

## CONSERVATION AND RESTORATION OF POMORIE LAKE COASTAL LAGOON, BULGARIA

*Zaštita i obnova obalnih laguna jezera Pomorie, Bugarska*

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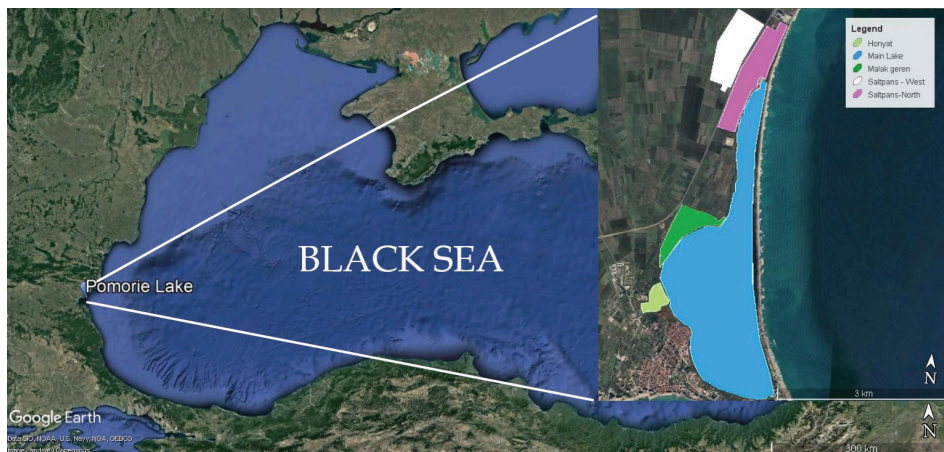
### ABSTRACT

Pomorie Lake is a hypersaline lagoon on the Bulgarian Black Sea coast. Its position along the second most important bird flyway in Europe – Via Pontica – and the existence of salt pans are the main factors defining the importance of this wetland for breeding, migrating, and wintering birds. The site hosts the largest breeding colony of Sandwich Terns on the Balkan Peninsula and significant shares of national populations of Avocet, Common Tern, Little Tern, Kentish Plover, and Black-winged Stilt. Critically endangered damselfly Dark Spreadwing *Lestes macrostigma* population recorded at Pomorie Lake is the most important in Bulgaria and important at the European level. Threats to the site are numerous and include tourism developments and habitat loss, disturbance of breeding birds by water sports and visitors, and developments leading to a disrupted hydrological regime. LIFE for Pomorie Lagoon project aimed to ensure a stable hydrological regime and restore bird breeding habitats. A baseline bird study revealed decreasing numbers of Sandwich Tern and Avocet due to damaged freshwater inflow control, resulting in lower salinity and flooding of nesting habitat. A restored wood-silt breeding islet had an imminent effect on the number of breeding pairs of Sandwich Terns and Avocets, with an increase of 52% and 150% on an annual basis between 2021 and 2022.

**Keywords:** Pomorie Lake, Natura 2000, Sandwich Tern, Avocet, Black Sea, Via Pontica

## INTRODUCTION

Pomorie Lake is a relatively small (760 ha) coastal hypersaline lagoon on the Bulgarian Black Sea coast (Figure 1). The lagoon was formed as a result of tectonic movements more than a thousand years ago that resulted in the formation of a double tombolo connecting the island of Pomorie to the mainland (Kanev 1980). Favorable natural conditions – flat relief, high solar radiation, low precipitation, and wind exposure – were utilized by humans for centuries for the production of sea salt by natural evaporation and Pomorie Salinas are the oldest in Bulgaria, dated as early as the 9<sup>th</sup> century (Ivanov 1900). High salinity is an important factor in the formation of medicinal mud that is widely used by two specialized hospitals and several SPA hotels. Natural values and importance of the site are defined by a combination of factors: the position along the second most important bird flyway in Europe (Via Pontica), as well as the existence of salt pans that circulate water and establish salinity and depth gradient with associated diverse conditions. More than 297 bird species (POPOV *et al.* 2023) have been recorded at Pomorie Lagoon and it is hosting the largest breeding colony of Sandwich Terns *Thalasseus sandvicensis* on the Balkan Peninsula with 1000-2400 pairs and significant shares of national populations of Avocet *Recurvirostra avosetta*, Common Tern *Sterna hirundo*, Little Tern *Sternula albifrons*, Kentish Plover *Charadrius alexandrinus* and Black-winged Stilt *Himantopus himantopus*. Saline conditions are important for the conservation of the Caucasian Dwarf Goby *Knipowitschia caucasica* population in Bulgaria. Population of damselfly species Dark Spreading *Lestes macrostigma* (critically endangered in Europe) recorded at Pomorie Lake is the highest in Bulgaria, making it a key site for the conservation of the species both at national and European level (LAMBRET *et al.* 2021). It is the most important locality for the Bulgarian Red Data Book-listed plant Sword-leaf Dogbane *Trachomitum venetum* and is one of the two largest (by surface area) locations of European Glasswort *Salicornia europaea* in the country. The site hosts 12 habitat types listed in annex I of EU Habitats Directive 92/43/EEC including priority ones, like 1150\* Coastal lagoons and 1530\* Pannonic salt steppes and salt marshes. The importance for biodiversity conservation and socio-economic importance of the lagoon are recognized by its designation as a Ramsar site (2002), an Important Bird Area (1989), a national protected area: protected site, IUCN category V (2001) and two Natura 2000 sites – Special Area of Conservation (SAC) „Pomorie“ (2020) under EU Habitats Directive 92/43 and Special Protection Area (SPA) „Pomoriysko ezero“ (2009) under EU Birds Directive 2009/147.



**Figure 1.** Map of Pomorie Lake and its location on the Western Black Sea coast

**Slika 1.** Položaj jezera Pomorie na zapadnoj obali Crnog Mora

Green Balkans NGO has been running a long-term conservation program for Pomorie Lake spanning more than 25 years. Thanks to diverse national and international donors and hundreds of volunteers, more than 2 million euros have been invested in the conservation of the site. It all started in 1996 as a collaboration project with BTCV (UK). Volunteers from Bulgaria and the UK have been restoring breeding habitats for threatened bird species like Avocets, Sandwich, Common and Little Terns. Firstly, parts of the existing eroded concrete wall were restored which has attracted Sandwich Terns and Avocets to nest. The next step was the creation of an artificial wood-silt islet adjacent to the restored concrete wall. The formation of a larger islet in the centre of the lagoon by reconstruction of the eroded dike was the next step in habitat restoration. The conservation program was elaborated in the period 2005-2010 when a management plan for the site was developed. It was the first effort in Bulgaria to draft an integrated management plan for two NATURA 2000 sites, a national protected area and a Ramsar site. The process included detailed studies of biotic, abiotic, and socio-economic factors, assessment of the conservation status of habitats and species, mapping and delimiting three zones of the site, developing a 5-year work plan and proposing a management body. Unfortunately, the plan was not approved by the Ministry of Environment and Water despite two revisions being made, with the last one in 2014. Opposition to the management plan was expressed through negative position papers by Pomorie Municipality, the Local Hunting Society and Saltwork Owners' Association. The main conflict that was identified by the plan was with Pomorie Municipality's draft Master Plan that proposed further urban developments through the conversion of agricultural lands (main-

ly extensive vineyards) into new holiday resorts within then proposed Site of Community Interest Pomorie (designated finally as SAC in 2020). The appropriate nature impact assessment report of the Master Plan was not approved by the Ministry of Environment and Water and thus its implementation was prevented.

Even though the developed Integrated Management Plan for Pomorie Lake was not approved, Green Balkans NGO continued the implementation of foreseen activities. In 2008, the existing canal connecting the lagoon to the Black Sea was restored, leading to a stabilized hydrological regime and ensuring better maintenance. Detailed technical design was developed for the drainage system's restoration that was protecting the lagoon from freshwater inflow and included two bypass channels, a pump station and a pipeline to the sea. Excessive cost estimation of this project impeded its realization. The visitor centre was built on the bank of the lagoon with the main aim of raising awareness, supporting the conservation of the site and hosting a proposed management body. While the first two aims were successfully achieved, the last one was blocked due to the unapproved management plan. Further restoration and creation of breeding habitats for birds was made in the form of a larger artificial island and wooden platforms. In the period 2010-2013 total of 297 (7 adults and 290 chicks) Sandwich Terns from the colony were marked with colour rings (Popov *et al.* 2012). Invasive plant species from the sand dunes at the site have been eradicated in the period 2012–2014.

Since 2014, new threats started to evolve: the municipality seized the non-operated drainage pump station from the company that operates salinas. It was converted into a stray dog management shelter and consequently, part of the drainage canal adjacent to the pump was filled with ground and blocked. In 2017, a project for the enlargement of the road Burgas – Sunny beach started that included circular by-pass roads around the towns of Pomorie and Aheloy. In parallel with that, a brand-new holiday resort was built just next to the northern edge of the salinas. Both these projects have been subject to an appropriate environmental impact assessment that foreseen no negative consequences. In 2019, Pomorie saltworks company and conservation non-governmental organizations initiated the development of a project idea seeking a solution to the problem of decreasing salinity of the lagoon that was the main obstacle to the normal operation of salinas. LIFE19 NAT/BG/000804 LIFE FOR POMORIE LAGOON project combines the expertise and knowledge of actors from different sectors: non-governmental organizations (Green Balkans NGO and Bulgarian Biodiversity Foundation), a private company (Pomorie saltworks) and a scientific institute (Tour du Valat of France). The main objective of the project is to tackle the increasing threat to the lagoon in the form of a disrupted hydrological regime and increased freshwater inflow, resulting in higher water levels and decreased salinity. For achievement of that goal, complete cleaning of 5340 m of bypass protective canals and restoration of 6460 m dykes that protect the salinas and ensure water

circulation were planned. Additionally, the restoration of the existing 250 m<sup>2</sup> islet where the mixed colony of Avocets, Sandwich, Common and Little Terns breeds and the creation of a new wooden platform for breeding Avocets and Common Terns was foreseen.

The current paper summarizes efforts for the conservation of the lagoon and its biodiversity together with newly developed threats, leading to a deterioration of the site.

## MATERIAL AND METHODS

The baseline study of birds at Pomorie Lake in 2020/2021 included more than 40 days of fieldwork: 25 days for monitoring during migration and winter periods, with the rest dedicated to monitoring breeding birds on foot and by drone. Activities started in September 2020 and during the first 18 months the baseline study of birds was completed and restoration works started. Green Balkans' experts conducted an ecological survey investigating the bird communities at Pomorie Lake to inform and assess the implementation of the project activities. Field surveys were undertaken twice per month between September 2020 and September 2021, comprising point transect surveys, patrolling of the dikes and shores and drone surveys. Surveys were designed to record the numbers and species composition of wintering, migrating and nesting birds at the lake. The survey has focused on water and wetland-dependent birds. Binoculars (Minox 8x40), telescopes (Opticron ES 80GA ED 20-60x80 and Swarovski ATX 30-70x95) and Drone DJI Mavic 2 Enterprise were used.

## RESULTS

As a result of conducted restoration activities that targeted breeding bird habitats, in the period 1998–2001, the number of Sandwich Tern pairs increased from 5 to 450 (GRADEV 2003). A further increase to 1500 breeding pairs in 2009 (PROFIROV *et al.* 2010) was a result of the enlargement of the small wood-silt islet. The creation of a large-size islet (4000 m<sup>2</sup>) covered with pebbles in 2013 further supported an increase of that number up to 2400 (Figure 2). The nesting of Mediterranean Gull *Larus melanocephalus* and Gull-billed Tern *Gelochelidon nilotica* in 2013–2018 was also witnessed in the new habitat. Since 2018, no breeding attempts have been observed at the large islet with the main mixed colony returning to the smaller islet. The colour-ringing scheme of Sandwich Terns from the Pomorie Lake colony has been quite successful. Out of the 297 ringed terns, only 20 were found dead within the year of hatching and of the remaining 277 birds, recoveries were reported for 94 (34%) individuals. More than half of these (55) had multiple observations, in different years including. Four of the ringed terns have been confirmed to reach the age of 11 years. Recoveries at the natal site have

varied between 1 and 41 individuals per year, while spatial distribution included coastal wetlands from the Mediterranean, Black Sea and Atlantic Ocean (Lanzarote, Canary Islands).

The total number of bird species registered during the 2020/2021 survey period is 119. Of these, 94 species can be identified as waterbirds or wetland-dependent species. The number of species observed per visit was between 34 and 60. The abundance of birds per visit varied between 2154 and 13710 ind. (Popov & Meshkova 2021). Conditions of the site have changed significantly throughout the year of the study. In 2020, the salinas operated quite successfully as freshwater inflow was blocked during the construction of the new circular by-pass road of Pomorie. In December 2020, since the road construction works were completed, the freshwater stream was unblocked, and a new bypass was cut, leading to its direct inflow in the lagoon. 2021 was the first year when the salinas were not operated and the circulation of saline water within the lagoon was completely stopped. During the period of the study, saltpans progressively dried out by evaporation and since May basins have been completely dry. Peripheral basins (Honyat and Malak Geren) dried out at the beginning of August and September, respectively. Precipitation during the autumn and winter was relatively high compared to previous years and exceeded 300 mm in total. Rainfall in spring has also been higher than in the previous 5 years and that, in combination with the non-operating salinas, has led to a higher water level of the lagoon. The surface of available breeding habitat for nesting terns and shorebirds was limited. In addition, flooding of embankments and smaller saltpans led to two failed incubation attempts by these species. The presence of predators (stray dogs, jackals and foxes) was also documented by both tracks and observations. During migration and winter, peak numbers of indicator species for the site have covered the set target values (Table 1). Target values were set as average values of the observed abundance of those species during the relevant season in the period 2006–2017.

**Table 1.** Observed peak numbers of indicator species for the site in 2020/21 and set target values.

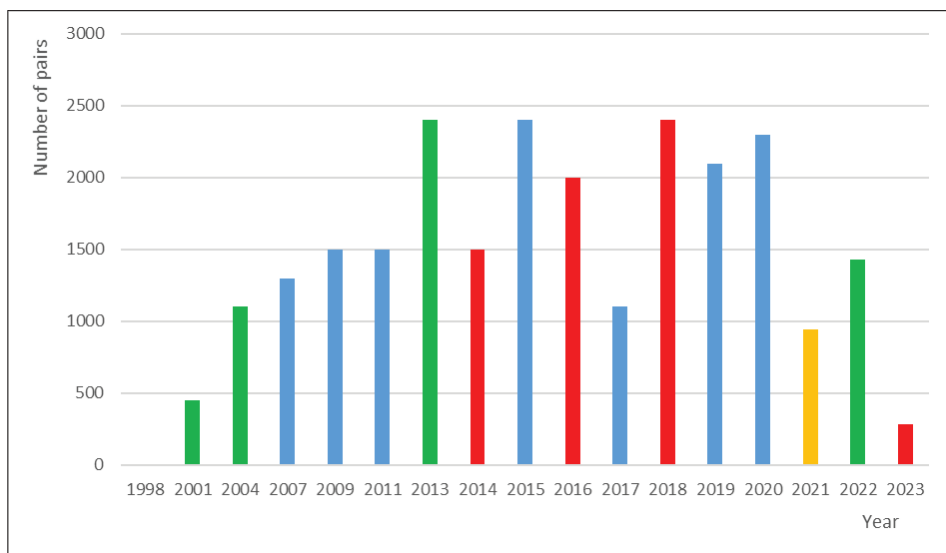
**Tablica 1.** Ciljne vrijednosti i najviše zabilježene brojnosti indikatorskih vrsta za područje u 2020./21. godini.

Species	Migration		Winter	
	Target	Observed max.	Target	Observed max.
Little Stint <i>Calidris minuta</i>	50	528		
Dunlin <i>Calidris alpina</i>	300	483		
Ruff <i>Calidris pugnax</i>	100	512		
Kentish Plover <i>Charadrius alexandrinus</i>	25	49		
Little ringed Plover <i>Charadrius dubius</i>	25	58		
Redshank <i>Tringa totanus</i>	60	109	60	68
Shelduck <i>Tadorna tadorna</i>			250	1454
Black-tailed Godwit <i>Limosa limosa</i>	70	144		

A survey of breeding birds in 2021 has shown that only three of the flagship species for the site had stable breeding numbers: Common Tern, Kentish Plover and Little Tern. The other typical species for which the site is an important breeding site at the national scale: Sandwich Tern, Avocet and Black-winged Stilt have had a marked decrease in the number of breeding pairs. In 2022, an increase in breeding pairs of Sandwich Terns and Avocets was observed, which were breeding mainly on the restored wood-silt islet. Data on the number of breeding pairs as set targets and observed numbers in 2021 and 2022 is shown in Table 2. Targets were defined as average values from recorded numbers of breeding pairs in the period 2006–2017.

**Table 2.** Target values and observed number of breeding pairs for indicator bird species in 2020/21.**Tablica 2.** Ciljne vrijednosti i najviši zabilježeni broj gnijezdećih parova indikatorskih vrsta za područje u 2020./21. godini.

Species	Target (pairs)	2021 (pairs)	2022 (pairs)
Sandwich Tern <i>Thalasseus sandvicensis</i>	1300-2000	944	1431
Common Tern <i>Sterna hirundo</i>	60-100	342	161
Little Tern <i>Sternula albifrons</i>	10-20	42	38
Kentish Plover <i>Charadrius alexandrinus</i>	5-20	12	14
Pied Avocet <i>Recurvirostra avosetta</i>	60-100	36	95
Black-winged Stilt <i>Himantopus himantopus</i>	40-80	26	23

**Figure 2.** Number of breeding pairs of Sandwich Tern at Pomorie Lake: green shows years with specific restoration effort, blue shows normal years, orange shows marked decline and red shows failed breeding due to human disturbance.**Slika 2.** Broj gnijezdećih parova dugokljune čigre na jezeru Pomorje: zeleno – godine u kojima je provedena obnova staništa, plavo – normalne godine, narančasto – izrazit pad brojnosti, crveno – nesuspješno gniježđenje zbog uznemiravanja od strane ljudi



## DISCUSSION

The growth of the main breeding colony of Sandwich Terns at Pomorie Lagoon is a direct result of conducted restoration activities in the period from 1996 until now. The number of breeding pairs gradually increased from 5 to a peak of 2400 pairs in 2013 and 2015 that occupied a newly created pebble-covered large islet. The last breeding attempt on that islet was observed in 2018 and the reasons why it was not occupied in the following years remain unclear. Vegetation cover (mainly *Artemisia santonicum*) could be the main reason and efforts for its removal have been made regularly since 2017 onwards. Despite overgrowing (at some parts in high density), breeding efforts in 2016–2018 were not prevented. In 2016, the main reason for abandonment was related to continuous disturbance by intensive kite-surfing in the period 21–24 May, but in 2018 the reason was not identified. Further to that, in 2017, a mixed colony of Gull-billed Terns, Avocets and Black-winged Stilts was observed on the edges of the islet despite no effort being made for vegetation removal before that. In 2022, mechanical removal of vegetation was conducted in early spring, but still no breeding attempt has taken place there. A mixed colony of Sandwich Terns, Avocets and Mediterranean Gulls occupied the large islet until its abandonment in early June, and since 2018 the old wood-silt islet has been the main breeding location. Even its vulnerability to human disturbance by uncontrolled mud-bathers (being only 160 m from shore) has not decreased the colony's fidelity to it. That was the main reason a specific effort for its restoration was made after the end of breeding season 2021 when limited surface resulted in a marked decrease of 50% in breeding pairs' numbers. The effect of the restoration within LIFE19 NAT/BG/000804 LIFE FOR POMORIE LAGOON, which included strengthening the wooden parts and filling in with silt, was positive and in 2022 the number of Sandwich Tern pairs increased by 50% compared to 2021 (Figures 3 and 4). A similar effect was also observed in the numbers of breeding Avocets with almost 50% of all pairs nesting at the islet in 2022.



**Figure 3.** Islet with nesting Sandwich terns in 2021 before restoration  
*Slika 3.* Otočić s gnijezdećim dugokljunim čigrama 2021., prije obnove



**Figure 4.** Islet with nesting Sandwich terns in 2022 after restoration  
*Slika 4.* Otočić s gnijezdećim dugokljunim čigrama 2022., nakon obnove

Activities targeting the restoration of the hydrological regime have been almost completed. Despite that, the operation of the created bypass canal that directs freshwater inflow into the lagoon continues to undermine conducted restoration. On-site checks by competent authorities and the responsible agency and contractor for the building of the new road have led only to a request for the restoration of the missing part of the bypass canal and the swamp that was filled with ground during a road construction project. Until now, no action by responsible parties has taken place. As a result, Pomorie Salinas are not operating for a second consecutive year, leading to the loss of 22% of the wetlands area. We can conclude that despite the enormous efforts and funds invested in the conservation and restoration of Pomorie Lagoon and the fact that the site is under various legal protection, effective management and control are lacking. That further underlines how important is lack of a site manager with relevantly delegated functions for control of activities affecting the wetland.

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This paper is dedicated to our late colleague Doncho Kirov (1976–2022) who has been an integral member of the Green Balkans NGO's "Pomorie Lake Conservation Program" through the years.

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## SAŽETAK

Jezero Pomorie je obalna slana laguna na bugarskoj obali Crnog mora. Laguna se koristi za proizvodnju soli i vađenje ljekovitog blata. Smještaj uz drugi najvažniji selidbeni sustav ptica u Europi – Via Pontica – i postojanje solana, glavni su čimbenici koji utječu na važnost močvare za gniježđenje, selidbu i zimovanje ptica. Na tom području nalazi se najveća gnijezdeća kolonija dugokljunih čigri na Balkanu s 1000 do 2400 parova i značajnim udjelima nacionalnih populacija modronoge sabljarkke, crvenokljune čigre, male čigre, morskog kulika i vlastelice. Populacija u Europi kritično ugrožene velike zelendjevice *Lestes macrostigma* (red Odonata) zabilježena u jezeru Pomorie najvažnija je u Bugarskoj i značajna na europskoj razini. Očuvanje i socio-ekonomska važnost lagune prepoznata je njezinim proglašenjem Ramsarskog područja, Važnog područja za ptice (IBA), nacionalno zaštićenog područja i dva područja Natura 2000 – posebnog područja očuvanja „Pomorijsko jezero” prema EU Direktivi o staništima 92/43 i područja posebne zaštite “Pomorijsko jezero” prema EU Direktivi o pticama 2009/147. Nevladina organizacija Zeleni Balkan vodi dugoročni program očuvanja ovog područja koji traje više od 25 godina. Rezultati obnove staništa najbolje se očituju u porastu broja dugokljunih čigri s 5 parova u 1998. na 2200 parova u 2020. godini i uočenom neredovitom gniježđenju crnoglavog galeba *Larus melanocephalus* i debelokljune čigre *Gelochelidon nilotica* u razdoblju 2013.-2018. Prijetnje su brojne i uključuju razvoj turizma i gubitak staništa; uznemiravanje gnijezdećih ptica vodenim sportovima i posjetiteljima; te razvoja koji dovodi do poremećaja hidrološkog režima. Projekt “LIFE for Pomorie Lagoon” imao je za cilj osigurati stabilan hidrološki režim i obnoviti stanište za razmnožavanje ptica. Istraživanja ornitofaune ukazuju na opadanje broja dugokljunih čigri i modronogih sabljarki zbog poremećene kontrole dotoka slatke vode i rezultirajućeg smanjenja saliniteta i plavljenja staništa za gniježđenje. Obnovljeni otočić za gniježđenje imao je neposredan učinak na gniježđenje dugokljunih čigri i modronogih sabljarki s porastom od 52% i 150% na godišnjoj razini između 2021. i 2022.