The Appraisal Exam Question Bank Department of Ecology and Evolutionary Biology

July, 2010 version for use in exams held after August 31, 2010.

This Question Bank and list of suggested study resources will be regularly reviewed by the Graduate Affairs Committee, initially on a yearly schedule. In anticipation of the revision expected in July, 2011, students and faculty are invited to submit a) suggestions for additions, modifications, and corrections to questions, and b) pointers to particularly effective additional study resources to Associate Chair Helen Rodd (helen.rodd@utoronto.ca).

Breadth assessment in the Appraisal Exam:

1. A roughly specified portion of the examination time (20-30 minutes) will be allocated to assessing the breadth of knowledge of the candidate using the Question Bank. Any substantial additional breadth requirements that the Advisory 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 departmental bank.

2. The breadth portion of the examination will focus on an over-dispersed selection of questions from the entire subject range of the departmental Question Bank (and any extensions specified in advance by the Appraisal Committee). The standard Question Bank will be continuously available to help students evaluate their level of knowledge and 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 his/her main discipline (as perceived by the examining committee) and provide reasonable answers for most of the questions farther from his/her center of expertise. If a student cannot answer a question, the committee should simply move on to another question, providing 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.

3. The Appraisal Committee should include one individual from outside of the advisory committee whose role is to broaden the ability of the committee to evaluate the breadth of ecological/evolutionary knowledge of the candidate. This person should normally be an EEB faculty member. [The committee as a whole remains responsible for evaluating the breadth of knowledge of the candidate; the additional member simply functions to help evaluate the candidate's answers to questions that may be outside the area of expertise of the other members of the Appraisal Committee.]

4. At the end of the examination the Appraisal Committee will use the entire examination (including both the public seminar and the in-camera portions) to evaluate whether the candidate has demonstrated adequate breadth of knowledge. Breadth deficiencies are not to be the sole reason for failure of the initial Appraisal Exam. If serious deficiencies are perceived, then the examining committee should prescribe one of the following ways for the student to satisfy the deficiencies:

a. Assignment of reading, followed by an oral reassessment of knowledge in the formerly weak areas by one or more appropriate members of the Appraisal Committee.
b. Assignment of one or more essay(s) on topics selected by the Appraisal Committee, the members of which would be responsible for evaluating the essays.
c. Additional coursework. (Auditing courses will not be considered to be adequate remediation unless the weak area(s) are reassessed by oral or written examination by relevant member(s) of the Appraisal Committee after the audit is completed.)

5. Any remediation requirements will be specified in writing by the Appraisal Committee in its report. The student's Advisory Committee will be responsible for enforcing the prescription and reporting the progress of remediation in the records of their meetings.

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. Stable link: http://links.jstor.org/sici?sici=0022-541X%28199704%2961%3A2%3C270%3ASPAIWR%3E2.0.CO%3B2-G

Gilbert, Neil. 1989. Biometrical interpretation : making sense of statistics in biology. 146 pp. ISBN: 019854250X. permanent UT library link: http://search8.library.utoronto.ca/UTL/index?N=0&Nr=p_catalog_code:997450&showDetail=first

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, N_e? What types of factors affect N_e?

[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.