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# Anatomic Atlas of Aquatic and Wetland Plant Stems

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# List of abbreviations

ae	aerenchyma
ca	cambium
ccy	central cylinder
ch	chlorenchyma
co	cortex
cr/cry	crystal
cu	cuticle
di	(ray) dilatation
dss	dark-stained substances
duct	duct
en	endodermis
ep	epidermis
ew	early wood
f	fiber
ft	fiber tracheid
ge	gelatinous fiber
gi	girder
gr	growth ring
he	helical thickenings
in	intercellulars, intercellular spaces
ivp	intervessel pit
la	laticifers

med phl	medullary phloem
mu	mucilage
nu	nucleus
p	perforation
pa	parenchyma
peri	pericycle
ph	phloem
phe	phellem
pit	pit
pith	pith
r	ray
rd	resin duct
sc	sclereid
scl	sclerenchyma
sf	septate fiber
si	sieve tube, sieve element
ta	tannins
tr	tracheid
v	vessel
vab	vascular bundle
vrp	vessel-ray pits
xy	xylem



Perennial, rootless submerged carnivorous plant with thin, linear, poorly branched shoot, free-floating. Shoot 8–20 cm long with regular leaf whorls, leaf with one snapping trap 3–6 mm long as two mobile lobes, fine bristles extend the trap. Solitary white flowers above water on a stalk 10–15 mm long, green fertile capsules with 1–12 seeds under water, the most capsules pale and sterile. Overwintering in 6–8 mm large, rhomboid-shaped dormant turions, actively sink down in autumn and float up in spring.

## Distribution and ecology

Cosmopolitan distribution in Old World continents, introduced to the USA. Very rare natural extant distribution only in PL (ca. 8 natural sites) and HU (1–2 sites); extinct from SK, CZ, AT, DE, re-introduced to PL (ca. 10 sites), CZ (ca. 4 sites) and CH (3 sites) to potential suitable habitats. Occurs in lowland standing waters, littoral of shallow lakes, backwater pools and oxbows of larger rivers, peatbogs, fen lakes, also after peat extraction, peaty fishponds. Very stenotopic, only at limited microsites in dystrophic, oligo-mesotrophic waters, shallow loose reed or robust sedge stands. Depends strongly on prey capture and high CO<sub>2</sub> concentration. Under optimum conditions, the plants richly branched, flowering depends mostly on high water temperature, seed set very rare. Plants spread by water birds.

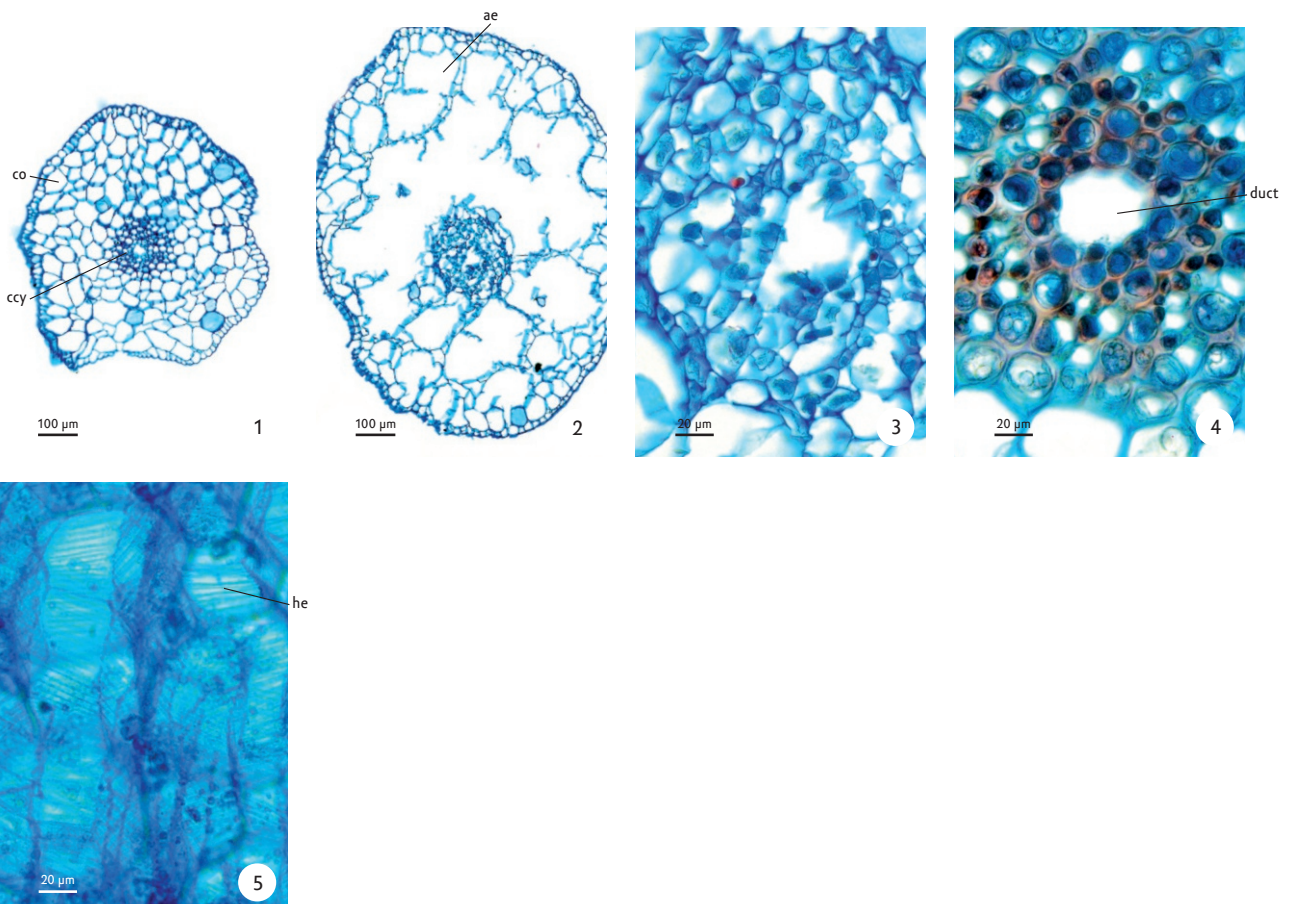
## Anatomy of the submerged annual shoots

Round shoot with a diameter of <1mm. Maximum age 1 year (1, 2).

The central cylinder (stele) is surrounded by a large cortex and an epidermis (1, 2).

A round intercellular canal is located in the center of the stele. The central cylinder contains angular sieve tubes and small companion cells and parenchyma cells (3). Cell differentiation is often difficult (4).

The stele is surrounded by an indistinct endodermis-like row of cells (3). The cortex consists of thin-walled, unligified parenchyma cells (1) or a net-like aerenchymatic tissue (2). The epidermis is composed of thin-walled cells (2). Cell walls of the parenchyma cells in the cortex contain scalariform-like thickenings (5).







Perennial wetland herb, semi-erect rosette of carnivorous leaves 4–8 cm long, rooting in the substrate. Slowly mobile leaf blade narrowly obovate to linear-oblonged, leaves bear many dozens of multicellular mobile emergences, ending with red glandular head. Non-branched thin roots 3–6 cm long with hairs. Oblonged capsules 4–5 mm long, 5–6 mm large hibernaculæ.

### Distribution and ecology

Circumpolar boreo-montane element. Rare in all CE countries, scattered irregularly mainly in wetland and peaty areas both in lowlands and highlands; lowland sites mostly endangered. Occurs in peatbogs, fens, lake and fishpond littorals, drainage canals in peatbogs and fens, typical microhabitats – ecotones between the depressions and *Sphagnum* hummocks. Prefers acidic to neutral substrates (pH ca. 4.5–7). Strictly heliophilous and hygrophilous, stenotopic, competitively very weak.

### Anatomy of the root collar

Round root collar with a diameter of 1 mm, without secondary growth.

The transition zone between the roots and the annual stem consists of a central cylinder (stele) with vascular bundles and a large cortex (1).

The cylinder of the upper part towards the leaves contains irregularly dispersed, closed and collaterally formed vascular bundles between parenchyma cells (3, 4). Vascular bundles consist of a few polygonal cells: lignified vessels, unligified sieve tubes and parenchyma cells (2). Fibers and rays are absent (1, 2). Vessels have a diameter of 10–20 µm and are 40–60 µm long (4). Vessels have round intervessel pits and simple perforation plates (4). Walls of parenchyma in the central cylinder and the cortex cells are net-like thickened (3).

The cortex and the stele are separated by an endodermis with Casparian strips (5). The cortex consists of thin-walled parenchyma cells and small intercellulars (1). The epidermis is thin-walled (1).

