Heads up! Vigilance behavior in American crows

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What have I been up to?

Conferences

- Brock’s MNK Conference (April)
- ASU SEEP workshop 2022 (May)
- CSEE/ESA 2022 Joint Annual Meeting (August)
- Brock's GRaD Conference (September)
- SQEBC 2022 at UQO (October)

What have I been up to?

Student life at Brock

Attempted to create an ecology module for LabLinks at Brock University

VP of events at GRAMSS

- Happy Hour
- Pumpkin Carving Contest
- Midwinter Social

Biology graduate student representative

Testing a scientific communication module with VPMI

What have I been up to?

Community work

SpeedQB

"Paintball"

- Introduced young and old players to a new style of play
- Organized two events that attracted players from the Southern Ontario region
- Setting up a league for 2023

Great feedback from the community & had the opportunity to use my communication skills in a non-academic setting.

What have I been up to?

Future Collaboration

Summer 2023

Crow Genoscape

- Collection of feathers in St. Catharines, Montreal and Quebec city
- Trial run in June
- Data collection in July-August

This is will depend wholly on the status on my thesis!

What have I been up to?

Thesis

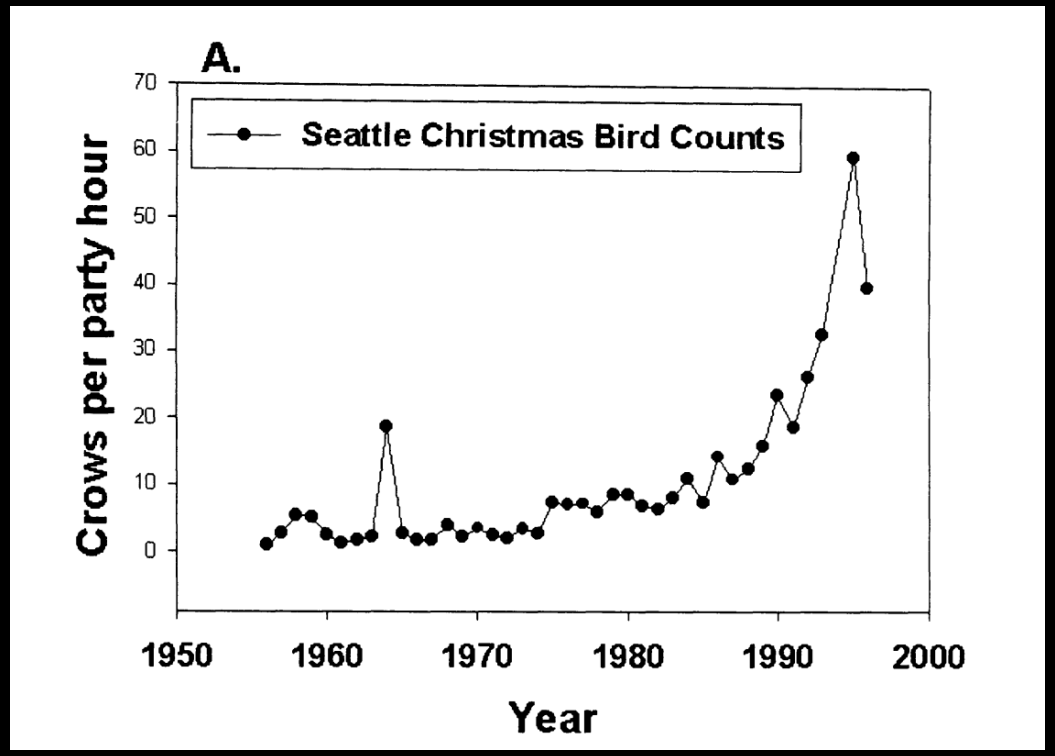
Scoping review

- Database searched (**WoS**)
- Title and Abstract screening completed
- Full-text screening nearing completion
- Researching how to conduct a meta-analysis and extract data

Field research

- Field season complete
- Videos coded
- Data analyzed

Some background information



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

Crows have been increasing in abundance in urban settings.

⇒Urbanized

What makes them so successful?

Individual behavioral adaptations

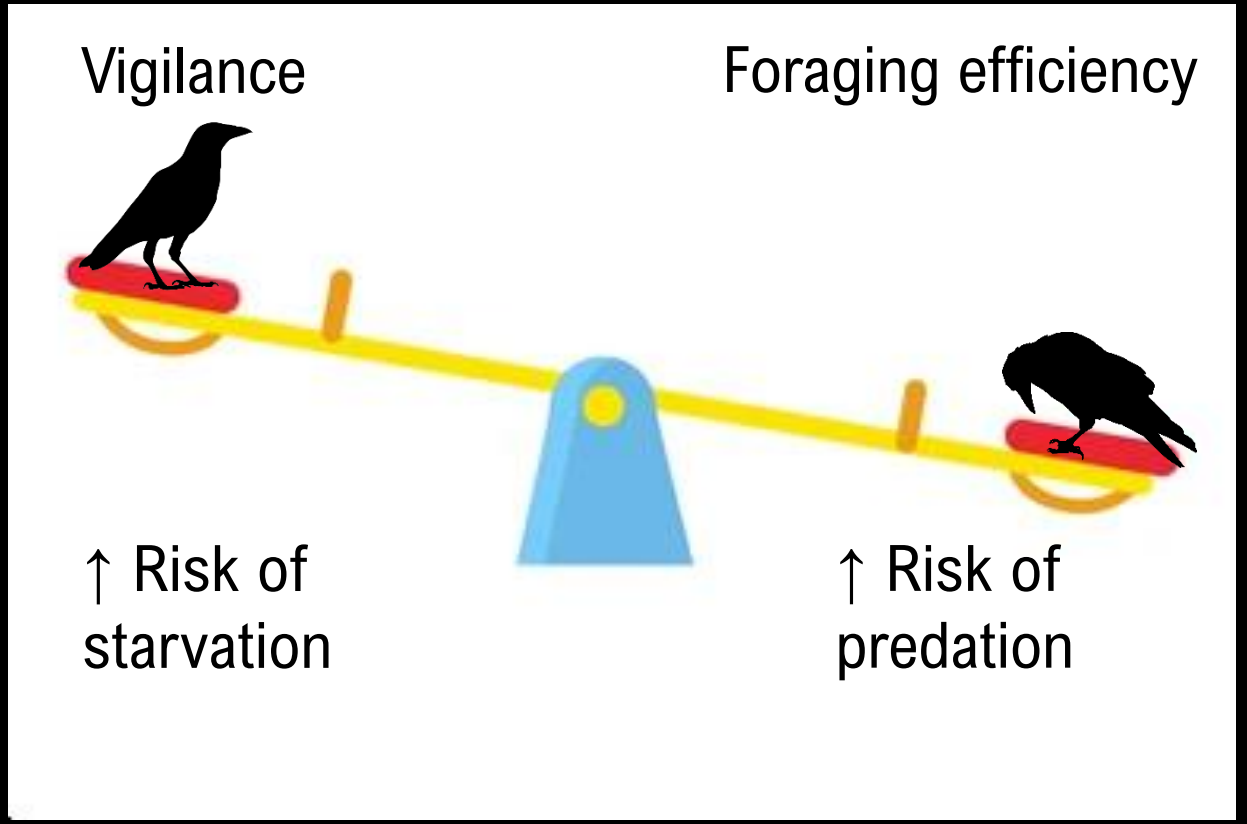
- Changes in foraging behavior
- Decreased neophobia
- Increased tameness towards humans

Some background information

What about social behavioral adaptations?

Social behaviors play into the trade-off between foraging efficiency and vigilance.

Too much is like not enough…

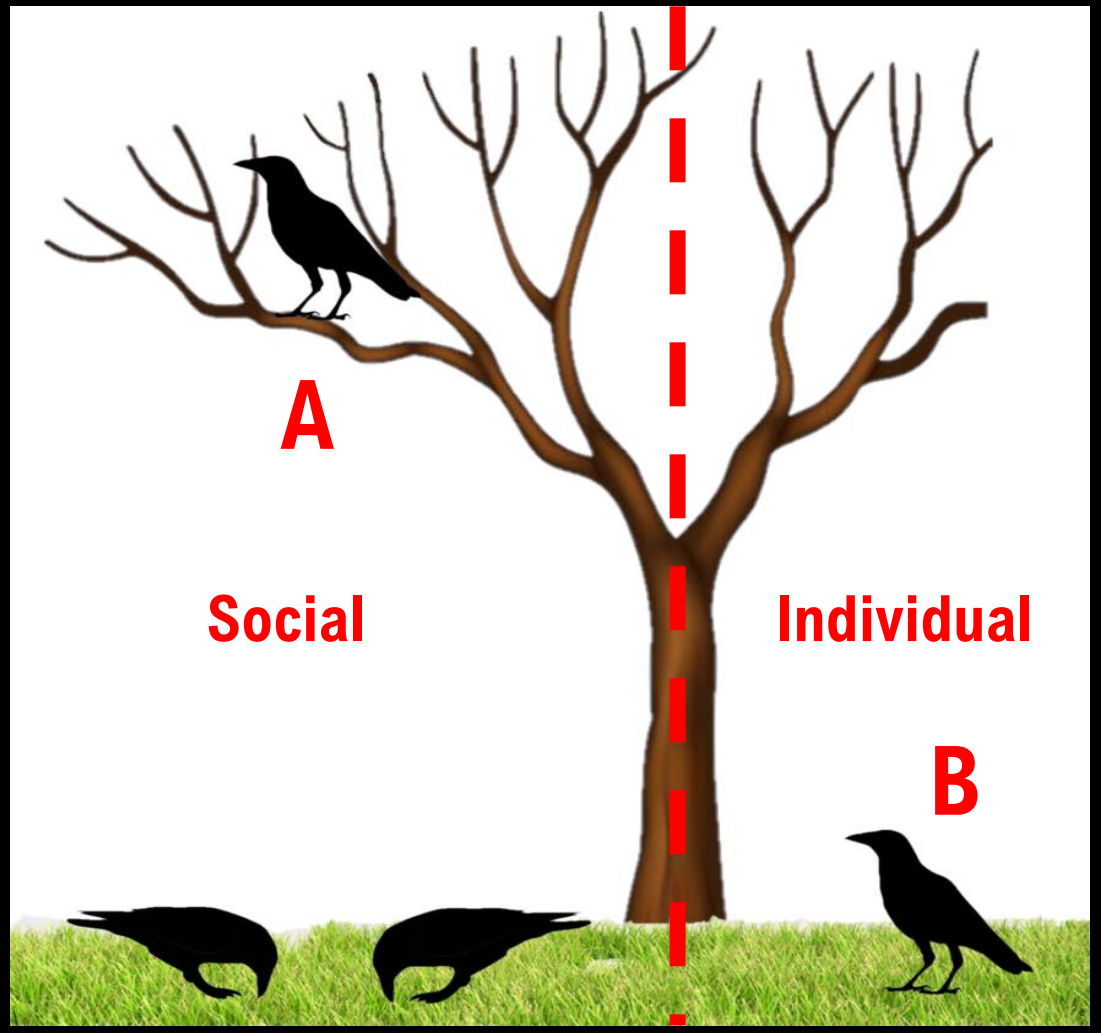


Some background information

Sentinel behavior is a type of social foraging behavior.

Sentinels (A) are constantly vigilant, providing security to the foraging members, but at a great cost to the sentinel.

Could this contribute to the success of crows in urban areas?



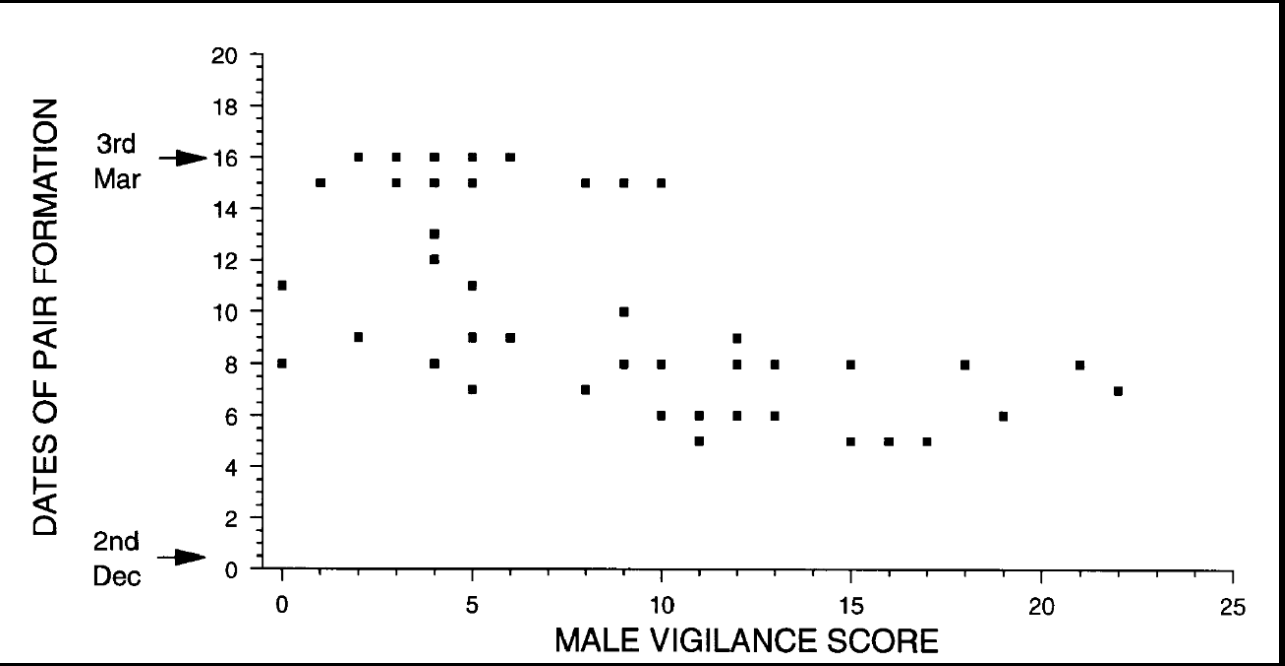
Sentinel behavior

Sentinel behavior is affected by multiple factors:

- Sex
- Dominance
- Pair status
- Age

Sentinel behavior as a type of sexual display.

↑ vigilance = ↑ success = better mate choice



From L. Beani and F. Dessì-Fulgheri (1998) in Grey Partridges

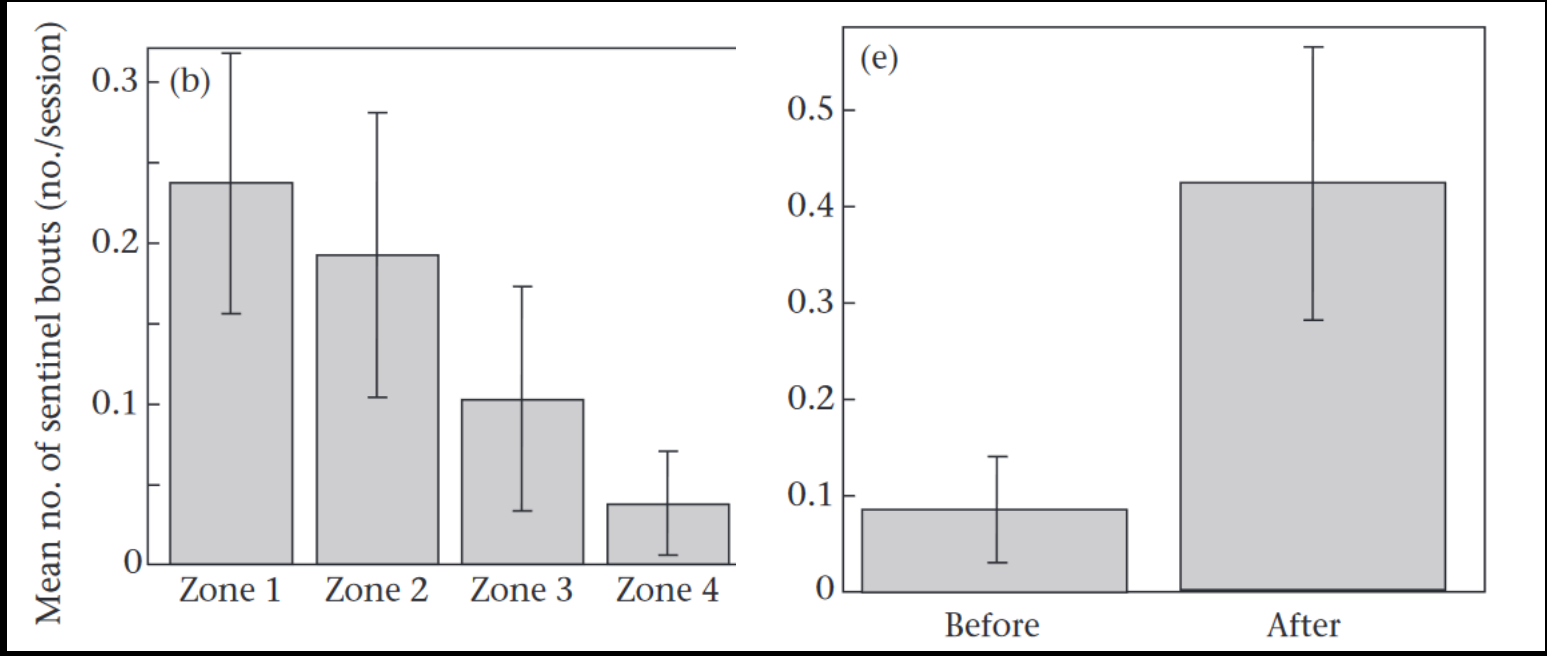
Vigilance decreased after pair formation.

Sentinel behavior

What about risk of predation?

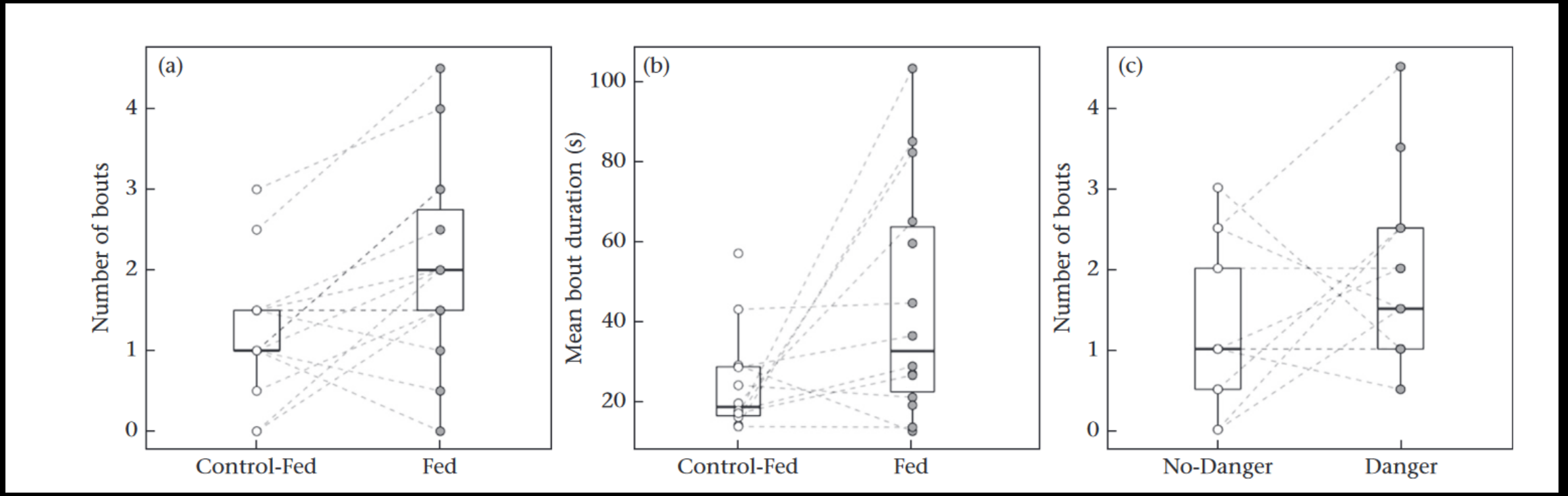
↑ risk = ↑ need for vigilance

Increased risk of predation causes an increase in frequency of sentinel behavior.



Mean number of sentinel bouts per session in response to increased risk of predation (b, Zone 1 = High predation, Zone 4 = Low predation) and in response to spotting a predator (e) in chestnut-crowned babblers.
From E. Sorato et al. 2012

Sentinel behavior



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

And satiation?

↑ satiation = ↓ need to forage

Well-fed individuals can be sentinels for longer and more often.

Sentinels and urban settings

Urban settings are expected to increase the likelihood of sentinel behavior

- Increased access to food = ↑ Satiation
- 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.

My 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.

I expect foraging individuals to be less vigilant in the presence of a sentinel but be more vigilant in commercial areas.

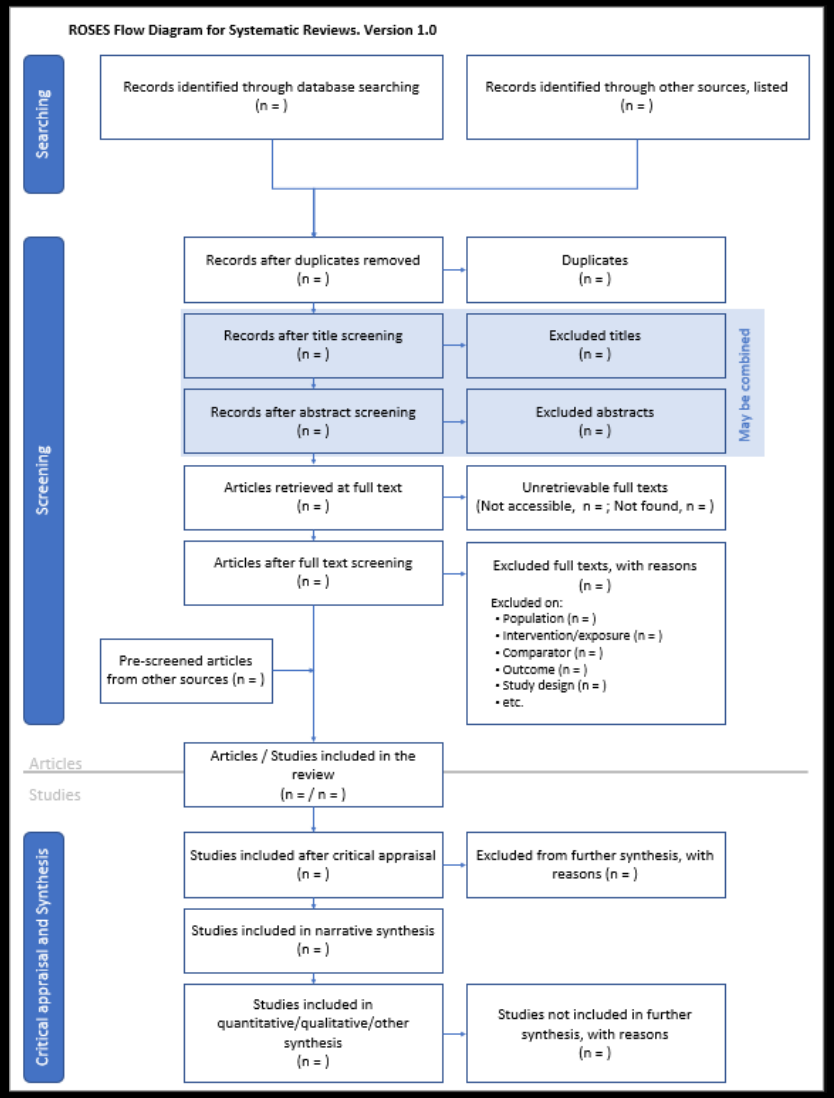
The scoping review

The objective of the scoping review remains the same:

- To identify factors that can affect sentinel behavior in terrestrial and avian species

Its purpose:

- To help me better explain what I observe in the field



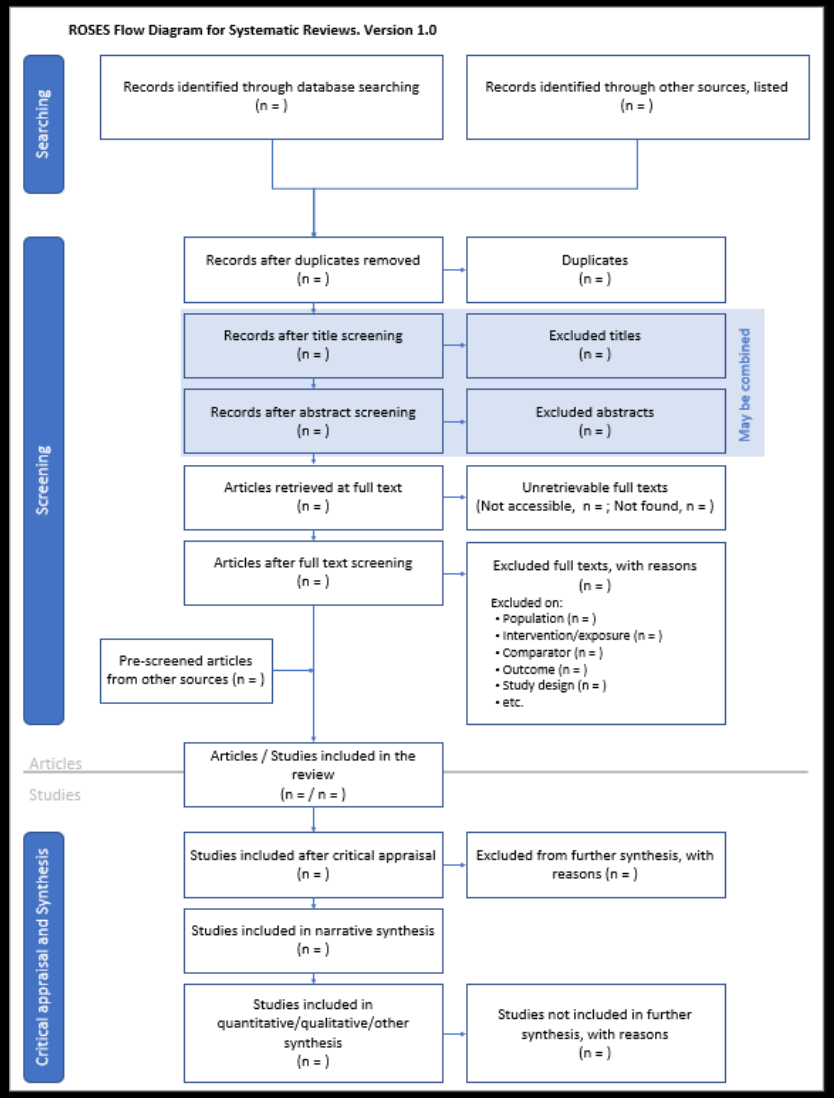
Methodology
Scoping review

I am following the ROSES workflow.

Searched Web of Science Complete using:

"Sentinel AND Behavio*"

Haddaway NR, Macura B, Whaley P, and Pullin AS. 2017. ROSES flow diagram for systematic reviews. Version 1.0. DOI: 10.6084/m9.figshare.5897389



Methodology
Scoping review

~~Excluded articles from unrelated fields of study and journals (e.g. Journal of Sleep Research)~~
NOT Optimal

Excluded irrelevant areas of research in WoS.

Excluded articles not written in English.

No need for de-duplication.

Haddaway NR, Macura B, Whaley P, and Pullin AS. 2017. ROSES flow diagram for systematic reviews. Version 1.0. DOI: 10.6084/m9.figshare.5897389

Search Strings – How not to do it

V1: (TS=(sentinel AND Behavio*)) AND ((LA==("ENGLISH") AND SJ==("BEHAVIORAL SCIENCES" OR "ZOOLOGY" OR "ENVIRONMENTAL SCIENCES ECOLOGY" OR "NUTRITION DIETETICS" OR "REPRODUCTIVE BIOLOGY" OR "BIODIVERSITY CONSERVATION" OR "WATER RESOURCES" OR "ACOUSTICS" OR "EVOLUTIONARY BIOLOGY" OR "COMMUNICATION" OR "DEVELOPMENTAL BIOLOGY" OR "URBAN STUDIES") AND DT==("ARTICLE" OR "ABSTRACT" OR "REVIEW" OR "UNSPECIFIED")) NOT (SILOID==("MEDLINE") OR SO==("SLEEP ROCHESTER" OR "SLEEP" OR "REMOTE SENSING" OR "JOURNAL OF SLEEP RESEARCH" OR "ENVIRONMENTAL BIOLOGY OF FISHES" OR "MEDICINE AND SCIENCE IN SPORTS AND EXERCISE" OR "MEDICINE SCIENCE IN SPORTS EXERCISE" OR "NEUROPSYCHOPHARMACOLOGY" OR "DRUG DEVELOPMENT RESEARCH" OR "JOURNAL OF TROPICAL ECOLOGY" OR "KOELLA W P ED SLEEP 1982 PHYSIOLOGY PHARMACOLOGY SLEEP FACTORS MEMORY SLEEP DEPRIVATION HYPNOTICS 6TH EUROPEAN CONGRESS ON SLEEP RESEARCH ZURICH MARCH 23 26 1982 XIV 435P S KARGER BASEL SWITZERLAND NEW YORK N Y USA ILLUS" OR "PSYCHOLOGICAL RECORD" OR "REVIEWS IN FISH BIOLOGY AND FISHERIES" OR "ALCOHOLISM CLINICAL AND EXPERIMENTAL RESEARCH" OR "ELECTROENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY" OR "FRONTIERS IN MARINE SCIENCE" OR "EVOLUTION AND HUMAN BEHAVIOR" OR "AMERICAN JOURNAL OF TROPICAL MEDICINE AND HYGIENE" OR "BEHAVIOR THERAPY" OR "CANADIAN JOURNAL OF FISHERIES AND AQUATIC SCIENCES" OR "CURRENT DIRECTIONS IN PSYCHOLOGICAL SCIENCE" OR "HUMAN PSYCHOPHARMACOLOGY" OR "REMOTE SENSING OF ENVIRONMENT" OR "HUMAN PSYCHOPHARMACOLOGY CLINICAL AND EXPERIMENTAL" OR "COMPUTERS IN HUMAN BEHAVIOR" OR "ZEITSCHRIFT FUR TIERPSYCHOLOGIE JOURNAL OF COMPARATIVE ETHOLOGY" OR "ZEITSCHRIFT FUER TIERPSYCHOLOGIE" OR "TRANSPORTATION RESEARCH PART F TRAFFIC PSYCHOLOGY AND BEHAVIOUR" OR "ECOLOGICAL MODELLING" OR "FRESHWATER BIOLOGY" OR "AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY" OR "BULLETIN OF THE PSYCHONOMIC SOCIETY" OR "COGNITIVE THERAPY AND RESEARCH" OR "PSYCHOPHYSIOLOGY" OR "ERGONOMICS" OR "HYDROBIOLOGIA" OR "EUROPEAN JOURNAL OF SOCIAL PSYCHOLOGY" OR "HERRMANN W M ED ELECTROENCEPHALOGRAPHY IN DRUG RESEARCH PROCEEDINGS OF THE SYMPOSIUM BERLIN WEST GERMANY JUNE 27 29 1980 XIX 608P BUTTERWORTHS WOBURN MASS USA GUSTAV FISCHER VERLAG STUTTGART NEW YORK N Y USA ILLUS" OR "IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING" OR "IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING" OR "INDUSTRIAL HEALTH" OR "SLEEP STUTTGART" OR "JOURNAL OF VETERINARY BEHAVIOR CLINICAL APPLICATIONS AND RESEARCH" OR "INTERNATIONAL JOURNAL OF REMOTE SENSING" OR "JOURNAL OF COMPARATIVE PHYSIOLOGY A SENSORY NEURAL AND BEHAVIORAL PHYSIOLOGY" OR "JOURNAL OF FISH BIOLOGY" OR "JOURNAL OF PSYCHOPATHOLOGY AND BEHAVIORAL ASSESSMENT" OR "JOURNAL OF ZOO AND AQUARIUM RESEARCH" OR "MARINE AND FRESHWATER RESEARCH" OR "PERSONAL RELATIONSHIPS" OR "JOURNAL OF CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY" OR "PERCEPTUAL AND MOTOR SKILLS" OR "EUROPEAN NEUROPSYCHOPHARMACOLOGY" OR "MARINE ECOLOGY PROGRESS SERIES" OR "PSYCHOPHARMACOLOGY") OR MC==("POPULATION STUDIES" OR "NEURAL COORDINATION" OR "ENDOCRINE SYSTEM" OR "POLLUTION ASSESSMENT CONTROL AND MANAGEMENT" OR "MOVEMENT AND SUPPORT" OR "MATHEMATICAL BIOLOGY" OR "EQUIPMENT APPARATUS DEVICES AND INSTRUMENTATION" OR "OCCUPATIONAL HEALTH" OR "TRANSPORT AND CIRCULATION" OR "COMPUTER APPLICATIONS" OR "AGING" OR "ECONOMICS" OR "ENZYMOLOGY" OR "INFORMATION STUDIES" OR "RADIOLOGY" OR "CLINICAL IMMUNOLOGY" OR "RADIATION BIOLOGY" OR "DERMATOLOGY" OR "SOCIOLOGY" OR "GASTROENTEROLOGY" OR "ONCOLOGY" OR "PHILOSOPHY AND ETHICS" OR "SURGERY" OR "URINARY SYSTEM" OR "UROLOGY" OR "CLINICAL ENDOCRINOLOGY" OR "HEMATOLOGY" OR "PALEOBIOLOGY" OR "PHARMACOGNOSY" OR "CARDIOVASCULAR SYSTEM" OR "MEDICAL SCIENCES" OR "PEDIATRICS" OR "PUBLIC HEALTH" OR "INGESTION AND ASSIMILATION" OR "PATHOLOGY" OR "BIOGEOGRAPHY" OR "NERVOUS SYSTEM" OR "COMPUTATIONAL BIOLOGY" OR "HUMAN MEDICINE MEDICAL SCIENCES" OR "MODELS AND SIMULATIONS" OR "AGRICULTURE" OR "MARINE ECOLOGY" OR "ANTHROPOLOGY" OR "BIOCHEMISTRY AND MOLECULAR BIOPHYSICS" OR "MOLECULAR GENETICS" OR "INTEGUMENTARY SYSTEM" OR "VECTOR BIOLOGY" OR "VETERINARY MEDICINE" OR "GERIATRICS" OR "DIGESTIVE SYSTEM" OR "HORTICULTURE" OR "SANITATION" OR "SPORTS MEDICINE" OR "AGRICHEMICALS" OR "ALLERGY" OR "BIOGRAPHY" OR "BIOMEDICAL ENGINEERING" OR "BIOPROCESS ENGINEERING" OR "CLINICAL IMMUNOLOGY HUMAN MEDICINE MEDICAL SCIENCES" OR "EDUCATION" OR "AQUACULTURE" OR "CLINICAL CHEMISTRY" OR "PHARMACOLOGY" OR "CHEMICAL COORDINATION AND HOMEOSTASIS" OR "PSYCHIATRY" OR "NEUROLOGY" OR "PHYSIOLOGY" OR "FRESHWATER ECOLOGY" OR "ALLIED MEDICAL SCIENCES" OR "DENTAL AND ORAL SYSTEM" OR "CELL BIOLOGY" OR "BLOOD AND LYMPHATICS" OR "SKELETAL SYSTEM" OR "RESPIRATORY SYSTEM" OR "RESPIRATION" OR "MUSCULAR SYSTEM" OR "EXOBIOLOGY" OR "GYNECOLOGY" OR "HISTORY" OR "HOSPITAL ADMINISTRATION" OR "HUMAN MEDICINE" OR "NEPHROLOGY" OR "NURSING" OR "PULMONARY MEDICINE" OR "SEROLOGY" OR "SOIL SCIENCE" OR "WASTE MANAGEMENT" OR "MEMBRANES" OR "IMMUNE SYSTEM" OR "CARDIOVASCULAR MEDICINE" OR "TOXICOLOGY" OR "ECONOMIC ENTOMOLOGY")))

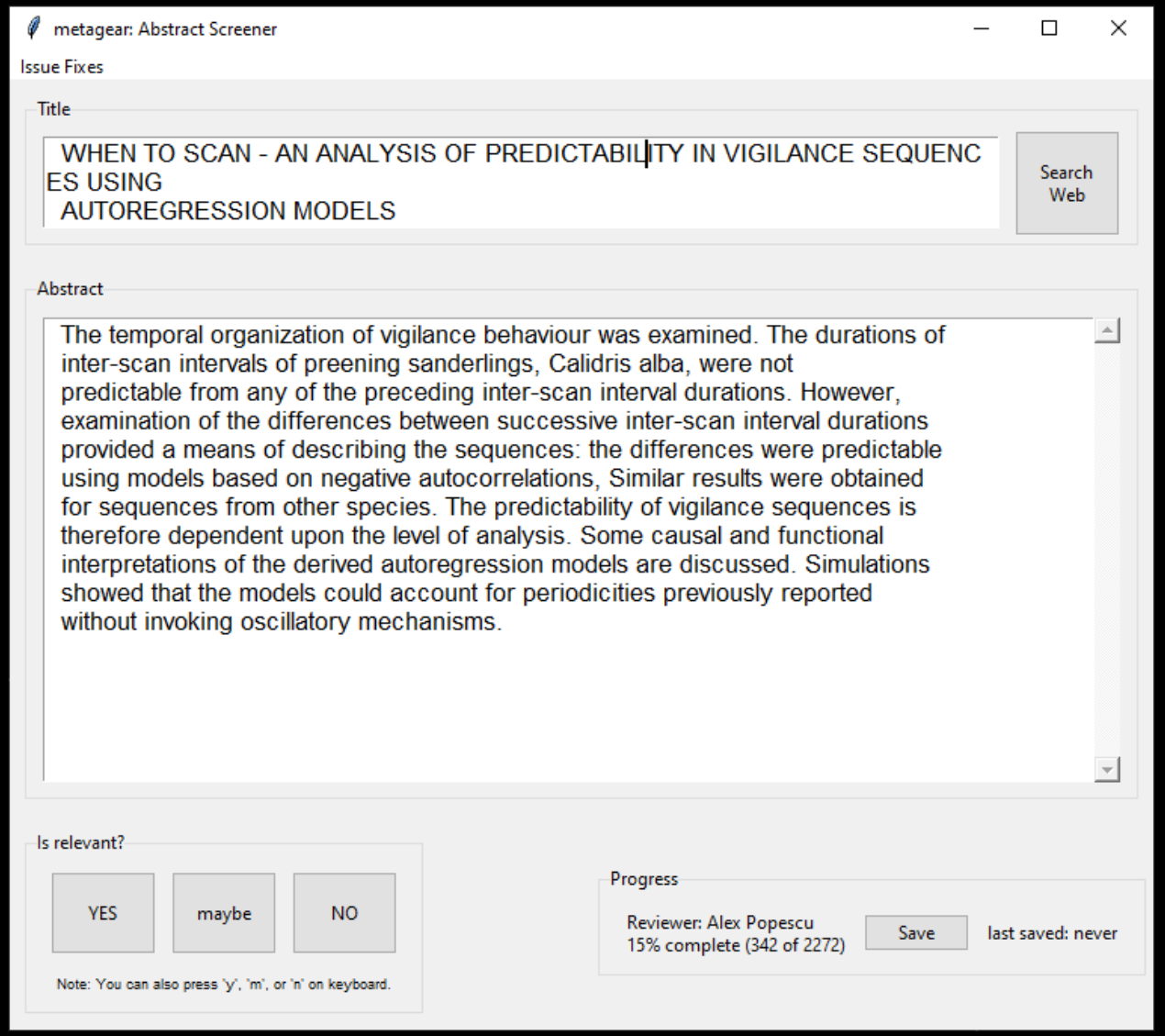
Horrible to work with and missed articles of interest.

Search Strings – The right way

V2: ((TS=(sentinel AND Behavio*)) AND ((LA==("ENGLISH")))) AND ((SJ==("BEHAVIORAL SCIENCES")) NOT (SJ==("HEALTH CARE SCIENCES SERVICES" OR "PEDIATRICS" OR "PHARMACOLOGY PHARMACY" OR "MARINE FRESHWATER BIOLOGY" OR "GENERAL INTERNAL MEDICINE" OR "METEOROLOGY ATMOSPHERIC SCIENCES" OR "SUBSTANCE ABUSE" OR "CRIMINOLOGY PENOLOGY" OR "RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING" OR "SURGERY" OR "MEDICAL LABORATORY TECHNOLOGY" OR "PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH“ OR "WOMEN APOS S STUDIES" OR "GEOCHEMISTRY GEOPHYSICS" OR "RESEARCH EXPERIMENTAL MEDICINE" OR "IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY" OR "EDUCATION EDUCATIONAL RESEARCH “

OR "BUSINESS ECONOMICS" OR "BIOTECHNOLOGY APPLIED MICROBIOLOGY")))

Much better results – 364 results on Nov. 1 2022 on WoS Complete



Metagear GUI while screening SorVandB in R

Methodology Scoping review

Performed article/abstract screening in R using Metagear.

Lajeunesse Lab is still a great resource!

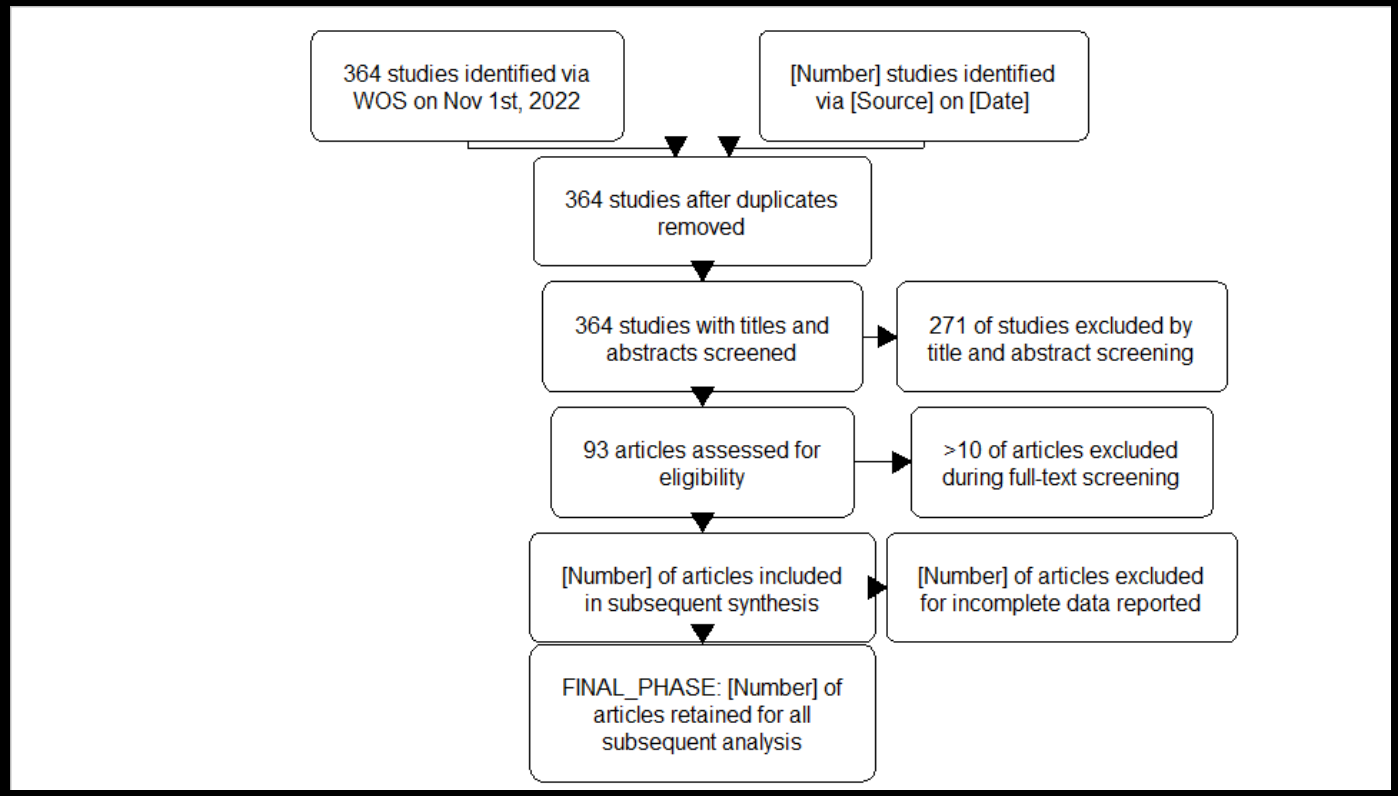
Following their methodology for meta-analysis and synthesis.

Methodology Scoping review

271 articles excluded

93 articles retained

Screened three times and nearly done full-text screening.



Prisma workflow of "Sentinel AND Behaviour"

Methodology: Field Research

Combination of baited sites and opportunistic baiting.

25 videos recorded from May to September.

Methodology: Field Research
Timeline of observations

- Arrive on-site -> 5min setup
- Set up camera, place bait, return to camera
- Record for 20 minutes, then leave for another site
- Stay 10 minutes after crows have left if bait was not fully consumed
- When leaving, leave 5 peanuts in-shell if no foraging occurred. If opportunistic site, then no peanuts were left.

Ethogram

Went through a couple more version versions in response to feedback received at meetings with Dr. Clark's lab and at conferences.

Behavior code	Description
Peck at Food/Bait	Focal individual uses its beak to peck at a food item.
Peck at Ground	Focal individual pecks at the ground, usually to hide food items - caching
Head Up	Individual is stationary and has its head and body in a upright position. Individual can have a mobile (scanning) or immobile head, but must not be looking downwards. Individual can be handling food.
Head Down	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 behaviours that make vigilance ineffective (e.g. preening).
Moving	Focal individual is moving, either by flying, hopping (leaping) or walking.
Away from Bait	Focal individual is at least 2.5m of the bait
Out of Frame	Focal individual is out of the frame of vision
Sentinel Present	A sentinel, a non-forager that exhibits constant vigilance over the foraging members of a group, is present.
Perched - Head Down	Individual is perched and has its head downwards or in a non-upright position, either pecking or handling food, looking for food or engaging in other behaviours that make vigilance ineffective (e.g. preening).
Perched - Head Up	Individual is perched and has its head and body in a upright position. Individual can have a mobile (scanning) or immobile head, but must not be looking downwards. Individual can be handling food.
Aggression	To peck or lunge at another individual. The recipient can either be a conspecific or a heterospecific.
Disturbance	A pedestrian, vehicle, pet or wild animal disturbs the 5m area around the bait.

Raw Data

Observation id	Duration (s)	ID	G.Env	Num.Rec	Baited
007 - Short Hills Vineyard - 1 crow - No Bait	2.251	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	3.507	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	0.988	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	7.768	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	16.498	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	6.776	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	1.022	7	Agriculture	1	N
007 - Short Hills Vineyard - 1 crow - No Bait	5.505	7	Agriculture	1	N
013 - First St Louth Farm - 3 crows - No Bait	1.991	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	0.749	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	1.509	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	4.249	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	1.749	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	1.001	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	0.996	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	9.234	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	5.227	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	1.493	13	Agriculture	2	N
013 - First St Louth Farm - 3 crows - No Bait	5.531	13	Agriculture	2	N

Results

Main test used: Linear Mixed Models (Robust or generalized)

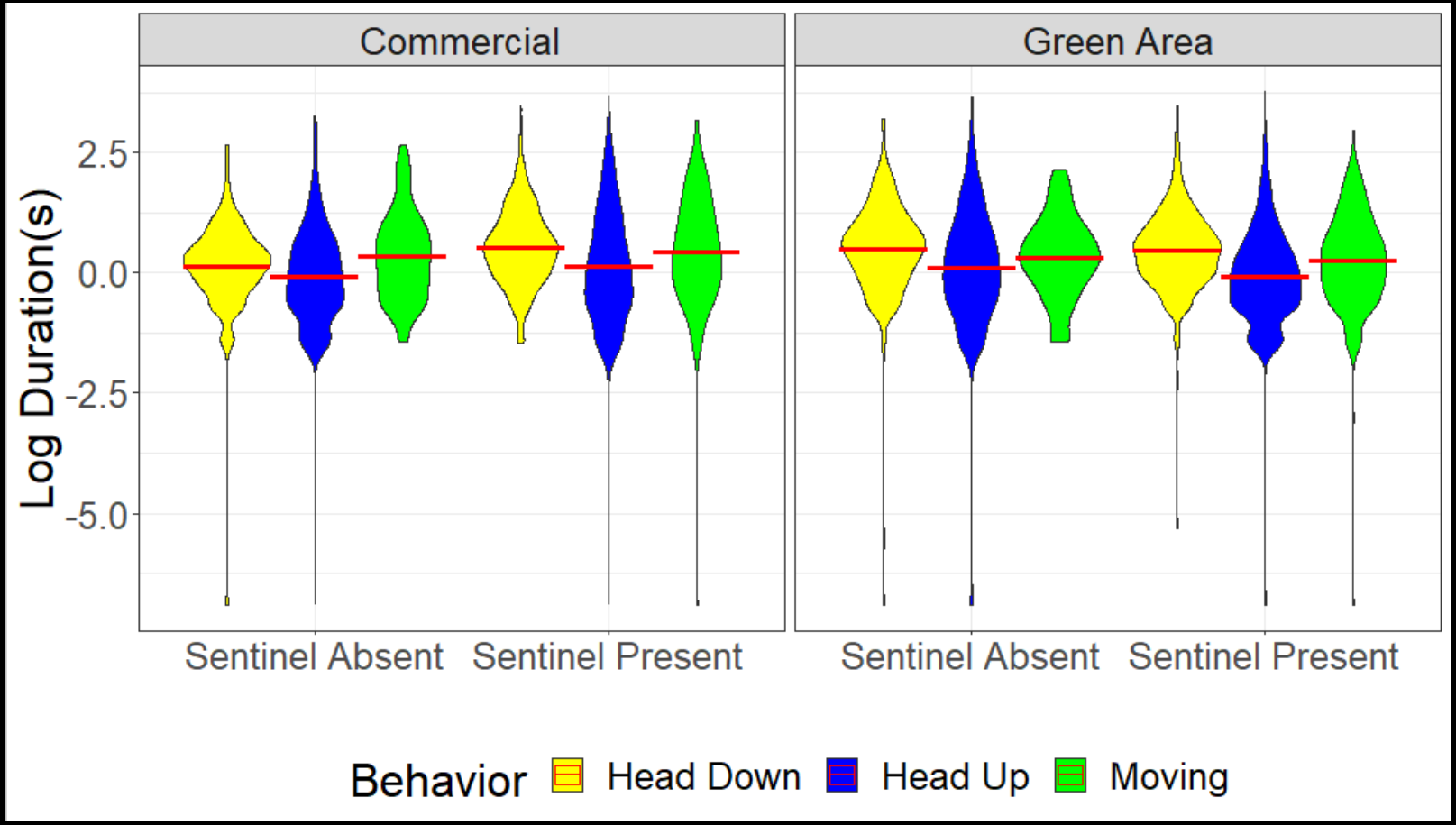
Fixed Effects:

- Behavior
- Presence of a sentinel
- Generalized environment
- Number of recorded crows
- Whether the site was baited

Random Effect:

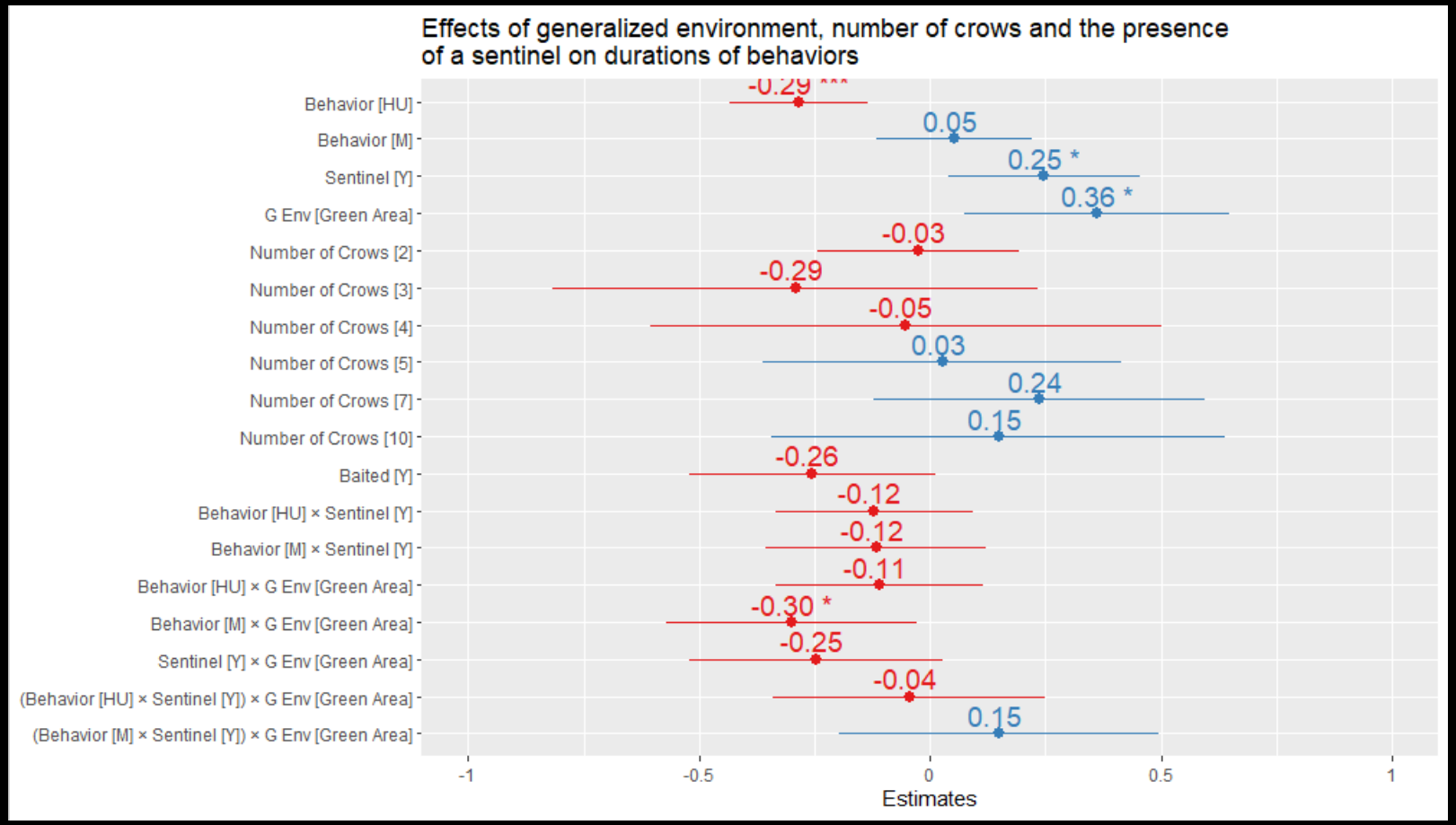
- ID

Duration of behaviors



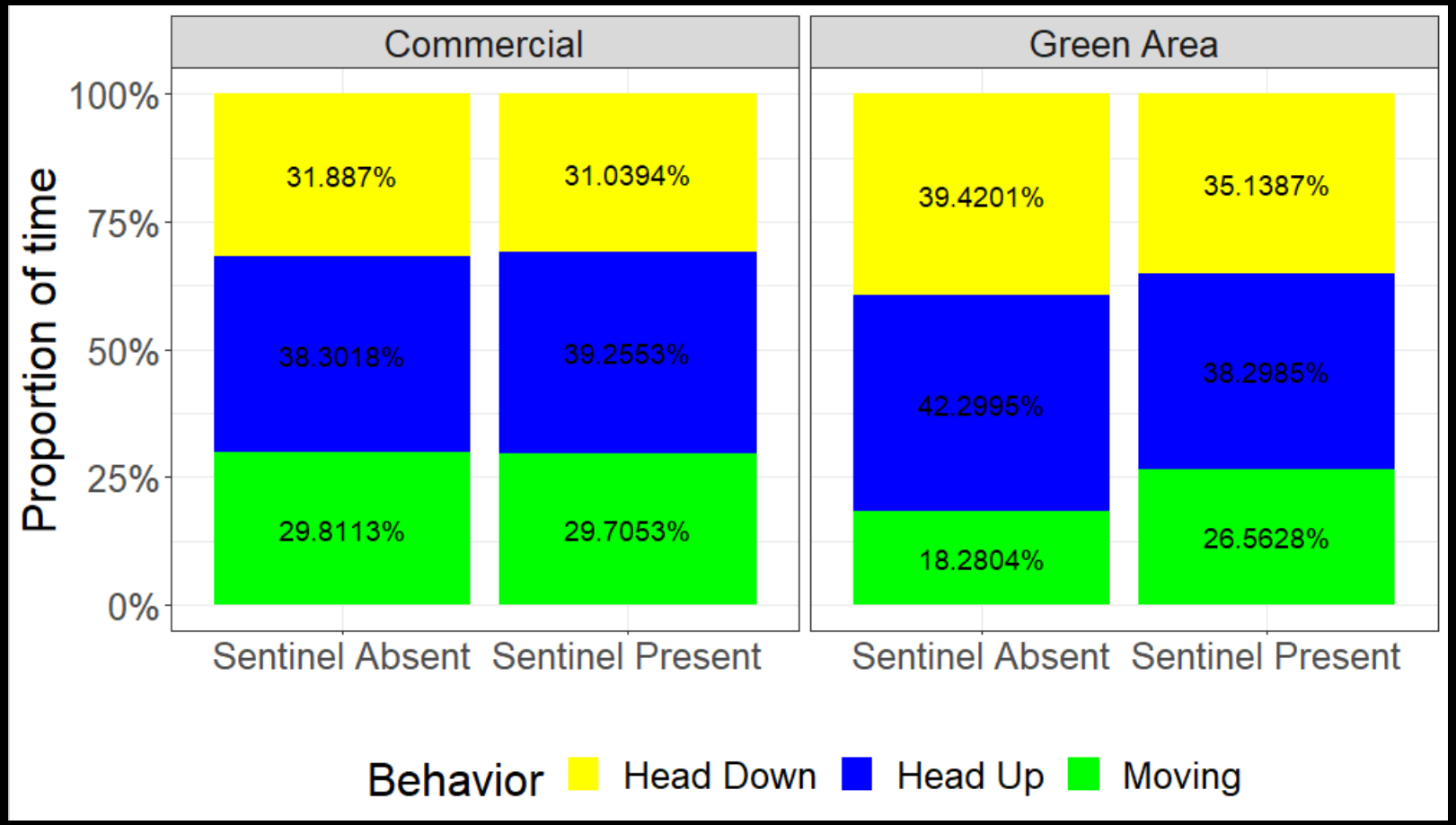
Duration with head up is lower than all other behaviors.

Duration of behaviors – Effect Sizes



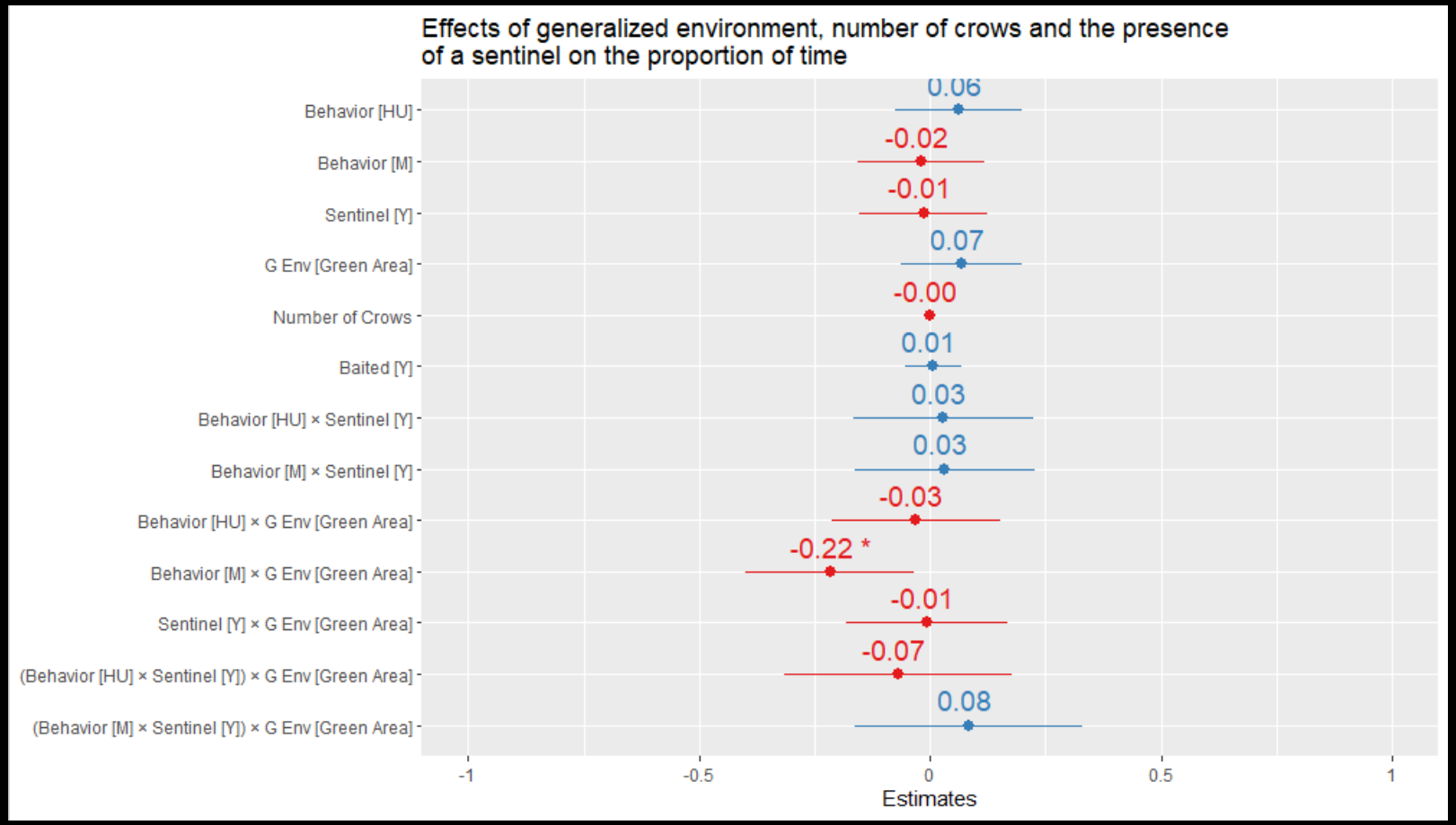
A robust LMM revealed multiple significant effects, with both positive and negative effects.

Proportion of time



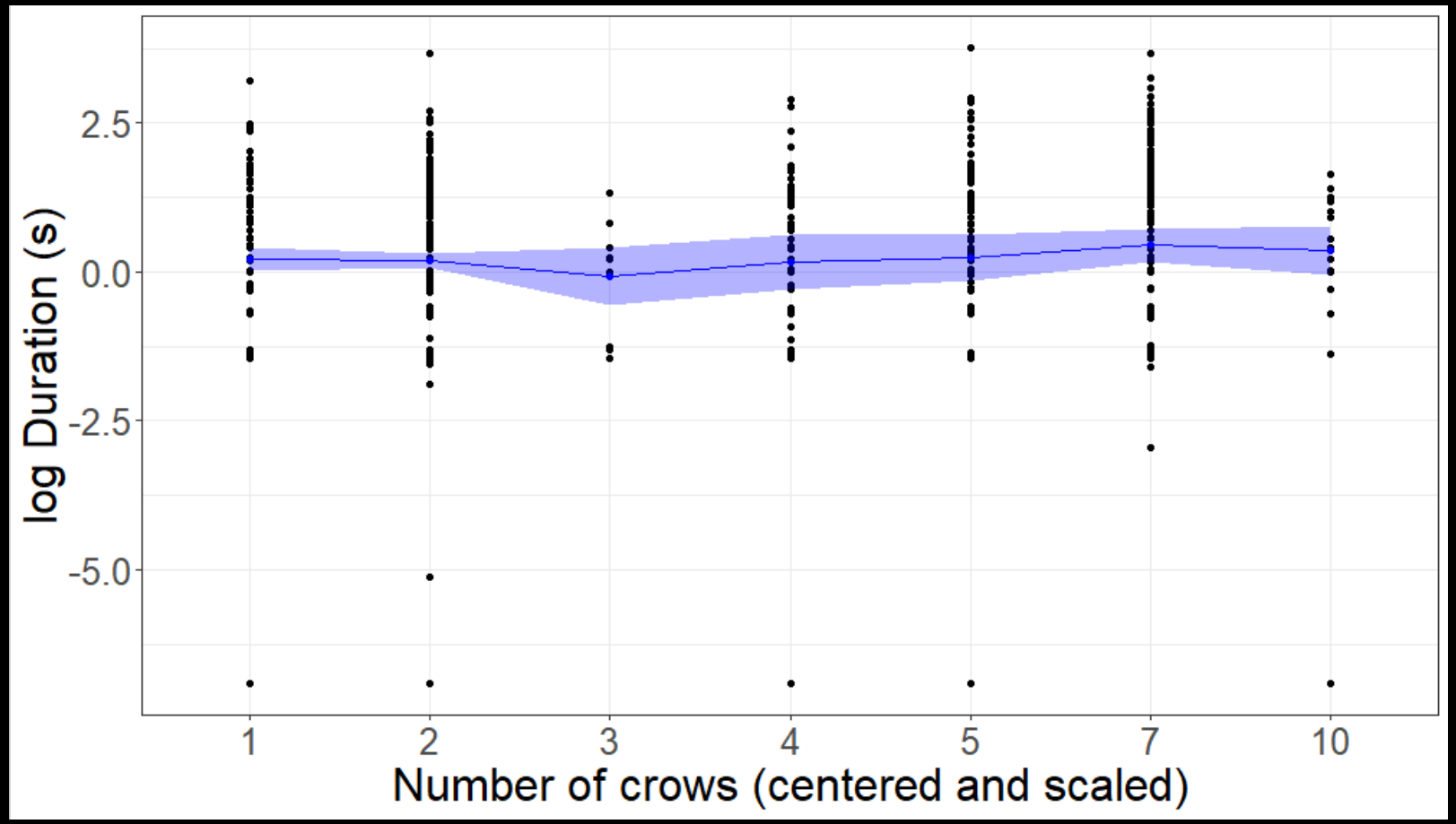
Similar to duration of behaviors, the proportion of time moving in green areas appears reduced.

Proportion of time – Effect Sizes



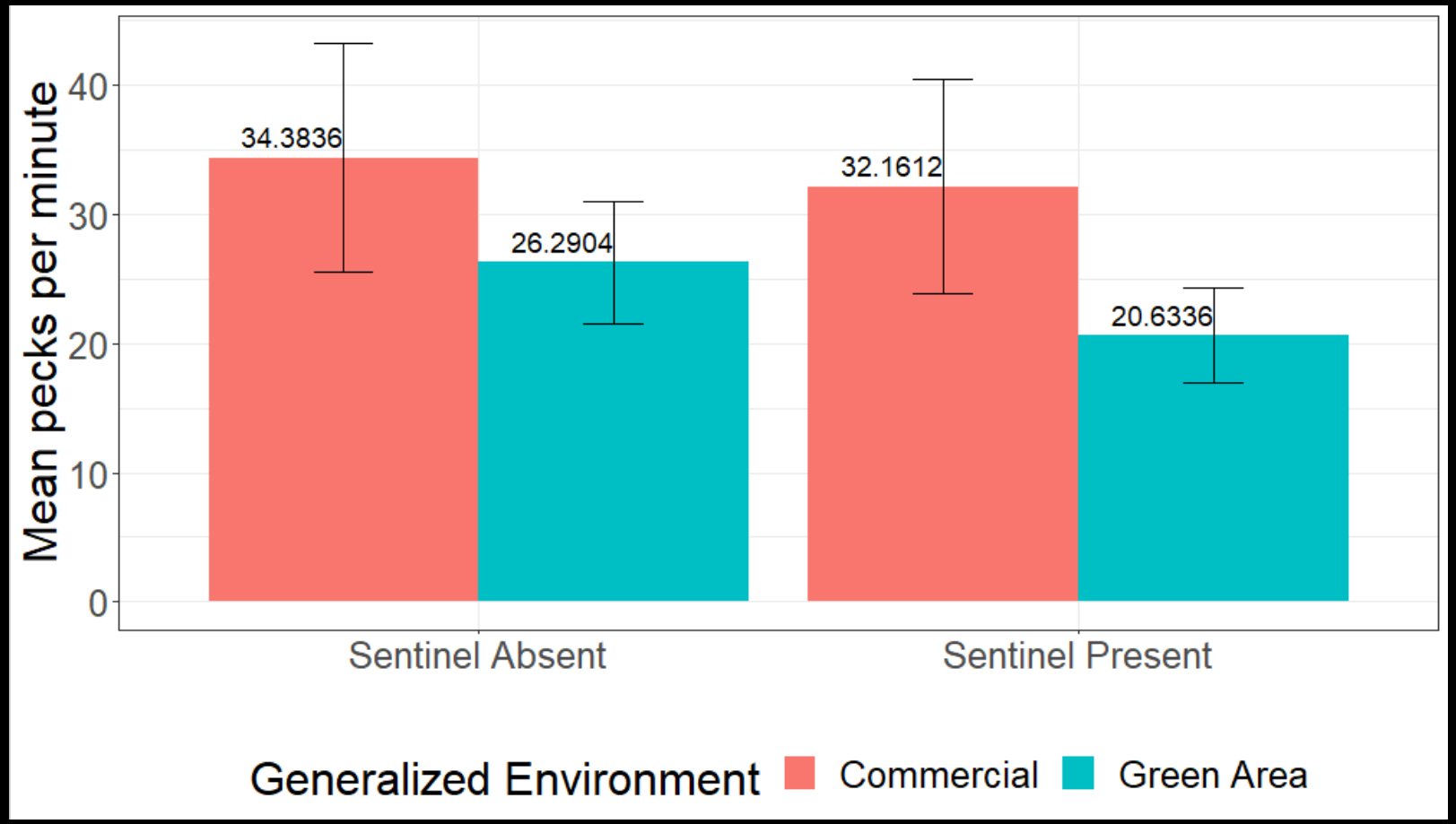
Indeed, the proportion of time moving in green areas was significantly reduced. No other effects significant.

What about group size?



The data does not follow the model's predicted effects. Group size does not affect the HU duration.

Pecks per minute



Appears as if crows pecked more frequently in commercial areas, but a GLMM revealed no significant effects.

My conclusions

- Head Up duration was significantly reduced, but the proportion of time was not
- Moving duration and proportion of time in green areas was significantly reduced
- The presence of sentinels significantly increased the duration of behaviors
- Group size had no effect on duration or proportion of behaviors
- There were no significant effects on peck rate

My conclusions

My objective was 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 presence of a sentinel increased the duration of behaviors, but does not change how much time an individual allocates to either vigilance or foraging behaviors

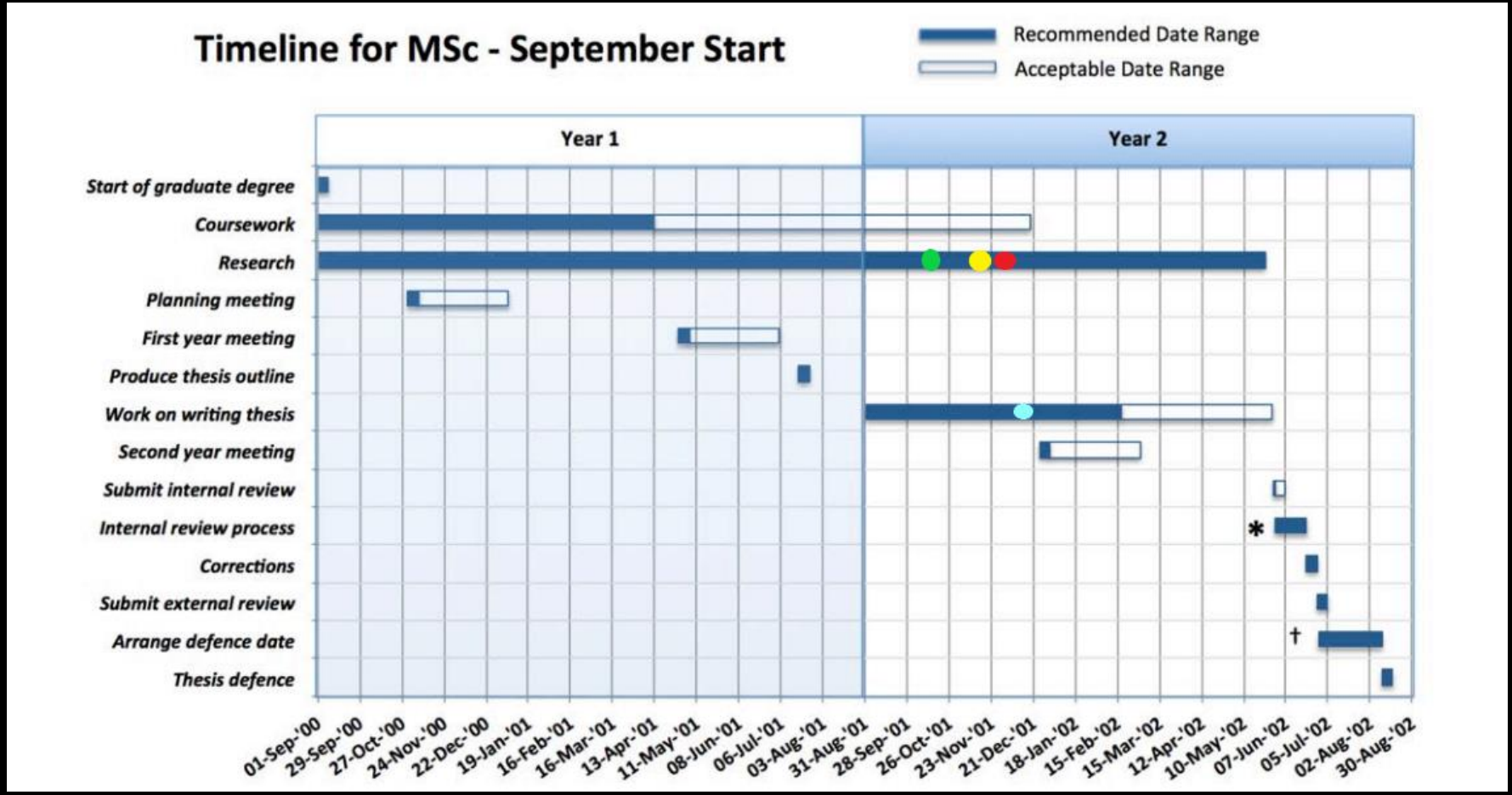
Green areas had a significant positive effect on duration overall, but significantly decreased ‘moving’ duration and proportion.

Future Endeavors

- Thesis outline
- Finish reading all the articles for the scoping review
- Extract data and perform a meta-analysis on the results from the articles
- Write the methodology section in December

Timeline

- Thesis outline must be finished
- Writing to commence immediately
- Next meeting in March



I greatly appreciate your feedback and constructive criticism