintain its coral reef resource.

PHUKET COMMUNITY PROJECTS FOR CORAL REEF PROTECTION

As part of a community-based coral reef protection program, Phuket local residents and the private sector undertook these projects...

- Phuket Diving Association and the Kata-Karon Diving Group volunteered time and equipment to help install mooring buoys in the Phuket area;
- Matlang Resort, Phuket Rotary Club and the Phuket Island Resort donated mooring buoys for coral reef protection;
- Local residents and the Provincial Government organized and participated in community events such as a Coral Reef Day;
- Holiday Diving Club and Promotion Diving Centre donated original underwater slides for educational brochures and posters;
- Kodak (Thailand) Limited donated signs, posters and brochures to help increase public awareness of coral reefs among tourists;
- Phuket Teacher's College developed, tested and distributed a coral reef curriculum for local schools;
- Phuket Aquarium developed new coral reef exhibits.



SUMMARY

Coral reef degradation is widespread in Thailand, but a resource of great significance still remains. Urgent action is required if Thailand is to preserve its remaining good reefs and continue to enjoy sustained benefits from its more heavily utilized reefs.

The type and intensity of reef use and the causes of reef degradation show considerable geographic variation. The degree of economic dependence on coral reefs also varies from one coastal community to another. These circumstances call for management approaches that are carefully tailored to local conditions.

Community-based habitat projects have demonstrated that simple, on-site sources of damage, such as litter and anchor damage, can be controlled if reef users and local businesses work with government in defining the issues, identifying solutions and taking practical measures. A key to success has been a vigorous public education campaign and the selection of low-cost solutions—such as training and mooring buoys—that are seen as tangible actions.

Central government agencies have and must continue to play a crucial role in encouraging local participation in coral reef management. They can provide appealing and accurate information on coral reefs. They must also offer technical assistance and provide specialized training opportunities for volunteers.

While local initiatives, national technical assistance and public awareness campaigns have enjoyed some success they cannot, by themselves stop the degradation of Thailand's reefs. Concerted national action and increased resources are needed to address such problems as:

- A lack of effective enforcement of existing laws;
- Gaps in the existing legal and institutional framework for protecting coral reefs;
- A tourism development process where the carrying capacity of coastal habitats such as coral reefs is overlooked;
- Delays and constraints in implementing a national system of marine protected areas; and
- Problems in anticipating and avoiding the water quality impacts of coastal development on coral reefs.



FORMULATING AN EFFECTIVE STRATEGY

Thailand's recent experiments in coral reef management have shown that an effective approach to coral reef management is one that will

- Balance the needs and expectations of local communities with national development priorities for sectors such as tourism;
- Tailor management objectives and the planning process to actual reef values, condition and uses;
- Set geographic priorities for management measures;
- Combine regulatory and non-regulatory measures and forge effective partnerships among national and provincial government and the private sector;
- Encourage local participation in management;
- Have built-in short-term and long-term incentives for implementation; and
- Provide for a monitoring program and dissemination of monitoring results.

Experience confirms that some actions are more effective if formulated and implemented locally while others can only be formulated at the national level. For example, the selection of overall habitat management priorities requires national guidance, particularly where it relates to national economic development policies. The allocation of government funds, scientific expertise, and other resources must also occur at the national level. Similarly, legal reform and inter-agency agreements for sharing management responsibility are all initiatives of central government.

Measures best undertaken at the local level include sorting out immediate and long-term problems including their underlying socio-economic dimensions. A local perspective is also needed to identify practical solutions that rely on the human and logistical resources available within a community. Finally, many on-site techniques for coral reef protection are most effective if implemented and monitored at the local level.



OBJECTIVES FOR A NATIONAL CORAL REEF MANAGEMENT STRATEGY

The goal of a national coral reef management strategy is to strive for optimal use of one of Thailand's important marine habitats. Its purpose is to better manage the Kingdom's reefs so that they can sustain multiple uses including fisheries, tourism, conservation and research.

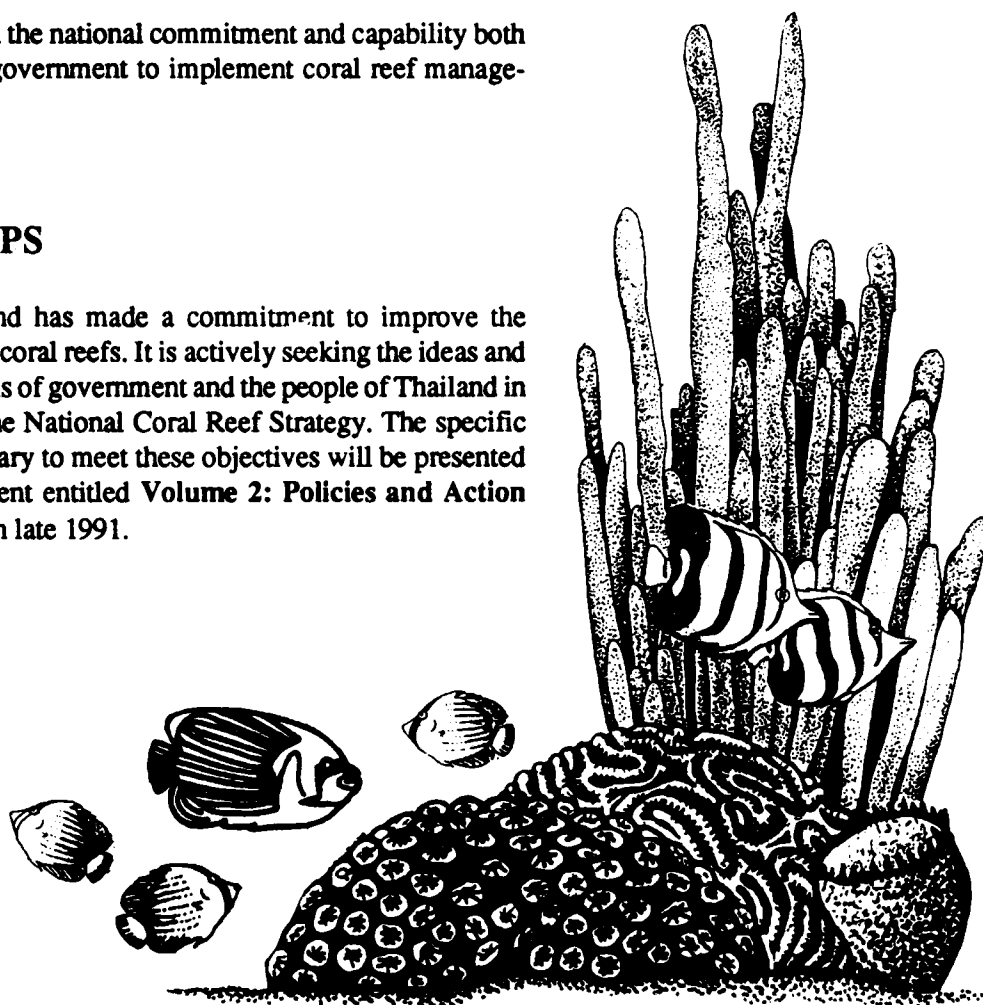
To achieve this purpose, the National Strategy must guide future management actions to meet the following objectives:

- Manage coral reefs according to their different ecological and economic values in order to maintain a balance of uses;
- Reduce the degradation of coral reefs to maintain their multiple benefits and uses;
- Preserve those coral reefs that are of outstanding value to the national heritage;
- Define and coordinate the actions required by both government and the private sector to achieve the objectives of the National Strategy; and
- Build and strengthen the national commitment and capability both within and outside government to implement coral reef management actions.



NEXT STEPS

The Government of Thailand has made a commitment to improve the management of the Nation's coral reefs. It is actively seeking the ideas and continued support of all levels of government and the people of Thailand in pursuing the objectives of the National Coral Reef Strategy. The specific measures and actions necessary to meet these objectives will be presented in an accompanying document entitled **Volume 2: Policies and Action Plan** scheduled for release in late 1991.



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