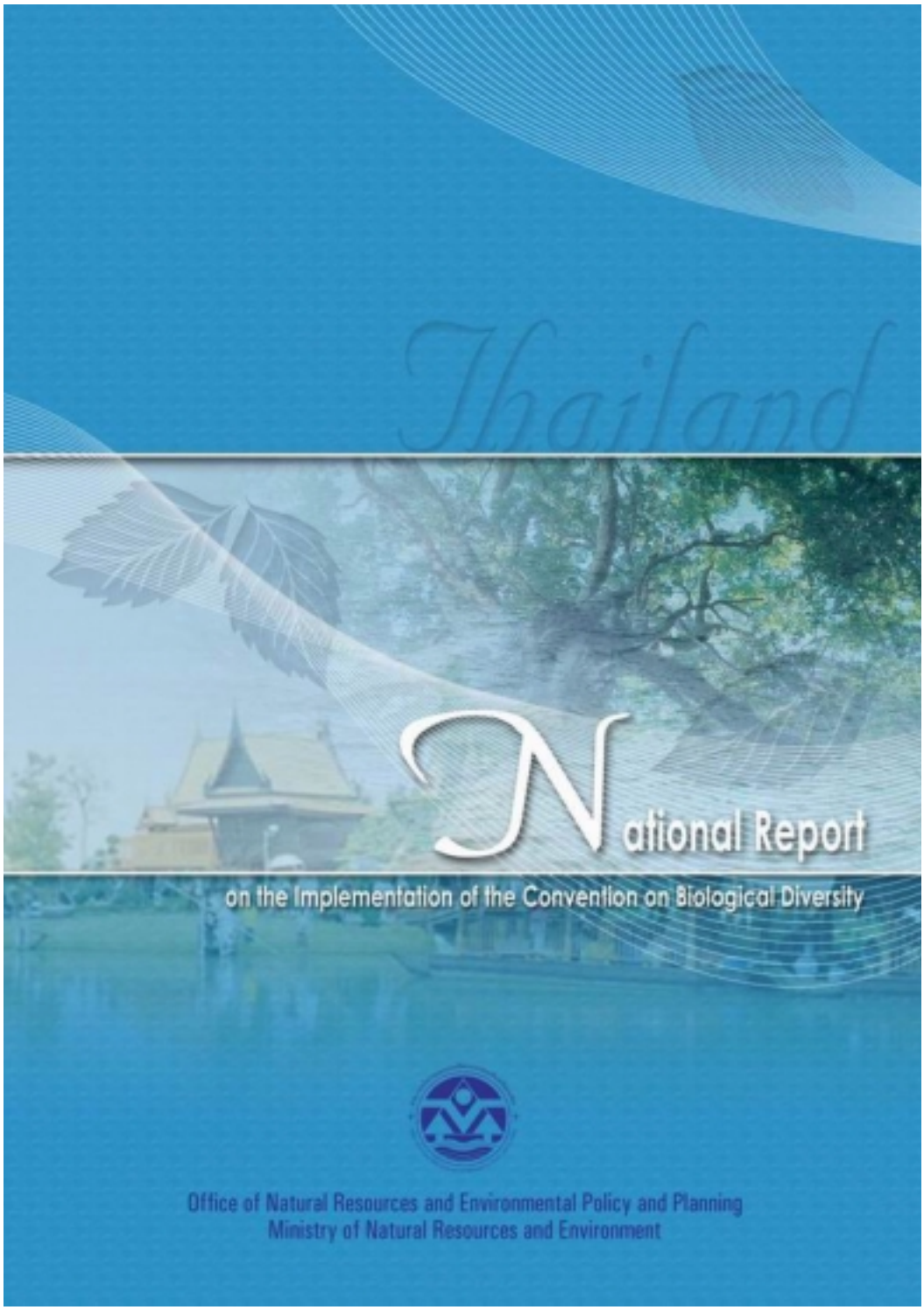
Thailand

National Report

on the Implementation of the Convention on Biological Diversity

Office of Natural Resources and Environmental Policy and Planning
Ministry of Natural Resources and Environment


Thailand
National Report
on the Implementation of the Convention on Biological Diversity
Office of Natural Resources and Environmental Policy and Planning
Ministry of Natural Resources and Environment

Foreword

Biodiversity's contribution to wealth and well beings of Thailand has long been recognized, at least by those affiliated with nature conservation. Such awareness spawned many activities that lead to conservation of important ecosystems and associated species as well as genetic resources of these organisms. The recognition also became the driving factor for Thailand's signing of the Convention on Biological Diversity in 1992 and cradled the country through the struggle until the eventual ratification of the Convention in October 2003. Becoming the Contracting Parties to the Convention, however, is not the end of the country's efforts for the conservation, but rather the end of the beginning for overcoming the challenges to maintain biodiversity for future generations.

Progress on biodiversity conservation, as with other initiatives and enterprises, can only be realized through taking stock of past achievements and failure. The Convention on Biological Diversity, therefore, mandated the Contracting Parties to regularly submitted reports on implementation of its provisions as well as action to address other related issues identified by the Conference of the Parties. Thailand has complied to this reporting obligation even before becoming the official Contracting Parties, with submission of the first and second national reports. Such action was often applauded by the Conference of the Parties and the country was expected to be among the first group of the Contracting Parties to submit the third national report. This report is therefore the evidence of the success in meeting such expectation.

Thailand's 3rd national report on implementation of the Convention on Biological Diversity is a chronicle of the country's actions undertaken to ensure biodiversity conservation and sustainable used. Based on the Convention's endorsed guideline, the report also illustrates status and trends of biodiversity and its components in the countries and identifies the threats to their existence. The report describes the efforts to implement provisions in selected articles and activities called for by thematic programmes of work and cross–cutting initiatives of the Convention as well as measures to provide support from the implementation Furthermore, this publication also presents highlight on the effects of the tsunami on biodiversity and the government's effort to cope up with the damage and loss of biodiversity of the Andaman Sea.

The publication of the 3rd national report by Office of Natural Resources and Environmental Policy and Planning, the Convention's national focal point for Thailand, was aimed to enable greater public awareness of the Convention and efforts taken to implement its provision. Above all, the report serves as a prime exhibit of how extensive biodiversity conservation could and should be. We are hopeful that this report could be useful not only for the Convention in the reviewing its global implementation but also the interest public who eager to learn about the real works and people behind biodiversity conservation in Thailand.

N. Kositratna

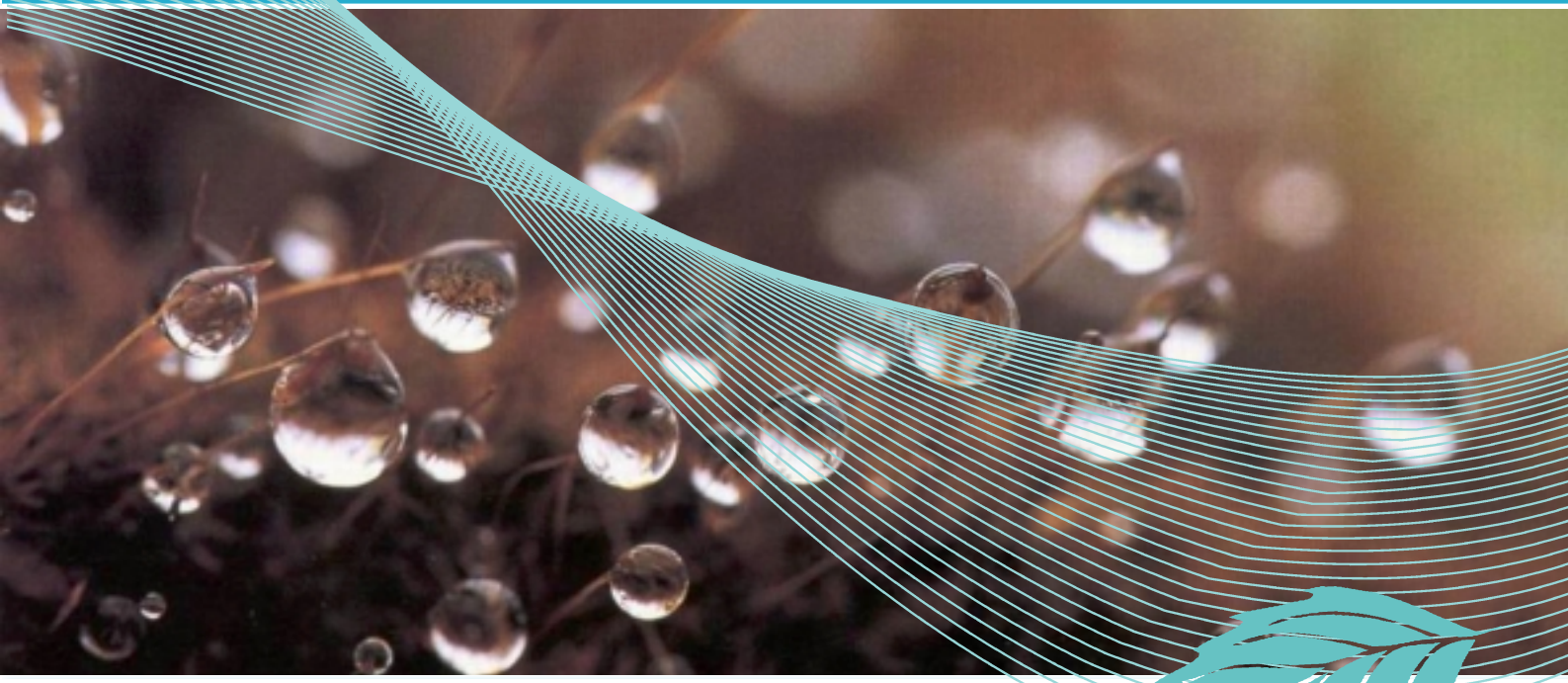
Ms. Nisakorn Kositratna
Secretary–General
Office of Natural Resources and Environmental Policy and Planning

Abbreviations

ADB	Asian Development Bank
BRT	Biodiversity Research and Training Program
CBD	Convention on Biological Diversity
CHARM	Thai–EU Coastal Habitat and Resource Management
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DEQP	Department of Environmental Quality Promotion
DGR	Department of Groundwater Resources
DLD	Department of Livestock Development
DMCR	Department of Marine and Coastal Resources
DMR	Department of Mineral Resources
DMSC	Department of Medical Sciences
DOA	Department of Agriculture
DOF	Department of Fisheries
DONP	National Park, Wildlife and Plant Conservation Department
DWR	Department of Water Resources
FAO	Food and Agriculture Organization
FIO	Forest Industry Organization
GMO	Genetically Modified Organic
GMS	Greater Mekong Sub–region
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
JoMPA	Joint Management of Protected Areas
LMOs	Living Modified Organisms
MOAC	Ministry of Agriculture and Cooperatives
MONRE	Ministry of Natural Resources and Environment
MRC	Mekong River Commission
NGOs	Non–Government Organizations
NBPC	National Biotechnology Policy Committee
NBSAP	National Policy Strategies and Action Plan on the Conservation and Sustainable Use of Biodiversity
NESDB	National Economic and Social Development Board
NSTDA	National Science and Technology Development Agency
ONEP	Office of Natural Resources and Environmental Policy and Planning
OPS	Office of the Permanent Secretary
PAO	Provincial Administration Organization
PCD	Pollution Control Department
PMBC	Phuket Marine Biological Center
RFD	Royal Forest Department
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
TAO	Tambon Administration Organization
TISTR	Thailand Institute of Scientific and Technological Research
WEFCOM	Western Forest Complex : An Ecosystem Approach
WG ABS	Ad Hoc Open–ended Working Group on Access and Benefit–Sharing
WPR	Warranty of Performance Responsibility
WWF	World Wildlife Fund for Nature

CHAPTER 1

Biodiversity in Thailand:
A Holistic Approach



CHAPTER 1

Biodiversity in Thailand: A Holistic Approach

Thailand signed the Convention on Biological Diversity (CBD) at the United Nations Conference on Environment and Development (UNCED) on 12 June 1992, in Rio de Janeiro, Brazil, following wide–ranging preparations. Thailand has since implemented various projects and activities in support of the Convention, in spite of many problems and obstacles that have been encountered. Thailand submitted the ratification instrument on 31 October 2003, becoming the 188th Contracting Party to the Convention on Biological Diversity on 29 January 2004.

Since time immemorial, Thailand has always been rich in biodiversity. From the past up to the present, biodiversity has supported the Thai way of life. The Thai people never had to face extreme problems of poverty and hunger. The country's rich biodiversity is seen in the abundance of food and herbal medicines, in the fertile culture and in the diversity of tools that are used to sustain life.

Biodiversity in Tradition and Culture

The Thai people's traditional way of life has always been in close harmony with nature. The Thai people have long developed beneficial uses of water, rice, fish, fruits, herbs and various forest products. Their indigenous way of life is reflected in ancient hieroglyphic stones. The discovery of rice and fruit grains is depicted in a cave in a northern province, dating some 6,000 years back.

The majority of the Thai people earn their living from agriculture. A wide range of plants and crops are grown for home consumption and for commercial purposes. The Thais recognize the importance of water for agriculture and the need to conserve forests. As a normal practice, the Thais train animals to assist them in daily life. For example, elephants are trained to help in the felling of trees and are used as a means of transportation.

Clearly, the Thai people's traditional way helps in supporting and sustaining the species and in maintaining genetic and ecosystem diversity.

The Thai people live in close harmony with nature is demonstrated in their indigenous culture. A wide variety of plants and animals serve as central features in traditional activities, beliefs, festivals and ceremonies, such as the offering of flowers, cow racing, and the presentation of lotus flowers during festivals.

Buddhism, which originated from natural laws and truths, is the religion of more than 90% of the population. Buddha's teachings, adhered to by the Thai people for more than 2,500 years, make many references to nature and the need to maintain the natural balance. They also refer to the relationship between

human beings and nature and the right of all living things to life. Religious practices are supportive of biodiversity conservation. A distinct example is the requirement that all Buddhist monks should remain in their temple dwellings during the rainy season, normally from July to October each year, when water is abundant and plants and animals are thriving. This practice minimizes the need for monks to travel on foot when they preach and this helps to reduce potential damage to various living organisms on the ground. The three month–period of temporary ordination, covering the Buddhist Lent, shows that biodiversity conservation has long been closely observed in Thailand. This is also shown by the fact that monks teach the people about the need to protect the environment. At present, Buddhist temples total some 21,500 and half of these are located in forests near villages where peaceful meditations are encouraged and forest conservation is promoted.

It can be seen that Buddhism and Thai culture are in harmony with nature.

Flower Offering Festival

In Saraburi Province, Tak Bart Dok Mai is celebrated on the day that marks Buddhist Lent, which is the first day of the waning moon in the eighth lunar month.

After offering rice to monks at the sermon hall of Wat Phra Buddha Bart in the morning, people gather flowers for the flower offering festival in the evening.

Formerly, only traditional Buddhist Lent flowers were chosen for the flower offering festival. These flowers are from the ginger and galingale families. Hellebore–like, they grow up to 25 cm high and are yellow, white and bluish purple in color. They grow on hill slopes and bloom during the Buddhist Lent. The bluish purple flowers are believed to bring the greatest bliss to those who offer them due to their rarity. These days traditional Buddhist Lent flowers are hard to find and the people now offers flowers of all types in the festival.

The Tak Bart Dok Mai commences around 4 p.m. Monks walk along the road to the temple, receive flowers from the people, and take these to the Mondop to worship the Lord Buddha's Footprint, the Stupa of the Crystal Teeth and the Great Mahathat Chedi.

Cow Racing

Wing Wua Larn or Cow Racing is an enjoyable form of leisure for villagers and farmers in Suphan Buri, Ratchaburi, Phetchaburi, Prachuap Khirikhan and other provinces where cows are still being used for farming. The annual race takes place during the Katin Festival and the annual temple fair.

Cow racing is a modification of rice threshing. The threshing yard is generally wide and has a radius of no less than 10 wah (20 m). A pole called "Sao Kiad" is set up in the middle, looped by a rattan ring. A long, thick rope called " Puang" or "Nuam" is tied to the ring, leaving the other end loose. In rice threshing, cows are tied to the rope and are forced to walk around the pole. As they move, they walk on the rice husks that are on the ground.

Cow racing imitates the act of rice threshing. Cows that play the most important role in the race are "Wua Nork", which are those in the outermost ring and are usually the most robust as they take the longest walk; and "Wau Rong", which are those in the second outermost ring. The race is carried out in a series of rounds, with each game consisting of 10 to 12 rounds.

The winning cow is a pride to its owner and undoubtedly commands a good price. It is usually exempted from hard labor and is well tended for future races.

Biodiversity in Nature and Environment

Thailand has a total land area of 513,115 sq km, lying in a hot and humid climatic zone in the middle of Southeast Asia. Such a location enriches biodiversity as it connects all forms of life in the Himalayan Mountain range and the southern part of China with the Malay Peninsula and the humid areas of Cambodia and Laos. This in turn supports a variety of tropical ecosystems. The range of terrestrial ecosystems includes moist evergreen forests, hill evergreen forests, dry evergreen forests, pine forests, mixed deciduous forest, dry deciduous forest, and grasslands. The freshwater ecosystem includes rivers, reservoirs, swamps, ponds, fresh swamp forests and peat swamp forests. Coastal ecosystems along the country's 2,631 km coastline and surrounding 594 islands are comprised of beach forests, mangrove forests, sandy beaches, mudflats, rocky shores, sea grass beds and coral reefs. Marine ecosystems are located on both sides of the peninsula. Agricultural ecosystems cover about one–fifth of the country, including biodiversity components of rice, farm crops and livestock.

There are approximately 15,000 plant species in Thailand, accounting for 8% of the estimated total number of plant species found globally. Thailand can be considered as a collective center of floristic elements consisting of Indo–Burmese, Indo–Chinese and Malesian elements. There are approximately 12,000 vascular plant species in Thailand, including 658 species of pterophyte, 25 species of gymnosperm and approximately 10,000 species of angiosperm, including over 1,140 species of orchids. There are more than 2,154 non–vascular plant species in Thailand, including algae and bryophytes, i.e. moss, hornwort, and liverwort.

Thailand has approximately 4,591 species of vertebrates, including

- 302 species of mammals of which 42% originated from the Malayan Peninsula, 34% from Indochinese and Indian sub–regions, and the remaining 24% from other parts of the Asian continent.
- 982 species of birds
- 350 species of reptiles (366 forms)
- 137 species of amphibians (138 forms)
- at least 2,820 species of fish; there are more than 2,100 marine and 720 freshwater fish species, accounting for 10% of the estimated total fish species world wide.

The country has approximately 83,000 invertebrate species, of which 14,000 species can be identified. Most of the identified species are insects.

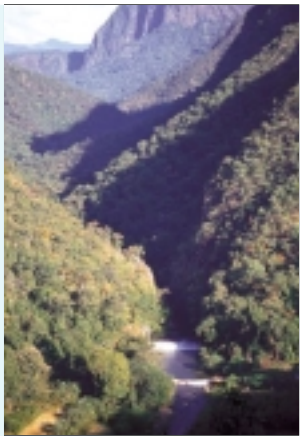
At present, the reduction of biodiversity in Thailand is mostly caused by over–exploitation through over–logging, illegal trading of animals and cutting of certain plants species for commercial purposes, poaching of tigers, bears, turtles, and seahorses, disturbance and loss of natural habitats, and pollution. Over–hunting of wildlife resulted in serious reductions in both the population and variety of wildlife.

The most serious threat to biodiversity is human disturbance. Disturbance of natural habitats and ecosystems includes the clearing of mangroves for shrimp pond development, of peat swamps for crop fields, of virgin forests for reservoirs and dams, of beach forests for resort development, limestone mountain forests for mines and freshwater swamp forest for urban expansion.

Biodiversity in Policy

The Government Administrative Plan 2003–2004 Strategy 4 (Policy on Natural Resource and Environmental Management) specifies the need for balance between utilization and conservation for sustainable development. The goal of this strategy is to have conserved forest areas account for 25% of the country's total land area and to have 1.5 million rai of mangrove forests. The strategy promotes sustainable and fair protection and utilization of biodiversity. The goal is to regulate access to and benefits from biodiversity, in addition to developing holistic knowledge and database of biodiversity and to promoting biological resource research and development for commercial purpose.

National Policy, Strategies and Action Plan for the Conservation and Sustainable Use of Biodiversity, 1998–2003, and 2003–2007 consist of seven strategies. One to four objectives are listed under each strategy. Several activities are set up to implement the Convention on Biological Diversity. The sevem strategies are the following:



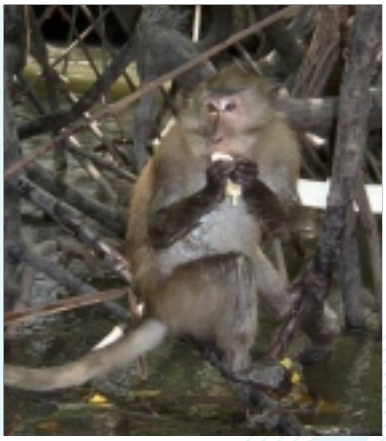
- **Strategy 1:** Enhance knowledge, understanding and public awareness of the importance and value of biodiversity.
- **Strategy 2:** Build capacity and expertise of institutions and their staff in biodiversity conservation.
- **Strategy 3:** Strengthen capacity in conservation, restoration and protection of natural habitats, within and outside protected areas.
- **Strategy 4:** Ensure efficiency in conservation and sustainable use of species and genetic diversity.
- **Strategy 5:** Control, monitor and reduce the threats to biodiversity.
- **Strategy 6:** Provide incentives and encourage public participation in the conservation of biodiversity in accordance with Thai traditional and cultural practices.
- **Strategy 7:** Promote and develop international cooperation and collaboration in the conservation and sustainable use of biodiversity.

The National Policy, Strategies and Action Plan for the Conservation and Sustainable Use of Biodiversity, 1998–2003, and 2003–2007 were approved by the Cabinet on 15 July 1997 and 11 June 2002 respectively. These will be implemented by various agencies using their own budgets. The agencies include the Office of Natural Resources and Environmental Policy and Planning (ONEP), National Park, Wildlife and Plant Conservation Department (DONP), Royal Forest Department (RFD), Department of Fisheries (DOF), Department of Livestock Development (DOD), Department of Agriculture (DOA), and Department of Medical Science (DMSC).

Biodiversity in Law

Thailand's biodiversity is protected by a number of laws and regulations. Some of the important ones are the National Park Act 1961, National Forest Reserve Act 1964, Wild Animal Reservation and Protection Act 1992, Plant Quarantine Act of 1964 and Plant Quarantine Act (second issue) 1994, Animal Species Maintenance Act 1966, Importing and Exporting of Goods Act 1979, Enhancement and Conservation of National Environmental Quality Act 1992, and Plant Varieties Protection Act 1999.

- The **Thai Constitution 1997** Article 56, stipulates the right of all individuals to participate with the government and community in helping to maintain biodiversity as well as to enjoy benefits from the utilization of natural resources and biodiversity. Article 79 of the Constitution stipulates that the government should enhance and support public participation in preserving, maintaining and utilizing the balance between natural resources and biodiversity.
- The **National Park Act 1961** stipulates that natural parks should be established. The objective is to initiate protection, control and overseeing of natural ecosystems and natural habitats of plants and animals. Picking or transporting of wood and natural resources out of any park's boundaries are prohibited. Other prohibitions include transporting and damaging animals, picking and transporting orchids, flowers, leaves and fruits. Profit–oriented activities are prohibited in the parks.
- The **National Forest Reserve Act 1964** prohibits unauthorized processing of wood and picking of wood products in national preserved forests. In addition, the Act authorizes the Ministry of Agriculture and Cooperatives (MOAC) to issue ministerial notification, as it sees appropriate, to establish national preserved forests in order to maintain the state of the forest, wood products and other natural resources.



- The **Plant Quarantine Act 1964 and Plant Quarantine Act (second issue) 1994,** and the notifications of MOAC on identification of prohibited plants, pests or vectors specify that GMO plants, as the result of biological technology, are prohibited materials. Export and/or import of prohibited items needs approval by DOA and is approved only for research and experiment purposes.

- The **Animal Species Maintenance Act 1966** protects and controls preserved animals for breeding purposes by prohibiting their castration, slaughter and export without permission.

- The **Import and Export of Goods Act 1979** controls the import and export of certain goods listed in the Royal Decree of 1975 (Issue no. 39) and 11 notifications on the export of goods of the Ministry of Commerce released since 1974. Such notifications list names of wild animals, wild animal carcasses, aquarium fish and other aquatic animals that are controlled and require export permits out of Thailand. Guidelines, methodologies and provisions concerning the export of such animals are contained in the ministerial notifications.

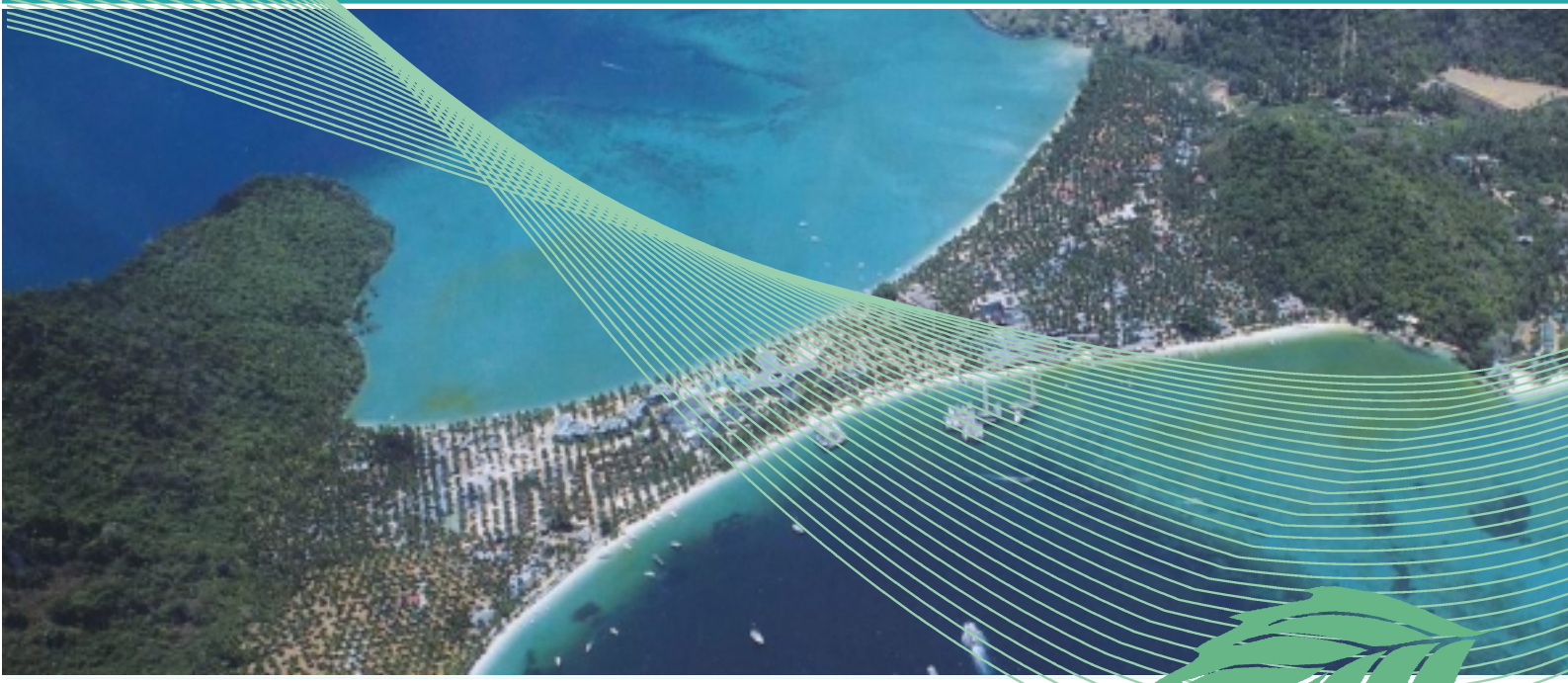
- The **Wild Animal Reservation and Protection Act 1992** was enacted after the Act of 1960. The Act stipulates the establishment of wild animal reservation zones in order to protect their natural habitats. The Act also lists 15 species of preserved and rare/wild animal species. The Act was revised to comply with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It also stipulates various articles concerning import/export control and supports the breeding of certain wild animal species. The objective is to increase their population numbers and to minimize pressure resulting from hunting.

- The **Enhancement and Conservation of National Environmental Quality Act 1992** stipulates the authority of the Ministry of Natural Resources and Environment (MONRE) to issue ministerial regulations to protect areas that have unique natural ecosystems or are vulnerable to destruction. These areas should be protected using reasonable measures that are in harmony with their unique character.

- The **Plant Varieties Protection Act 1999** provides protection of new plant species, endemic plant species, and local and wild plant species. The Act specifies that permission is needed and benefit–sharing should be clarified if the stored or collected plant species or their parts are used for species improvement study, experiment and research for commercial purposes.

CHAPTER 2

Tsunami and Biodiversity



CHAPTER 2

Tsunami and Biodiversity

On 26 December 2004, at 09:38 hours, a raging tsunami struck the Phuket coastline, the first area to be hit. Shortly after, five other southern provinces along the Andaman coastline, namely Ranong, Phang–nga, Krabi, Trang and Satun, faced the devastating tidal waves.

The Department of Mineral Resources (DMR) reported that shortly before the tsunami hit Thailand, there was an undersea quake at eastwest of Sumatra Island in Indonesia at around 07:58 hours. A common experience that was reported in all the devastated areas was as follows:

... "The sea swiftly receded from the coastline, receding from 500 to 1,000 m off the shore. Some 20 minutes later, the first series of two– to three–meter high tidal waves struck and hit the shore. Fifteen minutes later, three– to 10–meter high giant water walls, with a length of several kilometers and possessing enormous strength, hit the coast. They were powerful enough to hurl ships that were moored along the coastline to a distance of over 50 m ashore and to flatten and destroy buildings on their way. Inland areas that were more than one kilometer away from the shore were flooded. A third series of waves around five–meter high surged and ruined everything that they hit, causing sudden flooding all over. Generally, the height of the wave front increased at the beachfront where the slope was low and where the bay was relatively closed."

DMR also reported that at 09:35 hours, around the coastline of Khao Lak–Nam Khem Village, Takua Pa District in Phang–nga Province, the sea receded up to 100 m from the beach for about five minutes. At around 09:38 hours, a two– to three–meter high tidal wave struck the shore for the first time, followed by six– to seven–meter high water walls at around 09:43 hours. Later at 10:03 hours, a wave higher than 10 m struck the coastline for 20 minutes, resulting in immediate flooding that lasted for an hour and took approximately another hour to recede. Normal sea level was observed by 12:00 hours.

Consequent Losses and Damages

The tsunami that hits the coastline of Ranong, Phang–nga, Phuket, Krabi, Trang and Satun Provinces, especially the beaches of Patong Bay in Phuket Province, Takua Pa in Phang–nga Province and Phi Phi Island in Krabi Province on 26 December 2004 caused colossal destruction in Thailand's coastal areas and seaboards, including loss of lives and damage to property, natural resources and the environment. As well, it caused severe damages to the society and economy, especially the tourism industry. Although a year has passed since the disaster, dire consequences can still be felt, including psychological wounds inflicted on those who lost their loved ones. Problems remain evident in many coastal areas.

Damage to Natural Resources and Environment

A survey of 174 coral reef stations revealed that 60% of the corals were not damaged or were very slightly affected. Around 26% suffered slight to medium damage, while 13% were severely damaged. Regarding seagrass beds, around 5% were destroyed. Only a small number of rare and endangered marine species, such as tortoises, dolphins and dugongs, were injured or had died. Other natural resources that were affected were mangrove forests, including 3.04 sq km in Phang–nga Province, around 0.16 sq km in Ranong Province and more than 0.016 sq km in Phuket Province, or 3.216 sq km out of a total of 1,808 sq km of mangroves on the Andaman coast. Damage to land and land utilization was so severe such that agriculture, in terms of productivity and soil condition, was badly affected and some land can no longer be used for farming. Physical and structural changes due to flooding caused soil salinity and erosion. Other physical damages were the loss of land in washed–out coastlines, changes in waterways and rivers including geological changes in the contours of the coasts, spread of sediments and changes in water currents over the long–term future, salinity of ground soil and underground water, collapse of over 53 sinkholes in 16 different provinces and pollution from water–logged areas that had once been flooded, pollution of water sources, and spread of solid waste.

Damages to Natural Resources and Environment in 6 provinces

Provinces	Damages to Natural Resources and Environment
Ranong	Leam Son and Phayam Archipelago National Parks were affected.
	0.0336 sq km of coral reefs were damaged.
	Minor damage was found at various beaches.
	Seagrass beds at the mouth of Ban Bang Bane canal were buried in sandy sediments. However, the damage was minor.
	14 sea turtles (4 Hawksbill turtle and 10 Ridley's turtle) were washed out from captivity at the Ranong Marine Research Station.
	0.888 sq km of mangroves were damaged.
	0.0096 sq km of freshwater sources were damaged.
	Coastal erosion was found at Bang Bane Beach (Bang Bane Village) at a distance of 50 m from the original shoreline. At Ban Tale Nok Beach (Kum Puan Village) and Prapas Beach, coastal erosion was found at a distance of 80 and 50 cm, respectively, from the original shoreline.
	0.0032 sq km of solid waste dumping site and wastewater treatment plant were damaged.
	Soil deterioration (soil salinity) was found in area covering 0.6592 sq km.
Phang–nga	Similan Island, Lak Mountain–Lumlu, Lumpee Mountain–Tai Muang, Surin and Ra–Phra Thong Islands National Parks were affected.
	1 sq km of coral reefs were damaged.
	8 sq km of beaches were damaged.
	At Tung Nang Dum in Kuraburi District, sand dunes were destroyed by tsunami waves, while nearby seagrass beds were covered with sand. At Khao Kad, bottom erosion was found. However, the rhyzome remained attached to the substrate while the leaves were torn off. Sand was stirred by waves at the northern area of Koh Phra Thong and consequently, seagrass beds were covered with sand. At Ban Tha Noon and Pak Khlong Nai Yong, sand was found to cover some seagrass beds. In some areas, seagrass roots were exposed above the sand bottom.
	3.04 sq km of mangroves were damaged.
	5.6 sq km of forest were damaged.
	0.0096 sq km of freshwater sources were damaged.
	0.0016 sq km of solid waste dumping site and wastewater treatment plant were damaged.
	Soil deterioration (soil salinity) was found in area covering 5.6 sq km.

Damages to Natural Resources and Environment in 6 provinces (continue)

Provinces	Damages to Natural Resources and Environment
Phuket	Sirinat National Park was affected.
	5–20% of coral reefs were damaged.
	Minor damage was found at various beahces.
	At Laem Sai and nearby areas, some seagrass beds at Ban Ta Chatchai–Ban Pak Klong Yid remained in normal condition, while other beds were slightly damaged by sand.
	0.16 sq km of mangroves were damaged.
	Beach forests were withered.
	32 surface water resources, 99 artesian walls and 50 potable water system were damaged.
	Patong Municipality and Karon Sub–district Municipality of solid waste dumping site and wastewater treatment plant were damaged.
	Soil deterioration (soil salinity) was found in area covering 0.0352 sq km.
Krabi	Noparattara–Phi Phi Islands, Lanta Islands, and Tan Bok Koranee National Parks were affected.
	5 sq km of coral reefs were damaged.
	17 km beaches were damaged, of which 15 km was minor.
	20% of seagrass beds at the southern area of Koh Jum were destroyed. Sand deposition was found in the remaining seagrass beds in this area.
	126 shallow well and 50 artesian wells were destroyed.
	Soil deterioration (soil salinity) was found in area covering 0.0376 sq km.
	7 sinkholes.
Trang	Chaomai Beach National Park was affected.
	Minor damage was found at various coral reefs.
	Up to 5% of seagrass beds at the north eastern and the east–south areas of Koh Libong were damaged. The damages were caused by sand dune (substrate) erosion. Seagrass beds in some areas shed their leaves, although their plants were still attached to the substrate.
	0.032 sq km of mangroves were damaged.
	129 shallow wells were destroyed.
Satun	Tarutao and Patra Islands National Parks were affected.
	0.88 sq km of coral reefs were damaged.
	1.92 sq km of beahces were damaged.
	Seagrass beds at Koh Lidi Yai and Koh Lidi Noi were in normal condition. There was no trace of damage.
	14 sea turtles (4 Hawksbill turtles and 10 Ridley's turtles) were washed out from captivity at the Ranong Marine Research Station.
	0.016 sq km of mangroves were damaged.
	90 wells of freshwater sources were damaged.
	6 sink holes were found (3 in La Ngu District, 1 in Kuan Done District and 2 in Manung District).

Sources: Department of Disaster Prevention and Mitigation, 2005 and National Park, Wildlife and Plant Conservation Department, 2005

Emergency Relief

In a fraction of a second after the tsunami hit six southern provinces, namely Ranong, Phang–nga, Phuket, Krabi, Trang and Satun, serious damages became very evident, including loss of human lives and destruction of assets, natural resources and marine environment.

Right after the catastrophic event, the government and the private sector as well as NGOs, the residents, and agencies under the Ministry of Natural Resources and Environment (MONRE) dedicated their entire efforts to saving lives and helping the victims as the first priority. Local agencies under MONRE that were working in the devastated areas consisted of four marine and coastal resource conservation centers (Rayong, Chumphon, Songkhla, and Phuket), Phuket Marine Biological Center (PMBC), Groundwater Resource Center Regions 5 and 11, Water Resource Office Region 8, National Parks, Provincial Office of Natural Resources and Environment, and Environmental Office Regions 14 and 15. The national agencies that cooperated in the effort included the Department of Marine and Coastal Resources (DMCR), Pollution Control Department (PCD), DMR, Department of Water Resources (DWR), Department of Groundwater Resources (DGR), Department of Environmental Quality Promotion (DEQP), DONP, Office of Natural Resources and Environmental Policy and Planning (ONEP), and Office of the Permanent Secretary (OPS) of MONRE Those agencies searched, rescued and assisted the victims and tourists, to locate shelter, provide water for drinking and consumption, and collect and dispose debris and solid waste in the affected areas.

Recognizing that their primary mission is to conserve, protect and rehabilitate natural resources and the environment and to alleviate suffer of the Thai and foreign victims, agencies under MONRE worked relentlessly and, in the face of many problems, moved to the next stage of the operation. The Ministry had to confront such problems as the unavailability of equipment, especially heavy equipment, vehicles and diving equipment, bad weather, and waves and time pressure.

Survey of Damage to Natural Resources and Environment

MONRE initiated other work in support of activities carried out by other agencies, to address its primary mission, which is the preservation, conservation, utilization and restoration of natural resources and biodiversity, with the participation of the public. The Ministry has conducted initial surveys to determine the extent of the loss of natural resources and the environment. DMCR and DONP are the principal bodies responsible for the surveys.

Initial surveys of corals showed that some, especially those in shallow beds, were overturned, inclined and broken. For islands far from the coasts, such as Surin and Similan Islands, coral reefs were broken, slipped away from their original locations and were covered by sand sediments. Coral reefs close to the western coast of Phang–nga Province and islands along the coast of Ranong Province were covered by sand sediments. Corals in other areas were damaged after being covered by waste, natural materials and construction debris. Seagrass beds were slightly damaged counting in 5% of the surveyed areas and about 3.216 sq km of mangrove forests were damaged. An approximate area of 5.3504 sq km of beach forests was damaged. An approximate area of 3.4592 sq km in Laem Son National Park was severely damaged. Land forests were damaged after being flooded by seawater. Waste was found between the borders of beach forests and land forests. Plants had to adapt, such as by shedding leaves, in order to survive. Some nevertheless died.

Saving Marine Animals

DMCR reported that the tsunami swept at least 37 sea turtles ashore. There were green turtles, hawksbill turtles, and Ridley's turtles in the group. Six turtles died. A few were not injured, some were slightly injured. Twenty–six turtles were rehabilitated and released to the sea. Five were seriously injured and are still being nursed at PMBC. The giant waves partially destroyed beaches where sea turtles laid their eggs. The turtles had difficulty approaching the beaches which had become steeper and were blocked by tree debris. The waves also swept away green turtles from the nursing ponds of PMBC, Khao Lam Pee–Tai Muang Beach National Park, Third Fleet and Kasetsart University's Marine Research Institute in Ranong. Among the lost turtles, 53 were breeding and more than 1,000 were babies.

It was found that three dolphins were swept ashore. A female humpback dolphin (*Sousa chinensis*) was found in a reservoir at Pakarang Peninsula, Phang–nga. This dolphin was rescued and successfully released into the sea. Another two were the bottle nose dolphin (*Tursiops aduncus*). These were found dead in Phang–nga. Another one, a small, unidentified dolphin, was found dead in Phuket.

The waves, at the same time, swept ashore a large male dugong (*Dugong dugon*), measuring 2.75 m in length and 310 kg in weight. This was found, about one km away from the coast of Tub Lamu District, Phang–nga Province. The dugong had some shallow cuts and staff of PMBC cleaned its wounds and applied medications, including administering an injection before letting it return to the sea in front of Tub Lamu Naval Base. However, the dugong died and was swept ashore three weeks later.

Having saved many marine animals, as mentioned above, DMCR made sure that there were no marine animals left in surface water or fresh water resources. It looked for rare marine animals, including sea turtles and dolphins, that might be left unassisted in water sources around Phang–nga Province. The animals that were found were duly nursed before being released to the sea. The operation was completed in September 2005.

Restoration of Coral reefs and Seafans

Coral heads/colonies that flipped over, inclined, fell, broke, and slid, or were fractured and/or covered with sand, and seafans that came loose of their original substrate and dropped to the bottom, would not survive if left unassisted. Therefore, personnel from DMCR and DONP, volunteer divers, experts, researchers, and NGOs, such as Whale Shark Lovers Club and For Sea Foundation, worked together to restore coral reefs and seafans by overturning damaged corals and binding fractured pieces on stable materials, including replanting seafans. These are being monitored to ensure their survival and growth.

Volunteer Divers Joined Forces to Restore Coral Reef and Seafans

28 December 2004: More than 60 professional divers discussed methods to participate in solving problems caused by tsunamis.

2 January 2005: Volunteer divers held a meeting to decide and conclude their travel to survey damages to affected coral reefs.

4–9 January 2005: Over 80 volunteer divers joined the trip on the Andaman Princess to survey damage to coral reefs in areas around Siliman Islands.

11 January 2005: A press conference was held at the Government House; the Vice–Secretariat of the Prime Minister and representatives of volunteer divers announced an appeal for volunteer divers to participate in the survey.

12–15 January 2005: 20 volunteer divers traveled on a Marine Project Ship to overturn corals.

14–17 January 2005: 45 volunteer divers traveled on Phi Phi Harmony, Bubble Blue, and Fasai Ships to overturn coral heads and repair and restore seafans.

19–23 January 2005: 146 volunteer divers traveled on the Andaman Princess Ship to overturn coral heads and repair and restore seafans. This gathered the largest number of divers ever in Thailand.

23 January 2005: Representatives of volunteer divers held a meeting during which they agreed to set up the For Sea Foundation to serve as a center for volunteer divers working for the seas.

At present, For Sea Foundation members include over 500 volunteer divers who are ready to work for the benefit of the Thai seas.

Source: Nangnoy Yossundara, 2005.

Beach Cleaning

There were evidences of the devastating damages caused by the tsunami, including construction debris and thousands of tons of garbage, on land and underwater. MONRE accelerated efforts to clear the bays of Ton Sai, Loh Dalam, Lasama, and Yong Kasem, where some 50 tons of garbage were collected. At Raja Yai Island, over 20 tons of garbage were collected, about 10 tons of garbage at Nai Harn Bay and Kamala Bay, 20 tons at Patong Beach, and more than 5 tons at Kata and Karon Bays.

Rehabilitation

Immediately after the tsunami hit coastal areas along the Andaman Sea, MONRE initiated wide–ranging actions. Agencies under the Ministry mobilized resources to relieve the victims of their sufferings. In the ensuing period, the Ministry cooperated with all relevant organizations from the government and private sectors, including NGOs, in extending assistance by constructing necessary infrastructure, clearing up the land, creating employment, providing education and health care, and establishing an early warning service. These actions have been implemented on a continuing basis to restore and develop natural resources and the environment, thus providing the victims with food sources, fisheries, jobs and water supply, in addition to eliminating pollution caused by the tsunami. The Ministry also contributed in the zoning of safe areas and coordinating with related international organizations in various projects. One of the most important activities was conducting a survey of the victims' needs and expectations, in order to assess the responsiveness of relief efforts undertaken by concerned agencies and to plan for appropriate forms of assistance over the long–term.

Recovery of Sources of Food, Occupations and Fisheries

Coral Reefs

The level of damage to coral reefs caused by the tsunami varies from area to area. DMCR, in association with nine marine science institutional partners conducted a survey of coral reefs in the Andaman Sea from 174 location of stations. They found that the level of impact and damage varies depending on the geographical coordinates of individual areas and islands, or the reef, and on the depth and morphology of the reef in each area, which may increase and reduce the impact of the tsunami tidal wave. The most of severely damaged coral reefs were found in: 1) Shallow–water coral reefs along coastlines and islands, such as seen in coral reefs in Ranong Province, west coast of Phang–nga Province, and Phai island, Krabi Province;. 2) Shallow–water and deep–water coral reefs in water channels between islands, for example, in water channels between Northern Surin and Southern Surin Islands, in water channels between Similan Island and Bangoo Islands, in water channels between Dam Hok Island and Dam Khwan Island, and in water channels between Rok Nai Island and Rok Nok Island.

The most common damage patterns included flipping, inclination, overturning, breaking and fragmentation of coral parts or branches, resulting from being hit by the waves, and from crashing and banging of various types of vessels and waste, and debris of damaged/collapsed natural materials and man–made items that were carried along the water. Coral reefs that suffered these types of damage included those that were near crowded local community settlements at Phi Phi Don Island, Krabi Province and in the southern part of Patong Bay, Phuket Province. As the sandy bottom slid in slope areas, the corals slid too. Another common pattern is erosion of the seabed, covering the corals with sediments.

Quantitative statistics on coral reef damage in the Andaman Sea, compiled from the survey, indicated that in more than 60.34% of the stations (105 stations), the coral reefs were unaffected or least affected, in 26.44% of the stations (46 stations), they were moderately damaged, and in 13.22% of the stations (23 stations), they were severely damaged. An overviews of the impact in the affected areas or in provincial areas of the Andaman Sea showed that coral reefs in Phuket, Satun, Phang–nga Bay, and Krabi–Trang shorelines (excluding Phi Phi Islands) were less affected, compared with those in Ranong Province, west coast of Phang–nga Province, including Surin Islands and Similan Islands, and Phi Phi Islands in Krabi Province, which were severely damaged.

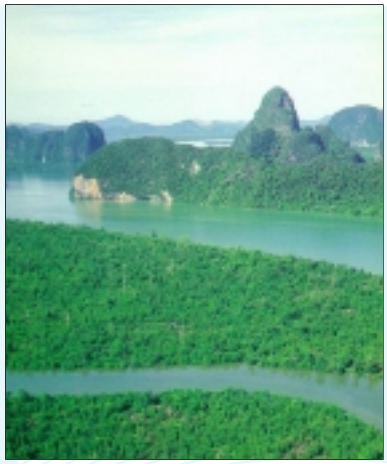
Ranong Province has a total coral reef area of 2.57 sq km, consisting of shallow water coral reefs in the east coast of Pha Yam Island, Khang Khao Island and Kum Islands. Before the tsunami, most of the coral reefs were moderately degraded. However, the coral reefs in Khang Khao Island were in a good condition. After the tsunami, most of the coral reefs were severely broken, flipped, overturned and covered with sediments. At the northeast coast of Kam Yai Island 50 to 90% of the coral reefs were damaged, compared with 80% in the northeast and southeast coasts of Kam Nui Island, and 95 to 99% in the northeast and southeast coasts of Lan Island.

Phang–nga Province has a total coral reef area of 25.6 sq km, covering both shallow water and deep water. The level of damage to coral reefs in the province varies. Some were not affected, while others were severely affected. Most of the damaged coral reefs were found in the coastal zone of the upper part of the province, especially in Surin and Similan Islands. The affected corals were commonly found in the straits or along water channels between the islands. Coral reefs in Chong Khad Bay are situated between northern Surin and southern Surin Islands, a corridor between southern Surin Island and Torinda Island, and in water channels between Ba Ngu (Nine Island) and Similan Island (Eighth Island). Minor to moderate damages on the coral reefs mostly happened as these were on sliding sand on slope areas. They were broken or flipped and their surfaces or bodies were covered by sand.

Phuket Province has a total coral reef area of 16.6 sq km. Most of the coral reefs were least affected or unaffected in some parts, except in the southern part of Patong Bay where 30 to 50% of the coral reefs along the outer sides suffered moderate damages. Most of the damages were caused by the crash of heavy tools and equipments and their weight on the corals. Coral reefs at major diving and tourist attractions, including Waew, Pu, Kata, Karon, Hae, Mai, Thon, Raja Yai and Raja Noi Islands, were least affected and diving and tourist activities went on as usual.

Krabi Province has a total coral reef areas of 13.5 sq km, comprising coral reefs found on the islands, most of them in shallow waters. Coral reefs on the islands, along the shoreline, including Ngang, Hong, Dam Kwan, Ma and Ngai Islands, were least damaged. Coral reefs at the northern part, especially in water channels between Dam Hok and Dam Kwan Islands, at the southern part of Dam Hok Island, were significantly affected by the waves and 30 to 40% of the corals were flipped. Coral reefs in shallow water at Laem Hang Nak, an open shoreline, were moderately damaged. Evidences of the impact of wave action and the crash of heavy items were found. Coral reefs at the outer islands, including Phi Phi Islands at Phai Island, Lo La Na Bay (Phi Phi Don Island) and the eastern part of Phi Phi Lae, were severely damaged. At Rok Nai and Rok Nok Islands, damaged coral reefs were found only in water channels between the islands, through which the tidal waves passed, causing the corals to flip and break and the sandy bottom in slope areas to slide. Coral reefs at diving sites and tourist attractions, including Bida Nok and Bida Nai, Maya Bay (Phi Phi Island), Dam Hok and Dam Kwan Islands, Ngai Island, Hin Muang Island, Hin Daeng and Rok Islands remained in a good condition for tourist and diving activities.

Trang Province has a total coral reef area of 4.5 sq km. Most of the coral reefs (75%) were least affected. However, shallow water coral reefs were affected by the waves, causing 20 to 30% of the corals to flip and stumble. At the southern part of Mook Island, approximately 30% of the corals were damaged. Most of them were *Porites lutea*.



Satun Province has a total coral reef area of 15.8 sq km. Most of the coral reefs were least affected. However, coral reefs in some areas of Adang–Rawi Islands, including Kata Island, and shallow water coral reefs at the southern and western parts of Adang Island, were severely damaged. Overall, there was not much impact on coral reefs used for tourist and diving activities.

The above–mentioned coral reef damages were duly monitored. DMCR and DONP in cooperation with relevant government organizations, the private sector, NGOs, academic institutions and local communities, urgently took joint action to recover damaged corals (turning the corals to the right position) and to clear areas where the affected coral reefs were located. Furthermore, MONRE rushed various types of aid to the local people, including repairing broken ship buoys and establishing additional buoys in areas with insufficient number of buoys so as to prevent anchoring in coral reef areas. In addition, the following activities were implemented: fixing damaged buoys, zoning coral reef areas outside national park areas; cleaning up fish shelter and clearing up undersea rubbish; additional monitoring of the status of coral reefs along the shoreline of Phuket Province; and establishing two diving points in Phuket Province.

In May 2005, five months after the tsunami, DMCR in cooperation with Chulalongkorn University surveyed and monitored the damages. They found coral bleaching in coral reefs at the southern and western parts of Pha Yam Island, Khang Khao Island, Kum Yai Island, Kum Nui Island, Lan Island, Khai Island, and in some parts of Surin Islands in Phakkad Bay, Tao Bay, Torinda Island and Phor Ta Island. It still was not clear if the tsunami caused such damage as coral bleaching could be due to rising temperatures and the impact of tourist activities and need not be directly associated with tsunamis. Deaths may be caused by sediments covering the corals and by suspended particles that prevent sunlight from reaching the corals. Further technical studies should be conducted to figure out if coral bleaching was a direct impact of the tsunami.

MONRE through DMCR has implemented many long–term measures and rehabilitation efforts, including repairing broken ship–buoys and establishing additional buoys to prevent anchoring in coral reef areas, and establishing appropriate diving points to minimize the impact of tourist activities on coral reefs, rehabilitating coral reefs by extending coral reef areas, and expanding areas for attachment by young polyps through the use of artificial corals. Furthermore, the Department also participated in developing zoning and most suitable utilization measures, developing underwater barriers to mitigate the force of the waves, and preventing coastal erosion by using artificial corals.

Mangrove Forests

Impacts on mangrove forests MONRE places a high priority on the rehabilitation of tsunami–affected mangrove forests. The Ministry surveyed mangrove forests in the six affected provinces. It was found that mangrove forest areas located along the shores were directly affected, while those in the inner/inland areas were less affected or unaffected. The level of severity from the waves varied for mangrove forests in estuary areas, mangrove forests at the waterfront/ river banks, and mangrove forests in beach areas.

In general mangrove forests in Phang–nga Province were the most severely damaged, affecting approximately 3.04 sq km (1.5536 sq km in Kura Buri District, 0.84 sq km in Takua Pa District and 0.8 sq km in Tai Muang District). In Ranong Province and Phuket Province, damaged mangrove forests covered 0.24 sq km (0.08 sq km in Sook Samran District, Ranong Province and 0.16 sq km in Phuket). The total area of damaged mangrove forests was 3.216 sq km. The total area for mangrove forests in Andaman coast is 1,808 sq km.

Apart from biological impacts, there are a number of physical impacts on mangrove forest areas included sand deposition, changes of waterflow in channels due to the wave impact, that is, water channels in some areas became more shallow, while others became deeper and wider. The direction of water channels also changed. Sea water became more dull in color and its smell became foul. Furthermore, soil surfaces were washed away and water in the forest was more salty. There were also changes in the physical components of water in mangrove forests. These impacts have the potential to lead to long–term biological damages.

Data from an assessment using micro organisms and water quality as major indicators showed that mangrove forest ecosystem mainly can adjust itself within 6 months after the tsunami. Results from the study on trends of mangrove forest recovery, using Baan Tale Nok area in Ranong Province as example, indicated that seedlings of *Avicennia marina* were found. This was a good sign that mangrove plants are capable of natural self–recovery after the tsunami disaster.

Mangrove Forest, a Natural Fortress that Mitigates the Impact of Tsunami

There used to be some 0.32 sq km of mangrove forest along Phang-nga Bay on Mook Island, Trang Province[1], which was maintained by the local community for a long time until the tsunami struck. Some 14 houses that stood in an area where there was no mangrove forest were destroyed by strong tsunami waves. However, damage to 80 other houses in the village was minor as these were protected by the presence of a mangrove forest. This proves that mangrove forests can actually mitigate the intensity of tsunami waves.

The coastline of Ranong[2] was another disaster area. The tsunami caused severe damage to human life and property and natural resources. However, community settlements in the vicinity of Kasetsart University's Marine Resources Research Station were not damaged because of the presence of dense and healthy mangrove forests.

Areas that suffered the most severe damage included certain districts on Yao Island and Tai Muang along Phang-nga Bay. In the Ya Mi Village community on Yao Yai Island Sub-district in Yao District[3], 15 canals convey seawater to the village. The area has 4 sq km of healthy mangrove forests with abundant plant species that are also important food sources for the community. The forests have been well protected by community regulations since 1987.

A large number of residents and their houses were saved by mangrove forests from the destructive effects of the tsunami. There were no casualties and injuries reported. Most of the houses were only slightly damaged. The forest trees slowed down the surging waves and minimized their destructive effects. After the tsunami, more and more people came to recognize the value of mangrove forests. The community revised relevant regulations to ensure more effective care for mangrove forests and even requested the Royal Forestry Department to designate the forest in the area as a community forest.

The first hand experience of those who witnessed the tsunami disaster clearly shows the value of mangrove forests as natural fortresses that mitigate the disastrous effects of giant tsunami waves.

1 Mr. Pisit Chansanor, President of Yad Fon Society
2 Professor Dr. Sanit Aksornkaew
3 Mr. Prasat Tomai, Community Leader, Ya Mi Village community

DMCR also collected dead plants and revival the damaged mangrove forest areas, including clearing the sediment deposited land. Reforestation program at affected mangrove forests in Phang–nga Province has a total area of 3.04 sq km. Local residents participated in planting mangrove trees in revival areas, approximately a total area of 2.24 sq km, and took part in caring for the growth of planted seedlings. Rehabilitation efforts included the development and installation of signs to show the forest boundaries, planting lines, and preparation of seedlings. DMCR will take future actions and coordinate with other relevant organizations in jointly rehabilitating mangrove forests in affected areas.

Recovery of Seagrass Beds

Data from the survey conducted by DMCR concluded that 5% of seagrass beds on the Andaman coast (with a total area of 57.6432 sq km or 72% of the total seagrass bed areas on the Andaman coast) were damaged by the tsunami, and 1.5% of seagrass beds in the survey areas were completely eroded. The damage included torn leaves, sediments in thin layers on the seagrass, thus reducing photosynthesis and deoxygenation of the lower part, resulting in decomposed/rotten seagrasses, as seen at Li Bong island. The other damage was sand erosion on the edge of seagrass beds, especially in Thung Nang Dam and the northern part of Phra Thong Island, Phang–nga Province. New leaves were found to replace the former ones in the latter area.

Most of the damaged seagrasses adjusted themselves and recovered within six to eight months, as seen in seagrasses at Tali Bong Island, Yao Yai Island (Lo Pa Lai Bay), Ta Lane Bay and Thung Nang Dam–Phra Thong Island. Six months after the tsunami, areas that suffered sand erosion and where the roots and rhysomes of seagrasses had been exposed were able to recover almost to their original state. Areas where leaves were torn off now have new leaves in place. It has been estimated that damaged seagrass beds will return to their original condition within one year without any interruption.

Beach Forest

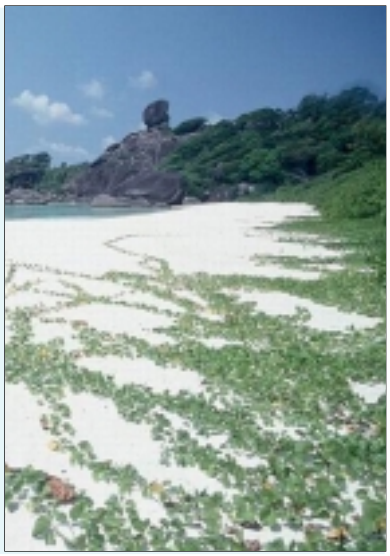
Up to 5.3504 sq km of beach forests were affected by the tsunami. The most severely damaged beach forests (3.4592 sq km) were at Laem Son National Park in Ranong Province. The second most damaged forests (0.8512 sq km) were at Khao Lumpee–Tai Muang Beach National Park in Phang–nga Province.

As part of the rehabilitation plan, DMCR, in association with local administrative authorities, students and local communities, planted some 3,000 mangrove plants and trees, such as *Casuarina equisetifolia, Barringtonia asiatica*, *Pandanus adoratissimus* and coconuts, on 29 July 2005, at Pakarang Peninsular Beach in Kuk Kak Sub–district, Takua Pa District, Phang–nga Province. Mr. Yongyut Tiyapairat, MONRE presided over this activity.

Rehabilitation of Tourist Attractions

Collection of Solid Waste and Debris and Clean–Up Efforts

MONRE and DMCR joined local communities, non–government organizations and volunteers to clean up fishery habitats and to collect underwater solid waste and debris. The activity areas were located within and outside national parks. Some 105 tons of solid waste and debris were collected during the earlier phase of the activity from January to March, on Phi Phi Island, Pai Island, Yoong Island (Krabi Province), Patong Beach, Patong Bay, Karon Beach, Kata Beach, Racha Yai Island, Nai Han Bay, Kamala Bay (Phuket Province), Surin Islands, Similan Islands (Phang–nga Province) and Kum Yai–Kum Nuey Islands (Ranong Province).



National Park Restoration

A preliminary survey by DONP showed that 13 national parks were damaged by the tsunami disaster. Five were badly damaged, including Laem Son National Park (Ranong Province), Similan Islands National Park, Surin Islands National Park (Phang–nga Province), Sirinat National Park (Phuket Province), and Nopparattara Beach–Phi Phi Islands National Park (Krabi Province). Those that were moderately damaged were Tan Bok Koranee National Park (Krabi Province), Pha Yam Islands National Park (Ranong Province), Khao Lumpee–Tai Muang Beach National Park (Phang–nga Province) and Chaomai Beach National Park (Trang Province). Four national parks suffered minor damages, including Lanta Islands National Park (Krabi Province), Khao Lak–Lumlu National Park, Ra–Phra Thong Islands National Park (Phang–nga Province) and Tarutao Islands National Park (Satun Province). The damages cost approximately 4.4 million USD. Three park officials died and five were injured.

Because of the damages to government property, coupled with the need to ensure public safety, MONRE after the tsunami closed certain areas within some national parks and prohibited diving activities. The closed areas were on Khang Khao Island and Kum Nuey Island in Laem Son National Park and Pakkad Bay and Torinda Island in Surin Islands National Park. Four islands were closed on Similan Islands National Park (these being Four, Seven, Eight and Nine Islands). On Nopparattara Beach–Phi Phi Islands National Park, Pai Island and Ton Sai Bay were closed. These have since reopened to tourists.

A Cabinet resolution on 18 January 2005 approved a budget for DONP to clean up tourist spots and attractions and to construct temporary facilities, such as camping grounds for tourists. In addition, the Department was allocated a budget to survey suitable designs for tourist service facilities and to construct anchor buoys to replace those that were lost and/or damaged and restore damaged government property and infrastructure in national parks.

PCD also engaged a consulting firm to study, survey and design appropriate solid waste, night soil and wastewater treatment in the above national parks that were destroyed by tsunami waves. DONP will then carry out the construction. As for solid waste management, the results of the study indicated the need to improve collection efficiency, minimize the amount of waste to be disposed, and use appropriate disposal system. For wastewater, the study recommended addition of essential components to the original system, i.e. septic tank, anaerobic filter tank, and overflow tank. In shops and food shops that do not have appropriate wastewater treatment units, waste and grease traps, septic and overflow tanks should be added to increase treatment efficiency.

Establishment of Environment Protected Areas

Various areas in six southern provinces were severely damaged by the tsunami, affecting natural resources and the environment, the economy and society, and the people's way of life. Restoring and rehabilitating the devastated areas require time and effort. Therefore, MONRE and ONEP envisaged the need to declare the affected areas as environmentally protected areas, as stipulated in the Enhancement and Conservation of National Environmental Quality Act 1992. This is one of the measures to support the restoration and conservation of natural resources and the environment, in addition to providing long–term security to local inhabitants.

On 8 March 2005, the Cabinet endorsed the principle of the draft Notification on Environment Protected Areas and Measures in Tsunami–affected Areas in Ranong, Phang–nga, Krabi, Phuket, Trang, and Satun. Prepared by MONRE, the draft was approved by the Office of the Council of State and endorsed by related agencies. Environment protected areas in Ranong Province covers 36 villages in 9 sub–districts, 40 villages in 8 sub–districts in Phang–nga Province and 25 villages in 9 sub–districts in Krabi Province. The affected areas in Phuket cover 26 villages in 7 sub–districts, 52 villages in 13 sub–districts in Trang, and 54 villages in 11 sub–districts in Satun. The draft is effective for a period of one year after its enforcement in the Royal Gazette. Details of the draft are summarized as follows:

- Control use of beachfront area by permitting only activities that promote marine safety and beach security, beach sport activities that do not create pollution or damage the beach and necessary zoning measures, including designating areas for boat mooring. The activities include those that regulate tidiness and promote safety.
- Control use of sand dunes by permitting only the planting of native or beach plants, establishing new sand dunes to replace lost or damaged ones, and digging and filling sand dunes for the purpose of repairing naturally–occurring damage.
- Control actions that cause pollution and prevailing negative impact on natural resources and the environment, on land and in the water, for the purpose of rapidly restoring natural resources and the environment to their original state.
- Control construction of buildings and other infrastructure by setting appropriate criteria for construction away from the shore and stipulating the height of hotel and resort buildings, so as to prevent further deterioration and to formulate a plan for land use and development.
- Promote actions that enhance environmental quality, by assigning responsible government agencies to restore coral reefs, seagrass beds, seawater quality, in addition to reforesting and restoring and conserving peat swamps.
- Establishment of a committee to oversee the results of protective actions in environment protected areas.

CHAPTER 3

Implementation of the Convention on Biological Diversity

CHAPTER 3

Implementation of the Convention on Biological Diversity

For the past several years, Thailand has implemented various projects and activities to support the conservation and sustainable use of biodiversity. Various agencies have been involved, including the Royal Forest Department (RFD), Department of Agriculture (DOA), Department of Livestock Development (DLD) and Department of Fisheries (DOF). Their respective responsibilities are the protection, research, and utilization of plants, wildlife, crops, livestock and aquatic animals. Although the concept of "biodiversity" might not have been included in their previous tasks, the fact is Thailand has always worked to promote and sustain biodiversity.

Coordinating Mechanism for the Ratification of the Convention on Biological Diversity

Prior to Becoming a Contracting Party

Thailand ratified the Convention on Biological Diversity (CBD) on 31 October 2003. The Convention became effective on 29 January 2004, making Thailand the 188th Contracting Party. Thailand undertook a great deal of preparations for the Convention. Firstly in 1993, the National Environment Board established the National Committee on CBD, with the Permanent Secretary of the Ministry of Agriculture and Cooperatives (MOAC) as the Chair and Office of Natural Resources and Environmental Policy and Planning (ONEP) serving as secretariat. Under the National Committee were working groups assigned to specific issues, such as the submission of a report on the state of biodiversity in Thailand and development of policies, measures and plans concerning sustainable conservation and utilization of biodiversity, and so on.

Secondly, the National Policy, Strategies and Action Plan on the Conservation and Sustainable Use of Biodiversity (NBSAP), 1998–2003, and 2003–2007 were developed and approved by the Cabinet on 15 July 1997 and 11 June 2002, respectively. The NBSAP's detail relevant measures, projects, activities, responsible agencies and budgets in support of the implementation of the Convention.

As a Contracting Party

At present the implementation of tasks related to biological diversity in Thailand is under the supervision of the National Committee on Conservation and Sustainable Use of Biodiversity. As part of the restructuring of government agencies in 2002, the Ministry of Natural Resources and Environment (MONRE) was established by incorporating agencies working on the environment with those under MOAC. On 14 June 2005, the Cabinet approved to revise the 2000 Regulation of the Office of the Prime Minister on Conservation and Sustainable Use of Biodiversity by restructuring the component of the National Committee on Conservation and Sustainable Use of Biodiversity to comply with the new structure, and assigning the Biological Diversity Division of ONEP as secretariat of the Committee.

The Cabinet resolution dated 10 August 2004 stipulated the following:

- Assigned ONEP as National Focal Point for CBD and Cartagena Protocol on Biosafety. The structure and manpower of the responsible unit will be revised so that they comply with the defined tasks and the operations are effective.
- Agreed to revise the Convention ratification mechanism by restructuring the national committees and their responsibilities, including establishing a biodiversity committee in each concerned agency to oversee and steer the implementation of the Convention on Biological Diversity.

- Agreed that concerned agencies accelerate the ratification of the Convention and approve the work plan/project and budget to implement the work program, strategy and initiative related to the Convention.

At present the Biological Diversity Division serves as National Focal Point of the Convention. The division coordinates with the Convention Secretariat to submit a list of Thai delegates to the Conference of the Parties (COP) and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), to organize consultative meetings among various working groups, to develop the National Report and to exchange and disseminate information and work progress in addition to coordinating with concerned agencies.

Protected Areas

Thailand set up a target to have 25% of the country's total land area as protected areas, based on the 7th National Economic and Social Development Board (NESDB) Plan 1992–1996. At present, protected areas declared by Royal Decrees (under the National Park, Wildlife and Plant Conservation Department (DONP) responsibility) account for 20% of the country's total land area.

The system of protected areas has not well established. There is a need to review the effectiveness in protecting biodiversity and legal status of all types in order to establish a national system. The following table lists the types and areas of protected areas.

Types and Areas of Protected Areas 2004

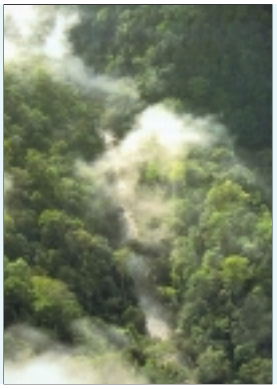
Categories	Refer to IUCN Protected Area Category	Number	Total area (sq km)	Percentage of Total Country Area
By Royal Decrees				
National Park	II	114	63,464.33	12.37
Wildlife Sanctuary	Ia & Ib	59	36,758.53	7.16
Marine National Park	II	27	8,627.62	1.68
Non-hunting Area	VI	55	4409.59	0.86
By Ministerial Declarations				
Forest Park	III	67	870.49	0.17
Botanical Garden	VI	15	58.96	0.01
Arboretum	VI	54	36.08	0.01
By Cabinet Resolutions				
Watershed Class 1 and 2*	I, II, IV & VI		93,090.00	18.14*
Conservation Mangrove*	VI		428.00	0.08
Environmentally Protected Area				
International Recognitions				
World Heritage (nature)*	II	2**		
Ramsar Site*	VI	10***	3,731.80	
Biosphere Reserve	VI	4	261.00+ ...	0.05+..
ASEAN Heritage*	II	2**		

* Total land area (sq km) is not shown because some overlap with other categories, e.g. national park, wildlife sanctuary, and non-hunting area.

** As legal status the World Heritage and ASEAN Heritage sites are either wildlife sanctuaries or national parks.

*** 8 out of 10 Ramsar sites are protected areas.

Source: DONP, 2004: ONEP, 2004: ICEM, 2002



Proposed additional protected areas

Terrestrial forest ecosystems: DONP has identified 48 unfragmented forest areas to be declared as national parks. Four are intended as wildlife sanctuaries. Each area covers at least 10 sq km. Some are adjacent to existing national parks or wildlife sanctuaries.

Marine and coastal ecosystems: The Department of Marine and Coastal Resources (DMCR) has identified 60 sq km of mangrove forests to be declared as protected mangrove forests. These will be managed with the participation of community members, thereby earning themselves a living. The Department has also set up a target of 300 sq km to be declared and managed as protected marine areas. In addition, the DMCR has been working with stakeholders and communities in Koh Pra Thong Island, Phang–nga Province. The goal is to put the principle behind CBD's protected marine areas into practice, enabling the declaration of the island as a new integrated/ protected marine area.

Both the Andaman Sea and the Gulf of Thailand are well covered by the existing protected areas. However, management principles for marine national parks need to be reviewed. This is because the national marine park is based on a terrestrial park legislation, the National Park Act 1961 which prohibits gathering of park resources. As this regulation is not practical in terms of generating community livelihoods, conflicts in management arise. It is expected that the national review system, will be able to suggest a new management regime that is in line with recommendations in COP decision VII/28.

Inland water ecosystems: A number of natural and artificial rivers, lakes, ponds, swamps have been declared as part of national parks, wildlife sanctuaries or non–hunting areas. According to the wetland categories (ONEP 1999), all Thai wetlands can be further divided into three categories depending on their level of importance, that is, International Importance (61 sites), National Importance (48 sites) and Local Importance (19,295 sites). Ten sites of International Importance have been designated as "Ramsar Sites". ONEP is the leading agency working with other agencies at the national, provincial, and local levels toward expanding and strengthening wetland conservation (refer to the Ramsar Convention). Hence, ONEP is working steadily towards the establishment of a national system to protect Thai wetlands. Integration of protected wetland areas into the national protected area system can be done with protected marine areas. More can be achieved in the latter part of 2006.

Joint Management of Protected Areas

DONP has informally adopted an ecosystem management approach to test its principles concerning protected area management under the project, "Joint Management of Protected Areas (JoMPA)". This project can be considered as the second phase of the Thai–Danida Project "Western Forest Complex: An Ecosystem Approach (WEFCOM)". The conceptual framework of the JoMPA project is geared to promote and test the integration of protected areas into broader land and seascape use, as mentioned in COP decision VII/28. The mechanism and principle of the project referred to the 12 Principles of the Ecosystem Approach in COP decision VII/11. In the first year of the project in 2005, JoMPA worked closely with various partners such as government agencies, particularly the governor and various development sections, NGOs and local communities in and around the Western Forest Complex, to formulate a strategy plan for the whole WEFCOM, known as "the WEFCOM Integration Conservation Management Strategy". In its third year, the JoMPA will replicate the process undertaken in WEFCOM in other protected area complexes, both terrestrial and coastal ecosystems. Details of the JoMPA and WEFCOM projects are presented at www.forest.go.th or e–mail: paiu_jompa@yahoo.com.

In addition to the JoMPA, DONP has requested MONRE to review its structure, roles and functions to emphasize and facilitate an administrative mechanism towards forest complexes. If the proposal is adopted, the result will be a new DONP structure that decentralizes national responsibility for protected area planning and policy to regional levels. Taking into account Thailand's current protected areas, the country can be classified into 19 forest complexes. Details can be found at www.mekong–protected–areas.org or www.forest.go.th.

World Heritage Sites

United Nations Educational, Scientific and Cultural Organization (UNESCO) 's designation in July 2005 of the Dong Phayayen– Khao Yai Forest Complex as the 2nd Natural World Heritage Site in Thailand has positively attracted MONRE's decision makers to the advantages of the ecosystem approach. DONP is now able to continuously campaign and raise awareness not only of the value of world heritage but also of the principles of the ecosystem approach to wider groups of stakeholders, in particular provincial and local government authorities. The next step for DONP is to work towards forest complex planning at others sites, including (1) Kaeng Krachan Forest Complex (adjacent to the tropical forest in Myanmar, the largest habitat for the Bengal Tiger), (2) Phu Khieo–Nam Nao Forest Complex, (3) Klong Saeng–Khao Sok Forest Complex, and (4) Andaman Sea Marine Complex.

Financial Support for Protected Areas

Through the DONP the Government provides financial support for protected area management in Thailand. In 2004 and 2005, the total amounts of 194.87 and 198.69 million USD were allocated to DONP. The budgets supported human resources, investment in and management of protected areas, biodiversity research, nature education, tourism services and development, and local investments.

Budgets for protected areas and additional budgets for infrastructure development are provided by local government authorities, such as the Provincial Administration Organization (PAO) and Tambon Administration Organization (TAO: sub–district level). PAO and TAO receive direct budgets from the national Budget Bureau at approximately one–third of the entire national budget each year. They generate their own incomes from the local system of taxation. In addition to these incomes and budgets, the TAO also receives 5% of all national park revenues every year. This sharing of park revenues started in 1997. The money is transferred to the TAO via the Department of Local Administration, Ministry of Interior.

In order to improve the mechanism for protected area management, the idea to incorporate tourism development in protected areas will be implemented by a special semi–government unit. The idea, first raised in 2002, is an initiative of a public organizations office and is known as "Authority for Ecotourism Development in Special Areas". The first pilot case was at Chang Island National Park in Trad Province. The principle of public organization is geared towards making organizations self–supporting, although in the beginning the budget will be allocated by the Government. After a few years of piloting a case in Chang Island, the Government added Phi Phi Island as another pilot site, following the tsunami in December 2004. The report has been drafted and underway is a study to review the organization's effectiveness, in term of reducing national park responsibilities and increasing visitor satisfaction during visits to pilot destinations.

Improvement of Protected Area System

Thailand recognizes the need to effectively evaluate protected areas, their management and governance. It has been planned to formulate, together with the project, a review of the national protected area system and plan.

The effectiveness of management and governance evaluation has been systematically introduced to all government organizations by the Government. DONP as a member of this new system has to reshape itself and to adopt the system in the management and governance of protected areas as well.

In 2004 concerned government officials requested to announce the use of Warranty of Performance Responsibility (WPR). The MONRE Minister submits the WPR to the Prime Minister, the DONP Director General to the Minister, the Director of National Parks Division to the DONP Director General, and the Chief of a protected area (national park) to the Director. The system is more complicated at the provincial level as the chief of a protected area submits the WPR to the CEO Governor. Targets and performance indicators that need to be measured and are time–bound are stated clearly in each WPR. DONP's performance indicators in 2005, for example, showed that 178 critical ecosystem sites were better protected, captive breeding was carried out for at least five species of rare/endangered and economically useful wild flora and fauna, and 80% of visitors were satisfied with the park's services. However, while drafting this report has been completed, the WPRs have yet to be evaluated.

Ecosystem Approach

As part of the country's national effort, Thailand supports the promotion of the ecosystem approach (EA) through various ASEAN and the Mekong River Commission (MRC) mechanisms, such as the Ministerial Meeting on Nature Conservation. The application of EA to ASEAN agreements related to biodiversity conservation is under discussion.

At the implementation level, Thailand works with international organizations, in particular the International Tropical Timber Organization (ITTO), World Wildlife Fund for Nature (WWF), Asian Development Bank (ADB) and World Conservation Union (IUCN), in promoting EA across national borders. Some projects are the Thai–ITTO Pha Taem Protected Forest Complex which aims to obtain cooperation for transboundary protected areas among Thailand, Laos PDR, and Cambodia, and the Greater Mekong Sub–region (GMS) Development. As the Mekong River runs through China, Myanmar, Lao PDR, Thailand, Cambodia, and Vietnam, Thailand along with other Parties in the region promote and apply EA principles in development projects that directly affect the river. Details concerning the GMS are presented at www.adb.org/Projects/GMS–biodiversity.

Since the EA has been informally and partially adopted as a new paradigm for natural resources management and conservation in Thailand, several programs and projects implemented by government agencies and NGOs have facilitated and promoted capacity building, exchange of experiences, transfer of know–how, and raising public awareness of EA implementation.

Nevertheless, it is important to note that most of these projects do not refer to the 12 EA principles and are normally focused on Principles 2, 3, 5, 6, 10, 11, and 12 only. This incomplete treatment is due partly to a lack of awareness of CBD and relevant decisions.

Examples of current programs that promote and support the exchange of experiences, capacity building, technology transfer and raising of EA awareness are as follows:

- DONP promotes EA as a new paradigm for protected area management under the Joint Management of Protected Areas. Key target actors are not only the department's national and regional staff and the staff of target protected areas, but also local communities and NGOs that are involved in implementing the project.
- DMCR initiated the Phang–nga Bay Management Project to promote communities, NGOs, and government agencies.
- The Thai–EU Coastal Habitat and Resource Management (CHARM) is another project that applies the ecosystem approach.

The reform of the Government structure, from a sector–based to an area–based approach, was finalized in 2003. However, after two years the Government is now considering restructuring its institutions once again. This current effort includes reviewing and developing new legal frameworks to support and promote decentralization, to establish facilities and mechanisms for public participation and to introduce a paradigm shift in managerial authority to integrate conservation, sustainable use, and development.

Restoration of Biodiversity

DMCR rehabilitated seashores and mangrove forests that were affected by the tsunami. The most affected coastal areas were in Phang–nga Province, covering the coasts of Phra–Thong Island and Kor Khao Island, beach areas in Kuk Kak, Bang Niang, Nang Thong, Khao Lak and Tai Muang, and the Tab Lamu port. Damages in these areas were due mainly to the fact that the coastline was parallel to the wave front and the sea bottom slope was low. The situation was aggravated by the large population density in coastal areas. The reforestation project covered approximately 2.3104 sq km, including areas in Phang–nga province (1.6704 sq km), Trang province (0.32 sq km) and Satun province (0.32 sq km). The project aimed at community participation in the reforestation of devastated areas and preservation of trees.

In Phang–nga province, some 3.1136 sq km of mangrove forests were damaged, including those located near the sea and islands and those along large canals that were affected by the force of sea waves. Other areas were less severely damaged. In Phang–nga province, affected mangrove forests, covering some 3.04 sq km, have been restored by cleaning up the forests and removing uprooted trees. Local communities participated in the project. They recognized the need for proper utilization of mangrove forests and beach forests and their effectiveness in intercepting the tsunami.

Conservation of Species Diversity

About 10% of coral reefs in the Andaman Sea, covering approximately 8 sq km, were destroyed by the tsunami. Most of the affected areas were in shallow seacoasts and in places that were besieged by the strong tide. Coral reefs between channels and islands which were hit by the strong tide were damaged. Coral reefs around the gulf, where the population density was high, were also damaged by the collision of demolished buildings and submerged equipment. DMCR cooperated with the private sector, including tour agencies, hotels and individual Thais and foreigners. More than 2,000 diving volunteers joined rescue efforts and gathered debris and solid wastes under the Andaman seabed. Corals were turned face up. The volunteers brought back coral branches and broken coral heads, eventually taking them back to the seabed.

DONP proposed a national master plan for wildlife resource conservation for the period 2005–2014 B.C. The Cabinet approved the plan on 25 October 2005. The overall objectives were to set up an effective system for the administration of wildlife resources in Thailand, to protect and maintain natural resources and wildlife habitats, to breed rare and endangered wildlife, and to promote and encourage the government, private sector and the public to participate in conservation, breeding and rehabilitation of threatened wildlife. There is a need to update the database and to develop systematic research in the next ten years.

The strategies include the following components:

- Research and collection of technical information, including building a wildlife and ecological system database.
- Administration and conservation of sustainable wildlife resources.
- Protection of the biodiversity of wildlife resources and ecological system.
- Sustainable utilization of wildlife resources.

For the past three years, the Thailand Institute of Scientific and Technological Research (TISTR) has been conducting a project concerning the conservation and breeding of rare and endangered native fragrant flowering plants. Under the project, mature seeds, seedlings and cuttings of some 30 varieties of native fragrant flowering plants throughout the country are gathered. Seeds and cuttings produce seedlings for the nursery stock. Seedlings that survive *ex situ* in the plains are cared for at the institute while seedlings that require further care are sent to the Queen Sirikit Botanical Garden in Mae Rim District, Chiang Mai Province and Inthanon Royal Project Foundation in Jom Thong District, Chiang Mai Province. The seedlings are then shared with institutes that are members of the fragrant and flowering plants network, to be planted for educational purpose and for sustainable conservation. Technologies for breeding, planting and maintenance of different plant varieties are transferred to the network's institutes and to interested members of the public. A book about rare and endangered species of native fragrant flowering plants in Thailand will be published.

Conservation of Genetic Diversity

DLD has surveyed and classified plants that are used as feed for native animals and micro–organisms. Also being carried out is the development of organic livestock in order to achieve conservation and sustainable use of biodiversity, in addition to registration and approval of animal breeds. The Department has implemented projects to raise public awareness and generate public participation in conservation and utilization of genetic resources of livestock. The National Pet Festival and the National Buffalo Festival are examples of such projects. The Department has formulated the draft Enhancement and Conservation of Native Animal Breeds Act. The Act includes principles and concepts that support the administration of biodiversity resources (animals), in accordance with the commitment of the CBD. This is useful for internal administration purposes.

RFD protects the genetic resources of forest trees by preserving these in a vegetation bank, as well in *in situ* and *ex situ* natural habitats. An example is the conservation of the genetic resource *Pinus merkusii* at Nong Ku Village in Sangkhla District, Surin Province and in Kong Jiam District, Ubon Ratchathani Province. The Department is also engaged in collecting branches and seeds from the genetic resources of approximately 27 plant varieties for planting forests, such as *Dalbergia cochinchinensis*, *Chukrasia velutina*, *Dipterocarpus turbinatus*, *Dipterocarpus alatus*, and others. These are in addition to 11 significant and rare species, such as *Masonia gagei*, *Dipterocarpus gracilis*, *Diospyros mollis*, and so on.

Access to Genetic Resources and Benefit–sharing

The Plant Protection Act 1999 stipulates the protection of both specific and general native plant and forest species. DOA has set up a ministerial regulation concerning access to and utilization of such species. The money earned is deposited to the plant protection fund, which is intended to help and support activities related to the conservation, research and development of plant species. It is also shared with communities that conserve such plant species.

The Department is developing guidelines, methods and conditions concerning applying for permits, collecting/gathering general native or forest plant species, and the agreement concerning benefit–sharing. Also, the Department is formulating guidelines and methods for community registration and registration of special native flora, including establishing national mechanism for exchanging data in order to enhance sustainable conservation and use of genetic resources for food and agriculture under a project of the Food and Agriculture Organization (FAO) of the United Nations.

As for the overall regulation on accessing and sharing the benefits of utilizing genetic resources, ONEP studied and evaluated relevant factors in 2004–2005 by looking into the present situation in Thailand and comparing it with relevant international agreements involving regulations and legislations in other countries. The legislation and mechanism for administration of biological resources by government agencies were also studied. The Office requested for comments from experts and involved persons and consequently formulated a draft regulation of the committee on conservation and use of biological resources concerning guidelines and methods to provide access and to share benefits from biological resources regulation. The objective is to set up guidelines for administration, accessing and sharing of benefits from utilizing genetic resources. Details are presented in Annex I. To gather relevant recommendations, the draft was presented at a meeting with concerned agencies, such as DONP, RFD, DOF, DLD, DOA and universities, including the private sector. The draft will support the creation of awareness among all agencies and will create negotiating mechanisms for benefit–sharing from research on biological resources. In the past, the benefits were intended for a few persons and research institutes only not for the entire nation.

Biosafety

By the authority of the Plant Quarantine Act 1964 and its amendment, DOA restricts the import of genetically modified organism (GMO) plants into the country for experimental or research use only.

To evaluate Thailand's overall performance in observing biosafety, ONEP has compiled data on the import–export of GMO related materials and products. The Office also considers and revises rules and regulations and looks into the enforcement of biosafety as basis for the formulation of the draft Biosafety Ligistation of Tahiland 2004–2005. Details are presented in Annex II. The Office has also consulted with relevant agencies to establish a National Focal Point and a Competent National Authority for the Cartagena Protocol on Biosafety. Preparations at the national level are on–going so that Thailand can access and use data pertaining to different agencies and exchange information with the Convention's Secretariat Office and other countries.

ONEP has submitted the draft legislation on national biosafety to the Committee on Development of Laws on Biosafety, which is chaired by the Permanent Secretary of MONRE. Information and recommendations provided by many agencies, such as the DOF, DLD, DOA, Kasetsart University and Office of the Council of State, will be used to finalize the legislation.

Biotechnology

Thailand's National Biotechnology Policy Framework (2004–2011) was endorsed at the first meeting of the National Biotechnology Policy Committee (NBPC), chaired by the Prime Minister. The meeting was held on 23 December 2003. The Framework, which provided guidelines for concerned agencies, demonstrated that Thailand's strength in biotechnology will be fostered, alongside improvements in the country's economic competitiveness and the upgrading of biotechnology personnel. As well, the Framework was intended help to create significant intellectual capital, a key factor for propelling Thailand into a knowledge–based economy in the coming era.

Biotechnology development in Thailand shows high potential, complemented by a series of on–going projects that have been effectively carried out. In this connection, the NBPC decided to draw up the Framework for a period of six years (2004–2009) and to establish six sub–committees to implement the six goals identified in the Framework. At the second NBPC meeting on 20 August 2004, major biotechnology policies were approved, including the establishment of Thailand's first biotechnology park and implementation of genetic engineering and biosafety alternatives.

The progress achieved by the six sub–committees, the Office of the NBPC Secretary, and other responsible agencies is summarized as follows:

Goal No. 1: Emergence and Development of New Biob–Business

- NBPC has assigned the National Science and Technology Development Agency (NSTDA) to establish a biotechnology park to attract both domestic and overseas investments. The Cabinet supported this move, reflecting the Government's policy to push forward economic initiatives and to encourage the private sector to invest in biotechnology research and development. Over 100 new biotechnology companies are expected to be established by 2009.
- Other indirect goals have been supported as a result, including market promotion in neighboring countries, large–scale research and development by agencies overseas, and expansion of existing biotechnology research and development activities.

Goal No. 2: Biotechnology Promotes Thailand as Kitchen of the World

- Establishment of the Committee on Shrimp Cluster Development to initiate networks of concerned agencies in the shrimp development industry.
- NBPC has endorsed a bioengineering policy that focuses on "providing alternatives to the society".
- The Cabinet recognized that subject areas concerning Genetically Modified Organisms (GMOs) and biosafety are important as they affect the people's occupations and way of life. However, knowledge of these areas has not been widely disseminated and seen from different viewpoints. A conference among experts was organized to identify appropriate solutions.

Goal No. 3: Thailand Represents Healthy Community and Healthcare Center of Asia

- Thailand has a strategy to solve the bird flu problem and a strategic plan to handle the outbreak of bird flu. This goal has been approved by the Cabinet.
- There is cooperation among the government and private sectors on the development of bird flu kits.
- Knowledge of science and technology should be promoted to create public health security nationwide.
- There is a large investment on genome and bioinformatics.

Goal No. 4: Utilization of Biotechnology to Conserve the Environment and to Produce Clean Energy

- NBPC agreed to make the Ministry of Energy as key host in promoting biogas production from wastes from pig farms and the food industry, in order to alleviate the waste problem and minimize the nation's dependence on fuel energy. At present 28 pilot factories are participating in the project to produce alternative energy from wastes from pig farms and the food industry. The project is financially supported from a grant and a low–interest loan.
- The Ministry of Energy has formulated policies to promote the use of gasohol and to support the growing of plants for the energy project. The Ministry of Agriculture and Cooperatives supports farmers to grow up to 16,000 sq km of palm oil by 2008. The oil will be used as alternative energy.

Goal No. 5: Biotechnology as Key Factor for a Self–Sufficient Economy

- To set up science communities in 60 provinces around the country.
- Practical use of biotechnology is applied in different areas, such as biodiversity conservation, improvement of local crops and economic plant species of the community such as Torch Ginger, ginger, and orchids.
- Quality of products, safety of community food, biofertilizer production and community solid waste management, and so on are improved.

Goal No. 6: Development of a System to Produce Qualified Human Resources

- No less than 5,000 personnel will be engaged as professional biotechnology researchers in the public and private sectors. The "Who is Who" in biotechnology will be revised. At present the database includes 1,100 experts.
- To begin to develop a curriculum on biotechnology in academic institutions.
- To establish projects in the development of research officers in neighboring countries and in policy research to establish proposed measures to develop human resources in biotechnology as required by the market.

Progress and success came as a result of cooperative and collaborative efforts among various concerned agencies, including those in the government, private sector and local community.

Clearing House Mechanism

ONEP has established a mechanism for accessing and transferring information on biological diversity. The mechanism can be used and connected to enable the exchange of information on biodiversity in other countries. In addition, work on various topics under CBD was carried out and this can be accessed through the website http://chm–thai.onep.go.th. Some of the topics are global strategy for plant conservation, global innovation in taxonomy, protected areas, performance of involved agencies, directory of biodiversity experts, and database of biodiversity in Thailand.

The information on biosafety can be accessed through http://bch–thai.onep.go.th. This website is connected with sources of information and news on biosafety in Thailand and abroad. This effort conforms with the country's commitment to CBD and the Cartagena Protocol on Biosafety, especially concerning dissemination of information on biosafety and administration of GMO, including technical data on biosafety from DOF, DLD, DOA, and basic information on biosafety. This effort is a part of preparations prior to ratifying the Cartagena Protocol on Biosafety.

Research on Biodiversity

The Biodiversity Research and Training Program (BRT) was one of the projects funded in 1996 by the Thailand Research Fund and the National Center for Genetic Engineering and Biotechnology. During 1996–2005, 308 projects were supported with a budget of approximately 7.65 million USD. These included 461 Master and Doctoral degree theses with a budget of 1.42 million USD; 183 short training programs with a budget of 0.32 million USD; 101 information management projects with a budget of 10.96 million USD; and two special projects with a budget at 1.26 million USD. Some 535 papers were accepted and published in both international and Thai journals (456 international journals and 79 Thai journals). Up to 461 students graduated with Bachelor, Master, and Doctor of Philosophy degrees, and 60 textbooks and 220 articles were published.

Researches under the BRT project led to the discovery of 548 new species and compiled up to 3,539 types of specimens and more than 20,000 reference collections.

At present, the project is aimed at supporting research by expanding area–based research related to local biodiversity in Thailand, as for example, projects to identify biodiversity at Western Thong Phaphum, Kanchanaburi Province southern islands and Kanom, and Nun Mountain, Nakhon Sri Thammarat Province.

Technical and Scientific Cooperation

ONEP and CBD Secretariat organized the 10th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA–10) and the Third Ad Hoc Open–ended Working Group on Access and Benefit–Sharing (WG ABS–3) at the UN Convention Center on 7–11 February and 14–18 February 2005. There were some 800 delegates and participants.

The SBSTTA–10 adopted 13 recommendations which will be submitted to the Conference of the Parties at the eighth meeting in March 2006 in Brazil.

At the SBSTTA–10, Dr. Chaweewan Hutacharoen, Director of the Forest and Plant Conservation Research Office, DONP, was selected as a number of the SBSTTA Bureau as representative from Asia and the Pacific Region. Her responsibility will cover SBSTTA–11 and SBSTTA–12.

For WG ABS–3, the participants brainstormed on international regimes concerning access to and benefit–sharing of genetic resources. Various definitions were revised and a matrix was developed. Further comments were presented at WG ABS–4 in Spain in January 2006.

Some 50 Thai delegates from different agencies joined the meetings which provided opportunities to strengthen Thailand's capacity to implement the Convention. In addition they established connections and relationships between the Thai and international scientists. Thailand also built up its image as an "international conference center" for the world. Lastly, the meetings reflected Thailand's efforts to conserve and utilize biodiversity in sustainable ways that comply with the objectives of the CBD.

Sustainable Use: Herbs

The Department of Medical Sciences (DMSC) carried out research on 12 species of medicinal herbs, i.e. *Curcuma longa*, *Andrographis paniculata*, *Butea superba*, *Kaempferia parviflora*, *Morus alba*, *Hibiscus sabdariffz*, *Cassia alata*, *Zingiber cassumunar*, *Centella asiatica*, *Piper nigrum*, *Garcinia atroviridis*, and herbal massage bag. The research emphasized the effectiveness of medicinal herbs.

DMSC has conducted other research studies related to the effects of medicinal herbs on the memory, healing of inflammation, and dental health. As for the production of medicinal herbs, there have been many research studies on genetic selection, entailing the use of DNA micro satellite markers and hormones to increase the production of medicinal herbs, establishment of community networks for the cultivation of medicinal herbs, and production of high quality medicinal herbs as raw materials. The research included the marketing of medicinal herbs products.

As for traditional Thai medicine, there have been research studies on the use of hemps and mushrooms as drugs. A study of various ancient medical recipes includes their clinical characteristic to cure cancer and so on.

Many research studies on medicinal herbs are supported by the National Science and Technology Development Agency (NSTDA). The research studies concentrated on the production of medicinal herbs as raw material for agricultural purpose, active chemical components active chemical tests of medical herbs, quality assessment, and basic knowledge.

Medicinal herbs research

Benefits to Health	Medicinal Plants
Resistance to cancer	*Ganoderma lucudum*, *Murdannia loriformis*, *Rhinacanthus nasutus*, *Jatropha curcas*, *Morinda citrifolia*, *Trichosanthes cucumerrina*, *Ericybe coriacea*, *Azadirachta indica* var. *siamensis*, *Botryllus schlosseri*, and sponges, *Eulophia graminea*, five herb species recipe
Resistance to HIV virus	*Momodica charantia*, *Murdannia loriformis*, *Gynura divaricata*, *Trichosanthes cucumerrina*, *Gynostemma pentaphyllum*
Reducing sugar in blood	*Gynostemma pentaphyllum*, *Murdannia loriformis*
Remedy for cholecystitis	*Fimbristylis miliacea*
Resistance to hemorrhoids	*Cissus quadrangularis*
Nervous and endocrine system	*Morus alba*, *Curcuma longa*, *Piper nigrum*
Remedy for arthritis	*Curcuma longa*
Oxidation reaction inhibition	*Gymnema inodorum*
Inflammation inhibition	*Acanthys ebracteatus*
Remedy for heart and blood vessel disease	*Tinospora crispa*

Studies by NSTDA focused on medicines for humans and animals, covering such topics as the effectiveness of polysaccharide gel from durian shale in resisting cancer, raw pharmaceutical material from nature, and so on.

Medicines intended for animals that are the subject of a study include a bird flu vaccine, anti–microorganism drugs for animals and probiotic to enhance animal health, and development of vaccines to protect certain diseases in chicken.

Nowadays, many medicinal herbs are used in the production of cosmetics. NSTDA plays an important role in this field by researching and developing the use of tea seeds to produce clean skin and hair, producing cosmetics from *Kaempferia parviflora*, producing scented oil and tamarind, and studying the technology for aloe extraction in cosmetics. Other research studies focus on producing spa products by using *Citrus hystrix*, making scented oil for aromatherapy and relaxation, and producing aromatherapy products from medicinal herbs.

Medicinal herb researches supported by the National Science and Technology Development Agency

Production of Medicinal Herbs as Raw Materials for Agricultural Purpose

- raw material production of *Jatropha gossypifolia*, *Stephania suberosa*, *Gynura divaricata*, *Centella asiatica*.
- study of nutrients and environmental factors that affect the growth of medicinal herbs, for example *Curcuma longa*, *Abelmoschus esculentus*, *Cassia alata*, *Centella asiatica*, *Andrographis paniculata*, *Garcinia atroviridis*, *Kaempferia parviflora*, *Morus alba*, and *Piper nigrum*. Study of causes of heavy metals contamination during the production of medicinal herbs, such as *Andrographis paniculata*, *Cassia alata*, *Centella asiatica*, *Hibiscus sabdariffz*, *Morus alba*, *Butea superba*, *Kaempferia parviflora*.
- support the processing of medicinal herbs and standardization of extraction technology.

Chemical Composition of Active Chemicals

- study of chemical composition of Leguminosae.
- analysis of active chemicals in tea.
- analysis of antioxidant in *Mimusops elengi*, *Syzygium cumini*, and *Telosma minor*.

Active Chemical Test of Medical Herbs

- prohibition of carbohydrate absorption.
- pest control.
- diabetes resistance.
- pharmacological value of herbal tea.
- effect of aloe agar on the production of collagen in cells separated from gills.

Quality Assessment

- quality assessment of medicinal herbs that are champion products.
- quality assessment of medicinal herbs used in spa and aromatherapy business.

Basic Knowledge

- composition and properties of rare medical herbs such as *Jatropha gossypifolia*, *Stephania suberosa*.
- database of scented oil.
- database of two– and three–dimensional structure and search system for the chemical structure.
- chemical content of medicinal herbs, i.e. *Piper sarmentosum*, *Cocos nucifera*, *Cinnamomum bdjolghota*, and development of standards.
- knowledge of DNA fingerprints on medicinal herbs.

Private Sector Participation

MOAC has taken the initiative for a reforestation project to commemorate the anniversary of His Majesty the King's 50th Year of Accession to the Throne in 1994. The main objective is to carry out reforestation in forest areas totalling 8,000 sq km around Thailand. PTT Public Company Limited is the main collaborating company in this forest planting project. The company's objective is to plant the forest and rehabilitate deforested areas during 1994 to 2005. The company has achieved its objective, having planted forests in 410 plantation areas in 48 provinces. The rehabilitation project covered 1,621.9968 sq km in 48 provinces, 1,479.424 sq km of forests, 103.7152 sq km of mangrove forests and 38.8576 sq km of peat swamps.

The Bangchak Petroleum Public Company Limited is one of the companies that supports forest rehabilitation projects, such as the project, Seedling, Return the Forest to Phu Long. Under the project to rehabilitate forests and water sources at Lam Pa Tao (Phu Luang), seedlings are cultivated by students and the company buys the seedlings for planting. The objective of this project is to increase the number of trees, totaling over 10,000 trees, by May 2006.

PTT Reforestation Project

The goal of the reforestation project is to restore the forest. Planting takes one year while maintenance work could run up to two years. Once the project is finished, the forests are turned over to DONP for closer care. Other related projects are the "save the forest" awareness campaigns directed at communities. Forest communities take care of the forest forever.

There are ten other supportive activities, such as the PTT youths love forest project, forest fire prevention volunteer project, PTT village development, save the forest long–term fund, forest protection local volunteer project, research and evaluation, public relations, green heart and green globe.

The objectives of the PTT Youths Love Forests Project are to educate and create awareness among teenagers and students who live around city and near PTT forest plantation areas. As a result, teenagers and students will have better awareness of the need to love the forest and to protect wildlife and nature. The project also gives teenagers and students opportunities to take care of forests. There are school opportunities for practical occupational training in agriculture and for selling agricultural produce in the market to increase family incomes. As of 2004, 187 training activities were organized for 717 schools, benefiting some 30,000 people.

The objective of the Forest Protection Local Volunteer is to support Her Majesty the Queen's project, Forest Guarding the Flag. Training is provided for people who live around forest areas to protect and look after the forest. A strategy to save forest areas forever, the project summons the people's respect for His Majesty the King as their source of inspiration to care for the forest. There are 94 training programs. Some 11,061 volunteers and four outstanding members will receive 23 flags.

The project on public relations seeks to stimulate awareness among the local people of the importance of forests, inspiring them to plant forest tress and take care of the forest forever. Media used in this project include newspapers, radio, television and exhibitions.

The objective of the Green Globe Project is to encourage the people in a given community to prevent the degradation of natural resources and the environment. This activity has creative components that promote annual forest conservation. The award is the Green Globe.

"Seedling, Return Forest to Phu Luang" Project

Phu Luang forest is on Phu Lan Ka Mountain at That Thong Sub–district, Phu Kiew District, Chaiyaphum province. This area used to have an abundance of forests. The forest area has since been reduced to dry forests, after ending 30 years of forest concessions with the Forest Industry Organization (FIO).

Phu Luang forest is rich in water resources and is a source of food for the local community. Food is in abundance and plants thrive, including mushrooms, young bamboo sprouts, native vegetables and medicinal plants. These generate income for the people in the community. There are diversity of plants, birds and wildlife, consisting of over 180 species. This is one important area that should be studied by the environmental community.

The forest area is includes land that was originally used to grow corn, potato, sugar cane and other crops. Some areas are burned during the harvest season and cause forest fires. Illegal logging is a problem that has drastically reduced the number of trees and natural food resources in the area, including seedlings and seeds. It is also associated with the burning of animals. Aridity occurs because of deficient water resources, depriving the local people of drinking water supply.

The Bangchak Petroleum Public Company Limited intends to create community forests and to apply sustainability as a strategy for living in the forest. The company is concerned about the rehabilitation of forests and water resources at Lam Pa Tao (Phu Luang). Student volunteers who live around the company's refinery as well as students from Phu Kiew District, Chaiyaphum Province, are engaged to promote the cultivation of local plants in the communities. They cultivate seeds until these become seedlings and are bought by the company and brought to different plantations in the area.

The project period will end in May 2006. The results are expected to increase the number of trees to more than 10,000, to make students living in communities near forest areas aware of the value of forest resources and to inspire them to take responsibility for the environment and for social development. Moreover, students gain better understanding of basic cultivation techniques and earn incomes from the sale of seedlings as well.

Non–government Agencies Involvement

Various non–government agencies (NGO's) have worked in Thailand for a long time to raise up public awareness on biodiversity conservation. WWF Thailand is one of these agencies that works for "wildlife Trade Campaign" which produced successful and practical outcomes in dealing with illegal wildlife trade between 2000–2004. The Wild Animal Rescue Foundation of Thailand (WAR) aims to rescue wild animals and work out the campaigns against hunting and cruelty to wild animals. The agency is recruiting volunteers to assist the team of researchers to investigate the decline of sea turtles along the Andaman coastline focusing Baan Talae Nork in Ranong Province. The project activities include monitoring the beaches, educating on conservation and rehabilitating wildlife at Wild Animal Rescue and Education Centre.

Bird Conservation Society of Thailand (BCST) has it objective to advance the knowledge of birds through birdwatching, education and field projects. The agency has been known because of its Saving Gurney's Pitta Project which supervised a youth camp for raising conservation awareness amongst schoolchildren.

Wildlife Conservation Society (WCS) has carried out the Tiger Project in Thailand since 1997 to monitor tiger population in the wild focusing the Huay Kha Khaeng and Thung Yai Wildlife Santuaries, the World Heritage Site. The agency also builds monitoring system for tiger conservation in Western Forest Complex.

CHAPTER 4

Biodiversity Loss

CHAPTER 4

Biodiversity Loss

Thailand's biodiversity has long been under threat. One reason for this is the practice of slash and burn agriculture and misuse of land originally intended for agriculture. For example, many ponds have been transformed to give way to development projects such as mining, dam construction, collection of forest products (such as wild orchids) and poaching (including bird hunting and egg picking). All these activities contribute to the destruction of biodiversity. Biodiversity in tourist areas has also been damaged due to the accumulation of solid waste, heavy pollution, collection of shells and fishes, and so on.

Threatened Species

Threatened species in Thailand include 116 mammals, 180 birds, 32 (33 forms) reptiles, 5 amphibians, 215 fish species, and at least 1,424 plant species.

Prevost's aquirrel *(Callosciurus prevostii)*

Mammals

Thailand has 302 species of mammals, include one extinct specie, four that are extinct in the wild, 12 critically endangered, 35 endangered and 69 vulnerable species. Some of these are the Schomburgk's deer *(Cervus schomburgki)*, which was in abundance in the central plateau of Thailand but became extinct more than 60 years ago. The lesser one–horned rhinoceros *(Rhinoceros sondaicus)*, hairy rhinoceros *(Dicerorhinus sumatrensis)*, Eld's deer *(Cervus eldii)* and Kouprey *(Bos sauveli)* are extinct in the wild and are raised only in captivity.

The 12 critically endangered species include hog–nosed bat *(Craseonycteris thonglongyai)* (found in Thailand and Myanmar), flat–headed cat *(Ictailurus planiceps)* (found at Phru Toh Daeng swamp forest in Narathiwat Province), banteng *(Bos javanicus)* (very rare and found only in six areas in Thailand), agile gibbon *(Hylobates agilis)*, hairy–nosed otter *(Lutra sumatrana)*, sunda otter–civet *(Cynogale bennettii)*, jungle cat *(Felis chaus)*, gingo–toothed beaked whale *(Mesoplodon ginkgodens)*, Irrawaddy dolphin *(Orcaella brevirostris)*, dugong *(Dugong dugon)*, Chinese goral *(Naemorhedus caudatus)*, and Prevost's squirrel *(Callosciurus prevostii)*.

Flat–headed cat *(Ictailurus planiceps)*

Of the 35 endangered species, three bat species are rare in the wild. These are the Marshall's horseshoe bat *(Rhinolophus marshalli)*, disc–nosed leaf–nosed bat *(Hipposideros halophyllus)* and Surat serotine *(Eptesicus demissus)*, an endemic specie in Surat Thani and Phang–nga Provinces. The disc–nosed leaf–nosed bat *(Hipposideros halophyllus)* is found at Samor Kon Mountain in Lop Buri Province in an area outside the conservation zone. It is captured by local inhabitants in large numbers. Other endangered species are the marbled cat *(Pardofelis marmorata)*, stripe–backed weasel *(Mustela strigidorsa)*, Eurasian otter *(Lutra lutra)*, spotted linsang *(Prionodon pardicolor)* and banded palm *(Hemigalus derbyanus)*. A study of marbled cat *(Pardofelis marmorata)*, based on camera observation, reveals that its population has increased. Other animals of interest are the Asian tapir *(Tapirus indicus)* and wild water buffalo *(Bubalus bubalis)*. The Asian tapir *(Tapirus indicus)* is found only in mountainous areas in many parts of the western and southern regions of Thailand. The only herd of wild water buffalo *(Bubalus bubalis)* was found at Huay Kha Kaeng. Only 75 individual tigers *(Panthera tigris)* were found in Phu Khiew Mountain, Khao Yai Mountain and Huay Kha Khaeng. Other animals of interest are dolphins and whales.

Number of Vertebrate Species in Thailand (Endemic and Threatened Species)

Group	Species in Thailand*	Endemic Species		Threatened Species**	
	(No. of Species)	(No. of Species)	%	(No. of Species)	%
Mammals	302	5	1.66	116	38.41
Birds	982	2	0.20	180	18.33
Reptiles	350 (366 forms)	47 (49 forms)	13.39	32 (33 forms)	9.02
Amphibians	137 (138 forms)	7	0.05	5	3.62
Fishes	2,820	72	2.55	215	7.62
Total	**4,591 (4,608 forms)**	**133 (135 forms)**	**2.93**	**548 (549 forms)**	**11.91**

Note: * Includes extinct species
** Includes critically endangered, endangered, and vulnerable species

Some of the 69 vulnerable species are the rodents, carnivores, moonrat, shrews, bats, primates, treeshrews, whale, dolphins, and bovine.

There are at least 15 near threatened species.

Five endemic species found only in Thailand are the disc–nosed/leaf–nosed bat *(Hipposideros halophyllus)* and Surat serotine *(Eptesicus demissus)*, Schomburgk's deer *(Cervus schomburgki)*, limestone rat *(Niviventer hinpoon)* and Neill's rat *(Leopoldamys neilli)*.

Birds

At one time or another at least 982 bird species have been found in Thailand. However, some of these are now extinct, including the giant ibis *(Pseudibis gigantea)*, which at present is found only in Cambodia, and the large grass warbler *(Graminicola bengalensis)*, which was last seen 10 years ago in the wetlands of Phatum Thani Province. Species that are extinct in the wild are the Sarus crane *(Grus antigone)* and white–shouldered ibis *(Pseudibis davisoni)*.

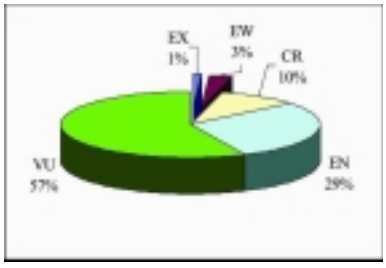

Gurney's Pitta *(Pitta gurneyi)*


Sarus crane *(Grus antigone)*

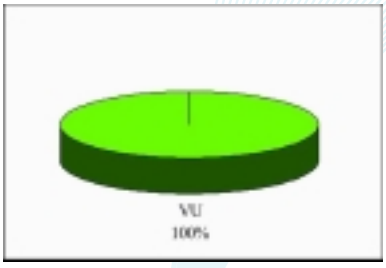
There are 43 critically endangered species, such as the Chinese crested *(Sterna bernsteini)* (once believed extinct but was seen lately in Taiwan), Gurney's pitta *(Pitta gurneyi)* (formerly found in many areas but is now found only at the Khao Pra–Nang Kram non–hunting area), Hume's pheasant *(Syrmaticus humiae)* (found in India, western Myanmar and eastern Thailand), lesser adjutant *(Leptoptilos javanicus)* (found laying eggs only at the Toh Daeng Peat Swamp in Narathiwat Province and Koh Phra Thong in Phang–nga Province), Christmas frigatebird *(Fregata andrewsi)* (with a global population of only 3,000, they nest and breed at Christmas Island, Indian Ocean).

Status of Vertebrate Species in Thailand

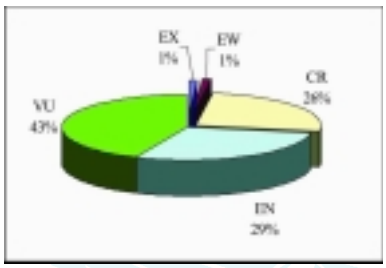
Group	No. of Species							
	Extinct	Extinct in the Wild	Threatened Species			Near Threatened	Least Concern	Data Deficient
			Critically Endangered	Endangered	Vulnerable			
Mammals	1	4	12	35	69	15	10	13
Birds	2	2	43	66	71	89	-	9
Reptiles	-	1	11	5 (6 forms)	16	48 (50 forms)	183 (190 forms)	89 (92 forms)
Amphibians	-	-	-	-	5	33	64 (65 forms)	35
Fishes	3	-	18	42	155	20	-	30
Total	**6**	**7**	**84**	**148 (149 forms)**	**316**	**205 (207 forms)**	**257 (265 forms)**	**176 (179 forms)**



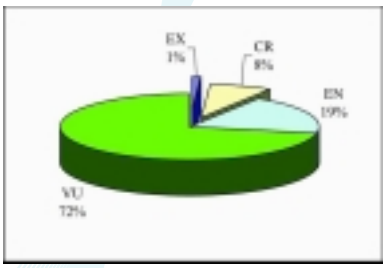
Mammals (n=121 species)



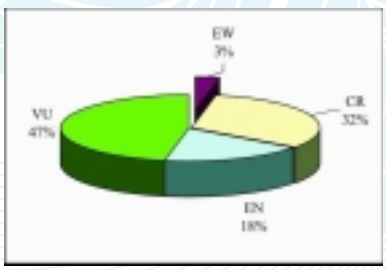
Amphibians (n=5 species)



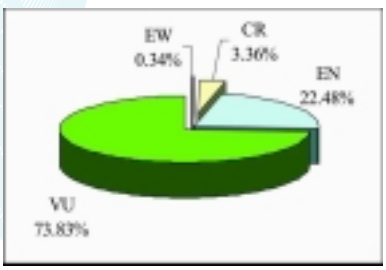
Birds (n=184 species)



Fishes (n=213 species)



Reptiles (n=33 species (34 forms))



Plants (n=596 species)

EX = Extinct EW = Extinct in the Wild CR = Critically Endangered
EN = Endangered VU = Vulnerable

There are 66 endangered species. Some of these are the chestnut–headed partridge *(Arborophila cambodiana)* (found only in some parts of Thailand and Cambodia that have an altitude of more than 900 meters), greater spotted eagle *(Aquila clanga)* (with a global population of only 2,500 to 10,000, they are found mostly in agricultural areas), Nordmann's greenshank *(Tringa guttifer)* (with a global population of 1,000, their nesting area is in eastern Russia; they migrate during winter to coastal mud flats and beach areas in the inner Gulf of Thailand), spoon–billed sandpiper *(Calidris pygmaeus)* (their nesting area is in northeastern Russia; they migrate during winter to the coast of the inner Gulf of Thailand) and Rufous–necked hornbill *(Aceros nipalensis)* (their population increase is slow and their habitat is hill evergreen forest which is facing destruction).

There are at least 71 vulnerable bird species, such as the Malayan partridge *(Arborophila campbelli)*, ferruginous pochard *(Aythya nyroca)*, pointed stork *(Mycteria leucocephala)*, red–faced liocichla *(Liocichla phoenicea)*, among others.

There are at least 89 near threatened species.

Two endemic bird species are the Deignan's Babbler *(Stachyris rodolphei)* and white–eyed river–martin *(Pseudochelidon sirintarae)*.

Green sea turtle *(Chelonia mydas)*

Taylor's warted tree frog *(Theloderma slellatum)*

Reptiles and Amphibians

In Thailand 350 species (366 forms) of reptiles and 137 species (138 forms) of amphibians are found. One that is extinct in the wild is the false gavial *(Tomistoma schlegellii)*. Some of the 11 critically endangered species are the estuarine crocodile *(Crocodylus porosus)* (very small population number in the wild; can be found at the southern coast of the country, in mangrove forests, and in peat swamps in Satun Province and Tarutao Islands, and Tapi River in Surat Thani Province), Siamese crocodile *(Crocodylus siamensis)* (almost extinct in the wild); four marine turtles i.e. green sea turtle *(Chelonia mydas)* (not found laying eggs in Thailand), hawksbill sea turtle *(Eretmochelys imbricata)*, Olive Ridley sea turtle *(Lepidochelys olivacea)* and leatherback sea turtle *(Dermochelys coriacea)* (lay eggs on once–deserted islands which are now tourist spots; the survival rate of hatched turtles has decreased); freshwater turtles including the river terrapin *(Batagur baska)* and painted terrapin *(Callagur borneoensis)* (live in river and lay eggs on sandy beaches; these are collected for commercial purposes); and three snapping turtle species that are heavily hunted for food, i.e. Thai giant softshell *(Chitra chitra)*, Burmese narrow–headed softshell *(Chitra vandijki)* (large size and found in Mae Klong and Salween Rivers, respectively) and Asian giant softshell *(Pelochelys cantorii)* (rarely found in Thailand).

The 5 (6 forms) endangered species are the big–headed turtle *(Platysternon megacephalum)* (lives in creeks in mountain areas and frequently caught for food or as pet), elongated tortoise *(Indotestudo elongata)*, Burmese brown mountain tortoise *(Manouria emys emys)*, Burmese black mountain tortoise *(M. emys phayrei)* and impressed tortoise *(M. impressa)* (used to be commonly found in areas in the central region but now popularly hunted as these areas have been turned into housing estates and urban areas). The Indochinese water dragon *(Physignathus cocincinus)* is heavily hunted and is now hardly seen.

Vulnerable species include 16 reptiles and 5 amphibians. These include 11 turtles, one soft–shelled turtle, four lizards, two frogs, i.e. the spiny–breasted frog *(Paa fasciculispina)* and Bourret's frog *(P. bourreti)* (found in habitats outside protected areas at Soi Dao and Pa Hom Pok Mountains, respectively; threatened and caught for food), and three tree frog species i.e. the large warted tree frog *(Theloderma gordoni)*, thorny warted tree frog *(T. horridum)* and Taylor's warted tree frog *(T. slellatum)* (difficult to find since their habitats have been transformed into agricultural areas).

In addition, there are 48 (50 forms) and 33 species of reptiles and amphibians, respectively, that are near threatened.

Of the endemic species, 47 (49 forms) are reptiles and seven are amphibians.


Siamese tiger fish *(Datnioides pulcher)*


Giant shovelnose ray *(Rhinobatos typus)*

Fishes

At one time or another, at least 720 freshwater fish species and 2,100 sea fishes have been found in Thailand. One that is now extinct from the world is the pangassius catfish *(Platytropius siamensis)*. Two that are extinct from Thailand in the wild are the Siamese tiger fish *(Datnioides pulcher)* and black–tipped silver shark *(Balantiocheilos melanopterus)*.

Some of the 18 critically endangered fish spices are the green sawfish *(Pristis zijsron)*, largetooth sawfish *(P. microdon)* and smalltooth sawfish *(P. pectinata)* (easily caught using fishing gears because of its large size and spine) and the Mekong giant catfish *(Pangasianodon gigas)* (not seen in the northeastern basin for a long time).

There are at least 43 endangered species. Four of these are sharks, i.e. tiger shark *(Galeocerdo cuvier)*, winghead hammerhead shark *(Eusphyrna blochi)*, scalloped hammerhead shark *(Sphyrna leweni)* and great hammerhead shark *(S. mokarran)* (hunted for food). Four other species that are rare as their habitats are disturbed by fishing activities are the sharpnose guitarfish *(Rhinobatos granulatus)*, yellow guitarfish *(R. schlegelii)*, clubnose guitarfish *(R. thouin)* and giant shovelnose ray *(R. typus)*. In addition, many freshwater fish species are threatened due to changes in the use of water channels, swamps and ponds.

There are at least 155 vulnerable species and at least 20 near threatened species.

There are 72 endemic fish species, such as Balitoridae (18 species), Cyprinidae (20 species) and catfishes (20 species). More than half of the endemic species are threatened. A wide diversity of large fishes can be found at certain areas in the Bang Pakong basin in Chanthaburi Pronvince, and from Hin Grood down to Chumpon Province, Songkhla Lake, Surin Islands and Similan Islands. However, these are under threat from over–fishing. Areas with the highest freshwater fish diversity are the Mekong River Basin, forest areas in the western region, Borapet swamp, Salween forest, Hala–bala forest and Toh Daeng peat swamp.

Plants

In Thailand at least 1,424 plant species are threatened and endangered, of which 757 are endemic species. One of them, the *Alnus thaiensis* (Betulaceae) is already extinct. A fossil was found at Li District, Lampang Province.

Amherstia nobilis has been extincted in the wild but is bred for commercial and conservation purposes and originally found in the border area of Mae Hong Son Province and Myanmar. Two species are extinct in the wild including *Vanda coerulescens* (Orchidaceae) found at an altitude of over 1,000 meter at Chiang Mai, Mae Hong Son and Phrae Provinces, *Amherstia nobilis* (Leguminosae–Caesalpinioideae) found in dry evergreen forest at Mae Hong Son Province.

There are at least 20 critically endangered species, two of which are the *Cycas chamaoensis* found at Chamao Mountain, Chanthaburi Province and *C. tansachana* found in Saraburi Province. The others are 18 species of Dipterocarpaceae family, including two species of *Anisoptera* spp., two species of *Dipterocarpus* spp., five species of *Hopea* spp. and 7 species of *Shorea* spp.

There are at least 134 endangered species of which 94 are wild forest plants, such as nine species of *Bulbophyllum* spp., 11 species of *Dendrobium* spp. and 15 species of *Paphiopedilum* spp., which are collected for commercial purposes. Their habitats are facing destruction. In addition, there is the *Bretschneidera sinensis* (Bretschneideraceae) which is found in Doi Phuka Mountain in Nan Province and in northern Vietnam and southern China.

There are at least 440 vulnerable species. Some of these are the *Wrightia sirikitiae* (Apocynaceae) found in limestone mountains in Nakhon Sawan, Saraburi and Srakaew Provinces, *Pedicularis nigra* (Scrophulariaceae) found in Chiang Mai and Mae Hong Son Provinces at an altitude of more than 1,000 to 1,500 meters above sea level, and in Yunnan Province in China, *Isachne smitinandiana* (Gramineae) found only at Phu Kradung and Phu Luang Mountains in Loei Province, *Caulokaempferia thailandica* (Zingiberaceae) and *Agapetes saxicola* (Ericaceae). Table shows number of threatened species identified by the Bangkok forest Herbarium DONP in 2005.

Threatened Plant Species in Thailand

Plant groups	Threatened species	Endemic species	Total no. found in Thailand
Pteridophyte	41	19	468
Gymnospermae	27	0	32
Angiospermae	1,356	738	8,560
Monocotyledonae	416	211	2,756
Orchidaceae*	175	87	1,200
Palmae*	85	16	150
Zingiberaceae*	57	27	270
Dicotyledonae	940	527	5,804
Euphobiaceae*	79	47	425
Rubiaceae*	71	53	600
Gesneriaceae*	63	46	144

Note: * Only major families are demonstrated.

Genetic Erosion

Thailand is one of the world's rice genetic resource. There are evidences that rice has been grown in Thailand for more than 5,500 years and it is estimated that the country has over 10,000 indigenous rice varieties. DOA's Rice Research Center in Pathum Thani Province has been collecting rice samples since 1937. As of 2001, the Center's collection included 5,928 indigenous rice varieties.

The country's rice genetic resource and original collection of rice samples have rapidly eroded. Rice paddies have been converted into urban areas. As farmers now prefer to plant new varieties that are more productive, there is no longer much use for collecting original varieties.

A large number of indigenous crops have also deteriorated. The major causes are natural (such as droughts and floods), expansion of community and industrial areas, dam construction, and so on.


Bretschneidera sinensis


Wrightia sirikitiae


Agapetes megacarpa

DOA has collected 175 varieties of durian, 210 varieties of mangoes, 19 varieties of lychees and 68 varieties of longan. Some of these varieties have been lost.

As a result of the importation of large numbers of foreign livestock, indigenous species have been ignored. These varieties include the local cow, Kao Lampoon; the northeastern region cow; Rad, Hailum wai pig; Nakhon Pathom duck, Banteng *(Bos javanicus)* and the golden horn cow which is fast becoming extinct in Thailand. In addition, the buffalo population is decreasing each year and now numbers only 1.5 million heads compared with five to six million heads in the past. The population keeps decreasing as some are cross–bred with foreign varieties which destroy or erode genetic resources.

Loss of Forest Ecosystem

In Thailand, forests are found almost anywhere. In 1961 Thailand was abundant in forests which covered 53.35% of the country's total land area. At present however, this has been reduced to 32.1%. Lack of knowledge and awareness of the importance of forest ecosystem are some of the principal causes of forest deterioration.

In 2004 it was reported that 73.87 sq km of forest areas were encroached and cleared, much larger than in 2001–2003. The loss of forest ecosystem continued for a long period as poaching and illegal trade of wild animals and plants further reduced the population of wild animals and the number of wild plants. A number of species also became endangered. A major concern at present is that the number of asian elephant *(Elephas maximus)* in the wild is only 1,975 to 2,380. As for wild water buffalo *(Bubalus bubalis)*, tiger *(Panthera tigris)*, banteng *(Bos javanicus)* and gaur *(Bos gaurus)*, those in the wild number 50–70, 250–500 and 200, respectively. Kouprey *(Bos sauveli),* Eld's deer *(Cervus eldii)* and lesser one–horned rhinoceros *(Rhinoceros sondaicus)* have not been seen in nature for a long time. Many wild plant species have been lost naturally, such as endemic species of Toh Dang peat swamp. Local plant species were also adversely affected by the smuggling in of more than 100,000 tons of wild orchids in 2003–2005. Orchid farms and collectors select good breeds to improve their sales. Some of these orchids are *Dendrobium* spp., *Bulbophyllum* spp., *Vanda* spp., *Ascocentrum* spp., *Rhynchstylis* spp., *Aerides* spp. and *Paphiopedilum* spp.


Caulokaempferia thailandica

Threats to Mountain Ecosystem

Mountain systems in Thailand are concentrated in the northern region. In particular, Doi Inthanon and Doi Chiang Dao Mountains are both renown for their rich highland biodiversity resources. At elevations above 1,000 meters of Doi Chiang Dao Mountain, the flora of upper montane forest, usually known as "subalpine vegetation" were found. Its main physical structure of open limestone ground creates the beautiful scenery resemble natural rock garden. There exists endemic plant species and a wide range of plant biodiversity. These upper montane forest habitats form the only places in Thailand where mammals from the palearctic habitat are found.

In the eastern "Chanthaburi" region, lower montane forest habitats are also found, particularly at the Khao Kitchakut National Park and the Khao Soi Dao Wildlife Sanctuary. Due to their maximum altitudes (1,085 and 1,600 m above sea level respectively), upper montane forest habitats are not found in this region, however the steep slope topography provides a similar geological habitat to that encountered in montane conditions in the north.

In the Northeastern region, Phu Luang Mountain is the dominant mountain of Loei Province with a plateau summit at a maximum altitude of 1,571 m above sea level. Owing to the peculiar tableland summit geology, the beautiful landscape is remarkably rich in flora and tends to be covered by clouds and fog throughout the cold season. The summit is also subject to montane forest habitat, though dominant tree species are notably different to the northern region, with mountain pines, maples, and oaks.

The most mountainous area of southern Peninsular is located in Khao Luang National Park, Nakorn Sri Thammarat Province, where the summit of Khao Luang Mountain is at an altitude in the order of 1,835 m above sea level. Notably, the forest structure and range of species found above 1,000 m differs from that for the rest of Thailand.

These mountain areas not only provide high biodiversity resources also creating a good scenic environment of sight seeing and tourism. As are result, mountain ecosystem areas may face to the strong addition influences caused as a result of the types of tourist activities, and also due to great seasonality of visits. Thus, environmental impacts on the ecosystems are likely to have knock–on impacts on tourism and recreation. In recent decades, rural poverty and other population pressures, caused by increased inhabitation of mountainous areas, has lead to increasing pressure on mountain ecological systems. Land use conversion resulted in deforestation for cultivation of marginal lands, excessive livestock grazing and a general loss of biomass cover and environmental degradation.



Damaged Marine and Coastal Ecosystems

Thailand's marine and coastal ecosystems consist of mangrove and beach forests; rocky shores, sandy beaches and mud flats; coral reefs; seagrass beds and open seas.

Mangrove forests

Some 36% of the entire coast of Thailand is covered with up to 1,920 sq km of mangrove forests. Almost 50% of these are in the provinces of Phang–nga, Satun, Trang, Nakhon Si Thammarat and Ranong. The oldest and healthiest mangrove forest is at the mouth of Ngao river in Ranong Province. In general, it can be said that the destruction of mangrove forests has resulted from the excessive cutting of trees, aquaculture development, and encroachment for housing and factory construction. Forests are a source of food and fuel wood and serve as ideal hatchery and nursery for aquatic animals. Mangrove forests provide habitats for a number of water fowls and mangrove bird species, including threatened and endangered ones. As additional benefits, mangrove forests serve as a buffer zone to mitigate the wave and wind forces and prevent coastal erosion.

Beach forests

For a long period of time, beach forest has been encroached in order to develop communities, ports and resorts. Only a small area of healthy beach forest remains, mostly on Tarutao Islands, Ang Thong Islands and Phi Phi Islands. Some beach forests were badly destroyed by the tsunami waves in 2004.

Coral reefs

More than 300 coral reefs and colonies are found in Thailand covering approximately 153 sq km. In the past, coral reefs were destroyed due to tourist activities, such as anchoring of tourist boats, touching, flipping and tramping. Sediments discharged from construction sites found their way to cover the reefs, rapidly destroying them. This situation is found in areas where hotel construction is excessive, such as in Chang Island (Trad Province) and Patong Bay (Phuket Province). In 2002 only 23% of all coral reefs were in good condition; 24% were in moderate condition; 52% were deteriorated and 1% was severely damaged. At present, the healthy reefs of the Andaman Sea are only half of those found in 1992, while the deteriorated reefs increased one–fold. In the Gulf of Thailand, most of the reefs are in a better condition and have not deteriorated further. The investigation made by the Department of Marine and Coastal Resources (DMCR) in 2004 indicated the deterioration of reefs in many areas.

Seagrass beds

Seagrass bed in Thailand cover a 104 sq km area in the Gulf of Thailand and the Andaman Sea. They are found at a water depth of 1–7 m. The largest bed is found around Phra Thong Island in Phang–nga Province. In 2004 it was reported that almost 60% of seagrass beds were healthy and 20% were deteriorated. The causes behind the deterioration were push nets and trawlers.

Large marine animals

Dugongs, dolphins and sharks can be found in Thai waters. Some 200 dugongs are critically endangered. Dugongs are hunted for food and at least 10, each year, are found trapped in fishing nets. The deterioration of seagrass beds, which is food for dugongs, is another factor that threatens dugongs. At the mouth of Trad river, a population of dolphins (as many as 70) can be found. The critically endangered Irrawaddy dolphin *(Orcaella brevirostris)* (10 to 30) were spotted at Mae Klong and Bangpakong river mouths. Irrawaddy dolphin *(Orcaella brevirostris)* (20 to 25) were found in Songkhla Lake. Each year, three to five of them are stuck in fishing nets. In addition, three schools of the vulnerable species, indopacific humpback dolphin *(Sousa chinensis)*, were found at Kanom Bay. In the Andaman Sea, there are 27 species of sharks, three are endangered and 23 are vulnerable, respectively. The cause is heavy hunting.

Excessive fishing that surpasses the rate of natural production and destroys coastal habitats, such as mangroves which provide a nursery ground, has decreased the yield during the past 10 years. Mollusk catch decreased by 70% during this period. The harvest of crabs from nature has gradually decreased. The population of large fishes, such as the endangered shark, smalltooth sawfish *(Pristis pectinata)* and freshwater stingray *(Potamotrygon* spp.), has also decreased.

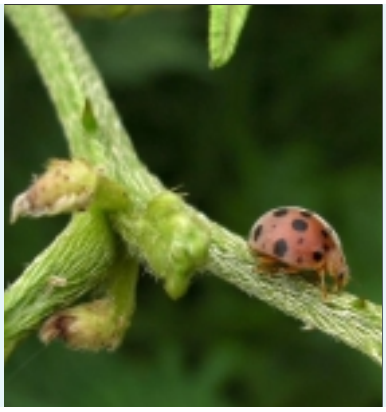
Threats to Island Ecosystem

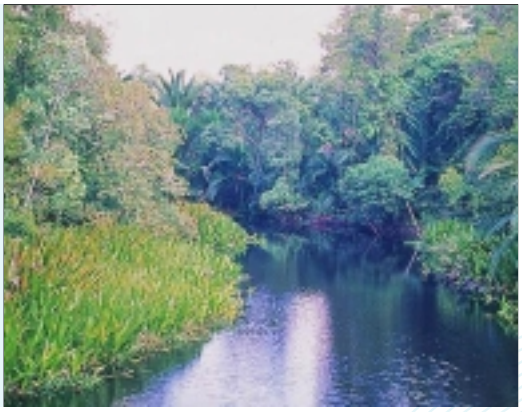
Beyond the coastline of Thailand's peninsular are two marine ecosystems, the Gulf of Thailand and the Andaman Sea. These marine ecosystems contain communities of plants, animals, and microbes interacting with each other and their environment. It is a kind of habitat that makes up the extensive ecosystem range from the productive near shore regions to the sea floor. Different species from tiny planktonic organisms to large marine mammals like dugongs have been found there. Both flora and fauna of island ecosystems in Thailand are not clearly different from those of the mainland because most islands locate close to its shore. For some remote islands with few disturbances, fauna and flora may be significantly different from those on the mainland because the islands are relatively isolated. Assuming that certain species can develop by taking advantage of isolated conditions, in particular on remote islands such as Surin Island 60 km from shore. For the coastal ecosystem, the geographical isolation of the islands has resulted in biodiversity richness as well.

For example, Losin Island in the Gulf of Thailand located 100 km from the coast are surrounding with deep sea coral reef (about 40 m). Many fauna species that have not been recorded anywhere else in the Gulf have been found there. Such remote islands in both sides of Thailand peninsular are therefore home of endemic and rare species. Which are at risk of deterioration introduced by tourism development. Various threats to island ecosystem are observed.

Dugong *(Dugong dugon)*

Irrawaddy dolphin *(Orcaella brevirostris)*





Degraded Freshwater Ecosystem

Riverine system

Chao Phraya is the country's most important river system. Fishes in the river and its tributaries are the most diverse in the country as well. However, the number of aquatic animals has decreased, water quality has deteriorated and land along the river bank is excessively utilized. Some fish species are extinct and more than 20 species are at risk of becoming endangered.

The Mekong river system consists of large rivers that are ranked the third largest in the world in terms of biodiversity. The rivers support life in China, Myanmar, Thailand, Laos, Vietnam and Cambodia. The river resources are diverse. There are more than 1,000 fish species. Along the banks of the Mekong river and its islands are habitats and breeding grounds for numerous bird species. At present the river is threatened by quarrying at the upper part of the river, sand mining and encroachment into agricultural area for commercial purposes and development.

Human settlement in some islands such as Phuket Island, Samui Island, Samed Island, has severely deteriorate native plant and animal populations. The sea water turbidity surrounding limestone islands is relatively higher than that of granite islands. It greatly affects to the loss of biological diversity found in these areas; for instance Ang Thong archipelago, located in the Andaman Sea which is limestone island. Approximately 50 species of coral have been found there, whereas more than 100 species have been found nearby the limestone–based Chang and Surin archipelagos. In addition, the turbidity conditions experienced by limestone islands prevent many invertebrates from being survive there as well. For example, mollusks, e.g. abalone *(Haliotis* sp.) and sea fan *(Subergorgia* sp.) have been rarely found.

Freshwater swamp forest

Originally the freshwater swamp forest was located along the Chao Phraya River Basin. Now large patches of forests are found along the Tapi River, including Nong Tung Thong Forest (Surat Thani Province), Bung Tale Noi Forest (Phatthalung Province), and Bung Tung Tam Forest at Mun–Chi River Basin (northeastern region).

In the past, Thailand was covered with peat swamps measuring over 160 sq km. Most of the swamps are in the southern part of the country, from Chumphon Province downward. Some are in the eastern and central regions. At present there are less than 96 sq km of peat swamp left. The original peat swamps that exist up to the present time are Toh Dang in Narathiwat Province, Kuntulee in Surat Thani Province and Sam Jumpa in Lop Buri Province. The destruction of peat swamps is caused mainly by the draining of water out of the swamp, land filling, burning, and construction of reservoirs. Despite these threats, the remaining peat swamps are genetic resources for more than 100 species of fish, prawns and mollusks.

CHAPTER 5

Challenges and Trends

CHAPTER 5

Challenges and Trends

In the case of Thailand, the global problem of increasing oil prices is compounded by the country's internal problems of declining earnings from tourism and decreasing importance of agricultural products, such as rice and sugar. In addition to reducing its energy consumption, the country has to look into new renewable energy (such as biofuel) and to further develop and transfer appropriate and efficient technology. At the same time, the country has a responsibility to ensure environmental sustainability. To achieve the first and seventh targets of the Millennium Development Goals, Thailand has to maximize utilization of its rich biodiversity to compensate for setbacks caused by poor research and development capacity.

In the near future, Thailand has to urgently undertake many projects pertaining to biodiversity, especially biodiversity protection, in parallel with research and development in biodiversity. Thailand also has to promote capacity building of resources persons and organizations in order to develop the country's commercial capability and make it internationally competitive.

From a global viewpoint, the issue of biodiversity protection has been sufficiently addressed. The World Summit on Sustainable Development Meeting in September 2002 agreed ***to significantly reduce the rate of loss of biological diversity by the year 2010.***

Significantly Reducing Biodiversity Loss by the Year 2010

Facts

Since the 17th century, biodiversity loss has been on the rise, increasing at a rate of 50 to 100 times that of natural extinction, It is expected that the rate will increase up to 1,000–10,000 times in the 21st century. It is also expected that more than 31,000 species will be wiped out.

The continuing loss of biodiversity puts the quality of human life at risk. Biodiversity loss could lead to diminished life support, including food, medicine, water, fuel, wood and fiber, even fresh air.

To prevent this, all countries have committed to urgently undertake appropriate means and measures to reach the 2010 target of putting a halt to biodiversity loss within the next four years.

Challenges

Thailand has undertaken effective activities and projects on biodiversity. These activities were given more emphasis right after the ratification of the Convention and when it entered into force in 2004. However, the project related to the 2010 target has not yet been launched officially. However many on–going projects undertaken by concerned agencies, private sectors and NGO's can be counted as the projects aiming towards the 2010 target.

The obstacles to the acheivement include inadequacy of financial support, lack of awareness among concerned agencies, lack of capacity building for resources persons and technicians, and lack of stakeholder interest.

Needs

- It is needed that biodiversity be seriously considered and placed high priority on the country's national agenda. Full support should be extended to activities related to the protection and rehabilitation of the ecosystems, under the responsibility of the government and the private sector. Capacity building for personnel working in the area related to conservation of biodiversity, as well as financial measures and relevant policies should be given due consideration as they are crucial factors in the program of implementation. This is to ensure significant reduction in the rate of biodiversity loss as set in the global commitment to achieve the 2010 target.

- The forest ecosystems, which are very crucial to all living species, should be rehabilitated.

To do this every province in the country should be encouraged to undertake forest plantation projects. Targets should also be set for the plantation plan. By the year 2010, provinces where forest ecosystems are currently not well maintained should be able to increase their forest areas by up to five percent of the total land area. In provinces where forests account for less than 10% of the total land area, the rate of expansion should be up to 15%.

- Urgently survey and monitor the status of biodiversity throughout the country, both in protected areas and in natural habitats outside protected areas. The data will be used in rehabilitation and protection of endangered species and ecosystems.

Biodiversity Projects Towards Achievement of ONEP's Goals for 2010

Survey of Biological Status Project: ONEP as the national focal point of the Convention on Biological Diversity, has prepared a database of endangered vertebrates (http://chm–thai.onep.go.th/). A database of plants will be completed by the end of 2006, to be followed by a database of invertebrates which will be proposed to the Cabinet as the National Red List. Its scope will include protection and observation measures as well as rehabilitation and survey of the population of invertebrates.

Biodiversity Survey and Information System Project: This project will be implemented in the following ecosystems: forest, coastal and marine, inland water, dry and semi–humid, mountain, island and agriculture. In 2005 ONEP and Kasetsart University selected the following as study areas: Doi Inthanon forest, coastal areas of Phang–nga province (Surin and Ang Thong Islands), Ping river watershed, and the highland agricultural areas of Pataem and Phu Paterb, Phu Luang, and Doi Inthanon–Jormthong. Information obtained from the project will support the protection and rehabilitation of deteriorated ecosystems and endangered species. Such information will be disseminated to the public in order to build awareness of the importance of biodiversity to human life. The results of the study will be presented to the press in the form of different media products. The project will be implemented in other areas.

Colorful Tree Plantation Project: To initiate the project, ONEP grew Indian Cork, *Radermachera ignea* (Bignoniaceae), the symbolic tree of Chiang Rai Province, along both sides of the road to Nong Bong Khai non–hunting area, which is a wetland of international importance (Ramsar Site). The project emphasizes cooperation between the Government and private organizations and local communities to save and protect the country's natural beauty by growing local plants from specific provinces, along highways and in front of temples and schools all over the country. The project hopes to enhance the green surroundings in different communities and to attract tourists who want to enjoy flowers in bloom as well as to rehabilitate destroyed ecosystems.

Clearing House Mechanism (CHM) Project: ONEP facilitates the collection of information on biodiversity and dissemination to the public through this mechanism. ONEP also provides assistance to relevant agencies, including DONP, DOA, DLD, and DOF. The Department of Clearing House (DCH) is prepared to link information from individual agencies for their mutual benefit. The project will soon be extended to universities nationwide and research data on biodiversity will be collected and disseminated through the University Clearing House (UCH). This will facilitate research and development on biodiversity in the future.

Biological Boy Scout–Girl Guide Project: The project will involve cooperation between MONRE and the Ministry of Education. It is aimed at imparting knowledge and building awareness of the importance of biodiversity to human life by applying the principle of learning by doing and using nature as a school. The youth will learn many things about nature, including how to conserve birds and corals, how to live in the woods, how to build a fire out of sticks, and so on. They will act as para–taxonomists who will make use of their capability to recognize plants and animals, including butterflies and ferns.

Producing Biofuel as an Alternative Energy

Trends

Following the energy crisis, there was a remarkable increase in Thailand's energy consumption. Many countries, including Thailand, have moved to accelerate agricultural production and the conversion of those products into ethanol to be used in producing gasohol. The National Committee on Ethanol has considered the use of agricultural raw materials for ethanol production. These raw materials include sugar cane, molasses and tapioca. In Thailand, tapioca yields are up to 1,875 tons per sq km. As tapioca is also an important source of food, Thailand has to develop new technology to increase tapioca yields and to prevent encroachment into reserved lands and transform these into farm land for agriculture. Other alternative sources have to be explored, including plants that have high potential as raw materials for the production of renewable fuel for diesel engines. For example, soybean oil can be derived from natural seeds. Plants used as a source of biodiesel include rape seed, sunflower seed, coconut oil, palm oil, soy bean oil and purging nut oil or physic nut oil *(Jatropha curcas*). It has been reported that oil extracted from the physic nut seed can be used as renewable fuel for low diesel engines that power electrical appliances, such as water pumps, generators, and ploughing machines. Thailand's physic nut seed production is approximately 187.5 tons per sq km, compared with approximately 750 tons per sq km in other countries. Improved plant varieties, techniques to develop plant varieties and oil refinery techniques are crucial to the production of high quality plant oil.

Challenges

Research and development studies concerning plants with a high potential to produce oil as a substitute for diesel fuels or benzene are still very poor and not up–to–date. Only a few of these can be used as basis for economic tools to address recent global economic developments.

Needs

- It is an urgent need to increase support to the research and development concerning plant oil, especially those plants with high potential as renewable fuel, benzene, or as a mixing agent for benzene. Research in oil extraction and refinery technology is also crucial.
- Business should be invited to support and be partnership with the local communities in the development of oil refinery technology and biodiesel production technology. Knowledge should be disseminated.

Utilizing Biodiversity as an Economic Tool for Poverty Alleviation

Facts

New trends in health care have given rise to the popularity of organically grown plants, herbs and various natural products. Plants and herbs with medicinal value are coming into greater use as traditional medicine, food, health products, dietary supplements, even as aromatherapy products. Thailand's export of medicinal plants and herbs, valued at around 16,000 USD at the end of 2005, continues to increase due to the country's rich biodiversity. These are exported both as plants and as extracts.

Challenges

Although research in medicinal plants and herbs is highly advanced, it is not intended for large scale production.

Developing Biotechnology as a Tool for Global Market Competition

Needs

- It is needed to allocate sufficient financial support, ensure capacity building for personnel, and introduce the use of appropriate technology in all aspects of herbal plant research. New products should be developed at an industrial scale and be promoted to be more acceptable and more preferable in both local and international market.
- The business sector should be encouraged to have full participation in research and development on herbal plants, including their use in associated business ventures, such as the manufacture of pharmaceuticals and the operation of spas.
- Information on herbal plants should be disseminated to rural communities in order to enable them to produce their own herbal products, such as herbal tea, and encourage them to grow medicinal plants for community hospitals.

Trends

Rapid increase in the world population has created imbalances in the world's food production. Through developments in biotechnology, plants are being given new characteristics that benefit agricultural production, the environment, and human nutrition and health. This is seen in the case of the "Golden Rice".

The genetically modified golden rice was developed to produce pro–Vitamin A. Under development is the embedding of daffodils and bacteria (Eruvian bacteria) genes in the natural strain of the rice. This technology will improve the ability of the natural rice strain to produce more vitamin A, at a level that is sufficient to prevent blindness and death for both children and adults. On the other hand, the level of vitamin A in non–GM rice is insufficient to prevent susceptibility to infectious diseases and blindness.

This golden rice variety has been further developed by the International Rice Research Institute and is used as crop seed in the Philippines.

Challenges

Because of its rich biodiversity, Thailand has a wide variety of plants and livestock that are appropriate to be used in resource– based research and development projects on global food security or on new medicines to fight life–threatening diseases such as cancer, AIDS, avian flu, and so on. Biotechnology has recently become the focus of government support. This is encouraging because biotechnology research is carried out for long periods and requires the expertise of competent and experienced authorities. Thailand still lacks adequate human and financial resources to help ensure the country's competitiveness in global trade.

Needs

- It is required for the capacity building of resource persons working in the development of plant varieties and well–directed biodiversity research pertaining to food and agricultural products, in order to support the nutritional needs of the country and the world.
- Financial support should be provided for the establishment of biological technology centers in different academic institutions.
- Draft of an ad–hoc and time–specific policy framework is urgently needed to address urgent or serious, naturally–occurring health problems, such as avian flu.

Building Technical and Knowledge–based Society

Trends

Developed countries have been carrying out surveys and research on taxonomy for many centuries in order to obtain basic knowledge and information to be used for future developments in biodiversity. Various specimens have been collected in herbariums and museums and documented/ identified in relevant books and documents. However, taxonomy is not as well developed in Thailand due to insufficient financial resources, inadequate institutional capabilities, and small number of competent resource persons on taxonomy. Existing resources cannot compete with those in other countries where extensive efforts are carried out to maximize the use of biodiversity resources in advancing their social, economic and cultural development.

Challenges

Biological science related to taxonomy is being neglected by the government and private organizations. Most taxonomists work on a voluntary basis and out of a personal dedication to their job, without aspirations for career advancement and encouragement and support from the government. Museums and herbariums are few in number and are not well managed. It has reported that as a practice, some specimens have been sent abroad for storage and safekeeping.

Needs

- Enhancement of capacity building is needed by establishing and maintaining a natural history museum, including an insectorium, herbarium, and botanical garden in academic institutions or universities that are noted for their high capability in these fields.
- It is required to establish of a national committee on taxonomy and taxonomic institutions in order to further develop taxonomy in Thailand. This will help to improve Thailand's competitiveness, putting it at par with developed countries.
- Financial support should be provided with priority given to taxonomic inventory and research in protected areas and other natural habitats.

Bibliography

Baimai, V. and R. Tantalaykha (Editors). 2005. **Annual Report Biodiversity Research and Training Program (BRT) 2005**. Biodiversity Research and Training Program. Bangkok Press Co. Bangkok. 74 pp. (in Thai)

Bird Conservation Society of Thailand and BirdLife International. 2004. **Lists of Important Areas for Bird Conservation in Thailand**. Bird Conservation Society of Thailand and BirdLife International. Bangkok. 306 pp. (in Thai)

Chamroonpong, B. *et al.* 2004. **Plant Germplasm Database: Mungbean / Blackgram**. Plant Variety Protection Section, Plant Variety Protection Office Department of Agriculture. Bangkok. 306 pp. (in Thai)

Chamroonpong, B. *et al.* 2004. **Plant Germplasm Database: Soybean**. Plant Variety Protection Section, Plant Variety Protection Office Department of Agriculture. Bangkok. 156 pp. (in Thai)

Department of Marine and Coastal Resources. 2004. **Annual Report 2004**. Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment. Bangkok. 84 pp. (in Thai)

Faculty of Forestry. 2005. **Final Report on Preparation the List of Endamic, Rare and Endangered Plants in Thailand and Set Up the Measure for Plant Species Protection.** Kasetsart University. Bangkok. (in Thai)

Jangtragul, S. *et al.* 2004. **Report on Biodiversity Meeting: Research from the Past to the Future**. Forest and Wildlife Biodiversity Management; Sustainable Plan for Conservation and Developmental Utilization. National Park, Wildlife and Plant Conservation Department. Bangkok. 420 pp. (in Thai)

Keratikunakorn, J. *et al.* 2004. **Plant Germplasm Database: Crown of Thorns**. Plant Variety Protection Section, Plant Variety Protection Office, Department of Agriculture. Bangkok. 182 pp. (in Thai)

Keratikunakorn, J. *et al.* 2004. **Plant Germplasm Database: Crested Euphorbia**. Plant Variety Protection Section, Plant Variety Protection Office, Department of Agriculture. Bangkok. 182 pp. (in Thai)

Moratob, S. *et al.* 2001. **Standard Character and Color of Buntum**. Livestock Biodiversity Project and Animal Husbandry Division, Department of Livestock Development, Ministry of Agriculture and Cooperatives. Bangkok. 26 pp. (in Thai)

Nabhitabhata, J. and T. Chan–ard. 2005. **Status of Mammals, Reptiles and Amphibians in Thailand**. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand.

National Park, Wildlife and Plant Conservation Department. 2005. **Database: National Park, Wildlife and Plant in 2005**. Planning and Information Office, National Park, Wildlife and Plant Conservation Department. Bangkok. 111 pp. (in Thai)

National Park, Wildlife and Plant Conservation Department. 2004. **Saving Thailand's Tigers: an Action Plan**. National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment. Bangkok. 47 pp.

Manager Newspaper. **Coral Reef after Tsunami: Beautiful after Disaster**. 5 November 2005. p 33–34. (in Thai)

Office of Environmental Policy and Planning. 1999. **An Inventory of Wetlands of International and National Importance in Thailand**. Ministry of Science, Technology and Environment. Bangkok. 414 pp. (in Thai)

Office of Environmental Policy and Planning. 2000. **Proceeding on Wetland in Next Century**. Ministry of Science, Technology and Environment. Bangkok. 125 pp. (in Thai)

Office of Natural Resources and Environmental Policy and Planning. 2005. **1 Year After Tsunami: Restoration of Thailand' s Natural Resources and Environment**. Ministry of Natural Resources and Environment. Bangkok. 128 pp.

Office of Natural Resources and Environmental Policy and Planning. 2004. **Proceeding on Biodiversity Day: Food, Water and Health**. Ministry of Natural Resources and Environment. Bangkok. 84 pp. (in Thai)

Office of Natural Resources and Environmental Policy and Planning. 2004. **Proceeding on Biodiversity Day: Biodiversity and Poverty Alleviation – Challenges for Sustainable Development**. Ministry of Natural Resources and Environment. Bangkok. 118 pp. (in Thai)

Office of Natural Resources and Environmental Policy and Planing. 2006. **Checklist of Plant Red Data of Thailand**. Ministry of Natural Resources and Environment, Bangkok. 124 pp.

Official of Forest Research Section. 2004. **Report of Research and the Progress of Research in 2003**. National Park, Wildlife and Plant Conservation Department. Bangkok. 219 pp. (in Thai)

Pimathai, R., R. Jukmongkol, P.D. Round and A.W. Tordoff. 2004. **Directory of Important Bird Areas in the Kingdom of Thailand: Key Sites for Conservation**. Bangkok. 192 pp.

Plant Variety Protection Office, and Agricultural Regulation Office, Department of Agriculture. 1995. **Plant Germplasm Collection and Conservation Center of Department of Agriculture: Working Group on Collect Plant Variety Cooperation**. Department of Agriculture. Bangkok. 299 pp. (in Thai)

Pooma, R., S. Suddee, V. Chamchumroon, N. Koonkhunthod, K. Phattarahirankanok, S. Sirimongkol and M. Poopath. 2005. **A Preliminary Check–list of Threatened Plants in Thailand**. The Agricultural Cooperation of Thailand, Ltd. Bangkok. 196 pp.

Sanguansombat, W. 2005. **Status of Birds in Thailand**. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand.

Santisuk, T. 2005. **Endemic and Rare Plant of Thailand**. Forest and Wildlife Biodiversity Management; Sustainable Plan for Conservation and Developmental Utilization. Bangkok. 188 pp. (in Thai)

Santisuk, T., Chayamarit, K., Phengklai, C. and Phuphathanaphong, L. 2005. **A Preliminary Check–list of Threatened Plants in Thailand**.

Satapoomin, U. 2002. **Comparative Study of Reef Fish Fauna in Thai Waters: the Gulf of Thailand Versus the Andaman Sea**. Phuket Marine Biological Center, Department of Fisheries Ministry of Agriculture and Cooperative. Bangkok. 41 pp.

Srettachau, C. and R. Pitaksombat (Editors). 2005. **Ecosystem and History: Seasonal Flooded Forest in Upper Songkram River Basin**. Mekong River Basin Wetlands Biodiversity Conservation and Sustainable Use Programme, IUCN, Southeast Asia River Network, Nakorn Phanom Environment Conservation Club, Thai Researcher Network of Lower Songkram River Basin. Chieng Mai Province. 153 pp. (in Thai)

Srikosamart, S. (Editor). 2004. **Wild Animal not use Product from Wild**. Biodiversity Research and Training Program. Jirawat Express Co., Ltd. Bangkok. 60 pp. (in Thai)

Sriwattanapong, S. 2003. **Biodiversity**. Biotechnology Journal 1(1): p. 24–27. (in Thai)

Suwanrangsri, D. 2002. **Thai Forest Heritage: Plant Kingdom and Variety of Life in Tropical Forest**. PTT Exploration and Production Public Company Limited. Bangkok. 238 pp. (in Thai)

Tabtimsaeng, W. *et al.* 2004. **Annual Report 2004 of Department of Marine and Coastal Resources**. Ministry of Natural Resources and Environment. Bangkok. 84 pp. (in Thai)

Taiutsar, B. 2005. **Guidelines of the Economic Forest Development in Thailand**. Presentation Document at Thailand Development Research Institute on 15 December 2005. (xerox document). (in Thai)

Thammabudh, S. and W. Gamnerdphet. 2000. **The Native Animal Development and Conservation of Department of Livestock Development**. Department of Livestock Development. Bangkok. 65 pp. (in Thai)

Titiprasert, V. *et al.* 2001. **Plant Germplasm Database for Durian**. Plant Variety Protection Office, Department of Agriculture. Ministry of Agriculture and Cooperatives. Bangkok. 154 pp. (in Thai)

Titiprasert, V. *et al.* 2001. **Plant Germplasm Database for Mango**. Plant Variety Protection Office Department of Agriculture. Ministry of Agriculture and Cooperatives. Bangkok. 142 pp. (in Thai)

Titiprasert, V. *et al.* 2001. **Report of Project: Set up the Plant Germplasm Database System**. Plant Variety Protection Office, Department of Agriculture. Bangkok 213 pp. (in Thai)

Titiprasert, V. *et al.* 2003. **Plant Germplasm Database: Litchi**. Plant Variety Protection Office Department of Agriculture. Ministry of Agriculture and Cooperatives. Bangkok. 221 pp. (in Thai)

Vidthayanon, C. 2005. **Status of Fishes in Thailand**. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand.

Vuteyayo, C. 2000. **Technical Document: Thai Natives Rice**. National Operation Center and Collect Rice Seed Germplasm, Patumthani Rice Research Center, Rice Research Institute, Department of Agriculture. Bangkok. 215 pp. (in Thai)

Wildlife Conservation Office. 2004. **Draft of National Master Plan for Wildlife Conservation 2004–2013**. Wildlife Conservation Office. National Park, Wildlife and Plant Conservation Department. Ministry of Natural Resources and Environment. Bangkok. 87 pp. (in Thai)

Annex I

Regulation of the National Committee on Conservation and Sustainable Use of Biodiversity

on Criteria and Methods of Access and Benefit–Sharing of Biological Resources

Objective

To establish standard guidelines and methods to access biological resources that are under the responsibility of government agencies.

Goal

The goal is to achieve sustainable conservation and utilization of biological resources, in parallel to equitable and fair sharing of benefits from the use of biological resources. This goal complies with the policy of the Government and the Convention on Biological Diversity.

Conditions Concerning Access to Biological Resources

Any person who would like to access biological resources must submit a completed application form and relevant attachments to the government agency that has responsibility over specific resources. The head of the agency may or may not grant the permit. In case the permit is granted, the applicant and the National Committee on Conservation and Sustainable Use of Biodiversity will be informed. After that the applicant must submit a final project report and sign the agreement on access. If the permit is not granted, the applicant will be informed through official notification that also indicates the reason for denial. If the applicant does not agree with the denial, he or she may inform the National Committee on Conservation and Sustainable Use of Biodiversity or the Biological Diversity Division for the issuance of the permit.

Agreements on Access to Biological Resources

The government agency that grants such permits will ask the applicant to sign an agreement concerning access using a form issued by the National Committee on Conservation and Sustainable Use of Biodiversity or the agency. (Note: The agreement should contain lists of criteria established by the National Committee on Conservation and Sustainable Use of Biodiversity and approved by the Office of the Attorney General). The agreement on access to biological resources is in two parts: for commercial purposes and for non–commercial purposes. In case an applicant who has been granted access for non–commercial purpose would like to change to commercial purpose, the responsible government agency will request the applicant to apply for access.

Benefits Derived from Using Biological Resources

The benefits derived from using biological resources should be shared with the concerned government agency and the community, based on criteria determined by the National Committee on Conservation and Sustainable Use of Biodiversity. The benefits include the following.

- Advance payment collected from successful applicants before actual access is carried out. The advance payment is a deposit to guarantee compliance with the agreement on access. The amount of the advance payment will be specified by the responsible government agency.
- Shared amounts of money or remuneration in the form of cash will be calculated based on the gross income generated from the use of biological resources and should be paid annually, as long as the products or outputs or process or information generates incomes to applicants who were given permits. The amount of remuneration will be specified by the responsible government agency.

- The responsible government agency may issue an agreement on shared benefits in other forms besides money, but the benefits should directly contribute to conservation and sustainable use of biological resources. The contribution may be on other aspects, such as public health aid, but with prior approval by the National Committee on Conservation and Sustainable Use of Biodiversity.

Monitoring and Reporting

During the validity period of the agreement and prior to the expiration of the permit, the responsible government agency that granted the permit should regularly monitor and observe the action of the permit holder. The permit holder should submit a report to the agency once every three months. The responsible agency must report the progress of the work on access to biological resources to the National Committee on Conservation and Sustainable Use of Biodiversity once every six months. The Committee will evaluate the implementation according to the agreement and report to the Cabinet once a year.

Officials

The scope of authority of the officials is as follows:

- Summon for interrogation those who were involved in providing access to biological resources.
- Call for materials or documents of the party possessing biological resources.
- Inspect the site of the permit holder.

Penalties

It is considered abusive if government offices or agencies do not act according to this regulation.

If an applicant for accessing biological resources does not act according to this regulation or the order of officers or if information is concealed or is false, the applicant should withdraw the application or cancel access. The fee will not be refunded.

Annex II

Status and Progress of Thailand's Draft Biosafety Legislation (2004–2005)

Thailand became a Party to the Cartagena Protocol on Biosafety on 8 February 2006. The decision of the Thai Government to address biosafety issues points to a need to put in place a legislative framework for the entire country. Such a framework should define how Thailand can regulate and promote modern biotechnology at a faster pace than in the past.

Mandate and Drafting Process

The Ministry of Natural Resources and Environment was mandated by the Cabinet on 11 October 2004 to consider drafting legislation on biosafety. The Cabinet resolution serves as a framework that resulted in a number of activities carried out by the Ministry. The Committee on Drafting Biosafety Legislation, consisting of experts and official representatives from all involved agencies, begun its work in earnest and continued efforts to draft a biosafety legislation in 2005. The Drafting Committee considered and designed appropriate components of the biosafety laws. A number of current laws and regulations in Thailand relating to living modified organisms were reviewed. Furthermore, gaps were identified prior to proposing the components. Obligations by the Party under the Cartagena Protocol on Biosafety were synthesized in order to identify components of the country's biosafety laws that should be included so that the Protocol can be effectively implemented for the benefit of the country. The current status and progress of the draft biosafety legislation, as of the beginning of 2006, are summarized here.

Terms

Definitions of essential terms and key procedures have been enumerated following the Cartagena Protocol, as for instance, modern biotechnology, contained use, intentional release to the environment, import and export, unintentional release, risk assessment and management, etc.

Scope

The scope of the laws encompasses all possible activities of living modified organisms that may occur in the country. All living organisms; plants, animals and micro organisms are covered. Nevertheless, some issues are excluded in compliance with the Cartagena Protocol.

National Committee and Bodies

The National Biosafety Committee of Thailand serves as main body to supervise, recommend and periodically report to the Government, to ensure effective and practical implementation of the law. Transparency and participatory decision–making on the use of modified living organisms are fostered.

Competent national authorities are seconded to relevant government agencies and institutions that are capable of and keen on specific Living Modified Organisms (LMOs). The draft laws extend the responsibility to potential and capable competent authorities under the supervision of the National Biosafety Committee.

The Ministry of National Resources and Environment, as the national focal point for the Cartagena Protocol, serves as coordinating agency and secretary of the National Biosafety Committee. The laws also authorize officials to implement, monitor and enforce laws. Authorized officials include those who have enforced other current laws.

The draft laws regulate all possible activities pertaining to LMOs in Thailand :

Import and Export of LMO's

Import and export of LMOs are not permitted without notification through information provided to the Biosafety Clearing House of Thailand, for example.

LMO's in Contained Use

Using LMOs for contained use requires a permit and may involve case by case risk assessment by a competent authority.

Release of LMO's

Intentional release of LMOs to the environment without authorization from a competent authority is not allowed. The request should be supplemented with a risk assessment and management report.

The sale, distribution or display of LMO products in the market is now allowed without permission, appropriate labeling and documentation. This is particularly true for at least the first case.

In case of the unintentional and accidental release of LMOs to the environment, permit holders have full responsibility to cooperate with the competent authority to resolve and redress the case as much as they can.

Details of regulations, procedures and requirements will be declared later by concerned competent authorities under the supervision of the National Biosafety Committee.

Public Involvement

The general public may contribute their opinions along with notification, authorization and request by a competent authority. Transparency and disclosure of data and information to the public are emphasized with respect to the right to keep identified confidential information on LMO users.

Risk Assessment and Management

Use risk assessment and management procedure as key tools to process permits for relatively high risk LMOs. Intentional release to the environment and distribution by selling, giving, borrowing of LMOs from a third party, are assessed before permit is issued.

Fund

A National Biosafety Fund is proposed by legislation. The major objectives include support for effective implementation of the regulation and monitoring, capacity building and research activities to support the laws.

Liability and Redress

Joint liability is channeled to redress the damage due to the use of LMOs. The burden of proof rests on those who have experienced damage.

There are a number of controversial issues in the current draft biosafety laws. For example, there is a need for concrete development of a biosafety policy in harmony with the country's policy on modern biotechnology. It is ideal to have biosafety laws that can balance the benefits of modern biotechnology with environmental and human health concerns soon. The public hearing and Cabinet submission of the draft biosafety laws are scheduled in 2006.

THAILAND National Report

on the Implementation of the Convention on Biological Diversity

Available from Biological Diversity Division
Office of Natural Resources and Environmental Policy and Planning (ONEP)
Ministry of Natural Resources and Environment
60/1 Soi Phibul Wattana 7, Rama VI Road, Bangkok 10400 THAILAND
Telephone (66) 2265 6636–40
Facsimile (66) 2265 6638, 2265 6640
www.onep.go.th

Citation Office of Natural Resources and Environmental Policy and Planning. 2006. **Thailand: National Report on the Implementation of the Convention on Biological Diversity.** Ministry of Natural Resources and Environment, Bangkok, Thailand. 64 p.

ISBN 974–286–017–3

Printing March 2006

Edited by Sirikul Bunpapong

Assisted by Vithet Srinetr Piya Pinyo

Designed & Printed by Integrated Promotion Technology Co., Ltd.
Telephone (66) 2585 2076, 2586 0837

Office of Natural Resources and Environmental Policy and Planning
60/1 Soi Phibun Wattana 7, Rama VI Road, Phayathai, Bangkok 10400 THAILAND
Tel. (66) 2265 6636-40 Fax. (66) 2265 6638, 2265 6640
www.onep.go.th