A Review of Mule and Black-tailed Deer Population Dynamics

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Background

• Role of predation in mule deer dynamics is controversial
• Still controversial because drivers of mule deer dynamics are not clear
• Resolving controversy requires understanding the interaction of all limiting factors (forage, weather & predation) and their effect on key vital rates:
  • Adult female survival
  • Juvenile survival and recruitment
  • Fecundity
Background

What we know from other ungulates:

- High and stable adult female survival
- Variable juvenile survival and recruitment
- Fecundity can be variable
- Senescent effects on survival and fecundity
- (Gaillard et al. 1998, 2000)
Background

• No predictive understanding of mule deer dynamics
• Fluctuations have surprised managers and hunters
• Do mule and black-tailed deer match patterns of other ungulates?
• How do predation, forage and weather affect these vital rates and dynamics?
Methods

• We searched literature and government reports & reviewed survival and cause of mortality studies

• Adult female and fawn survival
  • 0 to 6 months
  • 6 to 12 months
  • 0 to 12 months

• Factors affecting survival
  • Predation, malnutrition, and weather
  • Interactions
Research Geography

Studies by Ecoregion
Avg. Survival Rates

Adult survival
0.84 ± 0.09

Adult survival similar to other ungulates

Fawn survival
0-12 Months
0.29 ± 0.10

Fawn survival lower and more variable
**Proximate Cause of Mortality**

**Main Adult Predators**
- Mtn. Lions
- Wolves (BC)

**Diverse Fawn Predators**
- Coyotes
- Mtn. Lions-Bobcats
- Wolves
- Bears
Weather Effects on Survival

Harsh Weather Matters

Effect size is the reduction in mean survival during harsh weather.
Predation and Nutrition and Weather

- Little evidence for just predator regulation
  - 1 in 5 large scale removals found increase (see table)
  - Coyote removals did not increase deer
  - Compensatory mortality in mtn. lion removal
- 9 year study found $\uparrow$ survival $\neq$ $\uparrow$ growth (Hurley et al. 2011)
## Predation Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Type</th>
<th>Predator</th>
<th>Years</th>
<th>Spatial Scale (km²)</th>
<th>Predation Additive or Compensatory</th>
<th>Short Term Pop. Δ</th>
<th>Long Term Pop. Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atwood et al. 2007</td>
<td>Predator Colonization</td>
<td>Wolf</td>
<td>3</td>
<td>680</td>
<td>Unknown</td>
<td>↓ Predation risk</td>
<td>Unknown</td>
</tr>
<tr>
<td>Bartmann et al. 1992</td>
<td>Predator Removal</td>
<td>Coyote</td>
<td>7</td>
<td>140</td>
<td>Compensatory</td>
<td>None</td>
<td>Not measured</td>
</tr>
<tr>
<td>Brown 2009</td>
<td>Predator Removal</td>
<td>Coyote</td>
<td>2</td>
<td>10,518</td>
<td>Unknown</td>
<td>None</td>
<td>Not measured</td>
</tr>
<tr>
<td>Harrington &amp; Conover 2007</td>
<td>Predator Removal</td>
<td>Coyote</td>
<td>2</td>
<td>1,900</td>
<td>Additive?</td>
<td>↑ Density ≡ Fawn:Doe ratio</td>
<td>Not measured</td>
</tr>
<tr>
<td>Hatter &amp; Janz 1994</td>
<td>Predator Removal</td>
<td>Wolf</td>
<td>20</td>
<td>2,400</td>
<td>Additive</td>
<td>↑ Population</td>
<td>Stable at higher level</td>
</tr>
<tr>
<td>Hurley et al. 2011</td>
<td>Predator Removal</td>
<td>Coyote</td>
<td>6</td>
<td>14,700</td>
<td>Compensatory</td>
<td>↑ Fawn Survival (only in certain conditions)</td>
<td>No change in growth rate</td>
</tr>
<tr>
<td>Hurley et al. 2011</td>
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<td>Mtn. Lion</td>
<td>6</td>
<td>14,700</td>
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</tr>
</tbody>
</table>
Predation and Nutrition and Weather

• Nutrition status can affect all mortality rates
  • 4 year supplemental feeding study in Colorado (Bishop et al. 2009)
  • Increased nutrition reduced predation mortality in adults and fawns
Multi-prey and Multi-Predator Systems

• Fawn predation sensitive to alternate prey
  - Changes in microtine rodent/lagomorph prey affects coyote predation (Hamlin et al. 1984; Lingle 2000; Hurley et al. 2011)

• Adult predation changes with food web
  - Increasing white-tailed deer leads to increased mule deer mortality (Robinson et al. 2002, Cooley et al. 2008)
  - Wolf recolonization leads to elk habitat shift and reduction in mule deer predation risk from mtn. lions. (Atwood et al. 2007, 2009)
Mendocino
Cause of
Fawn
Mortality

Higher Bear and Felid predation than other research (so far)
Possible Patterns driving Mule Deer Dynamics

1. Weather and Nutrition Driven accentuated by Predation

2. Nutrition drives Adult vital rates – Nutrition-Predation interaction controls Fawn Recruitment

3. Human caused Changes Shifting the Food Web
   • Changes in landscape or species composition
Recommendations for Future Study

1. Gather and report data to calculate population growth rates ($\lambda$)
   - Fecundity and birth to recruitment needed

2. Age class specific survival is needed
   - What vital rates drive dynamics?

3. Multi-prey multi-predator community studies

4. University and management agency collaboration
Thanks
Literature Cited


