New World Screwworm Impacts on the Endangered Florida Key Deer

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Relevance

- First US outbreak in 50 years
- Warm-blooded animals at risk
- Threat to agricultural interests and wildlife populations
  - USDA estimates $750 million in annual livestock cost alone
  - Greater ecological impacts
Florida Key Deer

- Endangered subspecies of white-tailed deer
- Unique to the Lower Florida Keys
- Limited ranges and small extant population
  - Vulnerable
  - Extensive monitoring and research history

Hemingway’s Deer
Multi-Agency Response Efforts
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1. Elimination of screwworms (biological)
2. Treatment of impacted animals and implementation of preventative strategies (treatment)
3. Determine screwworm-related mortality impacts and provide population assessment and recovery strategies
Multi-Agency Response Efforts

1. Elimination of screwworms (biological)
2. Treatment of impacted animals and implementation of preventative strategies (treatment)
3. Determine screwworm-related mortality impacts and provide population assessment and recovery strategies
Goal

- Determine screwworm-related mortality impacts and provide population assessment and recovery strategies

Objectives

- Screwworm Deer Mortality
- Current Population Density
- Population Viability
- Management Strategies
Datasets

- Multiple data sets (1966 – current)
- Deer Mortality
  - Since 1966 (necropsy n=2,134)
- Telemetry
  - VHF radio collared deer (n=348, 1968 – 72, 1998-01)
- Population Surveys
  - Road index data - monthly estimates (1968 – 01)
  - Mark-resight data - weekly estimates (1968 – 72, 1998 – 01)
Objective 1 – Screwworm Deer Mortality
Screwworm Deer Mortality – *Methods*

- Utilized USFWS mortality database
- Summarized descriptive statistics of screwworm-related Key deer mortalities
Screwworm Deer Mortality – Monthly

July 2016–August 2017

Key Deer Mortalities

<table>
<thead>
<tr>
<th>Month</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb-Aug</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>7</td>
<td>20</td>
<td>97</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
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</table>
Screwworm Deer Mortality – Sex

<table>
<thead>
<tr>
<th>Island</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Pine Key</td>
<td>121</td>
</tr>
<tr>
<td>No Name Key</td>
<td>5</td>
</tr>
<tr>
<td>Middle Torch Key</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>127</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Month</th>
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<tbody>
<tr>
<td>July</td>
<td>4</td>
</tr>
<tr>
<td>August</td>
<td>7</td>
</tr>
<tr>
<td>September</td>
<td>20</td>
</tr>
<tr>
<td>October</td>
<td>96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>127</td>
</tr>
</tbody>
</table>
Screwworm Deer Mortality – Age

**Island**

<table>
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<tr>
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**Month**

<table>
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<td>July</td>
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</table>

**Females**

- adult (>3): 30%
- adult (<3): 10%
- yearling: 20%
- fawn: 10%
- unknown: 10%

**Males**

- adult (>3): 84%
- adult (<3): 7%
- yearling: 1%
- fawn: 1%
- unknown: 1%
Objective 2 – Current Population Density
Current Population Density – *Methods*

- Conducted road surveys (27 Oct – 3 Nov 2016)
  - Recorded deer observed, distance, location, sex, and age
- We used distance sampling analysis to estimate density
- Utilized survey and mortality databases
  - Evaluate long-term population trends
  - Validate the current density estimate
Current Population Density

T = Transitional Use
* = Estimate Outdated with Translocations
Current Population Density – BPK/NNK

Density Estimate

<table>
<thead>
<tr>
<th>Year</th>
<th>Density Estimate</th>
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<tbody>
<tr>
<td>1971</td>
<td>201</td>
</tr>
<tr>
<td>2001</td>
<td>482</td>
</tr>
<tr>
<td>2004</td>
<td>587</td>
</tr>
<tr>
<td>2016</td>
<td>804</td>
</tr>
<tr>
<td>2016 (Post-SW)</td>
<td>678</td>
</tr>
</tbody>
</table>

\( n = -126 \text{ SW} \)
Long-term Mortality and Deer Trends

3.5% Annual Growth

\[ y = 2 \times 10^{-29} e^{0.0354x} \]

\[ y = 1 \times 10^{-28} e^{0.034x} \]
Current Population Density (Validation)

- 3.5% growth
  - 2001 = 806
  - 2004 = 857
- Average = 831
- 2016 = 804
  - 126 screwworm mortalities added
Objective 3 – Population Viability

HERE LIES Bambi
ALL COLD and HARD
LAST DAMN DEER
TO POOP IN MY YARD
Population Viability Analysis (PVA)

- Method used to evaluate population(s) threats and provide a measure of species viability

- Components
  - Data collection (demographic and spatial data)
  - Data analysis and parameter estimation
  - Modeling and risk assessment
  - Sensitivity analysis and model refinement
PVA – Modeling and Risk Assessment

Demographics
- Survival
- Fecundity
- Rmax
- Abundance
- Dispersal
- Vegetation Grid = K
- Mortality Grid

Spatial Data
- Vegetation Grid = K
- Mortality Grid

Example

RISK$_1$  RISK$_2$
Mortality Causes

Percent Mortality

- Disease
- Drowning
- Entanglement
- Roadkill
- Other

Increased Risk
Population Viability

- Given the high number of male screwworm mortalities we assessed the core deer population to try and answer:

  Are there enough males in the population for a successful 2016 and 2017 breeding season?
Enough Males?

- **2016**
  - Females already bred

- **2017**
  - Assume 1 male will cover 10 females
  - Yearling males will breed given the opportunity

<table>
<thead>
<tr>
<th></th>
<th>Estimated Breeding Females</th>
<th>Estimated Males Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Pine Key</td>
<td>342</td>
<td>34</td>
</tr>
<tr>
<td>No Name Key</td>
<td>36</td>
<td>4</td>
</tr>
</tbody>
</table>

![Pie chart for Big Pine Key](chart_big_pine_key)

![Pie chart for No Name Key](chart_no_name_key)
Objective 4 – Management Strategies
Management Strategies – Reactive

- **Eradication is the goal**
  - Sterile fly release and preventative treatments

- **Monitor population**
  - Big Pine and No Name (monthly, intensive surveys)
  - Key outer islands (camera surveys)

- Establish USFWS with a female monitoring protocol
Management Strategies – Proactive

- Eradication is the goal
  - Continue to sterile fly release and doramectin treatments

- Continue population surveys:
  - Big Pine and No Name (monthly, intensive surveys)
  - Key outer islands (camera surveys)

- Establish USFWS with a female monitoring protocol
Shift in Threat

- Infestations may shift to females and fawns
  - Fawning season highest risk of infestation (e.g., vaginal discharge, umbilicus)
- Significant population impacts
Female Monitoring

- January 2017 we collared 30 adult females
  - Portable drop nets
  - Drive nets
Female Monitoring

- Physically restrained, hooded, and bound
- Equipped with vhf radio-collars
- Intramuscular antiparasitic injection
Female Monitoring

- USFWS intensively monitored collared females
  - Homing and/or visual locations 3x week
  - ID’s recorded during monthly population surveys to generate mark-resight population estimates
  - No screwworm-related infections occurred during fawning
Take Away

- Successful resolution following 2017 fawning season
- Population currently viable
- Reduced need for intensive data collection efforts
  - USFWS continues baseline monitoring for Key deer
- Applicable case study model for future reference
Acknowledgements

- TAMU – Roel Lopez, Nova Silvy, Israel Parker, Brian Pierce, and Alison Lund
- USFWS & National Key Deer Refuge Staff

https://nri.tamu.edu/