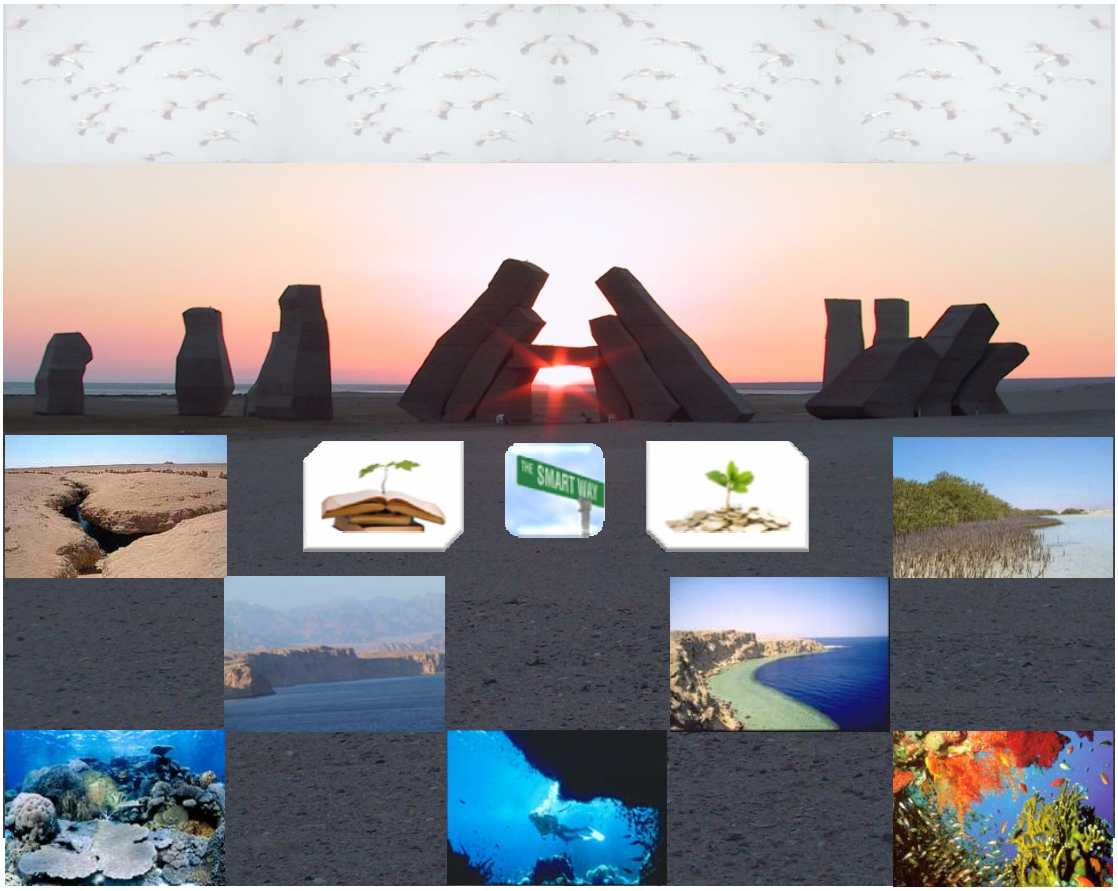
Economic Valuation of Ecosystem Benefits in Ras Mohammed National Park



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Strengthening Protected Area Financing and Management Systems

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Executive Summary

Despite ongoing efforts led by government and international partners, Egypt's biodiversity remains seriously threatened. A significant root cause for the degradation of the ecosystems is the absence of concrete figures which economically reveal the benefits provided by them and the cost of their damage. Very few economic valuation exercises have been undertaken in the Egyptian PAs. As a result, the Nature Conservation Sector (NCS) does not have a comprehensive economic case to prove current benefits of PAs to Egyptian society, nor does it have an assessment of tangible and intangible ecosystem services provided by the PA system. The lack of such information prevents NCS from building a strong case to elevate PAs' profile in public and private spheres. This information problem is tied to a lack of national capacities in environmental economic valuation methodologies.

The proposed long-term solution for biodiversity conservation of Egypt's protected areas is an effective and sustainable PA system that has the financial wherewithal and management capacities needed for effective management. The EPASP will help to achieve this by strengthening legal, regulatory and institutional frameworks that support sustainable PA financing; tools and practices for revenue generation and mobilization; and business planning and other tools for cost-effective management. The objective of the output 1.1 in the project AWP is to conduct a system-level economic valuation of the benefits of the PA ecosystem goods and services and its contribution to local and national economy on both public and private sectors level. This main objective is tied with other objectives to determine the economic costs of ecosystem degradation and benefits of better management and to determine the factors that affect the demand for the PA, the fair entrance fees and the appropriate revenue-generating mechanisms.

Economic valuation is crucial for conversation and ecological management decisions. It helps to better protect the threaten ecosystems, and assess the trade-offs involved in different management options. It also can help to increase awareness, penalise environmentally degrading activities, incentivise sustainable uses, galvanise support for conservation, and establish solid partnerships among the different stakeholders. Economic information is likely to be more influential in real policy-making situations than ecological information. Economic instruments such as user fees, taxes, licences and penalties can help generate revenues and at the same time modify human behaviour towards conservation.

Protected areas have a potentially critical role to play in reducing the threats to Egypt's biodiversity. PAs can yield long term benefits for Egypt and her people if they are protected from improper use and managed in an efficient, dynamic, scientifically orientated way that allows to quick response to challenges as they arise. If decision makers are aware of PA benefits, their values and the amount of money that they bring to their economy, then a more concerted and united effort can be effectively established. Moreover, this can empower the PA management and justify the commitment to conserve and manage its valuable ecosystems.

Ras Mohammed is the Crown Jewel of the protected areas in Egypt. It is renowned globally for the diversity and richness of its coral reefs, rated amongst the world's best. Such uniqueness makes the park a major recreational attraction and the cornerstone of ecotourism within South Sinai. The volume of tourists and the over-development along the coast of the Gulf of Aqaba have degraded the reef. An ecosystem services approach that can support the management of the park in the context of the seascape and takes into account the impacts of the land use should be adopted. Armed with a broader, deeper knowledge of the different aspects of the ecosystems, we will be better equipped to safeguard their future.

In the light of the interest in using the ecosystem services approach as a useful tool of PA management, the objective of this study is to elucidate the different services and benefits provided by the main ecosystems within Ras Mohammed National Park and shine a light on the magnitude of them in terms of people's welfare. This is tied with other objectives to elucidating the viability of valuing ecosystem benefits and identifying the associated measurement issues that make the valuation a unique challenge, demonstrating the different methods for deriving willingness to pay (WTP), investigating the contributions of attributes of the park and characteristics of individuals to elucidating choice behaviour, identifying how much use is acceptable without leading to a decline in visitor enjoyment, demonstrating the importance of tourism to the local economy and the impact of tourism on the park, drawing up the stakeholder analysis which describes the beneficiaries and different users of the park, and discussing the importance of valuing ecosystem benefits and the use of valuation results and visitor preferences to feed into a management plan for the park in order to insure the sustainable use of the park.

The economic values were calculated in terms of the recreational benefits that were thought to be the most important to the different stakeholders plus Ras Mohammed is a National Park and managed mainly for coral reef protection and recreation. Furthermore, coral reef tourism in South Sinai is the pillar of the local economy. By using the travel cost method, the total recreational benefit was estimated to be above US$ 1.1 billion per year.

To get a range of potential values of different ecosystem benefits and compare them to the valuation studies conducted in Ras Mohammed, a statistical evaluation of the summary findings of the literature was carried out. For the data sets the average was \$210,819 ha^{-1} yr^{-1} for coral reefs, \$126,069 $ha^{-1}yr^{-1}$ for mangroves, and \$27,961 ha^{-1} yr^{-1} for seagrasses.

The contingent valuation method was used to estimate the maximum willingness to pay (WTP) of the visitor on top of the existing entrance fee to support coral reefs conservation. The mean WTP was \$7. As a result, the entrance fees could be raised to\$12/person/day.

The choice experiments method was used to investigate the perception of visitors to Ras Mohammed and their attitudes towards coral reefs. The foreign tourist is WTP an extra \$0.5 for each 1% increase in the reef quality, \$0.2 for each 1% decrease in the congestion level and \$0.4 for each additional dive site while the national tourist is WTP an extra LE0.7 for each 1% increase in the reef quality, LE0.05 for each 1% decrease in the congestion level and LE0.3 for each additional dive site. A set of four scenarios were analysed in order to understand how visitors would react to various conservation management strategies and estimate the relative importance for each of them to visitors. The results showed that Ras Mohammed under any of the scenarios presented yields an efficiency gain. However, towards sustainability scenarios yield higher net benefits than business-as-usual scenarios.

This report attempt to partially fill the information gap by giving examples of the economic values associated with ecosystems in Ras Mohammed. Considerable further studies will be required to validate robustness and completeness of the socio-economic issues and economic values (e.g. pharmaceuticals, non-use values, and the contribution of the protected reef in enhancing yields in the form of increased recruitment and spillover of several commercial species into fished areas) and to address other ecosystems in Ras Mohammed and other PAs in Egypt. An annual visitor profile and feedback surveys in the region are also recommended to monitor changes in market demand. Despite this, the study provides a valuable first step in the continuous process of fully understanding and evaluating the importance of the many and complex values of Egypt's biodiversity.

Commitment from different governmental authorities towards protecting the ecosystems is needed to harmonise development and protection. The park authority must be the paramount planning authority and able to prevent any development likely to impact negatively on the ecosystems. It must have the means to deliver its mandate. Also, more environmental awareness efforts should be targeted at tourists and local communities in order to create the demand for environment protection and exert more pressure on the different stakeholders to interact with ecosystems in an environmentally responsible and sustainable manner. The major challenges are to meet multiple objectives and to achieve fair balance if they conflict and to reconcile the short term desires with the sustainable and long term needs. The direct and indirect consequences of human actions should be considered and the way these critical ecosystems are monitored and managed should be assessed. This emphasises the importance of conflict mediation, stakeholder involvement, capacity building and policy appraisal to be incorporated in the park management plan.

Of great interest to the management of Ras Mohammed is the need to: adopt a long term approach for managing financial reserves, seek to maximise income generation opportunities and build a diverse funding portfolio, develop a pricing policy on the payment of concessions and adopt new and non-traditional funding sources, remove the institutional distortions and obstacles to the park funding, assure the incentives and opportunities for the park management to retain funds at the park area level, establish a formal connection between those taking an action and those affected by it, incentives systems for stakeholders to conserve natural treasures, initiate better governance for fisheries and marine ecosystems to overcome the overlapping of legal mandates, build solid cooperation at the highest national levels, involving the coast guards and police, to stop different threats to coral reefs and illegal fishing, and take into account the impacts of the mass tourism and monitor their relative rates on the reef system in order to sustain its services and benefits. The need for these actions is of utmost urgency; particularly: the more the stress, the higher the probability of catastrophic change in value of the reef. Finally, unless economic values are taken into account, efforts to manage coral reefs and other ecosystems are not likely to be effective.

1. Introduction

Ras Mohammed National Park was declared in 1983. The area includes the islands of Tiran and Sanafir and all shorelines fronting the Sharm El-Sheikh tourism development area. The park is home to some of the most spectacular coral reefs and best known SCUBA diving areas in the world. This recognition is based on the diversity of flora and fauna, clear warm water devoid of pollutants, their proximity to shorelines and their breathtaking beauty. This combination plus its accessibility in most weather conditions and relative proximity for European tourists form the basis of Ras Mohammed's popularity as a tourist destination. Tourism is the fastest growing major industry in Egypt with over twelve million foreign tourists per year and coastal tourism is the largest sector in this industry (TDA, 2010). The Egyptian Red Sea has become one of the most well known dive destinations in the world. With a total of 158,362 certifications between 2001 and 2003, 76,266 people took the entry level PADI Open Water in Egypt (Ashworth, 2004). The number of visitors to Ras Mohammed increased from hundreds in eighties to hundreds of thousands in the noughties. The volume of tourists and the intensive recreational use by snorkelers and SCUBA divers have degraded the reefs. The reef degradation and the loss of productivity and biodiversity could have serious consequences. It is threatening the ecological services provided to millions of other dependent species and the numerous benefits provided to people. Moreover, the repercussions will not be restricted to coral reefs but will affect many other reef-associated ecosystems. Lack of awareness, insufficient enforcement of protective legislation, market failure and undervaluation of benefits are the root causes of several threats to many ecosystems in Ras Mohammed.

The ecosystem services approach can represent a consistent point of contact between ecology and economics and a way to incorporate economic valuation into ecosystem management decisions. Although, the ecosystem services are vital to our survival, we still know very little about them and their values. The deeper understanding of ecosystem services can improve their management and make people recognise that they are not only damaging the ecosystem but also destroying and losing a multitude of critical services and benefits with serious economic consequences.

The inherent link between decisions and valuation makes the latter non optional. If decision makers are aware of ecosystem benefits, their values and the amount of money they bring to their economy, then a more concerted and united effort can be effectively established. Moreover, this can empower the park management and justify the commitment to conserve and manage these valuable ecosystems. Economic valuation also helps to efficiently assess different alternatives, improve decision making, exhibit impacts on ecosystem services, penalise environmentally degrading activities, incentivise sustainable uses, increase awareness, galvanise support for conservation, and establish solid partnerships among the different stakeholders.

The challenge for Ras Mohammed is to generate considerable economic benefits while maintaining the ecosystems on which it depends. This study aims to assist in this debate through valuing the ecosystem benefits within Ras Mohammed National Park, determining the factors that affect the demand for the park, and investigating visitor perceptions towards park attributes.

2. Characteristics of the Study Area

2.1 The Park Overview

The different types of protected areas have been categorised based on their management objectives. Ras Mohammed is category II i.e. a protected area managed mainly for ecosystem protection and recreation. It is renowned globally for the diversity and richness of its coral reefs, rated amongst the world's best. Such uniqueness makes the park a major recreational attraction and the cornerstone of ecotourism within South Sinai. Ras Mohammed lies at the southernmost tip of the Sinai Peninsula at the northern end of the Red Sea, overlooking the juncture of the Gulfs of Suez and Aqaba (27°44'N 34°15'E) extending from a point opposite the Qad Ibn Haddan lighthouse on the Gulf of Suez to the southern boundary of the Nabq Protected Area on the Gulf of Aqaba. It is located just 12 km

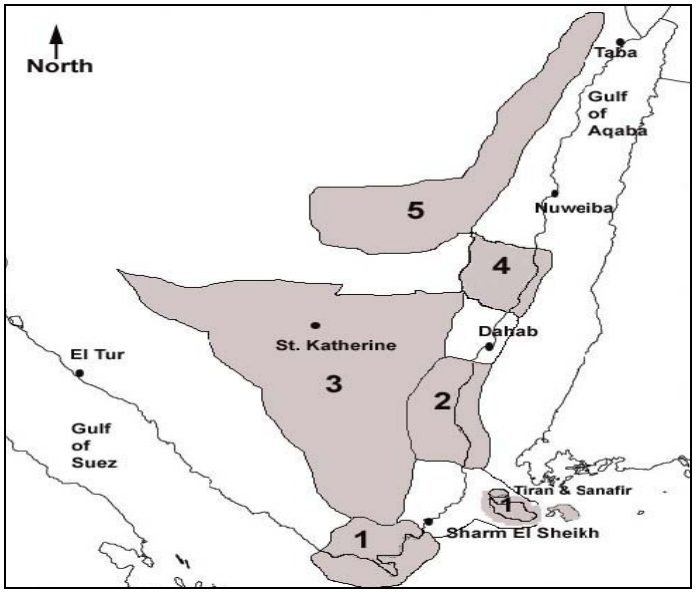
from Sharm El-Sheikh City and 446 km from Cairo. The terrestrial area is dominated by raised fossil reefs. Fringing coral reefs encircle most of the protected area. Tiran Island is dominated by arid mountains, with small areas of salt marsh on the coastline. Fringe reefs again dominate the coastline, with four large patch reefs in the Tiran Straits.


Entrance to Ras Mohammed National Park

2.2 National Designation and Legal Basis of Management

In 1983 Ras Mohammed was notified as a marine reserve under Decree No. 1068. Until 1988, Ras Mohammed was a 'paper park' when the Egyptian Environmental Affairs Agency was delegated by the government to regulate the park. Subsequently, Ras Mohammed was classified as a national park and extended to encompass the islands of Tiran and Sanafir and all shorelines fronting the Sharm El-Sheikh tourism development area. The park is protected under Presidential Law No. 102 of 1983 for Natural Protectorates and Prime Ministerial Decree No. 1068 of 1983 amended by Decree No. 2035 of 1996. Law 102 further gave the Egyptian Environmental Affairs Agency executive authority not only over protected areas but also over setback areas adjacent to marine reserves, which substantially extended the spatial jurisdiction of the protected-area regime. Law No.4 of 1994 (amended by Law 9/2009) establishes principles and procedures that address all environmental issues in Egypt. The entire system of offshore coastal reefs was declared protected when this law required review of any development less than 200 feet from the highest tide line. In addition, the international agreements provide international

recognition, prestige, and an additional layer of legal protection to the reef sites which can restrict the attempts of national governments to allow activities damaging to coral reefs.



South Sinai Protectorates (1 = Ras Mohammed National Park and Tiran & Sanafir Islands, 2 = Nabq Managed Resource Protected Area, 3 = St. Katherine Protectorate, 4 = Abu Galum Managed Resource Protected Area, and 5 = Taba Natural Monument)

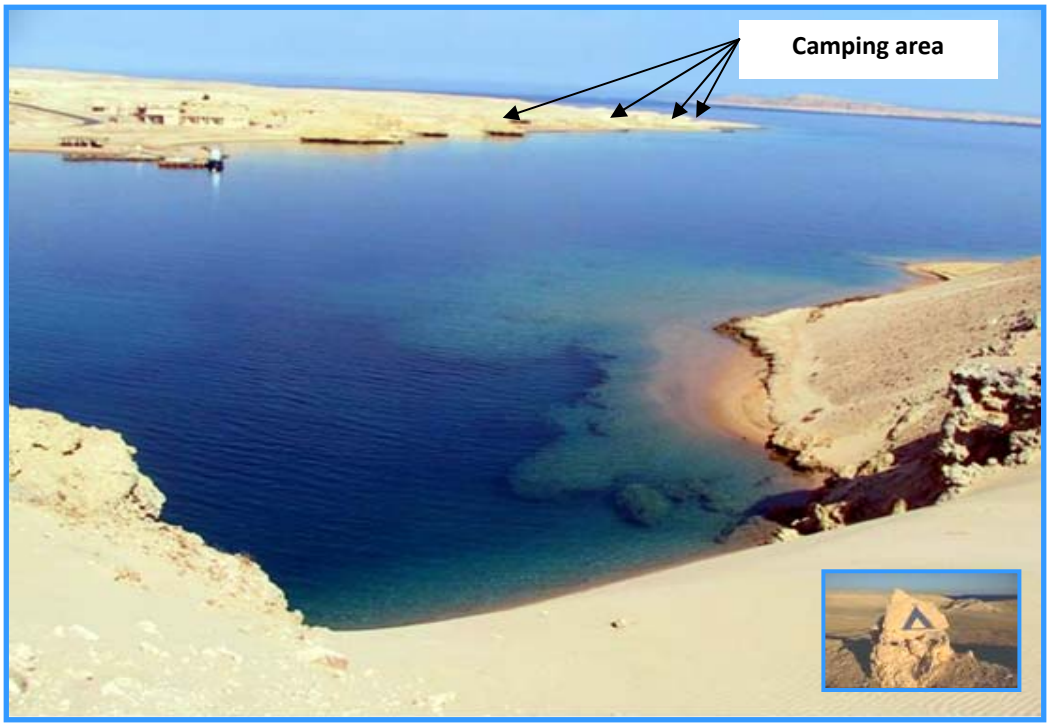
2.3 Park popular areas

Visitors arrive at Ras Mohammed on day trips by boat or from land. Shark Reef and Yolanda Reef are popular areas of coral reef in the park for divers. Other coral reef sites include South Bereika, Ras Ghozlani, Old Quay, and Shark Observatory. Beach areas are more prevalent on the eastern coast of Ras Mohammed facing the Gulf of Aqaba. Main Beach is located south west of Shark Observatory and to the east of Yolanda Beach. This beach has parking facilities and is accessed by the main road. The Main Beach remains one of the best locations to see vertical coral walls. To the west lies the Shark Reef which is separated from the beach by a relatively shallow canal. Shark Reef boasts a sheer wall dropping to well past 50 m along its north-east and eastern sides, giving way to a steep reef slope as the reef proceeds south-west toward Yolanda. Yolanda is the southernmost beach and is at the tip of the Ras Mohammed Peninsula. To the west is Yolanda Bay leading to the Hidden Bay. To the North East is Shark's Bay. Yolanda beach is surrounded by low rising

dry coral cliffs with some small caves. The water off the beach is a shallow reef table that vertically drops to a depth < 50 m away. The beach provides an excellent starting point to the Yolanda and Sharks' Reef diving sites if visitors plan to do it swimming. Shark Observatory is more of an access point to the famous diving site with the same name than an actual beach. The site is a vertical wall sloping outwards. Ras Ghozlani is a small inlet located across from the park visitor centre, at the mouth of Marsa Bereika, the large shallow bay that nearly separates Ras Mohammad itself from the Sinai mainland. Old Quay is one of the few beaches found facing the Gulf of Suez and can serve as an access point to the Quay diving sites. The beach has some of the best shallow water reef structure but with more turbid water. Aqaba beach is situated south of the Shark Observatory and represents the main access point to the Eel Garden and Jackfish Alley diving sites.

Popular beaches in Ras Mohammed

The visitor centre in Marsa Ghozlani



Camping Sites in Ras Mohammed

2.4. DPSIR (Drivers-Pressures-State-Impact-Responses) framework

Drivers

In developing countries where the achievement of economic progress topped the agenda of the policy makers, it is difficult to convince them about the value of conservation objectives. Although the conservation of ecosystems is the responsibility of the state in Egypt, the government itself has sometimes been responsible for the threats to these ecosystems. For instance, some policies of the ministries of Agriculture and Tourism sometimes clash with the efforts of the Environmental Affairs Agency to protect the natural habitats. Moreover, the revenues generated from tourism may not be effectively used for conservation. Pearce (2007) based the damage reasons on a combination of lack of commitment, lack of resources and lack of knowledge. The lack of knowledge about the value of benefits provided by ecosystems is an ultimate cause of a lot of the threats to them.

Pressures

- Tourism growth can be seen in Ras Mohammed (old boundaries), with the number of visitors increasing from 77,550 in 1994/95 to 520,012 in 2009/10. By adding the number of divers and snorkelers to the dive sites in the park extension (Tiran island and Sharm El-Sheik coastline), the number increases to more than 1 million visitor per year.
- Hawkins and Roberts (1993, 1994) found that damage to reefs was significantly higher in more heavily dived sites. They pointed out that some of these dive sites received between 35,000 and 50,000 dives per year. Another study revealed that more than 70,000 dives per year occurred in six dive sites which were heavily used in Ras Mohammed (PERSGA, 2003b). The two most popular beaches at Ras Mohammed, Yolanda Bay and Main Beach, were estimated to receive 83,868 and 75,280 visitors per year, respectively (Leujak, 2006).
- The number of dive boats in Sharm El-Sheikh has risen to more than 300.
- The number of diving centres has increased from 5 to more than 70 between 1988 and 2006 with a great variation in standards, services and quality.

- The population of South Sinai has boomed from 54,806 in 1996 to about 159,000 in 2010 (CAPMAS, 2010).
- Many reef fisheries are affected by illegal fishing and the increasing demand for fish from the residents and the restaurants of the tourist resorts in Sharm El-Sheikh. Pilcher and Abou Zaid (2000) stated that the General Authority for Fish Resources Development (GAFRD) plans to raise the total fish catches from about 36,000 tons in 1990 to 70,000 tons in 2017.
-The Red Sea is a main international shipping route which makes it vulnerable to many vessel accidents. Recently, there have been several ship groundings on the coral reefs in the Gulf of Aqaba with the rapid increase in the number of recreational boats.
- Increasing levels of sediments from coastal development, dredging and land reclamation plus the nutrient enrichment from human waste degraded the reef in many places along the shoreline fronting the Sharm El-Sheikh tourism development area.
- Flooding, disease and predator outbreaks are natural threats to coral reefs. However, these phenomena may result from anthropogenic inputs (PERSGA, 2003a).

State

The unique geological and bio-geographic features of the Red Sea provide an appropriate environment for numerous species and habitats. It may be the most diverse coral reef area apart from the coral reefs in Southeast Asia (Spalding et al., 2001). The coral reef ecosystems found in Ras Mohammed are recognised internationally as among the world's best. They vary from shallow slopes with sandy plateau (e.g. Turtle Beach) to steep walls (e.g. Shark Reef and Shark Observatory) (Pearson and Shehata, 1998). The fringing reefs are the most common reef type in the park with a reef flat ranging between 5 and 50 m along the coastline and a reef slope depth ranges from 10 to 85 m (PERSGA, 2003a). The patch reefs occur in the strait of Tiran and the northeast of the park with a shallow sandy platform ranging between 10 and 140 m and reef slope drops to depths ranging from 3 to 200 m (PERSGA, 2003a). The coral reefs along the coastline of Sharm El-Sheikh are all fringing reefs, and generally have relatively narrow reef flats of less than 100 m wide. The

western side of Ras Mohammed has discontinuous fringing reefs with a shallow reef flat ranging between 200 and 1800 m in width (PERSGA, 2003a).

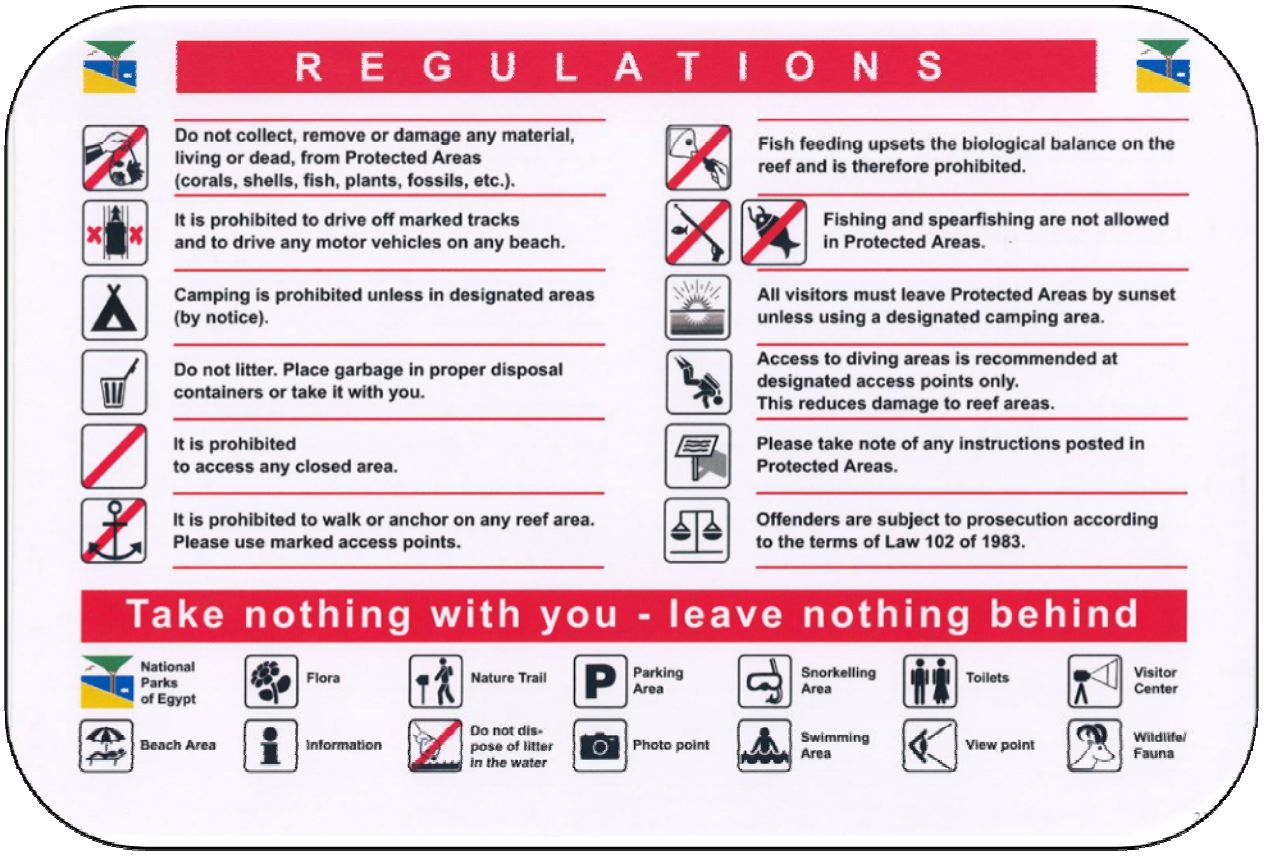
Impact

There has been a decline in coral cover by 20 to 30 % at many sites in the Red Sea (Jameson et al., 1997). Moreover, there was a decrease in the number of butterfly fish, which are considered an indicator species for reef health and diversity, from 9.7/100m2 to 5.2/100m2. Also, sweetlip populations decreased by 69% (Hassan et al., 2002). Over the last two decades, 29 dive boats have grounded on the coral reef and destroyed a wide area of the reef (PERSGA, 2003a). Coral diseases (e.g black band) have increased by a factor of 10 (Hassan et al., 2002). A moderate outbreak of crown-of-thorns starfish occurred at Ras Mohammed in 1994 while the major outbreak occurred in 1998 around the Gordon reef (PERSGA, 2003a).

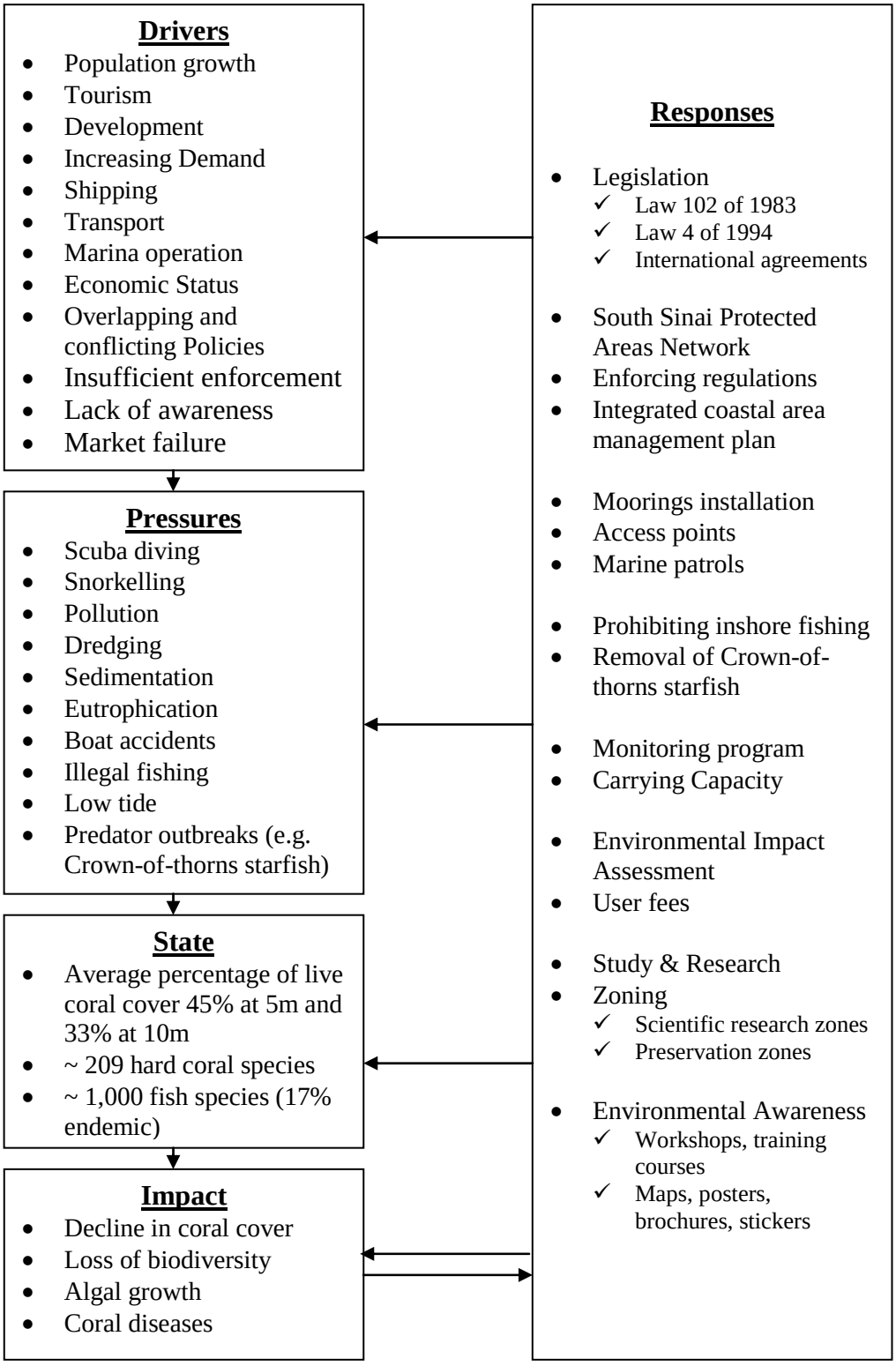
Responses

- A number of laws have been passed to regulate the relationship between environment protection and the promotion of economic development. Nature Protectorates Law 102 of 1983 and Environmental Law 4 of 1994 (amended by Law 9/2009) empower the government to enforce regulations and manage the natural resources.
- A network of protected areas was established in South Sinai to safeguard the environment against destructive development.
- Mooring buoys have been installed to reduce the anchor and diver damage to coral reefs.
- A number of walkways and access points were established to reduce the damage from trampling.
- Scientific research zones and preservation zones are kept closed.
- Environmental impact assessments are requested from all the developers. An entrance fees system (LE40 per day) and a fine system for reef damage ($300 per m^2) were established. However better systems, which consider the economic value of coral reefs, are needed.

- The South Sinai Protectorates organised the removal of over 60,000 starfish between 1998 and 1999 (PERSGA, 2003a).
- Inshore fishing (up to 500 m away from the reef crest) is prohibited along the coastline of Sharm El-Sheikh and in Ras Mohammed National Park.
- Environmental awareness has risen in Egypt due to the efforts of the media and the Egyptian Environmental Affairs Agency. Besides, the distribution of maps, films, brochures and regulations in several languages, the Nature Conservation Training Centre and South Sinai Protectorates have organised several workshops and training courses for the hotel staff, dive guides, instructors, and skippers.



Park Regulation



The DPSIR framework for Ras Mohammed

3. Ecosystem Services Approach

3.1. The Concept of Ecosystem Services

Terminology is a significant part of the valuation problem (Boyd, 2007). Studies that have addressed ecosystem services varied in their use of definitions and key terms, which has led to linguistic uncertainty and ambiguity around the concept of ecosystem service (Wallace, 2007). Although the early references to the concept of ecosystem services mixed between different terms such as structures, assets, stocks, processes, functions, services and values, the more recent studies have predominately linked the ecosystem services to human welfare benefits. Binning et al. (2001) represent them as "linkages between natural assets and the production of goods that are of value to humans" while they are "the benefits people obtain from ecosystems" in the Millennium Ecosystem Assessment (MA 2005). According to Fisher et al. (2009) ecosystem services are "the aspects of ecosystems utilised, actively or passively, to produce human well-being".

3.2. Ecosystem Services Classification

The classification system should be conditioned by the characteristics of interest and the decision context. Moberg and Folke (1999) divided the ecological goods of coral reef ecosystem into renewable resources (e.g. fish, seaweed, medicine) and reef mining (e.g. sand, rubble, coral blocks). The services are classified into five categories: physical structure services (e.g. coastal protection); biotic services (e.g. habitat maintenance); biogeochemical services (e.g. the retention of naturally occurring chemical compounds such as nitrogen and phosphorus) and the export of excess nutrients from the reef system; information services (e.g. climate record); and social and cultural services (e.g. aesthetic values, recreation). De Groot et al. (2002) classified 23 ecosystem functions into four categories: regulation functions; habitat functions; production functions; and information functions. They noted that the first two categories are essential for the other two categories. The Millennium Ecosystem Assessment (2005) divided ecosystem services into four groups: provisioning services such as food, genetic resources, medicines, and ornamental resources; supporting services such as photosynthesis, primary production,

and nutrient cycling; regulating services such as the regulation of erosion, wastes, climate and natural hazard; and cultural services such as recreation, education, spiritual fulfilment and aesthetic enjoyment. Because of its simplicity, the MA classification is one of the most widely used. However, several studies showed that the MA classification can be further refined to fit specific policy contexts. Without these refinements the MA scheme could lead to double counting the value of some services, particularly the supporting services. Wallace's Schema (2007) arranged ecosystem services in a hierarchical classification starting with adequate resources such as food, oxygen and energy and progressing to other categories such as protection from predators, disease, parasites; benign physical and chemical environment (e.g. temperature, light, moisture); and socio-cultural fulfilment (e.g. spiritual and philosophical contentment, meaningful occupation, knowledge). Although, this classification removes the risk of double counting and can yield useful information about the level or levels where people's needs are met by ecosystem services, it is not entirely consistent in terms of separating services and benefits. According to Fisher et al's (2009) approach the ecosystem services can be divided into intermediate services and final services depending on the degree of connection to human welfare. The final services in combination with other forms of capital provide benefits (e.g. the diversity of flora and fauna, clear warm water devoid of pollutants and pleasant surroundings are augmented by other forms of economic capital such as access facilities, boats, diving and snorkelling equipments, individual skills and time allocation to yield recreational benefits). This classification realises that services are often benefit dependent and suits valuation purposes.

3.3. The Importance of the Ecosystem Services Approach

The ecosystem services approach has become a key issue for conservation assessments, natural resources management and environmental valuation. The classification of ecosystem services provides better understanding for their characteristics which improves managing and valuing the benefits provided by them. For instance, better management and more concerted conservation policies can be established for reef services (e.g. shoreline protection, habitat maintenance) by knowing the seasonal fluctuations in tsunamis and

predator outbreaks. The ecosystem services approach also allows trade-offs and comparisons among the potential benefits and identifies the nesting and overlapping of the system aspects (Turner et al., 2008). A critical issue in environmental valuation is to understand the cause-and-effect linkages. The benefits arising from the coral reefs depend on the state of the whole reef and surrounding marine system. It is imperative to consider all the components of the ecological system and the political and social contexts surrounding the underlined ecosystem services. The ecosystem services approach can represent a consistent point of contact between ecology and economy and a way to incorporate economic valuation into ecosystem management decisions.

3.4. Economic Reasons for Maintaining Ecosystem Services

Many studies have demonstrated that the willingness to pay for ecosystem conservation outweighs the overall costs of conservation with benefit-cost ratios substantially greater than unity. For example, Balmford et al. (2002) estimated the required cost of a reserve system meeting minimum safe standards (covering 15% and 30% of land and sea area respectively) to be around $45 billion per year while the benefits of the ecosystem services were between $4,400 billion and $5,200 billion per year presenting a benefit : cost ratio around 100:1. Using the value estimates recorded in the literature for 17 ecosystem services across 16 biomes, Costanza et al., (1997) estimated the annual value of nature's services to be between $16 trillion and $54 trillion, with an average of $33 trillion per year. However, these estimated benefits are incomplete and do not include the many other services. Many ecosystems also are absent in the estimation of this value such as mountains, deserts, the Arctic, etc. Therefore this cannot be called the value of everything even if there aggregation efforts were technically reliable, which they are not.

Because of the reliance of other forms of capital, such as manufactured and human capital, on natural capital for their construction, many economic activities would stop without the ecosystem services. What gives the ecosystem services a new dimension of importance is that more than one billion people living in extreme poverty rely primarily on these services (World Bank, 2006). Therefore maintaining ecosystem services is crucial for economic development and poverty alleviation.

4. Economic Valuation

As long as we make choices about ecosystem services and cannot find a "win-win" solution, we need valuation (Costanza, 2000). Most of environmental decisions require weighing the different aspects of the decision problem, principally the benefits against the costs. Such relative weights given to the problem aspects imply valuations. This inherence link between decisions and valuation makes the latter not optional. The term of value generally means desirability or importance. The debate between economists and ecologists is always about how importance and desirability should be gauged and the role of human values in the ecological decisions. The value term has a range of meanings in different disciplines. Many studies have linked between the concept of value and the aim of valuation, e.g. the ecological value and sustainability, the economic value and the efficiency, and the socio-cultural value and the equity and cultural perceptions.

Economic valuation derives the change ecosystem service makes to human well-being. It has to be made in the context of benefits already (or will be) available to individuals. Thus, what is being valued is neither the ecosystem per se nor the services but rather the benefits provided by them. This does not mean that ecosystems and their services are not valuable but there is a difference between being valuable and being valued. Various aspects of ecosystem are valuable but cannot be valued because there are not related to peoples' choices. Economists value things in comparative terms. The economic value of an increased (or a preserved) amount of reef benefit can be measured in terms of the opportunity cost and the incremental changes to the current situation, as described by Turner et al. (2008), by estimating the amount of other resources that individuals are willing to forgo in order to obtain the increase (or maintain) the current situation.

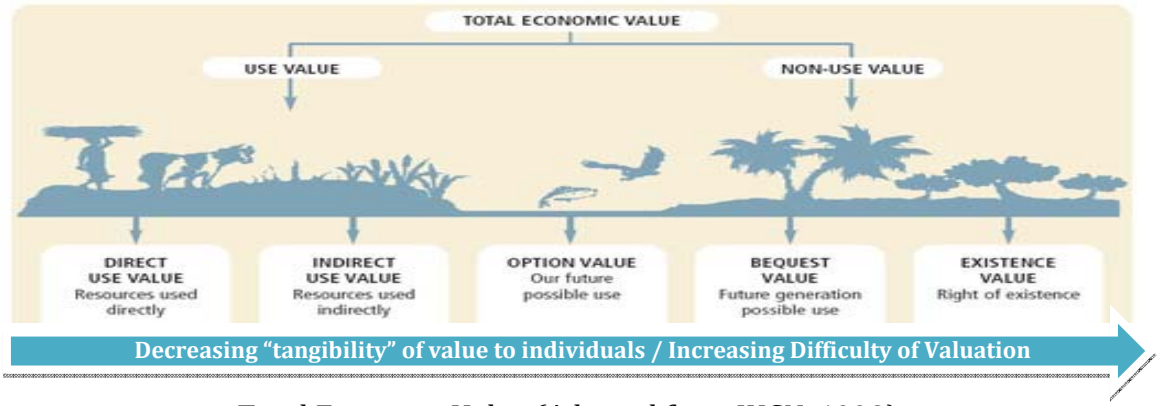
By allowing and weighting trade-offs across benefits of ecosystem services and between different time periods, economic valuation is crucial for conversation and ecological management decisions. It also can help to increase awareness, penalise environmentally degrading activities, incentivise sustainable uses and raise funds for conservation. It can be

coupled with (or be in the framework of) ecosystem services assessment to present an integrated view to welfare-optimising and sustainable policies. Finally economic information is likely to be more influential in real policy-making situations than ecological information.

4.1. Different Types of Values

Economists assign several types of values to ecosystem benefits. Some of these values are easy to identify and others are very intangible. Direct use values stem from human direct interaction with or utilisation of ecosystem services including extractive uses (e.g. fisheries, pharmaceuticals) and non-extractive uses (e.g. recreation) while indirect use values emanate from indirect utilisation of ecosystem services (e.g. coastline protection). Option values arise from uncertainty about the future and the desire of keeping open the option of utilising certain service in the future (e.g. the potential of deriving a cure for cancer from coral reefs) while quasi-option value relates to shunning irretrievable utilisation until new information proves if specific service has value that is not currently known. Non-use values can be divided into three categories: existence value which attributed to the pure existence of ecosystem services (stewardship motivation); bequest value that derives from the satisfaction of preserving ecosystem services for future generations (intergenerational altruism); and altruistic value which comes from knowing that other people in the current generation benefit from ecosystem services (intragenerational altruism). Many economists have settled for aggregating these types of values to calculate the total economic value (TEV) and ensure that the all the benefits provided by the ecosystem are taken into account. However, it may be better to focus on the benefits of interest than aggregation and TEV for several reasons. Some types of values may overlap while others cannot be added into TEV without some double counting. The boundaries of non-use values are not "clear-cut" and have been the subject of much debate. The different types of values are derived using several valuation methodologies and measures which may be incompatible. Moreover, it may be impossible to encompass all possible benefits associated with the ecosystem. Our current understanding of ecological and economic relationships is merely adequate to value only a handful of ecosystem benefits (Barbier, 2007). Meanwhile, the

values of few benefits are already suffice to show the costs of inaction. The economic approach to valuation is only a partial approach which is often employed to assess the management decisions.



Total Economic Value (Adopted from IUCN, 1998)

4.2. Valuation Methods

The main challenge faces economic valuation of ecosystem outcomes is that many of these outcomes are not valued on markets. A range of valuation methods can be applied to capture the different types of values of ecosystem benefits such as stated preference methods, revealed preference methods, and cost-based methods. Stated preference methods, such as the contingent valuation and conjoint analysis, include asking people about their willingness to pay for a certain ecosystem benefit (or set of benefits) or for the choices they would make via attribute-based stated preferences. Revealed preference methods, such as hedonic pricing and the travel cost method, use a relation with a market good or real choices that people make involving their time and the costs to estimate the willingness to pay for the benefit of service. Other valuation methods include market methods and production approaches where valuations are directly obtained from what people must be willing to pay for the benefit or from the impacts of the services on economic outputs. In cost-based methods, such as replacement cost and avoidance cost, the benefit of ecosystem service is valued in terms of what it would cost to replace that service or on the basis of costs avoided.

Category	Name	Description of approach
Market price based	**Market values**	Value based on market prices and taking into account any artificial Government intervention such as taxes and subsidies.
Output based	**Change in productivity**	Value is based on the change in quality and/or quantity of a marketed good and the associated change in total net market value (e.g. measuring fishery support function).
	Dose-Response	An environmental change is linked with a change in production
	Expected values	Value is based on potential revenues (less potential production costs) multiplied by probability of occurrence.
Cost based	**Damage costs avoided**	Value of an asset is equivalent to the value of the economic activity or assets that it protects (e.g. the damages avoided by maintaining a coast protection function)
	Replacement cost	Value is based on the cost of replacing the environmental function.
Revealed Preference / Implicit or Surrogate Market *(uses market based information to infer a non-marketed value)*	**Travel cost method**	Value can be inferred from the cost of travel to a site (i.e. expenses and value of time) using regression analysis.
	Hedonic price	Value of goods is based on the value of individual components (e.g. the landscape premium of property prices) which can be determined through regression analysis.
Stated Preference/ Construed market approach *(questionnaire surveys to ask people's direct willingness to pay or accept)*	**Contingent valuation**	Carefully constructed and analyzed questionnaire survey technique asking representative sample of individuals how much they are willing to pay to prevent loss of, or enhance an environmental good or service or willing to accept compensation for environmental costs
	Choice experiments	As above, but by asking respondents to select their preferred package of environmental goods at different prices and then inferring specific component values via econometric analysis.
Transfer of Values	**Benefits (Value) Transfer**	The transfer of economic values estimated in one context and location to estimate values in a similar or different context and location.

Valuation Methods (adopted from Dixon and Hufschmidt, 1986 and Freeman, 1993)

5. Methodology

The Recreational Value of Ras Mohammed

This study employed Individual Travel Cost Method (ITCM) to estimate the recreational value of Ras Mohammed. The ITCM function that relates an individual's annual visits to his/her travel cost is as follows: $V_i = f(TC_i, S_i)$

where Vi is number of visits made by individual i in a year; TCi is travel cost of individual i and Si represents other factors determining the individual's demand for visits to the park such as income, age, gender, and education level.

There is no consensus in the literature reviewed on the preferred functional form choice. Because the dependent variable consists mostly of low values (i.e. skewed to the left), we use the semi–log form. The logarithm of the dependent variable helps to adjust its skewness to normal distribution. The general semi-log function for the individual travel cost model is:

$$\text{Ln } V_i = a + bTC_i + cS_i + \varepsilon_i \qquad \text{OR}$$

$$V_i = e^{a + \sum dDi} \times e^{cSi} \times e^{bTCi}$$

Unobservable individual factors that influence recreation decisions are represented by ε and are incorporated into the error term in the econometric model.

The consumer surplus (CS) is estimated by the integral calculus of the demand function with respect to the travel cost between the price paid and the choke price. In other words, the CS is the area below the demand curve and above the price paid line.

The lack of survey data on people who did not visit the site cause truncation problem. However, the objective was to find out the number of visitors who would be willing to pay for conserving the coral reefs in Ras Mohammed, and not to get the total value of the site (which is more than just the recreational value), we used a Maximum Likelihood (ML) estimator instead of OLS.

Economic Valuation of Ecosystem Benefits

Value per Unit Area

A statistical evaluation of the summary findings of the literature is carried out in order to get a range of potential value of ecosystem benefits and compared to the valuation studies conducted in Ras Mohammed. Values from different years were converted to 2010 US$ using Consumer Price Index (CPI - U.S. Bureau of Labour Statistics). We selected the data of 2010 as an ordinary year for the aggregation to avoid the impacts of the Egyptian revolution on the results.

Welfare values

The contingent valuation method was used to estimate the maximum willingness to pay (WTP) of the visitor on top of the existing entrance fee to support coral reefs conservation. It is easier to get a more accurate result if a range of values is presented from which they can choose. So, the payment card method was used.

The classical OLS regression model is based on the assumption that

$E[y_i / x_i] = \beta' x_i$

where y_i is the WTP value for the I th respondent, x_i a vector of independent variables, and β is a vector of coefficients.

With a payment scale the observed dependent variable is categorical and is related to the underlying WTP value as follows

$y_i = 1$ if $y_i^* < a_2$

$y_i = 2$ if $a_2 \leq y_i^* < a_3$

⋮

$y_i = N - 1$ if $a_{N-1} \leq y_i^* < a_N$

$y_i = N$ if $a_N \leq y_i^*$

On the assumption that $y_i^* = \beta' x_i + e_i$, the model can be estimated by MLE as a grouped data regression using

$P(y_i = j) = \Phi [(a_{j+1} - \beta' x_i)/\sigma] - \Phi [(a_j - \beta' x_i)/\sigma]$

Attribute-based Stated Preferences

The choice experiments (CE) method is an application of Random Utility Theory (RUT) combined with the characteristics theory of value. Respondents derive utility from the characteristics or the attributes of goods rather than from the goods themselves. There is an observable component and an unobservable component for the utility. The method depends on the estimation of a response between choice probabilities and attribute levels. The probability of choosing an alternative increases as the levels of desirable attributes rise relative to the levels of the attributes in the other alternatives. Thus, the respondent *i* will choose the alternative *g* over alternative *h* if and only if:

$$\text{Prob}(U_{gi} > U_{hi}\ , \forall h \neq g) = \text{Prob}\{V_{gi} + \varepsilon_{gi} > V_{hi} + \varepsilon_{hi}\}$$

When the error terms are assumed to be independently and identically distributed (IID) with an extreme value (Weibull) distribution, the probability of an alternative *g* being chosen can be described in terms of the logistic distribution:

$$\text{Prob}(g) = \frac{\exp(\mu V_{gi})}{\sum_{j} \exp(\mu V_{ji})}$$

where μ is a scale parameter which is inversely related to the standard deviation of the error distribution and *j* refers to different alternatives in the choice set.

There are many reasons for the growing interest in choice experiments. The technique has many advantages over CV, TCM and other valuation techniques. For instance, it is superior in terms of modelling substitution possibilities and being able to study attribute levels beyond the observed range. The individual attributes, as well as situational changes, can be valued and more information is brought out from each respondent by using CE. Moreover, the estimates provided by CE are likely to be less site-specific and more suited to benefit transfer. The popularity of this method has resulted in numerous applications in different fields. However, the CE takes longer time, needs greater skills and higher costs. Furthermore, the CE requires the use of experimental design and making many important decisions such as the relevant attributes, the number of levels, how the attributes and levels should be described, the econometric analysis and the heterogeneity sources. Thus every method has its own idiosyncrasies that bear different challenges.

6. Application and Results

6.1 The Recreational Value of Ras Mohammed

The value of Ras Mohammed could be calculated in terms of the recreational benefits for many reasons:

- The recreational benefits are thought to be the most important to the different stakeholders.
- Recreation is often cited as the most significant economic benefit.
- The recreational value can be used as a lower bound of the reefs' value.
- Ras Mohammed is a National Park (IUCN category II) and managed mainly for coral reef protection and recreation.
- Coral reef tourism in South Sinai is the pillar of the local economy.
- Valuing one or a few benefits may be sufficient to show the costs of inaction and make a stronger point and more plausible picture than trying to measure everything.

The individual's recreational value is estimated by the area under his/her demand function. The Individual Travel Cost Model was selected from among the various travel cost models to estimate the recreational value of the park.

Variables	*Description*
LnV	Logarithm of number of visits
TCM	Sum of travel cost ($)
SUB	Binary substitute variable (1=yes, 0= no)
INCOME	Monthly income (VND)
MALE	Equals 1 if male, 0 if female
AGE	Age in years
EDUCATIO	Years in formal education
FAMILY	Visitor's family size
CERT	Equals 1 if respondent has diving certificate, 0 if s/he has not.
SKILL	Level of snorkeling skills, with 1 being bad and 4 being excellent
INFO	Information about corals (range: 1= none to 4 = rich)
CORAL	rating of health of coral reefs (range: 1= dead to 4 = very healthy)

Definition of Variables

Variable	Mean	Std.Dev.	Minimum	Maximum
	All results based on nonmissing observations.			
N_VISITS	2.22471910	4.85671021	1.00000000	55.0000000
TCM	1522.91976	854.011514	250.000000	3994.00000
SUB	.629213483	.484377928	.000000000	1.00000000
INCOME	1964.60674	2922.25004	50.0000000	12500.0000
MALE	.601123596	.491048545	.000000000	1.00000000
AGE	31.9943820	9.15682401	15.0000000	59.0000000
EDUCATIO	14.0449438	3.20278873	6.00000000	20.0000000
FAMILY	3.93258427	2.27637214	2.00000000	10.0000000
CERT	.511235955	.501283821	.000000000	1.00000000
SKILL	2.56179775	.996661729	.000000000	4.00000000
INFO	2.62359551	.842986683	1.00000000	4.00000000
CORAL	3.02247191	.712717852	1.00000000	4.00000000

Descriptive Statistics of variables

The average number of visits to Ras Mohammed was 2.2 times over one year. Over 74% of visitors visited the park for the first time. This implies that making a holiday in Egypt is not an annual habit while it is reasonable to expect this frequency for foreign tourists who have to pay a larger amount of money to visit the place. The average income of visitors was around US$ 1,964 per month. 60% of the respondents were male. The age structure showed that most visitors fell into the working age group, with the average age of 32 years. The average family size is about 4 members. About half of the respondents hold diving certificate, while 85% have snorkelling skills.

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
Constant	-2.366083063	.50942089	-4.645	.0000
TCM	-.1317987049E-02	.16046531E-03	-8.214	.0000
SUB	1.402583823	.22664590	6.188	.0000
INCOME	-.8741708547E-04	.47978393E-04	-1.822	.0685
MALE	-.5062937419	.16030870	-3.158	.0016
AGE	-.2235338270E-01	.90560446E-02	-2.468	.0136
FAMILY	.5141733980E-01	.28077154E-01	1.831	.0671
CERT	.7437848397	.18552581	4.009	.0001
SKILL	.3000583698	.78957133E-01	3.800	.0001
INFO	.4506086113	.10756400	4.189	.0000
CORAL	.4207351777	.10281752	4.092	.0000

Estimating semi-log demand

Most of the coefficients have the expected sign. Most importantly, the coefficient on travel costs is negative and significant. The more respondents have to pay, the less the frequency of their visits. The negative sign of the coefficient of income refers to the dive tourists to Egypt pay very little for their overall package than in most other places in the world. The negative sign of the coefficient of age means that younger people are likely to make more trips. The coefficients of having diving certificate, snorkelling skills, information about corals and coral reef status were positive as hypothesized. The semi-log form was used to estimate the consumer surplus per visit to be US$ 758. The sample consumer surplus mean, therefore, is US$ 929 (where the predicted number of visits mean is 1.225).

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
Fncn(1)	758.7327967	92.375994	8.214	.0000

Consumer Surplus per-visit

The recreational benefit per visit, which is calculated by summing up the consumer surplus per visit and the average travel cost per visit, is US$ 2,280. Based on the total number of visits to Ras Mohammed of 520,012 in the year 2009/2010, the total recreational benefit is estimated to be above US$ 1.1 billion per year. However, many visitors are multi-purpose trip visitors 'meanderers'. The literature presented two options for this problem: the first is to ask people to score the relative importance of a visit to the site and this score can be used to weigh their total travel cost. Second, meanderers may be excluded from the TCM analysis. In the case of Ras Mohammed, meanderers could not be excluded from the analysis since the survey showed they act for large proportion of visitors. We considered the criteria of satisfaction and time spent for the whole trip and specifically for the park to distribute the travel cost (e.g. the survey showed that the average length of stay in Sharm El-Sheikh is 7 days of which 2 days (29%) in Ras mohammed). Thus, only the third of the calculated value could be attributed to the park (old boundaries). By adding the number of visitors to the dive sites in the park extension, the preceding value remains valid.

6.2 Economic Valuation of Ecosystem Benefits

The valuation studies estimate the value of interdependent elements of ecological services and not the biodiversity itself. The ecosystem services could be grouped into three categories: production services, cultural services, and regulation services.

Production Services: This group of services relates to the provision of natural resources such as food, raw materials, and genetic resources. The challenge here is to estimate the shifts in the supply curve. Generally, the production function method was used by all the valuation studies in this region. This method may be implemented when ecosystem services are used in the production of some market good.

Cultural Services: This group of services present opportunities for recreation, research and education, aesthetic experience, cultural and spiritual support benefits. The challenge here is to estimate the shifts in the demand curve. Recreation is often cited as the most significant economic benefit. Some studies estimated the recreational value by accounting for the tourism revenues and ignored the consumer surplus and, thus, underestimate the recreational value. Meanwhile, the gross revenues overestimate the value by ignoring the opportunity cost of labour and capital. Other studies employed the travel cost and contingent valuation methods.

Regulation Services: This group of services are essential to the maintenance of natural processes, components and ecosystem health. Disturbance prevention, waste treatment and biodiversity maintenance are examples to this category. Economists often classify theses services as indirect use values. The valuation studies in the region tend to be based on hypothetical situations in which the demolition of the service were assumed and compared to the current situation. The most frequently used methods for estimating these services are based on costs (e.g. replacement cost, preventive expenditure. etc).

Value per Unit Area

Coral Reefs

Coral reefs provide a wide range of services with valuable benefits to humanity, physical as well as moral, as means of life support and quality of life enhancements. They are a source of food, medicine, protection, employment, leisure, and fascination. Coral reefs are the most biological diverse marine ecosystems of the ocean, and probably on the earth (Cesar, 2000), despite covering only 0.2% of the marine environment area. They are the home for about 33% of all described marine species (Reaka-Kudla, 1997). They rival the tropical rainforests in terms of diversity and outstrip other mega-diversity ecosystems (Spalding et al., 2001). A single reef may accommodate 200 species of coral, 300 species of fish and 10,000 - 100,000 invertebrates (Cesar, 2000). Up to 60,000 reef living animals and plants have been described to date (Reaka-Kudla, 1994), but the total number of species inhabiting the world's reefs may be between 0.5 and 2 million (Spalding et al., 2001). Coral reefs are also among the most productive ecosystems which provide protein and other benefits for millions of people. More than 100 countries have coastlines with coral reefs (Moberg and Folke, 1999) where around 500 million human beings reside within 100 km of a reef and benefit from its production and protection (Bryant et al, 1998). 1 km2 of healthy reef may produce food for 2,500 people per year (Cesar, 2000). The catch from reef areas represents about 10% of the world's total fisheries (Smith, 1978).

A literature review was carried out and 66 value observations, from 26 studies, for the different benefits provided by coral reefs were synthesised.

- The literature review reveals that only a few of services of reef have been captured.
- The valuation studies of coral reefs have predominantly focused on values associated with direct use of the reef 71% while the indirect use values attracted the least attention 14%. In terms of service category, 26% of the estimated values relate to production services (of which, 59% focus on fisheries), 60% concern cultural services (65% consider recreation) and 14% appertain to regulation services (of which, 67% estimate coastal protection).

	Mean	Median	Minimum	Maximum	Midpoint	Cases
Production Services						
fishery	537	111	1	3,946	1,974	10
aquarium trade	10	10	10	10	10	1
Seaweed farming	73	73	73	73	73	1
ornamental goods	1	1	1	1	1	1
Mining	2193	2193	155	4231	2,193	2
construction materials	9	9	9	9	9	1
Pharmaceuticals	65,551	65,551	65,551	65,551	65,551	1
	68,374	**67,948**	**65,800**	**73,821**	**69,811**	**17**
Cultural Services						
recreation	83,645	1,440	4	948,986	474,495	26
education and research	32	28	2	68	35	4
option and existence	33	33	33	33	33	1
artistic inspirational value	1	1	1	1	1	1
spiritual value	1	1	1	1	1	1
Aesthetic value	64	64	64	64	64	1
Amenity value	274	274	274	274	274	1
non-use value	16,751	9,276	48	56,893	28,471	5
	100,801	**11,117**	**427**	**1,006,319**	**503,373**	**40**
Regulation Services						
coastal protection	41,525	7,986	186	195,822	98,004	6
waste assimilation	99	99	99	99	99	1
refuge	12	12	12	12	12	1
biodiversity maintenance	8	8	8	8	8	1
	41,644	**8,105**	**305**	**195,941**	**98,123**	**9**
	210,819	**87,170**	**66,532**	**1,276,081**	**671,307**	**66**

Coral Reef Unit Value $ ha^{-1} year^{-1}

- Recreation yielded the greatest benefit of all reef benefits followed by pharmaceuticals and coastal protection benefits.

- Different valuation methods have been used to estimate benefits provided by coral reefs. The production function has been the most widely used valuation method and it produces the highest estimates of values while the contingent valuation method and the expenditure-based approach produce the lowest value estimates.

- For the data set the average of coral reef is $210,819 ha^{-1} yr^{-1}.

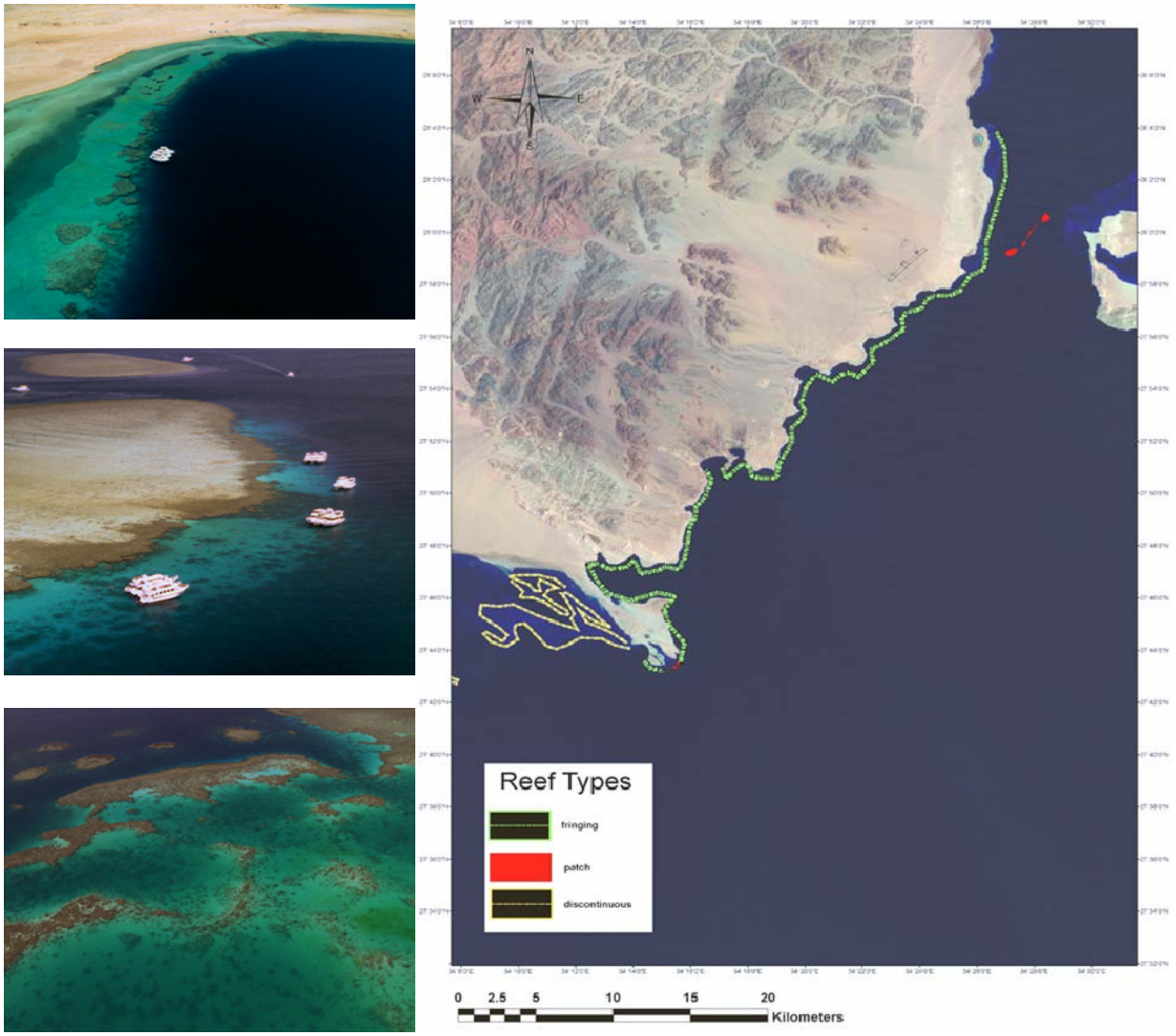
- Costanza et al. (1997) suggested that the reefs of the world had an annual value of at least $375 billion, based on a unit value of $6,075 ha^{-1} yr^{-1} applied to 62 million ha in

1994 (converted to 2010$ this is about $8,938 ha^{-1} yr^{-1}) . They extrapolated the average unit value of coral reef from 21 estimates identified from the literature. This study is likely to be an underestimate as it does not include many of the values associated with coral reefs (e.g. pharmaceutical and non-use values).

- At the same time, some insurance companies, over the last two decades, have been forced to pay multi-million dollar compensation payments where ships have grounded in popular areas. When the Cunard liner Royal Viking Sun hit a reef in the Gulf of Aqaba, Egyptian authorities sought $23 million in damages for the loss of about 2,000 m^2 of coral reef or $11,500/$m^2$ (Sheppard 1996). Another example, when R/V Columbus Iselin grounded in Florida, a compensation of $3.76 million was paid for the damage of 345 m^2 ($10,900/$m^2$) (Spurgeon 2003). The implied price of ~$110 million per hectare from both examples seems considerably high compared to the value estimated by Costanza and colleagues ($6,075/ha/yr). The latter value estimate is adopted by the United Nations Environment Program (UNEP). However, it only amounts to 60 cents per square meter which does not reflect the multitude of benefits provided by the coral reefs, sends very week message to the impactors, and seems minimal when compared to a square meter of land in Sharm El-Sheikh which can cost upwards of $1,000.

- Recently, it has been suggested in the global DIVERSITAS biodiversity conference (Cape Town, 2009) that a single hectare of coral reef provides annual services to humans valued at $130,000 on average, rising to as much as $1.2 million.

- All the preceding examples show the high cost of forfeiting reef services which may match with the high resultant average value from the literature synthesis. This is sustained by the need to establish deterrent system of fines in order to reduce the chances of the damage to coral reefs and reflect the loss of several hundred years of important growth.



Major Reef Types in Ras Mohammed

(a) fringing reef (b) offshore patch reefs (c) discontinuous reefs (PERSGA, 2003a)

Mangroves

Mangrove forests thrive in coastal zones characterized by desiccating heat, choking mud, and salt levels that would kill most plants. They provide us with a myriad of essential ecosystem services. For example, Mangroves provide pivotal support to commercial fisheries acting as nursery, breeding, spawning and hatching habitats for offshore fisheries and exporting organic matter to the marine environment, producing nutrients for fauna in both the mangroves themselves and in adjacent marine and estuarine ecosystems. Mangroves also play a crucial role in shoreline protection, where they serve as natural barriers, dissipating the destructive energy of waves and reducing the impact of hurricanes, cyclones, tsunamis and storm surges. They play a significant role in stabilizing fine sediments, contributing to shore stabilization and erosion control. Additionally, mangrove forests are often a rich source of timber, fuel wood, honey, medicinal plants and other raw materials. Finally, they attract ecotourists, and birdwatchers providing a valuable realized or potential source of national income.

Mangroves in Ras Mohammed

Salem and Mercer (2012) presented a synthesis of the mangrove ecosystem valuation literature through a meta-regression analysis. The number of studies included in the regression analysis was 44 for a total of 145 observations. The observations representing total economic values (i.e. studies estimate the total value not the total of the different benefits) lie in the range of \$2,772 to \$80,334 $ha^{-1}yr^{-1}$ with a mean of \$28,662 $ha^{-}1yr^{-1}$ and a median of \$3,847 $ha^{-1}yr^{-1}$ while the mean of the aggregation of the different benefits was \$126,069 $ha^{-1}yr^{-1}$ and the median was \$27,110 $ha^{-1}yr^{-1}$. The highest average service value was forestry (\$38,115) followed by recreation and tourism (\$37,927), while the lowest was nutrient retention (\$44).

Service	Obs.	Mean	Min	Max	Median
Fisheries	51	23,613	10.05	555,168	627
Forestry	35	38,115	18.00	1,287,701	576
Coastal protection	29	3,116	10.45	8,044	3,604
Recreation & tourism	14	37,927	1.74	507,368	1,079
Nutrient retention	1	44	-	-	-
Carbon sequestration	7	967	39.89	4,265	211
Nonuse	6	17,373	3.77	50,737	15,212
Biodiversity	1	52	-	-	-
Water and air purification/ waste assimilation	4	4,748	12.43	7,379	5,801
Traditional uses	1	114	-	-	-
Total	149				

Summary statistics for mangrove valuations by type of service (in US\$ $ha^{-1}{\cdot}yr^{-1}$). Source: Salem and Mercer (2012)

Mangroves provided a wide range of benefits to a broad range of stakeholder groups in Sinai. This is for their direct and indirect fisheries function, tourism related benefits, browsing (camels and goats), landscape benefits, coast protection and sediment regulation functions. Pharmaceutical, medicine and apiculture benefits are also potentially very important if they could be developed. Some mangrove uses that are important elsewhere, such as for timber and charcoal are not relevant in the Egyptian context due to the small size of the mangrove stands and because they are legally protected from destructive uses.

At Ras Mohammed magnificent examples of Mangroves can be found. Mangrove trees are located inside the park at the end of the Gulf of Suez at the East Southern coast. These trees are found inside a channel with a 250m length separating the dry land from an half-moon shaped iland. The maximum depth inside the channel is about l.5 m during the high tide and about 0.5 m during the low tide. A number of the land based tourist trips going to Ras Mohammed heavily promote a visit to the mangrove channel as part of the trip.

Based on Ras Mohammed mangroves being 2 ha, Spurgeon (2002) demonstrated that the Total Economic Value of the mangroves at Ras Mohammed could be as high as US$ 182,000/year or US$ 91,000/ha/yr (converted to 2010$ this is about $110,300 ha^{-1} yr^{-1}). The reason the values are so high at Ras Mohammed is due to the significant number of visitors to the area, the relatively few natural land features and the relatively small extent of the mangroves. Such values are unlikely to be expected anywhere else in the World.

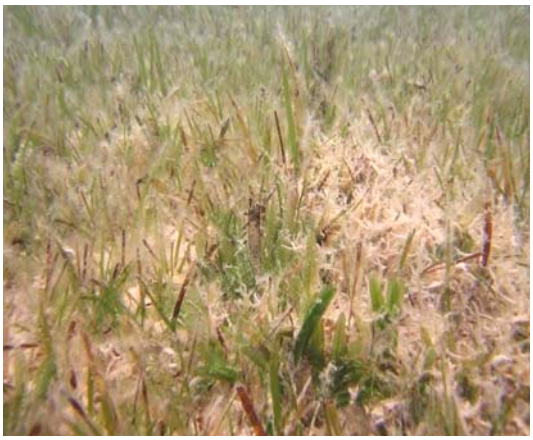
Type of Benefit	US$/yr	US$/yr/ha
Off-site fisheries	26,000	13,000
Recreation	130,000	65,000
Coast protection	-	-
Sediment regulation	-	-
Non-use values	26,000	13,000
Total	**182,000**	**91,000**

Estimated Total Economic Value of mangroves at Ras Mohammed
Source: Spurgeon (2002)

Seagrass

Seagrasses live in the coastal waters of most of the worlds' continents. They provide food and shelter for many organisms, and are a nursery ground for commercially important prawn and fish species. The high primary production rates of seagrasses are closely linked to the high production rates of associated fisheries. These plants support numerous herbivore- and detritivore-based food chains, and are considered very productive pastures of the sea. They also absorb nutrients from coastal run-off and stabilise sediment, helping to keep the water clear. Moreover, seagrass can be an important store and sink for carbon. Tropical seagrasses are important in their interactions with mangroves and coral reefs. All these systems exert a stabilizing effect on the environment, resulting in important physical and biological support for the other communities.

The associated economic values of seagrass meadows are very large, although not always easy to quantify. In Costanza et al. (1997), seagrass/algae beds are rated the 3rd most valuable ecosystem globally (on a per hectare basis), only preceded by estuaries and wetlands. The average global value of seagrasses for their nutrient cycling services and the raw product they provide has been estimated at 1994US$ 19,004 ha^{-1} yr^{-1} (converted to 2010$ this is about $27,961 ha^{-1} yr^{-1}). This value would be significantly greater if the habitat/refugia and food production services of seagrasses were included.



Seagrasses in Ras Mohammed

Welfare values

WTP values were estimated by using different valuation formats in different sites, years and conditions. The valuation results were reported in a wide variety of units and for different time periods (e.g. WTP/visit, WTP/person, WTP/day, WTP/year). Values were standardised to WTP/person/day in order to enhance data comparability. Some studies estimated the annual WTP. To maintain these estimates in the analysis, we divided the annual WTP on 365 to get the individual WTP per day, however this arbitrary conversion does not eliminate the difference between them. The analysis was carried out and 20 value observations from 16 studies were synthesised. On average, the use value of coral reefs tends to be lower than non-use value.

	Mean	Median	Minimum	Maximum	Midpoint	Cases
use value	4.85	2.58	0.10	15.09	7.60	15
non-use value	7.28	5.73	2.57	18.04	10.31	5
	12.13	**8.31**	**2.67**	**33.13**	**17.90**	**20**

Statistical Summary of WTP

Different formats for eliciting the value were employed. The open-ended questions generated lower estimates (average $1.3) than the dichotomous choice ($11.6) and payment card ($6). The valuation question affects the shape of the valuation function. For example, with the open-ended questions, the valuation function might be estimated by a simple regression analysis while the discrete choice model (e.g. logit model) might have been used if a dichotomous choice question was used to elicit WTP.

Tawfik (2004) surveyed a sample of visitors in Ras Mohammed first to collect stated preference data by using the contingent valuation method. The payment card was used in the questionnaire to avoid non-response and the starting point bias problems. The crucial valuation question was: "What is the maximum you would be willing to pay on top of the existing entrance fee to support coral reefs conservation?". The listed values were $1, $3, $5, $10, $10+. The mean WTP was $6.23 (converted to 2010$ this is about $7,19). As a result, the entrance fees could be raised to$12/person/day.

6.3 Attribute-based Stated Preferences

The choice experiments method was used to investigate the perception of visitors to Ras Mohammed and their attitudes towards coral reefs (Tawfik, 2009). Sets of options were presented to the visitors to determine how they would like to see Ras Mohammed reef sites managed and which characteristics matter to them. These options were defined in terms of four attributes: reef quality; site congestion conditions; number of dive sites; and the possible increase in entrance fees. These attributes were considered the most appropriate (after pilot testing) for the study objectives and the policy implementation. Four levels were used to secure sufficient variation in the alternative option. The attributes of the alternative option were expressed as increments to the current situation. Thus, the values of interest are the additional benefits and costs resulting from the implementation of the alternative policy.

All the attributes were statistically significant and had the expected signs (i.e. higher reef quality, lower congestion, more dive sites and lower entrance fees will result in higher utility level and a higher probability of that alternative option being selected). The coefficient of congestion level for the national tourists was significant at 90% probability level (not 95%). Therefore, whereas the international tourists (IT) prefer less people at reef sites, this attribute was not highly significant among national tourists (NT).

The elasticity for fees attribute was calculated as -0.44 and -0.49 for IT and NT respectively. However, it is relatively inelastic (<1). For the park management, this suggests that the revenue gained by any increase in the entrance fees will outweigh the negative impacts the fees increase will bring.

The foreign tourist is WTP an extra $0.5 for each 1% increase in the reef quality, $0.2 for each 1% decrease in the congestion level and $0.4 for each additional dive site while the national tourist is WTP an extra LE0.7 for each 1% increase in the reef quality, LE0.05 for each 1% decrease in the congestion level and LE0.3 for each additional dive site.

7. Management Implications

7.1. Tourism Development in South Sinai

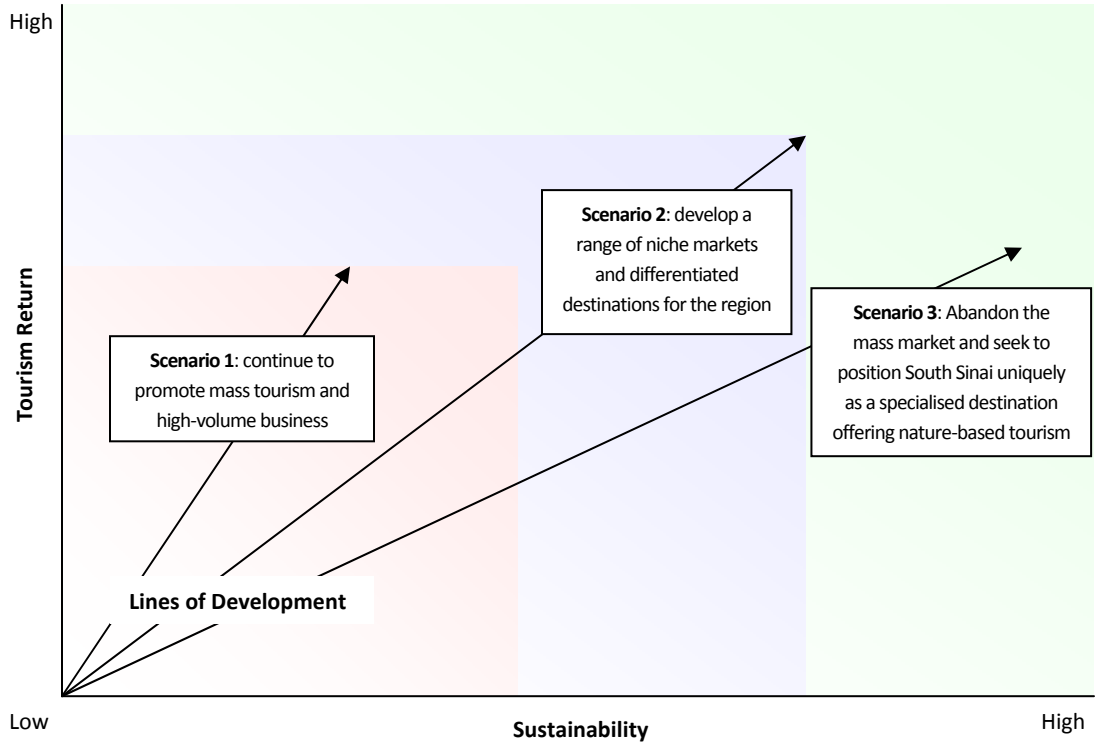
The economy of South Sinai is highly specialised; it mainly depends on tourism, particularly that related to Scuba diving. Sharm El-Sheikh, for example, is the most popular city in South Sinai and was awarded the title of best global destination for diving in 2007 by the World Travel Awards. Ecotourism and the existence of coral reefs and protected areas are closely correlated and form the cornerstone of the local economy of South Sinai. The growth in infrastructure and facilities reflects the rapid expansion of the region as a tourism destination. In 1989, there were just 13 hotels in South Sinai with a total of 1,150 rooms. By 2010, the number of hotels had increased to 343 with almost 69,376 rooms representing 29% of the total hotel accommodation capacity in Egypt (Ministry of Tourism, 2010). There are 131 dive operators and 9 aqua centres that offer non-diving watersports activities are members of the South Sinai Association for Diving and Marine Activities (SSDM) (SSRDP, 2008). The number of travel agents with head offices in South Sinai is 24 (SSRDP, 2008). Establishing the required infrastructure and supporting services served as the nuclei to create new societies and set many small businesses away from the densely populated Nile Valley. The total number of people employed in hospitality and tourism in South Sinai reached 60,000 in 2007 (SSRDP, 2008).

4.3 million tourists visited South Sinai in 2010 (i.e. 80% Sharm El-Sheikh, 11% Taba, 5% Dahab, 3% St. Katherine, 1% Nuweiba) (South Sinai Governorate information centre). The share of the national market was around 20% while the international market represented 80%. Therefore, overseas tourists have been the lynchpin of the growth. Until the end of the last decade, the market of South Sinai was dominated by northern Europeans. The Italians and Russians moved in to dominate the region in the subsequent years. These two markets plus UK account for about 66% of all arrivals. The average length of stay for visitors in Egypt is around one week where they spend an average of $130 a day (Central Bank of Egypt statistics). Accordingly, the total gross revenue through ecotourism was estimated at $3.9 billion in 2010. Without world class diving at Ras Mohammed, South Sinai

would receive many fewer visitors. A tourism survey carried out in 2004 highlighted the importance of Ras Mohammed, with 64% of South Sinai's tourists stating that they were visiting Ras Mohammed during their holiday (SEAM 2004).

However, only a small portion of gross revenues generated by tourism effectively remains in the local economy. Most of the international tourism revenues are subject to erosion in a variety of ways. Describing this as the great escape, English (1986) showed that the majority of money spent by tourists goes back to the international companies hosted in developed countries. He estimated that the destination retains only about 7% of air-fare costs in the form of landing fees, fuel costs, and other servicing arrangements completed at the destination. In South Sinai, foreign tour operators, diving centres and international management hotel chains dominate the tourism activities. 90% of resort-based beach packages are controlled by international tour operators/travel agents as distributional channels, 5% by local operators as part of supply chain controlled by international tour operators or travel agents, and 5% by local operators (SSRDP, 2008). These international tour operators impose on South Sinai resorts very low room rates through their haggling power and for securing a specific percentage of occupancy during the year. The industry standard today is $400-500 for 6-7 days in a beach resort at half board, including air travel and transfers. A package arrangement $25/room/night is currently prevalent for off-peak five star establishments, whereas the walk-in individual rate may exceed $100. In international comparative terms, the dollar price of a hotel room in South Sinai is relatively low. This pegged standard cannot be easily raised because of the stiff, cut-throat competition arising from the oversupply of hotel accommodation. Furthermore, there may be a stronger pressure to further reduce prices due to the rapid growth of the share of Eastern Europe and Russia markets. This is intensified by the efforts of the ministry of tourism to increase the number of tourists without considering the carrying capacity of the environment in the planned development areas (i.e. focusing on the quantity rather than the quality). This was not the case in eighties and nineties when South Sinai was marketed mainly as an area with unique coral reefs.

Development must ensure that the region should not be spoiled in the same way as has happened at Hurghada. Promoting mass tourism in South Sinai rather than developing niche markets and maintaining the region as a centre of excellence attracting classic divers and elite tourism is considered a short-term strategy that will not ensure the sustainability of the tourism industry. The lack of a comprehensive tourism development plan coupled with the policies of the Tourism Development Authority promote an unhealthy competition to build more, propagate the high-volume approach (in which numbers only count), impose further pressure on prices and ignore the impacts of the rapid expansion on the environment and on tourism in South Sinai in the long run. The present status of market imperfection, price manipulation policies and absurd governmental strategies lead to low economic yield from this important industry. These problems highlight the need for changes in the type and style of tourism development.



Tourism Development Scenarios for South Sinai (Adapted from SSRDP, 2008)

The preceding figure shows three possible scenarios that could be adopted in establishing tourism development policy for South Sinai. Only scenario 3 ensures long-term planning and sustainability.

7.2. Determinants of Demand for Reef Sites

Tourists often select the places where they can observe undamaged reefs and abundance of colourful fish. A significant relationship exists between the abundance of fish and living corals. The demand for reef sites is a function of many variables such as price (e.g. entrance fees), environmental quality (e.g. reef health, aesthetic value, marine life, visibility), conditions at the site (e.g. surface conditions, current), ease of access, and the availability of substitutes (Davis and Tisdell, 1995, 1996). Hensher et al. (2005) referred to the existence of two sources of influences on choice behaviour: the attributes of alternatives and the characteristics of individuals.

In the present study, the vast majority of international and national tourists (96%) felt the most important feature of their visit to Ras Mohammed was the reef quality. The level of congestion was identified as an important factor by 82% of International Tourists (IT) and 75% of National Tourists (NT) while 80% of IT and 89% of NT were interested in the number of dive sites. Both sets of tourists preferred high reef quality, low congestion, more dive sites and low entrance fees. However, international tourists showed significant preference for reducing congestion level and were willing to have restrictions on the number of visitors to reef sites in exchange of healthier reef, while national tourists did not demonstrate strong preference for this reduction. In the IT model, the WTP for higher reef quality is greater when the respondent is repeat visitor, male, old, member in environmental organisation, has high income, has small family, or visits the reef sites only in Ras Mohammed. Also, the highest WTP values are for the visitors from UK, France and USA where the visitors from Germany and Poland have the lowest WTP. For NT, the respondents hold diving certificate, have snorkelling skills, are females, young, or graduates are WTP more for improving reef quality. In addition, the respondents from Dakahlia, Cairo and Ismailia have the greatest WTP whilst the lowest WTP values are for respondents from South Sinai and Monufia.

7.3. The impact of the Egyptian Revolution on Tourism

Political turmoil presents major challenge to tourism industries despite marketing efforts. Many things have changed for one of the world's most successful tourist destination following the eighteen day revolution that emptied hotels from Cairo, to the upper class Sharm el-Sheikh tourist destination in the Sinai Peninsula. Regime collapse in the Arab world's most populous country was an event of far greater magnitude. The January 25th revolution obviously has had international impacts upon the tourist industry, primarily in regards to the opinion of the international community. Tour operators in Russia, Japan, Italy and Britain (4 major markets) have cancelled their reservations for flights to Egypt. Around 210,000 tourists had to leave Egypt in the last week in January 2011. Situations that make Egypt lose revenue of about U.S. $ 178 million. Not only that, many tourists canceled visits to Egypt during February and following months. For example, tourist arrivals in Egypt dropped by 37% in the second quarter following the revolution. Some 2.2 million people visited Egypt in the second quarter of this year compared to 3.5 million in the same period in 2010. Reports in May said Egypt had lost 13.5 billion pounds (2.27 billion dollars) in tourism revenues in the three months since the revolution. About 300,000 Egyptians may have lost their jobs as a result. Revenues from Egypt's vital tourism sector plunged last year. Tourism Minister Mounir Fakhry Abdel Nour said the number of tourists to Egypt dropped by over a third to less than 10 million and revenue was down by almost 30 percent. The loss was devastating for Egypt, for about 5-6 percent economic growth comes from revenue in the tourism sector.

However, the fall in the number of visitors following the revolution is probably a short term effect, assuming that stability is restored. The revolution set out to make changes for the better, but with over 10% of it's economy relying on tourism, Egypt must be conscience of the impression's of the international community. It is therefore essential for Egyptian tourist authorities to press for stability to return to Egypt, while simultaneously promoting the January 25th revolution. Egypt's tourism industry will return to the country as long as potential tourists' feel that it is safe to do so. Both the youth responsible for the revolution, and elements of the Egyptian government responsible for the tourist industry should take

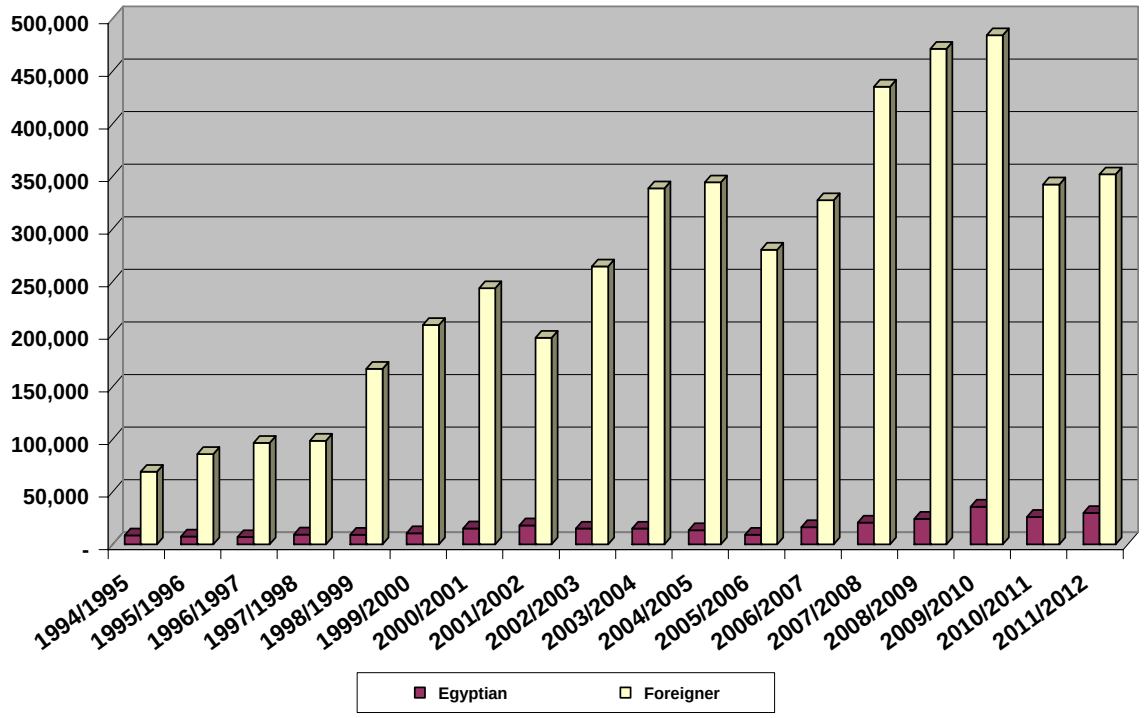
serious steps to move the political situation forward and ensure that the country is safe. Stability, and hence democracy, in Egypt depends largely on how the economy develops in the years to come. Tourism minister Mounir Fakhry Abdel Nour stated that "Egypt is not only Tahrir Square. It's a big country and loves tourists under any circumstances". It is that message Egypt hopes will bring the holiday-makers back. The revolution of January 25 could be an important part in the restructuring of the Egyptian tourism sector entity again. The good planning and management tools can enable the tourism sector to overcome this negative impacts and return the tourism what it was and better, especially as this revolution were not meant to hit tourism, it was a peaceful revolution.

Revolution at Tahrir Square

Despite Sharm el-Sheikh being so far away from the epicentre of the revolution in Cairo, the impact on the resort is palpable, with tourist shops boarded up, restaurants closed and a general lack of people. Sharm el-sheikh usually attracts three million visitors a year because of its year-round sunshine, sandy beaches, exotic fish, spectacular corals and blue sea. But a series of shark attacks off Sharm el-Sheikh which seriously injured four

swimmers and claimed the life a German tourist have added to the resort's woes. The revolution had caused more problems for business than any shark attack ever could. The political turmoil has hit tourism very hard, with many people losing their jobs or seeing their salaries cut by 50%. Hotels have had to close for a while and market workers not being able to pay their rent. Sharm el-Sheikh's Old Market is usually alive with tourists, lured in by stall holders offering cheap souvenirs, hand-woven rugs, and embroidery. But since the revolution that centred on Cairo's Tahrir Square, some 520km away (323 miles), visitors to the bazaar and other places in the popular Red Sea resort have been rather thin on the ground. UK airlines British Airways and Jet2 suspended their services to Sharm el-Sheikh, causing other carriers to put up their prices.

The number of visitors to Ras Mohammed has steadily increased during the last fifteen years. The annual rate of growth of visitors to Ras Mohammed was approximately 11 percent per year for national tourists and 17 percent for foreign tourists, rates far higher than experienced by most marine reserves. After the revolution, the number of visitors decreased by 29% (from 520,012 in 2009/10 to 368,391 in 2010/11).



Annual number of visitors to Ras Mohammed

7.4. Scales and Stakeholders

Capacity building and stakeholder participation are important elements in the management plan. Both beneficiaries and impactors at the different levels (local, national, international) should be identified. This gives a more complete picture of the effectiveness of the park. Sites which are established without broader consideration or enough consultation of the different stakeholders and without considering the associated costs and benefits of the protection are likely to meet with opposition and fail to achieve the proposed objectives. On the other hand, if these sites have the support of the local communities and national authorities, they can be highly effective in maintaining the different ecosystems. Such support for the conservation can be enhanced by clarifying the relationship between the reef management and the economic, ecological and societal outcomes. The management objectives at Ras Mohammed should be visible to the public in order to get the merited appreciation and achieve self-enforcement management strategies.

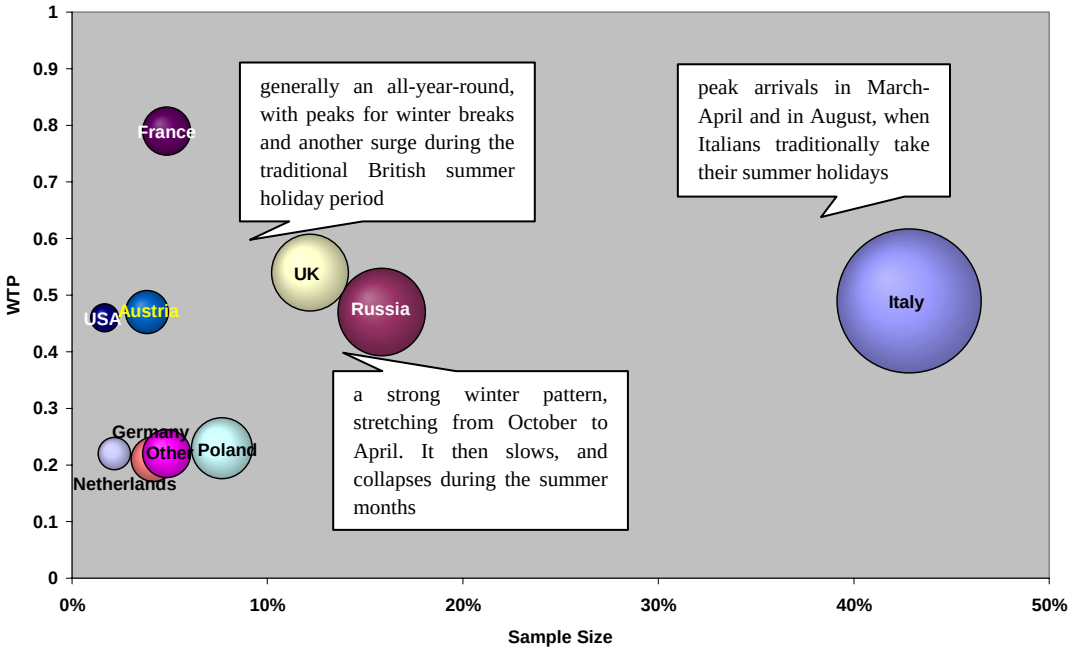
Examples for the stakeholders in South Sinai include: government authorities, Bedouins, developers, hoteliers, NGOs, tourists, tour operators, and guides. The authoritarian rule devitalises nature conservation efforts and environmental reform in Egypt (Sowers, 2007). The embedded autonomy of South Sinai Protectorates was the nucleus of a lot of achievements during the nineties. However, this autonomy was circumscribed in subsequent years when the Egyptian Environmental Affairs Agency embraced the protectorates division in its dominion. Despite the many claims from the government about the adoption of sustainable development concepts, on the ground practices take the opposite direction. The policies of the executive institutions responsible for tourism development, such as the Tourism Development Authority and Ministry of Tourism, sometimes conflict with the conservation programmes and protected areas division. Consequently, the latter proved less influential in coastal land-use decisions once these had been channelled through the former to promote tourism development, particularly with regard to the current explosion of coastal tourism development along the Gulf of Aqaba. For instance, the Tourism Development Authority set dreadfully low land prices ($\$1/m^2$) to encourage investment. Moreover, economic pressures and the need to create jobs for the

fast growing population undermine the importance of the environmental concerns with respect to planned developments. The military is one of the most significant powers in the region. It retains control of an area within Ras Mohammed. Military and environmental police are arresting hunters and limiting their activities in the park. Another influential authority in the region is the governor of South Sinai. He can play a critical role in facilitating or constraining the conservation efforts in the region (e.g. Governor's decree to ban the licensing of new boats of all kinds in Sharm El-Sheikh). The local resource users and communities should be involved in conservation efforts. Recognising their crucial role in the region, South Sinai Protectorates endeavoured to create mutual relationships with Bedouin tribes through providing employment and services. For example, Bedouin staff at Ras Mohammed have been contracted by EEAA to work as skippers, community guards or to provide services to the area. Also, the park provides mobile health care services and established a veterinary clinic. Furthermore, South Sinai Protectorates in cooperation with the European Union established a handicraft collective which was referred to as "Craft and Income Generation Project of the Bedouin Support Program" to preserve the traditional Bedouin embroidery of Sinai. Such efforts increased compliance with land use and marine restrictions.

Developers are requested by environmental law to submit Environmental Impact Assessments before starting any construction activities to ensure the environmental feasibility of the projects and to explore their repercussions on the coral reefs. The coastal zone management unit reviews the project designs for resorts in advance to identify problems and recommend mitigation measures. The unit provides developers with input into the design of lagoons, marinas, construction works, setback use, and disposal methods. However, if the proposed project has negative impacts on the natural resources, the weak enforcement of the law will not deter the developer from proceeding with construction. The Tourism Development Authority, for instance, approved investment applications regardless of the status of environmental impact assessments. Therefore, EIA studies, for many investors, are not more than papers to be submitted to the bureaucratic government authorities. With the weak enforcement of environmental laws, hoteliers only behave in an environmentally responsible manner if guests or tour operators demand this. There are

few NGOs in South Sinai with limited capacity to exert pressure for conservation. Because of the significant relation between the reef health and their businesses, the dive companies and other private operators should set restrictions on their own customers' activities such as preventing fish feeding, avoiding reef touch by ensuring adequate buoyancy control and providing briefing sessions, transferring training grounds to shallow lagoons, away from coral dominated sites, until buoyancy skills are mastered, and encouraging underwater photographers to be more aware of their actions when taking photographs. Guiding in South Sinai has not followed the national syndicated system. Without qualifications available, knowledge of a foreign language is usually the only pre-requisite to work as a tour operator. Many guides trained in history or Egyptology not nature-based tourism.

The national tourists have accounted for between 3% and 11% while the international tourists have represented between 89% and 97% over the last decade. The Italians make up the largest proportion of foreign visitors followed by Russians and Britons. The park receives a large number of visitors on day trip excursions above its carrying capacity. Peak seasons for Ras Mohammed are March to April and August to October.



WTP values for 1% increase in reef quality, sample size, and seasonality for different nationalities

7.5. Impacts of Tourism

Over the last two decades, the impacts of human activities on coral reefs have escalated in South Sinai. Until recently, the governorate was one of the least populous regions in Egypt. Starting from the early 1990s, the area has seen burgeoning human populations and rapid urbanisation of the society (e.g. the population of South Sinai has increased by three-fold during the last fifteen years). Tourism in particular has led to this kind of development. The tourism development along the Gulf of Aqaba has degraded the coral reefs. The majority of the resorts are built along the coastal strip with about 50–300 m coastal setback depending on the shoreline conditions. Increasing levels of sediments from coastal development, dredging and land reclamation plus the nutrient enrichment from human waste degraded the reef in many places and has led to its replacement by algal communities. The large number of tourists resulted in great disturbance to the marine life. The unwise governmental policies replaced elite tourism seeking for environmental uniqueness with low priced 3S (sea, sun, and sand) packaged tourists (e.g. the classic divers have tended to move on to less crowded sites). The Tourism Development Authority offered investors few if any restrictions on development activities regardless of the impacts on the natural resources. Many developers just pay lip service to the concept of sustainability. Preposterously, they are killing the goose that lays the golden egg.

Activities such as diving, snorkelling, trampling, sports fishing, fish feeding, boating and anchoring impose direct destructive effects on the reef system. Corals are damaged when visitors stand or walk on them or make contact with them with fins or hands and when visitors cause re-suspension of sediment which subsequently settles on the coral. Direct tourist impacts on coral reefs in Ras Mohammed have become evident over the years, with declining hard coral cover and increasing numbers of broken and abraded corals at many sites. Scuba Diving and snorkelling have been identified among the main visitor activities which cause damage to coral reefs. In 1988, 89% of visitors came for diving, but by 1995 this number had dropped to 40%, with as many as 76% of tourists coming for snorkelling (Medio, 1996). In a tourism survey in this study, diving was mentioned as a purpose of visit by only 31% of IT (18% of NT), while snorkelling represented 71% for IT (34% for NT).

Diving Impacts

15 contacts with corals per m^2 per year were reported at heavily dived sites around Sharm El-Sheikh (Medio, 1996). 8.2% of corals were broken on the back-reef at sites in Sharm El-Sheikh open to the public, compared to only 0.6% to1.2% at closed sites (Medio, 1996). Direct impacts due to kicks by divers' fins were the major cause of coral injury (PERSGA, 2003b). However, not all divers are equally impacting the reef, with more experienced diver (i.e. with better buoyancy control and reef etiquette) being less damaging than the novice diver (Dixon et al., 1993). Therefore, the diving impacts depend on the diver behaviour as well as diver numbers (Davis and Tisdell, 1996). Salm (1985, 1986) demonstrated that underwater filming and taking of photos during a dive increase the tendency of a diver to make accidental contacts with the substrate. 26.6% of divers using cameras and/or videos were responsible for 72.4% of all contacts (Medio et al., 1996). In the present study, divers were shown to have a greater knowledge about coral reefs compared to snorkelers or respondents who neither snorkelled nor dived. However, when divers were asked what was the highest level of diving certification they hold, 41% stated that they hold open water, 36% advanced open water, 9% rescue diver, 8% dive master, and 6% instructor. Given the high percentage of novice divers, it becomes apparent how important it is to require all dives to be led by guides and preceded by environmental awareness briefings.

Snorkelling and Trampling Impacts

With increasing numbers of visitors engaging in snorkelling rather than diving activities, trampling on shallow reef flats has become a major threat to the coral reefs. Increasing trampling intensities result in changes in the community structure of coral assemblages. Various studies examining trampling impact reported a decline in coral cover. Hawkins and Roberts (1993) found lower coral cover and higher rates of breakage, rubble and loose fragments on reef flats subject to trampling. In Ras Mohammed, Leujak (2006) investigated the impacts of reef walking on coral assemblages at Main Beach and Yolanda Bay. She noticed that walkways receiving the highest amount of tramplers (324-383/m2/year),

followed by the contiguous stations to walkways (97-114/m2/year), and then control stations furthest from the walkways (1.3-3.8/m2/year). Hard coral cover is decreasing with increased reef walking, from 25% at the control stations to 5% on the walkway of Main Beach. Breakage and flattening of colonies were found to be the most frequent types of damage to corals. Abrasions (0.5-0.04%) and flattened colonies (0.8-0.03%) were significantly more common at sites with high trampling intensities. The roping-off of nearby areas at Main Beach significantly limited walking to the walkway, with 81% of tramplers used it, 16% used the nearby area, and 3% were observed on the reef flat. At Yolanda Bay, where no walkway has been roped off, 23% of walkers were observed on a non-marked path, 62% on the adjacent station, and 15% on the remaining reef flat. Based on 4 minutes of reef walking activities, each trampler was estimated to damage on average 0.0008 m^2 of coral, with that wearing fins causing proportionally more contacts with the substrate. The amount of coral broken per year was estimated to be between 47 and 97kg indicating to the large impact of trampling. Coral cover remains high up to 50 tramplers/m^2 and dropped rapidly beyond this threshold. However, this number depends, among other things, on the environmental awareness and the snorkelling skills of visitors. We asked visitors how they describe their skills in snorkelling. Only 11% of foreign tourists characterised their skills as poor or very poor but this percentage increased to 30% for national tourists. Therefore, it is very important for the park management to designate walkway areas to restrict the movements of snorkelers, ban wearing fins in the snorkelling sites, and close the sensitive reef flat sites during the spring tides.

Trampling on the reef

7.6. Carrying Capacity

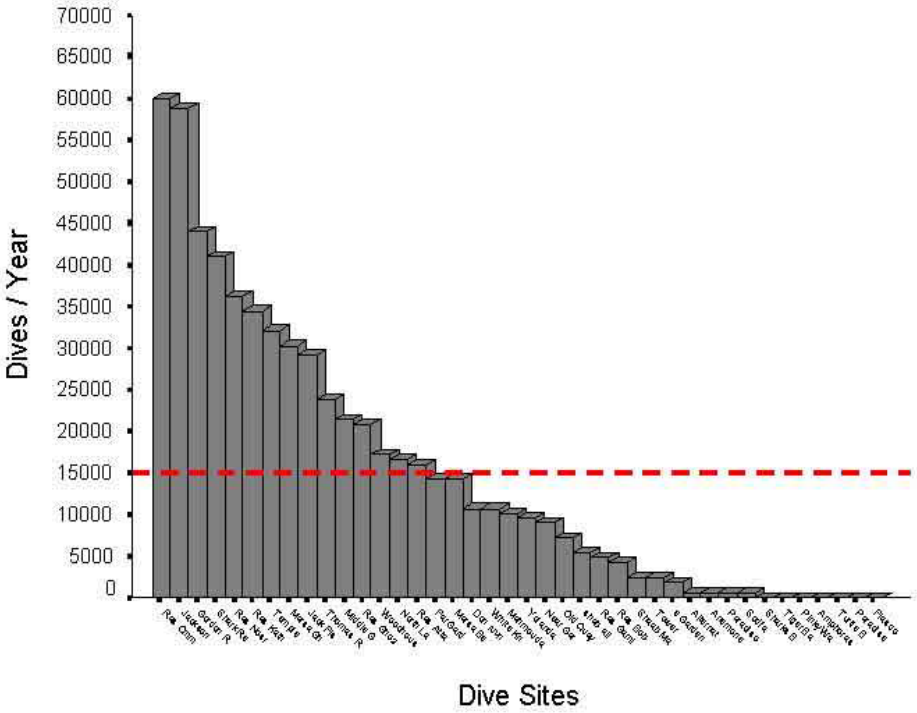
Explosive increases in visitor numbers and their impact on coral reefs have become a great concern over the past decade in Ras Mohammed. The park is attractive because its unique coral reefs are enhanced by its protected status. It is successfully marketed as a tourist destination by tour operators and diving centres. However, if the impacts of the mass tourism on the reef are not considered, much of Ras Mohammed's attraction would be lost along with the associated revenues. In other words, tourists coming in big numbers will destroy what they come to see. The marine tourists shift their demand to other reefs sites when the reef quality and fish diversity are reduced. Every satisfied visitor persuades 7 others to visit a certain destination while every dissatisfied visitor chases about 15 away (Child, 2006). This kind of tourism is very sensitive, the demand shift is irreversible and it is very difficult to replace this market with other visitors.

Many studies have proved that the increasing number of visitors to Ras Mohammed has adverse impacts on the coral reefs. This raises the questions: How many tourists on a reef are too many? What is acceptable in terms of diver-induced damage and what is not? Carrying capacity is a term which has been used to describe the level of visitation (or the amount of use) an area can receive (tolerate) beyond which its ecosystems would be significantly altered or degraded (Davis and Tisdell, 1996). The ecological carrying capacity estimation of the coral reefs depends on biological assessment of the reef and addresses some measures such as coral cover, diversity indices and evidence of physical damage. Meanwhile, social carrying capacity evaluation concentrates on visitor perceptions towards site attributes such as reef quality and congestion level, i.e. how much use is acceptable without leading to a decline in visitor numbers (Davis and Tisdell, 1995). Shelby and Hebelein (1986) noted that the social carrying capacity of a site is exceeded when more than two third of visitors feel crowded. Manning (1985) elucidated that crowding norms can be affected by differing expectations, visitor characteristics and situational variables.

Ecological Carrying Capacity

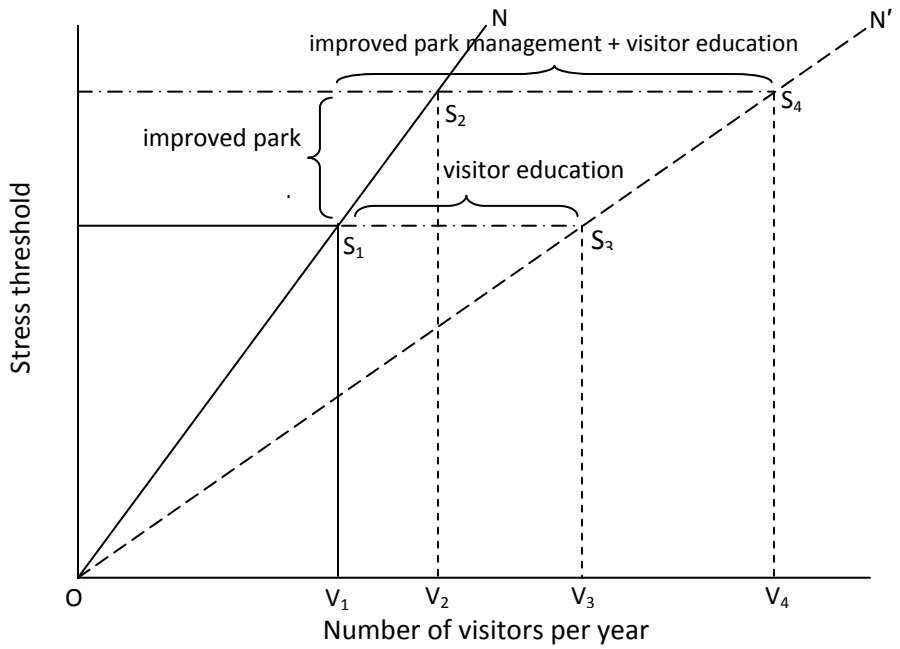
It appears that visitation at many sites in Ras Mohammed had already exceeded the local carrying capacity. The carrying capacity was estimated to be between 5,000 and 15,000

divers per year per site (Hawkins and Roberts, 1994; Abou Zaid, 2002). Based on the number of available dive sites (15 inside the old boundaries plus 25 in Tiran and the local area), the annual carrying capacity for Ras Mohammed is estimated at 225,000 dives (600,000 for all dive sites in the area). The number of visitors was 520,012 in 2009/10. More than one million dives are undertaken yearly within the area between Ras Mohammed and the strait of Tiran (PERSGA, 2003b). This diving pressure is not distributed equally among the established dive sites. As can be seen from the following figure, some dive sites receive a huge number of visits annually (e.g. Shark Reef, Jackson Reef, Ras Umm Sid) while others are not used any more by most of the diving operators (e.g. Fiasco, Paradise, Turtle Beach, Amphorus, Pinkys Wall, Tiger Bay). Some dive sites are now receiving over 60,000 dives annually (PERSGA, 2003b), with the recommended carrying capacity long being exceeded. In a recent study, Leujak (2006) estimated the visitor numbers at Yolanda Bay and Main Beach, the most popular beaches to visitors from land. The total numbers were estimated to be 83,868 (230/day) per year at the former and 75,280 (206/day) per year at the latter. With such level of visitation, a rapid loss of coral cover and reef biodiversity is expected.



The annual number of dives conducted in each site per year (Source: PERSGA, 2003b)
(Dotted red line indicates the globally acceptable level of dives per site per year)

Calculations of carrying capacity, however, can be inaccurate or ambiguous because of a number of limitations such as disregarding the indirect impacts of visitors, involving value judgements, the variation between sites, the reliance on the method used to assess reef health, the difficulty of establishing predictable linkages between use levels and impacts, the dependence on the coral reef characteristics which are being assessed, and the influence of the behaviour (not only the number) of visitors on the recreational use. Dixon et al. (1993) noted that it may be possible to increase the stress threshold through user education and improved management. At S1 the coral reef degradation due to the mass tourism begins to be noticeable. With better management, this stress point can be shifted to S2. Furthermore, line ON can be shifted out to ON' and the carrying capacity to point S3 by improved visitor education. Combining improved park management with visitor education can shift the stress point to S4. Accordingly, the permissible use of the park can be expanded (V_4-V_1), and more revenues can be generated. Such improvement can be achieved through monitoring and supervision of park users, regulation of underwater photography, promoting better buoyancy control, spacing out visitors and distributing the burden across the area, rotating open sites, installation of mooring buoys, and promoting the value of coral reefs. For example, Medio et al. (1997) found that a single environmental awareness briefing reduced the rate of divers' contact with reef substrates from 1.4 to 0.4 and the rates of contact with living corals from 0.9 to 0.15 contacts per diver per 7 minutes.



Park management and stress threshold (adapted from Dixon et al., 1993)

Social Carrying Capacity

Coral reefs and marine life are the main attractions for divers and snorkelers, and negative experiences are associated with environmental impacts such as damaged corals and overcrowding. Therefore for Ras Mohammed, it would need to be decided whether the reef quality currently provided is satisfying, or whether an improvement in quality is desirable. Only knowledge of visitor perceptions can give a clear indication as to whether the social carrying capacity of coral reefs has been or will be exceeded. Based on the interviews with visitors, 40% of IT and 31% of NT felt crowded and expressed their dissatisfaction with the level of congestion at Ras Mohammed while 70% of IT and 91% of NT were satisfied with the reef quality and 74% of IT and 87% of NT were satisfied with the dive sites number.

Leujak (2006) stated that the coral cover need to be 25 to 30% to make more than the half of visitors satisfied. Our survey showed that the individual characteristics had an effect on crowding perception. Respondents who were repeat visitors, visited the reef sites only in Ras Mohammed, held diving certificate, had snorkelling skills, had more knowledge about coral reefs, male, old, had higher education, were a member of an environmental organisation, had high income, or had a small family were more susceptible to concerns about crowding. As with the perception of crowding, the perception of reef quality has been demonstrated to be considerably reliant on respondent characteristics and expectations, with visitors possessing a higher level of experience about the park, snorkelling, diving, education or knowledge about coral reefs reporting greater dissatisfaction with reef quality. Although the literature on recreation and quality standards has predominately focused on crowding and ecological impacts, some authors (e.g. Ormiston et al, 1997) added the levels of facility development. 32% of IT and 61% of NT affirmed that Ras Mohammed needs more facilities such as toilets and showers, shelters, and cafeteria. The access to some sites is difficult due to the unpaved roads and this was confirmed by 6% of the respondents. There is not enough public awareness of the issue of environmental protection. 10% of the respondents referred to the paucity of signs, 6% to the paucity of brochures, and 42% stated they had poor information about the coral reefs.

Ras Mohammed has been experiencing a dramatic increase in visitor numbers over recent years, with national tourists increasing from 8,500 in 1994/95 to 35,894 in 2009/10 and foreign tourists increasing from 69,050 in 1994/95 to 484,118 in 2009/10. These high numbers indicate that crowding might already negatively influence visitors' enjoyment at certain sites. Ras Mohammed at present is experiencing a shift towards a visitor who is less environmentally aware, less concerned about crowdedness or degradation of environment, and more detrimental to reef because of the poor snorkelling abilities and the higher degree of carelessness. The social capacity for the park as whole is expected to be reached soon, moving from a consolidation stage to a stagnation stage (Leujak, 2006) which will be typified by large number of visitors complaining about the level of congestion and reef quality.

Crowdedness in Ras Mohammed

7.7. Management Interventions

Leujak (2006) explained why visitors violate rules and cause damage to coral reefs by three reasons: they might not care, they might be unable to change their behaviour (e.g. novice user might have a need for gear adjustment or resting on the reef) or they might be unaware of existing rules. The percentages of novice divers and snorkelers in Ras Mohammed imply that violating the park regulations is partly due to lack of experience and poor skills as opposed to a lack of knowledge. It is important for Ras Mohammed management to identify the reasons for violations of park rules.

There are many concerns as the challenges facing the different ecosystems are mounting due to increased tourism impacts. Additionally, several shortages of specific institutional capabilities for monitoring and protection were identified. The work environment at Ras Mohammed can be described as data-rich but information-poor. Moreover, there is a lack of park-wide management tourism plans. The park management needs to measure and react to the changes in the internal (e.g. products, facilities) and external (e.g. development activities and conditions in South Sinai) tourism factors, the changes caused by tourism, and the changes caused by management actions. There are many tools that can be used to monitor tourism impacts such as patrols by rangers, tourism surveys, and reports from tour operators, local communities, hotels, tourism and coastal police, and city council. Moreover, some management measures need to be implemented to reduce visitor impact and maintain coral reefs such as controlling the coastal development in Sharm El-Sheikh, promoting more environmentally friendly behaviour through public awareness campaigns, decreasing the number of visitors and distributing them between dive sites to alleviate the pressure on the popular sites, improving environmental education of divers and snorkelers through briefings, orientations and encouraging improved buoyancy control and reef etiquette, stipulating that all dives to be led by guides, restricting the number of dive boats, limiting specialised diving activities which have greater impact on the coral reef (e.g. underwater photography, night diving), designating certain dive activities to appropriate sites, restricting high impact uses (access limitations, moorings), containing recreational use (walkways, swimming pontoons), and developing monitoring programs for all the dive sites in the region not only inside the park to ensure that the coral reefs will continue to

attract tourists in the future. To achieve the preceding measures, the park management can use a combination of different instruments ranging from prescriptive regulations through to direct market mechanisms. For example, the management can reallocate divers among sites through direct means such as placing a limit on diver numbers or introducing a licensing system or through indirect interventions such as varying the ease of access to reef sites (Davis and Tisdell, 1996). Leujak (2006) concluded that management intervention (e.g. construction of a walkway coupled with a public awareness campaign) could reduce the numbers of reef walkers by 38.5%.

We found from the survey that 20% of the foreign tourists and 18% of the national tourists refused to pay any amount of money above the existing fees. This does not mean that their desirability for coral biodiversity does not exist (only 5% of them stated that they do not care). In fact, they do think that the coral reefs are valuable, but they are unwilling to pay because they assume their money will be wasted (33%) or that the reef conservation should be financed by the government (39%). This implies that tourists need to feel that their payment will translate into improved management. Therefore, the fund should be available to park management with transparent transactions and meaningful visible results such as healthier corals, more support infrastructure (e.g. mooring buoys, shelters, walkways) and improvements that enhance tourists' appreciation of the site (e.g. signboards, visitor centre).

7.8. Policy Scenarios Valuation

Complex decisions are based on several factors considered jointly rather than on one factor. The Choice Experiment method can identify tradeoffs visitors are willing to make and provide managers with a predictive understanding of how visitors are likely to change their behaviour in response to different scenarios. In other words it can be used to better understand preferences and predict behaviour. In order to understand how visitors would react to various combinations of coral reef conservation management strategies and estimate the relative importance for each of them to visitors, a set of four scenarios involving changes in attribute levels were analysed. For objective comparison purposes, increase in reef quality (REEF) was held constant for all scenarios. Scenario A represents the status quo conditions (i.e. SQ Congestion, SQ Sites), Scenario B includes more sites for the same number of people, Scenario C includes less people for the same sites and Scenario D includes more sites and less people. These scenarios vary from less (A, B) to more restrictive (C, D). Less people represents reducing the number of visitors by 50% while more sites means increasing the number of dive sites to 25 sites. The following table shows the values that used to estimate the costs and benefits of the different scenarios.

	Scenario A	Scenario B	Scenario C	Scenario D
People	usual number	usual number	50% fewer people	50% fewer people
Dive Sites	15	25	15	25
Population				
IT	471,142	471,142	235,571	235,571
NT	24,240	24,240	12,120	12,120
CS[a]				
IT		1,884,568	2,355,710	3,297,994
NT		13,222	5,509	12,120
		1,897,790	2,361,219	3,310,114
Entrance Fees[b]				
IT	2,355,710	2,355,710	1,177,855	1,177,855
NT	22,036	22,036	11,018	11,018
	2,377,746	2,377,746	1,188,873	1,188,873
WTP	2,377,746	4,275,536	3,550,092	4,498,987
Management	300,000	500,000	300,000	500,000
OC[d]	-	1,092,000	-	1,092,000
Net Benefit	2,077,746	2,683,536	3,250,092	2,906,987

Values used to estimate the costs and benefits of the different scenarios.

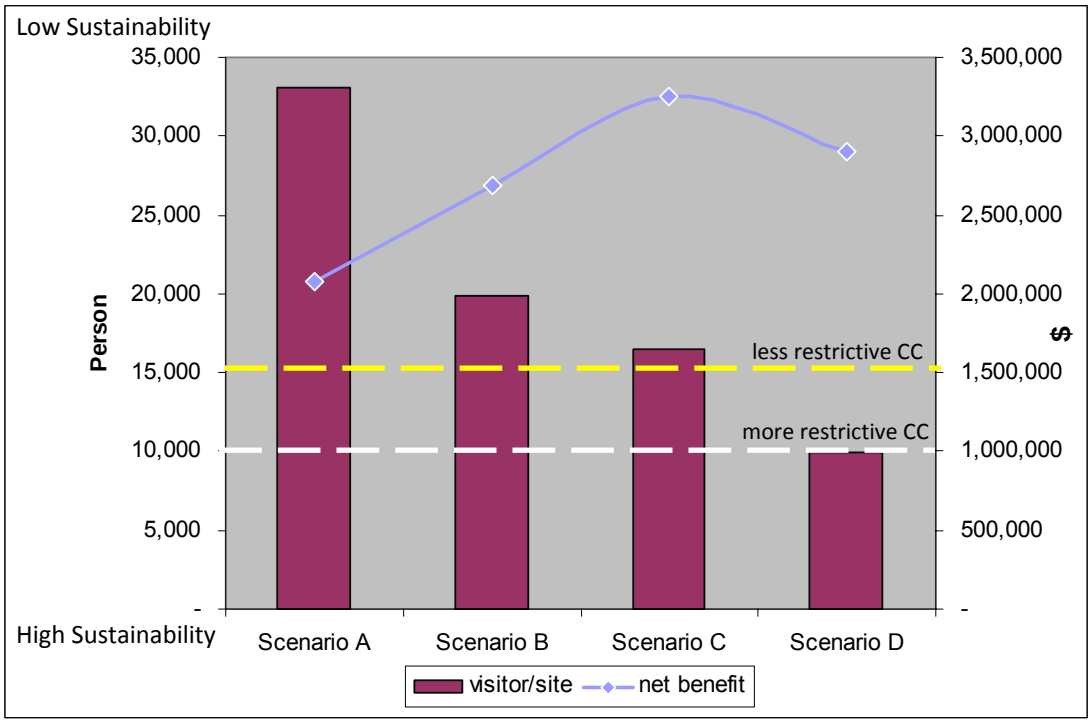
[a] the aggregated consumer surplus was calculated by using the results of attribute-based stated preferences in section 5.3 and the number of visitors in the year 2008/09.

[b] based on $5 for foreigners and LE5 for Egyptians.

[c] based on the expenditures of Ras Mohammed in 2006/07 adjusted to the financial year 2008/09.

[d] based on the carrying capacity of the diving site and the literature synthesis in section 5.2, the opportunity cost was calculated in terms of keeping the proposed sites as "preservation zones" or "scientific research zones"

The challenge is to bend the short-term pressures for unsustainability into a longer-term vision of sustainable tourism in Ras Mohammed. The results show that Ras Mohammed National Park under any of the scenarios presented yields an efficiency gain. However, towards sustainability scenarios (C, D) yield higher net benefits than business-as-usual scenarios (A, B). Also, by incorporating the opportunity cost of opening more dive sites in the park, Scenario C produces the highest net benefits. The difference in value between towards sustainability scenarios and business-as-usual scenarios can justify the commitment to conserve and manage the reef ecosystems.



Net benefits of proposed scenarios

In fact, the over-use of the reefs in scenarios A and B will diminish their qualities and attractiveness. Consequently, the number of divers and snorkelers will decrease leading to less yearly benefits to the park. In addition, with such level of visitation, a rapid loss of coral cover and reef biodiversity is expected. In contrast, the reef quality in scenarios C and D would likely increase with stricter management measures at Ras Mohammed due to lower densities of use and decreased impacts on the coral reefs. By using the implicit price for the increase in the reef quality, the estimated WTP for these scenarios would increase. This would also further increase the preferences for theses scenarios over the status quo and Scenario B.

8. Concluding Remarks

Egypt has determined that the future needs for coral reef conservation fall into three categorises: information requirements; development challenges; and public awareness (PERSGA, 2003a). The ecosystem services approach and economic valuation can play a crucial role in meeting these requirements. This report has attempted to address some of the key questions that underlie our limited understanding of the economy of ecosystems such as what are the benefits provided by ecosystems? Is the ecosystem services are valuable in an economic sense, why do we continue to use them in unsustainable way? Why are they not being better managed? Are continued expansion of dive tourism and coral reef protection compatible? To what extent is there deterioration and will deterioration reduce the overall attractiveness of the park as a tourist destination? How can the ecosystem service approach and economic valuation support policy and decision making to encourage more sustainable use of coral reefs and other ecosystems? Who loses and who gains?

The park management should take into account the social and economic factors in addition to the biological issues. The ecosystem services approach integrates the biophysical and socio-economic dimensions, improves the information available, and helps to direct policies and strategies. Armed with a broader, deeper knowledge of the different aspects of the ecosystem, we will be better equipped to safeguard the future of coral reefs and other ecosystems in the park. The aim should always be to ensure the quality of both the park and the experience of visitors using it. In addition to the rules and regulations, the management approach needs to focus more on the concept of enhancing the visitor's experience and fact-based information supporting decision-making to resolve the complex issues related to the visitor use. Implementing the basic principles of sound management induces the visitors to appreciate, understand and enjoy the park. Minimising detrimental impacts by visitors, while, at the same time, ensuring that high quality, non-crowded environmental resources will continue to attract environmentally aware and experienced divers and snorkelers, is one of the main challenges for the future management of Ras Mohammed.

The coral reefs ecosystem is the greatest asset Ras Mohammed has, and it is what it is selling to the world market. The park management needs to understand the visitor preferences to maintain or increase benefits for them while protecting the reef. The choice experiments method was used to analyse preferences of national and international tourists towards the conservation of coral reefs at Ras Mohammed. Four attributes were considered in the experiment for this purpose: the reef quality, the uncrowding conditions, the number of dive sites, and the increase in entrance fees. Both sets of tourists preferred high reef quality, low congestion, more dive sites and low entrance fees. However, international tourists showed significant preference for reducing congestion levels and were willing to have restrictions on the number of visitors to reef sites in exchange of healthier reef, while national tourists did not demonstrate strong preference for this reduction. One of the explanations of this result is the vast majority of Egyptians live along the narrow Nile Valley and Delta, and the rest of the country is sparsely populated, meaning that approximately 99% of the population uses only about 5.5% of the total land area. Thus, the perception of congestion may be different.

The management of reef sites in Ras Mohammed can be guided by knowledge of the relative economic value of individual attributes which may be affected by the management and the visitor preferences for different strategies which may be implemented. The park managers should know which of the alternative coral reef conservation management strategies are preferred, which are not, and which combinations of strategies are most preferred by visitors. Therefore, the evaluation of visitor preferences with regard to the park attributes is an important tool for developing strategies to adapt especially where economic and conservation objectives overlap.

The results presented in this study to elicit individuals' preferences for different attributes of the reef at Ras Mohammed could provide useful information for the policy makers concerning decisions of improving reef quality, regulating some activities inside the park, the allocation of resources for each attribute and choosing the best combination of attribute and levels for the policy to implement.

With the cheap package holidays to Sharm El-Sheikh, the elite tourism has disappeared and replaced by mass tourism. Without a comprehensive policy and a sustainable level of tourism and the institution of certain measures to ensure that any adverse effects on reef ecosystem are minimised, this industry will destroy itself in Sharm El-Sheikh. The management of Ras Mohammed should look at the impacts of mass tourism on coral reefs and other ecosystems in the park estimate appropriate carrying capacities for the different dive sites. An ongoing monitoring programme and a GIS database focusing on the reef sites should be developed and the number of mooring buoys should be increased and well distributed inside the park. The heavily used dive sites may be closed for a period of time to allow corals to recover and shifting use to new sites.

The coral reefs ecosystem is fragile and needs investment to be maintained and managed. The collected user fees should be used to pay for better management of the park. The successful implementation of the entrance fees requires allocating access rights and the ability to enforce these rights. The management of Ras Mohammed faces a problem with setting the entrance fees at the appropriate amount and enforcement of the access to the reef sites particularly in Tiran island and Sharm El-Shiekh coastline. A two-tier entrance fee is implemented where the foreign tourist pays $5 while the Egyptian pays LE 5 (≈ $1). The rationale of this system is foreign tourists do not pay taxes to the local government and they have higher income than the national tourists. The contingent valuation method was used to estimate the maximum willingness to pay (WTP) of the visitor on top of the existing entrance fee to support coral reefs conservation. The mean WTP was $7. As a result, the entrance fees could be raised to$12/person/day. Supplementary fees may be levied for visiting special or sensitive reef sites.

All the valuation examples presented in this study (particularly value per unit area for coral reefs, mangroves, and seagrass) show the high cost of forfeiting ecosystem services which may match with the high resultant average value from the literature synthesis. This is sustained by the need to establish deterrent system of fines in order to reduce the chances of the damage to ecosystems and reflect the loss of several hundred years of important growth.

It is important to ensure that the park has both the capacity and authority to maintain the coral reefs and achieve its objectives. The current levels of funding for management and staffing undermine the park capacity and protection activities. In order to achieve financial stability, the management of Ras Mohammed need to use the available funds according to clear strategies, meet the priorities of the park plan, improve budget management and control, promote cost efficiency and management effectiveness, minimise duplication of efforts with other stakeholders, adopt a long term approach for managing financial reserves, seek to maximise income generation opportunities and build a diverse funding portfolio. A pricing policy on the payment of concessions needs to be developed and new and non-traditional funding sources should be adopted. Moreover, the institutional distortions and obstacles to the park funding should be removed, and the incentives and opportunities for the park management to retain funds at the park area level should be assured. Financial and organisational autonomy can help the park to improve the conservation efforts and to build social capital and sustain beneficial linkages with the main stakeholders in society and the state, and thereby, to achieve successful environmental governance and enhance environmental capacities.

Future research could attempt to value the different benefits of other ecosystems in Ras Mohammed, particularly pharmaceuticals and the non-use values, and the contribution of the protected reef in enhancing yields in the form of increased recruitment and spillover of several commercial species into fished areas. It is recommended to invite more researchers to study the impacts of tourism development along the Gulf of Aqaba, on the ecological, economic and social sides. The question of carrying capacities of dive sites in Ras Mohammed has yet to be answered satisfactorily. An annual visitor profile and feedback surveys in the region are also recommended to monitor changes in market demand.

Coral reefs and other ecosystems can yield long term benefits for Egypt and her people if they are protected from improper use and managed in an efficient, dynamic, scientifically orientated way that allows to quick response to challenges as they arise. We hope that the economic valuation of the benefits of the ecosystems raises awareness about the importance of these natural treasures so that their beauty and utilities may be enjoyed forever.

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