PELICAN
WAY OF LIFE

Study of the Dalmatian pelican population status, movements, dispersal, threats and key sites along the Black Sea-Mediterranean flyway

Report under Action A1

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Authors: Sebastian Bugariu[1], Victoria Saravia-Mullin[2], Svilen Cheshmedzhiev[3], Manolia Vougioukalou[2], Jelle Harms[4], Mykhailo Nesterenko[4], Maxim Yakovlev[5] & Alexander Gaidash[5]

[1] *Romanian Ornithological Society/ BirdLife Romania*
[2] *Hellenic Ornithological Society/ BirdLife Greece*
[3] *Bulgarian Society for the Protection of Birds/ BirdLife Bulgaria*
[4] *Rewilding Europe*
[5] *Rewilding Ukraine*

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Mapping: Jelle Harms

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Danube Delta landscape. Photo: Sebastian Bugariu

1. Executive Summary

The Pelican Way of LIFE project (LIFE18 NAT/NL/716) was implemented from 2020 to 2025 to enhance the conservation of the Dalmatian Pelican (*Pelecanus crispus*) along the Black Sea–Mediterranean Flyway. Covering 27 Natura 2000 sites in Bulgaria, Greece, Romania, and two protected areas in Ukraine, the project included a wide range of activities. The present report summarizes the results of actions A1, which aimed at studying the current population status, movements, dispersal, threats and key sites along the flyway route. The focus of this action has been on assessing breeding, spring and wintering trends, tracking populations, and mitigating threats along the flyway through coordinated activities including ringing, satellite telemetry, and aerial and ground monitoring.

The key outcomes and findings of the activities implemented across all countries under action A1 during the project are summarized as follows:

Breeding Population Monitoring

Regular surveys between 2020 and 2024 provided detailed data on population size, breeding success, and colony dynamics. In Romania, the breeding population estimate has been established at 450–570 breeding pairs for the project duration, with key colonies at Lake Tasaul, Lake Lejai, and Ceaplace Island. In Bulgaria, 55–146 breeding pairs have been estimated, with notable growth following the installation of artificial nesting platforms.The breeding population in Western Greece has been estimated at approximately 320 breeding pairs, monitored at Amvrakikos Gulf and Messolonghi Lagoon. New colonies were confirmed or identified through aerial and drone surveys, while in Ukraine challenges such as restricted access prevent for the moment full aerial surveys or even ground access.

Breeding Success

Despite natural fluctuations, breeding success remained stable or increasing in most colonies. Artificial nesting platforms in Bulgaria directly contributed to new colony establishment and increased productivity.

Impact of the 2022 HPAI Outbreak

The 2022 outbreak of highly pathogenic avian influenza (HPAI) caused catastrophic losses, particularly in Northern Greece (Prespa colony), with over 2,300 deaths. Romania reported a loss of approximately 20% of its breeding adults. Despite this, most colonies showed population recovery and stable breeding success by 2024.

Spring and Winter Censuses

Annual coordinated spring (2021–2024) and winter (2020–2024) censuses were carried out across Romania, Bulgaria, Greece, Ukraine, and neighboring countries. Spring counts recorded between 3,812 and 5,471 Dalmatian Pelicans annually. Winter counts highlighted the importance of sites such as Burgas (Bulgaria) and the Danube Delta (Romania). Monitoring

revealed clear seasonal dispersal patterns, especially in the northern population, which now tends toward short to medium-distance movements and dispersal.

Color Ringing and Satellite Telemetry

In total over the duration of the project, 366 Dalmatian Pelicans were ringed, with a 10.2% recovery rate across project countries (13.2% in Romania). 24 individuals were equipped with GPS–GSM transmitters: 11 in Bulgaria, 6 in Greece, 7 in Romania.

Satellite telemetry revealed distinct movement patterns: Bulgarian and Romanian birds showed high mobility, moving across the Danube and associated wetlands, the Black Sea coast (as far north as the Kinburn Peninsula), and as far as Turkey and Serbia. Western Greek birds exhibited more localized movements with minimal exchange between western and northern populations. The longest distance recorded away from the tagging location was 515 km by a juvenile from Romania.

Regional challenges identified during the implementation of activities include

- Ukraine Access Restrictions
  Military conflict limited monitoring activities in Ukraine from 2022 onward, creating gaps in breeding and census data. Occasional observations and telemetry confirmed the area's continued importance.
- Data Collection Gaps
  Observer training, especially in age-class identification, remains a priority. Weather and logistical challenges affected census consistency, particularly in winter counts. The increase in number of available experienced observers is needed
- Potential Emerging Threats
  Beyond mortality caused by already known factors, illegal fishing may have an underestimated impact due to unknown quantities of nets in the wetlands. Further targeted studies are recommended.

Conservation and Policy Implications

The project demonstrated the value of multi-national collaboration, involving ornithologists, conservationists, volunteers, and authorities across countries. Artificial platform installation, standardized census protocols, and coordinated satellite telemetry provided actionable tools for species management. Findings support a shift from site-based conservation to corridor and flyway-scale strategies, recognizing the wide-ranging movements of northern populations. Ongoing studies initiated under the project will provide further insights into population structure and resilience.

2. Introduction

The Dalmatian Pelican (*Pelecanus crispus*), listed in Annex I of the EU Birds Directive and classified as Near Threatened on the IUCN Red List (2017), is one of the largest and rarest pelican species globally. With an estimated world breeding population of 7,347–8,993 pairs, approximately 42–54% are concentrated along the Mediterranean–Black Sea Flyway according to the latest evaluation of the International Single Species Action Plan. Despite recent increases in a few key colonies, the species remains highly vulnerable due to its patchy breeding distribution and exposure to multiple threats, including collisions with power lines, habitat loss, human disturbance, direct persecution, and insufficient public awareness.

Addressing these challenges, the LIFE project "Conservation of the Dalmatian Pelican along the Black Sea–Mediterranean Flyway" (Pelican Way of LIFE, LIFE18 NAT/NL/716) was launched to implement targeted conservation measures across Southeastern Europe. Actions targeting the conservation of the Dalmatian Pelican (DP) included systematic population monitoring, color ringing, satellite telemetry, installation of artificial nesting platforms, and patrolling schemes aimed at threat reduction. A central component of the project was the evaluation of these interventions to inform long-term conservation strategies for the species. The project covered 27 Natura 2000 Special Protection Areas (SPAs) in Bulgaria (10), Greece (2), and Romania (15), as well as two protected areas in the Danube Delta, Ukraine. Additional monitoring actions extended beyond these sites to provide a comprehensive overview of the Dalmatian Pelican's status and the threats it faces across its regional range. Some actions have been carried out in Ukraine, but the military conflict posed significant limitations on monitoring activities, highlighting the need for adaptive conservation planning in conflict-affected regions.

Table 1: Project areas, presence of pelicans and project conservation actions implemented on sites.

Country	Project area	Natura 2000 / Emerald	Surface (ha)	Presence of pelicans	Project actions implemented
Bulgaria	Shabla Lake Complex	BG0000156	3,195.4	Migrating, wintering	A1, A3, D1, E3
Bulgaria	Atanasovsko Lake	BG0000270	4,692	Migrating, wintering	A1, A3, D1, D2, E3, E4, E7, E8
Bulgaria	Belene Islands Complex	BG0002017	7,009.77	Breeding, migrating,	A1, A3, C2, C3, D1, E3, E4, E7, E8, E9
Bulgaria	Ovcharitsa Reservoir	BG0002023	4,304.5	Migrating, wintering	A2, A3, A4, C1, C2, D1, D2, E3, E4, E7
Bulgaria	Burgasko Lake	BG0000273	3,088	Migrating, wintering	A1, A2, A3, C1, D1, D2, E3, E4, E7, E8
Bulgaria	Mandra-Poda Complex	BG0000271	4,495	Migrating, wintering	A1, A2, A3, C1, C3, D1, E3, E4, E7, E8,
Bulgaria	Srebarna Lake	BG0000241	1,448.2	Breeding, migrating,	A1, A3, D1, E3, E7, E8
Bulgaria	Studen Kladenets	BG0002013	15,995.6	Migrating, wintering	A1, A3, C2, D1, E3, E4, E7
Bulgaria	Rozov Kladenets	BG0002022	1,281.1	Migrating, wintering	A1, A2, A3, C1, C2, D1, D2, E3, E4, E7

Bulgaria	Straldzha Complex	BG0002028	2,871.8	Migrating, wintering	A1, A3, D1, E3, E7
Greece	Messolonghi wetland	GR2310015	44,185	Breeding – Present all year	A1, A2, C1, C2, D1, D2, E4, E8
Greece	Amvrakikos Gulf	GR2110004	23,011	Breeding – Present all year	A1, A2, C2, D1, E4, E8
Romania	Danube Delta and Razim-Sinoe	ROSPA0031	512,820.110	Breeding, migrating,	A1, A2, A3, C1, D1, D2, E3, E4, E6, E7,
Romania	Iezerul Calarasi	ROSPA0051	5,001.1	Migrating, wintering	A1, A2, A3, C1, D1, D2
Romania	Lacurile Tasaul-Corbu	ROSPA0060	2,701	Breeding, migrating,	A1, A2, A3, C1, C2, D1, E3, E6
Romania	Confluenta Jiu-Dunare	ROSPA0023	22,000	Migrating, wintering	A1, A2, D1
Romania	Lacul Oltina	ROSPA0096	3,309	Migrating, wintering	A1, A2, A3, D1
Romania	Valea Mostistei	ROSPA0105	6,614	Migrating, wintering	A1, A2, A3, D1
Romania	Bistret	ROSPA0010	1,916	Migrating, wintering	A1, A2, A3, D1
Romania	Lacul Dunareni	ROSPA0054	1,269	Migrating, wintering	A1, A2, A3, D1
Romania	Valea Oltului inferior	ROSPA0106	54,074.8	Migrating, wintering	A1, A2, A3, D1
Romania	Lacul Bugeac	ROSPA0053	1,392	Migrating, wintering	A1, A2, A3, D1
Romania	Confluenta Olt-Dunare	ROSPA0024	21,285	Migrating, wintering	A1, A2, D1
Romania	Lacul Galatui	ROSPA0055	814	Migrating, wintering	A1, A2, A3, D1
Romania	Dunare-Ostroave	ROSPA0039	16,243.8	Migrating, wintering	A1, D1
Romania	Lacul Suhaia	ROSPA0102	1,250	Migrating, wintering	A1, A2, A3, D1
Romania	Balta Mica a Brailei	ROSPA0005	25,855.580	Migrating, wintering	A1, D1
Ukraine	Kiliya delta	UA0000018	50,213	All year round	A1, A3, A4, C3, D1, D3, E4, E8
Ukraine	Danube Lakes	UA0000142	52,807	All year round	A1, A3, A4, C3, D1, D3, E4

3. Methodology

-Breeding population census and breeding success
-Spring census
-Winter census
-Migration at bottleneck sites - Bulgaria
-Satellite tracking and ringing

Breeding population census and breeding success

The evaluation of the breeding population has been conducted by each partner in their respective countries during every breeding season throughout the project implementation period (2021-2024). Data on breeding population in Romania and Bulgaria is available also for the 2020 season. For Bulgaria and Romania, the survey encompassed all breeding colonies in each of these countries, equating to the entire breeding population of each of the respective countries, whereas for Greece, the project areas involved two of the seven existing breeding sites of the species in the country.

Due to variable breeding site characteristics in different countries, a variety of methods have been implemented.

In Romania, all surveys during the breeding season have been based on aerial imagery obtained either by using an ultralight aircraft (in the Danube Delta, mostly for otherwise inaccessible colonies) or by drone (both in the lagoon areas of the Danube Delta and at Lake Tasaul, where also ground surveys or direct observations of the colony have been performed). The methodology broadly involved the aerial survey and visual assessment/detailed photographic documentation of pelican colonies, followed by numerical evaluation conducted in the office. Photographs were taken from variable altitudes, ranging between 300 and 500 meters.

For the aerial survey of colonies, the most suitable aircraft are two-seater ultralight planes (pilot + passenger). Based on extensive experience using various types of aircraft over the years it has been concluded that ultralights are the most appropriate option due to several reasons, including:

- they offer sufficient flight autonomy (at least 3–4 hours), enabling comprehensive coverage of both the core areas of the Danube Delta and the associated lagoon system;
- they are relatively quiet and allow for low-speed flight, which in turn permits lower-altitude operation without disturbing the birds, while also enabling optimal photographic conditions.

In the initial phase, general overview photographs of the colony were captured. These served as reference images for the subsequent geolocation and alignment of detailed photographs. The overview photographs were followed by detailed photographic documentation of individual nesting units. Efforts were made to capture images with maximum stability (using the shortest possible exposure times) in order to eliminate the effects of aircraft vibration. Due to the pronounced light reflection in aerial photography over water surfaces, a series of camera settings specific to this type of imagery were applied (e.g., negative exposure compensation) to optimize image clarity and contrast. Apart from known colonies, different areas across the Danube Delta deemed potentially suitable for the installment of a breeding colony have been surveyed. During the 2024 season, the geo-political situation in the region

of the Danube Delta bordering Ukraine has determined significant difficulties in organizing monitoring flights and also the use of drones, due to military restrictions. However, the project team managed to obtain necessary permits in order to undertake the necessary surveys, although slightly delayed at the beginning of the season.

The use of drones in all countries has been implemented in accordance with the local regulations and according to guidelines on drone use for breeding colonies. Flight altitude and timing of surveys have been adjusted in order to eliminate any disturbance.
In Bulgarian colonies, the evaluation of the breeding pairs in each colony has been performed with the use of drones and in addition, observations from stationary points.
In Greece, a combination of methods have been implemented, both by direct observation/ ground surveys and by use of drones.
Monitoring has been implemented by organizing surveys several times during each of the breeding seasons in all countries, starting early on during the initial stages of the onset of breeding. The comparison between different survey sessions allowed for obtaining a complete picture of the breeding numbers in each colony, by detecting not only potentially failed nests but also new breeding nests/units or replacement clutches. Later evaluations in the season allowed for the numerical evaluation of the total number of fledged or near-fledged chicks.

Evaluation of the breeding population has aimed at 2 main parameters:

- No. of breeding pairs - the assessment has been carried several times during each of the breeding seasons in every country by direct count of AONs (Apparently Occupied Nests) in each colony, resulting in the total number of breeding pairs. The evaluations have been carried out mostly by implementing aerial surveys using ultralight airplanes in the Danube Delta in Romania and by obtaining aerial imagery using drones in all countries. Ground surveys have also been implemented in Greece.
- Breeding success/Productivity. Later surveys in the season (during the time when the chicks are fledging and are joining creches in the colony) have been aimed at evaluating the breeding success by direct counts of the total number of fledged chicks in each colony during each season. For the purpose of calculating the breeding success, the total number of fledged or nearly fledged young in one breeding colony is measured against the total numbers of nests, and their quotient represents the index for breeding success (no. of fledged or nearly fledged young /nest(pair)).

Aircraft used for aerial monitoring of colonies in the Danube Delta
(photo: Sebastian Bugariu)

Drone photograph of Dalmatian Pelican colony in Amvrakikos Gulf, Greece (photo: Aris Manolopoulos/ HOS)

Breeding colony in Kalimok-Brushlen Protrcted Area (photo: Damyan Petkov/BSPB)

Breeding colony on Ceaplace island (photo: Sebastian Bugariu

Spring census

Coordinated Southeastern European Spring Censuses of the Dalmatian Pelican have been organized in frame of the project across the Black Sea–Mediterranean Flyway every spring between 2021–2024. These 4 Spring censuses have been coordinated by HOS, following the same methodology that has been applied for 3 previous years (2016, 2017 and 2018) under the coordination of the Society for the Protection of Prespa (Catsadorakis and Alexandrou 2019). As such, during the project duration the 4th, 5th, 6th and 7th Southeastern European Pelican Spring Counts have taken place.

The aim was to estimate the number and demographic structure of the DP present in wetlands along the Black Sea–Mediterranean flyway during the breeding season. These counts aimed to assess total numbers, the geographic presence and in addition attempted to estimate the percentage of adults and immature birds, which serves as an indirect indicator of nesting habitat availability and overall reproductive potential across the species' metapopulation. Censuses were conducted in all project countries (Romania, Bulgaria, Greece, Ukraine) and extended to additional range states that are part of the flyway population and distribution range of the species, including Turkey, Albania, Montenegro, and North Macedonia. Ukraine participated in a full census in 2021 only, due to constraints determined by the geo-political situation in the region, which imposed significant access restrictions by the military authorities along the coast and the Ukrainian part of the Danube Delta. The inclusion of non-project countries was necessary to capture the presence and full extent of movements of the DP as a short-distance migrant, which utilizes numerous wetlands across borders in the region. A comprehensive understanding of pelican distribution and abundance during the breeding season is vital for informed conservation planning and adaptive habitat management.

Counts were scheduled annually around mid-May, when the majority of breeding adults are present at nesting colonies or adjacent wetlands. The surveys employed a standardized protocol, combining ground-based counts from vantage points with aerial surveys—particularly in Romania's Danube Delta, where colonies span large, inaccessible reed beds. To minimize potential for double-counting due to bird movement between wetlands, counts were conducted simultaneously where possible or within a controlled three-day window. In such cases, surveys typically covered one wetland in the afternoon followed by another the next morning. A limited number of counts conducted outside this window were included following case-by-case evaluation. The time interval for conducting the census was also set up in order to ensure balance between maximal coverage and enough available competent ornithologists and birdwatchers to voluntarily conduct the field work. Field teams distinguished between adult and immature individuals, recording age categories, with immature birds of all ages grouped under one category. This age-structured approach aimed at determining the proportions in the population. In Romania and Bulgaria, data were recorded using custom-built mobile applications developed by SOR and BSPB respectively. These tools supported real-time data entry including precise location, bird numbers and age classes, weather conditions, observed behaviors, and mortality events. Similar methods were applied in Greece and all participating countries. All data were centralized in a shared project database, developed under project Action A4, to support immediate and future demographic and distributional analyses.

The planned first coordinated spring count in 2020 was cancelled due to COVID-19 travel restrictions, despite preliminary preparations and outreach. The first completed census took place on 15 May 2021, involving Greece, Bulgaria, Romania, North Macedonia, Montenegro, Albania, Ukraine (Danube Delta only), and Turkey (Gediz Delta only, due to national lockdowns). In Romania, the Romanian Ornithological Society (SOR) led the national coordination and surveys covered the entire national distribution range, including the Danube basin (from the river's entry point into Romania to the delta), coastal areas, Dobrogea, and the Bărăgan Plain. Apart from a wide range of volunteers, in the Danube Delta mixed field teams—including inspectors from the Danube Delta Biosphere Reserve Administration (ARBDD) — have been organized for boat surveys while in parallel aerial counts have been performed in inaccessible areas across the delta and coastal lagoons. The 5th Southeast European Dalmatian Pelican Census was held on 15 May 2022. It covered all project sites and additional key habitats along the Black Sea coast. The 2022 season was notably affected by the avian influenza (HPAI) outbreak, which caused significant adult mortality in some breeding colonies. The 6th census took place on 25 May 2023 using the same methodology and expanded to include newly identified spring staging areas. In 2024, the 7th coordinated census was conducted between 30 May and 1 June, again covering the full Romanian breeding range with support from ARBDD for the Danube Delta Biosphere Reserve. In addition to coverage of the 15 designated project sites, the monitoring effort was expanded in subsequent years to include additional wetlands identified as relevant to the species' distribution range. As a result, the number of surveyed sites increased to between 20 and 30 per year, with fieldwork carried out by 15 to 20 dedicated monitoring teams, consisting of experts and volunteers of the project partners, supporting authorities and volunteers.
In Greece the number of sites increased from 37 at the beginning of the project to 56 at the end involving practically as many teams of people, between HOS staff members and volunteers plus staff from SPP and the protected areas management authorities (NECCA). Surveyed sites in Albania (10), Montenegro (1-2) and North Macedonia (1) remained stable throughout the years, increasing only in Turkey (from 1 to 12). Counts were carried out using the same methodology along the years, i.e. direct counts from land or boats.
In Bulgaria, expert teams and volunteers of BSPB participated in the Southeastern European Pelican Spring Census of all project years. Each year, coordinated surveys were carried out at the most ecologically significant wetlands for both pelican species within the country. These included Lake Srebarna, Persin Island, the Kalimok-Brushlen Protected Area, the Burgas Lakes, the Ovcharitsa, Rozov Kladenets, and Studen Kladenets reservoirs, Lake Varna, as well as various islands and sandbanks located along the Bulgarian stretch of the Danube River. Altogether, 20 sites have been visited by 10 teams across the range of the species in the country.
In Ukraine counts have been carried out along the entire stretch of the Danube delta in 2020. The counts were made from land, boats and use of drone in remote sites. In 2021 the count was organized during 15-22 May covering the entire sections of the Danube delta parts in Ukraine. The counts were slightly extended during the stormy weather conditions at these dates. During the survey, all major wetlands were covered. Spring counts in 2023 and 2024 were limited mainly to the upper parts of the delta due to the military restrictions.

The standardized approach, multi-national collaboration, and centralized database represented a significant advancement in the coordinated data collection on DP across the Black Sea–Mediterranean flyway. This series of coordinated censuses provided baseline

demographic context to long-term population monitoring. These data are critical for understanding population turnover, evaluating colony performance, and assessing the species' capacity for recovery following population drops such as the 2022 HPAI outbreak.

Spring census conducted in Ukraine (photo: Alexander Gaidash)

Spring counts in Romania, Tasaul Lake (photo: Sebastian Bugariu)

Aerial monitoring in the Danube Delta during spring census (photo: Sebastian Bugariu)

Winter census

The winter census represented an assessment of key sites for the species across project countries. The primary objective is to identify areas where large numbers of DP congregate during the non-breeding season. These observations allow for the estimation of the proportion of adult versus immature individuals, the verification of color rings, and the collection of other relevant ecological data. A crucial aspect of the winter assessment is to pinpoint wintering sites with high concentrations of pelicans. This information is essential both for the effective management of these areas and for understanding the species' winter distribution dynamics.

Winter counts have been conducted following the same methodology as for the coordinated spring census, with similar number of teams and coverage for Romania and Bulgaria, and also implemented during the International Waterbird Census programme (IWC) which takes place in mid-January, but it represented an enhanced version focusing at roosting sites in order to establish maximum counts.

In recent years, observations have indicated that DP begin breeding as early as early January in several wetlands across Southeastern Europe. As a result, December has been considered as the most representative and standardized period for assessing wintering populations, particularly prior to the onset of the breeding season.

Given the regional variability in breeding phenology among different subpopulations, synchronized winter assessments have been implemented in mid-December across Romania, Bulgaria, and Ukraine. These coordinated counts provided more robust and comparable estimates of the overwintering population within the Danube River basin. In Romania and Bulgaria, surveys cover the entire known national distribution of the species to ensure complete coverage and consistency across years.

In contrast, winter monitoring in Greece has been limited to the western part of the country, whereas the spring census encompasses the full national territory. In parallel, winter surveys have been conducted in Albania and Montenegro, on the same dates around mid-November, due to the earlier onset of breeding in these southern regions. These counts are restricted to key wetland sites along the western coastal zones of Greece, Albania, and Montenegro, which host populations that are distinct from those found in central Greece, Bulgaria, and Romania.

As with the Coordinated Spring Census, the winter monitoring is carried out in collaboration with protected area management authorities, environmental non-governmental organizations (NGOs), and networks of trained volunteers, ensuring wide participation and standardized data collection across international borders.

Wintering DP at Atanasovsko Lake, Burgas (photo: Svilen Cheshmedzhiev/BSPB)

Conducting winter census in Ukraine (photo: Maxim Yakovlev / Rewilding Europe)

Migration at bottleneck sites - Bulgaria

All project sites were visited by teams of BSPB experts and volunteers twice per month between end-January and end-April and between beginning of July and beginning of December during the first two project years. The data was collected using the SmartBirds Pro mobile application.

Color ringing

In addition to satellite telemetry, color ringing has been implemented to collect valuable data on the movement, dispersal, life history, threats, and causes of mortality. Since 2020, SOR has assumed responsibility for coordinating the color ringing of both pelican species in Southeastern Europe.

During 2020, multiple new national color-ringing schemes for Dalmatian pelican were developed in collaboration with the SOR international scheme coordinator. These schemes have been implemented in Romania, Bulgaria, Greece, Albania, and Montenegro. Both color plastic and metal rings were procured from certified manufacturers, and all ringing schemes were officially registered on the CR-Birding website and database developed in collaboration with EURING.

Color ringing of large chicks and fledglings in frame of the project has been conducted at breeding colonies in Romania, Greece, and Bulgaria. In Romania, ringing was carried out at the Lake Tașaul colony annually (except in 2022), with additional ringing at Lake Sinoe colony in 2024 and 2025. In Bulgaria, most ringing efforts were concentrated at the Kalimok-Brushlen colony, while in Greece, activities were conducted at both project sites—Amvrakikos and Messolonghi.

Ringing was strategically timed in the season to minimize disturbance and optimize capture conditions. Chicks were ringed when the majority are at about 4-5 weeks of age—large enough for safe handling and sufficiently developed for ringing but before they become mobile enough to evade capture. As a rule of thumb, sessions have been organized after the majority of the chicks started leaving the nests and moving around in communal groups. In Romania and Bulgaria, colony visits typically occurred from late April to early May, while in Greece they were conducted in March, reflecting regional phenological differences. Two primary methods were employed for chick capture and processing, depending on colony accessibility. At easily accessible island colonies (e.g., Lake Tașaul and the Greek sites), field teams used boats and coordinated efforts involving 9–12 participants to encircle and isolate chicks from water access. Two sub-teams, each consisting of a ringer and assistant, performed ringing and biometric measurements, while others maintained a perimeter to limit the access of birds to the water. Ringing sessions typically lasted for less than 1 hour (usually around 40 minutes) in order to minimize disturbance. In colonies with more challenging access (e.g., those with dense vegetation or muddy terrain), chick ringing has been organized later in May or June when the chicks are sufficiently large to easily leave the colony and access the water. In these cases, larger, more mobile chicks were captured using nets from boats. In 2024, genetic samples were collected from chicks at all active ringing sites across the participating countries to support ongoing population genetic studies. In addition to large chicks and fledglings, all DP individuals trapped for satellite tagging have also been ringed. Both color plastic rings and metal rings have been used for providing a unique identification code to each individual bird. The overlapping sides of the plastic rings have been glued together using instant glue to ensure durability and prevent detachment.

Ringing data was submitted to the respective national ringing centers. Re-sighting and recovery data has been sent by observers directly to members of the project team, reported through the ringing centres, or submitted through social media and email.

Color ringing at Lake Tasaul (photo: Ioana Cobzaru)

Dalmatian Pelican chick ringed in Amvrakikos Gulf, Greece (photo: Natalie Clements/ RE)

Ringing of chicks and sampling at Kalimok-Brushlen (photo:BSPB)

Satellite telemetry

Satellite telemetry has been employed as a core component of this project to obtain high-resolution, real-time data on the movements, dispersal patterns, home range, habitat use, survival rates, and mortality factors of individuals. As the primary method for tracking long-distance and fine-scale spatial behaviors, satellite telemetry enables the identification of critical habitats and temporal patterns in individuals across different populations.

This study focuses on telemetry data collected from birds originating from three major project areas holding populations of Dalmatian pelican in southeastern Europe: 1. the western Greek colonies, including the Amvrakikos Gulf and Messolonghi wetlands as a rather distinct population; 2. northern colonies in Bulgaria, particularly the Belene Island Complex (breeding) and Atanasovsko Lake (staging area for DP); and 3. the Razelm-Sinoe lagoon complex located south of the Danube Delta and Lake Tasaul breeding colonies in Romania.

A total of 24 individual pelicans were captured between 2021 and 2024 using varied methods: free-flying individuals, regardless of age, were trapped using leg-hold traps or net guns at staging or feeding sites. Capture efforts were intensive, requiring numerous trapping sessions to reach the target sample size. Fledglings were captured by boat near breeding colonies shortly before acquiring full flight capability. Individuals trapped in Greece were trapped as fledged juveniles on their colonies (n=3), whereas the rest three were trapped during the winter period. In Bulgaria three individuals were trapped as fledged juveniles around the colony whereas eight were trapped during the pre-winter and wintering period in Burgas wetland, while in Romania 2 individuals have been trapped during the winter period and 5 as fledged juveniles nearby their original colony.

The decision on which type of transmitter to be used was taken following extensive consultations with specialists experienced in pelican and large bird telemetry. Patagial-mounted transmitters were selected as the most suitable option, having been successfully used on pelicans and other large species such as vultures. The transmiters used are GPS-GSM patagial tag (OT-P33 and OT-P31; Ornitela Ltd.), in Greece (n=6), Bulgaria (n=11) and Romania (n=7). Of the 24 tagged individuals, 11 were juveniles, 9 immatures, and 4 adults. Transmitters were programmed to record GPS locations at intervals ranging from 10 to 30 minutes, depending on solar battery performance and seasonal light availability. In addition to telemetry devices, all tagged individuals were fitted with wing tags and color rings to facilitate visual identification in the field.

All movement data is stored and managed via the Movebank platform, where a dedicated project was created to integrate and monitor all deployed devices.

Tagging of an immature individual at Sinoie lake in Romania (photo: Sebastian Bugariu)

Re-sighting of an immature individual at lake Mostistea in Romania (photo: Ciprian Fântână)

Tagging of an adult individual in Amvrakikos gulf in Greece (photo: V. Saravia-Mullin/ HOS)

Tagging of juvenile in Messolonghi wetland in Greece

Tagging of an adult individual in Burgas wetland in Bulgaria (photo: BSPB)

4. Results

4.1. Breeding population census and breeding success

Breeding population data

The breeding population has been successfully assessed in all project countries over the project period, offering significant insights regarding the status of the population in project sites, the development of the breeding colonies, their breeding success and potential limiting factors.

From 2021 to 2024 the project team monitored the breeding numbers and breeding success of the Dalmatian Pelican colonies in the project areas. In Romania and Bulgaria, full coverage of all colonies have enabled estimates of the total national breeding populations, while in Greece the entire Western sub-population has been covered by annual surveys. The monitoring of these parameters presents several difficulties such as the remoteness of some of the colonies (inaccessibility by either land or water in the case of some Danube Delta colonies) or the need to reduce disturbance to the minimum. Therefore, different methods were used in different colonies, and even a combination of methods was implemented sometimes. As a result, the team was able to establish a general population trend for the colonies monitored, although it must be taken into account that this is just an approximation as the period of time is limited (only 4 years).

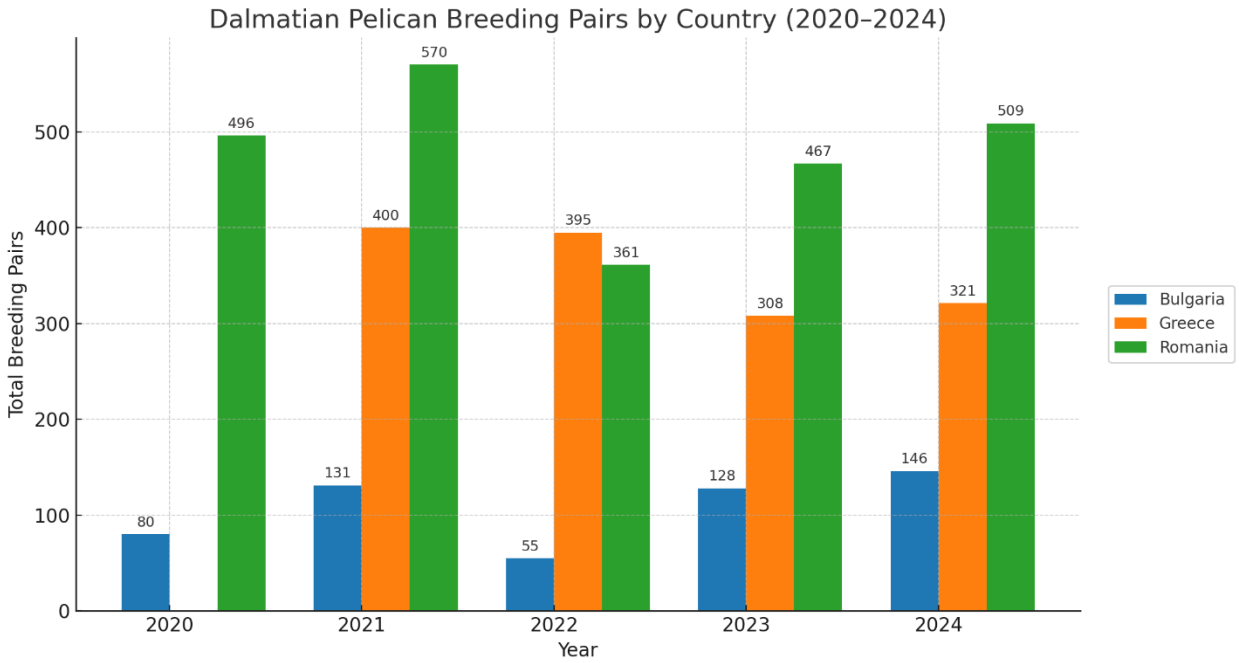


Figure 1. Total number of breeding pairs per country for all years of the project. For Greece the total represents the sum of the 2 project sites hosting breeding colonies. Estimates for Greece in 2020 have not been included. Values represent either absolute counts or the median values where range is available.

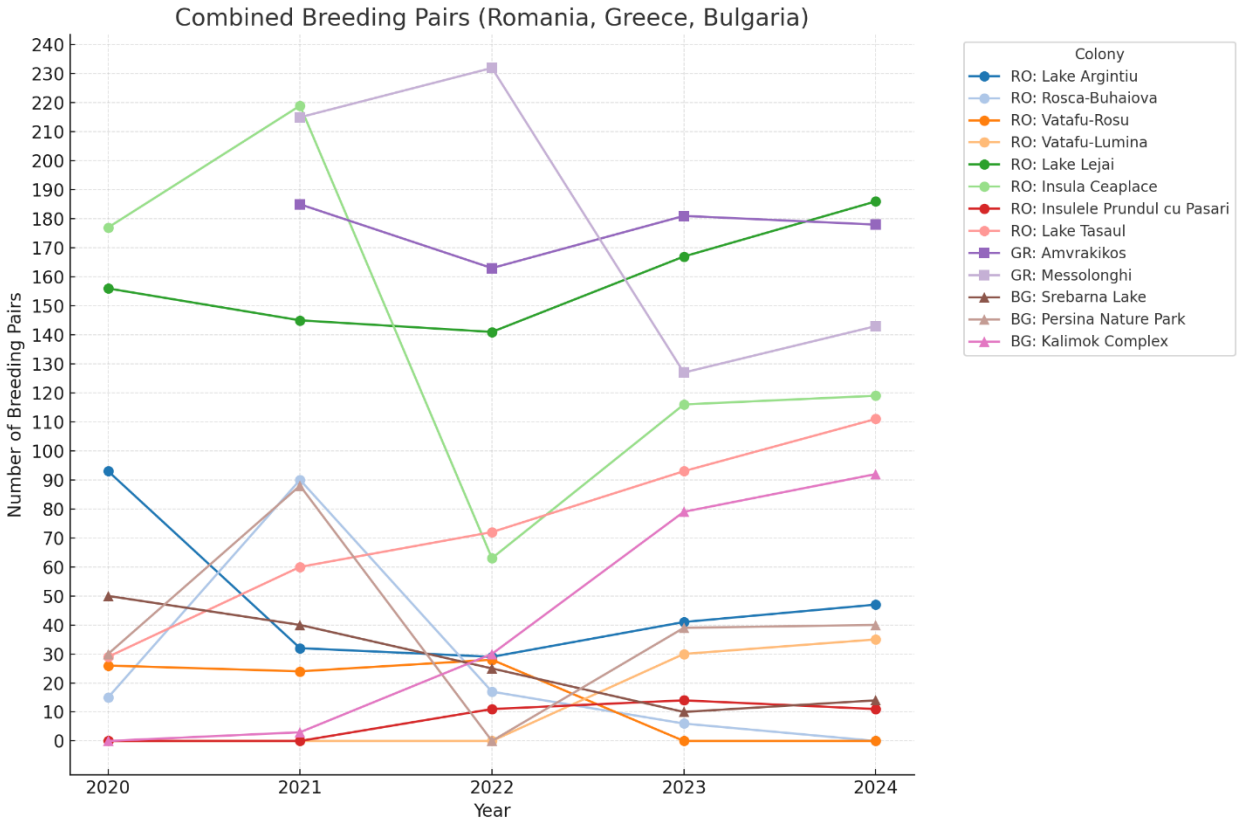


Figure 2. Breeding pairs for the period 2021-2024 in all the different colonies monitored by the project. It must be noted that, while usually two groups of nests that lie more than 3kms apart are considered as two discrete colonies (cf. Coulson 2002), for practical reasons in the present report, the data shown for Messolonghi and Amvrakikos are the pooled data of all the discrete colonies present in each wetland.

Breeding colony monitoring in Romania has been conducted systematically from February to June each year, utilizing drones, ground surveys, and aerial flights to cover the entire breeding population. Between 2020 and 2021, a general increase in the breeding population was observed, with a record high of 570 breeding pairs recorded in 2021—the highest number documented in the country to date. This growth was primarily attributed to increases in the largest and most stable colonies, particularly Lake Lejai and Ceaplace Island, as well as Lake Tasaul. However, in 2022, the spread of Highly Pathogenic Avian Influenza had a significant negative impact in some Romanian colonies (although most of the colonies monitored by the project weren't severely affected), notably reducing adult numbers in major colonies such as Ceaplace Island and Lake Tasaul, which resulted in a marked decline in the total number of breeding pairs. An approximate of about 20% of the national breeding population (individuals) have been lost in the HPAI outbreak. Since then, the population has shown signs of recovery, with an upward trend observed in both 2023 and 2024, indicating a strong recovery from the 2022 losses. While some colonies experienced fluctuations, a decrease in a site has been have been met simultaneously by recorded increases in others in the surrounding area, suggesting a redistribution or exchange of breeding pairs between spatially distinct sites—for example, between Lake Argintiu and Rosca-Buhaiova, or Vatafu-Rosu and Vatafu-Lumina, the latter being a newly identified colony in 2023. Furthermore, certain colonies, such as Lake Lejai and Lake Tasaul, have exhibited a steady rise in breeding pair numbers, with Lake Tasaul in particular benefiting from targeted conservation measures and

showing a notable expansion in colony size. Based on the obtained data throughout the implementation period of the project, the current estimate for the population size in breeding pairs in Romania is **450-570**.

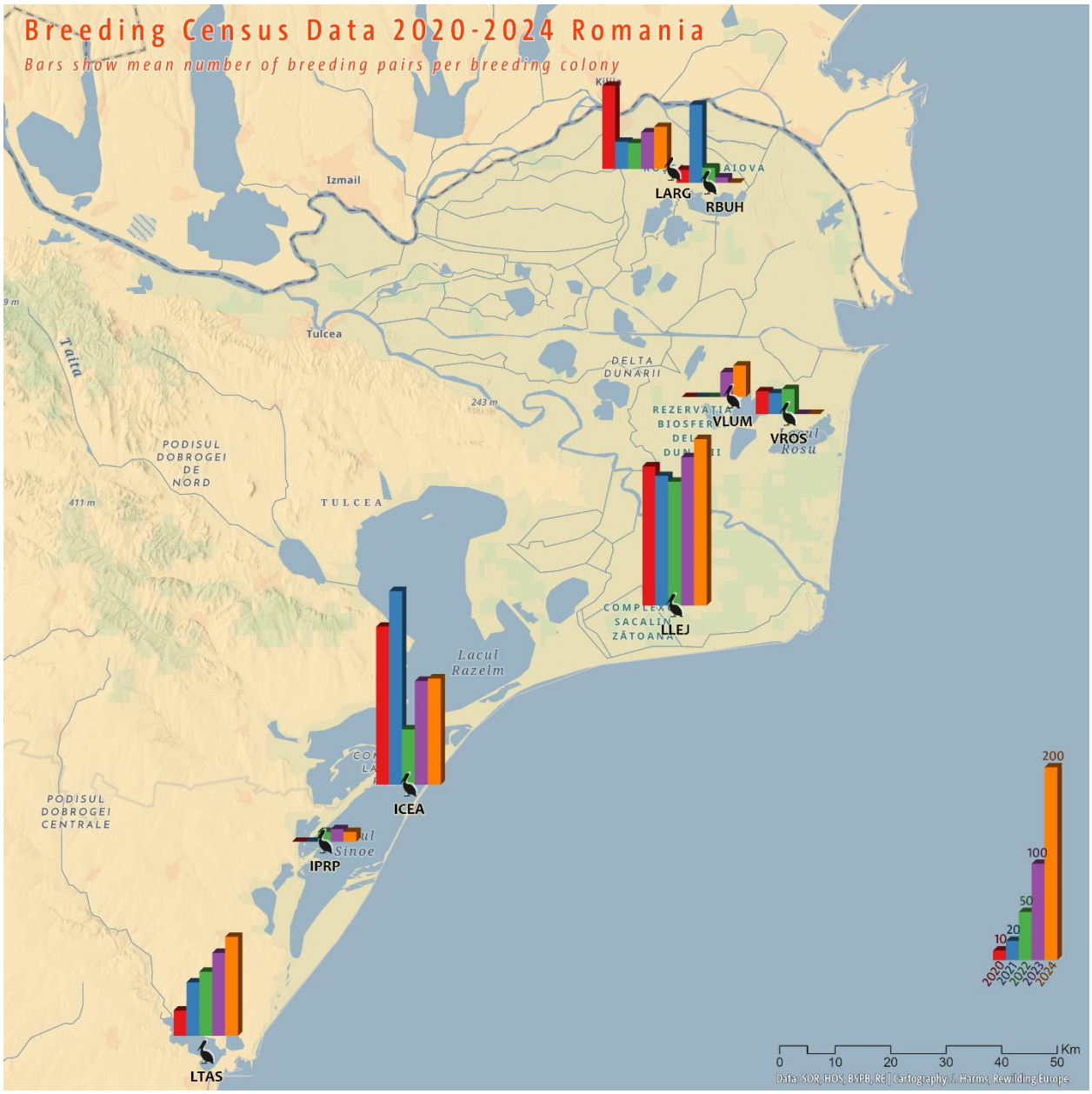


Figure 3. Map of all breeding colonies census data in Romania 2020-2024.

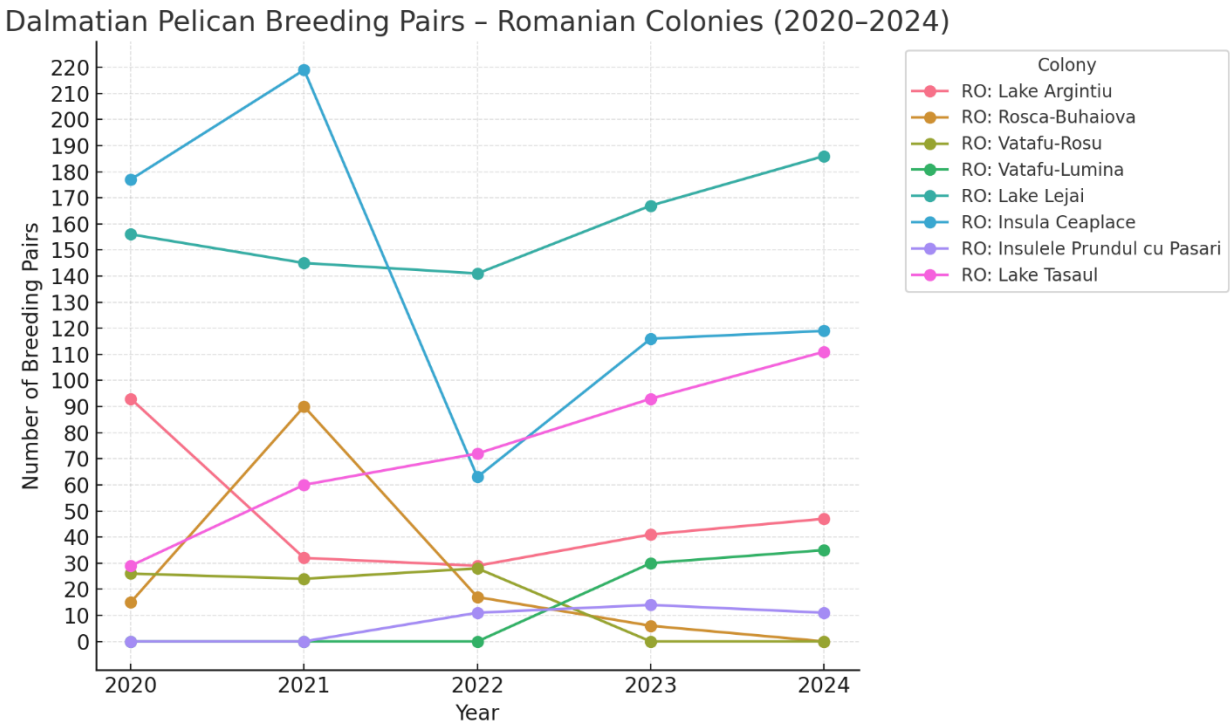


Figure 4. Number of breeding pairs in Romanian colonies

In Ukraine, individual pairs have attempted breeding in years before and at the beginning of the project (2019-2020) at Lake Kugurlui (2 pairs), but no breeding has been recorded since (potential limiting factor are the reedbed fires in the area at the onset of the breeding season). However, the area remains a potentially feasible breeding site for DP in the future.

During the implementation of the conservation project in Bulgaria, two new breeding colonies were successfully established: one in the Kalimok-Brushlen Protected Area and another in the Mandra–Poda Complex Special Protection Area (SPA). In addition, two new subcolonies were formed - at Mrtvo Marsh within Persina Nature Park and at Kalimok-Brushlen - as a direct outcome of conservation measures, particularly the installation of artificial breeding platforms. Annual monitoring recorded the following number of breeding pairs in Bulgaria: 80 pairs in 2020, 132 in 2021, 55 in 2022, 128 in 2023, and 146 in 2024. The notable decline in 2022 was attributed to exceptionally low water levels in the Danube River, which led to the drying of marshes on Persina Island during the breeding season. As a result, breeding at these sites was severely disrupted. The fluctuations in the number of breeding pairs are correlated with the hydrological conditions of the wetlands (largely dependent on Danube River levels) during the breeding period. Despite these challenges, the breeding population in Bulgaria has shown a significant overall increase, largely due to targeted conservation interventions. Although wooden breeding platforms were already present at key sites (Belene Islands Complex, Kalimok Complex, and Mandra–Poda), the project enabled the repair and expansion of existing structures and the construction of new ones—six platforms were repaired, and seven new platforms were built. These measures have proven highly effective, particularly at the Kalimok Complex, where breeding on artificial platforms began immediately and has expanded steadily since 2022. Based on the obtained data throughout the implementation

period of the project, the current estimate for the population size in breeding pairs in Bulgaria is **55 - 146**.

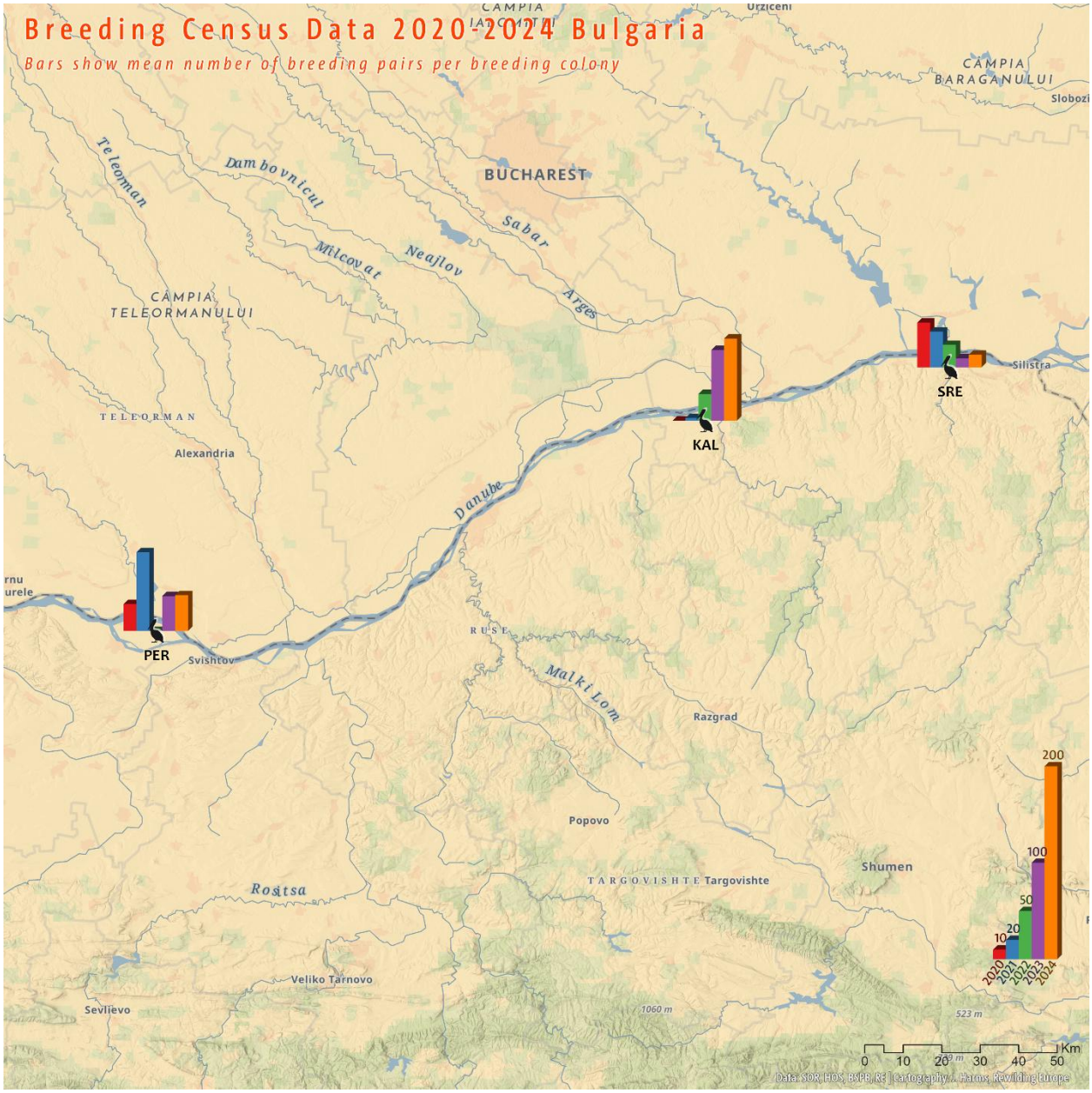


Figure 5. Map of all breeding colonies census data in Bulgaria 2020-2024.

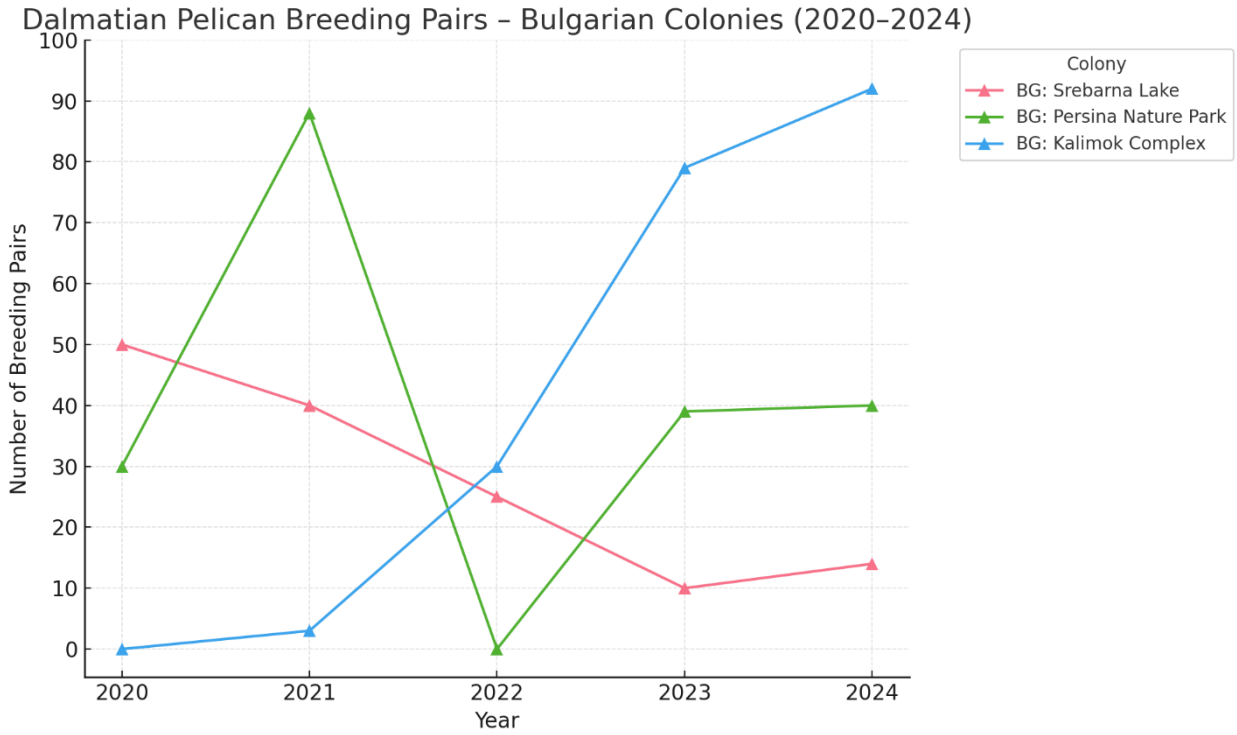


Figure 6. Number of breeding pairs in Bulgarian colonies

In Greece, monitoring efforts in 2020 and 2021 were partly constrained by the COVID-19 pandemic and national regulations governing drone use and during the initial stages the project staff was unable to complete the necessary drone pilot certification in time for the 2020 and 2021 breeding seasons. Despite these constraints, data were successfully collected during these years through close collaboration with the Management Authorities of the Messolonghi Lagoon and Amvrakikos Gulf protected areas. These partners conducted their own drone surveys or performed ground-based counts via direct observation. From 2022 to 2024, breeding seasons were monitored systematically using HOS-operated drones, with one exception in 2022, when the assessment of breeding success at Messolonghi was incomplete. Low water levels that year prevented boat access to one of the key breeding sites, resulting in only a partial survey. Overall, breeding parameters in both Messolonghi and Amvrakikos colonies remained relatively stable throughout the study period. The apparent decline at Messolonghi in 2023 is most likely attributable to minor differences in survey methodology rather than an actual reduction in breeding activity. This apparent decrease is likely influenced by methodological limitations during the 2023 breeding season. Specifically, logistical challenges in accessing remote islands within the colony area hindered the accuracy of the count that year. Importantly, systematic drone monitoring during the 2022 season confirmed that **no mortality of Dalmatian pelicans occurred** in either colony as a result of the HPAI outbreak that year. Based on the obtained data throughout the implementation period of the project, the current estimate for the population size in breeding pairs in the western Greek subpopulation is around **320** breeding pairs in 2024.

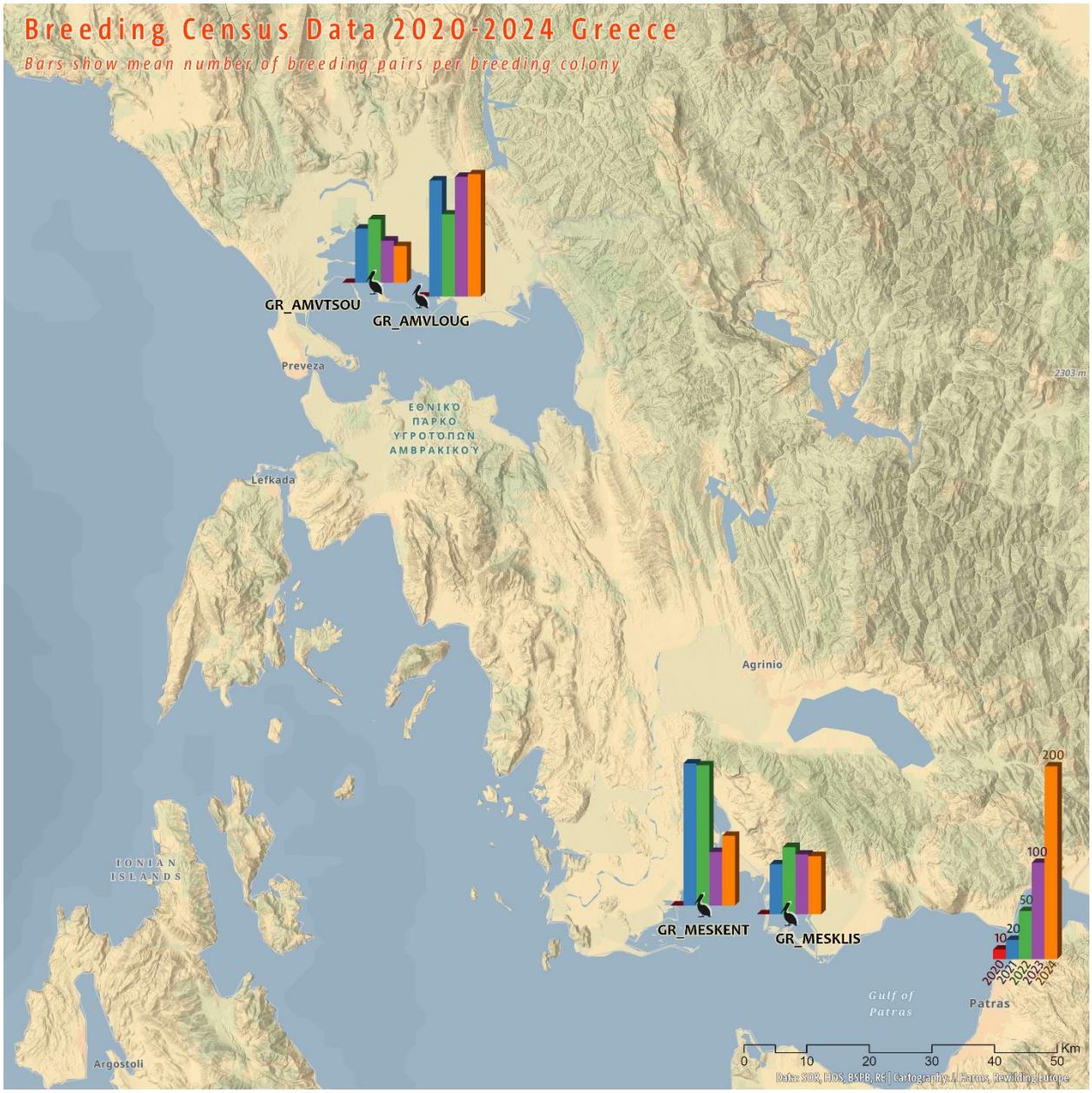


Figure 7. Map of all breeding colonies census data in project sites (western subpopulation) Greece 2021-2024.

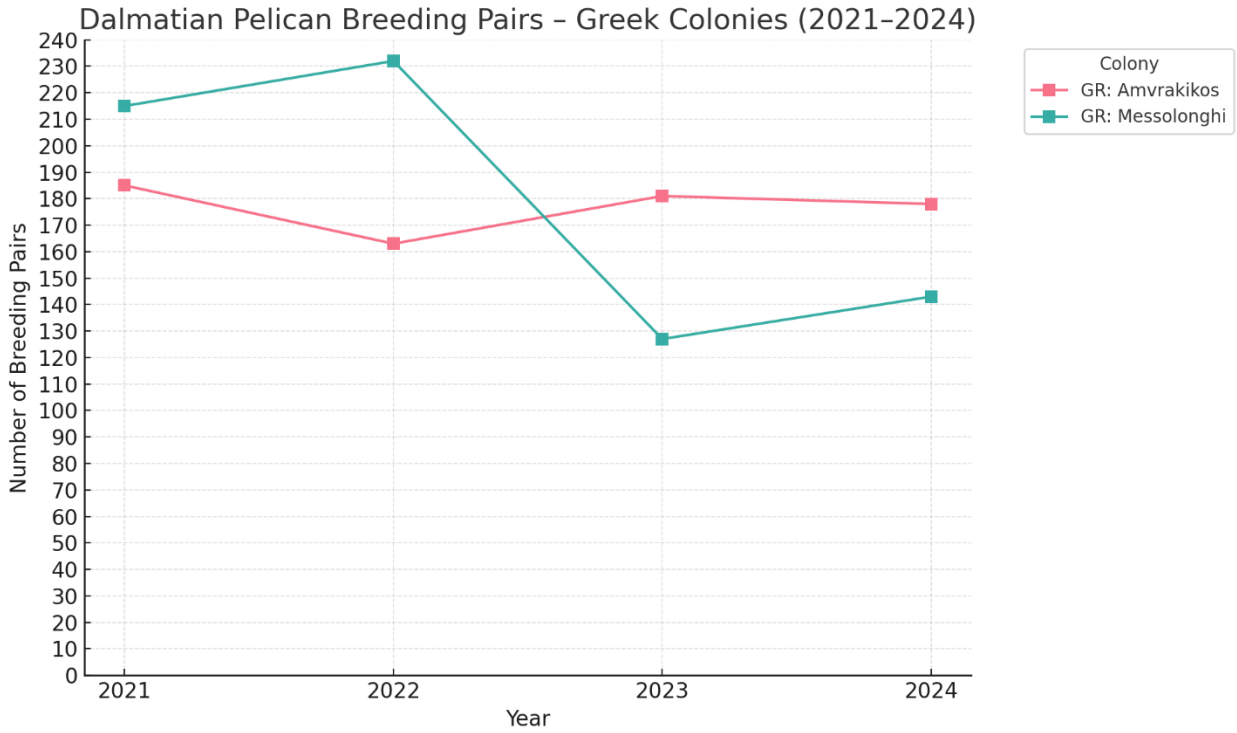


Figure 8. Number of breeding pairs in Greek colonies (western subpopulation)

4.2 The 2022 Highly Pathogenic Avian Influenza (HPAI) outbreak

In early 2022, an outbreak of highly pathogenic avian influenza (HPAI, H5N1 clade 2.3.4.4b) caused unprecedented mortality among Dalmatian pelican populations across southeastern Europe. Over 40% of the regional breeding population—approximately 10% of the global total—was lost, with Greece alone reporting nearly 2,300 deaths, primarily at the Lesser Prespa Lake colony, where about 60% of the breeding adults perished (Alexandrou, Catsadorakis & Höfle 2025). Additional mortalities in the region were recorded in Albania, Montenegro, and Romania, totaling about 190 individuals. A similar outbreak occurred in 2015 (the first recorded Avian Influenza event that caused mass mortality in Dalmatian pelicans), but the level of mortality recorded was considerably lower at least in Greece.

In Romania, the outbreak coincided with the start of the nesting season, with confirmed cases reported by the Romanian Ornithological Society (SOR) and the Danube Delta Biosphere Reserve Administration (ARBDD), particularly at Lake Tașaul and Lake Sinoie. A total of **158 adult** deaths were confirmed, representing nearly 20% of the national breeding population, with the highest numbers observed at Lake Sinoie (98 individuals). 24 were recorded on Lake Tașaul. All cases were communicated by both the SOR and the ARBDD to the Constanța Veterinary Health and Food Safety Directorate (DSVSA). Samples were taken from the Sinoie Lake area and, at the same time, the corpses were removed from the islands with the colony at Lake Sinoie. Carcasses were also detected in more remote, aerially monitored colonies such as Lake Lejai. Most deaths occurred in March and April, with minimal cases observed by May. Beyond direct mortality, the epidemic significantly reduced breeding success and the number of active nests, contributing to a 20% decline in Romania's nesting population in 2022. Despite these losses, monitoring in subsequent years has indicated an upward trend and signs of population recovery and resilience.

Fortunately not all colonies have been affected. In Greece, the two coastal colonies in the Amvrakikos wetlands and Messolonghi lagoons targeted by the project were not affected at all, likely escaping the impact of the outbreak due to the fact that the 2 subpopulations (eastern and western) are distinct with very little communication and interaction. Additionally, none of the Danube colonies located in Bulgaria have been affected (the decline in the breeding numbers during 2022 are attributed to a record low water level of the Danube River, which caused the marshes on Persina Island to dry out completely during the breeding season, preventing pelicans from nesting).

The 2022 outbreak marked an unprecedented event in terms of scale and duration, with continued impacts on colonial waterbird species, land birds, and even mammals globally. Similar mass mortalities were observed in species across many parts of the world (mass mortality of thousands of seabirds of various marine species has been reported in the UK islands, while other species along the south- American coasts (such as Brown pelicans) have also perished in their thousands), underscoring the widespread vulnerability of large categories of colonial species to HPAI.

4.3 Breeding success/Productivity

Breeding success is a key parameter for assessing reproductive output and potential population growth in DP colonies, although it is inherently difficult to measure with precision due to a range of influencing factors. Despite limitations, it remains useful and indicative for evaluating the overall condition of a breeding colony and its capacity to sustain or increase population size over time.

For the purposes of the study, breeding success was calculated by dividing the total number of fledged or nearly fledged chicks by the total number of nests (i.e., breeding pairs) within a given colony. This quotient yields an index of breeding success, expressed as the number of fledged or nearly fledged young per nest. An index value exceeding 1.0 is generally regarded as indicative of potential population growth over time.

In Bulgaria, breeding success values across monitored colonies have remained relatively stable and consistent. In Greece, the Messolonghi colony has also shown stable breeding success, whereas the Amvrakikos colony exhibited a slight upward trend following several years of lower success rates—potentially linked to fluctuating water levels in the lagoon where the pelicans nest. In Romania, breeding success in the larger, more established colonies has also remained generally stable. However, a temporary decline was observed in 2022 coinciding with the outbreak of highly pathogenic avian influenza (HPAI), and is attributed to elevated adult mortality during that year. Lower breeding success was also documented at the smaller colony of Prundul cu Păsări, where nesting attempts typically occur later in the season and involve only a limited number of pairs. Reduced breeding success was similarly observed in colonies experiencing recent shifts of individuals to other sites, such as Roșca-Buhaiova and Vătafu-Roșu. In contrast, breeding success in all other monitored Romanian colonies has remained stable or has shown an increasing trend over the past two years.

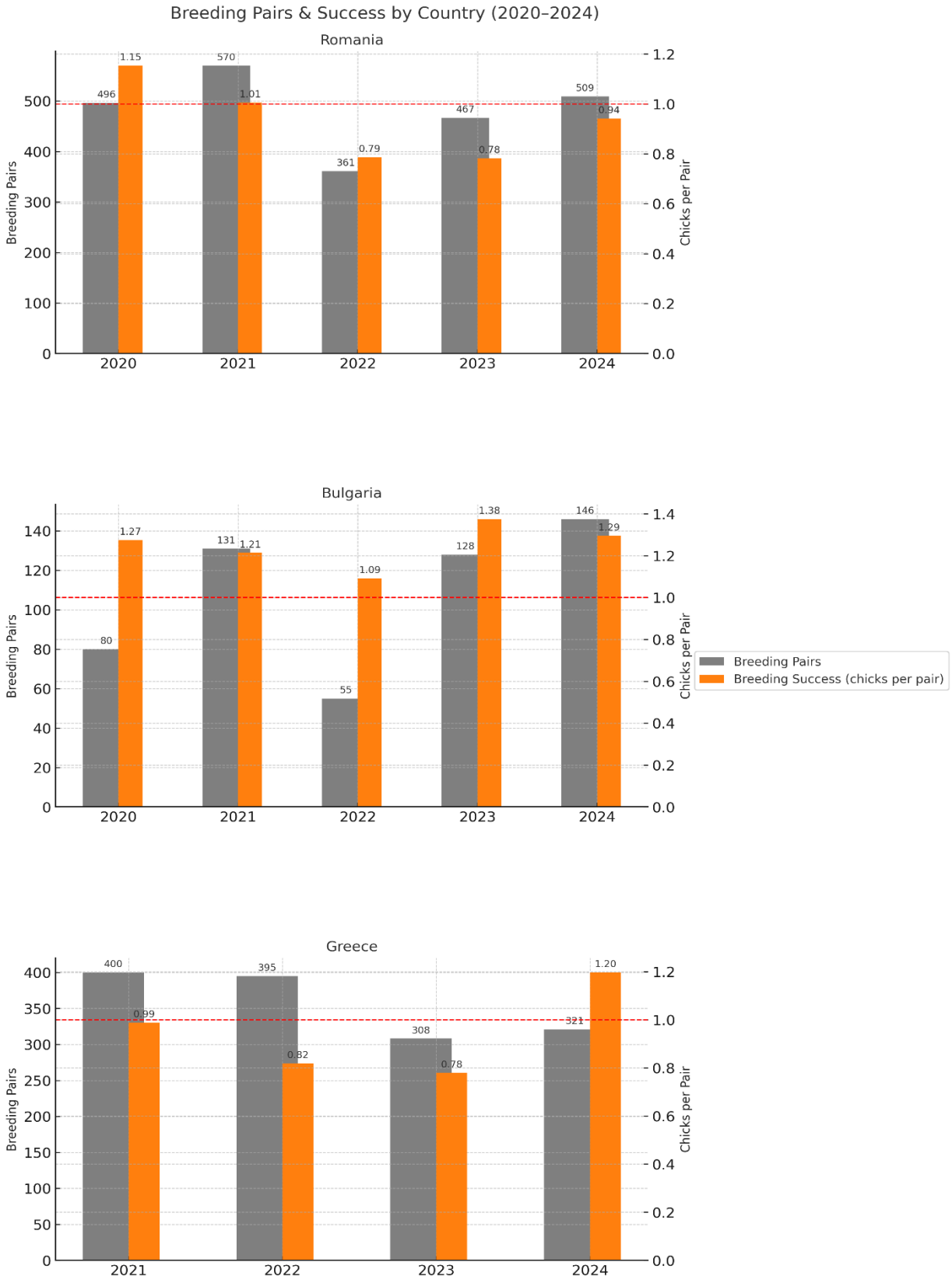


Figure 9. Overall breeding success calculated for the total population in each of the project countries.

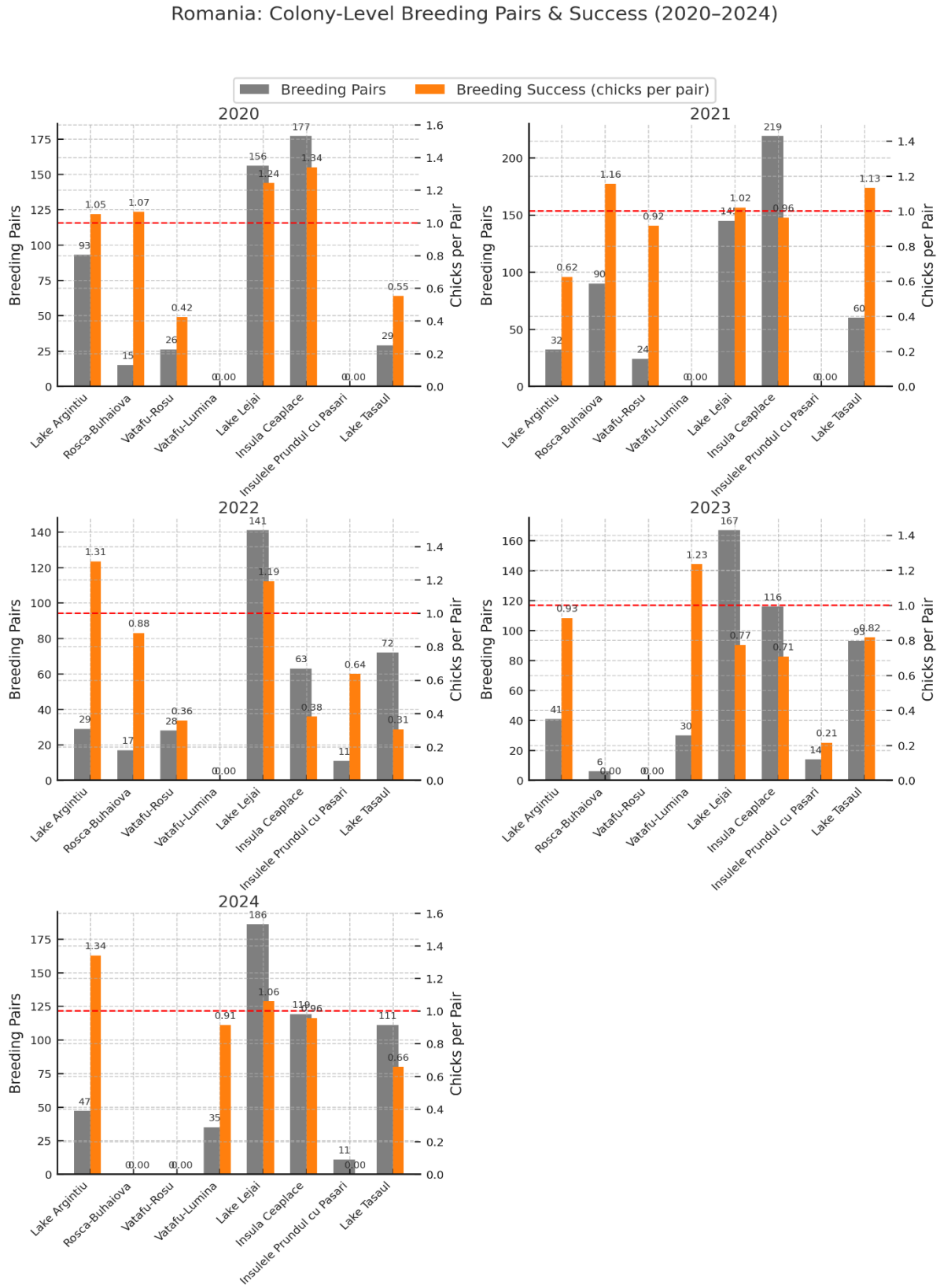


Figure 10. Breakdown of breeding success calculated per colony in every project year in Romanian colonies

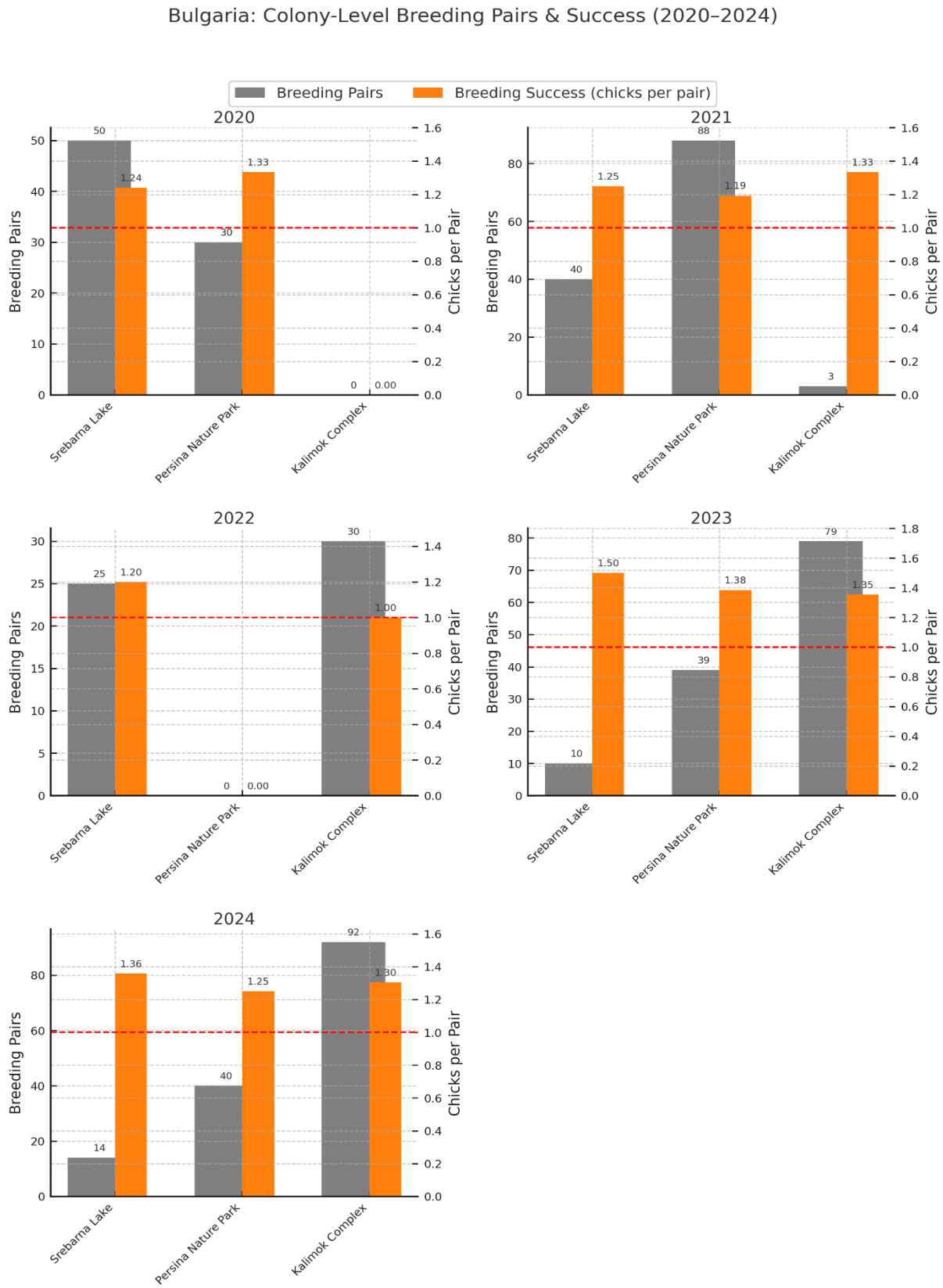


Figure 11. Breakdown of breeding success calculated per colony in every project year in Bulgarian colonies

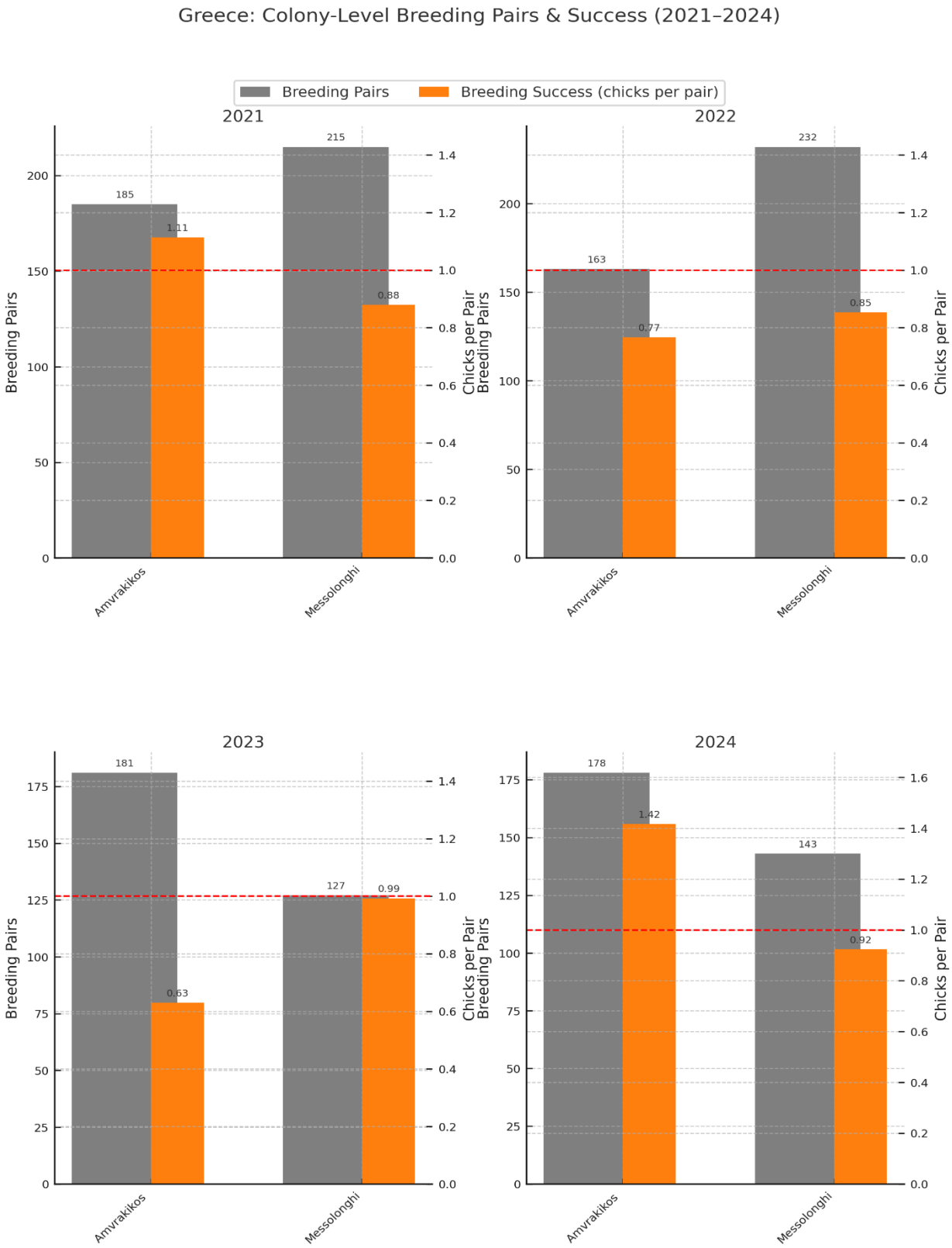


Figure 12. Breakdown of breeding success calculated per colony in every project year in Greek colonies (western subpopulation)

4.4 Spring census

The spring census has been conducted each year in May between 2021 and 2024 in all countries of the region (Romania, Bulgaria, Greece, Ukraine) and extended to additional range states that are part of the flyway population and distribution range of the species, including Turkey, Albania, Montenegro, and North Macedonia. The partners have been carrying out spring census every year in most of the wetlands across the distribution range of the Dalmatian pelicans, apart from the breeding grounds (i.e. wetlands used by birds for foraging or roosting, including those outside the project areas). The census spanned almost the entire distribution range of the species along the South-Eastern European flyway. It is notable that in Ukraine it was only possible to carry out a complete spring census in 2021 due to the current military restrictions regarding access and activities. The census was only possible with the participation of a substantial number of volunteers, organizations and management authorities of protected areas. For instance in Romania between 15-20 teams have taken part every year, consisting of experts and volunteers of the project partners, supporting authorities and volunteers.

Having the experience of previously implemented counts across the region (2016 to 2018), a total number of more than 140 wetlands have been visited across the region in all years, where emphasis has been put on the sites hosting breeding colonies. The total number of visited sites has increased every year with the addition of smaller wetlands presumed to potentially host pelicans as feeding areas, although this was not correlated with an increase of the overall number recorded (generally all the significant sites hosting pelicans have been included from the beginning where the vast percentage of birds are recorded). A notable exception is Turkey, where some of the important sites for pelicans have been included later over the project years. As such, although numbers in Turkey may seem to increase over the project years, this merely reflects an increase in the monitoring effort (namely more wetlands were censused) and not a real increase in the population size.

The distribution of wetlands by country where pelican presence has been observed has not varied significantly over the years, albeit pelicans have been recorded in an increased no. of sites in Greece compared to 2021. In total, the number of wetlands where pelican presence has been noted during the project years has varied between 76-109.

	Albania	Bulgaria	Greece	Montenegro	North Macedonia	Romania	Turkey	Ukraine	Total
2021	8	11	27	2	1	14	1	12	76
2022	11	13	46	1	1	15	7	–	94
2023	10	8	48	1	1	13	7	–	88
2024	10	17	50	2	1	17	12	–	109

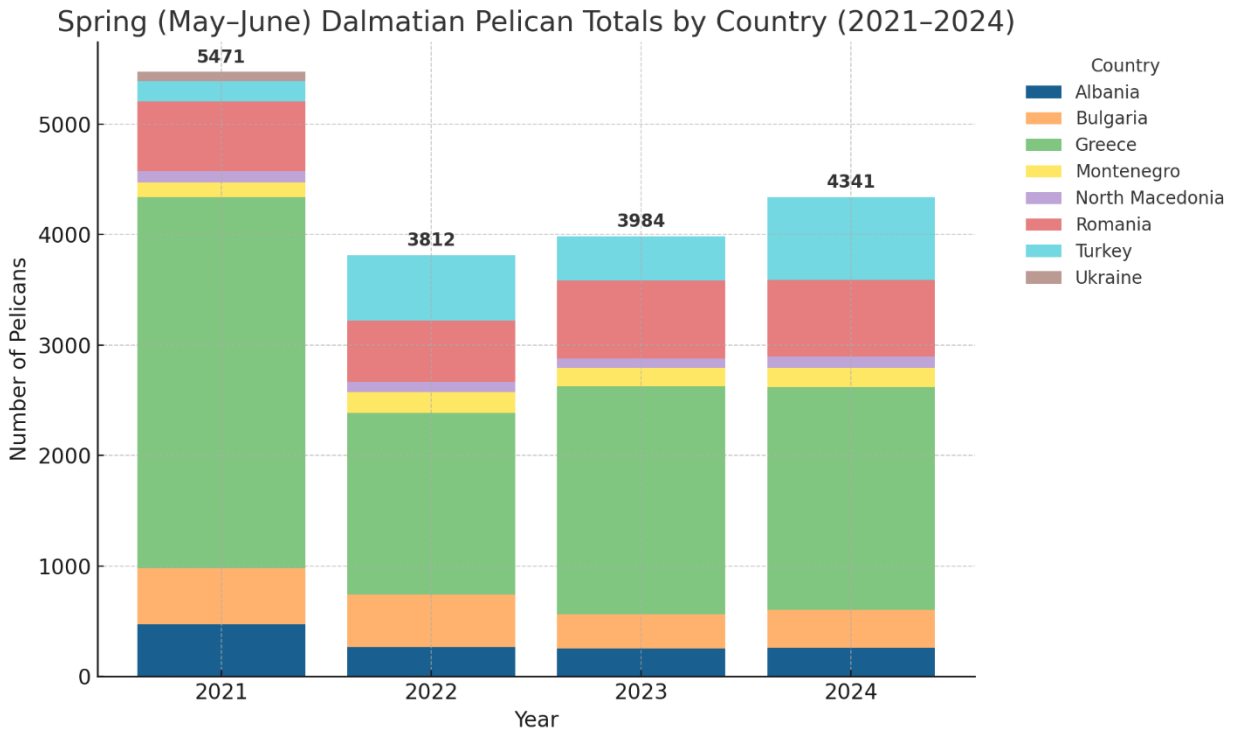
Table 2.. The total number of wetlands where Dalmatian pelican presence recorded during the census in all years. Note that for Romania the Danube Delta Biosphere Reserve is accounted for as one single site based on Natura2000 code, however it has been split into 6-10 separate sectors/sites with full ground and aerial coverage by 6-8 teams.

The total number of Dalmatian Pelicans recorded during the spring census campaigns throughout the project years ranged between **3,812 and 5,471** individuals. These figures provide a reliable indication of the species' presence across the surveyed countries and are consistent with the outcomes of the previous coordinated census conducted over a similar

three-year period (2016–2018), during which totals across the Black Sea–Mediterranean flyway ranged from 5,617 to 6,265 individuals (Catsadorakis & Alexandrou, 2019). According to the most recent global assessment published in the International Single Species Action Plan (ISSAP) for the Dalmatian Pelican, the breeding population in Southeastern Europe was estimated at approximately 3,000 breeding pairs, corresponding to roughly 6,000 adult individuals (Catsadorakis & Portolou, eds., 2018). Based on national-level estimates obtained in the current study, the proportion of immature individuals observed during the spring surveys varied between 15% and 35% of the total population. Overall, the SE European population is estimated to comprise roughly up to 10,000 individuals, representing around 50% of the global population.

The spatial coverage of sites and the overall implementation of the spring census across most countries was generally satisfactory. However, variations in the recorded numbers were influenced not only by actual population fluctuations but also by logistical limitations and uneven implementation capacity across countries. In several cases, these constraints affected the consistency and comparability of census results. In Ukraine, participation in the census was restricted to the year 2021 due to the ongoing socio-political context in the northwestern Black Sea region, which hindered field work in subsequent years. In Turkey, the inclusion of additional relevant wetlands after the first year of monitoring led to increased counts in later years. Therefore, the apparent upward trend in Turkish census data over the project period reflects improved monitoring coverage rather than a genuine population increase.

The most significant factor influencing population trends during the project was the outbreak of Highly Pathogenic Avian Influenza (HPAI) in 2022. This event had a pronounced and measurable impact on census figures, particularly in Greece, where the disease caused catastrophic losses during the breeding season. Although colonies included in this project (Amvrakikos and Messolonghi) have not been impacted by the outbreak, the Prespa colony which is the largest breeding site of the species globally experienced extensive adult mortality. In total, Greece reported over 2,200 deaths, Romania confirmed 158 casualties, and additional mortality events were recorded in Albania and Montenegro. An estimate of up to 40% of the SE European population was lost during just one spring, representing some 10% of the world population (Alexandrou et al. 2022). The resulting population declines are evident in the census data for 2022 across multiple countries in the region. However, during subsequent years, counts have revealed a gradual steady increase in numbers (not only limited to the increased monitoring effort in Turkey), indicating a steady but significant recovery and resilience of the population in the region.



	Albania	Bulgaria	Greece	Montenegro	North Macedonia	Romania	Turkey	Ukraine	Total
2021	469	513	3359	129	104	629	185	83	**5471**
2022	266	473	1643	192	92	557	589	0	**3812**
2023	255	308	2061	165	88	704	403	0	**3984**
2024	261	341	2018	173	104	691	753	0	**4341**

Figure 13. Total numbers of Dalmatian Pelicans observed during the spring counts in frame of the project.

As the census is organized mid-May, overall the largest proportion of individuals present have been recorded at sites hosting colonies (67.5% to 77.5%).

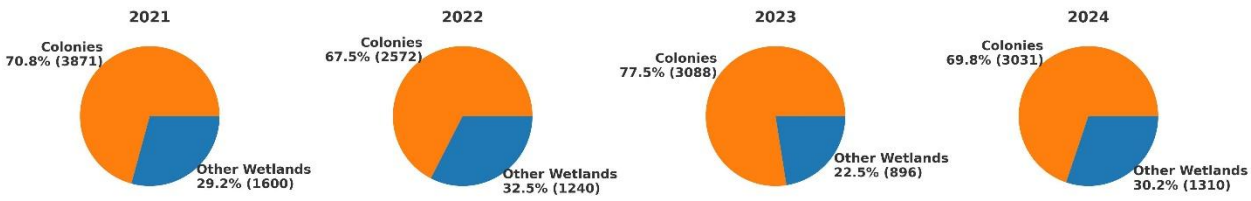


Figure 14. Proportion of individuals (of all ages) recorded in wetlands hosting colony sites versus other wetlands. Note that the data for Danube Delta and the lagoon area is aggregated under one wetland.

Accurately distinguishing between age classes in Dalmatian Pelicans presents several challenges in field conditions. These include similarities in plumage between age groups, transitional plumage changes in adults post-breeding or later in the season, and general observational constraints. In an effort to estimate age structure, despite these difficulties, it was possible to estimate the proportion of immature individuals for a specific segment of the

population, namely, the Danube sub-population. This estimation was based on data collected in Romania and Bulgaria, where observations were considered sufficiently reliable for age classification. All age classes other than “adults” have been grouped in one category “Immature”. Notably, the proportion of records classified as "unknown" in terms of age was relatively low, comprising less than 5% of all recorded individuals. Based on the available data, the estimated proportion of immatures among all observed Dalmatian Pelicans ranged from 15.1% to 33.6% across all implemented counts.

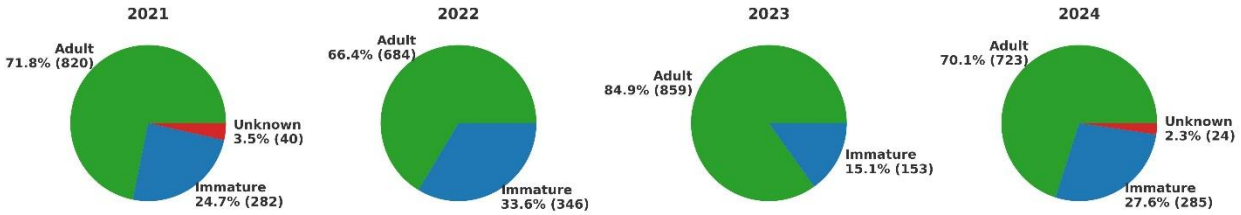


Figure 15. Proportion of adults and immatures (of all age classes) of the total number of individuals observed in Romania and Bulgaria

In Romania, the majority of individuals have been consistently recorded each year in wetlands hosting breeding colonies, as expected during the breeding season. The total numbers for the country ranged between 557-704. Between 62% and 75% of all observed individuals during spring censuses were concentrated within the Danube Delta (342 to 403 individuals) and its adjacent lagoon system (Razelm–Sinoie), Lake Tașaul, and along the Black Sea coastline. It must be noted that the spatial data collected for the Danube Delta are pooled/aggregated within the broader Danube Delta Biosphere Reserve. Beyond these core breeding areas, the distribution pattern of the species has remained consistent with previously reported trends observed during and between breeding seasons along the Danube River and in adjacent wetland systems during the past 2 decades (Bugariu & Fântână, 2008). A wide network of wetlands located along the Danube, as well as smaller lakes situated in the Dobruja region, the Romanian Plain, and southeastern Romania, form part of the species’ year-round distribution and serve as key foraging sites, especially for non-breeding individuals. Among these non-breeding habitats, several wetlands stand out due to their importance in supporting large aggregations of pelicans—often reaching several hundred individuals—across different seasons. Particularly notable are the reservoirs along the Lower Olt River, which form a system of over 13 water bodies spanning more than 150 km and have hosted significant congregations over the past two decades. Similarly, Lake Mostiștea and its associated water bodies along the Mostiștea River are of considerable importance; this site has also historically supported a breeding colony. Other major wetlands such as Lake Suhaia and Lake Bistreț are also extensively used by pelicans.

Importantly, some of these Romanian wetlands also serve as feeding grounds for pelicans breeding in Bulgarian Danube colonies, highlighting the shared foraging landscape of the Danube sub-population. Given suitable nesting conditions, these areas hold potential for range expansion and the establishment of new breeding colonies, especially in wetlands where the species was historically known to breed. Notably, observations in recent years have

confirmed a westward range expansion, with up to several dozen individuals recorded in the Iron Gates area of the Danube during and after the breeding season. Additionally, sightings of individuals moving north along the Prut River suggest a steady range extension in that direction as well.

The impact of the 2022 outbreak of Highly Pathogenic Avian Influenza (HPAI) was evident particularly at key colony sites such as Lake Tașaul, the Ceaplace colony in the lagoon area, and Lake Lejai in the Danube Delta. Despite the outbreak, catastrophic losses were likely mitigated by the relatively low nesting densities and the spatial dispersion of Romanian colonies— different from the density at Prespa colony in Greece, which suffered significantly greater losses. In Romania, a total of 158 confirmed deaths were reported during the 2022 breeding season, followed by a gradual recovery in subsequent years.

Beyond providing population data, the implementation of coordinated counts has greatly enhanced understanding of seasonal distribution, congregation hotspots, and site-specific habitat use. This improved knowledge is crucial for informing site-based conservation actions and identifying potential future breeding habitats, particularly in areas that regularly support large non-breeding aggregations.

Figure 16. Map of results of spring counts in Romania for all project years

During each year of the monitoring period, systematic surveys were conducted in Bulgaria's most important wetlands for both pelican species. These included Lake Srebarna, Persin Island, the Kalimok–Brushlen Protected Area, the Burgas Lakes complex, the Ovcharitsa, Rozov Kladenets, and Studen Kladenets reservoirs, Lake Varna, as well as various islands and sandbanks along the Bulgarian stretch of the Danube River. Total numbers of Dalmatian Pelicans recorded during the spring censuses were as follows: 2021 - 513 individuals, 2022 - 473 individuals, 2023 - 308 individuals, 2024 - 341 individuals

The majority of individuals were consistently observed at breeding colonies situated along the Danube River. A notable shift in distribution was recorded over the course of the project: a decline in numbers at the Srebarna colony was paralleled by a significant increase in the Kalimok complex. The latter trend corresponds with the implementation of targeted

conservation interventions in the Kalimok–Brushlen Protected Area, which appears to have positively influenced local breeding success and colony size.

Two additional sites of particular importance for Dalmatian Pelicans in Bulgaria are located in the Burgas region, which regularly supports large congregations and also hosts a substantial proportion of the Danube population during the winter months. Another key inland site is the Studen Kladenets Reservoir, where 58 to 118 individuals were recorded in 2021 and 2022, respectively. Observations of Dalmatian Pelicans in the western Danube, particularly on the Bulgarian islands adjacent to Bistreț in Romania, confirm the presence of the species in this section of the river during the spring months. This pattern supports the notion of seasonal range use extending into the western Danube corridor.

The data collected through the Southeastern European Pelican Spring Census significantly enhanced our understanding of the distribution and abundance of the species across Bulgaria. Moreover, these findings contribute to broader conservation planning at the regional level.

Figure 17. Map of results of spring counts in Bulgaria for all project years

The spring counts conducted in Greece and neighboring southeastern European countries have consistently confirmed the concentration of DP in wetlands that host established breeding colonies. In 2021, prior to the outbreak of Highly Pathogenic Avian Influenza (HPAI), the Prespa colony in northwestern Greece recorded the highest number of Dalmatian Pelicans in the Balkan region, with over 1,660 adult individuals present. Other key colonies such as Lake Kerkini and Karla Reservoir also hosted significant numbers, with over 470 and 285 individuals respectively—primarily adults.

A marked decline in observed numbers occurred in 2022 as a direct consequence of the HPAI outbreak, and resulted in the mortality of over 2,000 Dalmatian Pelicans in Greece alone. The impact of the outbreak was clearly reflected in the spring census data, particularly at colonies such as Prespa. Since then, a slow but observable recovery in population numbers has been recorded over the consecutive years.

In contrast, the western meta-population—inhabiting coastal wetlands and lagoons along the Ionian Sea—has shown relative stability in census numbers throughout the same period. This apparent resilience is likely due to limited ecological connectivity between the western and central-eastern meta-populations, potentially resulting in limited HPAI exposure. Correspondingly, the numbers recorded in Montenegro and Albania have remained steady across the monitoring years.

It is important to note that during the first two years of the project, overall population estimates were likely underrepresented due to partial coverage of relevant wetlands in Turkey. However, Turkish partners progressively expanded their monitoring efforts, increasing the number of surveyed sites. As a result, during the final three years of the project, census coverage in Turkey was considered satisfactory, encompassing key wetlands relevant to the southeastern European Dalmatian Pelican population. In these years, the number of individuals recorded in Turkey ranged from 185 to 753.

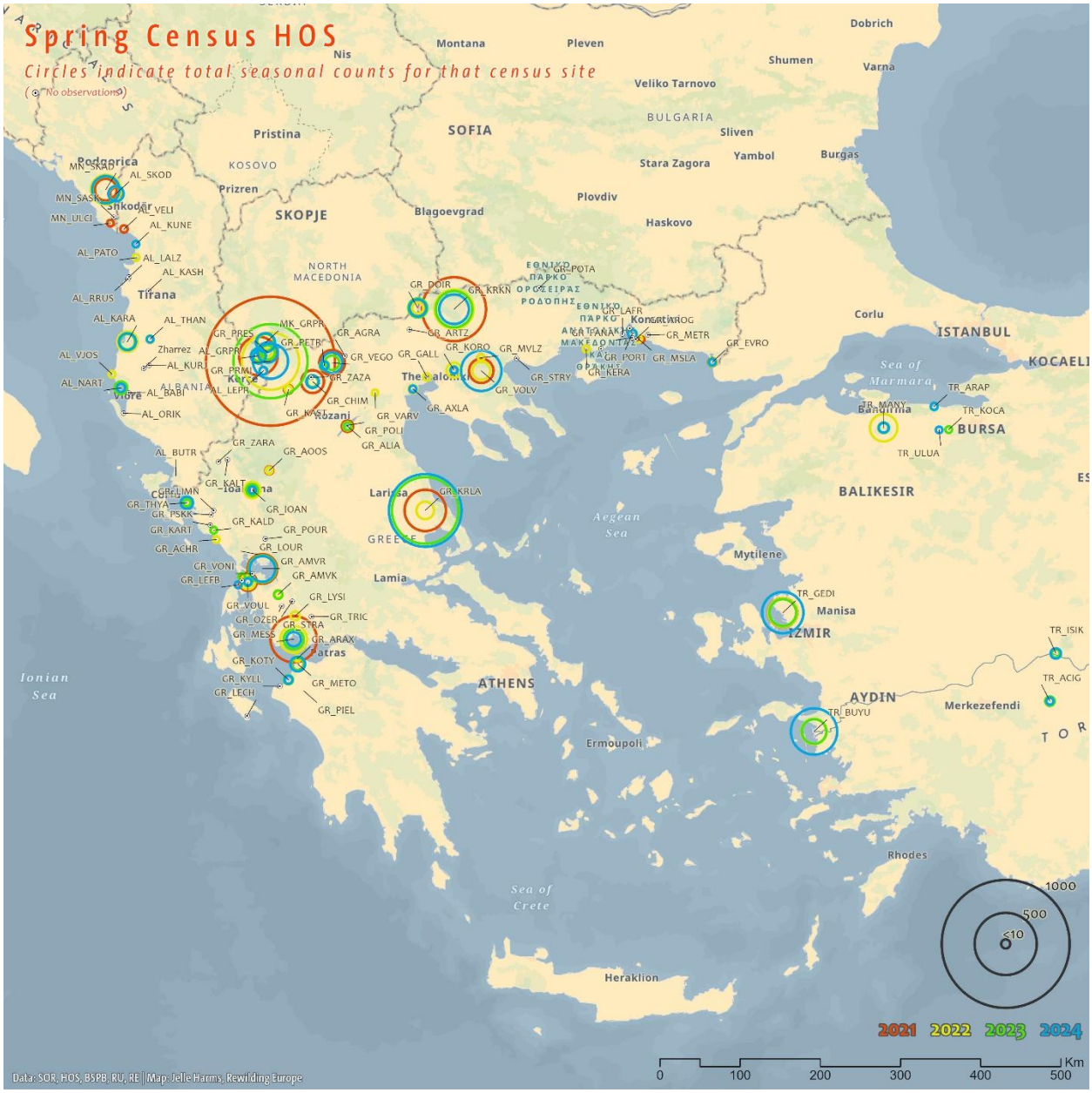


Figure 18. Map of results of spring counts in Greece for all project years

Due to military restrictions in key areas of Ukraine, comprehensive access for coordinated pelican census activities has been severely limited throughout most of the project duration. As a result, a full spring census was only successfully conducted in 2021. Nevertheless, data was collected sporadically during both the spring and winter census periods in other project years, and these observations, although sporadic, provide important insights into the species' spatial distribution.

In 2020, a targeted spring count was conducted between 25 and 31 May, covering the Ukrainian stretch of the Danube Delta. Surveys were carried out from land, by boat, and with the use of drones to access remote areas. A total of 58 DP were recorded on the Ukrainian side of the Delta during this effort.

The most comprehensive monitoring effort has taken place in 2021, when the coordinated census was organized between 15 and 22 May. This section of the Delta is of particular ecological significance, as it serves as a key foraging area for pelicans breeding in the Romanian colonies located in the northern part of the Delta. During the survey, all major wetlands were covered but due to bad weather, some of the islands were not surveyed - Great Daller, and Little Daller, as well as Tataru Island. It is worth noting that available data suggest these particular islands are infrequently used by pelicans. A total of 83 Dalmatian Pelicans were observed during this census.

In 2023 and 2024, military access restrictions further constrained survey efforts, limiting observations to the upper reaches of the Danube Delta. Consequently, only a few individuals were recorded: 5 in 2023 and 1 in 2024.

Although there are gaps in the dataset from Ukraine due to the above mentioned reasons, the information gathered is valuable for understanding the regional distribution and habitat use of Dalmatian Pelicans, particularly in the transboundary wetlands of the Danube Delta.

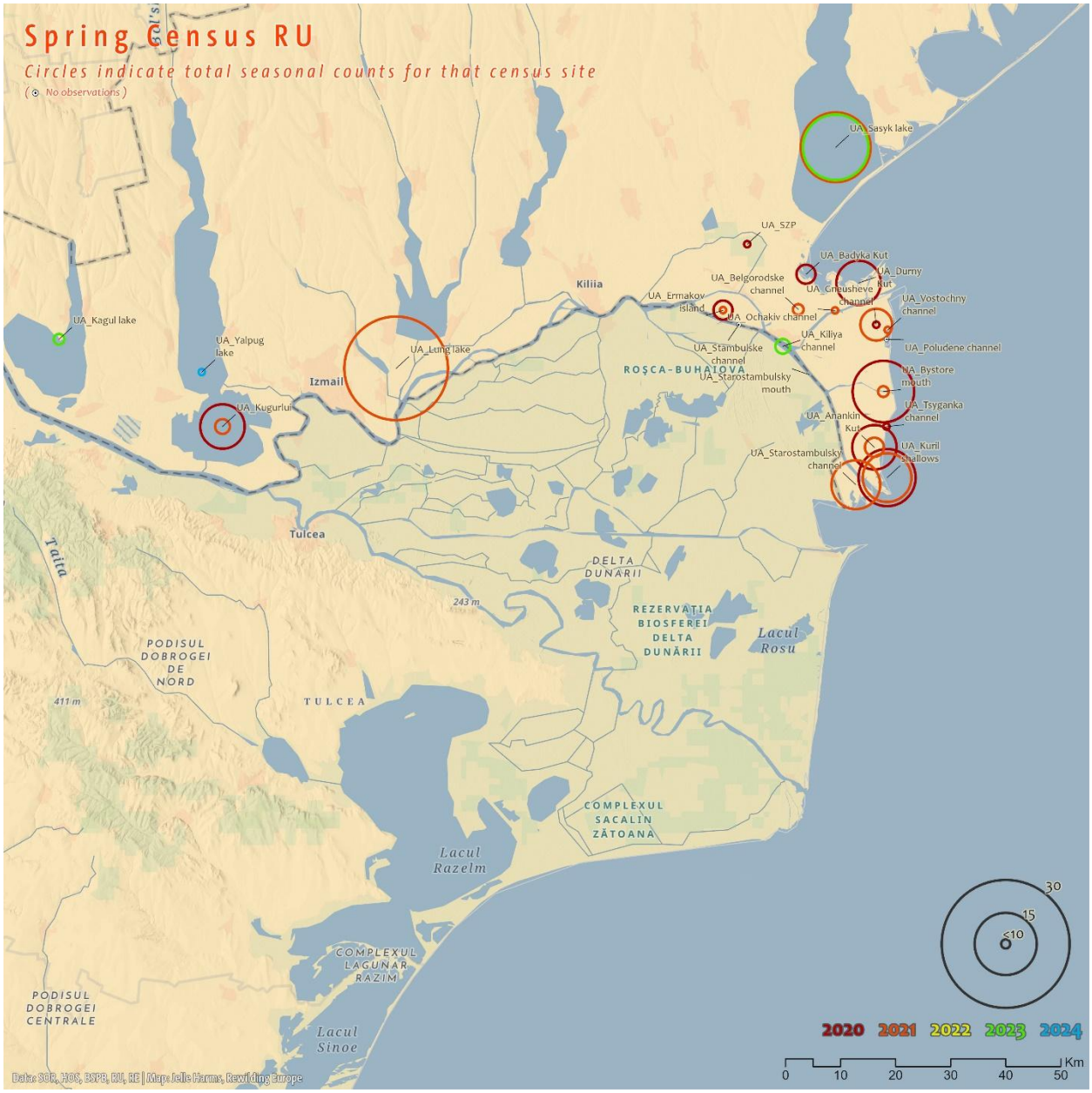


Figure 19. Map of results of spring counts in Romania for all project years

4.5 Winter census

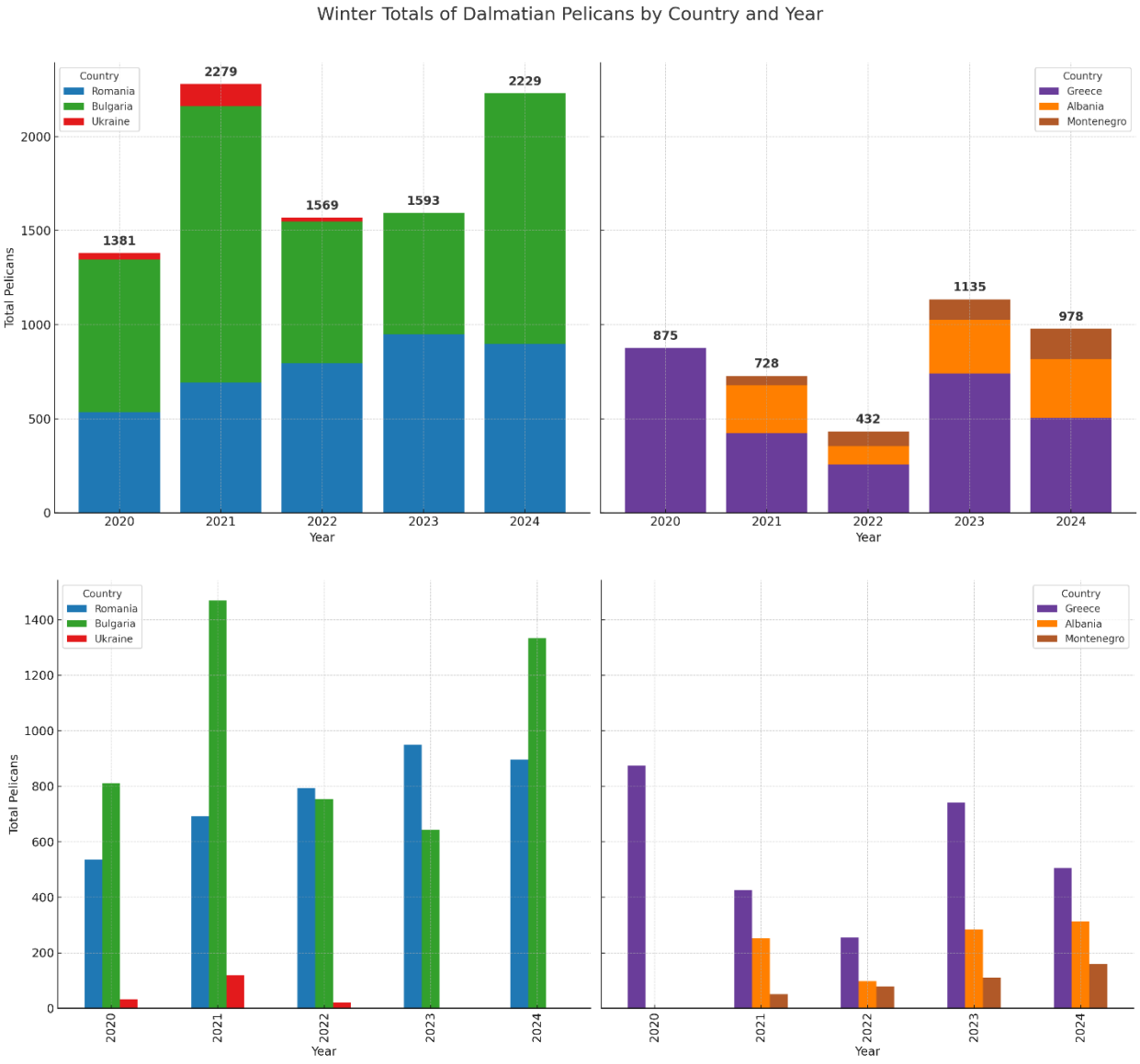
The census was successfully conducted every winter from 2020 to 2024 by all project countries split into 2 groups, based the timing of the breeding of pelicans in the separate populations (mid-November for Greece, Albania and Montenegro) and mid-December for Romania, Bulgaria and Ukraine. 2020, the first organized census of the project, can be considered a test year, due to the fact that participation was not sufficient to cover the entire Danube Delta in Romania, and also due to the fact that the weather was not favorable during the census days. For this reason, at least for the Danube population, the results do not reflect an accurate and complete image of the wintering numbers for 2020.

Monitoring efforts increased in the following years, with notably comprehensive coverage achieved in 2021. This year yielded the highest recorded numbers within the northern sub-population, notably with extensive site coverage in Ukraine. In subsequent years, spatial coverage and overall census implementation remained satisfactory across most participating countries—mirroring the consistency of spring census efforts—with the exception of Ukraine, where due to ongoing military restrictions, key areas in Ukraine became inaccessible in 2023 and 2024. In Romania, due to general winter conditions, organizing aerial monitoring is rarely possible, so the coverage in the Danube Delta has been ensured by multiple boat and ground teams to ensure coverage. The counts were conducted by project partners across the species' wintering range, prioritizing known roosting sites to optimize detection. However, many foraging and roosting wetlands, including those outside the designated project areas, were also monitored. In Romania and Bulgaria, surveys successfully spanned nearly the full extent of the Dalmatian Pelican's range. In contrast, Ukraine's contribution was reduced to sporadic coverage in 2022 and was entirely suspended in 2023 and 2024 due to conflict-related constraints.

Peak numbers in the northern project countries were recorded in 2021, prior to the outbreak of Highly Pathogenic Avian Influenza (HPAI), with Bulgaria documenting the highest count (1,469 individuals). This number included not only birds from the Danube subpopulation but likely also individuals pertaining to the eastern Greek population, as confirmed by color-ringing and satellite telemetry data, particularly in the Burgas region. The subsequent HPAI outbreak in early 2022 indicated noticeable population declines, especially reflected in the numbers recorded in Bulgaria. Although Romanian counts showed a slight increase that same year, Bulgaria's decline likely reflects the reduced influx of pelicans from the rest of the affected population that typically overwinter in Burgas. Numbers have rebounded in consecutive years, indicating both population recovery but also the influence of milder winter conditions. Warmer winters tend to retain birds in northern areas of the lower Danube, Danube Delta and adjacent coastal wetlands. In contrast, prolonged cold spells and ice cover prompt a southward shift, often concentrating birds in the Burgas area. Therefore, census data from Romania, Bulgaria, and Ukraine must be interpreted collectively, as these regions represent interconnected wintering area unit.

In Greece, monitoring focused on the western sub-population, in line with project objectives. Inclusion of Albania and Montenegro proved vital for a comprehensive understanding of regional population dynamics, given the movements of pelicans along the Ionian Sea coast outside the breeding season. Notably, a reduction in wintering numbers was observed in Greece in 2022. Although breeding season monitoring indicated that the western population

was not directly impacted by the HPAI outbreak, the winter census suggests a drop in numbers—likely reflecting a broader impact. Subsequent years have shown a steady recovery, with marked increases in observed numbers.



	Romania	Bulgaria	Ukraine	Totals			Greece	Albania	Montenegro	Totals
2020	536	812	33	**1381**			875	0	0	**875**
2021	691	1469	119	**2279**			425	252	51	**728**
2022	794	754	21	**1569**			256	97	79	**432**
2023	949	644	0	**1593**			741	283	111	**1135**
2024	896	1333	0	**2229**			505	313	160	**978**

Figure 20. Total numbers of Dalmatian Pelicans observed during the spring counts in frame of the project

One of the objectives of the winter counts is to assess the age structure of the DP population by estimating the proportions of adults and immatures across age classes. Ideally, the identification of first-calendar-year individuals and subadults can yield valuable demographic insights, particularly regarding annual breeding success and population turnover. However, in practice, this goal has been constrained by various factors including adverse weather conditions, suboptimal visibility, and variability in observer expertise. As a result, detailed age classification in the field was not always possible or sufficiently reliable.

To ensure consistency and potential for comparative analysis, all recorded non-adult individuals were grouped under a general "immature" category for the purpose of this analysis. Estimates of age structure were then calculated based on this classification.

In the northern subpopulation—encompassing Romania, Bulgaria, and Ukraine—the proportion of immatures recorded ranged from 19.2% to 61.7%. Notably, the years with these extreme values also corresponded with a high proportion of individuals recorded as "unknown" age. In years where the "unknown" category represented less than 2% of observed individuals, the proportion of immatures was more stable, consistently approaching 50% of the total count.

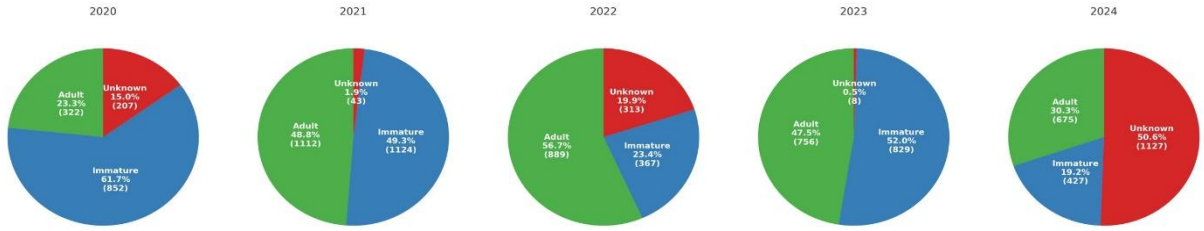


Figure 21. Percentage of adult and immatures observed at winter counts in Romania, Bulgaria and Ukraine across project years

In contrast, for the population census in southwestern Balkan countries (Greece, Albania, and Montenegro), the same analytical approach revealed lower percentages of immatures. This trend was most apparent in years where the proportion of individuals with unknown age was minimal (<2%). Although some years yielded higher immature proportions (up to 26.5%), these coincided with years when the "unknown" category was also relatively high, potentially limiting the accuracy of the estimate. It is yet unknown if this kind of differences highlight a real underlying demographic variability or, as expected, is also partly an artefact in the data collection process. While continued effort to standardize conditions and data collecting process and improve observer experience would enhance the reliability of such demographic assessments in future monitoring, the current findings may be considered as indicative of the age structure in winter for the areas assessed.

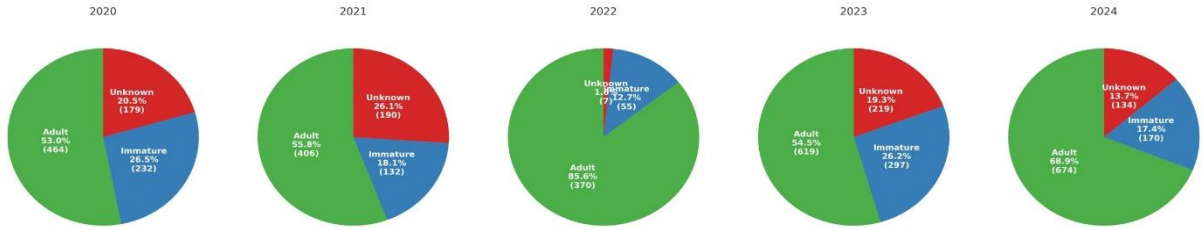


Figure 22. Percentage of adult and immatures observed at winter counts in Greece, Albania and Montenegro across project years

In Romania the recorded numbers ranged between **691 -949** individuals present during the winter counts. To the figure of 539 obtained during the count in 2020, an additional 93 individuals have been reported from the Danube Delta with a delayed interval of several days after the census, and as such the general count result of 2020 was established at 629 individuals. However the 2020 season in Romania was considered side data due to insufficient coverage and weather conditions. The 2023 count recorded 949 individuals, the highest since the project began. The 2024 count documented 896 pelicans, reaffirming stable and consistent wintering numbers across the Danube Basin and coastal Romania.

It is known that the vast majority of individuals are overwintering in Romania either in the Danube Delta or in wetlands along the lower Danube (Bugariu & Fântână, 2008); findings during the current project are consistent with this knowledge. Approximately 50-60% of the total numbers recorded throughout the project counts have been recorded in the Danube Delta, except for 2022 when larger congregations formed in several wetlands along the lower Danube. 2022 has been a year with record low levels of the Danube and it is likely that foraging conditions and decreased food availability in the Danube delta had an influence on the distribution of pelicans, as they mainly chose the large lakes of Suhaia and Oltina for staging and foraging. Similarly, Lake Mostiștea and its associated water bodies along the Mostiștea River have been found to host important numbers (up to 126 individuals) in the winter, as the site is a key area for foraging throughout the year. Additionally, significant numbers of individuals have been observed in adjacent floodplain areas, especially in Romania along the lower Olt River valley (109 individuals in 2020). This area comprises an extensive network of reservoirs and dams spanning over 150 kilometers. Substantial numbers of Dalmatian Pelicans are occasionally recorded wintering between the Vâlcea area and the confluence of the Olt River with the Danube. An interesting finding is the westward presence of DP along the Danube to the Iron Gates dam where several tens of individuals have been present outside of the breeding season, including during winter. Other relevant sites where DP disperse are smaller lakes in the Dobruja region.

The Danube population typically does not remain at the breeding colonies during the winter but instead disperses to forage on the large lakes of the floodplain and in the Danube delta. A proportion of the individuals also undertake movements southward toward the coastal wetlands near Burgas. These seasonal movements have been documented through data collected over the past several years, offering valuable insights into the population's winter distribution and habitat use.

Figure 23. Map of results of winter counts in Romania for all project years

The wintering population of pelicans in Bulgaria was assessed through coordinated winter surveys conducted jointly in Bulgaria and Romania, as well as within the framework of the International Waterbird Census (IWC), which takes place annually in mid-January. The coordination of counts between the 2 countries is essential as the congregations along the lower Danube practically make use of the wetlands on both sides of the Danube for roosting and foraging.

Joint winter counts were carried out in December from 2021 -2024. The total number of DP recorded ranged between **754 -1469** with the 2021 census recording the highest count of individuals over the four-year period.

Throughout all survey years, the highest concentrations of Dalmatian Pelicans were consistently recorded in the Burgas Lakes region, confirming its significance as a key wintering site for the species in Bulgaria, where individuals not only originating from the Danube population, but also from eastern Greek colonies congregate. Alongside Burgas, various smaller numbers have been recorded along the Danube a key roosting sites, in Varna region and also at Yazovir Rozov kladenets, a reservoir lake Natura2000 site important for DP as well as other wetlands in the region.

Figure 24. Map of results of winter counts in Bulgaria for all project years

Winter counts have been conducted in Ukraine successfully in 2020 and 2021. Starting 2022, winter counts of DP in Ukraine were conducted sporadically (between 27 and 30 December), and the survey covered only the inner parts of the Danube Delta, including the Danube-associated lakes, as access to the outer delta—historically the most important overwintering area for the species—was restricted due to the military restrictions. No winter counts could be conducted in 2023 and 2024 due to continued conflict and associated access limitations. Monitoring activities resumed in 2025, albeit again limited to the inner delta, with no access to key outer delta habitats.

The largest number of pelicans has been recorded in 2021 (**119 ind.**). The distribution of the pelicans underlined the importance of the large lakes located north of Tulcea area (Kagul, Yalpug, Kugurlui) as foraging areas, as well as the wetlands located along the coastline of the Danube Delta, north of the Chilia branch. Presence of the pelicans in these key areas has been confirmed also by satellite telemetry in frame of the project.

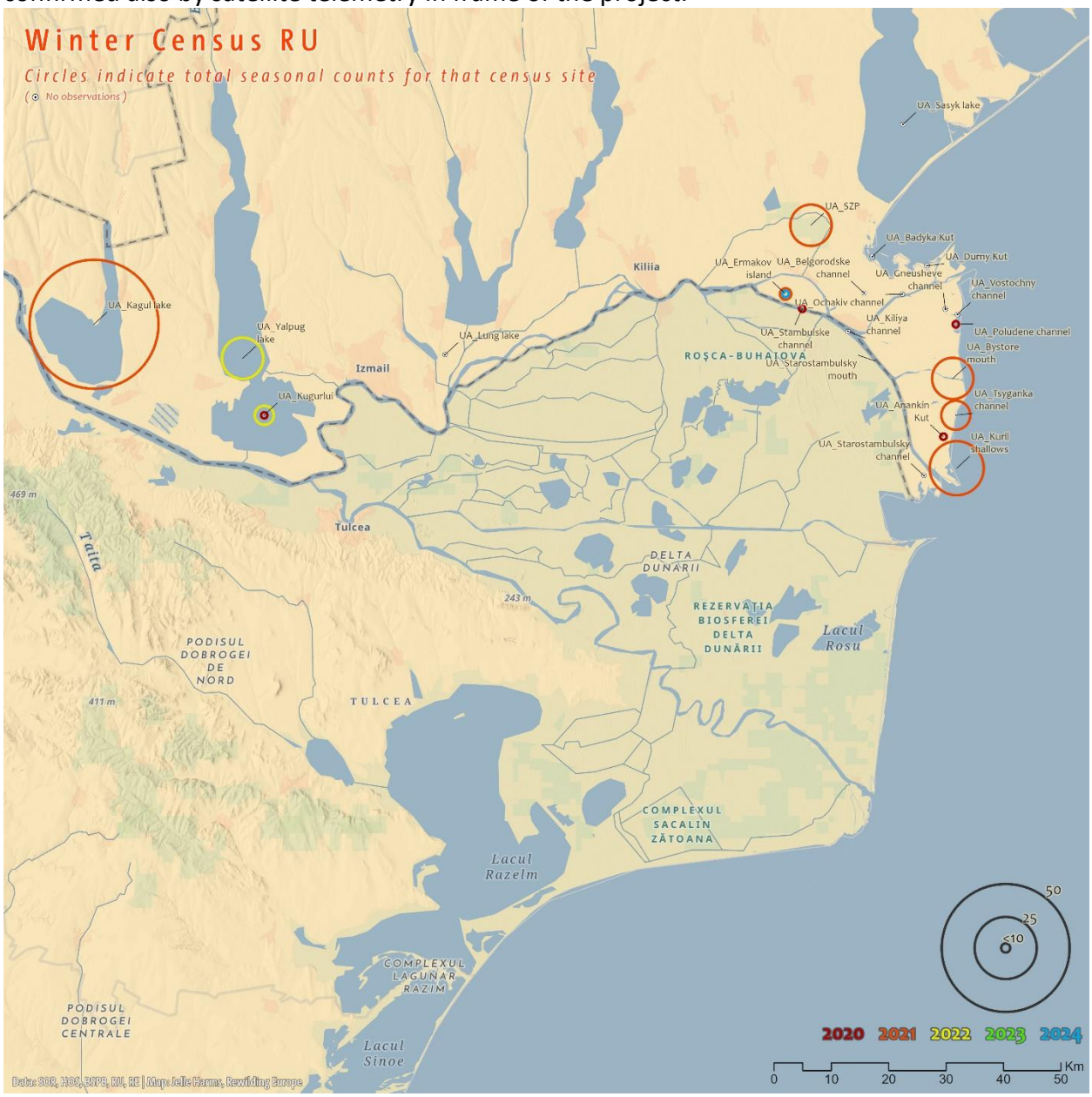


Figure 25. Map of results of winter counts in Ukraine for all project years

The winter census conducted across western Greece, Albania, and Montenegro has focused on monitoring the Dalmatian Pelican population along the Ionian Sea coastline. Data collected over the four-year period indicate a relatively lower degree of seasonal mobility among individuals compared to the Danube subpopulation.

The majority of Dalmatian Pelicans were consistently recorded in wetlands that also serve as breeding sites, such as Amvrakikos and Messolonghi in Greece, the Karavasta Lagoon in Albania, and Lake Skadar in Montenegro. These observations suggest a year-round presence of individuals in the colony wetlands, with limited dispersal during the non-breeding season.

In addition to these core sites, other important wintering areas were identified, particularly the lagoon systems situated in the southern part of the Patras Gulf, west of the city of Patras, which also supported notable concentrations of pelicans during the winter period.

Figure 26. Map of results of winter counts in Greece, Albania, Montenegro for all project year

4.6 Color ringing

Throughout the duration of the project between 2020-2024, a total of **313** Dalmatian pelicans were ringed across all participating countries. To this figure an additional 52 chicks and fledged juveniles ringed in Romania in 2025 can be added, three of which were also equipped with satellite transmitters, so as of 2025 the total of tagged individuals raised to 366.

In Romania, since 2020 intensive ringing activities have been conducted at key breeding colonies, notably Lake Tasaul and Ceaplace-Lake Sinoie. In 2020, six chicks of suitable age were ringed at Lake Tașaul. In 2021, SOR team with the support of volunteers successfully ringed 30 chicks. Due to the avian influenza outbreak, ringing activities were suspended in 2022. Efforts resumed in 2023 and 2024, resulting in record numbers of 40 and 55 chicks ringed, respectively, at Lake Tașaul, with an additional 14 individuals ringed at the Ceaplace colony. In 2025, 52 chicks were ringed at Lake Sinoe and Lake Tașaul. In total, including satellite tagged individuals, 210 Dalmatian pelicans were ringed in Romania during the project period and after its completion. Additionally, blood samples were collected from 50 chicks in 2024 for genetic analysis. Genetic sampling has been performed also in Greek and Bulgarian colonies.

In Greece, 113 chicks were marked with color rings at breeding colonies in Amvrakikos Gulf and Messolonghi Lagoon.

In Bulgaria, the Bulgarian Society for the Protection of Birds (BSPB) successfully ringed 42 Dalmatian Pelicans, with most individuals tagged during a dedicated mission in the Kalimok-Brushlen Protected Area.

Since the start of intensive ringing efforts during the breeding seasons in frame of the project, and up to the current reporting period, a total of 32 resightings or recoveries of ringed Dalmatian Pelicans have been documented. These include 21 individuals originally ringed in Romania, 7 in Greece, and 4 in Bulgaria. When assessed against the total number of ringed individuals, this corresponds to an overall recovery rate of **10.2%**, which is considered satisfactory compared to any other avian group. Specifically, for D pelicans ringed in Romania, the recovery rate reaches 13.2%. It is important to note that all recoveries are reports of live birds visually inspected for the rings and not mortality cases.

Dalmatian Pelicans, due to their large size and distinctive appearance, are readily observable and often attract attention from birdwatchers and wildlife photographers, thereby increasing the likelihood of ring resightings. In addition, systematic efforts to read rings have been integrated into regular project activities, particularly during site visits and coordinated census operations, further enhancing data collection on marked individuals.

DP ringed in Romania have been resighted across a broad geographic range, with a concentration of observations in the Danube River region and the coastal zones along the Black Sea. Notably, resightings have also occurred also in inland areas known for supporting

large aggregations of pelicans, such as Lake Mostiștea and various lakes along the lower Olt Valley.

International recoveries include observations along the Ukrainian Black Sea coast, extending as far north as the Odessa region, and in southern Bulgaria, particularly in the Varna and Burgas areas—both recognized as important wintering sites for the species. These findings are broadly consistent with the established movement patterns of the species. The recoveries from northern parts of the Danube Delta, when considered alongside satellite telemetry data, might suggest an increasing tendency for individuals to disperse more intensively into coastal habitats in Ukraine.

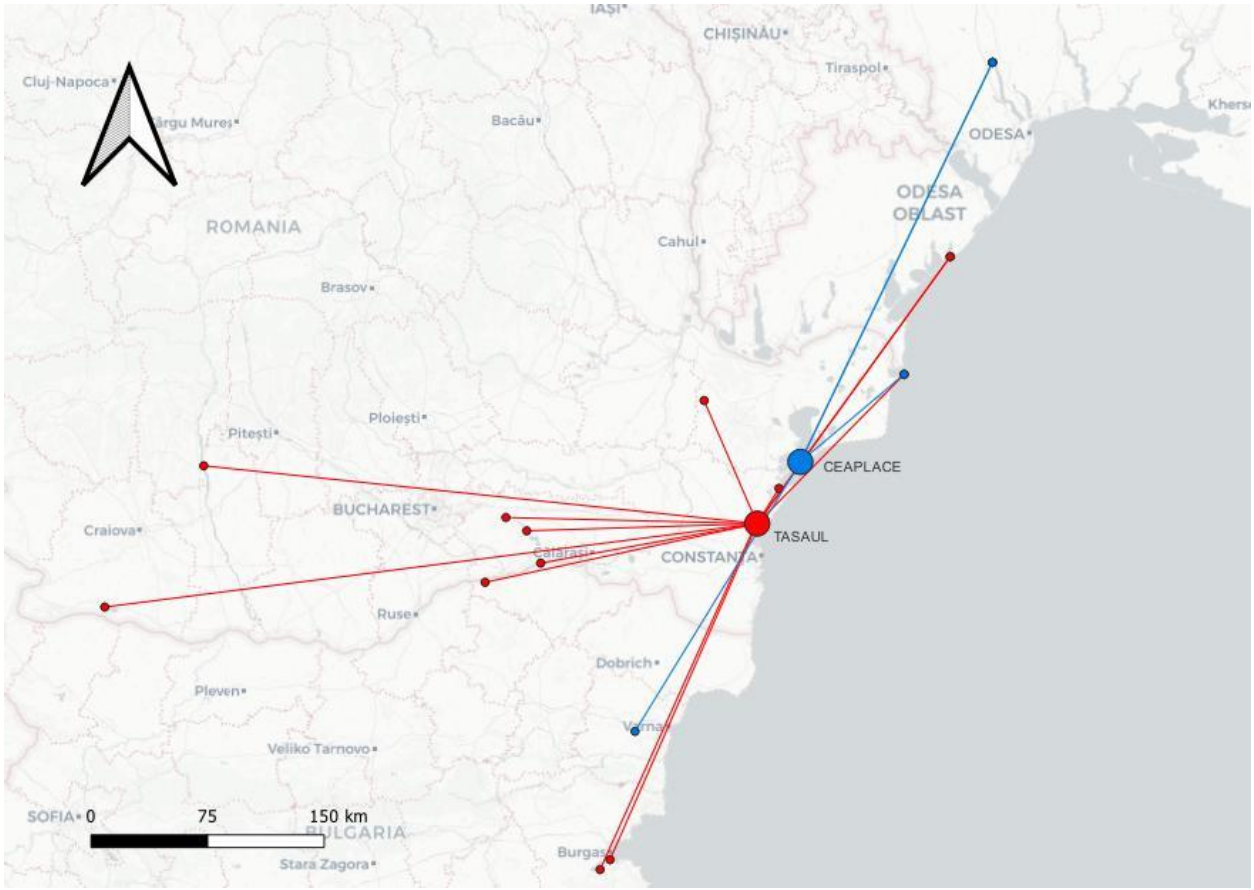


Figure 27. Color ring resightings from individuals ringed in Romanian colonies

Data obtained from color-ringed individuals in Greece, corroborated by GPS telemetry, support the hypothesis of limited movement and population exchange between the Dalmatian Pelican populations of Western Greece and the northern populations. Most individuals demonstrated site fidelity to wetland systems along the western Greek coastline, with restricted long-distance movements. Nonetheless, exceptions were observed as two juveniles were recorded wintering at Lake Kerkini, suggesting the possibility of occasional connectivity between the Western Greek and northern population. Additionally, a small number of juveniles exhibited broader dispersal patterns, reaching as far north as Montenegro. These longer-distance movements, however, appear to be rare and infrequent.

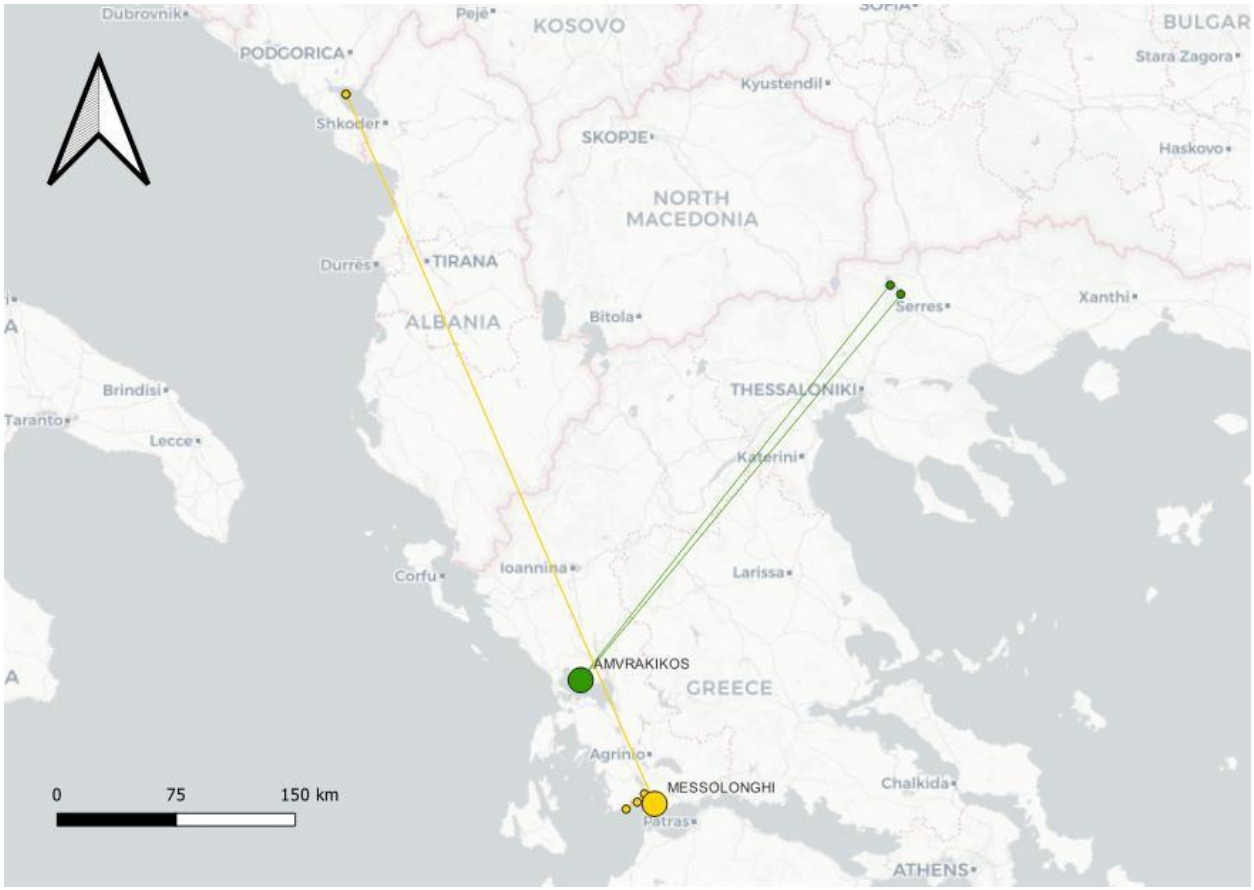


Figure 28. Color ring resightings from individuals ringed in Greek colonies

In Bulgaria, resighting data were subsequently reported from several key locations, including Lake Kerkini (Greece), Lake Sinoe (Romania), Lake Srebarna (Bulgaria), the marshes of Persin Island (Bulgaria), and sandbanks along the Danube River within both Bulgarian and Romanian territories. Bulgarian birds have been observed also in the colony of Tasaul in Romania during their second calendaristic year. In addition, a ringed juvenile from Montenegro has been reported in Bulgaria, indicative of new evidence of eastward wintering dispersion between distinct metapopulations. (Vizi et. al 2023)

4.7 Satellite telemetry

As part of the satellite telemetry study, obtained GPS tracking data to date has been used to in an attempt to determine critical pelican home-range areas across different seasons, integrate known mortality data to identify potential risk factors, and assess the effectiveness of existing protected areas in covering these critical habitats. The preliminary results and analysis are available under a separate technical report produced under actions A1 and D1: Bounas A., Bugariu S., Cheshmedzhiev S., Vougioukalou M., & Saravia-Mullin, V. 2025. **Dalmatian pelican monitoring with satellite telemetry. Technical report under actions A1 and D1**, Pelican Way of LIFE (LIFE18 NAT/NL/716). The report is made available as a deliverable of the project.

A total of 24 birds were tagged with patagial GPS-GSM transmitters, 11 in Bulgaria, 6 in Greece and 7 in Romania. Birds of all ages were tagged, nearly half of them juveniles (11), but also 9 immatures and 4 adults.

In Greece, HOS team tagged six Dalmatian Pelicans (three adults, one immature, and two juveniles) in Amvrakikos and Messolonghi. Of these, four individuals are still alive and continue to use wetland habitats along the western Greek coast.

In Bulgaria, BSPB successfully tagged 11 Dalmatian Pelicans using GPS–GSM transmitters (OrniTrack-P33). Eight individuals were captured during winter at Atanasovsko Lake near Burgas using loop traps, while three juveniles were tagged at the Kalimok-Brushlen Protected Area. The project's tagging target of nine pelicans was achieved and exceeded.

In Romania, trapping sessions organized by the SOR, the Danube Delta Institute, and the Danube Delta Biosphere Reserve Authority successfully deployed transmitters on 2 Dalmatian Pelicans in late 2023. Additional tagging occurred in 2024: 4 free-flying juveniles were tagged at Ceaplace colony, Lake Sinoe, 1 juvenile was tagged at Lake Tașaul. A total of seven individuals were equipped with transmitters in Romania in frame of this project, with two birds lost during the 2024 season. The remaining devices, including the 2 recovered ones, are scheduled for redeployment in 2025.

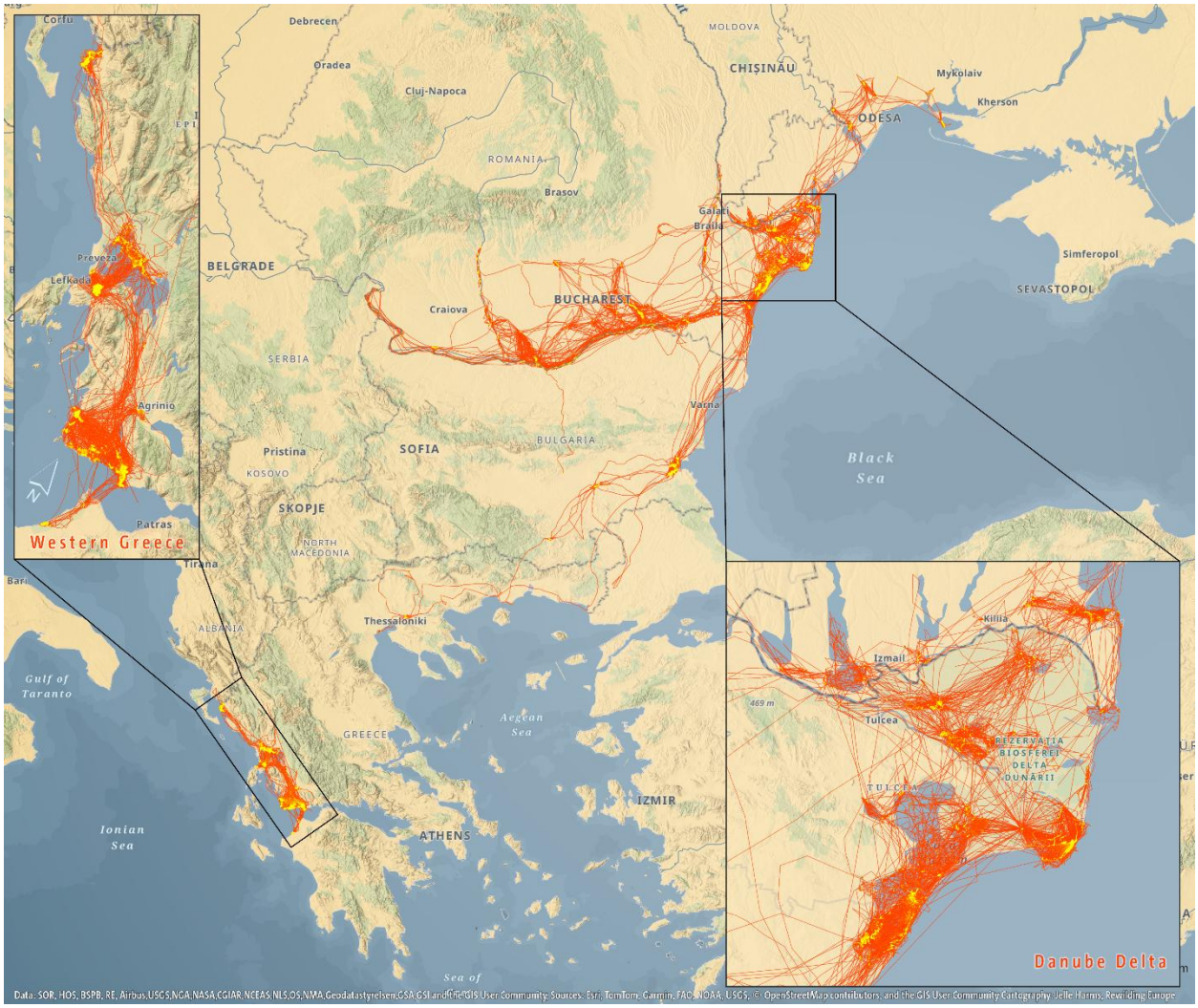


Figure 29. Map of movements of all GPS tracked pelicans to date.

Satellite telemetry combined with color ringing has confirmed movement patterns and colony connectivity. Birds tagged in Amvrakikos and Messolonghi (Western Greece) were observed moving between these two colonies and occasionally visiting other western coastal wetlands, such as Kalamas Delta and Strofilia. However, no movements were recorded toward colonies in northeastern Greece, indicating minimal interaction between western and northeastern populations (which also applies to colonies in Albania and Montenegro.)—an observation supported by rare color ring resightings. These tracking efforts also revealed several previously undocumented wetlands heavily used by Dalmatian Pelicans during the winter months.

In contrast, pelicans tagged in Bulgaria displayed markedly higher mobility, with individuals visiting wetlands in Eastern Greece, Turkey, Ukraine, Serbia, and Romania. Similarly, Romanian-tagged birds showed extensive movements within the Danube corridor and along the eastern Black Sea coast, ranging from Ukraine (near the Crimean Peninsula) to the Burgas region in Bulgaria. The longest recorded journey involved a juvenile Romanian pelican that traveled 515 km (straight-line distance) from Ceaplace Island in the Danube Delta to the Iron Gates area on the Romania–Serbia border.

The findings reported under the satellite tracking technical report (Bounas et al. 2025) clearly show that individuals originating from Bulgaria and Romania exhibit consistently larger Home Range and Core Area values than their conspecifics in western Greece. Northern individuals appear to track multiple resource-rich wetlands often covering substantial distances along the Black Sea coast and Danube River (Bugariu and Fântână 2008) whereas western pelicans exploit a more restricted set of coastal lagoons in the Ionian region. There is evidence for wide-ranging northern movements, often crossing multiple administrative borders, which emphasizes that management strategies must look beyond single sites to address an entire corridor or set of roost/foraging sites.

The resulting data provide valuable insights for conservation planning by identifying key movement corridors and critical wetland habitats essential for the species' protection.

Mortality causes

Out of the 24 birds fitted with satellite tags, 8 individuals have been confirmed dead due to various causes: entanglement in fishing nets (n = 3), collision with power lines (n = 1), collision with boats (n = 1), shooting (n = 1), while for two individuals the cause of death remains undetermined. An additional individual is presumed dead due to signal loss, although carcass recovery was not possible, so transmitter malfunction cannot be ruled out.

All confirmed cases of fishing net entanglement involved birds tagged in Bulgaria; however, incidents occurred across Bulgaria, Romania, and Ukraine. No tagged birds have been found dead in these circumstances in Greece, but the project team has recorded this type of mortality in Greece, so we can conclude that this threat affects the species throughout its range in the Balkans.

Similarly, while only 1 tagged individual was confirmed to have died from a power line collision, project monitoring recorded a total of 57 Dalmatian Pelican fatalities due to power line collisions across Bulgaria, Greece, and Romania. Additionally, 37 Great White Pelicans were found dead along the same power lines. Although both threats were previously recognized, telemetry data provided direct evidence of their impact on individual survival, emphasizing their significance for targeted conservation measures.

5. Conclusions

Our results confirm that coordinated, multi-annual efforts under the Pelican Way of LIFE project have been beneficial for the conservation of the Dalmatian Pelican in Southeastern Europe. Through the involvement of a wide network of specialists, volunteers, and partner organizations, the project has successfully established itself as a hub for knowledge exchange and capacity building, while generating a comprehensive dataset on the species' population status, movements, and key threats.

The data collected through color ringing, satellite telemetry, breeding surveys, and seasonal counts have provided an unprecedented overview of the Dalmatian Pelican population across Bulgaria, Greece, Romania, and Ukraine. These data have directly informed conservation measures implemented by the project and have contributed to safeguarding the species throughout its regional range.

A major event during the project period was the highly pathogenic avian influenza (HPAI) outbreak in 2022, which had a particularly severe impact on the largest DP colony globally. While the overall population in the region declined significantly that year, monitoring data indicate that the Romanian breeding population was less affected, and the western Greek population showed almost no impact. Successive spring and winter counts revealed both the scale of the outbreak's effect and encouraging signs of population recovery in subsequent years. Notably, most colonies covered by the project maintained stable breeding success despite these challenges. The project also promoted regional collaboration, exemplified by the initiation of joint studies aimed at understanding population genetic structure and resilience

Although some limitations in data collection were encountered—particularly in Ukraine due to military conflict and access restrictions—occasional observations and telemetry data confirmed the continued importance of Ukrainian wetlands for the species, with evidence of occasional breeding and regular presence along the northern Black Sea coast. Complete surveys in Ukraine are recommended as soon as conditions allow, especially given restricted access and limitations on aerial survey methods in the region.

The project provided a detailed understanding of breeding patterns. Artificial nesting platforms installed in Bulgaria have proven highly effective where natural nesting substrates are lacking, offering both nesting and roosting sites widely accepted by the birds. Assessment of platform capacity and potential expansion is advised, particularly considering disease risks such as avian influenza. In contrast, monitoring platforms that have been set up in the Ukrainian Danube Delta has been constrained by access restrictions.

Despite data gaps, coordinated spring and winter censuses have contributed essential information about pelican distribution and population trends, extending knowledge to previously under-reported regions such as Turkey. These efforts revealed positive trends across years, despite natural fluctuations. However, there are still notable limitations regarding observer coverage, training in age class identification, and logistical challenges, particularly during winter counts where weather and visibility can complicate observations.

The project confirmed that DP movement patterns in the region (especially the northern population) has shifted over recent decades from migratory to short-distance movements. Formerly considered a migratory species, the northern Danube population now largely remains within the lower Danube floodplain and Black Sea coastal wetlands during winter, influenced by milder winters and increased foraging opportunities linked to fishery activities. This behavioral flexibility also enables earlier returns to breeding grounds.

Color ringing proved to be an effective tool for assessing demographic parameters, with a high resighting rate. However, the effort must be sustained over time, combined with dedicated ring-reading initiatives across the species' range. Satellite telemetry, while resource-intensive, offers unparalleled data resolution, revealing movement patterns, habitat use, and mortality causes with much greater precision than ringing alone.

Telemetry identified entanglement in fishing nets as a potentially underreported threat, with three of eleven tagged Bulgarian individuals lost to this cause across Bulgaria, Romania, and Ukraine. Power line collisions, though confirmed in only one tagged individual, were verified through field monitoring to have killed 57 Dalmatian Pelicans and 37 Great White Pelicans across project countries. While direct persecution appears limited, isolated cases of shooting—such as a Bulgarian-tagged pelican killed in Ukraine—highlight the need for further study of this threat throughout the Balkans. Similarly, illegal fishing could have a larger regional impact than currently documented and warrants more detailed investigation.

In Ukraine, military conflict was identified as both a direct and indirect factor affecting Dalmatian Pelicans. While reduced human activity has decreased disturbance in some areas, evidence suggests military operations may have contributed to mortality in the outer Danube Delta. These impacts require further study once access is restored.

The project also clarified patterns of population connectivity. Movements between Western Greece and northern Balkan colonies are minimal, confirmed by both telemetry and ringing data. This limited interaction could have implications for genetic flow, although it may also reduce the risk of disease transmission between colonies. Romanian-tagged birds demonstrated high mobility, moving along the Danube and coastal wetlands from Ukraine to Bulgaria, with the longest recorded movement being a juvenile that traveled 515 km from Ceaplace Island to the Iron Gates region on the Romania–Serbia border. The project’s systematic monitoring confirmed clear seasonal dispersal patterns, particularly for the Danube population, which disperses to forage along floodplain lakes of the Danube and coastal wetlands such as those near Burgas during winter. These insights provide an important foundation for developing future conservation strategies, highlighting both successes and remaining challenges in securing the long-term viability of Dalmatian Pelican populations in Southeastern Europe.

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