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Taxonomic survey on the genus *Limonium* in the Maltese islands, with description of a new species

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Abstract

The native species of the genus *Limonium* (Plumbaginaceae) occurring in the Maltese Islands are investigated. According to current literature, this genus is hitherto represented in this territory by *L. virgatum*, *L. zeraphae* and *L. melitense,* but recent field surveys led to the discovery of a new species growing exclusively on the islet of Cominotto and described as *L. lanfrancoi*. The latter, for some morphological features regarding the vegetative and reproductive traits, shows closer relationships with *L. melitensis*, from which, however, it differs in several diacritical characters. For each species, a detailed illustration and a new morphological description based on rich herbarium materials are provided, as well as information on their typification, synonymy, phenology, ecology, distribution, conservation status and a list of examined herbarium specimens is given. Besides, an updating analytical key has been elaborated.

Key words: *Limonium*, Malta, new species, Sea Lavender, taxonomy

Introduction

In the frame of taxonomic surveys on the genus *Limonium* Miller (1754: 1328) carried out in several territories of the Mediterranean area, including Sicily (Brullo 1980, 1988; Ilardi *et al.* 2014; Brullo *et al.* 2016), Italian Peninsula (Brullo 1992; Brullo & Guarino 2017), Tunisia (Brullo & Erben 1989; Bartolo *et al.* 2003; Brullo & Giusso del Galdo 2006b; Sefi *et al.* 2020), Greece (Brullo & Erben 2016), Cyrenaica (Brullo 1978), the species occurring in the Maltese Islands are examined. According to more recent literature (Weber & Kendzior 2006; Lanfranco & Bonnett 2015; Casha 2015; Brullo *et al.* 2020), only three species, i.e., *L. virgatum* (Willdenow 1809; 336) Fourreau (1869: 141), *L. zeraphae* Brullo (1980: 285) and *L. melitense* Brullo (1988: 13), are reported as native to this archipelago, usually growing along the coastal belt on rocky carbonatic substrates or more rarely in salt marshes.

Previously, Domina (2011) mentioned from Malta also *L. cosyrense* (Gussone 1832: 90) Kuntze (1891:395) and *L. divaricatum* (Rouy 1903: 160) Brullo (1980: 286) probably based on old incorrect reports (Sommier & Caruana Gatto 1915; Borg 1927; Haslam *et al.* 1977). In fact, *L. cosyrense* is exclusive to the island of Pantelleria (Pignatti 1982; Brullo & Guarino 2017), while *L. divaricatum* is a synonym of *L. dubium* (Andrews ex Gussone 1832: 89) Litardière (1948: 212), a species distributed in Sicily, Sardinia and Corsica (Brullo & Guarino 2017; Erben & Del Guacchio 2021). Besides, Domina (2011) recorded from Malta also *L. narbonense* Miller (1768: 2), as an introduced (alien) species, whose occurrence on the island as a cultivated or naturalized plant was observed also by Borg (1927), Haslam *et al.* (1977) and Casha (2015).

In this context, it is important to emphasize that Sommier & Caruana Gatto (1915) recognized only three species of Sea Lavender in the Maltese Islands:*Statice virgata* Willdenow (1809: 326). *S. reticulata* Linnaeus (1753: 275),

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and a new variety of *S. cosyrensis* Gussone (1832: 90). Those authors, however, pointed out that, wider material collected in summer would have been required. Based on extensive field and herbarium researches undertaken in the last decades, it was possible to verify that *L. virgatum*, widespread in almost all the Mediterranean area, is frequent in Malta, while as concerns the other two species the question is somewhat more complex. In fact, *L. cosyrense,* is endemic to Pantelleria island (Brullo & Guarino 2017), and the populations identified by Sommier & Caruana Gatto (1915) as *S. cosyrensis* var. *melitensis* can be attributed to *L. melitense* proposed by Brullo (1988:13) as a new species, highlighting its relationships with the group of *L. bocconei* (Lojacono 1907: 25) Briquet & Litardière (1955:16), occurring in Sicily.

As regards *Statice reticulata*, it is a very critical species whose correct identification has always been very complicated and controversial, mainly due to its intricate lectotypification (cf. Del Guacchio *et al.* 2018), which led Jarvis (2007) to state that "the application of this name appears uncertain", based also on Salmon (1913) who wrote that the name of this species was misapplied by the botanist after Linnaeus (1753). Recently, Del Guacchio *et al.* (2018) while highlighting that Linnaeus (1753: 275) in the protologue of *Statice reticulata* indicated that it occurred in Malta ("habitat in Melita"), listed several synonyms applicable to this taxon, such as Sauvage (Meth. Fol.:15, 1751), Plukenet (1691: t. XLII, fig 4; 1696: 221), Boccone (1674: 82, t. 44) and Ray (1693: 396). In particular, Boccone (1674) and Plukenet (1691) provided both a good illustration for this plant, which are original materials for the name of *S. reticulata.* According to Del Guacchio *et al.* (2018) from the analysis of all the available original material, it can be deduced that Boccone's illustration (1674, "*Limonium reticulatum supinum*") is perfectly referable to *L. zeraphae* occurring in Malta, as well as its herbarium specimens kept in LD and P (cf. Pulvirenti *et al.* 2017). Even, the plant illustrated by Plukenet (1691) can be also identified with *L. zeraphae*, since he referred it to the Boccone's plant, the same can be asserts in the case of the description relating to the plant quoted by Sauvages (1751). Whereas, the plant described by Ray (1693), as emphasizing by Salmon (1913), must be attributed to *Statice bellidifolia* Goüan (1764: 231), nowadays *Limonium bellidifolium* (Goüan) Dumortier (1827: 27). Besides, there is another original element (Jarvis 2007; Del Guacchio *et al.* 2018) represented by the sheet at LINN (no. 395.9), bearing a single individual with the Linnaeus's annotation "*Statice*" and "*5 reticulata*", corresponding to the species number in the protologue. Unfortunately, there is no certain information about the origin of this specimen of Linnaeus, it is only known that it is a duplicate of a plant kept in Clifford's herbarium, probably collected by A. van Royen (Del Guacchio *et al.* 2018). However, it is certainly not of Maltese origin, and its morphological characteristics are in total contrast with the diagnosis reported by Linnaeus (1753) in the protologue of *S. reticulata*. Therefore, in relation to the abovesaid observations and mainly as can be seen from the protologue, Linnaeus did not describe *S. reticulata* only on Maltese material, but he used other ones belonging to different taxa too. All this has led many authors in the past to misapply this Linnaean name (cf. Hudson 1762; Withering 1776; Goüan 1764, 1796; Smith 1796, 1804; Lamarck & Candolle 1805; Marschall von Bieberstein 1808; Hooker 1830) prompting Del Guacchio *et al.* (2018) to submit a proposal to reject the name *Statice reticulata* on the basis of art. 56 of the Code. Actually, if one wanted to lectotypify this name, the syntype available would be the illustration published by Boccone (1674, t. 44), in this case *Statice reticulata* and *Limonium zeraphae* would become heterotypic synonyms. In any case, however, the name *Statice reticulata* cannot be used for a new combination of the genus *Limonium*, since a taxon with this name already exists (*L. reticulatum*) published by Miller (1768: no. 9), which, however, must be referred to a different species. In fact, this author in the protologue did not mention the Linnean species but only the polynomial of Boccone (1697: 143, tab. 103) "*Limonium minus flagellis tortuosis*", which he collected not in Malta but along the coasts of the Veneto. As confirmation of the fact that Miller (1768) in the protologue of this species deliberately does not make any reference to *Statice reticulata* Linnaeus (1753), he described it with "caule erecto", while the Linnaean species is described as having "caule prostrato". Furthermore, as can be seen from the relative illustration published by Boccone (1697, tab 103 as *Limonium flagellis tortuosis*), the polynomial can clearly be attributed to *Limonium bellidifolium*, a plant currently still occurring on the Veneto coasts (Bonometto 2015). Even Salmon (1913) agreed on this identification, considering *Limonium reticulatum* Miller a synonym of *Statice bellidifolia* analogously to *S. reticulata* sensu Hudson (1762), Withering (1776) and Smith (1804) not Linnaeus (1753). Therefore, it should be noted that *Limonium reticulatum* Miller represents a clear synonym of *L. bellidifolium*.

On the basis of recent field investigations, the genus *Limonium* in the Maltese Islands is represented not only by the three aforesaid native species, but also by another not yet described taxon discovered on a small uninhabited islet of this archipelago. In particular, it grows at Cominotto, an islet near Comino, from which it is separated by the famous Blue Lagoon, where it grows along the calcareous rocky coast. In relation to important morphological features, constant in all individuals of this isolated population, this Sea Lavender can be treated as a new species to science, namely *Limonium lanfrancoi.*

Materials and methods

The study was based on a detailed and in-depth investigations of herbarium specimens, field surveys and literature data, which allowed an overview of all *Limonium* species occurring on all islands of the Maltese archipelago. As concerns *Limonium lanfrancoi*, the morphological analyses were carried out on several specimens collected on the islet of Cominotto near Comino and kept in Catania herbarium (CAT), while for the comparative investigation of the other species (*Limonium virgatum*, *L. zeraphae* and *L. melitense*), the large collections of specimens occurring mainly in CAT and in some other herbaria (ARG, B, FI, MPU, U) were used. The acronyms follow Thiers (2022). The diagnostic features, allowing to distinguish the Maltese species from each other, were identified using stereo-microscopes with drawing device and their list is shown in Table 1. For nomenclatural considerations Turland *et al.* (2018) was followed.

TABLE 1. Main diacritic characters of the Limoniumspecies occurring in the Maltese Archipelago.

Characters	***L. lanfrancoi***	***L. virgatum***	***L. zeraphae***	***L. melitense***
Habit	erect	erect	prostrate to ascending	erect
Stem height (cm)	5–12	14–40	6–40	8–45
Caudices length (cm)	0.5–2	0.5–2	0.5–2.5	0.5–4
Stem internodes lenght (mm)	2–12(15)	5–40	15–50	3–20(40)
Leaf shape	spathulate	spathulate to oblanceolate	oblanceolate to oblanceolate-spathulate	oblanceolate
Leaf at flowering	dry	green	dry	dry
Leaf size (mm)	5–20 × 2–5	15–40 × 4–8.5	10–40 × 2–6(9)	10–40 × 3–8
Leaf apex	rounded	rounded to obtuse	rounded to obtuse	rounded to retuse
Inflorescence shape	obtrullate	trullate	obtrullate	paniculate
Inflorescence branches	slightly arcuate	slightly arcuate	markedly arcuate to reflexed	slightly arcuate
Branch angles (°)	20–30	30–45	90–160	15–45
Spikes lenght (mm)	5–25	5–80	20–80	10–45(70)
Spikelet shape	straight	more or less curved	straight	straight
Spikelet lenght (mm)	5–6	6–7	7–8.5	7–8
Spikelet number per cm	3–4	4–6	2–3	3–4
Spikelet number of flower	1–3	1–5	1–2	2–3(4)
Outer bract lenght (mm)	1–1.4	1.5–2.5	1.7–2	1.5–2
Outer bract shape	ovate	triangular-ovate	ovate	ovate-triangular
Outer bract apex	acute	acute	acute to obtuse	acute
Outer bract apiculum lenght (mm)	0.5–0.6	0.8–1	0.4–0.8	0.6–0.9
Middle bract lenght (mm)	1.5–1.8	1.8–2.5	1.5–2.2	1.5–2
Inner bract size (mm)	3.8–4.3 × 2.–2.5	5–5.5 × 3–3.2	(4.5)4.8–5 × 3.2–3.5	(4.5)4.8–5(5.5)
Inner bract shape	elliptical	elliptical to oblong	elliptical to oblong	elliptical
Inner bract apex	rounded	rounded to obtuse	rounded	rounded
Inner bract tip of midrib (mm)	0.5–0.8	1–1.5	0.8–1.2	1–1.4
Calyx lenght (mm)	4.5–5	5–6	5–6	5–6
Calyx exserted inner bract (mm)	1.5–2.5	1.8–2.2	2–2.5	2.5–3
Calyx tube indumentum	sparsely hairy	sparsely hairy	sparsely hairy at the base	sparsely hairy
Calyx tube lenght (mm)	1.2–1.5	2.5–3	2.3–2.5	1.5–1.8
Calyx limb lenght (mm)	3.3–3.5	2.5–3	3.5–3.7	3.5–4
Calyx lobes shape	triangular-ovate	semi elliptical	triangular-ovate	semi elliptical
Calyx lobes lenght (mm)	0.6	0.6–0.9	1–1.2	0.5–0.7
Calyx lobes midrib	reaching the base	reaching the base	reaching the middle	reaching the middle

Taxonomic treatment

Using previous data and new knowledge on the *Limonium* genus of the Maltese Islands (Sommier & Caruana Gatto 1915; Brullo 1980, 1988; Weber & Kendzior 2006; Lanfranco & Bonnett 2015; Casha 2015; Brullo *et al.* 2020), the native species currently occurring in this territory are examined. For each species, a new morphological description based on the numerous herbarium materials collected in this archipelago, of which a list is given, as well as a new detailed illustration and information on the type, synonyms, phenology, ecology, distribution, conservation status are provided. Furthermore, in order to make easier the identification of the species, an updating analytical key using the most significant diacritical tracts has been elaborated.

Limonium lanfrancoi Agius, Galea, Cambria, Giusso del Galdo & Brullo ***sp. nov.*** (Fig. 1).

Type: MALTA. Islet of Cominotto (loc. Kemmunett), north-west rocky coast. 9 October 2022, *D. R. Agius & M. E. Galea s.n.* (holotype CAT!, isotypes CAT!, ARG!).

Limonio melitense affinis, sed distincto scapo contracto, breviore, foliis brevioribus, spicis brevioribus, spiculis brevioribus, bractea exteriore breviore, bractea superiore breviore, calyce breviore, ex bractea superiore 1,5–2,5 mm exserto, tubo breviore, lobis triangulari-ovatis.

Plant perennial, glabrous, with short caudices. Leaves green, rigid, laxly inserted on the caudices, spathulate, 1–nerved, 5–20 mm long, 2–5 mm wide, often slightly revolute at the margin, rounded at the apex, usually withered at anthesis. Stem several, rigid, erect, 5–12 cm tall, densely branched from the base, obtrullate in outline, with numerous much branched sterile branches. Articles slightly arched, 2–12(–15) mm long, with deepened glands, forming branching angles of 20–30°. Fertile branches localized at the top of the stem. Spikes 5–25 mm long, straight, with 2–6(8) spikelets. Spikelets 5–6 mm long, 3–4 per cm, 1–3 flowered. Outer bract 1–1.4 mm long, ovate, acute, coriaceous in the central part, forming an apiculum 0.5–0.6 mm long, membranous at margin. Middle bract membranous, rounded, 1.5–1.8 mm long. Inner bract 3.8–4.3 mm long, 2–2.5 mm wide, elliptical, rounded, with outer hyaline margin and pale brown inner margin, central part herbaceous, with an apiculum 0.5–0.8 mm long, not reaching the apex. Calyx 4.5–5 mm long, sparsely hairy in the tube, 1.5–2.5 mm protruding from the inner bract, with tube 1.2–1.5 mm long and limb 3.3–3.5 mm long, with midribs ending at the base of the lobes, which are triangular–ovate, 0.6 mm long.

Etymology:—This species is dedicated to Edwin Lanfranco (1946) Maltese botanist author of several contributions aimed at improving the floristic knowledge of this small but interesting insular territory of the Mediterranean.

Phenology:—*Limonium lanfrancoi* flowers from July to October and producing seeds from August to November.

Distribution and ecology:—Based on current knowledge, *L. lanfrancoi* is localized exclusively on the uninhabited islet of Cominotto, which, with the island of Comino, delimits the well-known Blue Lagoon of the Maltese archipelago (Fig. 5, 7). This species, occurring on coralline limestone, constitutes a small population distributed along the northern and western coast of this islet, (Fig. 6) where it is a member of a plant communities belonging to *Crucianellion rupestris*, alliance of the *Crithmo-Limonietea* (Brullo *et al.* 2020). Usually it grows with *Frankenia hirsuta* Linnaeus (1753: 331), *Silene sedoides* Poiret (1789: 164), *Crucianella rupestris* Gussone (1832: 44), *Daucus rupestris* Gussone (1843: 335), *Limbarda crithmoides* (Linnaeus, 1753:883) Dumortier (1827: 68) subsp. *longifolia* (Arcangeli 1882: 371) Greuter (2003: 244), *Cichorium spinosum* Linnaeus (1753: 813), *Anyhyllis hermanniae* Linnaeus (1753:720) subsp. *melitensis* Brullo & Giusso (2006a: 309), etc.

Conservation status:—*Limonium lanfrancoi* is localized exclusively on the islet of Cominotto (0.06 km^2), which is just 200 m. from Comino island, in the Gozo Channel, where it is represented by a small population of more than a thousand individuals, distributed along the coast. This species grows mainly in the belt near the sea, directly affected by marine aerosol, habitat fortunately still not threatened by anthropic pressures as the summer tourism. Therefore according to the IUCN Red list category (IUCN 2023), this species for its restricted distribution, low number of mature individuals and absence of threats that can modify the natural environment, should be considered as Critically Endagered B1 + B2 a, b (ii,iii).

Specimens examined (Paratypes):—MALTA. Islet of Cominotto (loc. Kemmunett), northern rocky coast. 24 November 2021, *D. R. Agius & M. E. Galea s.n.* (CAT!); Islet of Cominotto, western rocky coast. 19 April 2023, *D. Agius & S. Cambria s.n.* (CAT!); Cominotto south-eastern coast, 19 April 2023, *D. Agius & S. Cambria s.n.* (CAT!).

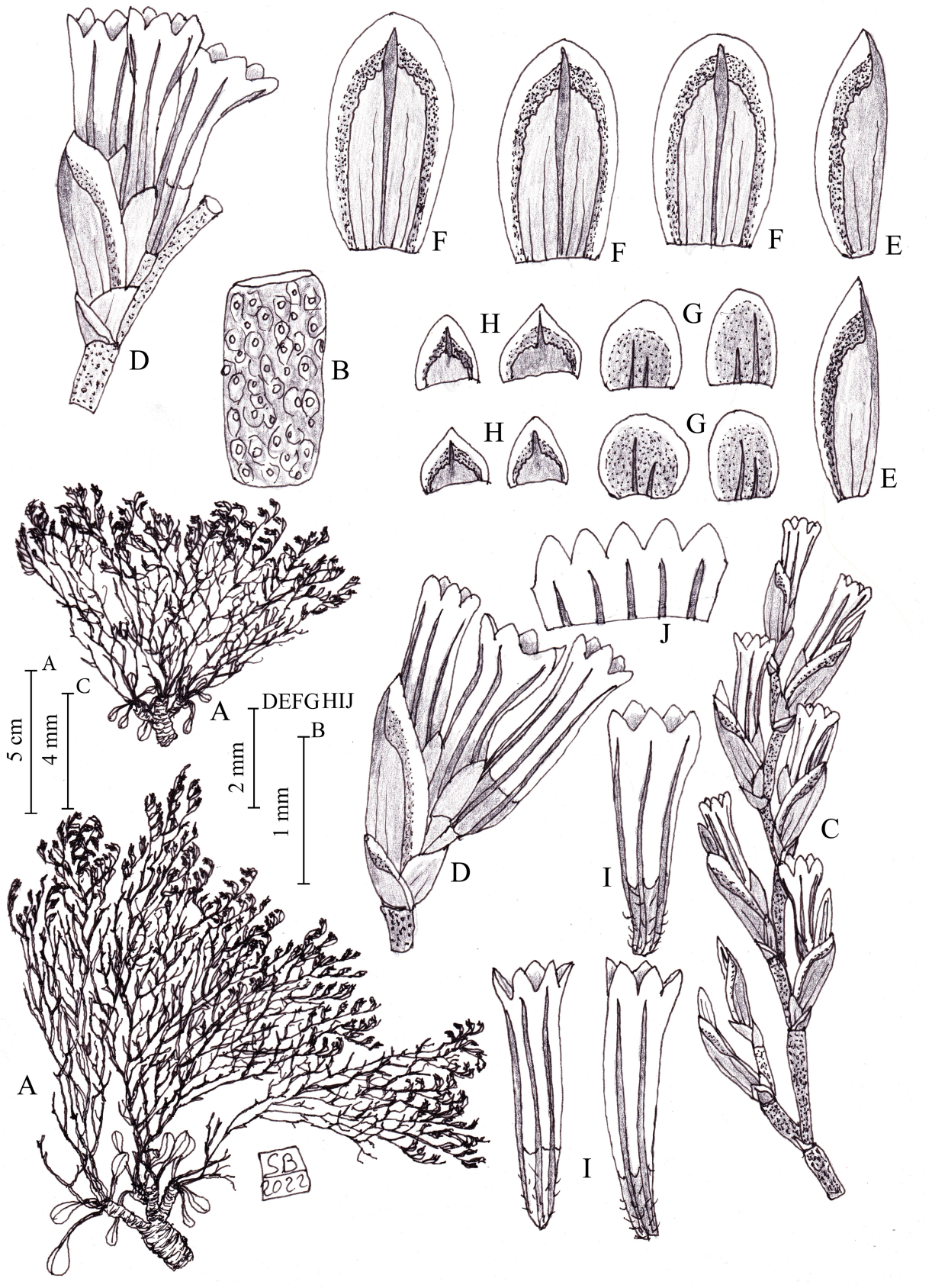

FIGURE 1. Diagnostic features of *Limomium lanfrancoi*. **A.** Habit. **B.** Stem article. **C.** Inflorescence. **D.** Spikelets. **E.** Inner bracts in lateral view. **F.** Inner bracts in dorsal view. **G.** Middle bracts. **H.** Outer bracts. **I.** Calyces. **J.** Calyx lobes. Illustration by S. Brullo based on living material coming from the type locality (CAT).

Limonium virgatum (Willdenow 1809: 336) Fourreau (1869: 141) (Fig. 2)

Type: SPAIN. "Habitat in Hispania", s.d., *s.cl.* (Lectotype B061891!), designated by Erben (1978: 456)

= *Statice virgata* Willdenow (1809: 336).

= *Statice smithii* Tenore (1824–1829: 350).

= *Statice virgata* Willdenow var. *tenia* Heldreich (1901: no. 1683)

≡ *Limonium tenium* (Heldr.) Rechinger (1961: 371).

= *Statice melia* Nyman (1881: 612).

≡ *Limonium melium* (Nyman) Pignatti (1971: 365).

Plant perennial, glabrous, with caudices branched, 0.5–2.0 cm long. Leaves green, rigid, laxly inserted on the caudices, spathulate to oblanceolate, 1-nerved, 15–40 mm long, 4–8.5 mm wide, more or less flat, rounded to obtuse at the apex, mucronate. Stem several, rigid, erect, 14–40 cm tall, branched from the base, trullate in outline, with several sterile branches. Articles slightly arched, 5–40 mm long, rugose and with deepened glands, forming branching angles of 30–45°. Fertile branches localized at the top of the stem. Spikes 5–80 mm long, straight or slightly arched, with spikelets loosely arranged. Spikelets more or less curved, 6–7 mm long, 4–6 per cm, 1–5 flowered. Outer bract 1.5–2.5 mm long, triangular-ovate, acute, fleshy at the base, membranous at margin, forming an apiculum 0.8–1 mm long. Middle bract membranous, rounded, 1.8–2.5 mm long. Inner bract 5–5.5 mm long, 3–3.2 mm wide, elliptical to oblong, rounded to obtuse, with outer hyaline margin and pale brown inner margin, central part herbaceous, with an apiculum 1–1.5 mm long, not reaching the apex. Calyx 5–6 mm long, sparsely hairy in the tube, 1.8–2.2 mm protruding from the inner bract, with tube 2.5–3 mm long and limb 2.5–3 mm long, with midribs ending at the base of the lobes, which are semi-elliptical, 0.6–0.9 mm long.

Etymology:—The Latin epithet "*virgatum*" refers to the twigs twiggy, long and slender.

Phenology:—*Limonium virgatum* flowers from June to October and produces seeds from August to November.

Distribution and ecology:—This species, widespread throughout the Mediterranean area, in the Maltese Archipelago occurs prevalently in Malta, where it grows mainly on marly and clayey substrata of the coastal belt and more rarely in the salt marshes (Fig. 7). According to Brullo *et al.* (2020), *L. virgatum* shows its optimum in the rocky coast characterized by marls, often rich in clayey component. In this stands it is a member of a plant community of the *Crithmo-Limonion*, alliance of the *Crithmo-Limonietea* class, referable to *Crithmo maritimi-Limonietum virgati*, association described by Pirone (1995) and distributed in several localities of the Central Mediterranean area. In this vegetation *L. virgatum* grows with other perennial halophytes, such as *Crithmum maritimum* Linnaeus (1753: 246), *Lotus cytisoides*, *Limbarda crithmoides* subsp. *longifolia* and *Daucus gingidium* Linnaeus (1753: 142). Sometimes, *L. virgatum* was also observed with a sporadic occurrence in halophilous plant communities tied to salt marshes and belonging to *Salicornietea fruticosae* class (Brullo *et al.* 2020).

Conservation status:—During the last decades, *Limonium virgatum* in the Maltese territory, due to the considerable anthropic pressure on the coastal environmental, shows a quite scattered distribution, disappearing completely in some stands, where it was previously recorded. Therefore, according to IUCN protocol (IUCN 2023), this species due to progressive and constant regression of its populations, represented by a small number of individuals, should be classified as "vulnerable" VU A2.

Specimens examined:—MALTA. Malta: Maddalena Tower, 23 September 1985, *S. Brullo s.n.* (CAT 013167!); Sliema, 29 September 1985, *S. Brullo s.n.* (CAT 013166!); Muxar (St. Thomas Bay), 25 September 1985, *S. Brullo s.n.* (CAT 013165!); Marsalook, fanghi salini. 19 August 1982, *E. Lanfranco s.n.* (CAT 013163!); Marsalook, 14 November 1986, *S. Brullo & P. Pavone s.n.* (CAT 013171!); Marsalook, 16 November 1986, *S. Brullo & P. Pavone s.n.* (CAT 013174!); Ras L-Irqitpe, 24 June 1973, *S. Brullo & G: Ronsisvalle s.n.* (CAT 013162!); Exiles (Sliema), terreno roccioso presso il mare, 30 August 1982, *E. Lanfranco 7062* (CAT 013164!); Qaliet (San Giuliano), terreno roccioso presso il mare, 26 August 1982, *E. Lanfranco 7069* (CAT 013162!); Qaliet, caruhging rocks, 20 October 1984, *E. Lanfranco 7212* (CAT 013168!); Rdum Tal-Vi-Gaju, 14 November 1986, *S. Brullo & P. Pavone s.n.* (CAT 013172!); Delimara, 10 April 1984, *S. Brullo & G. Ronsisvalle s.n.*(CAT 013171!); Delimara, 26 September 1985, *S. Brullo s.n.*(CAT 013169!); Dragunara, 23 September 1985, *S. Brullo s.n.* (CAT 013170!); Melita, 1845, *Delicata s.n.* (FI!). Ghadira, salt marshes, Mellieha, 17 October 2022, G. *Tavilla s.n.* (CAT!); Ghadira, salt marshes, Mellieha, 10 October 2022, *G. Tavilla s.n.* (CAT!); Pembrok, costa rocciosa, 28 September 2022, G. *Tavilla s.n.* (CAT!).

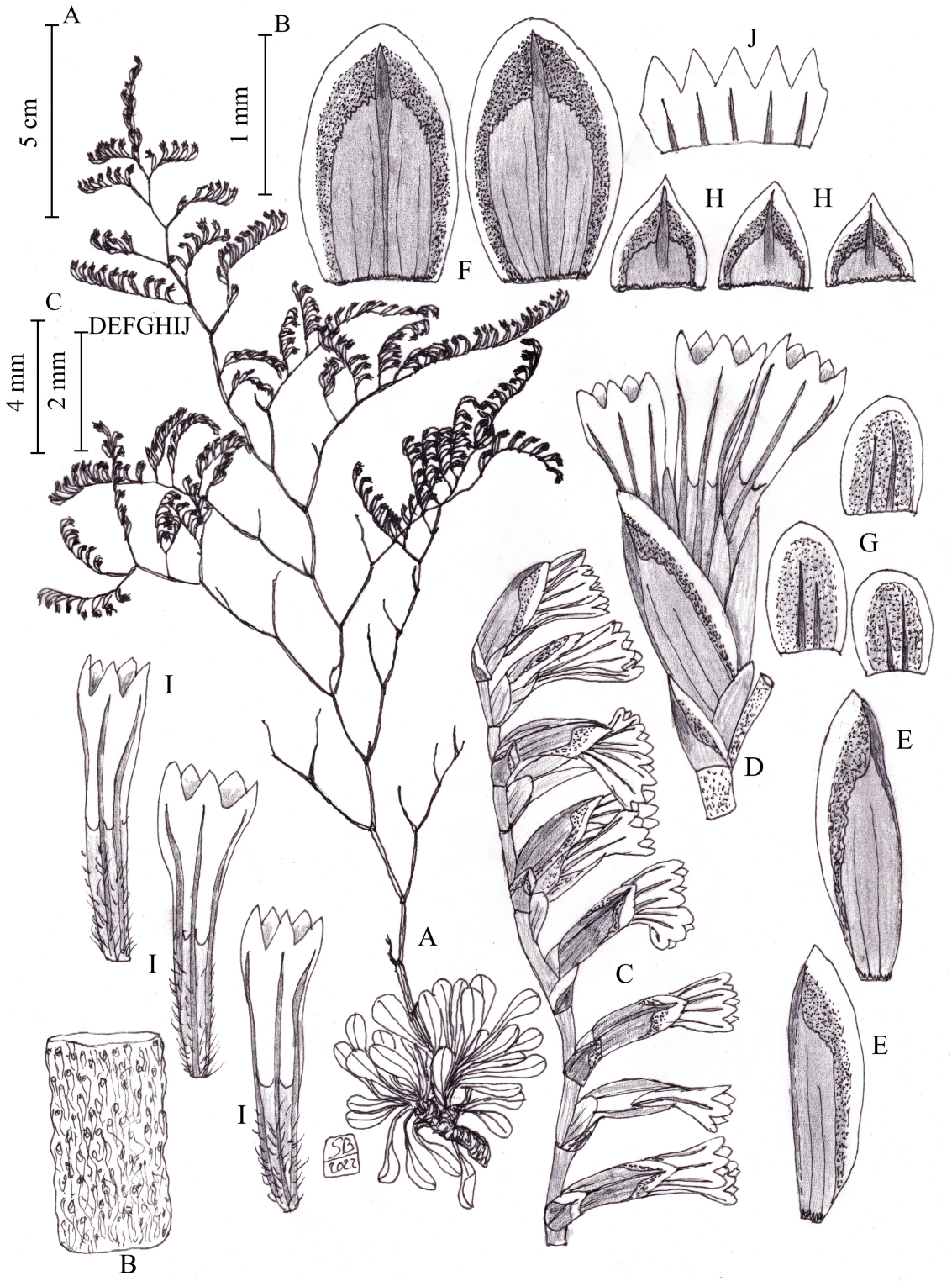

FIGURE 2. Diagnostic features of *Limomium virgatum*. **A.** Habit. **B.** Stem article. **C.** Inflorescence. **D.** Spikelet. **E.** Inner bracts in lateral view. **F.** Inner bracts in dorsal view. **G.** Middle bracts. **H.** Outer bracts. **I.** Calyces. **J.** Calyx lobes. Illustration by S. Brullo based on living material coming from Malta (CAT).

Limonium zeraphae Brullo (1980: 285) (Fig. 3)

Typus: MALTA: Malta, Il Blata i-Baida, 25 Juin 1973, *Brullo & Ronsisvalle s.n.* (Holotype CAT 013207!, isotype CAT 013207! hoc loco, MPU 821682! hoc loco).

≡ *Statice reticulata* Linnaeus (1753: 275) p.p.

– *Statice reticulata* Sommier & Caruana Gatto (1915: 213), non Linnaeus (1753)

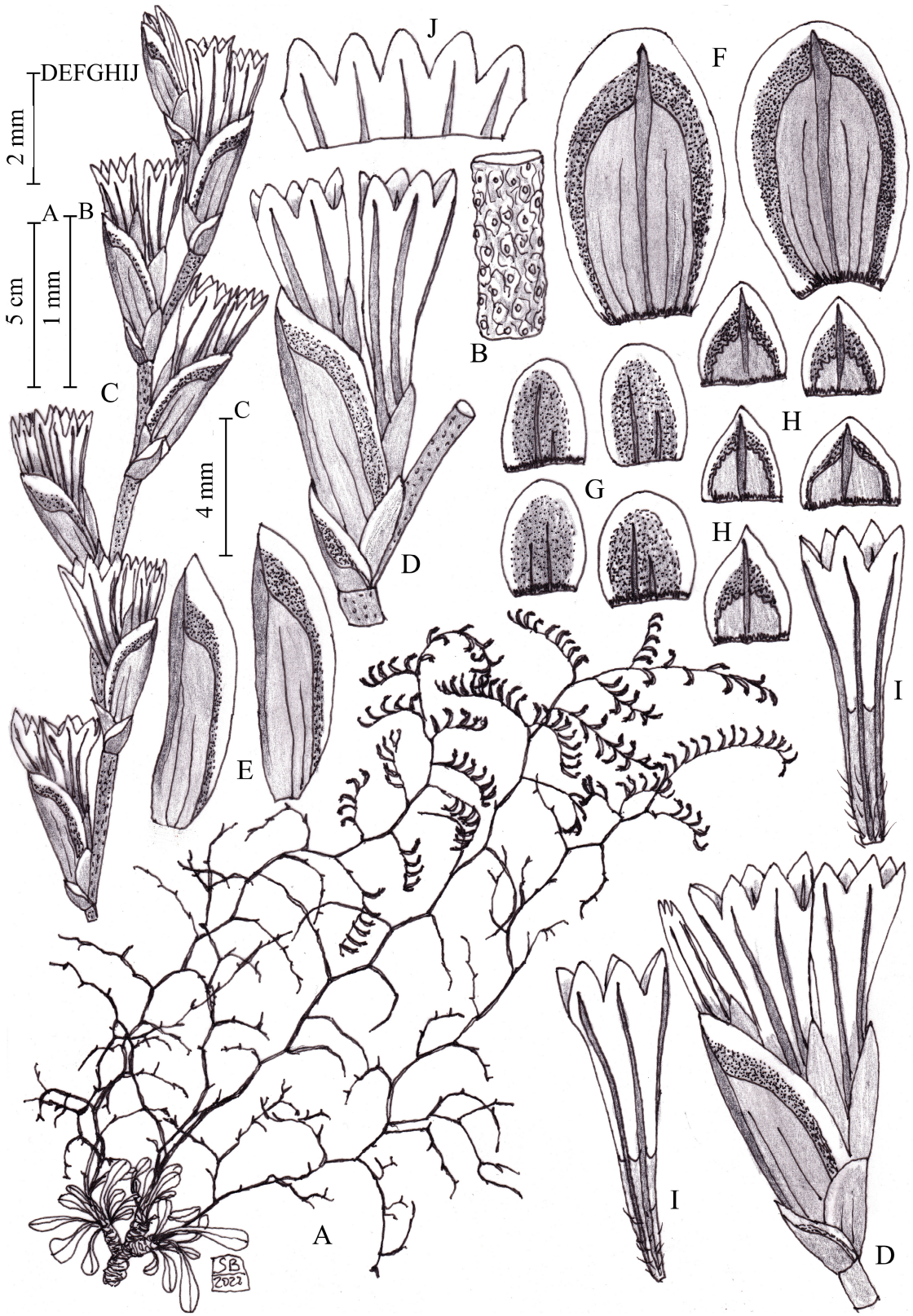

FIGURE 3. Diagnostic features of *Limomium zeraphae*. **A.** Habit. **B.** Stem article. **C.** Inflorescence. **D.** Spikelet. **E.** Inner bracts in lateral view. **F.** Inner bracts in dorsal view. **G.** Middle bracts. **H.** Outer bracts. **I.** Calyces. **J.** Calyx lobes. Illustration by S. Brullo based on living material coming from the type locality (CAT).

Plant perennial, glabrous, with caudices dense, contracted branched, 0.5–2.5 cm long. Leaves green, rigid, densely inserted on the caudices, oblanceolate to oblanceolate-spathulate, 1–nerved, 10–40 mm long, 2–6 (9) mm wide, more or less revolute at the margin, rounded to obtuse at the apex, usually withered at anthesis. Stem numerous, rigid, prostrate to ascending, 6–40 cm long, articulate, fragile at the nodes branched from the base, obtrullate, with numerous

branched sterile branches, markedly arcuate to reflexed. Articles 5–30 mm long, covered by deepened glands, forming usually branching angles 90–160°. Inflorescence paniculate, with fertile branches localized at the top of the stem. Spikes 20–80 mm long, very divaricate to arcuate, with spikelets remotely arranged. Spikelets 7–8.5 mm long, 2–3 per cm, 1–2 flowered. Outer bract 1.7–2 mm long, ovate, acute to obtuse, coriaceous in the central part, forming an apiculum 0.4–0.8 mm long, membranous at margin. Middle bract membranous, rounded, 1.5–2.2 mm long. Inner bract (4.5)4.8–5 mm long, 3.2–3.5 mm wide, elliptical to oblong, rounded, with outer hyaline margin and pale brown inner margin, central part herbaceous, with an apiculum 0.8–1.2 mm long, not reaching the apex. Calyx 5–6 mm long, sparsely hairy at the base of the tube, 2–2.5 mm protruding from the inner bract, with tube 2.3–2.5 mm long and limb 3.5–3.7 mm long, with midribs ending in the middle of the lobes, which are triangular-ovate, 1–1.2 mm long.

Etymology:—This species is dedicated to Stephano Zerapha (1791–1871), Maltese botanist and director of Floriana Botanical Garden.

Phenology:—*Limonium zeraphae* flowers from June to October and producing seeds from August to November.

Distribution and ecology:—This species is endemic of Maltese Archipelago, where it occurs in Malta, Gozo and Comino, mainly along the rocky coast (Fig.7). It is a chamaephyte, showing a prostrate and intricate habit, localized usually on coralline limestones, in the stands very close to the sea. The vegetation characterized by this peculiar halophyte was described by Brullo *et al.* (2020) as *Limonietum zeraphae*, association of *Crucianellion rupestris*, which is an alliance belonging to *Crithmo-Limonietea*. Ecologically, this plant community shows marked thermo-xerophilous requirements, since linked to very arid and sunny calcareous surfaces, with soils occurring only in the rocky crevices. The species more frequent in these habitats are *Crucianella rupestris, Cichorium spinosum, Crithmum maritimum, Lotus cytisoides, Plantago macrorhiza* Poiret (1789: 114), etc.

Conservation status:—In the last fifty years, the islands of the Maltese Archipelago have undergone a considerable alteration of the natural landscape, due to numerous anthropic factors, such as the increase of urbanization, road network, agricultural activities and above all tourism, which have particularly affected the coastal environment, where the species of *Limonium* have their highest concentration. In particular, *L. zeraphae*, which in the past had a much wider distribution, has currently undergone a significant reduction of its original range, especially near the most urbanized coastal areas. Therefore, the progressive and constant regression of its populations with a much lower number of individuals than in the past, *L. zeraphae* should be classified, according to IUCN protocol (IUCN 2023), as "vulnerable" VU A2.

Specimens examined:—MALTA. **Malta**: Mistra Bay, 23 September 1985, *S. Brullo s.n.* (CAT 013212!); Dragunara, 24 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013213!); Dragunara, 23 September 1985, *S. Brullo s.n.* (CAT 013230!); Dragunara, 9 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013236!); Ras L-Irquiequa, 24 June 1973, *S. Brullo & G. Ronsisvalle s.n.*(CAT 013219!); Wadi Babu, 27 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013220!); Wadi Babu, 24 September 1985, *S. Brullo s.n.* (CAT 013223!); Barrija Valley, 25 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013212!); Ramla Tar-Torri, 26 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013210!); Gar Lapsi, 27 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013211!); Gueja Bay, 28 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013215!); Grhaja Hadid, 26 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013216!); Gnejma Bay, 25 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013217!); Qawra Point, 23 September 1985, *S. Brullo s.n.* (CAT 013224!); Il Blata L-Bajda, 23 September 1985, *S. Brullo s.n.* (CAT 013225!); Zonqok Point (Marsaskala), 24 September 1985, *S. Brullo s.n.* (CAT 013228!); Gagar Kim, 10 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013253!); Marfa Point, 27 September 1985, *S. Brullo s.n.* (CAT 013249!); Marfa Point, 26 September 1985, *S. Brullo s.n.* (CAT 013234!); Madalena Tower, 23 September 1985, *S. Brullo s.n.* (CAT 013238!); Limarbat (Marfa), 23 September 1985, *S. Brullo s.n.* (CAT 013239!); Gar Lapsi, 27 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013242!); Qrejten Point, 25 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013243!); Qrejten Point, 23 September 1985, *S. Brullo s.n.* (CAT 013237!); Ras il Griebeg (Mellieha), 28 September 1985, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013228!); Ras L-Irquiequa, 25 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013244!); Imtahleb, in rupibus maritimis, 6 May 1907, *Sommier s.n.* (FI!); Mtaleb, Wied Migra Ferha, 14 November 1986, *S. Brullo & P. Pavone s.n.* (CAT 013245!); Paradise Bay, 23 September 1985, *S. Brullo s.n.* (CAT 013247!); Qahet (St. Julien), su terra in terreno roccioso in riva al mare, 28 October 1984, *E, Lanfranco 7213* (CAT 013229!); Gnejma Bay, 25 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013217!); Roum Rxawn (St. Paul Bay), 25 September 1984, *S. Brullo s.n.* (CAT 013231!); Roum Tal Vigaju, 14 November 1986, *S. Brullo & P. Pavone s.n.* (CAT 013233!); Selinum Palace, 9 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013235!); Malta alla Valletta, a S. Giuliano, June, *Todaro s.n.* (FI!); Malta in rupibus maritimis, 6 May 1907, *Sommier s.n.* (FI!); Melita, August 1845, *Delicata s.n.* (FI!); Malta, s. d., *Tineo s.n.* (FI!); L-Ahrax, costa rocciosa, 28 September 2022, *G. Tavilla s.n.* (CAT!); Qalet Marku, 28 September 2022, *G. Tavilla s.n.* (CAT!); **Gozo**: Xlendi, 29 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013221!); St. Dimitri Point,

25 September 1985, *S. Brullo s.n.* (CAT 013226!); Cala Dweira, 25 September 1985, *S. Brullo s.n.* (CAT 013227!); Insula Gaulos, Cala Dweira, in rupibus maritimis, 17 April 1906, *Sommier s.n.* (FI!); ibdem, 23 April 1907, *Sommier s.n.* (FI!); Dweira, 11 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013240!); Marsalfor Bay, 13 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013250!); Marsalforno, 26 April 1907, *Sommier* s.n. (FI!); Hekk Point (Zebug), 25 September 1985, *S. Brullo s.n.* (CAT 013230!); Ta Xiilep Qara, 13 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013254!); Quara, 29.June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 013241!); Ramla, 25 April 1907, *Sommier* s.n. (FI!); Gaulos in saxosis maritimis Redun il Kibvi, 13 April 1874, *Duthie s.n.* (FI!); **Comino:** Comino, 24 April 1907, *Sommier s.n.* (FI!).

FIGURE 4. Diagnostic features of *Limomium melitense*. **A.** Habit. **B.** Stem article. **C.** Inflorescence. **D.** Spikelet. **E.** Inner bracts in lateral view. **F.** Inner bracts in dorsal view. **G.** Middle bracts. **H.** Outer bracts. **I.** Calyces. **J.** Calyx lobes. Illustration by S. Brullo based on living material coming from the type locality (CAT).

Limonium melitense Brullo (1988: 13) (Fig. 4)

Typus: MALTA: Malta, Golden Bay, 28 September 1985, *S. Brullo s.n.* (Holotype CAT 012554!, isotype CAT 012554! hoc loco, B 100294997! designated by Brullo (1988:13),, G-293596/1! hoc loco).

= *Statice cosyrensis* Gussone (1832: 99) var. *melitensis* Sommier & Caruana Gatto (1915: 213).

– *Statice cosyrense* auct. fl. melit., non Gussone (1932).

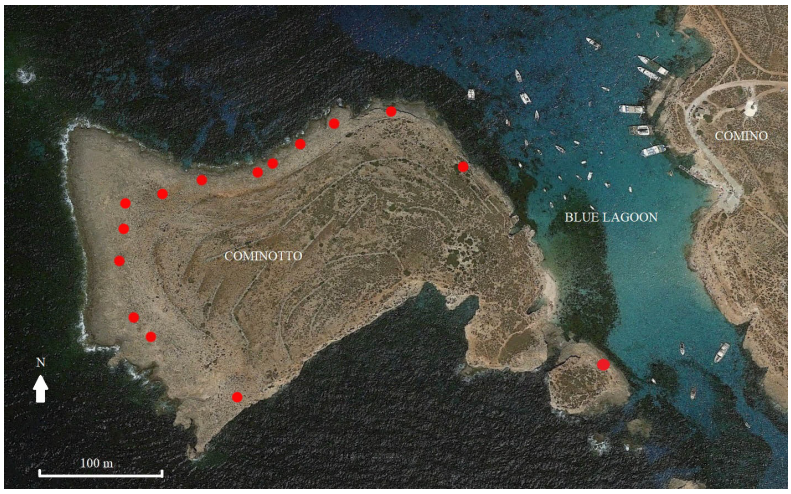

FIGURE 5. Geographical distribution of *Limomium lanfrancoi* (red dot) in Cominotto. From Google Earth (modified).

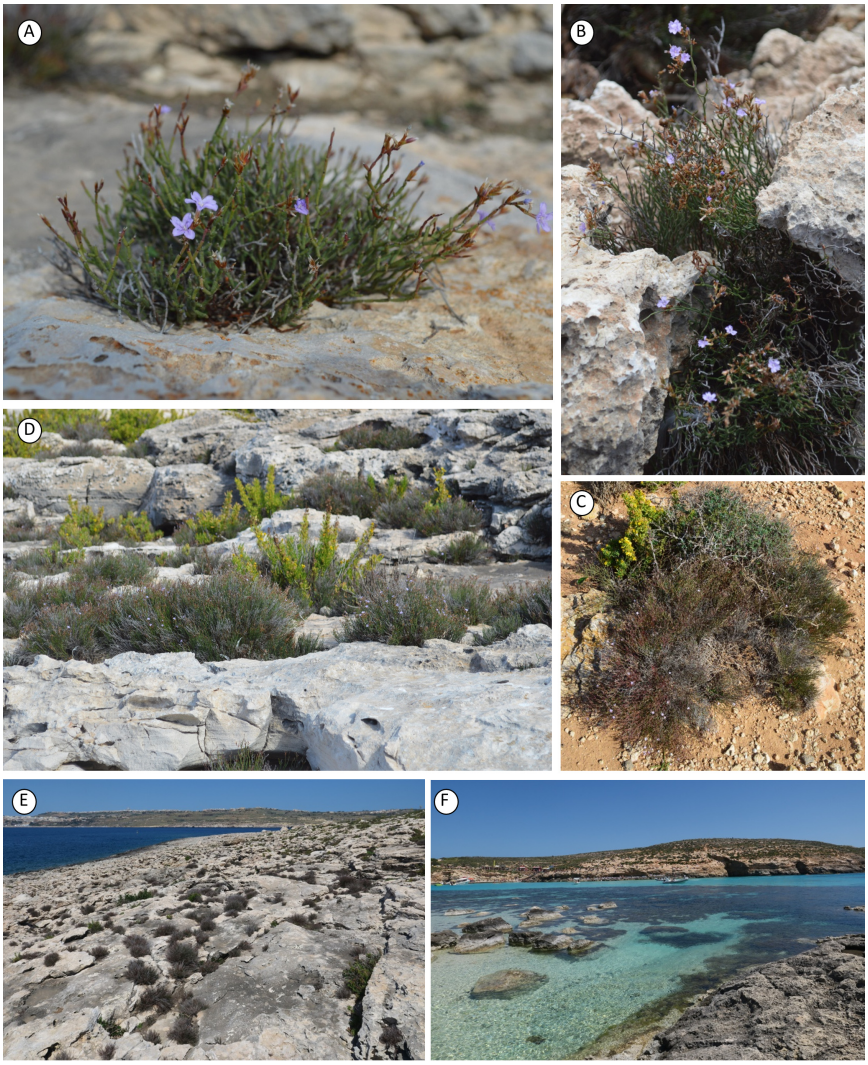

FIGURE 6. Phenological features of *Limonium lanfrancoi* from Cominotto. **A–C.** Individuals in natural habitat. **D–E.** Rocky coast with *L. lanfrancoi*. **F.** Blue Lagoon between Comino and Cominotto. (Photos A–D by M. E. Galea, E–F by S. Cambria).

Plant perennial, glabrous, with caudices dense, branched, 0.5–4 cm long. Leaves green, rigid, laxly inserted on the caudices, oblanceolate, 1-nerved, 10–40 mm long, 3–8 mm wide, flat, rounded or retuse at the apex, usually withered at anthesis. Stem several, rigid, erect, 8–45 cm tall, densely branched from the base, paniculate, with numerous much branched sterile branches. Articles slightly arched, 3–20 (40) mm long, with deepned glands, forming branching angles of 15–45°. Inflorescence paniculate, with fertile branches localized at the top of the stem. Spikes 10–45 (70) mm long, straight to slightly divaricate, with spikelets remotely arranged. Spikelets 7–8 mm long, 3–4 per cm, 2–3 (4) flowered. Outer bract 1.5–2 mm long, ovate-triangular, acute, coriaceous in the central part, forming an apiculum 0.6–0.9 mm long, membranous at margin. Middle bract membranous, rounded, 1.5–2.2 mm long. Inner bract (4.5)4.8–5(5.5) mm long, 2.3–2.7 mm wide, elliptical, rounded, with outer hyaline margin and pale brown inner margin, central part herbaceous, with an apiculum 1–1.4 mm long, not reaching the apex. Calyx 5–6 mm long, sparsely hairy in the tube, 2.5–3 mm protruding from the inner bract, with tube 1.5–1.8 mm long and limb 3.5–4 mm long, with midribs ending in the middle of the lobes, which are semi-elliptical, 0.5–0.7 mm long.

Etymology:—The epithet refers to "Melita", Latin name of Malta.

Phenology:—*Limonium melitense* flowers from June to October and produces seeds from August to November.

Distribution and ecology:—Similarly to *Limonium zeraphae* and *L. lanfrancoi*, also *L. melitense* is a species exclusive of the Maltese Archipelago, where it occurs in all the islands, mainly in the rocky coast (Fig. 7). It is a chamaephyte, showing an erect and densely branched habit and can be considered an edaphic vicariant of *L. zeraphae*, localizing mainly on *Globigerina* limestones and marly limestones. Sometimes, it occurs also on compact limestones, but limitedly to shade stands, showing clearly more mesic requirements than the previous species. The plant community physiognomically characterized by this species was described by Brullo *et al.* (2020) as *Limonietum melitensis*, association always belonging to *Crucianellion rupestris*. In fact, the species of this alliance are here well represented, such as *Crucianella rupestris, Cichorium spinosum* and *Daucus rupestris.* As concerns the distribution of this association, it is widespread mainly in the northern and north-west coasts of Malta, as well as in Gozo and Comino.

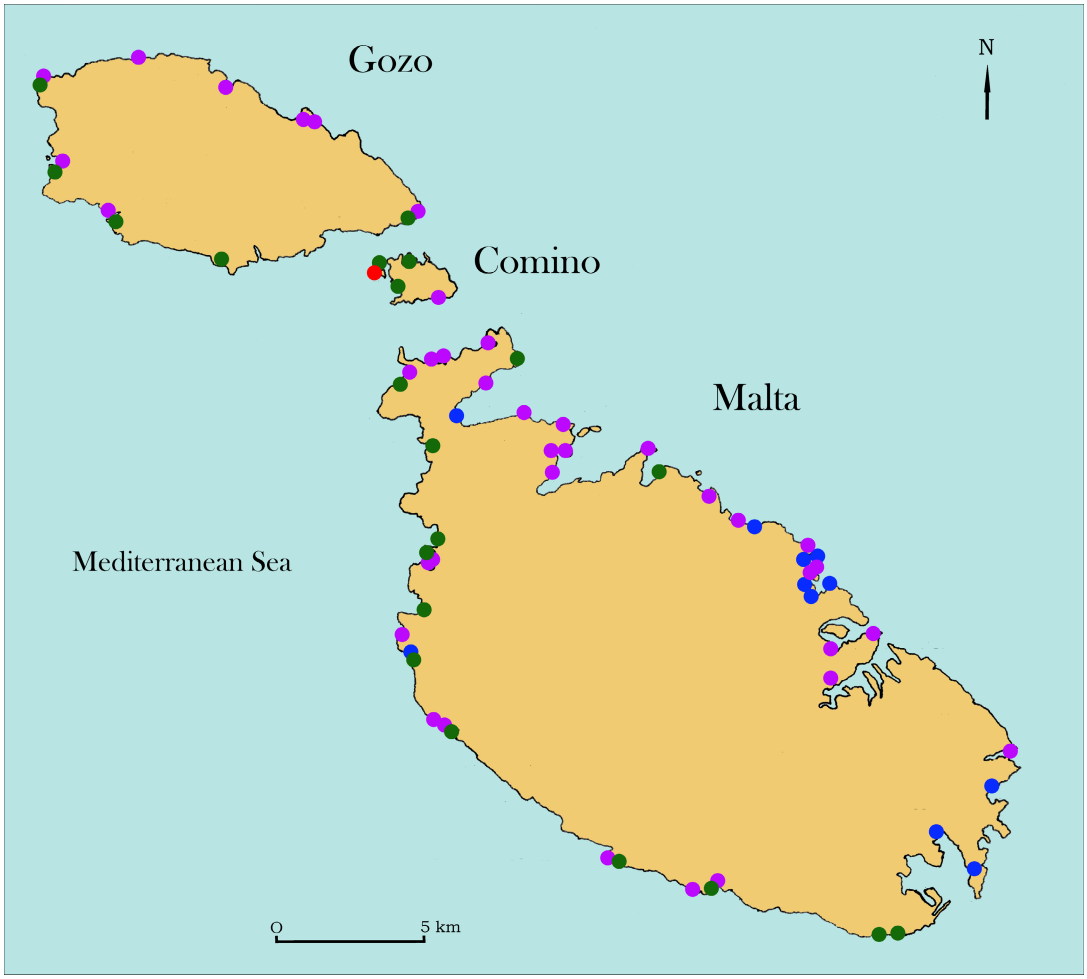

FIGURE 7. Distribution of *Limonium* species in the Maltese Archipelago. Green dots: *Limonium melitense*; blue dots: *Limonium virgatum*; purple dots: *Limonium zeraphae*; red dot: *Limonium lanfrancoi.* It is based only on examined specimens listed in the paper.

Conservation status:—As already highlighted for *Limonium zeraphae*, *L. melitensis* has also undergone a drastic reduction of its range due to the anthropic impact on the coasts. Therefore, the progressive and constant regression of its populations with a much lower number of individuals than in the past, *L. melitensis* should be classified, according to IUCN protocol (IUCN 2023), as "vulnerable" VU A2.

Specimens examined:—MALTA. **Malta**: Paradise Bay, 22 September 1985, *S. Brullo s.n.* (CAT 012577!); Ghar Lapsi, 24 September 1985, *S. Brullo s.n.* (CAT 012578!); Roum Tal Vi Gasu, 14 April 1984, *S. Brullo & P. Pavone s.n.* (CAT 012573!); Ghar Hasan, 24 September 1985, *S. Brullo s.n.* (CAT 012580!); Wadi Babu, 27 Juni 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012559!); Wadi Babu, 24 September 1985, *S. Brullo s.n.* (CAT 012581!); Ghajn Tuffieha, 27 October 1984, *E. Lanfranco 2717* (CAT 012586!); Il-Karraba, peninsula between Ghain Tuffieha Bay and Gnejna Bay (W-NW of Mgarr). Growing in soil among limestone boulders, 26 October 1974, L. Y. T. Westra & J. v. Rooden 243 (U1495365!); Mtahleb, 12 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012566!); Mtahleb, 24 September 1985, *S. Brullo s.n.* (CAT 012575!); Imtaleb, su terreno argilloso, 21 December 1985, *E. Lanfranco 7218* (CAT 012570!); Ta Xilep, 13 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012565!); Wied Migra Fecna (Mtahleb), 12 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012567!); Salina Bay, 26 November 1985, *S. Brullo s.n.* (CAT 012569!); Ras el Qarraba, terreno argilloso roccioso, 27 October 1984, *E. Lanfranco 7215* (CAT 012571!); Wied Znuber, rupi maritime, 27 October 1984, *E. Lanfranco 2578.2* (CAT 012560!); Ghar Hassan, rupi maritime, 27 August 1982, *E. Lanfranco 7068* (CAT 012581!); Gneja Bay, 12 April 1984, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012574!); Anchor Bay, 28 September 1985, *S. Brullo s.n.* (CAT 012564!); Bahrija Valley, 12 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012557!); **Gozo**: Cala Dweira, 25 September 1985, *S. Brullo s.n.* (CAT 012582!); Quara, June 1973, *S. Brullo s.n.* (CAT 012583!); Xlendi, June1973, *S. Brullo s.n.* (CAT 012584!); Xlendi, 29 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012562!); Ta Cenc, 28 June 1973, *S. Brullo & G. Ronsisvalle s.n.* (CAT 012556!); Ta Cenc, 29 June 1973, *S. Brullo & G.Ronsisvalle s.n.* (CAT 012558!); Ta Cenc, 25 September 1985, *S. Brullo s.n.* (CAT 012585!); Dimitri Point, 25 September 1985, *S. Brullo s.n.* (CAT 012586!); **Comino**: Comino, 25 September 1985, *S. Brullo s.n.* (CAT 012572!); Comino, near Santa Marjia Bay, 19 April 2023, *D. Agius & S. Cambria s.n.* (CAT!). **Cominotto**: Cominotto eastern coast, 19 April 2023, *D. Agius & S. Cambria s.n.* (CAT!);

Key to the species of *Limonium* genus occurring in Malta

1. Stem prostrate to ascending with branches markedly arcuate to reflexed, forming branching angles 90–160°, spikes with 2–3 spikelets per cm, calyx lobes 1–1.2 mm long.....*L. zeraphae*
- Stem usually erect with branches slightly arcuate, forming branching angles 15–45°, spikes with 3–6 spikelets per cm, calyx lobes 0.6–0.9 mm long..... 2
2. Stem up to 12 cm long, spikelet 5–6 mm long, outer bract 1–1.4 mm long with apiculum 0.5–0.6 mm long, inner bract 3.8–4.3 mm long, calyx 4.5–5 mm long with lobes triangular-ovate.....*L. lanfrancoi*
- Stem up to 45 cm long, spikelet 6–8 mm long, outer bract 1.5–2.5 mm long with apiculum 0.6–0.9 mm long, inner bract 4.8–5.5 mm long, calyx 5–6 mm long with lobes semi elliptical.....3
3. Leaves withered at anthesis, spikelet straight, 7–8 mm long, 3–4 per cm, calyx 2.5–3 mm exserted from inner bract, with tube 1.5–1.8 mm long..... *L. melitense*
- Leaves green at anthesis, spikelet more or less curved, 6–7 mm long, 4–6 per cm, calyx 1.8–2,2 mm exserted from inner bract, with tube 2.5–3 mm long..... *L. virgatum*

Acknowledgements

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