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

Amphibian / Amniote Split

Archosauria

Amphibia

Amphibians

Frogs

Salamanders

Caecilians

Reptilia

Reptiles

Lizards

Amphibians

Archosauromorpha

Archosaurs

Turtles

Snakes

Crocodylia

Birds

See Fig 2-1 (Pough et al., 2001)

Ranking Biodiversity?

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

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

Direct limited funds...

Ecological Contribution?
'Reptilia' (= 4 orders, without birds)

1. Testudines (Chelonia, Turtles)
   - duh
   - 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

>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>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>

Elevation Scores

Hydrology Scores
Vegetation Scores

Generate Distribution

Habitat Model

Iterative Process

Initial Model

Intermediate Model
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

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**

**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