Scientific Thesis BSc | MSc

Quick Guide

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This guide was compiled by Dr Saskia Otto and applies to both Bachelor's and Master's theses. Sections that apply only to Master's theses are marked with [MSc].

1. From Choosing a Topic to Submission

1.1 Initial Meeting and Topic Selection

Choosing a topic is the first and most important step in your thesis. Select a topic that genuinely interests you — real enthusiasm for your own research question is the best protection against frustration during difficult phases of work.

Which research group you write your thesis in is up to you. Often, research groups already have topics available, or supervisors welcome collaboration on an ongoing project. If you have a topic of your own in mind, approach the most suitable research group. Discuss your topic with your supervisor early on to ensure that it is appropriate in scope and complexity for your degree.

1.2 Preparation Phase

Before diving into the literature, an honest self-assessment is worthwhile. Ask yourself:

1. Which relationships and facts do you need to understand to address the topic?
2. Which of these have you already truly thought through?
3. Where do gaps in your understanding or knowledge remain?
4. What specific questions can be formulated to delineate these gaps?

Based on these questions, study the relevant literature and, if necessary, arrange a further meeting with your supervisor to clarify any questions that have arisen.

1.3 Writing a Proposal (Exposé)

Before the actual work begins, write a proposal (2–3 pages). This serves to structure and systematise your approach and lays the foundation for a successful thesis. The more carefully the proposal is prepared, the easier the subsequent work will be.

The proposal addresses the following **core questions**:

- What is the research area? What is the current state of knowledge? Which questions remain open?
- What is my specific research question and/or working hypothesis?
- Which methods and experimental approaches will I use to address the research question or test the hypotheses?
- What possible outcomes can be expected?

This leads to the following **structure**:

- Working title
- Problem statement and its relevance
- Research question(s) and, where applicable, hypotheses
- Brief overview of the current state of research
- Planned methodology
- Timeline with milestones
- Preliminary reference list

During this phase, literature databases should also be searched. It is advisable to start with the initial literature provided by your supervisor and the references cited therein. Important databases and search tools include:

- Web of Science — accessible off-campus via the Stabi portal or the UHH VPN client
- Google Scholar — broad coverage, citation counts as an indicator of relevance
- Electronic Journals Library (EZB) of the University of Hamburg
- ScienceDirect — journals from Elsevier, among others
- PubMed — particularly useful for biomedical and ecological topics

The proposal includes a timeline that fits the project within the available time frame.

Keep in mind: Empirical work often involves additional coordination efforts (e.g. laboratory time, ship time, permits) that are not entirely within your control. Plan accordingly and allow for generous margins.

1.4 Examiners and Second Review

You need two examiners for your thesis. The requirements differ depending on the degree:

- **Bachelor's thesis:** At least one examiner must belong to the group of university lecturers, or be a habilitated or doctoral member of the Department of Biology involved in the Bachelor's programme. The second examiner must be at least admitted to doctoral studies.
- **Master's thesis:** At least one examiner must belong to the group of university lecturers or be a habilitated member of the Department of Biology. The second examiner must hold at least a doctoral degree. Doctoral examiners without a teaching appointment under §64 HmbHG must apply for examination rights before the thesis is registered.

Arrange the second review early — ideally as soon as the proposal is ready, so that the second examiner has a clear basis for their decision.

1.5 Discussion, Approval and Registration

Discuss the proposal with your supervisor and make any necessary adjustments. Once the topic has been approved, register the thesis with the Student Office (Studienbüro): Fill in the registration form, have it signed by your examiners, and submit it via the contact form of the Studienbüro Biologie. You will receive a confirmation with the submission deadline, which you must acknowledge. Only then is your thesis officially registered and the processing period begins.

1.6 Prerequisites and Processing Times

Prerequisites for registration:

- Bachelor's thesis: at least 120 credit points (LP)
- Master's thesis: at least 60 credit points (LP)

Processing times:

- Bachelor's thesis: minimum 8 weeks, maximum 5 months after registration
- Master's thesis: minimum 5 months, maximum 6 months after registration

Final module:

- Bachelor's thesis: The thesis is assessed together with an oral examination (approx. 30 minutes). The oral examination may take place before submission but should be completed no later than 4 weeks afterwards.
- Master's thesis: The final module consists of the Master's thesis (90% of the module grade) and a colloquium (10% of the module grade).

In all cases, refer to the applicable examination regulations of your study programme (see Section 8).

1.7 Submission

The completed thesis is submitted as a single PDF file (max. 20 MB) via the contact form of the Student Office by the deadline. The submission date is determined by the ticket date. Important: Even within the submission period, you can only submit the thesis once — make sure you are sending the correct version. A printed copy is not required.

2. Structure of the Thesis

Scientific theses follow a fixed structure. Each section must be comprehensible on its own, even if the reader has not read the other sections. The thesis is structured as follows:

- Title page (according to the Student Office's specifications)
- Table of contents
- Summary / Abstract (for theses written in English, an additional summary in German is required)
- Introduction
- Materials & Methods
- Results
- Discussion
- References
- Acknowledgements (optional)
- Appendix (optional)
- Declaration of authorship (signed)

It is good practice to set certain goals for the text you are writing. Above all, this includes a clear structure: Design an outline with no more than three levels (e.g. 1.1.1). Before writing each subsection — at least mentally or during the planning stage — ask yourself what the following section of text is supposed to clarify. If you cannot answer this question, the section may not be justified.

3. Content of Individual Sections

3.1 Summary / Abstract

The summary is the showcase of your thesis. Anyone conducting a literature search will decide based on the title and abstract whether the work is relevant to them. It should therefore be formulated with particular care.

A good summary contains:

- An opening sentence explaining why the study was conducted
- The central research question or hypothesis
- The key methods (in one sentence)
- The most important results — concise yet comprehensible
- A closing sentence placing the results in a broader context

The summary does not contain citations, references to figures, or detailed results.

3.2 Introduction

The introduction takes the shape of a funnel: It starts by engaging the reader at a general level, draws them into the research area, and progressively narrows the focus until — ideally — the reader begins to ask the very question that is formulated in the final part of the introduction: the research question and hypotheses of the present study.

Recommended structure:

1. **General theoretical background** — only relationships relevant to the thesis. Do not cast the net too wide.
2. **Narrowing down to the specific topic** — What is the current state of research? What is known, what is not? Where are contradictions or gaps?
3. **Research gap** — What is unclear or contradictory? Why is the study necessary?
4. **Research question and hypotheses** — logically derived from the background.

Hypotheses must be testable and falsifiable. Distinguish clearly between the research question (What do I want to find out?) and the hypothesis (What do I specifically expect, and why?). Hypotheses are formulated before data collection, not adjusted to fit results after the fact.

Regarding literature in the introduction: Primary literature must be cited. Textbooks are not suitable as evidence but may be used for basic definitions. Where current review articles exist, these should be cited. Literature should not merely be paraphrased but analytically integrated: What does this study mean for your research question? Where do findings agree, and where do they contradict each other? Avoid long strings of citations without your own interpretation.

[MSc] In Master's theses, the state of research is expected to be not merely described but critically discussed. Identify gaps, contradictions, and methodological weaknesses in existing studies, and derive the necessity of your own study from these.

3.3 Materials & Methods

The methods must be written so that the study can be replicated without difficulty. All measurements and how they were obtained should be traceable. Methods that involve the problem of subjectivity (e.g. estimates, visual assessments) should be explained with particular care. In some cases, it is useful to describe materials (e.g. study area, study organisms) and methods in separate subsections.

Study design: Describe your study design explicitly:

- Which factors were investigated (independent and dependent variables)?
- How were samples selected (sample size, selection criteria)?
- Are there controls, and if so, which ones and why?
- How was replication ensured?

Pay particular attention to the distinction between biological and technical replicates — these are not the same, and confusing them (pseudoreplication) is one of the most common methodological errors.

Level of detail: A detailed description of well-established standard procedures is not necessary (e.g. how PCR works in general), but the specific parameters must be provided (e.g. primer sequences, annealing temperature, cycle number). For major instruments (e.g. sequencers, SEM, spectrophotometers), stating the type and manufacturer is sufficient. For standard equipment (centrifuges, PCR machines, water baths), this is not necessary. Software and R packages used must be listed with name and version and properly cited.

Statistics: Describe the statistical methods used and justify their choice:

- Which test was used for which research question?
- Whether and how the assumptions of the tests were checked (e.g. normality, homogeneity of variance)
- Which significance level was set
- Which software (including version) was used

[MSc] In Master's theses, it is expected that the choice of study design and statistical methods is justified, that the assumptions of the methods are discussed, and that robustness checks or sensitivity analyses are conducted where appropriate.

3.4 Results

The most important results should be presented in figures or tables. A useful guideline: A reader should be able to understand the results by looking at the figures alone. Nonetheless, all results must also be described in the text, with references to the corresponding figure or table. Data presented in tables and figures do not need to be repeated numerically in the text — instead, describe the patterns and trends.

The results section contains only results, not interpretations. Interpretations belong in the discussion.

Reporting statistics: For every statistical test, the following must be stated:

- The test name
- The test statistic with degrees of freedom
- The p-value

Example: "Species richness differed significantly among habitats (ANOVA, $F_{3,16} = 10.6$, $p < 0.01$)." The degrees of freedom follow the F-value: the first number refers to treatments, the second to the sample. In addition, effect sizes or confidence intervals should be reported where appropriate. A significant p-value alone says nothing about the biological significance of a result.

Presenting numbers: Do not report more decimal places than the precision of the measurement method allows. Example: The absorbance measured by spectrophotometer is 0.347; with an extinction coefficient of 0.83 L cm^{-1} mol^{-1}, this yields a concentration of 0.4180722891 mol L^{-1}. This suggests the highest precision — but only seemingly! The third decimal place of the absorbance measurement is already imprecise. Accordingly, reporting the first two to three digits is correct and meaningful, i.e. 0.42 mol L^{-1}. Complex ratios should preferably not be written with a slash (a/b·c) but in exponential notation (a b^{-1} c^{-1}).

3.5 Figures and Tables

Figures and tables are central elements of results presentation and should be prepared with particular care.

Basic rules:

- Table titles and captions are placed *above* the table.
- Figure titles and captions are placed *below* the figure (no figure headings above).
- Axes must be labelled with descriptions and units (in parentheses). Some software automatically uses the dependent variable as a graph heading — scientific figures do not have headings; instead they have a title below the figure and axis labels on the axes.
- A legend if multiple groups or symbols are used.
- Error bars where means are displayed, with indication of whether SD, SE, or CI.
- Consecutive numbering.
- Explained and referenced in the text.

Captions: The title and explanatory text of a figure or table must allow the viewer to grasp the content of the relationships presented.

- *Wrong:* "Fig. 1: Biomass as a function of temperature."
- *Right:* "Fig. 1: Modelled biomass (g C m^{-2}) of *Calanus finmarchicus* in the North Sea under three SST scenarios (RCP 2.6, 4.5, 8.5). Results of a size-structured population model driven by CMIP6 projections for the period 2050–2100. Shown are monthly means of total biomass with 95% confidence intervals from 1000 Monte Carlo simulations. Different letters indicate significant differences between scenarios within a month (Kruskal-Wallis test with Dunn's post-hoc correction, $p < 0.05$)."

Figures and tables are only integrated into the main text when they are directly referred to. Supplementary material belongs in the appendix.

3.6 Discussion

The discussion should begin with a brief summary of the most important results without repeating them in detail. This is followed by the contextualisation of individual findings: Compare your results with studies on the same species, on related species, or with studies that addressed similar questions in other organisms or on a theoretical basis. Ideally, you should synthesise the findings of earlier studies with your own results into an overall picture.

It is important to identify alternative explanations and, where possible, to rule them out through argumentation. It is generally unwise to "push" a favourite idea. Be sure to distinguish between compelling conclusions and speculation. Speculations must still be logical and justified, and must be clearly identified as such. The final section should address the significance of your results within the framework established in the introduction.

Important ground rules:

- Correlation is not causation. If your design does not allow causal inferences, phrase your conclusions accordingly.
- Do not over-interpret your results. A significant p-value does not automatically imply biological relevance.
- Non-significant results are not "negative" results — they can be equally informative and should be discussed.
- State limitations: What are the constraints of the study? What cannot be concluded?

[MSc] In Master's theses, it is expected that limitations are not only identified but that their consequences for interpretation are explicitly discussed. A critical reflection on the choice of methods is also expected: Could a different design have addressed the question more effectively? How do the assumptions of the methods affect the conclusions?

3.7 References and Citation

Why and what to cite: A statement is considered scientifically supported when it has been verified — for example experimentally — or substantiated through other forms of investigation in accordance with good scientific practice. This standard is ensured through publication in a peer-

review process. Therefore, wherever possible, original articles from peer-reviewed journals should be cited. Avoid citing from review articles, and never cite framing statements from an article's introduction.

Not citable: Wikipedia, lecture materials, other theses, and popular-science magazines. Use reference management software (e.g. Zotero, Mendeley, Citavi).

Reference list: The reference list includes all sources cited in the thesis — no more and no less. Entries must be complete: author(s), year, title, journal, volume, page numbers. For books: publisher and, where applicable, editor(s). The reference list is sorted alphabetically by surname. Follow the citation style of a journal in your field and apply it consistently.

In-text citation format:

- One author: "Oil palms are sensitive to waterlogging (Meier 2008)." Or: "As Meier (2008) observed, oil palms are ..."
- Two authors: "... (Meier & Müller 2009)." Or: "... as Meier and Müller (2009) already noted ..."
- More than two authors: "... (Meier et al. 2009)."

Reference list — examples:

Article: Meier P (2008) Herba inventa – a new species. Phytoerratica 22, 108–122. Meier P, Müller B (2009) Herba inventa – no new species. Phytoerratica 23, 100–111. Meier P, Lüdenscheid G, Müller B, Walter M (2009) Herba inventa – new interpretation. Phytoerratica 25, 212–213.

Book: Taiz L, Zeiger E (2006) Plant Physiology. Fourth Edition. Sinauer Ass. Sunderland.

Chapter in edited book: Lüdenscheid G (2012) Do we need a new definition of plant species? In: Walter M & Müller P. Plant Systematics. Springer Verlag, Berlin, 289–310.

References belong in the reference list at the end of the document, not in footnotes.

3.8 Declaration of Authorship

The thesis must include a signed declaration stating that it was written independently and only with the resources indicated. Follow the exact requirements of your examination regulations. Plagiarism — the use of others' ideas without proper attribution — results in a failing grade.

4. Language and Style

Only a well-written text will be read with pleasure. The quality of writing contributes significantly to how a thesis is perceived. Nonetheless, a scientific thesis is a sober report. The thesis may be written in either German or English.

Emotional evaluations such as "unfortunately" or "regrettably" have no place in a scientific text. All descriptions relating to your own experiments and results should be written in the past tense. Generally accepted facts and established knowledge are written in the present tense.

Do not start a new paragraph for every new sentence. Instead, aim to write fluent, logically coherent text. Avoid footnotes, excessive use of parentheses, and overly long sentences. Practise expressing ideas precisely in short, clear sentences. Pay attention to the logic of your statements and check that references are accurate.

It is a widespread tradition to write scientific texts in the passive voice. The passive is often stylistically cumbersome and has the drawback of obscuring not only authorship but also responsibility. An active style makes it clearer whether you achieved a result or are reporting the results of others.

The text should contain only complete sentences; bullet-point lists belong in tables. Direct questions are unusual in running text but are perfectly acceptable in titles. Careful proofreading for spelling and punctuation should go without saying.

5. Formatting

The Department of Biology does not prescribe specific requirements for page counts, fonts, line spacing, margins, or citation styles. Discuss the details of formatting with your supervisor.

As a recommendation: font size 12 pt, Times New Roman, 1.5 line spacing, margins 2.5 cm (top 2.5 cm, bottom 2.0 cm). Do not forget page numbers.

The title page must follow the specifications of the Student Office (title, name, date of birth, study programme, year of publication, names of examiners). The official specifications can be found here:

- Bachelor's thesis: Formal requirements for Bachelor's thesis (PDF)
- **[MSc]** Master's thesis: Formal requirements for Master's thesis (PDF)

6. Differences Between Bachelor's and Master's Theses

Criterion	Bachelor's Thesis	Master's Thesis
Prerequisite	min. 120 LP	min. 60 LP
Processing time	min. 8 weeks, max. 5 months	min. 5 months, max. 6 months
Final module	Thesis + oral exam (30 min)	Thesis (90%) + colloquium (10%)
Examiners	min. 1 with doctorate at Dept. Biology	min. 1 habilitated at Dept. Biology
Independent research	Not necessarily expected	Expected
Choice of methods	May be prescribed	Must be justified
Hypotheses	May be simple	Must be derived from the literature
State of research	Descriptive	Critical; identify gaps and contradictions
Discussion of limitations	Identifying them is sufficient	Discuss consequences for interpretation
Use of literature	Accurately reproduced	Critically contextualised and synthesised
Reflection on methods	Not necessarily expected	Discussion of alternatives and assumptions
Originality	Low weight	Expected (new application or perspective)

7. Common Mistakes

- Hypotheses that are not testable or were formulated only after seeing the results

- Missing or insufficient description of the study design (no sample size, replication, or controls stated)
- Confusion of biological and technical replicates (pseudoreplication)
- Statistical tests performed without checking assumptions
- p-value interpreted as a measure of biological significance
- Correlation presented as causation
- Results merely repeated in the discussion rather than contextualised
- Literature only paraphrased rather than analytically integrated
- Figures without axis labels, units, or error bars
- Spurious precision through too many decimal places
- Inconsistencies between sections (e.g. methods describe analyses that do not appear in the results)
- Conclusions that go beyond the results without being identified as speculation

8. Useful Tools and Resources

8.1 Examination Regulations

The binding rules on registration, processing times, examination modalities, and formal requirements can be found in the applicable examination regulations:

- Bachelor's thesis: Examination regulations BSc Biology (PDF)
- **[MSc]** Master's thesis: Examination regulations MSc Biology (PDF)

8.2 UHHthesis - Templates

To automatically meet the University of Hamburg's formal requirements for the title page, formatting, and structure, two templates are available:

- **UHHthesis (R package):** An R Markdown / Bookdown template that produces both PDF and Word output. The template already includes the correct page layout, fonts, table of contents, and the declaration of authorship. Available on GitHub: https://github.com/uham-bio/UHHthesis
- **quarto-UHHthesis (Quarto extension):** The newer variant for the Quarto publishing system. Recommended for new projects, as Quarto supersedes R Markdown and offers additional features (including native support for Python, Julia, and Observable). Available on GitHub: https://github.com/uham-bio/quarto-UHHthesis

Both templates generate reference lists automatically from `.bib` files (BibTeX format). The citation style is controlled via a `.csl` file and can easily be swapped (e.g. for the style of a journal in your field). A large collection of CSL files can be found at https://github.com/citation-style-language/styles.

8.3 Reference Management

From the very beginning, it is advisable to use a reference manager for organising, sharing, and citing scientific articles:

- Zotero — free and open-source, good integration with browsers and word processors
- Mendeley — free account with cloud storage, good PDF management
- Citavi — available free of charge via the UHH campus licence (Windows only)

All three programmes can export `.bib` files for direct use with the templates listed above.

8.4 Further Links

- Formal requirements for Bachelor's thesis title page: PDF
- **[MSc]** Formal requirements for Master's thesis title page: PDF
- UHH VPN access (for off-campus database access): https://www.rrz.uni-hamburg.de/services/netz/vpn.html
- Bookdown manual (basis of the UHHthesis template): https://bookdown.org/yihui/bookdown/
- Quarto documentation: https://quarto.org/docs/guide/