

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

Mondays, 6:00 – 8:30 pm, Miner Hall, Room 112



Instructor: Rachael Bonoan; Ph.D. Candidate Ecology, Behavior & Evolution; 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 Trunk. 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 11	<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 18	<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> Ghazanfar et al. (2016); Tewksbury et al. (2014) <i>DUE:</i> Pick-a-Pollinator presentation (email slides)
Sept 25	<ul style="list-style-type: none">• Natural history of bees, wasps, and ants (Hymenoptera)• What can we learn about other pollinators from honey bees?<ul style="list-style-type: none">○ <i>Field Trip:</i> Starks Lab observation hives	<i>Read:</i> Seeley (1985); Tautz (2008a, 2008b) <i>DUE:</i> Reading Response 1
Oct 2	<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> Larson et al. (2001); Mawdsley (2003) <i>DUE:</i> Reading Response 2, draft of Pick-a-Pollinator paper

Date	Primary Topics and Activities	Assignment(s)
Oct 9	NO CLASSES – Indigenous People’s Day	
<i>Concepts: Pollinator Ecology</i>		
Oct 16	<ul style="list-style-type: none"> • Introduction to pollinator ecology • How to read a scientific paper 	<i>Read:</i> Orford et al. (2015); Rader et al. (2015) DUE: final Pick-a-Pollinator paper
Oct 23	<ul style="list-style-type: none"> • How can understanding coevolution help us better understand pollinators? 	<i>Read:</i> Bartomeus et al. (2011); Pauw (2006) DUE: Reading Response 3
Oct 30	<ul style="list-style-type: none"> • How do our commercial pollination practices affect pollinator health and nutrition? 	<i>Read:</i> Bonoan et al. (2016); Vaudo et al. (2016) DUE: Reading Response 4
Nov 6	<ul style="list-style-type: none"> • What defenses do insect pollinators have against disease, and what role does the environment play? <p><i>Guest lecturer: Dr. Philip Starks, Associate Prof, Biology</i></p>	<i>Read:</i> Alaux et al. (2010); Starks et al. (2000); Wilson-Rich et al. (2009) DUE: Reading Response 5
<i>Applications: Pollinator Decline & Conservation</i>		
Nov 13	<ul style="list-style-type: none"> • What are the economic and social impacts of insect pollination services? 	<i>Read:</i> Garibaldi et al. (2013); Potts et al. (2016) DUE: Reading Response 6
Nov 20	<ul style="list-style-type: none"> • What is the current state of insect pollinator health? • What factors contribute to pollinator decline? 	<i>Read:</i> Potts et al. (2010) DUE: Reading Response 7
Nov 27	<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> Hegland et al. (2009); Miller-Struttman et al. (2015) DUE: Reading Response 8
Dec 4	<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> LaBar et al. (2014) DUE: Debate
Dec 11	<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 (email slides), draft of Pollinator Protection Plan paper
Dec 14	NO CLASS	DUE: Pollinator Protection Plan final paper (via email)

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 Trunk and 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 email me your presentation (PowerPoint) by **noon on Monday, September 18**.
- **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%)** Come to class with a rough draft that your peer reviewer can work with. 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 **at the beginning of class on Monday, October 2**. Please hand in your peer-reviewed draft with your final paper.

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 can be typed or hand written (if it's legible) and are due **at the beginning of class**.

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 email me your presentation (PowerPoint) by **noon on Monday, December 11**.
- **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%)** Come to class with a rough draft that your peer reviewer can work with. 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 email by **noon on Thursday, December 14**. Since this will be submitted via email, you do not need to include your peer-reviewed draft.

In-Class Participation (5%)

Attendance (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 final papers and slides, 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: will be posted on Trunk

- 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.
- Bartomeus I, Ascher JS, Wagner D, Danforth BN, Colla S, Kornbluth S, Winfree R, 2011. Climate-associated phenological advances in bee pollinators and bee-pollinated plants. *Proceedings of the National Academy of Sciences of the United States of America* 108:20645-20649. doi: 10.1073/pnas.1115559108.
- Bonoan RE, Tai TM, Tagle Rodriguez M, Feller L, Daddario SR, Czaja RA, O'Connor LD, Burruss G, Starks PT, 2016. Seasonality of salt foraging in honey bees (*Apis mellifera*). *Ecological Entomology* 42:195-201. doi: 10.1111/een.12375.
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- LaBar T, Campbell C, Yang S, Albert R, Shea K, 2014. Restoration of plant-pollinator interaction networks via species translocation. *Theoretical Ecology* 7:209-220. doi: 10.1007/s12080-013-0211-7.

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- Mawdsley JR, 2003. The importance of species of dasytinae (Coleoptera: Melyridae) as pollinators in western North America. *The Coleopterists Bulletin* 57:154-160.
- Miller-Struttman NE, Geib JC, Franklin JD, Kevan PG, Holdo RM, Ebert-May D, Lynn AM, Kettenbach JA, Hedrick E, Galen C, 2015. Functional mismatch in a bumble bee pollination mutualism under climate change. *Science* 349:1541-1544. doi: 10.1126/science.aab0868.
- 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.
- Pauw A, 2006. Floral syndromes accurately predict pollination by a specialized oil-collecting bee (*Redivia peringueyi*, Melittidae) in a guild of South African orchids (Coryciinae). *American Journal of Botany* 93:917-926.
- Potts SG, Biesmeijer JC, Kremen C, Neumann P, Schweiger O, Kunin WE, 2010. Global pollinator declines: trends, impacts and drivers. *Trends in ecology & evolution* 25:345-353. doi: <http://dx.doi.org/10.1016/j.tree.2010.01.007>.
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