



## Project Partners



### **Deliverable: Technical report on the population sizes assessment**

**Action A.3: Assessment on the population size of targeted bird species in the project sites**

**LIFE13/NAT/CY/000176 "Improving lowland forest habitats for Birds in Cyprus"**

**Nikos Kassinis, Game & Fauna Service**

**Nicosia, February 2016**

## ACTION A.3

### Assessment on the population size of targeted bird species in the project sites

#### **DELIVERABLE: Technical report on the population sizes assessment**

##### *LIFE-FORBIRDS: Improving lowland forest habitats for Birds in Cyprus*

###### Project Data

<b>Project location</b>	Kavo Gkreko (CY3000005), Koshi - Pallourokampos (CY6000009), Stavrovouni – Potamos Panagias Stazousas (CY6000007)
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Beneficiary responsible for implementation:

Department of Forests



with the support of all consortium members



With the contribution of the LIFE financial instrument of the European Union

**Favourable Reference Values, Target Values and population levels for Annex I bird species at 3 SPAs as part of the LIFE project: “Improving lowland forest habitats for Birds in Cyprus”  
LIFE13 NAT/CY/000176 LIFE FORBIRDS**



**N. Kassinis, Game and Fauna Service, 2016**



**Favourable Reference Values, Target Values and population levels for  
Annex I bird species as part of the LIFE project:  
“Improving lowland forest habitats for Birds in Cyprus”**



(ref: LIFE13 NAT/CY/000176 LIFE FORBIRDS)

This report has been produced and published by the Game and Fauna Service as part of the project 'Improving lowland forest habitats for Birds in Cyprus' which is co-funded by the LIFE financial instrument of the European Union.

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Cover photos: (clockwise) Cyprus Wheatear / Masked shrike / European Roller / Red-backed shrike. N. Kassinis /Game and Fauna Service

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## Abbreviations

**BD** – Birds Directive

**FRV** – Favourable Reference Value

**MVP** – Minimum Viable Population

**PVA** – Population Viability Analysis

**FCS** – Favourable Conservation Status

**HD** – Habitats Directive

**SPA** – Special Protection Area

**TV** - Target Value

## Glossary

**Birds Directive (BD)** and **Habitats Directive (HD)** – Two Directives of the European Union that relate to the conservation of wildlife and nature. The Birds Directive is formally termed the ‘Council Directive 2009/147/EC on the conservation of wild birds’ and the Habitats Directive is the ‘Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora’.

**Favourable Conservation Status (FCS)** – This term is defined in Article 1(e) of the Habitats Directive as when a habitat can be considered stable or increasing, the habitat is functioning as it should and will do so for the foreseeable future and, the species that are intrinsic to the habitat are also considered at favourable status.

**Favourable Reference Value (FRV)** – The FRV is the population size at which the risk of extinction is acceptably low, the species is biologically functional within the ecosystem and there is no contraction or decrease.

**Minimum Viable Population (MVP)** – The lowest level at which a population can survive without going extinct, for a given set of population parameters.

**Population Viability Analysis (PVA)** – A process of assessing the viability of a population through modelling, to find the probability of extinction over a set time period with a given set of demographic and reproductive parameters.

**Special Protection Area (SPA)** – Areas that have been classified by Member States under the EU Birds Directive because of their importance for species on Annex I of the BD, or other regularly occurring migratory species. The classification and protection of such sites is an obligation under the EU Birds Directive.

**Target Value (TV)**-The Target Value is the numbers of migrant/wintering species that should regularly occur in the corresponding areas in Cyprus. These numbers should be defined as a range, given the species inter-annual variations. This range was agreed to represent the numbers counted at each site following an agreed protocol and a constant annual effort.

## Summary

The EU LIFE project “Improving lowland forest habitats for Birds in Cyprus” (LIFE13 NAT/CY/000176 LIFE FORBIRDS), has as its main objective the implementation of specific conservation actions so to improve the ecological conditions of specific Annex I (Birds Directive) species occurring in the Natura 2000 (SPA) sites Kavο Greko (CY3000005), Koshi – Pallourokampos (CY6000009) and Potamos Panagias Stazousas (CY6000007). These sites, in order to come into Favorable Conservation Status, the qualifying species for each site must come into such favorable status as well. To permit evaluation of whether or not the European Union Birds Directive Annex I bird species breeding at the above SPAs are at favourable conservation status, favourable reference values (FRVs) for these populations must be set, which can then be used to evaluate current population levels and as conservation targets. FRVs have been set for the following breeding species: *Burhinus oedicnemus*, *Caprimulgus europaeus*, *Coracias garrulus*, *Emberiza caesia*, *Lanius nubicus*, *Oenanthe cypriaca* and *Sylvia melanothorax*. The above species, with some exceptions, do not occur in all 3 project areas in significant numbers so as to produce Favourable Reference Values or Target Values. For the purposes of this report, FRV have been also produced for *Melanocorypha calandra*, a trigger species for Koshi SPA. Target Values rather than Favorable reference Values have been set for 4 migratory species, *Alcedo atthis* (for Kavο Greko), *Circus macrourus*, *Lanius collurio*, *Lanius minor*. This report describes briefly the process selecting the appropriate methods for determining FRVs for populations of Cyprus birds at both site and national levels, and applies these methods to the 12 abovementioned Annex I species. FRVs were set at both site level and national level and population estimates are given for qualifying species.. The following tables summarize the set FRVs and TVs for breeding and migrating species, respectively.

Species	FRV at Cyprus level (breeding pairs)	FRV at site level (breeding pairs)		
		Koshi:	Stazoussa:	K.Greco:
Oenanthe cyriaca	30,000	300	200	250
Sylvia melanothorax	50,000	400	750	600
Lanius nubicus	8,000	Stazoussa: 25		
Emberiza caesia	8,000	Stazoussa: 200		
Burhinus oedicephalus	2,000	200	5	-
Coracias garrulus	3,000	50	30	-
Melanocorypha calandra	4,000	250	-	-
Caprimulgus europaeus	2,000	Stazoussa: 20		

species	Koshi SPA (individuals) Target Values	PanagiaStazoussa SPA (individuals) Target Values	Kavo Greco SPA (individuals) Target Values
Circus macrourus	5-20	2-5	5-50 Autumn 5-20 Spring
Lanius minor	30-60	20-40	200-500
Lanius collurio	30-60	40-100	500-1000
Alcedo atthis	-	-	20-50

## Introduction

### The Project

This report is produced as part of the project “Improving lowland forest habitats for Birds in Cyprus” (LIFE13 NAT/CY/000176 LIFE FORBIRDS), implemented with the support of the LIFE financial instrument of the European Union (EU). The report was prepared by the Game and Fauna Service, one of the four beneficiaries of the LIFE FORBIRDS project.

Responding to the deterioration and loss of the natural environment and its adverse effects on wildlife and ecosystems, the EU has passed two Directives to protect the natural environment of Europe, the Birds Directive 2009/147/EC and the Habitats Directive 92/43/EEC, which together define a set of actions and targets for Member States, including the designation of Special Protection Areas (SPAs) through the presence of qualifying species. The main objectives of the LIFE FORBIRDS project are: (I) to implement conservation / management measures that will substantially improve the ecological conditions for selected bird species listed in Annex I of the Birds Directive occurring in the Natura 2000 (SPA) sites Kavos Greko (CY3000005), Koshi – Pallourokampos (CY6000009) and Potamos Panagias Stazousas (CY6000007), (Fig. 1) (II) through the implementation of these pilot conservation management measures to demonstrate to the Cypriot foresters and other stakeholders, the benefits of adopting a more holistic forest management approach that will address the needs of birds inhabiting / using forest habitats, and (III) to contribute towards, enhancement of public awareness on the need to conserve wild birds and combating bird crime within the broader project area. The following 11 species are the target species: *Alcedo atthis*, *Burhinus oedipnemos*, *Caprimulgus europaeus*, *Circus macrourus*, *Coracias garrulus*, *Emberiza caesia*, *Lanius collurio*, *Lanius minor*, *Lanius nubicus*, *Oenanthe cypriaca* and *Sylvia melanothorax*. The above species, with some exceptions, do not occur in all 3 project areas in significant numbers so as to produce Favourable Reference Values or Target Values. For the purposes of this report, FRV have been also produced for Calandra Lark *Melanocorypha calandra*, a trigger species for Koshi SPA. The restoration and management of the sites is also expected to benefit other regularly occurring migratory species for which the sites are important.

The three-year LIFE project started in October 2014 with the involvement of four beneficiaries in Cyprus. These are the Department of Forests (coordinating beneficiary), the Cyprus Forest Association, Frederick University and the Game and Fauna Service (the competent authority for birds in Cyprus).

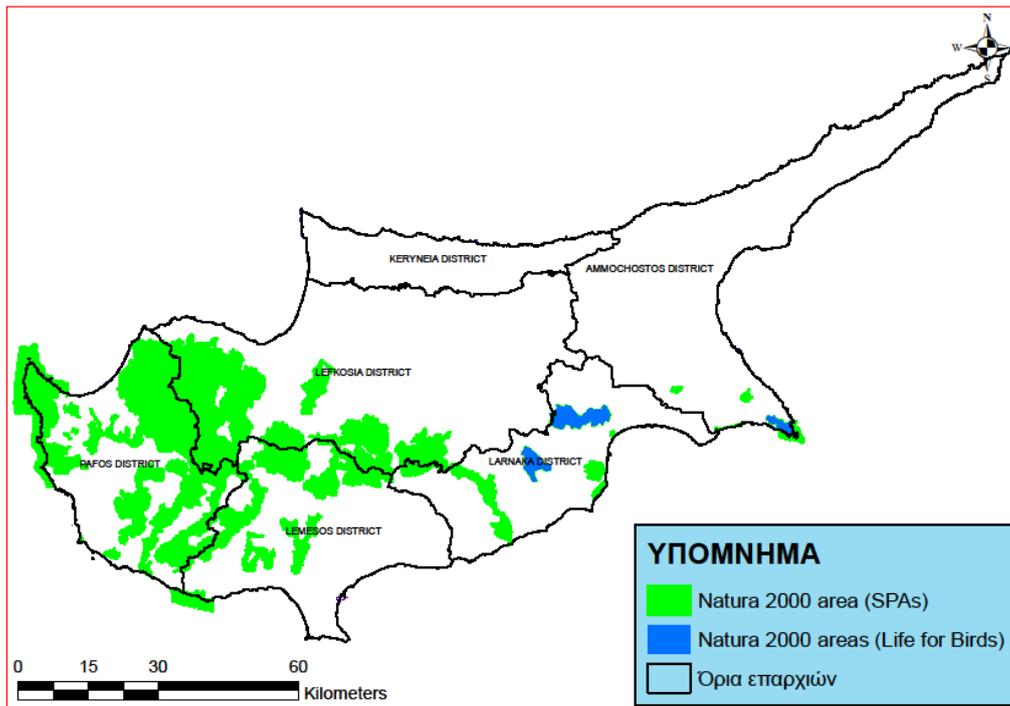


Figure 1. Natura 2000 Network (SPAs) and the 3 sites/SPAs of the Project LIFE FORBIRDS

## Species description and status-Site description-Ornithological Importance-Identified threats

### Species Description and Status

#### 1. Cyprus wheatear

The Cyprus wheatear is a small insectivorous species that is endemic to Cyprus and included in Annex I of the Birds Directive (2009/147/EU). It exists as a migrant breeder; it comes to breed in the spring and leaves the island for Africa in autumn. It breeds in a variety of habitats, from lowland open areas to the highest forested mountains. It is a cavity nester, both in trees, stone walls and steep banks.

#### 2. Cyprus warbler

The Cyprus warbler is a small, insectivorous species that is endemic to Cyprus and included in Annex I of the Birds Directive (2009/147/EU). It exists both as a resident and partially migratory species, since individuals have been found to overwinter in areas of the Middle East. It is found predominantly in thorny maquis where it breeds.

### 3. Masked shrike

The Masked shrike is the smallest species of the shrike family (*Lanidae*) that visits Cyprus, included in Annex I of the Birds Directive (2009/147/EU). It is a migrant breeder that winters in Africa and starts its migration in Cyprus by late March and leaves the island by mid-October. It feeds on large insects, lizards and mice, but sometimes preys on small birds. It prefers woodland areas, upland orchards and vineyards and open forest for nesting.

### 4. Cretzschmar's Bunting

The Cretzschmar's bunting is a member of the *Emberizidae* family. It is a migrant breeder in Cyprus. It is included in Annex I of the Birds Directive (2009/147/EU). It breeds mainly in open, mountain sides with phryganic vegetation, dispersed with grasses. It feeds on seeds and grasses.

### 5. European Roller

The European Roller is a species with a declining population in Europe, included in Annex I of the Birds Directive (2009/147/EU). It is a fairly large, colorful species that belongs to the *Meropidae* (Bee-eater family). It is a migratory species that overwinters in Africa and breeds in the Mediterranean areas and Eastern Europe. Cyprus hosts a significant part of the European population. It feeds on large insects (beetles and grasshoppers) but also small reptiles. It prefers open habitats such as dry cultivations (cereal fields) with scarce trees such as Carob and Olive trees. It is a cavity nester, nesting both in large trees cliffs and earth banks.

### 6. Eurasian Stone Curlew

The Eurasian Stone Curlew is a large, nocturnal *Charadriiform* (Wader family), included in Annex I of the Birds Directive (2009/147/EU). It is a resident species to Cyprus that breeds in significant numbers. It prefers open, mostly flat, sparsely vegetated areas. It is a ground nesting species of open areas such as dry river beds, bare rocky grounds and traditional, non-intensive cereal fields. It feeds mostly on large insects and small lizards.

### 7. European Nightjar

The Nightjar is a medium-sized, nocturnal species included in Annex I of the Birds Directive (2009/147/EU). It occurs both as a migrant breeder and passage migrant in Cyprus. It arrives from late March and stays until the end of September on the island, before migrating in Africa to overwinter. It feeds on flying insects caught at dusk and night. It nests on the ground. It can be seen in a variety of open habitats with scarce trees but also likes open, young pine forests.

**8. Calandra Lark**

The Calandra Lark is a resident species of semi-desert, steppe habitat but also of arable land. Its stronghold is the central plain of Mesaoria, most of which is not under the effective control of the Cyprus Government (since the Turkish invasion of 1974 and occupation of 37% of Cypriot territory). The Koshi SPA is part of Mesaoria area and holds a good population of the species. Besides Mesaoria, the species is declining from most of its former range, Larnaca saltlakes area, Pafos plain.

**9. Pallid harrier**

The Pallid harrier is a globally threatened raptor and Annex I species. It occurs as a passage migrant in Cyprus during both migration periods in spring (April-May) and in autumn (September-October). During migration, it can be seen in open habitats (both agricultural and Phrygana). It feeds on small mammals, birds and reptiles.

**10. Red backed shrike**

The Red-backed shrike is a member of the shrike family (Lanidae) and a common passage migrant in Cyprus. It is included in Annex I of the Birds Directive (2009/147/EU). It is more common during autumn migration when it starts arriving on the island by mid-August and it peaks in September. It is larger than breeding Masked Shrike but smaller than the Lesser Grey Shrike.

**11. Lesser Grey shrike**

The Lesser Grey shrike is a member of the shrike family (Lanidae) and a common passage migrant in Cyprus. It is included in Annex I of the Birds Directive (2009/147/EU). It is more common during autumn migration when it starts arriving on the island by early August and it peaks in late August-early September. It is the largest member of all shrikes that visit Cyprus regularly.

**12. Kingfisher**

The Kingfisher is the smallest and most common member of the kingfisher family that visits Cyprus. It is included in Annex I of the Birds Directive (2009/147/EU). It is more common in autumn (it starts arriving in late July but peaks in September) and much less in the spring. In winter, some individuals overwinter. It frequents coastal wetlands, harbors and coastal areas where it can fish.

## Site description-Ornithological Importance-Identified threats

### 1. Potamos Panagias Stazousas SPA code: CY6000007 Surface area (ha): 1746

The valley of Stazousa constitutes one of the most important areas for bird conservation in Cyprus. For this reason the area (1741 hectares) was declared by the Minister of Interior in 24/09/2007 as Special Protected Area (CY6000007) according to the Game and Wildlife Law (152(I)2003). The area is also of major importance for the conservation of the unfavourable conservation status species of European Roller (Vulnerable, SPEC2, Annex I species of the Bird Directive) which is the main target species of the SPA area. This diversity of vegetation, composed by low phryganean vegetation, dry agriculture fields with scattered low trees (mainly *Crataegus azarolus*) on dry infertile soils, provide an excellent habitat for desert and savanna species such as this long-distance migrant.

The river Stazoussa from Pyrga to Klavdia village is also one of the major migration corridors of Cyprus which is used by a large number of migrants such as the Turtle dove *Streptopelia turtur*, Lesser Grey Shrike and Red-backed Shrike, European bee-eater *Merops apiaster* and many raptors species of global and European conservation concern such as Red-footed falcon *Falco vespertinus*, Honey Buzzard *Pernis apivorus*, Pallid harrier *Circus macrourus* and Marsh harrier *Circus aeruginosus*.

Most of the area is private land as well as hali land (non-state forest government land). Two state forests that occur in the site, i.e., part of Stavrovouni state forest (area 21.2 ha) and Chorteri forest (43.5 ha). The state forest land makes the 3.7 % of the total area of the Natura 2000 site. The rest of the land is either fallow land (50%) or agricultural land (50% or 38% of the site area), privately owned. Agricultural land includes winter cereal crops, carob trees, olive orchards and a small portion of irrigated plantations.

The site is in the foothills of Stavrovouni mountains in the Larnaca district. The village of Klavdhia is less than 1 km from the easternmost corner of the site. The site is dissected by the small seasonal river between the villages of Pyrga and Klavdhia (Stazoussa). Along the river there are large stands of *Pistacia terebinthus*, *Tamarix* spp. and *Nerium oleander* and isolated stands of *Salix alba*. The small hills along the river are covered with low phryganean vegetation (mainly *Sarcopoterium spinosum* and *Thymus capitatus*). Small barley fields mixed with olive groves exist in flat areas. As the river runs northwest (towards Pyrga village) the slopes are becoming steeper and the hills higher, mainly covered with the thorny scrub, *Callycotome villosa*, scattered *Pinus brutia*, maquis consisting of wild olive trees and *Pistacia lentiscus* and *P. terebinthus* whereas agricultural fields with carob trees also exist. The highest peak on the site is Appidhaki at 416 m, about a 1.5 km to the south of Pseudhas village. That area is dominated with Pine trees and *Olea / Ceratonia* habitat type. Moving to

the southern end of the site, large stands of thorny scrub (mainly *Genista fasselata* / *Calycotome villosa*) are dominant. At the southernmost end of the site, just north of Aspropetra peak, there is a permanent water spring (locality "Mavronero") – outside the forest.

The site of the River Panagias tis Stazousas is a very important breeding habitat for European Roller. It hosts a significant number of breeding pairs of the species mainly due to the extensive ravines that run along but also across the site's main river. Also, the small cultivations around the river are important feeding areas for the Roller. In fact the site has one of the highest densities of Rollers island-wide. European Nightjar breeds on the higher parts of the site which are more densely vegetated.

Klavdia - Stazoussa, on the foothills of Stavrovouni mountains, the largest mountain complex in lowland Larnaca district is the hunting area for the resident Bonelli's eagle pair. Other important raptors that use the area for forage is the resident Long-legged buzzard *Buteo rufinus* that breeds (1 pair) within the SPA, another pair that recently occupied a territory just outside the SPA, and can be seen regularly scanning the less vegetated hills for rats but also for the abundant *Agama* lizards and snakes. Other important raptors are the migratory *Falco vespertinus* and *Circus* species, mainly during fall migration even though wintering *C. cyaneus* use the area frequently.

Resident owl species are common in the area, particularly *Athene noctua*, *Tyto alba* and the endemic *Otus scops cyprius*. The endemic Cyprus warbler breeds in large numbers in the extensive *Calycotome villosa* / *Genista fasselata* scrubby hills. Also, the Eurasian Stone Curlew breeds in small numbers at the lower, arid and less vegetated pastureland of the site. This site is one of the few confirmed breeding sites for *Lanius senator* on the island.

The river's extensive *Pistacia terebinthus* stands offer good feeding habitat for migrating warblers that are abundant during migratory seasons.

The targeted bird species occurring in the site are: Eurasian Stone curlew (resident), European Nightjar (migrant breeder), European Roller (migrant breeder), Cretzchmar's bunting (migrant breeder), Red-backed shrike (Passage migrant), Lesser Grey shrike (Passage migrant), Masked Shrike (migrant breeder), Cyprus wheatear (endemic-migrant breeder), and Cyprus warbler (endemic-resident).

### **Identified Threats**

(a). One of the main threats at the area is fires set by farmers to clear fields from stubble. Fires are also set accidentally due to explosions from the nearby military firing range which causes a number of fires annually.

(b). Extensive fire breaks created to prevent fires fragment significantly the shrub habitat. These also increase human disturbance since many of those can be driven by 4X4s.

(c). Isolated housing developments in surrounding villages increase human encroachment. They also fragment habitats through road development, increased noise/light pollution.

(d). Water scarcity and periodic drought. Although the site receives comparatively higher precipitation than the other two project sites (about 400 mm average), scarcity of water is prominent here as well despite the presence of the main stream which retains water from December to March or April every year.

(e). illegal dumping of industrial and domestic refuse.

(f). Poaching occurs in several forms; Occasional bird trapping during migration (especially in fall) for small passerines (*Sylvia* warblers) and in winter months, mostly for Song Thrush. Also, hunting dog training in closed areas/seasons presents a threat, especially to ground nesting birds. Finally, incidents of shooting of protected species have occurred in the area.

(g). the illegal placement of poisonous baits have been recorded at the site, posing a serious threat to wildlife and especially to diurnal raptors.

## **2. Koshi-Pallourokampos NATURA 2000 Code: CY6000009- Surface area (ha): 3720**

Most of the land is privately-owned. Part of the site, nearly 24% is state forest land, managed by the Department of Forests. Forest activities involve mostly fire protection and tending of forest plantations.

A considerable part (about 60%) of the privately – owned land is used for agriculture and grazing. The main crops are winter cereals, tree orchards. Irrigated crops are very scarce as a result of poor water conditions. The rest of the private land (40%) is fallow, with low phryganic vegetation. Outdoor recreation is of limited importance and is confined to hunting over a part of the site and collection of wild herbs by the nearby villagers like Asparagus, Capers etc.

The Koshi area is a low hilly area interspersed with flat lands, mainly covered with phryganic vegetation. The dominant plant species are *Thymus capitatus* and *Sarcopoterium spinosum*. Some parts of the area are characterized with some steep rocky slopes or steep clay slopes with small gorges. The rainfall is one of the lowest island-wide and does not exceed an average of 250-280 mm / per year. Nevertheless, in the small seasonal stream systems, irregular surface waters may be running depending on year's rainfall and small patches of reed beds with *Arundo donax* are present. There is no surface water in the site, with the exception of the

main stream which flows, usually from December to March. The vegetation in the forest part has been totally altered by past forestry practices through extensive plantings during the 1980s.

The natural habitats occurring in the area, i.e., 5220, (Arborescent matorral with *Zizyphus lotus*), 5330 (Thermo-Mediterranean and pre-desert scrub) and 5420 (*Sarcopoterium spinosum phrygana* /Cisto-Micromerietea) have been replaced by alien forest species, mostly *Eucalyptus* spp., *Acacia saligna* and various hybrids and species of *Pinus*. The natural vegetation exists only in small patches and is commonly suppressed by the exotics.

This site of low hilly areas and uncultivated areas of phrygana is important because it is relatively unique and undisturbed from human activities and infrastructure.

The important species in this site are mostly the European Roller and the Eurasian stone-curlew, for which the site is one of the best in the whole island. The site is very important for Calandra Lark, a species that breeds mostly in areas not under the effective control of the republic of Cyprus. This site is one of the last areas where the Black-bellied Sandgrouse *Pterocles orientalis* has been recorded. The protection of this site will contribute towards the conservation of this species. There are hopes that this species is not extinct from the island. A Long-legged Buzzard pair breeds regularly within the site as well as a Peregrine falcon *Falco peregrinus* pair at the easternmost part of it. At least 2 Long-legged Buzzard pairs occupy breeding territories at the boundaries of the site.

Another important feature of the site related to birds, is the presence of European Bee-eater which nests in small colonies in the site, on the chalky slopes along the main stream. The species is a scarce migrant breeder on the island.

The targeted bird species occurring in the site are Cyprus warbler, Cyprus wheatear, Eurasian Stone Curlew, European Roller, Calandra Lark, Lesser Grey Shrike, Red-backed shrike, and Pallid harrier. Masked shrikes and Cretzchmar's buntings have been recorded at the site in small numbers. European Nightjar and Common Kingfisher have not been recorded to the site.

### **Identified Threats**

(a). The extensive planting of exotic forest trees has dominated natural vegetation and altered native habitats.

(b). Forest fires occur periodically, mainly due to clearing agricultural fields from stubble.

(c). Climate change and prolonged droughts create water scarcity for long periods.

(d). Poaching in various forms; night shooting for hare occurs during hunting season, periodic bird trapping occurs during fall migration but also in winter months for Song Thrush.

(e). Dumping of domestic refuse in several locations of the site.

(f). The existence of large populations of *Rattus rattus*, especially in the vicinity of animal farms, poses a threat to wildlife.

### **3. Kavο Greco NATURA 2000 Code: CY3000005 Surface area (ha): 1876**

The site of Kavο Greco includes the forests of Kavο Greco and Agia Napa which are declared state forests. In addition, the forest of Kavο Greco and Agia Napa Forest were designated as a National Forest Park under the name of Kavο Greco, by the Ministerial Council Decision 38.942 (72/93), on 18/2/1993 based on the provisions of Forest Legislation. Kavο Greco area has been characterised as an Important Bird Area by Birdlife International.

Kavο Greco National Forest Park (including A.Napa Forest) is as already mentioned state forest land, covering a total area of 882 ha (project site) which makes the 92% of the terrestrial part of the Natura 2000 site. The area is managed by the Department of Forests of the Ministry of Agriculture, Natural Resources & Environment.

Forestry activities include nature conservation, provision of recreation (picnicking and hiking), fire protection and visitor management. The site receives large number of visitors because it neighbours to the heavily touristic municipalities of Agia Napa and Paralimni. Within the site, a Visitor Centre has been recently been completed and is expected to be functional in early 2016. Finally, some fields owned by the church are used exclusively for agriculture, mostly cereals and annual irrigated crops. Overall, 92% of the site is used for nature conservation and outdoor recreation (forest land) and 8% of the site is used for agriculture

The dominant vegetation of the site is Phoenicean Juniper maquis (Habitat type 5212), covering about one third of the area. A significant part of the area is planted with exotic species (*Acacia saligna*, *Eucalyptus* spp. and *Pinus halepensis* or hybrids of the latter species).

In large parts of the site the vegetation cover is natural. Along the sea cliffs, there is typical vegetation of the Mediterranean Sea cliffs (habitat type 1240).

Phrygana vegetation (Habitat type 5420) dominates at many places within the site. *Sarcopoterium spinosum* is abundant forming extensive colonies. There is also considerable occurrence of *Lycium sweinfurthii* in low coastal form, rarely exceeding 1 m high. At three sites there are small patches of *Zizyphus lotus* (\*5220) along with *Phagnalon rupestre*, *Noaea mucronata*, *Allium willeianum*, *Allium ampeloprasum*.

Vernal pools (Habitat type \*3170) are confined to small depressions on hard limestone ("kafkalla").

The climate of the area is semi-arid with mean maximum temperature during the summer months around 26.8 °C and mean minimum during the winter months around 12.2 °C. The mean annual rainfall is around 350 mm and most of the raining occurs from October or November to April (or March).

The soil is generally shallow limestone and a great portion of the area especially near the sea is bare rock with little soil which makes it sterile.

### **Ornithological importance**

Kavo Greco is one of the most important sites for bird migration, island-wide. Being at the easternmost tip of the island, it represents the first landing spot for many migrants coming from Africa and / or the Middle East. Millions of passerines and other migratory species use the site for resting. Seventy (70) Annex I birds species, including the endemics Cyprus warbler and Cyprus wheatear have been recorded in the site. Also, 130 other species, the majority of which being migratory bird species, use the site.

In addition, many irregular migrants for Cyprus (and Europe at some occasions) are recorded here like the Bateleur eagle *Terathopius ecaudatus* (first record for Europe), the Kurdish wheatear *Oenanthe xanthopyrma*, the short-toed snake eagle *Circaetus gallicus*, booted eagle *Aquila pennata*, corn crane *Crex crex*, etc. Moreover, the site has been designated as an important bird migrating corridor by the Game and Fauna Service (Ministry of Interior).

The targeted bird species occurring in the site are: Common Kingfisher (regularly occurring as passage migrant but not breeding at the site), Cyprus Warbler, Cyprus wheatear, Eurasian Stone Curlew (resident in very small numbers), European Nightjar, Pallid harrier, European roller, Lesser Grey shrike, Red-backed shrike (migration period), – only Cretzchmar's bunting is not recorded (as breeding species) for the site.

### **Identified Threats**

- (a). Bird trapping by lime-sticks and nets for passerines, illegal shooting of hare and partridge and training of hunting dogs are common in the area.
- (b). Extensive planting of exotic forest trees, some of which are invasive, especially *Acacia saligna* that has changed substantially the natural environment of the area.
- (c). The scarcity of water due to the entire lack of any stream, water spring or other surface water is a limiting factor for many fauna species, including birdlife, during the dry season.
- (d). Intensified agriculture making among others excessive use of herbicides and other agricultural chemicals that are potentially harmful to birds and other animals.
- (e). Large number of visitors, mainly foreign tourists, since the site is very close to

Agia Napa and Paralimni municipalities which receive a million visitors annually.

(f). Off-road driving mainly by youngsters and tourists causes disturbance to birds and other wildlife.

(g). abundance of *Rattus rattus* poses a threat to birds.

(h). Periodic dumping of domestic refuse has been recorded on several locations at the site.

## **Favourable Reference Values -Conservation Objectives- Favourable Conservation Status-Target Values**

The concept of Favourable reference values (FRVs) has been developed in order to facilitate the assessment of Favourable Conservation Status (FCS). FCS is defined in the EU Habitats Directive (92/43/EEC) as when a habitat can be considered stable or increasing, is functioning as it should and will do so for the foreseeable future and, the species that are intrinsic to the habitat are also considered at favourable status. FRVs permit both the quantification of conservation objectives and the measurement of progress towards them. FRV, as a general definition, is the population size or breeding density that a species must attain, in order to be considered not at extinction risk. The FRV for a species should be a population size at which the risk of extinction is acceptably low that a species is biologically functional within the ecosystem and there is no contraction or decrease.

All EU Member States are obliged to set conservation objectives for sites (or habitats) and species under the two EU nature directives, in order to achieve FCS for both habitats and species.

The task for EU Member States is to set FRVs for the species and habitats that they are obliged to protect, which are scientifically sound and realistic in light of irreversible changes that may have occurred to habitats. Such FRVs should allow assessment of the degree to which Member States have achieved FCS for species and habitats, as well as providing solid targets for conservation action.

There is currently no single accepted method for setting FRVs, and neither the Habitats Directive nor the Birds Directive prescribes a single method for use across Europe, although FRVs are expected to be transparently determined and comparable between countries. Setting an FRV is a difficult task and any methodology must take into consideration various factors, such as differences in species life history, amount of habitat available with and without restoration, minimum viable population sizes etc. FRVs are set at both national level (country level) and site level (for each SPA where the species occurs).

Target values, rather than Favourable Reference values are set for non-breeding migratory and / or wintering species that are important for the site(s). Target values are set to correspond to the range of numbers of passage/wintering species that should regularly occur in Cyprus. This range (in order to allow for inter-annual variations) is used as a conservation target at all-Cyprus and at site level in order to maintain favourable conservation status. This range was agreed to represent the numbers counted at each site following an agreed protocol and a constant annual effort.

## Methodology followed for developing FRVs

FRVs have been developed previously by BirdLife Cyprus, as part of LIFE OROKLINI PROJECT (LIFE10NATCY716) for 6 breeding species; *Himantopus himantopus*, *Vanellus spinosus*, *Burhinus oedicephalus*, *Charadrius alexandrinus*, *Sterna hirundo* and *Sterna albifrons* (Tye *et al.* 2014). The methodology followed was based to a large extent on previous work carried out in Italy by Brambilla *et al.* (2011). FRVs covering all Cyprus were developed by BirdLife Cyprus and IACO Consultants as part of another on-going project (IACO & BirdLife Cyprus, *in preparation*).

For the purposes of the current project, FRVs have been developed for 8 qualifying species, rather than 7, since Calandra Lark was included too for being a trigger species for Koshi - Pallourokambos SPA. Target values, rather than FRVs were set for 4 species that do not breed in Cyprus but occur mostly as passage migrants and/or winter visitors, in significant numbers (Table 1). The approach to defining FRVs is based principally on a combination of Population Viability Analysis (PVA) and the Habitat approach (IACO & BirdLife Cyprus, *in preparation*).

Finally, 'target values' for 4 migratory and/or wintering species (see Table 1) were set using data collected by Game and Fauna Service, both in the past and under field work carried out under the project LIFE FOR BIRDS. In addition, data collected by BirdLife Cyprus or published by individual ornithologists was used.

Once this data was collated and analysed, expert opinion was used to review and arrive at 'target values' that correspond to practically reasonable conservation target equivalents.

Scientific name	Common name	Population units	Status as SPA trigger species
<b>7 species for which FRVs were set</b>			
<i>Burhinus oedicephalus</i>	Stone Curlew	Breeding pairs	B (Breeding)
<i>Caprimulgus europaeus</i>	Eurasian Nightjar	Breeding pairs	B
<i>Coracias garrulus</i>	European Roller	Breeding pairs	B
<i>Oenanthe cyprica</i>	Cyprus Wheatear	Breeding pairs	B
<i>Sylvia melanothorax</i>	Cyprus Warbler	Breeding pairs	B
<i>Lanius nubicus</i>	Masked Shrike	Breeding pairs	B
<i>Melanocorypha calandra</i>	Calandra Lark	Breeding pairs	B
<i>Emberiza caesia</i>	Cretzschmar's Bunting	Breeding pairs	B
<b>4 species for which target values were set</b>			
<i>Circus macrourus</i>	Pallid Harrier	individuals	PM (Passage migrant)
<i>Alcedo atthis</i>	Kingfisher	individuals	PM/WV (Winter visitor)
<i>Lanius minor</i>	Lesser Grey Shrike	individuals	PM
<i>Lanius collurio</i>	Red backed Shrike	individuals	PM

Table 1. Species for which FRVs and target values were set, as part of project LIFE FOR BIRDS

### **Population Viability Analysis (PVA)**

Population Viability Analysis (PVA) is defined as a process of assessing the viability of a population through modelling, to find the probability of extinction over a set time period, given a set of demographic and reproductive parameters. The PVA model parameters are then adjusted so as to find a population size that has an acceptably low risk of extinction, which is the Minimum Viable Population (MVP), defined as the lowest level at which a population can survive without going extinct, for a given set of population parameters. The FRV is ideally set higher than the MVP, at a value depending on a range of practical factors to be taken into account.

The use of PVA software and MVPs in conservation biology is widespread, although the decision as to what is considered a viable population is essentially arbitrary and has been set at different levels by individual researchers. For the purposes of this report, the adopted definition of a viable population is one that has a probability  $\leq 0.01$  (not more than 1 %) of going extinct in the next 100 years; this was also the definition used by Brambilla *et al.* (2011). The publicly available PVA program *Vortex* was used to determine MVPs. To calculate whether or not a population is considered viable, the best estimates of each relevant parameter of the population (including breeding productivity, mortality etc.) are put into a model or software package and a probability of extinction is generated. To find an MVP using a publicly available software such as *Vortex* (Lacy 1993), all the necessary information is fed into the program and then the initial population size is varied to determine the smallest population that has a chance of extinction of  $< 1\%$  in 100 years.

It is worth noting here that for the majority of breeding species in Cyprus, the data needed for a PVA analysis (such as breeding productivity or mortality) is not available. Where available, data can be drawn from relevant published studies concerning the same species carried out in other parts of the world, but this must be done with caution as the data may not apply for the Cyprus situation.

Where PVA analysis is not considered possible (due to lack of relevant data for the species concerned), a rule-of-thumb methods for examining minimum viable population size is adopted. Rule-of-thumb values for MVPs have been a contentious topic and no widely accepted values exist, but the “50/500” rule (Franklin 1980) has been employed in this way, where a population of at least 500 breeding individuals may be considered to provide long-term genetic viability with no significant loss of genetic variability from the population over many generations, while a population of at least 50 breeding individuals may be taken as providing short-term genetic viability (over a few generations). While they have their limitations, these figures are used as a ‘fall-back’ in cases where PVA analysis is not possible.

### **Habitat Approach**

While an MVP is arrived at by PVA analysis or rule-of-thumb estimation, a hypothetical maximum population that the whole island of Cyprus might hold was investigated using the Habitat method (Phillips *et al.* 2006). The Habitat approach involves calculating the amount of habitat in a given country (or at a given site) that is considered suitable for the species under consideration and using this to derive the carrying capacity of the area, based on knowledge of breeding densities. Looking back at changes in land use over time allows assessment of changes in the amount of suitable habitat that was available and estimation of the population size this could have supported, although it is important to consider that some changes to habitat are irreversible. A major advantage of this method is that it generates predictions that can be valuable for management.

Under the habitat method, the suitable breeding habitat for a species in the island is mapped and its area is then multiplied by what is thought to be a reasonable value for breeding density for the species in that habitat. For species with adequate data on habitats, this can be the primary method by which the FRV is determined. However, even for species that are suited to the PVA approach the Habitat method is still applied as it provides additional information for the species and results in an FRV with increased confidence.

Overall the habitat approach is achieved with the combination of two analytical techniques.

1. Estimation of bird densities
2. Modelling of suitable habitat

The bird density derived from different estimation methods is then applied to the maximum available habitat area estimated from the habitat suitability model resulting in the estimation of the FRV population.

#### **1. Estimation of bird densities**

Data used was retrieved from field work carried out through monthly surveys of all 3 sites by the Game and Fauna Service (GFS) (transects shown in Annex I) combined with field work carried out by BirdLife Cyprus and GFS so as to generate values for target species, island wide. Also, data from the BirdLife Cyprus Common Birds survey programme, which involves distance sampling (in bands of 0-25m, 25-100m and 100+m) along transect routes of around 1km length, was analysed using the Distance program (Thomas *et al.*, 2010) to arrive at estimates of numbers and density for qualifying species.

The estimation of bird densities with the Distance approach is further supplemented with an estimation deriving from the habitat suitability approach where a different analytical procedure is applied to species presence data derived from the Common

Birds survey program. This approach evaluates the relationship of the recorded densities with the habitat suitability probability estimation of the habitat model by applying various statistical techniques (linear regression, frequency analysis) to examine this relationship (observations vs. predictions) and will be explained in detail at the final report.

The elaboration of two bird density estimations provides better decision ability for the final FRV estimation since both approaches can be examined in terms of accuracy and precision together with the results of the PVA analysis.

## **2. Modelling of suitable habitat**

In conservation biology, many statistical methods have been applied for predicting habitat suitability. These methods either use presence or both presence and absence data to develop models of species suitable habitats. However, absence data are rarely available or they may be of questionable value. Modelling techniques that require only presence data are therefore extremely valuable.

In this report, the maximum entropy method (Maxent) is used in order to predict environmental suitability for the species as a function of set of environmental variables, with presence-only data. Maxent is a general-purpose machine learning method with a simple and precise mathematical formulation, and it has a number of aspects that make it well-suited for species distribution modeling (Phillips et al. 2006). Overall, mechanistic models aim to incorporate physiologically limiting mechanisms in a species' tolerance to environmental conditions.

The approach combines occurrence data with ecological/environmental variables (both biotic and abiotic factors: e.g. temperature, precipitation, elevation, land cover and vegetation) to create a theoretical model of the species' ecological niche for the examined variables. The habitat suitability requirements were estimated by a set of presence data and a set of predictor variables (environmental layers). The overall process includes three methodological steps:

1. Pre-processing of presence data and collation of environmental layers.
2. Application of modelling algorithm to create the suitability map
3. Testing of model predictive performance with data-splitting approach.
4. Final estimation of maximum habitat on the basis of calibration with observation data (test data) that did not participate to the training of the model.

Expert opinion also had a significant role to play in the Habitat method analysis. The area of land cover polygons identified as suitable for a given species was reviewed and sometimes amended after consultation with local experts, to produce a more accurately determined area of actually suitable habitat.

In summary, the MVPs generated using the PVA program *Vortex* are used to determine what might simply be called the minimum or lower end of the acceptable range, of a population of a particular species for Cyprus, while the Habitat approach is generally used to determine the maximum population range for a species for Cyprus (can be at national or site level). With this range set by PVA (or rule-of-thumb) and Habitat analysis, expert opinion is then used to set the FRV at a level between these lower and upper values.

Expert opinion is used to decide on an FRV population size for the species that is both viable from a practical, management point-of-view, i.e. somewhere between the MVP calculated by PVA or rule-of-thumb and the hypothetical maximum population calculated by the Habitat method. It is not considered reasonable to use the maximum calculated by the Habitat method as the FRV, for the following reasons:

1. Habitat mapping and the determination of breeding densities incorporate great uncertainties.
2. The maximum number an area can hold may not be attainable every year and may not be sustainable in the long-term. Natural fluctuations in population size mean that a population may often be expected to be below the theoretical maximum.
3. If several species use the same area - particularly if their habitat requirements are different or their resource requirements overlap - then management to maximise the number of one species may adversely affect one or more others. In such cases, sites cannot be managed to favour all species equally, and aiming for a maximum for a given species may be inadvisable.

The procedure is outlined below (methodological approaches or models) followed for setting FRVs under this report (Table 4.2). The model/approach to be followed (1, 2, 3 in the table below) depends on the size and breeding ecology of the species concerned and on the availability or not of data relevant for PVA analysis. The last column of the table below shows the species for which FRVs are to be set under this report, were categorised under a suitable model/approach to be adopted for this FRV determination based on an analysis of species biology, population level in Cyprus and availability of relevant data.

Two recent projects were significant sources of additional, relevant data for species under this report:

1. The analysis carried out for the preparation of the revised inventory of Important Bird Areas in Cyprus (Hellicar *et al.* 2014) which involved an analysis of data from field work and publications. Important Bird Areas (IBAs) are areas identified by BirdLife International, through the use of scientific criteria, as

internationally important for the conservation of populations of one or more bird species.

- The analysis carried out in 2013 for reporting under Article 12 of the EU Birds Directive (2009/147/EC), covering the numbers (range) of visiting birds for a total of 55 regularly occurring wintering and passage migrant species.

Model followed	details				Relevant species
	Criteria	Step 1	Steps 2(+3)		
1	Species with a breeding population of <b>&gt; 2500 pairs</b>	Use of <b>habitat approach</b> to calculate maximum possible breeding population	Use <b>expert opinion</b> and other information to set FRV below this figure, at a values which could be supported by a realistic area of protected suitable breeding habitat		1. Oenanthe cyriaca 2. Sylvia melanothorax 3. Lanius nubicus 4. Emberiza caesia
2	Species with a breeding population of <b>&lt; 2500 pairs</b>	Sufficient data to carry out a Population Viability Analysis (PVA)	Use of <b>habitat approach</b> to calculate maximum possible breeding population	Use <b>PVA</b> to calculate a minimum viable population size (MVP).  <b>Expert opinion</b> on what is a realistic figure between of the 2 values (max. from Habitat approach vs min. from PVA analysis)	1. Burhinus oedicnemus 2. Coracias garrulus 3. Melanocorypha calandra
3	Species with a breeding population of <b>&lt; 2500 pairs and NOT a colonial breeder</b>	<b>Insufficient data</b> to carry out a Population Viability Analysis (PVA)	Use of <b>habitat approach</b> to calculate maximum possible breeding population	Use <b>rule of thumb MVP</b> as safety check and to calculate the minimum area required by this min population  <b>Expert opinion</b> on what is a realistic figure between the 2 values	1. Caprimulgus europaeus

Table 4.2. Methodology used for determining FRVs for relevant LIFE FORBIRDS species (adapted from Tyee *et al.* 2014).

## Results- Favourable Reference Values and Target Values for Koshi-Pallourokambos SPA, Panagia Stazousa SPA, Kavο Greco SPA at site and Cyprus levels- Population levels of target species

The species population levels were estimated following the CORINE classification below for the 3 SPAs:

Areas/CORINE habitats:

1. Koshi-Pallourokambos SPA—approximately 40km<sup>2</sup>: 70% bare, grassland, scrub 20% non-irrigated agriculture.
2. Stazousa SPA— approximately 17km<sup>2</sup>: 85% scrub, 10% non-irrigated agriculture.
3. Kavο Greco SPA—approximately 10km<sup>2</sup>: 66% scrub, 14% non-irrigated agriculture.

### **Calandra Lark *Melanocorypha calandra***

The estimated FRV for Cyprus was carried out based on habitat availability and density estimates – The estimated FRV was set at **4,000 b.p.**

Site FRVs and current population estimates:

Koshi-Pallourokambos SPA- FRV of **250 b.p.** – current population estimated at 50-100b.p. on basis of Distance density estimates.

### **Stone Curlew *Burhinus oedicnemus***

The estimated FRV for Cyprus was carried out under Oroklini LIFE project, based on habitat availability and density estimates – The estimated FRV was set at **2,000 b.p.**

Site FRVs and current population estimates:

Koshi-Pallourokambos SPA- FRV of **200 b.p.** – current population estimated at 50-150 b.p. on basis of Distance density estimates for Larnaca area in general (which is approximately 0.7 per km<sup>2</sup>, but this SPA is considered a ‘prime’ habitat for the species).

Stazousa SPA – FRV was set at **5 b.p.** The site does not have the habitat to support a large population of the species. This is not among the top sites for the species.

In Kavο Greco SPA, the species has been recorded occasionally in very small numbers.

### **European Roller *Coracias garrulous***

The estimated FRV at Cyprus level was set at **3,500b.p.**, based on latest Distance population estimate.

Site FRVs and current population estimates:

K-Pallourokambos SPA- FRV of **50 b.p.** – current population estimated at 50 b.p. on basis of Distance density estimates for Larnaca area in general (which is approximately 2 individuals per km<sup>2</sup>, but the specific SPA is considered ‘prime’ habitat for the species).

Stazoussa SPA – FRV of **30 b.p.** - current population estimated at 20b.p. on basis of Distance density estimates for Larnaca area in general (which is around 2 individuals per km<sup>2</sup>, but this SPA is considered a ‘prime’ habitat for the species).

In Kavos Greco SPA, the species is recorded as a passage migrant.

### **European Nightjar *Caprimulgus europaeus***

The estimated FRV at Cyprus level was set at **2,000 b.p.**, based on latest Distance population estimate.

Site FRVs and current population estimates:

An FRV was set only for Stazoussa SPA that has a representative population.

Stazoussa SPA – FRV of **15b.p.** – not considered a prime habitat for the species, but recorded in good density in night roadside transects - In general, estimated numbers for Larnaca district are generally low, but parts of this site has some good numbers.

### **Cretzchmar’s bunting *Emberiza caesia***

The estimated FRV at Cyprus level was set at **10,000 b.p.**, based on latest Distance population estimate.

An FRV was set only for Stazoussa SPA that has a representative population.

Stazoussa SPA – FRV – **200 b.p.**, current population around 200 b.p. based on Distance density estimate of 23/km<sup>2</sup> in scrub habitat.

At Koshi SPA the species was recorded in small numbers.

### **Cyprus wheatear *Oenanthe cyprica***

Cyprus FRV – **50,000b.p.**(based on latest Distance population estimate)

Koshi-Pallourokambos SPA- FRV of **300 b.p.** Current population estimate, based on distance density estimate for phrygana of 7b.p./km<sup>2</sup> is 200b.p.

Stazoussa SPA – FRV of **200 b.p.** - current population estimate based on Distance density estimate for scrub habitats of 30+b.p./km<sup>2</sup>, is 200 b.p.

Kavos Greco SPA – FRV of **200 b.p.** – current population estimate, based on Distance density estimate for scrub habitats of 30+b.p./km<sup>2</sup>, is 200 b.p.

**Cyprus warbler *Sylvia melanothorax***

Cyprus FRV – **75,000b.p.**(based on latest Distance population estimate)

K-Pallourokambos SPA- FRV of **400 b.p.** Current population estimate, based on distance density estimate for phrygana of 20/km<sup>2</sup>, is 250-300 b.p.

Stazousa SPA – FRV of **750 b.p.** - current population estimate based on Distance density estimate for scrub habitats of 100+/km<sup>2</sup>, is 700-1,000 b.p.

Kavo Greco SPA – FRV of **600 b.p.** – current population estimate based on Distance density estimate for scrub habitats of 100+/km<sup>2</sup>, is 500-700 b.p.

**Masked Shrike *Lanius nubicus***

The estimated FRV at Cyprus level was set at **8,000 b.p.**, based on latest Distance population estimate.

Stazoussa SPA –FRV and population level was estimated at 25b.p. Neither site was one of the top sites for the species.

FRVs at Cyprus level and at site level (where applicable) for the abovementioned species are presented at Table 3.

Target values for 4 migratory/wintering species, Pallid harrier, Lesser-grey shrike, red-backed shrike and Common Kingfisher are presented for each site at Table 4.

Species	Scenario	FRV at Cyprus level (breeding pairs)	FRV at site level (breeding pairs)		
			Koshi:	Stazoussa:	K.Greco:
Oenanthe cyprica	Species with a breeding population of > 2500 pairs	30,000	300	200	250
Sylvia melanothorax		50,000	400	750	600
Lanius nubicus		8,000	Stazoussa: 25		
Emberiza caesia		8,000	Stazoussa: 200		
Burhinus oedicephalus	Species with a breeding population of < 2500 pairs and sufficient data to carry PVA analysis	2,000	200	5	-
Coracias garrulus		3,000	50	30	-
Melanocorypha calandra		4,000	250	-	-
Caprimulgus europaeus	Species with a breeding population of < 2500 pairs but with insufficient data to carry PVA analysis	2,000	Stazoussa: 20		

Table 3. FRVs at Cyprus level and at site level (where applicable)

species	Qualifying season W-Wintering PM-passage migrant	Koshi SPA (individuals) Target Values	Panagia Stazoussa SPA (individuals) Target Values	Kavo Greco SPA (individuals) Target Values
Circus macrourus	PM	5-20	2-5	5-50 Autumn 5-20 Spring
Lanius minor	PM	30-60	20-40	200-500
Lanius collurio	PM	30-60	40-100	500-1000
Alcedo atthis	PM-W	-	-	20-50

Table 4. Target Values at site levels

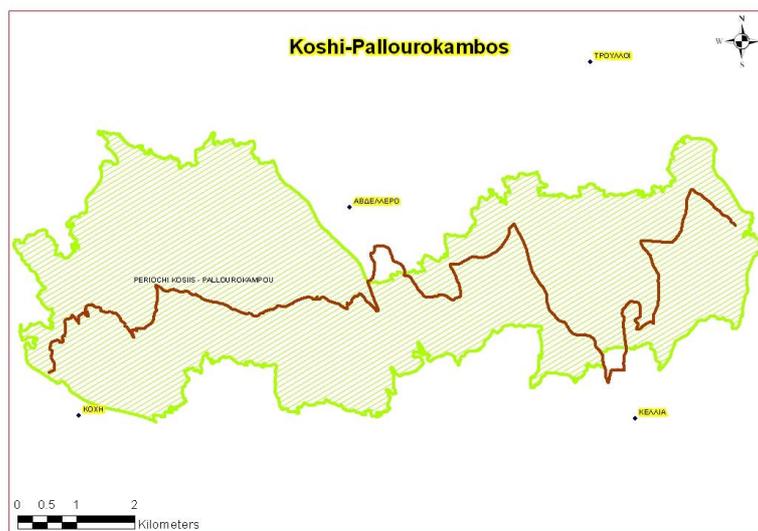
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## ANNEX I



Transect lines established for monitoring bird numbers and estimating population levels, FRVs, TVs, by Game & Fauna Service for the purposes of project LIFE FORBIRDS

