

# 1. CALLITRICHE Linnaeus, Sp. Pl. 2: 969. 1753.

水马齿属 shui ma chi shu

Morphological characters and geographical distribution are the same as those of the family.

The name *Callitriche stagnalis* Scopoli has been misapplied E of the Ural mountains of Russia. In China it has mainly been applied to *C. fehmedianii*.

In 1966, *Callitriche alata* A. I. Baranov & Skvortsov was described, based on a single specimen. The description is insufficient to separate it from other taxa occurring in the region; few details of reproductive features are provided and could apply to *C. fuscicarpa*, *C. palustris* var. *oryztorum*, or *C. raveniana*. The details of the holotype are also very sparse, and it is not clear how easy it might be to recognize it if it is represented in other herbaria.

- 1a. Fruit wingless.
  - 2a. Bracts lacking; fruits expanded at base to form ridge (strumose) ..... 6. *C. peploides*
  - 2b. Bracts present; fruits not expanded at base.
    - 3a. Bracts large and ovate; leaf venation simple ..... 4. *C. palustris*
    - 3b. Bracts as long as fruit but narrow; leaf venation complex ..... 3. *C. fuscicarpa*
- 1b. Fruit clearly winged.
  - 4a. Fruit widest in upper half, tapering from above midpoint to base.
    - 5a. Bracts lacking; leaves very uniform with 3 main veins ..... 5. *C. japonica*
    - 5b. Bracts present; leaves variable with 1 to many veins ..... 4. *C. palustris*
  - 4b. Fruit widest at or near middle.
    - 6a. Fruit winged only at top ..... 7. *C. glareosa*
    - 6b. Fruit winged all around.
      - 7a. Bracts lacking ..... 1. *C. hermaphroditica*
      - 7b. Bracts present.
        - 8a. Bracts shorter than 0.5 mm; leaves very uniform with 3 main veins ..... 8. *C. raveniana*
        - 8b. Bracts longer than 0.5 mm; leaves variable with 1 to many veins.
          - 9a. Wing of fruit narrower than 1 mm; dry fruits shorter than 1.1 mm ..... 3. *C. fuscicarpa*
          - 9b. Wing of fruit wider than 1 mm; dry fruits longer than 1.3 mm ..... 2. *C. fehmedianii*

**1. *Callitriche hermaphroditica*** Linnaeus, Cent. Pl. 1: 31. 1755.

线叶水马齿 xian ye shui ma chi

Plants always submerged. Leaf blades all ± lingulate or tapering from base, 5.5–15.3 × 0.6–1.8(–2.2) mm, translucent, slightly to markedly narrower at apex than base, with a single vein. Flowers solitary, a staminate flower or carpellate flower in 1 or both of a pair of axils; bracts lacking; styles 0.6–2.4(–2.5) mm, initially erect, recurved and eventually appearing to emerge below apex of mature fruit; filaments 0.5–0.9 mm, erect, continuing to grow after dehiscence; anthers (0.1–)0.2–0.6 × 0.2–0.7 mm, reniform, translucent; pollen grains colorless, ± circular, 20–30 × 20–30 μm, smooth. Fruits dark brown when mature, 1.2–2.4 × 1.2–2.9(–3) mm, ± as wide as high; mericarps divergent, such that from above fruit appears crosslike; testa cells in rings; fibrils only in wing cells.

Lakes, still water; 4000–5000 m. NE Nei Mongol, SE Xizang [pan-boreal].

- 1a. Dry fruits 1.2–1.6(–1.7) × 1.2–1.7 mm; wing 0.1–0.4 mm wide ..... 1a. subsp. *hermaphroditica*
- 1b. Dry fruits (1.5–)1.6–2.4 × (1.6–)1.7–2.8(–3) mm; wing 0.2–0.7(–0.8) mm wide ..... 1b. subsp. *macrocarpa*

**1a. *Callitriche hermaphroditica*** subsp. *hermaphroditica*

线叶水马齿(原亚种) xian ye shui ma chi (yuan ya zhong)

*Callitriche autumnalis* Linnaeus; *C. bifida* Morong.

Dry fruits 1.2–1.6(–1.7) × 1.2–1.7 mm; wing 0.1–0.4 mm wide.

Lakes, still water. NE Nei Mongol (Da Hinggan Ling) [pan-boreal].

**1b. *Callitriche hermaphroditica*** subsp. *macrocarpa* (Hegelmaier) Lansdown, *Watsonia* 26: 106. 2006.

大果水马齿 da guo shui ma chi

*Callitriche autumnalis* f. *macrocarpa* Hegelmaier, *Verh. Bot. Vereins Prov. Brandenburg* 9: 35. 1867.

Dry fruits (1.5–)1.6–2.4 × (1.6–)1.7–2.8(–3) mm; wing 0.2–0.7(–0.8) mm wide.

Lakes, still water; 4000–5000 m. SE Xizang [pan-boreal].

**2. *Callitriche fehmedianii*** Majeed Kak & Javeid, *J. Bombay Nat. Hist. Soc.* 79: 167. 1982.

西南水马齿 xi nan shui ma chi

Plants submerged, with floating rosettes, on wet mud or creeping through and over other plants. Petiole 1.1–5.2 mm; leaf blade spatulate and very broadly expanded, 2.5–9.9(–10) × 0.4–6.7 mm; venation complex, characterized by primary and secondary veins, plus additional loops and anastomosing veins both within and outside secondary veins. Flowers solitary in leaf axils; bracts persistent, sexually dimorphic, those

subtending carpellate flowers ca. 0.3 mm and staminate flowers 0.5–1.2 mm; styles shorter than 1.5 mm, persistent, erect to spreading when young, reflexed on mature fruit; filaments shorter than 2 mm, ± erect; anthers ca. 0.5 × 0.6 mm; pollen ovoid-ellipsoid, yellow, 18–21 × 16–20 μm. Fruit 1.3–1.5 × 1.6–1.9 mm, wider than high, dark with paler wing, subsessile or on pedicel shorter than 0.8 mm, broadly winged all round; wing 0.2–0.4 mm at top, 0.2–0.4 mm at side. Fr. Apr–Oct.

Pools, ditches, springs; 1100–3000 m. SE Xizang, C and W Yunnan [Bhutan, India, Indonesia (Sulawesi), Thailand].

### 3. *Callitriche fuscicarpa* Lansdown, Novon 16: 355. 2006.

褐果水马齿 he guo shui ma chi

Plants submerged or with floating rosettes. Petiole 2.9–5 mm; blade of submerged leaves ± lingulate, 6–9.7 × 0.5–0.8 mm; blade of those toward or at surface expanded, shorter than petiole, spatulate, 3.2–5.2 × 2.3–4.2 mm; venation complex, characterized by primary and secondary veins, plus additional sometimes branched loops and anastomosing veins outside secondary veins. Flowers solitary in axils or occasionally 2 carpellate flowers opposed by 1 staminate flower; bracts 0.7–1.1 mm, persistent; styles erect to slightly spreading, 0.7–1.2 mm; filaments (0.6–)1.8–2.3 mm, ± straight; anthers ca. 0.3 × 0.3 mm; pollen 20–24 × 15–20 μm, yellow. Fruit 0.7–1.1 × 0.7–1 mm, as long as or slightly longer than wide, dark brown becoming reddish, with faint reticulate pattern, resembling that of fruits of *C. palustris*, subsessile or pedicel shorter than 1 mm; wing poorly developed or up to 0.08 mm at top and side. Fr. Apr–Aug.

Lakes, ponds, swamps, marshes; 1800–3500 m. E Xizang, NW Yunnan [N India, Japan (Hokkaido), Nepal].

### 4. *Callitriche palustris* Linnaeus, Sp. Pl. 2: 969. 1753.

水马齿 shui ma chi

Plants submerged, with floating rosettes or on wet mud. Blade of lingulate leaves linear to narrowly expanded, (4–)5.6–9.7 × 0.5–1.2 mm, emarginate, with single vein; blade of expanded leaves elliptic to ± orbicular, 3.6–9.9(–10.3) × 1.2–4.3(–4.5) mm; most leaves with tertiary vein, generally also with additional veins arising from secondary veins, either as loops rejoining adjacent secondary veins or as short slightly curved veins pointing ± directly to leaf blade margin. Flowers usually represented by a carpellate flower in each axil or a staminate and carpellate flower in an axil opposed by a single carpellate flower, or more occasionally 1 staminate and up to 3 carpellate flowers opposite a single carpellate flower in an axil; solitary flowers of both sexes may occur with either a shoot or nothing in opposite axil; bracts translucent, whitish, persistent, caducous or lacking; pollen 6–24 × 5–23 μm, probably inaperturate, yellow, ± spherical, exine strongly ornamented, sculpture type a reticulate pattern or muri, lacking supracteal elements. Fruits 0.9–1.4 × 0.8–1.1 mm, sessile, higher than wide; wing 0.05–0.16 mm wide or lacking, when present wider toward apex of fruits.

Lakes, ponds, swamps, marshes, streams, ditches, rice fields; near sea level to 9500 m. Anhui, Fujian, Guangdong, Guizhou, N Heilong-

jiang, Hubei, Jiangsu, Jiangxi, E Jilin, E Liaoning, E Nei Mongol, Qinghai, Sichuan, Taiwan, SE Xizang, Yunnan, Zhejiang [Bhutan, India, Japan, Kashmir, Korea, Nepal, Russia; Europe, North America].

- 1a. Fruit winged all around, wing wider than 0.1 mm at top ..... 4b. var. *elegans*
- 1b. Fruit winged only at top, wing narrower than 0.1 mm.
  - 2a. Mature fruit blackish; bracts and style caducous ..... 4a. var. *palustris*
  - 2b. Mature fruit brown; bracts and style persistent ..... 4c. var. *oryzeturum*

### 4a. *Callitriche palustris* var. *palustris*

水马齿(原变种) shui ma chi (yuan bian zhong)

*Callitriche fallax* Petrov; *C. verna* Linnaeus; *C. verna* var. *fallax* (Petrov) H. Hara.

Bracts 0.5–1 mm, falcate, caducous. Fruit 0.9–1.4 × 0.8–1.1 mm, widest above middle; mericarps parallel; mature fruit black, mericarps sharply reticulate, reticulations appearing ± clearly in vertical rows; wing (0–)0.05–0.16 mm wide, mainly toward apex. Fr. throughout year.

Lakes, ponds, streams, ditches, swamps, marshes; near sea level to 9500 m. Anhui, Fujian, Guangdong, Guizhou, N Heilongjiang, Hubei, Jiangxi, E Jilin, Liaoning, E Nei Mongol, Qinghai, Sichuan, Taiwan, SE Xizang, N Yunnan, Zhejiang [Bhutan, India, Japan, Kashmir, Korea, Nepal, Russia; throughout N part of N Hemisphere; introduced in Australia].

### 4b. *Callitriche palustris* var. *elegans* (Petrov) Y. L. Chang, Fl. Pl. Herb. Chin. Bor.-Orient. 6: 53. 1977.

东北水马齿 dong bei shui ma chi

*Callitriche bengalensis* Petrov, Izv. Glavn. Bot. Sada S.S.S.R. 27: 358. 1928; *C. elegans* Petrov; *C. verna* subsp. *elegans* Petrov ex Komarov & Alissova; *C. verna* var. *elegans* (Petrov) Kitagawa.

Flowers generally with a carpellate and staminate flower in one of a pair of axils opposed by a single carpellate flower in other axil, very occasionally 2 carpellate flowers and 1 staminate flower in a single axil; bracts caducous, 0.8–1.2 mm, falcate; styles erect to slightly spreading, shorter than 1.5 mm; filaments ± straight, fugacious, rarely visible in axils below rosettes, shorter than 2.2 mm; anthers ca. 0.4 × 0.3 mm; pollen yellow, ovoid-ellipsoid, 21–26 × 17–25 μm. Fruit 1–1.4 × 0.7–1.1 mm, widest above middle, slightly strumose, black when mature, mericarps sharply reticulate, reticulations appearing ± clearly in vertical rows; wing less than 0.3 mm wide, mainly toward apex. Fr. throughout year.

Lakes, ponds, streams, ditches, swamps, marshes; near sea level to 5000 m. N Heilongjiang, Hong Kong, Jiangxi, E Jilin, Liaoning (Anshan), E Nei Mongol [Japan, E Russia].

### 4c. *Callitriche palustris* var. *oryzeturum* (Petrov) Lansdown, Novon 16: 359. 2006.

广东水马齿 guang dong shui ma chi

*Callitriche oryzeturum* Petrov, Izv. Glavn. Bot. Sada

S.S.S.R. 27: 358. 1928.

Flowers with a carpellate and staminate flower in each axil, very occasionally 2 carpellate flowers and 1 staminate flower in a single axil; bracts persistent, broadly ovoid, 0.58–0.9(–1) mm; styles erect to spreading, shorter than 1.7 mm; filaments straight; 1.6–2.7 mm; anthers 0.4–0.5 × 0.3–0.4 mm. Fruit 0.7–1 × 0.6–0.8 mm, widest near middle, mature fruit brown, smooth; wing lacking or up to 0.1 mm, only at apex. Fr. Mar–Oct.

Ditches, marshes, rice fields; near sea level to 3300 m. Fujian, Guangdong, Taiwan, Yunnan, Zhejiang [Japan].

**5. *Callitriche japonica*** Engelm. ex Hegelmaier, Verh. Bot. Vereins Prov. Brandenburg 10: 113. 1868.

日本水马齿 ri ben shui ma chi

*Callitriche nana* B. C. Ho & G. T. P. Vo.

Plants terrestrial on wet soil, riverine mud, or graveled tracks. Petiole 1–1.5 mm; leaf blade expanded, 1.5–4.5 × 1–2.5 mm, shiny and very neat in appearance; venation simple, generally limited to 1 primary and a pair of secondary veins with occasional short veins arising within and outside secondary veins. Flowers solitary, most frequently a pair of axils with a carpellate flower opposed by a staminate flower; bracts lacking; styles 0.28–0.33 mm, ± straight; filament 0.2–0.4 mm, ± straight; anthers 0.1–0.2 × 0.1–0.3 mm; pollen ca. 13 × 15.4 μm. Fruit 0.7–1 × 0.7–1 mm, brown to blackish when mature, tapering toward base; wing 0.05–0.13 mm at apex, 0.03–0.08 mm at side. Fr. Mar–Aug.

Riverbanks, disturbed ground, roads; near sea level to 2100 m. Fujian, Jiangxi, Taiwan [India, Indonesia, Japan, Thailand].

**6. *Callitriche peploides*** Nuttall, Trans. Amer. Philos. Soc. 5: 141. 1835.

台湾水马齿 tai wan shui ma chi

Plants terrestrial on wet soil or gravel. Leaf blade expanded, spatulate-obovate, 1.4–2.3 × 0.4–0.8 mm; venation simple, generally limited to 1 primary and a pair of secondary veins. Flowers usually in pairs, a staminate and a carpellate flower opposed by a solitary carpellate flower in a pair of axils; bracts lacking; styles shorter than 0.2 mm, erect or patent, persistent; filaments shorter than 0.2 mm, erect or patent; anthers ca. 1 × 1 mm, reniform; pollen ± spherical, yellow. Fruit black when mature, ca. 0.5 × 0.7–0.8 mm, wider than high, a little tapered toward base; wing lacking to narrow throughout, but base of mature fruit expanded to form a protruding ridge (strumose). Fr. Mar–Dec.

Wet mud, tracks, disturbed ground. Taiwan [native to America; introduced in Madagascar and Réunion].

**7. *Callitriche glareosa*** Lansdown, Novon 16: 355. 2006.

西藏水马齿 xi zang shui ma chi

Plants terrestrial on damp gravel. Leaf blade expanded; venation simple, generally limited to 1 primary and a pair of secondary veins. Flowers solitary, most frequently a pair of axils with a carpellate flower opposed by a staminate flower;

bracts lacking; style shorter than 0.6 mm, persistent, reflexed; filaments straight, shorter than 0.5 mm; anthers ca. 0.2 × 0.2 mm; pollen spherical to ellipsoid, yellow, 22–26 × 19–23 μm. Fruits 0.6–0.7 × 0.8–1 mm, slightly wider than high, subsessile or with pedicel shorter than 0.6 mm, faintly reticulate; mericarps expanded toward base, but not strumose; mature fruit black, winged only at apex; wing 0.05–0.1 mm wide. Fr. Mar–Sep.

Wet soil, gravel tracks; ca. 4400 m. S Xizang [Bhutan].

**8. *Callitriche raveniana*** Lansdown, Novon 16: 360. 2006.

细苞水马齿 xi bao shui ma chi

Plants terrestrial. Petiole 1.3–1.5 mm; leaf blade expanded, 2–2.5 × 0.5–0.8 mm; venation simple, generally limited to 1 primary and a pair of secondary veins with occasionally few branches arising from secondary veins. Flowers solitary, usually a carpellate and staminate flower in each axil; bracts persistent 0.2–0.3 mm; styles 0.2–0.3 mm; filaments 0.2–0.3 mm; anthers ca. 0.2 × 0.2 mm; pollen spherical to ellipsoid, yellow, ca. 20 × 18–20 μm. Fruits 0.6–0.9 × 0.8–1.3 mm, wider than high, subsessile to shortly pedunculate, winged throughout; wing 0.07–0.1 mm wide at apex, 0.05–0.08 mm wide at side.

• Streamsides, wet soil, roadsides; near sea level to 300 m. Taiwan.

