

## A COMPREHENSIVE STUDY ON TECHIRGHIOI LAKE'S ECOSYSTEM THROUGH CONSERVATION, ECOTOURISM, AND SUSTAINABLE PRACTICES

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### Abstract

*The paper aims to present the ecological potential of the Techirghiol area, focusing on the lake and its surroundings. Located in south east Romania, being the largest saline lake of the country, it is well known for its diverse ecosystems, habitat variety, and rich flora and fauna. In the introduction phase, multiple analyses were made, such as types of vegetation, species and habitats, trophic networks, and pollution. Regarding the results and discussions, the relationship between ecosystem and various factors was identified, creating a comprehensive synthesis. In terms of recommendations, the integration of ecotourism principles was strongly suggested to harmonise human interaction with lake ecosystems. This study underscores the fundamental importance of embracing conservation and sustainability, while developing an alternative type of tourism. As a conclusion, this study establishes a foundation for making well-informed decisions, thereby promoting a symbiotic coexistence between human activities and the valuable natural resources the lake provides.*

**Key words:** Techirghiol Lake, ecotourism, landscape sustainability, blue-green strategy, Natura 2000 site.

### INTRODUCTION

Techirghiol Lake is the largest salt lake in Romania, situated in the southeast of the country in the immediate vicinity of the coastline, approximately 15 km south of Constanța County. The site represents a Natura 2000 protected area and a special avifauna protection area (SPA), within the administrative territories of Techirghiol and Tuzla commune, near the national road DN39, connecting the municipality of Mangalia with Eforie.

Lake Techirghiol, formerly a fluvio-marine liman, spans an area of 1226.97 hectares, with a maximum depth of 9 meters and a salinity level of approximately 70 g/l. Positioned in the coastal expanse between Eforie Nord and Tuzla, the lake is divided by two dams into three segments. Among these, the eastern section, the most extensive, boasts high salinity, the middle section is brackish, and the western section, situated at the lake's tail, also known as Lake Zarguzon, is characterized by freshwater (Făgăraș et al., 2008).

Under these circumstances, the biodiversity of Lake Techirghiol is notably delicate, necessitating heightened attention. The long-term preservation of biodiversity involves implementing additional measures, specifically in the form of nature protection areas. Lake Techirghiol holds a crucial role within the Techirghiol Nature Reserve, acknowledged as both a Natura 2000 site and a Ramsar site. In addition to protective measures, effective strategic planning for the lake and its surroundings is paramount for conservation. Human activities, notably tourism, emerge as



Figure 1. Map showing the outline of the study area

the primary threats to the biodiversity and natural values of the lake and its environs.

This study strives to mitigate the adverse impacts of tourism activities by advocating for sustainable practices, emphasizing alternative tourism, and promoting a harmonious relationship between human activities and the environment. Within this framework, ecotourism emerges as a specific form of alternative tourism that prioritizes environmental conservation, cultural respect, sustainability, and educational initiatives.

Lake Techirghiol, along with a significant portion of its surrounding area, obtained the designation of a RAMSAR site in March 2006, securing its place on the List of Wetlands of International Importance. Additionally, it is recognized as an important Bird Area in Dobrogea (ROSPA0061), covering an expansive area of 3035.3 hectares.

The protected natural area comprises the lake, arable land, crops, meadows, swamps that provide food, shelter, nesting, and living conditions for several species of migratory or sedentary birds, as well as other species of fauna such as benthic, amphibians, reptiles, mammals.

Table 1. The surfaces of the Natura 2000 site

Site of Community Importance ROSPA0061	
TECHIRGHIOI LAKE	44.20%
UNIRRIGATED ARABLE LAND	35.59%
MEADOWS	15.80%
SWAMPS	2.93%
INDUSTRIAL AND COMMERCIAL UNITS	0.89%
BUILT AREAS	0.56%
SPORTS AND LEISURE FACILITIES	0.03%

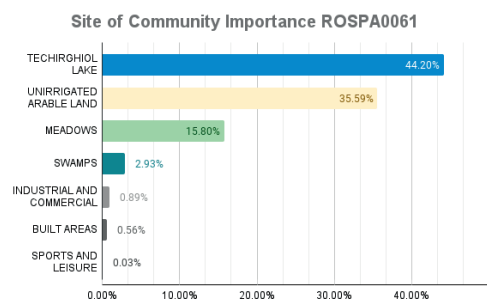


Figure 2. Illustrative graph for the surfaces of the site

## MATERIALS AND METHODS

The methodological approach of this study commenced with a thorough exploration of theoretical foundations, involving an extensive review of existing literature. This encompassed a comprehensive consultation of documents, specialized literature, and case studies, aiming to establish a robust theoretical framework.

The practical phase involved a systematic approach to documentation, comprising three key components. Firstly, a meticulous examination of maps, general/zonal urban plans, and relevant documents was conducted to compile data about the site. Secondly, direct on-site visits were undertaken to glean firsthand insights into the specific characteristics and dynamics of the studied area. Lastly, on-site analyses included a detailed vegetation analysis to understand flora composition and ecological significance, a fauna analysis to assess biodiversity and ecological interactions, and a pollution analysis to gauge environmental stressors in both the lake and its adjacent areas. This integrated approach allowed for a holistic understanding of the Techirghiol Lake ecosystem, facilitating a nuanced exploration of its ecological intricacies and anthropogenic pressures.

The concluding phase of the study was dedicated to the planning and development of the Şincai Peninsula, an integrated area of the site, considering the principles of ecotourism to minimize the environmental impact of typical tourist activities. This approach aimed at mitigating the environmental ramifications associated with conventional tourist activities, thereby underscoring a commitment to sustainable and environmentally conscientious development practices.

## RESULTS AND DISCUSSIONS

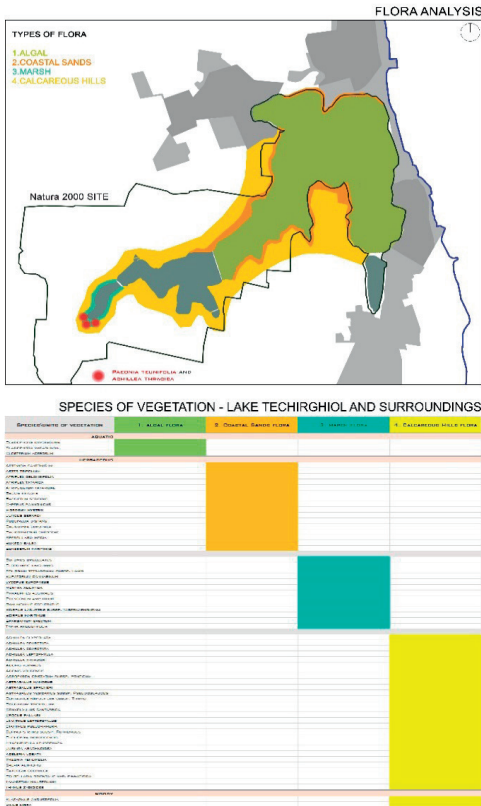
The establishment and enforcement of protected natural areas have resulted in a set of regulations and constraints governing the nature and conduct of human activities within these designated zones. In the vicinity of the lake, developmental initiatives adhere to the guidelines outlined in the area's management plan, strategically crafted to uphold and safeguard biodiversity (Băcănaşu, 2020).

The conservation of biodiversity involves a multifaceted and dynamic approach, entailing efforts to preserve species and ecosystems in their most natural state feasible, shielding them from the detrimental impacts of human activities.

Although Lake Techirghiol is a protected natural area and is subject to certain rules, no significant action has been taken in recent years on human activities harmful to biodiversity.

The main analyses that supported this study and directed the best planning and development decisions are presented below.

The flora analysis was carried out on several vegetation categories as follows: algal flora, littoral sands flora, marsh flora, and calcareous hills flora. It includes species of high decorative value, rare, or even protected species presented in Figure 3.



The number of floristic rarities in the south-western area of Lake Techirghiol is much higher, however, including *Achillea coarctata*, *Astragalus spruneri*, *Salvia aethiopsis*, *Euphorbia dobrogensis*, *Dianthus leptopetalus*, *Crocus pallasii*, *Adonis vernalis*, *Adonis volgensis*, *Achillea clypeolata*, *Achillea coarctata*. To these species are added numerous rare elements of Pontic (in the broad sense) or southern (Balkan, sub-Mediterranean or Mediterranean) origin: *Achillea leptophylla*, *Agropyron cristatum* subsp. *ponticum*, *Dianthus pseudarmeria*, *Centaurea napulifera* subsp. *thirkei*, *Astragalus vesicarius* subsp. *pseudoglaucus*, *Astragalus hamosus*, *Convolvulus cantabrica*, *Hyacinthella leucophaea*, *Colchicum triphyllum*, *Jurinea arachnoidea*, *Echinops ritro* subsp. *ruthenicus*, *Satureja coerulea*, *Scutellaria orientalis* var. *pinnatifida*, *Tanacetum millefolium*, *Thymus zygioides*, *Koeleria lobata*, *Salvia aethiopsis* (Făgăraș et al., 2008).

In addition to the floristic variation of the lake, it stands out, in particular, for the diversity of its avifauna, harbouring rare species in the context of Romania's avian fauna, including some that are endangered at global or European level. Of the over 400 species reported so far in Romania, 264 species of birds have been observed in the Techirghiol Lake area, meaning over 65% of the species present in Romania (SOR, 2017-2020), making it a unique ecosystem. This remarkable diversity underscores the lake's significance as a vital habitat for a wide range of species, contributing significantly to the overall biodiversity in the region.

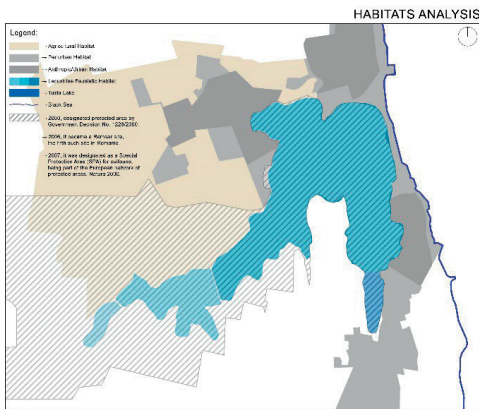


Figure 4. Habitats analysis

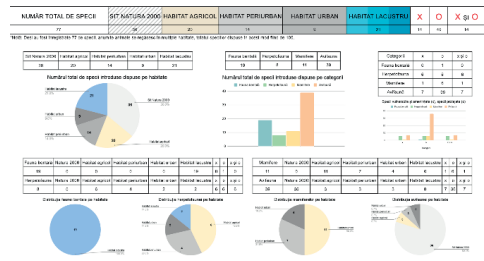


Figure 5. Illustrative graphs for the habitats analysis

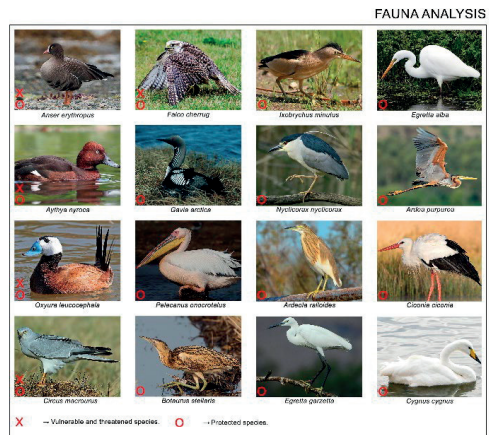
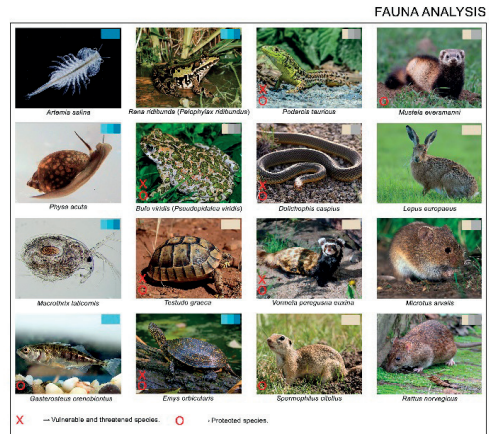


Figure 6. Fauna analysis

The lake in question is one of the main wintering sites in Europe for the red-breasted goose (*Branta ruficollis*). However, the surrounding region has been identified as a suitable habitat for more than 150 species of birds, both sedentary and migratory (Făgăraș et al., 2008). Among the vulnerable and threatened bird species in the Techirghiol Lake area (according to the Global IUCN Red List, 2008; Birds



Directive; Bern Convention, Bonn Convention), we mention: *Pelecanus crispus*, *Anser erythropus*, *Branta ruficollis*, *Aythya nyroca*, *Oxyura leucocephala*, *Circus macrourus*, *Falco cherrug* (Făgăraș et al., 2008).

Other strictly protected bird species in the Techirghiol Lake area (according to GEO 57/2007) are: *Gavia arctica*, *Pelecanus onocrotalus*, *Botaurus stellaris*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Egretta garzetta*, *Egretta alba*, *Ardea purpurea*, *Ciconia ciconia*, *Cygnus cygnus*, *Circus aeruginosus*, *Circus cyaneus*, *Buteo rufinus*, *Falco columbarius*, *Falco peregrinus*, *Charadrius alexandrinus*, *Pluvialis apricaria*, *Philomachus pugnax*, *Larus melanocephalus*, *Larus minutus*, *Sterna albifrons*, *Chlidonias hybridus*, *Chlidonias niger*, *Asio flammeus*, *Alcedo atthis*, *Lanius collurio*, *Lanius minor* (Făgăraș et al., 2008).

The impact of pollution on ecosystems is significant, affecting their health and functions. Various components of ecosystems, such as air,

water and soil, are vulnerable to pollution, with adverse consequences for biodiversity and ecological balance.

This relationship extends beyond immediate environmental concerns, affecting human health, economies, and even contributing to global challenges like climate change. Recognizing the interconnected nature of these issues is crucial for developing holistic approaches that address the complex web of challenges posed by pollution. Therefore, adopting sustainable practices is essential for a comprehensive strategy to ecosystems.

The table presented below outlines the relationship between different types of ecosystems and pollution, with a focus on both the source and impact of pollution. Agricultural ecosystems may cause minor soil pollution, urbanized ecosystems pose risks, and lakes play a crucial role in biodiversity. Meadows and ecotones generally contribute positively to biodiversity with varying impacts.

Table 2. The relationship between ecosystems and pollution

SOURCE (LEFT) / IMPACT (RIGHT)	AGRICULTURAL ECOSYSTEM	LAKE ECOSYSTEM	URBANIZED ECO SYSTEM	MEADOW ECOSYSTEM	ECOTONE (LAKE SHORE)	ECOTONE (BEACH)
AGRICULTURAL ECOSYSTEM		Food source. There are minor soil pollution factors.	Provides a food source for humans.	Food source for organisms, predominantly in the avifaunal zone.	The ecotone is very narrow due to the expansion of the agricultural area.	Does not interact directly.
LAKE ECOSYSTEM	Food source for birds, insects		Source of food and natural substances for treatment purposes.	Food source for organisms.	Increases biodiversity.	Increases biodiversity.
URBANIZED ECOSYSTEM	There may be a risk of built-up area expansion.	Water pollution source through discharges.		No direct impact.	Does not present major risk factors.	Human intervention has reduced the degree of biodiversity.
MEADOW ECOSYSTEM	Food source for birds, insects, rodents.	Increases biodiversity.	Does not present major risk factors.		Strongly biodiversified area in a good balance.	Does not interact directly.
ECOTONE (LAKE SHORE)	No strong impact interactions occur between zones.	Strongly biodiversified area in a good balance.	Does not present major risk factors over a short period.	Biodiverse environment.		Enhanced biodiversity.
ECOTONE (BEACH)	They do not interact directly.	Enhanced biodiversity.	Does not present major risk factors.	Does not interact directly.	Enhanced biodiversity.	

NEGATIVE IMPACT
POSITIVE IMPACT
NO SIGNIFICANT IMPACT

For the second part of the study, after conducting the macro-analysis on Techirghiol Lake's ecosystems, the case study examined in this paper is the Şincal Peninsula. From an administrative point of view, it is part of Eforie Nord and is located on the shore of Lake Techirghiol, constituting an essential part of the Techirghiol Natural Reserve. Its strategic position and its status as a protected area underline its importance in the conservation of biodiversity and ecosystems.



Figure 7. Map showing the location of the Şincal Peninsula in the context of Techirghiol Lake

According to the analyses carried out, it was found that the area of the Şincal Peninsula is under considerable pressure due to anthropic activities that have disturbed the ecological balance.

Upon closer local analysis, various abandoned structures and the concrete station can be observed on the peninsula, significantly impacting the fragile ecological balance of the lake. Within the peninsula, degradation of the vegetation landscape and the transformation of the recreational forest into an untended area can be observed. Additionally, due to construction along the shoreline, the location of the concrete station, and the uncontrolled development of green areas, the harmonious connection between human and nature has become impossible.

These disturbances not only affect the immediate environment but also have broader implications for the biodiversity and sustainability of the entire region. The repercussions extend beyond the Şincal Peninsula, impacting neighboring ecosystems and challenging the overall resilience of the local environment.

Increases in density are evident throughout Eforie Nord, either through new construction or the addition of extra floors to existing buildings. The rapid urbanization poses further challenges to maintaining a balance between human development and environmental conservation. Urgent measures and sustainable practices are necessary to address these issues and ensure the long-term health of the ecosystem in this region.

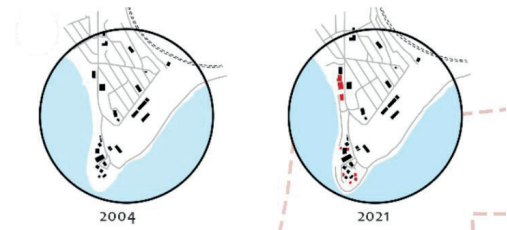


Figure 8. Urban growth trends of the Şincal Peninsula (Source: Guju, 2021)

However, increasing density at the end of the peninsula may have serious consequences for the fragile habitat of the bay and the natural landscape of the area. It should be noted that in Eforie's General Urban Plan and Local Planning Regulations, the Şincal peninsula, the landscape protection perimeter, is proposed for landscape rehabilitation.

Following the comprehensive analyses conducted in the area, incorporating a SWOT (which assesses the Strengths, Weaknesses, Opportunities, Threats) analysis can provide valuable insights into the overall strategies framework and potential future directions, as detailed below in Table 3.

Table 3. SWOT analysis

<b>Strengths (S)</b>
- Existence of natural resources: water with therapeutic benefits, sapropelic mud;
- High biodiversity area;
- Lake with great recreational, tourist and spa potential;
- Existence of numerous types of landscapes.
<b>Weaknesses (W)</b>
- Hostile space, disadvantaged by concrete station;
- Degradation over time of the typology and the way the station was originally designed;
- Poorly diversified leisure facilities;
- Chaotic buildings near the shore of Lake Techirghiol.
<b>Opportunities (O)</b>
- Growing the camping culture in Europe;
- Lake Techirghiol is a RAMSAR site and can attract funding for research and protection projects;

<ul style="list-style-type: none"> <li>- Increasing trend for alternative forms of tourism;</li> <li>- Possibility of scientific research on vegetation in areas of high biodiversity.</li> </ul>
<b>Threats (T)</b>
<ul style="list-style-type: none"> <li>- Decreasing interest of tourists in spa tourism;</li> <li>- Lack of vision to preserve natural heritage and promote cultural and spa tourism.</li> </ul>

The potential of the site is represented by its high biodiversity and strategic location on the shore of Techirghiol Lake, a protected natural site known for its curative and treatment qualities. The dysfunctions of the site include: fracturing from the rest of the town due to the railway infrastructure, the location of the concrete station in the vicinity of a fragile habitat, the lack of connectivity between the peninsula and the town (i.e. the railway station), and the non-regulated growth of the built-up area near the shore.

Thus, the result of this synthesis demonstrates that the studied area is endowed with a high potential for landscape rehabilitation and for the valorisation of the curative properties of the lake, right on its shore.

Table 4. Diagnosis - Vision - Mission for the site

<b>Diagnosis</b>
Loss of camping culture, balneal dimension and environmental values.
<b>Vision</b>
Integration and regeneration of the balneal culture while preserving the natural environment.
<b>Mission</b>
To enhance the landscape value of the natural and balneal heritage. Promoting alternative tourism and its forms in the balneal context.

The development strategy for the Şincai Peninsula is grounded in four key aspects: preserving and regenerating the vegetation, addressing environmental problems related to the impact of the concrete station on the delicate habitat of Lake Techirghiol, restoring a balneal tourist function that aligns with current challenges, and enhancing connections between the peninsula and the town. Importantly, the strategy aims to achieve these objectives without significant intervention in the natural landscape.

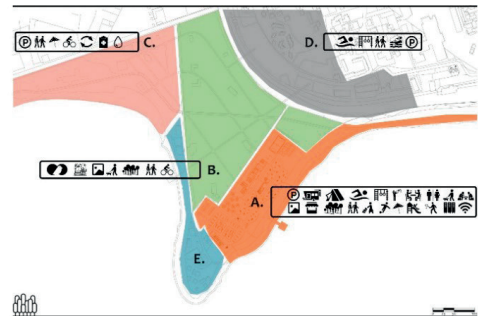


Figure 9. Şincai Peninsula's strategy (Source: Guju, 2021)

The proposed project aims to address the following issues: conservation of vegetation, including the development of a long-term management plan, regulation of movements on the peninsula to accommodate various user types without compromising the habitat of the Techirghiol Lake, establishment of a hybrid campsite to meet the current demand of tourists while adhering to environmental requirements, refurbishment of disused structures near the concrete station to minimize de built footprint of the peninsula, serving as new campsite facilities, introduction of sports facilities catering to both campsite users and the local community, development of an ecological beach for campsite users, including naturists.

In recent years, the global tourism industry has witnessed a paradigm shift towards sustainable and eco-friendly practices. The integration of ecotourism principles into camping site development offers a blueprint for sustainable and ecological tourism.

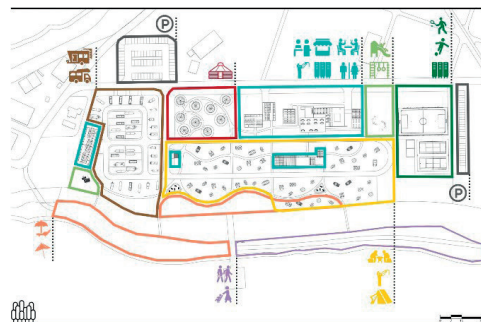


Figure 10. Proposed functions (Source: Guju, 2021)

By fostering a deep connection between campers and the natural environment, these sites become stewards of conservation, contributing to a more sustainable and harmonious relationship between humans and nature. As the demand for responsible tourism grows, camping sites embracing ecotourism solutions are poised to lead the way in shaping a more sustainable future for outdoor recreation.



Figure 11. Aerial perspective on the Șincai Peninsula  
(Source: Guju, 2021)

## CONCLUSIONS

In conclusion, this paper underscores the fragility of Lake Techirghiol's biodiversity and emphasizes the need of comprehensive measures to ensure its long-term preservation. Effective strategic planning is deemed essential for safeguarding the delicate balance of Lake Techirghiol and its surrounding environment. The recognition of human activities, particularly tourism, as primary threats to biodiversity underscores the urgency for sustainable practices.

Intervention in an area abounding in natural and cultural values must take into account a series of very well-established principles in order not to lead to their irreversible destruction. For this reason, all the activities in the studied site must be carried out in a controlled way, and the users of the space must take into account and educate

themselves on how they can contribute to the protection and conservation of the fragile habitat of Lake Techirghiol.

In this way, camping, as a form of alternative tourism, responds to these requirements and is the most sustainable form of tourism. The use of endemic species or species that are already part of the ecosystem balance of the site is recommended in the planning project.

Ecotourism, identified as a specific form of alternative tourism, is positioned as a solution that prioritizes environmental conservation, cultural respect, sustainability and educational initiatives, providing a framework for a responsible and enriching engagement with Lake Techirghiol and its unique ecosystem. The paper draw attention to the imperative to protect the biodiversity of Lake Techirghiol through a multi-faceted approach that combines protection measures, strategic planning and a shift to sustainable and responsible tourism practices, with a specific focus on the merits of ecotourism.

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