

The Caryophyllaceae of the Arabian Peninsula: a Checklist and Key to Taxa (Studies in the Flora of Arabia XII)

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ABSTRACT. A checklist and field key (with illustrations) to the genera and species of Caryophyllaceae (including Illecebraceae) recorded from the Arabian peninsula and Socotra is presented. The checklist includes a selective synonymy and distribution by country and the keys include brief subfamily and generic descriptions.

This paper follows a similar pattern to the recently published checklist and key to the Cruciferae (Hedge & King 1983) and is intended as a field guide to the Caryophyllaceae (including Illecebraceae) of the Arabian peninsula which in this context covers Saudi Arabia, Yemen Arab Republic, People's Democratic Republic of Yemen, Socotra, Oman, United Arab Emirates, Qatar, Bahrein and Kuwait. It is hoped that the information presented here will not only aid identification in the field but also provide a stimulus for further collection and lead to a better understanding of the family within our area and elsewhere.

In 1939 O. Schwartz recorded 18 genera and 33 species of Caryophyllaceae (including Illecebraceae) from the area of the Arabian peninsula south of the Tropic of Cancer and in 1978 A.M. Migahid noted 26 genera and 60 species from Saudi Arabia alone. Here we record 31 genera and 83 species from the whole peninsula (including Socotra) and, while a direct comparison of figures cannot be made because of the different areas covered, it is clear that there is an overall increase in the taxa now known from Arabia. Despite the additional records, largely a result of recent collections, these totals are relatively small for such a huge area. The low representation is not unexpected as the main centre of distribution of the family is in the Mediterranean and Irano-Turanian regions with few taxa in the tropical zones. However, all three subfamilies of the Caryophyllaceae

are represented in our area, the Paronychioideae by 19 genera, the Alsinoideae by 5 genera and the Dianthoideae by 7 genera. Included in the Paronychioideae are the three endemic genera: *Haya*, *Lochia* and *Xerotia*. These genera (and other endemic species) are confined to the extreme south of the peninsula and Socotra, a pattern of generic endemism that is reflected in a number of other families in our area.

Checklist of species

This checklist is necessarily provisional as species and distributions recorded here are drawn from literature as well as herbarium specimens (mainly collections held at Edinburgh, British Museum and Kew). The literature includes basic references (Appendix I) and the specialist literature listed on the general references. For further notes concerning the compilation of data see Hedge and King (1983).

Abbreviations

SA	= Saudi Arabia	SOC	= Socotra
NY	= North Yemen (Yemen Arab Republic)	O	= Oman (including Dhofar)
SY	= South Yemen (People's Democratic Republic of Yemen)	UAE	= United Arab Emirates
		Q	= Qatar
		B	= Bahrein
		K	= Kuwait

Endemic refers to a taxon known only from the area under discussion.

*Doubtful records

* <i>Ankyropetalum gypsophiloides</i> Fenzl	K
<i>Arenaria</i> * <i>deflexa</i> Dcne (syn. <i>A. graveolens</i> auctt.)	SA
<i>leptoclados</i> (Reichb.) Guss.	SA, SOC, O
<i>serpyllifolia</i> L.	SA, NY, SY, SOC?
<i>Cerastium dichotomum</i> L.	SA
<i>octandrum</i> Hochst. ex Rich.	NY
<i>Cometes abyssinica</i> R.Br. (incl. subsp. <i>suffruticosa</i> Wagn. & Vierh.)	SA, NY, SY, SOC, O
<i>surattensis</i> L.	SA, O, UAE
<i>Dianthus</i> cf. <i>crinitus</i> Sm.	SA?, O, UAE
<i>cyri</i> Fisch. & Mey.	O
<i>deserti</i> Kotschy	SA, NY, SY
<i>judaicus</i> Boiss.	SA
<i>longiglumis</i> Del.	NY
<i>sinaicus</i> Boiss.	SA
<i>strictus</i> Banks & Sol.	SA

<i>uniflorus</i> Forssk.	SA, NY
<i>zonatus</i> Fenzl	SA
<i>caryophyllus</i> L. (cultivated in NY)	
<i>Gymnocarpos decandrum</i> Forssk. (syn. <i>Paronychia decandra</i> (Forssk.) Rohweder & Urmi-König)	SA, O, UAE
<i>Gypsophila antari</i> Post & Beauv.	SA, K
<i>arabica</i> Barkoudah	SA
<i>bellidifolia</i> Boiss. (syn. <i>Saponaria barbata</i> Barkoudah)	O, UAE
<i>capillaris</i> (Forssk.) Christ.	K
<i>heteropoda</i> Freyn & Sint. subsp. <i>heteropoda</i>	K
<i>montana</i> Balf. f. (incl. var. <i>viscida</i> Balf. f., syn. <i>G. somalensis</i> Franchet)	SY, SOC, O
<i>pilosa</i> Huds. (syn. <i>G. porrigens</i> (L.) Boiss.)	K
<i>viscosa</i> Murr.	SA
<i>Haya obovata</i> Balf. f. [ENDEMIC GENUS]	SOC
<i>Herniaria hemistemon</i> J. Gay	SA, UAE, Q, B, K
<i>hirsuta</i> L. (syn. <i>H. cinerea</i> DC.)	SA, Q, B, K
<i>mascatensis</i> Bornm. [ENDEMIC]	O
<i>Holosteum umbellatum</i> L.	SA
<i>Lochia bracteata</i> Balf. f. (syn. <i>L. bracteata</i> Balf. f. subsp. <i>abdulkuriana</i> Chaudhri, <i>L. kuriensis</i> A.R. Smith) [ENDEMIC GENUS]	SOC, O
<i>Loeflingia hispanica</i> L.	SA, B, K
<i>Minuartia filifolia</i> (Forssk.) Mattf.	SA, NY
<i>hybrida</i> (Vill.) Schischk.	SA, O
<i>picta</i> (Sibth. & Sm.) Bornm.	SA
<i>Paronychia arabica</i> (L.) DC.	SA, O, UAE, Q, B, K
<i>chlorothyrsa</i> Murb.	SA, NY
<i>sinaica</i> Fresen.	SA
<i>Pollichia campestris</i> Sol.	NY
<i>Polycarpaea balfourii</i> Briq. (= <i>P. divaricata</i> Balf. f. (1882) non (Sol.) Poir. ex Steud.)	SOC
<i>caespitosa</i> Balf. f. (syn. <i>P. kuriensis</i> Wagner) [ENDEMIC]	SOC
<i>corymbosa</i> Lam.	SA, NY, SY, SOC
<i>paulayana</i> Wagner [ENDEMIC]	SOC
<i>repens</i> (Forssk.) Aschers. & Schweinf.	SA, NY, SY, O, UAE, Q, B, K
<i>spicata</i> Wight & Arn.	SA, NY, SY, SOC, O, UAE, Q, B
<i>Polycarpon *succulentum</i> (Del.) J. Gay	SA
<i>tetraphyllum</i> (L.) L.	SA, NY, O, Q, K

- Pteranthus dichotomus* Forssk. SA, K.
Robbireia delileana Milne-Redhead (syn.
Polycarpaea prostrata (Forssk.) Dcne,
P. robbireia (Kuntze) Greuter & Burdet) SA, NY, O, UAE, Q, K
Saponaria (barbata Barkoudah = *Gypsophila*
bellidifolia)
(montana (Balf. f.) Barkoudah
= *Gypsophila montana*)
umbricola J.R.I. Wood SA, NY
Scleranthus annuus L. SA
Sclerocephalus arabicus Boiss. SA, O, UAE, Q, B, K
Silene apetala Willd. SA, NY, SOC, O
arabica Boiss. (syn. *S. affinis* Boiss.) SA, Q, K
burchellii Otth. (syn. *S. schweinfurthii*
Rohrb., *S. chirensis* A. Rich.) SA, NY
colorata Poir. (syn. *S. oliveriana* Otth.) SA, NY?, K?
conica L. K
conoidea L. SA, O, K
flamulifolia Steud. ex Rich. NY
gallica L. SA, NY
linearis Dcne (syn. *S. salsa* Boiss.) SA, O, UAE, K
macrosolen Steud. ex Rich. SA, NY
**schimperana* Boiss. SA, NY
succulenta Forssk. SA
villosa Forssk. SA, O, UAE, Q, B, K
vulgaris (Moench) Garck. (syn.
S. cucubalus Wib.) SA
yemensis Defl. pro parte (syn.
S. engleri Pax) SA, NY
sp. A aff. *burchellii* (= *S. yemensis* Defl.
pro parte) SA, NY
sp. B SA
Spergula fallax (Lowe) Krause (syn.
S. flaccida (Roxb.) Aschers.) SA, NY, O, UAE, B, Q, K
Spergularia bocconii (Scheele) Aschers.
& Graebn. O, Q
diandra (Guss.) Heldr. & Sart. SA, O, UAE, Q, B, K
marina (L.) Griseb. SA, NY, UAE, B
**rubra* (L.) J. & C. Presl NY
Sphaerocoma aucheri Boiss. O, UAE, B
hookeri T. Anders. SA, SY
Stellaria media (L.) Vill. SA, NY, O, Q
pallida (Dumort.) Piré NY

<i>Telephium sphaerospermum</i> Boiss.	SA, NY, O
<i>Vaccaria hispanica</i> (Miller) Rauschert (syn. <i>V. pyramidata</i> Medik.)	SA, NY, Q, K
<i>Velezia rigida</i> L. s.1.	SA
<i>Xerotia arabica</i> Oliver [ENDEMIC GENUS] <i>sp.</i>	SY O

Diagnostic Characters of the Family

The Caryophyllaceae are herbs, often becoming woody at the base, or subshrubs. The leaves are simple, entire and opposite, rarely alternate (*Telephium*), and may be fascicled or apparently whorled; when stipules are present they are scarious and often silvery in colour. The flowers are usually in terminal or axillary cymes or solitary. The floral parts are almost always in 5's or multiples of 5 and a distinct perigynous zone may be present. The sepals are free or fused. The petals are free; if they are absent, staminodes resembling linear petals are usually present. The ovary is superior and has free-central placentation.

The family is easily recognised and should not be confused with other taxa in our area with the possible exception of one member of the Aizoaceae, *Mollugo cerviana* (L.) Ser., a small annual plant that may be distinguished by the completely 3-locular ovary and axile placentation.

Field Key to Genera

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|---|-----------------------|
| 1. Leaves alternate | 1. <i>Telephium</i> |
| + Leaves opposite (sometimes in fascicles or appearing whorled | 2 |
| 2. Fruit one-seeded, indehiscent (rarely dehiscent) | 3 |
| + Fruit a many-seeded capsule, dehiscing by valves or teeth | 14 |
| 3. Subshrubs, with woody branches | 4 |
| + Herbs, not woody except rarely at base | 8 |
| 4. Inflorescences with dendroid bract-like structures c. 10 mm long and very conspicuous in fruit | 2. <i>Cometes</i> |
| + Inflorescences without dendroid bract-like structures | 5 |
| 5. Stipules scarious, conspicuous, more than 2 mm long; fruits borne on prominent red fleshy peduncles; leaves flat | 3. <i>Pollichia</i> |
| + Stipules scarious inconspicuous, less than 2 mm long; fruits not as above; leaves terete | 6 |
| 6. Calyx lobes linear-oblong more than 3 mm long | 4. <i>Gymnocarpus</i> |
| + Calyx lobes lanceolate to ovate-lanceolate, less than 2.5 mm long | 7 |
| 7. Bracts brown-scarious, broadly ovate, 3-4 mm broad, not mucronate; leaves mucronate [SOC, O (Dhofar)] | 5. <i>Lochia</i> |

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|---|--------------------------|
| + Bracts ± green, with white scarious margins, ovate, c. 1.5 mm broad, mucronate-aristate; leaves not mucronate | 6. <i>Sphaerocoma</i> |
| 8. Bracts silvery-white, completely scarious, conspicuous | 7. <i>Paronychia</i> |
| + Bracts green or brown, sometimes with narrow scarious margins, not conspicuous | 9 |
| 9. Leaves linear | 10 |
| + Leaves elliptic to broadly obovate | 12 |
| 10. Inflorescences borne on broad, flattened peduncles (c. 5 mm broad); flowers 4-merous | 8. <i>Pteranthus</i> |
| + Inflorescences borne on terete peduncles (c. 1 mm broad); flowers 5-merous | 11 |
| 11. Inflorescence at fruiting stage a spherical, hard spinose head; stipules distinct, lanceolate | 9. <i>Sclerocephalus</i> |
| + Inflorescence at fruiting stage not as above; stipules indistinct, connate to leaf margins | 10. <i>Scleranthus</i> |
| 12. Leaves less than 8 mm long, suborbicular to elliptic, densely covered with stiff hairs; plant prostrate | 11. <i>Herniaria</i> |
| + Leaves more than 10 mm long, obovate to broadly obovate, glabrous; plant ascending to erect | 13 |
| 13. Inflorescences pedunculate with dendroid bract-like structures up to 10 mm long and conspicuous in fruit | 2. <i>Cometes</i> |
| + Inflorescences sessile, without dendroid bract-like structures [SOC] | 12. <i>Haya</i> |
| 14. Leaves with stipules | 15 |
| + Leaves without stipules | 21 |
| 15. Sepals with lateral lobes | 13. <i>Loeflingia</i> |
| + Sepals without lateral lobes | 16 |
| 16. Styles free to base | 17 |
| + Styles united, at least at base | 18 |
| 17. Stipules free; calyx glabrous | 14. <i>Spergula</i> |
| + Stipules connate; calyx glandular hairy | 15. <i>Spergularia</i> |
| 18. Petals clawed (narrowing abruptly at base) | 16. <i>Robbairia</i> |
| + Petals not clawed (narrowing gradually at base) | 19 |
| 19. Subshrub; sepals unequal, 2 outer larger than 3 inner [SY, O] | 17. <i>Xerotia</i> |
| + Annuals or perennials, rarely with a woody rootstock; sepals equal | 20 |
| 20. Sepals keeled, hooded; leaves not mucronate | 18. <i>Polycarpon</i> |
| + Sepals not keeled or hooded; leaves mucronate | 19. <i>Polycarpaea</i> |
| 21. Sepals free to the base | 22 |
| + Sepals fused for at least one third of their length | 26 |
| 22. Leaves filiform, 0.5 mm broad or less; capsule dehiscing by 3 valves | 20. <i>Minuartia</i> |

- + Leaves oblong to suborbicular, 1 mm or more broad; capsule dehiscent by 4 or more teeth or valves 23
- 23. Inflorescence umbellate 21. *Holosteum*
- + Inflorescence not umbellate 24
- 24. Petals entire or emarginate 22. *Arenaria*
- + Petals bifid 25
- 25. Lower leaves sessile, linear oblong; plant \pm densely covered with glandular hairs; capsule dehiscent by 8 or more teeth . 23. *Cerastium*
- + Lower leaves petiolate, ovate; plant lacking glandular hairs; capsule dehiscent by 6 valves 24. *Stellaria*
- 26. Calyx with commissural veins alternating with the midveins of the sepals; styles 3 25. *Silene*
- + Calyx without commissural veins; styles 2 27
- 27. Calyx with membranous hyaline or scarious intervals . . 28
- + Calyx without membranous hyaline or scarious intervals . 29
- 28. Calyx 10 mm or more long, inflated below and with 5 prominent veins forming wings 26. *Vaccaria*
- + Calyx less than 7 mm long, not inflated below and lacking prominent veins 27. *Gypsophila*
28. *Saponaria*
- 29. Calyx up to 1 mm wide without epicalyx of bracteoles; plant with rigid dichotomously branched stems 29. *Velezia*
- + Calyx more than 2 mm wide with epicalyx of bracteoles enclosing base; plant not branching as above 30. *Dianthus*

Genus Excluded from Key

Ankyropetalum Fenzl

Similar to *Gypsophila* from which it differs in having strongly 3-lobed petals and irregular capsule dehiscence. *A. gypsophiloides* Fenzl is doubtfully recorded from Kuwait in a Kew determination list of 1934.

Brief Description of Subfamilies and Genera with Keys to Species

All descriptions apply to the taxa in our area.

SUBFAMILY PARONYCHIOIDEAE (GENERA 1-19)

Stipules usually present; perigynous zone distinct; petals present or if absent then linear staminodes present; styles 2, 3 or 5 usually fused, rarely free; fruit a many-seeded dehiscent capsule or 1-seeded and indehiscent.

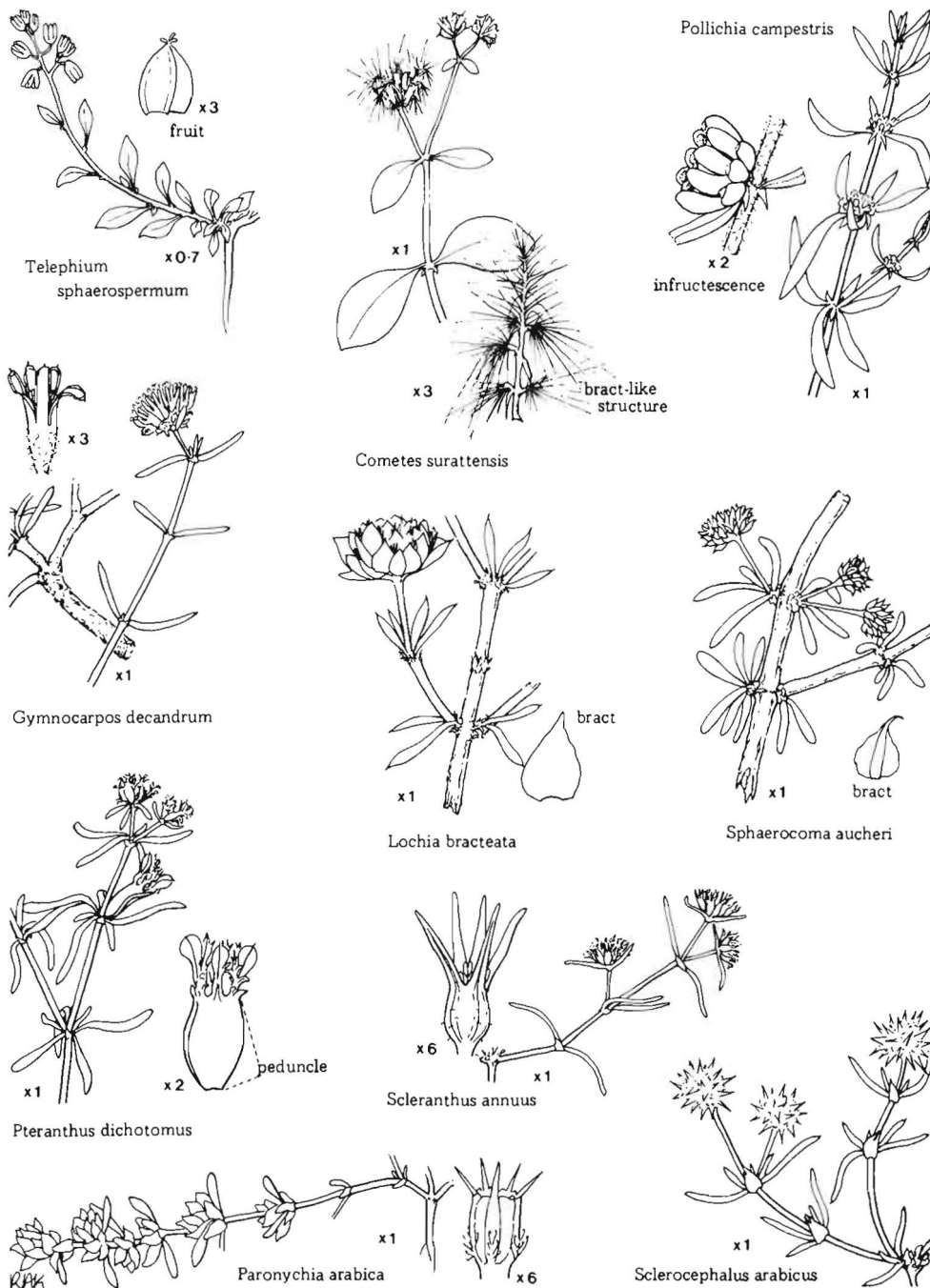


Fig. 1. Inflorescences and flowers (unless otherwise indicated) of selected species.

1. *Telephium* L.

Annual herbs, procumbent, glabrous; leaves alternate, lanceolate, 4-15 mm long; stipules c. 0.5 mm long; inflorescence terminal, lax; sepals c. 3-4 mm long; petals white, equalling sepals; fruit many-seeded; dehiscent by 3 valves. One species recorded, *T. sphaerospermum* (Fig. 1).

2. *Cometes* L.

Annual or perennial herbs or subshrubs, up to 40 cm, much-branched; leaves linear to broadly obovate, 5-35 mm long; inflorescences terminal or axillary, with distinctive dendroid, bract-like structures, up to 10 mm long and conspicuous in fruit; sepals c. 5 mm long; petals linear, stamens 5; fruit one-seeded, indehiscent.

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|--|-----------------------------------|
| 1. Leaves linear to lanceolate, less than 5 mm broad | <i>C. abyssinica</i> |
| + Leaves obovate to broad-obovate, more than 5 mm broad . | <i>C. surattensis</i>
(Fig. 1) |

3. *Pollichia* Sol.

Subshrub up to 50 cm; leaves appearing whorled, linear to lanceolate, 3.5-15 mm long; stipules c. 3 mm long; inflorescences in leaf axils; sepals reddish brown c. 1.5 mm long; petals white, much shorter than sepals, rarely absent; fruits one-seeded, indehiscent, borne on red fleshy structures composed of the swollen peduncles and bracts. Monotypic: *P. campestris* (Fig. 1).

4. *Gymnocarpos* Forssk.

Subshrub up to 60 cm, stems often whitish; leaves in fascicles on older stems, linear, 4-16 mm long, fleshy, mucronate; sepal lobes linear-oblong c. 4.5 mm long; petals absent; filiform staminodes present, stamens 5; fruit one-seeded, indehiscent. One species recorded, *G. decandrum* (Fig. 1).

5. *Lochia* Balf. f.

Subshrub up to 40 cm; leaves in fascicles on older stems, linear to obovate, 3-13 mm long, fleshy, mucronate; inflorescence capitate; flowers obscured by conspicuous brown scarious bracts; sepals c. 4.5 mm long, lobes lanceolate to ovate-lanceolate; petals absent; filiform staminodes present; stamens 5; fruit one-seeded, indehiscent. Probably monotypic.

Two species have been recorded from our area, *L. bracteata* (Socotra) and *L. kuriensis* (Abd-el-Kuri). However, recent collections from Dhofar, Oman, are somewhat intermediate and we have preferred to include both species under the older name *L. bracteata* (Fig. 1).

6. *Sphaerocoma* T. Anders.

Subshrubs up to 40 cm; leaves in fascicles on older stems, linear, 5-20 mm long, \pm fleshy, not mucronate; inflorescences capitate on peduncles up to 2 cm long; bracts greenish-brown with scarios margins, mucronate-aristate, not obscuring flowers; sepals similar to bracts; petals white, slightly shorter than sepals; stamens 5; fruit one-seeded, indehiscent.

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|---|-------------------------------|
| 1. Leaves 12-20 mm long; sepals of sterile flowers with elongate awns [SA, SY] | <i>S. hookeri</i> |
| + Leaves 4-10 mm long; sepals of sterile flowers without elongate awns [O, UAE] | <i>S. aucheri</i>
(Fig. 1) |

7. *Paronychia* Miller

Annual or perennial herbs, prostrate to procumbent; leaves linear-lanceolate to ovate, 3-15 mm long; stipules ovate to broadly ovate, conspicuous; inflorescence axillary or terminal, conferted, with conspicuous scarios bracts (bracts and stipules usually giving the plant a distinctive silvery-white appearance); petals absent; filiform staminodes present; stamens 5; fruit one-seeded, indehiscent.

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|---|-------------------------------|
| 1. Leaves mucronate; sepals with scarios margins, hooded and awned at apex | <i>P. arabica</i>
(Fig. 1) |
| + Leaves not mucronate; sepals without scarios margins, not hooded or awned at apex | 2 |
| 2. Sepals 4-7 mm long; bracts ovate | <i>P. chlorothyrsa</i> |
| + Sepals 2.5-3.5 mm long; bracts suborbicular | <i>P. sinaica</i> |

8. *Pteranthus* Forssk.

Annual herb, ascending to erect, up to c. 20 cm; leaves linear, 4-25 mm long; stipules inconspicuous; inflorescence of 3 flowers on flattened, \pm obovate peduncles 6-12 \times 4-6 mm; sepals 4 (outer 2 larger than inner); petals absent; stamens 4; fruit one-seeded, indehiscent. Monotypic: *P. dichotomus* (Fig. 1).

9. *Sclerocephalus* Boiss.

Annual herb, procumbent to suberect up to c. 20 cm; leaves linear, 5-15 mm long, slightly fleshy, mucronate; stipules distinct; inflorescence capitate becoming a hard, spherical, spinose head in fruit; petals absent; filiform staminodes present; stamens 5; fruit one-seeded, indehiscent. Monotypic: *S. arabicus* (Fig. 1).

10. *Scleranthus* L.

Annual or short-lived perennial herbs, procumbent to suberect; leaves linear, 4-15 mm long, mucronulate; stipules indistinct, connate to the base of the leaves; inflorescence capitate; sepals 4 mm long; petals absent; filiform staminodes present; stamens 5; fruit one-seeded, indehiscent. One species recorded: *S. annuus* (Fig. 1).

11. *Herniaria* L.

Annual or perennial herbs, prostrate, mat-forming; leaves elliptic to suborbicular, 3-8 mm long; flowers very small, c. 1.5 mm in diameter; petals absent; filiform staminodes present; stamens 4-5; fruit one-seeded, indehiscent.

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|---|----------------------------------|
| 1. Sepals 4, inner pair much shorter than outer pair | <i>H. hemistemon</i>
(Fig. 2) |
| + Sepals 5, all equal | 2 |
| 2. Perennial; leaves suborbicular, distinctly petiolate; indumentum of short (less than 0.5 mm) hairs [O] | <i>H. mascatensis</i> |
| + Annual, leaves lanceolate to oblong, sessile; indumentum of long (0.5 mm) white hairs [SA, Q, B, K] | <i>H. hirsuta</i> |

12. *Haya* Balf. f.

Perennial herbs, procumbent to suberect with glabrous stems up to 20 cm; leaves obovate, apiculate c. 10 mm long, sparsely ciliate on margins but otherwise glabrous; stipules ovate-acuminate c. 4 mm long, brown-scarious; inflorescences conferted in leaf axils; bracts c. 4 mm with brown-scarious margins; sepals similar to bracts; petals shorter than sepals, slightly fleshy at base; fruit 3-sided, one-seeded, dehiscent. Monotypic and endemic to Socotra: *H. obovata* (Fig. 2).

13. *Loeflingia* L.

Annual herbs, procumbent to erect up to 15 cm, diffusely branched; stems glandular-hairy; leaves linear to lanceolate, 4-19 mm long, mucronulate; stipules narrowly lanceolate c. 2 mm long, fused below to leaf bases; inflorescences terminal and axillary, \pm sessile; sepals with distinct scarious lateral lobes; petals white, shorter than sepals; fruit many-seeded, dehiscing by 3 valves. One species recorded, *L. hispanica* (Fig. 2).

14. *Spergula* L.

Annual herbs, ascending to erect, up to c. 30 cm; stems glabrous; leaves linear 10-25 mm long, not mucronate; stipules ovate-triangular, c. 1-2 mm long; inflores-

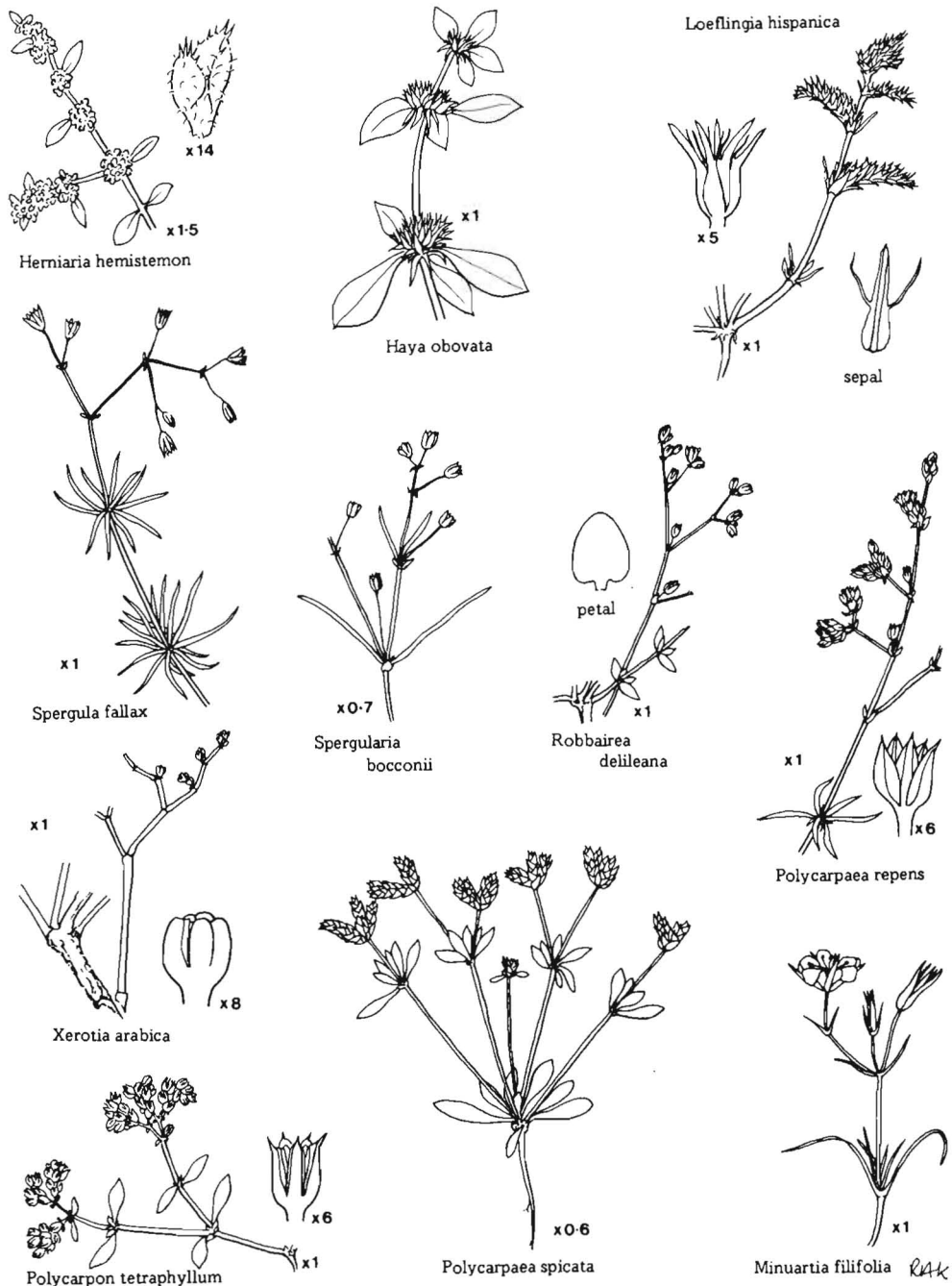


Fig. 2. Inflorescences and flowers (unless otherwise indicated) of selected species

cences terminal, lax, dichasial cymes; bracts similar to stipules but with mid-vein; sepals c. 3-4 mm in fruit, glabrous, scarious-margined; petals white (sometimes tinged pink) slightly shorter than sepals; fruit many-seeded, dehiscent by valves equal in number to styles (3 or 5); seeds winged. One species recorded, *S. fallax* (Fig. 2).

15. *Spergularia* (Pers.) J. & C. Presl

Annual, biennial or rarely perennial herbs, procumbent to erect, up to c. 20 cm; stems glandular-hairy; leaves linear 10-30 mm long, mucronate; stipules c. 1-2 mm long scarious, connate (surrounding node); inflorescences terminal, lax, dichasial cymes; sepals 2-5 mm long, glandular-hairy on outside, scarious-margined; petals pink, rarely white, shorter than or equalling sepals; fruit many-seeded, dehiscent by valves equal in number to styles (3); seeds winged or not.

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|--|--------------------------------|
| 1. Mature seeds light brown, 0.6-0.7 mm long, unwinged or mixed winged and unwinged; capsule usually 4-6 mm long, exceeding sepals; stipules on young shoots connate for about half their length | <i>S. marina</i> |
| + Mature seeds blackish or if light brown, less than 0.5 mm long, unwinged; capsule usually less than 4 mm long, ± equalling sepals; stipules on young shoots connate for much less than half their length | 2 |
| 2. Sepals 2 mm long or less; mature seeds black or brownish-black; capsule subglobose | <i>S. diandra</i> |
| + Sepals more than 2 mm long; mature seeds light grey-brown; capsule ovoid | <i>S. bocconii</i>
(Fig. 2) |

S. rubra is doubtfully recorded from N Yemen. It is a difficult species to identify differing in the lanceolate-acuminate and silvery stipules rather than the broadly triangular, not silvery stipules of the other species.

It is somewhat surprising that the widespread SW Asiatic species, *S. media* (L.) C. Presl has not been found in our area. It is very similar to *S. marina* but distinguished by its larger capsule (7-9 mm) and in having winged seeds only.

16. *Robbairia* Boiss.

Annual, rarely perennial herbs, procumbent to suberect up to c. 25 (-30) cm, glabrous; leaves narrowly oblong to lanceolate, c. 3-14 mm long; stipules triangular-ovate c. 1 mm long; inflorescences terminal, lax, dichasial cymes; sepals c. 2-3 mm long (inner 3 longer than outer 2); petal with an orbicular, cordate limb and a short claw, white to pink, equal to or longer than sepals; stamens 5; fruit many-seeded, dehiscent by 3 valves. One species recorded, *R. delileana* (Fig. 2).

This genus is closely related to *Polycarpon* and *Polycarpaea* and is often reduced to the synonymy of one or the other. It is distinguished solely by the abrupt narrowing of the petal at the base (forming a short claw).

17. *Xerotia* Oliver

Subshrub erect, up to c. 45 cm; leaves obovate to oblong, 4-8 mm long, fleshy; sepals c. 1 mm long, unequal; petals shorter than sepals; stamens 5; fruit many-seeded, dehiscent by 3 valves. Monotypic?: *X. arabica* (Fig. 2).

This genus was only known from the type gathering from the Hadramaut, PDRY, until a recent collection was made by M.D. Gallagher from central Oman (no. 6757/5). The Oman material differs from *X. arabica* in the form of the style and rounder capsule and possibly represents a new taxon; more material is required.

18. *Polycarpon* L.

Annual or perennial herbs, prostrate to suberect up to c. 20 cm; leaves ovate to lanceolate, 2.5-12 mm long; stipules triangular, c. 2 mm long; inflorescences lax; bracts scarious c. 2 mm long; sepals c. 1.5 mm long, keeled, hooded and with scarious margins; petals lanceolate, white, shorter than the sepals; stamens 5; fruit many-seeded, dehiscent by 3 valves.

Two species are recorded, *P. tetraphyllum* (Fig. 2) and *P. succulentum* but it is doubtful whether they are distinct: *P. succulentum* appears to differ only in its more succulent leaves. It is surprising that the widespread *P. prostratum* (Forssk.) Asch. & Schweinf. has not yet been found in our area. It differs from the other species in being distinctly pilose.

19. *Polycarpaea* Lam.

Annual, biennial or perennial herbs, prostrate to erect, up to 40 cm; leaves linear to ovate, spatulate to elliptic, mucronate; stipules triangular to lanceolate, 2-4 mm long; inflorescence terminal or axillary, lax or dense; sepals 2-4 mm long; petals lanceolate, white, equal to or shorter than the sepals; stamens 5; style trifid; fruit many-seeded, dehiscent by 3 valves.

Although six species are recorded from our area only four are keyed out here. Further investigation and material are necessary to clarify the situation in Socotra with respect to *P. paulayana* and *P. balfourii*.

- | | | |
|----|---|---|
| 1. | Lower leaves spatulate to elliptic; plant glabrous | 2 |
| + | Lower leaves narrowly linear; plant hairy at least when young | 3 |

- | | |
|--|-------------------------------|
| 2. Erect annual | <i>P. spicata</i>
(Fig. 2) |
| + Caespitose perennial [endemic to Socotra] | <i>P. caespitosa</i> |
| 3. Sepals green with white scarious margins, hairy; plant procumbent to suberect | <i>P. repens</i>
(Fig. 2) |
| + Sepals completely scarious, silvery-white (often with pink or brown markings), glabrous; plant erect | <i>P. corymbosa</i> |

SUBFAMILY ALSINOIDEAE (GENERA 20-24)

Stipules absent; sepals free; petals present (rarely absent); styles 3-5 free; fruit a many-seeded dehiscent capsule.

20. *Minuartia* L.

Annual or perennial herbs, prostrate to suberect up to 2.5 cm; leaves linear-filiform to linear-lanceolate up to 25 mm long; inflorescences terminal, lax, dichasial cymes; sepals ovate to lanceolate, acuminate, up to 6 mm long; petals white or rarely pink; stamens usually 10; fruit dehiscent by 3 valves.

- | | |
|---|---------------------------------|
| 1. Woody-based perennial, caespitose (often mat-forming) . | <i>M. filifolia</i>
(Fig. 2) |
| + Slender annual herbs, \pm erect | 2 |
| 2. Petals clearly longer than the sepals, pink (rarely white); sepals ovate with obtuse apex | <i>M. picta</i> |
| + Petals shorter than or subequal to sepals, white; sepals narrowly lanceolate, apex narrowly acute | <i>M. hybrida</i> |

21. *Holosteum* L.

Annual herb, \pm erect up to 30 cm, glandular-hairy; leaves linear-oblong to lanceolate c. 10-25 \times 5-8 mm; inflorescence umbellate, terminal, 5-12-flowered, (flowers on pedicels up to 25 mm, soon deflexing at base); sepals 4-6 mm long; petals white or pale pink; stamens 5 or 10; styles 3; fruit dehiscent by 6 teeth. One species recorded, *H. umbellatum* (Fig. 3).

22. *Arenaria* L.

Annual herbs, procumbent to suberect up to c. 20 cm; leaves lanceolate-ovate to suborbicular up to 11 mm long (including petiole where appropriate); inflorescences terminal, lax cymes; sepals narrowly lanceolate, c. 4 mm long; petals white; stamens usually 10; styles 3; fruit dehiscent by 6 valves.

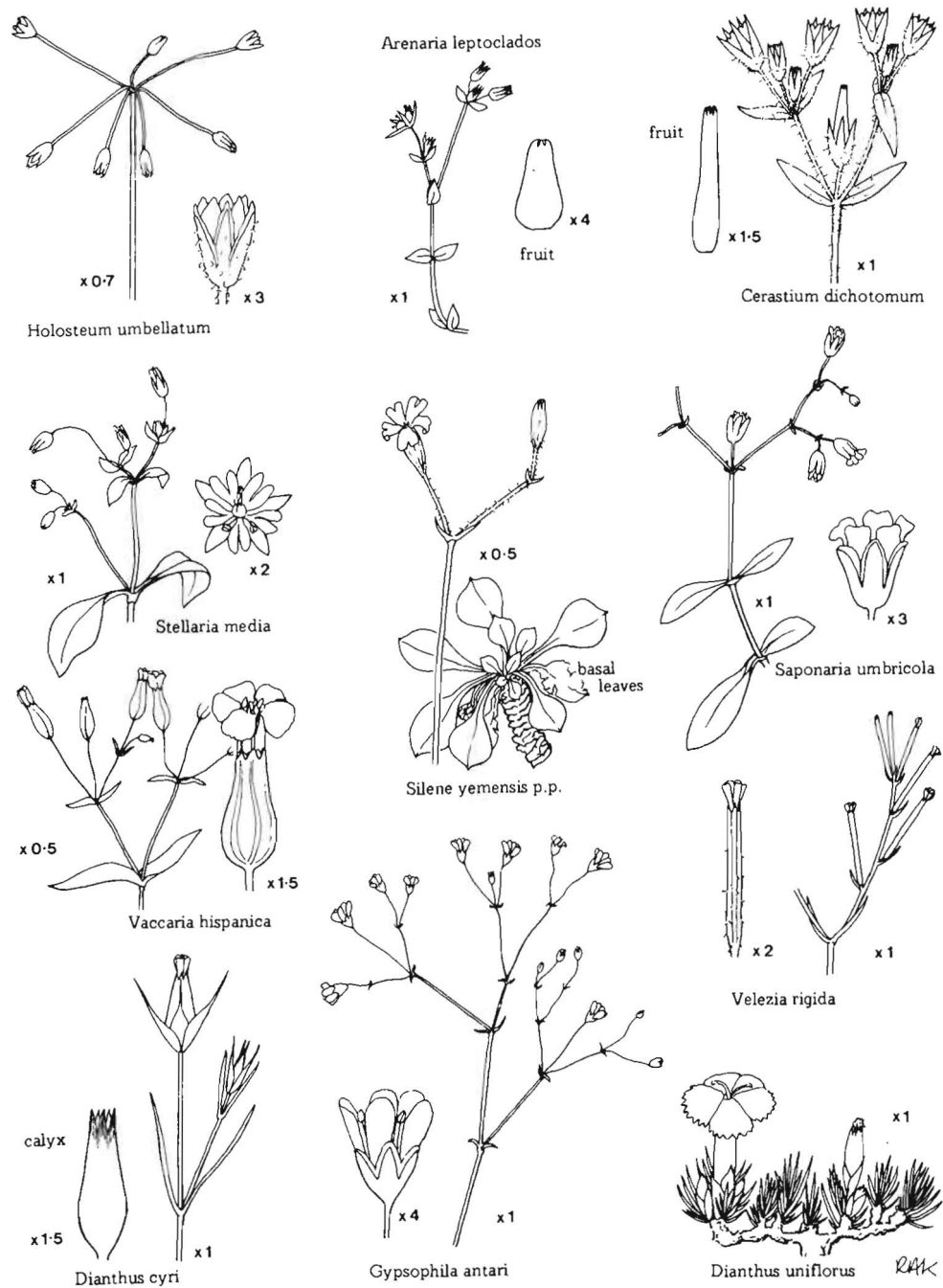


Fig. 3. Inflorescences and flowers (unless otherwise indicated) of selected species.

Two of the recorded species (distributions are mainly based on literature records) are very difficult to separate: *A. leptoclados* (Fig. 3) and *A. serpyllifolia* (see McNeill 1967). It would appear best to treat them as a species aggregate until more Arabian material is available. As yet, no specimens of the doubtfully recorded *A. deflexa* have been seen by us from our area; this species is readily distinguished from the others by the petals clearly exceeding the sepals.

23. *Cerastium* L.

Annual herbs, erect, up to 40 cm, often densely pilose, glandular; leaves linear-oblong to lanceolate, 3-25 × 1-10 mm; inflorescences terminal cymes; bracts foliaceous; sepals c. 6-8 mm long; petals white, bifid at apex, rarely absent; stamens 8-10; fruit dehiscent by twice as many teeth as styles (styles 4 or 5), clearly exerted from calyx.

- | | |
|---------------------------------------|----------------------------------|
| 1. Styles 5; sepals 7-11 mm | <i>C. dichotomum</i>
(Fig. 3) |
| + Styles 4; sepals 4-7 mm | <i>C. octandrum</i> |

24. *Stellaria* L.

Annual or short-lived perennial herbs, sprawling to suberect, up to c. 10 cm; internodes with a distinct longitudinal row of hairs; leaves ovate to elliptic-ovate c. 20 mm long, lower leaves petiolate; inflorescences terminal or axillary, lax cymes; sepals c. 3-5 mm long; petals white, deeply bifid at apex, sometimes very small or absent; stamens 1-10; fruit dehiscent by 6 valves.

- | | |
|---|-------------------|
| 1. Sepals usually less than 3 mm; petals absent (or minute) | <i>S. pallida</i> |
| + Sepals usually more than 3 mm; petals present (rarely minute or absent) | <i>S. media</i> |

SUBFAMILY DIANTHOIDEAE (GENERA 25-29)

Stipules absent; sepals fused for at least one third of their length, petals usually differentiated into claw and limb, often with coronal scales; styles 2, 3 or 5, free; fruit a many-seeded dehiscent capsule.

25. *Silene* L.

Annual, biennial or perennial herbs, often suffrutescent, up to c. 50 cm; leaves linear to lanceolate, spatulate or elliptic; inflorescences cymose, rarely flowers solitary; sepals fused into a 5-toothed ± cylindrical calyx tube; petals (rarely absent) with a distinct limb and claw, coronal scales usually present; stamens usually 10; styles 3; fruit with a carpophore, dehiscent by twice as many valves or teeth as styles.

- | | | |
|--|----|--|
| 1. Calyx with 15-30 nerves | 2 | |
| + Calyx with 10 nerves | 4 | |
| 2. Perennial; calyx with 15-20 indistinct nerves, inflated, especially in fruit | | <i>S. vulgaris</i> |
| + Annual; calyx with 25-30 distinct nerves, not inflated although enlarging in fruit | 3 | |
| 3. Calyx 20 mm or more long; capsule 15 mm or more long with a long narrow neck | | <i>S. conoidea</i> |
| + Calyx 18 mm or less long; capsule 10 mm or less with a short neck | | <i>S. conica</i> |
| 4. Petal limb entire or slightly emarginate | | <i>S. gallica</i> |
| + Petal limb bifid, sometimes nearly to base | 5 | |
| 5. Carpophore more than 25 mm long; calyx completely glabrous (including teeth margins) | | <i>S. macrosolen</i> |
| + Carpophore less than 25 mm long; calyx hairy at least on margins of teeth | 6 | |
| 6. Flower 30 mm long or more | 7 | |
| + Flower less than 30 mm long | 8 | |
| 7. Leaves obovate to narrow-obovate, 6 mm or more broad, succulent; plant of coastal areas | | <i>S. succulentum</i> |
| + Leaves linear to linear-lanceolate, less than 6 mm broad, not succulent; plant mostly of inland sand areas | | <i>S. villosa</i> |
| 8. Pedicels with some stalked glands | 9 | |
| + Pedicels without stalked glands | 11 | |
| 9. Annual, \pm densely covered with stalked glands | | <i>S. arabica</i> |
| + Perennial, with stalked glands on calyces and pedicels only | 10 | |
| 10. Basal leaves narrowly lanceolate, 3.5 mm wide or less, confluent but not forming rosette | | <i>S. flammulifolia</i> |
| + Basal leaves spatulate (4-)5 mm wide or more, forming rosette | | <i>S. yemensis p.p.</i>
(Fig. 3) |
| 11. Annual | 12 | |
| + Perennial | 15 | |
| 12. Carpophore 3 mm long or less | | <i>S. apetala</i> |
| + Carpophore 4 mm long or more | 13 | |
| 13. Inflorescence dichasial; carpophore glabrous | | <i>S. linearis</i> |
| + Inflorescence monochasial; carpophore pubescent | 14 | |
| 14. Leaves glabrous except for margin and midvein; stems erect | | <i>S. sp. B</i> |
| + Leaves hairy; stems decumbent to suberect | | <i>S. colorata</i> |
| 15. Leaves linear to lanceolate; roots tuberous | | <i>S. burchellii</i> |
| + Leaves broadly lanceolate to elliptic; roots not tuberous | | <i>S. sp. A. aff.</i>
<i>burchellii</i> |

Although *S. burchellii* has been keyed out here there is considerable doubt that this species, described from the Cape region of southern Africa, occurs *sensu stricto* in Arabia. The name has been generally applied from southern Africa to Ethiopia and SW Arabia by various authors. The complex requires thorough investigation throughout Africa before a definitive name can be used in our area.

26. *Vaccaria* Medik.

Annual herb, erect up to 90 cm, glaucous; leaves oblong to lanceolate, 30-60 mm long, cordate, sometimes \pm amplexicaul; flowers on slender pedicels c. 20 mm long; calyx c. 12 mm long with 5 broad wings; petals pink, coronal scales absent; stamens 10; styles 2; fruit dehiscent by 4 teeth. Monotypic: *V. hispanica* (Fig. 3).

27. *Gypsophila* L.

Annual, biennial or perennial herbs, often suffrutescent, erect; leaves linear-subulate to spatulate or elliptical, up to 8 cm long; sepals fused at least at base, calyx up to c. 6 mm long; petals white or pink, coronal scales absent; stamens 10; styles 2; fruit dehiscent by 4 valves.

- | | | |
|---|---|--|
| 1. Calyx 4 mm long or more | 2 | |
| + Calyx 3 mm long or less | 3 | |
| 2. Stems with dense indumentum of long (2.5 mm) spreading hairs | | <i>G. pilosa</i> |
| + Stems with \pm sparse indumentum of short (less than 0.5 mm) hairs | | <i>G. bellidifolia</i> |
| 3. Inflorescence axis with at least some stalked glands; leaf apex rounded [SY, SOC, O] | | <i>G. montana</i> |
| + Inflorescence axis glabrous, with at most some sessile glands; leaf apex acute [SA, K] | 4 | |
| 4. Stem internodes with patches of sessile viscous glands (usually causing adherence of sand particles etc); petals pink or white | 5 | |
| + Stem internodes completely eglandular, glaucous; petals white, usually with purple veins | 6 | |
| 5. Leaves lanceolate to oblanceolate, 8 mm or more broad | | <i>G. viscosa</i> |
| + Leaves linear to linear-lanceolate, 5 mm or less broad | | <i>G. heteropoda</i>
subsp. <i>heteropoda</i> |
| 6. Leaf margins papillose (sometimes obscurely so) | | <i>G. capillaris</i> |
| + Leaf margins not papillose | 7 | |
| 7. Leaves 3 mm or more broad; seeds with flat tubercles | | <i>G. antari</i> (Fig. 3) |
| + Leaves less than 3 mm broad; seeds with acute tubercles | | <i>G. arabica</i> |

28. *Saponaria* L.

Very similar to *Gypsophila* but often distinguished by appendages or wings on the petals. In our area this distinction breaks down and we have therefore keyed out the two genera together. J.R.I. Wood has recently described (*Kew Bull.* **39**: 130, 1984) a new species of *Saponaria*, *S. umbricola* (Fig. 3) from the Yemen Arab Republic. Barkoudah (1962) also places *Gypsophila bellidifolia* and *G. montana* in *Saponaria* but we have retained these two species in *Gypsophila*.

29. *Velezia* L.

Annual herbs, erect, up to c. 30 cm, dichotomously branched; stems rigid, often purplish; leaves linear (5)10-20 mm long; flowers usually solitary in leaf axils; calyx narrowly cylindrical, c. 12 × 1 mm, 15 nerved, usually with glandular hairs; petals pink, bifid, coronal scales absent; stamens 5 or 10; styles 2, fruit dehiscing by 4 teeth.

The only specimen known from our area is *Collenette 2598*, collected in W Saudi Arabia. It is in the *V. rigida* L. group (Fig. 3). The possibility that this record is based on an introduction cannot be ruled out.

30. *Dianthus* L.

Annual or perennial herbs, erect, up to c. 75 cm; leaves linear to lanceolate; flowers solitary or in few-flowered cymes; epicalyx of bracteoles enclosing base of calyx; petals white, pink or red, coronal scales absent; stamens 10; styles 2; fruit, often with short carpophore, dehiscing by 4 teeth.

- | | | |
|---|---|------------------------|
| 1. Calyx 25 mm or more long | 2 | |
| + Calyx 20 mm or less long | 6 | |
| 2. Bracteoles of epicalyx 10 or more; calyx narrowly cylindrical (c. 3 mm broad) | | <i>D. sinaicus</i> |
| + Bracteoles of epicalyx less than 10; calyx broader (4 mm or more) especially towards base | 3 | |
| 3. Petal limb with ± entire margin | | <i>D. judaicus</i> |
| + Petal limb distinctly dentate to fimbriate-laciniate | 4 | |
| 4. Bracteoles of epicalyx broadly ovate; petal limb dentate | | <i>D. caryophyllus</i> |
| + Bracteoles of epicalyx lanceolate to ovate; petal limb fimbriate | 5 | |
| 5. Leaves imbricate on lower stem; bracteoles of epicalyx to half as long as calyx [NY] | | <i>D. longiglumis</i> |
| + Leaves not imbricate; bracteoles of epicalyx to less than half as long as calyx [SA?, O, UAE] | | <i>D. cf. crinitus</i> |

- | | |
|--|-------------------------|
| 6. Calyx punctate-verruculose ($\times 10$ lens required to see minute protuberances); some calyx nerves not reaching the base so that parts of calyx nerveless | 7 |
| + Calyx not punctate-verruculose; all calyx nerves reaching the base | 8 |
| 7. Annual; bracteoles of epicalyx equalling or exceeding calyx | <i>D. cyri</i> (Fig. 3) |
| + Perennial; bracteoles of epicalyx up to half as long as calyx | <i>D. strictus</i> |
| 8. Petal limb bearded; calyx (13-)14 mm or more long | <i>D. zonatus</i> |
| + Petal limb not bearded; calyx 13 mm or less long | 9 |
| 9. Flowers sessile; leaves 5-13 mm long, 1 mm broad | <i>D. uniflorus</i> |
| + Flowers on peduncle of 3 cm or more; leaves 15-35 mm long, c. 2 mm broad | <i>D. deserti</i> |

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نباتات الفصيلة القرنفلية في شبه الجزيرة
العربية : قائمة مرجعية ودليل تصنيفي
(دراسات في نباتات شبه الجزيرة العربية -
(١٢

ر.ا. كنج وك.ج. كاي

الحديقة النباتية الملكية - إدنبرة؛ متحف ويلز الوطني ، كارديف،
المملكة المتحدة .

يشتمل هذا البحث على قائمة مرجعية ودليل تصنيفي (مدعم
بالتوضيحات والرسوم) لأجناس الفصيلة القرنفلية وأنواعها
(متضمنة اللبريس كذلك) التي سجلت في شبه جزيرة
العرب وقطر.

وتتضمن القائمة المرجعية مجموعة مختارة وتوزيعها في
شبه الجزيرة العربية، كما يتضمن الدليل وصفا مختصرا
للفصيلات والأجناس.