Good Practice Guide for the Management of Threats affecting the viability of the Bonelli's Eagle (*Aquila fasciata*)

LIFE17 NAT/GR/000514
LIFE Bonelli eastMed

June 2024

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Foraging habitat of a Bonelli's Eagle breeding territory in Karpathos.
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FOREWORD

The "Good Practice Guide for the Management of Threats affecting the viability of Bonelli's Eagle" is the result of the actions implemented in the framework of the LIFE Bonelli eastMed project on "Conservation & Management of the Bonelli's eagle population in the east Mediterranean" (LIFE17 NAT/GR/000514 - LIFE Bonelli eastMed).

The LIFE Bonelli eastMed project has a duration of 6.5 years (01/09/2018 - 28/02/2025), with pilot areas in Cyprus, Crete, Peloponnese, South Aegean and Attica and aims to address and solve the most critical threats to the populations of the Bonelli's Eagle in Greece and Cyprus, through the implementation of conservation actions in 22 sites of the Natura 2000 Network. Coordinating Beneficiary of the LIFE Bonelli eastMed project is the University of Crete - Natural History Museum of Crete (UoC - NHMC) and Co-beneficiaries are the Ministry of Agriculture, Rural Development and Environment of Cyprus - Forestry Department (FD Cyprus), the Ministry of the Interiors of Cyprus - Game and Fauna Service (GFS), the Hellenic Ornithological Society / BirdLife Greece (HOS), the Ministry of Environment and Energy - General Directorate of Forests and Forest Environment (MEEN - GDFFE) and NCC Environmental Studies Ltd (NCC). The project is co-financed by the European Union (75%), the Green Fund and the A.G. Leventis Foundation.

The "Good Practice Guide" documents certain practices that will help to reduce the disturbances of the Bonelli's Eagle in or near its territories (e.g. reducing disturbance of nesting sites and controlling Bonelli's Eagle territories, excluding road access to nesting territories, reducing disturbance from outdoor recreational activities etc.) and increase the potential for improving the habitat of the Bonelli's Eagle through seeding forage plants and providing water to game species. It also proposes interventions to reduce Bonelli's Eagle mortality (e.g. impacts of power lines on fauna, drowning prevention devices, reduction of mortality from unintentional or intentional poisoning, effective detection of poisoning incidents etc.), improve the environmental licensing of developments and activities in Greece and the existing legal framework (e.g. European Directives and the experience from the LIFE Bonelli eastMed project for the Bonelli's Eagle, individual guidelines for the correct procedure for conducting the Appropriate Assesment in EIAs and SEAs, results of the impacts of the development of wind farms to the Bonelli's Eagle during the LIFE Bonelli eastMed project etc.) and highlight the importance of the participation of stakeholders and synergies for the effective protection of the species.

Although the "Good Practice Guide for the Management of Threats affecting the viability of the Bonelli's Eagle (*Aquila fasciata*)" is not exhaustive nor does it contain all the good practices applied at European level for the management of threats to the species, we believe that it is an important tool for the management of threats to the species in both Greece and Cyprus.

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Contents

ABBREVIATIONS

A' HFCD	A' Hunting Federation of Crete and Dodecanese
APLIC	Avian Power Line Interaction Committee
CID	Criminal Investigation Department
CoS	Council of State
DAET	Decision of Approval of Environmental Terms
DAO	Distribution System Owner
DEL	Department of Environmental Licensing
DSO	Distribution System Owner
EAA	Environmental Assessment Approval
EAC	Electricity Authority of Cyprus
EC	European Commission
EIA	Environmental Impact Assessment
ELD	Environmental Licensing Directorate
ERA	Energy Regulatory Authority
FD	Forestry Department of Cyprus
GSCL	General State Chemistry Laboratory
GSL	General State Laboratory
GWS	Game and Wildlife Service of Cyprus
HEDNO	Hellenic Electricity Distribution Network Operator
HFMC	Hellenic Federation of Mountaineering and Climbing
HMGA	Hellenic Mountain Guides Association
HOS	Hellenic Ornithological Society
IAP	International Action Plan
IPTO	Independent Power Transmission Operator
JMD	Joint Ministerial Decision
LLIO	Local Land Improvement Organization
MD	Ministerial Decision
MEE	Ministry of Environment and Energy
NCC	Nature Conservation Consultants
NGO	Non-Governmental Organization
PAMU	Protected Areas Management Unit
PBDT	Poisoned Bait Detection Team
RES	Renewable Energy Sources
SDF	Standard Data Forms
SDGs	Sustainable Development Goals
SEA	Special Ecological Assessment
SEC	Standard Environmental Commitments
SPA	Special Protection Area
SUDPB	Special Unit for the detection of poisoned baits
TSO	Transmission System Owner
UoC-NHMC	University of Crete-Natural History Museum of Crete
VCF	Vulture Conservation Foundation
WCA	Wildlife Crime Academy
WPP	Wind Power Plant

INTRODUCTION

The LIFE Bonelli eastMed Project

The LIFE Bonelli eastMed project aims to address and resolve the most critical threats to the populations of the Bonelli's Eagle in Greece and Cyprus, through the implementation of conservation actions in 22 sites of the NATURA 2000 Network.

It actively supports the competent environmental authorities and key stakeholders in the implementation of conservation actions (regular and urgent), in line with the specifications of the International Action Plan (IAP) for the species and the published guidelines for its conservation. Both the IUCN standards and the conservation guidelines for the species are based on the long-term experience of western European countries that have worked extensively with the Bonelli's Eagle over the past decades. LIFE Bonelli eastMed is in constant contact and cooperation with relevant authorities in these countries, aiming to built an effective international conservation network for the species in Europe and the wider Eastern Mediterranean region. To this end, the Eastern Mediterranean Bonelli's Eagle Network (EMBoNet) was created within the framework of the project, which involves, in addition to project's beneficiaries and collaborating scientists from France, Spain, Bulgaria and other European countries, all the competent national and local authorities and bodies in Greece and Cyprus.

Adult and juvenile Bonelli's Eagles flying above Piperi islet. Aspasia Anagnostopoulou©UoC-NHMC Archive.

The Bonelli's Eagle

The Bonelli's Eagle (*Aquila fasciata*) is a medium-sized raptor, with a distribution range from the Iberian Peninsula to Indochina. It nests in all Mediterranean countries, with the largest European population concentrated in Spain. In Greece, although it is distributed throughout the country (about 100 breeding pairs), its densest populations are mainly found in the Aegean islands and Crete, while significant populations are also found in southern Peloponnese, Evia and western Greece. Isolated individuals are found in few areas of Thrace, Macedonia and Attica.

Cyprus (including the occupied areas) holds a significant population of the species with about 50 pairs. Most of them are concentrated in Paphos Forest and secondary in Pendaschino River valley, Troodos National Park and other areas.

Particularly agile, fast and dynamic, the Bonelli's Eagle is a typical species of open Mediterranean areas (scrubland and phrygana, open woodland and areas with alternating agricultural crops and natural vegetation), where it preys mainly on medium-sized mammals and birds. It establishes large territories of between 40 and 120 Km^2, but in small islands with a high density of prey and no particular human disturbance, the territories may be smaller. However, whatever the size of its territory is, it defends it vigorously, not hesitating to take on other raptors of much larger size.

In Greece, the Bonelli's Eagle build nests on steep cliffs and rocks while in Cyprus it prefers trees. It is characteristic of the species that it can have 2-10 nests which the pair uses alternately every year.

The main threats to the species

A symbol of the Mediterranean landscape in the past, the Bonelli's Eagle is now endangered. In Greece and Cyprus it is classified as a Vulnerable species (Red Book of Threatened Animals of Greece), while in Europe it is considered Near Threatened (NT), as it is recovering from moderate declines in its main population in the Iberian Peninsula (BirdLife International, 2004). Populations of the species in the Balkans and the Near East are very small or poorly studied. For these reasons, the species is strictly protected under both national and European legislation.

The main threats to the species in Greece and Cyprus are considered to be the following:

- Habitat degradation due to land use changes, disturbance, reduction of available food etc.
- Disturbance from human activities, such as the development of large infrastructure projects (roads, renewable energy infrastructure), urbanisation and intensive agriculture, which often lead to its displacement from the territory.
- Recreational activities (climbing, aerial sports, water sports etc.) and other activities such as fishing, hunting, logging and mining near the nests or even within the territory, which may cause significant problems for the reproduction of the species.

- The development of energy transmission infrastructure both inside and outside the species territories, and a large number of incidents of electrocution and impact with transmission cables, mainly of juvenile birds during the dispersal phase, have been recorded.
- Deliberate killing (either with firearms or by using poisoned baits) especially in Aegean islands and Cyprus, where the species is considered a threat to domestic animals and wild prey species.
- Accidental death by drowning in open tanks and water collections.

Popi Baxevani©UoC-NHMC Archive.

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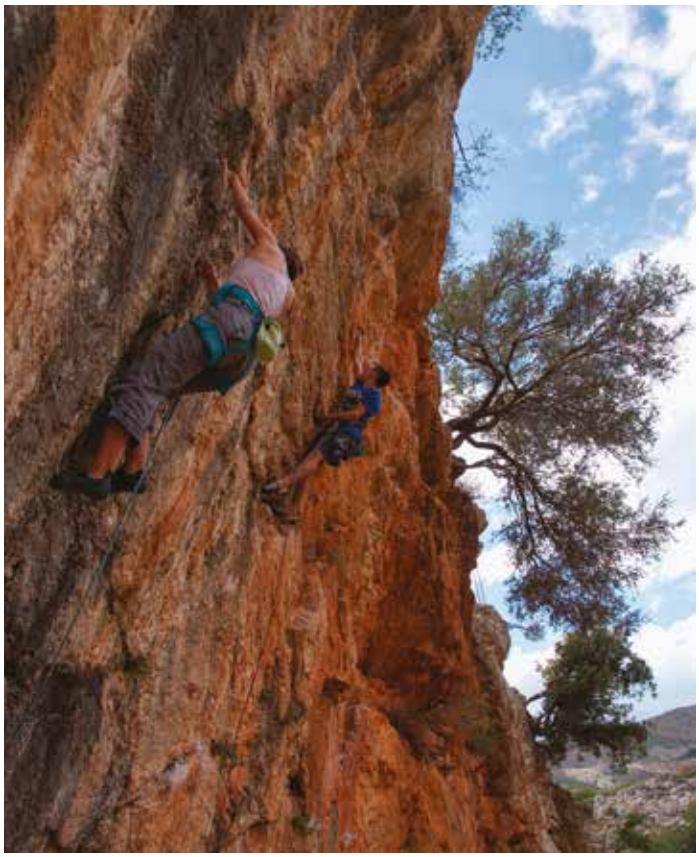

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The actions of LIFE Bonelli eastMed Project

In addition to the record and monitor surveys of the population of the Bonelli's Eagle in Greece and Cyprus, LIFE Bonelli eastMed project has also implemented a series of interventions in almost all project's pilot areas in both countries to address the main threats to the species.

These interventions aim to:

1. **Reduction of disturbance** near known Bonelli's Eagle nests or even within their territories. The following actions are carried out: (a) surveillance and guarding patrols of known nests by the Forestry Services of both countries; (b) restriction and/or prohibition of access to specific forest roads leading to critical habitats of the species, using no-entry gates; (c) informing the climbing community and other outdoor sports groups about the impact of these activities on the species, by issuing a special guide on the good use of rocky habitats and an online interactive map of avoidance of specific climbing areas in Greece; and (d) issuing forestry regulations banning hunting and dog training in the wider areas where Bonelli's Eagles live.

2. **Increase food availability by improving the species' habitat** in selected territories in both countries. To achieve this, the following actions were carried out: a) forage plant seeding in abandoned agricultural land, b) creation of clearances in forested fields (in Greece) and in wooded areas, mainly in Cyprus and c) construction and installation of special watering devices (watering troughs) and/or improvement of existing water catchments (natural, forage and/or hunting).

3. **Reduce the direct or indirect killing** of individuals of the species by electrocution, drowning or poisoned baits. For this: (a) more than 250 electricity poles/pylons were insulated and ca. 15 Km of medium and high voltage electricity cables that are considered potentially dangerous for electrocution/collision of Bonellis' Eagles will be equipped with markers in Greece and Cyprus; (b) more than 100 escape devices have been installed in both countries, in tanks of various species which were considered potentially dangerous for possible drowning of Bonelli's Eagles (and other raptors); (c) three (3) dogs specially trained in the detection of poisoned baits, for the detection and removal of toxic substances and dead poisoned animals from the countryside, have been purchased and are operating to date, together with their handlers; and (d) equipment and staff training have been provided to Wildlife Care Centres in Greece and Cyprus to improve the provision of first aid to Bonelli's Eagles, Golden Eagles and other raptors in both countries.

4. **Strengthen the knowledge and skills of government authorities and agencies** to better assess public works and infrastructure that create additional pressures and will cause serious impacts on the species' population and the environment in general. To this end, (a) risk maps have been produced proposing the exclusion of specific zones for energy transmission infrastructure, new roads, renewable energy infrastructure, mining activities etc, (b) the present

Good Practice Guide has been published in both countries, which will facilitate the social partners in the integration of actions to enhance the conservation of the species, and (c) a specific spatial tool will be produced to assist policy makers in the best possible planning of the location of harmful activities in areas vulnerable to the species.

5. **Strengthen cooperation between relevant agencies, services and scientists in Mediterranean countries that maintain populations of the species.** A network of experts from Greece, Cyprus, Spain, France, Portugal, Italy, Bulgaria, Turkey, Israel (EMBoNET) has been established since the beginning of the project and is in constant communication to monitor developments in scientific research on the species and the relevant legislation that affects or is likely to affect the Bonelli's Eagle and its habitats in the future. At the same time, all this knowledge and experience has been transferred to all stakeholders and decision making groups through the organization of more than 12 workshops in Greece and Cyprus and the participation of the project's team members in national and international conferences on raptors, organized from 2019 to date.

In the current "Good Practice Guide for the Management of Threats affecting the viability of the Bonelli's Eagle (*Aquila fasciata*)", some of the actions implemented by the LIFE Bonelli eastMed project are presented, which we believe have contributed to the improvement of the species' status in Greece and Cyprus and can be implemented both by agencies and institutions, as well as by individuals. For each action there is a description, followed methodology, technical specifications for the constructions and cost estimation, obstacles encountered and how they were dealt with, and other information relevant to each of them.

A Bonelli's Eagle in its nest. Aspasia Anagnostopoulou ©UoC-NHMC Archive.

Chapter 1

Reduction of disturbance to the Bonelli's Eagle

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1.1 Reduction of disturbance of nesting sites and control of Bonelli's Eagle territories

The availability of suitable nesting sites is known to be, together with the availability of prey, a primary limiting factor for raptor populations (Newton 1979).

The breeding season is of vital importance for wildlife since its succes affects the fitness of the species. This is particularly true for large birds of prey, which are highly sensitive to disturbance and invest more time on their breeding cycle, which includes nest preparation, long-term incubation (several weeks), chick hatching and rearing (months), the pre-fledging period and territory defense.

Large birds of prey (vultures and eagles) nest on steep and isolated cliffs (canyon slopes, vertical rocky crags etc.) and tall trees. In fact, for some of them, the minimum acceptable height of a cliff for nesting (Figures 1 and 2) varies inversely with the degree of wilderness available (Newton 1979). Human activity has been shown to affect the selection of nesting sites in various raptors (Newton 1976) such as the Bonelli's Eagle, and this may explain its recent population decline in the Mediterranean while other raptors have recovered in Spain (Arroyo et al. 1990, 1995).

Figures 1 and 2: Monitoring of a Bonelli's Eagle nest on a cliff, Larnaca District. ©Cyprus Game and Fauna Service.

Perona et al. (2019) studied Bonelli's Eagles tagged with GPS/GSM devices in Spain and found out that these raptors made greater movements on weekends and holiday periods during their annual cycle due to the increased human presence and disturbance throughout these days. Abandoning the nest during critical stages of the breeding season (i.e., nesting or when chicks have limited thermoregulatory capacity) has very negative consequences to the survival of the chick due to temperature loss, which can also lead to nesting failure. They recommended that measures should be taken to limit recreational activities in terms of space and time, especially during the most critical breeding periods (e.g. incubation, rearing of chicks).

In an extensive literature review Van der Grift and de Molenaar (2008) report a number of cases of disturbance by mainly military aircraft on low-level flights over nesting areas of large raptors.

Reduction of disturbance in Greece and Cyprus

A large percentage of Bonelli's Eagle habitats in Cyprus and Greece are included in the Special Protection Areas (SPAs) of the Natura 2000 network. Based on a recent publication for Cyprus

Figure 3 (from camera): Off-road movement of a motorbike near a Bonelli's Eagle nest during the breeding season, Paphos Forest. ©Cyprus Game and Fauna Service.

(Kassinis et al. 2024), about 80% of the nesting sites of the Bonelli's Eagle and 43% of the nesting sites of the Long-legged Buzzard *Buteo rufinus* were located within the Natura 2000 Network of Protected Areas. However, various forms of disturbance have been recorded in the above areas during the breeding period of large raptors.

Disturbance near the nesting sites of large raptors can take the following forms, from mild to very invasive:

1. Recreation (hiking, climbing etc.)
2. Hunting (January-February period for migratory birds)
3. Training of hunting dogs
4. Driving 4X4 vehicles
5. Off-road motorcycle riding (Figure 3)
6. Logging (Figure 4)

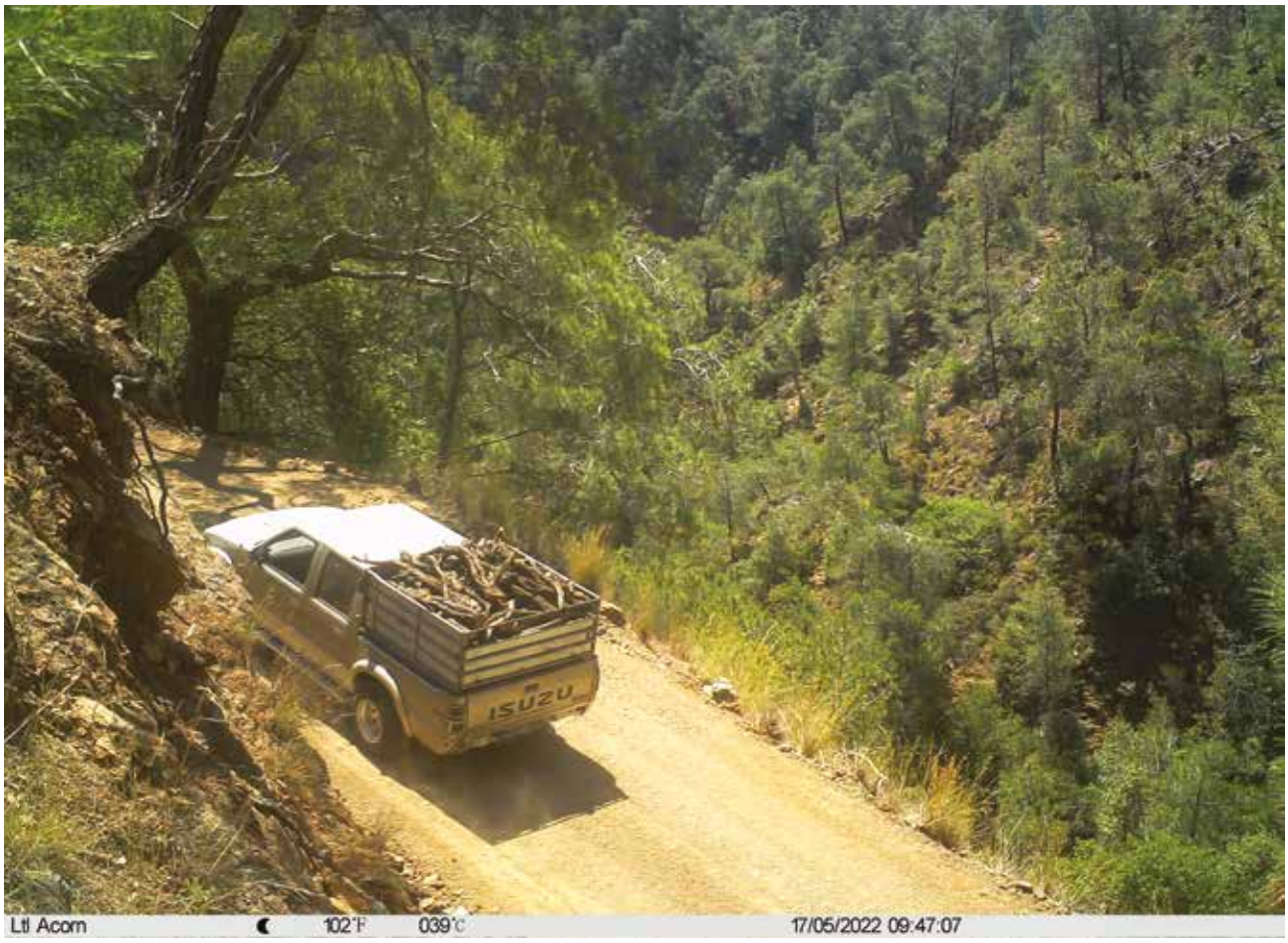

Figure 4 (from camera): Transport of illegally felled branches. ©Cyprus Game and Fauna Service.

7. Low flights of aircraft (mainly helicopters) in valleys where nesting sites are located during the breeding season.

D'Acunto et al. (2018), in a study simulating the success of trail closure strategies to reduce human disturbance to nesting Golden Eagles, determined that creating a protective (exclusionary) buffer zone of at least 600 m radius around the nest helped to prevent disturbance of nesting eagles.

Conservation measures - control measures for territories and nests

In the framework of LIFE Bonelli eastMed and in addition to the permanent control and guarding measures of the protected areas in both Greece and Cyprus, additional mitigation actions were carried out in the territories of the Bonelli's Eagle in both countries. More specifically:

1. A significant proportion of the Bonelli's Eagle nests are located within areas closed to hunting. The maps are reviewed annually and may include additional areas if and when required.
2. An effort is made in the areas where the species nests to reduce hunting activity in January - February.

Figure 5: Surveillance of a nest on a cliff from a safe distance, Paphos province. ©Cyprus Game and Fauna Service.

Figure 6: Detail of the above nest. ©Cyprus Game and Fauna Service.

3. Efforts shall be made to avoid opening areas for hunting dog training with Bonelli's Eagle nesting areas. This is not always possible because some sites have traditionally been given for this purpose and there is a possibility that Bonelli's Eagle pairs that maintain territories within these sites may choose nesting sites within hunting dog training areas.

4. There are frequent patrols by members of the Game and Fauna Service (GFS) in Cyprus and the local Forest Services in Greece during the breeding season, where any activities that could negatively affect the nesting of the species are checked. From time to time, there have been complaints of poaching, illegal logging near nesting sites as well as complaints of theft of raptor chicks from nests.

5. During the monitoring of the breeding success and nesting of large raptors, which takes place every year and includes at least 2 visits per successful nest, the members of the GFS in Cyprus and the Forestry Services of Greece in charge of this task take the necessary actions to prevent any activity that may cause disturbance.

6. Cameras are placed in areas where there is information that there may be interference or disturbance very close to a large raptor nest. The installation of cameras in public areas is likely to be regulated by existing legislation so prior to installing cameras, a necessary preliminary check should be made as to what is legally applicable in each case (Figure 7).
7. A number of adult Bonelli's Eagles have been tagged in Cyprus with GPS/GSM transmitters in order to collect detailed data on their movements and on their habitat use.
8. Where drastic measures are required, disturbance is reduced mainly by banning access to specific sensitive areas. Such spatial restrictions have been identified in forest areas in both countries where, in cooperation with the Cyprus Forestry Department and the Forestry Services of Greece, specific roads have been closed during the breeding season of the Bonelli's Eagle (Chapter 1.2). Access to these roads is only possible to competent authorities. Through annual monitoring of the species, disturbance data is enriched and the necessary management measures are taken.

Figure 7: Photographic material from a surveillance camera near an active Bonelli's Eagle nest, 2020. ©Cyprus Game and Fauna Service.

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1.2 Blocking of road approach to nesting territories

Of all the raptors, the Bonelli's Eagle is particularly vulnerable to disturbance. The development of large infrastructure projects such as roads and wind farms, urbanisation and intensive agriculture often lead to the species' displacement.

Recreational activities (climbing, aerial sports, water sports), as well as activities such as fishing, hunting, logging, mining, etc. in locations very close to Bonelli's Eagle nests can cause significant problems for the reproduction of the species.

One of the main threats identified through the LIFE Bonelli eastMed project is human disturbance to the species' nesting areas (climbing, rescue helicopters near nesting sites, military aircraft, hiking, tourism, hunting etc.).

Distance from inhabited houses or villages and roads are associated with a reduction in breeding success (Gil-Sánchez et al., 2004). Bonelli's Eagles choose higher cliffs to nest when they are closer to roads (Ontiveros, 1999), and in Sicily, poaching is the leading cause of mortality and a major constraint to their recovery (López-López et al. 2012; Di Vittorio et al., 2015).

At the same time, the species is affected by reduced productivity due to the degradation of the habitats it uses (feeding areas), with one of the main causes of degradation being forest fires. According to the statistics of the Cyprus Forestry Department (review of forest fires for the period 2000-2021), 85% of forest fires are caused by humans.

In addition, intense disturbance near breeding sites negatively affects breeding success and may even lead to abandonment of territories.

Reducing human presence in the species' nesting areas by cutting off access to forest roads helps mitigate the above pressures and threats it faces.

The aim of this action is to reduce disturbance during the breeding season of the Bonelli's Eagle by regulating the movement of vehicles and activities in the species' territories (mainly in nesting areas) within state forests in Cyprus and Greece.

Access was blocked by metal gates along forest roads adjacent to known Bonelli's Eagle nesting sites in the Project areas, which were locked with security locks to maintain access for forestry and other officials (Figure 1). The gates remain closed throughout the raptor breeding season, i.e., early January through the end of September. To facilitate forest management, the metal gates in each area use the same locking system so that they can all be opened with a master key.

Figure 1: Photos of the installation of the metal gates in Cyprus. Haris Nikolaou©Forestry Department Archive.

Methodology

In order to identify the most suitable locations for the cut-off of road accesses made within the LIFE Bonelli eastMed project, the following information/data were taken into account:

- Known nesting sites of the species, with emphasis on the project areas.
- The presence of forest roads at these sites and their distance from the nesting sites.
- The presence of any other human disturbance near the nesting sites and their distance from those areas.
- Any private property whose access would be affected by the road cut.
- The type and frequency of use of the forest road and any impact on it by cutting it.
- The utilization of the topography and terrain of the area so that the access of vehicles from the sides of the metal barrier is physically prevented.

Problems encountered during the implementation of the action

The biggest problem encountered during the implementation of this action was acts of vandalism and destruction of the gates, probably for access to forest roads for hunting, poaching and/or illegal logging in the excluded areas (Figures 4-6).

Possible areas for similar actions

This action may be implemented beyond the program areas to other nesting sites of the Bonelli's Eagle and other protected species on state forest land where the road does not interfere with access to private property.

Costs

The technical specifications for the construction of the metal gates are presented in Figures 2 and 3. The cost of construction and installation for each access cut-off gate is currently (2024) around 2,300.00€. In case of mass implementation of the measure in larger areas, where the distances between the gates are likely to be quite long and the installation is time-consuming and very costly, it is proposed to group the gates into sub-areas and on the basis of this grouping to request financial offers per sub-area of implementation.

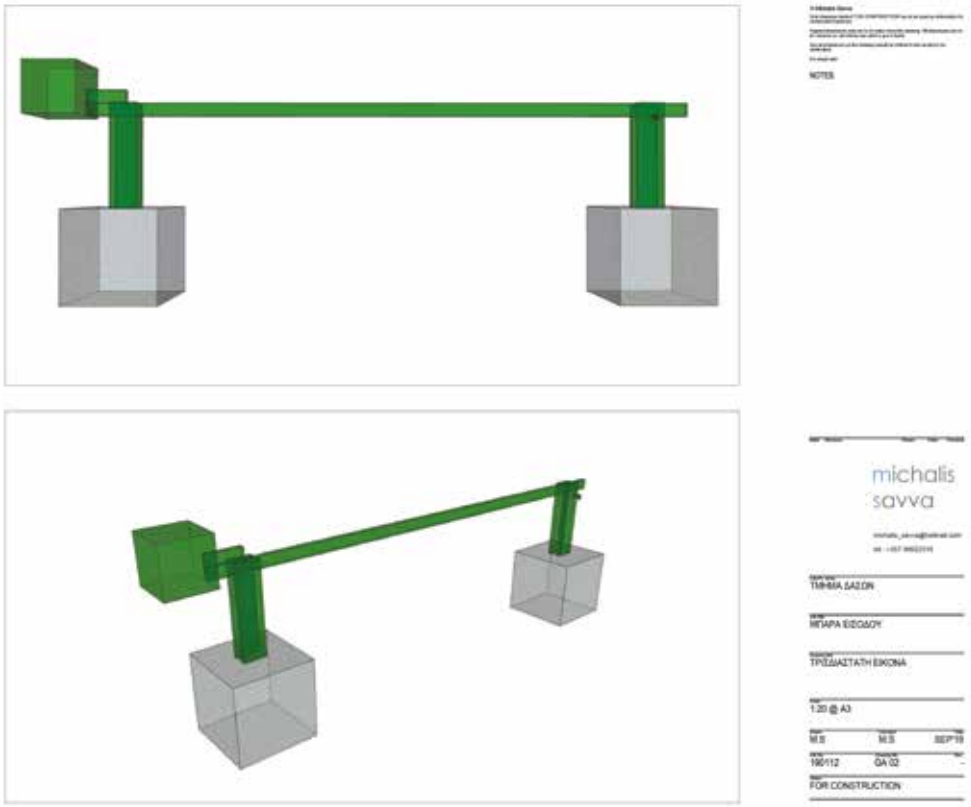

Figure 2: 3D image of a blocking gate.

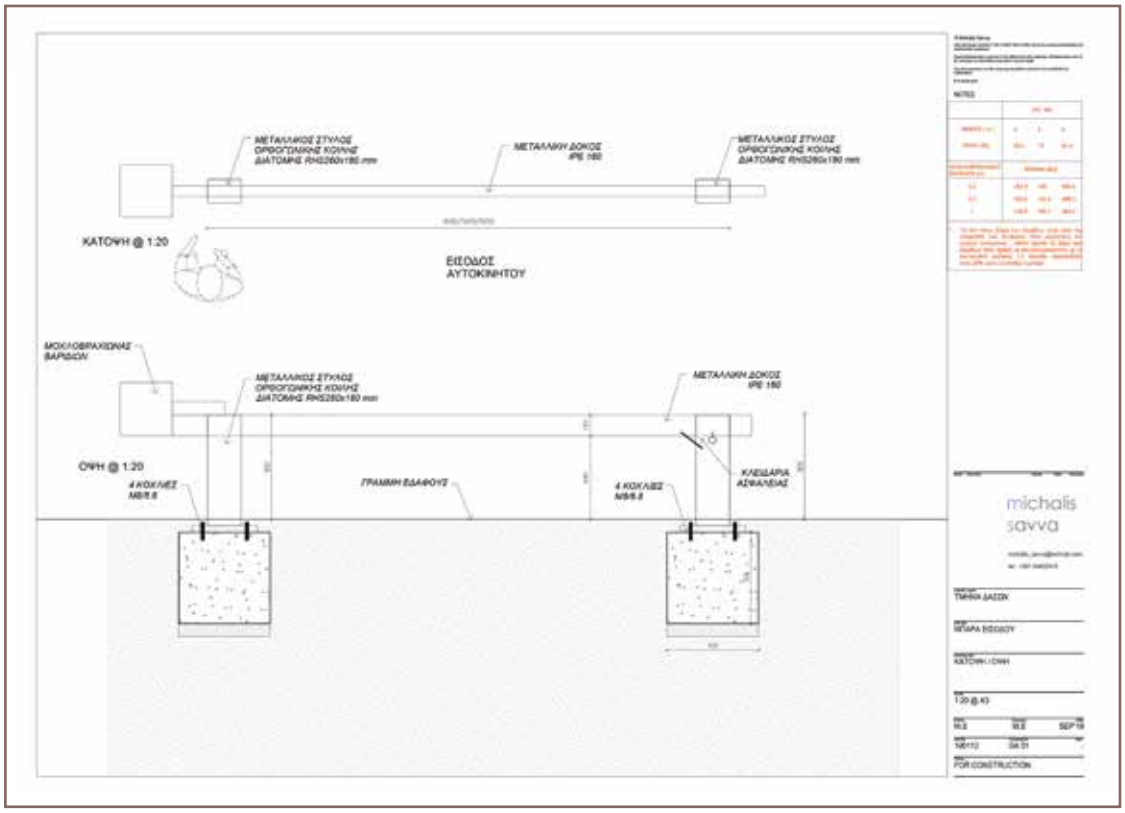

Figure 3: Architectural drawings of the gate.

Figure 4: Saitta case, the gate was destroyed as a result of a vehicle strike. Possibly the stakes were moved. With the re-installation of the new barrier, there may be problems in closing the gate. Michael Zacharias©Forestry Department Archive.

Figure 5: Case in Paphos, the gate was breached and completely destroyed. Michael Zacharias©Forestry Department Archive.

Figure 6: Capoura case, the gate was breached and the peg probably moved slightly, so the lock could not fit in both points (holes) and then locked. Michael Zacharias©Forestry Department Archive.

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1.3 Reduction of disturbance from outdoor activities

Human activity in natural areas always carries the risk of causing disturbance to wildlife, intentional or unintentional. Disturbance from outdoor recreational activities is one of the different forms of disturbance and, as we shall see below, comes with additional pressures and threats to the natural environment.

But what do we define as outdoor activities and disturbance?

- **outdoor recreational activities**

  Outdoor recreational activities can be defined as all recreational activities carried out in the natural environment. These activities can be environmental, sporting, tourist, social awareness activities etc. in the form of a simple experience or a planned program.

- **disturbance**

  Disturbance is defined as the disruption of the normal activity or physiology of an animal in response to stimuli. Cayford defined disturbance of avifauna by anthropogenic recreational activities as any relatively discrete event that disrupts ecosystems, communities or populations, where the disruption refers to a change in the behavior, physiology, abundance or survival of individuals or groups of birds.

Different types of stimuli are characterized by different reactions. Moreover, the level of response is not constant for each type of activity as it depends on a number of other factors.

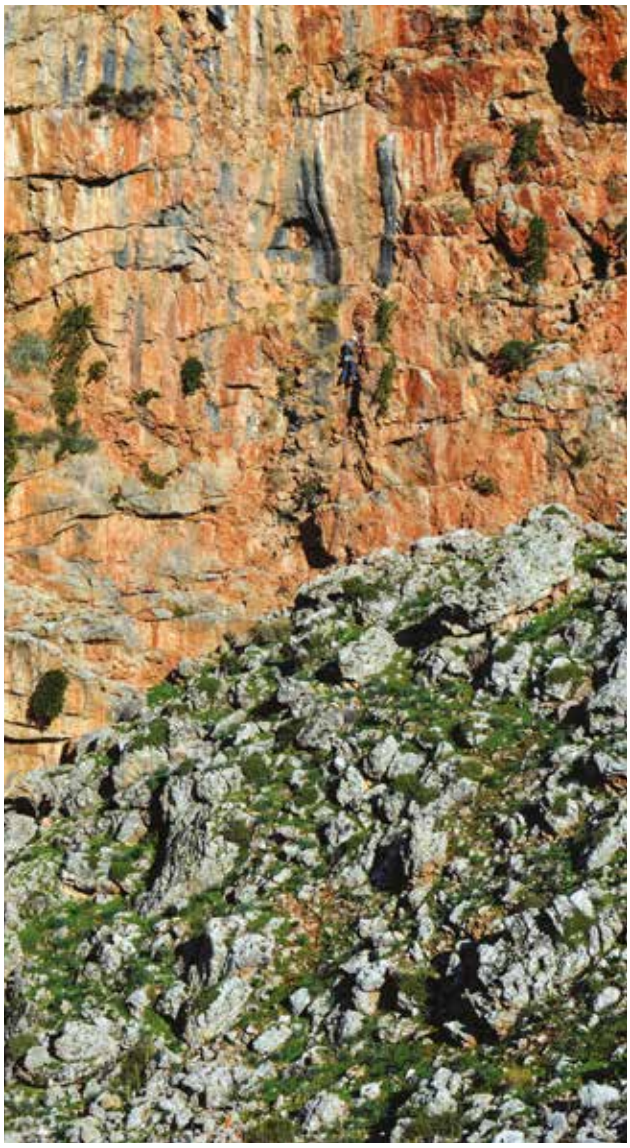
Outdoor recreational activities

Outdoor recreational activities are a very popular pastime for millions of people and, in addition, an important part of the economic activity of their host regions. Participation in activities in or in connection with the natural environment is seen by those engaged in them as a factor of improving their health and well-being. In recent decades, outdoor recreational activities have grown rapidly in both Greece and Cyprus, and involve all social groups, ages etc. In particular, following the COVID-19 epidemic crisis and the subsequent quarantine, there has been a significant increase worldwide in both the number of people practicing outdoor recreational activities and the number of areas hosting them.

Some of the most popular outdoor recreational activities practiced in Greece that can cause disturbance are:

- ✓ Climbing/Hiking/Via Ferrata
- ✓ Mountain Running
- ✓ Speleology
- ✓ Canyoning

- ✓ High line/slackline
- ✓ Flying fox/Zipline
- ✓ Canoeing - Kayaking/Rafting
- ✓ Aerial sports (hang gliding, paragliding)
- ✓ Horse riding
- ✓ Off-road driving
- ✓ Wildlife observation and photography.



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How the problem of disturbance arises

Disturbance, as mentioned above, is the alteration of the physiological activity of animals as a result of their reaction to stimuli caused by human activity. These stimuli may be **visual, auditory or chemical.**

As far as birds are concerned, the presence of these stimuli forces them into various kinds of reactions in order to deal with what they perceive as a threat. Birds' reactions can be varied and more or less harmful. Some of the most common are the following:

- ✓ Increase in stress-related hormones.
- ✓ Constant unnecessary movements and waste of energy.
- ✓ Escape responses from predators and/or warning calls to other individuals of the species.
- ✓ Interruption of feeding and/or breeding process.
- ✓ Abandonment of areas/Displacement.

These reactions have negative effects on the biology and ecology of birds. The type of effects and their severity depend on the time period in which they occur, their intensity, their frequency and, of course, the species under consideration.

During the breeding season, disturbance can adversely affect breeding success, because birds that feel threatened at their chosen nesting site, may be forced to leave it for the duration of the breeding season.

If this is temporary, it exposes the nest to risks such as loss of the correct incubation temperature, starvation of the chicks and exposure of eggs and chicks to predators. At the same time, the energy expended by the parents during the unnecessary movements they are forced to make may undermine the quality of their physical condition, with a negative impact on their hunting success rates and subsequently on their breeding success.

Later in the same period, the chicks need a safe environment to exercise their bodies until they make their first flight, but also until they become flightworthy. Finally, intense and prolonged disturbance may result in the birds abandoning the breeding effort altogether, and there is even the possibility of complete displacement of the birds from the area.

Disturbance during the non-breeding period can also lead to unnecessary movements and waste of energy, resulting in the inability to prepare properly for breeding and ultimately undermining breeding success. For raptors in particular, this undermining may also be indirect, for example if it affects prey species.

According to Cole (2004), we can make 5 general assumptions regarding the impact of the disturbance to wildlife due to outdoor activities:

- ✓ Impacts are inevitable when the activity is repeated.
- ✓ The effects of the disturbance come quickly but diminish slowly.
- ✓ The negative effects of disturbance are more pronounced when an activity is transferred to new areas, compared to an increase in intensity in an area where it is already taking place.
- ✓ The magnitude of impacts depends on the frequency, type and spatial distribution of the activity, as well as on environmental/ecological conditions.
- ✓ The relationship between the intensity of the activity and the severity of its effects is usually not linear.

At the same time, all kinds of human activities can **cause habitat degradation, changes in the abiotic characteristics of an area and changes in land use.**

More specifically, apart from the **direct** impacts caused by human disturbance, it also affects species **indirectly**, through associated activities in the same areas and the development of infrastructure to support visitors. For example, in addition to the disturbance caused by their very presence, walkers in a forest may cause additional disturbance if they have pets with them, degrade the habitat if they leave litter or increase the risk of fire. In addition, their activity is likely to be accompanied by other secondary (e.g. commercial) activities for their convenience or infrastructure such as a road or canteen may be built for them. These are factors that add up to greater impacts on species and ecosystems. Finally, some unforeseen threats that may arise from the presence of visitors in a natural area are the transport and spread of invasive and/or competing fauna and flora species and the dispersal of pathogens (e.g. avian influenza).

In order to properly assess the potential impacts of activities and effectively plan mitigation actions, all the information mentioned above needs to be collected and taken into account.

Climbing and disturbance of avifauna

The main outdoor activity that the LIFE Bonelli eastMed project focused on was **climbing**, as it is considered to be the activity that primarily conflicts with the conservation of the target species. In addition to climbing, other outdoor activities can be considered as potentially threatening to the species, the most important of which are canyoning, hiking and aerial sports activities.

Steep slopes are nesting and feeding area for many species of birds, some of which are highly specialized in this environment, and as a result are totally dependent on their conservation. At the same time, the same habitat hosts a number of other protected animal and plant species, many of which are endemic to Greece or even endemic to specific regions.

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LIFE Bonelli eastMed©UoC-NHMC Archive.

The development of extensive climbing fields and the consequent climbing activity on an intensive scale is relatively recent in Greece. Therefore, there are no relevant studies concerning the investigation of the impact of climbing and related activities on the avifauna of the area concerned. Clearly there are similar studies abroad, where outdoor activities have been developed for decades. The available international literature demonstrates the risk of environmental damage from the development and use of climbing areas and their possible accompanying projects outside the regulatory framework. However, proper planning and case-by-case regulation of how they are used can greatly reduce the aforementioned risk.

Most diurnal birds of prey, including the Bonelli's Eagle, nest from February to July while the exact breeding dates depend both on local climatic factors (altitude, weather) and the physiological condition (fitness) of the birds each year. Exceptions to this general rule for Greece are the Bearded and Griffon Vultures which nest in the middle of winter, and the Eleonora's Falcon which lays its eggs in early August. Other species that nest on the rocks at the same time of year are owls like the Little and Eagle Owl as well as corvids such as the Raven, Choughs and Jackdaws.

Unfortunately, the breeding season for most species is also the most popular for climbing, so in areas where there are crowded climbing fields, disturbance is a potentially significant threat to them.

Raptors, especially eagles and vultures, are known to have largely **fixed netsing sites** (e.g. a crag or canyon with many alternative nests) and roosting sites, which remain the same for successive generations. Thus, abandoning a nest and/or disturbing adult birds can have very serious consequences, especially in places where available nesting and resting sites are scarce.

The minimum safe distance to approach a breeding area depends on the species of bird nesting there and the topography of the site. In general, for large raptors (vultures and eagles) a 500 meters distance (in a straight line) is a limit that should not be exceeded under any circumstances, although this does not mean that it is always enough.

Outside the breeding season, as mentioned above, disturbance may be responsible for poor preparation of breeding individuals, lack of safe roosting sites and habitat degradation.

It is, however, not just large birds but also a good number of small birds which choose to build their nests on the cliffs. Their small size and possible abundance does not mean they are any less sensitive to disturbance. Of course the minimum distances at which they tolerate human presence are shorter than those of large raptors but are still required to be complied with in order to ensure that disturbance is avoided.

Climbing

At this point, it is advisable to provide a brief categorization of the individual activities that are included in the term "climbing" and which, in large numbers, influence the degree of risk. For the sake of simplification, not all forms of climbing are presented, but only those which are relevant to the subject matter.

Climbing activity in the areas where Bonelli's Eagle nest may belong to one of the following activities:

- ✓ Sport climbing

It is the most common form of climbing. Its practice requires the existence of organized fields with routes equipped with safety devices placed on the rocks. They usually occupy a wide range of rocks but are limited in height. In order to provide a high degree of difficulty, the routes are often developed in negative slopes crags, stalactite structures and smooth walls. Usually the fields have relatively easy public access and are located in not too remote areas. Famous sport climbing destinations in Greece are Kalymnos, Leonidio, Meteora, Manikia in Evvia, which attract thousands of Greek and foreign climbers. The increase in the number of climbing fields in Greece in recent years has been rapid and now covers the whole country, including many islands. It is practiced throughout the year.

- ✓ Traditional trad climbing

Traditional trad climbing does not make extensive use of pre-installed belays, but relies on the climber placing "natural" belays, which are then removed. It is not as popular because of its increased difficulty. 'Traditional' routes are usually developed on large crags, often of high altitude and with difficult access. Thus, although they are located in more 'wild' areas, their visitation is rather low. It is practised throughout the year.

- ✓ Via Ferrata

The term Via Ferrata is used to describe routes on which fixed metallic structures such as wire ropes, bridges and steps are installed. They are less difficult and do not require any special knowledge of climbing techniques. They are therefore a popular activity for beginners and in many cases are also offered as a tourist product (under the supervision of trained guides). The areas in which Via Ferrata is developed are usually crags and gorges of moderate difficulty and not particularly remote. It is practised throughout the year.

- ✓ Bouldering

Bouldering is the simplest form of climbing, which is practiced on low rocks (boulders) of high difficulty, without the use of ropes and safety equipment. It is not very popular because of its difficulty but has been gaining ground in recent years. The areas where it is practiced usually coincide with those of sport climbing. It is practised throughout the year.

- ✓ DWS (Deep Water Solo)

This is climbing without safety equipment on rocks that rise above the sea. The climbers usually start the route from a watercraft and if they have to abandon the route, they jump into the sea. The areas suitable for this type of climbing are usually inaccessible coastlines. It is not particularly popular but is on the rise. It is almost exclusively a summer type of climbing.

Risk reduction measures

Risk reduction measures can be divided into two main categories:

A) Preventive measures

Preventive measures shall be taken in the phase preceding the creation of new climbing areas or the opening of a separate route.

In order to achieve the least possible conflict between the conservation of elements of the natural environment (in this case the Bonelli's Eagle) and the activity, proper planning is required. Key elements required to make this possible are:

- ✓ Proper zoning - exclusion of sensitive areas. Proper zoning naturally requires the necessary environmental data to be obtained.
- ✓ The calculation of the visitor carrying capacity.
- ✓ The potential impacts of parallel activities and associated projects.
- ✓ Updating the existing legislation. To date, the development of climbing areas and professional activities in them have not been adequately covered by legislation. This is particularly evident in areas that are not under a protection regime.

In this procedure, the opinion of the responsible services (Forestry, Management Bodies etc.) is essential. In conjunction with the provision of the necessary information (primary biodiversity data), any properly designed project should be accompanied by an Environmental Impact Assessment and an Operational Plan which will, among others, provide for compliance with any environmental compliance rules.

B) Intervention measures

The intervention measures (risk reduction measures) are proposed to be applied mainly to existing climbing fields and individual routes. However, they can certainly also be applicable in the context of operational plans for fields under construction.

Bans and regulations are not always universally accepted by the climbing community. Unilateral and untargeted interventions are often discredited in practice and lead to failure. Cooperation with stakeholders and joint decision-making and measures, always respecting the law, are essential. Some of the main stakeholders are the local authorities, the authorities responsible for environmental conservation (PAMUs, Forestry Offices), the primary bodies of the climbing community, professional associations and local communities.

Some of the most common and effective measures are the following:

- ✓ Time limit on access (a season/month).
- ✓ Spatial restriction (exclusion of a section or route).
- ✓ Limiting the number of visitors.
- ✓ Restriction or prohibition of parallel activities.
- ✓ Restriction or prohibition of accompanying works and infrastructure.

Before deciding to implement any risk reduction measures, all the individual parameters that are unique to each region should be collected and interpreted. These include the type and intensity of climbing activity, biodiversity data, parallel activities in the same area etc. This is a necessary step in order to determine the degree of risk assessment and the effectiveness of the measures.

Risk assessment and effectiveness assessment

Risk is an important parameter that depends on multiple factors and the interactions between them. On this basis, the main threats are identified and measures to counter them are planned.

The LIFE Bonelli eastMed approach

For the needs of the project, the risk assessment and risk management were carried out in sections, following these steps:

Step 1. Identify the risks - Identify their sources and the factors that influence them.

Step 2. Risk assessment and prioritization - Assess existing risks (severity and possibility of environmental damage).

Step 3. Identify and prioritize the expected impacts (Table 1).

Step 4. Decision-making on risk reduction measures.

Step 5. Monitor effectiveness and review measures.

The data obtained from Steps 1 and 2 were used to conduct a weighted multi-criteria analysis (Weighted Multi Criteria Analysis).

Criteria for possibility of disturbance

- ✓ **Bird species (ecology, morphology, etc.).**
- ✓ **Season (breeding or non-breeding).**
- ✓ **Topography and morphology of the area (direct line of sight-distance from nest).**
- ✓ **Type of activity (sport climbing, trad etc.).**
- ✓ **Number of visitors - Intensity of activity (cumulative impact).**

Expected impact

- ✓ **Mortality of individuals.**
- ✓ **Displacement.**
- ✓ **Effects on breeding success/feeding.**
- ✓ **Habitat degradation (loss of roosts, reduction of food, etc.).**

Table 1: Identification and prioritization of expected impacts

		SEVERITY OF IMPACT	Grade.	*EVALUATION*
Expected Impacts	Mortality (adult or chick mortality)	VERY HIGH	5	*CRITICAL effects (calibration 5)*
	Displacement		5	
	Reduction in breeding success	HIGH	4	*SERIOUS effects (calibration 4)*
	Reduction of feeding capacity		4	
	Loss of roost	MEDIUM	3	*MEASURES impact (calibration 3)*
	Prey reduction		3	
	Minor habitat degradation	LOW	2	*LOW impact (calibration 1&2)*
	Minor habitat degradation	VERY LOW	1	

The factors "Probability of disturbance" and "Expected Impact" were scored and combined in a matrix. The scoring matrix (Table 2) assigns a final value (1-5) to each combination of criteria, from which the risk factor for each site and species can be calculated.

Table 2: Evaluation matrix

RISK MATRIX			Expected Impact (after Weighted Multi Criteria analysis)					
			Unknown (0)	Very Low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
			0	0.05	0.2	0.6	1.2	1.75
Possibility	Very High	5	0	0.25	1	3	6	8.75
	High	4	0	0.2	0.8	2.4	4.8	7
	Medium	3	0	0.15	0.6	1.8	3.6	5.25
		2	0	0.1	0.4	1.2	2.4	3.5
	Very Low	1	0	0.05	0.2	0.6	1.2	1.75
	Unknown	0	0	0	0	0	0	0

The implementation of risk reduction measures, where appropriate, should be followed by systematic monitoring of their effectiveness. The assessment of effectiveness essentially consists of the achievement of the environmental objectives set. These are decided in parallel with the risk reduction measures and can be indicators like:

- ✓ Presence of a target species in the area
- ✓ Breeding success of a target species
- ✓ Increase or maintenance of the population of a target specie.
- ✓ Desired number of visitors
- ✓ Biodiversity indicators

Presentation of the results of the risk assessment

In order to achieve the final objective, which is none other than the proper implementation of risk reduction measures, it is necessary to communicate the results of the assessment to the main users of the target areas, i.e. climbers.

Necessary conditions for the successful transfer of information were: (a) ensure a common code of communication and, (b) present the results in an understandable and user-friendly way.

Regarding the first condition, the communication code chosen was the adoption of climbing terminology for the spatial identification of the areas. The climbing fields (crags), which are then divided into sectors, in which there are lines.

For ease of mapping and sensitivity of nest site data, sector-level risk assessment was selected. This way, each climber receiving the information can accurately understand the geographical location of the point under assessment. In addition, all climbing guides, both printed and electronic, are structured in the same terminology, thus ensuring absolute homogeneity of information.

Regarding the way of presentation, a digital map was chosen as the most user-friendly, following the standards of electronic climbing guides and applications (thecrag.com, vertical-life etc.). This map (Figure 1) is posted on the project website and contains - in addition to the risk assessment by sector - useful information on the areas covered (https://lifebonelli.eu/el/charths-eyaisthhsias-se-ypaithries-drasthriothtes).

Each sector is assigned a colour which corresponds to the degree of danger, based on the traffic light system. Thus green represents the safe sector (Figure 2), orange draws the attention of users and red suggests avoiding a visit.

In addition, a fourth colour (grey) has been included for cases where there is not enough information. There is a distinction of the assessment for breeding and non-breeding periods.

At the same time, a broader communication was developed in order to raise the general awareness of the climbing community, using printed material and face-to-face information of the target groups (brochures, presentations, publications, seminars), covering a significant percentage of people involved in the activity in Greece (more in Chapter 5).

Figure 1: Screenshot of the Outdoor Activities Sensitivity Map of the LIFE Bonelli eastMed project.

Figure 2: Screenshot of the climbing field display after selecting criteria. The green color indicates that this field is safe for the specific time period that it has been selected to be used.

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A pair of Bonelli's Eagles in Kasos, 2023. Aspasia Anagnostopoulou©Uoc-NHMC Archive.

Chapter 2

Bonelli's Eagle habitat improvement

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2.1 Forage plant sowing

Birds of prey, being at the top of the food pyramid, are directly affected by the pressures on their habitats, such as changes in land use, infrastructure and RES works, biodiversity degradation due to climate crisis etc. Therefore, the cultivation of abandoned areas in mountainous and semi-mountainous island areas, with the main objective of improving prey indexes, can help inhibit or mitigate landscape degradation, protect river basins and water resources, create islands of biodiversity and microclimates and, overall, help ecosystems adapt to anthropogenic and other changes and improve their resilience index. In island ecosystems in particular, the pressure is already significant and is expected to increase, while where livestock farming is maintained, overgrazing and the abandonment of extensive grazing and crops in mountainous and semi-mountainous areas (Figure 1) have contributed to frequent and intense erosion events and to the decline of fauna and avifauna populations that are prey for large predators such as the Bonelli's Eagle.

The practice of cultivating and re-grassing degraded pastures has been acknowledged as a method to protect and enhance the resilience of natural ecosystems and agro-ecosystems and has been funded through various LIFE projects (e.g. LIFE TERRACESCAPE). In addition, sowing on rocky islets, used by birds of prey like the Bonelli's Eagle or by migratory species as foraging grounds, can increase food availability and quality, which is expected to contribute to increased breeding success. Specifically,

Figure 1: Abandoned terraces in Kasos. Aspasia Anagnostopoulou©UoC-NHMC Archive.

the cultivation of terraces, farmland and rocky islets will provide abundant, high quality food, shelter and nesting sites for prey species of the Bonelli's Eagle. At the same time, it will contribute significantly to soil protection from erosion, enriching the soil with nutrients and organic matter, protecting water resources and creating additional habitats for local indigenous species.

The preferred plants for the cultivation of private and public land are species that are traditionally cultivated in our country as forage plants in active pastoral areas (e.g. Asterousia Mountains in Crete) or that were cultivated in the past in abandoned pastoral areas like in islands and islets (e.g. Dia Island in Crete) and show increased adaptability and resistance to the soil and climate conditions of these areas. These species belong to the family of cereals and legumes and can be used as food for prey fauna (hares, wild rabbits, partridges) or to increase the population of symbiotic organisms, mainly insects, which serve as food for young prey birds, e.g. partridges. The preferred types of cultivated plants are shown in the table below.

Scientific Name	Common Name
Bromus hordeaceus	Soft Brome
Hordeum vulgare	Barley
Triticum sp.	Wheat
Vicia sativa	Vetch
Trifolium campestra	Hop Trefoil

Selection of cultivation and re-grassing areas

In order to ensure the maximum possible benefits for the Bonelli's Eagle and other birds of prey from the increase in game populations through the cultivation and re-grassing of land, requirements, like the following, must be met:

- Be within or near the boundaries of known territories of Bonelli's Eagle or other large raptors.
- Be in areas regularly visited by juveniles for foraging, based on the processing of telemetry data.
- The slope of the land should not exceed 10-15% depending on local conditions, in order to limit erosion phenomena in case of using mechanical means.
- The ratio of soil to rocky surface should be high (at least 50% soil).
- The altitude and local soil and climate conditions should be favorable for cultivation/sowing.
- Preference should be given to areas that are already fenced to reduce the risk of grazing by livestock or better still to select areas where there is little livestock activity, as is the case of small islands.

Taking the above parameters into account, it appears that the land available for cultivation falls into three main categories:

- Rocky islets
- Abandoned terraces
- Active pastures and agricultural land.

The rocky islets, with their special soil and climate conditions, are subject to intense and continuous pressures from natural and anthropogenic factors and as a result the disturbance of any vegetation is often irreversible and difficult to restore naturally. Rocky islets, however, that are not affected by livestock or other anthropogenic activity are ideal for seeding and installing water collection/irrigation systems for game birds as they can provide controlled and stable feeding areas for both migratory and non-migratory birds of prey. The cost of access and cultivation in many cases can be a limiting factor and therefore the selection of rocky islets should be based on a comprehensive cost-benefit study and the possibility of corrective interventions and monitoring of the effectiveness of measures to increase prey availability.

Terraces in insular countries and countries with prey availability like Greece have a recognized environmental and cultural value and cultivating those that are underutilized or abandoned offers numerous benefits. Depending on accessibility, age, condition and extent, conventional or non-conventional cultivation techniques can be used on terraces. If mechanical cultivation is used, it should not be carried out at a depth of more than 10 cm and at a distance of less than one meter from the dry stone, especially if an agricultural tractor is used, in order to avoid damaging the structure of the dry stone and disturbing the organisms living in it. Mechanical harvesting of crops on terraces is not recommended as it may damage the structure for the same reasons.

Traditional crops in pastures and fallow land offer shelter to many species of fauna, avifauna and insects and enrich the soil with nutrients while protecting it from erosion and reduction of organic matter necessary for plant growth.

For the cultivation of these areas, it is proposed to cooperate and coordinate with local users (mainly livestock breeders and farmers) so that they can benefit from the sowing, under the condition that grazing remains less than or equal to the grazing capacity to avoid overgrazing. The agreement can be drafted taking into account the planning and needs of the local user and may include a commitment a rotating e grazing scheme the cultivated area until early summer so that grass is available during the breeding season of prey species. Alternatively, in case the local user wants to harvest the grass, he should not harvest the entire sown area but maintain an unharvested zone at least one (1) meter around the perimeter of the cultivated area (Figures 2 and 3).

Cultivation methods

The choice of cultivation method is determined by the available land area, ownership, soil and climate conditions, and the labor force. Two farming methods can be used, conventional and non-conventional.

In conventional practices - using an agricultural tractor or tiller machine - it is recommended to avoid the use of chemical products (fertilizers or foregoing application of herbicides). In the case of mechanical means of ploughing and sowing, it is recommended that the surface disturbance of the soil should not exceed a depth of 10-15 cm and should be carried out during the autumn period, when humidity is high and average temperatures are low (late October to early December).

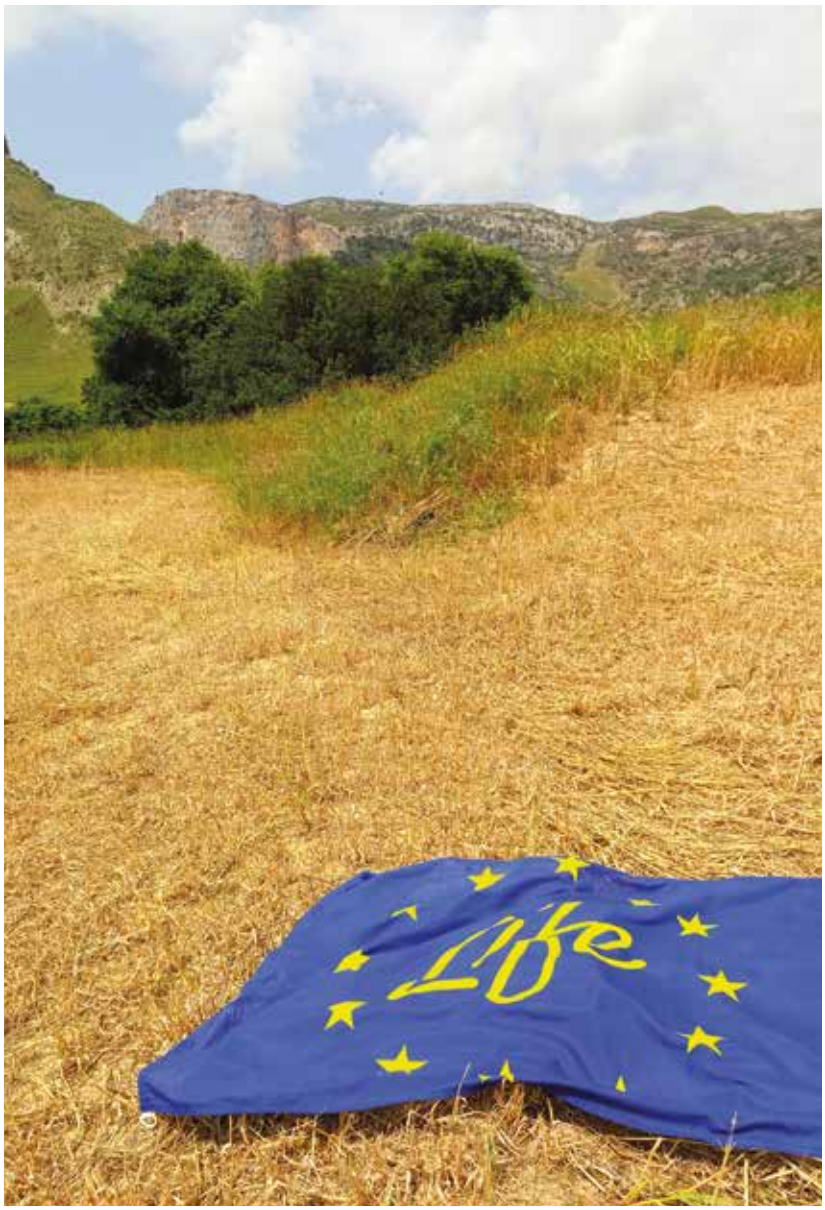

Figure 2: Circumferentially unharvested plot in Prasano Gorge. Kostis Damianakis©UoC NHMC Archive.

Figure 3: Circumferentially unharvested plot on the Plateau of Tsilivdikas Kostis Damianakis©UoC NHMC Archive.

In the case of unconventional methods, two are the preferred methods of re-grassing: a) the use of seed balls (Fukuoka method) and b) the use of coated seeds.

The seed ball method has very good germination results (Figures 4 and 5) of the seeds enclosed in it but a large number of balls is needed to cover the area of interest (usually more than 300 Kg of balls/ hectare).

The coated seed method on the other hand - which also has very good germination results (Figure 6) - may have higher losses due to seed consumption by birds and terrestrial insects but allows covering larger areas with fewer Kg of coated seed. For example, in areas with a 1/1 ratio between soil and rocky surface (typical ratio in many areas such as Sfakia in the Chania region), about 100 Kg of coated seed per hectare are needed, while in areas with soil surface over 80% (typical ratio in many areas of Asterousia) about 15 Kg per hectare are needed.

Figure 4: Test spreading of cereal/livestock balls in Doraki Asterousia. Kostis Damianakis©UoC-NHMC Archive.

Figure 5: Germination after 3 weeks. Kostis Damianakis ©UoC-NHMC Archive.

Process of production of coated cereal/legume seeds

- Place about 30 liters of clean water in a 50 liter container where a suitable inoculant has been dissolved at the ratio suggested by the manufacturer.
- Then add the seeds (25-30 Kg of medium sized vetch or wheat/barley seeds).
- Stir well until all the seeds are covered and soaked and leave the mixture in a shady place for half an hour.
- Remove the excess liquid by draining the seeds.
- Add the seeds gradually to a rotating stirring mixer such as concrete mixer.

- Add the coating material (Atapulgite or Zeolite <0,075mm - powder) to the bucket of the mixer gradually and stir for as long as necessary (~5 minutes), until the whole seed is coated with a thin crust. Alternatively, if a concrete mixer is not available, mix the seed with coating material by hand (Figure 7) or with appropriate tools (shovel, rake) and when coverage is achieved, sieve to remove excess material.
- Remove and allow the seed to dry in a shady and cool place, spread out on a clean surface.
- When sure that there is no moisture on the surface, place the seeds in weft/linen bags and store them in a dry and shady place until the sowing season.

Figure 6: Germination of coated seeds after 3 weeks. Kostis Damianakis©UoC-NHMC Archive.

Figure 7: Preparation of coated cereal seeds. Kostis Damianakis©UoC-NHMC Archive.

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2.2 Water supply to game fauna

The construction and placement of artificial water collectors and watering troughs in areas of interest for the Bonelli's Eagle and other birds of prey aims to address the main limiting factor that prey species face, the lack of water due to the generally dry and hot climate in the areas where most of the species' confirmed territories are located. Especially during the summer months and in a condition where the normality of climatic phenomena has been disrupted, interventions to provide water to prey species of the Bonelli's Eagle and other predators is perhaps the most important habitat improve ments.

During the design and construction phase of an artificial water collector it is necessary to take into consideration several parameters such as:

1. Intervention sites should be located within or near the boundaries of known territories of the Bonelli's Eagle or other large raptors or in areas regularly visited by juveniles of these species for feeding (derived from the processing of telemetry data).
2. Fenced areas should be preferred to reduce the risk of water depletion by livestock, especially in areas where there is a high concentration of stray farm animals.
3. The ability to easily the possibility of easy access the spot for the installation and modification or maintenance of a water supply structure should always be assessed.
4. A preliminary study is needed to decide the type and size of a water supply facility, evaluating the distance from alternative water sources for prey animals and the presence of supervised or stray livestock in the area.
5. Finally, it is important, if open-type water supply systems are chosen, to provide escape devices for animals and insects that may fall into the water, in order to prevent their drowning.

In view of the above, the types of water supply devices that can be chosen on a case-by-case basis to improve the habitat of the Bonelli's Eagle can be divided into the following types:

Open-type water pit

For the construction and sealing of an open-type water pit, it is necessary to first clean the area from waste and debris, excavate to ensure the desired characteristics of shape, depth etc., coat the surface with a non-permeable material e.g. clay soil and compact it. Alternatively, an HDPE waterproofing membrane more than 2 mm thick or concrete with an elastomeric waterproofing coating may be used to line the pit.

Lenticular water collection for easy transportation and placement in hard-to-reach places

This type can be built ex-situ and in bulk and can be installed in large numbers in areas where soil characteristics do not allow water retention after rainfall. These devices are ideal to retain and provide water for some days especially in the spring, summer and autumn months where rainfall is limited and the relatively higher temperatures compared to winter do not allow surface water to remain

in the soil. The 'basin' shape of lenticular water collectors makes it easier to place and transport them to inaccessible places and in large numbers. The key features of such device should be the following:

1. Use of lightweight, high-strength material for their construction, such as perlite.
2. Internal reinforcement with galvanized mesh type reinforcement, for greater resistance in case of pressure from a large animal e.g. a goat.
3. A non-permeable surface to prevent water absorption from the construction material, which is achieved by the application of plaster or other equivalent sealant.
4. White or light-colored sealing material to reflect solar radiation in order to avoid increasing the temperature of water and losses due to evaporation.
5. The diameter of the rim must be at least three times bigger to the diameter of the bottom, to provide a large surface area for catchment but a small surface area for evaporation of the collected water.
6. In at least two places (opposite to each other), if not over the entire inner surface, it shall be shaped with irregularities capable of allowing small animals and insects that may fall in to climb in and escape.
7. The total weight of the structure should not exceed 50 kg so it can be carried by two persons.

Based on the above, the LIFE Bonelli eastMed project constructed original lenticular water collectors with a diameter of 1.1-1.2 m and a maximum weight of 50 kg, which have already been installed in many areas of Crete, the Dodecanese and islands in the Cyclades (Figures 1-4). Initial measurements of the efficiency of the device have shown that it collects about 10 litres of water per 15 mm of rain-fall.

Self-contained water supply with a water catchment system

This type is suitable for areas where surface water is not available, especially in the summer months, but is relatively easy to access by road to top up the storage system with water when required. The device consists of a plastic water tank fixed to a metal frame, which is filled with water through a special inclined surface which has a hole through which the water harvested by the surface collector enters the tank. The size of the rainwater catchment/collection surface (approximately 1.5 square metres) has been determined on the basis of the calculation that in an average rainfall year where at least 500 to 600 mm of rain is expected, the tank will be filled, and if required in the summer months can be refilled, in consultation with the Forestry Department and/or the Fire Brigade and volunteer fire protection groups, if they have water available. The tanks connected to a plastic waterer fitted with a ball float valve through a common watering hose. To protect the waterer from livestock, a building mesh fixed to four poles is placed around the trough, as shown in Diagram 1 below.

Figure 1. LIFE Bonelli east-Med©UoC-NHMC Archive.

Figure 2. LIFE Bonelli east-Med©UoC-NHMC Archive.

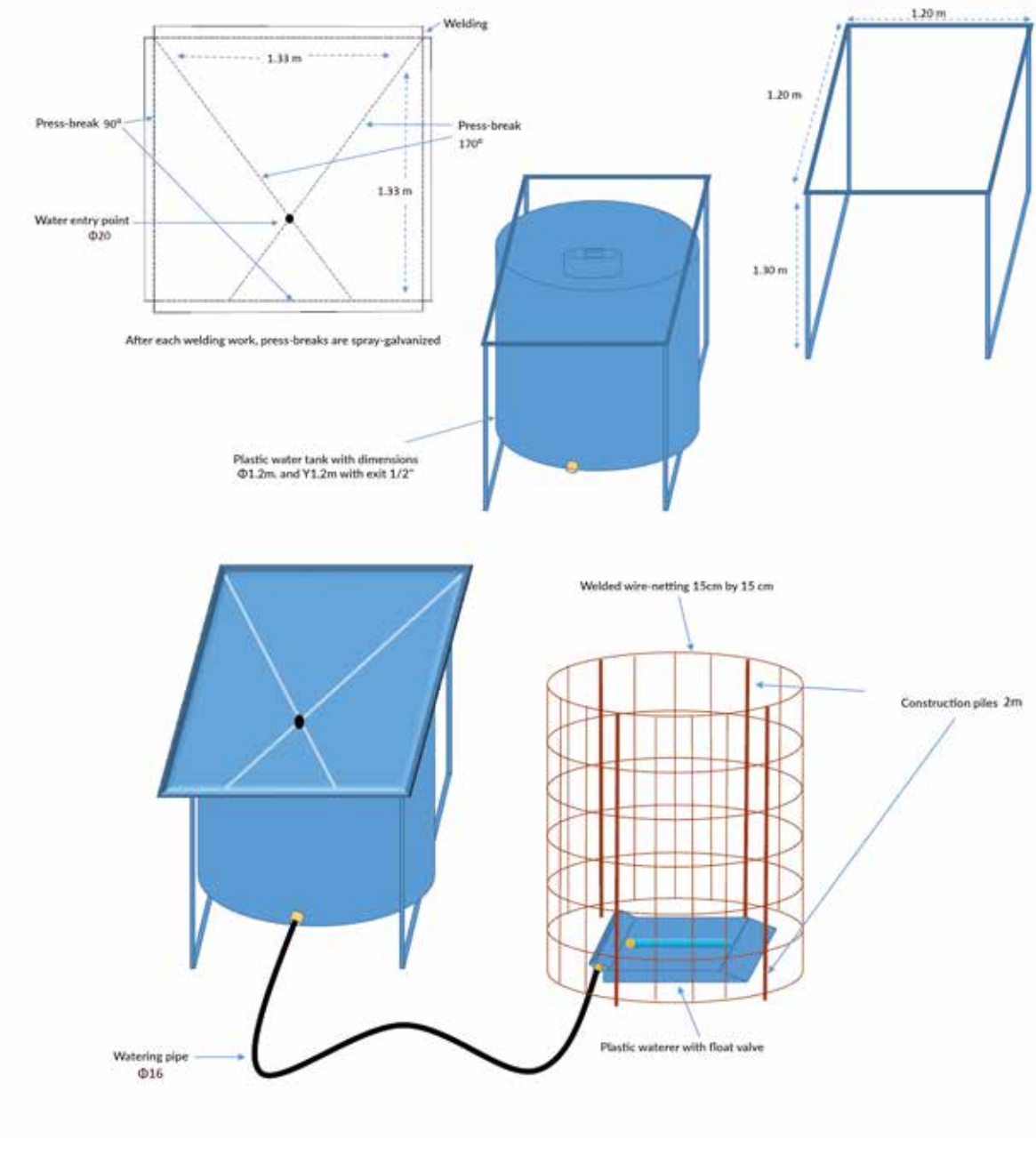
Figure 3. LIFE Bonelli east-Med©UoC-NHMC Archive.

Figure 4. LIFE Bonelli east-Med©UoC-NHMC Archive.

Such water collectors have been placed in various places in Crete and other Aegean islands by local hunting clubs (Figure 5-6).

Figure 5 & 6: Typical water collector for game fauna built by the Hunting Club of Neapolis Lassithi. ©UoC-NHMC Archive.

Diagram 1: Indicative technical specifications of an autonomous water supply system with water collection system. Prey availability increase Operational Plan. LIFE Bonelli eastMed. Kostis Damianakis©UoC-NHMC Archive.



Livestock water trough

In the case where cooperation has been achieved with local users of an area of interest, e.g. livestock breeders, farmers or beekeepers, systems of adapted livestock troughs connected to the water supply network of local users can be installed, who on the one hand benefit from the presence of troughs for the needs of their animals and on the other hand can supervise their proper operation and carry out their maintenance when required, with simultaneous benefit for the preys of the Bonelli's Eagle.

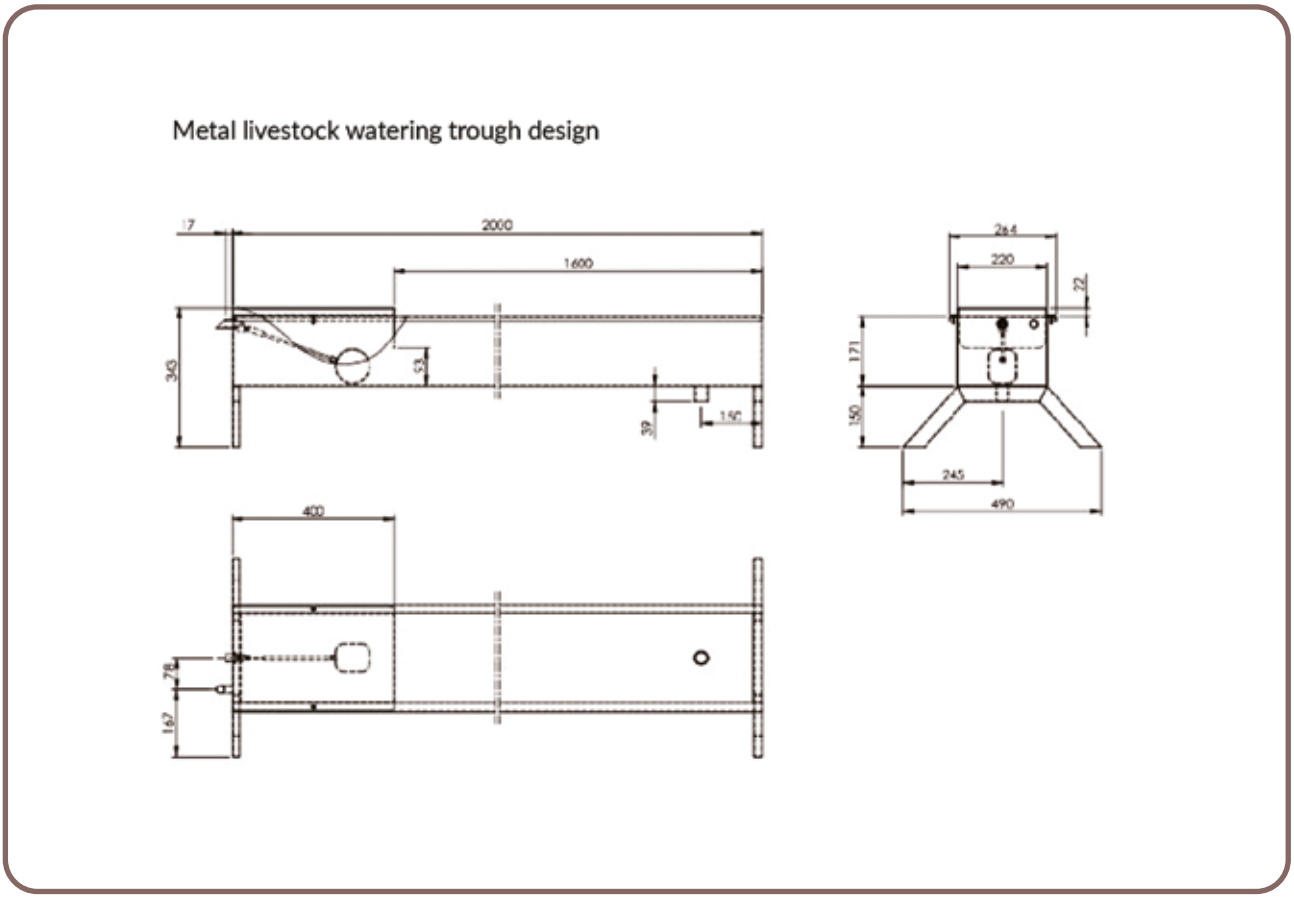
The aforementioned customized waterer catchment consists in the construction of watering troughs considerably lower than the traditional watering troughs of 40-50 cm, so that prey species have easier access (Figures 7 & 8). Alternatively, in areas of interest where irrigation networks exist, the watering troughs can also be connected (in consultation with the local Municipal Irrigation Operators) with irrigation water collectors in order to provide an uninterrupted supply for local prey species. In these cases, therefore, devices such as those normally used for sheep and goats can be installed, i.e. a 200 cm long x 25 cm wide basin and a maximum height of 15 cm from the ground so that prey species can easily access the water.

Figure 7: Model livestock watering trough of the project in Agios Nektarios, Chania. Kostis Damianakis©UoC-NHMC Archive.

Figure 8: Model livestock watering trough of the project in Samonas, Chania. Kostis Damianakis©UoC-NHMC Archive.

Watering troughs should have a ball float valve system and a hole with a simple tap underneath for easy cleaning. A prototype that has already been constructed and installed in several areas of Crete is shown in Diagram 2 and Figures 8-9 below.

Diagram 2: Indicative technical specifications of a customized metal livestock watering trough. LIFE Bonelli eastMed. Kostis Damianakis©UoC -NHMC.



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Morphometric measurements taken on a Bonelli's Eagle chick, Tinos island. Savvas Paragamian©UoC-NHMC Archive.

Chapter 3

Interventions to reduce the mortality of the Bonelli's Eagle

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3.1 Overhead power lines effects on wildlife and mitigation measures

We humans rely on electricity to achieve high levels of well-being and equal opportunities in our societies. However, to be able to use electricity, we have developed extensive networks of medium- and high-voltage power grids which currently count more than 70 million kilometers of lines globally. The use of electricity, even though beneficial for our species, has devastating consequences for other species and ecosystems on Earth. Policies and strategies have been developed and adopted, such as the EU Biodiversity Strategy of 2030, emphasizing the increased declines in biodiversity and the impacts of these declines on our planet's health and on our lives.

The growing demand for electricity, which is expected to increase by 30% until 2040, leads to energy infrastructure development globally without, in many cases, having adequate spatial planning and biodiversity associated potential risk analysis (Bernardino et al., 2018). This increase is always accompanied by the expansion of the power line networks, which affect various animal groups, but most of all the avifauna, with adverse impacts on the survival of many species. Raptors are among the avifauna groups that are most affected by the overhead power lines, with millions of birds estimated to have been killed due to collisions and individuals belonging to more than 70 species reported to have been electrocuted globally (Martín Martín et al., 2022). Across Europe, collisions result in high casualties among big raptors, while electrocution has been identified as a major mortality factor for Bonelli's eagle populations, and mitigation measures have been proposed through EU guidelines (European Commission, 2018). Furthermore, though not discussed here, it is pivotal to mention the impact that transmission lines have on avifauna's displacement, either because of their barrier effect or due to disturbances associated with their construction and habitat transformation (Ashwin et al., 2023; D'Amico et al., 2018).

Greece has a growing power network with more than 113,000 km of overhead distribution lines and 3,000 km of overhead transmission lines (HEDNO, 2024; IPTO, 2024). On the other hand, 33% of the distribution network in Cyprus is already underground, leaving 6,000 km of medium-voltage overhead lines and 1,150 km of overhead transmission lines (EAC, 2024). Nonetheless, the existing power network in Greece and Cyprus currently accounts for 17% of the casualties in juvenile and immature Bonelli's eagles due to electrocution and collision (LIFE Bonelli eastMed data between 2019 and 2023). It is urgent to apply mitigation measures and find solutions to the potentially increasing mortality risk that overhead power lines pose to bird life in our countries. LIFE Bonelli eastMed aims to lay the groundwork for mobilizing the electrical companies and the relevant authorities to consider mitigation measures for the survival of our raptor species. One of the project objectives is to reduce the direct mortality of the targeted species through infrastructure interventions, but the action is applied locally and to small areas. Our national policies must integrate biodiversity

data into spatial planning, and mitigation measures need to be adopted nationally by the electric companies.

This chapter aims to provide general guidelines and principles regarding the impacts of power lines on the avifauna, as well as commonly used solutions to minimize this risk. Specifically, this chapter provides information on the causation of electrocution and collision events, as well as general guidelines on the mitigation measures and solutions that have been adopted globally to reduce the mortality risk in avifauna. Guidelines on how to approach electric operators are discussed together with good practices that have been adopted by other European Mediterranean countries.

Causes of electrocution and collision

Electrocution

Electrocution occurs when a bird comes in contact with a single conductor and an earthed metallic structure (cross arm or ground wire) or when two conductors are simultaneously touched (Figure 1). This creates a short circuit, and electric current passes through the body, leading almost always to the bird's death (Figure 2 & 3). Avian electrocution is most common in distribution lines (22 kV in Greece, 11 kV or 22 kV in Cyprus). However, avian electrocution events are not evenly distributed through the aerial distribution network due to biological, environmental/topographical, and technical/engineering factors (Avian Power Line Interaction Committee (APLIC), 2006; Raptor Protection of Slovakia, 2021).

Biological factors

Species morphology and ecology play a detrimental role in the electrocution risk for each species. More specifically, size matters since species with a larger wingspan can create a close circuit when touching two conductors simultaneously; examples of such species are Bonelli's eagles (*Aquila fasciata*) or Golden eagles (*Aquila chrysaetos*). Birds of prey are also using perching sites as observation points for foraging. Therefore, it is detrimental if natural perches are abundant in the habitat used by each species for reproduction and forage (forest or open grassland) (Lehman et al., 2007). Age is linked to experience, with juveniles and immature birds having little flying and hunting experience and being less skilled at landings and takeoffs (Lehman et al., 2007). Less capability results in a reduced ability to maneuver, and consequently they utilize available aids, such as poles. Furthermore, immature individuals have a higher risk of getting electrocuted since, during their first years, they are moving away from the paternal territories and disperse on new grounds. Not being residents of a specific area could lead to being more exposed to threats, especially with structures that can be used as perching sites.

Environmental/topographical factors

Poles that are more elevated compared to their surroundings or are located on open landscapes that lack higher ground (e.g., trees) are excellent perches for the avifauna. Poles in such landscapes that are lacking natural perches are used either as roosting sites or hunting perches since they provide a vantage point for birds, and many electrocution events can occur in one of these poles since they are preferred (Lehman et al., 2007). Furthermore, electrocution events can alter depending on the weather and the season. For example, wet environmental conditions (rain or snow) lead to having wet feathers, which consequently increases the risk of electrocution. The direction of the prevailing wind in relation to the pole's crossarm may also influence electrocution incidences (Lehman et al., 2007).

Technical/engineering factors

Poles with certain configuration/typology and material are more dangerous than others (further discussed in the following paragraph). For example, poles made of steel or steel-reinforced concrete are of high risk for causing electrocution events even for birds of smaller size (Lehman et al., 2007). Connectors, but more importantly, transformers, are especially hazardous even to smaller birds, due to the numerous closed-spaced charged parts (discussed further below).

Certain species are more threatened by electrocution since their behavior and body size make them more vulnerable to it, mostly large raptors (i.e., eagles, hawks, vultures, kites, falcons), corvids and storks (Raptor Protection of Slovakia, 2021). These species are using the electric poles as perching sites, and their wingspan is large enough to make contact with two different elements on the pole leading to their electrocution (Lehman et al., 2007; Martín Martín et al., 2022). Factors interact and work synergistically. For example, perching on a pole that is located close to a water source where prey species are gathering to obtain their water intake provides a good hunting spot. Nonetheless, taking off from that pole can be lethal for the bird in question.

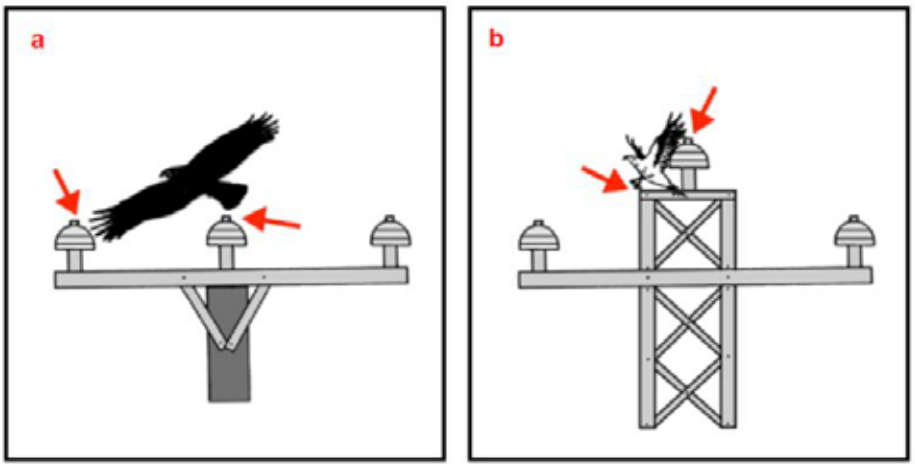


Figure 1: Electrocution occurs when an individual a) touches two conductors or b) touches a conductor and an earthed metallic structure (Rollan et al., 2016).

Figure 2: Immature Bonelli's eagle – 9 months old, born in the western most territory of the species of Asterousia mountains, on Crete. Named Olia – ring number: X000767, carcass found in South Asterousia – north of Diskos village on 09.12.2022. Dead from electrocution. LIFE Bonelli eastMed (source: UoC – NHMC, Afroditi Kardamaki)

Figure 3: Immature Bonelli's eagle – 8 months old, born on Andros Island. Ring number: X000746, carcass found in Thessalian plain in November 2019. Dead from electrocution. LIFE Bonelli eastMed (source: NCC, Lavrentis Sidiropoulos)

Collision

Collision occurs when birds in flight are not aware of the presence of the cables in trajectory or do not deviate in time, and most often takes place with transmission lines. Usually, collisions lead to fractured wings, keel, neck, skull and other injuries and most often end up being fatal. Three main groups of interconnected factors influence avian collision and are related to the species, the site, and the powerline (Bernardino et al., 2018).

Species-specific factors

Birds have a broad lateral and a narrow binocular field of vision. The extent of these fields varies among species, but in general, birds' eyes are positioned laterally which gives them the ability to detect prey or predators in their lateral or peripheral field of vision relatively away from them. On the other hand, the binocular field of view of birds is very narrow and allows them to detect objects that are very close to them (Figure 4) (Martin, 2022). Therefore, it is not easy for a bird to detect – while on flight – a wire in front of them when placed at a distance, especially when it is engaged in another activity such as foraging. That is firstly because of the fields of vision of birds as mentioned above and secondly because of the bling regions above and behind the head, which are projected towards the direction of the flight when a bird puts its head downwards to look for prey (Bernardino et al., 2018). Moreover, factors such as the maneuverability, time of migration (night or day), the age (which relates to experience), and flight behaviors of a species, as for example, high-speed flights during hunting or in general foraging flights, display flights and territory disputes, can highly affect the risk of collision.

Site-specific factors

The weather, light conditions, available habitats, and topography might affect exposure and susceptibility to collision. Aerial powerlines located on topographic depressions such as deep ravines or on mountain passes and mountain chains that act as pathways or as flyways for soaring-gliding birds due to thermals and other updrafts can pose a high collision risk. Heavy weather conditions, such as fog or rainfall, force birds to fly on lower altitudes that are closer to the ground and potentially closer to hazardous obstacles (Jenkins et al., 2010). Wind direction and force can have an impact on a bird's ability to maneuver and avoid thin-line obstacles. On the other hand, areas with preferable foraging, roosting, or breeding habitats concentrate more birds, which greatly affects the probability of collision.

Power line-specific factors

Certain power line features influence the risk of collision, such as the number of vertical wires and spacing between them, which relates to pylon spacing (Jenkins et al., 2010). The

height of wire above ground could also affect the likelihood of collision depending on the species' flight behavior (species-specific factors) and the surrounding habitat (site-specific factors) (Ferrer, 2012). However, the most detrimental power line element accounting for the majority of collision incidences in transmission lines is the earth wire. Earth wires are less visible since they are thinner compared to phase conductors, and typically run along the top of the wire array (Bernardino et al., 2018; Martín Martín et al., 2022).

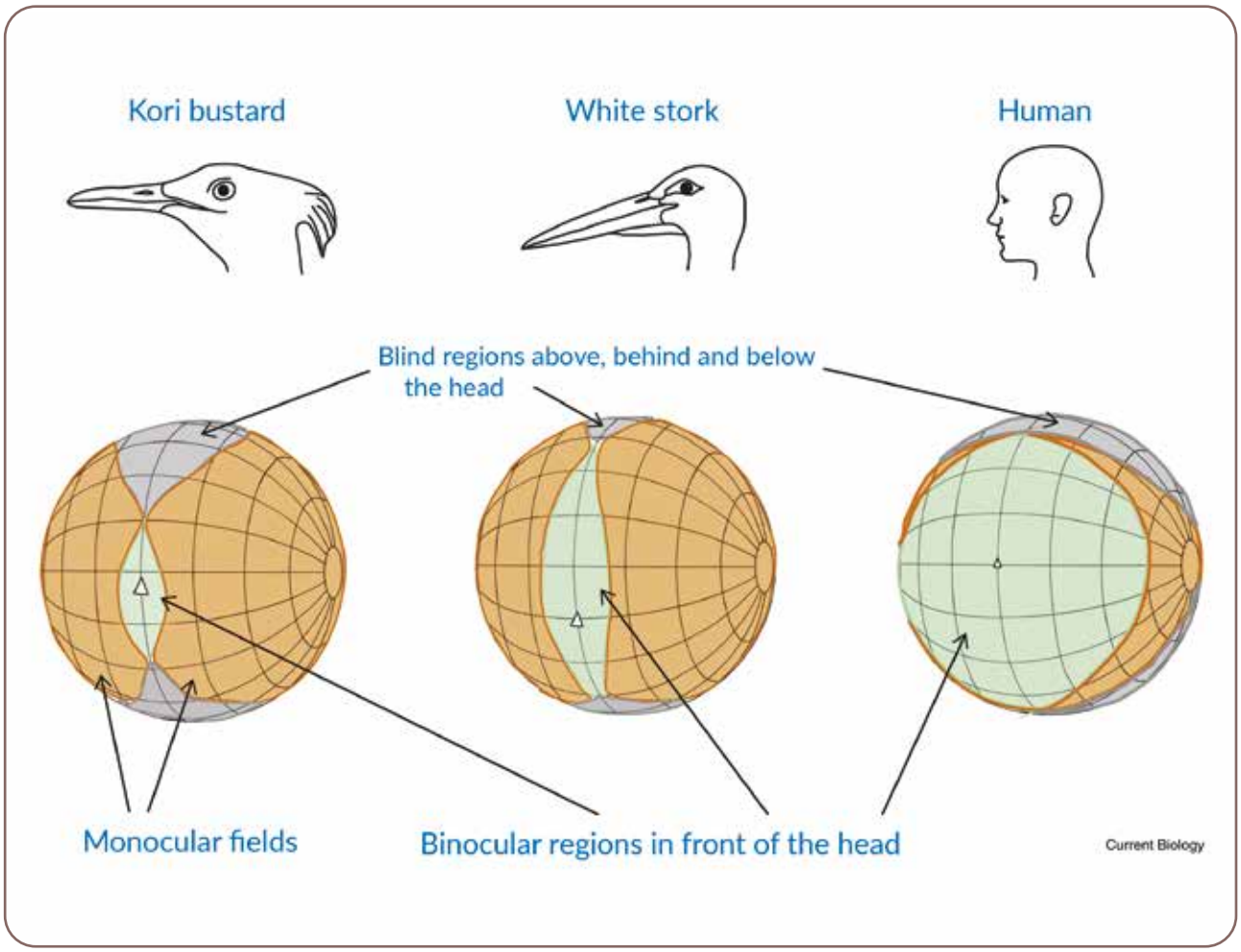


Figure 4: Presentation of the visual field of different species onto a sphere surrounding the head. Differences in the position of the eyes on the skull and differentiation in the visual fields result in distinct perceptions of the surrounding visual information (source: Martin, 2022).

Selection criteria

Victims of electrocution fall close to the base of the pole and therefore are more easily detected by power line staff, scientists, landowners, or the public. On the other hand, collision incidences could occur at any length of the aerial network, while the victims of collision are not necessarily found precisely under the wires. Having the knowledge of electrocution and collision events – a history of past events – helps identify poles and length of power lines

that are considered hazardous for the avifauna. Unfortunately, in most cases, carcasses are detected by chance and are not a product of systematic search or documentation. The extent of the aerial network and the lack of electrocution incidence documentation – at least the ones leading to power cuts – by the distribution operators result in our restricted knowledge on the matter. Nonetheless, tools such as the e-faunalert are involving citizens in obtaining the required information on dangerous power lines (more information at https://e-faunalert.org/). In the following paragraphs, we discuss the main criteria used to identify dangerous for electrocution incidences medium voltage poles (distribution network) and stretches of high voltage power lines (transmission network), which could lead to collision events. Due to a lack of extensive data on electrocution/collision events, the criterion related to history is not discussed further.

Distribution network – Electrocution events

A prerequisite for the initial selection of the wider area of interest is at least having basic knowledge of the species present since certain bird groups – here raptors that are our focus – are more threatened by electrocution, as discussed previously. Consequently, data on species established territories, dispersal and migration routes, and stopovers are crucial. Following that initial selection, two main criteria guide us to select the localities in which to apply measures and to identify dangerous poles:

1. Habitat characteristics
2. Pole's technical features

It is very important to note that these criteria are interlinked (Hernández-Lambraño et al., 2018). If for example, the configuration of a pole is of the dangerous type but it is rarely used by birds, then the electrocution risk is low. On the contrary, in habitats where natural perches are scarce, poles are used more intensively by raptors, and therefore the type and configuration of a pole in these cases could increase enormously the risk of electrocution.

Habitat characteristics

The characteristics of a habitat, such as vegetation type and coverage, and topographical features, such as wetlands, affect greatly the usage of poles within these areas. More specifically, poles located in habitats suitable and rich in prey species that lack natural perches, as for example trees, could qualify as dangerous to cause electrocution (Dixon et al., 2017; Harness and Wilson, 2001). Also, poles in transitional areas between ecosystems or areas with high concentrations of birds, such as landfills or croplands, could be potentially used by certain bird species (Hernández-Lambraño et al., 2018). Raptors often use poles in close

proximity to water sources like wetlands or artificial ponds as perching sites, as these oases tend to attract prey species. In these areas, oftentimes avifauna is perching on poles with wet plumage that they might spread to dry, which puts them at even greater risk (Martín Martín et al., 2022).

Pole's technical features

The type, configuration and function of poles used by birds are crucial in identifying their risk to avifauna. Certain types and configurations are more dangerous than others, and for this reason a three-level classification has been developed. Depending on their mortality risk, medium voltage poles can be grouped as low, moderate, or high risk. Nonetheless, it is extremely important to note that under certain conditions, poles that are considered relatively safe can become dangerous. For example, birds can be electrocuted during wet weather conditions either because their feathers are wet or because the wooden pole is wet – even on normally low risk structures (Avian Power Line Interaction Committee (APLIC), 2006).

Low risk

Poles with suspended insulators are relatively safe, depending on the length of the ring of insulators. If the distance between the crossarm (likely perch) and the energized parts (conductors) is greater than 60 cm and the conductors are spaced at least 140 cm apart, then these structures are considered low risk (Bern Convention, 2003) (Figure 5). Exception to this rule pose the vault type crossarm poles with suspended insulators (see high risk) (BirdLife International, 2007).

Moderate risk

In general, staggered type or straight type crossarm poles with strain insulators and jumper wires below the insulators (suspended jumper wire) are considered of moderate risk (Figure 6). However, the level of risk varies depending on the size of the bird, as larger birds are more likely to touch the jumper or both conductors. Increasing the length of strain insulators over 60 cm reduces the risk of electrocution.

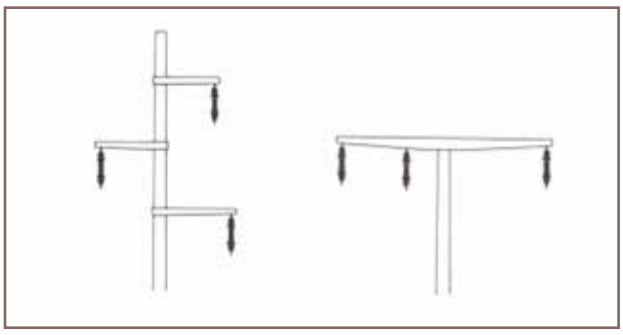


Figure 5: Staggered type crossarm (on the left) and straight type crossarm (on the right) with suspended insulators (BirdLife International, 2007).

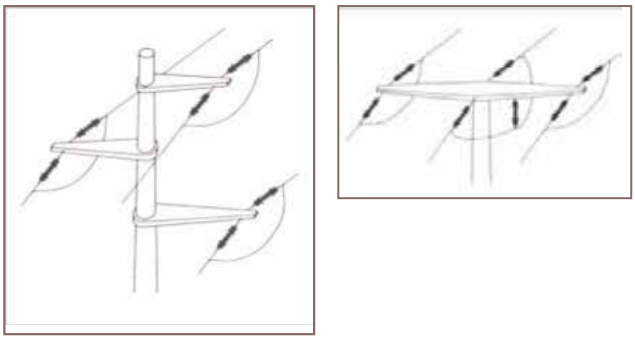


Figure 6: Staggered type crossarm (on the left) and straight type crossarm (on the right) pole with strain insulators and suspended jumper wires (source: BirdLife International, 2007).

High risk

All types of poles – regardless of their crossarm type – having pin-type upright insulators are considered high risk (Figure 7) (BirdLife International, 2007; Ferrer, 2012). Also, poles with jumper wires over the insulators – or just the central jumper exposed is of very high risk regardless of their crossarm type or the insulators used (Figure 7). On the other hand,

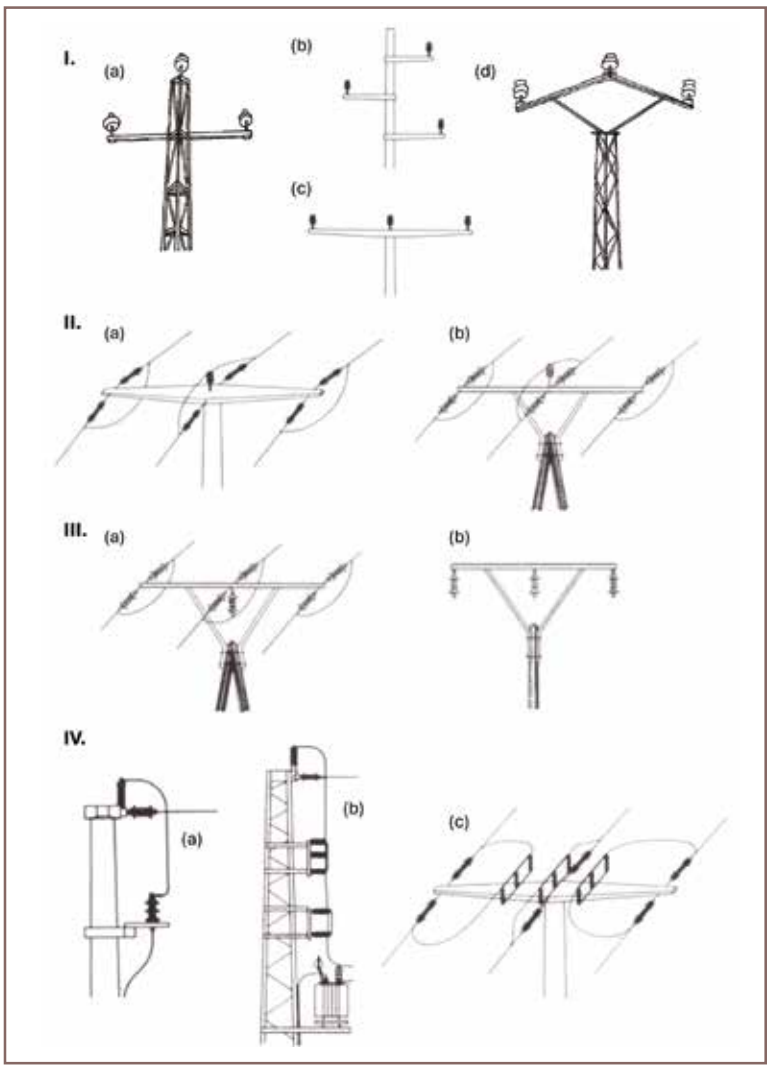


Figure 7: I) Pin-type insulators on: (a) triangle type crossarm, (b) staggered type crossarm, (c) straight type crossarm, (d) vault type crossarm. II) Strain insulators on: (a) straight type crossarm with the central jumper wire exposed, (b) vault type crossarm with the central jumper wire exposed. III) Vault type crossarm: (a) with strain insulators and jumper below the crossarm, (b) with suspended insulators. IV) Special function poles: (a) terminal pole, (b) pole with transformer, (c) switch pole. (sources: Bern Convention, 2003; Ferrer, 2012).

vault type crossarm poles with suspended insulators or with strain insulators with the central jumper wire below or above the crossarm are also considered high risk (Figure 7). In general, **new poles are recommended to avoid having a triangle construction or the vault type crossarm** (BirdLife International, 2007). Finally, poles with special constructions or functions, such as terminal poles, poles with transformers or switches, poles with derivation lines and protection elements are equally high risk for the avifauna (Figure 7).

Transmission network – Collision events

To be able to select the areas and consequently the sections of the transmission network that are dangerous for the avifauna, it is crucial to have at least basic knowledge of the dispersal areas, migration routes and home ranges of the bird species in the greater area of interest. Two main criteria serve as guides for the selection process:

1. Avifauna in the area
2. Topography & habitat

Avifauna in the area

The selection of transmission lines depends greatly on the behavior of a species. Species with defined home ranges, such as Bonelli's eagles, have a great risk of colliding with power lines within their home range due to certain behaviors, which take place within that area (Rollan et al., 2010). These behaviors could be hunting, courtship displays or repeated flights between feeding grounds and the nesting or roosting sites (Avian Power Line Interaction Committee (APLIC), 2012). Lines positioned or planned to be positioned on dispersal routes are of high risk due to the low experience level of immature and inexperienced individuals (Thompson, 1978). Lines positioned or planned to be positioned across migration corridors or important flyways where also high numbers of birds are passing are of high collision risk due to the unfamiliar terrain or time of migration – especially when light conditions are poor (Bern Convention, 2003; Prinsen et al., 2012).

Topography & habitat

Habitats used as hunting grounds, such as croplands or shrubs, are often visited by certain species (eg., raptors) which display hunting behaviors, and therefore power lines placed in these habitats increase the risk of collision (Rollan et al., 2010). Water sources such as river valleys, wetlands, or salines with high concentrations of species are also high risk areas (Jenkins et al., 2010) (Figure 8). Other topographic features, such as cliffs, hills, or other windbreak features next to or close to lowland habitats, should be considered since they provide thermal updrafts for soaring and the risk of collision is also high in such areas (Thompson, 1978) (Figure 8).

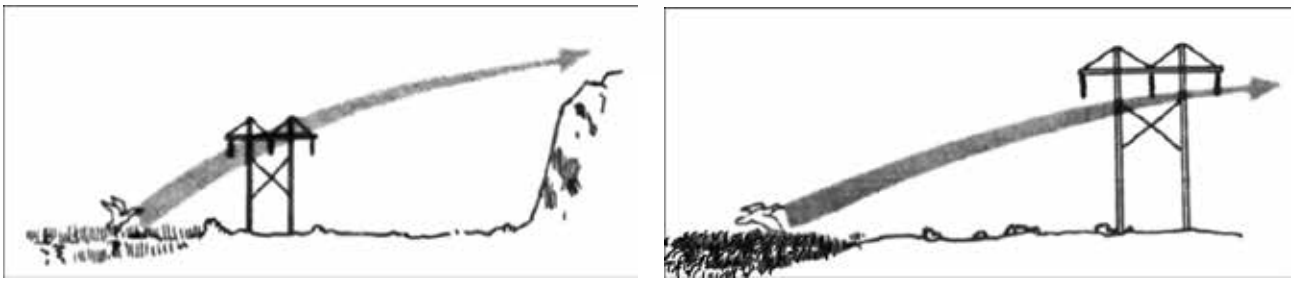


Figure 8: Collision risk on transmission lines close to cliffs (on the left) and transmission lines close to water sources (on the right) (after (Thompson, 1978).

Minimizing risk

The surest way to avoid the risk of electrocution and collision is to either not construct the power line, to place it underground, or if it must be above ground, to route it away from areas known or considered likely to have species that could be at risk (Bernardino et al., 2018; Jenkins et al., 2010; Prinsen et al., 2012). The best-case scenario is to design power lines a priori according to certain standards by considering the avifauna risks and by planning accordingly (Figure 9). In case of planning an above ground power line, it is necessary to conduct an ornithological evaluation during migration, breeding, and post-breeding seasons for at least one year (including: species abundances, flight patterns, flight routes, breeding grounds, nesting and roosting sites, stop-over migration sites, migration pathways, etc.) (Bern Convention, 2003). This evaluation should be combined with sensitivity maps and pre-

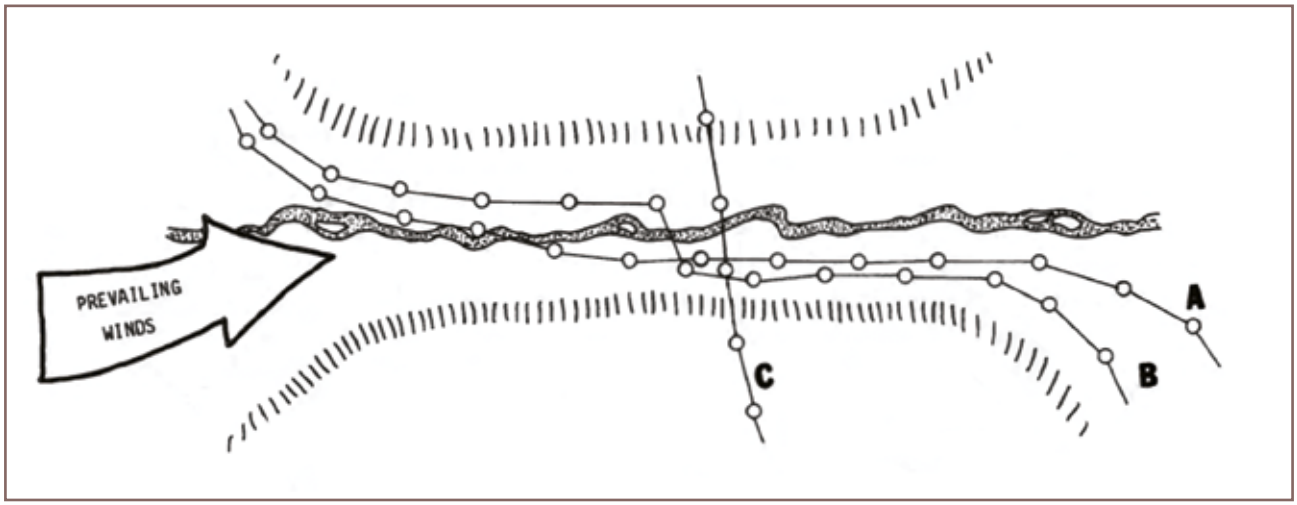


Figure 9: When route planning topographic and weather features as well as ornithological data should be combined. Variations on route planning where A routing is preferred over B and C due to the prevailing wind direction within a river canyon. In this example, parallel line placement to the prevailing wind direction and diagonal river crossing is preferred (route A) over parallel line placement to the prevailing wind direction and perpendicular river crossing (route B) or perpendicular line placement to the prevailing wind direction (route C) (source: (Thompson, 1978).

dictive models on the potential risks for the avifauna (incorporating power line characteristics, typology, etc.), and it ought to be reflected in the final routing and construction of the new power line. Strategic and careful route planning is considered one of the most effective ways to mitigate collision risk on transmission lines (Bernardino et al., 2018).

In the case of existing power lines, various mitigation measures can be applied to reduce the risk of electrocution and collision. The most effective of these measures are discussed in the following paragraphs.

Mitigating electrocution risk

Minimizing electrocution risk on above ground operational networks can be achieved through retrofitting. Two are the most effective mitigation strategies:

- Changes on design or configuration and

- Covering of energized parts

Oftentimes, both strategies need to be adopted to minimize electrocution risk.

Changes to powerline design and configuration

Changes to powerline design and configuration relate to changes on the top of the pole, either by making sure that all dangerous components are safe for birds and/or by sufficiently separating those dangerous components, which ensures that the birds cannot touch them (Prinsen et al., 2012). These changes can be achieved with the use of a) insulated and twisted conductors, b) crossarm configurations safe for birds, and/or c) the installation of certain elements (Martín Martín et al., 2022).

The use of insulated and twisted conductors is a permanent but expensive solution especially if the power network is already constructed, and therefore is not the most widely used solution. While changing to safe crossarm configurations and installation of certain elements is a more widely used solution. Safe cross arms are characterized by distances that allow birds to perch while minimizing risk. To achieve the latter, as a rule, the distance between the energized and grounded elements needs to be at least 60 cm, and the conductors should be separated at least by 1.4 m (or 1.8 m for bigger raptors) – however these distances depend on the species found in the area of interest (larger species require bigger distances) and also depend on the crossarm configuration and cannot be applied to all types of poles (Box 1). On the other hand, the installation of insulating elements is a corrective and electrocution preventive measure. This measure can be achieved by installing elements that increase the gap between the conductors on the crossarm, helping achieve the desired distance between the energized and grounded elements (Figure 10).

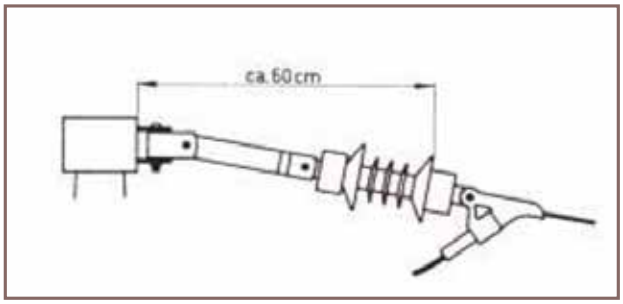


Figure 10: Insulator extension used to increase distance between the conductor and the crossarm over 60 cm (source: Bern Convention, 2003).

Covering of energized parts

Covering the conductors, wires and other energized parts of the pole (fuses, surge arresters, etc.) with insulating materials is another strategy used for mitigating electrocution risk. These covers are usually made out of plastic, PVC or silicone. It is important to note that all products used should be durable, made from long-lasting materials, and they should be installed correctly. These materials are ineffective or could even cause more harm if they are damaged or fitted improperly (Figure 11) (Raptor Protection of Slovakia, 2021).

These covers are used especially in pin type insulators and special structures where configuration is unchangeable (more information in Box1) (Figure 12).

Figure 11: Examples of covers that were not placed properly leading to partial of complete exposure of the energized parts. A) Exposed live metal part ©Justo Martín. B) Poor fitting of conductor cover leading to detachment ©Justo Martín. C) Poor fitting of conductor cover leading to detachment and movement along the conductor ©James Dwyer. (source: Martín Martín et al., 2022).

Figure 12: Example of placing covers on a straight crossarm pole with pin-types insulators in Crete (source: HEDNO - Stamatis Tomaras).

Below are the most suggested practices on minimizing the risk of electrocution on the most common types of poles. These strategies should be adapted depending on the species found in the area.

Vault type poles with suspended insulators is suggested to:

- change the design of the pole so that the distance between the top column and the insulator is at least 100 cm or,

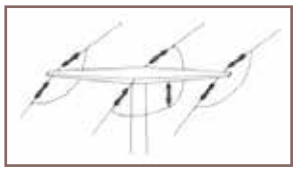
- use covers for the middle conductor over a total length of 200 cm (one meter on each side).

Staggered type crossarm and straight type crossarm poles with strain insulators and suspended jumper wires is suggested to:

- change the insulators' length and conductors' spacing. The distance should be at least 60 cm between the crossarm and the energized parts and at least 140 cm between conductors, or

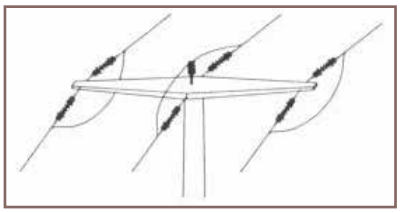
- use covers on the conductors which come close to the crossarm – need to cover at least 60 cm distance from the crossarm, or

- use a combination of both practices.



Straight type crossarm poles with strain insulators and with the central jumper wire exposed, possibilities:

- eliminate the conductor above the crossarm by installing a suspended insulator while simultaneously changing the insulators' length and conductors' spacing (at least 60 cm distance and 140 cm spacing respectively), or

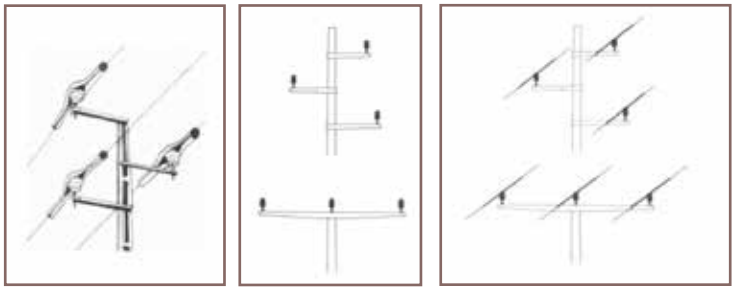


- use covers for the central jumper wire (insulator and aerial wire) and covers for the conductors which come close to the crossarm – need to cover at least 60 cm distance from the crossarm, or

- combine both practices.

All types of poles with pin-type insulators is suggested to use covers.

The covers are applied on all energized parts, specifically the insulators and the conductors. At least 60cm of the conductors should be covered on each side of an insulator.



(Sources: Bern Convention, 2003; Ferrer, 2012)

Mitigating collision risk

Minimizing collision risk on above ground operational transmission networks can be achieved by adopting different strategies, the 2 most common strategies are:

- Changes on power line configuration
- Wire marking

Changes on power line configuration

One of the suggested changes to power line configuration is the removal of the earth wire, as this is where the majority of collisions occur. This practice has been indicated to reduce collision by at least 50% (Bernardino et al., 2018). Nonetheless, this is probably not a realistic option on many occasions.

Another suggested practice is to reduce the vertical space that the lines occupy, which will consequently reduce the collision risk zone (Bevanger and Broseth, 2001). This could be achieved by changing the vertical position of the conductors and moving towards a single level arrangement (Avian Power Line Interaction Committee (APLIC), 2012) (Figure 13).

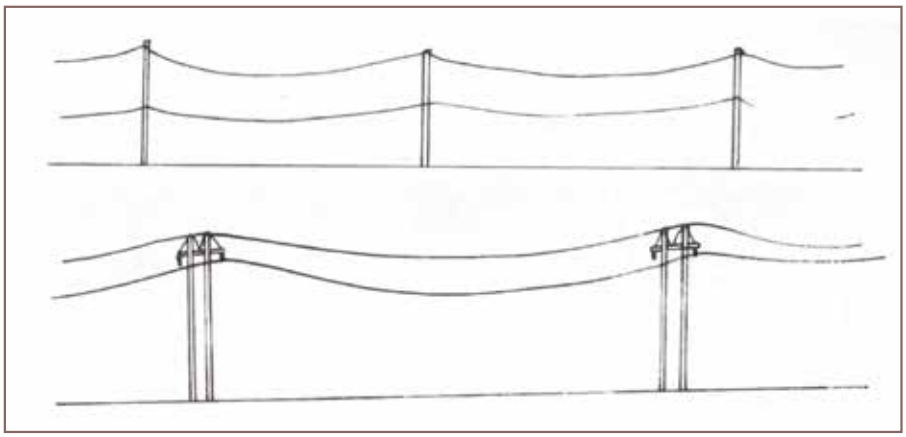


Figure 13: Example of reducing the size of the collision risk zone by changing the vertical position of the conductors (source: Thompson, 1978).

Wire marking

The most common mitigation measure for reducing collision risk is wire marking (Bernardino et al., 2018). The goal of adopting this strategy is to increase the visibility of the aerial wires to birds in flight by using devices that will divert the avifauna. A variety of markers, as they are also known as bird diverters, have been available on the market, such as spirals, strips, flappers, ribbons, and reflective markers (Figure 14). The selection between the different diverters is multifactorial and has to do with the budget available, the line design, voltage, topography, seasonality of harsh weather conditions, installation method, available staff and

Figure 14: Examples of diverters. A spiral diverter (swan-flight diverter) on the left and a reflective rotating diverter (firefly diverter) on the right (sources: PLP and Hammarprodukter).

if expertly trained (Bernardino et al., 2019; Raptor Protection of Slovakia, 2021). Nonetheless, some of these devices have not been proven highly effective, while others such as the reflective rotating markers (firefly diverters), have been reported to have significant results in reducing collision mortality (Ferrer et al., 2020; Raptor Protection of Slovakia, 2021).

Operators responsible

Greece

In Greece, the distribution and the transmission network are managed and owned by separate operators: the Hellenic Electricity Distribution Network Operator S.A. (HEDNO) and the Independent Power Transmission Operator S.A. (IPTO) (Figure 15).

HEDNO has two distinct responsibilities: operating the Hellenic Electricity Distribution Network (HEDN) and managing the markets for the non-interconnected islands (according to Law 4001/2011). HEDNO's main tasks are the operation, maintenance and development of the power distribution network in Greece while simultaneously taking care of the environment. At the same time, one of HEDNO's strategic goals is the protection of the environment by prioritizing the avoidance of biodiversity loss and the protection of threatened species by implementing interventions and adopting new technologies.

IPTO is responsible for the operation, control, maintenance and development of the Hellenic Electricity Transmission System (according to Law 4001/2011) as well as the operation of balancing Market and cross-border trade. It contributes towards the achievement of the United Nations Sustainable Development Goals (SDGs) by managing potential environmental impacts (such as impacts on biodiversity) that may arise due to the company's operation and through new projects (IPTO Sustainability Report 2022).

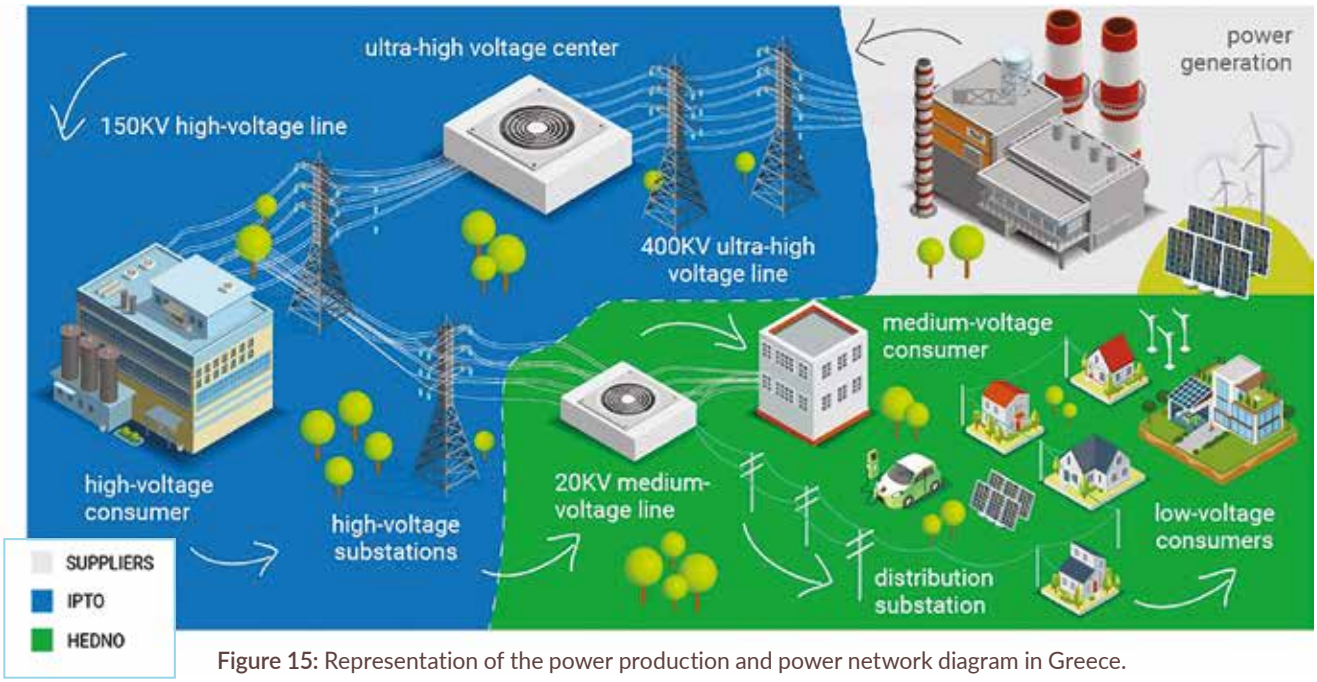


Figure 15: Representation of the power production and power network diagram in Greece.

Cyprus

In Cyprus, the distribution and the transmission network are managed and owned by the Electricity Authority of Cyprus (EAC). EAC is responsible for the development, construction, maintenance and management of the National Distribution Network as well as for the construction and maintenance of the National Transmission Network. EAC is divided into units; the transmission has been organized in a single unit, that of the Transmission System Owner (TSO), and the Distribution into two Units: the Distribution System Owner (DAO) and the Distribution System Operator (DSO).

Approaching the operator services

It is crucial to consider two factors while attempting to implement actions on the power network: a) the structure and organization of the operating company, and b) the geographic scope of the action per se. Certain electricity operators are centrally managed; thus, any change, such as retrofitting, or cable marking, must pass via central administration. While operators organized into units, such as geographic units, are likely to authorize and implement cable marking or retrofitting locally, overseeing their respective portions of the network. If the latter applies, the geographic scale of the planned mitigation measures should be considered. If mitigation actions will take place in a geographically defined area, it is advisable to communicate with the local offices. However, if the mitigation actions will be applied to multiple locations across a broad geographic scale, such as in multiple regional units, it is best to make all necessary arrangements

with the central administration first. This not only prevents conflicts, but also mobilizes various sectors and units within the relevant operator.

Good practices in other European countries

The case of Spain demonstrates excellently how bird mortality due to electrocution and collision can be reduced if political interest is shown and financial investment is made. For more than 30 years, Spain has been working on reducing avifauna mortality caused by the aerial power lines by undertaking conservation actions in collaboration with the power network operators and by taking steps on adopting and implementing legislation. In Spain's case, the adoption of local policies paved the way for the adoption of national policies on environmental and species protection.

The Andalusian Regional Government in 1990 (Decree 194/1990) passed the first executive order on regulating the construction of power lines in relation to their effect on the avifauna – making it the first Decree on the effect of the power grid in Europe. It was describing the typology, which is of high risk to the avifauna and the obligation to correct existing power lines. This Decree was initiated due to extensive studies conducted in Andalusia and especially in Doñana National Park on Spanish Imperial Eagles mortality and the impact of electrocution (Ferrer, 2012). Following Andalusia, another 6 Autonomous Communities passed their own legislation on power line regulation – in chronological order: Navarre (Foral Decree 129/1991), Madrid (Decree 40/1998), La Rioja (Decree 32/1998), Castilla-La Mancha (Decree 5/1999), Extremadura (Decree 47/2004) and Aragon (Decree 34/2005). Finally, in 2008, the Central Government of Spain passed Royal Decree 1432/2008 which established the technical mitigation measures for the protection of birds against electrocution and collision nationwide.

Prior to the adoption of the Royal Decree in 2008, corrective measures on power lines were partially funded by the electric companies in many of the Autonomous Communities with concrete results on bird survival. For example, in Andalusia Autonomous Community nearly 2.6 million EUR were spent on mitigating bird electrocution between 1992 and 2009, resulting in the increase of the reproductive population of the Spanish Imperial eagle by 50% (from 31 pairs to 60 pairs) (López-López et al., 2011).

In the past few years, Spain has invested more than 100 million EUR in mitigating electrocution and collision risks. Currently, approximately 60 million EUR has been allocated from the Post Covid EU recovery fund to retrofit 20,000 pylons in Spain (Moreno-Opo, 2023). While Red Eléctrica (partially state-owned and public limited Spanish corporation) invests 1 million EUR per year towards bird anti-collision measures; funding which corresponds to corrective actions on 200Km of transmission network per year (García Ruiz, 2023).

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3.2 Drowning prevention devices

During the implementation of the LIFE Bonelli eastMed project and from the results of a similar conservation project developed in Spain (AQUILA a-LIFE), it was found that one of the most important threats to the Bonelli's Eagle, which leads to the death of young individuals in particular, but also of other raptors and wildlife species, is drowning in open water tanks or in liquid waste deposits, as in the cases shown in Figures 1 to 4 below, where dead animals have been found in open tanks in Crete.

Figure 1: Bonelli's Eagle and Common Buzzard in an irrigation tank in Machaira, Municipality of Minoa Pediadas. Kostis Damianakis©UoC-NHMC Archive.

Figure 2: Bonelli's Eagle retrieved from an olive mill waste tank, Kato Gouves, Municipality of Hersonissos. Kostis Damianakis©UoC-NHMC Archive.

Figure 3: Badger in an irrigation tank in Asfendou, Municipality of Sfakia. Kostis Damianakis©UoC-NHMC Archive.

Figure 4: Stone Martens in an irrigation tank in the Monastery of Odigitria, Municipality of Phaistos. ©UoC-NHMC Archive.

In particular, from the recovery of dead Bonelli's Eagles that were tagged during LIFE Bonelli eastMed, it is estimated that 20-30% of the annual losses of young birds may be due to drowning in tarns and tanks. Reservoirs are mainly used for crop irrigation, livestock watering and/or water abstraction by the Fire Brigade and are scattered throughout the country, particularly in areas with relatively small land plots such as Crete, the Peloponnese and many islands, especially in the Southern Aegean.

The tanks found in these areas are mainly of four types: a) metallic vertical-wall tanks with an internal membrane liner which are usually covered, b) concrete vertical-wall tanks usually rectangular but also circular, c) sloping-wall tanks coated with a high-density polyethylene polymer (HDPE) membrane, and d) sloping-wall tanks with compacted rockfill.

To prevent drowning incidents in tanks, especially of types (b) and (c), it is recommended to install escape devices, also known as wildlife escape ladders. In the case of uncovered tanks of types (a) and (b), it is recommended to install floating (Figure 5) or fixed systems (Figure 6), while in the case of tanks of type (c) with sloping walls covered with a membrane, it is advisable to install fixed systems such as concrete ramps (Figure 7) or special heat-sealed plastic membrane of the NUMAGrid type made of polypropylene [produced only by NUMA Industrial S.A.[1] (Figure 8)], or install a suitable device with a surface that increases the traction of the animal trying to escape (Figure 9 and Figure 10).

Figure 5: Floating arrangement for vertical wall tanks. LIFE Bonelli eastMed©UoC-NHMC Archive.

1 NUMA Industrial S.A.

Figure 6: Fixed arrangement for vertical wall tanks. Source: Cap del Servei de Biodiversitat i Protecció dels Animals.

Figure 7. Concrete ramp. Source: Cap del Servei de Biodiversitat i Protecció dels Animals.

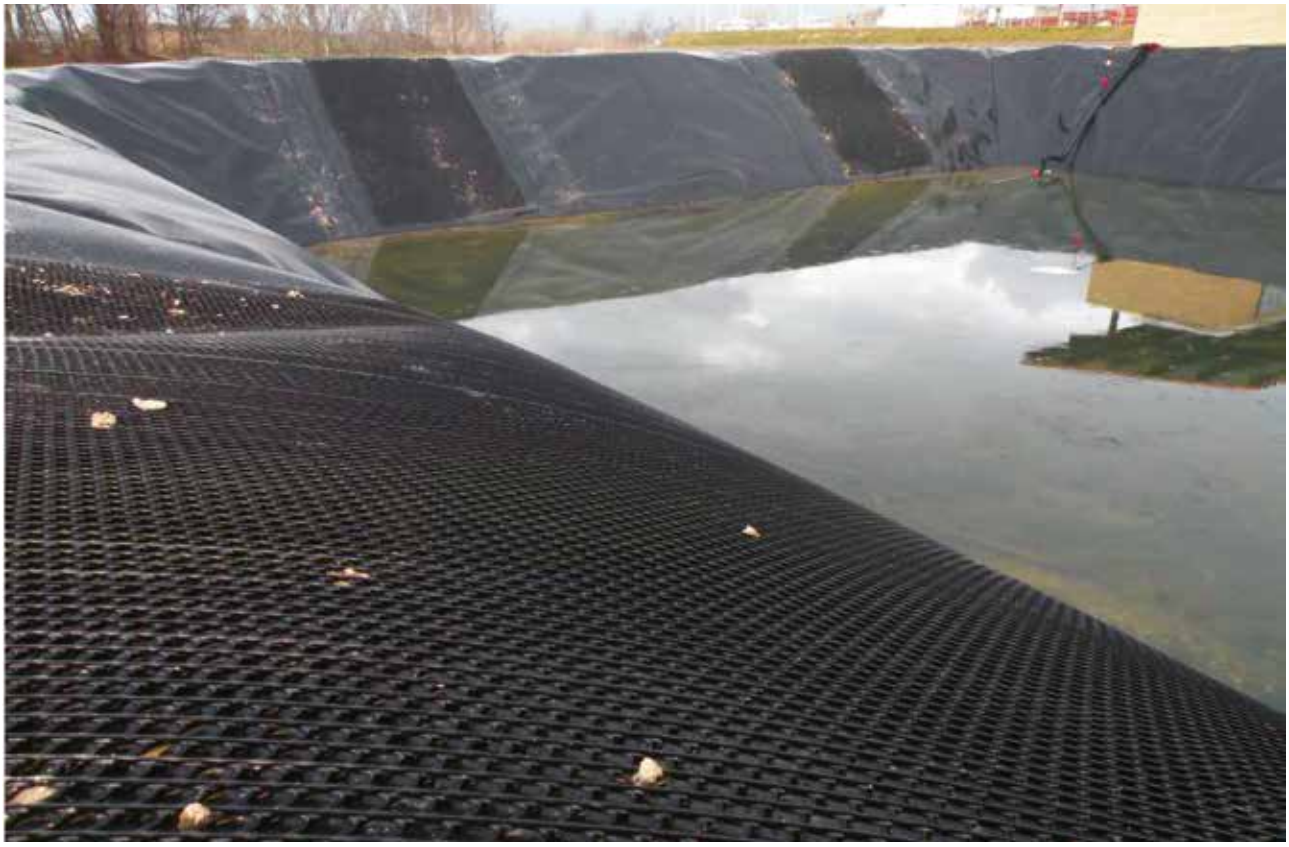


Figure 8: Heat-sealed mesh membrane. Source: NUMA Industrial S.A.

Figure 9: Traction enhancement device, stabilized in a tank with sloping walls. LIFE Bonelli eastMed©UoC-NHMC Archive.

Figure 10: Traction enhancement device, stabilized in a tank with sloping walls. LIFE Bonelli eastMed©UoC-NHMC Archive.

The importance of installing such systems is great as it ensures the survival of endangered species, but also the health of livestock and the hygiene of crops that are respectively watered and irrigated from such tanks, through the prevention of water contamination by decomposing animals that often seek water in open tanks during the warmer months. Their importance is demonstrated by the fact that the average number of birds drowned in tanks without escape devices is almost seven times greater to the number drowned in tanks with escape devices.

In the framework of the LIFE Bonelli eastMed project, two prototype escape systems were created: a. floating devices and b. fixed devices, which are economical so that they can be installed en masse in tanks of small properties and are easy to install and remove, if cleaning and repair procedures in the tanks need to be carried out.

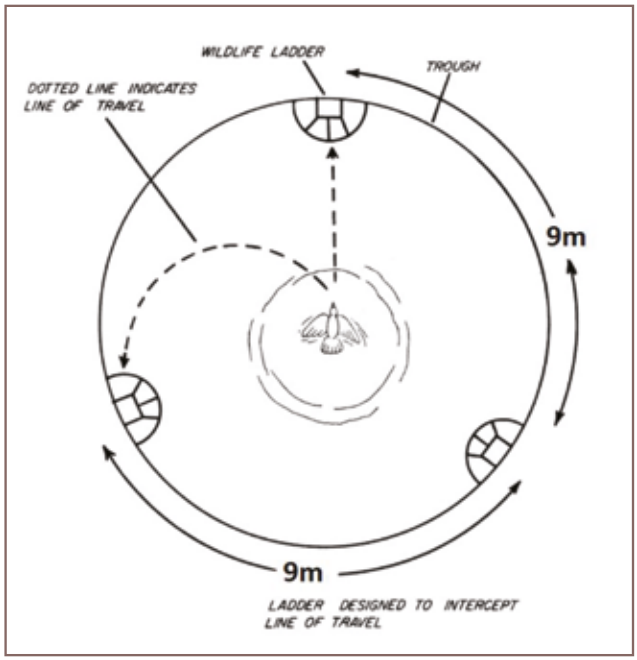
Floating escape devices

Floating escape devices are intended for installation in tanks with vertical walls and are designed to float tangentially to the tank wall, regardless of the water level, and their surface is always parallel to that of the water (Figure 11). Particular attention was paid to this as the relevant literature states that animals seeking a way out of the water always swim close to the walls of the tank in which they have fallen, as shown in Diagram 1 below.

During the design, care was also taken to ensure weight and buoyancy, so that the structure does not tip over when the animal climbs or stays on the horizontal surface.

Diagram 1:

Typical animal movement in search of an escape from the water. Source: Sherrets H.D., 1989. US Dpt. of the Interior, Bureau of Land Management, Idaho State Office.



The devices have been constructed from galvanized sheet metal measuring approximately 150 cm × 50 cm, stretched at 2 points so that the 2 sides create an angle of ~160° with the horizontal plane to facilitate the animal's climbing on it. Grooved saturated timber boards have been fixed to the sloping sides of each device to provide the required grip when the bird climbs up the horizontal side of the device. A branch is attached to the horizontal surface of each device on which the bird can remain until it is dry and ready to fly.

To ensure the buoyancy of the devices, 2 Φ160 mm, 50 cm length PVC pipes have been fixed to the underside of the horizontal surface, which act as a float. The pipes are sealed with PVC plugs with the application of polyurethane mastic. The choice of cross-section and length of the floats gives a buoyancy force of about 20 kg. This was decided considering that the structure with the characteristics described above together with a wet animal add up to about 15 kg.

Figure 11: Model of an escape arrangement in concrete vertical wall tanks, in the framework of the LIFE Bonelli eastMed project. ©UoC-NHMC Archive.

On each device, a metallic eye bolt (Figure 12) is attached to which the rope is passed through allowings the structure to be always tangential to the walls and the movement of the device on the vertical axis, depending on the water level of the tank.

The length of the rope to be used depends on the depth of the tank and the fixed point outside the tank to which it will be tied. During installation, a weight (e.g. a stone) is tied to one side of the rope and is slowly lowered to the bottom, taking care not to drop the whole rope into the water. Then, we thread the other end of the rope through the eye bolt from the bottom up and tie it to the fixed point outside the tank. We carefully check that the rope is clear of any obstacles (branches, stones, etc.) so that it can move freely all the way between the fixed point and the bottom (Figure 13).

With the help of a second person, we grab the structure by the sloping sides and carefully throw it into the water so that it falls on the right side (the tubes down and the branch up) and floats.

Then, we pull the excess of the rope as much as necessary so that the assembly is in contact with the tank wall and the eye bolt is resting on it and tie the rope permanently to the fixed point outside the tank.

Figure 12: Detail (eye bolt) of the model escape devices constructed in the framework of LIFE Bonelli eastMed. ©UoC-NHMC Archive.

Figure 13: Placement of the LIFE Bonelli eastMed floating escape device in a concrete tank with vertical walls. LIFE Bonelli eastMed©UoC-NHMC Archive.

Fixed escape devices

Fixed escape devices are intended for installation in tanks with sloping walls fitted with a sealing membrane in such a way that they are in contact with the membrane over their entire length and do not float on the surface. This is necessitated by the fact that an animal trying to avoid drowning is looking for a stable point to climb up (a sinking object may cause it additional distress and loss of strength) and it also may cause an inability to draw water from firefighting helicopters as has been pointed out by the Fire Department, which was consulted during construction (Figures 14 and 15).

The fixed devices shall consist of grooved impregnated timber boards measuring 95 × 12 × 2 × 2 cm, braided with 6 mm diameter polyester rope and spaced at a fixed distance of 3-4 cm from each other. The distances between them were adjusted with pieces of irrigation hose with a diameter of 16 mm and a length of 9 cm through which the rope passes on the lower side of each board. The devices are modular and consist of 28 boards which give a total length of about 4 meters.

One end of each device is free, while the other end is connected to a ~1 m long Φ125 mm PVC pipe, closed on both sides with plugs of corresponding diameter and filled with sand during the installation of the device. The objective is that the pipe holds one end of the device firmly against the bottom of the tank, acting as a weight, so that the device does not float but rests against the tank walls regardless of the water level. After the pipe has been filled with sand and tamped, the rolled structure is lied parallel to the ground at the point in the tank where it is to be installed and the free end of the device

Figure 14: Incorrect placement of a fixed escape device. LIFE Bonelli eastMed©UoC-NHMC Archive.

Figure 15: Correct installation of a fixed escape device. LIFE Bonelli eastMed©UoC-NHMC Archive.

is tied to a fixed point outside the tank. We then take a rope that is at least 2 times the length of the sloping side of the tank where the installation will be made and pass it around the coiled structure and slowly release the free side of the rope held in the hand. This way the structure slowly unwinds with its weight on the sloping wall of the tank.

Depending on the length of the tank's sloping wall, the device will be stabilized either when the sinker reaches the bottom of the tank, or at the point we set by adjusting the length of the rope with which it will be tied to a fixed point outside the tank (in case the sloping side of the tank is longer than the device). Note that it will take some time for the sinker to flood and maximize its weight, so we can be sure that the sinker will not move further.

For tanks whose sloping sides are longer than 4 m, it is recommended that ropes of appropriate length be added to the side of the device that is tied to a fixed point outside the tank, so that the device can provide an escape route for birds as the water level fluctuates during most of the year, or during the period when the possibility of birds falling into the tank is considered to be increased. In all cases, it is recommended to have spare rope at each installation, both for unwinding the structure and for adjusting the height at which it will be stabilized.

Of key importance is the adaptation of additional weights laterally to the assembly so that the buoyancy imparted by the construction material (timber, plastic rope) is neutralized. This can be done by dressing additional PVC pipes with sand as the final weight, every 1.5 m under the arrangement, or by wrapping metal rods (concrete rods) with a cross-section of Φ20 mm and a length of 3 m around the sides of the arrangement.

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3.3 Reduction of mortality from unintentional or intentional poisoning

One of the most serious lethal threats of the Bonelli's Eagle and other birds of prey in general is poisoning, either primary or secondary. As birds of prey may at some point during their life cycle consume dead animals if these have been covered/impregnated with toxic substances (primary) or have consumed dead animals poisoned by toxic substances used for the manufacture of poisoned baits (secondary), poisoning is inevitable.

One of the most effective tools to reduce and prevent poisoning in wild carnivore populations, especially in birds of prey, which has been used worldwide for more than 20 years, is the use of specially trained dogs that can detect toxic substances in the wild (and beyond). Detection dogs do not work autonomously, but are always accompanied by their handler, who is specially trained for the job. The early detection of poisoned baits and dead poisoned animals achieved by this method helps to reduce the real risk of chain poisoning of other species that share the same habitats with raptors.

In addition to their basic purpose, these teams help to better document the severity and extent of the problem by the immediate and in some cases massive discovery of poisoned animals or baits and the timely collection of samples for toxicological analysis.

The specially trained detection dogs, together with their specially trained handlers, constitute the Teams or Special Units for the Detection of Poisoned Bait (SUDPB). In Greece, a total of 11 SUDPB are currently operating, covering most of mainland Greece, Crete and the Dodecanese, with the capability of investigations throughout the country. Similarly, in Cyprus, two (2) Poison Bait Detection Teams (PBDT) are operating from 2022.

The establishment and operation of the existing SUDPB was officially acknowledged in Greece with the Joint Ministerial Decision (JMD) of the Ministries of Environment & Energy, Civil Protection, Interior and Rural Development & Food "Measures and procedures for the control of the illegal use of poisoned baits in wildlife species - Coordination of relevant services and agencies" (Government Gazette B/4459/2022), which provides for their participation in the control and investigation of incidents of illegal use of poisoned baits (Article 6.2c & d and Article 8).

How are detection dogs trained

With an olfactory sensitivity a thousand times stronger than a human, the sniffer dog can pick up the odors from the substances used in poison baits (a large family of highly toxic biocides often used in agriculture), which are carried by air currents and give evidence of their origin.

The training of poisoned bait detection dogs is carried out in special breeding-training centers that operate in various countries in Europe and in Greece, using the same methods that dogs are trained for the detection of drugs or explosives, applying mainly the completely painless Arcon training method (reward with game, Figures 1 and 2). The duration of their training ranges from 12 to 18 months (depending on the breed) and requires daily engagement and commitment from both the breeder-trainer during training and the handler. Their feeding, housing and transport, veterinary monitoring and general daily living are all challenges for the person who will be committed to handling them.

Handlers essentially "marry" the dogs for life, as they do not obey anyone but the person who has taken charge of them (Figure 3).

Figure 1: Rewarding a detection dog (Dalton) during his training in Crete, 2021. Popi Baxevani©UoC-NHMC Archive.

Figure 2: Rewarding a detection dog (Paka, LIFE Bonelli eastMed) with her toy, after detecting a poisoned bait, during a demonstration, 2019, Heraklion, Crete. Popi Baxevani©UoC-NHMC Archive.

Figure 3: Christina Diakidi with her colleague and partner Tsika, form the SUDPB in the Dodecanese. It took 3 years until Tsika accepted food from another person in the family, other than Christina. Christina Diakidi©UoC-NHMC Archive.

Purchase-training of scanner dog and handler training

The average purchase cost of each trained dog ranges from 2,500€-5,000€ (depending on the breed) and should include the relevant equipment that the dog must carry during patrols. A similar amount is required for the training of the handler, either at the headquarters of the breeder-trainer or at the headquarters of the handler.

If the purchase is made from a foreign breeder-trainer (Figure 4), some additional costs should be foreseen, depending on where the operator training is chosen to take place, i.e:

a. If the training of the handler is carried out abroad, the cost of travel, accommodation and food of the handler for a period of 30-40 days shall be taken into account.

b. If the training of the handler is carried out close to his/her home base, the following should be taken into account: 1. The cost of travel/accommodation/food and other expenses of the foreign breeder-trainer who will come to the country for the training. 2. The cost of a translator-interpreter and the cost of his/her accommodation if he/she is not a local. 3. The cost of boarding the dog for the duration of the training (if it is not in a government facility and needs to be boarded in a private facility e.g. dog hotel, private veterinary clinic, etc.). In Greece and for dogs purchased from abroad, accommodation was requested from the Air Force which has suitable premises in various areas of Greece for the needs of the working dogs it maintains. If this solution is chosen, a request for accommodation to the Air Force with exact details (days of accommodation, list of names of those entering the accommodation areas of the dogs etc.) is required to issue the relevant permits to enter/exit the military installation for the daily movement of the trainer and handler to the dogs' accommodation for feeding, cleaning, etc. 4. Dog consumables during the training (food, feeding utensils, transport box-pet porter, etc. in agreement with the breeder-trainer). 5. Transportation costs of the entire team during the training (trainer, interpreter, handler, and anyone else participating-associated with the training patrols i.e. purchase or rental of 4x4 vehicle(s), insurance, fuel, etc.) if not available from an agency.

If the purchase is made by a Greek breeder-trainer, the additional costs are also determined by the place where the training of the handler is chosen, i.e:

a. If the training takes place at the headquarters of the breeder and far from the handler's home area, the costs of travel, accommodation and food for a period of 30-40 days are taken into account.

b. If the training is conducted at the handler's home area, account shall be taken of: 1.The cost of travel/accommodation/boarding and other expenses of the breeder-trainer in the training area. 2. The cost of boarding the dog for the duration of the training (if it is not in a government facility and needs to be boarded in a private facility e.g. dog hotel, private veterinary clinic, etc.) unless it is boarded directly in its permanent living quarters set up in the handler's home. 3. The dog's necessary consumables during the training (food, feeding utensils, transport box-pet porter, etc. in consultation with the breeder-trainer). 4. The travel costs of the whole team during the training (instructor, handler and anyone else participating in the training patrols) i.e. purchase or rental of 4x4 vehicle(s), insurance, fuel, etc. if not available from an agency.

Figure 4: The Spanish breeder-trainer Mr. Jesus Lopez Valliadolid, who supplied 3 specially trained LIFE Bonelli eastMed dogs, with the experienced handlers Ms. Ela Kret (based in Thrace) and Mr. Spyros Nistikakis (based in Crete), during their training in Crete, in July 2021. Popi Baxevani©UoC-NHMC Archive.

Cost of maintenance of the SUDPB dogs

Dogs, after being picked up by their handlers, are required to reside in specially designed areas with certain specifications in the handler's home. The construction of these areas requires a sum of 500-2,500 € depending on the available space and the type of cage (metal or built-in).

The annual maintenance cost of a working dog (depending on the breed and size), ranges from 1,500€ to 3,000€ (special food of high energy value for working dogs, regular and emergency vaccinations, preventive and emergency examinations etc.) while a cost of 10-20€ for the transfer of the electronic ID (microchip) from the breeder-trainer to the handler should be foreseen.

In addition to the regular and fixed needs, it is advisable to provide an additional budget of 1,000-2,000€ per year for possible emergency situations such as e.g. injury of the dog in the field, unforeseen illness, need for surgery etc.

The dog must be delivered by the breeder-trainer with the necessary electronic identification device (microchip), the health booklet, pedigree certificate and passport (if from abroad).

Operating costs of the SUDPB

Additional costs (one-off or recurring due to damage or wear and tear) may also be incurred for the configuration of the SUDPB vehicle, depending on the type.

The dog must be transported in an isolated separate cage or pet porter. If it is a small capacity vehicle or a vehicle with a small boot, a special structure may be required, but this is not easy to use.

Provision and budget (one-off or recurring due to destruction or deterioration) should be made for storage space for the finds (decoys or dead animals) which should be placed in a portable camping-type cooler or other similar relevant structure. The storage area should be outside the cabin of the vehicle (e.g. roof suitcase).

There must be at least two full pharmacies (1 for the dog and 1 for the handler and/or assistants) in the vehicle, which must be renewed at regular intervals.

The SUDPB shall be equipped with a geolocation device (GPS or new generation mobile phone or other similar device), which is essential during the surveys.

Fixed annual costs of SUDPB conducting investigations

To ensure that the investigations of a SUDPB are carried out smoothly and that they are effective and successful, a substantial amount of money should be made available annually to cover:

- The remuneration and all levies for the handler and his/her companion (if appointed).
- Transportation costs (fuel, vehicle maintenance, insurance etc.) to the locations of the autopsies, considering the extent of the area covered.

- The consumables for handling the findings [sufficient quantities of disposable gloves, hard work gloves, tweezers of various sizes, hard black bags for storing dead animals, smaller plastic bags of various sizes and urine collectors for the findings (bait, tissues, other findings in the field) and other consumables (stickers, stationery, incident protocols etc.)]. Further details are set out in Annex V of the relevant Hellenic Ministry of the Environment/DIS/83415/2715 (Government Gazette B/4459/2022).
- Collection/transportation/storage of finds by special means (freezers, special packaging, decontamination, consumables etc.).
- Carrying out autopsies and extracting tissues from dead animals found for toxicological and other analyses, whether these are carried out by a state or private veterinarian.
- The cost of carrying out toxicological analyses.
- The cost of destroying the remaining finds and animal remains - which will not be used as evidence in the case files - by special procedures (incineration in special hazardous waste plants etc.).
- Legal costs if the incident goes to court.
- The costs of human resources that will deal with the organization, supervision, coordination, operation, problem management etc.

Autopsy procedure

The conduct of the surveys of the existing SUDPB was mainly based on the procedure followed for the operational function of the first two SUDPB created in Greece in 2014 by the Hellenic Ornithological Society (Thessaly) and WWF Hellas (Thrace), as well as the next two SUDPB created in Crete in 2016 by the University of Crete-Natural History Museum of Crete and the First Hunting Federation of Crete and Dodecanese. These are purely private initiatives while the first state-owned SUDPB were not established until 2022.

During their operation, the first private SUDPB faced a number of difficulties both because of the initial inexperience and the bureaucratic procedures that occasionally arose, and the fact that there had never before been any serious state response and intervention on the issue of illegal use of poisoned baits. The result of this situation was the confusion of responsibilities between the services, the total lack of training of the staff involved, the lack of equipment and infrastructure, the problematic operation of understaffed laboratories for toxicological analyses, the rudimentary or sometimes non-existent cooperation between the public authorities and the SUDPB or between them etc.

Much of these dysfunctions are expected to be resolved by the recently adopted JMD on “Measures and procedures for the control of illegal use of poison baits in wildlife - Coordination of relevant services and agencies” (Government Gazette B/4459/2022).

Regarding the three (3) Special Units for the Detection of Poisoned Baits established and operating within the LIFE Bonelli eastMed project, they consist of 3 specially trained dogs which were trained in a Spanish breeding-training centre. Their handlers are all Federal Game Wardens of the 1st Hunting Federation of Crete and the Dodecanese (HFCD) with the possibility of carrying out autopsies throughout the area of responsibility of HFCD and outside, if invited to assist (Figures 5 and 6).

Figure 5: The first two LIFE Bonelli eastMed SUDPBs started operating in December 2019 in Lasithi and the Dodecanese. Popi Baxevani©UoC-NHMC Archive.

Handlers shall carry out preventive and emergency searches. Preventive patrols shall be carried out as a matter of priority in the pilot areas of the program and in areas with a strong history of poisoning incidents, as well as during periods of high mobility of citizens in the countryside, especially before and during the hunting season. Emergency investigations are carried out following notification of a possible poisoning incident by citizens or services directly to the handlers and are planned on a priority basis based on the severity (detection of dead animals or confirmed presence of bait), the urgency of the incident (close to a residential area or place of congregation and human activities e.g. schools, hospitals, parks, Figure 7), the area (priority is given to investigate incidents in the countryside) and the weather conditions.

Figure 6: The 3rd SUDPB of the project started in November 2021. Popi Baxevani©UoC-NHMC Archive.

Figure 7: Autopsy in a residential area. The handler usually uses a leash, for the safety of the dog and to avoid accidents. ©UoC-NHMC Archive.

In principle, the SUDPBs carry out the surveys without the participation of other services, and sometimes they are accompanied by a second game warden, especially in the case of Crete (Federal or local Hunting Association, Figure 8). If a second game warden accompanies the patrol, he/she is responsible for transporting the findings to the relevant competent service and filing a complaint/notification, in case of course poison and dead animals are found.

Figure 8: Self-inspection by the Lassithi SUDPB in a forest area, accompanied by a second Federal Warden. ©UoC-NHMC Archive.

The following preparations are usually made for conducting a survey:

- ✓ Checking of the team's equipment (special clothing, recording protocols, GPS, disposable gloves, garbage bags, medical kit, dog toy, water etc.) by the handler before leaving for the survey area.
- ✓ Upon arrival of the SUDPB at the autopsy site, the operator shall perform the following tasks (Figure 9):
- ✓ Wear special clothing.
- ✓ Put special equipment on the dog.
- ✓ After activating the GPS and recording the starting point, releases the dog and follows it from a distance.
- ✓ Waiting for the dog's signal (in case of poison detection).

Figure 9: The Dodecanese SUDPB in full gear, during a survey in Rhodes. ©UoC-NHMC Archive.

- ✓ If the dog does not detect poisons, it returns to the handler.
- ✓ If it detects anything foreign to the area, the dog signals the handler and waits at the point of discovery for its reward (play).
- ✓ In case of detection of poisons or dead animals, the handler shall collect and remove the poisoned baits and/or poisoned dead animals from the field.
- ✓ The relevant protocol must be filled in with all the necessary information.
- ✓ When the research is considered complete, the dog is removed from the field.

Upon completion of the search, the handler or the escort shall take the findings that can be transferred to the competent authority, where a complaint/report shall be filed. Complaints shall be made either to the police station or to the forestry department/forestry office to which the area inspected belongs.

Usually, the complaint is filed against unknown persons, as most of the time it is not possible to identify the perpetrator in the act. The competent authority proceeds sending the samples for toxicological tests if the samples are suitable for examination, conducts a preliminary inquiry and, after receiving the results, proceeds to form a case file following the procedure laid down by law.

Until recently (2021), the competent agency for the control of the countryside, the protection and conservation of wildlife and the combating of crimes against wildlife was the relevant Decentralized Administration/General Directorate for Coordination and Forest Inspection with its local Forestry Directorates and Forestry Offices. Subsequently, and depending on the area of the incident (near an urban area, within a private area or pasture), the respective Municipality in whose territory the incident was recorded and the Police were also involved, while in case of finding poisoned baits or dead wild/domestic animals, the Rural Development and Food Services and the Veterinary Service of the respective Region and Decentralized Administration (responsible for the distribution of pesticides, animal welfare, human diseases etc.) were also informed. As of 2021, forestry services were transferred to the Ministry of Environment and Energy.

Similarly, for urban incidents, the competent authority was the Hellenic Police and the Municipality with all the relevant services involved, as well as the Rural Development and Food Services and the Veterinary Service of the respective Region and the Decentralized Administration (responsible for pesticide transport, animal welfare, zoonotic diseases etc.).

The services involved, their responsibilities and the way of administrative handling of poisoning incidents of wild and domestic animals are now defined on the basis of the JMD on “Measures and procedures for the control of illegal use of poisoned baits in wildlife species - Coordination of relevant services and agencies” (Government Gazette B/4459/2022).

It should be noted that the handler and the dog should be undistracted during their work, both for the most efficient execution of their work and for their safety. And ideally, they should not have the obligation after the field to take the findings to the relevant authorities and get involved with the bureaucratic procedures of the case. Therefore, a second person is permanently required to accompany them, especially when there is a certainty of a case of bait use or the presence of dead animals.

In addition, we should always bear in mind that the SUDPB should rest after each patrol, especially when the weather conditions (e.g. heatwave) are detrimental to the animals or if the handler has scheduled a second survey in the same day (this happens very regularly).

In any case, the handler and/or the escort should keep detailed protocols with specific information, that should be kept in a relevant database, which should be updated by the body to which the SUDPB belongs, which should also monitor the evolution of incidents (toxicological analyses, case files, courts, decisions etc.). For Greece, these details are included in the JMD "Measures and procedures for the control of the illegal use of poison baits on wildlife species - Coordination of relevant services and bodies" (Government Gazette B/4459/2022).

Other useful information

Any institution/organization/agency that decides to set up a SUDPB should also take the following into serious consideration:

1. The person who will be asked to take over as handler of the dog should be a trustworthy and a serious professional and should be willing to commit and work with the dog on a daily basis. Sometimes he/she may need to neglect holidays/Sundays/other commitments in order to be on call for an investigation. Ideally, this should be his/her main and sole occupation. He/she should also be prepared to deal with opposition or retaliation from those who put out the poisoned baits and pressure from individuals and/or agencies to avoid patrolling or suing.
2. The person who will be the dog's handler should be able to maintain it (food, accommodation, vets, etc.) if funding from the relevant authority/agency ceases (if the dogs are purchased under a funded program, for example).
3. The SUDPB should also be supported by local communities in order to be effective. This means that their work should be promoted on a regular basis, that residents should be regularly informed and encouraged to report or at least notify possible incidents when they come to their attention. Even if the culprits are not caught, at least the poisons will be removed from the countryside and further losses of domestic and wild animals will be prevented.
4. The person handling the dog should be assisted by the competent authorities. That is, either he/she will go out on patrol accompanied by a public official e.g. a ranger/police officer or a second person who will assist in transporting the findings and reporting to the relevant authorities.
5. Contacts should be made and a framework of cooperation should be created with all the competent services of each region, in order to assist in the work of each SUDPB, an action that we consider crucial for the proper functioning of the units and the more effective response to the problem.

6. The dog covers almost three times the distance from its handler and performs most of a job that is quite dangerous, both for itself and its handler. Both are a professional frontline team in the fight against the illegal use of poison baits, which should be respected and supported by local communities, institutions and agencies alike.

Snapshots of patrols by the LIFE Bonelli eastMed SUDPBs. ©UoC-NHMC Archive.

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3.4 Effective detection of poisoning incidents

Wildlife poisoning is one of the biggest challenges in wildlife protection and conservation efforts. Certain species of wildlife, such as carnivore mammals, raptors and scavengers such as vultures, are particularly vulnerable to the use of poisoned baits. In many parts of the world, it is the main reason for the population decline of certain species, making them endangered. In addition, the use of poisons hampers efforts to conserve or even restore the population of vulnerable fauna species. Unfortunately, the effects of the use of poisons are not limited to wildlife, but their use also poses risks to public health, as there is always the possibility that unsuspecting citizens, or worse still young children, may come into contact with toxic substances. The poisoning of domestic animals is not a rare occurrence, which proves that the use of poisoned baits in residential areas is, unfortunately, yet another aspect of this dangerous and illegal practice, which threatens not only animals but also humans themselves.

Detecting and preventing the use of poisoned baits in the wild is a difficult and complex process, which makes this practice particularly popular with potential offenders. The use of poison baits causes great losses to wildlife species with incalculable consequences, since the number of incidents detected and reported is very low compared to the actual number.

However, with proper coordination and proper management of such incidents, losses due to poisoning, whether to wildlife or pets, can be reduced when the extent of the problem is understood and appropriate measures are taken by all stakeholders in a country or region.

The investigation of poisoning incidents requires the involvement of various services, which should be able to cooperate and provide each other with the appropriate and necessary information that is crucial for the proper management of each incident. In some cases where there is a suspect, the necessary evidence may emerge at the end of the investigation, leading to a conviction by the competent court.

In Cyprus, most incidents of poisoned bait use are recorded in the countryside, away from urban centers and residential areas. In cases where poisoned baits are detected, where dead animals are found and the local Police Station is called for an autopsy (with the presence of the Cyprus Game and Fauna Service), the examiner should be aware of and follow a specific methodology for the management of the incident, in order to collect all the necessary documentation in the correct and appropriate manner, as well as to provide the necessary information about the incident to the other services that will be involved in the investigation of the case at a later stage (Veterinary Services, State General Laboratory, Judicial Authority).

Unfortunately, most of the times when the Police is called to examine a poisoning case, the examiner handling the case is different each time, making it extremely difficult for someone to acquire the necessary and relevant experience in investigating this type of cases, with the risk of omitting important data or evidence, or not managing them in the best possible way, which makes the work of the next parties involved (Veterinary Services, the General State Laboratory, the Judiciary, the State Police) more difficult.

In the light of the above, but also because the use of poisoned baits in the countryside is a complex problem that requires a multi-level response and the involvement of various authorities, it is important that they are properly trained to handle incidents and investigate this crime effectively.

The need to increase the efficiency of investigating poisoning cases led to the creation of the Wildlife Crime Academy (WCA) by the Vulture Conservation Foundation (VCF) [with training by Spanish experts with extensive experience in investigating wildlife crime] to fill this gap and to achieve specialized training of competent authorities in the Balkans and Cyprus through a series of seminars implemented between 2021-2023.

The courses included in the training have been designed to strengthen the operational capacities of the competent services in each country in the investigation, management and response to poisoning incidents. Now, 44 participants from 9 European countries, including Greece and Cyprus, are certified as Experts in the Investigation and Analysis of Wildlife Crime (Figure 1).

Figure 1: Wildlife Crime Academy graduates from all countries. ©Vulture Conservation Foundation.

It has been proven that these training courses have contributed significantly to the increase of the operational capacities of the relevant government departments and other stakeholders. They have also strengthened institutional cooperation and working cohesion, making the authorities' handling of possible future poisoning incidents more effective. Experts from Spain delivered courses focusing

on research, forensic pathology and toxicology, which are the most important in terms of managing wildlife poisoning incidents.

From Cyprus, personnel from the Game and Fauna Service, the Cyprus Police, the General State Laboratory and BirdLife Cyprus participated in this high-quality training. Subsequently, this team transferred the knowledge gained to other staff of the services through trainings organized in Cyprus in 2022 and which continued in 2023. These courses greatly assisted in the preparation of an Operational Protocol for the Response and Management of poisoning incidents, which is consistent with the trainings, thus establishing a standard procedure for the effective investigation of criminal incidents against wildlife.

The participation and training of Game and Fauna Service staff in the above-mentioned seminars took place in the framework of the implementation of LIFE with Vultures CY - LIFE18 NAT/CY/001018, while members of the Project Team of the GFS were certified as Experts in the Investigation and Analysis of Wildlife Crime (Figures 2 and 3).

Figure 2: The WCA seminar courses covered all aspects of wildlife crime. ©Vulture Conservation Foundation.

The results of these seminars, the cooperation of the Services and the creation and implementation of the Operational Protocol are already evident in Cyprus, where the first out-of-court fine for illegal poisoning of wildlife of €21,000.00 was achieved, while another case of vulture poisoning is being taken to court.

Figure 3: Snapshot from the 1st Training Seminar against Wildlife Crime in Cyprus. Stelios Demetriou©BirdLife Cyprus.

Action Protocol

The purpose of the Outdoor Poisoning Incident Action Protocol is to establish a standardized procedure to guide the actions for responding to and managing outdoor poisoning incidents so that any investigator, even if not knowledgeable, can manage an incident in the best possible way, avoiding mistakes or omissions due to inexperience, which may make it difficult to legally prosecute the potential suspect. The protocol should be standardized in a format that is simple and understandable to the examiner, who may not have the necessary knowledge and experience in managing poisoning incidents.

The Protocol applies in the following cases:

i. Incidents of detection of poisoned baits in the countryside.

ii. Incidents of sightings of poisoned wild animals (dead or alive).

iii. Incidents of detection of poisoned domestic animals in the countryside.

iv. Incidents of sightings of poisoned domestic pets that are not tagged and cannot be traced back to their owner as they may cause secondary poisoning in wildlife.

v. A combination of the above.

The creation and implementation of the Protocol achieves:

1. The cooperation and the role of the competent services involved (Game and Fauna Service, Cyprus Police, Veterinary Services and the General State Laboratory) for the collection and examination of potentially poisoned animals found, according to legislation.
2. The timely and coordinated procedure for the competent authorities involved to respond to incidents.
3. Rigorous recording of the chain of custody, from the stage of identification, collection, packaging and dispatch for scientific examination.
4. The recording of instructions to the services involved in dealing with incidents of poisoning or use of poisoned baits in the countryside.
5. The effective investigation and enforcement of the law, with the consequent reduction of this illegal act and the protection of wildlife, especially endangered species.

The Operational Protocol begins with the notification and alert of the existence or detection of a poisoned animal or poisoned bait and ends with the creation of the case file or the issuance of an extrajudicial letter, as appropriate. In more detail, the Protocol contains the procedures to be followed in order:

Notification-Information

In case the Police or the Game and Fauna Service (GFS) are informed of the existence of poisoned baits in the countryside or poisoned wild animals or pets (e.g. hunting dogs) then the two services are informed for immediate action. In the case of Cyprus, the Police are responsible for investigating incidents of poisoning of a wild animal or placing of poisoned baits in the countryside.

Detection and collection of possible poisoned wild animals or baits

In cases where the competent authorities are alerted to a possible poisoned wild or companion animal (dead or alive) or possible poisoned baits, the Police are immediately informed and go to the scene of the crime and cordon off the scene. The scene is investigated by the Police and the handling of the evidence is carried out by the Police or by members of the GFS with the obligation to hand over the evidence for scientific examination at the local Police Station. It is considered important to take photographs of the scene, dead animals and baits.

Members of the GFS remain on the scene to offer expert knowledge on species identification, indications of suspected poisoning (Figure 4), suggestion of any other offences in relation to the Wild Birds and Game Protection and Management Act 2003 (Law 152(I)/2003) and whatever else is required.

It is noted that if plant protection products are found in premises or in the possession of individuals during the investigation, the Cyprus Department of Agriculture as the Competent Authority for Plant Protection Products Law of 2011 (141(I)/2011) should be informed.

The Poison Bait Detection Teams also make an important contribution to the detection of evidence (dead animals, baits or other objects at the crime scene) if they are called upon and can assist in the investigation (Figure 5).

Figure 4: A characteristic feature of acute poisoning is the posture of the dead bird's feet. Silvio Rusmigo©BirdLife Cyprus.

Figure 5: Suspicious case of Common Buzzard poisoning and collection of samples by the operator of the Poisoned Bait Detection Team of the Game and Fauna Service. Silvio Rusmigo©BirdLife Cyprus.

The collection, handling and transport of the documents is carried out in an appropriate manner by the Police or the authorized members of the GFS, following the procedure indicated in the Protocol of Operations of Police Order 3/17, of the Chief of Police, to ensure the sequential handling of the documents. As an example, general guidelines for the collection of documentation involving dead, possibly poisoned, wildlife species or baits are included in Appendix I of the Protocol of Operations ("General Guidelines for the Collection of Documentation on Poisoned Bait and Poisoning Incidents").

Transport and storage

The transport and safekeeping of all documents is carried out by the Police in accordance with the orders of the Chief of Police. Where for practical reasons samples need to be stored prior to transport to the Veterinary Services, they shall be stored by the Police in a refrigerator or freezer (-20° C). All samples must be kept at the appropriate temperature as soon as possible before transport to the Autopsy and Toxicology Laboratory to avoid possible deterioration, thus facilitating the detection and identification of toxic substances in the laboratory.

Forensic autopsy

The autopsy is carried out at the Laboratory of Pathological Anatomical Bacteriology and Parasitology of the Veterinary Services, Ministry of Agriculture, Rural Development and Environment. The Veterinary Officer, in cases where the findings indicate that the probable cause of death is poisoning, shall take all necessary samples to forward them for toxicological or other tests for detection and identification of the substance and prepare a preliminary report. The Police receives the samples and the preliminary report of the Veterinary Officer stating that this is a poisoning incident and forwards them to the General State Laboratory (GSL) for the required toxicological analyses together with the required forms (Form D.161).

In case a live wild animal suspected of being poisoned is found, the Game and Wildlife Service is immediately informed in order to ensure its rapid transport to a qualified veterinarian or the provision of first aid on the spot in order to prevent the death of the animal, depending on the case. The veterinarian in coordination with the Game and Fauna Service then collects the necessary biological samples for the detection of any toxic substance and the protocol process continues to ensure the sequencing of the movement of documentation.

Toxicological analyses

The reference laboratory for the performance of toxicological analyses in Cyprus is the Laboratory of Forensic Chemistry and Toxicology of the General State Chemistry Laboratory (GSCL), Ministry of Health. The samples taken from the autopsy are collected by the Police and transferred to the Forensic Chemistry and Toxicology Laboratory. The Forensic Chemistry and Toxicology Laboratory prepares a report with the results of the analyses, which is sent to the Criminal Investigation Depart-

ment (CID) of the Police. Subsequently, the Police Station investigating the case is informed in order to identify the perpetrators. The report is added to the case file and the Veterinary Officer and the Game and Fauna Service (GFS) are informed for their own action.

The Police proceed to prosecute suspects or issue out-of-court notices as provided by law, if evidence against suspects and/or the results of toxicological tests are positive.

In cases of suspected lead poisoning, the Police forward samples from the Veterinary Services to a specialized laboratory.

Notes: *The necessary samples shall be taken in duplicate from the dead animal when the sample quantity allows. One set of samples is kept by the Veterinary Services and the other is sent for analysis to GSCL. GSCL does not keep samples after analyses. In cases of repetition, the samples kept at the Veterinary Services shall be used.*

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Bonelli's Eagle chicks in a nest in Karpathos. Aspasia Anagnostopoulou©UoC-NHMC Archive.

Chapter 4

Spatial planning of wind energy developments and Bonelli's Eagle (*Aquila fasciata*)

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Chapter 4

Spatial planning of wind energy developments and Bonelli's Eagle (*Aquila fasciata*)

General Introduction

In Greece, there has been a recent unprecedented increase in the rate of installation of Wind Power Energy Plants (WPPs) across the territory as a result of European policies and national goals (Target of Greece for 2030: 7.2 GW of installed capacity from land-based WPPs, National Goal for Energy and Climate, 2023) established for the energy transition in the context of addressing the climate crisis.

However, although European legislation provides a strong legal framework for the protection of nature (Birds and Habitats Directive) and a proper environmental licensing process for wind energy projects that may have negative effects on species and habitats of the Natura 2000 Network, Greece continues to insufficiently implement the aforementioned instructions and guidelines, as a result of which the status of conservation of sensitive habitats and species throughout the territory is threatened. Characteristically, in violation of European legislation, the Greek competent authorities continue to allow the environmental licensing of WPP projects in or near areas of the Natura 2000 Network without having carried out a Appropriate Assessment of the Strategic Environmental Impact Study and the Special Framework for Spatial Planning and Sustainable Development for the Renewable Energy Sources (SFSPSD-RES) dating from 2008.

In this chapter, an attempt is made to clarify the appropriate guidelines and practices, in the light of European and national law, for the correct siting of WPP projects with focus on the study species of the LIFE Bonelli eastMed program, the Bonelli's Eagle (*Aquila fasciata*).

Effects of Wind Power Plants (WPP) in avifauna

Generally

The effects of WPP on avifauna have been extensively studied for at least 2 decades by a number of researchers and ornithologists and have been shown to vary and depend on a range of factors related mainly to the technical characteristics of each project (location, type of wind turbine, height, rotor diameter etc.), the topography of the installation area, the habitats affected as well as the number and species of birds of the region (Drewitt & Langston, 2006; Madders & Whitfield, 2006; Perrow, 2017). The main categories of effects of WPP on avifauna are the following:

1. **Killing by direct impact** of birds in flight with the blades or other structures of wind turbines. It is the most frequently identified problem (Barrios & Rodríguez, 2004, Drewitt & Langston, 2006, Smallwood & Thelander, 2008, Xirouchakis et al., 2019), but mortality

levels (high or low) and the risk of bird strikes vary accordingly with the species of bird, the location and the technical characteristics of the project (Ana Teresa Marques et al., 2014; Refoyo Román et al., 2020). In Greece, from research that has been carried out, for example, for the Black Vulture (*Aegypius monachus*) in the Thrace region and for the Vulture (*Gyps fulvus*) in the Crete region, the annual predicted mortality due to impact for these species has been measured at least 13-16 individuals per year of the existing Black Vulture population (Sidiropoulos et al., 2022) and to at least 84 individuals per year of the existing Vulture population (Xirouchakis et al., 2019), respectively, based on existing and planned WPP in the due areas.

2. **Displacement due to disturbance.** It is a form of indirect habitat loss due to both the visual and the noise nuisance caused by WPPs (and/or the increased presence of people, machines, vehicles). For bird species such as raptors the resulting disturbance can lead to the complete displacement of a species and may involve the loss of breeding (nesting) sites as well as feeding sites or other activities of the species (Drewitt & Langston, 2006, Madders & Whitfield, 2006, Bright et al., 2010, Hötker et al., 2019). In Greece, according to a recent study in the region of Thrace (Sidiropoulos et al., 2022), for example, for the Black Vulture, avoidance rates of WPP data were found from 45% to 89% depending on the respective WPP.

3. **Direct habitat loss or degradation**, such as the loss of breeding sites or feeding areas (Madders & Whitfield, 2006) due to the installation of permanent infrastructures for WPPs, mainly wind turbines, but also other accompanying works necessary for the operation of WPPs such as roads and voltage-raising substations. There is evidence that such habitat loss and degradation can lead to measurable changes in bird populations (Pearce-Higgins et al., 2012, Steinborn et al., 2011).

4. **Barrier effect**, i.e. creation of an obstacle for the smooth passage of birds through an area due to the presence of multiple WPPs, resulting in the consumption of critical energy by birds, such as migratory species, in order to chang their route and adjust their flight path in order to avoid the arrays of WPPs (Masden et al., 2009; Cabrera-Cruz & Villegas-Patraca, 2016).

5. **Trophic cascade effects** that affect prey-predator dynamics and ecosystem functions (Thaker et al., 2018).

Birds of Prey and Wind Power Plants

Among the different avian species, large birds of prey are the group of birds with the greatest sensitivity to the effects of wind power plants and this is justified by a number of factors related to both morphology (size, weight and wing development), the range of their field of vision, their behavior and flying abilities (gliding, low maneuverability) of the specific species as well as with their conservation status which is often in a high risk category, and with their population status at local, national or international level (Martínez et al., 2010, Carrete et al., 2012, Gove et al., 2015). More specifically:

- Raptors are considered particularly sensitive to wind turbines both to displacement and/or habitat loss effects and to effects, especially when they use orographic conditions for their elevation (Barrios & Rodríguez, 2004, Drewitt & Langston, 2006, Madders & Whitfield, 2006, Martínez et al., 2010, Carrete et al., 2012, de Lucas et al., 2012, Sanz-Aguilar et al., 2015, Bastos et al., 2016, Hötker, 2017, Thaxter et al., 2017, Martín et al., 2018).

- Direct mortality occurs in different raptor species and at different stages of their life cycle (Barrios & Rodríguez, 2004, Smallwood & Thelander, 2008, Dahl et al., 2012) and for many species this type of impact is the greatest threat for them (Lekuona and Ursúa, 2007, De Lucas et al., 2008).

- Raptors are species that choose the k-strategy (long life span, low reproductive rate, and relatively slow rate of reproductive maturation), so even low levels of mortality due to a given WPP can lead to significant population declines, especially when it comes to rare species or species with already limited populations locally, nationally or supranationally and even more specifically when it comes to cases in which the mortality is the result of the synergistic action of multiple WPPs established in the same area (Tellería, 2009, Bastos et al., 2016).

- The areas in which birds of prey are mainly active are extensive, preferably open, habitats for foraging and predation (Bose et al., 2018). These areas present characteristics (e.g. high wind potential) which often make them attractive for the installation of WPPs, with the result that in the group of birds of prey a large degree of overlap of WPP projects with their areas of activity is found (higher than other species). Especially in Greece, where for a number of reasons (wind potential, legal framework, social reasons, etc.) the areas chosen for the installation of WPPs (mountainous, semi-mountainous zone, open spaces with low and sparse vegetation) are often critical habitats for these species, the specific phenomenon is intense (conflict of interest).

- Raptors are one of the most critical groups in terms of worldwide conservation status (IUCN).

Bonelli's Eagle and Wind Power Plants

The Bonelli's Eagle has several of the characteristics of large raptors that make it just as vulnerable to the effects of WPPs as other raptors. Specifically:

1. It is considered a large raptor. Morphologically, it has a wingspan ranging from 150cm to 180cm and its weight is between 1,400-1,800g for males and 2,100-3,000g. for females. Consequently, its body size makes it vulnerable to impact effects with wind turbines (Figure 1) because during its flights, taking advantage of thermal updrafts and orographic currents, it mainly chooses gliding (passive flight) and has little maneuverability.

2. It is a long-lived species (it can live up to 30 years in the wild) and therefore presents a relatively low reproductive rate (maximum 2-3 eggs per year), while it has been shown both internationally and by the LIFE Bonelli eastMed project results that it has a low reproductive success, with the degree of mortality of the chicks of the species being very high (>50%). Therefore, any additional threat that increases the chances of mortality of individuals of the species, can lead to a dramatic decrease in its population at a local or national level (Rollan et. al, 2016).

3. In Greece, the phenomenon of WPP projects siting (planning and installing) in areas that are critical habitats for the species (breeding territories and foraging areas), is very intense (Figure 2), as a result of which concerns are raised about the future viability of the species across the country. According to the LIFE Bonelli eastMed results, in the main distribution areas of the species in the country, i.e. Peloponnese, Evia, Cyclades, Dodecanese and Crete, a total amount of 228 wind turbines (corresponding to 36 WPPs) are currently operating, within 22 known species breeding areas (definition of a 3 km sensitivity zone around nesting sites of the species), while in the hypothetical scenario of the implementation of all planned projects (wind turbines from all

Figure 1: Dead Bonelli's Eagle (*Aquila fasciata*) after being hit and dismembered by a wind turbine in Cyprus (October 2020). The individual was located thanks to the GPS/GSM satellite transmitter with which he had been radio-tagged as part of the LIFE Bonelli eastMed project.

licensing stages), a total amount of 1,363 wind turbines (corresponding to 201 WPPs) at least will interupt within 60 known species breeding territories (30% of the total ranges) in the aforementioned areas (wind energy data derived via https:/geo.rae.gr/, accessed 09/14/2023).

4. One of the most important causes of mortality for the species is electrocution and/or collision on power transmission infrastructure (Rollan et al., 2016; Chapter 3.1 of this guide). Given the continuous expansion of the electricity transmission network (medium and high voltage) due to the ever-increasing installation of new WPPs, this threat is going to intensify if measures of proper spatial planning and mitigation measures are not taken.

5. According to the national Red Book, the species is considered 'Vulnerable' (VU), and it is a species of the Annex I of the Birds Directive 2009/14/EEC.

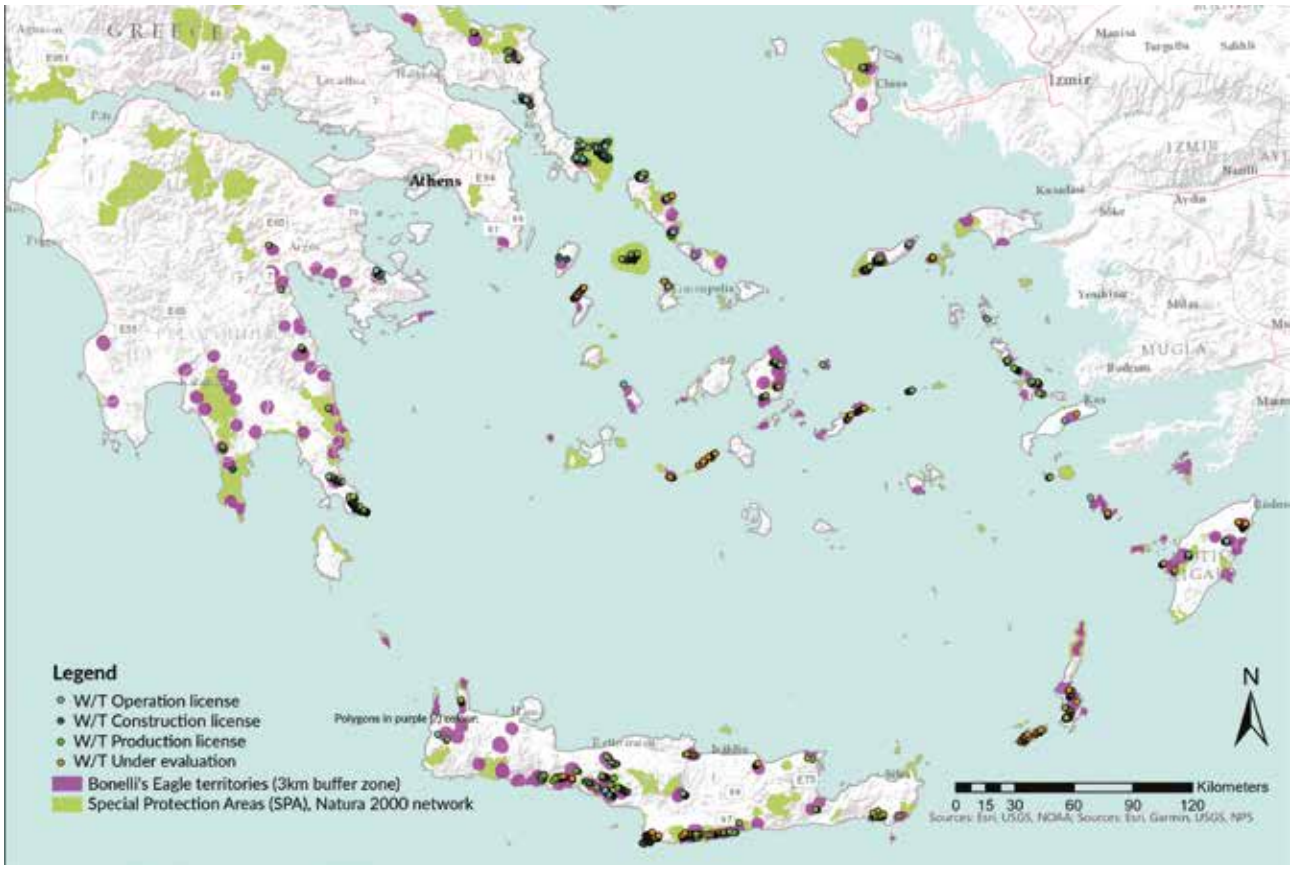

Figure 2: Map showing wind turbines from all stages of the licensing process that fall within the breeding grounds of the species (3 km sensitivity zone definition) in the regions of Peloponnese, Evia, Cyclades, Dodecanese and Crete (S.Aegean).

6. Although it is a species of the Annex I of the Birds Directive 2009/147/ EC, in many of species breeding areas that are part of the Natura 2000 Network, the Bonelli's Eagle is not a designation species. As a consequence, in Greece, where, in violation of the Birds Directive and the Habitats Directive, an Appropriate Assessment of the impacts is not carried out for all Annex I species that are included in the Standard Data Forms (SDF) of the Natura 2000 areas, but only for the designation species (a decision of the Court of Justice of the European Union following three preliminary questions of the Supreme Court of Greece regarding the specific issue following an appeal by the Hellenic Ornithological Society for the partial annulment of the JMD 8353/276/ E103/17-2-2012), the effects of a WPP on the species are not always taken into account. Thus, in many cases of EIA and SEA assessment for WPPs that are planned in or near the breeding grounds of the species, when carrying out the Appropriate Assessment, the effects of the project in this respect are not considered at all, with the result that the species is threatened by the inproper WPP sitting in the country and the non-observance of a proper environmental licensing procedure.

Incident of infrigement of environmental legislation for the licensing of a WPP within a breeding territory of Bonelli's Eagle in a Natura 2000 area during LIFE Bonelli eastMed program.

One of the most typical cases of violation of the EU legislation and the European directives on the environmental licensing of WPP projects in which the project has taken action. LIFE Bonelli eastMed intervened to prevent improper siting of wind turbines, is the case of a WPP with 5 wind turbines developed in the "Fragaki" area of southern Andros.

In this case, a company producing electricity from RES, received a positive opinion and consecutive licensing permits (Production License, EAA, Installation and Operation License) from the licensing authorities for the installation of 5 wind turbines within the Special Protection Area (SPA) with code GR4220028 (Andros: Central and southern part, surrounding islets and coastal and marine zone) and within a critical (active) Bonelli's Eagle (*Aquila fasciata*) breeding area.

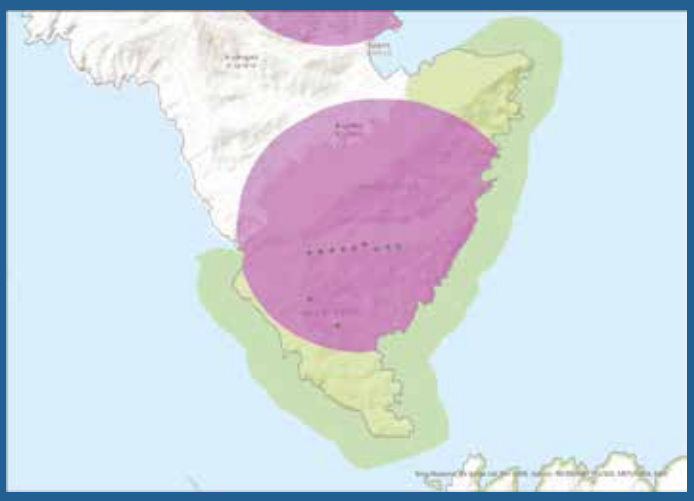

Figure 3: Breeding territory (purple) of the Bonelli's Eagle (Aquila fasciata) in southern Andros and licensed (blue) and planned (green) wind turbines at the "Fragaki" site.

The main violations committed by the company and licensing authorities in this particular case are the following:

1. The existing scientific information was not taken into account neither in the Special Ecological Assessment, nor in the Environmental Impact Assessment of the project, nor in the Environmental Assessment Approval.
2. The WPP was located within the boundaries of the SPA GR4220028 and in complete overlap with a territory of the Bonelli's Eagle (Figure 3) in which 2-3 nesting sites are located, one of them located at a distance of 600m from a candidate wind turbine installation site of the licensed WPP.
3. Arbitrary and unscientifically sound and documented assessments of the project's impacts were supported within the project's EIAs such as that the project: "a) will not affect the conservation status of the SPA, b) the operation of the wind turbines will not cause the delay or the interruption of the conservation objectives of the SPA, c) the population size of the species or the degree of conservation of its habitats will not be affected, and d) there is no reason to consider mitigation measures".
4. The findings of the SPA Management Plan of LIFE10 NAT/ GR/637 ANDROSSPA, which were, up to the time of preparing the EIAs, the best available scientific information for the SPA in question and which had been proposed by the largest part of the specific territory, were not taken into account , including the main nesting site of the species and part of its feeding area, as zone A, i.e. Absolute Protection, where the installation of WPP is prohibited.
5. No substantial reference was made to the nesting sites of the species within the territory.

In addition, with regard to the assessment of the project's impacts during the Appropriate Assessment of the project's SOA:

1. There was no mapping of the observations of the species, i.e. recording in a geographic information system of the flights (trajectories) and assessment of the use of the area and the polygons of the WPP (density of observations or number of crossings).
2. The cumulative effects, especially displacement due to disturbance and the risk of collision with the blades of the wind turbines, were not assessed (with a scientifically documented methodology) since within the boundaries of SPA GR4220028 five more wind turbines are located.

3. There was no precise delimitation of the territory of the breeding site and spatial mapping of the foraging areas of the species.
4. There has been no definition of safety distances of the wind turbines from the breeding sites (active and alternative) of the species which is particularly vulnerable to collisions and displacement in a clear way.
5. No minimum safety distance between the wind turbines and the species nesting locations has been estimated. All the wind turbines are located within its territory, while 48% of them are located at a distance of less than 3 km.
6. The compatibility of the WPP with the conservation objectives of the Natura 2000 Network and the requirements of Directive 2009/147/EC for the specific SPA (i.e. whether the conservation status of the species will be affected by the projects within it) was not clarified.
7. The importance of the SPA of Andros in the movement of migratory raptors on the Cyclades-Evia axis, but also as a connecting link between the population of the Cyclades Bonelli's Eagles and the southern Evia population, was not assessed.

Finally, with regard to the environmental conditions of the project, there were violations or circumventions such as:

1. In violation of the environmental condition of the 15MW WPP at the "Fragaki" location to avoid the implementation of construction works in sensitive areas (distance less than 3 km from a nesting site) during the breeding season of the avian fauna, in February 2020 construction works were carried out in parts of an existing rural road in the "Fragaki" area in the vicinity of the species' territory.
2. Similarly, according to an environmental condition of the 15MW WPP at the "Fragaki" site, the project operator must prepare a four-year environmental monitoring program, however, this condition circumvents the principle of prevention for projects within the Natura 2000 Network areas according to Community Directive on Habitats 92/43/EEC.
3. Finally, the environmental condition of the 15MW WPP for the installation of an automated RADAR system, for the detection of birds in real time and the activation of sound signals to remove the birds or temporarily stop the operation of the wind turbines at the "Fragaki" location, especially within the SPAs of the Natura 2000 Network and in the vicinity of breeding sites of critical avian species, circumvents key articles of the Birds Directive 2009/147/EC that refer to the ecological coherence of the Network and EU wild bird species.

The environmental licensing of projects and activities in Greece – Concise legal framework

Introduction

In Greece, for the environmental licensing of projects and activities of the public and private sector, the provisions of Law 4014/2011 (and its subsequent amendments) "Environmental licensing of projects and activities, regulation of unregulated building in connection with the creation of an environmental balance and other provisions of the Ministry's competence" (G.G. 209/A/2011) (https://ypen.gov.gr/perivallon/perivallontiki-adeiodotisi/perivallontiki-adeiodotisi-ergon/).

With MD 1958/12 (Government Gazette 21/B/2012) all projects and activities for which environmental licensing is required are classified into two categories: A (which is subdivided into subcategories A1 and A2) and B. Subcategory A1 includes projects and activities that may cause very significant effects on the environment, while subcategory A2 includes projects and activities that may cause significant effects on the environment. Category B includes projects and activities characterized by local and insignificant impacts on the environment.

According to the legislation, for the environmental licensing of projects and activities of category A, initially, the competent body of the project can (optionally) request from the competent environmental authority an opinion of Preliminary Determination of Environmental Requirements (PDER). If a positive opinion is given (in cases where the submission of an EIA file has been selected by the project operator), then the submission (by the project operator) and the evaluation (by the respective competent authorities) of an Environmental Impact Study (EIA) is required or a Special Ecological Assessment (SEA) as an annex to the EIA, when it comes to projects or activities planned for installation within (or near) areas of the Natura 2000 Network. Then, after a consultation process has been made public and completed (competent services, bodies, citizens) on the EIA and the relevant opinions are evaluated by the competent authorities [Department of Environmental Licensing (DEL) of the Ministry of Environment for subcategory A1 projects and environmental services of the relevant Decentralized Administrations for subcategory A2 projects], the Decision of Approval of Environmental Terms (DAET) or a rejection decision is drawn up and issued. For the environmental licensing of category B projects and activities, the submission and evaluation of an EIA is not required, but they are subject to Standard Environmental Commitments (SECs) that are an integral part of the permits required on a case-by-case basis for their construction, installation or operation. If category B projects are located within (or near) areas of the Natura 2000 Network, then a Special Ecological Assessment (SEA) is submitted to the competent regional environmental agency.

Projects involving the development of Wind Powered Plants (WPPs) often (but not always) fall under one of the sub-categories of category A, i.e. they are classified as projects that may cause significant (A2) to very significant (A1) impacts on the environment and therefore the responsible bodies of the projects are obliged to prepare an EIA and SEA in order to assess whether the respective project may violate the integrity of the Natura 2000 Network by causing potentially negative effects on species and habitats. However, the phenomenon of project "segmentation" is often observed, resulting in their classification to a lower category, with the consequence of bypassing stages of the environmental licensing including the Appropriate Assessment of environmental impacts of the projects.

Decision of Approval of Environmental Terms (DAET) for Category A projects and activities (article 2, law 4014/2011)

With the DAET, conditions, terms, limitations and variations are imposed for the realization of the project or activity, especially in terms of location, size, type, applied technology and general technical characteristics. Also, any necessary remedial or preventive measures and environmental monitoring actions are imposed, as well as compensatory measures. The terms concern, in order of priority, the avoidance or minimization of impacts or the remediation or restoration of the environment. In cases where, despite the application of all the above conditions, effects on the environment are found and if these are assessed as significant, additional compensatory measures or fees may be imposed. In any case, these terms, among others, must be:

1) Compliant with applicable environmental or other legislation and spatial and urban planning.
2) Sufficient for environmental protection.
3) Directly associated with the specific project or activity and its effects.
4) Fair and proportionate to the size and type of project or activity.
5) Accurate, achievable, binding and controllable.

EIA & SEA content for projects and activities within the Natura 2000 Network (law 4014/2011)

The content of the EIA and SEA (in more detail, the specifications in MD 170225/2014-Government Gazette 135/B/27.1.2014) of a project must focus on the consequences for the area based on its conservation objectives. The significance of the impacts is determined in relation to the specific characteristics and specific environmental conditions that prevail in the protected area to which the project or activity concerns, taking special account of the conservation objectives of the area. Based on the conclusions of the SEA and the EIA, the competent authority agrees on the relevant project or activity only after making sure that it will not damage the integrity (ecological functions) of the specific Natura 2000 area.

SEA for category B projects and activities

It includes the recording of elements of the natural environment with an emphasis on the protected species and habitats of the Natura 2000 area that may be affected and the assessment of the effects, individually or in combination with other projects or activities, considering the conservation objectives of the specific Natura 2000 areas.

SEA for category A projects and activities

It is included in an annex of the EIA, as an integral part of it, presenting: a) a detailed record of natural environment elements with an emphasis on the protected species and/or habitats of the Natura 2000 areas as referred to in paragraph 6 of article 9 of Law 3937/2011 (A′ 60), which may be affected by the project or activity and b) Appropriate Assessment.

The Appropriate Assessment must include an analysis and evaluation of the estimated impacts with qualitative and quantitative data on:

1. the types of habitats in Annex I of the JMD 14849/853/E103/4.4.2008 (B′ 645), especially in terms of their representativeness, relative surface area and conservation status;

2. the species of flora and fauna of Annex II of the JMD 14849/853/E103/4.4.2008 (B′ 645), especially regarding the size and density of the populations, their conservation status and their isolation;

3. the bird species of Appendix I of the JMD 37338/1807/E.103 (B′ 1495), as well as other migratory bird species with a significant presence in the Natura 2000 area, especially in terms of the size and density of the populations, their state of conservation and their isolation;

4. qualitative and quantitative data on whether the integrity of the areas. In case of assessment of possible significant negative effects, the necessary measures to prevent and minimize them are listed with corresponding documentation to ensure the integrity of the area. If it is not possible to ensure the integrity of the area, the necessary measures to offset the negative effects are listed, with appropriate documentation and in accordance with the provisions of article 10 of Law 4014/2011.

Good practices: European Guidelines* and the experience of the LIFE Bonelli eastMed program for the Bonelli's Eagle (*Aquila fasciata*)

** according to the "Guidance document on wind energy developments and EU nature legislation" (2021).*

Introduction

Greece, having been repeatedly warned and/or convicted for non-compliance with EU environmental law (infringement proceedings against the country by the European Commission and convictions by the Court of Justice of the European Union, such as case C-849/19-Non-compliance with the Habitats Directive 92/43/EEC, Article 4, paragraph 4 – Conservation objectives and Article 6, paragraph 1 – Conservation measures), lags behind largely in the full, clear and precise integration of European legislation as well as European best practices (guidelines) in the environmental licensing process.

With regard to the environmental licensing of WPP projects, recently (February 2023), the European Commission sent Greece a reasoned opinion [INFR(2014)4073] for non-compliance with the Habitats Directive (92/43/EEC) during project planning of wind energy, where, as mentioned, projects (RES) are approved in Greece based on the current "Special Framework for Spatial Planning and Sustainable Development for Renewable Energy Sources" (2008) without a prior Appropriate Assessment of its effects on Natura 2000 areas, i.e. in violation of EU law.

Therefore, it was considered appropriate, in this chapter, to review the most recent European Guidelines (2021) regarding the environmental licensing of wind energy projects, as these can form the basis for improving the existing Greek legislation and its application regarding the WPP environmental licensing process in the country. In addition, as the study species of the LIFE Bonelli eastMed program, i.e. the Bonelli's Eagle (*Aquila fasciata*), is confirmed to be threatened by the improper siting and licensing process of WPPs in the country, in this chapter, alongside the European directives, good practices that need to be taken into account as a matter of priority by the licensing authorities in the decision-making process regarding the licensing of WPP projects in order to safeguard that the integrity of the species will not be violated in its distribution areas throughout the country. It is noted that in this guide, the non-extensive inclusion of the European guidelines regarding measures to mitigate the effects of RES projects on the avifauna was chosen, as it is initially deemed necessary in Greece to comply with the European legislation on the proper siting of RES projects.

Environmental licensing of projects and activities based on European directives for the protection of species and habitats

In accordance with European legislation and the European Guidelines (2021) for the development of projects and activities, such as the development of WPPs, within Natura 2000 areas, the process of environmental licensing must be harmonized and compatible with the provisions for the protection of the sites of Article 6 of Directive 92/43/EEC on Habitats (habitats and species of community

interest in Annexes I and II, respectively) and with the provisions for the protection of the avifauna of the Birds Directive 2009/147/EU (wild birds listed in Annex I and migratory species of wild birds with regular arrivals not listed in Annex I of the Directive). In addition, it must be harmonized with the provisions for the protection of species of articles 12 and 13 of the Habitats Directive and the corresponding provisions of article 5 of the Birds Directive. These provisions apply both to strictly protected species under Annex IV of the Habitats Directive and to wild bird species covered by the Birds Directive.

Article 6 of Directive 92/43/EEC on Habitats

The process of assessment and licensing of projects and activities is determined by article 6 (paragraphs 3 and 4) of the Habitats Directive, as the implementation of projects in or near Natura 2000 sites is not excluded in advance and, therefore, the evaluation of projects, such as the installation of a WPP, is done on a case-by-case basis. According to this, the assessment and authorization process must be followed when considering plans or projects that could have an impact on one or more Natura 2000 sites. This process does not only apply to plans or projects within a Natura 2000 site, but also to projects that take place off-site (or near it) but have significant potential impacts on it. During the authorization process of a plan or project, the competent national authorities must check whether the assessment of significant impacts from wind energy plans or projects has been properly carried out (**EE, 2021**).

The assessment and licensing process takes place in 3 stages (Figure 4), which in summary are the following (EU, 2021):

- First stage: screening. The first part of the procedure consists of carrying out a preliminary assessment (“check”), in order to establish whether the plan or project is directly related to or necessary for the management of the Natura 2000 site (Article 6, paragraphs 1 and 2) and, in the event that it is not, if it is likely (that is if it cannot be ruled out) that it will significantly affect the place.

- Second Stage: Appropriate Assesment The second part of the process consists in carrying out a proper assessment of the effects on the site, considering its conservation objectives. This assessment must state whether it can be confirmed that the project or plan will not affect the integrity of the Natura 2000 site, either individually or in combination with other projects or plans, considering possible mitigation measures.

- Third stage: derogation from Article 6(3) under certain conditions. The third stage of the procedure governed by Article 6(4) is triggered if, despite the negative conclusions of the assessment, it is proposed not to reject the plan or project but to further investigate it. In this case, Article 6(4) allows derogation from Article 6(3) under certain conditions, which include a demonstrated lack of alternatives and the existence of compelling reasons of significant public interest to carry out the project. This requires adequate mitigation measures to be taken to ensure the overall coherence of the Natura 2000 Network.

Focusing on the first and second stages of the licensing process more specifically, we have:

1) **Screening**

Screening is a stage that precedes assessment and must be carried out in a timely manner based on the best available information or expert opinion (EU, 2021). At this stage, the likelihood that a project or plan will have a significant impact, either individually or in combination with other projects or plans, on a Natura 2000 site is considered. If there is a potential for a significant impact on the site, a Appropriate Assesment must be carried out in accordance with Article 6(3) (EU, 2021).

The audit is carried out in the following four stages (EU, 2021):

1. Determining whether the project or plan is directly related or necessary for the management of a Natura 2000 site.

2. Description of the project or plan and its impact.

3. Identification of Natura 2000 sites that may be affected, taking into account the potential impacts of the plan or project, individually or in combination with other plans or projects.

4. Assessment of whether significant impacts on the Natura 2000 site can be excluded.

Determining the Natura 2000 sites likely to be affected by the wind energy plan or project requires consideration of all aspects of the plan or project that could have potential impacts on any Natura 2000 sites in the area, taking into account the characteristics (species, habitat types) on the basis of which the sites have been designated. This includes any Natura 2000 sites:

- that overlap geographically with any of the actions or aspects (e.g. accompanying projects such as roads, medium and high voltage electric cables) of the plan or project in any of its phases or are located close to it,

- within the potential zone of influence of the plan or project. Natura 2000 sites located in the immediate vicinity of the project or plan (or at some distance) that could be indirectly affected by the actions or aspects of the project,

- in the immediate vicinity of the project or scheme (or at some distance) that host fauna that may move into the project area (common for avian species) and then experience mortality or suffer other impacts (e.g. loss of feeding or breeding grounds),

- the connectivity or ecological continuity of which may be affected by the project.

If a plan or project will most probably cause, either individually or in combination with other plans or projects, significant impacts on one or more Natura 2000 sites, then it must be subject to a Due Assessment.

2) **Appropriate Assessment**

Its purpose is to assess the effects that the plan or project will have per se or combined with other plans or projects, in relation to the conservation objectives of the site. It therefore focuses specifically on the species and/or habitats based on which the Natura 2000 site has been designated and it is the responsibility of the competent authority to reach a conclusion on the effects of the project on the integrity of a Natura 2000 site based on the conclusions of the Appropriate Assessment (EU, 2021).

The assessment must consider the potential impacts of the overall project or plan in question, including all activities envisaged in the various phases (preparation, construction, operation, decommissioning), while identifying and differentiating impacts by type, including direct and indirect, temporary or permanent, short-term and long-term impacts, as well as cumulative impacts. Appropriate Assessment entails considering all aspects of the plan or project that could significantly affect the Natura 2000 site at the screening stage.

When the Appropriate Assessment is completed, a report is drawn up which: 1) describes the project or plan in sufficient detail for the public to understand its nature, scale and objectives, 2) describes the reference conditions of the Natura 2000 site, 3) the adverse effects of the project or plan on the Natura 2000 site are identified, 4) the way in which these effects will be avoided or sufficiently reduced by the application of mitigation measures is explained, 5) a timetable is established and the mechanisms through which mitigation measures are established, implemented and monitored.

Making a decision to approve or reject a plan or project

The decision to approve a plan or project rests with the competent authorities and can only be taken after it has been ascertained that the plan or project will not damage the integrity of the site. To do this, the Appropriate Assessment should include full, accurate and definitive findings and conclusions, taking into account the most advanced scientific knowledge on the subject, i.e. based on good quality, objective information and reliable data, using appropriate scientific methodology so that that, from a scientific point of view, there is no doubt of any kind as to the absence of such negative effects (EU, 2021).

It is noted that the decision about whether a wind energy project or plan is likely to significantly affect a site has practical and legal consequences. As is typically stated within the European directives: "The safeguards provided for in Article 6, paragraph 3 are triggered not only by the existence of certainty, but also by the existence of a possibility that a plan or project will significantly affect the place or species. Mitigation should not be considered at this stage."

> "Article 6, Paragraph 3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public".

In addition, a key criterion for the approval or non-approval of a plan or project is the expression of the precautionary principle (Article 191 of the Treaty on the Functioning of the European Union) and the principle of proportionality (Article 5 paragraph 4 of the Treaty on the European Union). Within the framework of these principles, the vulnerability and non-replaceability of the protected habitats and species of a Natura 2000 area must be considered, among other things (EE, 2021). Therefore, it is very important that the competent authorities for the preparation and evaluation of Environmental Impact Studies (EIA) and Special Ecological Assessments (SEAs) take into account the principles in question, because their application leads to the effective prevention of potential negative pressures from plans or projects that threaten the integrity of protected sites and species.

➔ "A less stringent approval criterion would not be able to ensure as effectively the protection of the sites that the provision in question seeks. (...) The onus is therefore on demonstrating the absence of adverse effects rather than their presence, reflecting the precautionary principle." (EU, 2021).

In conclusion, and based on the flowchart (Figure 4) of the environmental process licensing according to the European Commission (2021), points that require special attention and must be taken into account by the competent licensing authorities, are:

- Timely and scientifically reliable screening.
- Examining all aspects of a project (including additional projects) that may have a negative impact on one or more (zone of influence) Natura 2000 sites.
- The impact assessment based on the conservation objectives of one or more Natura 2000 areas including necessarily meaning the cumulative effects.

Individual guidelines (good practices) for the proper procedure for conducting the Appropriate Assessment when evaluating EIA and SEA files

Time interval of reference data collection and spatial context (study area)

To reliably capture the species and habitats status of an area in the context of environmental studies (EIA and SEA) carried out due to a planned WPP in an area, the determination of the schedule of data collection from field sampling operations must take into account the need for collection of reference data for a sufficient period of time (EU, 2021).

In the case of birds, this period can be much longer than 12 months (minimum required period of sampling and reference data required for ornithological studies in the context of the EIA and SEA), in order to cover all the different and seasonal aspects of behavior (breeding, dispersal, migration) depending on the species of interest (EU, 2021). In addition, the impacts of a project like a WPP, must be considered throughout their life cycle (pre-construction, construction, operation, decommissioning).

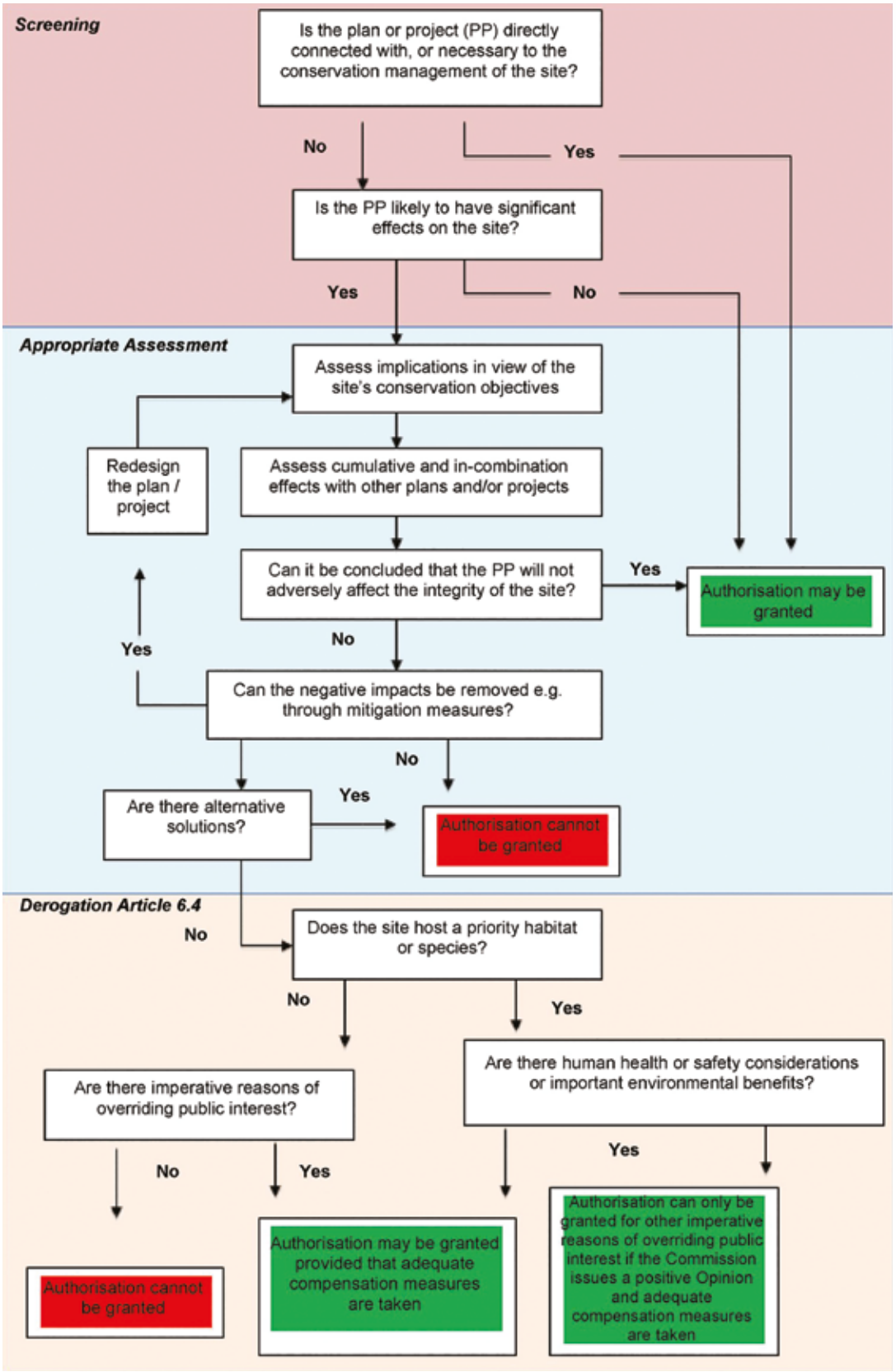

Figure 4: Flow chart of the authorization process under Article 6(3) and (4) (based on the European Commission's methodological guide, 2021).

The timetable should be flexible enough to consider past, existing and likely future reference conditions, the total time over which the effects are likely to be observed, the expected impacts of climate change on EU environmental conditions, protected habitats and protected species, as well as any foreseeable future projects, based on spatial plans and/or expert opinions (EU, 2021).

Moreover, the impacts of a WPP project are not limited to the impacts of the facility of the wind turbines per se, but they also extend to the effects arising from all the additional projects of the installation of a WPP, such as the opening of new roads, the installation of a new electricity transmission network (medium voltage pylons, high voltage pylons), voltage raising substations etc. These impacts may be widespread and impact on protected habitats and species distant from the plan or project. Therefore, the study area (spatial frame of reference) for the preparation of the EIA and SEA must be determined in such a way as to include the entire geographical area within which the activities and impacts of the plan or project are likely to extend.

Finally, when determining the location and time frame the potential cumulative effects must be also assessed (see below).

In the case of large birds of prey like the Bonelli's Eagle, the need for an extended time frame for the preparation of the environmental study, and therefore the assessment of the potential impacts, is necessary.

As a long-lived species, till the age of the first two or three years it is in a dispersal phase (traveling many kilometers to find suitable feeding and resting areas) and therefore the viability of the species depends mainly on the survival of the adults. So:

1. Direct mortality, such as that caused by collision to wind turbines in adult birds, may have very serious effects at the population level.
2. Loss of individual juveniles due to collision to wind turbines after their first flight or during migration/dispersal may not be directly measurable in the breeding population of a particular area but in the long term (at least 2-3 years later) it may be measurable if the adults are not replaced by younger ones.

Therefore, good practices in the case of the Bonelli's Eagle with regard to the time frame and the spatial reference frame (study area) for the preparation of the study, are:

- Estimating the impact of wind turbine collision mortality to the breeding population (and not just individuals) from the time the project starts to the time it ends and beyond.

- Designing a sampling schedule in such a way that a documented mapping recording of the observations of the species, i.e. the flights (trajectories) and assessment of the use of the area and the polygons of each WPP (density of observations or number of passes) can be carried out. To do this, daily observations or sampling periods covering consecutive parts of a day (e.g. three-hour rotations in consecutive visits) are required to complete a daily cycle and the samplings are representative of all hours of the day and seasons. In this way it is possible to estimate the collision risk based on the daily number of crossings (and their reduction per year).

- The definition of a minimum zone of 3-6 km. around active/historic breeding sites (nests) of the species in which WPP installation projects should not be implemented. For species of the genus Aquila, the 3-6km radius exclusion zone. from their nests is the minimum appropriate safe distance from a WPP to minimize the possibility of collision to wind turbines (de Lucas et al. 2008, Carrete et al., 2009, Drewitt & Langston, 2008, Martínez et al., 2010, Sidiropoulos et al., 2016, 2022; EU, 2021), while, for the Bonelli's Eagle, these distances seem to coincide perfectly with the safety distances, as the radius of operation mainly within its breeding grounds ranges from 3.2-6.4 sq. km from its nesting site (rock) (Bosch et al., 2010).

- Designing the study area to cover the entire area that could be affected by the plan or project (even areas outside the Natura 2000 area where the project is planned because of synergistic effects).

Ecological information and data sources for Appropriate Assessment

The assessment of the significance of the effects of an EIA on given species and habitats must be based on a scientific approach (including the best available methods and state-of-the-art knowledge) (EU, 2021). More specifically:

1. **Examples of relevant ecological reference information that can be used (EU, 2021):**

   - Population size and trends, degree of isolation, seasonality, age structure and conservation status.

   - Habitat area, degree of fragmentation and isolation and conservation status.

   - Biological and ecological relationships between habitats and species (e.g. spatial analysis).

   - Environmental features linking the site of the plan or project and Natura 2000 sites, e.g. air currents (migratory birds).

2. **Examples of important sources of information for impact assessment (EU,2021):**

   - Natura 2000 Network standard data forms.
   - Management Plans for the site and the types of characterization.
   - Species sensitivity maps.
   - Contemporary and historical maps, data and information from relevant national authorities, nature conservation organizations, NGOs, wind energy project databases and other organizations with relevant expertise.
   - Data and reports in the context of EU-funded research projects, as well as other research publications and databases from the academic community, NGOs, such as telemetry data.
   - Strategic environmental reports and project-level environmental reports, as well as environmental impact assessment reports, appropriate assessment reports and other evidence where plans or projects have been assessed in the past.
   - Additional field surveys of habitats and species if existing data (e.g. on habitat area or population size) do not provide sufficient detail. (EU, 2021).

➔ Where knowledge gaps are identified or data are not up-to-date, surveys by specialized and experienced ornithologist should be designed and conducted to fill in the gaps. (EU, 2021).

For the **Bonelli's Eagle**, the best practices and reference data for the assessment of the effects of a WPP are:

1. **Breeding data**, i.e. mapping the nesting sites of the species in each breeding territory (with simultaneous calculation of their distances from planned WPPs) and a description of the breeding activity of the species for at least the last 2 years before the Appropriate Assessment is carried out (number of active breeding grounds, nesting pairs and fledged chicks).
2. **Species sensitivity mapping** using criteria such as: a) distance from active or historical nests of the species, b) distance and relationship with the species' foraging grounds, c) dispersal areas of juvenile individuals of the species, d) population trend (population data), e) existence of other distribution area (cumulative effects) or other threats of mortality of the species (e.g. lack of food, poaching, extensive network of power lines).

3. **Development of a telemetry program** with duration of at least 12-24 months that includes all stages of the reproductive cycle of the species. Based on these data and results, an area equal to 50-75% of the home range of the territory of the species can be included in the exclusion zone of WPP establishment. In this way, a precise delimitation of the breeding site of the species' territory and a spatial mapping of the extent of its foraging areas can be carried out.

4. **Use of historical data** (beyond contemporary ones) with the aim of protecting areas of historical distribution of the species that can potentially be repopulated by new breeding pairs in the future.

5. In case of lack of data, **planning a data collection program within at least one to three years of the assessment.**

➔ More generally, the systematic combination of information regarding the current and historical distribution of the species, the long-term potential of the habitat and its breeding and feeding areas, as well as the modeled dispersal patterns of the species can lead to the identification of areas of different and/or graded functionality and importance for the survival and connectivity of its population and in this way help to properly assess the significance of the impacts of each WPP project on the species.

Assessing the significance of the potential impacts of a plan or project

When conducting the Appropriate Assessment, the manner and the criteria used for the final assessment of the impacts of WPP plan or project are of critical importance.

According to **Directive 2001/42/EC** on the assessment of environmental impacts of certain plans and programs, to determine the potential importance (determination of significance) of the impacts (article 3, paragraph 5), characteristics of the impacts of the area that may be affected should be investigated, mainly regarding:

1. the likelihood, duration, frequency and reversibility of the effects;
2. the cumulative nature of the effects;
3. the cross-border nature of the effects;
4. the magnitude and spatial extent of impacts (geographical area and size of population likely to be affected).

If we focus on the case of avifauna, according to the provisions for the protection of birds, their objective is, among other things, to ensure that *no project will cause destruction or damage to nests and eggs or the intentional disturbance of birds especially during the breeding season and dependence, when this has significant consequences in relation to the objectives of the Directive (conservation of wild birds), unless a derogation is granted by the competent authorities in accordance with the directives* (Birds Directive 2009/147/EC).

Impacts to be considered in the assessment and final assessment of their significance include (EU, 2021):

1) **direct loss of habitat**: destruction of breeding and feeding or roosting sites for the species (removal and/or reduction of the corresponding areas due to construction works such as placing construction materials on said places),

2) **habitat degradation**: degradation or reduction of habitat quality resulting in reduced abundance of the target species or changes in the population structure of various species,

3) **habitat fragmentation**: dividing a contiguous area into two or more small, isolated areas, resulting in a barrier between the individual areas used by a species,

4) **disturbances**: change in environmental conditions (e.g. noise, frequency of people and vehicles passing by, increase in suspended sediment or deposition of dust) with potential impact on the displacement of individuals of certain species, changes in their behavior and increased risk of mortality.

Regarding the effects on avifauna, emphasis should be placed on the effects due to:

1. collision risk,
2. barrier creation,
3. displacement due to disturbance.

The assessment of the significance of the impacts of WPP projects on birds like the Bonelli's Eagle should be based on parameters such as:

1. the quantification of size in terms of mortality of individuals of the species
2. the estimation of the change in the population of the species (based on the conservation objectives of a specific site)
3. the assessment of the risk of displacement of the species from its distribution areas.

Examples of methods used to estimate the above quantities are:

- Collision Risk Model-CRM: In Band-type models great attention must be paid to the parameterization and, in particular, to the integration of biologically realistic parameters regarding

the behavior of the birds (avoidance rates of wind turbines due to the behavioral response of the species) so that the results are as close to reality as possible. It is also necessary that the results can be evaluated based on real data during the post-construction environmental monitoring within the WPP operating polygons in positions within or near the breeding grounds of the species.

- Population viability analysis (PVA).

In addition, in the context of conducting Appropriate Assessment, measures **based on the precautionary principle** must be satisfied and taken into account, i.e. measures which:

- focus on data projection onviable populations of the species rather than local occurrences or individuals
- take into account the processes of population dynamics, i.e. variations in the use of space, as well as the connectivity of the population with other areas, rather than simply relying on a snapshot of occurrence data
- are based on a differentiated risk assessment, taking into account the relative likelihood and severity of the threat to the population;
- ensure the satisfaction of the minimum requirements of a viable population within or near the SPA.

Finally, great care is required in the case of WPP siting in areas which, although they may not be included in the Natura 2000 Network of Protected Areas, they may, however, be important sites and/or critical foraging and resting habitats for dispersing Bonelli's Eagle individuals. This particular parameter needs to be taken very seriously into consideration as especially the immature individuals of the species have an intense dispersal phase for the first 2-3 years of their life during which they move from area to area in an effort to find food and suitable habitats for hunting and rest. Therefore, areas which may not be located, for example, very close to active nesting sites of the species, may be equally important sites for the survival of the species and as such should be considered during the Appropriate Assessment (sensitivity maps for the Bonelli's Eagle, LIFE Bonelli eastMed project).

Assessment of cumulative effects when conducting Appropriate Assessment

Although the impacts of a single project may not always be considered significant, the combined impacts of several projects together may be. Thus, a very important category of effects introduced by both EU and national legislation is the concept of cumulative effects. Cumulative is defined as the effects on the environment, on species and habitats from the combined action of past, present and future projects and activities (EU, 2021). Given the ever-increasing number of applications for the installation of WPPs in Greece, the assessment of the cumulative effects during the preparation of environmental studies (EIA-SEA) is deemed more than necessary these days.

According to Article 6, paragraph 3 of the Habitats Directive, the assessment of the environmental impacts of plans and projects is a requirement during the environmental licensing process and concerns both the control (first stage of environmental licensing) and the Appropriate Assessment (second stage of environmental licensing).

According to the results of a recent study (Kopela and Dimitriadis, 2022) and a number of other reports, with regard to national legislation, it appears that the framework for the assessment of cumulative effects is incomplete and insufficient and does not ensure the correct integration and application of the requirements that derive from EU legislation. More specifically, according to the findings of the study:

1. "Legislation and specifications for impact assessment studies (EIA and SEA) do not clearly define the content of cumulative and synergistic effects and do not include clear directions to researchers and advisory authorities on the process, the main elements (e.g. the spatial and temporal scale to take into account other projects and activities) and the way in which the cumulative impact assessment is carried out.

2. In practice, it is common for EIA and SEA to refer only to conspecific projects (e.g. in other neighboring WPPs) and in addition only to the licensed and mainly installed ones, with an installation and operation permit, while there is concern regarding the projects with a producer certificate from the ERA. Furthermore, the assessment of cumulative impacts is a very small part of EIAs and SEAs and critical elements such as all pressures and threats are not considered in depth (e.g. species displacement and habitat fragmentation or other pressures, but mainly collisions and killings), the causal relationships between them, all protected objects.

3. Phenomena of 'segmentation' and 'fragmentation' of projects with the aim of circumventing the environmental licensing procedures and avoiding impact assessment have been observed in practice (especially with regard to category B projects for which an EIA is not planned)".

According to the guidelines of the European Commission for the siting of WPP and biodiversity conservation (EE, 2021), the recommended approach regarding the assessment of cumulative effects in the wind energy sector is proposed to include the following basic guidelines and good practices regarding the assessment of cumulative effects during the preparation of environmental studies (EIA and SEA):

- Plans and projects approved in the past but not yet implemented or completed should be included in that cumulative effects provision.
- The assessment of cumulative effects should not be limited to the assessment of projects or projects of a similar type covering the same field of activity (e.g. exclusively WPP projects). It should include all types of projects or projects that, together with the specific WPP, could have a significant impact.
- The assessment must take into account cumulative impacts not only from different projects or projects, but also from the combination of plans and projects (and vice versa). For example, a new project involving the construction of a WPP in or near a Natura 2000 site may not in itself have a significant impact on the site, but when considered in conjunction with an already approved transport infrastructure project in the same site, these impacts may be as significant as to detract from the site. Conversely, a project may not have significant effects on Natura 2000 sites on its own, but the assessment may be different if considered in conjunction with a major development project that has already been proposed or approved and is not included in the project in question.
- Wind energy plans or projects should be considered in conjunction with other activities that may have impacts on the same EU protected species and habitats. For example, the development of energy grid infrastructure has similar types of impacts to the impacts of the development of WPP on birds like the Bonelli's Eagle.
- WPPs that are considered 'small' scale should not be assessed as projects causing negligible impacts on species in one area when there is a large scale WPP in an adjacent area. In fact, all small-scale or larger-scale projects always contribute to the emergence and enhancement of cumulative effects.
- Despite all the challenges, potential cumulative effects should be assessed using reliable baseline data and not just qualitative criteria. These impacts should also be an integral part of the overall assessment and not just treated as an insignificant aspect at the end of the assessment process.
- For large-scale wind energy projects, which are primarily offshore —although it can also be land-based— a cross-border approach is recommended.

For species such as the **Bonelli's Eagle**, in addition to direct mortality, one of the most important impacts to consider in the light of cumulative impacts is displacement due to distur-

bance. Studies show that species related to the Bonelli's Eagle, like the Golden eagle (*Aquila chrysaetos*), in the presence of multiple WPP in its distribution area, carry out a gradual change of use of the space in response to the expanded occupation of its habitats by wind turbines (Itty, 2018, Sidiropoulos, 2022) . These studies are not yet widespread and therefore the displacement phenomenon is not well studied. Hence:

- When it comes to vulnerable species such as the **Bonelli's Eagle**, it is necessary when carrying out the Appropriate Assessment to try to assess the cumulative effects and studies to predict the possible displacement of the species from an area, when several different wind energy projects are installed or are going to be installed in that area.

In conclusion, in the case of the Bonelli's Eagle, the individual points whose completeness must be examined during the evaluation of EIA and SEA files, in summary, are:

1. Adequate time frame of field sampling (at least 60 days equally distributed in all seasons of the year) and appropriate monitoring protocol (supervisory points-vantage points).
2. Mapping of breeding sites (nesting sites), breeding data (such as numbers of breeding pairs, nests and fledglings) and safety distances from planned wind turbines (at least 3km from active nesting sites).
3. Mapping dangerous trajectories and flights (altitude) of the species using a density map of observations (reduced to the year) in relation to the wind turbines and the WPP polygon (especially if it is possible to use telemetry data).
4. Use of appropriate software (e.g. Band model) to calculate collision probabilty using realistic specific biological parameters, such as: a) morphometric data of the species (e.g. size, weight, wingspan, maneuverability), b) visual field range, c) rates of wind turbine avoidance due to behavioral response of the species.
5. Usage ofr the Species Sensitivity Map for Bonelli's Eagle in Greece (deliverable of the LIFE Bonelli eastMed project).

6. Mandatory and thorough assessment of cumulative impacts, particularly with emphasis on displacement due to disturbance of species from the combination of WPPs projects and other projects (such as accompanying projects and existing or planned electricity transmission grid lines).
7. Assessment of the significance of effects (Appropriate Assessment) based on rigorous scientific criteria that will be defined and adequately addressed within the study.
8. Asppropriate Assessment of the effects of each WPP (and of any classification category of the project) that is planned in or near the breeding territory of the species, even if it is not a designated species of the respective Natura 2000 site.
9. Incorporation into the environmental conditions of mandatory post-construction environmental monitoring for at least 2 years in WPP projects located within or near SPAs and breeding areas of the species.

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Ringing and satellite tagging by UoC-NHMC of a young Bonelli's eagle in its nest. Sfakia, 2022. Kostas Marmatzakos©UoC-NHMC Archive.

Chapter 5

Stakeholders' engagement

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5 Stakeholder engagement

Stakeholder engagement is an area that has developed particularly in the last twenty years, since studies around the world have shown that the protection and conservation of endangered species and habitats is achieved much more effectively when there is participation of various agencies or parties. Stakeholders are defined as groups, businesses or individuals that through their activities can positively or negatively affect the protected species/habitats. The person who proposes or initiates stakeholder involvement is often the person responsible for a protection or conservation program for a species or habitat. Stakeholder engagement involves several stages including getting to know each other, understanding each other, exchanging information and opinions, consulting, and co-shaping solutions. The E.U. has dealt extensively with the process of stakeholder engagement and supports it as an essential component of every protection and conservation project it funds. In addition, it promotes the process as a necessary component of site and species management plans, since each species and habitat are affected by many different stakeholders and conflicting land uses. Stakeholder engagement is a necessary component for improving the environmental awareness of citizens as well as of the stakeholders themselves.

There are several handbooks on best practices for achieving stakeholder engagement and minimizing impacts from conflicting goals and uses. In the LIFE Bonelli eastMed project we used the Biodiversa manual as a guide.

All handbooks on stakeholder engagement agree that it is very important for a project or a management committee to invest in the development of relationships and partnerships but they warn that this investment is time-consuming mainly because of the time it takes to cultivate trust between bodies and to have the maximum effect it must be medium- or long-term, i.e. not stopping with the end of a project.

Threats to the species and correspondence with stakeholders

In order for a project to identify potential stakeholders, it should first identify the threats of the species or area in which it will work.

In the case of the Bonelli's Eagle (*Aquila fasciata*) and the LIFE Bonelli eastMed project, the identification and recording of the threats was initially based on bibliographic references for the preparation of the proposal, and later in the context of the project with the preparatory actions.

The main threats to the species identified are:

- Electrocution and collision with parts of the electricity transmission and distribution network
- Collision with wind turbines (W/T)

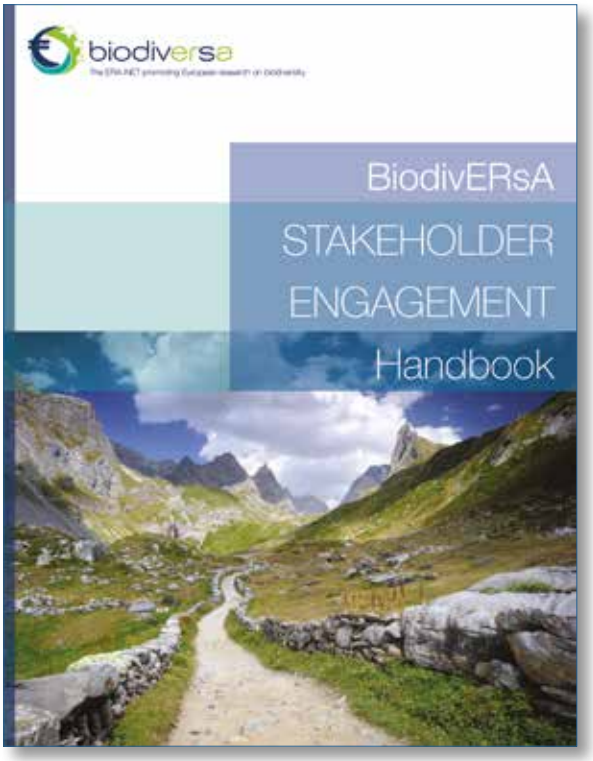
- Disturbance from recreational activities in nature such as climbing
- Drowning in water tanks in the countryside
- Poaching
- Illegal poisoning (especially in Cyprus)

Electrocution and collision with parts of the electricity transmission and distribution network, and collision with wind turbines, in addition to being already significant threats due to the expected rapid growth of Renewable Energy Sources (RES) installations and accompanying infrastructure (including the transmission network and road construction), the threat may become much more significant soon.

From the pressures identified, it is clear that these represent conflicting interests with business and economic activities.

The Handbook of Biodiversa

The Biodiversa handbook[1] was published in 2014, when Biodiversa was a partnership of various funds at national level mostly funding applied research, which could provide solutions and examples related to the implementation of conservation policy and laws of nature, as well as solutions for the protection of nature that could arise through other policies, such as e.g. the Common Agricultural Policy. In 2021, the fund changed form, and is now called Biodiversa+, and is co-financed by the European Commission, together with the national funds mentioned above, and there are annual calls for proposals that again focus on applied research and innovation around solutions that protect biodiversity and implement laws and policies to protect and preserve nature. The stakeholder engagement manual is available on the Biodiversa+ website.



According to the best practices mentioned in the Biodiversa manual it is important after mapping of the stakeholders to prioritize them, because some of them will be of primary importance for the success of the project and the minimization of pressures and threats to the species while some other less important could simply be updated on the progress of the project.

1 Durham E., Baker H., Smith M., Moore E. & Morgan V. (2014). *The BiodivERsA Stakeholder Engagement Handbook. BiodivERsA*, Paris (108 pp). https://www.biodiversa.eu/wp-content/uploads/2022/12/stakeholder-engagement-handbook.pdf

According to this prioritization system there are four ways of stakeholder engagement. These are: **Collaboration, Involvement, Information and Consultation**. According to the methodology, each stakeholder is placed in a matching table (Table 1) according to how much influence (low to high) and how much interest (little to great) it has for the object and as shown in the Table 1 below proposed in the manual, the proposed method of participation of each party emerges accordingly.

For example, for a stakeholder with a lot of influence but little interest in the protection of the species, involvement is suggested, while cooperation is suggested for an interested party with high influence and great interest etc.

Table 1: Correlation table based on Figure 3.1 on page 42, in the Biodiversa handbook (Durham et al 2014).

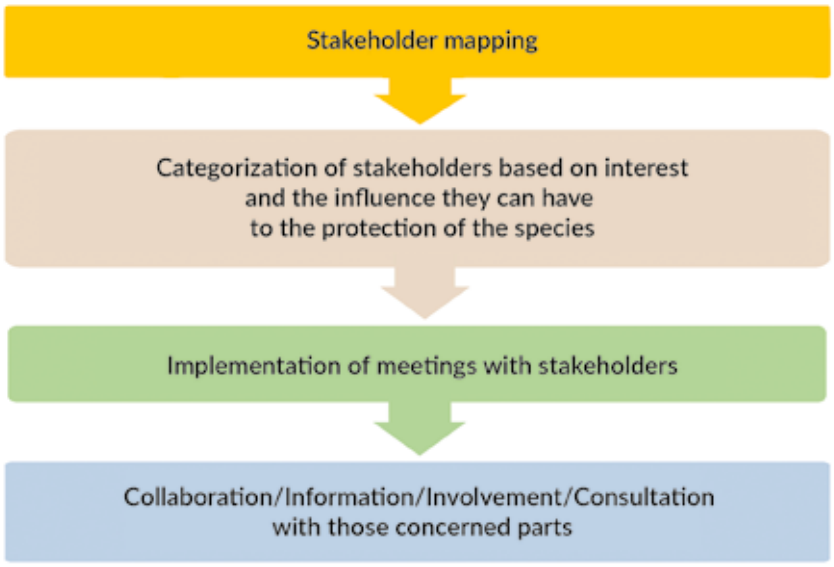
HIGH INFLUENCE	**Involvement**	**Cooperation**
LOW INFLUENCE	**Information**	**Consultation**
	LITTLE INTEREST	**GREAT INTEREST**

By following these suggestions it is possible to better plan the participation of each "type" of stakeholder. In the case of the LIFE Bonelli eastMed project, it is suggested that the influence mentioned above is related to the pressures and threats to the species. For example, since electrocution is listed as a significant threat to the species, then the respective agencies and services for the distribution and management of the electrical network are in the category of high influence. As in this initial phase the interest of these agencies is uncertain because there is still not enough feedback, they are included in the "Involvement" category but with the hope that they will be able to show active interest and be upgraded to "Collaborators".

The whole process of stakeholder engagement is primarily aimed at mutual information, mutual understanding, building trust and the constructive conversation, with the aim of co-shaping solutions that are beneficial for all (win-win).

Among the most serious problems that arise is that this process is time consuming. Moreover, another common problem is the high expectations that the stakeholders have been promised to and the actual, realistic outcome of the project that sometimes does not meet their expectations. This can lead to the frustration and the mistrust od the stakeholders. That is why it is very important to do careful and realistic planning from the beginning.

In summary, the stakeholder engagement process can be illustrated as follows:



Based on the above, the categorization of stakeholders for the LIFE Bonelli eastMed project was as follows (some stakeholders are presented in two positions since during the project their interest increased or their ranking may differ between Greece and Cyprus):

HIGH INFLUENCE	**Involvement:** Electricity Network Operators (Greece/Cyprus), Distribution Network (Greece/Cyprus), Livestock Breeders-Primary Sector (Greece/ Cyprus), CRES (Greece), Hunters (Cyprus), Government Services, Protected Area Management Units (Greece)	**Collaboration:** Electricity Network Operators (Greece/Cyprus), Government services, Forest services, Protected Area Management Units (Greece), Nature users (e.g. climbers), National and international NGOs
LOW INFLUENCE	**Information:** Local Government and local authorities, Offices of environmental studies, Universities, Local associations	**Consultation:** Local NGOs, Government agencies, International NGOs, Protected Area Management Agencies
	LITTLE INTEREST	**GREAT INTEREST**

Below are some examples of stakeholder involvement and collaboration from the LIFE Bonelli eastMed project since they are also the most important for dealing with the threats to the Bonelli's Eagle.

Examples of stakeholder engagement in the framework of the LIFE Bonelli eastMed project

a. Memorandum of Cooperation with the Independent Power Transmission Operator (IPTO) and with the Hellenic Electricity Distribution Network Operator (HEDNO), Greece

From literature and project data it has become clear that electrocution on medium voltage pylons and cables, as well as collision with high voltage cables are serious causes of mortality for the Bonelli's Eagle and threaten its conservation status. In addition, infrastructure networks for energy transmission and distribution are expected to develop further, due to the rapid increase of Renewable Energy installations.

Apart from the correct location, insulation of poles (mainly medium voltage) and cable marking (mainly high voltage) have proven to be effective measures to reduce the mortality of birds of prey in areas where a particular problem is observed (see also Chapter 3.1). What is requested is the immediate reduction of the mortality of the species by at least 25% in breeding territories and dispersal areas.

The LIFE Bonelli eastMed project had envisaged actions for pylon insulation and cable marking, so the involvement of the competent bodies for the network and energy transmission was imperative for the success of the project.

International conference organized by LIFE Bonelli eastMed project for managers of electricity transmission networks in Cyprus, 2019. Elsa Georgopoulou©UoC-NHMC Archive.

1. First of all, the responsibilities and tasks of the stakeholders were mapped, that is, the IPTO and the HEDNO.
2. A series of familiarization and working meetings were held with the relevant departments of the stakeholders – Familiarization with the objectives of the program and securing interest and initial agreement.
3. The Hellenic Ornithological Society (HOS), a partner of the LIFE Bonelli eastMed project, submitted a proposal for cooperation by drafting an initial text of a "Memorandum of Cooperation" on behalf of the program. The Memorandum of Cooperation is a non-contractual text that nevertheless functions as a declaration of real intentions and voluntary commitment. It does not create obligations and commitments. It is mainly a text of scope contemporaneity. After agreement on the text, two Memoranda of Cooperation were signed.
4. Memorandum of Cooperation with IPTO in April 2021 with the subject of 'Marking of electricity transmission network cables in reference areas of the program'. The commitments described in the Memorandum were also incorporated in the process of directly assigning the corresponding actions of the project.
5. Memorandum of Cooperation with HEDNO in November 2021 with the object of 'Application of covers to top structures of medium voltage pylons located in the reference areas of the program'. The commitments described in the Memorandum were incorporated into the respective public contracts for the implementation of the respective project actions.

Difficulties during the development of the action

Stakeholder engagement often faces difficulties and obstacles, especially in the beginning, so it is important that the project operators are prepared for possible delays and problems that arise along the way.

Specifically, some of the difficulties encountered in the case of the project's collaboration with IPTO and HEDNO were due to the fact that they are bodies with their own priorities and a strict and predetermined operating framework. Based on the objectives of the project, the coordination of different sectors with different responsibilities within each agency was required, which did not always prove to be smooth. The requirements of public tendering and contracting procedures imposed additional difficulties and delays.

Finally, frequent changes in agency administration created delays in approvals.

Shared benefits derived from the action

The now imperative development of corporate social responsibility and sustainable industry development for all companies, made stakeholders much more willing to engage and collaborate.

The two stakeholders realized, along the way, that the participation and support of the Bonelli's Eagle conservation actions brings added value to their turnover, is in line with the requirements for the protection of biodiversity and benefits them financially.

The drawing up and signing of Memorandums of Cooperation with the above-mentioned bodies is a pioneering achievement for Greece, since until the signing of these two Memoranda, similar actions had only been carried out individually and only at a local level.

Finally, the Memorandums of Cooperation can set a precedent for future actions with other agencies.

b. Cooperation with the Electricity Authority of Cyprus (EAC), Cyprus

In Cyprus, the agency that sought cooperation with the electricity company (EAC) was the Game and Fauna Service (GFS), which is the competent state service for the protection and management of wild birds.

In the past, GFS collaborated with EAC for the installation of buoys as part of compensatory measures for large projects such as the creation of a wind farm. Nevertheless, cooperation between different agencies on issues that have interactions in the program was unprecedented. What was requested through the actions of the program was the cooperation for the insulation of some medium voltage pylons as well as the marking of some high voltage cables.

To facilitate cooperation and understanding of the problems that can arise from power lines and pylons in wild avifauna, a representative of the EAC has been invited to participate in an international conference organized in Italy in 2023 on the best practices to avoid electrocution and collision with cables and pylons.

Cultivating personal relationships with EAC employees also played an important role, for the development of understanding and trust. The request was for EAC to be involved in finding solutions, as they know the technical difficulties or the possibilities of using various solutions.

At the same time, the fact that there were confirmed deaths of at least nine (9) raptors on pylons and cables in the last three years (among which five Bonelli's Eagles), and that these killing incidents were widely publicized, acted as a major lever of pressure on the EAC and it helped so that the authorities of the two bodies were interested in finding mutually acceptable solutions. As is well known, locating electrocution or collision victims is very difficult as often the birds, after falling to the ground, are quickly removed by predators. The identification of these victims involved the placement of transmitters on several Bonelli's Eagles within the framework of LIFE Bonelli eastMed. The signal that researchers receive from modern transmitters allows them to know in what condition and position the bird is and, therefore, move into the area immediately when they detect that the signal is stable for too long or stationary. In this way birds killed on cables or py-

lons are detected which otherwise would probably never be detected. The correct recording of the causes of losses with evidence is also necessary for public awareness. In addition, during the project, it was found that several cables that pass-through forest areas and are insulated to prevent forest fires, are not completely safe due to the fact that at the connection points of the cables on the pylons there are bare parts of the cable that may cause electrocution in large bird species such as raptors. In these cases, in addition to the risk of electrocution for the birds, there is also the risk of forest fire from the short circuit.

Finally, the need to insulate electricity pylons became more imperative due to the summer fires, since some of them resulted from overheating of cables passing through the forest. All these reasons contributed to the need for the services to work together to solve the problems.

c. Cooperation with farmers, Crete, Greece

In this action, the aim was to collaborate with land users throughout Crete, for three actions of the project, namely action C2.1: Sowing and cultivation of private and public lands with forage and local meadow plants, action C2.2: Creation of drinking water supply facilities and general upgrading of feeding areas, and action C3.2: Reduction of direct killing by installing escape facilities from tanks.

Information day for social partners on the management actions of LIFE Bonelli eastMed project, Heraklion, 2020. Popi Baxevani©UoC-NHMC Archive.

About 60 users were approached throughout Crete, and cooperation was achieved with 40 users in total (21 farmers/breeders for actions C2.1 and C.2.2, and with 19 for action C3.2).

The initial list of users was created using personal contacts of the project team and past collaborators from previous projects implemented by the University of Crete, to identify potential collaborators, breeders and farmers, in the project areas. Afterwards, a first telephone contact was made where a brief reference was made to the reason for the contact and face-to-face meetings were organized.

In the context of these personal contacts, an effort was made to inform about the characteristics of the species, the protection status and the relevant legislation, as well as the ecological importance of the Bonelli's Eagle, as well as other large raptors of the area. In the personal meetings, informational material was also provided and a discussion was held on the "exoneration" of the Bonelli's Eagle and other large raptors (especially the Golden Eagle) through examples and references to studies. Finally, an update was made on the benefits that the user could obtain.

An informal cooperation agreement was signed with those users who decided to proceed where its terms and duration were mentioned. The agreement was signed between the contracted breeders/farmers and the University of Crete, which was also the responsible partner for the implementation of these actions, on behalf of LIFE Bonelli eastMed. After the conclusion of the agreement, regular visits were made to the areas where the interventions of the program were carried out, to evaluate the actions and monitor compliance with the terms of the agreement.

The main requirement through the agreements and collaborations with local bodies is the building of trust between the parties. For this reason, it is extremely important that the side of the project, in this case the University of Crete, strictly respect the terms of the agreement that have been signed, since failure to comply them may create conditions of lack of trust and could even jeopardize the safety of the species, as well as the user's dedication to environmental protection in general. A negative experience of working with local users can have significant negative effects on the local community's perception and acceptance of the scientists, the project, the species and the ecology, so it is very important that when such an action is initiated there is commitment, time and insistence on cooperation.

But when such an action works well, the benefits are enormous, since an informed network of land users is created, helping the objectives of the program and other possible future environmental management projects. People in the network, as long as they are happy with the cooperation, can update immediately when they see events that may threaten the species, its area or other violations of environmental legislation. Finally, working with primary sector land users is a living example that the primary sector can go hand in hand with the protection of the species and the environment in general.

d. Cooperation with climbers, Greece

The purpose of the specific action is to reduce the disturbance to the species, which may has negative effects on its ecology and its biological cycle.

The vertical cliffs are an important and sensitive ecosystem that is home to relatively few, but important and rare species, such as the Bonelli's Eagle. Outdoor activities including rock climbing can cause environmental damage due to disturbance. In Greece, there are so far no documented scientific studies on the magnitude of the problem, but the matter is known from other countries. In Greece, the legal framework that governs the regulation of outdoor activities in order to avoid environmental damage is unclear and poorly applied in most cases. Therefore, measures have not yet been taken to avoid the disturbance caused by those engaged in outdoor activities.

Information day for climbers about the project and the project's outdoor sensitivity digital map. Popi Baxevani©UoC-NHMC Archive.

In Greece, as part of the LIFE Bonelli eastMed project, activities were carried out with the aim of reducing the risk of disturbance from outdoor activities in sensitive areas for the Bonelli's Eagle (see also Chapter 1.3). The main concern of the project was to provide information to those directly involved (private climbers, clubs, federations and professionals in the field, mountain guides, and trainers) about the possible risks and to raise their awareness of the protection of the Bonelli's Eagle habitats.

An additional goal of the program was the development of collaborations with the stakeholders in order to: (a) jointly set rules and restrictions, and (b) collaborate to further develop and disseminate communication and awareness-raising activities.

Steps followed:

1. First, the areas where there is a conflict of interest were identified and digitally mapped. In these, the potential threat was assessed and this information was incorporated into the mapping, resulting in the creation of a digital tool. This tool, which is freely available online at the project website (https://lifebonelli.eu/el/charths-eyaisthhsias-se-ypaithries-drasthriothtes) can provide guidance to all stakeholders and be used as a sensitivity map to avoid disturbance from outdoor activities.

2. In a second phase, it is important to identify the stakeholders and establish the communication channels that will allow cooperation. Within the framework of the program there was constant contact with climbing clubs and local groups at regional and national level, as well as with the primary collective body (Hellenic Federation of Mountaineering and Climbing, HFMC). In addition, the collective bodies of those professionally engaged in outdoor activities (Hellenic Mountain Guides Association - HMGA) were also included in the communication. Finally, the interested parties that are necessary for the cooperation include the state services such as Forestry Departments, Protected Areas Management Units, Ministry of Foreign Affairs, General Secretariat for Sports, Ministry of Tourism and the local government.

3. Planning the threat reduction actions, implementing them and monitoring their implementation and effectiveness. As mentioned above, the implementation of environmental legislation in matters of development and management of outdoor activities in Greece is incomplete. The aim of the program was to agree from the outset between the parties involved on the need to take measures for the protected object and not to impose regulations without consultation. Thus, in cases where problems of disturbance or potential conflicts of interest were identified, the program worked towards their resolution with stakeholder engagement. As a rule, this was successful as all engaged stakeholders worked together successfully. As an exception to the aforementioned, in the only case where an incident occurred (Manikia, Evvoia) which could potentially cause a very intense disturbance and only after it was not possible to reach a joint decision, LIFE Bonelli eastMed collaborated with the relevant forest services to protect the Bonelli's Eagle territory there, and as a result regulatory measures were taken to avoid the disturbance.

4. Planning and developing actions to reduce the threat. Finally, monitoring the implementation of the actions, their adaptation to new conditions and requirements, and the assessment of their degree of effectiveness is required. Given the large extent and time duration of the monitoring process, and in order for this to be possible, the cooperation of all inter-

ested parties is required. Mainly of the climbing community, which, being the main user of the areas of interest, has the largest temporal and spatial presence. Developing communication channels through the digital tool for climbers, social media and collecting information directly from climbers is the main way to get a complete figure of the effectiveness of the measures. Furthermore, as a proposed measure to strengthen the effort to evaluate the protection measures, the information/training of the competent state bodies (forestry departments, PAMU) is also included. This took place through online training seminars, thus giving the possibility of an even greater flow of information. Finally, the public can assist in data collection, having been exposed to the program's environmental information and awareness materials. This information - as long as it does not endanger the protection of the species - is distributed to all stakeholders, thus promoting the objectives of the program, upgrading the quality of the climbing areas and supporting decision-making where this is deemed necessary.

Difficulties during the development of the action

As with the other examples, any new approach may be perceived with hesitance and indifference. And in this case, during the initial approach there must be a sincere willingness to participate, cooperate and understand each other, the necessary time and dedication to build the necessary trust.

In addition, the creation and development of outdoor activities' infrastructure is in a period of a very high growth throughout Greece with many areas being under the "threat" of being climbing areas without environmental conditions and provisions.

Shared benefits derived from the action

In general, people who engage in recreational activities in nature are sensitized, so when they perceive the threat and its importance, they are usually willing to comply.

In addition, through this collaboration and acquaintance, there were also climbers who were so interested in the issue, that they became volunteers for the project to approach the nests for research purposes, in collaboration with the project scientists of course. In other words, they became volunteers for ringing chicks and placing transmitters. The skills of climbers are precisely essential for approaching nests on steep, vertical cliffs for scientific study.

General principles of stakeholder engagement and multiple benefits

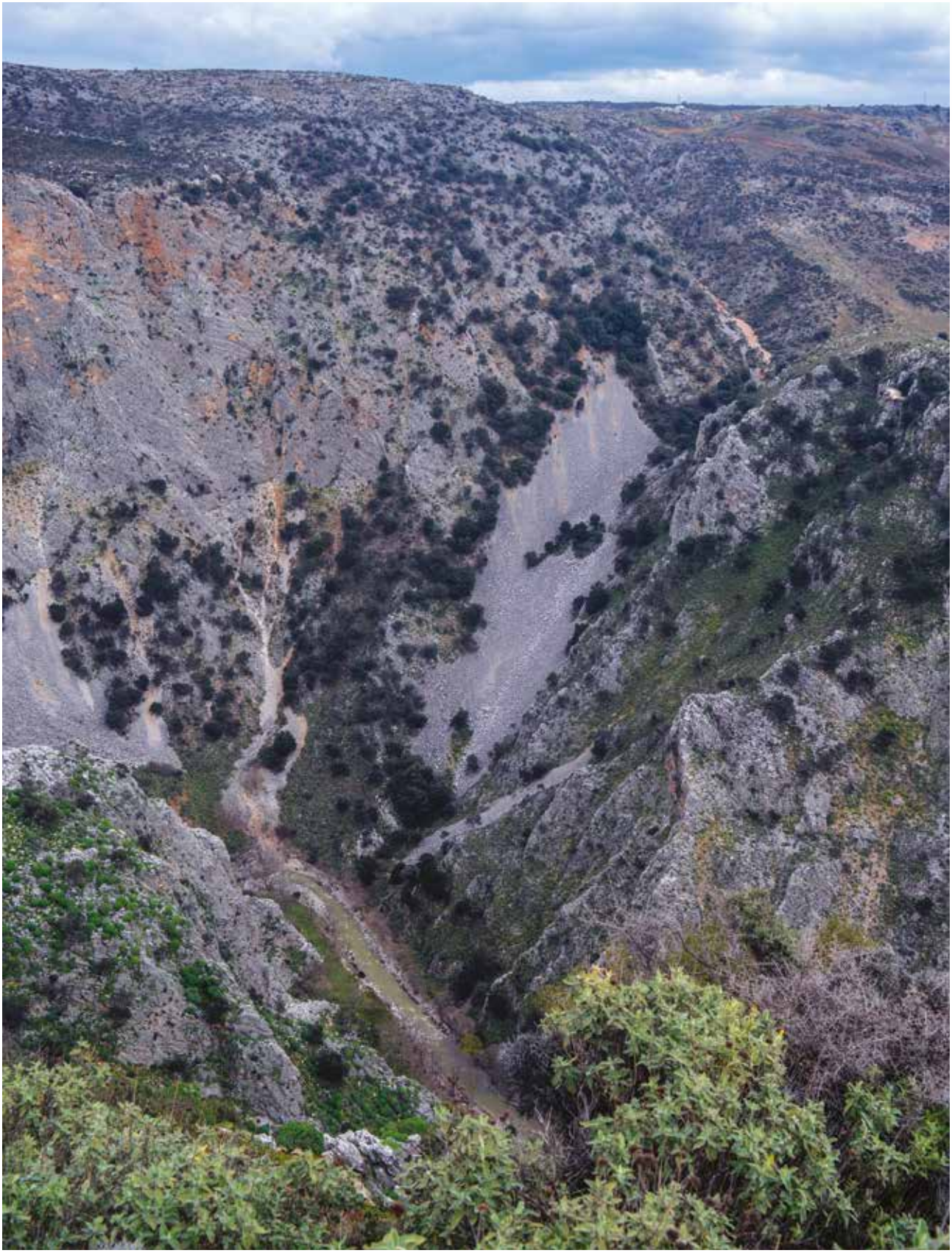
The process of engaging stakeholders and working with them, is definitely time-consuming and to be successful it should be medium- or long-term, i.e. not stop when a project is finished.

Some general principles emerging from the LIFE Bonelli eastMed project:

- It is important to make an effort to get to know and discuss with the engaged stakeholders to achieve their participation.

- This effort must be sincere and take the necessary time to the various stakeholders in order to build the necessary trust.
- If time is taken, agreements are made and adhered to, and cooperation is achieved, the benefits that can accrue are multiple and far beyond the narrow goals of the project.

Capturing a young Bonelli's Eagle with the help of climbers in Gyaros (left) and placing a transmitter on the same chick (right), 2022. Aspasia Anagnostopoulou©UoC-NHMC Archive.



In addition to a large colony of Griffons, the Prassano gorge is also home to the Bonelli's Eagle. Popi Baxevani©UoC-NHMC Archive.

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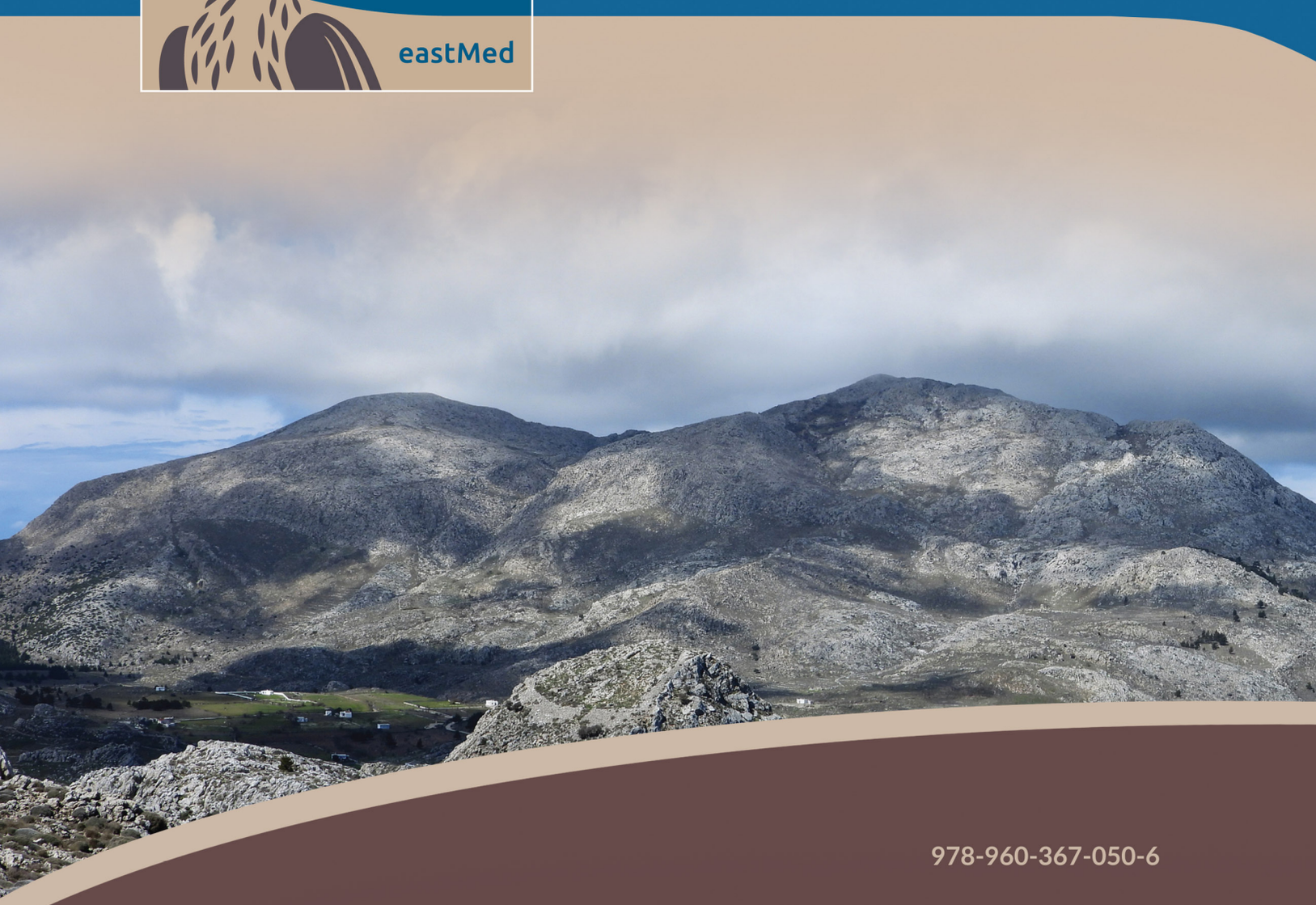
LIFE17 NAT/GR/000514 - LIFE Bonelli eastMed

Conservation & Management of the Bonelli's eagle population in east Mediterranean

LIFE Bonelli eastMed



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