I. Proposed Schedule

A. Overview of modeling in general and population dynamics of feral horses
B. Review of DOS version of *Equus*
C. Demonstration and testing of Windows version of *Equus*
D. Work session – help with your data

II. Overview – Modeling

A. Types of models used for population projection (Cohen 1995)
   1. mathematical extrapolation
      a. no mechanisms
      b. no allowance for random (stochastic) variation in growth rate
   2. demographic projection
      a. mechanism is age-specific birth and death rates
      b. may include stochastic variation in birth and death rates
   3. systems models
      a. detailed model of an ecosystem including physical factors, food supply, competing species, perhaps predators, space use of individuals in a population as well as birth and death rates
      b. site-specific
      c. Coughenour – Pryor Mountain

B. Use and abuse of models
   1. models make *conditional* predictions
   2. can be used for sensitivity analysis
   3. compare various scenarios (e.g., with and without fertility control)
III. Overview – population dynamics of feral horses

A. Data requirements of a demographic projection model such as *Equus*
   1. survival probabilities
   2. foaling rates
   3. sex ratio at birth
   4. initial age distribution

B. Survival probabilities for two populations

C. Foaling rates for two populations
D. Predicted and observed rates of population growth

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>Observed Average</th>
<th>Observed Range</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garfield Flat</td>
<td>21%</td>
<td>14.7%</td>
<td>4.4% – 29.8%</td>
<td>4</td>
</tr>
<tr>
<td>Pryor Mountains</td>
<td>18%</td>
<td>14.3%</td>
<td>2.0% – 32.4%</td>
<td>22</td>
</tr>
</tbody>
</table>

E. Year-to-year variation in survival and foaling rates
IV. Is there evidence for density dependence in feral horses?
V. How sensitive is population growth rate to changes in birth rates or death rates?

A. a classic example – loggerhead sea turtles

<table>
<thead>
<tr>
<th>Stage Class</th>
<th>Stage Duration (years)</th>
<th>Annual Survival Probability</th>
<th>Annual Fecundity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs/hatchlings</td>
<td>1</td>
<td>0.67</td>
<td>0</td>
</tr>
<tr>
<td>Small juveniles</td>
<td>7</td>
<td>0.75</td>
<td>0</td>
</tr>
<tr>
<td>Large juveniles</td>
<td>8</td>
<td>0.68</td>
<td>0</td>
</tr>
<tr>
<td>Subadults</td>
<td>6</td>
<td>0.74</td>
<td>0</td>
</tr>
<tr>
<td>Adults</td>
<td>&gt; 32</td>
<td>0.81</td>
<td>76.5</td>
</tr>
</tbody>
</table>

1. these data → a decline of about 5% per year in population size

2. elasticities are relative sensitivities of population growth rate to changes in survival and reproductive success

<table>
<thead>
<tr>
<th>Survival Stage</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>survival of eggs/hatchlings</td>
<td>0.07</td>
</tr>
<tr>
<td>survival of small juveniles</td>
<td>0.40</td>
</tr>
<tr>
<td>survival of large juveniles</td>
<td>0.46</td>
</tr>
<tr>
<td>survival of subadults</td>
<td>0.30</td>
</tr>
<tr>
<td>survival of adults</td>
<td>0.27</td>
</tr>
</tbody>
</table>

B. for feral horses at Garfield Flat
Survival (82.8%)  
Reproduction (17.2%)

Elasticity

Survival
Reproduction

Age

Elasticity

0 1 2 3 4 5 6-10 11-15 > 15