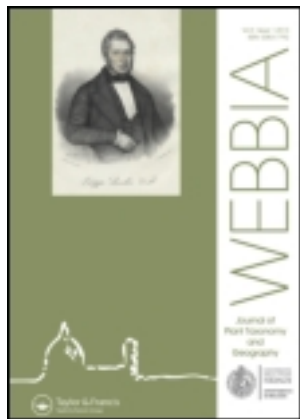


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Distribution of some rare or endemic chasmophytic and rupestral species growing along the coastal cliffs of the Maltese Islands

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This paper gives a detailed account of the distribution of endemic or rare species that comprise part of the chasmophytic and rupestral vegetative community lining the Maltese coastal cliffs. The species discussed in this paper are the following: *Palaeocyanus crassifolius* (Bertoloni) Dostál; *Cremnophyton lanfrancoi* Brullo and Pavone; *Helichrysum melitense* (Pignatti) Brullo, Lanfranco, Pavone and Ronsisvalle; *Linaria pseudolaxiflora* Lojacono; *Asparagus horridus* L. and *Allium sphaerocephalon* subsp. *arvense* (Guss.) Arcang. The first four are species found in article 17 of the Maltese habitats and species, listed in the annexes of the Habitats Directive by the European Commission. *Asparagus horridus* and *Allium sphaerocephalon* subsp. *arvense* are recent additions to the flora of Malta, and their distribution is given in this account. Discussion on the distribution and observations on the preferred habitat are given for each species supplemented by recommendations for the red data book.

Keywords: Article 17; coastal cliffs; endemic; Malta; Maltese flora; rupestral species

Introduction and background

The southern and western coastlines of Malta and Gozo are characterized by high rocky cliffs. Their height varies between 40–250m above sea level, sometimes, as at Dingli Cliffs, assuming two sheer rock faces separated apart by a sloping, 100–300m wide clay layer and scree (Figure 1). In mainland Malta, these high cliffs are situated from Bengħajsa to Ċirkewwa (a lining of about 40 km) and from Mġarr ix-Xini to Wied il-Għasri in Gozo (c.20 km). Similar rocky coasts are also found at l-Aħrax tal-Mellieħa and l-Imġiebaħ in the north part of the mainland but their vegetative communities are different and less important in terms of rupestral endemism.

These high coastlines are formed by long-term dynamic interactions between seawater bodies and land bodies. Water interactions include tides, waves, storms and salty aerosols, which have varying erosive effects on the coastal rock, causing recessions. Earthquakes, landslides, bradyseism, tectonics, subsidence and isostasy are examples of land movements in the earth surfaces that also play a part in the cliff morphogenesis of high coasts that have been evolving for thousands of years. Exogenous processes that may also have a role in cliff formation include sudden climatic changes and biological processes, for example, the splitting of rock by roots, calcium deposition or erosion by fauna. These complex processes interact together randomly and at different magnitudes, and as a result, it is difficult to find sections of high coastal cliffs that are identical in their morphology and ecosystems (Minelli 2004). In addition, massive landslides and subsidence of the Upper Coralline Limestone by fast recession of the underlying, highly

erodible and mobile layer of Blue Clay create another slightly different and possibly endemic habitat known as the Maltese *rdum*.

One of the most important habitats of coastal cliffs in the Maltese Islands is that which in the Interpretation Manual of European Habitats is assimilated to the *Calcareous rocky slopes with chasmophytic vegetation* (code 8210). As the name implies, it is a habitat that comprises species that are adapted to grow in the plant-hostile environment found in crevices, cavities and pockets in limestone cliffs or escarpments; such species are often part of the rupestral communities. Important species growing in this type of habitat are palaeo-endemics (relics from the pre-glacial Mediterranean flora) but also some neo-endemics and sub-endemics, most of which are halophytic chamaephytes, although a few are geophytes and therophytes.

Many rupestral species have been reported from numerous cliff sites that are easily accessible, but some of the 60 km cliff-length in Malta and Gozo is not accessible and hence not well explored. Maybe for this reason, several of these species are reported as rare: for example *Cremnophyton lanfrancoi* Brullo and Pavone in Lanfranco (1989) and Weber and Kendzior (2006); while a few other rupestral species are recent additions to the Maltese flora: for example *Asparagus horridus* L. in Lalov (2007) and Mifsud (2007). The author has surveyed the entire coastline adorned with these high coastal cliffs and new knowledge about the distribution and microhabitat preferences of six endangered rupestral species is reported in this work. The species accounted for are the following: *Helichrysum melitense* (Pignatti)

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Figure 1. High coastal cliffs at Rđum Depiro, Dingli, Malta.

Brullo, Lanfranco, Pavone and Ronsisvalle, (endemic) *Cremnophyton lanfrancoi* Brullo and Pavone, (endemic) *Palaeocyanus crassifolius* (endemic) (Bertoloni) Dostál, *Linaria pseudolaxiflora* Lojacono, (endemic) *Asparagus horridus* L. (rare) and *Allium sphaerocephalon* subsp. *arvense* Gussone (rare).

The scarce and endemic *Matthiola incana* subsp. *melitensis* Brullo, Lanfranco, Pavone and Ronsisvalle is often linked to rupestral habitats, but it is sometimes found inland (e.g. Tat-Taxis, Qala or Fontana, Gozo), and it is not as endangered as the species listed above. More frequent are *Hyoseris frutescens* Brullo and Pavone: a palaeo-endemic found in the western two-thirds of the coastline of Gozo; and *Darniella melitensis* (Botschantzev) Brullo: another species that is abundant in many coastal sites but also extends inland for a few kilometres. For these reasons, these endemic, sub-rupestral species are not discussed in this work.

This study is a meticulous update upon other surveys carried out during the last 20 years or so by E. Lanfranco and M. Briffa (pers. comm., 2010), Lalov (2007), Tabone (2007, 2008), Stevens and Gambin (2008) and Sciberras and Sciberras (2010) and is a useful account for the study of species distribution and ecosystems of Maltese coastal cliffs. It also provides new data for the distribution, red-listing, conservation strategies and micro-habitat preferences of the rupestral species tackled in this account.

Methodology

Numerous surveys have been carried out by the author between 2006 and 2012, either as a freelance or as part of the monitoring surveys in relation to the Habitats Directive (Article 17) of the Malta Environment and Planning Authority for updating species distribution maps. Surveys were based on walking at the very edge of the entire coastal cliffs except for a few inaccessible areas. Shorter surveys were carried out inland, about 100 m from the cliff edge. At regular and short intervals, the

author perched down from the cliff margin to observe (aided by Nikon 10 × 25 binoculars) the vegetation growing at the sheer cliff faces.

In mainland Malta the entire cliff line from Ċirkewwa to Bengħisa was surveyed, except for a few inaccessible parts: Tal-Mara, l/o Birżebbugia; the quarry of Wied Moqbol, l/o Żurrieq; rdum tal-Vigarju, l/o Rabat and part of the scree at Rđum id-Delli and Rđum Majjiesa. In Gozo, the area from Wied Milied (Għarb) to l-Ponta tal-iSkandlu, l/o Wied Sabbar (Sannat) was surveyed.

Due to the perils and hostile environment at the cliff edges, the survey was performed carefully without any haste, which in turn, helped to attain a more precise observation of the cliff-line and surroundings. *Cremnophyton lanfrancoi* stands out from other vegetation thanks to its particular greyish green leaves (dotted with red fruit in autumn). *Palaeocyanus crassifolius* has typical dark, stocky leaves, which also stand out from other rupestral species especially in June when they are in flower. With their unique greyish-pale green indumentum specimens of *Helichrysum melitense* are easy to spot all year round, especially during May–June when they have bright yellow flowers. Populations of these rupestral species often extended up to the top of the cliff and hence could be examined at hand, but many are located out of reach. In spite of this, the characters mentioned above make identification of this species possible for the trained eye at a considerable distance, especially with the help of binoculars.

When a meta-population of the studied species was observed, it was marked on a basemap supplied by the Malta Environment and Planning Authority. In this work, the distribution of a species is presented on a map of the Maltese Islands with a 1 × 1-km grid. Occurrences of (meta-)populations of the corresponding species are marked as a box on this basemap representing an area of 0.5 × 0.5-km resolution. Furthermore, the distribution of each studied species is complemented by a list of toponyms and localities. Reference is sometimes made to cliff lengths or distances in terms of km, estimated using the free ruler/path tool of the Google Earth satellite program.

The taxonomy is based on [The Plant List (TPL); <http://www.theplantlist.org/>] unless stated otherwise. The IUCN Red List status is obtained from the International Union for Conservation of Nature and Natural Resources (IUCN) website (<http://www.iucnredlist.org/apps/redlist/search>). The frequency and nativity of the species is quoted from an unpublished checklist of vascular plants by Lanfranco (unpublished 2001), which supersedes those quoted by the same author in the Red Data book for the Maltese Islands (Lanfranco 1989). The protection of each species is cited from the Legal Notice 311 of 2006: *Environment Protection Act (CAP.435) and Development Planning Act (CAP. 356) – Flora, Fauna and Natural Habitats Protection Regulations, 2006*, which in this article is abbreviated as

‘LN311/2006’. The threat status of the species is taken from the national red data book (here abbreviated as RDB), by Lanfranco (1989). ‘Annex II’ species are those listed in Annex II of the *Species & Habitats Directive 92/43/EEC* while ‘Article 17’ species are listed under Article 17 of the same Habitats Directive by the European Commission. Flowering time, Raunkiær plant life-form (Raunkiær 1934) and seed dispersal are based on personal observations (Malta Wild Plants; www.maltawildplants.com), the former concurring with that given by Haslam et al. (1977). Plant names are cross referenced from Haslam et al. (1977) and the RDB (Lanfranco 1989)

Palaeocyanus crassifolius (Bertoloni) Dostál

Principal synonyms:	<i>Centaurea spathulata</i> Zerafa non Tenore; <i>Cheirolophus crassifolius</i> (Bertol.) Susanna; <i>Centaurea crassifolia</i> Bertol.
Family:	Asteraceae Bercht. and J.Presl
Common names:	Maltese = Widnet il-baħar; English = Maltese Rock-centaury
Raunkiær plant life-form:	Chamaephytes
Nativity status:	Endemic, National Plant for the Maltese Islands in 1971.
IUCN Red List:	Critically Endangered B1ab(i,ii,iii,iv,v) ver 3.1
National RDB Status:	Rare, Restricted distribution in the Maltese Islands
Protection:	Regulation 26 (protected endemics) in LN311/2006
Annex II Species:	Yes
Article 17 Species:	Yes
Flowering time:	May–July
Seed dispersal:	Pogonochore, entomochore (secondary and limited)

Other remarks

The taxon of this species is still debatable between the monospecific *Palaeocyanus crassifolius* and *Cheirolophus crassifolius*. [TPL] and Montmollin and Strahm (2005), who accepted the latter taxon, but it seems that both taxa are currently widely recognized both by local authorities and the European Union. Another noteworthy remark is that this species was listed in the top 50 threatened wild plants for Mediterranean islands with a status of ‘‘Critically Endangered’’ based on the IUCN Red List (Montmollin and Strahm 2005).

Population: list of toponyms

GOZO: San Lawrenz: Il-Ponta tal-Wardija*; Santa Luċija: Il-Hawli*, it-Tenewt*, eastern part of Ġebel San Ġorġ*, rdum at the mouth of Wied Sansun, Ġħar ta’ Santa Katerina, it-Tkieken, tar-Riefnu; Munxar: il-Ħodba, Wied San Ġorġ; Ta’ Sannat: il-Qortina, iċ-Ċnus, il-Faqma, tal-Ħajt, ta’ Ċenc, rdum west of il-Qortina il-Kbir, tal-ikbiex, cliffs at the vicinity of ta’ Riglis.

MALTA: Mgarr: Fomm ir-riħ^{A1}; Rabat: Ras ir-Raħeb, il-ponta tal-Qliegh and il-Qligh l/o Bahrija^{*2,A2}; rdum tal-Vigarju, rdum tas-Sarġ, is-Siċċa tal-Frajna, Il-Mina, ir-Rfuf, Migra Ferħa, Ġħar Doson, Tal-Ferli, Ġħar id-Dwieb, Ras id-Dawwara, Ix-Xaqlibi, Tal-Gawwija; Dingli: Ta’ ġfien, rdum ta’ Nazju, rdum Depiru, rdum ta’ Ġħar Bittija, rdum ta’ Ġħajn Gidem, il-hotba l-bajda, rdum ta’ Gidem; Siġġiewi: rdum Dikkiena, rdum Ħurriqa, Buxih, il-Faqqanija^{A2}, il-Wardija^{A2}, San Ġorġ^{A2}, Misraħ Ġħar Daqquq^{A2}; il-Kullana, Miġer ilma, ix-Xwieki, ix-Xaqqa; Żurriq: il-Ħnejja, Wied Babu, it-Tirxija, id-Dahla, tax-Xaħra, l-Ixmiex, il-Ħrejfa, Ġebel maqtuħ, Wied il-Bassasa, il-Minkba, il-Kap ta’ Wied Fulija, Wied Fulija, il-Borġ ta’ Wied Fulija, taż-Żondu, ix-Xrejjek, Wied Diegu, Il-Ħaġra, Ġħar it-taraġ, l-iskoll tas-sajjetta, il-Ħaġra tas-sajjetta^{A4}, wied Moqbol^{A3}, l-Iskolji, l-Ġħawejra; Birzebbuga: l-Arblu, Ta’ Żġħer, il-Blajta, Wied Żnuber^{A3}, Minzel Spark, l-Artal, ġħar Hasan^{A1}, between ġħar Hasan and il-Mara.

Remarks

- A1 Albino forms of have been observed at Fomm ir-riħ (pers. comm: Darrin Stevens, 2009) and Ġħar Hasan (pers. comm: Michael Briffa, 2008)
- A2 Populations on this site occur on escarpments about 300–500 m inland from the coast.
- A3 Populations at the rocky sides of these valleys extend inland for about 100–200 m.
- A4 Recorded from an islet by Sciberras and Sciberras (2010)

* Denotes a new record found by the author, February 2010.

*2 Denotes a new record found by the author and E. Lanfranco, March 2012.

Distribution: see Figure 2.

Discussion on the species

Palaeocyanus crassifolius dominates the south and southwest cliffs of mainland Malta, but it occurs less abundantly in the southern rdum of Gozo. The distribution in mainland Malta extends along a coastline of 25 km: from Fomm ir-Riħ to Ġħar Hasan; and almost another 1.5 km at the inner escarpments of tal-Qligh and Fawwara. In Gozo, the population is estimated to run along 6 km of cliffs, from Ta’ Cenc to Wardija.

The species was not observed for a stretch of about 2.8k m from Lapsi reverse osmosis (Siġġiewi) to Wied iz-Żurriq (Qrendi). Most of this coastal area does not consist of high coastal cliffs plunging directly into the sea, but instead, it is composed of low, horizontally sloped, rocky shores followed by high inland escarpments some 400 m inland. It gradually changes back into coastal cliff habitat eastwards towards Haġar Qim and Wied iz-Żurriq.

In Gozo, in addition to the population known from Ta’ Cenc to Xlendi (with two main interruptions, one at

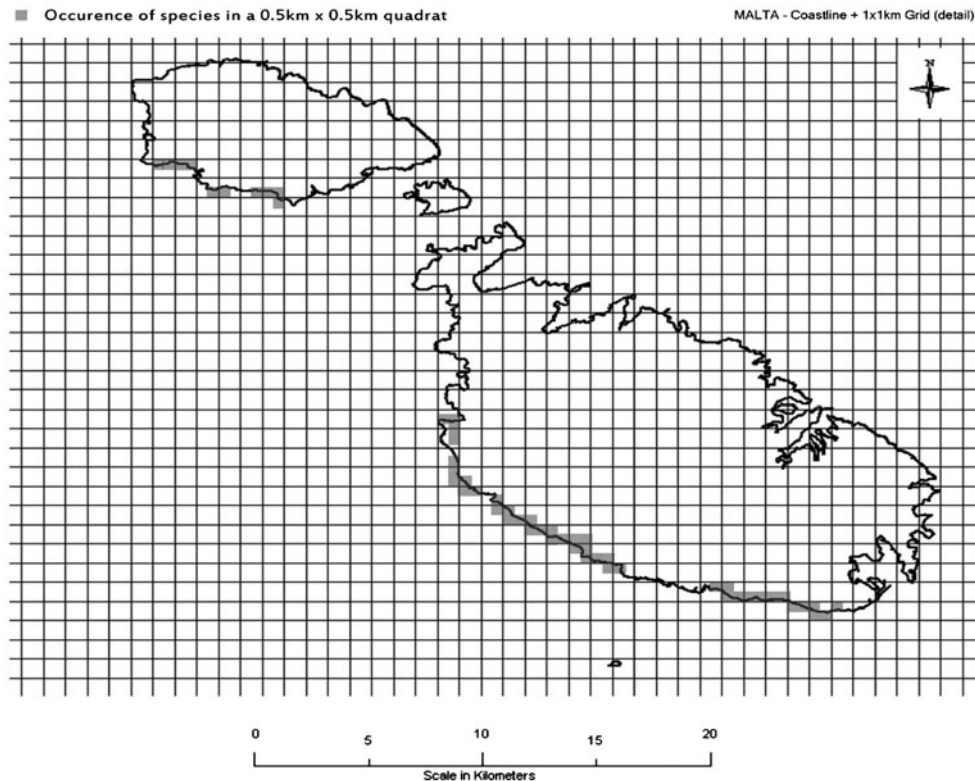


Figure 2. Distribution map for *Palaeocyanus crassifolius* in the Maltese islands.

Sanap to Xlendi Bay and the other at il-Bardan cliffs), it was found through this work that the population at Xlendi extends further west to Ġebel San Ġorġ and Wardija Point, (locality of San Lawrenz) and hence its presence at tal-Hawli, it-Tinewt and Wardija are new records; for instance it was not recorded from Wardija in an ecological survey for Dwejra by Cassar et al. (2004). The population found with E. Lanfranco at the inner escarpments at tal-Qligh, Bahrija is also a new record for this species.

The species seems to prefer the upper half of the coastal cliffs. It is mostly found on rocky debris or cavities and crevices situated in the Coralline Limestone layers of cliff sides. In contrast, it was seldom found on the Globigerina Limestone component of cliffs. In an inland horizontal sense, specimens were mostly found on the rim or upper border of the cliff flank and in only a few sites the population extended further inland. Principal examples where inland populations were observed are: (1) cliff top borders up to 50 m inland from the cliff edge, (2) successive secondary coastal escarpments that are not directly in contact with the sea (see remark A2 above), and (3) inland along sides of rocky valleys where their mouth joins the cliff line (see remark A4 above). It is not certain why this species does not colonize into inland rocky areas given that it produces numerous wind-dispersed seeds; coupled with the fact that plants cultivated in ordinary soil (frequently seen at traffic islands, parks and public gardens) grow very well. One reason for this behaviour might be that seeds do not

prefer competitive vegetation during their germination; a condition met in the hostile coastal cliff habitat, which lacks many ruderals and weeds, but that is abruptly lost away from the margin of the cliff plateau, where it becomes weedy.

In the author's opinion, the current status of B1ab(i,ii,iii,iv,v) for *P. crassifolius* given by the IUCN should be updated, based on criteria that the populations are neither severely fragmented nor occur at a single location, unless, the entire Maltese population is considered holistically as one location. Furthermore, Montmollin and Strahm (2005) state that the number of mature specimens in the wild is estimated to be about 1000 individuals only, but after this survey the number of specimens is definitely much more than 1000, even at least 20 times as much on a rough estimation. Similarly, the frequency of the Maltese Rock centaury should be updated from its current status of rare (Lanfranco 1989, unpublished 2001) to scarce (or locally frequent) in the future edition of the RDB, as it dominates most of the cliff line of the Maltese Islands, almost in same quantities as *Darniella melitensis*.

Cremonophyton lanfrancoi Brullo and Pavone

Principal synonyms: None {*Atriplex lanfrancoi* (Brullo and Pavone) G. Kadereit and Sukhor.}^{B1}
 Family: Chenopodiaceae L.
 {Amaranthaceae Juss.}^{B2}

Common names:	Maltese = Bjanka tal-Irdum; English = Maltese Cliff Orache
Raunkiaer plant life-form:	Chamaephyte
Nativity status:	Endemic
IUCN Red List:	Critically Endangered B1ab(i,ii,iii, iv,v) ver 3.1
National RDB Status:	Rare, Restricted distribution in the Maltese Islands
Protection:	Regulation 26 (protected endemics) in LN311/2006
Annex II Species:	Yes
Article 17 Species:	Yes
Flowering time:	August–October
Seed dispersal:	Clitochore, entomochore, anemochore (limited)

Other remarks

This species was listed in the top 50 threatened wild plants for Mediterranean islands with a status of “Critically Endangered” based on the IUCN Red List (Montmollin and Strahm 2005).

B1 According to molecular studies on Atripliceae (= Chenopodiaceae), Kadereit et al. (2010) concluded that the genus *Cremnophyton* Brullo and Pavone must be treated as *Atriplex* L. and hence the taxon of the species becomes *Atriplex lanfrancoi* (Brullo and Pavone) G. Kadereit and Sukhor. Until this new taxon gains more worldwide recognition, the author will maintain the conventional taxon of *Cremnophyton lanfrancoi*. However, major biodiversity databases like the International Plant Names Index (www.ipni.org), the Pan-European Species Directories Infrastructure (www.eu-nomen.eu), Pan-European Species Directories Infrastructure (www.eu-nomen.eu), the Euro+Med PlantBase (EMED; <http://ww2.bgbm.org/EuroPlusMed>) and Biological Library (www.biolib.cz/en/main/) already list *Cremnophyton* as a synonym of *Atriplex* !

B2 Phylogenetic studies by Kadereit et al. (2003) merged member species of the Chenopodiaceae Vent. family into the Amaranthaceae Juss. family and treated as such by the APG III classification system.

Population: list of toponyms

GOZO: San Lawrence: Il-Maxwell*, Rđum in the vicinity of ta' Gruzzi^{B3}, Ta' Slima^{B3}, Ġebbla tal-general (Borg 1927; Cassar et al. 2004; Sciberras and Lalov 2007), Rđum in the vicinity of ta' Ħarrux^{B3}; Munxar: il-Hodba*, Ta' Sannat: il-Qortina, iċ-Ċnus, il-Faqma, tal-Ħajt, Ta' Ċenċ, rđum west of il-Qortin il-Kbir, tal-ikbiex.

MALTA: Rabat: Ras ir-Raĥeb, Il-Mina*, ir-Rfuf, Migra Ferĥa, Tal-Ferli*; Dingli: rđum ta' Ġħar Bittija*, rđum ta' Ġħajn Gidem, il-Ħotba l-bajda*; Siġġiewi: rđum Dikkiena*, ġħar it-Turkija*, ġħar il-Ħamiem*; Żurrieq: il-Kap ta' Wied Fulija*, ix-Xrejjek*, Wied Diegu*, Ġħar it-taraġ*, l-Iskolji*, l-Ġħaweġra*; Birzebbuġa: l-Arblu^{B3,*}, Ta' Żġħer*, il-Blajta*, Wied Żnuber*, Minzel Spark*, l-Artal, ġħar Ħasan.

Population remarks

B3 Specimens found to extend few decametres upon the cliff plateau.

* Denotes a new record in the indicated site found by the author.

Distribution: see Figure 3.

Discussion of the species

Cremnophyton lanfrancoi is much less abundant than *P. crassifolius*; both in the number of meta-populations scattered along the cliffs and in the number of individuals comprising these meta-populations. Most meta-populations are scattered small clumps of about 20–100 specimens, though a few meta-populations have a wider localized distribution along the cliff face. As a result the overall distribution of the species is fragmented.

From the surveys carried out by the author, the following five major and isolated populations can be defined: (1) San Lawrence, Gozo (from San Dimitri to Wardija); (2) Munxar-Sannat, Gozo (from il-Ħodba to tal-ikbiex close to Ta' Ċenċ); (3) Rabat, Malta (from Ras ir-raĥeb to tal-Ferli); (4) Dingli-Siġġiewi, Malta (from Rđum ta' Ġħar Bittija to Ġħar il-Ħamiem); and (5) Żurrieq-Birzebbuġa, Malta (from Kap ta' Wied Fulija to Ġħar Ħasan).

Cremnophyton lanfrancoi seems to prefer the lower flanks of coastal cliffs, usually on white friable Coralline Limestone rock and Globigerina Limestone. Many plants have been observed close to sea level (estimated at 10–50 m above sea level) making them hard to spot by the untrained eye from the cliff top and possibly explaining why this survey reports several new meta-populations. Located at this low part of the cliff sides, the population faces a major threat by recession of cliffs caused by sea spray or sea storms. Natural dispersal of seed upwards is very difficult, hence limiting the species expansion to the upper parts of the cliffs that may have collapsed. In addition, Lanfranco (1989) reports that seed fertility of *C. lanfrancoi* is further reduced by parasites. On the other hand, several specimens were found seated at the cliff foot, on wide cliff ledges or protected in natural rock cavities and so they seem less endangered from the slow and continuous erosion or recession of the cliffs. Nevertheless, such rupestral specimens are inevitably endangered by the effects of rare but sudden rock falls or landslides from upper parts of the cliff caused for example by seismic movements or earth tremors.

Threats from man are of less concern because most of the population is found in non-accessible parts of the cliffs. Only at the wide rocky chasms of Miġra ferĥa, and some specimens along field walls at ta' Slima, can the specimens be reached and their protection should be well monitored. Individuals are occasionally found at the top and very edge of the cliff tops (e.g. rđum ta' Ġħajn Bittija; rđum ta' Ġħajn gidem at Dingli and at tal-Arblu in Birzebbuġa) but these are perilous sites that are seldom visited except occasionally by hunters.

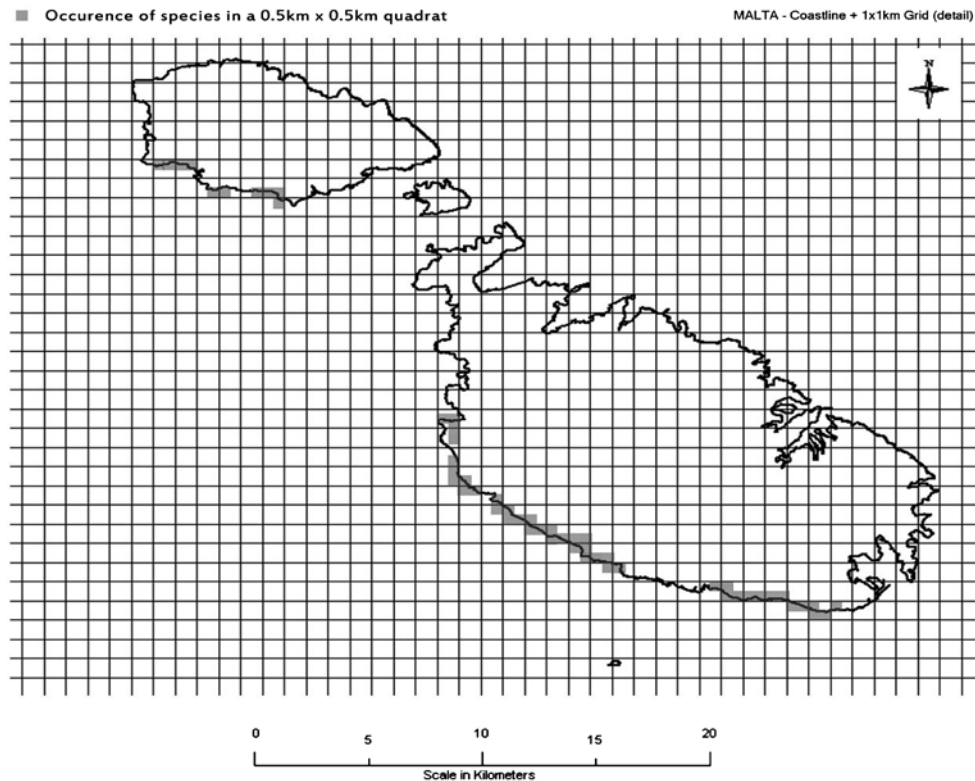


Figure 3. Distribution map for *Cremonophyton lanfrancoi*.

Helichrysum melitense (Pignatti) Brullo, Lanfranco, Pavone and Ronsisvalle

Principal synonyms:	<i>Helichrysum rupestre</i> (Rafinesque) DC. var. <i>melitense</i> Pignatti
Family:	Asteraceae Bercht. and J.Presl
Common names:	Maltese = Sempreviva ta' Ghawdex; English = Maltese everlasting
Raunkiaer plant life-form:	Chamaephyte
Nativity status:	Endemic
IUCN Red List:	Critically Endangered B1ab(i,ii,iii,iv,v) ver 3.1
National RDB Status:	Very Rare, Restricted distribution in the Maltese Islands
Protection:	Regulation 26 (protected endemics) in LN311/2006
Annex II Species:	Yes
Article 17 Species:	Yes
Flowering time:	May-June
Seed dispersal:	Pogonochore, entemochore (secondary and limited)

Other remarks

This species was listed in the top 50 threatened wild plants for Mediterranean islands with a status of "Critically Endangered" based on the IUCN Red List (Montmollin and Strahm 2005).

Population: list of toponyms

GOZO: Għarb: West part of il-Hodba ta' Milied^{C1}, valley mouth of Wied ta' Milied, taċ-Ċawla, l-Għalieuqi, valley mouth of Wied ir-Raheb*, rdum below tal-Ħamrija*, Ponta ta' San Dimitri, rdum in the vicinity of ta' Gruzzial, ta' Slima^{C1}, fuq il-Qawra^{C1}, fuq it-Tieqa^{C1}, il-Ħofra tal-Berwin^{C1}, escarpments around il-Bajja tad-Dwejra^{C1}, rocky land beside il-Pjazza tad-Dwejra^{C1}, rocky land west and southwest of it-torri tal-Qawra^{C1}, valley mouth of Wied tal-Port, rdum in the vicinity of iċ-Ċnus^{C1}, il-Menqa tal-Kurrat^{C1}, Ponta ta' Ħarrux^{C1}, Ġebbla tal-Ġeneral, between iċ-Ċnus and tal-Ibrag^{C1}, ix-Xurbeb^{C1}, it-Turretta^{C1}, id-Dejjaq, il-Ponta tal-Wardija and rdum in the vicinity of il-Wardija, Ġebel ben Ġorg*; Santa Lucija: il-Ħawli*, it-Tinewt*, Għajn Abdul hillock*; Għajnsielem: Xatt l-aħmar*.

Population remarks

C1 Specimens that extend inland from the cliff edge by at least 50 m.

C2 Specimens found away from the distributional range of the species.

* Denotes a new record in the indicated site found by the author.

Distribution: see Figure 4.

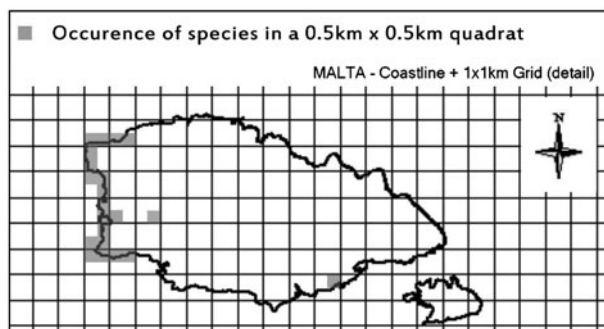


Figure 4. Distribution map for *Helichrysum melitense* (showing only map of Gozo, where the species occurs).

Discussion on the species

Helichrysum melitense was first recorded as *H. rupestre* DC by Grech Delicata (1853) from Wied Babu, Żurrieq, a record that has not been confirmed for more than 100 years. Sommier and Caruana-Gatto (1915) added the localities of Dwejra and Haġra tal-Ġeneral in Gozo. Borg (1927) reported the species as *H. inodorum* (Desf.) Fiori var. *rupestre* DC while Haslam et al. (1977) reported it under the taxon *H. rupestre* (Rafin.) DC from the same localities, and cited a record by Penza from “Balluta” in Gozo – a toponym that is not known from Gozo. Some 30 years ago, Lanfranco noted that the species at Dwejra further extend from il-Ponta ta’ San Dimitri southwards to Wardija. (pers. comm. E. Lanfranco, 2008). Sciberras and Sciberras (2009) recorded more specimens eastwards of San Dimitri up to Ta’ Milied (except at the area of wied Raheb) in their survey carried out in May 2007 – specimens that had been observed by the author a few months earlier and also at Wied Raheb.

Surveys carried out by the author show a single continuous population from ta’ Milied in the locality of Ġharb (northwest coast of Gozo) to tal-Ħawli in the locality of Santa Luċija (southwest coast of the island) with a decline at the low coastal rock and developed area near Dwejra bay. Tal-Ħawli and Wardija are the only sites in the Maltese Islands where both *H. melitense* and *P. crassifolius* occurs together: an overlap of about 300 m with scanty distribution of both species restricted to inaccessible parts of the cliff face. This may have a significant value for the ecological and geological characters of the Maltese cliffs – a study beyond the scope of this paper.

The distributional range of *H. melitense* in terms of length along the coastal cliffs was estimated to be a little less than 9 km. The specimens found offset from the main distributional range are interesting, one located at Ghajn Abdul (7 December 2010), about 1.2 km away from il-Menqa tal-Kurrat, and another at ix-Xatt l-Aħmar (15 December 2012), about 8.8 km away from Wardija.

Helichrysum melitense was often found on sloped or humped cliff sides (e.g. escarpments around il-bajja

tad-Dwejra and Ta’ Harrux); margins of sheer cliffs where occasionally they extend inland by about 50 m (e.g. fuq il-Qawra and Menqa ta’ Kurrat/Wied tal-port area) and limestone ledges, cavities or grooves in sub-vertical cliffs (e.g. taċ-Ċawla, Wied Raheb and Wardija). Unlike *P. crassifolius*, it was seldom found and hence not adapted to grow, at sheer cliffs made of Coralline Limestone but instead preferred Globigerina Limestone. In this respect, it shares the same substrate as *C. lanfrancoi*, and both species are often seen together in Gozo, but the inland extension into the cliff flanks and cliff tops is more pronounced in *H. melitense*.

Asparagus horridus L.

Principal synonyms:	<i>Asparagus stipularis</i> Forssk.
Family:	Asparagaceae Juss. (1789)
Common names:	Maltese = Spraġġ t’Għawdex; English = Grey asparagus
Raunkiaer plant life-form:	Geophyte
Nativity status:	Native (Malta is within distribution range of species, [EMED])
IUCN Red List:	Not assessed
National RDB Status:	Not listed [#]
Protection:	Not protected [#]
Annex II Species:	Not listed
Article 17 Species:	Not listed
Flowering time:	March–April
Seed dispersal:	Zoochore [Flora of Israel Online; http://flora.huji.ac.il/browse.asp?lang=en]

Other remarks

[#]Species was discovered by Lalov (2007) after the publication of the RDB (Lanfranco, 1989) and Legal Notice 311/2006.

Population: list of toponyms

GOZO: Ġharb: rdum in the vicinity of Wardija, Ġebel Ben Ġorg; Santa Luċija: il-Ħawli, it-Tenewt, Ġebel San Ġorg, valley mouth of Wied Sansun, tar-Riefnu; il-Munxar: il-Ħodba, Wied San Ġorg^{D1}, Wied tal-Kittinija^{D1}, It-Toqba tal-Klieb^{D1}, Wied Marietta^{D1}, Bardan, Ta’ Sannat: il-Qortina, iċ-Ċnus, il-Faqma, tal-Ħajt, Ta’ Ċenċ.

Population remarks

D1 Sites where meta-populations were dense and with numerous specimens.

Distribution: see Figure 5.

Discussion on the species

Asparagus horridus L. was first mentioned in the flora of the Maltese islands by Borg (1927) as *Asparagus aphyllus* var. *stipularis* Forsk from Wied Incita, Buskett and Wardija in mainland Malta: sites where this

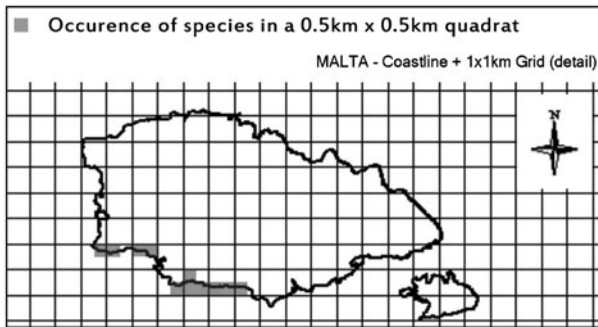


Figure 5. Distribution map for *Asparagus horridus*, (showing only map of Gozo, where the species occurs).

species was not recorded again until the present. Nevertheless, Lalov (2007) had confirmed and reported the species as *Asparagus stipularis* Forskl. from several meta-populations between Wardija point (Għarb) and Ta' Cenc (Sannat). Not knowing about the entire distributional range found by Lalov (2007), Mifsud (2007) also claimed to have found a new population at Sanap Cliffs, Munxar. To correct this ambiguity, the same author here affirms that this meta-population should be attributed to the holistic population reported by Lalov (2007). The author also concurs with Lalov (2007) that the records by Borg (1927) from inland stations are very doubtful, or even mistaken with some atypical large cladode forms of the variable *Asparagus aphyllus* L. Apart from these old records, which were never confirmed, *Asparagus horridus* in Malta is strictly restricted to coastal areas.

The distributional range of *Asparagus horridus* is from Wardija point (San Lawrenz) to ta' Cenc (Ta' Sannat) and was measured to be roughly 7 km. Almost all specimens have been found growing on the upper flanks, cliff ridges, cavities, horizontal grooves or debris composed of Globigerina Limestone. In parts along the distributional range of the species where the cliff-top is predominantly hard Coralline Limestone, the species is drastically reduced or even absent, for example at a 300 m stretch at tal-Ġebel and it-Tinewt (Santa Lucija) and the northwestern rocky side of Xlendi Bay (over Għar ta' Karolina). Specimens were always found on the edge of coastal cliff tops or the uppermost ledges or sides of the cliffs, and occasionally extending not more than 50 m inland. An exceptional case is that at Ta' Cenc and il-Wardija (Lalov 2007; personal observation) where few casual specimens were located a few hundred metres away from the coast. The meta-populations with most specimens were those at Saguna and Sanap cliffs (Munxar) as reported by Mifsud (2007)

Unexplainably, in most of its range, *Asparagus horridus* replaces the common wild asparagus, *Asparagus aphyllus* L. Another unsolved question is why in Malta *Asparagus horridus* is restricted to coastal cliffs

whereas abroad it grows in other rocky habitats similar to those that are present on our islands (Lalov 2007). Other sub-rupestral species that appear often in company with *Asparagus horridus* are *Matthiola incana* (L.) R. Brown subsp. *melitensis* Brullo, Lanfranco, Pavone and Ronsisvalle and *Darniella melitensis* (Botchantzev) Brullo.

Allium sphaerocephalon subsp. *arvense* (Guss.) Arcang.

Principal synonyms:	<i>Allium arvense</i> Guss; <i>A. viridialbum</i> Tineo
Family:	Amaryllidaceae { Alliaceae }
Common names:	Maltese = Tewm ta' Ghawdex; English = (white) round headed garlic
Raunkiaer plant life-form:	Geophyte
Nativity status:	Native (Malta is within distribution range of species, [EMED])
IUCN Red List:	Not assessed
National RDB Status:	Very rare
Protection:	Not listed in LN311/2006
Annex II Species:	Not listed
Article 17 Species:	Not listed
Flowering time:	June–July
Seed dispersal:	Clitochore

Other remarks

Chase et al. (2009) have classified the family Alliaceae, among other monocot families, into the family Amaryllidaceae.

Population: list of toponyms

GOZO: Għarb: west part of il-Hodba ta' Milied*², Wied ta' Milied*², taċ-Ċawla*², l-Għalieqi*², valley mouth of Wied ir-Raheb*², rdum below tal-ĦamrijaE1, Ponta ta' San DimitriE1, rdum in the vicinity of ta' Gruzzial[†], ta' SlimaE1, fuq il-QawraE1, il-Menqa tal-Kurra^{*3}, Ponta ta' Ħarrux*³, ix-Xurbeb*³, it-Turretta*³, id-Dejjaq*³, rdum in the vicinity of il-Wardija*³, Ġebel ben Ġorġ*¹; Santa Lucija: il-Ħawli*¹, it-Tinewt*¹; Ġebel San Ġorġ*¹, Tar-Riefnu*¹; Munxar: Tax-Xemx*⁴, il-Hodba*⁴, Ta' Sannat: il-Qortina*⁴, iċ-Ċnus*⁴, tal-Faqma*⁴, tal-Ħajt*⁴.

MALTA: Siġġiewi: Miġer ilma*⁵; Dingli: Dingli cliffs E2

Population remarks

E1 First records of the species by Michael Briffa from Dwejra, 18 April 1979 and then il-ponta ta Ras San Dimitri, 13-Nov-1985. (Pers.comm. Michael Briffa, 2010).

*New records by the author found in the following dates: *¹October 2011 to May 2012; *²9 February 2009; *³14 April 2011; *⁴9 December 2011; *⁵25 November 2011.

E2 Record by E. Lanfranco and D. Stevens, early 1990s. Distribution: see Figure 6.

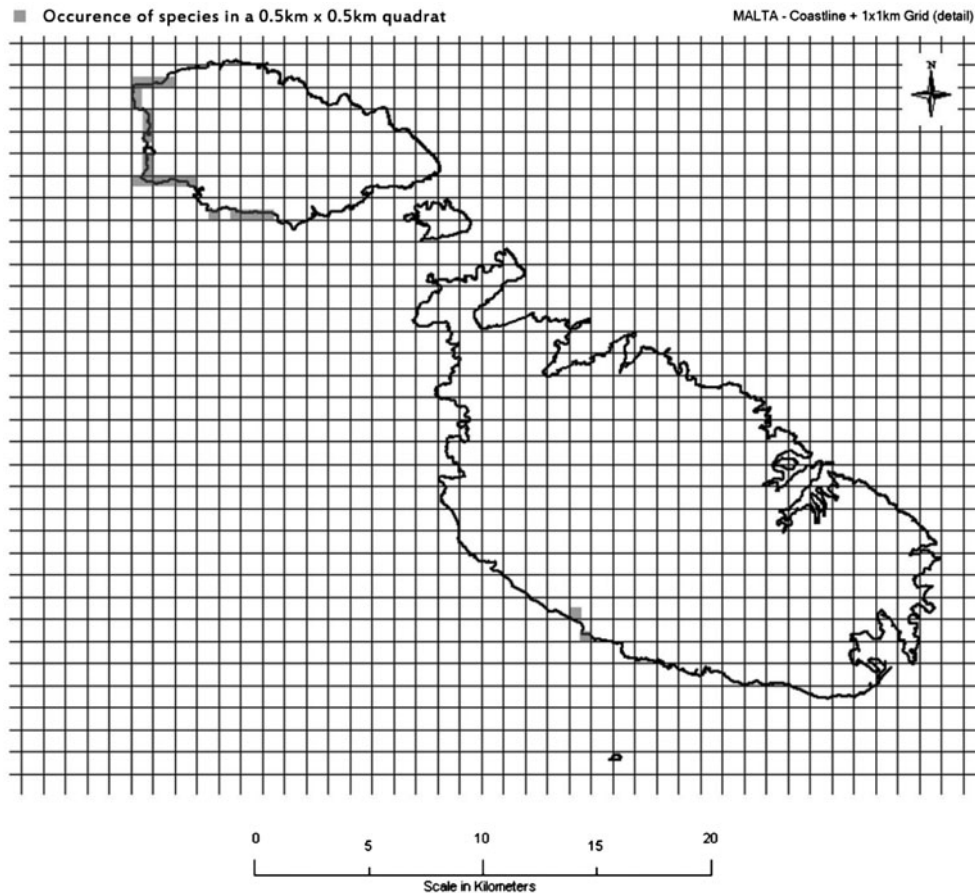


Figure 6. Distribution map for *Allium sphaerocephalon* subsp. *arvense*.

Discussion on the species

Allium sphaerocephalon subsp. *arvense* was first discovered at the coastal cliffs of Dwejra and then further north at San Dimitri by Michael Briffa. Present literature indicates this species to be very rare: stated so by Lanfranco (1989, unpublished 2001, 2007) and Cassar et al. (2004); and not listed in the work of Lalov (2007) or in the checklists of Tabone (2007, 2008).

The species occurs as individual clumps scattered at the very edge of cliff tops, or upper ledges of the cliff face. The clumps are often not conspicuously visible between August and April when the specimens are not in flower and as a result, its presence is very hard to detect in Winter/Spring. Only at San Dimitri and Dwerja, the populations were extensive and sometimes found inland by not more than 50 m from the edge of the cliff flanks. Apart from San Dimitri, the species was found to be abundant also at Wied Milied, Ġebel San Ġorg and to a less extent tal-Faqma. This paper also brings the first records from mainland Malta, as it was believed that this garlic is a Gozitan endemic (Cassar et al. 2004; Lanfranco 2007). Two meta-populations were confirmed from Dingli Cliffs (l/o Ta' Zuta), and Miġer ilma (l/o Fawwara), the former have been previously spotted by

E. Lanfranco and D. Stevens in the mid-1990s (pers. comm D. Stevens 2012).

This species has a more or less similar distribution to *Helichrysum melitense* though the habitat it grows in is slightly different: being a geophyte, it is mostly found on sub-horizontal ground on the marginal flanks of cliffs, and sometimes extending below to debris sitting on wide ledges above the cliff top (e.g. Tal-Faqma). It has not been observed to dominate the face of cliffs. Based on survey observations, it prefers Globigerina Limestone substrates. Like *Asparagus horridus*, no convincing explanation has been found to answer the question why in Malta, its distributional range is restricted to cliff-top habitats and hence it behaves as a rupestral species, given that in other countries, it grows in inland habitats (Kew Royal Botanic Garden; www.kew.org/plants-fungi/Allium-sphaerocephalon.htm).

Linaria pseudolaxiflora Lojaccono

Principal synonyms:	nil
Family:	Scrophulariaceae Juss.
Common names:	Maltese = Papoċċi ta' Malta; English = Maltese Toadflax

Raunkiaer plant life-form:	Therophyte
Nativity status:	Sub-endemic (Malta, Linosa, Lampedusa)
IUCN Red List:	Vulnerable D2 V3.1
National RDB Status:	Rare, Restricted distribution in the Maltese Islands and the Mediterranean region.
Protection:	Regulation 26 (protected endemics) in LN311/2006
Annex II Species:	Yes
Article 17 Species:	Yes
Flowering time:	March–May
Seed dispersal:	Entemochore

Other remarks

Nil.

Population: list of toponyms

GOZO: Nadur: Il-mixta cave (March 2008)^{F2}, rdum San Filep (March 2009)^{F2}; Żebbuġ: Ta' Dabrani hilltop (March 2008)*, Ta' Kuljat hilltop (April 2008)*, il-Qolla s-safra (T. Tabone, March 2003)^{F2}; Għasri: Ta' Gordan hilltop & Ta' Ghammar hilltop (T. Tabone, March 2008)^{F2}; Għarb: Taċ-Ċawl (February 2009)*; San Lawrence: Ta' Slima (January 2009)*; Ta' Sannat: Saguna cliffs, il-Qortin (T. Tabone, March 2008)^{F2}; Munxar:

Sanap cliffs, tal-Bardan (T. Tabone, March 2008)^{F2}; Victoria: Citadella di Victoria (Michael Briffa, 1979)^{F1}, Gelmus hilltop and Ta' Harrax hilltop (T. Tabone, 1990s)^{F2}; Għajnsielem: Comino and Cominoto (Borg 1927) specifically from Għemieri peninsula and around Wignacourt Tower, Comino (T. Tabone, March 2005)^{F2}.

MALTA: Meliċha: Rdum id-Delli (M. Briffa, 1991)^{F1}; Għarghur: Wied id-Dis (T. Tabone, April 2000)^{F2}; Żurriq: Wied il-Bassasa (T. Tabone, March 2000)^{F2}; Birżebbuġa: Wied Żnuber (T. Tabone, February 2004)^{F2}.

Remarks

* Denotes a new record in the indicated site found by the author.

F1 Information obtained by personal communication from M. Briffa (2010).

F2 Extracted from Tabone (2007, 2008).

Distribution: see Figure 7.

Discussion on the species

Linaria pseudolaxiflora Lojac. was described from the island of Linosa by Lojacono, and was shortly confirmed from Malta by Sommier and Caruana Gatto

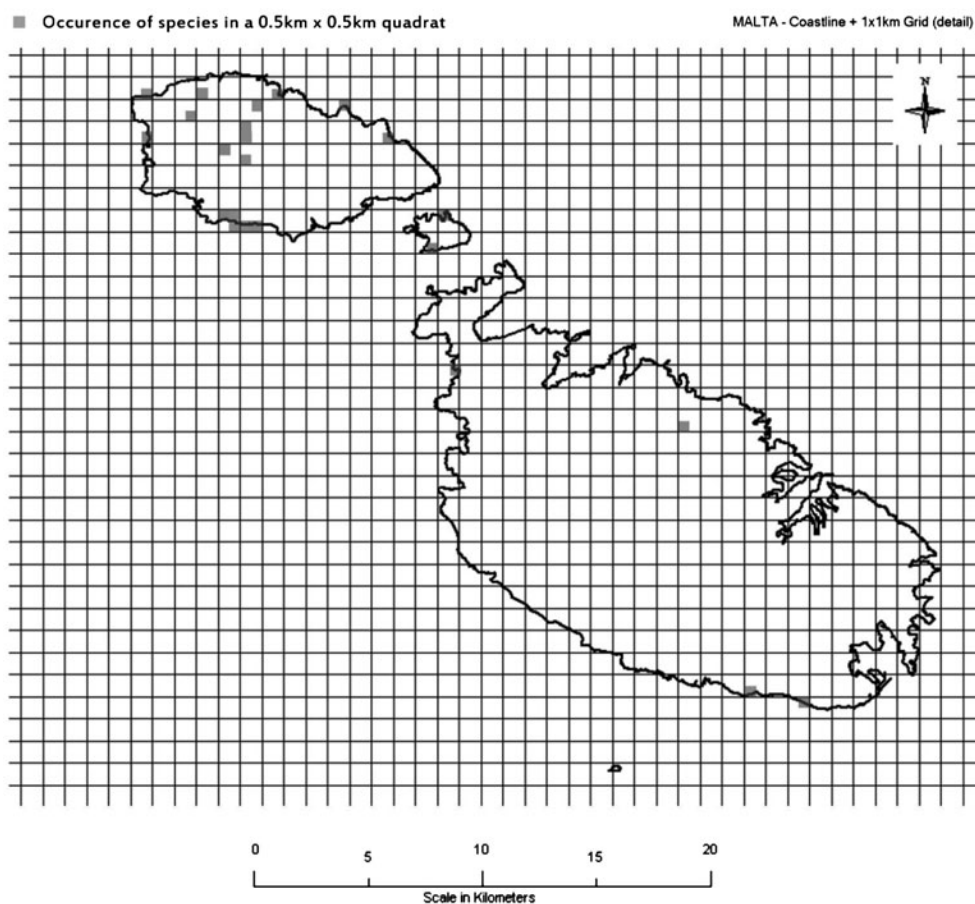


Figure 7. Distribution map for *Linaria pseudolaxiflora*.

(1915) from a few localities in Malta, Comino, Cominotto and Gozo. These authors never found *L. reflexa* from Malta reported by Grech Delicata (1853); a species that was not substantiated till now. The taxon chosen by Borg (1927) for this species was *Linaria laxiflora* var. *pseudolaxiflora* and lists the following localities: “Valletta Glacis, Delimara, Minsia, Wardia, Bingemma, Mel-leha, Selmun, Krendi near Wied Hoxt. Gozo, Gran Castello [= Citadella], (a form with pure white flowers), Ġgantia, Nadur [and] also in Comino and Cominotto [citing Duthie, 1875]”.

The habitat of most of the localities where the species is extant is rupestral but not specific to high coastal cliffs. It prefers semi-arid rocky ground with sparse non-weedy vegetation located at margins of escarpments, high valley sides, hill plateaus (this is apparently the preferred habitat of the species) and flanks of some coastal cliffs. It is questionable if the specific locations where this low-growing annual is found are only refuges of larger populations away from progressing weedy vegetation. Its presence in lower debris or rocky shelves at the sides of coastal cliffs is unlikely but cannot be completely excluded, because a close inspection was possible in only a few such sites. The author has not found the species in garrigue or steppe expanses.

Conclusion

Chasmophytes of the detrital coastal cliffs are limited to the cliff faces, and on only a few occasions do they extend inland by a few decametres onto cliff plateaus. Coastal cliffs offer hostile conditions to support plants: lack of soil substrate – limited to a little soil accumulated in crevices and small cavities or debris on cliff ledges; high salt concentration in the substrate and atmosphere as a result of sea spray and aerosols; long exposure to dryness and arid conditions as a result of negligible rain precipitation between June and September; and poor anchorage to vertical cliff faces. Species found on high coastal cliffs are hence chasmophytic, xerophytic and halophytic species, a combination of characters that are rare for the plant kingdom. Additionally, about one-quarter of the endemic flora are rupestral or sub-rupestral species, which reflects the importance of safeguarding them and their habitat.

Unfortunately, the restricted habitat in which they live is continually being reduced by natural processes, and the habitat is gradually depleted. Short-term coastal recession is rare but should not be neglected. Five years ago a landslide about 150 × 100 m situated along cliffs at the limits of Ghar Hasan took place. Populations of *P. crassifolius* and *C. lanfrancoi* occur in the neighbouring coastline.

On a positive note, this survey has revealed that the population of these rupestral species, is larger than that reported in the present literature, especially so for *C. lanfrancoi*. This study has also revealed that both *Allium sphaerocephalon* subsp. *arvense* and *Asparagus horridus*, both restricted in the Mediterranean region [EMED; Global Biodiversity Information Facility website, <http://data.gbif.org/>], behave as strict rupestral species on Maltese high coastal cliffs. Compared with the other protected rupestral species, these two species have a more restricted distribution in Gozo and so their protection should be considered in future updates of the legislation and the RDB. The occurrence of *L. pseudolaxiflora* from many inland hilltops and a few escarpments and valley sides indicate that this endemic is not a strictly coastal rupestral. With the exception of *P. crassifolius*, all the rupestral species covered in this work are found in Gozo, with *H. melitense* and *Asparagus horridus* completely missing from the largest island of the Maltese archipelago.

The IUCN status of *H. melitense*, *C. lanfrancoi* and especially *P. crassifolius* should be carefully revised, and the frequency for each species is suggested to be “rare but locally frequent”, “rare” and “scarce”, respectively, owing to the fact that the actual distribution is larger than previously reported, for example in Montmollin and Strahm (2005).

It is also suggested that the Malta Environment and Planning Authority (MEPA) extends the corresponding Natura 2000 Special Area of Conservation (SAC) boundaries to accommodate these species as follows: (1) the extension of the Dwejra SAC to cover all the *H. melitense* and *C. lanfrancoi* populations, that is, from Wied Milied at the north coast to Ġebel Ben Ġorġ in the south; (2) the extension of Xlendi’s SAC westward to meet Ġebel Ben Ġorġ so as to protect the population of *P. crassifolius* dwelling on those cliffs. This would practically mean that, like mainland Malta, the entire high coastal cliffs of Gozo are protected: from Wied Milied at Għarb to Mġarr ix-Xini at Xewkija (the latter already scheduled). In doing this, MEPA would be protecting more than 99% of the populations of three species listed among the top 50 threatened species of Mediterranean islands (Montmollin and Strahm 2005).

Finally, the equivalent habitat of the *Calcareous rocky slopes with chasmophytic vegetation* (code 8210) for the national interpretation of the habitats directive should include the species *Asparagus horridus* and *Allium sphaerocephalon* subsp. *arvense* because, as shown in this paper, their distribution is specific to marginal flanks and upper parts of high coastal cliffs.

Illustrations

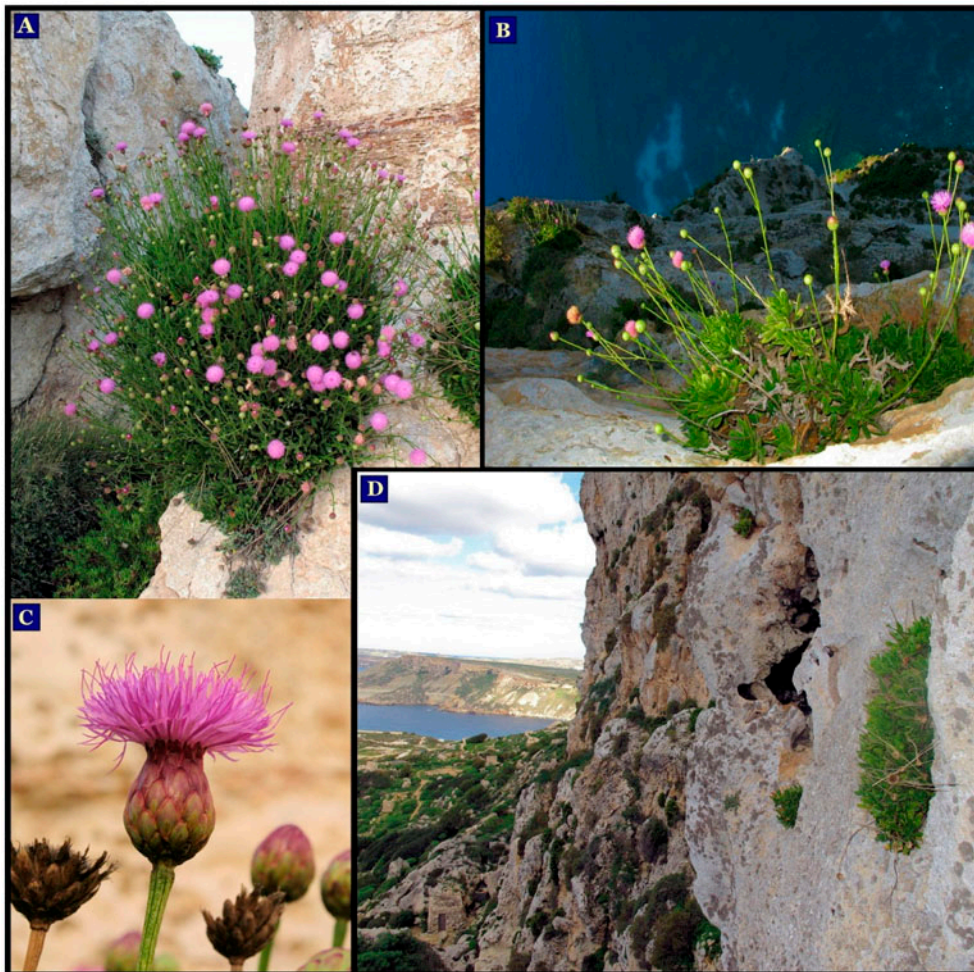


Figure 8. *Palaeocyamus crassifolius* from the Maltese islands. (A, B) Plant in its peak flowering time (beginning of June). (C) Lateral close image up of flower. (D) Population at tal-Qlighi, secondary inland cliffs about 500 m away from the coastal cliffs.



Figure 9. *Cremonophyton lanfranconi* from the Maltese islands. (A) Specimen from Ta' Slima, San Lawrenz (Gozo) on Globigerina Limestone flanks. (B) Close up of infructescence. (C) A few hundred specimens on ledged sub-vertical cliff face at Rdum Ghajn Gidem, Dingli (one of the largest meta-populations in Malta). (D) Habitat – specimens on cliff feet close to sea level.



Figure 10. *Helichrysum melitense* from the Maltese islands. (A) Specimen from ta' Kurrat, San Lawrenz. (B) Close up of inflorescence. (C) Dense population at ta' Harrux, San Lawrenz. (D) Habitat – Globigerina limestone ground few decametres inland from the cliff edge. (E) Specimen from Ġhajn Abdul, Santa Luċija (new record). (F) Specimen from Xatt l-aħmar, Ġhajnsielem (new record). (G) Habitat – grooves and cliff flanks along vertical cliff edges. (H) *Helichrysum melitense* and *Palaeocyamus crassifolius* at Ġebel ben Ġorġ, San Lawrenz (the only site where the two rupestral endemics are present together),

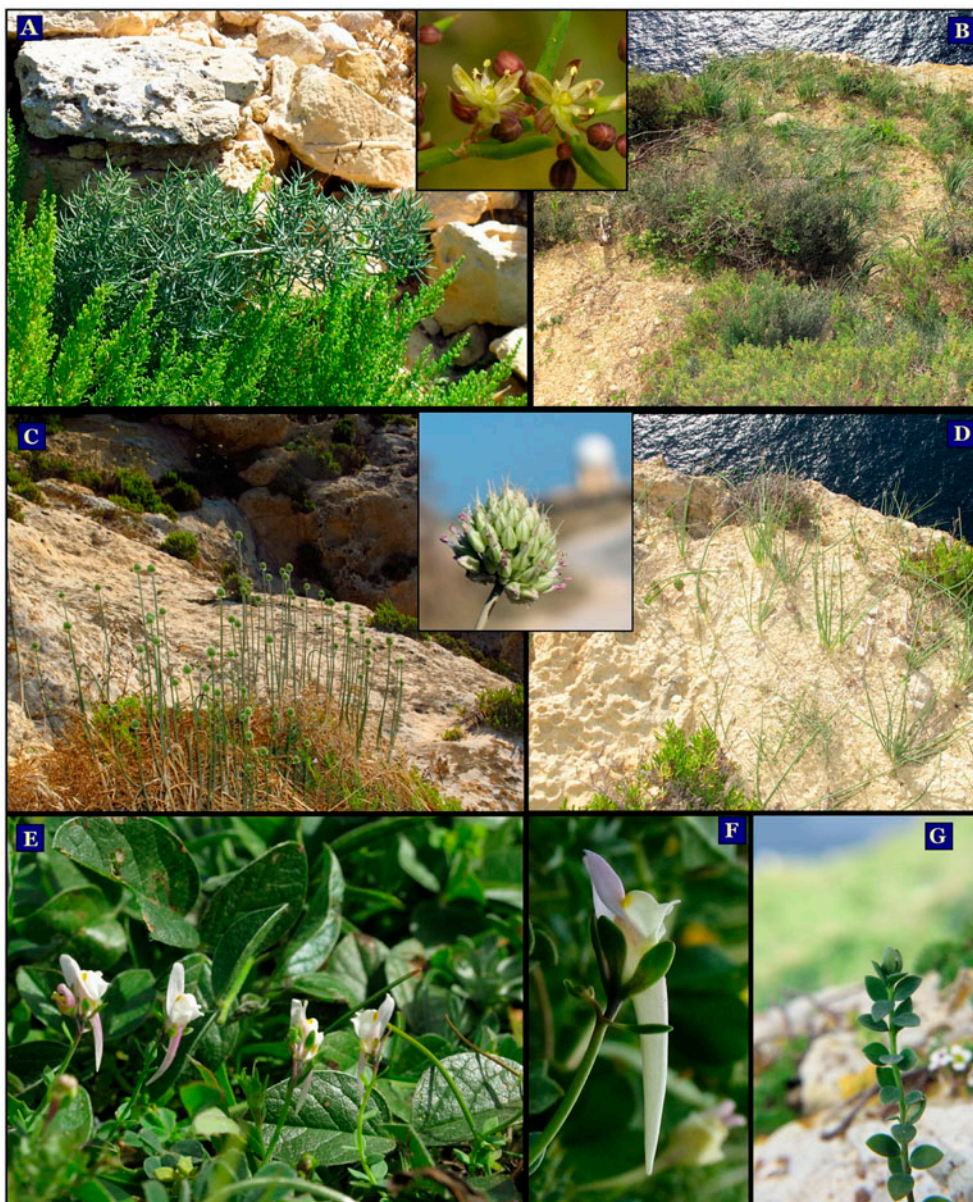


Figure 11. **(A, B)** *Asparagus horridus*. **(A)** Specimen from Ġebel San Ġorg, Santa Luċija. **(B)** Habitat – Globigerina limestone debris at flanks of coastal cliffs. Specimen from il-Faqma, Ta' Sannat (inset: close up of flowers from specimens in Munxar). **(C, D)** *Allium sphaerocephalon* subsp. *arvense*. **(C)** Specimen from Tat-Tinewt, Santa Lucija. **(D)** Habitat – Upper ledges of coastal cliffs composed of Globigerina limestone ground (inset: close up of flower-head from specimens in Dingli). **(E–G)** *Linaria pseudolaxiflora*. **(E)** Specimen from tad-Dabrani hilltop, Żebbuġ (Gozo). **(F)** Close up of flower. **(G)** Specimen from taċ-Ċawl, Gharb.

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Distribution of some rare or endemic chasmophytic and rupestral species growing along the coastal cliffs of the Maltese Islands

Stephen Mifsud

In this issue, Figure 3 was mistakenly displayed as Figure 2; the correct Figure 3 is shown here.

The publishers apologise for this error.

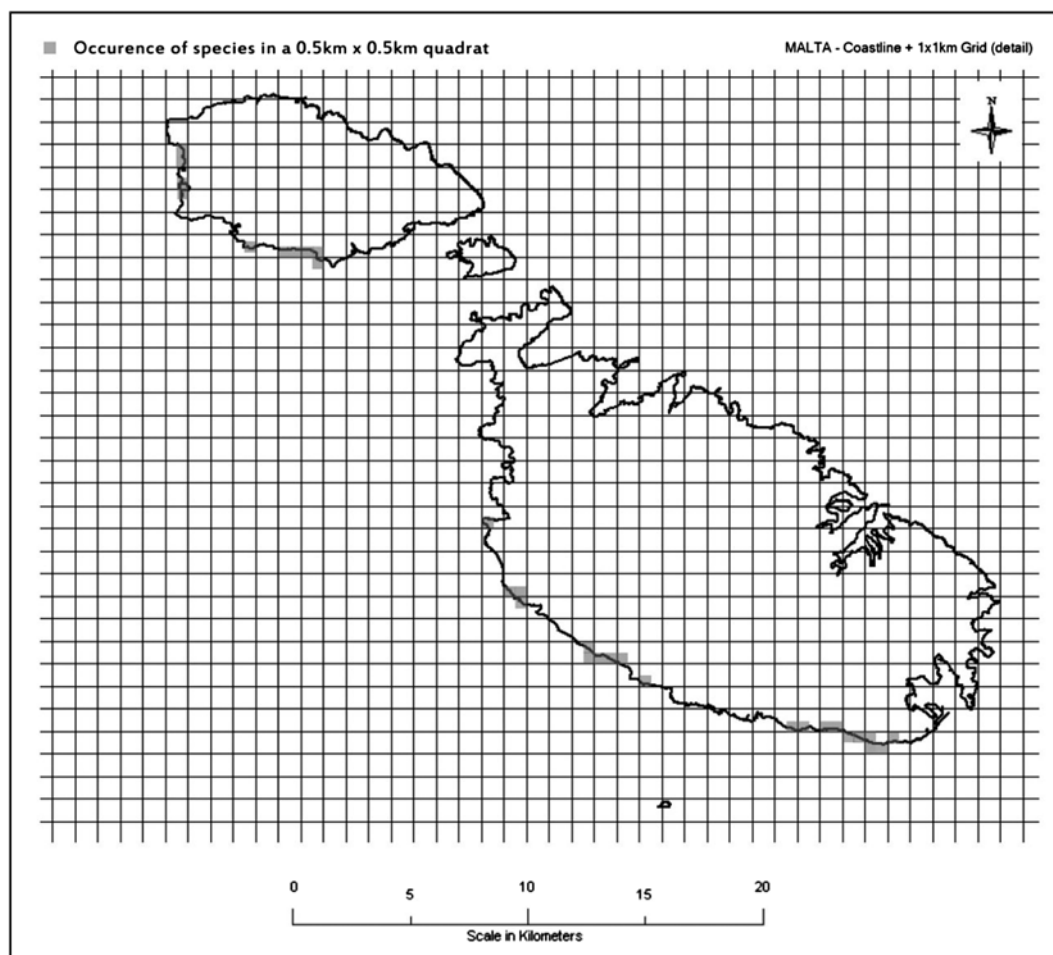


Figure 3. Distribution map for *Cremnophyton lanfrancoi*.