



Polygala helenae:
Population status, threats and conservation efforts

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Introduction

Polygala helenae belongs to the Polygalaceae family, which is widely distributed globally, except in the Sahara Desert, and comprises approximately 900 taxa across 26 genera, with a significant presence in tropical and subtropical regions (Christenhusz et al., 2017). The genus *Polygala* is the largest in the family, encompassing about 275 taxa. In Greece, the genus is represented by 16 taxa, of which six, including *P. helenae*, are endemic to the country.

The Polygalaceae family exhibits remarkable diversity in life forms, ranging from annual herbs to vines and trees. *Polygala helenae* (Fig. 1) is a perennial herbaceous plant, typically growing to a height of 5–12 cm. It has a branched structure with up to nine branches and is sparsely pubescent, with short, curved hairs more prominent on its upper parts. The base of the stem is woody and procumbent, lying close to the ground, while the upper branches are ascending. Its lower leaves are elliptic-lanceolate, characterized by a narrow oval shape with nearly parallel edges.

The plant produces dense terminal racemes, each containing 4–47 flowers, supported by short pedicels approximately equal in length to the basal bracts. The flowers feature two types of sepals: the outer two are whitish, measuring 9 mm long and 4 mm wide, while the inner sepals, often called wings, are whitish or lilac, 6–8 mm long and approximately 4 mm wide. The petals of *P. helenae* are pale blue, fused at the base to form a tube but separate distally. These petals are slightly longer than the inner sepals (wings), with the lowest petal, known as the keel, distinctly shorter than the two upper petals (Tan & Iatrou, 2001). The fruit is a capsule containing 1–2 dark brown seeds, each measuring 3.9 ± 0.002 mm in length and 1.5 ± 0.001 mm in width. Each seed has an elaiosome along its edge, measuring 0.8 ± 0.0007 mm in length and 0.9 ± 0.001 mm in width.

Distribution and Life Cycle

Polygala helenae is a narrow endemic species restricted to Kythira Island, Greece, where it occurs in two areas in the southern part of the island, near Kalamos village and the Monastery of Myrtidia. The species grows in diverse habitats, ranging from shaded areas under *Cupressus sempervirens* (near Kalamos) to open, stony sites. It is typically found protected within shrubs such as *Pistacia lentiscus*, *Genista acanthoclada*, and *Sarcopoterium spinosum*, with only its flowering parts protruding from the spiny cover of these shrubs. Flowering occurs from mid-March to early May, depending on annual weather variations, with mature seeds produced between early and late May. Seed dispersal is primarily mediated by ants, which are attracted to the elaiosome on the seed.

Conservation Status

Polygala helenae was initially classified as Vulnerable (VU) on the IUCN Red List due to its restricted distribution and small population size (Phitos et al., 1995; Phitos & Iatrou, 1988). In 2006, the species was reassessed and classified as Critically Endangered (CR) based on the existence of only one known population on Kythira Island and significant threats from agricultural expansion and grazing (Iatrou, 2006). More recently, the species was reevaluated and classified as Endangered (EN) (Aplada & Iatrou, 2025), following the discovery of two additional populations, increasing the total known localities on Kythira Island to three.

Population Monitoring and Conservation Trends

In 2019, under the funded SoBEx project, Dr. Kougioumoutzis and his team conducted the first attempt to record the population size of *Polygala helenae*, documenting 382 individuals across the three known localities on Kythira Island. In 2022, the NKUA Seed Bank team visited the island and recorded 39 individuals in the Kalamos (Vroulea) area and 86 individuals in the Myrtidia area. In 2023, the Vroulea population increased to 50 individuals, and a third locality, previously described by Yannitsaros (2004), was recorded with 200 individuals near Vroulea. The Myrtidia population also showed a slight increase, from 86 to 116 individuals (Stefi et al., 2023). In 2025, the NKUA Seed Bank team revisited the populations and recorded: 1) 46 flowering and 32 non-reproductive individuals in Vroulea, 2) 152 flowering individuals in the second area near Kalamos, and 3) 128 flowering individuals in Myrtidia. Non-reproductive individuals were only

recorded in Vroulea, where the species grows under *Cupressus sempervirens*, as the dense, thorny shrubs at other sites hinder observation of non-flowering plants.

Based on these observations, the population of *P. helenae* appears to have remained relatively stable since the 2019 estimate by Kougioumoutzis' team. However, accurately assessing the total population size is challenging due to the species' occurrence within thorny shrubs. We estimate a minimum population of approximately 700 individuals, roughly double the number of counted individuals. Since 2022, the abandonment of agricultural fields and reduced grazing pressure on Kythira Island appear to have facilitated the species' spread into more open areas (Fig. 1). Additionally, individuals within shrubs have grown significantly larger, with more parts exposed in open areas, which may simplify future population surveys if human-related pressures remain low.



Figure 1. *Polygala helenae* in flowering and fruiting stages (Oikonomidis S. & NKUA Seed Bank).

Threats

The primary threats to *Polygala helenae* are the expansion of human activities in its habitat, along with traditional agricultural practices and livestock grazing. In recent years, the intensity of agriculture and grazing has decreased, allowing this perennial species to increase in size, though no significant population growth has been observed. However, human presence, particularly in the form of tourism-related development, poses an on-going risk. In the Kalamos area, cottages near the sea and frequent visitors using unpaved roads increase the potential for habitat disturbance, especially with the possibility of road expansion and additional house construction in the area.



Figure 2. The habitat of *Polygala helenae* (Mouratidis S. & NKUA Seed Bank).

Conservation efforts for *Polygala helenae*

Currently, no official conservation plans are in place for *Polygala helenae*, and the species is protected only under national legislation (Presidential Decree 67/81). Therefore, the NKUA Seed Bank team continues to monitor the population status of the species and maintains two small seed collections (200 and 400 seeds, respectively) stored securely in its facility, with the first collection duplicated at the Millennium Seed Bank (RBG, Kew). Despite the small population size, the species appears to remain relatively stable. Given the recent reduction in major threats, such as intensive grazing, and an observed increase in individual plant size, effective grazing management in the area may be sufficient to support the species' survival, provided there is no further expansion of human settlements.

Moving Forward

Given the small population size of *Polygala helenae* and the limited number of seeds produced per mature individual, the priority for its future conservation will be ex situ propagation, leveraging the seed collections held by the NKUA Seed Bank and the species' perennial life form. By developing a successful germination protocol and supporting seedling development, a small population can be established at our facility. This could provide germplasm for in situ conservation actions, such as population enhancement and the establishment of new populations in suitable localities on Kythira Island.



Figure 3. (a) Ants collecting seed pods of *Polygala helenae*; (b) *Polygala helenae* flower pollinated by a bee (Stefi A. & NKUA Seed Bank).



Figure 4. *Polygala helenae* seeds scanned on millimetre paper (Costas A. Thanos & NKUA Seed Bank).

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