

Biology 164 Laboratory Style Guide for Papers and Lab Reports

Statistics, Tables, Figures and Citing of Literature

(from: Labov JB and RK Chipman. 1976. *Vertebrate Biology: A Laboratory and Field Manual*. URI Press, 143 pp.)

I. Reporting Statistics in the Body of Paper

A. Descriptive Statistics:

When the summary of results does not warrant a table or figure, the specific statistics can be reported directly in the body of the paper. For populations that are normally distributed, the mean and some measure of dataset variability (e.g., the standard error, SE) are included when summarizing results. For populations that do not have a normal distribution, the median and range are used for the summary. For both population types the sample size, n , is also reported as an indication of the extent of the sampling.

Example: “The mean (± 1 SE) wing length for *G. magnirostris* was found to be 81.0 ± 0.17 mm ($n=361$), while for *G. conirostris* it was 77.5 ± 0.17 mm ($n=331$).”

Example: “The median number of petiole hairs on the first true leaf of *B. rapa* plants was found to be 5, with a range of 35 ($n=120$).”

B. Comparative Statistics:

Parametric Tests

t-Test:

Results for the t-test should include the degrees of freedom, df (this statistic is directly related to the sample size, and hence provides an indication of the extent of the sampling) and the p-value.

Example: “The difference in wing lengths between *G. magnirostris* and *G. conirostris* was found to be significantly different (t-test, $df=690$, $p<0.001$).”

Non-parametric Tests

Mann Whitney :

Results for the Mann Whitney test should include the p-value and the sample size.

Example: “A highly significant difference in the number of petiolar trichomes on the first true leaf was found between *B. rapa* plants sampled in 2003 and in 2004 (Mann Whitney, $p<0.001$, $n=155$)”

B. Regression:

For regression analysis, include the coefficient of determination (r^2), the df , and the p-value. It is also customary to state how the factors being considered are correlated, e.g., either directly or inversely.

Example: “There was a direct relationship between beak length and beak height ($r^2= 0.681$, $df=1,901$, $p<0.0001$), and the relationship was described moderately well by a simple linear regression model.”

II. Tables are used to report data in a concise manner. The clarity of your table indicates the clarity of the thought behind it!

A. General Rules for Table Construction

1. Number tables consecutively and separately from figures.
2. The table must have a title legend with sufficient descriptive information so that the reader can interpret the table without having to refer to the text. Place the title legend above the table.
3. Make the table self-explanatory and easy to read by thoughtful arrangement of rows and columns.
4. **Avoid the use of vertical lines whenever possible. Columns can be denoted by the use of horizontal lines below column headings and by spacing between the columns. (Note some of the examples displayed)**
5. Try not to leave blank spaces in tables. It is usually possible to fill every blank by making a simple distinction between an observation giving a zero reading (0) and a missing observation (-).
6. Distinguish between partial totals, accumulative totals, and grand totals where several occur together.
7. When average values are given, give also the number of observations from which they are derived. Often a measure of variability (typically standard error) is also given (e.g., 260.1 ± 16.3 , $n=60$).
8. When numbers are given as percentages or converted in some other way, state clearly in the title legend what the conversion is and what the original data are.
9. When giving measurements, use the correct number of decimal places and be consistent. Be sure to provide units for all measurements

Example of properly formatted table:

Table 1. Mean daily temperatures (± 1 SE) measured during three seasons of 1994 for the atmosphere and for portions of the Colby-Marston bog mat exposed to differing amounts of sunlight. ($n=92$)

Location	Mean Daily Temperatures ($^{\circ}\text{C}$)		
	Spring	Summer	Fall
Atmosphere	19.3 ± 1.9	23.9 ± 2.6	20.5 ± 1.7
Open mat	16.7 ± 1.8	19.6 ± 2.3	18.6 ± 2.3
Shaded mat	11.1 ± 1.6	12.4 ± 1.2	13.8 ± 1.2

B. Tables Should Not Be Used In The Following Circumstances

1. When you want to show a trend. A graph is better for this purpose.
2. Simply for displaying "raw data". When data can be easily summarized with descriptive statistics such as means and standard errors, it is better to include them in the text in that manner.
3. When the concept shown (e.g., presence or absence, treated or untreated) can be easily stated in a sentence or two.

III. **Figures** are used to display trends and relationships. They express simply and graphically what can often only be written at great length.

General Rules For Figure Construction

1. Number figures consecutively and separately from tables.
2. The figure must have a title legend with sufficient descriptive information so that the reader can interpret the figure without having to refer to the text. Place the title legend under the figure.
3. Label each axis with units of measurement. Instead of simply labeling the axis as "Time", it should read "Time (seconds)".
4. The independent variable is generally placed on the X-axis (horizontal), the dependent variable on the Y-axis. Often the Y will be a biological characteristic and the X is often a physical or environmental one.
5. Quantities increase as they progress away from the origin. It is best, where possible, to have the origin at the point 0,0 (X=0, Y=0) unless it wastes too much space.
6. Distinguish between different sets of observations by using different symbols or lines. Avoid including too many different sets of observations in one figure, creating a figure that is difficult to read.
7. As much as possible, the figure should be approximately square and not disproportionately exaggerated in one direction or the other.
8. When designing two (or more) figures that will be compared, be sure to use the same range of values on the axes to make comparisons easier.

Example of properly formatted figure:

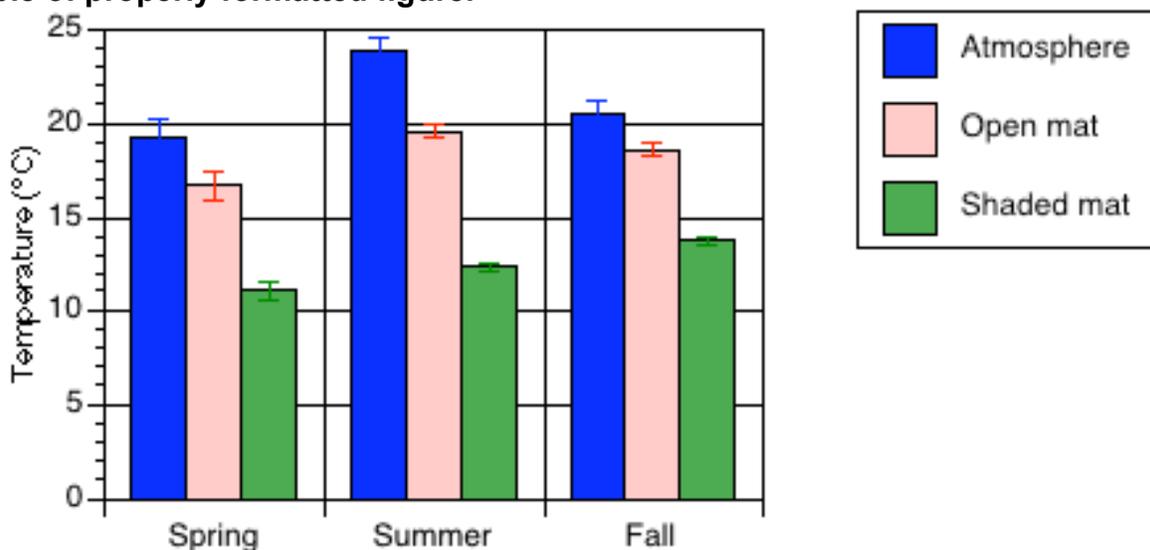


Fig. 1 Mean daily temperatures (± 1 SE) measured during three seasons of 1994 for the atmosphere and for portions of the Colby-Marston bog mat exposed to differing amounts of sunlight. (n=92)

IV. Citing of Literature

After finding the references you need for your research, it is important that they are cited accurately and in some standard manner. Some examples of common reference practices that should be utilized in biological papers and reports are provided below.

A. Citing Authors in Body of Text

Footnotes are not used for citing references. Instead, references are noted in the body of the text by author(s) and date of publication. The authors of your reference may be used as the subject of your sentence or may be noted at the end of the sentence in parentheses.

If one or two authors have written a paper, list their last names in the text followed by the date of publication. If the article is coauthored by three or more persons, list only the first author in the text followed by "et al." and the date of publication:

Hawn (1970) has found that gamma rays have an adverse effect on humans and a species of moon marigolds.

Recent evidence indicates that brown cows produce significantly more milk than white cows (Lottabull and Udder 1969).

To test the effect of oil spills on Alaskan caribou, Shell et al. (1970) doused an experimental group of animals with crude oil while controls were sprayed only with water.

If more than one paper has been published about a given topic, list all relevant authors, but separate authors of different papers by commas and order the papers by date. Within a particular year, order the papers alphabetically by author:

Although differences in light intensity are usually of primary importance, carefully controlled experiments demonstrate that cats can differentiate between objects by their color alone (Black and White 1963, Brown et al. 1966, Green 1969).

If you cite two or more papers written by an author(s) in the same year, place a small letter after the date to distinguish between papers:

Capp and Drucker (1975a) suggested several methods for making Introductory Biology textbooks more interesting to college students. They later found that a comic book format with a center foldout of DNA was most appealing (Capp and Drucker 1975b).

B. Literature Cited Section

All sources cited in the body of your paper/report must be completely referenced in a section at the end entitled LITERATURE CITED. List alphabetically in the Literature Cited only those papers and books you mentioned in the text. If you found 294 articles pertaining to your subject matter, but only reported on three of them in the paper, then the Literature Cited will contain three entries. If you cite more than one paper written by the same author(s) in different years, list these publications chronologically. References for books should not be separated from those for journals. Use the complete names of journals when listing a citation in the literature cited section.

Cite journal articles in the following manner:

Hawn, G. 1970. Effects of gamma rays on man and moon marigolds. *Ecology* **64**:2415-2502.

The above citation indicates that the paper appeared in *Ecology* in 1970, Volume 64, Issue Number 3, pages 2415 through 2502.

For two authors:

Lottabull JJ, Udder, CD. 1969. Differences in milk production in color morphs of the domestic cow (*Bos taurus*). *Journal of Animal Husbandry* **16**:1-18.

A correct citation for information published in a book should include: publisher's name, location of publisher, and total number of pages in the book:

Green SL. 1969. *Visual Acuity in Vertebrates*. W.B. Saunders Co., Philadelphia, PA, USA, 465 pp.

If your reference is included in a book as one of a number of articles by different authors, cite it as follows:

Shell OC, Richfield A A, Moco B B, Peck, O. 1970. The potential impact of oil spills on migrating Alaskan caribou. Pages 417-530 in J.P. Getty, editor. *The Alaska Pipeline: Social, Economic, and Ecological Considerations*. Little, Brown and Co., Boston, Massachusetts, USA, 814 pp.