An Economic Analysis of Coral Reefs in the Andaman Sea of Thailand

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EXECUTIVE SUMMARY

The focus of this study is the valuation of coral reefs and how this information can be used to improve planning for coral reef management in Thailand. The site analysed, Phi Phi Islands, is rich in reef systems and is envisioned as an eco-tourism destination by government planners. Phi Phi can generate large economic values through recreation. The consumer surplus estimated by the travel cost method reveals an annual value of 8,216.4 million Baht (US$205.41 million). This study also utilised the contingent valuation method to estimate both the use and non-use values of Phi Phi's coral reefs, representing an annual value of 19,895 million Baht (US$497.38 million).

It is apparent from this analysis that both local and national levels of government in Thailand can justify larger annual budget allocations for managing coastal resources. At present, the economic benefits from coastal resource management in Phi Phi are mostly due to the local residents and businesses. One of the economic instrument options to capture the net benefit values of Phi Phi is to directly target the consumers. Tourists could be charged fees for physically using the environment, such as participating in offshore water sports (specifically including snorkelling boats and dive operations), swimming and beach activities. The contingent valuation method provided information regarding the extent of the domestic consumer surplus. It estimated the consumer's willingness to pay to increase biodiversity at Phi Phi as 287 Baht (US$7.18) per visit.

Based on this figure, this study recommends a basic entrance fee of 40 Baht (US$1) per person per visit for Phi Phi. Supplementary user charges should also be levied by the Phi Phi Islands Marine Park when visitors receive additional services from the variety of recreational sites on offer at Phi Phi, or visit certain special and environmentally vulnerable recreational sites. For instance, after having charged the basic entrance fee of 40 Baht (US$1), the Park could impose an extra fee of 150 Baht (US$3.75) per person per visit if the visitor chose to visit the coral reef at Maya Bay. This user charge would help raise additional revenue for the Park by transferring surpluses from high-end consumers to economic gains and conservation, while leaving the low-income visitors unaffected. At the same time, charging an additional fee for particular reef sites would assist in reducing the number of visitors. This additional fee could be more expensive during periods when the marine environment is more sensitive to disturbance, thus providing an incentive for tourists to visit at other times. Both these measures could help relieve the negative pressure on the delicate marine environment.

Finally, the concept of adopting a discriminatory pricing scheme, where local and foreign visitors are charged different user fees, was considered as a means to increase the total revenue for the Park. The rationale for charging foreigners a higher entrance fee is firstly, foreigners do not pay income tax or business tax to the local government and secondly, foreigners tend to have a higher WTP for park visitation. However, this study found that, in fact, international visitors here do not have a higher WTP than domestic visitors. In addition, imposing a higher entrance fee for foreigners could create an unnecessary psychological barrier for foreign tourists and could negatively affect the image of Thailand's tourism industry. For this reason, this study recommends that foreign and local visitors be charged the same user fee.

AN ECONOMIC ANALYSIS OF CORAL REEFS IN THE ANDAMAN SEA OF THAILAND

Udomsak Seenprachawong

1.0 INTRODUCTION

1.1 Background

The southern coast of Thailand is of great significance, as it marks the boundary between two of the region's major oceans: to the east, the Gulf of Thailand, contained within the Pacific Ocean, and to the west, the Andaman Sea connecting to the Indian Ocean. Because of this strategic location, Thailand's seas are regarded as one of the country's major food sources. The Andaman Sea of Thailand, discussed in this study, is located on the country's west sea border, with Ranong, Phang Nga, Phuket, Krabi, Trang and Satun provinces forming its approximately 700-kilometre coastline.

The total macrobenthic fauna on the coastal seabed of the Andaman Sea ranges from 200 to 1000 individuals/m^2. Polychaeta and Crustacea are the most abundant groups at about 475 and 318 individuals/m^2 respectively. The remainder is made up of Mollusca, Echinodermata, Chordata and others. The Andaman Sea coast also consists of mangrove forest distributed along the coastal belt. On the northern stretch, the mangrove area ranges between 21,800 to 36,700 ha, whilst the southern stretch of mangrove area ranges from 26,500 to 31,500 ha. The largest mangrove area is concentrated on the Phang Nga coast. In addition, the coastal sea also possesses a considerable area of coral reef. A marine park was established on the major reef areas along the Andaman Sea coast, among which are the Surin-Similan Island belt and the Phi Phi Islands belt.

1.2 Issues and Significance of the Problem

Powerful economic forces are driving the current destructive patterns of coral reef use, often rendering short-term economic profits, which can be very large, to selected individuals. Measures for coral reef protection are often presumed to conflict with economic development and are said to sacrifice economic growth. Another issue is that some of the most important values of coral reefs, such as those to future generations and intrinsic values, cannot be quantified. The omission of these benefits in conventional economic analysis means that coral reefs are undervalued, which can result in unsustainable use. This is of particular concern for coral reefs in areas such as the Southern Seaboard Development Project (SSDP) area.

The SSDP is a large-scale project covering the area along the Andaman Sea coast in Krabi and Surat Thani provinces, and the Gulf of Thailand in Nakhon Si Thammarat province. It was designated an area for potential future development in the Sixth National Economic and Social Development Plan (1987-1991). Promoting the development of a new economic area in the Southern Seaboard region is one alternative to alleviate the urban concentration around Bangkok and to create a more equitable spatial balance in the country.

The SSDP area is well-favoured with natural resources, possessing fine beaches and outstanding scenery, fertile agricultural land, and rich deposits of minerals. It occupies a strategic location between the Lower South and Bangkok, facing the Gulf of Thailand to the east and the Andaman Sea to the west. Its major projects include a link connecting the two coasts by a two-lane toll highway, with expansion to a four-lane highway planned for eight years after opening (expected to have been in 1998). The total financial cost of the first stage of this proposed East-West Toll Highway project was estimated to be 4,163 million Baht (US$104 million), including land acquisition for an eventual four-lane alignment along the entire route, while the total financial cost of the second stage was estimated to be another 2,828 million Baht (US$70.7 million).

For two commercial port projects, a feasibility study was to have been carried out in 1993, with the detailed design being undertaken in 1994, and construction taking place from 1995 to 1997. The first year of operation would have been 1998. However, due to the economic crisis of 1997, these projects were postponed and the project site was changed to Tub Lamu in Phang Nga province. This proposed change of site will result in the destruction of pristine coral reefs in the Surin and Similan Islands' area.

Because local communities in the Andaman Sea area are totally dependent on the coral reefs and a rapid rate of environmental destruction is evident throughout Thailand, sustainable coral reef management options are urgently required for the area. This research intends to value the benefits of coral reefs on the west coast (in the Andaman Sea) of the project development area. Preservation of the unique marine ecosystem in the Andaman Sea requires maintaining the coral reefs intact. It is hoped that the results of this research will prove useful to policymakers and other relevant parties in use-planning for these coastal provinces.

The SSDP areas are endowed with a variety of existing and potential tourism resources, including the beaches co-existing with a good urban amenity in Phuket, and the magnificent coastal views of Phang Nga and Krabi. One of the nature-based developments with high potential for eco-tourism is that of the Phi Phi Islands. The two islands of Ko Phi Phi Don and Ko Phi Phi Ley rising out of the Andaman Sea are situated within the Had Nopparat Thara-Phi Phi Islands National Park. Tourist demands over recent years have transformed the idyllic appearance of these islands into a bustling holiday retreat.

Phi Phi Islands have high values, coming from both the use values (e.g. recreational and tourism; educational and scientific research) and non-use values (e.g. genetic resources and future uses, both known and unknown, of ecological functions). In fact, Phi Phi is being used as an important reference site for conducting coral reef valuations elsewhere[1]. It is a well-known site with relatively easy access and good opportunities for collecting reliable data. At present, there is no such study available for Thailand and such a valuation has implications for management at Phi Phi, as well as other sites at risk. Some of the potential deep seaport sites in the SSDP would threaten Phi Phi Islands, while others would threaten Similan Island. This study will not carry out a detailed analysis of Similan Island, but it will comment on how results from Phi Phi may be transferred to Similan Island or to other coral reef sites, such as coral reefs in the Gulf of Thailand: specifically, those near the coastal town of Ban Hin Krood in Prachuabkirikun province where there is a proposed project to build a thermal power plant.

2.0 ECONOMIC ANALYSIS OF CORAL REEFS

Of the three kinds of coral structures found in the world, only one widely occurs in Thailand, distributed throughout both its oceans. Fringing reefs, as they are known, extend outwards from any form of land mass, be it a submerged rock or an entire continent. The Andaman Sea also possesses, although on a much smaller scale, patch reefs: these are coral formations around completely submerged structures far from the shore. However, at present these reefs are increasingly being destroyed by a range of threats including (OEPP, 1995):

- A rise in maritime traffic (and therefore anchor-dropping, collisions, oil spills, etc.) damaging reefs in many parts.
- Improper fishing methods (such as the use of explosives to kill fish or chemicals to lure ornament fish) damaging or destroying reefs in some areas.
- Increased tourism activities, such as snorkelling, resulting in localised cases of disturbance and damage to coral reefs.
- Man-made changes in channel flows of rivers and streams, caused by channel dredging, damming, or diversions disrupting deposition/ erosion patterns and in turn affecting reefs.
- Mine tailings and other sediments from mining activities damaging corals in some parts.

[1] Some other potential sites for conducting coral reef valuations are Surin Island and Similan Island. However, these two islands are relatively expensive from which to collect reliable data. Moreover, the actual flow of visitors throughout the year is comparatively low since the islands are not easily accessible to tourists. It takes approximately 4-6 hours from Phuket to these sites by boat, while the boat ride from Krabi to Phi Phi Islands takes only 1 hour.

An economic valuation of the benefits of coral reefs can provide information for the design of coastal area management plans. The analysis of economic values of coral reefs can be carried out based on the reefs' many functions (Bakus, 1982 and Tomascik, 1993 cited in Cesar, 1996) including:

- Food and other resources (fish, mariculture, jewellery, aquarium items, etc.)
- Construction material (sand, rocks)
- Pharmaceuticals and other industrial chemicals
- Tourism and recreation (diving)
- Education and scientific interest
- Biological support (breeding and feeding for offshore fish)
- Coastal protection (to prevent sand erosion)
- Genetic resources.

Each of these functions has an economic value. According to the environmental economics literature (Dixon, 1995) the following can be distinguished:

a) extractive direct use values;

b) non-extractive direct use values;

c) indirect use values; and

d) non-use values.

The mapping between the functions and the types of values is presented in Table 1. Note that the non-use values also include known and unknown future values of direct and indirect uses, often referred to as quasi-option and bequest values. Together, these values can be taken to calculate the total economic value (TEV) for coral reefs.

Table 1. Types of Values Corresponding to Different Functions of Coral Reefs

Types of Values	*Functions*
Direct use value (extractive)	• Food/other resources (fishery) • Construction material • Pharmaceuticals and other industrial chemicals
Direct use value (non-extractive)	• Tourism and recreation • Education and scientific interest
Indirect use values	• Biological support • Coastal protection
Non-use values	• Genetic resources • Known and unknown future uses of the functions above

Source: Spurgeon, 1992 cited in Cesar, 1996.

3.0 OBJECTIVES OF THE STUDY

In this study, no attempt is made to calculate the TEV of the coral reefs. Instead, values are calculated for certain specific functions. One function that has been analysed in some detail is that relating to recreational and tourism values. As mentioned above, this does not imply that the other functions are less important, only that it is harder or even impossible to obtain reliable estimates for these other functions.

The general objective of this project is to calculate the recreational values of coral reefs in the Andaman Sea of Thailand. The specific objectives are:

a) to estimate the recreational benefits (consumer surplus) of Phi Phi Islands;

b) to estimate the consumers' willingness to pay (WTP) for improved coral reef quality at Phi Phi Islands; and

c) to use these values to determine the entrance fee for visiting the reef sites at Phi Phi Islands.

4.0 LITERATURE RELATING TO RECREATION AND TOURISM VALUATION

Cartier and Ruitenbeek, 1999, have raised two issues regarding recreation and tourism valuation. The first is that the recreation and tourism direct use value attributable to a coral reef is usually estimated by accounting for the tourism revenue generated by a particular coral reef holiday destination. From a utility perspective, these values ignore the consumer surplus generated by the recreation experience and, as a result, underestimate the value of the recreation experience. From a production perspective, gross tourism revenue – the figure most often calculated – ignores the labour and capital costs of supplying the services, as well as the costs associated with the environmental impacts of tourism.

The second problem with using tourism revenue relates to the packaging of a vacation destination's attributes. When a coral reef is just a single attraction in the total package, the tourism revenue cannot be said to be solely attributable to the reef. Yet, the more important the reef attraction is in the vacation experience package, the higher the proportion of tourist revenue that can be attributed to the reef. In any case, the basic problems of using gross revenue and ignoring associated costs persist.

Table 2 presents recreational and tourism valuations of various coral reef ecosystems. It can be seen that most studies focusing on coral reef recreation/tourism estimate consumer surplus by using a travel cost method (TCM) or a contingent valuation method (CVM). However, three studies use the gross revenue approach (Driml, 1999; Cesar, 1996; and Hodgson and Dixon,

1988, cited in Cartier and Ruitenbeek, 1999). The study of Negril, Jamaica by Wright, 1995 (cited in Cartier and Ruitenbeek, 1999) combines the CVM and the TCM. In addition, two studies valuing recreation in the Galapagos are included for comparison with each other: one uses a gross revenue approach, the other uses hedonic demand analysis.

Australia's Great Barrier Reef (GBR) is probably the most-studied reef in the world. Since 1975 many economic studies of the GBR have been carried out, mostly commissioned by the Great Barrier Reef Marine Park Authority (Driml et al, 1997 cited in Cartier and Ruitenbeek, 1999). Table 2 includes the most recent estimate of the GBR's gross financial value (Driml,1999), as well as consumer surplus estimates for recreational fishing, visits to the 'Reef Region', and visits to coral sites within this region (Hundloe et al., 1987 cited in Cartier and Ruitenbeek, 1999). Two studies are reviewed in greater detail here: Driml, 1999 for the GBR and Hundloe et al., 1987.

Driml estimates the gross financial value of tourism to the GBR for the 1995/96 period. It is an update of an earlier estimate by the same author. The calculation focuses on commercial tourism (reef trips, accommodation and resort packages), and recreational fishing and boating. Data pertaining to the volume and price of reef visits, total visitor nights at island resorts and elsewhere, and an estimate of the average daily tourist expenditure yields a value of A$647 million (1996 $) for commercial tourism. The value of recreational fishing and boating was estimated using earlier survey work by Blamey and Hundloe, 1993 (cited in Cartier and Ruitenbeek, 1999) and current records of registered private boats adjacent to the park. The survey data showed that 63% of registered private boats are used for recreational fishing. The data also provided an estimate of the average yearly expenditure on recreational fishing and boating. With this data, Driml calculates recreational fishing and boating in the GBR to be worth A$123 million (1996 $).

Hundloe et al. first use the TCM to estimate the consumer surplus for both domestic and international tourists to the so-called 'Reef Region', which comprises all the islands and reefs within the outer boundaries of the GBR region. The study then isolates the consumer surplus associated with visits to coral sites. (Coral sites are areas within the Reef Region where coral can be viewed.) For this, travel cost data was collected from visitors who had visited or planned to visit coral sites as part of their visit to the Region.

The consumer surplus associated with visits to the Reef Region is computed to be A$144 million per year; the surplus associated with visits to specific coral sites within the Region is A$106 million per year. However, the researchers felt that the latter estimate still included all the attributes of the Reef Region as a whole, valued by those who had come to view coral as part of their total vacation package. To calculate the consumer surplus of the coral sites only, with all other attributes of the Reef Region excluded, a CVM study was carried out focusing only on tourists visiting the coral reef sites. The resultant consumer

surplus was estimated to be A$6 million per year, which might be regarded as a lower bound of the direct recreational value of the GBR.

Table 2. Recreational and Tourism Valuations

Ecosystem and Original Study	*Approach (U = Utility, P = Production)*	*Valuation Results*
Recreation value Great Barrier Reef (Driml, 1999)	P	Productivity Change: Gross recreation value A$769 (1996), includes A$647 for commercial tourism and A$123 for recreational fishing and boating; based on volume and price data for hotel stays and reef trips, and survey data for private recreational boat use.
Visits to Great Barrier 'Reef Region' (Hundloe et al., 1987)	U	TCM: A$144 million/year consumer surplus for domestic tourists and international tourists; based on travel cost expenditure by visitors to the 'Reef Region'.
Visits to Coral Sites and the 'Reef Region' of the Great Barrier Reef (Hundloe et al., 1987)	U	TCM: A$106 million/year consumer surplus; based on travel costs to coral sites by both domestic and international tourists, and includes all attributes of the 'Reef Region'.
Visits to Coral Sites within the Great Barrier Reef (Hundloe et al., 1987)	U	CVM: A$6 million/year consumer surplus or over A$8/adult visitor WTP to see coral sites in their present (1986-87) condition; based on a survey of visitors to reef sites only, thereby excluding all other attributes of the Great Barrier Reef 'Reef Region'.
Coral Reef Value and its Impact on Tourist Volume, Negril, Jamaica (Wright, 1995)	U	CVM: $31/person/year WTP, for a consumer surplus of $5 million/year by visitors to maintain coral reef in current condition; and $49/person/year for a surplus of $8 million/year to restore reefs to an 'excellent' condition; based on CVM survey data and 162,000 visitors/year.
Dive Value, Bonaire Marine Park (Dixon et al., 1993)	U, P	CVM: $27.40 average WTP for a consumer surplus of $325,000; based on 18,700 divers in 1992 paying a $10/diver/year fee. Productivity Change: Gross tourist revenue of $23.2 million (1991).
Dive Value Bonaire Marine Park (Pendleton, 1995)	U, P	Productivity Change: Net Tourism Revenue $7.9 to $8.8 million (1991); based on ownership and profit data. TCM: $19.2 million consumer surplus. Park NPV: $74.21 million local benefits; $179.7 million consumer surplus; based on 20-year period, 10% discount rate.
John Pennekamp/Key Largo, Florida (Leeworthy, 1991)	U	TCM: $285 to $426/person/day consumer surplus; based on a survey of some 350 park users in 1990; nine models were estimated; final estimate range taken from the two models which best fit the data.
Tourism Palawan Coral Reef, Philippines (Hodgson and Dixon, 1988)	U	Productivity Change: PV gross revenue $6,280 with logging vs. $13,334 with logging ban; based on mean hotel capacity, occupancy and daily rates; and an assumed 10% annual decline in tourism revenue due to degradation of seawater quality from sedimentation.
Tourism Valuation, Indonesian Coral Reefs (Cesar, 1996)	P	Productivity Change: NPV of tourism loss/km^2 of reef $3,000-$436,000 (from poison fishing); $3,000-$482,000 (blast fishing or coral mining); $192,000(sedimentation); based on assumptions regarding the rate of reef degradation associated with each practice.
Recreation, Galapagos National Park (de Groot, 1992)	U	Productivity Change: $45/ha/year for the total protected area; based on maximum carrying capacity of 40,000 visitors/year, and average expenditure per visit of $1,300.
Vacation Value, Galapagos National Park, Ecuador (Edwards, 1991)	U	Hedonic Demand Analysis: $312/day/person in 1986; based on a non-linear regression using cost, duration, and itinerary data from travel brochures; as well as cost and duration survey data.

Source: Adapted from Cartier and Ruitenbeek, 1999

Note: Amounts quoted in US dollars unless otherwise stated.

5.0 DESCRIPTION OF THE SITE

Over the past few years, Ko Phi Phi (Ko translated into English means island) has grown from a peaceful little Muslim fishing village to one of the busiest tourist destinations in the country. Located about 45 km east of Phuket, the Phi Phi Islands group – part of Krabi province – is composed of the islands Ko Phi Phi Don (Hilly Island), Ko Phi Phi Lae (Phi Phi in the Sea), Ko Yung (Mosquito Island), and Ko Mai Pai (Bamboo Island). Tourists can charter a boat to visit these from either Krabi or Phuket provinces. The two main islands of Phi Phi Don and Phi Phi Lae rise out of the Andaman Sea 48 km south-east of Phuket (or 40 km west of Krabi) and are situated within the Had Nopparat Thara-Phi Phi Islands National Park.

5.1 Natural Characteristics of the Islands

Phi Phi offers the keen diver a wide range of superb diving possibilities. It is a delightful place to spend a few days relaxing on the exquisite beaches, exploring the numerous coves and bays, climbing the steep vertical peaks, and enjoying some colourful and enticing scuba-diving. In many places, the islands are fringed with hard-coral gardens, home to a wide assortment of brilliant tropical creatures. In most areas, coral growth and marine life – including five species of anemone fish – are profuse and most of the fish species that inhabit the Similan Islands can also be found around Ko Phi Phi.

The beauty of Phi Phi Islands has made them world-famous. Hundreds of visitors land on Phi Phi's shores every day. Snorkelling around the archipelago's coral reefs or climbing to one of the many karst limestone lookouts is an unforgettable experience. Sheer cliffs stained with earth colours soar from calm, clear seas. Phi Phi Don, the larger island, has several tropical beaches lining its southern and eastern shores. The smaller, more rugged island of Phi Phi Lae remains uninhabited, although during the day visitors are delivered by the boatload to inspect a so-called Viking Cave, complete with ancient Nordic scribblings and displays of bird-nest collecting. Maya Bay, breaking the island's western coastline, is rigorously snorkelled by visitors from Phuket, Krabi and Phi Phi Don.

5.2 Climate of the Islands

The climatic conditions of the Islands are influenced by two monsoons: the south-west monsoon during February to September and the north-east monsoon during October to January. The mean temperature recorded over the past 30 years shows small variations every couple of years with the average annual temperature being 27.3°C. The average rainfall per year is approximately 2,700 mm, and the mean relative humidity of the Islands is around 80%. The average surface wind velocity is about 4.3 knots with prevailing winds from the west, north-east and east.

5.3 Visitors and Facilities of the Islands

5.3.1 Visitors

The two most recent sets of tourist data (1997 and 1998) are shown in Table 3. Foreigners consistently form the majority of total visitors. The number of visitors to Phi Phi in the past two years has increased slightly, which may be mainly due to the depreciation of the Thai currency.

Table 3. Guest Arrivals at Accommodation Establishments in Ko Phi Phi 1997-1998

	1997			1998		
Month	*Domestic*	*Foreign*	*Total*	*Domestic*	*Foreign*	*Total*
January	951	11,909	12,860	974	15,637	16,611
February	1,015	10,352	11,367	1,123	13,822	14,945
March	2,014	8,754	10,768	1,950	11,822	13,772
April	3,638	6,755	10,393	1,237	11,158	12,395
May	1,518	4,166	5,684	1,898	9,046	10,944
June	724	3,191	3,915	2,055	8,377	10,432
July	1,112	4,991	6,103	1,122	6,780	7,902
August	868	4,947	5,815	932	5,109	6,041
September	1,604	4,856	6,460	1,250	5,667	6,917
October	2,856	9,178	12,034	2,713	11,656	14,369
November	2,586	13,982	16,568	2,171	14,110	16,281
December	3,124	19,141	22,265	3,115	23,093	26,208
Total	**22,010**	**102,222**	**124,232**	**20,540**	**136,277**	**156,817**

Source: Tourism Authority of Thailand, 1998

5.3.2 Facilities

Accommodation: Ton Sai Bay is the main tourist centre on Phi Phi Don. Phi Phi now welcomes hundreds of visitors each day, yet its spectacular beauty remains. The northern end is quiet and beautiful, with a few small resorts. There are many holiday bungalows and several hotels on Phi Phi Don.

Electricity: Electricity lines on the islands are supplied by the private sector. At present there are two diesel-powered generators with a total capacity of 2,000 kW per day.

Water supply: Available water resources include a number of drilled wells and a man-made water reservoir.

Communication: Postal services and telecommunications are provided by private businesses. There are also a number of Internet service providers on Phi Phi Don.

Transportation: Visitors have to travel first to either Phuket or Krabi and then take a boat to get to the Islands. Most visitors choose to take a public boat from the pier at Phuket or Krabi. The transit cost only from Phuket to the Islands is about 400 Baht return. Currently, there is a 20-Baht entrance fee to visit the Islands. In addition, any tourist agency can arrange day trips. For example, the cost of travelling from Phuket Town to the Islands is around 500-1,200 Baht, including lunch and bus transportation to the boat pier. Generally, the cost depends on how luxurious a boat the visitor chooses, as well as whether snorkelling or viewing the coral reefs is included. Once on Phi Phi, visitors can rent a private boat for 1,000 Baht a day to explore the Islands.

As outlined above, visitors' transport costs may differ widely depending on whether the trip to Phi Phi Islands is made by private or public means of travel. Costs will also depend on how far a visitor's area of origin is from the site. Travel costs from the visitor's home to Phuket or Krabi are classified into two categories:

1) The average travel costs incurred by visitors who use private means of travel.

2) The average travel costs incurred by visitors who use public means of travel.

Costs incurred by private means are based on the amount of fuel consumed in making a return trip from the visitor's home to Phuket or Krabi. The cost of fuel per trip is in turn divided by four (since the seating capacity is assumed to be four persons) to derive the cost per visitor using private transport means.

Costs incurred by using public transport are twofold: firstly, the fare from the individual traveller's home area to the bus terminal (or the airport) in Phuket or Krabi, and then that from the bus terminal (or the airport) to the boat pier. The fare for individuals travelling from the bus terminal (or airport) to the pier has been found to be uniform for all visitors. However, the fare from the traveller's home area to the bus terminal (or airport) varies according to distance and the mode of transport.

6.0 METHODOLOGY

Recreation is often cited as the most significant economic function of coral reefs. Three approaches to estimating values are usually evident: change in production, contingent valuation methods (CVM), or travel cost methods (TCM). From a utility perspective, the value arising from the change in production approach ignores the consumer surplus generated by the recreation experience, and as a result underestimates the total value of the recreation experience.

This study employed both TCM and CVM to generate estimates of the reef value at Phi Phi. It first used the TCM to estimate the consumer surplus for both domestic and international tourists to Phi Phi Islands. For this, travel cost data was collected from visitors who had had a recreational experience of the coral reefs (such as diving, snorkelling and fishing). However, the estimated value from the TCM may include all the attributes of Phi Phi Islands, valued by those who have come to view coral as part of their whole vacation package. To isolate the consumer surplus associated with visits to the coral sites alone, a CVM study was conducted that focused on both domestic and international tourists who visited the reef sites only. In addition, the CVM study was used to estimate the non-use values (option, existence and bequest values) of coral reefs at Phi Phi from domestic non-users.

6.1 Travel Cost Method

The TCM measures the demand function for visits to a site. A demand function is an empirical relationship between the price of a goods item and the quantity purchased:

$$Q = f(P,X) \qquad (1)$$

where Q is the quantity purchased, P is the price, and X represents a number of socio-economic variables which might shift the demand function, such as income or age. Economic theory suggests that demand curves slope downward ($dQ/dP<0$), meaning as its price rises, people purchase less of an item. Hundreds of empirical studies of markets have confirmed this theory. The travel cost demand function is a specific application of this general tool to recreational trips. It describes how many times people purchase trips depending on the price of each trip. As with market goods, theory predicts that the higher the price of a trip, the less often people tend to visit; and so the travel cost demand function should likewise be downward-sloping.

The TCM uses a survey technique based on interviews whereby visitors of recreational sites are invited to provide information on their trip (such as the cost, length, purpose of trip, and other sites visited) and on other socio-economic characteristics (including their income, age, and sex). The fundamental principle that drives this model is that if a consumer wants to use the recreational services of a site, he has to visit it. The travel cost to reach the site is considered to be the

implicit or surrogate price of the visit, and changes in the travel cost will cause a variation in the quantity of visits. Observation of these variations across individuals will permit the estimation of demand functions and the value of the site.

Two main variants of the TCM exist: the Zonal Travel Cost Model (ZTCM) and the Individual Travel Cost Model (ITCM). The ZTCM divides the entire area from which visitors originate into a set of visitor zones and then defines the dependent variable as the visitor rate (that is, the number of visits made from a particular zone in a period, divided by the population of that zone). The ITCM defines the dependent variable as the number of site visits made by each visitor over a specified period.

This study employs the ITCM. The demand curve in this model relates an individual's annual visits to the costs of those visits. That is:

$$V_i = f(P_i, X_i) \qquad (2)$$

where V_i = number of visits made per year by individual i; P_i = visit cost faced by individual i; total cost is the sum of expenditure made on fuel, opportunity cost of time for travelling and for visits on-site; X_i = all other factors determining individual i's visits (income, age and other socio-economic characteristics).

A functional form relating the dependent variable (visits per year) and independent variables (travel cost and socio-economic variables) has to be identified to obtain a more-accurate demand curve. The choice is between two functional forms: linear and double log. This study uses the double log demand function:

$$V_i = e^{\alpha_0 + \sum_{c=1}^{l} \alpha_c D_{ci} + \varepsilon_i} \bullet \prod_{j=1}^{k} X_{ji}^{\beta_j} \bullet P_i^{\beta_P} \qquad (3)$$

V_i = number of visits of individual i

D_{ci} = dummy variables referring to individual i

X_{ji} = socio-economic features of individual i and other variables referring to i

P_i = price paid by individual i (integration variable)

i = 1,…,n index of observations

c=1,…,l index of additive dummy variables

j= 1,…,k index of socio-economic variables

α_o = constant

α_c = coefficients of the additive dummy variables

β_j = coefficients of socio-economic variables

β_p = coefficient of the price variable

ε_i = error term

Once estimated, the model is expressed in the following form:

$$V = e^{\alpha_0 + \sum_{c=1}^{l} \alpha_c D_c} \bullet \prod_{j=1}^{k} X_j^{\beta_j} \bullet P^b \qquad (4)$$

For each single individual, the consumer surplus (CS) is the integral of the demand function v with respect to the price p between the lower bound p_{li} and the choke price or the upper bound p_{ui} . The choke price is the price that leads to a demand equal to zero. The indefinite integral of the demand function is:

$$\int v dp = e^{\alpha_0 + \sum_{c=1}^{l} \alpha_c D_c} \bullet \prod_{j=1}^{k} X_j^{\beta_j} \bullet \frac{p^{b+1}}{b+1} \qquad (5)$$

The integral between p_l and p_u is:

$$CS = \frac{e^{\alpha_0 + \sum_{c=1}^{l} \alpha_c D_c}}{b+1} \bullet \prod_{j=1}^{k} X_j^{\beta_j} \bullet (p_u^{b+1} - p_l^{b+1}) \qquad (6)$$

For each individual the consumer surplus is computed by plugging into the above general formula the values for each individual dummy variable D_{ci}, the travel cost p_{li}, the choke price p_{ui}, and the value of the explanatory variables X_{ji}:

$$CS_i = \frac{e^{\alpha_0 + \sum_{c=1}^{l} \alpha_c D_{ci}}}{b+1} \bullet \prod_{j=1}^{k} X_j^{\beta_{ji}} \bullet (p_{ui}^{b+1} - p_{li}^{b+1}) \qquad (7)$$

The annual consumer surplus per individual can be computed by summing up the consumer surplus estimates from all observed consumers (N) and dividing by N:

$$\text{CS per individual} = \frac{1}{N} \sum_{i=1}^{N} CS_i \qquad (8)$$

The annual consumer surplus per visit is calculated by dividing the annual consumer surplus per individual by the annual sample average number of visits:

CS per visit = CS per individual/Sample average visits per year (9)

The CS per visit is then multiplied by the total number of visitors to Phi Phi during the year to obtain the annual total benefit of Phi Phi.

Total benefit (TB) = CS per visit x Total visitors (10)

Loss of the site usually means loss of all future recreational opportunities, not just the current annual value. The entire future stream of annual recreational values must therefore be included. Because they happen in the future, economic theory suggests this stream of benefits be discounted to make them comparable with the present. Assuming that the annual value of recreation is constant over time, the present value of the stream of future benefits can be calculated simply by the following formula:

$$PV = \sum_{t=1}^{T} \frac{TB}{(1+r)^t} \tag{11}$$

6.2 Contingent Valuation Method

The CVM is a technique that allows the value of environmental goods and services to be estimated by asking people directly, usually by means of a survey questionnaire, their willingness to pay (WTP) for a change in the availability of such environmental goods and services. The individual maximum WTP for an environmental change is assumed to be the value the individual attaches to such a change. The major advantage of this approach compared with the reveal preference methods is that the CVM can elicit both use and non-use values. Another attraction of this method is that it may be applied at varying levels of complexity according to the time and financial resources available for the research.

In order to obtain answers that reflect the true maximum WTP of the respondent, different formats for eliciting the value judgement can be employed. The main formats are

1) Open-ended questions

2) Bidding games

3) Dichotomous choice (referendum) questions.

In the open-ended elicitation format, the individual is simply asked to state his maximum WTP for a described change. However, the main drawback of this approach is the ease with which the respondent can introduce a ‘strategic bias’. A second drawback to the open-ended elicitation format is that the individual may not be prepared to express a value judgement without a starting reference point with which to bound his value judgement.

To avoid a high rate of loose and/or missing answers caused by the lack of bounds typical of the open-ended format, an iterative technique called a bidding game can be used. This technique, however, suffers from the so-called ‘starting-point bias’. That is, it has been observed that the final judgement is affected by the amount proposed initially.

The elicitation format chosen in this study is the dichotomous choice format. This means that respondents were asked whether they were willing or not (yes/no answer) to pay a pre-determined amount of contribution to the trust fund (PRICE) to restore coral reefs at Phi Phi Islands. The PRICE[2] was randomly assigned among respondents so as to generate price variation. The price range used in this study was based on a pre-test survey carried out in the open-ended elicitation format. With closed WTP responses, information regarding consumer preferences towards coral reef restoration would be estimated parametrically.

Hanemann (1984) shows if there exists a representative consumer who has an indirect utility function $V(P,M,Q,S)$. The level of the consumer depends on price (P), income (M), socio-characteristics (S) and the quality (Q). The respondent is asked if he would pay to help restore the coral reefs at Phi Phi Islands at the given price, P. The respondent will say yes if

$$V(M-P,Q^1,S) > V(M-0,Q^0,S) \tag{12}$$

Equation (12) shows that the respondent will answer yes if his utility deriving from improved reef quality (Q^1) and paying the price (P) is higher than not having improved reef quality (Q^0) and not paying the price (P=0). If $V(P,M,Q,S)$ is the observable component of the utility, the probability of the respondent saying yes is

$$\text{Prob(yes)} = \text{Prob}[V(M-P,Q^1,S)+\varepsilon_1 > V(M-0,Q^0,S)+\varepsilon_0] \tag{13}$$

where ε_i is an unobservable component of the utility. Assuming that the random variable ε_i follows a logistic probability distribution, one can write:

$$\text{Prob(yes)} = \frac{1}{1+e^{-\Delta V}} \tag{14}$$

where $-\Delta V = V(M-P,Q^1,S) > V(M-0,Q^0,S)$

The recreational benefit of the hypothetical market (to improve the coral reefs at Phi Phi Islands) is measured as WTP and is defined as

$$V(M-WTP,Q^1,S) > V(M-0,Q^0,S) \tag{15}$$

Hanemann shows that if $V(M-P,Q,S)$ is linearly specified, then the probability of the respondent saying yes is

$$\text{Log}\left[\frac{\Pr ob(yes)}{1-\Pr ob(yes)}\right] = \alpha_0 - \beta_1 P + \beta_2 Q + \sum \beta_i S_i \tag{16}$$

[2] The values for each for each sub-sample are 50, 100, 300, 500, 700, 1000, 1200, 1500, 1800, and 2000 Baht for domestic respondents; US$1, 3, 8, 15, 20, 25, 30, 40, 45, and 50 for international respondents.

Parameters α_0 and β_i will be estimated parametrically. The mean maximum WTP for coral reef restoration can be calculated using formula (17).

$$\text{Mean maximum WTP} = \frac{1}{\beta_1}[\ln(1 + e^{\alpha_0 + \beta_2 Q + \sum \beta_i S_i})] \qquad (17)$$

7.0 DATA SOURCE

The data set used in this paper was collected through questionnaires to acquire information on travel cost or to elicit the amount of WTP. The questionnaire had three parts: travel cost data, socio-economic data, and WTP questions.

7.1 Questionnaire Design

In this study, the questionnaire was aimed at collecting information for both the TCM and the CVM. Specifically, it was divided into the following sections:

1) The first section attempted to identify the costs of travel faced by individuals in visiting the site, by asking them their origin, the vehicle used to reach the site, the time employed to reach the area from their origin and the trip plan. This section is thus relevant to the TCM.

2) The second section was devoted to the collection of socio-economic data. It is assumed here that age, education, income, profession, number of family members, and so on, are important determinants in visitors' behaviour towards recreational use of, or visits to Phi Phi.

3) The third section consisted of questions aimed at investigating the environmental concern and awareness of visitors. It is assumed that the higher the awareness of environmental problems, the higher the perception of the coral reef's recreational value will be. This section also contained the scenario presentation and the WTP elicitation questions.

7.2 Survey Strategy

A pre-test survey of 60 questionnaires was carried out during April 12-20, 2000, both on and off the site. The purpose of this pre-test survey was twofold. Firstly, it was used to discuss the questionnaire and its formulation with the interviewee, permitting misunderstandings to be corrected and other relevant questions to be included. Secondly, the pre-test survey served to decide a possible range of values for the maximum WTP to be used in this study's final dichotomous choice elicitation format.

The main survey was carried out over three trips to Phi Phi during July 2000 to January 2001. A total of 850 TCM questionnaires were distributed (to

700 domestic visitors and 150 international visitors). However, there were 70 domestic non-responses and 22 international non-responses. The number of completed questionnaires was therefore from 630 domestic visitors and 128 international visitors for the TCM. For the CVM survey, a total of 550 personal interviews were conducted (with 420 domestic visitors and 130 international visitors). The survey yielded 528 usable interviews (from 400 domestic visitors and 128 international visitors). In addition, 200 domestic 'vicarious users' (non-users in the rest of Thailand who value the existence of Phi Phi's coral reefs) were interviewed to estimate the non-use values of the coral reefs at Phi Phi.

7.2.1 Scenario Design

The hypothetical market is stated as follows: "There are many ways of measuring marine biodiversity. One simple indicator is coral abundance, in terms of area covered. An abundance of zero (ABU = 0) would mean that all of the coral has disappeared. An abundance of 100 (ABU = 100%) means that the reef is in its natural pristine state. The reef at Phi Phi Islands, according to the best scientific evidence, is about one-quarter degraded: at ABU = 75%. If we 'do nothing', scientists estimate that it will fall to a value of ABU = 60% in about 20 years. Current ongoing management of the area will maintain the level of biodiversity at a stable level of abundance. This level corresponds to a 75% abundance on the index just explained. A trust fund will be established to help the ecological restoration of Phi Phi's coral reef system if contributions are adequate. The trust fund will be held by the Phi Phi Islands Committee for exclusive use on projects to increase the biodiversity at Phi Phi Islands from the current 75% ABU to a 100% ABU. Examples of the projects proposed include treatment of sewage to a high standard, a new drainage system for storm water, planting mangroves and coastal plants to reduce the impacts of run-off, and establishing monitoring of fish, plant life and mangroves."

7.2.2 Elicitation Format

The elicitation format chosen in this study was the dichotomous choice format. This means that respondents were asked whether they were willing or not to pay a pre-determined contribution amount to the trust fund:

> "Would you be willing to pay US$_____ per year for the next 5 years to a trust fund to help restore the coral reefs of Phi Phi Islands from their current level of 75% ABU to 100% ABU?"

7.2.3 Payment Vehicle

The payment vehicle used in this study is the amount of contribution to the trust fund.

8.0 EMPIRICAL RESULTS

8.1 Estimation of Benefits Based on the Travel Cost Method

Table 4-A reports domestic visitors' total travel costs and average visits by region, and Table 4-B reports those of international visitors. In both tables, total travel costs consists of three components: cost of transport, time cost, and food and lodging plus other expenses. The tables indicate that transportation costs increase with distance, however note that the value of travel time used to calculate the price of a trip is somewhat controversial. Some (for example, OECD 1989) have suggested using a full hourly wage as a measure of the value of recreational travel time. Yet, other estimates approximate the value to be one-third of the full wage rate or even 10% of the wage (Farber, 1988). Both the full wage rate and one-third wage rate have been presented in the tables below.

Table 4-A. Total Travel Costs and Visits by Region (Domestic Visitors)

	North (n=14)	Northeast (n=6)	Central (n=194)	South (n=416)	Total (n=630)
Round-trip transportation costs (Baht)	4,475	3,491	3,344	898	1,755
Time costs (full wage rate) (Baht)	2,325	1,496	1,528	899	1,130
Time costs (1/3 wage rate) (Baht)	767	494	504	297	373
Other costs (food, lodging) (Baht)	1,681	408	1,206	1,439	1,363
Total costs (full wage rate) (Baht)	8,482	5,396	6,080	3,323	4,246
Total costs (1/3 wage rate) (Baht)	6,924	4,394	5,056	2,631	3,490
Visits	1.07	1.00	1.15	2.34	1.93

Table 4-B. Total Travel Costs and Visits by Region (International Visitors)

	America (n=20)	Europe (n=75)	Australia (n=7)	Asia-Pacific (n=26)	Total (n=128)
Round-trip transportation costs (US$)	106	189	218	131	166
Time costs (full wage rate) (US$)	748	770	489	498	696
Time costs (1/3 wage rate) (US$)	247	254	162	164	230
Other costs (food, lodging) (US$)	56	72	47	78	69
Total costs (full wage rate) (US$)	911	1,031	755	707	931
Total costs (1/3 wage rate) (US$)	409	515	427	373	465
Visits	1.2	1.1	1	1.8	1.2

Table 5 presents domestic and international visitors' socio-demographic characteristics.

Table 5. Socio-Demographic Characteristics of Visitors

	Domestic Visitors (n=630)		International Visitors (n=128)	
Characteristics	*Frequency*	*Percent*	*Frequency*	*Percent*
Level of education				
Primary (4th grade)	2	0.3	0	0.0
Secondary (6th grade)	11	1.7	4	3.1
High school (12th grade)	63	10.0	33	25.8
Diploma	206	32.7	24	18.8
Bachelor	296	47.0	48	37.5
Master	48	7.6	19	14.8
Doctoral	4	0.6	0	0.0
Gender				
Male	279	44.3	79	61.7
Female	351	55.7	49	38.3
Marital status				
Single	388	61.6	80	62.5
Married	242	38.4	48	37.5
Income (Baht) / Income (US$)				
0-2,500 / 0-100	23	3.7	5	3.9
2,500-5,000 / 100-200	115	18.3	13	10.2
5,001-7,500 / 201-300	129	20.5	7	5.5
7,501-10,000 / 301-400	94	14.9	5	3.9
10,001-15,000 / 401-500	91	14.4	9	7.0
15,001-20,000 / 501-1,000	70	11.1	17	13.3
20,001-25,000 / 1,001-1,500	31	4.9	17	13.3
25,001-50,000 / 1,501-2,000	51	8.1	16	12.5
>50,000 / 2,001-2,500	26	4.1	11	8.6
- / >2,500	-	-	28	21.9
Occupation				
Civil servant	98	15.6	10	7.8
Own business	118	18.7	13	10.2
Private employee	279	44.3	51	39.8
Labourer	6	1.0	7	5.5
Student	104	16.5	31	24.2
Retired	7	1.1	2	1.6
Non-working spouse	7	1.1	3	2.3
Others	11	1.7	11	8.6

Table 6 gives the definition of each variable used in the travel cost modelling and in the calculation of the consumer surplus, while Table 7 provides descriptive statistics for each variable. Table 8 summarises the results of the ITCM estimation of the linear demand function. Table 9 summarises the results of the ITCM estimation of the double-log demand function.

Table 6. Definition of Variables Used in Travel Cost Modelling and Consumer Surplus Calculations

Variable Name	*Definition*
AGAIN	AGAIN = 1 if the respondent will be back to Phi Phi again
AGE	The respondent's age
HHNUM	The respondent's household size
INC	The respondent's income
MALE	MALE = 1 if the respondent is male
MEMBER	MEMBER = 1 if the respondent is a member of an environmental organisation
NUMED	The respondent's number of years at school
OSITE	OSITE = 1 if the respondent visits other site(s) than Phi Phi
OWN	OWN = 1 if the respondent owns a house
SINGLE	SINGLE = 1 if the respondent is single
TC1	TRAV + Time cost (Full wage rate) + Other costs (food, lodging, others)
TC2	TRAV + Time cost (1/3 wage rate) + Other costs (food, lodging, others)
TRAV	Round-trip transportation costs
VISIT	Number of visits per year

Table 7. Descriptive Statistics for Variables Used in Modelling Demand for Phi Phi Islands

	Domestic visitors (n=630)				International visitors (n=128)			
Variable	*Min*	*Max*	*Mean*	*Std. Error*	*Min*	*Max*	*Mean*	*Std. Error*
AGAIN	0	1	0.63	0.48	0	1	0.44	0.49
AGE	14	69	29.9	8.9	17	65	31.5	10.95
INC	1,250	60,000	13,627	13,448	50	3,000	1,410.15	1,055.38
MALE	0	1	0.44	0.49	0	1	0.61	0.48
MEMBER	0	1	0.05	0.22	0	1	0.06	0.24
NUMED	4	22	14.9	2.11	6	18	14.5	2.57
OSITE	0	1	0.55	0.49	0	1	0.35	0.47
OWN	0	1	0.66	0.48	0	1	0.43	0.49
SINGLE	0	1	0.61	0.48	0	1	0.62	0.48
TC1	314	24,482	4,246	3,277	36.8	6,382.73	931.47	998.30
TC2	124	19,000	3,490	2,695	32.25	2,670	465	465.37
TRAV	150	15,000	1,756	1,922	20	2,010	166	296.88
VISIT	1	6	1.94	2.58	1	3	1.27	0.98

Note: INC, TC1, TC2, TRAV variables are in Baht for domestic visitors; US$ for international visitors

Table 8. ITCM Estimation of Linear Demand Function Parameters

MODEL 1			MODEL 2			MODEL 3		
Independent Variables	Dependent Variable: VISIT		Independent Variables	Dependent Variable: VISIT		Independent Variables	Dependent Variable: VISIT	
	Domestic N=630	International N=128		Domestic N=630	International N=128		Domestic N=630	International N=128
Constant	4.66	-0.54	Constant	4.71	-0.60	Constant	4.27	-0.66
	(5.1)	(-0.7)		(5.1)	(-0.8)		(4.7)	(-0.8)
AGAIN	0.07	-0.003	AGAIN	0.06	0.006	AGAIN	-0.001	0.01
	(0.3)	(-0.01)		(0.3)	(0.03)		(-0.00)	(0.1)
AGE	-0.002	0.01	AGE	-0.0009	0.01	AGE	0.003	0.01
	(-0.2)	(1.6)		(-0.1)	(1.6)		(0.2)	(1.7)
HHNUM	-0.08	0.0003	HHNUM	-0.08	0.0005	HHNUM	-0.07	-0.0003
	(-1.6)	(0.006)		(-1.7)	(0.01)		(-1.6)	(-0.01)
INC	0.00001	-0.0001	INC	0.000008	-0.0001	INC	0.000007	-0.0001
	(0.2)	(-0.9)		(0.9)	(-1.09)		(0.7)	(-1.1)
MALE	0.42	0.38	MALE	0.42	0.39	MALE	0.40	0.39
	(0.05)	(2.1)		(2.0)	(2.1)		(1.9)	(2.13)
MEMBER	0.56	0.05	MEMBER	0.56	0.06	MEMBER	0.42	0.07
	(0.2)	(0.1)		(1.2)	(0.16)		(0.9)	(0.2)
NUMED	-0.14	0.06	NUMED	-0.14	0.06	NUMED	-0.13	0.06
	(0.006)	(1.6)		(-2.7)	(1.6)		(-2.5)	(1.7)
OSITE	-0.23	0.18	OSITE	-0.21	0.19	OSITE	-0.21	0.22
	(0.3)	(0.9)		(0.3)	(1.04)		(-1.0)	(1.1)
OWN	-0.15	-0.01	OWN	-0.14	-0.02	OWN	-0.09 (-0.4)	-0.02
	(0.5)	(-0.007)		(-0.6)	(-0.12)			(-0.1)
SINGLE	0.30	0.35	SINGLE	0.29	0.36	SINGLE	0.35	0.37
	(0.2)	(1.39)		(1.2)	(1.4)		(1.4)	(1.5)
TC1	-0.0001	0.00001	TC2	-0.0001	0.0001	TRAV	-0.0003	0.0002
	(0.00)	(0.14)		(-4.2)	(0.42)		(-5.01)	(0.7)
R^2	5.9	8.5	R^2	6.5	8.6	R^2	7.5	8.9
F	3.50	0.98	F	3.89	0.99	F	4.58	1.03

Note: T-ratios are in parentheses

Table 9. ITCM Estimation of Double-Log Demand Function Parameters

MODEL 4			MODEL 5			MODEL 6		
Independent Variables	Dependent Variable: LNVISIT		Independent Variables	Dependent Variable: LNVISIT		Independent Variables	Dependent Variable: LNVISIT	
	Domestic N=630	International N=128		Domestic N=630	International N=128		Domestic N=630	International N=128
Constant	2.68	-1.47	Constant	2.81	-1.5	Constant	2.56	-1.22
	(5.2)	(-2.2)		(5.5)	(-2.2)		(5.6)	(-1.9)
AGAIN	0.03	0.02	AGAIN	0.03	0.02	AGAIN	-0.02	0.003
	(0.7)	(0.39)		(0.6)	(0.4)		(-0.5)	(0.04)
MALE	0.06	0.13	MALE	0.06	0.13	MALE	0.06	0.14
	(1.2)	(2.0)		(1.3)	(2.0)		(1.3)	(2.1)*
MEMBER	0.24	0.04	MEMBER	0.25	0.04	MEMBER	0.20	0.04
	(2.2)	(0.3)		(2.3)	(0.3)		(2.0)*	(0.3)
OSITE	-0.006	0.12	OSITE	-0.001	0.12	OSITE	0.004	0.09
	(-0.1)	(1.8)		(-0.03)	(1.8)		(0.1)	(1.3)
OWN	-0.05	0.05	OWN	-0.04	0.04	OWN	-0.003	0.05
	(-1.0)	(0.7)		(-0.8)	(0.7)		(-0.1)	(0.7)
SINGLE	0.03	0.17	SINGLE	0.02	0.18	SINGLE	0.03	0.15
	(0.5)	(1.9)		(0.4)	(1.9)		(0.6)	(1.7)*
LNTC1	-0.21	-0.01	LNTC1	-0.22	0.002	LNTC1	-0.3	-0.05
	(-5.9)	(-0.2)		(-6.9)	(0.04)		(-11.9)*	(-1.7)*
LNNUMED	-0.37	0.16	LNNUMED	-0.35	0.16	LNNUMED	-0.3	0.13
	(-2.6)	(0.9)		(-2.4)	(1.0)		(-2.0)*	(0.8)
LNINC	0.03	-0.03	LNINC	0.02	-0.03	LNINC	0.02	-0.02
	(1.1)	(-0.7)		(0.6)	(-0.9)		(0.7)	(-0.8)
LNHHNUM	-0.06	0.0008	LNHHNUM	-0.06	0.004	LNHHNUM	-0.06	0.002
	(-1.4)	(0.01)		(-1.5)	(0.05)		(-1.4)	(0.02)
LNAGE	0.03	0.34	LNAGE	0.03	0.35	LNAGE	0.08	0.35
	(0.2)	2.48		(0.3)	(2.5)		(0.7)	(2.5)*
R^2	9.4	12.6	R^2	11.0	12.6	R^2	22.0	14.7
F	5.81	1.52	F	6.94	1.51	F	15.80	1.82

Note: T-ratios are in parentheses * significant at 0.10

The first set of model estimates is reported in Table 8. Models 1-3 use a linear functional form where the number of visits taken to the site in the past 12 months (VISIT) is related to selected model explanatory variables.

The second set of model estimates is reported in Table 9. Models 4-6 use a double-log functional form where the natural logarithm of the number of visits (LNVISIT) taken to the site in the past 12 months is related to selected model explanatory variables. The double-log model 6 was judged to be better than the other models based on the explanatory power of the equation (R^2). Model 6, which uses the double-log functional form, eliminating the opportunity cost of

time and other costs (food and lodging), was judged the 'best' overall model. Significant demand effects were identified for the model, that is, the travel cost coefficient being negative and statistically significant. Model 6 was then re-estimated by dropping all insignificant explanatory variables. These results are shown in Table 10.

Table 10. ITCM Re-Estimation of Double-Log Demand Function Parameters

Dependent Variable: LNVISIT Domestic: n=630, R^2 = 0.207, F=55.727			
Model	*Coefficient*	*Std. Error*	*T-Ratios*
(Constant)	2.799	0.349	8.01
MEMBER	0.201	0.100	2.01
LNNUMED	-0.219	0.126	-1.73
LNTRAV	-0.266	0.072	-12.15
Dependent Variable: LNVISIT International: n=128, R^2 = 0.119, F=4.16			
Model	*Coefficient*	*Std. Error*	*T-Ratios*
(Constant)	-0.836	0.477	-1.753
MALE	0.132	0.064	2.057
SINGLE	0.146	0.085	1.723
LNAGE	0.334	0.125	2.665
LNTRAV	-0.076	0.031	-2.499

For every observation, the annual consumer surplus (CS) with the double-log demand function was calculated using equation (7). The upper limit of integration (the choke price) was set at 99% of the round-trip transportation costs, which equals 7,353 Baht (US$183.82) for domestic visitors and 80,400 Baht (US$2,010) for international visitors. An annual CS per individual was computed by using equation (8) yielding the annual CS per person of 6,568.86 Baht (US$164.22) for domestic visitors; and 75,920 Baht (US$1,898) for international visitors. These numbers were then divided by the annual sample average visit, which equals 1.93 for domestic visitors and 1.27 for international visitors. This results in the annual CS per visit of 3,403.55 Baht (US$85) for domestic visitors and 59,760 Baht (US$1,494) for international visitors.

The total benefits from the recreational services of Phi Phi were estimated to be about 69.90 million Baht (US$1.75 million) a year for domestic visitors and 8,146.4 million Baht (US$203.66 million) a year for international visitors[3]. These two numbers added together result in the total benefit of Phi Phi (in terms of recreational value) being 8,216.4 million Baht (US$205.41 million) a

[3] Based on the 1998 figures of total domestic and international visitors to Phi Phi of 20,540 and 136,277 visitors respectively

year. Therefore, the value of Phi Phi is around 249,720 Baht (US$6,243) per ha per year[4]. Assuming the real value of this recreational value of 8,216.4 million Baht (US$205.41 million) a year remains the same over thirty years, and using a real interest rate of 5%, the present recreational value of Phi Phi is 126,280 million Baht (US$3,157 million).

8.2 Estimation of Benefits Based on the Contingent Valuation Method

The findings from the survey are based on the analysis of 400 domestic and 128 international interviews. Table 11 shows the socio-demographic characteristics of respondents interviewed. Table 12 shows the distribution of responses to the valuation question, indicating the total number of respondents who stated that they would be willing to pay for the conservation program at each bid level. Bid amounts ranged from 50 to 2,000 Baht a year and from US$1 to US$50 a year for domestic and international respondents respectively.

Table 11. Socio-Demographic Characteristics of Visitors

	Domestic Visitors (n=400)		International Visitors (n=128)	
Characteristics	*Frequency*	*Percent*	*Frequency*	*Percent*
Level of education				
Primary (4th grade)	3	0.6	0	0.0
Secondary (6th grade)	9	2.5	0	0.0
High school (12th grade)	56	14.0	4	3.1
Diploma	101	25.2	33	25.8
Bachelor	194	48.5	24	18.8
Master	32	8.0	48	37.5
Doctoral	5	1.2	19	14.8
Gender				
Male	197	49.3	79	61.7
Female	203	50.7	49	38.3
Marital status				
Single	224	56.0	80	37.5
Married	176	44.0	48	62.5
Occupation				
Civil servant	64	16.0	10	7.8
Own business	79	19.7	13	10.2
Private employee	180	45.0	51	39.8
Labourer	5	1.3	7	5.5
Student	47	11.7	31	24.2
Retired	6	1.5	2	1.6
Non-working spouse	8	2.0	3	2.3
Others	11	2.8	11	8.6
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Age	30.99	9.44	31.51	10.95
Household size	4.20	3.38	2.95	1.55
Income	13,793	11,711	1,410	1,055

Note: Income is in Baht for domestic visitors; US$ for international visitors

[4] The reef area at Phi Phi is estimated to be 32,900 ha.

Table 12. Distribution of Responses by Bid Amount

Domestic Users (n=400)				International Users (n=128)			
Price (Baht)	*Pay*	*Not Pay*	*Total*	*Price (US$)*	*Pay*	*Not Pay*	*Total*
50	28	12	40	1	8	5	13
100	24	16	40	3	3	10	13
300	23	17	40	8	5	8	13
500	16	24	40	15	1	12	13
700	12	28	40	20	2	11	13
1000	7	33	40	25	2	11	13
1200	4	36	40	30	0	13	13
1500	4	36	40	40	1	12	13
1800	3	37	40	45	1	11	12
2000	3	37	40	50	2	10	12

Table 13 provides the definition of the variables used in estimating the unknown parameters in the indirect utility function. The estimation of the probability function was carried out using the maximum log likelihood method.

Table 13. Definition of Variables Used in Estimating the Unknown Parameters in the Indirect Utility Function

Variables	*Definition*
AGE	The respondent's age
INC	The respondent's income
MALE	MALE = 1 if the respondent is male
NUMED	The respondent's number of years at school
PAY	PAY = 1 if the respondent is willing to pay to contribute to the trust fund
PRICE	A predetermined amount of contribution to the trust fund
SINGLE	SINGLE = 1 if the respondent is single

The results of the logit estimation of the linear utility model by maximum likelihood are reported in Table 14. The T-ratio on the variable PRICE is very high, showing a high explanatory power of this variable with respect to the decision to agree or refuse to contribute to the trust fund. The variable NUMED appears to be highly significant, while the variables INC and AGE do not appear to be so. To calculate the mean maximum WTP, a new model was estimated by dropping all insignificant variables. The econometric results of the new model are reported in Table 15.

Table 14. Parameter Estimates of the Logit Model by Maximum Likelihood

	Domestic Visitors (n=400)		International Visitors (n=128)	
Model	*Coefficient*	*T-Ratios*	*Coefficient*	*T-Ratios*
(Constant)	-0.500	-0.273	-4.99	-2.28
INC	0.0000014	0.13	0.00013	0.48
PRICE*	-0.0019	-8.08	-0.05	-2.86
AGE	-0.029	-1.67	0.015	0.48
MALE	-0.039	-0.15	0.514	0.96
SINGLE	-0.52	-1.73	-0.242	-0.37
NUMED*	0.15	2.37	0.242	2.01

* significant at 0.05

Table 15. Re-Estimation of Parameter Estimates of the Logit Model by Maximum Likelihood

	Domestic Visitors (n=400)		International Visitors (n=128)	
Variable	*Coefficient*	*T-Ratios*	*Coefficient*	*T-Ratios*
(Constant)	-1.32	-1.42	-4.34	-2.39
NUMED*	0.13	2.18	0.26	2.23
PRICE*	-0.0019	-8.12	-0.052	-3.05

*significant at 0.05

The mean maximum WTP is calculated with the formula illustrated in equation (17). For the calculation of the mean maximum WTP, the NUMED variable is set at its sample mean value.

For domestic visitors:

$$\text{Mean maximum WTP} = \frac{1}{0.0019}[\ln(1+e^{-1.3+0.13(14.8)})] = 554 \text{ Baht (US\$13.85) per person}$$

For international visitors:

$$\text{Mean maximum WTP} = \frac{1}{0.052}[\ln(1+e^{-4.3+0.26(14.6)})] = 363 \text{ Baht (US\$9.08) per person}$$

The mean maximum WTP per visit is computed by dividing the mean maximum WTP per person by the sample average number of visits. Here, the mean maximum WTP per visit equals 287 Baht (US$7.17) for domestic visitors, and 286 Baht (US$7.15) for international visitors. The total values of Phi Phi's coral reefs were estimated to be 5.89 million Baht (US$0.147 million) a year for

domestic visitors, and 49.6 million Baht (US$1.24 million) a year for international visitors[5].

This study also used the CVM to estimate the non-use value of coral reefs at Phi Phi to domestic vicarious users (urban Thai population in the labour force). Table 16 shows the distribution of 200 responses to the valuation question. The results of the logit estimation of the linear utility model by maximum likelihood are reported in Table 17. To calculate the mean maximum WTP, a new model was estimated by dropping all insignificant variables. The econometric results of the new model are reported in Table 18. Once again, the mean maximum WTP is calculated with the formula illustrated in equation (17), with the NUMED variable set at its sample mean value. That is:

$$\text{Mean maximum WTP} = \frac{1}{0.0022}[\ln(1 + e^{-1.54+0.18(15.2)})] = 634 \text{ Baht (US\$15.85) per person}$$

Multiplying the mean WTP of 634 Baht (US$15.85) per person by the total labour force in Thailand of 31.3 million yields the non-use value of Phi Phi's coral reefs of 19,840 million Baht (US$496 million) a year. Therefore, the benefit values (use and non-use) of coral reefs at Phi Phi were estimated to be 19,895 million Baht (US$497.38 million) a year, averaging 604,720 Baht (US$15,118) per ha per year.

Table 16. Distribution of Non-Users' Responses by Bid Amount

Price (Baht)	*Pay*	*Not Pay*	*Total*
50	15	5	20
100	15	5	20
300	17	3	20
500	10	10	20
700	4	16	20
1000	3	17	20
1200	2	18	20
1500	3	17	20
1800	2	18	20
2000	2	18	20

[5] Based on the 1998 figures of total domestic and international visitors to Phi Phi of 20,540 and 136,277 visitors respectively.

Table 17. Parameter Estimates of the Logit Model by Maximum Likelihood

Model	*Coefficient*	*T-Ratios*
(Constant)	0.16	0.083
INC	0.000014	0.664
PRICE*	0.0022	-6.549
AGE*	-0.0651	-1.859
MALE	0.554	1.328
SINGLE	-0.266	-0.578
NUMED*	0.185	1.654

*significant at 0.10

Table 18. Re-Estimation of Parameter Estimates of the Logit Model by Maximum Likelihood

Variable	*Coefficient*	*T-Ratios*
(Constant)	-1.54	-1.00
NUMED*	0.18	1.80
PRICE*	-0.0022	-6.66

*significant at 0.10

9.0 CONCLUSIONS AND POLICY RECOMMENDATIONS

9.1 Methodological Issues

There are two lessons to be learnt from this study that may be relevant to future research. Firstly, interviewing visitors on site can introduce sampling biases to the analysis. It may be more desirable to initially intercept people at the site and then actually conduct the survey as a follow-up exercise after the visit has been completed and the respondent has returned home. For example, the researcher might conduct a telephone survey of the respondents, asking them about the trips they had taken over the year. Secondly, dichotomous choice contingent valuation questions are inefficient in that a very large number of observations are required to identify a distribution of resource values with any degree of accuracy. An alternative questioning strategy introduces a follow-up dichotomous choice question, such that if a respondent indicates a willingness to pay the first-offered amount, the new threshold will be approximately double the first. If the respondent is unwilling to pay the first-offered amount, the second threshold is reduced to about half the original amount. This questioning strategy is also called a 'double-bounded referendum' approach.

9.2 Benefit Transfer Issues

Benefit transfer refers to the practice of using values estimated for an alternative policy context or site as a basis for estimating a value for the policy context or site in question. There are various issues that should be considered

before transferring values, such as the similarity of the environmental goods being measured, the magnitude of the change under consideration, and the population size and socio-economic characteristics. Desvousges, Naughton and Parsons (1992) proposed five criteria against which the accuracy of a benefit transfer could be assessed. Based on their proposal, a smaller and simpler set of criteria has been adopted. Firstly, the study site and policy are similar. Secondly, the environmental change under consideration at the policy site is similar to the proposed change at the study site. Finally, the socio-economic characteristics of the populations and other site details are also similar.

This study provides the first published estimate of economic values of coral reefs in Thailand. In fact, Phi Phi is being used as an important reference site for other conducting coral reef valuations. This type of valuation has implications for management at Phi Phi, as well as other sites at risk. Direct transfer of benefits on a per-ha basis was used in this study because all the sites are seemingly similar. In addition, this approach is of most use where an indication of direction is required for policy-makers conducting a preliminary assessment.

Phi Phi has high values, coming from both the use (i.e. recreational and tourism, educational and scientific research) and non-use values (i.e. genetic resources, and known and unknown future uses of ecological functions). The travel cost method reveals that domestic and international recreation alone represents an annual value of 8,216.4 million Baht (US$205.41 million). Given that the Park comprises 32,900 ha, its recreational value averages about 249,720 Baht (US$6,243) per ha per year. The contingent valuation method indicates that together the use and non-use values of Phi Phi's coral reefs represent an annual value of 19,895 million Baht (US$497.38 million), averaging about 604,720 Baht (US$15,118) per ha per year. These figures were used to calculate coral reef values at other sites at risk, which are shown in Table 19. Nine marine national parks in Thailand include significant reef areas. Most of the parks containing reefs are in the Andaman Sea with only three sites in the Gulf of Thailand. Together with the Fisheries Protected Areas, approximately 60% of Thailand's coral reefs are located within a protected area.

Table 19. Economic Values of Coral Reefs in Marine National Parks of Thailand

Marine National Park	*Sea Area (ha)*	*Region*	*Recreational Values Million Baht/Year (US$ Million/Year)*		*Total Values Million Baht/Year (US$ Million/Year)*	
Tarutao	126,000	Andaman	31,466.8	(786.67)	76,194	(1,904.85)
Mu Ko Ang Thong	8,400	West Gulf	2,083.2	(52.08)	5,040	(126.00)
Mu Ko Surin	10,205	Andaman	2,530.8	(63.27)	6,122.8	(153.07)
Hat Nai Yang	8,000	Andaman	1,984	(49.60)	4,800	(120.00)
Khao Laem Ya-Mu Ko Samet	12,000	East Gulf	2,976	(74.4)	7,200	(180.00)
Mu Ko Similan	9,300	Andaman	2,306.4	(57.66)	5,580	(139.50)
Mu Ko Chang	4,480	East Gulf	1,110.8	(27.77)	2,688	(67.20)
Mu Ko Phi Phi	32,900	Andaman	8,216.4	(205.41)	19,895	(497.38)
Mu Ko Lanta	10,850	Andaman	2,690.8	(67.27)	6,510	(162.75)

Note: Reef areas protected in marine national parks are taken from ONEB 1991.

9.3 Policy Implications

Municipal and city governments are now the common planning units for natural resource management, due to 1997 legislation supporting decentralisation of this responsibility out to local government. These local government units are starting to seriously consider the plight of their coastal resources and are developing coastal resource management plans accordingly. Such plans require budgeting and support from the municipal or city councils, but often lack economic justification to help decision-makers appreciate what they are supporting. In this regard, there is an effort to raise awareness among local and national government decision-makers of the value of coastal resources and what would be lost if they were destroyed or not properly managed for long-term sustainability. This information helps justify investments in management and protection at a level of government that is directly concerned with its natural resource base.

The focus of this study is the valuation of coral reefs and how this information can be used to improve planning for coral reef management in Thailand. The site analysed, Phi Phi Islands, is rich in reef systems and is envisioned as an eco-tourism destination by government planners. Phi Phi is representative of many coastal areas in Thailand with potentially rich coral reefs in need of improved management so that economic and other benefits can be restored and enhanced. Phi Phi can generate large economic values through recreation. The consumer surplus associated with visits to Phi Phi represents an annual value of 8,216.4 million Baht (US$205.41 million). It is apparent from this analysis that the local and national levels of government in Thailand can justify larger annual budget allocations for the management of coastal resources. At present, the economic benefits from coastal resource management in Phi Phi are mostly due to the efforts of local residents and businesses.

9.4 Options for Phi Phi

Is continued expansion of dive tourism (with its associated economic benefits) compatible with ecosystem protection? The data presented from Phi Phi indicates that it may rapidly be approaching a point whereby increased dive tourism results in measurable degradation of the marine environment. The beauty of Phi Phi Islands has made them world-famous. But fame and easy access has its price: hundreds of visitors land on Phi Phi's shores every day, crowding this tiny island oasis. A number of private tour operators have been running boat tours to the islands for tourists, for whom snorkelling and fish-feeding have become popular activities. This increased use of the area has resulted in demands for improved facilities to serve the tourists. The consensus with regard to Phi Phi is that the rapid growth in tourist numbers, together with the infrastructure established to service their needs, have produced a severe reduction in the quality of the islands' ecosystem, particularly in the heavily used shallow sea areas.

Phi Phi, however, remains popular and provides an example of the concept of recreational succession[6]. Many now consider Phi Phi to be nothing more than a 'sacrifice area' – a location where the tourist masses can be channelled to concentrate their negative effects, thereby reducing the pressure on other islands in the Andaman Sea of Thailand.

Judging the relative costs and benefits of tourism is extremely difficult, if not impossible. It is, however, possible to agree that the goal of maximising the positive and minimising the negative impacts of tourism is a worthy one. Thus, rather than trying to quantify costs and benefits, it is better to concentrate on developing a management regime for marine tourism which maximises the good while minimising the bad.

There is a wide variety of strategies that can be utilised in developing such a regime. One strategy is to use economic instruments to modify people's behaviour. An example of this type of strategy is the use of higher entry fees to facilities during peak-use times in an attempt to spread visiting volume. Permits that are auctioned to commercial tourist operators can restrict the number of operators. Another example is use of a regulation combined with an economic disincentive, such as imposing fines for littering, taking undersized fish, or other inappropriate behaviour. Discounts on access fees to a marine park could be provided if groups undertook a clean-up project, or assisted with research during their visits. Given the increasing financial pressure under which many of these public management agencies find themselves, taking the opportunity to utilise

[6] This concept was first proposed by Stankey (1985) when he described the gradual deterioration of a camping site as it became increasingly popular with visitors. The overall result of recreational succession is a gradual 'creeping' of development of facilities and infrastructure and a gradual loss of 'wilderness' and environmental quality.

economic techniques to generate additional funds, and accomplish management objectives, may be worthwhile.

When using economic instruments to capture the net benefit values of Phi Phi, there are two general options to consider: whether to directly target the producers or the consumers. If the tourists (as consumers) are to be charged, instruments could be applied to those activities that physically use the environment, such as offshore water sports (specifically including snorkelling boats and dive operations), swimming and beach activities. However, such activities are dispersed among the many individual operators providing different services and are geographically spread throughout the Islands. The most obvious complementary service utilised by all tourists at Phi Phi is the accommodation sector. Therefore, a charge levied through the use of accommodation would effectively target this consumer group, and at the same time facilitate the administration and enforcement of the charge.

Another option is an annual user fee or resource use charge that would focus on producers, namely fishermen and water-sport operators. However, there are notable problems with setting the fee at an appropriate amount and enforcing the use of the resource (for example, ensuring that only those licensed are the exclusive users and monitoring to ensure that licensees' usage does not rise above specified or reported levels) (Huber et al., 1998). The ability to collect fees attached to the licensed use of Phi Phi requires that the exclusion of non-licensed users is able to be enforced. Without an effective ability to control access to the resource, licensed users would be reluctant to pay the associated fee because their exclusive rights to the resource could not be upheld. Furthermore, user fees increase the accountability of the management authorities in the delivery of effective management. Although arguably a benefit of the mechanism, this is likely to put pressure on management to implement a limited set of short-term services for the users, which may be at the expense of longer-term goals.

Finally, physical approaches (technical interventions) for mitigating the 'trampling effects' at Phi Phi can be implemented. In a number of situations, physical structures have been successfully used to control tourists while at sea. A typical example is to use mooring buoys for vessels to reduce anchor damage to coral reefs. In addition, regulations can be used to restrict the type of vessel permitted in an area: for example, by allowing only electrically powered boats in an area sensitive to noise disturbance. Thus, the negative impacts of tourist activities can be mitigated by a combination of regulatory and physical approaches.

9.5 Recommendations for Phi Phi

The results of the contingent valuation study provide information regarding the extent of the local consumer surplus. The most prominent local uses of Phi Phi are activities associated with the tourism sector, including offshore water sports, swimming and beach activities, as well as the broader spectrum of tourism services indirectly dependent on the marine environment.

These values represent the extent of the marine-derived production contributions at risk of being lost if conservation efforts prove inadequate. This study utilised the CVM to estimate the utility values associated with coral reef biodiversity at Phi Phi. 400 domestic survey respondents were asked whether they would contribute towards a trust fund that would be managed by the Phi Phi Islands Committee to increase biodiversity. The payment would be made on a per-annum basis over five years and would lead to a 25% increase in coral reef cover. At the sample means, a consumer's willingness to pay towards increasing biodiversity was estimated as 287 Baht (US$7.18) per visit.

A benefit capture instrument should be implemented in order to target the tourist consumer surplus. Determing an appropriate user fee for Phi Phi is quite straightforward, as the value that people obtain from visiting Phi Phi's reef sites has been established as 287 Baht (US$7.18) per visit. Therefore, based on this figure, this study suggests a basic entrance fee of 40 Baht (US$1) per person per visit for Phi Phi; that is, twice as much as the current rate of 20 Baht (US$ 0.50) per person. Supplementary user charges should also be levied when visitors receive additional services from the variety of recreational sites on offer at Phi Phi. It would seem reasonable for the Park to impose charges for tourists visiting certain special and environmentally vulnerable recreational sites. For instance, after having charged the basic entrance fee of 40 Baht (US$1), the Park could impose an extra fee of 150 Baht (US$3.75) per person per visit if the visitor chose to visit the coral reef at Maya Bay. This user charge would help raise additional revenue for the Park by transferring surpluses from high-end consumers to gains, while leaving the low-income visitors unaffected. At the same time, charging an additional fee for particular reef sites would assist in reducing the number of visitors. This additional fee could be more expensive during periods when the marine environment is more sensitive to disturbance, thus providing an incentive for tourists to visit at other times. Both these measures could help relieve the negative pressure on the delicate marine environment.

Local participation could be part of managing these special and fragile recreational sites, resulting in these user charges becoming a channel whereby revenue is distributed to the local economy. As tourism generates additional income to the local people, it will provide an incentive for the local community to help protect the Park, as they will see that preserving nature helps in attracting more visitors and therefore increasing their income.

The Park may also consider adopting other provisions related to the distribution aspect of the entrance fee. For instance, school children or university students who visit the Park as part of their school activities should be exempted from the entrance fee. In addition, discounts on the Park entrance fee could be provided if groups undertook a clean-up project, or assisted with research during their visits.

Finally, the concept of adopting a discriminatory pricing scheme, where local and foreign visitors are charged different user fees, was considered as a

means to increase the total revenue for the Park. The rationale for charging foreigners a higher entrance fee is firstly, foreigners do not pay income tax or business tax to the local government and secondly, foreigners tend to have a higher WTP for park visitation. However, this study found that, in fact, international visitors here do not have a higher WTP than domestic visitors. In addition, imposing a higher entrance fee for foreigners could create an unnecessary psychological barrier for foreign tourists and could negatively affect the image of Thailand's tourism industry. For this reason, this study recommends that foreign and local visitors be charged the same user fee.

The Park could instead adopt other strategies to transfer the surplus from foreigners to economic gains and conservation, namely, institute a voluntary hotel room fee of 40 Baht (US$1) per bed-night, as recommended by Gustavson (2000). The fee should be voluntary to reduce opposition from local hoteliers and increase the initial political acceptability of the program. Attaching the fee to a hotel room is justified on two counts. Firstly, the benefits from the marine waters at Phi Phi are enjoyed almost exclusively by foreign tourists. Secondly, the current open-access management of Phi Phi means that substantial transaction costs would be associated with instituting property rights effectively and enforcing efficient pricing of the resource (Clarke and Ng, 1993). Key in the recommendation is the adequate provision of information to hotel guests regarding management activities within the Phi Phi Marine National Park and the conservation benefits of the marine environment. Given that the fee would be voluntary, the provision of information (for example, through information boards, pamphlets, and so on) would be necessary to ensure that guests made informed payment decisions. It would also be advisable that guests were notified of the fee, provided information regarding the Park, and asked about their willingness to contribute at the time of check-in.

Critical issues remain to be explored further before the recommended policy for benefit value capture can be fully realised. These include policy procedures and the process for implementation, including information-sharing and consultation. The administrative organisation for implementation and enforcement will also require investigation. This stage is best conducted as a subsequent process under the management authority responsible, the Phi Phi Islands Committee.

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Coral Reefs' Recreational Values Survey

Sukhothai Thammathirat Open University

Instructions:

Introduce yourself to the respondent: "I am doing a tourist survey on behalf of the **School of Economics, Sukhothai Thammathirat Open University**. Your opinion and the information provided will be used to improve the quality of the coral reefs at Phi Phi Islands. Therefore, your honest response is essential for the success of this research project and for the future of coral reefs at Phi Phi Islands."

Date: ____/____/_____ Serial No. _____

Sampling Point:

☐ 1. Chao-fa boat pier ☐ 2. Ao Ton Sai ☐ 3. Ao Nang

☐ 4. View Point ☐ 5. Riley ☐ 6. Maya Bay

☐ 7. Shopping mall (specify)_____ ☐ 9. Others (specify)_____

Time interview starts: _____ ends: _____

SECTION 1 : Tourist Expenses

1. Current address : City _____ Province(State) _____Country _____
2. You came to Krabi/Phuket from (City) _____ (Province) _____ by
   - ☐ I live in the province
   - ☐ Plane
   - ☐ Bus
   - ☐ Train and bus combined
   - ☐ Private car
   - ☐ Other (specify) _____
3. Your estimated round trip travel expenses to Krabi/Phuket : US$_____
4. Number of people in your group: _____ persons
5. You are travelling
   - ☐ Alone
   - ☐ With friends
   - ☐ With family
   - ☐ With a tour group
   - ☐ Other (specify) _____
6. If you were not on this trip today, what would you most likely be doing?
   - ☐ Working
   - ☐ Shopping or watching movie
   - ☐ Staying home
   - ☐ Others (specify) _____
7. If you are not from Krabi/Phuket, you came to Krabi/Phuket for what reason
   - ☐ Vacation
   - ☐ Business
   - ☐ Conference/seminar
   - ☐ Study tour
   - ☐ Others (specify) _____
8. How many trips have you made to the following places in the past 12 months? (Please check all boxes that apply)

Place	*1 trip*	*2 trips*	*3 trips*	*4 trips*	*5 trips*	*More than 5 trips (specify)*
Shell Fossil Beach						
Nopparat-Tara Beach						
Ao Nang						
Riley						
Porda Island						
Phi Phi Islands						

9. What is your reason for visiting Phi Phi Islands?
   □ Friends ask to come along
   □ Easy access
   □ Reefs and beaches
   □ Tourism campaign
   □ Other (specify) _____

10. How long is your whole trip?
    □ 1 day □ 2 days □ 3 days □ More than 3 days (specify) _____ days

11. How long do you plan to stay overnight at Phi Phi Islands?
    □ Not stay overnight
    □ 1 night
    □ 2 nights
    □ More than 2 nights (specify) ___ nights

12. Please estimate what it costs you during your stay at Phi Phi Islands:
    - Round-trip boat fare US$_____
    - Lodging US$_____
    - Food and beverages US$_____
    - Recreation(diving, snorkelling) US$_____
    - Photographs US$_____
    - Others: (specify) _____ US$_____

13. Do you plan to visit other sites nearby Phi Phi Islands?
    □ Yes
    □ No → → **GO TO QUESTION 15**

14. Places that you have visited/or plan to visit during this trip
    (Please check all boxes that apply and fill in appropriate expenses)

Places	Not stay over night	Stay 1 night	Stay 2 nights	Stay 3 nights	Stay more than 3 nights	Lodging US$	Food US$	Recreation US$	Souvenir US$	Other expenses US$
Ko Porda										
Ko Lunta										
Ko PunYi										
Ko Similan										
Ko Surin										
Others (Specify)										

15. What activities do you plan to do at Phi Phi Islands?
    □ Sightseeing
    □ Swimming
    □ Snorkelling reefs
    □ Boating
    □ Rock climbing
    □ Fishing
    □ Others (specify) _____

16. Will you visit Phi Phi Islands in the future?
    □ YES □ NO □ Not sure

SECTION 2 : Tourist Socio-Economic Information

1. Current address : City _____ Province(State) _____Country _____
2. Your gender : □ Male □ Female
3. Marital status : □ 1. Single □ 2. Married □ 3. Other _____
4. Your age : _____ years
5. Your occupation
   □ 1. Civil servant □ 2. Own business □ 3. Private employee
   □ 4. Labourer □ 5. Student □ 6. Retired
   □ 7. Non-working spouse □ 8. Others (specify) _____
6. Number of members in your household
   □ 1-3 persons □ 4-6 persons
   □ 7-9 persons □ More than 9 persons (specify) _____
7. Your education
   □ 1. None □ 2. Primary □ 3. Secondary
   □ 4. Technical Diploma □ 5. Bachelor's Degree □ 6. Master's Degree
   □ 7. Others (specify) _____
8. Your <u>monthly</u> income
   □ Less than US$100 □ US$501-1,000
   □ US$100-200 □ US$1,001-1,500
   □ US$201-300 □ US$1,501-2,000
   □ US$301-400 □ US$2,001-2,500
   □ US$401-500 □ More than US$2,500

   If not working, record spouse's monthly income: US$_____
   If student record parents' monthly income: US$_____

9. Your <u>household's</u> monthly income
   □ Less than US$100 □ US$501-1,000
   □ US$100-200 □ US$1,001-1,500
   □ US$201-300 □ US$1,501-2,000
   □ US$301-400 □ US$2,001-2,500
   □ US$401-500 □ More than US$2,500

10. Are you working for /or have membership of any environmental organisation?
    □ YES (specify a name) _____ □ NO

11. What kind of house do you live in?
    □ 1-bedroom
    □ 2-bedroom
    □ 3-bedroom
    □ 4- or more bedroom

12. What is the tenancy status of your residence?
    □ Bought with full ownership
    □ Rented
    □ Other (specify) _____

SECTION 3: Tourists' Willingness to Pay

1. How concerned you are about each of the following issues in your country ?
   a. Quality of education

Not Concerned									Very Concerned
1	2	3	4	5	6	7	8	9	10

   b. Condition of major roads

Not Concerned									Very Concerned
1	2	3	4	5	6	7	8	9	10

   c. Crime

Not Concerned									Very Concerned
1	2	3	4	5	6	7	8	9	10

2. What in general do you think are the three most important problems related to nature and human impact on the natural environment in your country which you find personally worrying?

   □ 1. Water pollution
   □ 2. Deforestation
   □ 3. Air pollution
   □ 4. Degraded mangrove areas
   □ 5. Degraded coral reefs
   □ 6. Soil erosion
   □ 7. Solid waste
   □ 8. Others (specify) _____

3. Have you ever heard of the Had Nopparat Tara-Phi Phi Islands National Park?
   □ 1. YES □ 0. NO

> The Had Nopparat Tara-Phi Phi Islands National Park is 447,450 *rai* (71,592 ha) of Phang Nga Bay. It was designated a national park in 1983 to protect the many rare species of coral reef, sponges and fish. The coral reefs provide habitat for fish, sand for the beaches and protection from storm surges. Mangroves in the Park are important because they filter the silt out of storm water run-off and, along with seagrass beds, provide breeding grounds for fish.

4. Have you ever visited the Had Nopparat Tara-Phi Phi Islands National Park before?
   □ 1. YES □ 0. NO

> The national park covers the areas of Had Nopparat-Tara, Shell Fossil Beach, Porda Island, Red Rock Island, and Phi Phi Islands. Major attractions of the Park include Phi Phi Islands which are popular with yachtsmen, scuba-divers, snorkellers and day-trippers from Phuket. The islands are characterised by rocky cliffs, tranquil sea, dazzling underwater life, birdsnest caves and fine white sandy beaches. The islands are best visited during non-monsoon months of October through April.
>
> Yet more islands, some 80 in all, and most relatively small, are located off Ao Nang beach on the mainland. Ao Nang is some 6 km from Had Nopparat-Tara, probably Krabi's finest mainland beach which is fronted by pine trees, coconut groves and resort hotels. Another attraction is a 'shell graveyard', known locally as *Su San Hoi*, where fossilised shells, believed to be 10 million years old, form coastal slabs resembling ancient concrete.

5. Are you likely to visit Phi Phi Islands within the next 5 years?

□ 1. YES/LIKELY □ 0. NO/UNLIKELY

6. What, if any, direct and indirect benefits do you currently get from using the natural marine environment and natural resources of the Phang Nga Bay area?

□ 0.No benefit
□ 1.Tourist related income
□ 2.Swimming
□ 3.Diving/Snorkeling
□ 4.Fishing
□ 5. Boating/Sailing
□ 6. Just visiting the area/Scenery
□ 7. Eating seafood from the Bay in past 5 years
□ 8. Others (specify) _____

7. Have you ever heard of the concept of biodiversity before?

□ 1. YES □ 0. NO

Biodiversity is defined as the totality of genes, species and ecosystems in a region. Genetic diversity refers to the variation of genes within species. Species diversity refers to the variety of species within a region. Ecosystem diversity refers to the variety of systems, of living things and their environment, within a region.

Marine biodiversity in the context of coral reefs refers to the different habitats for fish, coral, molluscs, shellfish and other sea animals, but also vegetation, fungi and bacteria. The kind and number of such habitats depend upon: the total number of coral species, dominant species in an area, and the complex patterns that occur in coral reefs over time and space.

*** Trust Fund * ***

ABU = 75%

ABU = 100%

There are many ways of measuring marine biodiversity. One simple indicator is coral abundance, in terms of area covered. An abundance of zero (ABU = 0) would mean that all of the coral has disappeared. An abundance of 100 (ABU = 100%) means that the reef is in its natural pristine state. The reefs at Phi Phi Islands, according to the best scientific evidence, is about one quarter degraded: at **ABU = 75%.** If we 'do nothing', scientists estimate that it will fall to a value of **ABU = 60% in about 20 years**.

Current ongoing management of the area will maintain the level of biodiversity at a stable level of abundance. This level corresponds to 75% abundance on the index just explained. A trust fund will be established to help the ecological restoration of Phi Phi's coral reef system if contributions are adequate.

The trust fund will be held by the Phi Phi Islands Committee for exclusive use on projects to increase the biodiversity at the Phi Phi Islands from the current 75% ABU to a 100% ABU. Examples of the projects proposed include treatment of sewage to a high standard, a new drainage system for storm water, planting mangroves and coastal plants to reduce the impacts of run-off, and establishing monitoring of fish, plant life and mangroves.

Please keep in mind your own personal income constraints when answering the following questions. Remember this is only one of the many environmental issues which may cost you money. Also remember there are no correct answers.

8. Would you be willing to pay US$_____ per year for the next 5 years to a trust fund to help restore the coral reefs of Phi Phi Islands from their current level of 75% ABU to 100% ABU?

□ 1. YES → → **GO TO 10**
□ 0. NO

9. IF NO PAYMENT. What is the reason for your not wanting to pay anything/refusing to answer?

□ 1. I have no spare income but would otherwise contribute

□ 2. I feel the environmental improvement of Phi Phi Islands is unimportant

□ 3. I do not believe paying will solve the problem

□ 4. I believe this improvement will take place without my contribution

□ 5. I fail to understand the question

□ 6. Other (specify) _____

→ → **GO TO 12**

10. What is the reason for your wanting to pay to restore the reefs of Phi Phi Islands?

□ 1. For my own benefit □ 2. For the next generation
□ 3. For society as a whole □ 4. Others (specify) _____

11. Do you think there would be any direct and indirect benefit to you from this project?

□ 1. YES □ 0. NO → → **GO TO 12**

11-1. IF YES. Do these direct and indirect benefits relate to your current uses of Phang Nga Bay listed earlier at question 6 or are there other benefits to you?

□ 1. direct and indirect benefits due to current uses listed at question 6
□ 2. other direct and indirect benefits (specify)_____

12. In your current circumstances, instead of paying anything to the Trust Fund, would you be prepared to volunteer some of your time to help with projects and/or fund-raising to restore the coral reefs of Phi Phi Islands? If so how many hours per year for the next 5 years?

(Please fill in the number) _____ hours per year for the next 5 years

*** * End of interview; thank the respondent * ***