

Taxonomic Study of Capparaceae from Egypt: Revisited

Wafaa M. Kamel^{1*} • Monier M. Abd El-Ghani² • Mona M. El-Bous¹

¹ Botany Department, Faculty of Science, Suez Canal University, Ismailia, Egypt

² The Herbarium, Faculty of Science, Cairo University, Giza 12613, Egypt

Corresponding author: * wafaamoustafa@yahoo.com

ABSTRACT

The systematic revision of the Egyptian species belonging to the family Capparaceae based on fresh materials with extensive field observations and herbarium materials is reported. This revision showed the presence of four genera *Boscia*, *Capparis*, *Cadaba* and *Maerua*. Species delimitation in *Capparis* was re-evaluated, resulting in the recognition of four species of *Capparis*: *C. decidua* (Forssk.) Edgew., *C. sinaica* Veill., *C. spinosa* L. (with three varieties viz., *spinosa*, *canescens* and *deserti*) and *C. orientalis* Veill. The last species is proposed to be elevated from var. *inermis* to the species level. Our results revealed also that leaves, stipules, flowers and fruit characters are of significant taxonomic value. A key for identification of the genera, species and varieties is provided. Type, synonyms, and selected specimens for each species are also presented.

Keywords: Capparaceae, *Boscia*, *Capparis*, *Cadaba*, *Maerua* taxonomy, Egypt

INTRODUCTION

Capparaceae is a medium-sized family of approximately 40–45 genera and 700–900 species, whose members present considerable diversity in habit, fruit, and floral features (Cronquist 1981; Heywood 1993; Mabberley 1997). The flowers of Capparaceae are ecologically versatile and aesthetically exciting (Endress 1992). Floral variation in Capparaceae includes both actinomorphy and zygomorphy, a wide range of stamen number (1–250), and pronounced basal intercalary elongation zones that may produce gynophores, androgynophores, and elongated stamens (Endress 1992). Capparaceae are pantropical in distribution, being most conspicuous in tropical seasonally dry habitats.

The two major subfamilies of Capparaceae, Cleomoideae and Capparoideae, are quite distinct and have even been elevated to familial status by some authors (Airy Shaw 1965; Hutchinson 1967). Capparoideae (about 25 genera/440 species) are typically woody (shrubs to small trees) and have dehiscent or indehiscent fruits, which are fleshy. The larger Capparoideae are further divided into four tribes by Pax and Hoffmann (1936) and into three tribes by Hutchinson (1967) equivalent to his (Capparaceae). Although there is some agreement among these classification systems, most aspects of Capparaceae relationships remain unresolved. Cleomoideae (about 8 genera/275 species) are generally herbaceous and have dehiscent fruits with repla. In both subfamilies the type genus is by far the largest and houses the majority of the species: *Cleome* (200 species) and *Capparis* (150–200 species).

The traditional tribes in Capparoideae described by Pax and Hoffmann (1936) divided Capparoideae into Cappariideae, with rounded buds, stellate or simple hairs, scales, seldom with glandular hairs, and no sap (16 genera); Maerueae, with elongated cylindrical buds (3 genera); and Stixeeae, with flowers that typically have six sepals (5 genera). Similarly, Hutchinson (1967) divided Capparoideae (equivalent to his Capparaceae) into Cappariideae, with bisexual flowers and more than two ovules (25 genera); Cadabeae, with bisexual apetalous flowers and more than two ovules (8 genera); and Apophylleae, with unisexual flowers with one or two ovules (2 genera). In all cases where they sampled

more than one genus from any of the tribes recognized by the authors, monophyly was contradicted (Hall *et al.* 2002). Hutchinson's classification is particularly unsatisfactory because it splits two genera, *Maerua* and *Cadaba*, into different tribes because they are polymorphic with respect to the presence/absence of petals. The failure of traditional tribal classifications suggests that the traditionally important morphological characters are more homoplasious than previously considered (Hall *et al.* 2002).

Bremer *et al.* (1998) proposed to merge the families Capparaceae and Cruciferae under the common name Brassicaceae. Undoubtedly, if one takes into account the new results of molecular systematics (Kubitz 2002); it is inappropriate to maintain the two former families as they are traditionally defined. However, Hall *et al.* (2002) recognizing that a family Capparaceae inclusive of *Cleomoideae* would be paraphyletic and recommend the recognition of smaller, monophyletic family units instead, and accepted Cruciferae Adans., Capparaceae Adans, and Cleomaceae Horan, as separate families.

Fici (2004) investigated leaf surface and pollen features in the intraspecific taxa of *Capparis spinosa* by SEM and light microscope observations. The micromorphological evidence, coupled with other phenotypic features, supports the placement of this section at the base of the genus *Capparis* in the palaeotropical area.

Capparaceae are represented in the wild Egyptian flora by 4 genera, 10 species of wide ecological and biogeographical range of distribution (Montasir and Hassib 1956; Täckholm 1974) while Boulos (1999) included Capparaceae and Cleomaceae in one family (Capparaceae) containing 7 genera and 21 species and 4 varieties. The Egyptian taxa of Capparaceae belong to the xerophytic communities (Zahrán and Willis 1992; Abd El-Ghani and Marei 2006). Earlier studies on Capparaceae in Egypt focused mainly on leaf anatomy (Al-Gohary 1982), seed morphology (Al-Gohary 1997) and pollen morphology (Khafagi and Al-Gohary 1998). The systematic treatment and phylogenetic affinities of the Egyptian species of *Capparis* is still obscured, and unsolved problems concerning their biology and taxonomy need further verification and confirmation.

Capparis is a large and polymorphic genus with a

world-wide distribution in the tropics and subtropical zones. Infrageneric treatments have been proposed for it by various authors (De Candolle 1824; Endlicher 1836; Grisebach 1859; Eichler 1865; Pax and Hoffmann 1936), whereas Jacobs (1965) published a revision of the south Asian and Pacific taxa, no modern global classification exists other than Hutchinson's 1967, who atomized *Capparis* into several small genera that few other than himself have accepted. In so far as they are natural units, we consider them to be sections of *Capparis*. According to Iltis (2001) there are about 160 *Capparis* taxa world-wide, of which more than two third are present in the old World. Täckholm (1974) recognized 6 species of Egyptian *Capparis*, whereas, Boulos (1999) classified the genus as 3 species and 4 varieties.

Ahmed *et al.* (2007) investigated two Egyptian *Capparis* species namely *Capparis cartilaginea* and *C. deserti* for their glucosylates and rutin content. From *C. cartilaginea* four isothiocyanates were isolated and identified using GC and EI/MS techniques. In addition, two other compounds were isolated and identified from *Capparis deserti*.

Abd El-Ghani *et al.* (2007) investigated the leaf architecture of 19 species belonging to 7 genera of Egyptian Capparaceae. The venation pattern showed mostly pinnate brochidodromous or craspidodromous. Leaf architecture helped to distinguish the investigated species

The objectives of the systematic treatment are to give an updated survey of the occurrence of members of the Capparaceae in Egypt including a key to all genera and species and descriptions, data on distribution and additional information on the ecology in order to permit easier identification of material for the area and form a base for further investigations.

MATERIALS AND METHODS

The materials used in this study were fresh materials collected from different localities in Egypt, and herbarium materials. The locations were accurately located using GPS. Fresh materials were recorded and collected from their natural habitats, during the 2004, 2005 and 2006 growing seasons from Sinai Peninsula, Eastern Desert, Western Desert, Gebel Elba, western Mediterranean coast and the Nile Delta region. The herbarium specimens of the different species were obtained on loan from some of the larger herbaria in Egypt such as CAI, CAIM, CAIRC, DRC (Holmgren *et al.* 1990) and Suez Canal University Herbarium.

The selected specimens were examined with a Wild Stereo-

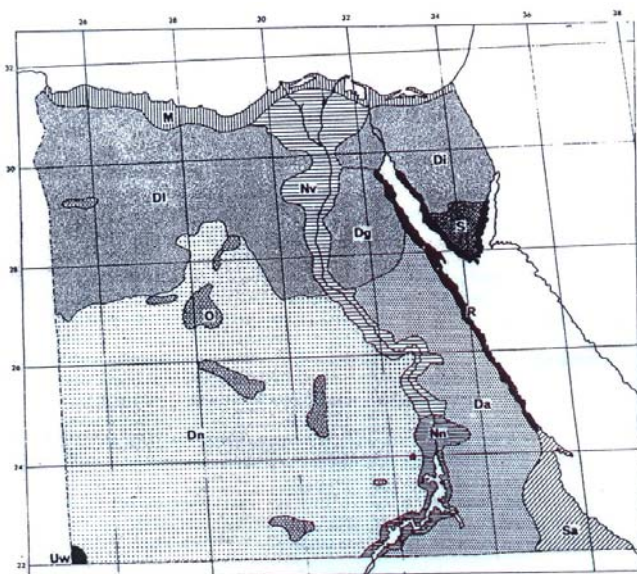


Fig. 1 Phytogeographical subdivisions of Egypt (after El Hadidi 2000). M: Mediterranean coastal belt, DI: Libyan desert, Dn: Nubian desert, DI: Isthmic Desert, Dg: Galala Desert, Da: Arabian desert, Nv: Nile Valley sector of the Nile –land, Nn: Nubian sector of the Nile land, O: Oasis of DI and Dn, S: Southern mountainous Sinai, R: Red sea coastal plains, Sa: Gebel Elba district; Uw: Gebel Uweinat area.

Microscope. Phytogeographical territories for the revised specimens are those proposed by El Hadidi (2000, Fig. 1).

SYSTEMATIC TREATMENT

Division: Magnoliophyta
Class: Magnoliopsida
Order Type: Eudicots-Rosids II
Order: Brassicales
Family: Capparaceae (APG 2003)

- 1. Fruit dry, globose, indehiscent, warty or pitted, with crustaceous exocarp *Boscia*
- Fruit succulent, baccate, with seeds surrounded by a little pulp 2
- 2. Leaves with hooked spiny stipules *Capparis*
- Leaves exstipulate 3
- 3. Stamens many 20 – 40 inserted on torus *Maerua*
- Stamens 5, inserted on petaloid androphore... *Cadaba*

CAPPARACEAE Juss.

Herbs, shrubs or trees, sometimes woody climbers; leaves alternate, or rarely opposite (sometimes deciduous), glabrous or furnished with glandular or eglandular hairs (Figs. 2, 3); hairs one to many celled, simple or branched, sometimes peltate, thorn like or glandula. Leaves, if present, simple or palmately compound, petiolate, stipulate or exstipulate; stipules, if present, inconspicuous or thorn-like. Inflorescence of terminal or axillary, racemes, corymbs, sometimes of solitary or clustered flowers. Flowers actinomorphic or zygomorphic, hypogenous, with open or closed aestivation, bisexual or very rarely unisexual. Perianth usually 4-merous (sometimes tubular or ± perigynous basally, or very rarely undifferentiated); sepals 4 (-8), free or connate; petals 4-16 or absent, free and alternisepalous (rarely 2, ± sympetalous, or apetalous). Receptacle usually glandular and often prolonged into an androgynophore. Stamens free, few to many,

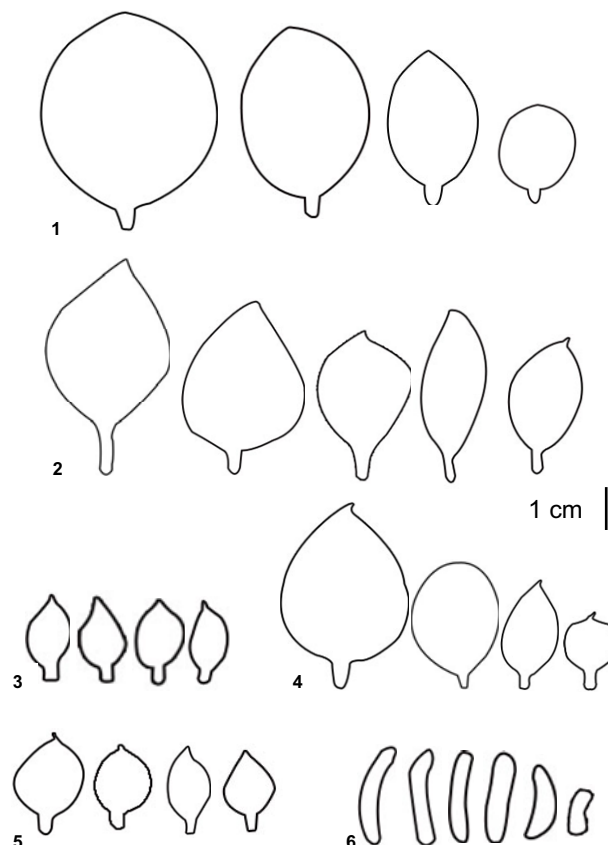


Fig. 2 Capparis leaf forms. 1. *Capparis orientalis*; 2. *Capparis sinaica* ; 3. *Cpparis spinosa* var. *deserti*; 4. *Capparis spinosa* var. *Spinosa*; 5. *Capparis spinosa* var. *Canascens*; 6. *Capparis decidua*.

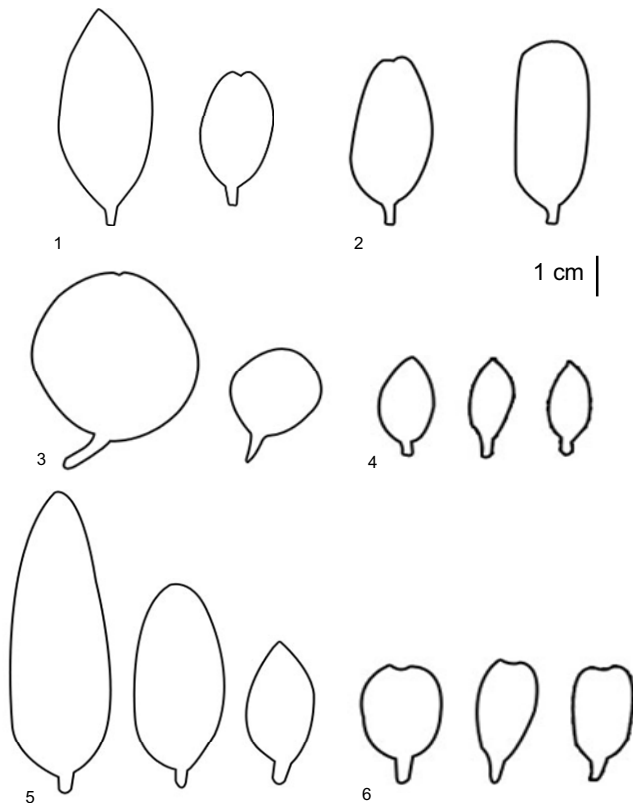


Fig. 3 Leaf forms of representative studied species. 1. *Boscia senegalensis*; 2. *B. angustifolia*; 3. *Cadaba rotundifolia*; 4. *C. farinosa*; 5. *Maerua oblongifolia*; 6. *M. crassifolia*.

alternipetalous; filamentous filiform or clavate; anthers \pm basifixed to versatile, introrse, 2-loculed, longitudinally dehiscent; pollen usually 3-colpate and \pm prolate. Ovary superior, sessile or usually borne on an elongate gynophore, 1-celled sometimes many-celled by false septa with parietal placentation (or rarely central placentae); ovules few to many, campylotropous, 2-integumented (sometimes with an inner layer of tracheary elements); style obsolete long filiform; stigma 2-lobed or capitate. Fruit succulent or dry, berry, drupe, nutlet or siliquiform, seeds often many-seeded, rarely 1-2; seeds reniform or angular, without or with scanty endosperm; embryo curved to variously convolute. About 50 genera and 800 species, widely distributed in the tropical and subtropical with a slight extension to the Mediterranean and Saharo-Arabian regions.

Type genus: *Capparis* L.

1. *Boscia* Lam. Tab. Encycl. 395 (1793) text:2:517(1819). [nom. Conserv.]

Small trees or shrubs; leaves simple, entire, alternate or clustered; inflorescence terminal or axillary, often of corymbose racemes corymbose; flowers scented, small, bisexual, actinomorphic; sepals 4, free; petals absent; stamens 4-9 in Egyptian specimens, free borne on short androphore; gynophore present; style short, stigma capitate; fruit globose, hardly indehiscent. About 37 species, especially tropical and southern Africa.

Key to the species of *Boscia*

1. Leaves glabrous, very long, 4.2-12 cm \times 2 cm
 *B. senegalensis*
 – Leaves pubescent, shorter, 2-4 cm \times 0.7-1.8 cm
 *B. angustifolia*

1.1. *Boscia senegalensis* Poir. in Lam., Tab. Encycl. 2:517 (1819).

Syn.: *Boscia octandra* Rodlk., Sitzungsber. Math. Phys. CL. Königl. Bayer. Akad. Wiss. München 14: 62 (1884).

Type: not designated.

Shrubs, or small trees, 7–8 m tall, leaf minutely pubescent, simple, coriaceous, elliptic to ovate elliptic, or oblong ovate, 4–12 cm \times 2–2.5 cm, obtuse to mucronate, with 5–6 pair veins and prominently looped; inflorescence terminal corymbose; flowers 3–5 mm, actinomorphic; sepals 4 equal, petals absent; stamens 8–20, androphore present; ovary glandular, with short gynophore, stigma capitate; fruit edible, dry, globose, nut, warty, minutely tomentose, 12 cm, many seeded.

Representative specimens: **Ra:** Mersa Alam, Red sea coast, Feb. 1977, *El-Gazzar* 52 (CAI).

Habitat: Nano-phanerophyte which grows in crevices of rocky slopes.

Distribution in Egypt: This species is very rare in Egypt and recorded from the wadis of Gebel Elba massive. Hassan (1987) recorded it near Mersa Alam (Red Sea coast).

General distribution: Mauritania, Senegal, Nigeria, Chad, Ethiopia, Eastern Sudan, Southern, Southeast Egypt.

1.2. *Boscia angustifolia* A. Rich. in Guillemin et al. Fl. Seng. Tent. 1:26, t.6 (1831).

Tree, 7–8 m tall, much branched, stem with greyish bark, pubescent; leaf simple, rigid, pale green, glabrous, oblanceolate or obovate, round, 20–45 \times 7–20 mm, subacute, or mucronate, base cuneate, inflorescence terminal or axillary corymbose racemose; pedicel 6–8 mm, puberulous; flowers actinomorphic, 5 mm, bract 4.5 mm, ciliate pubescent sepals 4, equal 4–5 mm \times 1.5–2 mm, puberulous, petals absent; stamens (5-) 8 (-9), 2–4 mm, no androphore, or reduced; gynophore 1–2 mm, glabrous, ovary 1–1.7 mm, ovoid, style reduced, 1 mm, subsessile, anthers 1 mm; fruit dry nut, green, crustaceous exocarp, warty, 35 (-50) \times 35 (-50) mm, globose; seeds wrinkled or postulate, many, \pm spherical – compressed.

Habitat: Nano-phanerophyte which grows on rocky crevices at high altitudes. This species has its value as an ornamental tree (El Hadidi *et al.* 1992).

Representative specimens: **Ge:** Wadi Akaw; Gebel Elba, 25.1.2001, *Iman El-Gohary* s.n. (DRC).

Distribution in Egypt: It is recorded from wadi Mawaw (Gebel Elba massive) which seems to be the northern most limit of the taxon distribution in Africa (El-Hadidi *et al.* 1992).

General distribution: Southeast Egypt, Southern Arabia, Sudan, Ethiopia, Chad, Nigeria, Senegal.

2. *Capparis* L. sp. Pl. 503 (1753); Gen. Pl. ed. 5, 5: 222 (1754)

Shrubs, trees often scrambling or climbing branches, sometimes prostrate. Leaves simple, sometimes deciduous, alternate often leathery; recurved stipular thorns usually present; inflorescence a corymbose or subumbellate raceme, or flowers solitary in the leaf axils; flower hermaphrodite, rarely unisexual, zygomorphic or actinomorphic; sepals 4, imbricate, soon falling, unequal the posterior often larger and more concave than others; petals 4, imbricate, often unequal, usually caducus after anthesis, the two posterior ones coherent, forming a nectariferous fleshy protuberance or cavity at the thickened base; receptacle flattened or subconical. Androphore absent; stamens 5-many, exceeding the petals, inserted at the base of gynophore of almost equal length. Ovary glabrous, cylindrical or ellipsoid, one – several celled, carpels 2-8, with two or more parietal placentae; ovules numerous; stigma sessile; fruit coriaceous, smooth, verruculose or grooved pericarp, baccate, 1-several seeded, an ovoid or cylindrical fleshy berry, usually indehiscent or separating into 3-4 valves when mature; seed surrounded by a gelatinous pulp, reniform or ovoid. About 250 species widespread in the tropics and subtropics of the Old and New Worlds, nearly half of which is American, a few in the Mediterranean and S.W. Asia, represented in Egypt by 4 species and 3 varieties.

Key to the species of *Capparis*

1. Leaves deciduous, flowers in corymbose, small 7-10 mm, petals red, fruit globose *C. decidua*
- Leaves persistent, flowers solitary large, 15-30 (90) mm, petals white; fruit clavate 2
2. Stipule absent, leaf orbicular, fleshy *C. orientalis*
- Stipules spiny hooked, leaf ovate, thin 3
3. Posterior sepal deeply saccate, helmet shaped *C. sinaica*
- Posterior sepal concave or subequal *C. spinosa*

2.1. *Capparis decidua* (Forssk.) Edgew. Proc. Linn. Soc. Bot. 6: 184 (1862).

Syns: *Sodada decidua* Forssk., Fl. Aegypt. Arab. 81 (1775); *Capparis aphylla* Roth, Nov. Pl. Sp. 238 (1821); *Capparis sadoda* R. Br. In Denham *et al.*, Narr. Travels Africa 225 (1826), nom. illeg.

Type: Arabia, Yemen, Forsskal (C)

Shrub much branched, sometimes attaining the size of a small tree, up to 6 m, straggling, glabrous, spartoid with bright green, patulous; branches green, often zigzag, terete, leafless (except in young plants); leaves few on the young twigs, glabrous or sparsely pilose, oblong cuneate or oblong elliptic, 3.5–20 × 0.5–2 mm, mucronulate spiny, soon deciduous; very short petiolate 0.5–1 mm, stipules thorny, 2.5–3 mm, recurved or straight; flowers red or scarlet in lateral corymbs or clusters of 2–5, born on short branches, 0.7–2 cm diameter, zygomorphic; pedicel erect, 0.8–1 (1.5) cm; sepals unequal, the posterior larger and deeply saccate, 0.5–1 cm long as twice as the anterior one, glabrous; the anterior one 0.7–0.9 cm long, oblong obovate; petals about 1 cm, the two posterior sepals, emarginate; anterior petals 0.8–1.2 cm long, oblong elliptic; stamens 5–8 (20), 1–2 cm long; ovary globular, on 1–2 cm long gynophore; style 1 mm long; fruit intensely red, 0.5–1.2 cm, ovoid-subglobular, glaucous; seeds few to many, reniform, 2–5 mm diameter.

Representative specimens: **Ug:** North Western Desert ca. 185 km SE of Gebel Uweinat, near Shaw's Camp, N: 18:20:27, E: 26:16:00, 4.2.1982, *F. Saad*, s.n. (CAIM); **On:** Balat, Dakhla Oasis, 4.11.1929, *Boulos*, s.n. (CAIM); **Ra:** Safaga–EL-Qusier road, Red Sea coast 15.3.1988, *Ibrahim El-Garf*, s.n. (CAI); **Da:** Wadi Gemal Protectorate, 25 km from the entrance, 1.11.2005, N: 24:37:17, E: 35:00:52, *Tamer Mahmoud*, s.n. (Suez Canal Univ. Herb.); **Ge:** Upstream part of the Wadi Nawaw across Gebel Asotriba, Gebel Elba, 28.19.1962 s.n. (CAI); **Ge:** Gorge across Gebel Elba, 20.5.1998, *El-Garf*, s.n. (CAI); North Tondob, Wadi Allaqi, alt. 1600–1500 m, *F. Saad*, s.n. (CAIM); **Da:** Between Aswan and Kom Ombo, 6.2.1975, *El Hadidi*, s.n. (CAI); **Da:** Wadi Hodein, 17 km SE of Bier Abraq, 26.01.1979, *Boulos*, s.n. (CAIM).

Distribution in Egypt: It is recorded from Sinai, western of Red Sea coast, and Gebel Elba region in desert wadis, sandy and alluvial plains.

General distribution: Tropical East and North Africa, Palestine, Saudi Arabia, Iran, Pakistan, NW India.

2.2. *Capparis orientalis* Duh. Traité Arbr., ed. 2, 1:142 (1801)

Syns: *Capparis rupestris* Sibth & Sm., Fl. Graec. Prodr. 1:355 (1809); *Capparis spinosa* L. var. *rupestris* (Sibth. & Sm.) Viv., Fl. Libyc. Spec. 26 (1824); *Capparis spinosa* L. subsp. *orientalis* (Duh.) Jafri in Ali & Jafri, Fl. Libya 12:3 (1977) *Capparis spinosa* var. *inermis* Turra, Fl. Ital. Prodr. 65 (1780);

Shrubs, up to 1 m high, almost prostrate; branches pendulous, glabrescent; stipules inconspicuous or absent. Petiole short, 0.2–0.6 (10) cm long, tomentose; leaves thick, glabrous orbicular or ovate, 2–5 cm long, 1.4–4.5 cm wide, obtuse mucronulate or acute, not spiny, subcordate at base; flowers large, 5–6 (9) cm long on 2.5–5 cm pedicel; gynophore glabrous, long, 3.5–7 cm longer than stamens.

Representative specimens: **Mm:** Mersa Matruh, Agiba beach, 26.8.2005, 31:24:86 N, 27:60:53 E, *El-Bous*, s.n. (Suez canal Univ. Herb.); **Mm:** Bir Qahara, Sallum, 19.4.1963, *Moustafa Imam* s.n. (CAIM); **Mm:** Saint Hagg Ayyad, Wadi El Habs, between Mersa Matruh and Agiba, 23.3.1974, *Täckholm & El Hadidi*, s.n. (CAI); **Mm:** El Negeela, near airport, on the coastal road, Alexandria-Sollum, *Amal Amin et al.*, s.n. (CAI); **Mm:** Ras El-Hekma, Mariut, 2.5.1955, *Botany Departement Excursion* s.n. (CAI); **Mm:** Mariut, Spring 1961, *V. Täckholm*, s.n. (CAI); **Mm:** Ras El Hekma, 2.5. 1995, *Botany Department Excursion*, s.n. (CAI); **Mm:** Wadi Halazeen, 45 km west Mersa Matruh, 24.4.1996, *El-Garf*, s.n. (CAI); **Nv:** Gebel Akhdar, 4 km east al marj along the Suez road, 23.1. 1967, *Boulos*, s.n. (CAI).

Distribution in Egypt: This variety is reported mainly on the sea shore from Mersa Matruh to Ras El Hekma.

2.3. *Capparis sinaica* Veill. In Duh., Traité Artr. Arbust., ed. 2, 1: 144 (1801).

Syns: *Capparis cartilaginea* Decne., Ann. Sci. Nat. Bot., Ser. 2, 273 (1835); *Capparis galeata* Fresen., Mus. Senkenb. 2:111 (1837); *Capparis spinosa* L. subsp. *cartilaginea* (Decne.) Maire & Weiller in Maire, Fl. Afr. Nord. 12:120 (1965).

Type: Egypt, Sinai, Bové 148 (P; isotype).

Scrambling shrub up to 3 m high and up to 3 m wide. Stem many, divaricately and intricately branching. Branches very flexuous and thickened at nodes, glaucous. Stem and branches glabrescent or glabrous, glaucous; leaves persistent, thick or leathery, glabrescent or pubescent, orbicular to ovate-elliptic, 2–5 (–6.5) cm × 1.5–4 cm, the midrib often protruding at apex as a salient 1.6–2 mm long prickle, usually spinous -mucronate; petioles 0.3–3 cm, glabrous or pubescent; basally cuneate or rounded, stipular spines short, 2–4 mm long, 1.5–2 mm broad, recurved sometimes abortive; flowers solitary in the axile of the upper leaves 2.3–9 cm; pedicles stout, glabrous or tomentose, 3–8 cm; buds strongly asymmetric; Calyx zygomorphic with posterior sepals up to 2–5 cm × 1.7–2.5 cm, saccate (helmet shape), the anterior sepals, 1.2–2.5 cm × 0.4–0.8 cm, oblong or ovate, concave, externally puberulous or glabrous, marginally tomentose; petals white, glabrous, the upper pair connate, obdeltoid, up to 3.5 cm long, apically included in the posterior sepals, the lower pair free, obovate 3.3–4 cm long; stamens numerous 3–4 (5) cm long, filaments and anthers creamy white, then turns pink after anthesis, anthers 2–4.5 mm long; gynophore 2.5–4 (–6) cm long, thickened in the fruit; ovary clavate elliptic or obovate, 4–6 cm long; stigma flattened discoid, subsessile; fruits berry, globose, clavate or oblong obovate, reddish 2.5–7 × 1.5–2.5 cm, glabrous, ribbed, on a recurved gynophore of about the same length; seeds reniform 3.5 × 2 mm.

Representative specimens: **Di:** Sinai, Wadi Nasab, 15.08.2004, *A. Moustafa*, s.n. (Suez Canal Univ. Herb.); **Di:** Suez–Ras Sedr Road, 5 km from Ras Sedr, 9.9.2004, N: 29:38:10, E: 32:42:37, *Kamel & El-Bous*, s.n.; (Suez Canal Univ. Herb.); **Di:** Hammam Faraoun, 9.9.2004, *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **S:** Wadi Fieran, 5 km high on the rocks, N: 28:31:04, E: 34:26:47, *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **S:** Sinai, 5 km, Nuaiba–Dahab, 35 m from Dahab, 9.10.2004, N: 28:44:35, E: 34:27:52, *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **S:** Sinai, 15 km from Dahab City, 9.10.2004, N: 28:36:19, E: 34:27:31 *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **S:** Sinai, before El-Tur City, 9.10.2004, *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **Da:** 8 km from the entrance of Wadi Gemal, Eastern Desert, 1.11.2005; 8.11.2004, N: 24:38:54, E: 35:01:06; *Tamer*, s.n. (Suez Canal Univ. Herb.).

Habitat: Ravines and rocks of hot deserts.

Distribution in Egypt: Di, Da, S. cliffs, stony wadis.

General distribution: East and Southwest Africa and tropical Africa (Sudan, Ethiopia and Somalia); south Iran to

Pakistan, Southwest Asia to India.

2.4. *Capparis spinosa* L., Sp. Pl., ed. 1, 503 (1753).

A sprawling or ascending, much-branched shrub, up to 2.5 m; stem terete, straight or flexuous, glaucous, often tinged purple, glabrous or tomentose, especially towards apex; leaves glabrous or glabrescent, sometimes thinly tomentose, green or glaucous, orbicular rarely obovate or elliptic, 1-5 cm long 0.8-5 cm broad, obtuse or mucronate spiny, sometimes emarginate, narrowed, truncate or occasionally subcordate at base, midrib usually exerted as a short spine, petiole short, 0.2-1 cm long; stipules strong, rarely absent rotose or hooked, rarely straight, 2-5 mm long; flowers 1.5-7 (9) cm long, zygomorphic, produced at intervals along the stems, pedicel long, 2.5-5 cm long, glabrous, usually rather longer than the subtending leaves; sepals glabrous, glabrescent or thinly tomentose, the two posterior sepals deeply concave, about 1.5-2 cm long and 1-1.5 cm wide, apex obtuse or subacute, anterior pair smaller, oblong obtuse, not markedly concave, about 1-1.8 cm long and 0.8-1 cm wide; petals white or tinged mauve, the posterior petals oblique concave 1.5-3 cm long, 1-2 cm wide, the anterior one 1.5-2 cm long, 1.2-1.5 cm wide, oblong to broadly obovate, narrowed to base; stamens numerous, 2-7 cm long; filaments usually longer than the petals, often tinged mauve pink especially towards the apex; anthers violet, narrowly oblong, about 2 mm long and 1 mm wide; gynophore 2-3.5 (7) cm long; ovary cylindrical about 2-5 (6) cm long, 0.1-0.2 cm wide; style absent; stigma capitate; fruit obovoid or ovoid or ellipsoid, about 2-4 cm long and 1-2.5 cm wide; epicarp rather leathery, distinctly 5-6 ribbed, glabrous, greenish, turning reddish when fully ripe; seeds numerous, smooth, glabrous, chocolate-brown, reniform 2.5-3 mm long and 2-2.5 mm broad.

Key to the varieties of *Capparis spinosa*

1. Leaves hairy or fleshy canescent, elliptic oblong var. *canescens*
– Leaves glabrous with small prickle.....2
2. Leaves oblong-ovate or orbicular-elliptic 1-1.5 × 1-2 cm, acute var. *deserti*
– Leaves ovate orbicular, obtuse or mucronate, 1.6-5 × 0.8-5 cm, round or retuse..... var. *spinosa*

2.4.1. *Capparis spinosa* L. var. *spinosa*

Syns.: *C. aegyptia* Lam., Encycl. Meth Bot. 1: 605 (1785); *C. ovata* Desf., Fl. Atlant. 1: 404 (1798); *C. sicula* Veill. In DUH., Arb. Ed. 2, 1: 159 (1801); *C. herbacea* Will. D., Enum. Pl. Hort. Berol. 560 (1809); *C. aegyptia* Lam., Encycl. 1: 605 (1785); Del., Fl. Eg. 237 (1813); *C. leucophylla* DC., Prodr. 1: 246 (1824); *C. spinosa* L. var. *canescens* Cossn, Not. Pl. Crit. 1: 28 (1848); *C. spinosa* L. var. *aegyptia* (Lam.) Boiss., Fl. Or. 1: 420 (1867); *C. spinosa* L. var. *leucophylla* (DC.) Boss., 1. C. Icon.: Zohary, Fl. Palaestina., tab. 358, 359 (1966).

Type Specimens *Capparidis aculeatae* in herb. Hort. Cliff. BM; Vide Burt & Lewis, Kew Bull. 249:299 (1949).

Stem and branches relatively stout; leaves glabrous, round ovate, or orbicular-cuneiform, (1.6) 3-4.5 (0.8) cm long, 2-4 cm broad, round or retuse with a small prickle; stipules strong or weak; petioles 5-10 mm long; petals obovate or orbicular, 1.5-4 × 0.8-8 cm, elongated after anthesis; fruit obovate, 2.5-5 × 1.5-2.5 cm.

Representative specimens: **Mm:** Ras El Hekma, Maruit, 2.5.1955, *El-Hadidi, M.* s.n. (CAI); **Mm:** Mersa Matruh, Plateau between Qara and Mersa Matruh, 21.4. 1968, *Romee, G. & El Hadidi, M.* s.n. (CAI); **Mm:** Hanging over a rocky wadi near Sallum, January, 1932, *Palmer Pasha, s.n.* (CAI); **On:** Ezbet El Mawkoul, Dakhla, Oasis, 17.8. 1967, *El Hadidi, M.* s.n. (CAI); **Nv:** Wadi Hof, 15.9. 2004, *El-Ghani, M.* s.n. (CAI); **Nv:** Wadi Hof, 28.11. 1952, *Abdallah Fawzi s.n.* (CAI); **Nv:** wadi Degla of the Helwan desert, 12.1. 1960, *Kassas, A.s.n.* (CAI); **Nv:** 20 Km south of Mansoura, 8.4. 1977, *El Gazzar, A. & S.Sisi, s.n.* (CAI); **Dg:**

Gebel Qiseib, N. galala, 9.2. 1956, *El Hadidi, M.* s.n. (CAI); **Dg:** Wadi Ramia of the Red sea coast, south of Suez, 7.6. 1960, *Täckholm, V. & Kassas, M.*, s.n. (CAI); **Dg:** Wadi El Dir, Eastern Desert, 10.3. 1954, *Boulos, L.*, s.n. (CAI); **Dg:** Wadi Aber, Gebel Ataqa, Suez, 8.4. 1967, *Täckholm, V.* s.n. (CAI); **Dg:** The spring at wadi Qoseib, North galala, Suez Gulf, 10.2. 1955, *A. Fahmy s.n.* (CAI); **Dg:** Eastern desert, 24:38:54 N, 35:01:86 E, 1.9. 2005, *Tamer s.n.* (Suez Canal Univ. Herb); **S:** Wadi Hammura, Sinai, April, 1965, *Salah Eid s.n.* (CAI); **S:** Near the Monastery of Saint Catherine, Sinai, 10.5. 1965, *El-Hadidi, M.*, s.n. (CAI); **S:** North east of Monastery of Saint Catherine, 28:33:43 N, 33:58:18 E, 9.10. 2004; *Kamel, W. & El-Bous, M.*, s.n. (Suez Canal Univ. Herb); **S:** Wadi Feiran, on rocks, 8.10. 2004, *Kamel, W. & El-Bous, M.*, s.n. (Suez Canal Univ. Herb); **S:** Km before Abu Zeneima, on rocks, 29:06:47 N, 33:05:35 E, 9.10. 2004, *Kamel, W. & El-Bous, M.*, s.n. (Suez Canal Univ. Herb); **Da:** Wadi El Gemal, *Tamer, s.n.* (Suez Canal Univ. Herb).

Distribution in Egypt: It was found especially in the rocky slopes, desert wadis, cliffs for instance in Wadi Hof, Wadi Feiran and similar places.

General distribution: Spain, France, Italy, Yugoslavia, Greece, Algeria, Egypt, Turkey, Iraq, Palestine.

2.4.2. *Capparis spinosa* L. var. *deserti* Zohary, Bull. Res. Council Israel D, 8:54 (1960).

Syns.: *Capparis parviflora* Boiss., Fl. Orient. 1:420 (1867). *Capparis deserti* (Zohary) Taeckh. Boulos, Publ. cairo Univ. Herb. 5:14 (1974).

Type: not designated.

Small shrub up to 100 cm high, prostrate; stem terete, white pubescent branches; stipules strong spiny, curved, 0.3-3 mm long; leaves glabrous or sparingly pubescent, 1-1.5 cm long, 1-2 cm broad, orbicular-elliptic or ovate-oblong, spiny tipped; flowers solitary, axillary, pedicellate, 2-4 cm long, slightly zygomorphic; sepals unequal; petals white, anterior petal ovate, 2-3.5 cm long, posterior petal concave, longer than anterior one; fruit fleshy berry, pear shaped, ripened green epicarp, endocarp red.

Representative specimens: **Mm:** A way from Mersa Matruh to Siwa Oasis, 150 Km from Matruh, 25.8. 2005, 30:37:39 N, 32:16:36 E, *EL-Bous, M.* s.n. (Suez Canal Univ. Herb); **Dg:** Eastern desert, 24:38:54 N, 35:01:86 E, 1.9. 2005, *Tamer s.n.* (Suez Canal Univ. Herb); **OI:** 134 Km North Siwa Oasis, 25.8. 2005, *El Bous, M.s.n.*, (Suez Canal Univ. Herb); **OI:** 128Km North Siwa Oasis, 25.8. 2005, 30:37:39 N, 13:23:29 E, *El Bous, M.* s.n. (Suez Canal Univ. Herb); **OI:** On the way to Matruh, 55-60 Km from Siwa Oasis, 25.10. 1963, *Boulos, L.*, s.n. (DRC).

Habitat: Chamaephyte which grows on sandy gravel plains.

Distribution in Egypt: It is a very rare species and confined to Sallum plateau and along Mersa Matruh-Siwa road.

General distribution: Known from North Africa eastward to Syria, Lebanon, Iraq and further eastwards to Asia.

2.4.3. *Capparis spinosa* var. *canescens* Coss., Notes Pl. Nouv., Fasc. 2: 28 (1849).

Syns.: *Capparis ovata* Desf., Fl. Atlant. 1:404 (1798); *Capparis sicula* Duh., Traité Arbr., ed. 2, 1:159 (1801); *Capparis leucophylla* DC., Prodr. 1:246 (1824); *Capparis ovata* var. *palaestina* Zohary, Bull. Res. Council. Israael D, 8: 56 (1960); *Capparis ovata* Desf. var. *canescens* (Coss.) Heywood, Feddes Repert. 69:56 (1964).

Type: [Spain] Buenavista prope Xeres, Bourgeau, 1849, pl. Esp. 43.

Shrub, 70-100 cm, erect, spreading, plant grayish or white canescent; stem hairy or soft villous, stipules strong hooked; leaves petiolate, hairy or fleecy, canescent, 0.5-2.5 cm long, 1-2 cm broad, elliptic oblong rarely ovate, acute or mucronate; flowers slightly zygomorphic, sepals subequal; petals unequal, anterior petal ovate, slightly divergent, longer than posterior one, nectariferous pit bordered by

strongly elevated folds of petals; stamens numerous, the anterior stamens longer than petal; the posterior one shorter than petal; gynophore pilose or hairy at base; filament purple or white; fruit pear shaped or broad pyriform, 2.5-3 cm long, 1.5-2 cm broad.

Representative specimens: **On:** Ain El Sheikh Omran near El Dakhla Oasis on canal bank, 12.2. 1937, *Hassib*, s.n. (CAI); **On:** El Dakhla at the Mut, 14.2.1937, *Hassib* (CAI); **On:** Dakhla Oasis, Rishda, fields behind the roman well Abu Osman, 16.3.1967, *El Hadidi*, s.n. (CAI); **On:** Ezbet El Mawkoul, Dakhla Oasis, 17.8.1967, *El Hadidi*, s.n. (CAI); **Nv:** Wadi Hof, 15.9.2004, *Abd El-Ghani*, s.n. (CAI); **Nv:** Wadi Hof, 28.11.1952, *Abdallah Fawzi*, s.n. (CAI); **Nv:** wadi Degla of the Helwan Desert, 12.1.1960, *Kassas*, s.n. (CAI); 20 km south of Mansoura, 8.4.1977, *El Gazzar & Sisi*, s.n. (CAI); **Dg:** Gebel Qiseib, N. galala, 9.2.1956, *El Hadidi*, s.n. (CAI); **Dg:** Wadi Ramia of the Red Sea coast, south of Suez, 7.6.1960, *Täckholm & Kassas*, s.n. (CAI); **Dg:** Wadi El Dir, Eastern Desert, 10.3.1954, *Boulos*, s.n. (CAI); **Dg:** Wadi Aber, Gebel Ataqa, Suez, 8.4.1967, *Täckholm*, s.n. (CAI); **Dg:** The spring at wadi Qoseib, North galala, Suez Gulf, 10.2.1955, *A.G. Fahmy*, s.n. (CAI); **Dg:** Eastern desert, 24:38:54 N, 35:01:86 E, 1.9.2005, *Tamer*, s.n. (Suez Canal Univ. Herb.); **S:** Near the Monastery of Saint Catherine, Sinai, 10.5.1965, *El Hadidi*, s.n. (CAI); **S:** North east of Monastery of Saint Catherine, 28:33:43 N, 33:58:18 E, 9.10.2004; *Kamel & El-Bous*, s.n. (Suez Canal Univ. Herb.); **S:** Wadi Feiran, on rocks, 8.10.2004, *Kamel & El-Bous*; s.n.; 8 km before Abu Zeneima, on rocks, 29:06:47 N, 33:05:35 E, 9.10.2004, *Kamel & El-Bous*; **Da:** Wadi El Gemal (Suez Canal Univ. Herb).

Distribution in Egypt: It was found especially in the rocky slopes, desert wadis, cliffs; for instance in Wadi Hof, Wadi Feiran and similar places.

General distribution: Spain, France, Italy, Yugoslavia, Greece, Algeria, Egypt, Turkey, Iraq, Palestine.

3. *Maerua* Forssk. Fl. Aegypt.-Arab. 104 (1775)

Shrubs, or tree or woody climbers; leaves alternate or clustered, simple or 3-foliolate; flowers actinomorphic, in terminal racemes or panicles, or clustered in leaf axils; sepals 3-4 free; petals (3-) 4, or absent; subequal; stamens 6-numerous, free, on the androphore; gynophore present; stigma capitate; fruits globose to ellipsoid or cylindrical, often torulose, indehiscent. Fifty species distributed mainly in tropical and southern Africa to India.

Key to the species of *Maerua*

1. Shrub or tree, densely pubescent; petals absent
..... *M. crassifolia*
- Scrambling shrub, glabrous; petals present
..... *M. oblongifolia*

3.1. *Maerua crassifolia* Forssk., Fl. Aegypt.-Arab. CXIII 1. 104 (1775).

Syns.: *Maerua uniflora* Vahl, Symb. Bot. 1: 36 (1790); *Maerua arabica* J. F. Gmel., Syst. Nat. 827 (1791); *Maerua rigida* R. Br. Obs. Pl. in Dehhan & Clapp., Exp. Afr. App. 21. 1826.

Type: Arabia, Yemen, Forsskal (C).

Shrub or tree, 200-500 cm. Ascending divaricate intricate spinescent branches, grayish, densely pubescent; leaf simple, short petiolate (1-5 mm), pubescent, succulent or sub fleshy, variable in shape, oblanceolate to obovate, 10-40 × 7-22 mm, macronulate or obtuse, pubescent, base cuneate; flower solitary or in 2-4 flowered clusters, axillary, actinomorphic; flower pedicel 2-10 mm, erect pubescent; flower bracteate, 4-12 mm; sepals (3-) 4, equal pilose, 4-12 × 3-4 mm, oblong, reflexed; petals absent; stamens 20-40; filament 4-5 mm, androphore present, shorter than gynophore; gynophore 8-20 mm, pubescent; ovary 2-4 mm; narrowly cylindrical, filament very short 2-3 mm; fruit pedicel 3-12 mm; fruit fleshy berry, pubescent, mealy velvety, cylindrical constricted to 6 globose sections, 25-70 × 3-6 mm,

peak 2-3 mm; seeds many, smooth, round, 4 mm diameter.

Representative specimens: **Ra:** Wadi Shoet, Red Sea coast, 4.2.1961, *Täckholm & Kassas*, s.n. (CAI); **Ra:** Wadi El Homeara, 2.2.1962, *Expedition to Gebel Elba distict, Täckholm & Kassas*, s.n. (CAI); **Ug:** Wadi Talh, Jebel Uweinat, Egypt, 28.10.1968, *Boulos*, s.n. (CAI); **Ge:** Between Mersa Halaib and Gebel Elba, 27.1.1929, *G. Täckholm*, s.n. (CAI); **Ge:** Shalateen, Gebel, Hamra Doom, 22:40:61 N, 35:37:71 E, 5.5.2005, *Kadry N. El-Sayed*, s.n. (Suez Canal Univ. Herb.)

Distribution in Egypt: The species is recorded from the Oases of the Libyan Desert, southern parts of the eastern desert, along the Red Sea coast and Gebel Elba massive.

General distribution: Egypt, Libya, Senegal, Mali, N. Nigeria, and Chad; eastwards to the Sudan, Somalia, and Ethiopia; South east to Uganda, Kenya, Tanzania, and also known from Palestine, Jordan, Saudi Arabia, Yemen, Oman, and eastwards to Iran.

3.2. *Maerua oblongifolia* (Forssk.) A. Rich., Tent. Fl. Abyss. 1:32, t.6 (1847).

Syns.: *Capparis oblongifolia* (Forssk.), Fl. Aegypt.-Arab. 99 (1775); *Capparis mithridatica* Forssk., Fl. Aegypt.-Arab. 99 (1775); *Niebuhria oblongifolia* (Forssk.) DC., Prodr. 1:244 (1824); *Maerua virgata* Gilg, Bot. Jahrb.33:226 (1903); *Maerua scbelensis* Chiov., Nuov. Giorn. Bot. Ital., n.s., 34:841 (1927).

Scrambling shrubs, up to 300 cm, unarmed woody shrub, branches elongate slender; stem pale brown with smooth bark, glabrous or with roughly short stiff hairs; leaves simple, glabrous, glaucous coriaceous, broadly to narrowly oblong or ovate oblong, 15-45 × 6-20 (30) mm, obtuse to acute, glabrous, base obtuse; inflorescence terminal corymbose raceme; pedicel 5-9 mm, stout, glabrous; flower 10-25 mm, bracteate; sepals 4, equal forming tube, with lobes, glabrous outside, pubescent within, symmetric, obovate oblong, 7-12 × 4-6 mm, petals 4, greenish white, ovate to lanceolate, 10 × 3-4 mm, obtuse; stamens many, inserted on 0.5 cm torus, filament 2.5 cm, white, brown on drying, androphore present, as long as or slightly longer than gynophore, longer than petals; gynophore 15-20 mm, glabrous; ovary 2-4 mm, cylindrical; stigma more or less conical patent, sessile, no style, filament white; anther 1-2.5 mm, basifixed; fruit fleshy berry, cylindrical torulose; pedicel 15-18 mm, pale brown, knotted smooth, glabrous, 10-35 × 13-14 mm; seeds many in 4 rows, ± globose, 5 × 6 mm, minutely echinate, red at maturity.

Representative specimens: **Ge:** Wadi Akaw, Gebel Elba, 25.1.2001, *El-Gohary, Iman* s.n. (DRC).

Distribution in Egypt: According to Täckholm (1974) the tree is confined to the wadis of gebel Elba massive endangered plant.

General distribution: Recorded from Libya, Mauritania, Niger, N, Nigeria, Chad, and Cameroon, eastwards to Uganda, Kenya; northwards to Ethiopia, Somalia and Sudan. Known also from Saudi Arabia, Yemen and Oman.

4. *Cadaba* Forssk. Fl. Aegypt.-Arab. 68 (1775)

Trees or shrubs; leaves simple alternate or clustered; Flowers zygomorphic, in terminal corymbose or racemes, sometimes solitary; Sepals 4, free; petals 4 or absent, clawed, nectarial appendage tubular, the upper part sometimes petaloid; stamens 4-5, androphore present; ovary 1- to 2-locular, gynophore present; ovules numerous; fruit fleshy, cylindrical, dehiscent. About 30 species, mainly in Old world tropics, especially Africa.

Key to the species of *Cadaba*

1. Plant climbing, petals present..... *C. farinosa*
- Plant shrub or bush or with dropping stem, petals absent
.....2
2. Leaves glabrous, large, 25-45 × 22-38 mm
..... *C. rotundifolia*

– Leaves glandular hairy small, 1.2–2.2 × 0.9–2 mm
..... *C. glandulosa*

4.1. *Cadaba farinosa* Fossk. 68 (1., Fl. Aegypt.-Arab 1775).

Type: Yemen, Forsskal (C)

Perennials, climbing slender shrubs, farinose, densely covered with sessile and subsessile scales, sometimes with stiff glandular and eglandular hairs; leaf simple, alternate on young shoots, clustered on older stem; petiole, up to 3–4 mm, densely farinose; leaf, elliptic to obovate or oblong-ovate, 4–40 × 3–25 mm, round or retuse, farinose or glabrescent, entire, base round or cuneate; inflorescence terminal raceme; flower pedicel 7–15 mm, farinose; flower bracteate, zygomorphic; sepals 4 equal, farinose outside, puberulous at margin, 5–12 × 4 mm, concave, ovate – elliptic; petals 4, creamy, equal, with 6–7 mm clav, oblanceolate, 4–5 mm long, obtuse; stamens 5, 10–14 mm long, androphore 7–9 mm, stamens shorter than petals, gynophore 8–12 mm, covered with subsessile or short stalked glands, ovary 4–4.5 × 0.5–0.8 mm, cylindrical, no style, stigma, sessile flattened; fruit fleshy, berry, subturlose, ± cylindrical, 22–40 × 2–3 mm, farinose; seeds numerous, reniform, embedded in scarlet pulp.

Habitat: Chamaephyte which grows on rocky slopes.

Representative specimens: **Ge:** Gebel Elba, Wadi Ashbia, 5.8.1995, *Morsi*, s.n. (DRC); **Ge:** Mersa Halaib, 21.1.1929, *G. Täckholm*, s.n. (CAI); **Ge:** Gebel Elba, Wadi Darawein, 3.2.1979, *Boulos*, s.n. (CAIM); **Ge:** Gebel Elba, Wadi Kansisrob, 1.2.1979, *Boulos*, s.n. (CAIM).

Distribution in Egypt: Kassas and Zahran (1971) noted that *Cadaba farinosa* grows on the runnels dissecting the North, east and south facing slopes of Gebel Elba massive.

General distribution: Recorded from Mauritania, Cameroon, Central Africa eastwards to Ethiopia, Somalia, Northwards to the Sudan, and eastwards to Saudi Arabia and Yemen., Pakistan, Iran and India.

4.2. *Cadaba rotundifolia* Forssk., Fl. Aegypt.-Arab. 68 (1775).

Type: Yemen, Forsskal (C, BM).

Shrubs, 100–400, erect with drooping much branches, young twigs covered with short glandular hairs, old stem suberulous with glandular hairs; leaf simple, puberulous, leathery, blue green, 25–45 × 22–38 mm, ovate, orbicular, or broad elliptic, retuse or round, glabrous, base cuneate, alternate on twigs of the current year, clustered on older wood, petiole 10–20 mm; inflorescence terminal raceme; flower pedicel 10–16 mm, puberulous; flower 20–22 mm, zygomorphic, bracteate; sepals 4, equal, glandular on both surfaces, 4–6 × 3–4 ovate; petals absent; stamens 5, 14–17 mm; androphore 2–3 mm, appendages below 17–20 mm with elliptic petaloid blade; gynophore very long 12–18 mm, glandular hairy; ovary 3–4.5 mm long, cylindrical; style absent, anther 2–2.5 mm, fruit pedicel 15–20 mm; fruit fleshy berry, ± torulose, 25–50 × 2–8 mm, cylindrical; seeds many, reniform, embedded in scarlet pulp.

Representative specimens: **Ge:** Gebel Elba, Bir Frukit road, 6.10.1995, *Eman El-Gohary*, s.n. (DRC); **Ge:** Gebel Elba, Wadi Kansisrob, 4.2.1933; Wadi Serimtai, 23.1.1962, *Täckholm et al.*, s.n. (CAI).

Habitat: Chamaephyte growing on wadi beds at higher altitudes.

Distribution in Egypt: This species is very rare in Egypt and confined to Gebel Elba massive with extensions to the Red Sea. Drar (1936) traced a single tree growing towards higher parts of Wadi Kansirob (Gebel Elba).

General distribution: Recorded from Kenya, Ethiopia, Djibouti, Somalia Northwards to Sudan; Eastwards to the Saudi Arabia, Yemen and Oman.

4.3. *Cadaba glandulosa* Forssk., Fl. Aegypt.-Arab. 68 (1775).

Type: Yemen, Forsskal (C)

Shrubs, 30–150 cm, branched drooping, viscid, densely covered with glandular hairs up to 0.8 mm; leaf simple, grayish green, glandular hairy or glabrescent, orbicular to obovate or elliptic, 1.2–2.2 × 0.9–2 mm, round or retuse, sometimes mucronulate, leaf base subcordate or rounded; with 2–8 mm long densely glandular hairy petiole; inflorescence terminal raceme; flower pedicel 0.7–1.6 cm, glandular hairy; bract trifid with central segment, ca. 4 mm; flower 19–20 mm; sepals 4, equal, hairy outside, glabrous within, 5–7 × 3 mm, obovate – lanceolate, petals absent; stamens 5, 11–14 mm, yellow with petaloid appendages; androgynophore 1 mm, appendages 1.6–1.9 cm, basally turbular, with pale yellow petaloid, oblong apex, stamens longer than gynophore, gynophore 12–17 mm, glandular, ovary 3–3.2 × 1.4–1.6 mm, spindle shape, fruit pedicel 1 cm, fruit fleshy, indehiscent, glandular pubescent, oblong-ovate, 10–13 × 4–6 mm; seeds numerous, reniform, embedded in scarlet pulp.

Habitat: Chaemaephyte which grows on rocky plains and hills.

Representative specimens: **Ge:** Gebel Elba, West Sarmatai, 18.8.1995, *Iman El-Gohary*, s.n. (DRC); **Ge:** Gebel Elba, Gebel Alafoot, 7.2.1962, *Täckholm*, s.n. (CAI).

Distribution in Egypt: The species is rare and recorded from southern parts of the eastern desert, Red sea coast and Gebel Elba massive; it is confined to *Acacia* bush land on rocky slopes of Gebel Elba distinct (El-Hadidi *et al.* 1992).

General distribution: Recorded from Mali, Niger, Chad, eastwards to Kenya, Uganda, northwards to Ethiopia, Somalia and Sudan; the eastwards to Saudi Arabia and Yemen.

DISCUSSION

The distribution of the studied taxa of Capparaceae; which are typically woody shrubs to small trees and have dehiscent or indehiscent, mostly fleshy fruits (Airy Shaw 1965; Hutchinson 1967; Hall *et al.* 2002); varied greatly between genera and even between species. Some of the species were very rare and under immediate threat. Some genera and species were restricted only to Gebel Elba region e.g. *Boscia*, and *Cadaba*, while *Capparis* spp. were of common occurrence in the Mediterranean region, Sinai, along the Red Sea coast, and the Oases of the Western Desert.

The genus *Maerua* is represented in Egypt by two species: *Maerua crassifolia* and *M. oblongifolia*. Corolla either absent in *M. crassifolia* or present (4 petals) in *M. oblongifolia*. Boulos (1999) described that genus *Maerua* has no androphore, but the intensive study of both fresh and herbarium specimens, and Rechinger (1970) showed that stamens of different species of *Maerua* either borne on androgynophore or on torus. *M. crassifolia* inhabits sandy plains, stony wadis and slopes. Kassas and Zahran (1971) noted that *M. crassifolia* grows on runnels dissecting the north and east facing slopes at the feet of the coastal hills of Gebel Elba massive. The previous studies showed that *M. crassifolia* is not under immediate threat but it is at risk because of expected future disturbance. Clearing of the vegetation for the establishment of new settlements, especially in the Oases and along the red Sea coast, cutting by natives and using the branches in roofing or firewood are other causatives for the species decline (El Hadidi *et al.* 1992). *M. oblongifolia* is characterized by broadly to narrowly oblong leaf, presence of petals, and many stamens inserted on 0.5 cm torus.

Boscia is represented in Egypt by two species namely *B. senegalensis* and *B. angustifolia*. In Egypt, *B. senegalensis* is an endangered plant. The extreme rarity of this species can be related to its limited geographical distribution in the country which represents the northernmost limit of the taxon distribution in Africa (El-Hadidi *et al.* 1992). Continuous cutting of the trees of *B. angustifolia* by the natives endangers this taxon. On the other hand, El-Karemy (2001) claimed that the occurrence of this species in Egypt is uncertain. El-Gazzar and Hamouda (2006) recorded *B. salicifolia* Oliv. as a new record to the Egyptian flora. They men-

tioned that this species was collected from Egypt, and was deposited in the two herbaria of Cairo University (CAI) and Agricultural Museum (CAIM). It was mentioned in earlier floristic treatments (unpublished lists and accounts of field trips that were conducted in the 1930's) but were overlooked in subsequent floristic works. However, our results exhibited that the occurrence *B. salicifolia* in the flora of Egypt is uncertain, and needs further studies.

The genus *Cadaba* is represented in Egypt by 3 species *C. glandulosa*, *C. rotundifolia* and *C. farinosa*. El-Hadidi *et al.* (1992) stated that *C. farinosa* is under immediate threat; but perhaps at risk because of its low population size and very restricted geographical distribution in Egypt. The nature rarity of *C. rotundifolia* in Egypt can be related to its limited distribution representing the northernmost limit in Africa. It was previously recorded from the Red Sea and Gebel Elba areas. Intensive search during the last decade proved its rarity to almost complete disappearance. This can be related to the recent touristic development of the area along the Red Sea coast. The plant is said to be purgative so that the native severely gathered its parts. During the last years the amount of rainfall was scanty leading to the species decline (El-Hadidi *et al.* 1992). *C. glandulosa* is a chamaephyte that grows on rocky plains and hills. The species vulnerability can be related to its small population size combined with severe collecting by Bedouins who use it as a firewood plant.

The study of the reproductive characters of genus *Capparis* L. is problematic because of the difficulty of preserving the flowers (Hedge and Lamond 1970). It is a large and polymorphic genus that includes about 250 woody species distributed in the tropical and subtropical regions of the Old and New world. According to Iltis (2001), there are about 110 *Capparis* taxa in the Old world. Infrageneric treatments have been proposed for it by various authors (De Candolle 1824; Endlicher 1836; Pax and Hoffmann 1936; Zohary 1960; Hutchinson 1967). Inocencio *et al.* (2005) used a genetic fingerprinting technique (AFLP) to determine the relationships among *Capparis* spp. The group of plants recognized as *C. spinosa* on the basis of morphological characters, included several cultivars and appears in an intermediate position between *C. orientalis* and *C. sicula*, and overlapped with each other. Although the results cannot confirm the hybrid origin of *C. spinosa*, the distribution of the bands supports the hybrid origin of *C. spinosa*. The present work showed that there was a combination of characters that segregated *C. decidua* from the remaining *Capparis* spp. These characters were: deciduous leaf, small flowers in corymbose inflorescence, red petals and globose fruit. This was also in agreement with the findings of Täckholm (1974) and Boulos (1999). The results were also in consistent with suggestion of Boulos 1999, in considering *C. sinaica* as a separate species on the bases of deeply saccate, helmet shape posterior sepal, and glaucous fleshy leaf. However, Rechinger (1970) and Täckholm (1974) have their own conclusion based on studying of substantial amount of material from Iran and Egypt in considering *C. sinaica* Decne as a variety of *C. spinosa*. This species, as reported by several authors (e.g., Zohary 1960-1966), exhibited a clear trend towards unisexuality by a portion of the ovary.

The taxonomic treatment of *C. spinosa* and its allies has varied greatly with different authors; a species with connection to the Mediterranean, Irano-Turanian and Saharo-Arabian regions. Undoubtedly, the different forms of this broad species, or at least some of them, possess their own geographical distribution and ecology and consequently have different phytogeographical value. Some of the characters used to separate taxa in the *C. spinosa* complex, such as leaf shape, indumentum, sepal size and shape, nectar pits on the petals, petal size and general habitat. From a biogeographical and phylogenetic point of view, *C. spinosa* is characterized by a disjunct, paleotropical range and by plesiomorphic features, that is simple hairs and axillary flowers. Within this group, several taxa from the Mediterranean region, eastern Africa, Madagascar, south-western

and central Asia, Himalaya, Pacific Islands and Australia were known.

Zohary (1966) reported that *C. spinosa* var. *inermis* is one ecotype confined mainly to sea-shore cliffs and marked by its rather succulent leaves, its weak stipular spines, often lacking altogether, and its large flowers. These are characters were common of coastal ecotypes. Several authors (Davis 1965; Boulos 1999; El-Karemy 2001) deal with *C. orientalis* as a variety of *C. spinosa* (*C. spinosa* var. *inermis*), and as separate species (*C. orientalis*) *sensu* Täckholm (1974) and Al-Gohary (1982). Morphologically, *C. spinosa* var. *inermis* resembled *C. sinaica* in having orbicular, and slightly fleshy leaves. Our results revealed that *C. spinosa* var. *inermis* may be elevated as separate species namely *C. orientalis*, matching with Täckholm (1974), Al-Gohary (1982) and Inocencio *et al.* (2005) but contradicted the findings of Boulos (1999). These results need further confirmation based on molecular studies.

On the basis of leaf shape and indumentum, Heywood (1964), Davis (1965) and Zohary (1966) distinguished between *C. spinosa* and *C. ovata*. They explained that *C. spinosa* is characterized by orbicular or ovate orbicular-leaves, fleecy and glabrous stem, while *C. ovata* characterized by obovate, ovate or ovate-oblong and hairy stem. Zohary (1966) also differentiated between two varieties of *C. ovata* depending on leaf shape, size of petals and shape of the nectariferous cavity of posterior petal. He distinguished var. *palaestina* Zoh. that characterized by elliptic oblong leaf, 1.5-2.5 oblong anterior petal which is much longer than posterior one and strongly elevated rim nectariferous cavity of posterior petal. This variety differed markedly from the varieties of *C. spinosa* by its larger and more divergent anterior petals, its soft villous or cob webby indumentum, and its whitish filaments. Boulos (1999) treated this species as *C. spinosa* var. *canescens*, while Täckholm (1974) described it as a separate species *C. leucophylla*. This study agrees with Boulos (1999) in recognition of only one variety named *C. spinosa* var. *canescens*.

Täckholm (1974) treated *C. spinosa* var. *deserti* as a separate species namely *C. deserti*, while Boulos (1999) and El-Karemy (2001) considered it as a variety of *C. spinosa* (*C. spinosa* var. *deserti*). The results of the present study agreed with Boulos (1999) and El-Karemy (2001) in retaining it as *C. spinosa* var. *deserti* on the basis of leaf shape and floral character. This variety is not believed to be under immediate threat, but it is at risk because of its very restricted geographical range of distribution. Future disturbance could result from clearing of the vegetation for search of oil or desert reclamation (El Hadidi *et al.* 1992). Fahmy (1990) traced two populations along Mersa Matruih-Siwa Oasis road, 160 and 203 Km north of Siwa.

Davis (1965) and Zohary (1960, 1966) distinguished between the two varieties: *C. spinosa* var. *spinosa* and *C. spinosa* var. *aegyptia* depending on the shape and size of leaf [var. *spinosa* 30-40 (45) mm long round ovate leaves, while var. *aegyptia* 16-20 (-25) and round leaves]. On the other hand, Täckholm (1974) and Migahid (1988) treated *C. aegyptia* as a separate species, while Boulos (1999) and El-Karemy (2001) considered the same species as the typical variety of *C. spinosa* (*C. spinosa* var. *spinosa*). Controversially, Boulos (1999) and El-Karemy (2001) reported that *C. spinosa* var. *spinosa* is a synonym of *C. aegyptia* and *C. spinosa* var. *aegyptia*. This study also demonstrated that the leaf size is unreliable characters for defining taxa. However, no clear-cut qualitative differences were found and only a few of quantitative nature. So, we agree with Boulos (1999) and El-Karemy (2001) in defining one variety namely *C. spinosa* var. *spinosa*.

Although the facts have led to take a wide view of taxa within the general orbit of *C. spinosa*. This study rejected Täckholm's consideration in that *Capparis* taxa were treated as six species, and recognized only four species, viz., *Capparis sinaica*, *C. decidua*, *C. orientalis* and *C. spinosa*. The latter species included three varieties viz., *spinosa*, *canescens* and *deserti*. However, based on morphological

studies, it is proposed to elevate var. *inermis* to the species level namely *Capparis orientalis* as recommended by Täckholm (1974) and Inocencio *et al.* (2005) and contradict those of Boulos (1999).

REFERENCES

- Abd El-Ghani M, Kamel W, El Bous M** (2007) The leaf architecture and its taxonomic significance in Capparaceae from Egypt. *Acta biologica Szegediensis* **51** (2), 125-136
- Abd El-Ghani M, Marei A** (2006) Vegetation associates of the endangered *Randonia africana* Coss. and its soil characteristics in an arid desert ecosystems of western Egypt. *Acta Botanica Croatica* **65** (1), 83-99
- Ahmed AR, Abdel-Shafeek KA, Abdel-Azim NS, Ismail SI, Hammouda FM** (2007) Chemical investigation of some *Capparis* species growing in Egypt and their antioxidant activity. *Oxfordjournals eCAM* **4** (1), 25-28
- Airy Shaw H** (1965) Diagnoses of new families, new names, etc. for the 7th edition of Willd's (Dictionary). *Kew Bulletin* **18**, 249-273
- Al Gohary I** (1982) Morphological studies on the Capparidaceae in Egypt. MSc thesis, Botany Department, Faculty of Science, Ain Shams University
- Al Gohary I** (1997) Biosystematic studies of Cleomaceae in Egypt. I. The seed morphology and its taxonomic significance. *Desert Institute Bulletin Egypt* **47** (2), 423-440
- APG** (2003) An update of the angiosperm phylogeny group classification for the orders and families of the flowering plants. *Botanical Journal of the Linnean Society* **141**, 399-439
- Boulos L** (1999) *Flora of Egypt (Vol 1) Azollaceae-Oxalidaceae*, Al Hadara Publishing, Cairo, 419 pp
- Bremer K, Chase MW, Stevens PF** (1998) An ordinal classification for the families of flowering plants. *Annals of the Missouri Botanic Gardens* **85**, 531-553
- De Candolle AP** (1824) *Prodromus systematis naturalis regni vegetabilis* 1. Paris
- Cronquist A** (1981) *An Integrated System of Classification of Flowering Plants*, Columbia University Press, New York, USA
- Davis PH** (1965) *Flora of Turkey*, Edinburgh University Press, Edinburgh
- Eichler AW** (1865) *Capparideae*. In: von Martius CFP (Ed) *Flora Brasiliensis* **13** (1), München, pp 237-292
- El Hadidi MN** (2000) *Flora Aegyptiaca. The Palm Press* **1** (1), 1-22
- El Hadidi MN, Abd El-Ghani M, Fahmy AG** (1992) *The Plant Red Data Book of Egypt. I. Woody Perennials*, The Palm Press and Cairo University Herbarium
- El-Karemy ZAR** (2001) Capparaceae in the flora of Egypt. *Taekholmia* **21**(2), 257-267
- El-Gazzar A, Hamouda AA** (2006) Nine revived records to the flora of Egypt. *Egyptian Journal of Biology* **8**, 20-26
- Endlicher SL** (1836) *Genera Plantarum*, Wien
- Endress PK** (1992) Evolution and floral diversity: the phylogenetic surroundings of *Arabidopsis* and *Antirrhinum*. *International Journal of Plant Sciences* **153**, 106-122
- Fahmy AG** (1990) Studies on the threatened plant species in Egypt. Woody perennials. MSc thesis, Cairo University
- Fici S, Valo FL** (2004) Seed dispersal of *Capparis spinosa* L. (Capparaceae) by Mediterranean lizards. *Naturalista Siciliano* **28** (3/4), 1147-1154
- Grisebach AHR** (1859-64) *Flora of the British West Indian Islands*, London
- Hall JC, Sytsma KJ, Iltis HH** (2002) Phylogeny of Capparaceae and Brassicaceae based on chloroplast sequence data. *American Journal of Botany* **89**, 1826-1842
- Hassan L** (1987) Studies on the flora of the eastern Desert, Egypt. PhD thesis, Cairo University
- Hedge IC, Lamond J** (1970) Capparidaceae. In: Rechinger KH (Ed) *Flora Iranica* **68**, Graz pp 1-9
- Heywood VH** (1993) *Flowering Plants of the World*, Oxford University Press, New York
- Heywood VH** (1964) *Capparis* L. (1st Edn), *Flora Europaea*, Cambridge University Press, Cambridge
- Holmgren PK, Holmgren NH, Barnett LC** (1990) *Index Herbarium 1. The Herbaria of the World. Reg. Veg.* (Vol 120), New York Botanical Garden, New York
- Hutchinson J** (1967) *The Genera of Flowering Plants* (Vol 2), Clarendon Press, Oxford
- Iltis HH** (2001) *Capparaceae*. In: Stevens WD, Ulloa C, Pool A, Montiel OM (Eds) *Flora of Nicaragua, Monographic System of the Missouri Botanical Garden* **85**, 566-584
- Inocencio R, Fay C, Alcaraz D** (2005) AFLP fingerprinting in *Capparis* subgenus *Capparis* related to the commercial sources of Capers. *Genetic Resources and Crop Evolution* **52** (2), 137-144
- Jacobs M** (1965) The genus *Capparis* (Capparaceae) from the Indus to the Pacific. *Blumea* **12**, 385-541
- Kassas M, Zahran MA** (1971) Plant life on the coastal mountains of the Red Sea. *Journal of the Indian Botanical Society* **50A**, 571-589
- Khafagi A, Al-Gohary IH** (1998) Biosystematic studies of Cleomaceae in Egypt. II. Taxonomic significance of some micromorphological characters of the leaf and pollen grains. *Al-Azhar Bulletin of Science* **19** (2), 1027-1036
- Khalifa S, Iman F, Al-Gohary H** (1982) Studies on the Capparidaceae. II: Taxonomic significance of micromorphological attributes of the *Cleome* species of Egypt. *Research Bulletin of the Faculty of Agriculture, Ain Shams University* **1959**, 1-13
- Kubitz K** (2002) Introduction to Capparales. In: Kubitz K (Ed) *The Families and Genera of Flowering Plants* 5, Berlin
- Mabberley DJ** (1997) *The Plant Book: A Portable Dictionary of the Higher Plants*, Cambridge University Press, Cambridge
- Migahid AH** (1988) *Flora of Eastern Saudi Arabia*, National Commission for Wild Life Conservation and Development, Riyadh
- Montasir AH, Hassib M** (1956) *Illustrated Manual Flora of Egypt*, Bulletin of the Faculty of Science (Part I, 1st Edn), Ain Shams University, Cairo
- Pax F, Hoffmann K** (1936) Capparidaceae. In: Engler, Prantl (Eds) *Natürlichen Pflanzenfamilien* **17** (b), Engelmann, Leipzig, Germany, pp 146-233
- Rechinger KH** (1970) *Flora Iranica* **86/30**, Akademische Druck-u Verlagsanstalt, Graz, Austria, pp 5-7
- Täckholm V** (1974) *Students' Flora of Egypt*, Cairo University. Coop. Co., Beirut, pp 162-165
- Zahran MA, Willis AJ** (1992) *The Vegetation of Egypt*, Chapman Hall, London, UK
- Zohary M** (1960) The species of *Capparis* in the Mediterranean and the near eastern countries. *The Bulletin of the Research Council of Israel* **8D**, 49-64
- Zohary M** (1966) *Flora Palaestina* (Vol 1), The Israel Academy of Sciences and Humanities, Jerusalem