

# Thesis Guide

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THESIS GUIDE

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FORMAT REQUIREMENTS AND INSTRUCTIONS  
FOR THE PREPARATION OF  
MASTER OF SCIENCE THESES

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DEPARTMENT OF BIOLOGICAL SCIENCES  
WESTERN ILLINOIS UNIVERSITY

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GRADUATE COMMITTEE

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## TABLE OF CONTENTS

	Page
INTRODUCTION .....	1
GUIDE FOR WORD PROCESSING AND PRINTING .....	3
FORMAT OF THESIS .....	6
GUIDE TO GRAMMAR AND STYLE.....	12
IN-TEXT CITATIONS AND LITERATURE CITED.....	20
APPENDIX A – INSTRUCTIONS FOR CREATING A *.PDF FILE .....	26
APPENDIX B – COMMON PROBLEMS AND FAQ.....	29
APPENDIX C – SAMPLE PAGES.....	31

## INTRODUCTION

A thesis is original research that is intended for eventual publication by the student as the first author and the advisor as the second author. Students are given 3 semester hours of credit for writing the thesis. The process can be long, tedious, and frustrating. Students should not take criticism of their thesis personally, but rather understand that the advisor and committee members are working to make the thesis the best possible document. Students should expect MANY revisions of their thesis based on comments from their advisor and two committee members. In the long-run, paying attention to format and writing details will shorten the process for everyone. Students need to adhere to the schedule of events in submitting, revising, and defending a thesis. Attempts by students to short-cut or bypass steps only results in delays and frustration of the thesis committee, which is also the oral examination committee.

During the process of writing a thesis, the advisor and committee experience the student's ability to work independently and professionally, to pay attention to detail, and to think critically. The thesis represents the caliber, analytical skill, and writing abilities of both the individual student and faculty in the Biology Department. A clear, concise document with consistent formatting suggests discipline and attention to detail, both of which are important in conducting research. Conversely, a sloppy, inconsistent document suggests the research also was sloppy. Thus, proper formatting of the thesis is important for creating a positive impression on the reader and serves as a basis for future publication.

This Thesis Guide contains the regulations and format requirements needed to prepare a master's thesis in the Department of Biological Sciences at WIU. The primary goal of this Guide is to be a "guide" – that is, to help you with your writing by providing answers to common questions, pointing out common mistakes, giving good examples, etc. A person with a Master's Degree in Biology should have good writing skills, and this document was created to help you gain those skills.

Another goal of this document is to enforce consistency both within an individual's thesis and among all theses created in the Department. Consequently, the most important concept to be followed when creating a thesis is consistency in format. This guide is NOT intended to provide strict guidelines covering all possible situations. While some broad formatting guidelines to which all theses must adhere are necessary, consistency within a thesis is more important than consistency between theses.

For problems which cannot be answered from this Thesis Guide, it is the student's responsibility to seek help from their advisor or from the Graduate Committee Chair. In addition, consulting the *Council of Biology Editors (CBE) Style Guide* (now called the Council of Science Editors, [www.councilscienceeditors.org](http://www.councilscienceeditors.org), accessed 18 May 2009) may be helpful.

Do not assume that "it will be all right", "they won't catch this problem", or "they won't require corrections to be made". The thesis will not be bound until it is free of errors. Do

not use past theses as examples of format because the format has changed several times over the last few years.

*The Department of Biological Sciences Graduate Student Handbook* outlines the steps for having a thesis reviewed and approved, giving a thesis seminar, and taking the final oral examination. This document can be found on the Biology Graduate Program web page ([www.wiu.edu/biology/graduate/](http://www.wiu.edu/biology/graduate/), accessed 18 May 2009).

Note that non-thesis students must also complete a research project, which is called an “Advanced Biological Project”. The Advanced Biological Project (ABP) must be written and defended just like a thesis, so all the information contained in this document applies equally to the non-thesis ABP. However, the ABP was designed to be more flexible, so its structure might be different. For example, the ABP might be based on an internship so that the traditional sections of a thesis (e.g. **RESULTS**) might not be relevant. The ABP could discuss the internship, the student’s responsibilities, the lessons learned, etc. The traditional thesis structure can be modified to suit the ABP as needed. Also note that the ABP is NOT submitted for binding – thus, it will not be in the Library and will not be in the online database. It will be kept in the Department, so maintaining proper formatting will still be important.

## GUIDE FOR WORD PROCESSING AND PRINTING

The School of Graduate Studies requires that certain procedures are followed in preparing a thesis ([www.wiu.edu/grad/resources/paper/guidelines.php](http://www.wiu.edu/grad/resources/paper/guidelines.php), accessed 18 May 2009). This Thesis Guide includes the requirements of both the WIU School of Graduate Studies and the Department of Biological Sciences. If an inconsistency or conflict arises between the requirements of the Graduate School and the Biology Department, the Biology Department's requirements will take precedence. Thus, the final thesis must meet all the format requirements of this Thesis Guide. More specific requirements and suggestions concerning the preparation of a thesis are described below.

**Electronic Submission** – All theses are now submitted electronically. The student does NOT need to print a copy on thesis bond paper. All pages of the thesis (including the **SIGNATURE APPROVAL PAGE**) must be combined into a single Adobe Acrobat (\*.pdf) file (see instructions in Appendix A). The Chairman of the Graduate Committee will work with the student to submit the thesis electronically via the University's electronic thesis web portal ([www.etsadmin.com/cgi-bin/school?siteId=189](http://www.etsadmin.com/cgi-bin/school?siteId=189), accessed 18 May 2009).

A nice feature of electronic submission is that extra files may be uploaded with the thesis. For example, if a thesis involved unique mating calls of a bird species, audio files containing recordings of the bird calls can be uploaded with the thesis. In this way, when others access the thesis from the database, they will also be able to access the audio files. This feature is not limited to just audio files; any type of relevant file can be uploaded with the thesis.

**Font Size** - Use 10 to 12 point font consistently throughout the text. Times New Roman, Calibri, or Arial font should be used. Care should be taken that the font and point size of figures and tables matches the text.

**Headings and Subheadings** – Major headings (e.g. **ACKNOWLEDGEMENTS, ABSTRACT, TABLE OF CONTENTS, LIST OF TABLES, LIST OF FIGURES, INTRODUCTION, MATERIALS AND METHODS, RESULTS, DISCUSSION, LITERATURE CITED, and APPENDICES**) should be centered, ALL CAPITALS, and bold.

Major headings always start at the top of a new page.

It is suggested that subheadings should be bolded with a single, double-spaced line before the subheading; no matter what format is chosen for subheadings, it is important that the same format be used consistently throughout the document.

If using *Microsoft Word*, apply a unique “Word style” to the major headings and a different style to the subheadings – this makes creating a **TABLE OF CONTENTS** much easier.

**Justification** – Text should be left justified

**Margins** - The margins required are 1 inch from the top, right, and bottom of the page. The left margin is 1.5 inches to accommodate binding.

**Number of Copies and Binding** – Students are required to pay for a minimum of TWO bound copies of their thesis. After the successful oral defense of the thesis and the final **SIGNATURE APPROVAL PAGE** is signed, the bound thesis is distributed as follows: one copy is for the Malpass Library and one copy for the major advisor. More than two copies may be ordered at the student’s expense. All fees will be charged to the student via credit card when they submit their thesis electronically.

**Oral Exam** – Once the graduate reader has approved the thesis, the student may schedule an oral exam in consultation with the advisor and committee members. The student must provide an electronic copy of the thesis to the Department Secretary at least 5 business days prior to the defense. This electronic copy will be provided to any faculty member who requests to review the thesis.

On the day of the defense, the student should provide each committee member a hard copy of their thesis to use as a reference during the defense.

At the oral exam, the student also must provide one copy of the **SIGNATURE APPROVAL PAGE** which will be signed by the committee, scanned in, attached to the final electronic version, and bound in each copy of the thesis, assuming the student passes the defense.

**Pagination** – With the exception of the **SIGNATURE APPROVAL PAGE**, the **TITLE** page, and the first page of the **INTRODUCTION**, every page in the thesis has a printed page number.

For prefatory materials (e.g., **ACKNOWLEDGEMENTS**, **ABSTRACT**, **TABLE OF CONTENTS**, **LIST OF TABLES**, and **LIST OF FIGURES**), use small Roman numerals (ii, iii, etc.). Center these page numbers at the bottom edge of the paper. The **TITLE** page has no page number.

For the body of the thesis, use Arabic numerals (2, 3, etc.) and place the page number in the upper right-hand corner. For pages that are in a landscape

orientation, the page number still is in the upper right-hand corner (pay attention to margins if putting a page in landscape orientation). The first page of the **INTRODUCTION** has no page number.

***Proofreading and Correcting*** – Be sure to run spell check before giving the thesis to the advisor.

Once the thesis is in final form, the Chair of the Graduate Committee will assign a Graduate Committee “reader” (a member of the Department’s Graduate Committee) to check the format of the thesis. The reader will require an electronic version (in *Microsoft Word* format).

***Spacing*** - Double spacing is required in the text, except that tables and figures may contain single spacing in places such as column headings and the caption. Also, the **TABLE OF CONTENTS, LIST OF TABLES, LIST OF FIGURES,** and **LITERATURE CITED** are single spaced.

***Word Processing*** - Enter the text of the thesis using a computer with *Microsoft Word* or similar software application. Due to the popularity of “proportionally spaced” fonts, the use of two spaces after a period or colon is no longer required. If the thesis is written in *Microsoft Word* (\*.doc or \*.docx) format, the advisor and committee members can use this program to track changes, which can be very useful when working through several drafts. However, the final thesis will need to be saved in the *Adobe Acrobat* (\*.pdf) format for electronic submission (see instructions in Appendix A).

## FORMAT OF THESIS

In final form, the thesis resembles a publication in a scientific journal, but is usually longer and more detailed than most journals will publish. It is arranged in three main sections: prefatory materials, thesis body, and appendices (optional). The number of parts within these sections may differ depending on the outline of the thesis.

Use a consistent scheme of designating headings and subheadings of sections. The divisions of text should follow a standardized sequence as described below. Refer to Appendix C (Sample Pages) to see examples of proper formatting.

***Prefatory Materials*** – The Prefatory materials include (in this order) the **SIGNATURE APPROVAL PAGE, TITLE PAGE, ACKNOWLEDGEMENTS, ABSTRACT, TABLE OF CONTENTS, LIST OF TABLES, and LIST OF FIGURES**. Prefatory materials (except the **SIGNATURE APPROVAL PAGE** and **TITLE PAGE**) are numbered with lower case Roman numerals which are centered at the bottom of each page.

**SIGNATURE APPROVAL PAGE** - After a successful defense of the thesis, the signatures of the examining committee will be entered on the page along with the date of the oral examination. Each committee member's name should be typed below their signature line.

If there are more than 3 committee members, additional signature lines should be added.

This page is not numbered and is not considered in the numbering scheme; that is, although it is the first page in the thesis, it does not count as "Page 1" or "Page i".

A template (in *Microsoft Word* format) is available on the Biology Department's web page.

**TITLE PAGE** – A page number does not appear on the **TITLE PAGE**, but it does count as page "i" of the prefatory materials. All of the information contained on this page is centered and every letter of every word in the title is capitalized but not bold. Each section is separated by a short border.

Genus and specific epithets in the title are *italicized*. Inclusion of the authority for scientific names is optional.

The full legal name of the author and advisor of the thesis is used to ensure proper identification.

A template (in *Microsoft Word* format) is available on the Biology Department's web page.

**ACKNOWLEDGEMENTS** – This page is numbered “ii” and the number is centered at the bottom. Acknowledgments of help received from others are indicated in this section. It is appropriate to mention help, suggestions, and criticisms the student receives from the advisor, committee, and others. Other acknowledgments may include mention of help with photography, illustrations, equipment, laboratory work, field work, and financial support. If a permit was needed to conduct the study, the number of the permit and permitting agency should be listed. If an Institutional Animal Use and Care (IACUC) approval is needed this should be noted in the acknowledgments section.

**ABSTRACT** – Pagination for the **ABSTRACT** begins with “iii” centered at the bottom. The **ABSTRACT** must not exceed two double-spaced pages.

The **ABSTRACT** summarizes the purpose of the study, the major and minor topics investigated, the methods used, the results obtained, their significance and the major conclusions from the research. Sometimes the abstract is the most difficult part of a thesis to write, yet it is the most widely read part of the thesis. Often the abstract should be written last. Students should take particular care to write a thoughtful abstract since this text appears in *Dissertation Abstracts*.

Do not cite literature, tables, or figures in the **ABSTRACT**.

**TABLE OF CONTENTS** – Pagination is a continuation of the lower case Roman numerals used for the **ABSTRACT**.

All major headings should be included in the **TABLE OF CONTENTS**; subheadings may be included. Page numbers should line up on the right side of the page.

The **TABLE OF CONTENTS** is single spaced. All major headings are separated by a blank line, and if subheadings are included they are separated from their major heading by a blank line. Subheadings should also be indented from the major headings.

Since page numbers will change often during revisions, it is suggested that the **TABLE OF CONTENTS** be created last.

To properly line up page numbers, use a “tab stop” at 5.75 inches from the left. While the text is left justified, this tab stop should be a “right aligned” tab stop, and the leader should be set to a series of dots. By using the tab stop, all numbers will be aligned on the right and all text will be aligned along the left, no matter what font is used. Do NOT simply insert a number of periods to act as the lead in to the page numbers – these will not be evenly spaced and the numbers will never line up.

A template (in *Microsoft Word* format) is available on the Biology Department’s web page. Note that lining up the page numbers in the **TABLE OF CONTENTS** is difficult, so it is strongly suggested that the template is used.

**LIST OF TABLES** –The **LIST OF TABLES** should include the table number and caption. If the entire caption is so long that it is unwieldy or awkward in the **LIST OF TABLES**, then a summary of the caption can be used.

Page numbers should be formatted as in the **TABLE OF CONTENTS**. A template (in *Microsoft Word* format) is available on the Biology Department’s web page. Note that lining up the page numbers in the **LIST OF TABLES** is difficult, so it is strongly suggested that the template is used.

**LIST OF FIGURES** –The **LIST OF FIGURES** should include the figure number and caption. If the entire caption is so long that it is unwieldy or awkward in the **LIST OF FIGURES**, then a summary of the caption can be used.

The template for the **LIST OF TABLES** can be modified and used to create the **LIST OF FIGURES**.

*Main Body of Thesis* – The main body of the thesis contains the **INTRODUCTION, MATERIALS AND METHODS, RESULTS, DISCUSSION, LITERATURE CITED**, and **APPENDICES** (if any). All pages in the main body (except the first page of the **INTRODUCTION**) are numbered in the upper right corner with Arabic numerals.

**INTRODUCTION** - This section describes the nature of the problem; includes a review of the most significant literature; states any hypotheses or anticipated results; and indicates the purpose, objectives, and scope of the investigation.

The first page of the **INTRODUCTION** does NOT have a printed number. The second page of text has the number 2 printed in the upper right corner.

The **INTRODUCTION** may include a short summary of the species' natural history, summary of key literature related to the hypotheses of the thesis, etc., and it ends with a list of objectives of the research.

It often is easiest to start with the "big picture" and end with the specific topic under investigation, followed by the objectives. For example, if the thesis topic was on metabolic rate in a local species of fish, the progression of the **INTRODUCTION** would first describe metabolism in fish in general, then metabolism in freshwater fish, then metabolism in fish of the same genus, pose the hypotheses for the particular fish species, and end with the objectives of the research.

Generally, there are no tables or figures in the **INTRODUCTION**.

*Review of the Literature (Optional)* - This section is an extensive review of previous publications which are related to the study. The **INTRODUCTION** and Review of the Literature may be incorporated into one section if warranted by the nature of the research.

A Review of the Literature may also be placed in an Appendix to reduce the length of theses body.

In general, a Review of the Literature is not publishable and would have to be eliminated or greatly condensed to include in a publication.

**MATERIALS AND METHODS** - This section contains a description of the materials, equipment, and methods employed in the investigation.

If relevant, this section should begin with a site description, i.e. a brief description of the location where the research was conducted. Note this is NOT relevant for laboratory research but is relevant for research conducted in a particular location, like Spring Lake, the Kibbe Research Station, the Niabi Zoo, etc.

The remainder of this section is written chronologically, i.e. in the order in which the research was conducted. For example, if studying fish movement in the Mississippi River, first describe where on the River the fish were studied (the site description). Then, describe how the fish were captured, how they were tagged, how they were tracked, how the data were collected, and how the data were analyzed. This sequence reflects the work accomplished in the order in which it was completed.

This section can be reduced by referring to existing publications that used the same methods. Note that this section should contain enough detail that another researcher could replicate your study; however, extraneous or excessive detail should be avoided (e.g. “One mL of reagent was measured in a Fischer pipette and transferred to a graduated cylinder with a blue base. A squirt bottle filled with distilled water was used to dilute the reagent to 100 mLs by squirting in water and watching the level in the graduated cylinder with the blue base until the proper volume was obtained...” can be reduced to “One mL of reagent was diluted to 100 mLs with distilled water.”

Often a diagram or photograph of the test apparatus, study site, etc. is useful.

**RESULTS** - This section includes a presentation of the observations and analysis of data obtained.

The values of statistical tests, sample sizes, and p-values are reported in the results, and most tables and figures will occur in this section.

The data are usually presented in tables and/or figures and described in the text. Use the text in this section to point out patterns or trends that you see in the data. Try to avoid simple sentences like “The results of the t-test are in Table 1.” Instead, indicate the important aspects of the Table, such as “Significantly more fish were captured behind wing dams than in the main body of the river (Table 1).”

Do not interpret the results or cite literature; that is done in the **DISCUSSION** section.

**DISCUSSION** - The **DISCUSSION** includes an explanation of the **RESULTS** and an analysis and comparison of the study to research published by other investigators. Any conclusions reached from the data obtained should be included in the **DISCUSSION**. Be sure to refer to the objectives set forth in the **INTRODUCTION** in this section, i.e. make sure to indicate how the results relate to the original hypotheses.

A common problem in writing the **DISCUSSION** is the tendency to repeat statements made in the results, rather than interpret the results.

Usually tables and figures are NOT included in this section, but earlier tables and figures can be referred to in this section.

**LITERATURE CITED**- This section is an alphabetical list of all the references organized by the last name of the first author in a citation. If this section contains multiple citations by the same author, list the oldest citations first.

These references are actually cited in the text; this section is not a bibliography.

Each entry should be single-spaced with a blank line between entries. Citations that span multiple lines should have a consistent hanging indent.

Realize that future readers will rely upon the **LITERATURE CITED** to find information cited in the thesis; thus, proper formatting which contains all the critical information for a citation is very important.

**APPENDICES (Optional)** – To minimize bulk, supplementary materials may be placed in appendices. These might include raw data, sample data sheets, correspondence, a Review of the Literature, etc.

Organize materials into appropriate parts and label each as **APPENDIX A**, **APPENDIX B**, **APPENDIX C**, etc., depending on the number of sections needed. Also, the title of the Appendix should contain a brief description of the contents (for example, “**APPENDIX A – SAMPLE ETHOGRAM**”).

Number the pages, the tables, and the figures in the appendices consecutively with those of the text. That is, if the last table in the body of the thesis is Table 10, then the first table in the Appendix is Table 11.

## GUIDE TO GRAMMAR AND STYLE

**Abbreviations** - The following specific applications are to be followed:

- 1) **Titles preceding personal names** are spelled-out with the exception of Mr., Mrs., Ms., and Dr., which are always abbreviated.
- 2) **Names of months and days of the week** are never abbreviated, except in direct quotations, tables, graphs and similar material. Use the format of ddmmyyyy, e.g., 23 March 2009.
- 3) **Chemical names and abbreviations** should follow the convention used in the particular field.
- 4) Do not abbreviate the **names of countries**, except for USA. Use the U.S. Postal Service abbreviations for the **names of states**, when appropriate.
- 5) Abbreviations may be used with **tables, maps, and figures**, but if they are unusual, they should not be abbreviated.
- 6) **Units of measure** should be metric, unless other units are standard in a particular field. Abbreviate entities denoting units of weight (kg, g, or mg), temperatures (°C), length measurements (km, m, cm, and mm), and volume measurements (µL, mL, or L) in the text only when preceded by numerals. These abbreviations are not followed by a period unless they occur at the end of a sentence. Note a space is placed between the value and the unit (e.g. 145 mm NOT 145mm). Some units of measure require capitalization, e.g. kHz, dB, Volts, Watts.
- 7) **Acronyms** should be defined when first used in the thesis e.g., Endangered Species Act (ESA).
- 8) In the text, spell out **genera names** when first used in combination with the specific epithet. Thereafter, genera names may be abbreviated using their first letter capitalized, unless confusion will result. Scientific names should be *italicized*.
- 9) Abbreviate **federal and state agencies** as FDA, NMFS, HEW, etc., not F.D.A.
- 10) All **values in tables and figures** must be written as numerals and not spelled-out.

**American vs. British English** - Words in English have two forms, depending on whether British English or American English is used. Pick one form and be consistent. Generally, if written by a US author or for a US journal use American English.

Examples:

<u>British English:</u>	<u>American English:</u>
grey	gray
behaviour	behavior
organisation	organization
vocalisation	vocalization
amongst	among
whilst	while

***Anthropomorphic and Emotive Words*** - Do NOT use anthropomorphic words, or words that give human characteristics to animals. For example, do NOT use “friendly” whales, “angry” dog, “lovable” puppy, or the bear “likes” apples, etc.

Do NOT use emotive words that express your feelings. For example, do NOT use I “love” this species nor, I “hate” this research project.

***Between vs. Among*** - The word “between” compares two objects. The word “among” compares more than two objects. So, USE “between fish and birds” and USE “among mammal species.”

***Capitalization*** - Use upper case letters for:

- 1) The first word of each sentence.
- 2) Proper nouns or proper adjectives (e.g., Townsend’s ground squirrel, Lake Michigan, the Earth); however, some words have been derived from proper nouns and that have a special meaning need not be capitalized (i.e., petri dish, paris green, bunsen burner, erlenmeyer flask). NOTE that your spellcheck often wants to capitalize these words.
- 3) Taxonomic ranks, such as Cetacea, Sirenia, Pinnipedia, or Carnivora. However, the shortened versions are NOT capitalized, such as cetaceans, sirenians, pinnipeds, or carnivores.
- 4) First word and proper names in titles of books and journal articles in the **LITERATURE CITED.**

***Contractions*** - Do not use contractions (for example: don’t, can’t, couldn’t, won’t, shouldn’t etc.) The word “it’s” is a contraction and means it is. The possessive form of “it” is “its” without an apostrophe, e.g. “...the fish used its caudal fin for forward propulsion...” but NOT “...the fish used it’s caudal fin for forward propulsion...”

***Figures (including photographs, drawings and graphs)*** - Figures are numbered consecutively throughout the manuscript with Arabic numerals at the beginning of the

caption. The word “**Figure**” and the figure number are in bold. The caption of the figure is single spaced, left-justified, and placed below the figure near the bottom of the page. Only the first letter of the first word in each sentence is capitalized, except for proper names, genera, or locations. The caption must be complete enough to describe all the data, including type of data, units of measure, name of organism, where collected, and when collected (that is, state who, what, where, and when). Only 1 figure is allowed per page.

The figure should be centered horizontally on the page. For large figures, it may be necessary to change the page orientation to landscape (be aware that this will affect your page number location and margins!).

The figure must be placed on its own page immediately following the text where it is first mentioned (or as near as possible). As a result, a thesis may have several consecutive pages of tables and/or figures, which should be arranged numerically and in the order they are discussed.

If the figures are drawings or photographs, they may be grouped onto a set of panels on a single page. Then each figure panel must be designated by a letter, which appears above and to the left of each panel.

Figure captions on facing (left side) pages should not be used, because printing and binding such pages is very difficult with the electronic submission procedure.

Photographs or other illustrative materials must be of high quality and must be digitized at a high resolution (anything less than 300 DPI might become pixilated during the binding process). Note that much of the material found online is copyrighted, so make sure you have permission to use someone else’s figure before you insert it into your document, and always cite material that is not yours.

Color photographs and figures are acceptable, and the colors will be reproduced in the bound version of the thesis. However, be aware that the thesis may be copied or printed in black and white by someone, so a color scheme might not be readable.

Figures in the appendices should be numbered consecutively following those in the text.

***Indentations and Quotations*** - The beginning of paragraphs, long quotations, and informal tabulations must be indented.

Quotations must have the exact spelling, punctuation, italics (underlined), etc., as the original. The source of the quotation must be cited.

A set of three periods (...) is used to indicate an omission of words within a quotation.

Brackets are used to enclose an explanation or note by the author, to indicate the thesis writer's interpretation, or to supply an omission.

*Italicizing* – use italicizing with:

- 1) Scientific names of genera, species, and varieties. Do NOT italicize names of classes, orders, families, etc.
- 2) Titles of books, pamphlets, and periodicals when these appear in the text. Do NOT underline or italicize such titles when they appear in the **LITERATURE CITED** section.
- 3) Software (italicize the software name but not the company name or location)
- 4) Do not italicize commonly used foreign words or abbreviations such as: i.e., e.g., viz., in situ, et al., in vitro, non vedemus, circa, ad libidum, etc.

*Jargon* – Do NOT use jargon. Many words that end with “ize” are the jargon form of a word. For example, do NOT write “utilize” or “customize” but DO write “use” or “custom”.

*Numerals* - The following statements govern the use of numerals in the text.

- 1) Use written words, rather than numerals, for numbers **zero through nine, unless the number is reporting data**. For example, “There are three kinds of squirrels” and “There were 9 squirrels in the study area.”
- 2) When numerals are in a **series**, then use numerals for all (e.g., “0, 1, 2, ... 19, 20”).
- 3) Use numerals whenever a number is followed by a **standard unit of measurement**, such as gram, etc. (e.g. “100 mL” but not “one hundred mL”).
- 4) Spell-out numbers when they **begin** a sentence (i.e., “Fifty-three geese flew over the lake.”)
- 5) **Ordinal numbers** from one to 10 may be spelled-out or put in numerical form (i.e., second or 2<sup>nd</sup>). Ordinal numbers greater than 10 should be in numerical form (21<sup>st</sup>, or 33<sup>rd</sup>).
- 6) In **very large numbers**, substitute a word for part of the number (i.e., 1.6 million rather than 1,600,000) or add appropriate prefixes such as mega, kilo,

micro, or milli to the basic unit of measurement. Scientific notation should be used when appropriate.

- 7) Always use **numerals for dates, page numbers, numerical designation, percentage, in direct quotations, and for expressions of the time** as: 1 January 1963; page 822; type 1; 10:15 and 27%.
- 8) Use **military time**, i.e., 08:00 or 16:32 h.
- 9) Use **commas** in large numbers (e.g., use “1,333,656” or “1,445” but do NOT use “1333656” or “1445”).

***Phrases to Avoid*** - In the **ACKNOWLEDGMENTS** do NOT use the phrase “I wish to” thank or “I want to” acknowledge; simply use “I thank” or “I acknowledge”.

Do NOT use the phrase “in order to”. In all cases these are unnecessary words that can be deleted. For example, “In order to conduct the research...” can be simplified as “To conduct the research . . .”

***Scientific Names*** – Species must be accompanied by the authority the first time they appear in the thesis if authorities are required by the thesis committee or advisor. After this initial reporting, they are omitted from the thesis text. Authorities are not used with a genus name.

The common name (if one exists) and scientific name of all species should be given the first time they are mentioned in the **ABSTRACT**. Thereafter in the **ABSTRACT** the species can be referenced with genus abbreviated or the common name.

In addition, the first time a species name is mentioned in the main text of a thesis both the common name and scientific name should be given. Thereafter, in the text the species can be referenced with the genus abbreviated or the common name.

Genus name is capitalized, but the specific epithet is not capitalized, and both are *italicized*.

Common names of animals should only be capitalized when a proper name is involved. For example: “red fox”, “coyote”, “Pacific white-sided dolphin”, and “Canadian geese.”

The common name and scientific name can either be separated by a comma (“...looked at hybridization in black crappie, *Pomoxis nigromaculatus*...”) or not (“...looked at hybridization in black crappie *Pomoxis nigromaculatus*...”) as long

as the same method is used consistently throughout the thesis. The scientific name can also be given parenthetically (“...looked at hybridization in black crappie (*Pomoxis nigromaculatus*)...”).

**Sex vs. Gender** - Use the word “sex” to describe male and female, not “gender”. Gender applies to the tendency to show masculine or feminine traits.

**Slash (/)** - This line may be used to indicate “per” some quantity (e.g., 14 g/1; 2.5 g/m<sup>2</sup>/yr). It is also acceptable to use superscripts (e.g., 14 g l<sup>-1</sup>)

**Since vs. Because** - The word “since” conveys time. The word “because” conveys cause. So, USE “Because the sky is blue...” NOT “Since the sky is blue...”.

**Spelling and Word Division** - A standard dictionary must be the final authority on spelling and hyphenation.

Since all theses will be created via word processing software, division of words at the end of a line is no longer relevant and should be avoided.

**Split Infinitives** - Do NOT use a split infinitive. When a verb is preceded by the word “to” it becomes the infinitive form of the verb. For example, “to read”, “to write”, “perchance to dream”. Do NOT use “to easily read”, “to readily write”, “to hungrily eat”, or “to rapidly drink.”

**Splitting Auxiliary Verbs from Main Verb** - Do NOT split the auxiliary verb from the main verb. For example:

Incorrect:

was improperly stated  
was especially joyful  
has never talked  
can hardly hear

Correct:

was stated improperly  
especially was joyful  
never has talked  
hardly can hear

**Tables** - Tables are numbered consecutively throughout the manuscript with Arabic numerals at the beginning of the caption. The word “**Table**” and the table number are in **bold**. The caption of the table is single spaced, left-justified, and placed above the table. Only the first letter of the first word in each sentence is capitalized, except for proper names, genera, or locations. The caption must be complete enough to describe all the data, including type of data, units of measure, name of organism, where collected, and

when collected (that is, state who, what, where, and when). For a long table which requires more than one page the legend should not be repeated, rather the heading of “**Table xx (continued)**.” should appear at the top of subsequent pages of the table.

Font of the tables should match that of the text.

The table must not exceed the margins of the page. In general, each table must be on a separate page, unless 2 consecutive tables use less than 1/3 of the page. If so, both tables can be included on the same page. For large tables, it may be necessary to change the page orientation to landscape (be aware that this will affect your page number location and your margins!). If necessary, the font size can be reduced to fit all data on one page, but fonts should not be smaller than a point size of 10.

A horizontal line must separate the table caption from the data in a table and the table must be completed with another horizontal line below the data. Footnotes should be placed at the bottom of the table, below the bottom horizontal line.

Column headings and data in a table should be single-spaced. Use consistent capitalization within the table. It is typical to put the abbreviated units of measure in parentheses with the column heading.

The table must be placed on its own page immediately following the text where it is first mentioned (or as near as possible). As a result, a thesis may have several consecutive pages of tables and/or figures, which should be arranged numerically and in the order they are discussed.

Tables in the appendices should be numbered consecutively following those in the text.

***Use of i.e. and e.g. - Be careful with the use of i.e. and e. g.***

“i.e.” can be substituted for the phrase “that is”. For example, “...the two tree squirrels in Illinois (i.e., gray and fox squirrels) are abundant...”

“e.g.” can be substituted for the phrase “for example” and is used to state a few examples, such as “...the rainbow trout has many colors (e.g., pink, gray, blue)...”

***Use of Past Tense - Use past tense in writing, UNLESS the statement is always true. For example, “the Earth is round” or “up is the opposite of down.”***

***Use of Two Nouns as an Adjective*** - Be careful when using two nouns as single-word adjective.

Some correct examples:

The underwater seal. The seal was under water.

The underground cable. The cable was under ground.

The airborne pathogen. The pathogen was air borne.

The haulout site for the seal was fast ice. The fastice seal hauls out.

***Using Certain Words*** - Use the word “human”, rather than “man” when speaking of the human population, unless some characteristic is true for only male humans. For example, USE “Humans have overpopulated the Earth.”

## IN-TEXT CITATIONS AND LITERATURE CITED

**Citations** - Footnotes are NOT permitted as a form of citation. Citations must be consistent and in the same name-and-year system. The year always accompanies the author(s) names, and can either use no comma (Doe 1988) or a comma can separate the two (Doe, 1988). Whichever method is chosen must be used consistently throughout the thesis.

The complete citation for each article mentioned in the text must also appear in the **LITERATURE CITED** section of the thesis, and all citations in the **LITERATURE CITED** must appear somewhere in the thesis.

The following are examples for citations in the text of the thesis:

- 1) **Single author:**
  - a. "Doe (1988) stated ..."
  - b. "... no relationship was found (Doe 1988)."
  - c. "According to Doe (1988), fish swim upriver ..."
  
- 2) **Two authors:**
  - a. "Doe and Jones (1974) noted ..."
  - b. "... no relationship was found (Doe and Jones 1974)."
  - c. "According to Doe and Jones (1988), fish swim upriver..."
  
- 3) **Three or more authors:** Use "et al." to represent all authors besides the primary author; NOTE that "et" means "and" and is the complete Latin word, so it has no period at the end. However, "al." is short for "alia" which is Latin for "others", thus it is an abbreviation and requires a period at the end.
  - a. "Doe et al. (1960) found that..."
  - b. "...no relationship was found (Doe et al. 1960)."
  - c. "According to Doe et al. (1960), fish swim upriver..."
  
- 4) **More than one paper in one year by the same author:** Use the appropriate citation, but place the letter a, b, or c, etc. after the year.
  - a. "...were genetically distinct (Smith 1985a, 1985b)."
  
- 5) **Multiple citations** in parentheses are separated with a comma OR semicolon. Whichever method is chosen must be used consistently throughout the thesis. Citations should be arranged chronologically from oldest to newest and alphabetically for multiple citations in the same year.
  - a. "...were genetically distinct (Smith and Jones 1975, Smith and Doe 1984)," OR "...were genetically distinct (Smith and Jones 1975; Smith and Doe 1984)."
  
- 6) **Personal communications:** Because these citations are not literature, do NOT include them in the **LITERATURE CITED** section, and the in-text citation

should contain extra information. At the very least, the full name of the individual being cited should be given. If their title or organization is important for establishing their authority on the subject, these too should be included.

- a. “Tom Smith (1985, personal communication) noted that...”
- b. “...in all seasons except winter (Tom Smith 1985, personal communication).”
- c. “...most fish have vacated the area by then (Tom Smith, Illinois Department of Natural Resources, 1985, personal communication).”

7) **Unpublished references:** Because these citations are not literature, do NOT include them in the **LITERATURE CITED** section, and the in-text citation should contain extra information. At the very least, the full name of the individual being cited should be given. If their title or organization is important for establishing their authority on the subject, these too should be included. Note that no year is given.

- a. “Tom Smith (unpublished) noted that...”
- b. “...in all seasons except winter (Tom Smith, unpublished).”
- c. “...most fish have vacated the area by then (Tom Smith, Illinois Department of Natural Resources, unpublished).”

8) **Computer Software:** Because these citations are not literature, do NOT include them in the **LITERATURE CITED** section, and the in-text citation should contain extra information. Software programs should be in italics and should contain the version (if known), the company that created the software, and the location of the company’s headquarters.

- a. “All statistical analyses were conducted with *SYSTAT 5.0* (SPSS Incorporated, Chicago, IL).”

9) **World Wide Web Pages:** Because these citations are not literature, do NOT include them in the **LITERATURE CITED** section, and the in-text citation should contain extra information. Realize that information is constantly moving around on the Web, so giving the full address of a document will not likely be useful in the future. Also, such full web addresses tend to be long and awkward. Only give the main address (the portion before the first backslash), underline the main address, add a comma and the word “accessed”, and then the date on which the information was accessed. Note that the software will often turn these links into active hyperlinks and might change the color of the font. This is fine as long as it is consistent. Realize that the bound manuscript will be in color, so any change in font color will be reproduced in the final document.

- a. “Spring Lake is located just north of Macomb, IL ([www.macomb.com](http://www.macomb.com), accessed 24 April 2005).”

Note that you **MUST** check the web page closely to determine the copyright information! Downloading figures, images, maps, GIS files, etc. is so easy

that many students simply download such material and insert it into their thesis without any thought. However, many items are protected by copyright and at the very least you need to contact the author to ask for permission to use them.

**References listed in the LITERATURE CITED** - Citations are not numbered, but must be listed in alphabetical order by surname of first author. If more than one citation is used for an author(s) they are listed chronologically with the oldest citation first. When more than one citation is included for the same author(s) for the same year, the letters a, b, c, etc. are added after the year in order of citing in the text.

Citations are single-spaced with a blank line between successive entries and with a hanging indent if they occupy more than one line of text.

NOTE that it is impossible to provide format examples for all potential citation sources, and some citation types (e.g. government documents) are difficult to cite. The overarching goal of the **LITERATURE CITED** section is to provide enough information that readers can find the exact information cited. This goal should be considered when citing “non-traditional” references.

- 1) The surname of the first or sole author precedes the initials or given name. Cite names of all co-authors as given in the by-line. Use initials instead of first names for all authors. The word “and” precedes the final author in a multi-author citation. For three or more authors, each author name is separated by a comma. A period follows the final author.
  - a. One author: Public, J. Q.
  - b. Two authors: Public, J. Q. and E. B. Jones.
  - c. Three or more authors: Public, J. Q, E. B. Jones, and B. K. Smith.
- 2) The year of publication follows the author(s) and is followed by a period.
  - a. Public, J. Q, E. B. Jones, and B. K. Smith. 1984.
- 3) The title of the book or article should have the first letter of the first word capitalized. The rest of the words should be lower case unless there is more than one sentence or the title contains proper nouns (genera, counties, states, etc.).
  - a. Public, J. Q, E. B. Jones, and B. K. Smith. 1984. Variation in caudal fin length in black crappie *Pomoxis nigromaculatus*.
- 4) For journal articles: The journal name follows the article name, followed by a space, and then the volume and pages. An issue, number, supplement or other part within a volume is shown in parentheses only when paginated independently. Any special series precedes the volume number. To avoid confusion or error, never abbreviate journal names.

- a. Regular journal: Public, J. Q, E. B. Jones, and B. K. Smith. 1984. Variation in caudal fin length in black crappie *Pomoxis nigromaculatus*. Transactions of the American Fish Society 114: 615-625.
  - b. Paginated independently: Public, J. Q, E. B. Jones, and B. K. Smith. 1984. Variation in caudal fin length in black crappie *Pomoxis nigromaculatus*. Transactions of the Canadian Fish Society 114(4): 213-223.
  - c. Special series: Public, J. Q, E. B. Jones, and B. K. Smith. 1984. Variation in caudal fin length in black crappie *Pomoxis nigromaculatus*. Transactions of the Mexican Fish Society, Series 3 114: 491-501.
- 5) For articles that are part of a book: If the article is part of a book, give the article pages and use the word “in” before the editor names (if appropriate), then give the book title. Do NOT give the total number of pages in the book, but do give the publisher and location. Note the “in” is italicized:
- a. Public, J. Q, E. B. Jones, and B. K. Smith. 1984. Variation in caudal fin length in black crappie *Pomoxis nigromaculatus*. Pages 123-133 *in* W. Dance, ed. Fish fin research. Walker Scientific Publishing, Bay City, IL.
- 6) To cite **entire books**, give the publisher, location, and the total number of pages in the book. Do NOT give the pages which contain the specific information that is cited.
- a. Earth, P. L, T. W. Wind, and G. G. Fire. 1984. Advances in volcano research. Walker Scientific Publishing, Bay City, IL. 432 pages.

**Examples for the LITERATURE CITED** – Note that this is not meant to be an exhaustive list, but it is designed to provide examples for the most common types of citations you will encounter.

**Abstract from article** – Use this style if you only read the abstract from an article.

Hildebrant, A. C. 1948. Influence of some carbon compounds on growth of plant tissue cultures in vitro. *Anatomical Record* 100: 674. (Abstract)

### **Anonymous publication**

Anonymous. 1996. How to use our newspaper to wrap fish. *Macomb Journal*, 21 June: 4-6.

**Miscellaneous numbered publication of federal agency** - This is an example of a typical government publication. Not all publications will have similar information, but this example is a good starting point.

Van Dersal, W. R. 1938. Native woody plants of the United States, their erosion-control and wildlife values. USDA Publication 303. 362 pages.

### **Book**

Schwartz, R. J. 1955. The complete dictionary of abbreviations. Thomas Y. Crowell Co., New York. 211 pages.

### **Book, part of**

Overstreet, H. A. 1925. The psychology of effective writing. Pages 87-109 *in* H. A. Overstreet. *Influencing human behavior*. W. W. Norton and Co., New York.

### **Chapter or paper in book by several authors (Editors of book named)**

Link, G. K. K. 1928. Bacteria in relation to plant diseases. Pages 590-606 *in* E. O. Jordan and I. S. Falk, eds. *The newer knowledge of bacteriology and immunology*. University of Chicago Press, Chicago, IL.

**Dissertation**

Scottt, M. 2000. A microeconomic analysis of traditional paper production in a digital world. Ph. D. Dissertation, University of California, Santa Barbra, CA. 110 pages.

**Editor of book, no author(s) named**

Hamer, P. M., ed. 1961. A guide to archives and manuscripts in the United States. Yale University Press, New Haven, CT. 775 pages.

**Federal agency, listed as author**

U.S. Bureau of the Census. 1927. United States census of agriculture 1925. U.S. Government Printing Office, Washington, D. C. 3 vols.

**Newspaper article (Pages separated)**

Maverick, M. 1944. The case against "gobbledegook". New York Times Magazine, 21 May: 11, 35-46.

**Series in publications of a society**

Salaman, R. N. and F. C. Bawden. 1932. An analysis of some necrotic virus diseases of the potato. Proceedings of the Royal Society of London, Series B 111: 53-73.

**Thesis**

Finley, D. E. 1963. An investigation of the *Isaria* complex. M.S. Thesis, Western Illinois University, Macomb, IL. 86 pages.

**Two or more independent articles in same year by same author, or by same authors with names in same order**

Magoon, M. L., R. W. Hougas, and D. C. Cooper. 1958a. Cytogenetic studies of tetraploid hybrids in *Solanum* for hexaploid-diploid matings. Journal of Heredity 49:171-178.

Magoon, M. L., R. W. Hougas, and D. C. Cooper. 1958b. Cytogenic studies of complex hybrids in *Solanum*. Journal of Heredity 49:285-293.

## APPENDIX A – INSTRUCTIONS FOR CREATING A \*.PDF FILE

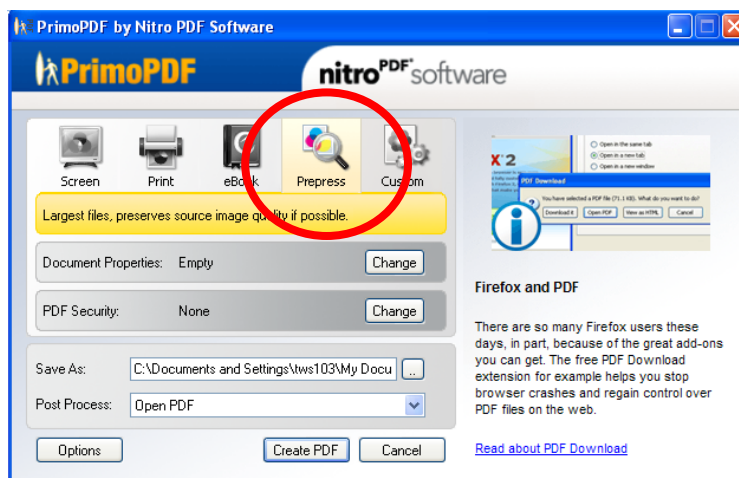
Since theses are now submitted electronically via a web site, the final version of the thesis must be in a single *Adobe Acrobat* (\*.pdf) file. This file **MUST** contain **ALL** pages, including the **SIGNATURE PAGE**, prefatory materials like the **TITLE PAGE**, **TABLE OF CONTENTS**, etc., and the body of the thesis. Also, this file **MUST** have all fonts embedded. The method shown here is designed to work when you have your signature page, prefatory materials, and thesis body in separate files (which most people do because it's easier to number pages that way).

In this method, we do **NOT** combine all the prefatory materials with the main body in Word. Instead, we create separate \*.pdf's for each file and then stick them together. For this to work, you need a free program called "PrimoPDF". Just download the program and install it. The program acts like a printer, so once it's installed you can go to the print menu in Word and find PrimoPDF listed as if it were a printer. But, if you choose this program to print, when you hit the "Print" button you will create a \*.pdf file instead of a hard, printed copy. The advantage here is that we can create a \*.pdf from the signature page, and then when we print the prefatory materials and main body to a \*.pdf file we can just add to the original \*.pdf. In this way, we can create a \*.pdf file with all the proper page numbers without going through all the above steps.

Step 1: Create a new file in Word that consists of a single, blank page. Make sure this page has no page numbering. Scan in your signature page and paste it into this Word document, making sure that the document remains only 1 page long.

Step 2: Print the document created in Step 1, but instead of sending it to your regular printer, send it to PrimoPDF.

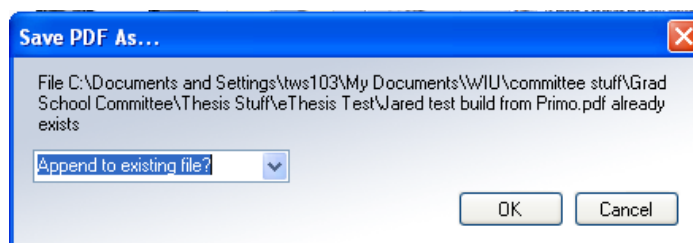
- After you hit "OK", choose the "Prepress" option on the PrimoPDF screen that pops up
  - o This option creates a slightly larger \*.pdf file, but this file will have all your fonts embedded, which is necessary for electronic submission



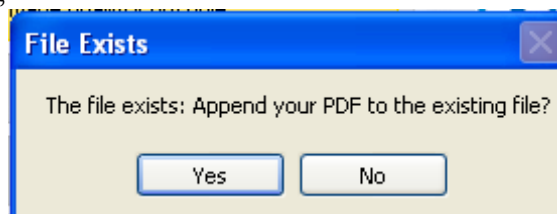
- Choose a place to save the \*.pdf file and give it a name in the “Save As” box; be sure to remember this location and name since you will need them in the next step
- When you hit “Create PDF” you will get a new \*.pdf file which contains your signature page

Step 3: Open the Word file which contains your prefatory material and make sure all these pages have the proper numbering (no number on the title page, rest of the pages have Roman numerals centered at the bottom) and the proper margins (1.5 inch on left, 1 inch on top, bottom, and right).

- Print this file using PrimoPDF
- When you get to the PrimoPDF screen, use the “Save As” box to save your new \*.pdf to the exact same file you created in Step 2!
- PrimoPDF will ask if you want to overwrite this file or append this file – you do NOT want to overwrite, you just want to append the new information to the existing \*.pdf



- When you hit “Create PDF” PrimoPDF will again warn you that you are appending information to an existing PDF – that’s exactly what we want to do, so hit “Yes”



NOTE: Often, if you have an inkjet printer, you have your computer set to print “Back to Front”, that is, when you print to your inkjet the last page are printed first, so that the final stack has the pages in the correct order. However, PrimoPDF might also print backwards, so that the \*.pdf you create has the pages in reverse order. If this happens, go into the “Options” from the printer dialog window in Word, choose the “Advanced” tab on the left, scroll down to find the Printing options, and uncheck the box for “Print pages in reverse order”.

Then, you MUST start all over with the signature page and re-do the \*.pdf!

Step 4: Finally, open the Word file which contains the body of your thesis. After you ensure the margins and page numbers are correct (no number on the first page of the Introduction, rest of the pages have regular numerals in the upper right) use PrimoPDF to append this to your existing \*.pdf.

That's it! You now have a single \*.pdf with all of your thesis, from signature page to the main body, and the numbering is correct throughout!

## APPENDIX B - COMMON PROBLEMS AND FAQ

**Common Problems** - Please read through the following list of common problems or mistakes made by students while writing a thesis:

- Reporting too many decimal points – only report one decimal place past the most significant value of data. For example, if data are whole numbers, the mean and standard deviations can only be reported as one place to the right of the decimal.
- Failing to report enough information about statistical analysis:
  - For most inferential stats, at a minimum the value of the test statistic (i.e,  $t =$ ,  $F =$ ,  $r =$ ), the degrees of freedom (df), and the p-value ( $p < xxx$ ) should be reported.
  - For descriptive stats, report a measure of central tendency (e.g., the mean), a measure of variability (e.g., standard deviation or standard error), and the sample size (n).
- Treating the word “data” as a singular noun, e.g., do NOT use “the data is clear...” but DO use “the data **are** clear...”; the singular of data is “datum”
- Creating a figure in color that does not print well in black and white (although this might no longer be an issue with electronic submission)
- Using inconsistent capitalization and justification of headings and subheadings
- Omitting a leading zero for numbers less than 1; for example, USE “0.003” do NOT use “.003”
- Repeating results in the **DISCUSSION** section. A common mistake in writing the **DISCUSSION** is to repeat statements from the **RESULTS**. The results need be interpreted in the **DISCUSSION**, not repeated.
- Cross-checking the text with the **LITERATURE CITED** to make sure all citations are listed in both places.
- Run spell check before submitting the thesis.
- Watch significant digits, don’t imply more precision than actually exists

***FAQ***

How long should my thesis be?

- Length will vary among theses and there is no limitation on the number of pages.

Do I need special paper?

- Nope, not any more. All theses are submitted electronically.

## **APPENDIX C – SAMPLE PAGES**

The following **SAMPLE PAGES** are provided as samples of some pages in a thesis. Some of these can also be found as templates in the MSWord format on the Biology Department's Graduate School web page.

### **SIGNATURE APPROVAL PAGE**

- Signed by oral exam committee after successful defense.
- The name of each member of the committee is typed underneath their signature (thesis advisor is the first signature).
- Scanned and added as very first page (un-numbered) of electronic version of thesis.
- Original signatures kept on file in Department office.
- Template is provided on web page.

### **TITLE PAGE**

- Entire page is in capital letters (NO bold, though).
- Each "section" on this page is separated by a short horizontal line.
- Although this page is considered "Page i" of the prefatory materials, it does NOT have a page number on it.
- Template is provided on web page.

### **ACKNOWLEDGMENTS**

- Starting with this section, each section begins with a section header which is in ALL CAPITALS, bold, and centered at the top of a new page
- This page is "Page ii" and has the page number centered at the bottom.
- If research was conducted under a permit, the permitting agency and permit number should be listed here. If research was approved by WIU's Institutional and Animal Use Committee (IACUC), that should be stated here as well.

### **ABSTRACT**

- The **ABSTRACT** should not be more than 2 pages long.
- This page starts as "Page iii" and has the page number centered at the bottom.

### **TABLE OF CONTENTS**

- At a minimum, include the section headings in the **TABLE OF CONTENTS**.
- If subheadings are included in the **TABLE OF CONTENTS**, all subheadings in the thesis should be included, with the exact same wording; simply copy and paste text.
- Although the bulk of the thesis is doubled spaced, the **TABLE OF CONTENTS** is single spaced.
- Use "tab stops" to line up the page numbers – the template on the web site is very useful

- This page continues the numbering from the **ABSTRACT** and has the page number centered at the bottom.

### **LIST OF TABLES**

- Although the bulk of the thesis is doubled-spaced, the **LIST OF TABLES** is single-spaced.
- Use “tab stops” to line up the page numbers – the template on the web site is very useful
- If the entire table caption is not included in the **LIST OF TABLES**, include enough of the caption to properly identify each table.
- This page continues the numbering from the **TABLE OF CONTENTS** and has the lower case Roman numeral page number centered at the bottom.

### **LIST OF FIGURES**

- Although the bulk of the thesis is doubled-spaced, the **LIST OF FIGURES** is single-spaced.
- Use “tab stops” to line up the page numbers – the template on the web site is very useful
- If the entire figure caption is not included in the **LIST OF FIGURES**, include enough of the caption to properly identify each figure.
- This page continues the numbering from the **LIST OF TABLES** and has the lower case Roman numeral page number centered at the bottom.

### **INTRODUCTION, MATERIALS AND METHODS, RESULTS, DISCUSSION. LITERATURE CITED, and APPENDICES**

- Headers for each of these sections should be ALL CAPITALS, bold, and centered at the top of a new page
- All pages except the first page of the **INTRODUCTION** should have the page number in the upper right hand corner

### **Tables**

- Captions of tables should state who, what, where, and when.
- Table captions are single-spaced and placed above the table.
- One blank line separates the caption from the table.
- A horizontal line should separate the caption from the table and a horizontal line should end the table. Footnotes are placed below the lower horizontal line.
- Tables should be centered as much as possible; note that the left margin is larger than the right margin, so the table will not be perfectly centered on the paper, but should be centered between the left and right margins.
- If a table is large, the text can be reduced to 10 points, but must in the same font as the rest of the text.
- If the table is rotated 90 degrees (landscape orientation), make sure the page number is still in the correct position in the upper right hand corner (pay attention to margins if putting a page in landscape orientation).

- If a table must span more than 1 page, use the same formatting as above but simply use “**Table xx (continued)**” in place of the caption.
- If tables are very small, no more than 2 can be placed on the same page.

### **Figures**

- Captions of figures should state who, what, where, and when.
- Figure captions are single-spaced and are placed below the figure, near the bottom of the page.
- Figures should be centered as much as possible; note that the left margin is larger than the right margin, so the table will not be perfectly centered on the paper, but should be centered between the left and right margins.
- The X- and Y-axis of a graph should have the variable name and unit of measure listed. For example, X-axis is labeled Time (sec) and Y-axis is labeled Frequency (kHz).
- If the figure is rotated 90 degrees (landscape orientation), make sure the page number is still in the correct position in the upper right hand corner (pay attention to margins if putting a page in landscape orientation).
- Only 1 figure per page.

### **LITERATURE CITED**

- Although the bulk of the thesis is doubled-spaced, the **LITERATURE CITED** is single-spaced with a single blank (single-spaced) line between each reference.
- Citations that span multiple lines should have a consistent hanging indent.
- Citations are in alphabetical order by the first author’s last name. Multiple citations by the same author are listed with the oldest reference first. Multiple citations by the same author in the same year must be delineated by lower case letters (e.g. “2008a” and “2008b”)

### **APPENDICES**

- Each Appendix should be clearly labeled with the type of information contained within the Appendix.
- Any tables or figures should continue to be numbered from the main body of the text (e.g. if the last Table in the text was Table 11, then the first Table in the Appendix is Table 12)

THIS THESIS HAS BEEN EXAMINED AND APPROVED:

Name \_\_\_\_\_  
Fred Smith  
Chair, Examining Committee

Name \_\_\_\_\_  
Jane Doe  
Member, Examining Committee

Name \_\_\_\_\_  
Lance Rock  
Member, Examining Committee

Date \_\_\_\_\_

A COMPARATIVE STUDY OF FISH COMMUNITIES ASSOCIATED WITH  
NEWBURY WEIR RIFFLES, NATURAL RIFFLES, AND POOLS IN JO DAVIESS  
COUNTY, ILLINOIS

---

A THESIS  
PRESENTED TO THE FACULTY OF  
THE SCHOOL OF GRADUATE STUDIES OF  
WESTERN ILLINOIS UNIVERSITY

---

IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE  
MASTER OF SCIENCE

---

BY  
JARED LEE WOODCOCK

---

DR. TIMOTHY W. SPIER, ADVISOR

2008

## **ACKNOWLEDGMENTS**

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## ABSTRACT

One problem impacting natural waterways and their watershed is sedimentation and erosion. In order to moderate the problem of bank erosion and sedimentation many bank stabilization techniques have been implemented. One such bank stabilization technique that has gained popularity of late is Newbury weir construction.

The structure is designed to neutralize stream flow (force) that leads to erosion, but creates habitat that resembles pool-riffles in natural streams. During low discharge water is stored above the riffle in a pool, which provides deeper water that is important for fish throughout their life stages. The riffles create obstacles and cause water to flow through narrow gaps between the riprap. Although these structures perform well at bank stabilization, little effort has gone into studying their effect on the stream biota.

An electric seine was used to assess species diversity and fish community similarities between Newbury weir riffle and pool habitats in four streams throughout Jo Daviess County, Illinois. A total of 3,706 fish representing 23 species from 6 families was sampled.

The data revealed no significant difference in species diversity between Newbury weir riffle and pool habitats; however there was a difference in species composition of the fish communities. This study demonstrates that different fish communities are utilizing and inhabiting the Newbury weir riffle and pool habitats, even though there is no difference in fish diversity throughout the streams. Without these riffle habitats created by the Newbury weirs, many of the fish species which are unique and have a limited distribution throughout Illinois would probably experience a decrease in numbers in these streams.

## TABLE OF CONTENTS

	Page
INTRODUCTION .....	1
MATERIALS AND METHODS.....	11
Study Area and Site Selection.....	11
Sampling Protocol.....	13
Fish Collection .....	16
Data Analysis .....	17
RESULTS .....	19
Simpson’s Index of Diversity .....	19
Community Analysis .....	22
DISCUSSION.....	31
LITERATURE CITED .....	36
APPENDIX A – SAMPLING SUMMARY.....	39
APPENDIX B- WATER QUALITY SUMMARY .....	52

**LIST OF TABLES**

Table		Page
1.	Stream Habitat Assessment Protocol (SHAP) averages and standard deviation for each stream in Jo Davies County, Illinois .....	20
2.	Water quality averages and standard deviation for temperature (°C), dissolved oxygen (ppm), conductivity (micro Siemens / cm), and pH for each stream in Jo Davies County, Illinois. ....	21
3.	Water Quality averages and standard deviation for temperature (°C), dissolved oxygen (ppm), conductivity (micro Siemens per cm), and pH for each stream .....	24
4.	Stream Habitat Assessment Protocol (SHAP) averages and standard deviation for each stream sampled.....	25

## LIST OF FIGURES

Figure	Page
1. The design and instructions for constructing a Newbury weir .....	8
2. Photo of a Newbury weir structure in Jo Daviess County, on 11 July 2006 at Scrub Creek in Jo Davies County, Illinois .....	9
3. The location of the Driftless Area throughout Illinois, Wisconsin, Minnesota, and Iowa, taken from the Driftless Area Initiative.....	12
4. The location of streams throughout Jo Daviess County and the location of the sampling sites using GIS software.....	14
5. The location of the watersheds throughout Jo Daviess County and the location of the sampling sites using GIS software .....	15
6. Simpson's Index of Diversity by habitat for each stream in Jo Davies County, Illinois .....	25
7. Simpson's Index of Diversity by habitat for all streams in Jo Davies County, Illinois .....	26
8. Non-metric Multidimensional Scaling plot of community composition as compared via Bray-Curtis within each stream in Jo Davies County, Illinois.....	28
9. Fish community similarity dendrogram constructed using Hierarchical Cluster Analysis based on Bray-Curtis .....	29
10. Non-metric Multidimensional Scaling plot of community composition as Compared via Bray-Curtis between the Newbury weir riffle and pool habitats in Jo Davies County, Illinois .....	30

## INTRODUCTION

Streams are very important throughout Illinois, and they provide many biological, recreational, and commercial resources for humans. Throughout every stream there are many different segments with different bed composition, riffles, pools, and runs, which provide different types of habitat for many different species (Cushing and Allan 2001). Both large and small streams are important for their role in the water cycle. For example, larger streams are used for commercial fishing and shipping, while streams of all sizes are used for recreational purposes such as canoeing, boating, swimming, and sport fishing (Krueger and Decker 1999).

### **Flow Rate**

There is no definitive definition for a stream; it can be used to define any lotic waterway (Illinois Department of Natural Resources Division of Fisheries 1996). There are, however, many characteristics that make up streams, and the biota found throughout them. The most important characteristic is the rate of flow, which is affected by the formation of the channel, the slope of the stream, sinuosity, and the presence of riffles (Cushing and Allan 2001). The rate of flow influences dissolved oxygen, water temperature, stream bed composition, forage, and pollution concentration (Stoker et al. 1972). The dissolved oxygen level and temperature are affected by the rate of flow because fast moving water keeps the stream aerated and causes more surface area which will allow for more evaporation. A rapid flowing stream will carry more debris away leaving cobblestone and gravel as the stream bed, but when the water is flowing slowly the stream bed is mostly silt and mud. The rate of flow will also affect the amount of

## MATERIALS AND METHODS

### Study Area and Site Selection

Jo Daviess County is located in the northwestern corner of Illinois; it is situated next to Wisconsin towards the north, the Mississippi River towards the west, and Carroll County and Stephenson County, Illinois towards the south and east. Jo Daviess County has a total area of 1,602 square kilometers. It is also located in the Wisconsin Driftless Section of the Central Lowland Physiographic Province. This area is the Coulee Region (Figure 3), which is known as the Driftless Area (McPeck 2005).

The Driftless Area is an area that escaped the Pleistocene glaciations, which causes the topography to be unique from the rest of Illinois and the Midwest. The topography of the Driftless area in Illinois is characterized by high rolling hills, wooded ridges, canyons, ravines, bluffs, cliffs, and some mounds (<http://www.inhs.uiuc.edu/cwe/rra/site1.html>). The Driftless Area extends northward into southwestern Wisconsin, northwestward into northeastern Iowa, and into southeastern Minnesota and has a total area of roughly 25,900 square kilometers (McPeck 2005).

Throughout Jo Daviess County, four streams (corresponding to McPeck (2005)) were selected for sampling. The landowners for each stream were contacted and permission was obtained to sample each stream. The first site was the West Fork of the Apple River, which has a watershed of 2,226 hectares and flows out of south Wisconsin in close proximity to the Apple River in Illinois. The second site was Irish Hollow Creek, which has a watershed of 1,497 hectares that drains parts of the southwestern corner of Jo Daviess County. The third site was Scrub Creek, which has a watershed of

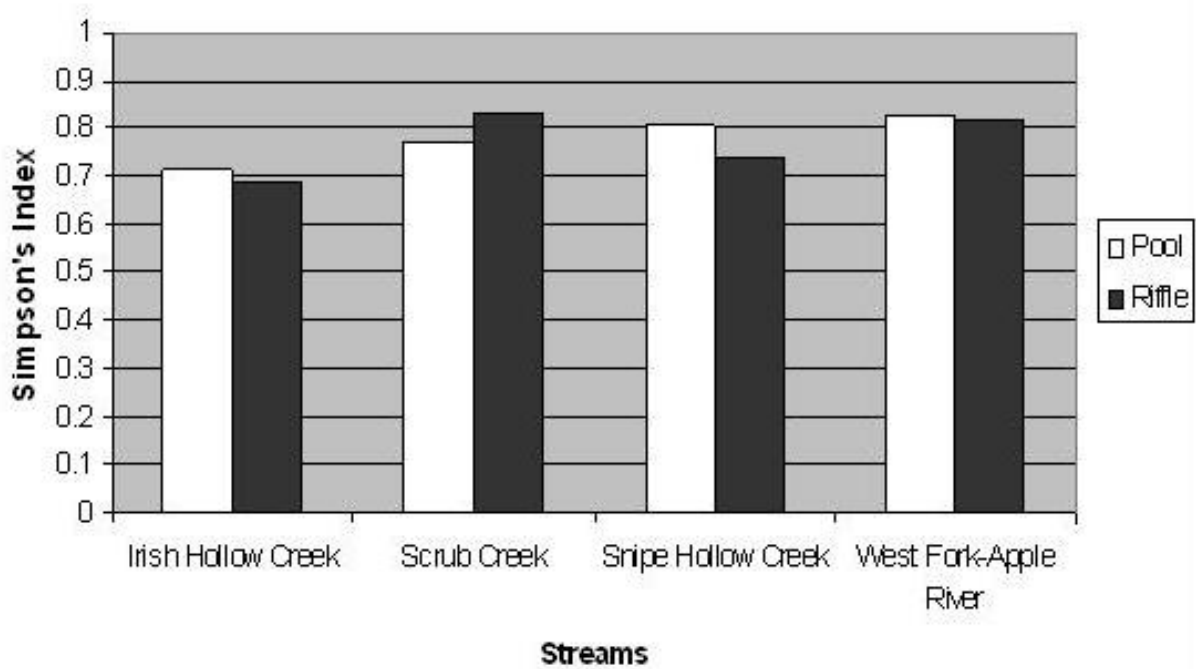
**Table 1.** Stream Habitat Assessment Protocol (SHAP) averages and standard deviation for each stream in Jo Davies County, Illinois.

Streams	Samples	SHAP Scores*
Irish Hollow Creek	8	117.4±(2.4)
Scrub Creek	8	109.9±(6.6)
Snipe Hollow Creek	4	132.8±(1.8)
West Fork Apple River	4	119.8±(1.8)

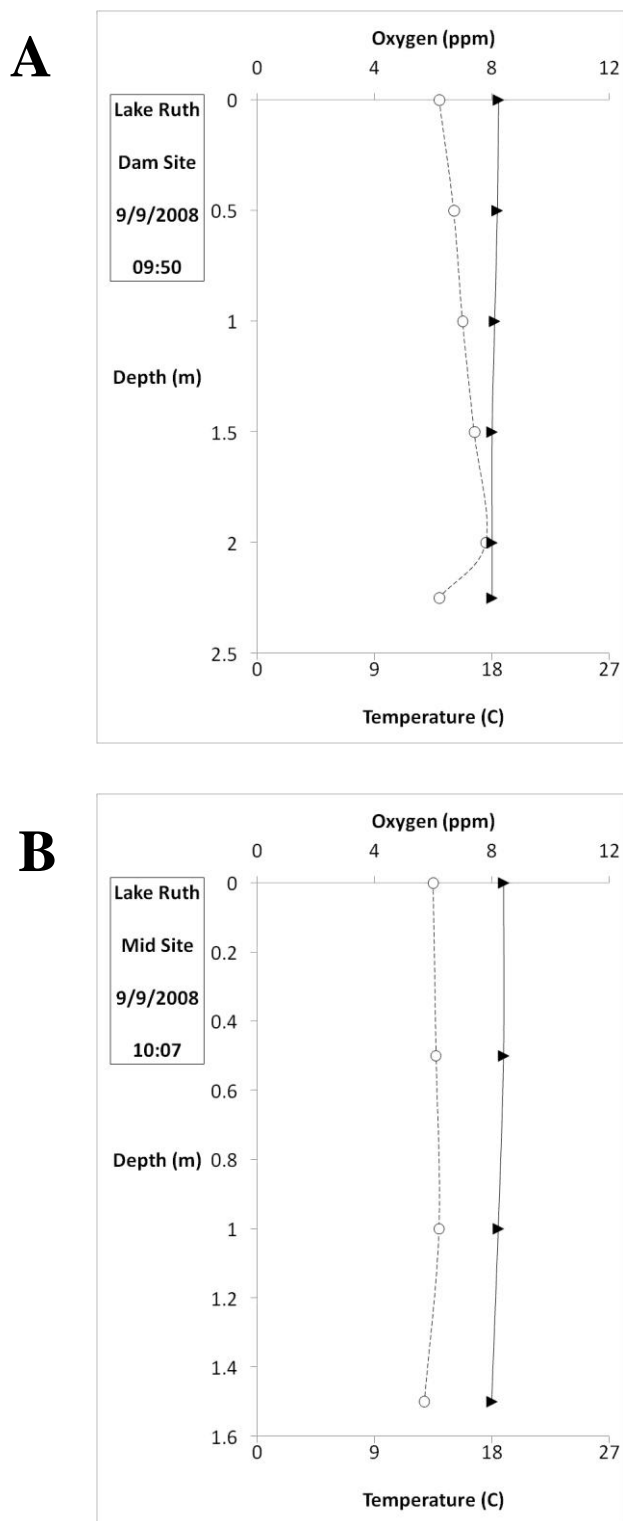
\*SHAP scores ratings: excellent is ( $\geq 142$ ), good is ( $< 142$  to  $\geq 100$ ), fair is ( $< 100$  to  $\geq 59$ ), and poor is ( $< 59$ )

**Table 2.** Water quality averages and standard deviation for temperature (°C), dissolved oxygen (ppm), conductivity (micro Siemens / cm), and pH for each stream in Jo Davies County, Illinois.

Streams	Samples	Temp.	Oxygen	Conduct.	pH
Irish Hollow Creek	20	18.93±(3.47)	7.99± (1.38)	620.3± (9.6)	8.09± (.42)
Scrub Creek	20	15.52± (1.69)	10.12± (.60)	782.3± (11.4)	8.27± (.24)
Snipe Hollow Creek	10	14.99± (2.02)	9.98± (.17)	627± (4.2)	7.87± (.16)
West Fork Apple River	10	20.17± (2.78)	7.31± (1.62)	745.5± (15.8)	8.18± (.16)



**Figure 6.** Simpson's Index of Diversity by habitat for each stream in Jo Davies County, Illinois.



**Figure 1.** Temperature (dark triangle) and oxygen (open circle) profiles from the Dam site (A) and the Mid site (B) of Lake Ruth on 9 September 2008.

## LITERATURE CITED

- Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. *Journal of Soil and Water Conservation* 54: 419-431.
- Bray, J. R. and J. T. Curtis. 1957. An ordination of the upland forest communities of southern Wisconsin. *Ecological Monographs* 27: 326-349.
- Brower, J. E., J. H. Zar, and C. N. von Ende. 1998. *Field and laboratory methods for general ecology*, 4<sup>th</sup> edition. WCB/McGraw Hill, Columbus, OH. 255 pages.
- Clarke, K. R. and R. M. Warwick. 2001. *Change in marine communities: an approach to statistical analysis and interpretation*. PRIMER-E, Plymouth, United Kingdom, 172 pages.
- Crandall, D. A., R. C. Mutz, and L. Lautrup. 1984. The effects of hydrologic modifications on aquatic biota, stream hydrology and water quality: a literature review. Illinois Environmental Protection Agency. EPA/WPC/84-001. Division of Water Pollution Control, Springfield, Illinois. 43 pages.
- Cushing, C. E. and J. D. Allan. 2001. Rivers as dynamic physical entities and abiotic factors. Pages 3-31 *in* C. E. Cushing and J. D. Allan, editors. *Streams: Their Ecology and Life*. Academic Press, San Diego, California.
- Frothingham, K. M. 2008. Evaluation of stability threshold analysis as a cursory method of screening potential stream bank stabilization techniques. *Applied Geography* 28: 124-133.
- Holtrop, A. M. and R. U. Fischer. 2002. Relations between biotic integrity and physical habitat in the Embarras River basin, Illinois. *Journal of Freshwater Ecology* 17(3): 475-483.
- Illinois Department of Natural Resources, Division of Fisheries. 1996. Rivers and streams. Pages 1-2 *in* FDM 6100 (Illinois Department of Natural Resources Manual of Operations), Springfield, IL.
- Illinois Department of Natural Resources, Office of Resource Conservation. 2002. Standard operating procedures for IDNR fisheries stream sampling. IDNR, Springfield, IL, 12 pages.
- IEPA, Division of Water Pollution Control. 1987. Illinois Environmental Protection Agency standards and specifications for soil erosion and sediment control. IEPA, Springfield, IL, 177 pages.

**APPENDIX A – SAMPLING SUMMARY**

**Table 20.** Species, scientific name, catch numbers, and catch per unit of effort (CPUE, number per hour) for all streams and habitat segments in Jo Davis County, Illinois.

Irish Hollow Creek- 7/11/2006			
<b>Section A- Pool</b>		<b><u>N</u></b>	<b><u>CPUE</u></b>
Southern Redbelly Dace	<i>Phoxinus erythrogaster</i>	1	3.45
Creek chub	<i>Semotilus atromaculatus</i>	29	100
Bluntnose Minnow	<i>Pimephales notatus</i>	36	124.14
Johnny Darter	<i>Etheostoma nigrum</i>	6	20.69
Central stoneroller	<i>Campostoma pullum</i>	4	13.79
Largescale stoneroller	<i>Campostoma oligolepis</i>	2	6.9
Blacknose Dace	<i>Rhinichthys atratulus</i>	6	20.69
Longnose Dace	<i>Rhinichthys cataractae</i>	6	20.69
<b>Section B- Riffle</b>		<b><u>N</u></b>	<b><u>CPUE</u></b>
Creek chub	<i>Semotilus atromaculatus</i>	11	45.99
Southern Redbelly Dace	<i>Phoxinus erythrogaster</i>	2	8.36
Central stoneroller	<i>Campostoma pullum</i>	9	37.63
Fantail Darter	<i>Etheostoma flabellare</i>	19	79.44
Largemouth Bass	<i>Micropterus salmoides</i>	1	4.18
Blacknose Dace	<i>Rhinichthys atratulus</i>	2	8.36
Longnose Dace	<i>Rhinichthys cataractae</i>	4	16.72
<b>Section C- Pool</b>		<b><u>N</u></b>	<b><u>CPUE</u></b>
Creek chub	<i>Semotilus atromaculatus</i>	32	137.14
Fantail Darter	<i>Etheostoma flabellare</i>	1	4.29
Johnny Darter	<i>Etheostoma nigrum</i>	4	17.14
Southern Redbelly Dace	<i>Phoxinus erythrogaster</i>	3	12.86
Common shiner	<i>Luxilus cornutus</i>	5	21.43
Blacknose Dace	<i>Rhinichthys atratulus</i>	2	8.57
Longnose Dace	<i>Rhinichthys cataractae</i>	5	21.43
Largemouth Bass	<i>Micropterus salmoides</i>	2	8.57
Bluntnose Minnow	<i>Pimephales notatus</i>	14	60
Central stoneroller	<i>Campostoma pullum</i>	21	90
Largescale stoneroller	<i>Campostoma oligolepis</i>	5	21.43