

Coastal Protection Measures

Tyre scale, Lebanon





Analysis of Threats and Enabling Factors for Sustainable Tourism at Pilot Scale

Coastal Protection Measures

Tyre scale, Lebanon



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OVERVIEW

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REVIEW

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Abstract

The purpose of this report is to identify the many risks to the natural stability of the Tyrian coastal zones, as well as the protection measures. It is created by reviewing available data at the national and regional levels. The paper is divided into three sections. Section 1 offers an overview of the current and potential future developments in Tyrian coastal morpho-dynamics. The threat and impact of tourism on coastal morphology are highlighted in Section 2. Section 3 reports on coastal preservation efforts to conserve natural ecosystems in the context of sustainable tourism.

I. Introduction

Since 1979, Tyre has been a UNESCO World Heritage Site. The city is currently known as one of Lebanon's most excavated cities, and as one of the country's most beautiful beach destinations. Tyre has a long history dating back to at least the third millennium B.C. and the main metropolis of the Phoenicians. Two major archeological sites are in the city: the Roman old city on the Al-Mina peninsula, a part of which submerged, and the Byzantine inland hippodrome of Al-Bass. A 4th-century church, a 5th century Roman circus, and the ruins of a 12th century Crusader cathedral, where the King of Jerusalem was crowned, may all be found in the city. Both main locations are available to the public. The historic souks are located between the two archeological sites. Besides historical landmarks, Tyre is also home to the Tyre Coast Nature Reserve, a 437.72 ha reserve and Ramsar site (UNESCO Wetland convention 1971), in which visitors can enjoy the largest, most beautiful, and finest sandy beach in Lebanon, in addition to many diverse fauna and flora, as well as prominent bird nesting site. Some of the animals found in that region are the endangered Loggerhead, the green sea turtle, and the Arabian spiny mouse. The site has three parts, a tourism zone that opens to visitors with beach activities and accommodations in spring and summer, an agricultural and archeological zone, and a conservation zone.

The coastal zone within the peninsular is mainly rocky and the lateral extends to the south and north are sandy beaches. The purpose of this report is to identify the many risks to the natural stability of the Tyrian coastal zones, as well as the protection measures. It is created by reviewing available data at the national and regional levels.



Figure 1. Tyre city showing the peninsular and coastal morphology

II. Morpho dynamic developments on Tyrian coast

II.1. Overview

Faour and Abi Rizk (2005) studied changes in Lebanese coasts between 1963 and 2003 to confirm the changes in the shoreline. Starting with supposedly stationary items such as historic structures, old houses, and many more places dispersed throughout the Lebanese coast, the same distances on various raster data were measured. According to the measurements, the north of Tyre has grown by 78 m; a simple measurement of the distance from the angle of the building marked in blue allowed us to identify a distance of 80 m on aerial photography from 1962 and a distance of 169 m on aerial photography from 2003; thus, an enlargement of 89 m instead of 78 m would have occurred, this variation of 11 m was considered acceptable.

But for littorals of equivalent vulnerability regarding marine erosion, the available protection policies vary considerably, from a total artificialization.

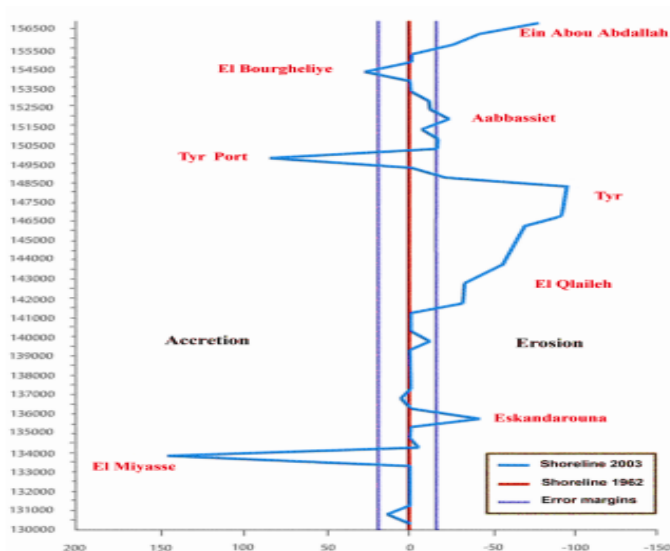


Figure 2. Coastal line variation in meters (Faour and Abi Rizk, 2005)

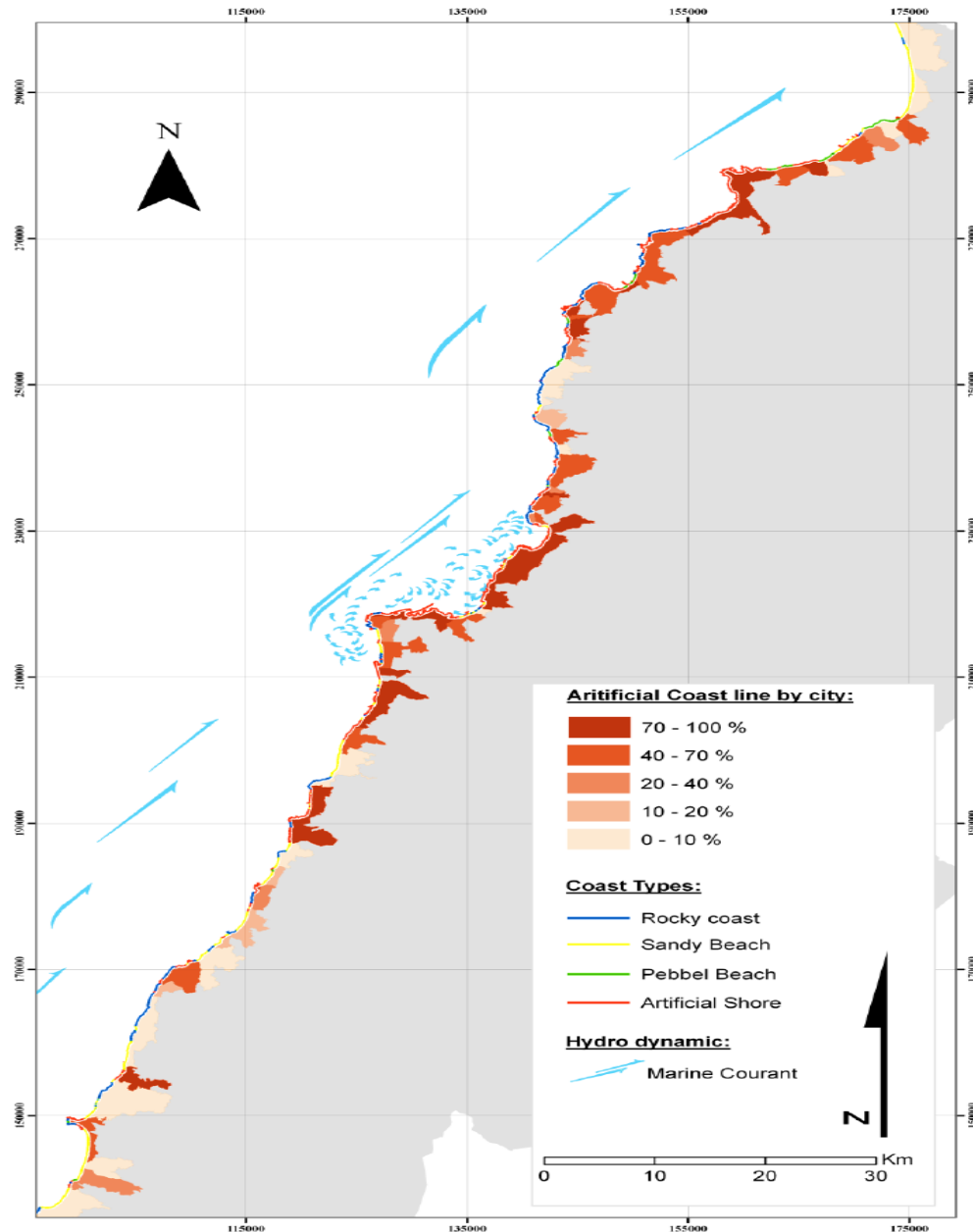


Figure 3. Coastal type and artificial coastline of Lebanon and Tyre (Faour and Abi Rizk, 2005)

The alterations in the shoreline along the Tyre caza's coast (southern Lebanon) In 2003, 8.19% (equal to 9.05 km) of the 110.44 km of rocky beaches were eroded, 12.35% (equivalent to 13.64 km) were artificialized (reclaimed), and 79.46% were designated as stable. Chalk shores are often unstable and erosion-prone rocky coasts that are in a state of instability. The pebble beach stretch for 18.99 kilometers where 24.01% (equivalent to 4.56 km) suffer from coastal erosion, 5.74% (equivalent to 1.09 km) were artificialized, and 70.25% were defined as stable in 2003. The sandy beaches of the

Lebanese littoral are currently spread out linearly over 81.90 km of which: 45.24% (equivalent to 37.01 km) suffer from coastal erosion, 8.5% (equivalent to 6.97 km) were reclaimed, and 46.26% were defined as stable in 2003. This study shows that the shore is locally affected by an important erosion of 45.24%. One of the reasons for this is that this beach endures massive winter storms and high-speed currents in a North North-eastern direction. These two factors constitute risks for sandy beaches. The velocity of the currents necessitated the establishment of large blocks used to protect the beach from natural erosion.

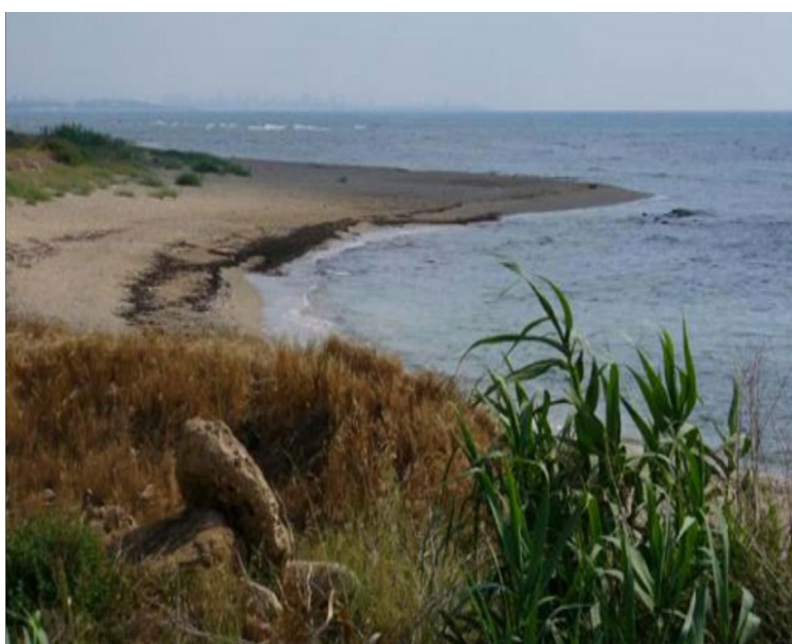


Figure 4. Sand extraction from Tyre beach (Faour and Abi Rizk, 2005)

The extraction of sand from beaches is not new; it dates to the 1960s, although the extraction process has advanced (1 500 m³ per hour). The seashore of Tyre - El Qlaileh (to the south) was significantly affected by this extraction. Since 1962, when it was 90 meters wide, this beach has shrunk to 20 meters wide. It used to be a sandy beach in 1962, now it has become pebble dunes. This withdrawal of the coastline of 70 ± 12 meters (1.4 meters per annum) is due to the marine currents which are available at high speed in a Northern North-eastern direction which is aggravated by the sand extraction of the beaches. Sand pumping from nearby seabed was sometimes done using a license to clean the ports and during other times without licenses. This pumping led to the development of underwater “terraces” and “depressions” of cylindrical forms which caused fatal accidents for some amateur swimmers.

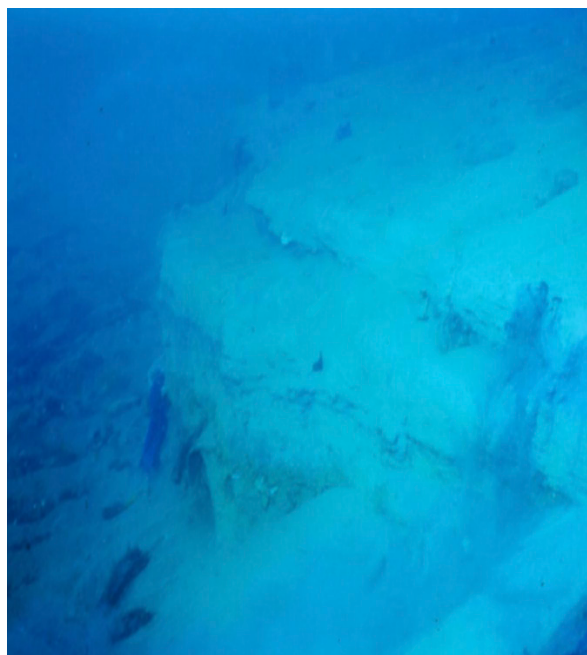


Figure 5. Underwater terraces caused by seabed sand extractions in Lebanon (Faour and Abi Rizk, 2005)



Figure 6. Deterioration of the sea-bed due to sand extraction in Lebanon (Faour and Abi Rizk, 2005)

II.2. Impacts on coastal stability

While coastal areas are suitable for tourism developments, at the same time these areas are considered hazardous locations threatened by climate change (TIFS, 2010; Lemmen *et al.* 2016; NOAA, 2016). Potential impacts of climate change on coastal systems can include increased coastal erosion; more extensive coastal inundation; higher storm surge; increased loss of property and coastal habitats; increased flood risk and potential loss of life; loss of renewable and subsistence resources and tourism recreation; and damage to other infrastructure (McLean *et al.* 2001; Wong *et al.* 2014).

Although some of the changes can be beneficial, in the form of economic growth and infrastructural developments leading to an overall improvement in living standards (Andres *et al.* 2017). Nevertheless, pressures on coastal ecosystems, especially environmental degradation, and pollution, could increase significantly in the coming decades due to this growth (Andres *et al.* 2017). Environment and climate change connect urbanization, and tourism is also an important element in both (UNWTO-UNEP, 2008). People in lower urbanized districts are more vulnerable since they have less capacity to cope with pollution and climate change risks due to poverty and lack of awareness of the environment and changing variability (Tran and Nitivattananon, 2011). CREST (2012) indicated that large-scale tourist developments have put increasing pressure on fragile ecosystems, especially in coastal zones. These impacts consist of

the destruction of local flora and fauna, pollution, the introduction of invasive species, land erosion, and conversion of public beaches into private ones. Those environmental impacts can be divided into three groups (Gouda, 2012): degradation of the natural composition of beach ecosystems, destruction of the great part of marine environments, and increased fragmentation between natural and developed areas.

Urbanization construction near the coastline transforms the coastal sandy habitats and their wildlife habitats. It generally ceases the processes and dynamics of sand replenishment and dissipation of wave energy. Dunes have the function of replenishing beach sand lost during catastrophic storm events and preventing coastal erosion. The loss of dune sand impedes this important beach-dune interaction. Even though the excavations have stopped, the quantity of sand removed and the range of disturbance to the ecosystem remains unknown. Furthermore, the unplanned urbanization will impact tourism by concealing the sea view and reducing the aesthetic parameters of this old city (MOE/UNEP/MAP, 2005).

In Tyre, the construction of hotels and secondary housing cooperatives has exploded because of unearned and real income expectations to the detriment of fertile land, creating aesthetic pollution and loss of tangerine and olive orchards. Soil degradation and land fragmentation due to the construction and operation of tourist and travel facilities (resorts, hotels, ports, airports, *etc.*) as well as delivery of products and services (field trips, *etc.*); Linear and coastal urbanization (littoralization).



Figure 7. Coastal area of Tyre, right before the southern coastal nature reserve

III. Threat and impact of tourism on coastal morphology

Amid the health-economic crisis that hit Lebanon in the last 3 years, the sectors that have been the most impacted in Lebanon are construction as well as services and sales (including accommodation and tourism, restaurants, and food services).

Tourism has been affected terribly by several crises and political instability. Tourists are always affected by what they see on social media as this will develop to damage the tourism sector in a country. Lebanon is short of tourists, representatives of hotels, bars, and restaurants. The country, whose economy has traditionally relied heavily on tourism, is facing an apparent inability to attract international visitors, including its expatriates, amid ongoing economic and political instability. Tourism in Lebanon did not reach its usual levels during the summer, normally a high season for visitors, even after worldwide travel restrictions were loosened. According to numbers published by Beirut Rafik Hariri International Airport, the number of passengers arriving in May and June 2021 (387,879) was far lower than the number of arrivals during the same period in 2019 (773,432), before COVID-19 and the economic crisis took hold.

IV. Coastal protection measures to conserve natural ecosystems

IV.1. Coastal protection measures

Tyre Coast Nature Reserve (TCNR) is a marine protected area MPAs, meaning it is protected by multiple national and international statuses. The country can thus activate international aid and mechanisms for its effective management.

A Marine Protected Area (MPA) is a clearly defined coastal or/and marine geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. International law does not provide a universal definition or legal framework for MPAs. However, several international agreements encourage States to establish such areas, as their existence is considered the most effective way to protect the ocean and marine natural resources.

To sustainably manage the coast, the TCNR is divided into three main zones from north to south:

Conservation zone: Human access is strictly prohibited. This zone is conserved to protect and research the fauna and the flora. Its protection will allow endangered sea turtles to come back and nest on the shore.

Agricultural and Archeological zone: This section includes the Phoenician springs of Ras el-Ain and a large area where agriculture remains an economic livelihood from many small family farms.

The tourism zone: Encompasses a sandy beach that opens to the public for swimming and sunbathing during the summer season that stretches from May to October.

TCNR strives to achieve conservation and sustainability by allowing the use of the resources in an environmentally friendly and sustainable manner.

Tyre Coast Nature Reserve (TCNR) is located immediately south of the city of Tyre. The Reserve is the biggest and most beautiful remaining sandy beach in Lebanon. It is characterized by its ecological, marine, and coastal ecosystem. In addition, it is an important nesting site for migratory birds and threatened sea turtles.



Figure 8. TCNR Open Beach

Beaches in Tyre are considered the most preserves beaches in Lebanon. The structure of land property can explain the preservation of the seashore from urban sprawl. Indeed, the littoral is till now generally free from any form of residential construction although some touristic establishments have been implemented (Ex: Tyros resort in Iskenderuna; CRI, 2015).

The rest of the coastline in Tyre, *i.e.*, to the north of the TCNR, is not studied, although they are subjected to major stresses by the communities and tourism, and by the natural elements, specifically those related to climate change. Urbanization and tourism have a substantial impact on the stretches between the reserve and the archeological sites along the southern coast. Somehow similar pressures exist on the rocky shores of the Historical quarters (with its nestled sandy strips). The northern shores beyond the historical fisherman's port and the commercial port are vulnerable to specific pollution, whereas the sandy shores along the northern entrance to Tyre are decaying due to the illegal refugees' community and its shanty housing and had been subject sand extraction. These northern shores are getting more vulnerable to rising sea levels and the more frequent but extreme weather spells, that generate high aggressive waves.

IV.2. Blue Economy

Since the country is already going through an economic crisis, the blue economy concept seems a promising plan for the country and especially for Tyre. The blue economy concept seeks to effectively manage water resources, especially seas and oceans, to preserve them as significant natural resources for current and future generations. The blue economy includes all the economic activities that directly correlate with the oceans, such as fishing, shipbuilding, maritime transport, coastal tourism, *etc.* Although the blue economy term seems to be new, the water resources and the awareness of their importance have been around since prehistoric times. The importance of water resources on the Earth's surface (oceans, seas, rivers, *etc.*) cannot be denied.

The concept of the blue economy has presented a new perspective of sustainable economic development in different countries or geographical areas such as coastal areas by using the oceans and marine resources at the various levels of development, regional, national, and international. The blue economy depends on the growth of industries and activities based on marine and ocean resources, such as fisheries, shipping, ports, marine logistics, coastal, and recreational tourism. Furthermore, there are many emerging sectors in a blue economy such as renewable ocean and seas energy (wind, tides, waves, *etc.*), extraction of gas and oil from the seas and oceans, mining, aquaculture and marine, blue biotechnology, monitoring and controlling seas and oceans, conducting marine research, and others that are characterized using cutting-edge technologies.

Coastal tourism is at the forefront of the blue economy economic sectors, offering job opportunities or sharing in the gross value added. A study reviewing the seven main sectors that formed the blue economy approach found that coastal tourism was the most active blue economy sector participating in providing job opportunities or sharing in the gross value added (GVA).

The Blue Economic Concept provides an opportunity to develop more economically and environmentally sound investments and businesses, utilize natural resources more efficiently and less environmentally, produce more efficient and cleaner systems to produce greater products and economic value, increase labor absorption, and provide an opportunity to benefit each contributor more fairly. The Blue Economic Concept was developed to answer the challenge that the world economic system tends to be exploitative and environmentally destructive. So far, the principles of resource efficiency, low carbon, and social inclusiveness have grown but still have not been able to overcome human greed to exploit more natural resources.

Although the conservation of nature should be considered the fundamental objective of MPAs, neglecting their social, cultural, and economic impacts has at times led to poor local consensus, if not hostility.

Fishermen and other stakeholders suffer from resource depletion due to overfishing and the use of illegal, unregulated fishing methods such as small fishing nets, use of surface supplied diving for spearfishing, and blast fishing. The lack of law enforcement and alternative schemes to generate income for fishermen has resulted in major impediments to sustainability in the fishing sector in the South of Lebanon.

V. Conclusions

Conserving and protecting the pristine beach stretches, coastal agricultural lands, marine ecosystem, and biodiversity from new developments urban sprawl, and pollution is becoming increasingly important, especially with the increased economic crisis.

Although, the development of the tourism industry can bring significant economic benefits to cities and improve urban infrastructure construction, further in-depth study of the Tyrian coasts, especially those that are not part of the nature reserve is a must to ensure proper measures are taken.

In general, the local authorities are aware of the various stresses, and collaboration between Tyre and neighboring municipalities to the north and south to develop common programs and measures for the better understanding of the coastal stretches, and work on the needed measures for rehabilitation, monitoring, and protection. The issue of climate change and ever more frequent high waves should be a concern for the local authorities and the international organizations dealing with refugees, specifically the UNIFIL, with immediate focus on the northern coastal entrance to Tyre at the area known as 'Jal El Bahr'. Although, the excessive development of the tourism industry inevitably has adverse consequences on the ecological environment, the better understanding of adverse effects, especially those related to climate change, on the shore would allow the protection of the ecological environment valorize it to serve the tourism industry.

Policies at the level of the Union of Tyre Municipalities could be developed through projects with binding agreements or charters adopted by the different municipalities, and communities, engaging themselves in sustainable policies and practices.

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