Monday 06 March 2006, 23rd class meeting
(Miller Chapter 6 and 7)

Environmental Biology (ECOL 206)
U. Arizona, spring 2006

Kevin Bonine, Ph.D.
Alice Boyle, Kristen Potter, Graduate TAs

1. Conservation Approaches
2. Lecture schedule updates on your website
3. 206 Lab Website for handouts and assignments
   No Lab this week

next installment of Group Project due Wed 08 March

Exam II Friday 10 March 2006 (review sheet on website)
Thank Don Swann, National Park Service
Biodiversity, the Species Approach

Species and ecosystems provide:

1. **Economic Goods**
   - Lumber, food, medicine

2. **Ecological Services**
   - Photosynthesis
   - Pollination
   - Soil formation
   - Nutrient cycling
   - Pest control
   - Climate regulation
   - Flood control
   - Water
   - Waste decomposition
   - Detoxification
   - Air and water purification
   - etc.

3. **Information**
   - Adaptability
   - Medicine
   - Science and education

4. **Recreation**
   - Movies or sporting events
   - Ecotourism
   - Tiger skin $1,000
   - Tiger watching $500,000

5. **Ethics**...

Nature’s Pharmacy

Figure 8-4: Nature’s pharmacy. Plants of those and a number of other plants and animals (many of them found in tropical forests) are used to treat a variety of human ailments and diseases. About 70% of the 3,000 plants identified by the U.S. National Cancer Institute as sources of cancer-fighting chemicals come from tropical forests. Despite their economic and health potential, fewer than 1% of the estimated 125,000 flowering plant species in tropical forests (and a mere 3,100 of the world’s 280,000 known plant species) have been examined for their medicinal properties. Many of these tropical plant species are likely to become extinct before we can study them. Miller, 2003

“Rosy Periwinkle Argument”
Ranking Biodiversity?

\[ R_i = (D_i + U_i)(\Delta P_i/C_i) \]

- \( D \) = distinctiveness
- \( U \) = utility
- \( \Delta P \) = enhanced probability of survival
- \( C \) = cost of strategy

Direct limited funds...

Ecological Contribution?

**Amphibian / Amniote Split**

340 MaBP (Paleozoic)

To Fishes and Ancestor

Amniotes

Amphibians

340 MaBP (Paleozoic)

Tetrapoda

Synapsida

Mammalia

Testudines

Squamate

Squamata

Lepidosauria

Reptilia

Archosauria

Archosaurus

Rhynchocephalia

Crocodylia

Aves

See Fig 2.1 (Pough et al., 2001)
‘Reptilia’ (= 4 orders, without birds)

1. **Testudines** (Chelonia, Turtles)
   - shell shape ~ ecology
   - no arboreal or gliding forms

2. **Squamata** (‘Lizards’ and Snakes)
   - lizards not monophyletic
   - repeated loss of limbs
   - very diverse

3. **Crocodylia** (Crocodiles, Alligators, Caiman)
   - threatened (21 spp. remain)
   - snout shape ~ diet
   - related to archosaurs
     (birds and dinosaurs)

4. **Rhynchocephalia** (Sphenodontida, Tuatara)
   - 2 extant species
   - islands of New Zealand
   - operate at ~cold temperatures
Biological Basis of the Sonoran Desert Conservation Plan

Thanks to Bob Steidl and others…

SDCP Biological Goal

Ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County…
Approach

- Select elements for planning
- Establish quantifiable goals
- Develop explicit rules for reserve design process
- Organize, synthesize, and acquire information
- Evaluate
- Establish, Monitor, Manage

Planning Alternatives

- **Biotic** elements
  - Vertebrates
  - Vegetation communities
- **Abiotic** elements
  - Land cover, land form, elevation, aspect, etc.
- **Unique** elements
Select Species

- Regionally “vulnerable” species
- Short-list of 55 species

Species chosen should have little influence on ultimate reserve design

Species List

- 9 mammals
- 8 birds
- 7 reptiles
- 2 frogs
- 6 fish
- 16 invertebrates
- 7 plants

7 bats
6 riparian
3 riparian
all riparian
all riparian
mostly snails
2 riparian

>60% of plants and vertebrates associated with riparian environments
Species Information

• Natural history accounts
• Species-environment matrix
• Decide best method by which to achieve goals for each species
• Less helpful if:
  – either rare or common
  – on lands that are protected or off-limits
  – limited natural-history information
• Reduced from 55 to 44 species

Land Cover

• Vegetation communities
• Abiotic / physical
• Urban, suburban, rural land-uses
• Ownership and level of protection
• Threats
Land Cover

Species Distributions

• Based on models rather than known locations or published distributions
• Developed to predict species distributions based on potential habitat
• Input and evaluation by experts
  – Habitat associations, known distribution
• Iterate
• Combine to identify areas of high species richness
Species-Environment Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. Attributes</th>
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<tbody>
<tr>
<td>Vegetation</td>
<td>29</td>
</tr>
<tr>
<td>Urban</td>
<td>9</td>
</tr>
<tr>
<td>Meso-riparian</td>
<td>9</td>
</tr>
<tr>
<td>Xero-riparian</td>
<td>13</td>
</tr>
<tr>
<td>Streams</td>
<td>8</td>
</tr>
<tr>
<td>Shallow groundwater</td>
<td>1</td>
</tr>
<tr>
<td>Springs</td>
<td>2</td>
</tr>
<tr>
<td>Elevation</td>
<td>13</td>
</tr>
<tr>
<td>Slope</td>
<td>9</td>
</tr>
<tr>
<td>Aspect</td>
<td>8</td>
</tr>
<tr>
<td>Landform</td>
<td>15</td>
</tr>
<tr>
<td>Carbonates</td>
<td>3</td>
</tr>
<tr>
<td>Geology</td>
<td>1</td>
</tr>
</tbody>
</table>

Matrix Rank Scores

Western Yellow Bat (Lasiurus ega)

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Score</th>
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<tbody>
<tr>
<td>195 - 600</td>
<td>2</td>
</tr>
<tr>
<td>600 - 800</td>
<td>3</td>
</tr>
<tr>
<td>800 - 1200</td>
<td>3</td>
</tr>
<tr>
<td>1200 - 1400</td>
<td>3</td>
</tr>
<tr>
<td>1400 - 1800</td>
<td>2</td>
</tr>
<tr>
<td>1800 - 2000</td>
<td>** mask **</td>
</tr>
<tr>
<td>2000 - 2800</td>
<td>** mask **</td>
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</table>
Elevation Scores

Hydrology Scores
Habitat Model

Iterative Process

Baseline Species Data

Fill Species-Environmental Matrix

Refine Model Parameters

Expert Input and Adjustments

Species Potential Distribution
Initial Model

Modeled Potential Habitat for Lowland Leopard Frog

Intermediate Model

Modeled Potential Habitat for Lowland Leopard Frog
Final Model + known locations

Initial Model
Intermediate Model

Final Model + known locations
Species Richness, 1 or more

Species Richness, 2 or more
Species Richness, 3 or more

Species Richness, 4 or more
Species Richness, 5 or more

Design Principles

- Comprehensive conservation
- Species richness as foundation
- Contiguousness and Connectivity
- Intactness
- Opportunity and Realism
Other Considerations

• Special elements
• Areas needed to meet species goals
• Landscape linkages
• Recovery areas for endangered species
• Areas identified by The Nature Conservancy as significant for conservation

Special Elements

Pygmy Owl Habitat

Saguaro and Ironwood communities
Reserve Building

Species richness

Mesoriparian + important xeroriparian  Special elements  PCA richness  Recovery areas  Scientific research areas

Reserve system boundaries

Initial Reserve Boundary
Conservation Lands System

- Biological Core
- Multiple Use
- Scientific Research
- Recovery Areas
- Agriculture Within Recovery Areas
- Existing Development

Species Richness, 5 or more
Biological Core

Species Richness – Expert Opinion
Biologically Preferred

Riparian as Foundation for Linkages

Important Riparian Areas
Only Listed Species

Monitoring and Adaptive Management

- Assess status and trends of representative organisms
- Information to assess land-management practices
- Careful and efficient design
- Long-term financial commitment