Bothalia 27,2: 125–128 (1997)

# *FSA* contributions 8: Ceratophyllaceae

C.M. WILMOT-DEAR*

Family **Ceratophyllaceae** *S.F.Gray*, A natural arrangement of British plants 2: 554 (1821).

Aquatic herbs, monoecious, perennating by buds, free-floating; stems branched, often reddish. *Leaves* in whorls of 3–10, filiform, once or more dichotomously branched, often ± rigid and brittle, margins often spinose-dentate, lowest part sometimes swollen and ± sac-like (due to parasite attack), apical segments truncate, 2-spined and with central reddish and glandular projection; stipules 0. *Flowers* unisexual, axillary, male 1(–4), female 1 per node, male and female often at different nodes, ± sessile. *Perianth* lobes (8–)9–12(–15), united at base, some often joined in pairs to over halfway, strap-shaped or obovate, each margin often with single spine or ± lacerate, apex 2-spined and glandular as leaves. *Male flowers*: stamens up to ± 30 in several whorls on domed torus around pistillode; filaments short or 0; anthers oblong, extrorse; loculi 2, parallel, dehiscing longitudinally; connective produced into 2 apical spines and glandular projection; immature anthers flattened, resembling perianth lobes but margins 1–3-spined, mature anthers swollen, glandular projection detached, tissues becoming gas-filled, bearing detached anther to surface where it floats horizontally and dehisces. *Female flowers*: staminodes 0; ovary superior, sessile, ovoid, tapering to long style; ovule 1, pendulous. *Fruit*: an achene, ovoid or ellipsoid, slightly laterally flattened, sometimes sufficiently to form a marginal rim or crenate to spiny wing, a pair of basal spines often present, surface smooth, spiny or warty; style ± persistent, forming a distinct terete apical spine; embryo straight, endosperm absent.

A worldwide family of one genus only.

2516000 CERATOPHYLLUM

**Ceratophyllum** *L.*, Species plantarum 1: 992 (1753); Agnew: 81 (1974); Hauman: 165 (1951); A.Raynal: 103 (1980); Wilmot-Dear: 243 (1985a); Wilmot-Dear: 1 (1985b); Wilmot-Dear: 124 (1991); Symoens & Wilmot-Dear: 212 (1996). Type species: *C. demersum* L.

Description as for family.

*Ceratophyllum* is a more or less cosmopolitan genus, here considered to comprise three very widespread species. Past authors have recognized between one and more than 10 species, although most have accepted three. Recent revisions have all subdivided it into three 'groups', whose types are respectively *C. demersum* L., *C. submersum* L. and *C. muricatum* Cham., but have recognized these groups at differing taxonomic rank. Les (1986, 1989) treats them as three sections, within which six species and several further infraspecific taxa are recognized. Wilmot-Dear (1985a) treated them as species or subspecies, reducing the *C. muricatum* 'group' to a subspecies of *C. submersum* in recognition of their extreme vegetative similarity and the existence (sometimes in the same one population) of a range of intermediate fruit forms, both of which facts suggest a very close affinity between the two taxa. However, taking into account all recent work, it seems more satisfactory to recognize *C. demersum*, *C. submersum* and *C. muricatum* at the rank of species, each having a typical form which is geographically widespread and to which belong most of the specimens collected; in each group other infraspecific taxa, of restricted distribution, are also recognized. In southern Africa only *C. demersum* L. *sensu stricto* and *C. muricatum* Cham. *sensu stricto* have been positively identified. The third species, *C. submersum*, which is very similar to *C. muricatum* but differs in lacking basal spines on its fruit, may also occur here. All fruits seen from southern Africa, however, had basal spines (see also notes under *C. muricatum*).

1a Leaves branching twice, rarely once or (only in lower parts, especially of main axis) thrice, spiny teeth on margin often many, prominent; mature fruit with long apical spine and 2 prominent basal spines, lateral flattening of fruit slight, surface ± smooth . . . . . 1. *C. demersum* var. *demersum*

1b Leaves, at least the majority on all parts of plant, branched 3–4 times, spiny teeth on leaf margin few, always small, inconspicuous; fruit with long or very short apical spine, with or without basal and marginal spines, lateral flattening of fruit ± well marked, forming a longitudinal marginal rim or wing, surface strongly papillose or warty:

2a Fruit with distinct, irregularly crenate to spinulose marginal wing; basal spines present, apical spine (1–)4–9 mm long; surface with abundant, often ± elongated warty papillae . . . . . 2. *C. muricatum* subsp. *muricatum*

2b Fruit with ± distinct marginal rim but without wing; basal spines absent, apical spine up to 15(–20) µm long; surface with numerous tiny warty-prickly papillae giving bristly appearance especially along marginal rim (occurrence in southern Africa unconfirmed) . . . . . 3. ?*C. submersum* var. *submersum*

1. **Ceratophyllum demersum** *L.*, Species plantarum 1: 992 (1753); J.M.Wood: t. 551 (1912); Engl.: 206 (1914); Skan: 326 (1917); Skan: 580 (1925); Robyns: 167 (1948); F.W.Andrews: 14, t. 13 (1950); Cufod.: 106 (1953); Keay: 65 (1954); Friedr.-Holzh.: 1 (1968); Lind & Tallantire: 114 (1971); J.H.Ross: 168 (1972); R.A.Dyer: 152 (1975); Wilmot-Dear: 3 (1985b); Wilmot-Dear: 125 (1991); Symoens & Wilmot-Dear: 214 (1996). Type: *Hortus cliffortianus 446* (BM, lecto.!).

Aquatic herb to 3 m long; main stem to 2 mm diam., delicate to robust and wiry. *Leaves* bright or olive green, 7–11 per whorl, 8–40 mm long, (once–) twice-dichotomous (in lower part of plant sometimes 3 times dichotomous), 0.2–0.7 mm (lowest segments sometimes to 1 mm)

* The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, England.
MS. received: March 1984.

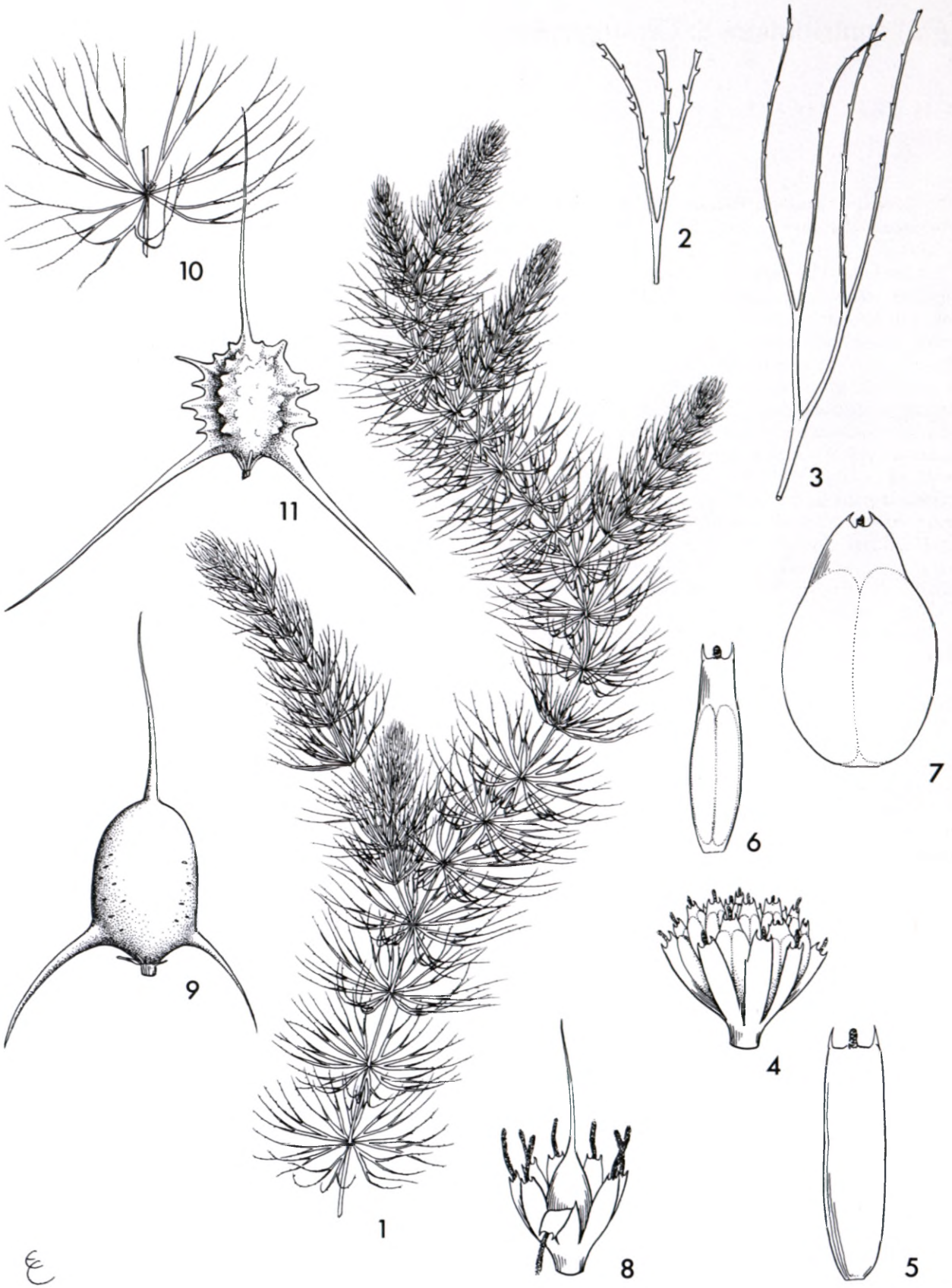


FIGURE 1.—*Ceratophyllum demersum* var. *demersum*, 1.1–1.3; 1.8, 1.9: 1.1, part of plant, × $^{2}/_{3}$, *Mauve 4269*; 1.2, leaf, × 2, *Musil 450*; 1.3, leaf, × 2, *Ward 6582*; 1.8, female flower, × 8, *Bogden 2333*; 1.9, fruit, × 4, *Ward 6582*. *C. muricatum* subsp. *muricatum*, 1.4–1.7, 1.10, 1.11: 1.4, male flower, × 8; 1.5, male perianth segment, × 24; 1.6, immature anther, × 24; 1.7, mature anther, × 24; 1.10, position of stem showing leaf-whorl, × $^{2}/_{3}$, all from *Stephens 31*; 1.11, var. *echinatum*: fruit, *Van der Schijff 5672*. Published with permission of Director, Royal Botanic Gardens, Kew.

thick, apical and often lower segments with many, rarely few, spine-tipped marginal teeth (0.1–)0.2–0.5 mm long. *Male flowers* 1–3 per node, often many per branch, up to 2.5(–3.5) mm in diam.; *perianth* broadly cup-shaped, lobes 0.5–1.3 × 0.2–0.4 mm, glandular projection to 0.2 mm long; *stamens*: up to ± 30, anthers subsessile, 1–2 × 0.4–1.5 mm when mature; pistillode ± 0.6 mm long. *Female flowers* solitary, few per branch; *perianth* closely surrounding ovary, persistent in fruit, lobes resembling male, glandular projection to 0.7 mm long. *Ovary* to 1.0 × 0.6 mm, smooth; style usually over 2 mm long. *Fruit* dark green or red-brown at maturity, surface smooth or finely papillose; basal spines usually long and conspicuous, sometimes reduced or absent.

var. **demersum**

*Ceratophyllum oxyacanthum* Cham.: 504, t. 5, fig. 6b (1829); non Schur. *C. demersum* var. *oxyacanthum* (Cham.) K.Schum.: 748 (1894); Engl.: 178 (1895). Type: Berlin, 1829, *Chamisso s.n.*, (B, holo.; K, photo. of holo.!).

*C. tuberculatum* Cham.: 504, t. 5, fig. 6d (1829). Type: India, Trankenbar [Tranquebar], Feb. 1798, *Klein 506 (3281) in Herb. Willd. 17546* (B-WILLD, holo.; IDC Microfiche No. 7440–29/1267: 1.3–6!).

*Fruit* very slightly laterally flattened and without marginal rim, (3.5–)4.0–5.5 × 3.0–3.5 mm; apical spine (1.5–)3.5–9.0 mm long; basal spines (0.5–)1.5–6.0 mm long; surface ± smooth, yellow-green becoming red-brown, with sparse or numerous slightly raised dark gland-dots. Figure 1.1–1.3; 1.8, 1.9.

Found scattered in Caprivi Strip (Namibia), Botswana (mainly towards north), Northern Province, Gauteng, Mpumalanga, Swaziland, Free State and coastal regions of Western and Eastern Cape; abundant along coastal region of KwaZulu-Natal (Figure 2); of almost worldwide distribution. Occurs in static to fast-flowing shallow or deep water, reed swamps, lakes, rivers, streams; tolerant of brackish estuarine conditions of high salinity but not found in seasonal, highly alkaline pools.

Vouchers: *Allen 416*; *Mauve 4269*; *Ward 7491*; *Van Son 28791*.

2. **Ceratophyllum muricatum** *Cham.* in Linnaea 4: 504, t. 5, fig. 6c (1829). Type: Egypt, Damietta, June 1821, *Sieber s.n.* [B, holo.†; HAL, lecto. (designated in Les: 296 (1986); K, G, iso.!].

*C. demersum* L. var. *muricatum* (Cham.) Hook.f. ex K.Schum.: 749 (1894).

*C. submersum* L. subsp. *muricatum* (Cham.) Wilmot-Dear: 266 (1985a).

Aquatic herb similar to *C. demersum* but usually more delicate and differing as follows: *Leaves* usually lighter green, 13–40 mm long, 3–4 times (rarely only twice in some whorls) dichotomously branched, 0.1–0.3 mm (lower segments sometimes to 2.5 mm) thick, marginal spiny teeth few, rarely numerous, inconspicuous, up to 0.1 mm to 0.2 mm long, often absent from 2 lower segments. *Flowers* resembling those of *C. demersum*, differing as follows: *male flowers* generally 2 per node, often at same node as female, diameter to 2 mm; anthers 8–15, often smaller and relatively broader, 0.6–0.8 × 0.4–0.7 mm. *Female perianth lobes* relatively narrower and usually longer, (1.5–)1.8–2.0 × 0.1–0.3 mm. *Fruit* dark green or brown at maturity, surface usually warty or papillose or sometimes with winged spines, lateral flattening sufficient to form a distinct crenate or spiny wing with spines sometimes longer than basal spines. Figure 1.4–1.7, 1.10.

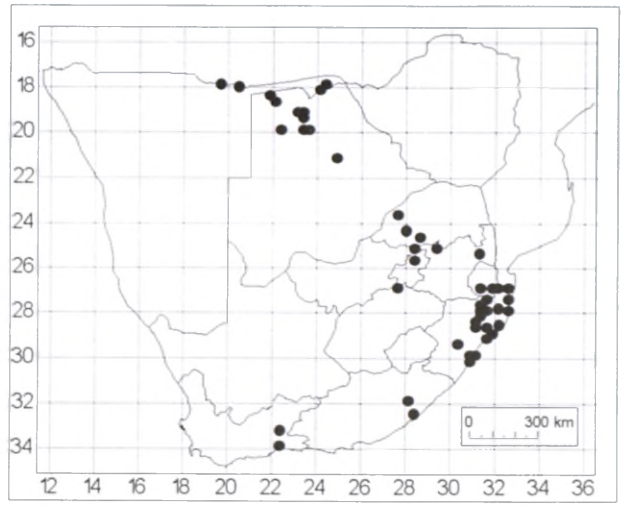


FIGURE 2.—Distribution of *Ceratophyllum demersum* var. *demersum* in southern Africa.

Recent authors have treated the *C. muricatum* group in various ways. However, whichever system is adopted, the taxon found in Africa corresponds to the type of *C. muricatum*.

subsp. **muricatum**

*C. cristatum* Perr. & Guill.: 296 (1833). Type: Senegal, circa Khan and N. 'Batel, ad peninsulam promontorii Vindis, March ?1833. *Guillemin & Perrottet s.n.* (P, holo.; K, iso.!).

*C. submersum* subsp. *muricatum* (Cham.) Wilmot-Dear var. *echinatum* (A.Gray) Wilmot-Dear: 266 p.p. (quoad specimina palaeotropica) (1985a); Wilmot-Dear: 126 (1991).

*C. demersum* sensu auctt. non L.: Skan: 327 (1917) p.p.; Keay: 65 (1954) p.p.

*Fruit* markedly laterally flattened with marginal rim widened into ± entire or irregularly crenate to long-spinose wing, ellipsoid, 3.0–4.5 × 2.0–3.0(–3.5) mm; apical spine (1–)4–9 mm long; 2 basal spines (0.5–)2.0–6.0(–10) mm long; surface rarely smooth, usually with (few–) many small, rounded to ± elongate warty papillae up to 0.2 mm long or sometimes with spines up to 0.3 mm high. Figure 1.11.

Found in Mpumalanga and probably also elsewhere in southern Africa (Figure 3; see note below on non-fruiting material); Senegal, Ghana, Chad, Sudan, ?Mozambique (fruit immature), India and Pacific Islands. Occurs mainly in slow-flowing or stagnant water including seasonal highly alkaline lakes and pools; not found in brackish estuarine conditions.

Voucher: *Van der Schijff 5672*.

Only one of all southern African specimens seen with 3–4 times dichotomous leaves was in fruit and was positively identified as *C. muricatum* subsp. *muricatum*. The identity of the remainder could not be determined for certain and it is possible that some of them belonged to *C.*

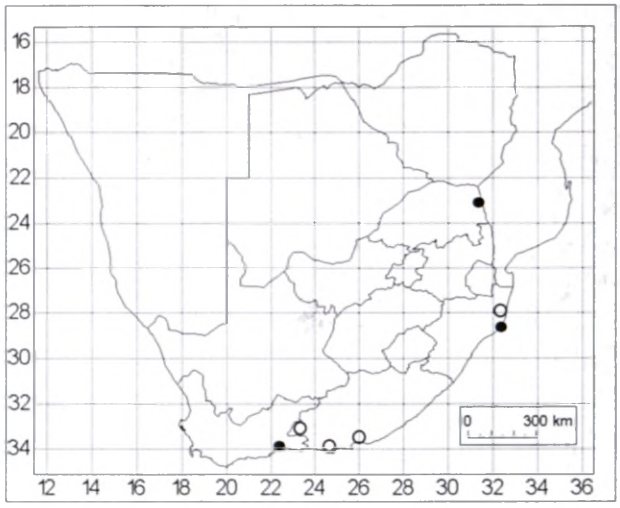


FIGURE 3.—Distribution of *Ceratophyllum muricatum* subsp. *muricatum* in southern Africa: fruiting material of certain identity, ●; non-fruiting material of uncertain identity, ❍.

*submersum* var. *submersum*, which occurs in parts of Africa in the same habitat and is vegetatively almost identical. A brief description of this taxon is therefore given below and it also appears in the key.

Sterile material with 3–4 times dichotomous leaves is found (rather rarely) in eastern KwaZulu-Natal and southern coastal regions of Western and Eastern Cape (Figure 3).

Vouchers (specimens without fruit): *Levyns 752* (BOL); *Stephens 31*.

3. ?**Ceratophyllum submersum** *L.*, Species plantarum edn 2: 1409 (1753); Hauman: 165 (1951); A.Raynal: 103 p.p. (1980); Wilmot-Dear: 4 (1985b); Les: 278 (1986); Wilmot-Dear: 126 (1991); Symoens & Wilmot-Dear: 216 (1996). Lectotype: Vaill.: 16 [not 21 as cited in L.: 1409 (1763)], t. 2, fig. 2(2) (1719).

Aquatic herb almost identical to *C. muricatum* except in fruit. *Flowers*: male with usually less than 10 stamens. *Fruit* 4.5–6.0 × 3.5–4.0 mm, surface with minute papillae or irregular, elongated warts, rarely ± smooth; lateral flattening sufficient to form a rim, this ± warty but never winged or spinose; basal and lateral spines completely absent.

Wilmot-Dear (1985a) considered subsp. *submersum* (which corresponds to *C. submersum* as conceived here) to comprise three varieties, of which only the typical one is widespread and known from Africa. Les (1986) did not consider the other two varieties as distinct.

var. **submersum**

*Fruit* markedly laterally flattened with ± distinct longitudinal 'marginal' rim, ellipsoid, 3–5 × 2.5–3.0 mm; apical spine 0.45–1(–2) mm long; surface rarely smooth, usually with numerous minute warty papillae especially along rim, giving prickly appearance.

Found in Cameroons, Zaïre, east tropical Africa, perhaps southern Africa, Dominica, parts of Europe and Asia.

REFERENCES


AGNEW, A.D.Q. 1974. *Upland Kenya wild flowers*. Oxford University Press.

ANDREWS, F.W. 1950. *The flowering plants of the Anglo-Egyptian Sudan* 1: 13, 14. Buncle, Arbroath.

CHAMISSO, L.K.A VON 1829. Aquaticae quaedam diversae affinitatis II: *Ceratophyllum*. *Linnaea* 4: 503–505.

CUFODONTIS, G. 1953. *Enumeratio plantae aethiopiae spermatophyta* 1: 106.

DYER, R.A. 1975. *The genera of southern African flowering plants*. Vol. 1. Department of Agricultural Technical Services, Pretoria.

ENGLER, H.G.A. 1895. *Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete*. C: 178. Berlin.

ENGLER, H.G.A. 1914. *Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika Expedition* 2.

FRIEDRICH-HOLZHAMMER, M. 1968. 40. Ceratophyllaceae. In H. Merxmüller, *Prodromus einer Flora von Südwestafrika*. Cramer, Lehre.

GRAY, S.F. 1821. *A natural arrangement of British plants* 2: 554, 555. London.

HAUMAN, L.L. 1951. Ceratophyllaceae. *Flore du Congo Belge et du Ruanda-Urundi* 2: 165, 166.

KEAY, R.W.J. 1954. Ceratophyllaceae. *Flora of west tropical Africa*, 2nd edn 1,1: 65.

LES, D.H. 1986. *Systematics and evolution of* Ceratophyllum *L. A monograph*. Ph.D. thesis, Ohio State University.

LES, D.H. 1989. The evolution of achene morphology in *Ceratophyllum*, 4. *Systematic Botany* 14: 254–262.

LIND, E.M. & TALLANTIRE, A.C. 1971. *Some common flowering plants of Uganda*: 114.

LINNAEUS, C. 1753. *Species plantarum*. Salvius, Stockholm.

LINNAEUS, C. 1763. *Species plantarum*, edn 2. Salvius, Stockholm.

PERROTTET, G.S. & GUILLEMIN, J.B.A. 1833. Ceratophylleae. In J.B.A. Guillemin, G.S. Perrottet & A. Richard, *Florae senegambiae tentamen* 8: 296, 297.

RAYNAL-ROQUES, A. 1980. Ceratophyllaceae. In J.R. Durand & C. Leveque, *Flore et faune aquatiques del l'Afrique Sahelo-Soudanienne*: 103. Paris.

ROBYNS, F.H.E.A.W. 1948. *Flore des Spermatophytes du Parc National Albert* 1: 167.

ROSS, J.H. 1972. The flora of Natal. *Memoirs of the Botanical Survey of South Africa* No. 39.

SCHUMANN, K. 1894. Ceratophyllaceae. In C.F.P. Martius, *Flora brasiliensis* 3,3: 738–752. München.

SKAN, S.A. 1917. Ceratophylleae. In D. Prain, *Flora of tropical Africa* 6,2: 326, 327. Reeve, London.

SKAN, S.A. 1925. Ceratophylleae. In T. Thiselton-Dyer, *Flora capensis* 5,2: 580, 581. Reeve, London.

SYMOENS, J.J. & WILMOT-DEAR, C.M. 1996. Les Ceratophyllaceae du Cameroun. *Bulletin des Séances de l'Académie royale des Sciences d'Outre-Mer* 42: 209–220.

VAILLANT, S. 1719. Caractères de quatorze genres des plantes. *Académie Royale des Sciences*, Paris, Histoire 1719: 9–47.

WILMOT-DEAR, C.M. 1985a. *Ceratophyllum* revised—a study in fruit and leaf variation. *Kew Bulletin* 40: 243–271.

WILMOT-DEAR, C.M. 1985b. Ceratophyllaceae. In R.M. Polhill, *Flora of tropical East Africa, Ceratophyllaceae* 1–5. Balkema, Rotterdam.

WILMOT-DEAR, C.M. 1991. Ceratophyllaceae. In E. Launert & C.V. Pope, *Flora zambesiaca* 9: 124–128. London.

WOOD, J.M. 1912. *Natal plants* Vol. 6. Natal Government & Durban Botanic Society.