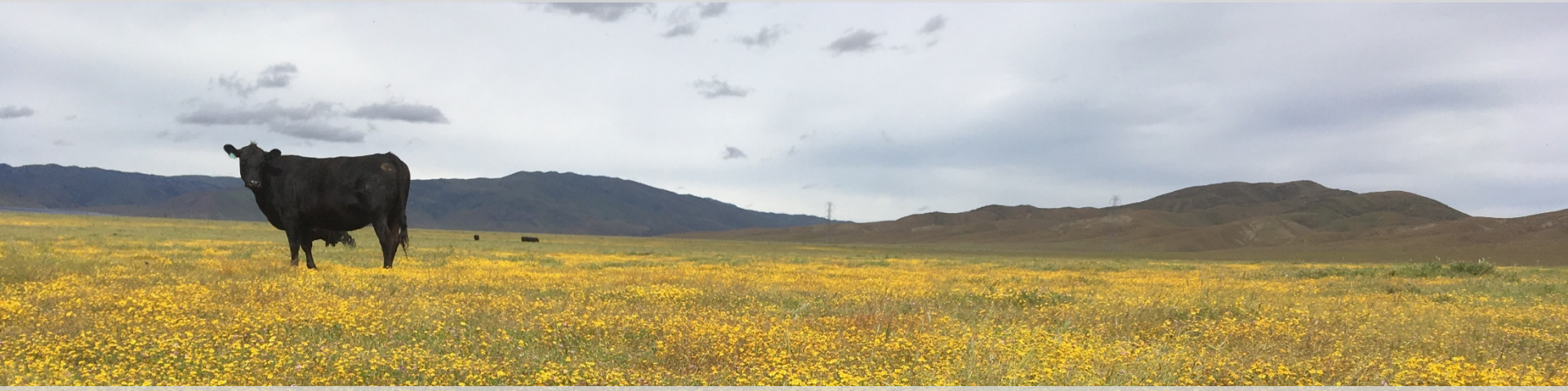
Plant Physiology and Plant ID

Rangeland and Livestock Management 101
Merced, CA

Devii Rao
May 1, 2019

Rangeland Definition



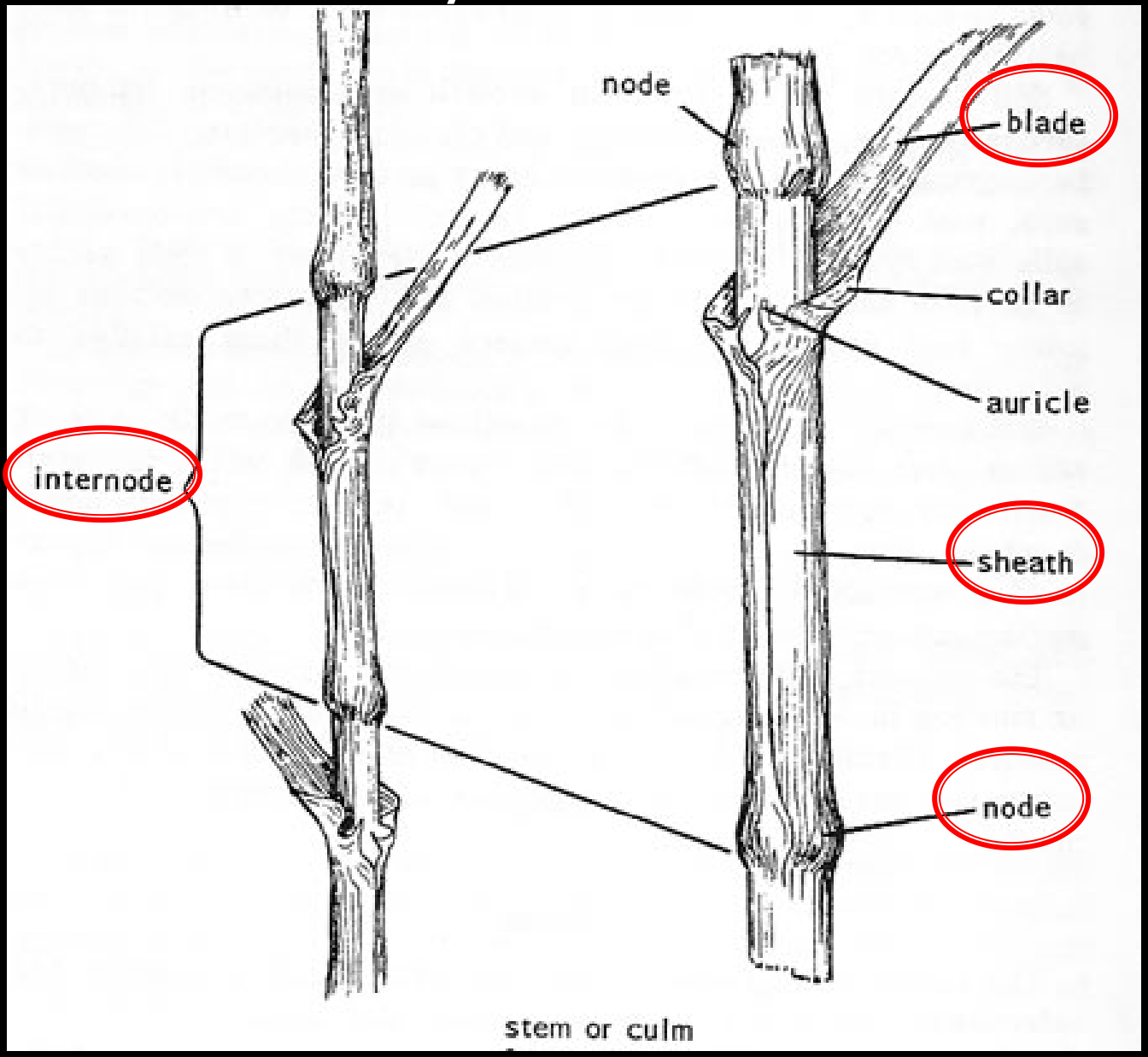
Land on which the vegetation is predominately grasses, grasslike plants, forbs (herbaceous dicots), or shrubs, and which is managed as a natural ecosystem, even if the dominant plants are non-native. The vegetation may include scattered trees (canopy cover ≤30%).

Rangelands include natural grasslands, savannas, shrublands, many deserts, tundras, alpine communities, marshes, and meadows (modified from Society for Range Management 1998).

This definition is from the Range Ecosystems chapter by Spiegal et al. in the Ecosystems of California book.

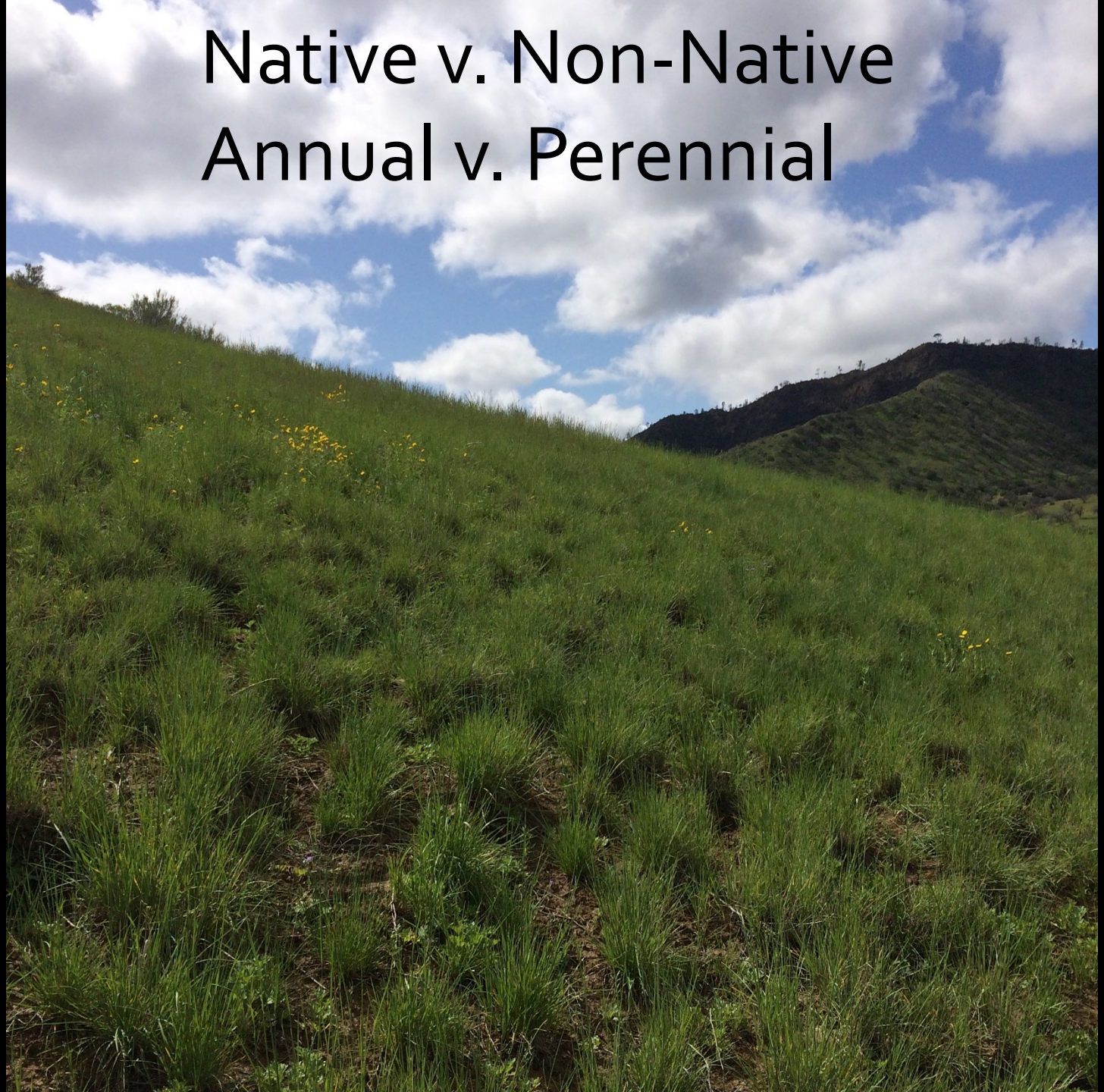
Grass

Phytomer



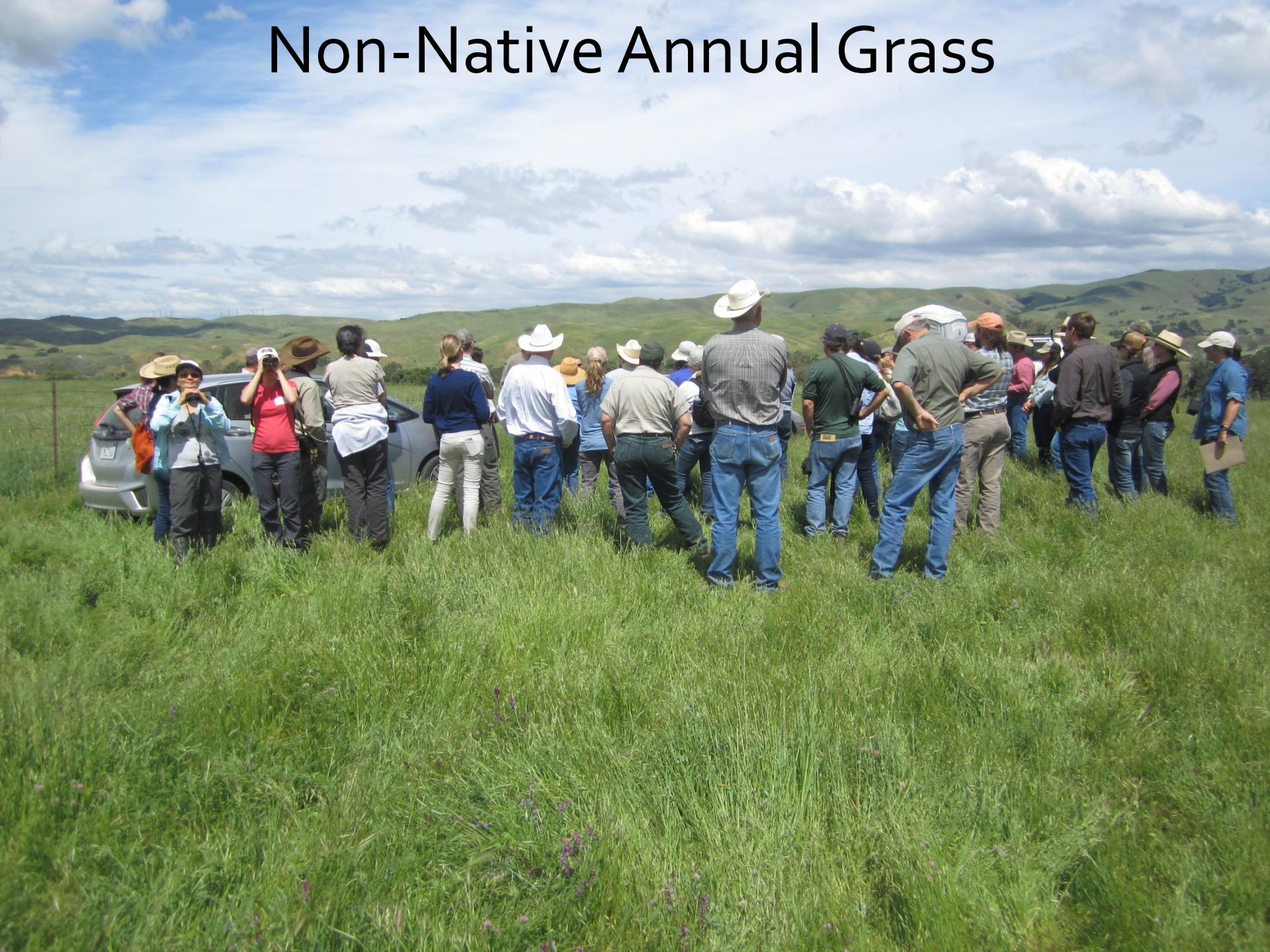
http://www.namethatplant.net/glossary_grass.shtml

Native v. Non-Native
Annual v. Perennial

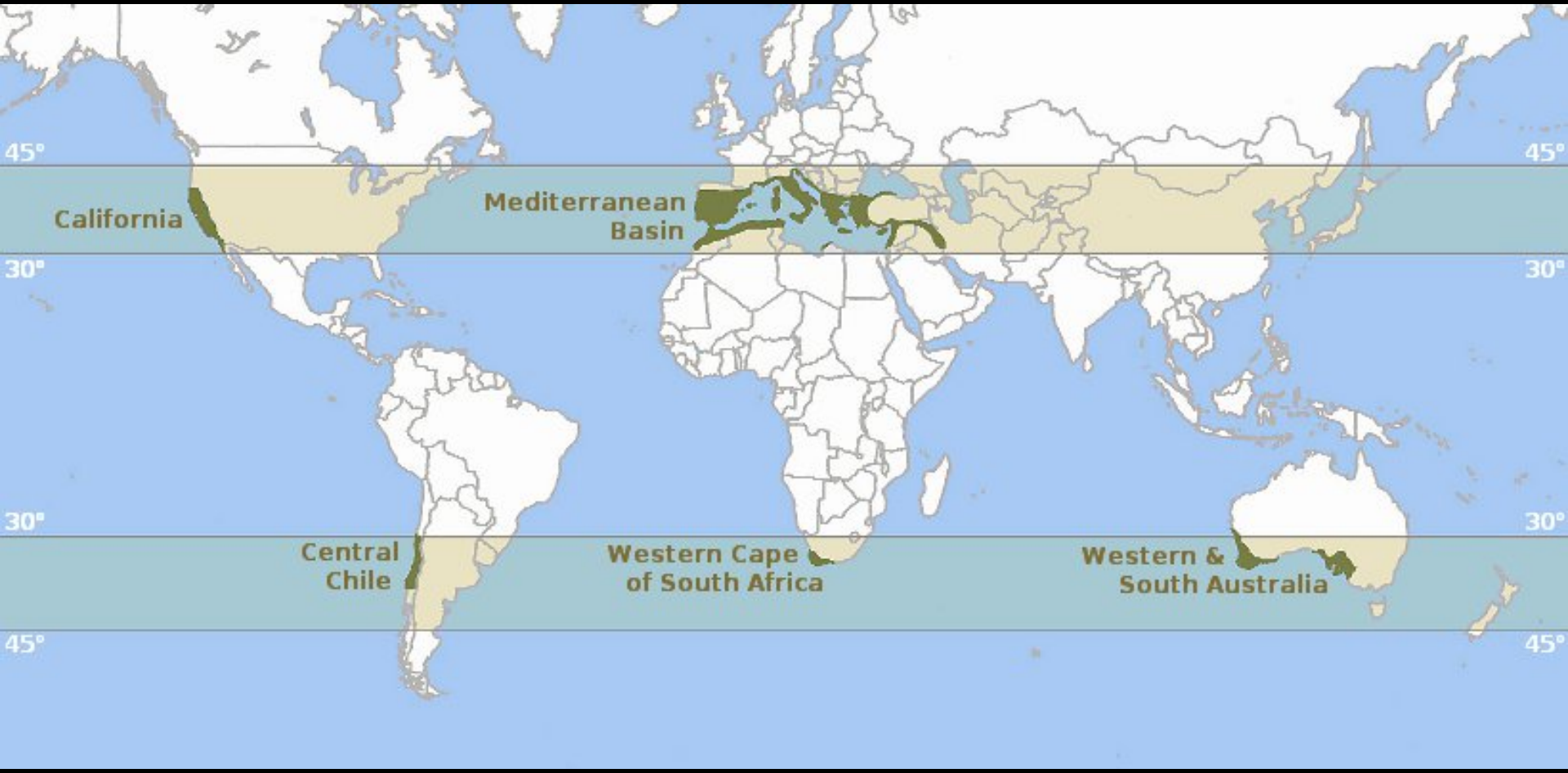


Native Perennial Grass

Non-Native Annual Grass



Native v. Non-Native
Mediterranean Ecosystems



Map by www.gimcw.org

Not a grass, but… biennial

Dipsacus sativus - Teasel

Grass-Like Plant

Grass-like Plants

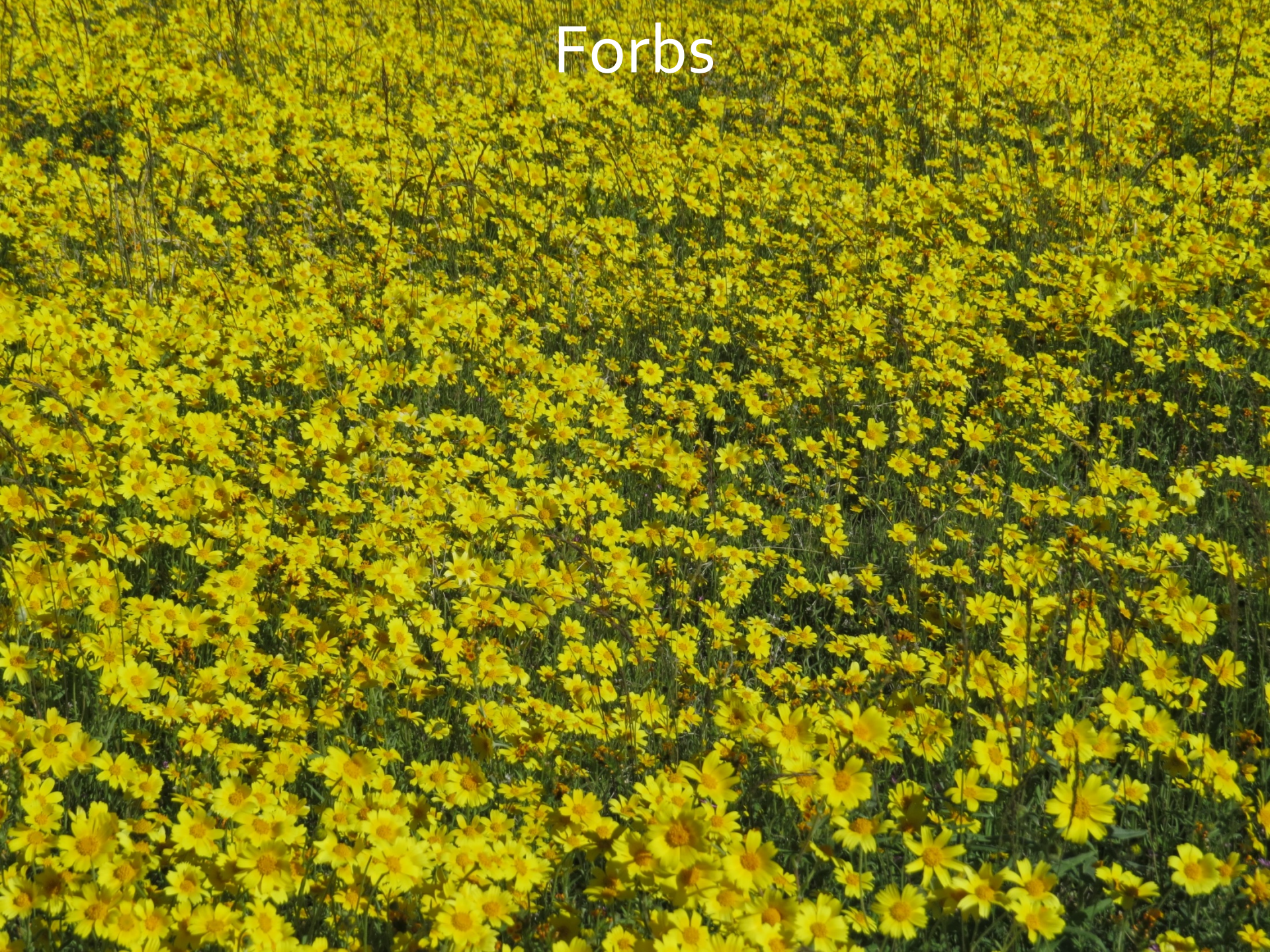
Rush: *Juncus acutus*

©2018 Dr. Amadej Trnkoczy

Sedge: *Carex alma*

©2008 Steve Matson

Forbs



Forbs

Shrubs

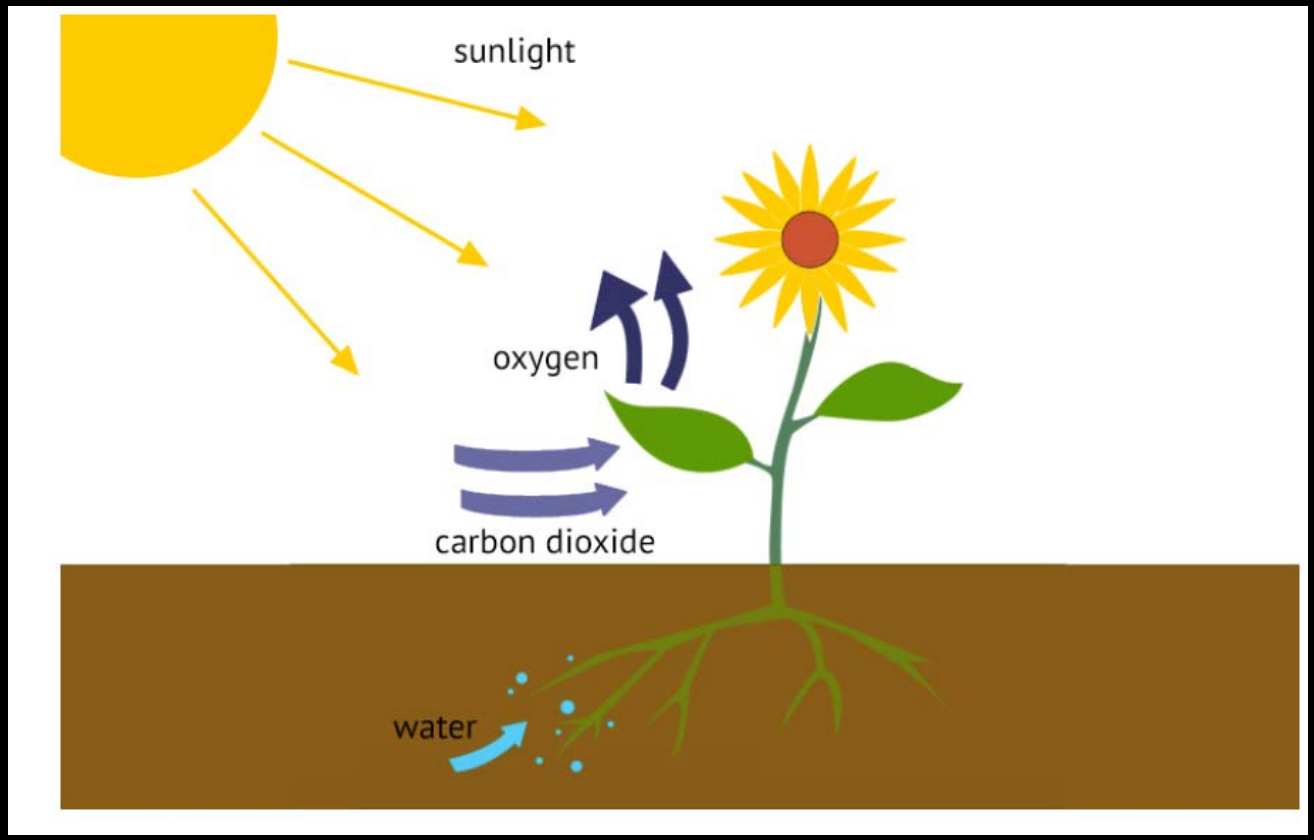
Shrubs

Trees - Blue Oak

Photosynthesis

$6CO_2 + 6H_2O + (energy) \rightarrow C_6H_{12}O_6 + 6O_2$

Carbon dioxide + water + energy from light produces glucose and oxygen.



- Water from roots
- CO_2 from open stomata in leaves
- Sunlight captured by the chloroplasts in leaves

https://www.philpoteducation.com/mod/book/view.php?id=782&chapterid=1131#/

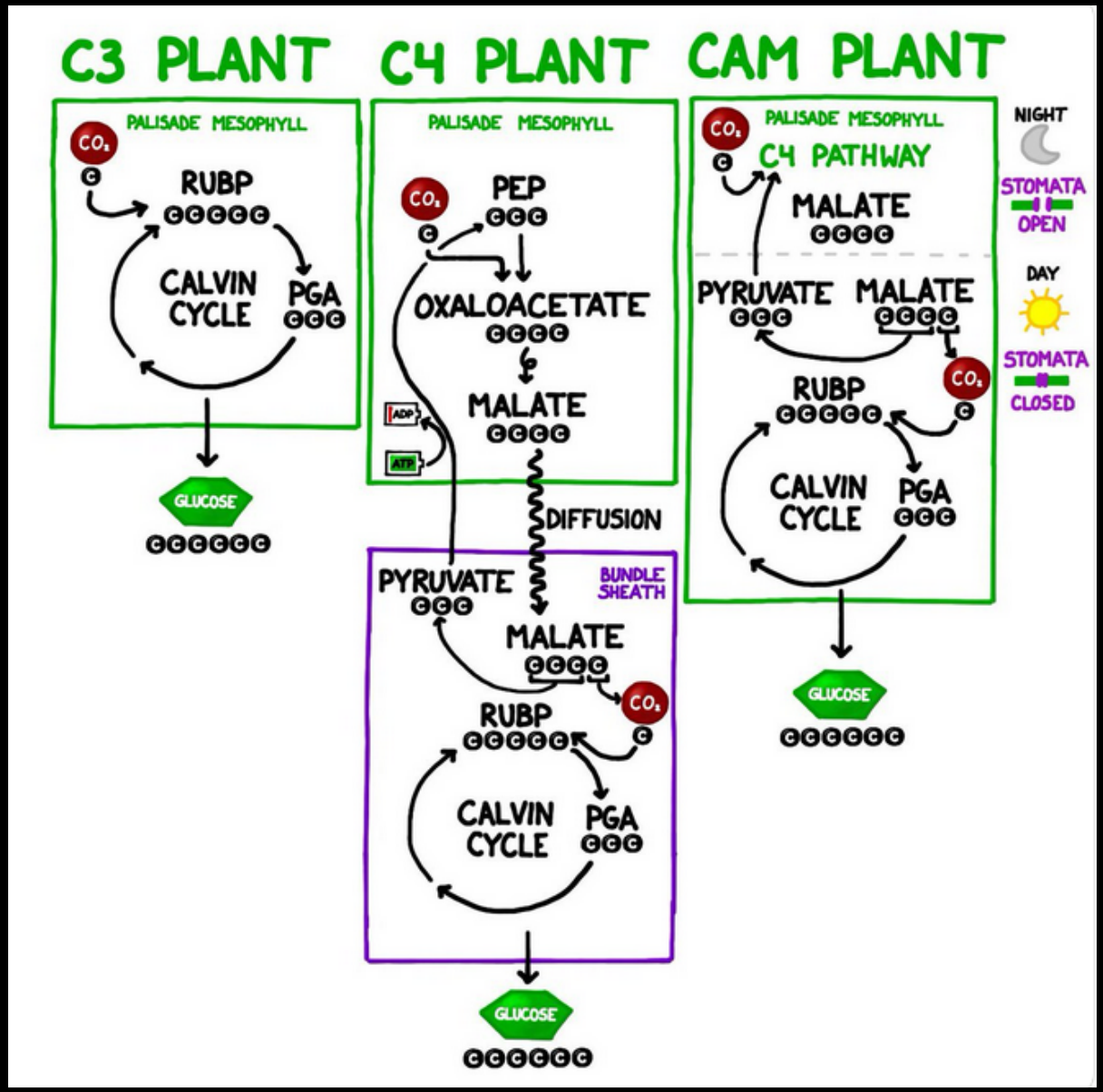
Three Types of Photosynthesis

Light-dependent reaction uses energy from sun to create ATP (not shown here).

In C3 plants, photorespiration can occur when O2 gets fixed instead of Co2 during Calvin cycle and no glucose is created.

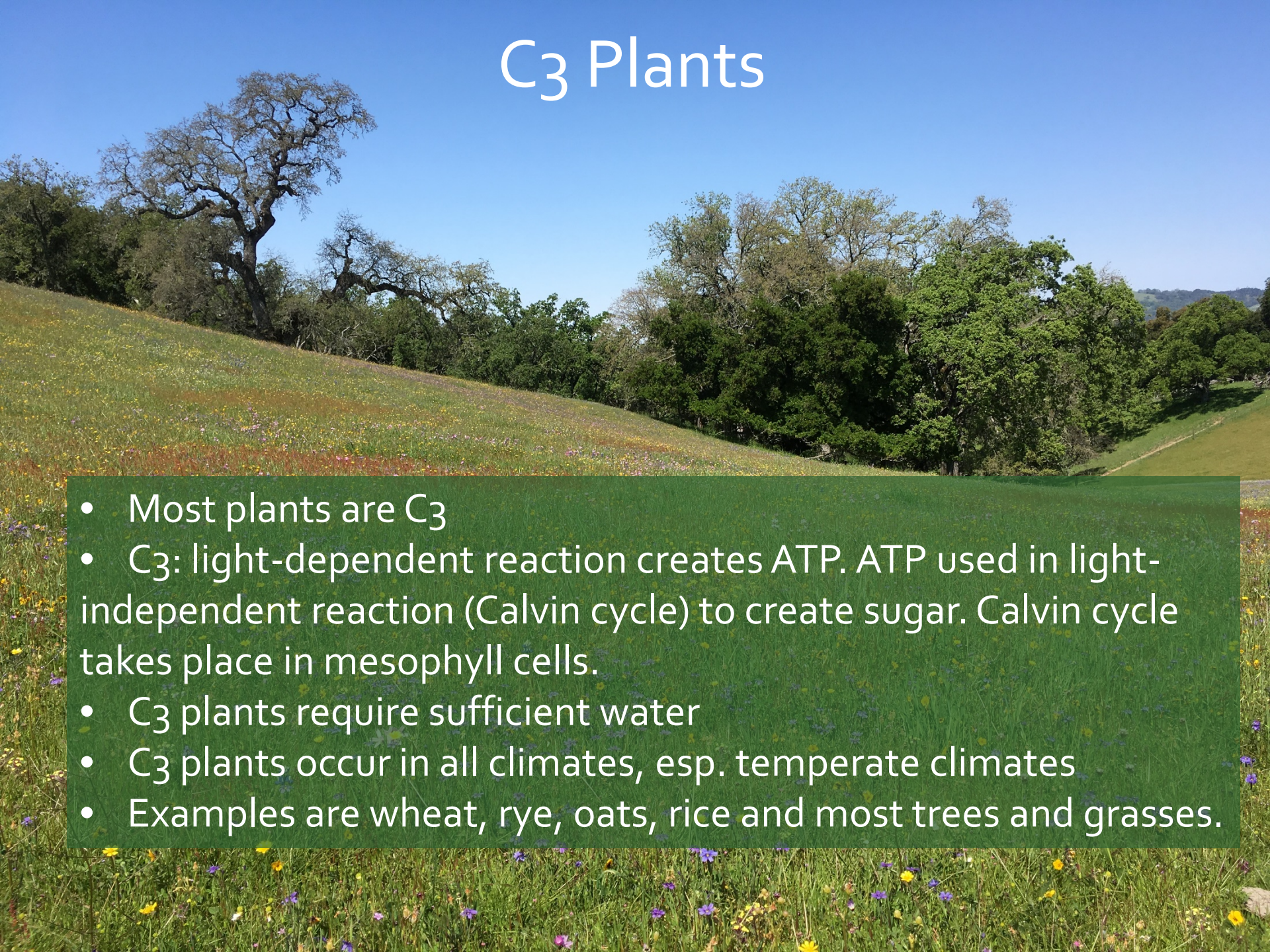
To avoid photorespiration, C4 plants perform Calvin cycle in bundle sheath cells – no O2 available.

CAM plants fix CO2 at night and Calvin Cycle happens during day, to reduce water loss.



https://twitter.com/BOGObiology

C3 Plants



- Most plants are C3
- C3: light-dependent reaction creates ATP. ATP used in light-independent reaction (Calvin cycle) to create sugar. Calvin cycle takes place in mesophyll cells.
- C3 plants require sufficient water
- C3 plants occur in all climates, esp. temperate climates
- Examples are wheat, rye, oats, rice and most trees and grasses.

C4 Plants

- C4: light-dependent reaction occurs in mesophyll cells, like C3 plants. But, Calvin cycle takes place in bundle sheath cells to reduce build up of O2.
- C4 plants occur in tropical environments, with elevated daytime temperatures, drought
- Examples are corn, sugar cane, sorghum

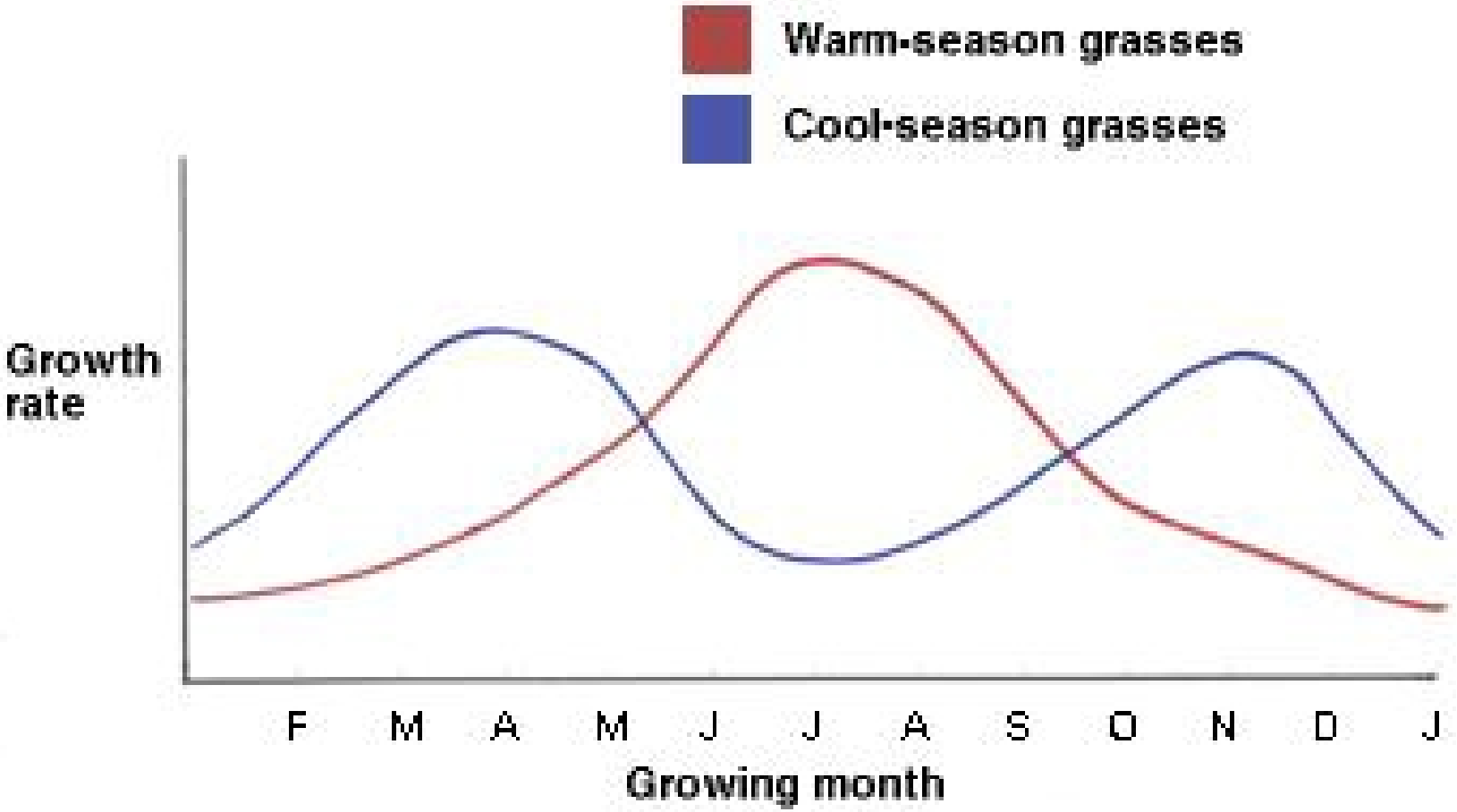
https://www.silveusfinancial.com/export-forecasts-hint-rising-corn-prices/corn-field-under-setting-sun

CAM Plants

(Crassulacean acid metabolism)

- CAM: open stomata at night to reduce water loss and allow CO_2 to enter. But, Calvin cycle takes place at during day using stored fixed CO_2.
- CAM plants occur in arid environments, like deserts.
- Examples are stonecrops and cacti. Also, pineapple.

https://www.kcet.org/shows/socal-connected/guide-seven-incredibly-old-mojave-desert-plants-o


Warm-season grasses
Cool-season grasses
Growth rate
F
M
A
M
J
J
A
S
O
N
D
J
Growing month

Grass Stats from *California Grasslands Ecology & Management Book*

- About ¼ of California is covered by grass-dominated vegetation.
- Poaceae is the 4th largest flowering plant family in the world with 11,000 species worldwide.

- California has 524 grass species.
- About 45% of grasses in California are introduced and about 55% are native.
- 37 grass species occur only in California.
- 51 California native grasses are annual and 240 are perennial.

Travis Columbus from Rancho Santa Ana Botanic Garden says to look for the following characteristics when identifying grasses.

We will cover some of the ones I use most.

1) Annual v. perennial
2) ~~Sheath open or closed~~
3) Ligule membrane or row of hairs
4) Inflorescence type
5) Number of florets per spikelet
6) ~~Position of sterile florets~~
7) ~~Number of veins on lemma~~
8) Awns present, #, position
9) ~~Disarticulation~~

Annual v. perennial

Perennial Grass Growth Forms

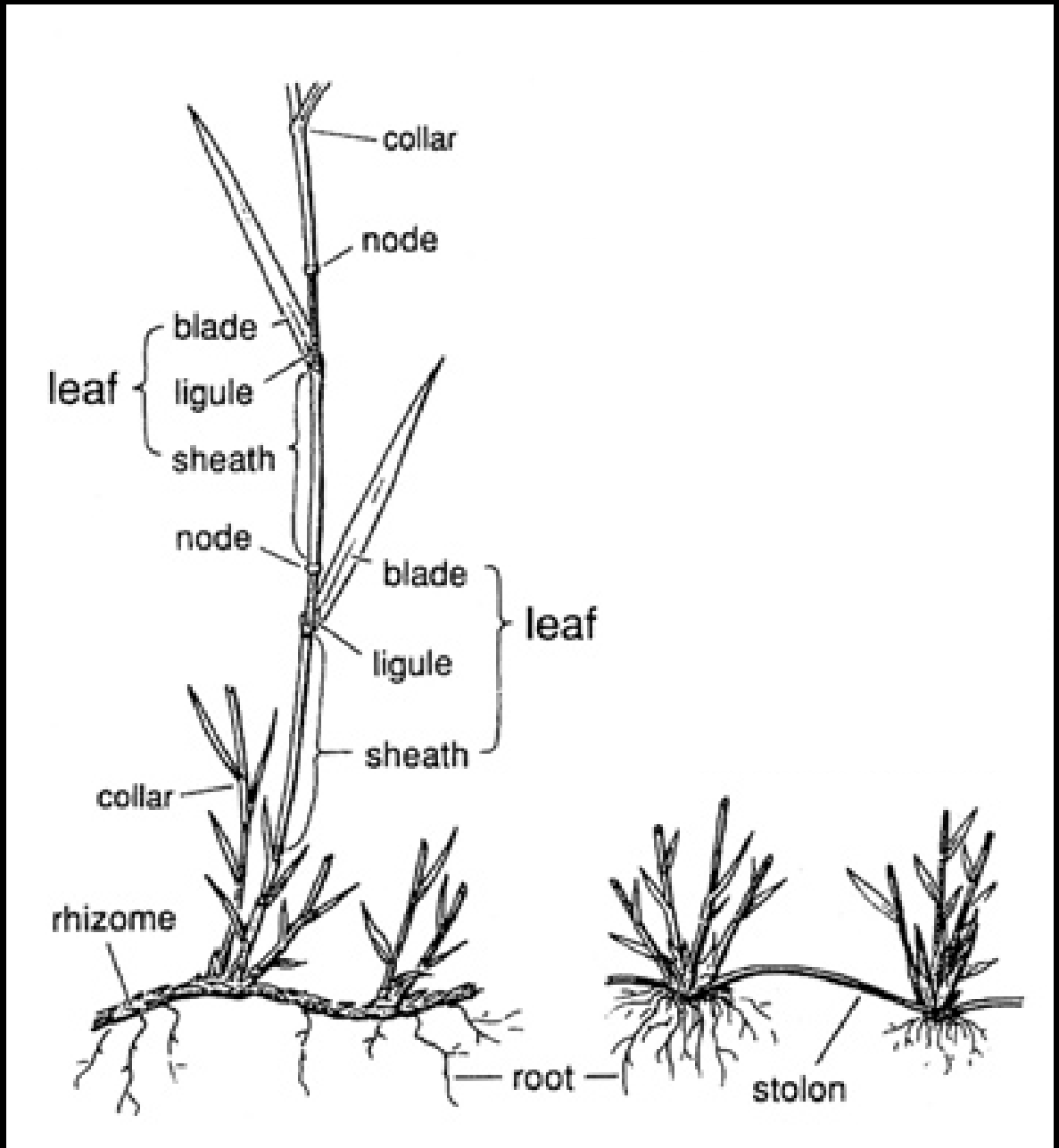
Cespitose (bunch grasses)

Rhizomatous (sod-forming)

Image From Jepson Manual

Perennial grasses may have rhizomes and stolons

Culm – a grass stem; is comprised of 1 or more stacked (nested) phytomers



Ligule: membrane or row of hairs
Auricle
Sheath (open or closed)

Image From Jepson Manual

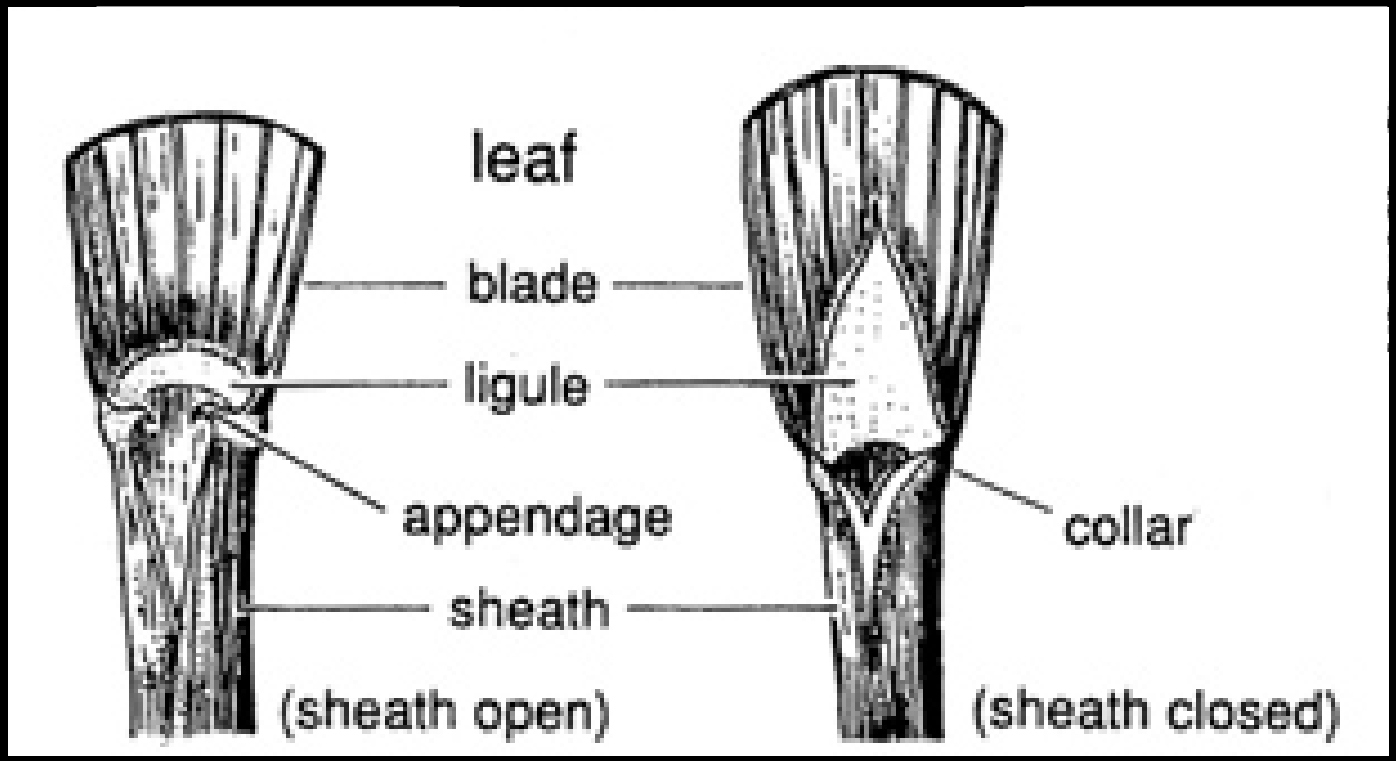
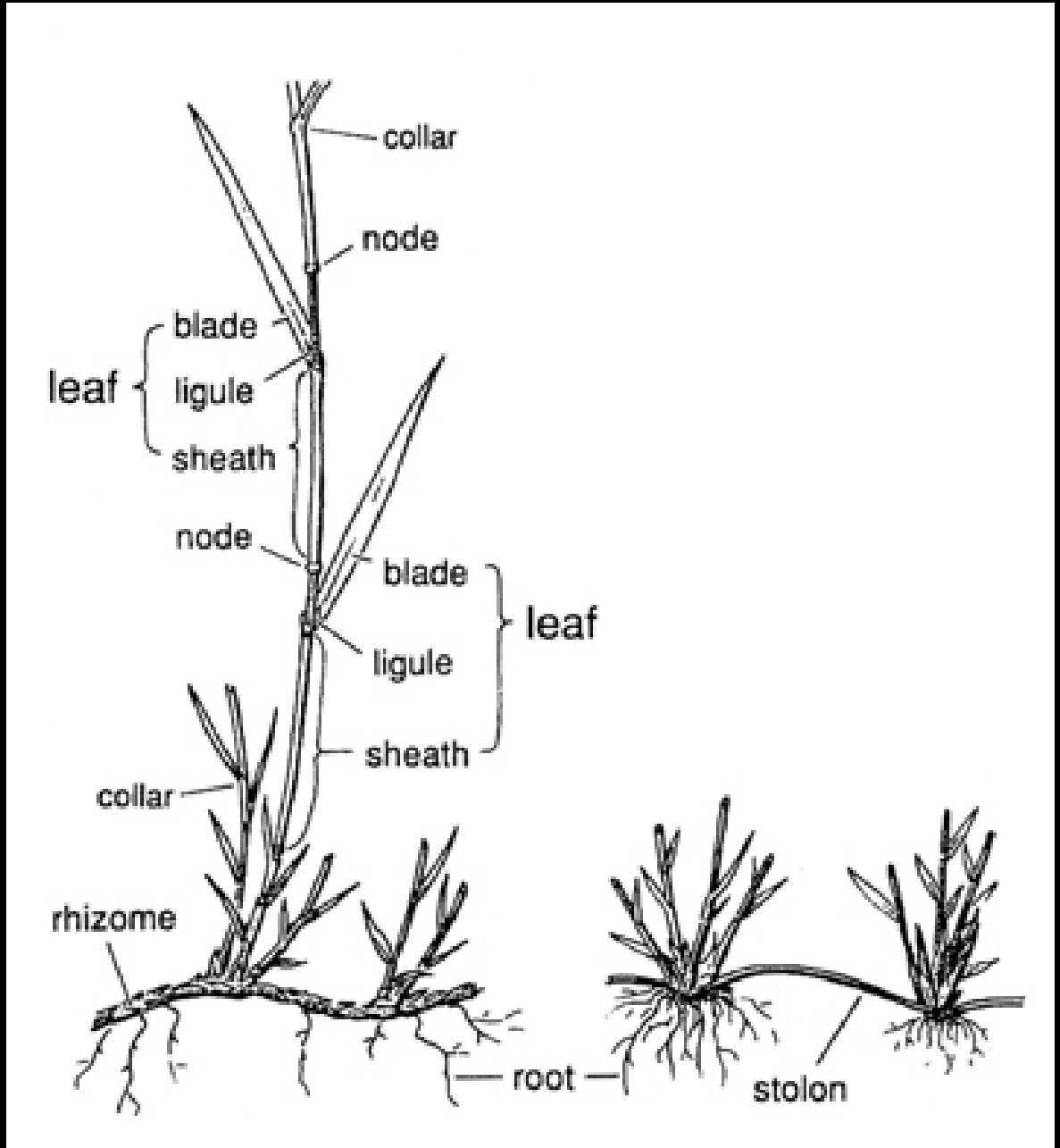


Image From Jepson Manual

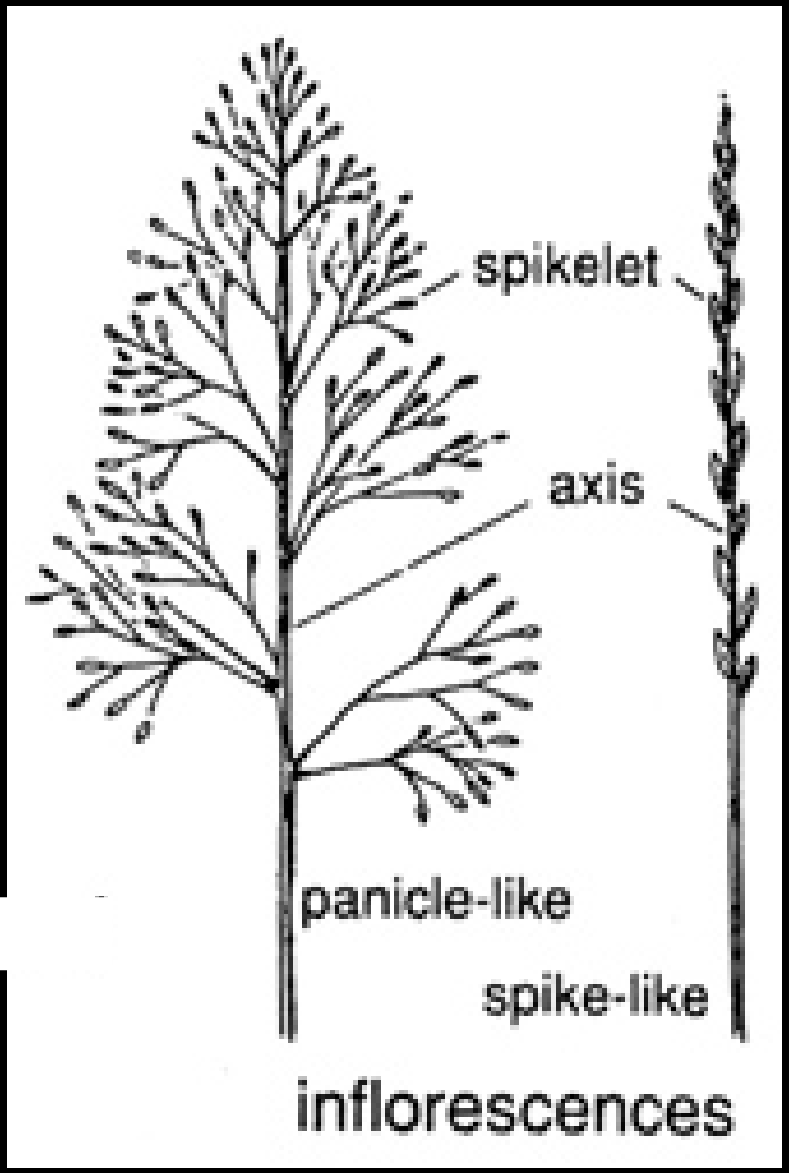
Intercalary meristems are above each node and at the base of each leaf blade.

Compare to apical meristem at the apex or top of the plant.



Inflorescence Types
Image From Jepson Manual

Spike-like: No branching
Panicle-like: Branching

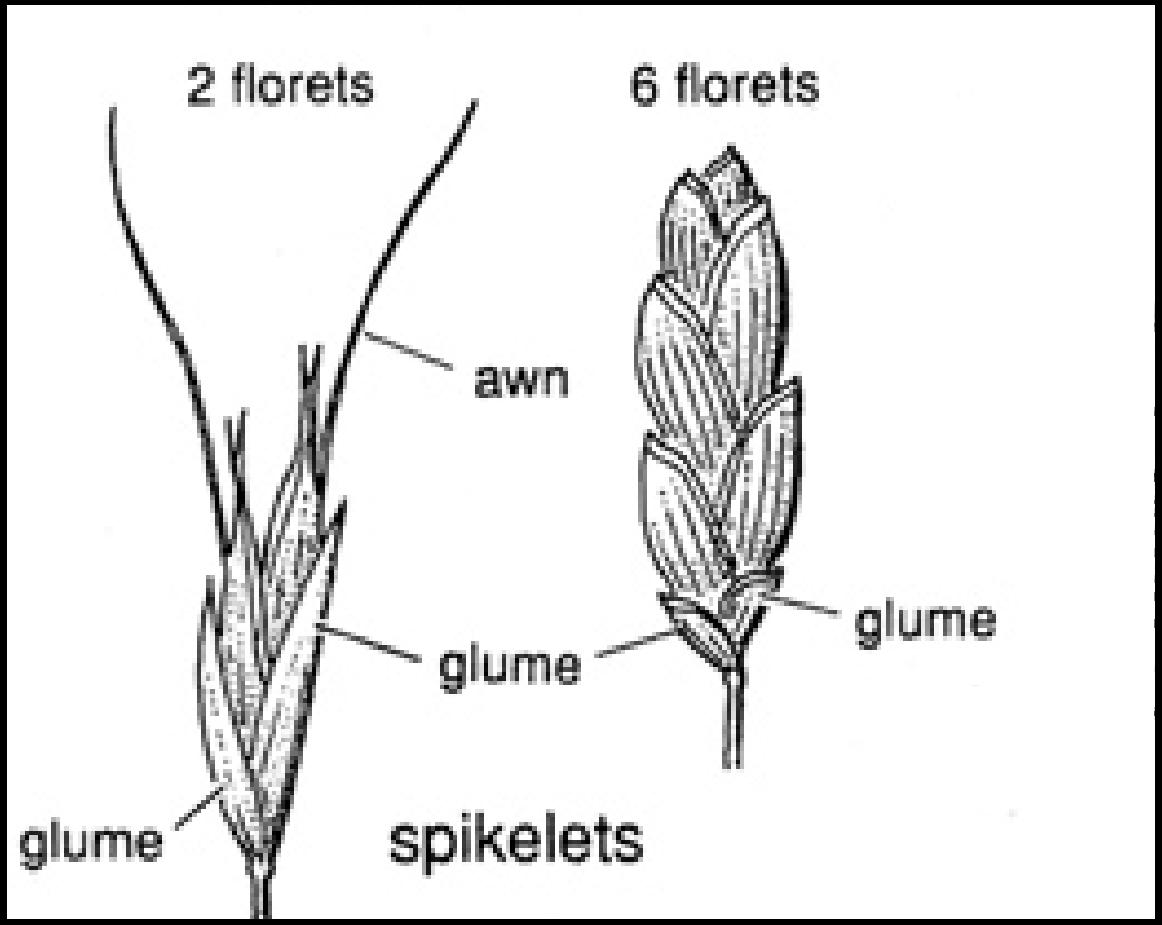


Flower Morphology
Image From Jepson Manual

Spikelet (includes glume)

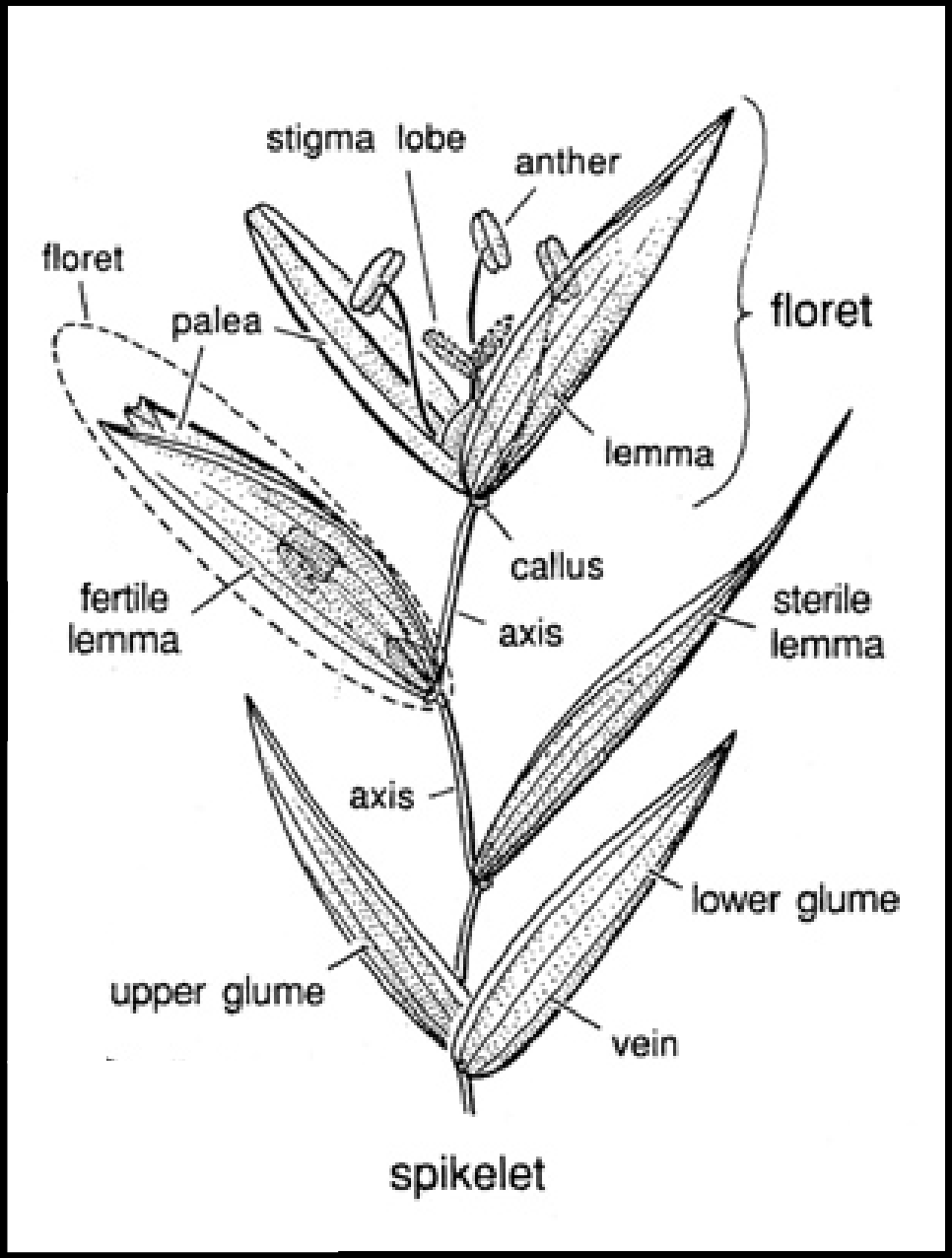
Floret (grass flower is inside)

Awn: present, #, position



Floret
Lemma
Palea
Stigma
Anthers
Glume
Spikelet

Image From Jepson Manual



Draw your grass!

- Node
- Leaf blade
- Leaf sheath
- Ligule
- Auricle
- Glume
- Inflorescence
- Palea
- Lemma
- Awn
- Floret
- Spikelet

©2008 Zoya Akulova

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What I look at for *Stipa Pulchra*:

- Bunch grass
- Really long, smooth awns
- Rough leaves
- Hairy ligules

Purple Needlegrass *Stipa pulchra* – bunchgrass

Stipa pulchra - awns

Foxtail

What I look at for *Hordeum*:

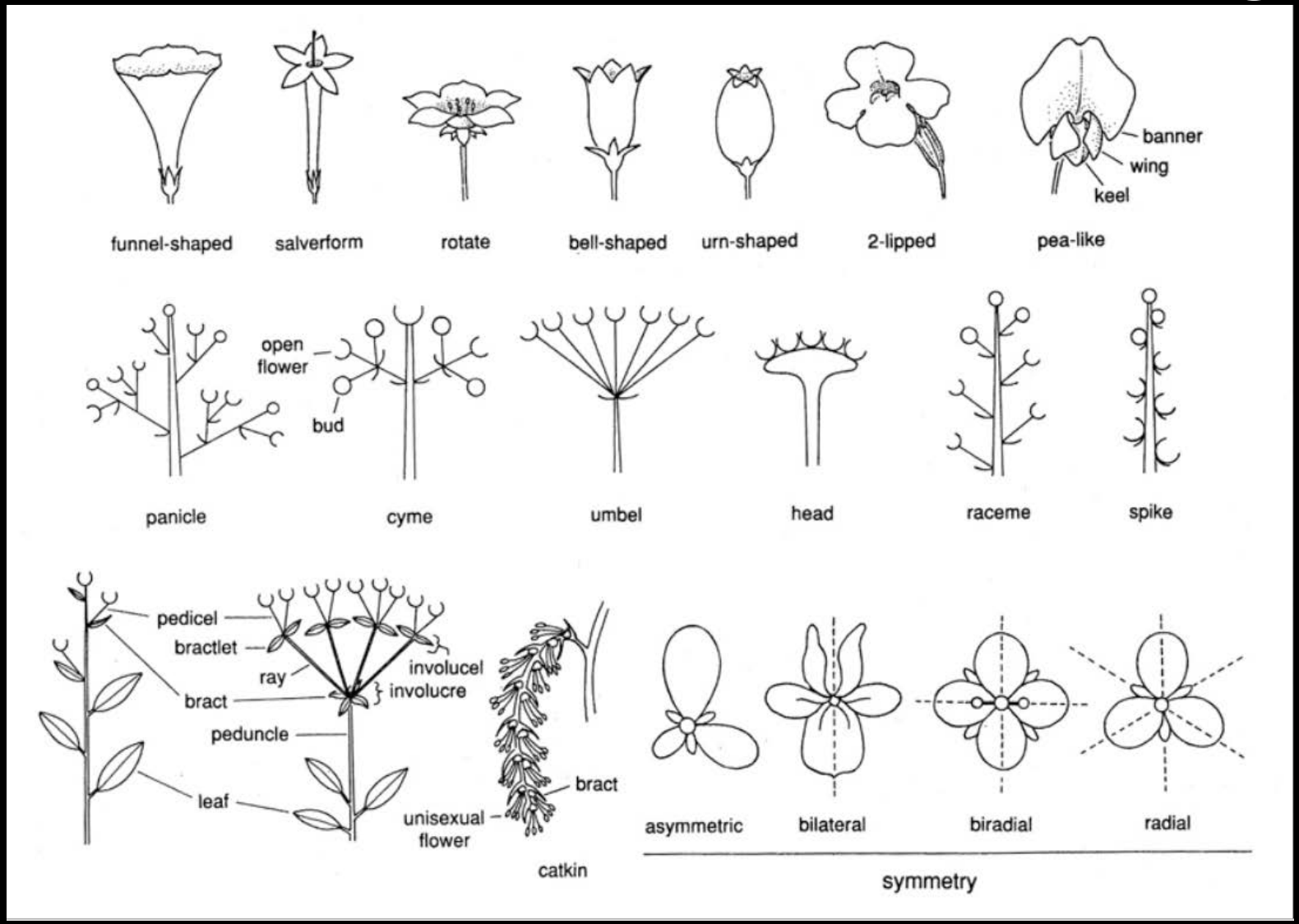
Hordeum murinum: annual; glume margins ciliate

Hordeum marinum: annual; glume margins not ciliate; darker green color

Hordeum marinum

Hordeum murinum

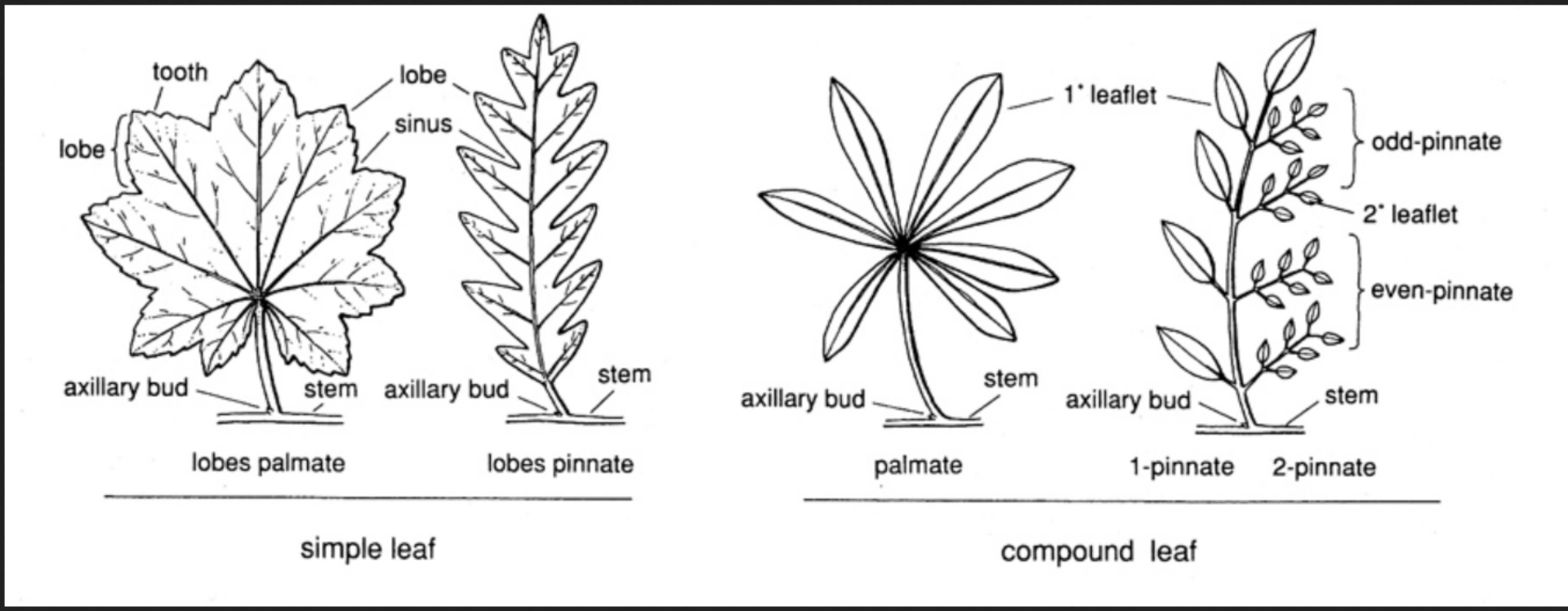
Flower and Inflorescence Morphology



Hickman, C. 'The Jepson Manual Higher Plants of California drawing by Linda Ann Vorobic et al. 1993.

Trifolium subterraneum – Subterranean Clover

Leaf Morphology



Hickman, C. 'The Jepson Manual Higher Plants of California drawing by Linda Ann Vorobic et al. 1993.

Leaf Shape - Simple

Erodium botrys
Broad Leaf Filaree

Leaf Shape – Pinnately Compound

Erodium cicutarium – Redstem Filaree

Erodium botrys - Broad Leaf Filaree

Leaf Shape – Palmately Compound

Medicago polymorpha – Burr Clover

RANGELAND MANAGEMENT SERIES Publication 8022

Annual Rangeland Forage Quality

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Agriculture
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http://anrcatalog.ucdavis.edu

California Rangelands Research and Information Center
http://agronomy.ucdavis.edu/calrng/range1.htm

Matching the nutrient demands of livestock with the nutrients supplied by range forage is a balancing act for a considerable portion of each year. The quality of range forage varies with plant species, season, location, and range improvement practices. Range forage is optimal for livestock growth and production for only a short period of the year. Early in the growing season, forage may be of high nutrient content, but high water content in the forage may result in rapid passage through the rumen and incomplete nutrient extraction.

Indicators of high forage quality such as protein, energy, vitamins, and minerals decline as the growing season progresses (Figure 1). Conversely, indicators of low quality such as fiber and lignin increase as forage plants mature.

Typically, four nutrients are of primary concern to managers of animals on California's annual-dominated foothill and coastal rangelands: protein, energy, carotene (the precursor of vitamin A), and phosphorus. Additionally, certain minerals may be deficient or toxic at certain times or locations. Annual range forage may be deficient in copper. A high amount of molybdenum aggravates copper deficiency. Potassium and zinc may also be deficient in mature weathered forage. Other minerals such as selenium may be found in deficient or toxic levels in certain areas of the state.

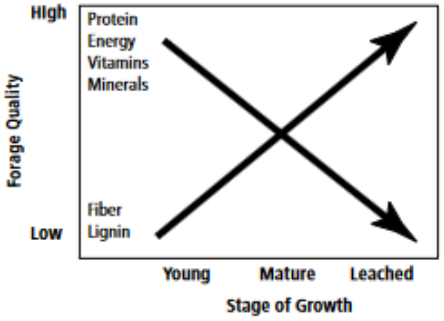


Figure 1.
Stages of growth and forage quality

UC PEER REVIEWED

Available at http://anrcatalog.ucanr.edu/pdf/8022.pdf

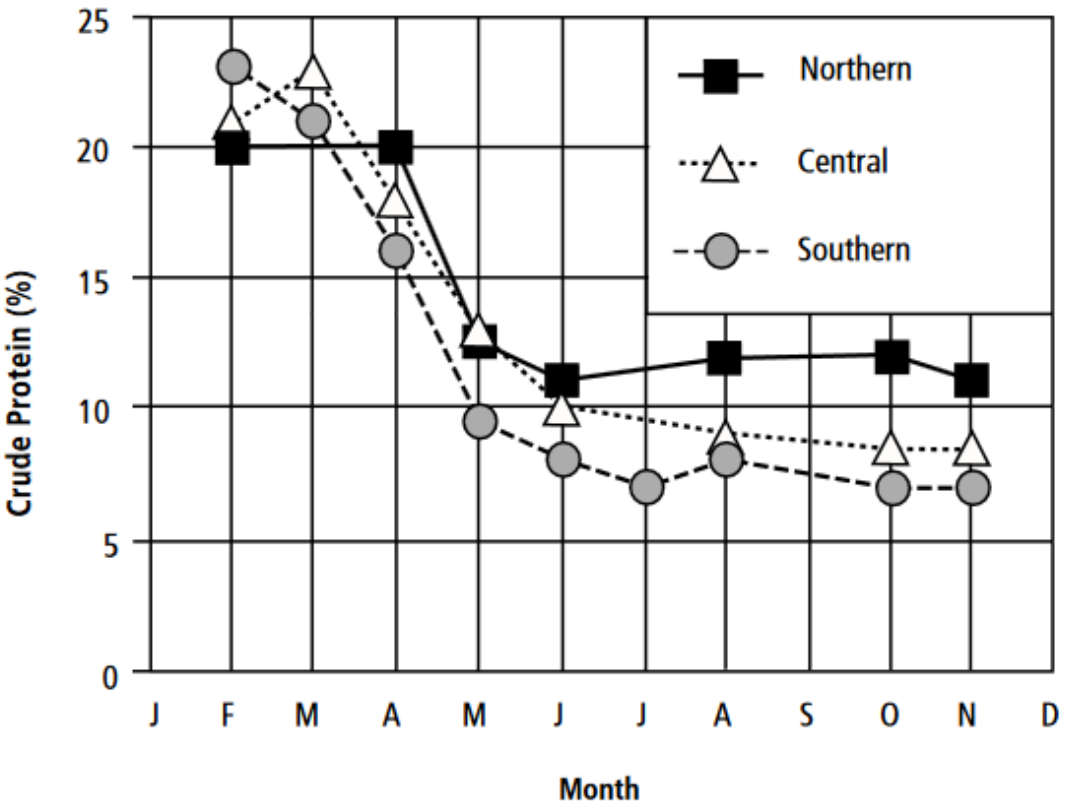


Figure 2.
Seasonal crude protein content of composite samples taken from 17 ranches along a north-south line from Red Bluff to Coalinga, California (Hart, Guilbert, and Goss 1932).

- The minimum dietary CP requirement for a 500 lb steer gaining 2.5 lb per day is about 12.5 percent CP, showing that growing animals require substantial supplementation during the dry season (NRC 1984).

- Fall-calving cows require only 7.5 percent CP in their diet during the last third of pregnancy in summer, while spring-calving cow (3 to 4 months postpartum) would require more than 9 percent. CP.

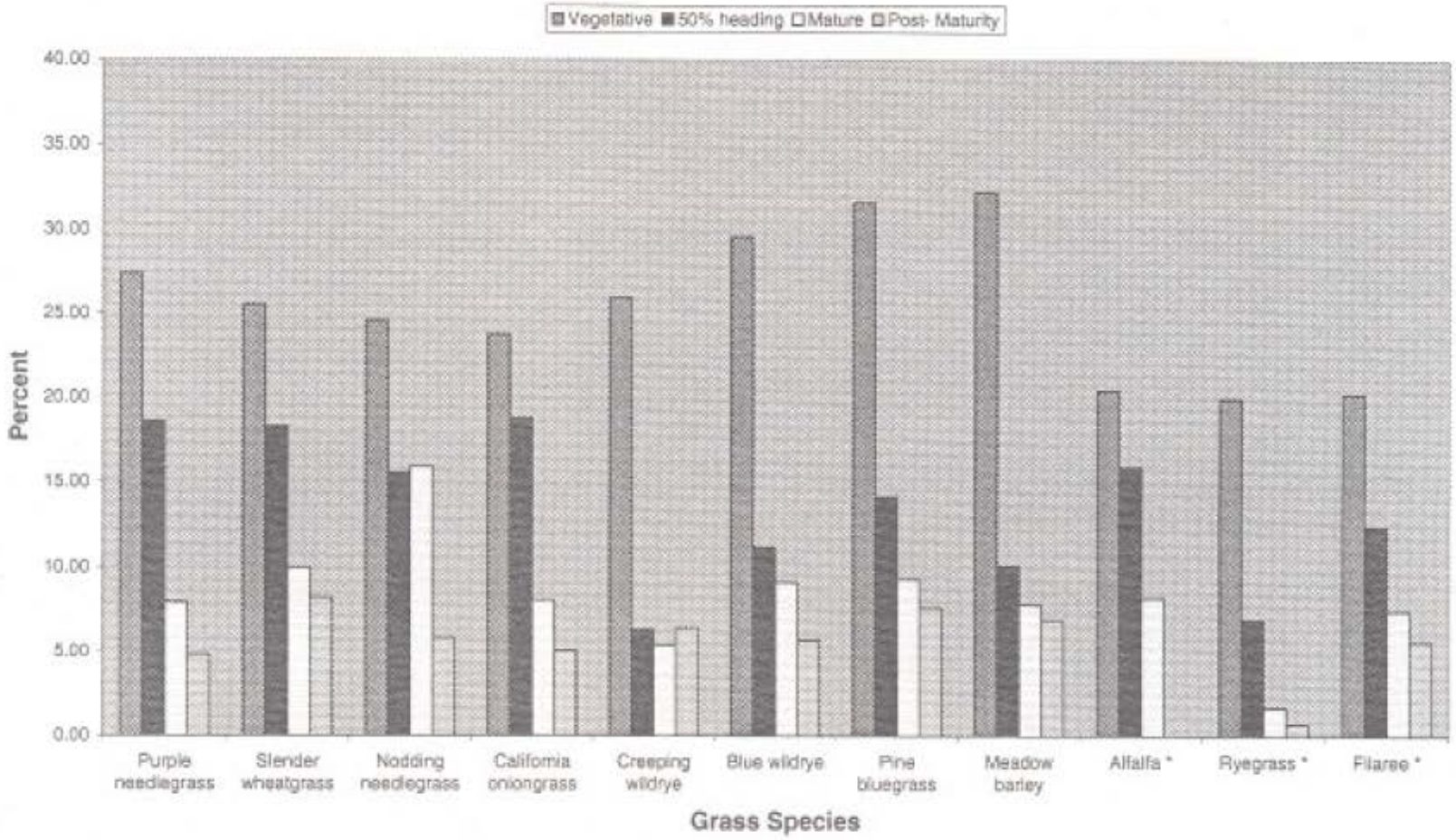
- Depending on the legume and forb content of the forage, supplementation may be required.

Table 1. Crude protein and crude fiber content of annual grasses, filaree, and bur clover at seven stages of maturity.

	Crude protein (%)			Crude fiber (%)		
Stage of maturity	**Annual grass**	**Filaree**	**Bur clover**	**Annual grass**	**Filaree**	**Bur clover**
Early vegetative	18	27	28	24	12	16
Late vegetative	15	25	27	25	14	17
Early flowering	15	22	26	26	16	19
Late flowering	10	16	22	29	21	23
Mature	6	10	19	33	26	26
Dry	5	7	18	34	28	28
Dry, leached	3	5	17	35	30	29

Source: Hart et al. 1932; Gordon and Sampson 1939

Crude protein for 8 native, perennial bunchgrasses and text values for 3 annual rangeland forages (*) at different sampling times



continued on page 5

Field Guide for Common California Rangeland and Pasture Plants

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Available at http://ceshasta.ucanr.edu/files/235849.pdf

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West Point

California Plant Finder

Enter Your Location! (To skip plants you'll never see)

Your County

Search By Name (For instance, Lupine)

Common Name

Botanical Name

Search By Appearance

Plant Type


Tree


Shrub


Flower


Fern


Grass

Flower Shape

3 Petals

4 Petals

5 Petals

6 Petals


Many


Pea Flower


Irregular


No Petals

Flower Color


Yellow White Pink Violet Blue Red Orange Brown Green

Leaves


Alternate Opposite Whorled Basal

Advanced

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Thank You