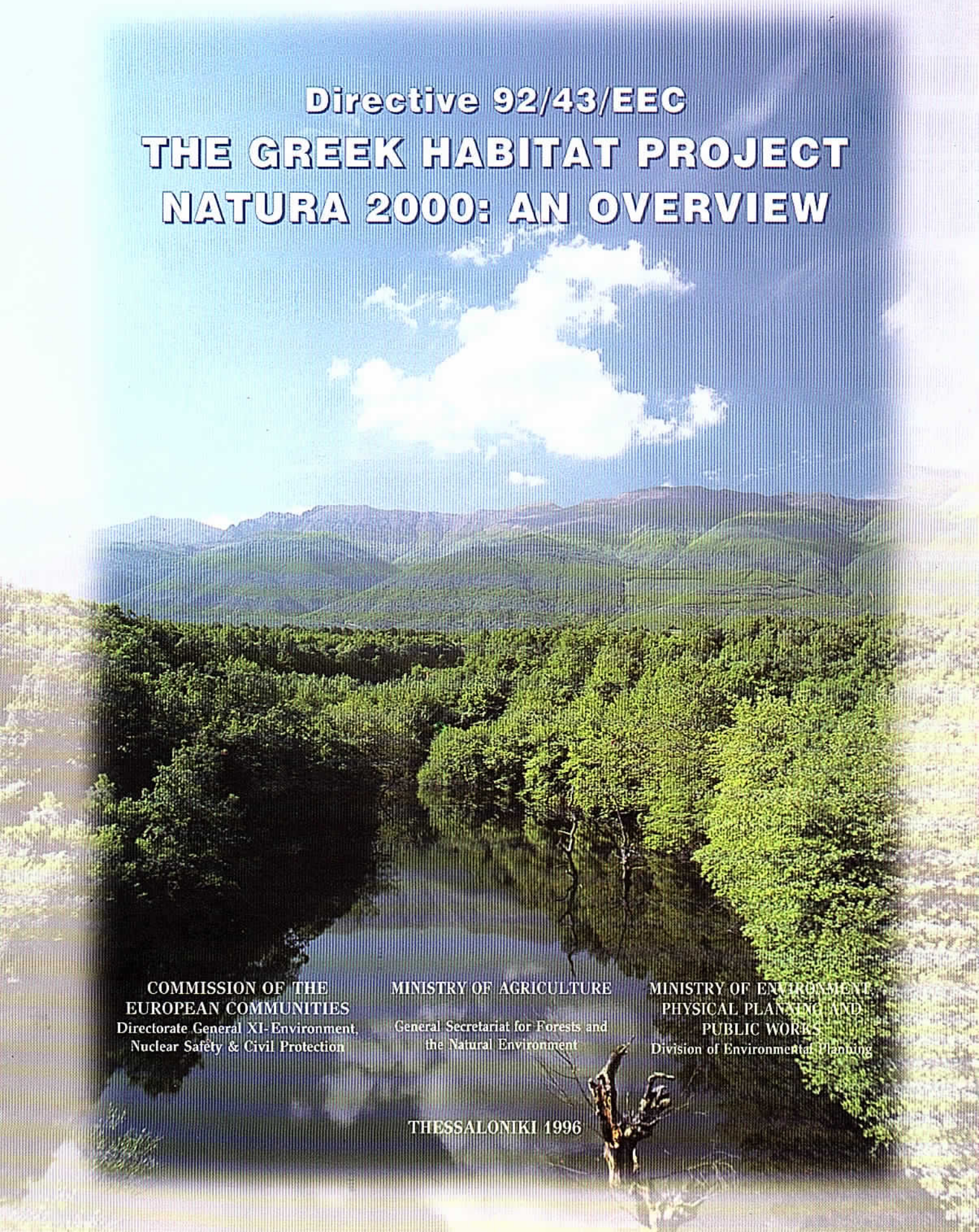
THE GOULANDRIS NATURAL HISTORY MUSEUM
GREEK BIOTOPE/WETLAND CENTRE
UNIVERSITY OF ATHENS - ARISTOTLE UNIVERSITY OF THESSALONIKI - UNIVERSITY OF PATRAS

Directive 92/43/EEC

THE GREEK HABITAT PROJECT
NATURA 2000: AN OVERVIEW



COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate General XI-Environment, Nuclear Safety & Civil Protection

MINISTRY OF AGRICULTURE
General Secretariat for Forests and the Natural Environment

MINISTRY OF ENVIRONMENT, PHYSICAL PLANNING AND PUBLIC WORKS
Division of Environmental Planning

THESSALONIKI 1996

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THE GREEK HABITAT PROJECT
NATURA 2000: AN OVERVIEW

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"Biodiversity must be conserved as a matter of principle, as a matter of survival, and as a matter of economic benefit"

(UNEP, IUCN & WWF 1992)

PREFACE

The course of Europe towards the year 2000 would be problematic if the Single Act which set the basis of the European Policy on Environment, had not been signed.

Europe was the scene, where major historical events took place for thousands of years. Rich in natural resources, it not only supported its people, but at the same time became a field of conflicts, battles, and rivalries.

For the last few centuries, Europe was the main field of the industrial revolution, while during the last decades its nations have written one of the most significant pages of their history by forming an Economic Community, i.e. the joining of the countries with closed economies and the effort for an harmonious regulation of the inequities among its Member States. Thus, Europe would ensure its cohesion and solidarity, based on a balanced economy and aiming at the promotion of economic growth.

During this course, the pace needed to speed up. The scientific and technological progress put into practice techniques of resource use which deteriorated the quality of life and led to over-exploitation of natural resources.

The urban, industrial and transport policies which were followed led to the fragmentation of the European landscape. The list of endangered plant and animal species is getting longer and longer.

One crucial issue nowadays is the isolation of small populations which cannot reach the natural resources of the ecosystems they were part of.

With a delay of many decades, the European Union gradually tries to change its conventional economic policies into ones that will take into consideration the need to conserve the natural environment. Among the pertinent efforts is to establish a network of sites hosting valuable natural habitats and species through Directive 92/43/EEC. The implementation of this Directive must be based on sufficient and reliable scientific data.

Nowadays, it is recognised that the conservation and restoration of the natural environment must be an integral part of the improved economic and social policies in Europe.

The execution of this project on the inventory and mapping of areas with high biodiversity and high ecological value in Europe is a demonstration of this improved policy.

The development of this European model is based on the common roots among the Member States; on Geography, History, and Civilisation, which offer a high potential for a uniform organisation and management of land and safeguard the earth. This mechanism will prevail in the future world.

The "inventory and mapping" turns a new page in European history. This project searches for the basic principles of ecological balance and the preservation of all life forms, so as to save the natural diversity and order which is left to be saved. It also consists the first evaluation at a European scale, of natural habitats and wild fauna and flora. It is a sound base of reference, highlighting the priorities for an integrated approach and global action.

The maps will be useful to study the life quality of the Europeans as related to their land. They will help in the planning of economic activities, so as not only to prevent the discontinuity of ecosystems of Europe, but also to enhance its natural richness.

The project is valuable from many aspects: at local, national and European level.

Greece is situated in the South East part of Europe, and consists the crossroads of three continents, having its terrestrial part bound up to the great massifs of inland Europe, and its insular part scattered in the Aegean, Ionian and Libyan Seas. Human presence is tightly connected to its natural environment. For thousands of years, the various interventions of humans were recorded in history. The small area of Greece contains a remarkably great number of natural and semi-natural habitats that host rich and valuable components of the natural heritage of Europe. In Greece, many ecosystems retain their biological functions undisturbed, while extended areas, although with clear signs of degradation, still preserve their high diversity in plants and animals. The landscape is also diverse: fields, rivers and lakes, forests, coastal areas and sand dunes, pastures. Both the natural and the man-made environment need our respect because what is good for the natural systems is good for the man-made systems and vice-versa.

The project "Inventory, identification, evaluation and mapping of the habitat types, and flora and fauna species in Greece (Directive 92/43/EEC)", especially for our country, gives a valid picture of the Greek nature. It also proves the tolerance of Greek land to its use by Man for thousands of years, and depicts the mosaic of diversity and complexity of the areas that escaped deterioration caused by humans and preserved their coherence and functions. It also evaluates the richness of Greek nature and the particularities of the landscape, as part of the European heritage. Traditional cultivations proved to be ecologically and economically valuable today, were also considered within the project.

The Goulandris Natural History Museum undertook the execution of the European project "Inventory, identification, evaluation and mapping of the habitat types, and flora and fauna species in Greece (Directive 92/43/EEC)". The Greek Biotope/Wetland Centre (EKBY) drew up the working plan and assembled the scientific community of the country under the inspirational steering of Prof. Spyros Dafis. Within a limited time, it managed to carry out the project and promptly submit to the Ministry of Agriculture and the Ministry of Environment, Physical Planning and Public Works a list of 296 sites in the country, as worthy of inclusion in the "Natura 2000" network.

The Goulandris Natural History Museum would like to thank the Directorate General XI of the European Commission, and the Ministry of Agriculture and the Ministry of Environment, Physical Planning and Public Works for their trust and for making available to the project their pertinent scientific bodies.

Niki Goulandris

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This volume is an overview of a project entitled "Inventory, identification, evaluation and mapping of the habitat types and flora and fauna species in Greece (Directive 92/43/EEC)". It provides us with the opportunity to express our deepest appreciation to DG XI of the Commission of European Communities for supporting (by 75%) the project. Also to the Ministers Kostas Laliotis (IPEHODE) and Ioannis Potakis (Agriculture) for providing the remaining 25% of the funds and their continuous encouragement. Our appreciation is extended to the Deputy Minister Ms. Elisavet Papazoi (IPEHODE) and to the General Secretaries Mr. Alexandros Voulgaris (Environment) and Mr. Ioannis Sbokos (Forests and the Natural Environment) for facilitating the project's progress in multiple ways.

The General Directors Mr. Ioannis Vournas (Environment) and Mr. Vassilios Giotakis (Forests and the Natural Environment) have embraced the idea of the project and have intervened in its favor up to its end. The Directors of the two Ministries Mrs. Theano Kelaidi, Mr. Charalambos Markou and Mr. Evangelos Papaevangelou have given the project their full attention and contributed to their success by expediting the collection of information and other procedures. The Section Heads of the two Ministries Mr. Panagiotis Drougas, Ms. Dimitra Spala and Mrs. Sophia Markopoulou assisted by Mr. Georgios Handrinos, Mrs. Stavroula Spyropoulou, Mrs. Katia Marmara and Mr. Spyros Plessas, have steered the project, offered invaluable advice on several key issues, and were instrumental in promoting the high spirit of cooperation among all bodies and persons who participated in the project. To all the above as well to all the experts and scientific collaborators of the project who worked enthusiastically and under heavy time-pressure we are grateful.

Special acknowledgment is due to the late Christodoulos Mavrovitis, General Secretariat of Forests and the Natural Environment, who was the first to start working on the planning of the project and who worked up to his last day for its proper implementation.

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The Editors

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INTRODUCTION

Greece is situated in the south of the Balkan peninsula and is a part of the European East Mediterranean Region. Its territory expands in approximately 132,000 km², its coast line is 15,000 km long, and has a great variety of geomorphological formations and rocks. In general, the climate of Greece can be regarded as Mediterranean, with mild winter and dry summer. The rainfall period is mainly during autumn and spring. The diverse composition of the substrate, the mountainous character of the country resulting in a diverse ground relief, the existence of about 42 mountains higher than 2000 m, the long coast line and the numerous peninsulas and islands all account for the high diversity of the landscape. Furthermore, distinctive and isolated biotopes result in a relatively great number of endemic or rare plant and animal species.

Greece has a wide range of climate types, ranging from the semi-arid, semi-desert climate of south-eastern Crete to the cold, humid continental climate of Rhodope. The flora has a Mediterranean, Central European and Irano-Caspian character. The physical relief is also complex; 70% of the land is mountainous. Equally varied are the geology and petrology of the country.

The diversity of bioclimates created by the interaction of the above parameters is reflected in the diversity and mosaic of vegetation and the high number of plant and animal species. Approximately six thousand plant species have been identified in Greece. In Europe, only the Iberian peninsula can show more. The diversity of vegetation, flora and fauna resulted in numerous ecosystems, from the semi-desert palm forest at Vai in Crete to the boreal forests of birch, scots pine and spruce in Rhodope mountain range. This diversity of ecosystems is crowded into a relatively small space; in travelling 150 km from the town of Kavala to central Rhodope all the vegetation zones i.e. Mediterranean, Central European and Northern (Scandinavian) are observed.

The climatic changes that have taken place during the Earth's history, and especially since the Ice Ages, have played a major role in the high degree of biodiversity in the Mediterranean basin. The north to south alignment of the Dinaric Alps and the Greek mountains facilitated the southerly movement of many species, thus enriching the flora and fauna of the region and creating many hybrids, especially among the forest trees (e.g. fir, beech). These channels of communication remain open even today. Thus, a significant number of purely mid-European species are encountered in Greece.

There is also a great variety of non-zonal wetland ecosystems (shallow coastal areas, lagoons, lakes, marshes, rivers, deltas, artificial lakes, salt works, etc.). These ecosystems are influenced more by their hydrological characteristics than by climate, and are thus classified as non-zonal.

The ecosystems of Greece, both dry land and non-zonal wetland, share a remarkable feature. Despite intense human activity which resulted in three quarters of the wetlands having been destroyed, and one of the lowest percentages of forest cover (25%) in the European Mediterranean area, these ecosystems have, to a large extent, retained their original composition. In no other Mediterranean or European country has such great biodiversity been preserved in such a natural state. Unfortunately this national and cultural heritage has not been adequately studied, evaluated, and inventoried to date. Although the existing studies provide much valuable information, they are the result of individual efforts which are scattered in various libraries and archives. It is essential to find and record all the work that has been done to date and to work out a plan of action to acquire all the information necessary for the rational management and protection of rare and unique habitats and species in Greece.

Following the adoption of the Convention on Biological Diversity at the Rio Summit in 1992, various efforts have been undertaken aiming to preserve the world biodiversity. In order to further promote the protection of natural resources, the Bern Convention on the conservation of European wildlife and natural habitats and the Directive 92/43/EEC were the next steps.

The Directive 92/43 of the EEC Council of 21 May 1992, commonly referred to as the "Habitat Directive" aims at contributing to the preservation of biodiversity through the conservation of natural habitats and wild fauna and flora within the territory of the Member States of the European Union. It provides for the development of a network of Special Areas of Conservation (SAC), called "NATURA 2000" which aims at ensuring a protection status for the natural habitats and species of Community interest. This network will consist of sites that host various types of natural habitats and flora and fauna species listed in Annexes I and II respectively. It is expected that the above network will ensure the conservation and hopefully the restoration of the various types of natural habitats and habitats of species within their natural boundaries.

In the context of the effort of the European Union for the identification and evaluation of biodiversity, the implementation of the Directive has started in June 1994 in Greece, with the execution of a project entitled "Inventory, Identification, Evaluation and Mapping of the Habitat types and Flora and Fauna species in Greece (Directive 92/43/EEC)". The creation of the NATURA 2000 network, to which the Greek Government is committed, will help protect endangered species and their habitats by ensuring their restoration or maintenance at a favourable conservation status.

The aim of this publication is to present the results of the inventory of natural habitat types and species included in Annex I and II to Directive 92/43/EEC respectively, in a concise and intelligible manner. Special emphasis was placed on the interpretation, evaluation, and illustration of the data recorded in the Standard Data Forms. To this end, distribution maps of natural habitats and species are annexed. Finally, data on species not listed in Annex II to the directive, which are referred to by the project as "Other Important Species" and which are present in the studied sites are also included in the present publication.

I. THE NATURAL FEATURES OF GREECE

by Spyros Dafis

Geographical position

Greece is the southern extension of the Balkan peninsula, and part of the European Eastern Mediterranean region. Its total land surface, including the islands, is 132,000 km² or 13.2 million hectares. It is situated from 34° 45′ N to 41° 45′ N latitude, and from 19° 30′ E to 29° 45′ E longitude. It is bordered to the north by Albania, Former Yugoslavia, and Bulgaria, and to the east by Turkey, while the coasts are washed by the Aegean, Libyan and Ionian seas.

Geology- Petrology

Greece presents a great variety of rock formations. Geologically and petrologically the rocks of Greece can be divided into pre-Alpine, Alpine and post-Alpine formations.

The pre-Alpine formations contain the crystalline schist rocks of the crystalline masses of Greece, and some small areas of sedimentary and igneous rocks. The Alpine and post-Alpine formations include the greater part of the sedimentary cover of Greece, as well as quite large igneous outcrops.

a) **Crystalline schist regions**: The crystalline schist rocks of Greece are found in the inner Hellenids zones (Rhodope massif, Serbomacedonian, Paionia, Almopea, Paiko, Pelagonian massif, and the Attico-Cycladic massif).

These zones include crystalline schist rocks found in Central and Eastern Macedonia, Thrace and on the islands of North Aegean and are composed of high grade metamorphic rocks (gneiss, marble, amphibolites) mainly of Palaeozoic.

The Pelagonian massif runs NW-SE, and extends from the Greek-Former Yogoslavia border (Varnous, Voras, Jena, Vermion, Pieria, Kamvounia, Ossa, Pelion, Orthrys) through the Attico-Cycladic massif into Asia Minor. It contains high, medium and low grade metamorphic rocks (gneiss, amphibolite, marble, phyllite, greenschist, etc.). In southern Greece crystalline schist rocks are also found.

b) **Limestone regions**: The limestones of Greece were mostly formed during the Mesozoic (Triassic, Jurassic and Cretaceous), and together with the paleogene strata and up to the flysch form the crystalline mass mountains of Greece. The mountain peaks of the Ionian islands, Epirus and Akarnania (Adriatic-Ionian region), Pindos, Agrafa, Tymfristos, Tzoumerka, the Aetolean, Tripoli and Parnon mountains, and most of the mountains in Crete consist of limestone.

c) **Flysch regions**: Flysch-strata of sandstone rich in quartz, alternating with clay schist, occupy a huge area in Greece, covering entire regions to a depth of up to 1000 m. The largest

paleogene flysch region extends from the Adriatic-Ionian mountains to the Olonos-Pindos systems, from the Albanian border to the southern Peloponnese.

d) **Neogene regions:** The neogene rocks (marine, riverine or lacustrine) consist mainly of mollasic formations (sands, clays, conglomerates, marls), travertines, and lignites porous limestones and cover large areas of low-lying land in horizontal strata. They are found mainly in Elis, on the north coast of the Peloponnese and in Corinth, in Attica, in the Kassandra peninsula in Chalkidiki, in north Evoia, in the area between Kalambaka and Kastoria, in the highest levels of the Serres-Sidirokastro-Nigrita depression and in many other parts of the country.

e) **Igneous rocks regions**: Igneous rocks (volcanic, rocks-plutonic, rocks-dikes) cover considerable areas, chiefly in northern Greece. The volcanic rocks appear as domes, napes or flows, and more rarely as dikes. Extensive extrusions, mostly of Tertiary volcanic rocks, exist in Rhodope, Thrace and Almopea, while other extrusions are scattered elsewhere in Greece, particularly in the Aegean islands (Lesvos, Limnos, Santorini, Melos, Kos, etc.). Plutonic rocks outcrop chiefly in Macedonia (granite, diorite, gabbro). The granite outcrops of Vrontou, Florina and Xanthi are important because of their size. Most of the igneous rocks in Greece are Tertiary, though some are Paleozoic. Ultrabasic rocks and ophiolites outcrop in many parts of Greece.

Orography- relief

Greece is a mountainous country, two thirds of which are largely covered by mountains of medium height. The great mountain masses run the length of the country from NNW to SSE (the Pindos complex, the Agrafa, Tymfristos, Panetolikon, Oiti, Vardousia, Parnassos, Giona in northern and central Greece, and Panachaikon, Erymanthos, the Aroania mountains, Kyllene, Maenalon, Parnon, Taygetos in the Peloponnese) and divide it into two distinct climatic and phytogeographic regions. The mountain ranges of Eastern Greece (Vermion, Pieria, Olympus, Ossa, Mavrovouni, Pelion) also run north to south and their eastern slopes face the easterly rain-laden winds, that are more humid than the western slopes, and therefore support lusher vegetation. Finally the mountain ranges of Northern Greece (Voras, Tzena, Paiko, Beles, Angistro, Falakron mountains and the Rhodope range) run east-west, shielding the country from the cold north winds. Olympus, the highest mountain in Greece, reaches a height of 2917 m and is the second highest mountain in the Balkans after Mt. Rila. Forty-one other peaks exceed 2000 m. The mountainous nature of the country produces intense relief, with steep and frequently precipitous slopes and many deep valleys, each of which, in combination with the variety of rocks, produces a distinct local environment. This creates conditions of isolation and endemism, a phenomenon very pronounced in Greece. The numerous islands and islets, chiefly in the Aegean Sea, also contribute to endemism.

Climate

The climate of Greece can be generally classed as Mediterranean, with spring and autumn rainfall, mild winters, hot summers and a varying period of drought. Within this general climate there are local climatic conditions, which have a considerable effect on the appearance of the vegetation in the area. In Greece, the following five climatic regions can be distinguished (Mariolopoulos 1938):

a) **The mountain region**, including the great mountain range which runs NNW to SSE, and the other mountains of Northern and Central Greece, the Peloponnese and Crete. The higher

the altitude, the cooler the summers, the harsher the winters, and the heavier and more even the rainfall. The climate, particularly that of Northern Greece, approaches the corresponding Continental and Central European climate.

b) **The region of Northern Greece**, consisting of Epirus, Thessaly, Macedonia and Thrace. The climate is transitional between the Mediterranean and the Continental and is marked by a relatively large annual temperature range (larger than 20°C), a more even distribution of rainfall and the reduction of the period of drought to 1-2 months.

c) **The Ionian region** (maritime Mediterranean), including the western coast of Greece and the Ionian islands. The climate is characterised by mild winters, greater rainfall which falls mainly in the winter but also in spring and autumn, and a relatively small annual temperature range of 16-17°C.

d) **The Aegean region** (continental Mediterranean). This region includes all of SE Greece as far as Thessaly, and the Aegean islands and Crete. The climate is similar to that of the Ionian region, but is cooler in winter, and drier. The annual rainfall is significantly lower, being almost half of that of Western Greece. The annual temperature range fluctuates between 13.7°C and 19.0°C, and is least on the Aegean islands. Due to the dry climate the atmosphere in this region possesses an exceptional clarity, as a result of which the sky is unusually blue.

e) **The region of Southern Crete** (semi-desert Mediterranean) has a climate transitional between the Mediterranean and the semi-desert, with low annual rainfall, mild winters and a long period of drought.

In Greece we thus meet with a wide range of climate types, from the purely Mediterranean (maritime and continental) to transitional Central European and Continental. Within these climatic regions, and in conjuction to the altitude, the relief and the nature of the rocks, there are many local variations, which are reflected in the vegetation.

History

The history of Greece has been as turbulent as the land is rugged. The early appearance of civilisation in Greece and especially in South-Eastern Greece, the cradle of ancient Greek civilisation, resulted in the early degradation and destruction of the natural vegetation, particularly in the lowlands and the islands. During its more than three thousand years of history, Greece has known triumph and disaster, and has suffered defensive and aggressive wars, conquest and pillage, all of which have left their mark on nature. Land clearance, fires, rapacious logging, overgrazing by goats etc. have so changed the original vegetation as to make a restoration practically difficult, if not impossible.

Flora

The main floristic regions found in Greece are the Mediterranean, the European (Eurasian) and the Irano-Caspian. The Mediterranean flora is found in a zone of varying width along the coasts and on the islands of the Ionian and Aegean Seas. The width of this zone and the altitude to which it reaches both decrease with increasing latitude. The Central European flora predominates on the mountains of Northern and Central Greece, gradually losing ground as we move south. Representatives of the Irano-Caspian flora, such as the oriental oak and others, are found in North-East Greece (Thrace) and on the islands of the North-East Aegean. In Crete representatives of the north-African flora are also found. Due to the geographical position and the coexistence of the above-mentioned flora regions, the flora of

Greece, in proportion to its area, is one of the richest in Europe, consisting of approximately 6,000 phanerogamous plants. Also, the country's mountainous nature and many islands favour conditions of isolation and endemism. As a result, significant proportion of plant species and subspecies (13%) are endemic. Finally, it should also be noted, that out of the 6,000 plant taxa, 263 taxa are considered as rare and threatened, according to the recently publiced Red Data Book of rare and threatened plant species (Phitos et al. 1995).

Vegetation

The interaction of all the above factors has created five vegetation zones, each with a distinct ecology, physiognomy, flora and history. The boundaries between these zones cannot be clearly distinguished, as the zones often overlap, so that representing them on a map of Greece will inevitably involve some simplification and distortion.

Coastal, hill and sub-mountain zone with Mediterranean vegetation (Quercetalia ilicis).

This zone, also known as the zone of evergreen broad-leaved vegetation, runs more or less continuously along the western, south-eastern and eastern coasts of Greece, the Ionian and Aegean islands, eastern coast and south of Chalkidiki, as well as along the Macedonian and Thracian coasts. This Mediterranean vegetation zone is divided into two sub-zones with distinct ecology, flora and physiognomy: the Oleo-Ceratonion sub-zone of olive and carob, which occupies the drier south-eastern and eastern part of Greece as far north as Mt. Pelion, the south Aegean islands, the low-lying land in the fingers and south of the Chalkidiki peninsula, and part of the Ionian islands, and the Quercion ilicis sub-zone of holm oak, which includes the wetter coasts of Western Greece, the eastern foothills of Pelion, Ossa and Olympus, the hill country of Southern Chalkidiki and the higher areas in the fingers, Eastern Chalkidiki from Stratoni to Stavros, the lower part of Mount Athos and the coasts of Eastern Macedonia and Western Thrace, while it also appears in the wetter locations on the islands of the north Aegean.

Each sub-zone is further divided into more growth zones-associations, such as Oleo-lentiscetum, Oleo-ceratonietum in Oleo-ceratonion, and Adrachno-Quercetum ilicis, Orco-Quercetum ilicis, Lauro-Quercetum ilicis etc. in Quercion ilicis. The broad-leaved evergreen zone also includes the pyrogenic associations of aleppo pine and brutia pine, the domestic pine and the spreading cypress (in Crete and Rhodes). Plant association research in this zone is limited and presents many gaps, despite its interest and the great variety of vegetation.

Sub-Mediterranean-Para-Mediterranean vegetation zone. Hill, sub-mountain, mountain (Quercetalia pubescentis-petraeae (dalechampii)).

Ascending the mountains or moving inland, we gradually leave the Mediterranean vegetation behind and enter an unusual transitional zone which appears similar to a zone of evergreen broad-leaved vegetation, from which it differs in terms of ecology and flora, or to a zone of drought-resistant broad-leaved deciduous trees and especially oak forest.

The climate here becomes gradually more Continental, with harsher winters and heavier rainfall. The dry season still clearly exists, however, although restricted. During the winter, temperatures fall below zero, and snow can last from several weeks to more than two months. This zone can also be divided into two or three sub-zones with distinct ecology, physiognomy and flora: Ostryo-Carpinion and Quercion confertae (frainetto)-cerris. For Southern Greece

(Crete-Peloponnese-Central Greece up to Lamia) a third sub-zone, that of Quercion cocciferae, can be distinguished.

i) Ostryo-Carpinion sub-zone (sub-Mediterranean):

The Mediterranean and sub-Mediterranean vegetation zones are clearly and easily distinguished in Central and Northern Greece. In Southern Greece and Crete, however, the boundaries are less clear, since *Quercus coccifera* appears in Oleo-Ceratonion, thus creating a distinct growth area (association), that of Cocciferetum mixtum. Here we see a series of growth areas (associations) such as Cocciferetum, Coccifero-carpinetum and Carpinetum orientalis (Sibljak).

ii) Drought-resistant deciduous forest zone (sub-mountain) (Quercion frainetto-cerris).

With increasing altitude we meet a zone of broad-leaved deciduous forest, which is part of the Quercion frainetto-cerris (Quercion confertae-cerris) co-association or sub-zone.

This sub-zone is a continuation of the previous (drought-resistant succession-zoning) or is found directly above the Mediterranean vegetation (moisture-loving succession-zoning). In Greece this sub-zone covers a large area, which decreases from north to south. About one third of all Greek forests belong to this sub-zone. The climate is transitional between Mediterranean and Continental (para-Mediterranean to sub-Continental), the winters are harsher and the snow lasts for several weeks, up to 2.5 months. The soil is either mountain para-Mediterranean or purely mountain brown forest soil.

This sub-zone is found on the hills, semi-mountainous and mountainous districts of Northern and Central Greece (Epirus, Western, Central and Eastern Macedonia, Thrace, Chalkidiki, Thessaly) as well as in Central Greece (Sterea Ellada) and the Peloponnese. Here too we can distinguish more growth zones: Quercetum frainetto, Tilio-Castanetum, Aceri-Castanetum, Quercetum montanum (Quercetum cerris and Quercetum dalechampii) etc.

Although this zone has been better studied than the previous one, due to its economic value, there are still many gaps in our knowledge, that represent a challenge to the new generation of plant association specialists.

Zone of beech, beech-fir and mountain para-Mediterranean conifer forests (Fagetalia). Mountain-sub Alpine

As moving up into the mountains the climate becomes mountain Mediterranean, approaching that of central Europe. The winters are harsher, the summers cooler, rainfall increases and is more evenly distributed throughout the year, the snow lasts several months and the dry season, although it does not disappear completely, is restricted to 1 to 1.5 months.

After the zone of para-Mediterranean broad-leaved deciduous trees (Quercetalia pubescentis-dalechampii), in Southern Greece up to Parnassos appears the zone of mountain para-Mediterranean conifers (*Abies cephalonica* and *Pinus nigra ssp. pallasiana*), while in Central and Northern Greece there is the sub-zone of hybrid fir forests, black pine forests, mixed fir and beech forests and beech forests, which extend up to the man-made treeline (1800-1900 m). This zone is also divided into two, or possibly three, sub-zones with distinct ecology, physiognomy and flora; the sub-zone of Abietion cephalonicae, the sub-zone of Fagion moesiacae or Fagion hellenicum and possibly also the soil dependent sub-zone of Pinion nigrae on dolomitic and ophiolitic rocks.

The first sub-zone is dominated by the cephalonian fir (*Abies cephalonica*), which is of

great value in Greek forestry. It is questionable, however, whether the cephalonian fir forests should be included in Fagetalia and this may be subject to reconsideration. The cephalonian fir frequently intrudes into the Quercetalia pubescentis-dalechampii region, and even into the higher region of Quercetalia ilicis, and many fir forests have occupied the sites of older oak forests. The undergrowth is also dominated by Quercetalia pubescentis species, while the Fagetalia species appear more rarely and in the most favourable sites. Here more growth zones can be distinguished.

The sub-zone of Fagion moesiacae or Fagion hellenicum can be divided into the growth zones, Fagetum moesiacum, Abietum borisii regis and Abieti-Fagetum moesiacae. The beech forests do not appear in a continuous band as in Central Europe or Former Yugoslavia, but in groves on north, north-east and north-west facing sites and almost exclusively on silicate rocks. Fagetum moesiacae, which could comprise a separate sub-zone (Fagion hellenicum), is further divided into more growth zones (associations): Luzulo-Fagetum, Galio odorati-Fagetum, Taxo-Fagetum, Fagetum nudum, Aceri-Fagetum etc.

The forests of hybrid fir (Abietum borissi regis) are found chiefly in central Pindos and belong to Fagetalia and Fagion moesiacae, with the flora of which they have much in common. Here more growth zones can be distinguished.

In medium sites, where beech is less able to compete, mixed forests of beech and hybrid fir (Abieti-Fagetum or Fagetum moesiacae-Abietosum) are encountered.

As mentioned earlier, of special importance are the forests of black pine, which usually occupy the same geographical areas as those of beech and fir, but mainly on ophiolithic or dolomitic rocks, where they create continuous communities dependent on soil conditions. Black pine and hybrid fir also appear in Quercetalia pubescentis-dalechampii areas. The black pine communities have very little in common with the flora of the fir, and even less with that of the beech.

Zone of boreal conifers (Vacinio-Picetalia) Mountain, sub-Alpine

This zone appears only in Northern Greece on the high mountains (Olympus, N. Pindos, Pieria, Orvilos, Rhodope, the highland arc of Aridea) and consists mainly of forest remnants. The climate is Continental with harsh winters, even rainfall distribution, no droughts and long periods of snow cover. Here two sub-zones can be distinguished; that of Pinion heldreichii, which is found chiefly on dolomitic-limestone and ophiolithic rocks on Olympus, N. Pindos and Orvilos, and that of Vaccinio-Piceion, which is found mainly on silicate rocks. To this sub-zone belong the Scots pine forests of Pieria, Rhodope, Lailias, the spruce forests of Rhodope, the birch forests of Rhodope and the highland arc of Aridea, as well as the forests of the Balkan pine (*Pinus peuce*). Here too the plant communities need to be further studied.

Highland zone above the treeline, mountain Mediterranean, sub-Alpine and Alpine (Astragalo-Acantholimonetalia, Daphno-Festucetalia).

Above the largely man-made treeline, scrubs and grasslands are found which have suffered from overgrazing, as these areas have been used as summer pasture for centuries by nomadic shepherds. Three sub-zones can be distinguished again: Astragalo-Daphnion on the limestone mountains of Central and Southern Greece, consisting of the thorny semi-shrub *Astragalus gr. tragacantha, Berberis cretica, Daphne oleoides, Stipa pennata, Festuca* sp. etc., the Junipero-Daphnion which appears on the mountains of Northern Greece, where are found *Juniperus communis* ssp. *hemisphaerica, Dapne oleoides, Festuca* sp. etc., and a purely Alpine zone

at the tops of the highest mountains of Northern Greece (Olympus, Tymfi, Smolikas, Voras, Falakron) with purely Alpine vegetation (Poion violacea etc.).

Fauna

The geographical position of Greece which is located between Europe, Asia and Africa, the climate and the variety of biotopes contribute to the special character and the large number of its animal species. However, the expansion and intensification of human activities have increased the pressures to the wildlife of Greece. Today there are still many gaps in our knowledge of the Greek fauna. Although invertebrates are the most poorly studied group of animals, there may also be vertebrates that have not yet been recorded. In particular, the total vertebrates number encountered in Greece is around 670 species and subspecies, whereas invertebrates are estimated to reach 20,000 although an invertebrate chek-list for Greece has not yet been produced.

II. BIODIVERSITY IN GREECE AND THE ROLE OF THE NATURA 2000 NETWORK

by Spyros Dafis

After the Rio Convention in 1992 the term "biodiversity" entered our lives, more or less as a panacea which would solve all ecological problems. However the term had been used long before Rio to express the diversity of life forms to be found in a particular place. Despite the simplicity and clarity of the term its content is one of the most abstract and debatable in ecology. The reason is that there are not one but many biodiversities at different levels of biological organisation, and that there is no uniform method of expressing or rather assessing this. In practice, four different levels of biodiversity can be distinguished, each having its own special value while at the same time being an inseparable part of the whole.

The **first level** is that of **"genetic diversity"**. Genetic diversity refers to the range of genotypes in a particular species. The greater the range the more tolerent the species in the face of external stresses such as pests and diseases, adverse climatic changes, etc. It is clear that natural species have a far greater range of genotypes than artificial or genetically improved species and hence are more robust and adaptable than the latter. In Greece, due to its geographical position, variety of climate zones, mountainous terrain and history, plant and especially tree species show a high degree of genetic diversity, which has so far been very little studied. During the Ice Age, many Central and Northern European species migrated southwards and reached Greece, thus creating either heterogeneous populations of one species or hybrids with the pre-existing species, and in this way expanding the range of genotypes. Well-known examples are the King Boris fir which is hybrid of cephalonian and silver fir, and the moesiac beech, hybrid of oriental and common beech. In these hybrid populations one meets all the variations and intermediate stages between the one species and the other, depending on the latitude and local climate. Another example of heterogeneity and consequently great genetic diversity comes from the population analysis of the scots pine in Pieria and the spruce in Rhodope. These species reached Greece during the Ice Ages from different regions, whose characteristics they bear even today. Thus within a small area the scots pine is to be found in all its forms from tall, narrow, thin-branched Alpine types to rounded, thick-branched types from the plains of Poland. The same goes for the Norway spruce: types dispersed in Central Europe are found in Greece gathered together in a relatively small area. This large genetic diversity of the above species (fir, beech, scots pine and spruce) is to be found in almost all Greek forest species. The same is probably true for other Greek plant and animal species. This, together with the great advantage that the country's ecosystems have, despite considerable degradation, remained qualitatively in their natural composition, makes Greece very important as a gene bank and in general a reserve of genetic material that needs to be studied and conserved.

The **second level** is that of **species biodiversity**. This biodiversity is expressed as the

number of plant and animal species to be found in a particular area. For many researchers however this definition is insufficient. They believe that the number of species does not always give a true measure of biodiversity, as the species population, the size of individuals, their biomass and the dominance of certain species also enter into the equation. Others measure biodiversity by the number of functions performed by the species in a particular ecosystem, in other words the number of niches. Since, however, it is difficult to evaluate all these parameters, for the time being we must be content to define species biodiversity as the number of plant and animal species found in a particular area or ecosystem. Species biodiversity is of obvious importance to ecological balance, the stability and operation of the feedback mechanisms in an ecosystem. The more species there are in an ecosystem, the more stable the system, the denser the food web and the biosystems, the smoother the biomass and energy flows and nutrient recycling, and the more efficient the operation of the feedback mechanisms. Apart from this, many organisms have in the course of their ontogenetic development become closely associated with other organisms, so that the existence of the one depends on the existence of the other. This is why the extinction of a species can have unforseable consequences. Greece, for the reasons mentioned above, presents high species diversity. Indeed, for its size it contains the greatest biodiversity of all Member States of the European Union. Although this level of biodiversity has been studied more than any other, there is still need for further work, particularly as regards the spatial distribution of species.

The **third level** is that of **habitat diversity**, expressed as the number of links between plant and animal species (habitats) found in a particular area. The number of habitats and their spatial distribution form a mosaic of habitat types which puts its stamp on the landscape of the area, so by protecting habitats not only one protects the species that compose them but also preserves the character of the landscape. Greece, due to its large number of links between plant and animal species, presents great habitat diversity, which unfortunately has been insufficiently studied despite its obvious importance. The competent authorities should accept the pressing need to map the country's plant communities, as being of vital importance for the conservation of Greece's natural environment.

The **fourth level** of biodiversity is that of **landscape diversity**, expressed as the number of landscape types in an area. Landscapes include not only natural habitats but also man-made ecosystems such as farmland and human habitations. The number of natural or man-made habitat types, their spatial distribution and relative frequency determine the character of the landscape. In addition to landscape architecture, which is taught in many educational institutions, recently the new science of landscape ecology has been developed, to study the interactions and interrelationships between the ecosystems that compose a landscape and especially between natural and man-made ecosystems.

Greece has great landscape biodiversity, for the same reasons that it has great genetic, species and habitat biodiversity. The landscapes range from the semi-desert of Eastern Crete to the Scandinavian (northern) of Rhodope and the Alpine of Mts. Olympus, Smolikas, Timfi, Voras and the other mountain ranges of Northern Greece. Within the relatively short distance from town Amphipolis to Central Rhodope one meets all the landscape types from the Mediterranean, with olives, holm oak and *Arbutus sp.*, to the northern landscapes of boreal conifer forests with Norway spruce, Scots pine and birch.

To sum up, one can say that Greece possesses a high degree of biodiversity at all levels-genetic, species, habitat and landscape.

Regardless of the distinctions between the different levels, biodiversity must be conserved as a continuum, as one entity. The conservation of each level depends on the conservation of

the levels above and below. Landscape protection and conservation depends on the conservation of the biodiversity of the component habitats. The stability of the habitats depends on protection and conservation of the species that contribute to their structure, that is the species biodiversity, and the protection and survival of the species depends on the conservation of their genetic biodiversity, the conservation of the full range of genotypes.

In closing we would like to stress that the conservation of biodiversity at all levels is not a romantic ideal but a precondition for the sustainable management of natural resources, and consequently for the survival of man himself.

The implementation of Directive 92/43/EEC for the conservation of natural habitats and wildlife and the creation of the European NATURA 2000 network will contribute significantly to biodiversity conservation. The greatest strength of the directive is that it aims to protect species and habitats via a network of protected sites. This will provide comprehensive protection of biodiversity, the principal aim of the directive and the NATURA 2000 network. Unfortunately, the Annexes to the directive listing the natural habitat types and plant and animal species of Community interest do not make allowance for the great biodiversity found in Greece. A significant number of habitat types and an even larger number of native endangered species of the country's wealth of flora and fauna have been left out of these Annexes. The competent Greek authorities must work to ensure that these habitat types and native plant and animal species are included in the forthcoming adaptation of the Directive. The inventory being drawn up as part of the implementation of Directive 92/43/EEC in Greece could contribute significantly to this goal, as could the researchers whose dedicated work has made it possible.