Interactive Conservation Platform for Orchids Native to Greece-Turkey

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GREEK-TURKISH WHITE PAPER

Current Status and Best Practice Analysis for Greek and Turkish native orchid flora conservation

Petrou N, Petrou M, Deniz G, Sezik E, Georgiadis C, Gletsos M

Hellenic Society for the Protection of Nature

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1. FOREWORD

With over 400 taxa of native orchids between them, Greece and Turkey host the richest orchid flora in the Mediterranean region. In particular the corridor including the Greek Eastern Aegean islands and the Turkish coastal zone is a world hotspot for orchids, supporting a significant percentage of those species, some being common to both countries. Wild orchids are seriously threatened in both countries, mainly by habitat loss through a variety of causes that will be described in the relevant chapter. The situation is particularly critical in the aforementioned areas because of rapid touristic development in the coastal zone. An unprecedented threat for wild orchids in Turkey is harvest for the production of salep, estimated to destroy more than 120 million orchids each year. Orchid diversity conservation and protection of their habitats through direct and indirect economic incentives like ecotourism, recreation, public health and sustainable usage has been given little attention.

The charismatic nature of orchids is addressed as a catalyst to implement existing EU legislation and communicate related information and practices to Turkey for wild flora, especially orchid, conservation. The ambitious goal of this project is to achieve engagement of relevant actors at the local, regional and trans-national level to support and expedite this process, especially important in view of Turkey's accession to the EU.

2. THE ICON PROJECT

The main objective of the project is cooperation between Greek, Turkish and German NGOs for the protection of wild orchids in Turkey and the creation of an innovative powerful common awareness/ educational tool.

Specific objectives include: the creation of a Digital Interactive Education Platform (DIEP); the preparation of methodologies for education in environmental protection); the preparation of common guidelines for species monitoring; the exchange of information and best practices between EU-based and Turkish NGOs; the establishment of a network between Greek and Turkish entities (NGOs, academic institutions) working in the field of environmental conservation, specifically focusing on wild orchids; increasing awareness of the Turkish public about specific endangered species; and the introduction of EU Environmental policies and legislation to the Turkish public and authorities. The DIEP is intended to reach and unify a multitude of audiences and stakeholders interested and/or participating in flora conservation through interactive education about wild orchids and associated areas of interest. It will also serve as a tool for wide dissemination of all messages of the project.

The project is funded by the Civil Society Dialogue between EU and Turkey Grant Scheme, and it is implemented by Sails-for-Science, a German NGO, the Hellenic Society for the Protection of Nature, a Greek NGO, and the Association for the Conservation of Antalya Orchids and Biodiversity, a Turkish NGO. Associates of the project include the Orchid Specialist Group of the IUCN, the Royal Botanical Gardens Kew, and the Smithsonian Environmental Research Centre, as well as academic institutions in Turkey (Çanakkale Onsekiz Mart, Yeditepe, Ondokuz Mayıs, and Akdeniz Universities).

The information and expertise transferred through the project to Turkish participants (NGO, universities) will be further disseminated through them to other Turkish entities with similar interests. All information will be freely available to all interested parties.

The purpose of this White Paper is to assess the current condition of orchids in both countries focusing on the threats, to describe the existing relevant international, European and national legislation and to present selected best practices applied in Greece and other European countries to address orchid conservation issues for adaptation in Turkey.

3. THE EASTERN MEDITERRANEAN REGION

The Mediterranean Basin, the largest of the planet's 5 Mediterranean-climate regions, is a global hotspot of biodiversity, hosting some 10% of the world's vascular plants (over 25.000 species) in approximately 1.6% of its surface area [1]. The phytogeographical boundary of the Mediterranean Biogeographical Zone corresponds to a great degree with the distribution boundaries of its "flagship" species, such as *Olea europaea*, *Quercus ilex*, *Pinus halepensis*, *Arbutus andrachne*, *Thymus capitatus*, *Euphorbia dendroides*, and many more.

Present day Mediterranean flora has evolved from temperate and tropical ancestors, in response to paleoclimatic and paleogeographic changes starting about 35-30 million years ago (Mya), during the Oligocene.

Endemism at species and genus level is quite high: approximately 11,700 species (47% of the total number) and 10% of the region's genera occur nowhere else in the world. However, time and isolation apparently have not been enough to bring about changes at higher taxonomic ranks: there are only two endemic families (Aphyllanthaceae and Drosophyllaceae) both represented by single species (*Aphyllanthes monspeliensis* and *Drosophyllum lusitanicum* respectively).

The factors contributing to the diversity and high endemism of the Mediterranean flora are many: landscape diversity, including a variety of geographical barriers (islands, gorges, high mountains, etc.); habitat diversity, including great variation in composition and properties of soils; climate and microclimate diversity; great diversity of insect pollinators (bees and allies) that may have accelerated speciation of plants; presence of numerous annual plants which, if reproductively isolated, will rapidly express different adaptive modes and become new taxa; and the human impact, especially continuous settlement over the last 10 millennia, which has reduced forest coverage and opened up new habitats, favouring diversification of the herbaceous annual flora.

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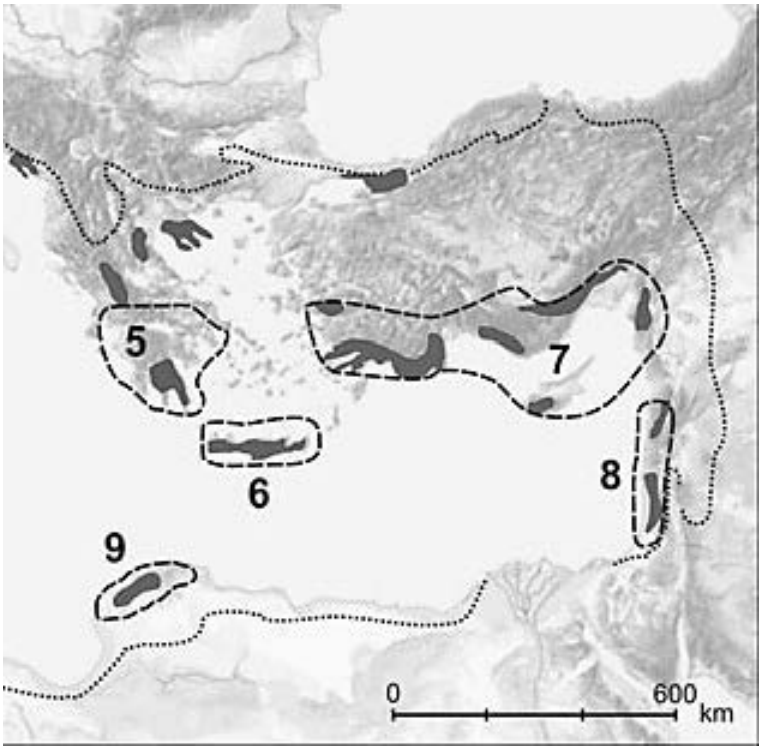


Another, recently recognised factor, is the presence, throughout the Mediterranean Basin, of 52 putative refugia. Refugia represent climatically stable areas that have provided shelter to species during the climatic changes of the Pleistocene, or even since the Tertiary, and constitute key areas in maintaining species and genetic diversity, both of Mediterranean and extra-Mediterranean plants [2].

Biodiversity and endemism are not uniform throughout the Basin; there are two main centres, one in the west including the Iberian Peninsula and Morocco, and another in the east,

centred on the Aegean and including Greece and Turkey. Furthermore, 10 regional mini-hotspots have been identified within the larger hotspot, characterised by areas of high plant richness and narrow endemism of more than the average 10% of local endemics. These 10 areas cover some 22% of the Basin's total area, yet host almost 5,500 endemic plants, approximately 47 % of all Mediterranean endemics [3].

There is a strong biogeographical congruence between the 10 regional hot spots, which represent key biodiversity areas, and the 52 locations of putative refugia. Major plant endemism areas (regional hotpots) are entirely included in the refugia, while half of the refugia (26) are included in the 10 regional hot spots. This pattern emphasises the critical importance of such areas for regional and local planning of conservation actions [4].

The eastern biodiversity nexus, centred on the Aegean, includes three regional hotspots (central and southern Greece; Crete; southern Anatolia and Cyprus) and 10 refugia: 5 in Greece (Mt. Olympus, central Greece-Pindus range, Peloponnese, Chalkidiki Peninsula and Crete) and 5 in Turkey (İzmit region, Boz/Aydın Dağ, Southwest Anatolia, Central Taurus and East Taurus). Additionally, this area coincides with the main distribution of ophiolites in the Mediterranean Basin. Ophiolites are ultramafic rocks, which are particularly important from a floristic perspective as they host extremely high numbers of endemic species [5].

The present day Aegean region and its adjacent landmasses (Greece to the west and Turkey to the east) share a common, complex geologic history [6,7] that started during the Oligocene, when land emerged from the sea for the first time. This orogenesis, part of the overall Alpine orogenesis in southern Europe, was completed during the late Oligocene (c. 25 Mya) with the creation of an extensive mountainous landmass. This continuous landmass, which covered the entire South Aegean and joined the lower part of current mainland Greece and the Peloponnese with Crete and Asia Minor, was called Aegeis, and remained intact until the middle Miocene (c. 12 Mya).

The current geomorphology of the Aegean is the result of three main parameters: tectonism, volcanic activity and the rise and fall of the sea level (eustatism). The islands of the Aegean actually started being formed during the Middle to Upper Miocene, (12 to 11 Mya), when the sea began to penetrate and slowly fragment the mass of Aegeis. The mid-Aegean trench (east of Crete and west of Kasos–Karpathos) began to form and was fully completed during the late Miocene (*c.* 10–9 Mya). This phenomenon caused the separation of the western from the eastern Aegean islands. Crete, which was connected with the mainland during the Miocene, became an island 5 Mya, and has not been connected with the mainland since then.

Numerous and complex tectonic movements that took place during the end of the Miocene (6 to 5.3 Mya) caused further fragmentation of the land, forming islands that constituted the current Cyclades. The central Aegean islands were united in a landmass connected to the Greek mainland until the Pliocene, although they have had no direct connection with the Peloponnese since 8 Mya. During the mid-Pleistocene (1.8 to 0.9 Mya) the main causes of change in the Aegean region geography was tectonism and the rise and fall of the sea level due to the alternation of the glacial and interglacial periods. Such phenomena caused expansion or reduction of the land areas and changes of the land connections between them.

In the late Pleistocene (21,500 year BP) the central Aegean landmass known as the Cyclades bridge had no connection with the mainland. The break-up of the Cyclades plateau into separate islands occurred later, at the beginning of the Holocene (about 11,500 year BP). Karpathos was connected with the Turkish mainland via Rodos during the early Pliocene. It was almost totally submerged during the late Pliocene, while in the Pleistocene it re-emerged and probably was connected with Kasos. Rodos

remained connected with the Turkish mainland until the early Pleistocene, when it was finally isolated. Finally, during the Holocene, with the end of the last glacial period, the sea level rise led to the isolation of the eastern Aegean islands (e.g. Samos, Lesvos, Chios) from the Turkish mainland and the permanent isolation of the Cyclades islands from one another.

As a result of these connections and later separations, many of the central Aegean islands share common fauna and flora species, including orchids, with the Greek mainland, while the eastern Aegean islands share common species with the Turkish mainland.

The main driver of evolutionary change and speciation, reproductive isolation by geographic or ecological barriers, has also been highly active in the region with its multitude of islands, peninsulas, rocky cliffs, remote mountain peaks and microclimates. Thus, islands that have been separated the longest, such as Crete and Rodos, and soaring mountains such as the massifs of the Peloponnese and the Taurus range, host high numbers of local and regional endemics, including orchids.

4. AN INTRODUCTION TO ORCHIDS

Plants belonging to the Orchidaceae family are called orchids. Including approximately 27.000 members classified in 736 genera, Orchidaceae is one of the most species-rich families of flowering plants in the world. It is estimated that one of every six species of flowering plants is an orchid. Orchidaceae belong to the Monocotyledons and are divided into five subfamilies, of which two are represented in the Greek and Turkish flora (Orchidoideae and Epidendroideae). Orchids are quite adaptable and occupy a variety of ecological niches, from the cold tundra to desert and from the seaside to alpine meadows, which accounts for their cosmopolitan distribution on every continent except Antarctica. With about 2% of orchid species being classified in one of the IUCN threat categories, the Orchid family is among the most threatened ones on a global scale.

Many authors believed that the family is relatively new in evolutionary terms, with an estimated age as young as 15 million years. However, recent studies based on molecular genetics estimate that it is about 100 million years old, a figure more in agreement with its global distribution and abundance of species [8].

Orchids are one of the most popular and easily recognisable plant families in the world. They have been well known since ancient times, with many species being used for medicinal purposes, such as the male-herb (a popular name usually attributed to species of the genus *Orchis*, thought to induce conception of male children), or for the production of salep, a beverage made of orchid tuber flour, mostly in Turkey but also in Greece and other middle Eastern countries. The family has significant economic importance because of their widespread use as a decorative plants; the tropical liana *Vanilla planifolia* has additional economic importance as the source of natural vanilla flavouring.

4.1. Description

Greek and Turkish orchids are perennial herbs, mostly 10-30 cm tall, rarely reaching one meter in height, easily overlooked by people that do not recognize them. Their underground part is composed of roots that stay active and alive only for the growing season, and tubers or rhizomes. The simple leaves, usually oblong or elliptic, can either form a basal rosette, or extend from nodes on a stem, and do not have a petiole. Myco-heterotrophic species have a few scale leaves, and lack chlorophyll.

Their inflorescence bears from few to many bisexual flowers. The flowers are zygomorphic (bilaterally symmetrical), and composed of six parts called collectively the perianth. The three sepals are usually identical. The two lateral petals are also identical, however the third one, called labellum or lip, is larger, has a distinctive morphology, and is often decorated with dots, lines or complex patterns and colours. Occasionally (depending on the species) it has a hollow, tube-like appendix that may be filled with nectar (called spur). The reproductive structures (apart from the ovary) are fused into a column, termed gynostemium. The single stamen, positioned at the distal end of the gynostemium is called pollinarium, and can be seen opposite to the lip. Pollen grains are packed in a structure called pollinium (plural pollinia), which is analogous to the anther of other plants. There can be one or two pollinia. The female receptacle (stigmatic cavity) occupies the centre of the flower, positioned at the base of the gynostemium. The ovary is behind the flower, and the leaf that is attached at its connection with the stem is called a bract. Seeds are miniscule and extremely light; an ovary may contain as many as 6,000 seeds.

4.2. Basic Biology

Seeds are produced in vast quantities, and become air born, which allows them to travel for long distances. This makes orchid seedlings able to colonize areas that can be quite distant from the mother plants. The problem with such a small seed is that it lacks food reserves to nourish the young seedling. This role in orchids is occupied by various taxa of symbiotic fungi. This symbiosis seems to be particular: only certain fungal taxa can aid the germination of a certain orchid species [9,10]. This form of relationship does not seem to stop when the plant has its own green leaves, but continues throughout the orchid's life, without being necessary for its survival. Some species, taking full advantage of this special relationship, do not produce any chlorophyll but use their symbiotic fungus continuously, essentially becoming parasites. These plants are called mycoheterotrophs [11].

If the seed is lucky enough to land at a spot with appropriate conditions and the correct fungi, it will start growing. Depending on the species it will sprout its first leaf and start producing its own food after one or two years. Most species need 2-4 years from seed to flower but some may take as long as 9-12 years.

The species present in Greece and Turkey (with the exception of *Goodyera repens* which is evergreen) have an above-ground life cycle that lasts from a few weeks to some months. They all spend part of the year underground as dormant tubers or rhizomes, protected from unfavourable climatic conditions - either the scorching heat and dryness of summer, or the heavy snowfall on the mountains.

Plants sprout leaves at the beginning of spring or autumn, depending on the genus, grow while storing nutrients and starch in their underground parts, and then flower. During this period the tuberous genera grow a new tuber (or for some species a few) to replace the one of the previous year, which withers.

4.3. Ecology

As perennials, most terrestrial orchid species need stable ecological conditions to survive. However, because they have underground storage parts and form a symbiosis with fungi, they can inhabit relatively poor soils, and compete with other plants for resources.

Genera that begin sprouting during spring (*Cephalanthera*, *Coeloglossum*, *Dactylorhiza*, *Epipactis*, *Gymnadenia*, *Neottia* and *Platanthera*) as well as the mycoheterotrophs (apart from the great generalist *Limodorum abortivum* that will grow almost everywhere, as long as it isn't wet all year round), most species of the genus *Orchis*, and the evergreen *Goodyera repens* need stable ecological conditions (forests, meadows, etc) while those that sprout during autumn (*Anacamptis*, *Himantoglossum*, *Neotinea*, *Ophrys*, *Serapias,* some *Orchis*, and *Spiranthes*) prefer alkaline, limestone derived soils, and are usually found in disturbed land, like burnt areas, old olive groves, abandoned farmland, road sideways, etc.

Depending on climatic conditions, certain species may not flower but remain hibernating underground.

Some species are reproduced vegetatively, either by producing one or more new tubers to replace the old one, or by the formation of two new buds on the rhizome, which in time will lead to it splitting, thus creating two separate plants.

4.4. Sexual reproduction

Apart from some notable exceptions (*Ophrys apifera*, some *Epipactis* species and sometimes *Limodorum*) the orchid species occurring in Greece and Turkey are not self-fertilising and instead use insects to achieve

pollination.

Very few of the eastern Mediterranean orchids reward their pollinators with nectar. Most insects are fooled by their resemblance to nectar bearing flowers (like *Anacamptis*, *Dactylorhiza*, and *Orchis*), while the flowers of *Serapias* look like little cavities, offering protection from low night temperatures or rain.

Pollination in the genus *Ophrys* is highly specialised. Their flowers closely mimic female bees or wasps (hence the common name "bee orchid" for *Ophrys apifera*), providing the correct scent (exactly mimicking the insect pheromones) and the appropriate visual (colours, patterns) and tactile (hairs) signals. Thus they trick the male insects to try and copulate with them, a process termed pseudo-copulation [12]. During pseudo-copulation, the pollinia stick to the body of the male insects, and are then transported to the stigma of the next flower they will attempt to mate with. Pseudo-copulation is highly species-specific. It has been reported that similar tactics may be used by the species *Serapias lingua*, *S. cordigera* and *Anacamptis papilionacea* [13].

Fertilization by pseudo-copulation is unique to orchids among members of the plant kingdom, with the possible exception of one species of *Gilliesia* of the family *Alliaceae* [14].

An important aspect for successful fertilisation (which increases population size of a particular species) is avoiding cross-pollination with other species. This can be achieved in many ways, including the use of different pollinators, differences in flowering period or some form of post pollination genetic incompatibility. However, hybrids do occur, sometimes in such abundance that they may form stable populations, replacing parental species, especially in the genus *Dactylorhiza* in which most species are considered of hybrid origin [15].

4.5. Taxonomic complications

In recent years, a plethora of botanists and researchers has taken interest in the orchid flora of Europe and especially the eastern Mediterranean region.

These studies, however, have created abundant problems, since many authors reject the taxonomy of others, giving different names to many taxa, or various taxonomic ranks (a species of one author may be a subspecies, variety or forma of another), or grouping many names under synonymy, forming entities that are morphologically heterogeneous, and creating nomenclatural instability.

The first problem with taxonomy is the classification in genera. Genera are artificial groupings of species (species are naturally occurring groups), created in order to organise the way we think about nature, and to aid memory. This does not mean that any artificial, morphologically uniform group comprises a genus. This way of thinking has been proven inadequate, since evolution often leads to similar solutions for similar problems (i.e. the spur has evolved independently in many plant groups, while wings occur in birds, but also bats which are mammals).

Today, the predominant opinion in botanical thought is that a genus, as well as any other taxonomically important group (family, class, etc), must be monophyletic, meaning that it includes an ancestral species with all its descendants, as it is inferred by an estimation of the evolutionary steps that lead to the forms we see today [16]. This way the genera created are more robust, being composed of species that share more common features between them than with species from other genera, while the use of single character classifications is eliminated.

This became obvious in the case of *Orchis*: with previous delimitation of its members, hybrids were not

formed between many species of the genus, but they were formed with species of *Serapias*. This was a strong indication that *Orchis* as previously delimited was an artificial group.

In recent years, advances in biochemistry, molecular biology, and genetics, have allowed us great insight on orchid phylogeny. Many universities and botanical gardens throughout the world are cooperating in order to systematically revise and reclassify the genera of Orchidaceae, in an effort to achieve taxonomic stability (a massive feature in a family composed by more than 900 genera) and a classification that will reflect all our knowledge about their evolution and natural history. The results of their studies are published since 1999 in the book series Genera Orchidacearum (Pridgeon et al. editors).

Recent changes from previous classifications include the inclusion of genera *Barlia* and *Comperia* within *Himantoglossum* [17,18], the separation of the genus *Coeloglossum* from *Dactylorhiza* [19], and the reassignment of species between *Orchis*, *Neotinea* and *Anacmptis* [20].

The main problem, however, that is responsible for the chaotic condition of European orchid classification (perhaps plant classification in general) is the delimitation of species. In order to deal with this issue different species theories have been devised. One of the most popular is the Biological Species Concept, also known as the Isolation Species Concept. According to it, members of different species cannot form hybrids (or hybrids are sterile). Unfortunately, though it seems simple and easy to use, it is of little or no value when it comes to plants. Apart from the fact that plants do form hybrids, various clones that do not produce seeds (like many fruit cultivars) and self-fertilising individuals would have to be recognized as separate species. Other theories put forth include the: Recognition Species Concept, i.e. individuals of one species recognize and prefer individuals of the same species for reproduction; Phenetic Concept, where species are separated by morphological gaps; and Evolutionary Concept, which focuses on the recognition of lineages [16]. Obviously, every theory has its pros and cons, and none seems to be universally applicable.

To provide an idea of the existing contradictions and confusion, Delforge [21,22], rarely uses the rank of subspecies, and has the tendency to break up taxa (even if they are exhibiting morphological uniformity) into separate species, without taking into consideration the naturally occurring variation among individuals and/or populations. Others, like Kreutz [23], believe that most of the recognised taxa in these groups are just local variations with minute differences (probably a consequence of geographic isolation), which at best should be recognized at the rank of formae. On the extreme, we find the grouping of all *Ophrys* into only 19 species by Pedersen et al. [24], which is too unifying. This approach may resolve problems in the field, making species recognition easy, but some species according to their classification seem extremely heterogeneous and artificial.

Increased fieldwork and continuing research in the eastern Mediterranean region also result in taxonomic changes. As an example, populations of *Himantoglossum caprinum*, *H. affine* and *H. montis-tauri* in Greece have recently been shown to fall within the variability of *Himantoglossum jankae*. Thus the presence of the three aforementioned species in Greece cannot be attested on the basis of morphology [25]. Other examples are *Epipactis atrorubens* subsp. *spiridonovii* that is now considered a synonym of *E. atrorubens* and *Dactylorhiza graeca* that is now downgraded as a variety of *D. cordigera* [26].

This taxonomic confusion complicates conservation issues and efforts, as most existing national legislation in both Greece and Turkey does not take into account recent additions or separations and changes in species names.

5. ORCHIDS IN GREECE

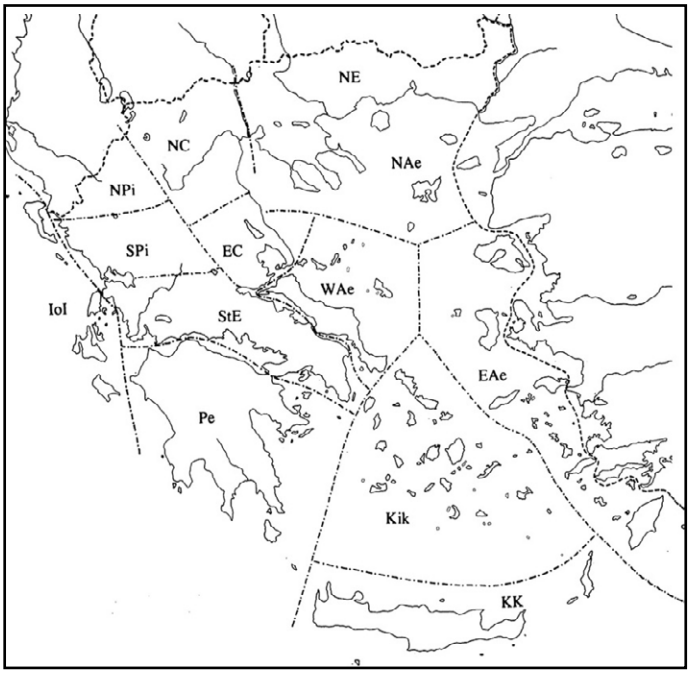
Due to a combination of geological, topographical, climatic and ecological conditions Greece hosts a great variety of habitat niches supporting a great wealth of flora species [27]. According to the most recent surveys Greek flora includes 5,752 species and 1,893 subspecies of vascular plants, which cumulatively represent 6,600 taxa, belonging to 1,072 genera and 185 families [26]. Greece is also one of the world's hotspots for endemic plants, with 1,278 endemic species (22.2% of total species) and 452 endemic subspecies, cumulatively representing 1,461 taxa (22.1% of total taxa).

Greece is dived into 13 floristic regions: Ionian Islands (IoI), Northern Pindos (NPi), North-central Mainland (NC), North-east Mainland (NE), Southern Pindos (SPi), East-central Mainland (EC), Sterea Ellada (StE), Peloponnese (Pe), North Aegean Islands (NAe), West Aegean Islands (WAe), East Aegean Islands (EAe), Cyclades (Kik), Crete and Karpathos (KK).

Greek orchids belong to 19 genera: *Cephalanthera*, *Epipactis*, *Neottia*, *Corallorhiza*, *Epipogium*, *Limodorum*, *Goodyera*, *Spiranthes*, *Platanthera*, *Coeloglossum*, *Pseudorchis*, *Gymnadenia Dactylorhiza*, *Serapias*, *Anacamptis*, *Orchis*, *Neotinea*, *Himantoglossum* and *Ophrys*. The total number of species and subspecies ranges from slightly below to well above 200, according to the taxonomic authority. Tsiftsis and Antonopoulos [28,29] describe 193 species and subspecies, Petrou et al. [30] describe 203, while Hirth [31] refers to more than 250. The genera presenting the greatest differences in species numbers are *Ophrys*, *Serapias* and *Epipactis*. Orchids amount to approximately 3% of the total number of Greek flora species and subspecies, thus ranking Greece among the richest countries in Europe; a particularly impressive fact if one considers its relatively small size.

Numerous species of European or Asian origin reach their distribution limits in Greece. For example, *Himantoglossum comperianum* is an Anatolian species which only occurs in very few eastern Aegean islands (mainly Lesvos, with occasional records in Samos), while *Gymnadenia rhellicani* is a species of the mid-European alpine zone that reaches its southeasternmost limit on Mount Falakro, and *Ophrys bertolonii* is a central Mediterranean species reaching its easternmost limit in Corfu and Epirus. The regions exhibiting the greatest diversity of species and the highest numbers of endemic taxa are the Peloponnese, Crete and Karpathos, the Eastern Aegean Islands, and the Cyclades. Many of the Aegean islands, even small ones, have their own, endemic species, mainly of the genus Ophrys; for example, in Lesvos there is *O. lesbis*, in Ikaria *O. ikariensis*, in Tilos *O. tili*, in Chalke *O. chalkae*, etc.

Figure 7. image10.jpeg



A full list of Greek species is presented in Appendix a.

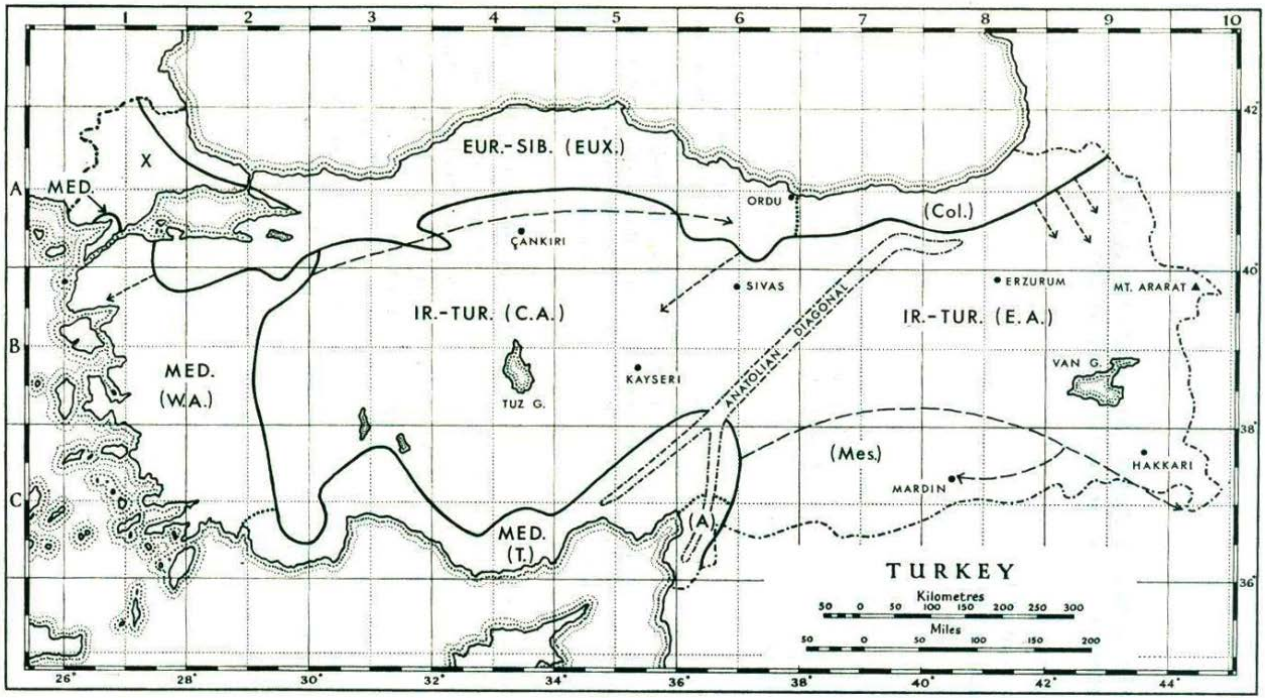
6. ORCHIDS IN TURKEY

Turkey has an extremely rich flora, and it is every bit as interesting as it is rich. The development of this diverse and fascinating flora we can generally be attributed to the many different climatic and geomorphic zones found in lands and the bridge it forms between Europe and Asia. The Flora of Turkey, an extremely detailed work contained in 11 volumes, was published between 1965 and 2000. Since the publication of the last volume, there have been many new species identified and added to the flora of Turkey. This number continues to rise with every passing day as new species are identified. Turkey has the richest variety of plant life amongst all its neighbours, and indeed more than most European countries. The most important factor that created this incredible biodiversity is the location of Turkey on the crossover of three Phytogeographic Regions (areas of the world designated upon careful examination of their indigenous plants). Turkey is positioned on the boundaries of three Phytogeographic Regions, also known as floristic zones; the Mediterranean (MED), the European-Siberian (EUR-SIB), and the Irano-Turanian (IR-TUR) Phytogeographic Regions and is divided accordingly into 9 floristic districts or sectors as shown on the map [32].

As a result the floristic wealth of the area, and also the importance of protecting it, are self-evident. In Turkey there are approximately 12,000 plant taxa (species, subspecies and varieties). Including species that have been identified after publication of the Flora of Turkey, the total number of endemic species has reached 3,035, and the number of endemic taxa is 3,649. Approximately 31,8% of Turkey's plants are endemic [33].

Turkey is also one of the richest countries in Europe and the Middle East regarding the Orchidaceae family. This broad and interesting floral make-up of orchid species can be attributed to the fact that Turkey is part of the land-bridge between the European and Asian continents, as well as to the wide general climatic and geomorphologic variations found here. Many orchid species have been identified

Figure 8. image10.jpeg



and added to the national flora after the publication of the Flora of Turkey. With the discovery of new species or taxa virtually every day, recorded numbers continue to rise.

Turkish orchids belong to 23 genera: *Anacamptis, Barlia, Cephalanthera*, *Coeloglossum, Corallorhiza, Dactylorhiza, Epipactis*, *Epipogium, Gennaria*, *Goodyera, Gymnadenia, Himantoglossum, Limodorum, Listera, Neotinea, Neottia*, *Ophrys, Orchis, Platanthera, Serapias, Spiranthes*, *Steveniella* and *Traunsteinera*. According to the literature included in The Checklist of The Turkish Vascular Plants, published in 2012, the total number of species, subspecies and varieties was defined as 186 by Deniz [34] and Güler [35]. At present, considering additions and some changes in taxonomic level, the total number of Orchidaceae taxa in Turkey is estimated at 191 (Appendix b). Orchid species that prefer forested or maquis areas are greatly differentiated in the suitable habitats they find in different phytogeographical zones and the transition zones between them. This situation is reflected in the high numbers of taxa we discover; the species showing the highest taxon count are *Anacamptis*, *Cephalanthera*, *Dactylorhiza*, *Epipactis*, *Himantoglossum*, *Ophrys*, *Orchis* and *Serapias.* These findings clearly show the biological richness of Turkey and also the need for its conservation. As a general conclusion regarding the distribution of Turkish orchids it is clearly dependent on the species' preferences in regard to floristic zones and the habitats found within these zones.

A full list of Turkish Orchidaceae species is presented in Appendix b.

7. LEGISLATION

7.1. International

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [36] is an international agreement between governments aiming to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of IUCN. The final text was agreed upon at a meeting of representatives of 80 countries in Washington, DC, USA, on 3 March 1973, and on 1 July 1975 it entered in force. To date 181 countries have signed CITES.

International wildlife trade is estimated at billions of dollars annually and includes hundreds of millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of products derived from them, including food products, leather goods, wooden musical instruments, timber, tourist curios and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction.

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.

CITES includes over 5,600 animal species and some 35,600 plant species, which are listed in three Appendices according to the degree of protection they need. Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but whose trade must be controlled in order to avoid utilization incompatible with their survival. Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

All species of Orchidaceae are included in CITES: six species (*Aerangis ellisii*, *Dendrobium cruentum*, *Laelia jongheana*, *Laelia lobatea*, *Peristeria elata*, *Renanthera imschootiana*) and all species of the genera *Paphiodedilum* (88 species) and *Phragmipedium* (25 species) in Appendix I and the remaining (some 27,600 species) in Appendix II.

Orchids are one of the main plant groups that are broadly traded worldwide. There is, as will be presented in the next chapter, increasing evidence that many species or parts and derivatives thereof are being traded across international borders without the mandatory CITES permits.

7.2. European Union

In many European Union countries certain orchid species are classified as endangered, and cutting of their flowers, uprooting as well as destruction of their habitats, are strictly forbidden. However, the overall provisions of EU environmental regulations and legislation regarding orchid protection are greatly

wanting as they include only a limited number of species.

The Convention on the Conservation of European Wildlife and Natural Habitats [37] of the Council of Europe, known as the Bern Convention, signed on 19/9/1979, was the first international treaty to protect both species and habitats and to bring countries together to decide how to act on nature conservation. It also recognises the intrinsic value of wild flora and fauna, which needs to be preserved and passed to future generations and takes account of the impact that other policies may have on natural heritage.

Fifty countries and the European Union have already signed up to the Convention and have committed to promote national conservation policies, consider the impact of planning and development on the natural environment, promote education and information on conservation, and coordinate research.

Species protected under the Convention are listed in three Annexes, of which Annex I includes some 700 strictly protected plants that may not be harmed or taken from the wild. The habitats of these species are also subject to strict protection, however the choice of habitat protection measures is left to the signatory states. Only 18 orchid taxa are listed in Annex I: of those only 7 occur in Greece (*Cephalanthera cucullata*, *Comperia comperiana*, *Ophrys argolica*, *Ophrys oestrifera*, *Ophrys taurica*, *Orchis provincialis* and *Orchis punctulata*) and 10 in Turkey (*Comperia comperiana*, *Ophrys isaura, Ophrys kotschyi*, *Ophrys lycia*, *Ophrys taurica*, *Ophrys oestrifera*, *Orchis provincialis Orchis punctulata*, *Spiranthes aestivalis* and *Steveniella satyrioides*). Annex I also includes *Cypripedium calceolous*, which, judging by the evidence of the recent decades, is now extinct (if it ever existed) in Greece.

In addition to the small number of species, the Bern Convention illustrates the problems arising from the continuous taxonomic rearrangements, as it does not reflect currently accepted nomenclature. *Comperia comperiana* (Steven) Ascherson & Graebner is now *Himantoglossum comperianum* (Loiseleur) P. Delforge, and *Ophrys taurica* (Aggeenko) Nevski is now considered a synonym of *Ophrys mammosa* Desfontains.

EU Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora [38], commonly referred to as the Habitats Directive, was adopted on May 21, 1992. It aims to promote the maintenance of biodiversity in the territory covered by all Member-States through the conservation of natural habitats and of wild fauna and flora, taking account of economic, social, cultural and regional requirements. Along with the Birds Directive (79/409/EEC) it forms the cornerstone of European nature conservation policy and establishes the EU-wide Natura 2000 network of protected areas, to be safeguarded against potentially damaging developments. The Habitats Directive has evolved to reflect successive enlargements of the European Union.

Some natural habitat types and species are designated as priority: this means that they are in danger of disappearance, and the Community has particular responsibility for their conservation in view of the proportion of their natural range which falls within the European Union territory. These priority habitat types and species are included in Annexes I and II and are indicated by an asterisk (*).

Annex I includes 232 natural habitat types of Community interest whose conservation requires the designation of Special Areas of Conservation (SAC). Special Areas of Conservation are designated by the Member States which are then required to apply the necessary conservation measures for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated.

Annex II includes approximately 900 animal and plant species whose core areas of habitat (designated

as SACs) must be protected within the Natura 2000 Network and managed in accordance with the ecological requirements of the species.

Additionally, for species and sub-species listed in Annex IV (over 400, including many also listed in Annex II) a strict protection regime must be applied across their entire natural range within the EU, both within and outside Natura 2000 sites. For species and sub-species listed in Annex V (94) Member-States shall, if deemed necessary as a result of monitoring work, take measures to ensure that their exploitation and harvesting in the wild is compatible with maintaining them in a favourable conservation status.

Annex II includes just 13 orchid species. Of them, only *Cephalanthera cucullata** and *Dactylorhiza kalopissii* occur in Greece and *Ophrys kotschyi** is present locally in Turkey. Annex IV includes 3 more species of which *Ophrys argolica* occurs in Greece and *Spiranthes aestivalis* in Turkey.

Even though other orchid species may benefit indirectly through the protection of habitat types –for example type 6210*: Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)– as well as through the protection of Natura 2000 sites where they may occur, the number of protected species is far too small to ensure adequate conservation of threatened orchids in Greece (estimated at a minimum of 37 species as you will see further on).

Further relevant EU acquis that may support conservation of orchids indirectly, through trade regulations or provisions to prosecute environmental damage includes:

Council Regulation (EC) No 338/97 [39], signed on 9 December 1996, on the protection of species of wild fauna and flora by regulating their trade. Much like CITES, this Regulation imposes controls on traffic and trade of wild animal and plant species and/or specimens thereof, or any goods that contain parts or derivatives of animals and plants.

Annex A includes 14 species and two genera (*Paphiodedilum* and *Phragmipedium*) of tropical and temperate orchids; among them only *Cephalanthera cucullata* and *Ophrys argolica* occur in Greece.

Unfortunately, the provisions of this Regulation are very rarely applied in practice.

Directive 2004/35/EC [40], signed on April 2, 2004 on Environmental Liability with regard to the Prevention and Remedying of Environmental Damage (ELD). This Directive establishes a framework based on the polluter-pays-principle to prevent and remedy environmental damage. As the ELD deals with the "pure ecological damage", it is based on the powers and duties of public authorities as distinct from a civil liability system for "traditional damage" (damage to property, economic loss, personal injury).

The Directive defines "environmental damage" as damage to protected species and natural habitats, damage to water and damage to soil. Operators carrying out dangerous activities listed in Annex III of the Directive fall under strict liability (no need to proof fault). Operators carrying out other occupational activities than those listed in Annex III are liable for fault-based damage to protected species or natural habitats. The establishment of a causal link between the activity and the damage is always required. Affected natural or legal persons and environmental NGOs have the right to request the competent authority to take remedial action if they deem it necessary.

Even though the ELD has been around for the last 12 years, the competent authorities (regional and local administration, investigating and prosecuting officers, judges, lawyers, etc.) and the public and other interested stakeholders are still not familiar with its provisions, and cases of environmental damage to flora species are rarely reported and even more rarely prosecuted. Furthermore, to date, there is no commonly acceptable method to assign a monetary value to species in order to determine the severity of

the crime and appropriate reparation, thus convicting and especially sentencing is very difficult. Still, this remains a powerful conservation tool for the public and NGOs to safeguard important sites.

One example regarding orchid species is found in the report of the Finnish Ministry of the Environment to the European Commission about the implementation of the Environmental Liability Directive [41]. This report mentions that on 2010-2011, the mining firm Mawson Ltd took soil samples in the Romppaat and Mustiaapa-Kaattasjärvi Natura 2000 areas in Lapland in a manner that caused damage to protected species and natural habitats referred to in the Directive. The authorities, in this case the forestry authority Metsähallitus and the ELY Centre of Lapland, did not learn of the unauthorised soil and rock samples and excavations until November 2011. The ELY Centre of Lapland is the competent authority under the Directive with regard to damage to protected species and habitats. In the summer and autumn of 2012, Metsähallitus made an inventory of species protected under Natura 2000 regislation (mainly *Calypso bulbosa* and *Cypripedium calceolus*) and concluded that the firm had damaged 160 occurrences of *Calypso* orchids by sampling. It is estimated that 117 hectares of the protected boreal natural forest in the area has been damaged. Measures under the Directive to compensate for the damage began on 25 April 2013. The case is still tied up in court.

Finally, the **IUCN European Red List of Species** [42], even though not a legislative vehicle, presents the conservation status of threatened species and thus may support conservation actions and measures. This review of some 9,730 European species (animals, selected groups of insects, and vascular plants) includes 29 orchids. Two are classified as Critically Endangered. Another 21 are classified as Endangered; among them *Cephalanthera cucullata*, *Dactylorhiza kalopissii*, *Epipactis greuteri* and *Orchis sitiaca*, all present in Greece, as well as Himantoglossum *comperianum* present in both Greece and Turkey. Six more species are classified as Vulnerable; among them *Ophrys argolica*, endemic to Greece, as well as *Cephalanthera epipactoides*, *Epipactis pontica* and *Orchis punctulata* present in both Greece and Turkey.

7.3. Greece

Greek legislation regarding orchids and is rather vague. According to the Presidential Decree 67/81 "For the protection of indigenous flora and wild fauna, and the establishment of procedures for coordination and control of related research" as it was amended by Presidential Decree 256/87: "...the collection, uprooting, cutting, transportation, selling and purchasing, or exporting out of the country, as well as the destruction, in any way, of the vegetating taxa, and their flowers or fruits, mentioned in Table A, and defined by their scientific names, is forbidden throughout the country and throughout the year ..." The attached Table A mentions "...all genera of *Orchidaceae*..." under heading "a) endemic taxa", where the following taxa are explicitly listed: *Cephalanthera cucullata*, *Ophrys argolica*, *Ophrys cretica*, *Ophrys helenae*, *Ophrys spruneri*, *Orchis* (= *Anacamptis*) *boryi*, *Orchis anatolica* and *Orchis prisca*. Further on, in section "c) Not endemic rare and threatened taxa", *Cephalanthera epipactoides*, *Comperia comperiana* (=*Himantoglossum comperianum*) and *Cypripedium calceolous* are mentioned separately. This phrasing makes it unclear whether "all genera" indeed means all orchid genera occurring in the country, or just those genera including endemic taxa.

The Law for the Conservation of Biodiversity (3937/2011) [43] amended the aforementioned Presidential Decree, mandating the creation of National Lists of threatened and endemic species (Articles 10 and 11 respectively). In addition, Law 3937/2011 incorporates the provisions of Directive 92/43/EEC regarding protection of habitats and species, the designation of Natura 2000 sites, and their management and monitoring. Therefore, the orchid species included in Annex II of the Habitats Directive are also

protected under national law.

Unfortunately, a comprehensive list of the threatened Greek orchids on the basis of IUCN criteria [44] is not yet available so, according to the provisions of Law 3937/2011, the National Lists are based on the most recent National Red Book lists. The Red Book of Rare and Threatened Greek Plants [45] includes only the following orchids: *Cephalanthera cucullata* (EN), *Dactylorhiza incarnata* (VU), *Dactylorhiza macedonica* (VU), *Dactylorhiza pythagorae* (CR), *Epipactis cretica* (EN), *Epipactis nauosaensis* (EN), *Epipactis pontica* (VU), *Epipactis subclausa* (NT), *Gymnadenia rhellicani* (VU), and *Neotia cordata* (VU). As a result, several genera, including the genus *Ophrys*, are still underrepresented in the latest edition of the Red Data Book.

A 2016 evaluation of Greek orchids according to the IUCN criteria [46] classifies a total of 37 taxa as threatened. Of them almost half (25 taxa) are Greek (22) or Balkan (3) endemics, while the remainder are taxa reaching their distribution limits in Greece. Seven taxa (*Dactylorhiza pythagorae*, *Epipactis persica* subsp. *persica*, *Gymnadenia odoratissima*, *Gymnadenia rhellicani*, *Ophrys bertolonii*, *Orchis punctulata* and *Pseudorchis albida*) are Critically Endangered (CR), 12 taxa (*Cephalanthera cucullata*, *Dactylorhiza incarnata*, *Dactylorhiza kalopissii*, *Epipactis cretica*, *Epipactis leptochila* subsp. *naousaensis*, *Epipactis olympica*, *Epipactis purpurata*, *Himantoglossum comperianum*, *Ophrys holoserica* subsp. *graeca*, *Ophrys insectifera*, *Ophrys lyciensis*, *Orchis sitiaca*) are Endangered (EN) and 18 taxa (*Dactylorhiza baumanniana* subsp. *smolikana*, *Dactylorhiza iberica*, *Dactylorhiza macedonica*, *Epipactis densifolia*, *Epipactis leptochila* subsp. *neglecta*, *Epipactis pinovica*, *Limodorum trabutianum* subsp. *thracum*, *Neottia cordata*, *Ophrys aegaea*, *Ophrys aeoli*, *Ophrys chiosica*, *Ophrys hippocratis*, *Ophrys lesbis*, *Ophrys lindia*, *Orchis militaris* subsp. *militaris*, *Platanthera chlorantha* subsp. *holmboei*, *Serapias neglecta* subsp. *ionica*, and *Serapias patmia*) are Vulnerable (VU). Additionally, *Cypripedium calceolous* is characterised as Regionally Extinct (RE) and 11 more taxa (*Anacamptis boryi*, *Anacamptis palustris* subsp. *elegans*, *Cephalanthera epipactoides*, *Epipactis halacsyi*, *Epipactis pontica*, *Gymnadenia frivaldii*, *Ophrys argolica*, *Ophrys rhodia*, *Orchis spitzelii* subsp. *nitidifolia*, and *Serapias cordigera* subsp. *cretica*) are classified as Near Threatened (NT).

As with European acquis, Greek national legislation for the conservation of flora specifically mentions very few orchid species (some 5% of the total number) and certainly does not cover all those in need of protection. Moreover it is mostly unknown to the general public and most authorities, and very rarely enforced.

7.4. Turkey

The Forestry Law numbered 6831 is one of the most important sources of legislation concerning the protection of Turkey's orchids, and the legal issues regarding salep collection. The provisions of the law as is pertains to the protection of orchid (salep) species remain a serious problem and are open to criticism: firstly there are questions as to whether the law truly fulfils its purpose; secondly the law does not state which body is responsible for its application - which is as important as the law itself. It is not specifically stated in which areas the collection of salep is prohibited. According to the Forestry Law 6831, the collection of orchids in forested or maquis-covered lands managed by the General Directorate of Forests is forbidden. However there is no clause which forbids the collection of orchids outside of land controlled by Forestry authorities [47]. The treaty concerning the international trade of endangered plant and animal species (CITES) was incorporated into Turkish legislation with the enactment of law 4041 on September 27, 1994, and came into force upon the publication of the official gazette numbered 22672 on June 20, 1996 [48]. In accordance with communiqué 98/16 of the Foreign Trade Under-secretariat

''concerning amendments made to communiqué 96/31 about goods which are export-banned or require pre-authorisation'', published in the official gazette numbered 23407 on July 19, 1996, the export of the tubers or their derivatives (powdered, tablet or any other form) of the Orchidaceae (salep) species is forbidden. In the aforementioned law and related directives it is clearly stated that the export of salep is illegal. The sale of salep collected from the countryside to ice-cream makers is accepted as commonplace, and continues outside any legal framework whatsoever. In addition to this, in spite of the sale abroad of salep (unprocessed whole tubers, or processed but not powdered tubers) being illegal, the sale of processed salep is not regulated by any legal framework. Sale of collected salep is carried out openly in the areas where it is found, as can be seen during public market days [47]. Sadly, the collection and sale of orchid tubers for the production of salep, including many locally endemic species, continues apace. Such species, especially in provinces where the populations are concentrated, are under threat of extinction.

When Turkish orchids are evaluated according to IUCN criteria (ver. 11) [49] with their EOO and AOO values and human pressure on them a total of 31 taxa can be classified as threatened. Six taxa (*Ophrys amanensis* subsp. *antalyensis*, *Ophrys climacis*, *Ophrys lycia*, *Ophrys isaura*, *Ophrys phaseliana*, *Ophrys argolica* subsp. *lesbis*) are Critically Endangered (CR); 8 taxa (*Dactylorhiza urvilleana* subsp. *ilgazica*, *Ophrys amanensis* subsp. *amanensis*, *Ophrys holoserica* subsp. *toroslaria*, *Ophrys oestrifera* subsp. *hygrophila*, *Ophrys oestrifera* subsp. *minutiflora*, *Ophrys sphegodes* subsp. *catalcana*, *Ophrys ulupinara*, *Orchis sezikiana*) are Endangered (EN); and 17 taxa (*Anacamptis laxiflora* subsp. *dinsmorei*, *Anacamptis palustris* subsp. *elegans*, *Cephalanthera kotschyana*, *Dactylorhiza osmanica* var. *anatolica*, *Epipactis tremolsii* subsp. *turcica*, *Ophrys amanensis* subsp. *iceliensis*, *Ophrys bornmuelleri* subsp. *carduchorum*, *Ophrys oestrifera* subsp. *akcaliensis*, *Ophrys reinholdii* subsp. *leucotaenia*, *Ophrys umbilicata* subsp. *calycadniensis*, *Orchis anatolica*, *Orchis quadripunctata*, *Himantoglossum montis-tauri*, *Himantoglossum comperianum*, *Platanthera holmboei*, *Serapias bergonii*, *Serapias politisii*) are Vulnerable (VU). Moreover, the taxa whose tubers are dug up to obtain raw material for salep powder can be classified as locally threatened according to their population sizes and distribution areas.

8. THREATS AND CONSERVATION ISSUES

8.1. International trade

The main purpose of reported trade in orchids is commercial, with a small amount of specimens traded for scientific purposes. Commercial trade encompasses the horticulture industry (including collectors) and uses in medicinal and nutritional products. The horticulture industry relies mainly on artificial propagation, and shipments usually comply with national and international requirements. On the other hand there is mounting evidence of increasing illegal trade, mainly in and from southeast Asia [50].

Random sampling carried out during 2011-2012 in the four largest wild plant markets of Thailand, and at its borders with Myanmar and Laos recorded trade of 348 orchid species (roughly 15-22% of the total national orchid flora) without any necessary permits. Approximately 16% of these species were classified as threatened, among them *Paphiopedilum* species included in CITES Appendix I, or were rare with limited, localised distribution [51].

Demand for wild rare species is high and increasing [46,50], and collectors often offer substantial sums of money, fuelling unsustainable local harvesting and forcing many species to the brink of extinction [52, 53]. Examples include Asian slipper orchids, where 99% of species are threatened with extinction because of wild collection to fulfil horticultural demand. Even recently discovered species, like *Paphiopedilum vietnamense* and P. *canhii* (found in Vietnam in 1999 and 2010 respectively), are already endangered because of illegal harvesting [54]. In 2015, a trader in the USA who obtained it from an orchid hunter identified *Dendrobium cynthiae* as a new, formerly unknown to science, species. Its country of origin is thought to be New Guinea.

Unfortunately, illegal orchid trade is in most cases undocumented, therefore "invisible". The Internet and widening social media trade, especially for rare and unusual species, are also invisible and essentially uncontrolled. A recent study [53] of 150 specialised orchid-themed social media groups (fora) from all over the world indicates that 17.3% of them prohibited trade but 28.6% explicitly permitted trade or allowed it to occur. Analysis of 55,805 posts recorded over 12 weeks, from 12,089 unique members in 30 groups showed that 8.9% of them contained plants for sale, and 22–46% of these posts pertained to wild-collected orchids. The volume of plants being traded could not be extrapolated, however many posts seemed to be advertisements for available stock, in one case accompanied by pricing for up to 50 kg(!) for *Dendrobium* sp plants. Although total numbers of posts about trade were relatively small, the large proportion of posts advertising wild orchids for sale supports calls for better monitoring of social media for trade in wild-collected plants.

There are reports of wild harvesting of rare species in Greece and Turkey by researchers and collectors, even for sale, but these have not, to date, been confirmed.

Commercial trade in orchid derivatives is worldwide. A 2014 study found 39 species of orchid in European commerce as ingredients in products we buy from supermarkets, health stores and pharmacies. It also indicates that many nutritional supplements contain orchid species that may not be legally sourced [56]. As a snapshot of the illegal trade in plants in the UK, data from Heathrow [57], the world's busiest international airport with over 1,000 flights a day, show a total number of 385 plant seizures in 2015, consisting of 287 health supplements or Traditional Asian Medicines, 46 live plants, 26 plant parts and

derivatives, and 26 timber or wood products. The seized materials were dominated by individuals or parts thereof of the orchid family (42%), which are all protected under CITES legislation. The health supplements were derived mainly from Asian *Dendrobium* species, with no indication as to whether the base material was from the wild or from artificial propagation.

Orchids have been, since ancient times, an important component of Asian, especially Chinese pharmacology, used in remedies for various ailments. Even though harvesting and use occur usually within the countries, and do not fall under CITES regulations, recently international trade, mainly into China, has expanded. Records show increasing illegal export of wild orchids from Myanmar (where they are not used in traditional medicine) to China since the late 1990s [58], and a 2015 study [59] reports that illegal collection for the Chinese market has decimated wild populations (mainly of *Dendrobium* sp.) in northern India.

Control of this trade is extremely difficult as orchid species are sold or described in products by their local names, or the same name is used for several species, while many products contain ingredients from many different species, as is the case with salep.

Trade in flours made from ground-up orchid tubers has been years restricted mainly to Turkey and small parts of Asia and Africa for a long time. This trade has now expanded to reach global markets. Turkey is the main harvester and producer of salep flour, however, extensive harvesting of tubers in Iran, Pakistan and India has been reported recently, as the result of increasing demand. In a 2013 study it was estimated that 7–11 million orchids, representing 19 taxa of seven genera, were harvested in Iran for salep production [60]. Most of these were destined for export to Turkey without any licensing. Growing interest in artisanal and wheat-free flours has seen the import of orchid flour or salep into many countries of the European Union (UK, Germany, Bulgaria), but also into Arab countries, Russia, Switzerland and even Australia. All of this trade is illegal [44].

In Zambia the traditional delicacy chikanda, made from ground orchid tubers and peanut flour, has been eaten for many decades. Most of the species harvested for chikanda production belong to the genera *Disa*, *Satyrium* and *Habenaria*. The depletion of native orchids In Zambia has led to the sourcing of tubers from other countries, including Tanzania, Angola, Democratic Republic of Congo and Malawi. A 2003 study estimated that some 2-4 million orchid tubers were being exported from Tanzania to Zambia every year [61] and a 2014 study [62] reports reduction of wild populations in southern Tanzania because of increasing illegal harvesting.

These data demonstrate an increasing demand for orchids in all forms and support the need to retain the orchid family in the CITES appendices. Other emerging issues are the lack of traceability of orchid products once they have been harvested and transposed into manufactured medicinal supplements and cosmetics, and the increasing globalisation of trade, which means that the source and manufacture of CITES-listed plant-derived products can be many continents apart. CITES enforcement needs to be robust and standardised around the world in order to curb the huge trade in illegal wildlife trafficking (of plants and animals), currently estimated to be worth between 8–20 billion euro each year [63].

8.2. Greece

Unfortunately, systematic fieldwork in Greece is still ongoing, and the status of many orchid taxa, especially rare and recently described endemics, or taxa presenting great variability, is indeterminate, and their actual distribution unclear. Many researchers have diligently studied the family for many years with

methodical fieldwork, but their conclusions and taxonomic listings are controversial. We believe that most Greek orchids are threatened, even some taxa considered common.

The rarity of a taxon is determined by the limits of its geographical distribution and/or the size and spread of its populations. Rare taxa include:

a. European or Asian taxa that reach the outermost limit of their distribution in Greece, and occur in very few, or even singular, locations, with small populations. Examples include *Orchis militaris* and *Gymnadenia rhellicani*, which occur only on Mount Falakro, *Himantoglossum comperianum* on three eastern Aegean islands, *Orchis punctulata* in only one location in Thrace and one in Chios, *Ophrys insectifera* in only very few locations in Epirus, and others.

b. Narrowly distributed endemics, as *Cephalanthera cuculata*, *Epipactis cretica* and *Orchis sitiaca* in Crete, *Dactylorhiza graeca*, with a small population on Mount Lailias near Serres, *Dactylorhiza pythagoraea* in very few areas of Samos, and many others.

These taxa are endangered by deterioration of their restricted habitats and, possibly, illegal harvest, as well as by their geographical isolation. This makes them susceptible to pressure from various factors, either ecological (environmental changes) or biological (diseases).

Even rather common taxa face the same danger when their populations are widely separated. Many taxa considered widespread and not threatened, since they occur all over Greece in large numbers, are under pressure, because they are dependent on specific habitats. An example is *Anacamptis laxiflora* that grows only in wetlands; wetlands are still drained, especially small ones on the islands, to provide land for cultivation or touristic infrastructure. Many taxa of the genera *Anacamptis*, *Neotinea* and, especially, *Ophrys*, show a preference for neglected or abandoned fields and old olive groves, which often succumb to urban expansion or are cultivated again, especially in recent years, because of increased subsidies for biologic agriculture and the economic crisis. In areas of the southern mainland, like the Peloponnese, and the larger islands conversion of lands for agriculture mainly affects low altitude areas with phrygana and maquis vegetation, both prime habitats for orchids.

The, often uncontrolled, use of agrochemicals and pesticides also affects orchid populations because it eradicates their pollinators.

Grazing is generally beneficial for orchids, especially *Ophrys* species, as it maintains the open habitats they prefer. However, in areas where the herds are stationary and do not change locations, overgrazing has denuded whole mountains of vegetation, except poisonous plants that even the goats will not eat. This is especially evident on some of the Cyclades islands and in the mountains of Crete, where overgrazing has brought *Cephalanthera cucullata* to the brink of extinction. On the other hand, land abandonment and reduction of animal farming in many areas, particularly in northern Greece, has led to an expansion of shrubs and forest that smother the open areas preferred by many orchids.

Urban expansion and tourist infrastructure "devour" more and more of the low-lying areas along the coastline, especially in favourite touristic destinations like Crete, Rodos and Corfu (which all have many endemic taxa). Alpine meadows on many mountains are threatened by the expansion of ski resort facilities and the plans for construction of new resorts even on mountains that already have one. Furthermore, the penetration of tourism to the furthest villages of Pindos, the Rodopi range and other, formerly difficult to reach, regions requires new infrastructures. Even though environmental impact assessment is mandatory prior to any public or private work, these assessments are often inadequate, with little attention paid to flora, especially orchids, and the specified environmental conditions and restrictions

Figure 9. image13.jpeg

are rarely met. Orchid habitats are frequently destroyed during the construction of public infrastructure, especially roads. The intensive construction of new roads in forests and on mountains –often just to absorb available funds and create the illusion of "development" in rural areas– and the unnecessary widening and/or paving of existing unpaved roads in remote areas have caused havoc in many previously undisturbed sites, affecting many populations of *Cephalanthera*, *Epipactis*, *Dactylorhiza*, and *Orchis*.

A typical example is the case of *Dactylorhiza incarnata*, a species included in the national Red List and, therefore, theoretically protected. *D. incarnata* was known from only five wet meadows in Epirus and central Macedonia. Within the last three years two of these sites were completely destroyed: the largest of all, in Epirus, was drained and covered by rubble during the widening of a secondary road and another in Macedonia was converted to a potato field. A third one in Macedonia has also been affected by a diversion of the water flow to it and the local population has been much reduced. Thus, within a very short time, a species with very limited distribution in Greece has suffered several local extinctions, leading to upgrading of its IUCN threat status to EN [64, 46].

There is evidence that many thousands of plants, mainly Orchis mascula, Orchis quadripunctata and several Ophrys and Dactylorhiza species, are illegally uprooted every year for the production of salep. Salep consumption has been increasing in recent years. During the last two years it has become standard fare in a significant percentage of the coffee shops, especially in cities of northern Greece, and it is sold in delicatessen shops and through the Internet as a "traditional" product. In preparation of this White Paper we have identified more than a dozen salep products on sale though various commercial websites, advertising its health properties and explicitly stating that it is a "natural product without preservatives". On one package it is even stated that the product comes from "Orchis mascula". Signs of large-scale collection have been repeatedly found on the mountains around the headwaters of the Aspropotamos River in Thessaly, in the greater area of Konitsa in Epirus, even within the boundaries of Mount Parnitha National Park, next to Athens [30]. To date we have no evidence that tubers and/or orchid flour are exported from or imported to Greece, but the possibility cannot be excluded. Given this alarming increase, the HSPN has initiated an investigation into the matter.

We must also, regrettably, point out that there are reports of researchers cutting and uprooting many plants for their herbaria, or even for sale, without any control whatsoever.

Finally, the limited knowledge and awareness of the public as well as most competent authorities about orchids, their importance, need for protection and relevant legislation, combined with the ambiguities created by the changing nomenclature and the small number of taxa actually included in legislative vehicles, significantly impede conservation efforts.

8.3. Turkey

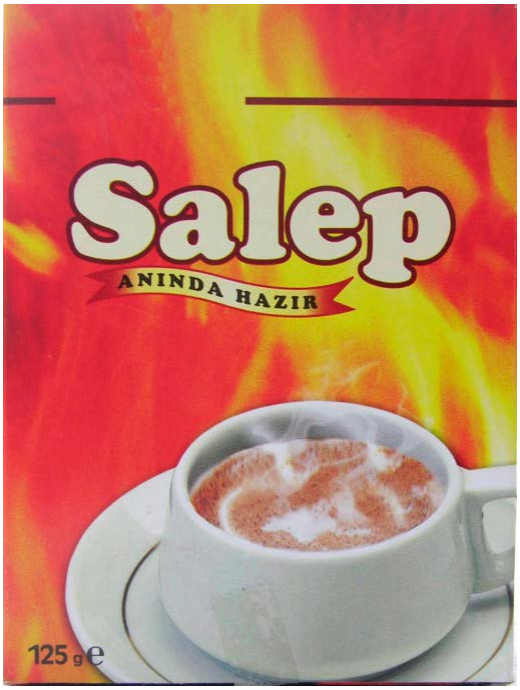


Figure 10. image13.jpeg

The most striking example of the damage that can be done to the biodiversity of Turkey is the tragic situation faced by species of the Orchidaceae family. Tuberous Orchidaceae species are used in the production of salep. The powder which is obtained from orchid tubers has been used within the country for centuries and is also exported. Salep is used in Turkish ice-cream, and for making a hot, milky beverage. Most of the tuber bearing orchids of Anatolia (90%) are used for salep extraction [65]. Therefore, in spite of the wealth of terrestrial orchids, due to the collection for salep, as well as increased grazing by animals in their habitats, they are under serious threat. Salep is extracted by drying the tubers and grinding them into the powder, which is then used in ice-cream and hot drinks. According to some foreign sources, during Ottoman times on average 6.5 tonnes of salep powder were exported every year. In 1975 this figure was 15 tonnes. If we assume domestic consumption to be at least equal to exports, we can estimate that twice these amounts of salep are produced in total. For every kilogram of dry salep powder, approximately 1,000 orchid tubers are needed [66]. It is thought that every year 100 million orchids are uprooted every year in our country to make salep [67]. In spite of the export of salep being forbidden, domestic consumption continues.

For obtaining salep raw material, the orchid plants are collected before or during the flowering phase, and, after the tuber is removed, the plants are discarded. Because of this, the plants are unable to develop, to fruit and produce seeds, therefore future generations are also destroyed. Based on this data we can see just how threatened are the salep orchids of Turkey and their habitats. It should be noted that just 10-15 major salep merchants benefit from the salep trade rather than the citizens who live in the countryside and are engaged in orchid picking. It should also be noted that, as seen by the many commercial products available in the market, rather than using natural salep it is possible to produce the ice-cream and hot drinks using other raw materials [67].

In addition to illegal harvesting, urbanisation, particularly in coastal regions, and the development of tourism infrastructures in maquis- and garrique-covered regions threaten the orchids' habitat. Many taxa including rare and endemic ones are seriously endangered. Agriculture, forestry, urbanisation, industrialisation and various projects concerning the use of water resources all pose a great threat to the natural environment. Additionally, overgrazing, forest fires and collection of orchids due to the poor economic situation of the orchid pickers is causing the eventual destruction of these valuable plants [68]. As an example, the slopes of Güllük where orchids used to grow are now the home of touristic infrsatructure. Likewise the area around Yatağan, where rare orchids were found, has been lost to a coal-fired power station, urbanisation and development of the road network, also causing the loss of some other endemic species [66]. For all of these reasons it is obligatory that Turkey develops a conservation strategy especially for orchids. According to Macado [69] one of the possible strategies for protecting critically endangered species is the mono-specific (covering just one species) approach. The protection and sustainability of Turkey's biodiversity is connected with the study and protection projects for critically threatened habitats and species requiring urgent action.

9. BEST PRACTICES – RECOMMENDATIONS

As described above, orchids in Greece face similar threats to other flora species and most of these are dealt with within the context of national and European conservation policies. In the case of orchids, however, problems are exacerbated by a widespread lack of knowledge and awareness about them, both of the general public and, most importantly, of the relevant authorities at all levels. Increasing public awareness and providing information to authorities, especially at the local and regional level must be considered a priority goal.

By itself, the declaration of conservation areas is not enough for the protection and sustainability of biodiversity. In Turkey's İğneada Forests, Kuşgölü Lake and Sultansazlığı Wetlands, areas of utmost importance to biodiversity, it was attempted to stop environmental degradation by granting protection status. As well as these, many protected areas (Areas of Special Natural Scientific Interest, Special Environmental Protection Zones, etc.) already designated in coastal districts have not been able to resist the pressures of tourism development in spite of legal protection [70]. In nature protection programmes conducted in recent years, instead of the classic conservation approaches for the protected areas, the necessity of new conservation and planning tools has come to the fore on the agenda. It was perceived that approaches that just protect, without reference to the local human populations cannot be successfully managed [71]. This again highlights the importance of species-focussed conservation. The first step of a conservation scheme is the initial polling of the species. In this context the flora and revision studies carried out on the family reveal the existence and spread of the species by taxonomic methods.

There is also a lack of academic interest in orchids, compared to other plant families and groups, with very little research and fieldwork carried out. It is important to stimulate research (eg. assignment of doctorate theses, cooperation with international projects and scientific bodies) in order to fill the remaining knowledge gaps. Studies of species that are under threat of extinction in the near future for reasons of very narrow distribution, or because of extremely high localised threats, must intensify [72]. Investigations continue and action plans are being prepared for projects that can become examples of the protection of orchid species in Turkey and species conservation in general. In summary, the inventory of Turkish orchids has been updated by recent flora and revision studies [35, 35, 73, 74, 75, 76]; the damage caused by salep production upon Turkish Orchid populations has been studied [67]; the General Directorate of Forestry, Non-Wood Products and Services department has prepared an action plan [77]; in 2011 and 2012 orchid and salep workshops were set-up.

A significant emerging issue is the rapidly increasing trade of salep, especially though the Internet. It is important to assess these products, identify their content and sources and, if coming from wild orchids, take appropriate actions according to national and European regulations. Information must be provided to the relevant authorities, which must be pressured to investigate. Since some of these products appear to come from reputable companies that might, unknowingly, use prohibited ingredients from wild orchids, acceptable substitutes must be proposed, based on available research and the expertise from Turkey.

Below follow brief examples of practices applied in Greece and other European countries to address orchid or other flora (even fauna) conservation problems and increase awareness and participation of the public, often in the framework of projects co-funded by the EU LIFE mechanism. Such practices may be adapted in accordance to local needs, special requirements of species, conservation policies and national legislation for use in Turkey.

9.1. Conservation and restoration of habitats

Habitat degradation and loss is one of the main threats for orchids, and can result from a variety of causes such as changes in land use, land abandonment and forestation, intensified agriculture, drainage, expansion of invasive native and non-native species, construction of public works, etc. In many cases it is possible to prevent loss and/or improve conservation status of habitats through localised interventions, focused according to the type of habitat and threat. Engagement and support of the local communities and stakeholders is very important for the success of such interventions, as is strong scientific support because often they involve significant cost and/or may class with various interests.

Specific examples concerning orchids are:

1. Restoration of calcareous grassland in eastern Luxembourg (LIFE13 NAT/LU/000782) [78].

The project's main objective centres on securing and restoring all calcareous grasslands known to exist in southeast Luxembourg, which includes endangered species such as those belonging to the genera *Ophrys* Orchis.

This goal will be achieved by: improving the conservation status of grassland habitats through removal of moss and dead biomass; expanding the surface area of target habitats by clearing of scrubs and removing non-native forestation, as well as preventing re-colonisation; cross-linking habitat patches through extensification of adjacent farmland; providing long-term protection through land purchases and management; and increasing public awareness concerning the cultural and historical importance of calcareous grasslands, thus laying the foundations for their future protection.

2. Conservation of alkaline fens (7230) in southern Poland (LIFE13 NAT/PL/000024) [79]

The project aims to maintain or improve the conservation status of the majority of alkaline fens in the south of Poland, contributing to the conservation of the full geographical and regional diversity of the habitat, and the conservation of key localities of fen orchid *Liparis loeselii* and other rare plant species of alkaline fens.

This goal will be achieved by: preventing excessive drainage and raising the water table in areas of alkaline fens through construction of small dams; inhibiting mineralisation and eutrophication of the surface peat layer; halting the loss of biodiversity in alkaline fens due to the expansion of species from habitats with lower humidity, such as grasses, trees and shrubs by removing them; propagating alkaline fens protection methods within management plans based on scientific knowledge, with particular emphasis on hydroecologic aspects; promoting the protection of alkaline fens as the refuge of rare and endangered species, which can also serve as regional and local attractions; engaging the local communities and creating a group of people interested in the long-term protection of alkaline fens; and encouraging farmers and other stakeholders to apply extensive mowing in the future.

3. Semi-natural dry-grassland conservation and restoration in Valle Susa, Italy, through grazing management (LIFE12 NAT/IT/000818) [80]

The project aims to conserve and restore the dry grasslands within a representative area of the "Oasi xerotermiche della Val di Susa - Orrido di Chianocco e Foresto" Natura 2000 site. The site is extremely significant due to the extent and richness of orchids and steno-Mediterranean rare species.

This goal will be achieved by: restoring shrub and tree-encroached areas through mechanical clearing and cutting; defining a methodology and guidance for sustainable grazing and applying these to

dry grasslands (e.g. by buying a "service flock" of domestic animals to graze the conservation area and installing mobile electric fences, permanent electric fences, water and salt points); regulating and restoring access to the grazed areas to improve protection of the habitat; applying management guidelines in order to demonstrate sustainable land use; increasing community awareness about the value of the SCI and the 6210* habitat through meetings and the involvement of students; developing the tourist potential of the area; and encouraging participation and thus greater awareness of issues related to the use of natural resources.

9.2. Localised in situ protection

This can be particularly effective for small, localised populations of rare and/or threatened species and can be pursued in a variety of ways (eg. through the purchase or lease of land, etc). It should be viewed as a management tool complementary to a nationally adopted "large site" strategy (in the case of European Union Member-States the Natura 2000 network), and can be particularly effective in areas not covered by it.

A novel approach arising from work done in EU countries is the concept of Plant Micro-Reserves (PMR). The concept (Microreserva de Flora) was proposed and developed in the early 1990s by Emilio Laguna of the Region of Valencia (Spain) for the in situ conservation and management of threatened and rare plants. It was put into practice in 1994 within the context of a relevant LIFE project.

Plant Micro-Reserves encompass areas of small surface (less than 20 ha), and should have a defined legal status forming, ideally, a network. They aim to protect selected samples the main populations of the rarest, endemic or most threatened species and, at the same time, establish a permanent monitoring system to record and evaluate long-term population fluctuations and tendencies. Additionally, they provide germplasm for ex situ conservation and can function as focal sites for a multitude of plant conservation and environmental awareness activities (reintroductions of species, plant population reinforcements and translocations, in situ management, environmental education).

During the past decade, the PMR concept has received a wide recognition and appreciation throughout the European continent. Apart from the extended network currently deployed in Valencia (about 250 PMRs), Micro-Reserves have been established in Minorca (24 sites) Crete (7 sites), Bulgaria (58 sites), Slovenia (30 sites) and Cyprus (5 sites).

In preparation, localities for the species/habitat targets must be inventoried, the size of the populations, the threats and the general ecotypic characteristics must be estimated and identified and the precise areas of the Plant Micro-Reserves must be proposed and adopted. After detailed mapping of the PMRs, management and monitoring plans are elaborated. It is advisable to engage the local communities in the effort to ensure their support through information campaigns, hiring locals as wardens, etc. It is also important to secure specific legal status for the PMRs, depending on national legal conservation tools. In Greece PMRs have been declared Wildlife Refuges.

Then, specific measures can be applied, depending on the management plan, for in situ (restricting access and grazing, protection of individual plants, artificial pollination, enrichment of population through planting, seed dispersal, watering, removal of competing species, etc.) and ex situ (storage of seeds in seed banks, elaboration of germination protocols and production of plantlets) conservation.

Monitoring within the PMRs includes target species flowering and fruiting, regeneration, population dynamics and trends, as well as meteorological conditions and related environmental and biotic factors.

Specific examples concerning orchids are:

PMR for *Cephalanthera cucullata*, Crete (LIFE04 NAT/GR/000453, PLANT-NET CY) [81].

This PMR is established near Koustogerako, in the western part of Mt. Lefka Ori (Natura 2000 site GR 4340008) and encompasses the entire local sub-population (1 out of 5 in Crete) comprising less than 200 individuals. The total surface of the Micro-Reserve is 12 ha. The main threat is overgrazing.

In situ conservation measures included:
i. Fencing of a large area and placement of additional small cages to protect individual plants from grazing. In one year the number of flowering plants increased by almost three times.
ii. Wardening.

Ex situ conservation measures included: Collection and storage of seeds, as well as development of a seed germination protocol. Cultivation of propagation material.

PMR for *Ophrys kotschyi*, Cyprus (LIFE08 NAT/CY/000104, CRETAPLANT) [82].

This PMR is established at Periochi Mitserou, in central Cyprus (Natura 2000 site CY 2000003) and encompasses the largest local sub-population (one out of 37 localities where this species occurs) comprising some 360 individuals.

In situ conservation measures included:
i. Hand pollination to increase the reproductive success, which is considerably low due to the limited presence of the species' insect pollinator. Assisted pollination increased production of seedpods from circa 2% (occurring naturally) to over 80%. Most of the collected seeds were released in nature in order to enhance natural regeneration, while some of them were used for seed germination experiments and *ex situ* conservation.
ii. Removal of dried, flammable biomass to limit the danger of wildfires and hence the destruction of the species' habitat.
iii. Creation of a marked pathway to facilitate movement of visitors while protecting the plants from trampling.

Ex situ conservation measures included: Development of a seed germination protocol.

9.3. Information campaign targeting local authorities (administrative, judicial, etc.)

Local authorities are the ones usually called upon to implement conservation measures, to enforce relevant legislation, and to prosecute those liable for environmental damages. At the same time, our experience from Greece indicates that said authorities are, more often than not, poorly informed, if not totally ignorant about conservation issues, threat status and available legal tools pertaining to flora, especially orchids.

As an example, recent original research conducted in Crete within the context of project LIFE14/GIE/GR/000026 "LIFE NATURA THEMIS" [83] indicates that the knowledge level of local and municipal authorities, investigative officials, lawyers, even prosecutors and judges, about the Natura 2000 network is limited or poor. Additionally, all groups examined, with the exception of prosecutors and judges, have limited or poor knowledge about national and European environmental legislation and were unwilling

to become involved in actions to prevent or prosecute environmental degradation, including damage to flora habitats and species.

Thus, forestry and urban planning officials are expected to approve environmental impact assessments and issue permits for works, investigative and judicial officers are expected to prosecute and to ensure remediation for damages, and customs officials are expected to control trade and enforce CITES regulations without knowing which species are threatened, how they protected, often not even what an orchid looks like.

Relevant information can be provided in a variety of ways, including workshops, seminars, posters and guidebooks. The latter are a very efficient means, as they can include photographs, detailed descriptions, etc., and they can be readily available to peruse.

Such guidebooks can be thematic, focusing on specific issues (conservation legislation, CITES, etc.), or comprehensive. They should include pertinent information in a condensed, easy-to-read way, highlighting the critical points and provide references to complete texts (of laws for example), studies or other scientific publications for more details. They should demonstrate the basic "parts" of on orchid, and include distinctive photographs and/or drawings of orchids, enabling identification at genus level at least. Highly endangered or endemic species, as well as species protected under international conventions should be identified. Photographs and/or drawings of orchid parts that may be traded (such as the tubers) should also be included.

A specific example is the technical manual for border officials (customs and veterinary) concerning trade in protected bird species, created in the framework of LIFE projects LIFE10/NAT/BG/000152 "Return of the Neophron" carried out in Bulgaria and Greece and LIFE14/NAT/BG/001119 "LAND for LIFE" carried out in Bulgaria. The manual contains a review of the international trade and relevant international and national legislation, it describes the most common ways of illegal trade and transport of wild birds and recommends effective ways of action. It also includes a section with illustrations of all relevant species and assorted other information about relevant authorities and organisations [84]. Such a manual can be prepared for orchids.

9.4. Information campaign targeting the public and civil society actors (i.e. NGOs) about the importance of flora conservation and available legal means

The previously mentioned original research within the context of project LIFE14/GIE/GR/000026 "LIFE NATURA THEMIS" [83] that the general public and civil society actors (even environmental NGOs) have limited or poor knowledge about national and European environmental policies and the legislative vehicles available to prosecute environmental degradation, including damage to flora habitats and species and to ensure remediation. Because of this the public often questions the adequacy of existing legislation. Additionally citizens mistrust and question the efficiency, effectiveness and integrity of investigative and judicial authorities and they are often wary to report such matters to the authorities because of the cumbersome and time-consuming procedures involved.

As a result only 6% of all cases tried in the courts of Crete relate to environmental damage; almost 60% of all cases of environmental liability are eventually dismissed while the mean interval between initiation of court proceedings and final verdict is more than 5 years; charges registered against unknown culprits are hardly investigated and almost all and are eventually dropped; over 70% of those accused

for environmental violations in Crete are found not guilty; 80% of all fines levied after convictions for environmental violations are smaller than 5,000 euro.

A campaign to inform the public and civil society actors about the available legal vehicles and to motivate them to take active part in prevention and prosecution of damage to orchids and their habitats can provide information in a variety of ways, including workshops, seminars, posters and guidebooks. Such guidebooks should be designed to provide an attractive source of understandable, accurate and useful information for citizens regarding environmental legislation and orchid conservation, and should focus on opportunities, legal rules, and tools that are available to local communities under environmental laws to protect biodiversity in their areas.

Nowadays, the technology of smart devices presents new opportunities for conservation. As Internet access and mobile phone coverage expand into most areas, and use of smart phones, tablets and other electronic devices continuously increases, opportunities to use them as conservation tools increase accordingly.

A specific example is a smart device application created by the HSPN within the aforementioned "LIFE NATURA THEMIS" project [85]. The application enables the user, upon becoming aware of environmental damage, or even the threat of such, to take photographs, tag them with georeference data, attach a short text describing the problem and pass it on to a database. The competent authority monitored the database will then be able to take appropriate steps to prevent, contain or remedy the damage, initiate investigations and ensure restoration and appropriate compensation. Additionally, if so designed, the application can directly inform specified appropriate administrators via e-mail or SMS to accelerate first response. As it is very easy to use, and the reports are anonymous, the application is expected to increase environmental damage and/or crime reporting. Relevant authorities will also receive information much faster, as reports of environmental crimes often require considerable time to filter upwards from the local level through the intervening administrative layers.

As an integrated conservation example, it can be shown that Turkey's most complete target-species and community based studies carried out on any orchid species was performed during the Lycia Kaş Orchid (*Ophrys lycia*) Conservation Project [86]. Within the scope of this project, the current population of the Lycian Kas Orchid, which is critically endangered, was studied for four years between 2011 and 2015. The number of individual plants recorded in 2011 was 237; this number increased to 951 in parallel with the conservation project. As part of the conservation project, two special protection areas of 100 acres each were established in areas belonging to the Forestry Works Directorate of the region. In addition, the populations of the species were established during field studies and their spread was mapped in 3D. The species' ecological needs were investigated, the pollinator was identified and seeds were transferred to the Turkish Seed Gene Bank. As it is the people who live in the same areas as the orchids that will protect the species and carry them to the next generations, seminars were given to school children, who make up our future generations, in their local schools. Nature education was provided both in schools and out in the natural environment, T-Shirts were printed and visual and written materials were distributed. Seminars were given during the most important cultural event of the region, namely the Lycia–Kaş Culture Festival. All the activities were recorded on video, and a documentary upon the Lycian Kaş Orchid was produced and distributed to schools. This and similar projects in Turkey about Critically Endangered orchid species, bringing together best-practice conservation plans in concert with public awareness projects can clearly increase the awareness of the general public regarding conservation issues, making the likelihood of success much greater.

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11. APPENDIX B.

Turkish Orchidaceae Taxa

1. Anacamptis collina
2. Anacamptis coriophora subsp. coriophora
3. Anacamptis coriophora subsp. fragrans
4. Anacamptis laxiflora subsp. dielsiana
5. Anacamptis laxiflora subsp. dinsmorei
6. Anacamptis laxiflora subsp. laxiflora
7. Anacamptis morio subsp. caucasica
8. Anacamptis morio subsp. longicornu
9. Anacamptis morio subsp. morio
10. Anacamptis morio subsp. picta
11. Anacamptis morio subsp. syriaca
12. Anacamptis palustris subsp. elegans
13. Anacamptis palustris subsp. palustris
14. Anacamptis palustris subsp. robusta
15. Anacamptis papilionacea subsp. messenica
16. Anacamptis papilionacea subsp. palaestina
17. Anacamptis papilionacea subsp. papilionacea
18. Anacamptis papilionacea subsp. schirwanica
19. Anacamptis pyramidalis
20. Anacamptis sancta
21. Barlia robertiana
22. Cephalanthera damasonium
23. Cephalanthera epipactoides
24. Cephalanthera kotschyana
25. Cephalanthera kurdica
26. Cephalanthera longifolia
27. Cephalanthera rubra
28. Coeloglossum viride
29. Corallorhiza trifida
30. Dactylorhiza aristata
31. Dactylorhiza euxina subsp. armeniaca
32. Dactylorhiza euxina subsp. euxina
33. Dactylorhiza euxina subsp. euxina var. euxina
34. Dactylorhiza euxina subsp. euxina var. markowitschii
35. Dactylorhiza iberica
36. Dactylorhiza incarnata subsp. cruenta
37. Dactylorhiza incarnata subsp. incarnata

38. Dactylorhiza maculata
39. Dactylorhiza nieschalkiorum
40. Dactylorhiza osmanica var. osmanica
41. Dactylorhiza osmanica var. anatolica
42. Dactylorhiza romana subsp. georgica
43. Dactylorhiza romana subsp. romana
44. Dactylorhiza saccifera subsp. bithynica
45. Dactylorhiza saccifera subsp. saccifera
46. Dactylorhiza saccifera subsp. taurica
47. Dactylorhiza umbrosa var. umbrosa
48. Dactylorhiza umbrosa var. chuhensis
49. Dactylorhiza urvilleana subsp. ilgazica
50. Dactylorhiza urvilleana subsp. urvilleana
51. Epipactis atrorubens
52. Epipactis condensata
53. Epipactis helleborine subsp. bithynica
54. Epipactis helleborine subsp. densifolia
55. Epipactis helleborine subsp. helleborine
56. Epipactis helleborine subsp. levantina
57. Epipactis microphylla
58. Epipactis palustris
59. Epipactis persica
60. Epipactis pontica
61. Epipactis tremolsii subsp. turcica
62. Epipactis troodi
63. Epipactis veratrifolia
64. Epipogium aphyllum
65. Gennaria diphylla
66. Goodyera repens
67. Gymnadenia conopsea
68. Himantoglossum affine
69. Himantoglossum caprinum
70. Himantoglossum comperianum
71. Himantoglossum jankae
72. Himantoglossum montis-tauri
73. Limodorum abortivum var. abortivum
74. Limodorum abortivum var. rubrum
75. Listera cordata
76. Listera ovata
77. Neotinea lactea
78. Neotinea maculata

79. Neottia nidus-avis
80. Ophrys akcakarae
81. Ophrys amanensis subsp. amanensis
82. Ophrys amanensis subsp. antalyensis
83. Ophrys amanensis subsp. iceliensis
84. Ophrys apifera
85. Ophrys apollonae
86. Ophrys argolica subsp. lesbis
87. Ophrys argolica subsp. lucis
88. Ophrys blitopertha
89. Ophrys bombyliflora
90. Ophrys bornmuelleri subsp. bornmuelleri
91. Ophrys bornmuelleri subsp. carduchorum
92. Ophrys bornmuelleri subsp. ziyaretiana
93. Ophrys candica subsp. candica
94. Ophrys candica subsp. minoa
95. Ophrys cilicica
96. Ophrys cinereophila
97. Ophrys climacis
98. Ophrys episcopalis
99. Ophrys ferrum-equinum
100. Ophrys fusca subsp. fusca
101. Ophrys fusca subsp. leucadica
102. Ophrys fusca subsp. persephonae
103. Ophrys heldreichii subsp. calypsus
104. Ophrys hittitica
105. Ophrys holosericea subsp. aramaeorum
106. Ophrys holoserica subsp. heterochila
107. Ophrys holosericea subsp. mesopotamica
108. Ophrys holoserica subsp. toroslaria
109. Ophrys holoserica subsp. vanbruggeniana
110. Ophrys iricolor
111. Ophrys isaura
112. Ophrys konyana
113. Ophrys kotschyi
114. Ophrys kreutzii
115. Ophrys levantina subsp. grandiflora
116. Ophrys levantina subsp. levantina
117. Ophrys lutea subsp. minor
118. Ophrys lycia
119. Ophrys lyciensis

120. Ophrys mammosa subsp. ciliciana
121. Ophrys mammosa subsp. leucophthalma
122. Ophrys mammosa subsp. mammosa
123. Ophrys mammosa subsp. posteria
124. Ophrys oblita
125. Ophrys oestrifera subsp. akcaliensis
126. Ophrys oestrifera subsp. bremifera
127. Ophrys oestrifera subsp. hygrophila
128. Ophrys oestrifera subsp. karadenizensis
129. Ophrys oestrifera subsp. minutiflora
130. Ophrys oestrifera subsp. minutula
131. Ophrys oestrifera subsp. oestrifera
132. Ophrys omegaifera subsp. israelitica
133. Ophrys omegaifera subsp. omegaifera
134. Ophrys phaseliana
135. Ophrys phrygia
136. Ophrys reinholdii subsp. antiochiana
137. Ophrys reinholdii subsp. leucotaenia
138. Ophrys reinholdii subsp. reinholdii
139. Ophrys reinholdii subsp. straussi
140. Ophrys schulzei
141. Ophrys speculum subsp. regis-ferdinandii
142. Ophrys speculum subsp. speculum
143. Ophrys sphegodes subsp. catalcana
144. Ophrys sphegodes subsp. caucasica
145. Ophrys sphegodes subsp. herae
146. Ophrys tenthredinifera
147. Ophrys transhyrcana subsp. mouterdeana
148. Ophrys transhyrcana subsp. paphlagonica
149. Ophrys tremoris
150. Ophrys ulupinara
151. Ophrys umbilicata subsp. attica
152. Ophrys umbilicata subsp. bucephela
153. Ophrys umbilicata subsp. calycadniensis
154. Ophrys umbilicata subsp. khuzestanica
155. Ophrys umbilicata subsp. lapethica
156. Ophrys umbilicata subsp. latakiana
157. Ophrys umbilicata subsp. umbilicata
158. Ophrys urteae
159. Orchis anatolica
160. Orchis anthropophora

161. Orchis italica
162. Orchis mascula subsp. longicalcarata
163. Orchis mascula subsp. pinetorum
164. Orchis militaris subsp. militaris
165. Orchis militaris subsp. stevenii
166. Orchis pallens
167. Orchis pauciflora
168. Orchis provincialis
169. Orchis punctulata
170. Orchis purpurea subsp. caucasica
171. Orchis purpurea subsp. purpurea
172. Orchis quadripunctata
173. Orchis sezikiana
174. Orchis simia
175. Orchis spitzelii
176. Orchis tridentata
177. Orchis ustulata
178. Platanthera bifolia
179. Platanthera clorantha
180. Platanthera holmboei
181. Serapias bergonii
182. Serapias cordigera subsp. cordigera
183. Serapias orientalis subsp. levantina
184. Serapias orientalis subsp. orientalis
185. Serapias politisii
186. Serapias vomeracea
187. Spiranthes aestivalis
188. Spiranthes spiralis
189. Steveniella satyroides
190. Traunsteinera globosa
191. Traunsteinera sphaerica