FISH 406:
Parasite Ecology

Instructor:
Professor Chelsea Wood
office: 206-685-2163
chelwood@uw.edu

TAs:
TBD (e-mail)
TBD (e-mail)
Course Outline

Lectures: DAYS, TIME in ROOM
Labs: DAYS, TIME in ROOM

Office hours: DAYS, TIME in FISH 202B and by appointment

Pre-requisites: None

Credits: 5 credits + this course counts toward the UW Additional Writing (W) requirement

Required readings: Foundations of Parasitology, Roberts and Janovy (used copies available from $20 on Amazon); additional reading material (including chapters of Karban and Huntzinger’s book, see below) available as pdfs through Canvas; for graduate students only (undergrads welcome but not required to read along) – Parasitism: The Ecology and Evolution of Intimate Interactions, Combes (used copies available from $8 on Amazon)

Optional (but highly recommended) readings: Parasite Rex, Carl Zimmer (used copies available from $8 on Amazon.com); Richard Karban and Mikaela Huntzinger’s book, How to Do Ecology: A Concise Handbook, will be an indispensable resource as you develop your term paper. You are required to read Chapters 1, 2, and 6, and these will be provided as pdfs on Canvas. But I encourage you to read the entire book, available on Amazon for ~$5 used.

Optional multimedia: Two podcasts – This Week in Parasitism (TWiP; www.microbeworld.org/podcasts/this-week-in-parasitism/archives) and selected episodes of RadioLab (www.radiolab.org/archive/)

Materials on reserve at the library:
Course Description

Parasites are ubiquitous: no ecosystem exists without them, and among all of Earth’s species, parasites outnumber non-parasites. But because they are usually small and hidden within their hosts, parasites can be easy to overlook. This course will introduce students to these rarely studied creatures, which span the entire tree of life, occupy all of Earth’s habitats, and influence many ecological processes.

Our material will survey all metazoan parasites, most protozoa, and some bacteria and viruses, addressing their distribution, ecology, and physiological effects on human and wildlife hosts. Because this is an ecology course, we will survey parasite diversity in light of evolutionary diversification. Phylogenetic relationships within and among groups will provide the framework for the course.

Within this phylogenetic framework, the bulk of our time will be spent exploring general disease ecology theory through relatable case studies of individual taxa. We will explore fundamental principles of parasite populations (e.g., SIR models, $R_0$, frequency- and density-dependent transmission) and communities (e.g., co-infection dynamics, host heterogeneity). We will investigate the effects of parasites on host populations (e.g., host population regulation), communities (e.g., parasite-mediated competition), and ecosystems (e.g., nutrient availability). We will strive to put parasites into a food-web context, assessing the impacts of parasites on food webs (e.g., connectance, nestedness, energy flow, biomass, food chain length) and of food webs on parasites (e.g., dilution effect hypothesis, biodiversity-begets-biodiversity hypothesis). Finally, we will use our accumulated knowledge to make predictions for how disease transmission might respond to human impacts like biodiversity loss, climate change, and urbanization and will evaluate the interventions available for wildlife and human disease control (e.g., vaccination, culling, environmental modification, biological control).

Learning Goals

By the end of the semester, I expect you will be able to:

1. recognize each of the major groups of parasites and describe their basic life cycles
2. analyze and critically evaluate graphical representations of data (from the scientific literature) and raw epidemiologic datasets (presented during lab sessions)
3. interpret, evaluate, and synthesize primary literature in parasite ecology (accomplished via writing assignment and “elevator pitch” presentation)
4. apply your knowledge of disease ecology to generate novel ideas for the management of wildlife diseases (accomplished via writing assignment)
5. critique your colleagues’ ideas respectfully yet substantively
6. communicate ideas about the ecology of disease effectively, in writing and speech
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<thead>
<tr>
<th>Assessment</th>
<th>Due</th>
<th>Proportion of your final grade</th>
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<tbody>
<tr>
<td><strong>Exams</strong></td>
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<tr>
<td>Exam 1</td>
<td>30 Oct</td>
<td>20%</td>
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<tr>
<td>Exam 2 (partially cumulative)</td>
<td>Finals week, between 11 and 15 Dec</td>
<td>20%</td>
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<td><strong>Term project</strong></td>
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<td>You are assigned a focal parasite/disease</td>
<td>17 Oct</td>
<td>n/a</td>
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<tr>
<td>You pitch your ideas for managing the transmission of your assigned parasite</td>
<td>31 Oct</td>
<td>0% – this is to encourage you to be as creative as possible! No ideas are too far-fetched.</td>
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<td>You submit a first draft of your 10-page term paper for peer review by two classmates</td>
<td>7 Nov</td>
<td>n/a</td>
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<td>Classmate provides peer review of your draft</td>
<td>14 Nov</td>
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<tr>
<td>You provide peer review of classmate’s draft</td>
<td>14 Nov</td>
<td>10% – peer review makes the science world go ’round. Here, you get to practice providing constructive suggestions to colleagues.</td>
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<td>You revise and give me the second draft</td>
<td>22 Nov</td>
<td>0% – your work on the term paper will not be graded until you submit the final version. This should give you the opportunity to put together a stellar paper, and lets you experience the iterative process of scientific writing.</td>
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<td>I hand draft back to you with feedback</td>
<td>29 Nov</td>
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<td>You give a 5-minute oral presentation of your findings (an “Elevator Pitch”)</td>
<td>5 Dec</td>
<td>10%</td>
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<td>You hand in your final draft (10 pages double-spaced)</td>
<td>8 Dec – yes, this is close to the date of the final, but you’ll have been working on this paper for &gt;1 month at this point!</td>
<td>20%</td>
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<tr>
<td><strong>Participation</strong></td>
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<tr>
<td>Lab notebook</td>
<td>5 Dec</td>
<td>10% – getting to know the parasites can be daunting. Careful scientific illustrations that are well-annotated help you to see the similarities, differences, and relationships among taxa, helping you to remember them.</td>
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<td>In-class, in-lab, and online participation</td>
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<td>10% – see below for a detailed grading breakdown. Online discussions will be conducted in Canvas.</td>
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*Note that there will be no curve.
Exam Policy
There are no alternative exam times. Make-ups for exams will be available only for emergency situations that can be verified. If you miss an exam due to illness or other emergency, make sure that you or a friend contacts the instructor, Dr. Wood, by email at chelwood@uw.edu within 24 hours of the exam. Documentation of illness will be required for any missed exam. To preserve the academic integrity of the course, the instructor reserves the right to alter the content and/or format of the original test in creating a make-up exam.

Extra Credit
There will be bonus questions on exams that will require you to think hard, synthesize your knowledge, and creatively generate hypotheses for patterns. These questions will draw heavily from the textbook and pdf readings and from content presented by Guest Speakers.

Regrade Policy
If you believe that an exam or assignment has been graded incorrectly, or that the grade entered is incorrect, you must contact me within one week of when the assignment was returned to you. Such a request must be submitted in writing (e-mail is fine) and must be accompanied by the original, unaltered assignment.

Academic Integrity
Students at the University of Washington are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). I expect you to know and follow the university’s policies on cheating and plagiarism. Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington Community Standards and Student Conduct website.

I don’t expect anyone in this class to engage in academic misconduct – disease ecology is a window into a new and exciting world, and cheating robs the cheater of the opportunity to explore and know that world. But just in case, I will state up front my policy for addressing academic misconduct: if you are caught cheating, falsifying data, plagiarizing, collaborating on assignments in a manner that is prohibited, or committing any other kind of academic misconduct as defined in the Student Conduct Code, you will receive an automatic zero on the assignment and the case will be referred to the College of the Environment for a Student Conduct Process hearing. If you are caught twice, you will receive a zero in the course and the case will be referred for an additional hearing.

Posting of Grades
You will be able to access your grades via Canvas. All graded material (exams and essays) will be returned promptly during scheduled class or lab times. If you find that there is a clerical error in a posted score, please contact me as soon as you notice the error. Exam scores will be posted no more than 10 days after the exam date.
Labs
Lab exercises are a key part of learning about parasites. You will work with a variety of living representatives of the groups discussed in lecture. We will also look at preserved specimens and slides. Lab Reflections assignments are designed to help you engage with lab material, are distributed at the beginning of lab, are collected at the end of the lab, and will be graded by your TAs. Please adhere to the following guidelines in lab:

- No food or drink, including gum
- Always wear close-toed shoes
- Put any sharp waste (scalpel blades, broken glass) in the sharps container
- Handle preserved specimens and shells carefully
- Rinse tools before and after use
- Rinse your hands well with water only to remove lotions or soaps before touching live animals
- Handle all animals gently
- Keep live animals in water and avoid temperature, oxygen, and light shock
- Don’t feed the animals unless you are instructed to
- Don’t let animals dry out
- Never place dead animals in the garbage – put them in the bags provided
- Put preserved animals back in the correct jar
- Don’t mix instruments used with live and dead animals
- If you are unsure of what to do, ask before you act

Participation
Science education research has demonstrated that students who take an active role in their learning learn more and retain that knowledge longer; therefore, it is in your best interest to prepare for and actively participate in class meetings – including small group activities and whole-class discussions. This is a relatively easy way to earn points toward your final grade. **One thing that may help you participate in class is bringing questions you have written out ahead of time.** I will also use a random name generator to call on students at random. Your participation grade will be determined by how often you contribute in class, as well as the quality of those contributions AND how often you contribute to online discussions via Canvas, as well as the quality of those contributions. 10 points (of 10) = student goes beyond required reading, bringing in outside examples and knowledge beyond the scope of the course or connecting concepts across lectures, 8 points = regular participation, usually well thought-out, useful contributions; 6 points = regular participation, sometimes useful, sometimes not; 4 points = occasional participation that is generally useful; 2 points = occasional participation, but generally non-substantive, adding little new information; 0 points = rarely contributed. I can provide feedback on your participation at any point in the semester, at your request.

Attendance Policy
Attendance is the best way to ensure you absorb the material and perform well on tests and assignments, but it will not be recorded. Absence from lab is to be absolutely avoided if at all
possible, because you’ll miss out on the opportunity to see demonstrations and slides that are designed to help you know the parasites well.

**Guest Lectures**
We will have visitors lecture on various topics. You are expected to show extra respect to our invited speakers by arriving early, if possible, for these presentations, remaining engaged throughout the class period, and asking thoughtful questions at the end. There will be at least one question on each exam about the material presented by these speakers.

**E-mail**
Any e-mail sent to me will receive a response within 48 hours. Detailed questions should be addressed to me in person – either after class or during office hours.

**Late Assignments**
Late assignments will not be accepted and will receive a grade of 0%. If you anticipate having trouble meeting one of the deadlines set out in this syllabus, please discuss with me beforehand.

**Incomplete (I)**
From UW's Faculty Resource on Grading: “An Incomplete is given only when the student has been in attendance and has done satisfactory work until within two weeks of the end of the quarter and has furnished proof satisfactory to the instructor that the work cannot be completed because of illness or other circumstances beyond the student’s control… To obtain credit for the course, an undergraduate student must convert an Incomplete into a passing grade no later than the last day of the next quarter… An Incomplete grade not made up by the end of the next quarter is converted to the grade of 0.0 by the Office of the University Registrar… An Incomplete grade does not count for registered hours nor in computation of grade-point averages.”

**Classroom Climate**
Diverse backgrounds, embodiments, and experiences are essential to the critical thinking endeavor at the heart of higher education. I expect you to follow the UW Student Conduct Code in your interactions with your colleagues and me in this course by respecting the many social and cultural differences among us, which may include, but are not limited to: age, cultural background, disability, ethnicity, family status, gender identity and presentation, citizenship and immigration status, national origin, race, religious and political beliefs, sex, sexual orientation, socioeconomic status, and veteran status. Please talk with me right away if you experience disrespect in this class, and I will work to address it. DCinfo@uw.edu is a resource for students with classroom climate concerns.

**Access and Accommodations for Persons with Disabilities**
It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is policy and practice to create inclusive and accessible
learning environments consistent with federal and state law. Full participation in this course requires the following types of engagement:

<table>
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<tr>
<th>Course component</th>
<th>Requirement</th>
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<tr>
<td>Lecture</td>
<td>the ability to attend 2 hour-long lectures per week with 30 other students; the ability to complete two written and timed exams; the ability to compose a 10-page research paper; the ability to give an oral presentation before the class</td>
</tr>
<tr>
<td>Lab</td>
<td>the ability to participate in weekly 4-hour lab sessions that include dissections, use of microscopes, and observing the behavior of live animals; the ability to participate in group discussions; the ability to stand and sit for extended periods of time, engage in repetitive motion activities, and manipulate lab equipment</td>
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If you anticipate or experience barriers to your learning or full participation in this course based on a physical, learning, or mental health disability, please immediately contact the instructor to discuss possible accommodation(s). A more complete description of the disability policy of the College of the Environment can be found here: https://environment.uw.edu/intranet/academics/teaching/disability-accommodation/. If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 V / 206-543-8925 TDD / uwdss@uw.edu e-mail / http://www.uw.edu/students/drs.

Roles and Responsibilities
- **Student**: inform the instructor no later than the first week of the quarter of any accommodation(s) you will or may potentially require.
- **Instructor and TA**: maintain strict confidentiality of any student’s disability and accommodation(s); help all students meet the learning objectives of this course.

Accommodations for Religious Observances
Students who expect to miss class or assignments as a consequence of their religious observance will be provided with a reasonable alternative opportunity to fulfill their academic responsibilities. Absence from class for religious reasons does not relieve students from responsibility for the course work required during the period of absence. It is the responsibility of the student to provide the instructor with advance notice of the dates of religious holidays on which they will be absent. Students who are absent will be offered an opportunity to make up the work, without penalty, within a reasonable time, as long as the student made prior arrangements. Pre-arranged absences for religious observances will not be counted against class participation.
FISH 406: Disease Ecology

Schedule of Lectures and Labs: Fall 2017

You are expected to have read these materials (from the textbook or course website) before each lecture. You are also expected to have read each lab overview before lab (available on the course website). This schedule is subject to change. R&J = Foundations of Parasitology, Roberts and Janovy. K&H = Karban and Huntzinger’s How to Do Ecology: A Concise Handbook, pdfs of chapters available on Canvas. Combes = Combes’ Parasitism: The Ecology and Evolution of Intimate Interactions (required ONLY for graduate students). TWiP = “This Week in Parasitism” podcast, available at: http://www.microbeworld.org/podcasts/this-week-in-parasitism/archives. OR = optional reading, available on the course website. PR = Parasite Rex, Carl Zimmer.

<table>
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<tr>
<th>Date</th>
<th>Lecture</th>
<th>Required reading and other assignments (grad-level assignments indicated with underline)</th>
<th>Multimedia (optional but recommended)</th>
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<tr>
<td>Friday, 29 Sep</td>
<td>Adaptations to parasitism (acquisition of energy, growth, fitness, body size, Law’s “Darwinian demon”, host specificity, dodging the host immune response) and Introduction to the trematodes (evolution of complex life cycles, eu-sociality, trophic transmission, behavioral manipulation, co-infection)</td>
<td>☐ R&amp;J Chapters 13 &amp; 15 ☐ Lafferty and Morris 2006 ☐ Combes Chapter 2</td>
<td>TWiP 27: Trematodes OR 4 – Cercarial dermatitis Why Captain Higgins is my favorite parasitic flatworm: <a href="http://theoatmeal.com/comics/captain_higgins">http://theoatmeal.com/comics/captain_higgins</a></td>
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<td>Monday,</td>
<td>The trematodes (Latin for parasitologists, life cycles as</td>
<td>☐ R&amp;J Chapters 17 &amp; 18</td>
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<tr>
<td>Date</td>
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<td>2 Oct</td>
<td>“variations on a theme”, paratenic hosts, evolution of parasitism in terrestrial/freshwater versus marine environments, biodiversity and disease</td>
<td>Combes Chapter 3</td>
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| Tuesday, 3 Oct | Lab #1: *Introduction to parasitology* (PPE/hand-washing, bleach, microscopy tutorial, demo mass-action SIR models/vaccination/complex LC transmission/dilution effect by having students wander the room blindfolded, fish guts lab) | Lab Notebook Guidelines (in this syllabus)  
Lab #1: Overview |
| Wednesday, 4 Oct | *Schistosomes* 1 (historical contingency in modern disease distributions, schistosome life cycle and pathology, the 80/20 rule, Kerry Naish’s personal schisto saga) | R&J Chapter 16  
Watch Shelly Xie’s video: [https://www.youtube.com/watch?v=lo1cRLdqKq4](https://www.youtube.com/watch?v=lo1cRLdqKq4)  
Combes Chapter 4 |
| Friday, 6 Oct | *Schistosomes* 2: (aggregated versus random versus uniform distributions, demography of parasites with complex life cycles, global versus local epidemiological statistics, the “ecological fallacy”, biological control) | Klepac et al. 2013  
Bockarie et al. 2013  
King et al. 2006  
Mkoji et al. 1999  
Combes Chapter 5  
PR Chapter 2 |
| Monday, 9 Oct | COLUMBUS DAY – NO CLASS | |
| Tuesday, 10 Oct | Lab #2: *Adult trematodes* (live schisto adults in mouse model, hatch eggs into miracidia, view slides and preserved specimens) | Lab #2: Overview  
K&H Chapter 1 |
| Wednesday, 11 Oct | *Cestodes* 1 (tapeworm anatomy and life cycle, parasite strategies for nutrient acquisition, energy budgets for host–parasite systems, spatial habitat partitioning, intra- and inter-specific within-host competition) | R&J Chapter 20  
Combes Chapter 6  
TwiP 6: Tapeworms, the long and short of it  
TwiP 7: Tapeworms are fantastic! |
| Friday, 13 Oct | *Cestodes* 2 (gene–environment interactions determine infection pathology, unique role of livestock and domestic animals in disease transmission, sylvatic versus | R&J Chapter 21  
Nelson and Rausch  
“The Vicious Worm” advocacy tool: [www.theviciousworm.org](http://www.theviciousworm.org) and intro paper (Johansen et al. 2014) |
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<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading Materials</th>
<th>Notes</th>
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| Monday, 16 Oct | Introduction to the nematodes (quiescence, Red Queen hypothesis, migration as an adaptation for escaping parasitism, Hamilton and Zuk’s “good genes” hypothesis, population regulation by parasites) | □ R&J Chapter 22  
□ Combes Chapter 9 | OR 5 – Neurocysticercosis |
| Tuesday, 17 Oct | Lab #3: Larval trematodes and larval cestodes (shed and dissect Batillaria attrementaria snails from coastal Washington, behavioral manipulation demo, view slides, discussion and assignment of focal parasite/disease for term project) | □ Lab #3: Overview  
□ Heymann 2006  
□ Dowdle 1999  
□ Forward and Chapter 1 of “What's Worked?” Working Group 2004 | PR Chapter 3 |
| Wednesday, 18 Oct | Special Guest Lecture: Marguerite Pappaioanou on Echinococcus granulosus and E. multilocularis | □ Pappaioanou and Schwabe 1984a  
□ Pappaioanou and Schwabe 1984b  
□ Combes Chapter 8 | |
| Friday, 20 Oct | Nematodes 1 (evolutionary relics, climate change and disease transmission, the hygiene hypothesis) | □ R&J Chapter 26  
□ R&J Chapters 27, 25  
□ Hotez et al. 2004  
□ Nuwer 2013  
□ Reddy and Fried 2007  
□ Combes Chapter 10 | TWiP 21: The giant intestinal worm, Ascaris lumbricoides  
TWiP 20: The whipworm, Trichuris trichiura  
TWiP 22: Hookworm  
TWiP 29: Neglected tropical diseases with Peter Hotez  
TWiP 71: Happy trails to you  
OR 6 – Whipworm |
| Monday, 23 Oct | Nematodes 2 (“dead-end” hosts, co-speciation of hosts and parasites, intra-cellular parasitism, carrion transmission, parasitism in extreme environments) | □ R&J Chapters 23, 24, & 28  
□ Combes Chapter 11 | TWiP 19: Enterobius vermicularis, the pinworm  
TWiP 23: Strongyloides stercoralis, a most unusual parasite  
TWiP 3: Trichinella spiralis |
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<th>Activity</th>
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| Tuesday, 24 Oct | **Lab #4: Nematodes** (discussion of Al Jazeera’s “How to Slay a Dragon”, discuss speciation of the dracunculids, dissection of pickled *Ascaris lumbricoides*, dissect live cockroaches and ID their pinworms, view slides of nematodes) | ☐ Lab #4: Overview  
☐ Harris 2014  
☐ K&H Chapter 2  
TWiP 5: The nurse cell  
TWiP 70: Invasion of the swamp eels  
OR 7 – Pinworm  
OR 8 – *Trichinella spiralis*  
OR 9 – Raccoon roundworm |
| Wednesday, 25 Oct | Nematodes 3 (“poverty traps”, diverse habitat associations within parasite taxa, aquatic parasites in arid environments, parasite eradication and co-extinction) | ☐ R&J Chapter 30  
☐ Biswas et al. 2013  
☐ Siddall 2013  
☐ Eberhard et al. 2014  
☐ Combes Chapter 12 | TWiP 37: Dracunculiasis  
PR Chapter 4 |
| Friday, 27 Oct | Nematodes 4 (vector-borne parasites, periodicity of microfilarial activity, biodiversity and disease) | ☐ R&J Chapter 29  
☐ Koplow Introduction  
☐ Koplow Chapter 1  
☐ Combes Chapter 13 | TWiP 24: *Onchocerca volvulus*, a vector-borne, filarial nematode  
TWiP 40: Doctor, there’s a worm in my eye!  
TWiP 25: *Wuchereria bancrofti* |
<p>| Monday, 30 Oct | EXAM 1 | | |
| Tuesday, 31 Oct | Lab #5: Pitch your term paper ideas for peer commentary; discussion of the costs and benefits of | ☐ Koplow Chapter 4 | |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading Materials</th>
<th>Other Notes</th>
</tr>
</thead>
</table>
| Wednesday, 1 Nov     | Introduction to the arthropods ("adaptive peaks", ectoparasites, Protelean parasites, micropredators, social aggregation as an opportunity for transmission, emerging infections) | ☐ R&J Chapter 33  
☐ Combes Chapter 14 | TWiP 41: Flying and crawling beasts  
TWiP 28: Medical entomology with Robert W. Gwadz |
| Friday, 3 Nov        | Arthropods 1 (why do ticks vector so many diseases?)                  | ☐ R&J Chapter 41  
☐ Combes Chapter 15 | PR Chapter 5 |
| Monday, 6 Nov        | Arthropods 2 (reservoir hosts, pace of life and susceptibility to disease, why don’t bed bugs vector any diseases? or do they?, temporal synchronization of animal and human epidemics across space) | ☐ R&J Chapters 36, 37, 38 | RadioLab: The Most Horrible Seaside Vacation (http://www.radiolab.org/story/169882-typhoid-mary/) |
| Tuesday, 7 Nov       | Lab #6: Arthropods and polychaetes (Demodex folliculorum demonstration, shucking oysters to find Polydora, arthropod slides) | ☐ Lab #6: Overview  
☐ K&H Chapter 6  
☐ Submit first draft of your term paper for peer review by two classmates  
☐ Collect two first drafts for peer review | |
| Wednesday, 8 Nov     | Arthropods 3 (biodiversity and disease, egg and cyst transport, biological control, parasitoids) | ☐ R&J Chapter 39  
☐ Combes Chapter 16 | |
| Friday, 10 Nov       | Bizarro world (a grab bag of taxonomically mysterious/ecologically enigmatic/rare/neglected metazoan parasites – myxozoans, nematomorphs, acanthocephalans, pentastomids, orthonectids, rhombozoans) | ☐ R&J Chapters 11, 12, 31, 32, 35 | TWiP 56: Whirling disease  
TWiP 44: Parasites provide a cricket subsidy for trout |
| Monday, 13 Nov       | Parasite biomass (do parasites play a role in the flow of energy through the biosphere? in what ecosystems) | ☐ R&J Chapter 4  
☐ Sato et al. 2012 | TWiP 39: I encyst, said the amoeba |
might infectious processes play an important energetic role? and Introduction to the Protozoa (evolution, anatomy)

| Tuesday, 14 Nov | Lab #7: Amoebae, gut flagellates, and analyzing epidemiologic data (dissect termites to find their gut flagellates, analyze epidemiologic data on cholera in 1850s London and the recent UW mumps outbreak, view protozoa slides) | Kuris et al. 2008  
Combes Chapter 17  
TWiP 17: Entamoeba histolytica  
TWiP 73: I'm nibbling my way back to you |
| Wednesday, 15 Nov | Protozoa 1 (African sleeping sickness and geographical patterns of colonization in sub-Saharan Africa) | R&J Chapters 5, 6, 7  
Miner 1961  
Combes Chapter 18  
TWiP 38: How to Trichomonas  
TWiP 16: Giardia  
TWiP 15: Tryp the light fantastic  
TWiP 14: Leishmania  
OR 10 – Trichomonas vaginalis  
OR 11 – Giardia  
OR 12 – Leishmaniasis  
PR Chapter 6 |
| Friday, 17 Nov | Protozoa 2 (coccidian life cycles, the world’s most successful parasite) | Combes Chapter 19  
TWiP 18: Cryptosporidium  
TWiP 57: An outbreak of cyclosporiasis  
OR 13 – Cryptosporidium  
TWiP 12: Toxoplasma gondii  
TWiP 13: Toxoplasmosis  
TWiP 60: Urine a game of cat and mouse  
OR 14 – Toxoplasma |
| Monday, 20 Nov | Protozoa 3 (malaria, especially in Hawaiian birds, balancing selection) | R&J Chapter 8 and 9  
Lafferty 2006  
Sachs and Malaney 2002  
Alonso et al. 2011  
Rogers et al. 2002  
TWiP 9: Malaria  
TWiP 10: Plasmodium life cycle  
TWiP 11: One times three million  
TWiP 63: Plasmodium of the apes  
TWiP 68: Malaria rising  
PR Chapter 7 |
<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 21 Nov</td>
<td>THANKSGIVING – NO LAB</td>
<td>Druilhe et al. 2005</td>
</tr>
<tr>
<td>Wednesday, 22 Nov</td>
<td>Summing up the parasites (how do we draw boundaries around our definition of “parasite”? what are we leaving out?)</td>
<td>Submit second draft for professor’s comments</td>
</tr>
<tr>
<td>Friday, 24 Nov</td>
<td>THANKSGIVING – NO CLASS</td>
<td></td>
</tr>
<tr>
<td>Monday, 27 Nov</td>
<td>Coinfection: What happens when two (or more) parasites occur in the same host?</td>
<td>Seabloom et al. 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ezenwa and Jolles 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combes Chapter 20</td>
</tr>
<tr>
<td>Tuesday, 28 Nov</td>
<td>Lab #8: Diagnose your dog (bring your own dog poop! If you don’t have easy access to dog poop, don’t worry – we’ll have some highly parasitized poop on hand [generously donated by a local shelter]; if we get lucky, we might also have some whale poop!; view slides of apicomplexans)</td>
<td>Lab #8: Overview</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If you’d like, bring your own dog poop! No cat poop allowed (sorry cat people).</td>
</tr>
<tr>
<td>Wednesday, 29 Nov</td>
<td>Special Guest Lecture: TBD (FDA scientist on food-borne disease in oysters of the Pacific Northwest)</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I will return your second drafts with my comments today</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combes Reflections</td>
</tr>
<tr>
<td>Friday, 1 Dec</td>
<td>Nature’s services, nature’s disservices 1: The dilution effect hypothesis, co-extinction, the host-diversity-begets-parasite-diversity hypothesis</td>
<td>Allan et al. 2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keesing et al. 2010</td>
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<td></td>
<td></td>
<td>Dunn et al. 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hechinger and Lafferty 2005</td>
</tr>
<tr>
<td>Monday, 4 Dec</td>
<td>Nature’s services, nature’s disservices 2: Can biodiversity buffer infectious disease transmission?</td>
<td>Wood and Lafferty 2013</td>
</tr>
<tr>
<td>Date</td>
<td>Activity</td>
<td>Notes</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tuesday, 5 Dec</td>
<td>Lab #9: Elevator pitch presentations</td>
<td>□ Ostfeld and Keesing 2013&lt;br&gt;□ Lafferty and Wood 2013&lt;br&gt;□ Wood et al. 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Come ready to present your elevator pitch&lt;br&gt;□ Bring your lab notebook to be submitted for a grade</td>
</tr>
<tr>
<td>Wednesday, 6 Dec</td>
<td>The “Parasitologist’s Dilemma”: What will become of our wormy world? (15 minutes will be set aside for completion of course evaluations – and if &gt;75% of students complete evals, there will be a 5-point bonus question on the final!)</td>
<td>□ Zarlenga et al. 2015&lt;br&gt;□ A paper about demographic transition TBD&lt;br&gt;□ Bring a device to class so you can fill out online course evals&lt;br&gt;□ Combes Conclusion</td>
</tr>
<tr>
<td>Friday, 8 Dec</td>
<td>Exam review</td>
<td>□ Final term papers due</td>
</tr>
<tr>
<td>Finals week, 11–15 Dec</td>
<td>EXAM 2</td>
<td></td>
</tr>
</tbody>
</table>


You are required to keep a lab notebook for this course. The notebook is worth 10% of your final grade. Lab notebooks will be collected on Wednesday, 15 April to be graded. Your lab notebook grade will be broken down as follows:

<table>
<thead>
<tr>
<th>Criterion</th>
<th># points (of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion</td>
<td>2</td>
</tr>
<tr>
<td>Handed in on time</td>
<td></td>
</tr>
<tr>
<td>Data (host, site of infection, etc.)</td>
<td>2</td>
</tr>
<tr>
<td>Methods</td>
<td>1</td>
</tr>
<tr>
<td>Sketches (anatomy, labeling)</td>
<td>2</td>
</tr>
<tr>
<td>Scale (magnification or measurement)</td>
<td>1</td>
</tr>
<tr>
<td>Detail (life cycle, pathology, etc.)</td>
<td>2</td>
</tr>
</tbody>
</table>

If more than one lab is missing from your notebook, the 10 completion points will be forfeited. If one lab is missing, 4 points will be deducted.

**Materials:** I suggest that you do your drawings and notes on good quality printer paper and keep the notebook in a three-ring binder. Composition books are also acceptable. No spiral notebooks or lined loose-leaf paper please – both tend to fall apart before the end of the semester. Colored pencils are useful for labeling host and parasite anatomy and will be available in the lab for you to use.

**Contents:** Your notebook should emphasize the living organisms and dissections from the lab. A major part of this lab course is the study of fresh material, and we are fortunate to have access to these animals. A good record of your observations will be useful to you for studying and review and for any future research that you may do in parasitology or ecology. A table of contents must be included in your notebook.

**Drawings:** Artistic ability is not necessary to produce workable specimen drawings and don’t worry, you will not be graded on the quality of your artwork. However, you will need to develop your observation skills. Even the smallest protozoan parasites have morphological and anatomical details that facilitate their identification. Find a specimen that shows the details described by your instructor, adjust the focus and illumination for optimal viewing, and observe the specimen carefully before you draw.
Drawings should be large enough to accommodate anatomical detail and clear labeling. Try sketching lightly in pencil and then trace over the lines that you want to keep for your finished drawing.

**Drawings should include the following details:**

1. Host identity (genus and species or lowest taxonomic level)
2. Host collection data (location and date of collection)
3. Host parameters (age, sex, size)
4. Dissection description (what parts of the host were examined?)
5. Parasite identity (genus and species)
6. Number of parasites found (for each parasite species found)
7. Site of infection (organ or tissue)
8. Scale bar or magnification (always use metric units)
9. Labeled parasite anatomy (notes and annotations are always useful)
10. Life cycle stage

**The following observations are also recommended:**

1. Pathology – describe any damage to host tissue or alteration of host morphology
2. Attachment – is the parasite attached or encapsulated?
3. Behavior – Describe any movement observed. Does the parasite respond to light, touch, or other stimulus? Do they abandon the host when disturbed?

The more detail that you include in your notes and drawings, the more useful your lab notebook will be to you.
Term Paper Guidelines

The World Organization for Animal Health (OIE) is the international authority responsible for wildlife and livestock disease, and was the driving force in the eradication of rinderpest. According to OIE’s website (http://www.oie.int/about-us/our-missions/), its responsibilities include:

- Ensuring transparency in the global animal disease situation
- Collecting, analyzing, and disseminating veterinary scientific information
- Encouraging international solidarity in the control of animal diseases
- Safeguarding world trade by publishing health standards for international trade in animals and animal products
- Improving the legal framework and resources of national veterinary services
- Promoting animal welfare through a science-based approach

In this assignment, you will write a report advising the OIE on your recommendations for addressing the global burden of one primarily aquatic parasite (i.e., do you recommend eradication, elimination, control, or even augmentation? Why and how?). Each student will be assigned a different parasite. Focal parasites will be discussed and decided upon in lab on DATE. Questions you might consider in your report include:

- Where (geographically speaking) do infections with this parasite primarily occur?
- Is eradication desirable (i.e., are there potential collateral impacts of eradication)?
- Is eradication possible? If not, is elimination possible for some regions? If not, is control possible?
- What has been tried already? Were those attempts successful? Why or why not?
- What obstacles stand in the way of eradication / elimination / control?
- Are there creative ecological solutions for eradication / elimination / control?
- What experiments would be needed to test your solution’s efficacy?
- Would your solution work in the environmental and economic context in which your parasite primarily occurs?

It is not necessary to address every question, but these should give you a starting point for thinking critically about what recommendations you might make to the OIE. Your arguments should be supported by references to the primary literature and should be
primarily ecological or veterinary in nature. Your references should follow the style guidelines on the final page of this document.

The purpose of this assignment is: (1) to get you to think critically about the ecology and management of parasites, (2) to get you intimately familiar with at least one important parasite, (3) to have you practice generating hypotheses and designing experiments to explore the ecology of parasite transmission, and (4) to hone your scientific writing skills.

Paper requirements:
- 12-point, Times New Roman font, double-spaced with 1” margins
- At least 10 pages long
- At least 20 references to primary literature
- No references to sources other than the scientific literature (i.e., no Wikipedia, no encyclopedias, no textbooks) – a handful of websites (< 3) is okay if warranted
- Number your pages
- References formatted according to Reference Formatting Guidelines (end of this document)

Parasites/diseases (not an exhaustive list – feel free to seek out alternatives!):
- Sea star-associated densovirus
- Abalone withering syndrome
- MSX in oysters
- Oyster herpesvirus
- Oyster nocardiosis
- *Euhaplorchis californiensis*
- Nematomorphs
- White band disease
- *Porites* trematodiasis
- *Batrachochytrium dendrobatidis*
- Ranavirus
- *Ribeiroia ondatrae*
- Anisakis or *Pseudoterranova*
- Phocine distemper virus
- *Philometra* sp. filarial nematodes
- *Giardia*
- *Toxoplasma gondii*
- *Fasciola gigantica*
- *Schistosoma japonicum*
- *Diphyllobothrium latum*
- Myxozoan infection / whirling disease
- *Ichthyophonus*
- Viral hemorrhagic septicemia
- Viral erythrocytic necrosis
- Infectious haemopoietic necrosis virus
Elevator Pitch Guidelines

Once you have crafted your plan for managing an important parasitic disease, you’ve got to convince people to put it into practice. Imagine that you are in a library on campus and you step into the elevator. Behind you, a man enters – and it’s Bill Gates. He’s at UW to give a speech to the School of Public Health. The Gates Foundation has generously funded human disease control projects throughout the developing world. You have the length of an elevator ride to convince Mr. Gates that your wildlife disease project is a worthy investment – that it addresses a major need, that it will work, and that it is cost-effective.

The purpose of this assignment is: (1) to get you comfortable with speaking about science to a variety of audiences, (2) to introduce some of the principles of excellent science communication, and (3) to have you practice boiling down complex scientific ideas.

Pitch requirements:
• No more than 5 minutes long – you’ll be stopped at 5 minutes on the dot
• This can be a more colloquial talk than you might give for a scientific audience. For inspiration, see the 3-minute TED talks: https://www.ted.com/playlists/81/ted_in_3_minutes
• If you want to use a visual aid, it must be something that you might reasonably carry with you into an elevator, with no prior expectation of meeting Bill Gates.
## Term Paper Grading Rubric

<table>
<thead>
<tr>
<th>Category</th>
<th>Exceeds expectations (5)</th>
<th>Meets expectations (4)</th>
<th>Nearly meets expectations (3)</th>
<th>Does not meet expectations (2)</th>
<th>Incomplete (0–1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title page, including abstract/executive summary</strong></td>
<td>Includes title and author’s name. Abstract/executive summary is concise and accurately reflects the content of the paper. Paper matches or exceeds minimum number of pages.</td>
<td>Includes title and author’s name. Abstract/executive summary is relatively concise and reflects the content of the paper, with some omissions or misrepresentations. Paper matches or exceeds minimum number of pages.</td>
<td>Includes title and author’s name. Abstract/executive summary is wordy OR only partially represents the content of the paper. Paper too short.</td>
<td>Includes title and author’s name. Abstract/executive summary is wordy AND only partially represents the content of the paper. Paper too short.</td>
<td>Any of the components (title, author’s name, abstract/executive summary) are missing.</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>The introduction successfully “funnels” by providing a broad context and narrowing in to the purpose of the paper.</td>
<td>The introduction provides appropriate background context but does not “funnel”.</td>
<td>The introduction states the main topic but does not provide appropriate background context.</td>
<td>There is no clear introduction or main topic and no background context.</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Thesis statement</strong></td>
<td>Clearly and concisely states the paper’s purpose in a single sentence, which is engaging and thought provoking.</td>
<td>Clearly states the paper’s purpose in a single sentence.</td>
<td>States the paper’s purpose in a single sentence.</td>
<td>Incomplete and/or unfocused.</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Body</strong></td>
<td>Each paragraph has topic sentences and thoughtful supporting detail sentences that develop the main idea.</td>
<td>Each paragraph has topic sentences and sufficient supporting detail sentences that develop the main idea.</td>
<td>Most paragraphs lack supporting detail sentences. Some topic sentences missing.</td>
<td>Paragraphs wander, failing to support the main idea. Some topic sentences missing.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Paper makes a convincing argument, well supported by primary research.</td>
<td>Paper makes a somewhat convincing argument, partially supported by primary research.</td>
<td>Paper makes an unconvincing argument with little support from primary research.</td>
<td>No clear argument emerges or no support from primary research is provided.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Creativity</strong></td>
<td>Entirely novel ecological solutions are proposed for eradication/elimination/control.</td>
<td>Somewhat novel ecological solutions are proposed for eradication/elimination/control.</td>
<td>Existing ecological solutions are proposed for eradication/elimination/control.</td>
<td>No solutions are proposed for eradication/elimination/control.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Organization – structural development of the idea</strong></td>
<td>Writer demonstrates logical and subtle sequencing of ideas through well-developed paragraphs; transitions are used to enhance organization.</td>
<td>Paragraph development present but not perfected.</td>
<td>Logical organization; organization of ideas not fully developed.</td>
<td>No evidence of structure or organization.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td>The conclusion is engaging and restates the thesis.</td>
<td>The conclusion restates the thesis.</td>
<td>The conclusion does not adequately restate the thesis.</td>
<td>Incomplete and/or unfocused.</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Mechanics</strong></td>
<td>No errors in punctuation, capitalization, spelling, sentence structure, or word usage.</td>
<td>Almost no errors in punctuation, capitalization, spelling, sentence structure, or word usage.</td>
<td>Many errors in punctuation, capitalization, spelling, sentence structure, or word usage.</td>
<td>Numerous and distracting errors in punctuation, capitalization, spelling, sentence structure, or word usage.</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>All references are cited in the correct format with no errors. All sources are legitimate.</td>
<td>Some references are cited in the correct format. All sources are legitimate.</td>
<td>Few references are cited in the correct format. Some illegitimate sources (e.g., websites).</td>
<td>No references are cited in the correct format. Reference list contains illegitimate sources.</td>
<td>Absent</td>
</tr>
</tbody>
</table>
# Elevator Pitch Grading Rubric

<table>
<thead>
<tr>
<th>Category</th>
<th>Exceeds expectations (5)</th>
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<th>Nearly meets expectations (3)</th>
<th>Does not meet expectations (2)</th>
<th>Incomplete (0–1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td>The information included is accurate and completely addresses each component of the assigned topic.</td>
<td>The information included adequately addresses each component of the assigned topic.</td>
<td>The information included inadequately addresses the assigned topic. The information included is sometimes inaccurate.</td>
<td>The information included does not address the assigned topic.</td>
<td>There is no evidence of accurate content information.</td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>The presenter effectively and creatively delivers the information while staying on topic. The presenter appears relaxed and self-confident. Body language, voice modulation, and eye contact are effectively used.</td>
<td>The presenter adequately delivers the information while staying on topic. The presenter appears relaxed and self-confident. Body language, voice modulation, and eye contact are mostly appropriate.</td>
<td>The presenter delivers the information but does not stay on topic. The presenter appears tense or nervous. Body language, voice modulation, and eye contact are inappropriate or lacking.</td>
<td>The presenter omits important information and does not stay on topic. The presenter appears tense or nervous. Body language, voice modulation, and eye contact are inappropriate or lacking.</td>
<td>The presenter does not effectively deliver the necessary information.</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>The presentation content has been organized using a logical sequence. The presentation is engaging and effective.</td>
<td>The presentation content has been mostly organized using a logical sequence, but some flaws exist. The presentation is adequate.</td>
<td>The presentation content has been organized using a somewhat logical sequence. The presentation is sometimes confusing.</td>
<td>The presentation content is disorganized, unclear, or confusing. The presentation is not adequate.</td>
<td>The presentation does not include evidence of organization.</td>
</tr>
</tbody>
</table>
Reference Formatting Guidelines*
*Adapted from Rutgers University Libraries Research Guide

In-text references
For references with one author: (First author’s last name Date), e.g., (Abrams 1987)
For references with two authors: (First author’s last name and Second author’s last name Date),
e.g., (Abrams and Menge 1987)
For references with three or more authors: (First author’s last name et al. Date), e.g., (Abrams et al.
1987)

Journal article: one author
Last name First initial Second initial. Date. Title. Journal Title volume number: page range.

Journal article: two or more authors
Last name First initial Second initial, First initial Second initial Last name, and First initial Second
initial Last name. Date. Title. Journal Title volume number: page range.

Chapter in a book
Last name, First initial Second initial, First initial Second initial Last name, and First initial Second
initial Last name. Date. Chapter title. Pages in First initial Second initial Last name and First initial
Second initial Last name, editors. Book Title. City of publication, State of publication, Country of
publication: Publisher name.
Example: Abrams PA, BA Menge, and GG Mittelbach. 1995. The role of indirect effects in food
and Dynamics. New York, NY, USA: Chapman and Hall.

Book
Last name, First initial Second initial, First initial Second initial Last name, and First initial Second
initial Last name. Date. Book Title. City of publication, State of publication, Country of publication:
Publisher name.
New York, NY, USA: Wiley.

Government document
Last name First initial Second initial, First initial Second initial Last name, and First initial Second
initial Last name, editors. Date. Document title. Report number. City of publication, State of
publication, Country of publication: Government agency, Agency division.
Example: Maschinski J, HD Hammond, and L Holter, editors. Southwestern rare and endangered
CO, USA: US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range
Experiment Station.