Multimedia Presentations Regarding the Gulf of Thailand

SOUTHEAST ASIA

START

IHDP • IGBP • WCRP

REGIONAL CENTRE

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Abstract

The Gulf of Thailand is an important mineral, biological, and transportation related resource. There are a number of important issues regarding the continued management of the Gulf that must be addressed by policymakers at local, national, and international levels. The goal of this project, completed at the Bangkok Project Center, Thailand, in conjunction with SEA START and SEAPOL, was to bring together data regarding these issues, and present the data in various media, including PowerPoint and a web site.

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Authorship Page

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Executive Summary

The Gulf of Thailand is a semi-enclosed sea located in Southeast Asia, immediately to the west of the South China Sea. Each of the nations surrounding the Gulf, Cambodia, Malaysia, Thailand and Vietnam, have historically profited from the Gulf's many resources. In recent years, there has been an ever-increasing need for uniform policy in the management of the Gulf.

The Gulf of Thailand itself is a very dynamic system composed of many intricate parts. Changes in one part of the system can have unintended consequences in another, and these consequences can be quite unfortunate. In light of this, all policy regarding the Gulf must be considered in terms of how it will affect the Gulf as a whole, and not just the specific part it is intended to regulate. A number of committees and organizations, both governmental and non-governmental, have been formed to help deal with the many issues of the Gulf of Thailand.

Among these organizations are SEA START-RC (SouthEast Asia SysTem for Analysis, Research, and Training Regional Center) and SEAPOL (SouthEast Asian Programme for Oceanographic Law, Policy and Management). START specializes in scientific data and research on global change, while SEAPOL handles information regarding the social aspects of the Gulf, including, as their name implies, law and policy.

While both organizations have collected large amounts of information, both from their own research and from other sources, this information often lies dormant. It is often written in reports that are highly technical, and these publications are only widely circulated at great expense. It was felt that both organizations would benefit from the development of multimedia presentations on contemporary topics of public concern

regarding the Gulf of Thailand. These presentations should be understandable to both laypersons and policymakers, and will ideally be easy and inexpensive to distribute.

A number of experts were interviewed to determine what current topics should be addressed in multimedia presentations. These experts, who included researchers, scientists, and policy specialists, also gave suggestions on just how the material should be presented. As a result of these interviews, the formats of a web site, an electronic photographic library, and multiple modular PowerPoint presentations were chosen for development, with recommendations towards the development of future presentations in formats such as video and CD-ROM.

The interviews also played a deciding role in determining what material the web site and presentations will be providing to their intended audiences. From the information gathered at the interviews, it was decided that the web site would be constructed using two set parameters, primary and secondary topics. The five primary topics chosen for presentation in multimedia formats are intended to reflect the complex interrelationships of the many parts of the Gulf of Thailand. These topics, living resources, pollution, coastal development, transportation, and storms and response, are each interconnected, and they impact the lives of the people in the countries surrounding the Gulf of Thailand. Secondary topics were chosen under each of these general topics, either to illuminate specific contemporary issues or to better illustrate examples of these interrelationships.

The electronic photographic library was compiled using images from the World Wide Web, as well as pictures from books, magazines, and journals. Information about each image including subject, origin, and all available copyright information was archived in a spreadsheet for future reference.

The web site was developed in raw hypertext markup language (html) using a simple text editor. All images used in the web site, including logos and navigation tools, came from either the photographic library or were created from scratch using a photopaint program. The text for the web site was written based on extensive analysis of contemporary publications regarding each topic. Information on the web site is intended for policymakers and the general public.

The PowerPoint presentations were developed in a more structured format than the web site. Focusing on the secondary topics, the presentations were designed based on specific, contemporary issues. By structuring the presentations modularly, adaptations to will be unrestrained. The content of the presentations can be tailored to meet the needs of the intended audience, making the presentation as informative as possible. Personnel from START and SEAPOL will be able to use these PowerPoint presentations when meeting with policymakers and other organizations.

Chapter 1

Introduction

Chapter 1: Introduction

The Gulf of Thailand is located in Southeast Asia, immediately to the west of the South China Sea. Its bordering nations, the Kingdom of Cambodia, Malaysia, the Kingdom of Thailand, and the Socialist Republic of Vietnam, have each historically profited from the Gulf's wealth of living and mineral resources. Millions of people derive their livelihoods from fish and petroleum harvested from the Gulf, and millions more are affected by changes in the environment of the Gulf, whether these changes are physical or political.

In recent years, there have been numerous disputes over the Gulf, both locally and internationally. The Gulf has suffered from drastic overexploitation of fishing and petroleum resources as well as environmental damage from misuse and accidents. If sustainable fishing practices are not developed and employed, the supply of fish in the Gulf could become depleted so severely as to cause economic depression and even starvation among those who fish the Gulf for subsistence. There have also been a number of maritime territorial disputes regarding fishing rights in the Gulf between the littoral states, some of which have led to bloodshed.

There is a great need for the development of policies to resolve these problems. Effective policy decisions, however, cannot be made without appropriate and sufficient background information on the matters in question. A number of non governmental organizations (NGOs) and researchers have conducted numerous studies of the Gulf, both social and scientific, in order to provide policymakers and the general public with the information necessary to make such decisions.

However, there are drawbacks to these studies. While the articles are well articulated and the arguments well established, many policymakers choose to overlook lengthy texts of largely technical information that are sent to them. Another approach must be taken to distribute this information.

The oceanographic and social information and research gathered by these organizations must be put together and presented in a format that is relevant and comprehensible to those responsible for decisions concerning the Gulf. Also, in the spirit of widespread information and understanding, this information would ideally be made available and understandable to the general public.

"The Cooperative Oceanographic Studies of Shared Coastal Waters of Southeast Asia Phase 1: the Gulf of Thailand" was initiated in February of 1997, under the auspices of IOC-WESTPAC (Intergovernmental Oceanographic Commission for the Western Pacific),[36] for the purpose of developing information to educate policymakers. This collaborative international effort was brought upon from recommendations given at two SEAPOL sponsored conventions. SEAPOL (Southeast Asian Programme in Ocean Law, Policy and Management) is an organization that is dedicated to the coordination of research and other such programs with the intention of bringing together delegations from the four littoral states of the Gulf in order to form a more cooperative effort concerning the continued management and preservation of the Gulf of Thailand. Publication by SEAPOL of four papers from the 'First Meeting of Experts' in Hua Hin provided readers with information concerning a proposed co-operative approach to the management of the Gulf of Thailand.

Present at this first meeting of experts were researchers from a variety of organizations, including SEA START RC (SouthEast Asia SysTem for Analysis, Research, and Training Research Center). START is an international network of organizations dedicated to the research and analysis of global change.
SEA START, located at Chulalongkorn University in Bangkok, Thailand, has done extensive marine and oceanographic research throughout Southeast Asia, including in the Gulf of Thailand. One of SEA START's goals is to provide policymakers with the scientific foundation necessary to make educated decisions. START also wishes to make their data and research available to all interested parties in the general public.

The papers developed at this First Meeting of Experts, although informative and relevant, are not necessarily easily comprehended by the general public, or by those officials who issue policies affecting the Gulf. Therefore, it is necessary to incorporate the information in a more appropriate medium for informing policy makers at regional and national levels. The current data provided are not in the most useful format for those charged with the creation of management policies.

Once the data and research are brought together in a manner that is easy to understand, the resulting information must be placed in a format conducive to appropriate dissemination. The development of a web site and PowerPoint presentations based on this information could provide viewers with a comprehensible overview of the accomplishments of SEAPOL and START and the ongoing research concerning co-operative management of the Gulf. The implementation of multimedia presentations might also allow for the publication of information to a much wider audience than at present.

The World Wide Web, which is universally accessible, would make the data gathered by SEAPOL and SEA START available to a much broader range of potential researchers, environmentally concerned individuals, and policy makers.

1.1 Goal Statement

The primary goal of this project is to create complete multimedia presentations with the purpose of educating policymakers and the public at large on the background information necessary to make informed decisions regarding the continued management of the Gulf of Thailand. These presentations will provide SEA START and SEAPOL with several valuable mechanisms for conveying the oceanographic data that they have collected to the public and to policymakers. Marine scientific research and oceanographic data from SEA START will be correlated with social, political, and economic data from SEAPOL to provide concise presentations on a variety of issues, including living resources, pollution, coastal development, transportation, and storms. By bridging the efforts of both SEAPOL and SEA START RC we will be able to provide informative data regarding current oceanic status, policies, and activities within the Gulf of Thailand.

Chapter 2

Background & Literature Review

Chapter 2: Background and Literature Review

In order to conduct a comprehensive analysis of oceanographic and social data regarding the Gulf of Thailand, the presentation of such data, and the circumstances in which the data will be utilized, it is necessary to establish a sound basis of background information. This chapter is intended to provide just such information on oceanographic data and organizations involved in the collection of oceanographic data and the distribution of that data to policymakers. The chapter will also contain information on relevant international policies, oceanography, geographic information systems, the forms of presentation that are currently in use, and techniques and protocol for setting up interviews.

2.1 Gulf of Thailand

The Gulf of Thailand is bordered by the states of Thailand, Malaysia, Vietnam and Cambodia. These nations have undergone a large number of political and even geographic transformations over the last two centuries. The current geographic status of the littoral states can be seen in Figure 1. In the mid-nineteenth century, influences of European colonialism swept over all of Southeast Asia except Thailand. The country now known as Malaysia was once the British colony of Malay, and Cambodia and Vietnam were collectively part of French-held Indochina. This Western influence wrought a number of superficial changes to the region, including the introduction of concepts such as national boundaries, but the indigenous cultures of the area remained largely unchanged. According to scholar Milton Osborne,

"The countries of Southeast Asia retain their individual identities, the products of a rich and complex history. It is a history that has only recently begun to be explored in depth so that scholars, students, and specialists alike still have the prospect before them of new insights and greater nderstanding.[10]"

In light of this, it is important to understand the cultural environs of Southeast Asia, where the policies regarding the Gulf must be developed.

Figure 1. Gulf of Thailand

The Gulf of Thailand is a semi-enclosed sea, approximately 400km by 800km, which covers an area of about 320,000 km^2. The Chao Phraya, Tha Chin, Mea Klong, and Bang Pakong rivers enter the gulf near its head;[36] there are also many rivers that flow along the coast. The Gulf is part of the Sunda Shelf and is relatively shallow. The mean depth is 45m, and the maximum depth is 80m.

The NAGA Expedition was sponsored by Thailand, South Vietnam and the United States of America between 1959 and 1961. This expedition provided a systematic study on the oceanographic conditions of the Gulf of Thailand. From this expedition, several physical properties of the Gulf were revealed. It was found that the Gulf is a two layered shallow water estuary. The low level salinity water of the Gulf is diluted from rain and from the freshwater runoff that flows out of the Gulf at the surface. The high salinity, cool water flows into the Gulf from the South China Sea at the mouth. Monsoons, tidal currents and precipitation create circulation of those waters, which influences the salinity and turbidity of the Gulf. The monsoons also influence the surface currents; the currents are clockwise during the southwest monsoon and counterclockwise during the northeast monsoon.[56]

The NAGA Expedition also evaluated the biological characteristics of the Gulf. It was found that there was a high level of phytoplankton in the inner Gulf and the estuaries of the four main rivers. These estuaries are enriched with nutrients that are discharged from industrial plants upriver; this increase of nutrient input is also contributed to by the use of fertilizers. Such high concentrations of nutrients can cause excessive growth of algae and lead to the occurrence of non-toxic red tide. Red tide is a discoloration of the seawater during periodic algae blooms. The substances released by these organisms, in some cases, can be lethal to fish and other organisms.

The density of plankton also varies with season, salinity and nutrient concentrations. The major plant resources found in the Gulf are seaweed and marine algae. Algae play an important role in productivity; they serve as food for other organisms and are also utilized for industrial products.

2.1.1 International Policy and the Gulf of Thailand

The Gulf of Thailand is an important resource for each of the countries that border it, in terms of minerals, fishing, and transport. In recent years there have been a large number of regional marine boundary disputes, occasionally dissolving into violence. In August of 1996, three Thai fishermen were killed and two trawlers were detained by the Vietnamese, who accused the Thais of trespassing into Vietnamese waters. In 1995, the crew of a Malaysian naval vessel killed the captain of a Thai trawler and his teenaged son. Thailand has also had recent bloody disputes with Burma over fishing rights in the Andaman Sea.[16] It is widely held by political observers that some action must be taken to prevent future disputes; however, there is little consensus as to what actually should be done.

The countries surrounding the Gulf have undertaken their own measures to settle future disputes. Between Thailand and Vietnam, there has been some contention over approximately 6,000 square kilometers located in the North Malay Basin, which is in the southern region of the Gulf. This particular territory is expected to be quite lucrative in terms of exploitable resources.[5] In 1995, in order to ameliorate this territorial dispute, Thailand and Vietnam formed an agreement to attempt to delineate the Gulf of Thailand, the first such undertaking for border

resolution that Thailand has entered into. On August 9, 1997, the two nations formally signed a delineation agreement.[17]

Thailand has since entered into a similar agreement with Cambodia, forming a joint committee that met for the first time in mid-1995. The Thai-Cambodia border disputes have another dimension of complexity as some of the claims extend into Vietnamese territory.[6] Thai-Cambodian relations have been tense in recent years over the issues of refugees and aid to the remnants of the Khmer Rouge regime. Thailand banned aid to the Khmer Rouge in 1995, improving relations between the two countries. Tensions have arisen again, however, as Thailand has stood fast in opposition to Cambodia's entrance to ASEAN.[14]

There have also been several disputes between the Malaysian and Thai governments regarding sales of petroleum products from the South China Sea. In answer to these difficulties, the Malaysia-Thailand Joint Development Area (JDA) and the Malaysia-Thailand Joint Authority (MTJA) were established.[7]

Each of the measures taken to resolve miscommunications regarding cross-boundary issues has eased some of the international tensions that have plagued Southeast Asia in recent years. Compiled information about current research and oceanic policies of the Gulf in a universally accessible format should further alleviate future predicaments.

2.1.2 International Law of the Sea

Oceans cover a majority of the world's surface, and so represent the planet's single most significant resource. As such, these oceans must be shared by all the nations of the world, and efforts must be taken by every state to protect and preserve the earth's oceans.

In 1982, representatives from all the member states of the United Nations converged at Montego Bay for the Convention on the Law of the Sea. Their intention was to form comprehensive legislation for the governing of the world's oceans. It took over a decade for all points to be sufficiently refined for ratification. The Law of the Sea was finally entered unto force in 1994.

The Law of the Sea contains provisions for nearly every issue regarding the earth's oceans. Each nation that has a length of coastline on one or more of the world's oceans, referred to as a Coastal State, is granted full sovereignty over a territorial sea that extends 12 nautical miles beyond the low tide line on its coast. A complicated yet comprehensive system was drawn up for determining the exact geometry of territorial seas; difficult cases, for example, arise for nations whose territory extends to offshore islands and nations whose territory is completely archipelagic.

The Law of the Sea further provides for Exclusive Economic Zones, regions that extend up to 200 nautical miles from the end of territorial seas. Coastal States have exclusive privileges towards the exploration and exploitation of all resources, living and non-living, in their Exclusive Economic Zones. They may enter into financial agreements with other States, or with corporations from other States, regarding the collection of those resources. Ships from all other nations have the right

to pass through any Exclusive Economic Zone, as long as their purposes are peaceful and they are engaged only in innocent passage, which is rigorously defined by the convention. Other States also have the right to lay submarine cables and pipelines in these zones in accordance with certain internationally accepted guidelines and with respect to the rights of the jurisdictional Coastal State.

In cases where the 200-mile extension of one Coastal State overlaps that of another, provisions are made for settling the overlapping claims. Delimitation, or sharing of territory, is the Convention's most highly recommended method of resolution. In absence of the formation of such an agreement, a line formed at the median is suggested by the Convention, although any agreement reached peacefully by the States involved is acceptable, including agreements that were reached prior to the signing of the Convention and agreements based in historical tradition. Despite these stipulations, there is still much conflict around the world over the true divisions of overlapping Exclusive Economic Zones. This is a particularly sensitive issue in Southeast Asia.

All territory that does not belong to either a territorial sea or an Exclusive Economic Zone is considered part of the Area. The waters of the Area are known as the High Seas. All nations have the right of passage and the right to conduct marine scientific research within the Area; provisions are made for all nations to share in the exploration and exploitation of the biological and mineral resources of the Area. Accordingly, all nations are expected to share in the duty of preserving and protecting the Area, and stipulations are made for sustaining global oceanic health.

Further, the Convention on the Law of the Sea establishes a governing body for oceanic matters in the form of the International Sea-Bed Authority. The Authority

consists of two legislative bodies. The first, the Assembly, contains one member from each Nation State of the United Nations. The second, the Council, is a 36-member organization elected by the Assembly, with its members representing both the economic and geographic interests of the world. The Authority's executive branch is composed of a Secretariat and Staff. The International Tribunal for the Law of the Sea represents and interprets judicial concerns. All international maritime disputes, if not resolved peacefully and expeditiously by the nations party to the dispute, come under the jurisdiction of the Authority.

The Gulf of Thailand is of such geography that it contains no water that is not part of at least one of the Gulf's littoral states' territorial seas or economic zones. As such, the Gulf of Thailand is considered by the Convention to be a semi-enclosed sea, as defined by Article 122. The Convention further stipulates some regulations and guidelines for cooperation between littoral states of semi-enclosed seas as follows:

> "Co-operation of States bordering enclosed or semi-enclosed seas
>
> States bordering an enclosed or semi-enclosed sea should cooperate with each other in the exercise of their rights and in the performance of their duties under this Convention. To this end they shall endeavour, directly or through an appropriate regional organization:
>
> (a) to co-ordinate the management, conservation, exploration and exploitation of the living resources of the sea;
>
> (b) to co-ordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment;
>
> (c) to co-ordinate their scientific research policies and undertake where appropriate joint programmes of scientific research in the area;
>
> (d) to invite, as appropriate, other interested States or international organizations to co-operate with them in furtherance of the provisions of this article."

There are also provisions made by the Convention for the sharing of research and marine technology, while still maintaining the rights of the nations, organizations, or people who collect and develop and proprietary data. There are regulations for the registration and duties of ships, the policing of the world's oceans, and for civil and criminal proceedings arising from alleged maritime infringements. Stipulations are made for the duties of ships and nations in the event of a maritime casualty, such as the collision of two ships or of one ship with an iceberg, particularly if such collisions will result in imminent loss of life or potential long-term environmental damage.

Provisions are also made for the world's disadvantaged nations, giving access to fertile fishing grounds to those nations that are economically disadvantaged, as well as making allowances for the sharing of marine technology and research to underdeveloped countries. and guaranteeing rights of access to landlocked nations. As signatories to the Convention, Thailand, Vietnam, and Malaysia each have a duty to uphold all of these proclamations, suggestions, stipulations, and guidelines.

2.1.3 Petroleum Policies in Thailand

Petroleum is among the world's most coveted resources, and the Gulf of Thailand is known to be a rich source of this lucrative substance. Although the Gulf's littoral states lack the equipment and capital necessary to fully exploit the petroleum supply in their own territories, they have entered into agreements with each other and financial arrangements with corporations from other nations to harvest the petroleum supply.

The exploitation of petroleum in the Gulf is lucrative to the nations and organizations involved; however, there are some significant environmental consequences associated with petroleum production. Petroleum related pollution can have a severe detrimental impact on the living resources in any marine environment. and as such there is great need for the development of sustainable policy with regards to the exploitation of petroleum resources.

In 1967, the Thai Government began to promote the development of petroleum resources in the Gulf of Thailand. The right to explore and produce oil in the Gulf is given to the company that makes the highest bid for a particular site. The past policy of the Thai Government was that foreign companies were invited to build refineries in their country, and the expansion of these refineries has also been approved. At that time, the Government divided the area of the Gulf into 19 blocks; 17 blocks were granted for exploration and production of oil to six companies.[3] Since then, more blocks have been created, and more companies have been granted production rights. The oil companies own the depots, which serve as the transfer points, but facilities for the handling of products for sale purposes are insufficient. and have to be distributed among many companies.

In Thailand. minerals and petroleum resources are owned by the central government, not the surface owner, and their exploration and exploitation are under the administration of the Department of Mineral Resources in the Ministry of National Development. Fuel oil consumed in Thailand is usually imported from overseas in crude or refined form. Importing crude oil and refining it in Thailand is less expensive than continued exploration for oil in the Gulf. Petroleum is usually imported via tankers directly to the refinery sites at which storage capacities are

located. Two separate petroleum laws, namely the Petroleum Act and the Petroleum Income Tax Act, were drafted in 1969. The drafting of these two petroleum laws was based exclusively on the "Consideration Bases in Applying for Petroleum Exploration and/or Production", under which petroleum companies have submitted their applications and entered into petroleum agreements with the Ministry of National Development. The Petroleum Act and the Petroleum Income Tax Act cover the areas of the continental shelf over which the Kingdom of Thailand has jurisdiction, under the generally recognized principles of international laws and compacts made with foreign governments.[3]

2.2 Non-Governmental Organizations

Non-governmental organizations (NGOs) are often formed to deal with particular topics or issues, such as the protection of certain ways of life or types of wildlife. While non-governmental organizations do not have the backing authority that governmentally sponsored organizations do, they sometimes have advantages over governmentally established and administered groups. NGOs do not necessarily possess any particular political affiliations, which can allow them to become liaisons between politically opposing organizations or governments.

2.2.1 START

The global change organization START, SysTem for Analysis Research and Training, is co-sponsored by three international global change research programmes, the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions of Global Environmental Change Program (IHDP), and the World

Climate Research Programme (WCRP). The IGBP first instituted START in the early 1990s. The IGBP's purpose in developing this organization was to reduce the scientific uncertainties concerning the global environment and improve the foundation of knowledge for sustainable development.

START was created with the mission to "to develop a system of regional networks of collaborating scientists and institutions:

- To conduct research on regional aspects of global change
- To assess the causes and impacts of regional global change,
- And to provide relevant information to policy makers and governments.[21]

The fundamental objective of the START regional networks is to provide a framework for the compilation of regional scientific data in an atmosphere that will allow an unbiased assessment of policy development.

The Regional Research Networks (RNs) of START were created to encourage cooperation among scientists and other individuals in the assemblage and exchange of collective research concerning global environmental changes. The RNs serve as a means of providing consistency between and greater competency among regional and national research agendas.

Through the regional research networks, organizations are able to exchange research data and results. This forum of scientific knowledge is intended to be helpful in informing the public and policy making bodies about regional changes.

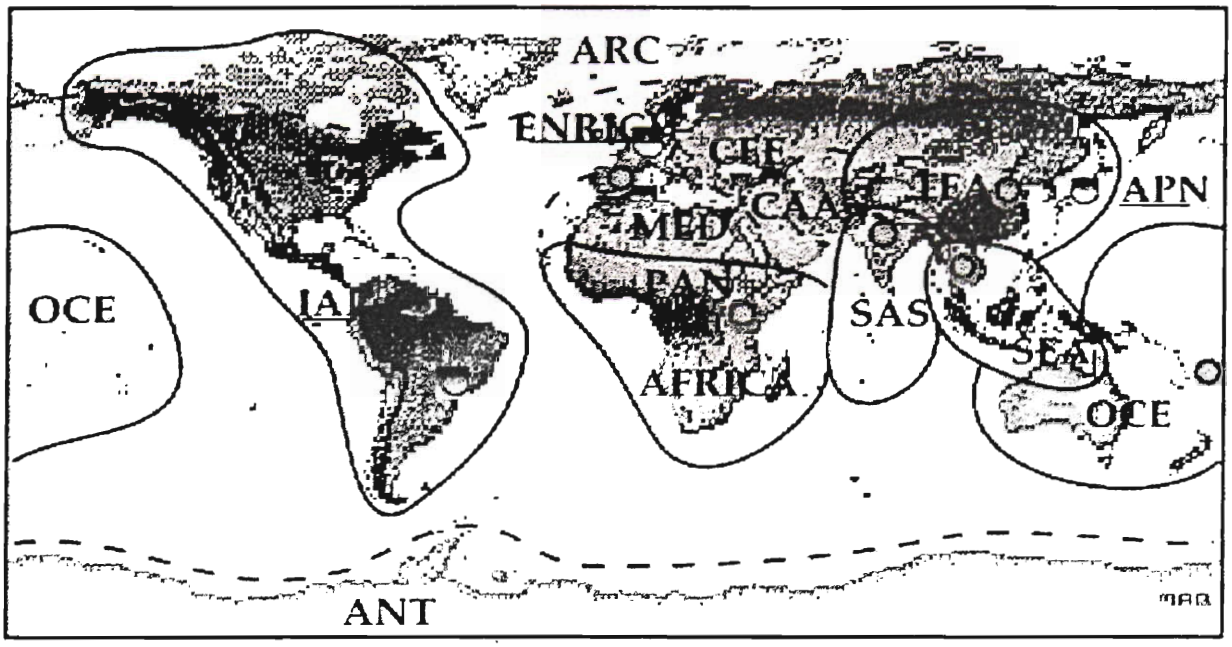

Figure 2. START Regional Networks[21]

START is currently divided into six regions, SAS (South Asia), TEA (Temperate East Asia), SEA (Southeast Asia), MED (Mediterranean), PAN Africa, and OCE (Oceania). These regions can be seen above in Figure 2.

This project will be focusing on the current efforts of SEA START, which will be discussed further in the following sections. Also indicated above in Figure 2 are the related intergovernmental efforts of START, the Inter-American Institute for Global Change (IAI), the European Network for Research in Global Change (ENRICH) and the Asia-Pan Network for Global Change Research (APN), and their Secretariat locations.

2.2.2 SEA START Research Center

One of the START regional research networks is SEA (Southeast Asia). The SEA START Research Centre is part of a global network of regional centres that help provide the aforementioned framework for the provision of scientific assessments to support policy development. SEA START is a non-governmental regional program that operates under funding from UNDP (United Nations Development Programme), GEF (Global Environmental Facility) and Chulalongkorn University.

SEA START has been hosted at the Environmental Research Institute of Chulalongkorn University since 1996. Due to its worldwide linkages through the START Regional Research Networks, SEA START RC is able to provide access to regional and global databases dedicated to research on global environmental change[14]. Geographically, SEA START represents, north to south, China-Taipei, Vietnam, Laos, Thailand, Cambodia, Philippines, Malaysia, Singapore, Brunei Darussalam, Indonesia, and Australia.

SEA START RC has supported multi-disciplinary research activities at several Regional Research Sites (RRSs). Located at local institutions the RRRs conduct research on significant issues regarding global change. The RRRs are affiliated with both the RRNs and the sponsoring programmes of the START initiative.

START's major objectives over the past year have included developing a database for global change research in Thailand and working in cooperation with IOC-WESTPAC to develop a regional marine data and information system. START has also worked on establishing information links with regional and global networks, global change research programs, and other research institutes.

2.2.3 IOC/WESTPAC

The constitution of UNESCO (the United Nations Educational, Scientific and Cultural Organization) was adopted in 1945, and went into effect on November 4, 1946, with the goal of promoting collaborations between nations through education, science, culture and community, and in the hopes of furthering universal respect. The IOC (Intergovernmental Oceanographic Commission) of UNESCO was founded in 1960. The IOC's purpose is to promote scientific investigations and other related oceanic services. The IOC consists of 126 member states, an Assembly, Executive Council, Secretariat, and subsidiary bodies.

The IOC subsidiary bodies (sub-commissions and regional committees) divide the globe into six major regions. The major regions are: the Caribbean and adjacent regions (IOCARIBE), Western Pacific region (WESTPAC), North and Central Western Indian Ocean region (IOCINCWIO), Central Indian Ocean region (IOCINDIO), Central Eastern Atlantic region (IOCEA), and the Southern Oceans region (IOCSOC). A map of the subsidiary bodies can be seen in Figure 3.

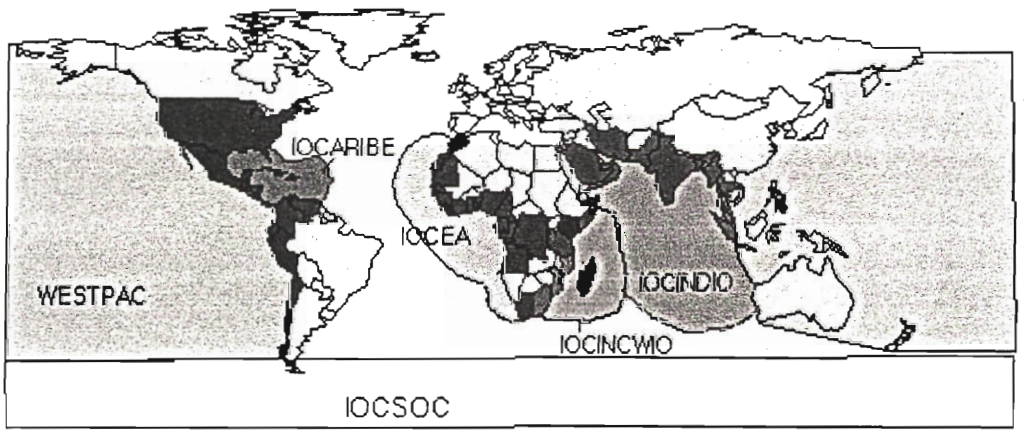

Figure 3. IOC Regions[21]

The subsidiary bodies or sub-commissions are responsible for developing and coordinating regional marine scientific research programmes and ocean observations for the Commission. The sub-commission for Western Pacific (WESTPAC) was established in 1989.

The Draft Science Plan (December 1996) of the IOC-WESTPAC Cooperative Oceanographic Studies of the Shared Coastal Waters of Southeast Asia, Phase1 Gulf of Thailand established its project objectives as:

- "To compile and construct an oceanographic data depository and exchange system for the Gulf of Thailand
- To provide oceanographic data, database directory and related information on the Gulf of Thailand and adjacent water bodies to general public, researchers and policy makers
- To analyze available oceanographic data and information and synthesize the oceanographic perspective of the Gulf of Thailand
- To identify the knowledge gaps and draft a science based plans for multidisciplinary researches and natural resource development
- To organize and coordinate integrated research programs and oceanographic cruises necessary to fill up missing knowledge[21]"

Programmes and projects that IOC-WESTPAC undertakes include work on ocean dynamics and climate, marine pollution research and monitoring, ocean sciences in relation to living resource and addressing integrated coastal zone management. Their works on ocean dynamics in the Western Pacific region include continental shelf circulation, and Asian-Australia monsoon oceanography. Marine pollution research and monitoring include a mussel watch in the WESTPAC region, assessment of river inputs of pollutants and atmospheric inputs of pollutants.

Research on ocean sciences in regards to living resource in the region includes programmes on harmful algae blooms; work on non-living resources includes palegeographic mapping and the impact of tectonics in coastal areas. In addressing integrated coastal zone management, a cooperative study on the Gulf of Thailand was initiated along with work on remote sensing for integrated coastal area management.

2.2.4 SEAPOL

The Southeast Asian Programme in Ocean Law, Policy and Management (SEAPOL) was established in 1981, preceding the Third United Nations Conference on the Law of the Sea. SEAPOL is a non-governmental organization consisting of researchers, government officials, private individuals, and other authorities on marine affairs of the Southeast Asian region. Their main objective is to provide a forum for these individuals to come together to exchange research data and information connected to current ocean laws and policies within the region.

During its early years SEAPOL conducted international conferences and workshops focusing on the implementation of the Third UN Convention on the Law of the Sea. Recently SEAPOL has broadened its base of activities and is conducting forums concerning problems with the environment and regional cooperation in the further management of resources in the Gulf of Thailand. With the renewal of funding from the Canadian International Development Agency (CIDA), SEAPOL's activities have come into focus on three basic themes, "(1) Increasing the ability of states to comply with international maritime obligations, (2) Improving the ability of states to better manage marine environment in the Gulf of Thailand, (3) Promoting the activities and cooperation among maritime institutions of the region." [35]

2.3 Oceanography

Oceanography is a scientific discipline concerned with all aspects of the world's oceans and seas, including their physical and chemical properties, their origin and geologic framework, and the life forms that inhabit the marine environment[40]. Oceanographic studies use quantitative data to develop models to predict the future behavior of the oceans, with a level of certainty.

Oceanography is divided up into specific areas of concentration, focusing on the physical, chemical, biological, and geological events occurring in the ocean. An oceanographer will usually specialize in one or two of these four areas, but it is important for oceanographers to be well versed in all four sciences. Physical oceanography is the study of all physical reactions, the change and motion of seawater. A chemical oceanographer studies the chemical reactions that take place on the sea floor and in the ocean. Biological oceanography is the examination of the distribution and occurrence of life along the sea floor and within the ocean. Marine geologists study the sediments and topography of the ocean floor, along with the deeper structure of the ocean floor and its physical properties.

By bringing these separate disciplines together, oceanographers are able to build models based on scientific theories. The complexity of a model will depend on the reason for its construction. Many models are based upon mathematical equations that describe certain processes. These equations, depending on their complexity, will often require numerical methods. Numerical models are useful instruments, and are often used to predict coastal erosion, waves, currents or water circulation, sediment transfer, and sea levels. The model is dependent on the quantity and quality of data

used; if this data is inaccurate, the model is of no use. Therefore the results must be used with precaution.

2.4 Living Resources

The Gulf of Thailand is a dynamic system with many intricate parts that closely interrelate. The most delicate of these parts are the many organisms that compose the Gulf's living resources. Changes in one part of the system can have extreme, unforeseen effects on other parts, and it is necessary to understand these relationships in order to preserve the Gulf's fragile balance of life.

2.4.1 Fishing Industry of Thailand

The fishing industry is important to each of the nations surrounding the Gulf. The summed catch of fish brought in by the littoral states of the Gulf was nearly 6 million tons in 1997.[47] Thailand alone amassed over 3 million tons. Marine fish exports account for over $5 billion of the income for Southeast Asian countries each year.[47]

In Thailand, fisheries are divided into five zones for statistical and administrative purposes. Within each zone, there are a large number of smaller groups consisting of individual fishermen; tens of thousands of households are employed in the fishing industry. As such, the fishing industry has a deep impact on both the country's economy as a whole and on many thousands of individual livelihoods.

Because of the economic importance of fishing, each country surrounding the Gulf has taken steps to safeguard the fishing rights of its own nationals. However, in recent years, fishing boundaries have allegedly been violated and a number of conflicts have arisen. There has also been some discord over the catching of migratory fish. There are some species of fish that can be harvested well before they enter the reproductive stage of their life cycle. When such fish are harvested by one group or nation premature to spawning, the fish supply becomes unnecessarily depleted, which can result in serious economic consequences for all involved.[46]

Overfishing has been another serious problem for the Gulf of Thailand in recent years. The amount of daytime fishing catch per unit decreased from 290 kg/hour in 1963 to 50 kg/hr in 1993.[47] There was also a 63% decrease in nighttime fishing catch in terms of weight per hour between 1976 and 1995.[47] Due to overfishing and the resulting decreased availability of fish, competition issues within the fishing industry, and consequently conflicts, have become more frequent and more intense. Fishermen utilize more powerful tools in order to catch more fish; many of these tools are illegal. Some examples of this include motorized push netters and cyanide fishing, which are harmful to coral and seagrass. Such devices can result in lasting deleterious impact to the marine environment.

In response to these and other issues, several methods of fisheries management have been proposed, and some have been implemented. The Thai Government passed the Fisheries Act, B.E. 2490 (14 June 1947) and it is widely held that this document contains key ideas to any current and future fisheries management statutes. The Fisheries Act makes provisions for:

1. Limitation of entry to fisheries through fishing licenses;
2. Prohibition of the use of certain types of fishing gear during the spawning and breeding seasons of some commercially important species;
3. Prohibition of certain types and sizes of fishing boats and gear in some areas;
4. Declaration of protected areas;
5. Protection of endangered and threatened species; and
6. Prohibition of the use of poisons, stupefying chemicals, explosives and electric stunning." [46]

There have been a number of ministerial regulations issued, but enforcement has not been effective due to misconducted operations of the government, poor coordination between government agencies, and fishermen who are unwilling to enforce or obey laws that are inconvenient to immediate economic gain. According to several researchers concerned with the development of sustainable fishing practices, a system for the monitoring, control, and surveillance of fisheries also needs to be established.[46]

2.4.2 Mangrove Forests

Mangroves are a specific type of forest that is found along coastlines and river mouths that are influenced by tides. The environment needed to sustain mangroves requires warm oceanic currents, so mangroves are only found near the equator.

Mangrove forests have both ecological and economic functions. There are many organisms within the area of the Gulf that are dependent on the existence of mangrove forests. Mangrove populated waters are known to function as a nursery

ground for all sorts of aquatic creatures such as fish, prawns, shell fish and different members of the crab family, and thus have a high economic value.

Mangrove forests are normally able to renew and preserve themselves. Mangrove forest regeneration, through budding sprouts, is determined by the condition of the surroundings. If the budding sprouts fall during low tide, they are able to get a firm hold in the mud, which provides for steady growth. However, if the budding sprouts fall during high tide, they float along with the current and have a slow growth.[43]

The natural rejuvenation of mangrove forests can guarantee their own conservation. However, due to erosion, decrease of water quality, and the increase of construction in the coastal regions, the mangrove forests within the Gulf are depleting. This depletion has led to several methods of manmade regeneration of the mangroves.

2.4.3 Coral Reefs

Coral reefs are only found in warm, shallow waters; most are found in tropical oceans near the equator. A reef is made of abundance of coral; when each coral dies, it leaves behind a calcium carbonate skeleton. Young coral attach themselves to the skeleton, and the growth cycle begins again. The warm water of the Gulf and the ready supply of food make coral reef communities a natural haven for sea creatures. The bush-like shape of the coral offers many nooks and crannies in which fish may live. Small fish can hide from larger predators inside a coral reef; because of this, many small tropical fish are found in coral reefs.

There are many threats to coral reefs, including unsustainable fishing practices and runoff water. An example of these types of fishing practices is cyanide fishing,

which is prevalent in Southeast Asia. Fishermen inject cyanide into reef areas where the fishes are found; the cyanide stuns and disorients the fish in the coral. The fishermen then break apart the coral in order to capture the fish. Another problem arises when the silt from the eroded soil in runoff water blocks the sunlight. Without sunlight, photosynthesis does not occur, the coral are unable to receive necessary nourishment, and the reef dies.[37]

2.4.4 Aquaculture

Aquaculture is the cultivation of the natural resources of water, such as fish or shellfish.[41] Aquatic plants and animals grown through aquaculture are used for commercial and scientific purposes. Fish are confined in earth ponds, barricaded coastal waters, and cages suspended in open waters. Limited ocean resources, along with our increasing demand for high priced fresh fish products such as shrimp, crayfish, and prawns, has led to the growing expansion of aquaculture. Aquaculture is also used to supplement the natural supply of shrimp, shellfish and other species that have been depleted due to overfishing, destruction of the habitats of coastal species from increased human population, and with economic and industrial development in coastal regions.

Estuaries are important sites for aquaculture. Located where rivers and seas meet; the salt water of the sea is diluted with fresh water from the river creating an estuary. The combination of these two water types is more conducive to fish growth than either type alone. Plant nutrients are trapped in estuaries and the circulation of the water initiates primary production.

Aquaculture sites are extremely vulnerable to contamination because of their locations. The mouth of a river, along with being a prime site for aquaculture, is often a promising site for urban development. Since most aquaculture sites are located near the mouths of rivers they tend to become exposed to high levels of sewage contamination and industrial effluents. The same water circulation that traps the plant nutrients will also trap the high concentration of pollutants.

Developing countries will often build several small fish pond impoundments; it has been found that these smaller ponds have a greater adverse affect on the environment than one large pond would. Multiple impoundments increase the overall aggregate shoreline of the pond, leading to a high density of mosquito larvae; these larvae can carry diseases such as malaria and lymphatic filariasis.

Aquaculture is often presented as a clean industry, but in reality aquaculture systems produce large quantities of polluting waste. This waste is similar to wastes from other forms of animal production. Terrestrial farm waste reaches water bodies by runoff from storms that cause the waste lagoons to overflow. Aquaculture waste is often released directly, since fish farms are located directly in the water supply or because effluent is discharged into bodies of water.

Aquaculture waste is comprised of uneaten fish feed and fecal and other excretory waste; this is a source of nutrient pollution. High nutrient levels can stimulate blooms of phytoplankton or algae populations. When algae die in large numbers, the degradation reduces the oxygen levels, stressing or killing fish and other organisms. Blooms of toxic algae produce large fish kills, which in turn contaminate the shellfish; this is referred to as a red tide. The contamination of shellfish poses potential health hazards to humans.

Cage and net-pen aquaculture systems have a high potential for causing environmental degradation. This is because these systems are in relatively open waters and the untreated waste is discharged directly. Pond and tank systems allow for better control of waste discharge; high concentrations of waste are discharged only during cleaning and harvesting.[41]

2.5 Pollution

Pollution is becoming an increasingly global problem, and the Gulf of Thailand is not at all immune to this environmental hazard. Pollution enters the Gulf through a number of means, including water flow from entering rivers, shipboard sources, and originating from the Gulf itself.

Land-based pollutants are the most significant source of pollution in the Gulf of Thailand. These can include industrial by-products and urban and agricultural waste, all of which can be quite harmful to the marine life of the Gulf. Petroleum related pollution is becoming a severe problem in the Gulf of Thailand. Petroleum is found in great supply in the Gulf: it creates a lucrative business that is beneficial for both the producers and consumers of petroleum products. Most petroleum pollution comes from petroleum spills, although there is also some pollution ambient to petroleum mining. Another substance responsible for pollution in the Gulf is mercury. While some mercury is released into the waters of the Gulf through seepage from the ocean floor, it is not this mercury that is a significant problem. Industrial mercury, released in much higher concentrations, presents a much higher danger to the many organisms of the Gulf of Thailand.

2.5.1 Land Based

Wastes from agricultural and industrial activities, and domestic sewage are all forms of land based pollution. Pollution is discharged directly into the sea, or enters the coastal waters through rivers. There are two types of pollution sources, point and non-point.

Point sources of pollution are sources that can be associated with one location, such as industrial and sewage treatment plants. Point sources account only for a fraction of the land-based sources of pollution affecting coastal and marine environments. Non-point sources harder to identify, and include urban storm water run-off and overflow discharges, as well as runoff from forest and agriculture. Pollution sources can be located far from coastal areas and still have a serious impact. Pollution from distant sources can also enter into the marine environment through atmospheric deposition[32].

The Biological Oxygen Demand (BOD) of a specific environment refers to the amount of oxygen needed by all organisms within that environment to survive. Within the Gulf, the dissolved oxygen level is decreasing because of the influx of domestic waste. This is deteriorating the quality of the coastal waters and is expected to increase over the next several years, because domestic waste is proportionate to the population size. See Appendix B for BOD loading within the coastal provinces.

Industrial development along the Gulf of Thailand has been increasing over the past few years. Industries located in coastal areas include textile and petrochemical plants and oil refineries. Industrial estates found along the eastern seaboard include Map Ta Phut, Laem Chabang, and Bang Poo. Map Ta Phut houses petrochemical plants and a fertilizer complex. Agro-based industries are found in

Laem Chabang; there are also a few oil refineries nearby. The estimated BOD from industrial estates such as these can be viewed in Appendix C. BOD loads of industrial estates are dependent on wastewater treatment. Pollutants discharged from these estates include organic matter, along with toxic and chemical substances. The construction of industrial estates along the southern coast is an early indication that there will be an increase of industrial waste in that region.[32] Industrial wastes discharged from plants along rivers often find their way into the Gulf. Appendices D, E and F show the BOD discharge from the industries in the river basins.

2.5.2 Mercury

Mercury, also known as quicksilver, is a white, poisonous, metallic element[48]. One of two elements that occur naturally in liquid form, mercury is found in the earth's crust at an average density of 0.08 grams per ton of rock[48]. Natural geologic deposits either occur in isolated drops or in fluid masses near hot springs or volcanoes. Mercury can also be brought to the earth by rainwater. Toxic emissions such as from coal combustion and solid waste incineration produce mercury that is released into the atmosphere. The mercury content in the atmosphere of oceans has doubled since the 19th century.[48]

Mercury that is found in the atmosphere is composed of 97% elemental mercury; another form, methylmercury, which can be lethal, comprises 95-99% of the mercury found in rivers and lakes. These high levels are from industrial wastes settling at the bottom of lakes and rivers. Fish can become insensitive to these deposits, as they are able to build up a level of mercury tolerance in their tissues and

thereby absorb higher amounts. The level of mercury allowed by this tolerance is highly toxic to humans and other living entities that would consume these fish.

Inhalation, ingestion, and absorption of mercury cause mercury poisoning. In humans, the central nervous system or brain is adversely affected by mercury poisoning. The first signs of exposure are loss of sensation to the extremities; slurred speech, tunnel vision, loss of hearing, convulsions, and eventually death follow this. The effects of mercury poisoning were first understood in the 1970s in Southern Japan.[49] The Chisso Corporation dumped tons of mercury into the Minamata Bay, contaminating the local fish. Over 2900 people suffered severe injuries, a third of which were fatal, and it is further estimated that at least 10,000 individuals were permanently harmed.

Ocean fish are not as susceptible to mercury build-up in their tissues. It is suggested that this is because the ocean is not acidic, and mercury levels are generally higher in acidic waters. Fresh water fish are quite susceptible and the contamination of these fish poses a serious risk to those that would consume them.

There has been great controversy over the issue of mercury pollution in the Gulf of Thailand in the last several years. In 1994, a group of researchers found high levels of mercury in fish samples taken from the vicinity of a Unocal gas platform. Questions then arose as to whether or not the activity at the petroleum platform was responsible for these elevated mercury levels. Many studies have been undertaken to determine the true cause of the high mercury levels reportedly found in the fish.

The root of the controversy comes in the methods that are undertaken to perform the actual testing of fish and water for mercury contamination. The sampling of fish presents several difficulties to quality control. First, in order to be

tested, the fish must be caught. There is almost no way to be certain that a truly representative sampling of fish has been caught. Also, fish and water are dynamic in nature; it is nearly impossible to tell exactly how much time a given fish or amount of water has spent in the vicinity of the petroleum platform.

Another source of controversy is the actual testing process. Even when mercury is present in potentially fatal concentrations, the actual amount in the water is extremely small, typically measured on the scale of nanograms. Testing for mercury levels this low is a particularly delicate process, and according to some researchers, it is a process that is easily corruptible. Ideally, such testing will be carried out in a mercury lab. However, such labs are expensive to build and maintain.

Also, some researchers recommend that fish not be tested in the same lab as water samples. Concentrations of mercury present in contaminated fish will typically be nearly 1000 times those found in water. When fish and water samples are tested in the same lab, the results can become tainted.

Unocal sponsored the initial investigation into the cause of the mercury contaminated fish. However, Unocal was not informed that the results would be publicized without screening, and a great scandal ensued. The testing is now under the authority of the Thai government, though Unocal and another petroleum company, Total, continue to conduct independent tests.

2.5.3 Petroleum

Petroleum hydrocarbon pollution of the marine environment is a global problem. Petroleum pollution arises mainly from oil and gas production activities. There are a number of factors for potential environmental risk relating to oil and gas development in the Gulf of Thailand. Petroleum hydrocarbon contamination in the Gulf has risen with increased industrial development in coastal regions. PHC concentration levels vary with distance from the shore; higher PHC levels are recorded inland than offshore. Also, PHC levels are higher near fishing ports and areas of shipping activities. This is because these areas are high risk for oil leakage.[32]

There have been frequent oil spills in Thailand's territorial waters; these oil spills represent the greatest source of petroleum related pollution in Thai territory. A list of the largest oil spill accidents that have occurred in the Gulf in the past twenty-five years can be found in Appendix G. As a consequence of the damage from oil spills, all oil companies in Thai territory are required to carry out environmental impact studies before, during, and after any activity they conduct in the Gulf.

In the event of small spillages, supply boats can quickly spray the area with chemicals designed to break up the oil and minimize environmental impact. Larger spills, however, require the notification of Tiered Area Response Cooperation (TARC), located in Singapore, in order to initiate necessary emergency measures.

2.6 Coastal Development

As human populations grow and expand, more territory is developed and prepared for human use, and coastal regions are often prime sites for industrial or other man-made installations. Construction and urban development must be handled

carefully, however, to keep from having an irreversibly harmful impact on the delicate coastal environment. Erosion is a natural geomorphologic process by which land based sediment is carried through rivers and streams into large bodies of water. Erosion is often accelerated by urban development and construction, and erosion has also become a means through which upland pollutants are introduced into the marine environment.

Tourism is a growing industry around the Gulf of Thailand. Thousands of tourists come to the Gulf every year to enjoy its beautiful beaches and exotic marine life like the many colorful coral reefs and unusual fish that they harbor. The coast must be maintained if the tourist industry is to continue to draw people to visit the Gulf, and at the same time, development for tourism must not be allowed to damage the fragile marine environments of the Gulf.

2.6.1 Tourism

Thailand has become one of the leading tourist destinations in the Asian-Pacific region. The number of foreign tourists visiting Thailand has increased over the past 20 years, from 1.2 million arrivals in 1975, to approximately 7 million in 1995.[33] Thailand's main attractions are natural and historical sites, as well as its culture and people. Management capacities in major tourist cities have been upgraded to accommodate the corresponding increase in pollution and garbage. In order for tourism development to be successful, urban planning and appropriate management must be introduced.

Human impact of tourism on the environment must be taken into consideration. Tourism resources along the coastlines, particularly marine ecology, are notably fragile, and education of tourists is an important way to protect the environment. Construction of new tourist attractions and hotels will also affect the environment. Construction of new hotels along Thailand's eastern and western seaboards is already in development; Chantaburi, Chachoengsao, Chonburi, Trat, and Hua Hin are a few of the cities that have hotels which are projected to open by the end of 1999 and in 2000. The impact that this construction and the predicted influx of more tourists will have on the environment is unknown[34].

2.6.2 Erosion

Millions of tons of soils and other weathered particulate geological matter are washed into the world's many bodies of water annually through erosion. While erosion is a natural geomorphologic process, it has become an agent through which urban pollutants are released into removed environments. Erosion is also unnaturally accelerated by urban development along coastlines.[51]

There are several different aspects of erosion that are harmful to the marine environment. One of these aspects is the introduction of concentrated amounts of particulate matter into the water. Excessive sediment loading brought by erosion can result in the smothering of fauna, the destruction of spawning areas and food sources, and the blocking of light essential for plant photosynthesis. These things each happen whether or the erosion occurs naturally or is artificially accelerated.

With the inception of industrial and urban growth and coastal development, there are added dangers to the marine environment from erosion. These dangers come from the specific particulate matter being carried into the water. Erosion can carry waste and sewage from urban and rural locations to bodies of water, where it can act as a nutrient stimulant to dangerous algae growth. Erosion can also serve as an avenue for pollutants from traffic, air pollution, litter accumulation, and construction sites to be introduced into the marine environment.[51]

2.6.3 Cross-Boundary Management Issues

The objectives of management of the Gulf of Thailand are to control the use of marine and coastal resources, to protect the environment, and to improve the quality of people's lives. Many of the problems occur in the Gulf of Thailand due to the lack of integrated, long-term planning in the coastal and marine environment. There is no clear direction and a strategic agreement for managing the Gulf of Thailand at the national or regional level does not exist.

The Gulf of Thailand is a large marine ecosystem with fundamental processes and dynamics. Its importance to society and vulnerability can only be understood if data become available from all parts of the Gulf. Different management needs, such as better science, awareness of the mutual role of science and policymaking, effective monitoring and data exchange, are not particular to any individual country. The management of the Gulf of Thailand is a responsibility shared by its four littoral states. Co-operation is particularly needed to deal adequately with the management of many problems affecting the Gulf of Thailand that are transboundary in nature[59].

In order to prevent long-term environmental harm and promote sustainable management of resources, it may be necessary to create new mechanisms for managing the Gulf as a sub-regional unit. There is evidence from other parts of the world, including the Gulf of Maine, the Mediterranean Sea, and the Baltic Sea, that point to the advantages of sub-regional institutional mechanisms for improving resource management.[53]

According to Grundy-Warr and Schofield, the ways for states to cooperate with each other are to:

- "coordinate the management, conservation, exploration and exploitation of the living resources of the sea;

- coordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment;

- coordinate their scientific research polices and undertake where appropriate joint programs of scientific research in the area;

- invite, as appropriate, other interested states or international organizations to cooperate with them in the furtherance of the provisions of this article.[52]"

All four Gulf of Thailand coastal states have signed the 1982 United Nations Convention on the Law of the Sea. There still is a question of whether the Gulf's littoral states are willing to accept a compromise that involves a balance between sovereign entitlement and environmental responsibility. The creation of a new sub-regional institution or commission is one step; there is a need to modify, adapt, and alter forms, even functions, over time and to create other mechanisms for cooperation.

2.7 Transportation

Transportation of goods and people is one of the many services and elements required in order for developing countries to move forward. Poor quality, infrastructure, or services can severely constrain not only economic growth but also political and social development. Improved transportation can bring countries within specific regions closer together, so that opportunities are created in order to attract economic ventures in which greater regional co-operation can yield mutual benefits.

The Southeast Asian region has historically relied heavily on marine transport, which has been developed not only for trade but also for communications, administration and political control. Southeast Asia requires an effective system of transport to move people and goods within the region as well as link the region to the rest of the world. Southeast Asia is a major producer of primary commodities including 80% of world's rubber and palm oil, 60% of coconut and pepper, 70% of tin and large quantities of rice, coffee, sugar, tropical hardwood, crude oil and other primary products.[50] The majority of this external trade is transported by sea.

Maritime transport plays an important role for imports as well as exports. In the agricultural sector, the expansion of farming requires fertilizers that need to be shipped in from foreign sources. If the fertilizers are produced domestically, they need to be distributed to the farming communities across the country. Therefore, the demand for shipping will increase as the growth of population, urbanization and greater industrial development. The greater spread of social and economic activities will also generate a higher demand for shipping services.

During the period from 1970 to 1981, transport and communications contributed 7% to the Thai GDP with a 7.2 annual growth rate[56]. Thailand's fleet carried only 6 to 7% of its trade in 1983.[50] The Office of the Mercantile Marine Promotion Commission (MMPC) was created to assist in the development of the shipping industry. However, the growth of the Thai national fleet was slowed due to difficulties in getting enough financing from the government or from the private sources. The location of the main port at Bangkok, away from the international trunk shipping routes, means that much of the general cargo is fed either into Hong Kong or Singapore for transshipment to final destinations. At the same time, the domestic maritime transport in Thailand utilizes only 40 shallow draft ports, which are publicly and privately owned. The ports of Bangkok and Sattahip, run by a national enterprise, were the only deep-water ports in 80s[50].

In order to provide for marine transport, under the Mercantile Marine Promotion Act, the Thai Government also allows a 50% rebate on the freight revenue to Thai exporters who use Thai ships. In 1981, the Thai Government, realizing the financial burdens faced by Thai companies, reduced the charter tax from 15% to 1% in order to assist the Thai companies in chartering vessels.[50]

A major issue of maritime transport and ports in many developing countries is still the matter of bulk fleet development and better management of liner shipping, both domestically and internationally. There is a need for appropriate institutions as well as efficient port operations and management. The Thai government owns the bulk of the shares of the Thai Maritime Navigation Company (TMNC). About one third of the United Thai Shipping Company (Unithai), as well as a portion of four other companies, Jutha Maritime Co. Ltd., Thai Petroleum Transport Co. Ltd.,

Jalaprathan Cement Co. Ltd., and Vanakarn Co. Ltd, are held by the Thai government. Thailand's liners operate as feeder services to Singapore and Hong Kong. Its deep-sea services extend to the main foreign trading areas of Europe and the Far East.[50]

2.8 Storms

The Gulf of Thailand is subject to a highly complex tropical weather system that is mostly defined by the Southeast Asian monsoon. The meteorology behind this monsoon is not yet entirely understood, though scientists and researchers are learning more every year. While the seasonal weather of alternating rainy and dry seasons in the Gulf do not give rise to as many tropical storms as are experienced elsewhere in the world, they are not impossible.

Under certain conditions, tropical storms can develop and intensify to become one of the deadliest natural forces on the planet. Once the storm's winds reach speeds of greater than 73 mph, the storm takes on a different name, depending on where it originated. In the Western Pacific, these fierce storms are known as typhoons.

Although the Gulf of Thailand does not experience severe weather such as typhoons as often as other place in the world, such extreme weather is not only possible, but all the more dangerous because of their infrequency. Residents of this region may be lulled into a false sense of security, which may leave them unprepared when the next fierce tropical storm does strike. The keys to minimizing loss of life in the event of such a disaster are emergency planning and response.

2.8.1 Meteorology

The weather in Southeast Asia is most heavily influenced by annual monsoon circulation. While the word "monsoon" is usually associated with torrential rains, monsoons are actually cycles of wind circulation, with a winter season that is typically dry and a summer season that is wet. During this wet season, the monsoon has dormant and active phases; it is during these active phases that the fierce rains for which monsoons are best known occur.

While the exact cause of monsoons is unknown, it has been determined that there are at least two significant contributors to monsoon circulation. One is latitudinal shifting of the intertropical convergence zone (ITCZ), and the other is associated with the differences in solar heating of land and water. The intertropical convergence zone, which parallels the heat equator, is a discontinuous series of thunderstorms that occurs where trade winds from the northern and southern hemispheres meet. The ITCZ changes latitude as the high temperature line of solar heating shifts and this northward migration typically incites the rainy season.[56]

Modern forecasting technology is sufficient that conditions conducive to the formation of tropical storms are apparent to weather monitoring centers at the moment of their inception. Although it is impossible to predict exactly the path that a tropical storm will follow, technology and the results of scientific research allow meteorologists to make reasonably accurate predictions and follow the actual path of the storm closely. Because of the number of factors involved in tropical storms gaining intensity, they are still not fully understood, but with each successive storm, meteorologists and researchers are coming closer to fully understanding these intense forces of nature.

2.8.2 Typhoons

Whether it is called a hurricane, a cyclone, or a typhoon, a fierce tropical storm with winds of over 74 mph can be one of nature's deadliest and most destructive forces. Typhoons, as they are known in the Western Pacific, develop from tropical storms. which always initially form over open water.

Tropical storms have their foundation in tropical waves, areas of concentrated low atmospheric pressure. that develop their own closed circulation. At this time, the weather phenomenon is referred to as a tropical depression. The storm continues to develop with clouds building higher into the atmosphere and pressure dropping further, which thereby attracts warm, humid air near the surface of the water.

Coriolis effects from the earth's rotation cause these low altitude winds to begin rotating around the low pressure center of the building storm. At the top of the storm, clouds continue to build, sometimes reaching altitudes of 7 to 9 miles above the ocean surface. At these upper heights, the rotation from the lower winds causes the clouds to close in on themselves in a spiral, creating the calm inner section known as the 'eye'.[54]

If conditions are right, the storm is able to intensify and fuel itself. Heat and humidity from the ocean water are drawn into the center of the storm by the low pressure created by the spiraling winds. Convection allows this warm air to rise rapidly, until it condenses as it joins the wall of clouds around the eye. The process of condensation releases energy into the surrounding winds, which allows them to become increasingly violent. Some energy is released into the outlying winds, but most of the energy is retained in the eyewall, making it the most fierce and destructive

part of the hurricane. The eyewall is typically found at a radius 24 kilometers from the center of the eye[55].

The intense winds and rain are not the only danger imposed by tropical storms. Equally dangerous are the storm surges that come in their wake. Storm surges are particularly destructive to areas where the coast is at a low altitude relative to sea level, and to estuaries of rivers that are also prone to flooding. Typhoon force winds are capable of creating surges that are often up to 15 meters high; these can be devastating to low-lying areas that have, for whatever reason, failed to evacuate.

Tropical cyclones in recent years have been extraordinarily fierce; there have been seven since 1963 with death tolls of more than 10,000. The most severe of these, a horrific storm that battered Bangladesh, has left an unknown total number of fatalities, though most estimates place it at around 300,000.[56]

2.8.3 Emergency Management

Preparedness has a number of aspects, each of which can go a long way towards saving lives and property.

With modern satellite technology, hurricane centers and other weather conscious organizations are aware of tropical storms from nearly the moment of their inception. Since it typically takes days for a tropical storm to develop into a full-blown hurricane, and modern forecasting technology is reasonably accurate in its prediction of the path that these storms will follow, areas that are in danger of being hit by one of these storms usually have several days' time with which to prepare.

These few days are crucial to minimize storm losses. The first essential step that must be taken is communication. Each country should have an established system for notifying its citizens of the impending danger, and should make known to its citizens recommended precautions they should take. The full recommendations made by the United States Federal Emergency Management Agency for hurricane precautions are included in Appendix L.

Typhoons are rare in the Gulf of Thailand, but they are not impossible. This infrequency adds to their danger, as the people of the coastal states are lulled into a false sense of security. This makes the people more likely to disregard the seriousness of typhoon watches and warnings that may be announced. Each country is responsible for the development and maintenance of emergency response teams to deal with disasters. There are also a number of international emergency response organizations, including the International Red Cross/ Red Crescent Federation.[57]

2.9 World Wide Web Authoring

The World Wide Web has provided the universal public with a revolutionary way to disseminate information. Without the extraordinary expenses of multiple printings and shipping that are a burden to "hardcopy", web-published documents can become accessible to anyone anywhere in the world with access to a modem. The expedient nature of publishing on the web allows for amazing changes in the transfer and sharing of data and other information. Documents written in HyperText Markup Language (HTML), the native language of the web, can be accessed from all nations, on all continents, within seconds of the posting of such documents. Because of the widespread, multi-national basis of the web, as well as its inherent spirit of free

transfer of information, there is no single governing body or authority for web-published documents. There has been developed, however, a set of standards in order to maintain and maximize worldwide accessibility.[44]

There are a number of computer programs known as web browsers that have been developed for the purpose of accessing, or 'surfing', the web. Because of the independent development process for each of these browsers, there does not exist one unique standard for HTML. Several committees and organizations have attempted to establish conventions for HTML, but there are still variances in capabilities of browsers. Consequently, any web page developer should careful to avoid browser-specific HTML.[44]

Computer technology changes rapidly, and equipment quickly becomes obsolete. Web page designers must keep in mind, therefore, that many web surfers will be searching the web using machines that are not state of the art equipment. Graphics should be in one of the two universally accepted formats, .JPG or .GIF, and file size should be kept as small as possible without compromising the comprehensiveness of the page to accommodate clients or 'surfers' with slower modems, or those accessing the internet in areas of heavier traffic. Also, it is considered poor 'netiquette' to cause surfers viewing a page to require needlessly large amounts of bandwidth.[45]

There are a number of tips and suggestions for webpage design depending on intended function and audience. Text should be in a standard font, and ideally will be a dark color on a light, simple background. It must be kept in mind that the resolution of the finest monitors that money can buy is only in thousands of dots per inch, while newspapers and other professionally printed material are at a resolution of millions of

dots per inch. Greater resolution is much more comfortable for the eye to perceive, and complicated fonts and colors only detract from the relative resolution.[45]

It must be remembered that surfers accessing the web have different software and equipment. Browser settings and screen resolutions can have a great effect on the appearance of a web site, so a web site's comprehensiveness should not be dependent on its appearance on one computer system's screen. Ideally, the web site will be comprehensive regardless of the relative sizes and locations of its elements.[44]

A large number of so-called 'bells and whistles' have been developed for the web, such as Java Script, Visual Basic, and many other multimedia applications. While these do certainly attract the attention of the surfer, they often detract from the information intended to be conveyed by a web page, and should be used in moderation. Such applications also increase the loading time of a web site, and can become an extreme burden to surfers with slow internet connections.[45]

Other general recommendations from experienced web authors include several suggestions regarding navigation. Navigation within a site should be immediately comprehendible to the surfer, and should be as consistent as possible throughout the web site. Also, although most browsers will allow for pages of limitless length, web documents should generally kept to five or fewer screens of text, with ideal web pages being three screens or less.[44] Site maintainers should leave contact information so that surfers may alert them to problems with the site, or suggest improvements that may make the site more informative or coherent.

2.10 Interviewing Skills

In order to learn what the people concerned with the continued sustainable management of the Gulf want and need in terms of technical information, data formatting, and data dispersal of oceanographic and social data, interviews will be developed. These interviews will be conducted with experts from a variety of sectors concerned with the Gulf, including academic, government, and scientific domains.

Before setting up an interview, the following questions about the respondent must be considered to best format the interview itself.[1]

1. What information do you want to gain from the respondent?
2. What will the respondent find reasonable to answer?
3. How much time will he or she really be willing to spend?
4. What will he or she answer freely without embarrassment?

Questions are an integral part of an interview. Because of this, some rules, format or style should be followed when designing the questions. The questions must be easy to understand and brief; the following considerations should be kept in mind when writing questions.[1]

1. When using multiple-choice questions, open up the narrow channels of choice by giving the options of all or none of the above.

2. Use hypothetical questions, because respondents may not have any direct experience with the subject matter. With a hypothetically proposed scenario, the respondent will be able to deliver genuine opinions.

3. Some open questions are needed to loosen up the interaction between the interviewer and the respondent. Such questions allow the respondents some freedom to explore their thoughts and provide a bit of variety to the interviewer.

4. Interviewers have the responsibility of pacing the conversation. It certainly helps if the questions themselves provide the respondent some alternative between the crisp choice and more reflective answers, some questions that can be answered without a great deal of thought, and others that invite considerable mulling.

5. Question writing is most often seen as the art of constructing an idea within a context that most people will find realistic, plausible and neutral, cast in the language and frame of reference that most people will find clear. Ask questions that the respondents may be interested in.

Bias is defined as an error of measurement based on a tool; in this case the tool is the interview. There are two types of bias, response and non-response. Response bias occurs when the individual does not tell the truth, or the information collected is not accurate. With non-response bias, the individual simply does not respond. In order to minimize the occurrence of bias, some guidelines should be followed.

1. Use telephone or in-person interviews instead of mailed questionnaires.
2. Word questions carefully.
3. Do not ask too many questions.
4. Ask questions in a neutral reasonable, matter-of-fact tone of voice.
5. Design questions so that the question elicits the respondents' intellectualized opinions more than their emotional reactions.

As a rule, the situation should be structured to protect the respondents from the interpersonal influence of those who ordinarily affect their attitude and behavior, and from the influence of the interviewer as well.[2]

When setting up an interview there are some initial tasks one encounters. First it is necessary to decide how the interview will be conducted. There are two ways of collecting information by interview, either by questionnaires or recording schedules. A questionnaire is a standard set of questions that has previously been prepared and follows a specific pattern. The answers are then recorded to preserve accuracy. A recording schedule is another method used to conduct interviews. A list of items is recorded on a schedule and then information is collected on these items. The exact questions to be asked are not standardized, and it is up to the investigator's discretion to decide whether the response is acceptable.

Questionnaires are most useful when the questions are familiar to ordinary people and carry some standard meaning. When the questions are vague or inherently complex, the recording schedule method should be used. For example, some terms (e.g. gainful activity, operator of an agricultural holding, salient hydrology) may be confusing given the social and economic conditions developing countries. The respondent may have no clear idea of what such terms mean, so the terms should be referenced in clear, simple form.

Chapter 3

Methodology

Chapter 3: Methodology

This chapter outlines the methods undertaken to complete the development of presentations regarding the Gulf of Thailand. The methods undertaken include the arranging and design of interviews with various experts, the formulation of the web site organization, and the gathering of both images and the permissions necessary to utilize them in order to make the presentations more dynamic. A single part of this methodology, that of interview design, was completed in Worcester; the rest of this methodology was completed on site in Bangkok.

3.1 Interviews

At the outset of this project, our team faced an abundance of both information and unresolved questions to consider regarding the Gulf of Thailand. To make multimedia presentations which are as effective and concise as possible, we must first determine which political issues most warrant widespread dissemination, and which will benefit from scientific documentation. In order to determine which of the contemporary matters regarding the Gulf best meet this description, we will be conducting interviews with individuals from SEAPOL, IOC-WESTPAC, and the Marine Science Department at Chulalongkorn University.

These individuals were selected to be interviewed because they represent a broad cross section of the expert opinions required to get a full picture of the issues surrounding the Gulf of Thailand. Through their daily work, each of these individuals deals with several aspects of oceanographic related matters, and each has experience with the challenges of disseminating technical information to those who lack the appropriate technical background to understand that information. Based on

their technical and communications experience, these people will provide instrumental information for forming presentations of technically oriented oceanographic and social data to our intended audiences of policymakers and the general public.

Through these interviews, we will ascertain what sort of oceanographic and socio-economic data each person believes should be made more comprehensible and accessible. We will also determine which forms of multimedia presentation each person considers most effective for dissemination of data to policymakers, researchers, and the general public. These interview sessions will also be used to gather design suggestions that each person believes would be most effective in conveying this data.

Following the protocol that was researched in our literature review, we have determined that the best way to conduct these interviews is by using a recording schedule. Since the main purpose for our interviews is to elicit opinions, it is not necessary to have a fully structured interview. The recording schedule provides a more appropriate setting for collecting information.

Prior to each interview we will establish the main objectives we wish to achieve from each conference. This will allow us to set up the questions we will be asking, but the order will not be structured. Depending on the flow of the discussion in the interview, we will be able to decide whether the answer is appropriate to our needs, or if further indepth questions are necessary.

We will preface each interview by presenting the subject with a summary of our project objectives. After the subjects have become familiar with our project objectives, and we have answered any questions they have regarding the nature and

purpose of our project, we will begin the actual interview. Questions from the recording schedule utilized include the following: What issues of main concern do you feel need to be addressed by policymakers? What topics would best thematically link the problems most pending in the Gulf? (i.e. using the issue of fisheries to link politics, economics, pollution, and other social factors.) What forms of multimedia do you feel are most effective for the dissemination of information in today's society?

After each interview, we will revise our questions to reflect the necessary changes in questions that become apparent during the interview. For example, after asking the subjects what topics they feel are most relevant and receiving their answers, we will then present the subjects with the topics suggested by the previous respondent. We will first inquire openly about possible topics to gain an unbiased response from each individual, and will then inquire about previously received suggestions to gain another perspective on the relevance and priority of those issues.

3.2 Gathering and Organizing Data from Contemporary Publications

Much has been written in recent years about oceanographic and political matters regarding the Gulf of Thailand. Contemporary documents must be read and analyzed thoroughly for the most pertinent information in order to develop accurate presentations on the Gulf which are complete and yet of reasonable length. The literature will be divided evenly between the IQP group members according to interest and background. The team members will carefully peruse their assigned literature and return to the group with a full summary of their newly acquired knowledge.

From these summaries, the most important and relevant information will be taken for incorporation into the presentations, and completely irrelevant documents will be set aside. The source of each piece of information will be carefully recorded so that a proper bibliography is maintained. We will choose issues and topics to become foci, and we will develop outlines for how the information will be organized in each multimedia format; the choices of topics and organization shall be revised based upon recommendations from each interview subject.

3.2.1 Permissions and Copyright Laws

While there are many advantages to the widespread availability of documents and images today, particularly via electronic media such as the World Wide Web, there are several disadvantages, including the dangers of unintentionally violating copyrights and other proprietary regulations.

International copyright law is currently something of a 'gray' area; some nations do not recognize individual ownership of documents and images. It is against the founding philosophies of some nations to recognize the ownership of anything, let alone controversial so-called 'intellectual property.' As a result, some people who do believe in such ownership have become hesitant about sharing their work, as they do not want it to be distributed without the proper accreditation.

In developing these presentations on the Gulf, it is imperative to guarantee that no copyrights are being violated, and that all proper credit for work is given where due. A meticulous bibliography is being maintained of each document and publication from which information was taken.

Images, however, present another problem entirely. Some of the images gathered for these presentations belong to SEA START and SEAPOL and can be utilized freely. Some images from other sources, however, have particular and specific copyrights. The owner of each of these copyrights will be contacted, typically via e-mail, and permission will be sought to use the images either as illustrative graphics or as the background for navigation graphics.

In the process of developing these presentations, a large number of written materials and graphics were created by the members of this IQP team. In the spirit of promoting research and understanding, we have chosen to place all of our work in public domain, though we will ask that permission is requested before using the Gulf of Thailand logo that was created for the web site.

3.2.2 Design and Manipulation of Images

Graphics are important to any form of multimedia presentation. While it is true that "a picture is worth 10,000 words," it can often be very difficult to find a picture or image that exactly matches what the page designer had in mind, and what the text has to say. Also, in many cases, a presentation develops a graphic theme or style of its own, and it can be difficult to find images that match that style. Incorporating images that detract from that style takes away from the presentation as a whole.

In light of this, we chose to design a number of our own images. The background for the Gulf of Thailand web site, along with all of the title graphics and some of the navigation tool images, were digitally designed 'from scratch' using Adobe Photoshop 4.0 and Paint Shop Pro version 5.00. These images are designed to be aesthetically pleasing, and to be eye-catching without being gaudy.

A background base of grayscale swirls, from which all of the other images have developed, was designed to be reminiscent of light reflecting from moving water. To make certain navigation tools, pieces of this base were cropped and converted to duotone, which is a single hue overlaid on a grayscale image. Full spectrum gradients were applied to navigation tools and rule bars for primary topics, showing that these topics interrelate a full spectrum of issues within themselves and are interrelated with one another.

There are two other distinct advantages to creating graphics as opposed to searching for them beyond style continuity. The first is that there will be no question as to violating copyrights in using the images. Any image created by this IQP group is fully available for use in this web site and PowerPoint, as well as future presentations made by START and SEAPOL. Also, the designer can keep in mind certain techniques such as limiting the number of colors used in the image in order to keep the file size of these digital images minimal.

It is also possible to manipulate existing images to fit a given style. Through the use of cropping, color overlays and adjustments, and other filters, images can be digitally altered to take on an entirely new look, and thereby better match a given design scheme. However, first it must be ascertained whether the owner of the original image has placed it in public domain or otherwise given permission for the image to be altered.

3.2.3 Electronic Photographic Library

In the course of designing the web site and PowerPoint presentations, we will be gathering large numbers of oceanographic, environmental and social photographs and other images. Photographs and hard-copy images will be digitized for use in the electronic media. For more efficient use in our own presentations, as well as future use by START, SEAPOL, and other interested parties, we will organize these images in an electronic photographic library. Images will be named in a logical manner, and a record of all images including subject matter, origin, and any copyright information will be maintained in Microsoft Excel.

A variety of internet search engines such as Yahoo, Lycos, Excite, and HotBot will be used to obtain a better sampling of search images available on the web. These search engines produce results based on key words entered by the user. Key words related to our topics such as aquaculture, shrimp, boats, and sewage are entered; depending on the number of results produced by the search engine, a limiting word will be added to narrow the range of the search. By narrowing the search, the final images used represent the best quality of images.

Since the focus of these searches is for photos, searches are sometimes more effective if the word "photos," "pictures," or "gallery" is used along with a key word that relates to the specific topic being sought. If the search engine produces no results, similar keywords such as synonyms (e.g. replace "ship" with "boat") or singular forms of the word will be used to perform the search again.

Since there are a limited number of web sites published on the Gulf of Thailand, finding pictures on each topic may be difficult. Countries with environs

and cultural settings similar to the littoral states of the Gulf will also be searched. Pictures will be chosen that best illustrate the text or the topics in our web site.

All images that are found will be downloaded in .JPG or .GIF format in order to minimize disk space consumed. Images will be named by a code according to topic; the web site address from which it was downloaded and any available copyright information will also be recorded for each image. This format will allow future users of the electronic library to chose images easily and quickly.

Besides web photo research, pictures will also be gathered from journals, magazines, and books. These images will be scanned in using a Hewlett Packard ScanJet 4C. The images will then be captured using Hewlett Packard's accompanying scanning software, and digitally adjusted as needed using Adobe Photoshop 4.0. Data for each of these images will be recorded in an identical manner as the data for images downloaded from the web.

3.3 Web Site Design

The design of the web site must incorporate data content with comprehensibility. The users must be able to understand how to navigate the site and find the information that they are looking for without prior instruction. We must organize the extensive scientific, social, political, and economic data that we have received from START and SEAPOL into a framework that easily conveys information. Also, since it is impossible to know what topics will be of greatest importance in the future, the design of the web site should allow for easy expansion and addition of material.

The information within the web site will be organized and refined by the use of primary and secondary topics. The primary topics were chosen to be broad for their future expandability. Each primary topic has secondary topics on specific issues. For example, the secondary topics for living resources are fisheries, aquaculture, coral and mangroves.

As the web site is developed, its components will be placed on the web at http://www.start.or.th/~gotwww so that they be reviewed and tested by sample audience members. An e-mail link has been set up on the prototype page so that viewers may send feedback directly from their web browser. This feedback will be considered and appropriate alterations will be made to the site.

Meta tags with keywords will be included in the html code so that the site will be recognizable to internet search engines. The site will also be manually registered with some of the most popular web wide search engines, as well as search engines set up specifically for Asian topics, global change topics, and other topics specifically relevant to the web site. Links will be made from the Gulf of Thailand web site to particular sites that have information relating to the content of our web site, and the people maintaining those sites will be contacted to see if they are interested in linking back to ours.

3.4 Development of PowerPoint Presentations

PowerPoint presentations will be developed for the secondary topics. Since the PowerPoint format is more rigidly sequential than the World Wide Web, a clear course of information on the main points for each topic will be developed. The presentations will be designed in a modular format. Personnel from SEAPOL and START, depending on to whom they are presenting the information, will be able to modify these PowerPoint presentations in the future. The PowerPoint presentations will contain information drawn from the same sources as the web site, but this information will be in a more concise and summarized format.

Presentations will be developed on individual subject matters such as bio-diversity, petroleum, fisheries, and maritime transport. Information from research and interviews will be combined with images gathered from a variety of sources to accentuate the key points of each presentation. Each presentation will be designed in such a manner that individual slides may be added or removed to refine that particular presentation or be inserted into another presentation to complement other topics.

Chapter 4

Results & Analysis

Chapter 4: Results and Analysis

This chapter outlines the results of each of the methodologies undertaken to complete the design and construction of several multimedia presentations regarding the Gulf of Thailand. These results include the information gained as a result of interviews and the organizational structures developed for various presentations.

4.1 Results of Preliminary Interviews

These preliminary interviews were each conducted to determine what topics and presentation formats would be best utilized. Each preliminary interview was conducted in Bangkok during the first two weeks of our stay.

4.1.1 Interview with Dr. Frances Lai, SEAPOL

Dr. Frances Lai is the Executive Director of SEAPOL, located at Sukhothai Thammathirat Open University in Nonthaburi, Thailand. In the course of her duties at SEAPOL, Dr. Frances has gained extensive exposure to the political and other social conditions and issues surrounding the Gulf of Thailand.

During our first interview with Dr. Frances on 13 January 1999, she gave us a wide variety of contemporary topics that could become the focus of multimedia presentations, including fisheries, pollution, and the degradation of the environment due to development. Dr. Frances also emphasized to us the need for broader communications between scientists and policymakers. According to Dr. Frances, some scientists are hesitant to become involved with policy related issues. Government officials and social scientists are invited to the international conventions sponsored by SEAPOL, but are frequently reluctant to attend. From this interview,

our IQP group determined that the World Wide Web and PowerPoint presentations would be the most feasible and effective forms of multimedia to develop.

At our next interview with Dr. Frances on 19 January 1999, we presented to her our proposal for the design of these multimedia formats. She believed that these formats would be appropriate to the subject matter, as well as helpful to SEAPOL's objectives. At this second interview, Dr. Frances presented us with more detailed information about fisheries, aquaculture, coastal zone management, the importance of economic indicators and sustainability, and the delicate international political balance surrounding the Gulf.

4.1.2 Interview with Suraphol Sudara, Asst. Professor, Marine Science, Chulalongkorn University

On 21 January 1999, we met with Suraphol Sudara, who is an Assistant Professor in the Marine Sciences department at Chulalongkorn University. As well as being a professor of marine sciences, Prof. Suraphol has frequently completed consultations for both government offices and non-governmental organizations regarding the environmental and social impacts of proposed policy and construction projects.

From Prof. Suraphol, we gained a much better understanding of how the many dynamic processes of the Gulf and human interaction with these processes are intrinsically related. He gave us many examples of current and past development projects that integrate numerous different oceanic, economic, environmental, and social conditions that may at first appear unconnected. Prof. Suraphol also

emphasized the need to use economic indicators to most dramatically convey results and projected impacts.

When asked which area of oceanography he felt was most important, Prof. Suraphol replied that all aspects are interrelated, and as such it is unwise to focus on only one. To better convey this message, he provided us with an example in which only one area was researched. A power plant was constructed, taking into consideration only the concerns for lasting geologic factors; the biological impacts were overlooked. The developers failed to realize that the wastewater from the power plant would be dumped into a prime area for fish spawning.

Prof. Suraphol also emphasized the need for better communication and understanding between political and scientific sectors. Scientists customarily believe that sufficient time must be taken to conduct complete research to produce exact and precise results before they will make recommendations; policymakers, however, are frequently impatient to wait for such research to be conducted.

In his experience, Prof. Suraphol has found that projects and policies that best balance the needs of the people and the environment are those projects and policies that involve people from the community and all involved sectors from the initiation of the project. For this to be achieved there must be widespread communication between all sectors. Prof. Suraphol believes that electronic media such as the World Wide Web and PowerPoint will be very effective for communicating with coming and future generations. For now, however, he believes that media such as radio, television, and printed matter are more effective for disseminating information to the Thai public at large.

4.1.3 Interview with Maarten Kuijper, WESTPAC

The final preliminary interview was conducted with the IOC Regional Secretariat of WESTPAC, Mr. Maarten Kuijper. Mr. Kuijper emphasized the need for determining for what audience the presentation is intended and then building the presentation to best suit that audience. While he agreed that fisheries and aquaculture are important issues, he also believes that there are a number of other issues that are, or should be, of major concern. These issues include bio-diversity, humanity value and the environment, coastal development, the effectiveness of typically expensive mathematical models, and the risk associated with major storms and other severe weather patterns.

Mr. Kuijper highly advocated the use of visual matter such as pictures, charts, and graphs to convey information and retain audience attention. He also accentuated the need for economic indicators, as well as risk quotients associated with pollution indices. Mr. Kuijper also echoed the need for more cooperation and better communication across political, scientific, and social sectors.

4.2 Analysis of Preliminary Interviews

From these interviews we gained several valuable insights about presentations and the Gulf itself. We were presented with many options of presentation formats and subjects to develop presentations on; while all of the suggestions were good, some were too time-consuming or too technically involved for us to undertake in our short 8 week stay in Bangkok.

We took several factors into account when considering the presentation formats that were suggested by the interview subjects as most useful. Our various interview subjects proposed a wide variety of presentation formats, including radio, television, video, PowerPoint, world wide web, and CD-ROM. The factors to be considered included the intended audience of each format, the technical complexity involved in creating the format in question, any special equipment that would be necessary for development, and the amount of time that each format would require for development.

When all of these factors were considered, we decided upon the formats of PowerPoint and a web site. The web site would be designed to present information to anyone who looked for it, including policymakers and other laypersons. The PowerPoint presentations would be developed with policymakers primarily in mind.

Our interview subjects also presented us with a wide list of topics to consider as subjects for presentations. While all of the topics suggested were relevant to current issues and deserve widespread dissemination, because of time and research constraints we had to limit the number of topics selected. The topics we chose were intended to present a full illustration of the many seemingly unrelated factors that interact and effect the Gulf of Thailand.

4.3 Web Site

An extensive World Wide Web site was developed containing information about a number of topics regarding the Gulf of Thailand. The address of this site is http://www.start.or.th/~gotwww. Information on each of the topics discussed in the web site was gathered from contemporary publications, as well as raw data from START and other sources. A summary of this information is reflected in our literature review. Although we were able to find large amounts of data specific to Thailand, we made the content of the web site as relevant to all four of the Gulf's littoral states as possible.

The front page of the web site (see Appendix K-1) contains a large map of the Gulf of Thailand, as well as large navigation buttons linking to each of the primary topics. Also on the front page are links to five uncategorized pages; there are links to these five pages from every page within the web site. The first, gulf.html, contains general information about the Gulf of Thailand, including geographic location and size. Projects.html is a page intended for START, SEAPOL, and other organizations to announce their current and on-going Gulf of Thailand related projects. The next one, glossary.html, contains a glossary of terms used within the web site. About.html contains a description about the building of the site, including information about WPI's IQP program, START and SEAPOL. Finally, links.html contains hyperlinks to web sites with information relating to the information presented in the Gulf of Thailand web site. The bottom of every page within this web site lists an e-mail address for viewers to contact with questions or comments about the site, and information on when that particular page was last updated.

The primary topics chosen for this web site are living resources, pollution, coastal development, transportation, and storms. Each primary topic page has the same format (see Appendix K-2). The left margin of each primary topic page contains a column of buttons that link to the front page and each of the other primary topics. At the top of each page is the name of the topic in a colored gradient over an eight-pixel high rule line similarly colored; beneath this rule line are graphical links to each of the primary topic's secondary topics. Independent of the number of secondary topics, on each page this line of graphical hyper links is fifty pixels high by six hundred pixels wide to ensure graphic continuity. The remainder of the page contains text describing how each primary topic affects the Gulf of Thailand, why each secondary topic is important, and some of the interrelationships between topics as is applicable. Within this text are textual links to each secondary topic. Illustrative images and graphs are also intermixed in the text. When appropriate, there are also hyperlinks to Geographic Information System (GIS) images related to the topic. These GIS images are not incorporated directly into the text because the file size of these images is frequently very large, and some users may not wish to wait for such large files to be downloaded.

It is the secondary topics that represent specific issues that the interviewed subjects felt were important. The secondary topics under living resources are aquaculture, coral, fisheries, and mangroves. Under pollution there are links to mercury, petroleum, and land-based pollution. Coastal development is linked to tourism and urban development as well as erosion, and the primary topic of storms has the secondary topics of meteorology, typhoons, and emergency management. The

primary topic of transportation has not yet been given secondary topics; suggestions for secondary topics under transportation will be included in the recommendations.

This web site was registered with a number of major internet search engines and directories. including Yahoo, AltaVista, Lycos, Hotbot, Excite, and Infoseek, as well as smaller search engines dedicated to particular topics such as global research or Asia-related sites.

4.4 PowerPoint Presentations

PowerPoint presentations were constructed on specific topics. During our preliminary interview with Dr. Frances Lai, she had recommended using PowerPoint presentations to introduce policymakers to information about the Gulf of Thailand. PowerPoint presentations are more illustrative than plain text in presenting information; they also attract the attention of viewer more.

Dr. Frances considers the fishing industry to be an issue of main concern, so we decided that the construction of a presentation focusing on the need for cross-boundary fishery management would be useful to SEAPOL. During our interview with Maarten Kuijper, he also expressed belief that PowerPoint presentations would be useful to the staff of SEA START RC. His recommendations led to our decision to construct a presentation on the petroleum industry of Thailand.

The presentation on fisheries focused on the need for a more sustainaable management framework. The information presented was taken from *Fisheries Management Needs and Prospects for the Countries Bordering the Gulf of Thailand*, written by Deb Menasveta and published in SEAPOL Integrated Studies of the Gulf

of Thailand. The fisheries management presentation can be summarized by the list below:

- Marine fisheries overview
- Status of fishing industry in Thailand
- Adverse impacts of overexploitation
- Coastal Environment
- Management framework

The management framework recommended by Deb Menasveta consists of eight separate agendas, each with an individual slide: (1) Government Policies, (2) Laws & Regulations, (3) Fishery Management Authorities, (4) Management Measures and Enforcement, (5) Information and Statistical Databases, (6) Fishery Research, (7) Technology Transfer and Capacity Building, and (8) Regional Cooperation. The presentation can be found in Appendix M. The full management framework for fisheries sustainability need not be presented together. The structure of the presentation allows separate agendas to be presented and for slides to be removed based on the needs of the audience.

The presentation on petroleum is structured differently. This presentation has more images reflecting areas of petroleum fields in the Gulf of Thailand and the joint development area between Malaysia and Thailand. The focus of this presentation is the environmental impact of oil exploration and exploitation in the Gulf. Specific sources of pollution are identified along with byproducts of exploration. The current status of environmental laws and pollution prevention plans are also addressed within the presentation. The information used in this presentation was taken from research found in our literature review along with information in Inside Petroleum, distributed

by the Petroleum Institute of Thailand. The petroleum presentation can be summarized by the list below:

- Petroleum Industry Overview
- Location of Petroleum Fields in Thailand
- Joint Development Areas
- Petroleum Pollution
- Environmental Laws
- Pollution Prevention

The full presentation can be found in Appendix N.

4.5 Electronic Photographic Library

So far, we have more than a hundred photos on topics related to the Gulf of Thailand, including fisheries, mangrove forests, aquaculture, transportation, storms and tourism. A record of each image's information containing the name, a brief description, the web site address, and the copyright contact information has been put into an Excel table. Shown below in Figure 4 is an excerpt of the actual table.

NAME	DESCRIPTION	WEB SITE ADDRESS	COPYRIGHT CONTACT
quaculture001	Milkfish	aqd.seafdec.org.ph	rddata@i-iloilo.com.ph
quaculture002	Aquaculture Photo1	info.utas.edu.au	web-master@postoffice.utas.edu.au
quaculture003	Treating Cattails	ag.ansc.purdue.edu/aquanic	lswann@purdue.edu
Beach001	Cancun, Mexico	www.natureworld.com	maxpower1@aol.com
Beach002	Low tide	mangrove.org/sim.htm	riley@mangrove.org
Beach003	Rawai Beach	www.thephuket.com/main.htm	comguide@samart.co.th

Figure 4. Electronic Library Table (Excerpt)

The data on the Excel table will be sorted in alphabetical order by the image names, so that the users can easily find photographs from each topic. The descriptions will inform the user about what the image is, so that they do not need to view every image to find what they are looking for. Also, if they wish to know more about the images or get detailed information, the web site addresses are given. Copyright contact data will give the users information about whom they should contact to receive the rights for using specific images.

4.6 Feedback on multimedia presentations

As the web site was developed, we sought feedback from a number of sources on graphic design and actual information content. Because the web site was placed online almost from its inception, and was updated regularly, it was possible to receive feedback from anyone in the world with access to a web browser. The site was announced via the e-mail alias for the Gulf of Thailand discussion group established by SEA START. A variety of other individuals were also contacted for feedback; these people were chosen to reflect the variety of people who may be visiting the web site. This also allowed us to consider the site as seen from a much wider variety of browser and equipment specifications than were available directly to us in Bangkok.

The feedback from these sources enabled us to further refine the organization and appearance of the web site. Respondents gave us suggestions on particular items contained within the web site, along with comments on the overall structure of the web pages. On several occasions, we were forced to reexamine our approach to navigational structure, and in one instance alter it entirely, based on issues brought to our attention by these parties.

After the web site and PowerPoint presentations were completed to a level of quality deemed sufficient by the team members, formal follow-up interviews were conducted with Dr. Frances Lai and Ms. Ankana Sirivivatnanon of SEAPOL, Dr. Anond Snidvongs of SEA START, and Mr. Maarten Kuijper of IOC-WESTPAC. We analyzed the feedback that we received from each person for suggestions that we felt were feasible and would truly enhance our presentations. We then undertook the recommended changes that were within our capability, and included the other attainable suggestions in our recommendations.

As a prelude to each follow-up interview, we supplied the URL of the web site to each subject and asked that they visit the site, at their convenience, and explore it fully. After each person had taken the time to go through the web site on their own, we asked them a series of questions. First we asked about their overall impression of the web site; in each case, it was received favorably. Each person also approved of the aesthetic appearance of the web site, as well as the navigational organization.

Our next area of inquiry regarded actual content of the web site. Each person expressed belief the information contained in the web site was informative, and that it should be expanded upon by the sponsoring organizations in the future. Dr. Anond stated that SEA START was willing to accept the responsibility for maintenance of the web site. Each interview subject had a number of suggestions for additional information, topics. and particular subject areas that could be incorporated in the future. In each case, the subjects' responses indicated that they believed this updating process would occur over a timeframe of several years. The topics and other additions that were suggested by each individual were wide in range and reflective of their own personal background.

Our final area of inquiry in these follow-up interviews concerned the overall usefulness of the site. Each person stated that they believed the site would indeed be useful as an educational tool to anyone who visited it. We also asked each person whether or not they would recommend this web site to other people; in each case, the subject replied that not only would they do so, but they had in fact already done so several times.

Similar feedback was received regarding the PowerPoint presentations. Because of time constraints, only two sources were queried for such feedback. Prof. Richard Vaz was queried based on his extensive previous experience in developing presentations, and Dr. Anond Snidvongs was interviewed as a representative of an organization that would be utilizing these presentations. Both of these sources gave suggestions regarding the structure and content of the presentations, and each person recommended topics for other presentations.

Chapter 5

Recommendations

Chapter 5: Recommendations

This chapter outlines recommendations for improving and updating the multimedia presentations regarding the Gulf of Thailand that were developed by this project team. Recommendations were based on the team's discussion of feasible presentations during the analysis of preliminary interviews along with feedback received during the follow-up interviews.

5.1 Web Site

In order for the web site to be useful to policymakers and most informative to the general public, **the web site should be continually updated**. It will be most practical for someone at START to take on this role, as the web site is being housed on START's web server, and they would have the easiest access to this file directory. Individual pages can be updated either in raw html through any text editing program, or through an html editor such as Netscape Composer. **Research and information on other issues should be added as it is gathered** in order to keep the web site as current as possible. It might be beneficial, for example, for START or SEAPOL to incorporate the results of the proposed fisheries conferences being tentatively planned as of February 1999.

As it is impossible to predict exactly what topics will be the most pressing and crucial in future years, the web site was designed with indeterminate expansion in mind. If future issues arise on subjects that are directly related to any of the major topics of living resources, pollution, coastal development, transportation, or storms, **pages on these new subjects should be inserted** into the web site as subtopics.

Future subtopics could include mud flats, beach environments, watersheds, and El Nino/La Nina in the context of the Gulf of Thailand.

Although the five primary topics were chosen to be all encompassing, we recognize that future needs could arise to add another primary topic. This is also possible, though slightly more complicated; detailed written instructions on how to do each of these things will be left behind. These instructions will first be tested by subjects who have no familiarity with building a web page and then will be revised according to the test results.

Along with information, **pictures, GIS images, and other images should be added** to illustrate new points and issues. Images should not only be added to the web site, but **they should also be incorporated into the electronic photographic library**, and appropriately catalogued in the library's documentation. It is recommended that someone within both START and SEAPOL assume this role of image librarian.

5.2 PowerPoint Presentations

The purpose of developing PowerPoint presentations was to provide SEA START and SEAPOL with contemporary and concise information that they would be able to use in presentations to policymakers and other individuals within government sectors. Additional presentations on other topics relevant to the Gulf of Thailand should be developed following the structured format that has been established, as outlined in the previous chapter. **Topics that should be addressed further in presentations include bio-diversity, shipping and maritime laws, cross-boundary management, and other current issues** specific to the Gulf. The modularity of

PowerPoint allows individual slides to be added to each presentation, and slides can be taken from each presentation to complement others. It will also be necessary to **continually enhance the current presentations with more images and recent data**. START and SEAPOL will be able to further **incorporate the current presentations into pre-existing presentations or add more slides to develop entirely new presentations**.

5.3 Future Work

A number of additional presentation formats were considered for development by this IQP group. While some formats were eliminated based on effectiveness, others were eliminated for practical considerations, such as the amount of time and resources required, and the technical skills and equipment necessary to develop the formats in question.

In particular, we feel that **START and SEAPOL could benefit from investing in the development of video and CD-ROM presentations**. Each of these formats has the disadvantages of being more structured, less modular, and harder to update than the electronic formats employed by this IQP group, as well as being technically complex and requiring a significant financial investment. However, video and CD-ROM offer several distinct advantages over the electronic media that have already been utilized.

Analog video is still considered one of the best ways to graphically illustrate subjects. While still images can be quite dramatic, moving images can be more so. With video, there is little concern over hardware compatibility. Television and video players have become commonplace technology, and relative screen dimensions are

nearly standardized. Video also allows for moving images at better resolution than digital equivalents, and while digital movies can require enormous amounts of disk space or bandwidth, analog video can be more efficiently stored and transmitted.

An interactive CD-ROM possesses even more graphical flexibility than does analog video, although digital moving images may possess a lower resolution than analog equivalents. CD-ROM can offer the interactivity which video lacks, and because there is no downloading or other file transfer involved, CD-ROM does not have the file size limitations that web sites do. Also, since a CD-ROM is a self-contained program, it does not have to be browser-compatible, and can possess more intricate and ostentatious programming.

Chapter 6

Conclusion

Chapter 6: Conclusions

The Gulf of Thailand, a semi-enclosed sea in Southeast Asia, is economically significant to the four nations that border it. As such, all four nations must cooperate in managing its many resources, particularly those that are in danger of becoming depleted. The Gulf itself is a complex marine environment and its many components are closely interrelated. Changes in one part of this dynamic system can have unanticipated impacts on other parts, frequently with adverse effects.

Because of these many interrelationships and their potential for unintended consequences, the people responsible for developing and implementing policies for the continued management of the Gulf should have a complete understanding of just how changes in one area might affect another. For example, any policy on petroleum exploitation should take into account the economic import of petroleum products and the ramifications that the policy will have on marine life in the vicinity of the petroleum production. If this policy has a negative impact on the fishing stocks in the area, then the benefits gained by petroleum production may be outweighed by the losses suffered by fishermen.

A large amount of data and information, both scientific and social, has been gathered by organizations and researchers who are concerned with the continued management of the Gulf of Thailand. Much of this information, however, is technical in nature and not easily understood by people who do not have an extensive background in oceanographic science or management. In order to further educate both the policymakers and public a new medium must be used to disseminate the information.

After interviews with experts and thorough research on various subjects pertaining to the Gulf of Thailand, this project team has developed an extensive web site along with PowerPoint presentations for conveyance of information about the Gulf of Thailand to policymakers and the public at large. These presentations were developed in conjunction with SEA START RC and SEAPOL, two organizations concerned with oceanographic issues in Southeast Asia. SEA START is dedicated to scientific research, while SEAPOL is concerned with the social, economic, and political aspects of the Gulf. The vast bodies of information from each of these sources was put together to construct a complete informational resource.

The web site is intended to educate all visitors about the background information necessary for the successful continued management of the Gulf. It contains information on the five primary topics of living resources, pollution, coastal development, transportation, and storms. There is further in-depth information on a number of secondary topics, including fisheries, petroleum pollution, tourism, and typhoons. This web site has been indexed with a wide variety of internet search engines so that people searching the internet for information about the Gulf of Thailand will be directed to this web site. Personnel at START and SEAPOL will recommend the web site to parties they feel will benefit from the information contained within the web site.

PowerPoint presentations were developed for START and SEAPOL to utilize in meetings with policymakers and other officials concerned with the management of the Gulf. These presentations were developed on the particular topics of fisheries management and petroleum in the Gulf of Thailand. These presentations can be used in conjunction with pre-existing presentations or adapted to fit the needs of START or

SEAPOL. Recommendations have been made to START and SEAPOL to further develop these presentations. As circumstances and situations change it will be necessary to update and expand on these presentations.

The development of presentations in other media formats will also be useful to START and SEAPOL. We have recommended that these organizations explore the possibility of using video and interactive CD-ROM to convey the information they have gathered. In regards to the continued maintenance of the presentations we developed, SEA START RC has agreed to take on the responsibility for maintaining and expanding the web site, and both organizations have expressed interest in updating and further developing the PowerPoint presentations.

The multimedia presentations that this team developed are designed to be informative and to reflect the need for preservation of the resources of the Gulf. With frequent updating and additions to include other contemporary topics, these presentations willl be sources of vital information for those concerned with the continued management of the Gulf of Thailand.

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Appendices

Appendix A: Coastline length, area and population of four littoral states of the Gulf of Thailand

Country	Total Land Area (km^2)	Marine Area* ($1000km^2$)	Total Coastline Length (km)	Population in 1996	Population Growth Rate (%, 1996)
Cambodia	181040	42	354	10861218	2.77
Malaysia	329750	139	2200	19962893	2.07
Thailand	514000	95	2631	58851357	1.03
Vietnam	329560	-	1750	73976973	1.5
Total	1354350	-	6935	163652441	-

Source: 1997 World Book Encyclopedia, quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix B: Population and BOD loading from coastal provinces in Thailand

Province	Population		BOD Loading (tones/year)	
	1994	2004	1994	2004
16 coastal provinces	9,253,469	9916,319	141,022	159,870
% increase per 10 years	7.16		7.49	

Source: Pollution Control Department, 1997a and b quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix C: BOD estimated for some major industrial estates in coastal area of Thailand

Estate (province)	Estimated water use (m^3/d)	Estimated wastewater (m^3/d)	BOD (kg/d)	Equivalent Population (person)
Laem Chabang (Chon Buri)	27,050	21,600	1,296	37,029
Map Ta Phut (Rayong)	72,000	57,600	3,460	98,743
Pa Dang (Rayong)	5,250	4,200	252	7,200
Bang Pakong (Chachoengsao)	1,875	1,500	90	2,751
Bang Poo (Samut Prakarn)	25,000	20,000	950	27,142
Ta Wan Oak (Rayong)	24,000	19,200	1,152	32,915
Total	**155,175**	**124,100**	**7,200**	**205,600**

Source: Pollution Control Department, 1997b quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix D: BOD discharged from industries located in major river basins of the eastern region of Thailand

River basin	River/Coast	BOD (kg/d)
Prachinburi, Saraburi	Prachinburi river to Bang Pakong	5,372
Nakorn Nayok	Nakorn Nayok river	5
Chachoengsao	Bang Pakong river	12,513
Chonburi	Coast	4,006,319
Rayong	Rayong river/Coast	96,916
Trad	Trad river/Coast	66
Chantaburi	Chantaburi/Coast	4,396
Total		**4,125,587**

Source: Pollution Control Department, 1997b quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix E: Present and predicted BOD discharge to watershed areas of the south river basins in the southern region of Thailand

Watershed	BOD (kg/day)					
Year	**1995**	**1996**	**1997**	**2001**	**2006**	**2016**
Petchburi	1,375	1,513	1,637	2,063	2,352	2,558
Pranburi	215,678	241,559	265,284	342,809	368,809	401,161
Kuiburi	96	108	118	153	164	179
Klong Tapapao	38,501	43,911	48,148	61,244	73,185	87,822
Lung Suan	6,708	7,647	8,385	10,665	12,745	15,294
Tapi-Pumduan	285,418	291,126	296,834	322,522	353,918	351,064
Pak Panag	10,689	11,651	12,719	15,178	18,278	19,881
Pattani	9,948	11,141	12,236	14,922	17,001	18,503
Saiburi	346	394	352	366	384	425
Bang Nara	1,501	1,517	1,532	1,592	1,667	1,847
Song Khla Lake	41,947	44,883	46,980	56,203	64,598	78,021
Total	**612,207**	**655,405**	**694,225**	**827,836**	**913,101**	**976,755**

Source: Pollution Control Department, 1997c quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix F: Present and predicted BOD (kg/d) discharged from industries located in the central river basins

Provinces	Samut Prakarn	Samut Sakhorn		Samut Songkham
Year	**Chao Phraya**	**Chao Phraya**	**Tha Chin**	**Mae Klong**
1997	51,156	76	48,509	1,296
2006	56,788	87	56,374	1,945
2016	63,354	104	69,908	2,592

Source: Pollution Control Department, 1997a quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thailand Vol. 1

Appendix G: Large oil spill accidents in the Gulf over the last 25 years

Date	Oil type	Volume	Location	Cause
1973	J.P.4	Unknown	Sriracha, Chonburi province	Fire tanker
1979	Crude oil	300 tonnes	Srichung Island, Chonburi province	Fire tanker
6 Mar. 1994	Diesel	400 tonnes	Srichung Island, Chonburi province	Collision of tanker and container
30 Oct. 1996	Crude oil	160 tonnes	Oil Loading station, Rayong province	Leaking during loading

Source: Pollution Control Department, 1996b quoted Chongprasith & Srinetr, 1998, SEAPOL Integrated Studies of the Gulf of Thaland Vol. 1

Trend of Tourism in Thailand
1996-1999

Year	International						
	Tourists		Average	Average Expenditure		Revenue	
	Number (Million)	Change (%)	Length of Stay (Day)	/person/day (Baht)	Change (%)	Million Baht	Change (%)
1996/1	7.19	+3.46	8.23	3,706	+0.34	219,364	+14.99
1997/1	7.22	+0.41	8.33	3,672	-0.92	220,754	+0.63
1998	7.72	+6.91	8.40	4,200	+14.38	272,362	+23.38
1999	8.28	+7.25	8.50	4,400	+4.76	309,672	+13.70

Year	Domestic						
	Thai Visitor		Average	Average Expenditure		Revenue	
	Trip (Million)	Change (%)	Length of Stay (Day)	/person/day (Baht)	Change (%)	Million Baht	Change (%)
1996/1	52.47	+0.40	2.22	1,314	+6.41	157,323	+6.20
1997/1	52.05	-0.78	2.31	1466	+11.58	180,388	+14.66
1998	52.50	+0.86	2.30	1500	+2.32	181,000	+0.34
1999	53.55	+2.00	2.35	1600	+6.67	201,200	+11.16

Note: /1 Actual figure

Source: Tourism Authority of Thailand, 19/11/1998

Appendix I: Fisheries of Thailand

Thailand	Total Production		Marine Fishery Production				Aquaculture Production				Export	Import
	in quantity (tonnes)	In value (US$1,000)	in quantity (tonnes)	% of Total	in value (US$1,000)	% of Total	in quantity (tonnes)	% of Total	in value (US$1,000)	% of Total	US$1,000	US$1,000
1990	2,786,370	1,614,497	2,362,218	85%	808,830	50%	296,952	11%	676,895	42%	2,382,000	805,000
1991	2,967,731	2,073,754	2,478,607	84%	1,032,609	50%	353,124	12%	912,450	44%	3,068,000	1,070,000
1992	3,239,827	2,568,360	2,736,352	84%	1,286,560	50%	371,475	11%	1,164,291	45%	3,239,000	965,000
1993	3,385,158	3,090,529	2,736,352	81%	1,427,833	46%	457,272	14%	1,485,735	48%	3,588,000	853,000
1994	3,522,233	3,423,113	2,804,426	80%	1,433,986	42%	519,754	15%	1,812,207	53%	4,352,000	842,000

Appendix J: Fisheries of Malaysia

Malaysia	Total Production		Marine Fishery Production				Aquaculture Production				Export	Import
	in quantity (tonnes)	in value (US$1,000)	in quantity (tonnes)	% of Total	In value (US$1,000)	% of Total	in quantity (tonnes)	% of Total	in value (US$1,000)	% of Total	US$1,000	US$1,000
1990	863,623	547,501	819,903	95%	498,505	91%	42,444	5%	48,996	9%	233,000	150,000
1991	767,412	532,670	709,587	92%	499,748	94%	56,367	7%	37,922	7%	269,000	175,000
1992	1,104,988	1,014,635	1,023,516	93%	933,316	92%	79,699	7%	81,319	8%	300,000	248,000
1993	1,154,557	1,039,314	1,047,350	91%	925,530	89%	105,237	9%	113,784	11%	312,000	269,000
1994	1,181,763	1,127,204	1,065,585	90%	986,372	88%	114,114	10%	140,832	12%	330,000	308,000

Appendix K:

Web Site

Living Resources

Pollution

Coastal Development

Transportation

Storms & Response

Information for the Continued Management

of the Gulf of Thailand

The Gulf of Thailand | Ongoing Projects | Glossary | About This Site | Links

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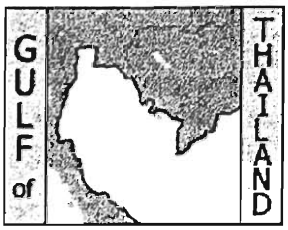
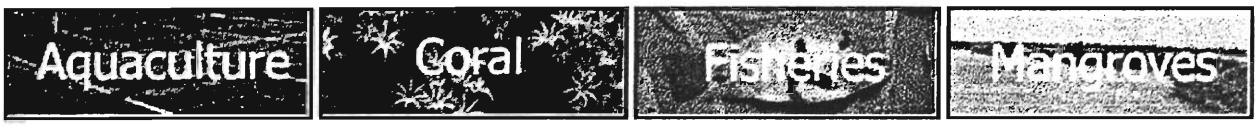
Questions or comments about this site should be e-mailed to gotwww@start.or.th

This page last updated on 24 February 1999.

Disclaimer: The political borders on the above map do not represent official boundaries, but merely offer approximate illustration of the territorial divisions of the region.



Living Resources



Home

Living Resources

Pollution

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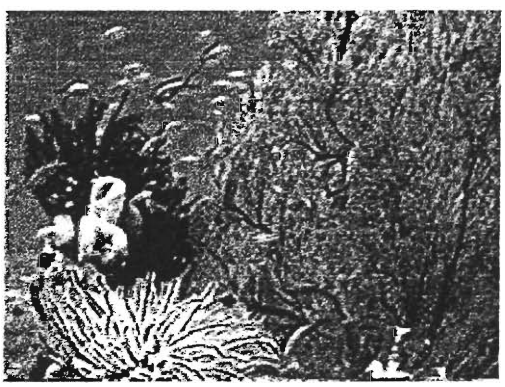
Transportation

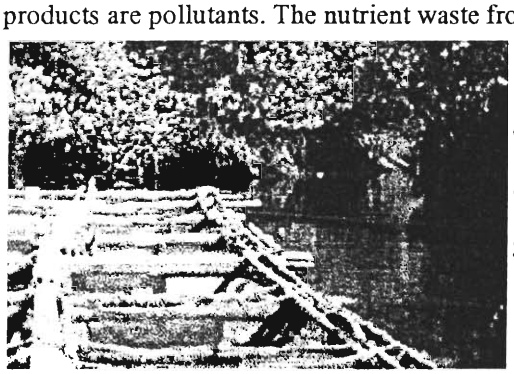
Storms

The Gulf of Thailand is a dynamic system with many intricate parts that closely interrelate. The most delicate of these parts are the many organisms that compose the Gulf's living resources. Changes in one part of the system can have extreme, unforeseen effects on other parts, and it is necessary to understand these relationships in order to preserve the Gulf's fragile balance of life.



Within the Gulf, there are a large number of species of fish and other organisms that are harvested by thousands upon thousands of fishermen to feed their own families and to sell for profit. These economically crucial fisheries are becoming endangered from a number of different causes. Fish stocks are being depleted from pollution, overfishing, and other environmentally dangerous fishing practices. Sustainable fishing policy is necessary to preserve these important resources.

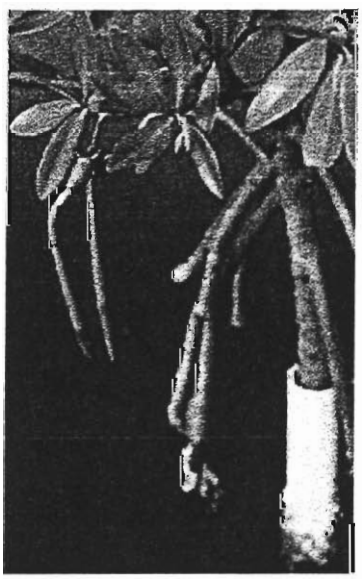
With the depletion of natural fishing stocks, aquaculture is becoming more and more widespread. While aquaculture sites are typically very productive during the first few years of operation, they cause a great drain on local nutrients, and their own waste products are pollutants. The nutrient waste from aquaculture can lead to widespread growth of algae, which can have dangerous consequences for local plants and animals, and even people who would eat shellfish grown in polluted areas.



Another result of the depletion of natural fishing stocks is that fishermen have begun using questionable and even illegal

fishing practices. These practices include the use of dynamite and cyanide to stun and kill fish. These practices offer great danger to other, delicate parts of the marine environment of the Gulf of Thailand, especially the coral reefs.

Coral reefs represent another part of the ecosystem that is in danger of becoming dangerously depleted. Coral are found only in warm, shallow waters; because of this and the nutrient value they possess, coral reefs in the Gulf of Thailand are a haven to many species of small fish and other organisms. These coral reefs are very sensitive to pollution, and are under threat from certain fishing techniques.



Mangroves are a special type of forest found only along tropical coastlines. These delicate environments are an important source of vital nutrients for many organisms, as well as a breeding ground for many marine animals, including crab, prawns, and shellfish. As such, mangroves are important to fisheries. Mangroves are especially sensitive to environmental change, and the rate of mangrove degradation along the Gulf is becoming alarmingly high. Aquaculture in particular is known to have very negative effects, and while natural rejuvenation of mangroves is possible, conditions must be appropriate for this rebirth to occur.

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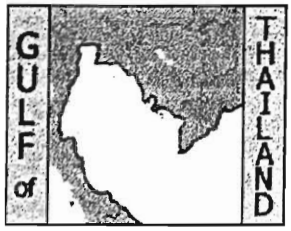

Aquaculture

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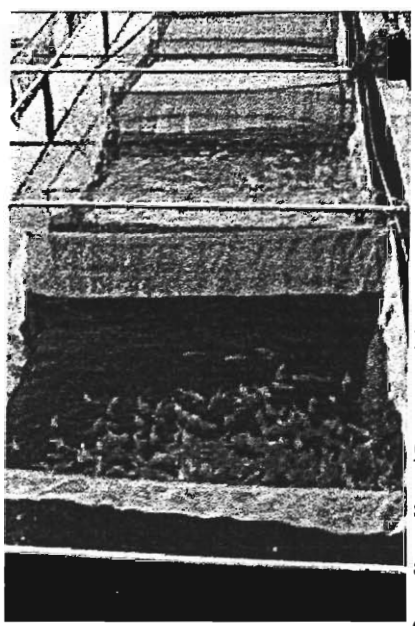
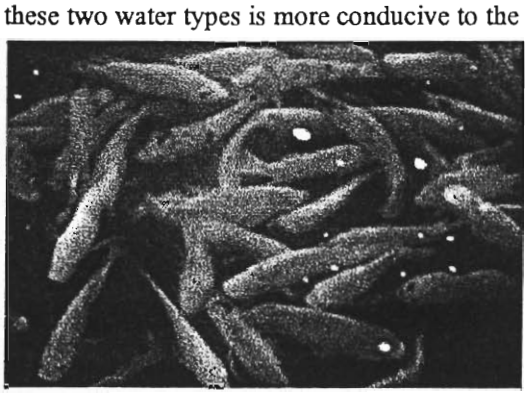
Aquaculture is the farming of the natural resources of water, such as fish or shellfish. Aquatic plants and animals grown through aquaculture are used for commercial and scientific purposes. Maritime farm animals are confined in earth ponds, barricaded coastal waters, and cages suspended in open waters.



Limited ocean resources along with increasing demand for high priced fresh fish products such as shrimp, crayfish, and prawns has led to the growing expansion of aquaculture in the Gulf of Thailand. Aquaculture is also used to supplement the natural supply of shrimp, shellfish and other species that have been depleted due to overfishing, destruction of the habitats of coastal species from increased human population along with economic and industrial development in coastal regions. Aquaculture farms are usually established along coastlines in or in estuaries.

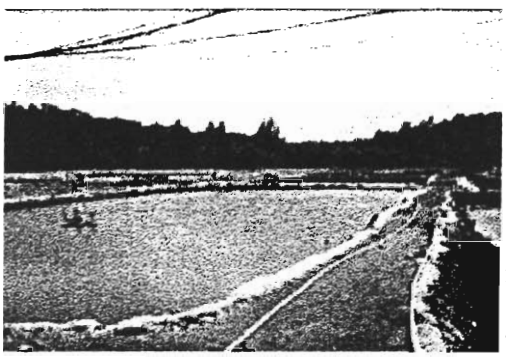
Estuaries and mangroves are particularly important sites for aquaculture. Mangroves naturally contain high levels of the nutrients necessary for aquaculture. Estuaries, where rivers and seas meet, contain salt water of the sea diluted with fresh water from the river. The combination of these two water types is more conducive to the growth of certain organisms than either type standing alone. High concentrations of plant nutrients are trapped in the circulating water, which also helps initiate production.



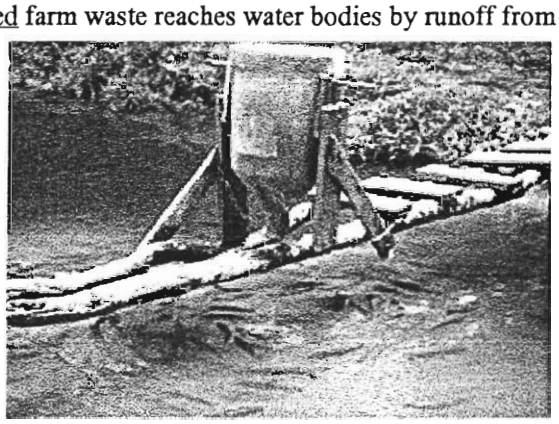
Aquaculture sites in estuaries are

extremely vulnerable to contamination. The mouth of a river, along with being a prime site for aquaculture, is often a promising site for urban development. Aquaculture sites located near the mouths of rivers tend to become exposed to high levels of sewage contamination and industrial waste. The same water circulation that traps the plant nutrients will also trap the high concentration of pollutants.

Aquaculture farmers will often build several small fish pond impoundments; however, it has been found that these smaller ponds have a greater affect on the environment than one large pond would. Multiple impoundments increase the total shoreline created. Aquaculture shoreline is also a fertile breeding ground for mosquitos, and increased shoreline leads to a higher density of mosquito larvae; these larvae can carry diseases such as malaria and lymphatic filariasis.



Aquaculture is often presented as a clean industry, but in reality aquaculture systems produce large amounts of polluting waste. This waste is similar to wastes from other systems of agriculture. Land based farm waste reaches water bodies by runoff from storms that cause waste lagoons to overflow, or by groundwater seepage. Aquaculture waste is often released directly, since fish farms are located directly in the water supply or because refuse is discharged into bodies of water.



Aquaculture waste is comprised of uneaten fish feed excretory waste; this refuse is a source of nutrient pollution. High nutrient levels can stimulate blooms of phytoplankton or algae populations. When algae die in large numbers, the consequent degradation reduces oxygen levels in the water, which in turn stresses or kills fish and other organisms. Blooms of toxic algae produce large fish kills, which leads to contamination of shellfish; this is referred to as a red tide. This tainting of shellfish poses potential health hazards to humans.

Cage and net-pen aquaculture systems have a high potential for causing environmental degradation. This is because these systems are in relatively open waters and the untreated waste is discharged directly. Pond and tank systems allow for better control of waste discharge; high concentrations of waste are discharged only during cleaning and harvesting.

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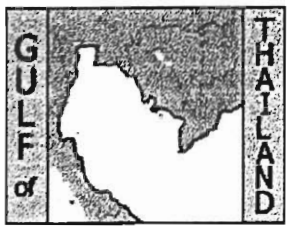

Coral

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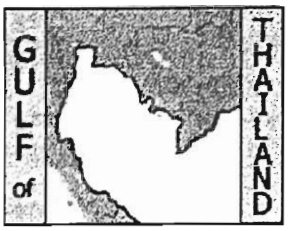
Coral reefs are only found in warm, shallow waters; most are found in tropical oceans near the equator. A reef is made of many indvidual coral. When coral dies, it leaves behind a calcium carbonate skeleton. Young coral attach themselves to this skeleton, and the growth cycle begins again.

The warm water of the Gulf of Thailand and the available supply of food make coral reef communities in the Gulf a natural haven for sea creatures. The bush-like shape of some species of coral offers many nooks and crannies for small fish looking to hide from larger predators. Because of this, many species of tropical fish depend on coral reefs for protection.

There are many threats to coral reefs, including unsustainable fishing practices and pollutants in runoff water. An example of these harmful fishing practices is cyanide fishing, which has become common in Southeast Asia. Fishermen inject cyanide into reef areas where the fish are found. The cyanide stuns and disorients the fish in the reef. The fishermen then break apart the coral in order to capture the fish.

Another problem for coral arises when silt from eroded soil in runoff water blocks sunlight. Without sunlight, photosynthesis can not occur. Under those conditions, coral are do not receive necessary nourishment to survive, and the reefs are unable to grow any further.



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The fishing industry is important to each of the nations surrounding the Gulf of Thailand. The summed catch of fish brought in by the littoral states of the Gulf was nearly 6 million tons in 1997. Thailand alone amassed over 3 million tons. Marine fish exports account for over $5 billion of the income for Southeast Asian countries each year.

- Fisheries statistics for Malaysia and Thailand, 1990-1994
- Table of fishing gear utilized in the Gulf of Thailand.

Because of the economic importance of fishing, each country surrounding the Gulf has taken steps to safeguard the fishing rights of its own nationals. However, since the early 1980's, fishing boundaries have allegedly been violated and a number of conflicts have arisen. There has also been some discord over the catching of migratory fish. There are some species of fish that can be harvested well before they enter the reproductive stage of their life cycle. When such fish are harvested by one group or nation premature to spawning, the fish supply becomes unnecessarily depleted, which can result in serious economic consequences for all involved.

Overfishing has been another serious problem for the Gulf of Thailand in recent years. The amount of daytime fishing catch per unit decreased from 290 kg/hour in 1963 to 50 kg/hr in 1993. There was also a 63% decrease in nighttime fishing catch in terms of weight per hour between 1976 and 1995. Due to overfishing and the resulting decreased availability of fish, competition issues within the fishing industry, and consequently conflicts, have become more frequent and more intense. Fishermen utilize more powerful tools in order to catch more fish; many of these tools are illegal. Some examples of this include motorized push netters and cyanide fishing, which are harmful to coral and mangroves. The use of such fishing techniques can result in lasting deleterious impact to the marine environment.

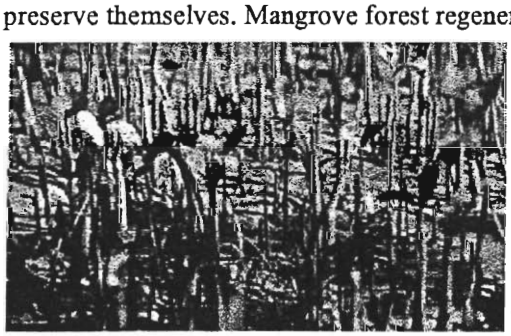
Mangroves

Mangroves are a specific type of forest that is found along coastlines and river mouths which are influenced by tides. The environment needed to sustain mangroves requires warm oceanic currents, so mangroves are only found near the equator.

- GIS Image of mangrove distribution around the Gulf, 1993 (113kb)
- GIS Image of mangrove distribution around the Gulf, 1984 (21kb)
- GIS Image of mangrove distribution around the Gulf, 1990 (20kb)
- GIS Image of mangrove distribution around the Gulf, 1996 (20kb)

Mangrove forests have both ecological and economic functions. There are many organisms within the area of the Gulf of Thailand that are dependent on the existence of mangrove forests. Mangrove populated waters are known to function as a nursery ground for all sorts of aquatic creatures such as fish, prawns, shell fish and different members of the crab family, and thus have a high economic value.

Under normal circumstances, mangrove forests are able to naturally renew and preserve themselves. Mangrove forest regeneration, through the budding of sprouts, is



regulated by the condition of the surroundings. If budding sprouts fall during low tide, they are able to get a firm hold in the mud, which provides for steady growth. However, if budding sprouts fall during high tide, they float along with the current and have a slow growth.

This natural rejuvenation of mangrove forests can guarantee their own conservation. However, due

to erosion, decrease of water quality, and the increase of construction in the coastal regions, mangrove forests within the Gulf of Thailand are depleting. This depletion has led to the development and implementation of several methods of manmade regeneration of the mangroves.

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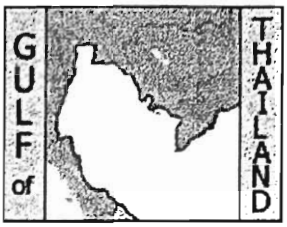

Pollution

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Pollution is becoming an ever increasing global problem, and the Gulf of Thailand is not at all immune to these environmental hazards. Pollution enters the Gulf through a number of means, including inflowing water from entering rivers, from shipboard sources, and originating from the Gulf itself.

Land-based pollutants are the most significant source of pollution in the Gulf of Thailand. These can include industrial by-products and urban and agricultural waste, all of which can be quite harmful to the marine life of the Gulf.

Petroleum is found in great supply in the Gulf. While it creates a lucrative business that is beneficial for both the producers and consumers of petroleum products, petroleum related pollution is becoming a severe problem in the Gulf of Thailand. Most petroleum pollution comes from petroleum spills, although there is also some pollution that is ambient to petroleum mining.

Another substance responsible for pollution in the Gulf is mercury. While some mercury is released into the waters of the Gulf through seepage from the ocean floor, it is not this mercury that is a significant problem. Industrial mercury, released in much higher concentrations, presents a much higher danger to the many organisms of the Gulf of Thailand. There has also been some controversy as to whether or not mercury pollution is related to petroleum production.

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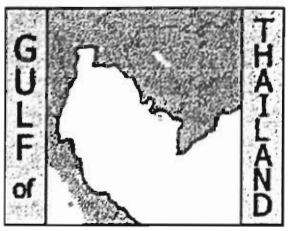

Land-Based Pollution

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Land based pollution is derived mainly from agricultural and industrial activities, but also includes domestic sewage. Pollution is discharged directly into the sea, or enters the coastal waters through rivers. Point sources of pollution are sources that can be identified to one location, such as industrial and sewage treatment plants. Point sources account only for a fraction of the land-based sources of pollution affecting coastal and marine environments.

Non-point sources, which are harder to identify, include urban storm water runoff and overflow discharges, as well as runoff from forest and agriculture. Pollution sources can be located far from coastal areas and still have an impact. Pollution from distant sources can also enter into the marine environment through atmospheric deposition.

- GIS image of the coastal basins surrounding the Gulf (135Kb)

The Biological Oxygen Demand (BOD) of a specific environment refers to the amount of oxygen needed by all organisms to survive. Within the Gulf of Thailand, the dissolved oxygen level is decreasing because of the influx of domestic waste. This is deteriorating the quality of the coastal waters and is expected to increase over the next years, because domestic waste is proportionate to the population size.

- GIS image of population distribution, 1998 (171Kb)
- GIS image of factory distribution around the Gulf of Thailand(169Kb)

Industrial development along the Gulf of Thailand has been increasing over the past few years. Industries located in coastal areas include textile and petrochemical plants and oil refineries. Industrial estates found along the eastern seaboard include Map Ta Phut, Laem Chabang, and Bang Poo. Map Ta Phut houses petrochemical plants and a fertilizer complex. Agro-based industries are found in Laem Chabang; there are a few oil refineries nearby. The BOD loads of industrial estates are dependent on the wastewater treatment. Pollutants discharged from these estates include organic matter, along with toxic and chemical substances. The construction of industrial estates along the southern

coast is an early indication that there will be an increase of industrial waste in that region. The industrial wastes discharged from plants along the river often find their way into the Gulf.

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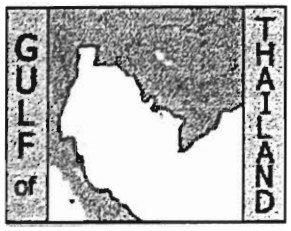

Mercury

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Unocal Mercury Scandal

Mercury, also known as quicksilver, is a white poisonous metallic element. Mercury, one of two elements that occurs naturally in liquid form, is found in the earth's crust at an average density of 0.08 grams per ton of rock. Natural geologic deposits either occur in isolated drops or in fluid masses near hot springs or volcanoes. Mercury can also be brought to the earth by rainwater. Toxic emissions such as from coal combustion and solid waste incineration produce mercury that is released into the atmosphere. The mercury content in the atmosphere of oceans has doubled since the 19th century.

Mercury that is found in the atmosphere is 97% elemental mercury; another form, methylmercury, which can be lethal, comprises 95-99% of the mercury found in rivers and lakes. These high levels are from industrial wastes settling at the bottom, of the lakes and rivers. Fish can become insensitive to these deposits as they are able to build up a level of mercury tolerance in their tissues. The level of mercury allowed by this tolerance is highly toxic to humans and other living entities who would consume these fish.

Mercury poisoning is cause by inhalation, ingestion and absorption of mercury. In humans, the central nervous system or brain is affected. The first signs of exposure are loss of sensation to the extremities; this is followed by slurred speech, tunnel vision, loss of hearing, convulsions, and eventually death. The effects of mercury poisoning were first understood in the 1970's in Southern Japan. Chisso Corporation dumped tons of mercury into the Minamata Bay, contaminating the local fish. Over 2900 people suffered severe injuries, a third of which were fatal, and it is further estimated that at least 10,000 individuals were permanently harmed.

Ocean fish are not as susceptible to mercury build-up in their tissues. It is suggested that this is because the ocean is not acidic, and mercury levels are generally

higher in acidic waters. Fresh water fish are quite susceptible and the contamination of these fish poses a serious risk to any who would consume them.

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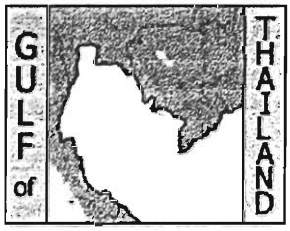

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Unocal Mercury Scandal

There has been great controversy over the issue of mercury pollution in the Gulf of Thailand in the last several years. In 1994, a group of researchers found high levels of mercury in fish samples taken from the vicinity of a Unocal gas platform. Questions then arose as to whether or not the activity at the petroleum platform was responsible for these elevated mercury levels. Many studies have been undertaken to determine the true cause of the high mercury levels reportedly found in the fish.

The root of the controversy comes in the methods that are undertaken to do the actual testing of fish and water for mercury contamination. The sampling of fish presents several difficulties to quality control. First, in order to be tested, the fish must be caught. There is almost no way to be certain that a truly representative sampling of fish has been caught. Also, fish and water are dynamic in nature; it is nearly impossible to tell exactly how much time a given fish or amount of water has spent in the vicinity of the petroleum platform.

Another source of controversy is the actual testing process. Even when mercury is present in potentially fatal concentrations, the actual amount in the water is extremely small, typically measured on the scale of nanograms. Testing for mercury levels this low is a particularly delicate process, and according to some researchers, it is a process that is easily corruptible. Ideally, such testing will be carried out in a mercury lab. However, such labs are expensive to build and maintain.

Also, some researchers recommend that fish not be tested in the same lab as water samples. Concentrations of mercury present in contaminated fish will typically be nearly 1000 times those found in water. When fish and water samples are tested in the same lab, the results can become tainted.

Unocal sponsored the initial investigation into the cause of the mercury contaminated fish. However, Unocal was not informed that the results would be publicized without screening, and a great scandal ensued. The testing is now under the authority of the Thai government, though Unocal and another petroleum company, Total, continue to conduct independent tests.

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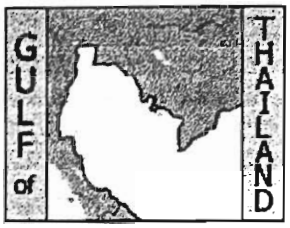

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Petroleum is among the world's most coveted resources, and the Gulf of Thailand is known to be a rich source of this lucrative substance. Although the Gulf's littoral states lack the equipment and capital necessary to fully exploit the petroleum supply in their own territories, they have entered into agreements with each other and financial arrangements with corporations from other nations to harvest the petroleum supply.

The exploitation of petroleum in the Gulf is lucrative to the nations and organizations involved; however, there are some significant environmental consequences associated with petroleum production. Not only are there concerns about petroleum itself being released into the Gulf, but in recent years there has been great concern and controversy over the possibility of mercury pollution being associated with petroleum production. Petroleum related pollution can have a severe detrimental impact on the living resources in any marine environment, and as such there is great need for the development of sustainable policy with regards to the exploitation of petroleum resources.

Petroleum hydrocarbon pollution of the marine environment is a global problem. Petroleum pollution arises mainly from oil and gas production activities. There are a number of factors for potential environmental risks relating to oil and gas development in the Gulf of Thailand. Petroleum hydrocarbon contamination in the Gulf has risen with the increased with industrial development in coastal regions. PHC concentration levels vary with distance from the shore. PHC levels are recorded to be much higher inland than offshore. Also, PHC levels are higher near fishing ports and areas of shipping activities, because they are high risk areas for oil leakage.

There have been frequent oil spills in Thailand's territorial waters. These oil spills represent the greatest source of petroleum related pollution in Thai territory. A list of large oil spill accidents that have occurred in the Gulf in the past twenty-five years can be found in the table below. As a consequence of the damage from oil spills, all oil

companies in Thai territory are required to carry out environmental impact studies before, during, and after any activity they conduct in the Gulf.

Date	Oil type	Volume	Location	Cause
1973	J.P. 4	Unknown	Chonburi province	Fire tanker
1979	Crude Oil	300 tonnes	Chonburi province	Fire tanker
6Mar1994	Diesel	400 tonnes	Chonburi province	Collision of tanker and container
30Oct1996	Crude Oil	160 tonnes	Ravong province	Leaking during loading

In the event of small spillages, supply boats can quickly spray the area with chemicals designed to break up the oil and minimize environmental impact. Larger spills, however, require the notification of Tiered Area Response Cooperation (TARC), located in Singapore, in order to initiate necessary emergency measures.

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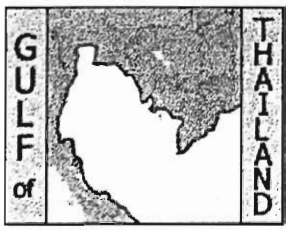

Coastal Development

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As human populations grow and expand, more territory is developed and prepared for human use, and coastal regions are often prime sites for industrial or other man-made installations. Construction and urban development must be handled carefully, however, to keep from having an irreversibly harmful impact on the delicate coastal environment.

Erosion is a natural geomorphologic process by which land based sediment is carried through rivers and streams into large bodies of water. Erosion is often accelerated by urban development and construction, and erosion has also become a means through which upland pollutants are introduced into the marine environment.

Tourism is a growing industry around the Gulf of Thailand. Thousands of tourists come to the Gulf every year to enjoy its beautiful beaches and exotic marine life like the many colorful coral reefs and unusual fish that they harbor. The coast must be maintained if the tourist industry is to continue to draw people to visit the Gulf, and at the same time, development for tourism must not be allowed to damage the fragile marine environments of the Gulf.

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Erosion

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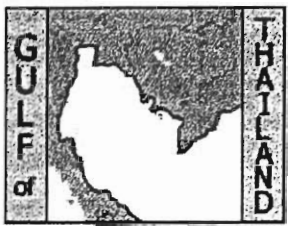
Millions of tons of soils and other weathered particulate geological matter are washed into the world's many bodies of water annually through erosion. While erosion is a natural geomorphologic process, it has become an agent through which urban pollutants are released into removed environments. Erosion is also unnaturally accelerated by urban development along coastlines.

- GIS image of coastal basins around the Gulf (135Kb)
- GIS coastal map, including cities, of the Gulf (103Kb)

There are several different aspects of erosion that are harmful to the marine environment. One of these aspects is the introduction of concentrated amounts of particulate matter into the water. Excessive sediment loading brought by erosion can result in the smothering of marine life, the destruction of spawning areas and food sources, and the blocking of light essential for plant photosynthesis. These things each happen whether the erosion occurs naturally or is artificially accelerated.

With the inception of industrial and urban growth and coastal development, there are added dangers to the marine environment from erosion. These dangers come from the specific particulate matter being carried into the water. Erosion can carry waste and sewage from urban and rural locations into bodies of water, where the waste can act as a nutrient stimulant to dangerous algae growth. Erosion can also serve as an avenue for pollutants from traffic, air pollution, litter accumulation, and construction sites to be introduced into the marine environment.



Urban Development

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The population and industrialization of each country around the Gulf is increasing, and correspondingly, urban development is expanding. With this expansion, however, comes an intrusion of certain elements into the marine environment. Not only does urban development accelerate erosion, but it also leads to greater amounts of land-based pollutants being introduced into the ecosystem of the Gulf of Thailand. The effects of these pollutants must be carefully monitored so that they are not permanently damaging to the living resources of the Gulf.

- GIS image of population distribution, 1998 (171Kb)
- GIS coastal map, including cities, of the Gulf (103Kb)
- GIS image of factory distribution (169Kb)

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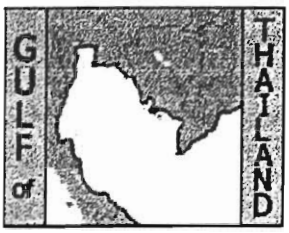

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Thailand has become one of the leading tourism destinations in the Asian-Pacific region. The number of foreign tourists visiting Thailand has increased over the past years, from 1.2 million arrivals in 1975, to approximately 7 million in 1995. Thailand's main attractions are either nature or historical sites, and its culture and people. The management capacities in major tourist cities have been upgraded to accommodate the increase in pollution and garbage. In order for tourism development in other cities to be successful, town planning and appropriate management must be introduced.

Human impact on the environment must be taken into consideration. Tourism resources along the coastlines, specifically marine ecology, are notably fragile; and education of tourists is an important way to protect the environment. Construction of new tourist attractions is also effecting the environment. Construction of new hotels along the southern coast and eastern seaboard are already in development. Chantburi, Chachoengsao, Chonburi, Trat, and Hua Hin are a few of the cities that have hotels opening by the end of this year. The impact that the construction, and the influx of more tourists, will have on the environment is unknown.

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The Southeast Asian region has historically relied heavily on marine transport, which has been developed not only for trade but also for communications, administration and political control. Southeast Asia requires an effective system of transport to move people and goods within the region as well as link the region to the rest of the world. Southeast Asia is a major producer of primary commodities including 80% of world's rubber and palm oil, 60% of coconut and pepper, 70% of tin and large quantities of rice, coffee, sugar, tropical hardwood, crude oil and other primary products. The majority of this external trade is transported by sea.

Maritime transport plays an important role for imports as well as exports. In the agricultural sector, the expansion of farming requires fertilizers that need to be shipped in from foreign sources. If the fertilizers are produced domestically, they need to be distributed to the farming communities across the country. Therefore, the demand for shipping will increase as the growth of population, urbanization and greater industrial development. The greater spread of social and economic activities will also generate a higher demand for shipping services.

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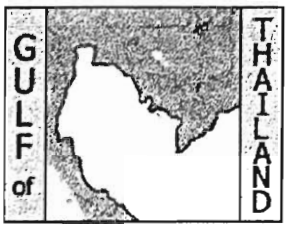

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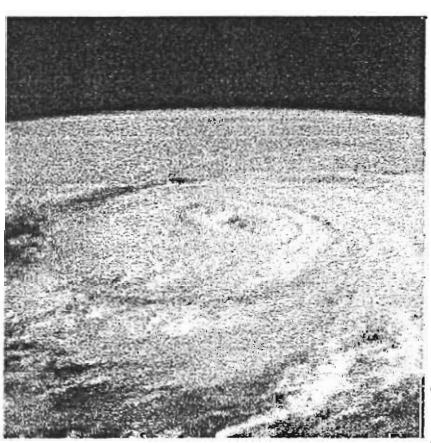
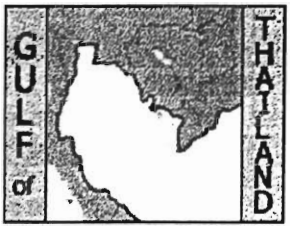
The Gulf of Thailand is subject to a highly complex tropical weather system that is mostly defined by the Southeast Asian monsoon. The meteorology behind this monsoon is not yet entirely understood, though scientists and researchers are learning more every year. While the seasonal weather of alternating rainy and dry seasons in the Gulf do not give rise to as many tropical storms as are experienced elsewhere in the world, they are not impossible.

Under certain conditions, tropical storms can develop and intensify to become one of the deadliest natural forces on the planet. Once the storm's winds reach speeds of greater than 73 mph, the storm takes on a different name, depending on where it originated. In the Western Pacific, these fierce storms are known as typhoons.



Although the Gulf of Thailand does not experience severe weather such as typhoons as often as other place in the world, such extreme weather is not only possible, but all the more dangerous because of their infrequency. Residents of this region may be lulled into a false sense of security, which may leave them unprepared when the next fierce tropical storm does strike. The keys to minimizing loss of life in the event of a weather related or other disaster are emergency planning and response.



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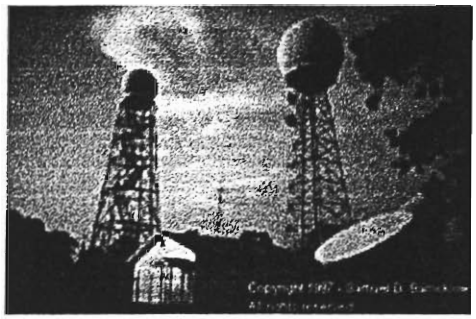
The weather in Southeast Asia is most heavily influenced by annual monsoon circulation. While the word "monsoon" is usually associated with heavy rains, monsoons are actually cycles of wind circulation, with a winter season that is typically dry and a summer season that is wet. During this wet season, the monsoon has dormant and active phases; it is during these active phases that the fierce rains for which monsoons are best known occur.

While the exact cause of monsoons is unknown, it is known that there are at least two significant contributors to monsoon circulation. One is north-south shifting of the intertropical convergence zone (ITCZ), and the other is associated with the differences in solar heating of land and water. The intertropical convergence zone, which parallels the heat equator, is a discontinuous series of thunderstorms that occurs where trade winds from the northern and southern hemispheres meet. The ITCZ changes latitude as the high temperature line of solar heating shifts, and this northward migration typically incites the rainy season. The two largest monsoons in the world are located over Southeast Asia and sub-Saharan Africa.

The rainy season for monsoons usually begins several weeks prior to the summer solstice and typically ends just after the autumnal equinox. The length and intensity of this rainy season vary from year to year, and droughts are possible.

Modern forecasting technology is sufficient that conditions conducive to the formation of tropical storms are apparent to weather monitoring centers at the moment of their inception. Although it is impossible to predict exactly the path that a tropical storm



will follow, technology and the results of scientific research allow meteorologists to make reasonably accurate predictions and follow the actual path of the storm closely. Because of the number of factors involved in tropical storms gaining intensity, they are still not fully understood, but with each successive storm, meteorologists and researchers are coming closer to fully understanding these intense forces of nature.

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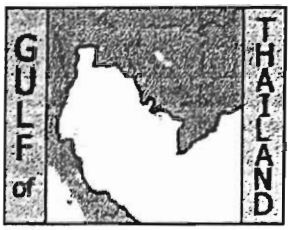

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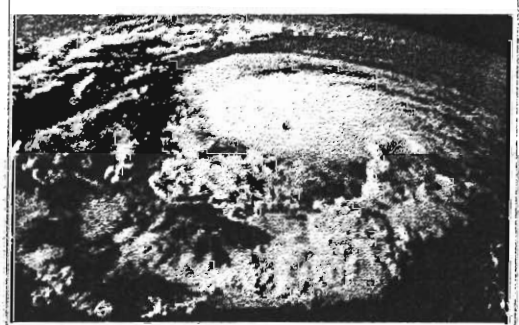
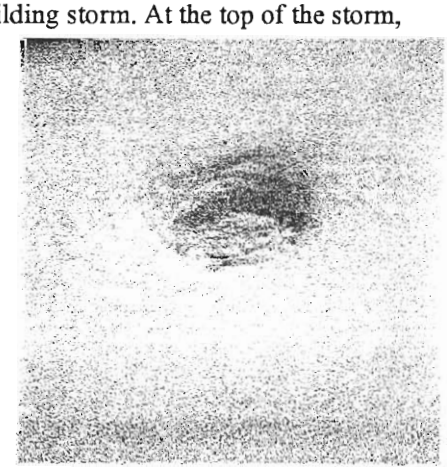
Whether it is called a hurricane, a cyclone, or a typhoon, a fierce tropical storm with winds of over 74 mph can be one of nature's deadliest and most destructive forces. Typhoons, as they are known in the Western Pacific, develop from tropical storms, which always initially form over open water.



There have been seven tropical cyclones since 1963 with death tolls of more than 10,000. The most severe of these, a horrific storm that battered Bangladesh, has left an unknown total number of fatalities, though most estimates place it at around 300,000.

Tropical storms have their foundation in tropical waves, areas of concentrated low atmospheric pressure, that develop their own closed circulation. At this time, the weather phenomenon is referred to as a tropical depression. The storm continues to develop with clouds building higher into the atmosphere and pressure dropping further, which thereby attracts warm, humid air near the surface of the water.

Coriolis effects from the earth's rotation cause these low altitude winds to begin rotating around the low pressure center of the building storm. At the top of the storm, clouds continue to build, sometimes reaching altitudes of 7 to 9 miles above the ocean surface. At these upper heights, the rotation from the lower winds causes the clouds to close in on themselves in a spiral, creating the calm inner section known as the 'eye'.



If conditions are right, the storm is able to

intensify and fuel itself. Heat and humidity from the ocean water are drawn into the center of the storm by the low pressure created by the spiraling winds. Convection allows this warm air to rise rapidly, until it condenses as it joins the wall of clouds around the eye. The process of condensation releases energy into the surrounding winds, which allows them to become increasingly violent. Some energy is released into the outlying winds, but most of the energy is retained in the eyewall, making it the most fierce and destructive part of the hurricane. The eyewall is typically found in a radius 24 kilometers from the center of the eye.

The intense winds and rain are not the only danger imposed by tropical storms. Equally dangerous are the storm surges that come in their wake. Storm surges are particularly destructive to areas where the coast is at a low altitude relative to sea level, and to estuaries of rivers that are also prone to flooding. Typhoon force winds are capable of creating surges that are often up to 15 meters high; these can be devastating to low-lying areas that have, for whatever reason, failed to evacuate.

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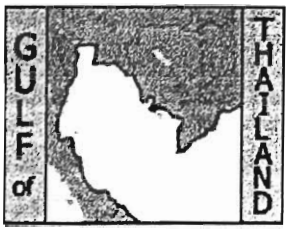

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With modern satellite technology, hurricane centers and other weather conscious organizations are aware of tropical storms from nearly the moment of their inception. Since it typically takes days for a tropical storm to develop into a full-blown hurricane, and modern forecasting technology is reasonably accurate in its prediction of the path that these storms will follow, areas that are in danger of being hit by one of these storms usually have several days' time with which to prepare.

These few days are crucial to minimize storm losses. The first essential step that must be taken is communication. Each country should have an established system for notifying its citizens of the impending danger, and should make known to its citizens recommended precautions they should take.

Typhoons are rare in the Gulf of Thailand, but they are not impossible. This infrequency adds to their danger, as the people of the coastal states are lulled into a false sense of security. This makes the people more likely to disregard the seriousness of typhoon watches and warnings that may be announced.

Each country is responsible for the development and maintenance of emergency response teams to deal with disasters. There are also a number of international emergency response organizations, including the International Red Cross/ Red Crescent Federation.

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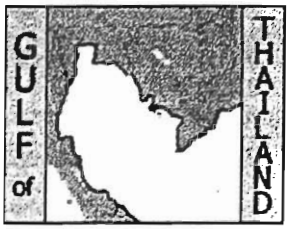

Law of the Sea

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In 1982, representatives from all the member states of the United Nations converged at Montego Bay for the Convention on the Law of the Sea. Their intention was to form comprehensive legislation for the governing of the world's oceans. It took over a decade for all points to be sufficiently refined for ratification. The Law of the Sea was finally entered unto force in 1994.

Actual text of The United Nations Convention on the Law of the Sea

Provisions for division of territory

International Sea-Bed Authority

The Convention as it applies to the Gulf

Provisions for marine scientific research

Provisions for disadvantaged nations

Each nation that has a length of coastline on one or more of the world's oceans, referred to as a Coastal State, is granted full sovereignty over a territorial sea that extends 12 nautical miles beyond the low tide line on its coast. A complicated yet comprehensive system was drawn up for determining the exact geometry of territorial seas; difficult cases, for example, include nations whose territory extends to offshore islands and archipelagic nations.

The Law of the Sea further provides for Exclusive Economic Zones, regions that extend up to 200 nautical miles from the end of territorial seas. Coastal States have exclusive privileges towards the exploration and exploitation of all resources, living and non-living, in their Exclusive Economic Zones. They may enter into financial agreements with other States or corporations from other States regarding the collection of those resources. Ships from all other nations have the right to pass through any Exclusive Economic Zone, as long as their purposes are peaceful and they are engaged only in innocent passage, which is rigorously defined by the convention. Other States

also have the right to lay submarine cables and pipelines in accordance with certain internationally accepted guidelines and with respect to the rights of the Coastal State.

In cases where the 200-mile extension of one Coastal State overlaps that of another, provisions are made for settling the overlapping claims. Delimitation, or sharing of territory, is the Convention's most highly recommended method of resolution. In absence of the formation of such an agreement, a line formed at the median is suggested by the Convention, though any agreement reached peacefully by the States involved is acceptable, including agreements that were reached prior to the signing of the Convention, and agreements based in historical tradition. Despite these stipulations, there is still much conflict around the world over the true divisions of overlapping Exclusive Economic Zones. This is a particularly sensitive issue in Southeast Asia.

All territory that does not belong to either a territorial sea or an Exclusive Economic Zone is considered part of the Area. The waters of the Area are known as the High Seas. All nations have the right of passage and the right to conduct marine scientific research within the Area; provisions are made for all nations to share in the exploration and exploitation of the biological and mineral resources of the Area. Accordingly, all nations are expected to share in the duty of preserving and protecting the Area, and stipulations are made for sustaining global oceanic health.

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The Convention on the Law of the Sea establishes a governing body for oceanic matters in the form of the International Sea-Bed Authority. The Authority consists of two legislative bodies. The first, the Assembly, contains one member from each Nation State of the United Nations. The second, the Council, is a 36-member organization elected by the Assembly, with its members representing both the economic and geographic interests of the world. The Authority's executive branch is composed of a Secretariat and Staff. The International Tribunal for the Law of the Sea represents and interprets judicial concerns. All international maritime disputes, if not resolved peacefully and expeditiously by the nations party to the dispute, come under the jurisdiction of the Authority.

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The Gulf of Thailand is of such geography that it contains no water that is not part of at least one of the Gulf's littoral state's territorial seas or economic zones. As such, the Gulf of Thailand is considered by the Convention to be a semi-enclosed sea, as defined by Article 122. The Convention further stipulates some regulations and guidelines for cooperation between littoral states of semi-enclosed seas as follows: "Co-operation of States bordering enclosed or semi-enclosed seas States bordering an enclosed or semi-enclosed sea should cooperate with each other in the exercise of their rights and in the performance of their duties under this Convention. To this end they shall endeavour, directly or through an appropriate regional organization: (a) to co-ordinate the management, conservation, exploration and exploitation of the living resources of the sea; (b) to co-ordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment; (c) to co-ordinate their scientific research policies and undertake where appropriate joint programmes of scientific research in the area; (d) to invite, as appropriate, other interested States or international organizations to co-operate with them in furtherance of the provisions of this article."

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There are also provisions made by the Convention for the sharing of research and marine technology, while still maintaining the rights of the nations, organizations, or people who collect and develop and proprietary data. There are regulations for the registration and duties of ships, the policing of the world's oceans, and for civil and criminal proceedings arising from alleged maritime infringements. Stipulations are made for the duties of ships and nations in the event of a maritime casualty, such as the collision of two ships or of one ship with an iceberg, particularly if such collisions will result in imminent loss of life or potential long-term environmental damage.

Provisions are also made for the world's disadvantaged nations, giving access to fertile fishing grounds to those nations that are economically disadvantaged, as well as making allowances for the sharing of marine technology and research to underdeveloped countries, and guaranteeing rights of access to landlocked nations. As signatories to the Convention, Thailand, Vietnam, and Malaysia each have a duty to uphold all of these proclamations, suggestions, stipulations, and guidelines.

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A

Algorithm - any mechanical or recursive computational procedure.

Aquaculture - The farming of sea organisms, such as fish or shrimp, for human use.

Archipelagic - Composed of a group of islands.

Autumnal Equinox - *see Equinox*

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B

Bathymetry - The measurement of the depth of large bodies of water.

Biological Oxygen Demand (BOD) - the amount of oxygen needed by the organisms living in a given area of water.

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C

Cartography - the art or technique of making maps.

Coriolis effect - effects relating to motion from rotation of the earth.

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D

Dynamic - Characterized by or tending to continual change and advance.

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E

Elephantiasis - Usually caused by filariasis, it results in chronic and extreme hardening and enlarging of flesh; it received its name because the affected area appears similar to elephant hide.

Equinox - An equinox occurs when the ecliptic orbit of the Earth intersects with the celestial equator; at equinox, the length of day and night are approximately equal. The vernal equinox occurs in mid March, and the autumnal equinox takes place in mid September.

Estuary - The part of the wide lower course of a river where its current is met by the tides, or an arm of the sea that extends inland to meet the mouth of a river.

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F

Fauna - A collective word for all of the animals of a given region.

Filariasis - Infestation of the lymph glands with one of several parasitic nematode worms; filariasis results in inflammation of the lymph glands and elephantiasis.

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G

Geomorphological - A process that brings about the evolution or change of land. Erosion is geomorphological.

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H

Heat Equator - Location of the highest average yearly temperatures; the heat equator is located about ten degrees north of the geographic equator.

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I

Impoundment - A reservoir built to retain water, and often also marine dwelling creatures.

Innocent Passage - A ship is engaged in innocent passage when it is passing through with peaceful intent, stopping only in the event of an emergency. The following activities violate innocent passage: making threats, attacks, spying, smuggling, fishing, and marine scientific research.

Intertropical Convergence Zone (ITCZ) - a discontinuous line of thunderstorms located near the equator, between the trade winds from the northern and southern hemispheres.

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J

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K

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L

Latitude - The angular distance north or south of the geographic equator.

Littoral - Of or existing on a shore. A littoral state of a body of water is a state which shares coastline with that body of water.

Longitude - The angular distance east or west of the prime meridian.

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M

Mangrove - Various tropical trees or shrubs that form dense thickets along tidal shores.

Methylmercury - a toxic form of mercury that is organic; a methylmercury molecule has one carbon atom, three hydrogen atoms, and one mercury atom.

Monsoon - A pressure and wind system that influences large climatic regions and reverses seasonally.

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N

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O

Organism - Any living entity.

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P

Particulate - Formed of separate, small pieces of matter.

Petrohydrocarbons -

Photosynthesis - The process by which chlorophyll containing plants convert light from the sun to chemical energy.

Phytoplankton - Minute, floating aquatic plants.

Pollutant - any gaseous, chemical, or organic waste that contaminates air, soil, or water.

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R

Red tide - Ocean water that looks red because of the concentration of red, single- celled plant like organisms in the water. In the case of a red tide, the concentration of these organisms is high enough to be fatal to fish.

Rejuvenation - Literally, to become young again; rejuvenation of forests implies the restoration of young, healthy plants that are able to help the forest maintain itself at sustainable levels.

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S

Salinity - A measure of the amount of salt in the water.

Solstice - A solstice occurs when the earth is at one of the extreme points in its rotation. The summer solstice marks the point when the earth is closest to the sun, and the winter

solstice occurs when the earth is at the furthest point from the sun in its orbit.

Stratosphere - The part of the atmosphere between the troposphere and the mesosphere, extending from a height of approximately 15 to 50 kilometers.

Sustainability - a sustainable condition is one that can be maintained or prolonged.

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T

Tropopause - A layer of the atmosphere; a boundary between the upper troposphere and the lower stratosphere that varies in altitude from 8 kilometers at the poles to 16 kilometers at the equator.

Troposphere - The lowest region of the atmosphere between the earth's surface and the tropopause.

Tsunami - A very large ocean wave caused by tectonic activity.

Typhoon - A small, intense tropical cyclone occurring in the Western Pacific.

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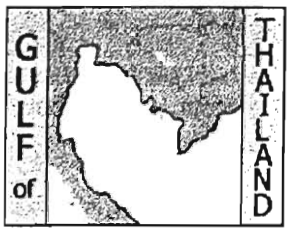

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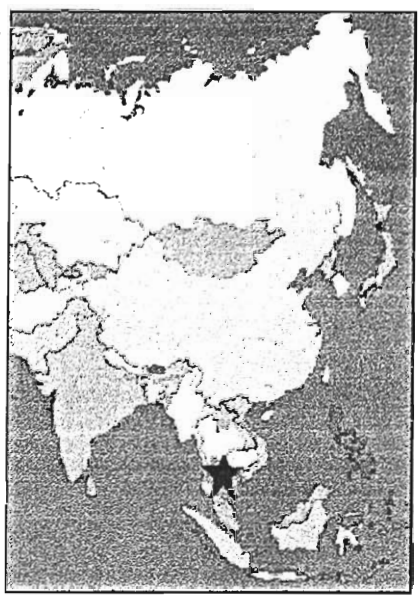
About the Gulf

The Gulf of Thailand is located in Southeast Asia, immediately to the west of the South China Sea. Its bordering nations, the Kingdom of Cambodia, Malaysia, the Kingdom of Thailand, and the Socialist Republic of Vietnam, have each historically profited from the Gulf's wealth of living and mineral resources. Millions of people derive their livelihoods from fish and petroleum harvested from the Gulf, and millions more are affected by changes in the environment of the Gulf, whether these changes are physical or political.



The Gulf of Thailand is a semi-enclosed sea, as defined by the Law of the Sea, that is approximately 400km by 800km, which covers an area of about 320,000 square kilometers. The Chao Phraya, Tha Chin, Mea Klong, and Bang Pakong rivers enter the gulf near its head; there are also many rivers that flow along the coast. The Gulf is part of the Sunda Shelf and is relatively shallow. The mean depth is 45m, and the maximum depth is 80m.

Country	Total Land Area (sq. km.)	Marine Area* (1000 sq. km.)	Total Coastline Length (km)	Population in 1996
Cambodia	181,040	42	354	10,861,218
Malaysia	329,750	139	2200	19,962,893
Thailand	514000	95	2631	58,851,357
Vietnam	329,560	N/A	1750	73,976,973

- GIS Coastal Map of the Gulf of Thailand (103Kb)

An in depth, systematic study on the oceanographic conditions of the Gulf was

completed by the NAGA Expedition . This expedition, which lasted from 1959-61, was sponsored by Thailand, South Vietnam and the United States of America. From this expedition, several physical properties were revealed about the Gulf. It was found that the Gulf is a two layered shallow water estuary. The low level salinity water of the Gulf is diluted from rain and the freshwater runoff that flows out of the Gulf at the surface. The high salinity, cool water flows into the Gulf from the South China Sea at the mouth. Monsoons, tidal currents and precipitation create circulation of those waters, which influences the salinity and turbidity of the Gulf. Monsoons also influence the surface currents, being clockwise during the southwest monsoon and counterclockwise during the northeast monsoon.

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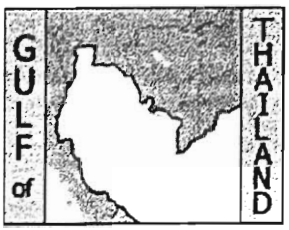

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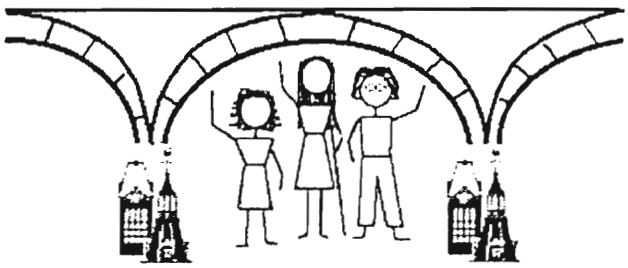

This web site was constructed as part of an Interactive Qualifying Project for Worcest Institute in Worcester, Massachusetts, USA. This IQP, Multimedia Presentations Regarding Thailand, was completed in residency at WPI's Bangkok Project Center during C-term of th academic year. This year was the Bangkok site's 10th year of operation.

The goal of this project was to bring together scientific and social data regarding curr the Gulf of Thailand. Information was collected from a wide range of sources and brough t several presentation formats, including this web site.

The IQP is an interdisciplinary project relating technology and society that brings tog from a variety of backgrounds. The three students on this team, Kristiferanne Dreyer, Virgi Justin Lin, are majoring in electrical engineering, mechanical engineering/humanities, and r respectively.

The students would like to thank their advisers, Prof. Richard Vaz and Karen Lemone guidance and their patience. Special thanks go to Dr. Anond Snidvongs and Dr. Jariya Boo START for their time, patience, and help. We would also like to thank Dr. Frances Lai, Ms Sirivivantnanon, Prof. Suraphol Sudara, Maarten Kuijper, and Prof. Manuwadi Hungsreug their expertise with us. A final thank you goes to all the people back home who patiently re pleas for feedback and read through our 'sample text' with great interest.

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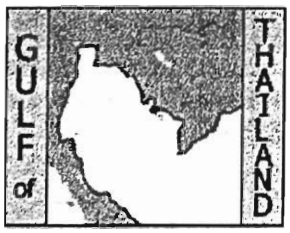


Links

Living Resources | Pollution | Coastal Development | Transportation | Storms | Related Organizations | Other

Living Resources links

Aquaculture

- AquaNIC - Aquaculture Network Information Center

Coral

- Coral Reef Information
- The Coral Reef NGO Directory

Fisheries

- Thai Government Department of Fisheries
- Aquatic Animals and Aquatic Plants of Thailand

Mangroves

- Mangrove Replenishment Initiative
- Global Mangrove Protection Web Site

Pollution links

Mercury

- Mercury Pollution Appears in a New Form

Petroleum

- About the Petroleum Authority of Thailand
- Abstract: "Petroleum Contamination of Coastal Waters of the Gulf of Thailand"

Coastal Development links

Tourism

- Amazing Thailand: Celebrate the Amazing River of Kings

Storm links Typhoons

- The Weather Channel - Hurricanes/Tropical Storm Index

Emergency Response

- United States Federal Emergency Management Agency

Related Organization links

- Gulf of Thailand Discussion Group
- SEA START RC
- START - SysTem for Analysis, Research and Training
- SEAPOL
- IOC Subcomission for the Western Pacific

- United States Global Change Research Information Office
- United States Global Change Research Program
- Center for International Earth Science Information Network at Columbia University
- NASA's Global Change Master Directory

Other links

- International Cooperative Study on the Gulf of Thailand
- Abstracts/Full Text of Some Articles Related to the Gulf of Thailand
- United Nations Oceans and Law of the Sea Homepage
- CIA World Factbook 1998

Questions or comments about this site should be e-mailed to gotwww@start.or.th

This page last updated on 24 February 1999.

Appendix L:

FEMA (Federal Emergency Management Association)

FACT SHEET: HURRICANES

Hurricanes can be dangerous killers. Learning the hurricane warning messages and planning ahead can reduce the chances of injury or major property damage.

BEFORE

-Plan an evacuation route.

Contact the local emergency management office or American Red Cross chapter, and ask for the community hurricane preparedness plan. This plan should include information on the safest evacuation routes and nearby shelters.

-Learn safe routes inland.

Be ready to drive 20 to 50 miles inland to locate a safe place.

-Have disaster supplies on hand:

Flashlight and extra batteries

Portable, battery-operated radio and extra
Batteries
First aid kit and manual
Emergency food and water
Non-electric can opener
Essential medicines
Cash and credit cards
Sturdy shoes

-Make arrangements for pets.

Pets may not be allowed into emergency shelters for health and space reasons. Contact your local humane society for information on local animal shelters.

-Make sure that all family members know how to respond after a hurricane.

Teach family members how and when to turn off gas, electricity, and water. Teach children how and when to call 9-1-1, police, or fire department and which radio station to tune to for emergency information.

-Protect your windows.

Permanent shutters are the best protection. A lower-cost approach is to put up plywood panels. Use 1/2 inch plywood--marine plywood is best—cut to fit each window. Remember to mark which board fits which window. Pre-drill holes every 18 inches for screws. Do this long before the storm.

-Trim back dead or weak branches from trees.

-Check into flood insurance.
You can find out about the National Flood Insurance Program through your local insurance agent or emergency management office. There is normally a 30-day waiting period before a new policy becomes effective. Homeowners polices do not cover damage from the flooding that accompanies a hurricane.

-Develop an emergency communication plan.
In case family members are separated from one another during a disaster (a real possibility during the day when adults are at work and children are at school), have a plan for getting back together. Ask an out-of-state relative or friend to serve as the "family contact." After a disaster, it's often easier to call long distance. Make sure everyone in the family knows the name, address, and phone number of the contact person.

Hurricane Watches and Warnings
A hurricane watch is issued when there is a threat of hurricane conditions within 24-36 hours. A hurricane warning is issued when hurricane conditions (winds of 74 miles per hour or greater, or dangerously high water and rough seas) are expected in 24 hours or less.

DURING A HURRICANE WATCH
- Listen to a battery-operated radio or television for hurricane progress reports.
- Check emergency supplies.
- Fuel car.
- Bring in outdoor objects such as lawn furniture, toys, and garden tools and anchor objects that cannot be brought inside.
-Secure buildings by closing and boarding up windows.
-Remove outside antennas.
-Turn refrigerator and freezer to coldest settings.
-Open only when absolutely necessary and close quickly.
-Store drinking water in clean bathtubs, jugs, bottles, and cooking utensils.
-Review evacuation plan.
-Moor boat securely or move it to a designated safe place. Use rope or chain to secure boat to trailer. Use tiedowns to anchor trailer to the ground or house.

DURING A HURRICANE WARNING
-Listen constantly to a battery-operated radio or television for official instructions.
-If in a mobile home, check tiedowns and evacuate immediately.
- Store valuables and personal papers in a waterproof container on the highest level of your home.
-Avoid elevators.
If at home:
- Stay inside, away from windows, skylights, and glass doors.
-Keep a supply of flashlights and extra batteries handy. Avoid open flames, such as candles and kerosene lamps, as a source of light.
-If power is lost, turn off major appliances to reduce power "surge" when electricity is restored.
If officials indicate evacuation is necessary:
-Leave as soon as possible. Avoid flooded roads and watch for washed-out bridges.
-Secure your home by unplugging appliances and turning off electricity and the main water valve.
-Tell someone outside of the storm area where you are going.
-If time permits, and you live in an identified surge zone, elevate furniture to protect it from flooding or better yet, move it to a higher floor.
-Bring pre-assembled emergency supplies and warm protective clothing.
-Take blankets and sleeping bags to shelter. Lock up home and leave.

AFTER

-Stay tuned to local radio for information.
-Help injured or trapped persons.
-Give first aid where appropriate.
-Do not move seriously injured persons unless they are in immediate danger of further injury.
-Call for help.
-Return home only after authorities advise that it is safe to do so.
-Avoid loose or dangling power lines and report them immediately to the power company, police, or fire department.
-Enter your home with caution.
-Beware of snakes, insects, and animals driven to higher ground by flood water.
-Open windows and doors to ventilate and dry your home.
-Check refrigerated foods for spoilage.
-Take pictures of the damage, both to the house and its contents and for insurance claims.
-Drive only if absolutely necessary and avoid flooded roads and washed-out bridges.
-Use telephone only for emergency calls.

INSPECTING UTILITIES IN A DAMAGED HOME

-**Check for gas leaks**--If you smell gas or hear blowing or hissing noise, open a window and quickly leave the building. Turn off the gas at the outside main valve if you can and call the gas company from a neighbor's home. If you turn off the gas for any reason, it must be turned back on by a professional.

-**Look for electrical system damage**--If you see sparks or broken or frayed wires, or if you smell hot insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice.

-**Check for sewage and water lines damage**--If you suspect sewage lines are damaged avoid using the toilets and call a plumber. If water pipes are damaged, contact the water company and avoid the water from the tap. You can obtain safe water by melting ice cubes.

Fisheries Management in the Gulf of Thailand

Presentation Information

WPI

Marine Fisheries

- Development of Malaysia and Thailand (1960s)
  - large increase in both quantity and value of the catch
- Development of Cambodia and Vietnam (1980s)
  - food security and betterment of economies

Development of Fisheries

- Increased demand from expanding populations
- Accelerated by demand for high-value fish and fishery products
- Overexploited fishery resources
  - total catch surpasses estimated MSYs in Thailand

Status of Fishing Industry in Thailand

- 1990, Total fishermen = 207,019
- 1994, GDP of Fisheries = USD2,398,000,000
- 1994, Exports = USD4,352,000,000

Coastal Resource Exploitation Possible Adverse Impacts

1. Reduction of catch and income, small-scale & commercial;
2. Increased conflicts due to competition of depleted resources;
3. Rising costs of exploitation and ensuing costs for consumers;
4. Reduction of per-capita consumption of fish by the population;
5. Decrease in export earnings;
6. Increase in importation of fish for domestic consumption;
7. Eventual collapse of fisheries in some fishing grounds of the region;

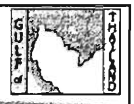
Coastal Environments

- Rapid development of coastal areas
- Reduction of mangrove forests for aquaculture
  - coral reefs
  - seagrass meadows
- Nearshore mining
- Population increase
- Effluents increase rate of environmental degradation

Resource Sustainability

- Current
  - fisheries management measures
  - conventional and conservation-oriented
- Future
  - need for quotas, Total Allowable Catch (TAC), economic controls
  - integrated fishery management measures

Management Frameworks

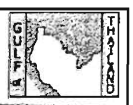


- Government Policies
- Laws & Regulations
- Fishery Management Authorities
- Management Measures and Enforcement
- Information and Statistical Databases
- Fishery Research
- Technology Transfer and Capacity Building
- Regional Cooperation

Government Policies

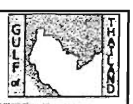
- Fisheries Sector
  - contributes to food security,employment and income
- General Policy
  - increase fish production
  - ensure food security
  - increase employment, income and export earnings

Government Policies



- Sectoral basis
  - protection of spawning and nursery grounds
  - alleviation of conflicts among resource users
- Fisheries recently included under integrated coastal area management scheme
- Fisheries management frameworks operating with varying degrees of efficiency
  - management measures supported by legislation, programmes, projects, and enforcement

Laws and Regulation



- Legal support for implementation of fisheries management measures
- Management regulations under core fisheries and environmental laws
  - confusion among fishermen –> non-compliance
- Laws constructed without environmental safeguards
- several agencies enforce independently
  - sets of laws & regulations needed to ensure coordination amongst the authorities

Management Authorities

- Department or bureaus of fisheries responsible for fishery management
  - some countries authority delegated to provincial or municipal agencies or local governments
- Coordination between the central and local governments is needed

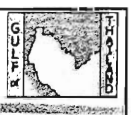
Management Measures and Enforcement

- Conservation-oriented policies
  - limitations of fishing units
  - restriction on catching power of fishing units
  - limitations on amount of time spent on fishing
- Management measures
  - monitoring, control, and surveillance systems
- Need for strong political will on part of the government
  - conserve fishery resources through improved and more effective management systems

Fisheries Information & Statistical Databases

- Need for timely and reliable data for fishery development planning
  - catch, catch per unit of effort
  - cost and earnings in fisheries
- Explain existing laws and regulations to the fishermen in simple terms
- Disseminate information to neighboring countries-publications can't be in local language

Fishery Research



- Need to improve:
  - quality of research
  - technical capabilities of researchers
  - infrastructure of research
  - research coordination between government institutes and universities

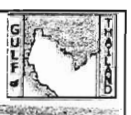
Fishery Research

- Low priority is given to marine fishery research
  - priority should be assigned by the governments in consultation with the fishing industry and academics
  - Priority should be given to fisheries management research in the areas of:
    - socio-economic research
    - development of resource assessment models
    - bio-economic analysis of exploited fish stock
    - management of transboundary fish stocks

Technology Transfer & Capacity Building

- Human resource development
  - education and training at all levels
- Transfer of appropriate technologies
  - improve capacity of personnel and methodologies employed in extension work
  - cooperation among administrators, scientific and academic institutes, fishing industry and fishermen

Regional Cooperation



- More than 20 organizations, programmes and projects concerned with fisheries and marine affair
- Already a regional framework for cooperation in various aspects of fisheries management and development
- Need to coordinate activities of these organizations
  - reduce the duplication of effort, economizing the running costs and accelerate the outcome of research and studies undertaken

Petroleum in the Gulf of Thailand

SEAPOL

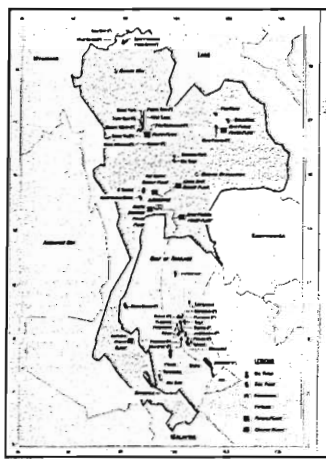
SOUTHEAST ASIA START REGIONAL CENTRE

Presentation Information

WPI

Petroleum Industry of Thailand

- 1960, exploration by foreign oil companies
  - 17 exploration blocks awarded in the Gulf
- Present exploration activities
  - 111 blocks have been delineated
  - 89 onshore, 22 offshore

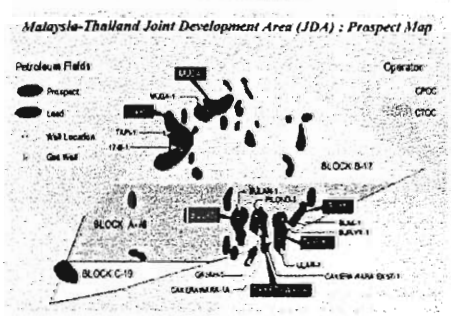


Petroleum Fields in Thailand

Malaysia-Thailand Joint Development Area

- To explore and exploit offshore petroleum reserves
  - mutual advantages
  - production sharing contracts awarded 1994
- JDA's reserves are at least 6 trillion cubic feet

JDA Prospect Map



Petroleum Pollution

- Petroleum hydrocarbon pollution (PHC)
  - caused by oil and gas production activities
  - concentration varies with distance from shore
  - higher levels recorded inland than offshore
  - higher levels near fishing ports and areas of shipping activities
- Oil Spills
  - caused by tankers running aground
  - clean-up is extremely expensive
  - impact on the environment, years to recover

Oil Spills

- TARC (Tiered Area Response Cooperation)
  - dispatches ships and equipment
- Oil spill accidents in the Gulf, past 25yrs

Date	Oil type	Volume	Location	Cause
1973	J.P.4	Unknown	Sriracha, Chonburi province	Fire tanker
1979	Crude oil	300 tonnes	Srichang Island, Chonburi province	Fire tanker
6 Mar. 1994	Diesel	400 tonnes	Srichang Island, Chonburi province	Collision of tanker and container
30 Oct. 1996	Crude oil	160 tonnes	Oil Loading station, Rayong province	Leaking during loading

Mercury Pollution and Petroleum Production

- In mineral form mercury is non-toxic
- Exploration site sediment has higher levels of mercury than found naturally
- Oil exploration disturbs sediment
  - mercury dissolves in water and disperses quickly
- Wastewater released near the surface contains volatile amounts of mercury
  - longterm accumulation of mercury in atmosphere

Environmental Laws

- Existing laws confront discharges of wastes into rivers
- No laws covering discharge of wastes in the Gulf
  - implementation problems, policymakers won't sign laws
  - moral obligations of oil companies

Pollution Prevention

- Preventing Environmental Pollution
  - regulations and guidelines
  - active clean-up operations
- Offshore drilling platforms
  - regular monitoring of platform legs and drilling areas to ensure no seepage

Pollution Prevention

- Water Treatment
  - voluntary actions, began late '97, gradually increasing among companies
  - mercury extracted from water before released into water
    - mercury used for other Industrial products
- Seawater Surveys of Platform Areas
  - Pollution Control Department
  - TOTAL
  - UNOCAL

Summary

- Petroleum industry has become a major sector in the economy
- Construction of refineries has made Thailand self-sufficient in most oil products
- Environmental Protection is a major concern
  - aware of compliance with rules and regulations
  - industry has set high standards to ensure safety and environmental protection