

UNIT TWO

2. LIFE FORMS

- Plants are classified taxonomically into families, genera, species, varieties, etc.
- This, however, is not the only way to classify plants.
- Species and individuals **can be grouped into life form or growth form classes** on the basis of their similarities in structure and function.
- Plant life form may be defined as **the structural form a plant assumes under the conditions of its habitat.**
- Structural form **reflects a plant's adaptation to its environment and indicates its response to disturbance such as grazing.**
- A plant life form is usually understood to be a growth form which displays an obvious relationship to important environmental factors.

E.g. a deciduous tree is a plant life form that responds to an unfavorable season by shedding its leaves.

- A geophyte is a herbaceous plant form that responds to an unfavorable season by dying back to an underground structure, be it a root or modified underground stem.

A. Main life-form groups according to Du Rietz (1931)

Physiognomic forms	Based on general appearance at full development
Growth forms	Largely based on shoot formation (<i>sensu</i> Warming)
Periodicity-based life forms	Based on seasonal physiognomic differences
Bud height-based life forms	Based on height of buds in the unfavourable season (<i>sensu</i> Raunkiær)
Bud type-based life forms	Based on differences in type and structure of buds
Leave-based life forms	Based on form, size, duration of the leaves

B. Growth forms according to Warming (1909); only main groups distinguished

Hapaxanthic (monocarpic) plants	Plants which reproduce only once and then die; including annuals, biennials and certain perennials, e.g. <i>Agave</i>
Pollakanthic (polycarpic) plants	Plants which reproduce repeatedly
Sedentary generative	Primary root or corm long-lived, with only generative reproduction
Sedentary vegetative	Primary root short-lived, with both generative and some vegetative reproduction
Mobile stoloniferous	Creeping above-ground with stolons which develop rootlets
Mobile rhizomatous	Extending below-ground with rhizomes
Mobile aquatic	Free-floating aquatic plants

C. Main terrestrial life forms according to Raunkiær (1934)

Phanerophytes (P)	Perennial plants with perennating organs (buds) at heights > 50 cm Tree P; Shrub P; Tall herb P; Tall stem succulent P.
Chamaephytes (Ch)	Perennial plants with perennating organs at heights < 50 cm Woody (frutescent) dwarf-shrub Ch; Semi-woody (suffrutescent) dwarf-shrub Ch; herbaceous Ch, low succulent Ch, pulvinate Ch
Hemicryptophytes (H)	Perennial plants with periodically dying shoots and perennating organs near the ground Rosette H; Caespitose H; Reptant H
Geophytes (Cryptophytes) (G)	Perennials losing above-ground parts and surviving below-ground during the unfavourable period Root-budding G; Bulbous G; Rhizome G; Helophyte G
Therophytes (T)	Annuals, completing their life cycle within one favourable growing period, surviving during the unfavourable period as seed or young plant near the ground Ephemeral T (completing cycle several times per growing period); Spring-green T; Summer-green T; Rain-green T; Hibernating green T (green almost all year).

D. Hydrotypes groups according to Iversen (1936).

Terriphytes

Seasonal xerophytes

Euxerophytes

Hemixerophytes

Mesophytes

Hygrophytes

Telmatophytes

Amphiphytes

Limnophytes

Terrestrial plants without aerenchyma

Paludal plants (growing in swamps and marshes) with aerenchyma

Aquatic plants with both aquatic and terrestrial growth forms

Aquatic plants in a strict sense

- In the ponderosa pine zone in northern Arizona, plants can be conveniently classified into the following life-form groupings:
 - 1) Long-lived trees and shrubs,
 - 2) Perennial tall grasses,
 - 3) Perennial midgrasses,
 - 4) Perennial short grasses,
 - 5) Perennial tall, mid-, and short forbs,
 - 6) Perennial prostrate forbs,
 - 7) Short-lived half-shrubs, and
 - 8) Annuals
- Life span and stature are the two most important life-form characteristics in this classification.
- Life span decreases from long lived woody perennials (trees and shrubs) to annuals.
- Stature decreases from tall trees to prostrate herbaceous plants.

- The life form of a plant species is usually a constant characteristics.
- The same species, however, may assume a different life when growing under very different environmental conditions.

E.g certain high altitude tree species assume a creeping growth habit, called “krummholz”, near the upper limit of its distribution, while they grow as perfectly normal trees below.

- Plants of the same life form growing together are likely to compete directly for the same space or niche (ecological role of a species in an environment).

- Their similarity in structure and form indicates a similarity in adaptation to the utilization of the environmental resources offered in a given space.
- The most extreme form of life form similarity is shown among individuals of the same species.
- Wherever they grow close together, they are also the strongest competitors, because they are adapted to use the environmental resources in the same manner.
- Species of very unrelated families may also be of the same life form. E.g. similar stem-succulents evolved in the families Cactaceae, Euphorbiaceae, Asclepidiaceae, and Liliaceae (or Agavaceae) – convergent evolution.

- Plant life forms, or growth forms, can tell you a lot about the forces shaping an ecological community.
- An analysis of the types and relative proportions of life forms in vegetation provides a basis for vegetation comparisons among different places, even when species composition is unknown.
- Life form analysis lends itself to a rapid assessment because it doesn't rely on prior identification of species.
- Examples of growth forms are: annual herbs, broadleaf evergreen trees, drought-deciduous shrubs, plants with bulbs or rhizomes, needle-leaf evergreen trees, perennial bunchgrass, dwarf shrubs.

- Growth form may include life history strategy of a plant, size, life-span, woodiness of a taxon (herb, annual, perennial, herbaceous perennial, woody perennial, tree, or vine).
- Growth form may include the degree of independence of a taxon: green and rooted in the ground, parasitic, saprophytic, epiphytic.
- Growth form may include the morphology of a taxon: stem succulent, leaf succulent, rosette form, spinescent, pubescent.
- Growth form may include the leaf traits: large, small, simple, compound, evergreen, winter-deciduous, drought-deciduous, needle leaf, or broadleaf.
- Growth form may include the location of the perennating bud, as defined by Raunkiaer (1934).

- Expected life forms in different areas.
- Alpine areas - **Chamaephytes** (small, woody or herbaceous perennial, having resting buds not more than 25 cm above soil surface) and **hemicryptophytes** (plant with resting buds at or near the level of the surface) dominated throughout the alpine areas.

Life Form Classification

- According to Raunkiaer, the range of adaptation of plants relates to the mode of shoot withdrawal in the unfavorable season.
- Perennial plants range from no withdrawal in trees, shrubs, and herbs in humid tropics, to foliage withdrawal in deciduous woody plants and shoot-reducing shrubs and herbs (chamaephytes and hemicryptophytes), to total shoot reduction in geophytes.
- The most complete form of shoot reduction is represented by the annuals or therophytes, which survive only in the form of seeds.

1. Phanerophytes

- the surviving buds or shoot apices are borne on shoots which project into the air.
 - i. evergreen trees
 - ii. deciduous trees
 - iii. resting buds more than 25 cm from soil surface

2. Chamaephytes

- the surviving buds or shoot apices are borne on shoots very close to the ground.
 - i. those bearing erect shoots which die back to the portion that bears the surviving buds.
 - ii. resting buds < 25 cm from soil surface
 - iii. passive chamaephytes – persistent weak shoots that trail on or near the ground.
 - iv. active chamaephytes that trail on or near the ground because they are persistent and have horizontally directed growth.
 - v. cushion plants.

3. Hemicryptophytes

- the surviving buds or shoot apices are situated in the soil surface.
 - i. rosette plants bearing all their foliage in basal rosette.
 - ii. Partial rosette plants bearing most of their foliage (and the largest) on short internodes near ground level.

4. Cryptophytes

- the surviving buds or shoot apices are buried in the ground (or under water).
 - i. geocryptophytes or geophytes which include forms with: rhizomes, bulbs, stem tubers, root tubers.
 - ii. marsh plants (helophytes)
 - iii. aquatic plants (hydrophytes)

5. Therophytes

- plants that complete their life cycle from seed to seed and die within a season (this group also includes species that germinate in autumn and flower and die in the spring of the following year).

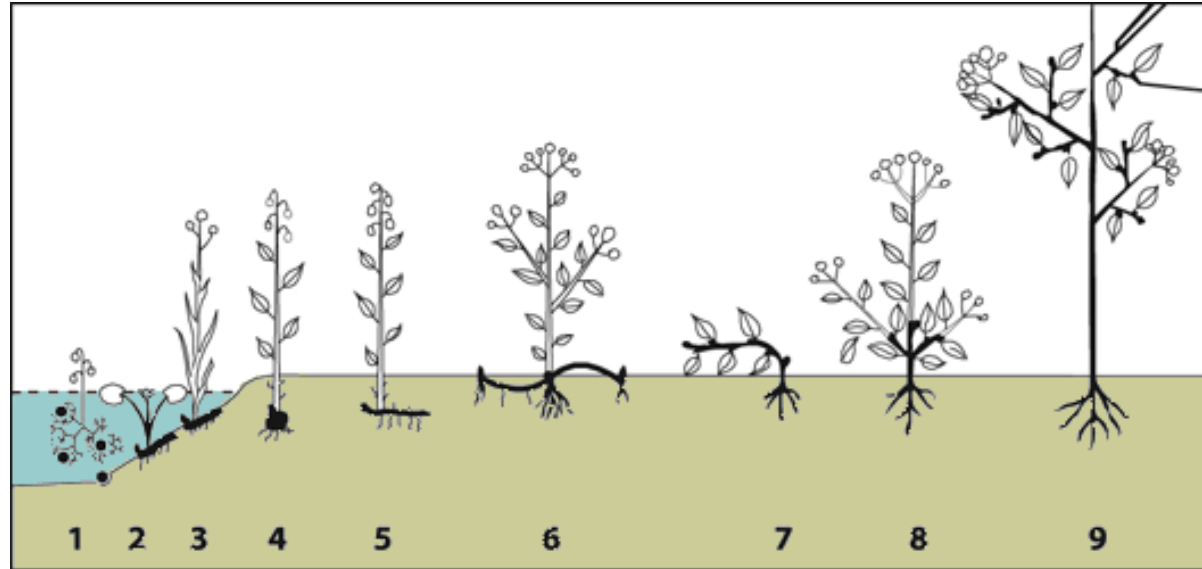
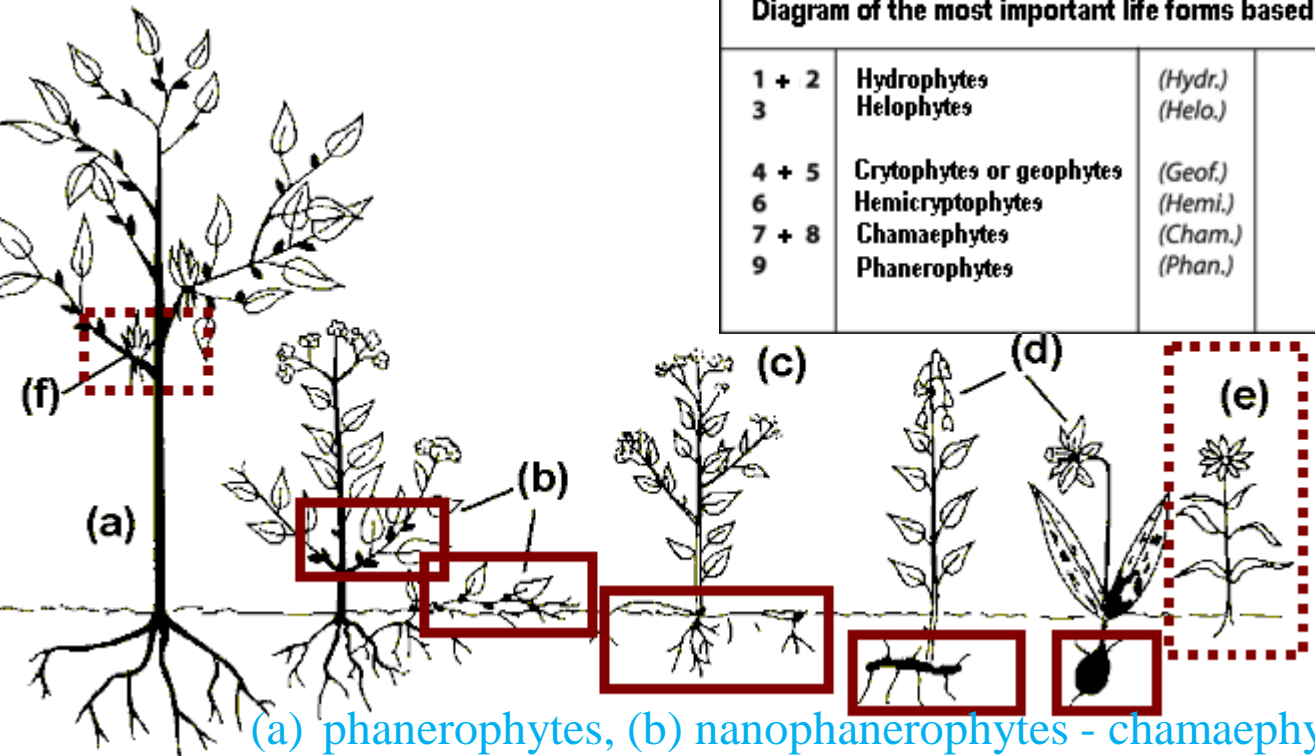


Diagram of the most important life forms based on the classification by Raunkiaer (1934)

1 + 2	Hydrophytes	<i>(Hydr.)</i>	water plants
3	Helophytes	<i>(Helo.)</i>	winter buds under water
4 + 5	Cryptophytes or geophytes	<i>(Geof.)</i>	flowering plants above water
6	Hemicryptophytes	<i>(Hemi.)</i>	winter buds below ground
7 + 8	Chamaephytes	<i>(Cham.)</i>	winter buds above or just below ground
9	Phanerophytes	<i>(Phan.)</i>	winter buds up to 50 cm above ground
			winter buds at least 50 cm above ground (i.e. trees, shrubs and lianes)



(a) phanerophytes, (b) nanophanerophytes - chamaephytes, (c) hemicryptophytes, (d) geophytes, (e) therophytes

Plant strategy types

- A concept more recent than life form which is also closely related to PFT is **plant strategy**.

The best known system of plant strategies is that by Grime (2001).

- **strategies**, ‘groupings of similar or analogous genetic characteristics which recur widely among species or populations and cause them to exhibit similarities in ecology’ (Grime) are the combined characteristics of a PFT.
- These characteristics have also been called **attributes**, used in relation to community changes caused by disturbances.

- The three strategy types proposed by Grime have been maintained virtually unchanged, even if the system has been regularly criticized.
- They enable plants to cope with environmental constraints of two kinds:
 - ✓ **stress**, ‘external constraints which limit the rate of dry matter production’,
and
 - ✓ **disturbance**, ‘destruction of plant biomass arising from outside abiotic, biotic and human impact’.
- The constraints leading to stress can be both shortages and excesses in the supply of resources, but in practice the focus is on shortages.

- Plants in the adult stage have developed three types of strategy.
- **Competitors (C)** are adapted to environments with low levels of stress and disturbance;
- **Stress tolerators (S)** to high stress and low disturbance, and
- **Ruderals (R)** to low stress and high disturbance.
- No plants have developed a ‘viable strategy’ for the combination of high stress and high disturbance.

- By distinguishing intermediate levels of stress and disturbance intermediate (so-called secondary) strategy types are distinguished:
- **competitive ruderals (C-R)** adapted to low stress and moderate disturbance;
- **Stresstolerant ruderals (S-R)** adapted to high stress and moderate disturbance;
- **Stresstolerant competitors (S-C)** adapted to moderate stress and low disturbance;
and
- **C-S-R strategists** adapted to moderate stress and moderate disturbance.

Some adaptations of stress-tolerant, competitive and ruderal plants, selected from the list presented by Grime (2001)

	Stress-tolerant	Competitive	Ruderal
Life form	Herbs, shrubs, trees	Herbs, shrubs, trees	Herbs
Shoots	Wide range of growth forms	Dense leaf canopy Wide lateral spread	Small stature Little lateral spread
Leaves	Small, leathery or needle-like	Robust, mesomorphic	Various, often mesomorphic
Maximum potential growth	Slow	Rapid	Rapid
Response to stress	Responses slow and minor	Maximizing vegetative growth	Less vegetative growth, flowering
Acclimation of photosynthesis and mineral nutrition to seasonal changes in resources	Strongly developed	Weakly developed	Weakly developed
Storage of photosynthates and mineral nutrients	In leaves, stems and/or roots	Rapidly incorporated into vegetative structures, partly stored	In seeds
Longevity of established phase	Long to very long	Long or relatively short	Very short
Longevity of leaves and roots	Long	Relatively short	Short
Leaf phenology	Evergreen; various patterns of leaf production	Peaks of leaf production in periods of maximum	Short phase of leaf production
Perennation	Stress-tolerant leaves and roots	Dormant buds and seeds	Dormant seeds

Assignments

A) Individual Assignment

- Write a term paper on comparison of different ecological succession categories and each mechanism

B) Group Assignment

Review and write a brief term paper on the following topics of vegetation organization:

1. Concepts of population, community and continuum
2. Analysis of communities (analytical and synthetic characters)
3. Classification and ordination
4. Community coefficients and interspecific association of communities
5. Concept of habitat and ecological niche