

Instructions and advice to the author of thesis work, PM, home exams, lab reports, literature work or similar at courses within EMG

Part I - Structure and Content

1 General

1.1 To whom do these instructions apply

These instructions apply for all written assignments that are handed in at the Department of Ecology and Environmental Science (EMG) if nothing else has been explicitly stated by the supervising teacher or course coordinator. The instructions are divided into three parts, and this first part pertains to structure and content. A checklist used for peer-review, done by a fellow student before your assignment is handed in, is also attached to these instructions.

1.2 Target group

The target group for your assignment is generally your fellow course mates. In certain cases, it may also be a potential external employer, though in such a case this will be made clear and specified by the teacher of the course. Word choice and vocabulary is to be adapted to suit your readers, which in this case means you can expect a certain knowledge and understanding of subject-specific terms.

1.3 Language

You may use either Swedish or English depending on what is agreed upon with your teacher. If you write in English, you may need to present your work in English. Keep in mind that the language use must be consistent, and that all terminology must be correct regardless of which language you write in. Your report needs to be written either in past or present tense. Past tense is generally most suited to describe the work you have conducted, while either past or present tense can be used to describe your data depending on the context. Please advise with your supervisor if you are uncertain regarding which tense to use.

2 Structure

A PM, report, or literature work (review?) should include the subsequent headings in the following order: i) Introduction, ii) Materials and Methods, iii) Results, iiiii) Discussion, and v) References. In some cases, it may be appropriate to include or exclude certain sections. For example, reports longer than ten pages should include an abstract and a table of contents. In certain cases, it may be justified to use appendices. Always consult your supervising teacher if you wish to digress from the structure presented above.

When you are writing your report, you must make sure there is a balance between the different sections, both regarding scope and the time you spend on writing them. The most important section as your report is always the discussion. It is this section you first and foremost should focus your work, both regarding time and scope. Your discussion should, for example, be longer

than your introduction. The scope, or length, of both your material and method section as well as your result section is dependent on the type of study you have conducted. These sections may be very short for simpler studies, or very extensive in more complex studies which use different methods and different types of data.

3 Contents of the different sections

3.1 Introduction

The introduction should briefly clarify why your study is of interest from a scientific perspective. The contents of this section should cover why the subject matter is interesting, what is currently known, or not known, about the subject matter as well as the current state of knowledge in the field, and what it is, concretely and specifically, that you intend to find out within the research question or questions you present i.e., what the purpose of your study is. The introduction is usually not divided into different subsections but is written as one cohesive section divided into logical paragraphs. Exceptions can be made if the introduction is very long. The scope of an introduction may of course vary, though a helpful guideline is to make sure your introduction does not exceed the length of your discussion. Also, keep in mind that your introduction is not meant to be a complete background on your chosen subject in which everything is covered. Instead, it should be tightly connected to your purpose and research question(s).

In the end of your introduction, the purpose of your study is to be presented. This is done in a separate paragraph which should start with the following phrasing: "The purpose of this study is to...". This paragraph is not to have a subheading. Purpose, research question(s), and hypothesis/es are closely linked and sometimes it may be difficult to know which is which. A purpose is often wider and less specific than a research question or hypothesis. The purpose is, for example, more general and not connected to a specific situation or place. However, a research question or hypothesis should always be clearly defined, and you should always be able to answer these from the data you present. This is not necessarily a requirement for your more general purpose. The difference between research questions and hypotheses is that research questions are more openly phrased, while hypotheses always should be phrased in a matter that allows them to be tried through your chosen methodology. Many times, a study has one purpose and one or more research questions, or one or more hypotheses. It is very rare that a study contains both research questions and hypotheses. Research questions and/or hypotheses should be presented in running text, and not as a formatted or numbered list. If you wish to present a given number of research questions you may do so through the above used listing of the report's different sections, i.e., i) research question 1, ii) research question 2 and so on.

The purpose, research questions and possible hypotheses should be clearly linked to the introduction. After reading the introductory paragraphs it should be abundantly clear to the reader why your study is interesting and how you have reached your purpose/research question(s)/hypothesis. If this is not clear, you either need to rephrase your purpose/research question(s)/hypothesis or develop your introduction to include and explain all necessary parts. To explain to readers why the question you are investigating is interesting and how you have developed your purpose, you need to start with a general background within which you refer to established research and knowledge in your chosen field. Because of this, the introduction is quite rich in references. In addition, you must also present the gaps in knowledge you intend to fill with your study and how this is connected to your research question(s) or hypothesis. This

part of the introduction narrows the more general perspective from the introduction's first part and focuses on one or a few more specific aspects of the subject matter. This part will also need references. Finally, you must be very concrete and present very clearly, exactly what you intend to do while conducting your study, which is to say, what your purpose is. Since this part, the purpose, should build on the previous parts, no references are generally needed.

The above stated requirements pertaining to the introduction result in it having to be focused on exactly what you want to be writing about. It is easy to include unnecessary information that you, and probably your readers as well, find interesting even though it does not have a direct connection to your study. If you intend to study what guides beavers' choices regarding the size of trees they cut down, the first part of your introduction probably needs to cover general theories on foraging. In the subsequent parts, you need to be more specific and examine beavers' choice of food and perhaps how they cut down trees. However, it is not relevant to include information regarding castoreum, since castoreum has nothing to do with beavers' foraging. Furthermore, it is probably not of interest to present the beavers' extinction in and later reintroduction to Sweden, however interesting it may be. Information like that may of course be relevant, though in that case the information must have a direct link to your research question(s). For instance, if you are examining something along the lines of if the beavers in Sweden originate from a group of beavers that exclusively ate tulips it may affect what that choose to eat today, it may be relevant.

3.2 Materials and methods

This chapter describes how the study has been conducted. Here, you describe which physical area has been studied, how sampling, field studies, interviews and/or surveys have been done, how you have analyzed your samples and which statistical methods you have used to process your data. This applies to both quantitative and qualitative data. If you use qualitative or semi-qualitative data, you also need to include references for the method or methods you have chosen to compile and analyze your data, as well as state any selection criteria you have used. If your methods chapter is long, it may be helpful to include subheadings, for example Object(s) of study, Sampling, Analysis, Data treatment/Statistics. Your description should be detailed enough to allow for the reader to reproduce your study.

Keep in mind, the methods section is not a lab manual or recipe which describes in detail how different tests or analyses have been conducted. The idea is that a person with knowledge in the subject area should be able to find all necessary information to be able to reproduce the study. It should, for instance, be clear which type of chemical you have used, including purity and concentration, though you do not need to describe exactly how you have diluted the solutions you use from a stock solution, or how you have measured the chemicals when you have dosed them. If you have used a methodology that has been published earlier, it is often appropriate to refer to those studies instead of repeating a long and complicated method that can be found in the literature.

Complete species names, including the scientific name, should be specified the first time a species is mentioned, e.g., Red campion (*Silene dioica* L.). Usually, the person who was first to describe the species is also mentioned. The L. in the example above means that Carl von Linné named the species. Write both genus and species in *italics*. In cases which your research question(s) demand it, you should also state size, age, origin, and other relevant information which may be of interest to someone aiming to repeat your study.

In the methods section, you should also describe how you have made sure your data is reliable. This is done, i.a., through presenting the results of the certified reference materials (CRM) that have been analyzed together with your other samples. You may also need to describe how you have calibrated your analysis equipment. The section in which you describe how you have treated your data, you may also include if and why you have removed any point(s) of data due to it being unreasonable for some reason, e.g., an error in analysis. Regarding the description of your statistical process, it depends on what you have done, but a minimum requirement is that you state which methods, which program, and which level of statistical significance you have used. If you have done the statistics by hand, you should state which literature you have used to conduct these calculations. However, you generally do not have to account for your null hypothesis or alternative hypothesis since they are commonly implied, as well as when they are rejected.

If your report includes experimental studies in a laboratory or in the field, where you in some way handle and/or manipulate vertebrae or octopi, you require an ethical permit to conduct animal studies from the Board of Animal Experimentation Ethics. This includes that anyone with a responsibility to do practical work with an animal undergoes and is approved for a course on animal testing ethics before the practical work included in the study can commence (See decision regarding "work requiring animal ethical permit" here; ask for help to read the document in Swedish http://www.emg.umu.se/digitalAssets/158/158008_beslut-150206-arbete-som-krver-djuretiskt-tillstnd.docx). It is your responsibility to check with your supervisor and the course coordinator that such a permit exists and that the permit applies to the type of study you are doing. Furthermore, your report should state that your study has an ethical permit by stating the diary number of the permit and the name of the permit holder.

If possible, organize your methods in the order they are used to answer the questions from the previous chapter. Also, consider that the most logical order to describe the different parts of your study may not necessarily be the same order in which you have done them. In the same manner, it is not always the case that the names you have given different samples in the field relate to how you use your data in the report. It may serve you well to change the names of the samples so they may correspond with how you present and use your data in the report.

3.3 Results

In this chapter, you present the results of your study. All your results should be reported in this chapter, and no results may appear outside this chapter without having been mentioned in the results. Feel free to use figures or tables to illustrate the results you are reporting, but do not forget to use words to describe what you want to illustrate in the figure or table. Figures and/or tables are a complement to the text, not the other way around. You cannot start a sentence with "In figure 1, one can see...". Instead, briefly explain what the figure shows and finish the sentence with a reference to the figure in parentheses (Fig. 1). The results chapter must contain explanatory text for any figures and tables, and a helpful guideline is that somebody should be able to read and understand the text without looking at the figure.

The results section usually contains few or no references, with exception of references to your own figures and tables. In some cases, it may be simpler to combine Results and Discussion into one chapter. If you are to combine these two, it is very important that you make clear what you present as your results and what is discussion. Consult your supervisor if you want to write results and discussion in the same chapter.

An important part of the scientific work is that all research data and results e.g., measurement values from field work or lab experiments, field or lab diaries, tape recordings or notes from interviews, etc. must be saved and made available to supervisors and examiners until the thesis is approved. Always check with your supervisor or the course coordinator how and where your data should be saved. Keep in mind that this does not only apply to the data you use in your report, but also to collected data that will not be published in the thesis. One thing that may be good to know is that all research data that is produced while you are connected to Umeå University is owned by the university and covered by the principle of transparency, which is to say that any official records or data tied to the university should be made available for public access. Personal data should be saved according to the rules for processing student reports FS.1.1-322-22.

3.4 Discussion

This chapter explains what the results you found mean in relation to the specific issues you presented in the introduction. Here, you address all the questions that you asked in your study's purpose, and it is through your discussion you create new knowledge. In the discussion, you interpret the results and put them in relation to previous studies. You may not include results from your study that are not mentioned in the results section of this chapter and at the same time all results from the results section that are relevant to your conclusions must be discussed. The focus of the discussion should be directed at your issues. which means that many of the references you have in the introduction will return here. New references are also likely to be needed to put your results into a larger context and support your interpretations. Similar to the introduction, the discussion should be reference rich and as a rule of thumb you can assume that anything not supported by your data should include a reference.

The discussion should include links between your and others' results, as well as a discussion of how your results compare to other alternative explanations of the results. You can also include some form of constructive criticism of your own work here. This may, for example, be about how reasonable or realistic some assumptions that have been made are and how it could impact the results if these assumptions are proven to be incorrect. However, you should not address things like incorrect analyses since this usually is treated in the method section. Avoid general remarks regarding the uncertainty of data and why it therefore is difficult to say anything with assurance. Also, be careful not to speculate too much concerning which relevance your results have for other questions. Instead, focus on the question(s) you have studied, or add another question in the introduction.

Please organize the discussion in the same order as you used in the chapters above. The discussion may well be concluded with a summarizing paragraph which connects your discussion with your introduction and your questions. Always make sure you have answered all your questions in you discussion, as well as in the possible summarizing paragraph. If there are alternative interpretations or answers, you should always try to consider which of them you see as the most probable one and argue why this is the case. The discussion is the most important section of your report, and it is here you should apply the most focus and effort. Try to write your discussion with clear cohesion, so that it may convey a connected and easily understandable representation of what you have concluded.

3.5 References

The purpose of references is that the person reading your report should be able to find all the facts that have been used in the text. In places where there are no references, the reader presumes that it is the author's own information. Because of this, there must be references for everything that is not your own information or results, if it is not common knowledge. For example, you do not need reference that supports that Stockholm is Sweden's capital. However, if you claim that Rönnskär is Sweden's largest source of lead pollution, this needs a reference if this is not a part of your study. If it is, you do not need a reference, although you should include a reference to a figure or table in which you present your data.

All references that are used in the text should be in the reference list, in the chapter "References" and vice versa. A reference list must be correct and clear. If it is not, it becomes difficult for the reader to find your sources. Please observe that there is a difference between the references *Andersson 2010* and *Andersson et al. 2010*. Furthermore, a reference usually only applies to the sentence in which it is written. You can, in other words, NEVER place a reference in the end of a paragraph with the purpose of having this reference apply to everything that has been written in that paragraph.

3.6 Appendices

Appendices are used for things that are too bulky or overwhelming to be included in the results and that is not necessary for the context. Examples of this can be raw data from different examinations, samplings, and interview or survey questions. If the data is needed to answer your research questions, it belongs in the results section. The appendices should be numbered separately, in the order they are mentioned in the text, and each appendix should have its own heading. The appendices are not included in the text's numbering, rather each appendix has its own numbering or none. If you have a table of contents, appendices should be stated in this, though they should not be included in the page numbering. Observe that if your teacher wants figures and tables to be placed last in your report, the reason being that your report is written as a manuscript and not a finished layout, these are NOT appendices.

4 Additions for student theses

Theses will, by and large, follow the same arrangement as the one presented above, with a few exceptions. Theses should include the following parts in the following order: i) Cover, ii) Abstract (including Key words), iii) Introduction, iv) Materials and methods, v) Results, vi) Discussion, and vii) References. In some cases, it may be warranted to include Acknowledgement(s) and Appendices. Always check with your supervisor if you want to diverge from this order. The following chapter presents the parts that are not usually included in reports but are specific to theses. All instructions mentioned above regarding structure and content in the introduction, materials and methods, results, discussion, as well as references are of course applicable for theses.

4.1.1 Cover and title

You can choose between two cover templates. These can be found here: <https://www.umu.se/student/ekologi-miljo-geovetenskap/blanketter-och-mallar/>. The title on the cover should always be written in the same language your thesis is written in. However,



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there should always be titles in both Swedish and English for the thesis. The title in the language your thesis is not in should be placed above the abstract.

4.1.2 Abstract

The report should contain an abstract in English consisting of not more than 250 words. The purpose of the abstract is to concisely summarize the most important aspects of the report/thesis, including background, methods, results, and their implications, with the aim of enabling a reader to quickly determine whether the report is relevant and should be read completely. The abstract should be used in the DIVA-database at the University library. The title of the report in English, title in the alternative language, the author's name, and the word Abstract (no numbering of the heading) should appear in that order on separate lines above the abstract. The abstract should be written as a single paragraph and should for the most part be written in the past tense as it describes completed work. The conclusions drawn from the results may be written in present tense, as the conclusions hopefully will continue to be valid for some time. There should be no tables, figures, or references to the literature in the abstract. Avoid using abbreviations that are not self-evident to a broad audience. If using such an abbreviation cannot be avoided, use the unabbreviated term the first time it appears in the abstract, followed by the abbreviation in parentheses, e.g., Dobzhansky-Muller incompatibilities (DMI). Avoid slang and jargon (e.g., call your work a "report", not a "paper").

The first sentences of the abstract should explain the purpose(s) of the study, i.e., why this is an interesting topic to address, followed by your specific aim of the study. Then you describe how the study was performed. Describe briefly both the study design and the methods and materials used. Do not write that a literature study was made, as a study of the literature is obligatory. The major focus of the abstract should be on presenting and discussing the results of your study. The abstract should end with a conclusion and the answer(s) to the question(s) posed in the introductory sentences or the implications of the results of testing your hypotheses. The words "Key Words" should appear below the abstract, followed by a list of no less than three and no more than five English terms or subject headings that characterize the study.

4.1.3 Acknowledgements

You may include an acknowledgement. Here, you thank those who have helped you during your work with your thesis. Acknowledgements are placed after the discussion and before the references.