# Sentinel Behavior & Urbanized American Crows

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# What have I been up to?

# Conferences

Brock’s MNK Conference

OE3C Conference 2023 at Western University

Brock's GRaD Conference

# What else have I been up to?

Mentored an undergraduate student

Volunteered at the Ontario Biology Day and the Niagara Regional Science & Engineering Fair

Brock’s 3 Minute Thesis

Refining my teaching skills by TA-ing various courses

# What have I been up to?

# Community work

## SpeedQB

- Introduced even more players to a new style of play
- Organized several events that attracted players from the Southern Ontario region & from Montreal

I had a great time and received a lot of positive feedback.

I look forward to growing the community even more next year

# What have I been up to?

# Thesis

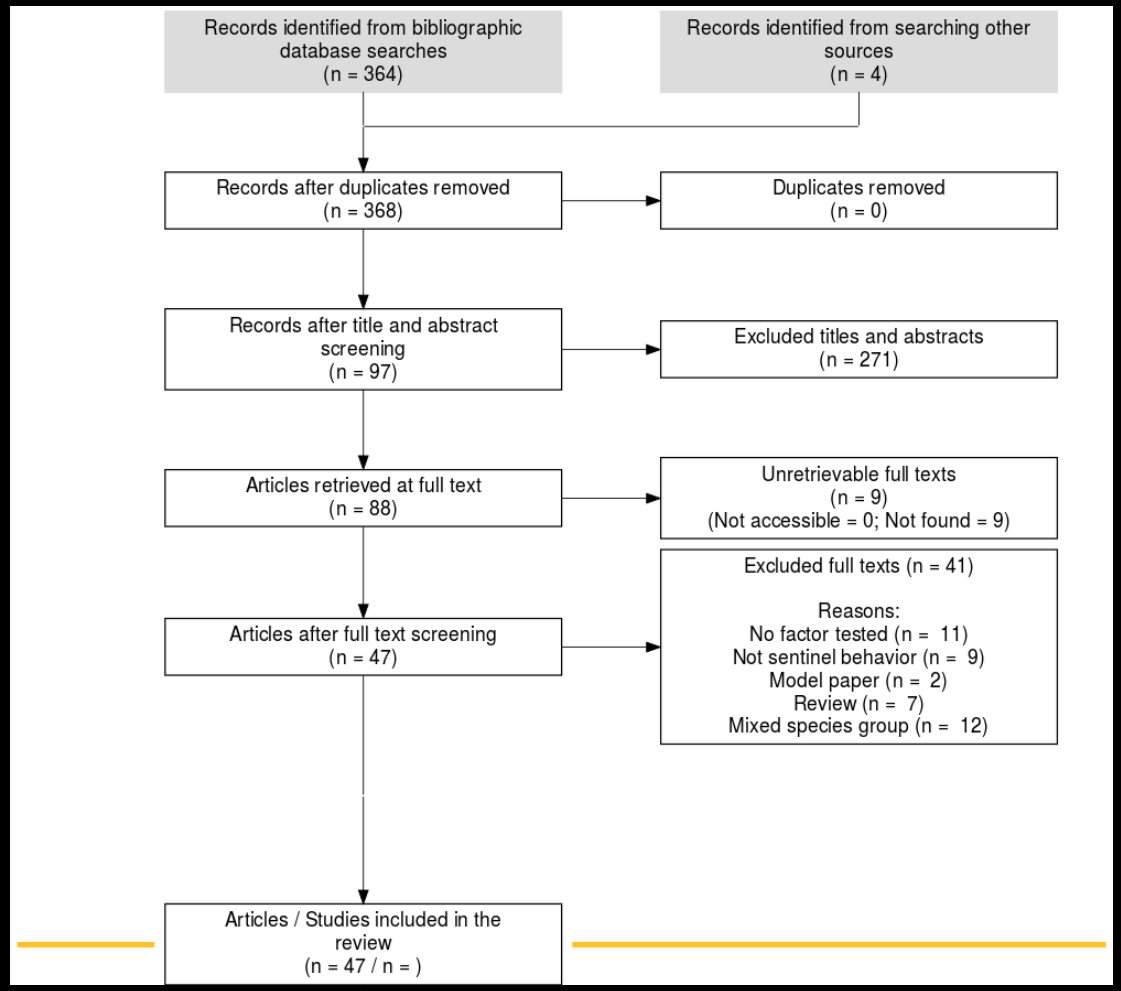
## Chapter 1 - Scoping review

- Narrative synthesis completed
- Writing in progress

## Chapter 2 - Field research

- Statistical analysis improved & completed
- Writing in progress

# Chapter 1 – The scoping review




Objective: To determine what factors can alter sentinel behavior to infer how urbanization can affect the behavior

- Searched 7 databases in Web of Science on Nov. 1st, 2022
- Additional articles found using Elicit, an AI-assisted search engine for research articles
- Resulted in 47 articles included in my scoping review
  - All exemplar articles retained

# What is sentinel behavior?

Dictionary definition: a soldier or guard whose job is to stand and keep watch

Frequently used definition: an individual that adopts a raised position, scanning for predators and warning others of danger

# A better definition

Frequently used definition: an individual that adopts a raised position, scanning for predators and warning others of danger

Not behaviors exclusive to sentinel behavior

- Contributes to the variations in definitions used
- Leads to misidentification

More recently, the coordination of sentinel bouts among group members has been identified as the defining feature

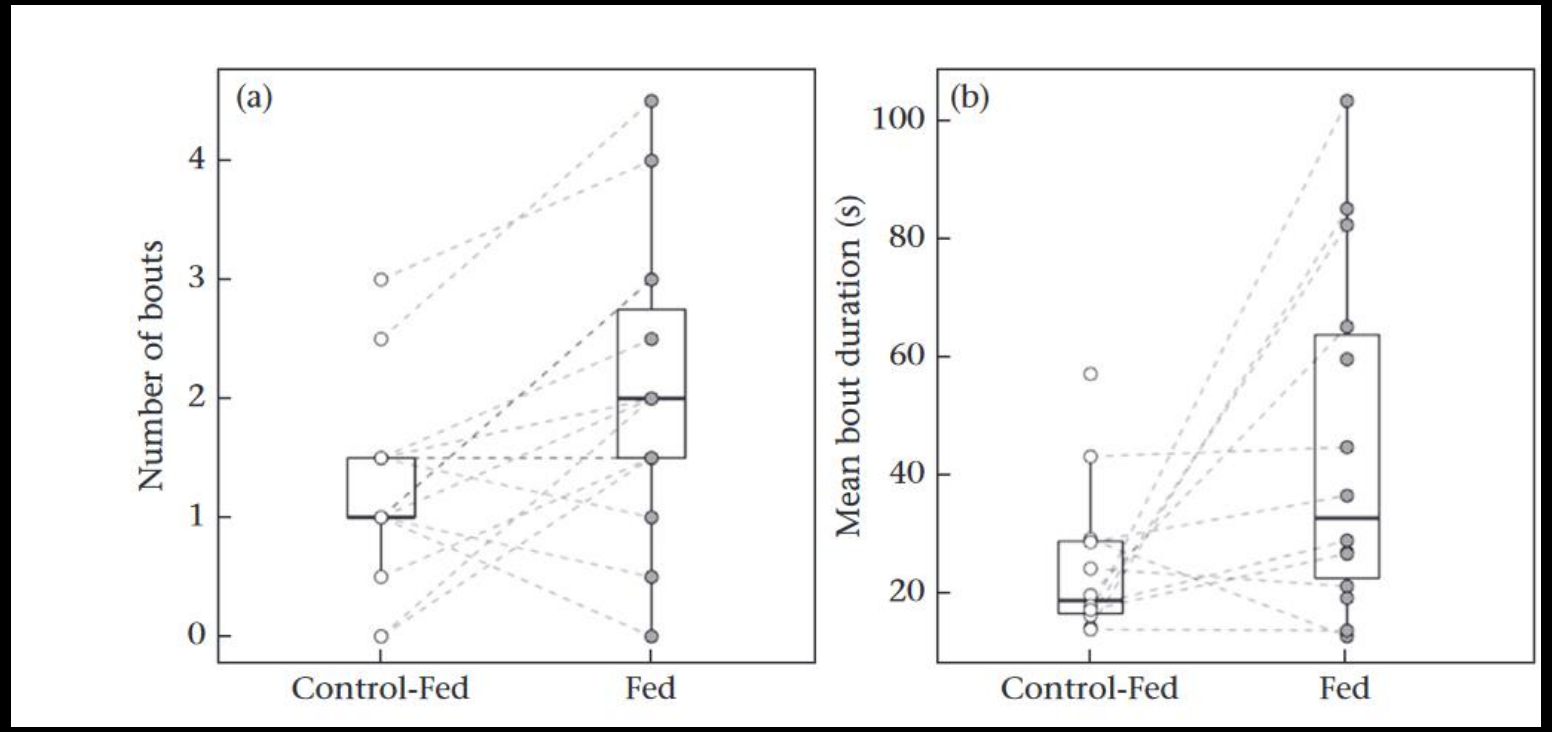
- Not frequently used in literature
- Out of  47 articles retained, 10 mention coordination as defining feature
- More difficult to test for

Bednekoff, Peter. (2015). Sentinel Behavior: A Review and Prospectus. Advances in the Study of Behavior. 47. 115-145

# Measurements of sentinel behavior

Generally, some variation on:

- Time spent
- Bout duration
- Number of bouts




From J. J. Arbon et al. (2020) in dwarf mongooses

Yet, many studies use wildly different measurements

- Makes performing a meta-analysis difficult to perform

# Main factors identified

| Level | Factor | Effect on sentinel “effort” | Species (# Articles) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

Other factors include breeding period, time of day, presence of young (pups), other sentinels/sentinel effort of other group members, presence/contact with rival or outgroup conspecifics…

# Selfish sentinels

What if there was a better explanation for sentinel decision-making?

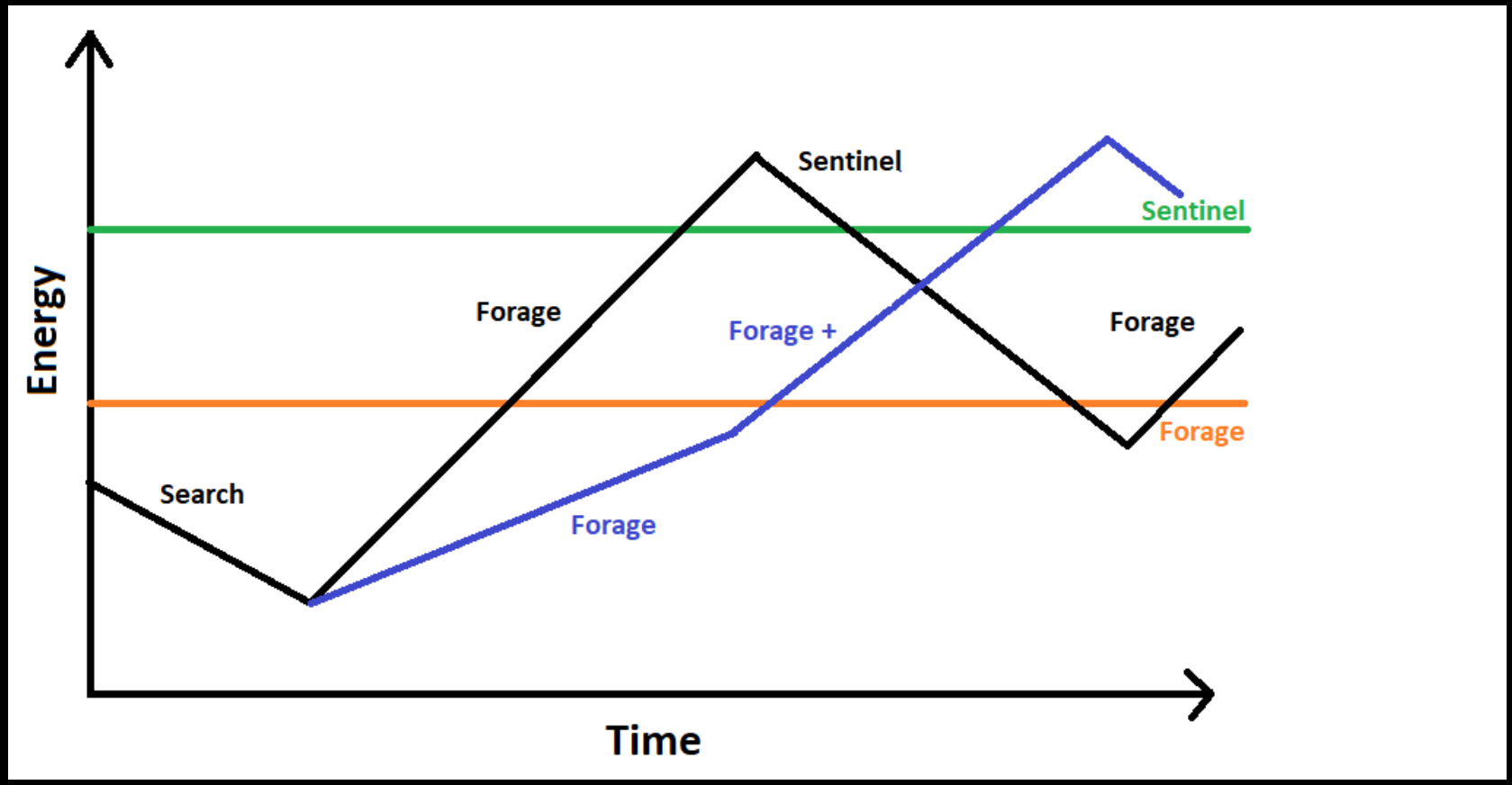
Proposed by Dr. P.A. Bednekoff in 1997, the selfish, state-dependent model for sentinel decision-making best explains sentinel decision-making

Relies on three main assumptions:

- Sentinel behavior is a low-cost activity performed by individuals that have sufficient energetic reserves from foraging.
- Benefits of sentinel behavior arise only from an increase in personal safety, not from protecting other group members
- Safe refuges do not exist, therefore the sentinel's post is the safest place to be if the alternative is foraging without a sentinel

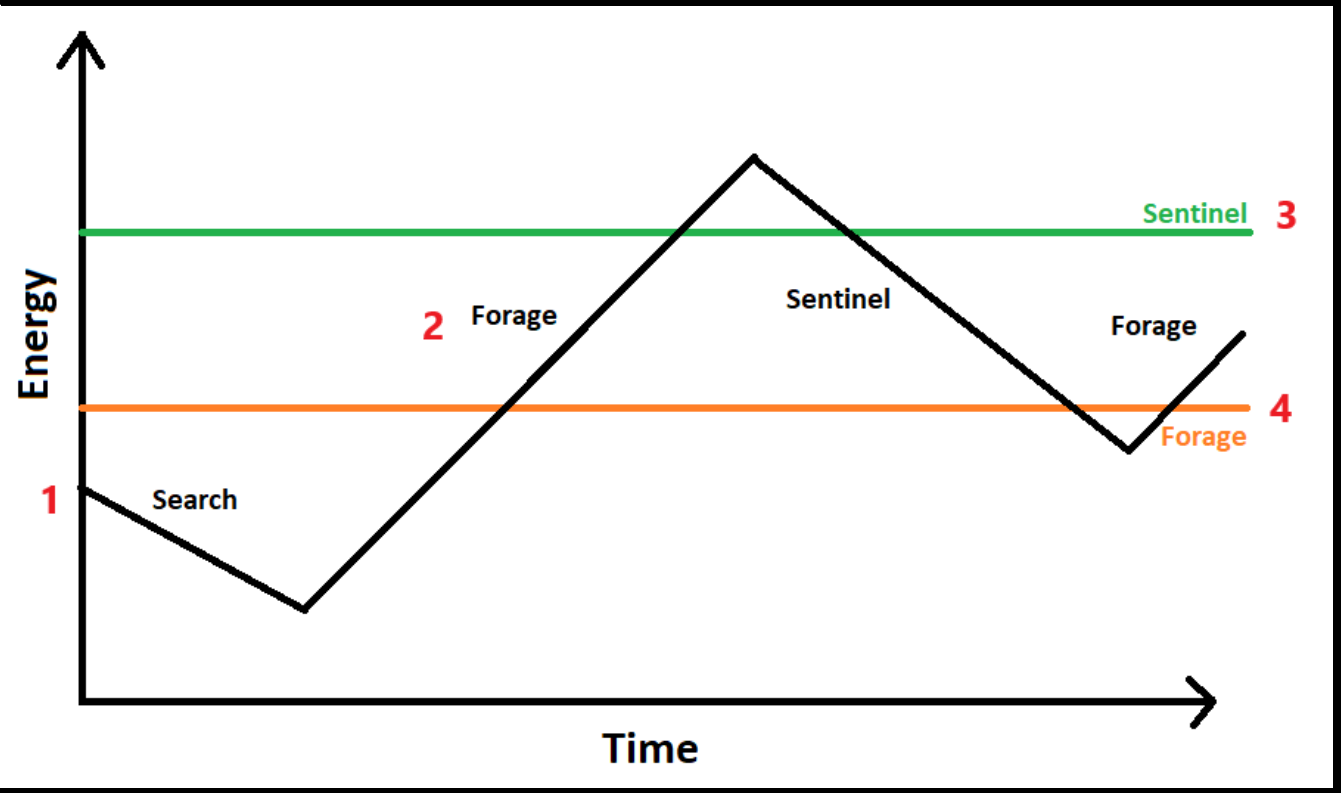
Bednekoff, P.A., Mutualism among Safe, Selfish Sentinels: A Dynamic Game. The American Naturalist 1997 150:3, 373-392

# In other words?



# Main factors identified

| Level | Factor | Point |
|---|---|---|
| Individual | Sex: Male | 3, 4 |
| | Sex x Dominance | 1, 2, 3, 4 |
| | ↑ Maturity | 2 |
| | ↑ Body Mass | 1 |
| | ↑ Satiation | 1 |
| Social | ↑ Group size | - |
| | ↑ Dominance | 1, 2 |
| Environmental | ↑ Predation | 3 |
| | ↑ Anthro. Disturb | 3 |



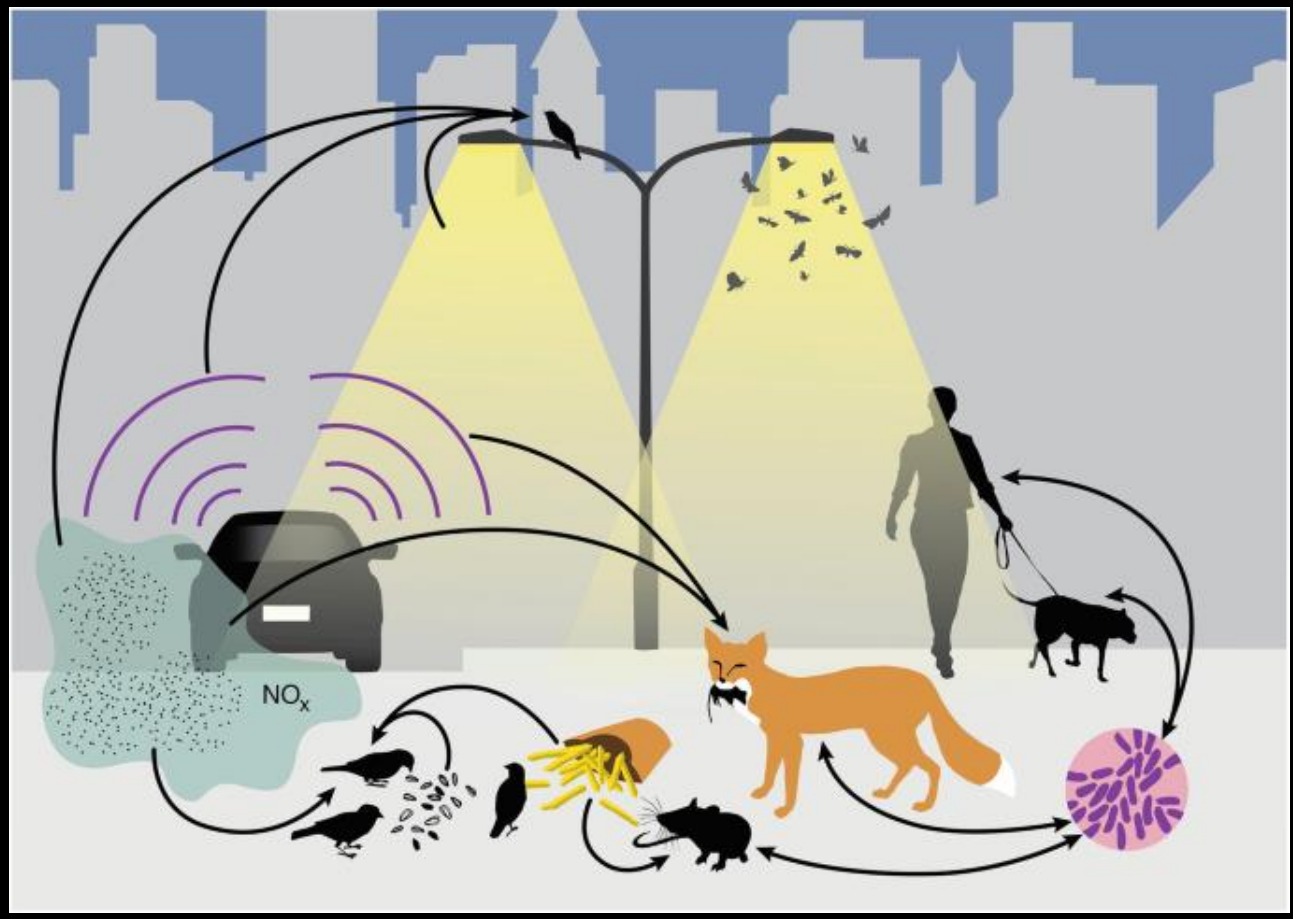
# Effects of urbanization

We have modified the environment to suit our needs…

- More impermeable surfaces
- Infrastructure
- Presence of trash cans, litter

And we inevitably have an impact on wildlife

- Increased proximity and interactions with humans
- People feeding animals
- Anthropogenic noise & disturbances

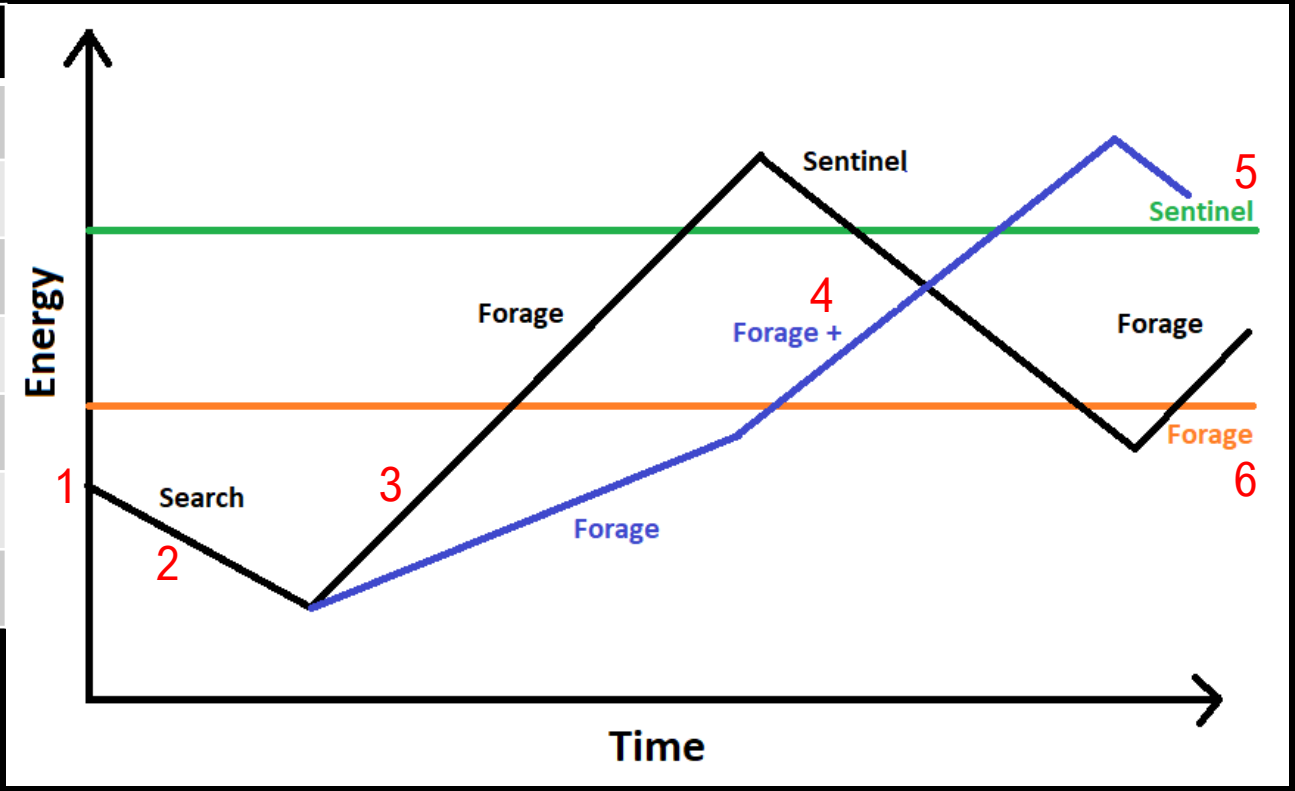



Isaksson, C. (2018). Impact of Urbanization on Birds. In: Tietze, D. (eds) Bird Species

# Effects of urbanization

| Factor | Point |
|---|---|
| ↑ Impermeable surface area | 2, 3 |
| ↑ Predictability of food sources | 1, 2, 5 |
| ↑ Availability of food sources | 1, 2, 5 |
| ↑ Infrastructure | - |
| ↑ Anthropogenic noise | 4, 5 |
| Heat island effect | 1 |
| ↑ Proximity to humans & pets | 5, 6 |

This is by no means an exhaustive list



# Sentinels and urban settings

Urban settings are expected to increase the likelihood of sentinel behavior

- Increased access to food = ↑ Energy
- Presence of urbanized predators and humans = ↑ Risk
- Abundant locations for sentinels to perch on

In turn, sentinels are expected to decrease the individual vigilance of foragers.

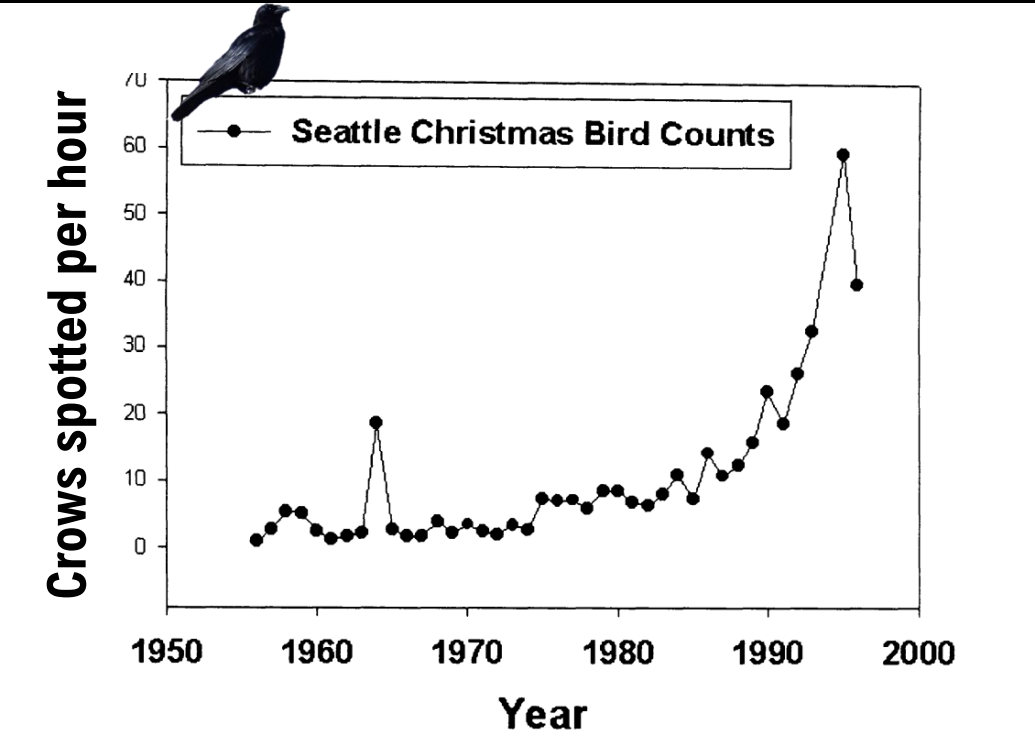
# Chapter 2 – The empirical study

Objective: To determine whether and how individual vigilance while foraging is affected by the presence of a sentinel and the environment in which the individual forages in.

The modified use of social behaviors in urbanized species is understudied and could explain, in part, the success of American crows in urban areas

Prediction: Foragers would be less vigilant in the presence of a sentinel but be more vigilant in commercial areas.

# American crows in urban areas




Marzluff *et al.*(2001). *Avian Ecology and Conservation in an Urbanizing World || Causes and consequences of expanding American Crow populations.*

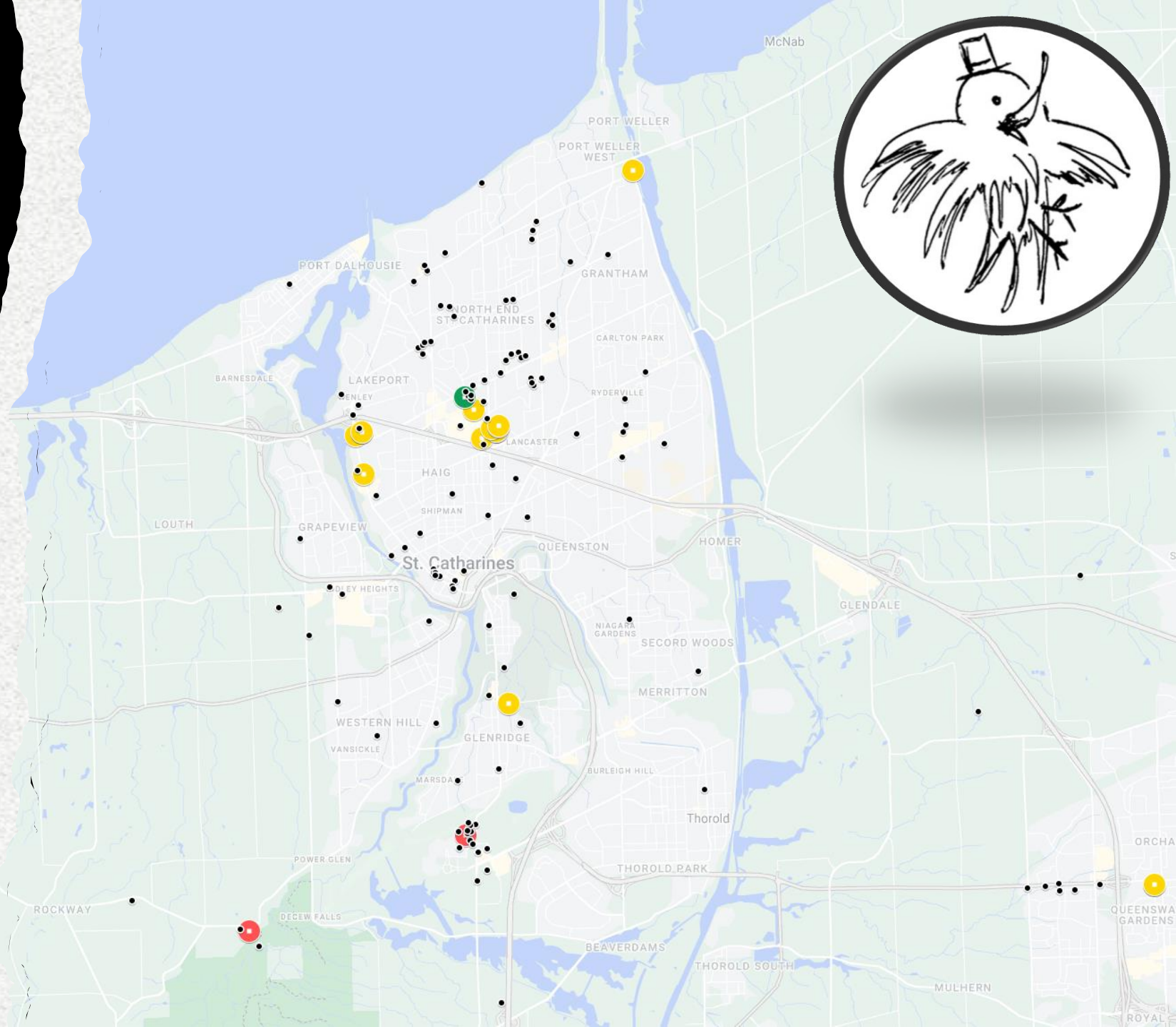
Does the social nature of urbanized species contribute to their success in urban areas?

American crows (*Corvus brachyrhynchos*) are an ideal model to test for social behaviors in urbanized species.

# Crowkemon Go

Started in Jan 2022

Participants across the Niagara region were invited to mark the locations of crows.



# Methods

Foraging bouts were video recorded from a distance and coded at a later date

25 videos recorded from May to September 2022

# Methods - Ethogram

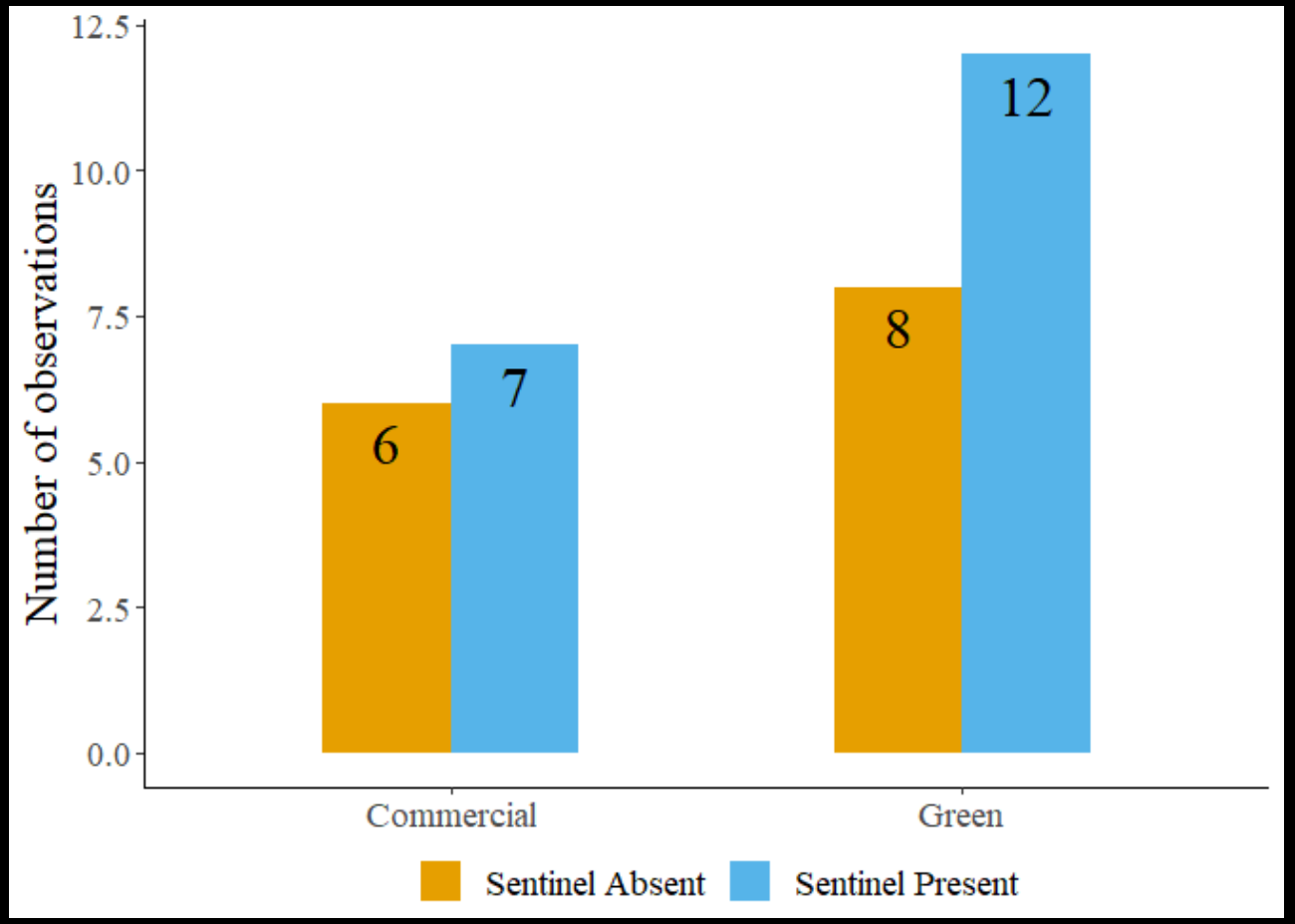
| Behavior | Vigilance | Definition | Illustration |
|---|---|---|---|
| Foraging | ↓ | Focal individual is stationary and has its head downwards or in a non-upright position, either pecking or handling food, looking for food, or engaging in other behaviors that make vigilance ineffective (e.g. preening). |  |
| Moving | | Focal individual is moving, either by flying, hopping (leaping), or walking. |  |
| Alert | ↑ | The focal individual is stationary and has its head and body in an upright position. Individuals can have a mobile (scanning) or immobile head but must not be looking downwards. Individuals can be handling food. |  |

# Methods – Measurements & Statistical Analysis

| Measurements | Test performed | Predictions |
|---|---|---|
| | | |
| Likelihood of a sentinel being present | | |
| Allocation of time | | |
| Duration of behavioral instances | | |
| Peck Rate | | |
| Number of transitions | | |

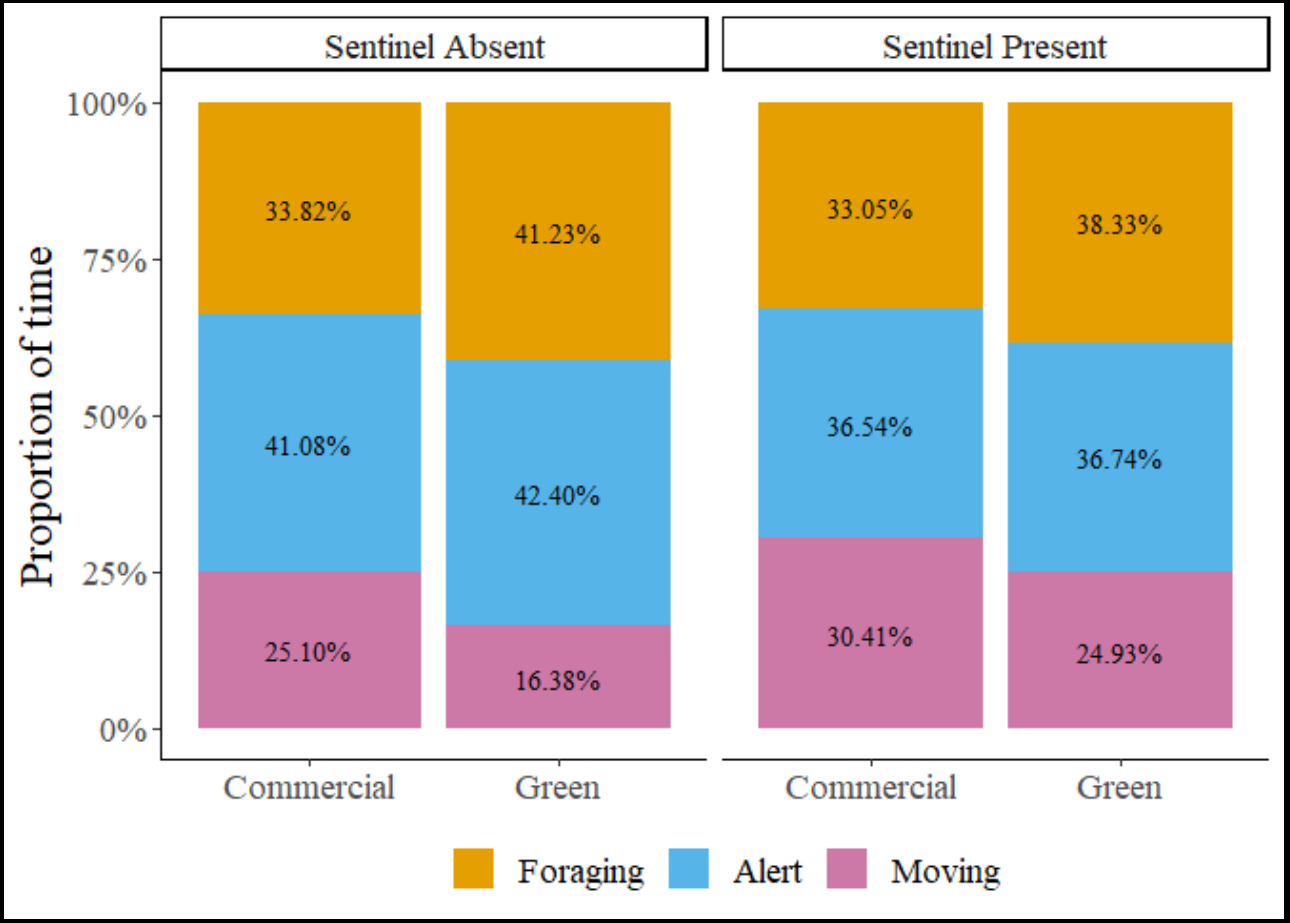
# Results: Likelihood of sentinel presence

Chi-square tests revealed no effects of generalized environment, disturbance frequency or group size.



# Results: Allocation of time

Linear model fit to proportion of time revealed no effects of sentinel presence or generalized environment

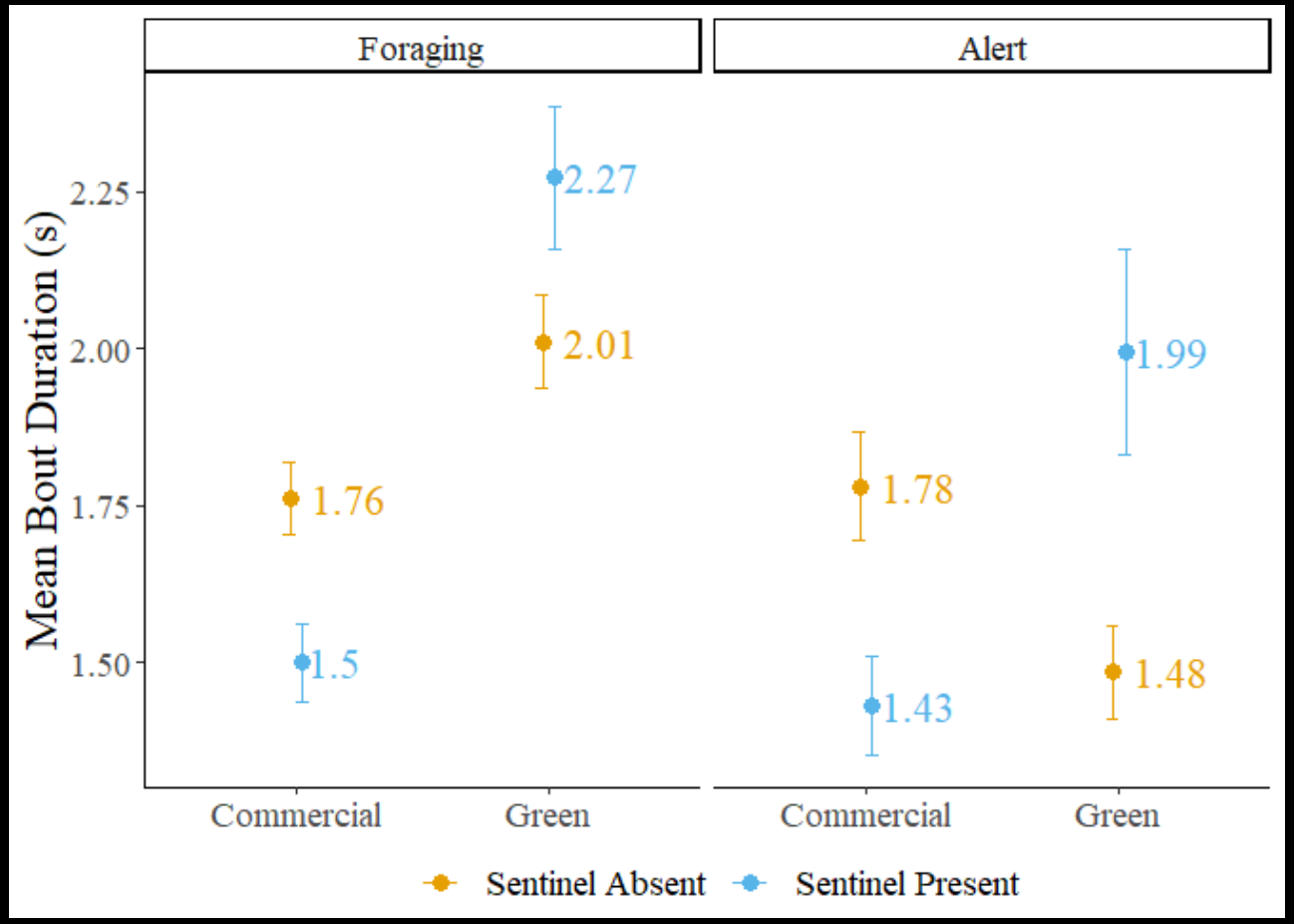



Proportion of time allocated to each behavior by foragers in commercial and green areas

# Results: Bout Duration

Sentinel presence significantly increased the duration of **all** bouts.

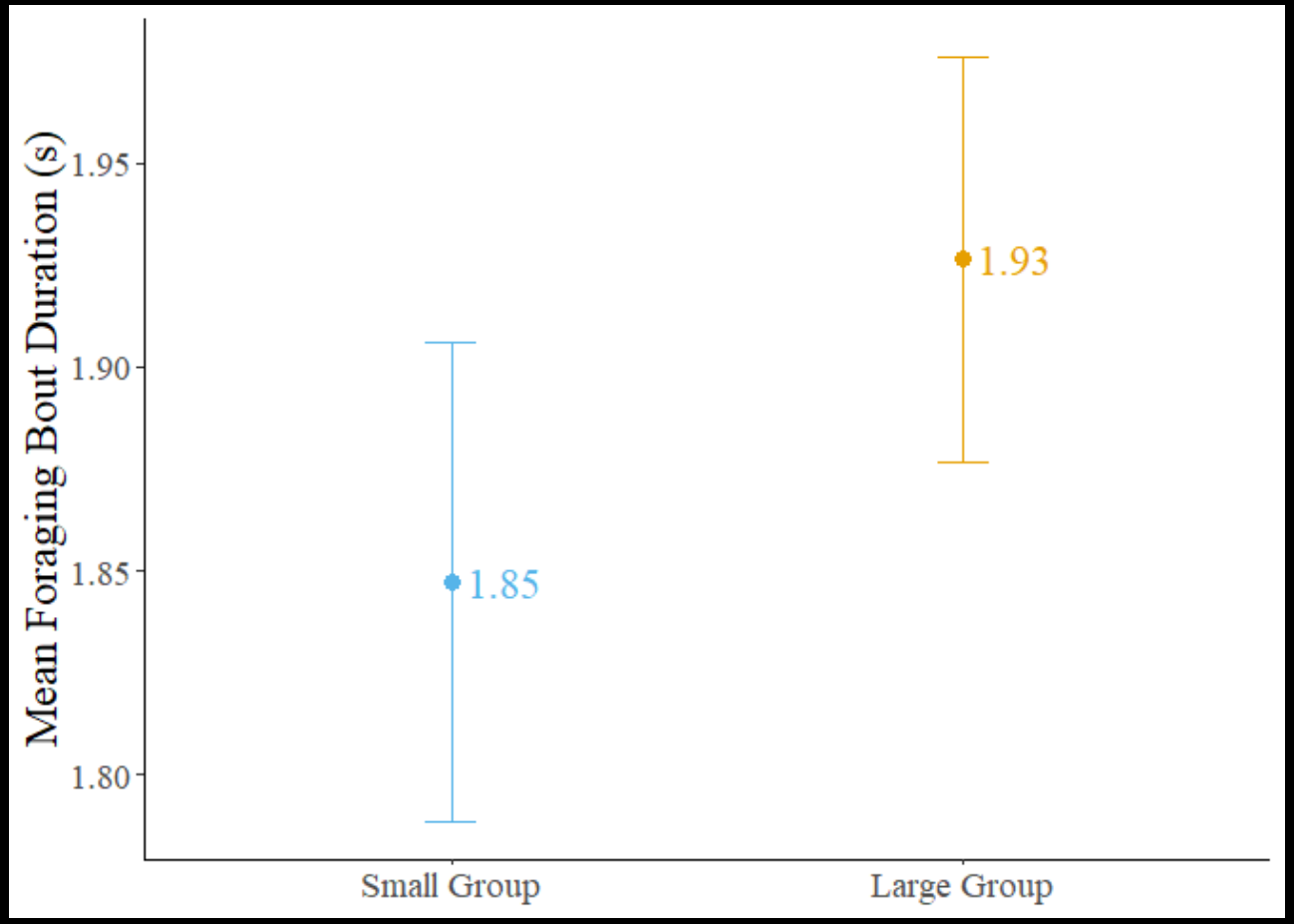
Bouts of **foraging** behavior were significantly shorter in commercial areas.




Mean bout duration of foragers in commercial and green areas
The dots represent the mean value, and the error bars represent the standard error.

# Results: Bout Duration

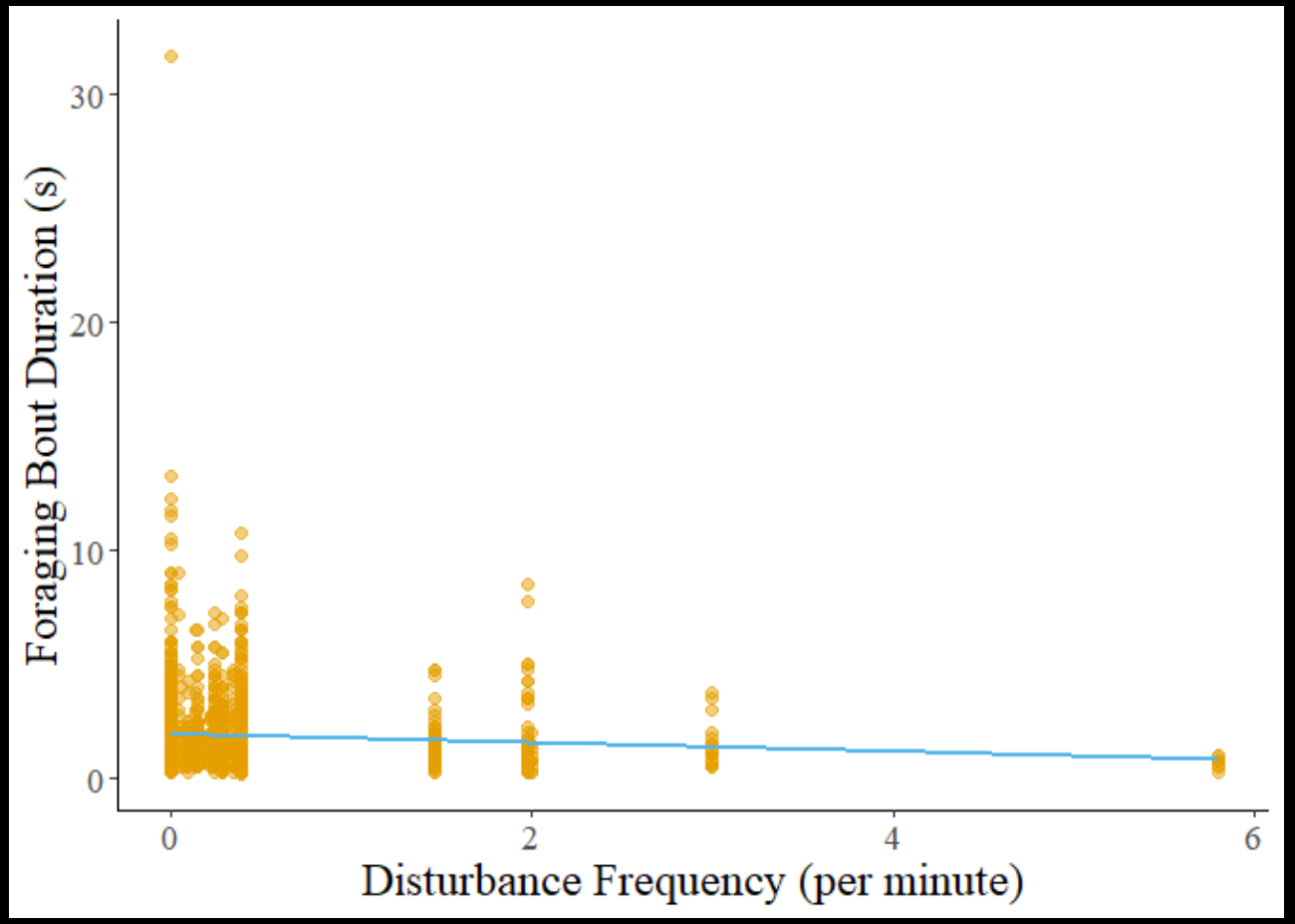
Bouts of foraging behavior were significantly longer in large groups.




Mean foraging bout duration of crows foraging in small and large groups
The dots represent the mean value, and the error bars represent the standard error.

# Results: Bout Duration

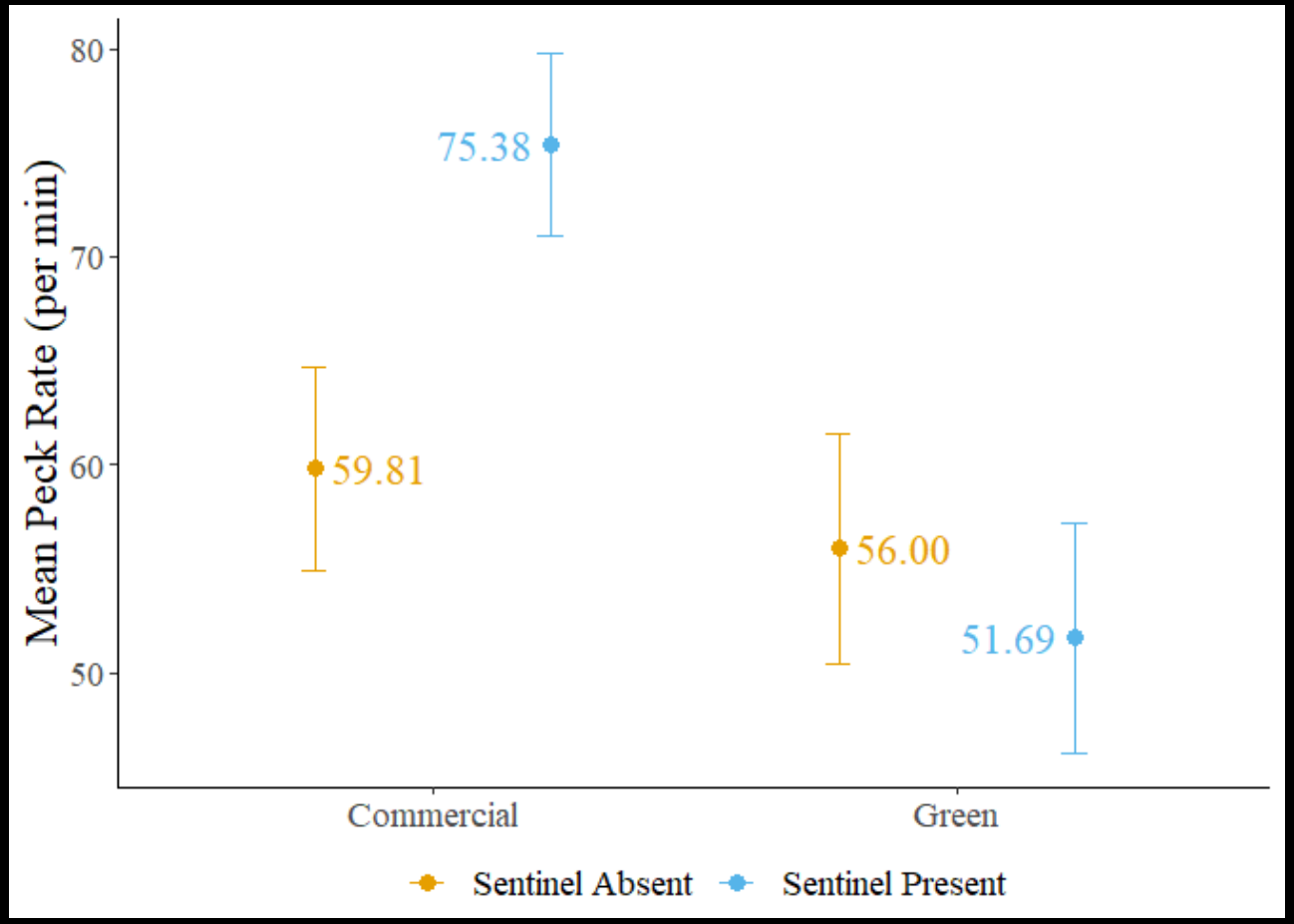
Bouts of **foraging** behavior significantly decreased as disturbance frequency increased.




Foraging bout duration decreasing with increasing disturbance frequency

# Results: Peck Rate

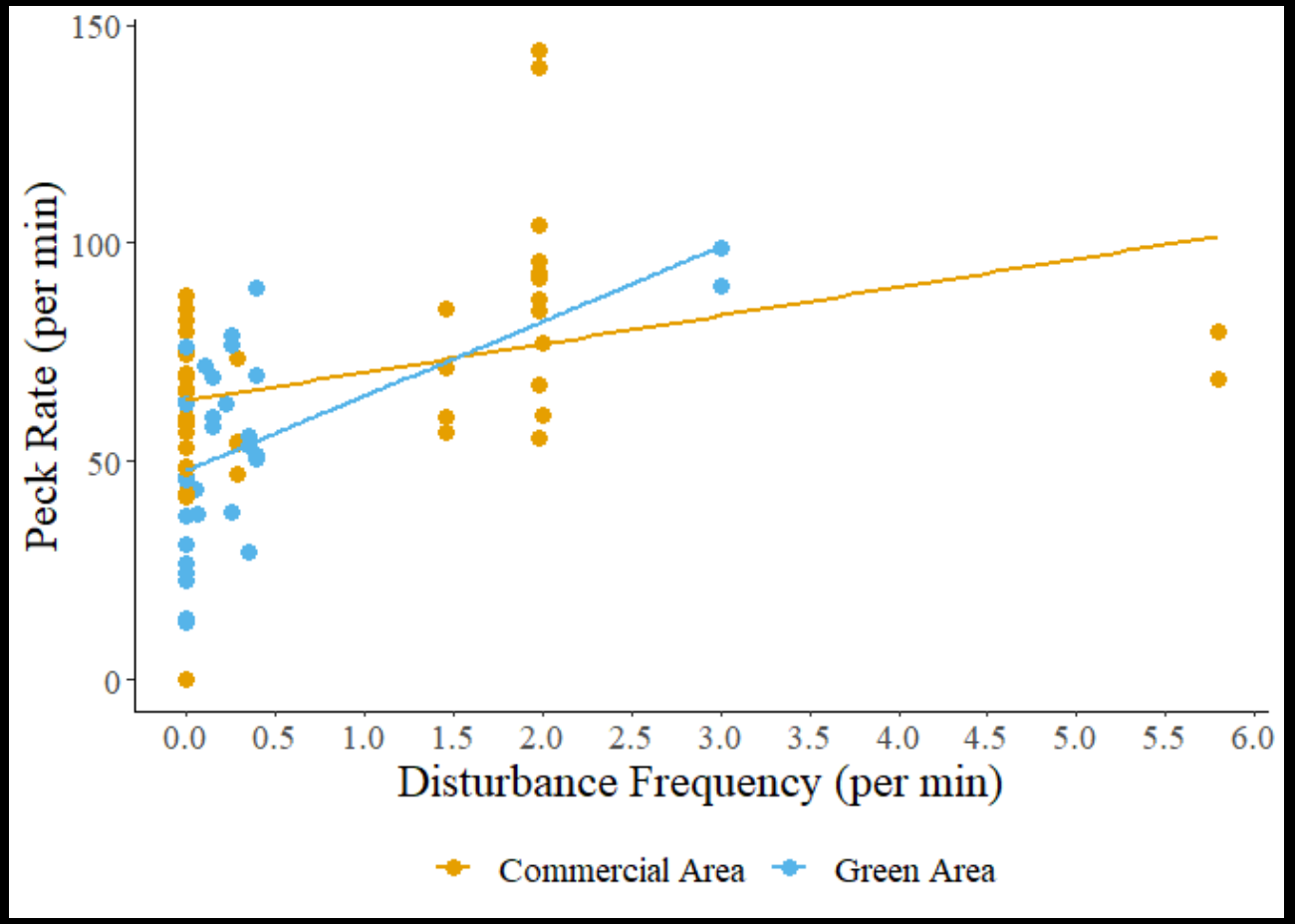
Neither sentinel presence nor generalized environment had a significant effect on forager peck rate.




Mean peck rate of foragers in commercial and green areas
The dots represent the mean value, and the error bars represent the standard error.

# Results: Peck Rate

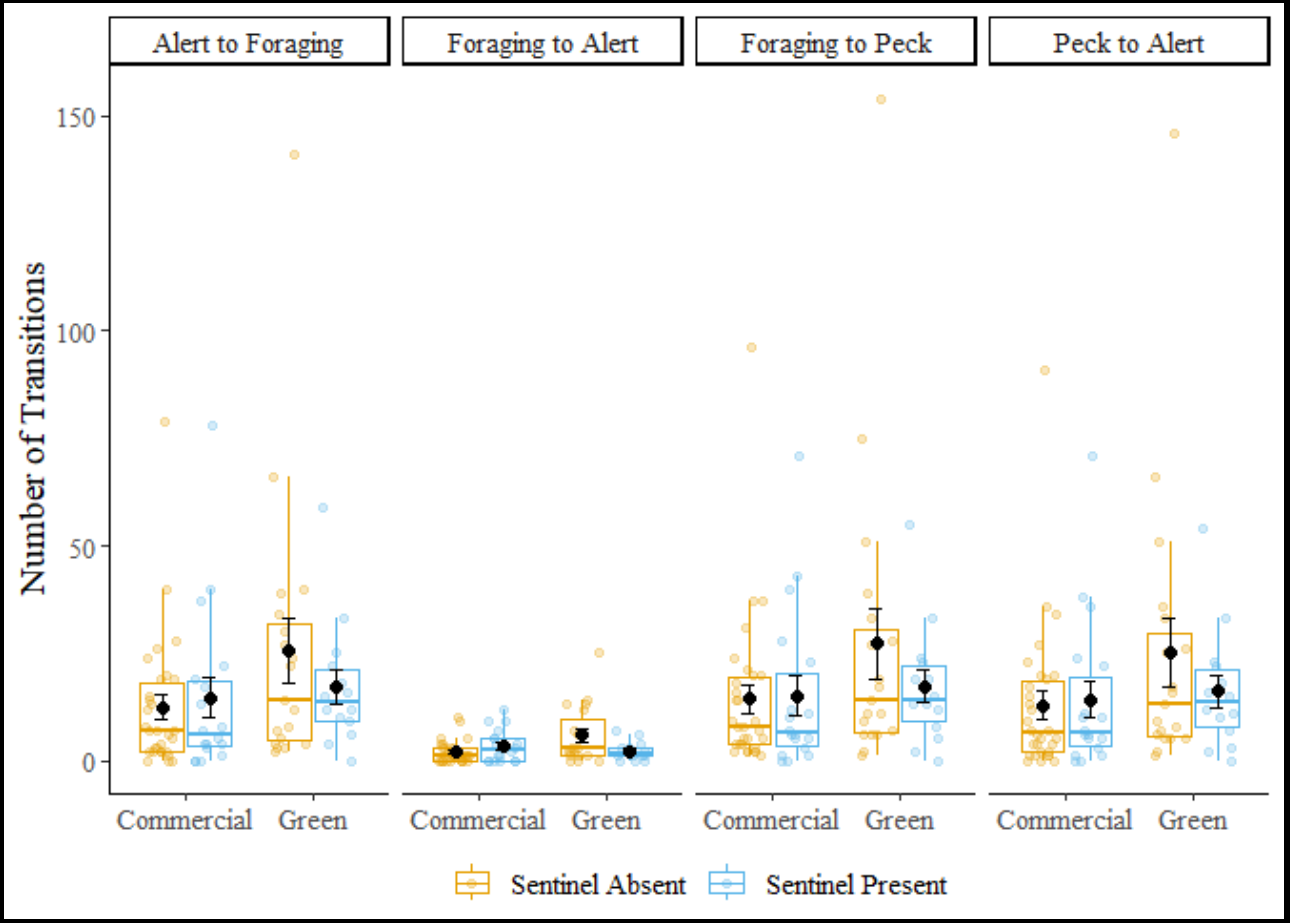
Peck rate significantly increased as disturbance frequency increased.




Peck rate increasing with increasing disturbance frequency

# Results: Number of transitions

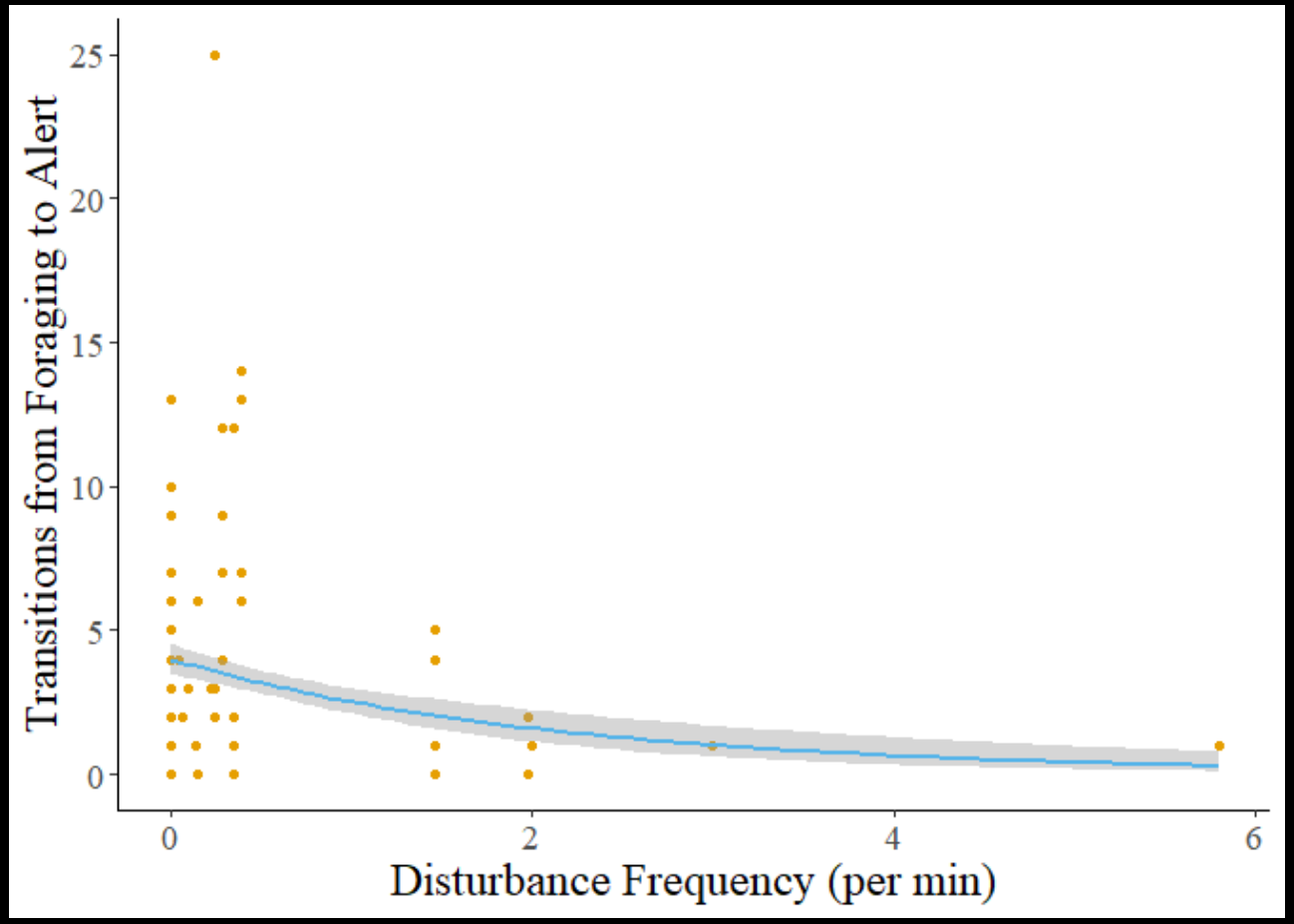
There were significantly fewer transitions from foraging to alert behavior in commercial areas.




Number of transitions performed by foragers in commercial and green areas
The black dots represent the mean value, and the error bars represent the standard error.

# Results: Number of transitions

The number of transitions from foraging to alert behavior significantly decreased with increasing disturbance frequency




Transitions from foraging to alert behavior increases as disturbance frequency increases
The grey shadow represents the standard error of the curve.

# Conclusions

| Measurements | Predictions | | Other effects |
|---|---|---|---|
| | Sentinel Presence | Commercial Area | |
| Likelihood of a sentinel being present | No Effect | | |
| Allocation of time to behaviors in foragers | No Effect | | |
| Duration of behavioral instances | **All bouts ↑** | **Foraging ↓** | **Disturbance Freq.<br>Group size** |
| Peck Rate | No Effect | | **Disturbance Freq.** |
| Number of transitions | No Effect | **Foraging → Alert ↓** | **Disturbance Freq.** |

# My conclusions

While urbanization could affect the likelihood of sentinel presence, my sample size is too small to make any firm conclusions.

The presence of a sentinel increased the duration of bouts of all behaviors but did not significantly change how much time an individual allocates to either vigilance or foraging behaviors.

Commercial areas significantly decreased the duration of foraging bouts and decreased the number of transitions from foraging to alert behavior, yet it did not affect the duration of bouts of alert behavior.

Foragers appear to be more responsive to disturbance frequency than their foraging environment.

# Future Endeavors

- Finish writing my thesis & successfully defend it
    - Upon completion, improve chapters & publish two articles
- Continue improving my abilities as a teaching assistant
- Network with fellow researchers & find future career opportunities

# Timeline

- Thesis draft completed by mid-December
- Final draft completed & sent to you in early 2024
- Thesis defense by the end of the Winter 2024 semester

I greatly appreciate your feedback and constructive criticism