

Protection of Ecosystems in Tourism Areas

Lebanon scale





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

Protection of ecosystems in tourism areas Lebanon scale



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OVERVIEW

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REVIEW

Contributors

Nahed MSAYLEB, PhD

📍 Lebanese University, Faculty of Agriculture and Veterinary Sciences, Lebanon

Myriam LTEIF, PhD

📍 National Center for Marine Sciences, CNRS, Lebanon

Myriam GHSOUB, PhD

📍 National Center for Marine Sciences, CNRS, Lebanon

Anthony OUBA, PhD

📍 American University of Technology, Lebanon

Reviewers

Talal DARWISH, Pr.

📍 National Center of Remote Sensing, CNRS, Lebanon

Amin SHABAN, Pr.

📍 National Center of Remote Sensing, CNRS, Lebanon

Supervisor

Béchir BEJAOU, PhD

📍 National Institute of Marine Sciences and Technologies, Tunisia

LAYOUT

Khouloud ATHIMEN, Engineer, Technical Coordinator

📍 National Institute of Marine Sciences and Technologies, Tunisia

Houaida BOUALI, Engineer

📍 National Institute of Marine Sciences and Technologies, Tunisia

Mohamed Ali BRIKI, Engineer

📍 Coastal Protection and Planning Agency, Tunisia

Mouna MRAD, PhD

📍 Water Technology and Research Center, Tunisia

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List of abbreviations

CBD	Convention on Biological Diversity
CNRS-L	National Council for Scientific Research-Lebanon
EIA	Environmental Impact Assessment
ICZM	Integrated Coastal Zone Management
IUCN	International Union for the Conservation of Nature
MoA	Ministry of Agriculture
MoD	Ministry of Defense
MoE	Ministry of the Environment
MoI	Ministry of the Interior and Municipalities
MoPWT	Ministry of Public Works and Transport
MoT	Ministry of Tourism
NBSAP	National Biodiversity Strategy and Action Plan
NCMS	National Centre for Marine Sciences
NGO	Non-Governmental Organization
NIPHE	National Institute for Public Health and the Environment
PINR	Palm Islands Nature Reserve
SPA/RAC	Specially Protected Areas/Regional Activities Centre
SST	Sea surface temperature
TCNR	Tyre Coast Nature Reserve
WTO	World Tourism Organization

I. Introduction

This report is about the «Output 3.1.1.10.: Deliverable ID-LB-11 it consists of the following issues:

- Enabling factors for sustainable co-evolution in touristic areas
- Protecting Lebanon Ecosystem: researching and illustrating the existing strategies, studying the measures of suitability and implementation in Lebanon while assessing threats on both the ecosystems and Tourism.
- Estimating ecosystem threats' impacts Pressures and finding key tools to overcome them, supporting decision-making which will be clearly identified.
- Evaluating “ecosystem protection” and “tourism sustainability” trade-offs to suggest recommendations to help involve both tourists and citizens.

Marine coastal ecosystems worldwide are all at stake due to the natural and anthropogenic pressures, that have become sharply increasing trends (Halpern *et al.*, 2015). Therefore, to contain such damage and to evaluate the ecological quality of the coast, several governmental players should intervene effectively such as scientists, decision-makers, environmentalists, as well as management professionals, experts in the field and even managers. In fact, they are all required to do their best and toil to come up with the most appropriate indicators and assessment tools (Halpern *et al.*, 2015).

As being part of the Mediterranean Levantine Basin that is widely known for its diverse global biodiversity hotspot, the Lebanese coastal zone is endowed with both an important biodiversity with a miscellaneous of marine life, as well with a vast majority of human activities that contributes greatly to the economy and provides potential economic, social, and cultural benefits (El Shaer *et al.*, 2012).

Nevertheless, Lebanese marine ecosystems today are witnessing the worst dramatic coastal situation ever. This is due mainly to anthropogenic activities and to climate-related factors. Besides, the coast has been abusively over exploited and spoiled because of human irresponsible behavior. Yet, both regulations and measures seem to be worn-out and ineffective since they have been neither implemented nor enforced, resulting in a devastating ecosystems disbalance and long -lasting disastrous impacts along the coast (Halpern *et al.*, 2015).

The Mediterranean Region is regarded as one of the highly most attractive touristic destination in the world. In fact, its coastal tourism activities are crucial features for such Mediterranean destinations, including the Lebanese coast. Tourism industry in Lebanon has been historically vital to the local community economy, on a national scale it is one of the major sources of profits and revenue for Lebanon (Owaygen, 2015).

Apart from climate-related factors and other anthropogenic activities, tourism may lead to further detrimental results on coastal areas. Hence, ecosystem protection has become a must for all Mediterranean regions and a duty for all the concerned in intervening within the issue of ecosystem rescue in Lebanon. In fact, the World Tourism Organization (WTO) has encouraged touristic destinations authorities to give priority to the sustainability aspect by motivating the local communities to participate effectively in the development and management of touristic activities (Owaygen, 2015).

II. Data Sources

The compiled information and data related to Lebanon coastal ecosystem protection in the current study, is mainly relying on already published reports, projects, and articles. In fact, these resources were of a crucial importance in providing a variety of information not only about the Lebanese coastal environment and setting but also about the different set of recently adapted ecosystem protection legislations of further sustainable coastal tourism. Some data and information have been obtained as well from the concerned ministries, local entities, and international organizations.

Threats on the coastal ecosystem in Lebanon, as well as the implemented governmental measures, strategies and institutional constraints will be later evaluated. Furthermore, coastal management and monitoring strategies will be assessed to develop guideline frameworks to overcome threats and to promote better sustainable coastal tourism.

III. Analysis of Existing Strategies and Measures Facing Relevant Threats on Ecosystems

III.1. Pressures and impacts on the Lebanese coastal ecosystem

The Lebanese coastal zone has always suffered from various natural (specifically climate-induced) and anthropogenic pressures. Thereby, badly affecting the main ecosystems, as well as the available services. In fact, the main threats and pressures impacting the Lebanese coast with its diverse ecosystems are detailed below:

Habitat destruction

The loss of habitats is the main cause of ecosystem degradation that leads ultimately to species extinction since habitats provide species with all the essential natural requirements and components of their ecological niches (MoE/GEF/UNDP, 2015). The Lebanese coast is mainly characterized by its dense urbanism which encloses a variety of activities including, industrial units, commercial (10%) and agricultural areas (41%), as well as recreational sites (7.5%) and a port space (5.3%) in addition to all types of facilities and amenities. It also has dunes and many sandbanks (4% length of 49 km) and rock protrusions (4.7% length of 11 km) (El Shaer *et al.*, 2012).

The main causes of coastal habitat degradation in Lebanon are due to the following reasons mentioned below:

- Beach resorts and hotels are constructed on coastal areas.
- Coastal land chaotic investments.
- Sand dredging both along shorelines and offshore for the purpose of construction has led to marine sediments reduction as well as to environmental sediment scarcity. Whereas a few sandy beaches are left in good condition.
- Exacerbated establishment of ports and harbor
- The amplified demographic pressure due to the increase in the number of Syrian refugees
- Uncontrolled urban sprawl (sea filling)
- Increased privatization of the shorefront

Marine pollution and eutrophication

Undoubtedly, the Lebanese coastal ecosystem seems to be not sustainably exploited and it is currently witnessing a sharp declining status due to the overexploitation and pollution from different origins (Abboud-Abi Saab *et al.*, 2008b). This uncontrolled Lebanese coast deterioration has devastatingly threatened the coast biodiversity. In

fact, such pollution calamities emerging from different sources are highly detrimental particularly they represent high danger on the terrestrial, marine, coastal, and freshwater ecosystems.

The main sources of both the marine and coastal ecosystem pollution are mainly the ones stated below:

- **Municipal and industrial wastes** (liquid and solid), caused by poor waste disposal management, infrastructure, and wastewater treatment plants.
- **Agricultural waste disposal**, caused mainly by the uncontrolled use of agricultural products and fertilizers that end up in the sea.
- **Recreational activities** lead ultimately to an increase in beach and marine litter, and subsequently a decrease in water and ecosystem quality (Figure 1).

Marine litter pollution is being exacerbated due to the presence of chaotic dumpsites for solid waste disposal along the coast (Figure 2). Besides, the direct untreated discharge of domestic and industrial raw sewage to the sea is the main contributor to marine pollution along the coast. Thereby, increasing the chance of eutrophication events, especially in closed areas of heavy nutrient pollution.



Figure 1. Beach litter on a sandy beach in Zouq region (Central Lebanon).



Figure 2. A garbage truck discharging its cargo in a dumpsite in Saida (Southern Lebanon).

Invasive species

Over the past decades, at least 300 Indo-Pacific species, known as Lessepsian migrants, have accessed the Levantine Basin to mix with the Mediterranean-Red Sea species composition. Lesseps species may become invasive and may affect significantly not only the environment (biodiversity loss, habitat modifications and alterations in community structure), but also economy (fishermen) and human health too (UNEP-MAP/RAC/SPA, 2010; UNEP-MAP-RAC/SPA, 2011).

Overfishing

The fisheries sector in Lebanon is still old, conventional, and artisanal. In fact, it is still based on small wooden vessels, and concentrated up to 6 nautical miles from the shore. The high concentration of fishing activities on the coastal strip has led ultimately to an overexploitation of coastal species. Moreover, fishing has also entailed the recurrence of detrimental practices, such as, the use of small mesh, hooks, and explosives, which thrive as a result of an outdated legislation and the lack of enforcement (Sacchi and Dimech, 2011).

Climate change

Over the past few decades, the phenomenon of unpredicted climate change has been really striking. It is clearly obvious mainly through the rainfall frequency and its continuously intensified patterns as well as the sharp increase in temperature rates (~ 1.8 °C). Consequently, all these factors entailed several extreme weather events, including floods and mass movements due to extremely torrential rain, as well as storms and heat waves, and forest wildfires (Bitar, 2008). As a matter of fact, the whole country has become more concerned with these events, which have already caused a harsh economic crisis which in its turn has led to social disturbance and turmoil. Furthermore, through the recent intermittent climate change events, it has become obvious that the Lebanon ecosystems are devastatingly changing, particularly, through the expansion of toxic species due to the increase in sea surface temperature (SST), as well as to the increasing nutrient and pollutant loads (Ouba, 2015; Abboud-Abi Saab *et al.*, 2008a).

Sporadic events (oil spill)

Over the last two decades, Lebanon has suffered from two sporadic oil spill events that have further exacerbated the Lebanese coast. The first one occurred in 2006 due to the Israeli Lebanese war that broke out in July 2006. This oil spill has dramatically affected an important part of Lebanon coastline and is widely spread over about 3000 km² including its marine protected areas (Tyre Coast Nature Reserve – TCNR, and Palm Islands Nature Reserve – PINR). To overcome such an oil spill calamity, several measures and initiatives were undertaken to clean up the sea and shoreline. Moreover, further additional measures have been taken to maintain healthier and more productive sea ecosystems. The second oil spill occurred recently in February 2021, and it took place in front of the port of Ashdod in Palestine. In fact, the currents, the waves, and wind directions had driven the oil/ tar towards the Lebanese shoreline and resulted in the

patched of sticky lumps black tar on the entire sandy and rocky beaches from Naqoura in the south to Tripoli in the north. Both oil spills have adversely affected the Lebanese ecosystem, especially in terms of both water and sediment quality.

III.2. Ecosystem protection laws and regulations at the Lebanese level

Lebanon has already compiled a bulky set of environmental legislations, laws, and regulations among which some date back to the 1920s and others are considered newly issued. Nevertheless, most of them are not effective enough to successfully manage the environmental status of the coast. Some of the marine and coastal areas conservation laws, on which ecosystem protection strategies and guidelines are based are detailed below (UNEP – ERML, 2012):

- Law no. 444/2002 (Code of Environment) specifies, under Chapter VIII, the protection, conservation and management of nature and biodiversity. It embraces the “polluter-pays”-principle, as well as the Environmental Impact Assessment and Strategic Environmental Assessment process, to help curb pollution, including seawater pollution. Furthermore, when complete, the Master Plan for Wastewater Treatment in the coastal zone will significantly reduce environmental pollution in the Mediterranean Sea by treating wastewater from an estimated 2.5 million people. Thus, Law 444 and the Master Plan apparently constitute a new framework for the protection and management of the sea and coastal area.
- Law no. 708/98 declaring the TCNR on November 5, 1998.
- Law no. 121/92 declaring the PINR on March 9, 1992.
- Law no. 508/04 (hunting law) is the latest attempt for regulating and controlling hunting in terms of season, type of protected birds forbidden for hunting, amount, and type of game birds along with a permit system based on hunting testing.
- The law, issued as decision no. 2775 dated 1929, relating to the control of marine and coastal fishing and its amendments.
- Decree no. 8213 dated 24/5/2012 relating to the “Strategic Environmental Assessment for Proposed Policies and Plans and Programs in the Public Sector” or SEA decree.
- Decree no. 8633 dated 7/8/2012 relating to the “Fundamentals of Environmental Impact Assessment” or EIA decree. According to this decree, all major development, infrastructure, and industrial projects are subject to EIA or IEE studies, including their effects on biodiversity, to promote conservation activities and prevent the damage of the surrounding environment by these projects before receiving approval.

- Decision of the Minister of Agriculture (MoA) no. 125/1 dated 23/9/1999 banning the fishing of marine turtles, monk seals and whales as well as selling, use or trade of any derivatives from the mentioned species.
- Decision of the MoA no. 1/385, issued on 26/1/1997, stating that fishing activities are prohibited in all estuaries all year round. The protected area involved extends over 500 m on each side of the estuary, 500 m inside the river and 2 kilometers seawards. All human activities are banned except for those of scientists and the coast guard.
- In addition, many ministerial decisions regulating fishing and fishing techniques are issued by the MoA, mainly:
- Decision of the MoA no. 346/1 dated 15/7/2010 regulating and identifying fishing types and equipment and banning the use of small mesh sizes and trawling nets and fishing using scuba diving equipment.
- Decision of the MoA no. 93/1 dated 14/3/2008 regulating the scuba-diving industry including permitting procedures and safety measures and scuba-diving fishing.
- MoA decisions banning dynamite fishing.

III.3. National entities involved in coastal ecosystem protection

The Ministry of Environment (MoE) is seeking cooperation and partnership with other local administrations to ensure a more effective coastal ecosystem protection and to sponsor the implementation of strategies and guidelines regarding this issue. These administrations are mainly those responsible for marine related issues such as the MoA, Ministry of Public Works and Transport (MoPWT), Ministry of National Defense (MoD), Ministry of Interior and Municipalities (MoI) as well as other stakeholders such as municipalities, local non-governmental organizations (NGOs), associations, fishermen syndicates and local communities. All these partners have already drawn a road map and have set diverse strategies to face the detrimental status of the coast.

Mandate of the following public administrations in relation to marine areas conservation, management and control is defined as follows (UNEP – ERML, 2012):

- The Law no. 690 dated 26/8/2005 organizing the MoE and defining its mandate, states that the MoE is responsible for the establishment, protection, and management of protected areas.
- The Law no. 214 dated 2/4/1993 (Establishment of the Ministry of Transport) and its amendments (law no. 247 dated 7/8/2000) state that MoPWT is mandated to control the implementation of the legislation and rules related to transport and marine public properties.

- The legislative decree no. 31 dated 18/1/1955, defining the mandate of the MoA, stating that it is responsible for implementing the legislation related to fishing activities.
- The decree no. 22 dated 22/1/1981 (Organization of the Army) states that the Marine Forces in the Army are responsible for coast defense. Therefore, the MoD/ Lebanese army oversees patrolling the sea and keeping its activities in order.

Some of the national coastal ecosystem protection activities implemented by national stakeholders are listed below:

The Ministry of Environment (MoE)

The MoE is mainly in charge of tackling the issue of climate change, biodiversity, environment protection and sustainable development. The following strategies and activities are being implemented:

- Lebanon's National Biodiversity Strategy and Action Plan (NBSAP) 2016-2030 addresses Lebanon's obligations under Article 6a of the Convention on Biological Diversity (CBD) and is an update of the country's first NBSAP issued in 1998.
- MoE & the International Union for the Conservation of Nature (IUCN): Supporting management of important marine habitats and species in Lebanon (UNEP – ERML, 2012).
- MoE & Specially Protected Areas/Regional Activities Centre (SPA/RAC): the Med-MPAnet Lebanon project.

National Center for Marine Sciences (NCMS)

The NCMS (belongs to the National Council for Scientific Research, CNRS-L) is responsible for implementing several research activities as well as, accomplishing the local and international projects aiming at assessing the Lebanese littoral environmental status. In other words, evaluating its level of alteration and helping in coastal ecosystem protection decision making. The NCMS has been implementing a continuous monitoring program of the coastal area for more than thirty years. In fact, this monitoring program can help in issuing policies to mitigate both pollution and marine litter. Thereby, ensuring coastal protection as well as, the development of the national coastal monitoring plan.

Universities

Various universities (specifically the Lebanese University, Balamand University, and the American University of Beirut) have also participated in the coastal ecosystem protection plan through national and international projects and they cooperated with various stakeholders (*e.g.*, ministries, NGOs, international organizations).

III.4. Tools for cumulative impact assessment in marine spatial planning

Ecosystem protection assessment requires continuous monitoring and relies heavily on gathering indicator tools to detect any threats or problems that might be due to anthropogenic or climate-related factors. In this regard, consequential satellite imagery, with high spatial resolution, calibrated with *in situ* field data can help implement coastal spatial planning and management that can promote ecosystem protection. Table 1 displays some tools/indicators based on anthropogenic and/or natural pressures and ecosystem components (Hammar *et al.*, 2020).

Table 1. Monitoring and assessment tools: pressures and ecosystem indicators.

	Indicator/tool	Parameters to monitor
Pressures	Eutrophication	Phosphorus; anoxia; nitrogen
	General pollution	Heavy metals; oil spill; toxins; bacteriological contamination, thermal water
	Shipping	Noise; oil spill
	Coastal development	Habitat loss; toxins from treatment plants
	Recreation	Boating; bird hunt
	Fisheries	Artisanal catch and bycatch
	Industry	Port and industrial toxins
	Sand extraction	Habitat loss; turbidity, instability of the adjacent terrestrial areas
	Defense	Explosion sounds and heavy metals from military areas
	Energy	Disturbance; noise; steam, engine cooling
Ecosystem components	Birds	Coastal and migratory birds
	Fishes	Pelagic and demersal species abundance, spawning <i>etc.</i>
	Habitats	Soft and rocky bottoms; vermetid reefs; shorelines <i>etc.</i>
	Marine mammals	Cetacean observation
	Marine turtles	Marine turtle habitats and nesting areas
	Marine flora	Phytoplankton, including toxic algae, macro-flora monitoring
	Marine fauna	Zooplankton abundance; micro-benthic fauna monitoring
	Marine biotope	Sediment composition; water column analysis (<i>e.g.</i> , SST, salinity, turbidity <i>etc.</i>)

IV. Analysis of Balance between Ecosystem Protection and Tourism

IV.1. Sustainable tourism as a factor of ecosystem protection

None can deny that Tourism can be unsustainable if it is a Tourism of mass hosting visitors. However, many alternative types of tourism and recreational activities have developed worldwide, and lately in Lebanon. Figure 3 reveals the comparison between sustainable and unsustainable Ecotourism. In fact, the latter types effectively promote Tourism sustainability. Ecotourism is one of these types. It is also known as nature tourism, and it has recorded a significant increase in the number of ecotourism providers since 1991. As a result of designating nature reserves and protecting Lebanon coastal areas, ecotourism has shown significant progress. For instance, around 56,000 visitors entered the Lebanese nature reserves in 2004, contributing to a growth of around 56% from the year 2000 (MoE and UNDP, 2011).

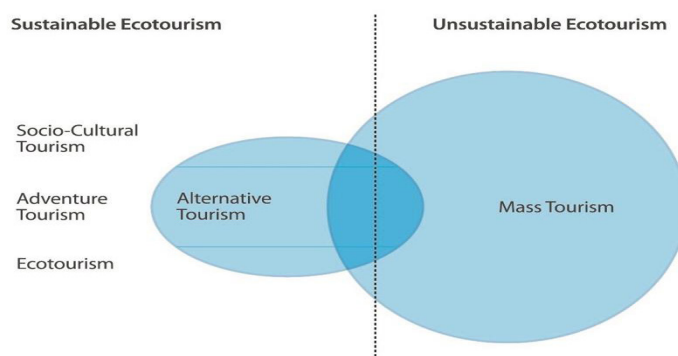


Figure 3. Sustainable versus unsustainable ecotourism (Dimopoulos, 2017).

The main pillars of ecotourism progress are mentioned below (Wood ,2002):

- Contributes to biodiversity conservation.
- Sustains local people's wellness.
- Includes an interpretation / learning experience.
- Involves tourists together with Tourism industry stakeholders to adopt responsible action towards nature.
- Requires less fossil-energy consumption.
- Stresses local participation, ownership, and business opportunities, particularly for rural people.

Sustainable development is highly crucial in tourism, as well as the connection between tourism and the environment. Therefore, ecotourism is regarded as the backbone of sustainable tourism. To achieve the latter goal, social, economic, and environmental aspects should be strongly taken into consideration. In fact, Ecotourism is a key in raising environmental awareness and promoting conservation and protection. Indeed, ecology and ecosystem exploration offer better environmental awareness thanks to the creation of an eco-friendly mentality, which in its turn will ultimately contribute to ecosystem protection.

Ecotourism, as well as its businesses/providers help in ensuring (Patterson, 2002):

- Low impact on natural resources and recreation techniques.
- General participation of stakeholders (individuals, local communities, eco-tourists, tour operators and government institutions) in the planning, development, implementation, and monitoring phases.
- General limitations on protected areas visits, either by limiting group size and/or the group numbers.
- Natural areas preservation by conservation groups.
- Customer orientation towards targeted regions.
- Local people recruitment within local companies.
- Local people motivation to purchase local products.
- Recognition of natural features and the related heritage as a central element within the tourist experience.
- Recruitment of touristic guides who are highly qualified and skilled in scientific and natural history interpretation.
- The protection of wildlife.
- The privacy, preservation and respect of local people's culture and tradition.

Local communities' contribution is the most significant aspect in sustainable tourism as it provides mutual benefit between the ecosystem and society. In fact, when maintaining the socio-economic aspect, the community will be encouraged to participate in ecosystem protection.

Lebanon ecotourism is obviously a key path towards ecosystem protection. The country has many chances to grow through sustainable tourism thanks to its protected areas, its preserved natural resources and landscapes, especially along the coastal zone. The main objectives of ecotourism should meet three criteria:

- Environmental conservation
- Meaningful community participation
- Effective profit and self-sustainability.

IV.2. Policy measures and sustainable coastal tourism

Several measures are recommended to ensure sustainable coastal tourism:

- Strengthen the role of MoPWT in the field of traffic management and in the founding of new roads to facilitate access to tourism destinations.
- Encourage investment and raise international funds to implement more sustainable touristic activities, such as ecotourism that should be sponsored by the Ministry of Tourism (MoT).
- Establish “information offices” in regions of high touristic importance such as areas where nature reserves are located.
- Improve Tourism by facilitating communication between the private sector and municipalities involved in touristic activities.
- Promote tourist awareness regarding cultural and sustainable tourism.
- Mainstream sustainability and climate change risks in national and regional tourism strategies, as well as increase awareness among tourism businesses, experts and professionals.
- Cooperate with the national meteorological and risk management services for better enhanced climate anticipation and weather forecast.
- Implement guidelines and rules for more resilient and eco-friendly tourism establishments.
- Implement Environmental Impact Assessment for tourism infrastructure and establishments.
- Implement strategic Environmental Assessment of tourism strategies and plans at the national and regional levels.
- Implement tourism development plans within the framework of Integrated Coastal Zone Management (ICZM).
- implement water-saving measures at touristic establishments.

V. Guidelines to involve tourists in citizen sciences activities

V.1. Citizen science (History, definition, and importance)

Definition

“Citizen science” is defined as: “The practice of public participation and collaboration in scientific research to increase scientific knowledge (National Geographic ,2021). Through citizen science, people share and contribute to data monitoring and collection programs. Collaboration in citizen science involves scientists and researchers working with the public. Community-based groups may generate ideas and engage with scientists for advice, leadership, and program coordination. Interested volunteers, amateur scientists, students, and educators may network and promote new ideas to advance our understanding of the world.”

History

People have been participating and contributing to scientific research for long years. However, ‘citizen science’ is a relatively new term. The field, which was given its name in the 1990s by researchers at the Cornell Laboratory of Ornithology, as Wells Cooke, a member of the Union, developed arguably one of the earliest formal citizen-science programs in America¹⁹. It empowers people from different regions with the possibility to participate in the scientific process and to help advance knowledge in a wider range of scientific disciplines (American Scientists, 2021).

Henry David Thoreau (mid-1800s), an amateur naturalist interested in the initial leafing and flowering of plants in springtime, was an early practitioner of citizen science. His records are drawing attention among ecologists seeking a view into paleoclimates (American Scientists, 2021). One of the oldest examples of citizen science can perhaps be traced back to 1900, when the Audubon Society began its Christmas bird counts by sponsoring a bird count. An experienced birder leads to a group called a circle of volunteers as they collect information about local populations of birds. In Europe, such record-keeping began more recently: In the mid-1700s, the Swedish botanist Carolus Linnaeus systematically noted flowering times for 18 locations in Sweden over many years (American Scientists, 2021).

Over the last two decades, citizen science has climbed in terms of popularity in several fields thanks to the development of Smartphone, which have allowed the flow of more information to be shared through digital media. Thereby, providing geo-location information about species or situations in real time. In the upcoming future, more phones could be outfitted with smart sensors, which would let people measure and record environmental data, such as air-quality levels and temperature readings (National Geographic ,2021).

Benefits

In fact, citizens can get acquainted with any research field of interest and at the same time contribute to scientific data collection. Citizen science offers plenty of opportunities, for researchers as well as for citizens. A top 10 list of benefits are listed below (NIPHE, 2018), and all these benefits can be of an important value for Lebanon ecosystem protection if effectively implemented:

- Achieving more participation in research.
- Facilitating research on a bigger scale.
- Tapping into new sources of information, knowledge, and perspectives.
- Increasing citizen engagement in scientific research and building stronger connections between citizens and scientists.
- Developing new methods and approaches.
- Improving openness and reliability of research.
- Ensuring citizens' understanding of scientific research.
- Ensuring that scientists and academic institutes understand current issues in society.
- Focusing on more relevant subjects and on citizens' priorities in conducting research.
- Improving scientific literacy: citizens are increasing their own knowledge and understanding of science.

V.2. Citizen science in Lebanon

Lebanon suffers from severe pollution originating from different sources, as well as from poor management and lack of efficient governance practices (MOE/UNDP/ECODIT, 2010). Furthermore, policies and planning are restricted by scarcity, often unreliable data (Buytaert, 2014) and the absence of well-maintained and operated monitoring networks (Weeser *et al.*, 2018).

For this purpose, collaborative citizen science approaches (training, interviews, field campaigns, *etc.*) involving local citizens and university researchers are undertaken to assess the reliability and accuracy of the information provided for scientific measurements/purposes (quality of water sources, people vulnerability, infrastructure and household surveys, urban recovery, *etc.*). In addition, secret agents (Greenpeace Med, Blue Shield guards, *etc.*) have empowered citizen science to help protect the Lebanese environment and especially the coast from toxic pollutants, emphasizing on the threats, constraints, and solutions, along with the extensive media coverage and interest (Baalbaki *et al.*, 2019).

V.3. Tourists in monitoring ecosystem quality

Tourism and the environment are two interchangeable supportive sectors. In fact, sustainable tourism might guarantee both more economical natural resources consumption and better environmental protection. It can generate additional resources to be invested in conservation, environmental infrastructures, and services, through donations, park entrance fees and tips for guides (Spilanis *et al.*, 2012).

More specifically, ecotourism has become an important sector in the tourism industry, with a 10 to 15% annual growth. In terms of social aspect, it seeks to benefit local communities through a sustainable and wise use of their land, resources as well as their capacities.

Usually, mass tourism can harm coastal ecosystems. Therefore, tourists should think in an eco-friendly manner and try to make the lowest impact on the environment. Nowadays, many travelers are progressively betting on sustainable tourism. Hence, the following recommendations have been demonstrated by Biodiversity Foundation to ensure more effective sustainable tourism.

Useful Instructions are mentioned below:

- Choose suppliers who guarantee higher quality and more respect for the environment.
- Try to minimize waste, cleaner waste disposal by recycling.
- Make the least possible impact on vulnerable and threatened areas.
- Help the local economy by purchasing local gifts or souvenirs from local small shops.
- Avoid disturbing the flora and fauna, especially in the case of protected or endangered species.
- Respect local people's traditions, culture, and gastronomy.
- Try to contribute to the development of responsible and sustainable tourism, by building a healthier and more solid planet.

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