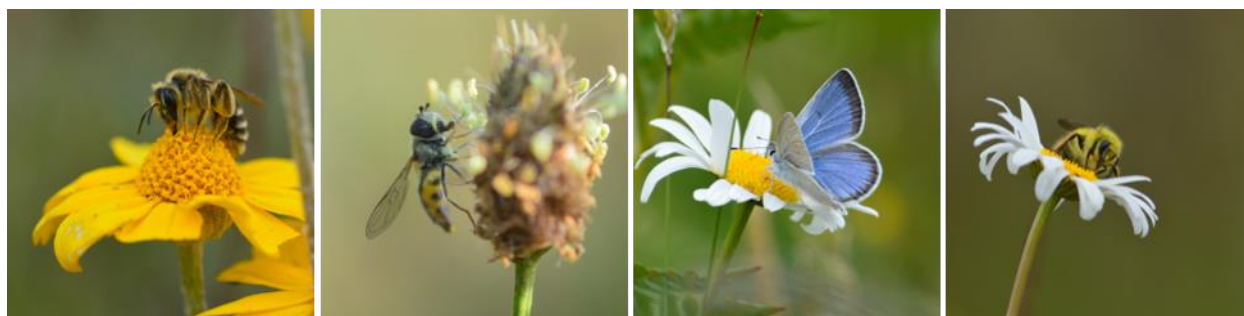


FROM BEES TO BEETLES: INSECT POLLINATORS AND REAL-WORLD SCIENCE (EXP-0021)

Mondays, 6:00 – 8:30 pm, Braker 223



Instructor: Dr. Rachael Bonoan, rachael.bonoan@tufts.edu

Office hours: by appointment

Course description: Animal pollination directly affects the yield and/or quality of 75% of globally important crops. Unfortunately, animal pollinator—specifically insect pollinator—populations are declining. What is the current state of our insect pollinators? How do insect pollinators contribute to food security? What factors contribute to the recent population decline? What can we do to help?

This semester, we will (1) answer the above questions and others while learning about a diverse set of insect pollinators, (2) become familiar with reading and understanding scholarly research articles, (3) explore how understanding basic science can help in the development of applied real-world solutions, and (4) develop oral and written communication skills.

Attendance: Since this is a discussion-based course, attendance and pre-class preparation are critical.

Readings: All required readings will be available in electronic form via Canvas. A complete list is provided at the end of this syllabus.

Course Schedule:

Date	Primary Topics and Activities	Assignment(s)
<i>Systems: Natural History of Insect Pollinators</i>		
Sept 10	<ul style="list-style-type: none">• Class introduction<ul style="list-style-type: none">○ <i>Assignment:</i> Pick-a-Pollinator• What makes a good presentation?<ul style="list-style-type: none">○ <i>Instructor Example:</i> Pick-a-Pollinator, Honey bees	
Sept 17	<ul style="list-style-type: none">• What is the natural history of our insect pollinators?<ul style="list-style-type: none">○ <i>Student Presentations:</i> Pick-a-Pollinator• Natural history of butterflies and moths (Lepidoptera)	<i>Read:</i> Glassberg (2017); Sections I, II, V in Schowalter (2011d); Tewksbury et al. (2014) DUE: Pick-a-Pollinator presentation (submit slides)
Sept 24	<ul style="list-style-type: none">• Natural history of bees, wasps, and ants (Hymenoptera)<ul style="list-style-type: none">○ <i>Guest Lecturer:</i> Nick Dorian• What can we learn about other pollinators from honey bees?<ul style="list-style-type: none">○ <i>Field Trip:</i> Starks Lab Apiary	<i>Read:</i> Seeley (1985); Tautz (2008a, 2008b) DUE: Reading Response 1
Oct 1	<ul style="list-style-type: none">• Natural history of flies (Diptera) and beetles (Coleoptera)• What makes a good peer review?<ul style="list-style-type: none">○ <i>Peer Review:</i> draft of Pick-a-Pollinator paper	<i>Read:</i> Section 1 in Willmer (2011a); Willmer (2011c) DUE: draft of Pick-a-Pollinator paper

Date	Primary Topics and Activities	Assignment(s)
<i>Concepts: Pollinator Ecology</i>		
Oct 9	TUFTS MONDAY <ul style="list-style-type: none"> • Introduction to pollinator ecology • How to read a scientific paper 	<i>Read:</i> Coelho (1991); Cook and Breed (2013); Schowalter (2011a, 2011b, 2011c) DUE: final Pick-a-Pollinator paper
Oct 15	<ul style="list-style-type: none"> • How can understanding coevolution help us better understand pollinators? 	<i>Read:</i> Austen et al. (2018); Gezon et al. (2016); Rosas-Guerrero et al. (2014) DUE: Reading Response 2
Oct 22	<ul style="list-style-type: none"> • How do our commercial pollination practices affect pollinator health and nutrition? 	<i>Read:</i> Bonoan et al. (2018); Bonoan et al. (2017); Vaudo et al. (2016) DUE: Reading Response 3
Oct 29	<ul style="list-style-type: none"> • What defenses do insect pollinators have against disease, and what role does the environment play? 	<i>Read:</i> Alaux et al. (2010); Starks et al. (2000); Wilson-Rich et al. (2009) DUE: Reading Response 4
<i>Applications: Pollinator Decline & Conservation</i>		
Nov 5	<ul style="list-style-type: none"> • What are the economic and social impacts of insect pollination services? 	<i>Read:</i> Garibaldi et al. (2013); Jankielsohn (2018); Orford et al. (2015); Potts et al. (2016); Rawlings and Peterson (2016) DUE: Reading Response 5
Nov 12	NO CLASS – Veterans Day	
Nov 19	<ul style="list-style-type: none"> • What is the current state of insect pollinator health? • What factors contribute to pollinator decline? 	<i>Read:</i> Colla and MacIvor (2016); Potts et al. (2010); Schultz et al. (2017); Willmer (2011b) DUE: Reading Response 6
Nov 26	<ul style="list-style-type: none"> • What is the impact of climate change on insect pollinator stability? • Commercial pollination vs. backyard beekeeping <ul style="list-style-type: none"> ○ <i>Assignment:</i> Debate, sides assigned 	<i>Read:</i> Bartomeus et al. (2011); Hegland et al. (2009); Miller-Struttman et al. (2015) DUE: Reading Response 7
Dec 3	<ul style="list-style-type: none"> • What needs to be done to conserve insect pollinators? <ul style="list-style-type: none"> ○ <i>Assignment:</i> Pollinator Protection Plan ○ <i>Instructor Example:</i> Pollinator Protection Plan • <i>Debate!</i> 	<i>Read:</i> Pitman et al. (2018); Tschardt et al. (2002); Westphal et al. (2003) DUE: Debate
Dec 10	<ul style="list-style-type: none"> • Pollinator Symposium <ul style="list-style-type: none"> ○ <i>Student Presentations:</i> Pollinator Protection Plan ○ <i>Peer Review:</i> Pollinator Protection Plan paper 	DUE: Pollinator Protection Plan presentation (submit slides), draft of Pollinator Protection Plan paper
Dec 13	NO CLASS	DUE: Pollinator Protection Plan final paper

Assignments and Grading: Please carefully read and follow directions. If you have questions, do not hesitate to ask in class or via email. For some assignments, additional instructions will be posted on Canvas and/or shared via email.

Pick-a-Pollinator Each student will pick a pollinator out of a hat. Research the natural history of your pollinator and prepare a presentation and paper.

- **Presentation (15%)** Your presentation should be 3-5 minutes long and cover the natural history of your pollinator. Please submit your presentation (PowerPoint or PDF) on Canvas by **noon on Monday, September 17.**
- **Paper (15%)** Your paper should cover the natural history in more detail than your presentation, and include at least 1 peer-reviewed primary source as a reference.
 - **Draft (5%)** Before class, submit rough draft that your peer reviewer can work with on Canvas. Please use the following format: 2-3 pages, 1" margins, double spaced, 12 pt. readable font, footer with last name and page numbers. Your heading should be left-justified and include: your name, the date, the name of the assignment (i.e. Pick-a-Pollinator), and the title of your paper.
 - **Final (10%)** The final paper should be in the same format as your draft and is due on Canvas **before the beginning of class on Monday, October 9.**

Reading Responses (5%) When applicable (see course schedule), write a 300-word response to the assigned readings. In your response, you can critique the paper(s), discuss a question that came to mind while reading, etc. Reading Responses will be graded as a ✓+, ✓, ✓-, 0. Reading responses are to be submitted on Canvas **by 11:59 pm the day before class.** *Late reading responses will not be accepted.*

Debate (15%) You will pick a side (commercial pollination, backyard beekeeping) out of a hat. More information about your side, and the format of the debate will be discussed in class.

Pollinator Protection Plan (as a group) Your final project will focus on your insect pollinator that you picked that very first week of class! Each student chose an insect pollinator species and 2-3 of you have species from the same taxonomic family. Form a group with the students that share your pollinator's family and come up with a plan to help save that pollinator! Both the paper and presentation should be prepared and presented as a group.

- **Presentation (20%)** Your presentation should include a brief introduction to your pollinator family (recall some natural history), the major factors that affect the well-being/health of your pollinator, and how people (scientists, the public, etc.) might be able to help your pollinator. Your presentation should be 10 minutes long. Please submit your slides (PowerPoint or PDF) on Canvas by **noon on Monday, December 10.**
- **Paper (20%)** Your paper should outline your family-specific Pollinator Protection Plan in more detail than your presentation, and should reference at least 3 primary sources outside of the in-class readings.
 - **Draft (5%)** Before class, submit rough draft that your peer reviewer can work with on Canvas. Please use the following format: 4-6 pages with same text formatting as Pick-a-Pollinator.
 - **Final (15%)** The final paper should be in the same format as your draft and is due via Canvas by **noon on Thursday, December 13.**

Attendance (5%) Absences will not be excused unless there is a verifiable health issue or a serious family emergency.

In-Class Participation (5%)

Late Policy: Unless there is a verifiable health issue or a serious family emergency, the following late policy will be enforced.

- Late reading responses will not be accepted.
- Late drafts for peer review will not be accepted or reviewed.
- Presentation and debate dates cannot be changed.
- For slides submitted after the deadline, 5% will be deducted.
- For final papers, 5% will be deducted for each day late.

Accessibility: Tufts University values the diversity of our students, staff, and faculty, recognizing the important contribution each student makes to our unique community. Students with disabilities are assured that the Student Accessibility Services office will work with each student individually to ensure access to all aspects to student life. Tufts is committed to providing equal access and support to all students through the provision of reasonable accommodations so that each student may access their curricula and achieve their personal and academic potential. If you have a disability that requires reasonable accommodations, please contact the Student Accessibility Services office at 617-627-4539, or through their email at Accessibility@tufts.edu, to make an appointment with the director to determine appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

Academic Integrity: I encourage collaboration, discussion, and communication, however, when it comes time for individual assignments, please only express *your* individual, original ideas. Any type of plagiarism in this course will be punished as described in the Tufts' Academic Integrity Policy. Please be familiar with the most current policies described here: <https://students.tufts.edu/student-affairs/student-life-policies/academic-integrity-policy>.

REQUIRED READINGS: posted on Canvas

Alaux C, Ducloz F, Crauser D, Le Conte Y, 2010. Diet effects on honeybee immunocompetence. *Biology letters* 6:562-565. doi: 10.1098/rsbl.2009.0986.

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Colla SR, MacIvor JS, 2016. Questioning public perception, conservation policy, and recovery actions for honeybees in North America. *Conservation Biology* 31:1202-1204. doi: 10.1111/cobi.12839.

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- Orford KA, Vaughan IP, Memmott J, 2015. The forgotten flies: the importance of non-syrphid Diptera as pollinators. *Proceedings of the Royal Society B: Biological Sciences* 282. doi: 10.1098/rspb.2014.2934.
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- Schowalter TD, 2011c. Introduction: ecosystem level. In: Schowalter TD, editor. *Insect Ecology: An Ecosystems Approach*, 3 ed San Diego: Academic Press. p. 479.
- Schowalter TD, 2011d. Pollination, Seed Predation and Seed Dispersal. In: Schowalter TD, editor. *Insect Ecology: An Ecosystems Approach*, 3 ed San Diego: Academic Press. p. 397-420.
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