BIOLOGY 4436G: BEHAVIOURAL ECOLOGY

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Laboratory Assistant: Sarah Lee (Chem 388/385; 661- 2111 ext. 86795).

Texts:

Krebs, J.R. and N.B Davies. 1993. An Introduction to Behavioural Ecology. 3rd Edition. Blackwell Scientific Publications, Oxford. (recommended, on 2 hour loan from Betty Taylor Library).

Lectures: 1:30-2:30 PM, Tuesday & Thursday, NCB 296.

Lab: 2:30- 5:30 PM, Friday, TBA.

Important Dates:

6 Jan:	First class
8 Jan:	Project outline and form groups of two
9 Jan:	SH 1310 for statistics lab and project discussion
16 Jan:	SH 1310 for project development and statistics help
23 Jan:	SH 1310 for project development and statistics help (optional)
27 Jan:	Project proposal due (10%)
12 Feb:	Critique 1 due (5%)
16 Feb:	Reading week – no classes
10 Mar:	Critique 2 due (10%)
17 Mar:	Presentations begin in class and lab section (10%)
7 Apr:	Project reports due (25%)
Final:	Final exam in exam period (40%)

Lecture Topics:

The lecture topics fall into three areas:

1. Experiment design and hypothesis testing in behavioural ecology
2. Economics of Decisions: modeling behaviour using present-future tradeoffs, cost-benefit analysis, marginal value theorem, and game theory
3. Sexual Selection: male-male competition, female choice, sexual conflict, genetic mating systems, sperm competition

Laboratory Projects:

The lab portion of the course consists of a research project to be carried out by students working in small groups (2 people). When choosing a partner make sure that at least one member has taken a course in statistics and knows about the following: paired and independent t-tests, one- and two-way ANOVA, linear and multiple linear regression, correlation, Chi Square and other non-parametric tests. Analysis of your data will require

one or more of the above tests. Any suitable stats program can be used for data analysis and graphing (e.g., Excel, SPSS, Minitab, PowerPoint), but SPSS is recommended.

The list at the end of the syllabus gives some possible topics for projects, with some background references. We will go over possible topics in an early lecture. Each group must have their topic approved by the TA before beginning.

a) Project Proposal:

Each group should:

1) Select a topic, collect literature (computer search recommended – e.g., Web of Science http://woscanada.isihost.com/), discuss relevant literature and
2) together formulate an interesting hypotheses suitable for experimentation then
3) design a set of well-thought-out experiments**,** specifying X and Y variables**,** that should provide an unambiguous test of the proposed hypothesis and
4) complete a rough outline the methods including information on: animals to be studied; where the research will be done; how many treatment groups; suggested # of subjects in each group; general protocol for running 1 subject; proposed X and Y variables; method of recording data; proposed statistical analysis of data; name of proposed tests; and finally a list of equipment that you think you will need to do the work (e.g. aquarium tanks, stopwatches, bread, plastic owl models, counters, measuring tapes, compasses, binoculars, calipers, microscopes, arm slings, crutches, sunflower seeds, wire, electronic balances, magnifying glasses, bird seed, etc.).
5) After discussing the proposal as a group, summarize the main points (steps 1-4) in a formal typed research proposal (see details below). Bring two-copies of the initial version of the proposal to the first stats lab to be discussed. One copy of the final version is due as indicated above.
6) After the projects have been approved, each group must arrange a bi-monthly progress meeting with the project supervisor.

The proposal should contain the following sections, which correspond with the steps involved in the development of the proposal as described above (see also structure of a scientific paper below). Proposals should be double spaced and up to 5 typed pages (figures and tables also may be included using up to two additional pages).

1. INTRODUCTION: starts with a broad statement of the research question, then review previous work that is relevant to the proposed research project; final paragraphs focus on the specific hypothesis tested in the proposed study, the general design of the experimental approach and predictions.

2. GENERAL METHODS: outline as clearly as possible the general design that will be used to test the hypothesis. The most important thing is that the results of the experiments will clearly support or refute the hypothesis of interest. Stay away from ambiguous experiments. For each proposed experiment, state the hypothesis being tested. When a series of experiments is proposed, clearly explain why and how the series are linked together. Think critically as a group about the logic of the experiments you are proposing before you spend many hours collecting and analyzing data that may be inadequate.

3. DETAILED METHODS: give a concise statement of the details of the experiments (see above). Specify numbers wherever possible. This is where you put the specific details of

your research plan on paper so it can be discussed with your supervisor and revised if necessary. Preliminary experiments are usually invaluable before submitting the revised proposal so that you get hands on experience with your experimental design and a better idea of what is actually feasible given the time and resources at your disposal. The detailed methods in the revised proposal are what your group is expected to try to execute, so all group members should have input and all should agree with what is being proposed.

Please consult the TA about your ideas for projects or where to get literature that is not in the library. Sarah Lee (Laboratory Assistant) can help with any problems that may arise with tanks, etc. Students who are also doing Bio450/451 must do a distinct project in Bio436G.

b) Project Report:

Members of each group should collaborate in all aspects of the project (i.e. design of experiments, data collection and analysis, interpretation of results etc.) and only 1 report will be submitted per group. This must be prepared in the form of a scientific paper (see also below): front page (title, author, abstract), and sections for Introduction, Methods, Results, Discussion, Acknowledgements, References, Figure Legends, Tables, Figures, and Appendices (if any) in that order. **Follow the format in a recent issue of *Behavioral Ecology*; see the instructions to authors at: http://www3.oup.co.uk/jnls/list/beheco/instauth/.** The report must be typed and double spaced. Place legends for tables above the table. Only list papers in References that you actually refer to in the text (see instructions to authors for how to report scientific papers in the reference section). The report should consist of no more than 10 pages of text (this does not include the front page, references, tables, figures, and appendices). Be sure to proofread your report for spelling and grammatical errors before handing it in.

Writing a Scientific Paper:

Organization: Each paper typically has, in this order, (1) a one paragraph abstract, (2) introduction, (3) methods, (4) results, including references to tables and figures (5) discussion (6) literature cited and (7) tables and figures.

Abstract: States the main hypothesis that is being tested. States the most important results. States the authors interpretation of the results, and the main conclusion from the study.

Introduction: This is the section where you convince the reader that your question is interesting (from a Behavioural Ecology standpoint) and legitimate. The first paragraph(s) usually provides a general introduction to the area research discussed (e.g. parental care), and includes citations of some main or key papers in this area. The subsequent paragraphs usually discuss the specific hypothesis and predictions that are being testing. Authors usually state the hypothesis, and provide the rationale for the hypothesis. They should also state the specific predictions for their test.

Methods: This is the section where you describe in detail your methods, experimental design, and sample sizes. As a rule of thumb you should provide enough information such that another person could repeat your experiment (and get similar results). Do not present any results in this section.

Results: This is the section where you present the data that resulted from your experiment. This is also the section where people have most difficulty presenting the information in a scientific format. Do not interpret or speculate about the meaning of your results in this section; simply present the outcome of the experiments themselves. Refer to tables and figures as necessary. You must summarize your data. Do not simply provide a list of the entire data set (i.e., the raw data). Results are typically presented according to the predictions that they test. This is the only way the reader will be interested in what is being conveyed. Use appropriate statistics to test your hypothesis, and present statistical results according to the guidelines.

Discussion: This is where you discuss the interpretation of your experiments, and your main conclusions. Remember that the whole point of the experiment was to test predictions of a specific hypothesis. Do not ramble on about tangential topics – stick to the main issues. Which of the results support or reject the predictions? How rigorous were the tests and data? Do problems with the data collected and the execution of the project limit the interpretation? What is your main conclusion (accept vs. reject hypothesis)? Any modifications you can suggest to the hypothesis? This is where authors often make suggestions regarding future work that could better test the hypothesis.

References (or Literature Cited): Every paper cited in the main text, and only those papers, must appear in the References. List them in alphabetical order, using the EXACT format found in the journal (Behavioral Ecology). This can be tricky and somewhat tedious.

Tables and Figures: These summarize the data. For instance, you can provide mean values of several variables in a table, with headings for the different treatment groups. Histograms are a useful way to summarize frequency distributions. Correlations are presented with scatter plots. Refer to other scientific papers (e.g., in the journal Behavioral Ecology) to see how tables and figures are used to present results and convey information effectively. Each table and figure should present unique data in a simple format – i.e., do not provide both a table and figure to show the same results.

Appendix: Use appendices to present raw data or other information that may be of interest, but not imperative to the current study. Your reports probably will not require an appendix.

A note on plagiarism: Plagiarism is a serious academic offence and will be dealt with accordingly. You are responsible for being familiar with the Scholastic Offence Policy in the University of Western Ontario Academic Calendar. You must write your reports in your own words. Whenever you take an idea or passage from another author, you must acknowledge your debt by a proper reference.

Possible Project Topics

Many of the projects listed below can be completed in the laboratory, but others require field data and are conducted outside of the laboratory. For topics that could support more than one project, the number of possible projects is indicated in parentheses. The papers listed represent only a few examples. Use computer searchers (e.g., Web of Science) to collect additional, recent papers that may be relevant to your project.

1. AGGRESSIVE BEHAVIOUR IN CRAYFISH

Berrill, M. and M. Arsenault. 1984. The breeding behaviour of a northern temperate Orconectid crayfish, *Orconectes rusticus*. Anim. Beh. 32(2):333-339.

Bruski, C.A. and D.W. Dunham. 1987. The importance of vision in agonistic communication of the crayfish, *Orconectes rusticus*. I. An analysis of bout dynamics. Behaviour, 103: 83-107.

Capelli, G.M. and P.A. Hamilton. 1984. Effects of food and shelter on aggressive activity in the crayfish *Orconectes rusticus*. J. Crustacean Biol. 4(2):252-260.

Rubenstein, D.I., and B.A. Hazlett. 1974. Examination of the antagonistic behaviour of the crayfish *Orconectes virilis* by character analysis. Behaviour 50:193-216.

Rutherford, P.I, D.W. Dunham and V. Allison. 1995. Winning agonistic encounters by male crayfish Orconectes rusticus: chelae size matters but chelae symmetry does not. Crustaceana 68:526-529.

Soderback, B. 1991. Interspecific dominance relationships and aggressive interactions in the freshwater crayfishes *Astacus astacus* and *Pacifastacus leniusculus*. Can. J. Zool. 69: 1321-1325.

2. REPRODUCTIVE BEHAVIOUR

Abrahams, M.V. 1993. The trade-off between foraging and courting in male guppies. Anim. Beh. 45:673-681.

Berglund, A. 1993. Risky sex: male pipefishes mate at random in the presence of a predator. Anim. Beh. 46:169-175.

Dugatkin, L.A. and J-G. J. Godin. 1993. Female mate copying in the guppy (Poecilia reticulata): age dependent effects. Behav. Ecol. 4:289-292.

Kodric-Brown A. 1989. Dietary carotenoids and male mating success in the guppy: an environmental component to female choice. Behav. Ecol. and Sociobiol. 25:393-401.

Magurran, A.E. and B.S. Seghers. 1990. Risk sensitive courtship in the guppy (Poecilia reticulata). Behaviour 112:194-201.

Magurran, A.E. and M.A. Nowak. 1991. Another battle of the sexes: the consequences of sexual asymmetry in mating costs and predation risk in the guppy. Proc. R. Soc London B 246:31-38.

Moller, A.P. 1992. Females prefer large and symmetrical ornaments. Nature 357:238-240.

Morris, M.R. 1998. Female preference for trait symmetry in addition to trait size in swordtail fish. Proc. R. Soc. London B.: 265:907-911.

Nicoletto, P.F. 1993. Female sexual response to condition-dependent ornaments in the guppy, Poecilia reticulata. Anim. Beh. 46:441-450.

Pruett Jones, S.G. 1992. Independent versus non-independent mate choice: do females copy each other? Am. Nat.: 140:1000-1009.

Thomas, F. and Poulin R. 1997. Using randomization techniques to analyse fluctuating asymmetry data. Animal Behaviour 54:1027-1029.

Thornhill, R. 1992. Fluctuating asymmetry and the mating system of the Japeneses scorpiofly. Animal Behaviour 44:867-879.

3. FORAGING ANIMALS

Abrahams M.V. 1989. Foraging guppies and the ideal free distribution: the influence of information on patch choice. Ethology 82:116-126.

Abrahams M.V. and L.M. Dill. 1989. A determination of the energetic equivalence of predation. Ecology 70:999-1007.

Gray, R.D. and M. Kennedy. 1993. Perceptual constraints on optimal foraging: a reason for departures from the ideal free distribution. Animal Behaviour 47:469-471.

Brown, J.S. and R.A. Morgan 1995. Effects of foraging behaviour and spatial scale on diet selectivity: A test with Fox squirrels. Oikos 74:122-126.

Kennedy M., C.R. Shave, H.G. Spencer, R.D. Gray. 1994. Quantifying the effect of predation risk on foraging bullies: no need to assume an IFD. Ecology 75:2220-2226.

Laland, K.N. and K. Williams 1997. Shoaling generates social learning of foraging information in guppies. Anim. Beh. 53: 1161-1169.

Lavery, R.J. and Kieffer J.D. 1994. Eggects of parent and offspring food rations on parental care in the convict cichlid fish. Behavior 129:63-77.

Harper, D.G.C. 1982. Competitive foraging in mallards: 'ideal free' ducks. Anim. Beh. 30:575-584.

Milinski, M. and G.A. Parker. 1991. Competition for resources. In: J.R. Krebs and N.B. Davies (Eds.), Behavioural Ecology, An Evolutionary Approach. 3rd Edition. Ch.5 pp. 137-168.

Utne AW. Brannas, E. and C. Magnhagen 1997. Individual responses to predation risk and food patch density. Can. J. Zool. 75:2027-2035.

Warbuton, K. 1990. The use of local landmarks by foraging goldfish. Animal Behaviour 40: 500-505.

4. EFFECT OF PREDATION RISK ON BEHAVIOUR

Abrahams M.V. and L.M. Dill. 1989. A determination of the energetic equivalence of predation. Ecology 70:999-1007.

Berglund, A. 1993. Risky sex: male pipefishes mate at random in the presence of a predator. Anim. Beh. 46:169-175.

Doucette, D.R. and S.G. Reebs. 1994. Influence of temperature and other factors on the daily roosting times of mourning doves in winter. Can. J. Zool. 72:1287-1290.

Dunn, E.H. and D.L. Tessaglia 1994. Predation of birds and feeders in winter. J. of Field Ornithology. 65:8-16.

Fraser, D.F. and F.A. Huntingford. 1986. Feeding and avoiding predation hazard: the behavioural response of the prey. Ethology 73:56-68.

Kennedy M., C.R. Shave, H.G. Spencer, and R.D. Gray. 1994. Quantifying the effect of predation risk on foraging bullies: no need to assume an IFD. Ecology 75: 2220-2226.

Lima, S.L. and L.M. Dill. 1991. Behavioural decisions made under the risk of predation: a review and prospectus. Can J. Zool. 68:619-640.

Magurran, A.E. and A. Higham. 1988. Information transfer accross fish shoals under predator threat. Ethology, 78: 153-158.

Milinski, M. and R. Heller. 1978. Influence of a predator on the foraging behaviour of sticklebacks (Gasterosteus aculeatus). Nature 275:642-644.

5. FORAGING BEHAVIOUR OF SQUIRRELS

Brown. L. and J.H. Downhower. 1988. Analyses in Behavioural Ecology. Chapter 7, pp. 28-30, Food value and the foraging preferences of squirrels. Sinauer Associates, Sunderland MA.

Lima, S.L. et al. 1985. Foraging efficiency-predation risk trade-off in grey squirrels. Anim. Beh. 35:155-165.

Lima, S.L. and T.J. Valone. 1986. Influence of predation risk on diet selection: a simple example in the grey squirrel. Anim. Beh. 34:536-544.

Newman, J.A. et al. 1988. Effects of predation hazard on foraging "constraints": patch-use strategies in grey squirrels. Oikos 53:93-97.

Thompson, D.C. and Thompson P.S. 1980. Food habits and caching behaviour of urban grey squirrels. Can. J. Zool. 58:701-710.

6. FORAGING OF WILD BIRDS AT FEEDERS

Brown, L. and J.H. Downhower. 1988. Analyses in Behavioural Ecology. Chapter 10, pp.38-40. Avian foraging : Place and Preference. Sinauer Associates, Sunderland MA.
Lima, S.L. 1987. Distance to cover, visual obstructions, and vigilance in house sparrows. Behaviour 102:231-238.
Marples, N.M. 1993. Do wild birds use size to distinguish palatable and unpalatable prey types? Anim Beh. 46:347-354.

7. SNAIL TRAILS

Bousefield, J.D. et al. 1981. Behavioural studies on the nature of stimuli responsible for triggering mucous trail tracking by Biomphalaria glabrata. Malacol. Rev. 14: 49-64.
Cook, A. 1977. Mucous trail following by the slug Limax groussui Lupu. Anim Beh. 25:774-781.
Pakarinen, E. 1992. The responses of terrestrial slugs to the mucous of stressed conspecifics and heterospecifics. Anim. Beh. 43:1051-1052.

8. SPATIAL DISTRIBUTIONS AND BEHAVIOUR OF HUMANS

Akande, A. 1997. Determinants of personal space among South African students. J. of Psychology 13:569-571.
Bell, J, Grekul J, Lamba, N., Minas C. and W.A. Harrell. 1995. The impact of cost on student helping behaviour. Journal of Social Psychology. 135:49-56.
Boice, K. and M. Goldman. 1981. Helping behaviour as affected by the type of request and identity of the caller. Journal of Social Psychology. 115: 95-101.
Brown, L. and J.H. Downhower. 1988. Analyses in Behavioural Ecology. Chapter 19, pp.74-77, The structure of human groups. Sinauer Associates, Sunderland MA.
Colaizzi, A., Williams, K.J. and Kayson W.A. 1984. When will people help? The effects of gender, urgency, and location on altruism. Psychological reports, 55: 139-142.
Eagly, A.H. and Crowley, M. 1986. Gender and helping behavior: a meta-analytic review of the social psychological literature. Psychological Reports 100: 283-308.
Edwards, D.J.A. 1975. Returning a dropped object: effect of response cost and number of potential helpers. J. Soc. Psych. 97:169-171.
Fedler, F. 1984. Studies show people still willing to help a stranger, but especially a women. Psychological Reports 54: 365-366.
Fisher, J.D. and D. Burn. 1975. Too close for comfort: sex differences in response to invasions of personal space. J. Pers. Soc. Psych. 32:15-21.
Gentile, M. Naughton, A.M. and Kayson, W.A. 1986. Factors affecting altruism: sex, urgency, and time of day. Psychological Reports, 59: 79-82.
Lantane, B. and Nida, S. 1981. Ten years of research on group size and helping. Psychological Reports 89: 308-324.
Mueller, U. and A. Mazur. 1997. Facial dominance in Homo sapiens as honest signalling of male quality. Behavioral Ecology 8:569-579.
Tucker, G.M. and J.A. Allen. 1993. The behavioural basis of apostatic selection by humans searching for computer-generated cryptic prey. Anim. Beh. 46:713-719.
Salminen, S. and T. Glad. 1992. The role of gender in helping behaviour. Journal of Social Psychology 132: 131-133.
Spina, S.P. and Mukerjee N. 1989. Marital adjustment and personal space orientation. Journal of Social Psychology 130: 633-639.
Young, A.E. and M.N. Guite. 1987. Departure latency to invasion of personal space: effects of status and sex. Perceptual & Motor Skills 64:700-702.

9. SPATIAL DISTRIBUTIONS IN OTHER ANIMALS

Dugatkin, L.A. and Sih, A. 1995. Behavioural ecology and the study of partner choice. Ethology, 99:265-277.

Griffiths, S.W. and A. E. Magurran. 1997. Familiarity in schooling fish: how long does it take to aquire? Anim. Beh. 53:945-949

10. OTHER ORGANISMS AVAILABLE: Cockroaches, earthworms, mealworms.

Rivault, C. and A. Cloarce. 1992. Agonistic tactics and size asymmetries between opponents in *Blattella germanica* (Dictyoptera, Blattellidae). Ethology 90:52-62.

11. Check journals for other ideas for projects: Animal Behaviour; Behavioral Ecology; Behavioral Ecology and Sociobiology; Proceedings of the Royal Society of London; Behaviour; Ethology; Journal of Social Psychology.