LABORATORY REPORT INSTRUCTIONS

Department of Biology and Marine Biology
University of North Carolina Wilmington
(Revised Spring 2014)

General instructions. All pages should be numbered and the text should be Times New Roman font, 12 point, and double-spaced. Margins should be 1" all around. Be concise, clear and complete. Use active voice rather than passive voice, as active voice tends to be more to the point and easier to understand. For instance, "I counted isopods" rather than "Isopods were counted". Use past tense when describing your work.

Refer to J. A. Pechenik's "A Short Guide to Writing about Biology" (Longman) for further details and advice for writing about biology as well as an example laboratory report. This book is a required text for all BIO and MBY majors.

Pay particular attention to Pechenik's section on plagiarism! You are responsible for knowing what plagiarism is and how to avoid it. Plagiarism is a serious academic offense and a violation of the UNCW Honor Code. (Refer to the UNCW Code of Student Life at http://www.uncw.edu/odos/documents/cosl-current.pdf .) First time offenses result in a referral to the Dean of Students and typically a grade of "F" on the paper, although harsher consequences, including a grade of "F" for the course, are possible. Repeat offenses are referred to the Academic Honor Board.

Your laboratory reports should include each of the following sections and each section, with the exception of the title and author and affiliation, should be labeled as such:

1. **Title**. Your title should be a concise but informative description of the work. It is a statement of what you did. Capitalize only the first word and proper names.

2. **Author(s) and Affiliation.** Your full name (e.g. Sammy C. Hawk) and your institution, which is University of North Carolina Wilmington.

3. **Abstract.** A no more than 250 word summary of your paper including the purpose, hypotheses, and major findings. Your abstract must be a complete, independent representation of your work, such that anyone reading it understands the point and findings of your study. The abstract should not include information that is not present in the paper itself, but should include all relevant phrases and key words that describe the experiment.

4. **Introduction**. The introduction should tell the reader why the study was conducted and provide necessary background information to understand the system under investigation and the significance of the work to the general field of study (ecology, genetics, marine biology, etc.) You should also explain the biological rationale behind your hypotheses. Citations to relevant literature are appropriate. This section will likely take 2-4 paragraphs. In the final paragraph of this section, you need to summarize the scientific objectives of the laboratory work you are reporting and clearly state the hypotheses you tested.

5. **Materials and Methods**. This section describes what you did so that you or someone else could repeat the study. Do not simply copy from your lab manual or from any other source. This section is a narrative of what you did and should be written in past tense as appropriate, and in your own words. You should:

- describe the methods so that anyone could read them and *repeat* your experiment;
- describe the study area, if appropriate;
- give the genus and species of any experimental organism, along with its common name, if appropriate;
- use SI units for your data measurements;
- state how the data will be analyzed, *e.g.*, which statistical tests will be used and what probability (p) values you will use to determine significance; and
- do not present any results.

6. **Results**. This section is where you report and describe your data (using SI units) objectively and without interpretation. These actual data should be presented as a table and/or figure. It is appropriate to include relevant, qualitative observations and/or general trends, but avoid repeating details presented in tables or figures. All tables and figures should be referenced in your text and numbered sequentially as they appear in your text. (Tables and figures are numbered separately, *i.e.* you may have both a Table 1 and a Figure 1.) Tables and figures are placed at the end of your paper. Instructions for preparing tables and figures are given later.

When reporting statistics, use appropriate measures and include all pertinent information. For instance, when describing characteristics of a population, you should include a measure of the central tendency and the variation. For example, you might report the mean and standard deviation as $\overline{X} \pm SD$. Reports of statistical tests must include the name of the test, the statistical value calculated (e.g., t-value or chi square value given as χ^2), degrees of freedom (df), sample size (N), and probability value (p). For example,

"The number of mature pines in Forest A was significantly greater than the number in Forest B ($\chi^2 = 4.23$, df = 1, p = 0.032)."

Do **<u>not</u>** present interpretations of the results in this section.

7. **Discussion**. This section is where you should interpret your results and consider their significance. Explain to your reader what everything means. Present the principles, relationships, and generalizations suggested by the data. You should state whether or not the data support or refute your hypotheses, and explain how you came to that judgment. It is not critical that your hypotheses are supported, but rather whether you have adequate data, which has been analyzed appropriately, and whether you have drawn valid conclusions. Recall that we are not proving or disproving anything; rather your results either support your hypotheses or they do not. Point out any discrepancies or dubious results and explain potential sources of error. Address any questions left unanswered and even suggest possible future studies.

8. **Acknowledgments**. You may work in groups to collect your data. If so, you should acknowledge your collaborators by name here. You should also acknowledge anyone who critiques drafts of your laboratory report.

Example. "I would like to acknowledge Har D. Weinberg, Mike Roflora, and Ben Thic for their help with the experimental design and data collection efforts. Dr. R. Kaye Selection provided useful comments on early drafts of this report."

9. **Literature Cited**. This is a list of the full bibliographic information for works you cite in your paper. The literature cited section should be a separate page(s) at the end of your paper. All lab reports include the expectation of use of adequate references from primary research articles. Specifically, you should cite from peer reviewed literature (*e.g*. journal articles published indexed in the ISI Web of Science, a database available through our library). Your references should be listed using a standard, accepted format. Your instructor will tell you if a specific format is to be followed. If no format is specified, choose one and be consistent! The following examples follow the format of the journal *Ecology* (note the use of offsetting, used in most formats):

Example from a Journal Article

Borrett, S. R. and O. O. Osidele. 2007. Environ indicator sensitivity to flux uncertainty in a phosphorus model of Lake Sidney Lanier, USA. *Ecological Modelling* 200:371-383.

Examples from a Book

Earley, L. S. 2004. Looking for Longleaf: The Fall and Rise of an American Forest. University of North Carolina Press, Chapel Hill, NC.

Jørgensen, S. E. and G. Bendoricchio. 2001. Fundamentals of Ecological Modelling. 3rd ed. Elsevier, New York.

Example from a chapter from an Edited Book

Post, W. M., C. C. Travis, and D. L. DeAngelis. 1985. Mutualism, limited competition, and positive feedback. Pp. 305-325 *in* D. H. Boucher, editor. The Biology of Mutualism. Oxford University Press, New York.

Example from the lab Manual

Borrett, S.R. (editor). General Ecology Laboratory Manual. University of North Carolina Wilmington, Wilmington, NC. http://people.uncw.edu/borretts/teaching.html (accessed Jan. 22, 2010).

All works listed in this section must be cited in the body of your text using an "author-date" format. For example, we might mention that Borrett and Osidele (2007) used the coefficient of variation to describe the ecosystem indicator uncertainties. We might also note that adult longleaf pine trees (*Pinus palustris*) have adaptations to survive low intensity ground fires (Earley 2004). For three or more authors, use the first name followed by *et al.* such as Avery *et al*. (1944) confirmed that DNA was the transforming principle. Be sure to cross check all text citations with your Literature Cited section to ensure that everything cited is listed at the end, and everything listed at the end is cited!

10. **Tables and Figures**. Your report should include appropriate tables and figures. This portion of the report is where you actually present your data. Tables and figures should supplement, not

duplicate the text. Tables and figures should not be redundant; when either is equally clear, a figure is preferable. Unless specified otherwise, all tables and figures should appear after the Literature Cited page. There should be only one table/figure per page and tables are presented before figures. Each table or figure must have a caption describing the information presented, a legend, if necessary, to explain any symbols used, and anything else the reader needs to understand what is presented.

Example Tables

Many journals have very specific formatting requirements for tables. There are several general rules that are universal.

- The caption of a table should be placed above the table itself and gives the number and description of the table.
- One or two horizontal lines separate the title from the column titles (called vertical headings).
- Another horizontal line separates the vertical headings from the row headings and data field.
- Vertical lines are not used.

Tables should be numbered in the order cited in the text.

TABLE 2. Abundance (number/m^2) of 10 common litter taxa compared regionally between Panama and Peru and between clay and sandy soils in Peru.

	Regional comparison			Soil comparison		
Taxon	Panama (n = 10)	Peru (n = 16)	χ^2	Clay (n = 8)	Sand (n = 8)	χ^2
Microbivores						
Collembola	1800	859	7.0*	680	1000	0.1
Oribatids	5600	4500	1.2	3900	5000	0.2
Isopods	70	27	7.8**	26	27	0.1
Diplopods	118	169	0.3	192	145	0.0
Predators						
Mesostigmatids	1000	1400	0.2	1500	1300	0.2
Pseudoscorpions	54	195	6.3*	142	248	0.5
Spiders	101	96	0.1	94	98	0.3
Chilopods	36	57	9.5**	45	69	0.8
Staphylinids	50	495	16.6**	371	619	4.0*
Ants	707	2000	10**	1400	2500	7.3**

Note: For comparisons, χ^2 is the two-tailed Kruskal-Wallis statistic.
* $P < 0.05$; ** $P < 0.01$.

TABLE 2. Multiple regressions of yearly intrinsic growth rates on climate variables show differences in species responses to the environment.

Variable	Estimate	SE	t	P
Pseudoroegneria spicata ($R^2 = 0.46$, $F = 2.53$, df = 5, 15, $P = 0.075$)				
Intercept	−1.85	2.11	−0.877	0.39
Fall precipitation ($t = 0$)	−0.014	0.004	−3.427	<0.01
Annual precipitation ($t = -1$)	0.002	0.001	1.608	0.13
Mean winter temperature ($t = 0$)	0.057	0.038	1.518	0.15
Mean fall temperature ($t = 0$)	−0.125	0.062	−2.004	0.063
Mean summer temperature ($t = 0$)	0.176	0.111	1.573	0.14
Poa secunda ($R^2 = 0.82$, $F = 6.94$; df = 8, 12, $P = 0.002$)				
Intercept	−4.081	1.340	−3.045	0.010
Winter precipitation ($t = 0$)	0.004	0.002	2.052	0.063
Spring precipitation ($t = 0$)	0.002	0.002	1.557	0.15
Fall precipitation ($t = 0$)	−0.008	0.003	−2.855	0.014
Annual precipitation ($t = -1$)	0.004	0.001	4.967	<0.001
Mean winter temperature ($t = 0$)	0.096	0.030	3.168	<0.01
Mean spring temperature ($t = 0$)	−0.202	0.051	−3.966	<0.01
Mean fall temperature ($t = 0$)	−0.152	0.040	−3.805	<0.01
Mean summer temperature ($t = 0$)	0.335	0.075	4.466	<0.001
Hesperostipa comata ($R^2 = 0.29$, $F = 7.81$, df = 1, 19, $P = 0.011$)				
Intercept	−0.04754	0.15735	−0.302	0.7659
Mean winter temperature ($t = 0$)	−0.075	0.027	−2.795	0.012
Artemisia tripartita ($R^2 = 0.48$, $F = 2.17$, df = 6, 14, $P = 0.11$)				
Intercept	−5.70	3.865	−1.474	0.16
Winter precipitation ($t = 0$)	0.005	0.004	1.275	0.22
Spring precipitation ($t = 0$)	−0.006	0.004	−1.494	0.16
Summer precipitation ($t = 0$)	0.007	0.003	2.063	0.058
Annual precipitation ($t = -1$)	0.002	0.002	1.225	0.24
Mean summer temperature ($t = 0$)	0.257	0.176	1.464	0.17
Mean annual temperature ($t = -1$)	0.172	0.098	1.745	0.103

Notes: Climate variables can exert effects in the present year ($t = 0$) or as lag effects from the preceding year ($t = -1$). Model selection was based on a stepwise AIC procedure, which may result in inclusion of variables with $P > 0.05$.

Example Figures

Figures should appear next, one per page.

- The figure caption is listed below the figure and should describe the information presented.
- Legends may be included in the "white space" of the figure if possible; otherwise they should be a part of the caption.
- Horizontal and vertical axes should be clearly labeled and the measurement units identified.
- Good figures should facilitate the cognitive task expected of the reader (e.g., trend analysis, comparison, etc.). Further, your figures should be free of what E. Tuffte calls "chart junk". This includes minimizing non-data ink, eliminating decoration, and not using unnecessary dimensions (e.g., a 3-D bar graph is almost never appropriate).

Again, figures should be numbered in the order cited in the text.

Here are four examples of figures from articles published in *Ecology* or *Ecology Letters*.

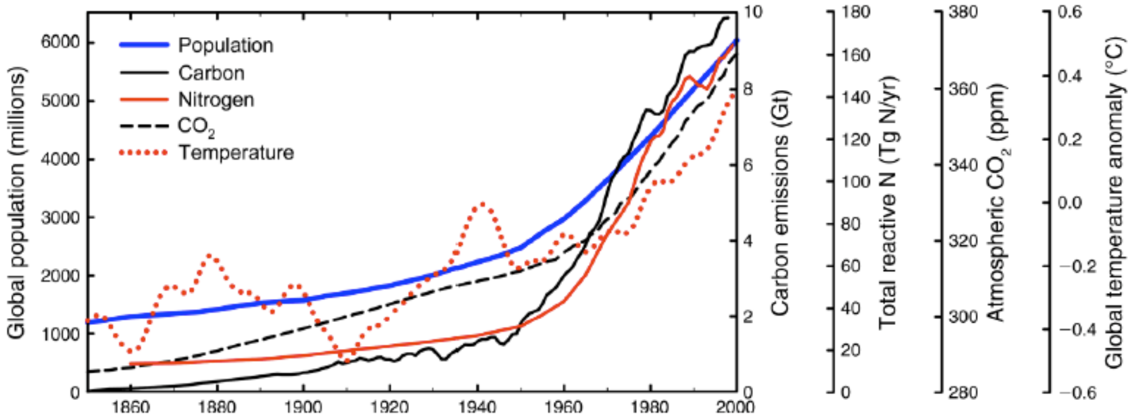

FIG. 1. Long-term trends in the global human population, CO_2 emissions, reactive N produced by humans, CO_2 concentration of the atmosphere, and the global temperature anomaly. Note the directional and cumulative increase in these metrics of global human impacts over the past 50 years. Population data are from the U.S. Census Bureau (⟨http://www.census.gov/⟩); energy consumption, from the U.S. Department of Energy Information Administration (⟨http://www.eia.doe.gov/⟩); total reactive N from Galloway et al. (2003); atmospheric CO_2 concentrations from the Carbon Dioxide Information Analysis Center (CIDAC; ⟨http://cdiac.esd.ornl.gov/⟩); and global average temperature anomaly data (Brohan et al. 2006) from the Met Office Hadley Centre for Climate Change (⟨http://www.hadobs.metoffice.com/⟩).

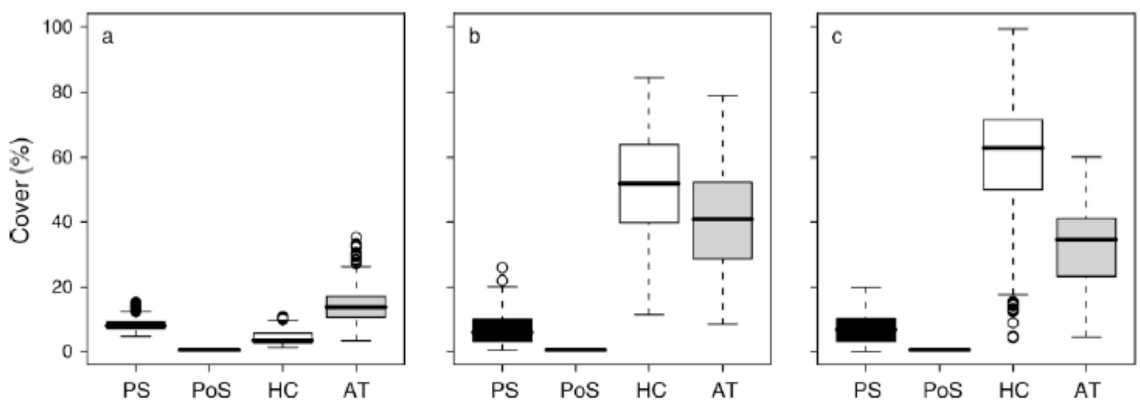

FIG. 4. Boxplots for the cover of the resident species (PS, *Pseudoroegneria spicata*; HC, *Hesperostipa comata*; AT, *Artemisia tripartita*) when *P. secunda* (PoS) is set to low abundance for the invasibility analysis. (a) Resident abundances based on a null approach using historical abundances, (b) resident abundances based on model simulations for a variable environment, and (c) resident abundances based on model simulations for a constant environment. The box indicates the lower and upper quartiles of the data, while the horizontal line inside the box shows the median. The bars extend to the most extreme data points not exceeding 1.5 times the interquartile range from the box. Data points falling outside this range are shown by circles.

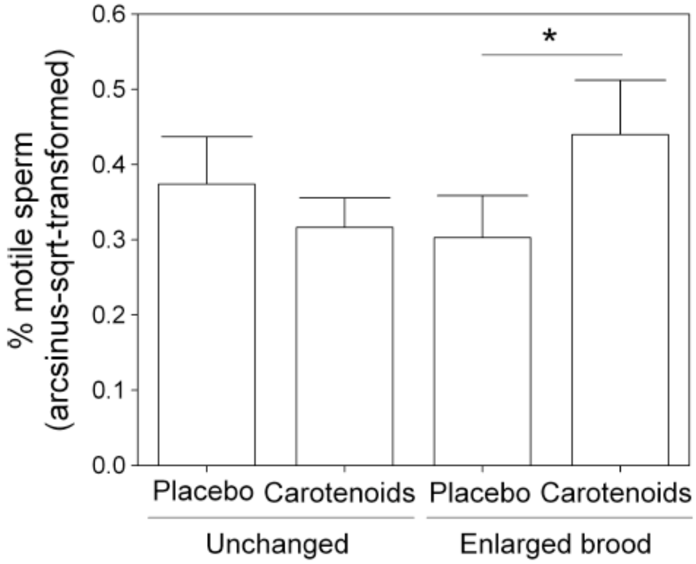

Figure 3 Percentage of motile sperm in relation to brood enlargement and carotenoid supplementation (means ± SE). Among males subjected to oxidative stress (enlarged brood), carotenoid-supplemented males produced sperm of greater motility than males that received a placebo (Scheffe *post hoc* test: $P = 0.038$, indicated by an asterisk in the figure).

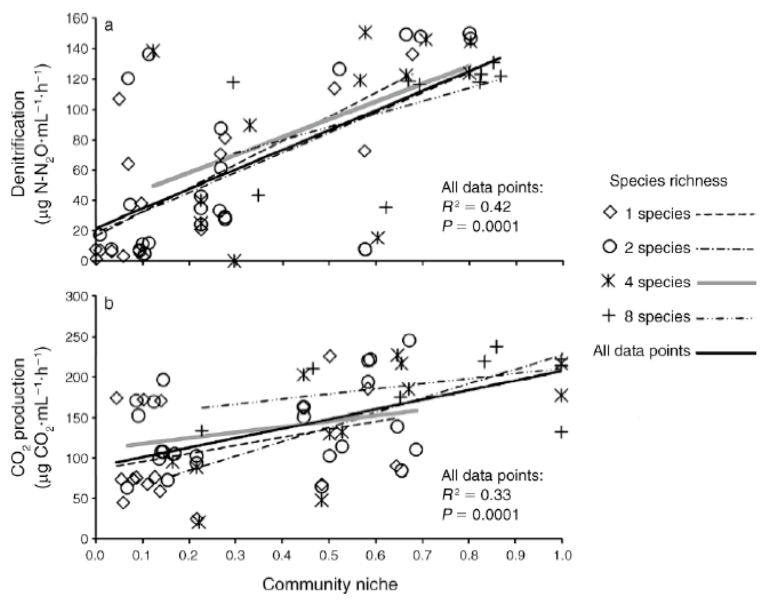

FIG. 3. Relationship between community functioning and community niche. Community niche was rescaled by dividing by the maximum value observed for all communities: (a) denitrification as a function of community niche defined according to monoculture ability to perform denitrification on each individual carbon source; (b) anaerobic CO_2 production as a function of community niche defined according to monoculture ability to produce CO_2 on each individual carbon source. Different symbols correspond to different levels of species richness. Each symbol corresponds to a single community, except for the monocultures, which are represented by their average performances ($n = 2$). The graph shows that communities with low richness but large community niche perform better than communities with high richness but small community niche.