

HYDROPHYTE GROWTH FORMS (text pp. 7-16)**First, a look at the Classical texts on Aquatic Plants:**

Agnes Arber, 1920. *Water Plants: A Study of Aquatic Angiosperms*. Cambridge University Press.

Contents

- I. Water plants as a biological group, with a consideration of certain typical life histories
- II. The vegetative and reproductive organs of water plants
- III. The physiological conditions of plant life in water
- IV. The study of water plants from the phylogenetic and evolutionary standpoints

Duncan Sculthorpe, 1967. *The Biology of Aquatic Vascular Plants*. St. Martin's Press, NY.

Contents

1. Salient features of aquatic vascular plants
2. Salient features of the aquatic environment
3. A link with land plants: Structure and physiology
- 4-7. Chapters on each of the four growth forms
8. Heterophylly
- 9-10. Sexual and vegetative reproduction
11. Geographic distribution
12. Ecology
- 13-14. Aquatic weeds
15. Aesthetic and economic value of aquatic vascular plants

G. Evelyn Hutchinson, 1975. *A Treatise on Limnology: Volume III, Limnological Botany*. John Wiley & Sons, NY.

Contents

- I. The lower rooted vegetation
- II. The nature and diversity of aquatic tracheophytes
- III. Biological characteristics of the tracheophytes of inland waters
- IV. The [limnological] chemical ecology of freshwater macrophytes
- V. The distribution of macrophytes in lakes
- VI. The algal benthos

Growth Forms

Arber

- I. Plants rooted in the soil
 - A. Essentially terrestrial but capable of living in submerged conditions
 - B. Sometimes terrestrial but heterophyllous when submerged
 - C. Plants that produce 3 leaf forms – submerged, floating, and aerial
 - D. Plants which may occur as land forms but are normally submerged
 - with a long, creeping axis
 - E. Plants which may occur as land forms but are normally submerged
 - with a short axis
 - F. Plants which are entirely submerged but with aerial inflorescences
- II. Plants which are not rooted but live unattached in the water
 - A. Plants with floating leaves and aerial flowers
 - B. Plants entirely or partially submerged
 - other subdivisions of these based upon whether inflorescences are aerial or submerged

Sculthorpe

- I. Hydrophytes attached to the substrate
 - A. Emergent hydrophytes
 - B. Floating-leafed hydrophytes
 - C. Submerged hydrophytes
- II. Free-floating hydrophytes

Hutchinson

- A. Free-floating, without roots or roots pendant in the water
 - I. At surface, upper part of plant ordinarily dry
 - a. small, reduced in structure
 - b-d. floating stoloniferous rosettes
 - e. floating rosettes
 - II. Below surface, plant entirely submerged
 - a. small counterparts of Lemnids
 - b. leaves capillary with traps
 - c. leaves capillary in whorls, no traps
- B. Rooted in sediment
 - I. Part of vegetative structure above water most of the year
 - a-b. elongate stems with narrow or lanceolate leaves
 - c. climbing and parasitic emergent plants
 - d-e. floating stems with lanceolate or compound leaves
 - f-g. foliose with emergent leaf, not stem – leaves not circular (f) or circular (g)

Hutchinson (concl.)

- B. Rooted in sediment
 - II. Leaves floating but usually not emergent
 - a. leaves not lanceolate
 - b. leaves lanceolate
 - c. compound leaves
 - d-e. heterophyllous types
 - III. Plant, except inflorescence, submerged
 - a. long stems with creeping rhizome
 - b. short stem with rosette leaves

The text uses the Sculthorpe system:

Emergent (emersed), Submerged (submersed), Floating-leafed, Floating

Emergent (emersed)

Description

Rooted in soil with basal portions that typically grow beneath the surface of the water
(aboveground portions are aerial in conditions with no standing water)
Includes both herbaceous and woody species

General Characteristics

Rely on aerial reproduction, soil as sole source of nutrients, and atmospheric CO₂

Habitats

Shallow surface waters (marshes); shores of lakes, streams

Productivity

Typically the highest productivity among aquatic plants
Maximum biomass (above + belowground): ~ 3980 g m⁻²
Range (above + belowground): 1 to 10 kg m⁻² yr⁻¹
data from Wetzel 2001

Examples

Poales (Grasses, Sedges, Rushes) Asteraceae, Araceae, Polygonaceae, Typhaceae

Submerged (submersed)

Description

Spend most of their lives beneath the water's surface (perhaps with the exception of flowering)

General Characteristics

Most are rooted in the sediments

All photosynthetic tissues are below water, so they rely on dissolved carbon

- pollination by wind or insects in those with truly aerial flowers
- 125-150 spp have pollen transfer at or below water's surface

Most or all plants parts tend to be "soft" because they are supported by the water

Most nutrients come from the sediments, although a minor fraction may be derived from the water, or, more likely, from attached microbial assemblages

- some, such as *Ceratophyllum* and *Utricularia*, have no roots and thus rely on water for nutrients (or, in the case of *Utricularia*, water + other "food")

Habitats

Coastal, estuarine, freshwater aquatic habitats

Productivity

Maximum biomass (above + belowground): ~ 140 to 700 g m⁻² (dep. on trophic status)

Range (above + belowground): 5 to 1500 **grams** m⁻² yr⁻¹
data from Wetzel 2001

Examples

Callitrichaceae, Ceratophyllaceae, Haloragaceae, Potamogetonaceae, *Utricularia*

Floating-leafed

Description

Rooted in the sediments but with leaves that float at the water's surface

General Characteristics

Most have oval, round, or cordate leaves with stomata on the upper surface

Most have long, flexible petioles

Can substantially shade the underlying water column

Most have floating (some aerial) inflorescences

Many exhibit heterophylly, in which floating leaves have a different morphology than submersed leaves

Habitats

Coastal, estuarine, freshwater aquatic habitats

Productivity

Maximum biomass (above + belowground): $\sim 1750 \text{ g m}^{-2}$
Range (above + belowground): 100 to ?? **grams** $\text{m}^{-2} \text{ yr}^{-1}$
data from Wetzel 2001

Examples

Nymphaeaceae, Potamogetonaceae, Ranunculaceae,

Floating

Description

Leaves and stems float on the water's surface – if roots are present, they are pendant within the water column

General Characteristics

Nutrients are absorbed solely from the water column (or from attached microbes)
Plants exhibit extensive vegetative growth
May be wind or insect pollinated
Some are the smallest known angiosperms (“Lemnaceae”)

Habitats

Coastal, estuarine, freshwater aquatic habitats

Productivity

Maximum biomass (above + belowground): ~ 150 (Lemnids) to 1750 (Eichhornia) g m^{-2}
Range (above + belowground): 300 to 5000 **grams** $\text{m}^{-2} \text{ yr}^{-1}$
data from Wetzel 2001

Examples

Lemnaceae, Pontederiaceae, Araceae (*Pistia* and actually, the Lemnaceae)