Ecología de los humedales (Bases)

LEIGH FREDRICKSON

Manejo de humedales para técnicos en México II

LAGUNA MEXICANOS, CHIHUAHUA

Club Raramuri

4-7 March 2014

WETLAND VALUES TO SOCIETY

- ATMOSPHERIC STABILITY
- FLOOD CONTROL
- NUTRIENT CYCLING
- GROUND WATER RECHARGE
- WATER PURIFICATION
- TRADITIONAL INCOME

TRADITIONAL INCOME

- ONLY ACCOUNTS FOR 5-10% OF TOTAL VALUE
- FOREST PRODUCTS
- FOOD
- RECREATION
  - VIEWING
  - HUNTING

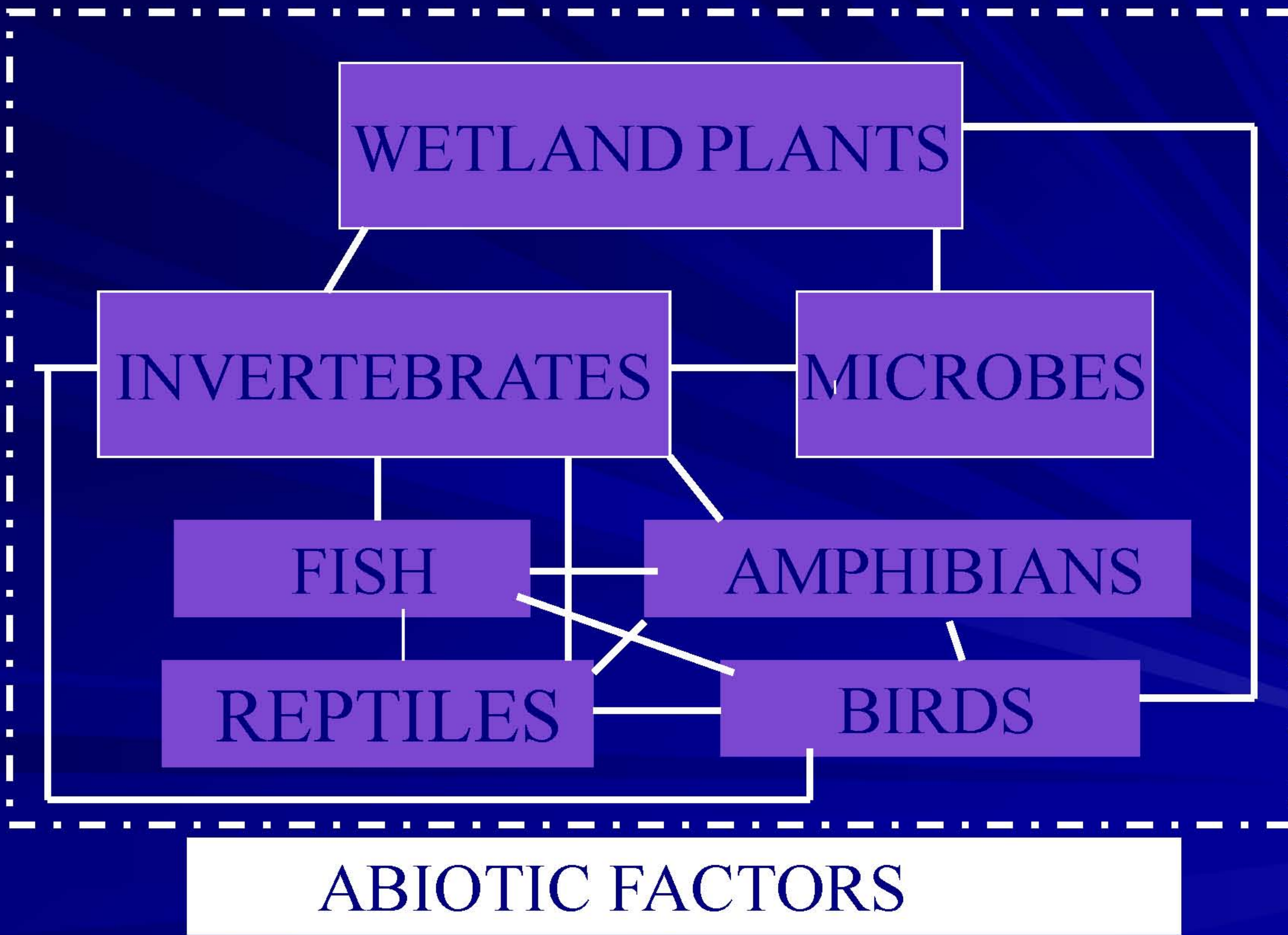
FLOOD CONTROL

- MISSISSIPPI ALLUVIAL VALLEY HOLDS ABOUT 60 DAYS WITH 25 MILLION ACRES OF BOTTOMLAND HARDWOODS
- IN FLOOD OF 1973 PREDICTION WAS THAT MAV STORED LESS THE 25% OF HISTORIC CAPACITY

NUTRIENT CYCLING

- AEROBIC TO ANAEROBIC
- OXIDATION VS REDUCTION
- BACK TO BASIC ELEMENTS RAPIDLY

WETLAND MODEL



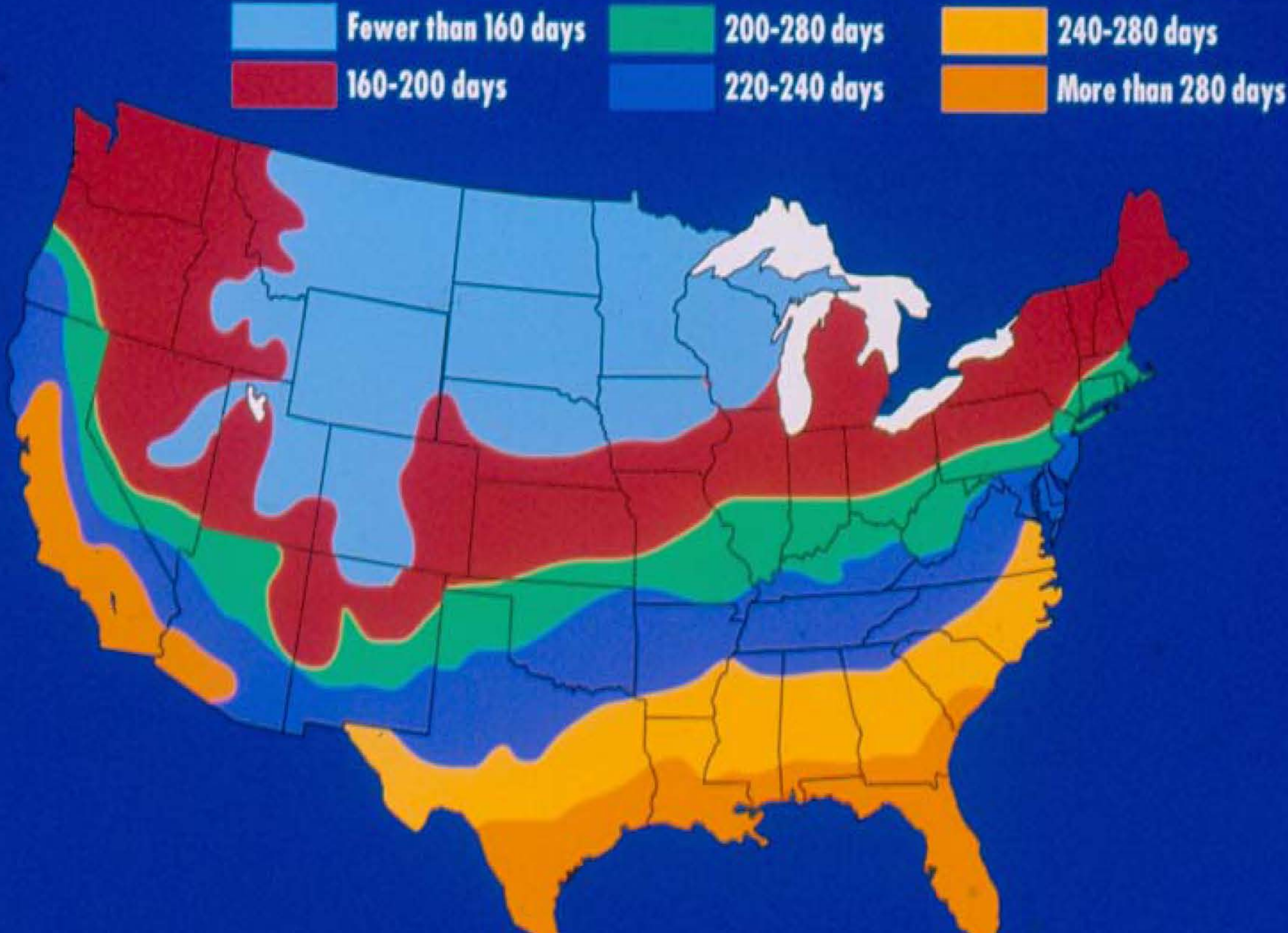
ABIOTIC FACTORS

HYDROLOGY

SOILS

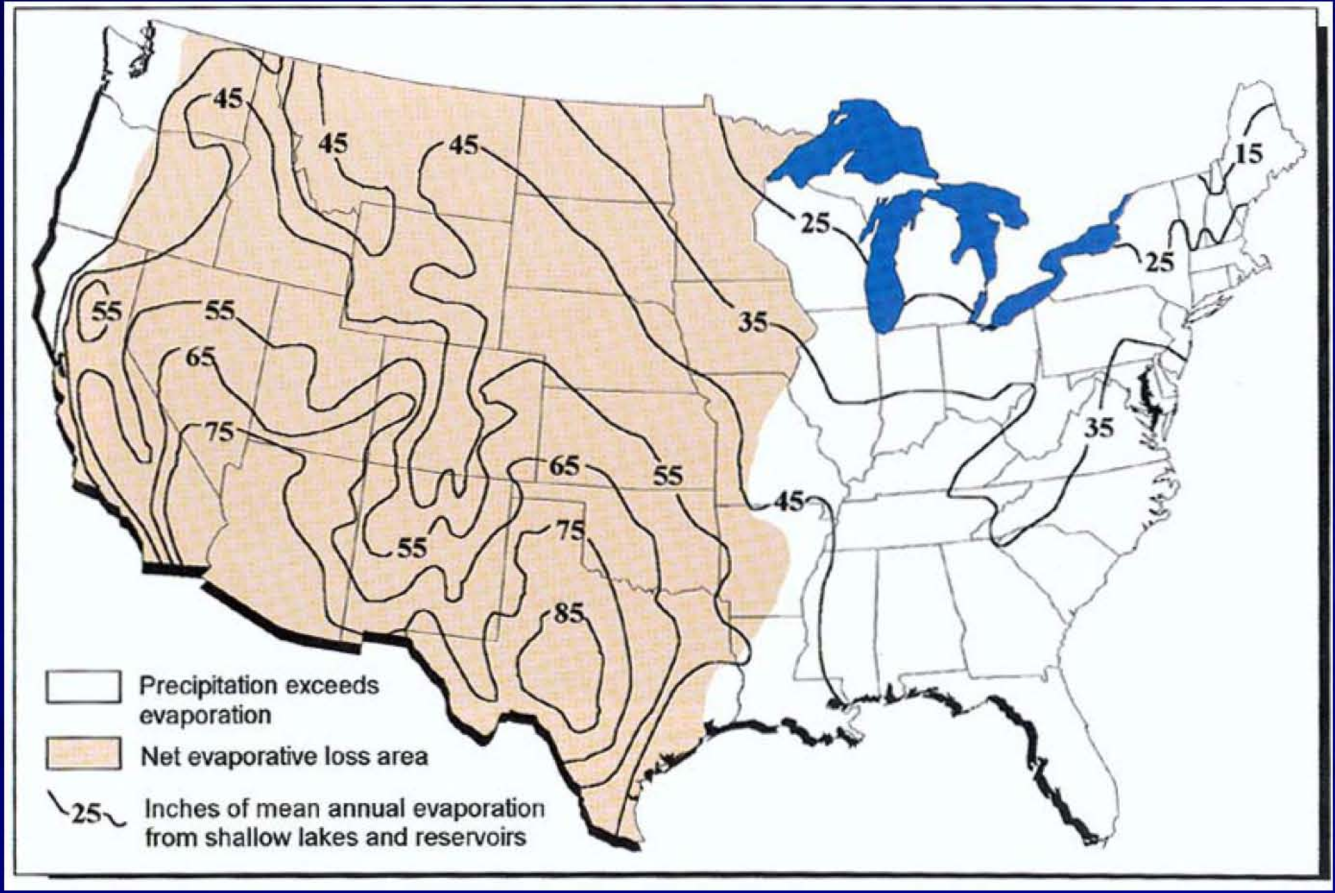
CLIMATE

FIRE



Fewer than 160 days
160-200 days
200-280 days
220-240 days
240-280 days
More than 280 days

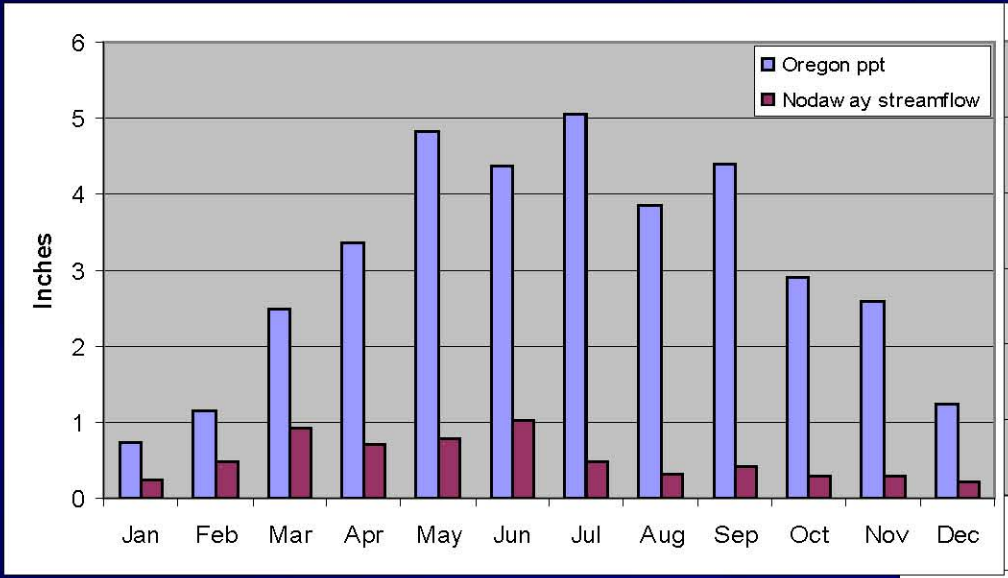
National Applicability for Riparian System

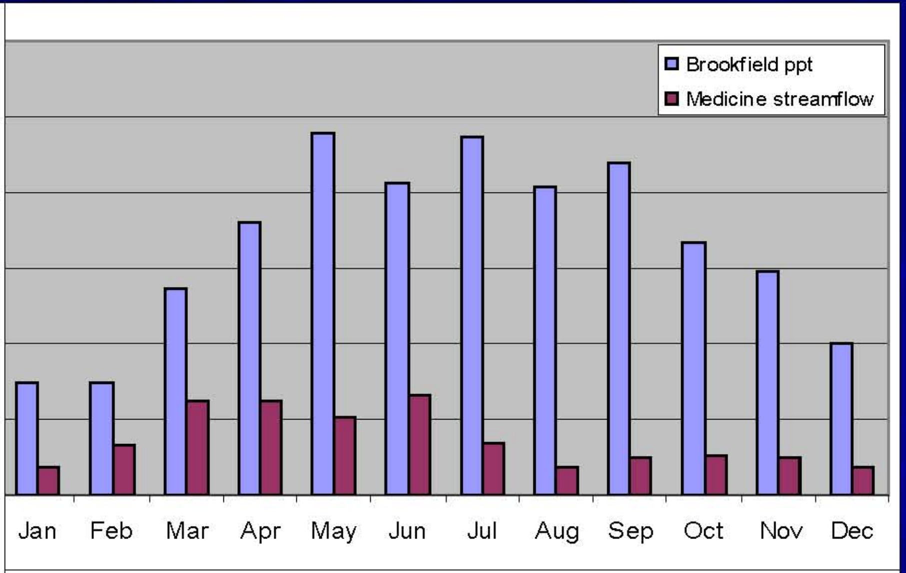


Mean annual evaporation exceeds mean annual precipitation.

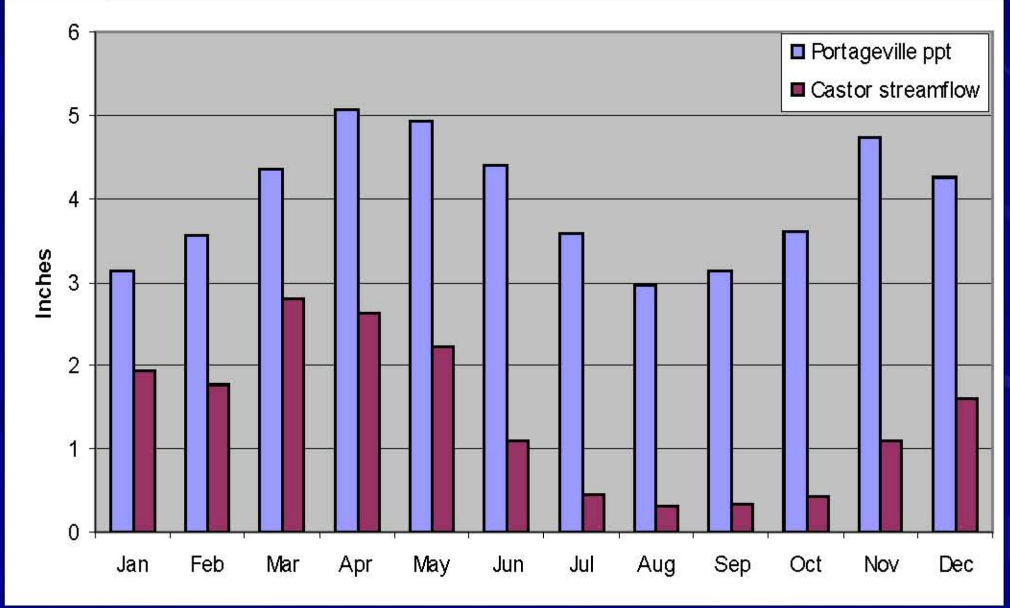
Source: USDA, 1981

Comparison of monthly mean precipitation and streamflow

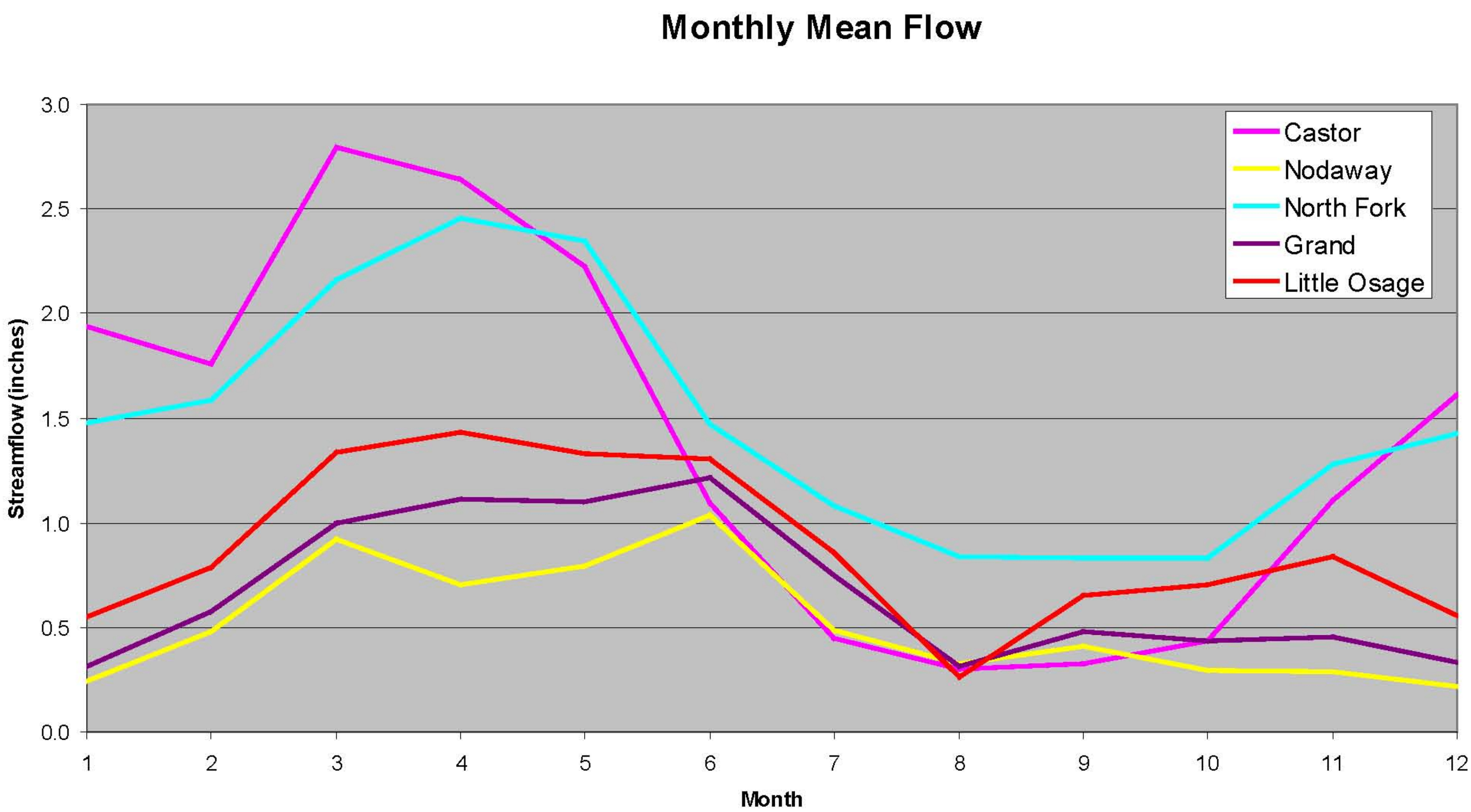




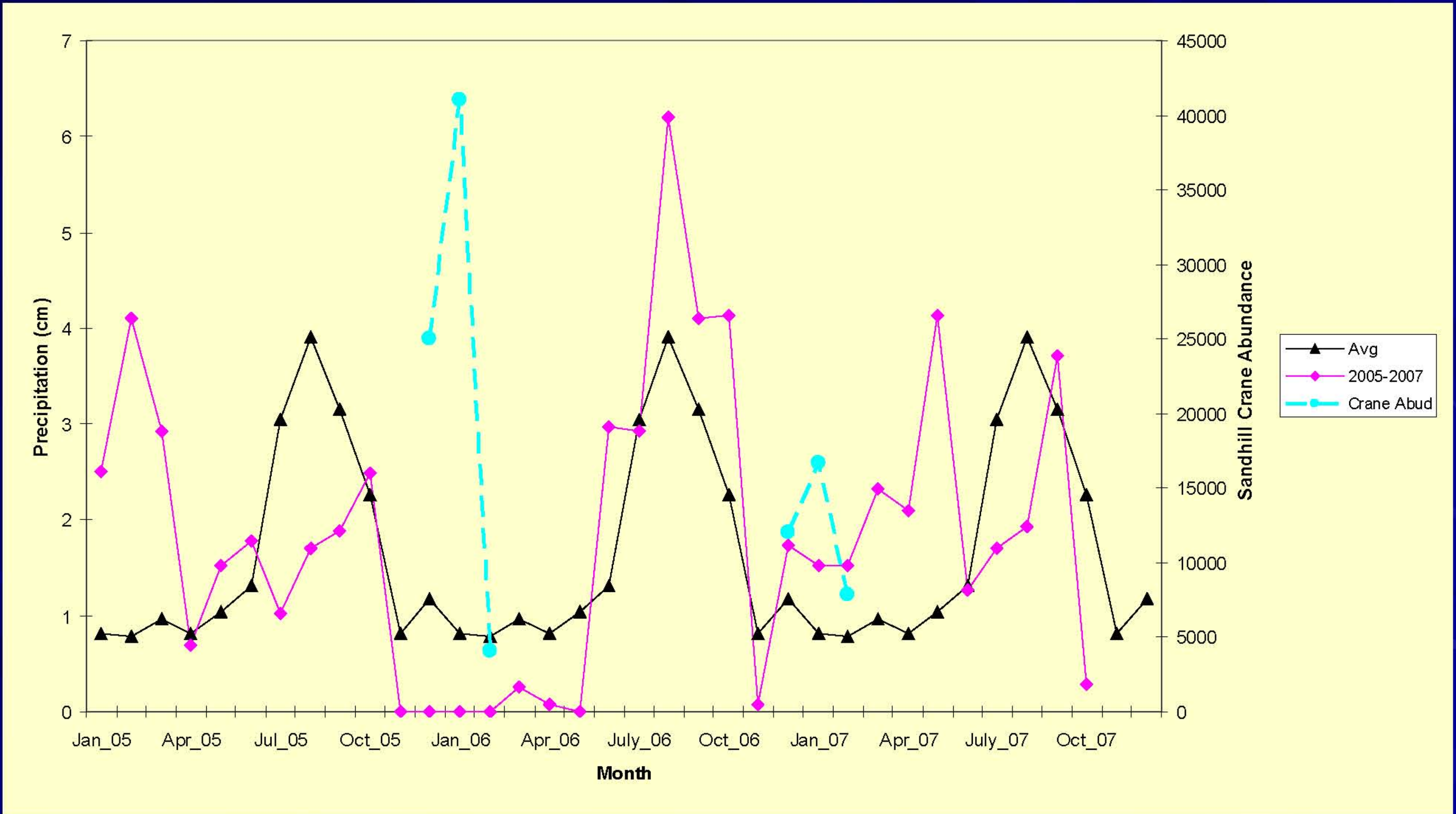
- Streamflow as a function of precipitation varies depending on watershed hydrology, ET, and soil moisture



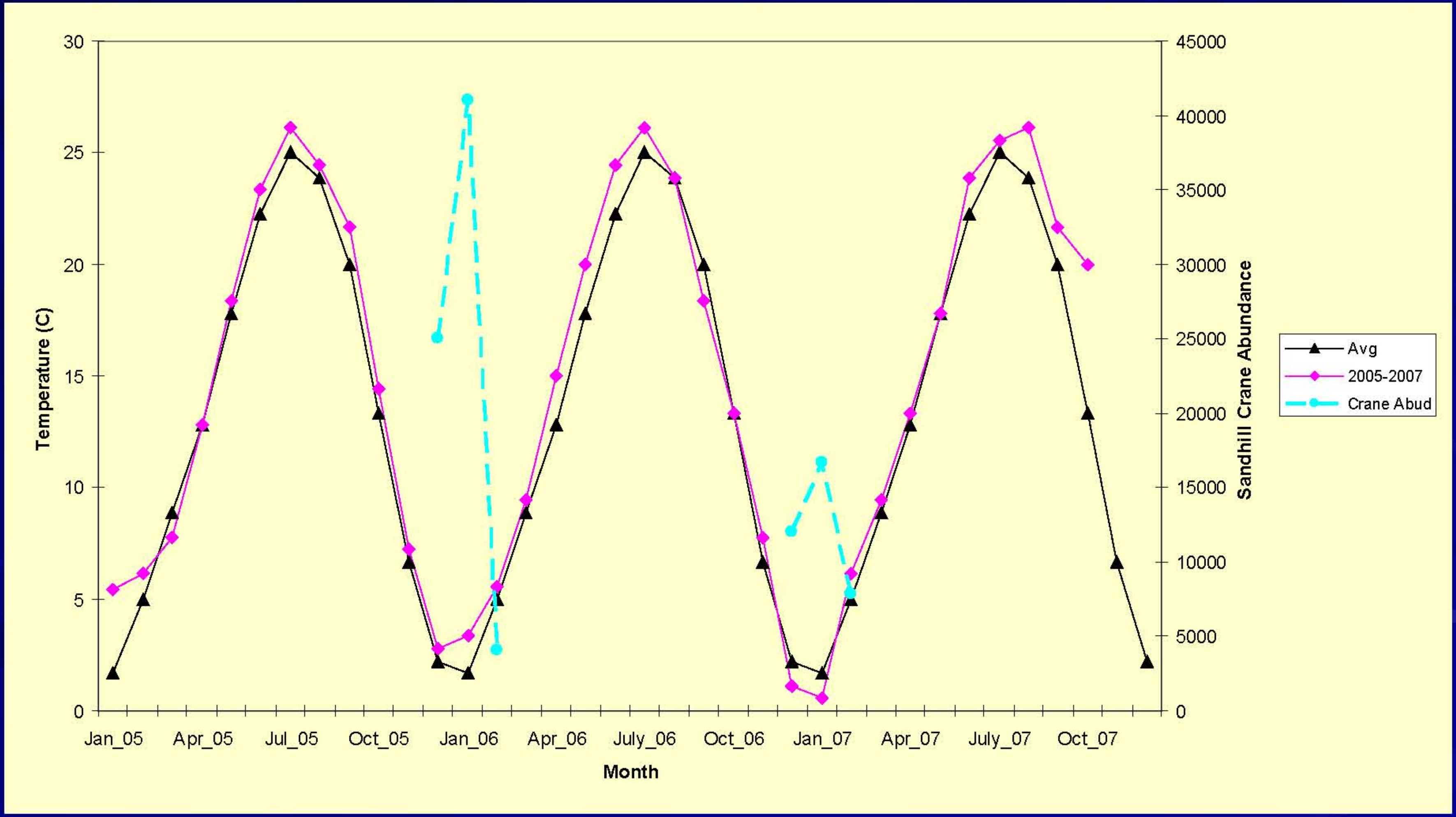
Looking just at streamflow for a few rivers

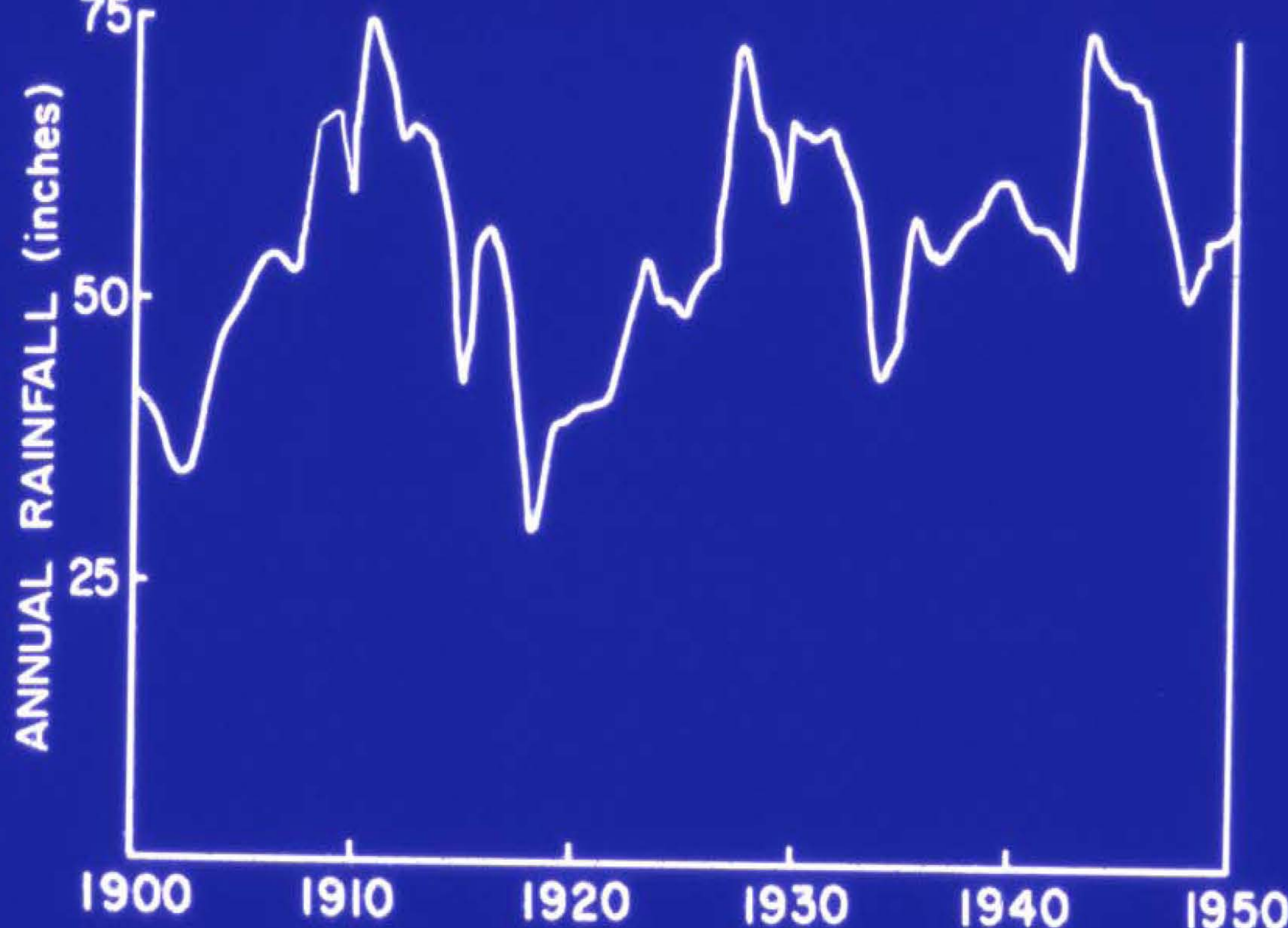


Precipitation Variation across Years Relative to Sandhill Crane Abundance for Bernardo, New Mexico



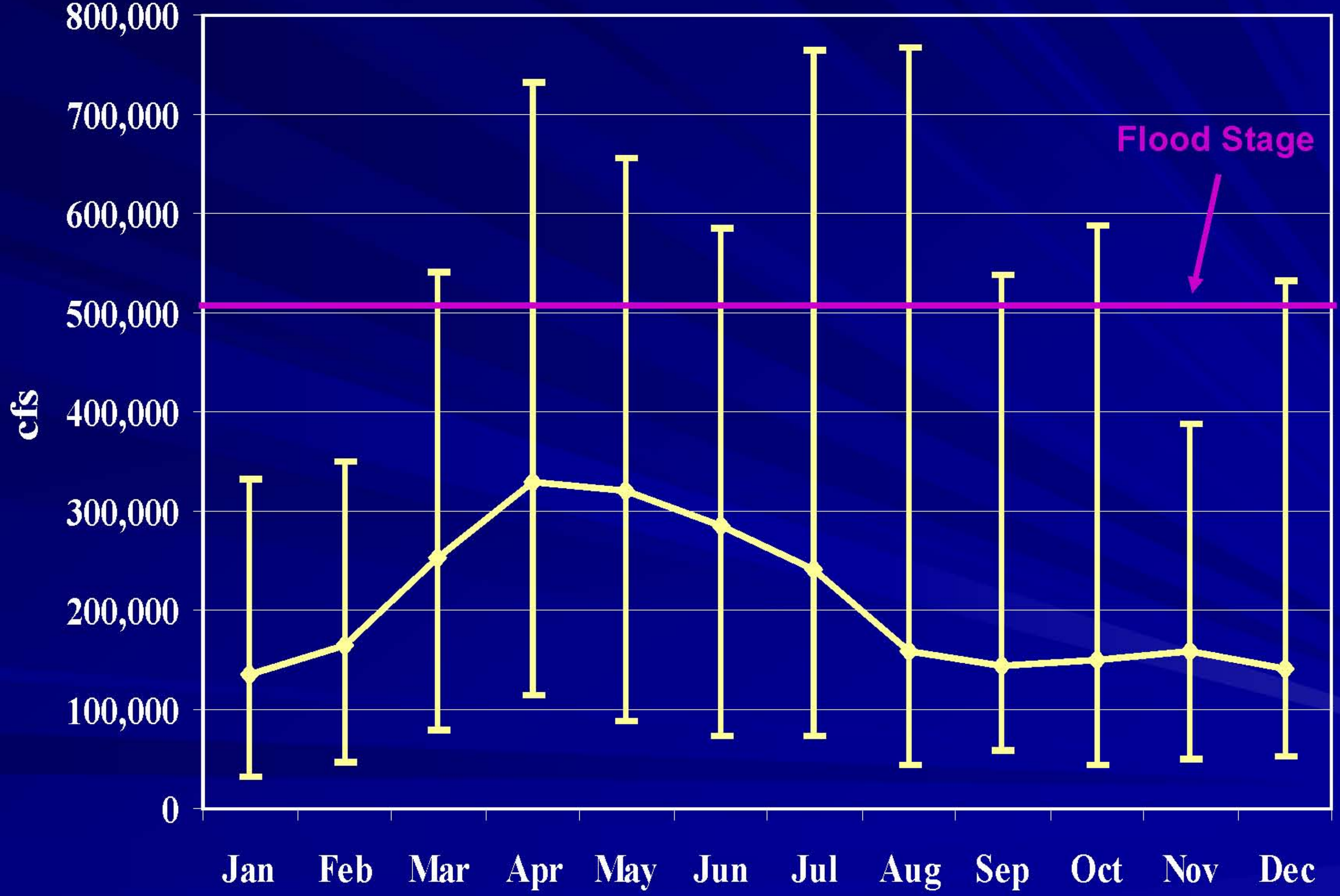
Temperature Variation across Years Relative to Sandhill Crane Abundance for Bernardo, New Mexico



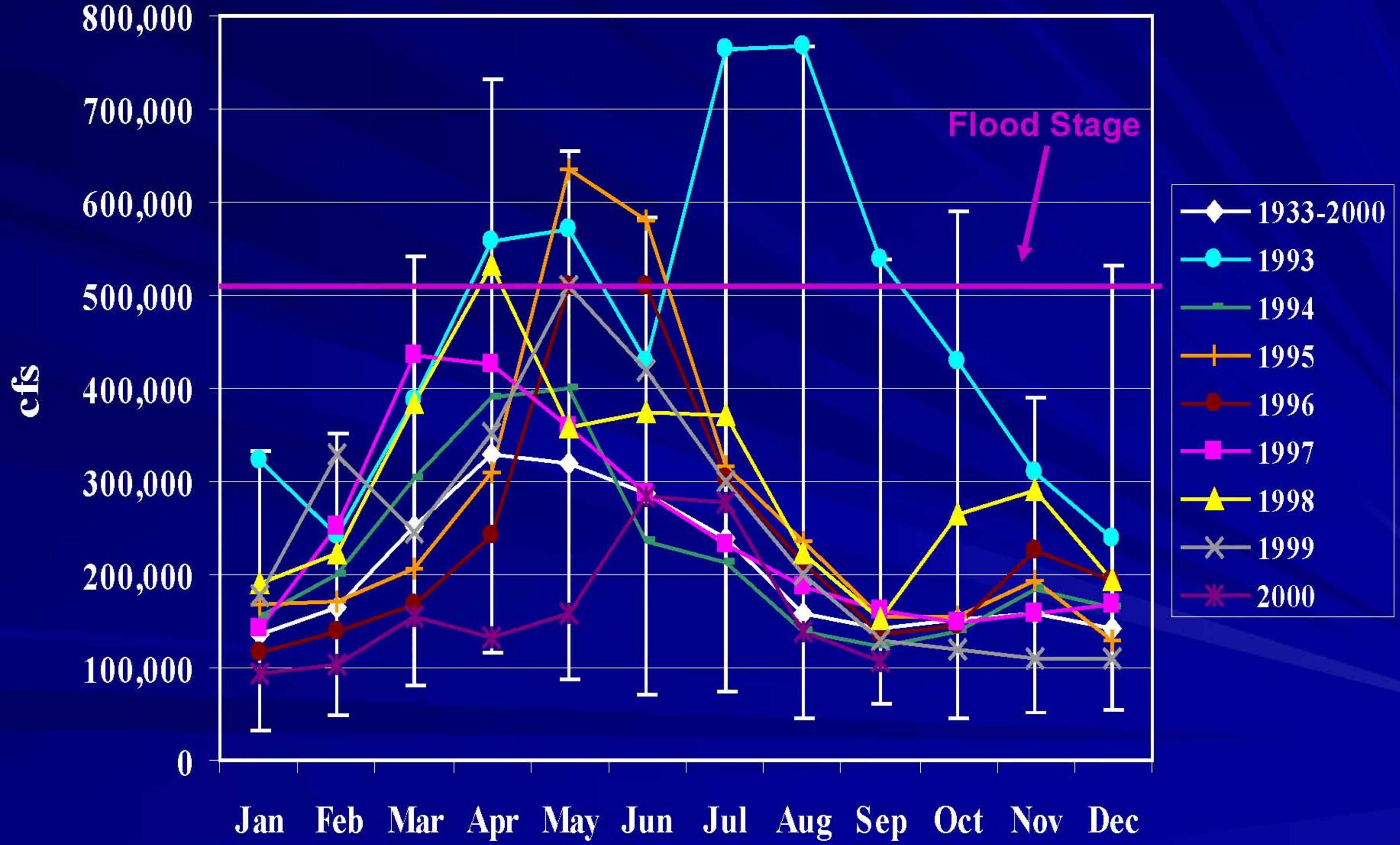


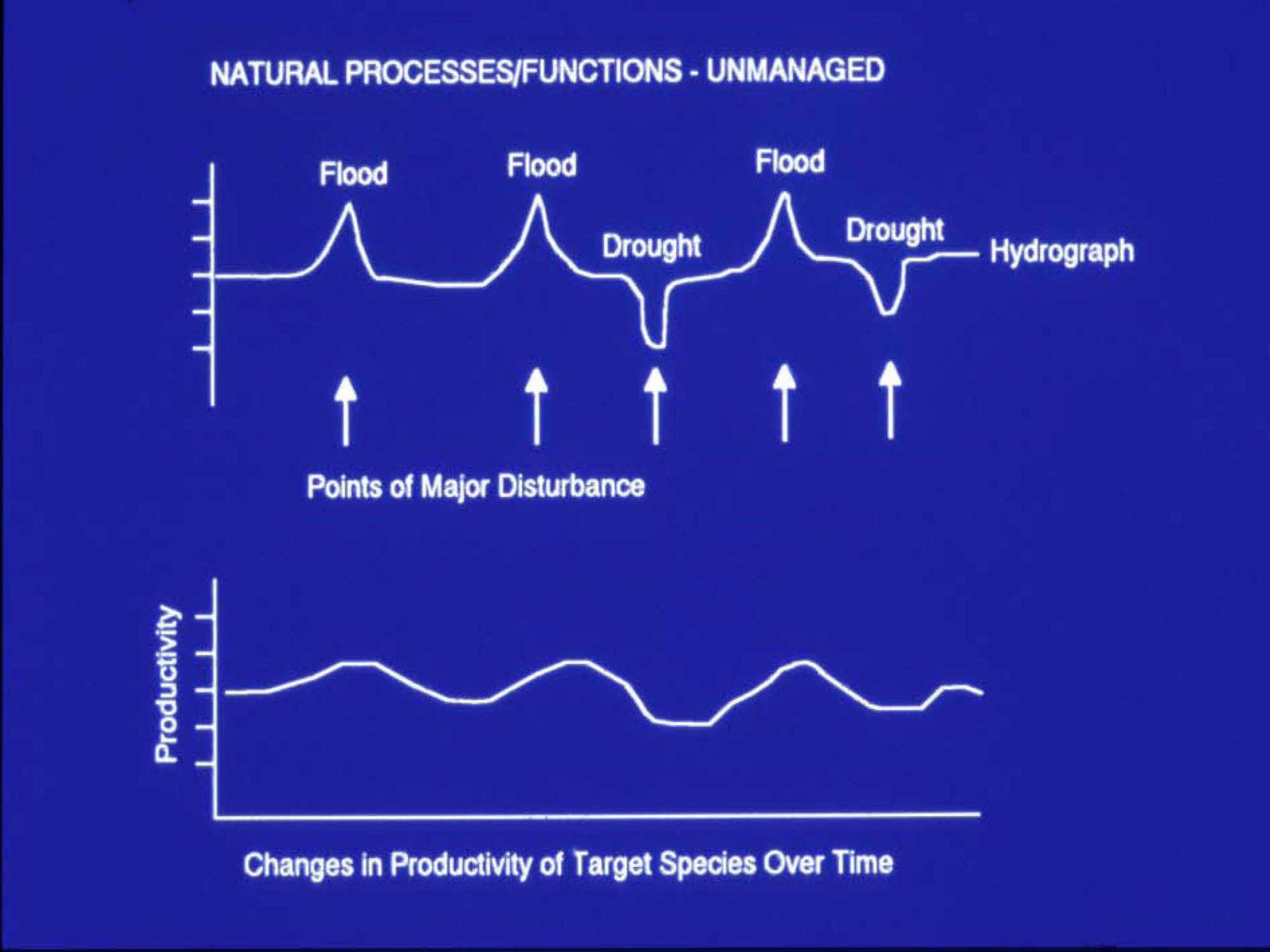
ANNUAL RAINFALL (inches)
75
50
25
1900
1910
1920
1930
1940
1950

Mean monthly discharge of the Mississippi River from 1933-2000

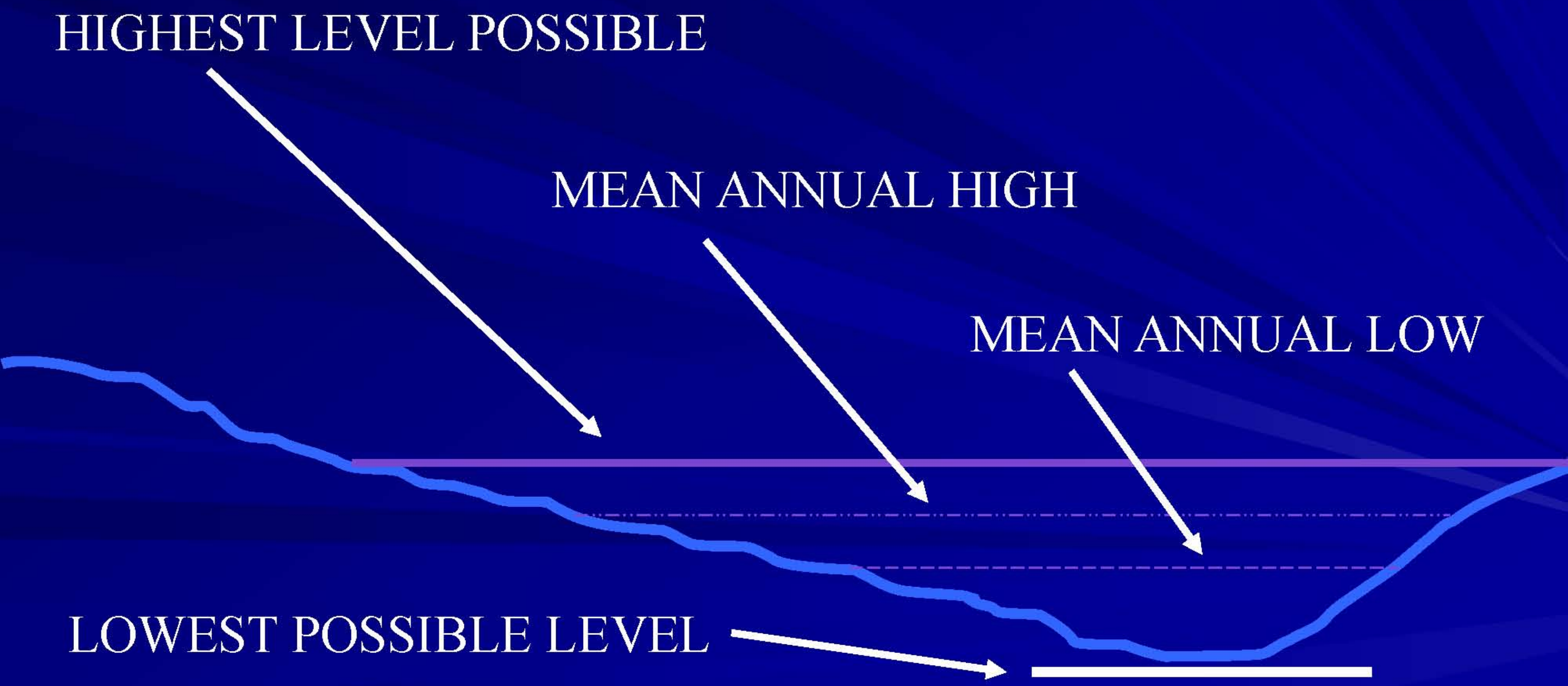


Mean monthly discharge of the Mississippi River from 1993-2000




NATURAL PROCESSES/FUNCTIONS - UNMANAGED
Flood
Flood
Drought
Flood
Drought
Hydrograph
Points of Major Disturbance
Productivity
Changes in Productivity of Target Species Over Time

VARIATION IN ANNUAL WATER LEVEL

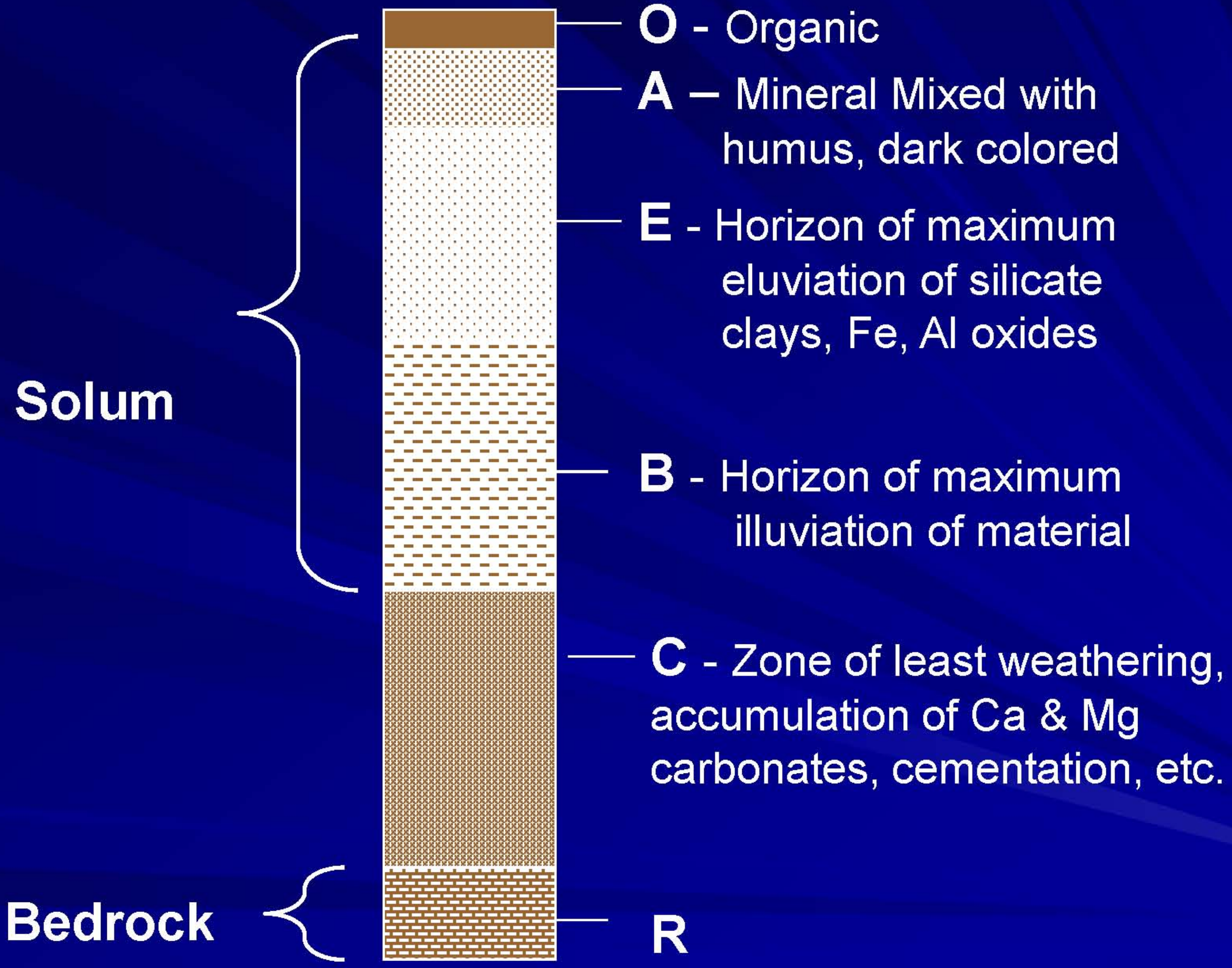


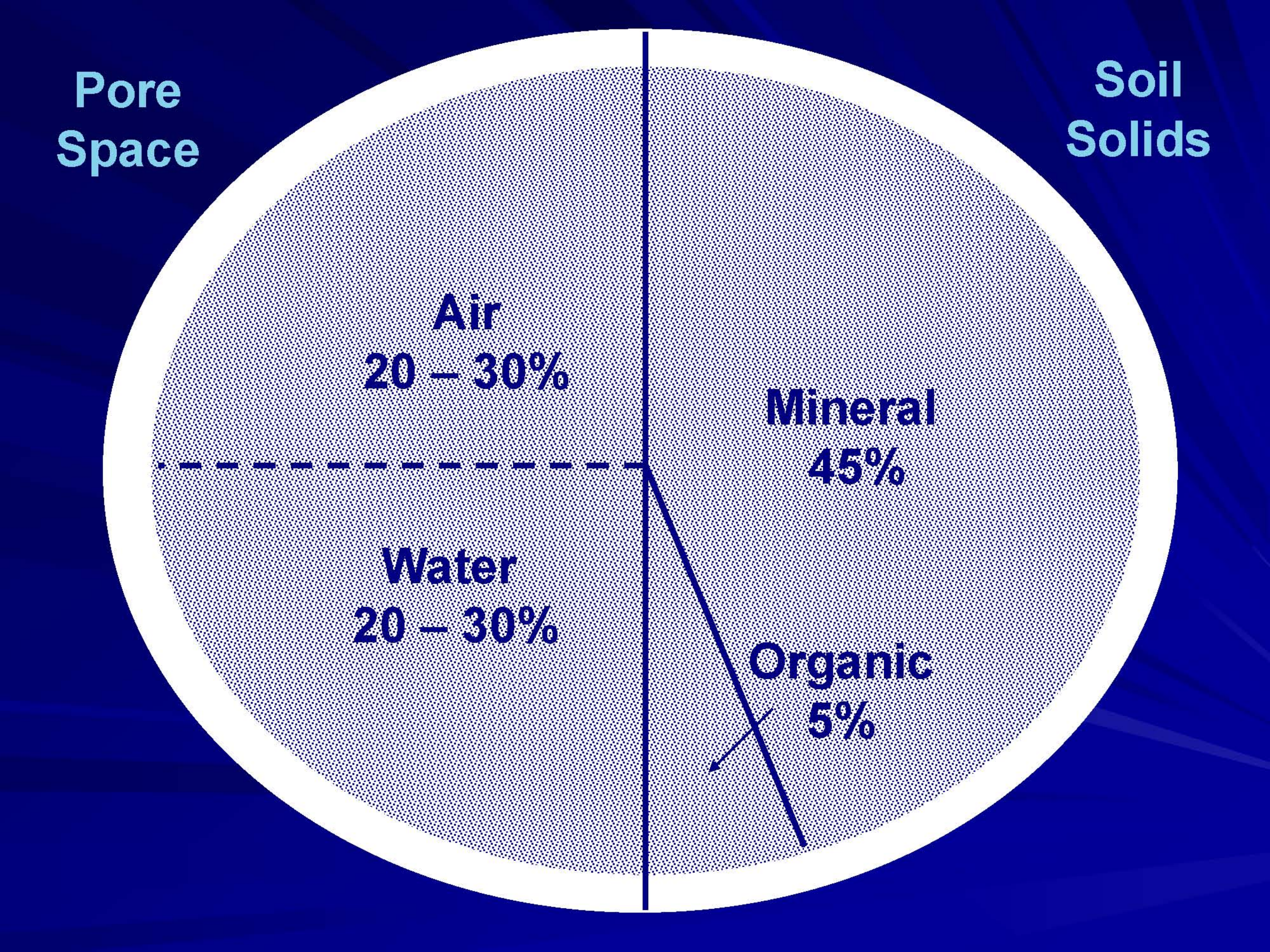
WETLAND SOIL

ANNUAL VARIATION IN RAINFALL ACROSS LATITUDES

SE MINNESOTA	30 INCHES
SE MISSOURI	50 INCHES
NC LOUISIANA	60 INCHES
S LOUISIANA	70 INCHES
CHIHUAHUA	20 INCHES

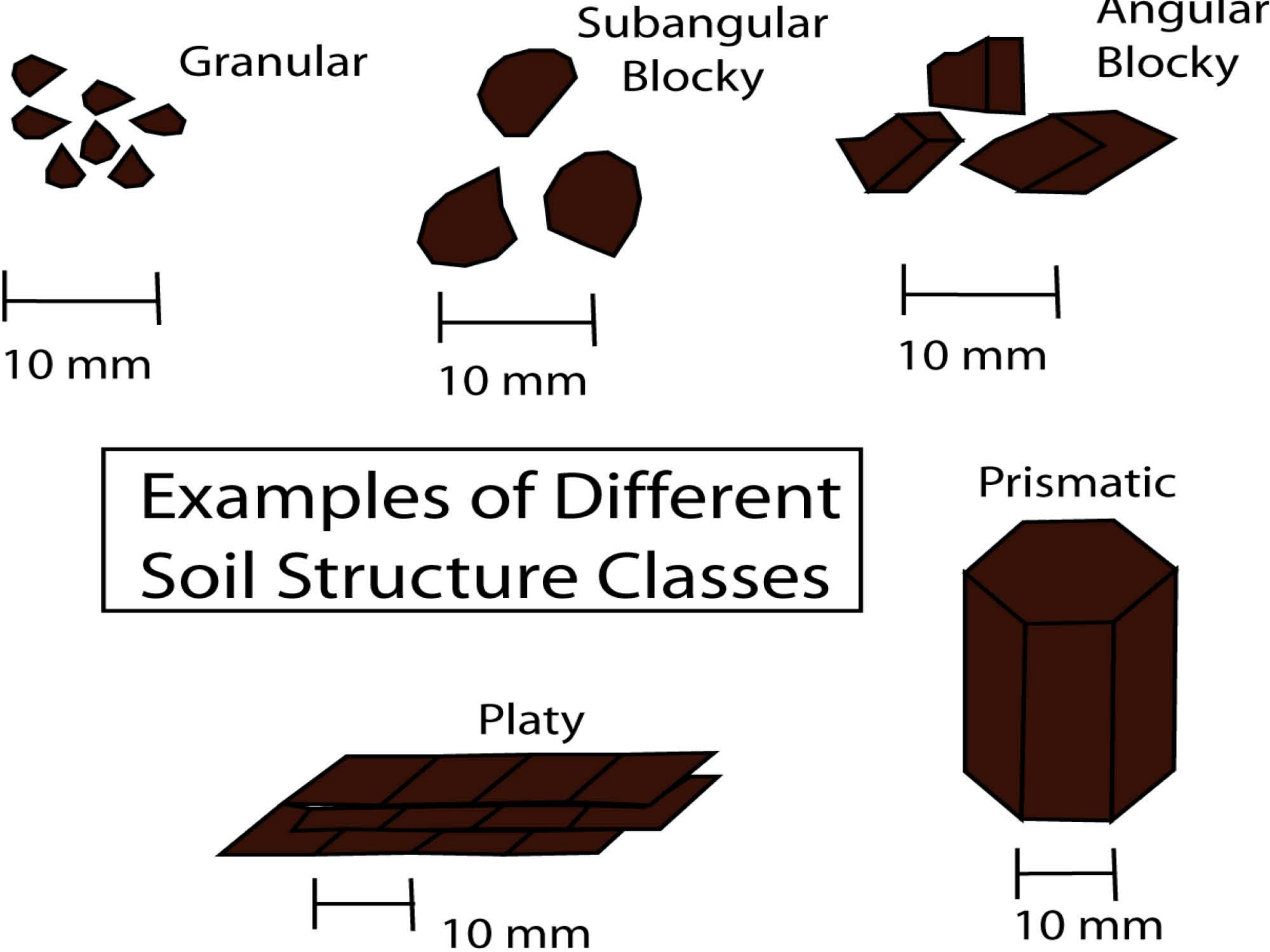
SOIL PROFILE

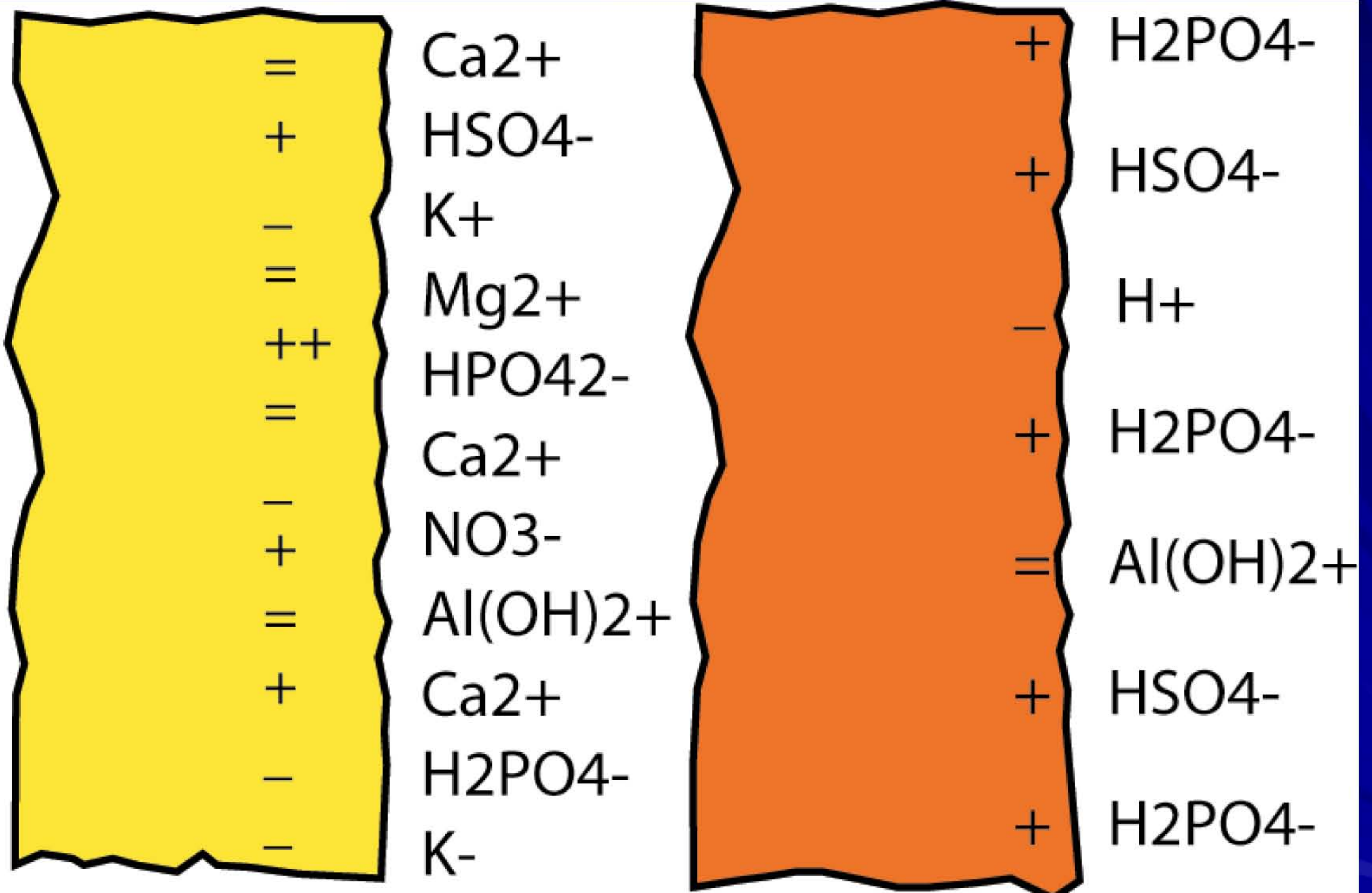

O - Organic
A – Mineral Mixed with humus, dark colored
E - Horizon of maximum eluviation of silicate clays, Fe, Al oxides
Solum
B - Horizon of maximum illuviation of material
C - Zone of least weathering, accumulation of Ca & Mg carbonates, cementation, etc.
Bedrock
R


Pore
Space
Soil
Solids
Air
20 – 30%
Mineral
45%
Water
20 – 30%
Organic
5%

Particle Fractions

Type	Size
– Sand	.05 – 2 mm
– Silt	.002 - .05 mm
– Clay	<.002 mm


Granular
10 mm
Subangular Blocky
10 mm
Angular Blocky
10 mm
Examples of Different Soil Structure Classes
Prismatic
10 mm
Platy
10 mm



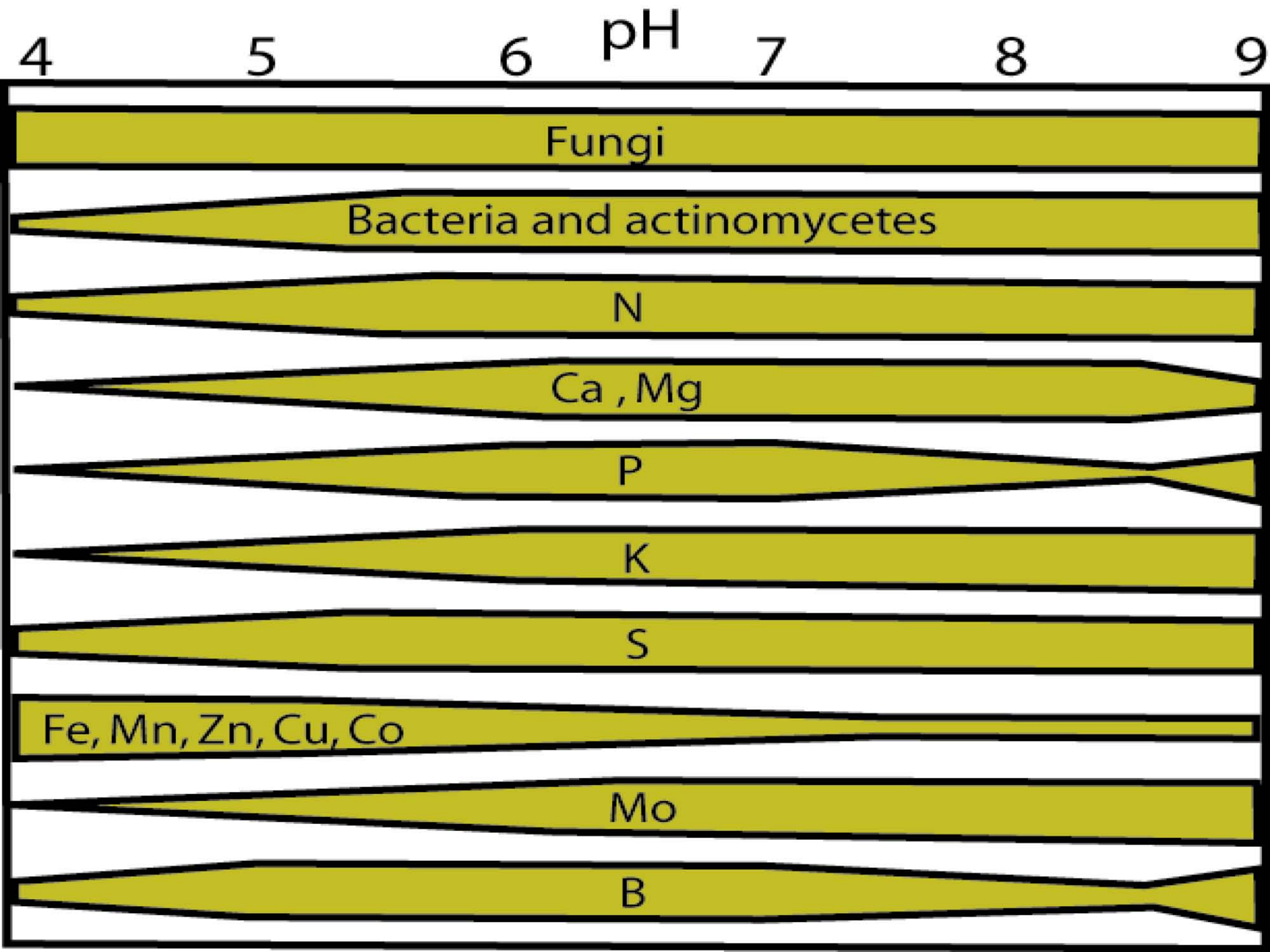
(a) 1:1 - type silicate clay particle

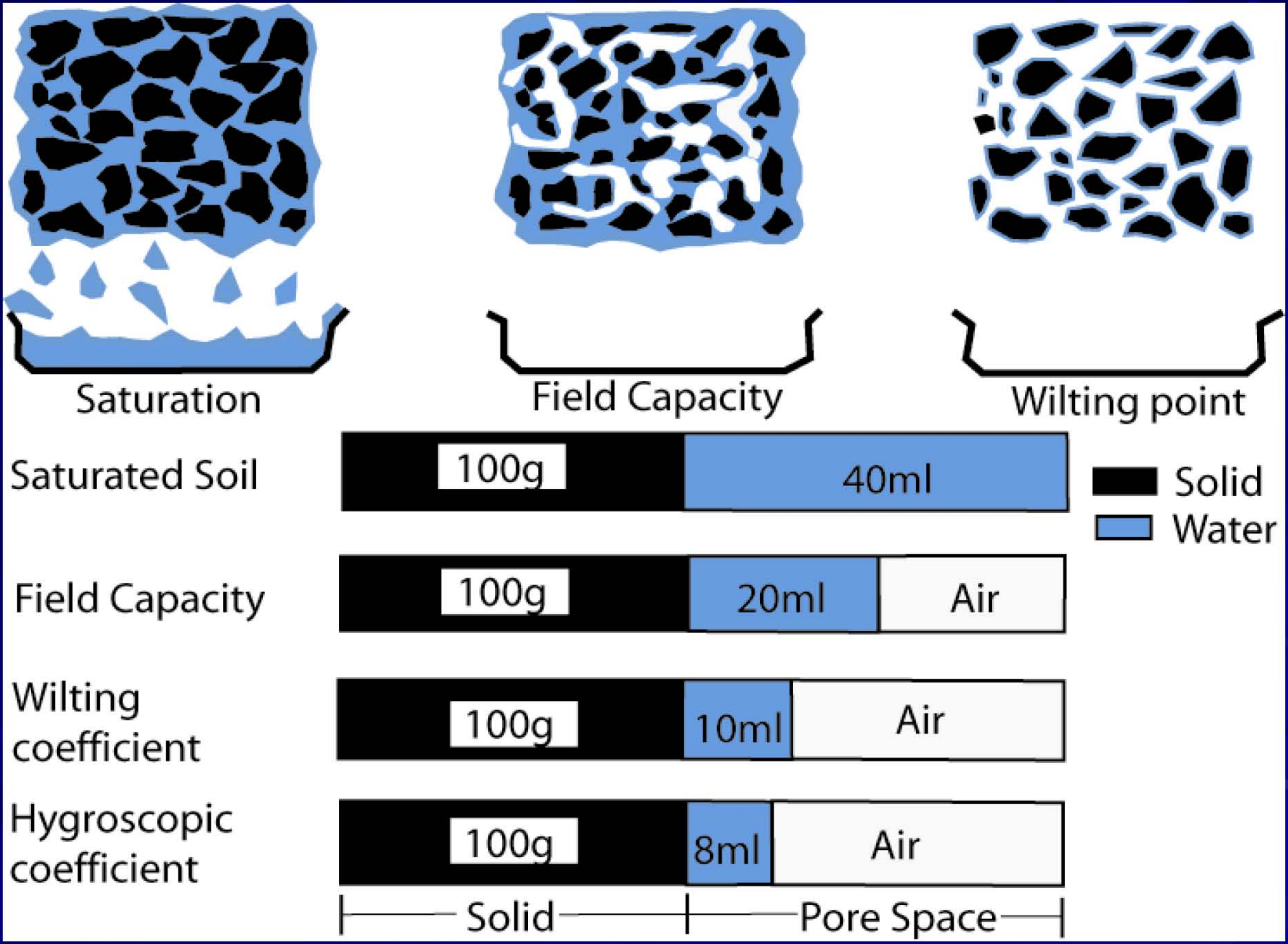
(b) Iron/aluminum oxide particle

Factors Affecting SOM

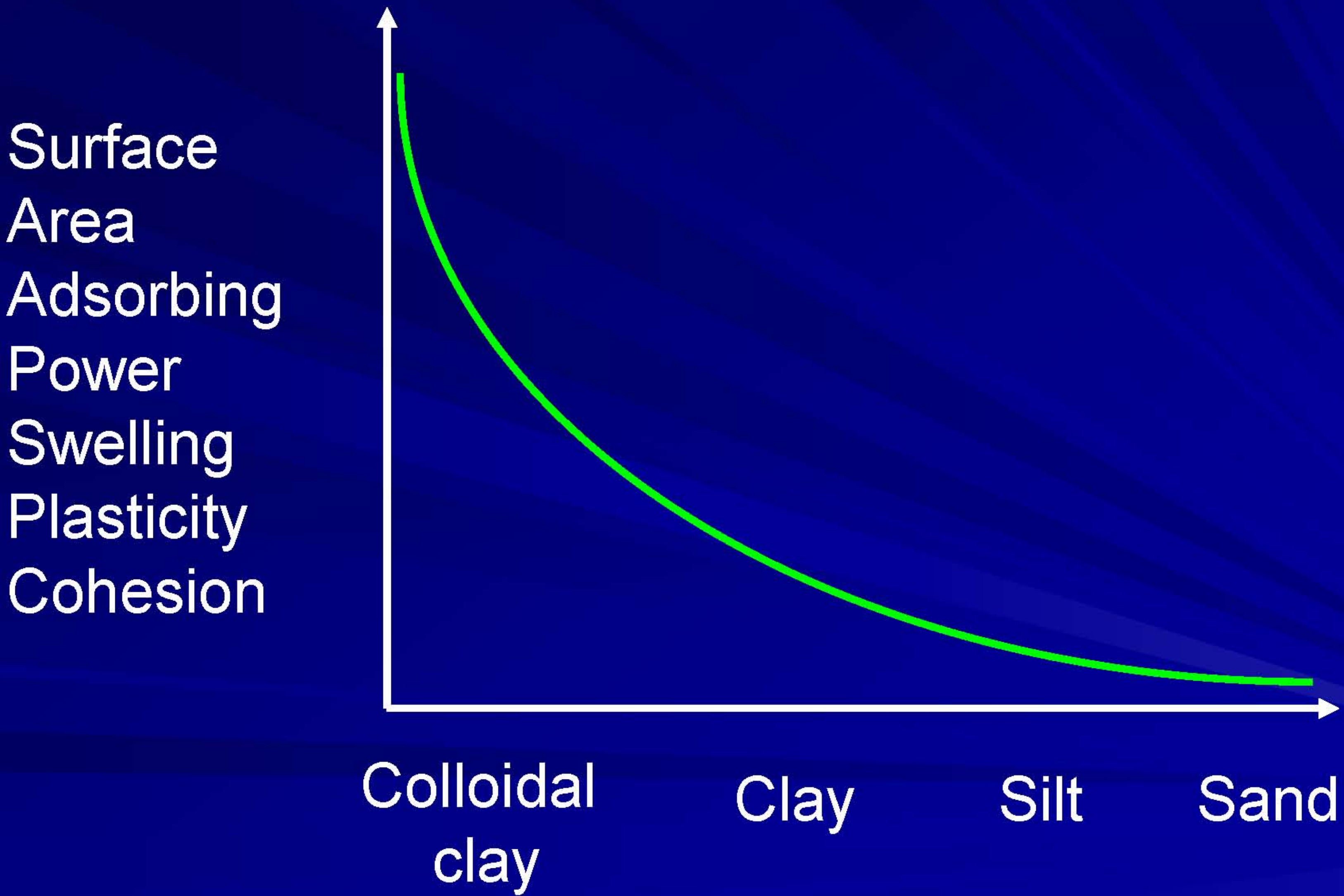
(Jenny 1930)

- Climate (temp & precipitation)
- Vegetation
- Topography
- Parent Material
- Age

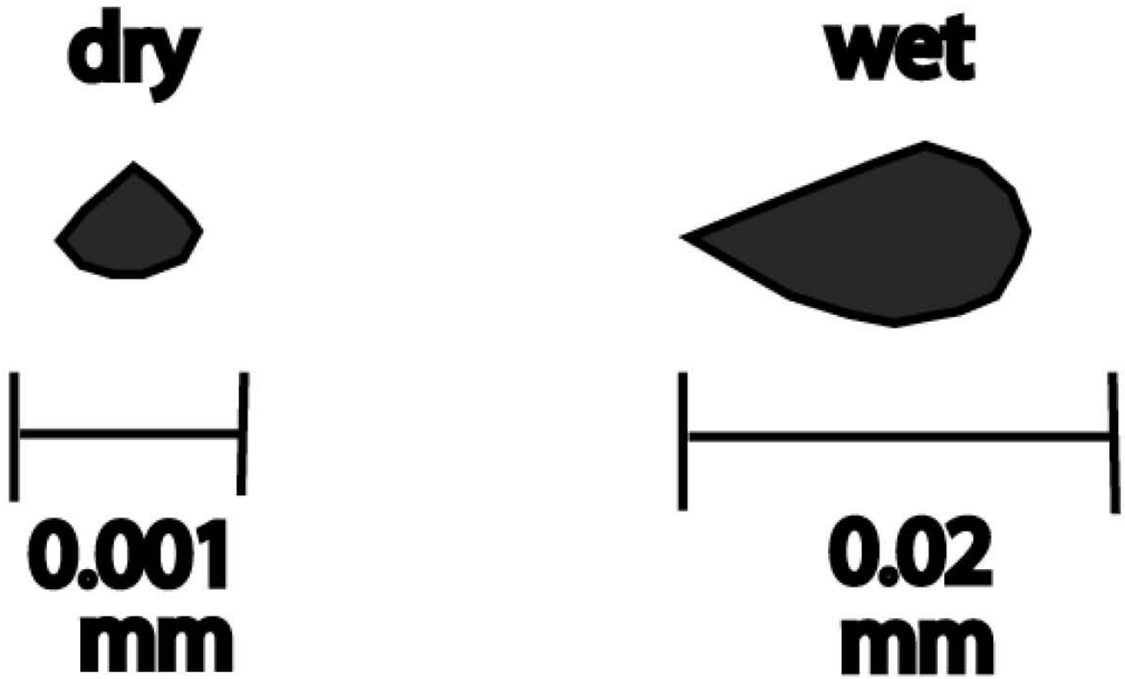

pH
4
5
6
7
8
9
Fungi
Bacteria and actinomycetes
N
Ca , Mg
P
K
S
Fe, Mn, Zn, Cu, Co
Mo
B


Saturation
Field Capacity
Wilting point
Saturated Soil
100g
40ml
Solid
Water
Field Capacity
100g
20ml
Air
Wilting coefficient
100g
10ml
Air
Hygroscopic coefficient
100g
8ml
Air
Solid
Pore Space

Characteristic of Soil Separates



Clay Shrink/Swell Capacity



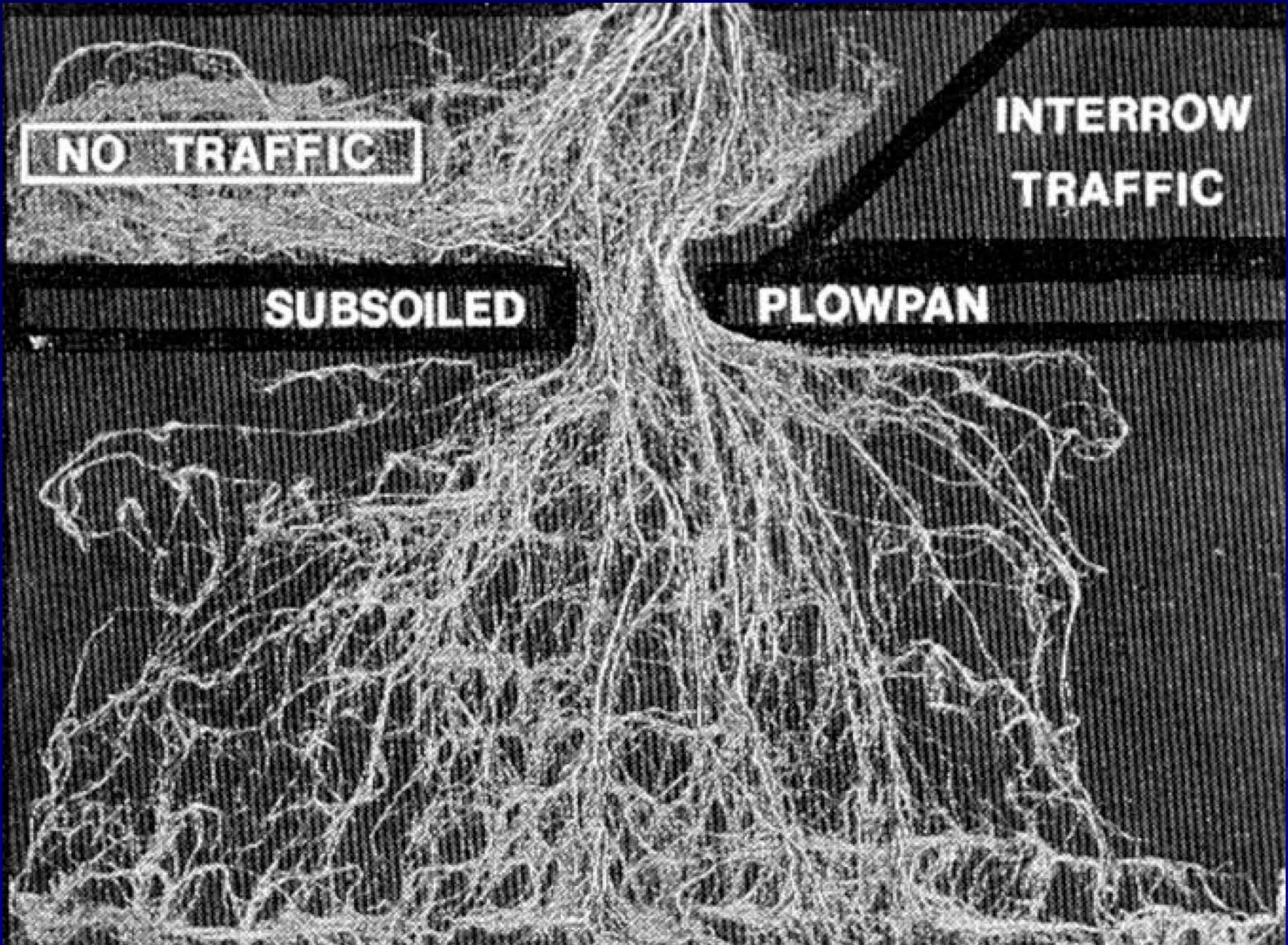
0 to 20 times Dry Size (Bentonite)

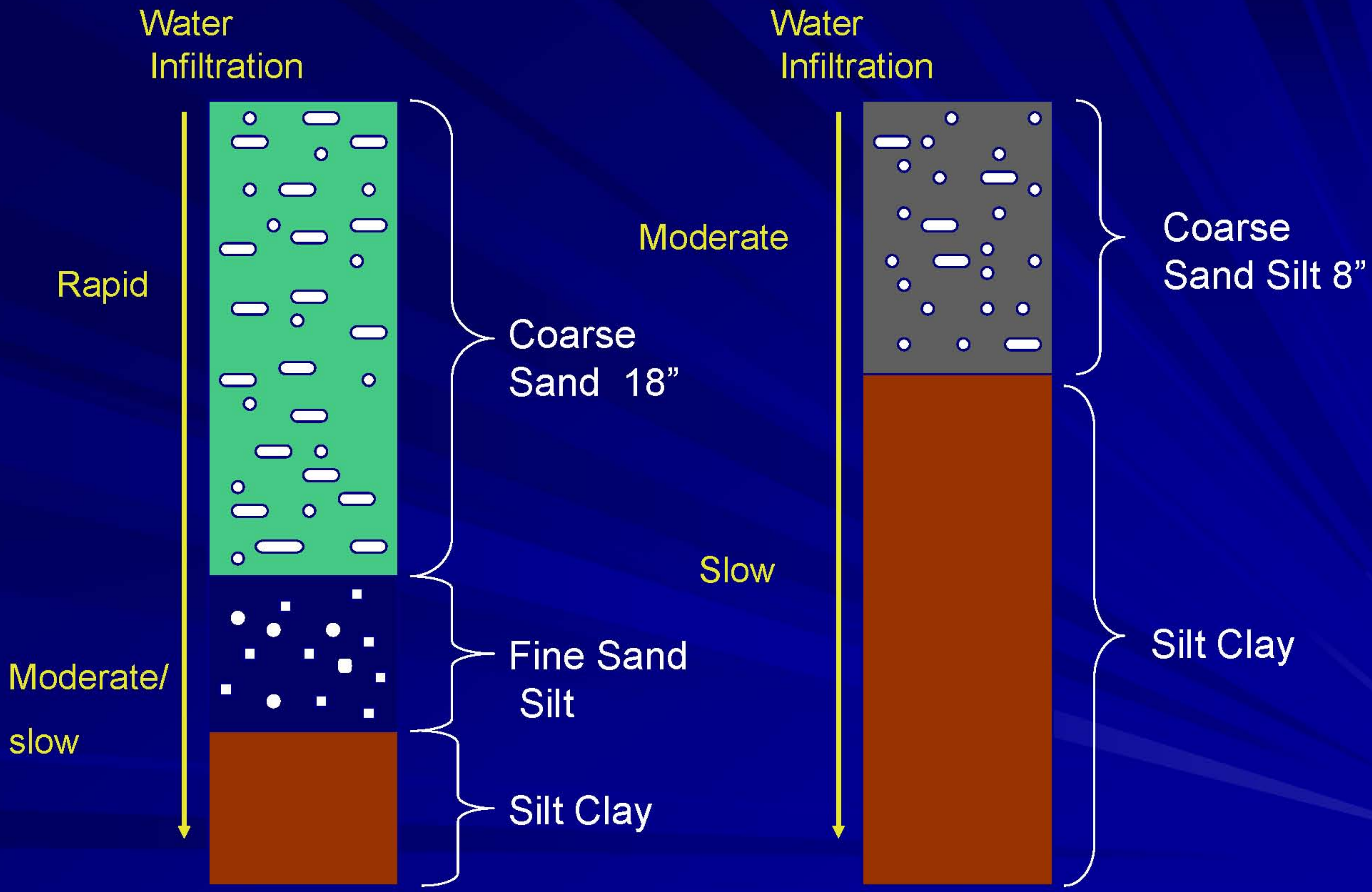
Capillary Fringe
(est. thickness)

Soil	Range in Depth	Avg.
Sands	0-3 in.	2 in.
Silts	0.5 – 5 ft.	<12 in.
Clays	5-10 ft.	<60 in.

Soil Compaction

- Deeper effects in wet soil
- Impedes surface water infiltration/flow
- Restrict root development


NO TRAFFIC
INTERROW
TRAFFIC
SUBSOILED
PLOWPAN



Water
Infiltration
Rapid
Moderate/
slow
Coarse
Sand 18”
Fine Sand
Silt
Silt Clay
Water
Infiltration
Moderate
Slow
Coarse
Sand Silt 8”
Silt Clay

WHAT ARE ARID LANDS

- ET MUCH GREATER THAN PRECIPITATION
- MAJOR PRECIPITATION EVENTS OCCUR ERRATICALLY
- PLANTS COMMONLY HAVE ADAPTATIONS TO CONSERVE WATER
- PRECIPITATION LOW AND OFTEN HIGHLY VARIABLE

ARID VS HUMID REGIONS

- WEST OF THE 100TH MERIDIAN
- SIGNIFICANT AREAS HAVE MARINE SEDIMENTS
- RAINFALL IS LIMITED BUT ET IS HIGH
- THE HIGHEST SEASONAL ET RATES OFTEN MATCH THE TIME OF GREATEST PRECIPITATION

ORIGIN OF SALTS

- WEATHERING OF PRIMARY MINERALS
- SALTS NOT SUFFICIENT AT SITE OF WEATHERING TO FORM A SALINE SOIL
- SALINE SOILS RECEIVE SALT FROM OTHER AREAS AND WATER IS THE PRIMARY CARRIER

IMPORTANCE OF SETTING

- OPEN SYSTEM
  - DRAINAGE DEVELOPED
  - SALTS MOVE THROUGH SYSTEM
- CLOSED SYSTEM
  - DRAINAGE POORLY DEVELOPED
  - SALTS CONCENTRATE IN SYSTEM

PRIMARY WATER INPUTS OFTEN ARE FROM OFF SITE

- SURFACE WATER
  - OFTEN FROM SPRING SNOW MELT
  - FROM LARGE ERRATIC PRECIPITATION EVENTS
- GROUND WATER
  - DIRECT DISCHARGE FROM AQUIFIERS
  - CAPILLARY FRINGE
  - SUBSURFACE RIVER CONNECTIONS

SOIL (IN SETTINGS WITH MARINE SEDIMENTS) CONDITION WHERE WATER IS LIMITED

- EXCESSIVE CONCENTRATIONS OF SOLUBLE SALTS OR EXCHANGEABLE SODIUM OR BOTH
- COMPROMISE VASCULAR PLANT GROWTH

SOILS IN ARID ENVIRONMENTS

- SALINE
  – ENOUGH SOLUBLE SALTS TO IMPAIR PRODUCTIVITY
- ALKALI
  – INFLUENCE ON EXCHANAGEABLE SODIUM
- SALINE-ALKALI
  – BOTH SOLUBLE SALTS AND EXCHANGEABLE SODIUM

PRIMARY SOLUBLE SOIL SALTS

- CATIONS
  - SODIUM
  - CALCIUM
  - MAGNESIUM
- ANIONS
  - CHLORIDE
  - SULFATE

MINOR SOLUBLE SOILS SALTS

- CATIONS
  – POTASSIUM
- ANIONS
  – BICARBIONATE
  – CARBONATE
  – NITRATE

FACTORS AFFECTING SALT CONTENT

- SOIL TEXTURE
- DISTRIBUTION OF SALT IN THE PROFILE
- COMPOSTION OF THE SALT
- SPECIES OF PLANT

SOIL DETERMINES

- PLANT COMMUNITY COMPOSITION
- PLANT STRUCTURE
  - LITTER FOR INVERTEBRATES
  - STRUCTURE FOR INVERTEBRATES
- FOOD PRODUCTION

WETLAND PLANTS

- TOLERANT OF SATURATED SOIL CONDITIONS -- GERMINATE AND/OR GROW WITH SOIL PORE SPACES FILLED WITH WATER
- ANNUALS PRODUCE ABUNDANT SEEDS
- PERENNIALS PRODUCE UNDERGROUND RESOURCES
- PROVIDE STRUCTURE FOR INVERTEBRATES AND VERTEBRATES

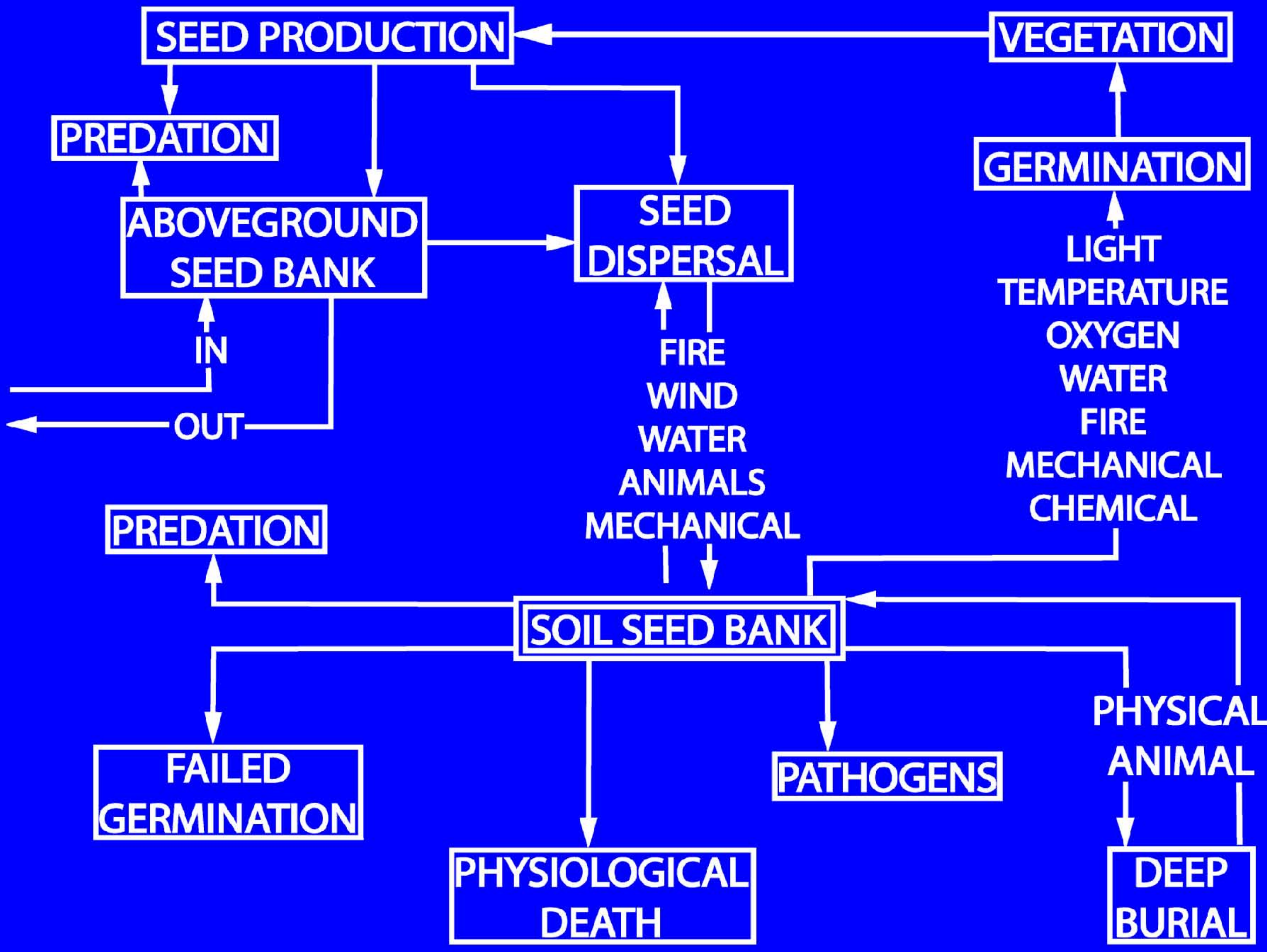
WETLAND PLANT ENERGETICS

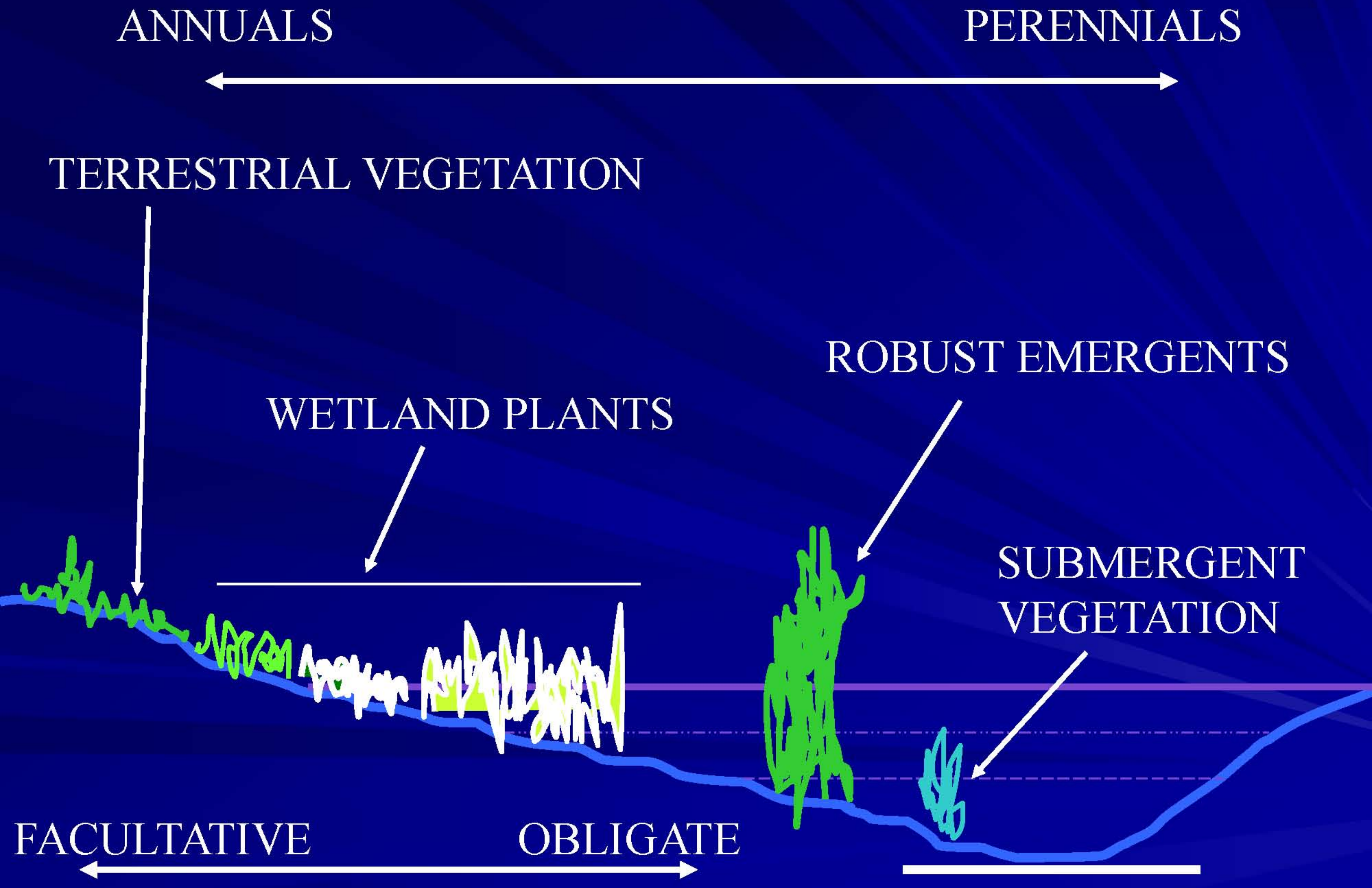
- How do they acquire oxygen?
- Where do they store energy?
- How do they store energy?
- What nutrients control their productivity?
- Are they inhibited by any natural occurring or man induced chemical conditions?

ALLEOPATHY

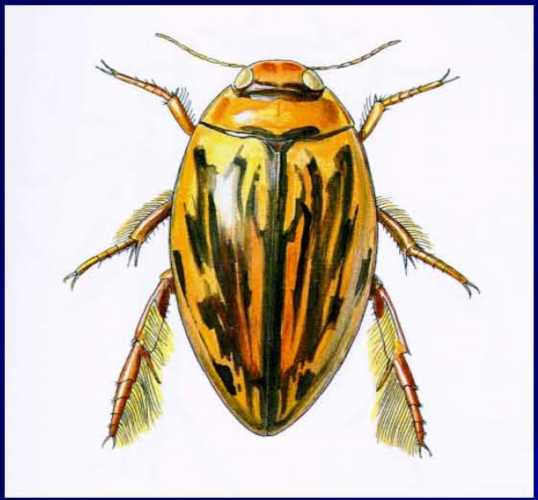
CATTAIL CHARACTERISTICS

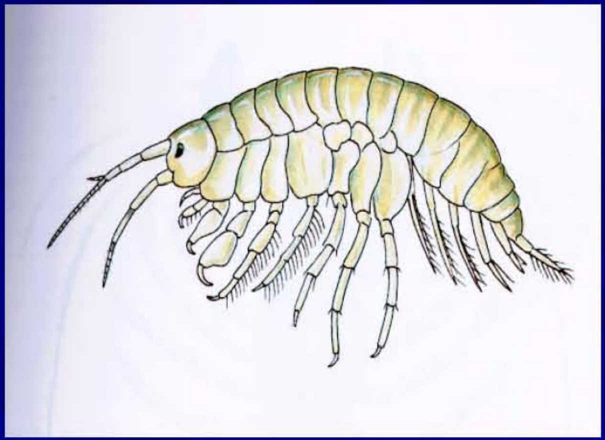
- PERENNIAL MONOCOT
- LARGE BELOW GROUND BIOMASS
- 3 COMMONLY RECOGNIZED SPECIES AND HYBRIDS
- EACH SPECIES HAS DIFFERENT CHARACTERISTICS
- CREATE OWN HABITAT
- IN SATURATED OR FLOODED SOILS
- AEROBIC AND ANAEROBIC RESPIRATION
- ALLEOPATHIC
- DO WELL WITH HIGH NUTRIENTS

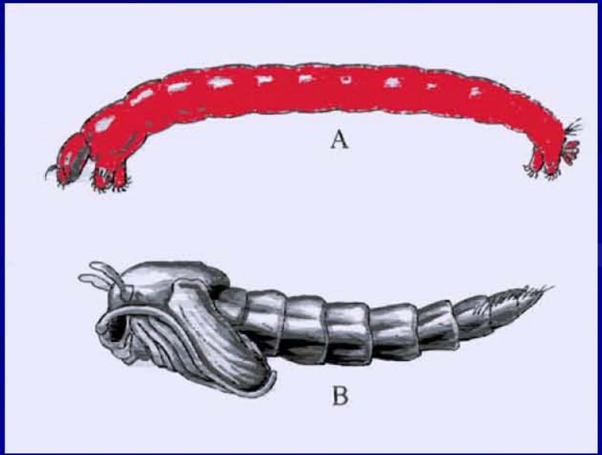

SEED PRODUCTION
VEGETATION
PREDATION
GERMINATION
ABOVEGROUND SEED BANK
SEED DISPERSAL
LIGHT
TEMPERATURE
OXYGEN
WATER
FIRE
MECHANICAL
CHEMICAL
IN
OUT
FIRE
WIND
WATER
ANIMALS
MECHANICAL
PREDATION
SOIL SEED BANK
PHYSICAL
ANIMAL
FAILED GERMINATION
PATHOGENS
PHYSIOLOGICAL DEATH
DEEP BURIAL


ANNUALS
PERENNIALS
TERRESTRIAL VEGETATION
ROBUST EMERGENTS
WETLAND PLANTS
SUBMERGENT VEGETATION
FACULTATIVE
OBLIGATE

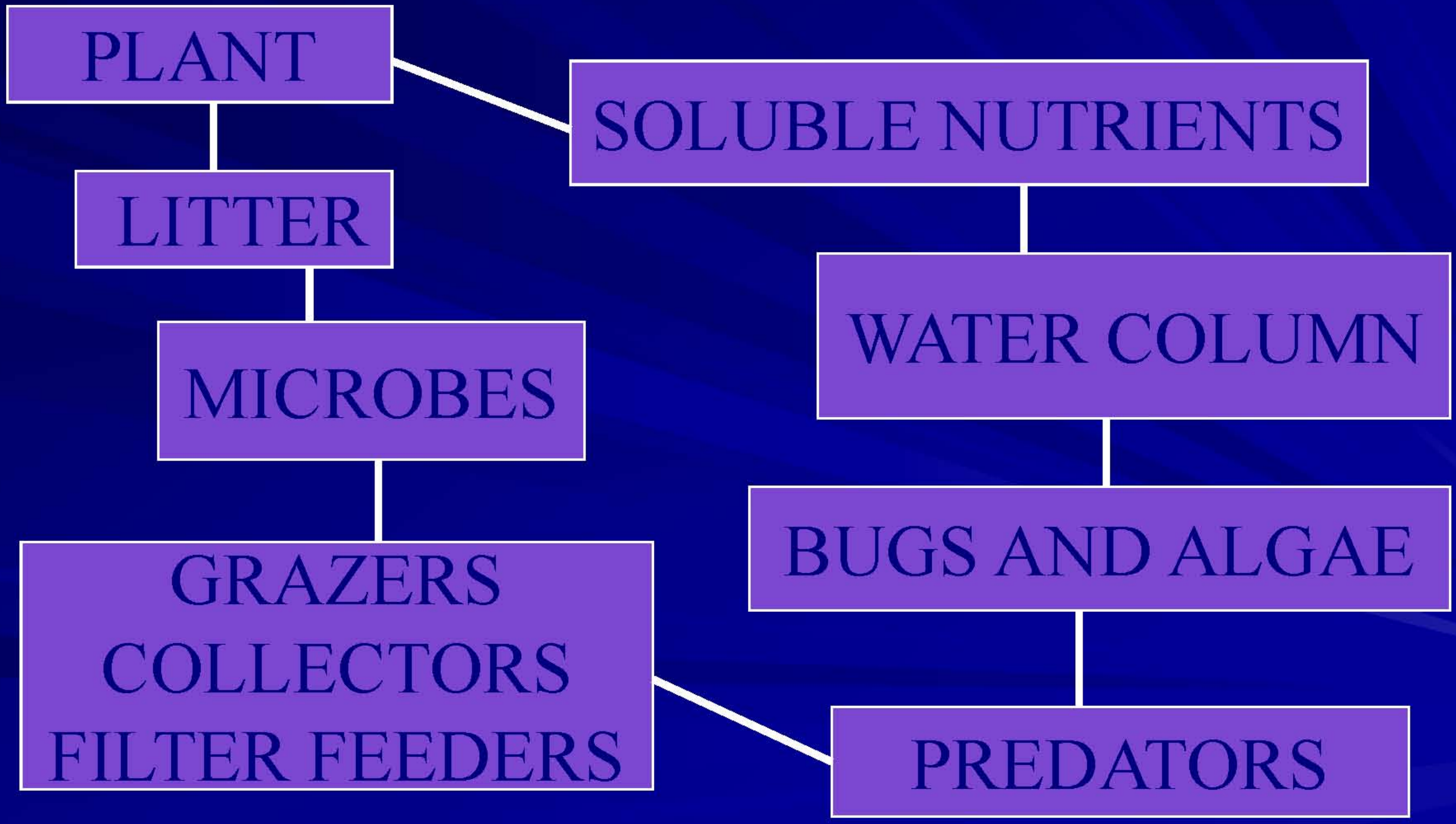
WETLAND INVEREBRATES







DECOMPOSITION AND BUGS



DECOMPOSING LITTER

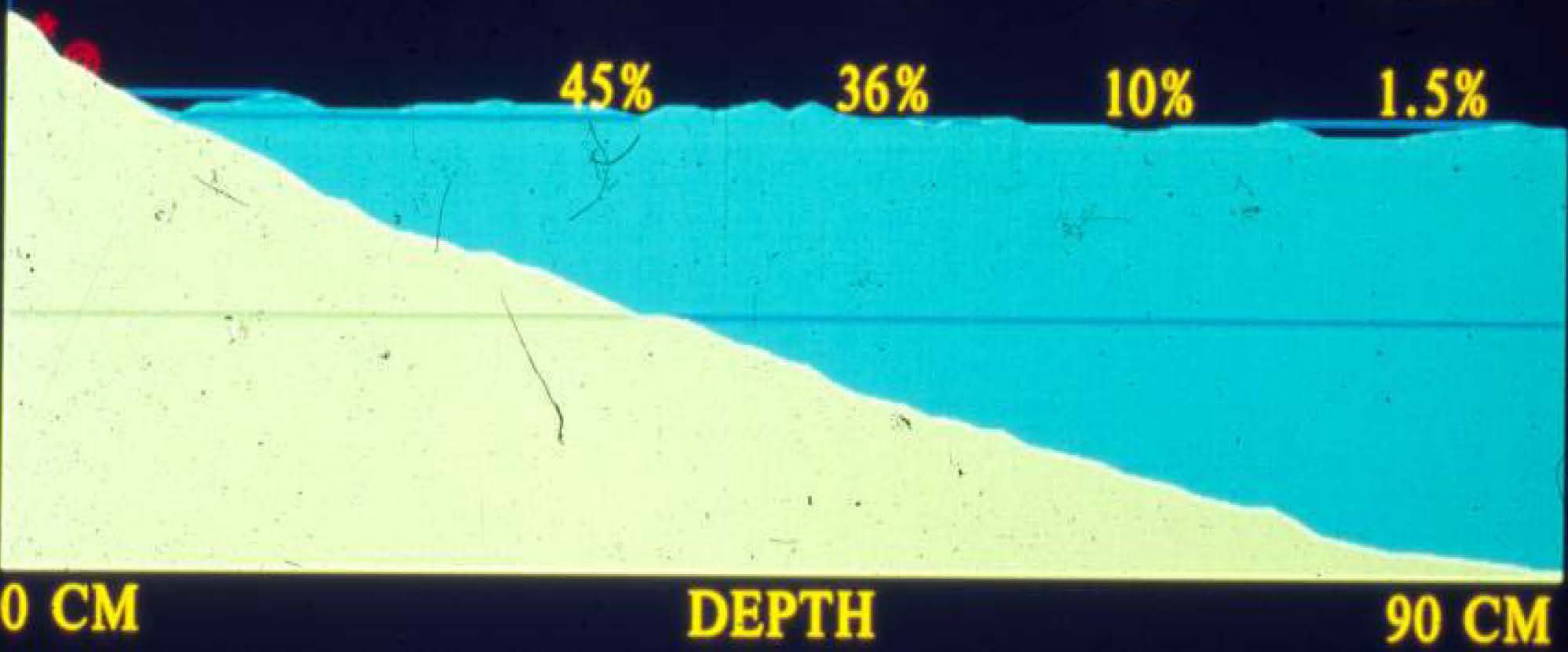
CHEYENNE BOTTOMS

- 15,000 ACRE MARSH
- CATTAIL DOMINATED MARSH
- 92 TONS DRY WEIGHT CATTAIL
- CHRONIMIDS DOMINATE IN OPEN MUD
- CHRONIMIDS DEVELOP OVER WINTER
- MANY OTHER SPECIES OF INVERTEBRATES

CHRONIMIDS ON CHEYENNE BOTTOMS
TONS DRY WEIGHT

NOV	MAR	APR	MAY	JUN
81	68	45	19	107

DEPTH (CM)	1-25	26-50	51-90	>90
OLIGICHAETE	16%	14%	5%	0.6%
CHIRONOMID	15%	12%	2%	0.4%
PELECYPOD	3%	7%	2%	0.4%
ISOPOD	6%	2%	1%	<0.2%
AMPHIPOD	2%	1%	<1%	<0.2%
PHYSID	3%	<1%	<1%	<0.2%
	45%	36%	10%	1.5%



ABIOTIC CONDITIONS IN COMBINATION WITH STRUCTURE AND FOOD DETERMINES

- COMPOSITION OF VERTEBRATE COMMUNITIES
- ABUNDANCE OF VERTEBRATE COMMUNITIES
- DISTRIBUTION OF VERTEBRATE COMMUNITIES

IMPORTANCE OF SINGLE WETLAND SITE FOR VERTEBRATES

- PACIFIC BLACK BRANT

IZEMBEK LAGOON

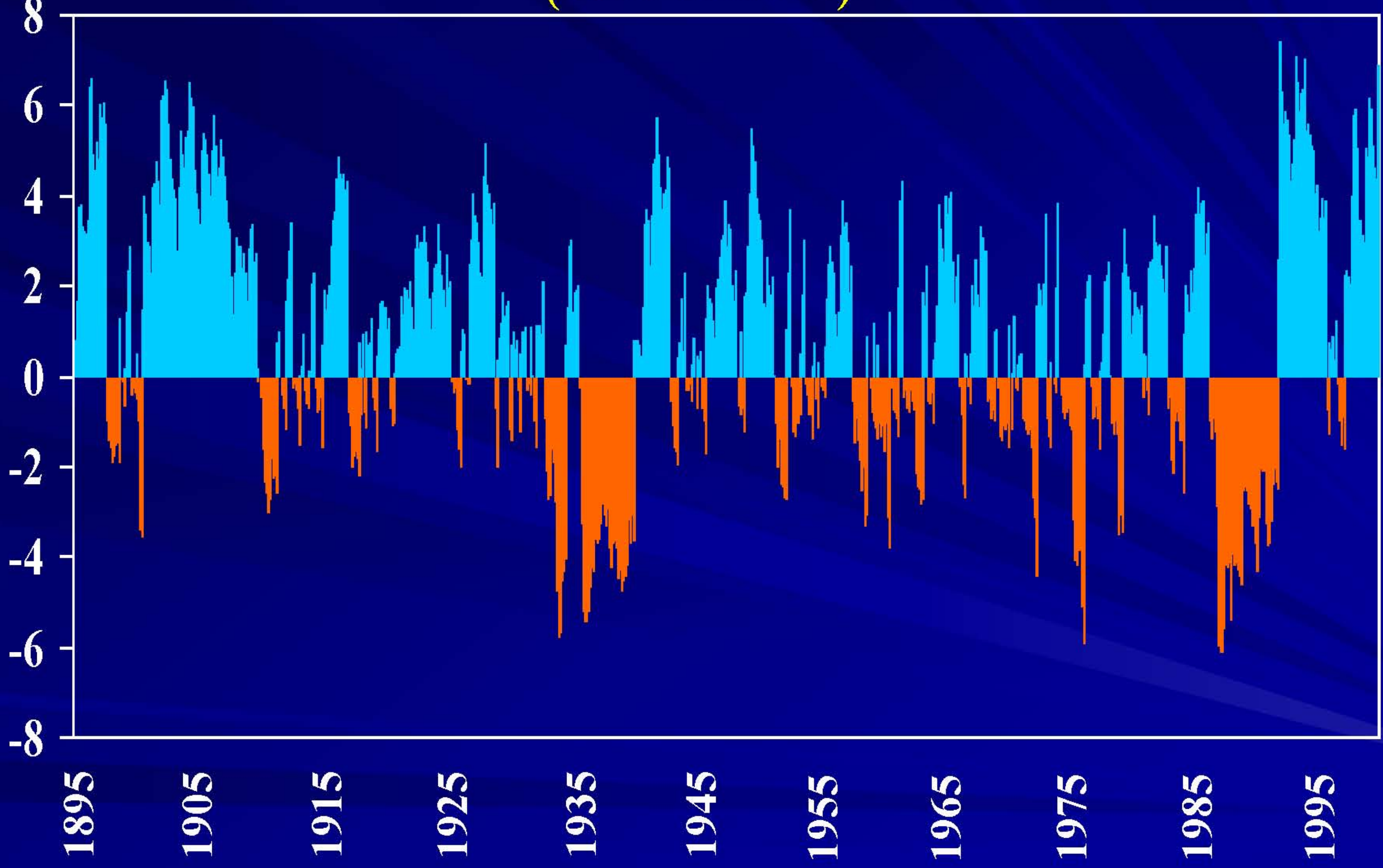
TESHEKPUK
LAKE
ICY
CAPE
IZEMBEK
LAGOON
3000 miles
SAN QUINTIN

PACIFIC BLACK BRANT

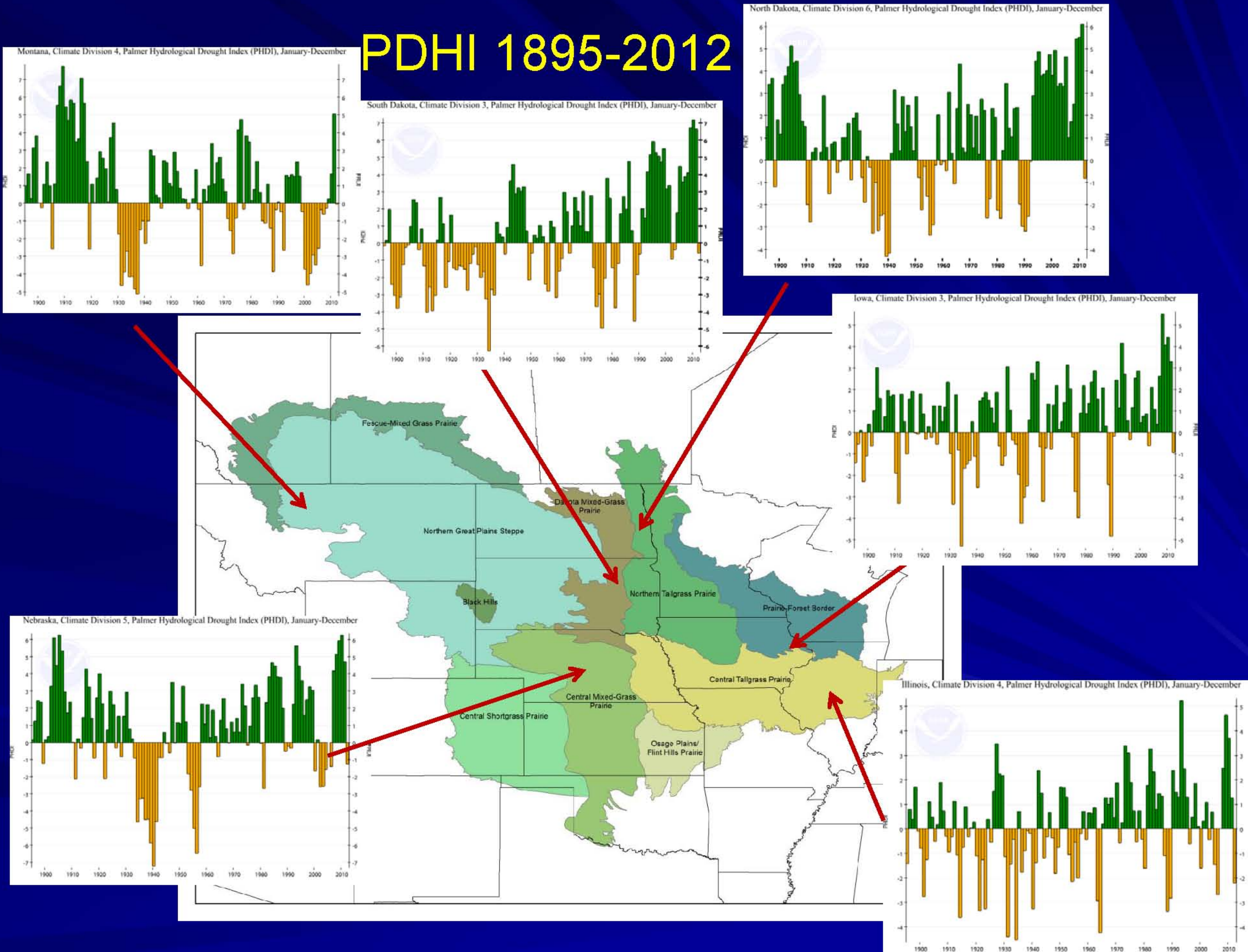
LOCATION	STATUS	DATE	WEIGHT (G)
TESHEKPUK LAKE	MOLT	JUL-AUG	1200-1400
ICY CAPE	MIGRATION	AUG-SEP	1200-1400
IZEMBEK LAGOON	ARRIVAL	SEP	1200-1400
	FALL STAGING	NOV	2100-2200
SAN QUINTIN	ARRIVAL	NOV	1200-1400
	SPRING DEPARTURE	FEB	2100-2200

WETLAND CYCLES

Palmer Drought Severity Index, Division 5, ND (1895 to 2001)

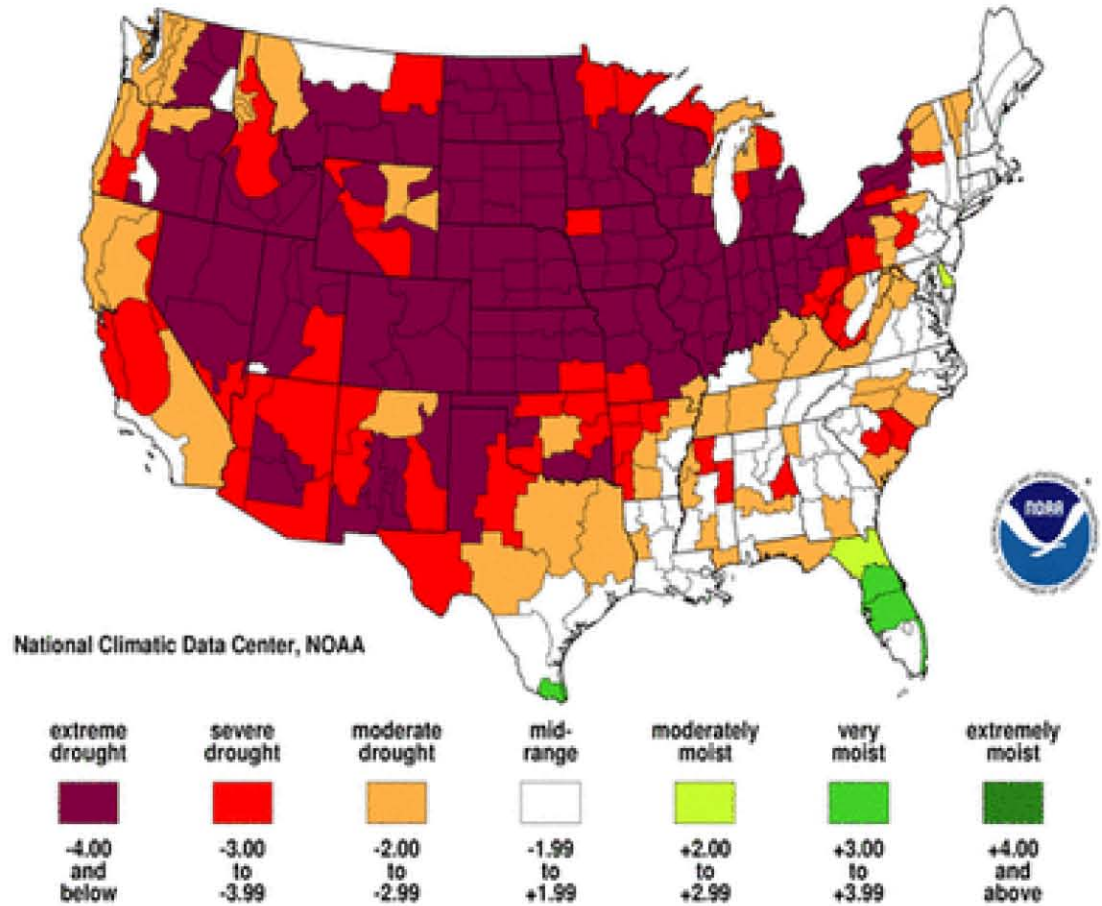


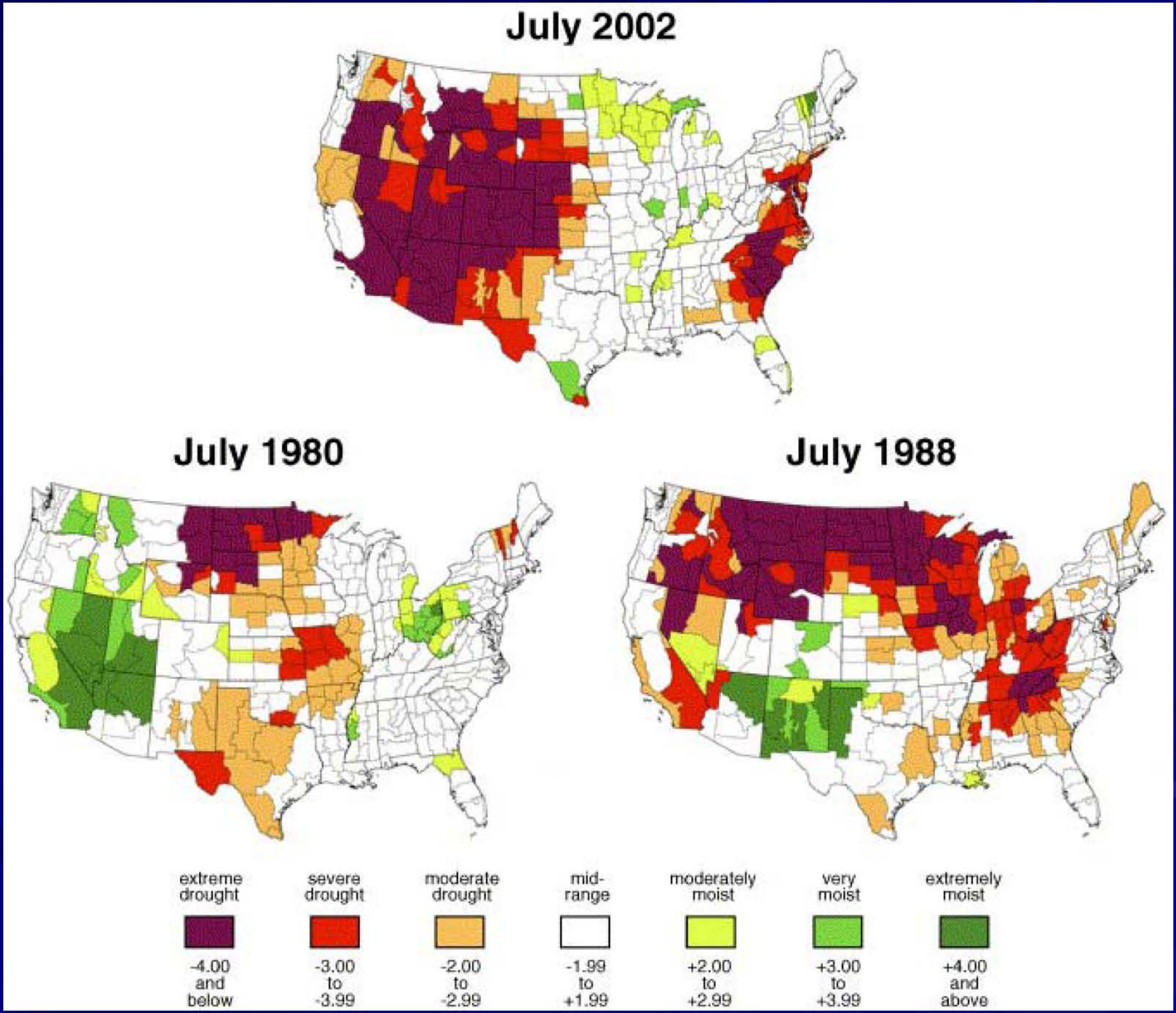
PDHI 1895-2012

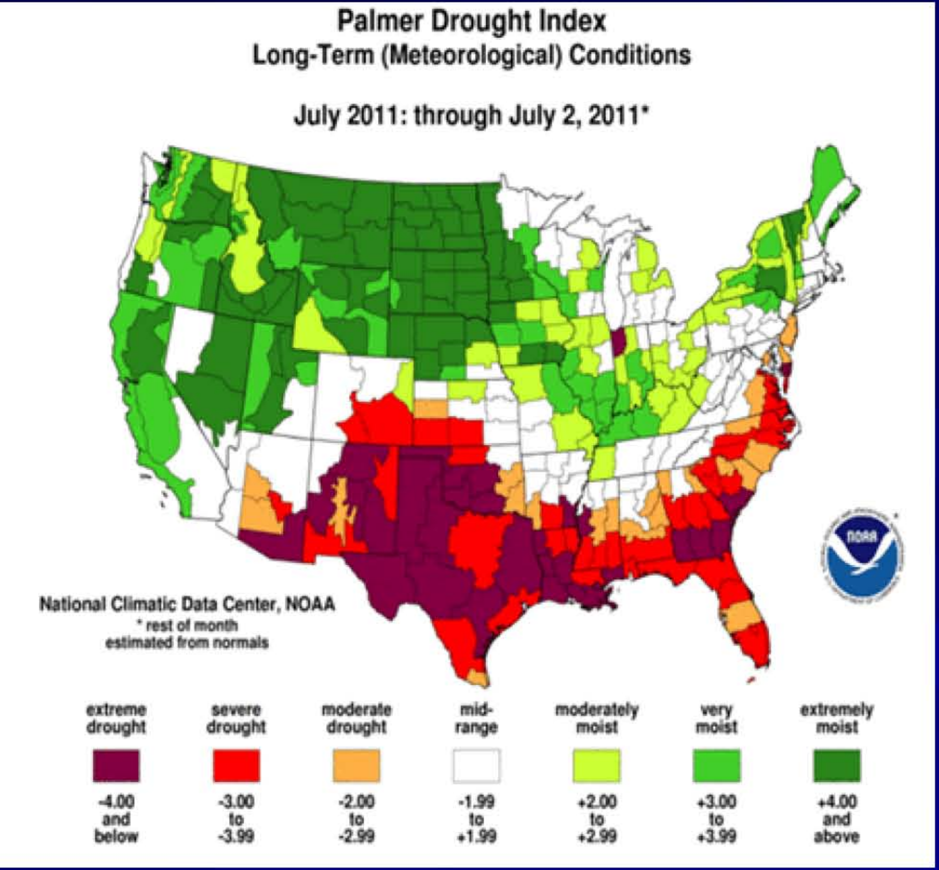


Palmer Hydrological Drought Index
Long-Term (Hydrological) Conditions

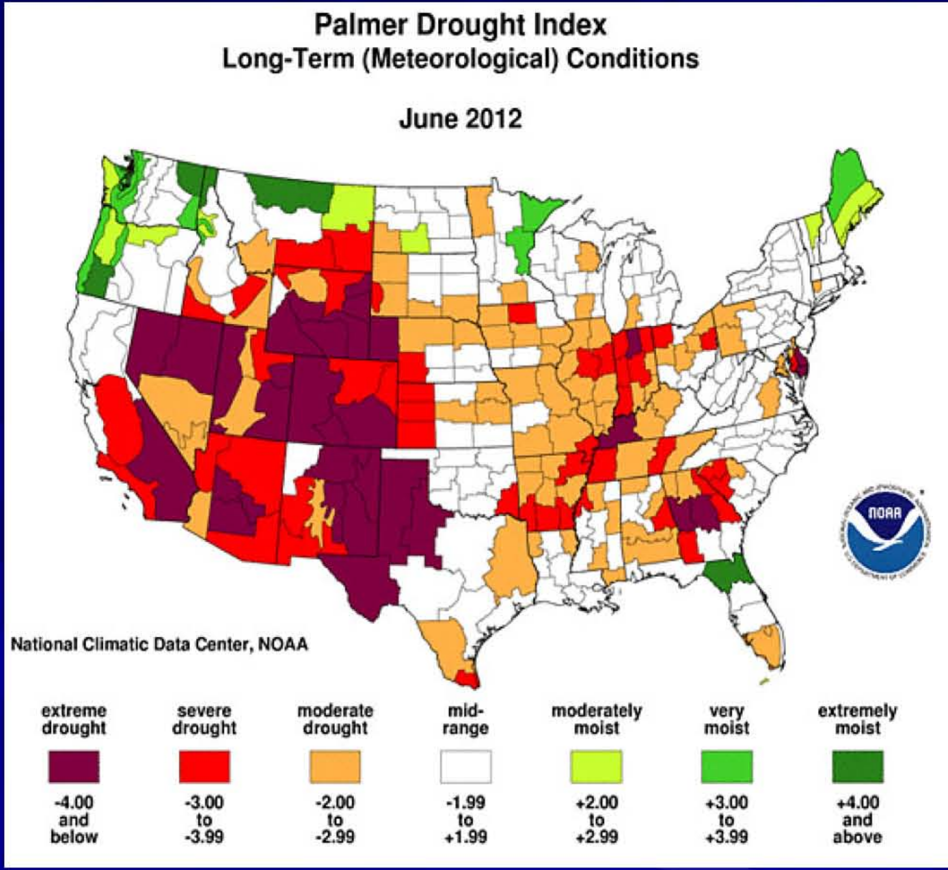
July 1934




July 2002
July 1980
July 1988
extreme drought
-4.00 and below
severe drought
-3.00 to -3.99
moderate drought
-2.00 to -2.99
mid-range
-1.99 to +1.99
moderately moist
+2.00 to +2.99
very moist
+3.00 to +3.99
extremely moist
+4.00 and above

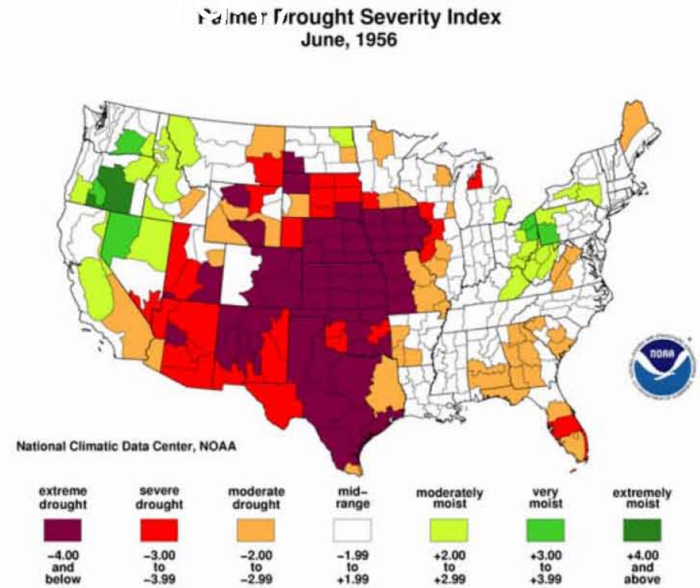


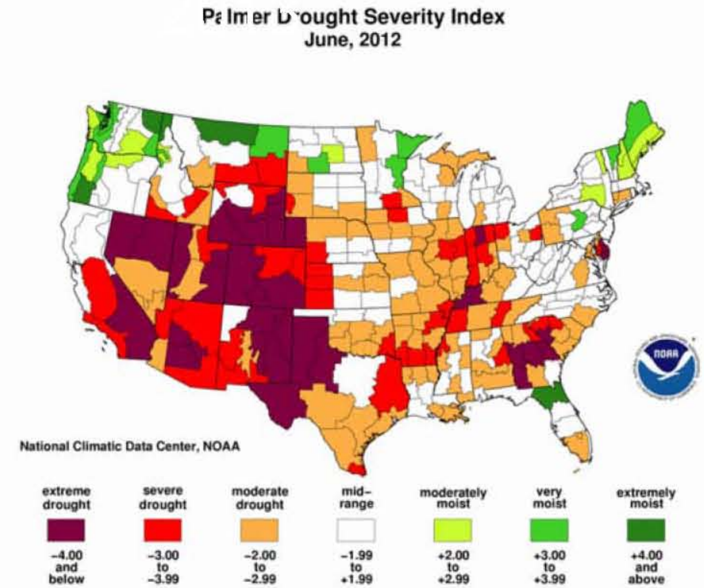
Palmer Drought Index
Long-Term (Meteorological) Conditions
July 2011: through July 2, 2011*
National Climatic Data Center, NOAA
* rest of month estimated from normals
extreme drought
severe drought
moderate drought
mid-range
moderately moist
very moist
extremely moist
-4.00 and below
-3.00 to -3.99
-2.00 to -2.99
-1.99 to +1.99
+2.00 to +2.99
+3.00 to +3.99
+4.00 and above

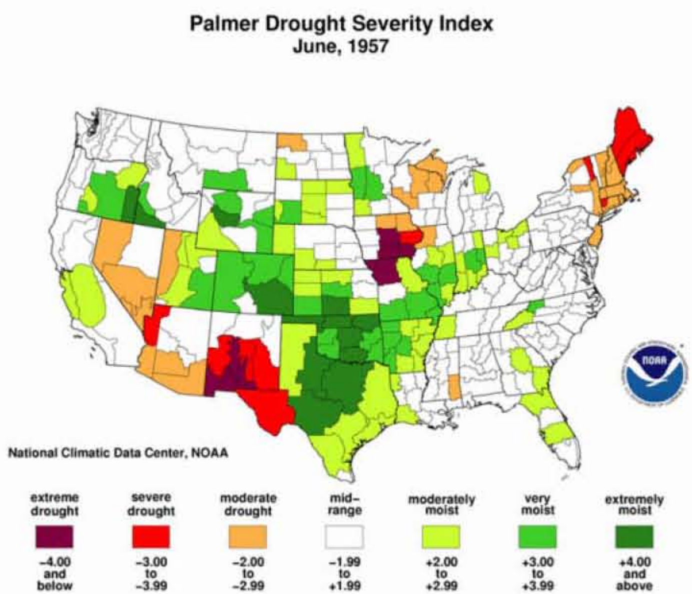


Palmer Drought Index
Long-Term (Meteorological) Conditions
June 2012
National Climatic Data Center, NOAA
extreme drought
severe drought
moderate drought
mid-range
moderately moist
very moist
extremely moist
-4.00 and below
-3.00 to -3.99
-2.00 to -2.99
-1.99 to +1.99
+2.00 to +2.99
+3.00 to +3.99
+4.00 and above

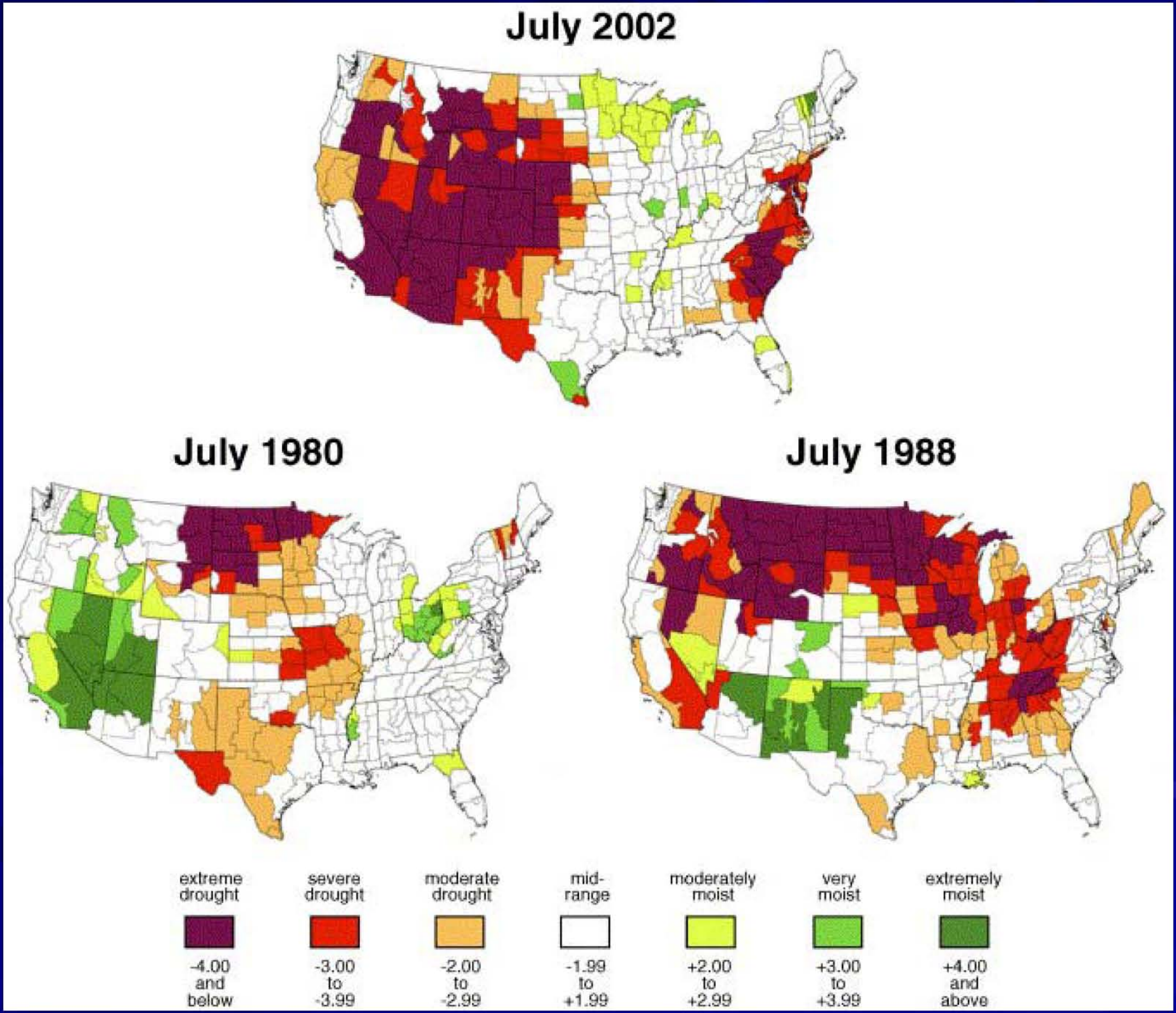
June 1956 & June 2012 &

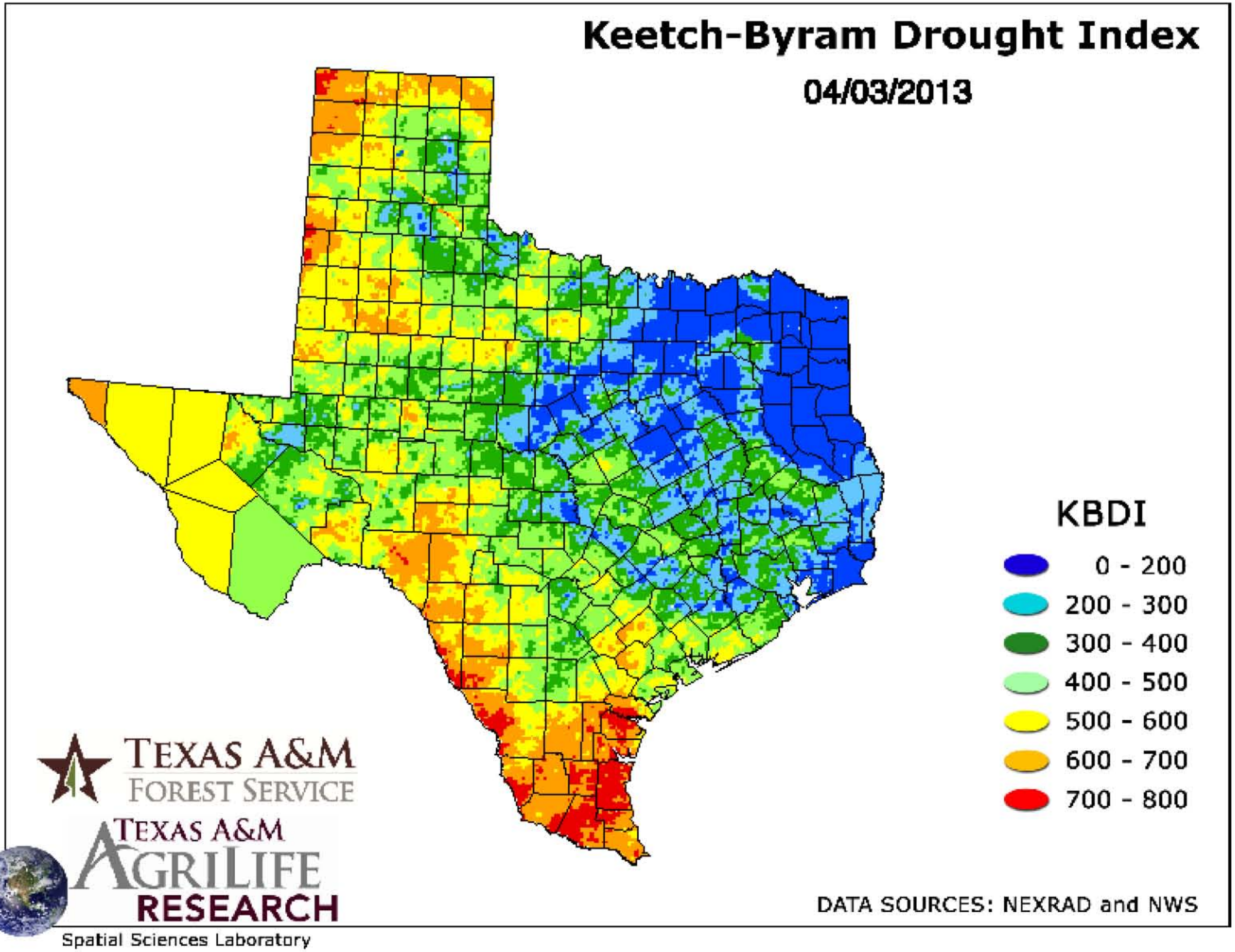


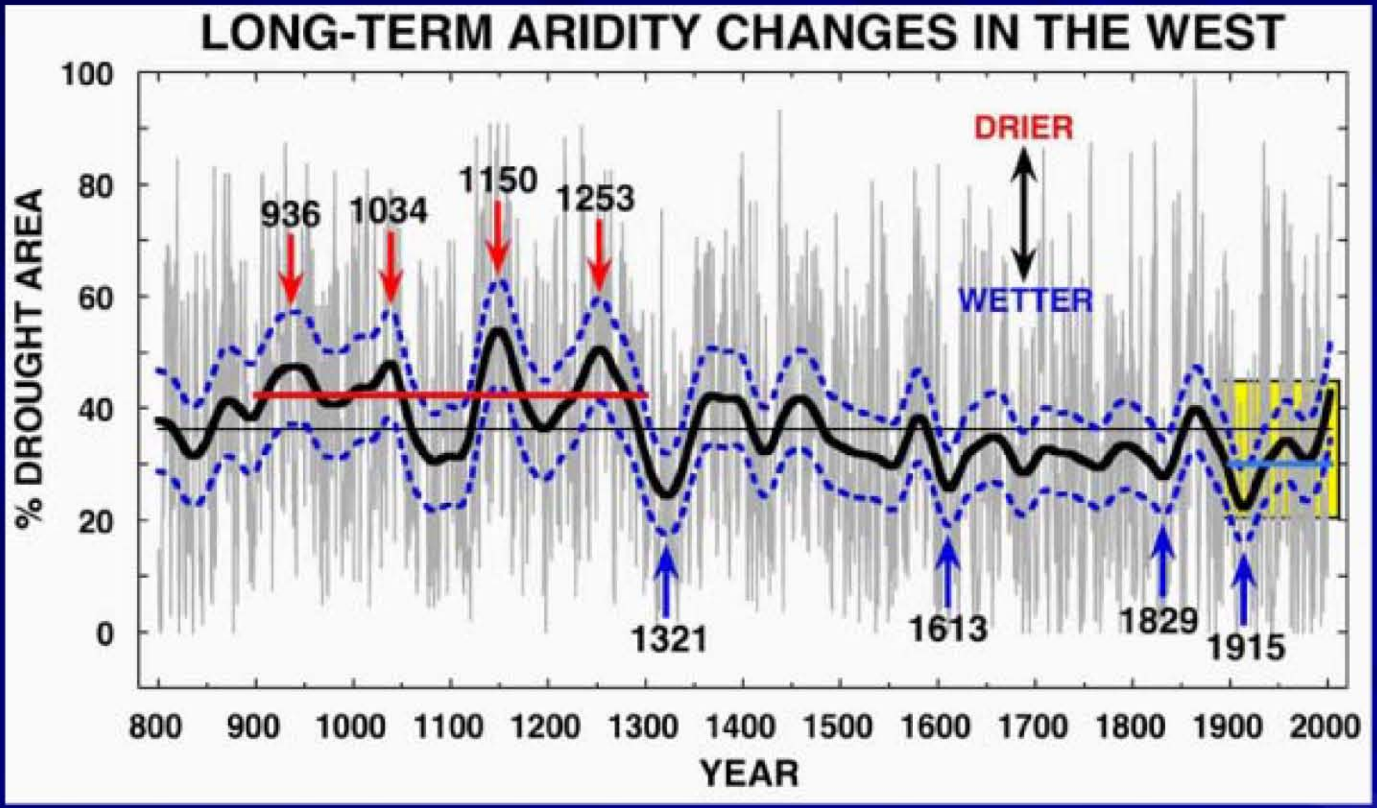




JUNE 2013

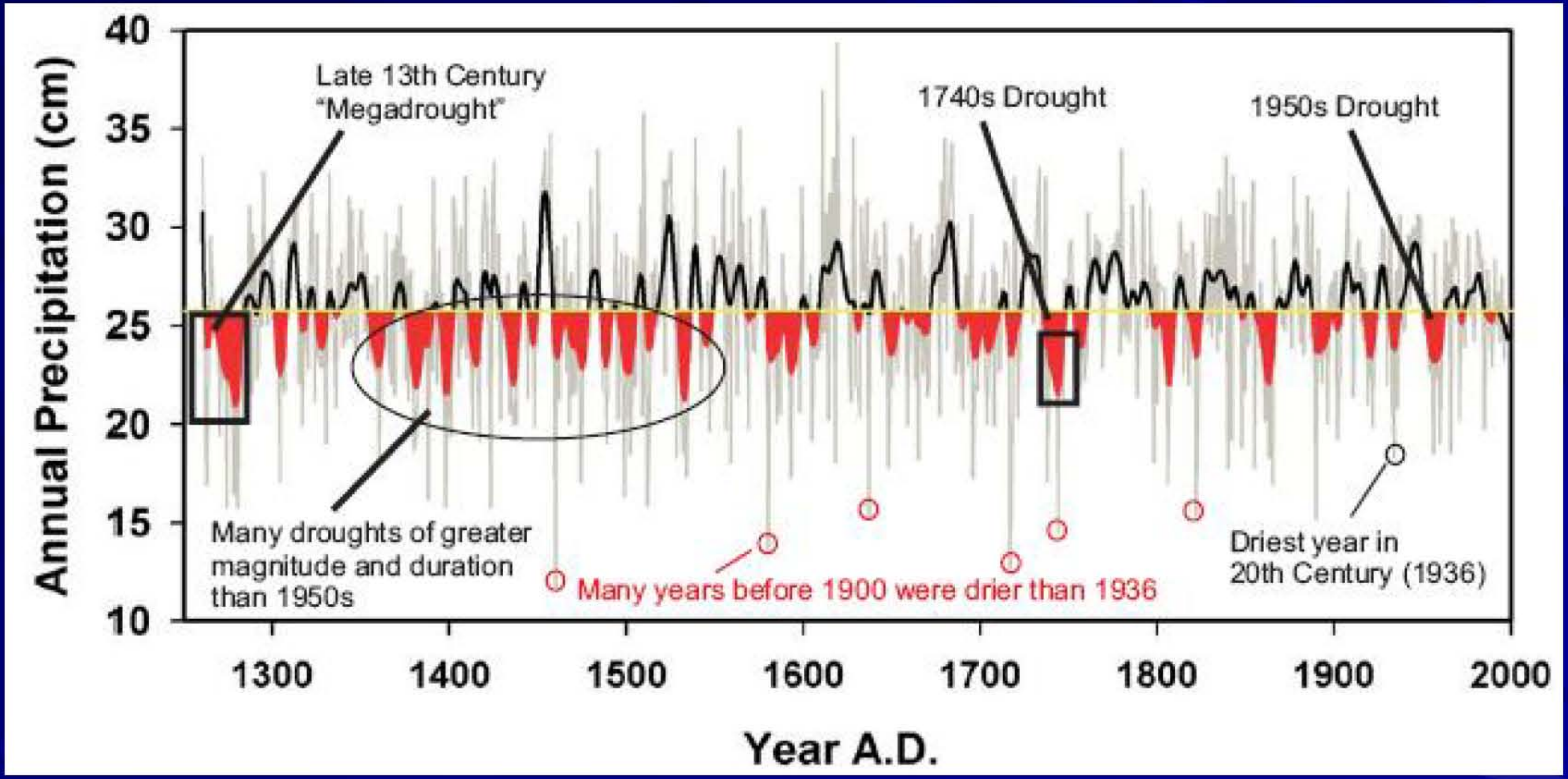

July 2002
July 1980
July 1988
extreme drought
-4.00 and below
severe drought
-3.00 to -3.99
moderate drought
-2.00 to -2.99
mid-range
-1.99 to +1.99
moderately moist
+2.00 to +2.99
very moist
+3.00 to +3.99
extremely moist
+4.00 and above


Keetch-Byram Drought Index
04/03/2013
KBDI
0 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
700 - 800
TEXAS A&M FOREST SERVICE
TEXAS A&M AGRILIFE RESEARCH
Spatial Sciences Laboratory
DATA SOURCES: NEXRAD and NWS



Cook et al. 2004

Comparison of 20th Century droughts to "Paleo-droughts" Bighorn Basin, WY (east of Yellowstone National Park)



Curtis and Grimes – Wyoming Climate Atlas

MARSH STAGES

LAKE MARSH

NARROW BAND OF EMERGENT VEG
LOW RICHNESS AND ABUNDANCE

OPEN MARSH

MORE OPENINGS AND LARGER
LOWER RICHNESS AND NUMBERS

DRY MARSH

BARE MINERAL SOIL
DEEP CRACKS
MANY ANNUALS
TEMPERATURE AND MOISTURE DETERMINE SPECIES COMPOSITION
LOWER STEM DENSITY OF PERENNIALS

DENSE MARSH

SOME DEGREE OF FLOODING
HIGHER STEM DENSITY OF PERENNIALS
MARSH SPECIES RETURNING
MUSKRATS RETURN

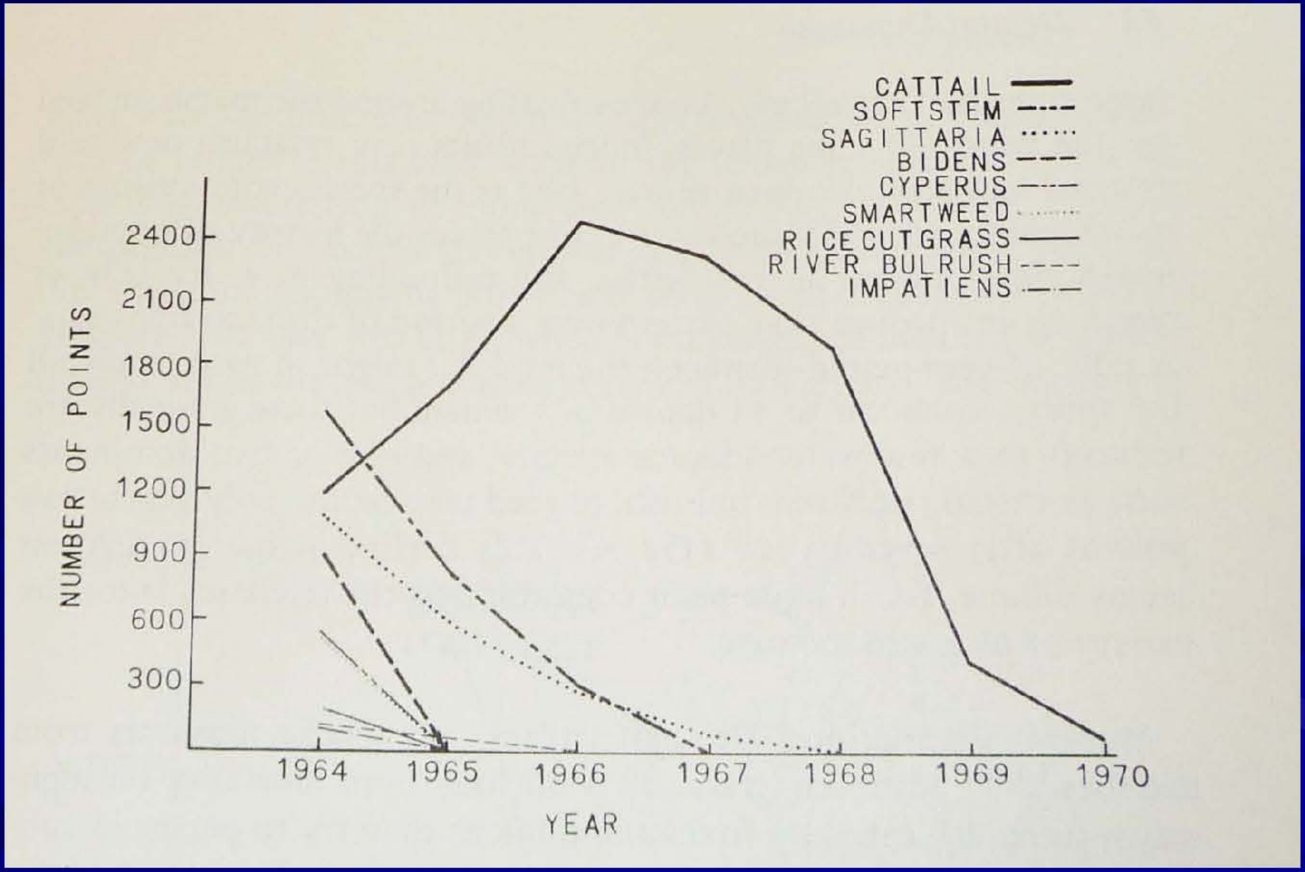
HEMI-MARSH

HIGHEST RICHNESS AND ABUNDANCE
IDEAL COVER/WATER INTERSPERSION
MUSKRATS PEAKING

AGASSIZ NATIONAL WILDLIFE REFUGE

DEWEY'S PASTURE, NW IOWA

TOLERANCE TO FLOODING

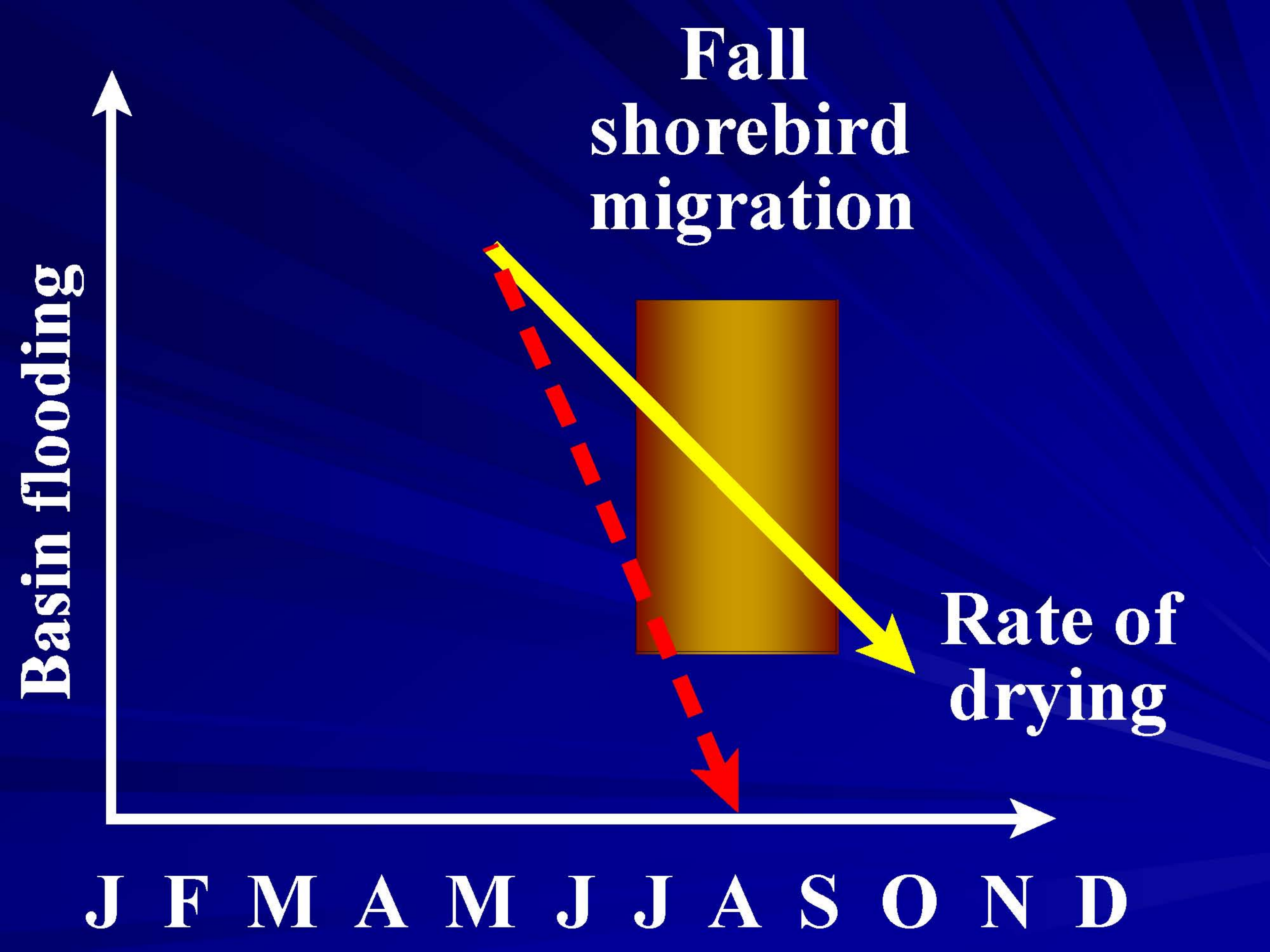


Weller 1987

A CHANGING LANDSCAPE

WHAT DOES IT MEAN FOR WETLAND DEPENDENT SPECIES?

Matching biological events with processes



Fall shorebird migration
Basin flooding
Rate of drying
J F M A M J J A S O N D

OTHER FACTORS INFLUENCING MANAGEMENT SUCCESS

- EXOTICS
- INVASIVE SPECIES
- DISEASES
- DISTURBANCE
- GLOBAL WARMING

TAKE HOME LESSONS

KNOW YOUR SITE

ESTABLISH GOOD OBJECTIVES

MONITOR YOUR RESULTS TO TEST YOUR OBJECTIVES

REMEMBER THAT WETLANDS ARE DYNAMIC

SHALLOW WATER IS BEST

THINK BEYOND ONE SEASON