Available from
Institute of Landscape Ecology
Slovak National Committee for UNESCO MAB Programme
Slovak Academy of Sciences
Compiled by: *Zuzana Guziova*
Design and Layout: *Index M*
Printed by: *OTA, a.s., Slovak Republik*
ISBN: 978-80-89325-00-9

PRIORITIES FOR CONSERVATION OF BIODIVERSITY IN BIOSPHERE RESERVES IN CHANGING CONDITIONS

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PROCEEDINGS FROM THE CONFERENCE
STARA LESNA
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This publication has been compiled and published with the financial support of UNESCO within a Framework of Participation Programme 2006-2007

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Published in 2007 by:
Institute of Landscape Ecology
Slovak National Committee for UNESCO MAB Programme
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ISBN: 978-80-89325-00-9

CONTENS

PLANT MICRO-RESERVES (A PILOT PROJECT IMPLEMENTED IN WESTERN CRETE) & SAMARIA BIOSPHERE RESERVE

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Abstract

Heavy exploitation of natural resources may eventually lead to species and genetic elimination or habitat and landscape deterioration. Man is both the cause of the problem and its ultimate victim. Combating actions usually involve the establishment of reserves, areas that actions are taken in order to reduce biodiversity loss. Biosphere Reserves, National Parks, protected areas and lately micro-reserves are measures taken in order to safeguard specific landscapes, the organisms that survive in them, including Man and his actions.

Crete, a Mediterranean island, is regarded as very important in terms of plant biodiversity, numbering a total number of 1734 plant taxa in a total area of approximately 8,300 km^2. A percentage of 10% of them is endemic to Crete. Sixty seven (67) native plants of Crete are considered as threatened species to extinction and thus they are included in the Red Data Book of Rare and Threatened Plants of Greece while fourteen native plants are protected by the European Directive 92/43/EEC and eight of them are considered to be of high priority for protection purposes (asterisk *). Samaria Biosphere Reserve, including the National Park of Samaria as well as a larger area in White Mountains (two NATURA 2000 sites) represents a hotspot that hosts a significant number of endemic organisms.

The National and Kapodistrian University of Athens in collaboration with the Mediterranean Agronomic Institute of Chania and the Forest Directorate of Chania are implementing a LIFE-NATURE project (LIFE04/NAT/GR/000104 - 'CRETAPLANT - A pilot network of Plant Micro-Reserves in Western Crete). The main objective of the project is the protection of six threatened Cretan endemic plants and one priority habitat. The establishment of a network of plant micro-reserves is used as a pilot programme in order to safeguard biodiversity. Micro-reserves constitute small areas (less than 20 ha) that are hosts of rare and threatened plants. This presentation will show how the idea of a micro-reserve that was developed in Spain in the nineties is implemented in Western Crete and in particular at the outer zones of Samaria Biosphere Reserve.

Six threatened to extinction species of European Community priority and one priority habitat (Palm groves of Phoenix), were selected. Plant species included perennials (*Androcymbium rechingeri* (a lily), *Bupleurum kakiskalae* (a carrot family member), *Cephalanthera cucullata* (an orchid), *Hypericum aciferum* (a St John's wort relative), *Nepeta sphaciotica* (a labiate) and the annual *Anthemis glaberrima* (a chamomilesmall daisy). Four of them (*Bupleurum kakiskalae, Cephalanthera cucullata, Hypericum aciferum, Nepeta spaciotica*) growsurvive in White Mountains. The project includes the following measures: mapping of the areas, installation of permanent, monitoring plots for the studying of various biotic and abiotic factors that affect their conservation, certain managerial measures (fencing, wardening, informative signs, etc.), ex situ conservation in three botanical gardens (A xerothermic plant garden at MAICh and two alpine gardens at the facilities offered in Omalos & Poria by Samaria National Park - Biosphere Reserve) and in the Seed Bank of MAICh. Finally, environmental

awareness of the public (students, locals, etc.) is targeted by running information campaigns at the Visitor Centre of the Botanical Garden at MAICh and in the Alpine Botanical Garden at Omalos (Samaria National Park - Biosphere Reserve). The legal aspects of micro-reserve implementation are also discussed within the project, since micro-reserves will act as a pilot tool for other areas that host threatened biodiversity. The project is used to draw ideas on the bridging of protected areas, such as National Parks, and Biosphere Reserves with the rest of the world.

Keywords: micro-reserves, Samaria Biosphere Reserve, plant biodiversity, *Bupleurum kakiskalae, Cephalanthera cucullata, Hypericum aciferum, Nepeta sphaciotica. Androcymbium rechingeri, Anthemis glaberrima, Phoenix theophrasti.*

1 Introduction

Human activities throughout the centuries have caused dramatic changes to the environment. Natural areas are being continuously invaded and threatened since humans compete with other organisms on our planet for space and energy. A heavier exploitation of natural resources has been evident during last and continues during this century. This results to a fast and constant decline of landscape richness, habitat variety and distinct flora and fauna variety due to the stronger environmental pressure shown in recent decades. Precious habitats are being damaged to an alarming pace, leading to decreases in diversity, number and distribution of a great number of species.

1.1 Protected areas

Countries have taken measures to stop and reverse the continuing deterioration in their natural environment. Internationally, important treaties and conventions have been proposed and introduced on the conservation of natural resources, including biotic and abiotic elements. Biodiversity gained international political dimension during Earth Summit in Rio de Janeiro (1992), where the Convention on Biological Diversity was adopted. It is referred to all life on earth, covering four main groups of reference: genetic, species (fauna, flora), ecosystem and landscape diversity [1].

Individual species are issued as threatened, thus measures are taken through legal actions and their enforcement in order to achieve their survival. Different international and European networks of protected areas have been also established in order to protect and preserve biodiversity at both habitat and species level. Individual countries launch schemes of protected areas, where various legal tools, policies and surface areas are used. This results to a large number of protected areas. National Parks, Biosphere Reserves and NATURA 2000 network are some forms of protected areas that individual countries, UNESCO and European Community have proposed with an eventual aim to safeguard biodiversity and achieve sustainability.

Specific areas in Greece were acknowledged by European and international bodies as important, thus they belong to different European and international networks. NATURA 2000 network that is eventually going to be the European protected areas network started by the establishment of special protection areas (SPAs) and Sites of Community Interest (SCIs) in every country following EEC Directives 79/409 & 92/43. Most Greek protected areas (National Parks, Nature Reserves, aesthetic forests, etc) are also included in the network. However, its official legal enforcement and establishment of the network is not foreseeable in the near future, due to the obligatory realization of article 6 (92/43/EEC) for Special Conservation Areas in each member State.

Various categories of protected areas are also designated with national Greek legislation. National parks, aesthetic forests, nature's monuments and other nominations were introduced and used in order to achieve environmental conservation combined with sustainable use of natural resources. According to the Greek legislation, National Parks are ' ..forested areas, interesting because of their flora and fauna, their geology,..' etc, initially excluding from the subject under protection all non forest areas (Forest Code). Zones, such as core areas and their outer transitional zone (second is not always present) of different protection status are also identified. The initial number of 10 National Parks of the country has recently changed to 19, since wetlands and marine Parks were also included. Samaria National Park is one of the first National Parks of the country nominated since 1962. Environmental Performance Reviews for Greece [2] reports nineteen (19) aesthetic forests in the county covering 32,500 ha (0.2% of the country), while there are 51 nature's monuments (historic plants and small areas). The total area of all Greek protected areas is 509,881 ha, almost 4% of the country [3].

1.1.1 The micro-reserve concept

Important plant species frequently occur in small areas that do not always belong to larger protected area units. Sometimes plants are found in small populations or isolated individuals, far from forests or other more organized ecosystems. Conservation is thus achieved by specific actions that can be enforced on the area that a plant species is distributed. In the early 90s, Laguna [4] in Valencia (Spain) proposed the introduction of micro-reserves, as a new legal designation for conservation applied for small areas (less than 20 ha) where certain important plant species grow. The two main purposes for plant micro-reserve establishment are:

1. The protection and conservation of a selected, small population of a rare, threatened plant species
2. The establishment of a network where monitoring of changes is also taking place.

Additional aims are: conserve the locus classicus of a plant species, guarantee the conservation of populations of wild relatives and ancestors of plants used traditionally in ethnobotany and, achieve the involvement of NGOs and City Councils in the micro-reserve conservation activities and establishment of low impact educational projects. The identity and uniqueness of a micro-reserve is equally important to its partnership and interaction with all other network members. Partnership is important especially in cases that minute plant species are concerned that have no individual glamour. In Spain, private ownership of micro-reserve land is equally important to public one, while the declaration of a micro-reserve requires a public consultation. Approximately 250 micro-reserves are currently established in Valencia, while other countries have also adopted the idea.

Laguna identified in his report the fact that small protected areas are lacking in Greece, thus he suggests that Greece, as well as Spain and Southern Italy (countries that share a botanical richness), should seriously consider the idea of adopting the micro-reserve model of conservation. This paper discusses how the idea of plant micro-reserves is currently being developed and implemented in Western Crete (Greece). University of Athens in collaboration with Mediterranean Agronomic Institute of Chania and Forest Directorate of Chania are implementing a LIFE-NATURE project (LIFE04/NAT/GR/000104 - 'CRETAPLANT'- A pilot network of Plant Micro-Reserves in Western Crete). The main objective of the project is the protection of six threatened, Cretan endemic plants and one habitat through the establishment of a pilot network of plant micro-reserves.

We will discuss how the idea of a micro-reserve is evolving in Western Crete and we will particularly focus on the micro-reserves close to Samaria gorge, since a number of them are located at the outer zone of Samaria Biosphere Reserve (White Mountains). A comparison between different conservation tools will be presented along with suggestions for the selection of the most appropriate legal basis for the establishment of the micro-reserve concept in Greece.

2 The island of Crete & Samaria gorge

Crete, the largest island in South Aegean and the fifth largest in the Mediterranean, is located at the crossroads of Europe, Asia and Africa. Its area is ca. 8,300 km2, with four main mountain massifs, the highest reaching to 2.456 m of altitude. Mountain regions are separated by lowlands, while flat plains, surrounded by mountain peaks, form isolated upland plateaus. Its karstic terrain is also important; it is formed by water activity on limestone and dolomite. Typical characteristics, especially of the western part of the island, are deep gorges and cave systems. One permanent natural lake is located in NorthWest (Kourna Lake) as well as a number of perennial rivers and streams. Temporary ponds are also found scattered in the area and represent particular habitats, areas that specific organisms are hosted. Being an island, remote from the rest of the land, combined with its geology, climate and morphological relief; all contribute to the formation of various isolated plant and animal populations, adapted to the environment that they survive. In cases that these populations are in no contact with the rest for a long time, form new species endemic to the isolated area. Thus, floristically, Crete is very important in terms of plant biodiversity, it hosts genera that have relatives in the three continents, which surround it. Most plants belong to the European element although Asiatic and North African plant genera are also occurring [5]. Crete has a total number of 1734 plant taxa identified on the island, with a percentage of 10% of them being endemic to Crete. Sixty seven (67) native plants of Crete are considered as threatened species to extinction and are therefore included in the Red Data Book of Rare and Threatened Plants of Greece while fourteen native plants are protected by the European Directive 92/43/EEC and eight of them are considered to be of high priority for protection purposes (asterisk *).

Samaria gorge, on the White Mountains (Lefka Ori) in Western Crete, is a hot spot on the island for its rich biodiversity, its characteristic ecology and geology forming a unique landscape that has hosted human presence for years. Samaria is declared an important bird area (IBA), while a recent inventory produced the following for the National Park of Samaria: 27 important plant species (among them 24 Greek endemic taxa), 3 animal taxa mentioned in the Red Data Book, 27 Greek endemic animals & 4 animal species protected by Bern and CITES Conventions [1].

2.1 Protected areas in Chania prefecture

In Chania prefecture, thirteen sites have been proposed to participate in NATURA 2000 network; they would cover almost 48% of the area. The National Park of Samaria as well as surrounding White Mountains are included into NATURA network with code numbers GR4340014 and GR4340008 respectively. Samaria National Park has been managed as such since its establishment. However, the slow evolution of the

European network causes a public discord due to uncertainty of the measures that NATURA 2000 participation may imply.

Samaria National Park (White Mountains) is the most multi - designated area of Greece due to its valuable biodiversity and geological uniqueness. Internationally, Samaria is the only area in Greece awarded the Diploma of the Council of Europe, while Samaria and Mountain Olympus are the only Biosphere Reserves of the country (MAB - UNESCO). It is been proposed that the Biosphere Reserve (BR- all three zones) covers all White Mountain area,. An area of 4850 ha has been managed for years as a Greek National Park, with the aim to achieve habitat conservation, environmental education and secondly recreation. Recent changes to the management authorities (Establishment of Management Body of Samaria National Park) include the enlargement of the Park, introducing a transition zone.

Samaria gorge is also a wild life refuge, however covering a larger area (7040 ha). Besides Samaria in Chania prefecture there are six more wild life refuges summing to 16,670 ha (nominated mainly due to their fauna). Their management includes restrictions in hunting and destroying natural vegetation, while new works are only permitted after an Environmental Impact Study and authorization of specific environmental regulations.

Another type of protected area is Nature's Monuments; however, this nomination is a rather static as a conservation procedure, since the declaration aims to simply satisfy the existence of the nominated nature's monument. There is no significant impact on the management of the area where the monument is located. In Chania, there are seven Nature' s monuments ranging from single plants (one olive tree at Vouves, the evergreen sycamore of Azogires, one sycamore tree at Vlatos and one cypress tree at Koustogerako) to small areas such as Gramvousa peninsula, the islet of Elafonisos and the Trypiti cape at Gavdos island.

2.2 Implementation of micro-reserves on Crete

Although legislation for the protection of specific plant and animal species exists in Greece for many years, its enforcement has not been always successful. Large protected areas as the ones mentioned above do not always satisfy conservation of individual plant biodiversity. One of the identified reasons for this is that specific knowledge was lacking and some species were only known as scientific references, without further idea of species biology and ecology [6]. Thus, the idea of a micro-reserve that involves research of the species provided the opportunity to both study and work on the conservation of specific plant species.

The Spanish experience of the establishment of plant micro-reserves is used in a similar pilot project. The project is initially focused in the Western part of Crete, Chania prefecture, since it covers a variety of different habitats, hosts a rich biodiversity and has an area that can be manageable for the project purposes. Six threatened to extinction species of European Community priority and one priority habitat (*9370) Palm groves of Phoenix, were selected. Plant species included perennials (*Androcymbium rechingeri* (a lily), *Bupleurum kakiskalae* (a carrot family member), *Cephalanthera cucullata* (an orchid), *Hypericum aciferum* (a St John's wort relative), *Nepeta sphaciotica* (a labiate) and the annual *Anthemis glaberrima* (a small daisy). An inventory of the localities that natural populations of the species occur was completed and fourteen populations have been identified. A selection based on specific criteria such as the degree of threat that the species is facing, the richness of the plant population, etc. was made (Table 1, Fig.1). They are all situated in three wide areas included in NATURA 2000 network. Finally, the development of a network of seven micro-reserves is selected, designed to include each of the above targeted species, as well as other neighbour species that would be also protected. Each micro-reserve covers an area less than 10 hectares, where initial studies are being carried out. In each micro-reserve the following actions have already taken place:

- Inventory of the area for the target species/habitats,
- Installation of permanent monitoring plots and meteorological equipment,
- Detailed mapping of the area &
- Management Plans identifying priorities for each Plant Micro-Reserve.

The establishment of a plant Micro-Reserve in the field included its designation with distinctive signs, as well as minor management measures (fencing and wardening of the area). A public awareness and dissemination campaigns were executed with school visitations, leaflet and T-shirts production with plant drawings. Three Botanical gardens are used for ex situ conservation, one xero-thermic plant garden at Mediterranean Agronomic Institute of Chania (MAICh) and two alpine gardens established close to the entrance of Samaria gorge and the Park Information Centre. An Information Centre for the Project is also being established at MAICh.

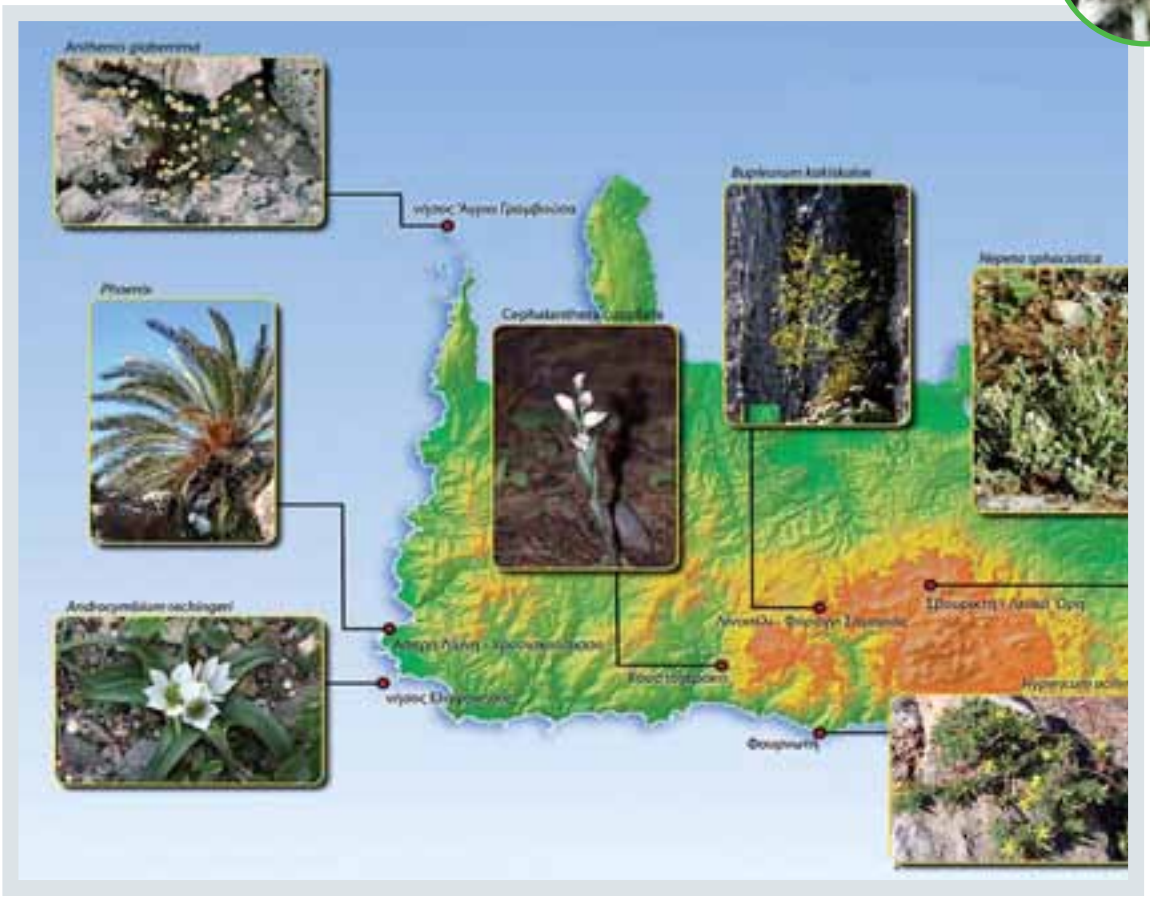

Figure 1. The Pilot Plant Micro-Reserves Network in Western Crete (Chania Prefecture).
(Map, photos and graphics: excerpt from the CRETAPLANT poster produced by MAICh, May 2006)

Each micro-reserve is being established on public land, which made the project easier, since there were no contradicting private interests. They cover a variety of altitudes ranging from sea level to 2,300 m (Svourichti). The project has not faced significant difficulties so far, except accessibility difficulties of certain areas (vertical rocks at Linoseli, or Svourichti, not accessible during winter). Public acceptance has been positive so far, with the locals getting involved in wardening and gardening activities. Neighbouring Municipalities are being actively involved as well. The dissemination campaign has also been welcomed everywhere. However, the legal framework that the micro-reserve concept should be based, needed further investigation. The reason was that a new idea had to be supported by the already existing legislation. National legislation (incorporating relevant European legislation) gave a variety of possible scenarios, however, a flexible legal tool was sought.

Table 1. Micro-reserve network on Crete

Micro-reserve name	Surface (ha)	Site Name & Code (NATURA)	Main protected species
Elafonisos (islet)	2	Elafonisos (GR-4340002)	*Androcymbium rechingeri*
Agria Gramvousa (islet)	4.5	Gramvousa (GR-4340001)	*Anthemis glaberrima*
Linoseli (Kakiskala)	1	White Mountains (GR-4340008)	*Bupleurum kakiskala*
Koustogerako	12	White Mountains (GR-4340008)	*Cephalanthera cucullata*
Fournoti	6.5	White Mountains (GR-4340008)	*Hypericum aciferum*
Svourichti (Lefka Ori-mountain summit)	4.8	White Mountains (GR-4340008)	*Nepeta sphaciotica*
Chrisoskalitissa	2.2	Elafonisos (GR-4340002)	*Phoenix theophrasti (Habitat)*

2.2.1 Micro-reserves in White Mountains

In the wider area of White Mountains, four out of the six priority plant species are found. They include: *Hypericum aciferum**, *Bupleurum kakiskalae**, *Nepeta sphaciotica** & *Cephalanthera cucullata** (Directive 92/43/EEC) naturally growing in designated areas shown in Fig. 2. Populations of the species that are found within the core area of Samaria National Park were not selected as micro-reserves, since the area is managed as a National Park (GR-4340014), thus facing fewer threats compared to the outer transitional zone.

Fig. 2. Map of the GR-4340008 (Lefka Ori = White Mountains) area indicating the locations where four of the target species occur (numbered 3,4,5,6) [7].

All above micro-reserves are located in the transition zone of the Biosphere Reserve, since the surrounding the Park NATURA site also serves as transition zone.

2.3 Selection of the appropriate legal tool for micro-reserves

The establishment of plant micro-reserves needed a detailed investigation on the use of existing legal framework of National and EU legislation and international treaties applicable to Greece, for the formulation of the appropriate legal act. After a thorough presentation of the relevant articles of existing legislation, certain proposals are made in order to provide the legal basis for a relevant legal tool in Greece [8]. The adequate articles and laws that can be used to cover the various legal provisions are mentioned and the necessary legal procedure analyzed.

Among the various possible scenarios, two are considered to be most appropriate: The first makes use of the legal procedure under the framework law for the protection of Nature in Greece (Law 1650/1986 and its amendments). The second makes use of the existing legislation for the protection of forest and wooded lands, and in particular, the provisions for the establishment of Wildlife Refuges (Law 2637/1998).

Although the first scenario seems to be more integrated, according to Greek and European legislation, the legal procedures are too complicated and time-consuming, so the effort becomes unrealistic. It is the case with most current protected areas that were established pursuant to the national legal framework and or to the Habitats Directive in Greece.

On the contrary, the experience from the use of Wildlife Refuges legislation is rather positive and the procedure flexible and effective. Thus, this scenario is proposed for adoption for the establishment of plant micro-reserves in Greece.

The advantages of the Wildlife Refuges include:

- A variety of different land use categories (wood, phrygana, wetlands, agricultural land, etc.),
- Detailed regulations concerning projects and demand for thorough impact studies,
- Fast procedures in the establishment and its implementation.

3 Conclusions

A new project, such as the micro-reserves, starts with an extra momentum. Research on the biology and ecology of the specific threatened species, a field where only scarce information had been available at the beginning of the project, was proved exciting and soon gave significant results [9, 10, 11]. We already know a lot about the species that are included in the project, as well as about their habitats and co-occuring plants. Since genetic diversity of each plant population was also studied, information is available on the conservation status of each of them [12]. Data showed lack of any diversity in some populations and certain variation in others. This knowledge will support any future, species re-introduction efforts, contributing significantly to biodiversity conservation. All this new information is very important for all but also the four species that are located at White Mountains and supports the aims of the whole area management.

Identification of individual threats, elaborated during the early stages of the project, in conjunction with initial monitoring of site changes gave the background for management measures proposed for each site separately.

They include fencing, the use of interpretation signs and wardening. Management measures are tested for the moment, by examining consecutive population data in order to finalize them. By the end of the project, each site will have a tested management protocol for the conservation of each species. Micro-reserves can be used as permanent sampling plots necessary in National Park research and management. Monitoring data will be also helpful in further monitoring studies.

The tessellated pattern of minute areas that are managed in a separate way, gives the necessary flexibility in order to work on individual species conservation. This is very important in the case of White Mountains, a large area with many different ecosystems where general measures are not applicable. Small areas are managed easier and are accepted by the locals. Additionally, the project pushed the acceleration of more general conservation procedures.

The project gave the opportunity to start a discussion on existing legal instruments, underline advantages and disadvantages not only on their establishment but also on their implementation. The identification of a flexible legal tool for micro-reserve establishment will be tested during and after the project.

Well known techniques of disseminating the results on micro-reserves have been used; however the involvement of scientific institutes, universities, forestry service and municipalities in a single conservation project has proved very successful giving a new perspective and vitality to the management of the National Park. Environmental education facilities of the Park are enriched, since an exhibition will be devoted to the project plants and the creation of an Alpine garden outside its Information Centre. Dissemination of results to numerous schools gave the opportunity to open the agenda of threatened species and their habitats, especially to youngsters.

The micro-reserve network is compatible and serves all functions of a Biosphere Reserve. Conservation, research and networking are obviously done through the project; however, development is also achieved by involving locals into micro-reserve management. The Alpine garden as well as exhibitions and other project dissemination actions will give them the knowledge on their environment thus contributing positively to local pride. The use of the micro-reserve network in combination with larger National Park and Biosphere Reserve networks contribute to a well-based competition on achieving conservation. Finally, the project may be used as a model for the development of a larger network, applicable not only elsewhere on Crete, but also in other Greek phytogeographical areas of high ecological interest.

Acknowledgements

The authors wish to acknowledge the financial support for the presented work to LIFE-NATURE program (LIFE 04/NAT/GR/000104).

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