Influence of marine tourism on the environmental natural resources in Egypt: Review.

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Introduction

Marine tourism has surfaced as a pressing topic in the field of ocean and coastal management. Neither necessarily good, nor bad, this tourism is inherently controversial today, demand for travel exhibits greater variation and magnitude than ever in history. In response, the tourism industry has become the largest business on earth. This coupled with the respect people profess for marine environments and local peoples create feelings of ambivalence for the tourist. Sociologically, the activity of tourism may be studied as a symbolic interaction fostering social solidarity. Ecotourism, a recent phenomenon attuned to the idea of sustainable development, is suggested to emerge through the social construction processes of restoration and enhancement. The papers in this themed volume add fuel to the proposition that the resolution of tourism problems in the coastal zone will require the scientific study of environmental and social conditions, policy analyses, planning, and public education.

Definitions of Marine Tourism

The ocean and the marine environment as a whole have become one of the new frontiers and fastest-growing areas of the world's tourism industry [1].

- Orams defines marine tourism as including 'those recreational activities that involve travel away from one's place of residence and which have as their host or focus the marine environment where the marine environment is defined as those waters which are saline and tide-affected [2].
- Such a definition emphasizes that marine and coastal tourism must also include shore-based activities, such as land based whale watching, reef walking, cruise ship supply and yachting events, within the overall ambit of marine tourism [3].

Marine Tourism & Coastal Tourism

The concept of coastal tourism includes a range of tourism, leisure, and recreationally oriented activities that occur in the coastal zone and immediate offshore coastal waters. These include tourism-related development (accommodation, restaurants and food services, attractions, and second homes), and the infrastructure supporting coastal and marine tourism development (e.g., retail businesses, transport hubs, marinas, and activity suppliers). Also included are tourism activities such as recreational boating, coast- and marine-based ecotourism, cruises, swimming, recreational fishing, snorkeling, and diving [2].

Marine Tourism & Global Environmental Change

Marine tourism resources exist under a range of global systemic threats to marine and ocean systems that are primarily anthropogenically driven. These include [1].

- Climate change.
- Overfishing.
- Bottom trawling (towing a trawl, which is a fishing net along the seafloor)
- Transfer of exotic species.
- Changes in waste, nutrient, and sediment inputs into coastal and marine ecosystems.
- Coastal urbanization and loss of natural capital in coastal areas, especially coastal wetlands.
- The experiences of these threats are "uneven", i.e., while they are global in scale their effects on tourism development and the tourist experience vary from location to location. Nevertheless, their effects are systemic in that over time they affect not only destinations but also, source regions as well.

The role of tourism in economic development

- Tourism, in the economic context, of the 21st century, is an essential activity in the structure of the economic mechanism and has an active role in the development and modernization of the economy and society.
- The importance and the economic contribution of this activity fluctuate from nation to nation.
- Although there are countries that rely largely on tourism, its role is so well integrated into contemporary economies that the economic impact is relevant even to the less important countries in terms of tourism-related activities" [5].
- The tourist destination represents the catalyst link that unites, maintains and drives all sectors of the tourism

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industry, namely transport, accommodation, food and entertainment, being a complex and specific item for tourism [6].

- Most successful destinations all over the world have been developed starting from a major tourist attraction. E.g. the City of Orlando revolves around Disney World [2].
- The tourism potential is determined by the sum of all resources (natural, human, cultural, historical, infrastructure) which, in turn, constitutes a destination's tourist offer [5].
- Tourism development, its integration into modern economic structures, and its integration into the sphere of needs, and consumption of the population, are all reflected in the continuous enrichment of its content.

Sustainable tourism development

Three main principles: [6]

- Ecological sustainability.
- Social and cultural sustainability.
- Economic sustainability.

The importance of tourism as an industry that provides competitive advantages, promotes economic growth and creates a positive image of countries is constantly growing nowadays.

In terms of economic efficiency, cruise shipping is the most profitable segment of maritime tourism. World experience demonstrates that the development of cruise shipping has a positive multiplier effect on the development of the country's economy at the expense of revenues from the provision of port services and from the consumption of additional tourism services on the land, such as sightseeing, shopping and food. According to the Cruise Lines International Association (CLIA), global cruise demand in 2016 reached 24.7 million passengers, up from 5.6 million in 1995. Between 2005 and 2016, the average annual increase in demand for cruise tourism in the world was 5.2%, which is higher than the similar indicator of international tourist arrivals (3.9%).

The economic importance of tourism in Egypt

Tourism in Egypt is considered as one of the main sources of national income as well as one of the major pillars of comprehensive development. It is associated with about 70 feeder and complementary services and industries. It is one important factor of economic growth as it represents about 40% of the Egyptian non-commodity exports in 2007/2008.

The tourism sector represents the main source of foreign currency. Also, it is one of the main labor-intensive activities as the total employment provided by this sector is estimated at about 4.5 million jobs which is equivalent to about 13% of the total labor force. Moreover, the contribution of the tourism sector in GDP in 2008/2009 reached about 3.6% [7]. The past years witnessed an expansion of hotels and tourist villages which amounted to up to 1486 hotels in 2009 with an accommodation capacity that reached about 213 thousand rooms. Also, the number of hotels under construction reached about 624 hotels with an accommodation capacity that exceeded 190 thousand rooms.

Off the coast of Egypt, the waters of the Red Sea are home to some of the most productive and diverse coral reefs in the world.

Year-round sunshine attracts millions of snorkelers, divers, and other visitors to the coastal resorts. The Red Sea region is particularly popular as tourists can obtain a "Sinai Stamp", a free alternative to a tourist visa, which makes a weekend trip from Europe easy to arrange. As a result, the tourism industry is one of the country's leading economic sectors, generating around 389 billion Egyptian pounds (€20.9 billion) for the nation's economy in 2018. But the high concentrations of tourists in cities along the Red Sea contribute significantly to plastic pollution, which threatens the region's marine life.

A recent move toward zero plastic tourism in Egypt's Red Sea region plans to protect marine life and preserve one-of-a-kind resort destinations like Hurghada and Sharm el-Sheikh for generations to come [8].

Plastic pollution is destroying our oceans, (Dhenin, 2020)

As many as thirteen million metric tons of plastic are dumped into oceans around the world each year, according to research from Pew Charitable Trusts. When plastic gets into the sea, it endangers fish, seabirds, sea turtles, and marine mammals, which can become entangled in or ingest debris and then suffocate, starve, or drown. Plastic rubbish also damages coral reefs, as the bacteria that causes white band disease, which destroys coral tissue, can colonise and spread via plastics.

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The team turned their research into a proposal for a ban on the production and use of single-use plastics in the Red Sea Governorate in spring 2019, and Governor General Ahmed Abdullah, put the proposal into law in April. It went into effect the following June.

Is banning single-use plastic that simple?, (Dhenin, 2020)

In the Red Sea region, Governor Abdullah supported HEPCA's proposal, which made the legal aspect of the plastic ban

relatively simple, explains El-Ramly. However, implementing it has proven more difficult.

With the ban in place, HEPCA launched a public awareness campaign to educate the public about the harmful effects of plastic pollution on both marine life and human health, and to encourage a move toward more sustainable alternatives. The campaign targeted restaurants, hotels, resorts, and other tourist hotspots. Last summer, HEPCA also began to offer certifications to businesses that eliminate single-use plastics. The Siva Grand Beach Hotel in Hurghada was the first to be granted the certification for its commitment to zero plastic tourism.

While several resorts are beginning to embrace the principles of sustainable tourism in the Red Sea region, supermarkets and restaurants have been a major obstacle to the implementation of the single-use ban because of their reliance on plastic bags.

Egyptians use an estimated twelve billion unrecyclable plastic bags every year, so both shopkeepers and consumers have been hesitant to phase them out. “Plastic bags are cheap for shops,” El-Ramly explains, and despite HEPCA’s public awareness campaign, “it was difficult to convince them to switch.”

Egyptians use an estimated twelve billion unrecyclable plastic bags every year

Now, more than a year later, many businesses and consumers have given up single-use plastics, but others still fail to comply with the ban. Those that do not comply are subject to fines, but El-Ramly says that when staff at HEPCA hear about violations, they prefer to take a more community-oriented approach to enforcement. “Whenever we find someone not complying, we talk to them,” El-Ramly says, “and we will not stop until we get the results we want.”

Thanks to the work of HEPCA and other conservationists, the Red Sea Governorate is leading the way toward sustainable, zero plastic tourism in Egypt. Several cities in South Sinai, including Sharm El-Sheik and Dahab, which is home to the notorious Blue Hole dive site, have since followed suit. El-Ramly describes the bans as a step in the right direction, but says that the conservation work never stops.

“I hope (a single-use plastic ban) will be implemented across the whole country one day,” she says.

A nationwide ban on single-use plastics is not likely to become law in Egypt anytime soon. If it did, though, it would go a long way toward protecting the Red Sea and Egypt’s other incredible natural wonders like Mount Catherine, the nation’s tallest peak, and Siwa’s salt lakes in Egypt’s western desert.

Coral Reefs, Hawkins, et al. (1994)

Coral reefs provide a major impetus for tourist development throughout the tropics. Their increased popularity has led to extremely rapid growth of many resorts. Using the Red Sea as a case history we examine the impacts that expanding coastal tourism has had on coral reefs. Present development is restricted almost entirely to Egypt, Israel and Jordan. The short coastlines of the latter two countries mean that most of their reefs are already, or soon will be, affected by tourism (developed or used recreationally).

Approximately 19% of Egypt's reefs are currently affected, but this figure is expected to rise to over 30% by the year 2000. However, the intensity of use of reefs is likely to increase

Table 1. *The authors of the article have identified the main problems associated with the development of tourism in the coastal region, and have also proposed directions for their solution.*

Problems	Ways of problem solution
Social	
Inequality of recipients’ income in the recreational zone.	Stimulation of the region developed as a whole, the introduction of the tax benefits for enterprises operating in the recreational zone.
Escalation of social tension between inbound tourists and residents of the recreational zone.	Price control in the recreational zone, boosting job creation by opening funds to support small businesses.
Conflicts on cultural and religious grounds.	Creation and support of non-governmental organizations promoting intercultural communication.
Political	
Military operations in the east of the country.	Stabilization of the political background, rehabilitation of Ukraine’s tourism image as a safe country.
Annexation of Crimea, coastline reduction.	Popularization and development of the inland marine and yacht tourism.
Political instability, lack of a clear political policy.	Selection of the priority directions of economic development; working out the strategy of the state development by the consolidated efforts of the political forces.
Economic	
High coastline maintenance costs.	Targeted use of tourist tax, “transparency” in tendering process.
The need to provide modern infrastructure and accommodation.	Facilities in the destination.
Attracting private investors, introducing tax “holidays” and deferrals Problems of tax evasion by tourism enterprises.	Strengthening tax control, creating tax optimization advisory centers
Ecological	
The necessity to create the coastal sewage treatment plants.	Increasing fines for environmental pollution, strengthening state control.
High dependence of the tourist flow on climate, season, and weather conditions.	Differentiation of the tourist flow through the development of such types of tourism that do not depend on weather conditions (for example, business tourism).
Dependence of the tourist flow on environmental quality.	Strengthening control over discharges and emissions into the environment.
Institutional	
The inefficiency of the state institutions for tourism development.	A clear division of functions concerning tourism control and development between government bodies.
	Corruption schemes of “money laundering” and “kickbacks” while Information transpa.

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much more during this period. Israel plans a further 43% increase in coastal tourism, Jordan 100% and Egypt a massive 11-fold expansion. Of the planned expansion in Egypt, 55% will occur around the established resorts of Hurghada and Sharm-el-Sheikh. Tourist development has already caused substantial damage to inshore reefs near Hurghada from infilling, sedimentation and over-fishing for marine curios. Elsewhere, new constructions are also beginning to modify reef habitats. Until now, damage to Sharm-el-Sheikh's reefs has been mainly caused by the direct effects of diving and snorkelling. Although, current levels of recreational use appear to be sustainable, the massive expansion planned throughout the region will place the long-term future of reefs in doubt. Unless the pace of tourist development in the northern Red Sea is significantly reduced soon the carrying capacity of coral reefs seems sure to be exceeded with widespread reef degradation the likely result (**Table 1**).

Nestled between the desert sands of Africa and Arabia, the Red Sea has lured adventurous explorers for hundreds of years. Now it attracts thousands of tourists. Once exotic and remote, it now has airports, hotels and diving package deals. The story is familiar wherever coral reefs occur. An unprecedented growth in global tourism is now threatening reefs. Using tourist development in the Red Sea as a case study we focus on a problem that has worldwide dimensions.

Almost all tourism to the Red Sea occurs in the north within Egypt, Israel and Jordan. Rapid development over the past 20 years has dotted the coastline with numerous resorts, and ambitious expansion plans will potentially quadruple the number of tourists visiting the area by the year 2000. In order to assess how coastal tourism has already, and may yet affect Red Sea coral reefs this paper will draw on examples from these three countries.

Sharm-el-Sheikh currently attracts upwards of 50 000 divers out of some 200 000 visitors per year. Future plans project a sevenfold expansion to accommodate 300 000 divers of a total 1.2 million visitors by the year 2000. All available building land for 24 km north from Sharm-el-Sheikh town has been sold to developers. To foster rapid growth, the government stipulates that construction must begin within three years of land purchase (O. Melika, pers. comm). Unfortunately, this has led to poorly conceived plans and uncoordinated development

Development elsewhere in Sinai has proceeded less rapidly. Nevertheless, there are similarly ambitious plans for expansion. Singled out for rapid development is the northern sector of the Gulf of Aqaba where a startling 40 000 hotel beds are expected by 2005. The Egyptian Ministry of Tourism sees this area as "a new gold coast".

Effects of present developments on reefs, hawkins, et al. (1994)

In the following, we examine the effects that tourist development has had on coral reefs in the northern Red Sea, focusing on Hurghada and Sharm-el-Sheikh as case studies. These two resorts show contrasting styles of development. In Hurghada, development has seriously damaged inshore reefs, so that what remains is "of little interest to divers or snorkellers". Offshore reefs 4-16 km from the coast now support the diving industry (**Figure 1**). In Sharm-el-Sheikh, both fringing reefs and those further offshore remain healthy and are still greatly acclaimed by divers.

Effects of Construction and Infrastructure Infilling: Coastal infilling has been widespread throughout Hurghada despite a setback requirement prohibiting development within 30 m of the high-tide line. This law has been flouted by town officials and developers a like causing major damage to fringing reefs,

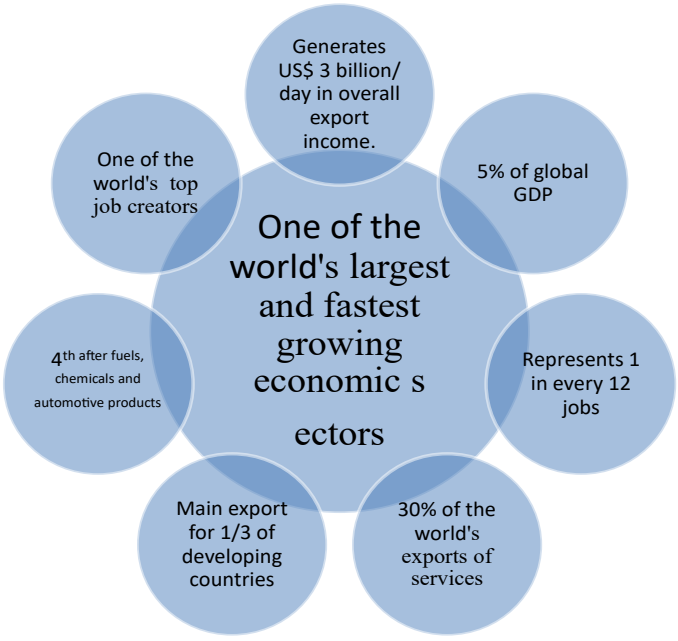

Figure 1: *Largest and fastest growing economic sectors.*

both directly from construction and indirectly through the effects of sedimentation. Landfill has proceeded unchecked probably because it creates prime but inexpensive land and improves access to the sea for tourists.

There has been almost no coastal infill around Sharm-elSheikh. This may be partly because the damage done by infilling in Hurghada has been widely noted, but is probably because most construction to date has occurred in sandy bays without reefs, or on the tops of cliffs. As new developments extend to areas where infilling could occur, it is hoped that pressure from the increasingly influential Ras Mohammed Marine Park will prevent such a practice.

Sediment from construction: Because there is so little rain along the Red Sea coast very little of the sediment released during construction is washed into the sea. Nevertheless, huge amounts of building dust blow offshore. Corals are very sensitive to sediment, which can kill them directly by smothering, reduce their growth rates and ability to settle.

Beach enhancement may also cause local damage to reefs. Along large parts of the Gulf of Aqaba and Red Sea coasts, uplifted fossil reefs rise close behind the living, submerged reef resulting in narrow or nonexistent beaches. At Quseir, on the southern Egyptian coast, developers are excavating at the edges of both the fossil and the living reef to make a broader beach and deeper swimming area. Comparable beach enhancement has not taken place around Sharm-el-Sheikh, but there may be future pressure to do so as development extends to more rocky shorelines. In other places, such as Dahab in the Gulf of Aqaba, the natural shoreline consists of coarse alluvial gravel. The three large hotels currently under construction plan to import fine sand to improve their beaches, much of which will eventually end up in the sea where it may damage reef organisms and inhibit reef regeneration.

Sewage disposal, desalination, irrigation and rubbish: An increasing threat to coral reefs throughout the world is eutrophication. Nutrient enrichment of coastal waters enables algae to thrive, overgrow and kill corals. Sewage disposal causes much of this nutrient input. At the moment, Sharmel-Sheikh directs all its sewage inland to fertilize a citrus farm

Although the President of the Hurghada City Council stresses that none of the town's sewage goes directly into the sea, there is plenty of evidence to suggest that treatment prior to discharge is inadequate (pers. obs.). Riegl and Velimirov found that algal overgrowth of corals was significantly higher on inshore fringing reefs of Hurghada than on offshore patch reefs, and suggested this was an effect of waste discharge.

A more localized source of nutrient input to reefs, but one which could have damaging effects over the long term, comes fromseepage of nutrient-rich irrigation water derived from hotel gardens. Many hotels water their gardens with treated wastewater, which gradually percolates through porous coastal rock and enters the sea.

As new developments spring up in more remote areas they will have to take responsibility for their own sewage treatment on site and generate their own electricity and fresh water. The hot brine effluent produced by desalination plants and generator cooling water can cause local damage to reefs. Hotels under construction at Quseir and Dahab plan to discharge these effluents via pipelines across the fringing reef. Many more hotels now in the planning stage are expected to do likewise.

Rubbish litters the Red Sea coast, but is particularly abundant around centers of population. Some ends up underwater where as well as being unsightly it can cause damage. For example, plastic bags can smother corals and rubbish litters the seabed in the Eilat Coral Reserve (D. Shapiro, pers. comm.). In the past few years, the litter problem around Sharm-el-Sheikh has been much reduced owing to an initiative by the local dive centers.

They now organize rubbish to be collected from the bins which were installed several years earlier by a Cairo diving club. Nevertheless, large quantities of rubbish still blow onto beaches and into the sea from local landfill sites.

Effects of tourism on local fisheries, Hawkins, et al. (1994)

Large-scale tourist development brings a great demand for fresh seafood. A huge appetite for lobster has led to overfishing and severely depleted stocks around Sinai. Immature individuals of lobster are regularly served in restaurants. Those too small to eat are used for garnishes. Recognizing that there was a problem the Governorate of South Sinai recently imposed a size restriction on lobsters, but this has not been enforced, apparently due to pressure from the hotel lobby (O. Melika, pers. comm.)

Large reef-fish are also heavily in demand, particularly groupers, snappers and emperors. A recent survey along the Gulf of Aqaba coastline showed that stocks of these fish are not yet overexploited. Nevertheless, fishing pressure is increasing.

There is a trend towards Egyptian fishermen from the north displacing local Bedouins and shifting the emphasis from sustainable to overharvesting. Reefs around Hurghada have been heavily fished for a number of years. Ormond suggests that serious overfishing occurred between 1967 and 1979 when military security prohibited local fishermen from using the Gulf of Suez. He also blamed spearfishing for the virtual absence of large edible fish on inshore reefs. All diving centers in Egypt ban spearfishing, but it remains a problem around Hurghada where there is poor enforcement of a new law prohibiting it. There is little spearfishing around Sharm-el-Sheikh.

The marine-curio trade is a cause for much concern around Hurghada. At least ten shops sell a wide variety of curios from shells, corals, sea urchins and starfish, to turtles, shark jaws and stuffed or dried-out fish. As well as posing a threat to the numbers of individual target species this trade can also affect wider reef ecology. Ormond suggested that sea-urchin population explosions around Hurghada in the early 1980s were partly due to removal of their pufferfish and triggerfish predators for sale as souvenirs. Population explosions of sea urchins after removal of these fishes have been demonstrated on Kenyan reefs. The large number of sea urchins at Hurghada

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has caused extensive reef erosion whilst feeding on filamentous algae which they scrape from the reef. Ormond reported that densities of urchin predators near Hurghada were down to one twentieth of those on little-fished reefs elsewhere in the Red Sea.

So far, there has been virtually no trade in marine curios at Sharm-el-Sheikh. Several of the dive centers feature posters against the marine-curio trade and all prohibit collection of souvenirs by their guests. By contrast, the last word from Hurghada is a roadside farewell sign showing a happy tourist caricature setting off home with a puffeffish lampshade tucked under his arm.

Direct Impacts of Diving and Snorkelling Impacts of recreational diving and snorkelling on corals can be striking in popular areas. Broken coral litters the reef and many broken colonies appear bleached or overgrown with algae.

Direct damage is caused by tourists kicking, trampling or holding onto corals which, once damaged, may be more susceptible to disease and algal competitors. Additional, often serious damage occurs when misplaced boat anchors scour the reef.

The most detailed studies of diver impact have been made around Sharm-el-Sheikh where the Egyptian Tourist Authority estimates that 25% of visitors are divers. In 1990, Hawkins and Roberts showed there was significantly more broken coral, fragments of coral reattached to the reef, partially dead and abraded corals, in areas heavily used by divers than in control areas. They concluded that although damage could rapidly accumulate within new dive sites, once a certain level of use had been reached the impact appeared to stabilize [9].

Despite very high levels of diving around Sharm-el-Sheikh, in 1990 only 37 sites were used in a 48.5 km stretch of coast. Assuming each site covers 500 m, and then 38% of the local coastline is subject to the direct effects of diving. Six sites were used very intensively with between 35 000 and 50 000 dives per year and it was feared that the carrying capacity of these reefs (defined as the point above which diver effects cause marked declines in abundance and diversity of organisms) had been exceeded. Since then, in one of several positive management steps recently made, the Ras Mohammed Marine Park has limited each diving center to only one boat a day visiting the popular Ras Mohammed peninsula.

However, problems lie ahead. Hawkins and Roberts concluded that if future plans to increase divers visiting Sharm-elSheikh by over sixfold were realized, the carrying capacity of the area for diving would be completely outstripped, even if the number of dive sites was increased and restrictions placed on the number of divers using the most popular sites.

Similar problems face reefs around Hurghada. Although divers form a smaller proportion of visitors than in Sharm-elSheikh, diving pressure is comparable, particularly since the bad state of inshore reefs magnifies pressures put on offshore dive sites. There is, as yet, no National Park or management plan for Hurghada to regulate against damaging effects of divers and snorkelers.

In Eilat, where management does exist in the form of the Nature Reserves Authority, the pressures are so great on such tiny areas of reef (reefs cover only 6.2 kin) that most appear badly knocked about (L. Montgomery, pers comm.). Riegl and Velimirov showed that 11% of the coral colonies they sampled around Bilat were broken. This compares closely with breakage levels of 10% found by Hawkins and Roberts onpopular reefs around Sharm-el-Sheikh. Interestingly, the subjective impression amongst divers and reef scientists was that the Sharm-el-Sheikh reefs were in much better condition than those of Eilat (D. Shapiro, pers. comm.). This may be because other stresses, such as pollution from the nearby port, exacerbate impacts from tourism.

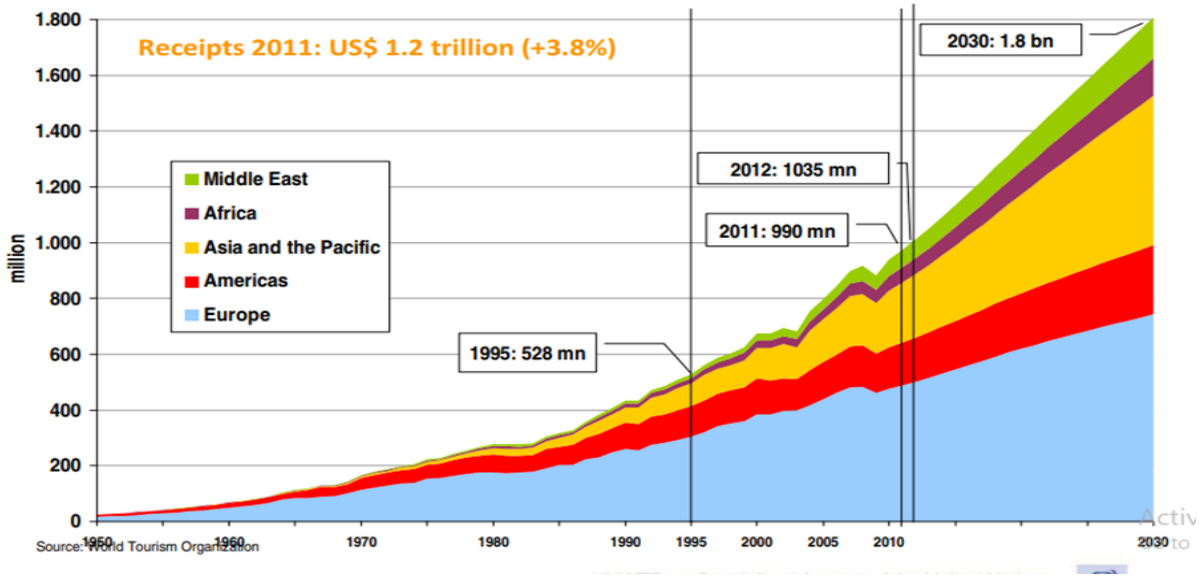

Figure 2. *International Tourist Arrivals, 1950-2030.*

**Current situation and forecasts UNWTO Tourism 2030 Vision, Cabrini.*

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Planning and future development, Hawkins, et al. (1994)

Many of the current problems from coastal development have arisen due to a lack of planning or at least a lack of adherence to development restrictions already on the statute books. The Egyptian Minister of Tourism has recently stated that "the Government of Egypt is striving to achieve sustainable exploitation of its tourism resources". However, as Mancy noted perceptively, "some governments may view tourism as the raison d'etre for the Gulf of Aqaba's coral reefs". In Egypt, government incentives to developers have created the massive-scale coastal construction presently underway before any coordinated development plans were drafted. Although it now appears to recognize the need for better coastal planning government initiatives to expand tourist development 11 -fold by early next century (**Figure 2**) pose a significant threat to reefs.

At present, approximately 19% of Egypt's reefs are affected by tourism (used for resorts and recreational activities). This will increase to over 30% if current tourism expansion plans materialize. In terms of area, such expansion does not seem excessive but it will be accompanied by a huge intensification of use of these reefs. Reefs cannot for example, support the same density of visitors that a sandy coast can. In Israel, 100% of reefs are currently affected by tourism and future development will intensify their use. Similarly, Jordan's planned tourism expansion will extend tourist effects to all of the country's reefs.

Unfortunately, the attraction of the Red Sea for tourists is unlikely to diminish in the face of environmental degradation.

Many divers seek destinations with warm clear water regardless of what there is to see. Once reefs become heavily degraded, tourism will shift from diving to beach-based activities. Facilities can thus continue to expand well beyond the point at which coral reefs have been severely damaged. For this reason, it is necessary to regulate development in areas with reefs to prevent such deterioration

Increased coastal tourism can also be expected to lead to increased coastal urbanization. As well as hotels, facilities must be developed to support their staff and local infrastructure improved to provide necessary services. In Egypt, facilities for workers in resort towns are currently sparse and most leave their families elsewhere. However, with Egypt's population set to double by 2020 expanding tourist resorts will become a focus for new settlement.

Some efforts towards integrated reef management and tourist development are now being belatedly introduced. In 1988, a project was initiated to develop a management plan for the Ras Mohammed Marine Park. Although the Israelis had first proclaimed the area a reserve and later legislation in 1983 made it an Egyptian Marine Park, it existed in name only for the next five years. Following initial success of this new management initiative, the park's boundaries have recently been extended to include the whole of the Sharm-el-Sheikh resort area plus two additional pockets of coast further north in the Gulf of Aqaba.

Whilst the stated intention of the Red Sea Governorate is to transform the coast between Hurghada and Safaga into a tourist riviera, at least part of that area will hopefully avoid mistakes made in earlier construction. Developers planning a resort covering 3200 ha around the beautiful headland of Ras Abu Soma have brought in consultants from the Ras Mohammed Marine Park to help them draft their plans.

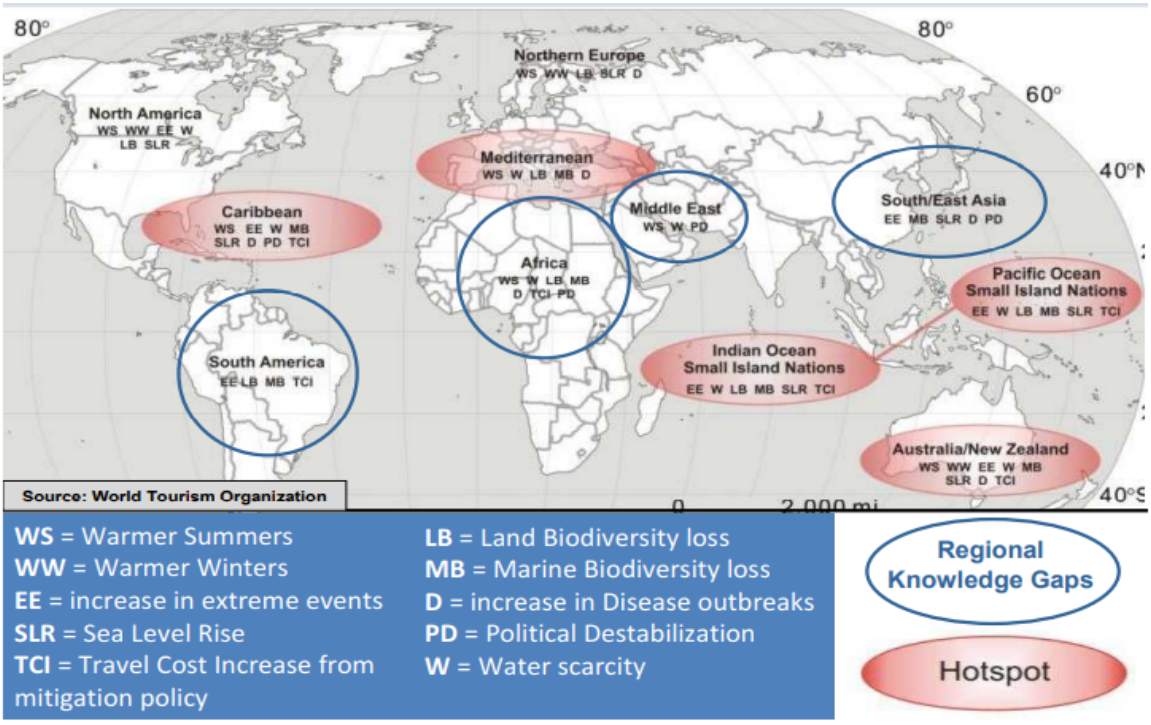

Figure 3. *Tourism Vulnerability 'Hotspots.*

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Suggestions for sustainable tourism, Hawkins, et al. (1994):

Development of tourism is clearly essential to the economies of coastal states throughout the developing world. (34) recently showed that diving tourism contributed USD 32 million annually to the economy of the tiny island of Bonaire in The Netherlands Antilles. They examined the effects of present levels of diving on the reefs and suggested that dive sites could support 4000-6000 dives per year without causing serious degradition. Based on this figure, and the amount of reef available for diving they recommended that Bonaire place an ultimate limit on this form of tourism of roughly 200 000 dives per year (or 20 000 divers if each makes 10 dives)

A similar approach can be used to calculate limits to sustainable tourism in the Red Sea. Based on studies in Sharm-elSheikh, Hawkins and Roberts have suggested that sites can withstand between 10 000-15 000 dives per year without serious degradation. They also estimated that this stretch of coast could support a doubling of the number of dive sites to 74. The average diver makes 10 dives, and reefs in this area could potentially support between 74 000 and 111 000 per year. At the upper end of this range this would mean that there were around 300 divers active in Sharm-el-Sheikh daily. This is only 50-100% more than are active daily at present and is much lower than the 300 000 divers planned for the year 2000. The latter figure would lead to over 40 000 dives per site per year if dives were evenly spread [10].

As we have shown above, in Sharm-el-Sheikh sources of stress other than diving or snorkelling have been kept to a minimum. In Hurghada, other forms of stress are likely to reduce limits for dive site carrying capacity. If development elsewhere follows the Sharm-el-Sheikh pattern, then Egypt's reefs might support a total expansion of diving tourism to 450 000 divers per year based around the seven existing and planned resort centers.

Israel's reefs 15 000, and Jordan's 30 000. Assuming that divers make up 25% of visitors these figures represent a substantial increase over present levels of development but peak at only about a quarter to a third of the levels planned. If projected levels of development are achieved, then widespread reef degradation can be expected, unless (i) construction is done in such a way as to limit pollutant inputs to reefs; (ii) discharges of sewage and nutrient-rich effluents are prevented; and (iii) the proportion of visitors who dive is reduced [11]

A shift away from diving tourism needs to be made in advance of reef degradation rather than as a consequence.

The cost of coral reefs and fisheries degradation in the Egyptian Red Sea area caused by unregulated tourism activities was estimated between US$ 2626 to 2673 million per year.

These include

1. The loss of natural capital: available estimates indicate that the replacement value of one square meter of coral reefs is US$ 3000. Based on an estimate of 4 million square meters (Institute of National planning, 2003) of coral reef damaged as a result of tourism projects within the studied area, the total value of the loss of the natural capital is about 12 billion US dollars.
2. The loss of natural capital: available estimates indicate that the replacement value of one square meter of coral reefs is US$ 3000. Based on an estimate of 4 million square meters (Institute of National planning, 2003) of coral reef damaged as a result of tourism projects within the studied area, the total value of the loss of the natural capital is about 12 billion US dollars.
3. Moreover, Cesar gave a value of US$ 9.6 billion/year globally for coral reefs contribution to tourism, i.e., Egyptian reefs represent only 1% of the total reef tourism incomes.
4. The cost of shoreline protection: the cost to build an artificial barrier replacing a damaged reef along the coast is estimated at 12.5 million US$ per km. Based on the fact that the length of the coast in the studied area that has been affected by tourism developments and has been subject to dredging and landfilling is estimated at 105 km. (north of Hurghada-Safaga) the cost of the coast protection would amount to 1313 million US dollars.
5. The cost of loss of fisheries resources: Based on the above-mentioned estimates (one square kilometer yields 15 tons of sea food products and 4 million square meters of reefs were damaged), the losses of fish production was estimated at 60 tons with a value of US$ 0.556 million at 2007 market prices.

Conclusion

At this stage, we reach the heart of our problem. Apart from the complications that climate change could cause, most of coral reefs damages came from tourism activity in this region of the Red Sea. At the same time, Egypt needs economic, financial, and social resources from this coastal and marine area.

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