PELICAN
WAY OF LIFE

Pelican Way of LIFE (LIFE18 NAT/NL/716)

"Conservation of the Dalmatian Pelican along the Black Sea - Mediterranean Flyway"

Dalmatian Pelican Monitoring Manual

December 2020

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Dalmatian Pelican Monitoring Manual

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FOREWORD

This Monitoring Manual was produced in order to support the monitoring activities of the LIFE project, "Pelican Way of LIFE". The project targets the Dalmatian pelican, *Pelecanus crispus*, (DP) and aims at the species' conservation in Southeastern Europe and Ukraine. The monitoring data collected in each country and by each observer need to be comparable, in order to obtain scientifically correct and accurate data. The use of such data enhances people's ability to make informed decisions for conservation action, whereas incompatible data may lead to invalid conclusions. Moreover, the project entails the trapping and handling of DPs for ringing and fitting with transmitters. The specialist experience accumulated in such techniques for the DP should be shared in order to maximise the effectiveness of interventions and minimise the risks for the birds. It is thus crucial to adopt common protocols and follow standard methods across all the project sites.

In this document we describe a standard methodology and common protocols for the DP– and secondarily the great white pelican, *Pelecanus onocrotalus*, (GWP), both large, ground-nesting species– for the purposes of surveying/census, trapping, handling, ringing, identification, ageing, fitting transmitters and reporting. In addition, an important opening section is dedicated to terminology, as the terms and concepts used by all partners should correspond to the collected data in an unambiguous and unanimously accepted manner. Lastly, this document aims to provide a helpful bibliography in order to give a brief account of the available research on the topics discussed here, and to provide a variety of perspectives on these topics. The content of this manual has been drawn from our long experience in working with the two large species of Old World pelicans in Greece and in Prespa in particular. In this manual we have tried to avoid the inclusion of those aspects of identification, ageing and methodological issues pertaining to colonial nesting seabirds and pelicans in general, which can be commonly found in most relevant textbooks. Instead we have tried to limit ourselves to methodological and field issues more specific to these two Old World pelicans, that cannot be easily found elsewhere in one place. The methods and approaches described below may of course possess some degree of applicability for other ground nesting species of pelicans nesting in similar habitats, but have little relevance for tree-nesting species.

The Monitoring Manual is accompanied by a complementary "Identification and Ageing Manual". This is a field guide with photos to help observers identify and age Dalmatian pelicans. Mis-identification and mis-ageing is not unlikely to happen during censuses and surveys, as DPs and GWPs often form mixed flocks; even experienced birdwatchers and ornithologists frequently confuse grown-up juveniles with 1st CY immatures (first calendar year: from hatching to 31st Dec of the same year) and 2nd CY immatures with post breeding adults. In the "Identification and Ageing Manual", moulting patterns and successive plumages of the DP are described in some detail.

The aim of this Monitoring Manual is to provide a handy tool for the partners of this project, which will allow them to implement all the activities foreseen in Action A.1 in the most efficient way. Furthermore, it is intended to be used to strengthen capacity among the actors for pelican

conservation in the key neighbouring countries sharing the DP sub-population, which are not participating in this LIFE project (Albania, Montenegro, North Macedonia and Turkey).

The Society for the Protection of Prespa

The Society for the Protection of Prespa (SPP) is a non-governmental, non-profit organisation, founded in 1991 and located on the Greek side of the Prespa basin, a wetland of international importance. During the last 29 years, the SPP has undertaken research, monitoring and conservation actions for the protection of the Dalmatian pelican, including research studies on the ecology and the biology of the species, measures to minimise disturbance at nesting and feeding sites, regular monitoring of parameters such as breeding population, habitat use and breeding success and management of important wetland habitats in Lesser Prespa Lake. Conservation efforts gradually led to the increase of pelican populations, making the Prespa colony the largest Dalmatian pelican colony on Earth with around 1,500 breeding pairs and one of the very few sites in Europe where both species (Dalmatian pelicans and great white pelicans) nest together. SPP conservationists had a key role in the International Pelican Research and Conservation Programme, which started in 1978 under the co-ordination of the Biological Station of Tour du Valat, and focused on the ecology and biology of the two pelican species. The SPP collaborates with academic institutes and researchers working on pelicans, and through the support of the Pelican Specialist Group (Old World) / WI-IUCN SSC co-ordinates a network of over 70 pelican experts from NGOs, universities, public institutions and governmental authorities from 23 countries. A big step towards Dalmatian pelican conservation was the completion of the International Action Plan for the Dalmatian pelican (AEWA) in late 2018, which was co-ordinated by the SPP and the Hellenic Ornithological Society. Furthermore, in an effort to provide guidance to managers and decision makers about artificial nesting structures (ANS), the SPP published a document entitled "Artificial Nesting Structures for Eurasian Pelicans – a decision-making and guidance document" (Catsadorakis 2017), which aims to provide an overview of the several scientific and practical issues associated with the building and use of ANS for pelicans. The continuous efforts of the SPP for the conservation of Prespa led to the award of 2 international distinctions: The Ramsar Wetland Conservation Award (1999) and the Goldman prize, received by two leading SPP conservationists (2001). Finally, the SPP has implemented three LIFE projects (LIFE02NAT/GR/8494, LIFE09/INF/GR/319 and LIFE12NAT/GR/000539) as a co-ordinating beneficiary, two of which were recognised as Best of the Best LIFE projects, and it is currently implementing a LIFE Nature project (LIFE15NAT/GR/936) on the conservation of nine waterbird species, including the Dalmatian pelican.

1. THE DALMATIAN PELICAN

The Dalmatian Pelican *Pelecanus crispus* is a large, piscivorous waterbird, classified as 'Near Threatened' in the global IUCN Red List, with a decreasing population trend (BirdLife International 2018). In the European Red List Assessment of 2015, the species was downgraded from 'Vulnerable' to 'Least Concern'. The DP is listed in Annex I of the Birds Directive, Appendix II of the Bern and Bonn Conventions and in Annex II of AEWA.

Dalmatian pelicans nest colonially at sites with minimum disturbance, on islands in freshwater lakes and coastal lagoons, where they are protected from land predators and where adequate food resources are available (Nelson 1980). Due to their specific requirements and deterioration in their wetland habitats, the disappearance of DP colonies has been the rule during the last century (Catsadorakis 2019).

The global population of the DP is 22,000-27,000 individuals within three sub-populations (Mediterranean-Black Sea, West/SW Asia, East Asia). The breeding population of the DP is estimated at 7,342-8,984 pairs, with the Mediterranean-Black Sea flyway population holding c. 33-41% of the global population of the species (Catsadorakis & Portolou 2018). Within the Mediterranean-Black Sea population, two meta-populations exist that have no, or very limited, exchange of genetic material, are demographically separate and need to be managed as separate units. These are the Western Greece-Albania-Montenegro population, which is small and in need of conservation action, and the population in wetlands of Central, Northern and Eastern Greece, Romania, Bulgaria, Ukraine and Turkey) (Catsadorakis et al. 2015). The DPs in both meta-populations are short-distance migrants that overwinter in wetlands lying close to their breeding sites, normally dispersing less than 900 km away, either in the same country or in neighbouring countries.

2. TERMINOLOGY

2.1. Introductory notes

Terms, expressions and concepts may be used by different people to signify different meanings. Even in the scientific literature of birds there are several examples of terms being used in various ways, depending on the context or the species etc. In the framework of a project with several actors, inconsistency in the use of terms may lead to incorrect data, confusion and false perceptions, and it could therefore jeopardise the trustworthiness of results. It is thus of the utmost importance that all partners use the same terminology, which clearly corresponds to the collected data in a precise manner. This will provide the accuracy and consistency needed for data collected by numerous observers in many different sites across four different countries. Here, we do not discuss terms, the meaning of which can be found in hundreds of textbooks and scientific papers on general ornithology. We only discuss these terms to the degree that their full understanding helps us gain insight into pelican-related matters.

2.2. Age, plumage and moult

CHICK: Not a scientific term. The technical term for very young birds is pullus (plural pulli), certainly before fledging. NESTLING refers to a pullus that is still in the nest, while YOUNG is also a non-technical term, denoting a bird before it is capable of breeding, encompassing chicks, juveniles and even immature birds.

JUVENILE: A grown-up bird that is old enough not to be called a chick. It also refers to a bird that hatched in the current calendar year and wears its first full plumage of normal feathers (see HY). After 31/12 of the hatching year it is better called IMMATURE-2nd calendar year.

HATCHING YEAR BIRD (HY): A bird capable of sustained flight and known to have hatched during the calendar year in which it was ringed (or seen/observed) / a bird in basic plumage in its first calendar year.

POST-JUVENILE MOULT (juvenile → immature): Timing very variable, apparently associated with the hatching date of the chick. Immature plumage is intermediate between juvenile and adult. Mantle is a mixture of white feathers and brown-grey feathers with white edges. Tail feathers are white and grey. Marginal and lesser upper wing coverts like mantle. Median and greater coverts are white, faintly mottled brown-grey. Gradually approaches adult plumage, reached 3rd calendar year.

PRE-BREEDING MOULT (adult bird from summer-autumn plumage → breeding plumage): Timing variable, starts roughly October-November and involves head and nape feathers (untidy crest of long narrow feathers, feathers – coverts of upperparts elongate white with black shafts. All greyish and brown-greyish feathers lost and plumage turning to white.

POST-BREEDING MOULT (breeder → summer-autumn plumage): Timing variable, becomes apparent to observers mainly after early May, with the appearance of increased numbers of sparse

brown-greyish mantle and wing coverts, mixed with white feathers, which give a strange spotty appearance to the adults, making them look like juveniles.

Photo 1. Adult Dalmatian pelicans in post-breeding moult in late July.

2.3. Colony and breeding

There are important variations in the international scientific literature regarding the terminology of colonial aggregations.

COLONY: Denotes "A number of birds breeding gregariously" (Campbell & Lack 1985), but it is actually not so clear and straightforward in the real world. This 'gregariously' is exactly the key word, the ambiguous concept, the central point of interest.

Focusing on DPs: A COLONY consists of one or several, more or less discrete groups of nests, close to each other. Within these groups nests are more or less synchronised. But in general there is no synchronisation between these groups. Or in other words intra-synchronisation is always higher than inter-synchronisation.

Most colonial birds breed asynchronously. Each colony, but not all, consists of groups of nests in which the birds have laid synchronously, more or less. Many times this group is also spatially distinguishable from its neighbouring group/s, but in other cases they are not, because later group/s of nests might have been created in contact with the older one. SYNCHRONISATION means they have all started incubating within a few days, normally 2-3 days. This group of nests is called a BREEDING UNIT (Crivelli 1987). Some authors call this breeding unit "a colony" (Knopf 1979, Johnston 2016). For the needs of the present project we suggest to call these groups "breeding units". A number of breeding units, not necessarily synchronised to each other may be located very close to each other, but still be clearly distinguishable, on a limited space, e.g. A NESTING ISLAND. What should this be called? It is suggested that this is called a SUB-COLONY.

The demarcation-of-colonies problem (Nelson 2006)

Consider two or more congregations of nests, within the boundaries of the same wetland (e.g. Lake Prespa, Lake Skadar, or the Danube Delta, and others) which may lie for example 2, 5, 10 or 30 kilometres away from each other. Can these be considered as separate colonies or not? And if yes, which is the minimum distance they have to be apart in order to be classified as separate colonies? This is known as the colony demarcation problem, a question that cannot be answered in a straightforward manner (Nelson 2006). Besides distance, the degree of interchange of individuals between colonies plays an important role. It declines with increasing distance and it also depends on the degree of philopatry of the species. However, for the practical purposes of this project we propose that if two breeding aggregations lie more than 3 kms apart they should better be considered and referred to as separate colonies (see the Lesser Prespa case demonstrated below).

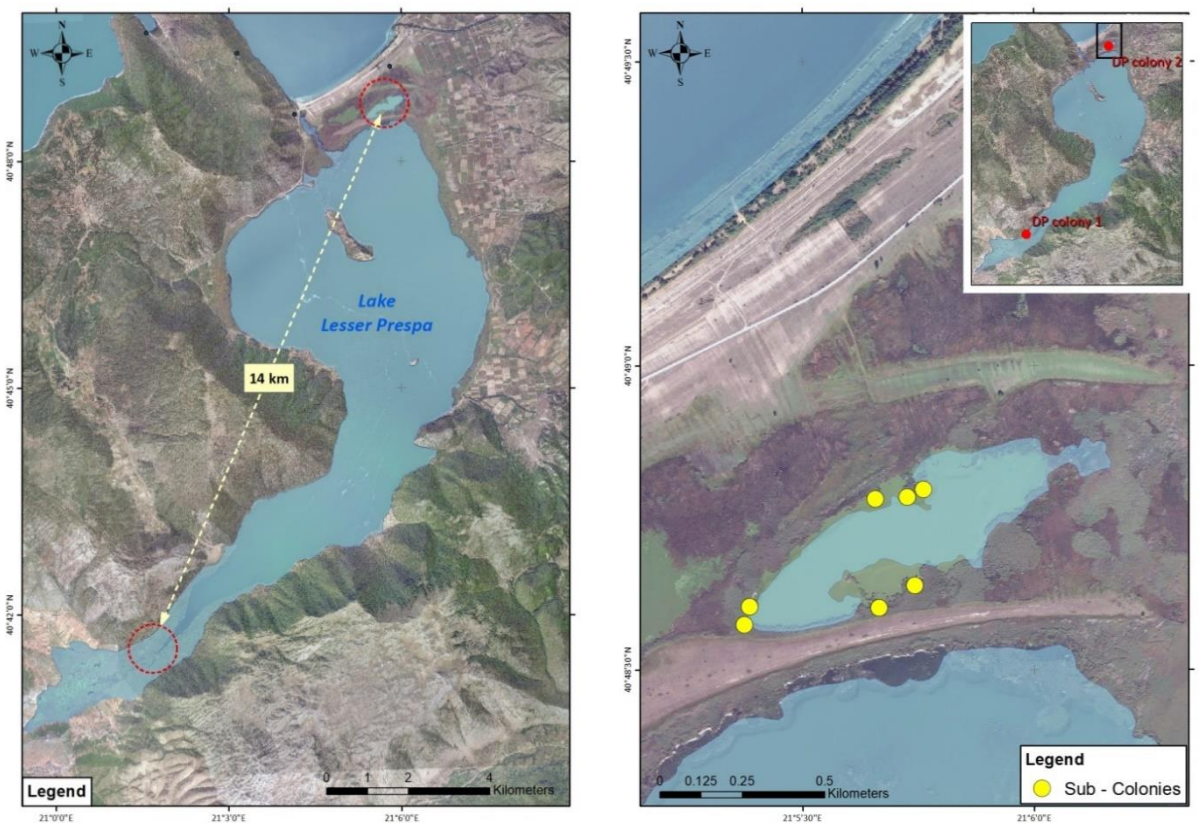


Figure 1: Visual aid to understanding the terms colonies/sub-colonies/breeding units: The Lesser Prespa Lake case. In Map 1 (left), two DP breeding concentrations are considered to be separate colonies, because of the large distance between them. On Map 2 (right), the northern colony consists of seven nesting islands, i.e. sub-colonies.

Photo 2. A nesting island, on which several discrete breeding units (outlined in blue) can be identified.

ARRIVAL DATE: The date on which the first ten individuals arrive at a certain breeding, staging or wintering site.

DEPARTURE DATE: The date on which the last ten individuals are observed at a certain breeding, staging or wintering site.

LAYING INITIATION DATE[1]: The date when the first eggs are laid. Alternatively: the mean date when the first ten eggs are laid.

BREEDING POPULATION (expressed in pairs): The number of pairs which attempt to breed, either successfully or unsuccessfully or more than once (re-nesting). Some authors have used this term as denoting the number of adult individuals present in the colony at the beginning of the breeding season, apparently in full breeding plumage and colours. This is erroneous and must be avoided. We cannot know the breeding population by simply counting the number of birds with full breeding plumage just present in a wetland. Only the number of pairs for which we have sufficient clues that they have actually attempted nesting should be taken into consideration (see below floaters, prospectors, etc.).

BREEDING PAIRS VS NESTING ATTEMPTS: Most of the time we are not able to count nesting pairs, but only the number of apparently occupied nests. If we base our breeding population estimates on one count (one census) then we can talk of the number of nests. If we base our breeding population estimates on more than one count (census), which take place some weeks apart from each other, then it would be better to talk about nesting attempts. In any case we should always have in mind that nesting attempts, or the number of nests, might well be different from the number of nesting pairs, i.e. actually breeding individuals/pairs. So, in practice, whether we are going to use breeding pairs or breeding/nesting attempts in our case depends on the method we are going to use and the time span of the laying period.

EARLY / LATE BREEDERS: A relative term having to do with the middle of the laying season. Those pairs that lay eggs before the middle of the laying period are called early breeders, those that lay later are called late breeders. The demarcation date between late and early breeders is arbitrary. We can also use one third and two thirds of the laying period to distinguish between early breeders and late breeders. Normally, late breeders might be younger or less experienced birds. However, there might be older and experienced birds amongst the late breeders, if they lay a replacement clutch. In general, early breeders have a higher breeding success than late breeders, for a variety of reasons.

LAYING PERIOD: The period (number of days) between the first and last egg laid in a colony/population. It is certainly at the level of a few weeks, but it becomes protracted when there is high number of replacement clutches.

[1] Dates can also be expressed in the number of days from the beginning of the year and in many cases it is better to be written in this form.

BREEDING PERIOD / SEASON: The period (number of days) between the date the first egg is laid in a colony and the fledging of the last young birds. This is also a relatively unclearly defined term, especially the termination of this period/season.

CLUTCH SIZE: The average number of eggs laid per female. It may differ significantly according to the group for which it is estimated (a breeding unit, a nesting island, a sub-colony, a colony), depending on the methods used for data collection.

REPLACEMENT CLUTCHES: DP are among those species that, when a pair for some reason loses its clutch (normally at egg stage, we do not have information on what happens at chick stage), might re-nest after a few days, after replenishing the resources necessary to perform pairing and form eggs again. These new clutches laid by birds which had already nested in the same breeding season are called replacement clutches.

CRÈCHE / PODS: At around 23-30 days after hatching DP chicks normally move outside the nest and form groups called a "crèche" or "pod", which move more or less within the colony, especially when there is disturbance or danger (Dentressangle et al. 2008)

Photo 3. A crèche or pod (group of chicks outside their nests).

GULAR FLUTTERING: By fluttering their gular pouches, young DP are able to cope with high temperatures and lower their body temperature (cooling) by increasing the circulation of cool air. It is a kind of thermo-regulation, the onset of endothermy. It starts at around day 17-19 (Dentressangle et al. 2008)

HATCHING SUCCESS: Ratio of eggs hatched to eggs laid (either in a breeding unit or in a sub-colony or a colony).

FLEDGING SUCCESS: The average number of offspring fledged per female (i.e. per breeding pair) in a colony in a given breeding period. Percentage of hatchlings that fledge (ratio of the number of hatched chicks to those that fledged). This is another expression of breeding success. Some authors also treat it as the ratio between eggs laid and chicks fledged. It can be a very misleading term. We suggest not using it in this project and keeping only the term BREEDING SUCCESS, i.e. the average number of offspring fledged – or almost fledged – per counted active nest (see also BREEDING SUCCESS and BREEDING POPULATION).

BREEDING SUCCESS: The number of chicks successfully raised to fledging (or to almost fledged age) per pair of breeders/ per nest / per breeding unit/ per sub-colony/ per colony (depends on which scale we measure it) or per nesting attempt. In practice, in pelicans it is often difficult to count fully fledged young, because some may have flown away from breeding site. Thus, it is allowed to count young just prior to fledging and consider them as almost equal to fledged.

Some authors have estimated breeding success (BS) as the number of fledged young in relation to eggs hatched, thus excluding all failed nests and eggs. Some authors also have estimated BS by taking into account only successful nests, i.e. nests that have either at least one egg hatched or at least one chick fledged.

For our needs, we simply need to know the number of breeding pairs and the number of fledged chicks. As we do not have individually marked breeding birds, we shall never be able to know how many of the late nests are in fact replacement nests. For this reason, we may only refer to the total number of different nests and relate them to the total number of fledged chicks, i.e. BS = Number of produced fledged chicks per number of breeding attempts.

In regard to comparisons, we have to be careful because BS may differ substantially from one study to another, according to which group it refers to (a breeding unit, a nesting island, a sub-colony, a colony).

DENSITY-DEPENDENCE: Regulation of population growth in regard to density. Changes in the rates of immigration, emigration, reproduction or mortality, in response to changes of population density. The effects of high competition for food and competition for nesting space are the usual expressions of density dependence phenomena. The high impact of diseases and high impact of predation (not the case with DP) impose restrictions on population growth. (Campbell & Lack 1985)

NON-BREEDERS, PROSPECTORS, FLOATERS, FLOATING BIRDS: Adults or birds of undetermined age, which do not reproduce, for a variety of reasons, but are present for varying durations at nesting colonies, apparently trying to secure a mate and breed. After a certain time, if they fail to do so, they disperse, mostly away from breeding colonies or breeding wetlands.

2.4. Activity patterns

SEARCHING-SWIMMING: When pelicans are observed just swimming in a water body apparently doing nothing in particular, (apart from if they are clearly dedicated to another straightforward comfort activity such as preening), they are in fact searching for prey. They are looking for fish.

They can do this either in the open water, far away from the coast, and in deep waters, or very close to the coastline, and many times, especially in early spring, at the edges of reedbeds. Thus, a swimming pelican should be considered to be actively searching for prey.

Besides the swim-and-look method, the main other active fishing methods pelicans use are the following:

- In dense flocks with great cormorants *Phalacrocorax carbo* (sometimes with *Larus* spp. and *Podiceps cristatus*), principally in deep waters. They also fish by actively looking for fish that have been pushed to the upper layers of the water by the diving cormorants, or by trying to kleptoparasitise the cormorants.
- In densely-packed groups and with synchronised movements (and in formations such as curved lines), and only in shallow waters, they fish by trying to push fish into the shallows (see general description in del Hoyo et al. 1992, Nelson 2006).
- Other methods of fishing are – swimming against the current in a stream or river, again watching for fish close to the surface; standing at the very edge of the water on the edge of the banks of rivers and striking passing fish, etc.

Photo 4. Dalmatian pelicans fishing with great cormorants in a dense flock at Kerkini Lake, north central Greece.

RESTING (status: standing, resting, roosting, sleeping, loafing, preening / roost counts)

- ROOSTING SITE = a site where birds mainly sleep and spend the night, rest, preen themselves/engage in comfort behaviour, but which is mainly used for sleeping.
- LOAFING SITE = a site where mainly comfort behaviour activities take place besides roosting. The main difference is that a roosting site's main use is for sleeping (but also other activities take place), while a loafing site is mainly used for comfort activities.
- STANDING = RESTING
- SLEEPING: When sleeping DP mostly turn back their head and rest their head and bill on the back half hidden in the feathers (back rest, bill tucked into plumage).

FLYING (flapping flight, soaring flight, gliding flight).

2.5. Census and monitoring

COUNT: One session of counting (individuals, nests, chicks, eggs out of nest, etc.).

CENSUS: Generally, population counts which can be used in monitoring programmes (Spellerberg 1991).

SURVEY: A set of qualitative or quantitative observations, usually through a standardised procedure and within a restricted period of time, but without any preconception of what the findings would be (Hellawell 1991).

SURVEILLANCE: The systematic measurement of variables and processes over time, aiming to establish a series of data in time (again without a preconception of what the results will be) to ascertain the variability and/or range of states or values which might be encountered over time (Spellerberg 1991).

MONITORING: Intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from an expected norm. Thus, it is a type of surveillance which assumes that there is a specific reason for that collection of data, such as whether those standards are met or not (Hellawell 1991).

3. COUNT-CENSUS-MONITORING

3.1. Introductory notes

Census and survey methods may vary between sites and between observers, resulting to incompatible data. The methods used in different habitats may require fine-tuning according to the site's peculiarities, nevertheless only the integration of the same basic concepts and methodological steps will guarantee that data are comparable, especially in the framework of a project with various actors. All the methods related to counts of breeding population of pelicans are presented below and discussed in detail, while the major problems and issues for estimating wintering populations of the Dalmatian pelican are also debated, along with suggested solutions.

3.2. Winter Census

In order to have a reliable count of DPs in a wetland in winter, the birds should be counted at their roost. Besides the advantage of its reliability, this option also has several drawbacks:

a. Short time available for count before it gets dark (and the arrival of the last pelicans).
b. The observer-s must know the roosting point beforehand (this requires some work prior to the census).
c. There might be more than one roosting/loafing point (this has higher demands in terms of necessary personnel).

In the case that a count at the roost is not possible, and one has to count the birds before roosting, then one should observe the following guidelines:

a. Start the census very early in the morning.
b. Scan the whole wetland as quickly as possible.
c. Start from one side of the wetland and proceed to the opposite side by scanning all the way along, noting the birds flying in the opposite direction.
d. Right from the start of the census, have an observer standing at a point where pelicans leaving and arriving in the wetland can be counted during the whole census. Of course, this needs work prior to the census to become familiar with the local behaviour and movements of pelicans.

In the case of very large wetlands, such as the Danube Delta for example, counts from aircraft may be necessary, but the methodology for work from aircraft will not be dealt with in this manual.

In the last decade, DPs have been observed to start breeding as early as the first days of January in many wetlands in SE Europe. Thus, the most typical and representative period for counting wintering numbers is December. We consider the days between 10th and 15th December to be appropriate days. It is important to discriminate between 1st calendar year individuals (i.e. juveniles born the year of the census, if the census is conducted in December) or 2nd calendar year individuals (i.e. juveniles born the year before, if the census is conducted in January) and all other individuals

(adults, immatures, adult-looking immatures) - for correct identification of the different age stages of the Dalmatian pelican consult the Dalmatian Pelican Identification Manual.

Photo 5. Dalmatian pelicans in the Evros Delta, northeastern Greece, an important wintering site in SE Europe. The photo was taken on 21st December 2017. Note that some individuals are already in breeding plumage and thus may soon depart for their breeding grounds or be on their way to them. Mid-January, when the standard IWC takes place, is late for counting DPs in their wintering grounds. Mid-December is more representative, and so we recommend that separate wintering counts should be considered for the species. Photo © Giorgos Iliadis / Evros Delta and Samothraki Management Body Archive.

3.3. Breeding Census

3.3.1. Working from the ground and from water

Methodological aspects: Nesting sites should be located and monitored as soon as possible, or be known prior to the start of surveys. Even in the case that we consider we know the exact locations of colony islands beforehand, we should still meticulously search all similar habitats within a reasonable radius around them for possible new breeding places. Again, in huge wetlands such as the Danube Delta, an exploratory aircraft survey should be carried out prior to the census work.

For most conservation work we need to know the following two parameters in order to be able to assess DP breeding success:

- *Number of nesting pairs (number of nests)*
- *Number of produced fledged young*

They might seem simple but they aren't so.

What do we need to record? Since the collection of certain parameters is closely dependent upon the method of census, in most cases it is necessary to collect a number of other parameters in addition, which will help us in correctly estimating the above two.

→ Arrival date of the first individual and arrival date of the first 10 individuals at the colony.
→ Date of initiation of courting-displays / copulations / carrying nesting material / territorial-fighting, in each one of the sub-colonies.
→ Date of incubation initiation for the first individual + date of incubation initiation of the first 10 individuals.

Collection of data: In theory we can collect all necessary (conservation-wise) information regarding the two above mentioned parameters, in a minimum of 5 steps (2 "observation" visits/sessions and 3 onsite visits). In practice, more onsite visits may be needed, but the more visits the higher the disturbance. **Thus, it is strongly recommended that physical visits to the breeding colonies are entirely avoided and the collection of all necessary data is done through drone photos** (see next section).

A. Vantage point: If there is a possibility to look at the colony from a vantage point through a telescope, we can have an estimation of the number of nests and the locations of "nesting aggregations[2]". A sketch of the spatial arrangement of units could be useful and is thus recommended.
B. Access by boat: In some cases, it is possible to approach the colony in a boat, keep a safe distance before the alarm / flashing distance is reached and, with binoculars or a telescope, observe the colony carefully and make a quick sketch with outlines of the shapes and spatial arrangement of breeding units, taking notes on the stage of the breeding cycle (copulating, courtship, sitting and collecting material, fighting, chicks just emerged, etc.). Each breeding unit is given an alphanumeric code and the order of establishment is noted.
C. 1st onsite visit: When should this take place? If we suppose that the first egg-laying takes place, for example, on February 10th[3], then this 1st visit should be done 45-50 days after we have seen the first birds sitting and incubating (10th February is day 41 from beginning of year + 45 days = day 86), i.e. around 27th March-3rd April.
   What we record: Total number of active nests per breeding unit, contents of each nest (chick-s, egg-s, empty), dead chicks and their age (by measuring lower mandible length – see Ageing for details – we have a measure of age). (For full description of FIELD SHEETS, see chapter 5 below).

[2] We refer to "nesting aggregations" and not to breeding units, because from far away it is not always easy to separate two neighbouring breeding units.
[3] All subsequent estimates are based on this hypothetical date. In each real case they must be adapted to the real dates.

1st visit count – Step by step

We first count the *total* number of apparently active, this year's nests (with some content or empty). On a next round we count number of empty nests, next we count nests with one chick – noting approx. age, then nests with two chicks, then nests with more than two chicks, then we count nests with one egg, then nests with two eggs and then nests with >2 eggs (if any). If there is a crèche we count its members first.

D. 2nd onsite visit: When should this take place? 100 days after we have seen the first birds sitting and incubating. Around 30th May-10th June if the hypothetical initiation is on February 10th.
   What we record: Overall number of grown up young, plus all recently hatched young. The total (young chicks + older chicks) number is considered the final number of produced young and it is used for the estimation of the BS.
E. 3rd onsite visit: When should this take place? 160 days after we have seen the first birds sitting and incubating. Around 20th-22nd July.
   What we record: Confirm number of active/used this year's nests and count dead young, and possibly count very late young (which have been possibly counted as very young chicks or eggs during the previous visit).

Recommended conditions for visits/approaching precautions: Especially for the onsite visit (spring and summer): We visit in the morning hours, so the sun is not yet very high up, but still having started to warm up the ground somewhat, i.e. until 10 to 11 am. No rain, no strong wind, no unusual cold. Ideally, we do not stay more than 15 minutes at each sub-colony. Always remember that eggs are at higher risk from over-heating than from getting cold.

As the boat approaches (slow to medium speed), we behave naturally, and sudden moves or shouting should be avoided, so that the birds are given the opportunity to understand that we are heading to their nesting island. When we move with a steadily slow to medium speed, they first get alarmed, they raise their heads and look to us with anxiety, and when they realise we are heading towards them they immediately start walking towards the edge of the island or start directly flying away. We need to give them time and distance to do this without haste or panic, because this will be disastrous. Slow speed so that they can leave in an orderly way, without stepping on nests, eggs and small chicks. If they have all left, then we can speed up again.

When the work is over, we move away from the colony this time creating some noise, as we need the birds to see clearly that we are departing. When at a certain distance from the colony and birds have started returning, we stop and watch to be sure that birds are returning normally and nothing impedes them, or nothing else abnormal has happened.

It is strongly advisable to only carry out the first visits if accompanied by a more experienced person (person who has worked with pelicans or other colonial waterbirds at least).

Photo 6. First visit count in Amvrakikos wetlands, western Greece, on April 4th. Notice the large age variation, from the recently hatched chicks at the front to the much older young at the back. Photo © Maria Katsikatsou / Amvrakikos Wetlands Management Body Archive.

Researcher disturbance

Is disturbance (by fishers, tourists, hunters, researchers, etc.) a real threat to DP colonies?

It is possible that pelicans who have already chosen a nesting place, if disturbed at the very early stages of nesting (i.e. during courtship, copulation, territory establishment, nest building), will abandon the place and either try to breed in another place, or try to breed later at the same place (less likely), or they don't breed that year at all.

Nests and eggs are easily abandoned, particularly in the first 15-20 days of incubation after an incident of serious disturbance.

The longer the time eggs and chicks remain unprotected by parents, the greater the risk is that they become easy prey to airborne predators, who may wait nearby for the opportunity (gulls, magpies, other corvids and others).

Chicks cannot thermo-regulate before 17 days of age (Dentressangle et al. 2008). If they stay unprotected for more than a few minutes they may die of cold if temperatures are low. Note that a much higher risk of death occurs after long exposure to high temperatures!

In their panic to escape disturbance, adults may step on eggs and crush them. They may even step on and squash or injure newly hatched chicks, especially those that are 1-4 days old. It is even more likely for grown up young to step on eggs and other small young in nests, if they are moving in panic trying to flee from invaders. In cases of severe disturbance adults may even abandon their offspring (though this is rare).

Moreover, if chicks get into the water they may start swimming away from the colony and end up very far away, where parents cannot find them or will not feed them, and they may thus starve to death or be predated upon.

3.3.2. Working with a drone

Drones (or UAVs: unmanned aerial vehicles) are remote-controlled aerial devices capable of collecting high-resolution spatial data in difficult-to-access areas, with non-significant disturbance to the breeding birds, and with an affordable cost depending on the surface to be covered (Sarda-Palomera et al. 2012). Remote control is possible through devices such as transmitters, receivers and sensors. The primary motivation for using drones in wildlife conservation is to generate high resolution images (Chabot & Francis 2016).

The use of drones makes it possible to obtain very detailed biological information without causing disturbance, which would not otherwise be possible. Visits to pelican colonies to count nests or young provide valuable information, yet they can cause major disturbance, especially in large colonies, and they require not inconsiderable time and preparation. On the other hand, counts performed from vantage points do not cause disturbance but they may lack accuracy. Counts from vantage points sometimes don't provide full coverage of the colony, because of the orientation of nesting sites, the vegetation or other factors. The use of a drone for monitoring pelican colonies

can provide extra data to verify or correct erroneous estimations from other counts, caused, for example, due to the overcrowding of pelicans on colonies. The results derived from more than 10 years of using drones in Prespa demonstrate the capability of the method for detailed monitoring of Dalmatian pelican colonies and their applicability for obtaining long-term comparable breeding population data.

Photo 7. Monitoring the Prespa pelican colony with a drone.

The purchase and operation of a drone is a relatively low-cost endeavour, and so drones can serve as a handy tool for monitoring pelican colonies. Potential users should be aware that some basic training is necessary and a good knowledge of the area in which you will operate it is essential. In addition, it is mandatory to have a license to fly a drone in most countries, while the heights at which they can be flown, the maximum distance from the operator, in which places they can fly and what purposes they can be used for, are all regulated by law.

Experience has shown that this method should be used to complement other methods. It should be stressed that if your research is based on drone use, then you should be able to replace the drone immediately in case of a crash, or be able to apply alternative methods. If this is not ensured then there is a risk of losing the whole monitoring season, especially if the phenomenon being studied, such as breeding, takes place with a narrow timeframe.

Photo 8. Hidden parts of the pelican breeding islets in Prespa, as seen when monitored from a high vantage point.

Types of drones used for bird monitoring and research

- Multi-rotor: These use multiple propellers to navigate and fly and they are the most common of all drones. Quadcopters (four propeller drones) are the most common multi-rotor drones. They are the easiest and cheapest option. Because they give great control over position and framing they are perfect for aerial photography work. They are limited to around 20-30 minutes' use, making them unsuitable for long distance inspection.
- Fixed-wing: Fixed-wing drones have wings in place of propellers just like an airplane. They are preferable for surveying large colonies due to their extended battery life and range (Lyons et al. 2019). The main downside of a fixed-wing drone is their inability to hover in one spot. Also, depending on their size, launching and landing can be trickier compared to a multi-rotor.

Drone flight execution for monitoring pelican colonies

The drone takes off from land, or water (e.g. from a boat or a floating raft), at least 100 m away from the colony. It ascends to about 60 m or higher and approaches the pelican nesting site. Then, the photography work can start; it is recommended to take 1-2 vertical and a few oblique photos facing several sides of the nesting site. The oblique photos can prove very useful during image analysis, as they provide more insight into what is going on under a pelican that is sitting (e.g. the pelican may have very small young that cannot be detected on a vertical image, as they are likely concealed by its body). Also, having both vertical and oblique photos of the same site allows for better judgment during image analysis: e.g. pelicans that appear to be sitting may be incubating eggs/guarding small young at their nests OR they could just be roosting on the nesting site without having a nest. Nesting material under a pelican's body will help us decide which of the two is true. A vertical photo alone may not be sufficient for drawing conclusions, and this is especially true for great white pelicans, whose nests are rudimentary structures with minimum nesting material, unlike Dalmatian pelicans whose nests are large and sturdy. The number of photos to be taken is decided in relation to the various circumstances and special needs at each site. In some cases, 1-2 photos can be enough. When the photography work is done the drone returns to land or continues its course towards another close-by nesting site.

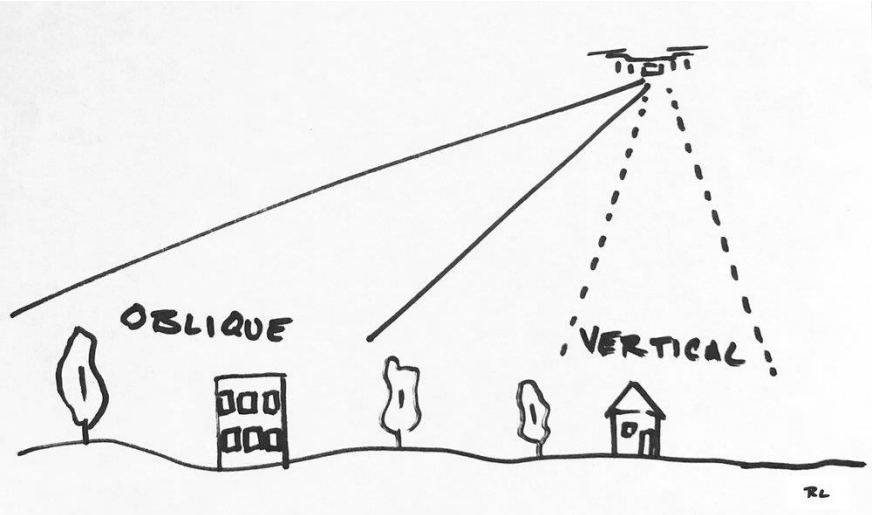


Figure 2. Vertical and oblique drone photography (*source: Rick Lohre photography https://www.ricklohre.com/category-aerial-imaging-obliques-vs-verticals/)*

Flight height: A flight height of 40-60 m is considered adequate for obtaining images of sufficiently high resolution to accurately detect individual nests in the image, but without causing disturbance to the breeding birds. These high-resolution images – 25 megapixels or higher is the ideal camera resolution – at a height of 40-60 m are highly satisfactory with respect to the average physical dimensions of pelicans, their nests and young. Flights below 40 m may trigger an adverse reaction and should be avoided.

Become familiar with behavioural signs of adverse reaction

A drone approaching a pelican colony and flying too low will trigger alertness: pelicans turn their heads towards the sky looking for what is generating the strange noise – in relatively quiet areas, drones are reasonably noisy, and can be heard 200-300 m away. If the drone persists for more than a few seconds, then pelicans may fly away. If that happens and the flight is taking place during incubation, then the risk of causing eggs to roll out of the nest or to break is very high. Therefore, the operator has to be extremely cautious in the early stages of nesting and on no occasion cause the drone to descend under the suggested threshold of 40 m.

Flight duration and approaching pelican colonies: A drone approaching a bird vertically is usually more disturbing, possibly because it is associated with a predator attack (Vas et al. 2015), thus vertical hovering over pelican colonies should be kept at a minimum, just a few seconds to take the images needed. Even if behavioural changes in pelicans are not recorded during most approaches – when these approaches are made in compliance with the flight height recommendations – this does not mean that the drone presence is not stressful for them. Hence, the drone operator should limit total flight time over each nesting site to a minimum to ensure minimal impact.

Flight schedule throughout the breeding period: The primary focus for monitoring in pelican colonies, is counting nests. Another important breeding parameter that is usually desirable is breeding success (BS), and thus an efficient count of young is also needed. In order to accomplish these tasks, 2-4 flights may be required during the breeding period.

Counting nests: In cases where all the pelicans at a colony have nested more or less synchronously, one flight at the beginning of the breeding period could be adequate for determining the total number of nests. This flight should be scheduled around 2-3 weeks after we observe the initiation of egg-laying. However, in most cases, Dalmatian pelicans don't nest synchronously, i.e. they arrive at the nesting site at different dates, in some cases throughout a period of two months. In this case, a second, and possibly a third, flight will be essential in order to count the additional nests of the late nesters.

Photo 9. Drone photo of a Dalmatian pelican islet in early April where asynchronous nesting is apparent – several adults sit on nests guarding eggs or very young chicks, while in other nests there are older chicks left unattended.

Counting young: Around 3 weeks after hatching, the young pelicans can be clearly detected and discriminated in aerial images, as they are left unattended by their parents for longer periods. Young Dalmatian pelicans fledge at circa 85 days, but they can swim long before fledging, at around 40-50 days and even much earlier. Therefore, good timing of the flight for counting young is very important. The following should be taken in account: 1. An early flight could fail to detect all young pelicans, as some may still be very young and thus covered by their parents' bodies, 2. An early flight could overestimate BS, because some of the young counted may still be too young and may not survive to fledge, 3. A late flight will underestimate BS, as some of the young have grown and may be in the water. Consequently, a good compromise should be sought for scheduling the flights aimed at achieving a satisfactory estimation of young. The available record of all facts and events related to breeding of the year should be taken in account. A hypothetical example is given for Prespa: Dalmatian pelicans started arriving very early in year X, due to warmer-than-usual winter weather. By the end of January quite a few Dalmatian pelicans had already arrived in Prespa and started egg-laying, according to our observations of the colony from vantage points. However, the majority of the breeders built their nests and initiated egg-laying on 10^{th}-15^{th} February. Thus, we would expect that most hatchlings would be produced on 11^{th}-18^{th} March (calculating an average incubation period of 30-32 days). With these facts taken in account, the respective flight would ideally take place in the last week of April or the first of May, when chicks would be 40-50 days old. Then, the estimated BS will be based on this count of young and will be representative of the core nesting period (not the early and late nesters), as it is unlikely that we have enough data to estimate the overall BS.

Environmental conditions: The environmental conditions that provide optimal flight conditions are high visibility and low wind speeds. Pelicans, being white, stand out in the images and are easily isolated from the background. However, with a bright background the contrast will be weak and this is sometimes the case with bright sunshine combined with the reflection of sunlight on water. Along the same lines, dark areas of water or land will produce very high (not optimal) contrast when photographing with midday light on a sunny day. Also, shaded vegetation on a nesting site could impede the detection of nests or young. To minimise the effect of hard midday light, special lens filters can be used to reduce the amount of light which enters the camera. Alternatively, light cloudy days are preferred, and as with standard wildlife photography, early and late in the day is the best time to photograph. Another drawback of flying at noon on a sunny day is obstructed viewing of the remote-controller's live-view (usually a tablet or a mobile phone). In bright sunshine the tablet is hard to see due to glare on the screen. Special sun shades can be very helpful with this.

Image analysis: As noted above, the primary focus for monitoring in pelican colonies, is counting nests. The number of nests can be determined manually through visual interpretation by an expert. Nesting material under a seated adult depicts a nesting individual. A simple grid drawn over the image (e.g. with Microsoft Paint) may prove helpful for a more efficient and less time-consuming count, especially of large colonies. Gridlines should be given a code to assist the process, e.g. vertical gridlines can be given numbers and horizontal gridlines can be given letters. Even in the case of small colonies, where a grid is not needed, a painting programme can serve as a useful tool for marking pelican nests or young, or drawing lines or circles for various reasons. Marking with a simple colored dot can help, for example, to distinguish between pelicans sitting on a nest versus pelicans roosting. Counting nests in groups of ten and circling them will speed up the process of counting.

Photo 10. A paint programme can prove very useful when analysing drone images.

Drone images are georeferenced, and thus have essential information that enhances their utility. Nevertheless, it is useful to include one or more stable reference points in the image, such as trees.

Such fixed points could be used for practical comparisons between years, as well as for more accurate surface and distance measurements.

As an alternative to manual counts, counts may be carried out by automatic count procedures based on image-analysis techniques (Grenzdörffer 2013, Afán et al. 2018). This is especially helpful in cases of very large breeding colonies, such as those of the great white pelican in the Danube Delta.

Further uses of drone images of pelican colonies: Drone images of pelican colonies can also be used for nest measurements, as well as to determine nest density and minimum proximity distance.

3.4. Occurrence Census (all year round)

In the situation where we need to be engaged in a year-round surveillance of pelicans using a wetland, we have to set clear goals and have clear answers to the questions of why we are doing this and in what way we are going to use the collected data. This is a tricky issue which is further explained below.

Things we should consider: Pelicans can move relatively easily, and with a low energy cost, for impressively long distances in a short time, they may well travel to a wetland to feed and then fly to another wetland to rest or roost. In a case like this, for example when we count pelicans in a specific wetland, we need to understand what the numbers counted in every single wetland represent. In the case of wetlands lying close together, or large complexes of wetlands (such as for example the Danube Delta, the lower Danube River, or the large Amvrakikos and Karavasta coastal lagoon complexes (in Greece and Albania respectively), or in case of transboundary wetlands (such as the Danube Delta, Prespa lakes, Evros/Meriç Delta, etc.) pelicans move easily from one country to the other. So, again, we need to know what the counted numbers of individuals represent each time. We have to have in mind that at the time of census a varying proportion of the total number of pelicans in one wetland may be absent at other wetlands or other parts of a wetland complex. Clearly, pelicans can use a wetland for staging, roosting, resting (or breeding, of course) and other wetlands for feeding. All the possible combinations and durations of use may vary throughout the year and between individuals. If we also take into consideration that the duration pelicans are present in a wetland also varies according to many factors specific to the particular wetland and its position and distance from other wetlands, then it is obvious that the time of census may well provide biased data, because each activity takes place at different hours of the day. For example, resident pelicans feed more intensively in the first 5 hours of the day, i.e. from dawn to ca. 11-12 o' clock, and then they again show a somewhat less intense feeding activity in the afternoon hours.

Tips on simultaneous counts over large areas:

- A good knowledge of the area is very important.
- Multiple teams are needed, so as to cover the area as simultaneously as possible.
- Timing of the count: Better to be carried out as late as possible in the afternoon, when pelicans tend to move less (i.e. fly from one wetland to another or from one area to another in the same wetland), and they have possibly returned from their visits to other nearby

wetlands. Most soaring birds in the temperate regions use thermals, which are stronger in the midday hours, thus they have concluded most of their journeys by the afternoon hours.

- Prior arrangements and during-the-count-communication between teams is needed in order to cope with the likelihood of double counts (e.g. a flock is moving towards team A from the direction of team B. Should it be counted?)
- The route chosen should be completed as soon as possible, to avoid double counts due to the possible movements of the birds within the wetlands, which will create confusion or go undetected.
- Care should be taken to include as much of the wetland as possible, not to leave blind spots.

Almost all small- and medium-sized wetlands with regular shapes and coastlines can be censused from a network of vantage points on land, while moving between the points carried out by vehicles or on foot. Large wetlands with irregular shapes and rugged coastlines, in which some parts cannot be seen from the land around them, should be censused either with a boat or from an aircraft. When using a boat, the pattern of the itinerary to be followed should be such as to ensure coverage of the whole wetland.

4. CAPTURING AND HANDLING

4.1. Introductory notes

Careful planning and proper handling are crucial for a bird's welfare when executing capture and handling activities. It is very important that the handler adheres to specific guidelines in order to avoid injuries and excessive stress to birds. Especially when handling large and heavy birds, like pelicans, special care and understanding of their distinct morphological and behavioural features is required. The techniques detailed here have been refined over the past thirty years of the SPP's experience working on pelicans in Prespa and other pelican colonies in Greece.

4.2. Trapping-capturing

Trapping large chicks: With this method, ideally, 3 boats approach the breeding island from three different directions simultaneously (in the case of an open water island). The timing of the boat approach is chosen so that chicks are discouraged from entering the water, but rather hide in the vegetation (except, of course, if you judge that they will be inaccessible there, in that case they are better encouraged /pushed to go into the water). The aim is to keep them on the colony, and for as many observers as possible to go ashore onto the colony quickly and encircle the young, keeping them huddled together. The majority of grown young are continuously on the move trying to flee away from the intruders, so if many larger-sized young are rounded up on the colony, then in order to keep them confined a self-made enclosure of plastic safety fencing material (up to 80 cm high) and light supporting sticks (such as canes for example) should be used to keep chicks confined, while researchers finish their job of ringing, tagging, measuring.

Photo 11. Keeping young great white pelicans in an enclosure while ringing on the nesting island.

Trapping young able to swim (but not fly): 2-3 swift boats with engines approach the colony simultaneously and encircle the nesting island/platform. Unfledged young will get into the water and swim away; they are followed by boat, and a person at the front or the middle of the boat collects them with a strong sweep-net and takes them into the boat, where other people undertake to handle them. The procedure stops when all the boats have collected enough young. This method is not appropriate for flying juveniles, immatures and adults.

Photo 12. Catching young by hand /sweep-net from a boat after following and circling them.

Trapping individuals capable of flight: Leg-hold traps are one of the methods used for trapping pelicans, usually in order to fit them with tracking devices (transmitters) (King et al. 1998). With this method, individuals of all ages can be trapped (juveniles, immatures, adults). Other methods for trapping pelicans include cannon nets, rocket nets and whoosh nets. Within this manual we will focus on leg-hold traps, which are easier to use and require minimum preparation.

- Leg-hold traps can be put in places where pelicans roost, rest and loaf, but not on the nesting site!
- No risk of injury for the pelican's foot.
- Risk of injury for other smaller birds, e.g. herons, gulls.
- This method can be used both during and outside the breeding season.
- Leg-hold traps can also be placed under water (e.g. shallow water near the coast).
- They can be covered with material found around the site for camouflage, or left as they are.

- They must be anchored very securely to a solid point. This is crucial, since if the anchor is not strong enough the pelican may be able to flee with the trap attached to its leg!
- The trapping site must be supervised from not very far away, so that when a bird is caught the observer may arrive within a few minutes.

Photo 13. A leg-hold trap used for trapping pelicans. Notice that the jaws of the trap are covered in rubber to eliminate the risk of injury. Also, the trap is purposely manufactured with slightly off set jaws for a softer catch, the drawback being that the pelican has some chances of escaping if the leg is only partially caught (*source: https://www.wildlifecontrolsupplies.com).*

4.3. Handling

To minimise time held in captivity, marking procedures should be conducted at, or as near as possible to, the capture site. If possible, captures should be scheduled, so as to avoid periods when birds may already be physiologically stressed, such as during breeding or migration (Whitworth et al. 2007).

When handling a pelican for marking or deploying a transmitter, a head cover should be used to cover the eyes and keep the bird calmer. For this purpose, a sleeve from an old shirt can be used as a head cover. In order to keep the bird still, one arm is put over the body and the folded wings and the other hand should hold the pelican bill.

Photos 14 and 15. A head cover to keep the pelican calmer and proper hold of a pelican for safe handling. Photo on the right © Theodoros Naziridis / Lake Kerkini Management Body Archive.

Safety precautions for the handler: One should never trust a seemingly calm pelican and leave the head uncontrolled, as they might strike and cause serious injury with the beak "nail". A waterproof outfit, boots and strong plastic gloves are recommended to avoid contact with the bird's excrement. All standard hygienic precautions and measures should be taken when handling birds, i.e. no eating, drinking or smoking during handling, and washing hands thoroughly afterwards.

4.3.1. Ringing

Both metal and plastic individually numbered rings are used for ringing pelicans, in order to enable individual identification. The shape of rings is oval (ellipse), to match the pelican leg. The internal dimensions of plastic rings are 24 X 38 mm, with a height of 45 mm. Plastic rings have alphanumeric codes, one to two letters and two to three numbers. The ring should be fitted with the letter towards the foot, so that code can be read from downwards to upwards (as in photo 17). We recommend that plastic rings are fitted using instant dry (super) glue (first put the ring around the leg and then apply the glue and keep the two ring edges pressed together for 20 seconds), as there have been indications that pelicans can remove them.

Photos 16 and 17. A pelican metal ring (left) and a fitted pelican plastic ring (right). Photo on the left © Manolia Vougioukalou / HOS Archive. Photo on the right © Kostas Papadopoulos / Lake Kerkini Management Body Archive.

4.3.2. Fitting patagial (wing) tags

Patagial tags are individually numbered plastic tags fitted to the wing in order to enable individual identification. They are permanent and are held onto the wing by a rivet punched through the patagium. Tagging the wing through piercing the patagium, if done correctly, should not cause harm to the bird. However, there is potential for causing serious damage rendering the bird flightless, if not done correctly! Implementation of patagial tags should only be done by trained professionals, or under the supervision of a trained professional. Care has to be taken so that the patagial tag is placed appropriately, so that it does not interfere with the bend in the patagium.

Photo 18. A patagial tag fitted by the SPP team on an adult Dalmatian pelican at Kerkini Lake, Greece. Photo © Kostas Papadopoulos / Kerkini Lake Management Body.

These tags can be printed, or made from PVC, and they are durable and visible. Alphanumeric codes are drawn with a permanent marker. Tags use a "male" and "female" attachment (similar to the ear tags for cattle), which are easy to implement with a hand-held applicator. The piercing should be made about 2 cm away from the edge and some centimetres away from the bend in the pelican's elbow (somewhere in the middle between elbow and wrist). The site should be thoroughly investigated by touch. The piercing should be at least 1 cm away from the pro-patagial tendon. The patagium should be thin in this region and piercing should not cause any bleeding. In no circumstance should a bird be tagged before primary feathers are fully developed and the bird has begun stretching its wings in preparation for its first flight (Wolter et al. 2014).

Photo 19. A patagial tag with "male" and "female" attachments and a standard cattle ear-tag applicator (*source: Wolter et al. 2014*).

4.3.3. Fitting tracking devices

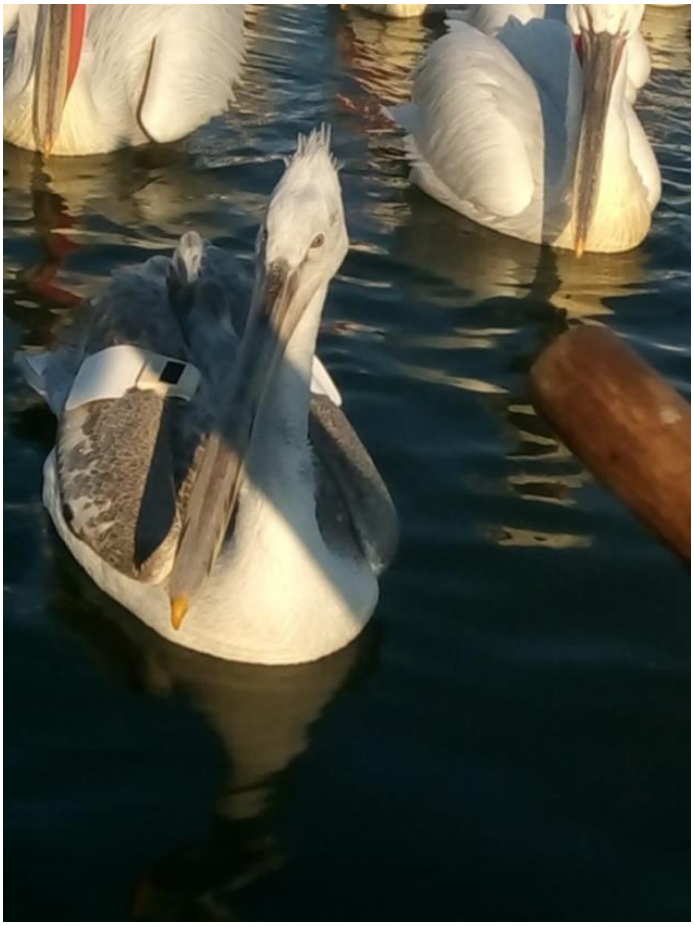
Based on the preliminary results of a long-term study in Greece, it is suspected that the backpack harness method may affect the breeding propensity of Dalmatian pelicans. Harmful effects, or data biases, from marks and devices, harness-mounted transmitters amongst them, have been observed in several species of birds (Calvo & Furness 1992, Barron et al. 2010, Dixon et al. 2016). We are thus inclined to recommend the use of patagial transmitters as a potentially less invasive method. However, we also briefly describe the backpack harness fitting technique. In each case, monitoring of the effect of transmitters on the behaviour of every bird supplied with a transmitter should be carried out carefully, and detailed notes be kept so that any effect can be assessed. We definitely need more data on the effects of transmitters on birds!

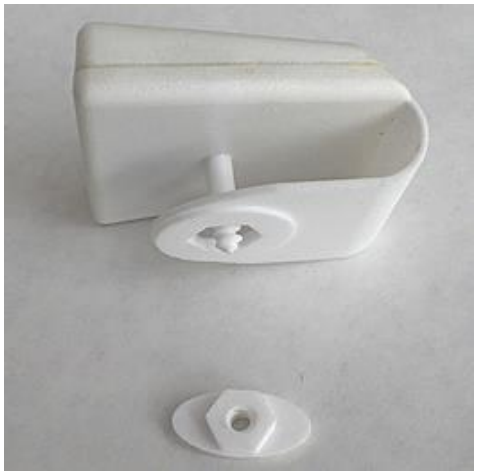
Backpack transmitter: This type is mounted on the pelican's back as a backpack, and is held in place by a harness made of silicone straps covered with tubular Teflon tape. Flexible metal rings are mounted on the straps using pliers, to keep the transmitter in the required position. This fitting

technique requires considerable bird handling time (30-40 minutes) and should be only done by a trained professional. Apart from the effects of this fitting technique on the bird, it also appears that mantle feathers (which become more elongated during breeding) can be preened by the pelican in such a way as to wholly or partly cover the solar panel, thus severely compromising its ability to charge and reducing the utility and life of the transmitter. To partly overcome this problem a shield made of transparent polyethylene terephthalate can be fitted under the transmitter to reduce the potential for it being covered.

Photos 20 and 21. An adult (left) and a juvenile (right) Dalmatian pelican fitted with backpack transmitters.

Patagial transmitter: This type of transmitter has recently been developed by various manufacturers. Patagial transmitters are more exposed to the sun, allowing better battery charging through the solar panels, and they are much easier to deploy compared to backpack harness transmitters. The technique is basically the same as fitting a simple patagial tag. Once the patagial tag is fitted, then the attachments are cut off and the patagial transmitter is put in the place of the tag or on top of the tag. Glue is put on the screw as a precautionary measure to prevent it from unscrewing.





Photos 22 and 23. An immature Dalmatian pelican fitted with a patagial transmitter photographed at Kerkini Lake, Greece (Photo on the left © Vasilis Arabatzis) and a patagial transmitter (lateral side) before deployment (*source: https://www.ornitela.com/*).

4.3.4. Measurements

Beak measurement and weighing are two basic measurements to be taken when handling a pelican. In addition, the measurement of the beak is useful for sexing Dalmatian pelicans.

Weighing: Pelicans may be relatively easily weighed, by carefully placing the bird into a bag (e.g. a large travel bag that allows the head to be out of the bag) and then weighing the bag using a handheld luggage scale. The bird must remain still long enough for the scale to settle and the handler will have to hold the head until just before lifting the bag. Remember to subtract the weight of the bag from the total weight. Alternatively, the pelican can be weighed using a hanging scale, for which the bird will have to be placed in a sack and then hung from the scale, or be weighed using a stand-on scale – the handler will weigh him/herself with the bird in hand and then subtract his/her weight from the total.

Beak measurement: The beak of the pelican is measured from the tip to the mandible bone embedded in the cheek (i.e. beyond the visible part of the beak, see photos).


Photos 24 and 25. Pelican lower mandible length measurement (from the back edge of the mandible bone to the tip).

Sexing: Female Dalmatian pelicans are slightly smaller than males, but this difference may not be discernible in the field, especially from a long distance. When handling, though, various measurements of females are smaller than males, and the beak measurement may be very useful for determining the sex in the vast majority of individuals. The general rule followed is that a lower mandible length in males is ≥47 cm, whereas in females it is <45cm, while beak lengths between 45 cm and 47 cm cannot be clearly determined.

5. FIELD SHEETS AND REPORTING

5.1. Introductory notes

Field sheets are essential for collecting and entering bird count data. Besides field sheets in the form of specific templates, a simple notebook may also be very useful, and handy for drawing sketches and keeping notes with comments on weather, bird behaviour or habitat conditions etc. Such notes may prove very useful at the later stage of analysis and interpretation of data. The results from pelican counts can be presented in a number of ways. Distribution maps can be drawn, the number of birds can be graphed or mapped, sketches of breeding units can be drawn, an analysis of trends between sites and across time can be presented etc. Authors must ensure that the results are reported regularly, in a consistent and complete manner, and in a format suitable for the target audience.

5.2. Field sheets

5.2.1. Counts from fixed points (land & boat)

When counting pelicans on breeding colonies the following data should be kept:

- Date (dd/mm/yyyy)
- Observer name
- Time of day (local time), start-end
- Name or code of vantage point
- Name or code of colony/sub-colony observed
- Number of pelicans present (discriminating, if possible, between adults and all the birds with immature plumage but not including numbers of chicks and juveniles). Use: Pelcri adults, Pelcri non adults, Pelono adults, Pelono non adults.
- Number of nests (apparently occupied nests, i.e. incubating or brooding adults).
- Visibility (*Good*, for very clear or normal/average visibility conditions and *Bad* when there are indeed visibility limitations set by inclement weather, drizzle, fog, etc.).
- Sketches of the distribution of breeding units with codes and number of nests.
- Visual coverage of the colony. Explain if the entire colony/sub-colony/island can be clearly observed or just a part of it, and indicate which, either in words or with a sketch.
- General Notes (activities, prevailing behaviour, noteworthy events, comments on weather and habitat, disturbance, etc.), also include here information on average age of chicks, the occurrence of dead individuals, etc.

5.2.2. Onsite visit

The following information should be included in a field sheet to be used for recording the data obtained in a field visit on a colony site:

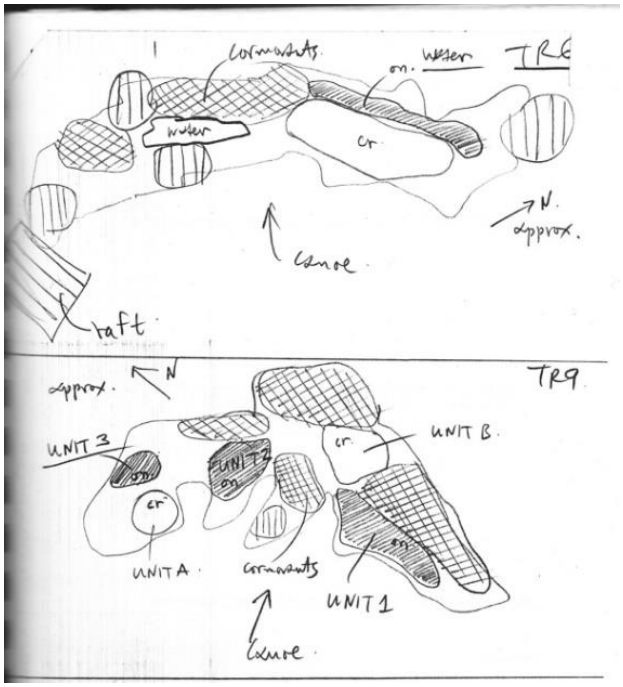


Figure 4. During an onsite visit a simple sketch of the distribution of breeding units with codes may prove very useful for future data analysis.

- **Date**
- **Observer name**
- **Person keeping notes** (if different from observer)
- **Time of day**
- **Name or code of colony,** sub-colony, breeding unit. Fill in a different field sheet for each separate breeding unit.
- **Sketches** of distribution of breeding units with codes and number of nests

At each breeding unit:

- **Code of unit**
- **Nest contents** (e.g. in a unit of 13 nests):
  3 nests X 1 egg,
  4 nests X 2 eggs,
  1 nest X 1 egg and 2 chicks, ca 1 week old,
  1 empty nest,
  4 nests X 2 chicks, older 14 days -younger 1 day,
  2 nests X 1 chick ca. 5 days' old.
- **Number of dead chicks**: Lower mandible length of each dead chick should only be noted if there is a special goal to identify the causes of mortality or connection with disturbance effects or predation instances, etc. An alternative would be to just note the estimated age class of the dead chick (i.e. 2 weeks old).

- **Notes and comments** (noteworthy events, dead adults or immatures found on the colony, comments on bird behaviour, habitat conditions and status, etc.).

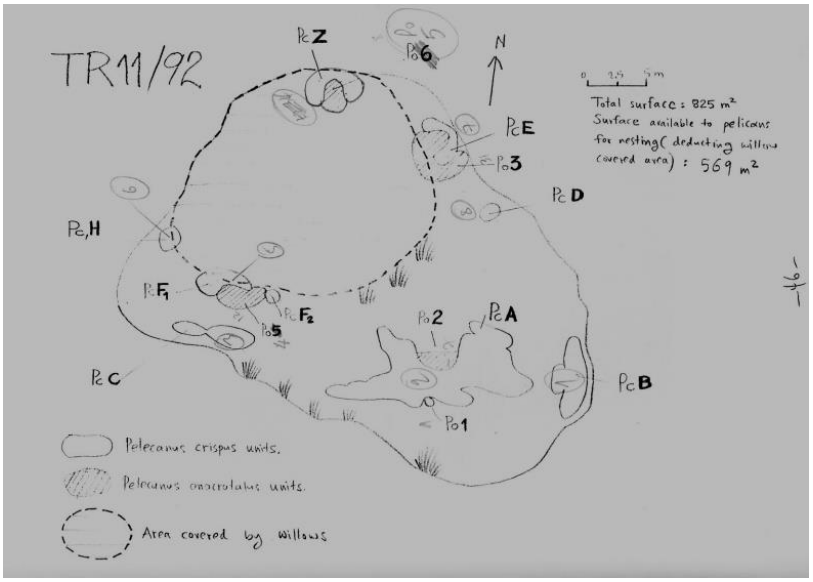


Figure 5. Indicative drawing from an onsite visit depicting a breeding island (sub-colony) with the spatial arrangement of Dalmatian pelican breeding units (PcA, PcB, PcC, PcD,…etc), great white pelican breeding units (Po1, Po2,…), and vegetation cover.

5.2.3. Morbidity and mortality records

The SPP, as part of the LIFE15 NAT/GR/000936 – Prespa Waterbirds Project https://www.prespawaterbirds.gr/ , prepared a plan for co-ordinated action aiming to ensure effective collaboration between local agencies, and to assist local veterinary authorities, in case of a zoonotic disease which may affect the populations of pelicans and/or other Prespa waterbirds. This plan included all the actions and measures that must be taken proactively, but also in the case of a disease outbreak. The following protocol was prepared in the context of this action and is presented here to cover the need of reporting dead or moribund birds (see also Appendix I).

PROTOCOL FOR RECORDING INCIDENCES OF DEAD OR MORIBUND BIRDS		
DATE:	SPECIES:	SITE:
DESCRIPTION OF BIRD'S CONDITION:		
POSSIBLE CAUSES OF DEATH/INJURY/CONDITION:		
PHOTOS (codes):		
OTHER COMMENTS:		
CLARIFICATIONS		
DATE: DD/MM/YY		
SPECIES: If not certain about the species, note the family eg. ducks, waders.		
SITE: Name plus description of the exact place plus GPS coordinates (if possible)		
DESCRIPTION OF BIRD'S CONDITION: Good description: how fresh does the corpse look, if there are open wounds, degree of decomposition, presence of larvae - flies, if there are external parasites, if it is very thin etc.		
POSSIBLE CAUSES OF DEATH/INJURY/CONDITION: Description by judgment. For example, electrocuted or collision with power lines because it was found under power lines, shot, unknown cause, drowned, entangled in nets etc.		
PHOTOS: We take photos of the corpse from all sides (up, down, right, left, and head close-up). We photograph the corpse with the surrounding area within a radius of 2 meters and 4-5 meters. Take a long shot (about 10 meters and if possible stand somewhere higher.) In the protocol, note the photo numbers and the date.		
OTHER COMMENTS: Anything you consider important and you can not write it elsewhere. e.g. How you found out about the incident and any other detail.		

In the same LIFE Prespa Waterbirds project, a leaflet was produced, targeted at local stakeholders and the general public, with actions to be taken in the case of a waterbird mortality event at Lesser Prespa Lake, including instructions for photographing dead or diseased birds. It has been deemed useful for the current project as well, and therefore it is presented below (see also Appendix II).

Instructions for photographing dead wild birds

Take a photo of the carcass from all sides (up, down, right, left, and a close shot of the head). Take a photo of the carcass with the surrounding area at a radius of 2 meters and 4-5 meters. Take a photo from a distance (approximately 10 metres, and, if possible, while standing at a higher point). You can use your mobile phone or any type of camera. Photos can be sent by email to: *spp@spp.gr*

Examples of photographs

www.prespawaterbirds.gr

LIFE15 NAT/GR/000936 – Prespa Waterbirds Project (2016-2021).
The project is 60% co-funded by the LIFE financial instrument of the European Commission.

SOCIETY FOR THE PROTECTION OF PRESPA

Tour du Valat

NATURA 2000

PONT PRESPA GREEK NATURE TRUST

Texts by: O. Alexandrou, G. Catsadorakis • Graphic editing: E. Savvatopoulou

Contribution to the management of incidences of disease outbreaks in waterbirds in the Prespa National Park

What to do
in cases of mass mortality of wild birds in Prespa

PRESPA WATERBIRDS

What should I do if I find dead or obviously sick wild birds?

Finding a dead wild bird is a common occurrence and should not generally raise concerns, since its death is usually due to natural causes (e.g. bad weather conditions, starvation etc.) or an injury. However, if we encounter incidents that seem unnatural (e.g. more than one dead bird in a small radius), then we should report the incident to the competent authorities, as soon as possible. At the same time, we should inform the Management Body for the Prespa National Park or alternatively the Society for the Protection of Prespa.

COMMUNICATION WITH THE LOCAL VETERINARY AUTHORITIES

Florina Department of Veterinary Medicine

TEL: 23850 54556, 23850 54558, 23850 54565

NOTIFICATION TO THE MANAGEMENT BODY FOR THE PRESPA NATIONAL PARK

In all cases, and especially during weekends, public holidays or when communication with the local veterinary authorities is not feasible for any reason

TEL: 23850 51870/ 23850 51433
6943881513

NOTIFICATION TO THE SOCIETY FOR THE PROTECTION OF PRESPA

During weekends, public holidays or when communication with the local veterinary authorities is not feasible for any reason

TEL: 23850 51211
6986387949/ 6975205994

If, for any reason, we cannot communicate with any of the above agencies, we take some photographs with our mobile phone and determine our position by GPS, if such an application is available on our mobile phone. Then we continue our efforts to contact the above agencies.

WE NEVER TOUCH OR COLLECT DEAD WILD BIRDS

Map of areas where high vigilance is needeeds

AVIAN FLU: Avian flu usually occurs during the **winter months**, when temperatures are low; it is transmitted by waterbirds, which are usually carriers of the low pathogenic avian flu viruses that do not make them sick, but can occasionally also be affected by the highly pathogenic avian flu virus strains that can affect domestic poultry, causing high mortality. In the lakeside villages of Agios Achillios and Mikrolimni at Lesser Prespa and Psarades at Great Prespa, there are domestic poultry that move freely next to the wetland. Apart from the fact that this practice is illegal according to the law, it also constitutes a potential risk for outbreaks of cases of avian flu.

AVIAN BOTULISM: Cases of avian botulism usually occur during the **summer months**, when temperatures are high. Avian botulism is associated with low oxygen levels in the water, high temperatures (above 35°C) and eutrophication, and therefore areas with shallow water and a lot of nutrients, such as Vromolimni and the area with the waterbird colonies at Krina, are considered more vulnerable.

5.3. Reporting

Suggested contents for an annual pelican status report

- **Title**
- **Suggested citation**
- **Contributors** and the kind of contribution each one has made (field work, analysis of results, writing, drone navigation, etc.).
- **Summary**
- **Introduction:** The overall context, scope and aim of the study and the report.
- **Environment info**: Noteworthy notes on weather / general description of weather, extreme phenomena that might affect pelican behaviour and performance/ add raw data if available (minimum – mean – maximum air temperature, water temperature, precipitation – rain, snow, wind direction and velocity, duration of snow cover, duration of ice cover (frozen water bodies and percentage of cover with ice) / raw data might be placed in an **Appendix** at the end of document.
- **Methodology:** Detailed description of all methods used, with particular emphasis on possible changes to the initial ones, or to those of previous years. These must include a table with all the dates that each method has been used to provide results for the report.
- Listing in chronological order, with brief description, of **noteworthy natural events, or those caused by man**, that may have affected pelicans (fires, natural or human-caused, gales, deluges, serious cases of disturbance, landslides, cases of poaching, mass mortality and/or morbidity to any organisms, etc.) / raw data might be placed in an **Appendix** at the end of document.
- **General map of the colony** with codes for sub-colonies/nesting islands (based on drone photos, Google Earth photos, conventional photos, etc.).
- **Maps/drone photos** of each sub-colony/nesting island with delineation of all breeding units.
- **Counts** per sub-colony (date, time, observer, birds present on sub-colony, number of nests on sub-colony, notes (new nests, new arrivals, copulations, intensive activities, everything noteworthy and relevant, dead chicks found, dead adults found).
- **Mortality:** Numbers of dead chicks and adults found on each sub-colony, numbers of dead or morbid adults and immature birds found dead in the colony with all accompanying information (when found, where, condition, possible cause of death/morbidity, measurements, photos) / raw data might be placed in an Appendix at the end of document.
- **Synthesis** of all results with final tables and figures (final estimations of breeding population size, number of young produced and Breeding Success).
- **Discussion** on results and comments, mainly comparisons with relevant literature and connection/comparison to results of previous years, etc.
- **Conclusions and recommendations**, on further work and conservation measures, priorities and suggestions.
- **Acknowledgements** to contributors, donors, etc.

- **Literature cited**
- **Appendices** (I, II, III, IV, etc.)

Acknowledgements

We wish to thank Dr Alain J Crivelli (Tour du Valat), who has shared with one of us (GC) much of his knowledge of the two species of pelicans of the Western Palearctic, a part of which is contained in this manual. We also wish to thank Foteini Papanousi for the creation of maps used in this document and Julia Henderson for her thorough English language editing.

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Appendix I. Protocol for reporting incidences of dead or moribund birds prepared in the context of LIFE15 NAT/GR/000936 – Prespa Waterbirds.

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DATE:	SPECIES:	SITE:
DESCRIPTION OF BIRD'S CONDITION:		
POSSIBLE CAUSES OF DEATH/INJURY/CONDITION:		
PHOTOS (codes):		
OTHER COMMENTS:		
CLARIFICATIONS		
DATE: DD/MM/YY		
SPECIES: If not certain about the species, note the family e.g. ducks, waders.		
SITE: Name plus description of the exact place plus GPS coordinates (if possible)		
DESCRIPTION OF BIRD'S CONDITION: Good description: how fresh does the corpse look, if there are open wounds, degree of decomposition, presence of larvae - flies, if there are external parasites, if it is very thin etc.		
POSSIBLE CAUSES OF DEATH/INJURY/CONDITION: Description by judgment. For example, electrocuted or collision with power lines because it was found under power lines, shot, unknown cause, drowned, entangled in nets etc.		
PHOTOS: We take photos of the corpse from all sides (up, down, right, left, and head close-up). We photograph the corpse with the surrounding area within a radius of 2 meters and 4-5 meters. Take a long shot (about 10 meters and if possible stand somewhere higher.) In the protocol, note the photo numbers and the date.		
OTHER COMMENTS: Anything you consider important and you can not write it elsewhere. e.g. How you found out about the incident and any other detail.		

Appendix II. A leaflet produced in the context of LIFE15 NAT/GR/000936 – Prespa Waterbirds targeted at local stakeholders and the general public, with actions to be taken in the case of a waterbird mortality event at Lesser Prespa Lake, including instructions for photographing dead or diseased birds.

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Take a photo of the carcass from all sides (up, down, right, left, and a close shot of the head). Take a photo of the carcass with the surrounding area at a radius of 2 meters and 4-5 meters. Take a photo from a distance (approximately 10 metres, and, if possible, while standing at a higher point). You can use your mobile phone or any type of camera. Photos can be sent by email to: *spp@spp.gr*

Examples of photographs






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Tour du Valat

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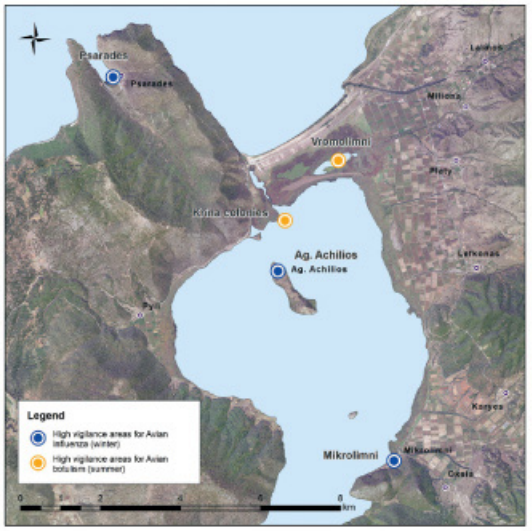
Map of areas where high vigilance is needeeds



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Pelican Way of LIFE

(LIFE18 NAT/NL/716)

https://life-pelicans.com/

Conservation of the Dalmatian Pelican along the Black Sea - Mediterranean Flyway

Conservation of the Dalmatian pelican along the Black Sea - Mediterranean Flyway project ("Pelican Way of LIFE") is a conservation project for the Dalmatian pelican (*Pelecanus crispus*) in Europe. It aims to reduce the threats to the birds and improve their habitat at 27 sites in Romania, Bulgaria, Greece and Ukraine. It will also support capacity building and research in Turkey, Albania, Montenegro and North Macedonia.

Coordinated by:

Rewilding Europe
Making Europe a Wilder Place

Project partners:

Bulgarian Society for the Protection of Birds

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HELLENIC ORNITHOLOGICAL SOCIETY

SOR
SOCIETATEA ORNITOLOGICĂ ROMÂNĂ

ПРИРОДЕН ПАРК
ПЕРСТИНА

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Rewilding Ukraine

With the contribution of the LIFE programme of the European Union

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