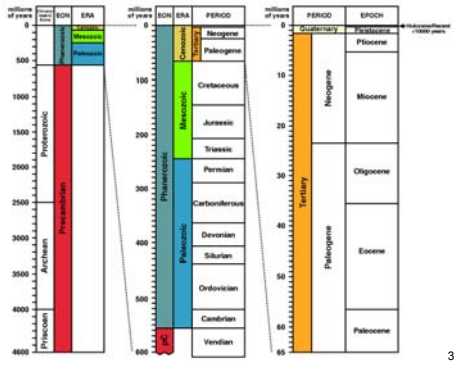
Setting the Stage

Climate, geology and vegetation patterns in Wyoming

Review

- Vegetation ecology has its roots in phytogeography:
  - Observation and description of PATTERNS of plant species distributions over elevation and climatic gradients.
- Today the emphasis has shifted to PROCESSES driving the patterns, and hypothesis testing to evaluate THEORIES explaining relationships
- Recognition of wide range of spatial and temporal scales, importance of legacies and disturbance

Landscape history of WY



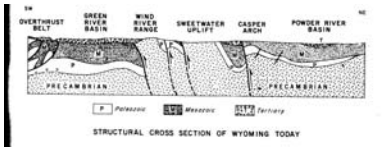
Landscape history of WY

- The cores of our large mountains are made of Precambrian igneous and metamorphic rocks (granite and gneiss)
- Uplift and erosion occurred at the end of the Precambrian, creating a major unconformity
- Starting in the early Paleozoic (Cambrian period), the surface subsided below sea level, and thousands of feet of sedimentary rocks were deposited
- Subsidence and sediment accumulation lasted until the end of the Mesozoic (Cretaceous period)

CROSS SECTION AT CLOSE OF MARINE CRETACEOUS

Landscape history of WY

- A major mountain building event started at the end of the Cretaceous (~60 MYA), called the Laramide orogeny
  - Folding and faulting during the Laramide orogeny left the landscape structurally similar to today's
- Volcanism originating from the Yellowstone area occurred starting in Eocene time (~50 MYA); the last major eruption was 660,000 years ago
  - Uplift has slowed but NW Wyoming is still tectonically and geothermally active

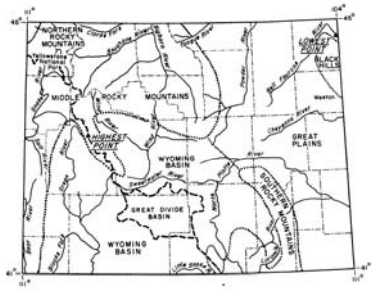


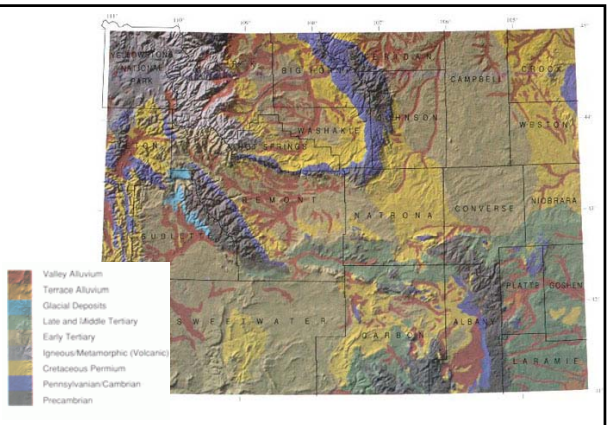
STRUCTURAL CROSS SECTION OF WYOMING TODAY

Landscape history of WY

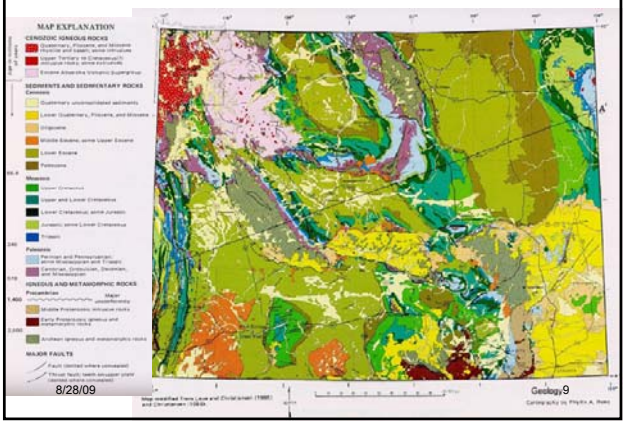
- The Pleistocene brought the ice ages and glaciers to the highest peaks
- Relics of periglacial processes can still be seen in basins (Knight, Fig. 2.8)

Modern day basin floors were deposited by rivers since Pliocene or Pleistocene times

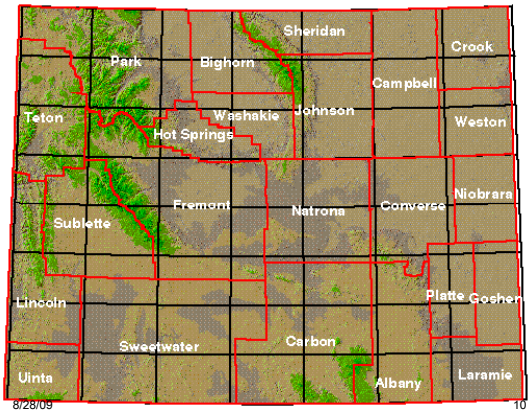




WYOMING GEOLOGY



WYOMING ELEVATION



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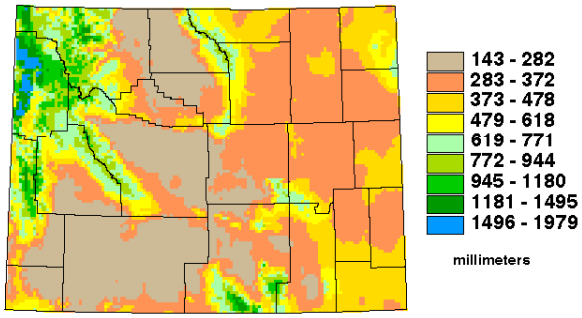
http://www.wygisc.uwyo.edu/atlas/

Wyoming Annual Precipitation Average from 1961-1990



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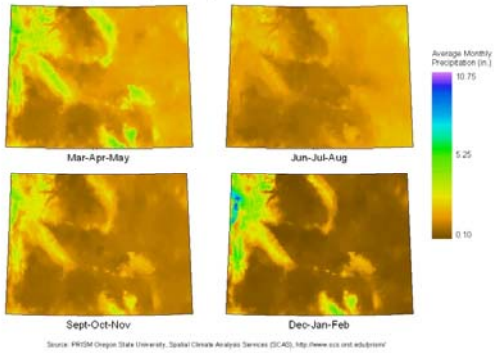
Average Precipitation by Season - 1971-2000



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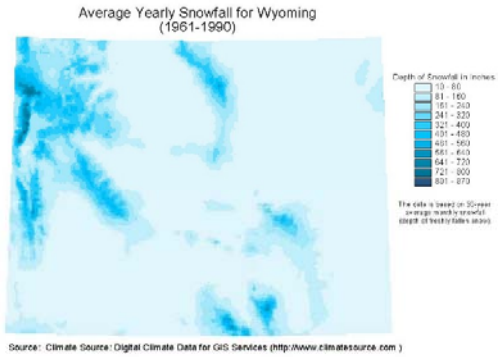
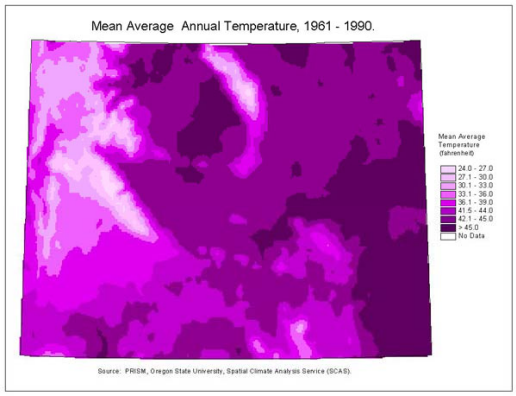
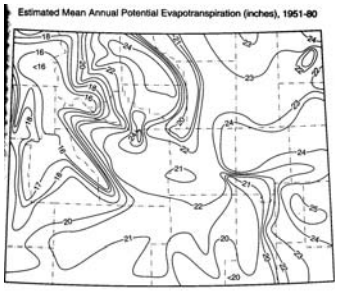


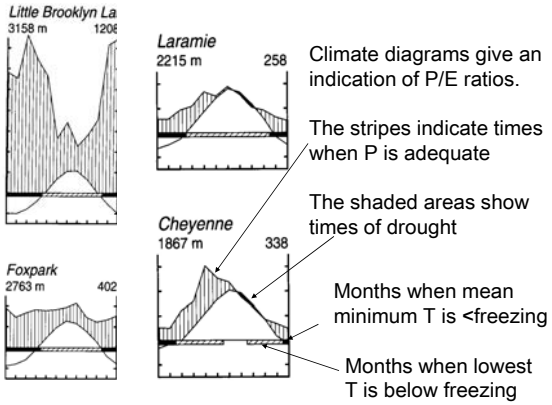


P/E Ratios and Potential Evapotranspiration

- Vegetation responds more to the ratio between precipitation and evaporation (P/E ratio) than to precipitation per se
- Potential evapotranspiration (PET) is determined by temperature, humidity, and solar radiation, assuming unlimited moisture (saturated surface)
- Actual evapotranspiration (AET) is the water actually lost from the surface as limited by moisture availability and plant physiology



PET is highest where it's warmest and sunniest



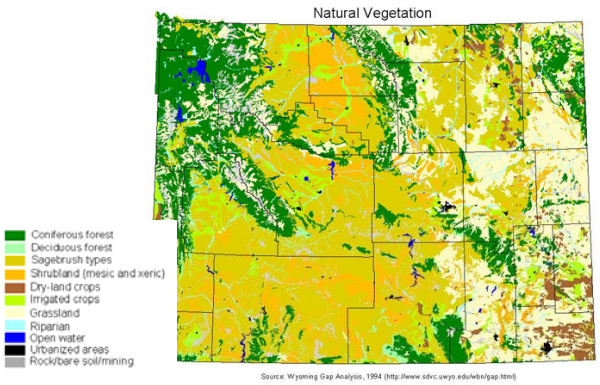
Climate diagrams give an indication of P/E ratios.

The stripes indicate times when P is adequate

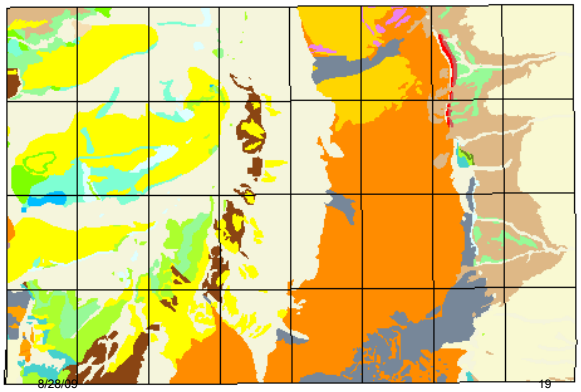
The shaded areas show times of drought

Months when mean minimum T is <freezing

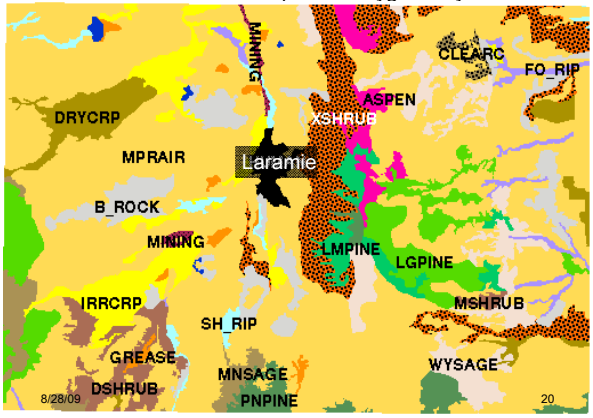
Months when lowest T is below freezing



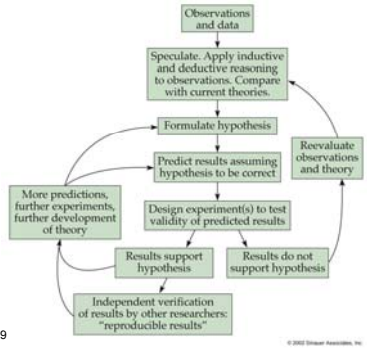
LARAMIE AREA GEOLOGY



LARAMIE LAND COVER http://www.wygisc.uwyo.edu/24k/cov/

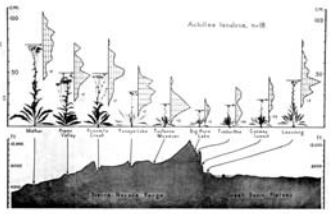


How do we know what controls vegetation dynamics on local, regional and global scales?



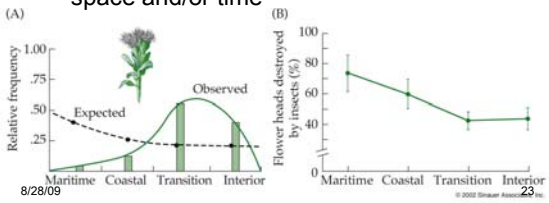
Types of Experiments

1. Manipulative: e.g., transplant gardens
   - Limited because of artifacts (side effects); spatial and temporal scale of experiment; some expts are unethical to carry out
   - Powerful because we can choose what factors to alter, and can eliminate interference of interactions



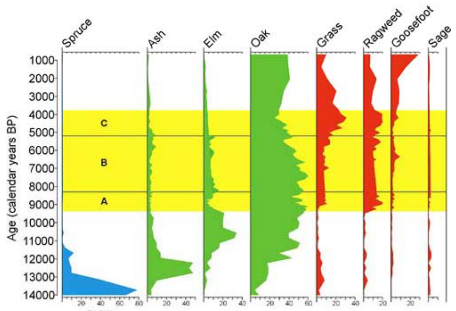
Types of Experiments (con't)

2. Observational: patterns occurring over gradients are explained by systematic data collection
   - Limited by multiple interacting factors; hard to ascribe cause-effect relationships
   - Powerful especially when replicated in space and/or time



Paleoecology demonstrates ecological legacies and climate-vegetation interactions

Chatsworth Bog, Illinois



http://www.museum.state.il.us/exhibits/midewin/pollendiag.html

Types of Experiments (con't)

3. Natural experiments are "manipulations" caused by a natural occurrence (e.g., fire)
   - Limited because we can't know if altered and unaltered areas were the same prior to event; possibility of interactions with other factors
   - Important to attempt to understand ecological consequences of disturbances; often can't be pursued experimentally