Ecology & Evolutionary Biology
UNIVERSITY OF TORONTO

October 2, 2024

GUIDELINES FOR THE EEB PhD APPRAISAL EXAMINATION

Students and Supervisors: Please review additional details in the accompanying documents: *Checklist for the Appraisal Exam*, *Advice for the Appraisal Exam*, and *EEB Grad Handbook*.

Appraisal Exam Committee Members: Please review below sections I (*Goals of the Appraisal Exam*) and III (*Appraisal Examination Procedures*), and refer to section IV (*Question Bank*).

I: Goals of the Appraisal Exam

Doctoral students in the EEB Department must undertake an Appraisal Examination as a required program milestone. The Appraisal Exam should occur between **14 and 20 months** after registration for students in the regular PhD pathway or between 14 and 26 months for students in the PhD-U pathway (including MSc-PhD transfer students).

The Appraisal Exam consists of a written proposal, a public seminar, an oral defense of the proposed research, and oral responses to general knowledge questions in the field of EEB. The written proposal and seminar should present the conceptual framework of the research, hypotheses or objectives, methods, a timeframe for completion of the research, and analyses of any preliminary data.

The Appraisal Exam is designed to:

1) determine whether the student can think critically, conduct research, and communicate at a level sufficient to produce a quality thesis;
2) ensure that the proposed research has sound scientific rationale and feasibility;
3) assess whether the proposed research can be completed within the remaining duration of the doctoral program. If completion of all of the proposed components of the thesis in a reasonable amount of time may not be possible, the components should be prioritized so that it is clear which of them could be dropped without compromising the ability of the student to satisfactorily complete the degree.
4) ensure that the student has sufficiently broad knowledge in ecology and evolutionary biology to recognize and effectively pursue opportunities for research and collaboration in these fields;
5) provide constructive feedback on the proposed research (e.g., suggestions on approach, additional scientific literature, methodology, statistics, modeling, etc.).

II: Overview of and Preparations for the Appraisal Exam

The student should prepare a **written research proposal** that must be 15-20 double-spaced pages (4000-5000 words), in 12-point font, with 2.54 cm margins; note that this length limit does not include figures, tables or citations. When a research proposal exceeds this word limit, the Appraisal Exam will be delayed until a revised research proposal has been provided. The student must provide examiners with both a Word file as well as a PDF file at least two weeks prior to the exam. Relevant appendices may be included for additional optional information (e.g., figures, manuscripts). See the "*Checklist and Advice on the Appraisal Exam*" document for more details.

The student should review the **Question Bank** to prepare thoughtful and concise answers to demonstrate their understanding of general concepts and topics in EEB.

The student should prepare a **public seminar** of 25-30 minutes duration that summarizes their proposed research, including relevant background, conceptual rationale, and the progress of any preliminary or ongoing research.

The **examination** consists of a public seminar given by the student on the thesis proposal to the whole department (25-30 minutes plus 5-10 minutes of questions from the audience), followed by a private *in camera* exam component during which the candidate responds to questions by the Appraisal Committee about the research proposal and from the Question Bank to evaluate breadth of knowledge. The private portion of the exam normally lasts 2-2.5 hours. Allow at least 3.5 hours in total for the seminar, questions from the audience, a short break before the *in camera* exam starts, the *in camera* exam, faculty deliberations before and after the exam, and feedback after the exam.

The **Appraisal Committee** consists of at least five members chosen by the student and supervisor including: a) at least three members of the supervisory committee including the supervisor and co-supervisor (if there is one), and b) two other EEB faculty members who have not been closely involved in the supervision of the student's progress. One of those latter two faculty members should be chosen to broaden the ability of the committee to evaluate the breadth of ecological and evolutionary knowledge of the candidate. The committee as a whole is responsible for evaluating the candidate's breadth of knowledge. The Appraisal Committee members must be approved by the EEB Graduate Office <grad.eeb@utoronto.ca> before the seminar and exam are scheduled and **at least three weeks before** the exam (see the "*Checklist and Advice for the Appraisal Exam*" document for details). The EEB Graduate Office will choose the exam chair from those committee members not on the supervisory committee.

All members of the Appraisal Committee must attend both the seminar and the *in camera* exam. See the "*Checklist and Advice for the Appraisal Exam*" document for information about scheduling.

Once Appraisal Committee membership is approved, the student should submit (1) the seminar title, (2) research abstract, and (3) written research proposal to the EEB Graduate Office <grad.eeb@utoronto.ca> **at least two weeks before** the exam. The student will email the written research proposal (as a Word and PDF files) to committee members at least two weeks before the exam. Students should ensure confirmation of the time, location, and title for the appraisal seminar well before your exam with the seminar organizer for your campus. The EEB

Graduate Office will circulate a formal announcement to the Appraisal Committee a week before the exam and seminar coordinator(s) will circulate seminar details publicly.

III: Appraisal Examination Procedures

The *in camera* examination component will normally last 2-2.5 hours and will be divided into two phases, research proposal questioning and Question Bank evaluation. The first phase should involve **questions and student responses about the research proposal** from both the written proposal and the seminar. Students can expect approximately 10-15 minutes of questions from each faculty member in the first round of questions, typically starting with faculty who do not serve on the Thesis Supervisory Committee. A second round of questions usually follows, and sometimes there will be a few questions in a third round.

Questions on the proposed research should explore the candidate's grasp of principles and concepts underlying the projects, and gauge the adequacy of the proposed methods. In this phase of the exam, the student should demonstrate advanced expertise in their research specialization. Some of the questioning should be on the theory and proposed approaches.

Questions should also evaluate progress-to-date. However, there is not an expectation that extensive data will have been collected and analyzed; indeed, taking the Appraisal Exam only after many experiments have already been completed is strongly discouraged. Rather, discussions about the data collected so far (e.g., a pilot study or in-progress experiment) will help the committee to evaluate whether the structure and design of the thesis are sound. Progress-to-date provided in the proposal will also help the committee to determine whether the student has developed competency in formulating and communicating clear questions, analyzing data, and interpreting results. Note that the committee's expectations will be higher for late Appraisal Exams (beyond 20 or 26 months of registration), so candidates should complete the Appraisal Exam on time (see "*Checklist and Advice for EEB Appraisal Exam*" document).

The Appraisal Committee should also determine, based partly on progress-to-date, the feasibility of the student to complete the proposed projects and thesis before exiting the funded cohort. Slow or unfocused progress and work of low quality indicate red flags in achieving the goals of completing research successfully and completing the thesis in the time available.

The second phase of the *in camera* examination, the **Question Bank** part, will allocate approximately 20-30 minutes to assessing the breadth of knowledge of the candidate using the EEB Question Bank. The student is expected to demonstrate senior undergraduate competence in general biological principles, mastery of fundamental ecological and evolutionary concepts, and advanced expertise in their research specialization. The breadth portion of the examination will involve an over-dispersed selection of questions from the entire subject range of the departmental Question Bank, typically 2-3 questions selected by each member of the Appraisal Committee. The standard Question Bank will be continuously available to help students evaluate their level of knowledge and to direct their studying. It is not expected that a student should be able to provide excellent answers to all questions. Rather, a student should be able to provide strong answers to almost all questions from their main discipline and reasonable answers for most of the questions farther from their center of expertise, as perceived by the Appraisal Committee. If a student cannot answer a question, the Committee member should simply move on to another question to provide the student with an opportunity to demonstrate understanding of another topic. In order to better evaluate the student's level of expertise in the

area, examiners may also pose questions inspired by satisfactory answers to questions from the bank, especially when they relate directly to the student's proposed research.

The questioning should also cover any substantial additional breadth requirements that the Thesis Supervisory Committee as a whole may have communicated in detail to the student well in advance (at least one month) of the Appraisal Examination date.

At the end of the examination, the candidate will be asked to leave the room while the Appraisal Committee deliberates. The Appraisal Committee will use the entire examination, including both the public seminar and the private portions, to judge whether the candidate has met the appropriate standards under the criteria of the Appraisal Exam outlined in Section I (Goals of the Appraisal Exam). Breadth deficiencies are not to be the sole reason for failure of the initial Appraisal Exam. If the student passes the overall Appraisal Exam, but serious breadth deficiencies are perceived in a first Appraisal Exam attempt, then the Appraisal Committee will choose a way(s) for the student to satisfy the deficiencies with a Conditional Pass (see below).

The three possible outcomes of the Appraisal Committee deliberations are:

1) Pass. A **positive vote of at least four members** of the Appraisal Committee confirms that the student has passed the Appraisal Exam and may continue in their program.

2) Conditional Pass. If the Appraisal Committee decides that the **student must fulfill post-examination requirements** before being approved for continuation of their program, then these conditions and each corresponding deadline must be clearly specified on the *Appraisal Exam Report* form. The (co)-supervisor(s) is/are responsible for ensuring that the conditions are met. The supervisor or student must submit the completed "*Post-Appraisal Requirements Completion Form*" to the EEB Graduate Office within two weeks of the last deadline specified on the *Appraisal Exam Report*. If the "*Post-Appraisal Exam Requirements Completion Form*" is not submitted on time, then the student will cease to hold good standing. They may not be allowed to register and funding may be withheld. Normally, the requirements should be fulfilled within 6 months, but a longer timeframe can be granted if the situation is unusual and the Appraisal Committee specifically approves a longer period.

   In case of a serious breadth deficiency observed during a first Appraisal Exam, the Appraisal Committee should choose among the following prescriptions to remedy the deficiency and specify the remedy in writing on the *Appraisal Exam Report* form:
   a. Assign reading, followed by an oral reassessment of knowledge in the formerly weak areas by one or more appropriate members of the Appraisal Committee.
   b. Assign one or more essays on topics selected by the Appraisal Committee. The Appraisal Committee members would be responsible for evaluating the essay(s).
   c. Assign additional coursework. Auditing courses will not be considered adequate remediation unless the weak areas are reassessed by oral or written examination by relevant member(s) of the Appraisal Committee after the course audit is completed.

3) Not Passed:

a. A negative outcome of a first Appraisal Exam attempt requires the student to retake the exam within four months; a longer timeframe can be granted if the situation is unusual and the Appraisal Committee and the Associate Chair (Graduate) specifically approve the longer period. The student will consider suggestions offered by the Appraisal Committee for improving the research proposal and, if required, ways to remedy any breadth deficiencies. Normally, the student will not be required to present another public seminar. For the other components of the Appraisal Exam, the Appraisal Committee will decide which components must be retested. For example, if the student performed well on the Question Bank questions, they might not be required to repeat that component. Which components will and will not be retested must each be indicated by the Appraisal Committee on the Appraisal Exam Report form. The student or supervisor will inform the EEB Graduate Office about the date and time of the retake exam at least two weeks before the exam.
b. If the student does not pass the second attempt at the Appraisal Exam, then they have failed to meet the required academic standards of the EEB doctoral program and may be advised by the Associate Chair (Graduate) that they may no longer be eligible to proceed in the program.

Post-exam responsibilities: The **Chair** of the Appraisal Committee is responsible for returning the *Appraisal Examination Report* form and other appropriate documents to the EEB Graduate Office within 24 hours of the Appraisal Exam. The **Chair** of the Appraisal Exam or the EEB Graduate Office will provide copies of the *Appraisal Examination Report* to the student and supervisor(s). The **student** is responsible for completing any required conditions or retake by the deadlines specified in the *Appraisal Examination Report* form. The student's **Thesis Supervisory Committee** will be responsible for enforcing the prescription and reporting the progress of remediation in the records of their Supervisory Committee Meetings. The **supervisor(s)** are responsible for completing the "*Post-Appraisal Exam Requirements Completion Form*" and returning it to the EEB Graduate Office (Kitty Lam).

--Last modified October 2, 2024

IV. Question Bank

Breadth assessment in the Appraisal Exam:

Approximately 20-30 minutes of the *in camera* component of the Appraisal Exam will be allocated to assessing the breadth of knowledge of the candidate using the Question Bank, with the expectations and process outlined in section III (Appraisal Examination Procedures). Any substantial additional breadth requirements that the Thesis Supervisory Committee, as a whole, wishes to examine should be communicated in detail to the student well in advance of the examination date. The ideal format for such communication would be specification of questions comparable to those already in the EEB Question Bank.

This Question Bank and list of suggested study resources will be regularly reviewed by the EEB Graduate Affairs Committee. Students and faculty are invited to the EEB Associate Chair (Graduate) submit a) suggestions for additions, modifications, and corrections to questions, and b) pointers to particularly effective additional study resources.

Suggested study resources:

Evolution:

- Futuyma, D. 1998. Evolutionary Biology. 3rd ed. Sinauer Assoc.
- Freeman, S. & Herron, J.C. 2004. Evolutionary Analysis. 3rd ed. Prentice Hall.

Ecology

- Levin SA (ed.) 2009. The Princeton Guide to Ecology. Princeton University Press.

Statistics

- Steidl, R.J., John P. Hayes, and Eric Schauber. 1997. Statistical Power Analysis in Wildlife Research. Journal of Wildlife Management 61(2):270-279.
- Gilbert, Neil. 1989. Biometrical interpretation: making sense of statistics in biology. 146 pp. ISBN: 019854250X.

Questions

1) What is microevolution? What is macroevolution?
2) What is fitness?

[Comparative biology]

3) In a few sentences, briefly describe the conceptual basis for phylogenetic reconstruction.
4) Evolutionary biologists are often interested in whether two traits tend to evolve together (e.g., metabolic rate and body size). This often evolves asking if there is a correlation between traits across species. Why are phylogenetic relationships important in this context? Conceptually, what are “independent contrasts”?
5) What is the biological species concept? Briefly discuss why it is difficult for speciation to occur in sympatry but easier in allopatry.
6) Compare how plants, animals, and fungi acquire C, water, and nutrients.

[Behavioural ecology]

7) Why does altruistic behaviour seem, on the surface, a problem for the theory of evolution by natural selection? How can altruism evolve?
8) What is parent-offspring conflict? Give an example of a behaviour thought to be involved in parent-offspring conflict and discuss what factors might affect selection on this trait.
9) Females tend to mate more often with certain types of males more than others. Briefly discuss how the concepts of sensory bias, good genes, and sexual conflict relate to this observation.
10) What processes might result in an even spatial distribution of individuals within a population?

[Evolutionary ecology]

11) Should parasites evolve to become more or less virulent over time? Briefly discuss some of the key issues.
12) Describe some of the primary costs and benefits of outcrossing relative to selfing.
13) What is a genetic correlation? Give an example of how a genetic correlation might affect evolution.
14) What are “selfish genetic elements”? Discuss the selective forces governing their evolution.

[Evolutionary genetics]

15) Briefly discuss several reasons why genetic variation may exist in natural populations.
16) Can deleterious mutations ever spread to fixation? What factors affect the chance of this happening?
17) Even very closely related species typically differ by hundreds or thousands of base-pairs across their genomes. Discuss how various evolutionary forces are likely to contribute to these base- pair differences.
18) Conceptually, what is effective population size, Ne? What types of factors affect Ne?

[Population ecology]

19) The classic model of logistic population growth is characterized by two parameters: the intrinsic rate of growth, r, and the carrying capacity, K. Draw a graph of logistic population growth (abundance vs. time, beginning at a very low initial abundance) and explain how parameters r and K affect the shape of this graph. What types of life history traits affect r and K?
20) Define reproductive value. What determines the reproductive value of an individual in an age- structured population?

[Community ecology]

21) Briefly describe the theory of island biogeography.
22) What is the "enemy release" hypothesis as it relates to biological invasions? How might this hypothesis be tested?
23) Explain one mechanism by which productivity might increase with diversity.
24) What is the neutral theory of ecology?

25) Briefly discuss at least two hypotheses for why the tropics may be more diverse than temperate zones.
26) Briefly discuss the ideas of local vs. regional control in understanding species diversity.
27) Discuss at least two mechanisms that would allow species that consume the same resources to co-exist.
28) Contrast the fundamental and the realized niche. Which one of these will be affected by a competitor and in what way would a competitor change this niche?
29) How might the removal of a predator from a system result in a less diverse prey community?

[Trophic dynamics]

30) What is a trophic cascade? Distinguish between top-down and bottom-up control of the density or biomass of a species.
31) Predators negatively affect prey populations directly by consuming them, but the mere presence of a predator may also cause prey to change their behavior or morphology. Describe 1 or 2 ways that these indirect effects of predators on their prey could have a large negative influence on the productivity of a prey population.
32) What is eutrophication in lakes and seas? Briefly discuss possible causes and consequences.
33) Describe two substantially different explanations for how relatively slow-growing organisms like plants can dominate terrestrial ecosystems in the face of herbivore communities full of organisms with much higher maximum population growth rates.

[Spatial ecology and metapopulations]

34) What is a metacommunity? Describe some of the processes that distinguish it from a local community.
35) What are patch dynamics?
36) What would happen to a metapopulation in which you blocked the movement of individuals between patches? Why?
37) What is the rescue effect and how might the size and distance between patches affect its role in a metapopulation?

[Physiological ecology]

38) Contrast the process of adaptation with the process of acclimation and give an example of each.
39) Aquatic communities often have more trophic levels than terrestrial communities. Discuss physiological and energetic reasons that might help explain this difference.
40) Plants are often more physiologically challenging foods for animals than are other animals. Describe some of the challenges of eating plants.

[Disturbance/temporal dynamics]

41) What are the predictions of the intermediate disturbance hypothesis?
42) Discuss why there may be a trade-off between colonization ability and competitive ability in plants. What would this trade-off predict about the traits of species across time during the process of succession?

[Statistical concepts]

43) Explain the meaning of “$p < 0.05$” associated with the result of a [frequentist] statistical test.
44) Explain the difference between type-1 and type-2 errors.
45) Define statistical power. Specify several ways that you might go about increasing it if a power analysis for a planned experiment indicated that your initial plans would not provide sufficient power.
46) Distinguish between statistical and biological significance.
47) Explain the difference between comparison-wise and experiment-wise type-1 error rates.
48) Explain why the F-value statistic from an analysis of variance is positively correlated with the degree of difference among the groups being compared.
49) Under what circumstances would it be most informative to state or plot the value of a biological parameter such as animal size as:
    a) Mean ± standard deviation
    b) Mean ± standard error
    c) Mean ± 95% confidence interval
    d) Median, quartiles, range

    If sample size were reported along with a) above, explain how you could calculate b) and c) from a) for that population.