Azorina vidalii & *Myosotis azorica*

a photographic case study on endangered plants of the Azores

Julie Weissmann

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introduction

The Azores are a group of nine volcanic islands in the middle of the North Atlantic Ocean, between the European and American continents, at the junction of the North American, the Eurasian and the African tectonic plates. Due to the distance to mainland, a very unique flora could evolve on this arquipelago, with a high percentage of endemic plants that do not exist anywhere else in the world. The majority of these unique species is endangered.

This booklet aims to introduce two endemics of the Azores in the particular setting of their occurence on Corvo Island, to convey a sense of their uniqueness and liveliness, their embeddedness in different kinds of interactions with other plants and animals, anthropogenically changing habitats, and groups of people that engage with these plants with caring attention.

With an area of 17,2 km^2, Corvo Island is the smallest of the archipelago and forms, together with Flores Island, the occidental group of the Azores. The island is formed by a volcano that collapsed, thereby forming a caldera referred to as the Caldeirão. The Island is inhabited since approximatively 1558, and its only town Vila do Corvo, situated in the souh of the Island, counts around 450 inhabitants.

Myosotis azorica

introduction

The Azores forget-me-not *Myosotis azorica* Wats. was first described in 1842 by Hewett Cotrell Watson. Worldwide, the plant is only found on the two western islands of the Azores Flores and Corvo. Its habitats are steep and humid slopes on cliffs, craters and waterfalls on altitudes between 200m and 600m.

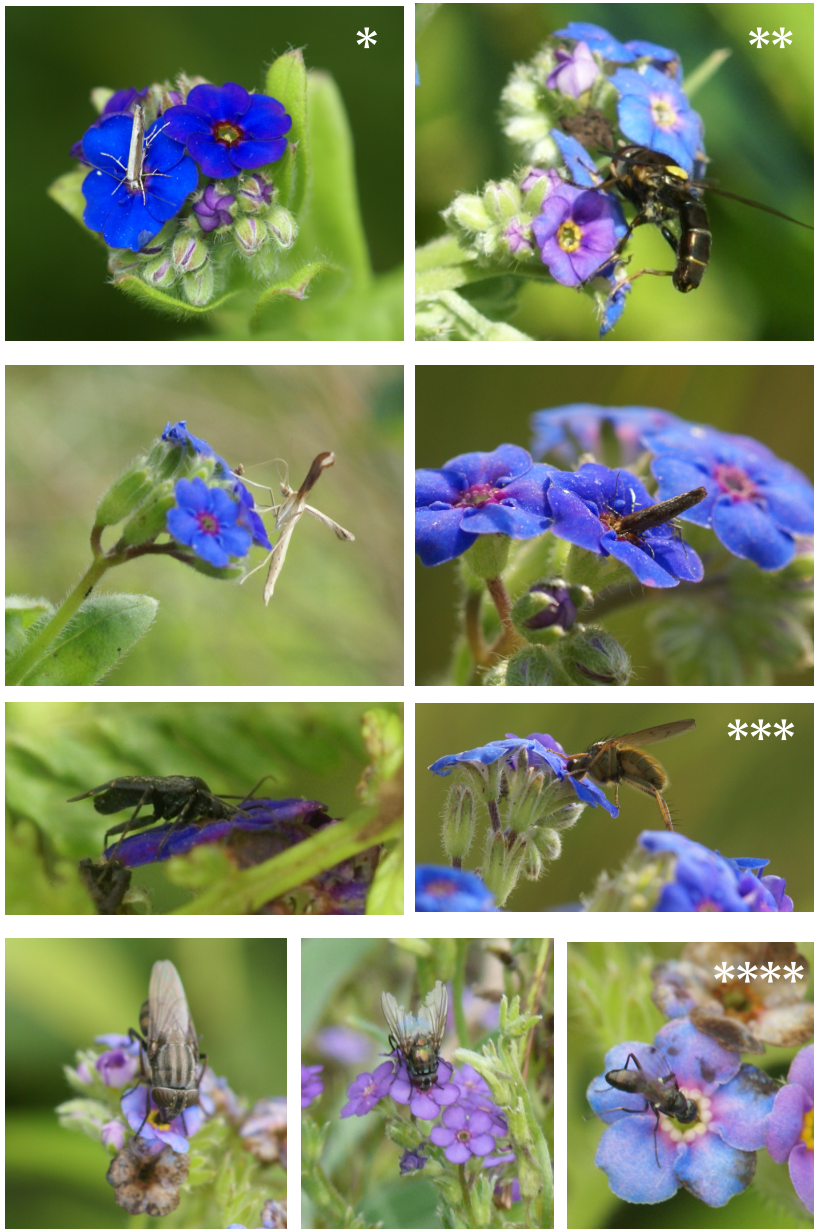
The adult plants reach 30-60cm height with upright, branched stems terminating in racemes of flowers. The alternate, fleshy leaves are oblong and covered with soft hair. The small flowers gradually change in colour from purple to deep blue, becoming slightly brownish when burned by the sun. Five petals form the radially symmetric flower, which has a central tube narrowed by yellow and red scales that preclude the entrance of larger insects. The fruit splits into four glabrous nutlets which are dispersed by animals and water.

Myosotis azorica is vulnerable according to the IUCN criteria, listed in the FFH-directive, and protected by the Bern Convention.

pollination

Myosotis azorica is pollinated by a variety of moths, flies and beetles. Some of the insects visiting its flowers, like the moth *Micrurapteryx bistrigella** and the hoverfly *Sphaerophoria nigra***, are themselves endemic to the Azores. The high share of fly species in the pollination of *Myosotis azorica* is probably related to human impact, as some of them, like the dung fly*** and black scavenger fly****, laying their eggs in animal excrements, were probably not present in the Azores before human settlement and are now favoured by the presence of cattle in the Caldeirão.

Because of the variety of insect species visiting its flowers, *Myosotis azorica* does not seem to be threatened by pollinator loss. However, an insect specialised on the flowers of this forget-me-not would be endangered (or might already have gone extinct) because of habitat fragmentation and the restriction of *Myosotis azorica* to only a few residual individuals.



risks

Grazing pressure by cows, feral goats and feral sheep has confined *Myosotis azorica* to very scarce stands on mid-elevation habitats along cliffs in the north and north-west of Corvo island. Those remote sites, although less accessible for herbivores, are in turn prone to landslides and often in proximity of the hortensias *Hydrangea macrophylla*. Those are native from Japan and have been introduced to the Azores as hedges to separate landparcels. They have become so widespread as to become an iconic plant of the Azores. Disseminating through seeds and rhizomes, they spread very easily in craters, cliffs and ravines, thereby suppressing endemics which are often less competitive. The few remaining *Myosotis azorica* individuals can often be found close to hortensias, probably because this plant provides them some provisional protection against herbivores. In the long term though, the hortensias are likely to spread and outcompete *Myosotis azorica*.
The cumulation of risks makes the small remaining population of *Myosotis azorica* on Corvo, constituted of about 50 individuals, extremely vulnerable.







conservation

The few remaining individuals of *Myosotis azorica* on Corvo and Flores constitute the only occurences of this plant worldwide. A first step for their protection constituted in localising the few remaining plants. Since 2001, no natural occurence was registered on Flores anymore. On Corvo, five plants were discovered in 2012, followed by the discovery of fifty individuals along the cliffs surrounding the island in 2014.

Because of the vulnerability of the remaining populations, conservation measures for *Myosotis azorica* are first of all targeted at preventing further impact by imminent threats by establishing fences against herbivores around particularly vulnerable individuals. On the other hand, efforts are put into reinforcing remnant populations by collecting seeds, propagating them in the greenhouses on Corvo and Faial, and planting young plantlets on suitable sites in Corvo and Flores. Finally, ex-situ conservation measures are carried out through the conservation of seeds in the Azores Seed Bank on Faial.

photo - siaram.azores.gov.pt

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Azorina vidalii

introduction

The Azores bellflower *Azorina vidalii* (H.C.Wats.) Feer was first collected in 1842 on the Island Flores and described by H.C. Watson under the name *Campanula vidalii* in 1844. Because of its morphological peculiarities within the bellflower family (Campanulaceae), it was recategorised into the monotypic genus *Azorina* by H. Feer in 1890, which means that it is the only species of this genus.

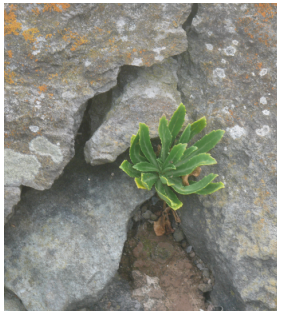
The plant is found on all Islands of the Azores, particularly in the western group constituted by the islands Flores and Corvo. It favours nitrogen-rich habitats on coastal cliffs and rocks, usually below 50m altitude. Under natural conditions, the habitat requirements were most likely provided in areas on coastal cliffs enriched in nutrients by the excrements of nesting seabirds or washed ashore by the sea. Because of anthropogenic alterations, the plant is nowadays mostly found in secondary habitats providing similar conditions: stone walls of houses or around agricultural fields, sometimes in proximity of landfills and drainpipes providing nutrients. On Corvo, adequate conditions prevail in the south of the island, in and around the only town Vila do Corvo.

Azorina vidalii is endangered according to the IUCN criteria, listed in the FFH-directive, and protected by the Bern Convention.

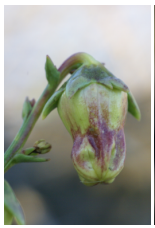





from plantlets ...



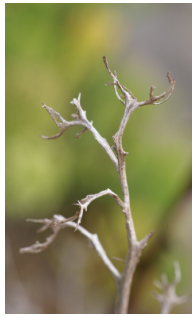
In the plantlets of *Azorina vidalii*, the leaf arrangement in basal rosettes is already recognisable. Mature plants usually reach around 70cm height and form evergreen shrubs with woody stems that produce latex when wounded. The flowers are bell-shaped and up to 3cm long. They vary in colour from pink (the dominant colour on Corvo) to white (predominant on Flores). After fertilisation, downward-facing capsules containing many






... to seeds

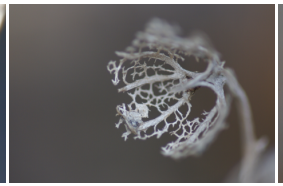





small seeds develop and progressively dehisce through growing pores to release the seeds until only the skeleton-like dry vascular bundles remain. Sometimes, dried, fruiting, flowering and budding stems can be found simultaneously on one individual. The plants can reach over 20 years of age before entirely drying out, while young plantlets develop from the seeds previously dispersed by animals, wind and water.








flowers
morphology and development

The development of *Azorina vidaliis* flowers from buds to fruits is a very dynamic and sophisticated process where the pollen is presented twice to potential pollinators. This phenomenon, known as secondary pollen presentation, is typical for plants of the bellflower family.

At an early stage of the development of the flower, the five stamens are fused together around the central female style, where special hairs progressively collect pollen from the stamens while the style grows through this cylinder. The stamens then detach from the style and slowly regress towards the base of the flower. Insects collecting pollen, or the orange nectar on the base of the flower, thus receive pollen both from the anthers and from the styles, where the pollen is gradually released through the progressive regression of the hairs.

Only then the stigma lobes spread and become receptive. This temporal differentiation in the maturation of male and female reproductive structures helps to avoid self-pollination. Insects or other potential pollinators that visit the plant at this stage most likely carry the pollen of another *Azorina* individual and, while foraging in the flower, leave some of it on the receptive stigma. The pollen tubes then grow through the style and the fertilization of the ovules can occur.

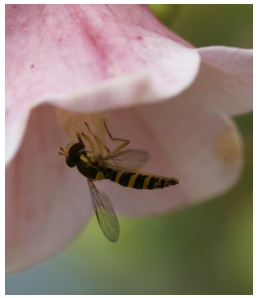
pollination

Azorina vidaliis flowers are visited by a variety of insect species including hymenopteres like sweat bees, buff-tailed bumblebees, honeybees[#] and european wasps[#], lepidopteres (moths), and dipteres like hoverflies, blow flies and thread horns[#]. This variety in pollinator species contributes to a resilient pollination network in which the plant is not dependent of one specialised pollinator.

The flower morphology of *Azorina vidalii* would actually fit best bird pollination. In fact, a few cases of species of the bellflower family are known to have evolved towards bird pollination after having colonised islands. Because of the distance to mainland, plants that manage to colonise remote islands like the Azores often lose their established network of mutualistic relationships. Crossing the ocean over bigger distances is not possible for many insects without human influence. Sometimes, plant adaptations consist in pollinator shifts towards unusual animal groups like birds, lizards or locusts. Although birds have never been observed on *Azorina* flowers so far, lizard-pollination has been reported from the Azorean islands Santa Maria and Terceira.







resource

Landsnales and caterpillars feed on different parts of *Azorinas* plant tissue. Earwigs forage the capsules for some of its seeds, and ants indirectly extract nutrients from the plant by exudating honeydew from scale-insects sucking on Azorina sap. Honeybees# collect latex from the stems of the bellflower to produce propolis to protect their hives against bacteria and other infections.






refuge

Wild bees, owlet moths, centipedes, crickets#, locusts and beetles# use the leaves, flowers, and capsules of *Azorina vidallii* as a refuge to sleep, rest and hide.






risks

With a population of more than 3500 adult individuals, *Azorina vidalli* does not seem to be in immediate risk of extinction on Corvo Island. Considering that this is one of the biggest occurences of this Azorean endemic, its protection is of particular importance.

The main risks for *Azorina vidalii* are related to - mostly anthropogenically induced - habitat degradation and alteration. Due to its occurence in proximity of settlements, *Azorina* is particularly impacted by escaped agricultural and ornamental plants like the New Zealand spinach *Tetragonia tetragonioides* and the African tamarisk *Tamarix africana*. Individuals along agricultural fields are impacted by the use of pesticides. Large concentrations of individuals in fallow land areas are particularly vulnerable to changes in land use. Individuals along the coast are exposed to the impact by recreational activities and trampling, as well as natural factors like soil erosion and storms. A few individuals show signs of damage by herbivores.







conservation

As in-situ conservation measures for *Azorina vidalii* on Corvo Island, seed capsules are collected by members of the Portuguese Society for the Study of Birds (SPEA) from potentially vulnerable sites and dried in the greenhouse. Parts of them are directly dispersed in suitable sites on the coast and in the Reserva Biológica do Corvo, a fenced area free of predators and invasive plants, conceived as a sanctuary for seabirds. A part of the seeds are offered to inhabitants of Vila do Corvo for them to sow the plant in their frontyards.

Individuals of *Azorina vidalii* from other islands of the Archipelago are also being propagated at the Jardim botânico do Faial. Additionally, seeds are conserved in the Azorean Seed Bank on Faial as an ex-situ conservation measure.

photo - Filipa Machado, SPEA

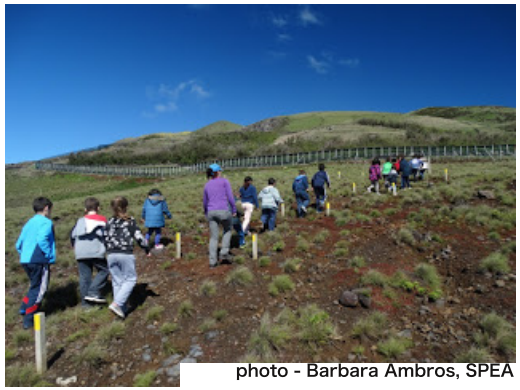


photo - Barbara Ambros, SPEA

photo - Tânia Pipa, SPEA

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remarks

All photos in this booklet are from the author, except when a source is explicitly indicated. They were made on Corvo Island in July and August 2016. A few pictures, marked with the sign #, were made on Flores island, which is the closest island to Corvo at about 24km distance. Pictures by siaram were made at the Jardim Botânico do Faial on Faial island.

The depicted conservation measures focus on actions carried out by the Sociedade Portuguesa para o Estudo das Aves (SPEA) and the Parque Natural do Corvo on Corvo Island, with additional information on measures by the Jardim Botânico do Faial on Flores Island and ex-situ on Faial island. They only give a small glimpse into some of the measures put into place on Corvo and other islands of the Azores for the protection of *Myosotis azorica* and *Azorina vidalii*.

acknowledgements

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