

Instructions

There are 5 total questions for a total of 100 points. Questions consist of a concept map (Q1), case study evaluations of species interactions (Q2), predicting the effects of anthropogenic disturbance on nutrient cycling (Q3), assessing biodiversity and instrumental values on the UTM campus (Q4), and directed reflections (Q5).

Question	Points to be Earned
Q1	15
Q2	30
Q3	25
Q4	20
Q5	10
Total	100

Write your short and concise answers in the boxes provided, and you may use point-form responses or paragraph form to answer the questions.

Answers written on the Question Booklet will not be evaluated, so make sure to write all your answers in the Answer Booklet.

Question 1. Synthesize your knowledge of ecology across hierarchical scales by drawing a concept map that:

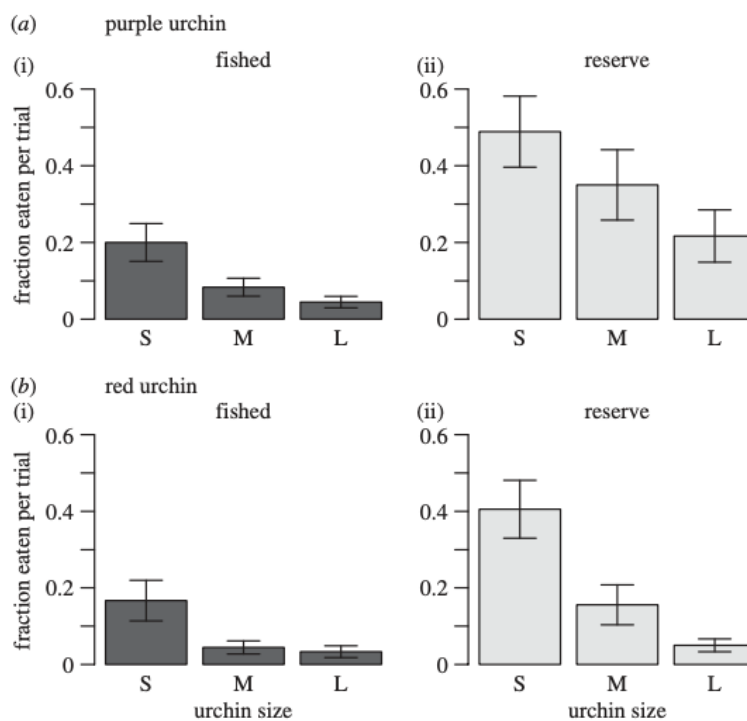
- Includes individual, population, community, and ecosystem levels.
- Summarizes key characteristics for each level of ecological organization.
- Indicates links across ecological levels.

Concept map = 15 points

Question 2. For each of the following species interactions, use the provided information and interpret the figure to describe how the interaction depends on the environment. **(30 total points)**

Question 2.1

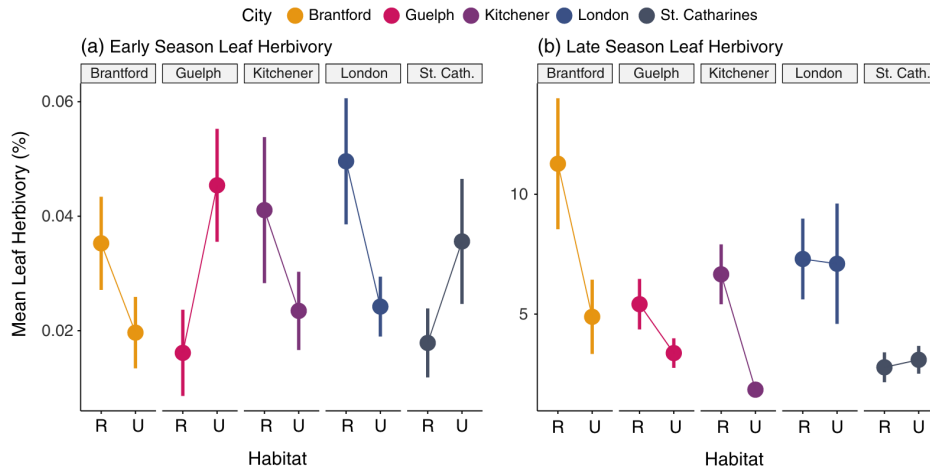
In California kelp forests, herbivorous sea urchins are preyed upon by California sheephead fish (*Semicossyphus pulcher*). Selden et al. (2017) evaluated how fishing of predators like the California sheephead affects predation on sea urchins. They sampled fished habitats and marine reserves and compared how many urchins were consumed by the predator.



- How do patterns of predation on purple/red urchins differ? **(3 points)**
- Propose an ecological explanation for the observed response. **(3 points)**

Question 2.2

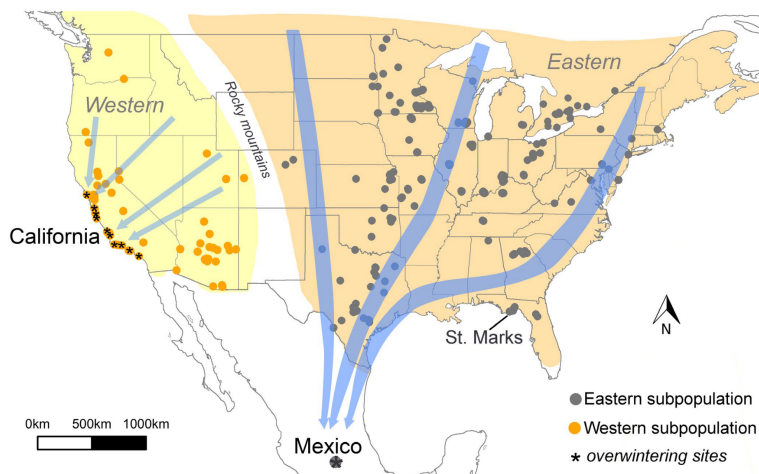
Urbanization can affect herbivore communities, but there can also be differences in herbivory through time. Miles et al. (2022) sampled 5 cities in southern Ontario to evaluate herbivore community diversity and abundance in addition to patterns of herbivory on the common milkweed (*Asclepias syriaca*). Leaf damage was assessed in the early and late summer, and each city had an urban (U) and rural (R) habitat.



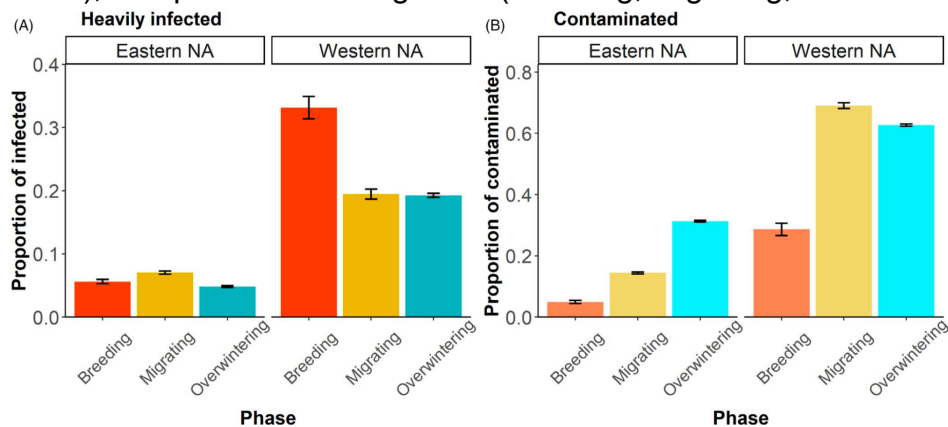
- How does leaf herbivory vary with season? **(3 points)**
 - (Note: you do not need to consider city or habitat for this question)
- Propose an ecological explanation for the observed response. **(3 points)**

Question 2.3

Monarch butterflies (*Danaus plexippus*) undergo extensive seasonal migrations for both its eastern and western subpopulations. Monarchs overwinter in Mexico (eastern populations) or in California (western populations), known as the overwintering stage. They then have a multi-generation migration back north (migratory stage) where they breed (breeding stage).



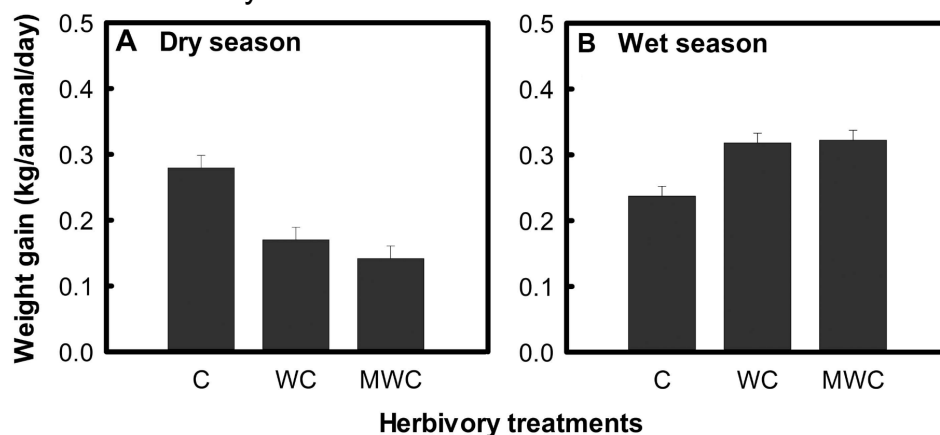
Unfortunately, monarch populations are experiencing declines. An emerging concern is the threat of a protozoan pathogen, *Ophryocystis elektroscirrha* (OE), which spreads through spores that monarchs acquire during their migrations. Heavily infected monarchs have >100 OE spores, while contaminated monarchs have <100 OE spores. Heavy infections lead to increased mortality, while contaminated monarchs survive but can spread the pathogen; infection requires the pathogenic spores are ingested. Majewska et al. (2022) wanted to evaluate how infection patterns varied between the two major monarch populations (eastern and western), infection status (heavily infected or contaminated), and phase of the migration (breeding, migrating, or overwintering).



- How do the eastern and western populations differ in the proportion of heavily infected monarchs? **(3 points)**
- Propose an ecological explanation for the observed response. **(3 points)**

Question 2.4

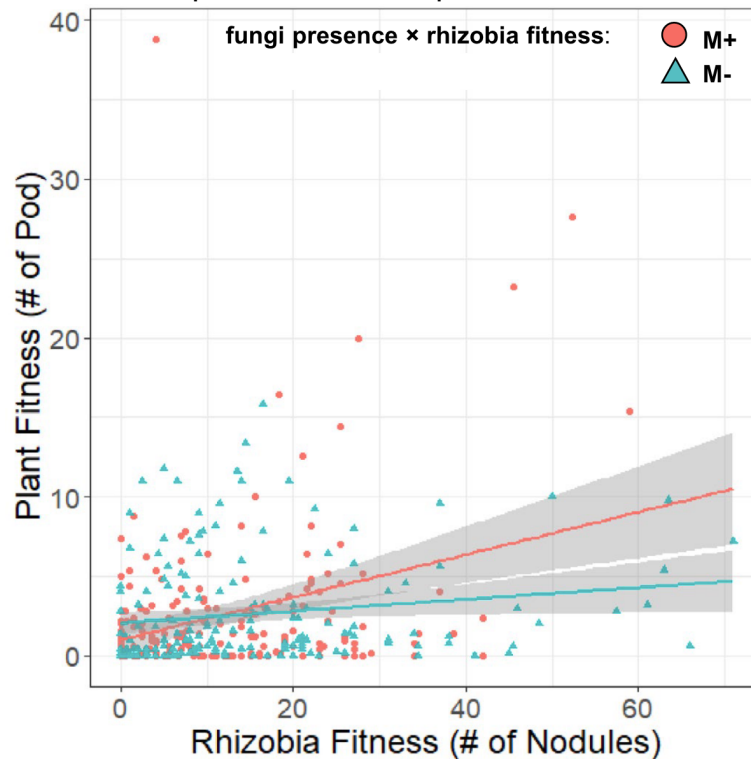
Savannas are crucial ecosystems for biodiversity and social, economic, and cultural values. As wildlife and livestock share these ecosystems, Odadi et al. (2011) conducted an experiment to test for competition between cattle, wild ungulates (e.g., zebra, oryx, gazelle), and megaherbivores (e.g., African elephant, giraffe) in an African savanna. They designed an experiment to test for the effect of just cattle (C), wild ungulate and cattle (WC), and cattle, wild ungulates, and megaherbivores (MWC) on food intake and weight gain between the dry and wet seasons.



- How does the wet season affect competition for resources and weight gain between wild ungulates (WC) and megaherbivores (MWC)? **(3 points)**
 - (Note: because both treatments include C, you can assume the differences between WC and MWC are due to the presence of megaherbivores).
- Propose an ecological explanation for the observed response. **(3 points)**

Question 2.5

Many organisms are involved in a mutualism with at least one partner. Afkhami et al. (2021) examined the effects of multiple mutualists (rhizobia and mycorrhizal fungi) on the barrel medic plant (*Medicago truncatula*). Rhizobia provide nitrogen to the host plant, while mycorrhizal fungi provided phosphorous. They inoculated the plant with either just rhizobia (M-) or both rhizobia and fungi (M+). They then measured how the plant fitness depended on the presence of multiple mutualists.



- How does the relationship between plant fitness and rhizobia fitness differ with (M+) and without (M-) fungi? **(3 points)**
- Propose an ecological explanation for the observed response. **(3 points)**

Question 3. Describe the ecological consequences of anthropogenic disturbance on the carbon, nitrogen, and phosphorus cycles. **(25 total points)**

Question 3.1.

For the carbon cycle...

- How would increasing temperatures, particularly at higher latitudes, affect the type and amount of carbon produced through soil microbial respiration? **(5 points)**
- How would increased atmospheric CO₂ affect primary productivity? **(5 points)**

Question 3.2

For the nitrogen cycle...

- How would increased nitrogen fertilizer use in agriculture alter the mutualisms between plants, rhizobia, and arbuscular mycorrhizal fungi? **(5 points)**
- How would you expect plant community diversity to respond to increased nitrogen? **(5 points)**

Question 3.3

For the phosphorus cycle...

- How does increased phosphorus affect oxygen levels in coastal marine ecosystems? **(5 points)**

Question 4. You are a scientist for a local conservation authority tasked with assessing the biodiversity status and instrumental values across the UTM campus. For each of the following habitats, rank its biodiversity (1 = lowest, 4 = highest) and name 2 instrumental values provided by that habitat to us. **(20 total points)**

- Forest **(4 points)**
- Grassland **(4 points)**
- Wetland **(4 points)**
- Disturbed **(4 points)**

Question 5. Directed reflection questions. **(10 total points)**

- **Question 5.1.** What was your favourite lecture/topic and why? **(2 points)**
- **Question 5.2.** What was your favourite component of the practical and why? **(2 points)**
- **Question 5.3.** How has the scientific process in the practical influenced your perspective on how science is done? **(2 points)**
- **Question 5.4.** Are you able to make links between individual components and see how they interact as a system? If so, can you provide one short, ecological example from your everyday life? **(2 points)**
- **Question 5.5.** Given all of your learning and work in this course, from the reflections, in-lecture activities, term test, practicals, and the lab report, what 'grade' do you think you earned and why? 'Grade' is a simple A, B, C, D, or F. **(2 points)**