BIOL 208 Lab 04 – Behavioural Ecology: Crow foraging class project

Contents

Learning Outcomes

- **Use Optimal Foraging Theory to make a prediction about animal decisions**
- **Use Risk Sensitive Foraging theory to explain patterns of vigilance and group living in animals**
- **Generate hypotheses, make predictions and test these with natural observations, collate data, interpret results and draw conclusions**
- **Undertake independent field data collection on animal behaviour using surveys and focals**
- **Write a scientific project report**

Overview

Perhaps you have noticed that there are lots of crows in Vancouver, but have you ever wondered why there are so many and what the consequences are?

These questions are important because the high abundance of crows could profoundly alter the urban environment. In particular, crows are predators of other birds eggs and chicks, termed 'nest predators' and may therefore depress numbers of other bird species. Birds are important community members and reducing their numbers may have important knock-on consequences, termed **interaction effects**. Ideally, we would therefore identify (i) what is boosting crow numbers and (ii) whether this is decreasing the abundance of other bird species as a result of nest predation.

In this lab we will design a research project to explore the first of these two questions (i). We will undertake the project as a class and collect, compile, analyze, interpret and present our data. You will each **produce a written project report of ~2000 words due in the week of Mar 8th – 12th** before Lab 7 and worth 5% of your course grade. Since we're working as a group our reports will be similar, but they must be different and in your own words. If our methods are good and you all follow them carefully, we may even try to publish a collective project report at the end of the term with all of those who collected data listed as authors?

To address our question, we will be adopting an **evolutionary approach** based on the **function** of behaviour and will therefore focus on whether crows behaviour can be understood based on decisions to **maximise reproductive success**. Behaviours are great for testing function, because you can predict or identify in the field exactly which behaviour is **optimal** (maximises reproduction) and test whether organisms adopt the optimal behaviour. Foraging is especially suitable, because acquiring or producing food is a strong selection pressure that shapes much of an organism's observable activity. Unfortunately, measuring how a moment-to-moment behaviour affects reproductive success can be difficult. As a result, we often measure a **currency** which predicts reproductive success. For example, the rate of energy gain is a good currency, because individuals that maximise energy will have more resources for reproduction.

We may therefore predict that foraging animals will **maximise their rate of energy gain** from foraging behaviour and **Optimal Foraging Theory** explores this possibility. At any given moment, individuals should adopt the foraging behaviour that maximises their rate of energy intake. Of course, individuals are not always free to make an independent decision and must account for the actions of **competitors.** Furthermore, organisms must simultaneously minimise the risk that they are eaten while still obtaining sufficient energy, and **Risk Sensitive Foraging** theory explores how organisms balance these conflicting pressures. This is a great example of a **trade-off**, where animals may have to balance risk and reward / **costs and benefits**. For example, you might get the highest foraging payoff from going to the middle of a field, but you might also be most vulnerable to predation because there is no cover. As a result, animals adopt tactics to reduce predation risk including enhanced **vigilance** to detect predators and **group living** which together decrease risk. However, these behaviours can reduce payoffs since foraging time and competition will be enhanced respectively.

Pre-lab

In the lab guide below, there are blank spaces to complete. You will be able to undertake the eLearn lab exercise to help you answer these and other questions.

Project Hypothesis and Predictions

To explore why there are so many crows in Vancouver we will develop and test one simple hypothesis (explanation).

What possible hypotheses can you think of for crow abundance in Vancouver? Try to come up with three:

We now need to make some predictions that we can test this with.

Identify a prediction based on a hypothesis?

Finally, we have one assumption underpinning our study, namely that there are lots of crows in the urban environment within Vancouver.

What prediction might we make to confirm this?

Project Methods

To design our project method we need to identify each prediction in turn and match this to a specific data collection method.

To determine whether crow abundance is high in urban habitat and more so than in natural habitat, we will:

To determine whether crows gain higher foraging payoffs when in urban habitat and whether these are greater than payoffs available in natural habitat, we will:

To determine whether crows gain high foraging payoffs in urban areas from invasive prey species and human food garbage, we will:

*When designing methods one must consider **alternate explanations** for observations made*. Try to think **'what if'** when considering the data you might produce. What if we found that crows prefer to forage in forests, even though fields offer higher energetic payoffs? We might then think about other constraints on behaviour, perhaps there is higher predation risk, or more chance of competitive disruption when foraging in an open habitat?

To account for the possibility that patterns of foraging are determined by competition and predation, we will additionally:

Crow Survey Methods

We will undertake crow surveys recording the total time spent looking for crows, the number of crows seen and what each was doing when observed. **For different habitats we can then estimate the:**

Each student must complete at least three surveys, aiming for 30 minutes per survey. Students must additionally note the following.

- Surveys must be conducted in new locations
- Students must undertake their surveys **on their own**, or with friends who are **not collecting data**
- Surveys must be in different habitats
- Surveys must be at different times of day
- Begin your survey in an area of your choice
- Try to avoid retracing your steps and avoid recording the same crow twice

Why is it essential to use a new location each time and to avoid two students recording data at the same time and place?

Survey protocol:

- Note the time when you began your survey and enter the following:
    - Observer identity – your surname and initial e.g., FlowerT
    - Area of Lower Mainland e.g. East Vancouver, Lynn Valley. Try to be specific
    - Conditions – Clear, Rain or Snow
    - Habitat
        - Field = grassy field or athletics field e.g. Inter-river park
        - wood = tree or vegetated area of a park

        - Urban = streets and houses with lawns, trees. e.g. residential / suburban
        - City = City centre areas with few trees or grass e.g. downtown or main shopping roads
        - Forest = unbroken canopy of trees e.g. Lynn Canyon Park
        - Beach = beach and 50m from top of beach
        - Scrub = open are of low shrubs and bushes

- **Whenever you encounter a crow that is <50 metres** from you, make a tally mark for its specific Crow Behaviour. Do not include crows that are flying over, but you can include them if they land in sight. If you see many crows, make a tally mark for each crow. Do not include crows >50m away or there will be bias to open areas where crows are more easily seen.
    - Crow Behaviour
        - Interacting – interacting with another crow
        - Perched – perched and stationary
        - Foraging – moving around looking at things and can be on the ground, in a tree or on a man made surface (garbage bin etc)
        - Predator – Mobbing or alarming at a predator
        - Other
    - If you think a crow has flown ahead of you, for example to mob a predator, then do not record it a second time. Only record crow individuals when seen for the first time.
- When you end your survey record the time you finish. Please note the following
    - If you change the type of habitat you are in, please end your previous survey and start a new survey. For example, if you move from an Urban area to a Park-field, then start a new survey row in your table.

Crow Focal Methods

During crow surveys, collect a crow focal on any crows seen foraging. You can also collect crow focals at other times. The aim of the crow focal is to record the number, size and types of food items caught by a crow during a period of time. **For different habitats we can then estimate:**

Additionally, we will record crow vigilance and the presence of other crows to control for any effect predators and competitors have.

Each student should collect a minimum of 5 crow focals of at least 5 minutes each in length. Try to get at least one focal during each survey. You may collect more than this if you choose. In fact, the database will be improved by getting more focals from crows in different habitats. When undertaking focals make sure of the following:

- Only do one focal on a crow. Move to a new area if you suspect that you might do a focal on a crow you previously recorded.
- No other students should record focals on the same crows as you.
- Try to avoid scaring your crow or you will not get the long focals you need: (i) watch them from as far away as possible, (ii) pretend not to look at them by looking at them sideways, Whenever a crow sees that you are watching, it may think you are a predator, (iii) move as little as possible and move smoothly and slowly, (iv) never walk directly towards a wild animal, instead circle towards them. (v) stand still and relax, often animals will relax too.

Why is it essential you minimize your disturbance of a focal crow?

Crow focal protocol

- When a foraging crow is sited make note of the following before starting a focal. If these are the same as for the preceeding crow, then you can simply enter "…" since you'll know nothing changed
    - Date
    - Time (24 hour clock)
    - Observer identity – your surname and initial e.g., FlowerT
    - Area of Lower Mainland e.g. East Vancouver, Lynn Valley. Try to be specific
    - Conditions – Clear, Rain or Snow
    - Habitat

        - Field = grassy field or athletics field e.g. Inter-river park
        - Wood = tree or vegetated area of a park
        - Urban = streets and houses with lawns, trees. e.g. residential / suburban
        - City = City centre areas with few trees or grass e.g. downtown or main shopping roads
        - Forest = unbroken canopy of trees e.g. Lynn Canyon Park
        - Beach = beach and 50m from top of beach
        - Scrub = open are of low shrubs and bushes
    - Crow Location
        - Grass – on the ground on grass
        - Ground – on the ground in an open area e.g. carpark
        - Veg – in or on low vegetation at <2m
        - Tree – in a tree at >2m
        - Man-Made – on a man-made structure e.g. garbage bin, house etc. If on a road, this is considered open-ground
    - Number of nearby crows – count of crows <50 metres away
- When you are ready to watch the crow, start a stopwatch timer, then continuously note the following.
    - Tally of vigilance = whenever the crow looks up, make a tally mark
    - Tally interactions with other crows e.g. displaced, chased or chases another
    - Whenever the crow finds a food item note the prey item Size, Type and Number of items
        - Size
            - T = Tiny, not visible, but seen swallowing
            - Small = less than a beak length (<5cm)
            - Medium = 1-2 beak lengths (5-10cm)
            - Large = 2-3 beak lengths (10-15cm)

        - Extra large = >3 beak lengths (>15cm)
    - Type
        - Worm
        - Grub (Chaffer beetle larvae)
        - Human
        - Other (you can write what it is if you wish)
    - Number
        - Count the items taken from one foraging location e.g. 6 grubs
- Notes
    - Interesting things might happen during the focal, feel free to make a note of these incidents.

- Stop the timer to end the focal at 5 minutes, or whenever the crow ceases to forage or moves out of view.
- You may then undertake a focal on a different crow, but you must never focal the same crow twice.

Data Input and Upload

All data must be entered into a spreadsheet program compatible with excel and then uploaded to the data assignment folder in eLearn. Data entry templates are available on eLearn.

Data entry protocol

- Download the eLearn data entry template
- Enter surveys and focals into their respective data sheets. Do not enter focals in the survey data sheet or vice versa.
    - Enter one survey/focal per row
    - Make sure you use the exact formatting instructions stated e.g., correct time format.
    - Helpful hint: If you select 'Ctrl+D' you will copy the information from the cell above. This will speed up data entry where many of the conditions do not change.
- Upload your completed data entry sheet to eLearn. **Make sure to rename this with your Surname and first name initial + data entry**; for example: 'Flower_T Data entry'

- I will be checking to ensure everyone did the following:
    - Uploaded data
    - Collected sufficient survey and focal data
    - Ideally, collected data at different times and in different habitats.

Project Timeline

Part 1: Crow focal training – Lab 3 Feb 1st – 5th

In this lab we will train you how to undertake crow surveys and focals, but our data will not yet be useable

Part 2: Crow focal data collection – Lab 4 Feb 8th – 12th

This is a self study lab where you will collect data on crow behaviour. Your instructor will have indicated a location in Vancouver where they will be if you wish to get additional support. However, you are encouraged to perform surveys and focals close to your home in urban and natural habitat.

Part 3: Crow focal data entry / write introduction and methods - Feb 15th – 19th

During reading week you will complete your crow surveys and focal, enter your data, and upload this to your eLearn website. In addition you should complete your introduction and Methods for your project write up.

Part 4: Crow focal analysis / write results and conclusions – Lab 5 - Feb 22nd – 26th

In this lecture, your instructor will guide you through analysis of the crow data, including graphical representation and interpretation.

Part 5: Crow foraging project due date Mar 8th – 12th

The hand in date for your final project report will be on the day of your lab in this week of the 8th-12th March.

How to complete your Project write up

A template for your project has been provided below and a guide to scientific writing has been uploaded to your eLearn site. The following template may contain more detail than will ultimately be included in your final write up. You will receive additional guidance on how to complete each section, especially statistical methods, and results.

Introduction

- First paragraph introduces the area of interest and then identifies the overall question.
    - Perhaps focus on the impact of invasive species, and human garbage and how they can alter communities?
    - Note that we do not mention anything about our specific system until later in the introduction – we present a general manuscript applicable to any system.

- Second paragraph introduces previous work on this topic
    - Examine the manuscripts/resources posted by your instructor on similar impacts
    - What has previous research shown with respect to invasive species altering community dynamics by acting as food for a native species
    - What has previous research shown with respect to human garbage altering community dynamics by acting as food for a native species
    - Short-comings, or open questions to address?
- Third paragraph considers methods required to investigate
    - How might we test whether an invasive species is altering the abundance of another species? Suggest how we'll use optimal foraging theory to explain habitat preferences and diet composition.
- Fourth paragraph highlights extra considerations
    - What else might affect behaviour of native species behaviour changes
        - What other hypotheses might you think of for crow abundance in urban areas?
- Fifth paragraph outlines the study species
    - What study system will we test
- Sixth paragraph identifies the hypotheses and predictions with respect to the study species

Methods

- Study system
    - Location
    - Dates
    - Species
    - General information
- Crow Surveys
    - State the overall hypothesis and then say what you will do. E.g.,
        - To determine whether crows are abundant in urban areas and prefer

these to other habitats we undertook crow surveys recording crow sighting rates

- Now provide all the details

- Crow focals
  - As above
- Statistical analyses
  - One paragraph/statement on overall approach
  - One mini paragraph per set of analyses
    - Crow abundance
      - Comparison of crow sighting rates in different habitats
    - Crow foraging payoffs
      - Comparison of crow foraging payoffs in different habitats
      - Comparison of diet proportion attributable to different food item types in different habitats
    - Crow predation risk
      - Comparison of vigilance rates in different habitats
      - Comparison of group size in different habitats
      - Comparison of predator encounters in different habitats
    - Crow competition
      - Comparison of competitive interactions in different habitats

Results

- 1st para – Descriptive statistics on
  - time in habitats and
  - proportions of food types in each
  - Vigilance, group size and predation
  - Competition

- 2nd para – Crow abundance
- 3rd para – Crow foraging payoffs
- 4th para – Crow predation
- 5th para – Crow competition
- Figures and data tables to support he above

Conclusions

- 1st para - Overall summary of the key findings
    - What is the main result and what is this supported by (combine from across the results in the previous section)
    - What additional findings are there?
    - What caveats are there?
    - What is the primary implication of the finding?
- 2nd para – Discuss the implication of the main findings within existing literature
    - How does the main finding advance the field
    - What has been shown before
    - What new insight did we get
    - What is the importance for our general knowledge
    - What is the next direction
- 3rd para – Discuss additional findings (you may have several of these paragraphs, each addressing an implication from your results)
    - How does the main finding advance the field
    - What has been shown before
    - What new insight did we get
    - What is the importance for our general knowledge
    - What is the next direction
- 4th Para – Caveats with the study

- What concerns/alternate explanations might exist
- What opportunities or major new questions does the study open up
- How might we investigate these in the future
- For example
  - Do we conclusively show that crows preferentially forage in urban areas because of invasives/human waste?
  - What experiments might we need to better prove our hypothesis false/correct

- Summary paragraph
  - We overall show the following
  - This is important because…