
**THE
CENTRAL MEDITERRANEAN
NATURALIST**



VOLUME 4 PART 4

MALTA, 2008

FOUR NEW RECORDS FOR THE FLORA OF THE MALTESE ISLANDS - *DACTYLOCTENIUM AEGYPTIUM* (L.) P.BEAUV. (FAM. POACEAE), *AMARANTHUS MURICATUS* (GILLIES EX MOQ.) Hieron. (FAM. AMARANTHACEAE), *FUMARIA REUTERI* BOISS. (FAM. FUMARIACEAE) AND *SPIRODELA OLIGORRHIZA* (KURTZ) HEGELM. (FAM. LEMNACEAE)

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ABSTRACT

Four plant species are reported as new to the flora of the Maltese islands: *Dactyloctenium aegyptium* (L.) P.Beauv. (Family Poaceae), *Amaranthus muricatus* (Gillies ex Moq.) Hieron. (Family Amaranthaceae), *Fumaria reuteri* Boiss. (Family Fumariaceae) and *Spirodela oligorrhiza* (Kurtz) Hegelm. (Family Lemnaceae). The article gives worldwide distribution, plant characteristics and information on the location and habitat that they were found in. The article is complemented by several illustrations.

Keywords: *Dactyloctenium aegyptium*, *Amaranthus muricatus*, *Fumaria reuteri*, *Spirodela oligorrhiza*, Malta

Taxa cited in this article are listed according to the online and up-to-date database of the Flora Europaea hosted on the Royal Botanical Gardens Website. <http://rbg-web2.rbge.org.uk>

***Dactyloctenium aegyptium* (L.) P. Beauv.**

Ref: Agrost. 72, Expl. Pl. 10 (1812)

Dactyloctenium aegyptium (L.) P. Beauv. (= *Cynosurus aegypticus* L.) is a caespitose plant with geniculately ascending, or decumbent culms. The lamina of the slender leaves is glabrous, but the margin and ligule are conspicuously ciliate. It is easy to identify from its characteristic digitate inflorescences, hence the English name "crowfoot". It normally forms 3-6 spikes (racemes) spreading and radiating out from the top of the culm and hence forming a digitate arrangement. The 12-65 mm long, oblong-shaped racemes are composed of 2 rows of spikelets, perpendicular to and at each side of the common rachis. Each spikelet comprise 3 to 4 fertile florets about 3mm long each producing a set of 3 white anthers, less than 1mm long. The fruit is obovoid, rugose, 1mm in size and with a soft pericarp.



Figure 1: *Dactyloctenium aegyptium* (L.) Beauv. from Wied tax-Xlendi, Gozo, Malta

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This low-growing grass species is known from warm tropical and sub-tropical regions of Africa and Asia (Tutin *et al.*, 1980 ; Pignatti, 1982; Holm *et al.*, 1977), where it occurs in at least 52 countries of this region (GRIN, 2002), including North Africa (Morocco, Algeria, Tunisia, Libya and Egypt). The latter territory is probably the source of origin in South Europe, were according to Tutin *et al.*, (1980) it is only found naturalised in Italy (Latium, Molise, Calabria, Sicily and Turin – Pignatti, 1982; Conti *et al.* 2005) and Crete. The species is the only member of *Dactyloctenium* in Europe (Tutin *et al.*, 1980). It is hence assumed that the populations found on the Maltese islands (Gozo) have been introduced, possibly originating from birds migrating from North African countries, since it is reported that some birds consume parts of *D. aegyptium* (L.) P. Beauv. (e.g. Swank, 1977, who found fruiting heads of the grass in the helmeted guinea-fowl in Kenya).

Four populations of this annual grass were found very close to each other in November 2007 at the south-facing side of Il-Wied tax-Xlendi, a valley situated at the SW coast of Gozo. All were found isolated in shallow temporary rock pools with thick layer of soil or in damp soil present in wide basins in the upper coralline limestone rock. The largest population was about 2 metres across. Plants were abundant and often carpeting most of the area of the rock basin that they were found in. This corresponds both with the fact that this species prefers moist places (Tutin *et al.*, 1980) and that it is considered as an invasive weed (Wagner *et al.*, 1997; Holm *et al.*, 1977). Accompanying species included *Scilla autumnalis* L., *Triglochin bulbosa* L. subsp. *laxiflora* Guss. (Rouy), *Plantago lagopus* L. and *Trifolium fragiferum* L.. Dominant species on the nearby rocky ground consisted of *Hypericum aegypticum* L., *Chiladenus bocconeii* Brullo, *Erica multiflora* L., *Adiantum capillusveneris* L., *Asparagus aphyllus* L., *Capparis orientalis* Veillard and *Rhamnus oleoides* L.

The habitat of the plant is described to be rather variable and it seems to possess wide environmental adaptability. Habitats described for *D. aegyptium* include sand dunes, uncultivated and disturbed habitats near the coast, (Pignatti 1982, Holm *et al.*, 1977), arable land near the sea (Holm *et al.*, 1977), sandy soils (Holm *et al.*, 1977), on lava, along roadsides, and in other dry, exposed, disturbed areas in Hawaii (Wagner *et al.*, 1997) and also reported as a weed in many countries in the humid tropics (Holm *et al.*, 1977). FAO (2008), declares that this species is tolerant of alkaline soils, resistant to drought, adapted to a wide range of soil texture and is a quick-growing, short-term grazing plant which colonizes disturbed land.

The author found the plants only where considerable depth of soil was present, and did not observed any plants growing in rock crevices close to the site or disturbed ground with fertile soil located few hundreds of metres away from the locus of the populations. Despite the invasive characteristics of *D. aegyptium*, the plants were localised and limited to these few rock basins with damp soil. On the other hand, seed dispersal (Holm *et al.*, 1977) to other damp fertile soils - perhaps damp clay slopes near the coast or valley beds - could be a plausible future threat. Hence, subject to control measures, the species may extend its range in Malta, as is reported to have happened for the Mediterranean region (Tutin *et al.*, 1980).

***Amaranthus muricatus* (Gillies ex Moq.) Hieron**

Apunt. Hist. Nat. (Buenos Aires) 2: 92 (1910)

Amaranthus muricatus (= *Euloxus muricatus* Gillies ex Moq.) is a herbaceous, multi-branching, decumbent plant which forms numerous narrow elliptical leaves, unlike many *Amaranthus* species which form broad leaves. Inflorescence consists of terminal, compact pyramidal panicles (up to 4cm long) of inconspicuous tiny flowers with 5 tepals, the staminate ones with 5 stamens while the pistillate with 3 stigmas. In the fruiting stage the rachis of the inflorescence becomes very long and somewhat curved and as a result the small, hard, knob-like fruit becomes well spaced out from each other. The indehiscent fruit bears tiny black seeds about 1mm in diameter and lenticular in shape.

A. muricatus is commonly known as the African Amaranth, but the name is a misnomer since it originates from South America (Bolivia, Paraguay, Uruguay and Argentina: GRIN, 2002). It is reported to be naturalised in SE USA, SE Australia, SW Europe (GRIN, 2002; GBIF, 2008) and NW Africa (GBIF, 2008). Pignatti (1982), Conti *et al.* (2005) GBIF (2008) and MCL (2008) report this species in the following Mediterranean countries: Portugal, Spain (including the Balearic Islands), Morocco, France, South England, Italy (including Sicily and Sardinia) and Greece. Pignatti (1982) considers the species as a casual alien for Sicily. The species is essentially regarded as a ruderal species, e.g. in Spain it is reported from 24 different provinces as a ruderal of nitrophylic communities (Alvarez, 2001).



Figure 2: *Amaranthus muricatus* (Gillies ex Moq.) Hieron on disturbed ground at Mriehel, Malta

Few specimens of *Amaranthus muricatus* (Gillies ex Moq.) Hieron were found in Malta in November 2007 lying on disturbed ground at the Industrial Estate of Mriehel. The area was surrounded by ruderal species, the most abundant of which being *Diploaxis tenuifolia* (L.) DC, *Foeniculum vulgare* L., *Dittrichia viscosa* (L.) Greuter and some specimens of *Ecballium elaterium* (L.) A. Richard and *Piptatherum miliaceum* (L.) Cosson. Plants exhibited themselves as a low mat of about 1 metre across consisting of dark green leaves, giving the first impression of a population of many plantlets, but close examination revealed a couple of large, highly-branched, procumbent plants. Two smaller populations of this herbaceous, short-living, perennial species were found at the same locality in May 2008; one growing on disturbed ground some 40m away from the population found in November, and another about 200m away, also on disturbed ground in an abandoned field, along other ruderal species. On the 3rd of October 2008, the site was revisited, and one of the smaller populations was not found (the site was cleared), while the other two had increased significantly in size. For instance, the population found in November 2007 had increased markedly and its area of occupancy was more than 2m across.

As for the Sicilian record, it is likely that *Amaranthus muricatus* has been introduced in Malta during the last third of the 20th century. This taxon is not mentioned in the old floras such as that by Borg (1927) or Haslam *et al.* (1977), although it might have been overlooked. The plant is considered a casual alien for Malta, but the species might become naturalised, as happened in Spain, since Malta also offers the warm climate that the plant prefers (Alvarez, 2001). Pignatti (1982) states that it was recorded only from Palermo (region of Sicily) in 1967, but few decades later, Conti *et al.* (2005), while confirming the Sicilian record, adds records from the regions of Molise, Calabria and Sardinia. The fact that within a short time the plant has shown up in three different regions in Italy reflects the spreading potential of this species. In view of this, more time is required to assess the invasiveness of this species for the Maltese islands. Based on reports from other Mediterranean regions, the tendency is for the plant to become naturalised as a ruderal of nitrophylic communities. Consequently, its invasive potential should not be underestimated.

***Fumaria reuteri* Boiss.**

Diagn. Pl. Or. Nov. 2(8): 13 (1849)

Fumaria reuteri Boiss. (= *F. apiculata* Lange; *F. transiens* P.D.Sell; *F. martinii* Clavaud), also known as Martin's Ramping-fumitory, is distributed in Spain, Portugal (Tutin *et al.*, 1993; GBIF, 2008; EFBI, 2008), Italy (Pignatti, 1982), South England (GBIF, 2008; Stace, 2008; EFBI, 2008), France (Alvarez, 2001; EFBI, 2008), South England (GBIF, 2008; Stace, 2008; EFBI, 2008), and is an introduced species in the state of Washington, USA (USDA, 2008). According to MCL (2008), it is native to France, Spain and Portugal, but not to the Mediterranean region, although Stace (2008) also reports it as native to the United Kingdom (South England) and its adjacent island territories (including the Scillies, Isle of Wright and Channel Isles).

Despite such distribution, this plant is reported as native to Northwest Europe, but not to the Mediterranean region (MCL, 2008). As such, *Fumaria reuteri* is considered as a possible introduction to Malta, perhaps through horticultural imports or tourist traffic. However, the date of introduction is difficult to determine, considering the close resemblance between different *Fumaria* species. Alvarez (2001) describes the species as a variable plant, often found in cultivated land and roadsides, and that is not a ruderal, while on a similar note, Wilson *et al.* (2003), states that the plant in UK is found growing in arable fields, hedge bottoms and allotments.

Fumaria reuteri was discovered in Malta at Santa Venera (l/o Qormi) in December 2007, and was found growing in abandoned fields and margins of fields cultivated with wheat. Accompanying vegetation included *Oxalis pes-caprae* L., *Borago officinalis* L., *Glebionis coronaria* (L.) Cass. ex Spach, and other species typical of ruderal areas. In January 2008, it was frequently found in urban areas close the location of first discovery, particularly in pavement crevices and private gardens. In April 2008 a large population was found in a public area close to the Primary School of ~ebbu~, Gozo, indicating that the species is possibly overlooked, and has a wider distribution in the Maltese islands.

This is possibly explained since the genus *Fumaria* L. comprises many species whose identification often depends on minute morphological details, where, for instance, a difference of 1-2mm in the fruit or sepals can be significant for the identification of the species (Pignatti, 1982; Tutin, 1993; Álvares, 2001). Additionally several species are quite variable and a number of specimens should be examined. When assessing the plants observed, the author could not place this taxon within any of the recorded *Fumaria* species in the Maltese islands; although these plants looked somewhat like *Fumaria muralis*, there were several features that did not match the descriptions of this species, most noticeably being the fact that the raceme was always longer than the peduncle and the sepals were subentire and more than 3mm long.

The author followed 3 different identification keys and all led to *Fumaria reuteri*. Since as mentioned, species of the genus *Fumaria* are quite controversial and difficult in their identification, the author is giving the process of his identification extracted from the 3 different keys of identification:

A) According to Pignatti (1982), *Fumaria reuteri* Boiss. (= *F. transiens*) keys out as follows:

1. Sepals longer than 1mm
2. Corolla longer than 9mm
3. Pedicels patent or erect
4. Fruit 2.0-2.5mm diameter
5. Sepals 3-5mm
- 6a. Sepals subentire, flowers occupy 3/4 of peduncle = *F. reuteri*
- 6b. Sepals dentate, flowers occupy 2/5 – 3/5 of peduncle = *F. muralis*

B) According to Tutin *et al.* (1993), *Fumaria reuteri* Boiss. keys out as follows:

1. Corolla at least 9mm
2. Sepals not more than 3mm wide
3. Fruit not more than 3mm wide
4. Sepals more than 2mm wide
5. Fruit smooth (not rugose)
6. Raceme longer than peduncle
7. Sepals 3.0-4.5 long
8. Sepals subentire
9. Corolla less than 11mm long
- 10a. Sepals 3mm long = *Fumaria muralis*
- 10b. Sepals 3.5 – 4.5mm long = *Fumaria reuteri*

C) According to Álvarez (2001), *Fumaria reuteri* Boiss. keys out as follows:

1. Flower more than 9mm
2. Fruiting pedicels erect
3. Tip of upper petal darker from rest
4. Sepals longer from 3mm
5. Fruit less than 2.5mm
6. Peduncles shorter than raceme
7. Sepals sub-entire, longer from 3mm
8. Bract shorter from pedicel

All these morphological features were found in the specimen under examination as demonstrated in Figure 3, where parts of the plant were photographed against a metric graph paper where each box corresponds to 2mm x 2mm.

Species similar to *Fumaria reuteri* found in the Maltese Islands include *Fumaria bastardii* Boreau (the Tall Ramping-fumitory), which has slightly smaller flowers and whose sepals are less than 3mm with a more dentate margin; and *Fumaria muralis* Sond. ex W.D.J.Koch (Common Ramping-fumitory), which has racemes which are shorter than the peduncles.

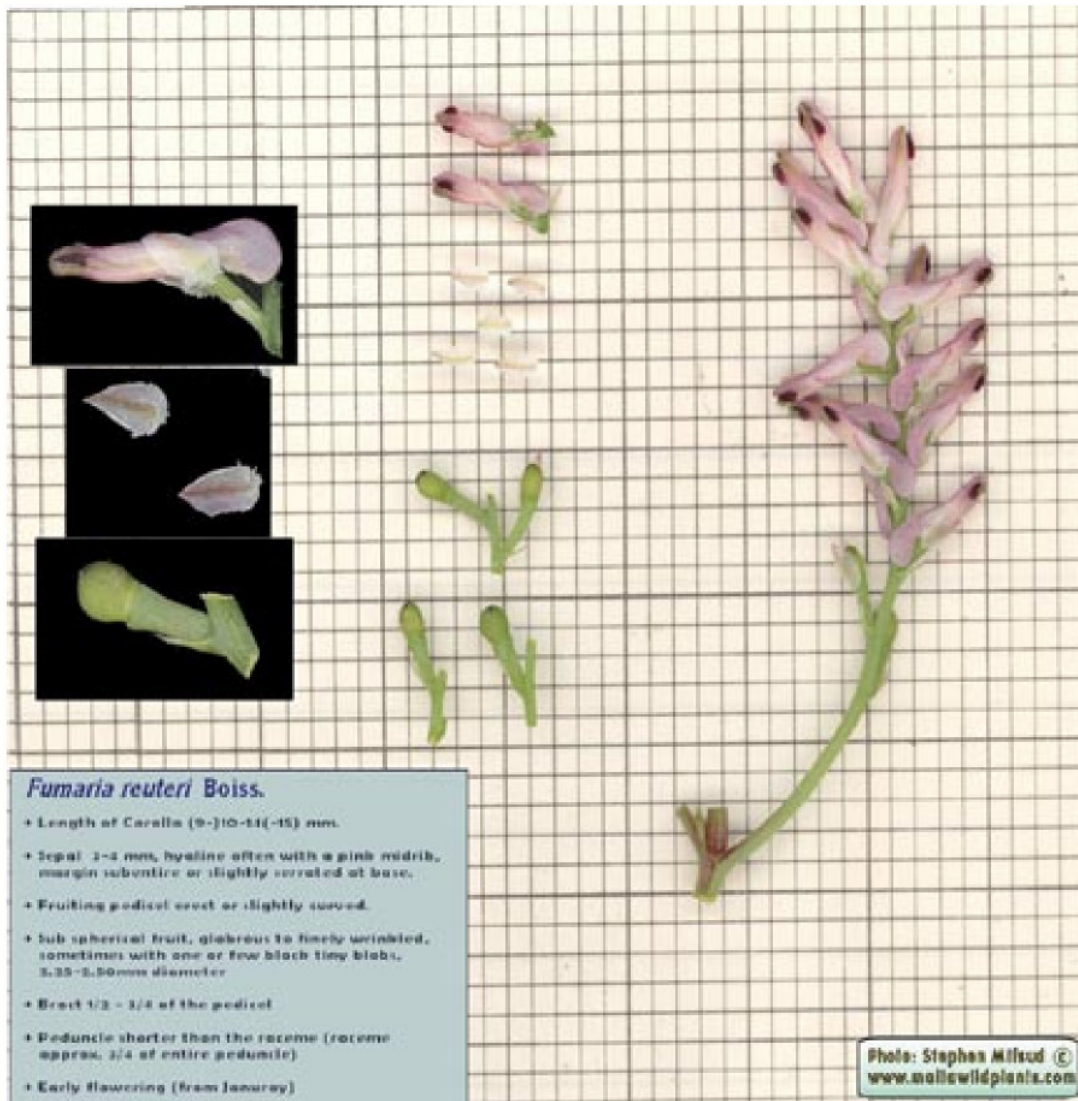


Figure 3: Specimen of *Fumaria reuteri* Boiss. against a metric paper. Each small box corresponds to 2mm.

***Spirodela oligorrhiza* (Kurz) Hegelm.**

Lemnac. 147 (1868)

Two species of the family Lemnaceae have been reported to date in the old floras of Malta, namely *Lemna minor* L. (Grech Delicata, 1853), Borg, 1927; Haslam *et al.*, 1977) and *Wolffia arrhiza* (L.) Hork. Ex Wimmer (Haslam *et al.*, 1977). More recently, Weber & Kendzior (2006) have reported the occurrence of *Spirodela polyrhiza* (L.) Schleid. (= *Lemna polyrhiza* L.) as the third species of Lemnaceae in Malta. Studies are ongoing on this group, since other Lemnaceae are known from the Maltese Islands. Additionally, since the importation of aquarium and horticulture products has increased considerably in the last decades, the risk of introductions has also increased.

A fourth species, *Spirodela oligorrhiza* (Kurz) Hegelm. (= *Lemna oligorrhiza* Kurz), was recorded by the author in three stagnant water ponds situated along the valley bed of Wied Sara and inside one large dam in the valley called Il-Wied ta' l-Ort (continuation with the valley of Wied Sara) in Gozo. These populations were observed in

April 2008 and all consisted of large numbers of specimens clumped together and covering almost the entire water surface of the ponds and a considerable area of the damn.

Other aquatic plants, such as species of Lemnaceae or *Ranunculus*, were not observed on this survey date, but a semi-aquatic, indeterminate *Persicaria* species, already known from the area, was present in 2 of the 4 sites described. From these observations, it can be concluded that *Spirodela oligorrhiza* is a fast-reproducing and locally invasive aquatic species of stagnant or slow moving water.

The specimens initially looked similar in habit to *Lemna minor*, but after a closer examination, several roots were observed growing from the underside of each frond (vegetative, leaf-like body), in contrast with *Lemna* spp., which always have one root only (Pignatti, 1982). Additionally, the lower surface was reddish-mauve in colour, unlike the green one of *Lemna minor* (FNA, 2004).

The specimen was further identified as *S. oligorrhiza* and not the closely related *S. polyrhiza* by having 2-4 roots (unlike 5-10 roots in *S. polyrhiza*) and fronds measuring 3-5mm across, smaller from those of *S. polyrhiza* which measures nearly a centimetre. (Pignatti, 1982). Other distinctive features between the two *Spirodela* species are the number of veins at the upper surface of the frond: in *S. polyrhiza* there are at least 7 distinct veins, while in *S. oligorrhiza* 3-5 only (Pignatti, 1982). Moreover, *S. polyrhiza* often possess a reddish/brown spot at the centre of the upper face of the frond, which is not found in *S. oligorrhiza*. (FNA, 2004).

Spirodela oligorrhiza is an aquatic plant found in many southern states of North America; South America; Asia, Africa, Atlantic Islands; Pacific Islands and Australia (FNA, 2004). Tutin *et al.* (1980) adds horticultural gardens of Calcutta, India but does not give any reference to European stations. Distribution in Europe seems to be restricted to Italy and is given by Pignatti (1982) as a new species (“ic nova”) in the region of Lombardy. The same and only Italian region was also given for *S. oligorrhiza* some decades later by Conti (2005). From the distribution given above, *Spirodela oligorrhiza* is likely to be an alien species in the Maltese Islands and possibly the rest of Europe. If this is the case, the source of introduction in the Maltese islands remains unclear for this species, but *Lemnaceae* species are often sought by aquarium hobbyists.



Figure 4: *Spirodela oligorrhiza* (Kurz) Hegelm. with 2-4 roots per frond and a mauve underside.



Figure 5: *Dactyloctenium aegyptium* (L.) Beauv. – new taxon for the Maltese Islands.



Figure 6: Fruit of *Amaranthus muricatus* (Gillies ex Moq.) Hieron. – new taxon for the Maltese Islands.



Figure 7: Flowering spike of *Amaranthus muricatus* (Gillies ex Moq.) Hieron. – new taxon for the Maltese Islands.



Figure 8: *Fumaria reuteri* Boiss. - new taxon from the Maltese Islands.



Figure 9: *Spirodela oligorrhiza* (Kurz) Hegelm. - new taxon from the Maltese Islands

ACNOWLEDGEMENTS

Special thanks to Mr. Darrin T. Stevens and Mr. Edwin Lanfranco for sharing their knowledge about the flora of the Maltese islands which was of benefit to this article, and to MEPA for allowing me to use part of the data (regarding the discovery of *Spirodela oligorrhiza*) gathered during a survey of Wied Sara, Gozo.

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(Submitted: July 2008)

(Accepted: October 2008)

