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Carrying Capacity Assessment of Pulau Payar Marine Park, Malaysia

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CARRYING CAPACITY ASSESSMENT OF PULAU PAYAR MARINE PARK, MALAYSIA

by **Li Ching Lim**

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This document assesses a few critical aspects of the "carrying capacity" of the Puiau Payar Marine Park, a marine resource sanctuary and tourist attraction off the west coast of Kedah state, in the northwest of Peninsular Malaysia.

The document is based on a survey of the park's coral reefs which are popular dive sites, and a land-based survey for which interviews were conducted with tourists, tour operators, divers and dive operators.

The document says that given the increasing number of tourists to the park, further expansion of tourism development is not desirable. Improving the "carrying capacity" of the park means taking appropriate management action to prevent degradation of the coral reefs and provide adequate facilities to cope with tourist use, demands and requirements.

Ms Li Ching Lim. Scientific Officer, World Wildlife Fund, Malaysia, conducted the survey for the Department of Fisheries, Malaysia. The study was made possible with funds provided by the Bay of Bengal Programme (BOBP) and the Malaysian Wildlife Conservation Foundation.

The author makes several recommendations concerning the reefs, the marine park, its facilities. and socio-economics.

The BOBP is a multi-agency regional fisheries programme which covers seven countries around the Bay of Bengal - Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka, Thailand, The Programme plays a catalytic and consultative role in developing coastal fisheries management in the Bay of Bengal to help improve the conditions of small-scale fisherfolk in the member-countries.

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FOREWORD

The Pulau Payar Marine Park is a treasurehouse of marine wealth. Its four islands are blessed with clear-water coral reefs. The Park has also been provided with other tourist facilities and attractions that delight nature-lovers, sightseers, sunbathers and snorkellers.

The Park obviously fulfils the cherished role of conserving the marine wealth of the area – all fishing activity within two nautical miles of the park is banned. Malaysia plays a pioneering role in the Bay of Bengal region in the use of marine parks for resource conservation. All its activities concerning the Park are therefore being watched with interest throughout the region.

The Marine Park came into being in 1989. It has spurred a 5,000% increase in visitors to the area over a period of seven years. The reefs therefore face increasing pressure from tourism development and related activities. How to sustain tourism development and maintain "visitor satisfaction" without endangering the Park's ecological environment is a matter of concern to the authorities.

This report reflects the concerns from growing use pressure. It is based on a coral reef survey and a land-based survey. It documents the rationale, results and recommendations of both surveys. The report says that a two-pronged approach is needed to manage the park – a strategy for the park itself, and a strategy for sustainable tourism. It also says that the management strategy for Pulau Payar Marine Park should be integrated with the overall planning and management of Pulau Langkawi.

In sum, we find this document to be very useful – both informative and thought-provoking. We are sure it will lead to action that makes the park an even more valuable resource than it is now.

Kee-Chai CHONC
Programme Coordinator BOBP

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CONTENTS

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EXECUTIVE SUMMARY

Pulau Payar Marine Park is a very popular tourist destination located to the north-west of Peninsular Malaysia. off the west coast of Kedah. It is situated between the islands of Pulau Langkawi and Pulau Pinang, themselvca popular tourist destinations. The Marine Park consists of a group of four islands - Pulau Payar, Pulau Kaca, Pulau Lembu and Pulau Segantang - the largest of which is Pulau Payar at 3 1.2 hectares. The islands are uninhabited, and since being afforded Marine Park status in 1989, the area has not been utilized by fishing communities.

The main attraction of the Marine Park to tourists is its coral reefs, which cater mostly for snorkellers, although some diving activity does occur in the area. The Marine Park has seen a tremendous increase in visitor numbers over the years. Annual visitors have increased from 1,373 in 1988 to 70,4 19 in 1995, representing a 5,000% increase in seven years. As such, the reefs are under increasing pressure from tourism development and related activities.

This study was undertaken to address some of the issues at Pulau Payar Marine Park with regard to carrying capacity. There were two components to the study; a survey of the surrounding coral reefs which are popular dive sites, and a land-based survey which involved distributing questionnaires and conducting interviews with tourists, divers, tour operators and dive operators.

The carrying capacity concept stresses the need for managing desired environmental and social conditions, and can be utilised to identify thresholds that require attention. Carrying capacity implies that there is a threshold limit for use, beyond which the reef environment is degraded, facilities are saturated and visitor satisfaction is lost. These are key elements for a sustainable tourism industry and should be safeguarded. As any human use of the natural environment inevitably results in some change to that environment, the focus would be to, identify how much change is acceptable for a given setting, and to highlight actions that may be taken to minimise or limit adverse anthropogenic impacts on the coral reef environment.

Visitors to Pulau Payar Marine Park are mainly foreigners, with the Taiwanese and Japanese being the largest nationality groups. Most of these visitors depart from Pulau Langkawi, and since there are no accommodation facilities at the Marine Park, they only stay for the day. The results of this study show that the diving industry at Pulau Payar Marine Park is relatively unsaturated. However, snorkelling is an extremely popular activity and is concentrated at the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef. The influx of large numbers of tourists to the area and their activities can cause direct physical damage to the reef environment, in addition to generating a host of other related problems such as pollution from tourism.

Given the increasing numbers oftourists to Pulau Payar Marine Park, and the increasing trends in visitation, further expansion of tourism development and related activities is not acceptable. This is due to the potential negative impacts on the marine environment, especially coral reefs; the physical limitations to space already experienced; the inadequacy of facilities available -- especially toilets, sewage and solid waste disposal – and increasing visitor dissatisfaction with some aspects of the Marine Park. While steps to increase carrying capacity can be taken, this does not imply steps to increase the number of visitors to the Marine Park. Instead. increasing carrying capacity means taking appropriate management actions which will ensure minimal degradation to the coral reefs despite their being exploited as a tourist attraction, that visitors remain satisfied and that adequate facilities are provided.

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The Marine Park is thus in need of a detailed management strategy which ensures that tourist activities cause minimal damage to the coral reef environment. A two-pronged approach is necessary for the tnanagement of the Marine Park – a strategy for the Marine Park itself, and a strategy for tourism which promotes the Marine Park in such a way that it complements Marine Park objectives.

The management strategy for Pulau Payar Marine Park should be integrated with the overall planning and management of Pulau Langkawi, given its close proximity and potential downstream effects. Positive management actions that can be taken for a period of at least five years include zoning the Marine Park; gazetting the islands as a State Park; implementing a comprehensive education and awareness programme; enforcing Marine Park regulations; limiting visitor use; training Marine Park managers, tour and dive operators; as well as establishing monitoring and evaluation programmes. Problems of solid waste and sewage disposal at the Marine Park must be addressed immediately; if not, they will result in adverse effects on the reef, besides engendering dissatisfaction among tourists The provision of proper reception and disposal facilities at Pulau Langkawi, Pulau Pinang and Kuala Kedah is integral to the proper management of solid waste and sewage for Pulau Payar Marine Park. Efforts must also be made to monitor activities at the Langkawi Coral Pontoon and to ensure that they are complying with Marine Park regulations. Monitoring should also be conducted around its house reef area to ascertain if there are any adverse impacts on the reef due to the presence of the pontoon itself.

Tourism promotion for the Marine Park, for Pulau Langkawi, for Kedah and the north-west region of Peninsular Malaysia should incorporate the conservation objectives of the Marine Park and target tourists who are more environmentally aware and responsible. The paucity of information on the Marine Park and the marine environment should be addressed and this information should be effectively communicated to visitors and tour operators. Alternative activities, such as the nature trails on Pulau Payar, should be promoted to disperse visitor pressure on the reefs. Alternative islands around Pulau Langkawi such as Pulau Singa, Pulau Dayang Bunting and Pulau Beras Basah should be promoted to the non-reefuser. Other islands around Pulau Langkawi with reefs should be identified and the feasibility of diverting tourists there explored.

Action must be taken now to ensure that the conservation objectives of Pulau Pay ar Marine Park are not compromised by tourism activities. Tourism planning for the Marine Park must be well integrated with the overall plan for tourism in the north-west region. The sustainability of the tourism Industry in the Marine Park and the surrounding region depends on the well-being of its marine environment, specifically coral reefs. The tourist industry of Pulau Langkawi especially could be affected as Pulau Payar Marine Park is an important attraction for many tourists to Pulau Langkawi. Tourism must be made environmentally, socially and economically sustainable; it should also benefit all stakeholders.

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RINGKASAN EKSEKUTTF

Taman Laut Pulau Payar yang terletak di luar pantai barat negeri Kedah di barat laut Semenanjung Malaysia, merupakan sebuah destinasi pelancongan yang terkenal. Ia terletak di antara dua buah destinasi pelancongan yang juga terkenal iaitu Pulau Langkawi dan Pulau Pinang. Taman Laut ini terdiri daripada sekumpulan empat pulau - Pulau Payar, Pulau Kaca, Pulau Lembu dan Pulau Segantang - Pulau Payar adalah yang terbesar dengan keluasan 3 1.2 hektar. Sejak dijadikan Taman Laut pada 1989, pulau-pulau yang tidak berpenghuni ini tidak digunakan oleh kaum nelayan.

Tarikan utama para pelancong ke sini ialah terumbu karangnya yang dapat memenuhi keperluan para pensnorkel terutamanya. Terdapat juga kegiatan menyelam di sekitar Taman Laut ini. Sejak beberapa tahun yang lalu, Taman Laut ini menyaksikan pertambahan bilangan pengunjung yang amat besar. Pertambahan ini telah meningkat secara tahunan daripada 1,373 orang pada tahun 1988 kepada 70,419 orang pada tahun 1995, iaitu sebanyak 5,000% dalam tempoh tujuh tahun. Tekanan terhadap terumbu-terumbu karang turut meningkat akibat pembangunan pelancongan dan kegiatan-kegiatannya.

Kajian ini telah dijalankan untuk mengutarakan beberapa isu berkaitan dengan keupayaan daya tampung di Taman Laut Pulau Payar. Kajian ini terbahagi kepada dua komponen; iaitu kajian ke atas terumbu-terumbu karang yang merupakan kawasan menyelam yang popular, serta tinjauan darat yang melibatkan pengedaran borang soal selidik kepada para pelawat, para penyelam, pengusaha pelancongan dan pengusaha penyelaman.

Konsep keupayaan daya tampung menekankan kepada pengurusan keadaan-keadaan sosial dan alam sekitar yang diingini dan boleh digunakan untuk mengenal pasti ambang-ambang yang memerlukan perhatian. Keupayaan days tampung membayangkan bahawa terdapat had ambang terhadap penggunaan, jika terlampau, keadaan di pcrsekitaran terumbu karang akan terjejas, kemudahan-kemudahan akan menjadi tepu dan rasa puas hati di kalangan pengunjung akan hilang. Ini merupakpn ciri-ciri utama bagi industri pelancongan yang mapan dan harus dipelihara. Lazimnya, setiap penggunaan manusia terhadap alam sekitar yang semula jadi pasti akan mengakibatkan beberapa perubahan kepada alam sekitar. Tumpuan konsep ini ialah untuk mengenal pasti berapa banyak perubahan yang boleh diterima bagi sesuatu persekitaran, dan mengutarakan tindakan-tindakan yang mungkin boleh diambil untuk mengurangkan atau menghadkan kesan-kesan antropogen yang huruk terhadap persekitaran terumbu karang.

Kebanyakan para pengunjung ke Taman Laut Pulau Payar terdiri daripada orang asing dengan rakyat Taiwan dan Jepun merupakan kumpulan-kumpulan yang terbesar. Para pengunjung yang kebanyakannya datang dari Pulau Langkawi, cuma datang untuk sehari kerana Taman Laut ini tidak menyediakan kemudahan-kemudahan penginapan. Hasil kajian ini menunjukkan bahawa industri menyelam di Taman Laut Pulau Payar masih tidak tepu. Walau bagaimanapun, mensnorkel merupakan aktiviti yang paling digemari dan ianya tertumpu di 'Marine Park Centre House Reef' dan 'Langkawi Coral Pontoon House Reef'. Pemasukan bilangan pelancong yang besar serta kegiatan-kegiatan mereka boleh mengakibatkan kerosakan fizikal secara langsung terhadap persekitaran terumbu di samping menimbuikan masalah-masalah lain yang berkaitan seperti pencemaran akibat pelancongan.

Berikutan dengan peningkatan dalam bilangan pelancong dan arah aliran kunjungan mereka ke Taman Laut Pulau Payar, perubahan seterusnya untuk meningkatkan pembangunan pelancongan dan kegiatan-kegiatannya tidak dapat diterima. Ini adalah berdasarkan kepada potensi kesan-kesan negatif terhadap alam persekitaran marin terutama sekali terumbu-terumbu karang, kesempitan ruang secara fizikal, kekurangan kemudahan-kemudahan yang disediakan terutama tandas, pembuangan kumbahan dan sisa pepejal serta peningkatan rasa tidak puas hati para pengunjung

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terhadap heherapa aspek Taman Laut tersebut yang kini sudah mula dialami. Walaupun beberapa langkah boleh diambil untuk meningkatkan keupayaan daya tampung, ini bukan bermakna mengambil langkah untuk meningkatkan bilangan pengunjung ke Taman Laut. Sebaliknya meningkatkan keupayaan daya tampung bererti mengambil langkah-langkah pengurusan yang sesuai untuk memastikan terumbu-tcrumbu karang mendapat kerosakan yang minima walaupun telah dieksploitasikan sebagai daya tarikan pelancong, memenuhi rasa puas hati para pengunjung dan memastikan bahawa kemudahan-kemudahan yang disediakan adalah mencukupi.

Taman Laut ini memerlukan satu strategi pengurusan yang terperinci untuk memastikan bahawa kegiatan-kegiatan pelancong mendatangkan kerosakan minima kepada persekitaran terumbu karang. Pendekatan dua penjuru bagi pengurusan Taman Laut ini diperlukan - satu strategi untuk Taman Laut itu sendiri, dan satu lagi untuk penggalakkan pelancongan dengan memenuhi matlamat-matlamat Taman Laut tersebut.

Berdasarkan kedudukannya yang berhampiran dengan Pulau Langkawi serta potensi kesan-kesan hilirannya, strategi pengurusan Taman Laut Pulau Payar harus disepadukan dengan perancangan dan pengurusan Pulau Langkawi secara keseluruhan. Langkah-langkah pengurusan positif yang boleh diambil dalam tempoh sekurang-kurangnya lima tahun termasuklah pengezonan Taman Laut; mewartakan pulau-pulau tersebut sebagai Taman Negeri; melaksanakan satu rancangan pendidikan dan kescdaran yang menyeluruh; melaksanakan peraturan-peraturan Taman Laut; menghadkan penggunaan pengunjung; melatih para pengurus Taman Laut, pengusaha pelancongan dan pengusaha penyelaman; dan juga mewujudkan rancangan-rancangan pengawasan dan penilaian. Masalah-masalah pembuangan kumbahan dan sisa pepejal di Taman Laut harus diberi perhatian segera; jika tidak, ini akan membawa kesan-kesan bumk kepada terutnbu di samping menimbulkan rasa tidak puas hati pelancong. Penyediaan kemudahan-kemudahan penerimaan dan pembuangan sisa pepejal dan kumbahan yang berkesan di Pulau Langkawi, Pulau Pinang dan Kuala Kedah adalah penting bagi pengurusan yang betul di Taman Laut Pulau Payar. Usaha-usaha harus dibuat untuk mengawasi bahawa kegiatan-kegiatan di 'Langkawi Coral Pontoon' adalah mengikut peraturan-peraturan Taman Laut. Pengawasan ini juga harus diadakan di sekitar kawasan terumbunya untuk memastikan sekiranya terdapat sebarang kesan buruk terhadap terumbu akibat kehadiran pontoon itu sendiri.

Pengalakkan pelancongan bagi Taman Laut Pulau Payar, Pulau Langkawi, Kedah dan kawasan barat laut Semcnanjung Malaysia harus mengandungi matlamat-matlamat pemuliharaan Taman Laut dan ditujukan kepada para pelancong yang lebih sedar dan bertanggung jawab terhadap alam sekitar. Kekurangan maklumat mengenai Taman Laut dan persekitaran marinnya mesti diatasi dan maklumat ini mesti diberitahui kepada para pengunjung dan pengusaha pelancongan. Kegiatan-kegiatan lain seperti denai-denai semula jadi di Pulau Payar harus dipromosikan untuk mengurangkan tekanan pengunjung terhadap terumbu-terumbu karang. Beberapa buah pulau yang terdapat di sekitar Pulau Langkawi seperti Pulau Singa, Pulau Dayang Bunting dan Pulau Beras Basah harus diperkenalkan kepada para pengunjung yang bukan pensnorkel atau penyelam. Pulau-pulau lain yang terdapat terumbu-terumbu karang di sckitar Pulau Langkawi harus dikenal pasti dan kemungkinan untuk mengalihkan tumpuan para pelancong ke sana patut diterokai.

Langkah untuk memastikan tujuan-tujuan pemuliharaan Taman Laut Pulau Payar tidak dijcjaskan oleh aktiviti-aktiviti pelancongan harus diambil sekarang. Perancangan pelancongan bagi Taman Laut ini harus disepadukan dengan baik bersama-sama keseluruhan rancangan pelancongan bagi kawasan barat laut tersebut. Kemapanan industri pelancongan di Taman Laut dan kawasan sekitarnya bergantung kepada kesejahteraan persekitaran marinnya terutama sekali terumbu-terumbu karang. Industri pelancongan, terutama sekali ke Pulau Langkawi. mungkin akan terjejas oleh kerana Taman Laut Pulau Payar merupakan satu daya tarikan yang penting bagi kebanyakan para pelancong ke sana. Di samping mcnguntungkan kesemua pihak yang bcrkepentingan, pelancongan juga boleh mendatangkan faedah scandainya dilaksanakan secara mapan dari segi alam sekitar, sosial dan ekonomi.

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1. INTRODUCTION

1.1 Coral reefs

A coral reef ecosystem consists of an assemblage of a variety of plants and animals in tropical waters where corals form the dominant components. Hard corals, which form the most visible part of a reef, are constructed by minute marine animals called coral polyps that secrete a calcium carbonate exoskeleton around themselves. They do this by precipitating calcium ions from the sea water. The polyps sub-divide as they grow, and form complex coral colonies which are made up of millions of polyps fused together by their skeletons. In addition to corals, coralline algae also produce limestone skeletons and help build and consolidate coral reefs.

The polyps of true reef-building or hermatypic corals contain unicellular dinoflagellates called zooxanthellae within their tissue, and this symbiotic association is mutually beneficial. The zooxanthellae use the sun's energy to photosynthesise, providing food for themselves and the coral polyps, thus enhancing the production of the calcium carbonate skeletons and the coral structures. The polyps themselves normally remain in their skeletons during the day, and feed at night using tentacles to capture their prey which subsequently filter into their stomachs. They can also absorb dissolved food from the water.

Coral reefs flourish in the warm shallow waters oftropical seas that optimally have temperatures between 26°C and 27ºC (Wells & Price, 1992). The shallow waters allow sufficient light penetration for the zooxanthellae and other primary producers to photosynthesise. They need constant high salinity and pollution-free waters to thrive. There is an estimated 600,000 km^2 of coral reefs worldwide, 25-30% of which are located in South East Asia. Malaysia has coral reefs on both the East and West coasts of the Peninsula, as we!! as off Sabah and Sarawak.

Coral reefs are amongst the most biologically diverse and productive ecosystems on Earth. Associated with coral reefs are a myriad of organisms; fish and invertebrates, especially molluscs, crustaceans and echinoderms predominate, and algae are also abundant. Coral reefs arc the feeding, breeding and nursery grounds for many fish and invertebrate species, many of which are commercially important. They are thus crucial for supporting the fisheries sector, and it has been estimated that reef fisheries have the potential to contribute approximately 12 per cent of al! fish caught annually throughout the world (Wells & Price, 1992).

Coral reefs act as a natural protection between the open seas and coastlines by acting as wave breaks, thus effective!> preventing coastal erosion. They may also perform a vita! role in protecting coastal areas from the consequences of predicted sea level rise such as storm flooding (Markham et al, 1993). Furthermore, there is increasing evidence of the potential of reefs to act as bio-indicators for climate change, as they are sensitive to sea level rise and sea temperature. In addition, reefs are good indicators of coastal pollution, as they are sensitive to changes in their ambient environment.

Coral reefs arc also a potential storehouse of medicinally valuable species, many of which have yet to be discovered. Several reef-dwelling organisms have been found to produce highly active biochemical compounds with antibiotic, antileukumic, anticoagulant and cardioactive properties (De Silva & Ridzwan, 1982). In addition, reef-related tourism such as SCUBA diving and snorkelling plays an important role in the economies of many countries. Nevertheless, exploitation of reefs for tourism purposes must be sustainable, and be appropriately managed to ensure that the reefs are not damaged.

Coral reefs are thus extremely beneficial to humankind, providing a variety of ecological and physical services which are also economically important. Box 1. I presents a brief summary of these benefits. The productivity of a

coral reef relies upon an intricate recycling process that passes nutrients through the ecosystem via a complex web of food chains. Unfortunately this characteristic means that a reef is vulnerable, and its finely balanced ecosystem can be easily disrupted by anthropogenic activities. As such, the conservation and protection of coral reef ecosystems are becoming increasingly urgent efforts, crucial to ensure that we do not lose their intrinsic values and resources.

BOX 1.1 BENEFITS OF CORAL REEFS

- Biologically diverse and productive
- Feeding, breeding and nursery grounds for many fish and invertebrate species, thus supporting the fisheries sector
- Natural protection between the open seas and coastlines
- Act as wave breaks and prevent coastal erosion
- Protect coastal areas from the consequences of predicted sea level rise
- Potentially act as bio-indicators for climate change
- Indicators of coastal pollution
- Potential storehouse of medicinally valuable species yet to be discovered
- Reef-related tourism plays an important role in the economies of many countries

1.2 Carrying capacity

The concept of carrying capacity is one which exemplifies the need to maintain development and activities at a level that is both ecologically and socially sustainable. It is related to the concept of resilience, and implies that there are limits, or thresholds, beyond which a system will not facilitate further changes or increase (Getz, 1982). This concept is increasingly applied to tourist destinations following the realisation that these places have a certain 'carrying capacity', that is, a level of tourist and recreation development and activities beyond which environmental degradation occurs, facilities become saturated, or visitor enjoyment diminishes (e.g. Hovinen, 1982; Mathieson & Wall, 1982). The concept of a tourist destination having a carrying capacity thus embodies the assumption that eventually, a threshold will be reached after which the destination will be decreasingly desirable.

Birthed from the study of animal populations, the carrying capacity concept now goes beyond estimating mere numbers; it has increasingly evolved as a planning and management tool to enable planners and managers to determine, not, "How much is too much?', but rather, "How much change is acceptable?" (Williams & Gill, 1991). As any human use of the natural environment inevitably results in some change to that environment, the focus would be to identify how much change is acceptable for a given setting (Stankey & McCool, 1992). The concept thus stresses the management of desired environmental and social conditions, which can be expressed using the Limits of Acceptable Change (LAC) planning system (Stankey & McCool, 1984). For carrying capacity to be a useful tool for tourism planning and management, it should not be approached in a mechanistic manner (i.e. trying to determine a "magic number"), but should rather be seen as a means of identifying thresholds that require attention, and as an optional form of controlling the system through the imposition of partial or complete limits (Getz, 1983). The traditional concept of carrying capacity is not without its limitations, and is modified here to highlight actions

that may be taken to minimise or limit adverse anthropogenic impacts on the coral reef environment. While recognising the limitations of the traditional carrying capacity concept, the concept can be used to help identify factors that impact negatively on the marine environment, and to generate management recommendations that may alleviate the tourism pressure on reefs. The focus is thus to highlight possible actions that may be taken to minimise or limit adverse impacts on the coral reef environment.

Carrying capacity can be broken up into its fundamental components of ecological, physical, social and economic carrying capacities. Nonetheless, the estimation of carrying capacity or limits of acceptable change is not an easy task, as many factors operate. Furthermore, there is no set method or formula available, and each case study should be viewed separately. For further information on the concepts and analysis of carrying capacity, please refer to Lim (1995a & 1995b). A framework guideline based on Lim's (1995a) recommendations is presented in Appendix 1.

1.2. I Definition of carrying capacity

A carrying capacity that needs to be established for Pulau Payar Marine Park is the tourism carrying capacity, that is, its capacity to accommodate visitors and development without detrimentally affecting the marine environment and its resources, or effecting a decline in visitor satisfaction (WTO & UNEP, 1992). Carrying capacity for tourist destinations implies that there is a limit to the amount of tourism development and activity that can occur in an area, beyond which facilities are saturated, visitors become dissatisfied and environmental degradation occurs. Tourism carrying capacity can be further broken down into its fundamental components of ecological or environmental, physical, social and economic carrying capacities.

The physical carrying capacity is the threshold limit for space. beyond which facilities are saturated (Getz, 1982). The social carrying capacity can be looked at from two perspectives; one is the capacity of the host population to tolerate the presence of tourists, the second is the level at which visitor enjoyment diminishes and dissatisfaction sets in (O'Reily, 1986). Graefe *et* al (1984) define social carrying capacity further as "the level of use beyond which experience parameters exceed acceptable levels specified by evaluative standards". Economic carrying capacity is the level at which tourism interference with non-tourism activities becomes economically unacceptable.

1.2.2 Coral reef carrying capaciy

The coral reef ecosystem is extremely vulnerable to changes in the environment. Globally, reefs are now receiving increasing pressure from both the expansion of reef tourism, and land-based activities. The concept of carrying capacity can be utilised for reef ecosystems to identify reef capacity determinants, and subsequently for the reduction or elimination of the causes of damage. This approach, if appropriately applied during the planning and management stages of coastal and marine resources use, can effectively raise reef carrying capacity (Salm, 1986) to an acceptable level, enabling the reef to be used for recreation purposes without compromising its ecological integrity.

The carrying capacity of one reef *vis-a-vis* other reefs should be looked at within the scope of a broader management strategy. Therefore overall reef carrying capacity is not determined on the basis of one reef and its individual factors alone but would depend on a variety of other interlinked factors.

Reef carrying capacity can be further examined from the perspectives of ecological, physical and social carrying capacities. The ecological carrying capacity of the reef is the threshold limit for visitor use and consequent incidental damage that the coral reef ecosystem can sustain without being degraded. Furthermore, coral reefs are only able to tolerate a certain amount of change in ambient qualities, and factors such as pollution, siltation and exploitation

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affect them adversely. Nevertheless, reef ecological carrying capacity is difficult to establish; this is an aspect of carrying capacity that would require in-depth long-term study of the reef ecosystem, which was not possible to do in this instance. The physical carrying capacity of the reef relates to the availability of boats which ferry divers and snorkellers to the reefs, as well as the number of mooring buoys available; space on the reef is also considered. The size and shape of the reef, as well as the composition of the coral communities also determine physical carrying capacity. The social carrying capacity of the reef is the limit to visual contact between divers and snorkellers beyond which they become dissatisfied (Salm, 1986).

I. 2.3 Determinants of reef carrying capacity

The concept of carrying capacity can be utilised for reef ecosystems to identify reef capacity determinants, and subsequently enables the reduction or elimination of the causes of damage. In addition, proper management will help ensure that user-related damage is controlled and minimised.

Reef capacity determinants are discussed briefly as follows :

(a) **Size and shape of the reef**

Large reefs can accommodate more divers and snorkellers than small ones (Salm, 1986). Divers or snorkellers swimming over uniform flat shallow reefs are limited in opportunities because of the homogenous nature of the coral communities. Movement is unrestricted and group interaction potentially higher; consequently social carrying capacity is easily reached. If there are irregularities in the reef morphology such as outcrops, these will restrict movement and act as screening between groups. At the same time, the irregularities present more options to explore and thus increase interest. The reef users will cover less reef area and group contact will be reduced; consequently from the perspective of inter-group contact, irregular reefs have a higher carrying capacity (Salm, 1986).

(b) **Composition of coral communities**

Reef use will almost certainly cause damage, but the extent of damage largely depends on the fragility of the coral colonies and the percentage of live corals present (Salm, 1986). Branching or foliose corals are more likely to be broken by careless divers and snorkellers, or anchors, than massive coral. Damage is also more obvious if there is a high percentage of coral cover. Therefore, reefs consisting mainly of live coral intrinsically have a higher carrying capacity. Reefs composed of large areas of soft corals also attract divers and snorkellers, but they are more resilient and can accommodate more physical contact. Soft corals tend to be flexible and less susceptible to physical damage.

(c) **Denth, currents, and visibility**

If a reef is deep and or has a strong prevailing current, it will not be as “user-friendly” to the average diver, and will immediately have a higher carrying capacity. Dive operators tend to initially visit the shallower reefs, and if there is little or no current running it will be easier for a Dive Master to control a large group. Poor visibility may reduce diver satisfaction but it can also increase social carrying capacity by limiting visual interactions between diving groups, especially on popular reefs.

(d) Level of experience of snorkellers and divers

The level of experience of divers can affect the carrying capacity of the reefs. Novice divers frequently stand on corals to rest, or blunder against them, and thus are more likely to damage fragile reef structures.

In comparison, more experienced divers would have better buoyancy control and spatial awareness, as well as a greater understanding of the reefecosystem and its fragility. When diving is carried out through a dive operator it is possible for the Instructor or Dive Master to decide upon the dive site depending on the experience of the members of the group. Novice divers should preferably be confined to reefs with boulder type corals, rocks, and scattered live corals, or to the sandy periphery of reefs and the gullies through them where they can do less damage (Salm, 1986).

(e) **Accessibility**

This is determined by the distance of a reef from the dive shops, or ease of location (locating a submerged patch reef can be a problem). If a reef is not marked by moorings or marker buoys, then local knowledge or a GPS will be required. Locating a reef in this way involves the risk of missing the site altogether, something that a dive operator with paying divers cannot afford to do. This implies that a reef can have a relatively high carrying capacity simply by being difficult to locate.

(f) **Attractions**

An aesthetically pleasing reef with interesting marine life will automatically have a lower carrying capacity, particularly if it is easily accessible, as popularity would put increasing pressure on the reef. Attractions include diverse hard corals, colourful soft corals, large fish, large schools of fish, turtles, sharks, manta rays and swim-throughs (underwater tunnels). Frequent visitation will mean an increased likelihood of physical damage to the reef and a shortage of moorings which can lead to anchoring problems.

1.3 Objectives of the study

In December 1994, the waters off 38 islands in Malaysia were gazetted as Marine Parks Malaysia, 35 of which are in Peninsular Malaysia. However, in Peninsular Malaysia, gazettement only affords protection to the offshore waters, while land on Marine Park islands may be still subjected to intense development, since the Establishment of Marine Parks Malaysia Order 1994 only affords protection to the waters up to two nautical miles off the islands. This is due to a constitutional difference in jurisdiction; land matters come under the purview of the respective State governments whereas offshore waters are under Federal jurisdiction. Integrated management of Marine Park islands is thus essential, whereby land use on these islands is properly planned, and both marine and terrestrial ecosystems are managed as a whole. These concerns culminated in a joint Department of Fisheries Malaysia-World Wide Fund for Nature (WWF) Malaysia report, "Marine Park Island Management Conceptual Plan for Peninsular Malaysia" (Aikanathan & Wong, 1994).

Amongst land-based activities, increasing tourism development of the inappropriate kind on Marine Park islands is bringing about degradatory impacts on the marine environment. One of the most consequent problems is that of pollution due to land-based activities. A WWF Malaysia report on "Tourism, Pollution and the Marine Environment in Malaysia" (Lim, 1996) identified the sources, types, impacts and contributory factors to marine pollution from island and coastal tourism, as well as the proposed practices to deal with these problems.

One of the best practice planning and management tools which was advocated *vis-a-vis* tourism is the concept of "carrying capacity" (Lim, 1995a) (see Section 1.2 for a more detailed discussion). An assessment of carrying capacity or the limits of acceptable change can contribute towards better planning and management of tourist destinations. The National Ecotourism Plan, in Part 3 : Ecotourism Guidelines for Malaysia, advocates the use of

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the carrying capacity concept in preparing development and management plans for a tourism area, especially protected areas (MOCAT/WWF Malaysia, 1996).

The Pulau Payar Marine Park, located off the west coast of Peninsular Malaysia, consists of Pulau Payar, Pulau Lembu, Pulau Kaca and Pulau Segantang. These islands are uninhabited, and are surrounded by diverse coral reefs and associated marine life. However, the Pulau Payar Marine Park is receiving increasing pressure from tourism, with visitor numbers swelling to worrying levels (from 1,373 visitors in 1988 to over 70,000 in 1995). This increase in tourist numbers poses a risk of detrimental impacts to the marine environment, through direct impacts of reef-related tourism and through pollution from tourism. Consequently, visitor dissatisfaction can have a negative impact on the tourism industry itself. It is therefore necessary for management to determine how much change is now acceptable and to manage visitors accordingly.

The Department of Fisheries Malaysia, under the auspices of the FAO/UN's Bay of Bengal Programme, is formulating a Special Area Management Plan (SAMP) for the Pulau Payar Marine Park, amongst other studies in the region. It was proposed that an assessment of Pulau Payar Marine Park's carrying capacity be carried out based on the framework guidelines set out in Lim (1995a & 1995b) (see Appendix 1), as a component of the support material for the SAMP. This study, in assessing carrying capacity, would thus attempt to address crucial issues such as the need for integrated management of Pulau Payar Marine Park specifically, and Marine Park islands generally, as well as recommend best practices in controlling and minimising negative impacts from tourism, drawing from previous work carried out by WWF Malaysia as mentioned above.

The impacts of land-based activities and tourism on the marine and island environment are extensive, from an ecological, physical, social and economic point of view. The scope of the study was limited to looking at the physical and social carrying capacities of Pulau Payar Marine Park. Host social carrying capacity was not looked at in this instance, as the study focused mainly on the Marine Park itself where no local communities reside. Although it would be important to look at host tolerance and perception of tourism in surrounding areas such as Pulau Langkawi, Kedah and Perlis, it was not within the scope of this study to do so. Nor was it within the scope of this study to look at economic carrying capacity. Furthermore, while recognising the limitations of the traditional carrying capacity concept, the concept is used here to help identify factors that impact negatively on the environment of Pulau Payar Marine Park, and to generate management recommendations that may alleviate the tourism pressure on its reefs. The focus of the study is thus to highlight possible actions that may be taken to minimise or limit adverse impacts on the coral reef environment.

There were two major components of the study. The marine aspect aimed at obtaining general baseline data for some of the more popular coral reefs. These included assessing coral cover and composition, and identifying some of the key threats faced by the reefs, in order to identify reef capacity determinants. The land-based survey aimed at identifying the main tourist attractions of the Pulau Payar Marine Park and estimating its capacity with regard to tourists arrivals and visitor satisfaction.

It is hoped that the study will lead to recommendations for the effective management and planning of the Pulau Payar Marine Park with regard to tourism. With visitor numbers exceeding 70,000 in 1995, there needs to be a management decision on an acceptable maximum number of visitors over a year, such that the natural assets of Pulau Payar Marine Park are not degraded or destroyed consequently. The integration of the carrying capacity concept in future planning stages of tourism development in Pulau Payar is needed to ensure the well being and long-term sustainability of the island's valuable yet vulnerable marine ecosystem.

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1.4 Background information on Pulau Payar Marine Park

I. 4.1 Location and geography

The Pulau Payar Marine Park is situated off the state of Kedah, between Pulau Langkawi and Pulau Pinang, at 6º02' - 6º05'N and 99º54' - 100º04'E (Map 1). The distances from its three common access points, Kuala Kedah, Pulau Langkawi and Pulau Pinang, are 15 nm, 19 nm and 32 nm, respectively. The Marine Park consists of a group of four islands - Pulau Payar, Pulau Kaca, Pulau Lembu and Pulau Segantang. They are under the administrative jurisdiction of the Pulau Langkawi District Council.

Pulau Payar is the largest of the islands, with an area of 3 1.2 hectares and an approximate length of 1.75 km (Aikanathan & Wong, 1994). The entire length of its north-western coast is predominantly rocky and characterised by steep cliffs and wave-cut gullies. There are four sandy beaches on the island, two of which are approximately 100 - 150 m long. There are very few low-lying areas on the island as it rises at a steep gradient from the shore. The entire island is covered with dense vegetation.

Pulau Kaca is approximately 0.4 nm to the north-east of Pulau Payar. The island is a conglomerate of rocky boulders with sparse vegetation, and an approximate area of 1.8 hectares (Aikanathan & Wong, 1994). It attains a height of approximately 10 m above sea level (De Silva & Ridzwan, 1982).

Pulau Lembu is situated to the east of Pulau Kaca and is about 0.75 nm north-east of Pulau Payar. It is 0.75 km long and has an area of 6.9 hectares. lt is thickly wooded, uninhabited and rises sharply from the shore to a height of about 70 metres (De Silva & Ridzwan, 1982). There is one small beach on the south-eastern facing side of the island.

Pulau Segantang is about 6.7 nm south-west of Pulau Payar and is made up oftwo rocky outcrops which are joined together underwater. The larger outcrop is approximately 200 m to 250 m long and about 50 m wide, while the smaller outcrop is approximately 50 m in length and 40 m in width (De Silva & Ridzwan, 1982). Scattered vegetation can be found on both outcrops.

1.4.2 Marine resources

The Pulau Payar group of islands constitutes one of the few coral reef areas found off the west coast of Peninsular Malaysia and a wide variety of habitat types are found within a relatively small area. In the early 1980's, 35 hard coral genera, 92 other marine invertebrates and 45 genera of fish, some of them commercially important, were recorded in the area (De Silva & Ridzwan, 1982).

Major coral genera reported include Acropora, Montipora and massive corals such as Porites, Platyara, Goniopora, Diploastrea and Plerogyra (Aikanathan & Wong, 1994). Smaller coral colonies such as Galaxea, Pocillopora, Pavona, Hydnophora, Favia as well as the mushroom corals Fungia and Herpolitha were found dispersed among the large coral (De Silva & Ridzwan, 1982).

Common fish life recorded include barracuda (Sphyraena sp.), groupers (Epinephelus sp. and Promicrops sp.), rabbit fish (Siganus oramin), fusiliers (Caesio chrysozonus and C. erythrogaster), sergeant-majors (Abudefduf saxatilis) and snappers (Lutjanus lineolatus) (De Silva & Ridzwan, 1982).

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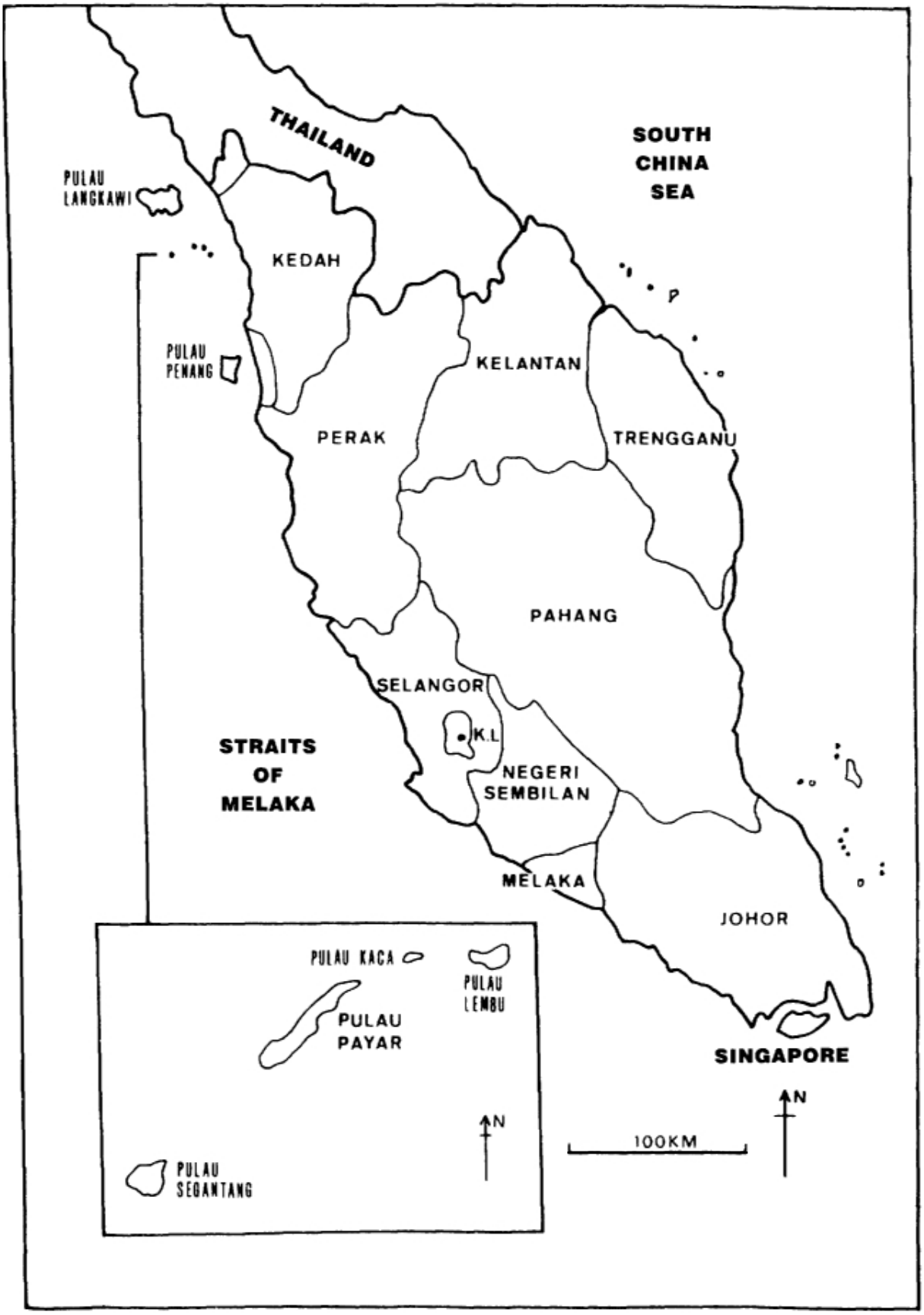

MAIP 1 **Peninsular Malaysia and Pulau Payar**

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1.4.3 Historical use

Traditionally, before the Pulau Payar group of islands were gazetted as a Marine Park, their surrounding waters were important fishing grounds for fishermen based in Kuala Kedah. Fishing activities that were carried out around the islands include drift netting, purse-seining, long-lining and bottom traps (Aikanathan & Wong, 1994). Pulau Payar itself has in the past been a sheltering place for fishing vessels, particularly during the monsoon period. In addition, rock oysters used to be harvested from Pulau Payar, Pulau Lcmbu and Pulau Kaca on a yearly basis up until the Marine Park Centre was established (De Silva & Ridzwan, 1982).

In the past, logging activities were also carried out on Pulau Payar, as evident from the abandoned logs observed both on the beach and underwater during an earlier survey (De Silva & Ridzwan, 1982).

1.4.4 Tourism in Pulau Payar Marine Park

In recent years, especially since the gazettement of the Marine Park, Pulau Payar has been expanding rapidly as a tourist destination, with visitor numbers increasing dramatically over the years. This can be attributed largely to the rapid development of the tourism sector of Pulau Langkawi as a major tourist centre for the northern region of Peninsular Malaysia. In addition, Pulau Langkawi is being promoted worldwide as a tourist destination. A visit to the Pu!au Payar Marine Park is often included in package tours or sold separately as a day trip from Pulau Langkawi.

Pulau Langkawi is a tourist attraction in its own right, and is the main island in a group of 104 islands in the northern part of the Straits of Melaka. It is an island of legends, the most well-known being that of Mahsuri, who when accused of a crime she did not commit, cursed the island for seven generations in her dying breath. Pulau Langkawi now has a booming tourism industry, much of it due to its natural beauty and beaches, sites of historical and legendary interest as well as its duty-free status.

Pulau Payar is in many instances considered as part of the Pulau Langkawi visitor package. Other islands around Pulau Langkawi which are also popular tourist destinations are Pulau Singa, Pulau Dayang Bunting and Pulau Beras Basah; some tour operators include these islands as part of an island hopping package, Pulau Payar Marine Park inclusive. However, these other islands do not have reefs comparable to that of the Marine Park, making Pulau Payar the first choice for a snorkelling or diving experience.

The promotion of Pulau Payar as a tourist destination is very strongly linked to that of Pulau Langkawi. Pulau Langkawi has been aggressively promoted overseas and coupled with the boom in tourist arrivals during Visit Malaysia Year 1990 and Visit Malaysia Year 1993, this has led to the island making its mark on the global tourist map. A package tour to Pulau Langkawi usually includes a visit to Pulau Payar Marine Park. For example, a visit to Pulau Payar is the main tourist attraction of Pulau Langkawi for the Japanese market. As such, promotion is carried out overseas as well, mainly by the Langkawi Development Authority (LADA). The Kedah State Economic Planning Unit (UPEN Kedah) tends to focus more on promoting Pulau Langkawi and Pulau Payar among domestic tourists. The promotion of Pulau Payar emphasises its marine environmental attributes, and is sold as a Marine Park with some conservation emphasis.

Pulau Payar itself is a small island with very few low-lying areas and beaches, as the land rises at a steep gradient from the shore. Coupled with the lack of freshwater sources on the island, this seems to have deterred any accommodation development on the island. The Marine Park Centre occupies a small area of 0.6 hectares and the existing beach, already limited in space, is made smaller by a picnic area with tables and chairs (Plate 1). The other

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islands are mere rocky outcrops, so any type of development there is out of the question. Since there are no accommodation facilities on Pulau Payar, the overwhelming majority of visitors are day trippers. Occasionally, visitors may camp on the island, but given the lack of basic facilities such as water supply, these are few and far between.

Photo : WWFM/Li Ching Lim

PLATE 1 Pulau Payar Marine Park Centre

Visitor permits to enable entry into Pulau Payar Marine Park are issued by the Department of Fisheries from Pulau Langkawi, Pulau Pinang, Kuala Kedah and Alor Setar. These have to be obtained by tour or dive operators prior to coming to Pulau Payar Marine Park, and along with a list of guest names and nationalities, are surrendered to Marine Park staff on arrival at the Marine Park Centre. Thus far, there are no limits to the issuance of permits, so long as the number of passengers per boat does not exceed the limit imposed by the Marine Department (12 passengers a boat). There are also no limits to the number of boats that can come in to the Marine Park per day; these vary with demand. Permits also have to be obtained for overnight camping, and there is a physical limit of 30 campers at any one time.

Sri Wani Holdings, through its subsidiary Langkawi Coral, operates a 50 m x 15m floating pontoon which is moored off the beach south of the Marine Park Centre, and can accommodate a maximum of 400 people. The pontoon is the only one of its kind in Malaysia. It is serviced once daily by a fast catamaran from Pulau Langkawi and can take a maximum of 162 passengers. Langkawi Coral offers as part of its tour package, snorkelling and diving facilities, an underwater observatory, glass-bottom boat rides, a sunbathing deck and restaurant facilities, Guests can make bookings either directly through Langkawi Coral's travel office or through the appropriate travel agents. Star Cruise from Singapore also utilises the pontoon every Thursday from 8 a.m. till 12 p.m., bringing their cruise guests in for the morning.

Pulau Payar Marine Park as a tourist destination is unique *vis-a-vis* the other Marine Parks in Malaysia in that it is an uninhabited island with no tourist accommodation facilities on it. As such the visitors to the Marine Park are day

trippers with the majority coming from Pulau Langkawi. In addition, the Langkawi Coral Pontoon is a unique attraction in Malaysia, offering visitors a luxury one-stop centre for reef-related activities. The small size of the island also limits entry and exit points and concentrates visitors at the Marine Park Centre area, making visitor control somewhat easier.

1.4.5 Pulau Payar as a Marine Park

The setting up of Marine Parks is provided for under Section 41 through 45 of the Fisheries Act, 1985. The principal goal of establishing Marine Parks in the country is to protect, conserve and manage in perpetuity representative marine ecosystems of significance, particularly coral reefs and their associated flora and fauna, so that they remain undamaged for future generations (Ch'ng, 1990). In addition, they aim to inculcate public understanding, appreciation and enjoyment of our marine heritage. Box 1.2 summarises the objectives of Marine Parks Malaysia. The Marine Parks are administered and managed by the Department of Fisheries Malaysia within the Ministry of Agriculture.

BOX 1.2 OBJECTIVES OF MARINE PARKS MALAYSIA

- to afford special protection to aquatic flora and fauna, and to protect, preserve and manage the natural breeding grounds and habitats of aquatic life with particular regard to species of rare or endangered flora and fauna
- to allow for the natural regeneration of aquatic wildlife where such life has been depleted
- to promote scientific study and research
- to preserve and enhance the pristine state and productivity of the environment
- to regulate recreational and other activities in order to avoid irreversible damage to the environment

Source : Fisheries Act 1985

The Pulau Payar group of islands comprising Pulau Payar, Pulau Kaca, Pulau Lembu and Pulau Segantang, were initially gazetted as Fisheries Prohibited Areas in 1985. The planning and construction of the Marine Park Centre on Pulau Payar began in 1986, and the centre was fully operational by 1988 (Aikanathan & Wong, 1994). Subsequently, the Pulau Payar archipelago was gazetted as a Marine Park in 1989 when the Establishment of Marine Parks Malaysia (Pulau Payar) Order 1989 was enacted. The Establishment of Marine Parks Malaysia Order 1994 revoked the 1989 Order, but firmly entrenched the Pulau Payar group of islands as a protected area together with another 34 islands. According to its First Schedule, "the limit of any area or part of an area established as a marine park shall be at a distance of two nautical miles seaward from the outermost points of the islands specified".

Activities that are permitted in Marine Parks include underwater photography, swimming, observation and appreciation of aquatic flora and fauna, SCUBA diving and snorkelling. The following activities are prohibited, except with permission : water skiing, speed boat racing, spear fishing, collection or corals and other aquatic life whether dead or alive, anchoring of boats over coral areas, carrying and using weapons that endanger aquatic life, and fishing in the Marine Park vicinity.

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2. METHODS

The field study in Pulau Payar was carried out from April 1996 to July 1996. There were two components to the study; a survey of the surrounding coral reefs which are popular dive sites, and a land-based survey which involved distributing questionnaires and conducting interviews with tourists, divers, tour operators and dive operators.

2.1 Coral reef survey

The Line Intercept Transect (LIT) method (English et al, 1994) was used to assess the sessile benthic community of the reefs. The community is characterised using lifeform categories which provide a morphological description of the reef community. The LIT is used to estimate the cover of a lifeform or group of lifeforms within a specified area (Gates, 1979) by calculating the fraction of the length of the line that is intercepted by that lifeform. Two general assumptions are made : the size of the lifeform is small relative to the length of the line; and the length of the line is small relative to the reef of interest (English et al, 1994). The measure of cover, expressed as a percentage, is then considered to be an unbiased estimate of the proportion of the total area covered by that lifeform.

At each dive site surveyed, 50 m transect lines were laid at a depth of 10 m using tibreglass measuring tapes. Where there was little or no coral at 10 m, transects were then laid at 6-8 metres depth, and these differences noted. Transects were repeated for all the reefs (except for Pulau Segantang) at least twice. Once the transect was laid, the observer moved slowly along the transect, recording on data sheets the life forms encountered under the tape. At each point where the benthic lifeform changed, the transition point in centimetres and the code of the life form was recorded. The intercept of each lifeform encountered under the transect is the difference between the transitions points recorded for each lifeform. To ensure standardisation of the data, the same observer recorded data for each individual transect, at all sites and during repeat surveys.

Other site variables were also noted, such as the depth range, visibility, currents, the general reef profile, attractions for divers and the extent of damage of the particular reef surveyed. The position of each reef surveyed was taken using a GPS (Global Positioning System).

While the LIT provides information on spatial pattern, it must be noted that this method, within the time constraints of the study period of 4 months. cannot provide detailed information on temporal change. Ideally, monitoring should be repeated each year, or at least every 2 years, and should be complemented with belt transects and/or photo-quadrat techniques to provide a more precise picture of temporal change. To ensure accuracy, the tape should remain close to the substratum (0 - 15 cm) at all times, and should be securely attached to prevent excessive movement. This however, was not always possible as at some sites the reef morphology was too uneven to allow close contact with the tape. At times, currents were very strong making data collection difficult. Despite these constraints, the LIT method enables reliable and efficient sampling of quantitative percent cover data.

2.2 Land-based survey : Questionnaires

A survey of the tourists and tour operators that come to the Pulau Payar Marine Park was conducted by means of questionnaires and interviews. The questionnaires used are presented in Appendix 2. Japanese and Mandarin translations of the tourist questionnaire were also used as the majority of tourists to Pulau Payar Marine Park are

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Japanese and Taiwanese. The main objective of this component of the study was to garner the opinions of the various parties concerned, as well as to gather some statistics for analytical purposes. In addition, it is hoped that the problems faced by all concerned will be highlighted, and action taken to remedy them.

In conjunction with the coral reef surveys, questionnaires and interviews targeting dive operators and divers were also conducted (Appendix 2). These investigations highlighted the perceptions of Pulau Payar Marine Park's reef users with particular reference to reef condition, diver satisfaction and marine conservation awareness.

It must be borne in mind that the results for the land-based survey are based on the responses of the respondents, and may therefore be subjective. It would also have been ideal to carry out questionnaires everyday to ensure a continuum of data, but this was not possible as not all the time was spent in the field due to other project commitments. A 10% sample size was obtained for each day that questionnaires were done (that is 10% of the total number of visitors for that day were surveyed), in order to ensure representative sampling. Despite the constraints present, the questionnaires were still useful to highlight certain aspects of carrying capacity, as well as the various problems faced by all parties including tour and dive operators, tourists and divers.

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3. RESULTS OF THE CORAL REEF SURVEY

3.1 The coral reefs studied

A total of 7 coral reef areas were studied, 6 of which are popular dive sites of the Pulau Payar Marine Park. These are,

(a) Marine Park Centre House Reef;

(b) Langkawi Coral Pontoon House Reef;

(c) Coral Garden;

(d) Pulau Kaca;

(e) Lembu Rocks; and

(f) Pulau Segantang.

These reefs were studied as they are all fairly heavily used by divers and are promoted as dive sites by dive operators. They are thus more likely to be the first to show any adverse impacts from tourism.

The 7th reef area studied was located at the northern tip of Pulau Payar and was used as a control site. It was selected as it is fairly representative of the fringing reefs around Pulau Payar and it is not a dive site utilised and promoted by dive operators.

A general profile was compiled for each site to add to their coral composition data. The results of coral cover and hard coral composition are summarised in Map 2 and Map 3 respectively.

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3.2 Reef profiles

(a) MARINE PARK CENTRE HOUSE REEF

POSITION	:	*N 6°03.81 1'* E 100°02.506'
TRANSECT DEPTH	:	7m
DISTANCE FROM THE MARINE PARK CENTRE	:	100 m from the shore
PREVAILING CURRENTS	:	NE/SW with tidal stream.
GENERAL MORPHOLOGY	:	The reef flat consists predominantly of isolated patches of stunted *Porites* spp. boulders, interspersed by a sandy bottom. The reef flat gradually slopes down to a narrow fore reef which continues at a steeper gradient to a sandy sea bottom. Massive corals such as *Porites* spp. and branching staghorn corals *(Acropora* spp.) form the bulk of the fore reef and reef slope areas, along with tabulate forms of *Montiporu* spp..
VISIBLE DAMAGE	:	Snorkeller and boat propeller damage, especially at low tide. Jetty construction on Pulau Payar has lead to sedimentation and construction waste on and amongst the reef along with litter. Bleaching *of Acropora* spp. and *Porites* spp. is also noticeable, the cause of which has yet to be established.
ATTRACTIONS	:	Accessibility, especially for the indiscriminate visitor and snorkeller. Introductory dives are carried out here by dive operators for unqualified tourists who want to experience using SCUBA equipment while having the opportunity to view the reef environment up close. Abundant fish (reef and commercial) and large groupers. Fish feeding is a very popular activity, especially for the many juvenile black tip reef sharks that frequent the reef.
NUMBER OF MOORINGS	:	*6*
GENERAL COMMENTS		Only reef accessible to non-diving visitors to the Marine Park Centre. Under high pressure from damaging snorkelling activities, present construction of a jetty and boardwalk on the island and possible sewage pollution from the Marine Park Centre.

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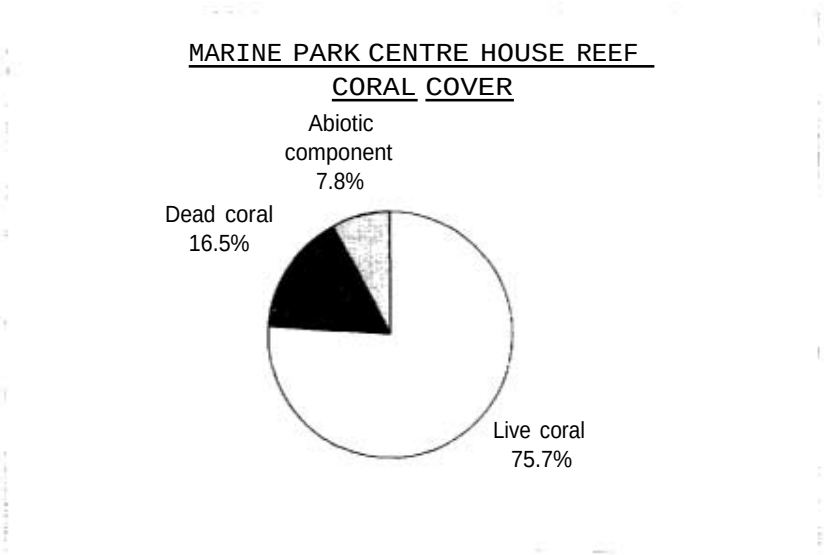
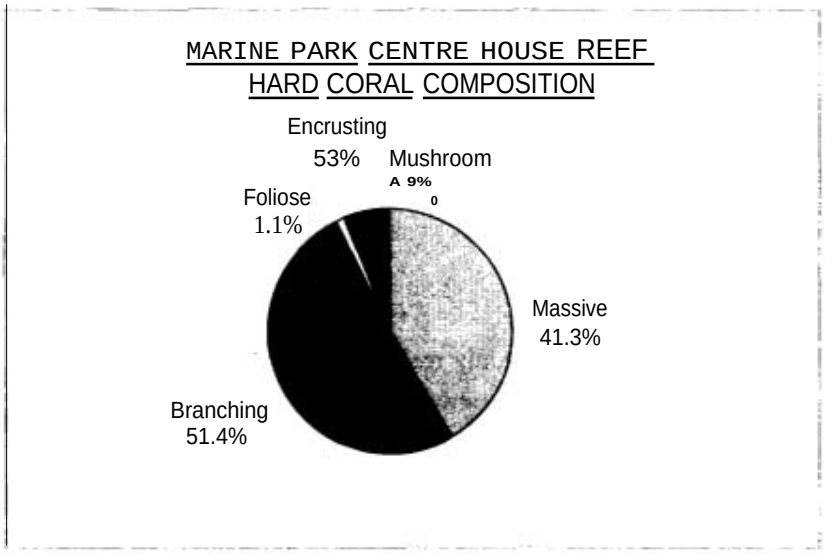
CORAL COVER

LIVE HARD CORAL	DEAD CORAL	ABIOTIC COMPONENT
75.7%	16.5%	7.8%



HARD CORAL COMPOSITION

BRANCHING	MASSIVE	ENCRUSTING	FOLIOSE	MUSHROOM
5 1.4%	4 1.3%	5.3%	1.1%	0.9%



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(b) LANGKAWI CORAL PONTOON HOUSE REEF

POSITION	:	N 6°03.907' E 100°02.592'
TRANSECT DEPTH	:	7m
DISTANCE FROM THE MARINE PARK CENTRE	:	0.1 nautical miles (nm)
PREVAILING CURRENTS	:	NE/SW depending on the tidal stream.
GENERAL MORPHOLOGY	:	The reef flat consists predominantly of isolated patches of stunted *Porites* spp. boulders, interspersed by a sandy bottom. The reef flat gradually slopes down to a narrow fore reef which continues at a steeper gradient to a sandy sea bottom. Massive corals such as *Poritcs* spp. and branching staghom corals (Acroporo spp.) form the bulk of the fore reef and reef slope areas.
VISIBLE DAMAGE	:	Snorkeller damage, especially at low tide. Construction damage and debris, probably from the jetty and the boardwalk construction. The shadowing effect of the pontoon seems to have reduced the photosynthetic activity of the coral-associated zooxanthellae and decreased the overall health of the reef in the shaded area.
ATTRACTIONS	:	Accessibility, especially for the indiscriminate visitor and snorkeller. Introductory dives are carried out here by East Marine, the dive operator that operates from the pontoon, for unqualified tourists who want to experience using SCUBA equipment while having the opportunity to view the reef environment up close. Large groupers and moray eels. Fish feeding is also a popular activity.
NUMBER OF MOORINGS		4
GENERAL COMMENTS		Only reef accessible to non-diving visitors from the Langkawi Corai Pontoon. Under high pressure from damaging snorkelling activities although there is some control from lifeguards. Visible from the underwater observatory on the pontoon.

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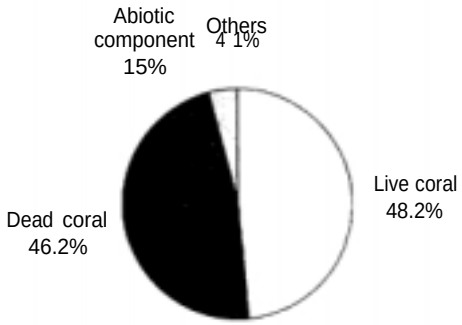
CORAL COVER

LIVE HARD CORAL	DEAD CORAL	OTHERS	ABIOTIC COMPONENT
48.2%	46.2%	4.1%	1.5%

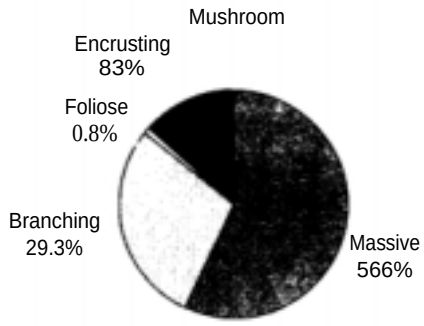
LANGKAWI CORAL PONTOON HOUSE REEF
CORAL COVER



HARD CORAL COMPOSITION

MASSIVE	BRANCHING	ENCRUSTING	MUSHROOM	FOLIOSE
56.6%	29.3%	8.3%	5.0%	0.8%

LANGKAWI CORAL PONTOON HOUSE REEF
HARD CORAL COMPOSITION



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(c) CORAL GARDEN

POSITION	:	N 6º03.439' E 100º02.240'
TRANSECT DEPTH	:	10m
DISTANCE FROM THE MARINE PARK CENTRE	:	0.6 nm
PREVAILING CURRENTS	:	Fairly strong as Coral Garden is on an exposed tip of the island. Currents predominantly move in a 180º direction.
GENERAL MORPHOLOGY	:	Rocky outcrop on southwest tip of Pulau Payar. Underwater rock face extends from the surface to the sandy seabed at approximately 15 metres. Rock face is very irregular being predominately made up of large boulders interspersed with rubble, and with steep gullies, ravines and crevices. The general aspect of the rocky slope is facing 90º with an angle of approximately 45". Colourful soft coral, predominantly Dendronephthya sp. can be found on the rock wall down to the bed.
VISIBLE DAMAGE	:	Limited, due to the natural physical tolerance of the coral lifeforms that make up the reef.
ATTRACTIONS		Accessibility, but unfortunately in an area of strong currents, Different from the other dive sites at Puiau Payar Marine Park due to the presence ofcolourful soft coral (Dendronephthya sp.). Large schools of reef and commercial fish, including barracuda. Moray eels, large groupers and porcupinefish are regularly sighted.
NUMBER OF MOORINGS	:	1
GENERAL COMMENTS	:	Most popular dive site at Pulau Payar Marine Park due to the colourful soft corals; all dive operators bring divers here. Some tour operators bring snorkellers as well, especially when the tide is too low at the Marine Park Centre House Reef for boats to disembark passengers or during calm days.

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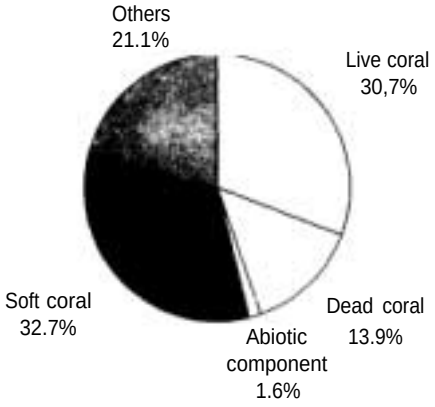
CORAL COVER

SOFT CORAL	LIVE HARD CORAL	OTHERS	DEAD HARD CORAL	ABIOTIC COMPONENT
32.7%	30.7%	21.1%	13.9%	1.6%

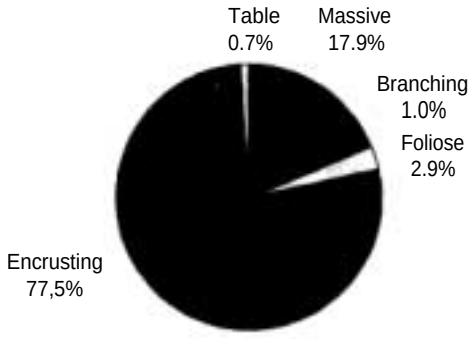
CORAL GARDEN: CORAL COVER



HARD CORAL COMPOSITION

ENCRUSTINC	MASSIVE	FOLIOSE	BRANCHING	TABLE
77.5%	17.9%	2.9%	1.0%	

CORAL GARDEN : HARD CORAL COMPOSITION



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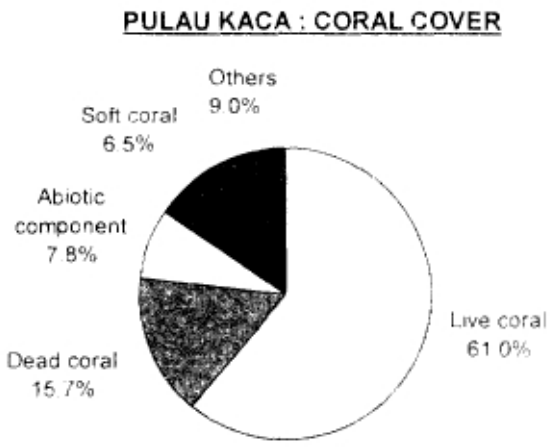
(d) PULAU KACA

POSITION	N 6°04.374' E 100°03.140'
TRANSECT DEPTH	8 III
DISTANCE FROM THE MARINE PARK CENTRE	*0.75* nm
PREVAILING CURRENTS	Strong, from 2 10°.
GENERAL MORPHOLOGY	Transects were laid at the north and northwest facing sides of the island, with the general aspect of the slope at 300" to 360" The slope angle was between 15° and 35". The shoreline is rocky, and slopes to a diverse population of corals which descends to a depth of about 9 m until reaching a sandy bottom. Common coral species found here include Acropora spp., Porites spp. and Montipora spp.. Also found are the dark green tree-like hard coral Dendrophyllia micranthus. and at the northeast side of the island the soft coral Sacrophyton sp.,
VISIBLE DAMAGE	Limited
ATTRACTIONS:	Easily accessible but in an area of strong currents. The corals are highly diverse and intermixed. Large schools of fish including barracuda. Also black tip reef sharks, abundant anemones and their commensal complements of the clownfish butterflyfish and the chance to see whale sharks. Opportunity for wreck dive.
NUMBER OF MOORINGS	0
GENERAL COMMENTS	Popular dive site, all dive operators bring divers to Pulau Kaca. More interesting dive site than the others due to the diversity of coral and the abundant amounts of fish present; most dive operators also include the wrecks as part of the dive.

<<

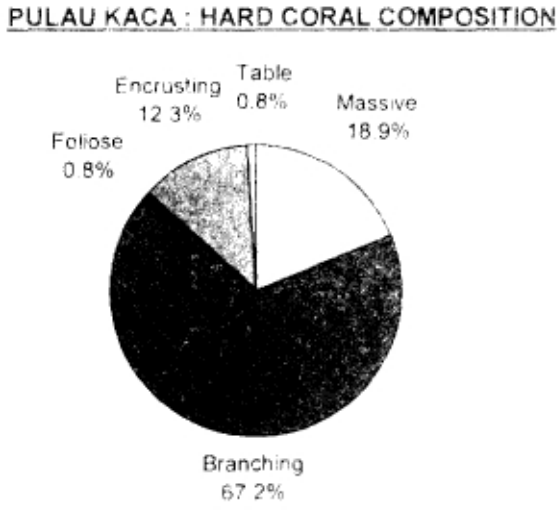
CORAL COVER

LIVE HARD CORAL	DEAD HARD CORAL	OTHERS	ABIOTIC COMPONENT	SOFT CORAL
61.0%	15.7%	9.0%	7.8%	65°c



HARD CORAL COMPOSITION

BRANCHING	MASSIVE	ENCRUSTING	FOLIOSE	TABLF
		12.3%	08%	0.8%



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(e) LEMBU ROCKS

POSITION		N 6º04.628' E 100º03.409'
TRANSECT DEPTH	:	8 m
DISTANCE FROM THE MARINE PARK CENTRE	:	0.9 nm
PREVAILING CURRENTS		Predominantly strong, from 240".
GENERAL MORPHOLOGY		The majority of the transect was across a slope of between 15º and 30º, leading up to dried out rocks at the surface and down to the sandy bed at 12 metres, how ever there were areas along the transect where the slope was as low as 5". Slope aspect was 35" to 38" approximately. There was little hard coral here, mainly boulders ranging in size from 0.5 metres to 5 metres plus in diameter with areas of sand and rubble in between A lot of the rock boulders are covered with sea anemones and the anemone-like false corals (Actinodiscidae)
VISIBLE DAMAGE		Fairly limited due to the low levels of hard coral present.
ATTRACTIONS		Accessibility. gullies in the high elevation, large schools of fish. large triggerfish, butterfly fish emperor angelfish, barrel sponges and anemones.
NUMBER OF MOORINGS		0
GENERAL COMMENTS		Not that utilised as a dive site

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CORAL COVER

0T HERS LIVEHARD CORAL DEAD HARD CORAL ABIOTIC COMAPONENT

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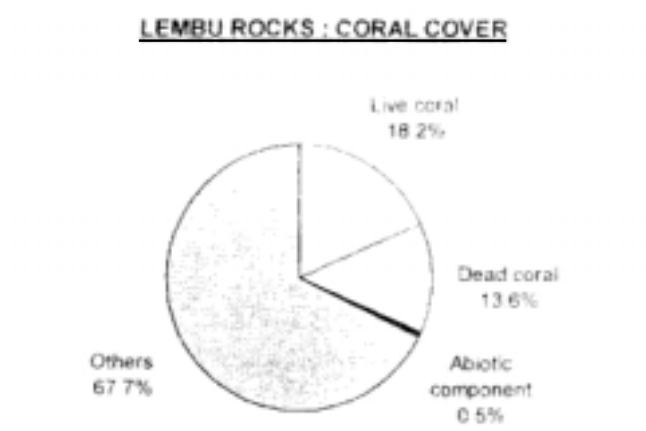
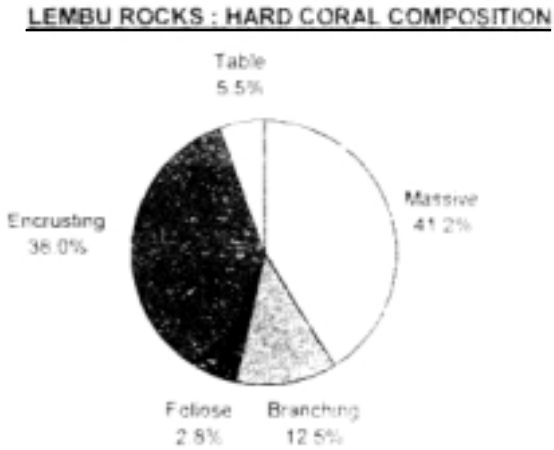


HARD CORAL COMPOSITION

MASSIVE **ENCRT STING** BRANCHING TABLE FOLIOSE



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(f) PULAU SEGANTANG

POSITION	N 6°02.376' E 99°55.69 1'
TRANSECT DEPTH	10 m
DISTANCE FROM THE MARINE PARK CENTRE	7.2 nm
PREVAILING CIJRRENT	Strong surge current.
GENERAL MORPHOLOGY	The transect was laid on the southeastern side of the island. Here, the rock face drops almost vertically down to a depth of about 10 m, beyond which it slopes gently to reach the sandy sea bottom. The rock face is predominantly covered with the anemone-like false coral (Actinodiscidae). Hard coral here is mostly in the encrusting form, although there are also massive Porites spp. present.
VISIBLE DAMAGE	Limited. There have been as yet unconfirmed reports of fishing nets on other parts of the reef.
ATTRACTIONS	Opportunity for deepdives and wall dives. Possible chance of seeing leopard sharks and whale sharks. Large schools of fish, both reef and commercial, including juveniles.
NUMBER OF MOORINGS	0
GENERAL COMMENTS	Popular dive site, but not all dive operators take divers here as it is not as accessible as the other dive sites. In addition, the sea here is quite often rough, with strong currents.

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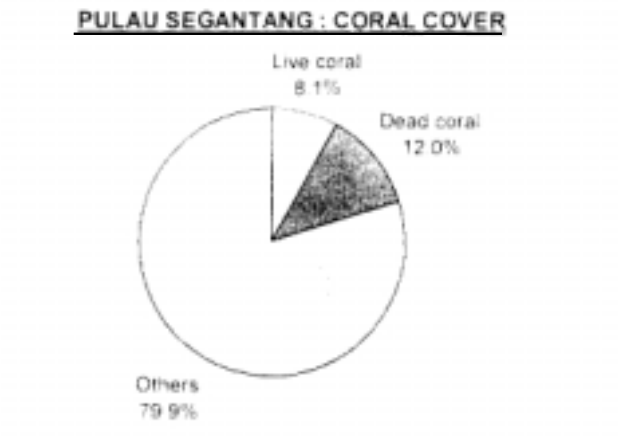
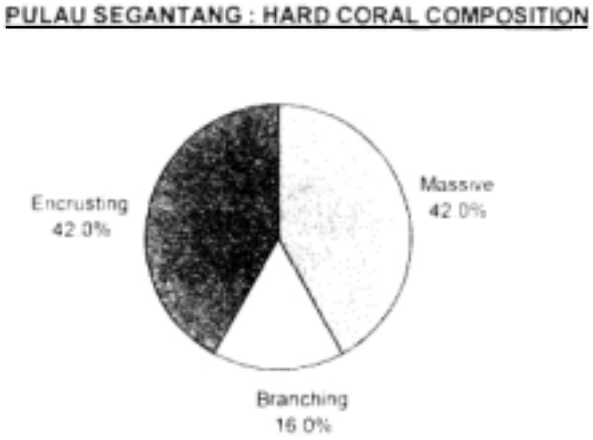
CORAL COVER

DEAD HARD CORAL	LIVE HARD CORAL	OTHERS
79.9%	12.0%	8.1%



HARD CORAL COMPOSITION

ENCRUSTING	MASSIVE	BRANCHING



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(g) CONTROL SITE (NORTHEASTERN TIP OF PULAU PAYAR)

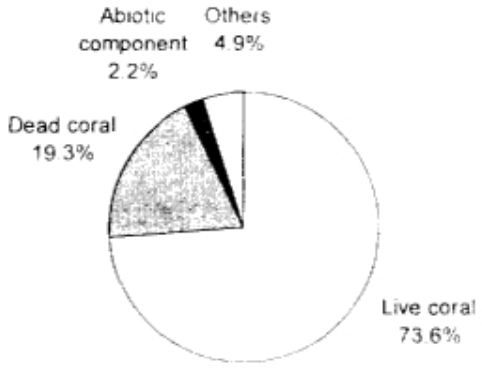
POSITION		**N 6°04.161'** **E 100°02.617'**
TRANSECT DEPTH		**10 m**
DISTANCE FROM THE MARINE PARK CENTRE	:	**0.3 nm**
PREVAILING CURRENTS	:	**Strong, from 300" along the reef.**
GENERAL MORPHOLOGY		**Rocky shoreline. The reef occurs on a gentle slope of between 10° and 30° with an aspect of 330". The slope then steepens down to a sandy bed at approximately 15metres. Predominantly branching Acropora spp. coral, although there is quite a high diversity of coral lifeforms present.**
VISIBLE DAMAGE	:	**Minimal physical damage; has relatively high live coral cover.**
ATTRACTIONS	:	**Accessibility. Black tip reef sharks, trigger-fish, pufferfish, large schools of reef fish.**
NUMBER OF MOORINGS		**0**
GENERAL COMMENTS		**Not utilized as a dive site. Since the reef here is fairly typical of the reefs around Pulau Payar Marine Park and it is not under any tourism pressure, it has been selected as a control site.**

<<

CORAL COVER

LIVE HARD CORAL	DEAD HARD CORAL	OTHERS	ABIOTIC COMPONENT
73.6%	19.3%	4.9%	2.2%

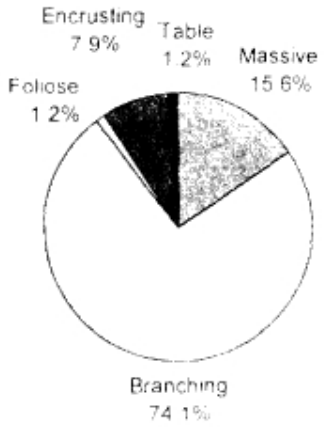
CONTROL SITE : CORAL COVER



HARD CORAL COMPOSITION

BRANCHING	MASSIVE	ENCRUSTING	TABLE	FOLIOSE
74.1%	15.6%	7.9%	1.2%	1.2%

CONTROL SITE : HARD CORAL COMPOSITION



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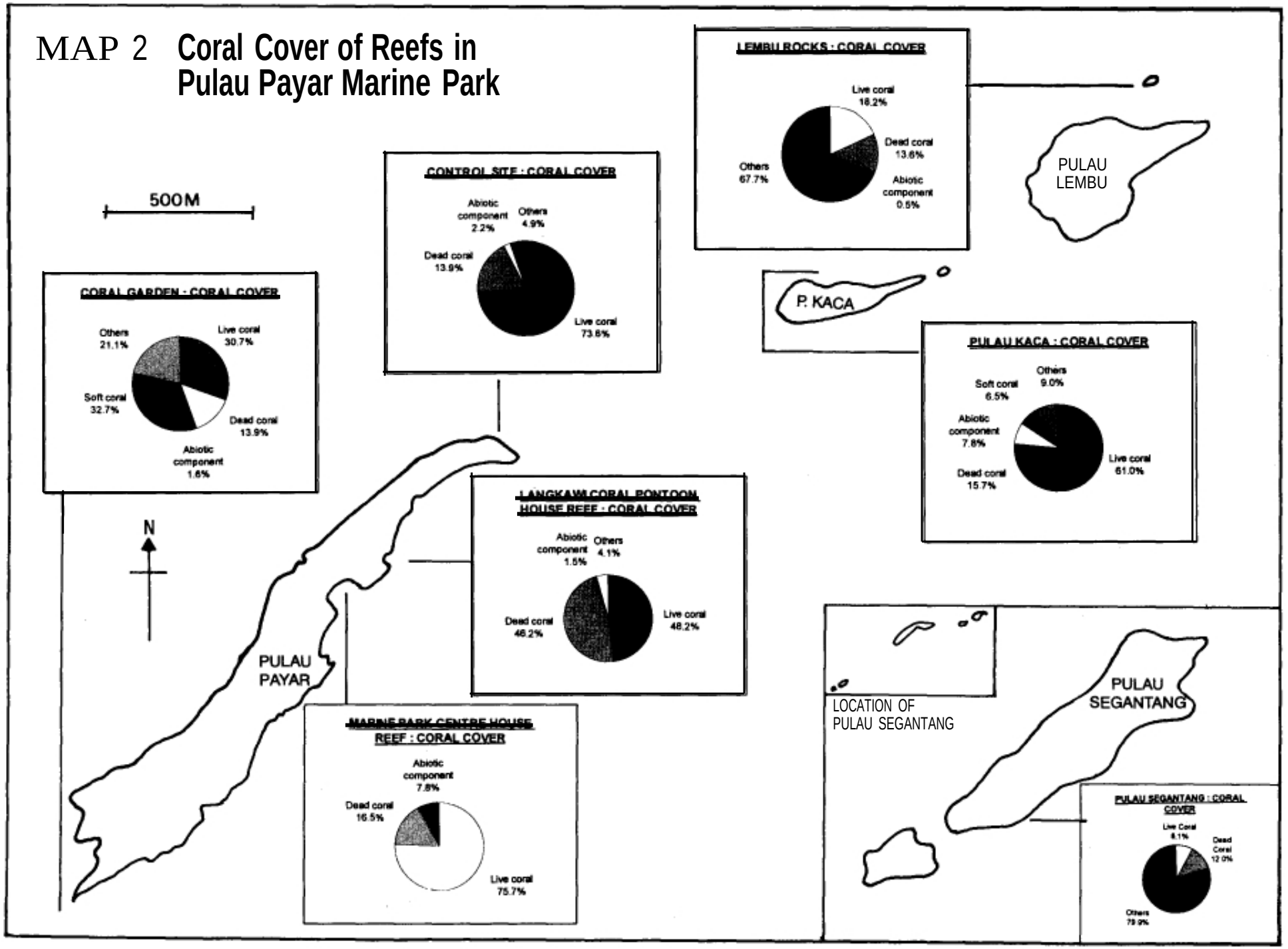
MAP 2 Coral Cover of Reefs in Pulau Payar Marine Park



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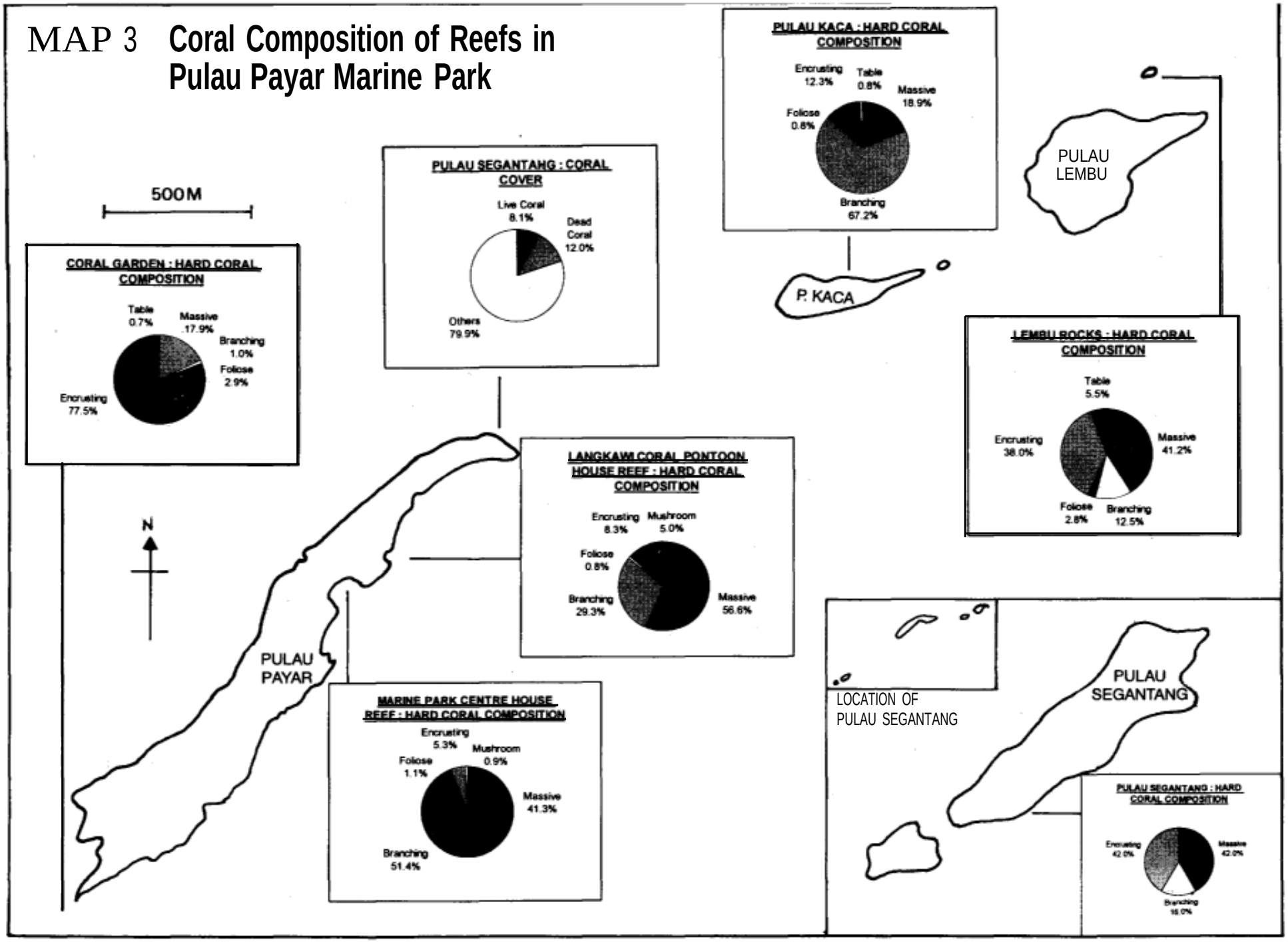
MAP 3 Coral Composition of Reefs in Pulau Payar Marine Park



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4. RESULTS OF THE LAND-BASED SURVEY

4.1 Visitor statistics

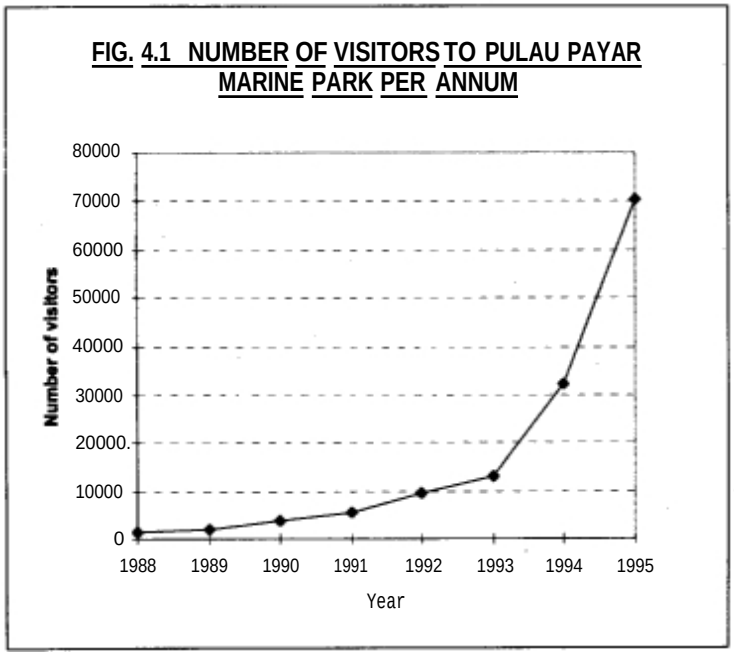
Since visitor numbers were first recorded in 1988, the growth in tourists arrivals to Pulau Payar Marine Park has been staggering, leaping from 1,373 visitors in 1988 to 70,419 visitors in 1995 (Table 4.1, Fig 4.1) (Visitor statistics are inclusive of visitors to the Marine Park Centre and the Langkawi Coral Pontoon). The Marine Park has thus seen a more than 5000% increase in visitors in the last seven years. This can be attributed to a variety of factors, the most important being the growth of Pulau Langkawi as a tourist destination and the easy accessibility of the Marine Park from Pulau Langkawi, Pulau Pinang and Kuala Kedah.

TABLE 4.1 NUMBER OF VISITORS TO PULAU PAYAR MARINE PARK PER ANNUM

YEAR	NUMBER OF VISITORS
1988	1,373
1989	1,942
1990	3,668
1991	5,613
1992	9,458
1993	13,038
1994	32,175
1995	70,419
* 1996	50,641

* *Visitor numbers till July 1996*

Source: Department of Fisheries Malaysia



The majority of tourists to Pulau Payar Marine Park now are foreigners (66.7% of the total number of visitors in *1995),* as compared to previously in 1988, when Malaysians formed the bulk of the visitors (76.4%) (Fig. 4.2).

<<

The Taiwanese and Japanese are the main foreign nationalities that visit Pulau Payar Marine Park. Malaysians also make up a large proportion of the visitors. This is reflected in the visitor numbers for the study period (April - July, 1996) (Fig. 4.3).

FIG. 4.2 RELATIVE PROPORTIONS OF MALAYSIAN AND FOREIGN TOURISTS TO PULAU PAYAR MARINE PARK IN 1988 AND 1995

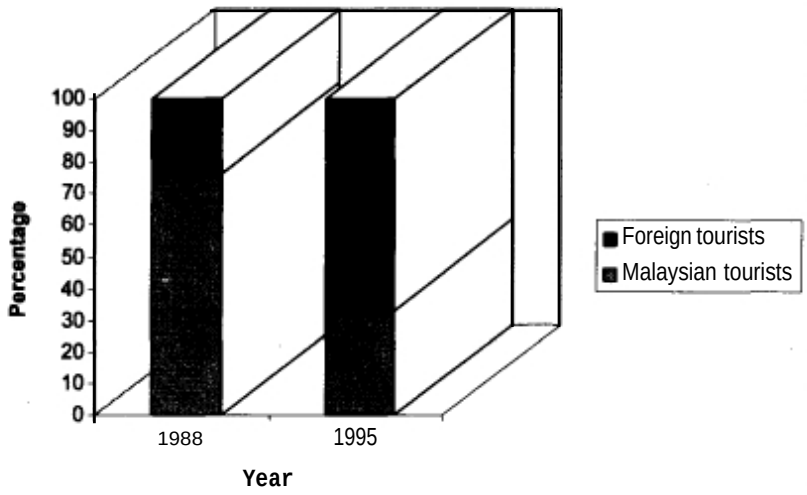
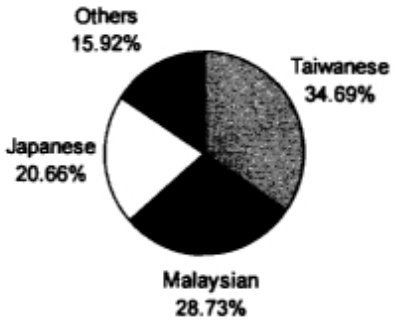


FIG. 4.3 NATIONALITIES OF VISITORS TO PULAU PAYAR MARINE PARK. APRIL - JULY 1996

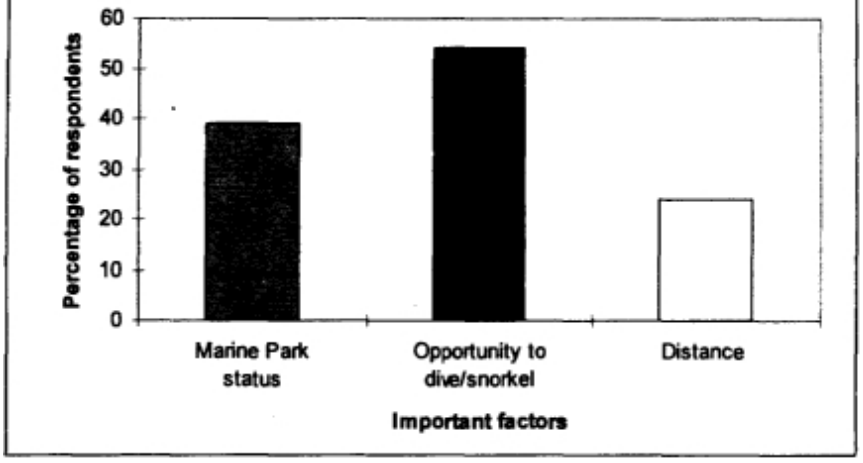


A total of 1009 tourist questionnaires were answered by tourists at the Marine Park Centre and Langkawi Coral Pontoon. Unless otherwise indicated, the time frame of the survey results is between April and July 1996. Results are in percentages and are taken as a proportion of the questions answered.

Of those surveyed, 80.06% stated that they chose specifically to visit the Marine Park whilst the remainder were on the island as part of a package or island hopping tour where they could not influence the itinerary. The fact that Pulau Payar Marine Park offers visitors an opportunity to dive and/or snorkel and observe marine life and coral

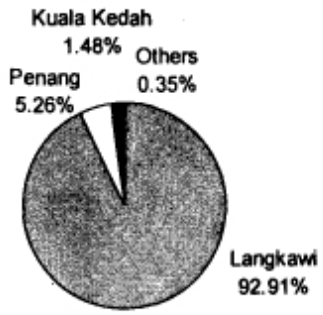
reefs was the main factor in influencing choice to visit (Fig. 4.4). A total of 54.16% of respondents rated this as a very important factor. Less important was the status of the area as a Marine Park; 38.92% of respondents rated this as a very important factor. Distance from the access points did not make much of a difference; only 23.95% of those surveyed rated this factor as very important.

FIG. 4.4 IM'ORTANT FACTORS INFLUENCING TOURISTS' DECISION TO VISIT PULAU PAYAR MARINE PARK



Department of Fisheries data from January 1996 show that a very high percentage (92.91%) of visitors to Pulau Payar Marine Park depart from Pulau Langkawi, with the remainder leaving from Pulau Pinang and Kuala Kedah (Fig. *4.5).* This is reflected in the survey results whereby 86.36% of those surveyed were staying in Pulau Langkawi.

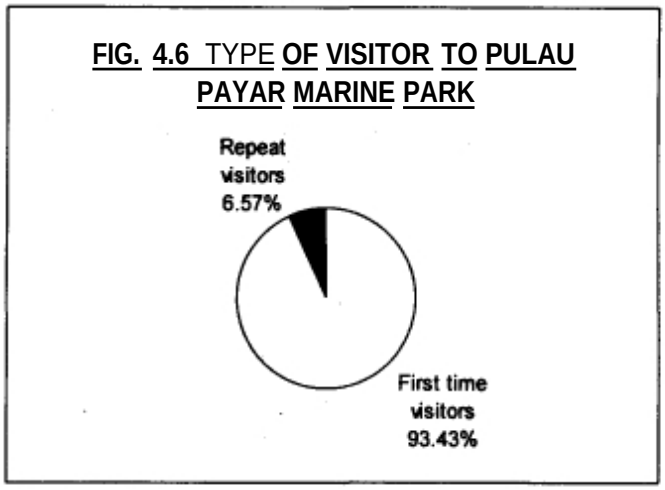
FIG. 4.5 LAST PORT OF EMBARKATION FOR TOURISTS TO PULAU PAYAR MARINE PARK JANUARY - JULY 1996



Most of the visitors were in Pulau Payar for the first time (93 .43%), whilst the remaining visitors *(6.57%)* were repeat visitors (Fig. 4.6). Those that had been to the Marine Park before noticed that the number of visitors overall and the number of divers and snorkellers have increased dramatically.

<<

All tourists visiting the Marine Park during the study periodwere on a day trip. Trips are packages arranged bythe tour operators, and the fare includes transfers, lunch and snorkelling equipment. The Pulau Payar Marine Park day trip can be booked directly from Pulau Langkawi, or alternatively be part of a larger package tour to Pulau Langkawi

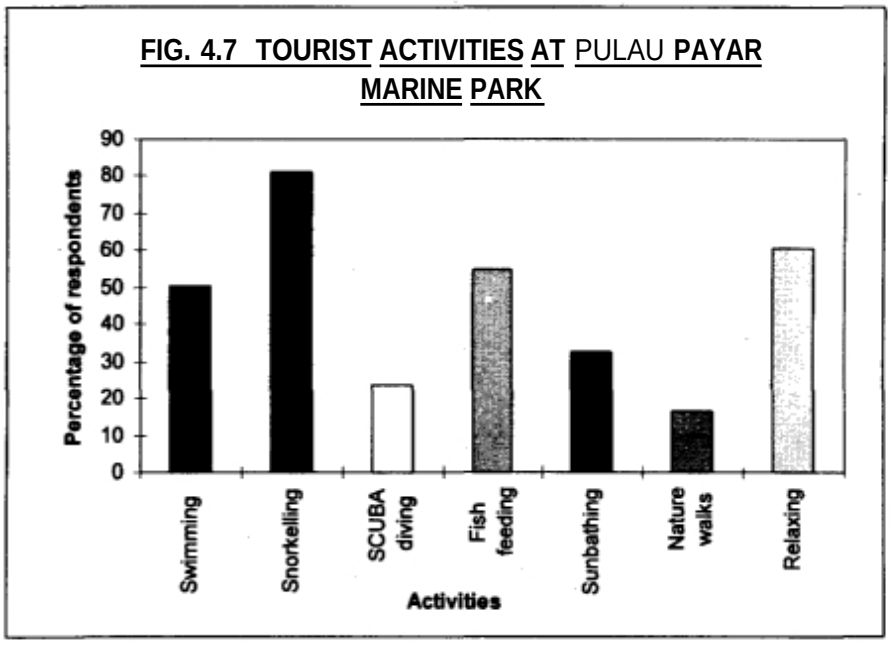


which would have been booked from the respective home countries. At times, this package would include trips to other islands (usually Pulau Singa and Pulau Dayang Bunting off Pulau Langkawi) or a fishing trip outside of the Marine Park. During the study period, no one utilised the camping options available.

4.2 General opinions of Pulau Payar Marine Park

4.2.1 Activities and facilities

Pulau Payar Marine Park is blessed with a number of attributes which render it attractive to the visitor. Not least among them are its natural resources and the marine environment. The majority of visitors to the island were there to appreciate the beauty of the marine and coral reef environment. Water sports activities were pursued actively, the



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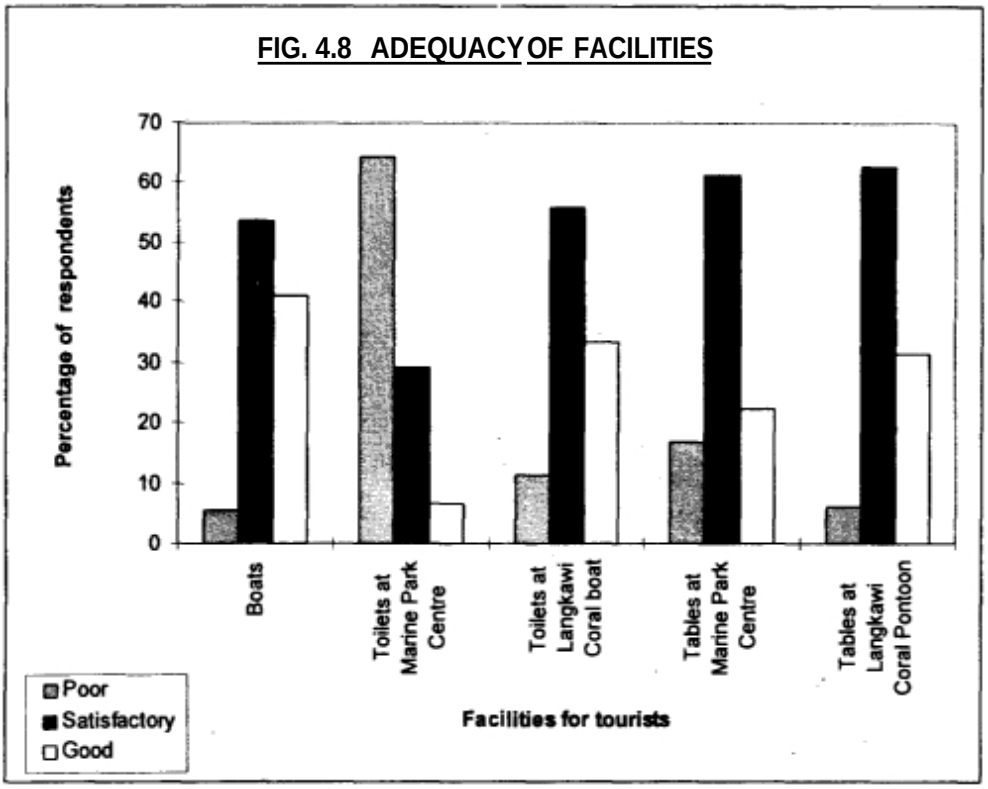
most popular being snorkelling (81.12%) and swimming (50.21%) (Fig. 4.7). A large proportion of tourists chose to spend time relaxing (60.55%) and sunbathing (32.38%), especially on the beach. Another immensely popular activity is fish feeding (54.75%), whereby bread is given to fish, and juvenile black tip reef sharks that come to the Marine Park Centre bay are fed with fresh fish. SCUBA diving is not as actively pursued, only 23.58% of visitors participated in this activity as most of the visitors were non-specialists and were at the Marine Park for snorkelling. Furthermore, not many people (16.46%) utilised the two existing trails on the island.

Fig. 4.8 presents a breakdown on tourists' opinions on the adequacy of facilities at Pulau Payar Marine Park. In general, most found the facilities satisfactory or good. The one major complaint was about the toilets at the Marine Park Centre - the vast majority (64.16%) felt that there were not enough toilets, and complained that there was no water in the toilets and that they were dirty.

FIG. 4.8 ADEQUACY OF FACILITIES



4.2.2 Perception of crowding and satisfaction.

The majority of tourists interviewed found it crowded at the Marine Park, especially at the picnic area at the Marine Park Centre itself (64.47%) (Fig. 4.9). Perception of crowding does not seem to be as acute for visitors snorkelling in the water, whether at the Marine Park Centre (48.93%) or at the Langkawi Coral Pontoon (40.83%). Data were also analysed separately for the three main nationalities of visitors to Pulau Payar Marine Park (Taiwanese, Japanese and Malaysian) (Fig. 4.10). The same general trends emerge, whereby most visitors found the Marine Park Centre crowded, and that perception of crowding in the water while snorkelling is not as acute. From the results, it also seems that Malaysians have a lower tolerance to crowding than the Taiwanese and Japanese.

When asked if an increase in visitor numbers would affect their enjoyment of Pulau Payar, 73.97% answered affirmatively.

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FIG. 4.9 GENERAL PERCEPTIONS OF CROWDING AT PULAU PAYAR MARINE PARK

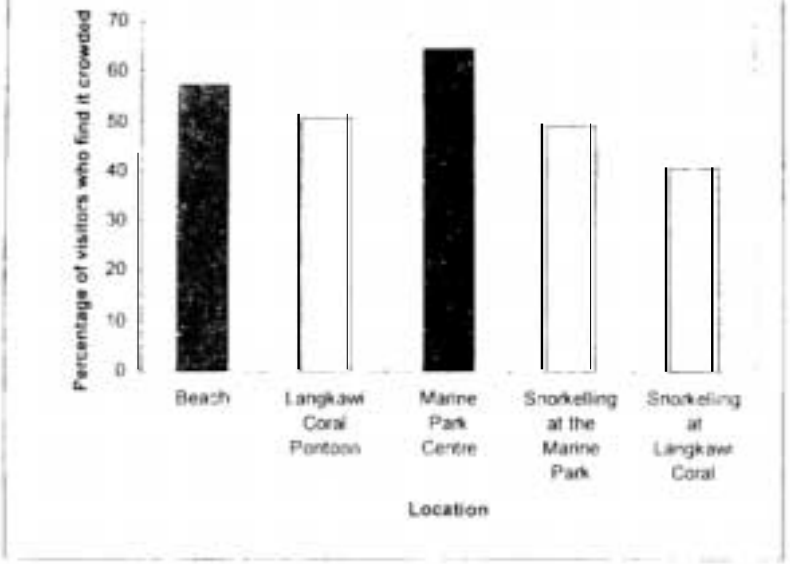
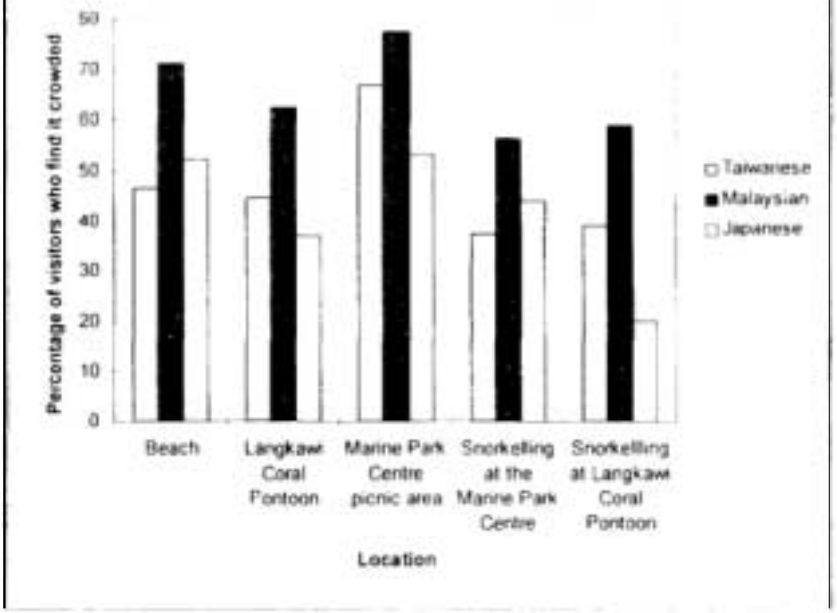


FIG. 4.10 PERCEPTIONS OF CROWDING AMONGST THE MAIN TOURIST GROUPS AT PULAU PAYAR MARINE PARK



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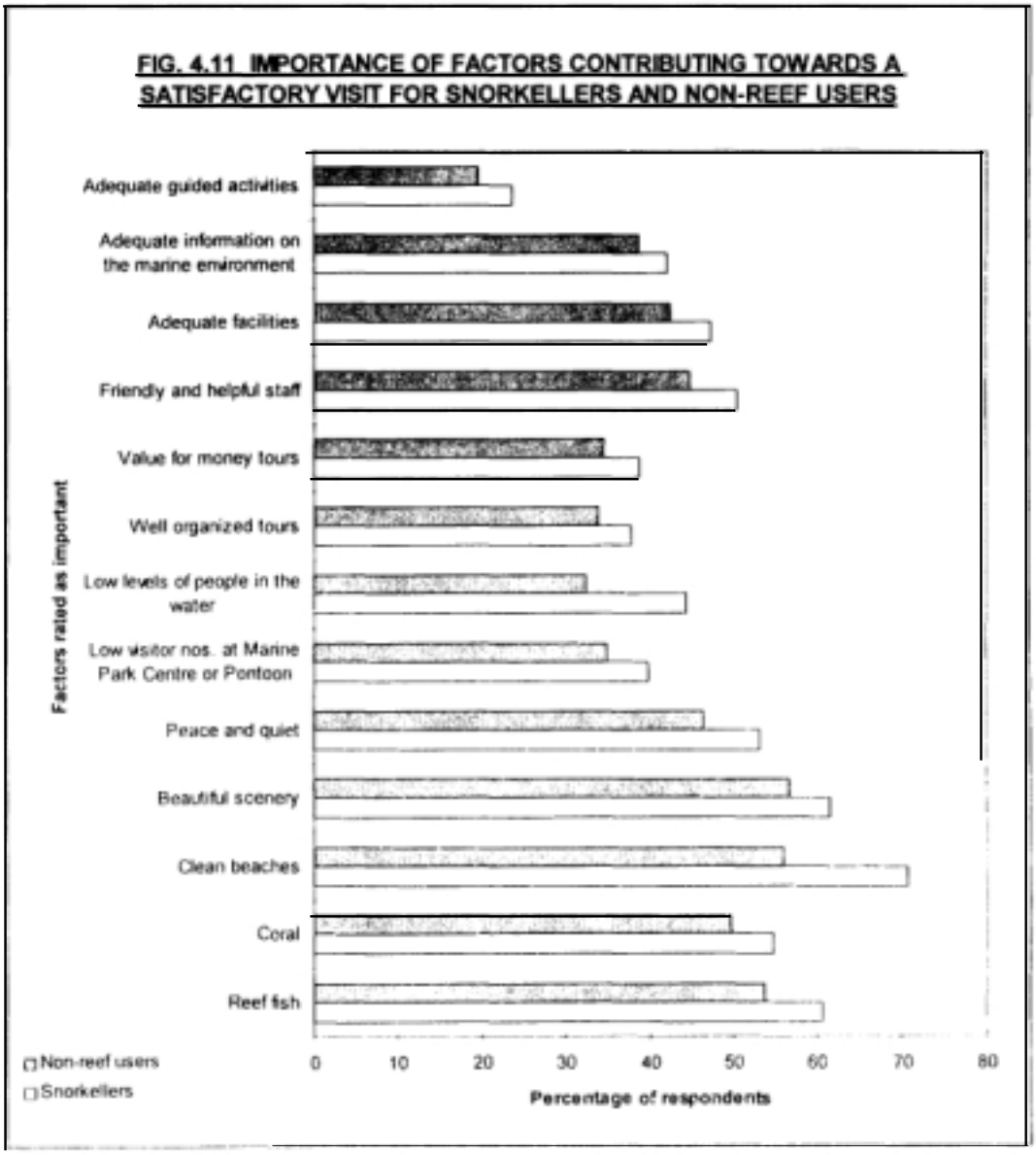
Tourists were asked to assess criteria that would contribute towards a satisfactory visit to Pulau Payar Marine Park. Results were divided between snorkellers and non-reef users (Fig. 4.1 1). The most important criterion for snorkellers was clean beaches (70.80%) while that for non-reef users was beautiful scenery *(56.59%).* Other very important criteria for snorkellers were seeing an abunaance of reef fish *(60.57%)* and diverse coral life (54.68%). For non-reef users, clean beaches (55.91%) and seeing an abundance of colourful reef fish (53.76%) were also very important. Criteria such as low visitor numbers were **not** as important comparatively. However, for snorkellers, low visitor numbers at the Marine Park Centre or Langkawi Coral Pontoon (39.73%) and low visitor numbers in the water

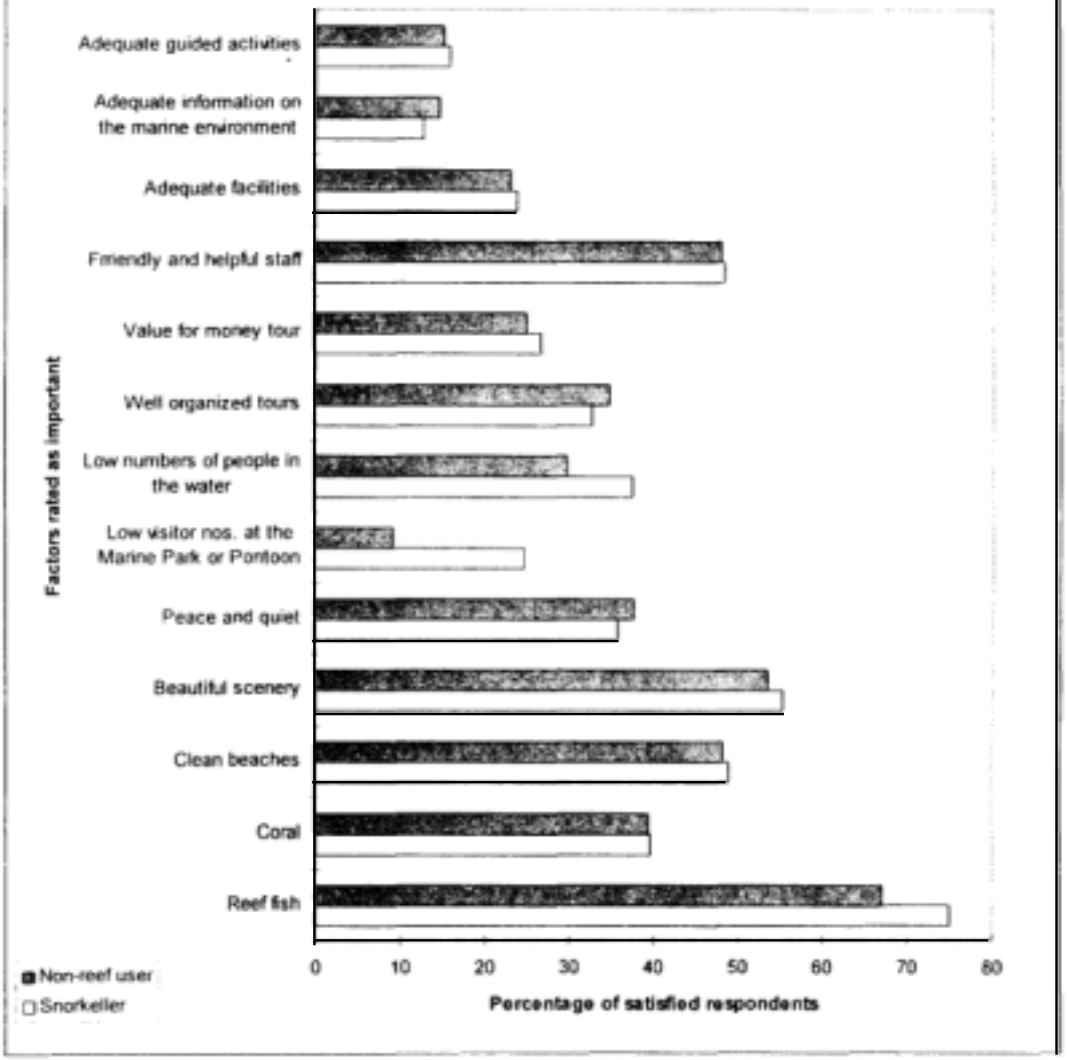


(44.35%) were more important for a satisfactory visit than for non-reef users (34.83% and 32.40% respectively), laying peace and quiet (53.08%, 46.37%). friendly and helpful Marine Park staff or Langkawi Coial Pontoon staff (50.37%, 44.83%). adequate facilities (47.37%, 42.46%) and adequate information on the marine environment (42.13%. 38.73%) were also fairly important criteria for both snorkellers and non- reef users respectively.

<<

Satisfaction with the different factors that contribute towards a visitor experience was also assessed by estimating if these criteria were met for both snorkellers and non-snorkellers (Fig. 4.12). The majority of visitors, both snorkeller and non-snorkeller, were satisfied with being able to see an abundance of reef fish at Pulau Payar Marine Park (75.06% and *67.05%* respectively). Visitors however thought that visitor numbers at the Marine Park Centre or Langkawi Coral Pontoon were too high. Furthermore, non-reef users were dissatisfied with the high numbers of visitors at these places, much more so than snorkellers; only 9.14% of non-reef users rated the criterion of low

FIG 4.12 LEVELS OF SNORKELLER AND NON-REEF USER SATISFACTION WITH FACTORS CONTRIBUTING TO A VISITOR EXPERIENCE



visitor numbers at the Marine Park Centre or Langkawi Coral Pontoon as being met as compared to 24.63% of snorkellers. Other criteria that were not met and hence caused dissatisfaction among snorkellers and non-reef users alike were the adequacy of guided activities and the adequacy of information on the marine environment.

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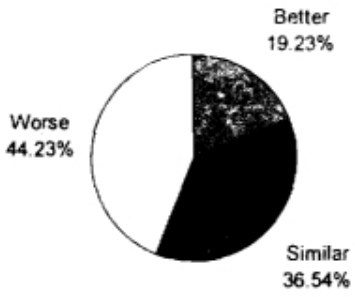
4.2.3 Marine Parks and conservation awareness

Most tourists (5 1.35%) were not aware that Pulau Payar is a Marine Park. In addition, the majority (92.09%) had not visited any other Marine Parks in Malaysia. Those that had visited other Marine Parks in Malaysia compared Pulau Payar Marine Park unfavourably with them, in terms of facilities, things to do and reef attractions (Fig. 4.13).

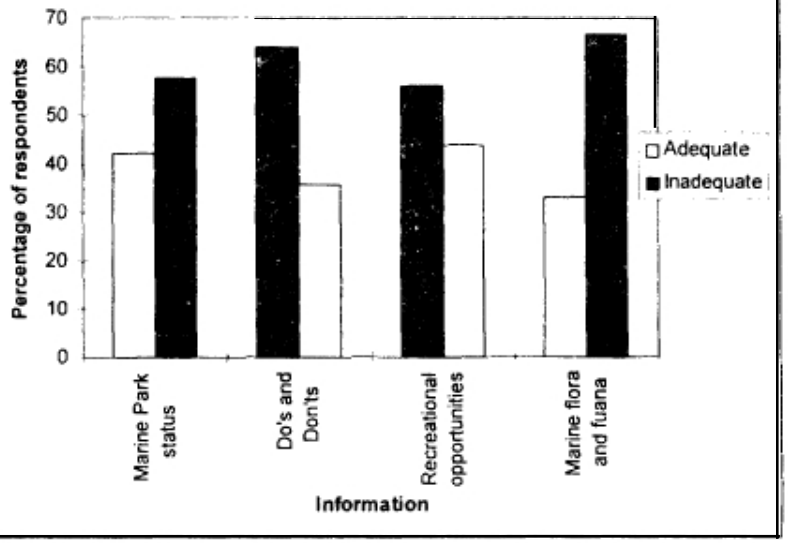
FIG. 4.13 A COMPARISON OF PULAU PAYAR MARINE PARK WITH OTHER MARINE PARKS IN MALAYSIA



Tour operators are supposed to brief tourists on Marine Park regulations, and most of the visitors interviewed (64.81%) were indeed briefed. However, this is not sufficient as by right all visitors to the Marine Park should be thoroughly briefed. Visitors are usually briefed prior to arrival to the Marine Park or at the Marine Park Centre itself before carrying out any activities. Marine Park Rangers do not usually give briefings to tourists, as there are too many tourists, and tour operators are in a better position to brief their clients and are more able to overcome language differences.

There is a paucity of information on the Marine Park and its surrounding marine environment which is made available to tourists, especially regarding Marine Park status and information on the marine environment, whereby 57.64% and 66.93% of visitors surveyed felt that this respective information was lacking (Fig. 4.14). Information

FIG. 4.14 ADEQUACY OF INFORMATION PROVISION IN PULAU PAYAR MARINE PARK



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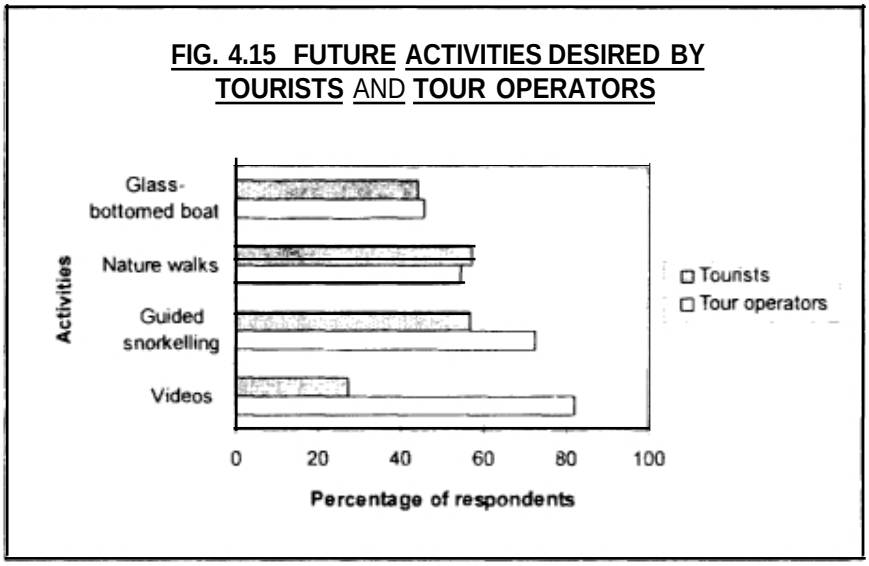
on Marine Park regulations and recreation opportunities is more readily available, as tour operators would brief their customers on these matters. The Marine Park Information Centre is terribly under-utilised, as most tourists do not even enter it. They are most probably put off by the "no entry" sign put up in front of the entrance, as Marine Park staff seem more worried that tourists with wet, sandy feet would dirty the Information Centre.

Some of the future activities desired by tourists to Pulau Payar Marine Park include glass-bottomed boat rides, guided snorkelling tours and nature walks on the island (Fig. 4. 15). Most of the tourists do not seem keen to watch videos or slide shows on the marine environment, although tour operators were of the opinion that these would he a worthwhile activity.

FIG. 4.15 FUTURE ACTIVITIES DESIRED BY TOURISTS AND TOUR OPERATORS



Willingness-to-pay is a measure of the economic value placed on being able to undertake specific marine tourist activities and on being able to visit specific marine and coastal tourist sites (Wong, 1997). 78.16% of the tourists interviewed were willing to pay a small fee for entry to Pulau Payar Marine Park or for participation in certain activities, if they knew that this fee would contribute to the management and conservation of the Marine Park. The proposed entry fee structure that is currently being explored by the Department of Fisheries Malaysia is two-tiered, with foreign individuals paying a sum of RM 8.00, and Malaysians paying RM 4.00. Proposed charges for students and senior citizens are half these prices, whilst local communities and fishermen are exempted. This fee structure is however currently being reviewed at the recommendation of the National Advisory Council for Marine Parks and Marine Reserves which would rather implement a single tiered and less discriminatory entry fee. In addition, there are also proposals to charge a fee for SCUBA diving and underwater photography activities in Marine Parks, although this is being reviewed at present. Also under review are proposals to charge weekly, monthly and annual levies on private boats that enter Marine Parks.

4.3 Information from tour operators

It was not possible to interview all the tour operators that bring visitors to the Marine Park; 14 of the 20-odd regular tour operators who are "registered" with the Department of Fisheries were interviewed. However there are no limits to the issuance of permits, as long as the number of passengers do not exceed the limit imposed by the Marine Department (12 passengers a boat); this is more a safety precaution than a conservation measure. There are also no

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limits to the number of boats that can come in to the Marine Park per day; these vary with demand. There seem to be enough boats at the moment to cater for the number of tourists coming in, even at peak periods.

Tour operators to Pulau Payar Marine Park mostly operate from Langkawi (78.57% of those interviewed), although there are a few based in Pulau Pinang (2 l .43%). They offer a package day trip to the Marine Park, inclusive of transfers, a packed lunch and snorkelling equipment. Some operators (64.29%) include the Marine Park as part of the itinerary of an island hopping trip, thus they only spend approximately two hours at Pulau Payar Marine Park Centre. Other islands that they might go to as part of this island hopping trip are Pulau Singa (50.00%), Pulau Dayang Bunting (64.29%) and Pulau Beras Basah (21.42%) off Pulau Langkawi. Most of the tour operators are fairly new operations, with all of those interviewed bringing tourists to Pulau Payar Marine Park in the last 5 years or less.

Among the foreign tourists to Pulau Payar Marine Park, the two highest in numbers are the Japanese and the Taiwanese. The peak period of tourist arrivals is the foreign holiday periods, especially the Taiwanese and Japanese holidays (during winter in early January, summer in August and September, and the Japanese Golden Week in late April/early May). Other busy periods are during the holiday seasons - Malaysian school holidays, Malaysian public holidays and weekends. At this time, the majority of tour operators (83.33%) report a 76-lOO% occupancy of their boats.

All the tour operators offer snorkelling equipment; they usually provide their guests with masks and snorkels, and a few might even provide fins. 85.7 l % of tour operators stated that the vast majority (76-I 00%) of their customers opt to snorkel while at Pulau Payar Marine Park. About half of the tour operators interviewed could also provide diving trips, but stated that only between O-25% of their customers would want to dive.

The majority of tour operators interviewed (69.23%) had plans to expand their operations to Pulau Payar Marine Park. This would mean bringing more tourists to the Marine Park, getting more boats to ferry tourists over and conducting more frequent trips to the Marine Park.

Most (92.86%) of the tour operators do not conduct tours to the other Marine Parks in Malaysia, i.e. those on the East Coast. Most (76.92%) are however aware of the conservation objectives of the Marine Park. All the tour operators supposedly inform their customers about Pulau Payar's Marine Park status and brief them on Marine Park regulations. This is all done by means of a talk or briefing either prior to arrival at the Marine Park or at the Marine Park Centre itself before any activities are carried out.

Future activities that tour operators are in favour of are videos/slide shows on the marine environment (8 l .82%), guided snorkelling tours (72.73%), nature walks on the island (54.55%) and glass-bottom boat or semi-submersible rides (45.45%) (See Fig. 4.15).

The majority of tour operators (75.00%) are willing to pay a small fee to enable their customers to enter the Marine Park, if this fee would contribute to the management and conservation of the Park. However, most of them state that they would be agreeable to the charging of fees only if the Marine Park implements proper facilities and services such as having adequate toilets, adequate tables and benches and adequate shelters for when it rains. The Department of Fisheries Malaysia is currently reviewing proposals to charge boat operators an annual fee for passenger boats that enter Marine Parks. The proposed fee charges are based on boat size or Gross Registered Tonnage, ranging from RM 500 to RM 5,000 for Malaysian operators, and RM 1,000 to RM 10,000 for foreign operators. Also being proposed are permit and licensing charges for mooring pontoons or platforms in Marine Park waters. These charges would vary depending on the size of the structure.

The major grouses from tour operators include the lack of dialogue with the Department of Fisheries (a regular formal meeting is held twice a year, which some feel is not sufficient), and the fact that they feel that their complaints are not heard. Tour operators also complain that there is a lack of enforcement on the part of the Department of Fisheries regarding the prohibition of fishing, as they sometimes see fishing vessels operating in Marine Park waters, especially at Pulau Segantang. Another complaint is that Marine Park staff are sometimes not as polite as they should be to visitors.

4.4 Information from divers and dive operators

4.4.1 General information

There are a total of 6 dive operators who bring divers regularly to Pulau Payar Marine Park, of which all were surveyed. Occasionally, independent dive operators may bring divers to the Marine Park. The regular operators that bring divers to Pulau Payar Marine Park at the time of the study are East Marine which operates from the Langkawi Coral Pontoon, Pro Dive, SRM Holidays, Blue Marlin Dive Centre and Ocean Quest. Borneo Divers was also interviewed, although it has since shut down its operations at Pulau Langkawi/Pulau Payar, preferring to concentrate on other dive spots in Malaysia it is associated with, such as Pulau Sipadan off the Sabah coast.

Five out of the six dive operators interviewed are based in Langkawi, with Blue Marlin Dive Centre being the only one operating from Pulau Pinang. Between them, they have 8 boats, each able to accommodate a maximum of 12 divers at any one time. However, the average number of divers in a dive group is usually six.

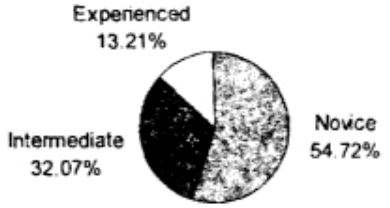
Most of the dive operators (50.000%) stated that the average percentage of boats filled every day is only between 51-75%. However, during the peak periods (Japanese and Taiwanese holidays, Malaysian public holidays and Malaysian school holidays), the majority (75.00%) said that between 76-100% of their boats are filled then.

All the dive operators stated that the pattern of diver numbers is increasing; this is prevalent in many of Malaysia's Marine Parks due to the increasing popularity of the sport. However, they are all of the opinion that there are currently enough dive operators running dive trips to Pulau Payar Marine Park.

434.2 Diverprofiles

A total of 53 certified divers were surveyed. A large proportion of these divers could be considered novice divers (54.72%) (Fig. 4.16).

FIG. *4.16* LEVEL OF DIVING EXPERIENCE



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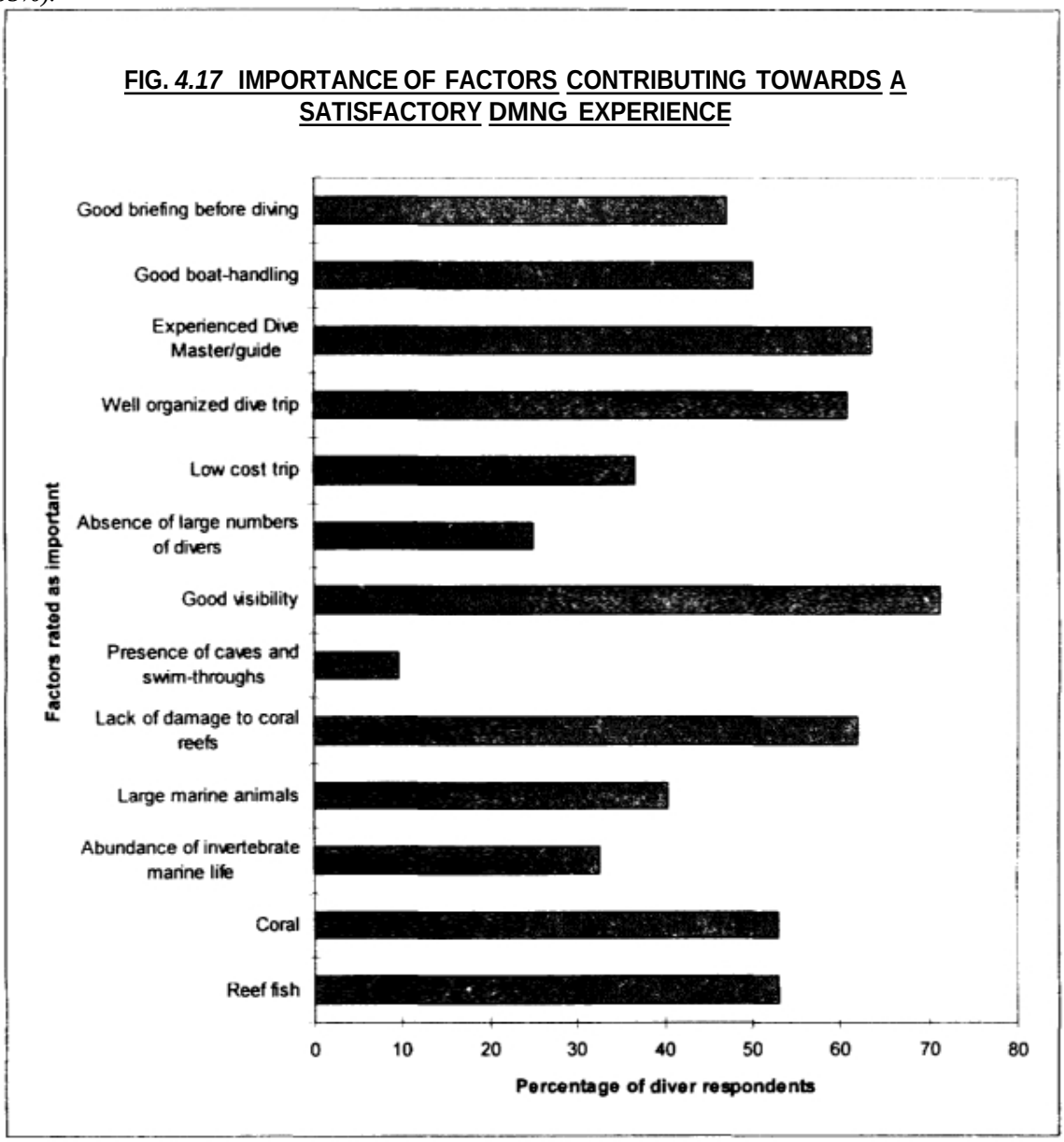
The majority of divers were staying at Pulau Langkawi (87.50%), while the rest were from Pulau Pinang. Most of the divers were just diving for the one day (72.00%), although a small percentage (28.00%) dived for two days. Usually, two dives are made in a day, as noted by 65.39% of those surveyed. The majority of divers were diving with a group (88.02%).

79.25% of respondents were first time divers at Pulau Payar Marine Park. Those that have dived at Pulau Payar Marine Park previously perceived an increase in the number of divers and diving trips offered.

4.4.3 Diver satisfaction

Divers were asked to assess criteria that would contribute towards a satisfactory dive (Fig. 4.17). Very important criteria were good visibility (71.15%), having an experienced dive guide or Dive Master (63.46%), a well organised dive trip (60.79%), seeing an abundance of reef fish (53.06%) and seeing an abundance and diversity of coral *(52.95%).*

FIG. *4.17* IMPORTANCE OF FACTORS CONTRIBUTING TOWARDS A SATISFACTORY DMNG EXPERIENCE



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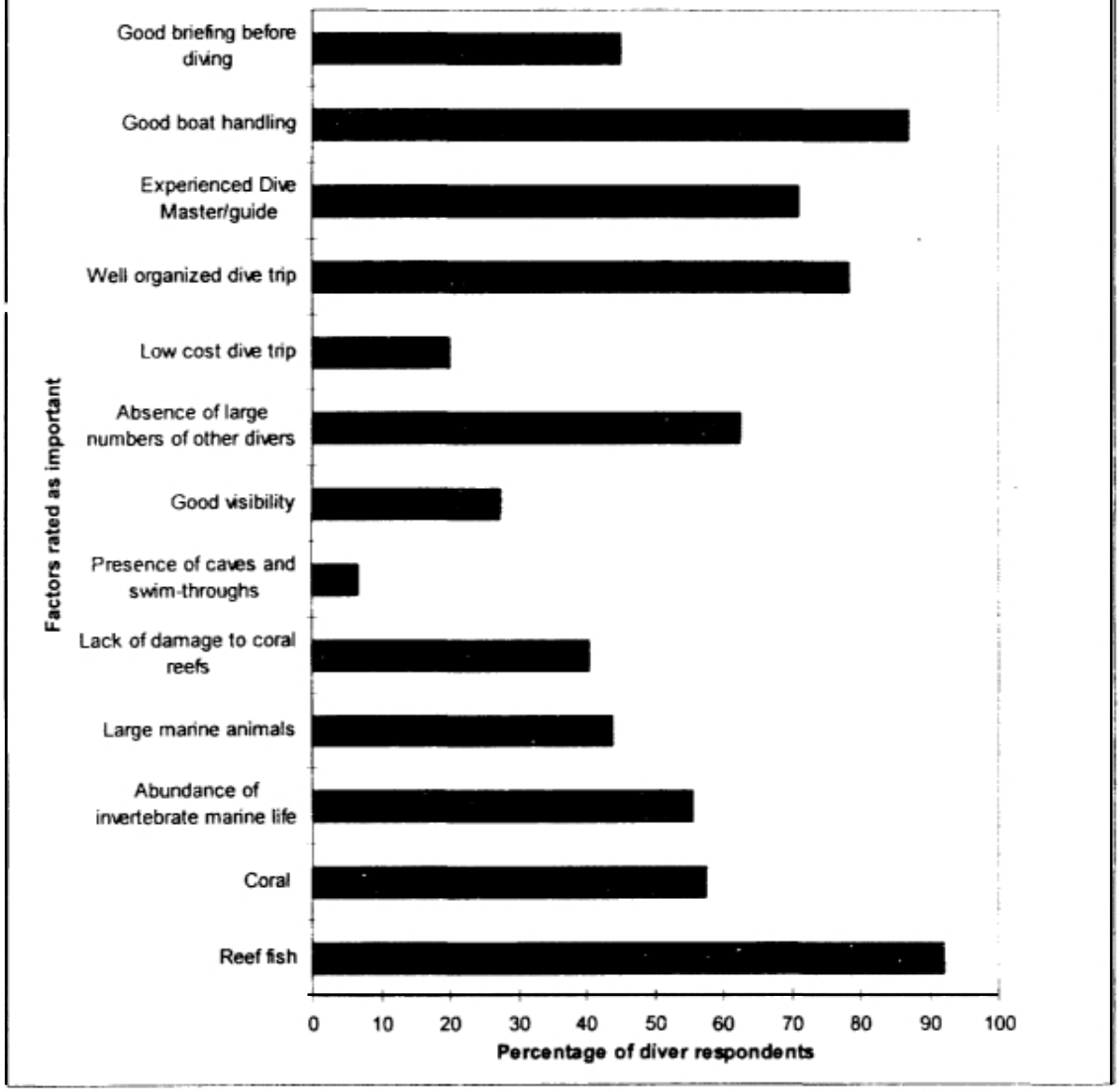
In terms of diver satisfaction or criteria that were met at Pulau Payar Marine Park, the majority of divers did see an abundance of reef fish (92.11%), and were satisfied with boat handling (86.96%), the organisation of the dive trip (78.38%) and the experience of their Dive Master (71.05%) (Fig. 4.18). Another criterion that was reasonably well met was the absence of large numbers of other divers (62.50%).

FIG. 4.18 LEVELS OF DIVER SATISFACTION WITH THE CONTRIBUTING FACTORS TO A PULAU PAYAR MARINE PARK DIVING EXPERIENCE



Most divers (54.00%) would prefer no contact with other diving groups while diving; this includes not seeing other dive boats at a specific dive site (48.08%). In terms of tolerance, the majority of divers would tolerate up to two incidences of contact with other dive groups (45.10%) and dive boats (40.39%).

More than half the divers interviewed (58.82%) said that given the opportunity, they would dive at Pulau Payar again (Fig. 4.19).

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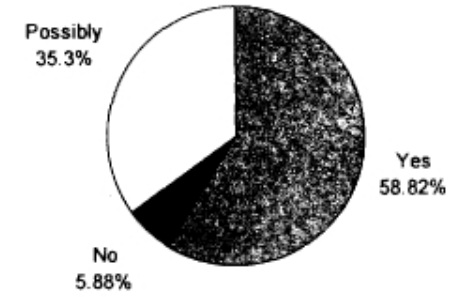
FIG. 4.19 DESIRE TO DIVE AT PULAU PAYAR MARINE PARK ON A RETURN VISIT



Most divers (61.54%) were aware that Pulau Payar is a Marine Park. This fact does influence divers in choosing to dive at Pulau Payar, with 33.33% and 36.11% of divers being influenced and greatly influenced respectively. Since Pulau Payar is a Marine Park, the majority of divers (79.17%) expected their diving experience thereto be better than at other Malaysian islands which are not protected. For most divers (77.14%), this expectation was met.

4.4.4 Marine conservation awareness

In general, marine conservation awareness among divers is quite high, more so than for the average snorkeller. Perhaps the opportunity to get in close proximity with reefs and their associated life instils a better appreciation and understanding of the fragile marine environment. Dive operators felt that visiting divers to Pulau Payar Marine Park are aware of the sensitivity of the reef environment, and most (83.33%) felt that their actions whilst diving reflect this.

Most divers (69.39%) were briefed on Marine Park regulations prior to diving. This would have been done by the Dive Instructor or Dive Master. According to all the dive operators, they do brief their divers on Marine Park regulations. They do this by means of a talk or briefing.

4.4.5 Assessment of dive sites

Most of the divers surveyed (69.39%) had dived at Coral Garden. Other popular dive sites are Pulau Kaca, the Marine Park Centre House Reef and Pulau Segantang. All the dive operators surveyed brought their customers to Coral Garden and Pulau Kaca, with the Marine Park Centre House Reef (83.33%) and Pulau Segantang (66.67%) being popular reefs as well (Fig. 4.20). Coral Garden was rated as the most popular dive site at Pulau Payar Marine Park. The Langkawi Coral Pontoon [louse Reef is only utilised by one operator, East Marine, which operates from the pontoon itself.

70.83% of divers thought that the current level of diving at Pulau Payar Marine Park was not having an adverse effect on its coral reef environment while all of the dive operators surveyed held the same opinion. Divers were also asked to assess the level of damage at reefs they had dived at (Fig. 4.21). A high percentage assessed the level of

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damage at Pulau Kaca, Pulau Lembu and Pulau Segantang to be low *(87.50%,* 80.00% and 80.00% respectively). Reefs with high perceived levels of damage include the Langkawi Coral Pontoon House Reef(40.00%) and the Marine Park Centre House Reef (30.00%).

FIG. 4.20 UTILIZATION OF DIVE SITES

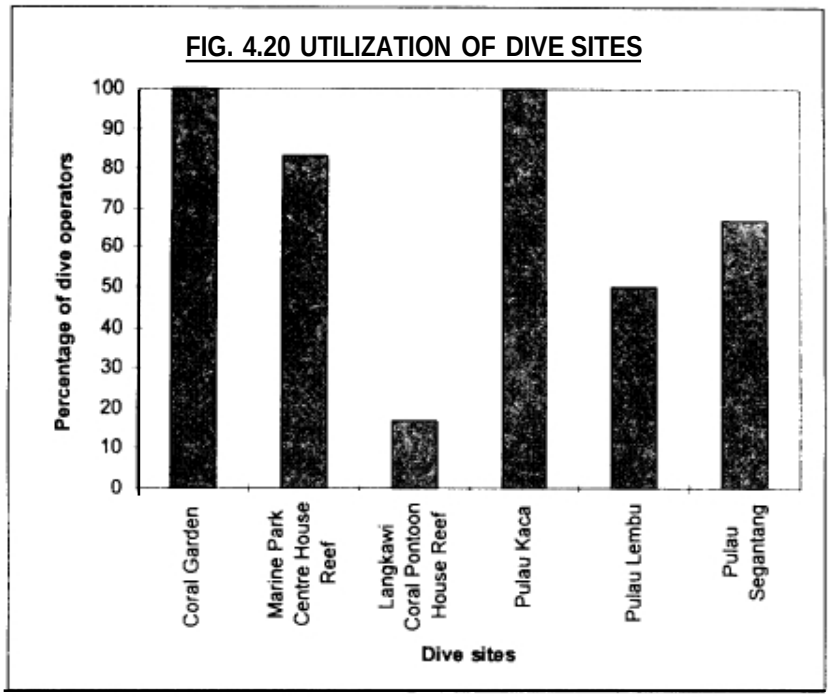
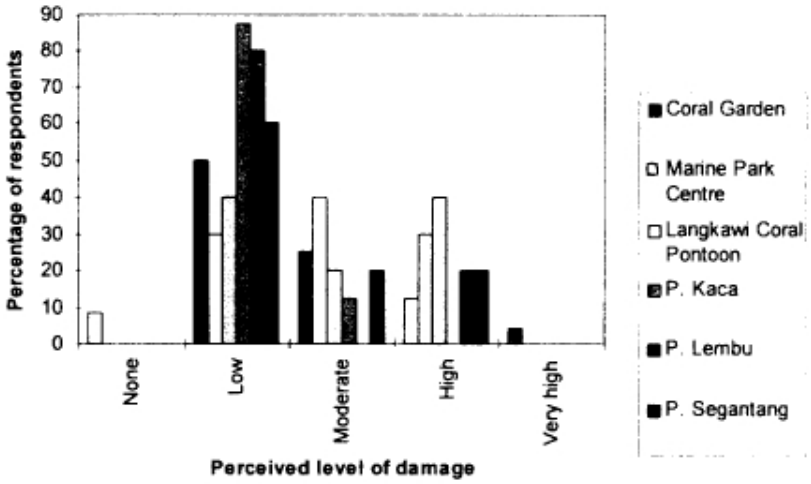


FIG. 4.21 ASSESSMENT OF DAMAGE TO REEFS



In comparison with other Marine Parks in Malaysia however, the diving at Pulau Payar was unfavourable in terms of reef health and coral diversity (53.85%), although many divers recognise the abundance of fish life at Pulau Payar Marine Park.

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5. DISCUSSION OF RESULTS

The Department of Fisheries, Malaysia, under the auspices of the FAO/UN's Bay of Bengal Programme, is formulating a Special Area Management Plan (SAMP) for Pulau Payar Marine Park. This study is one of three complementary studies and assessments conducted under the SAMP Project in an effort to determine the past and current conditions of valued resources within the SAMP area. Information from the three studies will be used by the SAMP Committee process to help develop management measures to address the problems identified. This study deals with the trends and the probable effects of human activities (including tourism) on Pulau Payar Marine Park's fishery habitats. The two additional studies include the status and trends of key target species of the area's fisheries, monitoring ecological indicators within the SAMP area to provide a baseline for measuring change in the ecosystem resulting from management actions implemented under the SAMP.

5.1 Carrying capacity as a planning and management tool

As visitors to Pulau Payar Marine Park increase dramatically, there is considerable pressure on its reefs, both through reef-related tourism and land-based activities. In addition, the proximity of Pulau Langkawi to Pulau Payar Marine Park implies that development activities on Pulau Langkawi could also have considerable negative impact on the Marine Park's marine environment. The concept of carrying capacity can be utilised for reef ecosystems to identify criteria that affect capacity and to subsequently enable the reduction or elimination of any causes of damage.

For carrying capacity to be a useful tool for tourism planning and management, it should not be approached in a mechanistic manner (i.e. trying to determine a "magic number"), but should rather be seen as a means of identifying thresholds that require attention, and as an optional form of controlling the system through the imposition of partial or complete limits (Getz, 1983). While recognising the limitations of the traditional concept of carrying capacity, it is used here to help identify the factors that have a negative impact on the marine environment of Pulau Payar Marine Park. Focus is then on identifying management recommendations that may alleviate tourism pressure on the reefs, so as to limit adverse impacts on the coral reef environment.

As discussed in Section 1.2, a carrying capacity that needs to be established for Pulau Payar Marine Park is the tourism carrying capacity, that is, the capacity of the Marine Park to accommodate visitors and development without any detrimental effect on the marine environment and its resources, or a decline in visitor satisfaction (WTO & IJNEP, 1992). This can be further broken down into its fundamental components of ecological or environmental, physical, social and economic carrying capacities, See Section 1.2.1 for definitions of carrying capacity. In addition, the reef carrying capacity needs to be determined; this is further examined from the perspective of ecological, physical and social carrying capacities. A more detailed discussion on coral reefcarrying capacity and its determinants is presented in Section 1.2.2 and Section 1.2.3.

5.2 Type of tourism

Pulau Payar Marine Park is a popular day trip destination, especially for visitors to Pulau Langkawi. Due to the type of visitor that visits Pulau Langkawi and the marketing of the area, the tourism industry that has developed in Pulau Payar Marine Park leans towards mass tourism, which is not so appropriate for a Marine Park. Marketing and

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promotion strategies should follow closely the marketing action plan and guidelines spelt out in Parts I and 3 of the National Ecotourism Plan (MOCAT/WWF Malaysia, 1996) so as to ensure that the tourists that come to the Marine Park are environmentally aware and responsible.

The vast majority of visitors (81.12%) to the Marine Park go snorkelling (see Fig. 4.7). This is largely confined to the house reefs off the Marine Park Centre and the Iangkawi Coral Pontoon, putting these two reefs under considerable visitor pressure (Plate 2). Occasionally, tour operators may bring visitors to Coral Garden for snorkelling, weather permitting. Many of these snorkellers have no prior knowledge of marine ecosystems, nor of the purposes and functions of the Marine Park. Only 38.92% of respondents rated the Marine Park status of the islands as an important factor in influencing choice of visit (see Fig. 4.4). The education and awareness programme of Pulau Payar Marine Park thus needs to be stepped up and improved to target this large group of reef users.

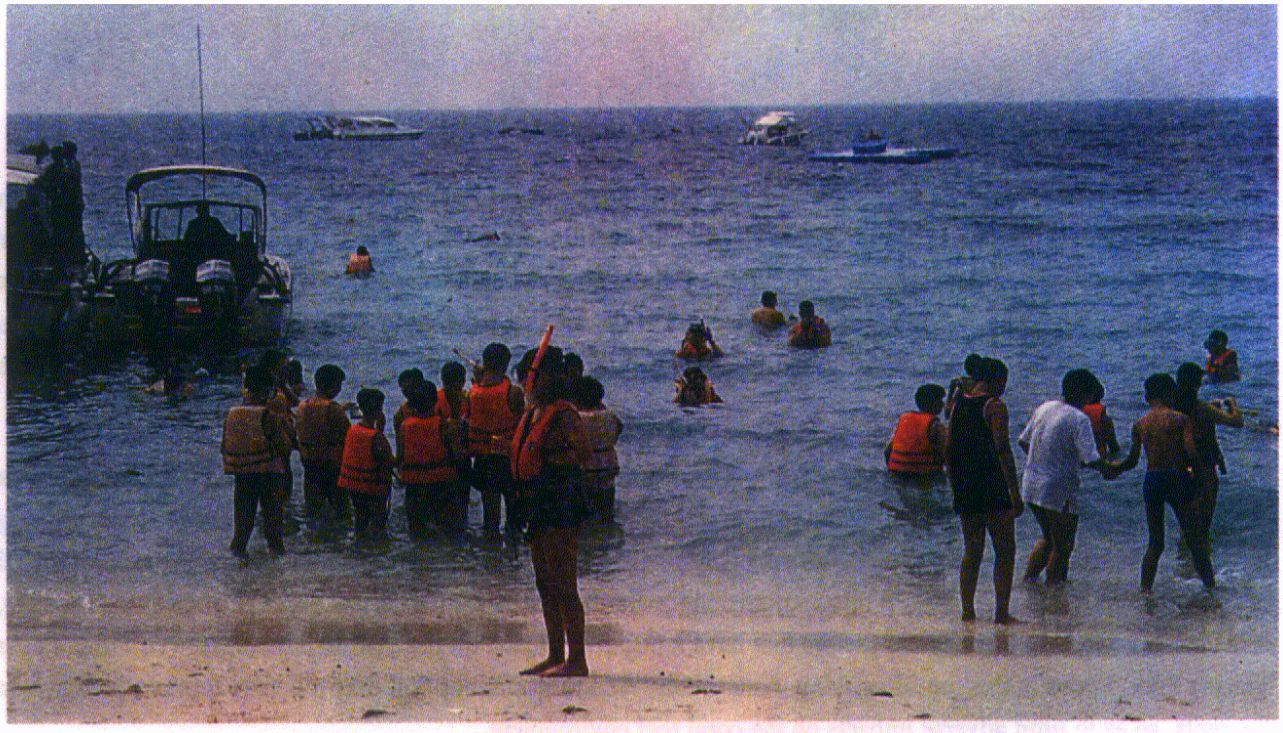

Photo : WWFM/Li Ching Lim

PLATE 2 Large numbers of snorkellers in front of the Marine Park Centre

Pulau Payar Marine Park is also fairly popular as a diving destination as attested to by 23.58% of respondents who participated in SCUBA diving activities (see Fig. 4.7). Yet, diving activity in Pulau Payar Marine Park is still considerably low, especially when compared to the industry on the East Coast of Peninsular Malaysia. Diving at Pulau Payar Marine Park is also more expensive when compared to diving on the East coast. Thus the diving industry mainly targets introductory divers rather than certified divers, as certified divers who are in the know would rather pay less and dive at better spots elsewhere in Malaysia.

Many people appreciate the natural resources of the Marine Park, especially that of the marine environmem. Their activities also reflect this, once again emphasising that the island's attraction lies in its natural marine environment and the recreation opportunities it offers. A total of 54.16% ofvisitors interviewed rated the opportunity to dive and/or snorkel as a very important factor in influencing the choice of visit (see Fig. 4.4). It would thus be wise to manage Pulau Payar Marine Park with guidelines to safeguard both its terrestrial and marine environment, as to disregard it would be to destroy the very attraction that the island possesses.

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Tourists from Pulau Langkawi who want to go snorkelling or diving do not really have a choice in terms of sites as Pulau Payar Marine Park is the only established and easily accessible, decent coral reef area with relatively good visibility on the west coast of the Peninsula. In addition, alternative sites in the Pulau Langkawi package are lacking, with tour operators concentrating mainly on islands such as Pulau Dayang Bunting, Pulau and Pulau Beras Basah which are already receiving extremely large numbers of visitors themselves. Alternative sites around the Pulau Langkawi group of islands, both for divers/snorkellers and non-reef users, should be explored to divert and disperse visitor use, thus reducing visitor pressure on Pulau Payar Marine Park.

5.3 Management objectives

Since the waters of the Pulau Payar group of islands have been gazetted as a Marine Park, the management objectives of the area would have to comply with its current status. Section 41 of the Fisheries Act 1985 has provisions for establishing a Marine Park in order to :

- afford special protection to the aquatic flora and fauna, and to protect, preserve and manage the natural breeding grounds and habitats of aquatic life with particular regard to species of rare or endangered flora and fauna
- allow for the natural regeneration of aquatic life where such life has been depleted
- promote scientific study and research
- preserve and enhance the pristine state and productivity of the environment
- regulate recreational and other activities in order to avoid irreversible damage to the environment

Thus the two main objectives of the Marine Park (Liew & Abdul Rahim, 1996) are :

- to conserve and protect the marine ecosystem, especially coral reef areas, in order to ensure the sustainable usage of fisheries and marine resources in coastal waters
- to protect and manage the natural marine ecosystem for research on biodiversity, educational purposes and sustainable development of recreational/ecotourism activities.

There needs to be compatible recreational and tourist use of the Marine Park while simultaneously managing it to protect its resources. A balance is desired between encouraging public awareness and appreciation of the marine environment, yet not increasing on-site visitor use beyond its sustainable carrying capacity. It must be ensured that the education and research functions of the Marine Park do not conflict with biotic and genetic protection (White, 1988). It is also pertinent to note that tourism is important but is not the main objective of Marine Parks Malaysia. Instead, it is the conservation and preservation of the marine environment which is the priority. These factors themselves contribute to tourism, which is an objective of another aspect of Malaysian policy. The two issues need to be reconciled and considered when making management decisions.

It is crucial that explicitly stated objectives are spelled out for Pulau Payar Marine Park to enable appropriate management actions and to indicate acceptable resource and social conditions. The broad objectives of Marine Parks need to be further refined specifically for Pulau Payar Marine Park. Only then can management for desired social and environmental conditions within the limits of acceptable change be pursued with any success.

In addition, management objectives for the Marine Park should incorporate the objectives of the Special Area Management Plan (SAMP) for Pulau Payar Marine Park. The SAMP's principal objective is to assure the

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conservation, protection, restoration and enhancement of the total natural community of living species and the unique resources of Pulau Payar Marine Park, both for maintaining balanced, indigenous populations which determine ecosystem health, and for the long-term vitality of human economic and recreational activities which depend on the renewable living resources. The SAMP's goal is thus to manage the Marine Park and adjacent land areas of Pulau Langkawi and the mainland as habitat enhancement for the conservation and sustained production of the area's reef fishery resources.

5.4 Criteria that affect capacity

BOX 5.1 SUMMARY OF CRITERIA THAT AFFECT THE CAPACITY OF PULAU PAYAR MARINE PARK

- Physical criteria
- Ecological criteria
- Social criteria
- Economic criteria
- Availability of facilities and infrastructure
  - transportation
  - solid waste disposal
  - sewage disposal
  - electricity supply
  - water supply
- Development in Pulau Payar
- Human threats to the coral reef environment
  - fishing
  - pollution from sewage and solid waste
  - reef-related tourism

5.4. I Physical criteria

The steep terrain and lack of low-lying areas in Pulau Payar place a natural constraint on development on the island. Thus most of the island (30.6 hectares or 98.08%) is still relatively untouched. The other three islands are far too small to allow any sort of development or accommodation facilities. The lack of freshwater supply has also acted as a natural deterrent to any development of accommodation facilities on Pulau Payar. Furthermore, there are only four small beaches on Pulau Payar, with the one at the Marine Park Centre approximately 100 m long, leaving little room for any major infrastructure or facilities provision.

The Department of Fisheries Malaysia has a 0.6 hectare plot of land on which the Marine Park Centre is built, consisting of a small information centre, staff quarters, kitchen, toilets and a picnic area by the beach. The Marine Park Centre houses 17 tables and benches at a picnic area which is approximately 27.25 m x 5.75 m in area.

There are three toilets, two of which are for public use. The third toilet is kept locked and only meant for Marine Park staff use. There are no showers at the Marine Park Centre for public use.

A jet float (a floating platform approximately four metres square that snorkellers and swimmers can climb up onto) has been moored at the snorkelling area in front of the Marine Park Centre, at the reef edge. This enables snorkellers to rest and relax. This is possibly one of the means of preventing snorkellers from walking or resting on coral when they are tired. At present there are no rest floats (buoys that snorkellers and swimmers can hold on to rest while in the water) in the snorkelling area, although there are plans to put some up once a snorkelling area has been cordoned off after the new jetty is ready.

The Langkawi Coral Pontoon is moored permanently at the bay adjacent to the Marine Park Cenire. It is ***50*** m x 15m and can accommodate a maximum of 400 people, although at the moment maximum capacity is limited to the number of passengers that can be brought over from Pulau Langkawi by the catamaran (162 people maximum). There are **33** tables on the pontoon (Plate 3) and four showers for guest use. There are also 2 open showers for rinsing, and two toilets for staff use. Toilet use for guests is more or less restricted to the catamaran. The dive operator (East Marine) on the pontoon provides about 200 masks and snorkels for guests, and also has 80 sets of dive gear. In terms of diving, they have a minimum of six Dive Instructors or Dive Masters everyday on board the pontoon. They have their own compressor and 90 tanks. Langkawi Coral also has an underwater observatory and two glass-bottom boats which can take a maximum of 20 passengers per boat.

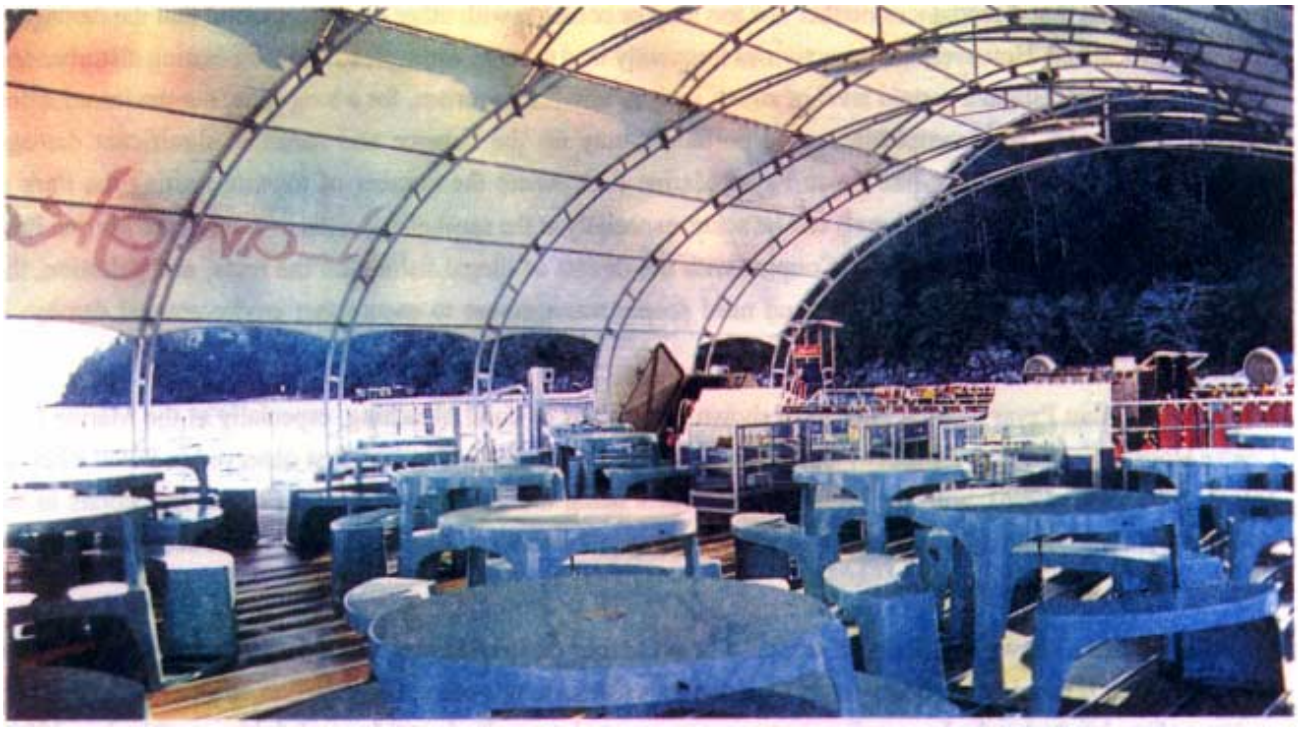

Photo: WWFM/Li Ching Lim

PLATE 3 On board the Langkawi Coral Pontoon

The physical carrying capacity of the coral reefs is dependent on the number of boats available to ferry divers and snorkellers to and from the reef. In addition, at the dive sites, the boatmen prefer to moor their boats rather than "hover" around waiting for their divers. The number of mooring buoys that the Department of Fisheries has made available sets a physical limit to the number of boats, and thus to the number of divers and snorkellers that can visit a particular reef. Mooring buoys also avoid the need for anchoring on reefs, an activity which can cause extensive physical damage to coral structures.

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At the moment buoys are provided only off the Marine Park Centre and the Langkawi Coral Pontoon. The Department of Fisheries has put up six buoys off the Marine Park Centre whilst Sri Wani have put up four buoys around the Langkawi Coral Pontoon, and have also cordoned off a snorkelling area. More mooring buoys will be put up off the Marine Park Centre once the new jetty is ready. The chain anchoring the lone buoy at Coral Garden was recently broken. No buoys are provided at the other dive sites as the Department of Fisheries does not want the presence of buoys to encourage fishermen to moor at the reefs and fish.

Anchoring mooring buoys is a time-consuming and expensive business; consequently the number of buoys available is limited and often does not meet the demand, especially at peak periods. When there is an inadequate number ot buoys to cater for boats, anchoring is likely to occur. The mooring buoys themselves come under threat from the monsoon, theft, vandalism and general wear and tear, so the number available varies frequently.

5.4.2 Ecological criteria

Coral reefs are by nature very fragile. The reef is a complex ecosystem, supported by an intricate interaction of biotic and abiotic factors. Its finely balanced ecosystem makes it vulnerable to changes in the environment, both natural and anthropogenic. Because reefs thrive only under very specific conditions, they are frequently disturbed by natural events such as storms, temperature fluctuations, predator outbreaks, terrestrial run-off and climatic disruptions (Wells & Price, 1992). Nonetheless, they are fairly resilient ecosystems and can recover from major damage provided that disturbances neither last too long or coincide with other disruptions, and that the damage is reasonably localised. However, human activities frequently lead to more widespread and long-lasting disturbances. Reefs can often withstand a certain level of stress, such as low-level tourism, for a long time, but the introduction of a second impact, for example increased pollution, may tip the balance and result in significant damage (Kinsey, 1988). In a situation like Pulau Payar Marine Park where the number of tourists visiting the Park is significantly high, pressure on the reefs can be acute, especially at the snorkelling areas in front of the Marine Park Centre and Langkawi Coral Pontoon. Coupled with the threats of illegal fishing on the reefs, and pollution, the reefs at the Marine Park are vulnerable and need proper management to ensure that environmental damage is controlled and minimised.

The reefs at Pulau Payar Marine Park have shown some signs of coral bleaching, especially at the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef. Bleaching was first observed in Pulau Payar in March 1995 (Tan, 1996), with the worst afflicted reefs being the Acropora spp. and Porites spp. corals in the shallow reef flats. Although the causes of coral bleaching in Pulau Payar Marine Park have not been established it is indicative of a reef under stress.

Corals have been known to bleach in response to a number of stresses - elevated temperatures above normal maxima (which is the most common trigger), sudden decreases in temperature, UV radiation, low salinities, turbidity) and/or reduced light levels, hypersaiine water, exposure at abnormally low tides and doldrums (Hopley, 1997). Coral bleaching occurs when zooxanthellae are expelled from the coral polyps, revealing the corals' normally masked white skeleton. Since this would disrupt the zooxanthellae-polyp symbiotic relationship, corals then cannot grow or reproduce properly. When it is the zooxanthellae alone that are released, recolonisation by new unicellular algae may occur when the environment returns to 'normal'. However, in severe events whole endoderm cells from the coral polyp are released with the zooxanthellae and if a large proportion of the coral colony is affected, mortality is likely to occur (Hopley, 1997). Bleached corals are also more susceptible to other diseases and pathogenic organisms, and the phenomenon is often followed by the death or partial break-up of elaborate coral structures (Tan, 1996).

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Studies have shown high amounts of phosphate and nitrate in the areas where corals had bleached in Pulau Payar Marine Park; excess amounts of the two nutrients are detrimental. These nutrients are believed to originate from Pulau Payar due to the lack of proper sewage treatment and disposal facilities on the island (Tan, 1996).

5.4.3 Social criteria

Perceptions ofcrowding have more to do with the nature of interactions, settings and visitor attributes and expectations than they do with user density (\\'atson, 1998). In a Marine Park setting which connotes some sort of wilderness experience, most people would expect a less crowded environment whereby emphasis is placed on appreciating the natural marine environment.

Visitor satisfaction may not necessarily be a good measure ofsocia! carrying capacity as the number of visitors may reach a point where the desired experience is no longer provided even though there may not be a noticeable reduction in satisfaction of thc visitors present. Satisfaction will always be fairly high for current visitors to recreation areas. although their experiences may be drastically different from previous visitors (Watson, 1988). Nevertheless, visitor satisfaction can still act as a useful indicator for social carrying capacity. In addition, the consequences of visitor dissatisfaction with Pulau Payar Marine Park will have to be weighed in relation to the effect on the tourism industry. not only in the Marine Park itself, but also in Pulau Langkawi as the two are closely linked and jointly promoted.

5.4.4 Economic criteria

The proximity of Pulau Payar Marine Park to the international tourist destinations of Pulau Langkawi and Pulau Pinang has contributed greatly to its expansion as a tourism centre. Pulau Langkawi has been estcnsively promoted abroad, with direct flights from Japan and in the near future, Taiwan. A trip to Pulau Payar Marine Park is often on the itinerary of package tours and promoted as the main selling point of Pulau Langkawi. Since there are no other alternative diving/snorkelling areas within the vicinity that are as extensively promoted, Pulau Payar Marine Park is thus the main destination for those wanting to snorkel or dive.

At present, much of the revenue earned from these trips benefit Pulau Langkawi directly, and not the Marine Park. as most tour operators are based in Pulau Langkawi and most of the tourists stay there too. None of the economic benefits of tourism to Pulau Payar Marine Park are channelled back into the conservation and management of the Marine Park. The setting up of a fee structure for entry into the Marine Park should he looked into to ensure that the revenue earned from tourism benefits the Marine Park as \vell. This is currently being explored by the Department of Fisheries, Malaysia. Proposals include fees for entry to hlarinc Parks, fees for undertaking recreational activities, annual deposits from commercial boats, entry fees for private boats, fees for mooring pontoons, fees for conducting EIA monitoring programmes and insurance fees. The proposed entry fee structure that is currently being explored by the Department of Fisheries Malaysia is two-tiered. with foreign individuals paying a sum of RM 8.00. and Malaysians paying RM 4.00. Students and senior citizens are charged half these prices, while local communities and fishermen are exempted. This fee structure is however currently being reviewed at the recommendation of the National Advisory Counci! for Marine Parks and Marine Reserves which would rather implement a single tiered and less discriminatory entry fee.

An individual's willingness-to-pay is a measure of the economic value placed on being, able to undertake specific marine tourist activities and on being able to visit specific marine and coastal tourist sites (Wong, 1997). Preliminary

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results of the questionnaire survey show that most tourists and tour operators are willing to pay a small fee for entry to the Marine Park or to be able to participate in certain activities, provided that this money is channelled towards the conservation and management of the Marine Park. Revenue generated from the fees should be used to manage the site, repair damages to the natural resources or infrastructure, or to implement environmental mitigation measures (Wong, 1997). In addition, of an entry fee or user fee could help reduce the number of visitors to the Marine Park. It would attract only those who are willing to pay. These visitors are often also more environmentally aware and responsible.

It is obviously the natural marine environment that attracts visitors to Pulau Payar Marine Park in the first place. Promotion of the area must be in line with its Marine Park objectives and must emphasise the conservation aspects of the Park. The promotion of Pulau Langkawi and Pulau Payar Marine Park thus has to be closely monitored, as it can affect the number and type of tourists coming in. Mass tourism to Pulau Payar Marine Park is not desirable, and the relevant agencies need to ensure that the conservation values of the Marine Park are maintained by targeting tourists who are environmentally aware and responsible.

5.4.5 Availabilitv of facilities and infrastructure

The majority of visitors to the island found the transportation and infrastructural facilities, as well as amenities, satisfactory or good (see Fig. 4.8).

(a) **Transportation**

The vast majority of tourists (94.49%) interviewed found the boat transportation to Pulau Payar Marine Park at least satisfactory or good (see Fig. 4.8). Boats to the Marine Park normally take a maximum of 12 passengers. These boats are modern, fast and comfortable speedboats; there are thus no major complaints about transportation to the Marine Park. In addition, 54.55% of the tour operators interviewed were of the opinion that there are currently enough boats available to ferry visitors to Pulau Payar Marine Park.

(b) **Solid waste disposal**

The Marine Park Centre provides rubbish bins for tourists, as well as sells bin liners for 20 sen a piece to tour operators. The tour operators are thus responsible for ensuring that solid waste generated by tourists coming to the Marine Park is collected in the bin liners and brought back to wherever they came from for disposal. This is one of the conditions given to tour operators for obtaining a permit to visit the Marine Park. The operators of the Langkawi Coral Pontoon also bag and bring their solid waste back to Pulau Langkawi for disposal.

The onus is thus on tour operators to ensure that solid waste disposal does not become a problem for Pulau Payar Marine Park. To date, this system seems to work effectively. Unfortunately, there have been reports of a few unscrupulous individuals who have been known to throw their waste into the sea on the way back to Pulau Langkawi, Pulau Pinang or Kuala Kedah. Continued education of tour operators and boatmen should ensure that the waste returns to these areas. However, the transportation of solid waste and subsequent disposal in Pulau Langkawi, Pulau Pinang or Kuala Kedah invariably shifts the problem of waste disposal elsewhere. In order to ensure that the practice of transporting solid waste back to these places does not create further problems, there have to be adequate reception and disposal facilities set up in Pulau Langkawi, Pulau Pinang and Kuala Kedah to cope with the influx of solid waste from Pulau Payar Marine Park. Appropriate guidelines on solid waste disposal must also be formulated to ensure that disposal practices do not carry on unregulated.

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Littering by tourists sometimes occurs in the Marine Park. Especially a problem are the plastic bags which contain food to feed the fish; a lot of this is often left on the jet float and has to be collected by Marine Park staff. In addition, tourists do complain about vast amounts of rubbish washing up onto the beach. This waste is probably not generated by the Marine Park itself nor from tourists to the Marine Park, but is brought in by tides and currents from possible source areas like Pulau Langkawi and the mainland. Nevertheless, it is an eyesore and needs to be dealt with effectively. The rubbish is usually collected by Marine Park staff every morning and burnt. Recyclable items like glass and aluminium cans are collected and sent back to Kuala Kedah for recycling. In addition, solid waste generated by the Marine Park itself, and waste from the toilets, is also burnt.

In the short term, the action of burning waste on the island seems sufficient. However, in the long term, there needs to be a proper, well-managed solid waste disposal system for the island. The option of disposal by landfills or pits in the long term is not viable because of space constraints as well as further contamination problems via leaching to groundwater and escape of gasses. Small-scale incineration is another option for the island, although by itself it can lead to further problems such as the release of noxious gases and contaminants. In addition, there is the problem of disposing of ash particles, which may themselves concentrate pollutants. It is recommended that solid waste be bagged and shipped back to Kuala Kedah along with the recyclable glass and plastic that is returned already. Although the transportation of waste back to the mainland will invariably shift the problem elsewhere, facilities on the mainland are much better able to cope with the problem than the island. As such, the transportation of waste to the mainland is probably the best option for the island, provided that are adequate reception and disposal facilities there.

First and foremost however, a reduction in the generation of waste should be advocated. The Department of Fisheries, Malaysia, should implement a proper education scheme for visitors on the reduction of waste and promote civic consciousness among tourists, as well as implement an appropriate waste separation and recycling programme. The separation of waste is important; organic waste can be composted, bottles and plastic containers reused, and recyclables recycled. Recycling as an option has not been explored fully; recycling of paper, cans, glass and plastic bottles should be practised and can also be sold to obtain revenue.

(c) Sewage disposal

There are currently two toilets at the Marine Park Centre, definitely not enough for the number of visitors (Plate 4). Rut there are plans to put in two more toilets for tourists, and two attached to the new staff quarters currently under construction. Sewage disposal for the Marine Park Centre is effected by means of septic tanks. These have overflown before, with serious environmental implications. Furthermore, with no freshwater available for visitor use, these toilets are flushed with seawater. This increases the salinity in the septic tank and obstructs natural degradation processes (Tan, 1996). There is thus the danger of contamination of inshore waters, especially in the light of the high and increasing number of tourists at the Marine Park.

Langkawi Coral prefer to ask their guests to use the toilets on the catamaran although there are now two toilets **on** the pontoon. Sewage is stored in a tank and then periodically pumped out onto the catamaran. The Langkawi Coral catamaran is supposed to bring the sewage back to Pulau Langkawi for disposal. Unfortunately, Pulau Langkawi does not have reception facilities for this, so reportedly, sewage is dumped into the sea on the way back to Pulau Langkawi. It is thus essential that proper sewage reception and disposal facilities are available at Pulau Langkawi so as not to create further problems of sewage disposal for the island. If the option of transporting sewage back to Pulau Langkawi is not available, Langkawi Coral will have to continue flushing sewage into the sea; although the assimilative capacity

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of the sea is relatively vast, it would be much better to treat and dispose of the waste properly at Pulau Langkawi.

Photo : WWFM/Li Ching Lim

PLATE 4 Tourists queuing for the toilets at Pulau Payar Marine Park Centre

The implementation of a proper sewage disposal system is crucial for the island. Septic tanks are not sufficient, in the light of the high numbers of visitors and the porous nature of the coastal soils. Alternative technology and the feasibility for implementation in the Marine Park should be examined, for example, the use of composting toilets which do not depend on water.

Perhaps the feasibility of having a small treatment plant on the island itself should be further examined. Then the sewage can be treated appropriately, and further disposed of. The main principle of sewage treatment is to reduce the polluting capacity of the waste water by enabling bacteria to oxidise the organic matter within the treatment plant, rather than to let this process take place in the water course. Even with primary and secondary treatment, nutrients like nitrogen and phosphorus are still discharged (Irving, 1993), and these affect coral reefs adversely. Nutrient stripping should thus be introduced to any sewage treatment works planned. Ideally, treatment should be done until the tertiary level, which removes all organic matter and nutrients.

Disposal options include outfalls to the sea or incineration. If outfalls are considered, factors like distance from the coast, and the extent of sewage treatment must be first examined. The diversion of outfalls away from reefs, into deep water, or on to an open, well-flushed coast is preferable, especially iftreatment is not sufficient. Again, treatment to the tertiary level is the best option.

Another alternative for sewage disposal would be the introduction of portable toilets to be provided by tour operators (Tan, 1996). Waste can then be brought back to either Pulau Langkawi or Pulau Pinang for proper disposal. To ensure that this system works, it is crucial that proper reception and disposal facilities are provided in the respective places.

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(4 **Electricitv supply**

The Marine Park currently has a 5.5 kva diesel generator which is only switched on at night. Some lights in the Centre itself operate on solar energy generated by solar panels. With the completion of the new jetty. they will obtaining a 50 kva generator to cater for the anticipated increase in electricity demand. This should be sufficient for future needs, as well as for electrical equipment such as a TV set, a video cassette player and slide projector during the day. Langkawi Coral have their own generator on board which is sufficient to cater for their needs. Where possible, the use of more efficient low-wattage incandescent or fluorescent light bulbs should be encouraged (MOCAT/WWF Malaysia 1996).

(e) **Water supply**

The Pulau Payar group of islands do not have any freshwater supply. At the Marine Park Centre, rain water is stored in tanks for staff use. There are now new 24,000 gallon tanks at the Marine Park, bringing total capacity to 36,000 gallons. Water is used sparingly, as supply is very dependent on rainfall. No freshwater is supplied in the toilets, which is a major complaint from tourists. It is unlikely however, that any fresh water will be supplied in the toilets, even with the new tanks. Sea water will continue to be used. Fresh water is brought in to the Langkawi Coral Pontoon by the catamaran and is adequate to cater for the pontoon's daily needs. Due to the difficulty in obtaining fresh water on the island, it is important that the water resources are conserved and used wisely (MOCAT/WWF Malaysia, 1996).

5.4.6 Development in Pulau Payar

Since there are no accommodation facilities on Pulau Payar for tourists, and the island is predominantly a day trip destination, associated negative impacts from development such as land clearing and sedimentation are not as great a problem, as seen in the Marine Parks on the east coast. Any development on Pulau Payar has been minimal and seen as necessary, confined to improving the infrastructure and facilities of the Marine Park.

Construction of a new jetty is under way at Pulau Payar Marine Park, which is expected to be ready by the end of 1996. This project is undertaken by the Public Works Department (Jabatan Kerja Raya). The-jetty extends about SO m out to sea, and there will be a 50 m long floating pontoon at the end to facilitate the landing of boats. However, during the course of the study, a storm broke one of the chains holding the construction barge, causing a relatively large area of destruction to the reef adjacent.

Alongside the jetty construction, a new walkway connecting the beach in front of the Marine Park Centre to the next bay (the beach in front **of** the Langkawi Coral pontoon) has also been constructed. It has gazebos and resting areas, and the intention is to utilise these to put information boards up.

New staff quarters housing one room for staff and one room for guests have also been constructed. Jt has two attached bathrooms. A new room to house the new generator has also been constructed and there are plans to build two more toilets for tourists.

5.4.7 Human threats to the coral reef environment

The reef environment, being fragile, is subject to many threats, both natural and anthropogenic. The natural cycle of growth and erosion determines reef development; this cycle is thrown out of balance by widespread and long-

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lasting disturbances attributed to humans (Wells & Price, 1992). Reefs may be able to withstand low level threats, but the introduction of a second impact often tips the balance and results in damage.

Impacts of human use on the reefs occur directly and indirectly. Direct impacts include harvesting of reef resources such as fish, shells and corals, anchor damage, damage to reefs by divers or snorkellers who step on thetn. use of spear guns, and grounding on reefs by boats. Indirect impacts which arise as a consequence of land use include land-based sources of pollution such as sedimentation, eutrophication, chemical pollution, oil and grease pollution, as well as construction on and around reefs. Desludging of ships is also a source of marine pollution.

Human activity at Pulau Payar Marine Park threatens its reefs in three main ways :

(a) Illegal fishing
(b) Pollution from sewage and solid waste
(c) Reef-related tourism

These factors are not mutually exclusive, but may interact to bring about adverse effects on the reef environment.

(a) Illegal fishing

Coral reefs are the breeding, feeding and nursery grounds for many marine species, some of which are of commercial value. Consequently, they are popular and profitable fishing grounds for commercial fishing operations. Unfortunately, the fishermen often have little regard for the fragile reef that is supporting their catch; anchor damage and coral smothered in entangled and abandoned nets are all too common sights. Fishing activities often tend to be indiscriminate in terms of fish size and species; using a small tnesh means that juvenile commercial fish and reef fish are also caught. This disturbs the balance of the complex food web of the reef; similarly it is detrimental to the reef ecosystem to catch the large predators, many of whom take years to reach sexual maturity.

The reefs of Pulau Payar Marine Park are rich in fish life, some of which are of commercial value. In addition, the large schools ofjuvenile fish present indicate that some of the reefs in the area are nursery and breeding grounds (Ridzwan & De Silva, 1982). Traditionally, the waters around the Pulau Payar archipelago have been fishing grounds for fishermen from the coastal communities in Kedah, especially around Kuala Kedah. Pulau Payar has in the past been also used as a sheltering place for fishing vessels particularly during the monsoon period.

The designation of the Pulau Payar group of islands as a Marine Park in 1989 gave the Department of Fisheries the power to enforce a ban on all fishing activities within two nautical miles of the islands. However, at several of the reefs there is evidence of illegal fishing activities e.g. the presence of nets on the reefs and fishing vessels in the vicinity of the reefs. Illegal fishing appears to be a more common occurrence at Pulau Segantang despite the Marine Park ban; in fact during the course of the field work for this report Marine Park staff confiscated a vessel which was fishing illegally at Pulau Segantang. Dive operators who visit Pulau Segantang often allege that illegal fishing occurs commonly there, and complain about nets on the reef.

To combat the problem of illegal fishing at Pulau Payar Marine Park, enforcement of the no fishing regulations must be strict. Regular patrols should be conducted by the Department of Fisheries, especially to Pulau Segantang. In addition, an effective programme to raise awareness among the fishing communities of Kuala Kedah about the benefits of protecting coral reefs is necessary. Fishermen must be made to understand

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that the ban on fishing at the Marine Park is crucial to ensure that the degradation of the reef community is not perpetuated by fishing activities and that fisheries resources are protected for the long-term sustainability, of the fisheries industry of the area.

(b) **Pollution from sewage and solid waste**

Marine pollution is the most serious, persistent and fast-growing threat to the marine environment. A wide variety of contaminants, including . sediments, sewage. oil and synthetic organic chemicals adversely affect marine species, populations. and ecosystems (Pullen & Hurst. 1993). Land-based sources (of marine pollution (including atmospheric deposition) account for about 77% of marine pollution globally (GESAMP, 1990).

Pulau Payar Marine Park, as the only clear-water coral reef area on the east coast of Peninsular Malaysia, is a unique area in the Straits of Melaka. However, the Straits receive pollutants from three main categories of sources - agricultural, industrial, and domestic wastes come from land-based activities discharging directly into the ocean or indirectly to rivers emptying into the ocean (Dow, 1995). In addition. sea-bawd sources of marine pollution include the operational and accidental discharges from tankers and other shipping vessels as well as the fishing fleet. I iigh levels of total suspended solids, the faecal coliform Escheriehia Coli, and oil and grease are prevalent pollutants in the Straits of Melaka. The number of oil spill incidents in 1995 numbered 26, as compared to five in 1994 and I 1 in 1993.

The proximity ot'Pu1au Payar Marine Park to Pulau Langkawi and Pulau Pinang also makes it intrinsically vulnerable to pollution frorn these two urbanised and populated islands. According to 3 recent newspapet report. "The major ocean currents wash from Pulau Langkawi to Pulau Pinang, and back to Pulau Langkawi. Pulau Payar, sitting in the middle ofthc path, becomes the recipient of whatever pollution originates from the two developed islands" (Tan, 1996).

Aside from the ambient pollution already present in the Straits of Melaka and by virtue of its proximity to Pulau Langkawi and Pulau P'inang, at Pulau Payar Marine Park. the main pollutants would be sewage and solid waste. These pollution problems are an indirect impact of the increasing numbers of tourists to the Marine Park.

Eutrophication, the process of nutrient enrichment in water bodies. is a major cause of decline of reefs. Nutrients enter the marine environment naturally, and a trophic equilibrium is maintained if inputs balance outputs; man however frequently upsets this delicate balance. Roth nitrogen (usually in the form of nitrate) and phosphorus (usually in the form of phosphate) arc key elements in the eutrophication process. and it is the ratio of the two which determines whether or not the process occurs. At Pulau Payar Marine Park, the main sources of nutrients would be from sewage run-otf from the Marine Park Centre and possibly the Langkawi Coral Pontoon.

Although nutrient enrichment will increase marine productivity initially, there is an overall decrease in biodiversity as opportunistic species outcompete pollution-sensitive ones. Changes in species composition will also occur. depending on the relative amounts of nitrogen and phosphorus available. This may have knock-on effects throughout the food \veb as$ many zooplankton grazers have distinct feeding preferences (Irving, 1993). The increase in nutrients like phosphorus and nitrogen also tends to favour the growth of phytoplankton and algae. Increased nutrient inputs in reef areas arc thought to promote algal growth to the detriment of coral species, as they outcompete corals for tight and nutrients (Pullen & Ilurst, 1993). Algal blooms may he toxic in nature, and extensive blooms promote light attenuation, hence preventing

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light from reaching photosynthesising species. This would affect the photosynthetic capability of the coral-associated zooxanthellae, thus decreasing reef productivity. As a bloom dies off, it can smother benthic communities, as well as result in anoxic conditions as it decomposes. The depletion of oxygen can further lead to fish kills and benthos mortalities, especially in shallow, semi-enclosed basins.

Tourism at Pulau Payar Marine Park has also brought in additional problems like the generation of solid waste, especially given the lack of adequate disposal facilities. Solid waste that is disposed of in the sea, or inadequately disposed of such that it ends up in the sea, can settle on reefs and destroy them. Plastic strapping and packaging bands can entangle and girdle marine mammals and large fish and become progressively tighter as the animal grows, restricting movement, respiration and feeding (Pullen & Hurst, 1993). Plastic bags especially can smother reefs, and can suffocate and strangle marine organisms such as birds, turtles and mammals. Death can also be brought about by the accidental ingestion of litter. In addition, rubbish washed ashore is not aesthetically pleasing to tourists. The questionnaire survey results show that having clean beaches is the most important criterion for a satisfactory visit to Pulau Payar Marine Park for snorkellers (70.80%) and is also important for non-reef users (55.91%) (see Fig. 4.11).

For amore comprehensive discussion on possible solutions to the sewage and solid waste disposal problems at Pulau Payar Marine Park, please refer to Section 5.4.5(b) and Section 5.4.5(c) respectively.

(c) Reef-related tourism

The world's coral reefs have become a major attraction, as SCUBA diving has become one of the most popular and fastest growing sports internationally. This has lead to certain diving and snorkelling destinations (islands in particular) being subjected to considerable pressure. Problems associated with diving include breaking coral branches for souvenirs, fin damage (generally as a result of inexperience and poor buoyancy control), spear fishing, shell collection (often live), dive boat anchoring, littering and boats beaching on shallow reefs.

The extent to which reeftourism and associated recreational activities can directly damage reefs may be far greater than previously believed. This is demonstrated by the fact that popular reefs in the Caribbean and other top tourist destinations such as Hawaii are starting to suffer increasing damage (Wells & Price, 1992). Furthermore, dive sites in the Ras Mohammad Marine Park in the Red Sea, which attract large numbers of diving enthusiasts, have been found to have significantly more dead coral than less popular dive sites (Hawkins & Roberts, 1992). At Pulau Payar Marine Park, this phenomenon is particularly evident at the Langkawi Coral Pontoon House Reef, whereby dead coral cover is high (46.2%) compared to the control site (19.3%). Although this may be due to a combination of effects, snorkeller and diver damage cannot be ruled out as a possible cause for the decline in coral cover seen, given the high numbers of snorkellers and divers who frequent that particular reef.

Snorkellers are harder to control and monitor during their time in the water; this is particularly evident at Pulau Payar Marine Park. Any visitor can hire a mask, snorkel, and fins set, and swim or float (many visitors to the island are unable to swim) over the shallow reef. Many of the snorkellers appear ignorant of the fragility of the coral reef ecosystem; when this ignorance is combined with poor swimming ability, considerable damage is likely to be done to the reef structures from trampling and breaking of coral. Damage is more likely to occur at low tide when the reef is within easy reach. Despite signs showing prohibited activities in the Marine Park, some coral and shell collection for souvenirs does occur as well. In addition, the current practice of boats coming in over coral at low tide to drop visitors off at the Marine Park Centre causes physical destruction when propellers and the hulls of boats hit fragile coral structures.

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A comprehensive education and awareness programme targeting snorkellers specifically should be implemented for Pulau Payar Marine Park. Raising awareness about the fragility and benefits of the coral reef ecosystem will help towards fostering a more careful attitude in the water. In addition, enforcement must be effected to ensure that tourists do not collect coral and shells. Tour and boat operators should also be responsible for the actions of their guests. Furthermore, boats should not be allowed to pass over reef areas at low tide, and this should be strictly enforced.

When compared to the majority of snorkellers, divers present considerably less potential damage to a reef due to their thorough training and hopefully greater awareness. The actions of the divers can also be controlled to some extent by Dive Masters or Dive Instructors who can give briefings, and take groups to reefs suited to their abilities and experience.

5.5 Carrying capacity assessment

5.5. 1 Tourism carrying capacity

Tourism is a major industry, both for Pulau Langkawi and for Pulau Payar Marine Park, but inappropriate tourism expansion can consequently bring about adverse effects on the environment. The carrying capacity concept, although not able to produce a "magic number" that can dictate the number of tourists and divers that the Marine Park can support, is valuable in highlighting the criteria that affect capacity and the causes of any decline in capacity. The traditional concept of carrying capacity is not without its limitations, and is modified here to highlight actions that may be taken to minimise or limit adverse anthropogenic impacts on the coral reef environment. The concept is thus used as a management tool to generate guidelines for development and tourism to ensure that any changes that occur in the ecological, physical, social and economic environment of Pulau Payar Marine Park are acceptable

(a) **Physical carrying capacity**

Findings of this assessment, as described in this study, indicate that physical carrying capacity of visitors may be reached at levels of visitation during this study, especially in terms of space at the Marine Park Centre. The beach in front of the Centre is small (only about 100 m long), and at high tide is completely submerged. There are not enough tables and chairs to cater for the large numbers of visitors especially at peak periods (Plate 5) At such times, many of the visitors are crammed onto tables evidently not large enough, or do not even have a place to sit down. This situation is unacceptable in terms of providing adequate facilities for visitors. Already the majority of tourists interviewed found it crowded at the Marine Park, especially at the picnic area at the Marine Park Centre itself (64.47% of those interviewes (see Fig. 4.9).

Space on the Langkawi Coral Pontoon is adequate as it can cater for a maximum of 400 people whilst at present, numbers are limited by the number of passengers that the catamaran can take (162 people).

At present, the number of boats available is enough to cater for tourists and divers, with the number of boats coming into Pulau Payar Marine Park depending on the demand, which there are no problems meeting currently. In fact, at peak periods, the number of boats at the Marine Park jetty is very large, making it crowded and potentially unsafe for visitors embarking or disembarking (Plate 6). In light of the high numbers of boats already coming into the Marine Park, potentially causing oil and grease or hydrocarbon pollution, and the adequacy of transportation, there should not be any efforts to increase boat traffic to the Marine Park.

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Photo : WWFM/Li Ching Lim

PLATE 5 Large numbers of visitors at Pulau Payar Marine Centre

Photo : WWFM/Li Ching Lim

PLATE 6 Large numbers of boats at the Marine Park jetty

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The snorkelling area in front of the Marine Park Centre can also get pretty crowded at peak periods. especially on the jet float. However, crowding in the water is not as acutely felt as on land (48.93% of visitors interviewed found it crowded at the Marine Park Centre snorkelling area and 40.83% found it crowded at the Langkawi Coral Pontoon snorkelling area, as opposed to 64.47% of visitors finding it crowded at the Marine Park Centre itself). Of more concern would be the potential damage that careless snorkellers can cause to the reef environment.

Disposal of solid waste on the island could be further improved so as not to undermine the values of the Marine Park (see Section 5.4.5(b)). This is of increasing urgency in lightof the high volume of waste generated by the increasing numbers of visitors to the Marine Park.

The number oftoilets at the Marine Park Centre are evidently inadequate. Two usable toilets arc definitely not enough to cater for the hundreds of tourists that flood the Marine Park everyday. The lack of proper toilet facilities would cause dissatisfaction among the tourists. Already 64.16% of those surveyed found the toilet facilities at the Marine Park Centre inadequate. Similarly, a study by Wong (1996) which surveyed tour operators showed that tour operators found the toilet facilities at the Marine Park to be inadequate to extremely inadequate. In addition, the sewage disposal facilities on the island also need to be improved as the septic tanks cannot cope with such high numbers oftourists and the possibility of sewage contamination of the surrounding waters cannot be excluded (see Section 5.4.5(c)).

Facilities like water and electricity supply are considered adequate to meet present and future needs, especially with the introduction of the new water tanks and new generator.

It is recommended that no accommodation facilities for tourists be allowed on any of the four islands ofthc Marine Park (Aikanathan & Wong, 1994). The focus should thus be on upgrading and improving existing facilities to ensure continued visitor satisfaction.

(b) **Social carrying capacity**

In social carrying capacity research, the emphasis is no longer on user numbers as there is no fixed value for any recreational setting. The determination of social carrying capacity for Pulau Payar Marine Park is ultimately a value judgement that needs to be made by the Marine Park managers based on the nature of the various experiences that managers wish to provide for visitors and the standards by which managers have chosen to measure those experiences (Watson, 1988).

Since the majority of tourists surveyed (64.47%) found it crowded at the Marine Park, especially at the Centre itself, the social carrying capacity with respect to crowding is probably reached due to the high numbers of visitors to the island (see Fig. 4.9). In addition, a recent study- found that 75% of 13 tour operators interviewed found the beach/picnic area of the Marine Park crowded (Wong, 1996).

Although an increase in visitor numbers may not necessarily *result* in visitor dissatisfaction (Graefe et al, 1984). 73.97% of respondents felt that an increase in visitor numbers would affect their enjoyment of Pulau Payar Marine Park. In general. visitor satisfaction is fair; however from the survey results it is evident that there are some aspects of visitor experience which are important to tourists. but were not adequately met at Pulau Payar Marine Park. These include the lack of information provision on the marine environment, the lack of adequate facilities especially toilets and the presence of large numbers of other tourists, especially at the Marine Park Centre and the Langkawi Coral Pontoon (see Fig. 4.12).

The consequences of visitor dissatisfaction with Pulau Payar Marine Park would affect the tour package as a whole and therefore the Pulau Langkawi tourism industry. This needs to be seriously considered in

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planning by the Langkawi Development Authority (LADA), the Kedah State government and the Department of Fisheries Malaysia. Planning for Pulau Payar Marine Park must be integrated with the overall planning and management of Pulau Langkawi, taking into account the specific needs of the Marine Park.

Diving norms where divers would prefer not to see any other diving groups or dive boats at a dive site or where they would tolerate up to two encounter incidences can act as an example of idea! conditions for Pulau Payar Marine Park. Currently however, the diving industry in Pulau Payar Marine Park is relatively unsaturated so there is genera! satisfaction in terms of perception of crowding at dive sites.

Divers are generally still satisfied with their diving experiences on the island, and are happy with the facilities and standards of diving operations. This is reflected in quite a large proportion of divers (58.82%) wanting to dive at Pulau Payar Marine Park again (see Fig. 4.19). Hence, it can be said that the social carrying capacity with regards to diver satisfaction has yet to be reached. However, some important factors that contribute towards a satisfactory dive experience were not met at Pulau Payar Marine Park, the most obvious being good visibility (see Fig. 4.18). Of course, visibility would vary with weather conditions, and in genera!, visibility at Pulau Payar Marine Park is much worse than on the East Coast of Peninsular Malaysia. It is important then that dive operators inform their divers of this situation so as not to raise expectations, and instead highlight the good points of diving in the area, such as the abundance and diversity of fish they are likely to see on a dive. Another fairly important factor that was not met at Pulau Payar Marine Park was low dive trip costs (see Fig. 4.18). Although divers generally do not mind paying for diving, the cost of diving at Pulau Payar is higher than on the East Coast, and probably not as good, thus causing some dissatisfaction in this area. Divers would also like to see minima! damage to coral reefs when diving (62.00% of those surveyed) (see Fig. 4. 17), however only 40.54% of divers stated that this criterion was met (see Fig. 4.18).

5.5.2 Reef carrying capacity

A summary is presented at the end of this section, in Table 5. I.

(a) Marine Park Centre House Reef

The reef situated in front of the Marine Park Centre is the most intensively used reef in the Pulau Payar Marine Park, coming under considerable pressure from snorkellers, introductory divers, the construction of the new jetty and walkway, as we!! as pollution from land-based sources. It is very accessible and practically a!! visitors to Pulau Payar Marine Park would snorkel or dive there (83.33% of dive operator\ interviewed regularly bring their customers there). It is also a fairly shallow reefwhich is sheltered, presenting ideal conditions for snorkellers especially.

The reef is made up of a large proportion of live hard coral (75.7%), consisting mainly of large areas of branching (51.4%) and massive (41.3%) corals. Branching coral lifeforms are more easily damaged physically than the massive and encrusting lifeforms whose coralline skeletons are less easily broken Fortunately, the most physically fragile part of the reef is in water too deep to suffer from either direct snorkeller or propeller contact and is therefore relatively healthy when compared to the coral nearer the beach, much of which is dead already. Parts of the reef in very shallow water have evidently suffered physically from both snorkeller and propeller damage at low tide, particularly in areas of Porites spp. growth. Despite signs of damage, the overall extent of dead hard coral is surprisingly, comparatively low (6.5%), similar to that at the control site (19.3%). The reef appears to have evolved and stabilized to a

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degree to cope with the many pressures imposed on it, as a result the physical carrying capacity could be considered to be moderate. Since this is the site of the majority of the tourist activity there is potential for using the reef as a "sacrificial" site rather than developing other areas as visitor numbers increase.

Social carrying capacity is fairly high at the Marine Park Centre House Reef because it is predominantly used as a snorkelling destination, and the average snorkelling tourist and introductory diver tends to be less concerned with reef user interaction than the high fee paying diver. The snorkellers arrive in groups and take to the water in groups; the number of people surrounding them in the water seems of little consequence. Nonetheless, about 48.93% of visitors do find it crowded while snorkelling at the Marine Park Centre House Reef, as compared to 64.47% of visitors finding it crowded on land, at the Marine Park Centre itself. This could be an indication that, although fairly high, the social carrying capacity of this particular reef is in danger of being exceeded.

The major threat to the Marine Park Centre House Reef seems to be its accessibility to large swimming and snorkelling groups who stand on, knock, and sometimes purposely break off coral branches as souvenirs. Boats passing over the reef at low tide to disembark visitors also cause extensive physical damage. In addition, many of the snorkellers and introductory divers that utilize the reef are inexperienced and may cause accidental physical damage. Another potential serious threat to the Marine Park Centre House Reef is that of sewage pollution from the Marine Park Centre. There are already signs of coral bleaching, and although this phenomenon cannot be conclusively linked to sewage pollution, the possibility cannot be excluded. Already studies have shown high amounts of phosphate and nitrate in the areas of bleached corals. These nutrients are believed to originate from Pulau Payar due to the lack of proper sewage treatment and disposal facilities on the island (Tan, 1996).

(b) Lanekawi Coral Pontoon House Reef

The Langkawi Coral Pontoon is a 50 m x 15 m floating platform similar to those found on the Great Barrier Reef in Australia and is capable of accommodating a maximum of 400 visitors, however the catamaran connecting the pontoon with Pulau Langkawi can carry up to 162 passengers per trip. The pontoon is used as a swimming, snorkelling and diving platform and has an underwater observation chamber that enables guests to appreciate the reef environment without getting wet! The platform provides direct access to the reef for many visitors doing introductory dives and snorkelling, as well as makes the reef accessible to non-diving visitors. Consequently, the reef is under considerable pressure from snorkelling and diving activities despite the constant presence of lifeguards and Dive Masters who monitor visitor activities in an attempt to reduce damage to the reef. The reef is also fairly shallow and sheltered, making it ideal for snorkellers and introductory divers.

Despite the high levels of massive coral present (56.6%), the physical carrying capacity of the Langkawi Coral Pontoon House Reef is relatively low. This is largely due to the ease of access afforded to large numbers of reef-users everyday of the year and the shallow nature of the water above much of the reef. In addition, the reef faces many threats from various sources. At present, levels of live and dead hard coral are similar, at 48.2% and 46.2% respectively. Dead coral cover is worryingly high, especially when compared to the control site which has a live coral cover of 73.6%.

The high level of dead coral can be attributed to several factors. The pontoon itself creates a shadowing effect over a large strip of the reef and this is believed to have reduced the photosynthetic activity of the zooxanthellae that are associated with coral polyps. Consequently, the health of the reef has suffered. In addition, much of the reef to the landward side of the pontoon is shallow and is often damaged by snorkellers. Also, since the reef is largely utilized by introductory divers, their inexperience could result in

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poor buoyancy control and hence accidental damage to the reef. Construction of the new jetty and boardwalk on Pulau Payar has also resulted in considerable amounts of debris being deposited on the reef, not only damaging the reef but also reducing its aesthetic appeal considerably. There are already signs of coral bleaching, and although this phenomenon cannot be conclusively linked to sewage pollution, the possibility cannot be excluded. Already studies have shown high amounts of phosphate and nitrate in the areas of bleached corals. These nutrients are believed to originate from Pulau Payar due to the lack of proper sewage treatment and disposal facilities on the island (Tan, 1996). The possibility of sewage contamination from the pontoon itself should not be overlooked either.

The social carrying capacity ofthc Langkawi Coral Pontoon f Louse Reef is fairly high for the same reasons that it is at the Marine Park Centre I louse Reef i.e. the average snorkelling tourist and introductory diver tends to be less concerned with reef user interaction than the high fee paying diver. Nonetheless, about 40.83% of visitors do find it crowded while snorkelling at the Langkawi Coral Pontoon House Reef, as compared to 64.47% of visitors finding it crowded on land, at the Marine Park Centre itself. This could be an indication that, although fairly high. the social carrying capacity of the reef is in danger of being exceeded.

(c) Coral Garden

The so-called Coral Garden on the southwestern tip of Pulau Payar was once described as "...one of the *most colourful underwater localities in Malaysia This area will perhaps be second to none in the world during* clearwater *periods* . . . " (De Silva & Ridzwan 1982). While still being the most visited and most popular dive site in the Pulau Payar group of islands (all the dive operators interviewed bring their divers there) this quote seems unlikely today since the diversity of soft corals seems to be less than that reported in the past. Nonetheless, soft coral still has the largest coverage at 33. 7% and there is also 30.7% live hard coral cover. In addition, 2 1.1 % of the area is covered with other marine invertebrates such as anemones and sponges. Dead hard coral cover is fairly low, 13.9%, comparable to the control site (19.3%).

Coral Garden is visited by dive groups almost everyday since it is easily accessible from the Marine Park Centre. 'The diving is interesting since the area is situated on the rocky tip of the island and the irregularity is appealing. Combined with this is the colourful coverage of soft coral on some areas of the rock face I lowever the dive site is exposed to strong currents and swell which can make diving a challenge as well as causes poor visibility. As a result of the aforementioned natural forces the area is unsuitable as a snorkelling destination although it is sometimes used for such purposes. The high levels of soft coral and mainly tolernt encrusting (77.5%) and massive (17.9%) hard corals combined with the rocky irregular nature of the site means that the physical currying capacity is high despite its accessibility and popularity.

Coral Garden is not heavily utilized as a snorkelling area as compared to the Marine Park Centre I louse Reef and the Langkawi Coral Pontoon House Reef, It thus doesn't see as high numbers of visitors. Noverthelees, it is still the most heavily visited and popular dive site in Pulau Payar Marine Park. Despite this, social carrying capacity is fairly high since diving groups can remain separated by the irregular rocky, outcrops and hidden by the poor visibility.

(d) Pulau Kaca

Pulau Kaca is another popular diving destination and all the dive operators interviewed brought their divers there. It is also very accessible from the Marine Park Centre. A dive at this site often involves the reef surrounding the island and the nearby wrecks that have been sunk by the Department of Fisheries Malaysia over the last few years

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There is a large component of live hard coral (61.0%) on the reef around Pulau Kaca of which 67.2% is branching coral, along with a limited cover of massive, encrusting, foliose and table coral. Dead hard coral cover is relatively low at 15.7% and is comparable to **that** at the control site (19.3%). The reef is healthy, varied and attractive, often supporting large schools of fish, black tip reef sharks and occasionally whale sharks are encountered at this dive site. Alongside Coral Garden, Pulau Kaca is **the** most intensively used reef in the area and the presence of high levels of branching coral means that the physical carrying capacity is fairly low despite the reef being relatively undamaged as yet.

Social carrying capacity is fairly high at this site due to its irregular reef morphology, the circular tour of the reef taken by dive operators and the opportunity to swim away from the island to the wrecks. The visibility at Pulau Kaca tends to be fairly poor, between 5-10 m, (a common problem in the Pulau Payar group of islands) and this helps to increase the social carrying capacity by reducing visual contact, but may decrease diver satisfaction at the same time. When compared to levels of diving at other Marine Parks in Malaysia e.g. Pulau Tioman or Pulau Redang, diving at Pulau Payar Marine Park is a relatively small scale operation and does not seem to pose too great a threat to either the physical or social carrying capacities of even the most fragile of reefs in the group, such as Pulau Kaca.

(e) Lembu Rocks

Pulau Lembu is the most northerly island **in the** Payar group. There are only a few small isolated patch reefs around the island itself. Most of the diving activity takes place just north of the island, at Lembu Rocks. It is however not as intensively used as a dive site; only three of the dive operators interviewed brought divers here.

Lembu Rocks consists of a pile of boulders which has a considerable cover of anemones, sponges and other sedentary marine life (67.7%). There is a wide variety of different species of fish, many of which occur in large schools. There is relatively little live hard coral (18.2%) at Lembu Rocks, therefore the site is more physically tolerant towards reef activities and has a high physical carrying capacity. However, there is considerable algae presence on the substrate highlighting the possibility that the coral here may not be in optimum health.

Since Lembu Rocks is not an intensively used **dive** site, the problems of crowding do not occur here, hence it has a high social carrying capacity. In addition, the boulders that make up the site create an interesting underwater landscape and effectively increase the social carrying capacity by shielding dive groups from each other.

(f) Pulau Segantang

Pulau Segantang is located about 13 km to the southwest of Pulau Payar and is often used by dive operators en route to Pulau Payar from Pulau Langkawi, providing an interesting alternative to typical reef diving. The island is made up of two rocky outcrops joined together underwater but separated at the surface by a channel approximately 10 metres wide. Both the rocks have steep sides which continue underwater to a depth of up to 10 metres before sloping gently down to a depth of 20 metres. The opportunity for wall diving at Pulau Segantang is a significant attraction as is the plentiful fish life, in particular large shoals of commercial and reef fish, for example, barracuda, angel fish and butterflyfish. Pulau Segantang is also an important nursery and breeding ground for several species of fish (De Silva & Ridzwan, 1982), and sightings of whale sharks are not uncommon around the island.

The rocky substrate of the site has a high cover of marine invertebrates such as sponges and anemones (79.9%) and a low live hard coral component (8. | %). The hard coral cover consists largely of encrusting and massive corals (42% respectively). Unfortunately strong currents are common at Pulau Segantang and the island is isolated and not as accessible from the Pulau Payar Marine Park Centre as the other reefs. Coupled with the physically tolerant benthic lifeform composition, it can be concluded that the physical carrying capacity of Pulau Segantang is likely to be high.

Despite being a fairly popular dive site, with 66.67% of dive operators bringing divers there, its inaccessibi | ity tends to counter this, resulting in a relatively low level of reef utilization. This factor, coupled with the general morphology and typically poor visibility mean that the reefs social carrying capacity is high.

TABLE 5.1 REEF CARRYING CAPACITY AT PULAU PAYAR MARINE PARK

DIVE SITE	PHYSICAL CARRYING CAPACITY	SOCIAL CARRYING CAPACITY	OVERALL CARRYING CAPACITY
Marine Park Centre House Reef	Moderate	High	Moderate
Langkawi Coral Pontoon House Reef	Low	High	Low
Coral Garden	High	High	High
Pulau Kaca	Low	High	Moderate
Lembu Rocks	High	High	High
Pulau Segantang	High	High	High

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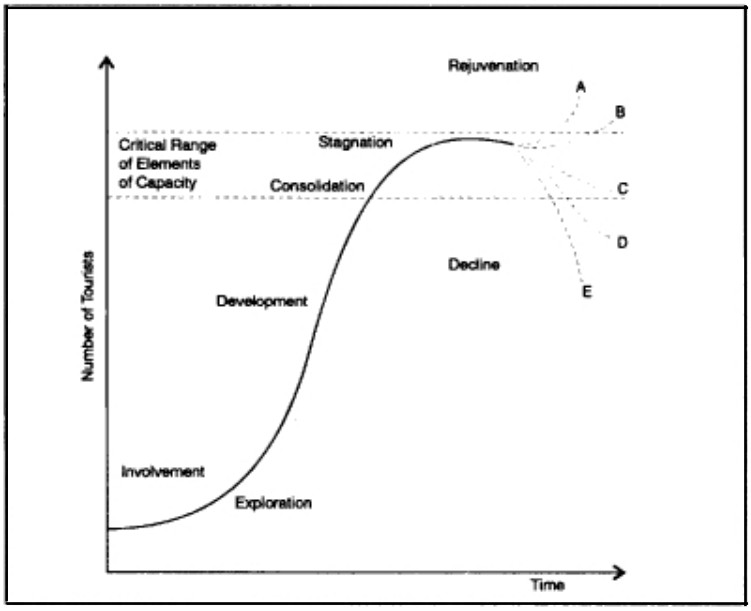
6. MANAGEMENT OPTIONS

Christaller (1963) first conceived the concept that tourist areas follow a relatively consistent process of evolution, from discovery, to growth, to decline. Butler (1980) expounds the concept further by using an S-shaped curve to illustrate an area's cycle of evolution (Fig. 6.1). The stages a tourist area passes through are exploration, involvement, development, consolidation, stagnation and decline.

FIG. 6.1 THE TOURISM LIFECYCLE CURVE



A, B, C, D and E are possible pathways following stagnation that may be taken, depending on whether rejuvenation or decline occurs, and the rates they occur at.

If a policy is established early in the tourism lifecycle, it may be possible that the area may never reach the decline stage. Steps have to be taken in order to maintain a desired position or to improve upon an unacceptable one. Based on the visitor number records of Pulau Payar Marine Park (Fig. 4.1), it is currently at the development stage. Management to control tourism development is thus important now, along with proactive measures to address environmental problems.

Management responses to unacceptable or crowded conditions in recreation settings may include an array of actions that do not involve use limitations. Clearly stated management objectives are essential and the emphasis on management needs to be on the outputs, that is the experiential and environmental conditions desired, rather than on inputs such as use levels (Watson 1988). It must be realised that it is not only the numbers of people that affect the environment, but that their behaviour also contributes to problems.

Thus, possible management responses to perceived crowding include the redistribution of spatial and temporal use patterns, better design of use systems and facilities, more emphasis on maintaining environmental quality, fostering higher rates of compliance with rules and regulations, providing users with a greater basis for choice, eliminating motorcrafl and all unnecessary structures, and zoning to alleviate resource damage (Stankey, 1973; Manning, 1985; Becker *etal*, 1984).

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Coupled with the emphasis on conservation of the marine resources of the Pulau Payar group of islands, the following management options are discussed with respect to the Marine Park. It must also be borne in mind that the specific needs of Pulau Payar Marine Park must be taken into account and integrated with the overall planning and management of Pulau Langkawi.

6.1 Zonation according to use and objectives

In Malaysia, the main criteria for selecting and identifying sites as Marine Parks are that they must have unique marine ecosystems of significance, with a rich diversity of natural resources which are in relatively good condition and not materially altered by human exploitation (Chang, 1990). The other criteria include aesthetic value and potential for recreation and tourism; this is important to safeguard and increase local economies. Hence a Marine Park is a multi-use protected area whereby conservation and tourism are prime objectives, and the two must be reconciled and managed accordingly.

The zonation of Marine Parks is a viable and effective management procedure whereby different zones within a Park define what uses are limited, to what extent, and by what means (White, 1988). Zonation is especially effective for multi-use areas like Marine Parks and is a recommended ecotourism guideline for Marine Parks, as stated in the National Ecotourism Plan (MOCAT/WWF Malaysia 1996). By providing for a gradation of restriction, a zoned management scheme is easier to establish and police, since it can satisfy the requirements of a range of resource uses (White, 1988). Zonation also renders protection from damaging activities to sensitive habitats, confines intensive use to sites that can sustain it, and separates incompatible activities (Ch'ng, 1990). Recreation and tourism areas can be confined to specific zones, and if properly designed and controlled, can be significant assets to the Marine Park by facilitating education, providing cultural exchange and generating revenue (White, 1988). Zones can also be used to limit a certain number of people in a particular area so that adverse impacts from their activities are minimised or avoided. In addition, clear and specific management objectives or targets for each zone can be set to ensure systematic management (Wong, 1996).

Special functions of zones may include (Ch'ng, 1990) :

- selective control of activities at different sites, including strict protection and various levels of use
- creating sanctuaries for core conservation areas
- separation of incompatible recreational activities to increase the enjoyment and safety of different pursuits
- setting aside damaged areas to enable recuperation
- protecting breeding populations of fishes and other organisms for the natural replenishment of overfished areas nearby
- buffering core zones to protect them further from adverse impacts of damaging activities
- periodically closing an area from human presence e.g. during the breeding season of a particular animal

The following zones have been identified for Marine Parks in Malaysia and may be designated (Ch'ng, 1990) :

- Core Zone - covers all coral reef areas, within which activities are controlled and strict protection prevails. No collecting or fishing is allowed, and access is limited
- Buffer ***Zone*** - established around core zones; only traditional fishing activities allowed

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- *Reserve* Zone - no human activities whatsoever allowed in order to maintain undamaged wilderness areas for the retention of a gene pool
- *Scientific* □ *Reseurch* Zone- ecologically sound research allowed
- *Preservation Zone* - damaged reef areas closed to activities to allow regeneration
- *Recreational* - controlled recreational activities allowed

Pulau Payar Marine Park, although small, can still be zoned according to activities. Almost all the tour operators have agreed that planning through zonation and the provision of buffer zones are important toward the protection of the Marine Park (Wong, 1996). With the establishment of specific zones for Pulau Payar Marine Park, it would be easier to limit visitor activities and numbers according to the respective zones.

All the reefs around the Marine Park should be in a Core Zone, with appropriate Buffer Zones established around them. Dive sites and snorkelling reefs would fall under Recreational Zones; furthermore, the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef should be designated specifically for snorkelling and introductory diving. Reserve Zones can also be established for the Marine Park, for example, the eastern facing side of Pulau Payar which is very rarely used by dive operators and is still in good health, as attested to by the control site. Scientific or Research Zones can be identified as and when needed, as can be Preservation Zones. All these zones will have to be continually monitored and evaluated as their designations may change over time depending on reef health and condition.

6.2 Gazettement of a State Park

Although thegazettement of the 38 islands as Marine Parks is an important step towards protecting marine resources, in Peninsular Malaysia, this applies to offshore waters surrounding Marine Park islands only. According to the Establishment of Marine Parks Malaysia Order *1994, "the limit of any area or part of an area established as a marine pork shall be at a distance of two nautical miles seawardfrom the outermost points of the islands specified as measured* at low *water mark".* Thus, the Department of Fisheries Malaysia does not have jurisdiction over the land on islands, as land matters are constitutionally under the respective State governments. This has lead to conflict and problems in Marine Park island management as any development that occurs on land is not required to comply with any Marine Park regulations or management plan (Aikanathan & Wong, 1994).

As most pollution threats to the marine environment are from land-based sources, it is critical that holistic and integrated approaches in management be taken. The concept of island ecosystem management (Ch'ng, 1990) which advocates the management of the marine habitat, coastline features and terrestrial habitats as a single unit is thus useful. Both Federal and State governments have recognised the need for management of Marine Park islands as one integrated system. In order to facilitate implementation, it is recommended that unalienated land, i.e. State land, on islands adjacent to Marine Parks be established as State Parks under a State Enactment (Ch'ng, 1990).

Since the four islands of the Pulau Payar Marine Park are small, and there are no inhabitants or tourist accommodation present, it would be feasible to gazette the islands in their entirety as State Parks. This positive step would enable better and more integrated management of the Pulau Payar Marine Park.

The Kedah State government is in the process ofenacting legislation for the establishment of a State Parks Corporation which would be responsible for managing State Parks in Kedah for conservation purposes. There is provision in the enactment for the establishment of State Parks on islands surrounded by Marine Parks. In such cases, the State Parks Corporation can, with the approval of the State Authorities, delegate powers to the Director-General of the

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Department of Fisheries Malaysia to manage the State Park. Section 3(5) of the draft State Parks Corporation Enactment (Kedah) 1996 states that "For the purpose of the management and administration of National Parks that are surrounded by Marine Parks the Corporation may with the approval of the State Authorities delegate its powers to the Director-General of Fisheries responsible for Marine Parks established under the Fisheries Act I985 to control and administer ".This legislation will need to be tabled at the State Legislative Assembly before it can come into force. To date however, this has not been done yet.

Nevertheless, the Kedah State government seems sincere in wanting to gazette the Pulau Payar group of islands as a State Park and handing over the management of the land to the Department of Fisheries Malaysia. Furthermore, the legislation lays down restrictions and conditions for development activities such as the construction of accommodation facilities. It is the intention of the Kedah State government not to allow any future development (in terms of accommodation and recreation facilities) at Pulau Payar other than what is already present at the Marine Park Centre. Thus, the status of the islands themselves as protected areas would better lend weight to the commitment to protect Pulau Payar Marine Park and its resources. Inappropriate tourism development activities would not be permitted, and by virtue of handing over the management of the State Park to the Department of Fisheries Malaysia, more holistic and integrated management of the Marine Park can be pursued.

However, the legislation does not spell out to what extent State Park status can meet the needs for land-based pollution problems such as sewage. Thus, these issues must be addressed jointly by the Department of Fisheries Malaysia and the Kedah State government; both agencies must play a part in ameliorating the sewage disposal problem, both in terms of finances and commitment. In addition, it must be realised that activities further afield, such as in Pulau Langkawi, Pulau Pinang and the mainland may also adversely affect the coral reefs of Pulau Payar Marine Park. This necessitates integrated planning between Federal and State governments.

6.3 **Increasing carrying capacity**

6.3. I Increasing reef carrying capacity

The carrying capacity of a reef does not necessarily always have to remain the same; it can be lowered with increased use and abuse, alternatively it can actually be raised in a number of ways (see Salm, 1986). However, it is stressed here that increasing reef carrying capacity does not imply taking steps to increase the numbers of reef users; instead increasing reef carrying capacity means taking appropriate management actions that will ensure that minimal degradation to the coral reefs occur despite them being exploited as a tourist attraction. The following options are management actions that may be considered. Throughout all this, the continual monitoring of reef conditions relative to available baseline information is essential.

Increasing public awareness through education, using a number of techniques: guidebooks (possibly underwater guidebooks or fish/coral field charts), conservation articles in the media, television documentaries, and placing increasing importance on reef conservation in diving courses. Specifically crucial at Pulau Payar Marine Park would be a marine education and awareness programme that targets the snorkellers. (See Section 6.4).

Regulating reef activities with lawsbanning certain activities such as spear-fishing, commercial fishing, anchoring, souvenir collection and aquarium fish collection. Marine Park regulations already exist, as afforded under the powers of the Fisheries Act 1985. Unfortunately, enforcement of laws is particularly difficult in the marine situation; there has to be a certain amount of co-operation with the tourist industry which is often reluctant to accept

responsibility. Penalties can be levied on boat operators if their clients do not comply with the laws. Careless reef users should be warned of the damage they are causing to the reef and fined if necessary. (See Section 6.5).

Zonation of certain reef areas is a powerful tool for increasing carrying capacity, possibly with exclusion zones to protect vulnerable coral communities or threatened marine life species. (See Section 6.1).

Laying moorings at popular reefs to reduce anchor damage improves access thus improving the physical carrying capacity at the reef. However improving access can reduce social carrying capacity and stretch the ecological carrying capacity, thus a balance is required so that the overall carrying capacity is not exceeded. In addition, increasing the number of mooring buoys at the more tolerant reefs relieves the pressure on the more fragile sites.

Creating alternatives to snorkelling and diving such as the glass-bottomed boat rides operating from the Langkawi Coral Pontoon relieves some of the physical pressure on the reefs. These tours open up the coral reefs to tourists, many of whom may never have seen them before and they can act as educational aids as well as entertainment. Many of the snorkelling tourists to Pulau Payar Marine Park cannot swim and their potential for reef damage is high; a glass-bottomed boat ride is thus an alternative for them - "dry snorkelling"!

Artificial reefs such as wrecked ships, aircraft, vehicles, barges or piles of tyres and concrete structures provide a substrate for reef organisms to grow on, shelter for fish and most importantly interesting alternatives that will relieve the environmental pressure on the natural reefs. If placed in strategic positions e.g. close to heavily dived reefs or in challenging situations, artificial reefs (in particular ship/aircraft and vehicle wrecks) can be very popular, often as popular as the natural reefs themselves. The wrecks at Pulau Kaca are already a popular dive site, and should be promoted further among the divers that come to Pulau Payar Marine Park.

63.2 Increasing tourism carrying capacity

Similarly, increasing tourism carrying capacity does not mean increasing visitor numbers to Pulau Payar Marine Park. In light of the extremely high visitor numbers the Marine Park is already receiving and the high rate of increase in visitor numbers over the last seven years (5000%), increasing visitor numbers will only lead to reef degradation, visitor dissatisfaction and a saturation of facilities. In fact, the current high levels of visitation already mean that negative impacts are occurring on the marine environment of Pulau Payar Marine Park. Thus, increasing tourism carrying capacity implies that appropriate management actions should be taken to manage the existing levels of visitation and limit visitor use such that the marine environment is not degraded, visitor satisfaction is met and adequate facilities are provided.

There is not much scope for increasing physical carrying capacity at Pulau Payar Marine Park given the limited space on the island. In fact, this is not a desirable option as the area is already crowded and the reefs under pressure from visitor activities. It is recommended that no accommodation facilities for tourists be built on Pulau Payar (Aikanathan & Wong, 1996). This is supported by a recent study on Pulau Payar Marine Park which found that Marine Park managers and tour operators were unanimous in their agreement that stricter controls on development projects in the Marine Park are essential for protecting the marine environment (Wong, 1996). Both parties were not in favour of more developed facilities such as chalets or a restaurant, but felt that more toilets were necessary. Thus, the best option would be to upgrade and improve existing facilities rather than building new unnecessary facilities.

The new broadwalk will connect the beach at the Marine Park Centre with the beach in front of the Langkawi Coral Pontoon. This would allow some visitor dispersion and alleviate crowding slightly. Simple facilities could be

added to this beach, for example, shelters and waste bins; however, the effectiveness of this alternative in dispersing visitor pressure should be weighed against any potential negative impacts on the marine environment.

Physical carrying capacity can be increased for aspects that are desirable, such as by improving transportation services, having a safe jetty and providing mooring buoys at the appropriate reefs. Particularly crucial to Pulau Payar Marine Park would be the implementation of adequate sewage and solid waste disposal facilities. The upgrading of such facilities increases the carrying capacity of the island, without bringing subsequent detrimental effects. Furthermore, more toilet facilities are needed, and should be provided while ensuring that sewage disposal facilities arc adequate and efficient. Of the visitors surveyed, 64.16% found the toilet facilities at the Marine Park Centre to be inadequate. This is supported by a study that shows that tour operators feel that existing toilets are inadequate to extremely inadequate (Wong, 1996).

The existing nature trails (Plate 7) on the island can be further promoted as they are currently under-utilised; only 16.46% of tourists interviewed had walked the existing trails. These will allow some dispersion of activities and alleviation of pressure on the reefs. The trails would be particularly attractive to non-reef users. 54.55% of tour operators and 57.07% oftourists interviewed indicated that this would be a desirable future activity in the Marine Park. These trails will however need to be well signposted and should contain interpretative information. Other alternative activities to diving and snorkelling such as glass-bottomed boat rides could be explored; Langkawi Coral already operates such rides for their customers and the Department of Fisheries is thinking of introducing similar rides at the Marine Park Centre

Photo : WWFM/Li Ching Lim

PLATE 7 ONE OF THE TWO EXISTING NATURE TRAILS ON PULAU PAYAR

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Other alternative islands around Pulau Langkawi can also be promoted to disperse pressure on Pulau Payar Marine Park. The marketing of islands such as Pulau Dayang Bunting, Pulau Singa and Pulau Beras Basah, which are already tourist attractions, should be targeted at visitors who are not so interested in going snorkelling in coral reef areas, as these areas do not have coral reefs comparable to Pulau Payar Marine Park. The promotion of other islands in the Pulau Langkawi group with good reefs would also complement Pulau Payar Marine Park; these islands should be identified and the feasibility of directing visitors there studied.

Social carrying capacity can be increased by ensuring visitor satisfaction is met and properly addressing any complaints raised. The implementation of a marine education and awareness programme is essential (see Section 6.4), and the Information Centre needs to be utilised more. Dialogue with the tour and dive operators also need to be held regularly, to give them an opportunity to voice their opinions, suggestions and grievances.

6.4 Implementation of a marine education and awareness programme

Frost & McCool (1988) argue the case for education as an effective management tool, stating that *"If the visitor understands the rationale for the regulation, there may be more understanding of the regulation and consequently, more voluntary compliance with it... Thus perceptions of the adequacy of information seemed to be a factor in the acceptance of restrictions.. . with a good rationale and careful explanation of the rationale, visitor regulation, at least in some places, may enhance recreational experiences"*. In addition, good interpretation enhances visitor experience, gives greater satisfaction and ultimately a better reputation to the area (MOCAT/WWF Malaysia, 1996). Coral reefs in particular have immense popular appeal which should be exploited for conservation purposes.

A recent study has shown that tour operators who bring visitors to Pulau Payar Marine Park feel that the information required for instilling awareness about the Marine Park is inadequate (Wong, 1996). This is supported by the results of the land-based survey of this study which showed that more than half the visitors interviewed (5 1.35%) were not aware that Pulau Payar is a Marine Park. In addition, most visitors surveyed felt that information regarding Marine Park status (57.64%) and information on the marine environment (66.93%) was lacking.

The Pulau Payar Marine Park Centre should be the focus of a comprehensive education and awareness programme that can reach all nationalities. A visit to the Marine Park Information Centre should be made compulsory itinerary for all tour and dive groups. At the moment, the Information Centre is terribly under-utilised, and more efforts should be made to attract visitors to enter it. Interpretation should not only comprise information on the marine environment and marine life found in the area, but should also communicate Marine Park policies and management objectives to visitors (Wong, 1996). A pre-departure programme is also necessary to educate visitors to consider the effects of their visit in advance and to prepare them to minimise their negative impacts (MOCAT/WWF Malaysia, 1996). This should initially concentrate in Pulau Langkawi, and should ultimately include Pulau Pinang and Kuala Kedah.

There also needs to be an expansion and improvement of the interpretation materials used, employing a variety of methods. Brochures, posters and information boards should be multi-lingual, taking into consideration the major nationalities that visit Pulau Payar Marine Park. The new jetty and broadwalk offer more opportunities for putting up information boards, as the Information Centre is quite small, and the Department of Fisheries does have plans to utilise this new area for such purposes. Audio-visual aids, for example videos and slide shows, should be run at regular intervals for the benefit of visitors to the Marine Park. This would be possible once the new generator is in use. Videos could also be screened at the Kuah jetty in Pulau Langkawi for visitors to watch prior to departure for the Marine Park. Other techniques include brochures and leaflets, checklists and identification keys. In addition,

a code of practice should be formulated for activities like swimming, snorkelling, diving and fish feeding (Wong, 1996). This must be effectively communicated to visitors to ensure that they are aware of the negative consequences of their activities and to foster more responsibility towards the surrounding marine environment.

Since the Langkawi Coral Pontoon lacks any sort of Marine Park presence, the pontoon operators must also play their part in creating awareness amongst their guests. In this respect, they have gone some way, by putting up signboards on the pontoon, showing videos during the catamaran trip from Pulau Langkawi to the pontoon and briefing guests before arrival at the Marine Park. The Marine Parks videos should be given to the Pontoon operators to be shown on board the catamaran before arrival at the Marine Park.

The Department of Fisheries Malaysia is currently dependent on the tour and dive operators (who are better able to overcome language barriers) to brief their guests on Marine Park regulations (Plate 8). The Marine Park staff themselves do not brief visitors but liaise with tour and dive operators in this aspect. Thus tour and dive operators are important middle men, and need to be the target of a marine education and awareness programme as well, so as to ensure that they communicate the right messages to visitors. It must be ensured that tour and dive operators do indeed briefvisitors. The land-based survey results show that 64.81% of those interviewed were briefed; this shows that not all tour and dive operators are conducting briefings. Visitors should be briefed on Marine Park regulations. environmental guidelines and proper behaviour (MOCAT/WWF Malaysia, 1996). Tour and dive operators should also share the responsibility of raising awareness amongst their guests. There is also a need for the Department of Fisheries Malaysia to work with tour and dive operators to foster greater interest in protecting Pulau Payer Marine Park, and to encourage self regulation among them.

Photo : WWFM/Li Ching Lim

PLATE 8 VISITORS TO PULAU PAYAR MARINE PARK BEING BRIEFED BY A TOUR/DIVE OPERATOR

Closer co-operation should be fostered between dive operators and Marine Park staff. On the whole, the diving industry is well aware of the necessity for improved reef management, and can be motivated into becoming a major

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force in reef conservation (Wells & Price, 1992). Regular meetings and dialogue sessions need to be conducted to ensure that communication between the two parties is not stifled. Dive operators need to be conversant with the role of Pulau Payar Marine Park, as well as its rules and regulations. The role of Dive Instructors and Dive Masters in promoting reefawareness and conservation cannot be overemphasised. They are in a pivotal position to influence divers, and should educate as well as personally supervise divers and snorkellers that are under them. Dive operators can also provide practical tips (e.g. proper buoyancy control) to divers. Divers, by virtue of the close contact they have with marine ecosystems, can also better appreciate the need for protecting and conserving the marine environment.

An annual beach and reef clean-up is held at Pulau Payar Marine Park, under the auspices of the Professional Association of Dive Instructors (PADI) Project A.W.A.R.E., involving the Department of Fisheries Malaysia, Langkawi Coral, Pro Dive and other tour and dive operators. This is an important awareness raising event that should be further promoted and encouraged.

The education of local residents in Pulau Langkawi, Kedah and Perlis on the long term benefits of the Marine Park is crucial to ensure acceptance of the Marine Park, and to avoid any ill-feeling or resentment with regards to any infringement of rights, especially pertaining to fishing. Fishing communities should be specifically targeted to ensure that they understand how the Marine Park helps to sustain their livelihood. A marine conservation and awareness programme must be implemented in local schools to ensure that residents, from young, are inculcated with the right attitudes towards their surrounding environment. The Department of Fisheries Malaysia conducts diving courses for local fishermen in order to enhance their knowledge and appreciation of the marine environment. In addition, under the Bay of Bengal Programme, fishermen are being trained as ecotourism guides. These are important steps, not only in raising awareness, but also in encouraging community participation in the planning and management of the Marine Park.

6.4. I Training of Marine Parkmanagers, tour operators and dive operators

Staff of the Marine Park, tour operators and dive operators should be adequately trained, especially in matters pertaining to visitor management and relations, as well as to increase general knowledge and conservation awareness of the marine environment. The Department of Fisheries Malaysia already conducts regular training programmes for their staff. In addition, Marine Park rangers and managers have also been sent to undergo short-term attachment training with the Great Barrier Reef Marine Park Authority in Australia (Hiew & Abdul Rahim, 1996). Rangers are also trained on basic coral reef research methods to increase the capacity for data collection.

In addition, training on nature interpretation should be provided for Marine Park staff, tour operators and dive operators. This will help increase social carrying capacity, as training will help achieve high standards of service. Training should endeavour to improve skills, develop understanding, raise motivation, and help ensure that limited resources for conservation and enjoyment of the marine environment are used more effectively (MOCAT/WWF Malaysia 1996).

6.5 Enforcement of Marine Park regulations

The Department of Fisheries Malaysia has a significant role to play in the strict enforcement of Marine Park regulations. They must ensure that the regulations are adhered to, and that non-compliance is strictly dealt with.

Wong (1996) found that both Marine Park managers and tour operators agreed unanimously that strict enforcement of regulations was important to extremely important for protecting the marine environment. However, it is important to also realise that it is insufficient to rely strictly on regulatory controls of activities and behaviour (Wong, 1996). Enforcement of Marine Park regulations cannot stand alone, but must instead complement other effective management strategies.

The Establishment of Marine Parks Malaysia Order 1994, which was conferred by subsection 41 (1) ofthe Fisheries Act 1985 brought into force Marine Park regulations with immediate effect. Fishing is a prohibited activity within Marine Park waters; unfortunately illegal fishing still occurs occasionally, especially at Pulau Segantang which is further away and more difficult to police. Nonetheless, enforcement measures must continue as the illegal fishing activities will ultimately undermine the integrity of the Marine Park. Patrols around the waters of the Marine Park, including around Pulau Segantang, should be conducted regularly. Department of Fisheries staff heading back to Kuala Kedah are supposed to patrol Marine Park waters, including around Pulau Segantang, every time there is a shift change. This should be adhered to as far as practical and possible.

At low tide, boats tend to pass over the Marine Park Centre House Reef to transfer passengers. This not only poses a safety risk to snorkellers in the water, but can also result in physical damage to the reef when boats run aground on coral or propellers hit coral. Once the new jetty is built and a snorkelling area is cordoned off, this problem should be eliminated. In the meantime, Marine Park staff should not allow boats to pass over coral at low tide. Tour and boat operators should check tide tables and time their arrivals such that they can safely pass over the reef to get to the existing jetty.

Tourist control when they are snorkelling, especially at low tide, is essential to ensure that they do not trample on coral, or collect coral and shells. Tour and dive operators should operate a self-regulatory system, and ensure that their customers adhere to Marine Park regulations. Marine Park staff should also step up surveillance ofthe snorkelling area in front of the Marine Park Centre, as should Langkawi Coral Pontoon staff at their house reef.

The fish feeding activities at the Marine Park should also be regulated. At present, visitors are free to feed fish and juvenile sharks whatever they like, both in terms of quantity and quality. There have also been cases of visitors being bitten by sharks as they were not careful when feeding them. The impacts of fish feeding on fish health, natural aggregations and predator-prey relationships have not yet been studied. This should be considered for future research activities. In the meantime, some form ofregulation and control on fish feeding activities is necessary. At the very least, the type of food given, the quantity of food given and who does the feeding should be regulated.

Since the Langkawi Coral Pontoon lacks any sort of Marine Park presence, the pontoon operators must be self-policing and ensure that their guests comply with Marine Park regulations. in this respect, they have gone some way, by putting up signboards on the pontoon and briefing guests on Marine Park regulations before arrival at the Marine Park. Marine Park staff should make occasional visits to the pontoon to monitor visitor activities and to ensure that Langkawi Coral is not contravening any regulations.

In addition, the management of sewage and solid waste disposal should adhere to existing legislation such as the Environmental Quality Act 1974, the Environmental Quality (Sewage and Industrial Effluents) Regulations 1979 and the Street, Drainage and Building Act 1974. It must be ensured that discharge of sewage into the sea does not occur indiscriminately and that proper reception facilities are provided at Pulau Langkawi to deal with waste effectively.

6.6 Limiting visitor use

The 5,000% increase in visitor numbers to Pulau Payar Marine Park over the last seven years is an unacceptable change, given the Marine Park status of the islands, the physical limitations to space, the inadequacy of facilities especially toilets, sewage and solid waste disposal, the increasing dissatisfaction of tourists with some aspects of the Marine Park and the threats the reefs are currently facing from tourism. In light of this, a serious decision has to be made by the Department of Fisheries Malaysia, as managers of the Marine Park, to limit visitor numbers and to manage visitors such that detrimental effects on the marine environment are minimised.

A few options are available to the Department of Fisheries Malaysia should they decide to limit visitor use. The existing permit requirement system can be utilised for such purposes, seeing that tour and dive operators already have to apply for a permit for entry to Pulau Payar Marine Park. Visitor permits are issued by the Department of Fisheries from Pulau Langkawi, Pulau Pinang, Kuala Kedah and Alor Setar. Thus far, there are no limits to the issuance of permits, as long as the number of passengers do not exceed the limit imposed by the Marine Department (I 2 passengers a boat); this is more a safety precaution than a conservation measure. There are also no limits to the number of boats that can come in to the Marine Park per day; these vary with demand. At present, there seems to be enough boats at the moment to cater for the number of tourists coming in, even at peak periods. Permits also have to be obtained for overnight camping, and there is a physical limit of 30 campers at any one time.

To limit visitor use, the Department of Fisheries Malaysia can therefore choose to :

(a) Limit the number of tourists to Pulau Payar Marine Park per day. This would require determining a limiting number, and rejecting permits once this number is reached. However, this action would probably be very difficult to implement as tour operators already have tours booked in advanced, and would not be able to change this or reject customers based on daily fluctuations in visitors.

(b) Limit the number of tourists in a tour group, that is limiting the size of a tour group that may enter Pulau Payar Marine Park. This action is possible, as long as tour operators are consulted and are given advanced warning so that they can tailor their operations to meet the new requirements.

(c) Limit the number of boats that may enter Pulau Payar Marine Park per day. This would require determining a limiting number, and rejecting permits once this number is reached. However, this action would probably be very difficult to implement as tour operators already have tours booked in advanced, and would not be able to change this or reject customers based on daily fluctuations in visitors.

(d) Limit the number of boats that a certain tour or dive operator can utilise to bring visitors to Pulau Payar Marine Park. This action is possible, as long as tour and dive operators are consulted and are given advanced warning so that they can tailor their operations to meet the new requirements.

(e) Limit the number of licensed tour and dive operators that may bring visitors into Pulau Payar Marine Park. This action is possible, and would enable stricter policing as we!!. The current system allows for any tour operation to come into the Park, regardless of whether or not they have their own boats, as they can rent boats from other tour or boat operators. The preliminary list drawn up by the Department of Fisheries does not take into account many other tour operators who tag onto the listed operations. The first step would be to identify a!! the tour and dive operators that bring visitors to the Marine Park, and from there, create a system whereby only registered tour or dive operators can bring visitors into the Marine Park.

(f) Limit the number of divers that may enter the Marine Park per day. This is a step that is probably unnecessary at the moment as diver related damage to the reefs is minima!.

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(g) Limit the number of divers in a dive group at any one time. It is recommended that this be done, based on boat capacity and the ability of Dive Masters to control a dive group. Currently most dive operators bring in on average, groups of six to eight. This is an ideal number and should be implemented.

In addition, the zoning system for the Marine Park can also be utilised to limit visitor use. Limits on the number of visitors that may enter a certain zone can then be set and implemented. Another tool for limiting visitor use would be the implementation of user fees. The setting up a fee structure for entry into the Marine Park should be looked into to ensure that the revenue earned from tourism benefits the Marine Park as well (see Section 4.4.4 for a more detailed discussion). An individual's willingness-to-pay is a measure ofthe economic value placed on being able to undertake specific marine tourist activities and on being able to visit specific marine and coastal tourist sites (Wong, 1997). Thus, the implementation of an entry fee or user fee could help reduce the numbers of visitors to the Marine Park by attracting only those who are willing to pay for the benefits they obtain from visiting the Marine Park; these visitors are often also more environmentally aware and responsible.

The participation of tour and dive operators in this whole exercise of limiting visitor use is crucial for its success. A consensus must be reached about whether or not limits should be imposed, how they should be imposed and what limits should be imposed.

6.7 Establishing monitoring and evaluation programmes

Tourism in Malaysia's Marine Parks has yet to be well-documented, monitored and evaluated, leaving Marine Park managers with insufficient objective information for decision making and actions (Wong, 1996). This has led to ad hoc and reactive responses rather than proactive and planned decision making. Monitoring and evaluation will enable the maintenance ofa record of marine resource and social conditions over time, as well as will help managers assess the effectiveness of any management actions implemented.

Since coral species survive within narrow salinity and temperature ranges, any marked changes in parameters such as light penetration, sedimentation, nutrient levels and dissolved oxygen may affect the growth or survival of reef organisms. Physical and chemical properties of water should be measured regularly as should reef condition relative to baseline information. It is also crucial to monitor indicators such as coral cover, water quality, changes in reef biota such as fish and coral, algal cover and the number of broken coral branches (to demonstrate damage by boats, snorkellers and divers). The impacts of fish feeding at the Marine Park Centre and Langkawi Coral Pontoon should also be monitored closely. Particularly important would be the effects on fish assemblages and predator-prey relationships. On-going activities such as the monitoring of the coral bleaching phenomenon and the impact of the Langkawi Coral Pontoon on its house reef should be continued.

Visitor numbers should continue to be monitored, along with information such as nationality oftourist and place of embarkation. Social aspects of tourism such as visitor response to crowding and visitor satisfaction should also be monitored by means of a simple questionnaire.

The specification of what level of effect should be detectable by any monitoring programme implicitly involves setting limits of acceptable change. When the monitoring results are obtained, any observed changes are compared against an implicit critical threshold which will trigger some sort of management action designed to rectify the situation.

7. RECOMMENDATIONS

In light of the extremely high numbers of visitors to Pulau Payar Marine Park, and the increasing trends in visitation, further change to increase tourism development and activities at the Marine Park are not acceptable. This is due to the potential negative impacts on the marine environment especially coral reefs, the physical limitations to space already experienced, the inadequacy of facilities available especially toilets, sewage and solid waste disposal, and the increase in visitor dissatisfaction with some aspects of the Marine Park.

This chapter is a summary of some basic recommendations for the management of Pulau Payar Marine Park, which are derived from the findings of this study. The main findings of this study are briefly summarised in Box 7.1.

BOX 7.1 SUMMARY OF FINDINGS

Visitor information

- Visitor numbers to Pulau Payar Marine Park are increasing tremendously. There has been a more than 5,000% increase in visitors in the last seven years.
- The majority of visitors to Pulau Payar Marine Park depart from Pulau Langkawi.
- The majority of visitors are foreigners; these are mostly from Taiwan and Japan.
- The fact that Pulau Payar Marine Park offers visitors an opportunity to dive and/or snorkel is a very important factor in influencing choice of visit.
- Most of the visitors to the Marine Park are first time visitors.
- All the visitors to Pulau Payar Marine Park were on a day trip.
- The majority of visitors go snorkelling while in the Marine Park.
- The existing trails on Pulau Payar are under-utilised by visitors.
- The main complaint from visitors was that there are not enough toilets at the Marine Park Centre.
- The majority of visitors found it crowded at the Marine Park Centre, especially at the picnic area.
- A large percentage of visitors agreed that an increase in visitor numbers to the Marine Park would affect their enjoyment of the area.
- Important factors that contribute towards a satisfactory visit to the Marine Park include clean beaches, an abundance of reef fish, diverse coral life, peace and quiet, friendly and helpful Marine Park staff or Langkawi Coral pontoon staff, adequate facilities and adequate information on the marine environment.
- Visitors were more or less satisfied with their visit to the Marine Park, but some aspects brought about dissatisfaction, namely the too high visitor numbers, the lack of guided activities and the lack of information on the marine environment.
- About half the visitors surveyed were not aware that Pulau Payar is a Marine Park.

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BOX 7.1 SUMMARY OF FINDINGS (Cont.)

- Most of the visitors had not visited other Marine Parks in Malaysia
- Not all visitors surveyed were briefed by their respective tour operators on Marine Park regulations.
- There is a lack of information on the Marine Park and its surrounding marine environment.
- The Marine Park Information Centre is very under-utilised.
- The majority of tourists, tour operators and dive operators were willing to pay a small fee for entry to the Marine Park or for participation in certain activities.

Tour and dive operator information

- The majority of tour operators and dive operators that bring visitors to Pulau Payar Marine Park operate from Pulau Langkawi.
- Some tour operators include Pulau Payar Marine Park as part of the itinerary of an island hopping trip that includes other islands off Pulau Langkawi, such as Pulau Singa, Pulau Dayang Bunting and Pulau Beras Basah.
- The majority of tour operators have plans to expand their operations to Pulau Payar Marine Park, this includes plans to bring more tourists into the Marine Park, to have more boats and to conduct more frequent trips to the Marine Park.
- Tour operators are in favour of having the following activities at the Marine Park - videos or slide shows on the marine environment, guided snorkelling activities, nature walks on the island and glass-bottomed boat rides.
- Most tour operators complained about the lack of dialogue with the Department of Fisheries and the lack of enforcement on the prohibitions on fishing.
- The majority of dive operators felt that there are enough dive operators running dive trips to Pulau Payar Marine Park.

Diver information

- The large proportion of divers at Pulau Payar Marine Park are novice divers.
- Important criteria for divers include good visibility, an experience Dive Master, a well-organised dive trip, an abundance of reef fish and an abundance and diversity of coral. Most of these criteria were met.
- Most divers prefer no contact with other dive groups, and includes not seeing other dive boats at a specific dive site. The majority of divers would tolerate up to two incidences of contact with other dive groups and other dive boats.
- Marine conservation awareness amongst divers appears to be higher than amongst snorkellers.

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BOX 7.1 SUMMARY OF FINDINGS (Cont.)

Reef information

- Coral Garden and Pulau Kaca are the most heavily utilised dive sites at the Marine Park. The Marine Park Centre House Reef and Pulau Segantang are also popular.
- Reefs with high perceived levels of damage, as assessed by the divers surveyed, are the Langkawi Coral Pontoon House Reef and the Marine Park Centre House Reef.
- The diving industry in Pulau Payar Marine Park is relatively unsaturated, however the reefs, especially at the Marine Park Centre and at the Langkawi Coral Pontoon are under pressure from reef-related activities.
- The Marine Park Centre House Reef shows signs of coral bleaching, the cause of which has yet to be established. Some potential anthropogenic sources of damage are the high numbers of snorkellers present, boats passing over the reef at low tide and debris from the jetty construction. Similarly, the Langkawi Coral Pontoon House Reef also shows signs of damage.
- Some of the reefs, especially Pulau Segantang, have been illegally fished.

7.1 Reef management

The **reef carrying capacity may be increased** where necessary (see Section 6.3.1), bearing in mind that increasmg reef carrying capacity does not mean increasing the numbers of reef users, but rather

taking appropriate management actions to minimise the degradation of reefs that are exploited for tourism purposes. Options include :

- increasing public awareness
- regulating reef activities
- zonation of reefs
- laying moorings at popular sites
- creating alternatives to diving and snorkelling
- providing artificial reefs

Table 7.1 illustrates some of the strengths and weaknesses of these options, as well as the opportunities that should be taken to increase reef carrying capacity and the potential threats that one needs to be aware of.

7.1.1 Activities of dive operators

The diving industry at Pulau Payar Marine Park is relatively unsaturated. Thus, in terms of diver impact on the reefs, this is minimal and can be easily regulated by responsible dive operators. Crowding on reefs is not a problem either, and diver satisfaction is still relatively high. Although Pulau Payar Marine Park has the potential to be expanded as a diving destination, the snorkelling activities that occur there are pretty much at maximum levels.

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TABLE 7.1 A S.W.O.T. ANALYSIS OF MANAGEMENT OPTIONS TO INCREASE REEF CARRYING CAPACITY

MANAGEMENT OPTIONS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Increasing public awareness	. Ensures acceptance of and compliance with Marine Park regulations . Long term benefits of conservation awareness among general public	. Snorkellers not targeted . Marine education and awareness programme not sufficient	. Target snorkellers who form the largest group of reef users, and who are most likely to cause damage . Improve marine education and awareness programme, using a variety of tools e.g. displays, videos	. Ingrained attitudes and habits may be difficult to counter
Regulating reef activities	. Ensures detrimental activities do not occur . Marine Park regulations already exist	. Enforcement of regulations difficult . Tour operators at times not co-operative	. Foster a self-regulatory system among tour and dive operators . Improve Marine Park enforcement measures	. May reduce popularity and cause conflicts with tour guides and reef users
Zonation of reefs	. Protects sensitive habitats from damaging activities . Confines intensive use to sites that can sustain it . Separates conflicting activities	. Zones that are further away may be difficult to police . Requires increased staffing and fiances	. Pulau Payar Marine Park is small and thus easier to establish and police zones	. May reduce popularity and cause conflicts with tour guides and reef users
Laying moorings	. Avoids the need for anchoring on reefs, thus reducing potential physical damage	. Loss of moorings, especially after the monsoon . Costly, time consuming and labour intensive to install	. Moor buoys at popular reefs that are utilised by divers	. Danger of encouraging fishermen to moor at reef areas and fish . Improved access may attract too many divers and cause damage
Creating alternatives to diving and snorkelling	. Relieves pressure on natural reefs . Allows non-swimmers to appreciate the reef environment	. Requires increased staffing and finances	. Langkawi Coral Pontoon runs glass-bottomed boat rides and has an underwater observatory . Possibility of the Department of Fisheries introducing glass-bottomed boat rides	. Possibility of oil and hydrocarbon pollution from glass-bottomed boats
Artificial reefs	. Relieves pressure on natural reefs . Can be very popular with divers . Can enhance fish stocks and promote coral growth	. Costly to establish	. Promote Pulau Kaca wrecks	

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Thus, **further diving and snorkelling activity at the Pulau Payar Marine Park reefs should be discouraged** before there is any significant impact on its reefs.

Fees could be charged to the dive operators before they are allowed to use the Marine Park and a **limit imposed on the number of individual operators** allowed to bring divers into the Park. Dive operators should also **limit the number of divers in a group** to make organisation and control of divers' activities easier. In addition, **a limit should be imposed on the number of boats that a certain dive operator can utilize** to bring visitors to the Marine Park.

Dive operators should **co-ordinate their schedules** such that their activities are dispersed, and that their visits to a particular reef do not coincide. **The more tolerant reefs and alternatives, for example the wrecks at Pulau Kaca should be promoted.** In addition, **divers should be taken to reefs suited to their abilities and experience** to maximise carrying capacity.

Dive operators should conduct **thorough briefings for visiting divers and snorkellers** with emphasis on Marine Park regulations (do's and don'ts) and the importance of marine conservation in the reef environment. Dive operators must recognize the importance ofconserving the reef environment on which their livelihoods depend, and a **system of self-regulation should be promoted** among them. They must **be responsible for their customers** and not allow illegal activities to occur. To ensure that they do this, perhaps **tines could be imposed,** not only on offenders who collect shells and corals, but also on the dive operators and boatmen concerned.

Boat crews should be made more aware of the fragility of the reef environment and **anchoring on reefs must be strictly prohibited. Boats should not be allowed to beach at the Marine Park Centre or pass** over **the reef area at low tide.** This problem should be eliminated once the new jetty is operational.

Many of the divers to Pulau Payar Marine Park are novice divers or are taking diving courses. **Dive instruction and skill exercises should be conducted in sandy areas. Introductory dives should be conducted on a one to one basis** whereby one Dive Instructor or Dive Master would be responsible for one student. Introductory dives should also be **confined to the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef,** and **new divers kept well away from reef.**

7.1.2 Recommendations for reefs

In general, Pulau Payar Marine Park **should not be further promoted as a dive destination.** The level of diving at the Marine Park is sufficient at the moment, with limited impact on the coral reef environment. Diving visitation can be sustained at its present levels. However, certain measures can be taken to further improve management of the reefs and to ensure that the diving activities do not impact adversely on the reefs in future. See Table 7.1 for a summary.

At least **one mooring buoy should be sited at each dive** site to reduce any possible anchor damage. More use should be made of the various artificial reefs in the group e.g. the wrecks at Pulau Kaca. This could be promoted by **anchoring mooring buoys at various points above the wrecks. Introductory dives should be restricted to the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef** to avoid the possibility of further spreading the diver related reef damage that sometimes occurs as a result of inexperience.

The Marine Park Cenire House Reef and the Langkawi Coral Pontoon House Reef are mainly snorkelling reefs and are very heavily used. Snorkelling has evidently damaged these two reefs, and thus **activities need to be strictly**

TABLE 7.2 CORAL REEF CARRYING CAPACITY : STATUS, THREATS, AND RECOMMENDATIONS

REEF	HEALTH	POPULARITY (VISITATION LEVELS)	HUMAN RELATED THREATS	OVERALL CARRYING CAPACITY	RECOMMENDATIONS
Marine Park Centre House Reef	Moderate	Very high for snorkelling	. Trampling . Souvenir collection . Boating . Pollution from sewage and solid waste . Littering . Jetty construction	Moderate	. Cordon off a snorkelling area . Put in rest floats for snorkellers . Do not allow boats to beach at low tide . Restrict dive instruction to sandy areas . Ensure one-to-one introductory dives . Regulate and monitor tourist activities . Continually monitor and evaluate reef health and ambient parameters
Langkawi Coral Pontoon House Reef	Poor	Very high for snorkelling	. Trampling . Souvenir collection . Pollution from sewage and solid waste . Littering . Jetty construction	Low	. Put in rest floats for snorkellers . Restrict dive instruction to sandy areas . Ensure one-to-one introductory dives . Regulate and monitor tourist activities . Continually monitor and evaluate reef health and ambient parameters
Coral Garden	Good	High	. Diving	High	. Re-anchor the mooring buoy . Continually monitor and evaluate reef health and ambient parameters
Pulau Kaca	Good	High	. Diving	Moderate	. Anchor one mooring buoy . Promote wrecks (anchor buoys at the wrecks) . Continually monitor and evaluate reef health and ambient parameters
Lembu Rocks	Moderate	Low	. Some commercial fishing	High	. Anchor one mooring buoy . Promote as a dive site . Continually monitor and evaluate reef health and ambient parameters
Pulau Segantang	Good	Moderate	. Commercial fishing . Diving	High	. Anchor one mooring buoy . Promote as a dive site (wall dive. drift dive) . Continually monitor and evaluate reef health and amhient parameters

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controlled and policed there to ensure that visitors do not trample on coral, break coral or collect coral and shells. Rest floats should be located at the Marine Park Centre House Reef and Langkawi Coral Pontoon House Reef for snorkellers, so that if they are tired they can hold on to these instead of trampling on coral. For the same reason, the use of life jackets should be also be encouraged for weak swimmers.

The snorkelling area in front of the Marine Park Centre should be cordoned off for visitor safety and to prevent boats from coming in. This would help eliminate boat-related damage on reefs, which is prevalent at low tide.

Table 7.2 summarizes recommendations for the individual reefs.

7.2 Marine Park management

It is crucial that specific management objectives for Pulau Payar Marine Park are adequately formulated, along with a detailed management plan. Planning and management of the Marine Park should also be integrated into the planning and management of Pulau Langkawi given its close proximity and the potential downstream effects.

Other management actions that can be taken are summarised below (see Section 6) :

7.2. I Zonation according to use and objectives

The Marine Park should be zoned according to its use and objectives (see Section 6.1.). Furthermore, the Marine Park Centre House Reef and the Langkawi Coral Pontoon House Reef should be designated specifically for snorkelling and introductory diving. These zones will have to be continually monitored and evaluated to enable flexibility in designations should changes in reef health and condition occur.

7.2.2 Gazettement of a State Park

The Kedah State government should complete its efforts to protect Pulau Payar Marine Park by tabling, in its State Legislative Assembly, the proposed Kedah State Parks Enactment to allow the Payar group ofislands to be gazetted in its entirety as a State Park (see Section 6.2). Jurisdictional authority of the islands should then be handed over to the Director-General of the Department of Fisheries Malaysia. Inappropriate tourism development should not be allowed; this includes ensuring that no construction of accommodation facilities occurs on Pulau Payar. Land-based pollution problems should also be jointly addressed by the Department of Fisheries Malaysia and the Kedah State government.

7.2.3 Implementation of a marine education and awareness programme

A marine education and awareness programme must be implemented at Pulau Payar Marine Park and the Langkawi Coral Pontoon to complement the enforcement and management programme (see Section 6.4). It is felt that with regard to reef users, it is the snorkellers rather than the divers that pose a greater threat to the reefs. They are also the largest group of reef users, hence efforts must be made specifically to target an education and awareness programme at snorkellers. A pre-departure programme should also be initiated in Pulau Langkawi especially, Pulau Pinang and Kuala Kedah.

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A visit to the Marine Park Information Centre should be compulsory for all tour and dive groups. **The Information Centre should be promoted and improved** as it is currently underutilized. **A variety of methods should be used to communicate information on the marine environment and on the Marine Park;** these include information boards and audio-visual aids. These should **be multi-lingual,** taking into consideration the various nationalities that visit the Marine Park. **Videos and slide shows could be run at regular intervals** for visitors, once the new generator **is** in use. A **code of practice for activities like swimming, snorkelling, diving and fish feeding** should be formulated and effectively communicated to visitors.

Training courses on marine environmental awareness and Marine Park management should be conducted for both Marine Park staff and the tour operators/guides. **Dive Instructors and Dive Masters should educate and personally supervise divers and snorkellers** that are under them, as well as provide practical tips. **Briefings should be conducted** before any activities are carried out.

The **education of local residents in Pulau Langkawi, Kedah and Perlis** on the long-term benefits of Pulau Payar Marine Park is also essential. **A marine education and awareness programme should also be implemented in the local schools.**

7.2.4 Enforcement of Marine Park regulations

Marine Park **regulations must be strictly enforced** (see Section 6.5). This includes regulations regarding the ban on commercial fishing within the Marine Park waters. **More patrols,** occasionally at night, and especially around Pulau Segantang, should be conducted, to discourage illegal fishing operations.

Random dives can be conducted by Marine Park officials as spot checks, to ensure that divers, dive operators and dive boatmen adhere to Marine Park regulations. In addition, **regulations on anchoring need to be enforced,** and **boats should not be allowed to pass over reef areas at low tide.** Tour and boat operators should be encouraged to **check tide tables and time their arrival** such that they can allow passengers to disembark at the jetty safely without having to pass over the Marine Park Centre House Reef. Marine Park **regulations on coral and shell collection must also be adhered to. Fines could be imposed** onto offenders, as well as tour and boat operators, who should take responsibility, and not permit their customers to collect corals or shells. A **self-regulatory system** whereby tour and dive operators are responsible for their customers' actions, should complement Marine Park surveillance efforts, especially at Langkawi Coral Pontoon. **Fish feeding activities should be regulated,** especially with respect to the type and quantity of food given.

The management of sewage and solid waste disposal should adhere to existing legislation. **Discharge of sewage into the sea must be prohibited,** and **proper disposal facilities** should be provided in Pulau Langkawi.

7.2.5 Limiting visitor use

A limit should be placed on the number of visitors to Pulau Payar Marine Park as the Marine Park is currently over-utilised at peak periods (see Section **6.6).** The **existing permit system could be utilized to impose some sort of limit to visitor numbers.** Viable options include **limiting the number of tourists in a tour group,** that is limiting the size of **a** tour group that may enter the Marine Park; **limiting the number of boats that a certain tour or dive operator can utilize** to bring visitors into the Marine Park; **limiting the number of licensed tour and dive operators** that may bring visitors into the Marine Park; and **limiting the number of divers in a dive group** at any one time. These actions would need **a process of consultation with tour and dive operators** to obtain a consensus and to enable them to tailor their operations to meet the new requirements.

7.2.6 Establishing monitoring and evaluation programmes

Monitoring and evaluation programmes should be established for the physical and chemical properties of Marine Park waters such as light penetration, sedimentation, nutrient levels and dissolved oxygen. Biological criteria such as fish, coral and algal cover should also be monitored, as should the impacts of fish feeding, the coral bleaching phenomenon and the effects of the Langkawi Coral Pontoon. Also important for monitoring are social factors such as visitor numbers, response to crowding and visitor satisfaction.

7.3 Facilities and development management

7.3. I Focus of development

Inappropriate tourism development should not be allowed; this includes ensuring that **no construction of accommodation facilities** occurs on Pulau Payar. Thus, the best option would **be** to **upgrade and improve existing facilities.** Physical carrying capacity can be increased for aspects that are desirable, such **as** by **improving transportation services, having a safe jetty and providing mooring buoys at the appropriate reefs.**

7.3.2 *Addressing sewage and solid waste pollution problems*

There are currently not enough toilets at the Marine Park Centre to cope with the high numbers of visitors; there should be **adequate provision of toilet facilities with appropriate associated sewage disposal systems.** There needs to be a **proper sewage disposal system for Pulau Payar,** as septic tanks may not be able to cope with the high amounts of waste generated. **Alternative methods** of disposal to septic tanks, and their feasibility for use at the Marine Park Centre, should be looked at.

Langkawi Coral must ensure that **sewage from the pontoon is transported back to Pulau Langkawi and that sewage discharge at sea is avoided.** In addition, should portable loos be introduced by tour operators at the Marine Park Centre, waste should also be transported back to the respective embarkation points. It must be ensured that **proper sewage disposal and reception facilities are provided in Pulau Langkawi, Pulau Pinang and Kuala Kedah** in order to receive waste brought in from the pontoon as well as possibly from the Marine Park Centre.

Tour and boat operators must **bag the solid waste generated by their guests, and ensure that it is properly disposed of in the respective embarkation points.** In line with this, **proper solid waste disposal facilities must be provided in Pulau Langkawi, Pulau Pinang and Kuala Kedah** to dispose of waste brought in from Pulau Payar Marine Park. **Continued education of tour and boat operators** is needed to ensure that they do not dispose of the bagged waste into the sea. The education of tourists is also essential to curb any littering problems.

A **proper solid waste disposal system** is crucial for Pulau Payar as the current practice of burning waste is not viable in the long-term. The best option for the island is for the Department of Fisheries Malaysia **to bag and transport solid waste back to Kuala Kedah,** provided of course that there are proper disposal facilities there. Waste that can be, should be, recycled. A proper **education scheme for visitors on the reduction of waste** should be implemented, **as** well **as** a **programme to promote civic consciousness** among tourists.

TABLE 7.3 PHYSICAL CARRYING CAPACITY : ADEQUACY OF FACILITIES AND HECOMMENDATIONS

FACILITY	ADEQUACY	RECOMMENDATIONS	LEAD AGENCIES
Tables and benches at Marine Park Centre	Inadequate	. Limit the number of tourists in a tour group . Limit the number of licensed tour and dive operators that can bring in visitors	. Department of Fisheries Malaysia . Tour operators . Dive operators
Dive operations	Adequate	. Limit the number of dive operators that can bring in visitors . Limit the number of divers in a dive group	. Department of Fisheries Malaysia . Dive operators
Dive boats	Adequate	. Limit the number of boats that a dive operator can utilise	. Marine Department . Department of Fisheries Malaysia . Dive operators
Tourist boats	Adequate	. Limit the number of boats that a tour operator can utilise	. Marine Department . Department of Fisheries Malaysia . Tour operators
Solid waste disposal	Inadequate	. implement a proper solid waste disposal system . Implement a waste reduction programme . Implement an education programme for visitors, tour and boat operators . Ensure that reception and disposal facilities are available in Pulau Langkawi. Pulau Pinang and Kuala Kedah	. Department of Fisheries Malaysia . Langkawi District Council . Langkawi Coral . Tour and dive operators
Sewage disposal	Inadequate	. Implement a proper sewage disposal system . Ensure that reception and disposal facilities are available in Pulau Langkawi, Pulau Pinang and Kuala Kedah	. Department of Fisheries Malaysia . Langkawi District Council . Langkawi Coral
Electricity supply	Adequate	. Ensure adequate transmission . Use efficient, energy-saving light bulbs	. Department of Fisheries Malaysia . Langkawi Coral
Water supply	Inadequate	. Ensure adequate supply . Encourage water conservation and wise use	. Department of Fisheries Malaysia . Langkawi Coral
Mooring buoys	Inadequate	. Anchor more buoys at the appropriate reefs	. Department of Fisheries Malaysia
Information Centre	Inadequate	. Encourage visitors to enter . Improve and diversify displays	. Department of Fisheries Malaysia

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7.3.3 Alternative activities

The diversification of activities would help alleviate some of the crowd pressure on the beach and in the water at Pulau Payar. **The two paths on Pulau Payar should be further promoted** to encourage especially the non-reef users to utilize them and provide alternative recreation opportunities. These paths should be well signposted and should contain interpretative information.

Alternative islands around Pulau Langkawi should also be promoted to disperse visitor pressure on Pulau Payar Marine Park. Islands that are already established as tourist destinations such as Pulau Dayang Bunting, Pulau Singa and Pulau Beras Basah can be further promoted, especially **targeted at visitors who are not so interested in going snorkelling in coral reef areas,** as these islands do not possess reefs comparable to Pulau Payar Marine Park. **Other islands around Pulau Langkawi with reefs should be identified** and the feasibility of directing tourists there studied.

7.4 Socio-economic management

Visitor and diver complaints should be addressed to ensure continued satisfaction. **Marine Park staff, tour operators and dive operators should be adequately trained in visitor management and relations.**

Marine Park staff should hold **regular meetings and dialogue sessions** with tour and dive operators, to give them an opportunity to voice their opinions, suggestions and grievances. **A process of consultation should be initiated** for any decisions affecting tour and dive operators, especially with regard to limiting visitor numbers.

The setting up a fee structure for entry into the Marine Park should be initiated to ensure that the revenue earned from tourism benefits the Marine Park as well. Revenue generated from the fees should be used to manage the site, repair damages to the natural resources or infrastructure, or to implement environmental mitigation measures.

Promotion of Pulau Payar Marine Park must be in line with its Marine Park objectives and must emphasise the conservation aspects of the Park. Mass tourism to Pulau Payar Marine Park is not desirable, and the relevant agencies need to ensure that the conservation values of the Marine Park are maintained by **targeting tourists who are environmentally aware and responsible.**

TABLE 7.4 A S.W.O.T. ANALYSIS OF SOME TOURISM ASPECTS OF PULAU PAYAR MARINE PARK, INCLUDING OPPORTUNITIES FOR INTEGRATED MANAGEMENT ACTIONS

TOURISM ASPECTS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS	LEAD AGENCIES
Islands	. Small islands with limited access points easier to police . No accommodation facilities present	. Inadequate toilet facilities . Inadequate sewage disposal facilities . Inadequate solid waste disposal facilities . Lack of freshwater supply	. Gazettement of the islands as a State Park . Provide adequate toilets, as well as adequate sewage and solid waste disposal facilities . Plan, manage and promote in line with Marine Park objectives	. Land-based sources of pollution undermine Marine Park objectives and status . No alternative islands in the Pulau Langkawi package for snorkelling and diving results in high pressure on the Marine Park's reefs	. Kedah State govemment . Department of Fisheries, Malaysia . Langkawi District Council . Ministry of Culture, Arts and Tourism . Malaysian Tourist Promotion Board
Reefs	. Main tourist attraction for the Marine Park . Marine Park status affords protection	. Not adequately protected and managed . Difficult to enforce regulations	. Can be sustainably exploited for tourism if adequately managed . Step up enforcement . Tour and dive operators to be self-regulatory	. Illegal fishing still □▯▫◆□. . Unregulated reef tourism affects reefs adversely	. Department of Fisheries, Malaysia . Tour operators . Dive operators
Tour & dive operations	. Only day trips conducted . Briefing on Marine Park regulations given	. Too many tour operators bringing in too many visitors . Tour and dive operators not trained in conservation matters and ecotourism	. Limit the number of licensed tour and dive operators that can bring in tourists . Limit the number of tourists in a tour group . Limit the number of divers in a dive group . Train tour and dive operators according to the National Ecotourism Plan guidelines	. Too high visitor numbers result in degradatory impacts on the reefs	. Tour operators . Dive operators . Department of Fisheries, Malaysia . Ministry of Culture, Arts and Tourism

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TABLE 7.4 A S.W.O.T. ANALYSIS OF SOME TOURISM ASPECTS OF PULAU PAYAR MARINE PARK, INCLUDING OPPORTUNITIES FOR INTEGRATED MANAGEMENT ACTIONS (cont.)

TOURISM ASPECTS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS	LEAD AGENCIES
Langkawi Coral Pontoon	. Unique tourist attraction . Opportunity for non-reef users to view the reef through the underwater observatory and glass-bottomed boat rides	. Activities of pontoon visitors not adequately monitored by the Marine Park	· Pontoon operator needs to be self-regulatory . Marine Park staff should visit the pontoon regularly to monitor activities	. Pontoon itself may cause adverse impacts from shading and pollution	. Langkawi Coral . Department of Fisheries, Malaysia
Pulau Langkawi	· Main source of tourists to Pulau Payar Marine Park . Popular tourist destination . Strong publicity	. Inadequate reception and disposal facilities for sewage and solid waste . No consideration for the needs of Pulau Payar Marine Park in its planning, management and promotion	. Ensure adequate sewage and solid waste reception and disposal facilities . Integrate the needs of Pulau Payar Marine Park into a holistic management plan for Pulau Langkawi	. Development and pollution impacts from Pulau Langkawi ultimately affect Pulau Payar Marine Park . High numbers of visitors to Pulau Langkawi spill over to Pulau Payar Marine Park	. Langkawi Development Authority (LADA) . Langkawi District Council . Ministry of Culture, Arts and Tourism
Visitors	. Visitors arrive in tour groups makiig visitor management and regulation easier	. Too high numbers of visitors to Pulau Payar Marine Park . Not all visitors go snorkelling . No other alternatives available	. Diversify tourist activities . Promote alternative islands for non-reef users . Identify other islands around Pulau Langkawi with reefs and study feasibility of directing tourists there . Enforce limits to visitor numbers using existing permit system and options outlined in Section 6.6	. Too high visitor numbers result in degradatory impacts on the reefs, a saturation of facilities and visitor dissatisfaction	. Department of Fisheries, Malaysia . Langkawi Development Authority (LADA) . Ministry of Culture, Arts and Tourism . Malaysian Tourist Promotion Board

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8. CONCLUSION

The visitation levels to Pulau Payar Marine Park cannot be sustained at present levels unless appropriate management actions are taken. At present, the 5,000% increase in visitor numbers in the last seven years is a change that is unacceptable, given the potential negative impacts on the reefs, the saturation of facilities, the inadequacy of sewage and solid waste disposal facilities and the decline in visitor satisfaction.

Nonetheless, acceptable changes are scientifically difficult to quantity: as there is little agreement about what constitutes a healthy reef in different parts ofthe world, and also what impacts would be likely to cause an unacceptable departure from this normal healthy state. Tourism wise, acceptable changes might be small as aesthetics are important. It is important for reef managers to recognize that damage caused by recreational activities will reduce a reef's attractiveness as a tourist site. It must be realized that although the damage may have a gradual impact on the actual ecology of the reef, visitor numbers are likely to fall sharply as soon as the aesthetic appeal of the corals is affected (Wells & Price, 1992). Thus the threats from tourism and external activities affect not only the Marine Park environment itself but also threaten the long term sustainability of the tourism industry there. The tourism industry of the surrounding region, especially Pulau Langkawi, could also be potentially affected as Pulau Payar Marine Park is an important attraction for many tourists to Pulau Langkawi. Other important sectors such as fisheries would also be adversely affected.

Pulau Payar Marine Park thus needs to be managed such that minimal damage to the reef environment occurs as a result of tourism development and activities. As such, specific management objectives and a detailed management plan are essential. These must be taken into consideration in the overall planning and management of Pulau Langkawi, whose close proximity and potential downstream impacts would affect the Marine Park. Appropriate management actions can minimize the impacts oftourists on coral reefs and hence alleviate degradation, improve visitor satisfaction and ensure the adequate provision of necessary facilities.

Measures such as zoning the Marine Park, gazetting the islands as State Parks, implementing an education and awareness programme, enforcing Marine Park regulations, limiting visitor use, establishing monitoring and evaluation programmes and capacity building are all important management actions that can be taken. Coupled with the promotion of alternative activities and alternative islands to disperse pressure on the reefs of Pulau Payar Marine Park, these actions can help ensure that the tourism industry at the Marine Park is environmentally, socially and economically sustainable.

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Appendix 1

FRAMEWORK GUIDELINES FOR ASSESSING CARRYING CAPACITY

The main points from Lim (1995a) are summarised below with the intention of assisting and guiding the implementation of carrying capacity studies. This broad framework can be used as a reference document, but the final output and conclusions will depend on the nature of each study area and its values.

GENERAL APPROACHES TO ASSESSING CARRYING CAPACITY

1. Define the carrying capacity that needs to be established for the study area :

Options :
- tourism carrying capacity
- recreation carrying capacity
- others

Consider the above from one or more of the following perspectives :

- physical carrying capacity
- ecological carrying capacity
- social carrying capacity
- economic carrying capacity

Consider factors that affect the overall capacity of an area :

Options :
- access capacity
- commercial capacity
- construction capacity
- service capacity
- transport capacity
- others

2. Consider the type of tourism existing or being planned from the following contexts :

- physical
- social
- cultural
- infrastructure
- economic benefits
- tourism image
- indigenous environment
- others

3. List the objectives of the area :

Options :
- conservation of natural resources
- preservation of areas of unique scientific, historical and cultural value

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- preservation of heritage
- tourism and recreation
- employment opportunities
- others

Ecological and social consequences of use should be consistent with area management objectives. If an area has more than one objective, then state the objective of highest priority.

In the Spey Valley example, Getz (1981) assessed the key indicators of impact by reference to the objectives of tourist development boards, and subsequently derived quantifiable and subjective criteria (Table I). This is useful for monitoring the impacts of tourism on an area.

TABLE I. KEY INDICATORS FOR ASSESSING IMPACT IN SPEY VALLEY

OBJECTIVES	QUANTIFIABLE CRITERIA	SUBJECTIVE CRITERIA
Population stabilised (or growth encouraged)	. out-migration halted . in-migration as needed . age/sex structure balanced	. types of in-migrants . expectations/motivations of in-migrants . choice of location
Opportunities for employment increased	. new jobs created in tourism . indirect generation of jobs . reduce unemployment . increase activity rates . retain jobs which might be lost; avoid job displacement	. jobs to benefit special needs . opportunity for choice . opportunity for advancement . satisfaction with jobs
Incomes increased	. raise personal and household incomes . minimise inflation . raise local authority income	. risks of dependency on tourism . who benefits most?
Viability of communities enhanced and efficier use made of resource	. infrastructure, services and facilities made adequate . housing and supply of land made adequate . employment, commuting and strategies for public transport	. attitudes toward change . leadership (availability and quality) . satisfaction with conditions, and preference for living environments
Welfare and social integration fostered	. crime, police work and social work problems minimised . health and other essential services improved and distributed equitably	. integration of newcomers (types of newcomers; their expectations and actions; attitudes towards them)
Cultural wealth strengthened	. maintenance of traditions . facilities . encouragement of events	. degree of commercialisation . satisfaction with traditional way of life: . leadership
Leisure choice increased	. facilities provided and used . membership in groups . changing patterns of activity . cost of participation	. satisfaction with opportunities for leisure: preferences and espectation s . special needs catered for; appropriateness of facilities
Conservation assisted	. preservation of unique cultural and natural features . avoidance of pollution, litter and fire . effective management provided . benefits and costs, versus development	. attitudes to conservation . environmental preferences
Amenity enhanced	. avoidance of crowding, noise and loss of privacy	. visual amenity preferences . level of satisfaction

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4. Establish criteria that affect capacity :

(a) Physical :
- area size
- accessible space
- visual impact
- climate
- aesthetics
- accommodation quality
- availability of facilities
- transportation
- number of people that can be accommodated
- others

(b) Ecological :
- the need for conservation
- fragility of the environment
- wildlife resources
- topography
- vegetative cover
- behavioural sensitivity of species
- diversity
- uniqueness of species
- concealment
- resilience of ecosystem/species
- impact of use on the area
- others

For coral reefs, the following must also be taken into account :
- size and shape of reef
- composition of coral communities
- type of underwater activity
- level of experience of divers/snorkellers
- others

(c) Economic :
- investment
- volume of tourists
- cost of the holiday
- level of economic benefits provided
- level of enjoyment suited to the residents
- others

(d) Cultural :
- volume of tourism with no detrimental effects
- cultural attractions
- quality of crafts and food
- involvement of local communities/residents
- others

(e) Social :
- visitors' choice
- visitors' opinions
- visitors' attitude and behaviour

<<

- expectations and preferences
- perceptual and behavioural response
- response to rising use levels
- visitors' activities
- visitor satisfaction
- acceptable level of crowding
- involvement of local communities/residents
- others

(f) Availability of resources and infrastructure :

- cash incentives
- public utilities
- transport facilities
- essential facilities e.g. hospitals
- availabi I ity of water supply
- proper disposal of solid and liquid wastes
- others

(g) Administrative and political factors:

- level at which management is implemented
- legal restraints
- policy incentives
- others

For example, Getz (1981), when assessing the capacity of the Spey Valley, formulated responses to such criteria (Table II).

Variations in criteria should also be considered :

- seasonality
- developing tourism areas
  - optimise benefits
  - ensure negative impacts of saturation do not occur
- developed tourism areas
  - emphasise management rather than planning
- others

5. Establish thresholds or tolerable levels of use that can act as management guidelines : (cf. Geb, 1981; Table II).

Options :

- physical
- economic
- ecological
- perceptual
- social/cultural
- political/administrative
- others

Bear in mind that thresholds may be eventually reached, or may change with time.

<<

TABLE II. CRITERIA IN THE MEASUREMENT OF CAPACITY TO ABSORB TOURISM IN SPEY VALLEY

CRITERIA	PHYSICAL	ECONOMIC	ECOLOGICAL	PERCEPTUAL	SOCIAJJCULTURAL	POLITICAL/ ADMINISTRATIVE
SOME COMPONENTS FOR MEASUREMENT	. Accessibility . Accommodation . Transportation . Space/Land . Infrastructure . Attractions	. Capital investment . Running costs . Opportunity costs . Effects on other sectors . Labour supply/skills . Inflation . Supply and demand	. Changes in natural processes . Risk of fire, litter, pollution, erosion . Viability of wildlife and vegetation	. Scenery . User preferences and motivations . Activities	. Population stability . Migration . Standard of living . Services and amenities . Stress, hazards . Community viability . Attitudes and social problems . Satisfactions . Traditions, language	. Plans and programmes . Policy priorities . Receptiveness to change . Assistance given to development
POSSIBLE THRESHOLDS	. Physical limits of supply . Dangerous crowding	. Inadequate funds . Better alternatives become available . Uncontrolled inflation . Critical shortage of labour or skills . Excessive competition . Serious damage to other sectors	. Uniqueness lost or threatened . Disaster expected . Changes irrevocable	. User dissatisfaction . Failure to attract tourists . Major change in landscape quality	. Valued traditions lost . Inequitable spread of benefits so that locals are dominated by newcomers . Serious crime or disruption . Great resentment of tourists	. Inability to achieve objectives . Failure to cope with pressures . Costs cannot be recovered
PROBLEMS	. Physical limits can be altered . Supply can be substituted	. Economy fluctuates . Markets can be created/changed . Competition prevents some choices . Difficulty to forecast viability	. Management can alter effects and processes . What are acceptable changes? . Difficult to predict impacts	. Management can reduce problems . User perceptions differ . Different user-groups can be attracted to area	. Attitudes change, and residents adapt . Definition of benefits varies with the level of community examines (local, regional and national perspectives) . How much change is acceptable? . Problems can be ameliorated by services	. Co-operation between agencies and levels difficult to achieve . Priorities can change . Programmes can always be made more efficient
OBSERVATIONS IN SPEY VALLEY	. Facilities inadequate at peak times . Infrastructure deficiency in some villages . Large surplus of accommodation, except at peaks	. High demand for labour and shortage of local skills, but transients till the needs . Financial restraints prevent some needed instruments . Some inflation of costs in land and housing	. No evidence of major damage, but . . . Pressures in central corridor are great . Wilderness value of has been compromised	. Some visitors alienated by changes, but . . User choice has expanded . Crowding at peaks reduces satisfaction . Rural atmosphere is compromised	. Satisfaction generally high . Benefits not fully available to natives . Social problems arise from tourists and transients . Serious shortage of housing	. Pro-growth sentiment dominates plans and priorities . Some conflict exists between national and local/regional interests over conservation

<<

6. Assess the carrying capacity of the area :

(a) Physical carrying capacity

(i) Consider in terms of time and space variables, and tourist function rates.

Time.
- peak capacity
- daily capacity
- weekly capacity
- yearly capacity
- seasonal and diurnal
- others

Space .
- space coefficients
- unit measures
- density zones
- equipment ratios
- others

Tourist function rates :
- ratios
- others

Threshold capacities :
- economic viability
- water resources
- others

Non-measurable criteria (use comparative analyses) :
- ecological impacts
- cultural impacts
- psychological effects
- others

(ii) Apply Boullon's (1985) formula.

$$\text{Carrying capacity} = \frac{\text{Area used by tourists}}{\text{Average individual standard}}$$

The total number of allowed daily visits is then obtained :

$$\text{Total daily visits} = \text{Carrying capacity} \times \text{Rotation coefficient}$$

The rotation coefficient is thus determined :

$$\text{Rotation coefficient} = \frac{\text{No. of daily hours area is open for tourists}}{\text{Average time of visit}}$$

(b) Social carrying capacity

(i) Establish conditions requiring judgmental inputs (Shelby & Heberlein, 1984) :

- relationship between use levels/management parameters and experience parameters
- agreement about the type of recreational experience to be provided
- agreement about the appropriate levels of experience parameters

<<

(ii) Document visitor particulars and activities, as well as their expectations and preferences. Then a theoretical evaluation based on experience and accumulated knowledge can be used for comparative analyses.

Options .
- frequency of site visits
- group size
- length of stay
- activity patterns
- expectations and preferences
- others

(c) Ecological carrying capacity

(i) Consider the level of ecological use the area can support.

(ii) Consider if factors such as the following are at risk :

- soil erosion
- pollution of water resources
- landslides
- loss of species
- others

(iii) Assess the capability of the area to cope with increased water demand and waste disposal.

(d) Recreation carrying capacity (requires an assessment of both environmental and social capacities)

(i) Apply the ROS process to establish the acceptable numbers of visitors suited to each zone:

- visitor surveys
- density guidelines
- others

(ii) Describe observable characteristics and carry out evaluation which involves judgements on acceptability of impacts (Graefe et al, 1984) :

Description :
- management parameters
- impact parameters

Evaluation :
- measurable
- non-measurable
- absolute
- empirical terms
- others

MANAGEMENT AND IMPLEMENTATION GUIDELINES

1. **Consider the stage of the tourism life cycle that the area is in, and manage accordingly :**

Options :
- exploration stage
- growth/development stage
- mature/consolidation stage
- decline stage

<<

2. **Zone the area according to its use and objectives, and develop specific management plans for each** zone :

For example :
- primitive
- rural
- suburban
- urban
- others

3. **If in line with management objectives, consider ways to increase the carrying capacity of the area :**

Options :
- establish quotas which set numerical limits on visitors
- reduce conflict between competing uses
- provide adequate information
- increase durability of resources
- expand the capacities of utility services
- expand the capacities of transport facilities
- develop purpose-built tourist resort complexes
- invest in careful design of infrastructure
- access restriction
- activity restriction
- time separation e.g. seasonal closure
- implement speed limits on boats
- ensure amenity features and facilities are available to residents at reasonable costs
- encourage local resident participation in tourism
- others

In addition, there can be the option to disperse pressure on an area by creating alternatives or opening up new areas. This also provides economic benefits of additional income and employment elsewhere.

Options :
- disperse tourist attractions
- develop new attractions and tourist facilities
- design new viewing tracts, trails, etc.
- extend visit season
- encourage wet or off-season use
- others

4. **Implement an education programme which will help create awareness and educate the public on conservation matters :**

Options :
- exhibits and signs
- surface or underwater trails/routes
- guidebooks and brochures
- public awareness programmes
- □♦≈ℝ□·

5. **Incorporate all these into a management plan, ensuring that a government mandate is included :**

A competent management programme should incorporate both environmental considerations ***and*** human needs and desires.

<<

6. Implement appropriate action at the various levels :

Options :
- local
- municipal
- district
- state
- federal

7. Monitor and evaluate conditions :

This would enable management policies to be amended if necessary.

EXAMPLES OF OVERALL FRAMEWORKS FOR ASSESSING CARRYING CAPACITY

(a) The LAC process (Stankey & McCool, 1984)

- identify area issues and concerns
  - economic
  - social
  - environmental
  - political constraints
- define and describe opportunity classes
  - resource
  - social
  - managerial
- select indicators of resource and social conditions (cf. Getz, 198 1, Table I)
  - economic
  - social
  - environmental
  - political
- inventory existing resource and social conditions
  - current status of indicators
  - standard data base
- specify standards for resource and social conditions for each opportunity class
  - acceptable limits
  - observable limits
  - measurable limits
- identify alternative opportunity classes allocations
  - type of use
  - location
  - timing
- identify management actions for each alternative
  - direct
  - indirect

<<

- evaluate and select a preferred alternative
  - costs versus benefits
  - consensus building
  - management capability

- implement actions and monitor conditions
  - compare against standards
  - adjust management strategies accordingly

In short,

- identify the location, type and level of change considered appropriate and acceptable
- compare existing and desired conditions
- implement the management of conditions, rather than use levels per se

(b) The QUAL process (Chilman et al, 1989) :

- management goal : quality recreation
  - operational definition of "quality"
  - obtain consensus of quality

- inventory existing conditions
  - reconnaissance of areas
  - comparison to other areas
  - divide management areas into subunits
  - measurement of subunit conditions

- analysis of alternatives
  - locate area of management focus
  - implications of changing area conditions
  - aspects of uniqueness or fragility

- objective : setting and implementation
  - select desired set of conditions
  - select condition indicators and management strategies
  - implement programmes and communicate progress

- monitoring and evaluation
  - determine if objectives are being achieved
  - determine what changes are occurring
  - search for ways to improve quality

(c) The VIM process (Graefe et al, 1990) :

- identify unacceptable visitor impacts - use indicators
- determine factors affecting incidence and severity of impacts
- select potential strategies for dealing with these unacceptable impacts
- monitor effectiveness of strategies implemented

<<

EXAMPLES OF QUESTIONS TO CONSIDER WHEN DETERMINING CARRYING CAPACITY

Adapted from McIntyre et al. (1993).

(a) Physical and ecological factors

- What is the size of the area to be developed?
  What portion is available for use by tourists?
  Are there seasonal limitations? (Consider viewing patterns; are they evenly distributed or concentrated?)

- What space modifications could improve the use? (Consider such things as plant buffers to minimise visibility or signage to manage accessibility.)

- What is the potential for ecological damage?
  For instance, how fragile is the soil?
  The plant life?
  The animal life?
  Other geological features?
  What facilities or design policies could prevent damage?

- What are the conservation needs of the marine life?
  Other wildlife?
  The plant life?
  The soil and other geological features? (Remember that the carrying capacity will be affected by such factors as diversity and distribution.)

- What are the preservation needs of historic or archaeological features?
  What places, or sites, because of fragility, should be off-limits to tourists?
  Or available only for limited use?

- Who has or should have the responsibility to assure that the infrastructure is appropriately built for the carrying capacity of the tourism resources?

- Will an increase in visitors affect the behaviour of animal life?
  How can conflict between competing uses be managed? (Consider restricting human visitation to tourist zones.)

(b) Social factors

- What volume of tourism can comfortably be absorbed into the day-to-day social life of the community? (Consider the willingness of residents to share their community.)
  Are there variations in tolerance levels during festivals, celebrations, religious occasions, or other special events?
  Is there a desire to modify/limit tourist behaviour or participation in cultural activities?
  If so, how might that be accomplished? (Consider dispersal policies.)

- What traditions could be affected by increased tourist visitation or interaction?
  How might this be positive rather than negative?
  How might contacts be a learning experience rather than a point of conflict?

- How will local residents be made aware and educated about the interrelationships among sustainable tourism, the environment, and the rest of the community?

(c) Economic factors

- Does the community receive satisfactory economic benefit from tourism activity?
  What is reasonable to expect?
  Will the economic benefits be sufficient to motivate the community to protect the environment?
- Is the current volume of tourism providing optimal economic benefits?
  If not, how can benefits be increased? (Consider adding value to existing services and products.)
- Does the tourism industry offer jobs and opportunities for local residents?
  Are they reasonably compensated?
  Are work conditions acceptable?
  Is job skill training available?
  Are there opportunities for promotions and advancements?
- Are there opportunities for local investments in businesses serving tourists?
  Or are profits drained off by outside investors?
  If so, how can this situation be remedied?
- Are locally produced goods available in quality and quantity sufficient to meet tourist expectations?

(d) Infrastructure factors

- What transportation facilities and services are available?
  Are tourism sites accessible by existing transportation services?
  If not, how can they be provided?
- Are utility services including water, power, sewage and solid waste disposal available and adequate for projected use?
  If not, how can they be provided?
- Are the provisions for health and public safety adequate ?
  If not, how can they be provided ?

EXAMPLES OF POTENTIAL INDICATORS OF IMPACTS

Adapted from Graefe (1987).

Physical :
- soil bulk density
- soil drainage
- soil compaction
- soil chemistry
- soil productivity
- amount and depth of litter
- area of barren core
- visible erosion/area of bare ground

Biological :
- soil fauna and microflora
- ground cover density
- percent loss of ground cover
- plant species composition and diversity

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- proportion of exotic plant species
- plant height
- plant species vigour
- extent of diseased vegetation
- extent of scarred or mutilated trees
- number of tree seedlings
- exposed tree roots
- abundance of wildlife species
- presence/absence of species
- frequency of wildlife sightings
- wildlife species diversity
- wildlife reproduction success

Social :

- number of visitors : in area per day
  by mode of transportation
- number of groups : in area per day
  by mode of transportation
- no. of encounters : with other groups per day
  with other individuals per day
  by activity type
  by mode of transportation
  by location of encounter
  by size of group
- visitor perception : of impact on environment
  of crowding
- visitor satisfaction
- reports of undesirable visitor behaviour
- amount of litter in areas
- number of visitor complaints

EXAMPLES OF POTENTIAL INDICATORS OF EXISTING TOURISM CONDITIONS

Adapted from Williams & Gill (199 1).

Environmental conditions :

- built environment size, distribution, capacity
- land use pattern and mix
- pollution loading levels
- noise levels
- natural habitat structure
- composition and diversity of species
- vegetation cover
- quality of air, water, soil
- health of humans
- health of biota
- demand for land, water, energy resources
- population densities and structure

Economic conditions

- number of full-time jobs; part-time jobs
- types and distribution of jobs created

<<

- types ofjobs displaced
- wage and salary levels
- amount of local investment
- tourism expenditure levels
- tax revenue levels
- inflation levels
- personal/household income levels
- costofliving
- cost of tourism services
- local access to tourism facilities
- housing affordability

Social-cultural conditions

- encounters between residents and tourists; tourists groups
- encounters by mode of transportation; location
- tourist satisfaction levels
- resident satisfaction levels

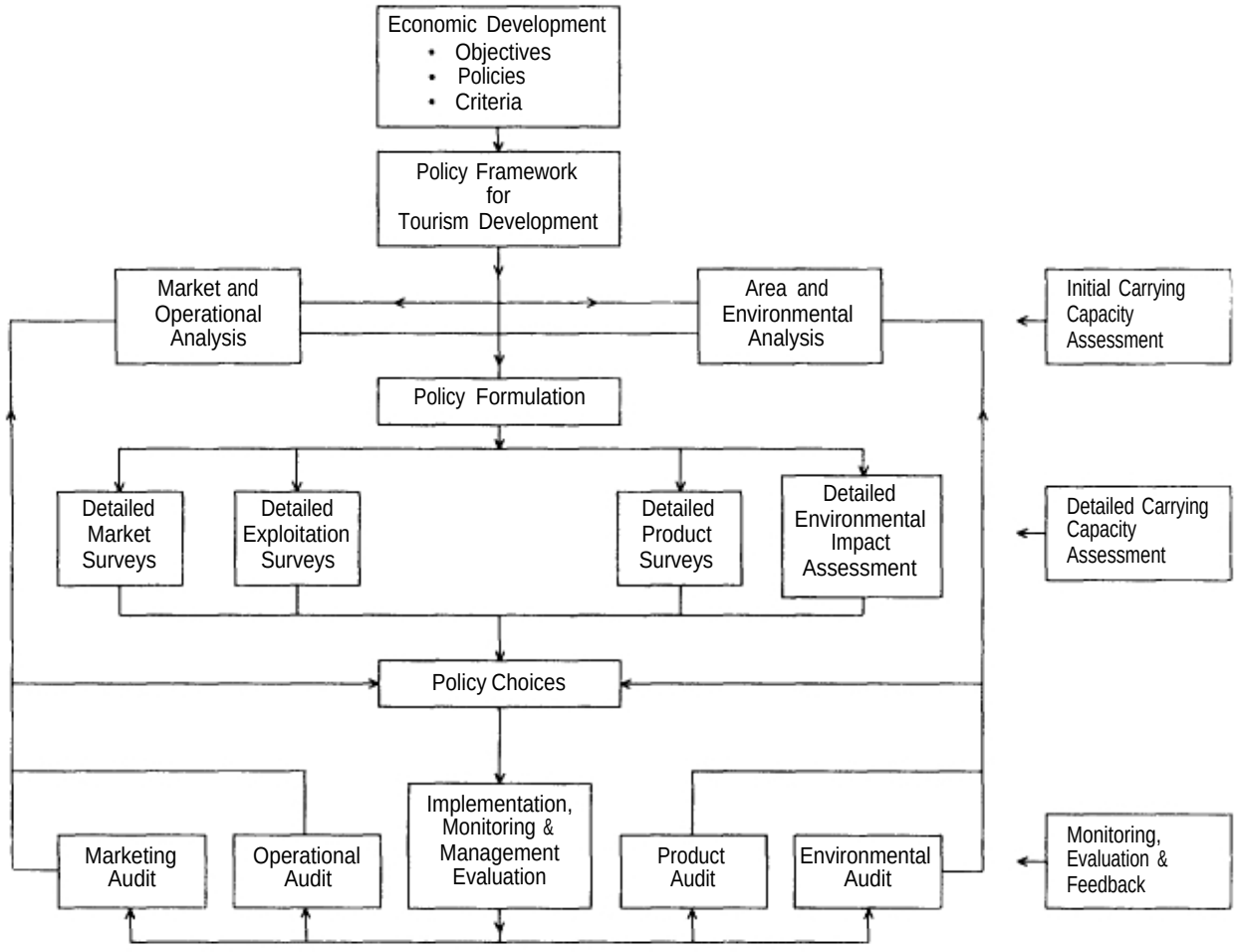

Figure I : Carrying capacity and sustainable tourism development.

Source : Mcintyre *etal* . , (1993).

<<

- tourist perceptions of crowding
- number of: tourist complaints; resident complaints
- employee housing availability
- access to community services and facilities
- perceived quality of community services and facilities

Carrying capacity should be considered at the three levels of policy formulation, detailed studies, and implementation and monitoring (Figure 1) (McIntyre et al, 1993).

It must be borne in mind that each case should be viewed separately, as management applications will vary according to the geographical, ecological, political, social, economical and cultural conditions of the particular area.

The carrying capacity concept is not intended to be used singularly, but should complement other management tools such as environmental impact assessments. land-use policies, tourism strategies and development plans.

The key lies in focusing research, not on the question "how much is too much?", but rather on, "how much change is acceptable?". This would entail an assessment of what hinds of resources and social conditions are appropriate and acceptable in different settings. Hence management focus is shifting from efforts to control numbers of visitors, to management strategies that reflect a predetel mined set ofenvironmentally and socially desirable conditions (Williams & Gill, 1991).

<<

Appendix 2

QUESTIONNAIRES

- Questionnaire for tourists
- Questionnaire for divers
- Questionnaire for tour operators
- Questionnaire for dive operators

<<

QUESTIONNAIRE FOR TOURISTS

Please either circle the appropriate letter tick the appropriate box or write your answer in the space provided Thank you.

Date : ..... Location : Marine Park Centre / Langkawi Coral Pontoon
(please cancel if not applicable)

1. Nationality : .....

2. Did you choose specifically to visit Pulau Payar?

(a) Yes (b) No

If yes, how important were the following in influencing your choice to visit Pulau Payar?

	Not important	Important	Very important
It is a Marine Park/protected area			
Opportunity to dive/snorkel and observe marine life and coral reef			
It is close to Langkawi/Penang/mainland			

If yes, was Pulau Payar on the itinerary of a package tour or island hopping tour?

(a) Yes (b) No

3. Please name the tour operator you are with : .....

4. Where did you take the boat to come to Pulau Payar?

(a) Langkawi (b) Penang (c) Kuala Kedah

5. Is this your first visit to Pulau Payar?

(a) Yes **(b) No**

If no, how many times have you visited the island previously? .....

If no, when was your last visit to Pulau Payar? .....

If no, what changes have you perceived in terms of the following?

	Improved	Deteriorated	No change
Number of visitors			
Number of divers			
Number of snorkellers			

	Improved	Deteriorated	No change	N/A
Number of visitors				
Number of divers				
Number of snorkellers				

<<

I I. Would an increace in visitor numbers affect your enjoyment of Pulau Payar?

(a) Yes (b) No

12. How important are the following factors to you in contributing towards a satisfactory visit to Pulau Payat?

13. Which of the following criteria were met during your visit to Pulau Payar? Please place a tick in the box(es) on the right hand side of the appropriate statement(s).

	12.			13.
	Not important	Important	Very important	Criteria met
Abundance of colourful reef fish				
Abundance of diverse, colourful coral				
Clean beaches				
Beautiful scenery				
Peace **and** quiet				
Absence of large number of people at the pontoon				
Absence of large number of people in the water while swimming and snorkelling				
A well organised tour				
A value for money tour				
Friendly and helpful Marine Park staff / pontoon staff				
Adequate facilities at the Marine Park Centre / pontoon				
Adequate information given on the marine environment				
Adequate guided activities such as videos / slide shows, nature walks, etc.				
Others (please state)				
.....				

14. Before arrival to Pulau Payar, were you aware that it is a Marine Park?

(a) Yes (b) No

15. Have you visited any other Marine Parks in Malaysia?

(a) Yes (a) No

If yes, please name them : .....

If yes, how does the Pulau Payar Marine Park compare with them?

(a) Better (b) Worse (c) Same

<<

16. Which of the following factors do you consider as important in a Marine Park? Please rate the level of importance.

	Not important	Important	Very important
Abundance and high diversity of coral			
Abundance and high diversity of fish and other marine life			
Absence of visible damage to corals			
Clean and clear waters			
Low visitor numbers			
Readily available information on the marine environment, flora and fauna			
Trained Marine Park Staff			
Others (please state)			
.....			

17. Were you briefed on Marine Park regul;ations (do's and don'ts) before arriving or on arrival?

(a) Yes (b) No

18. Do you think that you were given enough information on Pulau Payar regarding the following?

	Yes	No
Explanation on Pulau Payar's Marine Park status		
Marine Park regulations or do's and don'ts		
Recreation opportunities on the island and in its waters		
Surrounding marine flora and fauna		
Surrounding terrestrial flora and fauna		

19. Which of the following activities do you think will have a negative impact on the marine environment at Pulau Payar Marine Park? Please rate the level of impact.

20. Did you observe any of the following activities occurring in the Marine Park? If yes, please put a tick in the box(es) on the right hand side of the appropriate statement(s).

	19.			***20.***
	No impact	Negative impact	Very negative impact	Activity seen
Walking on coral				
Collecting coral/shells				
Boats anchoring on corals				
Recreational fishing				
Fish feeding				
Littering				
Others (please state)				
.....				

<<

21. How important do you think the following would be in ensuring protection of Pulau Payar's marine environment?

	Not important	Important	Very important
Strict enforcement of regulations			
Increase number of Marine Park Rangers			
Limit to the number of visitors to the park			
Control of recreation activities			
More information on do's and don'ts			
Others (please state)			

22. Which of the following activities would you like to see in future at Pulau Payar Marine Park?

- ☐ Guided snorkelling tours
- ☐ Glass-bottom boat/semi-sub rides
- ☐ Canoe rental
- ☐ Videos/slide shows on the marine environment
- ☐ Nature walks on the island
- ☐ Others (please state) .....
- ☐ .....

23. Would you be willing to pay a small fee for entry to the Marine Park or for participation in certain activities, if this fee would contribute to the management and conservation of the Park?

(a) Yes (b) No

<<

QUESTIONNAIRE FOR CERTIFIED DIVERS

Please either circle the appropriate letter; tick the appropriate box or write your answer in the space provided Thank you.

Date :.....

1. Nationality .....

2. Highest diving certification level attained : (eg. PADI Advanced Open Water etc.)

.....

3. Number of dives logged to date .....

4. Please name the dive operatoe you are with : .....

5. Did you to come to Pulau Payar MarinePark specifically to dive/on a dive trip?

(a) Yes (b) No

If yes, where are you staying for the duration of this trip?

(a) Langkawi (b) Penang (c) Mainland (please ***state town)*** .....

(d) Not applicable

6. How many days are you diving at Pulau Payar Marine Park? .....

7. How many dives have you made on this trip? .....

8. Please name the dive sites of Pulau Payar Marine Park you have dived at on this trip :

.....

.....

If you dived at any of the artificial reefs (boat and tyre reefs) or at the wreck, please state

.....

9. Are you diving with a group?

(a) Yes (b) No

If yes, how many of you are there? .....

10. Is this the first time you are diving at the Pulau Payar Marine Park?

(a) Yes (b) No

Ifno, how many times have you dived at Pulau Payar previously? .....

Ifno what changes have you perceived in the following?

	Improved	Deteriorated	No change
Number of visitors			
Diving trips offered			
	Improved	Deteriorated	No change
State/health of the reefs			
Abundance and diversity of marine life			
Visibility			

<<

II. Which of the following factors would you consider as important for a satisfactory dive experience?

12. Which of the following criteria were met during your dive(s) at Pulau Payar Marine Park? Please place a tick in the box(es) on the right hand side of the appropriate statement(s)

	11.			12.
	Not important	Important	Very important	Criteria met
Abundance of colourful reef fish				
Abundance of diverse and colourful coral species				
Abundance of other invertebrate marine life (e.g. sponges, anenomes, nudibranchs)				
Sightings of large marine animals (e.g. turtles, sharks, rays, etc.)				
Absence of visible damage to coral reefs				
Caves and swim-throughs				
Good visibility				
Absence of large number of other divers				
Low dive trip costs				
Well organised dive trips				
Experienced Dive Master/dive guide				
Good boat handling				
Being well briefed prior to the dive (e.g. underwater conditions to expect, marine flora and fauna)				
Others (please state)				

13. While diving, what is the frequency of contact with other diving groups you

	None	One	Two	Three	> Three
would prefer?					
will tolerate?					

14. At a site that you are at, how many other dive boats

	None	One	Two	Three	> Three
would you prefer to see?					
will you tolerate seeing?					

15. On average, whilst diving at the Pulau Payar Marine Park, how many times did you come into contact with another diving group? .....

If at least once,

which dive site did contact occur at? .....

did this contact affect your diving experience and in what way?

.....

<<

16. Would you dive at Pulau Payar again?

(a) Yes (b) No (c) Possibly

17. How long will the following activities impact negatively on the marine environment?

18. Did you observe any of the following activities occurring while diving? If yes, please place a tick in the box(es) on the right hand side of the appropriate statement(s).

	17.			18.
	No impact	Negative impact	Very negative impact	Activity seen
Boat anchoring on corals				
Walking on/breaking coral				
Touching coral				
Disturbing marine life				
Collecting coral/shells				
Spearfishing				
Others (please state)				
.....				

19. Do you think that the current level of diving at the Pulau Payar is having an adverse effect on its coral reef environment?

(a) Yes (b) No

20. What do you perceive to be the level of damage on the reefs you have dived at?

Name of dive site	None	Low	Moderate	High	Very high
1.					
2.					
3.					
4.					
5.					

21. Prior to diving here, were you aware that Pulau Payar is a Marine Park?

(a) Yes (b) No

If yes, how did Pulau Payar status as a Marine Park influence your decision to dive here

(a) Did not influence (b) Influenced (c) Greatly influenced

22. Since Pulau Payar is a Marine Park, did you expect your diving experience here to be better than at other Malaysian islands which are not legally protected?

(a) Yes (b) No

If yes, were your expextations met?

(a) Yes (b) No

<<

23. How do the dive sites at Pulau Payar compare to those of other islands (which are not Marine Parks) in Peninsular Malaysia?

(a) Better (b) Similar (c) Worse (d) Not applicable

24. Have you dived at other Marine Parks in Malaysia?

(a) Yes (b) No

If yes, please name them : .....

If yes, how does the diving at Pulau Payar Marine Park compare to them?

(a) Better (b) Similar (c) Worse (d) Not applicable

25. Were you briefed on Marine Park regulations or do's and don'ts before diving?

(a) Yes (b) No

If yes, who did the briefing?

(a) Dive Instructor/Dive Master/guide (b) Marine Park Rangers (c) Both

26. How important do you think the following would be in ensuring the protection of Pulau Payar Marine Park's marine environment?

	Not important	Important	Very important
Zonation of reefs for different activities (e.g. diving, research, off-limits)			
Limit to the number of dive groups at a dive site at one time			
Grading reefs according to difficulty and allowing entry depending on diver's experience			
Mooring buoys for five boats			
Creating alternatives (e.g. artificial reefs, glass-bottomed boats)			
Others (please state)			
. . . . .			

27. Would you be willing to pay a small fee to dive at the Marine Park, if this fee would contribute to the management and conservation of the Park?

(a) Yes (b) No

<<

QUESTIONNAIRE FOR TOUR / BOAT OPERATORS

Please either circle the appropriate letter, tick the appropriate box or write your answer in the space provided. Thank you

Name of establishment .....

Number of boats .....

Maximum number of people per boat .....

Average number of people in a tour group .....

Tour rates per person .....

1. Where is your company based?

   (a) Langkawi (b) Penang (c) Kuala Kedah (d) Kuala Lumpur

   (e) Others (please state).....

2. Where do you bring customers from to visit Pulau Payar?

   (a) Langkawi (b) Penang (c) Kuala Kedah

3. How many does your company conduct to Pulau Payar

   per weak? .....

   per year? .....

4. is Pulau Payar part of the itinerary of a package tour or island hopping tour you conduct?

   (a) Yes (b) No

   If yes, which other islands do you go to as part of this package tour/island hopping tour?

   .....

5. How long have you been conducting dive trips to Pulau Payar Marine Park? .....

   What changes have you perceived in terms of the following?

	Improved	Deteriorated	No change
Number of visitors			
Number of divers			
Number of snorkellers			

6. What nationality makes up the majority of your customers to Pulau Payar?
   (Please list the top three nationalities)

   1.....

   2.....

   3.....

7. What percentage of your boat(s) is tilled every day on average?

   (a) 0 - 25% (b) 26- 50% (c) 51 -75% (d) 76 - 100%

<<

8. When is the peak period of visitation to Pulau Payar? Please rank in order of importance (1 being the most important peak period :

- ❒ School holidays
- ❒ Weekends
- ❒ Public holidays
- ❒ Others (please state) .....

.....

What percentage of your boat(s) is filled then?

(a) 0- 25% (b) 26-50% (c) 51-75% (d) 76 - 100%

9. Do you think the number of boats available to ferry visitors to Pulau Payar is adequate?

(a) Yes (b) No

10. Do you offer snorkelling facilities?

(a) Yes (b) No

If yes, approximately how many percent of your customers opt to snorkel?

(a) 0-25% (b) 26- 50% (c) 51-75% (d) 76 - 100%

Il. Do you offer diving facilities?

(a) Yes (b) No

If yes, approximately how many percent of your customers opt to dive?

(a) 0 - 25% (b) 26-50% (c) 51 - 75% (d) 76 - 100%

If yes, do you offer the opportunity of introductory dives to people with no previous diving experience?

(a) Yes (b) No

12. Do you plan to expand your operations to Pulau Payar?

(a) Yes (b) No

If yes, what are your plans?

.....

.....

13. Please elaborate on how you deal with the following (ifapplicable) :

Sewage diaposal :.....

Solid waste disposal : . . . .

Water supply: ....

Spent fuel :.....

14. Do you conduct tours to other Marine Parks in Malaysia?

(a) Yes (b) No

If yes, please name them : .....

15. Are you aware of the conservation objectives of the Pulau Payar Marine Park?

(a) Yes (b) No

<<

16. How important are the following actions (that you as a tour/boat operator can take) in contributing towards conserving Pulau Payar's marine environment?

	Not important	Important	Very important
Limiting the number of customers brought to Pulau Payar			
Controlling the recreation activities the customers can undertake			
Ensuring customers do not break or step on coral or collect coral and shells			
Ensuring customers do not litter			
Providing more information on do's and dont' (Marine Park regulations)			
Others (please state)			
.....			

17. Do you inform your customers about Pulau Payar's Marine Park status and brief them on activities that can or cannot be carried out?

(a) Yes (b) No (c) Only snorkellers and/or divers

If yes, in what form is this information given? Please tick against the appropriate items :

- ❒ Talks
- ❑ Brochures
- ❒ Videos
- ❒ Slide shows

Others (Please state) : .....

❑ . . . . . .

18. Do you think that the status of Pulau Payar as a Marine Park has affected your business in any way?

(a) Yes, positively (b) Yes, negatively (c) No

Please elaborate in what way :

.....

.....

19. Which of the following activities would you like to see in future at Pulau Payar Marine Park?

- ❒ Guided snorkelling tours
- ❑ Glass-bottom boat/semi-sub rides
- ❒ Canoe rental
- ❒ Videos/slide shows on the marine environment
- ❒ Nature walks on the island
- ❒ Others (please state) .....

❑ .....

20. Would you be willing to pay a small fee to enable your customers to dive at the Marine Park or to participate in certain activities, if this fee would contribute to the management and conservation of the Park?

(a) Yes (b) No

<<

QUESTIONNAIRE FOR DIVE OPERATORS

Shop Owners, Dive Instructors and Dive Masters

Please either circle the appropriate letter; tick the appropriate box or write your answer in the space provided Thank you.

Name of dive operation .....

Number of boats .....

Maximum number of divers per boat .....

Average number of diversin a dive group .....

Rate per dive (with equipment) .....

(without equipment) .....

1. **Where is your company based?**

   (a) Langkawi (b) Penang (c) Kuala Lumpur (d) Others *(please state)*.....

2. **Where do you bring customers from to dive at Pulau Payar?**

   (a) Langkawi (b) Penang (c) Kuala Kedah

3. **How many dive trips do you conduct to Pulau Payar**

   per weak? .....

   per year? .....

4. **Please name the dive sites of Pulau Payar Marine Park that you bring divers to :**

   .....

   .....

5. **How long have youbeen conducting dive trips to Pulau Payar Marine Park?**.....

   What changes have you perceived in terms of the following?

	Improved	Deteriorated	No change
State / health of the reefs			
Aundance and diversity of marine life			
Visibility			

6. **What nationality makes up the majority of your divers?**
   (Please list the top three nationalities)

   1 .....

   2 . . ..

   3. . . . . .

7. **What percentage of your boat(s) is tilled every day on average?**

   (a) 0-25% (b) 26- 50% (c) 51 -75% (d) 76- 100%

<<

8. **When is the peak period for Pulau Payar** *Please rank in order of importance (1 being the most important peak* **period)**

- ❒ **School holidays**
- ❒ **Weekends**
- ❒ **Public holidays**
- ❒ **Others (please state)** .....

.....

What percentage of your boat(s) is filled then?

(a) 0 - 25% **(b) 26-50%** **(c) 51 - 75%** **(d) 76 - 100%**

9. **What is the pattern of diver numbers like?**

(a) Increasing **(b) Decreasing** **(c) Unchanged**

10. **Do you think there are currently enough dive operators running dive trips to Pulau Payar and its surrounding islands?**

(a) Yes **(b) No**

11. **Which is the most popular dive site at Pulau Payar?** .....

12. **How do the dive sites of Pulau Payar compare to those of other islands in Peninsular Malaysia?**

(a) Better **(b) Similar** **(c) Worse**

13. **Do you conduct dive trips to other Marine Parks in Malaysia?**

(a) Yes **(b) No**

If yes, please name them : ....

14. **Are you aware of the conservation objectives of the Pulau Payar Marine Park?**

(a) Yes **(b) No**

15. **Do you inform your divers about Pulau Payar's Marine Park status and brief them on activities that can or cannot be carried out?**

(a) Yes **(b) No**

If yes, in what form is this information given *Please tick against the appropriate items :*

- ❒ **Talks**
- ❒ **Brochures**
- ❒ **Videos**
- ❒ **Slide shows**
- ❒ **Others** *(Please state) :* .....
- ❒ .....

16. **Do you think that visiting divers to Pulau Payar are aware of the sensitivity of the reef environment?**

(a) Yes **(b) Moderately** **(c) No**

Do their actions while diving reflect this?

(a) Yes **(b) Sometimes** **(c) Rarely** (d) No

<<

17. Do you think the current level of diving at Pulau Payar is having an adverse effect on its coral reef environment?

(a) Yes (b) No

18. How important are the following actions (that you as a dive operator can take) in contributing towards conserving Pulau Payar's marine environment?

	Not important	Important	Very important
Limiting the number of divers brought to Pulau Payar			
Limiting the number of divers in a dive group			
Limiting the number of dive groups at a dive site at one time			
Grading reefs according to difficulty and allowing entry depending on diver's experience			
Ensuring divers do not break or step on coral or collect coral and shells			
Not anchoring on reefs			
Thoroughly briefing divers on Marine Park regulations before dive			
Others *(please state)*			
.....			

19. Do you think that the status of Pulau Payar as a Marine Park has affected your business in any way?

(a) Yes, positively (b) Yes, negatively (c) No

Please elaborate in what way :

20. Would you be willing to pay a small fee to enable your divers to dive at the Marine Park. if this fee would contribute to the management and conservation of the Park?

(a) Yes (b) No

<<