Introduction to Ecology, Biodiversity, Adaptation and the Environment

Plant Ecology in a Changing World
Jim Ehleringer, University of Utah
http://planteology.net
“Plant Ecology in a Changing World” encompasses

**Traditional topics**
- Physiological ecology
- Functional and evolutionary ecology
- Ecology of regional landscapes

**Topics central to humankind and our future**
- Ecology of urban landscape
- Appreciation of the many global changes
- Understanding man’s impacts on landscapes
- A solutions approach to sustainability
Everything is on the web and in Canvas!

- All lectures
- Old exams (including answers)
- All assignments - already spelled out
- No printed handouts . . . yeah, go electronic

- All assignments must be submitted as PDFs
- E-mail and SKYPE are easier forms of communications that sometimes better fit into your schedule
We instruct using several approaches
• lectures (including online recordings)
• discussions
• slide shows

We evaluate using several approaches
• analysis projects
• examinations
• peer-to-peer reviews
• student presentations
Explore topics of regional interest

• hanging gardens of Utah
• impacts of El Nino and La Nina
• biological crusts in Utah's deserts
• biodiversity and invasive species
• conservation and fragmentation
• how has Utah changed
• what are ecological consequences of policies
• biological invasions and what they mean
• urban forests
As citizens of the world consider topics of global interest

- impacts of El Nino and La Nina
- climate change
- loss of biodiversity
- fragmentation of habitats
- atmospheric changes
- disturbance and human impacts in ecology
- ecology and human health issues
- is there a cost for ecosystem services
You will instruct using several approaches:

Debate Discussions - Pro and Con, such as
- fire ecology and fire prevention
- riparian ecosystems
- invasive species
- biodiversity

Peer-to-peer reviews

Policy papers
Approaches to the science of plant ecology

- Descriptive - observational or analytical
- Experimental - physiology and biochemistry
- Economics - with gains, losses, and tradeoffs
- Consideration of how processes scale
- A genetics approach
- A comparative approach
Why are there so many different life forms?

biomes

resources and adaptation

partitioning of resources

life in a changing world
Eriogonum inflatum

Ramalina menziesii
How do plants work at the individual and community levels?

Consider plants as

- integrated systems
- a series of repeating, and semi-independent modules
We will consider economic analogies: costs and benefits

- energy and nutrition costs
- lost opportunity costs
- tradeoffs
- net carbon gain approach
Life is a series of tradeoffs
Consideration of whole plant as an integrated system: how are resources used?

- Capture
- Transport
- Utilization
- Storage
- Loss
Trees consist of many leaves, which in turn consist of many chloroplasts.
Is what happens at the chloroplast level relevant to higher scales?

Yes, the scale at which you address your question does matter
Within each of those leaves, acclimation occurs with respect to leaf size, cell size, and chloroplast size.
Genetics matter:
Consider *Potentilla glandulosa*, a common herb in California

A cross-section through central California

Studies conducted by Clausen, Keck, and Hiesey at the Carnegie Institution of Washington at Stanford University

photo from http://www.wildutah.us/images/plants_scenery/potentilla_glandulosa_guardman_pass_001.jpg
Growth performance of *Potentilla glandulosa* - a common herb in three different habitats

Studies conducted by Clausen, Keck, and Hiesey at the Carnegie Institution of Washington at Stanford University
### Growth of *Potentilla glandulosa* ecotypes

#### Common garden location

<table>
<thead>
<tr>
<th>Ecotype</th>
<th>Stanford</th>
<th>Mather</th>
<th>Timberline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanford</td>
<td>55 cm</td>
<td>35 cm</td>
<td>died</td>
</tr>
<tr>
<td>Mather</td>
<td>50 cm</td>
<td>69 cm</td>
<td>11 cm</td>
</tr>
<tr>
<td>Timberline</td>
<td>23 cm</td>
<td>44 cm</td>
<td>25 cm</td>
</tr>
</tbody>
</table>

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Studies conducted by Clausen, Keck, and Hiesey at the Carnegie Institution of Washington at Stanford University
Comparative approaches are common in ecology

- ecotypes and transplants
- environmentally induced changes
- genetic differences and tools
- environmental gradients
- controlled environments
- convergent forms
Equilibrium is a fallacy - the history of a site is relevant
Global Changes are occurring

Climate Change
- Warming
- Precipitation change
- Extreme weather events

Atmospheric Composition Change
- $[\text{CO}_2]$ and other GHG
- Stratospheric ozone

Land Use and Cover Change

Biological Invasions
Over the past 400,000 years (prior to the Industrial Revolution), \([\text{CO}_2]\) has varied 180-280 ppm

Implications for evolutionary aspects: adaptation, acclimation, exaptation, adaptive radiation
Things to do today after class:

• get to know your classmates

• check out our home page http://planteology.net

• consider signing up for a debate

• consider forming a group for your upcoming project
  [once decided, send Jim an e-mail with group list]