Harnessing Camera Trap Data to Understand Wildlife Dynamics at Water Sources: Effect of Predation Risk on Prey Behavior

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Overview

- Inevitable overlaps between predators and prey at water sources
  - Water availability impacted by climate change and human settlement
- Importance:
  - Predators and prey of conservation interest
  - More environmentally friendly settlement
- Camera traps set up near filled water pans and away from water in central Kenya
- Citizen scientists for help with animal identification and count
- Assess effect of predation risk on characteristics of prey visits (measurable antipredator behavior?)
  - Results show more predation presence correlate with more prey presence
  - More general presence, interactions at water sources as opportunities for food

Wildlife Interactions

- Need for access to water sources naturally drives interactions
  - Allows study of predator-prey overlaps in a natural environment

FIG. 1. Watering hole in Africa displaying the diversity in wildlife and possible overlaps at water sources. (Source: Wikimedia Commons)

- Availability of water affected by climate change and human settlement [1, 2]
  - Drought, irrigation use, unnatural competition with livestock
  - Wildlife use of watering holes necessary for quality and cleanliness control [3]
  - Many species of conservation interest strongly affected

FIG. 2. Watering hole crowded by livestock and human activity. (Source: Piqsels)

- Calculating predation risk at certain locations in comparison to characteristics of prey visits:
  - Presence
  - Number of visits per day
  - Average visit duration
  - Average herd size
- Quantify antipredator behavior, or lack of, through data analysis

Camera Traps and Citizen Science

- Gather visual and environmental data from natural settings
- Non-invasive, effective in detecting animal movement and a large range of species [4]
- Citizen scientists (Zooniverse) for animal identifications and count

FIG. 3. Example camera trap. (Source: Wildlife Act)

Studying Antipredator Behavior

Data Collection

- Ol Pejeta Conservancy, Laikipia county, Kenya
- Camera traps triggered by animal movement or heat
  - Ran for 2 years (August 2016 - August 2018)
  - Images uploaded to Zooniverse (citizen science website)

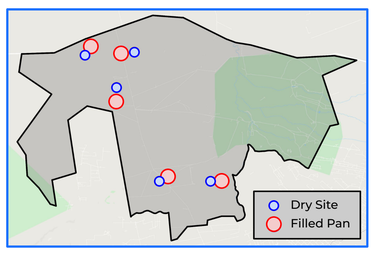

FIG. 4. Map of the Ol Pejeta Conservancy in central Kenya (0.0043° S, 36.9637° E).

'Filled pans' are centered about a filled pan and 'dry sites' are 1 km away from any water sources.

(Redrawn from [5] with the help of Google Maps)

Data Processing

- Triggers as movement within 5 minute windows
  - Duration, animal count, animal species

Data Analysis

- Presence - Binary measure of existence of prey visits
- Number of visits per day (animals/day) - Total count of species summed over 24 hour period
- Average visit duration (seconds) - Average duration of all triggers from a 24 hour period
- Average herd size (animals) - Average count of species in a trigger from a 24 hour period
- Plotted against risk level (animal*seconds) - Count of predators * duration of predator visits from a 24 hour period

Prey Species	*Predator Species*
A. melampus	***A. jubatus***, *C. mesomelas*, ***P. leo***, ***P. pardus***, *P. anubis*
E. quagga	***A. jubatus***, *C. crocuta*, ***L. pictus***, ***P. leo***, ***P. pardus***
T. oryx	*C. crocuta*, ***L. pictus***, ***P. leo***, ***P. pardus***

TABLE 1. Table of prey and predator species studied.

Bolded species are of conservation interest (near threatened or higher), underlined species are impacted by diminishing access to and/or drastic changes in water sources.

(Created with the help of [6])

Results

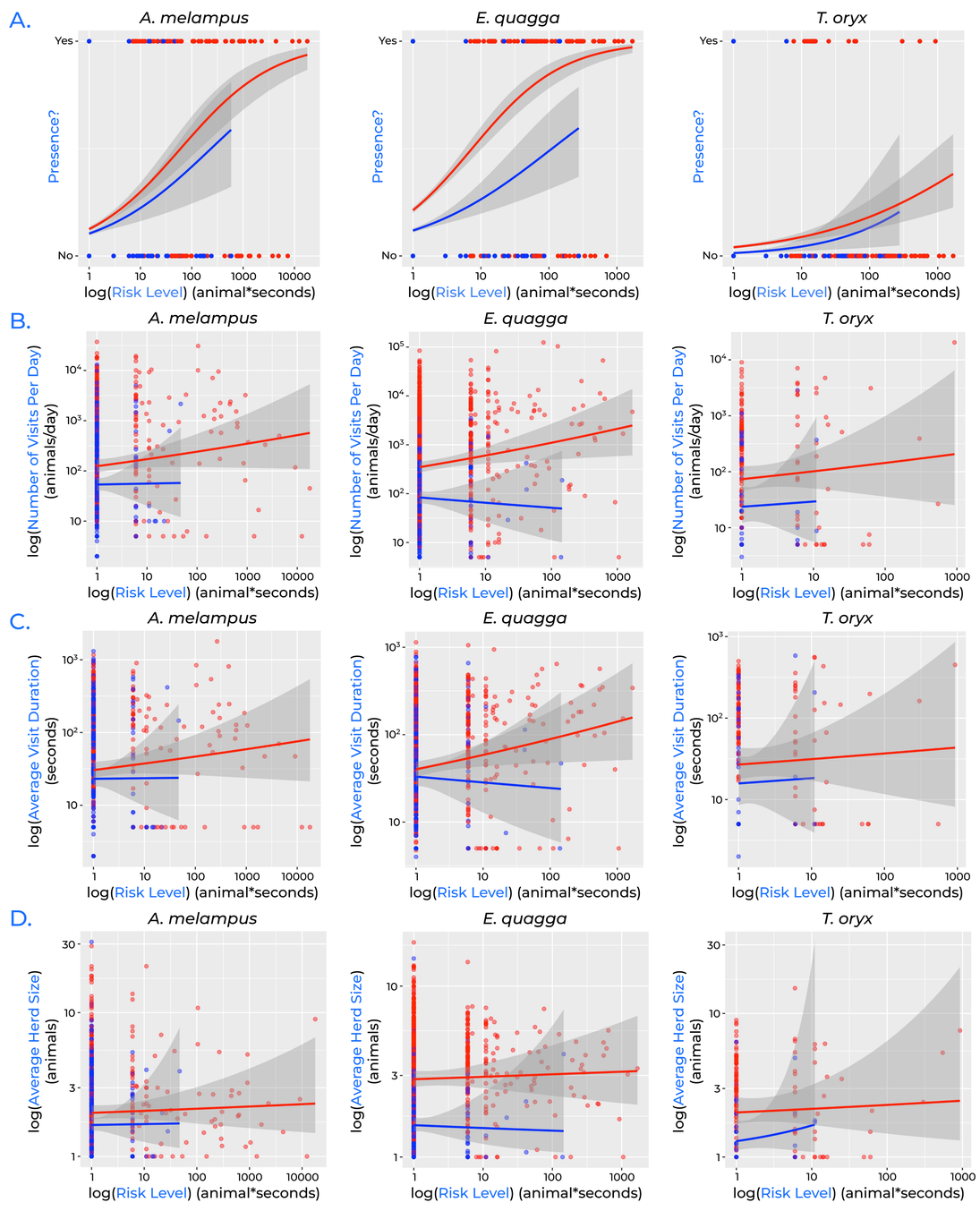

FIG. 5. Graphs of **A.** likelihood of presence, **B.** number of visits per day, **C.** average visit duration and **D.** average herd size plotted against predation risk level, separated by species.

A. fitted using a binomial logistic regression model, leading to a line describing the likelihood of finding prey based on different risk levels, due to the binary option of 'yes' or 'no.' **B., C.** and **D.** fitted using a negative binomial generalised linear model due to non-normal data. Logarithm used for all data (except presence) due to the heavily right-skewed data.

Effect of Risk Level

- Significant effect on presence / number of visits per day / average herd size at filled pans ($p < 0.001$), but insignificant at dry sites ($p > 0.05$)
- Insignificant effect on average visit duration for both filled pans and dry sites ($p > 0.05$)
- Overall, increasing risk level did not show signs of antipredator behavior, except for average herd size

Effect of Water

- 1.8x, 5.6x, 1.3x, 1.7x greater presence / number of visits per day / average visit duration / average herd size at filled pans than at dry sites
- 179x, 100x, 54x, 6x greater rate of increase at filled pans than at dry sites, for presence / number of visits per day / average visit duration / average herd size, respectively
- *E. quagga* heavy dependence on a reliable water source seen in:
  - Negative trend for number of visits per day / average visit duration / average herd size at dry sites
  - High difference in average likelihood of presence at filled pans compared to dry sites (0.243% vs 0.123%)

Discussion

Conclusions and Main Takeaways

- No measured antipredator behavior
  - More general presence with both's count increasing together, especially around water sources
  - Interactions at water sources as opportunities for food means prey activity can drive predator activity
- Water is a natural driver of predator-prey interaction

Possible Future Work

- Broaden types of animals studied (only medium-sized land mammals chosen)
- Gather more data for times with increased predator and prey activity, especially at dry sites (minimise error bars)
- Look at small-scale interactions (focused on measuring large-scale patterns)

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