Chronology of Reproductive Investment Determines Predation Risk Aversion in a Felid-Ungulate System

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Relationships of Predators and Prey

Consumptive effects:

- Non-consumptive effects
  - Physiological
    - Stress Hormones and Reproduction
  - Morphological
    - Defensive adaptations
  - Behavioral
    - Increased vigilance
    - Altered space use
    - Altered patterns of activity
Non-consumptive effects:

- **Physiological**
  - Stress Hormones and Reproduction

- **Morphological**
  - Defensive adaptations
Relationships of Predators and Prey

Non-consumptive effects:

- Behavioral
  - Vigilance
- Altered space use
- Altered patterns of activity
How has a 400% increase in panther abundance reshaped the landscape of fear?
Objectives:

1. Identify when and where deer experience relatively high risk of predation by panthers.

2. Examine the interactions of spatial and temporal variation in risk with biological seasons of deer.

3. Determine if male and female deer differ in their respective thresholds for risk of predation.
Hypotheses:

1. Spatiotemporal variation in risk of predation by panthers elicits avoidance of high risk spaces and times by deer.

- Objectives 1 & 2: Identify when and where deer experience high risk & examine the interactions of variation in risk with biological seasons of deer
Hypotheses:

2. Male and female deer employ different antipredator strategies as a result of differing requirements for reproduction.

- **Objective 3:** determine if the sexes of deer differ in their respective thresholds for risk of predation.
METHODS

Legend

- Cameras
- Grids
- North Addition Lands
- Bear Island
- FPNWR

Big Cypress Basin
South Florida

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Rearing
Female Activity ↑ (peak lactation)
Male Activity ↓ (antler calcification → disbanded bachelor groups)
Pre-Rut
Female Activity −− (fawns weaned; relatively low nutritional demand)
Male Activity ↑ (preparing for breeding season)
Post-Rut
Female Activity −− (baseline activity levels)
Male Activity ↓ (recuperation from 10-30% loss of body mass)
Fawning
Female Activity ↑ (seeking/defending fawning habitat)
Male Activity ↓ (bachelor group + antler growth)

February 1, 2015 – October 31, 2015
We estimated detection rates and activity overlap at camera traps.

Female Activity ↑ (activity correlated with Males)
Male Activity ↑ (actively pursuing breeding opportunities)
Rut
Analyses:

Detection rates:

Poisson Generalized Linear Mixed Effects Models (GLMM)

- Trail: On-trail vs. Off-trail
- Time: Day vs. Night
- Season: Fawning, Rearing, Pre-Rut, Rut, Post-Rut
- Random effect of individual cameras
**Objective 1:** High risk time = Night  
High risk space = On-trail

<table>
<thead>
<tr>
<th>Season</th>
<th>On-trail</th>
<th>Off-trail</th>
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<tbody>
<tr>
<td>Fawning</td>
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<td><img src="graph2.png" alt="Graph" /></td>
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<td>Rearing</td>
<td><img src="graph1.png" alt="Graph" /></td>
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<td>Pre-rut</td>
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</tbody>
</table>

Panther:

On-trail activity > Off-trail activity  
Night activity > Day activity
Male Deer:

Activity during high-risk times in low-risk areas.

Exposure to risk ↑ as rut approaches.

In high-risk areas, activity > during low-risk times.

On-trail (High-Risk) vs. Off-trail (Low-Risk):

- Diurnal (Low-risk)
- Nocturnal (High-risk)

Male Deer Detections Per 1000 Hours:

Season:
- Fawning
- Rearing
- Pre-rut
- Rut
- Post-rut

* Signifies significant difference.
Female Deer: Risk exposure during high-risk times, Fawning, Rearing, Pre-rut, Rut, Post-rut.

- On-trail (High-Risk):
  - Fawning: 2.3 (±0.5)
  - Rearing: 3.0 (±0.6)
  - Pre-rut: 1.5 (±0.3)
  - Rut: 4.0 (±1.0)
  - Post-rut: 1.5 (±0.3)

- Off-trail (Low-Risk):
  - Diurnal (Low-risk): 2.0 (±0.4)
  - Nocturnal (High-risk): 3.0 (±0.8)

* denotes significant difference between on-trail and off-trail detections.
Females are more active in high risk scenarios than males during Fawning and Rearing.

Males are more active in high risk scenarios than females during Pre-rut, Rut, and Post-rut.
Activity Overlap Analysis:
Program R; Package: overlap (Ridout and Linkie 2009)

- Kernel density estimation of image time-stamps
- Estimated coefficient of overlap of Males and Females with panthers for each biological season
Male-Panther overlap > in high-risk areas than female.

Female-Panther overlap > during periods of high energetic demand.

On-trail (High-risk)

Off-trail (Low-risk)
Discussion

- Females are more risk averse than Males until energetic demand ↑ (Fawning and Rearing).

- Males are more active at night and on-trail than Females, especially leading up to, during, and after Rut.

- Both sexes appear to buy reproductive opportunity at the cost of increased risk of predation.
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