

## *Polypodium vulgare* subsp. *melitense* new subspecies from Gozo, Maltese Islands (Pteridophyta: *Polypodiaceae*)

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**Abstract:** Peroni, A.; Peroni, G. & Mifsud, S. 2013. *Polypodium vulgare* subsp. *melitense* new subspecies from Gozo, Maltese Islands (Pteridophyta: *Polypodiaceae*). *Bot. Complut.* 37: 41-46.

*Polypodium vulgare* L. subsp. *melitense* subsp. nov. from the island of Gozo (Malta) is described. *Polypodium vulgare* s.l. is being recorded for the first time from Malta. Comparison of the new subspecies with other *Polypodium* taxa present in continental Europe and the Mediterranean area is outlined. Pteridophyta of the Maltese Islands are finally listed.

**Key words:** Pteridophyta, *Polypodiaceae*, *Polypodium vulgare* new subspecies, Gozo, Malta.

**Resumen:** Peroni, A.; Peroni, G. & Mifsud, S. 2013. *Polypodium vulgare* subsp. *melitense* nueva subespecie de Gozo, islas Maltesas (Pteridophyta: *Polypodiaceae*). *Bot. Complut.* 37: 41-46.

*Polypodium vulgare* L. subsp. *melitense* es una subespecie nueva descrita de la isla de Gozo (Malta). *Polypodium vulgare* s.l. constituye primera cita para Malta. Se realiza la comparación de la subespecie nueva con otros taxones de *Polypodium* presentes en Europa continental y en el área mediterránea. Se aporta una relación de Pteridophyta presentes en las islas Maltesas.

**Palabras clave:** Pteridophyta, *Polypodiaceae*, *Polypodium vulgare* subespecie nueva, Gozo, Malta.

### INTRODUCTION

The genus *Polypodium* L. belongs to the family Polypodiaceae which includes between 100-150 species (Tryon & Tryon 1982, Haufler *et al.* 1993), distributed mainly in the New World, but with some species occurring in Europe, Asia and Africa (Tryon & Tryon 1982, Hennipmann *et al.* 1990, Kramer *et al.* 1995).

Three species are to be found in continental Europe: *Polypodium cambricum* L. (= *P. australe* Fée) a diploid with  $2n = 74$ , *P. vulgare* L. is tetraploid with  $2n = 148$  while *P. interjectum* Shivas is an allohexaploid with  $2n = 222$  (Valentine & Moore 1993, Prelli 2001). Considering that the Atlantic islands of Macaronesia and the Canary Islands which are politically part of Spain, and the Azores and Madeira which are politically part of Portugal, two other species are included: *P. azoricum* (Vasc.) R. Fernandes and *P. macaronesicum* Bobrov (Muñoz-Garmedía 1986, Valentine & Moore 1993). The three species found in mainland Europe give rise to as

many hybrids: the triploid *P. × font-queri* Rothm. (*P. vulgare* × *P. cambricum*), the tetraploid *P. × shivasiae* Rothm. (*P. interjectum* × *P. cambricum*) and the pentaploid *P. × mantoniae* (Rothm.) Shivas (*P. vulgare* × *P. interjectum*) (Knobloch 1996, Prelli 2001, Peroni *et al.* 2006).

Among the species present in continental Europe, the most widespread is *P. vulgare*, the distribution of which ranges from the cooler and temperate regions of Europe, though somewhat rare in the Mediterranean area (Pichi-Sermolli 1979, Ferrarini *et al.* 1986, Prelli 1990, Soster 2001), to the Caucasus, Central Asia and Siberia (Grubov 1999, Prelli 2001), Turkey (Keynak *et al.* 1996), North Africa (Morocco) and South Africa (Schelpe & Diniz 1979, Schelpe & Anthony 1986), as well in Madeira (Bonalberty Peroni *et al.* 2001, Bonalberty Peroni *et al.* 2003). It is also naturalised in New Zealand (Prelli 2001, Shepard & The Papa 2006). In Italy the species is present in most of the regions from the Valle d'Aosta down to Basilicata, between 100 to over 2000 m of altitude (Soster 2001), but is only doubtfully recorded from Calabria and

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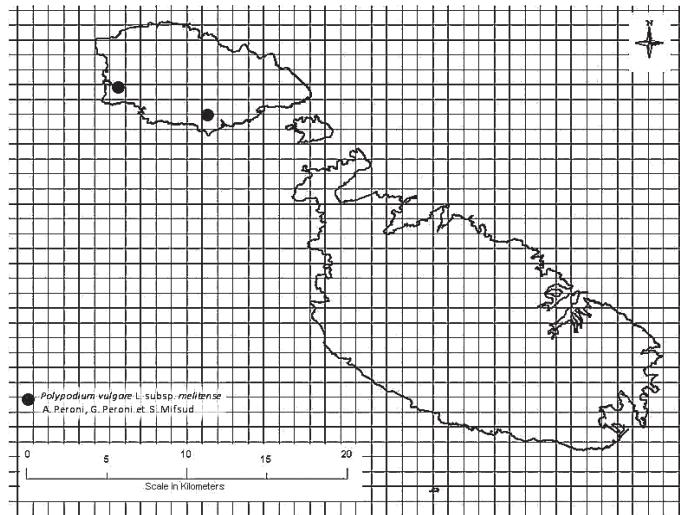


Fig. 1– Distribution of *P. vulgare* subsp. *melitense* in the Maltese islands - both stations restricted to the island of Gozo.

Sicily and seems to be absent in Sardinia (Nardi & Tomei 1976, Marchetti 2003, Conti *et al.* 2005).

#### MATERIALS AND METHODS

The spores were examined by immersing in a 50% solution of glycerol in water and then observed using a Will Wilomed VB 350 PHK microscope. The size of the spores, minimum, mean, maximum, are given in  $\mu\text{m}$ . For the study of the stomata of the epidermis, the method proposed by Peroni & Peroni (2004) was employed: parts of the pinnae were immersed in a 25% solution of NaOH for about 24 hours; these were then rinsed in running water for about 60 minutes and, after washing in distilled water, they were immersed in a solution with the following composition: 270 ml 95% ethanol, 105 ml distilled water, 120 ml glycerol and 15 drops of 40% formalin. The samples were then stained with an aqueous solution of Ruthenium Red and studied with an Olympus BX-40 microscope. The dimensions in terms of minima, mean and maxima of the stomata and adaxial cells are provided. Spore and epidermal samples were photographed with a Nikon D300S digital camera.

#### RESULTS

On the 23rd December 2009, during a botanical survey in the island of Gozo, one of the authors (SM), found some 15 fronds of a *Polypodium* were in the site known as Ta' Ċenċ (locality of ta' Sannat) at an altitude of about 150m above sea level. The plants were found in a small vertical cavity in rock face made of karstic limestone. On the 6th December 2010 three *Polypodium* fronds were found by (SM) in a small rock cavity in the valley known as Wied il-Kbir (locality of San Lawrenz), also in the island of

Gozo. Although the specimens had a resemblance to *P. vulgare*, some character states did not match up with the description. On submitting the material to (AP) and (GP), their diagnosis resulted that the Maltese material correspond to a new taxon at subspecies of *Polypodium vulgare* as explained below. The subspecies rank was

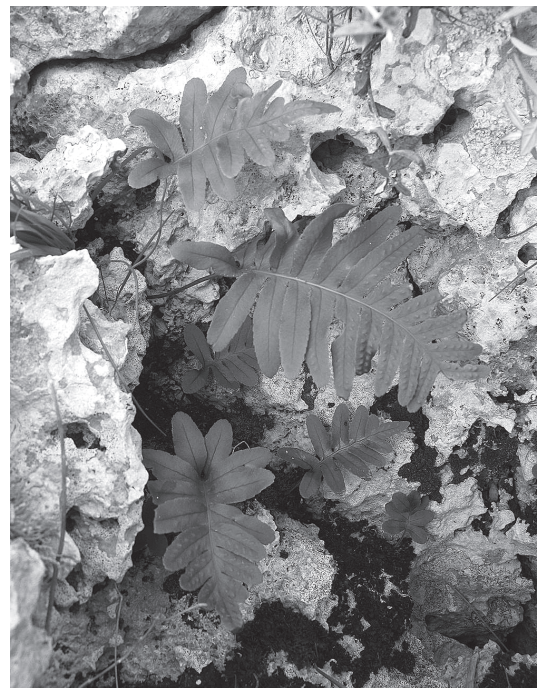


Fig. 2– *Polypodium vulgare* subsp. *melitense*. Population from Sannat, Gozo, Malta (23-Dic-2009).



Fig. 3—Sori and dichotomies of the veins of the abaxial face of the pinnae.

assigned based on the considerable number of relevant differences exhibited and that the population on the Maltese islands is more or less disjuncted from the main distribution range of the *P. vulgare* s.str.

***Polypodium vulgare* L. subsp. *melitense* A. Peroni, G. Peroni et S. Mifsud subsp. nov.**

English diagnosis: *Polypodium vulgare* L. subsp. *melitense* is similar to *Polypodium vulgare* subsp. *vulgare*, but forming very short fronds with an ovate-triangular shape and only about 12 cm long with a much smaller length/width ratio of only  $\times 1.5$ . The sori are slightly oval rather than circular. The principal type of stomata are polycytic but differs in being 10% diacytic and 10% anomocytic. Instead of perennial, fronds are dropped at the end of Spring and formed again in Autumn.

Derivation of subsp. epithet name: from Melita, the Latin name of Malta.

Holotype: Maltese Islands: Island of Gozo, Ta Ċenċ (locality of Sannat), c. 150 m above sea level, 23-12-2009, Leg. Mifsud S., Herb. Museo di Storia Naturale dell'Insubria, Clivio (VA). Paratypes: the same, at the Authors' herbarium.

## DISCUSSION

European pteridological literature does not record any native species of *Polypodium* from the Maltese Islands (Jalas & Suominen 1972, Jermy 1984, Derrick *et al.* 1987, Valentine & Moore 1993). Neither does any of the Maltese flora (Gulia 1909, Borg 1927).

Table 1 compares 16 characters of three *Polypodium* taxa with those of *P. vulgare* subsp. *melitense* of which data was adapted from Frey *et al.* (2006), Peroni & Peroni (2004), Marchetti (2003), Prelli (2001), Soster (2001), Page (1997), Valentine & Moore (1993), Muñoz Garmedia (1986), Pignatti (1982), Nardi & Tomei (1976) complemented with personal observation by the authors. As summarised in this table, while the characters of the Maltese specimens match best with *P. vulgare*, there are morphological differences from the nominal species by which the new subspecies is described.

Macroscopically the Gozo samples were markedly smaller compared to those of continental Italy. The mature fronds of the new subspecies varied from 2.5-18.0 cm while Italian specimens of the nominal subspecies could grow to 40-50 cm. The ratio between the length and width of the mature fronds of the subsp. *melitense* ranges from 1.32-1.61 (mean 1.47) while in the case of the subsp. *vulgare*, calculated from Italian (Piemonte, Lombardia, Toscana) and French (Alpes Maritimes) material, this ratio ranged from 2.18-3.33 (mean 2.81). Similarly, Prelli (2001) reports for *P. vulgare*: “*rapport largeur/longueur le plus souvent inférieur à 1/3*”). Mature fronds of *Polypodium vulgare* subsp. *melitense* are ovate-triangular in outline, the maximum width being towards the base, thus being more similar in that respect to *P. cambricum* rather than to those of *P. vulgare* which has narrower and more lanceolate fronds.

It is not known if this small habit form is a result of the small space of the rock cavities that the specimens were growing in. Growing fronds from spores in abundant soil would take several years for obtaining results, and hence cannot be experimentally tested in this work.

*P. cambricum* is a species present throughout the Mediterranean area from southern Spain eastwards to Greece and Turkey, as well as in North Africa (Ferrarini *et al.* 1986, Prelli 2001). It is closely related to *P. vulgare* and distinction is mostly based on microscopical characters. While the dimensions of the stomata (Fig. 4) and the spores (Fig. 5) are similar in both species (Benoit 1966, Pignatti 1982, Valentine & Moore 1993); *P. cambricum* lack paraphyses in its sori and has less cells in the annulus (4-8 in *P. cambricum*; more than 10 in *P.*

Table 1– Summary of some micro- and macrocharacteristics of the European species of *Polypodium* L. Data adapted from Frey *et al.* (2006), Peroni & Peroni (2004), Marchetti (2003), Prelli (2001), Soster (2001), Page (1997), Valentine & Moore (1993), Muñoz Garmendia (1986), Nardi & Tomei (1976) and on personal observation by the authors.

Character	<i>P. cambricum</i>	<i>P. interjectum</i>	<i>P. vulgare</i> subsp. <i>vulgare</i>	<i>P. vulgare</i> subsp. <i>melitense</i>
Fronde development	autumn	spring, autumn	spring, beginning of summer	autumn
Life cycle	fronds die off in spring	fronds perennial	fronds perennial	fronds die off in spring
Length of fronds including stalks	up to 80 cm	up to 70 cm	up to 50 cm	up to 18 cm
Outline of frond	triangular to ovate	linear-lanceolate to ovate-lanceolate	linear-lanceolate to ovate-lanceolate	linear-ovate to ovate-triangular
Basal pair of pinnae	thend to be directed forwards	thend to be directed forwards	not tending to be directed forwards	thend to be directed forwards
Secondary veins of pinnae	3-4 (-6) times dichotomous	3-4 times dichotomous	1-3 times dichotomous	1-2 (-3) times dichotomous
Length of rhizome scales	10-15 mm	3-6(-10) mm	3-6 mm	4-6(-8) mm
Shape of sori	elliptical	elliptical	round	round to sub-elliptical
Paraphyses in sori	present	absent	absent	absent
N° of cells in the annulus	4-8 (-10)	(4-) 7-10 (-13)	(7-) 11-14 (-18)	10-16
Colour of mature annulus	pale yellow or light brown	colourless or light brown	reddish-brown	reddish-brown
Size of stomata (in $\mu\text{m}$ )	(39-) 46.38 (-51) $\times$ (30-) 34.56 (-39)	(48-) 54.00 (-60) $\times$ (30-) 36.34 (-42)	(36-) 42.10 (-48) $\times$ (30-) 33.45 (-39)	(39-) 44.47 (-48) $\times$ (27-) 32.30 (-36)
Principal type of stomata polycytic	(10% anomocytic) polycytic	(12% anomocytic) polycytic	(6% diacytic; 4% anomocytic)	polocytic (10% diacytic; 10% anomocytic)
Length of frond's adaxial cells ( $\mu\text{m}$ )	(60-) 87.69 (-111)	(66-) 101.36 (-150)	(66-) 96.58 (-135)	(66-) 94.53 (-132)
Spore size ( $\mu\text{m}$ )	(66-) 72.00 (-78)	(69-) 79.20 (-90)	(54-) 64.00 (-75)	(54-) 63.22 (-75)
Habitat	calcareous cliffs, walls, bark of trees	calcareous cliffs, walls, bark of trees	cliffs (often acid), walls, bark of trees	shaded cavities in calcareous rocks

*vulgare*). Both characters are considered determinant and used by many taxonomists and published in several floristic keys to distinguish the 2 species (Pignatti 1982, Muñoz Garmendia 1986, Jermy & Camus 1991, Valentine & Moore 1993, Page 1997, Prelli 2001). The examined Maltese material did not possess any paraphyses and had 10-16 annular cells. Further differences include the colour

of the mature annulus: reddish brown in *P. vulgare* and pale yellow or light brown in *P. cambricum* (Benoit 1966); and length of scales of the rhizomes: more than 10 mm in *P. cambricum* according to Valentine & Moore (1993); and similarly (5-)8-16 mm in *P. cambricum* (3-6 mm for *P. vulgare*) according to Hutchinson & Thomas (1996), who both consider the scale length as a

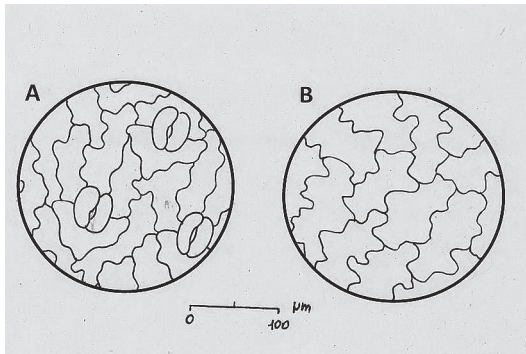


Fig. 4— Details of epidermis of *Polypodium vulgare* subsp. *melitense*. **A:** abaxial face of a pinna with stomata (at the top right can be seen a diacytic stoma). **B:** adaxial face of a pinna.

determinant distinguishing character coupled with the presence/absence of the paraphyses. Again, the copper-brown colour of the mature annulus and the 3-6(-7) mm long scales found in the examined material corresponds best with *P. vulgare*.

In their majority, the stomata of the new subspecies are polocytic, which is as well the main stomatal type of many members of the Polypodiaceae (Hennipmann *et al.* in Kramer & Green 1990, Neuroth 1996), with about 10% anomocytic and c. 10% diacytic (Fig. 4). Even in the nominal subspecies the stomata are mostly polocytic with some 6% diacytic and some 4% anomocytic (Peroni & Peroni 2004).

The young fronds of *Polypodium vulgare* subsp. *melitense* start to appear at the beginning of October. For instance, on the 3rd October 2010 the most developed frond was only 15 mm long at Ta' Ċenċ. This is the time when the temperature starts to fall, with maxima between between 26-28 °C and minima between 18-21 °C. In addition, following the dry summer months, September marks the start of the rainy season with a mean September rainfall of 70 mm in 2010. (MWA, 2010).

On visiting the population of Ta' Ċenċ in November 2010, two of the six fronds still carried incompletely developed sori denoted by their light green hue. The plants mature later, by the end of autumn to the beginning of winter. Towards the end of winter the growth cycle starts to decline while in April the old fronds display dark brown sori with empty sporangia. The fronds dry out completely in June (beginning of Summer). In contrast, in Italy, spore formation in *P. vulgare* subsp. *vulgare* starts in late spring (May-June) and is over in autumn (October).

The Ta' Ċenċ population of *P. vulgare* subsp. *melitense* was accompanied by only a few other plants and mosses.



Fig. 5— Photograph of a spore (x 400).

In fact, in the cavity where it grew only the polypody was present, possibly because it was not exposed superficially. At Wied il-Kbir, the population of *P. vulgare* subsp. *melitense* was found accompanied by few specimens of *Scilla autumnalis* L. the Maltese endemic *Hyoseris frutescens* Brullo & Pavone and casual occurrences of young *Galium murale* (L.) Allioni, and seedlings of a *Medicago*. sp. and *Daucus* cfr. *carota* L.

In this contribution, apart from the description of a new subspecies, the number of pteridophytes present in the Maltese Islands, and specifically the island of Gozo, is further augmented. In various botanical expeditions carried out by one of us [SM] during the last 5 years, the following pteridophytes were recorded: *Selaginella denticulata* (L.) Spring (rare), *Equisetum ramosissimum* Desf. (frequent in some localities), *Adiantum capillus-veneris* L. (frequent), *Anogramma leptophylla* (L.) Link (frequent in some localities), *Phyllitis sagittata* (DC) Guinea et Heywood (rare), *Asplenium ceterach* L. (rare), *Asplenium trichomanes* L. (rare), *Asplenium marinum* L. (very rare) and *Pteridium aquilinum* (L.) Kuhn (very rare). These species were already recorded from the Maltese Islands over a century ago by Gulia (1909).

The same author (Gulia 1909) also recorded other pteridophytes which have not been reported since and which might be extinct. These are: *Salvinia natans* (L.) All. which was recorded as “*specie rarissima*” from Gozo and which has not been found by Borg (1927), *Isoetes histrix* Bory (“*assai rara*”), recorded from humid places in Malta and Gozo, and *Phyllitis scolopendrium* (L.) Newm. (“*assai rara*”) which has never been confirmed and

possibly confused with *P. sagittata*, a quite similar species. Thus *Polypodium vulgare* L. subsp. *melitense* brings up to ten the number of pteridophytes currently present and substantiated from the Maltese Islands.

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