# THE MOUNTAIN AENOS OF CEPHALONIA ISLAND

## HISTORY – PHYSIOGRAPHY – BIODIVERSITY

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MANAGEMENT BODY OF AINOS NATIONAL PARK

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*Abies cephalonica* cones from Mt. Aenos (*locus classicus* of this species).

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# PREFACE I

In 1998, the book titled *Dedication to the National Park of Ainos* was published by the Museum of Natural History of Cephalonia and Ithaca, and edited by the President of this Museum, Dr. Niki Efthymiatou-Katsouni.

In the preface of that edition, it is noted by the writer of this preface: *This book constitutes a scientific and historic summary of Aenos.* The content of this publication could be considered similar. If that is the case, however, what is the necessity of publishing a similar work, just as painstaking and, in our day and age, multifold costlier? It has to do with the fact that 17 years have passed! And in the meantime, many things have come to pass and just as many have changed! Yet, the charm of Mt. Aenos, historical, geographical and cultural, but mostly the love of the Cephalonians for the mountain, have remained unchanged.

In the meantime, the Administrative Council and the personnel of the Management Body of the National Park of Mt. Aenos, along with their partners, have worked and continue to work with zeal for the protection of the Park from forest fires, the creation of walking trails with informative posters for the trekkers, excursions for the young pupils of primary and secondary education, as well as for the many others, who are interested in the beauties of the mountain. They mainly provide, however, for the protection and promotion of the biodiversity of the National Park and its publicity, through scientific seminars, informative days, posters, provision of material for awareness raising etc.

Dr. Niki Efthymiatou-Katsouni, possessing both scientific knowledge of the history of Mt. Aenos and a patriotic love towards it, states the following in the book *Dedication to the National Park of Ainos*: *We believe that this particular mountain constitutes the underlying cause for a series of events, which determined the historic, socioeconomic and cultural framework, in which our ancestors lived and laboured. Even at the mere mention of Ainos, numerous thoughts intermingle and rise from the depths of our historic memory, linking our present with the past. The history of Cephalonia is tied to its mountain.*

Having faith in the above words, the editors of this publication, as well as the invaluable and distinguished colleagues who participate with their specialised contributions, present you with the work you hold in your hands. A multifaceted and copious work.

Whatever more I could have added to this preface is included in the one I wrote in the edition of the first book *Dedication to the National Park of Ainos*. For this reason, it is presented in the next page in its entirety!

Patras, December 2015

Dimitrios G. Phitos
Prof. Emeritus, University of Patras
Honorary President of the Hellenic Society
for the Protection of Nature

# PREFACE II

## From the Book *Dedication to the National Park of Ainos, 1998*

*"...and Ulysses led the magnanimous Cephalonians..."*
Homer, the Iliad, B, 631

I dedicate this short preface to the "magnanimous Cephalonians", those who with their love, their cheerfulness and their humor accompanied the unforgettable Prof. J. Damboldt, Georgia Kamari and myself on numerous excursions to the peaks and sea-sides of their island. Our purpose was to study the most interesting flora of Cephalonia and to record it in a pertinent publication.

The geomorphology of the island with its changing landscape, high peaks, numerous bays and marshes, as well as its diverse geologic composition, has created a number of habitats. To the above we should add the location of the island near mainland Greece as well as its bio-geographical relation to the eastern coast of Italy, especially to Gargano mountain. What else would an island like Cephalonia need in order to be considered a privileged place, in a biological sense? All the above facts are reflected in the wealth of its flora, especially the flora of Aenos. The crown of this wealth and symbol of this island is undoubtedly the Cephalonian Fir. The Cephalonians righteously recognised its value and immortalised it on their coins (Municipality of Pronni, 4$^{th}$ century BC).

Besides the flora, the various groups of animals referred to in the special chapters of this book are also interesting and rich in species.

A small team of Cephalonians decided that this wealth of the island's world of plants and animals, both those alive today and those that lived in the past (fossils), as well as minerals etc., must be made known. I imagine this is the reason which brought the Museum of Natural History of Cephalonia and Ithaca at Davgata into being, a project for which a lot of courage and self-confidence was needed. The members of the Museum's Governing Council had the necessary mental reserves so that the private initiative could once again work miracles. I am certain that the humble buildings, housing today the first acquisitions of the Museum, will soon grow and expand.

Already the educational and cultural mission of the Museum is becoming a reality. Visits of about 500 students from ten Elementary and High Schools followed the opening of the Museum in 1997. The work has already started bearing its first fruits. We must not forget that getting young people, even from childhood, interested in the cause of the protection of Nature is the only hope for the formation of environmentally conscious citizens. It must be noted here that paragraph 21 of the Declaration of the International Conference of "Environment and Society" organized by UNESCO (Thessaloniki 1997) states: "Schools must be encouraged and supported in adjusting their curricula to the needs of a promising future".

Certainly the protection of nature is not a simple matter, since it is usually dependent upon the economic development of the country. But the need, on the other hand, for harmonisation and attainment of a dynamic equilibrium between economic development and humane environment is unquestionable. Everybody knows, anyway, that avoiding progress in order to leave the environment untouched is a romantic sentiment. Are there indications of such balance in our country? Why, for example, preserve the fir forest of Aenos instead of turning it into pasture land? Perhaps, in this case, the words of a foreign scientist are more persuasive than ours: *Nature always gives credit but never forgets to present the bill! Now, the time has come to pay our debt to the environment.*

This book constitutes a scientific and historic summary of Aenos. The separate chapters on the fauna, the flora, the geology and the history of the mountain, written by specialists, lend the book distinctive prestige. Of course, it is impossible for the book chapters to include anything but the basic information. It is, however, the first time that such material on Aenos is contained in one volume. The many photographs accompanying the texts give the book a special aesthetic charm. The satisfaction of those few who undertook the burden of this edition will surely be the pleasure it will give the reader. For it is certain that not only the unsuspecting but also the nature lovers will discover in its pages the beauty of Cephalonian nature. The greatest benefit, however, will come at the moment when the innocent eyes of a child turning the pages of this book will light up in wonder at the sight of a beautiful flower or a strange insect. At that exact moment it will be impossible to consider anything else other than to protect this nature.

I will conclude my preface with a hymn to the much-enduring but proud Aenos to which this book is dedicated. It is the words of the Austrian botanist F. Unger who visited Cephalonia in 1860.

*Imagine the view opening in front of you standing at an altitude of 5000 feet on the top of a mountain, the southern part of which emerges almost straight out of the sea not* *far from the closest point of mainland Greece, surrounded by smaller islands…At the same time, however, it is easy to understand the reasons why foreigners – in this case the British conquerors – brought to light this gem of an island, ideal recreation refuge during the unbearable hot days of summer. The sun was already setting and that meant it was time to leave this admirable temple of nature…Quickly we started back. Already it was getting dark at Valsamata and on way to Argostoli, passing over the bridge crossing the lagoon, myriads of stars were mirrored in its calm dark waters.*

The stars that Unger saw are in the same place today, the land and the islands are still there. The appearance of Aenos, however, in no way reminds us of the Black Forest, the "Monte Nero".

In 1962, the forest of Aenos was designated as a National Park in order to preserve whatever was left of its famous beauty and biological wealth. The legal frame for its protection has been established. The Cephalonians, with the help of the competent Forestry Service, are capable of putting it into effect. All they need is their will to do it!

Dimitrios G. Phitos
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We particularly thank our distinguished and invaluable collaborators, who participated with scientific contributions in the synthesis of this work and at the same time we express our delight for this collaboration. Their names are cited in a subsequent list, but also at the end of each contribution. Besides, we cannot hide our satisfaction that this book is the product of “Greek minds”!

The Assistant Professor of the University of Patras, Dr. Argyro Livaniou-Tiniakou, supervised during the years 2012-2015 the implementation of the project with the title “Assistance in recording, monitoring and sustainable management of the flora of the National Park of Mt. Aenos”. Within the framework of her involvement, she offered with exemplary eagerness her experience during the writing of this work. We owe her our warmest thanks.

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Dr. Rea Artelari, Associate Professor, Dr. Argyro Livaniou-Tiniakou, Assistant Professor and Dr. Sofia Spanou of the University of Patras read with particular care certain chapters of the English edition of the book. We express our sincere gratitude for their valuable comments and corrections.

We also thank our other collaborators and friends, who offered photographic or other informational material, as well as all those who contributed in any way to the completion of this volume with their interest.

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The Editors

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# P A R T I

## HISTORICAL OVERVIEW OF MT. AENOS

# A. AENOS, THE MOUNTAIN OF CEPHALONIA

*Apollonius Rhodius II, 297*

## Introduction

This article is intended as a tribute to the *Big Mountain* of Cephalonia, Mt. Aenos, which for centuries is connected to the course of its history.

The presence of this mountain literally haunts the fate of the island and in one way or another affects the residents' lives through the centuries. The ancient writers surrender Aenos to us as a historical and sacred mountain, surrounded by the glamour of mystery and Deity. It has always played a decisive role in shaping the political, economic and social life of the inhabitants, guiding their choices and also forming their metaphysical searches and their religious sentiment. Its relationship with various myths, religious or historical events and its role in the overall political development of the island place it as the central point of reference for the overall progress of Cephalonia from mythical times until today (Efthymiatou-Katsouni 1998).

Aenos, therefore, seems to have a continuous timeless presence. Since the era of the island's historical obscurity, without any sources, written or other, having reached us, folk tradition preserved only morsels from the 'perpetual present' of the sacred mountain. These elements are traced disguised under various mantle in customs and traditions that survive to this day in folk memory. Therefore, the characterisation "Aenos of myth and history" is rightfully appropriate.

But time does not work only at the expense of memory and tradition. The forest, vegetation and fauna are at the mercy of environmental changes and over the centuries human interventions have injured the forest's wealth, threatening the survival of endemic and rare species of flora and fauna biodiversity. However, we believe that despite these problems, nowadays it has been realised what the *Big Mountain* means for Cephalonia and Greek nature and that neither the memories with which it is affiliated will be lost nor its natural wealth will disappear. These objectives are also served by this work as a whole.

With regard to our own focus area, we will try to highlight the diachronic effects of Aenos as a natural factor in the historical course of the island.

## A1. Let us start with the names. The ancient sources. Cephalonia and Cephalonians

Attempting to investigate the presence of Cephalonia, Cephalonians and Aenos in the past, we will find ourselves at an impasse. Paradoxically, historical references of the three mentioned names are not chronologically consistent. Because the relationship among the island, the mountain and the residents involves dynamic interdependence, as it appears at least from the 5th century B.C., we consider it advisable to cite the sources of names concerning Cephalonia and its mountain.

Homer mentions neither *Cephalonia (Κεφαλληνία)* nor *Aenos (Αίνο)*, but only the people *Cephalonians (Κεφαλλήνες)*, who do not reside solely on one island but in different regions: *Ithaca* and *Niriton*, *Krokilia, Aigilipa, Zakynthos, Samos* and the opposite mainland coasts (Iliad B, 631-635, see Monro & Allen 1958). It is no wonder that Zakynthos is mentioned, but not Cephalonia, the distance from which is equally small, as in Homer's time, and it was in the same position as 9,000 years ago. Also, no other island is named as *Cephalonia*; in fact only its people, the *Cephalonians* are cited. Then, to which island did these people give their name? What was the Homeric name of the island neighbouring Zakynthos? Logically, we conclude that Zakynthos retains its name from the Homeric times, while the island, which later on became known as *Cephalonia* initially would be known by another name and it was "re-baptised" at some point during its historical course (Efthymiatou-Katsouni 2012).

The questions, posed by the identification of Homeric geography, remain unanswered since the time of Strabo, who was the first to point them out since the first century B.C. and they are subject to different interpretations by successive researchers (Strabo X. C455, 13 and 456, 14, see K.L.G. 1994). So far no definitive answers have been given. Therefore, we are restricted at the stage of inquiry and theory until the successful and final judgement by the archaeological research.

Specifically: delving into the sources, we meet the name *Cephalonia* for the first time in the 5th century B.C. in Herodotus (484-410 B.C.) during the recounting of the Persian Wars, in which Pali's inhabitants (*Παλεῖς)* participated with two hundred men (Herod. IX. 28 see K.L.G. 1992). Pali was the first of the states of the Cephalonian Tetrapolis (four cities), which appears to have had an active role in Greek affairs.

The Greeks, after their triumphant victory against the Persians at Plataies in 479 B.C., dedicated to the Delphic Apollo a 6 m tall, bronze column, built from the spoils of the wars against the Persians (Fig. 1).

At the top of the column a gold tripod was based. Its body consisted of three entangled serpents, on the coils of which the names of the 31 cities that took part in the battle had been inscribed, Pali among them too: During the Byzantine times this tripod was transferred to the Hippodrome of Constantinople and part of it is preserved until today.

After Herodotus, the more analytical Thucydides (455-404 B.C.) designates the geographical position of the island opposite of Akarnania and Lefkada, naming all four cities of the Cephalonian Tetrapolis: *Pali, Krani, Sami, Pronni*. Also in the description of the Peloponnesian War's events he refers to the navy of Pali and the Battle of Krani's inhabitants against the Corinthians in the valley of Krania (Thuc. A. 27 B, 33 see K.L.G. 1992-1994).

Fig. 1. Part of the bronze tripod of Delphi. In the third coil from the base, the name of Pali's inhabitants is stated as Palii (*Παλεῖοι*) (Photo from the History of the Greek Nation, Vol. B, p. 351).

## A1a. The citation of Aenos in the sources

Aenos is first cited in the work *Γυναικῶν Κατάλογος* ἤ *Ἠοῖαι* (Ginakon katalogos i Iie), which is attributed to Hesiod (750-700 B.C.). We translate verse 28 (57): "*There they prayed to Aeneio* (Zeus), *who lived up above*" (Hesiod, see Lekatsas 1939). In the late 3rd century B.C. it is also cited in the *Comments* of Apollonius Rhodius (II, 297, in Partsch 1892). We translate: "*There is a mountain of Cephalonia, where there is the sanctuary of Aenesius Zeus, which is mentioned by Leon in Periplus and by Timosthenes in Limenes*".

The sources which the scholar, grammarian and poet of the *"Argonaftikon"* Apollonius Rhodius refers to, is the work *"On ports and islands"* by Timosthenes, also from Rhodes. He was almost a contemporary of Apollonius (3rd century B.C.) and admiral of Ptolemy Philadelphus, king of Egypt. Leon may have been the *Macedon*, historian of the 4th century from Pella.

In the 1st century B.C. Strabo also describes Aenos in his *Geografika* (I. C456. 15, see K.L.G. 1994). We translate the excerpt: *"This (Cephalonia) is mountainous ... in it there is a very big mountain, in which the temple of Aenesius Zeus is found.*" Comparing the aforementioned sources from a chronological point of view the following concern rises: why does Homer (8th century B.C.) ignore the famous temple, while Hesiod (750-700 B.C.) mentions it slightly later? And why is this important temple not mentioned anywhere else from Hesiod until Apollonius Rhodius, even though a period of roughly over three hundred years had passed in between? It could perhaps be said that in the meanwhile, the relevant sources might have been lost. The answer, in our opinion, is connected with a) the paternity of the work "*Ἠοῖαι*" and b) the final configuration and prevalence of the Greek Pantheon in mainland Greece and on the islands.

## A1b. Why is Aenos not mentioned by Homer?

In order to best approach the inexplicable to us until now non-mentioning of Aenos by Homer, we must comment upon the authenticity and authorship of the work "*Ἠοῖαι*" or "*Γυναικῶν Κατάλογος*". It is now certain that this work is not Hesiod's, but rather of a whole school of poets of Hesiodic tradition in Alexandria, so clearly a work created later than Hesiod's time, i.e. after the end of the 8th century B.C., during which the poet lived. This can be concluded based on the date that *"Ἡοίας της Κυρήνης" (Iias tis Kirinis)* was written. The Greek colony of Cyrene in Egypt, which he is referring to, was founded in 630 B.C. Therefore, this specific "*Ηοία*" was, logically, written after 630 B.C., i.e. at a time, when neither Homer nor Hesiod lived (Jacob & Girgenis 2001). Thus, the mountain became known by the name Aenos after Homer and Hesiod.

Given the fact that the geomorphology of Cephalonia remains stable for almost 9,000 years (Phitos & Kamari 2009), the question arises: what was the name of the mountain in Homer's time? Aenos existed as a mountain, since Cephalonia emerged from the bottom of Tethys. Its mountains neither moved nor disappeared, as neither did the island itself on which Aenos stood. However, it is easier to shift a place's name within the same area.

More specifically: the mountain, the outstanding natural beauty of which emerges from the verses of the Odyssey, is *Niriton* of Homeric Ithaca and not of today's Ithaca, *"the* *majestic, windswept mountain, fully covered by forests"*. But eminently, these are features of the Cephalonian mountain, which is covered by dense Fir forest. We, therefore, believe that *Niriton* is the earlier name of Aenos. This is supported by the geomorphology of the mountainous regions of Cephalonia, which are high enough for the Fir trees to thrive, while the altitude of the mountains of today's Ithaca does not justify the existence of an extensive Fir forest. If we take into account that its highest mountain, Niritos, is only 804 m, and the Fir tree grows above 600 m, it is obvious that if in today's Ithaca there previously existed a Fir tree forest, this would have extended only along a narrow and limited strip between 600 and 804 m.

Given the above observation, we present the view that the poet could not have been impressed by the sight of the sparse forest of Ithaca, while ignoring the view of the majestic Fir forest on the exact opposite mountain (the Cephalonian one) of the island, not named Cephalonia. Besides, the eastern part of Cephalonia, the area of Sami, where Aenos stands proud, was part of the Odyssean State. Furthermore, the matching of the Fir tree with the "*paddle*", and the wandering of Odysseus with "the Fir tree", i.e. with the paddle on the shoulder, indicates a tradition inherited to Cephalonians by more ancient generations. The skill and experience of the hero in the treatment of the Fir tree, as described in the construction of the boat on the island of Calypso, testify to the long duration of him learning this art, which is associated with the close proximity and contact with Aenos, the source of the raw material (Odyssey E, 237-240, see Allen 1958/1962).

It is impossible for Homer to ignore the prestigious mountain of the Ionian sea given its volume and height, while otherwise thoroughly describing the characteristic landscapes and nature of Homeric Ithaca, such as: the twin ports, the bay of Forkinos, the lair of Nymphs, the stone of Korakas, the islet of the of the suitors' ambush, the vineyards, the orchards with the fruit trees, the sheepfolds etc. Therefore in our view, the omission of Aenos from the epos is due to the fact that the mountain was then known under another name.

Summarising the above, we draw the following conclusions: Homer does not mention Aenos, because he does not know the mountain as Aenos, since apparently, the worship of *Zeus*, with hymns (=Aenos), from which it took its name, had not yet been established for reasons which we shall mention in the following chapters. When Homeric *Niritos* was renamed to Aenos, that name was transferred to a neighbouring, anonymous mountain of Ithaca, thereon called *Niritos*. The same happened also with the anonymous (?) island, which became known by Herodotus as Cephalonia in the recounting of the Persian Wars, approximately three centuries after Homer (Efthymiatou-Katsouni 2012).

### A1c. When was the mountain named Aenos?

The period of antiquity when the mountains and the islands of Greece acquired their names, as well as whether this happened at the same time, is unknown. The etymology of only some of the names testifies to a pre-Hellenic root, such as: Υμηττός, Αρδηττός, Παρνασσός, Δίκτη, Ίδη, Όλυμπος, Πήλιον, Μαίναλον, Ερύμανθος etc. (Ymittos, Ardittos, Parnassos, Dikti, Idi, Olympos, Pilion, Menalon, Erymanthos etc. and generally of those names ending in -ηττος, -σσος, -νθος (-ittos, -ssos, -nthos) (Babiniotis 2002).

However, there is no data for mountains on islands that are smaller than Crete. We do not exclude the possibility that they were gradually being named over time, i.e. when the need arose to define the mountain ranges either as state borders, for religious reasons or on the occasion of several other important events. Most mountains might not have had a name.

We believe that naming Aenos stemmed from such a need. The meaning of the word Aenos (from the Greek word *αἶνος*=hymn, praise to God) refers to worship ceremonies {*αἰνείω* and *αἴνημι* (Aeolian type) synonyms of αίνέω-ῶ=praise}. Because of *αἶνος* (praise), with which the priests or worshippers addressed Zeus, the mountain was named *Aenos*. Therefore, we express the opinion that the name was given to the mountain at the same time with the establishment of the worshipping of Zeus in Cephalonia as well, resulting in the foundation of the sanctuary at the summit of Megas Soros. In this context, Zeus received the surname *Aenesius* and Ae*neios* (Αἰνήσιος and Αἰνήιος) (Fig. 2 & 3), due to his being locally worshipped on the mountain.

Before the prevalence of Greek Zeus in Cephalonia there was the cretomycenean religion with several characteristics derived from Minoan Crete, such as the worship of Cretan deities (Efthymiatou-Katsouni 2008, 2010). We estimate that the establishment of the new worship on the island must have taken place after the $8^{th}$ century B.C., i.e. after the formation of the Greek Pantheon, to which the Doric ethnic groups that started arriving in Greece in 1100 B.C. contributed (see also chapter B).

Based the above we conclude that the names Cephalonia and Aenos that have survived from ancient sources are in fact results of renaming. It is completely unreasonable to assume that the mountain and the *shady island,* overgrown by forests, had no names and did not exist in the time of Homer! The *Cephalonians* of the widespread Odyssean State, as cited by Homer, due to the extensive movements of the Greek races, following the Doric descent, restricted themselves on the anonymous (?) or of unknown name island, which thereafter became known as *Cephalonia*.

We speculate, therefore, that the island's renaming into Cephalonia preceded chronologically the renaming of the mountain into Aenos, because the worship of Zeus did not become established at the same time with the settlement of the people on the island. It took considerable time to integrate and assimilate the components of the earlier religion, which had deep roots and can even be traced to present day's devotional customs and traditions, such as the snake worship, during the commemoration of the passing of Virgin Mary on August 15 (Efthymiatou-Katsouni 2008).

Fig. 2. Partial view of the western side of Mt. Aenos from Pessada. The summit of Megas Soros is indicated with an arrow. At the foot of the mountain lies the region of Ano Livathos with the villages of Vlahata and Simotata (Photo from the archives of the Management Body of the National Park of Mt. Aenos).

Fig. 3. View of Megas Soros, the highest summit of Mt. Aenos (1,627 m) from the rocky position of *Pano Vigla*. The location where the altar or sanctuary existed is marked with an arrow.

# B. AENOS – SACRED MOUNTAIN

## B1. The ancient worship on Aenos

*The visitor, who will climb to 1,627 meters of Soros with the steep slopes descending almost vertically beneath his feet, the gaping cliffs and the spectacular panoramic view of the land and the surrounding islands in the deep blue Ionian sea, will experience the magic of the ancient myth of the Harpies being persecuted by the winged sons of Boreas, along with the feeling that his feet are not touching the ground, but that he is rather floating and is very close to heaven* (Efthymiatou-Katsouni 1998).

### B1a. The dating of the sanctuary

In the previous chapter we already mentioned that the establishment of Zeus' worship on Mt. Aenos succeeds both Homer and Hesiod. In our view, it is associated with the prevalence of the Doric element on the island, once the processes of shaping the Greek Pantheon were completed and a new way of thinking prevailed, regarding the perception of the divine. Greek Zeus has no longer something to do with Zeus of Minoan Crete, known as Kritageni (Κρηταγενή). The Doric realm pierced through the Ionian Sea and the western Mediterranean during the second phase of the Greek colonisation, late 9$^{th}$ to early 8$^{th}$ century B.C. Doric Corinth founded a colony on neighbouring Ithaca in late 9$^{th}$ century, as well as on Corfu in 734 B.C. (Sakellariou 1971).

Regarding Cephalonia, the sources do not provide sufficient information about what happened from the Doric migration onwards. The elements of aeolodoric (αιολοδωρικής) dialect, which survive in some names of Cephalonia, e.g. *Paga* and *Lanu* (*Παγά* and *Λανού)* attest to the Doric presence on the island, but the place, the extent and the time of its establishment remain unknown. We suppose that the colonies in Ithaca and Corfu must have preceded any Doric colonies in Cephalonia, since colonisers mostly followed the coastal line towards the West, while cruising the mainland coasts.

The final configuration of the religious scenery on the island must have been delayed, compared to the rest of Greece. We estimate that the time that worshipping on Aenos started, i.e. the establishment of the sanctuary, is the late 7th to early 6th century B.C. during the 2nd Greek colonisation of the western Mediterranean. The 6th century Doric temple at Gradou, Skala in SE. Cephalonia, at the southeast foot of Aenos, orientates us towards that time frame.

The archaeological excavation has revealed Cephalonia as an extremely important Mycenaean center, the historical role of which has not yet been determined (Kolonas 2007). Data from this cretomycenean past with many Minoan origins survive until today in Christian worship customs of the island, such as the worship of the Virgin Mary with the snakes on August 15 (Bodson 1978, Efthymiatou-Katsouni 2008, Loukatos 1946, 1981). The fact that remnants of the Minoan worship appear even today, means that the roots of the pre-Hellenic religion were still very deep at that time. Therefore, Greek Zeus must have fought fiercely against the preceding deities, in order to become established on Aenos. For this reason, we assume that before the late 7th to early 6th century B.C. the new worship had either not been introduced on Cephalonia or had not become sufficiently integrated to the previous one in the religious subconscious of the residents.

This raises the interesting question: What kind of worship were the ancient inhabitants of the island performing on Aenos?

## B1b. The identity of bones

The highest peak of Aenos, "Megas Soros" is called by the villagers "Sto Soro ta Kokkala" (The bones on the pile), because until recently, there used to be a pile of fossilised bones there. These bones were interpreted as the remains of sacred sacrificial carcasses. According to the traveller D. Ansted, as reported by Marinatos (1962), they were "bones of burned oxen and goats." He adds: "the altar remains are preserved until today ...... rocks and bones are still visible", without commenting on the identity of the bones. Partsch (1892) informs us that Dr Hasse, who examined a collection from Megas Soros recognised the bones of goats and sheep, but adds that Hyrtl thought that he also recognised pig bones in a collection by Unger. We do not know if any of them still exist today and where. Moschos (2007) states that in 1931-1932 Benton also collected bone fragments, without any other indication.

The only person with another view on the origin of the bones is Samios (1908). He asserts that at his time there was a plethora of bone fragments on Megas Soros, among which larger pieces were also to be found. He adds that he, himself, "received" some of them. However, he believes that they have suffered a type of decalcification or calcination, due to solar exposure, thus appearing as burnt. He quotes the stories of local residents around Aenos, based on which among these bones there were also human ones from the fires of 1793 and 1797. Perhaps it is the same fire that the sources mention as occurring at a different date (Partsch 1892). The stories state that the Venetians set fires on purpose to exterminate the bandits. Samios himself states, however, that this fact is not verified by any historical source. The fire causes are different, as reported in Chapter D1e. Besides, in no source is there a reference to the existence of human bones, which would have triggered suspicions of human sacrifices. Only on Mt. Lykaion of Arcadia were human sacrifices being held while worshipping Zeus, according to ancient Arcadian traditions, cited by Pausanias (VIII, 1-6, see Papachatzis 1980). Despite the fact that there were links between Arcadia and Cephalonia of that time (?), since the leader of the "magnanimous Cephalonians", Odysseus, was of Arcadian origin (Marinatos 1962), the issue of similar rituals taking place on Aenos has not arisen.

In our opinion, the name that the people gave to the peak, "Sto Soro ta Kokkala", expresses on one hand the impressive size of the pile of bones and on the other it indicates their "placement" on a specific spot that remained always the same, an action that denotes human intervention in the creation of a "pile".

Unfortunately, as inferred from above, the pile "was looted" repeatedly for opportunistic collections, the fate of which remains unknown, but also for "souvenirs" by several visitors, therefore today it is impossible to draw reliable conclusions. In addition, the steep slope of the peak, along with its winds, rain and snow has completed the dispersion of even the last pieces that may have had remained until they disappeared completely.

The reports, however, of the ancient writers, Apollonius Rhodius and Strabo, are clear. They both mention a *sanctuary* on Aenos (see Chapter A). It is known that the sanctuaries in ancient Greek religion are associated with rituals, offerings and sacrifices to the gods. Therefore, we reasonably conclude that at the sanctuary of Aenos similar ceremonies were being held and that the bones are remains of sacrifices. Pottery fragments, collected by Benton in 1931-1932 (Moschos 2007) possibly dating back to the Bronze Age (3300-1100 B.C.), bone fragments and a series of rocks also point to the existence of a sacrificial altar in the pre-Homeric era.

## B1c. The sanctuary type. The onset of the worship

As noted above, reports by Apollonius Rhodius and Strabo are clear, regarding the existence of the sanctuary of Aenos. Marinatos (1962) places it "*... not exactly at the highest peak, but a few meters to the east and lower*". Today these "*traces*" do not exist. Partsch (1892) cites Peutinger's painting, in which a sanctuary is indicated at that particular spot. No excavations have been carried out. The ceramics of Benton (Moschos 2007) are not enough to determine what type of worship was performed, when it began and how it continued.

Since the sources mention *sanctuary,* a reasonable concern arises as to the type of sanctuary. The ancient sanctuaries may be small, roofed, temple-like structures, operating in caves or they can even be outdoors. What is vaguely described by Marinatos (1962) as *'surviving traces'* does not refer to a temple-like or some relevant, roofed building or even some foundation remains. A cave does not exist at this location. The two caves of Aenos *Nifi* and *Petasi* are not found on Megalos Soros. At the same time, the existence of the pile of bones points us to the conduction of sacrifices and thus to a sacrificial altar. We therefore wonder: did the worship of Zeus on Aenos possibly succeed a more ancient one? Is this a pre-Hellenic outdoor *Peak Sanctuary* of Minoan tradition and if yes, how old is it? The finding of a bronze statuette of *Zeus*, which will be discussed in detail in the next chapter, points us to the direction of the outdoor sanctuary. The total absence of traces of a building's walls, within which the statue would have been placed, leads us in the same direction (see Katsouni 1998). From the excavations at Minoan outdoor sanctuaries, i.e. Petsofa and Kithira, it is known that the offerings were exposed in open space, on an altar or on specific platforms-pedestals (Kounenaki 1997, Mylonas 1977, Sakellarakis 1997).

In our opinion, the suspicion expressed by Hyrtl (Partsch 1892), should not be ignored. Indeed, if bones of pigs were found too, it means that the worshipers did not sacrifice only sheep and goats on the altar of Aenesius. The pig was a sacred animal of sacrifices to chthonic (terrestrial) deities (Fig. 4). We encounter it in the purification rituals of the Eleusinian mysteries which are of Minoan origin (Goudis 1936/1999). The question is: if indeed bones of pigs were also found, how were the subterranean sacrifices justified on the altar of Zeus, who was a celestial deity?

The sole most important indication, regarding the performance of pre-Hellenic worship on Megas Soros stems from the Bronze Age pottery fragments, found by Benton (Moschos 2007). We clarify that the Bronze Age begins in 3000 B.C. with the descent of the first Greek races and it ends in 1100 B.C. with the advent of the Dorians, who initiate the Iron Age. This reinforces our view that earlier than that of Zeus, a worship was being performed on Aenos, the origins of which have been lost in the millennia during the Bronze Age.

Relics of pre-Hellenic worship in Cephalonia are traced in the area of Elios-Pronni on the SSE. foot of Aenos. In that area, interesting legends, traditions and customs are preserved, which, in our opinion, shed light on the dark and the historically undescribed past of Cephalonia. We have already mentioned at B1a of this chapter that only in the settlements of Markopoulo and Arginia is the worship of the Virgin Mary with the snakes in mid-August performed. In the area of Poros the allegorical myths about the "Dragon of Aenos" and the "Dragon of Steno" also have a historical-religious character and relate to situations and events that took place in the distant past. They accentuate latent memories and influences from Minoan Crete. Besides, the existence of Cretan deities in Cephalonia (e.g. *Vritomartis* and *Lafria Artemis*) advocates a strong religious bond between Cephalonia and Minoan Crete (Efthymiatou-Katsouni 2007, 2008, 2010, 2012).

## B2. Aenesius Zeus

Earlier on, we formed the opinion that the worship of *Aenesius Zeus* was one that appeared after that of pre-Hellenic deities of nature. It is known that in the western screes of Megas Soros, above the area of Simotata and Sissia, a bronze statuette of *Lightning Zeus* (Κεραυνείου Διός), i.e. at the moment when he unleashes the lightning, was found. The statuette, ca 30 cm tall, was found by the shepherd Spyros A. Thomatos or Tsetis from Simotata, a settlement of the western outskirts of Aenos. Among others, he also showed it to the parents of the author of this Part of the book, who were the ones to describe it. Unfortunately, this valuable finding disappeared during the German occupation (Efthymiatou-Katsouni 1998).

The discovery of this bronze statuette renders it obvious that, before being swept away by the downpours under Megas Soros, it must have been positioned somewhere. Since there are no traces indicating the existence of a building, inside which the statue would have stood, we are inclined towards the existence of an open-air sanctuary, as already mentioned. The specific representation of the god as Lightning Zeus agrees entirely with his attributed property as the Master of the Storms (nefeligeretis), since the top of Aenos, usually overcast during the winter months and often throughout the year, is

Fig. 4. Ritual sacrifice of a pig to a chthonic deity. The woman is holding the pig over a sacrificial pit with one hand. With the other hand she is holding a basket with the “sacred”. The chthonic character of the ritual is demonstrated by the torches that are planted in the ground (From a lekythos of the National Museum of Athens. Harrison 1996b).

characterised by outbreaks of heavy storms with thunders, lightning and thunderbolts. According to the Greek perception of Zeus, the posture of unleashing the lightning also symbolises the speed with which the god was punishing and taking revenge (Richepin 1953-54). We cannot therefore exclude the worship of Zeus as *punisher god*, in addition to *protector god*. However, we consider all these attributes as later ones.

Under which attribute of his was the god initially worshipped? Only as the God of Lightning, as represented by the statuette, or otherwise? Realising that the adjectives *Aeneius* (*Αἰνήιο*ς) and *Aenesius* (*Αἰνήσιος*) define only the place of worship and not the personality and the attributes of the god himself, we shall attempt to highlight the missing "divine profile". At first we need to distinguish the Greek Zeus from the Cretan Zeus. It is established that the original ancestral deities during the shaping of the Greek Pantheon were split into as many newer ones, as their properties (e. g. *Gorgo, Potnia Thiron, Ilithiia, Artemis Lafria)*. It has also been observed that a new god displacing an older one incorporates his attributes, too, for example Apollo: he became the oracular god, when he displaced the worship of Gaia from Delphi, who was the one to initially possess that privilege. Something similar has happened with Zeus, the dominant figure of the twelve gods.

According to Harrison (1996b), it is impossible to detect how many and which ones were the old worships incorporated by Zeus. It is indicative that many of the epithets attributed to him nationwide were associated with specific properties (Richepin 1953), such as: the god who raises clouds (*nefeligeretis*), patron of hospitality (*xenios*), patron of family (erkios), patron of the oath (orkios), patron of house and property (ktisios), redeemer (afesios), consultant (vouleos), patron of freedom (eleftherios), the one who brings rain (omvrios), voracious (lafystios), the one who raises dust (konios), who signals with thunders (simaleos) etc. (Pausanias I, see Papachatzis 1974). In Corinth he appears as triune. Pausanias saw three of his statues there. Two of them bore the inscriptions *Chthonios, Ipsistos* (Chthonic and Celestial, respectively). The third had no inscription. However, on a pottery vessel of the 5$^{th}$ century B.C., where Zeus is also depicted as triune, the third form is determined as *ypochthonios* (subterranean) Poseidon (Fig. 5). As *Ipsistos,* he holds the thunderbolt facing upwards, as *Chtonic* he holds the thunderbolt facing downwards and as *Poseidon* besides the thunderbolt which he holds horizontally in his left hand, he also holds a trident in his right hand. In this way he appears as the absolute master of all three worlds, celestial, chthonic and subterranean (Pausanias II, see Papachatzis 1976).

Thucydides reports that in Athens, during the celebration of *Diasia*, Zeus was worshipped as a Milichios (*Μειλίχιος*) beneficent demon, since he was propitiated with expiatory offerings of honey (Thucyd. A, 126, see K.L.G. 1992, 1994). Pausanias (I. 37, see Papachatzis 1974) writes that an ancient altar of *Milichios Zeus* existed near Kifissos, where Theseus underwent cleansing for the murder of the bandit *Sini*s. While interpreting

Fig. 5. Zeus the triune from a pottery painting of the 5th century B.C. Left: Celestial Zeus. Middle: Chthonic Zeus. Right: Zeus-Poseidon, subterranean (Photo: Pausanias II, in: Papachatzis 1976).

ancient sculpted representations depicting an oversized, bearded *serpent-god*, Harrison (1996a) writes: "The Greek anthropomorphic Zeus quietly took the place of the old serpent-god. The art clearly portrays what was overshadowed in rituals and mythology. Olympian Zeus had no "*chthonic attribute*", but because he belonged to the Celestial World of lightning and thunderbolt, he repelled an ancient demon-serpent of the Underworld, *Milichios*. *Milichios* is indigenous and autochthonous. He existed before the creation of Zeus". And elsewhere: "The worship of the Olympian Zeus was founded on the worship of the being, called Milichios".

In a previous chapter we were concerned with the existence of pig bones on Megas Soros. We detect a possible connection of this animal with the worship of *Milichios Zeus*, as it occurred in *Diasia*. It was a celebration of the magical curses, the exorcisms and anathemas, during which the pig holocaust took place. Zeus – as Milichios – is depicted as a bearded serpent (Fig. 6). He is a demonic, chthonic deity, god of catharsis and purification and during the ancestral ritual in his name, the pig holocaust is offered! They attribute to him opposing qualities: *Milichios, Affable, Noble, Gentle* but also *Memaktis* (the stormy one, thirsty for blood and revenge) (Harrison 1996b)! This *avenger* attribute of his can be traced back to the following tradition of Pronni: Zeus, while angry, unleashed the thunderbolt to punish the Dragon, who tried to dethrone him from Aenos and to claim his reign (Vounas 1969). Behind this myth hides the worship succession and the deity struggle for dominance: Aenesius Zeus pushes aside and finally absorbs a previous worship, such as that of the demon *Milichios* depicted as a serpent, i.e. as a dragon. We note that in antiquity with the word *dragon* they meant the serpent (snake) in general. Because of its ability to change skin (regenerate), creep and disappear into the earth, the snake was a symbol of a chthonic, pre-Hellenic deity and of nature's regeneration. At this point, the correlation with the *snake goddess* in Minoan Crete is inevitable.


Fig. 6. Sculptings from the sanctuary of Piraeus (today in the Berlin Museum). Left: worship of a bearded Milichios Demon. Middle: Milichios as a bearded serpent with the inscription "Heraclides to God". Right: Milichios Zeus. It bears the inscription "to Milichios Zeus" (Harrison 1996b).

Therefore, based on the fact that: a) only at the SSE. edge of Aenos i.e. in the villages Arginia and Markopoulo and not in any other village of Cephalonia does the snake worship survive until today, even though these snakes (*Telescopus fallax*) are found all over the island, and b) the stories of the *dragon's* killing by a god reflect the struggle of religions and the succession of worship (e.g. the murder of the *dragon Python* at Delphi by Apollo), we conclude the following: many of the elements governing the worship on Aenos underwent transformations each time, as the worship passed through successive phases, i.e. from the ancestral to the next one and all the way to the present day. The human presence in Cephalonia 100,000 years ago is scientifically verified (Moschos 2007). The passing of these millennia justifies any form of worship from the awakening of the primitive spirit and the evolution of the religious feeling up to the modern times.

## B3. The islet of Zeus and the double sacrifice

On the Southwest coasts of Cephalonia opposite Liakas cape is the islet of Zeus with a chapel dedicated to the Virgin Mary Vlaherena and before that there was a monastery, which collapsed during the 1953 earthquakes. After the earthquakes only the chapel was reconstructed (Fig. 7 & 8). Marinatos (1962) mentions the following testimony of the traveller D. Ansted (1863), regarding two parallel sacrifices to Zeus: while the first was taking place on the peak Megas Soros of Aenos and upon seeing the smoke, the priests would make a second sacrifice on the islet. Partsch (1892) and Marinatos (1962) express doubts, because this is not inferred from recorded testimonies and there are no ancient

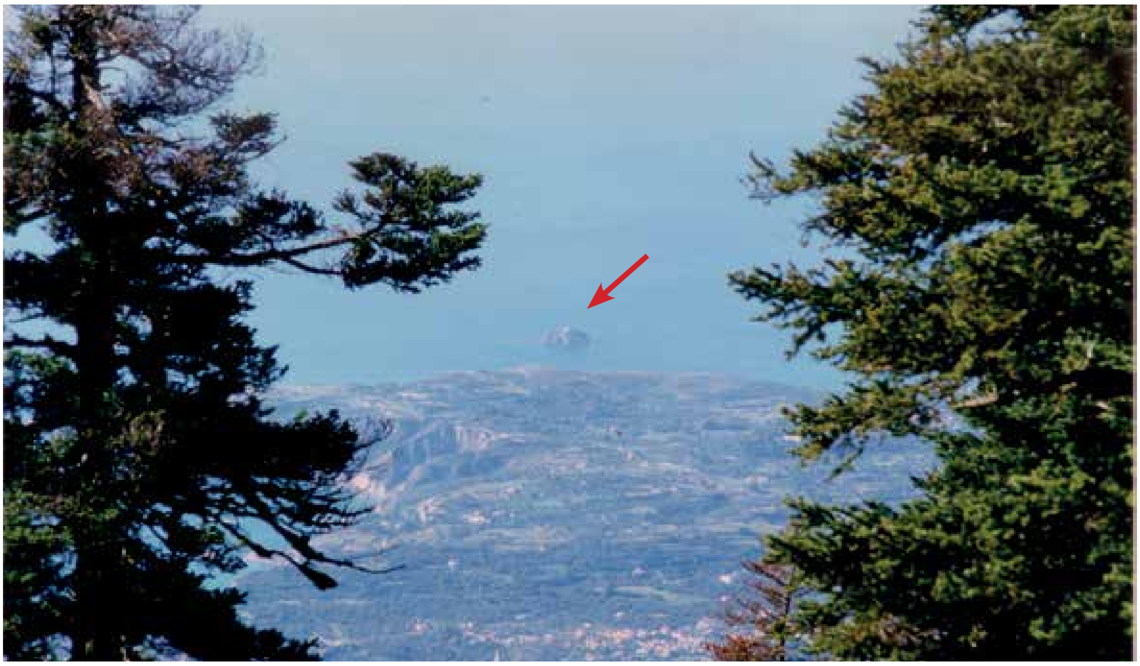


Fig. 7. The islet of Zeus (indicated with an arrow), as seen from Aenos.

Fig. 8. The islet of Zeus from above. The chapel and the carved staircase on the steep rock that starts from the small, jetty – also carved – are visible (Photo: N. Chaidemenos, J. Giannelos. Album "Hellas, Anothen. Ionio" [in Greek]. Ed. Militos. Offered with the newspaper "Proto Thema"). Inset: Partly destroyed column, remnant of an older building at the bottom of the stairs (Photo: A. Voutsinas).

traces on the islet. Tsitselis (1877) mentions "stones of dubious origin". However, as mentioned by Marinatos (1962), the scholar B. Schmidt, who wrote in 1871 about the *Life of the Modern Greek people*, speaks of the remains of an ancient building under the chapel of the Virgin Mary and the monastery.

Therefore, there exist two testimonies that in the 19th century there were still traces of an ancient building on Zeus islet and that the memory of the performed sacrifices of the past had not worn off. The small size of the islet, its steep and inclined surface and the successive destructive earthquakes contributed so that the scarce building traces rolled and fell into the sea. Since the earthquake of 1867 the entire coastal strip of Cephalonia Island along the Gulf of Lourdas and opposite Zeus sustained great damage. We do not know if in 1871, when Schmidt made his publication, he had recent information on the islet, i.e. gathered shortly before or shortly after the 1867 earthquake. In this case, the remains of the buildings that he mentioned could have disappeared during that seismic activity. We add that before 1867, 61 earthquakes occurred in Cephalonia, four of which were particularly destructive. From 1867 until 1953, 32 other earthquakes occurred (Toumasatos 2007).

In any case, the ruins on the islet of Zeus either disappeared with the 1867 earthquake and Schmidt recorded the still fresh memory, or they remained there for some additional time, only to be finally wiped out by the subsequent earthquakes. If the double sacrifice is indeed a fact, then it constitutes a large and important worship at an ancient, Panhellenic sanctuary.

## B4. Who was praying to Aeneius Zeus

The disputed fragmentary verse 28 (57) in "*Ηοία*", which contains the oldest reference to the worship on Aenos translates to: "... there they prayed to *Aeneius (Zeus),* who lived up high." Those who prayed were the winged sons of Boreas, *Calais* and *Zetes*, comrades of *Jason* in the Argonautic campaign. They chased the *Harpies*, the winged monsters, which grabbed and soiled the food of the blind seer *Phineas* (Fig. 9 & 10).

However, fate dictated that they (the Harpies) would either perish by the sons of Boreas or the sons would die themselves, if they did not succeed in reaching them. In the aerial struggle of life and death, the *Boreads* caught up with *Aello* (storm swift) over Peloponnese. Chasing after *Ocypete (swift wind)* they almost reached over the *Echinades* islets that were named Strofades (from the Greek strofi=turn), because the Harpy turned to see how close her pursuers were (Today Strofades refers to the islet group south of Zakynthos).

The sons of Boreas, jaded from the aerial chase and with their strength abandoning them, upon seeing the peaks of Aenos, prayed to “*Aeneius* (Zeus), who lived up high” so that he would help them. Their prayer was heard, their strength returned and they caught up with Ocypete, who dropped dead. Following that, the seer Phineus, freed from the torture, advised Jason on how to pass through Symplegades (Clashing Rocks) (Apollodorus L.I., see Frazer 1995).

Fig. 9. From the kylix (cup) of Wurzburg or kylix of Phineas. Right: Phineas, lying on a couch in front of a banquet table. His healers are nearby. The winged sons of Boreas with swords in hand, chasing the Harpies. The overseas chase in the skies is indicated by the fish and the wavy line at the left edge of the depiction. The Boreads and the Harpies have four wings, as demons of the winds. The Harpies symbolise the defiled and destructive winds, whereas the Boreads the cool and clean ones (The kylix was published in photocopy by Carl Sittl in 1892. Harrison 1996a).

Fig. 10. The Boreads chasing the Harpies. From a laconic kylix 550 B.C. (Villa Giulia). Source: www.hellinon.net/arpyies.htm.

## C. IMPACT OF AENOS, AS A NATURAL FACTOR, IN THE FORMATION OF THE POLITICAL – TERRITORIAL STATUS OF CEPHALONIA

Given the fact that Cephalonia's geomorphology has not changed in the last 9,000 years, the island's mountainous partitioning was the main factor that led to the formation of the territorial status of the separate states, with the main mountain range of Aenos-Roudi and its extensions functioning as a defining border. Mythical tradition and recorded sources lead us to the conclusion that long ago three divisions of the island had taken place, which, in our view, were based on this territorial criterion.

The first division took place following the victorious campaign of the King of Mycenae, Amphitryon, against *Taphians* or *Tilevoes*, who are considered the first named inhabitants of Cephalonia. Amphitryon's comrades-in-arms, Kefalos and Elios, following the Taphians' defeat, divided the island and the other territories that the latter possessed. It is said that Kefalos received northwestern Cephalonia, Ithaca, part of Akarnania and Echinades, while Elios received southeastern Cephalonia, where the name Elios persists until today, as well as Zakynthos (Livieratos 1926/1998). The NW.-SE. axis, on which the division of the island was based, constitutes at the same time the main axis, along which the mountain range of Aenos-Roudi also extends.

The aforementioned campaign is cited by Herodotus (V, 59, see K.L.G. 1994), who saw the votive tripod that Amphitryon had dedicated to Delphi after his victory, bearing the inscription (in translation): Amphitryon dedicated me to the God by the Tilevoes". He even "speculates" that the campaign took place during the reign of Laius in Thebes; i.e. approximately 1400-1350 B.C. Except for Herodotus, the campaign was also mentioned by Hesiod in his work *Ασπίδα Ηρακλέους (Aspida Herakleus)* (ver. 1-19, Jacob & Girgenis 2001), as well as by Apollodorus (L. II. IV. 7, see Frazer 1995). Apart from Kefalos and Elios, Creon of Thebes and the Phoceans also participated in this campaign. This warfare incident constitutes the most ancient historical event concerning Cephalonia. Many researchers identify it with Taphos since the place name Taphios is preserved in the western coast of Paliki. We express the opinion that this war expedition of the great and almost panachaean alliance against the Taphians, reflects the westward expansion of the Achaeans. The naval state of the piratic and commercial Taphian people dominating the Ionian Sea stood as an obstacle, hampering their expansionistic plans. Besides, these types of stories, which switched over to the realm of myths and are preserved in popular memory, have a historical basis and constitute the unwritten history of the people, during dark times that left us with no recorded evidence.

If it is proven that the Homeric Doulichio is the Peninsula of Paliki (the westernmost part of Cephalonia), combining this with Odysseus' domination on Sami, which is the eastern part of the main body of the island, we can hypothesise that during the Homeric times the second territorial division of the island took place, following in the footsteps of the first, i.e. in a western and an eastern part. The information on the identification of Doulichio as Pali is rescued by Strabo, while commenting on the controversy of writers that were older than him, regarding the location of Doulichio (X. C C455, 13 and 456, 14, see K.L.G. 1994). At the same time, however, he cites that among these writers, Ferekidis and Andron identify Doulichio as Pali, although he disagrees with them. Pausanias also mentions that "*Pali's inhabitants* were formerly known as *Doulichiis*" (VI. 15, 7, see Papachatzis 1979). The same is mentioned in Hesychius' Dictionary, under the entry "Δουλίχιον" (Doulichion) (see K.L.G. 2004).

The establishment of the two kingdoms acted probably as the starting point of the political scheme of Tetrapolis that ensued, as verified by the written testimonies (see section A). We believe that the form of Tetrapolis emerged over time from the two large kingdoms, through secession or independence of their parts, possibly due to colonisations, as well as political-social changes and attitudes (Efthymiatou-Katsouni 2012).

In the Homeric epic poems, even though the Cephalonians are mentioned as the people led by Odysseus, there is no reference to the island's name. This becomes known for the first time as *Κεφαλληνία* (Kefallinia) by Herodotus in 5$^{th}$ century B.C., while recounting the Persian Wars (Herod. IX 28 and 31, see K.L.G. 1992). We translate the verse: "After them, eight hundred Lefkadii and Anaktorii were lined and along with them, two hundred Palees (inhabitants of Pali) from Cephalonia". It becomes apparent that with the epithet *Παλείς (Παλέες)* (Paliis-Palees), the historian separates them by name from the citizens of the other towns of the island. Cephalonia is now *Tetrapolis*!

According to Thucydides (Β΄. 30, see K.L.G. 1992): "Cephalonia lies opposite Akarnania and Lefkada, being Tetrapolis, that is Pali, Krani, Sami, Pronni". Strabo (Ι΄. 2. 13, see K.L.G. 1994) lists the three states of Tetrapolis with the national epithets of their respective inhabitants *Σαμαῖοι, Παλεῖς, Κράνιοι,* (Samei, Paliis, Kranii) and the fourth one with the epithet *Πρώνησος* (Pronnisos). We clarify that *Pali* as a city-state does not coincide with Paliki. The term Pali is a later one. In the aforementioned sources it is spelled differently. Herodotus writes Παλέες (Palees), Thucydides *Παλῆς*, Strabo and Pausanias *Παλεῖς* (Paliis), whereas Polyvios (5.1, 3, 16, see K.L.G. 1996) uses the spellings *Παλαιεῖς* (Paleis) and *πόλις Παλαιέων* (town of Paleeon). The peninsula of Paliki was part of Pali's territory, as it is inferred by the few remaining traces. Yet, the state's size is unknown to us. We can only approximately estimate it, because it might have been extending beyond the natural limits of the peninsula.

Therefore during the classical years, there were four independent city-states in Cephalonia, in contrast with other islands, such as in the Aegean, where an entire island constituted a single state. In those, the national epithet of the residents was derived from the island's name, such as Thiraioi from Thira, Rhodii from Rhodes, Milii from Milos, Naxii from Naxos and so on. In Cephalonia, however, due to Tetrapolis, the national epithet of the residents was derived from the city-state, as already mentioned above and during the period of the state division of the island, they used that instead of Κεφαλλήνες (Cephallines).

The borders, limiting the four states, were defined by the arrangement of the island's mountainous masses on either side and below the central mountain range of Aenos-Roudi (Fig. 11). The existence of fortified acropoles and long wall lines attests to the suspicion that existed between them concerning treacherous actions and to the fear of a possible invasion not only from an external enemy but also from a neighbouring city.

According to our view, the importance of Aenos mountain range as the critical border among the states of Tetrapolis is also tracked in the name of the mountain range of Atros, which lies opposite and along Aenos. Since Aenos was **the mountain,** acting as limit and border, we define that Atros stems from the Greek word *ἄντορος (*antoros), **<** *ὁ ἀντί ὄρος* (anti oros), dialectic form of *ἄνθ' ὄρος* (anth' oros), meaning *the opposite border, the opposite limit*, here in relation to Aenos (Liddel & Scott 1907). From *ἄντορος* (antoros), following the deletion of 'o' (*ἄντøρος*), the form *ἄντρος* (antros) emerged and then the form *ἄ(ν)τρος > ἄτρος* (atros), after the subtraction of the pronunciation of the dental spelling complex *ντ* (nt) into the dental τ (t) (Efthymiatou-Katsouni 2012).

Aenos, therefore, had been the regulating factor, defining the state changes of Cephalonia during antiquity. Even in modern times, the "icon" of Tetrapolis is still perceptible in the administrative division of the Prefecture of Cephalonia into counties homonymous to the ancient towns Pali, Sami and Krani, which incorporated the area of Pronni. Ithaca, being a separate county, had also been included in the Prefecture of Cephalonia. This arrangement lasted until the 20th century (1960s), but even after its abolishment, the names survive until today, as geographical divisions.

The division of the island's areas and their isolation, due to the mountain ranges have also affected the character of the inhabitants, who, in each different area, have shaped a different temperament, promoting a sense of individuality and their dynamic, creative rivalry, a characteristic feature of the Cephalonians.

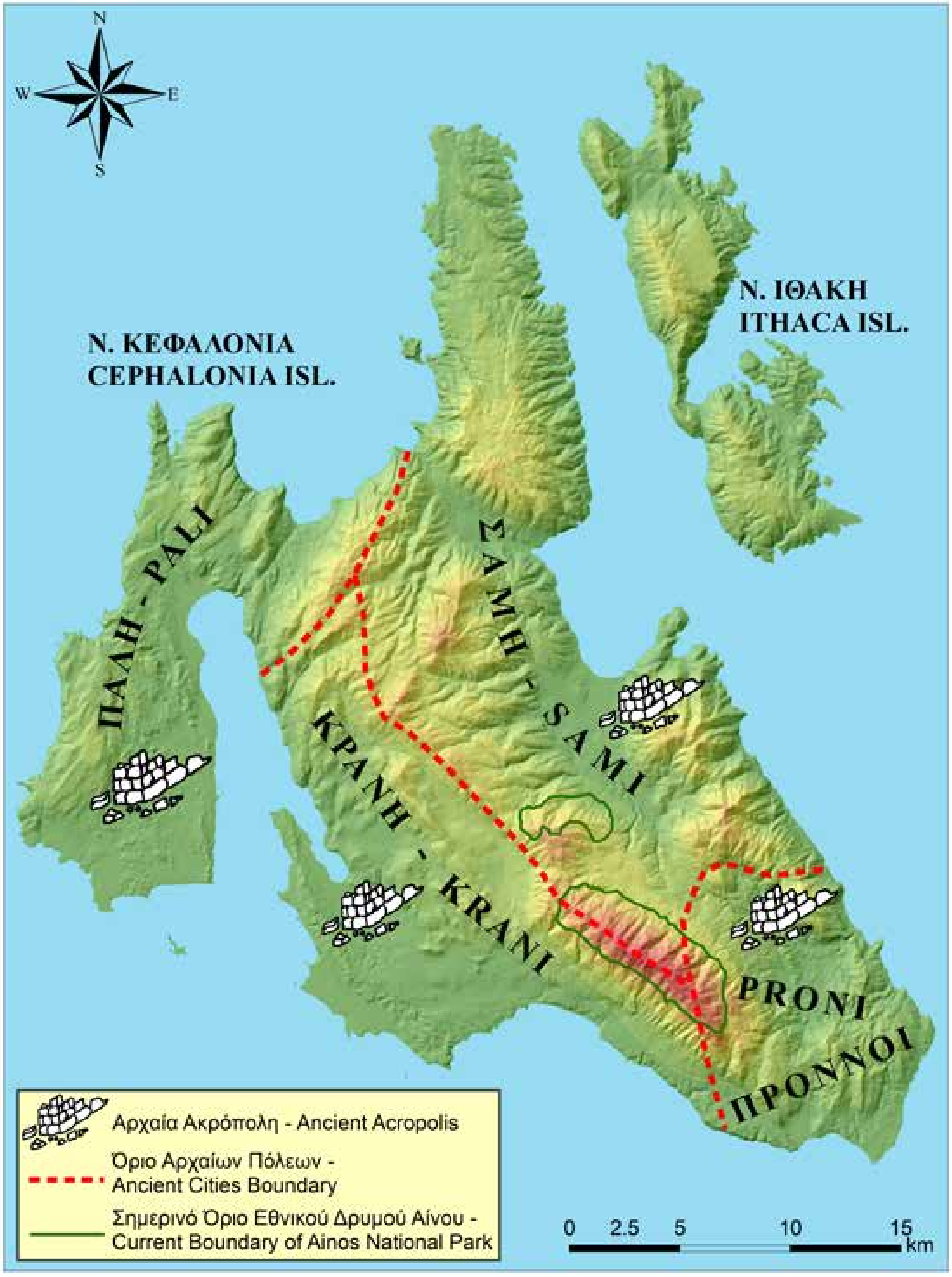



Fig. 11. The boundaries of the city-states of the Cephalonian Tetrapolis, approximately along the mountain ridges (produced by M. Xanthakis 2015).

# D. AENOS AS A DIACHRONIC NATURAL RESOURCE AND THE HUMAN INTERVENTIONS

## D1. Aenos the Life-Giver

### D1a. In the Stone Age

The human presence in Cephalonia dates back to the Stone Age, about 100,000 B.C. (Moschos 2007). A recent oceanographic, geological and archaeological research by Ferentinos & al. (2012) reinforced the previous theories by Kavvadias (1984), Andreikos (1993) and Sordinas (1996) that Neanderthal groups reached the island from the opposite mainland coasts during the last glacial period (Würm), 115,000 years ago (Phitos & Kamari 2009). The "land bridges" that formed, when the sea level lowered by about 120 m because of the glaciers, were preserved until 18,000 years B.P. Through these land passages, both people and animals moved from the opposite land into mountainous and densely forested Cephalonia (Efthymiatou-Katsouni 2012).

In the life cycle of these people, who were following the migratory herds of large mammals to the south, the lush forests of Aenos were undoubtedly an important destination, thanks to both their dense vegetation and their milder climatic conditions, when compared to the northern mainland forests. Besides the migratory animals, these forests constituted the refuge and the permanent habitat of many and different prey animals. Since the survival of the human population mainly depended on hunting, the central mountain range of Cephalonia would have been a rich "hunting ground". We clarify that our reference to the central mountain range of Aenos always includes Roudi as its continuity.

The traces left behind on the island by these Nomadic hunters, mostly stone tools, cover the entire spectrum of the Stone Age, as revealed by the archaeologists and researchers and are presented below.

They are partly dated from the Paleolithic Period, i.e. from approximately 44,000 years B.P. They are encountered throughout the Mesolithic (8000-7000/6900 B.C.), up until the end of the Neolithic period, in 3300 B.C., when the Bronze Age begins (Moschos 2007).

The dispersal of the stone tools on almost the entire surface of the island (Fig. 12) indicates a capable human population (Efthymiatou-Katsouni 2012). This hypothesis is reinforced by the Paleolithic and Mesolithic findings from positions around the central mountain range of Aenos, such as at Saint Nikolaos Grouspas of Roudi by Petrochilos (1959) and Marinatos (1960/1962), at Sami, the neighbouring area of Aenos, by Andreikos (1993), but also in the wider region, as reported by Kourtesi-Filippaki (1996), Moschos (2007) and Cubük (Samson 2007). Moreover, in the habitation remains of the caves, found by Kavvadias (1984, 1985) at the *Cave of Chaliotata* and by the Hellenic Speleological Society (see D.E.S.E. 1966) at the cave *Fytidi* of *Poulata*, there were, among other findings, bones of young mammals, foxes, wild boars and red deer, prey consumed by the inhabitants of these caves. These bones attest to the rich fauna around Aenos and Roudi, which attracted the hunters of the Stone Age. However, the fate and evolution of this Neanderthal population still constitutes an unresolved issue, due to lack of information, the elucidation of which is left up to the anthropologists of the future.

Fig. 12. From the collection of N. Efthymiatou-Katsouni: Various types of tools: awls, chisels, scrapers, knives and arrowheads.

In the case of the human presence in Cephalonia, his dependent-on-Aenos relationship, which provided the necessary goods, prey and timber for his survival, was also confirmed during the Late Neolithic period (~ 5600 to 4800 B.C.). This is revealed by the findings of the stromatographic excavation in the cave of Drakaina at the gorge *Steno of Poros* (Poros Straits) (Hatzioti & Stratouli 2000) (Fig. 13, 14). The charcoal analysis from the 'fireplaces' showed that the Neolithic inhabitants of the cave were burning wood from Cephalonian Fir Trees and Black Pine Trees, species which constitute until today the forested area of Aenos (Ntinou & Stratouli 2011).

The charred remains of fruit and cereal, as well as the multitude of bones from domesticated and wild animals found during the excavation, outline the lifestyle of these people (Kotzampopoulou 2009). They have passed into the agricultural and animal raising phase, but they continue to hunt on the slopes and in the forests of Aenos, in order to supplement their diet and procure firewood for the cave's fires.

In any case, the timber of Aenos would not only serve to support the fires lit in the cave. Certain findings, such as marble from Naxos, obsidian from Melos, gabbro probably from Argolis and talc of unknown origin, reveal established relationships with the Aegean world (Stratouli 2007) (Fig. 15). Under these circumstances, it can be reasonably concluded, in our view, that the communication of the cave with the Aegean or at least with the Peloponnese was bidirectional.

Sea communication over the centuries requires sea vessels, the construction of which is always proportional to the craftsmanship of the time and the available materials. It is impossible that the people of Drakaina manufactured their own vessels using wood other than what was already familiar to them, i.e. the Cephalonian Fir or the Black Pine, which were available in abundance on neighbouring Aenos and, as mentioned above, were detected in the cave's charred residues.

The certified late Neolithic and early Helladic habitation sites in Arginia at the southwest foot of Aenos, dating from 4000 until 1900 B.C., as well as the findings of wild boar tusks (Sotiriou 2000), confirm once more that they were chosen because of their proximity to the Big Mountain and their instant access to the dense forest, source of timber and prey.

From the above, we conclude that Aenos' forests, besides meeting the survival needs of the first people who set foot on the island, offered a different parametre in the evolution of man as a social being: the means with which to satisfy the need of communication, of contact with other people and certainly the exchange not only of goods but also of experience and know-how. Therefore, the existence of this forest, which provided the materials that allowed the accomplishment of sea voyages, helped the people to overcome their isolation on the island, broaden the horizons of their knowledge and come into contact with the

Fig. 13. Drakaina cave on the south side of Steno of Poros. The entry is marked with an arrow (Photo in Stratouli 2007).

Fig. 14. From the excavation at Drakaina cave (Photo in Stratouli 2007).

Fig. 15. From the marine communication of the Neolithic inhabitants of Drakaina with the Aegean Sea and Argolida. Right: zoomorphic utensil foot made from Naxos marble. Centre: stone tool smeared with red dye. Bottom: white beads from talc and *Dentalium* shell, green beads from gabbro (Photo in Stratouli 2007).

Neolithic centres of civilisation of the Greek mainland and the distant Aegean region. In our opinion, the skill of the island's inhabitants at sea dates from this era and was passed on down the centuries, thus establishing the naval tradition of Cephalonians.

## D1b. In the Mycenaean and Homeric Times

In subsequent years, the survival relationship evolved into a relationship of economic exploitation of the natural resources of Aenos. The Fir tree did not only serve for firewood or possibly for wooden tools and constructions. At the same time, it was also a symbol of superiority and wealth derived from the exploitation of the forest, which was ruled by the local king or lord. Valuable information is revealed to us by the engraved stones of Fig. 16 that depict this relationship. They come from the Mycenaean tomb of Tzannata in the area of Pronni, adjacent to Aenos (see. Fig. 11, section C) and are dated around 1400-200 B.C. (Kolonas 1994).

The engraved representations that they bear are not accidental. As occurs in the entire spectrum of civilisation evolution, people – motivated always by the same need, which defines them as social and spiritual beings (confirmation of their ego, demonstration of power, posthumous fame, communication) – initially imprinted the most important moments of their lives either on the walls and on the roofs of the caves or later on monumental buildings and works of art. We notice this on the frescos, but also in miniature works of art from Thera, Knossos, Tirynth and the metopes of the Parthenon; hunts of prehistoric animals, scenes of religious worship or death, battles and other military feats.

In particular, hunting, which accentuates the strength of the body, the person's skills and the capture or killing of the prey as a feat, is the most favourable topic. With that in mind, we considered that the engraved stones of the Mycenaean tomb of Tzannata depict talking symbols, remaining bits of the ancient routine of the people who once lived in the shadow of Aenos.


Fig. 16. Engraved stones from the domed tomb of Tzannata. Stone **a,** in our view, has the oldest depiction of the Cephalonian Fir Tree: in the center a shaped twig with its needle-like leaves in bilateral arrangement. Right and left of the central motif lie halved Fir twigs, with only the leaves of the left or right side, respectively. Stone **b** bears an engraving of an upright twig of the Fir tree on the right and a double axe with an inconspicuous representation of a human figure on the left. Stone **c** depicts a hunting dog, holding a posture of tense attention. The three parallel lines, indicated by the arrow, symbolise perhaps leaves of the Fir Tree, the forest environment in which it searches for prey. In stone **d** a deer (?) or chamois (?), attacked by arrows, is depicted. At the back side of the animal we distinguish an upright human figure with a bow (Photo in Kolonas 2007).

The combination of the four depictions acquires a conceptual continuity with a narrative character. It enables us to represent the complete picture of an organised hunting trip in the forests of Aenos, a significant activity of the mighty lord of the region of Pronni. We will, therefore, attempt the following interpretation: 1) In engraved stone a, the composition of Fir Tree twigs symbolises the dense forests of Aenos. 2) In b the blurred human figure probably depicts the mighty lord. The arrow at the top means that he is in charge of the hunt, and the upright twig of the Fir Tree symbolises his domination on the forest. 3) In engraved stone c, the intensity of the hunt is reflected in the dog's posture. Those engaging today in this specific activity will recognise the familiar image of the greyhound, as it crosses the hunting field. These fields, in our view, are the forests of Aenos, as indicated by the three parallel carvings on the left, depicting the needle-like leaves of the Fir Tree. The rear-facing head of the animal, the upright ears and the bent front leg is a characteristic posture of the greyhound, as any sound, whistle or command of its master, makes it stop searching the forest for prey, turn its head toward the sound source and listen with undivided attention. 4) The engraved stone d shows, in the foreground, the prey, perhaps a deer or chamois, targeted by arrows, already travelling towards the animal's back and abdomen. In the background and on the right, the hunter is, in our opinion, being depicted with the curved bow, which covers part of the animal's thigh (Efthymiatou-Katsouni 2012).

These illustrations do not only mark the survival relationship via the securing of prey but they also highlight a special aspect of the social life of the people of that era, for whom hunting is a social event for demonstrating skills and for recreation, as in the era of Mycenae 'Rich in Gold' (Fig. 17).

In Homeric times the existence of the valuable Fir Tree promoted the craftsmanship of shipbuilding, which is reflected in Odysseus' experience during the construction of his vessel (Od. ρ 291-295 see Allen 1958/1962). Due to the usability of its wood, intertwined with the naval needs, the Fir Tree in Greek came to mean the ship's paddle itself, something that fed the island's naval tradition in the following centuries as well. We also believe that the youth of the Odyssean State - the island, later known as Cephalonia, was part of that State – would have certainly included Aenos, the richest source of prey, in their hunting excursions (Efthymiatou-Katsouni 2012).

Therefore Aenos, as a natural resource, with the activities that unfold in its forests during the Mycenaean and Homeric times, sets the framework within which both the quality of life and the cultural level of the people who live in its vicinity, emerge through the ages.

Fig. 17. Representation of lion hunting on a bronze dagger of Mycenae with a pressed decoration in gold, silver and niello (Photo in Marinatos 1959).

## D1c. In Classical and Roman Times

The naval tradition of Cephalonians, which was born, was nourished and matured in the shadow of Aenos and the forests of the Fir Tree, remains strong in historical times, too (Fig. 18).

The Cephalonians become an appreciable naval, commercial and military power, mentioned in ancient sources (Pausanias IV, 20, see Papachatzis 1979). Therefore, this natural resource adds another parametre into the historic course of the island, i.e. that of naval rivalries and battles. This is the one we shall keep referring to below, in the absence of any other and until future works provide novel information revealing Ainos' effect in other areas.

In classical times the Cephalonian Fir Tree appears again, but for the first time as a coin-engraved symbol of a very famous Greek city. The undisputable depictions of its cone on the coins of $5^{th}$ century Pronni, constitute an undeniable reference to Aenos and to the foremost representative of its flora (Fig. 19). It is noteworthy that at the same area of Cephalonia, Pronni, the same symbol appears engraved for the second time. The repetition of the depiction reveals a dynamic relationship of man and a natural resource of the island, which is interpreted as the exploitation of the forest wealth, an undeniable economic element of the city. In our opinion, the illustration of the Pine cone (Fig. 19) in the coins of that state has the same meaning. It probably has to do with the Black Pine tree, a valuable resource for shipbuilding (like the Fir Tree), which occurs on Aenos until today (Efthymiatou-Katsouni 2012).

The coins as a means of commercial transactions of the city, accentuate the Fir Tree as its symbol and underline the importance of its exploitation as the most important natural resource for the economy and defense of the island. With its engraving on a coin it now

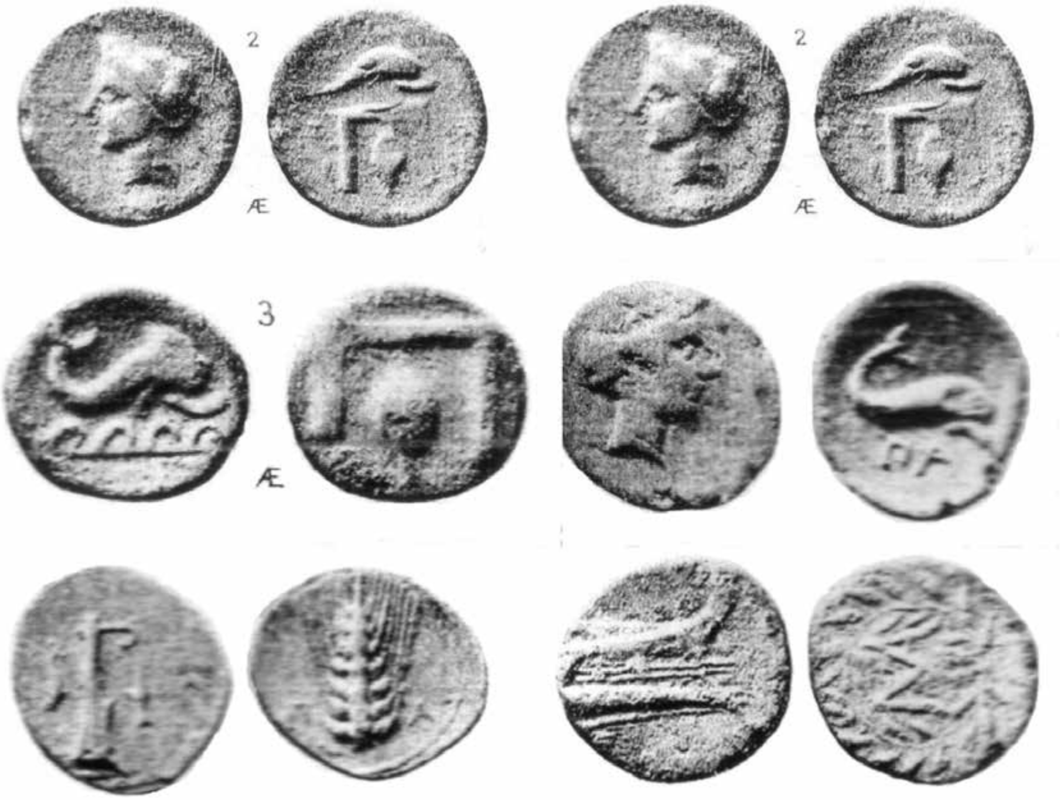



Fig. 18. The naval tradition of Cephalonians imprinted on coins of Tetrapolis, mainly of Pali and Sami. Upper two rows: woman's head and dolphins. From the letter P, initial of Pali, a barley grain is hanging. Below on the left: ship's steering wheel and wheat ear from Pali. On the right: the bow of the ship from Sami and S, the initial letter of the city, within a laurel wreath (Photo in Gardner 1887).

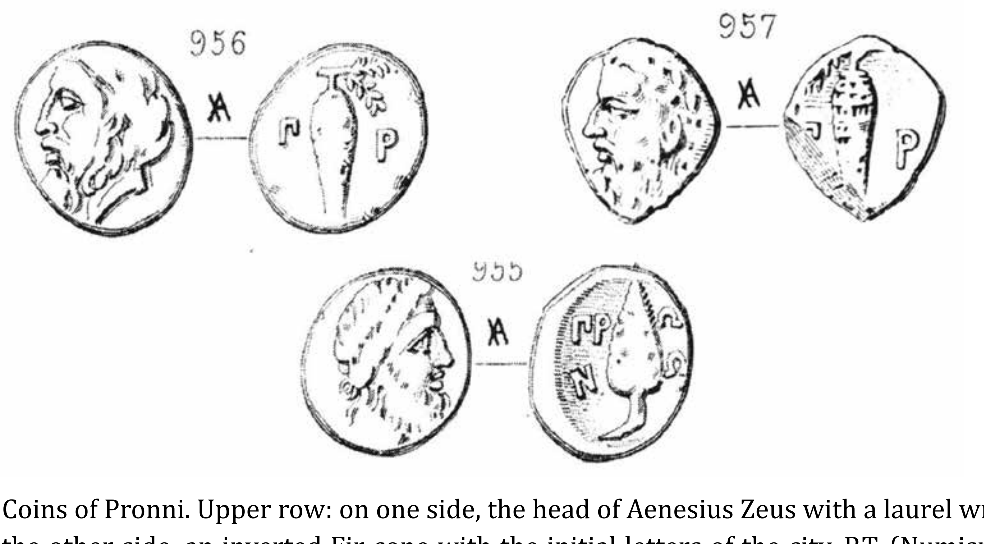



Fig. 19. Coins of Pronni. Upper row: on one side, the head of Aenesius Zeus with a laurel wreath and on the other side, an inverted Fir cone with the initial letters of the city, P.T. (Numismatic Museum). Bottom row: Laureate head of Zeus and a Pine cone with its peduncle (Photo: Postolakas 1868, Gardner 1887).

becomes known nationwide. It is likely that as a raw material for shipbuilding it would cover not only the respective needs of the state of Pronni, but it would also become an important exportation product. If we consider that in classical times the power of the states is mainly judged by the outcome of sea battles, then the Fir forest of Aenos, with an abundance of available raw material and accessibility from the side of Pronni, was the source of the naval superiority of the island. The role of the Cephalonians in the naval operations during the Peloponnesian War is reported by Thucydides (A, 27 B and 30, see K.L.G. 1992-94).

During the Hellenistic period, Cephalonia is mentioned more often in the sources, because the war events in western Greece in conjunction with the developing Roman imperialism shifted the center of developments to the Ionian Islands (Souris 1976). In 226 B.C. Cephalonia, the great naval power of its time, will initially confront Philip V of Macedonia, an ally of the Romans, and later on, Rome itself, which wanted to obtain the strategic advantage of the island, that controlled the entrance of the Corinthian Gulf and the sea trade to Sicily (Polybius 4. 6. 8. and 5. 3 6-9 see K.L.G. 1996). The warfare continued until the Romans conquered the island in 188 B.C.

### D1d. In the Byzantine Times. Naval Thema of Cephalonia

In the 5th A.D., C. Hesychius in his Dictionary makes an indirect reference to the forests of Cephalonia in its characterisation as *skiara* (meaning shady/forested) and *melaina* (meaning dark) island because of the dense forest coverage of its mountains (see K.L.G. 2004). It is evident that in Byzantine times the existence of this natural resource will keep the naval tradition thriving. Indeed, in the early 9th century, Cephalonia was defined as the base of a Naval Thema, i.e. an independent military command unit for the defense of the western sea borders of Byzantium against pirate raids (Zakythinos 1962).

### D1e. Exploitation and fate of the forests of Aenos – Roudi during the Venetian period

In the years that elapsed, there is a large information gap. However, from the 11th century onwards, rich material for the economic role of Aenos is preserved in the Archives of Venice. The names Monte Nero by the Venetians, Elatovouni or Mavrovouni by the locals and Black Mountain by the English meant that Aenos was still covered to a great extent with a thick Fir Tree forest. Because the fate of the forests is directly related to the historical adventures of the island, we consider a small flashback as necessary.

From the late 11th century onwards, the balance of power in the Mediterranean is changing due to the Crusades and the progressive decline of the Byzantium. Normans, Genoese, Venetians and Turks claim the Ionian Sea space and Cephalonia becomes a field of wars and conflicts. After the final conquest of the Byzantine Empire by the Turks, the Venetians become masters of the island from 1483 until 1797 (Treaty of Kampoformio). The French followed (1798) and afterwards the Russians and the Turks (1798-1800). With the assurance of England, the Seven Islands were decreed as autonomous (Eptanisos or Ionian State 1800-1807). The French return (1807-1809) and from 1809 until 1864 Cephalonia and the other Ionian islands are occupied by the English (Moschopoulos 1988, 1990).

During the Venetian domination, Cephalonians preceded the people from Hydra and Spetses in the naval battles against the Turks. They were distinguished as maritime explorers, such as John-Apostle Fokas-Valerianos (1532- 1603), known as Juan de Fuca, from the village Valeriano of Cephalonia. They also participated in the naval battle of Nafpaktos (Lepanto) in 1571 with Don Juan d' Austria against the Turks (Livieratos 1916/1988).

Venice needed the valuable timber of the Fir forest for the maintenance and renewal of its fleet, as well as for its defense. In the NW. foot of Aenos it founded a colony of 2,000 carpenters and lumberjacks. The fortresses of Assos and Zakynthos (1517) were built with Fir tree timber and the town of Zakynthos was rebuilt in a similar manner (1574). Senate resolutions determined that the timber from Aenos should be used in shipbuilding (for the masts, the antennae and the decks of the ships), for the wheels of the mills and the 'doges', i.e. wine barrel staves (Partsch 1892, Samios 1908).

Parallel to its exploitation the Venetians also took protection measures for the forest. They appointed rangers, empowering them with the right to impose penalties on offenders. Then, towards the end of the 16th century the catastrophic fires occurred. They burned 2/3 of the forest on Aenos, which was 13.9 km long and 5.2 km wide before the fire. The fires were repeated in 1677, 1730 and 1760. The worst one occurred at the end of the Venetian rule in the year 1793 or, according to others, in 1797. The cause was the illegal decision of the Intendant Vartolos Tsigonis to allow, after receiving money, the villagers east of Aenos to cultivate the forbidden areas that adjoined the forest (Samios 1908).

We detect a significant intervention on the exploitation of the natural resources of Aenos in the document by the island's Intendant Fantinos Malipieros in May 1509, which implies the intention to privatise part of the forest. In this document, a beast, known as the *Dragon of Aenos*, is described as feathery and of enormous dimensions, which could swallow a man (Samios 1908) (Fig. 20 & 21).

Ainos remains at the centre of economic activities, irrespective of whether these relate to the conquerors or the local population. Regarding the large prey, for which the

## THE DRAGON OF AENOS IN A NARRATIVE ILLUSTRATION


Fig. 20. a) In the forest of Saint Nicholas in Anemodouri there was a huge winged dragon devouring livestock and humans. b) The Intendant announced that whoever found the courage to kill it, would be rewarded with the forest of Saint Nicholas and all the land on the western foot of Aenos. The brothers Jacob and Bernard Vrescani listened to the preacher and decided to exterminate the beast.


Fig. 21. c) The two brothers – wearing their armour and armed with a sword and an axe, respectively – killed the dragon. One of the brothers was killed by the beast during the fight, while the other died later from his injuries. d) The body of the dragon was burned in front of the chapel of St. Nicholas, where there was a thanksgiving service and a litany (Illustrated by Maria Nterozario, according to the cited description in the aforementioned document of the island's Intendant. – M.F.I.K.I. Archive).

forests and the slopes of the mountain were their final refuge, Andreas Morozini, the Venetian Intendant of Cephalonia (1621-1622), confirms that during his time the last deer on the island was killed (Loverdos 1888, Moschopoulos 1999).

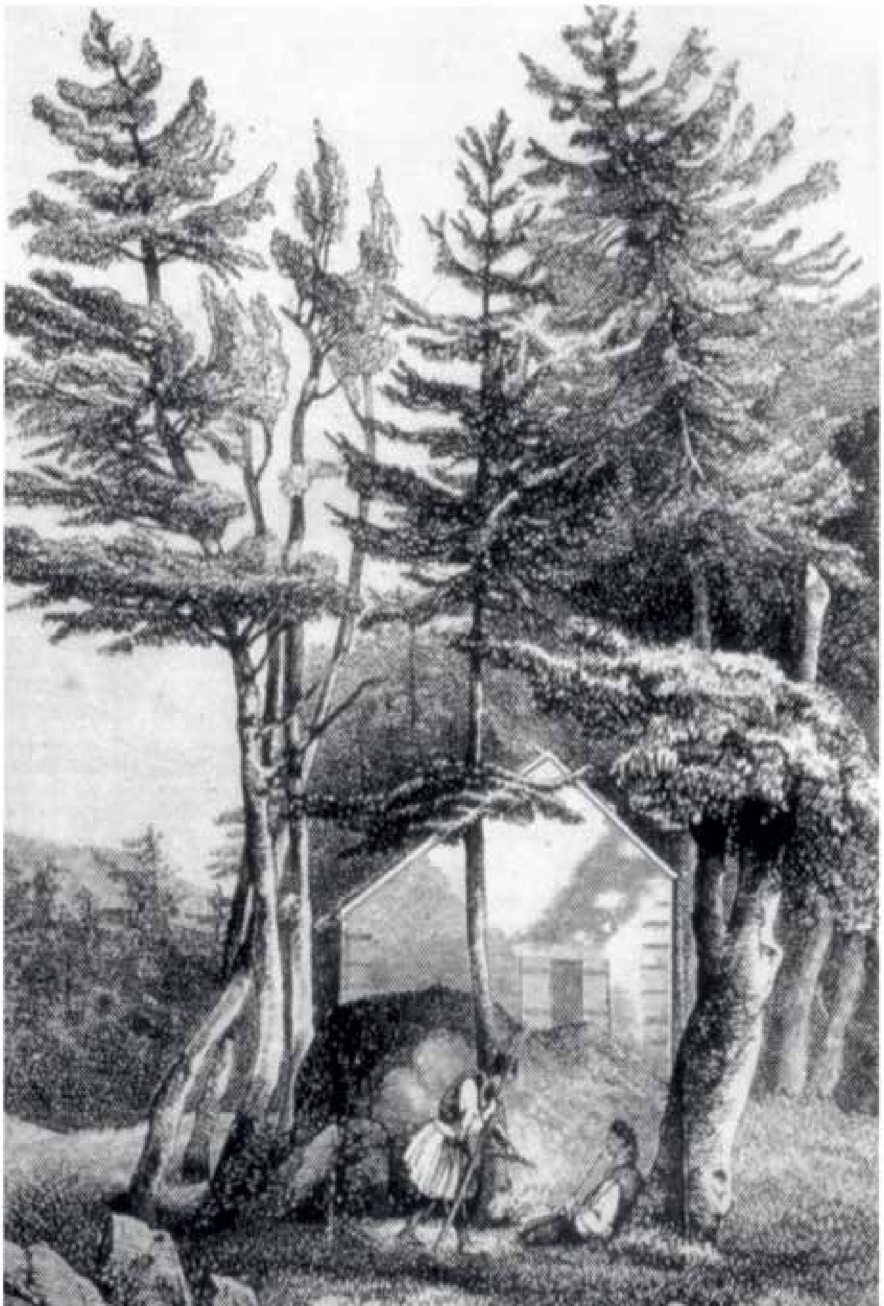
The Venetians were mainly interested in the Fir Tree as an exploitable resource. The stockbreeders claimed the uncontrolled and free grazing for their flocks as their right, inherited since antiquity. Their long-lasting bond with the mountain was so strong, that they considered unthinkable and hostile any attempt to doubt it. Stockbreeding was an important source for the survival of the island's population. The forest satisfied their needs for roofs, farming tools, utensils, firewood and charcoal. The pressure to ban grazing brought the reaction. The strict laws for the protection of the forest were violated, the eastern boundary of the forest was cultivated with no authorisation and in the southern part of Aenos the Monastery of Zoodochos Pigi was founded, which served as refuge for stockbreeders and outlaws (Partsch 1892).

### D1f. The 19th century: Aenos under English domination until the Unification with Greece

During most of the 19th century, Cephalonia was under English protection. It is a period of political and national events, with a growing economic activity and social mobility. Even during this period, Aenos remains one of the decisive parametres of English policy, but also a principal natural resource for rural residents. At the same time, the Fir Tree and the flora of Cephalonia in general become objects of interest for outstanding European scientists. We will limit ourselves only to J.W. Loudon, who in 1838 classified the Fir Tree of Aenos as a separate species, i.e. Cephalonian Fir Tree (*Abies cephalonica*), and to Fr. Unger (1862), who in 1860 published the first botanical description of Cephalonia and Aenos with beautiful lithographs (Partsch 1892).

The governor of Cephalonia, Charles Jacob Napier, exhibited a particular interest in the forest. In the eight years of his rule (1822-1830) with the help of his engineer, J.P. Kennedy, the first road to Aenos was constructed (Cosmetatou 1991). In 1828 they built a small house for the forest's rangers, the Casa Inglesse (Fig. 22) and a cistern for water collection was built (cistern of Kennedy). A second, smaller ranger's checkpoint was built on Roudi. Traces of the English road construction have been preserved until today near the cave Petasi, which the English used for snow storage. Until 1939, the Charity Shops of Cephalonia reaped the economic benefits from the management of the ice warehouse in Petasi (stored snow for sale).

The rural development policy of the British resulted in increased pressures on the natural



Κατάλυμα των Άγγλων στον Αίνο, η Casa inglese, το σπίτι της Κυβέρνησης.
Από το βιβλίο του Fr. Unger, Reise in Griechenland und in den jonischen Inseln. Wien 1862.

The British lodge on Ainos, Casa Inglesse, the Governmental house.
From the book of Fr. Unger, "Reise in Griechenland und in den jonischen Inseln". Wien 1862.

Fig. 22. Lithograph by Unger (1862) with the Casa Inglesse on Aenos.

environment, since the population in 1863 amounted to 70,948 inhabitants, distributed in 226 settlements. Yet again, the forest's protection measures did not succeed, but this time not only because they were contrary to the interests of the livestock owners, but also because the situation had become complicated in general, leading to popular opposition and uprisings.

The *Radical movement* against the English had already developed from 1848 with the uprising in Argostoli. In 1849, Skala revolts. At that time the English forest ranger was assassinated on Aenos (Moschopoulos 1988). The uprisings were repressed, 45 people took refuge in the mountain, but the reprisals were severe: 21 people were hanged, 12 publicly flogged in the presence of their families, others were imprisoned, others exiled. However, the names of the rebels became national symbols, praised by the popular muse.

In 1864, the Ionian Islands were united with Greece. During the regime transition from the British occupation to the Unification, there was a period of administrative weakness until the Domestic Regulation, voted by the Provincial Council of Cephalonia in 1858 (Demponos 2012), was implemented. The measures led to a shift of the majority of livestock breeding onto the mountains. Aenos became yet again the field of stockbreeding activities. The production of famous dairy products, mainly feta cheese and myzithra (μυζήθρα), indicates the growth in livestock volume. The cultivation of raisin and of the exquisite winemaking variety, *Robola*, spread on its slopes.

## D2. The 20$^{th}$ century. The early 21$^{st}$ century

During the first half of the 20$^{th}$ century the island was torn by the suffering of two world wars, economic recession, immigration and the 10-year long civil conflict.

The economic importance of the forests of Aenos-Roudi in the postwar period is substantial. The inhabitants used timber for the construction of their houses and for general constructions (roofs, window frames, floors etc.) and all kinds of boxes, such as for the packaging of raisins and other agricultural products. Illegal logging in the forest was intense.

Firewood was estimated at around 100 tonnes per year. It was also used for fuel in limekilns and for ceramics and charcoal production. During the years 1928-1952 the timber produced by the forests of Aenos and Roudi for trading amounted to 14,473 m$^3$ i.e. 2,315,680 kg. Besides these, an additional 248 m$^3$ were available for the needs of local residents. Exporting timber ouside the island was not allowed. Argostoli, Sami and Lixouri constituted consumption centres (Samios 1908, Kafasis 1964-1973).

The existing place names in and around the core of the National Park, such as *Paliokamina, Karvounolakkos, Prionistra, Lakkos of Tsasi* etc. attest to the human activities (logging, charcoal production) causing corresponding effects on vegetation, too. Stockbreeding remained the key element of primary production, but until the mid-century, it was still being practiced under the provisions of the 1858 Regulation.

The era after the 1953 devastating earthquakes was decisive for the whole island. Whole towns and villages were flattened. Much of the population moved to large urban centers. The forest was not unaffected by the new situation. Its timber became sought after for shelters, floors and roofs, during home reconstruction.

Stockbreeding does not cease to be a major source of economy. In recent decades, the pressure on the natural environment is growing, due to the large number of goats and sheep in the peripheral zone of Aenos and because of fires. The livestock zone of Cephalonia, which extends above the altitude of 600 m, includes the foot and the entire peripheral zone of Aenos and Roudi.

Upon our country's joining the EEC after 1979 and entering the Eurozone in 2001, the stockbreeding-agricultural sector was financially subsidised, in the framework of programs that aimed at increasing and improving production. According to the census of the Hellenic Statistical Authority (1991-2000) in 2000, 195,152 sheep and goats were being bred in Cephalonia. The number exceeds by far the recommended "safety limit" of 98,000 animals (35,000 sheep + 63,000 goats) (Vokakis 1987).

Subsidies for Robola vines in the western outskirts of Aenos were also a reason that intensified the pressure on its peripheral zone. Moreover: the construction of the electricity, telecommunications and media broadcasting networks of the island and the improvement of transportation connections (road, sea and air transport) concentrated on serving tourism. Along the high peaks of Aenos, the island's aerial telecommunications lines were set through Aenos' forest and thousands of Cephalonian Fir Trees were cut in the process.

The forests of Aenos, in addition to the economic importance of timber production and mountainous farming, constitute a major asset, because of their hydronomic role, on which vegetation, flora, fauna and, thus, man depend. They affect climatic factors, air composition, as well as the residents' aesthetics and health. The altitude and the Fir Tree forests were the means for the treatment of tuberculosis, which, along with malaria plagued the island in times when there were no appropriate treatments. For this reason, the Xilospito (Ξυλόσπιτο=wooden house) was built on Aenos in 1936 by the benefactor Chr. Vallianos and so was the *Sanatorium*, under the Cephalonian Ioannis Metaxas as Prime Minister, which, later on, was turned into a tourist kiosk. Because of the beginning of the Second World War the Sanatorium never operated.

Today, at the onset of the 21st century, our National Park strongly bears the marks of centuries of impunity, exploitation, and mismanagement. However, because of the struggles of environmentally conscious individuals and associations, such as the Society of the Protection of Cephalonia and Ithaca, thanks to the European environmental legislation and the nowadays favorable disposition of the Local Government, the notion for the protection of the natural heritage of Cephalonia has matured. The Management Body of the National Park of Mt. Aenos, established by the Greek Law 2742/99, has engaged in a titanic struggle to heal the long-lasting wounds, to protect and promote the forest.

Following the above, it becomes apparent why Aenos is a life source for Cephalonia and a precious natural and historical heritage. Since ancient times, it has been the factor that determined the state and administrative division of the island, shaped its economy and affected the mentality and temperament of the residents. Inextricably entwined with the historical adventures of the island, it was the center of political and economic interest of both its conquerors over time, and the Cephalonians themselves.

## D3. Ownership status

We consider it appropriate to refer to the ownership status, which took form during the period of the foreign rule, because, due to that rule, the legislation which currently governs the forests of Cephalonia, is different from the one in force for the forests of the rest of Greece.

The Venetians and the British were enacting laws for the protection and management of the forests, which they considered public property of Cephalonia. However, during the English Protection, in the “Constitution of the United State of the Ionian Islands of 1817” public lands and forests did not exist nor were they foreseen as property of the United State of the Ionian Islands, in which case they would have found themselves to belong to the Greek State after the Unification with Greece (1864). This regime recognised the occupation of forest land and forests by individuals. As a result, in order for the Greek State to obtain the right of ownership of a particular area, it had to *prove* the forest state of that area and its ownership, in accordance with the Ionian Civil Code or the Civil Code valid from 23.02.1946 or with some special law (Nomiko Vima V. 34/1986 No. 340/1985 Sect. C). It has been noted that the ownership regime for the forest areas is to blame for the frequent fires that happen in the Ionian Islands, particularly in Cephalonia, which has more forested areas (Kathimerini 2011).

We hereby cite the successive phases of the forest ownership status from 1500 to 1864: During the foreign rule in the Seven Ionian Islands (Venetian, French and English) the forests of Aenos were part of the public property of Cephalonia under the direct supervision and management of the respective local government. In 1830 the Local (English) Government, in order to protect the forest from illegal activities, passed the Regulation of the Forests of Aenos, Roudi and Atros that included strict protection measures. In 1862 it passed the Agronomic regulation – a stricter one – handling issues of property, exploitation and protection. However, it reinstated the small-scale grazing within the forest, under the permission of the Tax Collection Body that was responsible for its management.

According to Law 710/1878 and until 1939, the administration and management of the forest passed on to the Brotherhood of the Cephalonian Charities. Afterwards, according to the Development Law 1791/1939, its exploitation was assigned to the Fund of Agriculture, Livestock and Forests, placing the Chief of the Forestry Service of Cephalonia in charge in name of the Brotherhood, which remained the forest owner.

In 1962 it was decreed a National Park, in order for the Cephalonian Fir Tree (*Abies cephalonica*) forest to be protected. In 1968, the Greek government buys it from the Cephalonian Charities for the sum of 3,500,000 drachmas. Since then, and with the Royal Decree 776/19.11.1962, the management of all forests of Aenos is defined with the Development Law 856/1937 and the Legislative Decree 996/1971. The National Park of Mt. Aenos is the smallest of the 10 National Parks of Greece. Today it has a total area of 2,862 hectares and includes two forest sections: the part of Aenos with a pure forest of *Abies cephalonica* (2,316 hectares) and the part of Roudi with a mix of *A. cephalonica* forest and high maquis vegetation (546 hectares) (Efthymiatou-Katsouni 1998).

Due to the Cephalonian Fir Tree (*Abies cephalonica*) and its rare endemic species of flora, Aenos has been included in the EU Natura 2000 Network (GR 22200002). The Management Body of the National Park of Mt. Aenos, as mentioned above, plays a leading role for the protection and promotion of its natural wealth.

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# P A R T II

## GEOMORPHOLOGY – GEOLOGY – HYDROGEOLOGY OF MT. AENOS

# INTRODUCTION

The text presented in the following pages, comes from the main report of the research project entitled *Study of the ground water capacity of Cephalonia*, which was conducted during the period 1984-1990 by my research group, after my proposal to the Prefecture of Cephalonia. The Prefecture funded and fully covered the expenses of two large research drilling projects, which we proposed and were conducted by its own means, with our scientific and technical supervision and accountability.

These drilling projects supported our research with rich information but they also gave the opportunity to convert several probing wells from scientific to productive ones, in order to supply towns and villages of the island with good to satisfactory quality ground water. We have also provided advice and recommendations for their sustainable management, in order to prevent their salinisation from potential sea intrusion.

The reports containing thousands of pages, the maps, the graphs etc. produced from the research on Cephalonia Island, have been deposited to the proper Prefecture Directorates. I hope that this rich material concerning the water potential of the island is being utilised in support of sustainable water use and its conservation.

For the present Part, I have paid great effort to choose and focus only on, if possible, the information with regards to Mt. Aenos and the large limestone massif of the main part of the island, which constitute a uniform geological and hydrogeological unit, delimited by faults and fault zones, grabens and the sea, as described later on.

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## A. GEOMORPHOLOGICAL DESCRIPTION

### A1. The Cephalonian Mountains

The largest part of Cephalonia is mountainous (36.9%) and semi-mountainous (38.4%). Mt. Aenos constitutes the largest mountain range at the southeastern part of the island, which extends longitudinally with a NW-SE orientation. The mountain ridge part, with elevations exceeding 1,000 m, has a total length of 11 km. Several high altitude peaks can be observed along this mountain ridge. From SE to NW the following peaks are present: Kourkoumbia (alt. 1,508 m), Megas Soros (highest peak at 1,627 m), Stavros (alt. 1,532 m), Vounos (alt. 1,312 m), Vigla (alt. 1,050 m), Kefali Petri (alt. 1,025 m) etc.

In Aghios Eleutherios area (Radar) the mountain range bends to the north, where Mt. Roudi, located east of Valsamata village, is found, the highest summit of which is Gioupari (1,124 m). The mountain range of the island's main land mass extends to the NW, where several peaks with high altitudes are present. The peaks of Aghia Dynati (alt. 1,131 m), Eumorfia (alt. 1,041 m) and Xerakia (alt. 1,065 m) present altitudes that exceed 1000 m and are located NNW of Dilinata along the Dilinata – Drakopoulata line, i.e. with a SSW–NNE direction.

With the same SSW-NNE direction, parallel to Aghia Dynati – Eumorfia, another mountain range of lower altitude is observed, which reaches to the NW the graben of Thinias in Aghia Kyriaki – Myrtos gulf.

The two mountain ranges of Ag. Dynati-Eumorfia and Imerovigli-Gerani complete their NE expansion at the syncline of Pylaros, whereas NW-wards they end up with almost subvertical slopes to the graben of Argostoli-Livadi gulf.

North of the lowlands of Pylaros extends the mountainous peninsula of Erissos, which ends up to the east at the marine depression of Ithaca's Channel.

West of the Argostoli-Livadi gulf and the Thinia-Ag. Kyriaki graben extends the Paliki peninsula, albeit with an overall smoother relief, compared to the rest of the island. Its northern and western part is semi-mountainous, consisting of limestone mountains with very steep slopes, which end up at the sea westwards and northwards. Their coasts are for the most part vertical, where cliffs of an altitude of 100 to 200 m also occur.

## A2. Plateaus and Altiplanes

The intense vertical fragmentation of the island, as well as the karstic erosion of the limestones, which cover more than 70% of its total area, have resulted in the formation of several plateaus and altiplanes, the most important of which are the following:

a) Omala Plateau

It constitutes the lower part of the Valsamata enclosed catchment, the lowest point of which is located between Aghios Gerasimos and Valsamata, with an altitude of 395 m. The elevation of Rachi, north of Fragkata, separates the plateau in two sections: the southern one presenting lower elevations and the northern one with altitudes higher than 450 m.

The mountain peaks surrounding the plateau are made of limestone and so is its bottom, which is however covered by thin layers of terra rosa.

The mountain peaks in the north-northeast and southeast part are higher (Eugeiros 938 m, Xerolimba 982 m, Monolati 999 m, Korinthos 835 m, Gioupari 1,124 m, Vigla 1,050 m and Kefali Petri 1,025 m), compared to those in the southwestern part (Koryfi 671 m, Falagga 564 m).

The plateau's surface water runoff is drained through sink holes located in its lower part.

b) Troianata Plateau

Another small enclosed catchment is formed southwest of Valsamata, surrounded however by lower limestone mountains compared to the above-mentioned one. In its lower part, the small plateau of Troianata extends, the lowest point of which has an altitude of 255 m. Water scarcity constitutes a severe problem for this region. In cooperation with the villages of the Omala plateau a water association has been established, in order to supply the villages with water, coming from a well in the area of Razata. As the amount of water has been completely insufficient to cover the water needs, our study has tried and managed to improve this situation. Since 1990, two wells, each situated in the area of Troianata and Valsamata respectively, have been made available, in order to cover the water demands.

c) Dilinata – Faraklata – Razata Altiplane

West of the limestone mountain range of Eumorfia – Eugeiros – Koryfi, an elongated altiplane with a NW–SE orientation is observed, situated in limestone rocks, with altitudes ranging from 100 to 350 m. The lowest elevations are found in its southern part, in the region of Razata. At the western side, a series of low limestone elevations, which extend from Davgata to Prokopata, delimit the altiplane, separating it from the hilly beach of Argostoli gulf. The drainage towards this side is processed through streams, two of which end up directly in the sea, whereas the southern one, draining the southern area of Razata, emanates from the Krania plain.

## A3. Catchments – Torrents

Due to the intense vertical and lateral fragmentation of the island several catchments, mainly of small size, have developed.

In the main part of the island three large catchments are present: those of Poros, Sami and Ag. Efimia, which flow eastwards through torrents. They are considered the largest catchments of Cephalonia.

Due to the nature of the rocks covering the ground surface of the three catchments, the surface runoffs in the two northern ones are very poor, whereas in the area south of Poros they are richer. In the northern ones, 80-90% of their surface is covered by very thick limestones, whereas a large portion of the Poros catchment surface is covered by impermeable rocks, favouring surface runoff. In the latter catchment, we have conducted a few water measurements (see the respective report) and suggestions for its runoff exploitation are described in a particular issue (see the Prefecture's Archives).

The surface of these catchments is:

| | | | |
|---|---|---|---|
| • Sami catchment: | 110 | $km^2$ | Total 226.2 $km^2$ |
| • Ag. Efimia catchment: | 50 | $km^2$ | |
| • Poros catchment: | 66.2 | $km^2$ | |

Thus, the above-mentioned catchments comprise 29% of the total area of Cephalonia.

# B. GEOLOGICAL CONDITIONS

## B1. Introduction

At the initiation of our studies on Cephalonia, in May 1984, the only published geological map was that of B.P. Co at a scale of 1:100000. We also had in our disposal a copy of an unpublished geological map at a scale of 1:50000, created by a group of Geologists of the University of Munich (1962-68 mappings). This map was finally published in 1985 by I.G.M.E. with additions of faults, resulting from photogeological interpretation by G. Migkiros.

Furthermore, geological depictions of different parts of the island in several of the numerous previously published geological studies were also available. However, there were no integrated geological maps, with the exception of those of the southernmost part of the island, at a scale of 1:50000, and of another part southwest of Argostoli (down to Cape Liaka) at a scale of 1:40000, included in the doctoral thesis of D. Sorel (1976).

Interesting geological maps and tectonic depictions of specific sections of the island (southwest of Argostoli, Pylaros, Thinia, southeastern part of the island) are included in the doctoral thesis of J. K. Underhill (University of Wales, 1985).

In addition, geological maps of the southeastern part of Cephalonia and south Paliki at a scale of 1:25000 were included in the doctoral thesis of K. Nikolaou, completed in 1986 (University of Athens).

In the following sections an attempt is being made to briefly describe the island's geological conditions and the surrounding area, as they emerge from the combination of the numerous references and our observations and geological mappings.

It should be noted that several geological research studies, conducted mainly by foreign geologists, are available for this region of Greece, covering a time period of 150 years (H. E. Strickland's being the first in 1838). Many of them are specialised studies, whereas the results of several ones are often controversial. As a consequence, it is apparently difficult to proceed to their combination or to present all the different opinions.

We have followed mainly the doctoral theses by De Mulder (1975), D. Sorel (1976), J.R. Underhill (1985) and K. Nikolaou (1986), as well as the studies by the geologists of B.P. Co. D.A. Jenkins (1972) and W.D. Jones and by the group of the German geologists K. Braune (1965), F. Fabricius (1984), G. Dremel (1968a, b) etc.

Very briefly, the following can be reported for the broader area (Sorel 1976):

1. In the Ionian, as well as in the Pre-apulian zone up to the Upper Triassic, the carbonate sedimentation had already started and evaporitic sedimentation had been taking place, the base of which remains unknown.

2. In the Pre-apulian zone from the Upper Triassic to the end of the Cretaceous a period of sea regression and deposition could be identified, during which a 4,000 to 5,000 m thick carbonate sequence has been recorded. At the end of Cretaceous to the Middle Miocene the basin plunging in this zone was interrupted and fragmentation of the basin from syn-sedimentary faults occurred. The sedimentological conditions were different: the deposition thickness was small, the stratigraphic hiatuses were plentiful and from one site to the other the lithostratigraphic series were variable (I. F. P. 1966, Bizon 1967).

3. In the relatively wide Ionian zone, three sub-zones have been distinguished, characterised by some "independence", which has been expressed through the differentiation of the deposits' thickness and facies (I. F. P. 1966).

In the external sub-zone, found also in eastern Cephalonia, the carbonate series starts from the Upper Triassic and extends up to the Upper Cretaceous. The series thickness ranges from 900 to 1,300 m, i.e. four times thinner than the respective sediment thickness of the Pre-apulian zone, on which it has been thrusted.

4. In the two zones (Pre-apulian and Ionian) the carbonate sedimentation was followed by clastic-mechanical sedimentation, supplied by the erosion of rocks from the tectonic regions, which gradually uplifted from west to east.

## B2. Geology of Mt. Aenos and its surrounding area

### B2a. Pre-apulian zone

In Greece, the Pre-apulian zone formations are found surficially only on the islands of Paxi, Antipaxi, Lefkada, Cephalonia and Zakynthos. They present their larger expansion on Cephalonia, covering almost 80% of its total area (Fig. 1).

Subsequently, we will focus only on the formations which are present on the surface of the island. Regarding the deeper ones, they have been made known from the drilling survey for hydrocarbon investigation and brief information has been given in a previous chapter.

L o w e r  C r e t a c e o u s: They are the oldest rocks of the Pre-apulian zone which appear on the surface of the island. They are found surficially only on Cephalonia, comprising the lowest parts of the southwestern slopes of Mt. Aenos (from Simotata to Markopoulo) and the northwestern part of Mt. Kalon Oros (southeast of Assos towards Patrikata, the altiplane of Kalon Oros, Harakas, Myrtos bay).

In the geological map published by I.G.M.E. (1985) the Lower Cretaceous is being

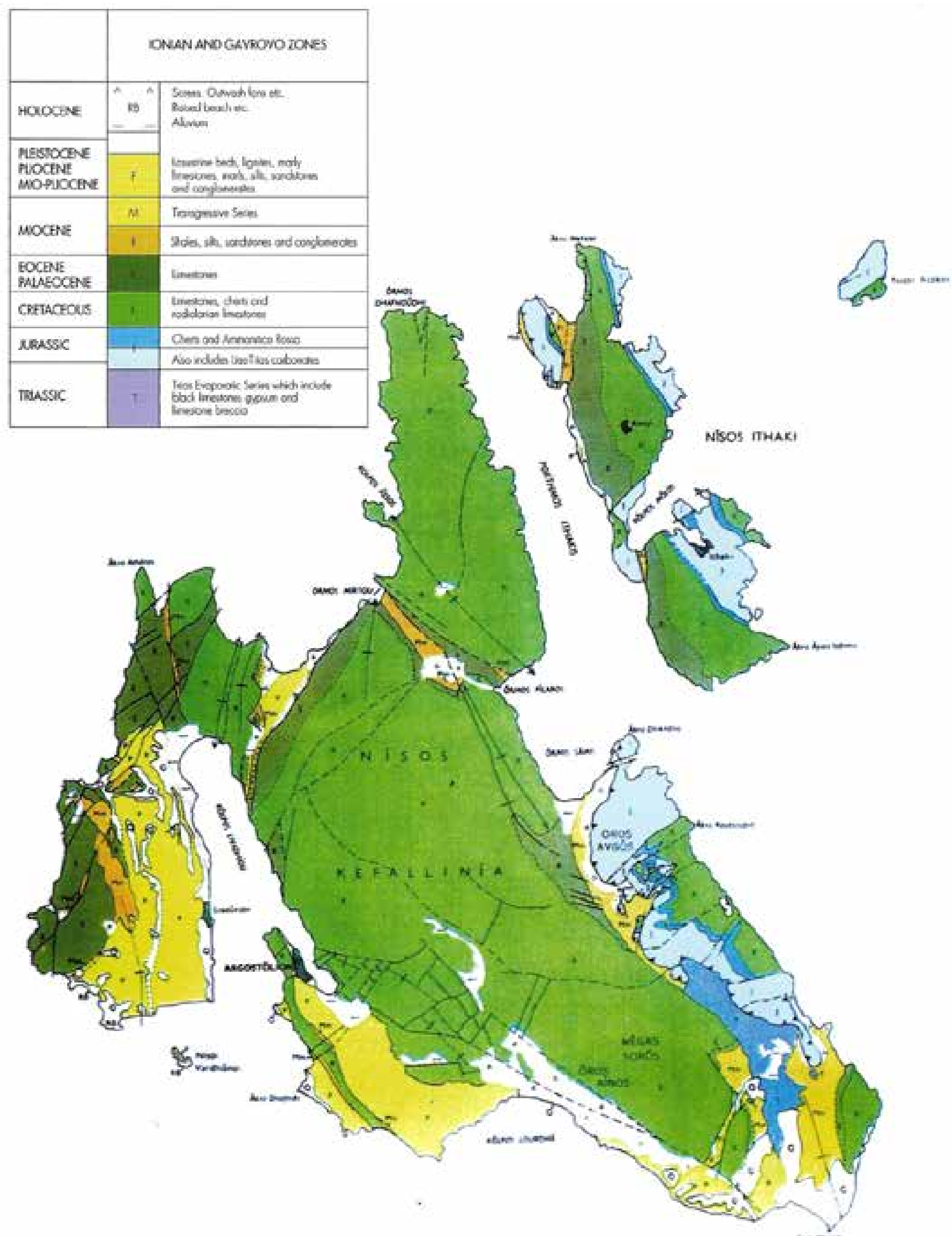


Fig. 1. Geological map of Cephalonia. Excerpt from the B.P. (1971) geological map.

described with:
a) Sub-yellow limestones in 1 to 20 cm thick layers which shift upwards to schists and partially to compact limestone. Occasionally, intercalations of flintstones occur, which are locally replaced by dolomites. The thickness at the valley of "Kambos Analipsis" is 100-150 m.
b) Ashy grey to greenish and/or brownish dolomites with clear bedding and intercalations of white flintstones at the lower horizons. Although no fossils have been found, due to their stratigraphic position they are considered as pre-Cenomanian. Thickness up to 500 m.

Within the framework of our study five wells have been conducted in Lower Cretaceous formations: two in the zone of southwest Mt. Aenos (Markopoulo, Atsoupades) and three in the area of Assos.

The Mt. Aenos wells drilled the series down to 350 m without reaching underground water, though this depth corresponds to depressions of 70 m and 50 m below sea level, respectively in the two sites. From the washing material, it has been discovered that dolomite dominates.

In the Assos area, two of the wells were shallow (42 m and 58 m), whereas the third one reached a depth of 160 m. The deepest one did not reach underground water (elevation -26 m), whereas the rest were successful. One of them has been employed to counteract water scarcity in this touristic community.

In all the wells, the drilling started from the oldest (deepest) layers, which expand to the surface. Therefore, they drilled deeper Lower Cretaceous horizons, where dolomites dominate, as it is already known by the hydrocarbon drilling survey from Zakynthos.

Upper Cretaceous: Neritic limestones, approximately 1000 m thick (limestone deposition in shallow marine environments) with lots of rudist fragments and micro-fossils from the Cenomanian were described by B.P. (1971) in a section close to Koulourata. They are white to light brown-grey coloured limestones. A few of these layers are cherts, while others are locally oolithic.

According to the legend of the geological map of I.G.M.E. (1985) the Upper Cretaceous includes five lithologic carbonate horizons with different characteristics among them.

As it can be concluded from the literature, there are very important differences, mainly regarding the thickness of the Cretaceous limestones, among the geologists of B.P. and the German ones from the University of Munich on the views of which the legend of the geological map of I.G.M.E. was based.

The difference between the opinions results from the lack of index horizons, a fact that also complicates tectonic surveying. Furthermore, as it has been reported in another locality, the presence of reverse faults and the difficulty of their identification in the system of Cretaceous limestones may have led to erroneous estimations of their thickness.

P a l a e o c e n e: Palaeocene layers are found in restricted areas of the elongated zone in the syncline of Pylaros, at the coast north and south of Fiskardo and at the eastern foot of Mt. Aenos (from the area of Sami-Poulata to Charaktio, as well as at Kambitsata).

According to the legend of the geological map of I.G.M.E., Palaeocene is represented by thin plated (Pylaros area) or unbedded (area east of Mt. Aenos) pelagic limestones, which contain transported material of Upper Cretaceous limestones.

E o c e n e – O l i g o c e n e: According to the geological map of I.G.M.E., Eocene is represented in Cephalonia by unbedded or thick-bedded limestones, which contain large Foraminifera, mainly Nummulites and Alveolines. The thickness of these neritic limestones reaches up to 100 m in the area of Thinia. In other localities they interchange with unbedded pelagic limestones of 120 m thickness, which contain grey to reddish flintstone layers.

The Eocene limestones expand significantly in Paliki, but they also appear in narrow elongated zones, parallel to those of Palaeocene limestones, i.e. in Pylaros, in the eastern foot of Mt. Aenos and in Thinia. Small outcrops also exist in the faulted Argostoli anticline and the Kourouklata graben.

According to the geological map of I.G.M.E., the southern part of the small, elongated, mountainous ridge of Ailias, north of Palia Scala, is composed of Eocene limestones of the Pre-apulian zone and not of the Ionian, as mentioned on the map of Nikolaou, who argues that it is a new tectonic horst with Eocene limestones on the surface.

It should be noted that Underhill (1985) regards Ailias limestones, as well as those of Palaiokastron, as a thrusted tectonic fragment of the Ionian zone Jurassic limestones, which lie on the Miocene sequence. Sorel (1976) has expressed the same opinion, concerning the Palaiokastron peak.

We consider that the data in support of Nikolaou's opinion are stronger, at least regarding Ailias locality, except that the thickness of Eocene and underlying Mesozoic limestones is greater than what it appears in the exposed sections.

In the legend of the geological map of I.G.M.E., together with the Eocene limestones an Oligocene age sequence is reported, however it is noted that it has not been proven. In addition, according to the B.P. map legend (1966) the Oligocene is absent from Cephalonia. The same is also supported by G. Dremel (1968) about South Cephalonia, mentioning that there are no sediments from the Upper Eocene on the island. On the contrary, he verifies the presence of Oligocene layers in the northern part of the island.

M i o c e n e: Due to the significant research interest of the Miocene in Cephalonia, but also to its financial importance because of the contained phosphorites in it, several geologists have investigated it since the beginning of the previous century (Simoneli 1904).

The expansion of its rocks is significant in western Paliki, in the Thinia-Agkonas zone, in Pylaros, to the longitudinal zone south of Sami towards Koulourata, as well as in south-eastern Cephalonia. A small outcrop nevertheless with significant scientific interest is also found in the coastal zone of Liaka Cape.

According to the legend of the geological map of I.G.M.E., at the base of the Miocene sequence a transgressional basic conglomerate is found locally (Tzanata area), containing transported boulders of Cretaceous limestones, with a diameter up to 2 m at the base. Its thickness reaches up to 15 m and it is of Aquitanian age.

This conglomerate is covered by organoclastic limestone that is called "*Lepidocyclina breccia*", which in other areas has been deposited directly on the Eocene limestones (area of Palaia Skala, Agkonas basin). Well bedded pelagic marbles and marly limestones follow, which turn into unbedded marls with condyles. The thickness of the beds above the basic conglomerate is, according to the I.G.M.E. map, approximately 50 m. They are considered to be of Aquitanian to Lower Bourdigalian age.

An Upper Bourdigalian conglomeritic and brecciated limestone follows, which is mainly found locally at the base together with large Foraminifera and towards the upper parts interchanges with sandy marls. Towards the top, it changes to argillaceous marls (area of Pastra). In other regions (west Tzanata basin) the whole section consists of lagoonal argillaceous marls. Locally black Vitumenian marls and gypsum layers appear (Upper Miocene). The above-mentioned unit is 200-300 m thick.

All these constitute a very brief presentation of what is regarded as Miocene formations, because, as is evident from the literature, there is much richer information and in some cases, controversial views prevail. We have to note that in the geological map of I.G.M.E., a large area has been mapped from the area of Ag. Nikolaos to Pastra, consisting of Upper Vourdigalian to Messinian formations. In fact, it concerns the area where the Triassic series with the black shales, the breccia and the Ionian zone gypsum extends, the presence of which is not obviously accepted by the German geologists, yet is on the mapping of which the geological map of I.G.M.E. is based. All the other geologists that have worked in this area, including us, accept the Triassic series.

### B2b. Tectonics

The thrust of the Ionian zone formations is the dominant tectonic event (B.P. 1971, Jenkins 1972, etc.) during the first years of the Lower Pliocene (Smith & Moores 1974; Sorel 1976; Nikolaou 1988) over the considered autochthonous system of the Pre-apulian zone (Fig. 2).

This extensive tectonic line constitutes part of the western thrust of the external Hellenic zones, the front of which passes, with a NNW–SSE orientation, west of Corfu and through Paxi - southwestern edge of Lefkada – northwestern edge of Ithaca – southeastern parts of Cephalonia and Zakynthos, heading southwards west of Peloponnese.

As far as the above-mentioned general tectonic boundary of the two geotectonic zones is concerned, despite their disagreements in the details, researchers generally agree. Discrepancies are mainly located in the southern part of Cephalonia, where more complicated tectonics have perplexed the situation.

We consider that the best supported view is the one expressed by Nikolaou (1986). According to him, in south Cephalonia a thrust line passes through the Kateleios area and towards the north it crosses the region of Pastra and Ag. Eirini and then (according to all views) it curves to the NW. Subsequently, it crosses Kambitsata, Andriolata (slightly to the east), Ag. Nikolaos (slightly to the west), Digaleto, Koulourata and it ends up at the mountain foot, located east of Sami bay. To the north, it follows the channel between Cephalonia and Ithaca, reaching its northwestern edge.

Underhill (1985) mentioned that the thrust surface close to the front is sub-horizontal. In a short distance east of the front, the thrust surface must incline more than 40°. Thus, this can explain the thickness of the Mesozoic carbonate rocks, extending between Sami and Poros. These rocks form a large anticline, the axis of which expands parallel to the Ionian thrust.

Based on Nikolaou's interpretation, south of Pastra the thrust line is covered by the Lower Pliocene formation of Kateleios (marles and sandstones), which lies in unconformity above the depositions of the Pre-apulian zone west of the thrust, as well as above the Upper Miocene layers of the Ionian zone, i.e. the Aleimatas breccia and the Asprogerakas marbles. These layers have been transported from the east with the thrust, "loaded" on the limestones of Ailias and their westwards underground extension (extension to the south of the Palaiokastron limestones).

In general terms, we concur with Nikolaou's general tectonic model for the south – southeast Cephalonia shown on the geological map (Fig. 3) and the various sections. However, we highlight that the real picture is much more complicated, mainly due to the significant expansion of the listric and transverse faults.

During the Lower Pliocene, a period of intense compressional stress, except for the large thrust described before, in the rest of Cephalonia, i.e. the expansion area of the Pre-apulian zone rocks, reactivation of older normal faults took place (Sorel 1976), which had been formed under a tension stress regime (syn-sedimentary faults).

The reactivation of these faults under a compressional regime had as a result their function as reverse – overthrust faults.

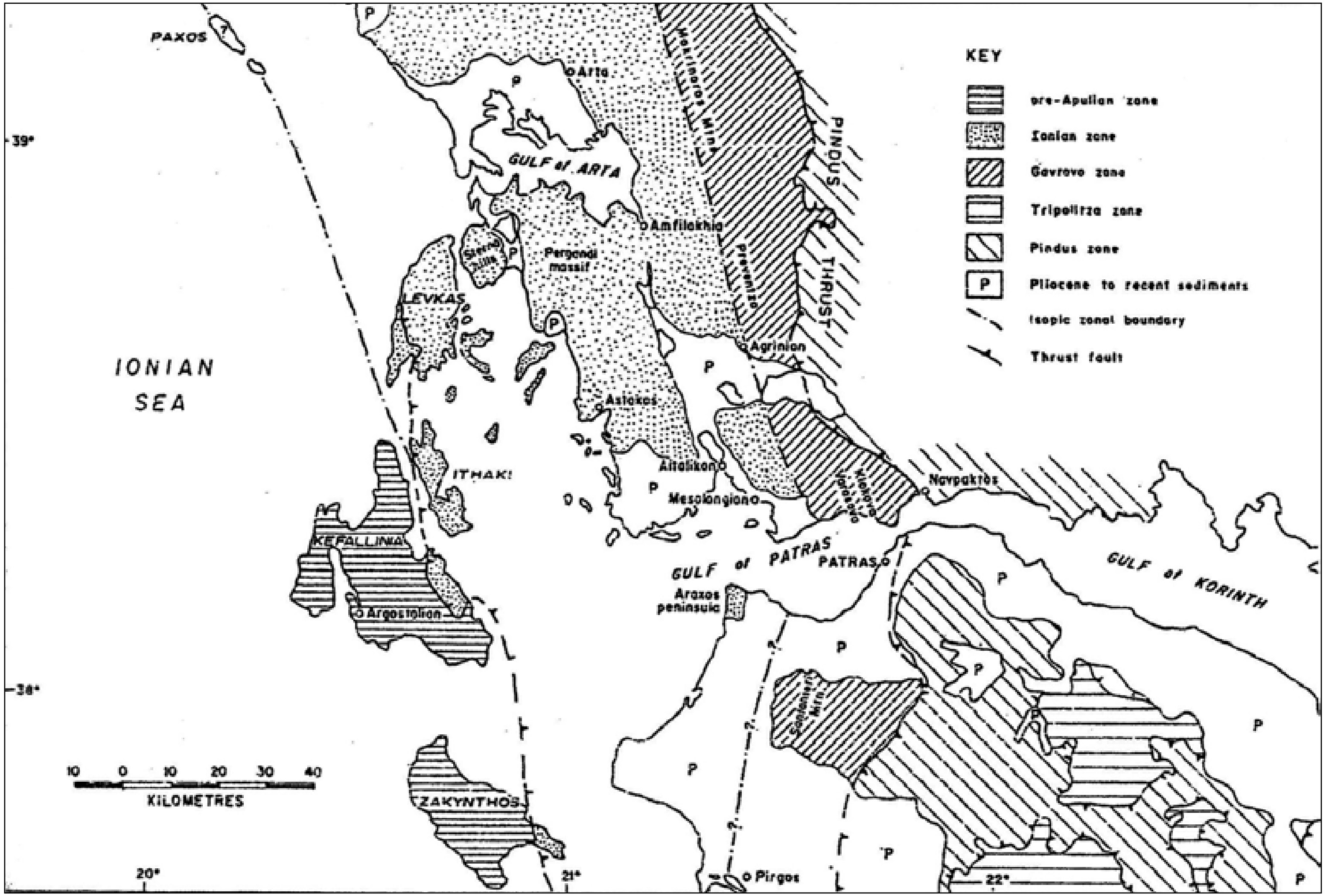


Fig. 2. Geotectonic belts of Western Greece (Jenkins 1972).

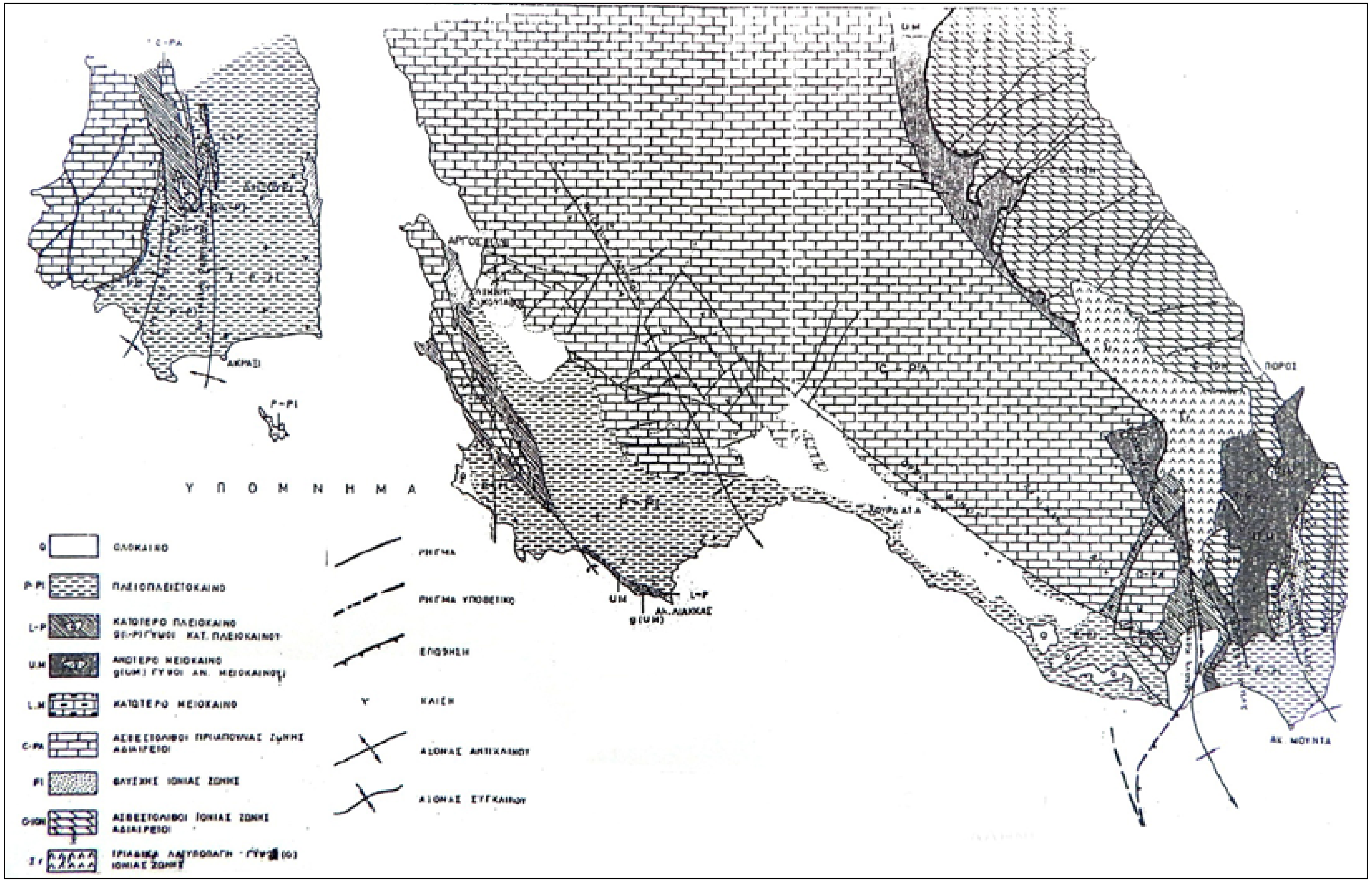


Fig.. 3. Simplified geological and tectonic map of southern Cephalonia (Nikolaou 1988).

# C. HYDROGEOLOGICAL CONDITIONS

## C1. Hydrolithologic classification

Taking into account the active porosity and the permeability of the various rocks and the geological formations, which form the island, and grouping those of them that exhibit similar behaviour, in order to simplify their classification, concerning the infiltration and the flow of underground water through them, the following groups can be distinguished:

1st Group

In this group all rocky formations can be classified, in which a secondary porosity could develop, due to fragmentation and/or karstic process, the values of which may possibly range widely and their permeability may exhibit significant fluctuations.

In large volume rock masses of this group, it is possible that the permeability values could be very low, although high values may also occur, mainly due to large karstic tubes.

All limestones, independent of their geotectonic–stratigraphic zone and age, are attributed to this group.

Dolomites are also attributed to this group, although they behave more frequently, compared to the limestones, as almost impermeable rocks. A typical case of impermeable dolomites constitutes the longitudinal zone of the southwest foot of Mt. Aenos, between Simotata and Markopoulo. Three probing wells in this zone, of 350 m depth each, drilled dry dolomites down to an elevation of -70 m. Dry dolomites were also drilled in the area east of Assos down to -27 m, as well as north of Vovikes down to -40 m.

It should be noted that except for the dolomites, dry limestones have been also drilled in 7 wells at different areas, where depths ranging from 15 to 78 m below sea level were investigated.

In most cases, in wells in limestones, as well as in sites where waterlogged dolomites were drilled (Assos and Alafona), the ground water capacity was found in negative elevations. However, ground water rose in them and finally got balanced at positive elevations, although in a few cases the equilibrium was achieved at depths just a few metres below sea level.

These phenomena are explained by the siphoning of the karstic tubes, but also by other factors, acting simultaneously.

In some cases (see next paragraph), ground water capacity in limestones was also found at positive elevations, being exceptionally high in the wells of Thinia, Palaia Skala and Koulourata. The phenomenon of increased piezometry could be derived either from local blockages of the karstic tubes (the cases of Thinia and Koulourata) or from the confinement of limestones by impermeable or low permeability rocks (the case of Palaia Skala) (Koumantakis & Mimidis 1989).

2nd Group

This group includes the geological formations in which permeable and impermeable rocks intercalate vertically or horizontally. The thickness of the layers is not stable and weathering is common.

Intercalating layers of Miocene, Pliocene and Pleistocene and marly limestones belong in this group (subgroup a).

In addition, the terrestrial Quaternary deposits could be included in the same group, i.e. the alluvials, the screes, the fluvial deposits and the lateral screes (subgroup b). It should be noted that in these deposits unsorted materials dominate and intercalations and wedges are common and could be often observed within a few metres.

In the rocks of this group water tables under pressure could develop or even free ones, when ground water capacity develops in granulated formations, which are not covered by impermeable materials.

3rd Group

In this group the practically impermeable formations and rocks are included, such as the mixture of Triassic clays-breccias-gypsum and the Neogene and Quaternary deposits in which clay, marly and silty components dominate.

In some cases, in the areas where rocks of this group are found, poor ground water capacities can develop, either in their regolith or in permeable bodies of small volume, which sometimes they overlay or sometimes they intercalate in the watertight unit and have the ability to be supplied by direct or lateral infiltrations. Several small springs on Cephalonia drain such poor ground water capacities.

## C2. Water tables – Hydrogeological units

### C2a. General information

The intense tectonic strain has caused limestone cracking, fragmentation, crumbling, as well as in some cases mylonisation. Under these circumstances, in some cases and areas the limestones have undergone a very profound karstic process.

As a result, a rich and complicated network of underground karstic tubes and characteristic surficial karstic forms has developed.

The most impressive karstic form is the well-known and globally famous sinkhole of Mylos in Argostoli, through which seawater flows. The seawater is being mixed with freshwater coming from mountainous limestones, welling as brackish water 15 km to the east, at positive elevations, in the broader area of Karavomylos coastal zone.

Since the 19$^{th}$ century a lot of researchers have studied this rare phenomenon. A lot of articles have been written, focusing however on its theoretical aspect, in order to explain this as a hydraulic phenomenon.

During the period 1959-61 Maurin & Zoetl (1963) studied it and, based on the data from pigment tracing (160 kg of uranine), they proved the connection of the Argostoli sinkholes with the Karavomylos springs.

In the most recent, related publication, Drogue (1989) highlights three factors acting simultaneously, which probably contribute to the genesis of this phenomenon: first, the energy of the Aegean-Adriatic sea current leading to a higher sea level of 2-30 cm at the side of the sinkhole, compared to the area of Karavomylos; second, the difference between the density of the sea water flowing into the sinkhole (1.258 kg/dm$^3$ at 25°C) and the density of the brackish water effusing from the springs (1.0002 kg/dm$^3$ at 15°C); and third, the existence of deep, karstic, siphon-type tubes, with an underwater action, contributing additionally to the phenomenon of the effect of the Aegean-Adriatic sea current.

Other significant karstic forms in the island's limestones are the numerous caves, pothole caves and funnel-like depressions. A few of them are accessible to the public, such as the pothole cave of Melissani and the Drogarati cave. Other well-known but partially explored pothole caves are those of Agalaki at Poulata and Zervati at Karavomylos.

These pothole caves extend slightly higher or lower than the sea level and constitute expansions of complicated karstic networks. Their lower parts are flooded by brackish waters, which flow from the interior towards the coastal zone of Karavomylos. During the tracing experiment conducted by Maurin and Zoetl with the use of pigments, these were also tracked in the pothole cave of Melissani.

Our observations in the Zervati pothole cave have shown 1 m fluctuations of the hydrostatic level. According to the locals, during the first years of their settlement in Karavomylos (Nea Vlachata) after the destructive effects of the 1953 earthquake on the old village, the pothole water was used for drinking. However, there are no facts concerning the water chemical quality back then. Today the water is brackish, as are the waters flowing in Melissani and Agalaki and generally in the limestone zone from the coastal area of Ag. Efimia-Karavomylos to Poulata-Chaliotata-Mouzakata.

Except for the karstic springs of the Karavomylos-Ag. Efimia front, from which large quantities of brackish waters flow, with significant inflows as well, other springs with brackish waters (from the discharge of large limestone masses) are the coastal and underwater flows north of Poros, several underwater ones between this site and Sami, south of Poros and towards Skala, as well as the underwater flows downstream of Koulourata (Argostoli-Livadi bay) and the southwestern and western coast of Paliki.

With the exception of the Karavomylos springs, for which the IGME study has provided relevant data (fluctuations of supply and quality changes), measurements data for the remaining brackish coastal and underwater springs are not available yet, since on one hand it is considered a very difficult to impossible task to be achieved and on the other hand there is no practical relevance for such measurements.

Besides the large known and the numerous unknown small springs with brackish water draining the limestone masses, there are also two fronts of karstic upwelling with significant supplies. The first front lies in the Koutavos-Papadatos region, at the southern edge of Argostoli lagoon, from which slightly brackish to semi-brackish water (300-500 mg/l Cl-) streams out, partially draining the northwestern sector of Mt. Aenos. The other front concerns the spring lake Megali Avythos or Akoli, where water of good quality streams out at an elevation of 288 m with supplies ranging from 50 to 500 $m^3$/hr, draining the Ionian zone limestones of Mt. Aenos.

Detailed data for the above-mentioned springs of Koutavos-Papadatos and Megali Avythos are included in the following reports of our research project: Springs - Surface Flows and The spring lake function regime of Megali Avythos – Proposals for the effective water management in southeast Cephalonia.

Other impressive surface karstic forms are the large poljes of Omala and Troianata, several smaller ones, such as those of Mesovounia at Erisos and Kolymba at Peratata, as well as the numerous dolines. All these forms constitute closed catchments drained through sinkholes, the lower parts of which may temporarily flood during winter.

As it appears from the above mentioned, in the limestone massive rocks with dense fractures and rich karstic network, ground water capacity develops, supplied by the infiltration of precipitation. This infiltration is plentiful, benefiting from several factors, such as the high permeability, the numerous closed catchments lacking surface flows, the dense plant cover at the higher zone of Mt. Aenos and the increased rainfall (1,000 mm at the coastal zone up to 2,000 mm at the higher mountainous regions).

The water infiltrating the limestones enriches the ground water capacities usually at the sea level, provided that in a few cases conditions of pulling back or halting groundwater flow result in the formation of karstic ground water capacity with a hydrostatic level at higher altitudes.

The latter cases are considered very interesting, since ground water is protected against sea intrusion, however, it is very rare and in several cases very difficult to identify suitable sites.

Within the framework of our drilling project we identified several of these sites and more precisely the trapped, large volume limestones of Palaia Skala-Ailias with increased ground water capacity (two wells), the area of Kardakata-Nyfi (Thinia wells) and Koulourata (Koulourata ruins well) with restricted ground water capacity and finally the area of Omala (Ag. Gerasimos well) with satisfying ground water capacity. Detailed information concerning the first three cases is given by Koumantakis & Mimidis (1989), whereas for the latter case further research is needed.

Brief data on the large hydrogeological unit of Mt. Aenos – Ag. Dynati are given in the following paragraphs. For the individual, smaller hydrogeological units of the island's limestones, relevant information can be found in the original reports kept in the Prefecture's Archives.

### C2b. Large hydrogeological unit of Mt. Aenos – Agia Dynati

This unit, being a very large limestone mass, constitutes the main body of the island, expanding at an area of approx. 300 km$^2$ and covering almost 45% of its total area.

To the south it emerges from the Arginia tectonic graben and to the north it ends up at the Thinia and Pylaros grabens. These grabens are filled with impermeable or little permeable, Neogene deposits.

Approximately, 2/3 of the perimeter of this limestone unit is also surrounded by Neogene deposits and more precisely in the area southeast of Koutavos down to Atsoupades and southeast of Sami down to Kambitsata.

More specifically, the contact between the ground surface of the limestone unit and the Neogene deposits follows the line: Koutavos – Travliata – Kerameies – Dorizata – Mousata – Vlachata – Simotata – Atsoupades – Arginia – Kapandriti – Xenopoulo – Kambitsata

– Andriolata – Digaleto – Koulourata – Mouzoukata – Sami. In some cases, the limestones extend in the underground under the Neogene deposits, quite far from this boundary line.

The occurrence of Neogene deposits, being either impermeable (marls and silts) or alternating layers of impermeable and permeable rocks, creates conditions of limestone hydraulic isolation or semi-isolation from their environment along the above-defined line. As a result, the sea cannot permeate the karstic limestones along this boundary. Infiltration may occur in specific regions, but only if ground water capacity develops in the Neogene deposits, where intensively pumped wells taking advantage of it lead to piezometry reversals. This phenomenon would be accelerated if hyperintensive exploitation of the karstic aquifer occurs simultaneously.

The ground water capacity, developing in the above-mentioned confined limestone mass of Mt. Aenos and having the sea as base level, with which it comes into contact north of Koutavos up to the Thina graben and north of Sami at the Pylaros graben, develops at the sea level.

However, due to the long distance between the southern part of this aquifer and its water discharge in Koutavos lagoon and Sami, a significant rise of the hydrostatic level takes place, as the distance from the discharge zones increases. It has been concluded that at the southern edge of the limestones in the area of Kambitsata the water level may even rise up to an altitude of +10 m.

In order to investigate this large karstic aquifer, we inevitably had to conduct probing wells only in its perimeter zone, where the elevations had been generally lower. Further from this zone towards the inland, the elevations exceed 300 m and thus, the drilled well may become troublesome, in particular when water is found, as the water exploitation turns out to be a very difficult and unprofitable task.

However, even in the perimeter zone, the elevations in some regions may be very high, rendering the well drillings impossible. Such regions are the perimeter band among Kolaitis – Arginia – Kapandriti – Xenopoulo – Andriolata – Digaleto and the ruins in the old Koulourata village, as well as the elevated zone of Vlachata – Simotata – Atsoupades.

Indeed, in the latter zone Lower Cretaceous dolomites and dolomite limestones develop, but, based on the findings of our two probing wells of 350 m depth (one at Simotata and the other at Atsoupades), neither of them has proven to have ground water capacity.

Unlike the wells of the southwestern perimeter zone, the rest of the probing ones conducted in 10 different sites northwest of its extension, i.e. in the area from Vlachata to Koutavos, encountered the karstic ground water capacity and hence, they have been exploited as drilled wells. More precisely, in two of them located in the area of Alafona, upstream of the Koutavos springs, two arrays of 4 and 5 shallow drilled wells were bored respectively, in order to supply Argostoli with drinking water (see report Probing wells).

For the first array, a total exploitable inflow of 150 $m^3$/hr was defined, based on the conducted probing wells. The inflow would have been much larger, however a protective system against sea intrusion had been established, which safeguarded the water quality, but reduced the upwelling potential.

Along the northeastern perimeter zone, well drilling could be conducted only at the outermost areas, due to the lower elevations. In the southern part two well drillings have been conducted at Kambitsata, namely G13 and G25, which, due to their exploitable water supply potential of 60 and 15 $m^3$/hr respectively, have been opted for providing Poros and the adjacent settlements with water. On the other hand, two drilling attempts, in the area 1 km northwest of Andriolata was not completed, due to technical reasons.

In the northern part four probing wells were organised: two in the area of Mouzakata (G38 and G1') and another two in the area close to the ruins of the old Koulourata village (G36 and G2'). In the former case, the G38 well reached a depth of 78 m, but no ground water capacity was found, contrary to the G1' of the second research phase and the G2' well, where ground water capacity was encountered a little higher than the sea level.

The other well located in the vicinity of the ruins of the old Koulourata village (G36) was found to support under pressure ground water capacity, which results in an automatic artesian ground outflow during the wet period (at an elevation of approx. 202 m), though the daily supply potential was finally proved to be very low, i.e. at around 50-70 $m^3$.

Further north, at the lower zone of Sami plain, Chaliotata and Poulata, numerous wells have been drilled by citizens, the village councils and further back by the Ministry of Agriculture. However, all of them have reached brackish water, which is inappropriate for any use and thus, not exploitable.

As mentioned above, the limestone mass north of Sami up to Ag. Efimia and north of Koutavos up to Ag. Ioannis at Thinia graben is adjacent to the sea along several kilometres. Also, the north edge of the limestone unit communicates directly with the sea for a length of 4 km between the bays of Ag. Kiriaki and Myrtos.

Due to the absence of continuous impermeable zones and to the usually large limestone rock mass permeability north of the Sami-Koutavos line, water infiltrating into it is discharged easily and quite quickly in the sea. Consequently, piezometry at the peripheral coastal zone is very low, whereas at the rather larger internal one, the fresh water lens cannot be exploited through wells, because of the very large depths which can be explained by the high elevations of this zone.

In the limestones of this part of the island, deep U-shaped karstic tubes expand at high negative elevations (-100 m or even deeper). The sinkholes of Mylos by Argostoli and the Koutavos springs communicate through these karstic tubes.

At the sea fronts of this unit several large and small springs with brackish water exist, the most important of which are those of the Karavomylos and Ag. Efimia group (to the east), those of Kourouklata in the Argostoli – Lixouri bay (1.1 km west-southwest of the Kourouklata well) and the ones of Papadatos – Koutavos at Koutavos lagoon.

As it has been already mentioned, all wells conducted before, southwest of the Karavomylos springs front in the areas of Poulata and Chaliotata, came across brackish ground water capacity. This fact should be attributed to the well described connection between the Mylos sinkholes in Argostoli, through which seawater flows, the Karavomylos springs and the water of the Melissani pothole. We consider that the water degradation in this region is probably a result of the Argostoli sinkhole seawater rather that of the sea intrusion from the bay of Sami.

At the coastal zone from Karavomylos to Ag. Efimia the situation is not expected to be more promising. As expected, a private well bored in 1988 came across brackish under water capacity.

In the area of Ag. Efimia, in the Pylaros graben two surveying wells were drilled. The first one came across very low piezometry and brackish ground water capacity, whereas in the other one the hydrostatic level was relatively high (+11.9 m on 27.01.1989).

North of these wells, in the zone of the limestones that are attached to the Neogene rocks of the graben, two surveying wells were bored (G34 at Markyotika and G8' at Loukata), which came across a 2-3 m piezometry and water of good quality. One of them (G34) has been extended and was assigned to the Union of the nearby villages to support their water supply. Regarding the other one the survey has not been completed yet.

The limestone mass in its northern part, as already described in the chapter of Geology, overthrusts the Neogene rocks of the Thinia graben. On top of the overthrust zone between the villages of Petrikata and Nyfi, a surveying well (G22) came across "perched" under water capacity in the limestones, with an equilibrium level ranging between 190 and 202 m, depending on the season. We attribute this increased ground water capacity to the karstic tubes blockage of the elevated karstic network of the limestone mass, due to the overthrust on top of the impermeable Neogene marls.

During the autumn of 1986 the well supply was recorded to be higher than 25 $m^3$/hr. However, after having been delivered to the village of Thinia for its water supply in the summer of 1988, the supply was significantly lower. This was due, at least partly, to technical problems (filling with rubble, insufficient gravel pack, metal cone fall inside the hole etc.). It might also have been due to efficiency reduction as a result of other primary reasons. Nevertheless, the water from this well is of exceptional quality, in fact it is not threatened by any sea intrusion.

In contrast to this well, the water from the Kourouklata well and the private ones situated to the south, opposite Argostoli and behind the quarries, are threatened by sea intrusion.

As it has already been highlighted, the survey of the inner part of the large limestone unit of Mt. Aenos – Ag. Dynati is considered a difficult task, due to the high elevations of the relief. Nevertheless, four probing wells have been successfully conducted at its lower parts: two in the polje of Troianata, one at Ag. Gerasimos and one at the Dilinata plateau. One well in Troianata drilled dry limestones, whereas the other one as well as the Dilinata one came across karstic ground water capacity with a hydrostatic level close to the sea level. On the other hand, the Ag. Gerasimos well came across ground water capacity with an equilibrium level up to an altitude of 121 m.

For the first two wells an exploitable water supply of 20 $m^3$/hr was assessed, while for Dilinata a constant monitoring plan for the water quality fluctuations was proposed, as it will be threatened by sea intrusion (see report Probing wells). In the Troianata well a protection system was installed during the fitting of pipes in order to eliminate this threat.

At the southeastern extension of Dilinata plateau two older drilled wells exist, one at Razata and another one located at the south, providing the villages of Omala and Faraklata, respectively, with water. However, their water has recently presented higher salinity values. This phenomenon has been also observed at wells drilled at the Krania plain either in limestones or in alluvial deposits, which after drilling, came in contact and exploited the karstic ground water capacity of the underlying limestones.

Based on the above-mentioned information, regarding the large limestone unit of Mt. Aenos – Ag. Dynati, the following conclusions can be reached:

- Several favourable factors contribute in allowing rich infiltrations from the rich atmospheric precipitation to enrich the underground water tables with large quantities of water.
- A lot of unfavourable factors impede the formation of underground water tables, rich in exploitable water reserves of good quality.
- The most serious threat for the underground water is the saltwater intrusion along the exposed fronts between Sami – Agia Efimia, Koutavos lagoon – Thinia and the bays of Agia Kyriaki – Myrtos.
- The coastal zones behind these fronts have been intruded by the sea and thus, groundwater has undergone salinisation. Salinisation is more intense along a large zone in the wider area of Karavomylos-Sami-Poulata-Chaliotata-Mouzakata. In the rest of the zones, such as the Krania plain and the coastal zone between Koutavos and Thinia, salinisation is less intense.
- The most favourable conditions, in terms of groundwater protection against saltwater intrusion, dominate the area south of the imaginary line connecting Tsakarisianos and Travliata.
- The most suitable zones for further underground water exploitation are the following:

a) The lower limestone zone northwest of Kambitsata to Andriolata expanding 1 km to the north.
b) The lower limestone zone of Peratata-Karameies-Dorizata-Mousata-Ardaki.
c) The polje of Omala
d) The polje of Troianata
e) The Plateau of Dilinata-Faraklata-Razata and
f) The lower limestone zone southeast of the old village of Koulourata.

All these zones are presented in the maps included in the report titled *Probing Wells*. It should be noted that in all cases, when under water capacity is developed close to the sea surface level, a protection system should be installed close to the well bottom, which would prevent the drop of the dynamic level below the elevation of +0.3 to +0.5 m.

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# PART III

## THE CLIMATE OF MT. AENOS

## A. CURRENT STATUS OF THE METEOROLOGICAL STATIONS NETWORK AT THE WIDER AREA OF MT. AENOS

The mountainous region of Mt. Aenos or 'Megalo Vouno' (alt. 1,627 m), also named Monte Nero by the Venetians, is included among the highest mountains of both Cephalonia Island and the rest of the Ionian Islands (Miliarakis 1890). This mountainous region is situated at the southeastern part of the island with northwestern to southeastern direction and is characterised by rocky slopes, mainly covered by the Cephalonian Fir forest. Two mountainous areas of lower altitude, i.e. Roudi (alt. 1,125 m) and Kefali Petri (alt. 1,025 m) extend northwest and west of Mt. Aenos, respectively. Additionally, the valley of Omala is located west of Mt. Aenos, surrounded also by Roudi, Kefali Petri, Limi (alt. 647 m), Falaga (alt. 564 m) and Korifi (alt. 671 m), the latter being an extension of Mt. Evgeros (alt. 1,125 m). The Automatic Meteorological Station of Mt. Aenos is located on Mt. Kefali Petri within the area of the National Astronomy Centre of "Evdoxos" (alt. 1,003 m), which is operated by the Cephalonian Research Institute. It was in operation from end-2006 to mid-2015 and is equipped with sensors for air temperature ($^{o}$C) and relative humidity (%), wind direction (degrees) and speed (m/sec), as well as for precipitation (mm). It should be noted that, following reliability check, the air temperature and humidity data that are presented here, come from the period of 2007–2011, while wind and precipitation data cover the period of 2007–2013.

On the mountainous region of Mt. Aenos within the borders of the core of its National Park and specifically at the site "Chionistra" (alt. 1,584 m), an Automatic Telemetric Meteorological Station (A.T.M.S.) is located, which was installed in 2015 and is being supervised by the Management Body of the National Park of Mt. Aenos. It is equipped with sensors for temperature and humidity, wind speed and direction, and precipitation. An additional A.T.M.S., supervised by the Peripheral Centre for Plant Protection and Quality Control of Achaia, is located in the agricultural region of the Omala valley (alt. 386 m), the records of which, however, suffer from gaps in the meteorological data, therefore they cannot be included in the estimation of the prevalent climatic conditions of that region. Finally, the nearest climatic station in relation to Mt. Aenos is situated at the southwestern part of the island, near Argostoli, specifically, at the region of the National Airport of Cephalonia "Anna Pollatou" (alt. 25 m) and is being supervised by the Hellenic National Meteorological Service (H.N.M.S.). Therefore, it can be concluded that for the estimation of the climatic conditions of the region of Mt. Aenos, the analysed data were provided by the National Astronomy Centre of "Evdoxos".

## B. DESCRIPTION OF THE CLIMATIC CONDITIONS OF MT. AENOS

Analysis of the data from the meteorological station of the National Astronomy Centre "Evdoxos" showed that the mean annual air temperature value is 12.5 °C, while the respective mean value is greater by 5.6 °C at the station of Argostoli (HNMS 1999). Mean monthly air temperature values (Fig. 1a) showed that the coldest month is February with a mean air temperature of 4.1 °C, while the hottest month is August with a mean temperature of 23.0 °C. However, the coldest months in Argostoli are January and February, with a mean air temperature difference of +7.4 °C, in comparison to Mt. Aenos. Additionally, the hottest month in Argostoli, August, is warmer by 2.9 °C, compared to August on Mt. Aenos (HNMS 1999). Analysis of the progressive changes of mean monthly air temperatures between months showed that the greater changes are observed from April to May (+4.6 °C) and from August to September (-5.5 °C), while the lowest are observed from January to February (-0.8 °C) and from July to August (+0.5 °C). It was determined that the warmest period begins from May, while cyclones (low pressure systems from the North Atlantic and Northeastern Africa) and the continental anticyclone are declining. During the summer months, the weather in Greece is controlled both by the low pressure system of India and Pakistan and by the Azores anticyclone, centres that promote stable air masses towards the Mediterranean region (Chronopoulou-Sereli & Flocas 2010). The noticeable reduction in the air temperature from August to September can be attributed to the reduction of the duration of the day and the meridian height of the sun (Karapiperis 1967), as well as the prevalence of northwestern winds at the Ionian Sea and the coasts of Western Greece (Chronopoulou-Sereli & Flocas 2010, HNMS 1999).

The seasonal distribution of air temperature shows that the mean values in winter and in summer are 4.9 °C and 21.5 °C, respectively. The mean air temperature of Mt. Aenos during autumn (13.0 °C) is greater than that of spring (10.4 °C), which means that between the two transitional seasons of the year autumn is hotter than spring. In Argostoli the mean air temperature of the winter period is 12.0 °C, which is greater by 7.1 °C in comparison to that of Mt. Aenos. Therefore, winter at coastal regions of the island (Argostoli) is milder than at mountainous regions and presents climatic similarities with the Cyclades islands, namely Syros, Naxos, Paros and Milos Isl. (Theoharatos 1978). It should be noted that during the summer months, the mean air temperature in Argostoli displayed similarities with the aforementioned Cyclades islands and is greater by 3.4 °C than the respective value on Mt. Aenos.

The Annual Temperature Range, i.e. the difference between the mean temperatures of the coldest and hottest month, is 18.9 °C on Mt. Aenos, while this value in Argostoli is lower by 4.5 °C.

The mean monthly and absolute values of the air temperatures extremes on Mt. Aenos (Fig. 1b, c) show a similar behavior with that of the mean monthly values of air temperature during the year. In particular, the value of the mean annual maximum temperature is 15.6 °C, while the mean annual minimum temperature is 9.6 °C. The highest value of the mean maximum temperature (26.5 °C) was observed in July, while the lowest value (6.7 °C) was observed in February. The mean annual values of the temperatures extremes in Argostoli were greater by 5.5 °C and 4.5 °C, respectively.

The progressive monthly changes of the values of mean maximum and mean minimum temperatures presented a similar behavior with the respective values of mean air temperature. Specifically, the greatest positive changes were observed from April to May and were +5.1 °C for the maximum and +4.1 °C for the minimum temperature. Additionally, the greatest negative changes were from September to October for the maximum temperature (-5.6 °C) and from August to September and from September to October for the minimum temperature (-4.6 °C).

Data analysis of the absolute values of the air temperatures extremes (highest-lowest) on Mt. Aenos showed that for the period 2007-2011 the absolute maximum air temperature was 36.6 °C on 24.7.2007, while the absolute minimum temperature was -8.8 °C on 17.2.2008.

The annual progress of the mean monthly relative humidity values on Mt. Aenos (Fig. 2a) follows a reverse course when compared to that of air temperature with a maximum value in December (92%) and a minimum one in August (48%). The mean annual value of relative humidity reached 74%, while regarding the seasonal values, the lowest occurred during summer (55%) and spring (65%). In contrast, during the two other seasons (autumn and winter) relative humidity reaches higher levels up to 87%. The analysis of the progression of the monthly changes of this parametre shows that the greatest changes are observed from March to April (-12%) and from August to September (19%), i.e. during spring and at the beginning of autumn. It should be noted that during the winter and autumn period the relative humidity in Argostoli is lower by 16% than that of Mt. Aenos, while during spring it is similar and during the summer months it is higher by 10% than the relative humidity on Mt. Aenos. This fact could be attributed to the prevalence of northwest winds (Maistros) in Argostoli (HNMS 1999) that, in combination with the influence of the sea, contribute to the rise of the values of this parametre.

The annual precipitation, as recorded by the station of Mt. Aenos is 1,534.9 mm with a high maximum in February (240.3 mm) and a low maximum on December (229.7 mm). In contrast, there is no precipitation in July (Fig. 2b) it is almost null in August (1.0 mm).

On a seasonal level, the analysis of precipitation distribution showed that the maximum values of this parametre were observed during autumn (678.0 mm) and winter (577.4 mm). During spring and summer, lower precipitation values were observed (<160.0 mm). It has been estimated that during the October-February period, precipitation accounts for 74% of the total annual value, a fact that can be attributed to the low pressure systems of the Mediterranean region that move in a western-eastern direction and contribute high precipitation levels to the Ionian islands and the coasts and mountains of Western Greece (Karapiperis and Katsoulis 1969, Theoharatos 1978, Chronopoulou-Sereli & Flocas, 2010). It should be stated that in the coastal region of Argostoli the much lower annual precipitation (820.0 mm), compared to that of the mountainous regions of Mt. Aenos, could be attributed to the role of the relief, taking into account that in the western slopes of the mountainous regions great precipitation amounts were observed, because they stand perpendicular to the movement of weather systems (Chronopoulou-Sereli & Flocas 2010).

The maximum precipitation value for the 24 hour period has a significant importance for floods and should be taken into account, during infrastructure design and construction. The annual course of this parametre (Fig. 2b) presents a double oscillation with the maximum values during the autumn period (October, November) and in January. Specifically, there are two maxima in October (63.9 mm) and November (61.3 mm), and high values (~55.0 mm) are observed in September and in January. The minimum values of this parametre are observed during the hottest months of the year (July, August).

Observing the annual variation in wind speed (Fig. 2c) it is concluded that the higher values occur during winter and the lower during summer and in September.

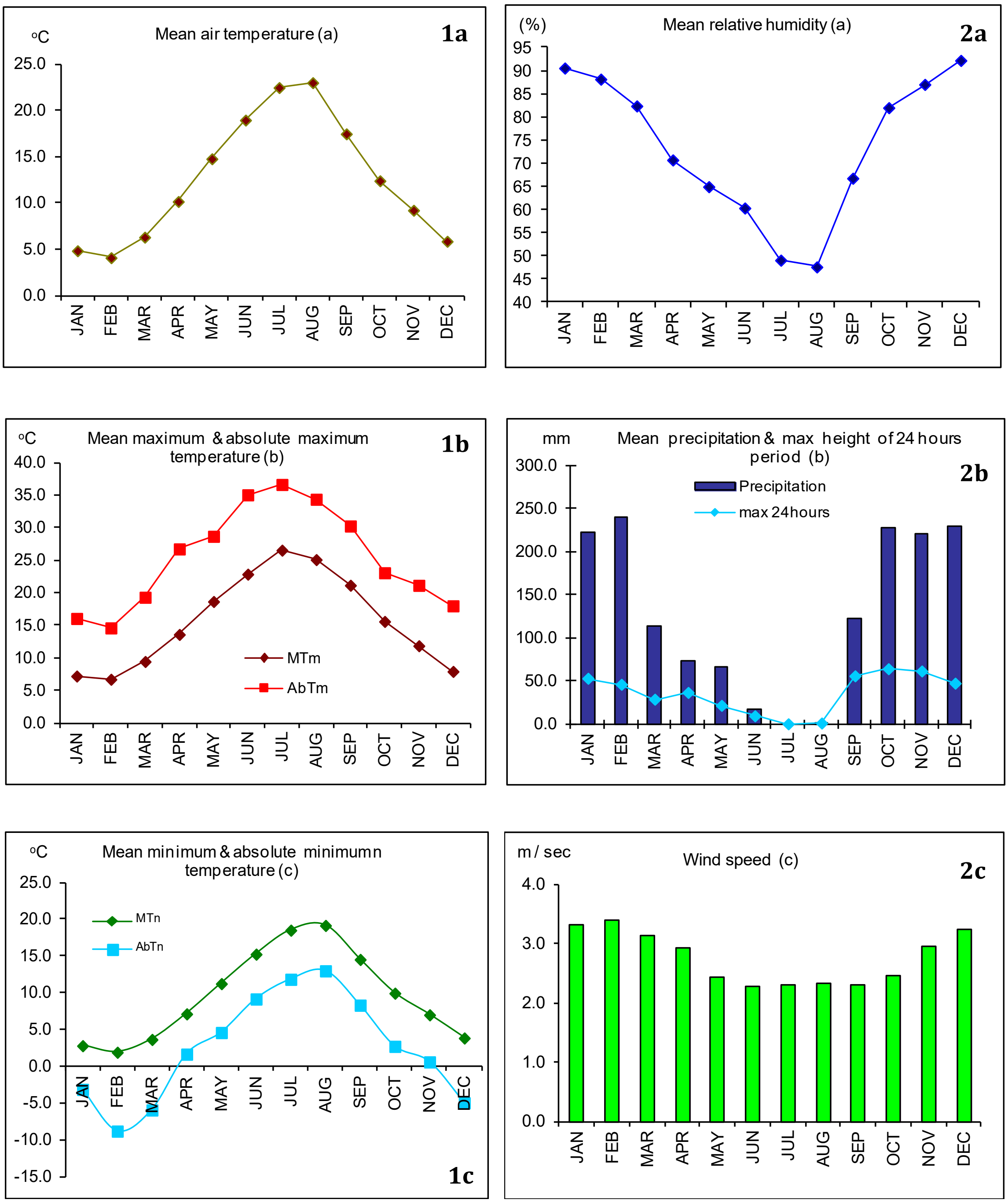


Fig. 1 & Fig. 2. Annual variation of climatic parametres from the Meteorological Station of Mt. Aenos (National Astronomy Centre of "Evdoxos").

## C. BIOCLIMATIC CONDITIONS – THERMAL COMFORT

The data of the monthly values of air temperature and precipitation of the mountainous area of Mt. Aenos and of the wider coastal area of Argostoli permitted the determination of the climatic type, Csa, according to Köppen's classification, taking also into account the annual values of these parametres, the precipitation of the periods of April–September and October–March, the respective values of precipitation for the driest and the wettest month of the year and the monthly values of air temperature of the hottest and coldest month of the year. All the above values were calculated using the data from the two previously mentioned meteorological stations. Therefore, the climatic type of the areas of Mt. Aenos and Argostoli is characterised as "Mesothermal temperate, terrestrial Mediterranean with a very warm and dry summer".

The climatic type, according to the bioclimatic classification by UNESCO-FAO, is defined based on the criterion of biological dryness for the Mediterranean regions (Chronopoulou & al. 2012). Data analysis showed that the biologically dry period on Mt. Aenos is defined by the months June, July and August. The respective period for Argostoli begins in April and ends in August. Climatic data analysis for the region of Argostoli showed that it is classified as "Thermo-Mediterranean with a quite long, dry period" ($125<X\leq150$, $X$=140.6 – $X$: Xerothermic Gaussen index). The climatic data for the region of Mt. Aenos are not enough for the determination of ($X$), therefore the climatic type, according to the above bioclimatic classification, cannot be determined. On the other hand, from the spatial distribution of this index (Fig. 3) it is evident that the south and southeastern regions of Paliki, the coastal area of Drapano, Argostoli and Livatho are characterised by the above climatic type: "Thermo-Mediterranean with a quite long, dry period". In the remaining coastal and semi-mountainous regions of this island, the climate switches to "Meso-Mediterranean with a quite long, dry period" ($75<X\leq100$), while the mountainous regions of Mt. Roudi and Mt. Aenos are classified as "Meso-Mediterranean climate ($40<X\leq75$) with a smaller dry period" (Mavrommatis 1978, Chronopoulou & al. 2012):

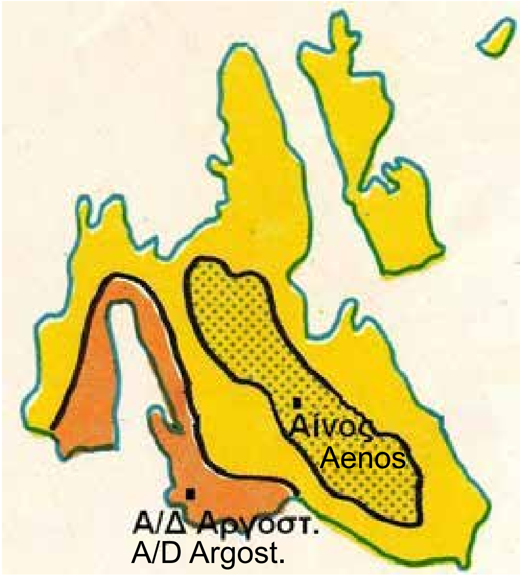


Fig. 3. Spatial distribution of the Xerothermic Gaussen Index, X and characterisation of Mediterranean bioclimate of Cephalonia Island, Greece (Mavrommatis 1978, Chronopoulou & al. 2012):

Thermo-mediterranean with a quite long, dry period ($125 < X \leq 150$)

Meso-mediterranean with a quite long, dry period ($75 < X \leq 100$)

"Meso-mediterranean with a smaller dry period" ($40 < X \leq 75$)

Sites of the meteorological stations.

For a more thorough description of the bioclimatic conditions in the regions of Mt. Aenos and Argostoli, the Emberger method was applied, according to which the pluviothermic quotient of Emberger ($Q$) is estimated from annual precipitation (mm), the mean maximum temperature (Kelvin degrees) of the warmest month and the mean minimum temperature (Kelvin degrees) of the coldest month (Tn) of a year (Chronopoulou & al. 2012). Data analysis showed that the mountainous region of Mt. Aenos is characterised by a "Very wet floor" ($Q = 276.2$) and a "subfloor with a mild winter" (Tn = 6.7 $^{o}$C), while at the coastal area of Argostoli the bioclimatic conditions are formed with a "Wet floor"($Q = 135.0$) and a "subfloor with a warm winter" (Tn = 8.5 $^{o}$C).

In addition to the above methods, the bioclimatic conditions that prevail in a region can be also determined through the estimation of the thermal comfort, which is expressed by the quantification of agreeable, disagreeable or neutral thermal comfort for humans (Chronopoulou & al. 2012). In particular, for the estimation of thermal comfort a number of indices are used, the most common of which (Toy & al. 2007, Kamoutsis & al. 2007, Chronopoulos & al. 2012) is the Thermohygrometric Index (THI) for mountainous areas, which takes into account the monthly climatic data of temperature and relative humidity.

Table 1. Annual distribution of the Thermohygrometric Index (THI) values with the respective classes of thermal comfort for the coastal area of Argostoli and the mountainous zone of Mt. Aenos, in Cephalonia Island, Greece.

| MONTHS | METEOROLOGICAL STATION | | | |
|---|---|---|---|---|
| | **AENOS** | | **ARGOSTOLI** | |
| | THI (°C) | CLASS | THI (°C) | CLASS |
| JANUARY | 5,34 | Cold | 11,97 | Cold |
| FEBRUARY | 4,77 | Cold | 12,00 | Cold |
| MARCH | 7,10 | Cold | 13,17 | Cool |
| APRIL | 10,86 | Cold | 15,08 | Comfortable |
| MAY | 14,72 | Cool | 18,55 | Comfortable |
| JUNE | 17,98 | Comfortable | 21,65 | Hot |
| JULY | 20,23 | Hot | 23,33 | Hot |
| AUGUST | 20,55 | Hot | 23,73 | Hot |
| SEPTEMBER | 16,92 | Comfortable | 21,82 | Hot |
| OCTOBER | 12,60 | Cold | 18,82 | Comfortable |
| NOVEMBER | 9,59 | Cold | 15,52 | Comfortable |
| DECEMBER | 6,23 | Cold | 13,05 | Cool |

Therefore according to the above, the bioclimatic conditions that prevailed at the mountainous region of Mt. Aenos and at the coastal area of Argostoli are presented in Table 1. Specifically, during the cold and wet period (October-April) the class "Cold" (THI from -1.7 to +12.9 °C) has prevailed for Mt. Aenos and only during the hottest months of the year (July, August) was the class "Hot" (THI from +20.0 to +26.4 °C) obtained. In addition, during the months June and September, i.e. at the beginning of the summer and winter periods, the bioclimatic conditions that prevail are classified as "Comfortable" (THI = from +15.0 to +19.9 °C). It is noted that May is bioclimatically classified as "Cool" (THI = from +13.0 to +14.9 °C).

In contrast, during the summer months and at the beginning of autumn disadvantageous conditions, classified as "Hot", prevail at the coastal region, in comparison to other periods and to Mt. Aenos. The neutral condition "Comfortable" is obtained during the last two months of the transitional seasons, while the class "Cool" occurs at the beginning of spring (March) and of winter (December). From the relevant comparison of the bioclimatic conditions of Argostoli's coastal areas and of the mountainous zone of Mt. Aenos a clear differentiation is apparent.

## D. THERMOMETRIC CONDITIONS OF THE WIDER AREA OF MT. AENOS IN RELATION TO TYPES OF GROUND COVERAGE

The microclimatic conditions that prevail in vegetated areas are influenced by the relief, the orientation and the type of ground coverage, as well as by the composition and the density of vegetation (Chronopoulou-Sereli & Flocas 2010, Kamoutsis & al. 2014). Specifically, air temperature data analysis from sensors with data loggers positioned in selected sites of the National Park, showed that during the year 2011 the site "Eza" (main entrance of the National Park), with a western-northwestern orientation, was warmer than the site "Fteri" of the same altitude (1,100 m) but with an eastern-northeastern orientation. For example, the mean annual temperature at "Eza" during the year 2011 was higher than the one at "Fteri" by 0.4 $^{o}$C. The air temperature dissimilarities between these two sites with a different orientation were greater during the autumn and winter periods of 2011. Also, during the same year the mean annual temperature at the site "Megas Soros" (alt. 1,584 m) near the highest summit of Mt. Aenos was lower by 2.4 $^{o}$C in comparison to "Eza". This fact is proof of the role played by altitude on the microclimatic conditions in mountainous regions (Kamoutsis & Maniatis 2012). In these regions, where there is a complex terrain with valleys and plains, surrounded by mountains, local microclimates are formed. Therefore, in the wider region of the National Park of Mt. Aenos there are areas with different microclimatic conditions. Specifically, in daytime and during the two extreme seasons (winter, summer) higher values of air temperature prevailed at the valley of Omala (Agios Gerasimos), which is covered by fields and vineyards of the "Robola" variety, in comparison to the Cephalonian Fir-covered regions of Mt. Roudi. In contrast, a "pool" of cool air forms in the valley during the night that is due not only to the type of ground coverage (fields and vineyards) but also to the descent of masses of cold air, because of the dissipation of high wavelength radiation from the higher altitude mountain regions of Mt. Aenos, Mt. Roudi and others (Kefali Petri, Limi, Falaga, Korifi).

The density and the composition of the vegetation affect the thermal environment of vegetated regions. Therefore, the slopes of Mt. Roudi (e.g. Agrapidies) with dense clusters of Cephalonian Fir and dense bushy vegetation are warmer during the night and the first morning hours than the higher altitude open areas (Gioupari). The latter are covered by Cephalonian Fir trees with many uncovered areas and intense grazing signs. This thermal situation could be attributed to the combined effect of topography – mainly of the altitude – and of the different types of ground coverage ("closed" and "open" regions).

During the noon hours of a typical summer day, the canopy surfaces of the Cephalonian Fir-covered sites at Agrapidies were cooler by 6-7 $^{o}$C in comparison to surfaces covered by bushy vegetation. This difference is lowered to 3-4 $^{o}$C and 1.0 $^{o}$C during a sunny and an overcast day of the winter period, respectively (Kamoutsis & al. 2014). Additionally, at "open", uncovered by vegetation slopes of higher altitudes, surface temperature is increased by 20.0 $^{o}$C during the warm hours of a summer day, in comparison to the canopy surface temperature at dense Cephalonian Fir stands of adjacent areas (Fig. 4).

Based on the above, we conclude that higher temperatures and therefore, worse microclimatic conditions prevail at open sites that are barren from vegetation, compared to vegetated sites, particularly during the noon hours of a summer day. This should be taken into account, during the planning of actions for the protection of the mountainous environment from fires. For example, a year after a fire incident, the surface of the bushy canopy of burned sites was warmer by 8-10 $^{o}$C (Fig. 5, above) compared to the adjacent, unburned sites with bushy vegetation. Two years following the fire incident, there was a relative improvement of the thermal environment, with the above temperature difference reduced to 3-4 $^{o}$C (Fig. 5, below).

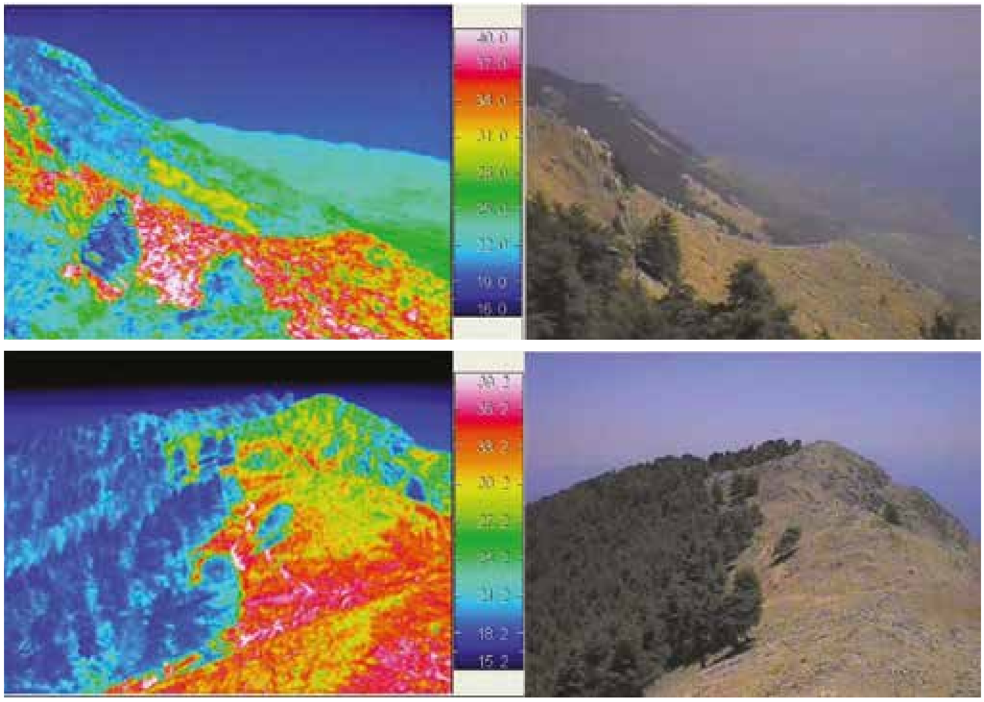

Fig. 4. Infrared images of the thermal condition of the mountainous regions of Mt. Aenos at the sites "Thea" (above) on 22.08.2011 and "Megas Soros" (below) on 23.06.2011 from 12:00 to 14:00 (local hour).

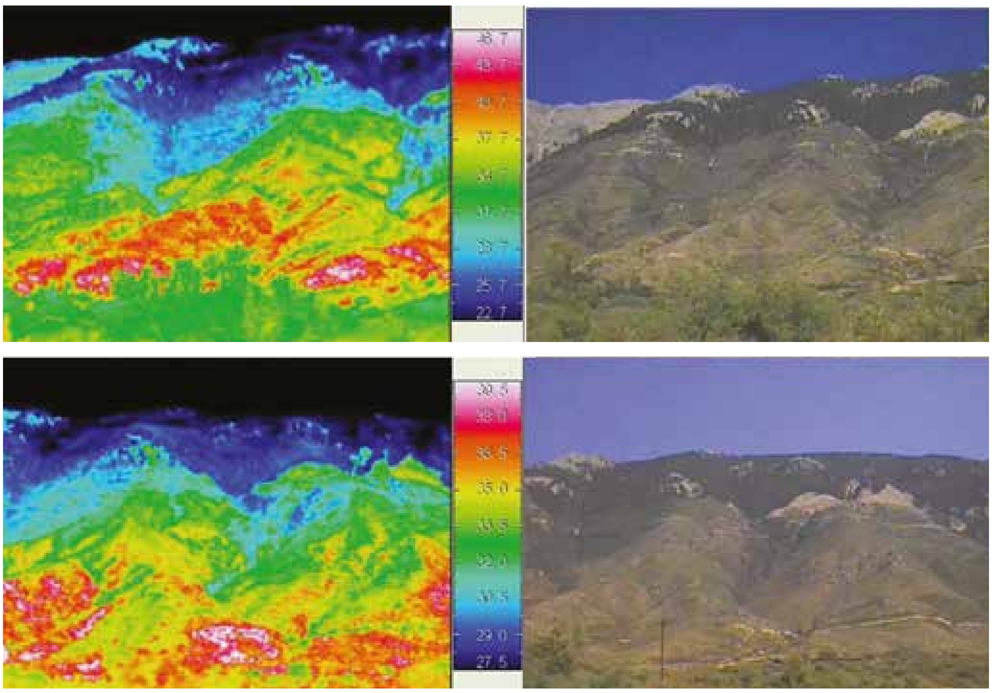

Fig. 5. Thermal images of burned and unburned sites of the mountainous region of Mt. Aenos near Simotata on 23.08.2011 (above) and on 25.08.2012 (below), from 12:00 to 14:00 (local time).

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# PART IV

## THE VEGETATION OF MT. AENOS

# A. GENERAL OVERVIEW OF THE VEGETATION OF MT. AENOS

One of the basic elements, which have defined the composition of the vegetation of Mt. Aenos is the geohistory of Cephalonia, closely linked to the part of continental Greece located opposite the island (known as Etolia-Akarnania). We are obviously referring to the forest of *Abies cephalonica* on Mt. Aenos, which grows from an altitude of ca 600 m (as solitary individuals), while the formation of tree stands commences at 700 m, reaching nearly up to the peak of Megas Soros (alt. 1,627 m).

The ecological, scientific and historical value of this forest, which is repeatedly being emphasised throughout the various chapters of this book, rendered vital the designation of the forest as a National Park (1962). The core of the National Park is comprised of two independent areas that are close to each other: the main area is the one around the peak of Megas Soros (alt. 1,627 m), covering an area of 2,316 hectares and the second one is around the peak of Roudi (or Gioupari), alt. 1,125 m, covering an area of 546 hectares. The two peaks make up Mount Aenos (inset map at the end of the book).

In recognition of its importance, the National Park of Mt. Aenos has been characterised on an international level as a European Biogenetic Reserve and has been included in the Natura 2000 European Network as a Special Area of Conservation (GR2220002) and as a Special Protection Area for the avifauna (GR2220006). Together with its designation as a National Park, it was also decreed a Wildlife Reserve.

It is obvious that it was neither possible nor in the scope of this book to go into detailed descriptions of the various zones of vegetation or of its formations on Mt. Aenos. We shall limit ourselves to a concise description of the vegetation of the mountain complex, primarily based on the two works by Dafis (2010) and Phitos & Kamari (2009), making it comprehensible to the non-specialists.

In any case, a study on the core of the National Park of Mt. Aenos has been conducted within the framework of the Action undertaken by its Management Body titled "Assistance in the assessment of the conservation status of habitat types in the National Park of Mt. Aenos”. This study was completed by “Technomoiostasi G.P.” with Research Scientist, Dr. Pavlos Konstantinidis (ELGO DEMETRA), as the scientific supervisor.

## A1. The forest of *Abies cephalonica* J.W. Loudon

As is apparent, the Cephalonian Fir received its name from the island of Cephalonia, because the species specimens, which were used for its scientific description as a new species, came from Mt. Aenos of Cephalonia. Specifically in 1824, the English General Charles James Napier, Governor of Cephalonia (1822-30), sent Fir seeds from Mt. Aenos to his friend L. Long, who cultivated them. Later, Long received from another source a branch of Fir from Mt. Aenos, with numerous mature cones. Based on the above material, J.W. Loudon (1838) described the Fir of Mt. Aenos as a new species for the Botanical Science under the name *Abies cephalonica*.

The most characteristic morphological features of this species are the following: Needles rigid, acute 18-30x1.8-2.5 mm in length, spirally arranged. Upper surface dark green and flat, whilst the surface below keeled with two white, parallel bands. Cones cylindrical, erect, brownish-green 12-20 cm in length. They mature by the end of autumn and then disintegrate, dispersing their seeds (Fig. 1). It blooms during May and June. The height of the tree reaches 15-25 rarely exceeding 30 m, with horizontal branches and a conical crown.

Like all Fir species, the Cephalonian Fir is a monoecious species and its flowers are unisexual, that is, the male reproductive organs are separate from the female but coexist on the same tree. The male inflorescences are deep purple in colour (red catkin) and develop on the lower branches of the tree (Fig. 1), while the female ones are yellowish.

From the secretions of Fir cones, when they are afflicted by aphids, the fir honey is produced!

*Abies cephalonica*, an endemic species of the Greek flora, does not only appear on Cephalonia (Fig. 2 & 3) but also in Peloponnese, Evvia, Sterea Ellada, extending up to northern Pindos and east-central Greece. Its presence, yet sporadic, has even been recorded on Athos peninsula, as well. It mainly grows between 600-1,800 m.

While referring to the Fir, Theophrastus writes that it is a wild tree, evergreen, cold-loving, growing only from seed, tall and straight, with a long trunk. And, as Dafis notes (2010), a better description, from a forestry point of view, could not have been provided!

Fig. 1. A Fir tree top with mature cones (top) and a branch with male inflorescences (bottom).

The Cephalonian Fir is an invaluable species, especially for our country. It is known for its resistance against drought, it is relatively frugal and produces a considerable amount of lumber. Its wood is white, soft and pliable. It forms beautiful, dense forests of great ecological, aesthetic, economic and protective value.

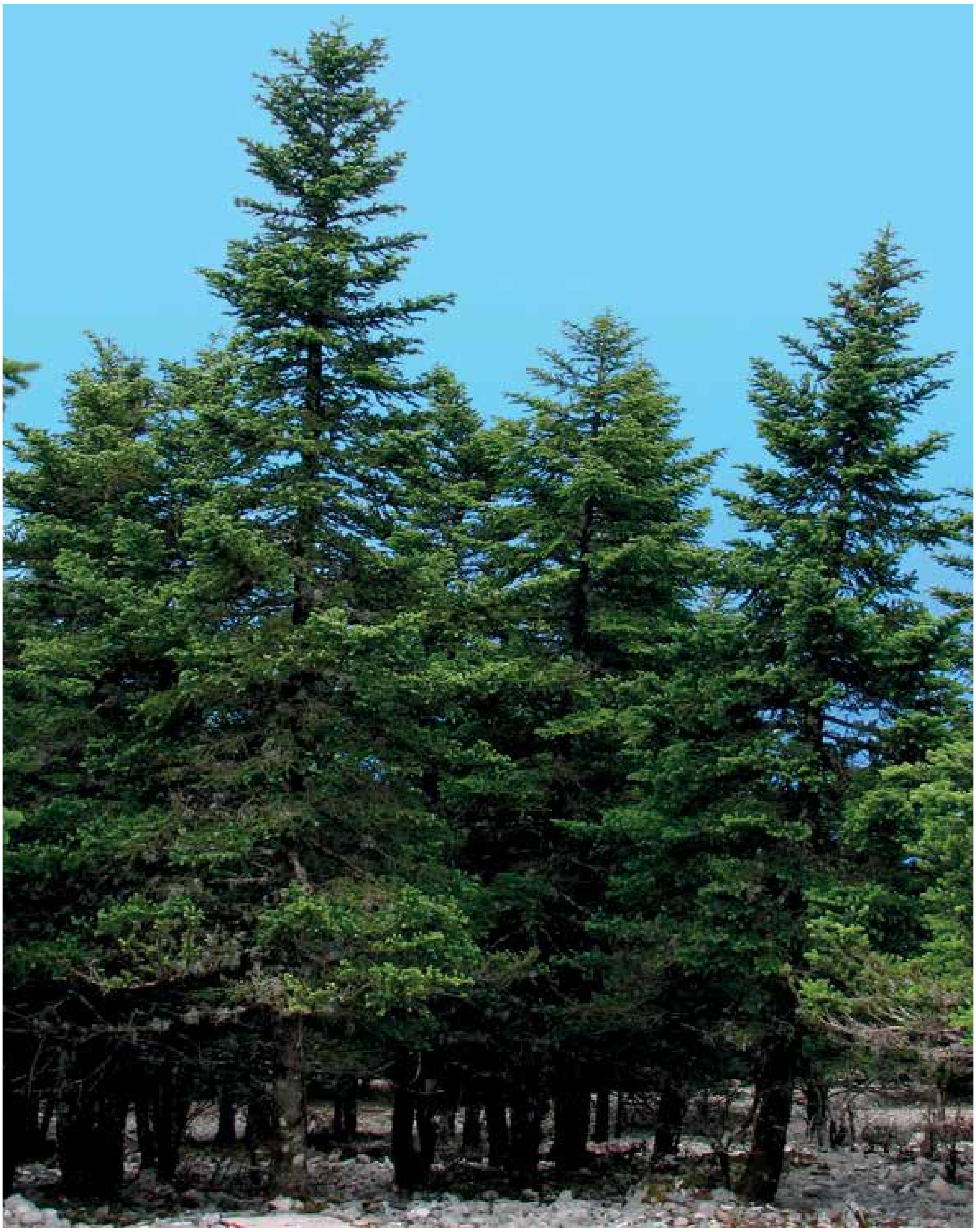

Fig. 2. A small stand of tall Cephalonian Fir trees on Mt. Aenos.

Fig. 3. Eastern slopes of Mt. Aenos covered in dense Fir forest.

The vast importance of the Fir's presence in Cephalonia for the economy of the island, among other things, ever since the pre-historic times and until today, is described in detail in the first part of this book.

## A2. The presence of the black Pine on Mt. Aenos

***Pinus nigra*** J.F. Arnold
**subsp. *nigra***

***Pinaceae***

The black Pine (*Pinus nigra*) is a polymorphic species, divided into many subspecies. In Greece, *Pinus nigra* subsp. *nigra* is found, and more accurately var. *caramanica* (Bosc ex Loudon) Rehder.

It is a tall tree, the height of which usually reaches 20-40 m and in rare cases 45 m (Pindos variety). Needles in pair, 8-15 cm in length, dark green, rigid, persisting for 4-6 years. Cones ovoid, 5-8 cm in length, vertically oriented towards the branches in groups of 2-4, lacking a peduncle, shiny and yellowish-brown. They mature in October-November during the second year after blooming. The seeds are dispersed during the next spring (March-April) (according to Dafis 2010).

The black Pine forms small stands, temporarily mixed with Fir and Beech, and permanently mixed with Heldreich's Pine in N. Pindos and Mt. Olympos. It occurs at an altitude of (200-)400-1,800(-2,150) m in all continental Greece, on the Aegean Islands of Lesvos, Thasos and Samos, as well as on the island of Cephalonia.

A few years ago it was first announced that 5 individuals of *Pinus nigra* subsp. *nigra* were found amidst the forest of *Abies cephalonica* in the core of the National Park of Mt. Aenos (Efthymiatou-Katsouni & Phitos 2011). It was the first time that the presence of the said *Pinus* subspecies was verified not only for Cephalonia, but also for the Ionian Islands in whole. Since then and following an extensive investigation by the personnel of the Management Body of the National Park of Mt. Aenos, 63 additional individuals were recorded within the boundaries of the National Park, thus today a total of 68 individuals of the said subspecies are known to exist (Xanthakis & al. 2015) (Fig. 4).

The discovery of *Pinus nigra* in the forest of *Abies cephalonica* should not be considered surprising, for reasons that will be explained later on. What could be considered as a surprise is that, till this day, even though Mt. Aenos is believed to be

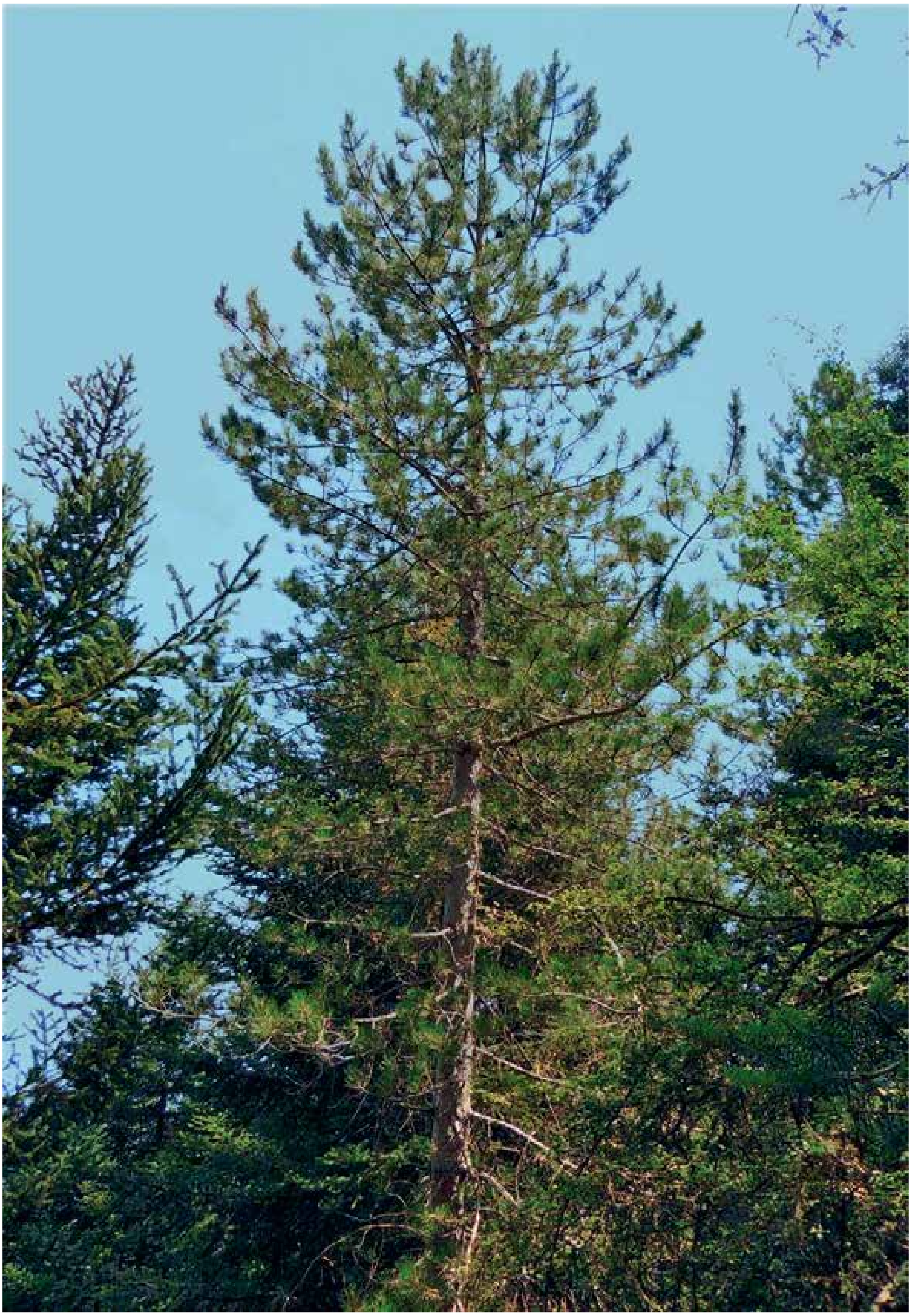

Fig. 4. A few, solitary black Pine individuals amidst the Fir forest of Mt. Aenos.

well studied from a floristic point of view, this forest species had not been recorded. It is, however, obvious that this is due to the fact that the encountered individuals of *Pinus nigra* are only 68, hidden amidst a dense stand of *Abies cephalonica* trees.

As concerns the presence of *Pinus nigra* in Cephalonia, there is no doubt that it must be considered indigenous for the following, main reasons:

It is known that the Ionian Islands, which Cephalonia belongs to, are a special floristic region of Greece. However, the fact that these islands have emanated from the mainland and border the western coast of mainland Greece, lends the flora a continental rather than an insular floristic character. In this regard, a typical example is the appearance of *Abies cephalonica* on Cephalonia (Phitos & Kamari 2009). The same applies to *Pinus nigra,* therefore its appearance on Mt. Aenos from a phytogeographical point of view cannot be considered surprising.

Besides Cephalonia, *Abies cephalonica* also occurs in a large part of mainland Greece, as well as on Evvia island. *Pinus nigra* is even more widely distributed (mainland Greece and on the Aegean Islands of Evvia, Samos, Lesvos and Samothraki). In many areas of Greece (e.g. Peloponnese, Evvia Island, etc.) the coexistence of these two species is common, also because the altitudinal range of both species largely coincides [600 - 1,800 m for *A. cephalonica* and 300-1,800 (-2,150) m for *P. nigra*].

The island of Cephalonia has been known since the ancient times, not least for its famous forests, which covered a large part of the island and mainly Mt. Aenos. Strabo (65 B.C. - 23 A.D.) names Cephalonia 'Melaina', because of the dark colour impression given by its dense forests. Moreover, the Venetians used to call Mt. Aenos 'Monte Nero'. During the island's occupation by the Venetians (1500-1797), the most devastating fires took place on the island and particularly on Mt. Aenos. At the end of the 16th century a major fire wiped out two-thirds of the forest of Mt. Aenos. In 1730 and 1760 further fires ensued on the island. In 1797, however, the last year of the Venetian rule, the fire that occurred was perhaps the most destructive, since it lasted for weeks and obliterated half of the forests that were left in the wider region of Mt. Aenos (Partsch 1890). We have every reason to believe that these fires contributed to the dramatic decline of *Pinus nigra* forests in Cephalonia, same as with *P. halepensis* (see below).

Since antiquity, residents of Cephalonia have had a naval tradition. They participated in wars, in sea battles with a sufficient number of ships, which were built on the island, and they also conducted trade with their own ships (Efthymiatou-Katsouni 1998). Existing coins of the 5th and 4th century B.C. with illustrations of fir cones and pine cones show the importance that they gave to the abundant raw materials, required for shipbuilding, but also remind us of the thoughtless exploitation of the forests at that time, mainly of *Abies* and *Pinus.*

Due to the above, namely the devastating fires, the uncontrolled exploitation of the forests, etc., today's forests merely constitute sad remains of the once famous forests of the island. The 68 individuals of *Pinus nigra* found on Mt. Aenos are a characteristic example of such remains. We believe that *Abies cephalonica* and *Pinus nigra* coexisted as indigenous forest stands in at least some locations of Mt. Aenos, especially in its southeastern and northeastern foot. It should be noted that Ntinou & Stratouli (2011) in a carbon analysis of the Neolithic cave 'Drakaina' in south Cephalonia have found remains of *Pinus nigra.*

As is the case today with the neighbouring island of Zakynthos, which is covered with the indigenous *Pinus halepensis,* the same used to be true also for Cephalonia. Nowadays in Cephalonia, however, the indigenous stands of the Aleppo Pine are rare and indistinguishable. What happened to this species is the exact same thing that happened to *Pinus nigra. P. halepensis,* for the same reasons as in the case of *P. nigra,* mostly disappeared from the island. Heldreich, who visited Cephalonia three times between the years 1861 and 1872 and stayed for a total of more than three months, notes in his *Flore de l' île de Céphalonie* (1883) that nowhere did he see *P. halepensis ... "sed nullo vidi in insulae loco".* The same is reported by Samios (1908) in his particularly thorough work *The forests of Cephalonia.* Only Spreitzenhofer (1877) notes some naturally occurring clusters of *P. halepensis* on the beach of Sami. In the period 1936-1940 there was a great effort to plant *P. halepensis* trees mainly on the coastline of Cephalonia. Most of the currently existing stands of *P. halepensis* on the island owe their existence to the tree planting efforts of that period.

It is obvious that the issue of the protection of *Pinus nigra* subsp. *nigra* is limited to the island of Cephalonia, since this species is widely distributed in the rest of Greece. As already mentioned, *P. nigra* is limited to Mt. Aenos on this island, where within the forest of *Abies cephalonica* ca 68 individuals have been found so far. In this specific, isolated case and in accordance with the IUCN criteria, these few individuals, representing the subsp. *nigra* in Cephalonia must be classified as Endangered (EN). Of course, an already established shield that protects these individuals is the fact that they are located within the core of the National Park of Mt. Aenos. However, at least for reasons of historical value, we should not only ensure their monitoring, but also continue the investigation on the possible existence of other individuals of this species on Mt. Aenos (Fig. 17).

## A3. Eu-Mediterranean vegetation zone (*Quercus ilex* & *Q. coccifera*)

The Eu-Mediterranean zone of vegetation occurs in coastal regions of western, northeastern and eastern Greece, from sea level to various altitudes in different locations. For instance, in northern Greece it reaches an altitude of 300 m, in Crete it reaches up to 1,000-1,500 m, while in western Greece and specifically in Cephalonia it usually reaches 900-1,000 m. In this zone *Quercus ilex* is or, formerly, was the dominant species, accompanied by *Q. coccifera.* The climate in the regions of this zone is typical Mediterranean with autumn and winter rains, a prolonged dry season, with a mild winter and a hot summer. Precisely because of the particularly mild climate of this zone and the easy access to the sea routes, the Greek civilisation flourished from prehistoric times till today. This region was inhabited by the majority of the population of Greece and at the same time its forests suffered from the most extensive damage.

Therefore, the evergreen, sclerophyllous *Quercus ilex* forest, reaching up to 18 m and covering the lowland and semi-mountainous zones, used to be an expression of the climate of the Mediterranean region in Greece (Fig. 5). Accompanying the species of *Q. ilex* was *Q. coccifera.* The primeval forests of the eastern Mediterranean and apparently of our country have suffered significant degradation, due to intense human interference (logging, land reclamation, fires, etc.), thus remaining today as residual stands with arboreal forms of *Quercus coccifera, Phyllirea latifolia* and others as accompanying species. These residual stands no longer appear frequently. In general, the holm oak forests have given their place mainly to the evergreen-sclerophyllous shrub formation with all the lower stages of succession that ensue and where this vegetation has suffered further degradation.

The above, of course, apply also to the vegetation of Cephalonia, where mature forests, dominated by *Quercus ilex* (Holm Oak), no longer exist on the island! Only residual elements, i.e. solitary Holm Oak individuals or small clusters of few individuals are found on Mt. Aenos, as well (Fig. 5, 6). *Quercus ilex* participates today as a key component in the evergreen, sclerophyllous shrub form, as described below.

The same applies to the second *Quercus* species of this zone, i.e., *Q. coccifera*.

A typical residue of the primitive forest of *Quercus coccifera* (Kermes Oak) occurs at the Monastery of "Themata" of Mt. Agia Dynati. The trees of this stand have a height exceeding 15 m! (Fig. 7 & 8). This residual vegetation of Ag. Dynati is well worth mentioning, even though it lies outside our main study area. At lower altitudes of the mountain, i.e. up to 500 m, *Q. coccifera* constitutes small groups, more or less dense, which take a semi-arboreal form.

From this altitude and above, Kermes Oak assumes an arboreal form (Fig. 7). This becomes particularly evident in the Monastery of "Themata" (alt. 502 m), where we encounter a dense tree stand of several hectars, the individuals of which reach 17 m in height! The existence of this stand is undeniable evidence of the residual character of a once dominant and majestic forest of arboreal *Q. coccifera.* In addition to these and up to an altitude of 820 m, there appear solitary arboreal individuals of this species.

From an altitude of approximately 820 m and above, the stony, limestone soil of the upper treeless zone of the mountain is hopelessly bare. Only the wind turbines along the mountain ridge of Agia Dynati rise from a desertified landscape, the result of centuries of intensive grazing in the area.

Fig. 5. *Quercus ilex* in Roudi (alt. ca 1,000 m). Reliable, solitary witness, as a residual element, of the once flourishing forest of Holm Oak. The tree exceeds 15 m in height! (Photo N. Katsouni).

Fig. 6. Twigs of *Quercus ilex* (Holm Oak) with mature acorns.

In conclusion, we gather that the remaining forest of Agia Dynati is a living testimony of the forests that existed in this region in the past. Similar residual stands of *Quercus coccifera,* such as those on Mt. Agia Dynati, are no longer encountered on the mountain complex of Aenos, apart from solitary individuals.

**A3a. Evergreen-sclerophyllous shrubs**

Today, the typical vegetation of the Mediterranean region, which has largely replaced the primeval forests of *Quercus,* are various forms of bushy vegetation. It is the formation of evergreen-sclerophyllous shrubs, adapted to the Mediterranean climate, which feature relatively small, leathery leaves, coated with waxy substances, stomata sunk in cavities and, generally, a structure that reduces the great loss of water during dry periods. This vegetation consists, typically, of the species *Arbutus unedo*, *A.*

Fig. 7. Stands of *Quercus coccifera* at the Monastery of "Themata".

Fig. 8. *Quercus coccifera* (Kermes Oak) twigs with mature acorns.

*andrachne*, *Myrtus communis*, *Olea europaea* subsp. *oleaster*, *Phillyrea latifolia*, *Pistacia lentiscus*, *Quercus coccifera*, *Erica arborea* etc. Under favourable conditions – mainly of increased humidity – this vegetation becomes tall and forms dense and impassable stands, whereupon it is given the name "macchie" (from the French term maquis: dense, bushy vegetation). Therefore, the term macchie describes the formation of evergreen-sclerophyllous shrubs, 1.5-3.5(-6) m in height, densely growing, with an aerial part, which, usually, is not clearly differentiated into trunk and foliage.

We will confine ourselves to a single reference of similar, typical scrubs in the area under study on the mountainous complex of Mt. Aenos. It concerns the typical semi-arboreal formation of evergreen, sclerophyllous species, called, as mentioned above, macchie vegetation. The area in which it develops is the northwestern slopes of Mt. Roudi (where sometimes solitary individuals of the Cephalonia Fir occur) from an altitude of 600-650 m (Fig. 9), which descend to the surface depression, separating Mt. Roudi from opposite hills alongside the road to Sami for a length of about ten km. These hills are Corinthos (835 m), Madoura, Lampidi (638 m) and Agrilides. The northeastern foot of these hills is covered with the same vegetation as the northwestern foot of Mt.

Roudi and they meet at that surface depression. This is the typical macchie vegetation with the known composition of the evergreen, sclerophyllous species of the eastern Mediterranean: *Quercus coccifera*, *Q. ilex*, *Pistacia lentiscus*, *P. terebinthus*, *Arbutus unedo*, *A. andrachne*, as well as *Phillyrea latifolia*, *Olea europaea* subsp. *oleaster*, etc (Fig. 10 & 11). We are dealing with a typical macchie vegetation, impassable, thriving, flourishing and evergreen, both in winter and in summer. Moreover, at the outskirts of Mt. Roudi, next to the road, at an altitude of about 500 m, *Paeonia mascula* (Fig. 12), *Sternbergia lutea* (Fig. 13), as well as other exquisite herbaceous species are found!

Generally, wherever the above shrub vegetation has been further degraded, all stages of the ecological succession are encountered, i.e. garigue formations, phrygana, even barren soil.

Recently, for the characterisation of another form of vegetation in Greece, the word gar(r)igue is used. This term expresses, mainly in Spain, low shrub forms in which the degraded – due to grazing – low form of *Quercus* coccifera dominates. In our country, this term, which is also used in the Annex to Directive 92/43/EEC (garigue of E. Mediterranean) could more accurately express an intermediate form between the shrub and the phryganic vegetation, as the result of degradation of forest formations or bushy vegetation. These are semi-bushy formations with a height of 0.15-1.5 m, occurring in the Eu-mediterranean zone of Greece, which are dominated by the thorny species *Calicotome villosa* and *Genista acanthoclada*. A degraded – due to excessive grazing or pruning – form of *Quercus coccifera* often participates in these formations, as well as *Erica manipuliflora*, *Cistus* species, *Spartium junceum*, *Anthyllis hermanniae*, *Rosmarinus officinalis* (e.g. in Zakynthos and Cephalonia), *Globularia alypum*, *Phlomis* species etc. Since it is considered appropriate to use the concept of the term garigue, the term *spiny semi-bushes* could be proposed for the Greek region, related to this formation, since in this area the thorny species *Calicotome villosa* and *Genista acanthoclada* dominate (Phitos & Kamari 2009). This vegetation type occurs in the northeastern and eastern slopes of Mt. Aenos and Mt. Roudi at an altitude of 850-1,150 m, mainly on calcareous soils. The garigue formation is quite widespread in the region of Mt. Aenos, due to the severe degradation that has been caused by the well-known fires, mainly during the late 18$^{th}$ century, and also by grazing, causing the extinction of two thirds of the Fir forest.

The ecological importance of the above mentioned type of vegetation, as well as of the phryganic vegetation, is immeasurable in a country like our own, where the forest vegetation has been dramatically eliminated. It contributes mainly to the containment of soil, but also in maintaining the unique biodiversity that has been created. This role is of particular value to the large, bare areas of Mt. Aenos.

Fig. 9. Mixed stand, consisting of solitary individuals of *Abies cephalonica*, as well as of the dominant species of the macchie vegetation (*Pistacia lentiscus*, *Arbutus unedo*, *A. andrachne* etc). Among them, a nice “discord”: the presence of some individuals of the deciduous species *Cotinus coggygria.* NW. slopes of Mt. Roudi.

Fig. 10. Typical macchie vegetation at the NW. edge of Mt. Roudi.

Fig. 11. *Arbutus unedo,* a key element of macchie vegetation in that area.

Fig. 12. *Paeonia mascula* subsp. *russoi* at the outskirts of Mt. Roudi (alt. 500 m).

Fig. 13. *Sternbergia lutea* at the outskirts of Mt. Roudi (alt. 500 m).

## A4. Rare forest species of Mt. Aenos

### ***Ostrya carpinifolia*** Scop.

### ***Betulaceae***

*Ostrya carpinifolia* is very common in Greece, where it plays a significant part in the composition of deciduous forests. It also occurs in open coniferous forest stands, in macchie vegetation, but also in the form of solitary individuals, at an altitude of 200-1,400 (-1,800) m. It blooms in April and May (Fig. 14 & 15).

*Ostrya carpinifolia* (commonly known as Hop Hornbeam) is found in the Ionian Islands, but is known only from Cephalonia, Lefkada and Corfu.

Specifically, in Cephalonia its appearance is, as in the case of *Quercus ithaburensis* subsp. *macrolepis*, similarly sporadic. Across the island, around 10 individuals have been located to date. At the core of the National Park of Mt. Aenos, 2 individuals have been found in the localities "Fagias" and "Rema Melanitsas" (M. Xanthakis, in preparation). It would

Fig. 14. Twigs of *Ostrya carpinifolia* in bloom.

Fig. 15. Solitary individual of *Ostrya carpinifolia* in the area “Melanitsa”of Mt. Aenos (alt. 1,000 m).

be particularly useful if the competent authorities took suitable action for the protection of those few *Ostrya* individuals, so that they can at least remind us of the historical progression of the vegetation of Cephalonia. Heldreich (1882) refers to it as a rare species on Mt. Aenos, from the location of Kapandriti (Heraklion). Phitos & Damboldt (1955) report that, in their botanical investigations in Cephalonia, they only found one individual of that species in the core of the National Park of Mt. Aenos (Fig. 17).

***Quercus ithaburensis*** Decaisne
**subsp*. macrolepis*** (Kotschy) Hedge & Yalt.

### *Fagaceae*

Yet one more, rare forest tree in Cephalonia is *Quercus ithaburensis* subsp. *macrolepis*. Its common name is Valonia Oak. It is the "imeris" of Theophrastus (Fig. 16).

The Valonia Oak is a species found from the Mediterranean up to the upper Mediterranean zone. It appears in most of Greece (Crete, Peloponnese, Central Greece, Ionian Islands, Epirus, etc.) at an altitude of 0-600 (-1,200) m, as solitary individuals, as small or large stands, while it rarely forms extensive forests. This species was once of great economic significance for the regions where it grew because its acorn cups (known as valonia) were used in leather tanning.

A typical compact forest is the Xiromerou Valonia Oak Forest. It is the largest forest of *Quercus ithaburensis* subsp. *macrolepis* in Greece, covering approximately 15,000 hectares and it is located in the western part of the prefecture of Etolia-Akarnania, in Xiromerou province. A preliminary study of the Oak Forest has been issued in a special, elegant edition by Vlami et al (2003).

In Cephalonia it appears scattered in various locations on the island with at most one or two individuals in each location. The total number of individuals previously found in Cephalonia was 9. Recently, M. Xanthakis, found a cluster of Valonia Oak trees, consisting of about 20 individuals, in Kourouklata (Phitos & al. 2015). Of relevance is the characteristic observation by R. Knapp, who notes in his respective work *Die Vegetation von Kephallinia* (1965) that during his investigations in Cephalonia he had found, as well, an aged individual in Monodendri. It should be noted that Th. Heldreich *(Flore de l' île de Cephalonie, 1883)* reports the finding of the oak above Heraklion and close to Kapandriti, as well as on Mt. Atros, near the Monastery and close to the village of Bari in the province of Erissos (Fig. 17).

Fig. 16. A solitary *Quercus ithaburensis* subsp. *macrolepis* individual from the area of Livatho.

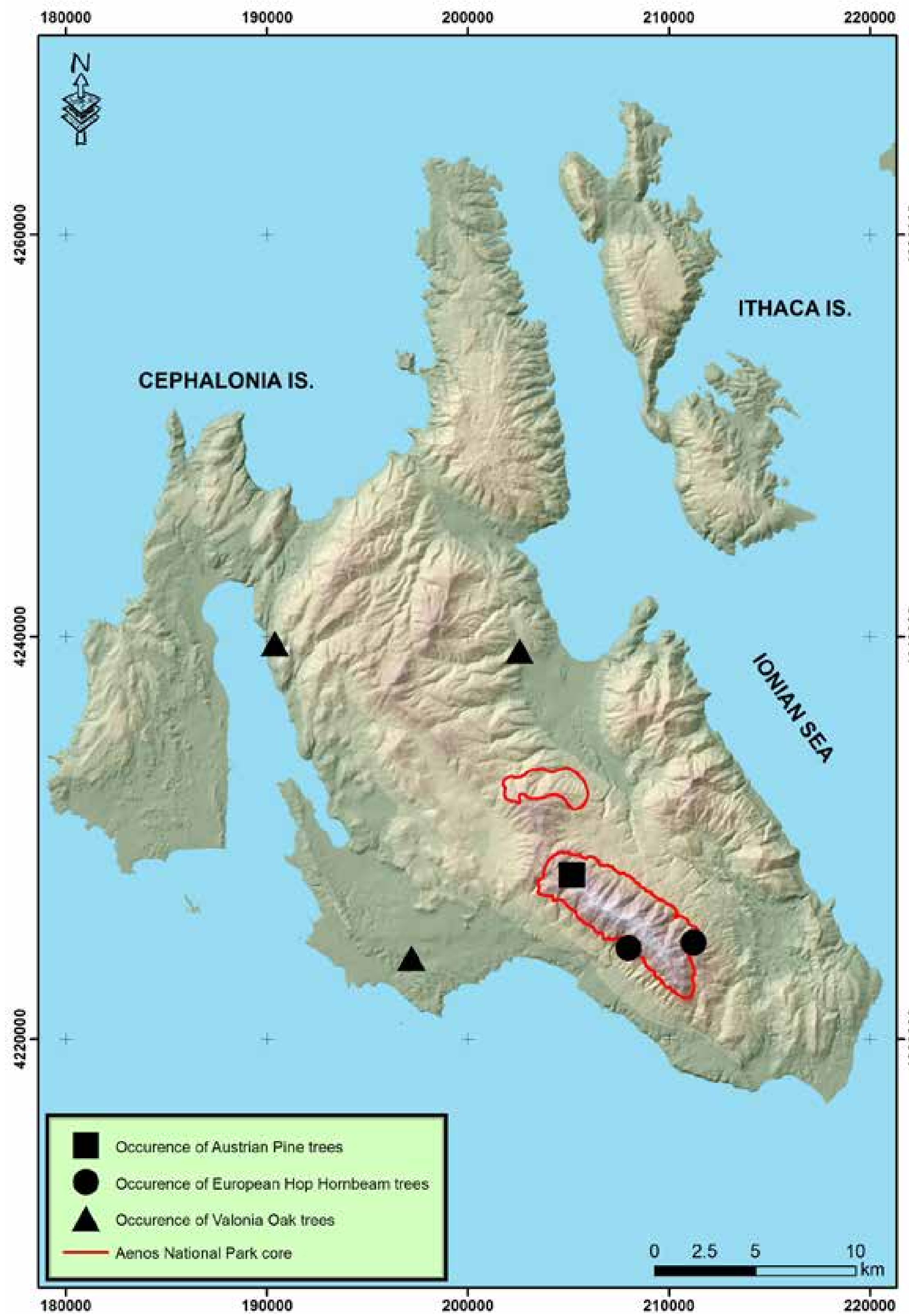


Fig. 17. The localities of Cephalonia where the species: ■ *Pinus nigra* subsp. *nigra*, ● *Ostrya carpinifolia* and ▲ *Quercus ithaburensis* subsp. *macrolepis* have been found.

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# P A R T  V

## THE FLORA OF MT. AENOS

## A. HISTORICAL OVERVIEW OF THE BOTANICAL RESEARCH ON THE ISLAND OF CEPHALONIA

The historical-botanical overview of an island with such long history, as is Homer's Cephalonia, is not only particularly interesting but also multi-faceted. Here, we will limit ourselves to the more recent times. However, the most original and undoubtedly the most official report on the flora of Cephalonia comes from the Municipality of Pronnoi (4$^{th}$ century B.C.). It is about the representation of a Fir cone (obviously of *Abies cephalonica*), which is depicted on the one side of a copper coin from this classical city of Cephalonia, as well as a cone (in all probability of *Pinus halepensis*) on another coin of the same city (Postolakas, 1868) (Pg. 33, Fig. 19). Besides, Titus Livius (id. Loverdos 1888) mentions that the island produced only "acorns, wheat and barley" (3$^{rd}$-4$^{th}$ century B.C.). This obviously testifies to the abundance of the Oak (*Quercus*) during those times. A fact worth noting is that both in the classical times but also later on and especially during the period of the Venetian domination in Cephalonia the once very rich vegetation of the island is mentioned or implied (Partsch 1890, Samios 1908). For example, Strabo (id. Loverdos, 1888) mentions, among the names ascribed to Cephalonia, the name "Melaina", derived from the thick forests on the island at the time. Moreover, during the Venetian domination a similar name had been given to Mt. Aenos, "Monte Nero" (black mountain), obviously for the same reasons.

In 1821 we have the first publication on the flora of the island by the Italian doctor N. Dallaporta. It concerns the report of about 160 indigenous species, but also other cultivated or non-indigenous species with medicinal or economic importance. Their mentioning along with their respective common names follows the system of Linnaeus, their scientific names, however, do not always inspire trust as to their accuracy, and that is why they are not included here. This work of Dallaporta, nevertheless, can be considered significant from a folkloric point of view.

A. D. Maziari, an Italian Botanist, during his long stay on the Ionian islands (1817-1857), collected plants from the whole area and, of course, from Cephalonia. Part of his

Phanerogama collection was received by his contemporary Botanist, Tommasini, who deposited it to the Natural History Museum of Triest. One part of Mazziari's Cryptogama collections was handed to Heufler, who published the respective catalogue (1861 and 1868). This catalogue, apart from Bryophyta, Lichens and Algae, includes 18 Pteridophyta species from all the Ionian Islands, seven of which are reported as collected in Cephalonia. In any case, as mentioned by Heldreich and Heufler, Mazziari's notes of his collections on the area of origin are not always reliable.

In this chapter a special mention is owed to general Ch. Napier, British governor of Cephalonia (1822-1830), who connected his name not only with the island, but also with Botany (id. chapter on the Fir).

During the autumn of 1834, G. Schimper and Wiest visited the island, at which time they collected a small number of species, mentioned by De Candolle (1824-1874) and Boissier (1867-1884).

In September 1858 the island was visited by A. Mousson, Professor in Zurich, who, apart from his main interest in zoology, mentions in a relevant report some observations on the vegetation and especially on the Fir forest.

The first significant botanical exploration of the island was conducted by F. Unger during April 1860, when he investigated the island for a week. Unger did not only collect 176 floral species, but also made observations and presented information, which was included in his work (1862) concerning Mt. Aenos.

The first fundamental study of the flora of Cephalonia was made by Th. Heldreich, a German naturalist (1822-1902). From 1848 and for fifty years, Heldreich held the position of Curator of the Botanical Gardens of the University of Athens and from the year 1858 onwards that of the Curator of the Botanical Museum of that same University (Fig. 1). In 1861 (6-12 May) Heldreich, accompanied by J. Schmidt, director of the National Observatory of Athens, visited Cephalonia for the first time. This visit was followed by two more, in 1867 (26 August – 4 September) and in the end of 1872 (22 July – 24 September). It should be noted that J. Schmidt visited the island in 1867 and while conducting his own research, he gathered botanical material, which he then gave to Heldreich. As a result of this research, the most important work of Heldreich, *Flore de l' île de Céphalonie* (1882) was completed. In this work, Heldreich gathered all the knowledge known until then on the flora of Cephalonia and he finally reported 754 species of Spermatophyta and 12 of Pteridophyta. In addition to those, he mentions some species of Bryophyta, Lichens and Algae, as well. The number of Spermatophyta and Pteridophyta species presented by Heldreich in a reviewing manner in his aforementioned work has, from that point onwards, given a clear picture of the floristic character of Cephalonia, while the particular interest with which he worked during his stay on the island is praiseworthy.

With his profound knowledge on the Greek flora and his scientific authority, Heldreich set with this work the foundation for the further study of the flora of the Ionian Islands.

G. Spreitzenhoffer, in the first (1877) out of a total of four trips to the Ionian Islands, visited Cephalonia during April 16-19. In the results of his trip (1877) he reports 116 Phanerogama species from Cephalonia.

In the following year, 1878, M. Letourneux made a small collection mainly from Mt.

Fig. 1. Theodore Heldreich (1822-1902). From the personal archives of D. Phitos.

Aenos. His collected species are mentioned in the work by Heldreich (1882).

Much praise should be given to the work by K. Samios *The forests of Cephalonia* (1908). Samios, Forests Director for the Greek Ministry of Finance and Professor of the Polytechnic School of Athens, visited Cephalonia in 1907, to study its forests. His aforementioned work was the result of this study, in which 23 species of trees and shrubs are mentioned. The great value of this work lies not only in the mentioning of these species, but also in the most valuable historical and forestry information on the forests of Cephalonia, and on the Fir forest in particular. The above mentioned work by Samios constitutes a model forestry research for our country.

Th. Just visited Cephalonia during June 1-19, 1929, as a member of a research team, consisting mainly of zoologists, who also explored Corfu, Lefkada and North Peloponnese. The botanical material, which he collected from these areas, was analysed by M. Servit (1935, Lichens) and G. Cufodontis (1936, Pteridophyta and Spermatophyta).

R. Knapp in his study *Die Vegetation von Kefallinia* (1965) mentions about 460 species from Cephalonia, which he collected with his partners, during his study on the island. The said species are mentioned as participants in various plant communities of the island, while the exact collection location is given for only a few species.

In 1967 D. Phitos and J. Damboldt (Professor of Systematic Botany, Freie Universität Berlin) commenced their botanical research in the Ionian Islands, aiming at writing *Flora Ionica*. Their joint research was interrupted in 1977, due to the illness of J. Damboldt, who passed away in 1978. With this untimely death the author of this article (D. Phitos) lost a dear friend and a valuable partner. The void left by Jürgen was never filled! Since then, 7 years had to pass before inner strength could be gathered, and the former writer published a part of their research, limited, now, to the island of Cephalonia (D. Phitos & J. Damboldt: *The Flora of the Island of Cephalonia* (1985). The collected botanical material for this study remains deposited to the Botanical Museum of the Laboratory of Botany, University of Patras, (UPA).

From 1969 onwards, G. Kamari, along with D. Phitos (and J. Dumboldt until 1977) (Fig. 2 & 3), took part in nearly all the botanical excursions on the Ionian Islands. As a result, numerous relative contributions on the flora of the area were published.

The contribution of Dr. W. Gutermann (member of the Section of Systematic and Evolutionary Botany of the University of Vienna) to the promoting of the flora on the Ionian Islands is well worth mentioning. W. Gutermann with his team of collaborators, but also students, researched, mostly during the years 1985-1989, as well as later, Corfu, Lefkada, Cephalonia, Ithaca, Zakynthos and smaller islands in the Ionian, in order to write *Flora Ionica*. Therefore, he meticulously continued the long tradition of Austrian Botanists in the study of the flora of the Ionian Islands.

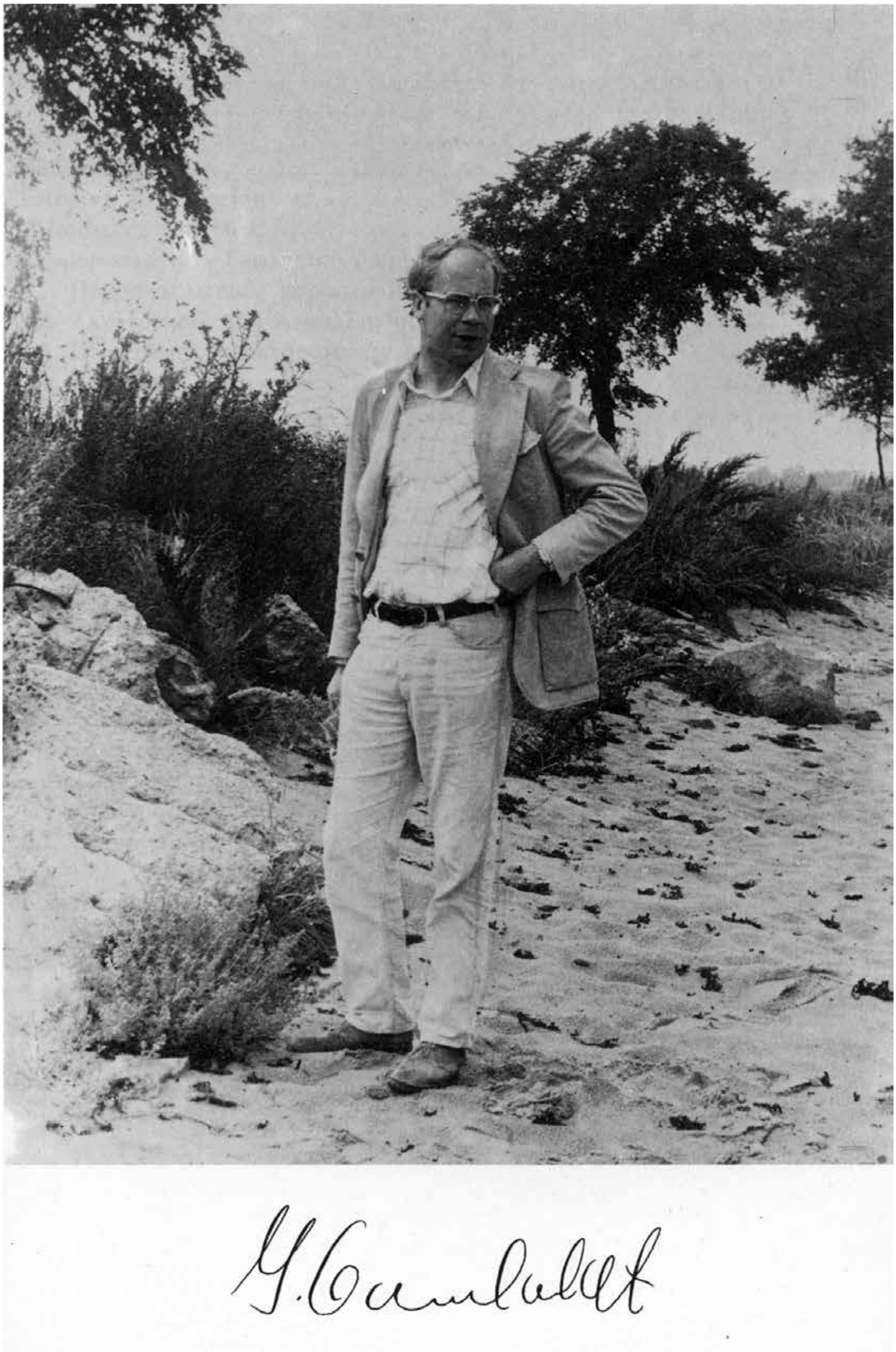

Fig. 2. Prof. Jürgen Damboldt (1937-1978). From the personal archives of D. Phitos.

Fig. 3. Prof. J. Damboldt and Prof. Georgia Kamari on Mt. Aenos (1970). From the personal archives of D. Phitos.

Dr. Niki Katsouni, Director of the Museum of Natural History of Cephalonia and Ithaca, gathered with great care botanical material for the enrichment of the collection of that Museum and, at the same time, studied taxonomically some plant groups.

A vital contribution to the knowledge of the Orchids of Cephalonia, as well as of the other islands, were the publications by B. & H. Baumann (1984), P. Delforge (1994), A. Alibertis (2015) and others.

## B. ON THE FLORA OF MT. AENOS

At first, as mentioned already in Part II on the geology of Mt. Aenos, it should be noted that Mt. Aenos consists of two independent mountain volumes, i.e. the main part, Aenos with the Megas Soros summit (alt. 1,627 m.) and Roudi with the Gioupari summit (alt. 1,125 m). This clarification is deemed necessary, given the fact that quite often the mountain part of Roudi is considered a separate mountain.

The Flora of Mt. Aenos is characterised by continental, floristic elements, given Cephalonia's proximity to continental Greece, but also due to its geo-historical origin. The most characteristic example of this claim is obviously the presence of *Abies cephalonica* on Mt. Aenos. However, besides the Cephalonian Fir, a notable number of endemic species of the Ionian floristic region (Fig. 4) occurs also at the opposite Akarnanika mountain range (Sterea Ellas), which we believe should be included in the aforementioned floristic region. Some of the included floristic elements are the following: *Acis ionica*, *Campanula garganica* (including subsp. *cephalonica* and subsp. *acarnanica*), *Centaurea subciliaris* (including subsp. *subciliaris* and subsp. *acarnanica*), *Cerastium illyricum* subsp. *illyricum*, *Erysimum cephalonicum*, *Lomelosia crenata* subsp. *dallaportae*, *Paeonia mascula* subsp. *russoi*, *Petrorhagia fasciculata*, *Teucrium halacsyanum*, etc. Based on the above we believe that the neighbouring Akaranika mountain range could be included in the Ionian floristic region.

Cephalonia island, according to and including the most recent data, hosts ca 1,200 Pteridophyta and Spermatophyta taxa (species and subspecies).

From the wealthy flora of Mt. Aenos, which amounts to ca 450 taxa, only a selected few species and subspecies will be discussed in the current chapter, belonging to the following categories:

B1. Endemic species of Mt. Aenos
B2. Endemic species of Cephalonia Isl. that also occur on Mt. Aenos
B3. Endemic species of the Ionian floristic region that also occur on Mt. Aenos
B4. Species of particular phytogeographic interest that occur on Mt. Aenos


Fig. 4. The Ionian floristic region, as well as the neighbouring regions: Floristic region of the Ionian Islands (IoI), Peloponnese, (Pe), Sterea Ellada (StE). South Pindos (SPi) and North Pindos (NPi).

## B1. Endemic species of Mt. Aenos

***Scutellaria rupestris*** Boiss. & Heldr.
**subsp. *cephalonica*** (Rech. f.) Greuter & Burdet

### *Lamiaceae*

**Description:** Perennial herb. Stems up to 20 cm, procumbent. Stem leaves, petiolated, ovate-triangular with crenate to serrate margins. Bracts 3-6x2-3 mm, ovate-lanceolate. Corolla 10-13 mm with upper flower tube and upper lip pale pink, tube base whitish (Fig. 5).

**Flowering season:** End of May till July.

**Geographical distribution:** Endemic subspecies of the Greek flora. Its distribution is restricted on Mt. Aenos of Cephalonia, at an altitude of 800-1,600 m.

**Habitat**: It grows on open calcareous places, rocky or gravelly, but also at the margins of forest roads. At the calcareous, stony locality Ampelaki-Chionistra (1,600 m) of Mt. Aenos, it occurs together with *Viola cephalonica* and *Cerastium candidissimum.* It has also been found on two restricted areas on Roudi summit. Recently, it was found close to the Environmental Center of Mt. Aenos (Livaniou-Tiniakou 2015).

**Threats and threat category assessment:** Two of the subpopulations of this subspecies are found in the National Park of Mt. Aenos. The largest of the two is found at the Ampelaki-Chionistra locality. In a counting conducted on 2007 it amounted to 500 individuals. That locality constitutes also the habitat of the narrow endemic of Cephalonia *Viola cephalonica* and it does not occupy more than 570 $m^2$. This subpopulation is constantly being exposed to the seasonal operation of snow ploughs and other heavy machinery that clean and maintain the road that surrounds the habitat and leads to the telecommunication and media antennae. This fact renders this subpopulation particularly vulnerable, because it is susceptible to extinction during every relevant operation. Also the example of the extinction of the smaller 'Kissos' subpopulation proves that the viability of *S. rupestris* subsp. *cephalonica* requires close monitoring.

Because of the limited distribution area, which the existing subpopulations of this subspecies occupy and the constant threats that it is faced with from human influences and illegal grazing, it has, at least for now, been characterised as Endangered (EN) (Katsouni & al. 2009)

**Conservation measures**: Because *Scutellaria rupestris* subsp. *cephalonica* is mostly found in the National Park of Mt. Aenos, its protection is closely linked to the strict abid-

Fig. 5. *Scutellaria rupestris* subsp. *cephalonica* on Mt. Aenos.

ing by the specific regulation regime that governs the National Park. However, we consider it necessary to fence the habitat at the Ampelaki-Chionistra locality, because this measure has been successfully used in the past for *Viola cephalonica*. We also suggest that reproduction of the subspecies should be conducted in suitable, protected areas, followed by reintroduction of the grown plants to the respective habitats, thus reinforcing its populations, while at the same time preserving seeds in seed banks.

## *Viola cephalonica* Bornm.

### *Violaceae*

**Description:** Perennial herb 5-15 cm tall. Creeping to ascending stems, usually glabrous, lacking leaves at the lower part. Leaves entire, glaucus-green, glabrous or shortly haired mostly on petioles and stipules, shallowly crenate. Lower stipules entire. Upper stipules leaflike with pedicels 3-12 mm long. Sepals deep green, glabrous, 6-11x1.6-3.8 mm, entire, linear-lanceolate, acute. Flowers bluish-violet, upper petals usually darker than the rest. Spur thin, glabrous, 9-14 mm long, pale violet, slightly curved upwards (Fig. 6 & 7).

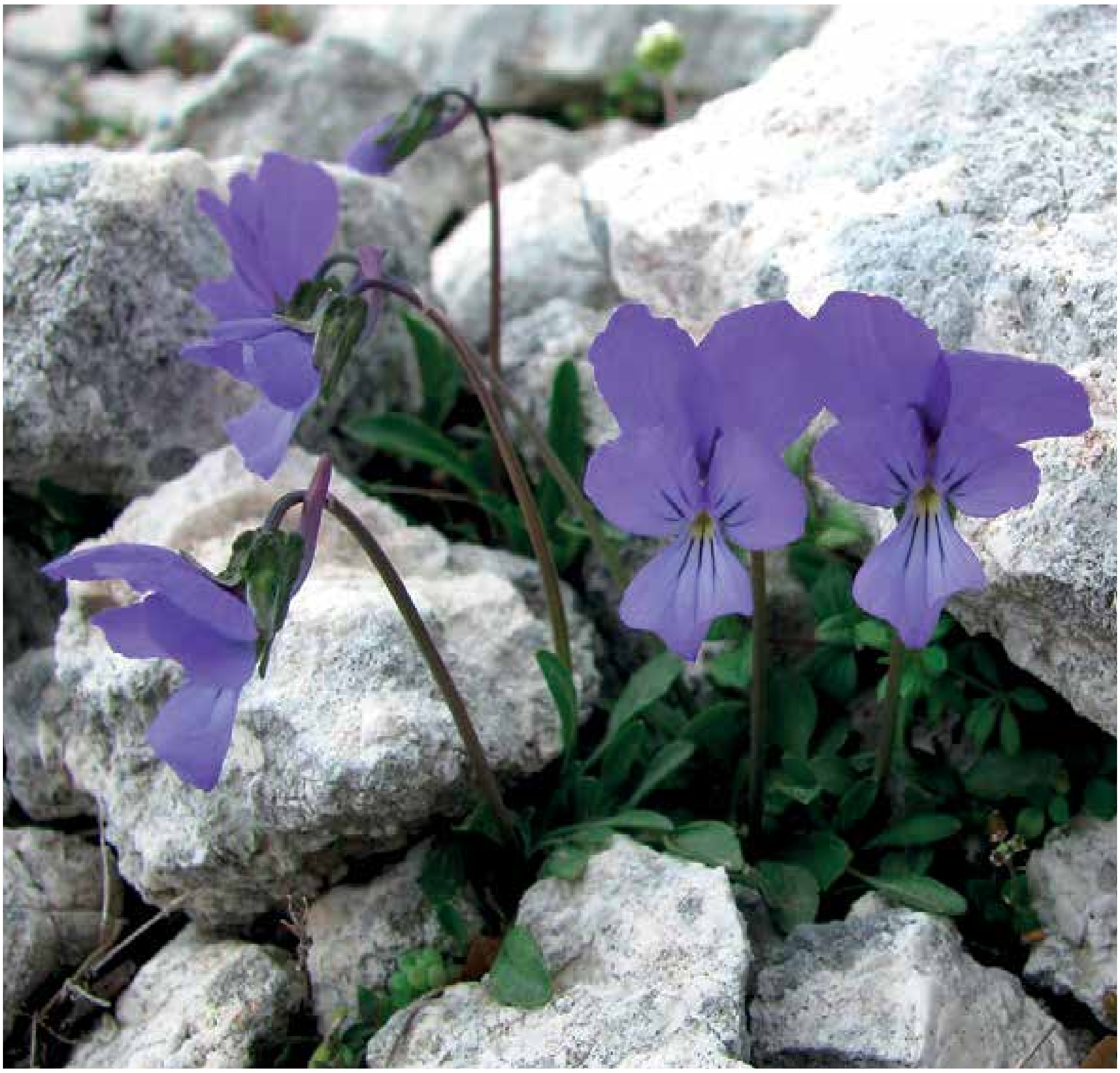

Fig. 6. *Viola cephalonica* on 'Chionistra' locality, Mt. Aenos.

Fig. 7. *Viola cephalonica*, near the highest peak of Mt. Aenos, Megas Soros.

**Flowering season:** End of May till July.

**Geographical distribution:** Narrow endemic species of Cephalonia Isl. Known only from Mt. Aenos, where it grows in the National Park.

**Habitat**: *Viola cephalonica* occurs on two locations of the mountain ridge of Mt. Aenos. These locations are calcareous, stony or rocky, devoid of vegetation and lack shading, with a S.-SW. exposure:
a) Locality: Ampelaki-Chionistra, at an altitude of 1,600 m, where the telecommunications and media antennae have been installed. At this locality *Viola cephalonica* coexists with other rare and endemic species, such as: *Astragalus sempervirens* subsp.*cephalonicus*, *Aubrieta deltoidea* var. *deltoidea*, *Cerastium candidissimum*, *Corydalis solida*, *Scutellaria rupestris* subsp. *cephalonica*, *Veronica glauca* subsp. *peloponnesiaca* etc.
b) Locality: Epano Vigla, towards the highest peak of Mega Soros at an altitude of 1,620-1,627 m. At this locality, it grows towards the steepest slopes of Mt. Aenos over the screes of the S.-SW. slope and coexists with the same species of the previous locality.

**Population status:** The population of *Viola cephalonica* at the Ampelaki-Chionistra locality was the most dense. That locality has been turned into an "antennae park", serving public and private media stations. The several impacts, the landscaping works for the leveling of the area and the widening of the road that accesses the "antennae park" have caused a severe deformation of the natural environment. In 2007 this *V. cephalonica* habitat was fenced (ca 1,500 m$^2$). This measure was successful and in 2015 that fenced area was full of ca 1,300 mature individuals of this species. At the second locality (Epano Vigla) up until the highest summit of Megas Soros, at an area of ca 10,000 m$^2$ there have been counted ca 1,000 individuals, scattered in rock crevices, mostly towards the steep slopes of the S-SW. side of the mountain, where they can be protected from grazing.

**Threats and threat category assessment:** The *Viola cephalonica* populations both at the Ampelaki-Chionistra locality and the locality Epano Vigla, towards Megas Soros, is in immediate danger of extinction, due to persisting illegal grazing, observed during spring and throughout summer. The rosettes of the plants, their stems and the seed containing capsules are consumed by the animals, drastically reducing the reproductive capacity of the population.

**Conservation measures**: It would be unnecessary to suggest conservation measures for *Viola cephalonica* since its distribution area lies exclusively within the core of the National Park of Mt. Aenos, the protection of which is governed by strict and established regulations. Unfortunately, despite these established, strict conservation measures and the meticulous surveillance of the region at the same time, the threat for a further restriction of the distribution of this most rare species has not been averted.

It should be underlined again that the core of the National Park of Mt. Aenos has been included in the Natura 2000 network with the code GR2220002 as an area of particular scientific and community interest.

Because of the very restricted area occupied by *Viola cephalonica* and the persisting threats, imposed by human influences, as well as illegal grazing, it has been characterised as Critically Endangered (CR) (Katsouni & al. 2009). At the same time, seed preservation in seed banks is deemed necessary.

## B2. Endemic species of Cephalonia Isl. that also occur on Mt. Aenos

***Ajuga orientalis*** L.
**subsp. *aenesia*** (Heldr.) Phitos & Damboldt

***Lamiaceae***

*Ajuga orientalis* subsp. *aenesia* is a herbaceous plant, 10-30(-40) cm tall. The whole plant, but mostly the leaves are covered by soft, wooly, grayish pubescence. It differs from the typical form of *A. orientalis* (at least from its Greek populations) in the bracts with characteristic violet-purple colour and sparce shallow teeth, as well as in the deep purple, occasionally bluish-violet color of the corolla (Fig. 8 & 9).

*Ajuga orientalis* has a wide distribution in different regions of the E. Mediterranean (Greece, Italy, Albania), but also of Anatolia (Crimea, Turkey etc).

This taxon is the only known subspecies within *Ajuga orientalis* and is a Cephalonian endemic. Its main distribution area lies in the National Park of Aenos-Roudi. Lately, its presence was verified on two other mountains of Cephalonia: Mt. Monolati and Mt. Strogylo Vouno. It is not a rare species where it occurs and prefers the sides of forest roads between 700 and 950 m. of altitude.

During the last years, the various populations of this subspecies are showing a reduction in number of individuals, mainly due to the widening of certain forest roads in the National Park, but also due to illegal grazing. As an example, we mention the population at the locality Petalas of Mt. Aenos, where in 2014 ca 200 individuals had been counted, whereas none were found in 2015! The same is also true for the population above Arginia, where in 2013 about 120 individuals had been counted, whereas in 2014 and 2015 it had disappeared from that locality! Therefore, its systematic monitoring is recommended (Livaniou-Tiniakou 2015).

Fig. 8. *Ajuga orientalis* subsp. *aenesia* on Mt. Aenos.

Fig. 9. The habitat of *Ajuga orientalis* subsp. *aenesia* on Mt. Roudi.

## B3. Endemic species of the Ionian floristic region that also occur on Mt. Aenos

***Acis ionica*** Bareka, Kamari & Phitos

***Amaryllidaceae***

*Acis ionica* plants were found on Cephalonia isl. for the first time by Schimper & Wiest and reported by Boissier (1884) as *Leucojum autumnale* L. Since then, these plants were mentioned again in 1974 with the name *L. valentinum* by Damboldt & Phitos, during a karyosystematic study of the genus *Leucojum* from numerous Cephalonian populations.

In 2004 Tan & al. described the said taxon as *L. ionicum*.

In the year 2006, the above taxon was described by Bareka & al., based on a thorough study, as a new species with the name *Acis ionica*. Our view that these plants belong to the distinct genus *Acis* was reinforced by the particularly interesting publication by Lledó & al. (2004), who in the meanwhile had completed a cladistics analysis, using morphological and molecular characters. These authors concluded that genus *Acis* should be separated from genus *Leucojum*, as suggested by Salisbury, already since 1807. Lledó & al. included in the genus *Acis* the species *Leucojum valentinum*, *L. autumnale* and *L. trichophyllum* that occur in Spain.

However, in Flora Iberica Vol. XX (2014) the author of the genus *Leucojum*, although recognising the results by Lledó & al. (l.c.), states that for practical reasons only, he does not separate the genus *Acis* from *Leucojum*! We do not share these practical reasons that ignore at the same time the scientific ones and we preserve the name of the genus *Acis*.

*Acis ionica* (Fig. 10 & 11) is characterised by a compact scape, bending to the ground during fructification, linear filiform leaves that appear during or usually after flowering, white flowers with filiform pedicels and a prominent epigynous disc with 6 widely triangular lobes (Bareka 2001, Bareka & al. 2003). The species of this genus that are phylogenetically closer to *Acis ionica* are: *A. nicaeensis, A. fabrei* and *A. valentina*, from which it is distinguished by the shape of the internal tepals, as well as by the lobe size of the epigynous disc. From the above species, the one closest to *Acis ionica* is *A. valentina,* a Spanish endemic. The former is distinguished from the latter, mainly by the thinner scape, the tepal shape and the lobe length of the epigynous disc. Despite the notable morphological similarity of the two taxa, the molecular study, conducted by Lledó & al. (2004) demonstrated a significant differentiation between them.

*Acis ionica* occurs in open stony or rocky calcareous places with phrygana or bushy vegetation (Fig. 10). It constitutes one of the most characteristic species of the Ionian floristic region, being distributed in the islands Zakynthos, Cephalonia, Ithaca, Lefkada, as well as in various regions of continental Greece opposite those islands (Prefecture of Etolia-Akarnania). We should also particularly note its presence in the Albanian coasts close to Argyrokastro.

### ***Allium ionicum* Brullo & Tzanoud.**

### ***Alliaceae***

*Allium ionicum* constitutes a characteristic element of the Ionian floristic region. It occurs on the islands Zakynthos, Cephalonia, Ithaca, Lefkada, Oxia, Kalamos, as well as in the coastal regions of continental Greece opposite those islands (Prefecture of Etolia-Akarnania).

Plants of this species were found for the first time in 1980 by D. Phitos and G. Kamari on Lefkada isl., close to the village Agios Nikitas (No. 16422). Specimens of that collection were given to D. Tzanoudakis for a preliminary examination, who under unknown circumstances described it with S. Brullo as a new species (Brullo & Tzanoudakis 1994)!

Fig. 10. Typical habitat of *Acis ionica*.

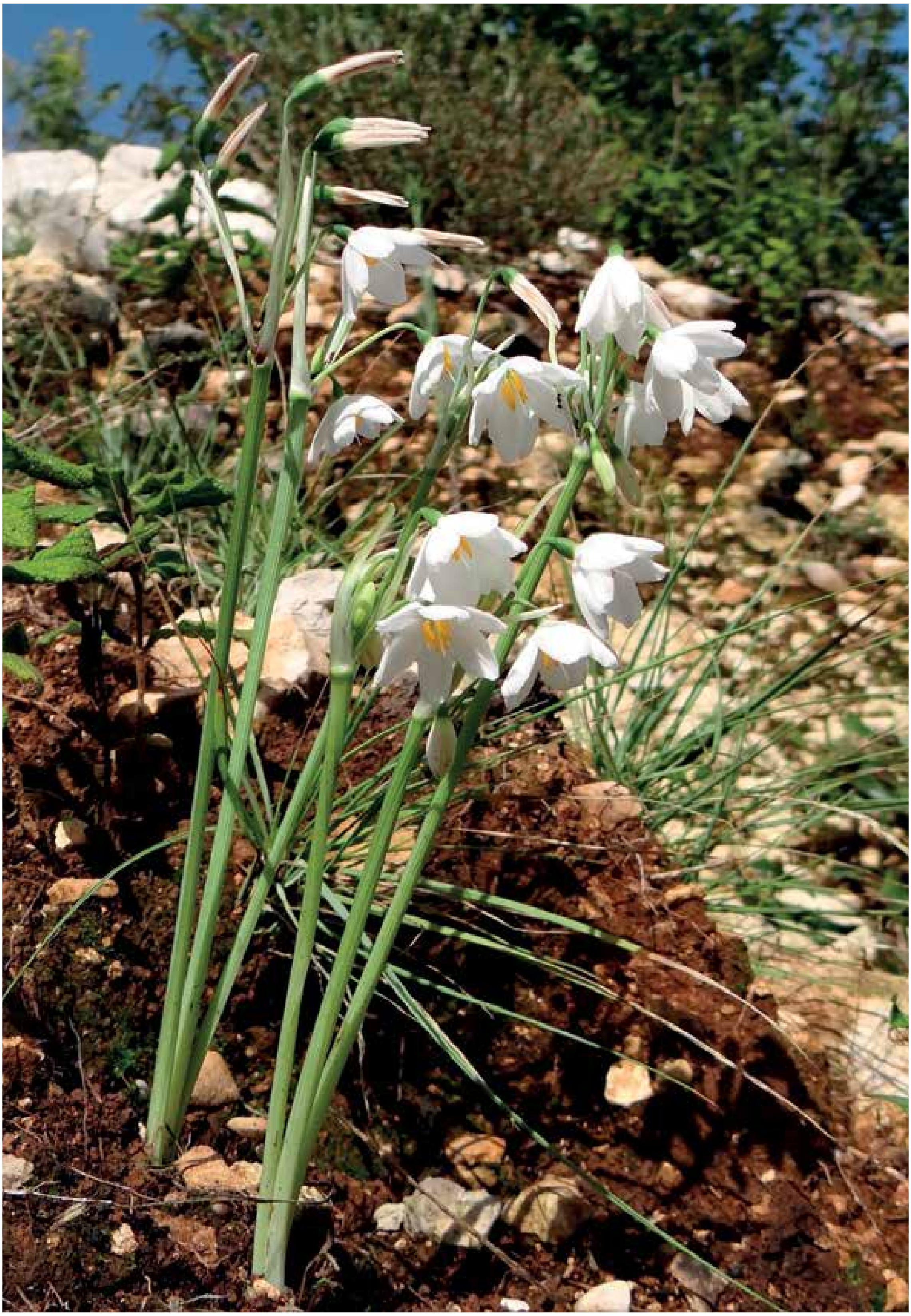

Fig. 11. *Acis ionica.*

*Allium ionicum* (Fig. 12 & 13) is widely distributed in Cephalonia, from the coastal level (e.g. Lagkadaki bay of Paliki by Poros etc.) up to the Fir forest of Mt. Aenos (e.g. on Roudi summit at 1,000 m alt.), but also at the foot of Mt. Aenos above Michata village at an altitude of 450 m.

It grows mostly on open stony places.

It flowers from mid-May till the beginning of July.

It is easily distinguished from its related species, mostly by its pubescent leaves and their sheath, the spathe which is shorter than the inflorescence, as well as the barely visible teeth among the stamen filaments (Fig. 13).

Fig. 12. *Allium ionicum* from the foot of Mt. Aenos, alt. 450 m.

Fig. 13. *Allium ionicum*, above the village Michata, alt. 450 m.

## ***Campanula garganica*** Ten. **subsp. *cephallenica*** (Feer) Hayek

### ***Campanulaceae***

Perennial herb, sparsely pilose, rarely almost glabrous. Stems usually ±25 cm in length, occasionally reaching 45 cm. Basal leaves cordate irregularly serrate, rarely dentate. Corolla with light bluish-violet color, rarely whitish, almost discoid, 10-12 mm diameter.

It flowers from the end of April till the beginning of June.

It usually grows on calcareous rocky places as a chasmophyte, but also on old castle and house walls. Its altitude of occurrence ranges between 50 and 1,550 m. In the *Abies cephalonica* forest on Mt. Aenos, it usually occurs in crevices of calcareous rocks (Fig. 14 & 15).

*Campanula garganica* subsp. *cephallenica* is an endemic species of the Ionian floristic region, distributed in Cephalonia, Zakynthos, Ithaca, Lefkada and Kalamos.

Fig. 14. *Campanula garganica* subsp. *cephallenica.*

From a taxonomical point of view, *Campanula garganica* is distinguished in three subspecies: subsp. *garganica*, occurring on Mt. Gargano at the Adriatic coasts of Italy, subsp. *acarnanica*, occurring on Akarnanika Mts (Prefecture of Akarnania) and subsp. *cephallenica*, the distribution of which is provided above.

*Campanula garganica*, with its three aforementioned subspecies and the Adriatic-Ionian geographical distribution, constitutes one of the most characteristic examples of the above floristic region.

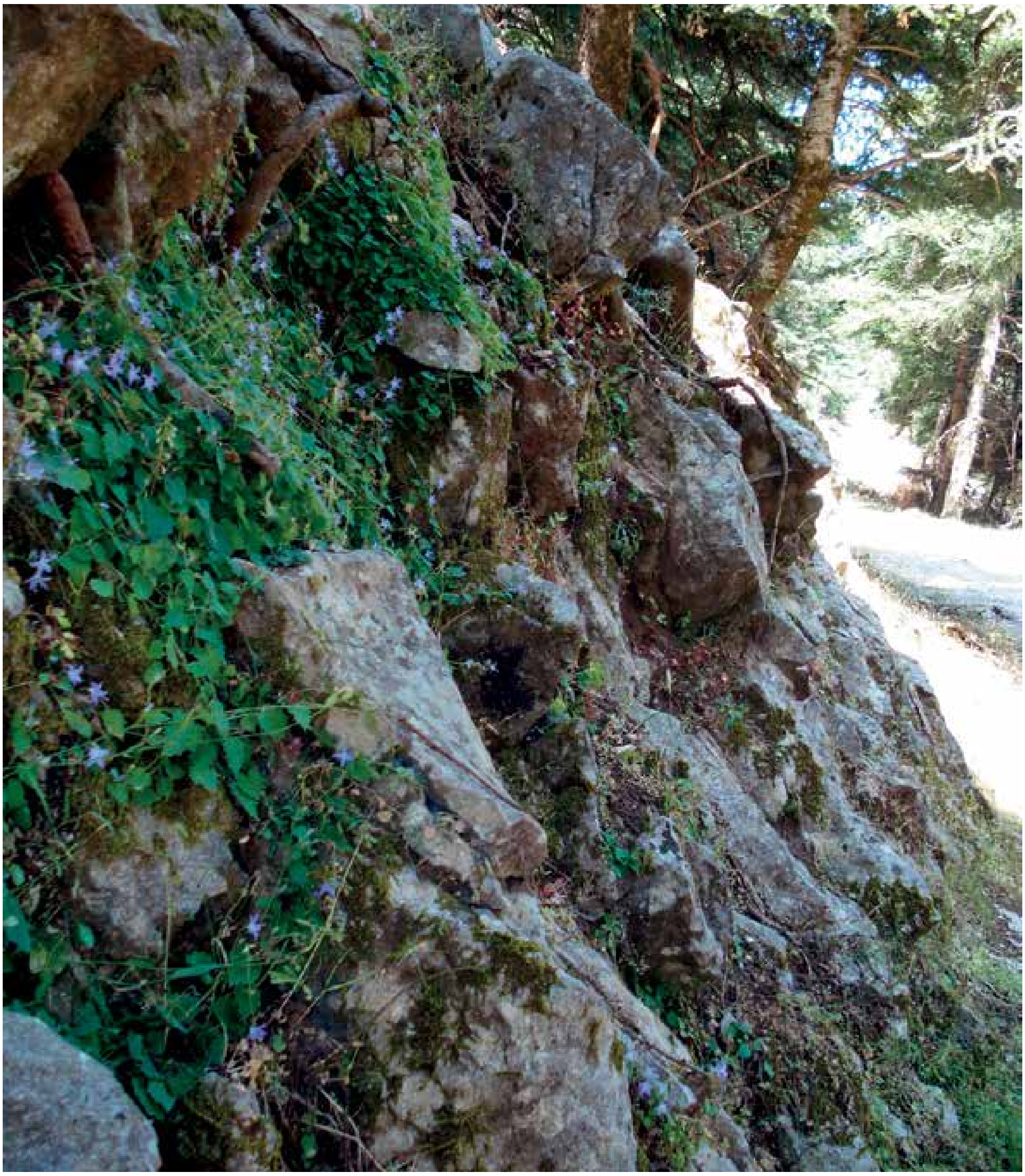

Fig. 15. *Campanula garganica* subsp. *cephallenica.* Its habitat on the National Park of Mt. Aenos.

The only population of the Cephalonian Bellflower, which is protected, lies within the National Park of Mt. Aenos. In the other localities, particularly those close to human settlements, it sustains pressures by the widening of rural roads, by the settlements themselves and in general by the modification of its habitat. For these reasons, the above subspecies is characterised as Vulnerable (VU) (Phitos & al. 2009), according to the IUCN criteria (2001).

## ***Centaurea subciliaris*** Boiss. & Held.
## **subsp. *subciliaris***

### ***Compositae***

*Centaurea subciliaris* is an endemic species of the Ionian floristic region. It grows on the islands Cephalonia and Lefkada, as well as on the opposite continental region of Akarnanika Mts (Prefecture of Etolia-Akarnania). From a taxonomical point of view, this species is distinguished in two subspecies, subsp. *subciliaris* (Cephalonia and Lefkada) and subsp. *acarnanica* (Akarnanika Mts). It is a very interesting species, with a wealth of available literature (id. mostly Matthäs 1976 and Phitos & Damboldt 1985).

It should be noted that the subspecies is mentioned in the work *Vascular plants of Greece – An annotated checklist* (Dimopoulos & al. 2013) as *Centaurea alba* subsp. *subciliaris*. As is known, *C. alba* does not occur in Greece but instead in western Europe (id. the recent publication by Lopez - Vinyallonga & al. 2015). Therefore, we preserve the name *C. subciliaris.* Besides, this subspecies is reported to appear in Bulgaria (Mt. Slavyanka), however, the examination of specimen photographs, kindly provided by Herbarium Plovdiv (SOA), showed that the depicted species is not *Centaurea subciliaris*.

*Centaurea subciliaris* (Fig. 16) is a perennial herb with stems of (15-)20-45(-80) cm, simple or usually branched. Basal leaves forming a rosette, usually pinnate with elliptic-lanceolate lobes. Stem leaves similar to those of the rosette but smaller. Uppermost leaves usually lanceolate. Involucre ovate, 8-12 mm length. Involucral bracts with hyaline margins, entire with an ovoid-triangular central part, light brown to brown. Flowers pale pink to light violet.

*Centaurea subciliaris* usually appears on mountainous altitudes. For example, in Lefkada it grows above 750 m, whereas on Akarnanika Mts, above 500 m. As an exception, we mention the population of the locality Omala in Cephalonia (at the foot of Mt. Aenos) where it grows from an altitude of 380 m, reaching up to 1,600 m at the peak Ampelaki-Chionistra of Mt. Aenos.

Fig. 16. *Centaurea subciliaris* subsp. *subciliaris*. Rosettes of the plant (above) and involucres (below).

***Cerastium illyricum*** Ard.
**subsp. *illyricum***

***Caryophyllaceae***

*Cerastium illyricum* is a Greek endemic species, particularly polymorphic. It is distinguished in three subspecies: subsp. *illyricum*, occurring on Cephalonia, Lefkada and Corfu, subsp. *brachiatum* growing on Peloponnese, Cephalonia and Zakynthos, as well as subsp. *crinitum* of Akarnanika Mts.

Subsp. *illyricum* has been described from the lower parts of Mt. Aenos, close to the village Valsamata.

It is a small herb with thick pubescence, with many stems from the base, up to 6 cm tall. Pedicels 1-2.5 times longer than sepals. Sepal hairs do not usually surpass their tip. Petals shorter or equal to the sepals in length.

***Fritillaria messanensis*** Raf.
**subsp. *gracilis*** (Ebel) Rix

***Liliaceae***

*Fritillaria messanensis* subsp. *gracilis* is a characteristic plant of the Adriatic-Ionian floristic region. It occurs on all the islands of the S. Ionian Sea (Zakynthos, Cephalonia, Ithaca and Lefkada), as well as in Sterea Ellada (Mt. Boumistos), but also in N. Albania and Montenegro.

It is a tuberous plant (geophyte) with a small tuber, usually consisting of two scales. It has characteristic glaucous, narrow, lanceolate, alternate leaves. It is 40(-60) cm tall and its single stem with 1-2, rarely up to 4 flowers, narrowly campanulate, deeply purplish-brown externally and lightly colored internally with large ovate nectaries (Fig. 17 & 18).

*Fritillaria messanensis* subsp. *gracilis* differs from its related subspecies, subsp. *messanensis* and subsp. *sphaciotica* by its flowers, which externally have a deep purplish-brown color, lacking the characteristic yellowish-green fascia along the tepals that the other two *Fritillaria messanensis* subspecies have. Moreover, the uppermost leaves are 1-2, whereas they are usually 3 in the other two subspecies.

The thorough study (morphological, phytogeographical and karyological) of the *F. messanensis* group s.l. has proven that the populations, particularly those of the Ionian Islands, demonstrate a significant morphological and karyological variability (Kamari

Fig. 17. Characteristic habitat of *Fritillaria messanensis* subsp. *gracilis.*

& Phitos 2006). In particular, with regard to their karyotype, the said populations carry different types of SAT-chromosomes), as well as different numbers of B-chromosomes.

Subsp. *gracilis* usually grows in small groups at low altitudes (20-500 m), rarely at higher (up to 1,000-1,800 m), such as in Albania and Montenegro. It prefers open stony, calcareous places, however it often grows between shrubs, on forest clearings or at the margins of olive groves and rural roads.

The plants of Cephalonia have the darkest flowers, whereas those of the other Ionian islands (particularly of Zakynthos) demonstrate a strong variability, even within the same population, occasionally looking similar to those of the typical *F. messanensis.*

## ***Galium ionicum*** Krendl

## ***Rubiaceae***

*Galium ionicum* is an endemic of the Ionian floristic region. The name *G. ionicum* constitutes the nomenclatural correction of *G. mixtum* Krendl, which had been described as a new species from Corfu (Krendl & Vitek 2007). It is the commonest species of the

Fig. 18. *Fritillaria messanensis* subsp. *gracilis.*

genus *Galium* in the Ionian floristic region and it grows on almost all its islands (Zakynthos, Cephalonia, Ithaca, Lefkada, Kalamos, Corfu etc.).

It occurs at an altitude of 20-1,550 m at open phryganic or bushy places, as well as at open stony places of the Fir forest on Mt. Aenos.

### ***Paeonia mascula*** (L.) Miller
### **subsp. *russoi*** (Biv.) Cullen & Heywood

### ***Paeoniaceae***

The plants of *Paeonia mascula* that occur on the islands of the Ionian floristic region, Zakynthos, Cephalonia and Lefkada, as well as on the Akarnanika mountain range at the opposite side (W. Sterea Ellada), constituted, until a few years ago, a distinct subspecies under the name *P. mascula* subsp. *russoi* (Fig. 19 & 20). De-Yuan & Xiao-Quan (2006) classified the Ionian plants under *P. corsica* Sieber. The same name is being used by Stearn & al. (2012).

It is evident, mostly because of the numerous synonyms of *Paeonia mascula* at the S. tip of the Italian Peninsula, Sicily, Corsica and Sardinia that the distinction of the respective taxa of this species has been ambiguous. De-Yuan & Xiao-Quan, l.c., based on certain similarities of the plants of the Ionian Islands with *P. corsica*, as well as on the identical chromosomal number ($2n = 10$) of the Corsican and the Ionian plants, classified *P. mascula* subsp. *russoi* as *P. corsica*. We do not consider the above facts as sufficiently convincing, to justify renaming the plants of the Ionian Islands to *P. corsica*. Even less convincing is the phytogeographical distribution of *P. corsica* by Stearn & al. (2012).

For the above reason we preserve here the old name *Paeonia mascula* subsp. *russoi*. The molecular work on *Paeonia mascula* s.l., which has been undertaken by the Universities of Palermo and Patras, is expected to aid towards the more accurate phylogenetic classification of the species and subspecies of this group.

In Cephalonia (Katsouni & al. 2009), *Paeonia mascula* subsp. *russoi* occurs in 6 subpopulations, two of which at the mountainous range of Aenos: the first at the SE. side of Mt. Aenos, at the locality Fteri Melanitsa (within the National Park), is sparsely arranged, consisting of ca 30 individuals. The second, main subpopulation is observed on Mt. Roudi. It occurs at the upper side of the road that connects Argostoli with Sami at a transect 2 km long and 100 m wide and is, surprisingly, quite populous.

It flowers from the middle of March till the end of April.

In the *Red Data Book of Rare and Threatened Plants of Greece* (Phitos & al. 2009) *Paeonia mascula* subsp. *russoi* has been assessed as Near Threatened (NT), according to the IUCN criteria (2001).

Fig. 19. *Paeonia mascula* subsp. *russoi* at the NW. foot of Mt. Roudi.

*Paeonia mascula* subsp. *russoi* has an important ornamental value, therefore it is suggested that its commercial exploitation is made through cultivation and plant reproduction, in order to avoid uncontrolled plant collections from nature. Moreover it is deemed necessary to preserve seeds of this subspecies in seed banks.

Fig. 20. *Paeonia mascula* subsp. *russoi* above Giagana bay, at an altitude of ± 60 m (Erissos area).

## ***Saponaria aenesia*** Heldr.

### *Caryophyllaceae*

*Saponaria aenesia* is an annual herb with stems usually decumbent or ascending, glabrous or sparsely glandular-hairy in upper part. Lower leaves ± oblong-spatulate, upper leaves sessile, oblanceolate, recurved, crispate-undulate margin, glabrous or rarely sparsely glandular-hairy. Petal limb purplish-pink, suborbicular with two coronal scales. Pedicles shorter than calyx, abruptly curved downwards during frutification. Capsule ovoid-globose, shorter than calyx (Fig. 21).

It flowers in April and May.

*Saponaria aenesia* mainly grows on calcareous mountainous places at an altitude of 200-1,600 m with or without shade. In none of the places it is found does *S. aenesia* form large populations. In particular, its populations, at least on Cephalonia island, are few and scattered.

As mentioned in Flora Hellenica (Phitos 1997), Mt. Aenos hosts the typical form of *Saponaria aenesia*, whereas intermediate forms between it and *S. calabrica* have been found on Corfu. Moreover, we express the opinion that similar forms could occur on other Ionian Islands as well. Indeed, Gutermann & al. (2014), realised through the study of a wealth of material that the intermediate forms of the two species grow not only on Corfu, but also on Kalamos and Lefkada.

Besides, the above authors verify that both Ithaca and Lefkada contain typical populations of *Saponaria aenesia*. Obviously, a further study is necessary, in order to clarify the degree of relationship between the two aforementioned species.

The subpopulation sparseness that characterises *Saponaria aenesia* on Cephalonia, constitutes at the same time its greatest threat to its survival. For example, the case of the subpopulation on Mt. Eumorphia with ca 10 individuals is not at all encouraging (Katsouni & al. 2009). The subpopulation on Mt. Aenos appears to be in better condition. The subpopulation at the locality Kissos of Mt. Aenos has been recently found to amount to 205 individuals (Livaniou-Tiniakou 2015). At the aforementioned subpopulation sparseness of *S. aenesia,* one should also add the non-negligible threat posed by grazing throughout its distribution area outside Mt. Aenos. The said species has already been characterised as Endangered (EN) (Katsouni & al. 2009).

Fig. 21. Top: *Saponaria aenesia*. The curved capsules, characteristic of the species, are visible. Left: Isolated flowers with the characteristic pubescence of the calyx.

## ***Silene ionica*** Halácsy

### ***Caryophyllaceae***

*Silene ionica* resembles *S. fabaria*, but the former has fewer stems, 30-50(-80) cm tall. The lower cauline leaves are orbicular-obovate, glaucus, white-variegated, crowded near base. Upper leaves smaller, lanceolate. Flowers white, few, in terminal, strongly assymetrical dichasia (Fig. 22 & 23).

It flowers from May till the beginning of July.

It grows on calcareous, stony and mostly gravelly places at an altitude of 300-1,200 m.

*Silene ionica* is known from Cephalonia and Lefkada. It is also reported from Akarnanika Mts (Greuter 1997). The latter report needs to be confirmed.

Fig. 22. Cluster of *Silene ionica* individuals at alluvial deposits.

Fig. 23. Rosette of *Silene ionica*. The white variegated leaves are very prominent.

## ***Thymus holosericeus*** Čelak

## ***Lamiaceae***

*Thymus holosericeus* is a perennial shrub, up to 10(-20) cm tall with woody primary branches. It is distinct, mainly due to its velutinous leaves, the slightly dentate upper lip of the calyx and the particularly characteristic, large, pink-violet corolla. The flowers form a dense ovate capitate inflorescence.

It usually grows on open, mountainous, stony and occasionally rocky places, often at an altitude of 500 m or above. It flowers from the end of June till August (Fig. 24 & 25).

*Thymus holosericeus* is an endemic of the Ionian floristic region and appears in Zakynthos, Cephalonia and Lefkada.

It is strongly scented and is occasionally used for aromatic and medicinal purposes.

Fig. 24. *Thymus holosericeus*. All three photographs display the rocky or stony habitat of the species.

Fig. 25. *Thymus holosericeus*.

## B4. Species of particular phytogeographic interest that occur on Mt. Aenos

***Hypopitys monotropa*** Crantz
**subsp. *monotropa***

***Ericaceae***

We use here the modern name of the species *Hypopitys monotropa*, noting at the same time that up until a few years ago, it was known as *Monotropa hypopitys*.

We include this species, not because it is an endemic species of the Ionian floristic region. In contrast, it is not rare in continental Greece. However, the presence of *Hypopitys monotropa* on the Ionian Islands is verified only for Mt. Aenos (Fig. 26), where it was found again after 137 years! In particular, it has been reported by Heldreich in his work *Flore de l' île de Céphalonie*, who declares that the finding of this species is owed

Fig. 26. *Hypopitis monotropa.*

to his friend Letourneux on July of 1879! It was found again just a few years ago by staff members of the Management Body of the National Park of Mt. Aenos.

Besides the above information, we also include *Hypopitys monotropa* for its rare morphological features: It is a saprophytic species, i.e. lacking chlorophyll. The whole plant has a yellowish to yellow colour, occasionally with purplish-pink to brownish dots. Stem 5-25 cm. Petals 6-13 mm linear to linearly spatulate, erect, usually curved at the apex. Sepals obovate-spatulate. Stamens shorter than the sepals.

It usually grows in conifer and beech forests.

On Mt. Aenos it has been found in *Abies cephalonica* clearings, at an altitude of 1,200-1,400 m.

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## B5. The orchids of Mt. Aenos (*Orchidaceae*)

### B5a. The orchid family

The orchid family (*Orchidaceae*) is one of the richest families of the Plant Kingdom, consisting of approximately 800 genera and more than 25,000 species and subspecies. Though orchid taxa are distributed all over the world (except Antarctica), most of them are found in the humid tropical and subtropical regions.

Characteristics of the orchid family have triggered experts' interest and amateurs' love. This interest derives from their spectacular beauty and their eccentric flowers, their complex biology, and last but not least, from the bizarre ways through which pollination takes place.

From a taxonomical point of view, the orchid family is further classified into five subfamilies. However, species of only two of them are distributed in Greece (*Orchidoideae* and *Epidendroideae*). The presence of the third subfamily *Cypripedioideae* (consisting of the species *Cypripedium calceolus* L.) has not been yet confirmed in Greece.

### B5b. Orchid Evolution

The evolution of orchids must have started almost simultaneously with the evolution of other plant families, the age of which has been estimated from fossils. In particular, the *Orchidaceae* family (as well as other highly evolved families including *Iridaceae*) is classified under the Asparagales order. It is believed almost with certainty that this order evolved before the end of the Cretaceous period. Consequently, the orchid family, as one of the first-diverging families within the order Asparagales, must have its origin and diversification occurring shortly thereafter. The above view is further supported by the fact that complex pollinating insects, such as Hymenoptera, regarded to be responsible for the high diversity of the orchid family, do not appear in fossils, dating 100-110 million years ago. Thus, the evolution of the orchid family could not have existed much before these dates, as its evolutionary diversification must have depended on the above mentioned pollinators. The estimation of the time orchids first appeared on earth is further hindered by the fact that no fossils of their early species have yet been found. The earliest orchid fossil is *Eoorchis miocaenica* Mehl, which was found in Germany in a layer, dating back to 15 million years (Upper Miocene), in a period when the climate of Europe was tropical.

## B5c. The morphology of orchids

Terrestrial orchids have an extremely simple root system. Each plant, apart from tubers, often develops fleshy and unbranched roots. This kind of root system is typical of the species that have mycorrhizae. The root system consists of oval (*Ophrys, Orchis* s.l.), palmate (several species of *Dactylorhiza*) or flattened and digitate (*Gymnadenia*) tubers, whereas other genera have a more or less branched (*Cephalanthera, Epipactis*), coral-like (*Corallorhiza, Epipogium*) or nest-like (*Neottia*) rhizome. The thick and fleshy roots serve a variety of functions, including mycotrophy, the absorption and storage of nutrients and the anchoring of the plant body to the ground; their normal life span is up to three years. In tuber-bearing species, the oldest tuber decays during flowering, whereas during winter, simultaneously with the development of leaves and the relaunch of the photosynthesis process, nutrient storage in the young tuber begins. This emerging tuber will be preserved until the following year and will eventually replace the old tuber.

Leaves, as in most Monocotyledons, are entire usually with parallel veins. The basal leaves usually form a rosette, as in most species of the genus *Ophrys*. The leaves of the stem are opposite or spirally arranged and the upper ones are very small and bract-like. On the contrary, in most saprophytic orchids, the leaves have been reduced to scales.

Orchids form spikes that consist of resupinate flowers. A resupinate flower is one in which the ovary or the pedicel does a 180-degree twist while it develops, bringing what would be the bottom of the flower to the top. The perigon (Fig. 1) is formed by two whorls, one on the exterior and one on the interior. A part of the inner whorl forms a lip known also as labellum. The lip is highly specialised and constitutes the part on which insects sit during the pollination process. In several genera, the back of the lip is elongated and forms a spur. The lip is usually positioned at the bottom of the flower facing at the front. In closed buds the lip is positioned at the top but it turns downwards during the development of flowers. In some species (e.g. *Epipogium aphyllum* and *Gymnadenia rhellicani*), the flowers are not resupinate or rotate by 360$^{o}$. Even if flowers turn, the lip remains erect.

## B5d. Biology (Germination - Mycorrhiza)

Unlike the seeds of other plant families, orchid seeds are very small, namely having the size of a dust particle (microspermy). A typical feature of the seeds is that they have no endosperm and that their embryo is undifferentiated. When the mature capsule splits, the seeds are released and dispersed by the wind. The seeds consist of an

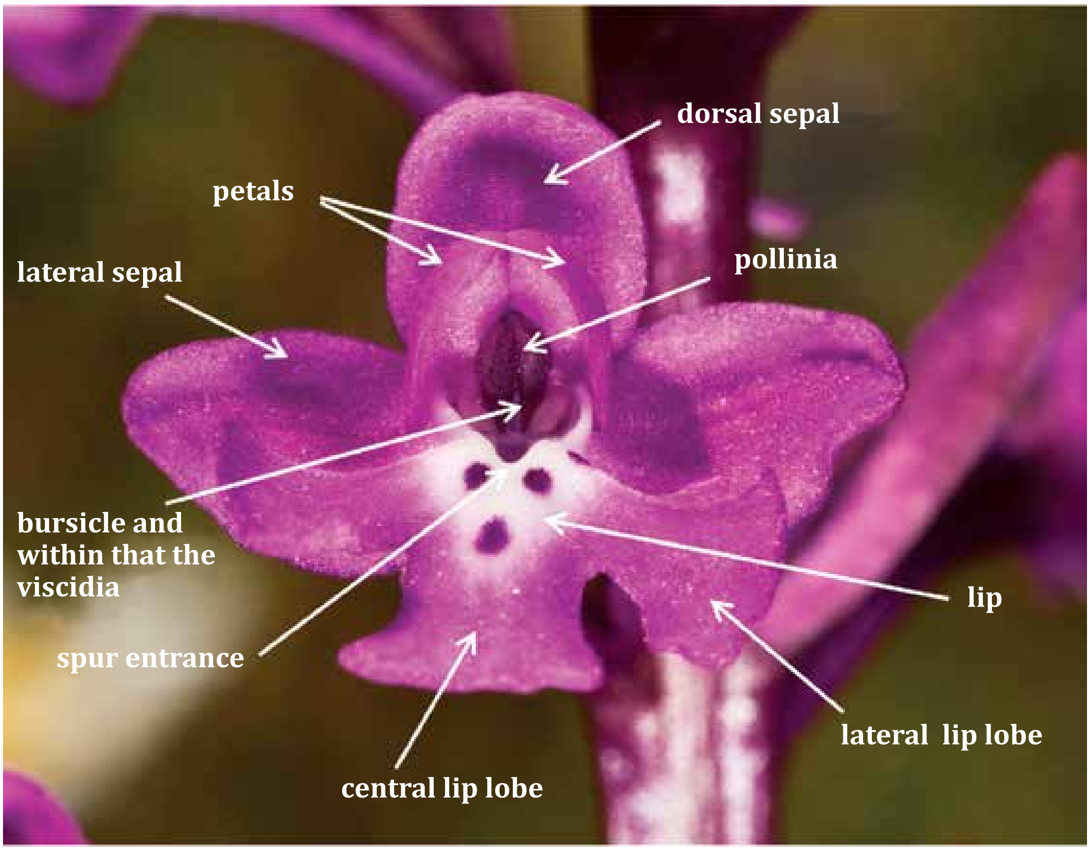


Fig. 1. Orchid flower morphology.

outer membrane, surrounding the embryo in such a manner that allows a considerable amount of air within them. This, in turn, enables seeds to float on air for a longer period, travel further and disperse more widely than any other wind-dispersed plant species. Notwithstanding the very large number of seeds released, only a small percentage eventually germinates, as many seeds either fasten in the vegetation and never reach the ground or do not germinate, because they land on unsuitable substrates. Another factor which affects germination is the consumption of seeds by the soil fauna. However, their germination depends on their infection by fungi, the seeds' main suppliers of water and minerals. Fungi infection can be highly specialised, as some orchid species are infected by only certain species of fungi. At the beginning, fungal hyphae penetrate the cell walls of the orchid seed and after that they penetrate the roots, forming characteristic coils that nourish the plant. This heterotrophic nourishment of orchids is called myco-heterotrophy or mycotrophy. There are times when orchids rely entirely on myco-heterotrophy; other times they either alternate to or combine myco-heterotrophy with photosynthesis. Myco-heterotrophy is a process that allows orchids to adapt to a wide variety of habitats, even to those with extreme conditions (e.g. in sites with little soil or lack of light). Indeed, when conditions are unsuitable, the underground organs of orchids can remain alive and stagnant for several years; when conditions improve these organs start growing again.

### B5e. Pollination

No other plant family, in its evolutionary history, has developed such an impressive and complex reproduction mechanism, as the orchid family has.

Orchids are mainly insect pollinated species. Their pollinators are attracted:

- by nectar (rewarding orchids);
- due to deception (mimicry of nectariferous plants by non-nectariferous plants, also known as food deception or Batesian floral mimicry);
- by sexual and visual (floral) mimicry;
- because they find a shelter against harsh weather conditions.

Finally, some orchids are self-pollinated (e.g. *Ophrys apifera, Epipactis* sp.).

During pollination process, the pollinaria are attached to the bodies (particularly to the heads) of pollinators. When a pollinator visits another flower, the pollinia adhered to its body come in contact with the viscous (sticky) surface of the stigma and pollination takes place. A very important and remarkable mechanism of attraction by orchids is sexual and visual mimicry. Sexual mimicry is a complex process during which the flowers of several orchids (mainly species of the genus *Ophrys*) release specific volatile chemical compounds that are similar to sex pheromones released by female insects (Hymenoptera). In most cases, the chemical composition of the flower-released pheromones varies between different species. Therefore, in many cases, orchid species are pollinated only by specific insects. Male insects are further deceived by the orchid flowers' shape and colour that give the impression of female insects; under this false impression, male insects proceed to pseudocopulation on the lip of the flowers. During pseudocopulation, the pollinaria are attached to the head or the abdomen of the insects and are later transferred to a flower, either of the same or of another individual. This recurrent process results in the pollination and fertilisation of flowers by insects. Visual or floral mimicry is another mechanism with which orchid species mimic species of other plant families and share their pollinators.

Apart from deception, pollinators may visit some orchid species for other reasons. Indeed, some orchid flowers – due to their morphology – form a hood, in which insects can find shelter. This need for shelter is the main reason behind the attraction of pollinators by orchid species of the genus *Serapias*, as well as by species, such as *Anacamptis papilionacea* and *Anacamptis morio*, which form a hood. Finally, it must be noted that some orchid species are self-pollinated. These species do not need insects to transfer the pollinaria from one flower to another. Self-pollination is the primary reproduction method of *Ophrys apifera*; it can also happen in species of the genera *Epipactis* and *Cephalanthera*, whereas, moreover, it has been noted in *Spiranthes spiralis, Neottia nidus-avis* and *Neottia ovata*.

### B5f. Orchids of Mt. Aenos

Mount Aenos (and generally Cephalonia Island) had triggered naturalists' and researchers' interest, who performed botanical explorations even by the end of the 19th century. Despite, however, the large number of floristic explorations performed on the island, the first and systematically conducted research focusing on orchids was performed by Brigitte & Helmut Baumann (Baumann & Baumann 1984) and later by Pierre Delforge (Delforge 1994). In total, 58 orchids (species and subspecies) have been recorded in Cephalonia, whereas on Mt. Roudi and Mt. Aenos the combined number is 25 taxa. Although narrow endemic orchids of the above area do not exist, the orchid flora of the island consists of Ionian endemics (e.g. *Ophrys cephalonica*, *Serapias neglecta* subsp. *ionica*) (Fig. 2), as well as of species occurring in the high altitude areas of central and northern Greece (e.g. *Cephalanthera damasonium, C. rubra, Dactylorhiza saccifera, Epipactis helleborine, Neottia nidus-avis*). These are the reasons which make the island of Cephalonia a common visiting place for those who love orchids or other floristic elements in general.

#### ***Anacamptis coriophora***
**subsp. *fragrans*** (L.) R.M. Bateman, Pridgeon & M.W. Chase
Syn.: *Anteriorchis fragrans* (L.) Szlachetko

Plant up to 40 cm tall, with 2-4 linear-lanceolate, slightly keeled, basal leaves. Inflorescence dense, cylindrical, 4-10(-15) cm, with numerous flowers. The inflorescence is further characterised by the bright coloured flowers, which can be greenish to brownish or pinkish, marked by reddish papillose spots on their lips. Their scent, unlike that of *A. coriophora* subsp. *coriophora*, is pleasant. The sepals and the petals are acute and form a pointed hood. Their lip is 3-lobed, with a clearly longer than the lateral, median lobe, which also is bending backwards. The lateral lobes are curved backward side lobes. On the back side of the lip there is an equally-sized to the lip spur (Fig. 3A).
Flowering: March – June.
Habitat: It is found in grasslands, scrubs and forest openings.

G e o g r a p h i c a l  d i s t r i b u t i o n : Mediterranean taxon, widely distributed in southern Greece, it becomes rarer in northern areas. It is found on the southern and southeastern areas of Mt. Aenos.

Fig. 2. *Serapias neglecta* subsp. *ionica.*

***Anacamptis papilionacea*** (L.) R.M. Bateman, Pridgeon & M.W. Chase
**subsp. *aegaea*** (P. Delforge) L. Lewis & Kreutz
Syn.: *Orchis papilionacea* subsp. *heroica* (E.D. Clarke) H. Baumann

It is a small-sized plant (up to 45 cm) with few basal leaves, which form a rosette. Its inflorescence is short and dense. Flowers not more than 15, relatively large-sized, pinkish or reddish tinged. The sepals and petals run by dark-reddish veins, converge and form a loose hood. Lip entire, heart-shaped with undulate margins, which bend upwards. Lip light coloured, with contrasting pinkish or reddish lines and dots. Base of lip pale, bearing two projections that are separated by a corrugation. On the lip's back side there is a conical spur initially horizontal, curved and bent downwards later (Fig. 3B).

F l o w e r i n g: February – May.
H a b i t a t: It is found in grasslands, phrygana, scrubs, well-lit forests, in a variety of substrates.
G e o g r a p h i c a l d i s t r i b u t i o n: It is a subspecies occurring in the SE Mediterranean area, commonly found in southern Greece and Greek islands, as well as in west Turkey. It is scattered in the low altitude areas of Mts. Aenos and Roudi.

***Cephalanthera damasonium*** (Miller) Druce
Syn.: *Cephalanthera latifolia* Janchen
*Cephalanthera alba* (Crantz) Fritsch

Plants 15-60 cm tall, with glabrous or slightly pubescent stem towards its tip. Leaves longer that the respective internodes, the lower short, oval-ellipsoid, the median oblong-oval, flat to slightly keeled, leathery and near erect or slightly softer and recurved. Inflorescence lax, composed of almost 4-15 whitish flowers. Flower parts characteristically obtuse; hypochile is yellowish inside, whereas epichile also yellowish towards its base, bearing 3-5, longitudinal papilose ridges. The fruiting capsules remain standing until autumn (Fig. 4A).

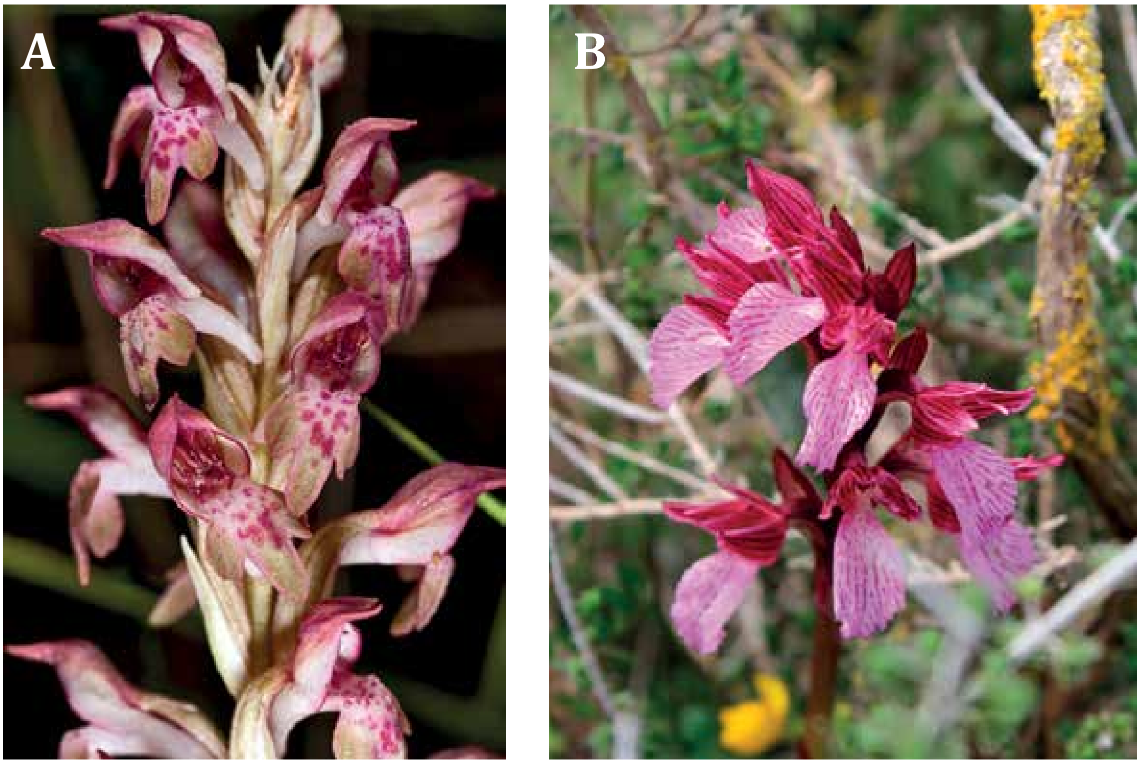


Fig. 3. A, *Anacamptis coriophora* subsp. *fragrans.* B, *Anacamptis papilionacea* subsp. *aegaea*.

F l o w e r i n g: May – July.
H a b i t a t: It is found in shady sites within forests or scrubs, usually on calcareous substrates.
G e o g r a p h i c a l  d i s t r i b u t i o n: It is a species of the temperate and Mediterranean areas of Eurasia. It is mainly distributed in mainland Greece, reaching Peloponnese in the south, whereas it is rarer in the islands Crete, Evvia and Cephalonia, where it was found within the core area of the National Park.

***Cephalanthera rubra*** (L.) L.C.M. Richard
Syn.: *Epipactis rubra* (L.) Allioni

It can be easily recognised as it is the only species of the genus with pinkish flowers. It is also characterised by the hairy stem, the narrow oval to lanceolate and pointed leaves, as well as by the lax and pubescent inflorescence. Flowers generally pinkish, without spur, with acuminate perianth segments and pubescent sepals on their outer surface. Hypochile is white with yellow veins and erect, bearing pinkish lateral lobes. White epichile pointed with numerous longitudinal ochre-yellow ridges (Fig. 4B).

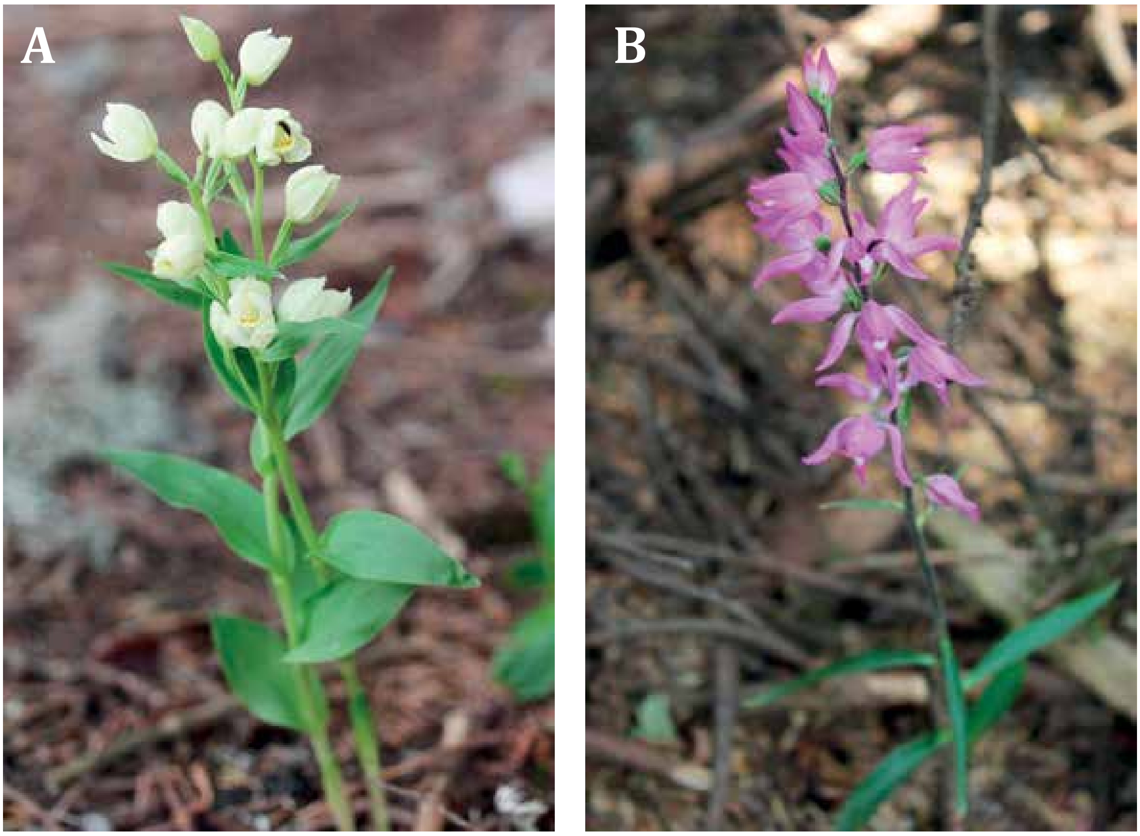


Fig. 4. A, *Cephalanthera damasconium.* B, *Cephalanthera rubra.*

F l o w e r i n g: Mid-May – July.
H a b i t a t: It is mainly found in forests and scrubs, usually on calcareous substrates.
G e o g r a p h i c a l d i s t r i b u t i o n: It is a common species of central and south Europe. It is widely distributed in mainland Greece. In Cephalonia, it has been recorded only on Mts. Aenos and Roudi.

***Cephalanthera longifolia*** (L.) Fritsch
Syn.: *Cephalanthera xyphophylla* Reichenbach,
*Cephalanthera angustifolia* Simonkai

It is similar to *Cephalanthera damasonium* from which it can be easily distinguished by its long and narrow lanceolate leaves and the intensely white flowers which have acuminate perianth segments. Moreover, it is recognised by the concave and white hypochile with the erect lateral lobes surrounding the gynostegium, and by the heart-shaped, concave and the white with yellow tip epichile which have numerous longitudinal orange-yellow ridges at its base. After flowering, the fruiting capsules fall to the ground and only the axis of the inflorescence remains standing (Fig. 5).
F l o w e r i n g: April – June.
H a b i t a t: This species can be found in a wide range of habitats, as it prefers coniferous and broadleaved forests, forest edges, scrubs or even grassland communities.
G e o g r a p h i c a l d i s t r i b u t i o n: It is a widely distributed species in the temperate areas of Eurasia and the Mediterranean. It is a common species of mainland and insular Greece. In Cephalonia, it has been recorded just once within the core area of the National Park of Mt. Aenos.

***Dactylorhiza romana*** (Sebastiani) Soó
Syn.: *Dactylorhiza sulphurea* subsp. *pseudosambucina* (Tenore) Franco

It is a species of a relatively small height (up to 35 cm), having narrow oblong to linear-lanceolate leaves, forming a rosette at the base of the stem. Inflorescence cylindrical, rather dense, with several white, whitish-yellow or light to dark violet flowers. Lateral sepals free, while the dorsal one forms a hood with the petals.
Lip clearly or obscurely 3-lobed towards the top, slightly convex. Median lobe almost square or nearly circular, sometimes oval-triangular, obtuse. Lateral lobes oblong-oval, rounded. Spur cylindrical, rarely conical, horizontal or strongly curved upwards, clearly longer than the ovary (Fig. 6A).
F l o w e r i n g: March – May.

Fig. 5. *Cephalanthera longifolia.*

H a b i t a t: It grows on dry habitats, especially grasslands, scrubs or forests.
G e o g r a p h i c a l  d i s t r i b u t i o n: It is a species of the Mediterranean and submediterranean areas. It is widely distributed in Greece, mainly in the southern parts and the islands. It has been recorded just once, west of Mt. Roudi.

***Dactylorhiza saccifera*** (Brongniart) Soó (1832)
Syn.: *Dactylorhiza maculata* subsp. *saccifera* (Brongniart) Sundermann

It is a highly variable species both as regards the shape and the colour of its flowers. It is distinguished by the large and solid stem and the spotted leaves, which can be broadly lanceolate to narrow lanceolate. Inflorescence lax and conical to very dense and oblong. Flowers numerous (up to ca 150), pink to purplish or rarely white. Lateral sepals usually spotted, divergent and the dorsal one forms a hood with the petals. Lip clearly 3-lobed, diverse, characterised by the deep notches between the lobes and its thick, curved downwards spur (Fig. 6B).
F l o w e r i n g: May – July(-beginnings of August).
H a b i t a t: It is a species that can be found in a variety of habitats (from forests and



Fig. 6. A, *Dactylorhiza romana.* B, *Dactylorhiza saccifera.*

scrubs to road edges and streams).
Geographical distribution: It is a Mediterranean species, widely distributed mainly in mainland Greece as well as on a few islands. In Cephalonia it had been recorded just once in 1934, within the core of the National Park.

***Epipactis helleborine*** (L.) Crantz (1769).
Syn.: *Epipactis latifolia* (L.) Allioni

An especially variable species, the shape of which depends on the habitat where it grows. It reaches 70-80 cm with hairless or slightly pubescent stem, especially on the upper part. Its leaves can be lanceolate, elliptical, ovate or oblong, keeled or flat, opposite or spirally arranged. The flowers are variable as well and are characterised by the well-developed rostellum and clinandrium, which constitutes the physical barrier between pollinia and the stigma surface. The shape of the flower lip is almost always stable, and characterised by the shape of the epichile, the width of which is bigger than its length (Fig. 7A).
Flowering: Mid-June – August.
Habitat: It can be found in a great variety of habitats. It mainly prefers forest ecosystems.
Geographical distribution: It is a widely distributed species of Eurasia, common throughout Greece and on some islands of the Aegean and Ionian seas. It is found in a restricted number of sites within the core area of the National Park of Mt. Aenos.

***Epipactis microphylla*** (Ehrhardt) Swartz
Syn.: *Epipactis latifolia* subsp. *microphylla* (Ehrhardt) Bonnier & Layens

It is a species of relatively small size (up to 50 cm tall), which is characterised by the presence of dense, grey hairs along the stem, the rather lax, nearly one-sided inflorescence, and as its name indicates, by the small-sized leaves, which are shorter than their respective internode. Flowers small, pendant to nearly horizontal, bell-shaped, greenish-white washed violet in colour, vanilla-scented. Hypochile shiny, whereas the epichile heart-shaped, whitish-green, sometimes washed pink, with its margins wavy-scalloped and two irregularly shaped protuberances at its base. Ovary slightly hairy, whereas the pedicel relatively short and very hairy (Fig. 7B).
Flowering: May – August.
Habitat: The plants of this species are distributed in semi-mountainous and mountainous areas, ideally in dense deciduous forests (rarely in coniferous forests) and scrubs, in a variety of geological substrates.



Fig. 7. A, *Epipactis helleborine.* B, *Epipactis microphylla.*

Geographical distribution: It is a species of the temperate and southern areas. It can be found all over mainland Greece, and on a few islands with suitable conditions (e.g. Crete, Ionian and eastern Aegean Islands). It has been recorded just once in Cephalonia, within the core area of the National Park.

***Himantoglossum jankae*** Somlyay, Kreutz & Óvári

One of the most robust (up to 120 cm tall) and spectacular species of the orchid family in Greece. Basal leaves large, gradually drying towards the end of the flowering period. Inflorescence cylindrical and elongated, composed of 10-40 (-50) large flowers. Lip 3-lobed, characterised by the blotched with purple spots, white centre. Lip margins more intensely coloured, lilac-brownish or deep purplish and rarely greenish. Middle lobe of the lip characteristically large (40-100 mm), while its tip usually separated by a deep notch. Spur on the back side of the flower (ca 5-7 mm) (Fig. 8A).
Flowering: May – July.
Habitat: It is found in forest openings, scrubs or more rarely in broadleaved forests.
Geographical distribution: It is a Balkan species, widely distributed all over

mainland Greece and to a limited extent on islands. In Cephalonia it has been reported only from Mt. Aenos, where it occurs in a limited number of sites.

## ***Himantoglossum robertianum*** (Loiseleur) P. Delforge
Syn.: *Barlia robertiana* (Loiseleur) Greuter

Robust plant (up to 100 cm tall), with shiny leaves, which form a large-sized rosette at the base of the stem. Inflorescence dense, cylindrical, composed of numerous and large-sized flowers. Flowers 3-lobed, having obtuse lobes; median lobe further divided in two secondary lobules. It is distinguished by the other species of the genus occurring in Greece by the lack of filiform extensions of the lobes of the lip. Long (4-7 mm) and thick spur on the back side of the flower, bending downwards (Fig. 8B).
Flowering: February – May.
Habitat: It is found in a variety of habitats, e.g. grasslands, scrubs and well-lit forests or olive groves.
Geographical distribution: It is a Mediterranean species, widely distributed in

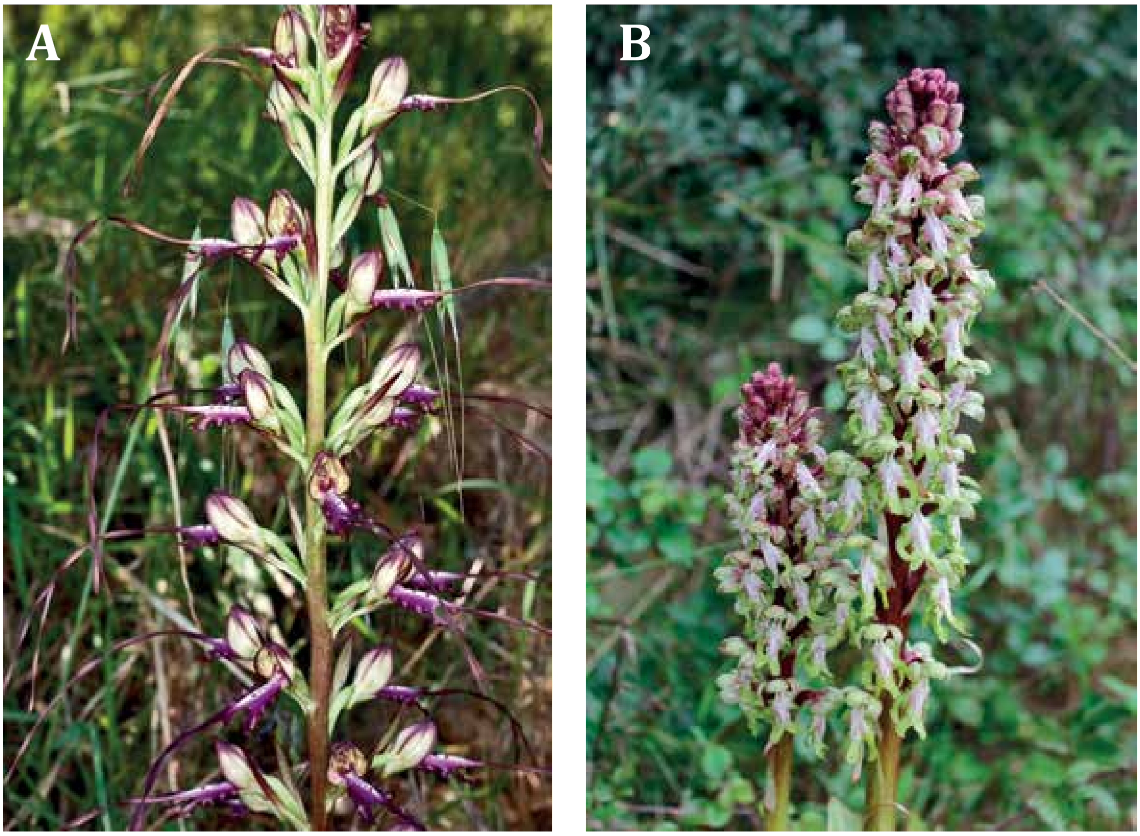


Fig. 8. A, *Himantoglossum jankae.* B, *Himantoglossum robertianum.*

southern and insular parts of Greece. Scattered in Cephalonia, where it occurs on the eastern areas of Mt. Aenos, especially at low altitudes.

***Neotinea maculata*** (Desf.) Stearn
Syn.: *Neotinea intacta* (Link) Reichenbach fil.

It is easily distinguished by the reddish or dark reddish tints on the basal leaves and especially on their edges. Cauline leaves sheath a great part of the stem. Inflorescence dense, oblong, composed of many, small-sized flowers. Sepals form a loose hood with the petals, which is whitish, brownish-red to reddish on its outer surface. Lip of the flower 3-5 mm long, divided in two lateral, narrow linear lobes and a median which is further divided in two smaller secondary lobules. Short spur (1.5-2 mm long) on the back of the lip, shorter than the one found in other species of the genus.
Flowering: March – May.
Habitat: A species without any special demands from its habitat. It is found in grasslands, scrubs and mainly light-permeable forests, usually on acidic soil.
Geographical distribution: It is mostly distributed in western Mediterranean, extending, however, even up to Turkey and Syria. In Greece, it is most commonly found in the southern and insular areas. It has been recorded on Mt. Roudi, as well as on the mid-altitude areas of Mt. Aenos.

***Neottia nidus-avis*** (L.) L.C.M. Richard
Syn.: *Serapias nidus-avis* (L.) Steudel
*Neottiditum nidus-avis* (L.) Schlechtendal

It is one of the few orchids that completely lack chlorophyll and develop saprophytically. It is an easily distinguishable species at all parts and stages of its life cycle. Rhizome characteristic, which consists of thick and fleshy, nest-like roots. Stem usually brownish-yellow, rarely whitish, with 4-6 sheaths. Sheaths (lacking green leaves) 2-6 cm long, the upper ones longer and more bulging. Inflorescence cylindrical and elongated, composed of numerous flowers. Sepals and petals yellowish brown, rarely whitish or yellowish, forming a loose hood. Lip pendant, 9-12 mm long, with an oblong, nectariferous cup at its base, with 2 broad, divergent lobes at the tip.
Flowering: May – July.
Habitat: It is exclusively found in forests and scrubs. It mainly prefers broadleaved and secondarily coniferous forests.
Geographical distribution: It is a widely distributed species in central and

southern Europe. It is found throughout mainland Greece, reaching Peloponnese southwards (Mts. Taigetos, Parnon) and Cephalonia, where it has been recorded on only one site of Mt. Aenos.

***Ophrys cephalonica*** (B. & H. Baumann) J. & P. Devillers - Tersschuren
Syn.: *Ophrys sphegodes* subsp. *cephalonica* B. & H. Baumann

Plant up to 70 cm tall, with lax and elongated inflorescence, composed of 5-15 flowers. Sepals usually whitish-green to pale greenish, whereas the lateral might be violet tinged on lower half. Petals usually narrow triangular, with undulate margins (sometimes darker than the centre), yellowish-green to bright olive-green. Lip entire, 12-17x7-10 mm, with intensively turned down sides, giving the impression of a triangular or oblong lip. Colour of the lip greenish-brown, with dense, long, pale to violet hairs towards its margins. Moreover, characterised by the complex shaped speculum, usually H-shaped, with a narrow, whitish borderline (Fig. 9).
Flowering: March – April.
Habitat: It is found in grasslands, phrygana, scrubs and light forests (especially cypress forests), usually on alkaline substrates.
Geographical distribution: It is an endemic of western Greece and the Ionian Islands. It is relatively commonly found on the low and mid-altitude areas of Mt. Aenos.

***Ophrys ferrum-equinum*** Desfontaines

It is a robust plant, up to 30-40 cm tall. Inflorescence rather dense, usually consisting of 2-10 flowers. Sepals usually light to dark pink, rarely white or greenish. Petals narrow triangular to lanceolate, with straight or wavy edges, pinkish to dark purple. Lip is entire or rarely slightly trilobed (11-17x12.5-19 mm), dark coloured, usually blackish to red-brownish, velvety towards the centre with greyish to red brownish hairs towards the edges. In the lower half of the lip, the speculum consists of two broad lines or two elongated drops, sometimes combined, forming a horseshoe shape. In the plants found in the Ionian Islands in particular, lip edges bend downwards, thus attributing a triangular-shape appearance. These plants have been described as a separate taxon, under the name *Ophrys gottfriediana* (Fig. 10A).
Flowering: March – May.
Habitat: It mostly prefers well-lit habitats, such as grasslands, phrygana, scrubs and open forests on calcareous substrates.
Geographical distribution: Species of the eastern Mediterranean, relatively common in southern and insular parts Greece. Commonly found on the low and mid-altitude areas of Cephalonia.

Fig. 9. *Ophrys cephalonica.*

## ***Ophrys fusca* subsp. *leucadica*** (Renz) H. Kretzschmar
Syn.: *Ophrys leucadica* Renz

Medium-sized plant (up to 30 cm tall) with an inflorescence composed of 2-10 relatively large-sized flowers. Sepals yellowish-green to whitish-green. Petals yellowish-green, olive-green or brownish, especially towards their edges. Lip almost horizontal or slightly pendant, 15-22x11-17 mm, 3-lobed, dark black-purplish, with dense and short hairs. Lateral lobes usually rounded; medium lobe slightly bilobed and longer than the lateral. Lip edges usually yellowish, bending downwards. Base of lip whitish to yellowish, usually pale-coloured or purplish, triangular, rather angular, with two thick, distended ridges (separated by a deep, V-shaped groove, with short, dense, whitish hair). The speculum is bilobed, of bluish-grey colour, tinged grey and sparse grey hairs (Fig. 10B).

Flowering: January – April.

Habitat: It is found in well-lit and shady habitats. It prefers grasslands, phrygana, scrubs and coniferous forests.

Geographical distribution: It occurs in the eastern areas of the Mediterranean. It is widely distributed in Greece, especially in the southern and insular areas. It is common in the low and mid-altitude areas of Cephalonia.

### ***Ophrys lutea*** Cavanilles **subsp. *lutea***

Robust plant usually up to 30 cm tall. Inflorescence usually dense, composed of 1-10

Fig. 10A. *Ophrys ferrum-equinum.*

Fig. 10B. *Ophrys fusca* subsp. *leucadica.*

large-sized flowers. Sepals yellow-greenish to pale whitish; edges convex and dorsal sepal bending onto the gynostegium. Petals yellowish to greenish, having straight or somewhat undulate edges. Lip oblong-oval, 14-18x13-19 mm, trilobed, with long and thick hair, bending downwards. Lip base whitish to yellowish with two globular ridges (separated by a V-shaped groove with whitish or blackish hairs). Centre of the lip convex, pale orange-brownish to dark brown, and edges bright yellow tinged and hairless. Lateral lobes of the lip rounded; the median one broadly oblong heart-shaped, usually fully yellow and often slightly overlapped from the lateral ones. Speculum bilobed, finely velvety, with bright blue-greyish colour, sometimes pale towards the edges (Fig. 11).

Flowering: (February-)March – May(-June)

Habitat: It is usually found in well-lit habitats, such as grasslands, phrygana and scrubs.

Geographical distribution: It is a Mediterranean taxon which can also be found in the western European areas. In Greece, it is widely distributed in the western and southern mainland areas, as well as on the islands. It is scattered throughout the low and mid-altitude areas of Cephalonia.

Fig. 11. *Ophrys lutea* subsp. *lutea*.

***Ophrys lutea* subsp. *minor*** (Todaro) O. & E. Danesch
Syn.: *Ophrys sicula* Tineo

Morphologically, subsp. *minor* is similar to the typical subspecies from which it is distinguished by its obviously smaller size and its flat lip. In particular, it is a spindly and small plant, the flowers of which are smaller and the lip is horizontal (6-13x5-12 mm). Lip trilobed; lobes well separated. The base of the lip does not bend and its appendages are less obvious (Fig. 12).

Flowering: January – April(-May).

Habitat: It is found in similar habitats with those of *O. lutea* subsp. *lutea*.

Geographical distribution: It is a widely distributed taxon throughout the Mediterranean. In Greece it is common in the central and southern areas, as well as on the islands. It is also a very common taxon of Cephalonia, widely distributed within the National Park of Mt. Aenos.

Fig. 12. *Ophrys lutea* subsp. *minor*.

***Ophrys oestrifera*** F.A.M. von Bieberstein **subsp. *oestrifera***
Syn.: *Ophrys cornuta* Steven
*Ophrys scolopax* subsp. *oestrifera* (F.A.M. von Bieberstein) Soó

Tall (up to 50 cm) and spindly plant. Inflorescence lax, composed of 3-15 flowers. It is a highly variable taxon as regards the shape and the colour of its flowers. Indeed, the sepals may be found to be greenish, whitish to more or less pinkish, usually with a prominent, green central vein. The petals may have the same colour with the sepals or darker and are villous. It is distinguished, due to the heavily trilobed lip that has blackish-brown hair, very distinct in the lateral lobes and the tip of the lip. The lateral lobes are very elongated, conical with filiform edges. The speculum is very diverse and complex in shape, several times occupying a large part of the lip (Fig. 13).
In Cephalonia, the variety *O. oestrifera* subsp*. oestrifera* var*. minuscula* can also be found, which is distinguished by its small size, compared to the typical individuals.
Flowering: (March-)April – June.
Habitat: It is found in well-lit forests, scrubs, phrygana and grasslands.
Geographical distribution: Species of the Balkans and the Pontus area in the Black Sea region. It is widely distributed in Greece and has been recorded in numerous sites throughout the island of Cephalonia.

***Ophrys tenthredinifera*** Willdenow

It is a highly variable species from which a few new taxa have been described. It is a rather robust plant, up to 45 cm tall. Inflorescence usually dense, composed of 3-10 flowers. Sepals and petals usually of the same colour, pale whitish, pinkish, purplish or even violet. Lip trapezoidal, 9-16x10-20 mm, dark brown to reddish, almost entire and ± convex to globular. Submarginal rim wide, bright yellow, yellowish-green or pale brown with two rather distinct shoulders at its base. Speculum small-sized, almost triangular or usually bilobed, brownish to violet, bordered by a fine whitish line at its base. The appendage of the lip is also characteristic, which is very distinct, globular to triangular and erect (Fig. 14).
Flowering: (January-)February – May.
Habitat: It prefers well-lit or semi-shaded habitats, such as grasslands, phrygana, scrubs and well-lit forests, usually on alkaline soil.
Geographical distribution: Widely distributed throughout the Mediterranean. It is commonly found in the western, southern and eastern parts of Greece. It is scattered in the low and mid-altitude areas of Cephalonia and has also been recorded on Mt. Roudi.

Fig. 13. *Ophrys oestrifera* subsp. *oestrifera.*

Fig. 14. *Ophrys tenthredinifera.*

***Orchis anthropophora*** (L.) Allioni
Syn.: *Aceras anthropophorum* (L.) Aiton

Plant 10-40(-50) cm tall. Leaves at the base of the stem oblong lanceolate, slightly bluish-green, with prominent veins. Inflorescence rather dense towards its top, composed of 10-40 flowers. Sepals forming a globular hood with the petals, in which the sepal edges distinct and reddish. Lip 3-lobed and hanging, characteristically anthropomorphic, green-yellowish to reddish; its edges usually brownish or reddish. Lateral lobes of the lip slender, whereas the median one longer than the lateral and further divided in two secondary lobules (Fig. 15).

Fig. 15. *Orchis anthropophora.*

Flowering: April – May(-June).
Habitat: It is found in well-lit or semi-shaded habitats, such as grasslands, phrygana, scrubs, forest edges or coniferous forests.
Geographical distribution: It is widely distributed in north-western Europe. It is scattered in southern and insular Greece. In Cephalonia, it has been recorded on the low altitude areas, west of Mt. Roudi, as well as on one site of Mt. Aenos.

### ***Orchis italica*** Poiret.
Syn.: *Orchis welwitschii* Rchb.

Medium sized plant (up to 45 cm tall); basal leaves either spotted or unspotted, forming a rosette, whereas their edges characteristically undulate. Inflorescence short and rather ovate, conical or globular, composed of pinkish flowers. Sepals and petals acuminate, forming a hood. Lip divided in three parts; median lobe, further divided in two long and slender, secondary lobules, separated by a filament-like appendage. Lateral lobes similar to the secondary lobules of the median lobe, but divergent. Tips of the lip lobes characterised by their intense coloration compared to the other parts of the lip, whereas the lip centre decorated with pinkish dots (Fig. 16).
Flowering: March – May.
Habitat: It prefers grasslands, scrubs and, rarely, coniferous forests.
Geographical distribution: Mediterranean species, widely distributed in the southern and insular areas of Greece. It is rather common on the western areas of Mt. Roudi, as well as on the eastern areas of Mt. Aenos.

### ***Orchis pauciflora*** Tenore
Syn.: *Orchis provincialis* subsp. *pauciflora* (Tenore) Lindl.

It is a relatively short plant (it rarely reaches 30 cm), with 4-9 unmarked leaves that form a rosette. Inflorescence short, usually lax, composed of up to 15 relatively large flowers. Flower colour generally yellowish to bright yellow, whereas in Cephalonia another colour variety can be found, characterised by the pale yellow to pale whitish flowers. Lateral sepals diverge, the dorsal forming a hood with the petals. Lip 3-lobed, convex or sharply folded along and finely marked by blackish-purple tufts in the centre. Lateral lobes nearly rhomboidal, rounded with their margins relatively scalloped; median lobe slightly longer than the lateral, obscurely 2-lobed. Spur on the back side of the lip cylindrical and curved, either horizontal or ascendant (Fig. 17).
Flowering: March – May.

Fig. 16. *Orchis italica*.

Habitat: It usually prefers grasslands, phrygana, scrubs, forest openings, whereas it can be rarely found in well-lit forests.
Geographical distribution: It is a species of the Balkan and Italian Peninsulas. In Greece it is mainly found in Crete, Peloponnese and the central parts of the country. It is commonly found on Mts. Roudi and Aenos.

Fig. 17. *Orchis pauciflora*.

## ***Orchis quadripunctata*** Cyrillo ex Tenore
Syn.: *Anacamptis quadripunctata* (Cyrillo ex Tenore) Lindley

It is a spindly plant (up to 30 cm tall), whose stem is purplish-red in its upper part. Basal leaves forming a rosette, either blackish spotted or unspotted. Inflorescence cylindrical (up to 10 cm), composed of up to 35, laxly arranged, lilac, purplish or sometimes white flowers. Sepals oval and divergent; petals folded down, forming a hood. Lip characteristically trilobed, marked by blackish-purple papillose dots on its flat centre. Lateral lobes of the lip broad, quadrangular to rhomboidal and rounded; median lobe nearly quadrangular, rounded, slightly convex and entire or sometimes obscurely bilobed. Filiform spur on the back side of the flower, horizontal or descendent and slightly curved (Fig. 18).

Fig. 18. *Orchis quadripunctata.*

F l o w e r i n g: March – June.
H a b i t a t: It prefers grasslands, scrubs and phrygana, usually on calcareous substrates.
G e o g r a p h i c a l  d i s t r i b u t i o n: It is a species of the central and eastern Mediterranean, widespread in southern and western Greece. It forms large colonies between Mt. Aenos and Mt. Roudi.

***Serapias vomeracea*** (N.L. Burman) Briquet
Syn.: *Orchis vomeracea* N.L. Burman
*Serapias cordigera* subsp. *vomeracea* (N.L. Burman) Sundermann

Robust species, forming groups of plants, up to 60 cm tall. Inflorescence lax and elongated, perhaps composed of up to 12 large flowers. Apart from the plant height and the elongated inflorescence, the species is also easily distinguished by the floral bracts that are clearly longer than the hood as well as by the colour of the lip which can be yellowish or yellow-reddish to reddish (Fig. 19). Hypochile with two parallel lamellae at its base;

Fig. 19. *Serapias vomeracea.*

its centre usually greenish and lateral lobes blackish-purple, placed entirely within the hood. Epichile lanceolate, relatively large in size (18-30×8-13 mm) and often bending down and backwards.

Flowering: April – beginning of June.

Habitat: It is found in open habitats such as grasslands, phrygana, scrublands and forest openings.

Geographical distribution: Widely distributed throughout the Mediterranean and the Atlantic coasts. It is commonly found in the southern and western mainland areas of Greece. It is rare on the islands and in northeastern Greece. It is rather rare in Cephalonia, where it has been recorded just once between Mt. Aenos and Mt. Roudi.

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# PART VI

## THE MUSHROOMS OF MT. AENOS

# A. GENERALLY ON MUSHROOMS

## A1. What mushrooms are

While walking in the hiking trails of Mt. Aenos, in autumn or spring, amidst the forest of the Cephalonia Fir, one can easily detect those polymorphous, variously coloured formations, the mushrooms, which spring up from soil or wood. Mushrooms are of the strangest and most miraculous beings in Nature. They appear suddenly, shortly after the first rainfall of autumn or the snow-melting in spring, when the temperatures are relatively high, and just as suddenly they also disappear. But what are mushrooms? They are but the fruit-bodies, namely the reproductive structures, of certain organisms, the macromycetes. The macromycetes belong to the Kingdom Fungi and are important members of the terrestrial ecosystems. Their body, called mycelium, comprises of hyphae, microscopic filaments that thrive for many years hidden in various substrates, such as soil, litter, dead wood and living trees (Fig. 1). The appropriate combination of temperature and humidity results in the production of their large, macroscopic fruit-bodies, the mushrooms. Therefore, the term macromycetes is used for mushroom-producing fungi. Most macromycetes belong to the phylum Basidiomycota and the rest to Ascomycota, forming fruit-bodies that are called basidiocarps and ascocarps, respectively.

The mushrooms are complex structures that can assume various shapes, sizes, colours, textures and are usually ephemeral, but also annual or perennial. The most commonly known mushrooms have the shape of an umbrella, while others are shell-shaped, club-shaped, coral-shaped, cup-shaped, crustose etc. The sole purpose of mushroom formation is the production and dispersal of spores, so that the perpetuation of the species can be accomplished. The best season for mushroom formation is autumn and spring with different species appearing each season. Most autumnal species belong to Basidiomycota, while the vernal ones to Ascomycota.

In a typical fleshy umbrella-shaped mushroom one can distinguish the pileus (pi), the stipe (st) and the hymenophore, i.e. the spore-bearing surface under the pileus that can usually have the shape of bladelike lamellae (la) or of longitudinal tubes ending in pores (po) (Fig. 2 & 3). Sometimes, while the mushroom develops, a protective tissue layer, called


Fig. 1. Mycelium in natural habitats A. litter B. dead branch.

partial veil, covers the hymenophore. As the pileus expands, the veil breaks, and remnants of the partial veil may remain as an annulus (an) around the stipe (Fig. 2 & 3). In other cases, a universal veil surrounds the developing fruit-body. As the mushroom matures, it expands and the universal veil ruptures and remains as warts or patches on the pileus surface and as a cup, called volva (vo), at the base of the stipe (Fig. 3). The development of the two veils is independent and mushrooms can have either of the two veils or both.

## A2. Ecological and economic importance of the mushrooms

The permanent but inconspicuous presence of macromycetes is of vital importance for the ecosystems they are part of, especially for forests, such as the one of Mt. Aenos. They can be either saprotrophs, mutualists or parasitic and pathogens. As saprotrophs, they decompose the complex dead plant organic compounds, such as lignin, cellulose and hemicelluloses, causing the brown and white rots of the wood (Fig. 4). The ecological

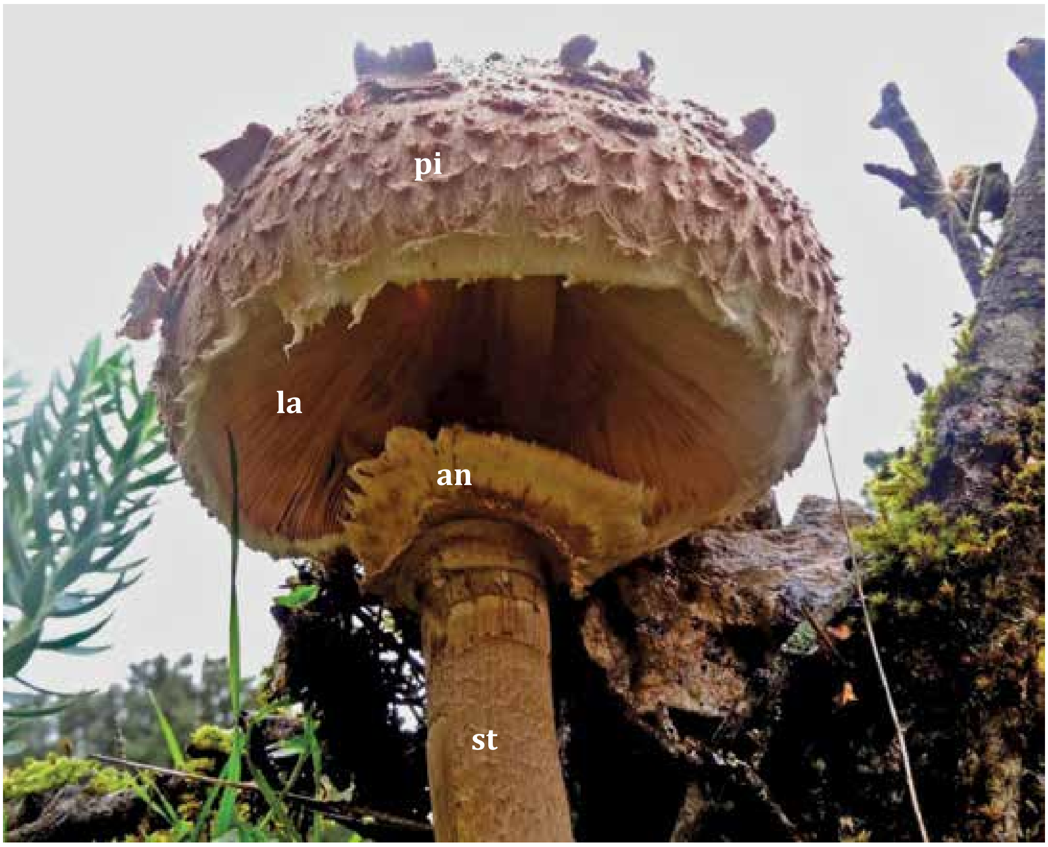


Fig. 2. Basidiocarp of the genus *Macrolepiota*: pileus (pi), stipe (st), lamellae (la) and annulus (an).


Fig. 3. Basidiocarps of the genera *Amanita* (above) and *Xerocomellus* (below): pileus (pi), stipe (st), lamellae (la), pores (po), annulus (an), volva (vo) and remnants (re) of universal veil on pileus surface.

role of the mushrooms as saprotrophs is unique and irreplaceable, since they complete the carbon cycle in nature and participate in the cycles of many elements. As mutualists they form intimate relationships with the roots of trees and shrubs, the well-known mycorrhizas. The presence of mycorrhizas enhances the development of the plants and increases their resistance to plant pathogens, especially under stress conditions. Finally, macromycetes can act as weak parasites or strong pathogens in plants. Pathogens can destroy crops and cause death of trees, thus resulting in significant damage of natural and cultivated woodlands as well as in serious economic losses.

Mushrooms number some thousands of species among which edible, non-edible, hallucinogenic, poisonous and lethal ones are included. There is a wide array of edible mushrooms with great variety of odour and taste. The edible mushrooms are consumed not only for their nutritional value but also for their medicinal properties. Great care should be taken when collecting wild mushrooms in order to prevent any mushroom poisoning, due to misidentification. Unfortunately, there are no general identifiers for poisonous mushrooms. For a safe collection of wild mushrooms a good knowledge of the edible and poisonous mushrooms, as well as of their distinctive characteristics is needed.

## A3. Mushroom diversity on Mt. Aenos

Until recently, the data referring to the diversity of mushrooms on the island of Cephalonia were very few. After an extensive bibliographical research, 43 species of mac-


Fig. 4. Decomposition of a laying dead fir trunk by brown-rot (B) and white-rot (W) fungi.

romycetes attributed to 35 genera were recorded from 6 sources. From these species, only 7 were Ascomycetes and the rest were Basidiomycetes. The oldest references of mushrooms came from the work of the Austrian official, local historian, writer and botanist Hohenbuehel-Heufler (1868), who reported only 12 species. Almost a century later, the Greek mycologist Professor Maria Pantidou, in her publication about macromycetes from forests of *Abies cephalonica,* reported 14 species from Mt. Aenos (Pantidou 1980). In the book of Keltemlidis (1990) 2 more species were recorded from the island, while in Pantidou's book (1991) the 12 reported species mostly coincided with those of her earlier publication. D. Vasiliades in the album dedicated to Mt. Aenos (1998) wrote a small chapter on the mushrooms of Cephalonia, where 10 species and a few genera were reported. Finally, Gonou-Zagou (2003) reported 2 more species in her Ph.D. thesis.

The incomplete knowledge of the diversity of mushrooms and the importance of the forest ecosystem of Mt. Aenos, which is the "*locus classicus*" of the Cephalonian Fir (*Abies cephalonica*), led to the cooperation of the mycological research team of the Biology Faculty of the University of Athens with the Management Body of the National Park of Mt. Aenos. Aim of the work was the exploration of the diversity of mushrooms in the National Park of Mt. Aenos and in other localities of Cephalonia. For this purpose macromycetes were collected, studied and recorded mainly from the mountainous areas of Mts. Aenos and Roudi.

From the results of the aforementioned study, it can be assumed that the diversity of mushrooms is rich and consists of common, as well as interesting and rare species. Many edible but also poisonous and lethal species are recorded, while the great majority can be characterised as non-edible. *Macrolepiota procera, Helvella lacunosα, Oudemanciella melanotricha, Clitocybe odora, Clavariadelphus truncates, Morchella* sp. and *Sarcosphaera coronaria* are the most commonly found edible species. *Amanita pantherina*, *A. muscaria, A. phalloides* and *Lepiota subincarnata* are the main representatives of the poisonous species with the two latter usually being fatal to humans.

Up to now 101 species have been identified, 85 of which consist first records for the island. The species were mainly collected from Cephalonian Fir and Mediterranean sclerophyllous evergreen woodlands on Mt. Aenos and Mt. Roudi, respectively. Moreover, 40 discrete taxa were studied that have not been identified to species level yet. For many species, such as *Atheniella αdonis, Chamaemyces fracidus, Clitocybula familia, Exidia thuretiana, Inocybe griseolilacina, Leucoagaricus crystallifer, Parasola kuehneri, Pluteus primus, Tricholomopsis flammula* and *Tubaria dispersa,* very few nationwide references exist. It is important to notice that the genus *Mycopan* and the taxa A*rrhenia lilacinicolor, Bisporella sulfurina*, *Conocybe dumetorum, Geastrum corollinum, Mycena pilosella* var. *heterocystidiosa*, *M. supina*, *Mycopan scabripes* and *Pseudoclitocybe expallens* are recorded for the first time not only from the island of Cephalonia but also from all over Greece.

### ***Amanita pantherina*** (DC.) Krombh.

Pileus up to 100 mm, hemispherical in young specimens, applanate in mature specimens, surface dark brown, ochre-brown near the margin, covered with white, floccose remnants of the universal veil, margin striate. Lamellae free, white, crowded. Stipe 90x9-12 mm, central, cylindrical, with bulbous base, surface white, smooth, minutely scaly below the ring. Annulus white, soft, fragile. Volva white, soft, surrounding the bulbous base, forming 1-3 characteristic rings near the joint with the stipe (Fig. 5).

Found on soil, in *Abies cephalonica* forest, mixed with scattered individuals of *Crataegus monogyna*, near the entrance of Arginia of Mt. Aenos, alt. 1,020 m asl.

*A. pantherina* is a very common species in Greece. It is easily identified, due to its brownish pileus, which has a striate margin and is covered with white floccose patches, and due to its white stipe that possesses an annulus and a bulbous base, which is surrounded by the volva. The volva forms 1-3 characteristic rings near the joint with the stipe. Mycorrhizal. Extremely poisonous!

Fig. 5. *Amanita pantherina*.

***Amanita phalloides*** (Vaill. ex Fr.) Link

Pileus 35-110 mm, hemispherical in young specimens, convex to applanate in mature specimens, pale yellowish green, typically with olive green to grayish green tinges, sometimes pale brownish green, with a paler to almost white, non striate margin, surface smooth, shiny, in young specimens possessing large, membranous, white remnants of the universal veil. Lamellae free, densely crowded, white. Stipe 100-160x7-15 mm, central, cylindrical, with bulbous base, white. Volva saccate, whitish. Annulus white, in mature specimens often yellowish (Fig. 6).

Found on soil, in forest of *Abies cephalonica*, on Mt. Roudi, Alonia locality, alt. 987 m asl.

One of the most poisonous mushrooms, it is responsible for the majority of human deaths from mushroom poisoning, worldwide. It is easily identified due to its yellowish green, olive green tinges on the pileus and its saccate volva, which surrounds the base of the stipe. It is a very common species in Greece, found mostly in deciduous forests, but in fir forests as well. Mycorrhizal. Deadly poisonous!

***Bisporella sulfurina*** (Quel.) S. E. Carp.

Ascocarps apothecia, disk-shaped, yellowish, with a paler margin and outer surface, stipe reduced (Fig. 7).

Located on a dead branch, in vegetation consisting of individuals with *Cupressus sempervirens*, *Quercus coccifera* & *Olea europaea.*

This specimen represents the first report of *B. sulfurina* from Greece and was found on the SE. slopes of Mt. Aenos, above Tsakarisianos village. It is macroscopically so similar to the common species *B. citrina* that the two species can be easily confused in the field. Saprotrophic. Inedible.

***Clitocybula familia*** (Peck) Singer

Pileus 25-40 mm, convex, surface fibrillose, pale brownish to ochre-brownish, margin in mature specimens that splits radially. Flesh of pileus thin. Lamellae adnate, medium crowded, white. Stipe 35-50x2-4 mm central, cylindrical, surface whitish. Basidiocarps in dense clusters (Fig. 8).

Found on a dead branch of *Abies cephalonica*, on Mt. Aenos, near the entrance of Eza, alt. 950 m asl.

Fig. 6. *Amanita phalloides*.

Fig. 7. *Bisporella sulfurina*.

Fig. 8. *Clitocybula familia*.

This specimen from Mt. Aenos represents the second report of *C. familia* from Greece. It is characterised by growing in large clusters on dead wood of *Abies* and by the mycenoid form of the basidiocarps. Saprotrophic. Inedible.

## ***Conocybe dumetorum*** (Velen.) Svrček

Pileus 7 mm in diameter, plano-convex, surface almost smooth, margin radially striate dark brown in the central part, yellowish orange near the margin. Lamellae adnexed, medium crowded, pale brownish orange. Stipe 20x1.5 mm, central, cylindrical, surface dark brown, covered by grayish-white scales (Fig. 9).

Found on soil, near the base of a trunk of *Platanus orientalis*, in Vouva Canyon, in the vicinity of Agios Nikolaos village.

This small specimen, found on the slopes of Mt. Aenos, represents the first report of that species from Greece. Saprotrophic. Inedible.

Fig. 9. *Conocybe dumetorum*.

## ***Coriolopsis gallica*** (Fr.) Ryvarden

Basidiocarps 180x70 mm, hemispherical, bracket shaped or irregular, laterally or dorsally attached to the substrate, often fused with other basidiocarps covering several centimetres of the substrate. Upper surface hairy, ochre brown, orange brown to brownish. Lower surface with pores, grayish-brown, pores angular. Texture tough (Fig. 10).

Found on a fallen trunk of *Quercus coccifera*, on Mt. Aenos, at the Monastery of Zoodochos Pigi, alt. 888 m asl.

It is characterised by the morphology of its basidiocarps, which possess a hairy, brownish upper surface and grayish brownish pore surface. Saprotrophic. Inedible.

Fig. 10. *Coriolopsis gallica.*

## ***Discina ancilis*** (Pers.) Sacc.

Ascocarps apothecia, disk-shaped in young specimens, with irregular wrinkles and folds in maturity, inner surface brownish, outer surface pubescent, whitish. Stipe reduced (Fig. 11).

Found on a fallen trunk of *Abies cephalonica*, on Mt. Aenos, near the National Park's recreation area, alt. 1,470 m asl.

*D. ancilis* is a vernal species with characteristic ascocarps. Saprotrophic. Possibly deadly poisonous if eaten raw. Edible if eaten well cooked and after discarding the water that was used for cooking. Suspected of toxicity for some persons, even after cooking.

Fig. 11. *Discina ancilis*.

## ***Exidia thuretiana*** (Lév.) Fr.

Basidiocarps with jelly texture, pulvinate in young specimens, fused and crust-like in maturity, transparent, whitish, pink-ochraceous, with grey-bluish tinges, surface smooth, folded, in some parts hirsute (Fig. 12).

Found on fallen branches in a mixed forest of *Abies cephalonica*, *Crataegus monogyna* and *Quercus coccifera*, on Mt. Aenos, near the entrance of Arginia, alt. 1,017 m asl and on a fallen branch of *A. cephalonica*, on Mt. Aenos, near the National Park's recreation area, alt. 1,470 m asl.

It can be easily confused in the field with the morphologically similar species *Myxarium nucleatum*. The two species can be distinguished after careful microscopic examination. Macroscopically, a good distinguishing feature between the two species, are the folds that are formed on the jelly basidiocarp of *E. thuretiana*. This species is reported from Greece for the third time, with previous reports being those of Dimou & al. (2002) and Konstantinidis (2006). Saprotrophic. Inedible.

Fig. 12. *Exidia thuretiana*.

## ***Geastrum triplex*** Jungh.

Basidiocarps star shaped, up to 45 mm in diameter. Exoperidium fleshy, beige to pale ochre-brown, splitting into 5-7 rays, and also splitting around the endoperidium forming a collar at its base. Endoperidium spherical, sessile, surface smooth, ochre-brown to olive brown, peristome simple, fibrillose (Fig. 13).

Found on soil, in *Abies cephalonica* forest, of Mt. Aenos, near the entrance of Eza, alt. 950 m asl.

*G. triplex* is a very common species in Greece. It is identified due to its characteristic star shaped basidiocarps, the exoperidum of which splits at maturity around the endoperidium forming a collar. Saprotrophic. Inedible.

## ***Gymnopus brassicolens*** (Romagn.) Antonín & Noordel.
(=*Micromphale brassicolens* (Romagn.) P.D. Orton)

Pileus 15-30 mm, convex to applanate, dark reddish brown in the central part, pale reddish brown to ochre brown near the margin, hygrophanous, pale pinkish brown to ochre brown. Lamellae adnate, medium crowded, whitish, pink-ochraceous to pale pinkish-brown in maturity. Stipe 25-45x3-5 mm, dark reddish brown to black in whole

Fig. 13. *Geastrum triplex*.

length, apart from a reddish brown to orange brown band at the apex. Odour, reminding of rotten cauliflower (Fig. 14).

Very common species on Mt. Aenos and on Mt. Roudi. Found on the forest floor in a mixed forest of *Abies cephalonica*, *Arbutus* sp. and *Quercus coccifera* on Mt. Roudi, alt. 666 m asl and also in *A. cephalonica* forest, on Mt. Aenos, Fterolakkos locality, alt. 1,090 m asl.

Characteristic features of this species include the dark, two tone stipe and its odour. Saprotrophic. Inedible.

### ***Hebeloma mesophaeum*** (Pers.) Quél**.**

Pileus 25-45 mm, convex, central part depressed in mature specimens, surface viscid, fibrillose, pinkish-brown, in the centre orange-brown to reddish brown. Lamellae adnate, pale pinkish-brown, with a whitish margin, medium crowded. Stipe 35-55 mm, central, cylindrical, surface dry, fibrillose, whitish to pale pinkish-brown (Fig. 15).

Found on soil, in *Abies cephalonica* forest, on Mt. Aenos, near the entrance of Eza, alt. 950 m asl.

It is distinguished from other species in the genus by the colour contrast between the reddish brown central part of the pileus and the pinkish-brown margin, as well as by microscopic features of the basidiospores. It is a species that has been reported only a few times from Greece. Mycorrhizal. Inedible.

Fig. 14. *Gymnopus brassicolens*.

Fig. 15. *Hebeloma mesophaeum*.

## ***Hebeloma sinapizans*** (Paulet) Gillet

Pileus up to 70 mm in diameter, convex to almost applanate, surface slightly viscid, smooth, pinkish ochraceous to pinkish-brown, near the margin whitish. Lamellae emarginate, densely crowded, whitish in young specimens, brown in mature specimens, with white margin. Stipe 50-80x8-13 mm, central, cylindrical, surface dry, squamulose, whitish. The squamules form concolourous bands on the stipe that appear often reddish brown, due to the coverage by the spores (Fig. 16). Found on the forest floor, in mixed forest of *Abies cephalonica*, *Arbutus unedo*, *A. andrachne*, *Quercus coccifera*, on Mt. Roudi, near the National Park's entrance, alt. 666 m asl.

Very common species in Greece. It is distinguished from other species of the genus, by its robust basidiocarps, which possess pinkish ochraceous to pinkish-brown tinges on the pileus, in combination with microscopical features. The collected basidiocarps appeared on soil forming a "fairy ring". Mycorrhizal. Inedible.

## ***Hygrophorus pudorinus*** (Fr.) Fr.

Pileus up to 100 mm, convex to applanate, surface viscid, smooth, yellowish orange, pinkish orange to pinkish brown. Stipe up to 50-90×15–25 mm, central, cylindrical to

Fig. 16. *Hebeloma sinapizans*.

slightly clavate, whitish, often with pale yellowish tinges. Lamellae adnate, medium crowded, almost whitish, with pale orange tinge (Fig. 17).

Found on soil, in *Abies cephalonica* forest, on Mt. Aenos, near Fterolakkos locality, alt. 1,090 m asl and on Chionistra locality, alt. 1,540 m asl.

Very common species in Greece. It is characterised by the robust basidiocarps that possess pinkish orange tinges on the pileus and the lamellae. Mycorrhizal. Edible, of poor gastronomic value.

### ***Hypholoma fasciculare*** (Huds.) P. Kumm.

Pileus 20-80 mm, convex to applanate, surface smooth, dry, pinkish orange in young specimens, brownish orange in the centre, yellowish with greenish tinges to the mar-

Fig. 17. *Hygrophorus pudorinus*.

gin in mature specimens. Lamellae adnate, densely crowded, bright yellow in young specimens, later yellow with greenish tinge, grayish green in mature specimens. Stipe 45-90x5-10 mm, central, cylindrical, surface smooth, bright yellow. Basidiocarps in clusters (Fig. 18).

Found on the base of dead, standing or fallen trunks, and logs of *Abies cephalonica*, on Mt. Aenos, near the entrance of Arginia, alt. 1,020 m asl and near the National Park's recreation area, alt. 1,470 m asl.

Very common species on Mt. Aenos and in Greece. It is distinguished in the field by

Fig. 18. *Hypholoma fasciculare*.

the greenish yellow tinge of the lamellae and the bright yellow tinges of the stipe and the pileus. Saprotrophic. Inedible.

## ***Inocybe griseolilacina*** J.E. Lange

Pileus 10-15 mm, hemispherical in young specimens to conical in mature specimens, surface fibrillose, brown to grayish brown. Lamellae adnate, medium crowded, pale grayish brown. Stipe 25-40x2-4 mm, central, cylindrical, surface fibrillose, pale greyish with violet tinges (Fig. 19).

Found on the forest floor in a mixed forest of *Abies cephalonica*, *Arbutus* sp. and *Quercus coccifera* on Mt. Roudi.

Not a common species; there exists only one previous report of it from Greece (Delivorias 2014). The species of the genus *Inocybe* develop ectomycorrhizal relationships with various forest tree species. Possibly poisonous.

## ***Lycoperdon perlatum*** Pers.

Basidiocarps 20-40x30-70 mm, pyriform, often with well-developed pseudostipe. Exoperidium, consisting of densely crowded, pyramidal spines, white to brownish, sur-

Fig. 19. *Inocybe griseolilacina.*

rounded by smaller, grain-like warts in an almost circular pattern. Endoperidium thin, whitish to pale brown. Gleba initially white, grayish brown to dark brown at maturity (Fig. 20).

Found on soil, among remnants of dead wood of *Abies cephalonica*, on Mt. Aenos, near the entrance of Eza, alt. 950 m asl.

Very common species in Greece. It is easily identified by the shape of the basidiocarps, in combination with their characteristic decoration pattern, which consists of densely crowded, pyramidal spines, each surrounded by smaller, grain-like warts in an almost circular pattern. In mature basidiocarps, the pyramidal spines fall off, in contrast to the smaller warts that remain and leave a characteristic pattern on the surface of the endoperidium. Saprotrophic. Inedible.

## ***Macrolepiota procera*** (Scop.) Singer

Pileus 90-250 mm, spherical to hemispherical in young specimens, convex to almost applanate in mature specimens, with a distinct umbo, brown to dark brown in the central part, surface covered with dark brown scales, arranged in a concentric pattern, surface with a velvety texture. Flesh yellowish white, not turning red. Lamellae free, densely crowded, white to yellowish. Stipe 170-250x10-17 mm, central, cylindrical, with a bulbous base, whitish to yellowish, covered with brown scales, arranged in concentric

Fig. 20. *Lycoperdon perlatum*.

bands. Annulus double, fleshy, white, movable (Fig. 21).

Found on soil, in *Abies cephalonica* forest, on Mt. Aenos, near the entrance of Arginia, alt. 1,020 m asl and also on Mt. Roudi, Alonia locality, alt. 987 m asl.

A choice edible and very common species in Greece. It occurs in forest openings and is characterised by the fairly large basidiocarps, the double movable ring, the banded pattern on stipe, and by the flesh which does not turn reddish when cut. The latter feature can be used to distinguish *M. procera* from the similar but toxic, in some cases, *Chlorophyllum rachodes* (=*M. rachodes*), the flesh of which turns reddish when cut. Saprotrophic. Choice edible.

## ***Mycena acicula*** (Schaeff.) P. Kumm.

Pileus 5-10 mm, hemispherical to convex, surface smooth, yellowish-orange, in the central part reddish-orange, radially striate. Lamellae adnate, distant to medium crowded, whitish. Stipe 20-50x0.7-1.0 mm, central, cylindrical, very slender, yellowish (Fig. 22).

Fig. 21. *Macrolepiota procera*.

Found on the forest floor, in a mixed forest of *Abies cephalonica*, *Crataegus monogyna*, *Quercus coccifera*, on Mt. Aenos, near the entrance of Arginia, alt. 1,017 m asl and on Mt. Roudi, near the National Park's entrance, alt. 666 m asl.

*M. acicula* can be easily distinguished in the field from other species of the genus *Mycena* by the gracile basidiocarps, with the yellowish-orange pileus and the bright yellow, long and slender stipe. Saprotrophic. Inedible.

### ***Mycena renati*** Quél.

Pileus 7-20 mm, paraboloid to campanulate, surface smooth, radially striate, pinkish yellow to pinkish brown. Lamellae adnate to emarginate, distant, white. Stipe 25-40 mm, central, cylindrical, surface smooth, bright yellow, with white fibrils at base. Basidiocarps in clusters (Fig. 23).

Found on dead wood, in mixed forest of *Abies cephalonica*, *Crataegus monogyna*, *Quercus coccifera* on Mt. Aenos, near the entrance of Arginia, alt. 1,017 m asl and near the entrance of Eza, alt. 950 m asl, as well as in mixed forest of *Arbutus* sp., *Quercus coccifera*, *Crataegus monogyna*, on Mt. Roudi, near the National Park's entrance, alt. 666 m asl.

Very common species on Mt. Aenos, Mt. Roudi and all over Greece, where it occurs in

Fig. 22. *Mycena acicula*.

Fig. 23. *Mycena renati*.

broadleaved and mixed forests. It is easily identified among other species of the genus *Mycena* by the combination of the bright yellow stipe and the pinkish brown pileus. Saprotrophic. Inedible.

### ***Mycena supina*** (Fr.) Quél.

Pileus 3-6 mm, hemispherical, surface smooth to powdery, whitish with pinkish tinge, pinkish ochraceous, pale ochre brown to violet, radially striate to plicate. Lamellae adnate, distant, whitish to concolourous with the pileus. Stipe 6-12 mm, central, cylindrical, surface powdery, concolourous, with the pileus, covered with white fibrils at base (Fig. 24).

Found on the bark of dead branches of *Quercus coccifera*, on Mt. Aenos at the Monastery of Zoodochos Pigi, alt. 888 m asl and also on the bark of a living *Abies cephalonica* tree on Mt. Aenos, near the National Park's recreation area, alt. 1,470 m asl.

These specimens constitute the first reports of the species *M. supina* from Greece. The very similar species *M. meliigena* and *M. pseudocorticola* are distinguished from *M. supina* after careful microscopic examination. Saprotrophic. Inedible.

Fig. 24. *Mycena supina*.

***Mycopan scabripes*** (Murrill) Redhead, Moncalvo & Vilgalys
Syn. = *Hydropus scabripes* (Murrill) Singer

Pileus 15-30 mm, convex to applanate, often with broad umbo, surface smooth, radially striate to plicate, pale grayish brown to whitish. Lamellae adnate with a decurrent tooth, distant, white. Stipe 35-60x2-3 mm, central, cylindrical, surface minutely strigose, whitish to pale grayish yellow (Fig. 25).

Found on the forest floor, on dead twigs and cypress cones, in vegetation consisting of *C. sempervirens*, *Quercus coccifera* & *Olea europaea* individuals, in the vicinity of Agios Nikolaos village.

This is the first report of this species and in fact of the genus *Mycopan* from Greece. Saprotrophic. Inedible.

Fig. 25. *Mycopan scabripes*.

**_Phaeoclavulina flaccida_** (Fr.) Giachini
Syn. = *Ramaria flaccida* (Fr.) Bourdot

Basidiocarps 25-45x25-40 mm, coralloid, whitish to yellow ochraceous, darkening by drying, with white rhizoids at the base (Fig. 26).

Found on the forest floor, in a mixed forest of *Abies cephalonica*, *Arbutus unedo*, *A. andrachne*, *Quercus coccifera* on Mt. Roudi, near the National Park's entrance, alt. 666 m asl. A relatively common species in Greece. Inedible.

Fig. 26. *Phaeoclavulina flaccida*.

**_Podofomes trogii_** (Fr.) Pouzar

Basidiocarps annual, texture tough, not fleshy. Pileus 40 mm, circular when seen from above, upper surface pubescent, velvety, irregular, dark blackish-brown in the central part, reddish brown to the margin, poroid surface whitish. Stipe almost central, cylindrical, tapering downwards (Fig. 27).

Found on soil, near the roots of *Abies cephalonica*, on Mt. Aenos, the entrance of Eza, alt. 950 m asl.

This species possesses a poroid hymenophore and is characterised by the presence of an evident stipe. Saprotrophic. Inedible.

Fig. 27. *Podofomes trogii*.

### ***Sarcosphaera coronaria*** (Jacq.) J. Schröt.

Ascocarps up to 60 mm in diameter, initially spherical, hollow, at maturity splitting into rays beginning from the top, turning to star shaped. Inner surface smooth, dark violet to brownish-violet, cracking and revealing the white flesh, outer surface smooth, whitish, ochre whitish to ochre brown (Fig. 28).

Found on the forest floor, in a mixed forest of *Abies cephalonica*, *Arbutus unedo*, *A. andrachne*, and *Quercus coccifera*, but also in a forest of *Abies cephalonica*, on Mt. Roudi, near the National Park's entrance, alt. 666 m asl and near Alonia locality, alt. 987 m asl, respectively.

Very common, vernal species in Greece. In some European countries it is considered threatened (Dahlberg & Croneborg 2003, Otto 2011). Edible, if eaten well cooked and after discarding the water that was used for cooking, otherwise toxic.

### ***Tricholomopsis flammula*** Métrod ex Holec

Pileus 30-60 mm convex to almost applanate, with broad umbo, surface pale to bright yellow, covered by minute reddish brown, dark purplish-red to dark purplish fibrillose scales. Lamellae adnate, yellowish to yellow ochraceous, medium to densely crowded. Stipe 40-90x7-12 mm central, cylindrical, surface smooth to fibrillose, whitish to yellowish. Basidiocarps in clusters (Fig. 29).

Found on a fallen trunk of *Abies cephalonica* on Mt. Aenos, near the National Park's recreation area, alt. 1,470 m asl and near the entrance of Eza, alt. 950 m asl, as well as in various locations on Mt. Roudi.

Fig. 28. *Sarcosphaera coronaria*.

Fig. 29. *Tricholomopsis flammula*.

*T. flammula* is considered a rare species in Europe. The collected specimens from Mt. Aenos possess all the microscopic features that distinguish this species from the common and very similar *T*. *rutilans*. Only two previous reports of *T. flammula* exist from Greece (Konstantinidis 2006). Saprotrophic. Inedible.

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# PART VII

## THE FAUNA OF MT. AENOS

## A. ON THE FAUNA OF MT. AENOS

The unique faunal wealth of Cephalonia, whether it concerns Invertebrates or Vertebrates, has, for many years, attracted the interest of researchers from various nations. For instance, the first comprehensive records of amphibians and reptiles appeared already at the end of the 19th – beginning of the 20th century (e.g. Werner 1894, 1938). Over the years, researchers have systematically included Cephalonia as a study area, while investigating the fauna at a national or an even larger scale (e.g. Ondrias 1968, Handrinos & Akriotis 1997, Werner 1927, 1938), have focused their efforts on the Ionian region (e.g. Werner 1894, Keymar 1986) or more specifically on Cephalonia itself and the National Park of Mt. Aenos (e.g. Catsadorakis 1985). As a result of all those efforts, the wealth of data gathered on the fauna of Cephalonia till the end of the 20th century was already significant. As for the National Park of Mt. Aenos in particular, the very important work, under the editing care of Efthymiatou-Katsouni (1998) summarises, in the relevant chapter '*The Fauna of Ainos'*, all the available information on the vertebrate fauna of the National Park until then.

The systematic efforts to study the fauna of Cephalonia during the past 15 years and until the present day have substantially helped update the data of previous studies, usually confirming the older records and at times expressing doubts about them. Mainly, however, they have added valuable, new data, which significantly enhance our knowledge on the diversity of the fauna of Cephalonia. This is particularly true for certain animal groups, for which the data was scarce until recently, such as the Chiroptera (bats). In these studies foreign researchers have also contributed (e.g. Wilson 2006), yet, it has been mainly Greeks who have done so, as a result of studying and monitoring the fauna of Cephalonia for many years.

In more detail, a research program was implemented in 2003 under the supervision of Professor E. Giagia-Athanasopoulou, from the Department of Biology, University of Patras, titled "Locating and describing the endemic, rare, and interesting animals of Cephalonia and Ithaca – Enriching the photographic material and creating a database" and funded by the Museum of Natural History of Cephalonia and Ithaca. The significant data from this research program were complemented a while later by the important results derived within the framework of the MSc dissertation by Efthymiatou-Katsouni

(2006) on the biodiversity of Cephalonia and Ithaca.

Since 2007 and until the present day, the central role in coordinating and implementing studies on recording and monitoring the fauna of the National Park of Mt. Aenos, but also of the wider region of Cephalonia and Ithaca, is held by the Management Body of the National Park of Mt. Aenos, within the framework of the relevant EU Directives (Directive 92/43/EEC for the protection of species of flora and fauna and habitat types and the Directives 79/409/EEC and 2009/147/EC for the protection of the avifauna). These studies are undertaken either directly by its trained scientific staff, or with the support of external collaborators, in the form of research programs which are being designed, announced and coordinated by the Management Body itself.

In particular, with the funding from the 3rd Community Support Framework (2000-2006) and in cooperation with the Hellenic Ornithological Company a study was conducted in 2009 with the title: ''Recording and Management of the avifauna of the National Park of Mt. Aenos and the wider region of the Prefecture of Cephalonia and Ithaca''. This project set the groundwork for further recording and scientific monitoring of the avifauna of the National Park, which was funded by the National Strategic Reference Framework (NSRF-2007-2013), conducted in cooperation with the company Technomiostasi G.P. and was completed at the end of 2015. It had the title "Assistance in the evaluation of the conservation status of certain species of avifauna within the SPA of the Management Body, under the Directive 79/409/EEC".

For the recording and the scientific monitoring of the remaining vertebrate fauna, the Management Body was supported by other research teams from three Universities of Greece (University of Patras, with the participation of Assist. Prof. S. Giokas and the PhD candidates Mr. O. Mettouri and Ms. O. Tzortzakaki, Aristotle University of Thessaloniki, with the participation of Assoc. Prof. D. Youlatos and the PhD candidate Ms. D. Migli and University of Thessaly with the participation of Prof. A. Sfougaris), as well as from other researchers. The research project titled: "Assistance in the recording, monitoring and sustainable management of the fauna of the National Park of Mt. Aenos, but also of the wider region of the Prefecture of Cephalonia and Ithaca" was also funded by NSRF (2007-2013) and was conducted from 2012 till the end of 2015, under the coordination of Prof. Sfougaris, offering valuable new data.

Part VII of the book, with the title 'THE FAUNA OF MT. AENOS', attempts to present in a concise manner the existing knowledge on the fauna of the National Park of Mt. Aenos, incorporating the most recent data from the respective studies and emphasising on those elements, which confirm the definitive importance of the National Park for the fauna of Cephalonia. The information presented is organised based on accepted taxonomical groups in Zoology: Lepidoptera (restricted to Butterflies), Lissamphibians and Reptiles, Birds, as well as Mammals which are found in the National Park. Furthermore, a separate chapter is dedicated to the wild horses of Mt. Aenos, one of the most emblematic species of the National Park (Fig. 1).

Fig. 1. The wild horses of the National Park of Mt. Aenos.

## B. BUTTERFLIES (LEPIDOPTERA)

The butterfly fauna of Cephalonia has been adequately studied during the last 30 years (Efthymiatou-Katsouni 2006, Gaskin 1996, Gaskin & Littler 1986, Pamperis 2009), whereas recent studies under the coordination of the Management Body of the National Park of Mt. Aenos (Maroulis & Xanthakis 2015) have focused their interest on the National Park itself (Fig. 2). The data that has been gathered until today on the butterfly fauna of the National Park are presented in detail in subchapter 4.3 of Part VIII of this book.

Fig. 2. The speckled wood butterfly *Pararge aegeria* in the National Park of Mt. Aenos.

# C. LISSAMPHIBIANS – REPTILES

## C1. Lissamphibians

The Amphibia or, more accurately, the Lissamphibia consist of organisms which, by rule, depend at least partly on water for their survival. The name Lissamphibia (from the Greek word *lissos*=naked, smooth) derives from the fact that their skin is not covered by protective structures that characterise other vertebrates, like the scales of reptiles, the feathers of birds or the hair of mammals, but is moist, smooth and bare. Furthermore, it is rich in tiny blood vessels, which support the unique way of breathing used in a considerable degree by Lissamphibia, i.e. breathing through the skin!

According to the *Red Data Book of the Threatened Animals of Greece* (Legakis & Maragou 2009), 22 out of a total of 64 European species are found in Greece. Based on the relevant studies conducted in Cephalonia, 5 species of Lissamphibia have been observed, four of which belong to the Order Anura (frogs, toads) and one to the Order Urodela (salamanders, newts). Among those, only one, the toad *Bufo bufo*, has been observed within the National Park of Mt. Aenos (Valakos 1998). As it is known, despite the high levels of humidity that characterise the National Park, there are no permanent or, at the very least, temporary, yet noteworthy, water masses (lakes, rivers, streams etc.). Such conditions create difficulties for the survival of many Lissamphibia species that are found in Greece and mostly for the completion of the reproduction cycle and the development of the tadpoles, processes that are dependent on the presence of water. The toad *Bufo bufo* is a nocturnal species which overcomes these difficulties by living constantly away from water, feeding on various invertebrates. During the mating period, any kind of small, temporary waterpool is enough to create impressive gatherings of individuals of both sexes, that mate quickly and deposit tens of thousands of eggs, which, after going through the tadpole stage, will transform into little toads in about 2.5 months. *Bufo bufo* is the largest anuran Lissamphibian of Greece with a head-to-tail length that reaches 15 cm (Pafilis & Valakos 2012, Valakos & al. 2008)! However, during the most recent studies completed under the supervision of the Management Body of the National Park of Mt. Aenos (2012-2105), there has been no confirmation of the presence of this species in the National Park.

## C2. Reptiles

In Greece there are at least 64 species of reptiles including tortoises, terrapins and sea turtles (Order Chelonia), lizards and snakes (Suborder Sauria and Suborder Ophidia, respectively, Order Squamata). Nine species and 14 subspecies are Greek endemics (Legakis & Maragou 2009). It is very likely that the above numbers will change, as the results emerging from numerous molecular and other studies over the past years have been leading to important taxonomical revisions and discoveries of new taxa within the reptiles, which also concern the taxa distributed in Greece (e.g. Thanou & al. 2014).

As mentioned in a previous chapter, the reptiles of Cephalonia have been studied already since the end of the 19th century and, till this day, 24 taxa have been recorded in total. For many of the above species the reports are based on the findings of scarce (mostly killed) individuals and for only a few species has there been a record of a satisfactory population size. For one of these, i.e. the Peloponnese wall wizard (*Podarcis peloponnesiaca*), the report is very old (Werner 1894) and since then, its presence on Cephalonia has not been verified and the same seems to be also true for the Mediterranean spur-thighed tortoise (*Testudo graeca*). From the above taxa, 14 have been recorded in the National Park of Mt. Aenos: 1 tortoise species (*Eurotestudo hermanni*), 7 lizard taxa (*Anguis cephalonica*, *Pseudopus apodus, Ablepharus kitaibelii, Algyroides moreoticus, Algyroides nigropunctatus* subsp. *kephallithacius, Lacerta trilineata* and *Podarcis tauricus* subsp. *ionicus*), the first two of which are legless and 6 snake species (*Elaphe quatuorlineata*, *Hierophis gemonensis, Malpolon insignitus*, *Telescopus fallax*, *Zamenis situlus* and *Vipera ammodytes*). From the above, Hermann's tortoise, *Eurotestudo hermanni* is included in the *Red Data Book of the Threatened Animals of Greece* as Vulnerable (VU) and the species *Anguis cephalonica* and *Algyroides moreoticus* as Near Threatened (NT) (Legakis & Maragou 2009), whereas the species *Eurotestudo hermanni, Anguis cephalonica*, and *Elaphe quatuorlineata* are evaluated, according to IUCN, as Near Threatened (NT). Moreover, all of the above lizard species, as well as the snakes *Telescopus fallax* and *Vipera ammodytes* are included in Annex IV of the Directive 92/43/EEC, whereas the tortoise *Eurotestudo hermanni,* and the snakes *Elaphe quatuorlineata* and *Zamenis situlus* are included in Annexes II and IV of the above Directive.

Hermann's tortoise (*Eurotestudo hermanni*) constitutes one of the three tortoise species that occur in Greece and at first sight it looks very similar to the Mediterranean spur-thighed tortoise, *Testudo graeca*. Only a few individuals have been found in the National Park, restricted to Mt. Aenos (Fig. 3). Even though Greece hosts the largest population worldwide of this tortoise species, its size is showing signs of steady decrease (Legakis & Maragou 2009).

According to Valakos (1998), the two aforementioned legless lizard species, i.e. the Peloponnese slow worm (*Anguis cephalonica*) and the European glass lizard (*Pseudopus apodus*) (Anguidae), have been reported in the wider area of the National Park of Mt. Aenos. The legless lizards may look like snakes, however they possess moving eyelids, a large number of linearly arranged, ventral scales, visible acoustic pores and their tail

Fig. 3. Hermann's tortoise (*Eurotestudo hermanni*) from the National Park of Mt. Aenos.

can be shed. In contrast, snakes do not possess moving eyelids, acoustic pores, they cannot shed their tail and the ventral scales are much larger than the dorsal ones and transversely arranged.

Following the most recent taxonomic revision, *Anguis cephalonica* (Gvoždík & al. 2010, Thanou & al. 2014), constitutes now an endemic species of Peloponnese and of the Ionian Islands, Cephalonia, Ithaca and Zakynthos. Its length reaches about 0.5 m and the dorsal side is creamy-brown, whereas the flanks and the ventral side is dark brown. It is strictly a ground dweller (it cannot climb) and usually prefers moist areas, meadows, bushes, but also cultivated areas and gardens. As is also true for *Pseudopus apodus*, only a few individuals of *Anguis cephalonica* have been reported not only in the National Park but in Cephalonia in general.

The European glass lizard *Pseudopus apodus* is an impressive legless lizard, the length of which can easily exceed 1 m and which is characterised by a very distinctive, deep lateral groove. The colour of adults is yellow-brown to brown, whereas the colour of juveniles is characterised by dark transverse bands on a silver background (Fig. 4). This lizard is strong and generates much noise while moving, however, it is completely harmless! Unfortunately, it is quite often encountered as a victim of the Greek roads, while trying to cross them.

One of the least noticeable lizard species of the National Park, due to its tiny dimensions, is the snake-eyed skink (*Ablepharus kitaibelii*), the only representative of the family Scincidae on Cephalonia (Fig. 4). Its body is remarkably thin, its total length not exceeding 14 cm and the legs are hardly noticeable (Pafilis & Valakos 2012, Valakos & al. 2008). There exist only a few reports of this species from Cephalonia and even fewer from the National Park of Mt. Aenos (Wilson 2006 and other recent surveys).

The remaining lizard taxa reported from the National Park, belong to the family Lacertidae. Among them, the taxa *Algyroides moreoticus* and *Algyroides nigropunctatus* subsp. *kephalithacius* are of particular interest. Both differ from the other lacertid taxa, because they possess keeled, instead of smooth scales. *Algyroides moreoticus*, a relatively small-bodied lizard, is an endemic of Peloponnese and of most Ionian Islands. It prefers places that reach up to an altitude of 800(-1,200) m and habitats with high humidity levels that offer shade and cover (Fig. 5). Therefore, both the lower parts of Mt. Aenos and the parts of Mt. Roudi, where it has been found, constitute ideal living areas. On the other hand, the subspecies *Algyroides nigropunctatus* subsp. *kephalithacius* constitutes

Fig. 4. Left: Juvenile individual of a European glass lizard (*Pseudopus apodus*). Right: Adult individual of a snake-eyed skink (*Ablepharus kitaibelii*).

an endemic of Cephalonia, Ithaca and Lefkada (Fig. 6). It has a comparatively larger body and also prefers moist habitats with rich vegetation at an altitude that does not exceed 1,200 m. During the reproductive period, the males acquire a deep blue colour at the neck area, whereas an intense orange colour characterises the ventral side of the body (Pafilis & Valakos 2012, Valakos & al. 2008).

The most common lizard of the National Park of Mt. Aenos is by far the Balkan wall lizard (*Podarcis tauricus* subsp. *ionicus*), which is an endemic subspecies of Epirus, western Peloponnese and the Ionian islands. It prefers open areas and uncovered places with low vegetation or bushes at an altitude that ranges from sea level to 2,300 m. It is a medium-sized lizard (the total length may exceed 24 cm) and is usually characterised by a wide green band that runs along the dorsal side of the body, being flanked by narrow brown-yellow bands (Fig. 7) (Pafilis & Valakos 2012, Valakos & al. 2008). In any case, depending on the prevalent colours of its surroundings, one can notice colour variations of the dorsal side that serve camouflage purposes! During sunny days on Mt. Aenos or Mt. Roudi we can come across tens of individuals that exit their hiding places in order to seek food or find a mate, or even encounter mating couples (Fig. 8)!

The last lizard species that occurs in the National Park of Mt. Aenos in small numbers, based on existing data so far (Valakos 1998, Wilson 2006), is the three-lined lizard (*Lacerta trilineata*). Without doubt, it is by far the largest lizard species of Cephalonia with a length that can reach 0.5 m, mostly thanks to its very large tail! The species name refers to the three light-yellow lines that run along the dorsal side of the juvenile body, whereas the adults (mainly the males) acquire a dorsally and laterally uniform bright green colour and a yellow neck.

All six snake species that have been reported from the National Park of Mt. Aenos are rather rarely encountered. The species *Hierophis gemonensis, Malpolon insignitus* and *Zamenis situlus* have been merely mentioned from the National Park by Valakos (1998), with no population data. It should be noted in fact that the Balkan whip snake (*Hierophis gemonensis*) is considered the rarest snake species of Cephalonia (Wilson 2006). It is a medium-sized, strong and agile snake that reaches 1.5 m in length; however, it is timid and completely harmless, since it is non-poisonous. Its usual colour is grey-brown with irregular dark spots, mostly concentrated at the upper half of the body. It prefers arid habitats and is more common at lower, rather than at higher altitudes.

The Montpellier snake (*Malpolon insignitus*) appears to be the most common snake in Cephalonia and one of the most frequent road victims of the Greek roads. It is a strong and robust snake, reaching a large length that approaches 2.5 m! The dorsal colouration is olive-green, and one can occasionally encounter melanistic forms. The arrangement of the head scales gives the impression of an angry look. When threatened, it may ex-

Fig. 5. The lizard *Algyroides moreoticus* at a shady spot of the Cephalonian Fir forest on the SE. slopes of Mt. Aenos.

Fig. 6. The lizard *Algyroides nigropunctatus* subsp. *kephalithacius* from an area close to the National Park of Mt. Aenos.

Fig. 7. An adult Balkan wall lizard *Podarcis tauricus* subsp. *ionicus*.

Fig. 8. A mating couple of Balkan wall lizards *Podarcis tauricus* subsp. *ionicus*.

hibit an aggressive behavior, lifting its upper body, inflating its neck area, hissing and attacking (Fig. 9)! This is a typical species of the Mediterranean ecosystems, occurring at forest edges, near stony-rocky places, but also in cultivated areas (Pafilis & Valakos 2012, Valakos & al. 2008).

The cat snake (*Telescopus fallax*) is a medium-sized snake, the length of which does not exceed 1.2 m. It bears dorsally several brown-black spots on a grey-beige to light brown background (Fig. 10). The head has a dark pattern that resembles the sign of the cross. It is a very capable climber and prefers stony-rocky substrates, walls, ruins etc., where it hides or hunts (Pafilis & Valakos 2012, Valakos & al. 2008). The cat snake is very familiar to the Cephalonian people, since several individuals are collected every year around the Dekapentavgoustos time (August 15, a holy day to commemorate the passing of Virgin Mary) by villagers of Arginia and Markopoulo and placed in the churches and on the icons of Virgin Mary. Their appearance is considered a good omen! In contrast to most snakes, it is a rather nocturnal species, therefore it is not easily detected during the day. Based on the existing observations in Cephalonia, this species seems to be restricted in areas within and around the National Park of Mt. Aenos.

The four-lined snake (*Elaphe quatuorlineata*) is an impressively-sized snake of the Greek herpetofauna with a length that can exceed 2.5 m! It is easily distinguished by its four dark lines that run along its otherwise brown body. It seems to prefer Mediter-

Fig. 9. The Montpellier snake *Malpolon insignitus.*

ranean ecosystems with a rocky substrate, as well as forest edges and areas associated with human activities. Despite its large size, it is completely harmless and characterised by a rather slow and gracious movement (Pafilis & Valakos 2012, Valakos & al. 2008). It has been recorded from the borders of the National Park and specifically at the peripheral zone of Mt. Roudi.

The leopard snake (*Zamenis situlus*) with its characteristic brick-red spots on a silvery-gray background is one of the prettiest snakes of the Greek herpetofauna. It is a slender, medium-sized snake that can exceed 1 m in length. It constitutes also a typical species of the Mediterranean vegetation (phrygana-maquis) at an altitude not exceeding 1,600 m, but can also be present close to human settlements. It is a very calm and completely harmless snake (Pafilis & Valakos 2012, Valakos & al. 2008).

Both *Malpolon insignitus* and *Telescopus fallax* possess poison of mild toxicity, that is administered by specialised rear fangs (opisthoglyphous species). Therefore, due to the administration manner and the low toxicity of their poison, these two species are practically considered harmless for humans.

The only potentially dangerous snake of Cephalonia for humans is the viper (*Vipera ammodytes*). Even though *Vipera ammodytes* is by comparison the commonest species among the five viper species of Greece, it is not frequently encountered. In fact, it appears that in Cephalonia it is quite rare and possibly restricted in and around the Na-

Fig. 10. The cat snake *Telescopus fallax.*

tional Park of Mt. Aenos. Even though it constitutes a snake with one of the most toxic poisons of Europe, it is a very timid species that hides in human presence (Fig. 11) and will only attack when threatened and no other option is available. Moreover, it is easily distinguished from all the other species, due to the keratinous protrusion at the tip of the rostrum (hence the common name '*nose-horned viper*'). The body is short and thick that rarely exceeds 0.5 m in length and is characterised by a dark colour (grey to yellow-brown in males and reddish in females) that runs along the back in a zig-zag or rhomboid pattern.

Irrespective of how easy it is to distinguish the viper from other harmless snakes, it is strongly advised to those that have not acquired extensive experience on snake handling and identification, not to approach them and even more importantly, not to try to handle them!

Fig. 11. Adult, male individual of the nose-horned viper *Vipera ammodytes*, hidden among dense vegetation.

## D. AVIFAUNA

Several scientists have recorded the avifauna of the Ionian Islands and especially of Cephalonia (Alivizatos 1999). One of the main specialised researchers, the English Alan Vittery (1996), regularly visited the island over a whole decade, in order to record bird species. Furthermore, a research team from the Zoological Institute of the University of Munich, with Dr. Albert Klarenberg in charge, conducted ornithological observations in cooperation with the N.G.O. *Archipelagos*, during the years 1990-1995. Estimates conducted until the present day report 245 species of birds in Cephalonia (Handrinos et al. 1997), that correspond to more than half of the bird species recorded in Greece (449 species). In total, 72 of those 245 species – that is, about one third – need protection, according to the Directive 2009/147/EC.

The avifauna of the National Park of Mt. Aenos is typical of the mountainous ecosystems and mostly includes forest-dwelling and nesting species of coniferous forests, Mediterranean scrubland and evergreen, broadleaved species. Due to the importance of the National Park for the protection of the avifauna, the wider region has been included in the EU network of Special Protection Areas (GR2220006 – Kefalonia: Aenos, Kalon Oros and Agia Dynati). Following its declaration as a National Park, it was also decreed as a Wildlife Refuge.

Catsadorakis (1985), in a study requested by the Forestry Service of Cephalonia, recorded several species of avifauna in the area of the National Park of Mt. Aenos. Moreover, the Management Body of the National Park, in collaboration with the Hellenic Ornithological Society, conducted in 2009 an ornithological study, setting the foundation for the further scientific survey of the avifauna of the National Park. Indeed, within the framework of the National Strategic Reference Framework (2007-2013), the Management Body of the National Park of Mt. Aenos funded a further study on the avifauna of the National Park. Total species counts, based on up-to-date estimates, mention about 100 species of birds in the National Park of Mt. Aenos (Handrinos et al. 1997 and recent studies). Unfortunately, the presence of some important and rare bird species which had been reported in older surveys (Catsadorakis 1985; Vittery 2002), such as the Griffon Vulture (*Gyps fulvus*) and the Black Woodpecker (*Dryocopus martius*) has not been verified by the results of later studies.

According to the most recent study, it appears that several birds of prey demonstrate an important presence in the National Park of Mt. Aenos, such as the following: Golden Eagle (*Aquila chrysaetos*) (Fig. 12), Short-Toed Snake Eagle (*Circaetus gallicus*), European Honey Buzzard (*Pernis apivorus*), Montagu's Harrier (*Circus pygargus*), Hen Harrier (*Circus cyaneus*), Levant Sparrowhawk (*Accipiter brevipes*), Northern Goshawk (*Accipiter gentilis*) (Fig. 13) Long-Legged Buzzard (*Buteo rufinus*), Red-Footed Falcon (*Falco vespertinus*), Peregrine Falcon (*Falco peregrinus*) and Lanner Falcon (*Falco biarmicus*), a trigger species for the designated SPA (Pergantis 2009). All of them are considered threatened species and are included in Annex I of the Directive 2009/147/EC for the protection of wild birds. From the nocturnal birds of prey, those recorded in the National Park are the Little Owl (*Athene noctua*), the Eurasian Scops Owl (*Otus scops*) (Fig. 14) and the Tawny Owl (*Strix aluco*).

An important avifauna element of the National Park is the Rock Partridge (*Alectoris graeca*), endemic species of Europe, which is included among the 'Vulnerable' species in the *Red Data Book of the Threatened Animals of Greece* (Fig. 15). The Rock Partridge lives on the peaks of Mt. Aenos and on steep rocky slopes with sparse, bushy vegetation. It is mainly being affected by a) hunting, because, although it is threatened with extinction,

Fig. 12. Golden Eagle (*Aquila chrysaetos*).

Fig. 13. Northern Goshawk (*Accipiter gentilis*) on the peripheral road of Mt. Aenos.

Fig. 14. Eurasian Scops Owl (*Otus scops*) inadvertently trapped on a mist net for Chiroptera and released immediately after being photographed.

Fig. 15. Rock Partridge (*Alectoris graeca*) in the National Park of Mt. Aenos.

it is still considered a game species and b) its hybridisation with the other partridge species occurring in the National Park, i.e. the Chukar Partridge (*Alectoris chukar*) which, even though not cited in the literature, is a species that was, unfortunately, at some point released on the island and has since established permanent populations.

Moreover, numerous passerine species are found in the National Park of Mt. Aenos: Eurasian Skylark (*Alauda arvensis*), Tawny Pipit (*Anthus campestris*), Dunnock (*Prunella modularis*), Black Redstart (*Phoenicurus ochruros*), European Robin (*Erithacus rubecula*), Woodchat Shrike (*Lanius senator*) (Fig. 16), Common Blackbird (*Turdus merula*), Mistle Thrush (*Turdus viscivorus*) (Fig. 17), Eurasian Blackcap (*Sylvia atricapilla*) Subalpine Warbler (*Sylvia cantillans*), Goldcrest (*Regulus regulus*), Common Firecrest (*Regulus ignicapilla*), spotted flycatcher (*Muscicapa striata*), Common Chaffinch (*Fringilla coelebs*), Eurasian Blue Tit (*Cyanistes caeruleus*), Coal Tit (*Parus ater*), Great Tit (*Parus major*) (Fig. 17), Northern Wheatear (*Oenanthe oenanthe*) (Fig. 18), Black-Eared Wheatear (*Oenanthe hispanica*) and others. Among those, the presence of the Cretzschmar's bunting (*Emberiza caesia*), is of high importance as it constitutes a trigger species for the designated SPA (Pergantis 2009).

In conclusion, the National Park of Mt. Aenos alone is considered very important for the avifauna, since it supports ca 100 species, belonging to 26 bird families. Among these species, 21 belong to Annex I of the Directive 2009/147/EC. According to the Red Data Book of the Threatened Animals of Greece (Legakis & Maragou, 2009), *Circus pygargus*

Fig. 16. Woodchat Shrike (*Lanius senator*) in the National Park of Mt. Aenos.

Fig. 17. Mistle Thrush (*Turdus viscivorus*) (left) and Great Tit (*Parus major*) (right) on Cephalonian Fir branches in the National Park.

has been evaluated as Critically Endangered (CR), *Falco biarmicus* as Endangered (EN), *Alectoris graeca* and *Buteo rufinus* as Vulnerable (VU) and *Circaetus gallicus, Alauda arvensis* and *Lanius minor* as Near Threatened (NT). Moreover, according to the International Union for the Conservation of Nature (IUCN), *Falco vespertinus* has been evaluated as Near Threatened (NT). Finally, eight species from the families Falconidae and Strigidae, which occur in the National Park, have been included in the CITES Convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora) which regulates the international trade of species of indigenous flora and wild fauna, threatened by extinction.

Fig. 18. Northern Wheatear (*Oenanthe oenanthe*) in the National Park of Mt. Aenos.

## E. MAMMALS

Mammals constitute the most evolved group of vertebrates, characterised by an impressive variation, in terms of forms, body sizes, ecological requirements, dietary habits etc. They occupy almost every available habitat on land and in water and include herbivorous, carnivorous or omnivorous species, as well as species with flight capability, species living underwater, above or below the ground, on trees etc. In Greece, one can find some of the smallest mammalian species of Europe, e.g. the tiny Etruscan shrew *Suncus etruscus* weighing no more than 2.5 gr and up to the largest ones, such as the brown bear *Ursus arctos* with a weight that approaches 1.5 tonnes!

Most mammalian species avoid humans, therefore recording and studying them relies less on direct observations and encounters and more on other indirect methods. These include the detection of bioindicative signs (feces, animal tracks, food remains, owl pellets etc.), which often permit the identification at genus or even species level. Also, it is possible to record certain mammalian groups with the use of specialised equipment, exploiting the way they communicate and orientate themselves in their environment, for example, ultrasounds in bats. However, the most important means to record the mammalian fauna of a region, particularly applicable to small mammals, remains the use of specialised traps. The trap type to be used and its placement in the field, the chosen bait, the frequency of trap checking and rebaiting and the selected season for a trapping session constitute a few of the parametres to be considered by a researcher and be adjusted, based on the mammalian group under study. Of course, due to the remarkable variability that characterises Mammals, it is easy to realise that the relevant scientific efforts require particular experience and specialisation, as well as the possession of suitable equipment, in order for them to be successful and result in a satisfactory determination of the mammalian species in a region and their population status. Therefore, it should not come as a surprise that for several mammalian species of the Greek fauna, particularly small mammals, the available data remain scarce and are usually derived from old scientific works. As a result, about half the Mammals of the Greek fauna are regarded as Data Deficient (DD) or Not Evaluated (NE) in the *Red Data Book of the Threatened Animals of Greece* (Legakis & Maragou 2009).

From the 115 mammalian species that occur in Greece, according to the *Red Data Book*

(Legakis & Maragou 2009) almost 37 taxa have been recorded in Cephalonia. These include medium and small-sized Mammals, since Cephalonia could not possibly meet the ecological conditions required by the larger mammalian species of Greece, e.g. the golden jackal or the grey wolf. An exception to this rule concerns the wild horses of Mt. Aenos (id. Section E.2). At least 33 of the 37 above taxa have been reported from the National Park of Mt. Aenos (Giagia-Athanasopoulou and other recent studies). Four taxa belong to the Order Eulipotyphla, previously known as Order Insectivora (*Erinaceus roumanicus, Talpa stankovici, Crocidura leucodon*, *Crocidura suaveolens*), 6 belong to the Order Rodentia (*Glis glis, Apodemus epimelas*, *Apodemus flavicollis*, *Apodemus sylvaticus*, *Mus musculus domesticus*, *Rattus rattus*), 1 to the Order Lagomorpha (*Lepus europaeus*) and 5 to the Order Carnivora (*Martes foina*, *Mustela nivalis*, *Meles meles*, *Felis silvestris*, *Vulpes vulpes*). In addition, based on the important findings of the recent studies on the fauna of Cephalonia, about 16 species of Chiroptera (bats) have been recorded for the first time in the National Park of Mt. Aenos and are being discussed in detail in section E.1.

It is interesting to note that 17 out of the 18 small and medium Mammals of the National Park are reported as Not Evaluated (NE) in the *Red Data Book of the Threatened Animals of Greece*. Also, from the Chiroptera species of the National Park, 6 are reported as Data Deficient (DD) and five species (*Miniopterus schreibersii, Myotis capaccinii, Myotis emarginatus, Rhinolophus blasii* and *Rhinolophus euryale*) as Near Threatened (NT) (Legakis & Maragou 2009). Finally, the bat *Miniopterus schreibersii* has been evaluated globally, as Near Threatened and the bat *Myotis capaccinii* as Vulnerable (VU), according to the IUCN.

Based on the gathered data so far, 7 out of the 32 above mammalian species of the National Park have been recorded exclusively within its boundaries. Among them, two Carnivora species are included, i.e. the wildcat (*Felis silvestris*, Felidae) and the Eurasian badger (*Meles meles*, Mustelidae), for which, however, the older reports (Catsadorakis 1985, Diamantis & Gounaris 1973) are not confirmed by later studies and probably constitute false records. Moreover, the recent reports do not confirm the older one (Diamantis & Gounaris 1973) regarding the occurrence of the least weasel (*Mustela nivalis*, Mustelidae) in the National Park, however, this cannot be excluded, since this small-bodied and agile carnivore is an easy-to-miss species in surveys.

Among the Eulipotyphla, the Northern white-breasted hedgehog (*Erinaceus roumanicus*, Erinaceidae) constitutes a relatively common species of Cephalonia, albeit less frequent in the National Park. The lesser shrew *Crocidura suaveolens* (Soricidae) has been recorded, according to recent studies, only on Mt. Aenos (Fig. 19), without ruling out its occurrence in other places of the National Park and of Cephalonia in general, whereas the bicoloured shrew *C. leucodon* (Fig. 19) has been recorded both inside the National Park (Mt. Aenos) and outside. *C. leucodon* is a small-bodied species with a whole body length that does not exceed 15 cm and a weight that reaches 15 gr at most. However, it is larger than *C. suaveolens*, from which it is further distinguished by the clear colour distinction between the dark dorsal side and the light ventral side, a distinction that also extends to the tail (Macdonald & Barrett 1993). Since these animals are generally cryptic, their recording is usually based on the use of pitfall traps, placed in the ground in specific arrangements (Fig. 20), from which they cannot escape, because they lack the ability to jump high. Even though someone could confuse a shrew for a mouse, the former has a comparatively pointier snout (a general characteristic of Eulipotyphla) and its forelimbs have 5 fingers instead of the 4 fingers that characterise the forelimbs of a mouse. The shrews are nocturnal animals that will be more often encountered following a rainfall, at which point they will come out in search of their food (mainly several Invertebrate species). They are known for their remarkably high metabolism since daily food intake may exceed their body weight! Also, because of the profound stress they manifest, shrews constitute one of the most fragile groups of small Mammals that will not easily survive in captivity for more than a few hours. Therefore, during their study, the pitfall traps need be checked several times a day and the animals have to be released immediately, minimising their disturbance as much as possible.

Stankovic's mole (*Talpa stankovici,* Talpidae), constitutes the fourth Eulipotyphlan species of the National Park and occurs exclusively in several locations of Mt. Aenos. Even though its occurrence in the National Park has been known for long (Catsadorakis 1985, Giagia-Athanasopoulou 1998), the confirmation that the population of Mt. Aenos belongs in fact to the species *T. stankovici* and not to some other species has become clear only recently (Tryfonopoulos & al. 2010). It is one of the least known species of

Fig. 19. The shrews *Crocidura suaveolens* (left) and *C. leucodon* (right).

Fig. 20. Pitfall traps arrangement for the collection of small mammals in the National Park of Mt. Aenos.

the Greek fauna, since it lives almost exclusively underground in a network of tunnels and is collected with great difficulty. Its presence is betrayed by the soil mounds on the ground, derived from the soil that the mole removes from inside its tunnels, during their construction and maintenance (Fig. 21). Similar to other Eulipotyphla species, the mole has a pointy snout and, in addition, a thick, black fur, small eyes and short tail, as well as very strong forelimbs with prominent claws, lending it significant digging abilities. Like shrews, the mole is also very difficult to keep in captivity for more than a few hours, mostly due to its high metabolism. It requires the intake of 40-50 gr of food on a daily basis, which corresponds to ca 1/3 or more of its body weight! This species feeds on Invertebrates, showing particular preference to earthworms. Even when not hungry, it gathers them in a special chamber of its tunnel system, where it paralyses them and keeps them alive, until it's time to consume them!

All the Rodents that occur in the National Park are rather common and not threatened elements of the Greek fauna. From the ground-dwelling species, it appears that the yellow-necked field mouse (*Apodemus flavicollis*, Muridae) is the most frequent. *A. flavicollis* is a small to medium-sized mouse with a brown back and a whole body length that reaches 25 cm. It prefers, among others, forests and hedgerows and to a lesser extent open bushy areas. It builds its nest under trees or rocks, however, it can, alternatively, take advantage of the existing tunnel system of the mole! Compared to the fairly similar species, *A. sylvaticus,* which also occurs on Mt. Aenos, *A. flavicollis* shows a larger preference to conifer forests and is a more capable climber (Fig. 22). Externally, the two species are distinguished

Fig. 21. Soil mound of Stankovic's mole *Talpa stankovici*.

Fig. 22. The yellow-necked field mouse *Apodemus flavicollis* on a Cephalonian Fir branch, shortly after its release.

most of the time, since *A. flavicollis* is usually larger and commonly carries a clear orange ventral patch between its forelimbs, which is absent from *A. sylvaticus*. Moreover, the profoundly rocky substrate of the National Park offers suitable habitats for the third and larger-bodied field mouse species, the Western broad-toothed field mouse *A. epimelas*. This species is a medium-sized mouse with a whole body length that reaches 27 cm. Based on current data, *A. epimelas* and *A. flavicollis* have only been recorded in the National Park so far, however it is almost certain that they also occupy other areas of Cephalonia.

The only tree-dwelling Rodent species in Cephalonia and the National Park of Mt. Aenos is the edible dormouse (*Glis glis*, Gliridae). The edible dormouse is the largest, most common species of the Gliridae family in Greece, characterised by a grey fur colour and a bushy tail. Its whole body length can reach 30 cm and it can achieve a weight of 300 gr before entering hibernation at the onset of winter. It is a nocturnal, omnivorous species that hibernates in lower tree parts or even underground, up to a depth of 60 cm (Macdonald & Barrett 1993)! The observant visitor will hear it moving among tree branches (Fig. 23) or will locate mounds of e.g. eaten pine cones on the ground that disclose its presence.

Upon entering the National Park at dawn or upon exiting at dusk, it is very likely to encounter hares (*Lepus europaeus*, Leporidae) on the main and peripheral road network that will attempt to slip away, by moving fast and constantly changing direction. Even though the distribution of this nocturnal species is not restricted to the National Park in Cephalonia, it is possible that its most sizeable populations live within the National Park's borders. This is probably due to the fact that hunting is prohibited in the National Park, which makes the Park a safe haven away from human threats that permits unhampered breeding. In contrast, no European rabbits (*Oryctolagus cuniculus*) have been reported in Cephalonia. It is easy to distinguish the hare from the rabbit, since the former is larger with bigger hind limbs and black-tipped ears that are longer than the head length. When running, the hare's tail remains horizontal and its black dorsal colour is visible, while in the rabbit the tails rises, revealing its white ventral surface.

Regarding the Carnivora species reported from the National Park of Mt. Aenos, on top of the wildcat, the Eurasian badger and the lesser weasel, discussed previously, the red fox (*Vulpes vulpes*, Canidae) and the pine marten (*Martes foina,* Mustelidae) have also been reported in older literature (Catsadorakis 1985, Dianantis & Gounaris 1973, Giagia-Athanasopoulou 1998). The presence of the red fox is considered rather rare not only for the National Park, but also for Cephalonia in general, with only sporadic encounters in the last decades. Also, even though by comparison the beech marten is the most common Carnivore in Cephalonia and possibly in the National Park, only a few sightings have been confirmed. In general, despite the recent, extensive surveys on the fauna of the National Park of Mt. Aenos, the Carnivores remain one of the least studied mammalian groups of Cephalonia.

Fig. 23. The edible dormouse *Glis glis*, is a nocturnal, tree-dwelling Rodent (The photograph is from Razata Cave, Cephalonia).

## E1. Chiroptera

Cephalonia is characterised by a calcareous geological substrate and in particular by a rich network of small and large caves and potholes of considerable scientific value. These are distributed from sea level to the highest altitudes of the island. As an example, we mention the respective caves of the National Park of Mt. Aenos that predispose for a rich Chiroptera (bat) fauna for Cephalonia. Such geological formations constitute suitable habitats for supporting their particular life cycle. However, despite the notable scientific efforts to record the Chiroptera fauna of Greece already since the 19$^{th}$ century, only a few of them had included Cephalonia as a research area (id. Hanák & al. 2001). As a result, up until the end of the 20$^{th}$ century, only three Chiroptera species had officially been recorded from Cephalonia (*Rhinolophus euryale, Rhinolophus hipposideros* and *Pipistrellus kuhlii*), none of which from the National Park of Mt. Aenos (Hanak & al. 2001, Miller 1912)!

In 2003, within the framework of the scientific programme, undertaken under the supervision of Professor E. Giagia-Athanasopoulou (id. Chapter A), the number of known bat species from Cephalonia increased to 6 with the addition of two species of the genus *Rhinolophus (Rh. blasii* and *Rh. ferrumequinum*), as well as of *Myotis myotis* or *Myotis blythii* (a positive species identification was not possible). However, the most important contribution to the study of the Chiroptera fauna of Cephalonia came through the scientific project that was announced by the Management Body of the National Park of Mt. Aenos for the study of the fauna of the National Park and also the rest of Cephalonia, as well as Ithaca (id. Chapter A). A researcher specialising in the study of bats, Dr. Elena Papadatou, was responsible for the recording and monitoring of this animal group, supported by foreign and Greek researchers, as well as by staff members of the Management Body. It should be noted that, since Chiroptera constitute a particularly fragile and sensitive mammalian group, the modern methods that are chosen aim at minimising stress and disturbance for the animals and are followed by their quick release. Therefore, the studies of Chiroptera were conducted through a) direct bat identifications during visits in their habitats (e.g. caves) or through the analysis of photographic material taken during those visits, b) trapping and identification of bat species with the use of specialised trapping equipment, such as mist nets and harp traps (Fig. 24) followed by their immediate release (Fig. 25) and c) recordings, with bat detecting equipment, of the ultrasounds that the bats emit, which were analysed with the use of specific software. It should be noted that the study of bats requires great specialisation and considerable experience in the use of the necessary equipment, in animal handling, as well as in species identification, which quite often appear phenotypically similar.

Based on the results of the above scientific project, the number of known species for Cephalonia increased to ca 19, i.e. 54.3% of the species known from Greece, whereas, as mentioned in the beginning of this chapter, this was the first time that ca 16 species were recorded from the National Park of Mt. Aenos! These species belong to all 4 Chiroptera families that have been recorded in Greece: 1 species of the family Molossidae (*Tadarida teniotis*), 1 species of the family Miniopteridae (*Miniopterus schreibersii*), 4 of the 5 species of the family Rhinolophidae (*Rhinolophus ferrumequinum*, *Rh. hipposideros*, *Rh. blasii* and *Rh. euryale*) known from Greece and 10 out of 28 species of the spe-


Fig. 24. Setting up mist nets in 'Fterolakkos' locality of the National Park of Mt. Aenos (left). Ultrasound recording of a greater horseshoe bat (*Rhinolophus ferrumequinum*), following its capture and prior to its release (right).

Fig. 25. Bat release, following its identification.

ciose family Vespertilionidae (*Eptesicus serotinus, Myotis aurascens, M. blythii, Nyctalus noctula, N. leisleri, Pipistrellus kuhlii, P. nathusii, P. pipistrellus, P. pygmaeus* and *Hypsugo savii*). Moreover, the presence of the species *Myotis myotis* is possible. It should be noted at this point that the report for some of the above species is based on bat sound recordings, which, due to the significant similarities that the sound patterns of some species present, e.g. of the species *Pipistrellus kuhlii/P. nathusii*, their presence will have to be confirmed in the future through direct observations or live trappings.

The above studies included the two most well-known caves of the National Park, both on Mt. Aenos, i.e. Nifi cave and Petasi cave. Nifi cave is found in the SE. slopes of Mt. Aenos and accessing it is not easy, because of the vertical slopes one needs to climb down, in order to reach its opening (Fig. 26). Besides, due to its small size it does not host a large number of bats and during the few visits that have been made, only a few individuals of the greater horseshoe bat were found (*Rhinolophus ferrumequinum*) (Fig. 27). Petasi cave is found above the 'Kissos' location of Mt. Aenos and is easily accessible (Fig. 26) by one of the walking trails of the National Park. It has a sizeable room in two levels of relatively low height. In contrast to Nifi cave, it hosts considerable bat aggregations throughout the year. In detail, at the end of spring and in summer one can record breeding colonies, consisting of females and their young ones, belonging to the species *Rh. ferrumequinum* and *Rh. euryale* (Fig. 28), as well as a few individuals of *Myotis blythii*, whereas during winter it is used as a hibernating area at least by the above species (Fig. 29). The Chiroptera fauna of Mt. Aenos is supplemented by additional species that have been recorded in open areas within the Cephalonian Fir forest. Moreover, bat diversity

Fig. 26. The entrance of Nifi cave (left) and Petasi cave (right) of the National Park.

Fig. 27. Greater horseshoe bat (*Rhinolophus ferrumequinum*) from Nifi cave.

on Mt. Roudi is also impressive, since, despite the lack of caves and the smaller mountain size, it presents a comparable number of bat species with Mt. Aenos!

In summary, from the 16 aforementioned Chiroptera species, about 12 have been recorded on Mt. Aenos, 5 of which (*Tadarida teniotis, Myotis blythii, Rhinolophus ferrumequinum, Rh. hipposideros* and *Rh. euryale*) have not been recorded on Mt. Roudi. Also, 11 species have been reported from Mt. Roudi, 3 of which (*Myotis aurascens*, *Pipistrellus pipistrellus* and *Rhinolophus blasii*) have not been observed on Mt. Aenos. It is also important to note that, based on current information, a relatively rare species, the Serotine (*Eptesicus serotinus*), has been recorded only on Mt. Roudi and nowhere else in Cephalonia! The remaining 7 out of the 16 species occur on both mountains (Mt. Aenos and Mt. Roudi) of the National Park.

For the sake of brevity, the current chapter does not contain detailed descriptions of all the species recorded in the National Park, but only a few that demonstrate the main differences among the bat families to which they belong. It should be noted that, irrespective of any morphological, ecological and other differences among the Chiroptera species of the Greek fauna, all of them are insectivores. For any further information, the reader is encouraged to take advantage of the notable available literature, such as the work by Dietz & al. (2009), from which the following information is taken.

Fig. 28. Horseshoe bat assemblage (*Rhinolophus* sp.) in Petasi cave during summer.

Fig. 29. Mouse-eared bat assemblage (*Myotis myotis/M. blythii*) in Petasi cave during winter.

Family Rhinolophidae (horseshoe bats) includes species that emit ultrasounds through their nostrils. Their snout is characterised by complex skin formations (noseleaf), the largest of which is horseshoe-shaped. This peculiar structure manages to focus the emitted sounds at specific areas in front of the face (Fig. 27). This structure presents small differences among different Rhinolophidae species, which are used for species identification. No other species of the Greek bat fauna have such particular nose formations. The species of this family do not carry a tragus at the base of their ear and emit very high frequency ultrasounds that can exceed 100 kHz. In the National Park of Mt. Aenos both the largest (*Rhinolophus ferrumequinum*) and the smallest horseshoe bat species of Greece (*Rh. hipposideros*) were recorded, the latter of which is usually observed as solitary or in groups of few individuals (Fig. 30). Apart from the size difference (body weight of the former reaches 18-24 gr, vs. 4-9 gr of the latter), both species are characterised by remarkable morphological similarity. When in rest position or during hibernation, the flight membrane, called patagium, covers the body almost entirely.

The European free-tailed bat (*Tadarida teniotis*) of the family Molossidae, is a large bat species with a weight that can exceed 30 gr. The tail membrane half-covers it and its rounded ears with no tragus extend forward from the snout. In contrast to Rhinolophidae species, sounds produced by *T. teniotis* are placed within the human hearing range (10-14 kHz), therefore they can be detected by the experienced researcher without the need of specialised equipment. It is the fastest flying bat species of Europe, which flies high at speeds that reach 65 km/h!

Schreiber's bent-winged bat (*Miniopterus schreibersii*) of the family Miniopteridae constitutes a medium-sized bat (body weight: 10-14 gr) with a tail membrane that covers the tail completely (Fig. 31). Its characteristic feature is its dome-like, abrupt forehead and the fact that in rest position the wing tips fold. The ears carry a short, curved tragus. It rests in caves, occasionally forming huge colonies.

Fig. 30. Lesser horseshoe bat (*Rhinolophus hipposideros*), the smallest horseshoe bat of Europe.

Fig. 31. Schreiber's bent-winged bat (*Miniopterus schreibersii*).

Family Vespertilionidae constitutes the most speciose bat family and within some genera, species identification is very difficult. Most species emit ultrasounds of variable frequency that cover a wide sound range. All species carry a tragus and the ears vary in size. The tail is long and is usually completely covered by the wing membrane. In resting position the wings fold at the sides of the body, leaving it almost completely uncovered. The species *Myotis myotis/M. blythii* constitute the largest Vespertilionidae species of the National Park of Mt. Aenos (body weight that approaches 20 gr), whereas the species belonging to the genera *Pipistrellus* (Fig. 32) and *Hypsugo* are the smallest. For example, the pygmy pipistrelle *P. pygmaeus* is one of the smallest bat species of Europe (Fig. 33), with a body weight that does not exceed 7 gr!

## E2. The horses of Mt. Aenos

In the S.-SE. slopes of Mt. Aenos one can notice the free-living, largest Mammals of the National Park: The semi-wild horses of Mt. Aenos (*Equus caballus*). Their existence at that location is the result of another human interference in his natural environment. According to Menegatos (1998), the horses of Mt. Aenos are derived from a horse race of the Pindos mountain range, therefore belonging to the mountain type of Greek horses that locals were buying from regions of western continental Greece in order to use as labour horses in their everyday activities. It is estimated that they were deserted after the end of WWII, and from the few herds existing in the past, only one survives today.

Lacking systematic human support, the horses of Mt. Aenos were forced to adapt to the unhospitable, harsh conditions of the mountain: High altitude, stony-rocky and hard to cross substrate with steep clines, unsuitable or poor quality vegetation, exposure to freezing temperatures in the winter and high temperatures in the summer, lack of a steady, sufficient water supply etc. They are relatively short horses, shorter than those of Pindos by now (Menegatos 1998) with a shoulder height around 1.25-1.30 m and a very rich mane and tail.

Because of the small number of horses that comprises the herd of Mt. Aenos, the unfavourable environmental conditions they are faced with, the pressures they encounter, but also the lack of reliable evidence regarding their way of living, the Management Body of the National Park of Mt. Aenos assumed, during the last years, the coordination of actions, aiming at the thorough study of the existing herd. This study was implemented by staff members of the Management Body, volunteers that contributed to this effort, in the context of volunteering programs that were hosted by the Management Body, but mostly in the framework of the research project that was announced for the period

Fig. 32. Kuhl's pipistrelle (*Pipistrellus kuhlii*), the first bat species that was ever recorded in Cephalonia!

Fig. 33. The pygmy pipistrelle (*Pipistrellus pygmaeus*), one of the smallest bat species of Europe.

Fig. 34. The horses of Mt. Aenos. Their small body and their rich tail and mane are clearly visible. At the same time, the rather unsuitable habitat they live in is apparent.

2012-2015 for the recording and monitoring of the fauna of the National Park (id. chapter A). A significant part of this project was devoted to the horses of Mt. Aenos, under the guidance of the overall project supervisor, Professor A. Sfougaris.

From the results of the above scientific efforts, it becomes apparent that the herd consists of more than 35 individuals, possibly approaching 40, based on the latest, 2015, data. Depending on the season, the herd appears to be subdivided into 4-6 main subgroups, each of which includes 2-8 individuals. It appears also that February-May designates the pregnancy period of the mares, since at that time several subgroups present new colts. Fatalities are rather minimal and usually due to natural causes or accidents.

The horses' habitat mainly includes the areas defined by the human settlements of Arginia, Pastra, Kremmydi and Markopoulo, as well as by the area around the Monastery of Zoodochos Pigi, at the foot of Mt. Aenos. Despite their ecological preference for pasture areas, it appears that they have adapted to the habitats available to them, which include slopes and hills with phryganic and bushy vegetation. However, the restricted availability of herbaceous vegetation in those habitats forces them to enter cultivated areas with cereals and trees, near the above settlements, where damages are caused.

Despite the fact that the herd seems to move and utilise all available habitats, its study for several years has revealed a specific pattern in spatial use, characterised by three distinct phases. During the hot summer period, the horses opt for elevated areas with herbaceous vegetation and Fir trees. They centre their activity around the Monastery of Zoodochos Pigi, where the only natural water spring of Mt. Aenos exists and manages to support the horses (Fig. 35). Also, during this period, the horses appear to occupy steep slopes, a fact that is not compatible with their ecological requirements and certainly constitutes a choice out of necessity, due to antagonistic interactions, disturbance because of the heightened touristic activity of the summer, search for new feeding grounds etc. Even though the area around the Monastery carries, in comparison to neighbouring areas, richer vegetation, it is still considered inadequate for covering the feeding requirements of the horses. Nevertheless, most horses do not exhibit signs of malnutrition, a fact that shows their adaptation to the difficult environmental conditions. During the summer period, the horses may approach the village of Arginia, however they do not move towards lower settlements.

During the cold winter period, the horses choose lower areas with pastures, phrygana and cultivations. Specifically, they approach and enter the villages Markopoulo, Kremmydi and Pastra. During their movement to those areas in autumn the horses feed upon, among other things, almond-leaved pear fruits (*Pyrus amygdaloformis*). They present a rather scattered distribution while in search of food and water in a wider region and on a daily basis they have the tendency to move to higher regions during the day and to lower regions during the afternoon, as soon as the temperature starts falling. At this period of activity it is more common to encounter damages to cultivations, either attributed to grazing or to the horses' habit to roll in the vegetation.

For the prevention of such damages, the inhabitants of these regions put up fences

Fig. 35. The horses of Mt. Aenos around the Monastery of Zoodochos Pigi, during the summer period.

around cultivated fields or in other positions, in an effort to restrict and control the access to the villages, albeit with little success.

Finally, in spring the horses occupy intermediate positions, in comparison to the two previously discussed activity phases and they gather, in order to climb up to the Monastery of Zoodochos Pigi, as summer approaches.

Even though the horse herd of Mt. Aenos seems to remain steady in size with small fluctuations over the years, its small size and low reproductive rate (an average of 4 new colts per year) (Fig. 36), render it particularly vulnerable to pressures from its coexistence with humans and the unsuitability and insufficiency of its habitats for its proper sustenance, as well as prone to diseases and genetic collapsing, due to inbreeding. These risks demand the systematic monitoring, support and protection of the horse herd. A very important role in this effort will be played by continuous public awareness raising activities targeted particularly to the residents of the regions that the horses use. Indeed, several of these residents have the will to contribute to the sustainable management of the horses of Mt. Aenos, despite any discomfort experienced, due to the damages that the horses may cause.

Fig. 36. A group of horses with a young colt among them.

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# PART VIII

## THE NATIONAL PARK OF MT. AENOS AND ITS MANAGEMENT BODY

# THE NATIONAL PARK OF MT. AENOS AND ITS MANAGEMENT BODY

The National Park of Mt. Aenos, Cephalonia, is the smallest National Park of our country with a total area of 28,620 km$^2$ (Fig. 1). In 1962, it was declared a National Park with the Royal Decree 776/1962, having as its main purpose the protection of the *Abies cephalonica* Loudon (Cephalonian Fir) forest, which is an endemic species of Greece. In the Ionian Islands it is exclusively found on Mt. Aenos (Fig. 2). Besides, Mt. Aenos is the *locus classicus* of the Cephalonian Fir, which was described as a new species by the English Botanist J.W. Loudon in 1838 (Fig. 3). At the same time, however, a second reason for declaring this National Park was the protection of its rich and particularly interesting flora and fauna biodiversity. The core of the National Park consists of two unconnected, yet neighbouring areas. The main area is the one around the summit of Megas Soros (alt. 1,627 m), which is 23,160 km$^2$ and the second area is the one around the summit named Roudi or Gioupari (alt. 1,125 m), which is 5,460 km$^2$. It should be noted that the summit Megas Soros as well as the summit Roudi or Gioupari make up the total mountain volume attributed to Mt. Aenos (Fig. 1).

In 1968, the Greek State bought the area of the National Park from the Charity Institution for 3.5 million drachmas. The parties responsible for its management are the Forestry Service of Cephalonia and the Management Body of the National Park of Mt. Aenos. The Management Body of the National Park was founded by law 3044/2002 (GG 197A/27.8.2002), along with 24 more Management Bodies for Protected Areas and has undertaken the protection, promotion and sustainable management of its protected areas. In recognition of its importance, the National Park of Mt. Aenos has been characterised as a European Biogenetic Reserve, it has been included in the European Ecologic Network of Special Zones “Natura 2000” (GR2220002) and in the network of Special Protection Areas of the European Community for the protection of avifauna (GR2220006). With its declaration as a National Park, it was simultaneously designated as a Wildlife Refuge.

In 2003 (GG 918B/4.7.2003) the first Administrative Council of the Management Body of the National Park of Mt. Aenos was appointed, which operated until March 2004. In 2006 (GG 775B/28.6.2006) the second Administrative Council was appointed,

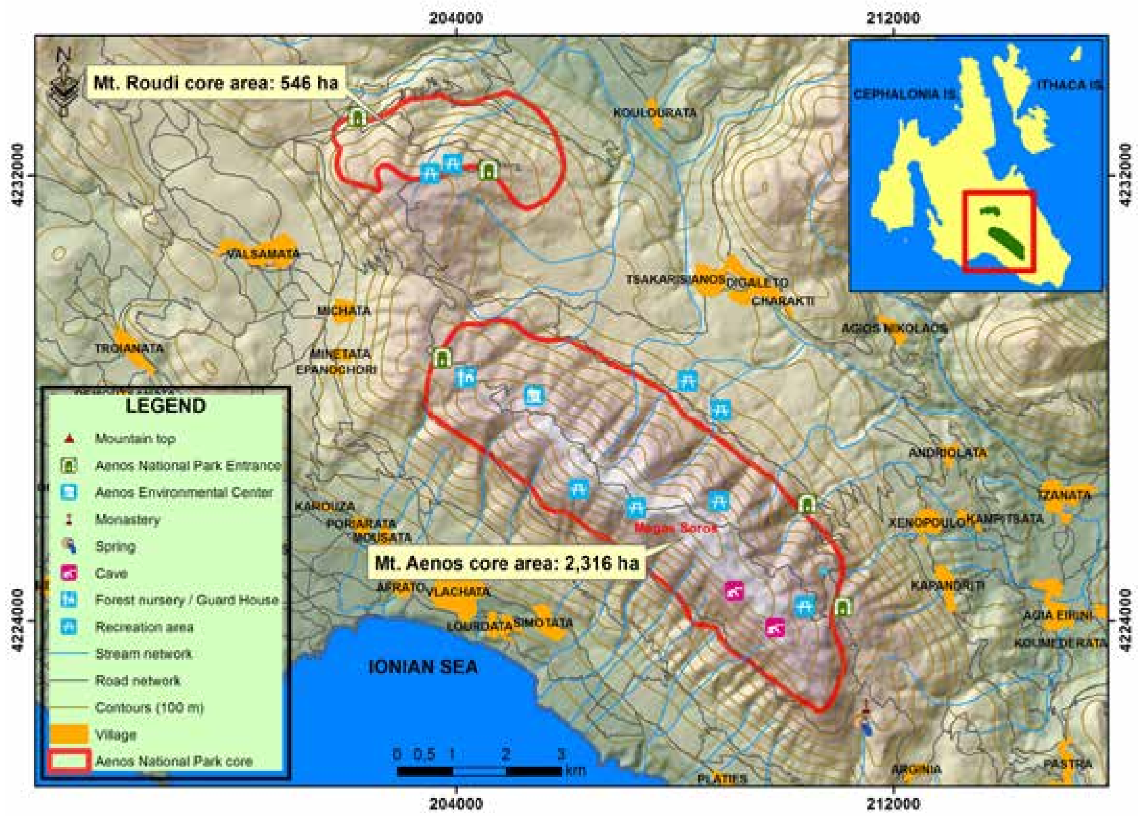


Fig. 1. Map of the core of the National Park of Mt. Aenos.

which remains in power, with only a few modifications in its composition, until today. It consists of 9 appointed and 9 alternate members: it includes representatives of the –then– Ministries of Environment, Development, Agriculture, as well as of Local Administration, Local Stakeholders, specialised scientists and others. Since then and until this day, the President of the Administrative Council is Professor Emeritus of the University of Patras, Dr. Georgia Kamari.

The Management Body, during its first phase of operation, implemented the Project "Management and Operation of Ainos National Park", which was funded by the Operational Programme "ENVIRONMENT 2000-2006" and is already completing the Project with the title "Protection and Conservation of the Biodiversity of Ainos National Park" which was funded by the Operational Programme "ENVIRONMENT AND SUSTAINABLE DEVELOPMENT 2007-2013, extended until the end of 2015" (Priority Axis 9 – "Protection of Natural Environment and Biodiversity") of NSRF, funded by the European Union by 80% and through National funds by 20%. The priorities set by the Management Body during the under-completion Operational Programmme, aim at the protection, conservation and sustainable development of the protected area of the National Park of Mt. Aenos, emphasising on the protection of its biodiversity.

Fig. 2. The *Abies cephalonica* forest on Mt. Aenos, the *locus classicus* for this species.

The scheduled Actions, within the framework of the funded programme, are divided into five main Lines of Actions:

## 1st Line of Actions: Surveillance/Guarding of the National Park of Mt. Aenos by the Management Body

The Management Body of the National Park of Mt. Aenos plays an important role in the Surveillance/Guarding of the National Park of Mt. Aenos. The effective Surveillance/Guarding of the protected area is assured by the drawing out and implementation of an action plan, which defines the daily presence of staff members of the Management Body in the Protected Area. Apart from keeping records of illegal activities within the Protected Area, the Surveillance/Guarding staff of the Management Body is responsible for maintaining the recreational infrastructures of the forest, clearing the forest road network from fallen trees and rocks (Fig. 4), informing the public, providing guided

Fig. 3. *Abies cephalonica* trees on Mt. Aenos. They constitute the emblem of Mt. Aenos and its Management Body.

tours and offering any kind of assistance to the visitors of the National Park.

The Line of Actions "Surveillance/Guarding of the National Park of Mt. Aenos by the Management Body" started being implemented in 2007 once the Management Body was manned with the necessary staff, that is, a Forestry Scientist, a Forest Technician, Forest Rangers, and particularly so once it started hiring 5 individuals (Forest Technician, National Park and Recreational Areas Tour Guide and 3 Forest Rangers) as "seasonal staff" that worked for six months per year (during the busy season). In 2011, the Forestry Scientist of the Management Body was appointed as Supervisor of the Surveillance/Guarding Action and the relevant Action Plan was compiled. Hiring the above staff aimed at the protection the National Park from illegal activities and the prevention of forest fires, especially during the summer months. The Surveillance/Guarding staff is being assisted by the scientific staff of the Management Body, increasing the number of involved individuals in this Action to fifteen. Due to the fact that the institutional framework governing the operation of the Surveillance/Guarding personnel is imperfect, the personnel cannot conduct checks or arrest offenders, so the surveillance is in fact restricted to observations, the issuing of verbal warnings and immediate notification of the proper authorities (e.g. Forestry Service, Fire Department, Vice-Regional Governor etc.), seeking, therefore, the active cooperation and coordination with all the jointly responsible authorities. Ensuring that the operation regulations of the National Park are observed contributes significantly to its effective protection.

Fig. 4. A fallen tree is being removed from the forest road network of the National Park of Mt. Aenos by the staff of the Management Body.

The Surveillance/Guarding Action Plan designates the existence of two interchanging surveillance teams during the summer fire prevention period (01.05-31.10) and one surveillance team during the winter period (01.11-30.04), which patrol from dawn till dusk on a daily basis. The staff surveils, either from stationary locations (which offer a panoramic view to be scanned with binoculars), or as a mobile patrol (Fig. 5). Upon completion of the shift, the team completes a daily report, which states all the incidents recorded, the actions taken, as well as statistical data about the visitors of the National Park (number of individuals, nationality etc.). In case an illegal activity is intercepted, the Action coordinator goes through all the necessary steps to inform the appropriate authorities.

The means at the Management Body's disposal for the safeguarding of the protected area are two 4x4 vehicles, equipped with binoculars, GPS devices, first aid kits, field guides about flora, fauna and avifauna species, as well as habitat types, detailed maps of the area and informative leaflets for visitors. For the best coordination not only among the members of the surveilling team during each shift, but also between them and the Fire Department, especially during the critical fire prevention period, a radio communication system is in operation.

Furthermore, during the fire prevention period, one of the Management Body's vehicles is equipped with fire-fighting equipment, consisting of a water tank, a petrol engine, a water pump and related accessories (fire hoses etc.) that offers a fighting chance in case of a fire. Also, the above vehicle is permanently equipped with an electric winch, fixed at its front end, which allows the towing of stranded cars and the removal of large objects (fallen trees or rocks/boulders) from the forest road network of the National Park.


Fig. 5. The staff of the Surveillance/Guarding Line of Actions of the Management Body operates either from stationary locations or as a mobile patrol.

The staff is equipped with professional tools and equipment, such as chainsaws, a hedge trimmer, digging tools, a toolbox, tarmac brooms, towing belts, fortified ropes, an expandable ladder, a fence cutter, ribbons for cordoning off areas, safety vests, work gloves, protective gloves for fires, safety masks, etc., so that they can immediately and effectively intervene to solve any problems that may arise.

The National Park of Mt. Aenos, as is also true for all the protected areas of Greece, is faced with numerous threats. In rare cases there have been reports of illegal activities, such as the lighting of a fire, collection of plants and other species, which are all against the operation regulations of the National Park (Fig. 6).

Based on the experience gathered so far from this Line of Actions by the corresponding staff, the most serious threats that have been recorded are briefly discussed below: the most serious, direct threat posed against the natural environment of the National Park, especially during the summer months, is the fire threat. The majority of forest fires threatening the National Park are related to arson and mostly originate from pastural or forest areas in the peripheral zone of the National Park, and mainly from the SW. slopes of Mt. Aenos. There have been cases of fires having originated from lightning, but those are rather rare, isolated events.

The most dangerous fire (Fig. 7), which started just above the village Vlachata and threatened the National Park with destruction, broke out on 17.08.2010. The threat for the National Park was averted, thanks to the extraordinary efforts of the Fire Department, but also of the personnel of the Management Body and all the people involved in putting out the fire, the existing peripheral road of the National Park, and most importantly, thanks to the change in wind direction.

Another serious threat to the biodiversity of the National Park is the illegal grazing in the core of the Protected Area. The Forestry Service, realising the danger of degrading the natural wealth of the National Park because of illegal grazing, went on in 1968 to demarcate the borders of the National Park and build a fence around it. As expected, after half a century went by, the fence is in its majority destroyed and the personnel of the Management Body has undertaken anew the demarcation of the National Park preparing the reconstruction of its fence (Fig. 8).

The Surveillance/Guarding personnel of the Management Body of the National Park of Mt. Aenos successfully concluded the demarcation of the fence of the core of the National Park in 2012. The demarcation was created on-site with the use of GPS equipment. A study was then carried out for the replacement/repair of the fence, which, unfortunately, is still awaiting approval from the proper Forestry Services. Despite those measures, the danger from illegal grazing remains serious until today, due to the great exploitation of the grazing grounds around the National Park by pastural farming and,


Fig. 6. Poster in the National Park with the regulations to be followed, during a visit.

Fig. 7. The dangerous fire that broke out just above the village Vlachata on the SW. slopes of Mt. Aenos and threatened the National Park with destruction.

of course, because of the largely destroyed and thus ineffective fence. The farm animals, mainly because of lack of supervision, enter the core of the National Park (Fig. 9), causing the destruction of both the herbaceous and bushy vegetation and hampering the regeneration of the Cephalonian Fir forest. The long-lasting overgrazing in the National Park has had as a result, the crucial degrading (desertification) of the soil in many areas, as well as the reduction of the biodiversity in the core.

The study and meticulous monitoring of illegal grazing by the staff of the Management Body during the past years has proven that its daily presence in the Park has played an important, diminishing effect on this illegal activity (Fig. 10).

Hunting in the core of the Park was forbidden with the declaration of the National Park. Because of inadequate guarding during the previous years, poaching incidents occurred often. Today, with the daily presence of the Surveillance/Guarding personnel of the Management Body, this illegal activity has been significantly restrained. The rare poaching events that have been recorded are dealt with according to the forestry legislation and formal complaints are filed with the Forestry Service of Cephalonia.

The number of visitors to the National Park increases during the summer months, that is, from June till August, while in winter there is a rise in the number of visitors

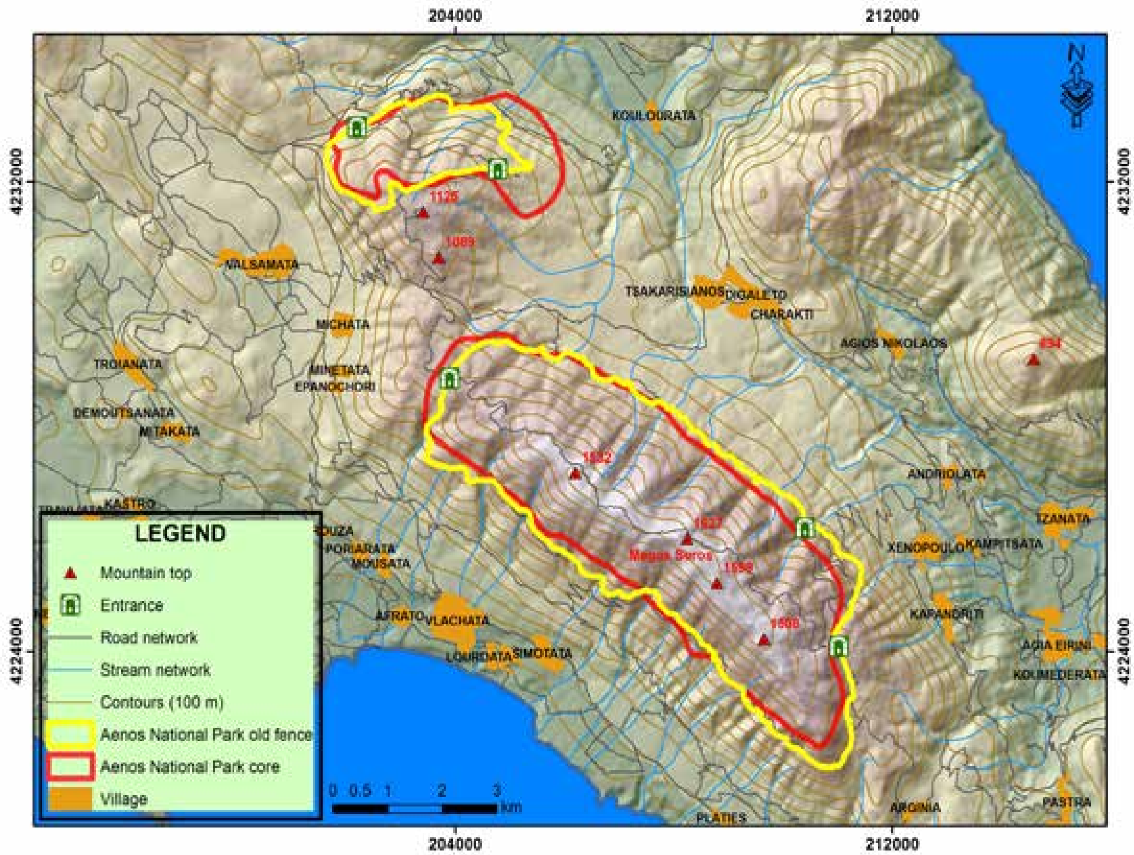


Fig. 8. Limits of the old and new fence of the core of the National Park of Mt. Aenos.

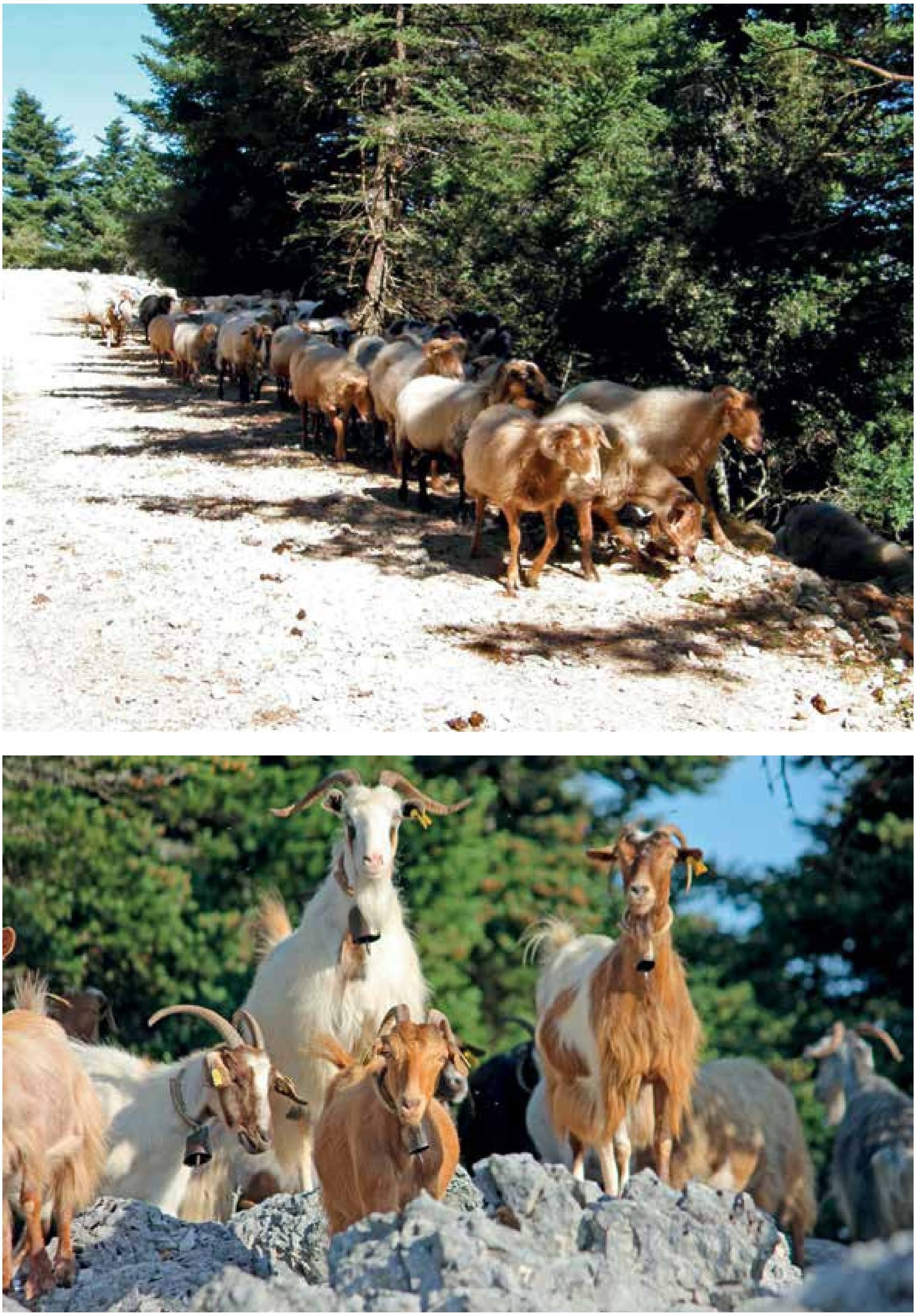

Fig. 9. Incidents of illegal grazing in the Core of the National Park.

during sunny days and especially after a heavy snowfall. The great majority of visitors treats the National Park with the utmost respect.

The establishment of the radio-television and telecommunication transmitters in the location 'Chionistra' of the National Park, resulted in a serious degradation of the natural characteristics of the affected habitat and in the limitation of the area of occurrence of rare and endemic plant species of Mt. Aenos. In an attempt to protect this location from further human influence, a fence was put up in 2008 by the Management Body of the National Park with the help of the Forestry Service of Cephalonia, which ensured the reproduction and conservation of these species (Fig. 11).

During the ending Programming Period (2007-2013), illegal grazing constitutes the most profound illegal activity recorded by the personnel of the Management Body within the Core of the National Park (82.4%), followed by vandalisms on the Park's recreational facilities (6.4%) and the illegal collection of flora species (4.2%) (Fig. 12).

Other important activities in which the Surveillance/Guarding personnel participates are their contribution to the recording of the biodiversity of the National Park of Mt. Aenos and of Cephalonia in general, the support on environmental awareness activities for the public and the environmental education of students, but also their involvement in all the actions undertaken by the Management Body, which it conducts either on its own or in

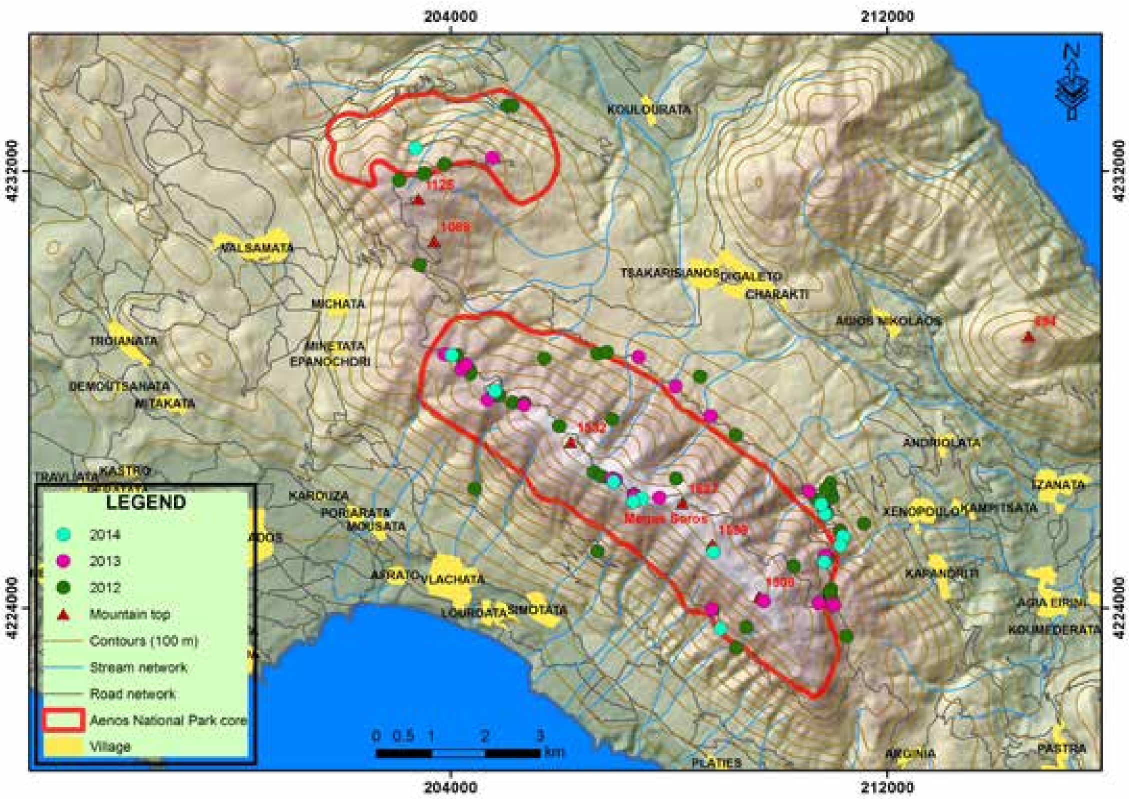


Fig. 10. Records of illegal grazing incidents during the years 2012, 2013 and 2014.

collaboration with external partners (Universities, private companies and others). The surveillance but also the scientific staff are constantly being trained, thus acquiring vital experience in the recording and observation of the biodiversity of the National Park.

Besides, the Management Body today, with its constant presence, has succeeded in owning an important digital database on the biodiversity of the National Park of Mt. Aenos, in recording and photographing every important event and in collecting monitoring data for species and habitat types!

The Surveillance/Guarding personnel of the Management Body of the National Park of Mt. Aenos (Fig. 13) conducts, in cooperation with primary and secondary education partners, environmental awareness raising activities and guided tours for groups, schools and visitors on the trails of the National Park of Mt. Aenos, offering them a day filled with beautiful experiences in the Cephalonian Fir forest. Furthermore, in cooperation with the Prefecture and the Municipality of Cephalonia, it guides the visitors to the Centre of Environmental Education of Mt. Aenos, as well as to related Info Days.

Fig. 11. The summit 'Chionistra' on Mt. Aenos, where the "Antennae Park" and the habitat of *Viola cephalonica* are located. This is the small area that was fenced for the conservation of *Viola* and the other endemic species that grow there.

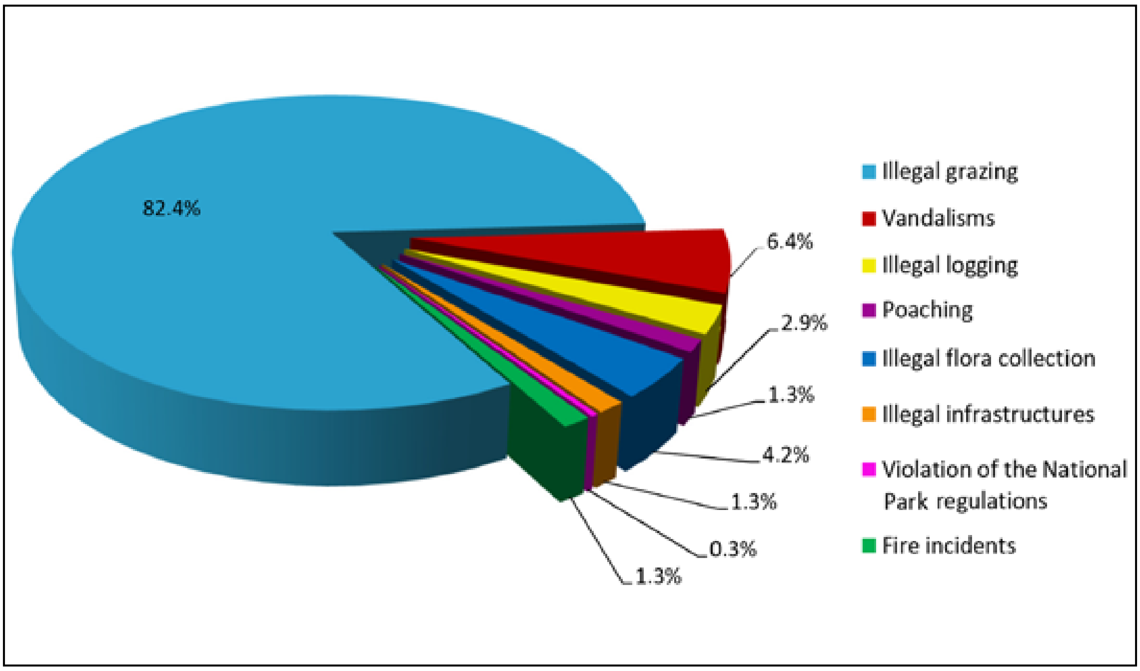


Fig. 12. Incidents of illegal activities in the National Park of Mt. Aenos.

Fig. 13. The President of the Administrative Council and part of the personnel of the Management Body of the National Park of Mt. Aenos, in the excursion that took place during the 17th Panhellenic Forestry Meeting, in October 2015.

## 2nd Line of Actions: Recording and monitoring of the biodiversity of the protected area

In short, the Actions related to recording and monitoring the biotic parametres, conducted by the personnel of the Management Body, in conjunction with collaborating external partners, are the following:

### 2.1. Recording, monitoring and sustainable management of the Flora of the National Park of Mt. Aenos, but also of the wider region of Cephalonia and Ithaca

External Partner: University Patras, Department of Biology, Scientific Supervisor: Assistant Professor Dr. A. Livaniou-Tiniakou.

Regarding the flora of the National Park, in Part V of this book ''THE FLORA OF MT. AENOS'' (p. 115) there is much information about both the floral diversity of the National Park and the most important endemic or rare species found in it. The University of Patras team mainly focused on the monitoring and assessment of 17 floral species for which the threat status had to be assessed, according to the international IUCN guidelines (2001, 2003, 2006).

According to the above study, the relevant literature (Phitos & Damboldt 1985, Efthymiatou-Katsouni 1998, 2012) and the recordings of the scientific personnel of the Management Body, it was concluded that there are around 450 species of flora in the National Park (Pteridophyta and Spermatophyta), of which 36 are endemic of Greece, 7 of the Ionian Islands and 2 are exclusive endemics and grow only on the National Park.

In general, as shown in Fig. 14, only 14.2% out of the 450 recorded taxa found on Mt. Aenos, are under some regime of protection and are included in Greek (Natura 2000) or international (IUCN, CITES) lists, the Presidential Decree (P.D. 67/81) or in Red Data Books.

Between the two exclusive endemics of the Park, *Viola cephalonica* Bornm, which is a narrow endemic species of Mt. Aenos, has a distinguished position (Fig. 15, 16). It is found only on its highest peaks, from the locations 'Chionistra', 'Megas Soros' up to the peak 'Koumpia', growing on open rocky locations. It has been described in the *Red Data Book of the Rare and Threatened Plants of Greece* (Phitos & al. 2009) as Critically Endangered (CR), according to the IUCN criteria (2001).

The second narrow endemic taxon occurring only in the National Park is *Scutellaria rupestris* subsp. *cephalonica* (Bornm) Greuter & Burdet (Fig. 17A), which is often found together with *Viola cephalonica*. It has been characterised as Endangered (EN) in the *Red*

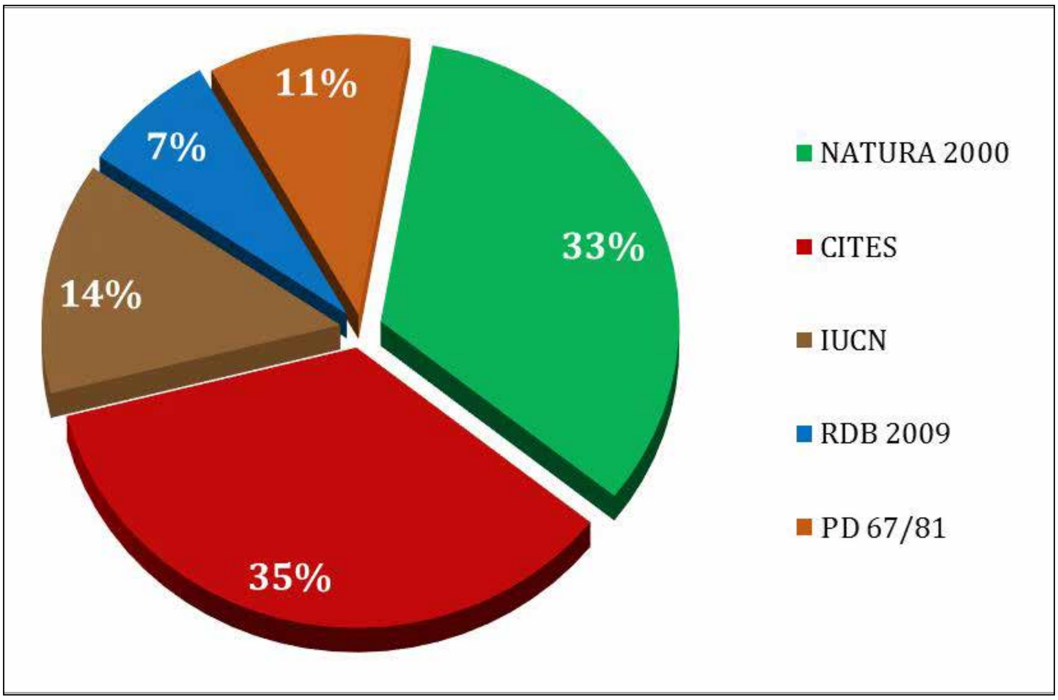


Fig. 14. Percentage of the species of Mt. Aenos, which are in a regime of protection.

Fig. 15. The distribution area and the habitat of *Viola cephalonica* at the top of Mt. Aenos.

Fig. 16. *Viola cephalonica* at the location 'Chionistra' of Mt. Aenos.

*Data Book*, mainly because of the very small population size. Some additional endemic species of the Ionian phytogeographical area, which have been found on Mt. Aenos and which are also included in the *Red Data Book* are the following: *Saponaria aenesia* Heldr (Fig. 17C) which is also mentioned as Endangered (EN), the endemic subspecies *Campanula garganica* subsp. *cephallenica* (Feer) Hayek (Fig. 17D) along with the rare and impressive subspecies *Paeonia mascula* subsp. *russoi*, which are both evaluated as Vulnerable (VU). More information on the rare and interesting taxa of Mt. Aenos is found, as well, in Part V of this book ''THE FLORA OF MT. AENOS'' (p. 115).

## 2.2. Recording, monitoring and sustainable management of the fauna of the National Park of Mt. Aenos but also of the wider region of the Prefecture of Cephalonia-Ithaca

External Partner: University Thessaly, Department of Geopony, Scientific Supervisor: Professor A. Sfougaris, in cooperation with the Departments of Biology of the University of Patras and the Aristotle University of Thessaloniki.


Fig. 17. Some of the rare plants of Mt. Aenos: A, *Scutellaria rupestris* subsp. *cephalonica.* B, *Campanula garganica* subsp. *cephallenica.* C, *Saponaria aenesia* and D, *Paeonia mascula* subsp. *russoi.*

Regarding the fauna of the National Park of Mt. Aenos, much information is provided in Part VII of this book “THE FAUNA OF MT. AENOS” both on the diversity of the National Park and on the most important, endemic or rare species which are found there.

More specifically, the scientific personnel of the Management Body emphasised on the monitoring of the 35-40 horses of Mt. Aenos (*Equus caballus* L.), which live in a semi-wild state in the area of the Monastery of Zoodochos Pigi and elsewhere (Fig. 18). During this monitoring period, the contribution of the personnel of the Management Body but also of Greek and foreign volunteers, within the framework of the programme European Voluntary Service (EVS) was vital (Fig. 19). Moreover, the monitoring of the horses of Mt. Aenos was assigned in the context of a Practical Training to a student from AgroParisTech (Paris Institute of Technology for Life, Food, and Environmental Sciences) under the supervision of the Management Body’s personnel.

### 2.3. Assistance in the assessment of the conservation status of certain species of avifauna within the SPA of the Management Body, under the Directive 79/409/EEC

External Partner: “TECHNOMOIOSTASI O.E.”, Scientific Supervisor: Associate Professor P. Birtsas.

The study included the search for presence, the recording and the assessment of the conservation status of the endemic, rare and threatened species of avifauna and particularly of the species of community interest of the Directive79/409/EEC, for the conservation of wild birds in the Protected Area of the National Park of Mt. Aenos and Cephalonia, in general.

More specifically, since 2013, the personnel of the Management Body participated in the scientific monitoring of the avifauna of Cephalonia. The surveys took place not only in the National Park of Mt. Aenos, but also in the two most important wetlands of Cephalonia (Koutavos and Livadi), in which the presence of more than 120 species of birds was recorded (Fig. 20). These results have been announced in Scientific Conferences (Xanthakis & al. 2014, 2015)

### 2.4. Assisting in the assessment of the conservation status of habitat types in the National Park of Mt. Aenos

External Partner: ‘TECHNOMIOSTASI G.P.’, Scientific Supervisor: Dr. Paulos Konstantinidis, Senior Researcher, Hellenic Agriculture Organisation “DIMITRA”.

This study concerns the recording, monitoring and mapping of the habitat types in the core and the peripheral zone of the National Park of Mt. Aenos, as well as the

Fig. 18. The semi-wild horses (*Equus caballus*) in the National Park of Mt. Aenos.

Fig. 19. Horses monitored by a volunteer of the EVS programme at the Monastery of Zoodochos Pigi, Mt. Aenos.

Fig. 20. Little egrets (*Egretta garzetta*) observed by the personnel of the Management Body at the wetland of Livadi.

assessment of their conservation status.

More information on the habitat types can be found in Part IV of the book "THE VEGETATION OF MT. AENOS" (p. 89).

## 2.5. Recording and monitoring of Macromycetes species (mushrooms) in the National Park of Mt. Aenos

External Partner: National and Kapodistrian University of Athens, Department of Biology, Scientific Supervisor: Lecturer Zacharoula Gonou-Zagou.

The study concerns the recording and monitoring of macromycetes species in the protected area of the National Park of Mt. Aenos, as well as in other areas on the island of Cephalonia. Most emphasis was given to species with rare appearance and/or limited distribution.

The contribution of the Management Body's personnel was also very important, as was the knowledge gained in recording the mushroom biodiversity of Mt. Aenos, examples of which are given in Fig. 21.

The results derived from the work of the external partner are presented in Part VI of this book (p. 187).

The monitoring of the macromycetes of the National Park will continue with the cooperation between the scientific personnel of the Management Body and the University of Athens.


Fig. 21. Results of the cooperation of the Management Body in the monitoring of mushrooms: A, *Geopora* sp. B, *Amanita muscaria*. C, *Cortinarius* sp. D, *Clitocybe* sp.

## 3rd Line of Actions: Information/Awareness Raising – Communication Strategy

This Line of Actions is implemented through direct labour by the Management Body.

In order for the Management Body to successfully complete the scheduled Actions for the protection, promotion and management of the National Park, it is necessary to clearly present its role to the local community, so as to receive acceptance. Towards this goal, an integrated communication strategy has been planned and is being carried out, throughout the programme's duration, which aims at acquainting the local community with the key role that the Management Body plays in the protection of the National Park of Mt. Aenos, but, furthermore, to encourage the active participation of organised groups, pupils and citizens towards this effort.

In order to achieve this important goal, this particular Line of Actions includes informing and raising awareness among the island's population, the pupils of primary and secondary education but also the visitors, as well as organised groups. Towards this direction, activities with special presentations are held in the Centre of Environmental Information of Koutavos in Argostoli, which hosts the main office of the Management Body (Fig. 22), in the Environmental Centre of Mt. Aenos (Fig. 23), which is located in the core of the National Park or as part of guided tours on Mt Aenos. The topics discussed are the special/unique abiotic and biotic characteristics and the value of the ecosystems of the National Park of Mt. Aenos, as well as the pressures and threats that they face. The aim of these activities is the awareness raising among the citizens on the necessity for protection and respect toward the protected area, but also on the undisputable benefits that are derived from it.

More specifically:

### 3.1. The Trails of the National Park of Mt. Aenos

The National Park of Mt. Aenos attracts thousands of visitors, particularly because of the impressive Cephalonian Fir forest, the famous typical Mediterranean vegetation elements, its rich biodiversity, its mythical charm and its ease of accessibility.

The roads and trails that run through Mt. Aenos, a network in excellent condition, offer the experienced trekker, as well as the visitor, who does not have a particular interest or experience in mountaineering, a chance to learn more about Mt. Aenos and its rich biodiversity.

The Management Body of the National Park, in its attempt to promote the biodiversity of the flora, the fauna, the avifauna and the natural beauty of Mt. Aenos, designed informative posters and placed them in chosen locations throughout the core, providing readers with useful directions about what is allowed and what is forbidden (Fig. 6), with

Fig. 22. The Centre of Environmental Information of Koutavos in Argostoli, where the Management Body of the National Park of Mt. Aenos operates.

Fig. 23. The Environmental Centre of Mt. Aenos, where there is a special exhibition with information on the National Park and the capability for presentations or accommodation of small groups of people.

thematic posters about the entrances of the National Park (Fig. 24), information about the flora and the fauna of the National Park (Fig. 25), about the Cephalonian Fir (Fig. 26) and about the narrow endemic species *Viola cephalonica* (Fig. 27) and finally on its trekking trails (Figs 28, 29 & 30).

The National Park of Mt. Aenos has five trekking trails, with a small or medium degree of difficulty and with a total length of 26 km. The paths of Mt. Aenos are shown on a map (Fig. 28), but for each trekking trail, the Management Body has created special posters with all the information about them. The trails of Mt. Aenos are the following:

Fig. 24. Informational poster at the entrance of the National Park above Arginia.

### a. “Environmental Centre of Mt. Aenos – Chionistra”

***Trail Description:***

**Start – Finish**: Environmental Centre of Mt. Aenos (the route is circular).

**Length**: 6,184 m.

**Duration**: About 1 ½ hours.

**Inclination**: Part A (largest part): small (10-30% uphill), Part B (on the main road): very small (10-20% downhill).

**Difficulty level**: 1 – Small.

**Altitude at Start/Finish**: 1,384 m.

**Recreational areas**: 1) close to the Environmental Centre of Mt. Aenos 2) on the trail, 3) before the location Chionistra.

**Shading**: Broad shading almost throughout the trail.


Fig. 25. Poster in the National Park with information about its flora and fauna.

## b. “Epano Eza – Melissi”

***Trail Description:***

**Start**: Location Epano Eza (left of the Main Entrance of the Park).

**Finish**: Location Melissi (on the north peripheral dirt road of the Park).

**Length**: 2,596 m.

**Duration**: About 1 ½ hours.

**Inclination**: Small to medium (5-30%).

**Difficulty level**: 2 – Medium.

**Altitude at Start**: 1,044 m.

**Altitude at Finish**: 770 m.

**Recreational areas**: None.

**Shading**: Broad shading almost throughout the trail.

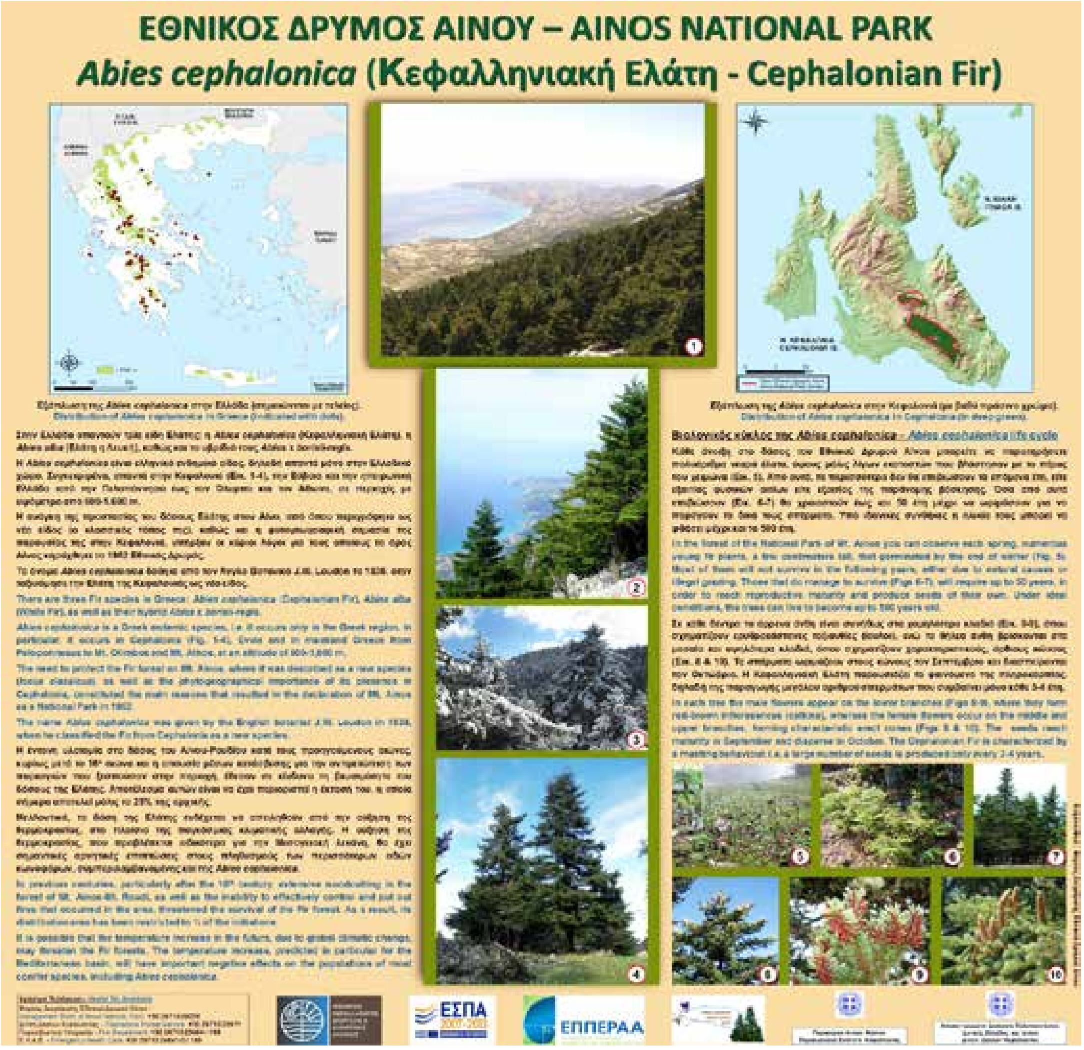


Fig. 26. Thematic poster in the National Park about *Abies cephalonica.*

## c. "Environmental Centre of Mt. Aenos – location Aria"

***Trail information:***

**Start**: Location Aria.

**Finish**: Environmental Centre of Mt. Aenos.

**Length**: 2,065 m.

**Duration**: About 1 ½ hours.

**Inclination**: Medium (up to 30% uphill).

**Difficulty level**: 2 – Medium.

**Altitude at Start**: 865 m.

**Altitude at Finish**: 1,288 m.

**Recreational areas**: None.

**Shading**: In certain parts only.

Fig. 27. Thematic poster with information about *Viola cephalonica* and its habitat.

## d. ”Kissos-Petasi-Kroukoumpia (Nyfi)-Megas Soros-Kissos” (Fig. 29)

***Trail information:***

**Start – Finish**: Location Kissos (suggested route is circular).

**Length**: 8,640 m.

**Duration**: About 4 ½ hours.

**Inclination**: Part A: medium (30-40%), Part B: small (10-30%), Part C: very small (10-20%), Part D: very small (dirt road).

**Difficulty level**: Parts A & B: 2 – Medium, Parts C & D: 1 – Small.

**Altitude at Start/Finish**: 1,200 m.

**Recreational areas**: Close to the starting point.

**Shading**: Broad shading in parts A & D, none in parts B & C.

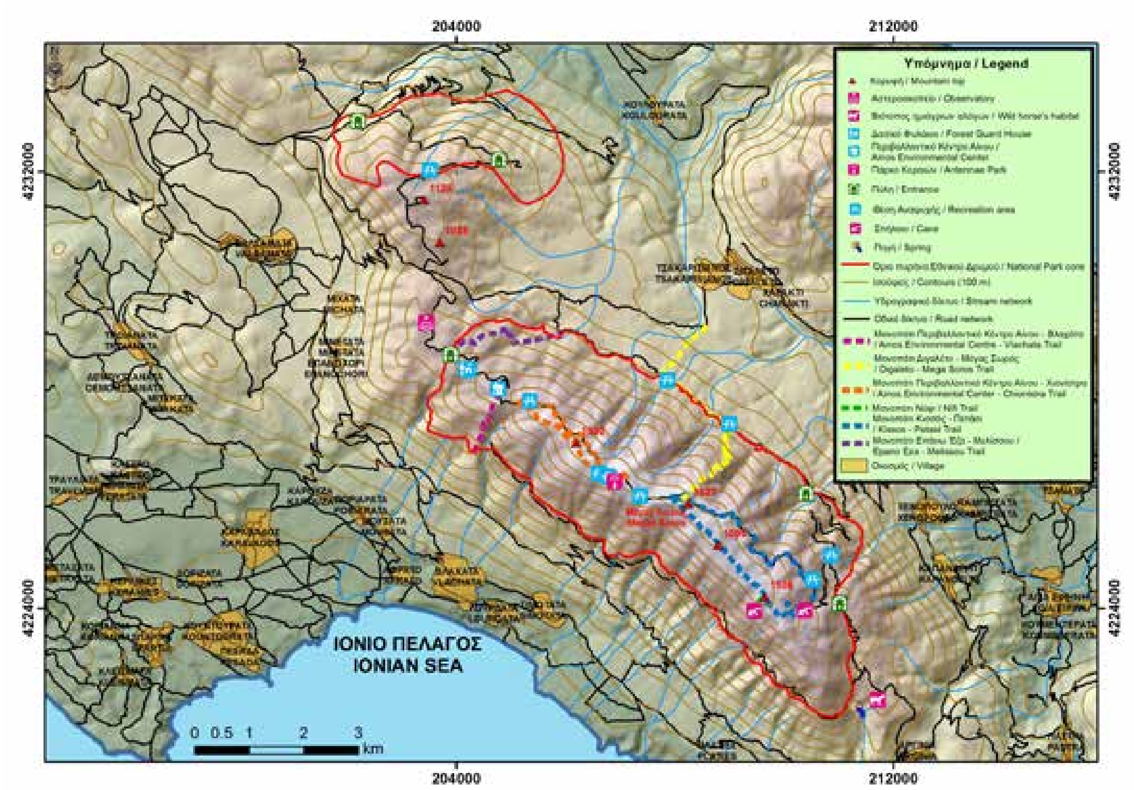


Fig. 28. Map of the National Park with its borders (red line) and the 5 trails (in various colours) outlined.

## e. "Digaleto – Megas Soros" (Fig. 30)

***Trail information:***

**Start**: 1 km south of the village Digaleto on the "Digaleto – Ag. Eleftherios" road.
**Finish**: Aenos summit
**Length**: 6,595 m.
**Duration**: About 4 ½ hours.
**Inclination**: Part A: small (up to 20%), Part B: very small (dirt road), Part C: large (45-50%), Part D: large (over 45%).
**Difficulty level**: Parts A & B: 1 – Small, Parts C & D: 2 – Medium.
**Altitude at Start**: 532 m.
**Altitude at Finish**: 1,627 m.
**Recreational areas**: Karvounolakos, Pigadia, Kato Soros.
**Shading**: Broad shading almost throughout the trail.

In many places along the trails there are recreational areas with benches, which offer a magnificent view and moments of rest and meditation for the visitors. Visitors with enough time to spare can climb up to the highest peak of Mt. Aenos (Megas Soros, 1,627 m.), by following either the fourth or the fifth trail. Moreover, by following the first or the third trail they can visit the Environmental Centre of Mt. Aenos and explore the exhibition on the National Park, guided by the personnel of the Management Body, while, at the same time enjoying the breathtaking view of Argostoli and Lixouri from the balcony of the building.

The project of creating the trails of the National Park of Aenos was funded by the Operational Programme "Environment and Sustainable Development" (EPPERAA) and it was a subproject included in the Project: "Protection and Promotion of the National Park of Aenos". The Prefectural Administration of Cephalonia & Ithaca was the initial project promoter, but following the 'Kallikrates' project that led to a thorough reorganisation of

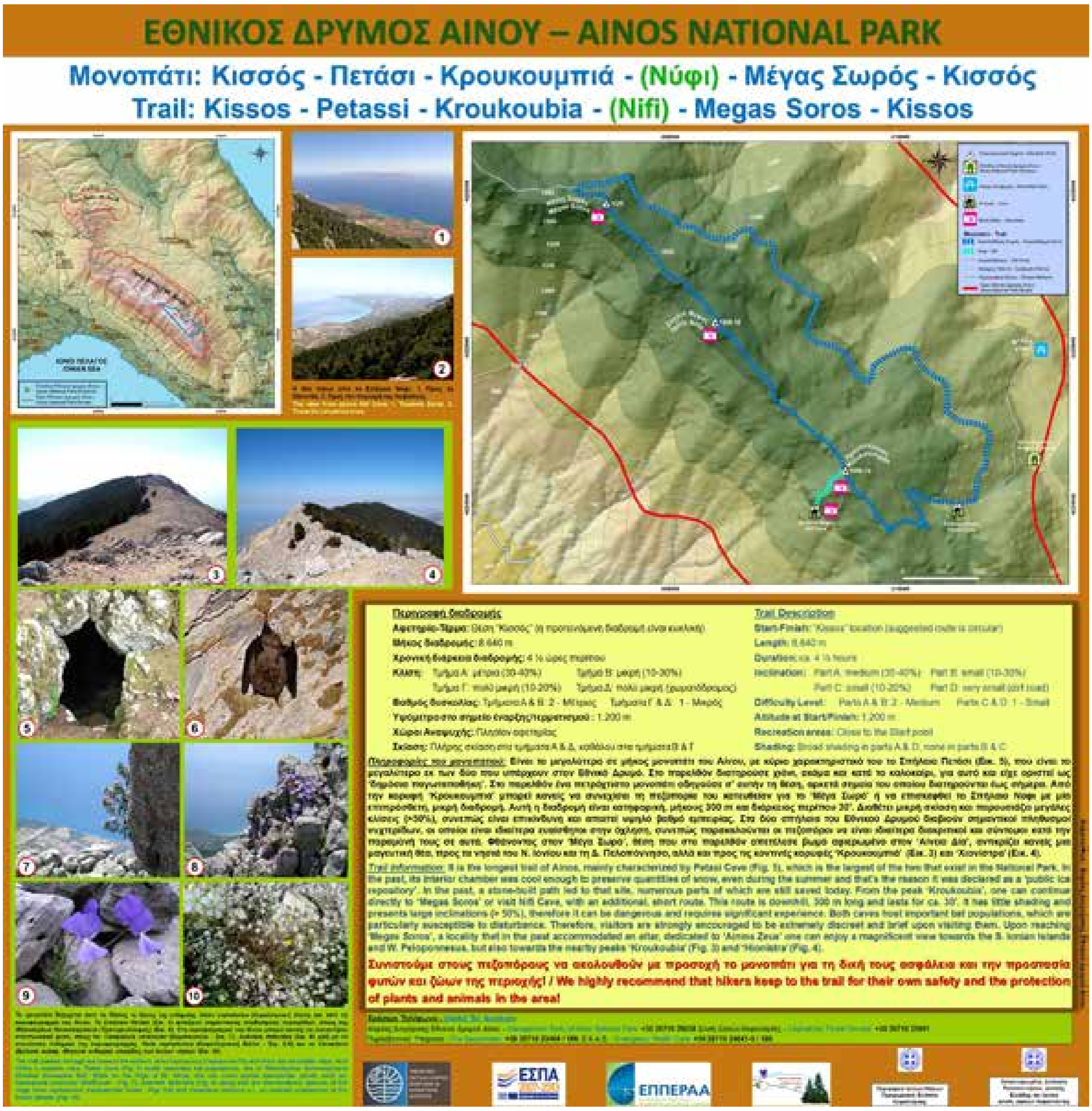


Fig. 29. Informational poster on the circular path "Kissos – Petasi – Kroukoumpia (Nifi) – Megas Soros – Kissos".


Fig. 30. Informational poster on the trail "Digaleto – Megas Soros" of Mt. Aenos.

the Local Administration in Greece, the project was completed by the Regional Unit of Cephalonia and was delivered to use in 2012.

The participation of the local community in Information/Awareness Raising activities is crucial in order for the Management Body to achieve its goals in protecting, managing and promoting the National Park. By organising trekking excursions, at times covering a specific topic – e.g. learning about the mushrooms of Mt. Aenos, the orchids of Mt. Aenos, excursions on Environmental Day or on Forestry Day and others – visitors have the opportunity to receive information about the protected area, the Cephalonian Fir forest and its uniqueness and a chance to further acquaint themselves with the biodiversity of the Park, while locating rare species of plants and animals.

For instance, the informative seminar and excursion for the aromatic and edible oregano plant is one of the many important activities, which the Management Body hosts every year in summer. Aim of the excursion is to inform the visitors of the National Park about the oregano plant and proper collection practices, thus helping achieve its sustainable management in the area (Fig. 31 & 32).

## 3.2. Environmental Education Activities designed for schools

### 3.2.a. Student visits to the Environmental Centres:

The schools that visit the Centre for Environmental Information of Koutavos receive information about the wetland of Koutavos and its importance and are guided through the exhibition of the Centre, where information about the environment of Cephalonia is presented to them. The area of Koutavos lagoon is an excellent environment for familiarising the pupils with birdwatching. The Management Body lends out binoculars and spotting scopes during their visit and they recognise birds by using illustrated field guides (Fig. 33). Of course, their visit cannot but include games (Fig. 34). The children add to their positive memories from the visit to Koutavos lagoon with their participation in games and crafts (Fig. 35). In the Environmental Centre of Mt. Aenos, in which there is an exhibition on the biodiversity of the National Park, guided tours take place for groups of pupils or other visitors (Fig. 36).

The area of Mt. Aenos offers the opportunity to hike on forest trails, with degrees of difficulty low enough to make them suitable for children. Trekking in the forest of Mt. Aenos is a great chance for children to get closely acquainted with the forest and its elements and to learn about the rare and endemic species of Cephalonia (Fig. 37). In this way, the pupils of primary (Fig. 38) and secondary education (Fig. 39) will not only find out about the Cephalonian Fir but also about the Cephalonian Violet, the Bugle of Mt. Aenos, the Soapwort of Mt. Aenos, the Bellflower, the orchids and many more. The National Park has recreational areas, ideal for resting and for games (Fig. 40). In that way, children become environmentally aware and learn to love nature.

### 3.2.b. Environmental Education at schools:

In those cases where the pupils of schools did not have the means to visit one of the two Environmental Centres, operated by the Management Body, the personnel would visit those schools so that they, too, could also participate in environmental education activities (Fig. 40). The intention is to provide environmental education to as many

Fig. 31. Collecting oregano at 'Fagias' locality after a specialised seminar on the proper collection and preservation practices.

Fig. 32. Following the collection of oregano, the traditional 'riganada' takes place in the Monastery of Zoodochos Pigi.

Fig. 33. Birdwatching at Koutavos Lagoon by young pupils.

Fig. 34. Environmental Education of pupils in the area around the Centre of Environmental Information of Koutavos.

Fig. 35. Games and crafts by pupils at the Centre of Environmental Information of Koutavos.

pupils as possible, mainly about the National Park of Mt. Aenos and through this process the work of the Management Body can become known, since the children get a first-hand experience of its activities for the protection of the environment.

Fig. 36. A guided tour, taking place in the Environmental Centre of Mt. Aenos.

**3.2.c. Green corners and composting at schools:**

An important activity of the Management Body is the creation of small gardens at schools, where pupils learn to grow endemic and rare plants (Fig. 41).

The Management Body, using the funding tool “Natural Environment” of the Green Fund, purchased composters, which were given to primary and secondary schools, so as to make the children aware of how to produce natural fertilisers for plants (Fig. 42).

**3.2.d. Teacher awareness on Environmental Education:**

Aiming at offering teachers the most complete and detailed information about the environmental education programmes that can be offered by the Management Body to pupils, in cooperation with the Offices of School Activities of Primary and Secondary Education, a relevant Informational Day is organised for them at the beginning of every school year (Fig. 43).

Fig. 37. Primary school pupils trekking on the “Chionistra – Environmental Centre of Mt. Aenos” trail.

Fig. 38. Primary school pupils with their teachers and personnel of the Management Body at the Central Recreation Area of Mt. Aenos.

Fig. 39. Secondary education pupils getting acquainted with 'The pharmaceutical plants of Cephalonia', in the course of their project.

Fig. 40. Environmental Education conducted in schools.

## 3.3. Eurobirdwatch and 'Chelidonismata'

The Management Body of the National Park of Mt. Aenos in cooperation with the Hellenic Ornithological Society has successfully organised over the past three years two most important activities at different times of the year for our young friends.

Every autumn, a Europe-wide event for birds, called Eurobirdwatch, takes place. It is an event under the auspices of Birdlife International, which takes place simultaneously in about 40 countries. In Cephalonia the event is held at its two most important wetlands, i.e. Koutavos and Livadi of Paliki (Fig. 44).

Fig 41. Activities of the research project ''Our school's Green Corner''.

The participants are informed by the personnel of the Management Body about bird migration, the importance of our country in this process and of the Ionian in particular as a route, used by millions of migratory birds and about the habitats of the species. Via environmental games, the pupils and children that participate, have the chance to understand the dangers hidden in the migratory journey and how important it is to protect the areas where the birds nest and reproduce, as well as their migratory routes.

During spring, a special event is organised, which welcomes the arrival of spring and swallows. This event, called 'Chelidonismata' (from the Greek word '*chelidoni*'=swallow) aims at raising awareness among young and old participants regarding the arrival of the swallows and their preceding, long journey. As part of this event, the participants help the swallows by building for them nests made out of clay (Fig. 45).

Fig. 42. Delivery of composters to a primary school.

Fig. 43. Informing teachers on the environmental education programmes run by the Management Body.

## 3.4. Cooperation between the Management Body and Greek and Foreign Higher Education Institutions

Apart from its cooperation with Primary and Secondary Education, the Management Body of the National Park of Mt. Aenos constantly pursues cooperation with Higher Education Institutes, both Greek and foreign, eagerly encouraging and assisting the education/training of students interested in the study, protection and sustainable management of the protected areas. The specialised equipment of the Management Body and its highly educated personnel offer students of Higher Education in departments of Biology/Environmental Studies (Fig. 46) the opportunity to participate in a series of scientific studies, in line with their academic obligations (dissertations, Practical Trainings).

The Management Body has already cooperated with various Higher Education Institutions of Greece, such as the Technological Educational Institution of Ionian Islands, the University of Patras, the National and Kapodistrian University of Athens and the University of Ioannina. Furthermore, the Management Body went on to cooperate with AgroParisTech (Paris Institute of Technology for Life, Food, and Environmental Sciences) of France, as a result of which Practical Trainings were conducted in the National Park of Mt. Aenos from two French students, under the supervision of the Management Body.

Fig. 44. Eurobirdwatch in Livadi, Paliki.

## 3.5. Organisation of Seminars – Informational Days

In the spirit of 'data dissemination', the Management Body of the National Park of Mt. Aenos organises Informational Days, thematic Seminars and co-hosts other events for

Fig. 45. Building nests for the swallows at the Centre of Environmental Information of Koutavos.

the general public or for specific audiences so as to inform them and make them aware of issues related to the environment of the Protected Area of the Management Body.

More specifically, the range of topics of the events are dedicated to the National Park and its Management Body, the actions completed by the Management Body, concerning the protection and the preservation of the biodiversity of the National Park, the Surveillance/Guarding Action of the National Park, the Environmental Informing/ Awareness Raising actions the innovative actions conducted by the Management Body, such as the operation of a Seed Bank, seminars on aromatic, medicinal and edible indigenous plants of Cephalonia, the development of Ecotourism in Cephalonia, the fire protection of the Forest (Fig. 47 & 48) and many more.

Fig. 46. MSc students of the University of Patras in the National Park (above) and the Environmental Centre of Mt. Aenos (below).

One of the most important events that the Management Body organised recently was the 17th Panhellenic Forestry Meeting, in cooperation with the Hellenic Forestry Society and other parties (Fig. 47).
During the past years the Management Body has held numerous Information Days and Seminars, the most recent of which are shown below:

**Informational Days**:

- "**50 years of The National Park of Mt. Aenos – 10 years of The Management Body**", Sunday, 16.12.2012.
- "**Actions of the Management Body of the National Park of Mt. Aenos**", Sunday 22.06.2014.
- "**The orchids of Cephalonia**", Saturday 25.04.2015 (Fig. 47).
- **Special Meeting of the Management Bodies of Protected Areas during the 17th Panhellenic Forestry Congress**, Tuesday 6.10.2015 (Fig. 47).

**Seminars**:

- "**Meet the world of mushrooms**!", Saturday 2.11.2013.
- "**Aromatic, Medicinal, and Edible Indigenous Plants: Uses**", Saturday 15.11 2014 (Fig. 47).
- "**Ecotourism and Protection of Biodiversity**", Saturday 15.11.2014 (Fig. 48).
- Seminars on Flora – Fauna – Habitats titled: **"Environment 2015: "Recording and Monitoring Biodiversity in the National Park of Mt. Aenos**", Saturday 13.06.2015 (Fig. 47).
- Seminar on Fire Protection titled: "**Protecting the Forest**", Friday 24.07.2015 (Fig. 48).

## 3.6. Developing volunteer activities

The Management Body of the National Park of Mt. Aenos, in order to promote the idea of volunteering and the citizens' active participation in issues concerning the environment and especially its protection, as well as the promotion and sustainable management of protected areas, has made from 2012 onwards a greater effort to develop volunteer activities. The aim was for volunteers, especially from abroad, not only to gather a complete overview of the National Park of Mt. Aenos and the management

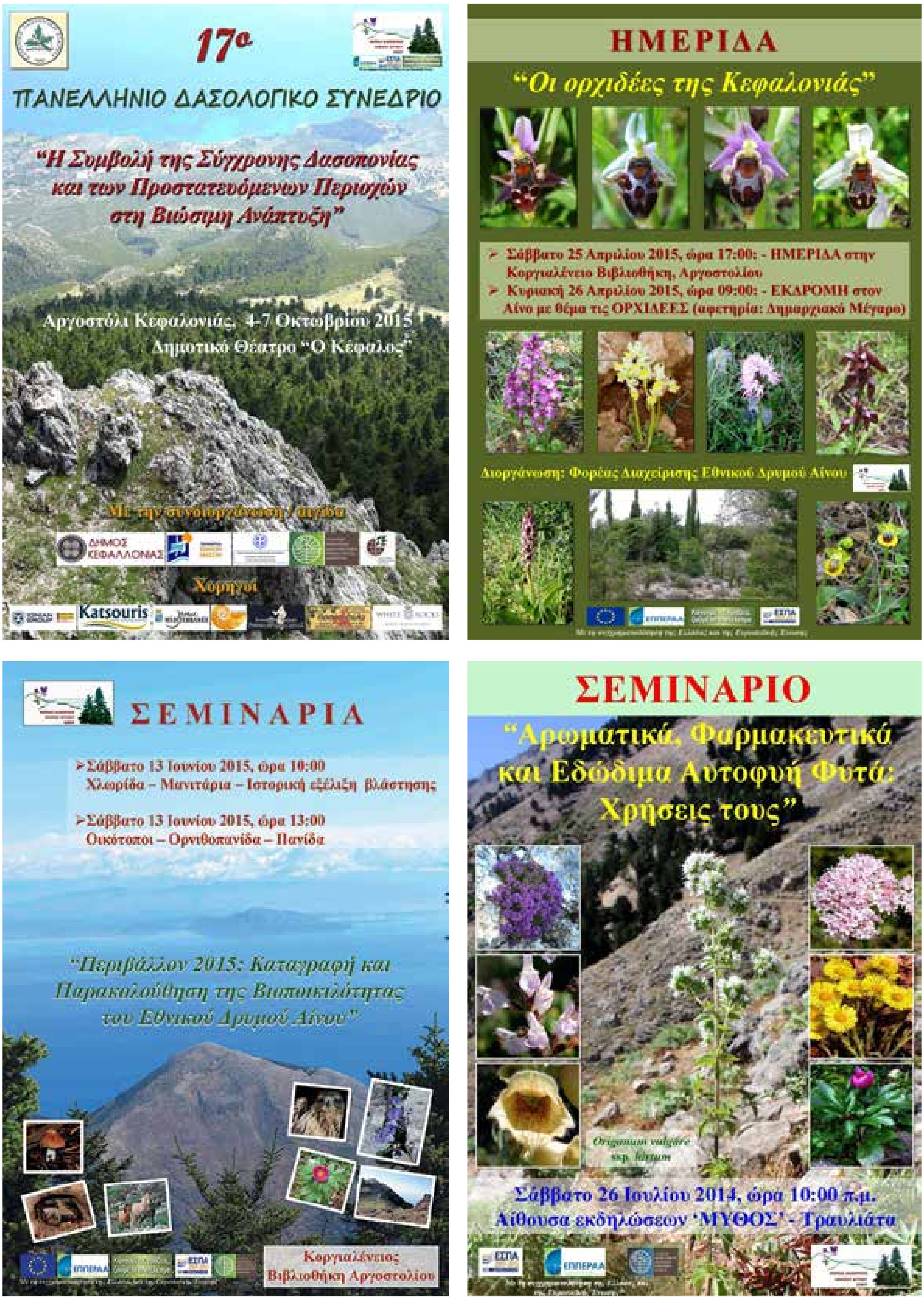


Fig. 47. Posters of the Management Body on organised Informational Days and Seminars.



Fig. 48. Posters of the Management Body on ecotourism (above) and fire protection (below).

work done, but also to contribute to the communication/PR policy of the Management Body towards tourists from other countries and to the promotion and publicity of the National Park of Mt. Aenos abroad.

The Management Body is a member of the European Voluntary Service (EVS), as it has received the necessary certification from the European Union and now operates as a Hosting Institution and Coordinating Institution for this programme.

EVS is part of the European Union's action called "New Generation in Action" which aims to support the participation of young people in various forms of volunteering actions, within and outside of the European Union (Fig. 49). The European Voluntary Service is now an action of a new European Union programme, Erasmus+.

To this day, four volunteers from Spain have been hosted by the Management Body. Their duties included the partaking in all actions of the Management Body.

In the course of their activities, they have the chance to develop their own project, depending on their interests and skills. In this way, the EVS volunteers have procured results on the assessment of the condition of the Cephalonian Fir, the semi-wild horses of Mt. Aenos and have produced audiovisual material for the promotion of the National Park.

Fig. 49. Volunteers from the EVS programme, participating in the study of *Abies cephalonica.*

## $4^{th}$ Line of Actions: Developing innovative actions

The Management Body is running the following innovative actions:

### 4.1. Seed Bank Operation & Laboratory for the Regeneration of Flora Species

The Seed Bank is a form of *ex situ* or off-site conservation of living organisms. Their *ex situ* conservation refers to the preservation of samples of living organisms away from their natural environment. In the case of plant organisms, the samples include plants, parts of plants, seeds, pollen, tissues or cells. Specifically, Seed Banks remain the most common method of *ex situ* conservation and decisively contribute to the protection of flora. The importance of *ex situ* conservation is widely recognised and therefore has been included in the goals of the Rio Convention on Biological Diversity (1992) and the "Global Strategy for Plant Conservation" (2002).

The Management Body, in recognition of the importance of the Seed Bank for the protection of the environment, included its creation and operation within its Actions. In particular, the aim of the Seed Bank of the Management Body is the conservation of

Fig. 50. Processing seeds for the Seed Bank.

endemic, rare and endangered plant species found in the National Park of Mt. Aenos, but also in the rest of Cephalonia.

The operation of the Management Body's Seed Bank includes, in short, locating the plant material (seeds) in nature, collecting and processing them, conducting germinating experiments, conserving the seeds for long periods of time and checking on the viability, as well as sharing the conclusions from the relevant experimentations with the scientific community and the local population.

The operation of the Seed Bank would not be possible without the necessary scientific equipment (Fig. 50), which was purchased, thanks to the financial means provided by the Operational Programmes "Environment" and "Environment and Sustainable Development". Nowadays, the Seed Bank of the Management Body boasts a fully equipped laboratory, which supports its operation. All the equipment of the Seed Bank is located at the Centre of Environmental Information of Koutavos, which is also the headquarters of the Management Body.

Seeds of 22 endemic or rare taxa (species and subspecies) have been collected and are being preserved in the Seed Bank, while their growth behaviour and their conservation has been studied. For some of these rare plants a related poster was created, so as to raise public awareness (Fig. 51).

It must be noted that the collections include a small number of seeds, in order for the impact on the natural populations of the taxa to be minimal, as their populations are limited both in distribution areas and in size.

The produced data, resulting from their study is, for the most part, new, as they are being studied in the Management Body for the first time ever.

### 4.2. Creating an infrastructure for recording the monitoring data with the use of Geographic Information Systems (G.I.S.).

This particular Action offers the Management Body the opportunity to digitally organise in its entirety the data that is produced from the Surveillance/Guarding Actions and the monitoring of the biodiversity, implemented by the Management Body.

For the implementation of the Action, the Management Body owns Geographic Information System software and software for processing and managing satellite images. The first software is a system for managing spatial data. In its strictest form, it is a digital system capable of assimilating/incorporating, adapting, analyzing and presenting geographically related information, which is gathered by the personnel of the Surveillance/Guarding Action in the National Park of Mt. Aenos by using GPS devices. It is also a 'smart map' tool, which allows the scientific personnel of the Management Body, from the office, to portray spatial data from the National Park and then to analyse


Fig. 51. Poster which includes some of the rare and threatened plants of Mt. Aenos and Cephalonia, seeds of which are being preserved in the Seed Bank.

them, to interactively create queries of spatial or descriptive character, which in their turn help correctly apply management policies in the National Park of Mt. Aenos. The final product of the above process is either printed maps (concerning flora, vegetation, fire protection, Habitat Types and others), or digital means (archives of spatial data, interactive maps on the internet etc.) (Fig. 52).

The second software, owned by the Management Body, combines remote sensing methods for the processing of satellite images, contributes to their classification and the locating of changes in land use, while it calculates environmental indicators, which help describe the condition of the Habitat Types in the National Park of Mt. Aenos.

The Action is conducted by personnel of the Management Body, specialised in using the Geographic Information and Remote Sensing Systems.

### 4.3. Recording and Monitoring the Butterflies of the National Park of Mt. Aenos

The order Lepidoptera is named after a particular trait of its wings. Even though they are membranous, like in other insects, they are not transparent, since both their upper and lower surfaces are coated with overlapping scales. These are responsible for the colouration of the wings, as well as their correct weight balance that provides their flight capability. Each scale has a unique color, genetically determined for each species and partly differentiated in each individual, thus leading to the extensive color pattern variability that characterises Lepidoptera wings (Pamperis 2009).

The common name 'butterflies' refers in fact to those Lepidoptera species that belong to the Rhopalocera group. This group includes diurnal species, in contrast to the Heterocera group which mostly consists of nocturnal species (moths). Moths significantly outnumber butterflies in species richness. Accordingly, in Greece most of the 3,197 lepidopteran species are moths and just ca 235 species belong to butterflies. At least 10 taxa are Greek endemics and at least 30 species residing in Greece are deemed threatened on a European or global level. Forty-nine species are protected by Greek legislation and 11 by European legislation (Pamperis 2009, Legakis & Maragou 2009).

A butterfly merely constitutes the adult stage (imago) of the insect's life cycle, which is short, compared to the preceding larval and pupal stages. Butterflies are, preferentially, more active between 15 and 35 °C. Therefore, locating them becomes easier during warm, windless days. Their detailed study, however, requires a good knowledge of their life cycle, in order to, among other things, successfully locate and record them in the habitats they occupy.

The butterflies of Cephalonia have been satisfactorily studied during the last 30 years. The first important study was performed by Gaskin & Littler (1986), who recorded 29

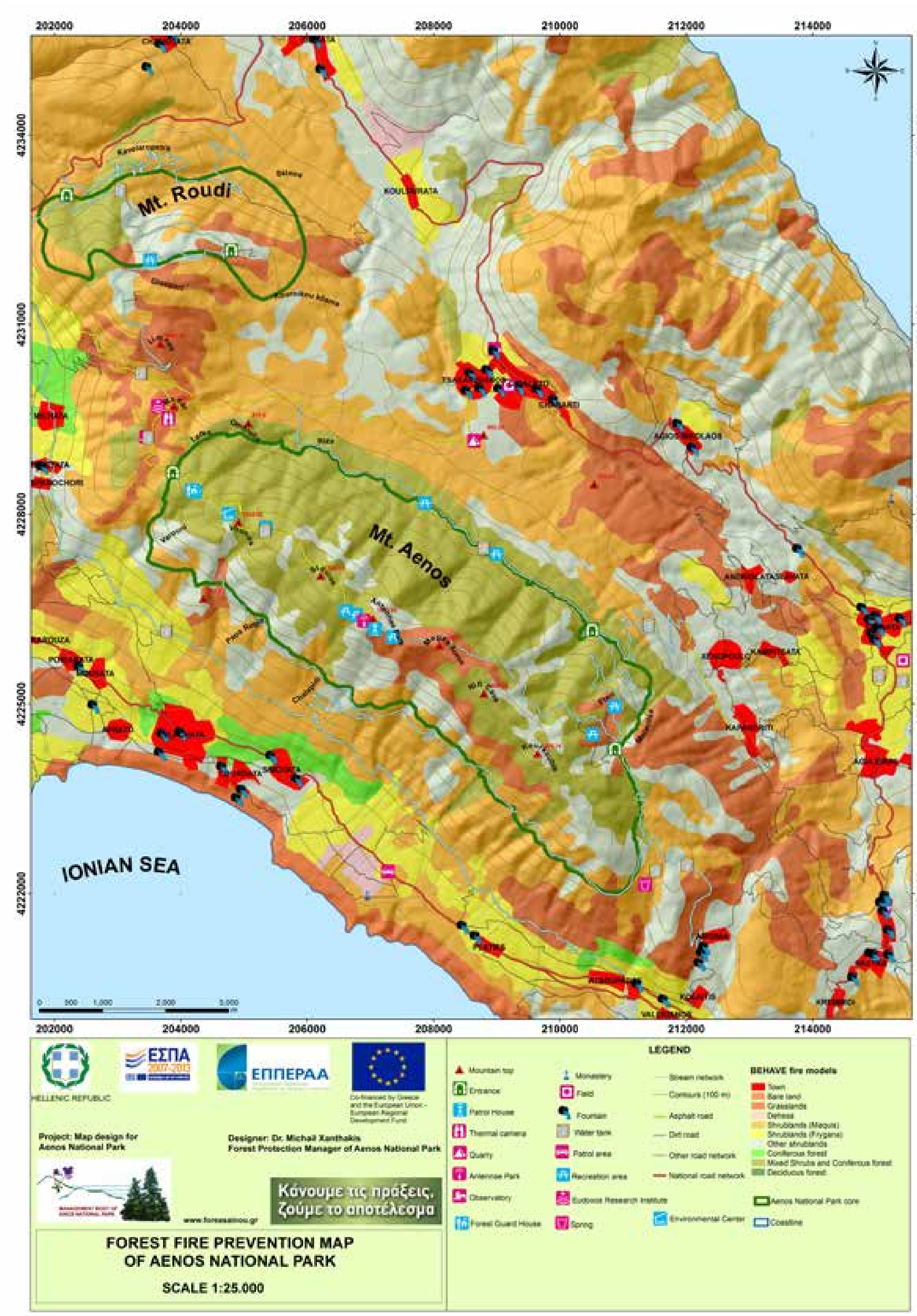


Fig. 52. Map showing the fire protection structures of the National Park of Mt. Aenos against fires.

species in total. In 1996, Gaskin supplemented that work by recording 16 additional species as new for Cephalonia. However, the most comprehensive study was undertaken by Efthymiatou-Katsouni (2006), who confirmed the occurrence of 49 species in Cephalonia, 14 of which constitute new findings. Recently, Maroulis & Xanthakis (2015) confirmed the existence of 31 species in the region of Paliki and in the National Park of Mt. Aenos. Finally, Pamperis (pers. comm.) reports that ca 63 species live on Cephalonia, i.e. more than 25% of the total of ca 235 that occur in Greece. These species are divided among five large Rhopalocera families (Pamperis 2009): *Papilionidae* (4 species), *Hesperiidae* (7 species), *Pieridae* (13 species), *Lycaenidae* (15 species) and *Nymphalidae* (24 species).

Among the butterflies of Cephalonia, one subspecies, *Hipparchia volgensis delattini* (Fig. 53) is a European endemic. Moreover, four species, *Pseudophilotes vicrama*, *Hipparchia fagi*, *Hipparchia statilinus* and *Thymelicus acteon*, are evaluated as Near Threatened (NT) in Europe, according to the criteria of IUCN (2001).

In general, the butterflies cannot regulate their body temperature on their own, but rely on the accumulation of solar radiation, in order to attain any temperature increase. The dark brown colouration of the wing surface of several butterfly species, e.g. of *Hipparchia volgensis delattini* (Fig. 53), which has been located on Mt. Roudi of the National Park, is considered to enhance the quick body temperature increase, thus achieving the desired activation of these butterflies at a shorter time, when compared to other species.

In addition, *Pararge aegeria* gathers heat from sunrays that reach clearings or manage to penetrate the thick foliage of the Cephalonian Fir trees of the National Park and, accordingly, defends the advantageous spots it has occupied against any potential adversary that may try to claim it.

During the summer months, many butterfly species gather at the National Park of Mt. Aenos, showing preference to several plant species. For instance, the flowers of the thyme species, *Thymus holosericeus*, attract numerous, impressively coloured butterflies that belong to *Argynnis paphia*, *Gonepteryx cleopatra* or *Iphiclides podalirius*. Around *Quercus coccifera* stands, swarms of the species *Neozephyrus quercus* can be observed. Also, the forest meadows of the National Park support easily noticed species, such as *Polyommatus icarus*, *Lasiommata megera*, *Lasiommata maera*, *Colias croceus*, *Spialia orbifer*, *Satyrium ilicis, Papilio machaon* etc. Contrary to that, species, such as those of the genus *Hipparchia* (Fig. 53), are hardly noticed e.g. resting on tree trunks, thanks to their excellent camouflage. Among the latest important observations on the Lepidoptera of Cephalonia is the fact that individuals of *Vanessa cardui* (Painted Lady) appear to go through their whole life cycle (from egg to adult stage) in Cephalonia, instead of adults being temporary and not locally breeding visitors that migrate from Africa, as previously considered (Maroulis & Xanthakis 2015).

Fig. 53. The European endemic butterfly taxa *Hipparchia volgensis delattini* (Delattin's Grayling - left) and *Hipparchia fatua* (Freyer's Grayling - right) that occur in the National Park of Mt. Aenos.

During mating, the butterfly bodies remain affixed with each other and do not separate until the completion of the reproduction act (Fig. 54). The unusually long duration of the reproductive process is due to the fact that the male seals the abdominal opening of the female with a keratinous projection it builds, thus hampering the female from mating with another male. This structure is called 'sphragis', named after the Greek word that means 'seal' (Pamperis 2009).

Fig. 54. Mating of the species *Vanessa cardui* (left) and *Pieris brassicae* (right) in Cephalonia.

Adult butterflies feed on nectar, which they gather with their sucking, curling proboscis, from deep flower areas. Therefore, they contribute significantly to plant pollination and fertilisation, since they inadvertently transfer pollen from stamens to the ovary. Nevertheless, butterfly larvas feed on parts of their host plants (they possess chewing mouthparts), often causing significant damage to cultivations. For example, *Pieris brassicae* larvae feed on plants of the *Brassicaceae* family. The females place their fertilised eggs on plant parts or on the ground. Following hatching, the small larvae will massively feed on leaves and other parts of their host plant, grow in size, undergoing several moulting stages, until they turn into pupae and then, following metamorphosis, into adult butterflies (Pamperis 2009).

The natural enemies of the butterflies do not actually constitute a real danger that could lead to their extinction. Contrary to that, biodiversity loss, in relation to habitat degradation, the abandonment of traditional cultivation practices on the island, fires, the use of insecticides, illegal woodcutting and, in many cases, the removal of butterflies from their natural population in order to supplement personal or scientific collections constitute the most immediate threats for the survival of butterflies. For the protection of these insects, particularly of those that are rare or endemic species, usually sought after by avid collectors, the Presidential Decree 67/1981 "On the protection of indigenous flora, fauna and habitats" is in effect.

Within the framework of the recently conducted recording of Lepidoptera species in the National Park of Mt. Aenos by members of the scientific personnel of the Management Body of the National Park, in collaboration with Mr. Christos Maroulis, wildlife photographer, a poster was created on the "Butterflies of the National Park of Mt. Aenos", which is displayed on the following page (Fig. 55). The availability of such posters for the visitors of the National Park supports the Environmental Information/ Awareness Raising activities that the Management Body has been implementing for several years, as outlined previously.

### 4.4. Investigation of the historical evolution of the vegetation of Mt. Aenos

External Partner: Aristotle University of Thessaloniki, School of Forestry and Natural Environment, Scientific Supervisor: Prof. Achilleas M. Gerasimidis.

The investigation of the historical evolution of the vegetation was performed by the pollen analysis method. More specifically, during the period of implementation of the Action with the help of the personnel of the Management Body, sampling sites were found in different parts of Cephalonia (Fig. 57). The most important prerequisite for the completion of the survey was to find a permanently wet location, where conditions


Fig. 55. The poster of the Management Body on the butterflies of the National Park of Mt. Aenos.

permit the conservation of pollen grains in the sediment layers. Sampling bryophyta near the sampling location of the sediment and their analysis helped to investigate the accumulation of fresh pollen in the specific location and to correlate the data of this analysis with the corresponding analysis of the sediment, from which the conserved pollen of past periods was isolated.

From the pooled material, preparations were made for the microscopic study, the identification and the registration of the pollen grains, in order to gather the necessary data, which, with further processing, provided the basis for the construction of the pollen diagrams.

The radiocarbon dating of pollen samples is shown in Fig. 56.

The studied sediment consisted mainly of:

- Peat with ±Clay at places (depths of 0-50, 80-82 cm)
- Sand (depth 29- 50, 119-121, 152-154, 158-159 cm)
- Sandy clay (depth 203-215, 203-215 cm)

During the analysis of the samples collected, a total of 91 types of pollen were identified, which correspond to an equal number of plant taxa, including 79 Spermatophyta and 12 Pteridophyta. Of the pollen types, belonging to Spermatophyta, 24 correspond to woody plants (trees and shrubs).

At the same time, an analysis of microscopic charcoal particles (charcoal) was conducted so as to study the history of the fires. The application of the pollen and charcoal analysis method from the same sample produced information about the connection between climate, vegetation, fire and human impacts.

The first three innovative actions are being implemented exclusively and directly by the personnel of the Management Body, while the fourth in collaboration with the School of Forestry and Natural Environment, Aristotle University of Thessaloniki.

| | Depth (cm) | Code | Years B.P. | Calendar Year |
|---|---|---|---|---|
| 1. | 30.0 | UBA-25097 | - | <1950 A.D. |
| 2. | 93.5 | UBA-25098 | 754±25 | 1261 A.D. |
| 3. | 194.0 | UBA-25100 | 1,716±29 | 322 A.D. |
| 4. | 242.0 | UBA-22371 | 2,633±30 | 806 B.C. |

Fig. 56. Radiocarbon dating of the studied sediments.

Fig. 57. Sediment sampling in the area of Livadi, Paliki.

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