



Plants and Climate

Why have most Cacti no leaves and Spanish Moss no roots?

Does the shape of plants have something to do with the climate or other abiotic based characteristics?

Institute: Schulbiologisches Zentrum, Hannover (SBZH)

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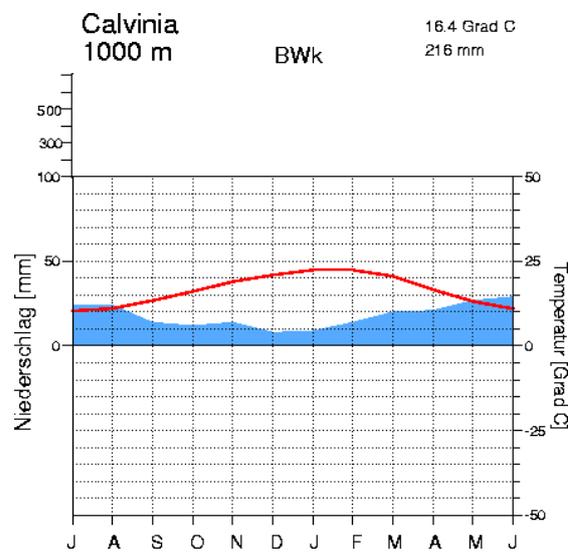
Grade level: Lower years of academic secondary Schools ('Gymnasium')

Junior secondary level, grades 7 / 8

Duration: 8 hours

Conopyhtum

Conophytum truncatum (Thunb.) N.E.Br.



31°28'S, 19°46'E, 1000 m





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Summary:

In the grounds and greenhouses of SBZH, plants from nearly all climatic zones are cultivated. They can be used not only at the centre; SBZH also provides (mostly potted) 'plant sets' as learning packages on specific topics to all schools throughout the year. One such set is named 'Plants and Climate' and consists of 24 plants with various specific typical adaptations to their original habitat.

Pupils should develop an awareness of biodiversity while working with the different plants within the set. They build up hypotheses on the advantages for survival of each plant based on the morphological structures of the plants.

The pupils investigate the specific morphology of each plant using various scientific methods and conduct certain experiments related to investigating physiological plant processes. Subsequently they relate climate diagrams to the respective plants, justifying how the specific morphology of each corresponds to the climatic conditions to the climate diagram.

Lessons held in the botanical gardens can start with the plant image sets. Students are asked to find the species in the grounds of the botanical garden to compare the cultivated plants with the more original shape of the species as shown in the image. They can also use resources such as the climate diagrams, identification cards and the plant management plan to work outdoors.





The 'Climate and Plants' lesson in the context of the Secondary school curriculum

Topics:

Content-related competences

- 🔍 Store food stuffs in rodent proof containers.

- 🔍 Types of plant form
- 🔍 Indicator plants, plant form types in relation to climatic conditions
- 🔍 Plant physiology in relation to climatic conditions
- 🔍 Identification exercises
- 🔍 Devising care plans for various types of plant
- 🔍 Allocating plants to regions on a climate diagram
- 🔍 Indicator plants
- 🔍 Experiments with plant physiology:
 - Morphological adaptations of plants and leaves
 - Types of stomata
 - Water transportation (capillary action) in plants
 - Transpiration
 - Succulence
 - Development of a window leaf in *Peperomia*
 - Photosynthesis

Process-related competences:

- 🔍 Acquiring knowledge
 - Observing, describing and comparing different plants in the 'learning package'
 - Applying knowledge transfer
 - Devising scientific questions and setting up hypotheses
 - Planning, carrying out and evaluating experiments
 - Working with scientific models
 - Accessing data sources
- 🔍 Communication, teamwork, discussion, devising criteria
- 🔍 Evaluation, critical reflection

Learning objectives – students should:

- 🔍 develop an awareness of biodiversity
- 🔍 understand the influence of climatic factors on plant morphology
- 🔍 identify and know about various plants
- 🔍 assign morphologically adapted plants to a climate diagram
- 🔍 learn about plant anatomy and plant physiology
- 🔍 be encouraged to take responsibility for their own research-based learning.





Teaching principles and methodology

Habitat and habit

A plant's degree of adaption is often expressed in the habit of the living organism. With experience one can, for example, see that a certain plant is 'succulent' and would assign it to a dry habitat. There are many recurring 'adaption strategies', especially in extreme conditions. In deserts the predominant plants have a reduced surface area (e.g., spherical form), spikes and thorns (defence against herbivores) and recessed stomata (limiting evaporation). Many such 'adaptations' are convergent i.e. they emerged independently in various locations and in species that are not closely related.

The 'Plants and Climate' activity set contains plants that are adapted to their local climate in morphologically diverse ways. Students should thereby develop an awareness of biodiversity and an understanding of the ways in which plants adapt to their environment (abiotic factors). Other plant learning sets produced at Schulbiologiezentrum (SBZH) Hannover e.g., the form series of *Peperomia* demonstrates the development of succulence, of surface area reduction, and of the staged development of a light window from what were originally broad-leaf moist tropical forms. *Peperomia dolabriformis* is included in the 'Plants and Climate' set. Further phylogenetic series with other adaptation developments are available.

Further pedagogical approach: climate zones and diagrams as indicators of how to care for plants (plant management)

Many of the plants in the set are common houseplants and familiar to the pupils. How do we create suitable growing conditions for these plants from far away? What about taking a look into the atlas? Can we derive care management strategies from climate diagrams? To this end, the teacher's notes in this set include climate diagrams and a worksheet for a plant care /plant management plan.

Introduction to the topic:



Following a brainstorming session about plants in different climatic zones to recap on prior knowledge, students in small groups are assigned a table /working space. The entire plant collection is spread out randomly on a table. Students collect as many different plants, as they want, and take them to their own group's table. Any doubles need to be returned. Student groups then develop their own criteria for classifying the plants on their table, justifying

their reasons for selection. Often, students will sort the plants according to size, colour or leaf shape. Usually, and without prompting, the sorting leads to a hierarchy according to water requirements.

In the next stage, students need to categorise the various plants according to abiotic factors (represented by labels – e.g. moist, warm, sunny, cold etc.,) so that in the subsequent stage their habitats will be easier to identify.





The following categorisation of climate zones (moist inner tropics, dry tropical, sub-tropical, temperate zones, boreal regions) is then simpler to deduce. As each zone, with the exception of the moist inner tropics, is represented twice, an indication is needed as to whether the plant is from the northern or southern hemisphere. **NB** This is not apparent from looking at the plants and it is unlikely that students will know the answer. **Tip:** You could place the plants on the climate diagram and ask students to find the locations in an atlas.

With the help of further thematic maps (physical, climate zones, annual rainfall, wind systems, inter-tropical convergence, soil distribution, natural vegetation etc.) a relatively detailed picture of conditions at the plants' locations can be established.

Student Activities

Context: Basic questions: What is the characteristic morphology of each plant? Why has the plant developed such an appearance? How can you investigate the plants?

Student tasks

Topic/Question	Time	Prior Learning	Activity: What happens and how is it achieved
Introduction Knowledge about typical plants which live in certain climate zones.	10 min.	Climate zones	Brainstorming about typical plants which live in certain climate zones.
Distinguishing as many different plants as possible	15 min.	Previous knowledge about the structure of plants	Pupils work in groups of four to six. The activity takes part in the classroom or in a botanical garden. There is a table with 5 plant sets, The first task for each group is, to find different plants and take them to their group table.
Grouping the plants according to self-developed criteria	15 min.	Structure of plants, climate zones	The pupils are asked to find criteria to group the plants and present their outcomes to the rest of the class (justifying their decisions!)
Grouping the plants according to their abiotic needs	15 min.	Structure of plants, climate zones	The pupils are asked to group the plants according to their abiotic needs using the pictograms (temperature, sun, shadow, moisture, rain).





Plant care / management plan	90 min.	Structure of plants, abiotic factors, climate zones	<p>The pupils are asked to create a plan to care for the plants needs.</p> <p>Groups develop criteria for a plant care plan.</p> <p>Internet research for climate data of the original habitat of the plants as basis for their care plan</p> <p>They develop their own worksheet or use the SBZH worksheet.</p>
Investigate plants' morphology and physiology	90 min. or long-term investigations, max. 6 months	Structure of plants	<p>Pupils are asked to select three different plants and make hypotheses about their obvious adaptations to a certain climate.</p> <p>What is an advantage for surviving in a certain climate, and what has the plant developed?</p> <p>How can you investigate your hypotheses? (A pool of material for experiments is provided from which pupils can choose).</p>
Relate plants to original habitat	45 min.		<p>Pupils relate the climate diagram to the plant. They search for the area on the world map and place the plant on the map</p>





Resources

Resource 1: The 'Plants and Climate' – Plant Set

Criteria for the selection of particular plants for the plant set

- 📍 The set should include plants from all important climate zones
- 📍 The set should include annuals, perennials, trees
- 📍 Each plant has to show good morphological and anatomical adaptation strategies to the climate
- 📍 Many plants should be stenoecious (Restricted to a narrow range of habitats and environmental conditions) and react sensitively to climate changes
- 📍 The plants should be easy to cultivate in a nursery.
- 📍 The set should include common plants e.g. known house plants as well as unknown ones with unusual shapes





List of Species:

Botanical name	English name	Original habitat	Species in genus
<i>Asplenium nidus</i>	Bird's Nest Fern	East Africa, Himalayas, trop. Asia, Australia and Polynesia in tropical rainforests with only short dry seasons. below 2,000 m, on old trunks and branches or rocks in dense forests or below huge canopies	361
<i>Buphthalmum salicifolius</i>	Yellow Ox-Eye Daisy	France, northern Italy to Balkans, eastern central and central Europe, on calceous, stony or peaty soils with low nutrition content, semi-dry grassland, dry forests and fens, in the Alps up to 2000 m	2
<i>Calendula officinalis</i>	Pot Marigold	Probably Mediterranean, naturalized in Spain, Italy, Great Britain	11
<i>Conophyllum truncatum</i>	Conophyllum, Living Pebble	Cape through Namaqualand to western South Africa, on rocky and permeable subsoils, mostly in winter rain areas (<300 mm)	95
<i>Dryas octopetala</i>	Mountain Avens	Boreal circumpolar, in more southerly latitudes in corresponding altitudes in the mountains	6
<i>Echeveria setosa</i>	Hen and chicken, Mexican Firecracker, Bristly Echeveria,	Southern Mexico (Oaxaca, Puebla, San Luis Atolotitlán, Cerro de la Yerba)	167
<i>Echinopsis thelegona</i>		Argentina (Jujuy, Salta, Tucumán), dry slopes, 500-1000 m	130





<i>Euphorbia milii</i>	Crown of Thorn, Christ's Thorn	Central, eastern and southern Madagascar, in bush and forest habitats, on rocks (mostly granite)	2031
<i>Ficus benjamina.</i>	Weeping Fig, Benjamin's Fig	Himalayas, India, Myanmar, S. China, Malaysian Archipelago, N. Australia; grows as a semi-epiphyte in rain and monsoon forests	830
<i>Grimmia pulvinata</i>	Grey Cushioned Grimmia	Worldwide distribution on sunny dry stones and concrete, never soil, in altitudes from 0 – 1,000 m	86
<i>Kleinia ficoides</i>		Northern Cape: Namaqualand (Alexander Bay)	54
<i>Lavandula officinalis</i>	Lavender, Common Lavender	NW. Mediterranean area, Spain to the Balkans, in rocky habitats and garrigues	45
<i>Lecanora sp.</i>	Crustose Rock Lichen	Worldwide on silicate and limestone, on exposed aggregate concrete, bricks, asphalt; only seldom on wood	ca. 300
<i>Mammillaria microhelia</i>		Mexico, federal state of Queretaro (northeast of Mexico City), Cerro Zamorano, St. Maria del Mexicano, Colón to San Pablo Tolimán; rocky slopes, 1,200-2,600 m	176





<i>Maranta leuconeura</i>	Prayer Plant	Western, central and southeast Brazil; in warm humid forests	41
<i>Marchantia aquatica</i>	Well Liverwort	Worldwide in cool wet places	6
<i>Nerium oleander</i>	Oleander	Mediterranean, S. Portugal, naturalised in the Crimea and the Caucasus; in summer-dry rivers and in the mountains	1
<i>Peperomia dolabriformis</i>	Prayer Peperomia	Northern Peru (Cajamarca), in sandy places at Rio Huancabamba from 600-1,200 m as small shrubs	845
<i>Spathiphyllum floribundum</i>	Peace Lily	Columbia to northwest Venezuela, northern Peru, wet warm forests	50
<i>Streptocarpus saxorum</i>	False African Violet, Cape Primrose	Tanzania and Kenya, on rocks and cliffs	18
<i>Tillandsia usneoides</i>	Spanish Moss	From Virginia to Chile, West Indies, from 0 – 3,300 m; on trees, power poles, rocks, cacti, in dry habitats with temporarily high atmospheric humidity	671
<i>Tradescantia sillamontana</i>	Hairy Spiderwort, Cobweb Spiderwort, White Velvet Spiderwort,	Northeast Mexico, Federal State of Nuevo Leon on the Texan Border	75
<i>Viola cornuta</i>	Horned Pansy, Horned Violet	Pyrenees, Cantabrian Cordillera	265
<i>Vrisea psittacina</i>		Brasil (Bahia, Espirito Santo, Rio de Janeiro), Paraguay; epiphytic in humid forests	340





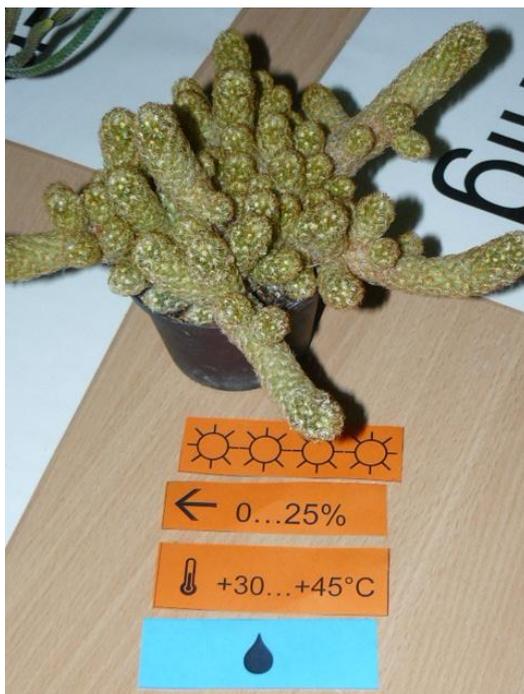
Resource 2: Labels for abiotic factors

-  Hot
-  Warm
-  Sunny
-  Humid
-  Dry
-  Wet
-  Cold
-  Shaded



N.B: Plants are sorted according to their climatic requirements

Resource 3: Symbols of abiotic factors

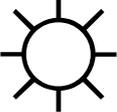
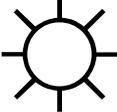
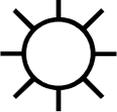
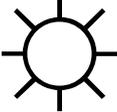
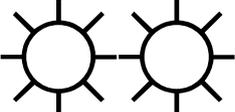
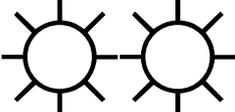
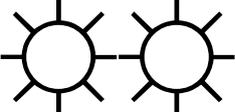
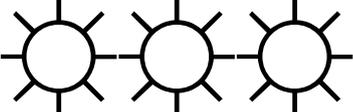
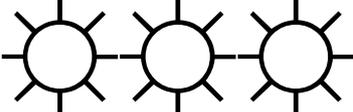
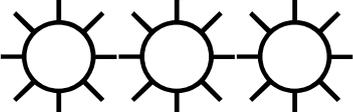
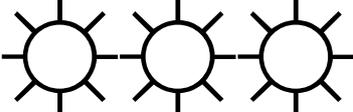
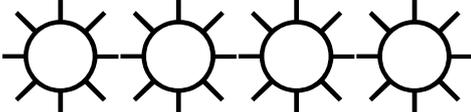
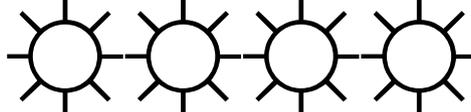
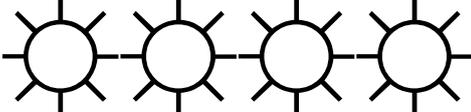
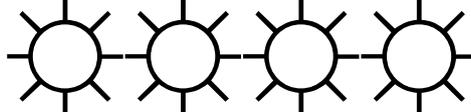


Plants related with pictograms and symbols to their abiotic needs





Symbols for Light





Symbols for Temperature

 -15...0°C	 -15...0°C
 -15...0°C	 -15...0°C
 0...+15°C	 0...+15°C
 0...+15°C	 0...+15°C
 +15...+30°C	 +15...+30°C
 +15...+30°C	 +15...+30°C
 +30...+45°C	 +30...+45°C
 +30...+45°C	 +30...+45°C





Symbols for Water





Symbols for Humidity

← 0...25%	← 0...25%
← 0...25%	← 0...25%
↖ 25...50%	↖ 25...50%
↖ 25...50%	↖ 25...50%
↗ 50...75%	↗ 50...75%
↗ 50...75%	↗ 50...75%
→ 75...100%	→ 75...100%
→ 75...100%	→ 75...100%





Symbols for Nutrition

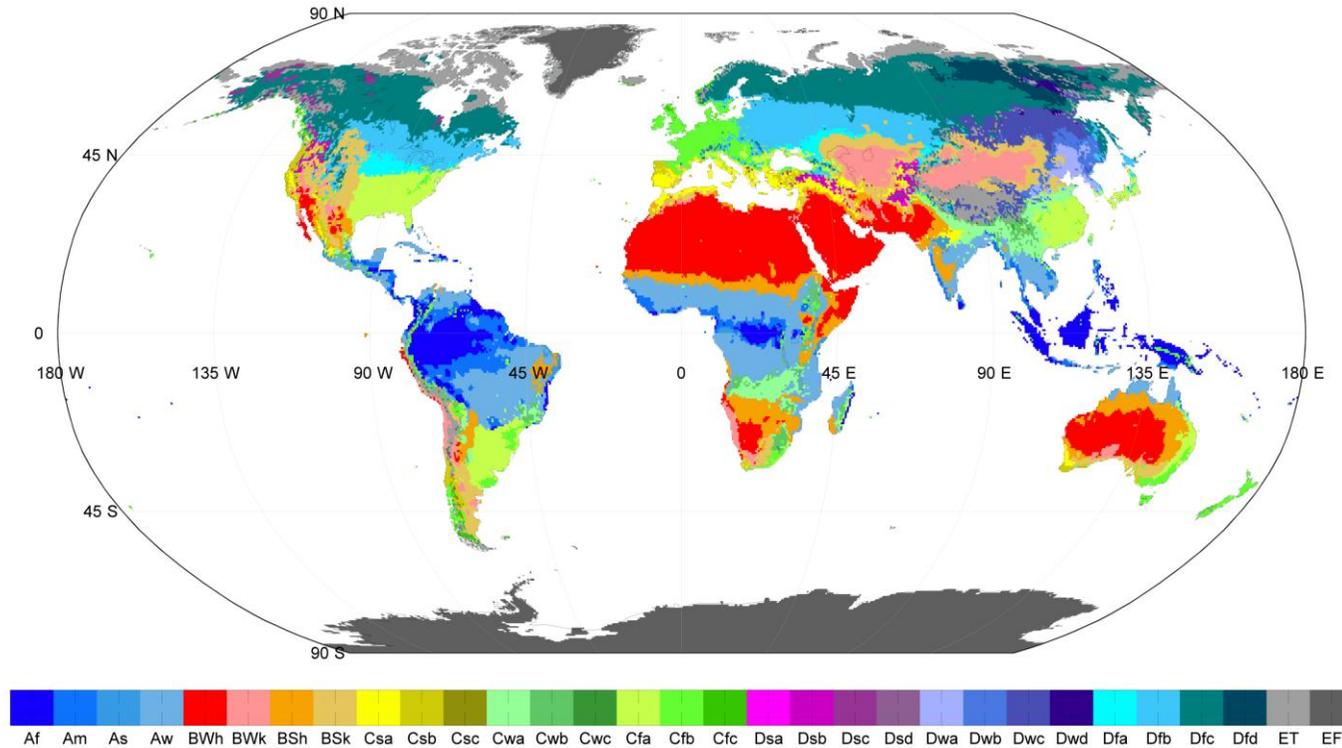
	
	
	
	
	
	
	





Resource 4: World Map of Climate

World map of Köppen climate classification for 1901–2010



First letter	Second letter	Third letter
A: Tropical	f: Fully humid	T: Tundra
B: Dry	m: Monsoon	F: Frost
C: Mild temperate	s: Dry summer	a: Hot summer
D: Snow	w: Dry winter	b: Warm summer
E: Polar	W: Desert	c: Cool summer
	S: Steppe	d: Cold summer

Data source: Terrestrial Air Temperature/Precipitation: 1900-2010 Gridded Monthly Time Series (V 3.01)

Resolution: 0.5 degree latitude/longitude

Website: <http://hanschen.org/koppen>

Ref: Chen, D. and H. W. Chen, 2013: Using the Köppen classification to quantify climate variation and change: An example for 1901–2010. Environmental Development, 6, 69-79, 10.1016/j.envdev.2013.03.007.





Resource 5: Pants- from 'habit' to a 'care plan'

Portrait:

Habit:

English name:

Botanical name: _____

Origin: _____



Drawing:

The plant grows...

- ...on the ground in deserts
- ...on the ground in forests
- ...on top of other plants (epiphytic)
- ...as a bush or tree

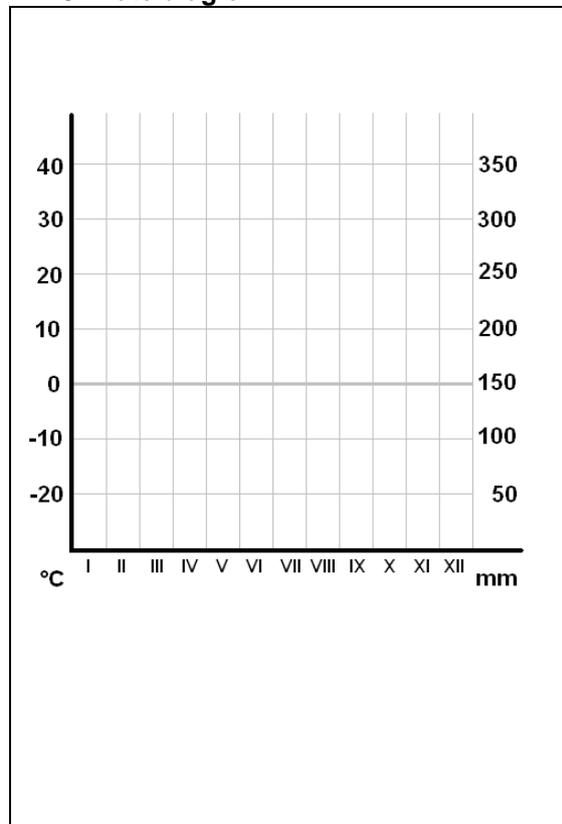
Climate in the original area of the plant: Region: _____ Country: _____ Continent: _____

Geographically coordinates (longitude/latitude): ___° __ , ___° ___ Climate zone/-type _____

Climate table

	P. mm	T °C
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Climate diagram





Needs of the plants / abiotic factors

Try to apply the climate and soil conditions of the original habitat to a care plan for indoor plants

Original habitat	Requirements as a potted plant: <input type="checkbox"/> indoor, <input type="checkbox"/> outdoor
Light: Summer: _____ Winter: _____	Light: Summer: _____ Winter: _____
Temperature Summer: _____ Winter: _____	Temperature Summer: _____ Winter: _____
Precipitation/ humidity Summer: _____ / _____ Winter: _____ / _____	Irrigation/ humidity Summer: _____ / _____ Winter: _____ / _____
Soil: _____	Potting ground: _____ Soil humidity: _____
Nutrition content	Nutrition content/fertilization :





Care instructions

Light (Summer)	☀less			☀☀			☀☀☀			plenty ☀☀☀☀		
Light (Winter)	☀less			☀☀			☀☀☀			plenty ☀☀☀☀		
Temperature (Summer) °C	-10	-5	0	5	10	15	20	25	30	35	40	45
Temperature (Winter) °C	-10	-5	0	5	10	15	20	25	30	35	40	45
Irrigation (Summer)	💧 low			💧💧			💧💧💧			high 💧💧💧💧		
Irrigation (Winter)	💧 low			💧💧			💧💧💧			high 💧💧💧💧		
Humidity (Summer)	← low			↖			↗			high →		
Humidity (Winter)	← low			↖			↗			high →		
Fertilization (Summer)	☺ very little			☺☺			☺☺☺			A lot ☺☺☺☺		
Fertilization (Winter)	☺ very little			☺☺			☺☺☺			A lot ☺☺☺☺		

Example of care instructions:

Flora exemplissimo communis	S	☀☀☀☀	15	💧💧💧	↗	☺
	W	☀☀☀☀	0	💧💧	↗	☺





Resource 6: Plants and abiotic factors

	Light	Water	Humidity	pH	Others
<i>Asplenium nidus</i> Bird's Nest Fern					
<i>Buphthalmum salicifolium</i> Yellow Ox-Eye Daisy					
<i>Calendula officinalis</i> Pot Marigold (plant or seed)					
<i>Conophytum truncatum</i> Conophytum, Living Pebble					
<i>Dryas octopetala</i> Mountain Avens					
<i>Echeveria setosa</i> Mexican Firecracker, Hen and Chicken, Bristly Echeveria					
<i>Echinopsis thelegona</i>					
<i>Euphorbia millii</i> Crown of Thorn, Christ's Thorn					
<i>Ficus benjamina</i> Weeping Fig, Benjamin's Fig					





	Light	Water	Humidity	pH	Others
<i>Grimmia pulvinata</i> Grey Cushioned Grimmia					
<i>Kleinia ficoides</i>					
<i>Lavandula angustifolius</i> Lavander, Common Lavender					
<i>Lecanora sp.</i> Crustose Rock Lichen					
<i>Mammillaria microhelia</i>					
<i>Maranta leuconeura</i> Prayer Plant					
<i>Marchantia sp.</i> Well Liverwort					
<i>Nerium oleander</i> Oleander					
<i>Peperomia dolabriformis</i> Prayer Peperomia					





	Light	Water	Humidity	pH	Others
<p><i>Spathiphyllum floribundum</i> Peace Lily</p>					
<p><i>Streptocarpus saxorum</i> False African Violet, Cape Primrose</p>					
<p><i>Tillandsia usneoides</i> Spanish Moss</p>					
<p><i>Tradescantia sillamontana</i> Hairy Spiderwort, White Velvet Spiderwort, Cobweb Spiderwort</p>					
<p><i>Viola cornuta</i> Horned Pansy, Horned Violet</p>					
<p><i>Vriesea psittacina</i></p>					





Resource 7: Identification Cards without plant pictures

<ul style="list-style-type: none">Leaves form a funnelBasal leaves narrow, broad in the middleLeaf ribs are dark brownLeaf underside partly covered with powdery stripes (Sporangia) <p>Bird's Nest Fern (<i>Asplenium nidus</i>)</p>	<ul style="list-style-type: none">Shoots withered (or cut down) in winterOld plant remains at baseSoft leafy rosetteFresh leaves are hairy <p>Yellow Ox-Eye Daisy (<i>Buphtalmum salicifolium</i>)</p>
<ul style="list-style-type: none">• Only exists as seed in winter <p>Pot Marigold (<i>Calendula officinalis</i>)</p>	<ul style="list-style-type: none">Plant smallPlant is grey-green with translucent areas at topUsually only two leaves per shoot visibleLeaves are very thick and fleshy <p>Conophytum, Living Pebble (<i>Conophytum truncatum</i>)</p>
<ul style="list-style-type: none">Plant smallPlant is grey-green with translucent areas at topUsually only two leaves per shoot visibleLeaves are very thick and fleshy <p>Mountain Avens (<i>Dryas octopetala</i>)</p>	<ul style="list-style-type: none">Plant smallPlant is grey-green with translucent areas at topUsually only two leaves per shoot visibleLeaves are very thick and fleshy <p>Mexican Firecracker, Hen and Chicken, (<i>Echeveria setosa</i>)</p>





<ul style="list-style-type: none">• Young plants grow upright• Shoots (stems) have ribs• Plants have modified leaves (spines) which grow out from a white circular basal section (areole) <p><i>(Echinopsis thelegona)</i></p>	<ul style="list-style-type: none">• Shoot upright and branched• Shoot light grey• Shoot with thorns• Green, spatulate leaves <p>Crown of Thorn, Christ's Thorn</p> <p><i>(Euphorbia milii)</i></p>
<ul style="list-style-type: none">• Plant upright, branched, (in maturity a tree)• Young shoots with grey brown bark; later light grey• Leaves with slightly waxy surface Leaves with pointed tips <p>Weeping Fig, Benjamin's Fig</p> <p><i>(Ficus benjamina)</i></p>	<ul style="list-style-type: none">• Plant is small and grows cushion shaped• Cushion appears greyish green• Many unbranched shoots• Leaflets small, lying close to the stem• Plant bears green capsules (visible with a magnifying glass) <p>Grey Cushioned Grimmia</p> <p><i>(Grimmia pulvinata)</i></p>
<ul style="list-style-type: none">• Young plants growing straight up• Leaves fleshy; round in section• Leaves bluish and waxy with a whitish powdery coating <p><i>(Kleinia ficoides)</i></p>	<ul style="list-style-type: none">• Plant an upright semi-shrub• Leaves small and narrow, covered with light grey hairs• Plant has a strong fragrance <p>Lavender, Common Lavender</p> <p><i>(Lavandula angustifolia)</i></p>





- 🔍 Flat crust-like growth
- 🔍 At the edge of the growth area, often lobe-shaped and divided
- 🔍 Lichen carries shield-shaped elevations (Apothecia) (visible with a magnifying glass)

Crustose Rock Lichen

(Lecanora sp.)

- 🔍 Thick green shoots
- 🔍 Branching only from the base
- 🔍 Covered with bright, star-shaped spines raised up from the surface

(Mammillaria microhelia)

- 🔍 Shoots growing flat
- 🔍 Leaves thin; patterned on the top side
- 🔍 Leaf underside partly reddish coloured
- 🔍 Young leaves partly curled

Prayer Plant

(Maranta leuconeura)

- 🔍 Plant grows with flat branching structures close to the ground
- 🔍 Plant dark green; very delicate
- 🔍 Plant with little 'umbrella' or 'cup-like' structures on the upper surface

Well Liverwort

(Marchantia aquatica)

- 🔍 Shoots upright, becoming woody
- 🔍 Three leaves at each node
- 🔍 Leaves narrowly ovate, with a tip
- 🔍 Leaves evergreen, leathery

Oleander

(Nerium oleander)

- 🔍 Young shoot green, later becoming woody
- 🔍 Leaves are hatchet-shaped and fleshy
- 🔍 Leaves waxy
- 🔍 Leaf underside is translucent and appears to be dark green

Prayer Peperomia

(Peperomia dolabriformis)





- 🔍 Plant without a visible stem
- 🔍 Leaves clearly divided into leaf blade and petiole (leaf stalk)
- 🔍 Leaf blade as big as a hand; long petiole
- 🔍 Leaves dark green

Peace Lily

(Spathiphyllum floribundum)

- 🔍 Plant herbaceous; soft to the touch
- 🔍 Plants divided into leaf blade and petiole
- 🔍 Leaves with small bumps (visible with magnifying glass)
- 🔍 Leaf blades and petioles with fine hairs
- 🔍 Three leaves at each node

***False African Violet,
Cape Primrose***

(Streptocarpus saxorum)





- 🔍 Plant pendulous (weeping/ hanging down)
- 🔍 Shoot and leaves difficult to distinguish
- 🔍 Plant is densely grey scaled (visible with magnifying glass)
- 🔍 Plant has no roots

Spanish Moss
(*Tillandsia usneoides*)

- 🔍 Plants herbaceous, upright or decumbent (growing across ground)
- 🔍 Shoots with a high water content
- 🔍 Leave blades sessile, (without a leaf stalk)
- 🔍 Leaves with soft white hairs

**Hairy Spiderwort,
White Velvet Spiderwort, Cobweb Spiderwort**
(*Tradescantia sillamontana*)

- 🔍 Plant small; branched from the base
- 🔍 Plant herbaceous, with a high water content
- 🔍 Leaves divided into leaf petiole and blade
- 🔍 Leaves crenate (wavy edged)

Horned Pansy, Horned Violet
(*Viola cornuta*)

- 🔍 Leaves sword-like, broad at base
- 🔍 Leaves growing from a rosette
- 🔍 Leaves form a water retaining funnel

(*Vriesea psittacina*)



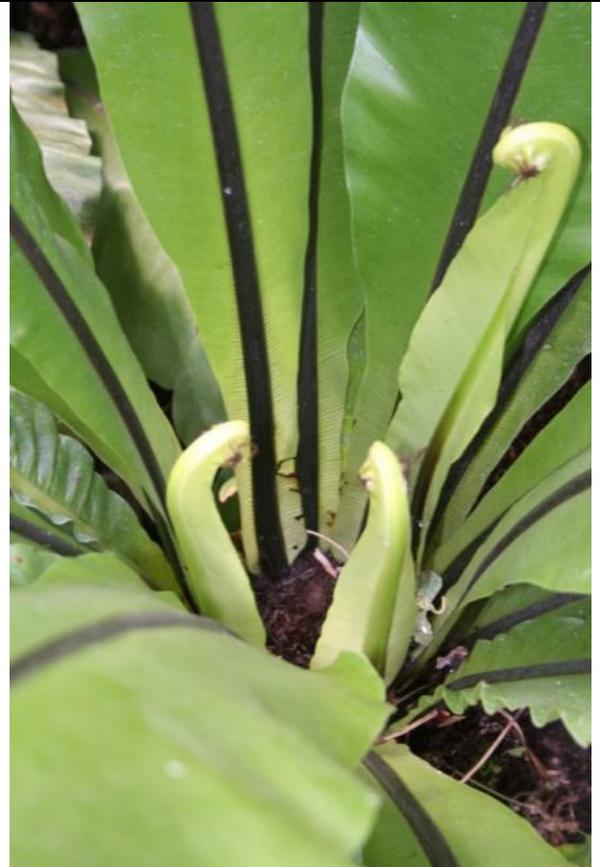


Identification cards with plant pictures

- 🔍 Leaves form a funnel
- 🔍 Basal leaves narrow, broad in the middle
- 🔍 Leaf ribs are dark brown
- 🔍 Leaf underside partly covered with powdery stripes (Sporangia)

Bird's Nest Fern

(Asplenium nidus)



- 🔍 Shoots withered (or cut down) in winter
- 🔍 Old plant remains at base
- 🔍 Soft leafy rosette Fresh leaves are hairy

Yellow Ox-Eye Daisy

(Buphtalmum salicifolium)





- 🔍 Only exists as seed in winter

Pot Marigold
(*Calendula officinalis*)



- 🔍 Plant small
- 🔍 Plant is grey-green with translucent areas at top
- 🔍 Usually only two leaves per shoot visible
- 🔍 Leaves are very thick and fleshy

Conophytum, Living Pebble
(*Conophytum truncatum*)





- 🔍 Plant grows close to the ground
- 🔍 Basal shoot parts are woody
- 🔍 Leaves are dark green and leathery
- 🔍 Leaf underside with dense white hairs (visible with magnifying glass)

Mountain Avens

(Dryas octopetala)



- 🔍 Plant grows as a compressed rosette
- 🔍 Leaves are spatulate (spoon shaped) and fleshy
- 🔍 Leaves covered in bristly white hairs

***Mexican Firecracker,
Hen and Chicken,***

(Echeveria setosa)





- 🔍 Young plants grow upright
- 🔍 Shoots (stems) have ribs
- 🔍 Plants have modified leaves (spines) which grow out from a white circular basal section (areole)

(Echinopsis thelegona)



- 🔍 Shoot upright and branched
- 🔍 Shoot light grey
- 🔍 Shoot with thorns
- 🔍 Green, spatulate leaves

**Crown of Thorns,
Christ's Thorn**

(Euphorbia milii)





- 🔍 Plant upright, branched, (in maturity a tree)
- 🔍 Young shoots with grey brown bark; later light grey
- 🔍 Leaves with slightly waxy surface
- 🔍 Leaves with pointed tips

**Weeping Fig,
Benjamin' s Fig**

(Ficus benjamina)



- 🔍 Plant is small and grows cushion shaped
- 🔍 Cushion appears greyish green
- 🔍 Many unbranched shoots
- 🔍 Leaflets small, lying close to the stem
- 🔍 Plant bears green capsules (visible with a magnifying glass)

Grey Cushioned Grimmia

(Grimmia pulvinata)





- 🔍 Young plants growing straight up
- 🔍 Leaves fleshy; round in section
- 🔍 Leaves bluish and waxy with a whitish powdery coating

(Kleinia ficoides)



- 🔍 Plant an upright semi-shrub
- 🔍 Leaves small and narrow, covered with light grey hairs
- 🔍 Plant has a strong fragrance

**Lavender,
Common Lavender**
(Lavandula angustifolia)





- 🔍 Flat crust-like growth
- 🔍 At the edge of the growth area, often lobe-shaped and divided
- 🔍 Lichen carries shield-shaped elevations (Apothecia) (visible with a magnifying glass)

Crustose Rock Lichen

(Lecanora spec.)



- 🔍 Thick green shoots
- 🔍 Branching only from the base
- 🔍 Covered with bright, star-shaped spines raised up from the surface

(Mammillaria microhelix)





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(Marchantia aquatica)



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- 🔍 Three leaves at each node
- 🔍 Leaves narrowly ovate, with a tip
- 🔍 Leaves evergreen, leathery

Oleander

(Nerium oleander)





- 🔍 Young shoot green, later becoming woody
- 🔍 Leaves are hatchet-shaped and fleshy
- 🔍 Leaves waxy
- 🔍 Leaf underside is translucent and appears to be dark green

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(Peperomia dolabriformis)



- 🔍 Plant without a visible stem
- 🔍 Leaves clearly divided into leaf blade and petiole (leaf stalk)
- 🔍 Leaf blade as big as a hand; long petiole
- 🔍 Leaves dark green

Peace Lily

(Spathiphyllum floribundum)



- 🔍 Plant herbaceous; soft to the touch
- 🔍 Plants divided into leaf blade and petiole
- 🔍 Leaves with small bumps (visible with magnifying glass)
- 🔍 Leaf blades and petioles with fine hairs
- 🔍 Three leaves at each node

**False African Violet,
Cape Primrose**

(Streptocarpus saxorum)





- 🔍 Plant pendulous (weeping/ hanging down)
- 🔍 Shoot and leaves difficult to distinguish
- 🔍 Plant is densely grey scaled (visible with magnifying glass)
- 🔍 Plant has no roots

Spanish Moss

(Tillandsia usneoides)



- 🔍 Plants herbaceous, upright or decumbent (growing across ground)
- 🔍 Shoots with a high water content
- 🔍 Leave blades sessile, (without a leaf stalk)
- 🔍 Leaves with soft white hairs

**Hairy Spiderwort,
White Velvet Spiderwort, Cobweb Spiderwort**

(Tradescantia sillamontana)





- 🔍 Plant small; branched from the base
- 🔍 Plant herbaceous, with a high water content
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Horned Pansy, Horned Violet

(Viola cornuta)



- 🔍 Leaves sword-like, broad at base
- 🔍 Leaves growing from a rosette
- 🔍 Leaves form a water retaining funnel

(Vriesea psittacina)

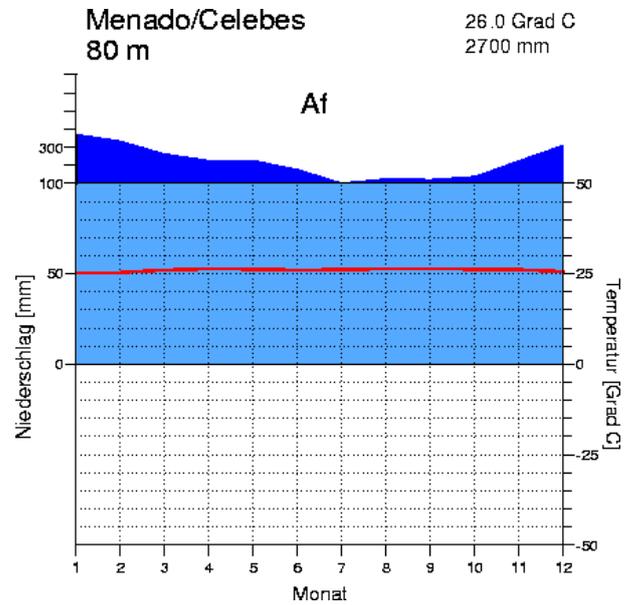




Resource 8: Climate diagrams with plant pictures

Bird's Nest Fern

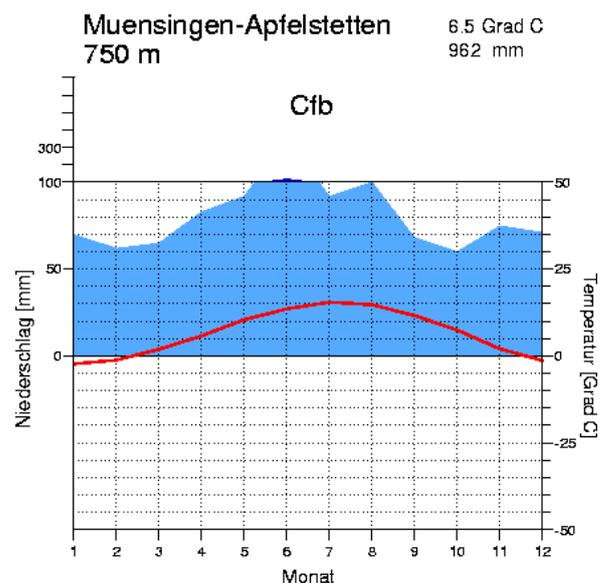
Asplenium nidus L.



1°32'N, 124°55'E, 80 m

Yellow Ox-Eye Daisy

Bupthalmum salicifolium L.



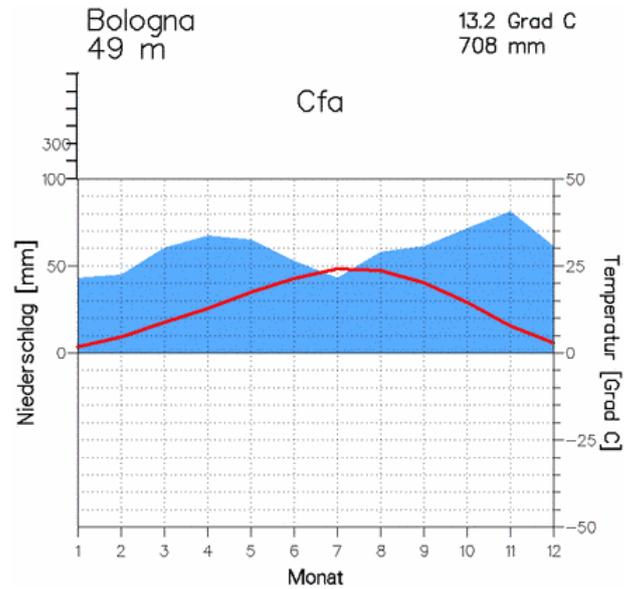
48°23'N, 9°29'E, 750 m





Pot Marigold

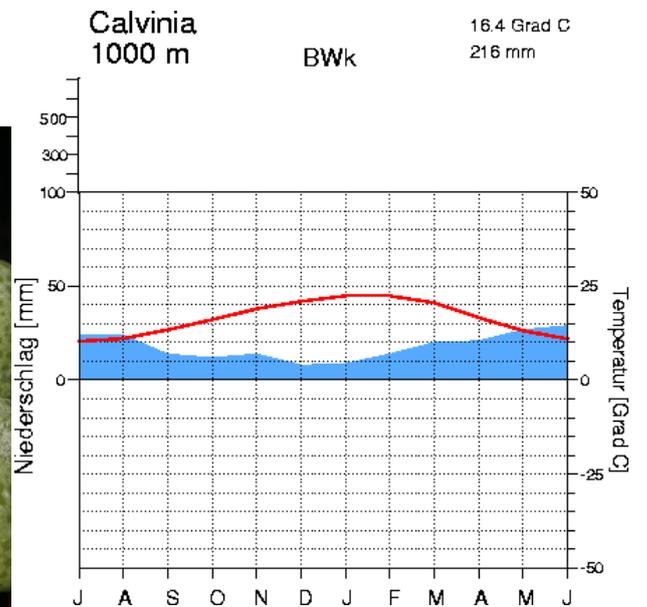
Calendula officinalis L.



44°32'N, 11°18'E, 49 m

Conophytum, Living Pebble

Conophytum truncatum (Thunb.) N.E.Br.



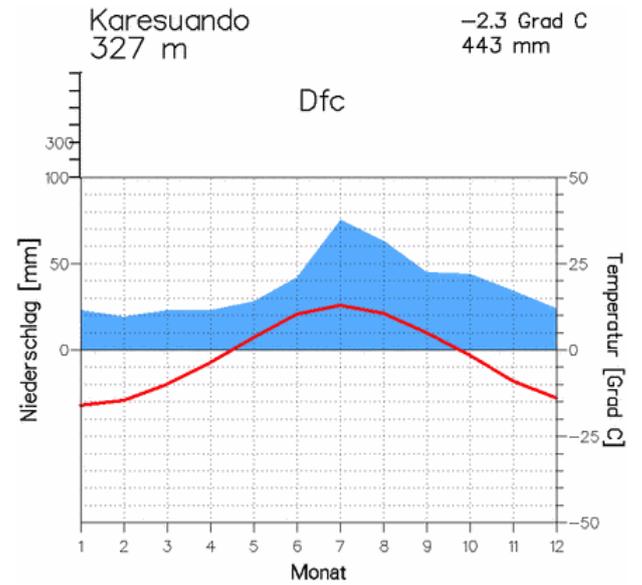
31°28'S, 19°46'E, 1000 m





Mountain Avens

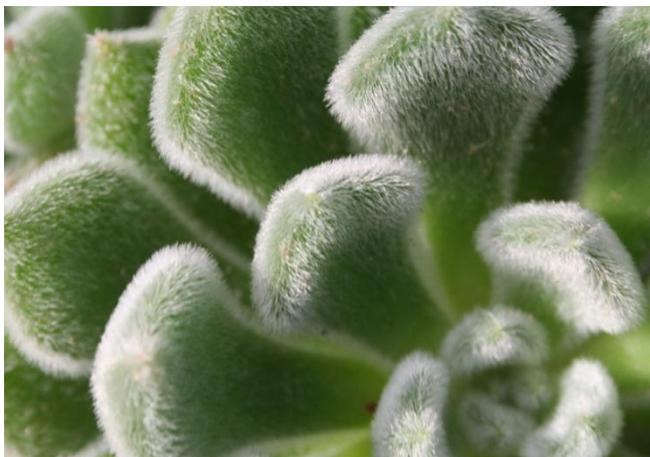
Dryas octopetala L.



68°27'N, 22°30' E , 327 m

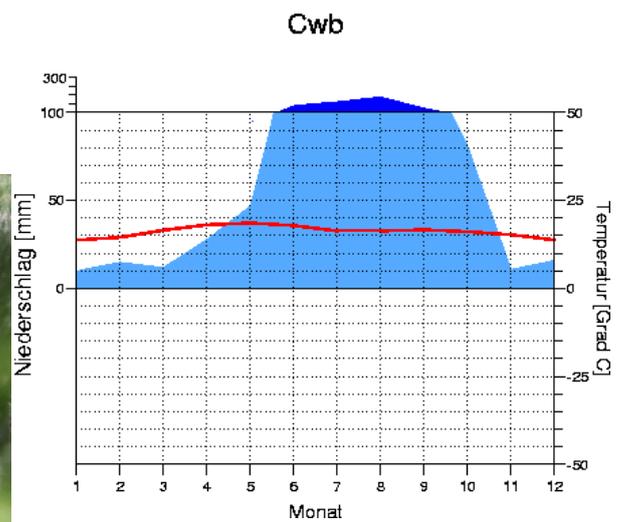
Mexican Firecracker, Hen and Chickens

Echeveria setosa Rose et Purpus



Mexico City
2308 m

18.5 Grad C
894 mm



19°24'N, 99°12'W, 2308 m





Echinopsis thelegona

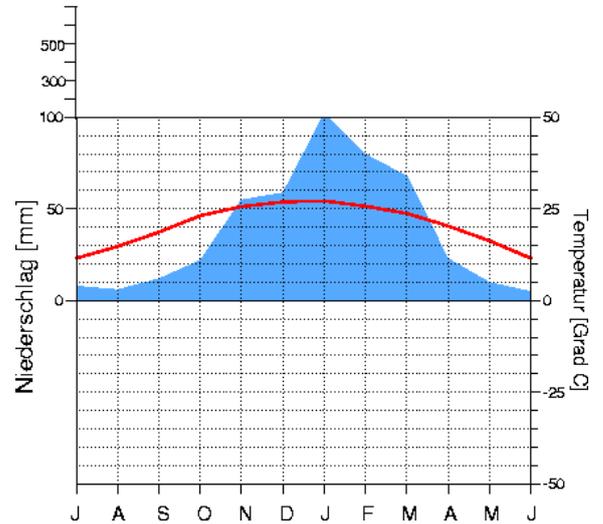
(Web) Friedrich & G. D. Rowley



Catamarca
454 m

BSh

20.5 Grad C
450 mm



28°36'S, 65°46'W, 454 m

Crown of Thorns, Christ's Thorn

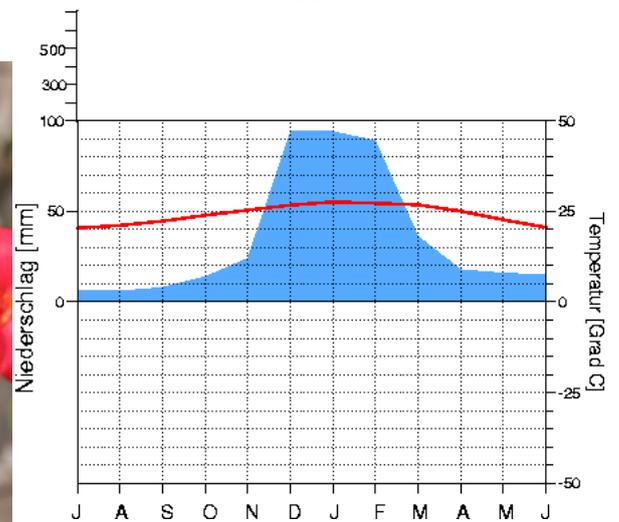
Euphorbia millii Des Moul



Tulear
8 m

BSh

24.1 Grad C
420 mm



23°23'S, 43°44'E, 8 m





**Weeping Fig,
Benjamin's Fig**

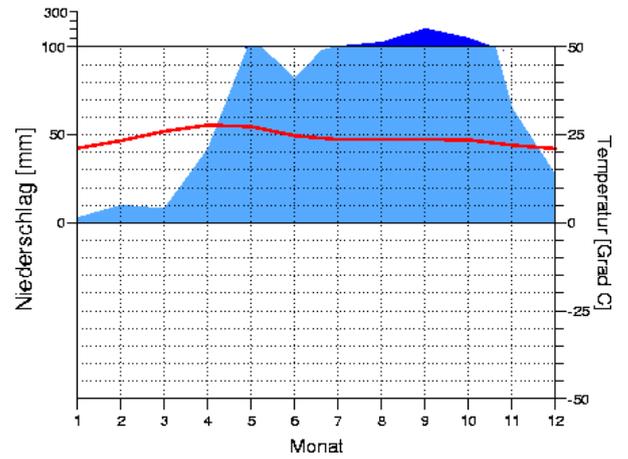
Ficus benjamina L..



Bangalore
921 m

24.0 Grad C
947 mm

Aw



12°58'N, 77°35'E, 921 m

Grey Cushioned Grimmia

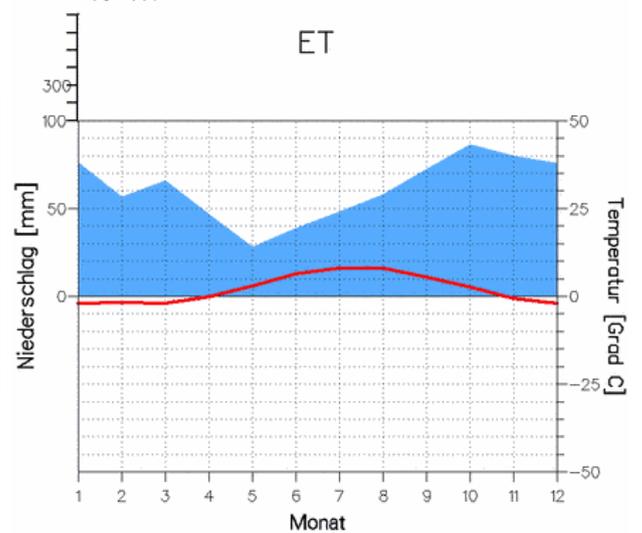
Grimmia pulvinata (Hedw.) Sm.



Raufarhoeft
10 m

2.0 Grad C
732 mm

ET



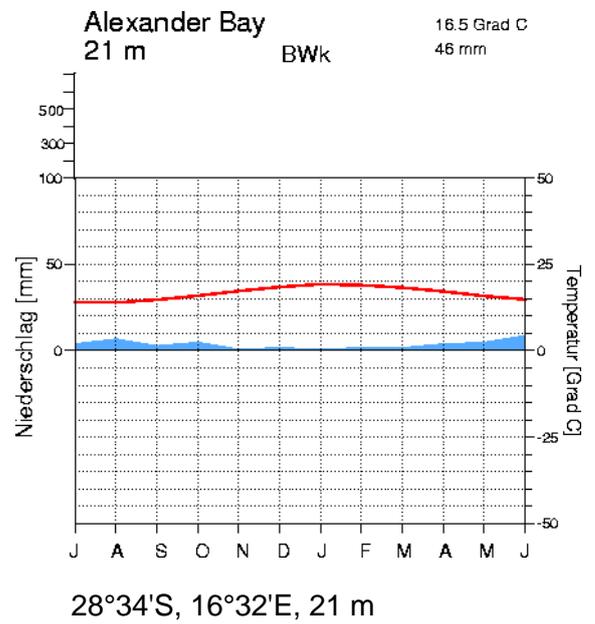
66°27'N, 15°57'W, 10 m





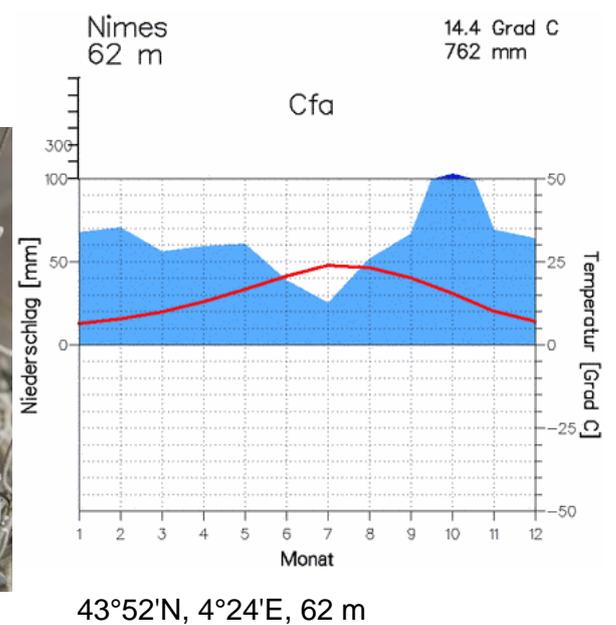
Kleinia ficoides

(L.) Haw.



Lavander, Common Lavender

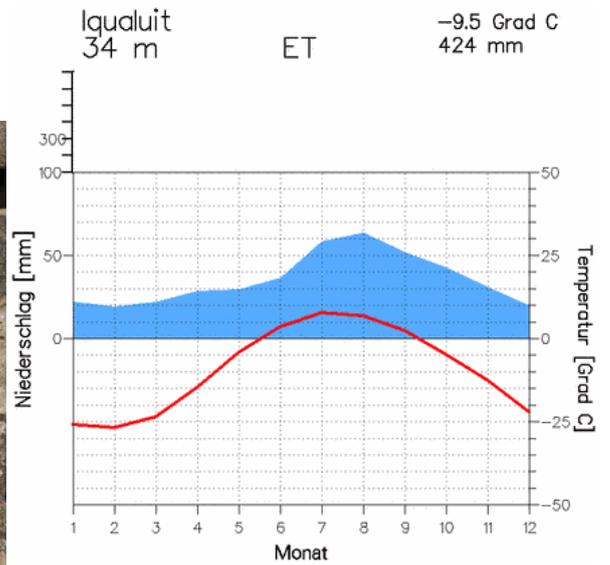
Lavandula angustifolius Mill.





Crustose Rock Lichen

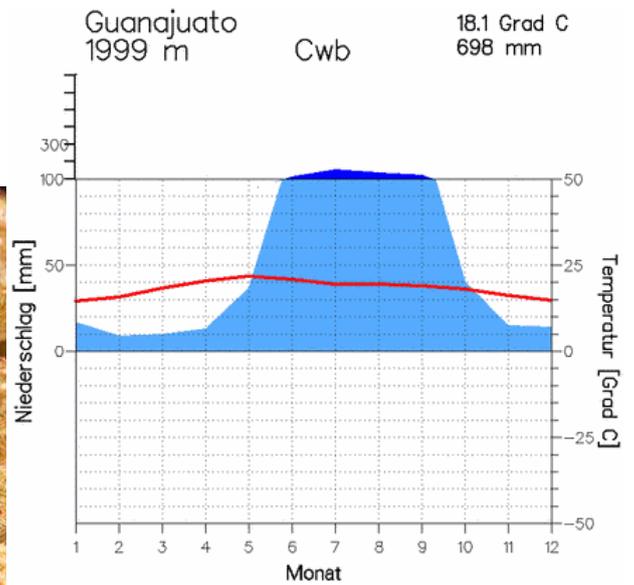
Lecanora sp.



63°45'N, 68°32'W, 34 m

Mammillaria microhelia

Werderm.



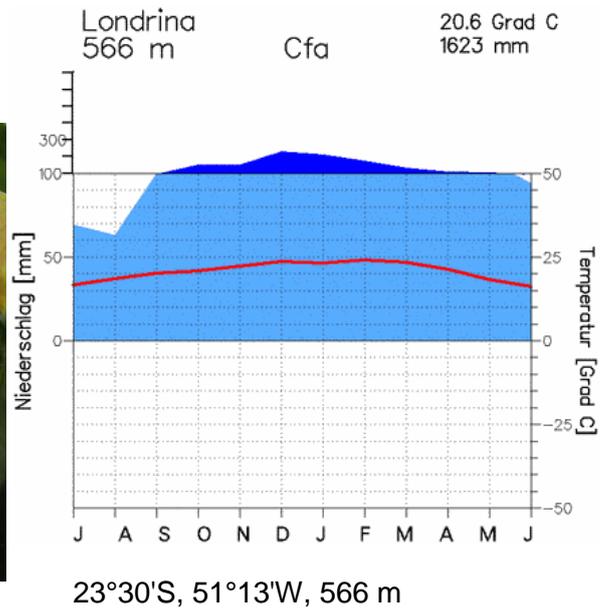
21°01'N, 101°15'W, 1999 m





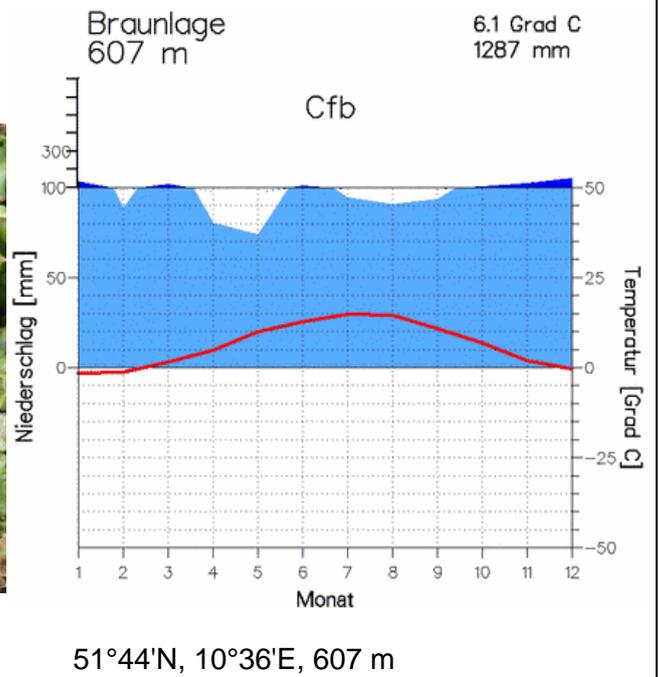
Prayer Plant

Maranta leuconeura Morren



Well Liverwort

Marchantia aquatica (Nees) Burgeff.





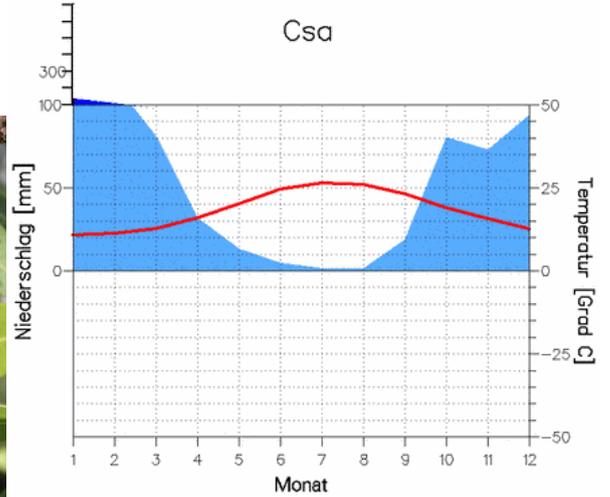
Oleander

Nerium oleander L.



Khania/Kreta
151 m

18.1 Grad C
653 mm



35°29'N, 24°07'E, 151 m

Prayer Peperomia

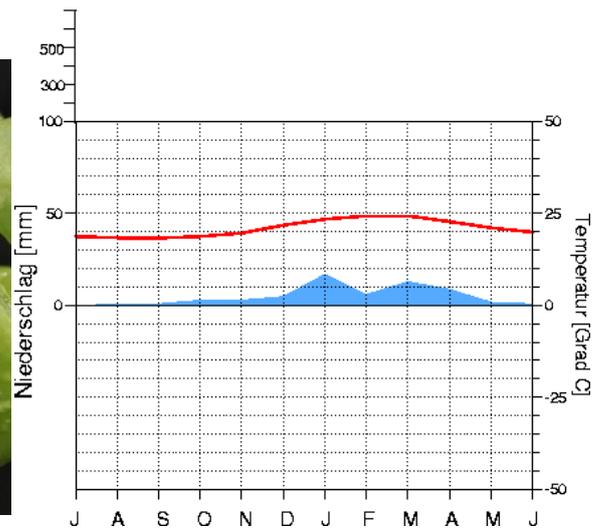
Peperomia dolabriformis Kunth.



Chiclayo
34 m

BWh

21.0 Grad C
62 mm



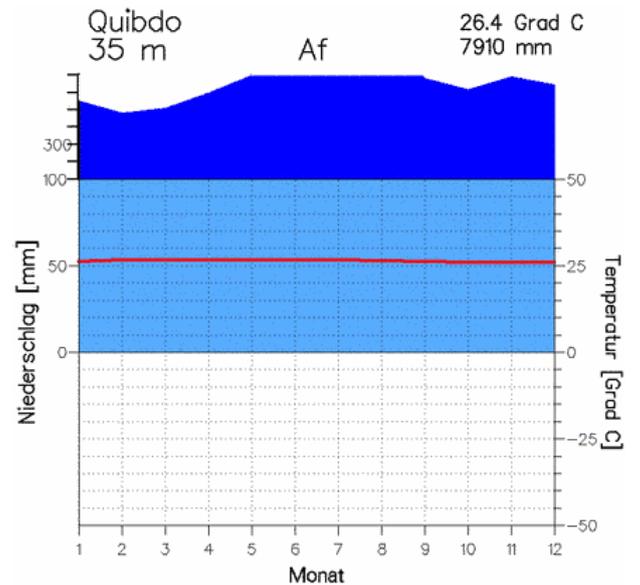
6,8° S / 79,8° W, 34 m





Peace Lily

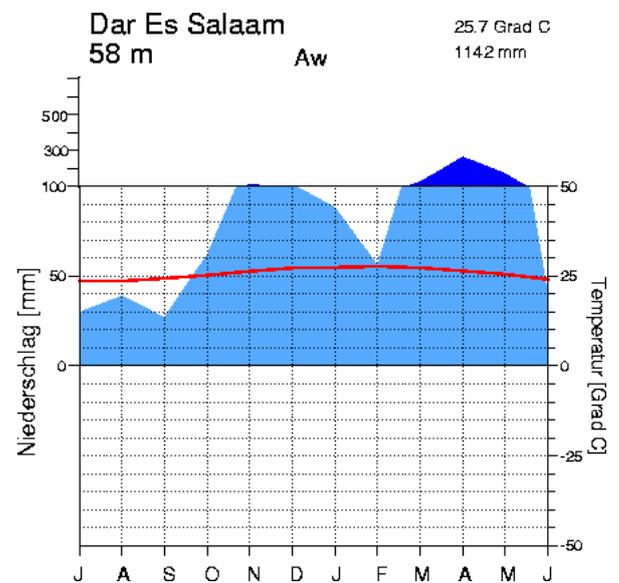
Spathiphyllum floribundum (Linden & André)
N.E.Br.



5°41'N, 76°39'W, 35 m

**False African Violet,
Cape Primrose**

Streptocarpus saxorum Engl.



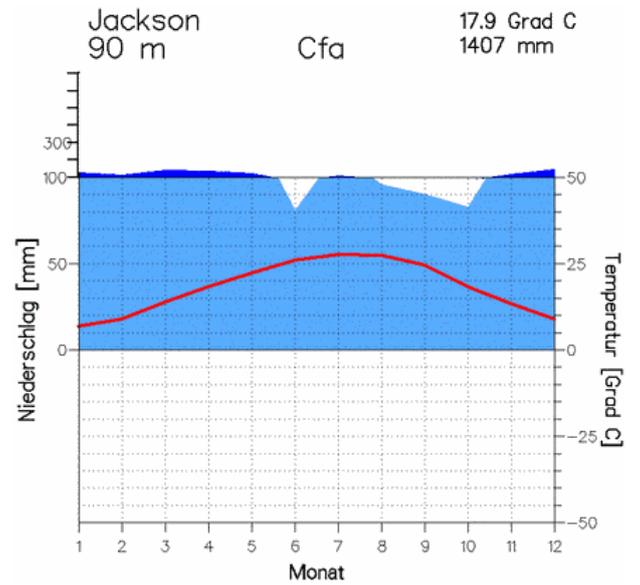
6°52'S, 39°12'E, 58 m





Spanish Moss

Tillandsia usneoides (L.)



30°50' N, 91°13' W, 90 m





**Hairy Spiderwort, White Velvet Spiderwort,
Cobweb Spiderwort**

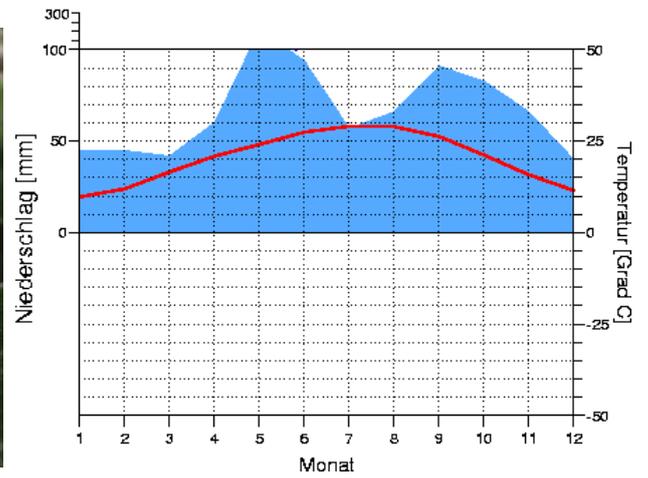
Tradescantia sillamontana Matuda



San Antonio
242 m

20.3 Grad C
800 mm

Cfa

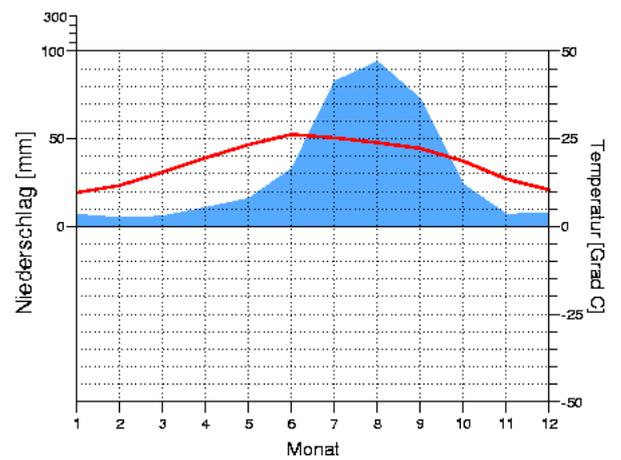


29°32'N, 98°28'W, 242 m

Chihuahua
1435 m

18.4 Grad C
368 mm

BSh



(two diagrams)

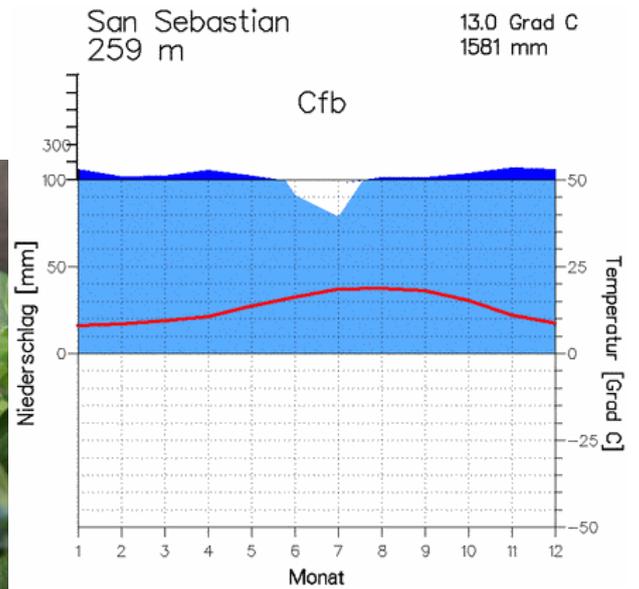
28°38'N, 106°05'W, 1435 m





**Horned Pansy,
Horned Violet**

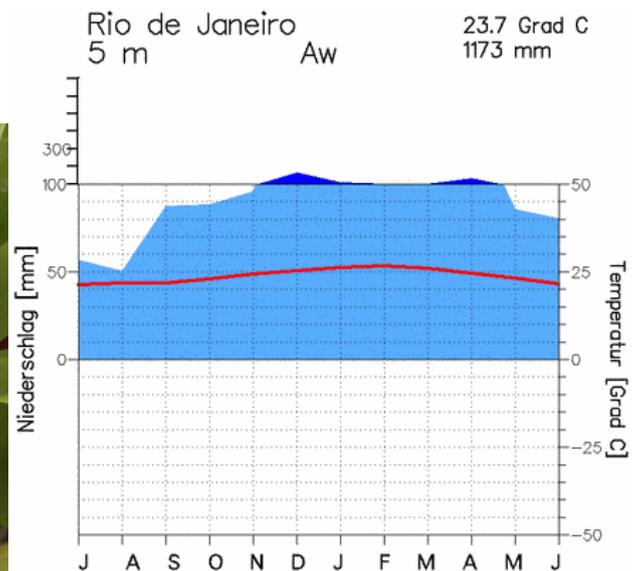
Viola cornuta L.



43°18'N, 2°03'W, 259 m

Vriesea psittacina

(Hook.) Lindl.



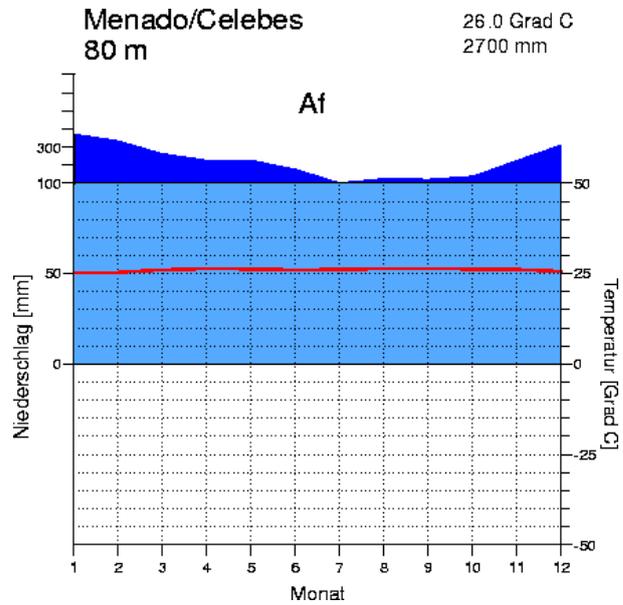
22° 54 'S, 43°12'W 5 m





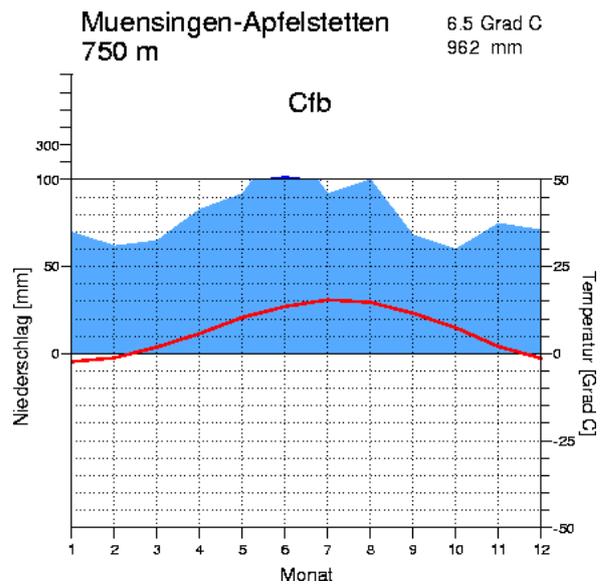
Climate diagrams without pictures

Bird's Nest Fern
Asplenium nidus L.



1°32'N, 124°55'E, 80 m

Yellow Ox-Eye Daisy
Buphthalmum salicifolium L.



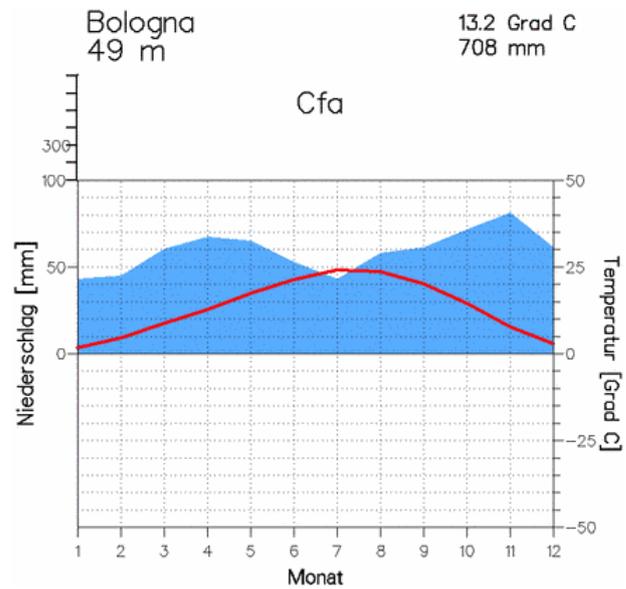
48°23'N, 9°29'E, 750 m





Pot Marigold

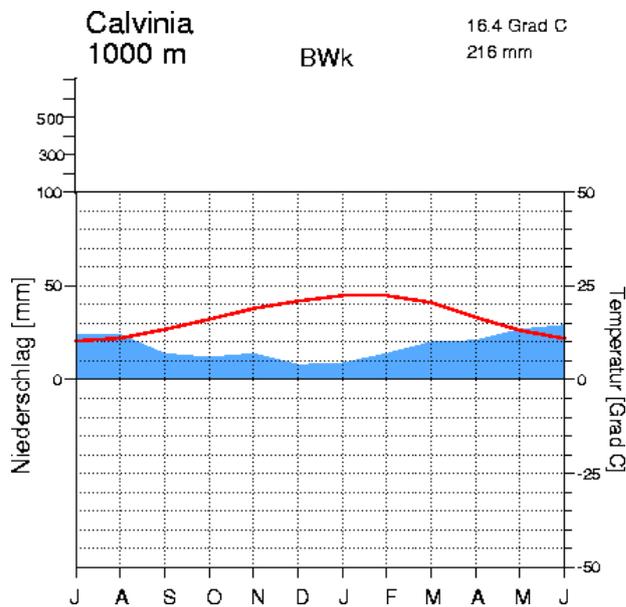
Calendula officinalis L.



44°32'N, 11°18'E, 49 m

**Conophytum,
Living Pebble**

Conophytum truncatum
(Thunb.) N.E.Br.



31°28'S, 19°46'E, 1000 m



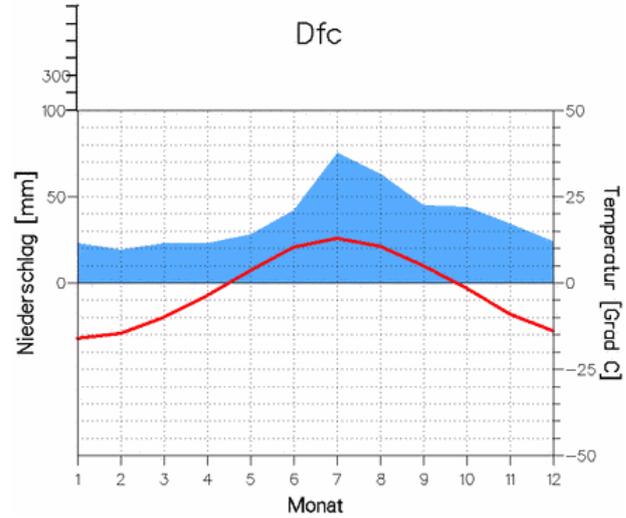


Mountain Avens

Dryas octopetala L.

Karesuando
327 m

-2.3 Grad C
443 mm



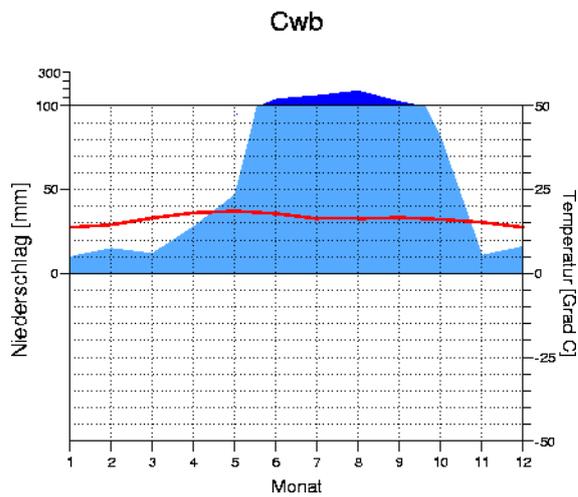
68°27'N, 22°30' E , 327 m

**Mexican Firecracker, ,
Hen and Chicken**

Echeveria setosa
Rose et Purpus

Mexico City
2308 m

16.5 Grad C
894 mm



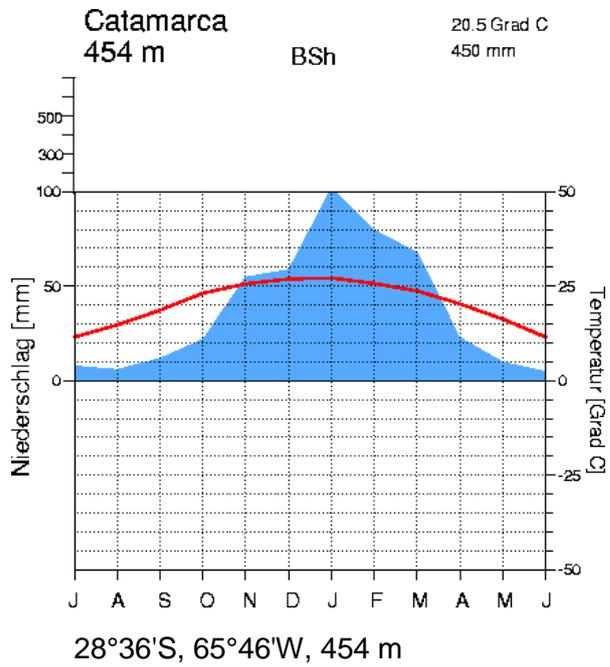
19°24'N, 99°12'W, 2308 m





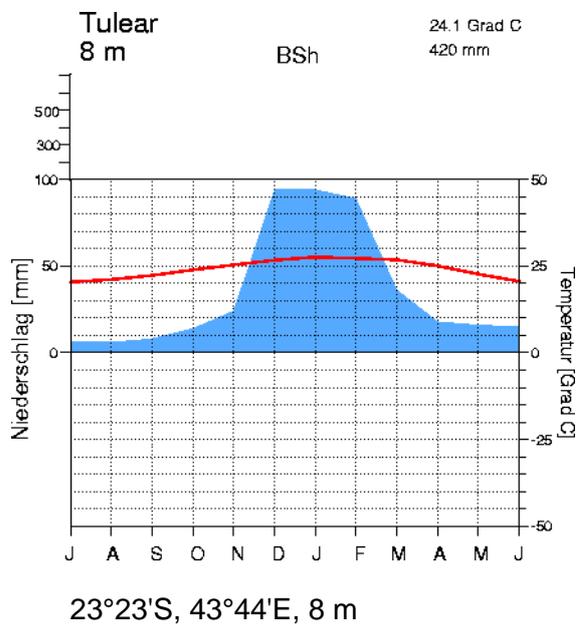
Echinopsis thelegona

(Web) Friedrich & G. D. Rowley



**Crown of Thorns, ,
Christ's Thorn**

Euphorbia millii Des Moul





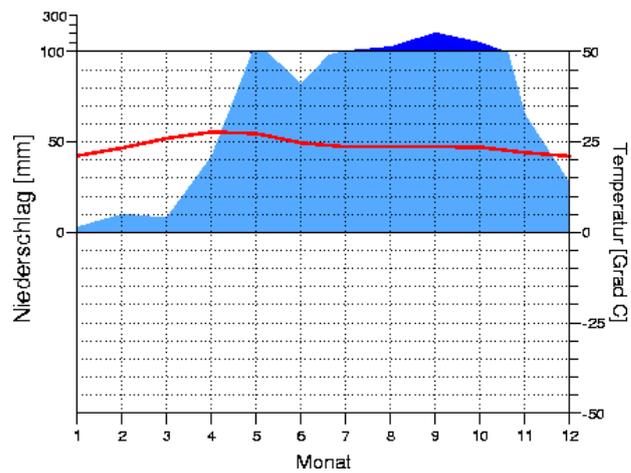
**Weeping Fig, ,
Benjamin´s Fig**

Ficus benjamina L..

Bangalore
921 m

24.0 Grad C
947 mm

Aw



12°58'N, 77°35'E, 921 m

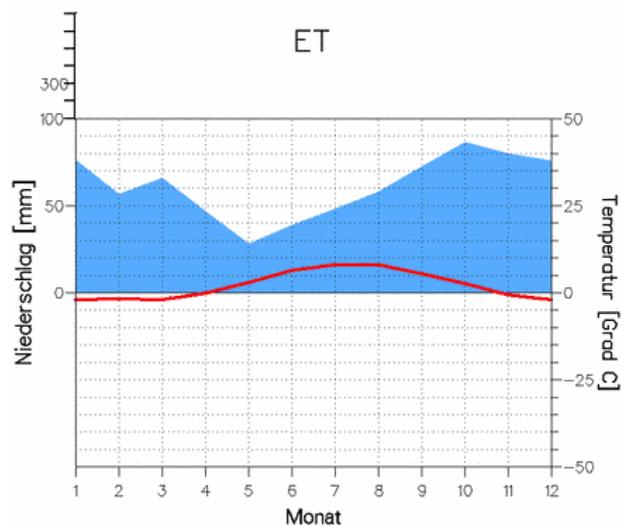
Grey Cushioned Grimmia

Grimmia pulvinata (Hedw.)
Sm.

Raufarhoefn
10 m

2.0 Grad C
732 mm

ET



66°27'N, 15°57'W, 10 m



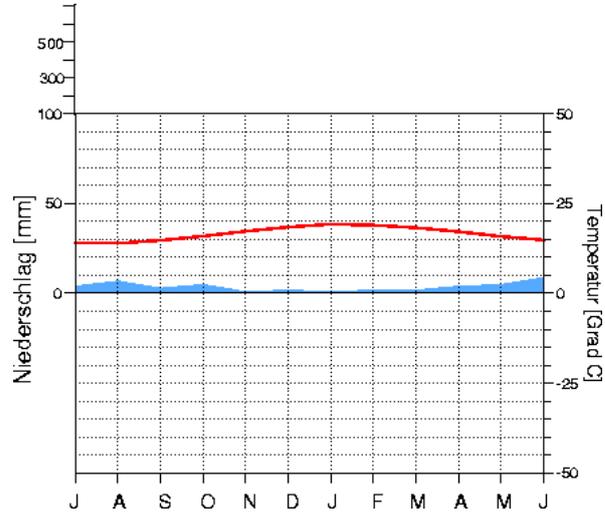


Kleinia ficoides (L.) Haw.

Alexander Bay
21 m

BWk

16.5 Grad C
46 mm



28°34'S, 16°32'E, 21 m

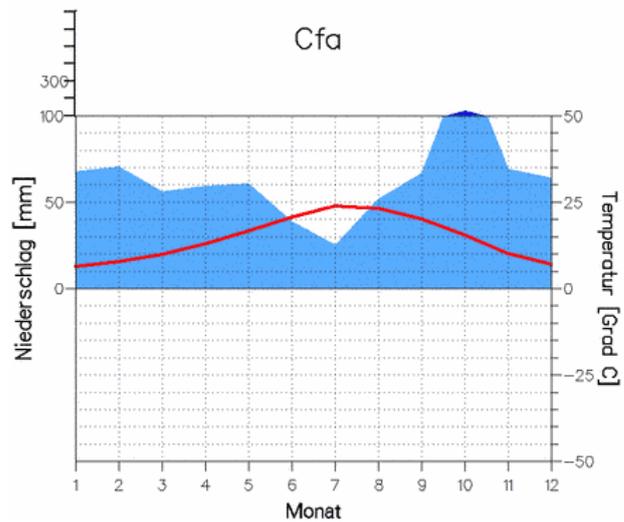
**Lavender, ,
Common Lavender**

Lavandula officinalis L.

Nimes
62 m

Cfa

14.4 Grad C
762 mm



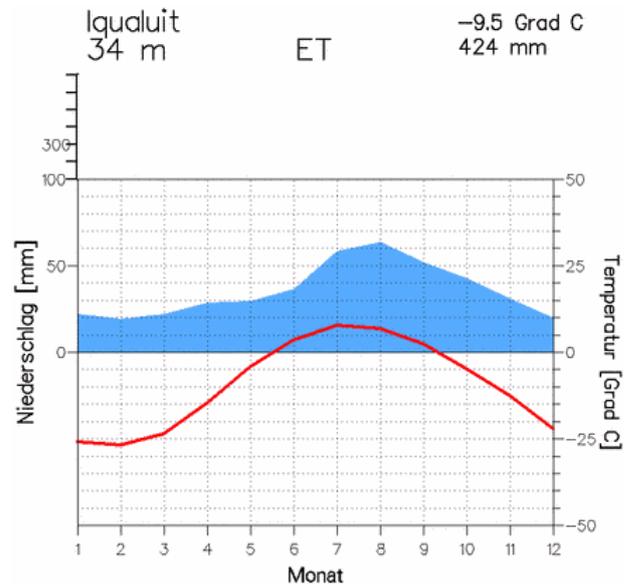
43°52'N, 4°24'E, 62 m





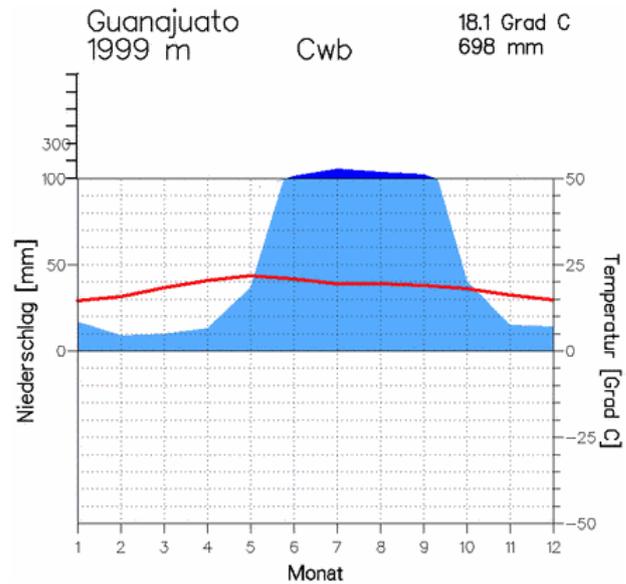
Crustose Rock Lichen

Lecanora spec.



63°45'N, 68°32'W, 34 m

Mammillaria microhelica
Werderm.



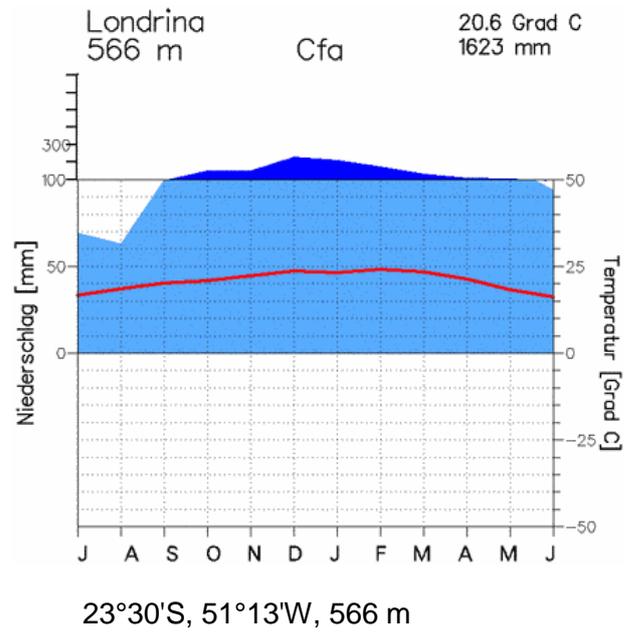
21°01'N, 101°15'W, 1999 m





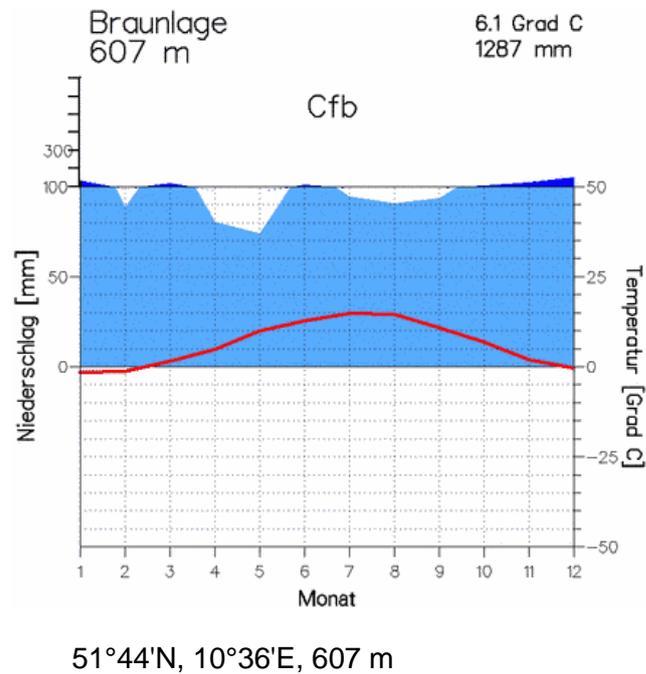
Prayer Plant

Maranta leuconeura
E. Morren



Well Liverwort

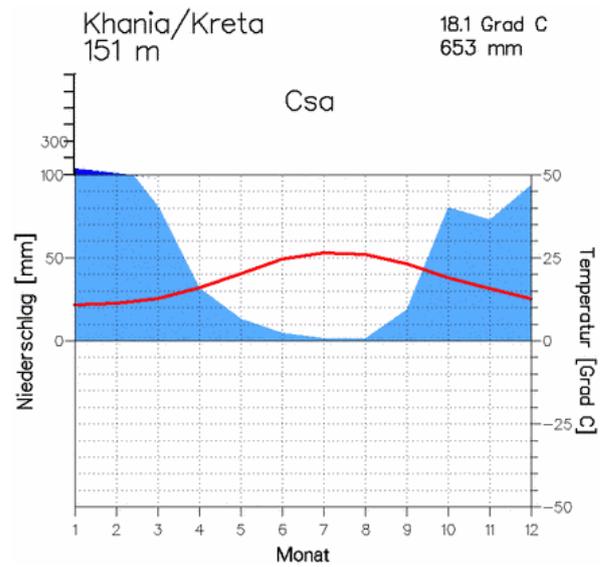
Marchantia aquatica
(Nees) Burgeff.





Oleander

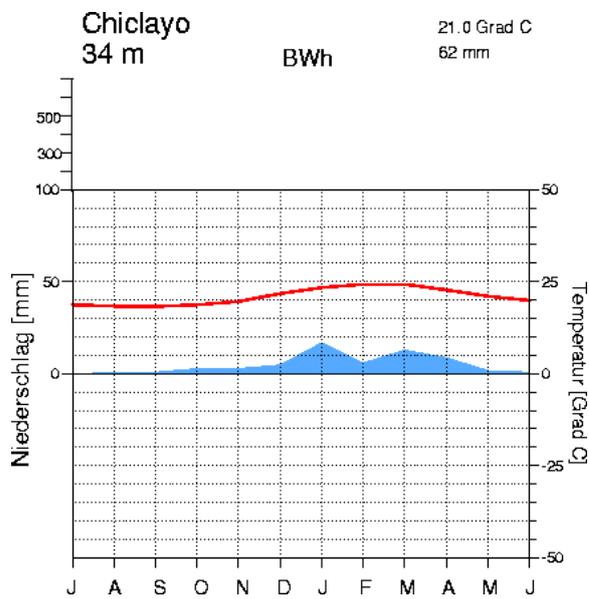
Nerium oleander L.



35°29'N, 24°07'E, 151 m

Prayer Peperomia

Peperomia dolabriformis
Kunth.



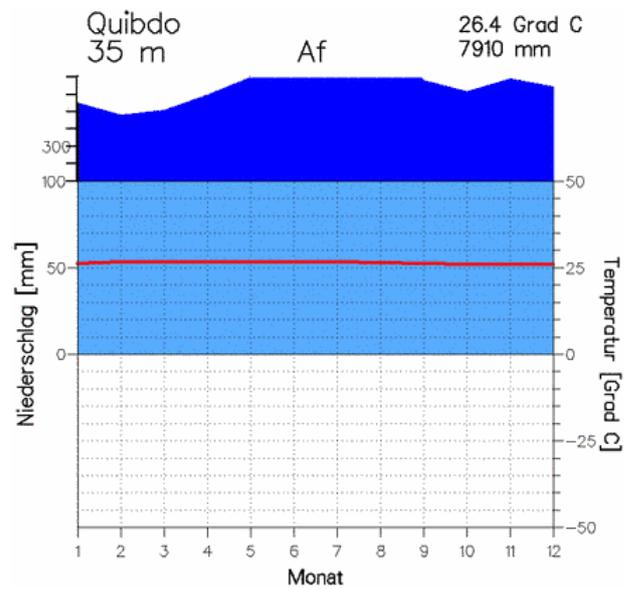
6,8° S / 79,8° W, 34 m





Peace Lily

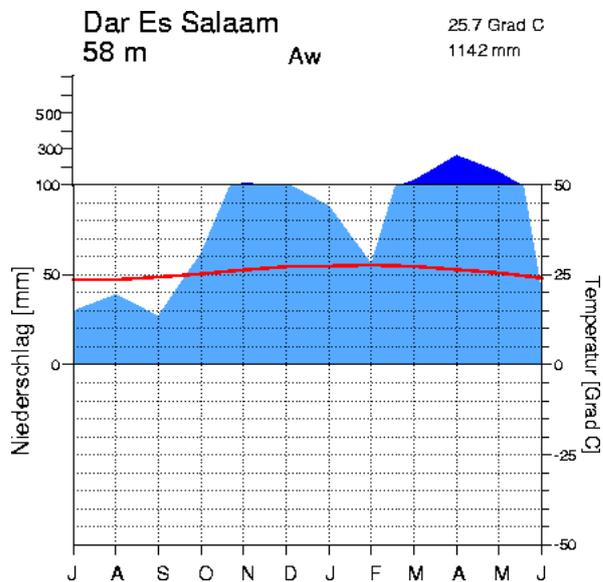
Spathiphyllum floribundum
(Linden & André) N.E.Br.



5°41'N, 76°39'W, 35 m

**False African Violet,
Cape Primrose**

Streptocarpus saxorum
Engl.



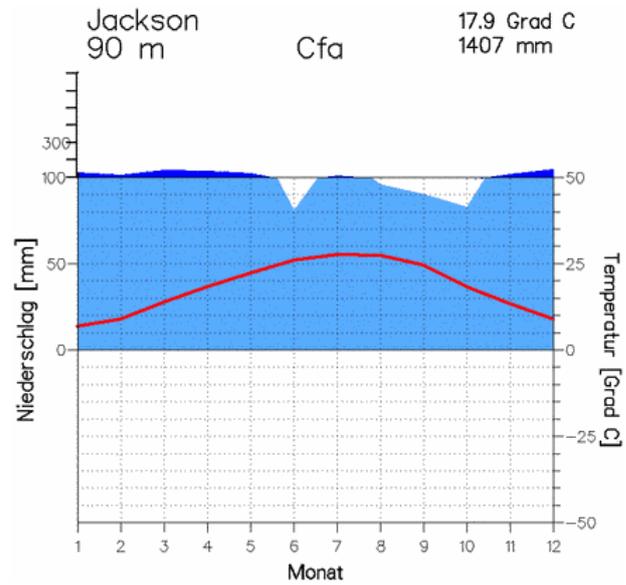
6°52'S, 39°12'E, 58 m





Spanish Moss

Tillandsia usneoides (L.) L.



30°50' N, 91°13' W, 90 m





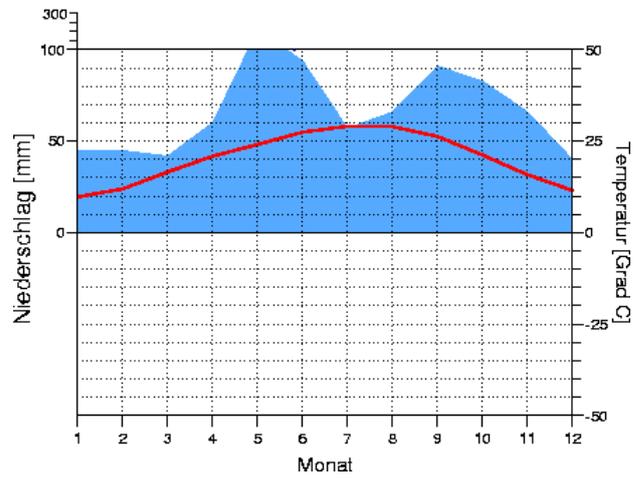
**Hairy Spiderwort,
White Velvet Spiderwort,
Cobweb Spiderwort**

Tradescantia sillamontana
Matuda

San Antonio
242 m

20.3 Grad C
800 mm

Cfa

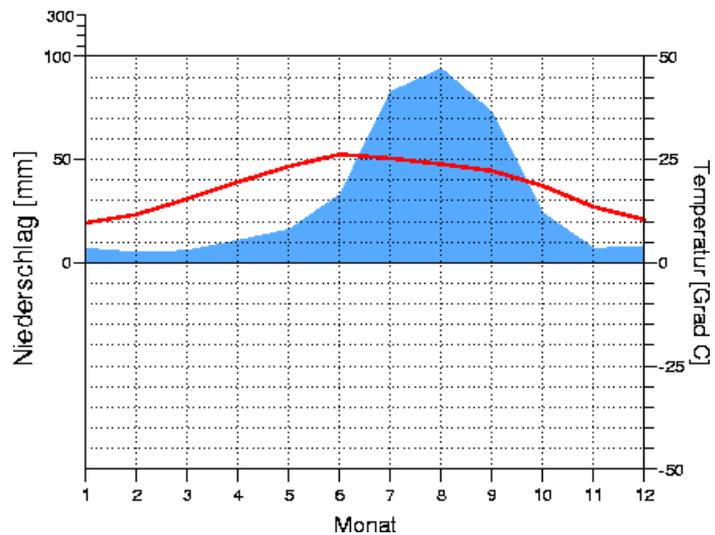


29°32'N, 98°28'W, 242 m

Chihuahua
1435 m

18.4 Grad C
368 mm

BSh



(two diagrams)

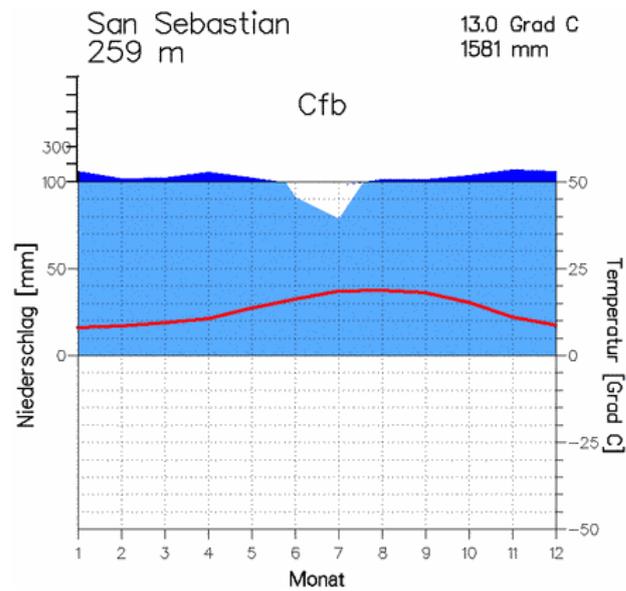
28°38'N, 106°05'W, 1435 m





**Horned Pansy,
Horned Violet**

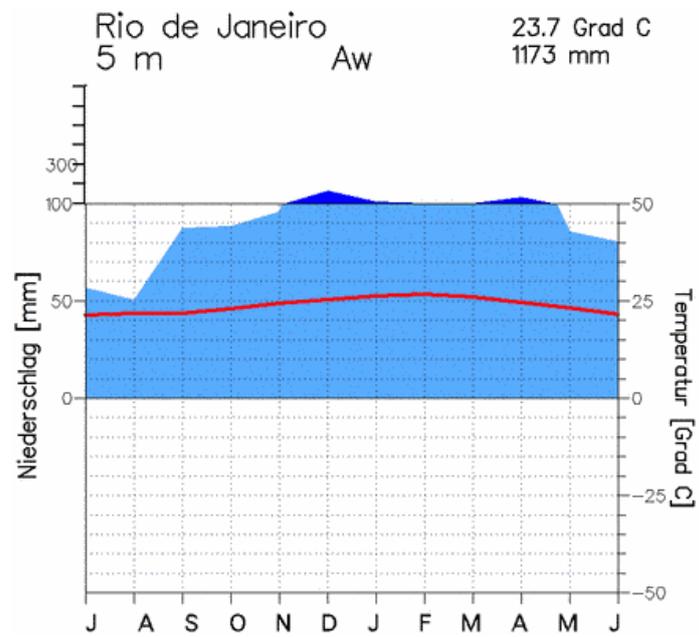
Viola cornuta L.



43°18'N, 2°03'W, 259 m

Vrisea psittacina

(Hook.) Lindl.



22 ° 54 'S, 43°12'W 5 m

Climate diagrams: <http://www.klimadiagramme.de>

