Raven Survivorship in Yellowstone

By: Daniel Solorzano-Jones
Faculty Advisor: Dr. John Marzluff

Image: David Watkins
Common Raven

- *Corvus corax*
- Largest Corvid
- Highly Intelligent
- Generalist Species
- Lives about 10-15 years

*USGS 2021
*Britannica 2020
Raven Telemetry Study

- Conducted by Dr. Marzluff and Dr. Loretto

- Sex, Age and Breeding Status data

- Solar powered GPS “backpacks”
  - 30 min intervals
  - Coordinates
  - Temperature
  - Ground Speed
## Fate Determination

<table>
<thead>
<tr>
<th>Alive</th>
<th>Unknown</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consistent Temperature</td>
<td>• Low Battery Level</td>
<td>• Varying Temperatures</td>
</tr>
<tr>
<td>• Ground Speed</td>
<td>• Dropped Tag</td>
<td>• No Ground Speed</td>
</tr>
<tr>
<td>• Normal Activity</td>
<td>• Normal Activity</td>
<td>• Strong Clusters</td>
</tr>
<tr>
<td>• Weak Clustering</td>
<td>• Abrupt Cutoff</td>
<td></td>
</tr>
</tbody>
</table>
FATE: DEAD

FATE: ALIVE
Statistical Analysis

- Done using R
- Kaplan-Meier Model
- Cox Proportional Hazards Regression
- ANOVA of Cox P.H.R.

Full Data
- Unknown fates = censored
- Tag failures = censored
- 72 fates, 18 deaths

Filtered Data
- Tag failures = dead
- Unknown fates = dead
- 72 fates, 33 deaths

Sex and Breeding Status VS Sex and Age Group

*Suedkamp et al. 2007
*Webb et al. 2012
Full Data: Cox P.H. Results

Sex and Breeding Status model
- Female Risk – 39%
- Non-breeder Risk – 64%
- AICc = 143

Sex and Age model
- Female Risk – 31%
- Adult Risk – 20%
- AICc = 144

ANOVA
- Significant difference
K.M. Survival by Sex

Log-rank

$p = 0.42$

Survival probability

Time (Days)

Female

Male

<table>
<thead>
<tr>
<th>Time (Days)</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>250</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>(1st Year)</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>500</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>(2nd Year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Filtered Data: Cox P.H. Results

Sex and Breeding Status model
Female Risk – 71%
Non-breeder Risk – 60%
AICc = 256

Sex and Age model
Female Risk – 65%
Adult Risk – 4%
AICc = 258

ANOVA
Significant difference
K.M. Survival by Sex and Breeding Status

Log-rank

\[ p = 0.15 \]

<table>
<thead>
<tr>
<th></th>
<th>Time (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Female Breeder</td>
<td>15</td>
</tr>
<tr>
<td>Female Non_B</td>
<td>21</td>
</tr>
<tr>
<td>Male Breeder</td>
<td>16</td>
</tr>
<tr>
<td>Male Non_B</td>
<td>20</td>
</tr>
</tbody>
</table>
Discussion

Interpretations
• Sex impacts survival
• Territoriality increases survival
• Age has a negligible effect

Limitations
• Sample Size (76)
• Sample Period
• Unknown Fates (4)
• Tag Failures (8)

Recommendations
• Continuation of the study
• Investigate causes of tag failure

*Marzluff et al. 2006
Citations


Thank You!