



# Evaluating the Impact of Climate Change and Human Activities on Marine Tourism Activities from the Perspective of Diving Instructors and Marine Sports Activities: Applied on Sharm El-Sheikh

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## ABSTRACT

The research sought to assess the effects of climate change and anthropogenic activities on marine tourism in Sharm El-Sheikh, as perceived by diving instructors and marine sports professionals. We used quantitative techniques to collect data through a questionnaire, aiming to meet the research objectives and assess its hypotheses. The research sample included 87 professional diving instructors and marine sports activity facilitators in Sharm El-Sheikh. The sample was intentionally chosen to fulfill the research goals. The research revealed that the marine ecology of Sharm El-Sheikh was severely adversely impacted by rising temperatures owing to consecutive climate changes. The elevated levels and prevalence of acid rain at Sharm El-Sheikh significantly disrupt the marine ecosystem, adversely affecting different water sports activities, including diving, snorkeling, and other marine pursuits. Following the findings of the field study, a series of recommendations were formulated, the most critical of which is the necessity to adopt sustainable practices to mitigate the effects of increasing temperatures due to ongoing climate changes, thereby safeguarding the marine ecosystem in Sharm El-Sheikh.

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## 1. Introduction

Since the beginning, the climate on Earth has varied throughout the course of history. In the past 800,000 years, there have been eight cycles of warmer times and ice ages, with the end of the last ice age roughly 11,700 years ago signaling the beginning of the present climatic era and human

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civilization. The bulk of these climatic shifts may be traced to minute fluctuations in the Earth's orbit, which vary the amount of solar energy that is received by the planet (Nasa, 2023).

In addition, the contemporary phenomenon of global warming is unusual owing to its undeniable relationship with human activities going back to the mid-1800s, and its fast advancement exceeds anything recorded in past recent millennia. The influence of human activities on the formation of atmospheric gases, which have resulted in a greater retention of solar energy within the Earth system, is evident. The extra energy has resulted in the warming of the atmosphere, ocean, and land, leading to vast and quick modifications in the atmosphere, ocean, cryosphere, and biosphere (Nasa, 2024).

Moreover, the National Oceanic and Atmospheric Administration (NOAA) has produced the Annual Greenhouse Gas Index (AGGI) as a tool to assess the effect of human-generated greenhouse gases on climate change. The investigation looks at the cumulative warming effects of carbon dioxide, methane, nitrous oxide, and industrial chemicals used in cooling, refrigeration, and aerosol sprays. The AGGI evaluates the overall direct warming impact in a particular year and compares it to 1990, when countries promised to cut emissions (BUTLER, 2022).

In the same vein, the complex biological networks that control the passage of energy from producers to consumers, predators, and illnesses are known as marine ecosystems. The cycling of nutrients, productivity, and ecosystem function are all influenced by these interactions. Significant consequences of climate change on marine ecosystems include rising ocean temperatures, increasing ocean acidity, increasing sea levels (Figure 1), growing ocean stratification, decreasing sea ice extent, and altering circulation patterns. Without immediate mitigation, these permanent alterations are anticipated to grow in the coming decades and may transcend the tolerances of species.

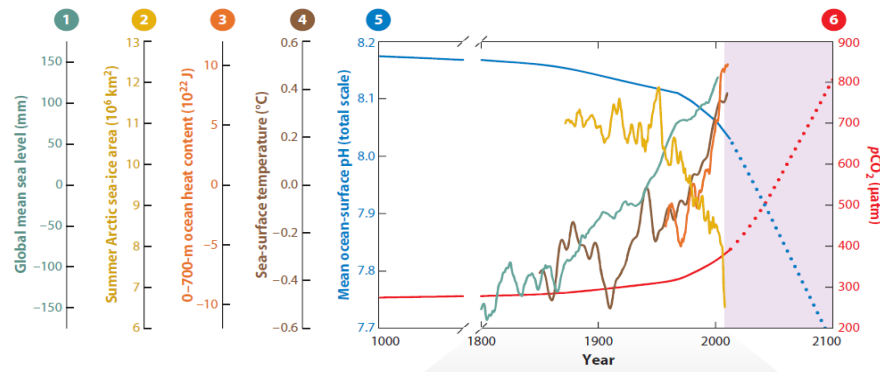


Figure 1. Significant effects of climate change on marine ecosystems. (Source: Doney, S. C., Ruckelshaus, M., Emmett Duffy, J., Barry, J. P., Chan, F., English, C. A., Galindo, H. M., Grebmeier, J. M., Hollowed, A. B., Knowlton, N., Polovina, J., Rabalais, N. N., Sydeman, W. J., & Talley, L. D. (2012). Climate change impacts on marine ecosystems. Annual Review of Marine Science) .

Correspondingly, ocean ecosystems are damaged by growing CO<sub>2</sub> levels due to the use of fertilizers, habitat loss, overfishing, aquaculture, and invasive species. Coastal hypoxia is expanding over the globe, resulting in the loss or deterioration of 50% of salt marshes, 35% of mangroves, 30% of coral reefs, and 29% of seagrass beds (Harvey et al., 2018).

Therefore, this paper will discuss the extent of the impact of climate change and human activities on the practice of marine tourism activities in Sharm El Sheikh from the point of view of practitioners of diving trainers and marine sports activities.

## 2. Literature review

### 2.1. The Influence of Climate Change on Marine Environment

Ocean and ocean-based economies will be badly impacted by anthropogenic climate change, which is being generated by greenhouse gas emissions from the industrial period. This demands fast reductions in order to retain a healthy maritime economy. The loss of ocean health is predicted to cost the global economy \$1.979 trillion by 2100 and \$428 billion by 2050, according to the Intergovernmental Panel on Climate Change (The Expected Impacts of Climate Change on the Ocean Economy, n.d.). The effects of climate change on three significant ocean-based industries—wild catch fisheries, marine aquaculture, and coral reef tourism—have been comprehensively assessed by the High Level Panel for a Sustainable Ocean Economy (Figure 2). (Cooley et al., 2022). The distribution and productivity changes in the world's fish populations based on numerous climate scenarios up to 2100.

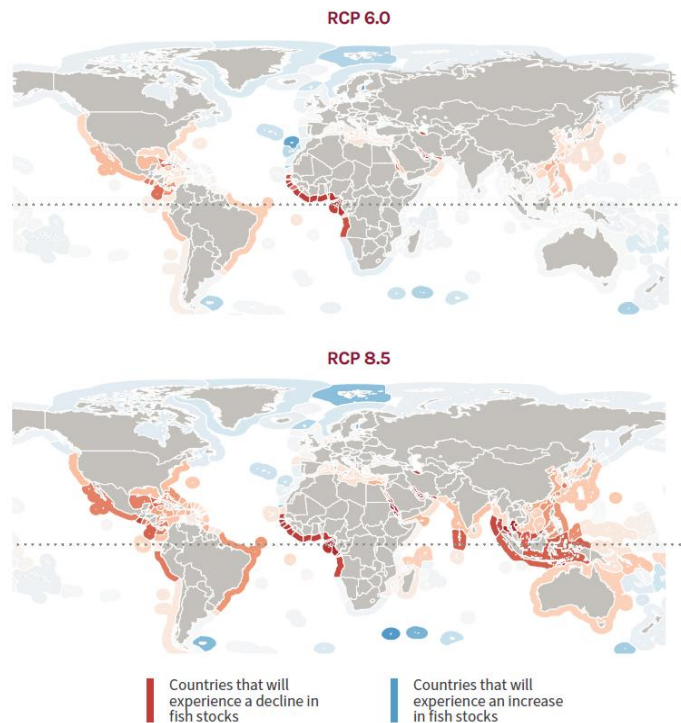


Figure 2. The distribution and productivity changes in the world's fish stocks based on several climatic scenarios up to 2100. (Source: Adapted from Free et al. (2019).

Indeed, an interactive web program has been created by the University of California, Santa Barbara's Sustainable Fisheries Group to examine how fisheries are influenced by climate change and the probable benefits of climate adaption management.

Similarly, marine animal biomass is anticipated to reduce by 15-20% by 2100 as a consequence of climate change, with regional differences contributing to the overall loss in marine fisheries (Shoaira et al., 2019). Coral reef tourism, valued at \$35.8 billion annually, feeds millions of people and businesses in developing tropics and tiny island states. However, climate change is expected to drop global coral cover by 72–87% by 2100, substantially hurting the industrial and socioeconomic implications of many nations (Tapsuwan & Rongrongmuang, 2015). In 2100, the economic potential of the coral reef tourism industry may have been drastically diminished by more than 90% owing to the consequences of climate change, such as ocean acidification and heat (Harvey et al., 2018). The graph depicts the predicted percentage change in coral reef tourist values as a consequence of climate change in 2100 (figure 3).

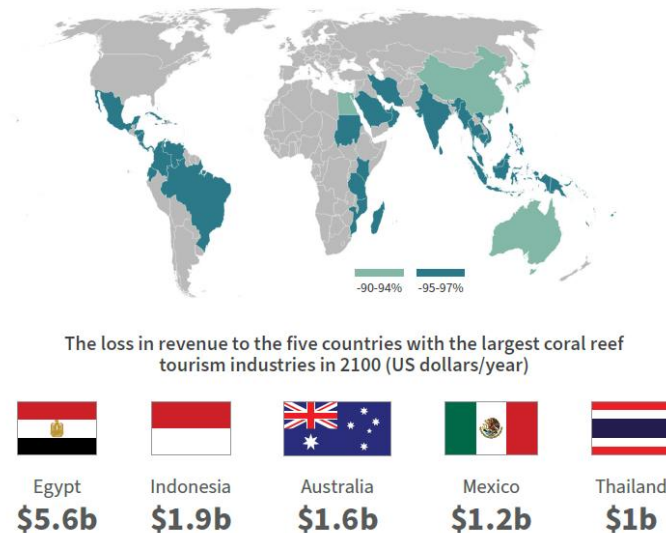


Figure 3. the loss in revenue to the five countries with largest coral reef tourism industries in 2100. (Source: Country-level tourism values data provided by M. Spalding. Model for change in coral cover adapted from Chen et al. (2015).

As the chart illustrates, the top five countries with the biggest tourism values produced from coral reefs are Egypt, Indonesia, Mexico, Thailand, and Australia. Between 45 and 86 percent of these nations' tourist revenues are obtained from on-reef activities like diving and snorkeling. RCP 8.5 is the foundation for the climate change effect, and values are rounded to the nearest hundred million.

### 2.1.1. Coral reefs

- **Overview of coral reefs ecosystem**

Coral reefs are generated by a symbiotic interaction between coral polyps, small animals related to sea anemones and jellyfish, and microscopic algae called Zooxanthellae. The algae produce food via photosynthesis, while the coral offers a sheltered habitat and the substances required for photosynthesis. Over generations, these complex structures generate coral reefs (Khalil et al., 2022).

- **Recent changes have occurred in the extent of anthropogenic stresses on coral reef ecosystems**

According to (Hoegh-Guldberg et al., 2017), ecosystems are quickly declining as a consequence of human activities that represent significant dangers to coral reefs. Over the previous 30 to 50

years, warm-water coral reefs have suffered a 50% loss in size, while cold-water reefs have been under growing pressure since the mid-1980s. Commercial bottom trawling, deep sea mining, hydrocarbon exploration, trash dumping, pollution, coral exploitation, trade, and harmful scientific samples are some of the primary causes of the damage. As a result of the rapid developments in technology for understanding and exploiting deep water settings, impacts have grown. Because deep-sea coral colonies have slow turnover rates, they take longer to recuperate from human pressures. Deep-sea reef ecosystems also serve as resource frontiers for high-value and high-tech metal mining, as well as hydrocarbon extraction. Coral reef ecosystems are predicted to suffer rising risks as a consequence of these impacts coupled with ocean warming and acidification. Given the highest rates of environmental change in recorded Earth history, it is critical that we recognize and manage both local and global risks to coral reefs.

- **Climate change and its impact on coral reefs**

- 1. Increasing Ocean Temperatures**

Indeed, one big concern hurting coral reefs is coral bleaching, which is brought on by climate change. Warm water stress causes corals to lose their bright colors, potentially leading to mass coral mortality. More reefs are at risk due to rising ocean temperatures, which affect both human populations and marine wildlife (Riegl, 2003).

- 2. ocean acidification**

The primary cause of ocean acidification is increased carbon dioxide emissions. When CO<sub>2</sub> dissolves in seawater, it generates carbonic acid, which subsequently decomposes into hydrogen ions and bicarbonate. This lowers the pH of the water, affecting coral growth and overall health. Calcium carbonate skeleton development and maintenance are impeded by the acidic waters (Thirukanthan et al., 2023).

- 3. Rise in Sea Level(SLR) and Frequency of Storms**

Shallow coral reef systems are being influenced by warmer seawater and increasing sea levels brought on by the melting of polar ice caps. Deeper oceans would restrict light penetration, which would impact the major food source for corals. Climate change has also increased the frequency and intensity of tropical storms and cyclones, destroying reefs and choking corals with silt(Thirukanthan et al., 2023).

## **2.2.The Effect of Human Activities on Marine Environment**

At the outset, humanity has relied on the oceans for numerous reasons throughout human history, such as nutrition, waste disposal, recreational activities, economic opportunities, and more. Our actions in the maritime environment have an influence not only on marine life, but also on the activities we participate in on land. Given that over 50% of the world population lives within a 100-kilometer radius of the shoreline, it is unsurprising that our activities have a negative impact. Human repercussions have grown in unison with our exponential population expansion, massive technical developments, and considerable changes in land usage. Overfishing, pollution, and the introduction of non-native species are damaging the marine ecology (science learning hub, 2023).

## 2.2.1. Human activities that effects on marine environment

### 1. Pathogens

In fact, wastewater pollution increases corals' exposure to disease-causing viruses, bacteria, or other organisms, commonly known as pathogens (Figure 4). Outbreaks of two of the most widespread coral ailments, white pox and black band disease, have been tied to wastewater pollution. White pox is directly caused by the human gut bacterium *Serratia marcescens*, but black band disease is tightly related to macroalgal cover that increases in polluted rivers. Diseases may also affect invertebrates, such as shellfish, because they may absorb infections and other toxins when they filter ocean water (Reef Resilience Network, 2024).



Figure 4. coral reefs being exposed to viruses and bacteria as a result of sewage.

### 2. Nutrients

Without a doubt, marine life relies on nutrients as building blocks. On the other hand, excess nutrients from land-based pollution sources, such as wastewater and agricultural runoff, result in coral disease and bleaching, reduced coral skeleton integrity, decreased coral cover and biodiversity, increased phytoplankton shading, and algal overgrowth in the marine environment. ref. The health of other marine invertebrates, such as shellfish, may also be damaged by nutrients. Shellfish require nutrients from the water to build their shells and tissues, so their nutrition levels can fall. Algal blooms, which may devastate coral reefs and coastal ecosystems, are a result of continuous nutrient loading and are anticipated to grow more frequent and widespread owing to climate change (Reef Resilience Network, 2024).

### 3. Contaminants

Basically, wastewater toxins may harm corals and other marine life, including fish, through several life phases. Herbicides damage symbiotic algae, impede photosynthesis, and induce bleaching. Metals and synthetic chemicals, such as PCBs, affect coral reproduction, feeding, and development, limiting habitat options for other species. They accumulate in fish's food chain and raise mortality rates in larger species. Pharmaceuticals may have negative behavioral and health effects on fish. More study is required to understand these pollutants and their repercussions(Chen et al., 2023).

#### **4. Fisheries**

Fundamentally, people have long used the ocean for food, but innovations in fishing equipment, bigger ships, and monitoring systems have led to a fall in fish populations globally. Continental shelf zones are currently deemed overfished. Irresponsible fishing tactics, such as dredging and trawling, may destroy marine ecosystems and creatures, as well as capture non-target organisms, known as bycatch, which are discarded. This has led to substantial devastation to the marine ecology (science learning hub, 2023).

#### **5. Chemical Pollution**

There have been countless deadly chemical spills at sea and from industry on land, causing immediate harm to animals via ingestion or long-term disruptions to reproductive cycles and other biological processes (ocean conservation trust. (2024). Humans Impact on the Ocean., 2024).

#### **6. Oil Spills**

Sadly, oil spills still occur, coating beaches, sinking to choke ocean plant life, and killing a diverse variety of birds, fish, and marine mammals (science learning hub, 2023).

#### **7. Plastic contamination**

The world has woken up to the millions of tons of plastic that have entered the Ocean during the last 100 years. The repercussions of this pandemic will linger a much longer (science learning hub, 2023).

### **3. The effects of climatic changes on marine tourism activities in Sharm El-Sheikh**

#### **• Effects of coral reef tourism (scuba diving)**

Egypt is one of the world's best-known tourist destinations for underwater diving. This is due to the Red Sea's unique environment, which includes hundreds of different kinds of fish, rich marine life, and underwater diving throughout the years. Egypt is also a prominent tourist destination for water activities, including diving and boat cruises along glacier beds, which are known as Egypt's "Carabi Europe" since they allow the closest access to the net tropical seas for millions of European tourists (رضا & على, ٢٠٢٣).

Furthermore, Egypt ranked first in the British magazine's annual vote in 2008, 2009, 2010, 2015, and 2018, and came in second place for the third consecutive year as the best site in the world for recreational diving in AM 2021 (محمد محمد, ٢٠٢٠).

In addition, the Red Sea's distinct geographic location and its warm water, which is abundant in a variety of marine life and coral reefs, set it apart. The cities along the Red Sea Coast's distinctive settings are the main attraction for visitors. Their deep-sea coral reefs and sandy beaches are what draw tourists there, along with the hundreds of coral reefs and numbers of fish and other aquatic life (كمال et al., 2021).

Accordingly, reef tourism brings about US\$35.8 billion annually, with the most revenue coming from Egypt, Indonesia, Mexico, Thailand, and Australia. Between 72 and 87 percent of these countries' coral cover and 90% of the value derived from only coral reef-related activities, such as diving, snorkeling, and glass-bottom boats, may have been gone by the year 2100. If these countries don't do anything to stop the rise in greenhouse gas emissions, coral reefs will suffer (Langsdorf et al., 2022). Coral reefs provide significant locations for fish reproduction in addition to safeguarding coasts, enhancing biodiversity, and offering other environmental and commercial

benefits. They also provide visitors the opportunity to go diving and fishing. 3,800 kilometers of stunning coral reefs may be found along Egypt's Red Sea coastline. These reefs are sporadic due to flooding, yet they extend from the Gulf of Suez to the Sudanese border. Of the 300 solid coral reef species found in the Red Sea, only one continuous species is known to exist (Spalding et al., 2017). Egypt, the most popular tourist destination in the world for coral reefs, earned \$7 billion in revenue in 2019—more than any other country and twice as much as Indonesia. Visits to coral reefs accounted for 44% of all tourism activity in 2017. However, it is estimated that by 2100, climate change would have devastated 74% of Egypt's coral reef ecosystem, potentially costing the nation \$5.6 billion in lost revenue. The High-Level Panel for a Sustainable Ocean Economy estimates that Egypt's diving and snorkeling sector earns more than \$7 billion a year. Coral reefs are vulnerable to temperature fluctuations at the ocean's surface and may lose their algae, which provides them with color and nutrition. While short-term bleaching may recover, prolonged bleaching may cause permanent harm (United Nations, 2022).

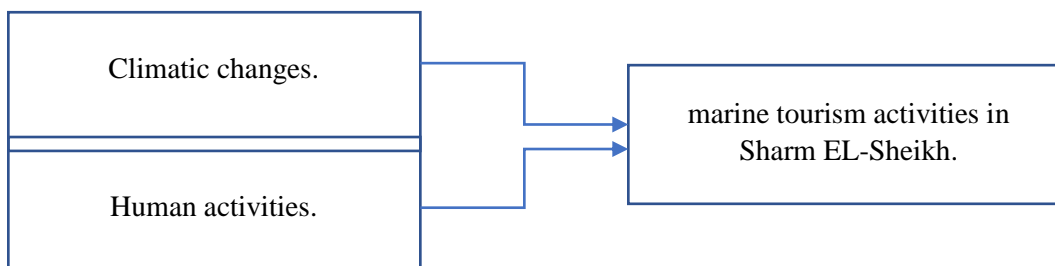
In addition, wind and rainfall have a significant impact on the ecology of coral reefs; strong winds have the potential to produce waves that damage the reefs' front slopes. Rainfall affects ocean salinity, which affects the establishment of Holocene reefs. Reduced salinity brought on by more rainfall stunts coral reef growth and may cause diseases like coral bleaching. The Intergovernmental Panel on Climate Change projects that losses to coral reefs would range from 70 to 90 percent by the end of this century. It is predicted that losses would reach 99 percent at 2°C of warming. This has an effect on the tourism industry as well as the coral reef environment (Khalil et al., 2022).

### 3. Methodology

#### 3.1. Conceptual framework and Study hypotheses

The basic framework of the present research has been designed based on the literature analysis of Evaluating the influence of climate change and human activities on marine tourist activities from the viewpoint of diving instructors and marine sports activities: applied on Sharm El-Sheikh. Figure 5 demonstrated how human activity and climate changes are examples of independent factors that directly affect Sharm El-Sheikh's marine tourist industry. In light of this, the present research attempts to assess the following hypothesis:

**Figure (5) Study framework**



H1: There is a significant impact of climatic changes on marine tourism activities in Sharm EL-Sheikh.

H2: There is a significant impact of Human activities on marine tourism activities in Sharm EL-Sheikh.



### 3.2. Research methods

This research evaluated the proposed model using a deductive approach with a quantitative methodology. The suggested research model consists of three constructions. Figure (5) A questionnaire form is used to assess the constructions, and it is supplied to diving instructors and marine sports activities in Sharm EL-Sheikh. As shown by Table 1 below, statements that were utilized to gauge the study constructs were created from the literature review. and to gauge the respondents' opinions, a five-point Likert scale was used (1 being strongly disagree and 5 being strongly agree). Four broad variables may be used to classify the features of the websites, as Table 1 below illustrates.

**Table 1. Questionnaire Structure for the study.**

Indicator	Variables	Empirical studies
<b>Impact of climate changes on the natural components of the marine environment.</b>	Marine ecosystems have been severely affected by rising temperatures due to climate change.	(Doney et al., 2012)
	There has been a significant impact on the marine environment due to the increase in the percentage and rates of acid rain resulting from climate change.	(Doney et al., 2012)
	There is a severe weakness in marine ecosystems due to climate change due to human activities.	(Doney et al., 2012).
	The degree of purity (clarity) of sea water has been affected, which has affected the nature and locations of marine organisms due to climate change.	(The Expected Impacts of Climate Change on the Ocean Economy, n.d.)
	Sea level rise (SLR) has affected the depth of diving areas, making it difficult to practice the activity.	(Tapsuwan & Rongrongmuang, 2015).
<b>The impact of practicing human activities on the nature of marine ecosystems.</b>	There is a significant impact on the marine ecosystems due to some irresponsible activities such as (overfishing, use of explosives and use of narrow nets).	(Chen et al., 2023).
	There is a significant impact on the marine ecosystems due to the density of tourist yachts at rates greater than permitted.	(Reef Resilience Network, 2024).
	There has been a severe impact on the marine ecosystems due to exhaust fumes from boats and ships.	(science learning hub, 2023)
	The marine ecosystems have been severely affected due to the failure to determine the capacity of the various diving points.	(ocean conservation trust. (2024). Humans Impact on the Ocean., 2024)
<b>changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities.</b>	Climate change has had a significant impact on changing the morphology of beaches, which has severely affected the practice of marine tourism activities.	(Pathak et al., 2021)
	Climate change has led to an increase or change in water currents and their direction, which has affected the practice of marine tourism activities.	(Shoaira et al., 2019)
	Sea level rise (SLR) resulting from climate change has led to economic losses for marine tourism such as (increasing the depths of diving areas - death or decay of coral reefs).	(Chen et al., 2023)
	There is a severe negative impact on the practice of tourism activities related to coral reefs due to climate change at unprecedented rates.	(Khalil et al., 2022).
	Wind speeds and directions have significantly affected the practice of marine tourism activities.	(Sharaan et al., 2022).

	The practice of some marine tourism activities has been severely affected as a result of the movement of the usual tourist season, especially in the summer due to high temperatures.	(Hefny et al., 2019)
	The practice of tourism activities related to the marine environment has been severely affected due to the significant increase in the temperature of surface waters above normal rates.	(Pathak et al., 2021)

**3.3. Study population and sampling**

The study sample amounted to about (87) diving instructors and marine sports activities in Sharm EL-Sheikh

After the data gathering stage, the Statistical Package for Social Sciences (SPSS version 23) was used to analyze the collected data. The intended study's findings were obtained via a number of statistical procedures. To assess the data, both quantitative and descriptive metrics were used.

- **Firstly, descriptive measurements.**
  - A. Frequency table
  - B. Measures of central tendency "mean" T. Measures of dispersion standard deviation "std"

- **Second: Quantitative measurements**

The quantitative measures used in the study were represented in testing the significance of the hypotheses through the relationship of influence and influence between the independent variables and the dependent variable through the simple linear regression equation, as it is the most appropriate statistical method to achieve the objectives of the study.

**3.4. Time delineation**

The present study is cross-sectional, which indicates that data for two or more variables were acquired simultaneously for many occurrences. This study accordingly adopted a cross-sectional design. A total of 87 surveys were supplied intentionally to the diving instructors and marine sports activities in Sharm EL-Sheikh from March 2023 to August 2024.

**4. Results and Discussion**

**4.1. Descriptive analysis**

The descriptive analysis of the questionnaires that were distributed to the diving instructors and marine sports activities in Sharm EL-Sheikh (mean and standard deviations).

**Table 2. Impact of climate changes on the natural components of the marine environment in Sharm El-Sheikh**

<b>Impact of climate changes on the natural components of the marine environment in Sharm EL-Sheikh</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Rank</b>
Marine ecosystems have been severely affected by rising temperatures due to climate change.	4.023	.9273	1
There has been a significant impact on the marine environment due to the increase in the percentage and rates of acid rain resulting from climate change.	3.299	1.1321	4
There is a severe weakness in marine ecosystems due to climate change due to human activities.	3.977	.9762	2
The degree of purity (clarity) of sea water has been affected, which has affected the nature and locations of marine organisms due to climate change.	3.517	1.1700	3
Sea level rise (SLR) has affected the depth of diving areas, making it difficult to practice the activity.	2.368	1.1725	5

**Weighted mean= 3.636**  
**Std. Deviation= 1.075**

**We assessed Table 2. Upon inquiring the diving instructors and marine sports activities in Sharm EL-Sheikh about Impact of climate changes on the natural components of the marine environment in Sharm EL-Sheikh the following turns out:**

- Marine ecosystems have been severely affected by rising temperatures due to climate change., it was determined that the general average of their thoughts was agree, with 41.4% selecting this option, a mean value of 4.023, and a standard deviation of .9273.
- The respondents' replies showed agree of 44.8% about the severe weakness in marine ecosystems due to climate change due to human activities., with an arithmetic mean of 3.977 and a standard deviation of .9762.
- Regarding the degree of purity (clarity) of sea water has been affected, which has affected the nature and locations of marine organisms due to climate change., the percentage of agree choice was 41.4%, with an arithmetic mean of 3.517 and a standard deviation of 1.1700.
- When the respondents were questioned about There has been a significant impact on the marine environment due to the increase in the percentage and rates of acid rain resulting from climate change, their answer in selecting agree was 34.5%, with an arithmetic mean of 3.299 and a standard deviation of 1.1321.
- Regarding the Sea level rise (SLR) has affected the depth of diving areas, making it difficult to practice the activity' responses was 2.368 with a standard deviation of 1.1725, and the percentage of disagree on this element was 29.9%.

The weighted mean average of the impact of climate changes on the natural components of the marine environment in Sharm EL-Sheikh was 3.636, which suggests that the trend of climatic changes and their effect on the natural components of the marine environment in Sharm EL-Sheikh is agree as a general tendency according to a 5-point Likert scale as indicated in the above table because 3.636 lay in the internal (2.368-4.023).

The general average of the respondents' comments was agreeing, which demonstrates that diving instructors and marine sports activities in Sharm EL-Sheikh agree that there is a negative impact resulting from climate change on the natural components of the marine environment in Sharm El Sheikh. This is consistent with the views of (Hoegh-Guldberg et al., 2017) (Riegl, 2003) (Thirukanthan et al., 2023) regarding the negative impact of some climatic elements on the natural components of the marine environment.

**Table 3. The impact of practicing human activities on the nature of marine ecosystems in Sharm El-Sheikh.**

<b>The impact of practicing human activities on the nature of marine ecosystems.</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Rank</b>
There is a significant impact on the marine ecosystems due to some irresponsible activities such as (overfishing, use of explosives and use of narrow nets).	4.483	.7130	1
There is a significant impact on the marine ecosystems due to the density of tourist yachts at rates greater than permitted.	4.184	.9588	3
There has been a severe impact on the marine ecosystems due to exhaust fumes from boats and ships.	4.127	.8654	4

The marine ecosystems have been severely affected due to the failure to determine the capacity of the various diving points.	4.276	.8982	2
<b>Weighted mean= 4.267</b> <b>Std. Deviation= 0.858</b>			

**We assessed Table ۳. Upon inquiring the diving instructors and marine sports activities in Sharm EL-Sheikh about The impact of practicing human activities on the nature of marine ecosystems the following turns out:**

- There is a significant impact on the marine ecosystems due to some irresponsible activities such as (overfishing, use of explosives and use of narrow nets), it was determined that the general average of their thoughts was strongly agree, with 56.3% selecting this option, a mean value of 4.483, and a standard deviation of .7130.
- The respondents' replies showed strongly agree of 47.1% about the marine ecosystems have been severely affected due to the failure to determine the capacity of the various diving points, with an arithmetic mean of 4.276 and a standard deviation of .8982.
- Regarding the significant impact on the marine ecosystems due to the density of tourist yachts at rates greater than permitted., the percentage of strongly agree choice was 46%, with an arithmetic mean of 4.184 and a standard deviation of .9588.
- When the respondents were questioned about the severe impact on the marine ecosystems due to exhaust fumes from boats and ships, their answer in selecting agree was 43.7%, with an arithmetic mean of 4.127 and a standard deviation of .8654.

The weighted mean average of the impact of practicing human activities on the nature of marine ecosystems in Sharm EL-Sheikh was 4.267, which suggests that the trend of the impact of practicing human activities on the nature of marine ecosystems in Sharm EL-Sheikh is agree as a general tendency according to a 5-point Likert scale as indicated in the above table because 4.267 lay in the internal (4.127- 4.483).

The general average of the respondents' comments was agreeing, which demonstrates that diving instructors and marine sports activities in Sharm EL-Sheikh believe that human activities related to the marine environment in Sharm El Sheikh negatively affect marine tourism activities. This is consistent with the views of (Reef Resilience Network, 2024) (Reef Resilience Network, 2024) (Chen et al., 2023). (science learning hub, 2023) (ocean conservation trust. (2024). Humans Impact on the Ocean., 2024) regarding the negative impact of some human activities on marine tourism activities.

**Table 4. changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities in Sharm El-Sheikh.**

<b>changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities in Sharm EL-Sheikh.</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Rank</b>
Climate change has had a significant impact on changing the morphology of beaches, which has severely affected the practice of marine tourism activities.	3.563	.9487	4
Climate change has led to an increase or change in water currents and their direction, which has affected the practice of marine tourism activities.	3.333	1.0962	5
Sea level rise (SLR) resulting from climate change has led to economic losses for marine tourism such as (increasing the depths of diving areas - death or decay of coral reefs).	2.943	1.2138	7

There is a severe negative impact on the practice of tourism activities related to coral reefs due to climate change at unprecedented rates.	3.759	.9879	2
Wind speeds and directions have significantly affected the practice of marine tourism activities.	3.264	1.1459	6
The practice of some marine tourism activities has been severely affected as a result of the movement of the usual tourist season, especially in the summer due to high temperatures.	3.816	1.0290	1
The practice of tourism activities related to the marine environment has been severely affected due to the significant increase in the temperature of surface waters above normal rates.	3.667	1.1780	3
<b>Weighted Mean= 3.577</b> <b>Std. Deviation= 1.085</b>			

**We assessed Table 4. Upon inquiring the diving instructors and marine sports activities in Sharm EL-Sheikh about changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities the following turns out:**

- There is a significant impact on the practice of some marine tourism activities has been severely affected as a result of the movement of the usual tourist season, especially in the summer due to high temperatures, it was determined that the general average of their thoughts was agree, with 46% selecting this option, a mean value of 3.816, and a standard deviation of 1.0290.
- The respondents' replies showed agree of 43.7% about the negative impact on the practice of tourism activities related to coral reefs due to climate change at unprecedented rates, with an arithmetic mean of 3.759 and a standard deviation of .9879.
- Regarding the practice of tourism activities related to the marine environment has been severely affected due to the significant increase in the temperature of surface waters above normal rates, the percentage of agree choice was 33.3%, with an arithmetic mean of 3.667 and a standard deviation of 1.1780.
- When the respondents were questioned about the Climate change has had a significant impact on changing the morphology of beaches, which has severely affected the practice of marine tourism activities, their answer in selecting agree was 39.1%, with an arithmetic mean of 3.563 and a standard deviation of .9487.
- Regarding the Climate change has led to an increase or change in water currents and their direction, which has affected the practice of marine tourism activities, the percentage of agree choice was 32.2%, with an arithmetic mean of 3.333 and a standard deviation of 1.0962.
- Wind speeds and directions have significantly affected the practice of marine tourism activities, it was determined that the general average of their thoughts was agree, with 33.3% selecting this option, a mean value of 3.264, and a standard deviation of 1.1459.
- The respondents' replies showed neutrality of 26.4% about Sea level rise (SLR) resulting from climate change has led to economic losses for marine tourism such as (increasing the depths of diving areas - death or decay of coral reefs), with an arithmetic mean of 2.943 and a standard deviation of 1.2138.

The weighted mean average of the changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities in Sharm EL-Sheikh was 3.577, which suggests that the trend of the changes in the natural components resulting from climate change, human activities and its effect on marine tourism activities in Sharm EL-Sheikh is agree

as a general tendency according to a 5-point Likert scale as indicated in the above table because 3.577 lay in the internal (2.943 - 3.816).

The general average of the respondents' comments was agreeing, which demonstrates that diving instructors and marine sports activities in Sharm EL-Sheikh believe that climatic changes and human activities have negatively effect of marine tourism activities in Sharm EL-Sheikh. This is consistent with the views of (Langsdorf et al., 2022) (Spalding et al., 2017) (United Nations, 2022) (Khalil et al., 2022) The resulting change in the marine ecosystems is mainly caused by climate changes, most of which are the result of various human activities, which negatively affects the practice of marine tourism activities.

**4.2.The regression**

The study's assumptions were evaluated using the linear regression coefficient, and the findings are shown in the tables below.

• **Regression analysis and hypothesis testing as following:**

1. Table 7. Measures the correlation of the independent and dependent variables' coefficients of determination
2. Table 8. F-test used in ANOVA to evaluate if there is a significant relationship between the effect of independent variables and the marine tourism activities in Sharm EL-Sheikh.
3. Table 9. Regression of the independent variables and their effect on the dependent variable.

Table 5. Coefficient of determination (R<sup>2</sup>) between independent variables and the marine tourism activities in Sharm EL-Sheikh.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.612 <sup>a</sup>	.374	.359	.62460

a. Predictors: (Constant): human activities, climatic changes

It is noticed from the previous analysis of the Model Summary Table that there is a link between climatic changes and human activities (the independent variable) and the marine tourism activities in Sharm EL-Sheikh (the dependent variable), as the correlation coefficient between these variables equals .612<sup>a</sup>. This means that the correlation is strong positive (greater than or equal to 0.5) and that these climatic changes and human activities impacted the marine tourism activities in Sharm EL-Sheikh 37.4%, while the rest of the percentage of effect is attributable to other variables. This is considered conclusive material evidence that climate change and the practice of unplanned and irresponsible human activities affect the practice of marine tourism activities in Sharm El Sheikh. Therefore, strategies must be developed to mitigate the effects of climate change and adapt to its severity, as well as implementing some practices to mitigate the severity of irresponsible human activities.

Table 6. F-test used in ANOVA to evaluate if there is a significant relationship between the effect of independent variables and the marine tourism activities in Sharm EL-Sheikh.

ANOVA <sup>a</sup>						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.589	2	9.795	25.106	.000 <sup>b</sup>
	Residual	32.771	84	.390		
	Total	52.360	86			

a. Dependent Variable: tourism activities

b. Predictors: (Constant): human activities, climatic changes.

It is noticed from the preceding variance analysis table that the climatic changes and human activities have a considerable and actual influence on the marine tourism activities in Sharm EL-Sheikh. This is obvious from the result (F) = 25.106 at a significance level of .00b<sup>b</sup> (less than 0.05). Table 7. Regression of the independent variables and their effect on the dependent variable.

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.677	.471		1.438	.154
	Climatic changes	.551	.097	.524	5.666	.000
	Human activities	.212	.109	.180	1.950	.000

a. Dependent Variable: tourism activities.

With a beta coefficient value of .551 and a significance level of .000, less than (0.05), it is evident from examining the preceding regression table that climatic changes has impact the marine tourism activities in Sharm EL-Sheikh. This supports the first hypothesis, which states that there is a significant impact of climatic changes on marine tourism activities in Sharm EL-Sheikh.

With a beta coefficient value of .212 and a significance level of .000, less than (0.05), it is evident from examining the preceding regression table that human activities has impact the marine tourism activities in Sharm EL-Sheikh. This supports the second hypothesis, which states that There is a significant impact of Human activities on marine tourism activities in Sharm EL-Sheikh.

### 5. Conclusion and recommendations

This study is useful for countries suffering from the effects of climate change and irresponsible human activities that affect the marine environment and associated tourism activities, by identifying the most prominent of these climate changes and how they affect the practice of marine tourism activities as well as the most prominent human activities that affect the marine environment and the practice of tourism activities associated with it in Sharm El-Sheikh. Based on the analysis of the results in the previous tables, the study concluded with a set of results as follows:

1. Marine ecosystems have been severely affected by rising temperatures due to climate change also the severe weakness in marine ecosystems due to climate change due to human activities. This is consistent with the views of (Hoegh-Guldberg et al., 2017) (Riegl, 2003) (Thirukanthan et al., 2023) regarding the negative impact of some climatic elements on the natural components of the marine environment.
2. There is a significant impact on the marine ecosystems due to some irresponsible activities such as (overfishing, use of explosives and use of narrow nets) also the marine ecosystems have been severely affected due to the failure to determine the capacity of the various diving points. This is consistent with the views of (Reef Resilience Network, 2024) (Reef Resilience Network, 2024) (Chen et al., 2023). (since learning hub, 2023) (ocean conservation trust. (2024). Humans Impact on the Ocean., 2024) regarding the negative impact of some human activities on marine tourism activities.
3. The Climate change has led to an increase or change in water currents and their direction and wind speeds and directions have significantly affected the practice of marine tourism activities also sea level rise (SLR) resulting from climate change has led to economic losses for marine tourism such as (increasing the depths of diving areas - death or decay of coral reefs). This is consistent with the views of (Langsdorf et al., 2022) (Spalding et al., 2017) (United Nations, 2022) (Khalil et al., 2022) The resulting change in the marine ecosystems is mainly caused by climate changes, most of which are the result of various human activities, which negatively affects the practice of marine tourism activities.

### **3.1.Recommendations**

**Firstly: recommendations directed to the specialists at the Ministry of Environment and Tourism in order to mitigate the severity of climate change on the natural components of the marine environment in Sharm El-Sheikh.**

#### **1. Implement Marine Protected Areas (MPAs)**

Designate and expand MPAs to safeguard critical habitats such as coral reefs and seagrass beds, reducing stress from human activities and enhancing resilience against climate change.

#### **2. Promote Sustainable Tourism Practices**

Encourage eco-friendly tourism by regulating visitor numbers, implementing strict guidelines on diving and snorkeling, and promoting education on the importance of preserving marine ecosystems.

#### **3. Enhance Coral Restoration Programs**

Support coral restoration projects by planting resilient coral species, engaging local communities in restoration efforts, and conducting ongoing monitoring to assess the success of these initiatives.

#### **4. Reduce Coastal Pollution**

Strengthen regulations on wastewater management, reduce plastic waste, and promote the use of biodegradable materials to minimize pollution entering the marine environment.

#### **5. Monitor and Research Climate Impacts**

Establish a comprehensive monitoring program to track changes in sea temperature, ocean acidification, and other climate-related factors. Collaborate with research institutions to develop adaptive management strategies based on scientific data.

**Secondly: recommendations to officials at the Ministry of Tourism and Environment to reduce irresponsible human activities related to the marine environment in Sharm El Sheikh.**

#### **1. Strengthen Regulations on Marine Activities**

Implement stricter regulations on activities such as diving, snorkeling, and boating to minimize damage to coral reefs and other sensitive habitats.

#### **2. Enhance Enforcement of Environmental Laws**

Increase patrols and surveillance to ensure compliance with environmental protection laws, deterring illegal fishing, anchoring, and waste disposal.

#### **3. Promote Sustainable Tourism Practices**

Educate tourists and operators on eco-friendly practices, such as using reef-safe sunscreens and adhering to designated pathways to prevent trampling of marine life.

#### **4. Implement a Carrying Capacity Limit**

Limit the number of visitors and boats in popular marine areas to prevent overcrowding and reduce environmental pressure on marine ecosystems.



## 5. Ban Single-Use Plastics

Prohibit the use of single-use plastics by tourism operators and visitors to reduce marine pollution and protect wildlife from ingestion and entanglement.

Future studies must be conducted to measure integrate marine biology, climate science, tourism management, and social sciences to assess the multifaceted impacts of climate change and human activities. Also, long-term studies should be established to monitor changes in marine biodiversity, water quality, and coral health about climate variables and human activities.

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