Pronghorn fawn survival on the northern Carrizo Plain

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Pronghorn distribution in California and North America

(Calif. Dept. of Fish & Game 2012; Wildlife Management Institute 2001)
Current pronghorn distribution and status in California

(Calif. Dept. of Fish & Game 2012; Wildlife Management Institute 2001)
Current pronghorn distribution and status in California

- All southern populations declining
- Significant decline for the Carrizo Plain

(Calif. Dept. of Fish & Game 2012; Wildlife Management Institute 2001)
The Carrizo Plain:
The Carrizo Plain:

Carrizo Plain National Monument (CPNM)
The Carrizo Plain:

Northern Carrizo Plain (NCP)

Carrizo Plain National Monument (CPNM)
Population decline:

340 pronghorn translocated (1987-1990)

(Maher 1994, Cal Fish & Game 2012)
Small populations and the Allee Effect

[Diagram showing a graph with population growth rate on the y-axis and population size or density on the x-axis. The graph includes a dashed line labeled 'Classical density dependence'.]
Small populations and the Allee Effect

The Allee Effect

Population growth rate vs Population Size or Density
The Allee effect on the Carrizo Plain

Per capita rate of change

Population Size

Per capita growth rate

Allee effect

$R^2 = 0.53$

$F = 5.59, P < 0.05$

$R^2 = 0.69$

$F = 11.07, P < 0.05$

CPNM

NCP
Topaz Solar Farms

- Pronghorn locations (2000 – 2013)
- Topaz Solar (Current)
- Topaz Solar (Planned)
- Major roads
- Mitigation Lands

California Valley
Why study fawns?

• Fawns
  - Recruitment critical for population recovery
  - High mortality due to predation (10-20 days of age)

• Adults
  - Difficult and expensive to work with
  - Low mortality from predation and mild winter climate

![Survival Rate graph](image-url)
Objectives

1. Measure **fawn survival** and determine **causes of mortality**.

2. Examine relationship between fawn habitat selection and survival.
Objectives

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2. Examine relationship between fawn habitat selection and survival.
Collaring Fawns

**GPS collars**
- Lightweight (80 g)
- Expandable
- Detach (~ 60 days)
- Collect locations (2 hrs.)
- VHF tracking
- Mortality sensor
Locating fawns

⇒ Pregnant female:
  • Bulging stomach
  • Grouped with other adults
  • Getting up and down

⇒ Female with fawns:
  • Flat stomach
  • Isolated from other adults
  • Alert
Minimizing Impact/Disturbance

- <15 min. processing time
- Captured at 1 - 5 days of age
- Captured after reunion period
- Large secure net
- Equipment stored in local vegetation
Monitoring status of fawns

Collared Fawns:

- VHF signal (collar still attached)
- Ear tag (after collar detaches)
Monitoring status of Fawns

Uncollared Fawns:

Visual observation

- Collared sibling
- Pelage/markings on mother
- General daily location
Survivals:

- > 60 days = survival

(90% of mortality occurs at < 20 days of age)

(Gregg et al. 2001)
Mortalities:

• Field necropsies
  1. Predation?
  2. Type of predator

• Laboratory necropsies
  1. Health related?
  2. Additional information
Predator sightings and fawning areas (April – July 2013)

- Areas used by fawns
- Coyote locations
- Golden Eagle locations
Survival…

- 25 Fawns born
- 14 Collared Fawns
- 11 Uncollared Fawns
Survival...

25 Fawns born

14 Collared Fawns

3 Survivals

11 Mortalities

11 Uncollared Fawns

5 Survivals

6 Mortalities
Survival compared to other studies...

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th># born</th>
<th># survived</th>
<th>Survival Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern CP</td>
<td>2013</td>
<td>25</td>
<td>8</td>
<td>32%</td>
</tr>
<tr>
<td>CPNM</td>
<td>2011</td>
<td>11</td>
<td>4</td>
<td>36%</td>
</tr>
<tr>
<td>CPNM</td>
<td>2010</td>
<td>12</td>
<td>5</td>
<td>42%</td>
</tr>
<tr>
<td>CPNM</td>
<td>2009</td>
<td>22</td>
<td>3</td>
<td>14%</td>
</tr>
<tr>
<td>Across range*</td>
<td>1976 - 1999</td>
<td>995</td>
<td>293</td>
<td>29%</td>
</tr>
</tbody>
</table>

(*O’Gara and Shaw, 2004)

\(z = -0.18, p = 0.86\)

\(z = -0.10, p = 0.92\)
<table>
<thead>
<tr>
<th>Cause of mortality…</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Carrizo Plain:</strong></td>
</tr>
<tr>
<td>10 Necropsies</td>
</tr>
<tr>
<td>7 (70%) Evidence of predation (Coyote)</td>
</tr>
<tr>
<td>3 (33%) No evidence of predation (Cause unknown)</td>
</tr>
</tbody>
</table>
Cause of mortality...

10 Necropsies

Northern Carrizo Plain:
7 (70%) Evidence of predation (Coyote)
3 (33%) No evidence of predation (Cause unknown)

Compared to....

*Other populations:
76% Evidence of predation (Coyote, Eagle, Bobcat)
24% No evidence of predation (Starvation or disease)

*O’Gara & Shaw 2004  
\[ z = -1.07, p = 0.29 \]
Survival curves for pronghorn fawns

- **Northern CP (2013)**
- **CPNM (2009-2011)**

**Survival rate** vs **Age (days)**
Objectives

1. Measure fawn survival and determine causes of mortality.

2. Examine relationship between fawn habitat selection and survival.
Habitat at different scales:

**Micro-habitat**

- Fawn selects bedsit
- < 100 m distance
- Subtle habitat characteristics

**Macro-habitat**

- Doe selects birth site and general fawning habitat
- large scale landscape features
Measuring micro-habitat:

1. Vegetation height

2. Vegetation type (grass, forb, shrub, bare ground)

3. Visibility at adult height (1 m)

4. Visibility at fawn height (0.5 m)

~ 1,000 Fawn locations from GPS collars
Measuring micro-habitat:

1. Vegetation height

2. Vegetation type (grass, forb, shrub, bare ground)

3. Visibility at adult height (1 m)

4. Visibility at fawn height (0.5 m)

- 136 Fawn locations
- 132 Random locations
Measuring macro-habitat:

- Generated using a GIS (Geographic Information System)

- Distance to...
  1. Solar development (as of June 2013)
  2. High use roads (Hwy 58, Soda Lake Rd)
  3. Low use roads (dirt roads)
  4. Ephemeral drainages
Habitat model results: **Micro-habitat features**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 50 meters</td>
<td>↓</td>
</tr>
<tr>
<td>100 meters</td>
<td>↑</td>
</tr>
</tbody>
</table>

Note: Vegetation height and type were not significant
Habitat model results:
Macro-habitat variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar development</td>
<td>↑</td>
</tr>
<tr>
<td>Minor roads</td>
<td>↑</td>
</tr>
<tr>
<td>Water sources</td>
<td>↑</td>
</tr>
<tr>
<td>Major roads</td>
<td>↓</td>
</tr>
<tr>
<td>Ephemeral drainages</td>
<td>↓</td>
</tr>
</tbody>
</table>
Pronghorn Fawn Habitat Selection Model for the Carrizo Plain National Monument

- Top 5% of Model Values
- Top 5-10% of Model Values
- Top 10-15% of Model Values
- Collared Fawn Locations (2009-2011)
- Roads
Conclusions and Discussion

1. Fawn survival

- Similar to CPNM and other populations

- However - Low raw numbers of recruited individuals

  - High annual variability common

  - Vulnerable to environmental and demographic stochasticity
Conclusions and Discussion

1. Causes of mortality

- Predation similar to CPNM and other populations

- However...
  - Importance of predation increases for small populations in marginal habitats
  - Mean survival time low (6.75 days)
Conclusions and Discussion

2. Habitat

- Low availability of vegetative concealment
- Low forage opportunities for adults (high % bare ground)
- Ephemeral drainages likely provide habitat for both fawns and adults.
Questions?
<table>
<thead>
<tr>
<th></th>
<th>Mean vegetation height</th>
<th>Mean adult visibility</th>
<th>Mean fawn visibility</th>
<th>Mean vegetation composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Forb</td>
</tr>
<tr>
<td>Fawn locations</td>
<td>3.6 cm (0.2 cm)</td>
<td>97.8% (0.8%)</td>
<td>97.7% (0.9%)</td>
<td>17.7% (0.3%)</td>
</tr>
<tr>
<td>Random locations</td>
<td>5.9 cm (0.3 cm)</td>
<td>94.2% (2.2%)</td>
<td>92.0% (2.7%)</td>
<td>18.7% (0.7%)</td>
</tr>
</tbody>
</table>
Methods

Emigration from CPNM to Northern Plain?
Methods

Emigration from CPNM to Northern Plain?

\[
\text{Population outside CPNM} \rightarrow \text{CPNM Population}
\]

Negative = Emigration
Methods

Emigration from CPNM to Northern Plain?

Population outside CPNM

CPNM Population

Positive = Reduced growth rate in CPNM
Methods

Emigration from **CPNM** to **Northern Plain**?

![Graph showing emigration from CPNM to Northern Plain](image)

- **Northern Plain Population**
- **CPNM Population**

- **2001**
- **2012**

**Emigration**

**Reduced Growth Rate**
Methods

Emigration from CPNM to Northern Plain?

The graph shows the population trends from 2001 to 2012. The y-axis represents the Northern Plain Population, and the x-axis represents the CPNM Population. The graph includes points for the years 2008 and 2012, indicating changes in population trends.