MEDITERRANEAN ISLANDS COLLECTIVE PROJECT

Getting to know the important plants of Gavdos and Gavdopoula









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Introduction

This edition aims to inform and raise awareness among the residents and visitors of Gavdos and Gavdopoula about the important biodiversity of the islands, and specifically about the rare threatened and protected plants that are found in the area.

The selection of the species was made from the plant lists of the two islands known to date. The most important plants were evaluated, i.e. plants which are included in the Red Data Books of Rare and Threatened Plants of Greece and in the Red Lists of threatened species of the International Union for Conservation of Nature (IUCN), plants with a restricted distribution (e.g. endemic plants), plants protected by the Greek legislation or international conventions, and other important plants of the two islands.

The protected habitats where several of the important plants are found as well as the pressures and threats that they face mainly due to human activities are also presented.

Finally, some recommendations are given, which could contribute to the conservation of the rare flora and unique natural environment of the islands that we all admire, love and respect!

Brief description of Gavdos and Gavdopoula

The islands Gavdos and Gavdopoula are located 21 miles south of the southwest Cretan coast and form the southernmost edge of Greece and Europe. The island of Gavdos is the larger of the two, with an area of 29.58 km² and maximum altitude 362 m. Gavdopoula lies 3 miles northwest of Gavdos with an area of 2.62 km² and maximum altitude 113 m.

Geologically the two islands consist of limestone of upper Cretaceous (Pindos zone). Also on the island of Gavdos there are metamorphosed rocks. In Gavdos there are extensive neogene deposits with marine fossils. In the east side, between the settlements Karave and Kastri, there are also late Pleistocene deposits (psammitic) with well conserved land snail fossils. Although Gavdos is not characterized by a high altitude, it has several valleys and seasonal streams.

The climate of Gavdos is typical of the Mediterranean climate. The wet season of the year lasts from November to March (87% of the annual rainfall) while the average annual rainfall is only 311 mm. The temperature ranges from 13 °C in the months of January and February to 28 °C in the months of July and August.

The wealth of natural resources of Gavdos attracted people from as early as the Palaeolithic period as mentioned in the wonderful publication of the Ephorate of Antiquities of Chania entitled «Gavdos and its monuments». Today, the 151 inhabitants of the Municipality of Gavdos, which is the smallest Municipality in Greece, live in Gavdos while Gavdopoula is uninhabited. However, less than 100 people live on the island permanently throughout the year. In the summer months, the general population of the island, due to tourists, can reach 3,500, with most of them being campers. The inhabitants are mainly engaged in livestock farming, fishing and tourism.

The flora and vegetation of Gavdos and Gavdopoula

Gavdos and Gavdopoula, together with Crete and the other islands of the North and South Cretan Sea, as well as the islands of the South Aegean, constitute a phytogeographical connection between Europe and Asia. Furthermore, the flora of the above islands is particularly remarkable for its affinities to North Africa and especially to Cyrenaica of Libya, while on Gavdos and Gavdopoula these affinities are more pronounced.

On Gavdos, 490 plants have been recorded until today, 1 of which is endemic to the island, i.e. it is found on Gavdos and nowhere else in the world. Furthermore, 8 plants are endemic to Crete & Gavdos, i.e. they are found only on Crete and Gavdos, and 14 plants are endemic to Greece. About 70% of the plants of Gavdos are also present in Cyrenaica of Libya. The Red Data Books of Rare and Threatened Plants of Greece include 10 plants of Gavdos and 30 plants are protected by the Greek legislation.

On Gavdopoula, 183 plants have been recorded, 4 of which are endemic to Crete & Gavdos, 9 are endemic to Greece, 5 are protected by the Greek legislation, and 1 is included in Annexes II and IV of the Habitats Directive. The Red Data Books of Rare and Threatened Plants of Greece include 2 plants of Gavdopoula.

In total, about 510 different plants have been recorded on Gavdos and Gavdopoula whereas 22 of these plants have only been recorded on Gavdopoula.

With regards to the vegetation, on Gavdos it consists of maquis, forest (mainly pine forest of *Pinus brutia*) and phrygana, and there are extensive sand dunes with *Juniperus* spp. on the north side of the island. Also, there are many abandoned cultivated fields and terraces which have been converted to forest or phrygana. On Gavdopoula the vegetation consists mainly of phrygana, a few clusters of lentisk (*Pistacia lentiscus*), small areas with annual herbaceous plants and sea cliff vegetation.



Important habitats of Gavdos and Gavdopoula

Gavdos, Gavdopoula and the surrounding sea zone constitute the NATURA 2000 site with the Code GR4340013. In this site there are 16 different habitat types of the European Habitats Directive (13 terrestrial and 3 marine), which host many important plant species. Four of these habitats are classified as priority habitats for protection and they are protected by the European and Greek legislation: the marine habitat "1120* - Posidonia beds (*Posidonion oceanicae*)" and the terrestrial habitats "2250* - Coastal dunes with *Juniperus* spp.", "3170* - Mediterranean temporary ponds" and "6220* - Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea".



History of floristic explorations of Gavdos and Gavdopoula

The first documented visit of a botanist on the islands of Gavdos and Gavdopoula was that of Prospero Alpini in 1584, on his way back from Egypt to Padua. Alpini was the personal physician of the Venetian consul in Egypt and he described the plants that he found in the Region of Crete and the Aegean in his work "De plantis exoticis", which was published in 1627, 10 years after his death. About two centuries later, the Austrian botanist Ignaz Dörfler visited the island of Gavdos during the period 19-24 March 1904 and he recorded 137 plants. Herbarium specimens of Dörfler's collection from Gavdos are kept in excellent condition at the Botanical Museum of Berlin. During the 2nd World War, another Austrian botanist, Karl Rechinger, visited Gavdos in the period 6-7 June 1942. Since 1980 several botanists have visited the island of Gavdos. The first complete list of the flora of Gavdos was published by Bergmeier et al. in 1997 while in 2011 the list of the flora of Gavdopoula was published (Bergmeier et al. 2011).



Artemisia inculta Delile

Asteraceae

DESCRIPTION: It is a perennial sub-shrubby aromatic plant, with stems up to 40 cm. The florets are tubural, 2-4 per capitulum, reddish. The fruit (achene) is small, about 1 mm.

FLOWERING PERIOD: December to February

GEOGRAPHICAL DISTRIBUTION: The native Artemisia of Gavdos grows nowhwere else in Greece or in Europe. We find it by the road from Karave to Kastri in two small areas near the churches Christos and Panagia, and mainly at the beginning of the path from the church Christos to Siopata. Elsewhere it grows in Libya and Egypt.

HABITAT: It grows in open areas surrounded by pine forest *Pinus brutia*, on soft, marly limestone, at ~80-100 m altitude.

CONSERVATION STATUS: It is considered a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (1995), in which it is referred to as *Artemisia herba-alba*. According to relatively recent revisions of the genus, the plants of Egypt, Libya and Crete have been separated to the species *A. inculta*.

THREATS: It is threatened by livestock farming, expansion of the pine forest and land use changes. In addition, heavy rainfalls at flowering time have been observed to affect the seed production of the plant and, consequently, its sexual reproduction.

PROTECTION MEASURES: Genetic material of the plant (seeds) is conserved at the Seed Bank of MAICh; it is protected by the Greek legislation.



Artemisia inculta in fruiting



Inflorescences of Artemisia inculta



Habitat of Artemisia inculta in the area Siopata of Gavdos



Distribution map of the plant Artemisia inculta on Gavdos

Atriplex mollis Desf.

Amaranthaceae

DESCRIPTION: Atriplex mollis is a perennial shrubby or sub-shrubby plant, 30-70 cm in height. It is distinguished by its narrow leaves and round fruits.

FLOWERING PERIOD: August to November

GEOGRAPHICAL DISTRIBUTION: It is a plant of North Africa (Libya, Tunisia, Algeria), which also has a population on Gavdopoula, the unique population of Europe. It has also been introduced in Sicily. On Gavdopoula, it was first found in 1998 at the south-east end of the island.

HABITAT: It is a constituent of scrub on calcareous neogene and hard limestone, with *Frankenia corymbosa*, *Limonium roridum*, and other halophytes (i.e. salt-tolerant plants).

CONSERVATION STATUS: not assessed.

THREATS: not assessed

PROTECTION MEASURES: -



Distribution map of the plant Atriplex mollis on Gavdopoula



Atriplex mollis in flowering and fruiting



Habitat of Atriplex mollis on Gavdopoula



Fruit and seed of Atriplex mollis

Bellevalia brevipedicellata Turill

Asparagaceae

DESCRIPTION: *Bellevalia brevipedicellata* is a perennial bulbous plant, with 2-3 glabrous, green leaves, wavy, usually reddish at the base, of about the same length as the stem, 8-17 cm.

FLOWERING PERIOD: January to early March

GEOGRAPHICAL DISTRIBUTION: It grows in SW Crete and on Gavdos and Gavdopoula islands, and nowhere else in the world. So it is an endemic plant of the SW Cretan area. On Gavdos, we find it at several localities: Kastri, Kastri to Karave, Karave to Sarakiniko, Sgoudiana to Korfos, Vatsiana to Korfos, around church Agios Pandeleimon, Fragediana, Ambelos and Cape Tripiti.

HABITAT: It grows in soil pockets with phrygana on rugged slopes and flats of hard limestone, at an altitude of 0-250 m.

CONSERVATION STATUS: *B. brevipedicellata* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (2009) and is assessed as Endangered (EN) in the IUCN Red List of Threatened Species.



Habitat of Bellevalia brevipedicellata in the area Sgoudiana of Gavdos

THREATS: It is threatened mainly by touristic activities, the expansion of residential areas and overgrazing.

PROTECTION MEASURES: Genetic material of the plant (seeds) is conserved at the Seed Bank of MAICh; it is protected by the Greek legislation.



Bellevalia brevipedicellata in flowering



Distribution map of the plant *Bellevalia brevipedicellata* on Gavdos and Gavdopoula

Bupleurum gaudianum Snogerup

Apiaceae

DESCRIPTION: *Bupleurum gaudianum* is an annual herbaceous plant, 2-7 cm tall or more, with small yellow flowers.

B. gaudianum is often confused with another annual species of the same genus, *Bupleurum semicompositum*. It is difficult to distinguish the two species. Their fruits differ in size, shape and outer appearance. The fruits of *B. semicompositum* are larger, lighter in colour and they are covered with small whitish papillae, while the fruits of *B. gaudianum* are smaller, dark brown, wrinkled, and without papillae. They can also be distinguished from the number of bracts (small leaves that surround the inflorescence), which are usually 4 for *B. gaudianum* and 5 for *B. semicompositum*. Because the two species can be confused, it is possible that sites in the literature for *B. gaudianum* refer to *B. semicompositum*.

FLOWERING PERIOD: April to May

GEOGRAPHICAL DISTRIBUTION: *B. gaudianum* is the unique endemic plant of Gavdos, i.e. it is the only plant of the island that grows nowhere else in the world. We find it at several localities on the island: along the path from Vatsiana to Korfos and to Tripiti, Metochi Pateridon to Korfos, Ai Stratigos to Vatsiana, and generally in the south part of the island.



Distribution map of the plant Bupleurum gaudianum on Gavdos

HABITAT: It grows in low phrygana and open pinewoods on neogene sediments and sandstone, at 0-300 m altitude.

CONSERVATION STATUS: *B. gaudianum* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (1995) and is assessed as Vulnerable (VU) in the IUCN Red List of Threatened Species.

THREATS: It is threatened by land use changes and forest fires.

PROTECTION MEASURES: Genetic material of the plant (seeds) is conserved at the Seed Bank of MAICh. It is a species protected by the Greek legislation. In the framework of the project "Gavdos Island – Crete – Ultra-threatened plant recovery project", an Action Plan has been elaborated for the long term monitoring of the plant on Gavdos in order to assess its conservation status.



Bupleurum gaudianum in flowering



Details of the *Bupleurum gaudianum* inflorescence; photo by Louis-Marie PREAU



Dry specimens of Bupleurum gaudianum (left) and B. semicompositum (right) from the Botanical Museum (Herbarium) of MAICh



Fruits of Bupleurum gaudianum (left) and B. semicompositum (right)



Field work for monitoring of the plant population of Bupleurum gaudianum in the area Ai Stratigos of Gavdos

Callitriche pulchra Schotsman

Plantaginaceae

DESCRIPTION: *Callitriche pulchra* is an annual aquatic plant with slender stems and characteristic fruits.

FLOWERING PERIOD: February to April

GEOGRAPHICAL DISTRIBUTION: In Greece the beautiful water-starwort *C. pulchra* grows only on Gavdos. In particular, it has been recorded in the areas Kastri, Agios Pandeleimon, Ai Giannis, Fokia, Fragediana, Violiana, Sgoudiana and Vatsiana. Elsewhere it grows in Libya and it has recently been recorded in Cyprus.

HABITAT: It grows in seasonal shallow karstic rock pools (a few cm in depth) that have water only in winter or spring, at 100-350 m altitude. It is not found in all the seasonal pools of Gavdos and it is not found in the same pools each year. In 2015 specialist biologists of the *Callitriche* genus surveyed a total of 319 seasonal pools and *C. pulchra* was recorded in 101 pools. The plant is one of the keystone species of its habitat, which is of high ecological importance due to its floristic composition and the numerous ecosystem services it provides, e.g. collection of nutrients, water supply for livestock and wild animals, biodiversity tank and landscape cultural elements.

CONSERVATION STATUS: *C. pulchra* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (2009) and is assessed as Critically Endangered (CR) in the IUCN Red List of Threatened Species.

THREATS: It is threatened by livestock causing eutrophication in the rock pools and other human disturbances to the rock pools, the expansion of the pine forest and the destruction of the rock pools due to residential expansion.

PROTECTION MEASURES: The habitat of the plant is referred to as priority habitat for protection in the Habitats Directive of the European Union, with the name "Mediterranean temporary ponds" (code 3170*), and it is protected in all the areas where it is found. The temporary ponds of Gavdos have been mapped in detail and a management plan for their conservation has been elaborated in the framework of the project "Actions for the conservation of Mediterranean temporary ponds in Crete - MEDPONDS" (LIFE04 NAT/ GR/000105). In addition to the protection of its habitat, the plant C. pulchra itself is protected by the Greek legislation. Genetic material of the plant (seeds) is conserved at the Seed Bank of MAICh. It is a species protected by the Greek legislation. In the framework of the project "Gavdos Island - Crete - Ultra-threatened plant recovery project", an Action Plan has been elaborated for the long term monitoring of the plant on Gavdos.



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Callitriche pulchra fruits



Distribution map of the plant Callitriche pulchra on Gavdos



Callitriche pulchra plant



Karstic rock pools at Agios Pandeleimon of Gavdos

Crepis pusilla (Sommier) Merxm

Asteraceae

DESCRIPTION: *Crepis pusilla* is an annual plant with almost no stem or very short stem and leaves 2-7 cm long.

FLOWERING PERIOD: March to May

GEOGRAPHICAL DISTRIBUTION: *C. pusilla* is scattered in the Mediterranean area. In Greece it has been recorded in Sounio and Aigina, islands of the East Aegean, Kasos and Karpathos, Kastelorizo, Crete, Gavdos and Gavdopoula. On Gavdos, until today, it has been recorded in 3 localities: Ai Giannis, Sgoudiana and Fragediana to Agios Panteleimonas.

HABITAT: It grows in flat clayey areas, hard stony ground, abandoned terraces, between cobblestones of old paths, at 200-350 m altitude.

CONSERVATION STATUS: There is inadequate data about the conservation status of *C. pusilla* according to the IUCN Red List of Threatened Species. We do not have a complete picture of the distribution of the plant in the Mediterranean, possibly because it is overlooked due to its small size.

THREATS: It is threatened by livestock farming and human disturbances which degrade its habitat.

PROTECTION MEASURES: *C. pusilla* is included in Annexes II and IV of the Habitats Directive and it is protected by the European and Greek legislation. Genetic material of the plant (seeds) from populations of Crete is conserved at the Seed Bank of MAICh.



Habitat of Crepis pusilla in the area Fragediana of Gavdos



Crepis pusilla in flowering



Crepis pusilla in flowering



Distribution map of the plant Crepis pusilla on Gavdos and Gavdopoula

Leontice leontopetalum L.

Berberidaceae

DESCRIPTION: *Leontice leontopetalum* is a perennial plant with a tuber 4-8 cm in diameter. It is erect, 25-60 cm tall at flowering and fruiting, with 2 or 3 basal leaves inserted at ground level.

FLOWERING PERIOD: February to mid-April

GEOGRAPHICAL DISTRIBUTION: *L. leontopetalum* grows in the East and South Mediterranean area. On Gavdos it was recorded in Ambelos by Doerfler in 1904 and since then its presence has not been confirmed. It is almost certain that it has disappeared from the island.

HABITAT: It usually grows in cultivated fields with annual crops.

CONSERVATION STATUS: *L. leontopetalum* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (2009). However, locally there still are healthy populations, especially in NE Peloponnisos. It is assessed as Least Concern (LC) in the IUCN Red List of Threatened Species.

THREATS: In the past it was characterised as a weed of ploughed fields, and now it is in danger of extinction as a result of herbicide use and other modern agricultural practices or land abandonment.

PROTECTION MEASURES: Genetic material of the plant (seeds) from populations of Crete is conserved at the Seed Bank of MAICh.



Leontice leontopetalum plant in flowering



Leontice leontopetalum plant in fruiting



Distribution map of the plant Leontice leontopetalum on Gavdos

Periploca angustifolia Labill.

Apocynaceae

DESCRIPTION: *Periploca angustifolia* is a perennial shrubby plant with stems 1.5 to 3 m long and small, simple, narrowly oblong leaves 10-25 x 2-5 mm. Flowers c. 9 mm in diameter, actinomorphic. Fruit a pair of fusiform follicles 4.5-8 x 0.6-1 cm, narrowed towards apex.

FLOWERING PERIOD: Mainly April to May and sporadically at other times

GEOGRAPHICAL DISTRIBUTION: In Greece *P. angustifolia* is only found on the Cretan islands of Gavdos, Gavdopoula and Chrysi. It is also found in S Spain, S Italy (Sicily, Lampedusa), Malta, N Africa and W Syria. On Gavdos we find it at the localities Kastri, Karave, Tripiti, Sarakiniko and Vatsiana.

HABITAT: It grows in scrub in ravines and on rocky slopes, at 0-150 m altitude.

CONSERVATION STATUS: *P. angustifolia* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (1995).

THREATS: It is threatened by livestock farming and land use changes.

PROTECTION MEASURES: Genetic material of the plant (seeds) from Gavdos is conserved at the Seed Bank of MAICh. It is also grown in the Botanical Garden of MAICh. *P. angustifolia* could be used as an ornamental plant. For example, in Tunisia it is used as a windbreak. It should be noted that the plant has low water requirements and is impressive with its hornlike fruits.



Habitat of Periploca angustifolia in the area Karave of Gavdos



Periploca angustifolia flowers; photo by Louis-Marie PREAU



Periploca angustifolia plant in fruiting



Distribution map of the plant Periploca angustifolia on Gavdos and Gavdopoula

Reseda minoica Martin-Bravo & Jim.-Mejĺas

Resedaceae

DESCRIPTION: *Reseda minoica* is an annual, biannual or short-lived perennial plant with stems 10-50 cm in length. The flowers are aromatic, white, each with 12-16 orange-yellow anthers.

FLOWERING PERIOD: Mid-March to May

GEOGRAPHICAL DISTRIBUTION: In Greece *R. minoica* only grows on Crete in the area of Matala, on Gavdos and on the island Anafi in the Cyclades. It also grows in Cyprus and S Turkey. On Gavdos we find the plant at Kastri, Vatsiana, Ai Giannis and Karave.

HABITAT: It grows in rocky places in phrygana as well as roadsides and ruderal habitats, at 0-300 m altitude.

CONSERVATION STATUS: *R. minoica* is a threatened plant according to the Red Data Book of Rare and Threatened Plants of Greece (2009), in which it is referred to as *R. odo-rata*. *R. minoica* was separated from *R. odorata* and described in 2013. Among others, it differs from *R. odorata* in the pap-illose-hispidulous indumentum, frequent presence of lobed leaves, whitish petals and fewer stamens (12-16 vs. 18-22).

THREATS: It is threatened by touristic activities and land use changes.

PROTECTION MEASURES: Genetic material of the plant (seeds) from Gavdos is conserved at the Seed Bank of MAICh.



Habitat of Reseda minoica on Gavdos



Inflorescence of Reseda minoica; photo by Louis-Marie PREAU



Fruit of Reseda minoica



Distribution map of the plant Reseda minoica on Gavdos

Silene succulenta L. subsp. succulenta

Caryophyllaceae

DESCRIPTION: *Silene succulenta* subsp. *succulenta* is a fleshy perennial plant with a woody stock and numerous pubescent stems. Flowers white, relatively large, single or 2-3 or more together.

FLOWERING PERIOD: March to mid-June

GEOGRAPHICAL DISTRIBUTION: In Greece *S. succulenta* subsp. *succulenta* grows only on W Crete, Gavdos and the islands of Chrysi and Koufonisi south of E Crete. It also grows in the south and east Mediterranean area from Tunisia to Lebanon. On Gavdos we find the plant at Sarakiniko and Lavrakas.

HABITAT: It grows in coastal sand dunes with phrygana and open woodland of *Juniperus macrocarpa*, at 0-30 m altitude. *S. succulenta* subsp. *succulenta*, as well as all other ammophilous plant species, are important for maintaining the sand dune systems and their high ecological value, as they are involved in functions such as retaining the sand, stabilisation of the coastline and protection of the plant communities behind the sand dune belt. Due to their high degradation, sand dunes are a priority for conservation, especially those with *Juniperus* spp. The habitat of sand dunes with *Juniperus* spp. is among the rarest in the Aegean area.

CONSERVATION STATUS: *S. succulenta* subsp. *succulenta* is included in the Red Data Book of Rare and Threatened Plants of Greece (1995).

THREATS: It is threatened mainly by touristic activities in coastal areas and the degradation of its habitat.

PROTECTION MEASURES: The habitat of the plant is referred to as priority habitat for protection in the Habitats Directive of the European Union, with the name "Coastal dunes with *Juniperus* spp." (code 2250*), and it is protected in all the areas where it is found. In the framework of the project "JUNICOAST – Actions for the conservation of coastal dunes with Juniperus spp. in Crete and the South Aegean (Greece)" (LIFE07NAT/GR/000296) [2009-2012], *S. succulenta* subsp. *succulenta* was classified as a keystone species of the habitat in all the localities on the islands of Chrysi and Gavdos. Therefore, seeds of the plant were collected from the sand dunes of Gavdos and they are stored in the Seed Bank of MAICh. In addition, management plans for the protection of the habitat have been elaborated. The plant is protected by the Greek legislation.



Silene succulenta subsp. succulenta in flowering



Habitat of *Silene succulenta* subsp. *succulenta* in the area Sarakiniko of Gavdos



Distribution map of the plant S. succulenta subsp. succulenta on Gavdos

Other important plants

Sand dunes with Juniperus macrocarpa Sm.

Orchids

To this day, 20 different species of orchids have been recorded on Gavdos whereas for Gavdopoula there are no records. The orchids are protected by the Greek legislation and therefore it is prohibited to uproot them or destroy them. Indicatively, on Gavdos we will find the orchids *Anacamptis papilionacea* (L.) R. M. Batemanet et al. subsp. *aegaea* (P. Delforge) L. Lewis & Kreutz (1), Anacamptis pyramidalis (L.) Rich (2), Himantoglossum robertianum (Loisel.) P. Delforge (3), Ophrys fuciflora (F. W. Schmidt) Moench (4), Ophrys fusca Link (5), Ophrys sphegodes Mill. (6), Ophrys tenthredinifera Willd. (7), Orchis italica Poir. (8) and Serapias orientalis (Greuter) H. Baumann & Künkele subsp. orientalis (9).

Orchids of Gavdos; the numbers of the photos correspond to the names of the plants in the text. Photos 2, 5, 6 and 9 by Louis-Marie PREAU.

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Endemic plants of Greece

In addition, the Greek legislation protects the plants of Gavdos and Gavdopoula that are endemic to Greece, 22 plants and 13 plants, respectively. Such examples are the plants *Ononis verae* Širj. (10), *Limonium elaphonisicum* A. Mayer (11), *Asperula rigida* Sm. (12) and *Muscari spreitzenhoferi* (Heldr. ex Osterm.) Vierh. (13), which are endemic to Crete & Gavdos, and the plants *Acinos nanus* P. H. Davis & Doroszenko (14) and *Nepeta melissifolia* Lam. (15), which are also present on other islands of the Aegean.



Protected marine angiosperms

In the marine area around Gavdos and Gavdopoula, the marine angiosperms *Posidonia oceanica* (L.) Delile (16) and *Zostera marina* L., both of which are protected by the Bern convention, have been recorded. The Posidonia beds are referred to as a priority habitat in Annex I of the Habitats Directive and they are protected. This habitat type is characteristic of the Mediterranean coasts and it is absent where there is low salinity, poor renewal or pollution of the water. It is a habitat of high importance as it contributes to the conservation of biodiversity and to the reduction of the coast hydrodynamics.

Dry specimen of the protected marine plant Posidonia oceanica from the Botanical Museum (Herbarium) of MAICh



Aromatic and Medicinal plants

Many plant species are collected and used by the inhabitants of Gavdos. Thyme [*Thymbra capitata* (L.) Cav.] (17) and Cretan savory [*Satureja thymbra* L.] (18) are used as aromatic and medicinal plants, and/or as beekeeping plants. It is also known that juniper [*Juniperus macrocarpa* Sm.] (19) fruits helped the inhabitants to survive during difficult historical periods.

Aromatic plants of Gavdos; the numbers of the photos correspond to the names of the plants in the text.



Wild edible plants

About 40 plants of Gavdos are considered edible and are collected as leafy vegetables. The most common are the spiny chicory/"stamnagathi" [Cichorium spinosum L.] (20), the wild artichoke [Cynara cornigera Lindl.] (21), the crown daisy [Glebionis coronaria (L.) Tzvelev] (22), the Mediterranean hartwort [Tordylium apulum L.], the common poppy [Papaver rhoeas L.] (23), the white hedge-nettle [Prasium majus L.] (24), "galatsida" [Reichardia picroides (L.) Roth] (25), the prickly scorpion's-tail [Scorpiurus muricatus L.] (26), the bladder campion [Silene vulgaris (Moench)] (27), the hedge mustard [Sisymbrium officinale (L.) Scop.], the endive daisy [Rhagadiolus stellatus (L.) Gaertn.] (28), sowthistles [Sonchus asper (L.) Hill and Sonchus oleraceus L. (29)], the oyster plant [Tragopogon porrifolius L.] (30), the Cretan weed [Hedypnois rhagadioloides (L.) F. W. Schmidt] (31), fennel [Foeniculum vulgare Mill.] and the Mediterranean asparagus [Asparagus aphyllus L.].

There are also wild plants that are pickled, e.g. the bulbs of the tassel hyacinth [*Muscari comosum* (L.) Mill.] (32) and the star of Bethlehem [*Ornithogalum narbonense* L.] (33), the rock samphire or sea fennel/" kritamo" [*Crithmum maritimum* L.] (34), etc.

The wild beet [*Beta vulgaris* L. subsp. *adanensis* (Pamuk.) Ford-Lloyd & J. T. Williams] is an important crop wild relative of beetroot and it is protected by the Bern Convention.

To date, there has been no complete ethnobotanical study about the uses of the plants of Gavdos and the permanent residents of the island that still maintain this traditional knowledge are very few.

Wild edible plants of Gavdos; the numbers of the photos correspond to the names of the plants in the text.





















Pressures and Threats

The flora and the habitats of Gavdos are mainly threatened by various human activities such as uncontrolled tourism development, land use changes and changes in agricultural practices. In addition, there is high pressure from overgrazing and the island is threatened by forest fires, especially in the areas where the pine forest has expanded.

An important fragile habitat of the island is the habitat of coastal sand dunes with Juniper spp., which we find in three areas (Sarakiniko, Ai Giannis and Lavrakas). In this habitat we can see rare and threatened plants, such as Silene succulenta subsp. succulenta, Bellevalia brevipedicellata and *Limonium elaphonisicum*, which are included in the Red Data Books of Rare and Threatened Plants of Greece. The sand dune plants are threatened by the uncontrollably increasing number of visitors and campers in these areas, and in particular by trampling, camping constructions, pollution and the risk of fire. In addition, in Sarakiniko, tourism development has led to high construction activity. It goes without saying that the protection of the habitat will contribute to the protection of the rare ammophilous flora of the island. Concrete actions for the protection of the habitat have been proposed in the framework of the LIFE+ JUNICOAST project after consultation with the residents and the relevant management bodies. More information can be found on the project website http://www.junicoast.gr/.

Most of the cultivated land on Gavdos has been abandoned. The remains of the traditional terraces are indicative of the cultivations of the past which have now been invaded mainly by the pine forest. The remaining traditional cultivated fields, where no herbicides are used, contribute substantially to the biodiversity of Gavdos. Here we can find important plants such as different orchid species, which are all protected by the Greek legislation, the wild beet species Beta vulgaris subsp. adanensis, which is protected by the Bern Convention, and the plants Lolium subulatum and Roemeria hybrida subsp. hybrida, which are included in the Red Data Book of Rare and Threatened Plants of Greece (2009). These plants are threatened by agricultural intensification or agricultural land abandonment. For example, they are threatened by the use of herbicides and also by invasive plants such as Oxalis pes-caprae (known as xinida). O. pescaprae is transferred to the fields via materials (planting soil, manure, etc.) that contain the small bulbs of the plant and spreads very fast, especially when the field is tilled/ ploughed, not allowing other wild plants to grow. O. pescaprae has been observed in olive groves in Kastri and elsewhere, and its removal is extremely difficult. The threatened weed Leontice leontopetalum has probably disappeared from Gavdos due to agricultural intensification or agricultural land abandonment.

The seasonal karstic rock pools of Gavdos, apart from their important ecological role as resting places for migratory birds, host rare plants such as the threatened plant *Callitriche pulchra* and the protected plant *Crepis pusilla*. The habitat is threatened mainly by the expansion of residential areas and expansion of the pine forest, the disposal of rubble and other waste, and the abandonment of their traditional



The protected habitat "Coastal dunes with Juniperus spp." at Ai Giannis



Abandoned terraces of Gavdos; photo by Louis-Marie PREAU

use. Until recently the rock pools were cleaned in order to collect rain water for the livestock. This traditional practice resulted in the presence of the fragile aquatic plant communities of annual species that they host until today. It is noteworthy that the characteristic plant of these plant communities, *Callitriche pulchra*, which was first recorded by Doerfler in 1905, is still present today, after more than a century, as a result of this traditional practice.

Another special protected habitat is the salt lake in Tripiti, around which there are special species of plants which are adapted to salinity, such as an important *Limonium* spp. The habitat is considered important for migratory birds and has been included in the network of small island wetlands of Greece. To date there are no pressures recorded due to touristic activities in the area of Tripiti.

Finally, in the framework of tourism and residential development, some of the plants used for ornamental purposes are invasive alien species and they constitute a threat for the island flora. A characteristic example is the plant *Carpobrotus edulis* (known as bouzi), which has created major problems on other Mediterranean islands.



Unplanned roads on the sand dunes at Sarakiniko



Carpobrotus edulis: invasive alien plant which is planted as an ornamental but rapidly spreads in the natural environment to the detriment of the wild vegetation



Carpobrotus edulis in flowering



Oxalis pes-caprae: invasive alien plant

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Dear residents and visitors,

You can also contribute to the protection of the flora of Gavdos!



