Weeds and Water

The interacting effects of phenology, competition, climate, geology, and soils on soil moisture, surface flows, and ground water recharge

Goal

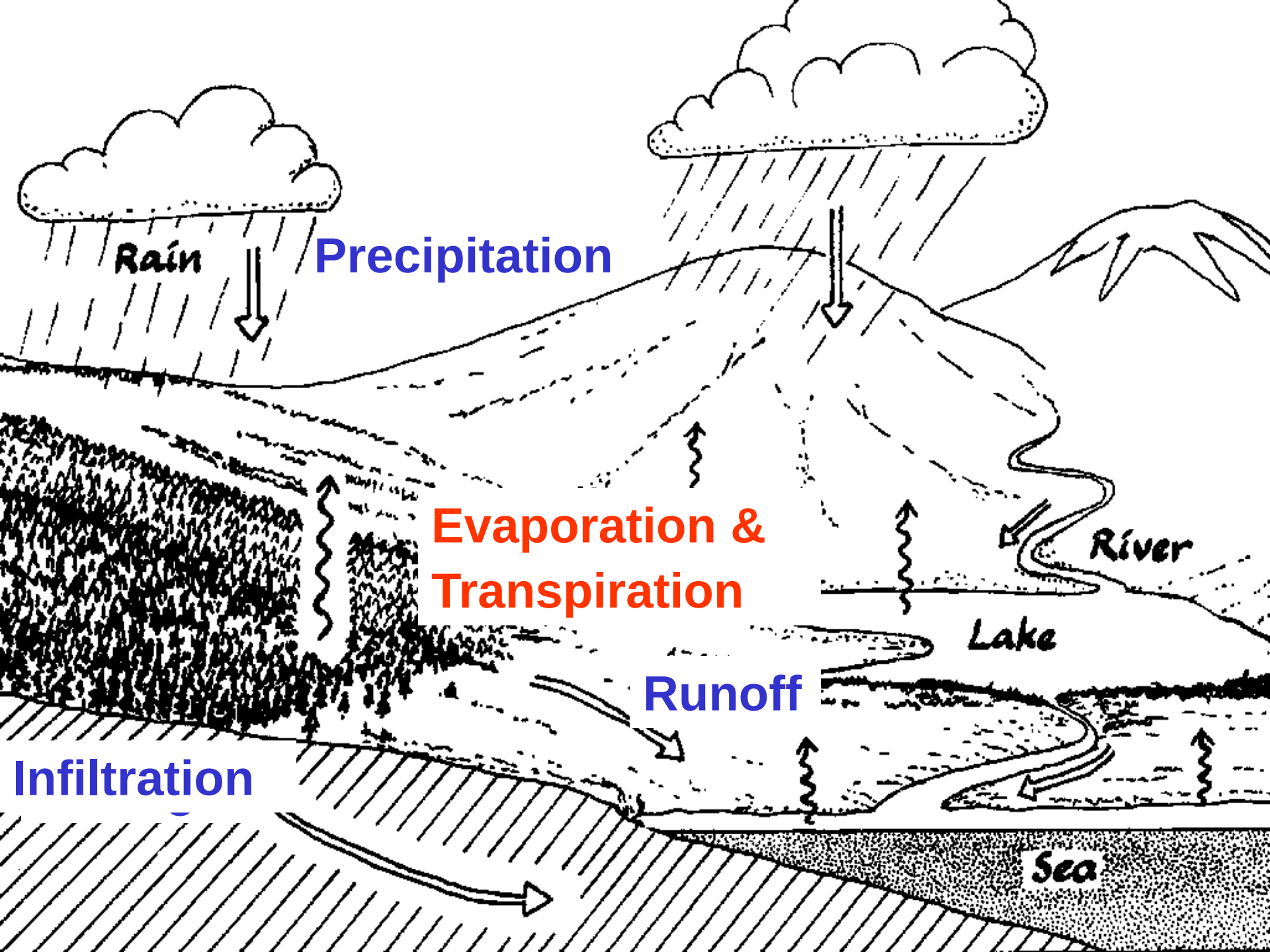
Solve applied problems.

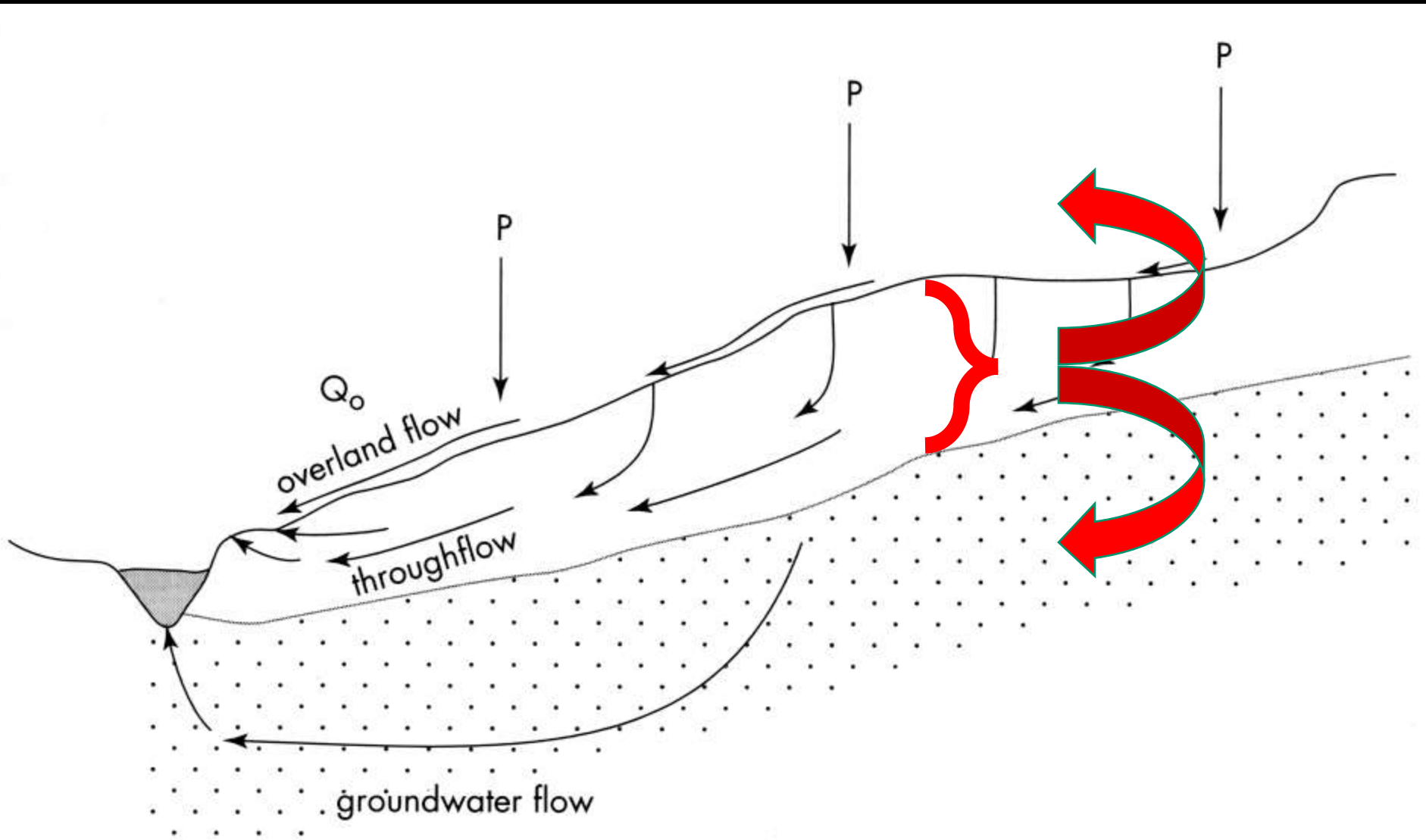
Outline

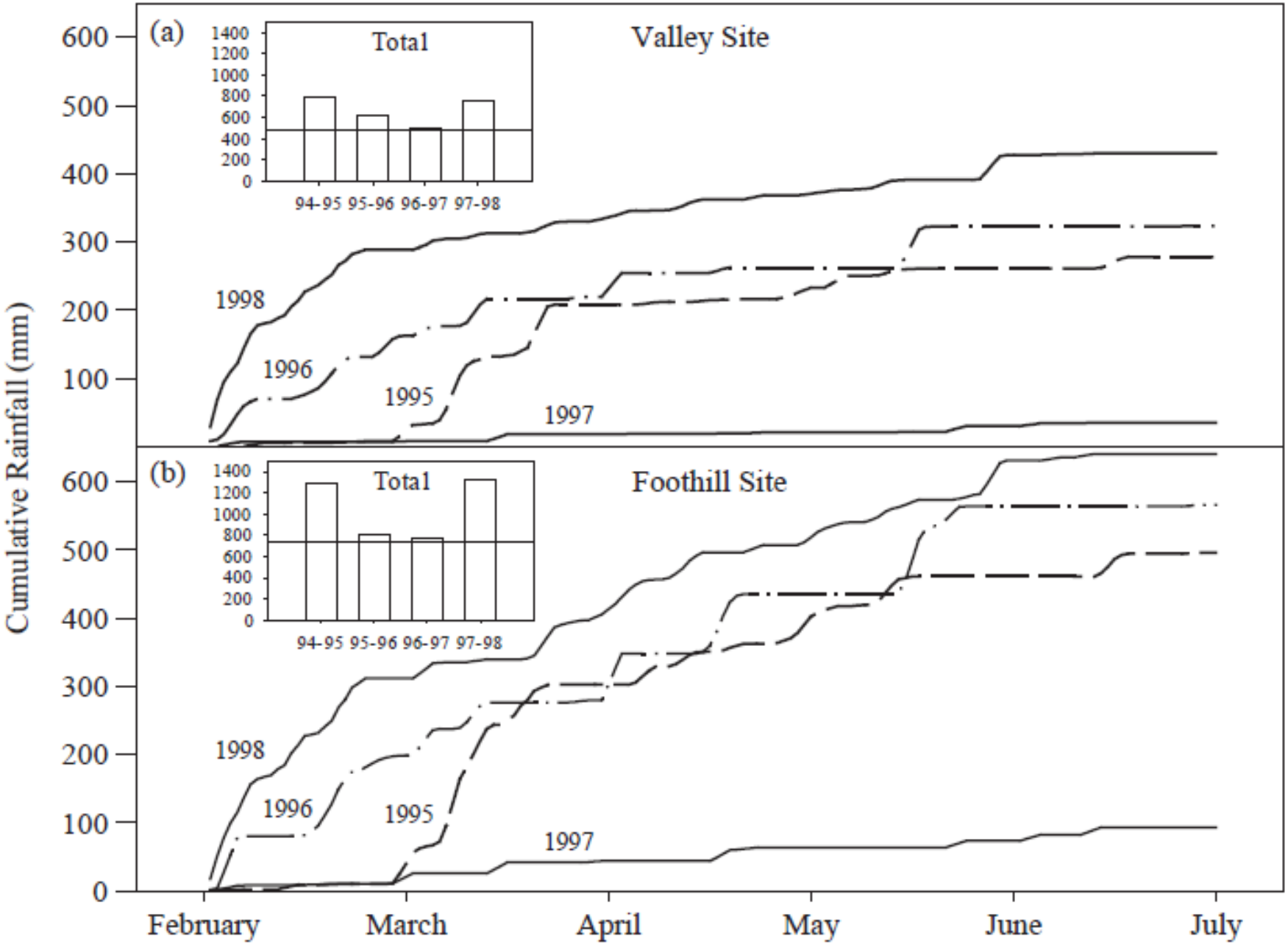
1) Identifying the Effects
2) Water Cycles – Med-Type Climate
3) Starthistle – Effects and Costs
4) Complicating Factors

Identifying the Effects

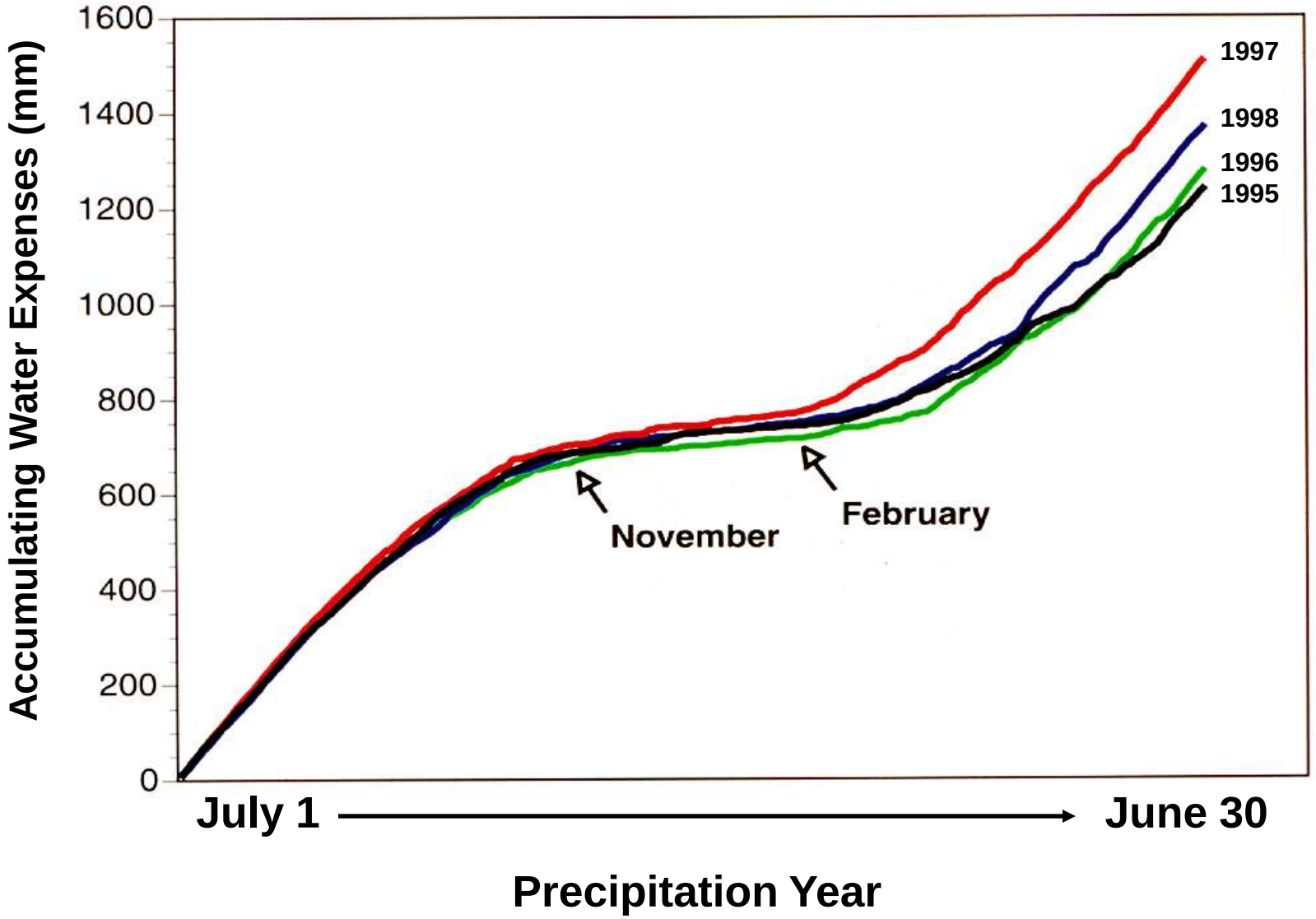
Water Cycles


Rain
Precipitation
Evaporation &
Transpiration
River
Lake
Runoff
Infiltration
Sea

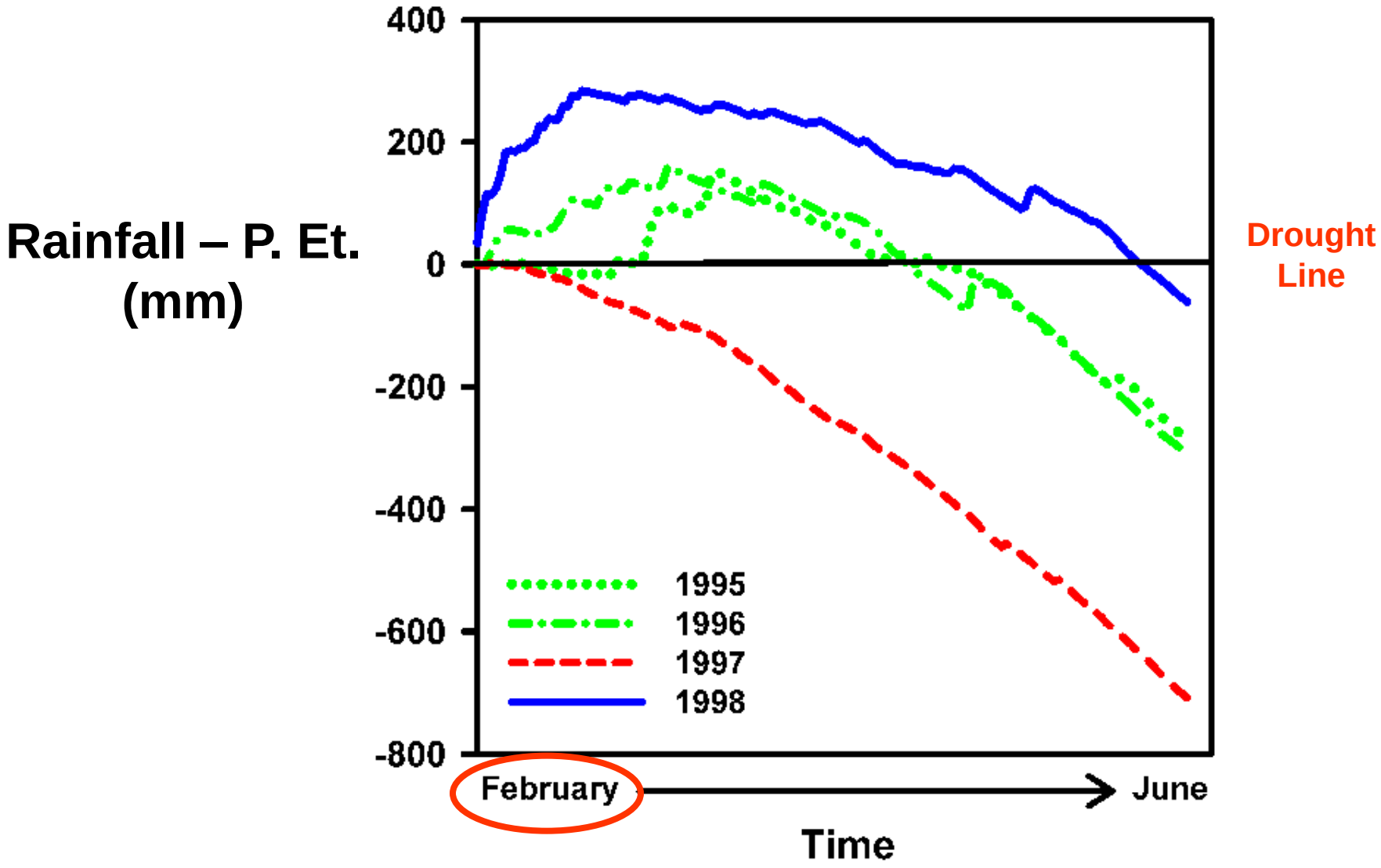

P
P
P
Q_o
overland flow
throughflow
groundwater flow

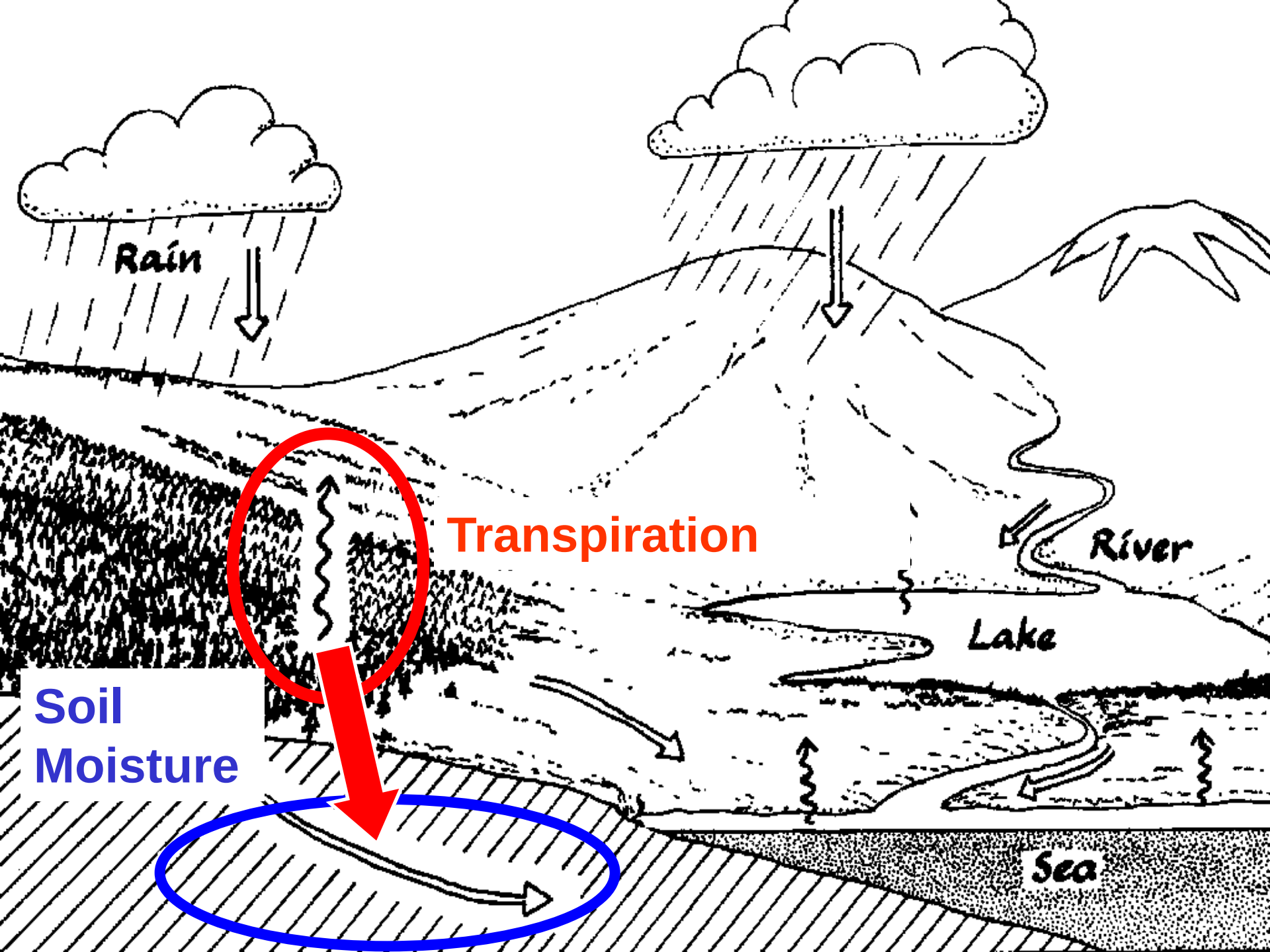

(a)
Valley Site
Total
1400
1200
1000
800
600
400
200
0
94-95 95-96 96-97 97-98
1998
1996
1995
1997
(b)
Foothill Site
Total
1400
1200
1000
800
600
400
200
0
94-95 95-96 96-97 97-98
1998
1996
1995
1997
Cumulative Rainfall (mm)
600
500
400
300
200
100
0
February
March
April
May
June
July

Evapotranspiration through the Season



Rainfall – Potential Evapotranspiration



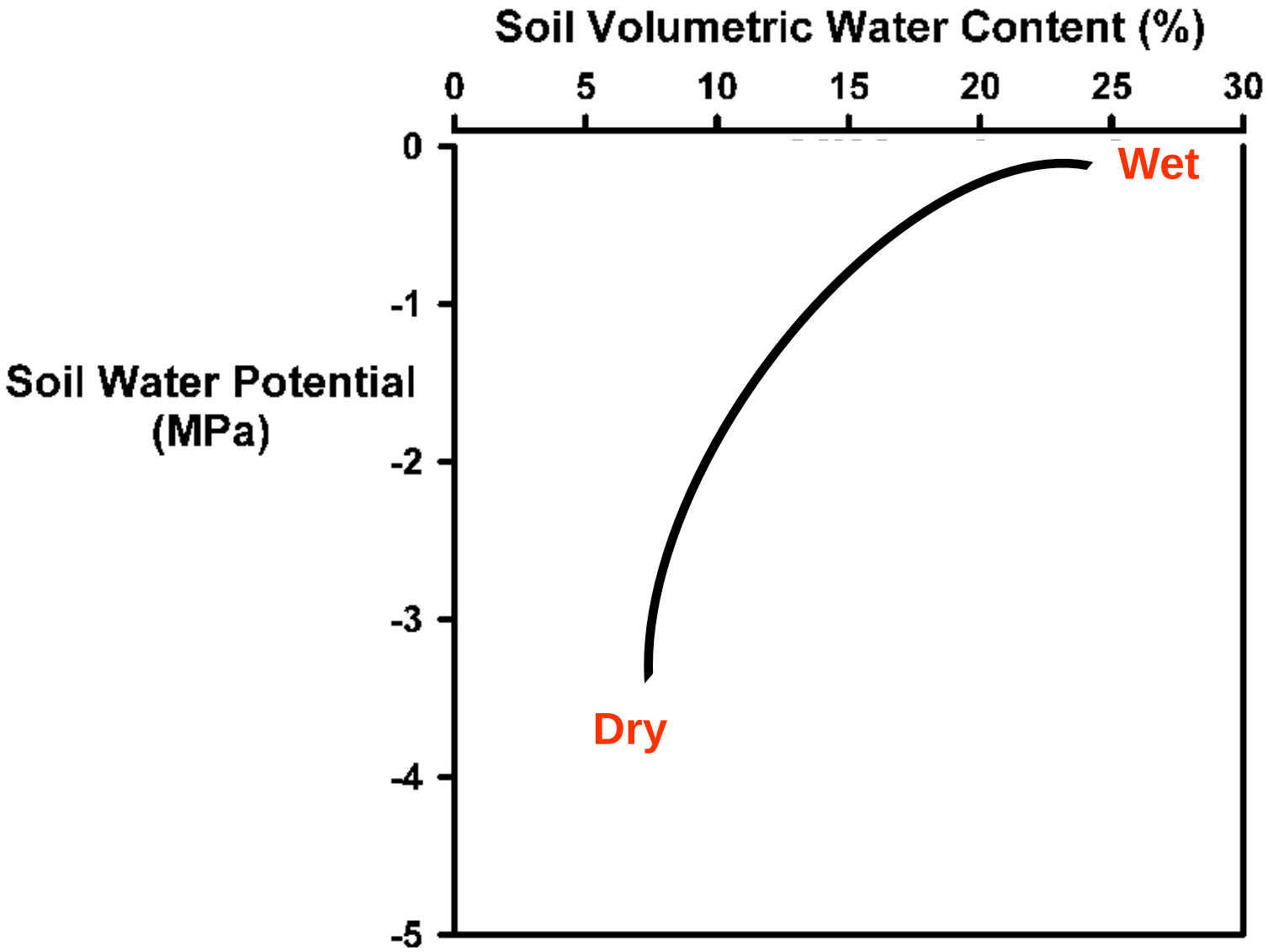

Rain
Transpiration
River
Lake
Soil
Moisture
Sea

Yellow Starthistle Effects and Costs

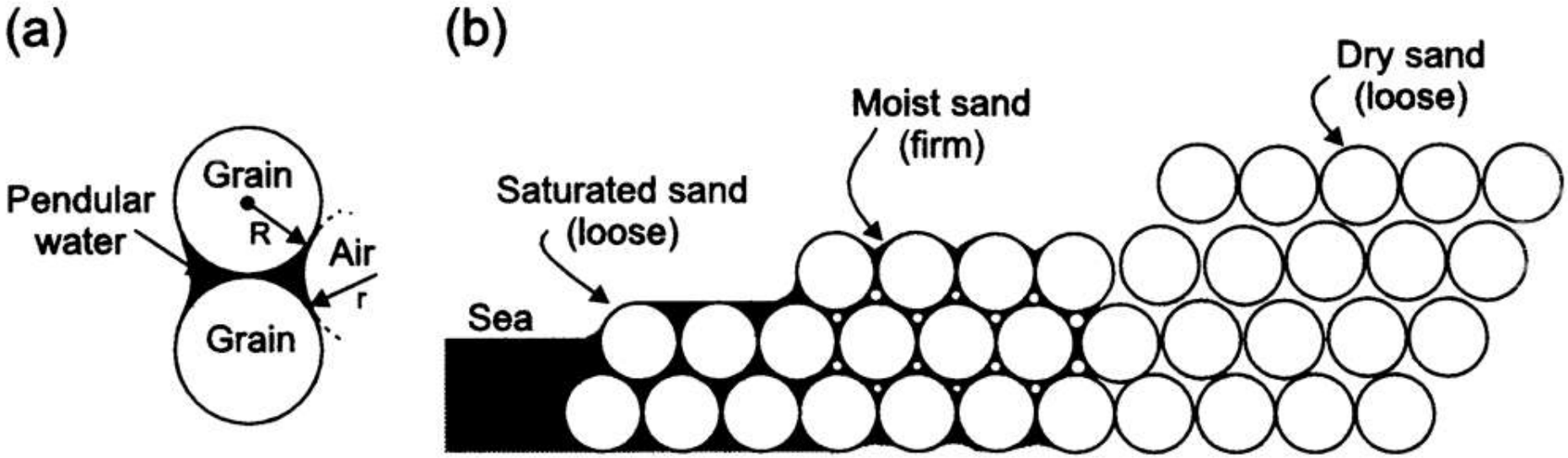
Use Indirect Measurement of Transpiration

- Change in Dry Season Soil Moisture

Two ways to quantify soil moisture:

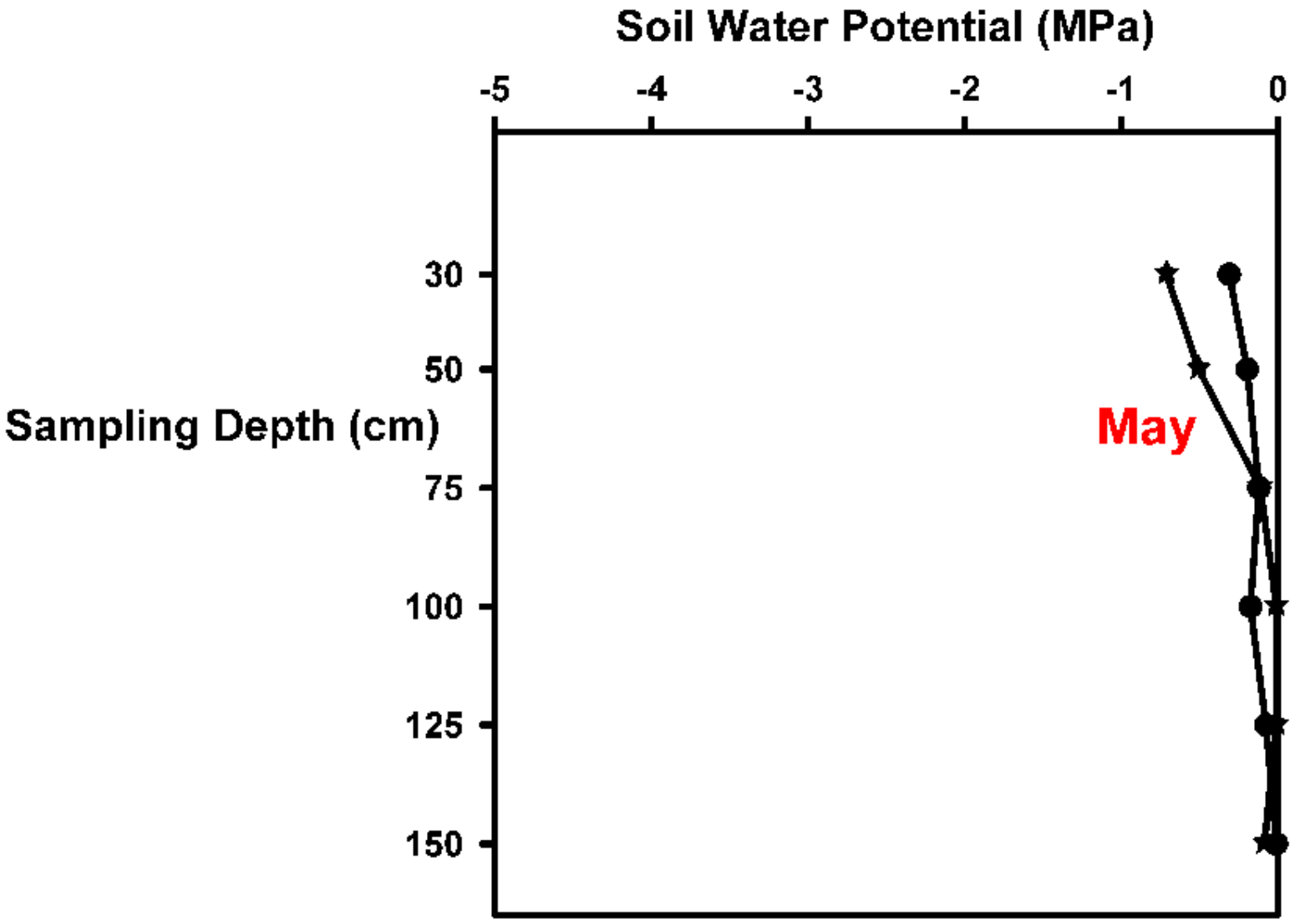


Sand Castles and Soil Moisture

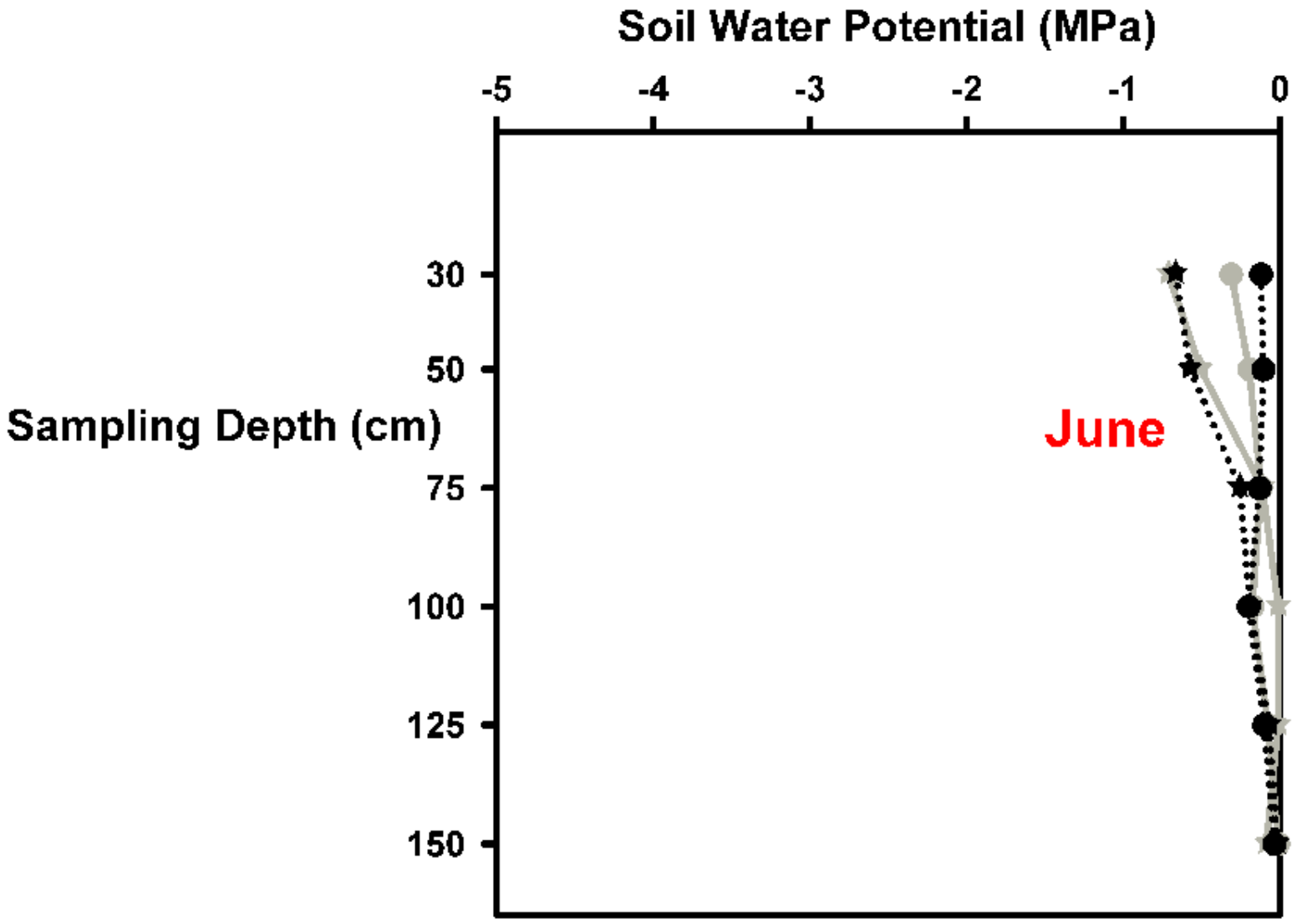



90
80
70

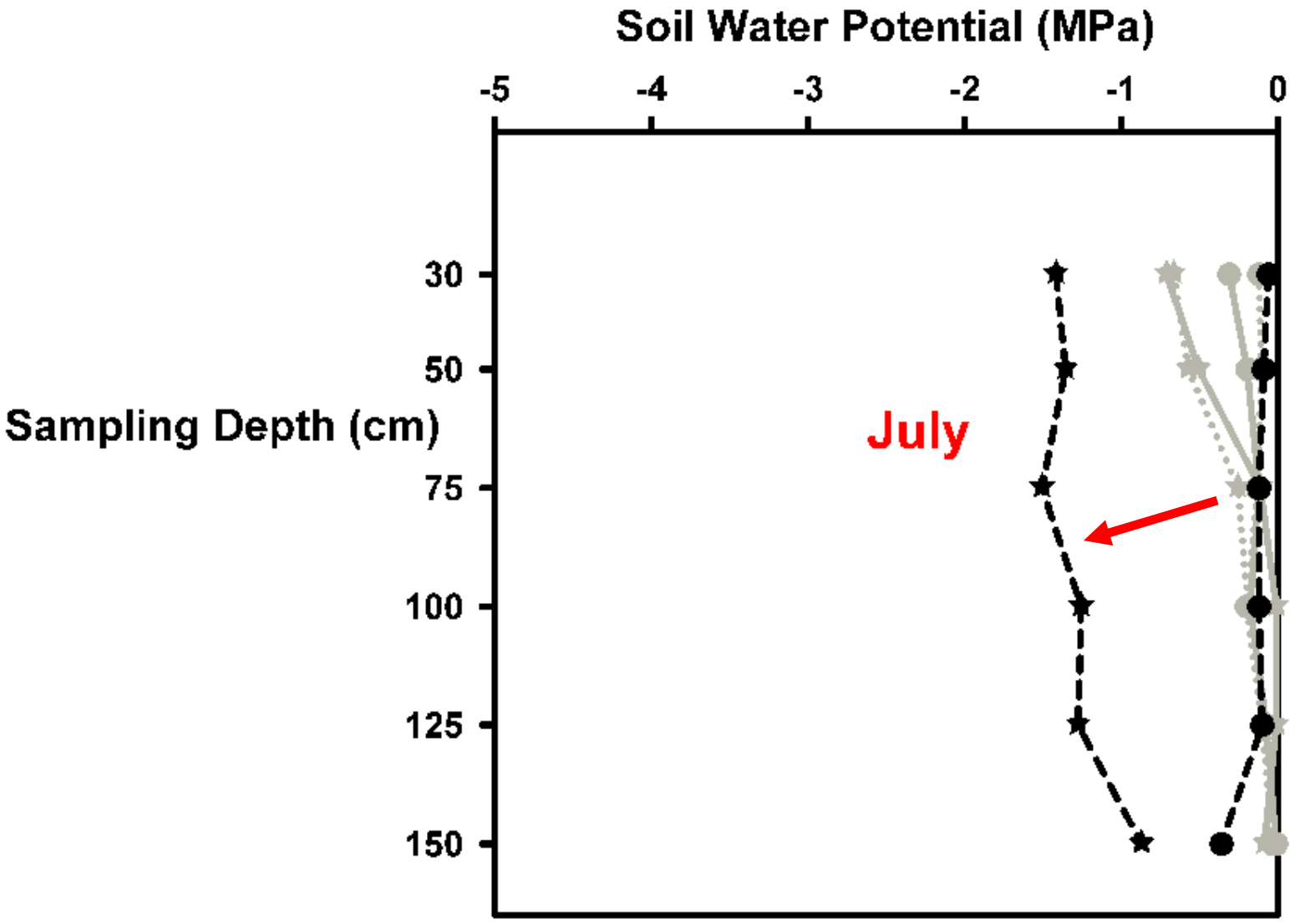
Use of Soil Moisture During Summer



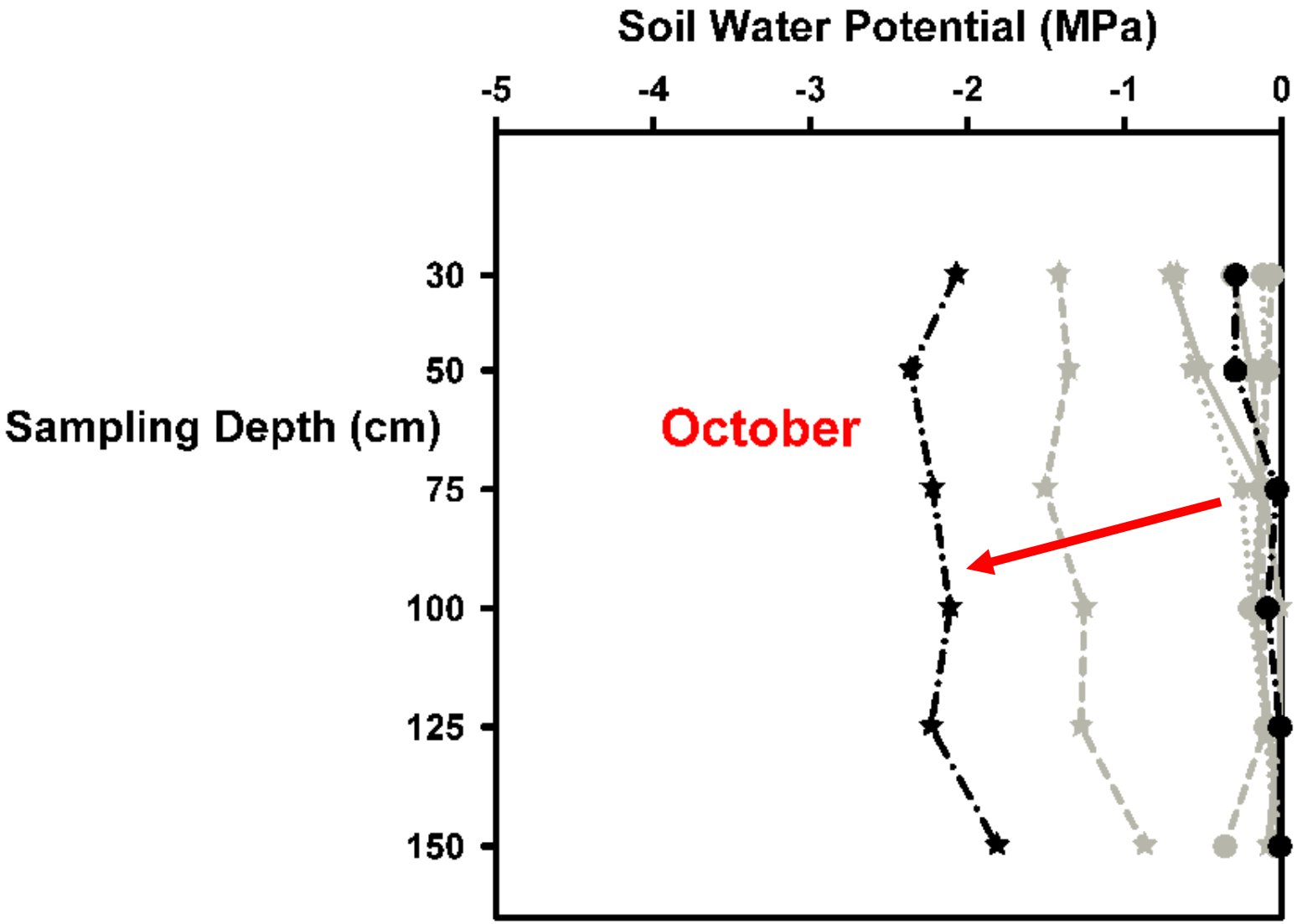
Use of Soil Moisture During Summer

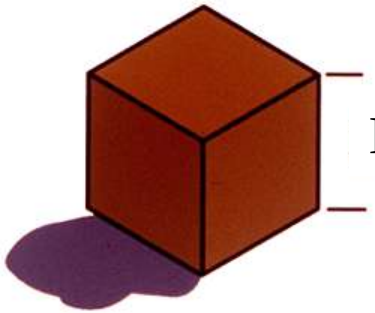


Use of Soil Moisture During Summer



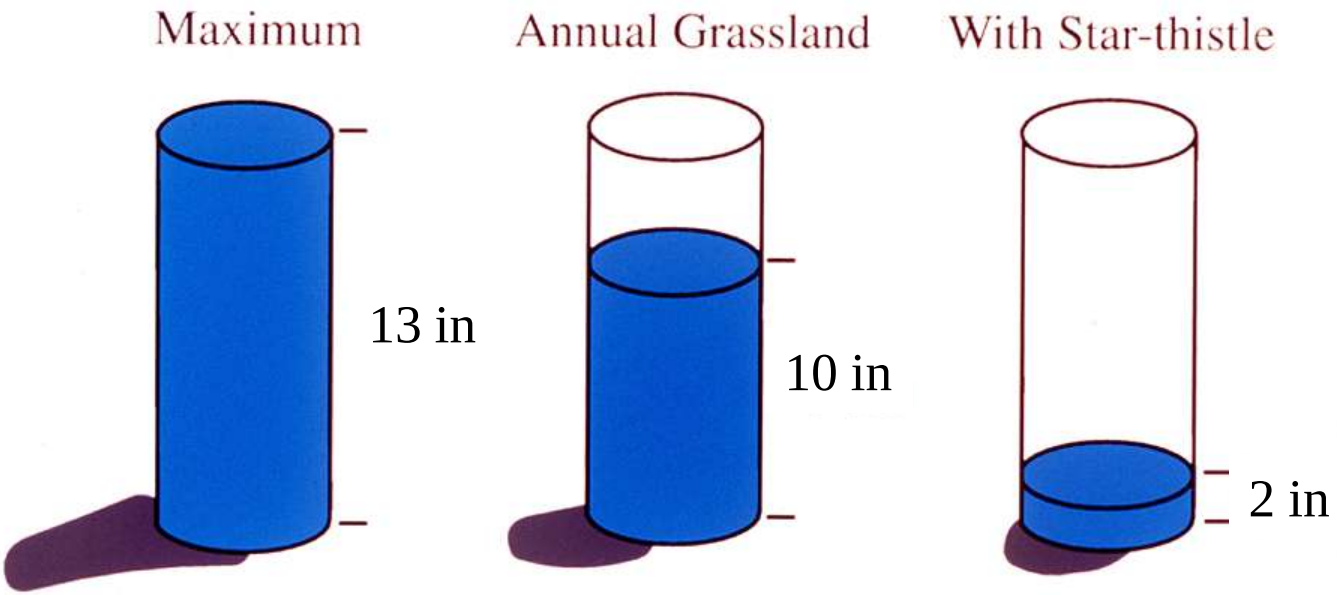
Use of Soil Moisture During Summer

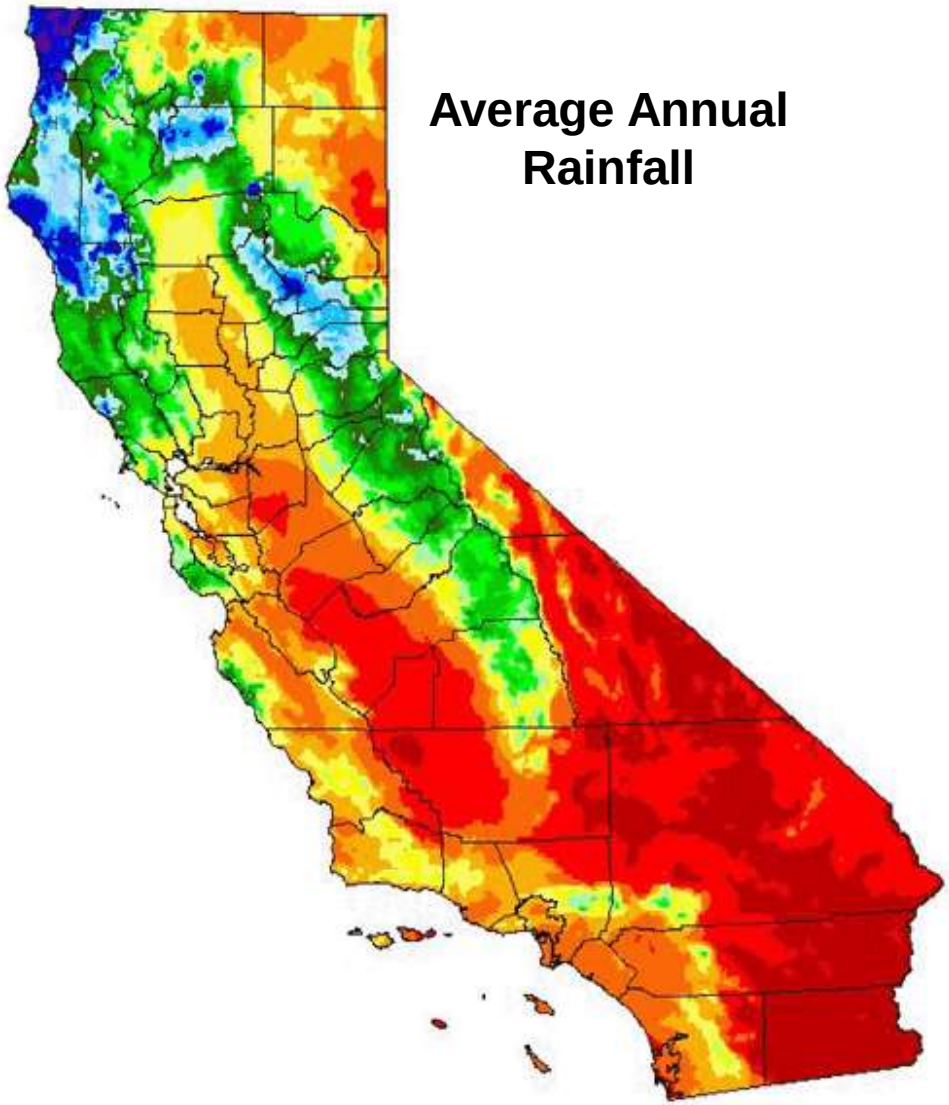




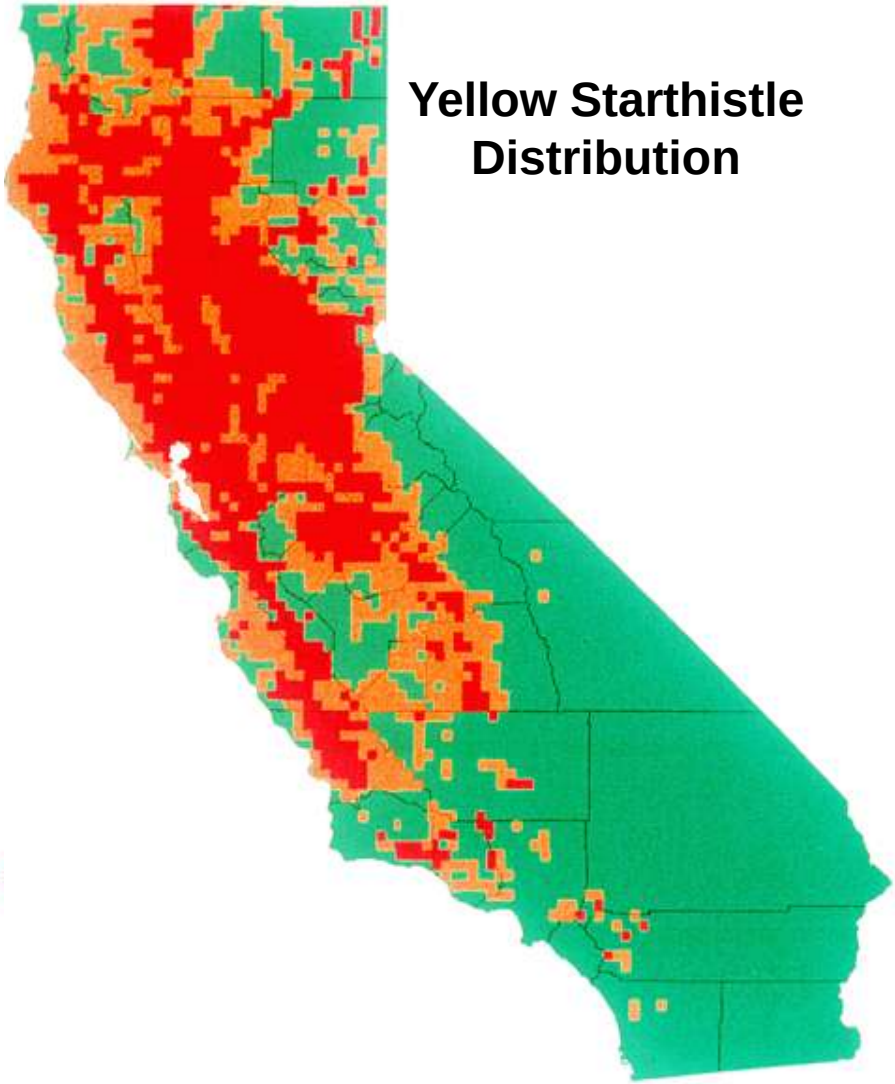
Loamy soil 3 ft deep

Amount of Rainfall Stored in the Soil





Average Annual Rainfall



Yellow Starthistle Distribution

Calculating the Effect

Assumptions:

1. **Use Sacramento Valley distribution only**
2. **1% of mapped distribution occupied**
3. **$500 to $2,000 per acre foot (Sept. 2014)**

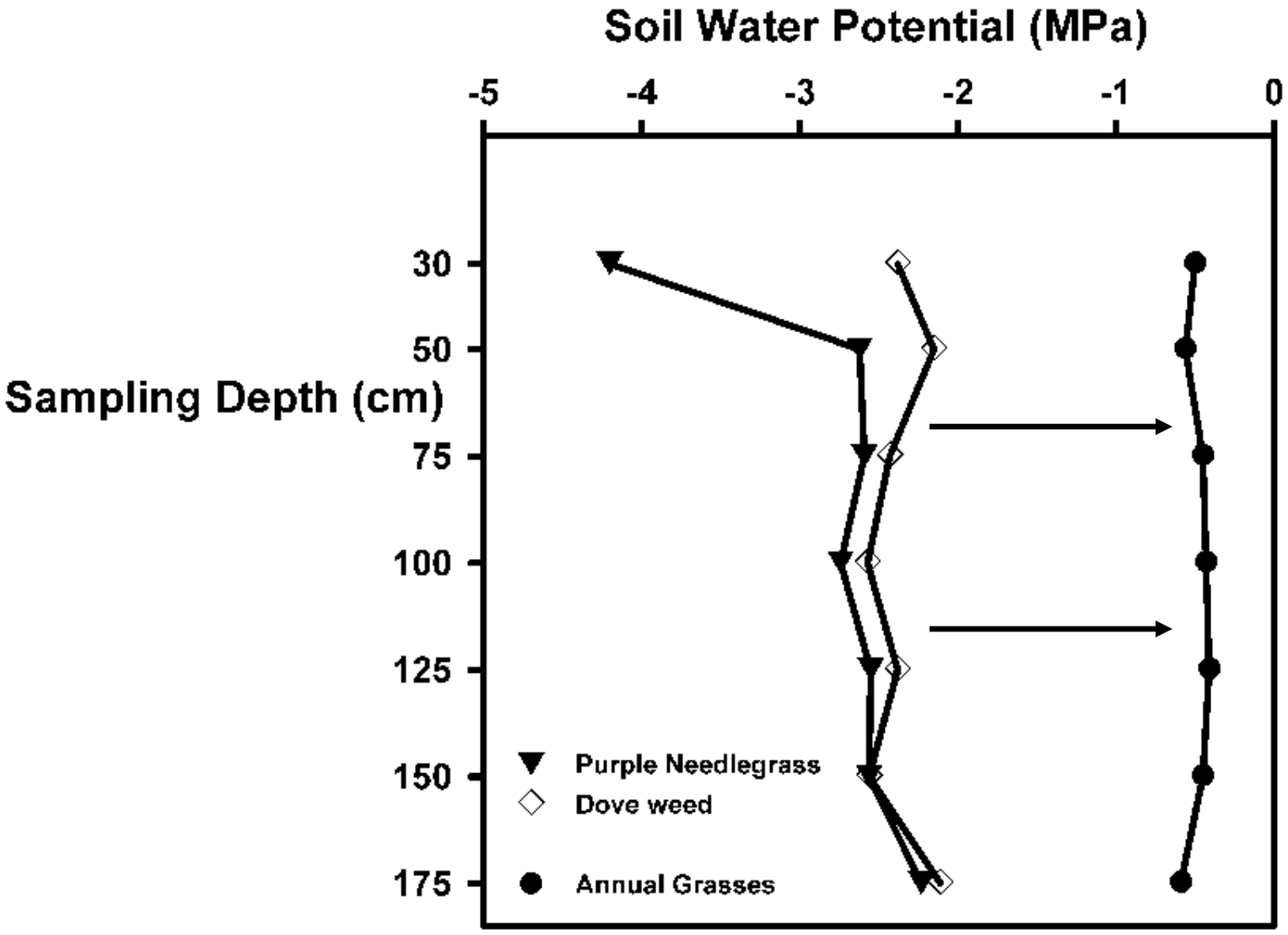
Loss = 40,900 acre feet to 46,700 acre feet

Value of water = $20.4 million to $93.4 million

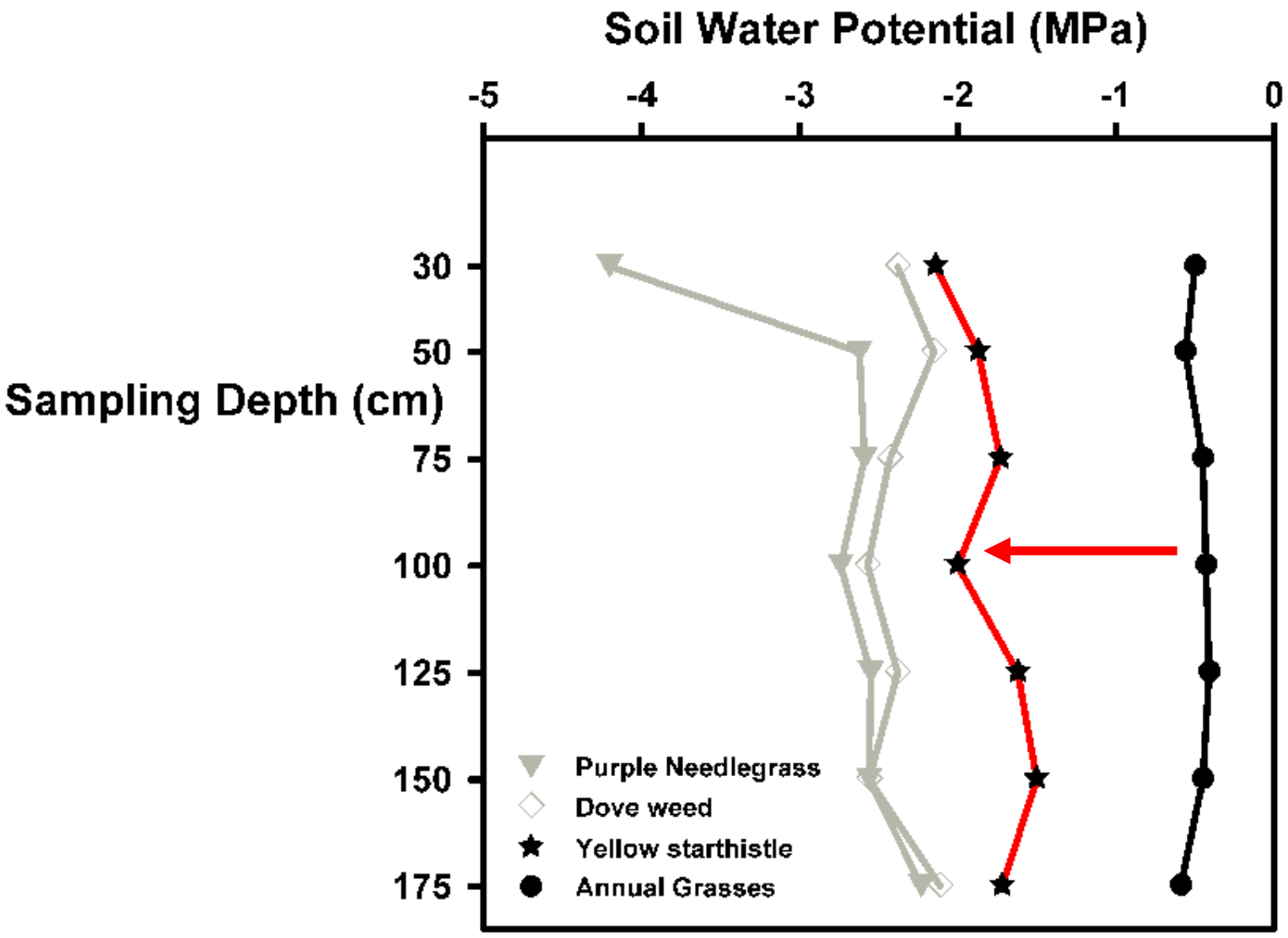
Complicating Factors

Effect is Caused by Serial Changes in Vegetation

Impacts of Vegetation Change on Soil Moisture



Impacts of Vegetation Change on Soil Moisture

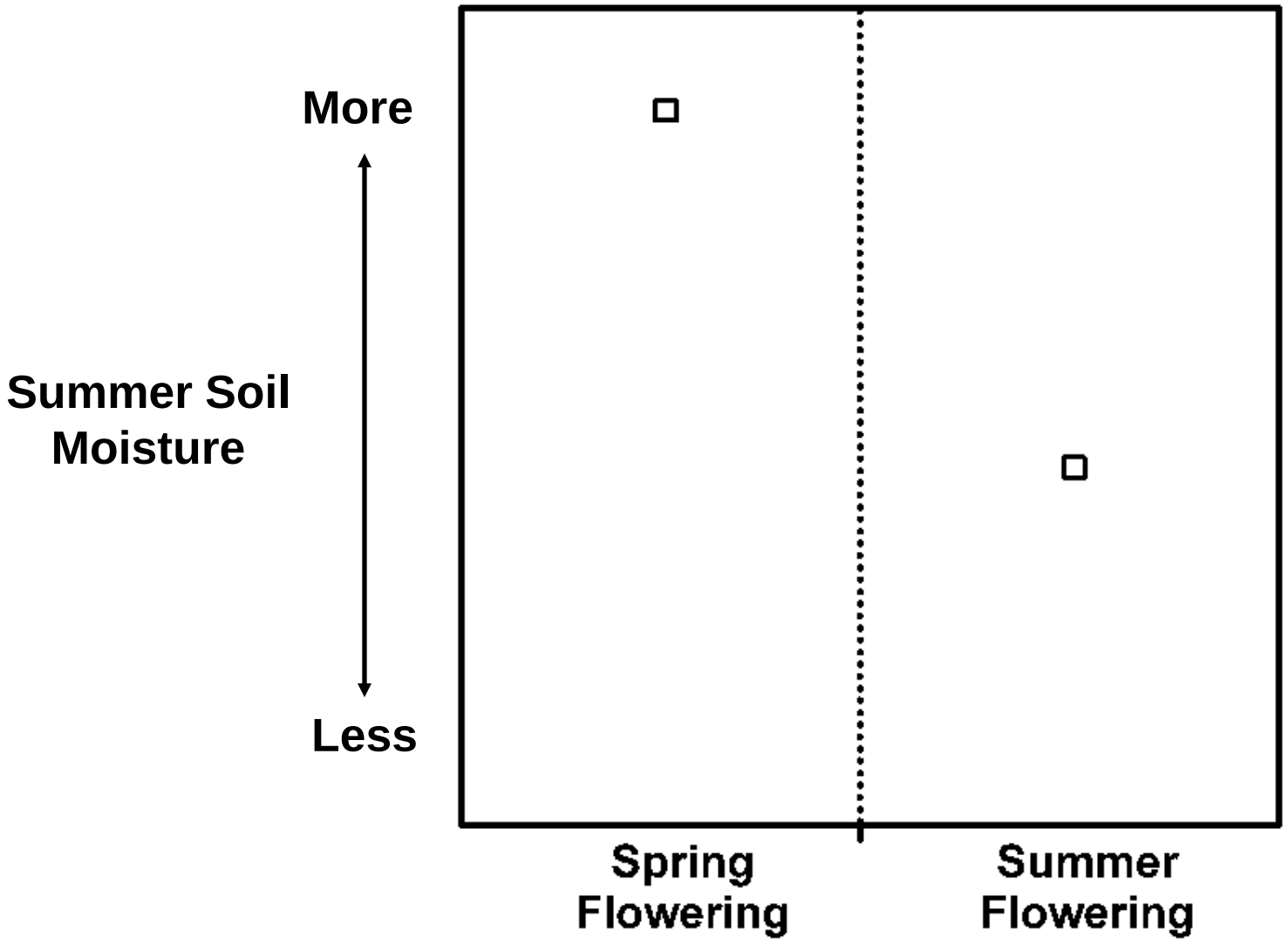


Can you generalize to other species using the functional group concept?

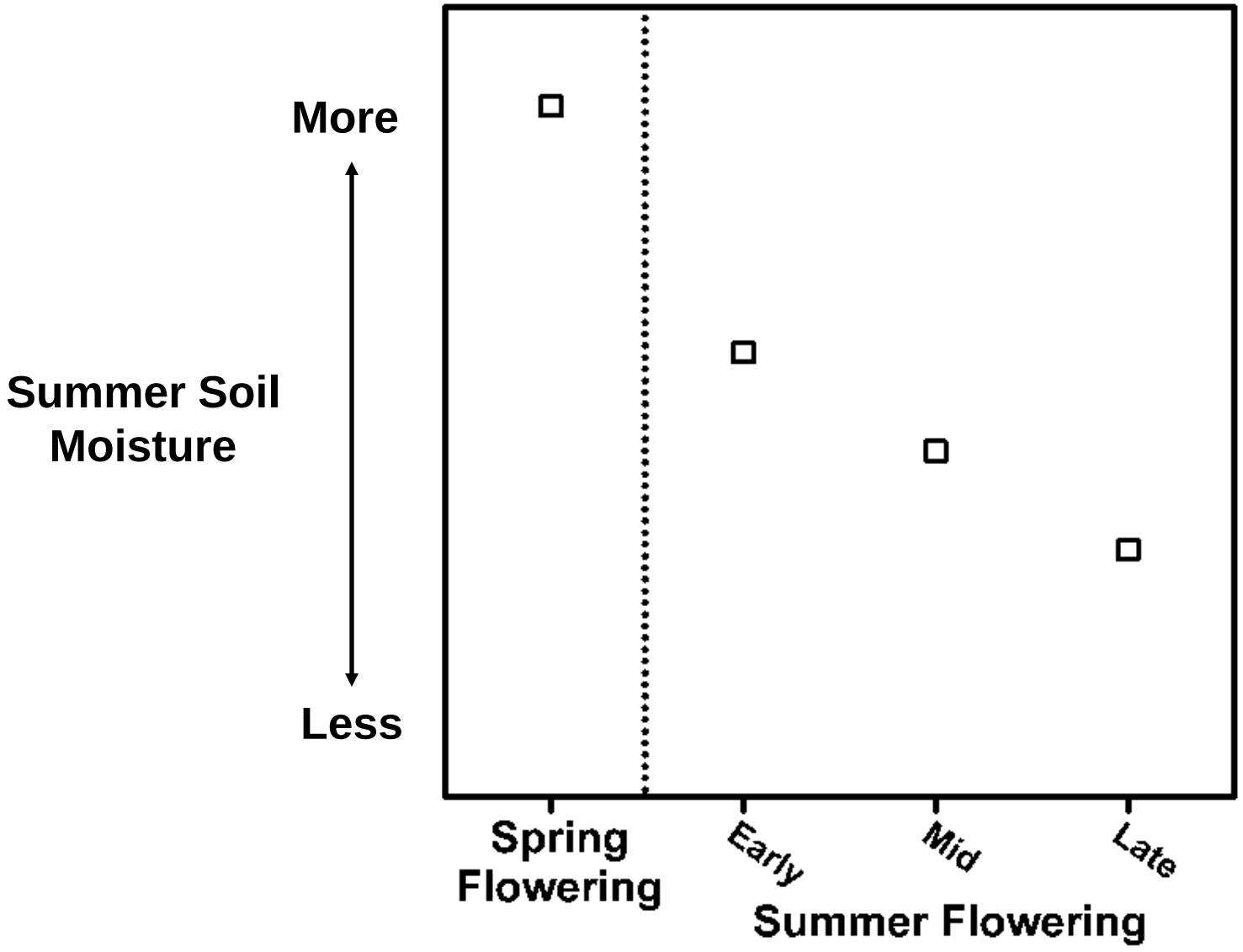
Transpiration effects on dry season soil moisture is determined by:

1. **Lifespan**
2. **Competition**
3. **Soil characteristics**

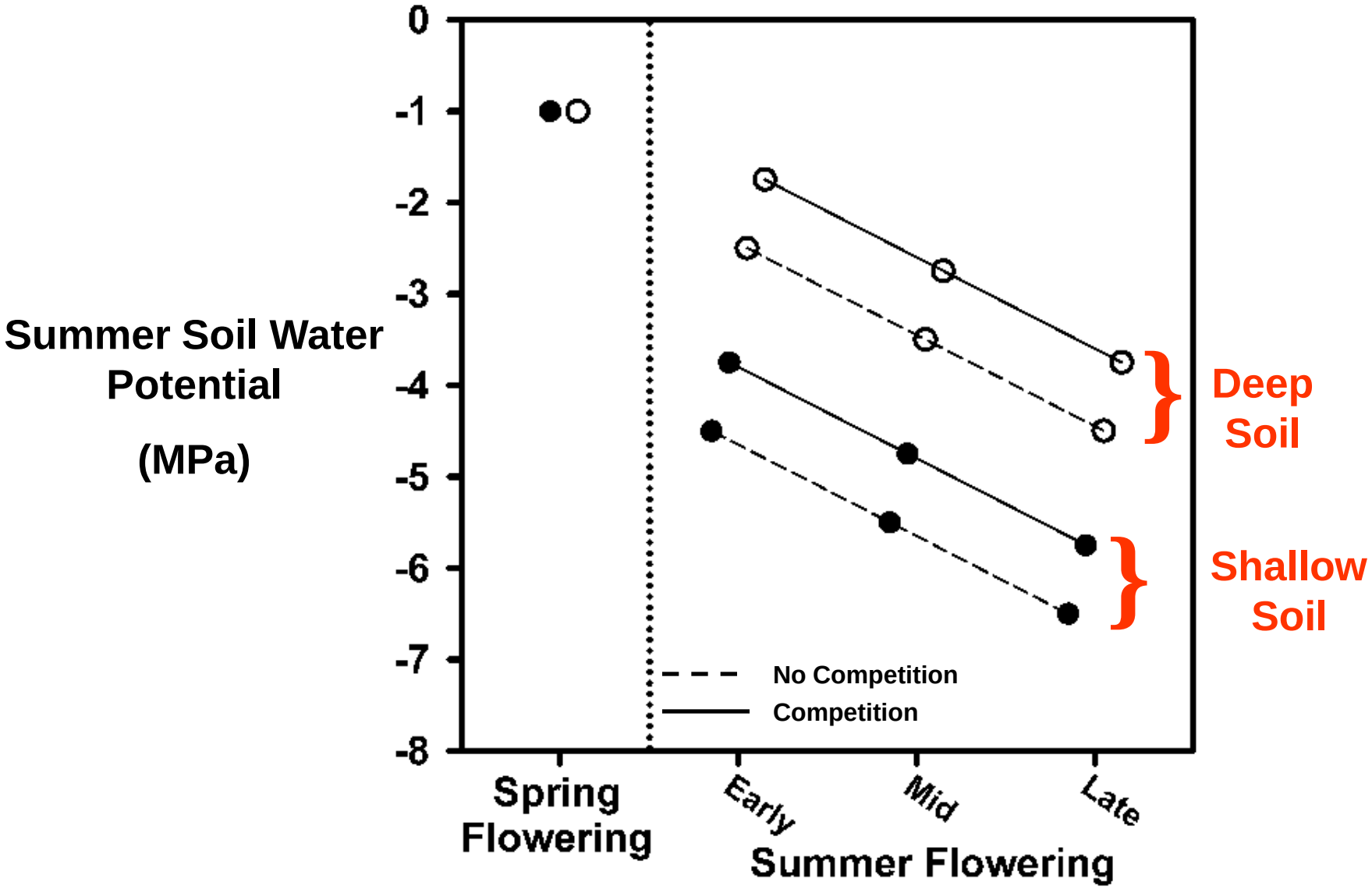
Standard Functional Groupings of Annual Plants



Functional Groupings Based on Summer Phenology



Functional Groups, Soil Depth, and Competition



Summer Flowering Annuals - *Centaurea*

Early

C. melitensis

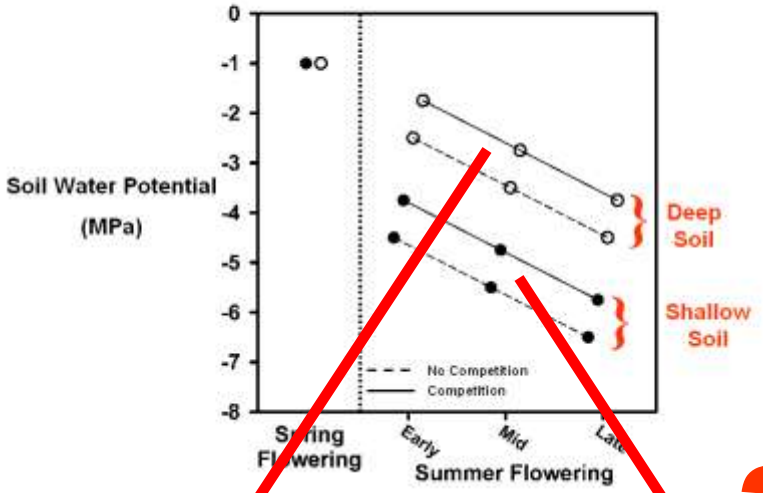
Mid

C. sulphurea

Late

C. solstitialis

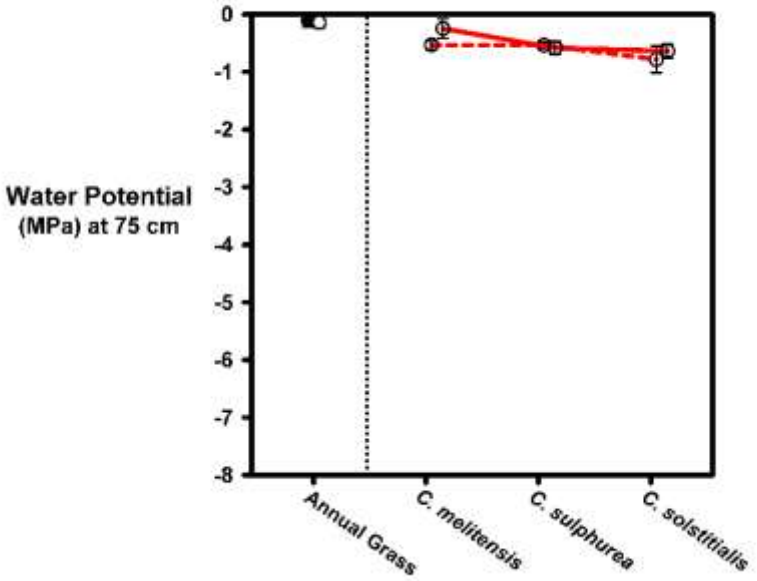
Functional Groups, Soil Depth, and Competition



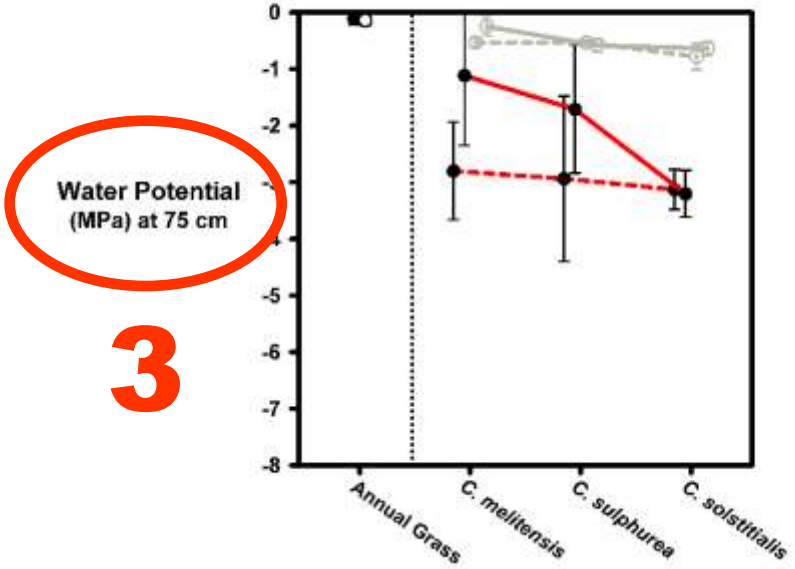
1

2

Deep Soil Treatment



Shallow Soil Treatment



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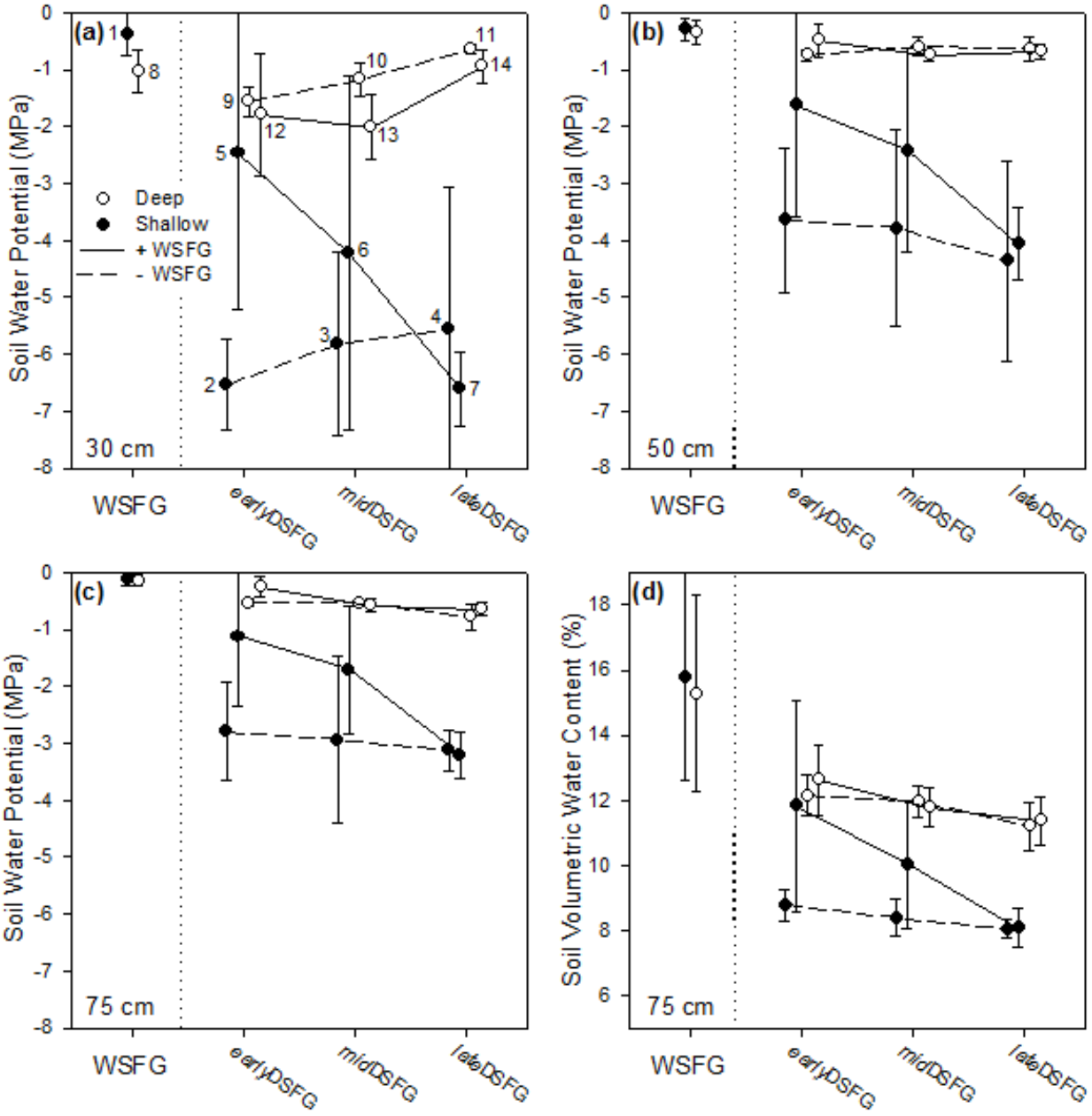
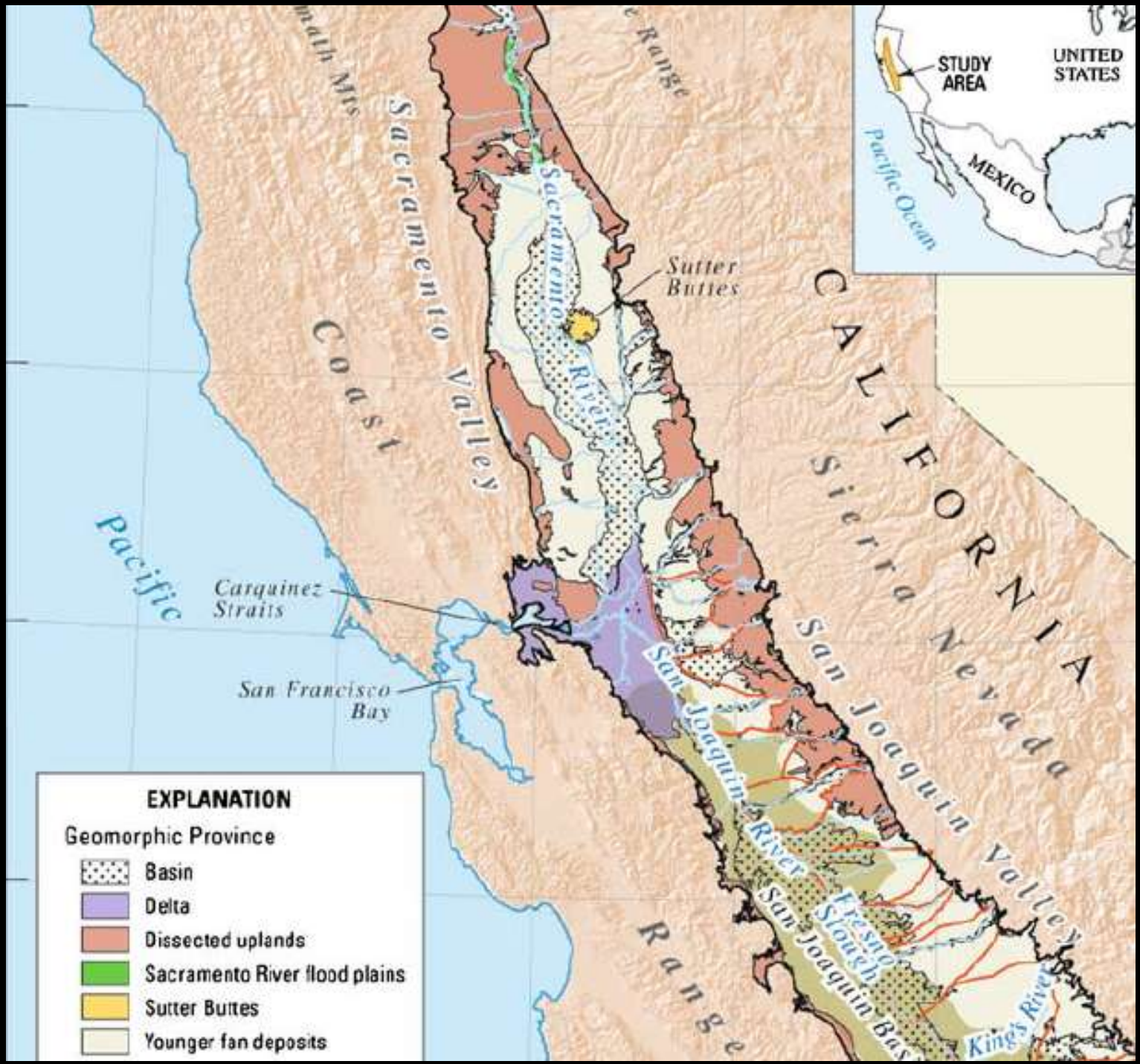
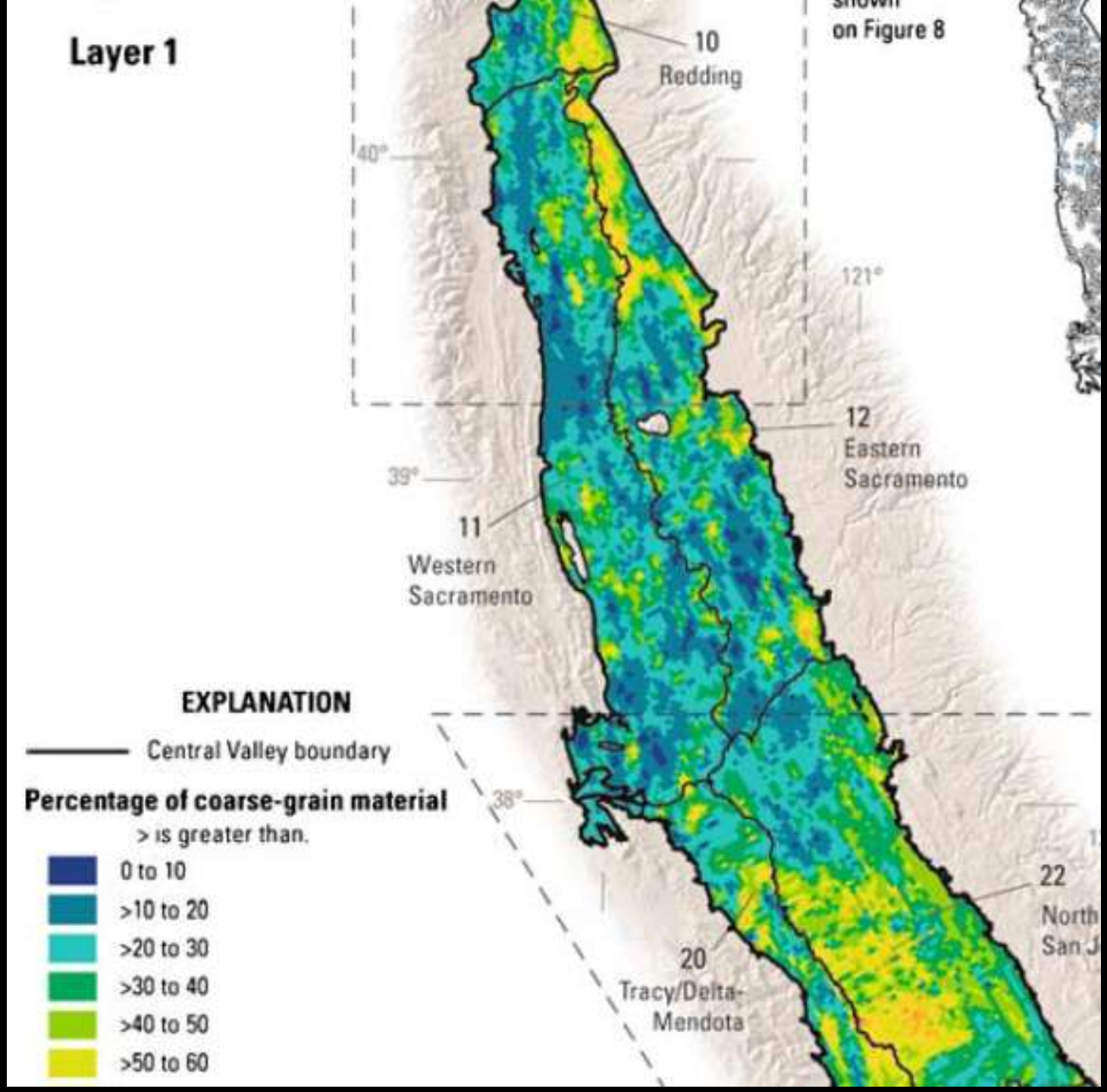
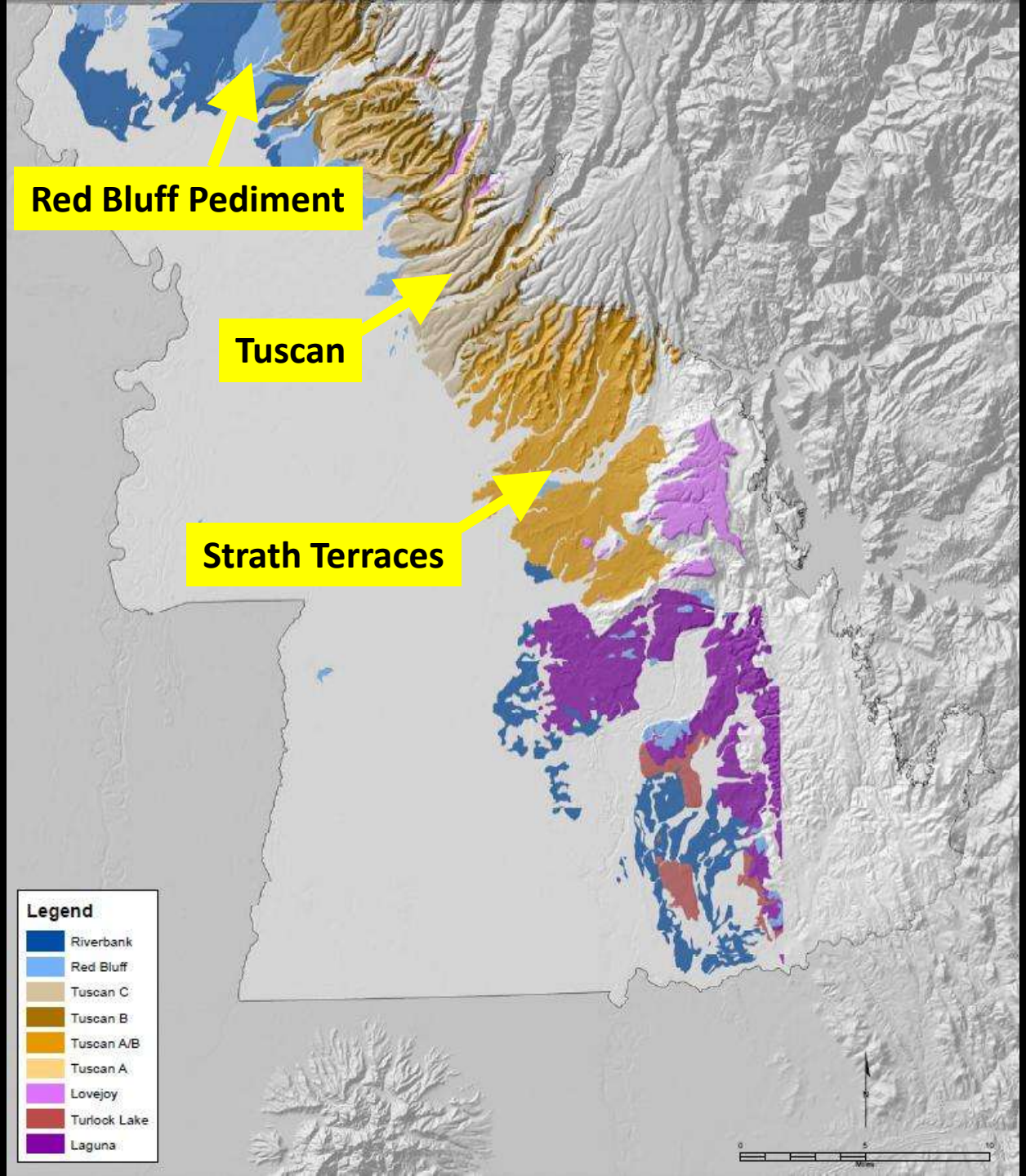

(a)
(b)
(c)
(d)
Soil Water Potential (MPa)
Soil Volumetric Water Content (%)
Deep
Shallow
+ WSFG
- WSFG
30 cm
50 cm
75 cm
WSFG
earlyDSFG
midDSFG
lateDSFG
1
2
3
4
5
6
7
8
9
10
11
12
13
14

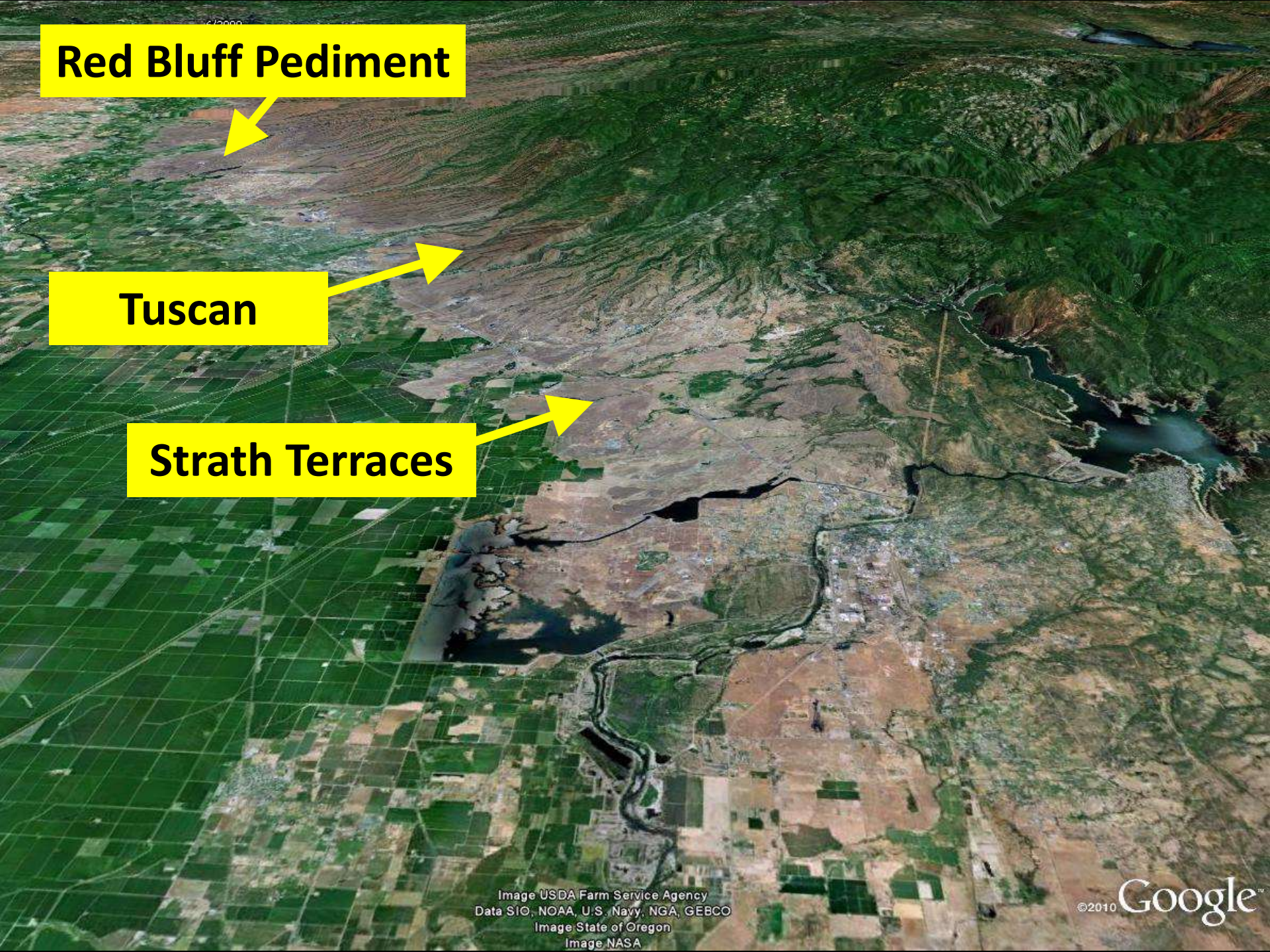
“Functionality” varies with physical and biological conditions making it difficult to generalize about effects.

Can you evaluate a landscape for areas that are most likely to be affected?


STUDY AREA
UNITED STATES
MEXICO
Pacific Ocean
Sacramento Valley
Coast
Range
Sacramento River
Sutter Buttes
CALIFORNIA
Sierra Nevada
San Joaquin Valley
Pacific
Carquinez Straits
San Francisco Bay
San Joaquin River
Fresno Slough
San Joaquin Basin
King's River
Range
EXPLANATION
Geomorphic Province
Basin
Delta
Dissected uplands
Sacramento River flood plains
Sutter Buttes
Younger fan deposits


Layer 1
shown on Figure 8
10
Redding
40°
121°
12
Eastern Sacramento
39°
11
Western Sacramento
EXPLANATION
Central Valley boundary
Percentage of coarse-grain material
> is greater than.
0 to 10
>10 to 20
>20 to 30
>30 to 40
>40 to 50
>50 to 60
38°
22
North San J
20
Tracy/Delta-Mendota


Red Bluff Pediment
Tuscan
Strath Terraces
Legend
Riverbank
Red Bluff
Tuscan C
Tuscan B
Tuscan A/B
Tuscan A
Lovejoy
Turlock Lake
Laguna


Red Bluff Pediment
Tuscan
Strath Terraces
Image USDA Farm Service Agency
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image State of Oregon
Image NASA
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9/2009
Image USDA Farm Service Agency
Image State of Oregon
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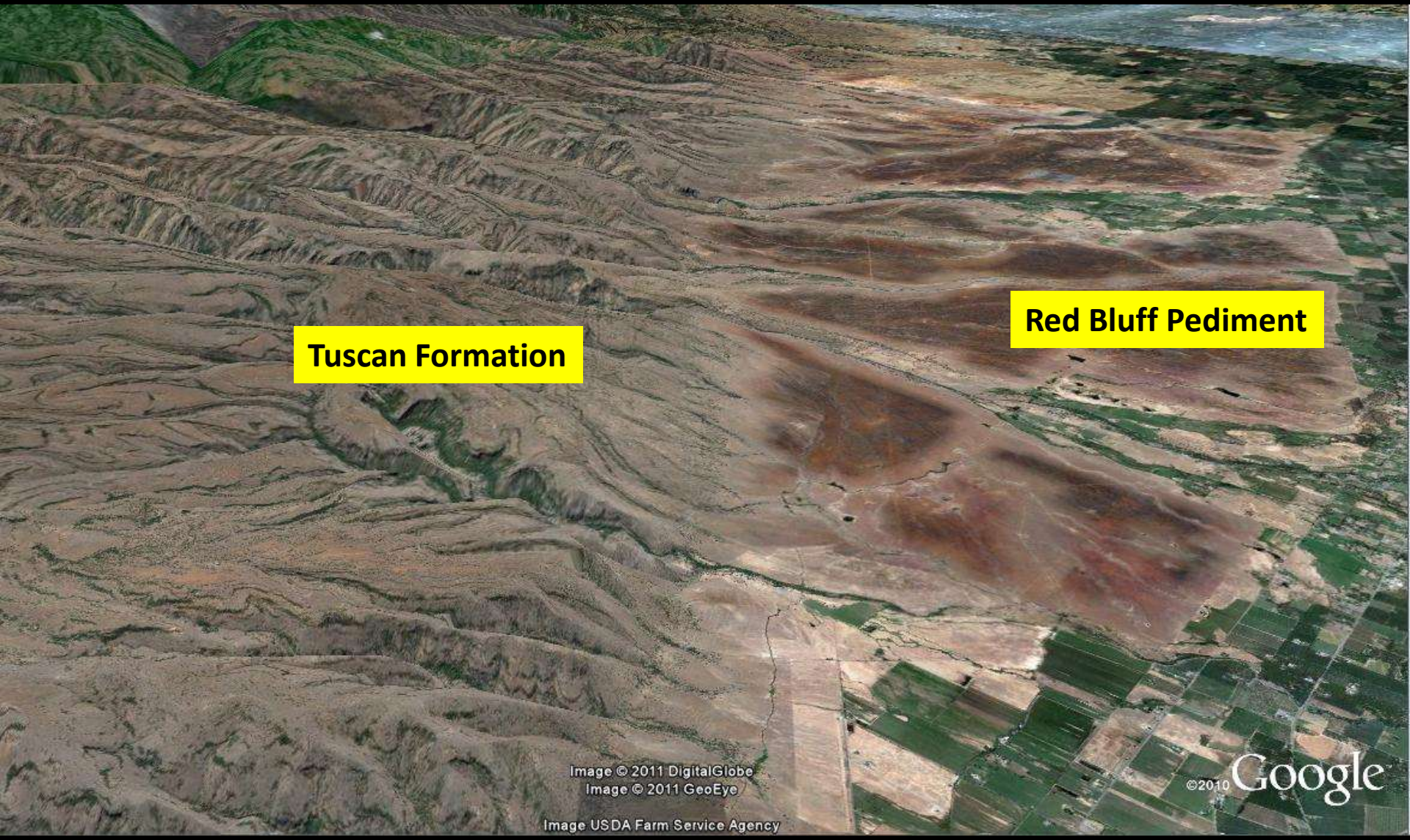
Tuscan Formation
Red Bluff Pediment
Image © 2011 DigitalGlobe
Image © 2011 GeoEye
Image USDA Farm Service Agency
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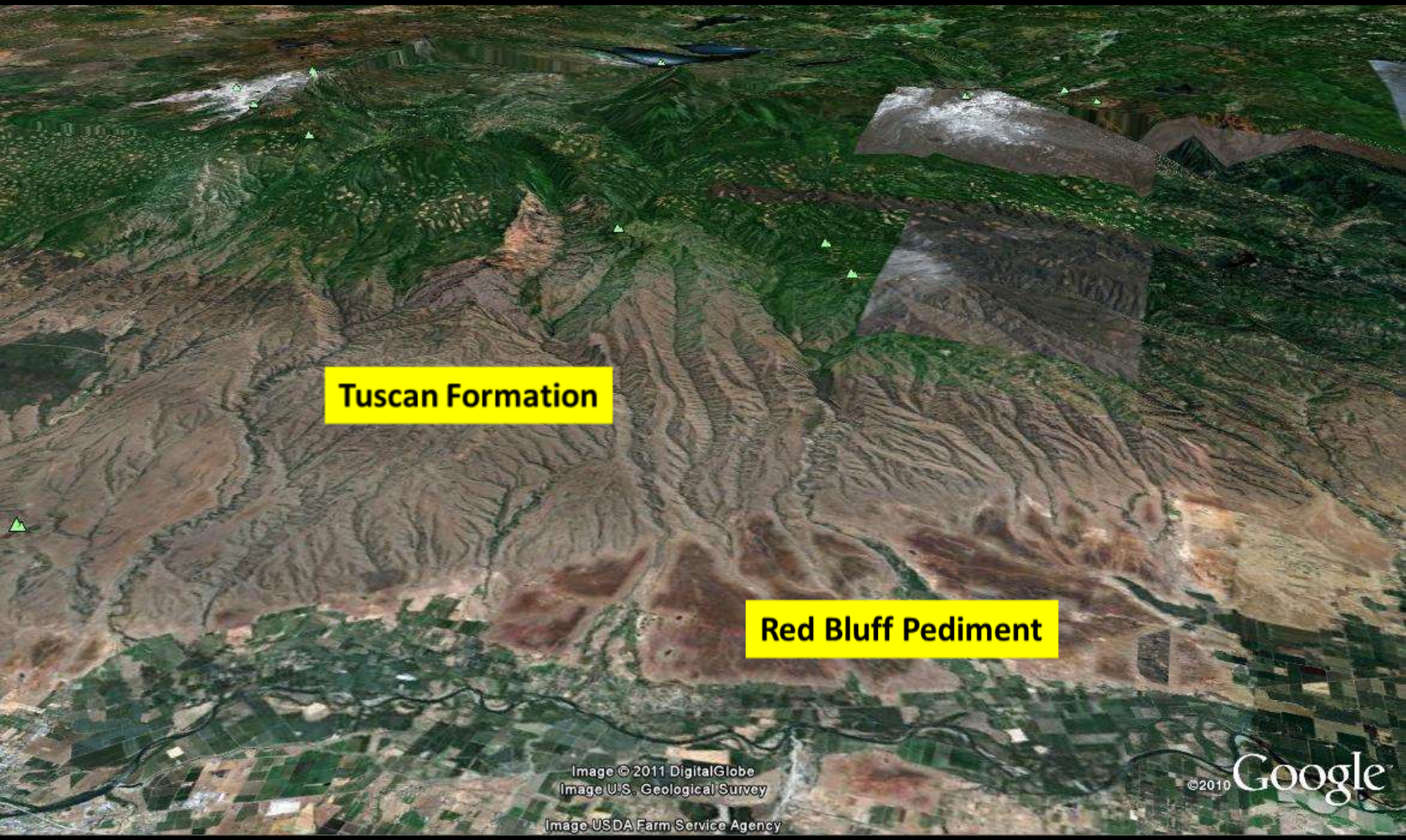
Tuscan Formation
Red Bluff Pediment
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