A key to Raunkiaer plant life forms with revised subdivisions

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I. KEY TO THE MAIN GROUPS OF PLANT LIFE FORMS

Aa Autotrophic plants

Ba Kormophytes (= vascular plants)

Ca *Self-supporting plants*

Da Woody plants, or herbaceous evergreen perennials

Plants that grow taller than 25–50 cm, or whose shoots do not die back periodically to that height limit *

Phanerophytes 1

Plants whose mature branch or shoot system remains perennially within 25–50 cm above ground surface, or plants that grow taller than 25–50 cm, but whose shoots die back periodically to that height limit *

Chamaephytes 2

Db Perennial (including biennial) herbaceous plants with periodic shoot reduction

Periodic shoot reduction to a remnant shoot system that lies relatively flat on the ground surface

Hemicryptophytes 3

Periodic reduction of the complete shoot system to storage organs that are imbedded in the soil

Geophytes (Cryptophytes) 4

Dc Annuals. Plants whose shoot and root system dies after seed production and which complete their whole life cycle within one year **Therophytes** 5

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* In particularly favourable environments (e.g. humid tropics and warm seepage water habitats) this height limit may be extended to 100 cm.

Cb *Plants that grow by supporting themselves on others*

Ea Plants that root in the ground

Plants that germinate on the ground and maintain their contact with the soil **Lianas** (Eu-lianas) 6

Plants that germinate on other plants and then establish their roots in the ground, or plants that germinate on the ground, grow up the tree and disconnect their soil contact **Hemi-epiphytes** (Pseudo-lianas). 7

Eb Plants that germinate and root on other plants (these include dead standing plants, telegraph poles and wires, stumps and such like) **Epiphytes** 8

Cc *Free-moving water plants* (= errants)

Errant vascular Hydrophytes... 9

Bb Thallophytes (= non-vascular cryptogams)

Fa *Plants attached to the ground surface* (here defined as any material making up the surface of the ground, such as mineral soil, rock, humus, litter, decaying wood or other solid media covering the surface)

Ga Perennials

Cushion-formed or pulvinate mosses and liverworts and fruticose lichens **Thallo-chamaephytes** 10

Flat-matted mosses and liverworts, foliose and crustose lichens, algae (including endolithic lichens and algae) **Thallo-hemicryptophytes** 11

Gb Annuals **Thallo-therophytes** 12

Fb *Plants attached to others*, either directly to the bark, leaves or such like, or indirectly to soil and humus pockets occurring in branch-forks, bark fissures etc.

Thallo-epiphytes 13

Fc *Free-moving autotrophic thallophytes* (= errants)

Ha Photosynthesizers

In water (salt, brackish or fresh) **Errant thallo-hydrophytes** 14

In snow and ice **Kryophytes** 15

At and near the soil surface (including humus and decaying wood) **Edaphophytes** 16

Hb Chemosynthesizers **Chemo-edaphophytes** 17

Ab Semi-autotrophic plants

Green plants growing attached to other living autotrophic plants

Ia Kormophytes **Vascular Semi-parasites** 18

Ib Thallophytes **Thallo-semi-parasites** 19

Ac Heterotrophic plants

Ka Kormophytes

Growing on living plants

Vascular Parasites 20

Growing on dead organic matter

Vascular Saprophytes 21

Kb Thallophytes

Growing on or in living plants

Thallo-parasites 22

Growing on dead organic matter

Thallo-saprophytes 23

II. KEY TO THE SUBDIVISIONS OF THE MAIN GROUPS OF PLANT LIFE FORMS

Subdivision has been carried through the autrophic terrestrial plant life form groups 1–13. These are also the main producers of concern to the terrestrial plant ecologist. A satisfactory subdivision of life form groups 14–23 requires special knowledge and would go beyond the present scope.

The key employs the decimal system. The first digit designates the main life form group, e.g.:

1. Phanerophytes
2. Chamaephytes etc.

The second digit denotes the next subgroup, e.g.:

1.1 Phanerophytes with normal woody stems and branches
1.2 Tuft trees
1.3 Bottle trees etc.

The third digit denotes an important characteristic in the Phanerophytes:

1.01 Single-stemmed (scapose) = trees
1.02 branched from near the base (caespitose) = shrubs

The forth digit refers to height classes in the phanerophytes:

1.001 <2 m = nanophanerophytes
1.002 2– 5 m = microphanerophytes
1.003 5–50 m = mesophanerophytes
1.004 >50 m = megaphanerophytes

The above digit places are reserved for these attributes in the phanerophytes. Other important attributes, such as evergreen vs. deciduous, follow by added digits, and whatever attribute best characterizes the subgroups occupies further digit places. In the other life form groups, such as chamaephytes, hemicryptophytes etc., the digits following the first one are also chosen for the next important characteristics, which are of course not always the same as in the phanerophytes. In the height classes, the smallest is always denoted with 1, the next higher one with 2 etc.

In places where a zero (0) occupies a certain digit place, the attribute is undetermined.

Abbreviations of life form names have been added only as far as they are already used in literature.

1. **Phanerophytes** (P)

1.1	Phanerophytes with normal woody stems and branches	P
1.11	*Trees* = single-stemmed phanerophytes with more or less numerous lateral branches (= scapose)	P scap
1.111	Dwarf trees = Nanophanerophytes <2 m	N P scap
1.112	Small trees = Microphanerophytes 2– 5 m	Mi P scap
1.113	Large trees = Mesophanerophytes 5–50 m	Mes P scap
1.114	Giant trees = Megaphanerophytes >50 m	Meg P scap
1.12	*Shrubs* = Phanerophytes branched from near the base of the stem (= caespitose)	P caesp
1.121	Normal-sized shrubs = Nanophanerophytes <2 m .	N P caesp
1.122	Tall shrubs = Microphanerophytes 2–5 m	Mi P caesp
1.123	Giant shrubs = Mesophanerophytes >5 m	Mes P caesp

1.13 "*Krummholz*" = creeping phanerophytes, whose stems or branches are bowed down, but whose height exceeds 50 cm vertically from the ground (= reptant habit) .... rept

1.131 Typical "krummholz" < 2 m ..... N P rept

1.132 Tall "krummholz" > 2 m ..... Mi P rept

The above height classes and the distinction between trees, shrubs and krummholz need to be applied to specific field conditions. For simplifying the mechanism of this classification the following separations are based on features that apply to almost all normally woody phanerophytes (P) in their appropriate size-class ranges, whether they are trees or shrubs.

1.100.1 Evergreen
Broad-leaved

Without bud protection, probably almost exclusively tropical rain (ombro = o) forest species

1.100.11 Malacophyllous (= m; soft leaves that collapse immediately when held over hot water vapor, e.g. *Macaranga*) . omP

1.100.12 Semi-sclerophyllous to sclerophyllous (= s, e.g. *Coffea*) . osP

With bud protection

1.100.13 Malacophyllous (= m, e.g. *Hibiscus tiliaceus*) ..... mP

1.100.14 Sclerophyllous (= s, e.g. *Metrosideros collina*) ..... sP

1.100.15 Needle-leaved (belonido = b, e.g. *Pinus*) ..... bP

1.100.2 Summer-green or cold-deciduous (aestivo = a)

1.100.21 Broad-leaved (e.g. *Fagus*) ..... aP

1.100.22 Needle-leaved (e.g. *Larix*) ..... abP

1.100.3 Drought-deciduous (cheimo = c), mostly with strong bud protection during the dry season, e.g. *Erythryna*) ... cP

Each of these life forms can be further subdivided by:

(a) Crown shape

1.100.001 With sphaerical crown (e.g. *Mangifera indica*)
.002 With umbrella-like crown (e.g. *Samanea saman*)
.003 With cylindrical crown (e.g. *Metrosideros collina* in ash-fallout areas on Hawaii)
.004 With conical crown (e.g. many alpine temperate-zone conifers, but also for example young *Rhizophora mangle*)
.005 With umbellate crown (e.g. *Albizzia moluccana*)
.006 With irregular crown or crown of indefinite shape

(b) Crown extension

1.100.000.1 Crown restricted to the uppermost top of tree (most co-dominant trees of ombrophilous tropical lowland forest)
.000.2 Crown restricted to upper $\frac{1}{3}$ of tree height
.000.3 Crown about $\frac{1}{2}$ length of tree
.000.4 Crown extending down to more than $\frac{1}{2}$ of tree length
.000.5 Crown extending to near the base of the tree

(c) Leaf size (includes phyllodes)

.000.01 Nanophyllous, usually less than 1 cm^2
.000.02 Microphyllous, usually less than 5 cm^2
.000.03 Mesophyllous
.000.04 Macrophyllous, usually larger than 100 cm^2
.000.05 Megaphyllous (giant leaves), usually larger than 500 cm^2

(d) Leaf shape (includes phyllodes)

Needle-shaped leaves, already accounted for as belonido; includes all temperate-zone conifers, but also *Araucaria* and *Casuarina*. The latter has narrow cylindrical phyllodes as photosynthetic organs, which appear needle-shaped.
.001 Scale-needles (e.g. *Thuja, Chamaecyparis*)
.002 Micro-needles, shorter than 1 cm
.003 Meso-needles, 1–5 cm
.004 Macro-needles, longer than 5 cm

Laminate leaves = broad-leaved, already accounted for; this group includes all but the following:
.005 Feathery leaves (many legume trees, e.g. *Albizzia* spp.)

(e) Rooting features that are recognizable above the ground

1.100.000.000.1 Buttresses, board-roots (characteristic for many lowland tropical rain forest trees, e.g. *Ficus variegata, Shorea balangaran* and other dipterocarps)
.2 Stilt-roots, regardless of function (e.g. *Pandanus, Rhizophora, Iriartea orbignyana*)
.3 Pneumatophores = asparagus- or knee-shaped epi-surface roots, e.g. *Avicennia, Sonneratia, Bruguiera*
.4 Aerial roots, suspended as adventitious roots from main stem or branches (e.g. *Eucalyptus robusta* in perhumid rain forest conditions, *Metrosideros*, several *Ficus* spp.)
.5 Xylopod = bulbous, water-storing, mostly subterranean stem base (e.g. *Capparis* spp.)

(f) Bark features

1.100.000.000.01 Green bark, mostly thin or moderately thick (e.g. *Commiphora*)
.02 Thin, smooth, non-green bark (e.g. many humid tropical trees, e.g. *Albizzia moluccana, Ficus religiosa*)
.03 Moderately thick, smooth, non-green bark that remains relatively smooth at maturity (e.g. *Fagus silvatica*, most *Abies* spp.)
.04 Moderately thick, smooth, non-green bark becoming fissured at maturity (e.g. *Fraxinus excelsior, Thuja*)

.05 Thick, fissured bark (e.g. *Quercus robur*, *Pseudotsuga menziesii*, *Pinus ponderosa*)
.06 Thick, corky bark (e.g. *Quercus suber*)

(g) Thorns (thorns and spines in the morphological sense)

1.100.000.000.001 Absent
.002 Very few, mostly on branches
.003 A few, mostly on stem
.004 A few, both on stem and branches
.005 Abundant
.006 Leaves or phyllodes reduced to thorns

(h) Position of inflorescence

1.100.000.000.000.1 Apically (e.g. *Abies*)
.2 Laterally on branches or no definite position, i.e. throughout the crown (e.g. *Pseudotsuga*)
.3 On main stem or main branches, i.e. cauliflory (e.g. *Cercis siliquastrum*, some *Ficus* spp., *Theobroma cacao*, *Couroupita*)

1.2 Tuft trees. Phanerophytes with woody stems and large apical leaf-fronds or terminal, rosulate branches (= rosulate phanerophytes, e.g. palms and tree ferns) ..... P ros

1.201 Dwarf trees = Nanophanerophytes <2 m ..... N P ros
1.202 Small trees = Microphanerophytes 2– 5 m ..... Mi P ros
1.203 Large trees = Mesophanerophytes 5–50 m ..... Mes P ros
1.204 Giant trees = Megaphanerophytes >50 m ..... Meg P ros

The above height classes should be applied to specific field conditions where they arise. Following are the more common forms of rosulate phanerophytes:

1.210 Unbranched
1.210.1 Laminate leaf-fronds (e.g. some *Cecropia* spp.)
1.210.2 Feathery leaf-fronds (e.g. *Cocos*)
1.210.3 Fan-shaped leaf-fronds (e.g. *Mauritia*)
1.220 Branched
1.220.1 Simple, laminate leaf-fronds (e.g. *Xanthorroea*)
1.220.2 Feathery leaf-fronds (e.g. *Schizolobium excelsum*)
1.220.3 Fan-shaped leaf-fronds (e.g. *Hyphaene thebaica*)
1.230 Tufted, twin stems arising from common rootstock or rhizome
1.240 Hollow stem filled with roots (*Puya raimondii*)

1.200.4 Leaves with woolly hair cover (e.g. giant *Senecio* of high tropical mountains)
1.200.5 Semi-succulent leaves (e.g. *Aloë* spp.)

1.3 Bottle trees. Phanerophytes with markedly swollen, water-storing stem (phanerophyta dolaria = dol, e.g. *Adansonia*) .. P dol

1.300 Height and tree-shrub variations can be locally evaluated as before. Therefore the two zero digits.

1.300.1 Evergreen

1.300.11 Normal leaves (e.g. *Brachychiton*)

1.300.12 Leaf-fronds (palm, e.g. *Colpothrinax wrightii*)

1.300.13 Succulent leaves (e.g. *Aloë dichotoma*)

1.300.2 Drought-deciduous (including aphyllous forms,

1.4 Tall succulents, with succulent stem extending from base to apex or with upright growing succulent cladophylls..... P succ

1.400 Height and tree-shrub variations as before, except megaphanerophytes, which are not present

1.410 Single-stemmed, but commonly branched

1.410.1 Cylindri-formed stem

1.410.2 Cladophyllous (e.g. *Opuntia macracantha*)

1.411.1 Nanophanerophytes (e.g. *Ferrocactus wislizenii*)

1.413.1 In height up to mesophanerophyte (e.g. *Carnegia gigantea*)

1.420.1 Caespitose, cylindri-formed, in height up to mesophanerophyte (e.g. *Pachycereus pringlei*)

1.5 Phanerophytes with herbaceous stem or variously lignified (but herbaceously derived) stem. This group includes all herbaceous and suffruticose (woody base with herbaceous branch-ends) perennials that become taller than about 50 cm and do not exhibit a periodic die-back to that height limit. In particularly favourable environments this height limit may be extended to 1 m, e.g. humid tropics, warm seepage water habitats a.o.

1.500 Where applicable, height and scapose-caespitose variations can be evaluated as before. Therefore the two zero digits. A third variation for stoloniferous and rhizomatous forms appears practical to include here

1.500.1 Phanerophytic grasses or graminoid phanerophytes ... P gram

1.500.11 Lignified (e.g. various species of bamboo)

1.520.11 Caespitose

1.530.11 Reptant

1.500.12 Herbaceous (e.g. various species of sugar cane)

1.520.12 Caespitose

1.530.12 Reptant

1.500.2 Phanerophytic forbs (non-graminoid herbs)..... P herb
1.500.21 Lignified (or suffruticose)
1.510.21 Scapose, with large leaf-fronds (e.g. *Musa* spp.)
1.520.21 Caespitose
1.520.211 With large leaf-fronds (some *Musa* spp.)
1.520.212 With normal branches and leaves (e.g. *Indigofera*)
1.530.21 Reptant
1.500.22 Herbaceous
1.510.22 Scapose
1.520.22 Caespitose
1.520.221 Centrally open, or with loose center
1.520.221.1 With large leaf-fronds (tall herbaceous ferns, e.g. *Hicriopteris*)
1.520.221.2 With normal branches and leaves (e.g. *Begonia* spp.)
1.520.222 Centrally dense, or with compact center, usually with flower stalk arising from center
1.520.222.1 Leaves relatively glabrous (non-woolly, e.g. *Lobelia deckenii*, *Lupinus alopecurus*)
1.520.222.2 Leaves woolly
1.530.22 Reptant

2. **Chamaephytes** (Ch)

In addition to the features given in the key (p.56) chamaephytes have typically a shoot-crowding habit. They are more or less broomy or bunchy from the ground up to 30–50 cm. This applies particularly to those with ascending shoots. If they become taller than 50 cm, branches or shoots thin out rapidly as a rule. This is the shoot portion that dies back periodically in the unfavourable season. In more favourable habitats this height limit may be extended to 100 cm, for classifactory reasons. Another typical chamaephyte habit is sprawling along the ground. Therefore, in contrast to phanerophytes, height differences are not as important. Instead, of major importance is the degree of lignification and the habit of the shoot system. But a height classification is given at the end.

2.1 Woody dwarf-shrubs. Woodiness completed into branch-tips. Frutescent chamaephytes ..... Ch frut
2.11 Caespitose (most frequent, therefore "caesp" may be omitted)
2.111 Evergreen
2.111.01 Malacophyllous (m, e.g. *Daphne striata*) .....m Ch frut
2.111.02 Sclerophyllous (s, e.g. *Mahonia aquifolia*) ..... s Ch frut
2.111.03 Aphyllous, phyllocladous (p, e.g. *Ephedra* spp.) . p Ch frut

2.112 Cold-deciduous (aestivo = a, e.g. *Vaccinium myrtillus*) a Ch frut
2.12 Reptant (e.g. *Arctostaphylos uva-ursi*) ..... Ch frut rept
2.13 Pulvinate (cushion form, e.g. *Acantholimon* spp.) .. Ch frut pulv

2.2 Semi-woody dwarf-shrubs. Woodiness restricted to the base of the shoot system. Suffrutescent chamaephytes ..... Ch suff
2.21 Caespitose
2.211 Evergreen
2.211.01 Malacophyllous (e.g. *Helianthemum nummul.*) .. m Ch suff
2.211.02 Sclerophyllous (?) ..... s Ch suff
2.211.03 Aphyllous, phyllocladous (?) ..... p Ch suff
2.212 Cold or drought-deciduous (thero = t, e.g. *Vaccinium parvifolium*) ..... t Ch suff
2.22 Reptant (e.g. *Linnaea borealis*) ..... Ch suff rept
2.23 Pulvinate (?) ..... Ch suff pulv
2.24 Scapose (e.g. *Crotalaria mucronata*) ..... Ch suff scap

2.3 Herbaceous chamaephytes. Includes all non-woody evergreen perennial forbs, grasses and ferns that do not get much taller than 1 m or die back periodically to a remnant shoot system that remains green at least 25 cm above the ground surface ..... Ch herb
2.31 Caespitose
2.311 Evergreen in the strict sense (e.g. *Dryopteris paleacea*) Ch herb
2.312 Shoots dying back periodically, i.e. almost all at once (thero = t); transitory to hemicryptophytes (e.g. *Andropogon virginicus*) ..... t Ch herb
2.32 Reptant
2.321 Evergreen (e.g. *Stellaria holostea*) ..... Ch herb rept
2.322 Shoots with periodic die-back (t, *Stenotaphrum secundatum*) ..... t Ch herb rept
2.33 Pulvinate ..... Ch herb pulv
2.331 Globose (g, e.g. *Androsace helvetica*) ..... g Ch herb pulv
2.332 Flat (f, e.g. *Silene acaulis*) ..... f Ch herb pulv
2.34 Scapose ..... Ch herb scap

2.4 Low succulents. These include all succulents below 50 cm height, except those that die back to a remnant portion at the soil surface (hemicryptophytes) or within the soil (geophytes), e. g. many succulents characteristic of the South African and American deserts .. Ch succ
2.41 Stem-succulents (st, e.g. *Euphorbia mauretanica*) ..... Ch st succ

2.42 Leaf-succulents, some may be hemicryptophytes, which are here included (l, e.g. *Crassula* spp.) ..... Ch l succ

2.43 Root-succulents, with subterranean storage organs (r, e.g. *Pachypodium bispinosum*) ..... Ch r succ

2.5 Poikilohydrous chamaephytes. These are mostly ferns, as far as known, of arid climates, whose water household changes with the humidity of the surrounding atmosphere. Their shoots survive the droughty season in latent condition and become green immediately upon return of moister conditions (e.g. *Cheilanthus hirta*) ..... Ch poik

Subdivisions as to height can be applied where necessary, for example:

2.000.1	Very low chamaephyte	< 3 cm
.2	Low chamaephyte	3– 10 cm
.3	Typical chamaephyte	10– 30 cm
.4	Tall chamaephyte	30–100 cm
.5	Very tall chamaephyte	till > 100 cm

3. **Hemicryptophytes** (H)

The remnant shoot system, which during the unfavourable season lies relatively flat on the ground, is often protected by dead shoot remains. During the growing season the active shoots are always raised above the perennial ground-shoot. Hemicryptophytes are typically herbaceous throughout, but the maturing stem may show some secondary thickening (lignification), particularly when standing as a dead remnant, e.g. in many biennials.

3.10 Caespitose hemicryptophytes (bunched or circular shoot arrangement) ..... H caesp

3.101 Cold-deciduous shoot system (aestivo = a, e.g. *Dactylis*) a H caesp

3.102 Drought-deciduous (cheimo = c, e.g. *Heteropogon contortus*) ..... c H caesp

3.103 Sparingly evergreen (e) during unfavourable season; transitory to chamaephytes (e.g. *Deschampsia flexuosa*) e H caesp

3.20 Reptant hemicryptophytes (creeping or matted) .. H rept

3.201 Cold-deciduous (e.g. *Agrostis stolonifera*) ..... a H rept

3.202 Drought-deciduous (e.g. *Tricholaena repens*) ..... c H rept

3.203 Sparingly evergreen (e.g. *Cynodon dactylon*) ..... e H rept

3.3 Scapose hemicryptophytes

3.30 Without rosette ..... H scap

3.301	Cold-deciduous (e.g. *Scrophularia nodosa*)	a H scap
3.302	Drought-deciduous (e.g. *Chrysopogon acicularis*)	c H scap
3.31	Rosette	H ros
3.311	Cold-deciduous (e.g. *Bellis perennis*)	a H ros
3.312	Drought-deciduous (e.g. *Desmodium triflorum*)	c H ros
3.32	Semi-rosette (sem)	H sem
3.321	Cold-deciduous (e.g. *Ranunculus acer*)	a H sem
3.322	Drought-deciduous (e.g. *Erigeron canadensis* in summer-drought areas)	c H sem
3.4	Aquatic hemicryptophytes (hydrophyte = hyd) ...	hyd H
3.41	Caespitose (e.g. *Isoëtes*)	hyd H caesp
3.42	Reptant (e.g. *Pilularia*)	hyd H rept
3.43	Scapose (e.g. *Lobelia dortmanna*)	hyd H scap

In addition a breakdown into height classes can be applied, where required, as follows:

3.000.1	Very small hemicryptophyte	< 3 cm
.2	Small hemicryptophyte	3– 10 cm
.3	Medium-sized hemicryptophyte	10– 30 cm
.4	Tall hemicryptophyte	30–100 cm
.5	Very tall hemicryptophyte	> 100 cm

4. **Geophytes** (G, Cryptophytes)

These herbaceous plants with their survival organs well protected in the soil are typically found in climates with pronounced unfavourable seasons. However, they may occur also in less severe climates, where they may fill a temporary niche as complementary species in certain plant communities.

4.1	Root-budding geophytes (radicigemma = rad)	G rad
4.11	Spring-green (earizo = ear)	ear G rad
4.12	Summer-green (aestivo = a; e.g. *Cirsium arvense*) ...	a G rad
4.13	Rain-green (cheimo = c)	c G rad
4.2	Bulbous geophytes, arising from bulbs or corms	G bulb
4.21	Spring-green (e.g. *Leucoium vernum*)	ear G bulb
4.22	Summer-green (e.g. *Lilium martagon*)	a G bulb
4.23	Rain-green (e.g. *Stenomesson*)	c G bulb
4.3	Rhizome-geophytes, arising from rhizomes of various lengths	G rhiz

4.31 Spring-green (e.g. *Anemone nemorosa*) ..... ear G rhiz
4.32 Summer-green (e.g. *Agropyron repens*) ..... a G rhiz
4.33 Rain-green ..... c G rhiz

4.4 Aquatic geophytes (hydrophytic = hyd) ..... hyd G
4.41 Root-budding (?) ..... hyd G rad
4.42 Bulbous (?) ..... hyd G bulb
4.43 Rhizome (e.g. *Nymphaea*) ..... hyd G rhiz

Subdivisions as to caespitose, scapose or reptant growth habit can be applied where required:

4.001 Caespitose
4.002 Scapose
4.003 Reptant

Subdivisions for height differences can be applied as follows:

4.000.1	Very small geophyte	< 3 cm
.2	Small geophyte	3– 10 cm
.3	Medium-sized geophyte	10– 30 cm
.4	Tall geophyte	30–100 cm
.5	Very tall geophyte	1– 3 m
.6	Extremely tall geophyte	> 3 m

5. **Therophytes** (T, Annuals)

As a rule therophytes live much shorter than a year and some complete their life cycle within a few weeks. However, exceptions are, for instance, the weeds in the winter-rye fields, which germinate in the fall and flower in the following vegetation period, or the succulent mesembrianthemums of African deserts that, because of their water-storing properties, may live longer than a year after a penetrating rain. Yet, they are therophytes in that they complete their life cycle within one favourable growing period and die after seed production. Not included are the hapoxanthous species (like *Agave*, *Argyroxiphium* a.o.) that die after seed production, but grow for several years before reaching that state. They are true perennials and their life cycle does not depend on one favourable growing season.

5.10 Caespitose therophytes ..... T caesp
5.101 Spring-green (e.g. *Aira caryophyllea*) ..... ear T caesp
5.102 Summer-green (e.g. *Setaria viridis*) ..... a T caesp
5.103 Rain-green (e.g. *Chloris inflata*) ..... c T caesp

5.104 Winter-green, i.e. germinating in fall and living till next summer or fall (metoporino = met, e.g. *Apera spica-venti*) ..... met T caesp

5.2 Reptant therophytes ..... T rept
5.201 Spring-green (e.g. *Veronica hederifolia*) ..... ear T rept
5.202 Summer-green (e.g. *Alopecurus geniculatus*) ..... a T rept
5.203 Rain-green (?) ..... c T rept
5.204 Winter-green (e.g. *Stellaria media*) ..... met T rept

5.3 Scapose therophytes
5.30 Without rosette ..... T scap
5.301 Spring-green (e.g. *Veronica triphyllos*) ..... ear T scap
5.302 Summer-green (e.g. *Chenopodium polyspermum*) .... a T scap
5.303 Rain-green (e.g. *Eragrostis tenella*) ..... c T scap
5.304 Winter-green (e.g. *Ranunculus arvensis*) ..... met T scap
5.31 Rosette, without leaves on the stalk ..... T ros
5.311 Spring-green (e.g. *Erophila verna*) ..... ear T ros
5.312 Summer-green (?) ..... a T ros
5.313 Rain-green (?) ..... c T ros
5.314 Winter-green (e.g. *Arnoseris minima*) ..... met T ros
5.32 Semi-rosette, with leaves on the stalk ..... T sem
5.321 Spring-green (e.g. *Stenophragma thalianum*) ..... ear T sem
5.322 Summer-green (e.g. *Sonchus oleraceus*) ..... a T sem
5.323 Rain-green (?) ..... c T sem
5.324 Winter-green (e.g. *Capsella bursa-pastoris*) ..... met T sem

5.4 Aquatic therophytes (e.g. *Najas*) ..... hyd T

5.5 Succulent therophytes (e.g. *Portulaca oleracea*) .... T succ

Subdivisions for height can be applied as follows:

5.000.1	Very small therophyte	< 3 cm
.2	Small therophyte	3– 10 cm
.3	Medium-sized therophyte	10– 30 cm
.4	Tall therophyte	30–100 cm
.5	Very tall therophyte	1– 3 m
.6	Extremely tall therophyte	> 3 m

6. **Lianas** (L), Eu-lianas

Lianas are treated as a special group, since they depend for their support on other, self-supporting plants or artificial props, which in turn determine also the height of the liana.

6.1 Phanerophytic and chamaephytic lianas, including all climbing plants that do not die back periodically to the ground ..... PL

6.11 Root climbers, closely attached to their support by modified adventitious roots (radici = r) ..... r PL

6.111 Woody (fruticose, e.g. *Hedera helix*) ..... r PL frut

6.112 Semi-woody (suffruticose, e.g. *Parthenocissus* spp.) .... r PL suff

6.113 Herbaceous (?) ..... r PL herb

6.12 Winding climbers, encircling their support (strepano = st) st PL

6.121 Woody (e.g. many tropical lianas) ..... st PL frut

6.122 Semi-woody (e.g. *Humulus lupulus*) ..... st PL suff

6.123 Herbaceous (e.g. *Polygonum dumetorum*) ..... st PL herb

6.13 Tendril climbers, attaching themselves by tendrils of different morphological origin (elitto = el) ..... el PL

6.131 Woody (e.g. *Bauhinia* spp.) ..... el PL frut

6.132 Semi-woody (some *Cissus* spp.) ..... el PL suff

6.133 Herbaceous (e.g. *Passiflora* spp.) ..... el PL herb

6.14 Spread-climbers, propping their branches on other plants (diateino = d) ..... d PL

6.141 Woody (e.g. *Chusquea* and other bamboos) ..... d PL frut

6.142 Semi-woody (e.g. many *Rubus* spp.) ..... d PL suff

6.143 Herbaceous (?) ..... d PL herb

Within each group, subdivisions are possible, e.g.:

6.000.01 Evergreen (no additional symbol)

6.000.02 Cold-deciduous, summer-green (aestivo = a) ..... a

6.000.03 Drought-deciduous, rain-green (cheimo = c) c

Height classes can be applied in relation to the supporting life forms, or for a finer definition separate height classes may be devised by beginning with the 5th digit, i.e. 6.000.1, etc.

6.2 Hemicryptophytic lianas, dying back periodically to a remnant shoot system near the ground ..... HL

6.21 Root climbers (?) ..... r HL

6.22 Winding climbers (?) ..... st HL

6.23 Tendril climbers (e.g. *Vicia sepium*) ..... el HL

6.24 Spread climbers (e.g. *Galium mollugo*) ..... d HL

6.3 Geophytic lianas, dying back periodically to subterranean storage organs ..... GL

6.32 Winding climbers (e.g. *Convolvulus arvensis*) ..... st GL
6.33 Tendril climbers (e.g. *Lathyrus maritimus*) ..... el GL
6.34 Spread climbers (e.g. *Corydalis claviculata*) ..... d GL

6.4 Therophytic lianas ..... TL
6.42 Winding climbers (e.g. *Polygonum convolvulus*) ..... st TL
6.43 Tendril climbers (e.g. *Vicia hirsuta*) ..... el TL
6.44 Spread climbers (e.g. *Galium aparine*) ..... d TL

7. **Hemi-epiphytes,** pseudo-lianas, epiphytic lianas (EL)

These plants may either be classified as lianas or as epiphytes depending on their developmental status during analysis. However, where their nature can be assessed with certainty the following classification may be applied:

7.1 Roots winding around host plant or otherwise surrounding it (e.g. by ramifying roots); stranglers

7.2 Roots descending down without encircling host plant
7.21 Along trunk of host plant
7.22 Hanging free from branches of host plant

8. **Epiphytes** (E), vascular epiphytes

8.1 Epiphytes with normal root systems growing in soil or humus pockets (mostly facultative epiphytes)
8.11 Phanerophytes (e.g. *Cheirodendron trigynum*) ..... PE
8.12 Chamaephytes ..... ChE
8.121 Woody or suffruticose (e.g. *Psilotum nudum*) ..... ChE frut
8.122 Herbaceous ..... ChE herb
8.122.1 With leaves arranged in funnel shape (e.g. *Asplenium nidus*)
8.122.2 With leaves not showing any funnel arrangement, i.e. leaves as in normal soil-adapted herbs (e.g. many orchids)

8.2 Epiphytes with strongly modified root systems, stems or leaves (or other unusual morphological modifications) adapted to growth on branches that have no soil or humus pocket-accumulations in branch forks etc. (mostly obligative epiphytes)
8.21 Succulents (e.g. *Peperomia* spp.) ..... ChE succ
8.22 Non-succulent plants

8.221 With unmodified leaves (i.e. not in any way peculiar or unusual), but modified stems or roots

8.221.1 With strongly swollen stem-base (e.g. *Myrmecodia tuberosa*)

8.221.2 With green string-like roots (e.g. many orchids)

8.222 With strongly modified (i.e. unusual) leaves

8.222.1 With upright cup or funnel-shaped leaves (e.g. *Bromelia* spp.)

8.222.2 With leaves specially adapted to form humus layers (e.g. *Platycerium*)

8.223 With completely modified plant body, resembling bearded lichens (e.g. *Tillandsia usneoides*)

Two ecologically significant height strata can usually be evaluated:

8.000.01 Occupying sun-exposed positions in the upper tree canopy

8.000.02 Occupying lower canopy area and lower branches, growing in more shaded positions

9. **Errant vascular Hydrophytes,** free-moving in water, not attached or rooted in the ground (e.g. *Eichhornia*, *Salvinia*, *Lemna*, *Utricularia*)
Kormo-Hydrophyta natantia ..... k Hyd nat
Subdivisions possible.

10. **Thallo-chamaephytes** (Th Ch)

10.1 Hummock-forming mosses (= sphagnoid bryophytes) ..... Br Ch sph

10.2 Heavy carpet-forming mosses (= reptant bryophytes, e.g. *Pleurozium schreberi*) ..... Br Ch rept

10.21 On mineral soil and humus ..... Br Ch rept (soil)

10.22 On decaying wood ..... Br Ch rept (wood)

10.23 On rock ..... Br Ch rept (rock)

10.3 Cushion-forming mosses (= pulvinate bryophytes, e.g. *Leucobryum glaucum*) ..... Br Ch pulv

10.31 On mineral soil and humus ..... Br Ch pulv (soil)

10.32 On decaying wood ..... Br Ch pulv (wood)

10.33 On rock ..... Br Ch pulv (rock)

10.4 Cushion-forming or caespitose and fruticose lichens (= chamaephytic lichens, e.g. *Cladonia silvatica*) ..... Li Ch

Substrate differences may be recognized.

11. **Thallo-hemicryptophytes** (Th H)

11.1 Flat-lying mosses, bryo-hemicryptophytes (e.g. *Plagiothecium curvifolium*) ..... Br H
11.2 Flat-lying liverworts, hepatic hemicryptophytes (e.g. *Marchantia*) ..... Hep H
11.3 Foliose lichens, lichen-hemicryptophytes (e.g. *Peltigera*) Li H fol
11.4 Crustose lichens, crustaceous lichen-hemicryptophytes (e.g. *Lecidea*) ..... Li H crust
11.5 Endolithic lichens, living in stones near the surface .... Li H end
11.6 Adnate algae, phyco-hemicryptophytes (e.g. some *Pleurococcus*) ..... Phyc H
11.7 Endolithic algae ..... Phyc H end

12. **Thallo-therophytes** (Th T)

12.1 Short-living mosses, bryo-therophytes (e.g. *Ephemerum*) Br T
12.2 Short-living liverworts, hepatic therophytes (e.g. *Riccia*) Hep T
etc.

13. **Thallo-epiphytes** (T E), living on bark or leaves

13.1 Epiphytic thallo-chamaephytes ..... Th Ch E
13.11 Mosses (e.g. *Pseudisothecium*) ..... Br Ch E
13.12 Liverworts ..... Hep Ch E
13.13 Lichens (e.g. *Alectoria*) ..... Li Ch E
13.2 Epiphytic thallo-hemicryptophytes ..... Th H E
13.21 Mosses (e.g. *Hypnum cupressiforme*) ..... Br H E
13.22 Liverworts ..... Hep H E
13.23 Lichens (e.g. *Parmelia*) ..... Li H E
13.24 Algae (e.g. *Pleurococcus*) ..... Phyc H E
13.3 Epiphytic thallo-therophytes ..... Th T E
13.31 Mosses ..... Br T E
13.32 Algae ..... Phyc T E

10.–13. Subdivisions incomplete,
14.–23. to be worked out later.

The authors will be grateful for any comment. Please send it to Prof. Ellenberg, Untere Karspuele 2, D-34 Goettingen (West-Germany).