

**Review of biodiversity research results from Cyprus that
directly contribute to the sustainable use
of biodiversity in Europe.**

Unit of Environmental Studies

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1. Introduction

1.1 Biodiversity “hotspots”

The worldwide human population increase and associated alteration of the global environment triggered the sixth major extinction event in the history of life and caused widespread changes in the global distribution of organisms (Chapin III *et al.* 2000). The original ranges of many animal species are being degraded, reduced and fragmented and, in some cases they have been reduced to endangered small relict populations (Bainbridge and Jabbour 1998). Species that are not extinct but are threatened with extinction are listed by Hilton-Taylor (2000). The list includes 11,046 species threatened with extinction, 816 species that have already become extinct or extinct in the wild, 4,594 species as data deficient or in the lower risk categories of conservation dependent and near threatened, and 1,769 infra-specific taxa, or sub-population level assessments. The 11,046 species threatened with extinction, (<1% of the world’s described species) include 24% of all mammal species and 12% of all bird species (Hilton-Taylor 2000). This means that in the near future, one in every four mammals and one in every eight birds will be facing the risk of extinction. The number of extinct-listed mammals increased from 1,096 in 1996 to 1,130 in 2000 and of the birds from 1,107 in 1996 to 1,183 in 2000. This is an indicator that more and more species are becoming threatened, and more conservation efforts should be made for the protection of non threatened species (*loc. cit.* 2000).

Most threatened species tend to be concentrated in certain countries and certain ecoregions that are particularly rich in endemic species and have been heavily inhabited by humans. Twenty five areas with such large concentrations were identified and called biodiversity “hotspots” (Myers *et al.* 2000). These areas once occupied about 11.8% of the planet’s land surface, but they have cumulatively lost a frightening 88 % of their original extent. What remains intact covers only 1.4% of the Earth’s land area, but is comprised of an amazing 43.8% of all vascular plants and 35.6% of all nonfish vertebrates (mammals, birds, reptiles, and amphibians) as endemics. More than two-thirds of the worlds most endangered mammals and more than 80% of the most endangered birds inhabit in these hotspots (Conservation International 1998; Hilton-Taylor 2000; Myers *et al.* 2000).

Cyprus is the third largest island in the Mediterranean region, with an area of 9,251 Km², and is located among the biodiversity hotspots (Myers *et al.* 2000; Hadjisterkotis 2001). The geomorphology of Cyprus, the great variation in temperature and rainfall, its location – bridging three continents (Europe, Africa and Asia) – along with 10 000 years of history and civilisation, yielded a flora and fauna of great richness and diversity. Although Cyprus is a Mediterranean island and presumably has a Mediterranean climate, according to V. Pantelas *et al.* (1991, 1997) its bio-climate ranges from hot semi-desert in the central plain of Mesaoria, to wet and cool on the top of Troodos mountains. This creates a tremendous biodiversity, with a variety of plant communities, such as coniferous forests, maquis, garigue and the batha vegetation, while more localized communities occur around salt marshes, sand dunes, stone walls and mountain streams, with a considerable number of

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endemic species (Meikle 1977, 1985; Hadjikyriakou, 1997; Pantelas et al. 1993, 1997; Tsintides et al. 2002; Makris 2003).

Cyprus is considered a biodiversity “hotspot” area (Myers *et al.* 2000) because **it is the only centre of birds endemism in Europe and the Middle East** (Bibby *et al.* 1992; Kourtellarides 1998), **a centre of mammals endemism** with six out of its 11 wild mammals being endemic (Hadjisterkotis and Masala 1995; Hadjisterkotis 1995, 2003a, Bonhomme 2004; Cucch 2006), **a centre of insects endemism** (Makris 2003) and **a centre of plant diversity** (WCMC, 1992, Pantelas et al. 1993; Hadjikyriakou, 1997; Tsintides et al. 2002; Tsintides and Kourtellarides 1995). The Cyprus flora includes in total 1910 taxa (species, subspecies, varieties, forms and hybrids) as native or naturalized. Among them, 143 taxa are endemic and more than 400 are cultivated. Consequently, the percentage of Cyprus endemism, calculating all the taxonomical levels, is 7.39% which is one of the highests in Europe (Hadjichambis and Della 2007).

The reason of the Cypriot biodiversity uniqueness is because Cyprus is an oceanic island, isolated from the nearby continents for millions of years. The formation of Cyprus is estimated between 92 and 85 million years ago (time scale of Harland et al. 1982) with the genesis of the Troodos Massif, a fragment of an uplifted oceanic crust (Gass 1980; Mukasa and Ludden 1987; McCallum and Robertson 1990). A significant uplift of the Troodos Massif has mainly taken place in a pulsed nature in the Miocene, Pliocene and Pleistocene (McCallum and Robertson 1990; Robertson 1990). By the Late Miocene, the Troodos Massif was a low-lying island, and the Kyrenia Range, which had been deeply submerged, began to rise. A severe compression and drastic uplift occurred in Cyprus in the Pleistocene. The Troodos Massif, Kyrenia lineament, and Mesaoria basin were uplifted together, forming a single structural unit (McCallum and Robertson 1990). That uplift raised Mt. Olympus to 1951 m. Therefore, Cyprus was never connected to the mainland.

Similarly to the rest hotspot areas and the planet in general, Cyprus and its biodiversity are affected by the man-induced alterations to the global climate and environment, the invasion of alien species (Hadjisterkotis 2004; Hadjisterkotis and Heise-Pavlov 2006; Hadjikyriakou and Hadjisterkotis 2006), forest fires (Hadjisterkotis 1999, 2001), epidemics from livestock-born diseases affecting wildlife (Hadjisterkotis 1993, Toumazos and Hadjisterkotis 1997; Papaprodromou et al. 1997) and due to problems because of wildlife mismanagement practices (Arruga et al. 2007; Hadjisterkotis 1993, 1996, 2000a, b; 2001; Hadjisterkotis and Bider 1997; Hadjisterkotis and van Haften 1997).

Therefore, when Cypriots consider biodiversity conservation and research they should have in mind the unique characteristics of their island, and the need to study and protect not only the habitats and the species which are designated by the European directives, but also the unique Cypriot species, subspecies, varieties, cultivars, and habitats.

2. Biodiversity Research in Cyprus

Until the end of the twentieth century research on wildlife in Cyprus was limited to a small number of game species (Hadjisterkotis 1996; 1998; 1999), on Cyprus mouflon (Hadjisterkotis 1993, 1996, 1999, 2001, 2002; Hadjisterkotis & Bider 1997, Hadjisterkotis and Van Haften. 1997, 2003b) on Fruit bats *Rousettus aegyptiacus* (Hadjisterkotis 2006), on the monitoring of marine turtle nesting and reproduction, and the pollution and ecology of the salt lakes by the Department of Fisheries and Marine Research. Considerable research on biodiversity was also carried out by the Department of Forests, which was

monitoring the number of vultures (*Gyps fulvus*) and recording the flora species of Cyprus, with emphasis on the endemic species (Pantelas *et al.* 1993, Tsintides and Kourtellarides 1995, Hadjikyriakou 1997). The vegetation of Cyprus was also studied by a number of individuals (Meikle 1977, 1985, Hadjikyriakou and Hadjisterkotis 2002, 2006). Most of the work on the study of birds was carried out by the Ornithological Society of Cyprus, and included visual observations of annual records.

The opportunity to intensify research and to improve protection of the Cypriot wildlife and biodiversity in general, was provided when Cyprus became a candidate state for membership in the European Community. The obligations of Cyprus toward the European Community, mainly to establish the Natura 2000 sites, was a vital motive or instrument for a new era of research programs for the establishment of Special Protection Areas (SPA), adopting a list of Sites of Community Importance (SCI), designating Special Areas of Conservation (SAC) and establishing management priorities and necessary conservation measures for SAC's and SPA's.

In view of the EU Enlargement, Cyprus went through the process to formally transpose the EU environmental acquis into Cyprus law, as well as to implement it. One of the most important Directives regarding nature protection which had to be transposed was the Habitats Directive No 92/43/EEC of 21 May 1992 regarding the conservation of natural habitats and of wild fauna and flora (Official Journal of the European Communities No L 206/7-49, 22.7.92). An interdepartmental committee assisted from the University of Athens, Greece, was appointed by the government to complete this transposition, and the technical sheets on the habitats and species for which adaptations of the technical annexes had to be proposed. These, were Annex II (animal and plant species of community interest whose conservation requires the designation of special areas of conservation) and Annex IV (animals and plants species of community interest in need of strict protection). Most of the work for the recording of the vegetation and the bird species in the forest areas and in all Natura 2000 sites, as well as their mapping was carried out by members of the Department of Forestry, and the Department of Fisheries for the marine areas.

The committee, having in mind the above unique features of Cyprus, proposed the following species, which were accepted by the European Commission in the annexes of the habitat and bird directives:

Mammals: Egyptian Fruit bat *Rousettus aegyptiacus*, the endemic Cyprus mouflon *Ovis orientalis ophion*. Reptiles: Cypriot whip snake *Coluber cypriensis*, the Cypriot grass snake *Natrix natrix cypriaca*, and the marine turtle *Chelonia mydas*.

Birds: Cyprus tree creeper, *Certhia brachydactyla dorotheae*, Kentish plover *Charadrius alexandrinus*, Masked shrike *Lanius nubicus*, Cyprus wheatear *Oenanthe cypriaca*, Cypriot coal tit *Parus ater cypriotes*, and the Cyprus warbler *Sylvia melanothorax*.

Insects: *Propomacrus cypriacus*,

Flora: *Arabis kennedyae*, *Astragalus macrocarpus ssp. Lefkarensis*, *Brassica hilarionis*, *Centaurea akamantis*, *Chionodoxa lochiaie*, *Crocus cyprius*, *Crocus hartmannianus*, *Delphinium caseyl*, *Ophrys kotschyi*, *Phlomis brevibractea*, *Phlomis cypria var. cypria*, *Pingulcula crystalline*, *Ranunculus kykkoensis*, *Salvia veneris*, *Scilla morrisii*, *siderites cypria* and *Tulipa cypria*.

Currently, in order to fulfil the obligations toward the ten priority objectives of Annex 1, EU Action Plan to 2010 and Beyond, and specifically **Objective 1: To safeguard the EU's most important habitats and species, A1.1.1**, the Environment Service of the Ministry of Agriculture, Natural Resources and Environment (MANRE), has submitted a proposal with a total of 38 regions to be included in Natura 2000 network. In

addition, the Service is preparing 12 management plans for 12 Natura 2000 sites. The first eight are expected to be completed before the end of 2008.

Additionally, the Service is preparing tenders for another 13 management plans mainly for areas outside the state forests, for the elaboration of a Coastal Biological Diversity Action Plan (CAMP Cyprus) and for a study entitled: Biological Diversity Strategy. The Department of Forests is preparing management plans for the forested areas of the Natura 2000 network (**Actions A1.1.1 and A2.1.3**).

Furthermore, the Environment Service is the coordinator of four projects which are financed by the Research Promotion Foundation (Objective A1.1.2):

1. The study of the land snails in the regions of Natura 2000 sites.
2. Quantitative and qualitative analysis of the small mammals in the regions of Natura 2000 sites.
3. Conservation biology of four priority plants of the directive 92/43/EOK.
4. The study of the ecology and behavior of the lizard *Acanthodactylus shreiberi* on sand dunes.

The above management plans are going to fulfill Cyprus obligations not only for the conservation of biodiversity in the Natura 2000 sites, but to a certain extent the obligations deriving from **Objective 2**: To restore biodiversity and ecosystem services in the wider EU country side. To meet the obligations of Objective 2, the Agricultural Research Institute (ARI) of the Republic of Cyprus is doing considerable work.

3. The scientific research on biodiversity conservation of the Agricultural Research Institute (ARI) of the Republic of Cyprus

Objective A2.1.3. As noted above, Cyprus is a biodiversity “hotspot” area. The unique Mediterranean island environment and the long isolation period, affected not only the evolution of the wild species, but also the evolution of domestic live stock, as well as the evolution of unique cultivated trees and plants. Man has been farming the land for thousands of years. Human activities have shaped the landscape and created a wide variety of semi-natural habitats that birds, mammals and other wildlife have been adapted to and often prosper in. Many birds and small mammals have become largely dependant on agricultural habitats.

The Agriculture Research Institute of the Republic of Cyprus has several projects regarding cultivated species, as well as local domestic livestock, action which will help register the diversity among these plants and animals and will identify high-value farmland (Action A2.1.3). For the conservation of both cultivated and wild plants, ARI is working on the creation of a gene bank. A summary of these projects is presented below.

ARI is currently working on the registration, check up, identification using DNA, the clearing from pathogens (viruses, viroids, mycoplasma, bacteria and fungi of the apical meristems), and the development of methods of mass *in-vitro* micropropagation of clone varieties of plants such as citrus (Kapari-Isaia *et al.* 2002, Kapari-Isaia *et al.* 2004b, Kapari-Isaia *et al.* 2005, 2006), grapevines (Minas 2001, 2002a, 2004a, 2006d, Papayiannis *et al.* 2006a, 2006b), stone-fruits (Kapari-Isaia *et al.* 2004a), Taro (Kolokasi) *Colocasia esculenta* (Minas 2002b), bananas (Minas 2002c) and indigenous and/or endemic flowering plants such as narcissus (*Narcissus* spp.) cyclamens (*Cyclamen* spp.), the tulip of Akamas (*Tulipa cypria*), pancratium (*Pancratium maritimum*), crocus of Troodos (*Crocus cyprius*) oregano and other medicinal, aromatic and ornamental plants (Minas 1996, 2004b,c, 2006a, b, c). The aim of the project is the conservation and

multiplication of the genetic biodiversity of Cyprus, and the utilization of these materials for the genetic improvement and the direct agricultural production.

3.1. FARVALDI PROGRAM (Objective A2.1.11)

As part of the European strategy to prevent genetic erosion, Cyprus is participating through the ARI in the INTERREG IIC. The project aims to collect, evaluate in terms of the agronomical, genetic (biochemical, biotechnological) and market point of view, conserve *ex situ*, and to promote the utilization of the appropriate genetic material by local farmers *in situ*, in order to introduce products of specific origin. Up to this point, a number of local varieties of beans, black eyed beans, melon, tomatoes, fakoushi and zambura have been collected and a morphological characterisation was performed, with most of them already providing sufficient genetic material for storing in the Agricultural Research Institute Gene Bank. Additionally, the phylogenetic analysis for melon varieties is almost to be completed, and preparations are being made for the analysis of beans and tomatoes during the next semester. Finally, the varieties are undergoing gustatory analysis, based on which some of them will be promoted in the European market. It must be noted, however, that during the survey to locate local varieties, it became apparent that a significant amount of the traditionally cultivated genetic material had already been lost, for example, the inability to locate the long-type cucumber of Chloraka, as well as the absence of the traditional big-seeded watermelons. A number of tomato cultivars appeared to have been lost as well.

3.2 . CITRUS BIODIVERSITY IN CYPRUS (Objective A2.1.11)

Citrus (*Citrus* sp.) is one of the most important crops in Cyprus. It has been grown on the island for thousands of years (Meikle 1977) and has been systematically exported since well before 1955. The citron (*Citrus medica* L.) is known to have been cultivated in the Mediterranean area since the Classical times, and the sour orange was recorded growing in Famagusta in 1394. However, both of these as well as the lemon had probably been introduced to the island long before that date. Nevertheless, none of the citrus fruits can be considered part of the indigenous or naturalized flora of Cyprus (Meikle 1977).

Presently the main orange cultivars are Valencia (59%) and Shamouti (27%). A small amount of Washington navel (13%) and acidless (1%) oranges are produced for the domestic market. The majority of grapefruit produced are Marsh seedless (85%), with the rest being mainly Star Ruby. From the mandarins and mandarin/hybrids Ortanique (42%), - locally known as Mandora - is the main cultivar almost exclusively exported, followed by Clementine (27%) and the local "Arakapa" variety (24%) which are both produced for the domestic market. Small amounts of Minneola (6%) and Nova (1%) are produced for exports. Ortanique is considered a new crop for Cyprus. Lemons (*Citrus limon*) are produced exclusively from the local variety "Lapithkiotiki". The recently introduced Ellendale, Delta and Lane Late have been planted in a limited scale.

The area covered with citrus in 1997 was 6800 ha, representing 5.3% of the total crop area and 18% of the total irrigated area. Citrus is mainly cultivated in the south – western coast of the island and in the central plain of the capital, Nicosia. Citrus production in 1999 was 143000 tones of which 25 % were oranges, 38% grapefruit, 15% lemons and 17% mandarins and mandarin hybrids. A total of 68000 tones were exported, of which 29% were oranges, 33% grapefruit 15% lemons and 22% mandarins and mandarin hybrids.

In the five-year period 1991-95 citrus contributed 5.2% to the total value of agricultural production and 9.7% to the crop output. In the same period citrus was one of the most important agricultural export commodities. However, its importance is declining while its share to the raw agriculture exports averaged 32.8%. The last agricultural census indicated that there are 11395 citrus holdings and the total number of trees was estimated over 2 million.

All commercial varieties were introduced during the 20th century. The main introductions took place during 1969-70, 1977-78, 1989 and 1993-95, and included not only scion varieties such as oranges, lemons, grapefruit (*Citrus paradise*), mandarins (*Citrus deliciosa*)/mandarin hybrids and pumello, but also rootstock varieties.

A certification program was implemented in 1997 for the production, maintenance and distribution of healthy virus-free propagating material. In order to provide the industry with healthy budwood of the local genetic material, the lemon variety "Lapithkiotiki" was cleaned (Ioannou et al., 1991) and 'Arakapas' is presently being cleaned by the process of shoot - tip micrografting applied at ARI (Kapari-Isaia et al. 2002, Kapari-Isaia et al. 2005, Kapari-Isaia et al. 2006).

Citrus germplasm in Cyprus is preserved in the following *ex situ* collections:

1. A basic block under insect-proof screen which houses all citrus varieties that are available in a clean state.
2. Two budwood multiplication blocks under insect-proof screen.
3. Two open-field mother blocks.
4. A collection of 30 recently introduced scion varieties.
5. Two collections of more than 30 previously introduced scion varieties.
6. A rootstocks collection.
7. A collection of more than 10 clones of the local lemon variety.

According to this program, the Ministry of Agriculture keeps a basic block which houses all citrus varieties that are available in clean state, and two other budwood multiplication blocks, all under insect-proof screen, as well as two open-field mother blocks whereas another field block will soon be established. The commercial nurseries have to obtain clean material either as budwood or as budded trees from the Ministry and they may establish their own multiplication block under insect-proof screen which can be kept for no longer than five years.

As it was noted above, citron, sour orange and lemon were found on the island since ancient times. Citron is considered to have high levels of genetic diversity since it reproduces sexually. However, its production in Cyprus has always been very limited. Sour orange is considered to have low genetic diversity because of its nucellar mode of reproduction and lemon moderate since it reproduces partly-sexual. Therefore, the amount of genetic diversity is expected to be higher within lemon. In addition, the local lemon variety 'Lapithkiotiki' is undoubtedly very important for Cyprus citrus industry, because it combines high productivity, superior horticultural characteristics and satisfactory tolerance to mal secco (*Phoma tracheiphila*), the most dreadful disease of lemon in the Mediterranean region. This variety is produced for both domestic and export market. For the above reasons priority has been given to the study of the genetic diversity of the local lemon variety 'Lapithkiotiki'.

In 1994 ARI initiated a program for the collection, evaluation, conservation and use of genetic material of the local lemon. Following a survey of all lemon-growing areas, 33 trees/clones were identified and described. For each tree and for four successive years various tree and fruit characteristics were determined. The results showed a considerable variation in fruit characteristics such as weight, horizontal and vertical diameter, cone size, neck size, number of seeds, percent juice and peel smoothness. The selected material will be evaluated for its horticultural performance under the same edaphoclimatic conditions and its genetic variability will be identified.

The other local variety grown in Cyprus is the mandarin 'Arakapas', which is produced only for the local market and is very popular because of its distinctive and rich aroma and taste. 'Arakapas' is presently being cleaned by the process of shoot - tip grafting *in vitro*.

Through the centuries, Citrus plantations were developed into an important habitat for Cypriot wildlife. Several species of Passeriformes such as Greenfinches (*Garduelis chloris*), Goldfinches (*Carduelis carduelis*), and Linnets (*Carduelis cannabina*) are known to nest among the branches of these trees. Additionally, the two most important game birds of Cyprus, Chukar partridge (*Alectoris chukar*) and the Black Francolin (*Francolinus frnacolinus*) are known to nest on the ground amongst the weeds growing next to the tree stems (Kourtellarides 1998). Citrus plantations are also an important habitat for reptiles, mammals and insects.

3.3. Conservation of Olive biodiversity and clonal selection of the local olive variety (*Olea europaea*) and characterization, collection and utilization of olive genetic resources in Cyprus² (Objective A2.1.11)

The Olive tree is native to Cyprus, growing in the wild in many areas – Akamas, Pafos, Troodos, Limassol forest and other forested areas like Pentadaktylos, Karpasia etc. (0-1000m asl.). The most extensive wild olive groves are found in the Limassol forest. It is also widely cultivated in all parts of the island up to an altitude of 700 m. (Tsintides et al. 2003).

This project was funded by the European Union and the International Olive Oil Council (IOOC). The main objectives and expected benefits of the project are:

- To document, publish and disseminate through the internet the olive biodiversity carried in centuries through growers/nature interaction
- To stop genetic erosion by saving the genetic variability not yet lost for future generations
- To identify and select clones with desirable characteristics from the «Local» olive variety. Such characteristics are productivity and adaptability to a variety of local conditions, resistance to or tolerance of biotic and abiotic factors, suitability for the processing industry and meeting the preferences of consumers. The practical approach to this work is to select and to improve clones for distribution to farmers who intend to develop this crop (Kapari-Isaia et al. 2004a).

There were two successive phases of work.

A. Exploration and identification of plant material: A general investigation was carried out leading to the identification and description of the largest possible number of clones

² Based on a manuscript provided by Costas Gregoriou, Deputy Director and Head of Production Divisions of the ARI of Cyprus, 2007

in the various parts of the island. For this purpose, the observations made covered the following: a) identification of clones for subsequent observation; b) description of the local environment (soil and climate) and collection of agronomic information on the trees under observation (cultural practices); c) description based on a certain number of morphological characteristics of tree, leaf and inflorescence and d) description of cropping and fruit characteristics. The field observations were carried out for a period of five years on the trees that were identified (Banilas et al. 2003; Gregoriou 1996, 1999, 2006a, 2006b).

B. Establishment of olive plant collection and evaluation: During phase A, thirty-one clones were selected with desirable fruit and cropping characteristics (see Table with names of clones). Plants propagated by cuttings taken from each mother tree were planted in 1987 in a collection (Gene Bank) at Zyghi Station aiming to evaluate the clones under the same edaphoclimatic conditions. The names given to the clones represented the areas where they were found.

Table of Clones

Kiti, Paliometochos, Meniko 1, Lithrodondas, Analiondas 1, Analiondas 2, Ay. Trimithias, Kato Drys, Korakou, Evrychou 1, Evrychou 2, Evrychou 3, Flasou, Alethriko, Klirou 1, Klirou 2, Arediou 1, Arediou 2, Peristerona 1, Peristerona 2, Arediou 3, Athalassa, Lefkara 1, Anafotia, Lagoudera, Kato Drys 1, Kato Drys 2, Lefkara 2, Lefkosia, Meniko 2, Mazotos.

3.4 The importance of olive trees for birds

Olive trees are important nesting areas for many birds in Cyprus, such as the woodpigeon (*Columba palumbus*) (Hadjisterkotis 2000b), the Turtle Dove (*Streptopelia turtur*) the hooded crow (*Corvus corone cornix*), the magpie (*Pica pica*) and many other species such as the cavity nesting endemic Scops Owl (*Otus cops cyprius*) and the colourful Hoopoe (*Upupa epops*) (Kourtelarides 1998, personal observation).

In addition, several species of birds in Cyprus are using the old nests of the Hooded Crow and the Magpie to nest. These are the Long-ear Owl (*Asio otus*), the endemic species of Scops Owl and the Kestrel (*Falco tinnunculus*) (Hadjisterkotis 2003b). The great spotted Cuckoo (*Clamator glandarius*) is parasitizing the nests of magpies by laying one or more eggs in each nest, and leave them to the care of the nest owner (Kourtelarides 1998; Šťastný 1990, Hadjisterkotis 2003b). Therefore, the old nests of some species of the crow family are vital in the survival of several avian species, some of which – such as the Long-eared Owl - are rare in Cyprus (Hadjisterkotis 2003b).

In Europe the Long-eared Owl breeds in old nests made by birds of prey, crows, pigeons and squirrels as well as in nest boxes (Šťastný 1990). In Cyprus there are no squirrels, and there are no breeding records in old nests of other species of birds other than crows and magpies.

Further more, olives are an important item in the diet of woodpigeons, thrush, chukar and other species.

3.5 *Ex situ* CONSERVATION OF PLANT BIODIVERSITY OF CYPRUS: THE ROLE OF THE NATIONAL GENE BANK (Hadjichambis and Della 2007)

In 1979 the Agricultural Research Institute initiated a programme for collecting, conserving and utilizing the genetic variability existing in local germplasm of cereals, food

and forage legumes, as well as rare and endemic plants. The collected material is conserved under 0-4°C at the National Genebank located at the ARI, Nicosia and it's comprised of approximately 12,000 samples. Most of the collected germplasm kept in storage has been disappeared from the farmers' fields (Hadjichambis and Della 2007).

In 1996 ARI created a herbarium to serve as a reference collection for the identification of unknown plants. Several plants were recorded for the first time, while others contributed to the study of the distribution of the taxa of Cyprus. More than 10,000 named specimens exist in the herbarium, while a large number has still to be identified and documented (Hadjichambis and Della 2007). Duplicates of the ARI collections were sent to Kew Gardens where unnamed specimens were identified. In 1990 the ARI Herbarium was established as the National Herbarium in which all the historical collections will also be maintained (Della 1999).

The witless use and overexploitation of natural resources, tourist development, fires, the destruction from the illegal Turkish invasion and occupation, as well as the rapid built-up development threatens the rich Cypriot flora. Consequently, a considerable number of Cypriot plant species are characterized as endangered with extinction or vulnerable and are included in the Red book of Cyprus flora.

In this tragic situation, at which many uses and activities threaten the plant biodiversity in several regions of our planet, *ex situ* conservation (conservation out of countryside, in laboratories or other places), as it is recognized by the Convention on the Conservation of Biodiversity, has to play an important and reinforcing role for plant conservation. The World Strategy for Plant Conservation which was adopted by the Convention on the Biological Diversity includes, *inter alia*, the objectives below:

- Conservation of 60% of the threatened plant species in accessible *ex situ* collections, at preference in the country of origin, and
- Conservation of 70% of the genetic diversity of cultivated species and other important plant species from socioeconomic point of view.

A number of research activities are carried out in the Agricultural Research Institute aiming to *ex situ* plant conservation mainly through the conservation of seeds. The project for the collection, conservation and utilization of genetic diversity of local plant genetic resources was initiated on 1979. This project led to the foundation of the National Genebank of Cyprus in 1985, which is known with the code name CYPARI, co-financed by the Cyprus Government and the IBPGR (Della 1999).

The collected germplasm is kept in heat-sealable foil pouches and is conserved under 0-4 °C for medium term conservation. The conservation and use of old varieties of several species is encouraged by the Ministry of Agriculture, Natural Resources and Environment. Additionally, some of the collections conserved in the Cyprus National Genebank belong to native plant species which nowadays are very rare, facing the threat of extinction.

Since its foundation, the National Genebank of Cyprus in the Agricultural Research Institute has been participating in a number of research projects for seed collection that originated from all the botanic divisions of Cyprus and consequently the collections are characterized by high geographic distribution that covers the more important regions of the island. Moreover, different populations, ecotypes and a variety of different habitats and ecosystems are represented in the collections aiming to adequate conservation of the genetic wealth of Cyprus flora. Today, in the National Genebank of Cyprus more than 12,000 accessions of cultivated species and local varieties as well as endemic, rare and threatened plant species of Cyprus flora are conserved.

Beyond the seed-collection projects the National Genebank of Cyprus (CYPARI) participates in a lot of European, Mediterranean and International networks and projects aiming to the coordination of action and exchange of information and scientific data on seed conservation such as IPGRI, ECP/GR, EPGRIS, EURISCO, ENBI, MEDUSA and RUBIA.

In an effort to increase public awareness and interest for the protection, conservation and sustainable utilization of the indigenous flora, promotion is carried out through all mass media including radio and television. Promotional lectures aiming to boost the enthusiasm among students, of all ages are given by the Ministry of Agriculture, Natural Resources and Environment in cooperation with the Ministry of Education and Civilization. During field days, numerous plants are planted in school gardens and other public areas with the active participation of students, teachers and the public.

Very important turning-point for the CYPARI is also its participation in the European project ENSCONET, which gives from now on an accent in the conservation of all native plants of Europe with priority in rare and endangered with extinction species. This participation will lead to an increased awareness and sensitization regarding the importance of genetic diversity conservation of native plants of Cyprus through the seed conservation and will considerably contribute to the conservation of the native plants of Cyprus.

3.6 Field genebanks and the promotion of *in situ* conservation (Action A2.1.11)

The Ministry of Agriculture, Natural Resources and Environment encourages the conservation and use of old varieties of artichoke, water bottle, loufach, and sweet pepper by multiplying the seed and selling it to the farmers at cost prices. The Cyprus government since 1997 supports the conservation and harvesting of carob trees (*Ceratonia siliqua*) by subsidizing the product delivered to the co-operatives. This encourages farmers to continue the cultivation and the conservation of carob tree, promoting their *in situ* conservation (Action A2.1.11). The carob tree, together with the olive tree, the almond tree (*Prunus dulcis*) and the characteristic Mediterranean Hawthorn (*Crataegus azarolus*) are a prominent feature of the Cypriot landscape around the semi mountainous regions, and are very important nesting habitats for the same species of birds noted in section 3.4 (Hadjisterkotis 2000b, 2003b). There are field genebanks of both foreign and local material of many tree crops. The field genebanks of local tree crops include collections of citrus, olives, loquat (*Eriobotrya japonica*), figs (*Ficus carica*), pomegranates (*Punica granatum*), hazelnuts (*Corylus avellana*) and walnuts (*Juglans regia*). The collections are at stations belonging to the ministry of Agriculture, Natural Resources and Environment, either at ARI or the Department of Agriculture (Hadjichambis and Della 2007)

3.7 Study of the genetic diversity among domestic breeds of sheep and wild animals on a European level (A2.1.11)

To study the genetic diversity among different breeds of domestic sheep and goats from several Mediterranean islands (Cyprus, Khios - Greece, and Sardinia - Italy), the University of Sassari is cooperating with the Ministry of the Interior of the Republic of Cyprus since 1995 (Hadjisterkotis *et al.* 1994a; Hadjisterkotis *et al.* 1995, Manca *et al.* 1997, Rando *et al.* 1997, Palici di Suni *et al.* 1999, Pirastru *et al.* 2001, Pirastru *et al.* 2002, Manca *et al.* 2007).

Additionally, the study of the genetic and haemoglobin differences among Mediterranean wild sheep (*Ovis orientalis (=gmelini) musimon* from Sardinia and Corsica

and *O. g. ophion* from Cyprus) has been going on since 1993 (Hadjisterkotis et al. 1994b, Serreri et al. 1999, Serreri et al. 2000a, Serreri et al. 2000b, Masala et al. 2000, Masala et al. 2001, Palici di Suni et al. 2001, Serreri et al. 2001, Palici et al. 2002, Pirastru et al. 2002a, Pirastru et al. 2002b, Serreri et al. 2002).

Scientists from the University of Saragossa Spain, as well as the Ministry of the Interior of the Republic of Cyprus have been studying the genetic diversity of chukar partridge, aiming at the management of the European game resources (Tejedor et al. 2005, Arruga et al. 2005, Arruga et al. 2007).

4. A short description of other biodiversity programs of the Agricultural Research Institute

4.1 Ethnobotanical and ethnographic study in the region of Mediterranean.

RUBIA FP 5 (2003 – 2006) Participants 8 countries

The main goal of the program is the recording of Ethno-botanical and ethnographic data aiming at the creation of a model for re-evaluation of tools and technology relevant to the traditional uses of wild and ignored cultivated plants which are used as food, pharmaceuticals, for dyeing etc.

The benefits for the farmers, rural economy and the country in general are the following:

- Recording of villages and individuals in Cyprus who are exercising traditional jobs related with the utilization of plants.
- Composition of a booklet which will be sold in the communities-villages from where the information originated.
- Recording of information from the very last people who perhaps possess the traditional knowledge.
- This information is important for the rural culture, our culture, as well as for the general rural development.

4.2. European Network of Maintenance of Sperms of local Plants ENSCONET FP 6 (2004-2008) Participants 23 European countries

The main goal of the program is the creation of a European Network of Maintenance of Sperms of indigenous Plants aiming at the development of common protocols of collection of seeds in all the European bio-geographic regions, for the indigenous species with interest in their use, the strengthening of quality and safety of maintained seeds and the creation of a Digital European bank of seeds of indigenous species.

With the participation in the European network the country profits from the experience and the knowledge of other European countries for the suitable maintenance of sperms that is taken care of in the National Bank of Sperms at the ARI, in order to maintain the plant genetic resources of Cyprus. There's great contribution to the preservation of the Cypriot plant genetic bank including rare, threatened, endemic species, related cultures and other indigenous plants of Cypriot flora, and generally in the protection of biodiversity of Cyprus.

4.3 Ecological Network for the promotion of converging strategies for the conservation of coastal ecotypes of Community importance (Objective A3.1.5)

ECONET ARCHIMED IIIB (2006-2007), Participants 4 countries.

The main goals of the program are the creation of an ecological network for the management of coastal ecotypes; the creation of a data base on Studies of Environmental Impact Assessments and Decision-making; to provide assistance for the establishment and management of regions of the Natura 2000 network and finally to educate professionals and researchers in coastal habitats management.

During this program the knowledge regarding coastal ecotypes management will be strengthened, resulting in the improvement and the conservation of the coastal regions of Cyprus that will be included in the Natura 2000 Network. A unified approach will be promoted on the management of coastal ecotypes in-between the participating countries, assisting the process of decision-making and educating special researchers and professionals. Moreover, Lara region in the Akamas peninsula will be used for the implementation of a pilot case study (Action A3.1.2).

4.4 The Red Book of Cypriot Flora Protocol No. 93 KYPRINIA - FOUNDATION OF THE PROMOTION OF RESEARCH

(Duration: November 2002 – 2005, 36 months) Participants 2 countries

The main goal of this program is to localize threatened plant taxa according to the IUCN criteria, after a field study of all known plant populations in Cyprus and the creation of the Red Book.

The program will contribute to the conservation of Cypriot flora species threatened with extinction. Publication of the Red Book of Cypriot Flora will contribute to the briefing of scientists, technocrats and the general public of Cyprus regarding the threatened plants. It is expected to stimulate park managers, foresters and other experts to take better conservation measures, and to implement at MS level actions or management plans for species under threat and review and update as necessary, elaborate and implement [2007 onwards] additional species action or management plans for a wider range of plant species under threat (Action A1.3.1-2).

4.5 Publication Ecology of Threatened Coastal Ecosystems of Cyprus

EYOIKO-OIKOAKT RPF

The main goal of this program is the publication of results from the study of the sand dunes and halophytic coastal ecotypes of Cyprus aiming at their conservation. It also includes results from the study of the flora, vegetation and ecological situation of 11 types of natural ecotypes that are protected from the European directive of 92/43 of EEC.

The program will benefit the consultation of scientific community, technocrats and general public regarding the threatened coastal habitats of Cyprus, their ecological characteristics and management. It will contribute to the conservation of Cyprus coastal habitats.

5. The importance of farmland for wildlife

As mentioned earlier, human activities in Cyprus have shaped the landscape and created a wide variety of semi-natural habitats that birds, mammals and other wildlife have adapted to and often prosper in. Many birds and small mammals have become largely dependant on agricultural habitats. Birds are often viewed as agricultural pests. They can also be of huge benefit to farmers and need to be part of any sustainable, stable agricultural ecosystem (Hellicar 2003). In Cyprus, as in the rest of Europe, agriculture dominates much of the landscape. A large number of bird species – from eagles and harriers to warblers and finches, partridges and francolins to wheatears and larks – live in this strongly human-influenced environment.

In Cyprus, small fields with a diversity of arable land and tree crops such as the traditional Cypriot olive groves, carob trees and vineyards, create a mosaic landscape ideal for many bird species and many other wildlife species. In Europe, agricultural intensification can largely be attributed to the policies enshrined in the EU's Common Agricultural Policy (CAP). By linking subsidies to yield and guaranteeing that excess production is bought up by the EU, the CAP has made intensification highly profitable. However, farmland bird populations have crashed over the past 20-30 years due to agricultural intensification across Europe. Intensification and abandonment are already happening in Cyprus and both processes are likely to continue (Hellicar 2003).

Aware of the potential impact of agricultural intensification on the island's birdlife, a one-year island-wide study of the issue has been funded by the Leventis Foundation and supported by the Bi-Communal Development Programme. Coordinated by the Environmental Studies Centre (ESC), the study was completed in November 2003. It records and compares bird communities in more and less intensively farmed sites in the Paphos, Limassol, Nicosia, Larnaca, Famagusta, Kyrenia and Morphou districts. The project covered cereal field sites, vineyards, groves (citrus, olive, almond and carob orchards) and abandoned scrub sites in all four seasons. The project showed that non-intensive farmland generally hosts higher bird populations and greater variety of birds than intensive farmland. The project also found that non-intensive farmland is comparable in bird abundance and species richness to scrub, which is a semi-natural habitat generally considered to be good for birds. Abandoned farmland was consistently species-poor and held fewer birds than non-intensively farmed sites or scrub sites.

The study briefly describes the benefits birds provide for farm crops by feeding on insects ridding crops of pests, and provides recommendations for wildlife-friendly agriculture (Hellicar 2003).

The above study is valuable in identifying high value farmland areas (Action A2.1.3) as far as bird biodiversity is concerned, and will influence national plans of CAP implementation on biodiversity (Action A2.1.4).

6. Agriculture and small mammals

It seems that intensive farming and other human activities also affect the biodiversity among small mammals. Despite the fact that Cyprus is a large oceanic island in the Eastern Mediterranean, isolated from the mainland since five Ma, local fauna has received little attention from the mammalogists.

Recently, a group of French and Cypriot scientist have studied the taxonomy and distribution of mice on Cyprus, by using live traps at fifteen trapping localities in different biotopes of the southern part of the island. *Mus cypriacus*, a new species described for the

first time in Europe, was captured in eight of them. *Mus cypriacus* has been found mainly in the Troodos region between 300 and 900 meters a.s.l. Its habitat includes abandoned cultivation terraces with vineyards, grassy fields, and bushes like Mastic trees (*Pistacia lentiscus*) and Terebinthes (*Pistacia terebinthus*). Within the altitudinal range of 100-150 m, *Mus cypriacus* can be coexisting with the house mouse (*M. m. domesticus*) in forested riverine areas. At low altitudes (less than 100 meters a.s.l.) *Mus cypriacus* seems absent from areas with strong anthropogenic pressure such as the overexploited agricultural fields of the *Mesaoria* (central plain of the island), human dwellings and farms, orchards (orange groves) where the house mouse is almost exclusively dominant (Cucchi *et al.* 2006)

7. Biodiversity studies by the Cyprus Ornithological Society – BirdLife Cyprus

In addition to the above study, BirdLife Cyprus is currently performing a number of additional studies on birds, of considerable value to biodiversity. Some of them, for example the Roller Breeding Survey will identify, island-wide, new regions in need of protection which were not studied in the past. Many of these areas are mainly river banks, as well as agricultural areas. Other ongoing studies by BirdLife Cyprus are the following:

1. Annual Demographic Inventory of Aquatic Birds of Cyprus on a Monthly basis (Annual Monthly Waterbird Census). Demographic Inventory of aquatic birds in more than twenty Cypriot wetlands.
2. Annual Autumn Migratory Raptor Census. Inventory of species and their populations that migrate through Cyprus at the Autumnal Migratory Period (end of August – beginning of November) on a daily base.
3. Cyprus Common Bird Census. Report bio indicators and populations per species with the use of sampling quadrants of one square kilometre, which covers specific biotope / plant community of Cyprus.
4. Eleonora 's Falcon Breeding Survey. It takes place during autumn and it covers the unique colonies of this species which are located across the coast of Cape Aspro up to the peninsula of Akrotiri.

8. A short description of biodiversity research programs of the Department of Fisheries and Marine Research

8.1 Conservation of sea turtles.

The program runs since 1976, and its main goals are:

- The protection of marine turtle nesting beaches
- The protection of the freshly hatched young turtles
- The protection of the adult turtles when they arrive on the beach to lay their eggs.

The inventory covers the population parameters of the marine turtles and their reproductive activity. The project includes the education of the public for the protection of the marine turtles.

8.2 Observations of the wetlands of Larnaca Salt Lakes, Akrotiri Salt Lake, and the wetlands of Levadi near Akrotiri Salt Lake.

The program begun in 1988 and its main goal is the protection of the ecosystem of the above wetlands and the study of its ecology. This incorporates water level, temperature, salinity and PH. Additionally, the program includes the study of the shrimps *Artemia selina* and *Branchinella spinosa*. *Artemia*, similarly to *Branchinella*, produces fertile cysts (eggs) with a tough shell when the water of the lakes is reduced from the heat at the beginning of the summer, and when the salinity is over a certain point. In the summer, because of the high heat and the lack of rain the lakes are dry. The cysts are able to survive in the dry salt left on the bottom of the lake under very hot conditions, for several years if there are drought conditions. The cyst will hatch again with the first rains during winter. The most appropriate salinity for hatching is around 25%. These shrimps are the main food item of the Greater Flamingo *Phoenicopterus ruber*. The study also incorporates lake pollution monitoring.

The above study, in combination with the Annual Monthly Waterbird Census performed by the Cyprus Ornithological Society, gives a complete view of the ecology of the Lake, and enables the managers to take the proper management and conservation measures. Considering that the above two salt lakes are two of the most important overwintering areas for many European birds, the above intensive studies are important for the conservation not only of the Cypriot bird fauna, but also for the European migratory waterfowl (Action A1.2).

8.3 Program SMAP of the European Union. Establishment of marine protected areas in the Mediterranean, MedMPA. (Objective A3.1.1, A3.6.2)

Duration 2001-2004. The purpose was to record the biodiversity in the three marine areas proposed for conservation: Cavo Greco, Moulia and Akamas. The abovementioned program included the socio-economic study of these regions, as well as the elaboration of the preliminary management plans.

8.4 LIFE program. Protection and management of the Natura 2000 (marine) sites (Objective A3.1.1-2, A3.6.3).

Duration 2004-2008. The main aims of this project are the adoption of management tools and the immediate application of action plans for 5 coastal areas, the formation of guidelines for the elaboration of management plans, and the creation of an electronic data base for management.

The coordinator of the program is the Environment Service. The Department of Fisheries and Marine Research is responsible for the coastal / marine areas.

9. Invasive Alien Species (IAS)

Objective 5: To substantially reduce the impact on EU Biodiversity of Invasive Alien Species (IAS) & Alien Genotypes

The IUCN/Species Survival Commission (SSC) Invasive Species Specialist Group set out recommendations for reducing the risk of biodiversity loss caused by alien species. These guidelines are designed to assist governments to meet their obligations under the Convention on Biological diversity (Clout and Lowe 1997). According to the guidelines,

“... in general, no alien species should be deliberately introduced into any natural habitat, island, lake, sea, ocean or centre of endemism, whether within or beyond the limits of national jurisdiction”.

The introduction of alien species by people transporting them across biogeographical boundaries has, along with habitat destruction, been a major cause of ecological change throughout the world in the past few hundred years (Clout and Lowe 1997). Many alien species have become invasive, establishing in natural ecosystems, disrupting ecological processes and often causing widespread extinctions by competing with or preying on native species. Many of these extinctions have gone unrecorded, but there is now an increasing realization of the massive ecological costs of biological invasions through the irremediable loss of native biodiversity, and greatly altered ecosystems. Biological invasions now threaten biodiversity on a global basis.

Invasive Alien plants, birds, mammals and fish were introduced and released in Cyprus without taking into consideration the above guidelines provided by IUCN, and without first conducting an Environmental Impact Assessment. In certain cases the results were nearly catastrophic for the Local species of wildlife. One such example is the introduction of several species of exotic fish in the lakes and dams of Cyprus.

9.1 The introduction of alien fish and its impact on the endemic grass snake *Natrix natrix cypriaca*.

On the island of Cyprus there are only two natural lakes, the Akrotiri Salt Lake and the Larnaca Salt Lake, which usually in the summer are completely dry. There are also 107 artificial dams. The only lake which hosts one species of fish is Akrotiri, the Mediterranean Toothcarp *Aphanius fasciatus*. *Afanius* is a small dumpy fish, which survives in brackish waters, poorly oxygenated and stagnant regions (Wheeler 1992). However, it does not exist in any fresh water streams or dams.

The oldest dam on the island which was constructed about 106 years ago is Kouklia dam. Six more dams were built in the 1940s, nine in the 1950s, 46 in the 1960s, seven in the 1970s, 30 in 1980s, five in the 1990s, and three during the last five years. The construction of the dams provided new habitat for overwintering, or migrating waterfowl, and a number of species use them for breeding. The new dams boosted the population of the local amphibian populations, and consequently in one particular case the large availability of frogs (*Rana levantina*) helped to increase the threatened with extinction endemic grass snake *Natrix natrix cypriaca*.

In order to provide the opportunity for sport fishing, the Department of Fisheries has been introducing a large number of exotic fresh water fish (16 species) and cray fish *Procambarus clarkii* in every dam and pond, particularly during the last 30 years. Introduction of non-native fishes to "improve" local fishing has been a worldwide phenomenon for over a century (Courtenay and Stauffer 1984, Moyle 1986). There was never an Environmental Impact Assessment performed before any fish introduction.

The Cypriot grass snake was not common in Cyprus, and it was believed that after the early 1960's it was extinct (Blosat 1998). A small population was rediscovered in 1992 (Wiedl and Böhme 1992). This and some other recently discovered populations are so small that they urgently need strong protection (Reese and Hadjisterkotis 1994, Blosat *et al.* 1996, Blosat 1998, Hadjisterkotis *et al.* 1996). Grass snakes feed mainly on frogs and some dams before the introduction of fish provided excellent breeding habitat for frogs. The large population of frogs in combination with the appropriate habitat for this aquatic snake provided plentiful food for the snakes and assisted in the recovery of the species,

particularly in one dam on Troodos mountains. In 1995 in the dam there were only Mirror Carp (*Cyprinus carpio*), mosquito fish (*Gambusia affinis*) and Rainbow trout (*Oncorhynchus mykiss*) introduced for fishing. By that time it was estimated that there were 200 Snakes. In the year 2000 large mouth bass (*Micropterus salmoides*), and cray fish (*Procambarus clarkii*) were introduced and later Roach (*Rutilus rutilus*). Except roach all these species are known to feed on either stage of amphibians (frogs, tadpoles and spawn). This combination of fish and cray fish eliminated the frog population from the dam and is gradually leading the grass snake to extinction.

To save the grass snake from extinction the government invited Dr. Birgit Blosat, an expert from Germany to study the situation, and start a captive breeding program, as well as to make recommendations for the conservation and protection of the Cypriot grass snake (Blosat 2002, 2005). The result was a management plan which is implemented by the Departements of Fisheries and Marine Research in Cooperation with the Environment Service (Actions A1.3.1)

9.2 The introduction of wild boar

Another case of introducing an Invasive Alien Species is the Introduction of Wild Boar (*Sus scrofa*). According to Hadjisterkotis (2000) and Hadjisterkotis and Heise-Pavlov (2006), wild boar was introduced to the island of Cyprus 17 years ago, when five animals were imported from Greece for game farming. In 1994 wild boars were illegally released in Lemesos (Limassol) Forest and in 1996 in the Troodos National Forest Park. Soon the population increased and dispersed throughout the park. The Troodos National Forest Park, an area of 9337 hectares, has the highest biodiversity in Cyprus, with 72 endemic plants. Because of this, wild boar has the potential to cause considerable damage to the local fauna and flora (Hadjikyriakou and Hadjisterkotis 2006). On the 6th of November 1997, the government of Cyprus decided to eradicate wild boar because of the danger of transmitting diseases to livestock and to prevent possible environmental destruction. To control the wild boar, hunting was permitted and the game wardens were instructed to eliminate the free- ranging animals. In January 2005 there were no wild boars seen in Troodos, Pafos and Limassol forests. The reasons for the possible failure of wild boar establishment in Cyprus were discussed by Hadjisterkotis and Heise-Pavlov (2006).

9.3 Invasive Alien Species of plants

Finally, the most recent study on Invasive Alien plants was carried out by Hadjikyriakou and Hadjisterkotis (2002). According to the study, Georgiades (1994) recorded 152 adventive species for Cyprus, out of which the following 16 species were regarded as spreading to natural habitats: *Vinca major* L., *Cistus ladanifer* L., *Tagetes minuta* L., *Tanacetum balsamita* L., *Tanacetum parthenium* (L.) Sch.Bip., *Corylus maxima* Mill., *Iris albicans* Lange, *Acacia saligna* (Labill.) H.Wendl., *Robinia pseudoacacia* L., *Epilobium angustifolium* L., *Oxalis pes-caprae* L., *Eschscholzia californica* Cham., *Papaver somniferum* L., *Dodonaea viscosa* (L.) Jacq., *Antirrhinum majus* L., *Vitis vinifera* L. Hadjikyriakou and Hadjisterkotis re-examined the spreading status of these species and they found that *Acacia saligna* (Labill.) H.Wendl. is the most serious invasive species in Cyprus, threatening many natural habitats, invading forests, maquis, garigue, phrygana, marshy areas and agricultural land, becoming a serious weed. *Robinia pseudoacacia* L. similarly to *Acacia saligna*, but to a lesser extend is spreading in forests, maquis, garigue

and phrygana vegetation. Apart from the above species, it was observed for the first time that the following adventive species are spreading in natural habitats, namely: *Celtis australis* L., *Cercis siliquastrum* L., *Prunus dulcis* (Mill.) D.A.Webb, *Ailanthus altissima* (Mill.) Swingle and *Casuarina cunninghamiana* Miq. The spreading status of *Ailanthus altissima* threatens natural habitats invading forests and maquis. Furthermore, *Fraxinus angustifolia* Vahl subsp. *angustifolia*, *Pyrus malus* L. and *Prunus persica* (L.) Batasch are new additions to the adventive flora of Cyprus, recorded for the first time. These three species are also spreading in natural habitats. The problems posing to the environment and to biodiversity are also discussed in the study.

A recent study which was completed and presented last December by Atlantis Consulting Cyprus Ltd titled: Study for the Assessment of the Environmental Impacts from the Operations for the Management and restoration of the Larnaca Salt Lakes CY 6000002, Action C12, in the framework of the project LIFE04NAT/CY/000013 entitled 'Conservation Management in NATURA 2000 sites in Cyprus' which was funded by the DG Environment of the European Commission and the Ministry of Agriculture Natural Resources and Environment of the Republic of Cyprus, revealed that *Acacia saligna* was threatening the habitat of the salt lake of Larnaca, and it became necessary to remove a number of such plants from the area.

Besides the above species, the Game Service of Cyprus was introducing for years pheasants for hunting, releasing them just about anywhere, including the habitat of the indigenous black francolin, without considering that pheasants have similar habitat requirements with black francolin, and that they might compete with each other with unknown consequences.

Conclusions

The designation of a number of sensitive areas and important habitats in Cyprus in the Natura 2000 network, the inclusion in the Annexes II and IV of several endemic Cypriot species of vertebrates and plants, and other species like the Egyptian Fruit which was almost extinct from persecution (Hadjisterkotis 1996), are an indication of the great benefit to the Cypriot wildlife and to the Cypriot biodiversity from joining the European Community and the Natura 2000 network.

With the upgrade of the National Genebank of Cyprus, fulfilling all the requirements of international standards, the most effective conservation of seed collections in Cyprus will be possible. CYPARI constitutes the main answer of the country relevant to *ex situ* conservation strategies. With the thousands of seeds that it conserves from every part of the island, the National Genebank of Cyprus is a live ark of salvation transporting through the years the plant genetic wealth of the southeastern most point of Europe.

Additionally, the production of more plants using biotechnological methods (micropropagation) by the ARI is going to help in the conservation of rare and threatened species. However, it would be much more effective if the above efforts were combined with the creation of a botanical garden specializing in the propagation of threatened species, and the reintroduction of the produced specimens in their natural habitats by the Department of Forestry, or a specialized team of botanists.

All the above research projects are an important contribution toward the study and conservation of the Cypriot biodiversity, and consequently of the European biodiversity. Although the taxonomy of the Cypriot plants and animals was well studied, still nothing is known on the taxonomy of the fleshy fungi (mushrooms) and myxomycetes of Cyprus, which are an important part of the environment. Very little is known on the Cypriot bats

and the campaign to reduce the number of fruit bats during the 20th century perhaps eliminated a number of other bat species. A thorough taxonomic study on Cypriot bats is necessary, as well as on their habitat requirements, feeding habits, and behaviour. Similarly, we need additional ecological and behavioural studies on the endemic species of birds, reptiles, mammals and amphibians, in order to provide the necessary information for their management and conservation. The conundrum of research in Cyprus is that although the island recently created a university, and although the university has a Biology Department, the department does not have a section dealing with ecology, botany, zoology, ornithology, herpetology, forestry, or mycology. The University of Cyprus thanks to a donation of Mr. Tasos Leventis will build in the near future a biodiversity centre with only two research positions. It is believed that it would be much better if the above sections, (ecology, zoology, ornithology, conservation, wildlife management, etc.) were included in the centre.

Unfortunately, taxonomic and other scientific work is impossible without a good library, or reference collections. Such libraries for the moment do not exist in Cyprus. A National Museum of Natural History with reference collections and the appropriate research sections is also a need for Cyprus. A Biodiversity University Department in combination with a museum of natural history, and perhaps a botanical garden will contribute considerably in the study and conservation of the biodiversity of Cyprus.

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