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Laboratory of Applied Ecology

Research proposal

a guideline for master and
doctorate candidates



April 2019

Research proposal

a guideline for master and doctorate candidates

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INTRODUCTION

The World Bank has reported an increase (from 0.44 % in 2003 to 0.72 % in 2012) in the performance (quantity and quality) of the research outputs in Sub-Saharan Africa over the past decade (World Bank Group 2003; World Bank Group 2013). This increase however accounts for less than 1 % of the world's research outputs compared with its share of global population that is at 12 %. This regrettable situation is mainly due to the limited capacity to conduct high standard research. Moreover, with the world's increasingly complex problems and resource limitations, there is urgent need of scholars who are qualified to train the next generation of professionals and to expand society's store of knowledge. Society needs critical minds trained at advanced level with skills and competencies in creating new knowledge and in analyzing the environment. Indeed, at the end of their Master of Science or Doctorate training, graduates should be able to conduct excellent scientific research in various scientific fields. They are also expected to apply theories to a research problem and write good and relevant research proposals and dissertations or thesis within the chosen area of specialization; and to apply the acquired knowledge, competencies and skills in writing scholarly papers and publish in peer review journals.

Regarding the urgent need for capacity building in scientific production, appropriate actions have to be

conducted. The first step of a given research study is the establishment of the research proposal. This document focused on research proposal in order to allow graduates or scholars mastering this first step that is essential for an excellent research production. Therefore, the present document provides guidelines for writing an excellent and relevant research proposal at MSc as well as at PhD level. Writing a meticulous proposal will help students establish the groundwork for their research study. It will also help them pre-empt any problems they may experience during the course of their writing and research.

This guideline for research proposal writing is intended to harmonize the conduct of research (by students) and supervision (by supervisors). This guideline provides a standard format for research proposals writing by students at the Universities of Abomey-Calavi. Both the students and the supervisors should therefore carefully comply with this guideline.

DEFINITION, FEATURES AND PURPOSE OF A RESEARCH PROPOSAL

According to Capdevielle *et al.* (2008), a research proposal is the statement of conditions and rules for conducting a scientific experiment. It is in general a document of maximum 3000 words or 20 pages, which gives an opportunity for the researcher to communicate his/her passion in the subject area and to make a persuasive argument about what the research can accomplish. It is also a document that provides a work plan (a sort of road map), orders in time and space the research ideas logically expressed, represents an evaluation reference, and gives an exchange of ideas' opportunity with other researchers.

Table 1 presents the main expectations of a well-written research proposal. A research proposal shall show a very clearly stated research idea, question or problem, and may address a demonstrable gap in the existing literature. The research proposal must build a strong persuasive argument, and convinced the supervisor or the mentor affiliated to the work. A research proposal shall be well structured since poorly formed or rambling proposals indicate that the proposed research may suffer the same fate (ICBSU Uganda 2013). Research proposals are assessed not only for their intellectual ambition and significance, but also for the likelihood that the researcher can complete this study

in the timeline (ICBSU Uganda 2013; Strauss *et al.* 2018). It can occur that supervisors or mentors may not necessary be experts in the research study field and it is up to the researcher to make the study project and subject matter engaging to his/her readers.

The main purpose of a research proposal is to demonstrate that (i) the person intending to do research (the student/ researcher) has a clear and systematic conceptualization of the research problem and the research process; and (ii) that she/he has done adequate reading and is informed about recent work done in the area of interest. It is important to keep in mind that ***“Just because it has not been done before is no justification for doing it now”*** (Peter Attiwill, Editor-in-Chief, *Forest Ecology and Management*) (Elsevier 2014).

Table 1: Expectations vs Unexpectedions of a research proposal

Wanted	Not wanted
Originality	Duplications
Significant advances in field	Reports of no scientific interest
Appropriate methods, case studies and, conclusions	Work out of date
Readability	Inappropriate/incomplete methods or conclusions
Studies that meet ethical standards	Studies with insufficient data

STRUCTURE OF A RESEARCH PROPOSAL



Preliminary pages



Cover Page

The cover page (Figure 1) should have the following:

- university of registration, lab
- title/topic of the study,
- student's names and registration number (optional),
- names and titles of supervisors,
- statement about the purpose of the proposal like
- month and year of submission.

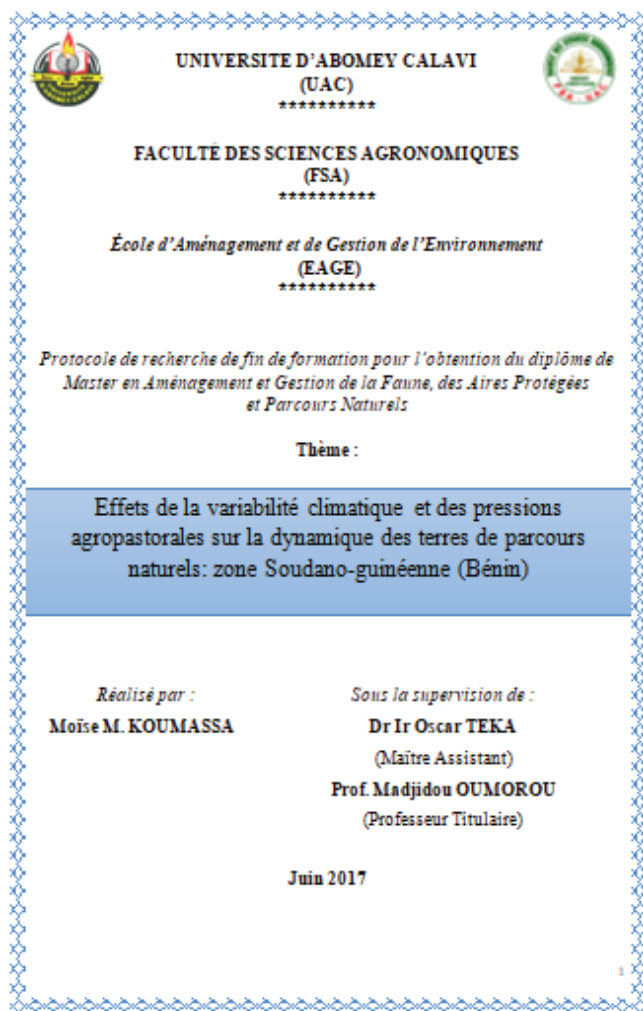


Figure 1: An example of research proposal cover page

Source : MSc Dissertation (Koumassa 2017)



Title

A good title/topic should contain the **fewest** possible words (20 words maximum) that **adequately** describe the contents of the research proposal (Figure 2).

 	 
• Be specific • Be concise • Be complete • Attract readers • Reflecting what your research is about	• Use unnecessary jargon • Use uncommon abbreviations • Use ambiguous terms • Use unnecessary detail • Focus on part of the content only

**Ecology of isolated trees in
tropical savannahs: modelling of
plant species distribution and
colonization of new habitats
through long-distance
dissemination and facilitation**

GOOD TITLE ?

True ☐ or False ☐

Explain :

.....

.....

.....

.....

.....

.....

Figure 2: An example of research project title 1

**Ethnobotany and Ecology of
Mimusops andongensis Hiern
and *Mimusops kummel* Bruce
Ex A. DC: implications for their
management and conservation
in Benin (West Africa)**

GOOD TITLE ?

True ☐ or False ☐

Explain :

.....

.....

.....

.....

.....

.....

.....

Figure 3: An example of research project title 2

**Socio-economic importance
and study of the ecological,
morphological, genetic and
biochemical variability of
Baobab (*Adansonia digitata* L.)**

GOOD TITLE ?

True ☐ or False ☐

Explain :
.....
.....
.....
.....

Figure 3: An example of research project title 3

■ Table of content

A table of contents should:

- list the research proposal sections in a hierarchical way, using titles and subtitles,
- give accurate page references for each section.

It can be followed if necessary by the lists of figures and tables.



Abstract

The abstract or summary should answer the why, what, how, and when of your research study. It often requires several drafts and is not written first (Strauss *et al.* 2018). The quality of an abstract may strongly influence supervisor(s) assessment of the proposed study. A good abstract should:

- be **precise** and **honest**;
- **stand alone**;
- use **no technical jargon**;
- be **brief** (250 - 300 words) and **specific**;
- **minimize** the use of **abbreviations**;
- cite **no references**.

Example of traps to avoid in an abstract: “The present study will show an innovative set of tools developed to support a methodology to design and upgrade wastewater treatment systems **(WTS)**. Previous work by **Grey (2004)**, **Lacey (2001) and others** ...This study will illustrate the merits of these tools to make the innovative methodology of interest to **everyone** involved in **WTS** and will become the **new design standard worldwide**.”

Abstracts also include **keywords**, which are important for indexing, enabling your proposal to be more easily classified. Keywords should also be specific (3 - 5 words), may avoid uncommon abbreviations and general terms, and avoid also copying words from the title (See after).

Impacts of land use types on spatial patterns and neighbourhood distance of the agroforestry palm *Borassus aethiopum* Mart. in two climatic regions in Benin, West Africa

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Received: 12 September 2016 / Accepted: 5 February 2018
© Springer Science+Business Media B.V., part of Springer Nature 2018

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diversity of farmlands' functions and services. Further studies should examine whether the observed increased ND due to human-disturbances in farmlands is detrimental for the species pollination services, fruit production and whether it affects the species spatio-temporal population genetic structuring.

Keywords Climatic conditions · Anthropogenic pressure · Impacts · Spatial pattern · Point pattern process



Keywords: impacts, Benin, spatial patterns, climate, *Borassus aethiopum*



There exist three main types of abstract (see below):

- **Indicative (descriptive) abstracts:** They outline the topics covered in a piece of writing so the reader can decide whether or not to read on. Often used in

Review



Received: 25 February 2017

Revised: 7 July 2017

Accepted article published: 21 July 2017

Published online in Wiley Online Library: 12 September 2017

(wileyonlinelibrary.com) DOI 10.1002/jsfa.8568

Indigenous food ingredients for complementary food formulations to combat infant malnutrition in Benin: a review

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Abstract

This paper reviews indigenous Beninese food resources as potential ingredients for complementary infant foods with the aim to develop affordable formulations for low-income households in each agro-ecological zone of the country. Potential ingredients were selected on their documented nutritional value. The selected foods encompass 347 food resources, namely 297 plant products from home gardens or collected from natural vegetation and 50 animals, either domesticated or from the wild. The compiled data reveal that the distribution of the available food resources was unbalanced between agro-ecological zones. Only a few animal ingredients are obtainable in northern Benin. Most resources are seasonal, but their availability may be extended. A high variation was observed in energy and nutrient contents. Antinutritional factors were identified in some resources, but processing techniques were reported to reduce their presence in meals. In general, ingredients from local tree foods (*Adansonia digitata*, *Parkia biglobosa*) were adequate as sources of nutrients for complementary infant foods. Based on this review, local foods for the development of complementary food formulas for Beninese infants and children may be selected for each agro-ecological zone. The approach used is exemplary for other sub-Saharan African countries in need of complementary infant foods.

© 2017 Society of Chemical Industry

Supporting information may be found in the online version of this article.

Keywords: local food resource; infant food; standards; nutritional value; Benin

- **Informative abstracts:** They summarize the study based on the research proposal structure (problem, methods, expected results, work plan), but without section headings.

Impacts of land use types on spatial patterns and neighbourhood distance of the agroforestry palm *Borassus aethiopum* Mart. in two climatic regions in Benin, West Africa

Valère Kikawolé Salako  · Christel Kénou · Kasso Dainou · Achille Ephrem Assogbadjo · Romain Glèdè Kakai

Received: 12 September 2016 / Accepted: 5 February 2018
© Springer Science+Business Media B.V., part of Springer Nature 2018

Abstract Spatial pattern (SP) and neighbourhood distance (ND) of trees are crucial for pollination services, in particular for dioecious species. However, land use types through human disturbances may affect the natural SP and ND and possibly have a negative effect on pollination services. Though several studies have focused on the effect of land use types on SP of trees, few have reported on ND. In this study, we compared SP and ND of the dioecious *Borassus aethiopum* Mart. between two land use types (protected areas vs farmlands) in two contrasting climatic regions (semi-arid vs sub-humid) in Benin. Trees were mapped in twelve plots from six populations. Pair-correlation function was used to generate univariate and bivariate SP and ND. Next, ANOVA was used to compare ND. While supporting the overall trend

towards a less aggregated pattern along plant life-cycle, the study showed that the SP of *B. aethiopum* was altered from aggregated and spatial association in protected areas toward random and independence patterns in farmlands with increased ND among individuals, particularly between adult males and females. In addition, differences in ND between land use types varied across climatic regions, the differences being higher in the drier semi-arid region, thus suggesting more intense human activities in this region and climatic region-specific management. Management actions should mainly aim at reducing or not further increasing ND, particularly between female and male adult populations in farmlands in the semi-arid region through planting new individuals of *B. aethiopum* trees or limiting their removal but at the same time account for other tree species to maximise diversity of farmlands' functions and services. Further studies should examine whether the observed increased ND due to human-disturbances in farmlands is detrimental for the species pollination services, fruit production and whether it affects the species spatio-temporal population genetic structuring.

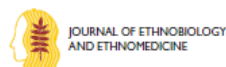
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Keywords Climatic conditions · Anthropogenic pressure · Impacts · Spatial pattern · Point pattern process

- **Indicative (descriptive) abstracts:** They outline the topics covered in a piece of writing so the reader can decide whether or not to read on. Often used in

Gouwakinnou et al. *Journal of Ethnobiology and Ethnomedicine* 2011, **7**:8
http://www.ethnobiomed.com/content/7/1/8



RESEARCH

Open Access

Local knowledge, pattern and diversity of use of *Sclerocarya birrea*

Gerard N Gouwakinnou^{1*}, Anne Mette Lykke², Achille E Assogbadjo¹, Brice Sinsin¹

Abstract

Background: Growing interest is on food tree species in general, and particularly Indigenous fruit tree species in developing countries since they are inherent to most tropical landscapes and serve the dual function of local livelihood support and biodiversity conservation. It is therefore relevant to assess the level of integration of these species in local cultures and the factors affecting them. This study aims at assessing knowledge and uses of *Sclerocarya birrea* subsp. *birrea* and factors affecting the use values within and between communities.

Methods: This study combines quantitative and qualitative ethnobotanical approaches to investigate uses and factors affecting the use value of *S. birrea* subsp. *birrea*. Nine group discussions as well as 161 individual interviews were held in the dry and typical Sudanian zones. Seven different ethnic groups were involved and the survey focused on local uses and perception of factors affecting the dynamics of *S. birrea*.

Results: The species has a multitude of uses; all organs are used for more than 20 different purposes. The study highlights how gender, local availability, ethnicity and community location interact to influence the utilization value of the species. People living in drier areas with high occurrence of the *S. birrea* use it more than those living in wetter areas with low occurrence. While domestic and subsistence uses do not appear to threaten the species, carving, clearing and drought stand out as the major causes of its decline.

Conclusions: Many factors and their interactions influence the use pattern of the species within and between communities. When compared to the level of exploitation of *S. birrea* subsp. *caffra* in southern Africa, the subspecies *birrea* is at this point relatively underutilized. A high commercial potential exists due to its simple propagation ability and makes it an interesting agroforestry resource.

Background

Growing interest is on food tree species in general, and particularly indigenous fruit tree species in devel-

oping a framework for its sustainable use based on local demands [2]. Previous studies have revealed that both consumptive and non-consumptive values derived



Introduction

The Introduction section is essential for any research document. It generally prepares the readers to the information they may gain from the document. Without an introduction, you can leave your reader feeling disoriented and confused. Consequently, there is a high risk that these readers, in turn, leave you and your research proposal in order to go read something else that doesn't make them feel that way. It should be constituted of three main subsections: background and statement of the problem; objectives; and hypotheses. The wrap up of essential features of a good introduction is presented in Table 2 in page xxx.



Background and statement of the problem

The background section may deal with the rationale providing evidence and conditions of the existing situation to make the reader feel the urgency of the problem and the need to study it in order to solve it or contribute to its solution. It may be an attempt to persuade, inform or indicate to the reader of the need for the research. The background must masterly demonstrate the subject to be investigated by the student. This masterly is demonstrated among others by the currency of the citations made. The student's articulate understanding of empirical studies done at the global,

regional and national context in relation to the study area is very critical to show the student's knowledge base. The section must demonstrate that the student is aware of the historical evolution and theoretical developments of the proposed study area. It must be consistently and carefully written. For that, the background should start by providing information that orientates the reader to the research's general contexts (socio-political, historical, scientific, and educational). Then, the specific context of the study may be presented. All this can be accomplished by providing a frame of reference, a definition, or a discussion of the significance of the topic in the field (see Appendix 1).

A problem statement can be a theoretical problem or on the state of nature. The author must be clear on which of these problems is to be investigated. A problem is the heart of the research and must show the urgency why the study has to be conducted. Four basic qualities of the research problem (Amin, 2005) need to be emphasized:

- researchable,
- theoretically or practically significant (should contribute to the improvement of knowledge),
- clear and
- ethical.

The author should avoid giving the symptoms of the problem but must give the real problem of the research. The statement of the problem must clearly define the

variable(s) and show the relationship(s) / issue(s) that will be investigated. Reference should be made to the problem that has been detected and needs a theoretical and practical solution, the nature of the problem and its known or estimated magnitude or extent should be clearly stated where practically possible (see Appendix 1). Students are guided to rely on the use of facts like statistical information or citations from known scientists in the author's field of research in a brief, specific and concise manner. Such facts may be used to highlight the magnitude or extent of the problem. Major previous researches undertaken on the subject should be cited (where applicable in case of theoretical problems) and this will enable the candidate to indicate the gaps in the knowledge and justifies the need for the proposed study. The statement of the problem should be concise (a half page may be enough). A common problem in research proposals is for the author to delay too long in stating the specific research problem. The author has to make sure the research problem is stated no later than the end of the second or third paragraph, and that it is fully stated in one place.

Table 2: Essential things to do and avoid in an introduction

Do	Do Not
"Set the scene"	Write an extensive review of the field
Outline "the problem" and hypotheses	Cite disproportionately your own work, work of colleagues or work that supports your findings while ignoring contradictory studies or work by competitors
Ensure that the literature cited is balanced, up to date and relevant	Describe methods, results or conclusions other than to outline what was done and achieved in the final paragraph
Define any non-standard abbreviations and jargon	Overuse terms like "novel" and "for the first time"

📌 Research question

What is a research question?

A research question is a section of a research proposal that sets out the framework and the specific terms of inquiry needed to address the research problem. Research questions are drawn to reflect the nature of the research problem under study.

Examples of quantitative research questions

- **Eventual cause/effect assessment:** Does the adoption of new agricultural technologies have significant effect on crops production performance?
- **Use of theories for explanation:** Does the adoption of new agricultural technologies have significant effect on the comparability of smallholder farmers' financial statement?
- **Assessment of differences and magnitude:** Has the adoption of new agricultural technologies received significant acceptance among local communities in Benin?)

Examples of qualitative research questions

- **Interpretive:** Do local communities consider the adoption of new agricultural technologies important?
- **Process oriented.** Did the attitude of local

communities over the adoption of new agricultural technologies improve over time?

How important are research questions in a research proposal framework?

The research question section is often considered as the most critical part of a research proposal. It defines the proposal, it guides your arguments and inquiry, and it incites interests of the reader (supervisor/reviewer). If your research questions do not work well, no matter how strong the remaining of the proposal is, the proposal is unlikely to be successful. Therefore, it is highly required to spend considerable time on the researching, conceptualizing and forming of each individual word of the research question.

How can you state successful research questions?

To write a strong research question you will need time. Step away from your computer; consider what drew you to your topic. What about it animates and matters to you? Listen to yourself and start formulating your question by following your own interests. Remember, you will spend a lot of time researching and writing about the proposed project: if it does not interest you in the beginning, it will certainly become very difficult to write about in the end.

Next, extensively research your topic. What have people said about it? How have they framed their research? What gaps, contradictions, or concerns arise for you as you read, talk to people, and visit places? After you have done this you can go back to your computer or note pad and start crafting the question itself. When you do, consider that a strong research question should be evocative, relevant, clear, and researchable.

- **The research question should be evocative**

Evocative questions are ones that catch the interest of the reviewer and draw her/him into the proposal. Equally important, they easily adhere in the reviewers' memory after reading the proposal. Questions tend to be evocative because of the ways they engage with challenging topics: they pose innovative approaches to the exploration of problems, and because of this the answers found are far from obvious. There is no single way to form a conceptually innovative question. However, some of the following qualities are common to successful proposals. Below are some characteristics of an evocative question:

Affordability in time: Make your question relevance clearly discernible for your supervisor/reviewer.

Framed as a paradox: Frame your question around a provocative paradox. For example, why have violent conflicts over forest resources increased in the last ten years while the very people involved in these conflicts have

become less and less dependent on forest resources for their livelihoods? There are many potential answers to this question, and your research may ultimately challenge your own expected explanation but this in itself is a relevant discovery. These types of paradoxes pull the reader into the proposal and set up a situation whereby the research will fill in a provocative piece of the puzzle and make clear a much-needed broader understanding.

Distinctive: a question that approaches an old problem in a refreshingly new way, or proposes a surprising angle of analysis on a difficult dilemma, is likely to prove evocative for reviewers. This could involve a new methodology, a new conceptual approach, or the linking of two previously disparate fields of knowledge. These innovative approaches both develop confidence in the intellect of the student/researcher and hold promise for new understandings and insights to old and difficult questions.

- **The research question should be relevant**

Questions that clearly demonstrate their relevance to society, a social group, or scholarly literature and debates are likely to be given more weight by reviewers. Of course the relevance of a research question, not to mention the question of who finds it relevant, will vary widely according to the funding source. As a general rule, research is more likely to be funded if it is seen as part of a larger intellectual project or line of inquiry, not just a way for the researcher to get a degree. Below are two common ways to demonstrate

this in your proposal.

Fill in the missing piece: If your proposal can lay out a given field or dilemma and then point to a specific portion that is missing in that field or dilemma/gap, which will be filled by the answer to your research question, your research is likely to garner a great deal of support. Reviewers will note its importance and recognize its relevance to a larger community of researchers.

Make connections: Even if you are working on a narrow topic or in a specific place, ask questions that help relate the research to broader trends, patterns, and contexts. Doing this will help show how funding a seemingly distinct research project helps fuel larger debates. For example, show how a given species requirements in water may explain the least growth of another species in its neighborhood.

- **The research question should be clear**

Clear questions tend to be short, conceptually straightforward, and jargon-free. This does not mean they have to be overly simplistic; but save your theoretical gymnastics and abstract disciplinary language for the analysis. Work to keep your questions as lucid and simple as possible. This may be easier in some cases than in others, but some of the strongest and most theoretically sophisticated proposals we reviewed were framed by some of the simplest, most straightforward research questions. In contrast, the most complicated questions tended to

appear in proposals where the researcher seemed more interested in demonstrating his/her theoretical knowledge than in engaging the research itself. Below are simple ways to keep your question clear.

Ground the questions: keep your questions close to the topic or place you are researching. Questions that are too abstract or obtuse make it difficult for the reader to determine your question's relevance and intent. You must still link your question to a larger context, but ground that connection in temporal and spatial specifics.

Limit variables: If a question is burdened with too many variables or too many clauses it becomes both difficult to read and difficult to research. Here are two contrasting examples from the SSRC web site: a question like "Was the decline of population growth in Brazil the result of government policies?" is much easier to understand than "Was the decline in population growth in Brazil related more to sex education, the distribution of birth control, or resource depletion?" You may talk about all these factors in your proposal, but the first question allows the reader to focus on the central aspect of your research rather than the variables surrounding it.

- **The research question should be researchable**

Research questions need to be clearly achievable. One of the most common rationales for rejecting proposals is that the question is simply too expansive (or expensive) to be carried out by the student/applicant. There are many

questions that you will need to ask yourself to avoid this pitfall. Above all else, consider your limitations. Many very practical questions need to be considered when choosing your research question. First among them is: How long will the research take to carry out? Next, do you have the appropriate background to carry out the research? Are there ethical constraints? Is the project likely to be approved by your advisor and your university's committee for the protection of human subjects? Can you obtain the cooperation from all the necessary individuals, communities and institutions you need to answer the question you have asked? Are the costs of conducting the research more than you will be likely to rise? If you cannot complete this project well, can you break it down and address the most important component? Remember that writing a research question is an iterative process and such concerns need to be carefully considered in your research design and budget.

Research objectives

A study should be based on a clear conceptualization of relationship between variables, which define the parameters of the study problem. The objectives of the study spells out how the postulated relationship(s) will be investigated and what the researcher hopes to achieve by carrying out the proposed study. It should include words to indicate the intent of the study. The author may identify the independent and dependent variables, as well as any

mediating, moderating or control variables that will be used in the study and use words that connect the independent and dependent variables (Cresswell 2009). The author should make sure that objectives are clearly articulated; avoid vague and cryptic statements.

Six important guidelines that should be observed when developing research objectives are:

- be presented briefly and concisely
- be presented in logical sequence
- be realistic (e.g., achieved within the expected timeframe, achieved within the available resources)
- be phrased in operational terms (i.e., in a way that brings the scientific world closer to its knowledge improvement objectives)
- use action verbs that are specific enough to be evaluated or measured (e.g., assess, determine, compare, verify, calculate, describe)
- be static once the study work begins (i.e., objectives should not be moving targets)

For illustrating these points, we explore three potential research objectives by demonstrating (1) what the researcher would like to achieve, (2) example of a weak objective and why it is considered as weak, and (3) example of a stronger objective (Goetz 1992; Venter *et al.* 2011).

Focus 1: Predict the sustainability potential of *Irvingia gabonensis* regarding climate variations



- **Weak objective:** Observe the growth of *Irvingia gabonensis* in different climatic factors.
- **Why it is weak:** While this objective is presented concisely, it lacks precisions. How does the observation will be done ? According which parameters the growth dynamics will be observed ? And what climatic factors are we talking about ?

- **Stronger objective:**

To evaluate the substrate, light and temperature requirements for seed germination and for seedlings survival and initial growth of *Irvingia gabonensis*

Focus 2: Model the household food marketing behaviour in Sub-Saharan Africa



- **Weak objective:** Use a selectivity model to assess the food marketing behaviour of household in three Sub-Saharan Africa countries.
- **Why it is weak:** Worded in this manner, the objective is not specific enough to be evaluated. By including details about variables or parameters of the model in your objective, you are better positioned to get the intelligence required.

- **Stronger objectives**

To assess/determine marketed surpluses in the context of polychotomous-choice situation* while explicitly dealing with the resulting selectivity biases (Goetz 1992).

*Polychotomous situations involve different states such as when households sell to (or buy from) markets and parastatals or both.



Research hypotheses



Definition

There are many approaches of definition of hypothesis among which we can list:

- "Hypothesis is a formal statement that presents the expected relationship between an independent and dependent variable" (Creswell, 1994).
- It is a tentative prediction about the nature of the relationship between two or more variables.
- "An hypothesis is a statement or explanation that is suggested by knowledge or observation but has not, yet, been proved or disproved." (Macleod and Hockey 1981).

In general, hypothesis can be defined as a temporary explanation, a kind of educated guess about what will happen under certain conditions.

Example:

- **Question:** Do plants need light to grow?
- **Hypothesis:** If green plants kept in light to grow, then only plants kept in light can display growth.

⊕ **Goal**

The aim of formulating hypotheses is to offer a clear framework and a guide when collecting, analyzing and interpreting data. In many cases hypotheses serve as a testing tool of the relationships between variables (see Appendix 4).

⊕ **Nature**

The hypothesis is a clear statement of what is intended to be investigated. It should be specified before research is conducted and openly stated in reporting the results. It is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry. It should meet the following characteristics:

- Can be tested - accepted or rejected
- Not moral or ethical questions
- Is neither too specific nor too general
- Is a prediction of consequence
- Is considered valuable even if proven false

Example: Case study

Suppose that you are a nutritionist working in a zoo, and one of your responsibilities is to develop a menu plan for the group of monkeys. In order to get *all* the vitamins they

need, the monkeys have to be given fresh leaves as part of their diet. Choices you consider include leaves of the following species: (a) A (b) B (c) C (d) D and (e) E. You know that in the wild the monkeys eat mainly B leaves, but you suspect that this could be because they are safe whilst feeding in B trees, whereas eating any of the other species would make them vulnerable to predation. You design an experiment to find out which type of leaf the monkeys actually like best: You offer the monkeys all five types of leaves in equal quantities, and observe what they eat.

There are many different experimental hypotheses that could be formulated for this.

H1: When offered all five types of leaves, the monkeys will preferentially feed on B leaves. This statement satisfies both criteria (prediction and testability) for experimental hypotheses. It predicts the anticipated outcome of the experiment and it allows knowing whether or not they monkeys ate more B leaves than the other types.

H2: When offered all five types of leaves, the monkeys will preferentially eat the type they like best. This statement certainly sounds predictive, but it does not satisfy the second criterion of testability. There is no way you can test whether it is true once you have the results of your study. Your data will show you whether the monkeys preferred one type of leaf, but not why they preferred it (i.e., they like it best). The above statement can be seen

as an assumption that is inherent in the design of this experiment, rather than as a hypothesis.

H3: When offered all five types of leaves, the monkeys will preferentially eat B leaves because they can eat these safely in their natural habitat. This statement is problematic because its second part ('because they can eat these safely in their natural habitat') also fails to satisfy the criterion of testability. You can tell whether the monkeys preferentially eat baobab leaves, but the results of this experiment cannot tell you why.

H4: In their natural habitat, howler monkeys that feed in B trees are less vulnerable to predation than monkeys that feed on A, C, D, or E. This is a perfectly good experimental hypothesis, but not for the experiment described in the question. You could use this hypothesis if you did a study in the wild looking at how many monkeys get killed by predators whilst feeding on the leaves of A, B etc. However, for the experimental feeding study in the zoo it is neither a prediction nor testable.

H5: When offered all five types of leaves, which type will the monkeys eat preferentially? This is a question, and questions fail to satisfy criterion of prediction. Questions are not predictive statements. Hence, a question is not a hypothesis.

⊕ **Hypothesis formulation**

The formulation of the hypothesis basically varies according to the nature of the research study: qualitative or quantitative. It can also be divided into two approaches: deductive (Observation -> Pattern -> Tentative hypothesis -> Theory) and inductive (Theory -> Hypothesis -> Observation -> Confirmation). Here, we will develop the approaches regarding the study nature.

Qualitative approach

In this approach, hypothesis is more frequently replaced by questions, which are characterized by:

- Use of words: what, how. These words specify whether the study: discovers, seeks to understand, explores or describes the experiences.
- Use of non-directional wording in the question. These questions describe, rather than relate variables or compare groups.
- The questions are under continual review and reformulation will evolve and change during study.
- The questions are usually open-ended, without reference to the literature or theory.
- Use of a single focus.

Quatitative approach

In experiment studies, the formulation of hypothesis is more frequent. It often represents the comparison or relationship

between. It should be characterized by:

- The testable proposition has to be deduced from theory.
- Independent and dependent variables have to be separated and measured separately.
- Consider the alternative forms for writing and make a choice based on the audience for the research.

Figure 5 shows a simple way to generate research hypotheses. It is recommended that the number of hypotheses be the same as the research specific objectives or questions.

Example: Consider the example of a simple association between two variables, Y and X.

- **H1. Y and X are associated (or, there is an association between Y and X).** It provides a simple statement of association between Y and X. Nothing is indicated about the association that would allow the researcher to determine which variable, Y or X, would tend to cause the other variable to change in value.
- **H2. Y is related to X (or, Y is dependent on X).** It is also a simple statement of association between Y and X, but this time it may be inferred that values of Y are in some way contingent upon the condition of the X variable.
- **H3. As X increases, Y decreases (or, increases in values of X appear to effect reduction in values of Y).** It is the most specific of the three. Not only does it say that Y and X are related and that Y is dependent on X for its value, but it also reveals something more about the nature of the association between the two variables.

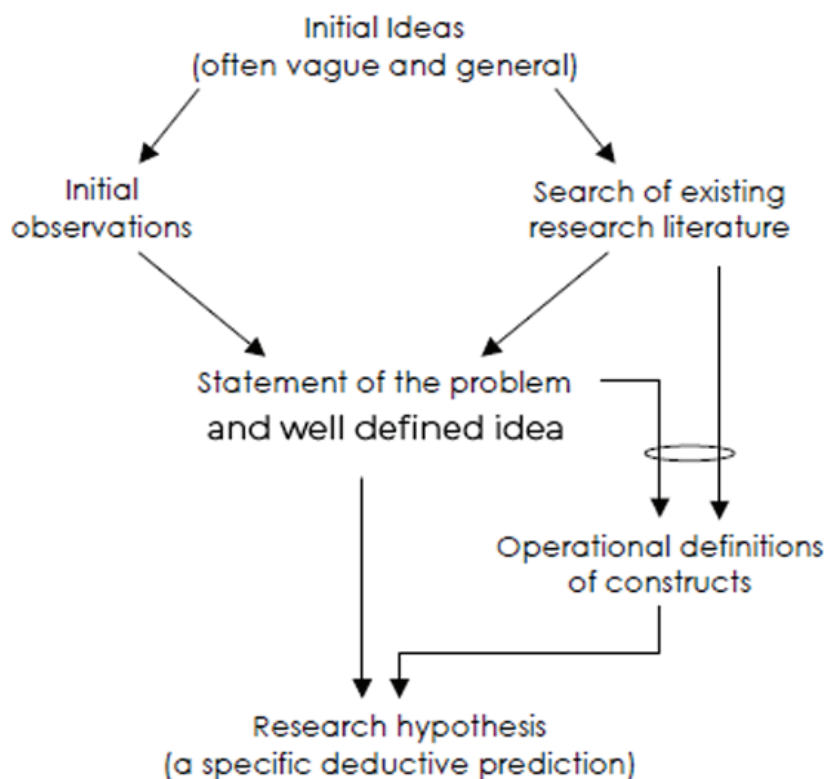


Figure 5: How to generate research hypotheses?



Synthesis of literature review

From a literature review, the author needs to critically assess studies/theories that are important to his/her research. Indeed, the author should identify the key lessons learnt from the literature review. The gaps that have been identified in the literature which the study intends to address have to be highlighted. Please remember that the synthesis constitutes **a piece of argumentative writing** in which you critically engage with relevant scientific/academic sources. The literature review does not simply provide background information to your study; it justifies your research question/hypothesis/theoretical framework/method and signals your in-depth knowledge of recent studies in your field. The primary purpose here is to show readers that you are familiar with the field and are thus qualified to offer your own opinions. The author may also specify which issues or concepts s/he will concentrate on in your review (this may well change as you read more widely and deeply). For that, we propose a step-by-step approach to allow young researchers to critically analyze a journal article.



What is the structure of the article?

The author should respond to the following questions:

- What type of text is it? (For example: Is it a primary

source or secondary source? Is it original research or a comment on original research?)

- What are the different sections and how do they fit together?
- Are any of the sections particularly effective (or ineffective)?



What is the purpose/hypothesis/aim/objective of the study?

Here, the author may:

- Write down the exact statement in which the article authors describe what they were testing (This information may be provided in the article as a purpose statement or as a hypothesis). Include quotation marks around the exact wording, and indicate page number(s).
- Then describe the purpose of the study (as you understand it) in your own words.
- Identify what was the “gap” in the research that the authors were trying to fill by doing their study?



What is/are the major finding(s) of the study?

Here,

- Make some notes about the authors’ major conclusions or findings as written in the article.

Include quotation marks whenever you use their exact wording and indicate page number(s).

- Then write those conclusions (as you understand them) in your own words.



How did the authors test their hypothesis?

- Briefly summarize the main steps or measurements that the authors used in their methods. Try to explain in your own words as much as possible.
- Do the authors suggest any problems or limitations with their methodology? Do you see any problems or limitations with their methodology?
- How did the authors analyze their data? What test(s) did they use?



How reliable are the results?

The main question you have to respond to at this step is: do the authors suggest any problems with the study that could lead to unreliable results?



Based on your analysis, are the claims made in this journal article accurate?

- Do the conclusions made (about the results) by the authors make sense to you? Are the conclusions too broad or too narrow based on what was actually done in the study?
- Based on the accuracy of the methodology and the reliability of the results as described in **Step 3** and **4**, do you think the conclusions can be believed?



What is the importance of this scientific work?

- Write (in your own words) the significant contributions of the experimental work in this journal article as reported by the authors.
- Re-read your notes and explain why you think this is
 - * A strong or weak scientific article
 - * A strong or weak scientific study
 - * Or any other conclusion you have made on the article evaluation.

By following those steps completely, the student is expected to be able to make a good critical review.



Methodology

The methodology section is one of the most important parts of a research proposal/dissertation. It should be the bulk of the research proposal and it must provide sufficient information so that a knowledgeable reader can reproduce the experiment. This section provides your readers the information on what procedures will be followed to undertake or to come up with the research results. Methods can include statistical, historical, sampling and/or theoretical and where appropriate, actual examples of the use of the methodology should be included (case studies). Equations, algorithms, flow charts and figures/tables are often included in the methodology section for descriptive purposes. The methodology section can be generally divided into several subsections.



Research design

This subsection may describe the conceptual structure or the type of research design that will be used (structural arrangement within which research will be undertaken). It describes the nature and pattern, which the research intends to follow (whether it is longitudinal or cross-sectional, descriptive, explanatory or experimental, case based or representative). The choice of research design depends on the type of research being conducted and the research questions to be answered. The choice of a particular design needs to be justified and the author after

articulating the design must state in precise approach(es) that will be used in the study. The choice can be either qualitative or quantitative or a mixed methods approach and whatever choice is made must be explained and justified.

Study population

This is the description of the population and its objects/elements from which samples will be drawn. A distinction or comparison could be made between a target and accessible population and the researcher must state the exact or estimated population from which the sample will be selected. All categories of the likely population to be studied must be given and their numbers should be appropriately given.

Sample size

This is the description of the actual sample that will be studied and how it will be selected /computed/determined. There are different approaches recommended for sample size determination and students must find the most appropriate approaches without reproducing approaches that other students have previously used. The sample size determination will among others be determined by the nature of the study-qualitative and or quantitative study and the expected degree of generalization. There exist theories on sample size determination (see Dagnelie 1998).

📌 Sampling techniques and procedure

This subsection describes in detail the sampling techniques that will be used in selecting the sample to be studied e.g. Probability or non-probability-based sampling (**probability-based sampling**: simple random, systematic random, stratified, random, cluster; **Non-probability sampling**: purposive, maximum variation, homogenous, snow ball, quota, convenient or accidental). The section should describe in detail the procedure used in selecting the sampling.

📌 Control group: importance and features

A control condition or group is an essential element of a true experimental design, without which results are generally uninterpretable, and the research is often useless. The control group consists of elements that present exactly the same characteristics of the experimental group, except for the variable applied to the latter. This group of scientific control enables the experimental study of one variable at a time, and it is an essential part of the scientific method. In a controlled experiment, two identical experiments are carried out: in one of them, the treatment or tested factor (experimental group) is applied; whereas in the other group (control), the tested factor is not applied. In other terms, the control group does not receive the experimental

treatment and so that it may help isolated the effect of the treatment on the experimental groups. Since the only difference between the experimental and control groups is the application of the treatment to only the experimental groups, it is obvious that when there exists a difference after the study, it should be due to the treatment. At times, some form of treatment different from the experimental treatment is given. On other occasions, several groups are used, each receiving lesser amounts of the experimental treatment. We present below some practical examples that may be helpful for students in this exercise when designing their experiments.

Example 1: Orthodontic study (Python 2013)

Orthodontists, is the assessment of the influence of medicine over orthodontic tooth movement. In these cases, it is important to examine if the supposed effects of the applied drug are produced only by the drug. In this situation, identical groups of patients or animals are compared, one of them receives the drug and the other receives a placebo or, in many cases, does not receive any drug (control group). In order to avoid bias, it is always important to prevent not only the researchers, but also the individuals who will receive the medicine from knowing which group receives the real drug.

Example 2: A germination study on Horitaki (*Terminalia chebula* Retz.) (Hossain 2005)

The study was conducted over a period of six months from January to June 2004 to explore the effects of different seed treatments on germination and seedling growth attributes of a popular medicinal plant, Horitaki (*Terminalia chebula* Retz) in the nursery of Chittagong University, Bangladesh. Seeds were subjected to six pre-sowing treatments in a Randomized Complete Block Design (RCBD) such as:

- T0: control (intact fruits without depulping and soaking);
- T1: fruits were depulped but were not soaked in water;
- T2: fruits were depulped and soaked in cold water for 12 hours;
- T3: fruits were depulped and soaked in cold water for 24 hours;
- T4: fruits were depulped and soaked in cold water for 48 hours;
- T5: fruits were depulped and soaked in hot water (80°C to 100° C) for 2 minutes and were immediately washed in cold water

Data collection methods

This includes the specific techniques to be used in the collection of data. Methods could include measurements, face-to-face interview, key informants' interview, focus group discussion, survey, observation, documentary review. This requires the researcher to briefly explain the procedures that will be followed in the data collection. This subsection includes also the instrumentation to be used e.g. interview guide, questionnaire, Key informants' guides, group discussion topics, observation checklists, forestry materials, etc.

Data analysis

This spells out how the data will be processed and summarized. It should indicate statistical tests that will be carried out and how the resulting information will be used for the research report. Where both qualitative and quantitative data is expected, the student should describe in a detailed way in which the data will be analyzed.



Work plan and timeframe

This is the schedule or timetable of activities and the period in which the research is to be conducted with due regard to budgetary limitation. It could be presented in a tabular form indicating activity, duration, and dates (Table 3). It is preferable on a Gantt Chart (Figure 6).

Table 3: Example of tabular work plan

Activity	Duration (day/week/month)	Date

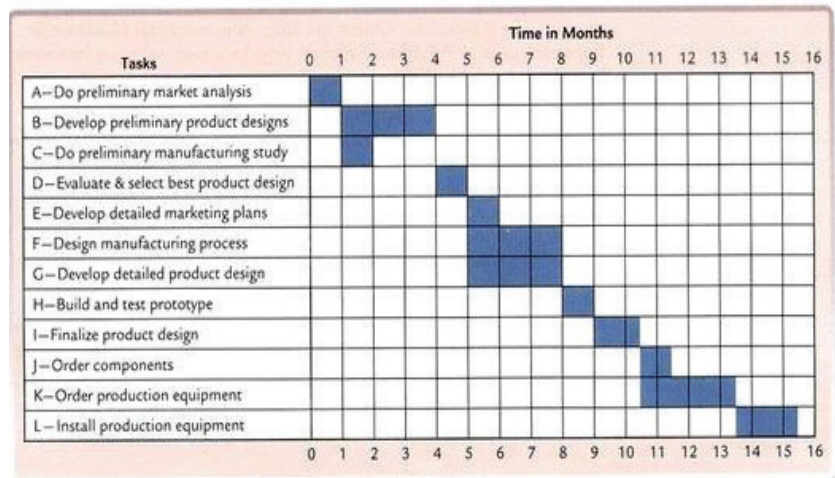


Figure 6: Example of Gantt chart

Budget

A budget for conducting the study should be included at the end of the proposal. The budget consists amount of activities and items that are necessary to carry out the research. This is the financial plan and financial resources needed for the implementation of the research. It should be clear and reasonable (affordable) and preferably activity based. It should be itemized according to an acceptable format (Table 4).

Table 4: Example of budget format

Items	Quantity	Unit cost	Total cost	Justification
Subsistence allowance				
Honorarium				
Travel (vehicle hire)				
Data analysis				
Secretarial services (processing the research instruments and reports)				
Photocopying				
Report production (print and binding)				
Other expenses (specify)				



Cited references

This section presents the list of all cited references in the text. For that, it is important to check:

- the reference style and format required by the Higher Education Institution in which you are registered. It is common to use the **Havard System** (alphabetical by author/date) but there exist many systems.
- * **Havard System**: Wilson, RT 1988, Vital statistics of the baobab (*Adansonia digitata*), African journal of ecology, vol. 26(3): pp. 197-206.
- * **APA (American Psychological Association) System** (alphabetical): Wilson, R. T. (1988). Vital statistics of the baobab (*Adansonia digitata*). African journal of ecology, 26(3), 197-206.
- * **Vancouver System** (numbered in order or citation): 1. Wilson, RT. Vital statistics of the baobab (*Adansonia digitata*). African journal of ecology. 1988, 26(3): 197-206.
- The punctuation, spelling of author names,
- The number of authors to include before using "et al."

It is also very important to avoid:

- Personal communications, unpublished observations and submitted manuscripts not yet accepted.
- Citing articles published only in the local language.
- Excessive self-citation and journal self-citation.

A practical guidance on how to manage references using the software Endnote is proposed in Appendix 1.

APPENDICES

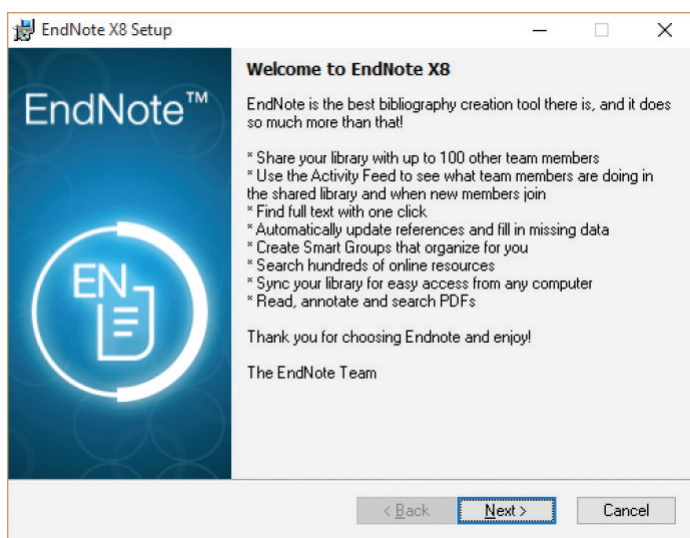
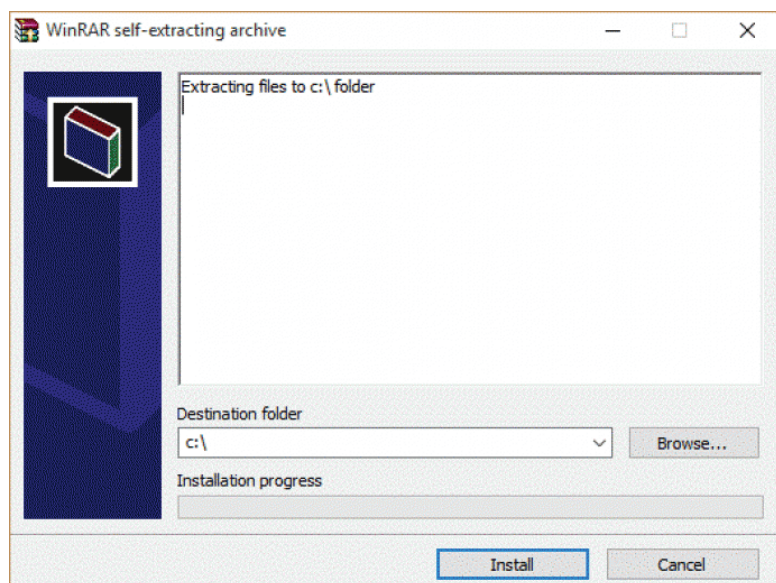


Appendix 1: How to use Endnote to generate references in MS Word under Windows?

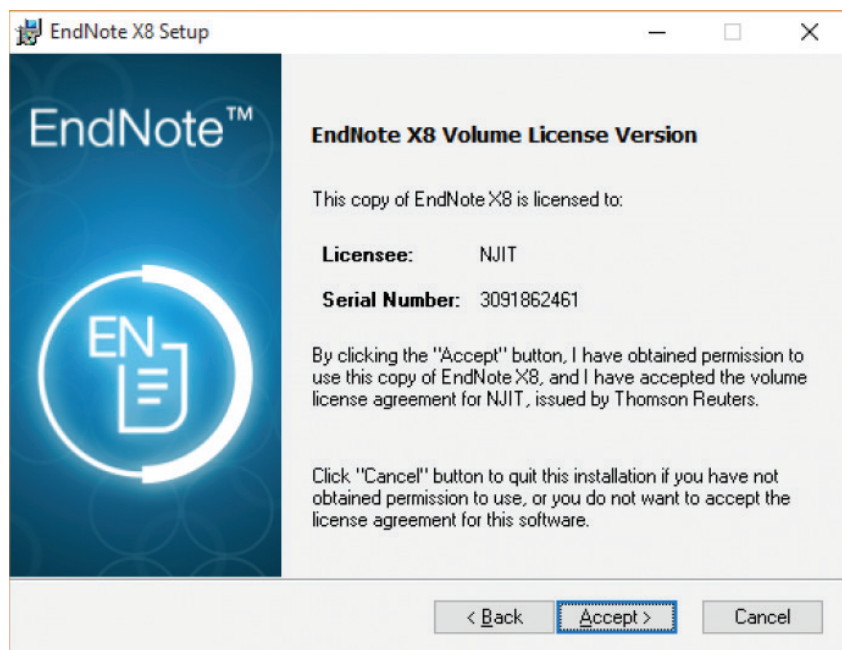
Step 1. Installing the software on your computer

To Install EndNote X8 (the version X8 is just selected for this purpose, you may check for last version if available) **on a Windows Operating System:**

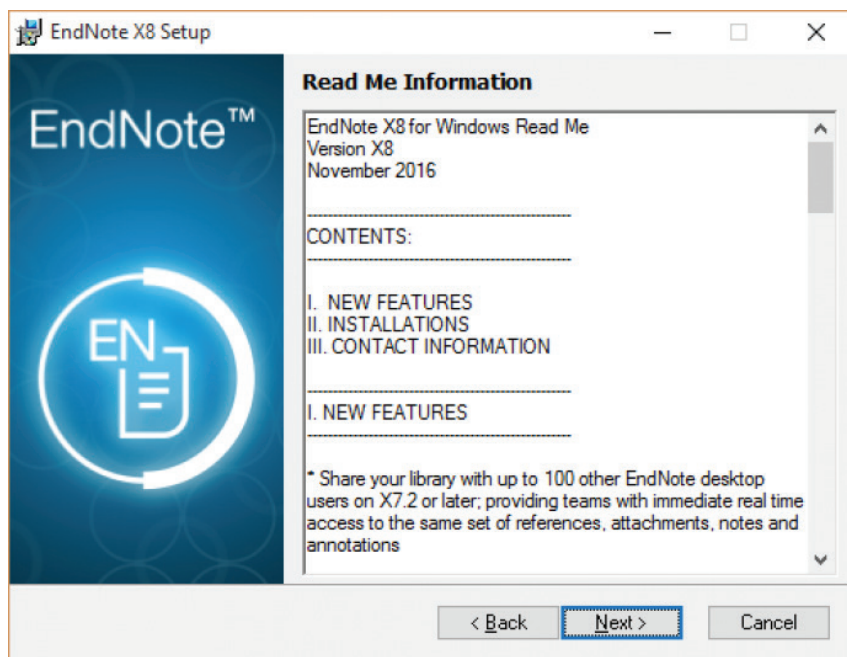
1. Download **EndNoteX8Windows.exe** from the ist.njit.edu website.
2. Double click the **EndNoteX8Windows.exe** file to extract all files to your hard drive.
3. Click **Install**.
4. The installer will open. Select **Next** at the bottom of the screen to begin installation



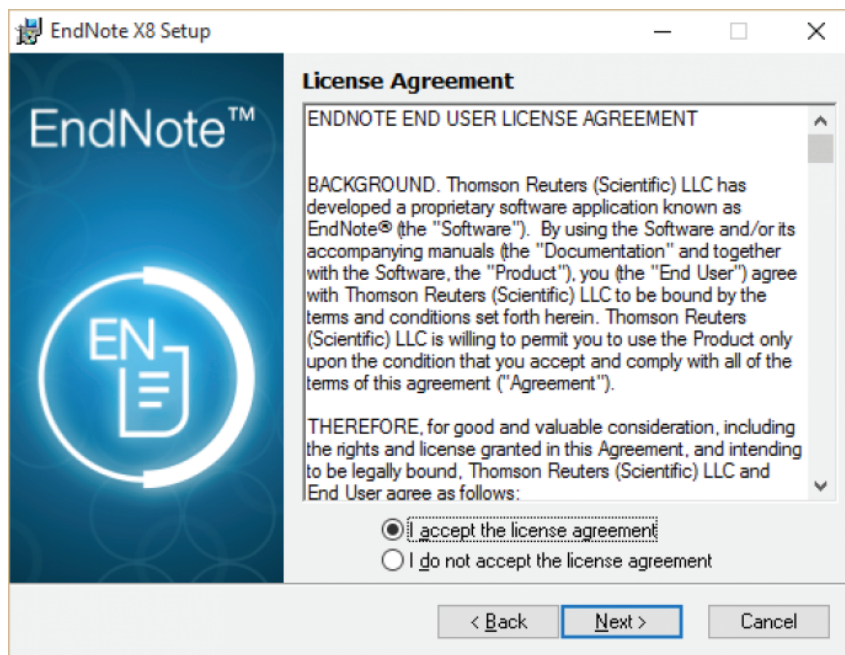
5. The License screen will appear. Click **Accept**



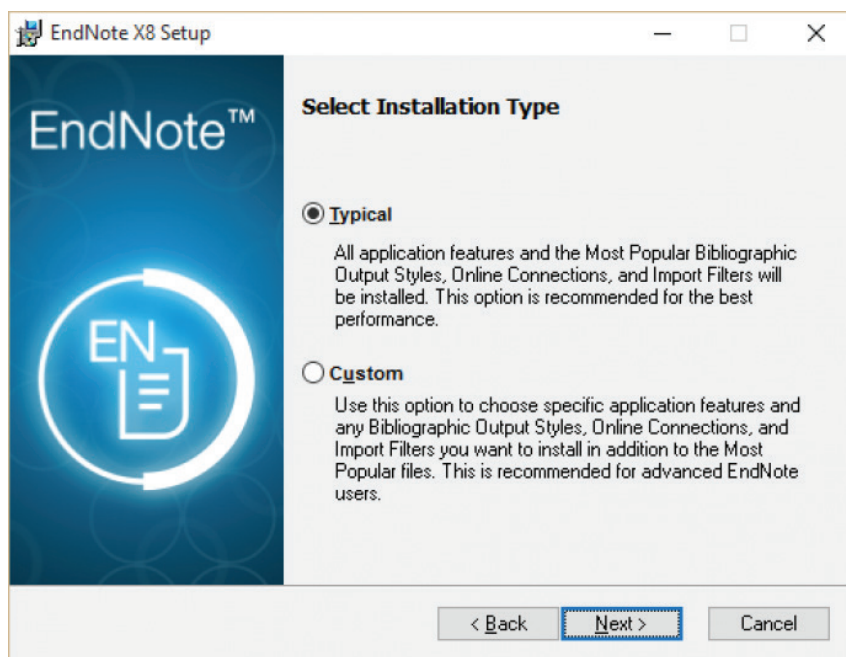
6. Review the Read Me information screen, and click **Next**



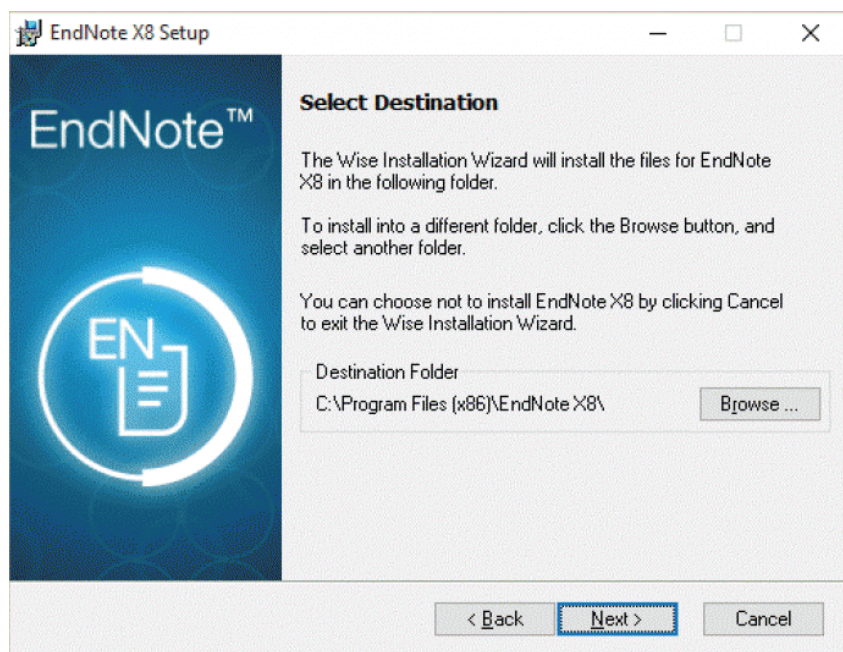
7. Read the License Agreement, and select **Next** at the bottom of the window to continue



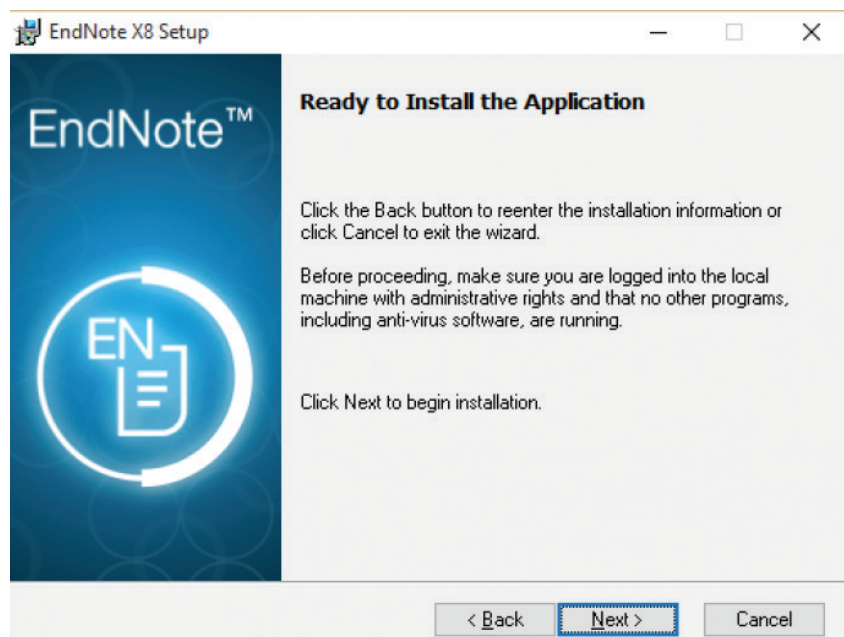
8. Choose your Installation Type, and click **Next** at the bottom of the screen



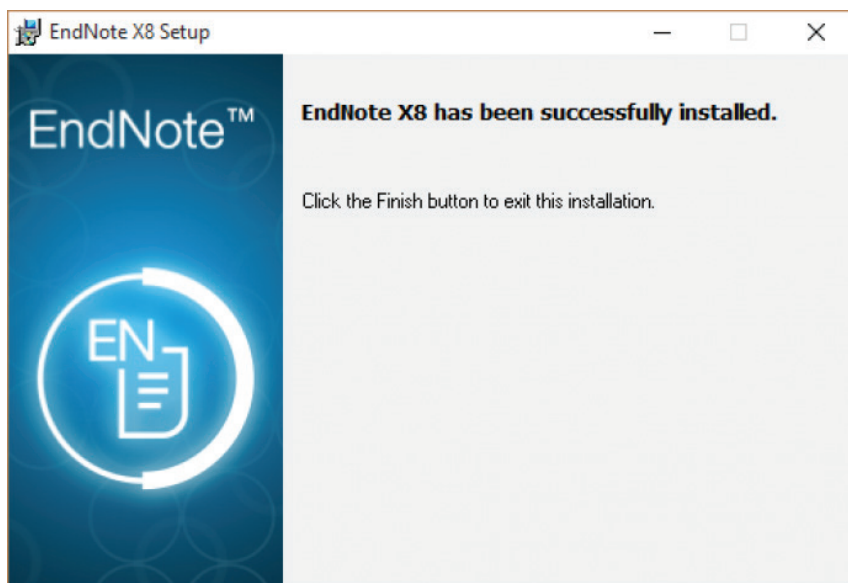
9. Pick your Destination Folder, and click **Next**



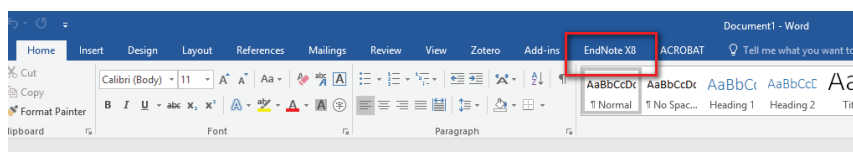
10. Click **Next** to begin installation at the bottom of the screen



11. Wait for the installer to download the program

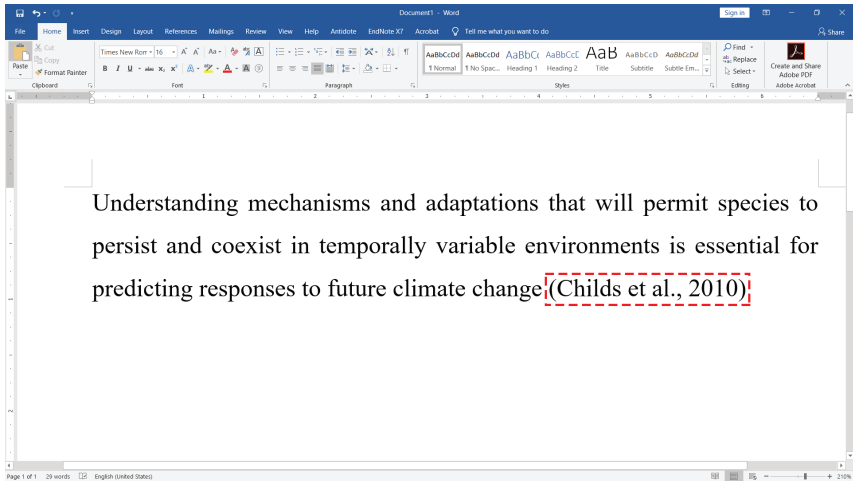


Endnote X8 should now install on your computer. At the end of the installation, the Endnote toolbar should appear in MS Word.



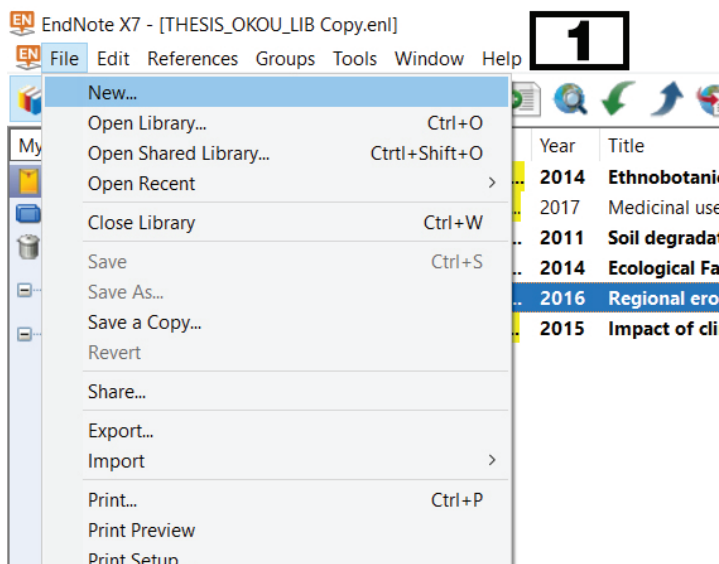
Step 2. Edition of a reference

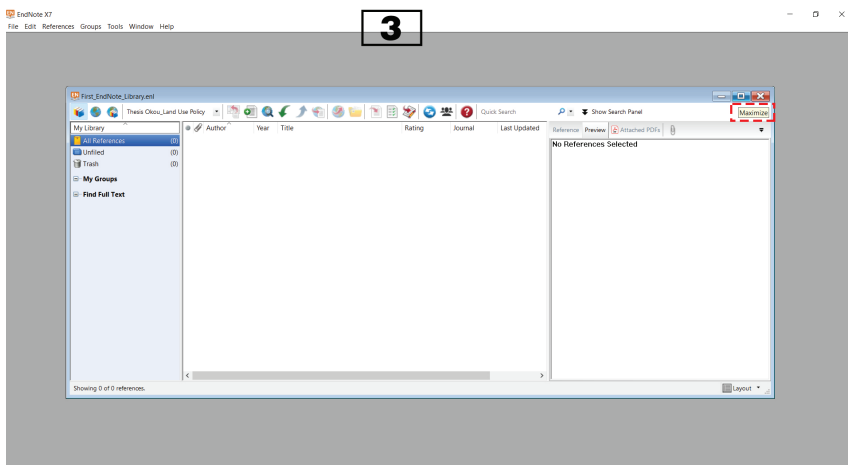
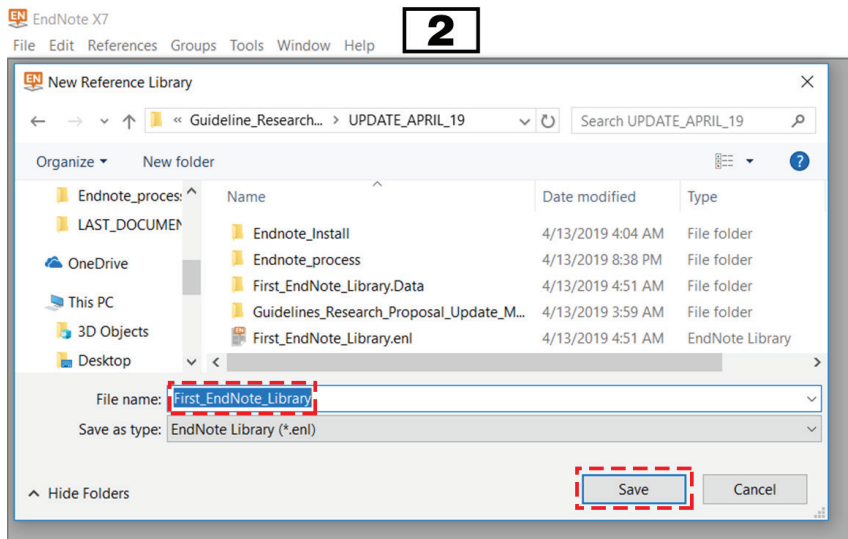
In this example the researcher aims to cite Childs *et al.* 2010.

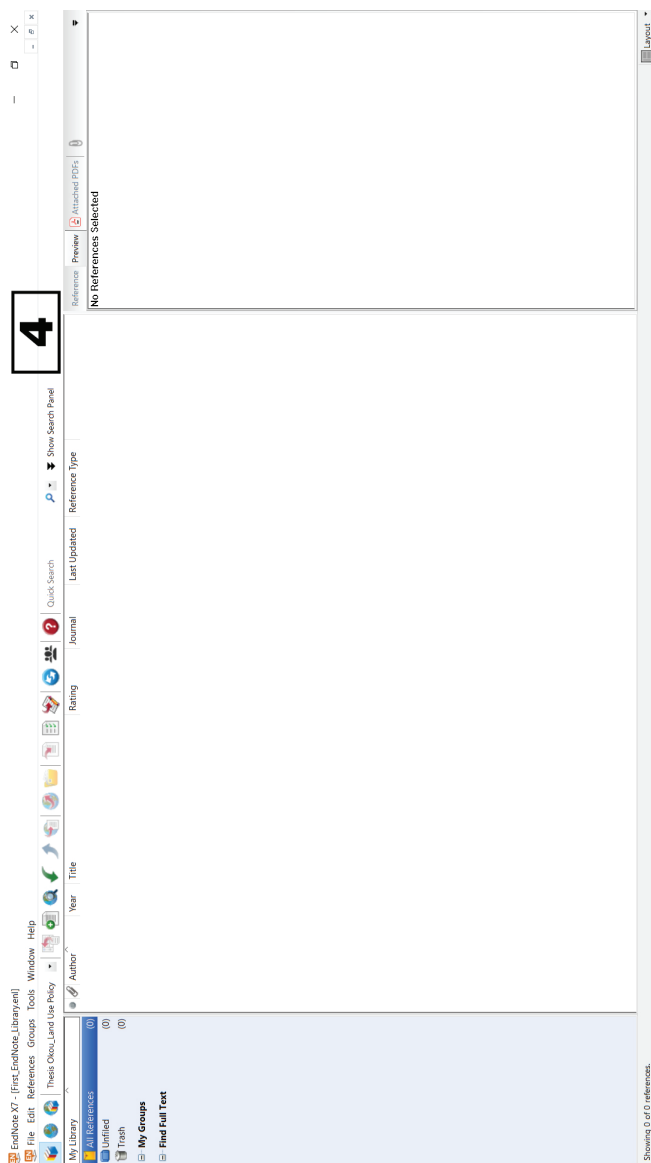




➡ First, create a new endnote library.



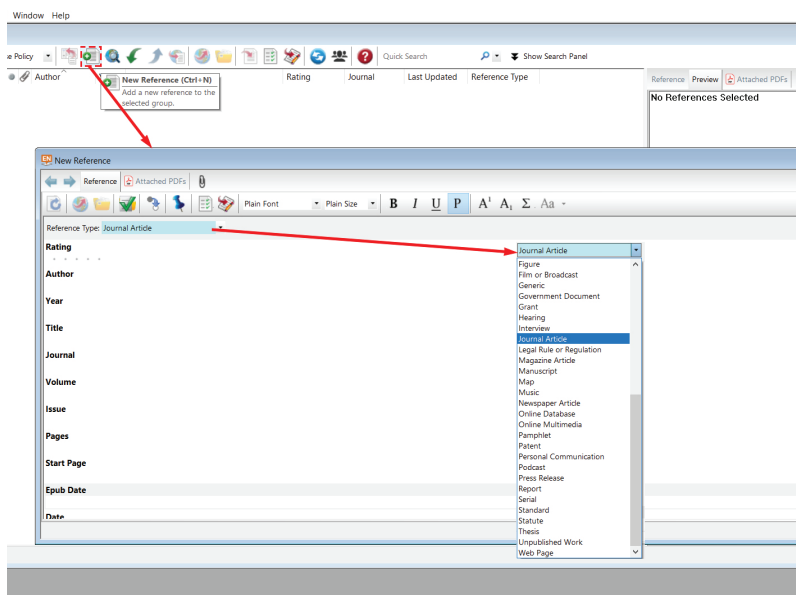


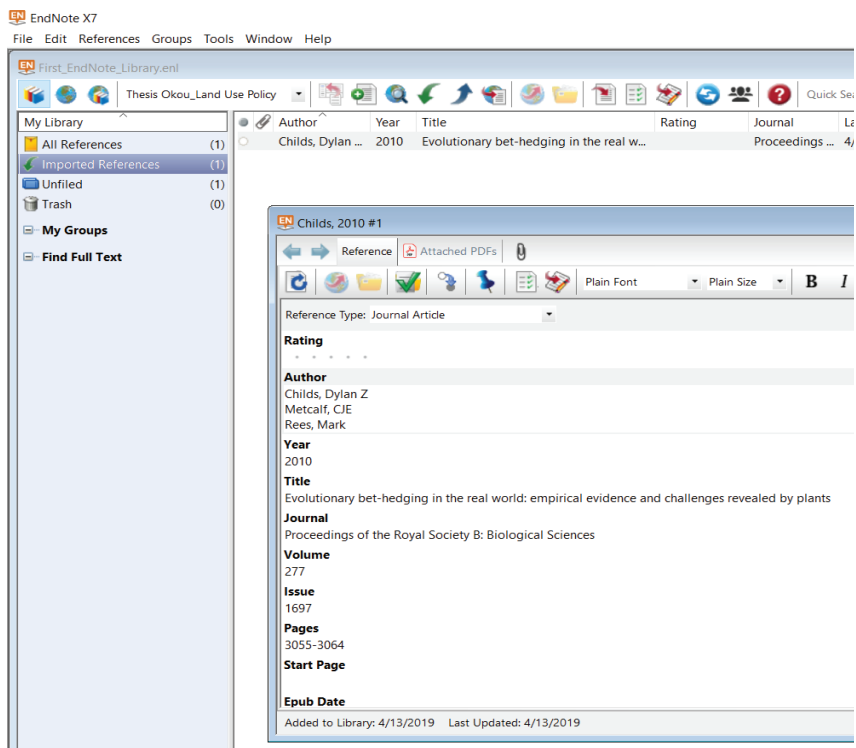


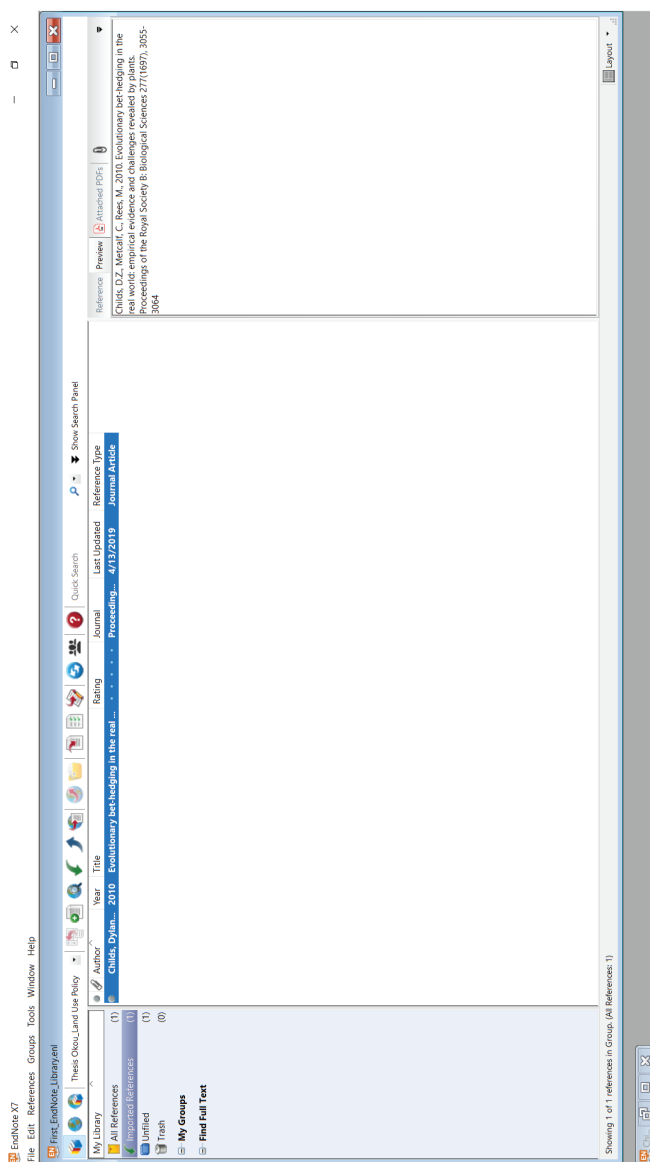
✎ After that, you can add new reference in Endnote. Here, we will show you two methods to do that.

Offline method

Click on the new reference toolbar, choose the type of scientific document (article, book), fill the boxes as shown below, and save.

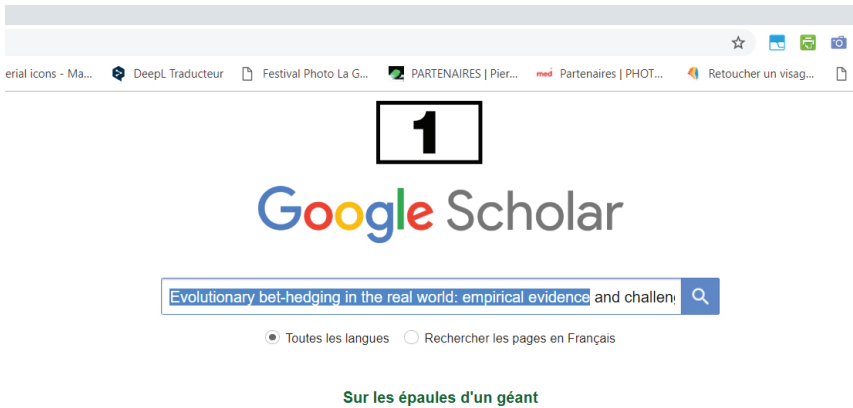






Online method

Go to **Google scholar** website and search for the article. Find the citation mark " and click on it. Select endnote to download the reference. On your computer search for the file downloaded and open it. These steps are described below.



Evolutionary bet-hedging in the real world: empirical evidence and challenges

https://scholar.google.fr/scholar?hl=fr&as_sdt=0%2C5&q=Evolutionary+bet-hedging+in+the+real+world%3A+empirical+evidence+and+challe

Google Scholar Evolutionary bet-hedging in the real world: empirical evidence and challenges

Articles

2

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Depuis 2019
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Depuis 2015
Période spécifique...

Trier par pertinence
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☒ inclure les brevets
☒ inclure les citations

Evolutionary bet-hedging in the real world: empirical evidence and challenges [PDF] royalso

DZ Childs, CJE Metcalf, M Rees - Proceedings of the ... 2010 - royalsocietypublishing.org

Understanding the adaptations that allow species to live in temporally variable environments is essential for predicting how they may respond to future environmental change. Variation at the intergenerational scale can allow the evolution of bet-hedging strategies: a novel genotype may be favoured over an alternative with higher arithmetic mean fitness if the new genotype experiences a sufficiently large reduction in temporal fitness variation; the successful genotype is said to have traded off its mean and variance in fitness in order to ...

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3

APA Childs, D. Z., Metcalf, C. J. E., & Rees, M. (2010). Evolutionary bet-hedging in the real world: empirical evidence and challenges revealed by plants. *Proceedings of the Royal Society B: Biological Sciences*, 277(1697), 3055-3064.

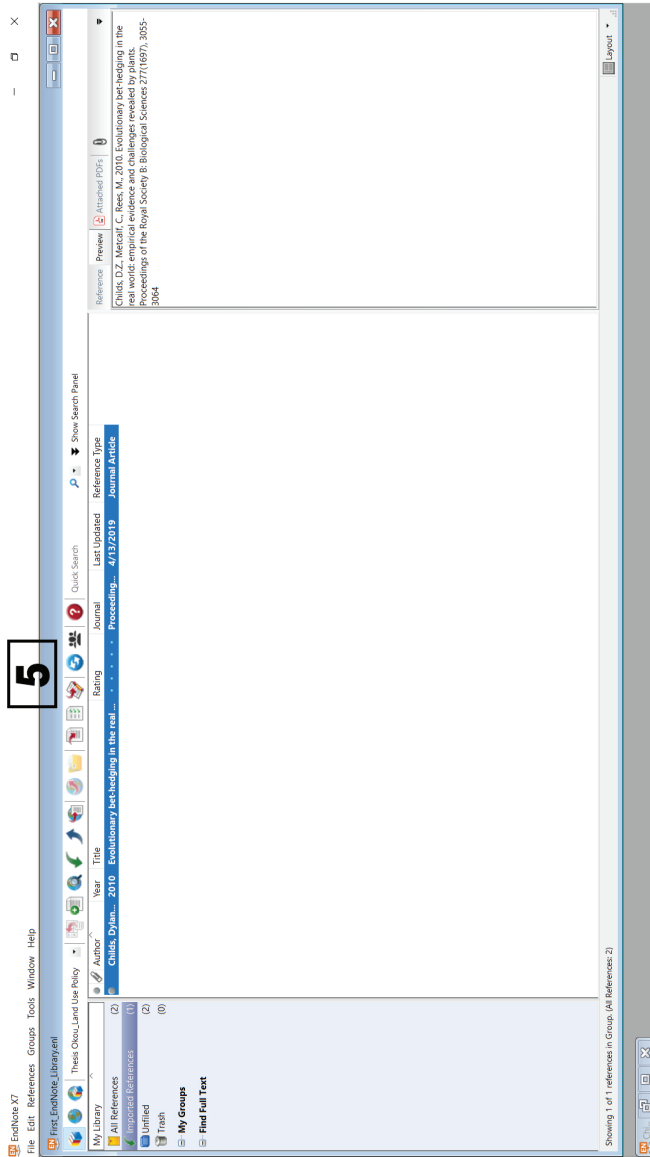
ISO 690 CHILDS, Dylan Z., METCALF, C. J. E., et REES, Mark. Evolutionary bet-hedging in the real world: empirical evidence and challenges revealed by plants. *Proceedings of the Royal Society B: Biological Sciences*, 2010, vol. 277, no 1697, p. 3055-3064.

MLA Childs, Dylan Z., C. J. E. Metcalf, and Mark Rees. "Evolutionary bet-hedging in the real world: empirical evidence and challenges revealed by plants." *Proceedings of the Royal Society B: Biological Sciences* 277.1697 (2010): 3055-3064.

4

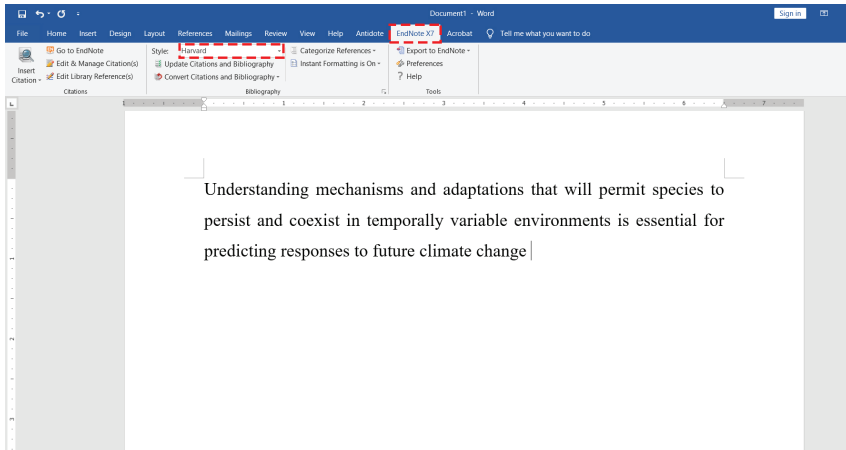
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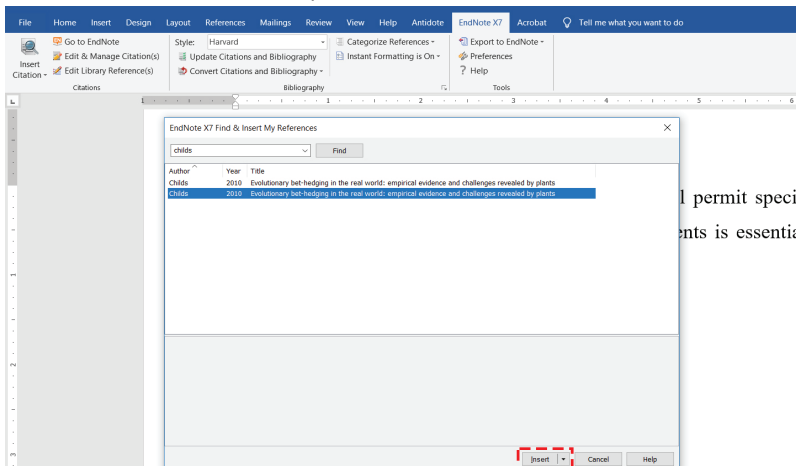


➡ Secondly, insert this new reference in the text.

👉 Click on the toolbar Endnote and select your preferred reference style (here we chosen **Harvard system**)

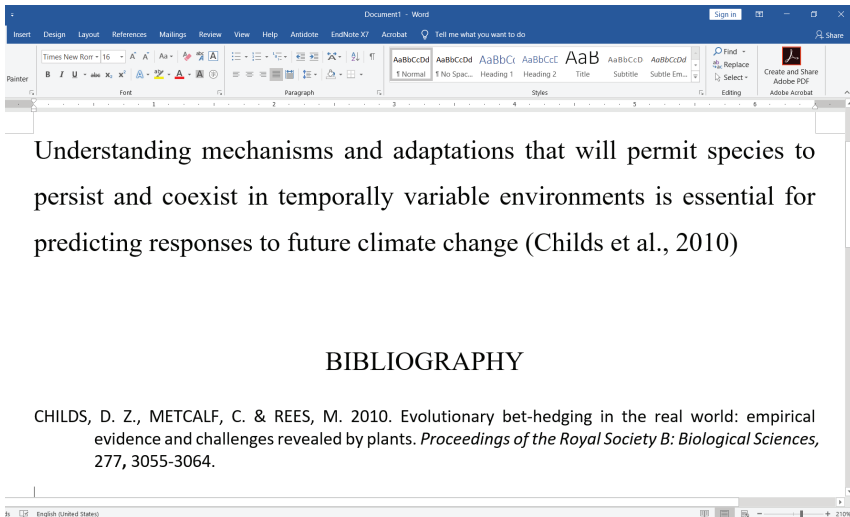


👉 Go to "Insert citation" and select the reference, then click OK



Understanding mechanisms and adaptations that will permit species to persist and coexist in temporally variable environments is essential for predicting responses to future climate change

✎ Then it automatically generates the citation in the text and also adds this reference to the list of cited references.





Appendix 2. Ethical issues Plagiarism and auto-plagiarism

Plagiarism is a serious offence that could lead to paper rejection, academic charges and termination of employment. It will seriously affect your scientific reputation. In this appendix we use the online test on plagiarism proposed by UNamur (<https://survey.unamur.be/index.php/784813>), to assess your knowledge on the issue. At the end the responses to questions are presented. Please check first your knowledge before verifying the responses.

Questions (French)

01 - Insertion texte internet

Si on veut inclure dans son travail un extrait de texte trouvé sur internet, on peut le copier textuellement sans le mettre entre guillemets.

VRAI ou FAUX



02 - Insertion d'une citation en langue étrangère

Si on veut insérer dans son travail une citation trouvée dans une langue étrangère, on n'a qu'à la traduire

VRAI ou FAUX



03 - Réutilisation du travail d'un ami avec son accord

Dans le cadre d'un cours, un travail est à remettre dans une semaine et vous n'avez pas encore commencé. Un de vos amis a déjà suivi ce cours et il vous propose de réutiliser son travail. Comme vous avez son accord, il ne s'agit pas de plagiat.

VRAI ou FAUX



04 - Sanction en cas de plagiat

Quelqu'un qui est reconnu coupable de plagiat, peut être expulsé de l'université

VRAI ou FAUX



05 - Paraphrase

Lorsqu'on rédige un travail, il n'est pas nécessaire de donner la référence si on paraphrase, car une paraphrase reprend les idées et non les mots exacts d'un auteur.

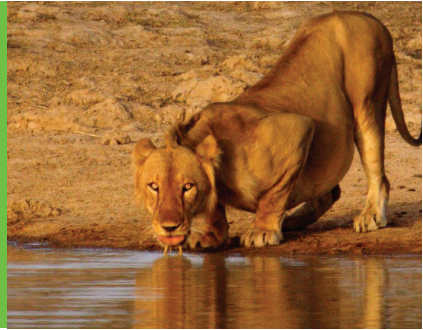
VRAI ou FAUX



06 - Notoriété publique et citation

Ce qui est de notoriété publique n'a pas à être cité

VRAI ou FAUX



07 - Mentions personnelles

Il n'est pas nécessaire de faire une citation lorsqu'on rapporte ses propres expériences, ses propres observations ou encore ses propres idées sur un sujet

VRAI ou FAUX



08 - Paraphrase et synonymes

Pour une bonne paraphrase, il suffit simplement de remplacer tous les mots de l'extrait que l'on veut paraphraser par des synonymes

VRAI ou FAUX



09 - Indications des sources

Lorsqu'on effectue un travail de recherche, pourquoi doit-on indiquer ses sources

- Pour donner de la crédibilité à ses propos
- Pour offrir à ses lecteurs des références sur le sujet
- Pour se protéger du plagiat
- Toutes ces réponses



10 - Modifications d'une citation

Si on désire modifier une citation (par exemple donner des explications sur un terme de la citation), on doit utiliser:

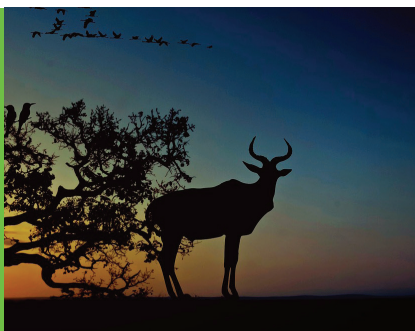
- Des parathèses
- Des crochets
- Il n'est pas possible de modifier une citation



11 - Citation extraite d'un livre

Vous consultez le livre Histoire de la France au XVIII^e siècle et vous y trouvez un passage intéressant que vous aimeriez insérer dans votre travail. Ce passage est en fait une citation tirée du livre Le siècle des Lumières. Dans votre travail, quelle(s) source(s) devez-vous mentionner?

- Histoire de la France au XVIII^e siècle
- Le Siècle des Lumières
- Les deux



Responses (French)

01- FAUX.

Explication : Non seulement on doit mettre l'**extrait entre guillemets**, mais on doit également en **mentionner la source**.

02- FAUX.

Explication : - Si on présume que les **lecteurs comprennent l'anglais**, il n'est pas obligatoire de traduire la citation : on doit alors mettre l'**extrait de langue anglaise en italique et entre guillemets**.

- Si on pense que **les lecteurs ne comprennent pas l'anglais**, on doit **d'abord essayer de trouver une traduction déjà publiée** de l'extrait. Si **aucune traduction** n'a été publiée, on doit **traduire soi-même** l'extrait, le mettre entre guillemets et indiquer la **mention [Notre traduction] entre crochets**.

03- FAUX

Explication : Vous n'avez **pas produit ce travail**, donc le **faire passer comme le vôtre** constitue un acte de **plagiat**.

04- VRAI

Explication : Être reconnu coupable de plagiat entraîne des sanctions diverses allant du **simple avertissement** au **renvoi de l'université**.

05- FAUX

Explication : On doit donner la **référence de toute information empruntée à un auteur**, que ce soit ses **mots** ou ses **idées**.

06- VRAI

Explication: Un **fait de notoriété publique** n'a effectivement **pas à être cité**. Par contre, **toute interprétation d'un fait doit être citée**.

07- VRAI

Explication : Comme ces **expériences, observations** et **idées** sont les **vôtres**, vous **n'avez pas à les citer**. Par contre, on doit **toujours citer** lorsqu'il s'agit des **expériences**, des **observations** ou des **idées** de **quelqu'un d'autre**.

08- FAUX

Explication : Il faut effectivement **remplacer** des mots de la paraphrase **par des synonymes**, mais il faut **également modifier la structure des phrases, changer les parties du discours** et **effectuer tout autre changement jugé pertinent**. Une bonne paraphrase implique que l'on comprend aisément ce que l'auteur a voulu dire et qu'on l'exprime par ses propres mots.

09- TOUTES LES REPONSES

Explication : En effet, on doit indiquer ses sources à la fois pour donner de la **crédibilité** à ses propos, offrir à

ses lecteurs des **références** sur le sujet et se **protéger du plagiat**.

10- DES CROCHETS

Explication : Toute modification dans une citation doit être signalée par des crochets [...].

11- LES DEUX

Explication : Vous devez non seulement **mentionner la source consultée**, c'est-à-dire *Histoire de la France au XVIIIe siècle*, mais également la **source de laquelle est tirée la citation**, soit *Le siècle des Lumières*. Dans la **bibliographie** par contre, vous indiquerez **uniquement la source consultée**, soit *Histoire de la France au XVIIIe siècle*.

EVALUATION

- Vous avez obtenu un score de **10** à **11** points ? Vous connaissez tout sur le plagiat. Toutefois la législation change, donc tenez-vous au courant en consultant ce site.
- Vous avez obtenu un score de **7** à **9** points ? Vous avez de bonnes connaissances sur la propriété intellectuelle, mais encore quelques points à rafraîchir. Nous vous invitons à relire les points ratés.
- Vous avez obtenu un score de **0** à **6** points ? Aïe! vous risquez, involontairement, de vous mettre en porte-à-faux avec le droit d'auteur.

Source : <https://survey.unamur.be/index.php/784813/lang/fr/newtest/Y>



Appendix 3. Elements of style for well writing a research proposal

This appendix aims to allow young researchers developing a strong and excellent style of scientific writing. The main source used to build this appendix is Griffies *et al.* (2013).



Most important rule

It is important to take into account readers' behavior when writing. It is recommended to write for the busy reader who is easily distracted. For that, the author should know some readers characteristics:

- Most readers do not grant enough time to go through the whole scientific document.
- Readers will use almost any excuse to put down your document, particularly when encountering poor writing that leads to reader fatigue and frustration.

Therefore, the author has to communicate every single information (sentence, paragraph, subsection, section, figure, derivation) in a compelling and well written manner.

Basic rules of proposal language

A research proposal language should be accurate, concise, clear and objective. The use of a spellchecker in English (or French depending on the language you use) may be very important to prevent spelling errors. The writer should also pay attention to tenses, grammar, sentences and paragraphs.

• Tenses

- * *Present tense*: Use the present tense for known facts and hypothesis, for example, "*Adansonia digitata* **is** present in Benin..."
- * *Future tense*: Use the future tense for describing experiments that will be conducted and presenting objectives, for example "Analysis of variance **will be** performed to assess the difference between..."
- * *Past tense*: Use past tense to present previous works results mainly in the synthesis literature review.

• Grammar

- * **Avoid abbreviations and acronyms**: The writer should avoid contractions such as "it's", "isn't", or "weren't", which are not often used in professional and scientific writing. Abbreviations/acronyms except for very well-known ones should be avoided especially in the abstract. S/He should also avoid to use acronyms as replacement for citations.

- * **Eliminate redundant words or phrases** (Table 5)
- * **Double-check unfamiliar words or phrases.**

Table 5: Some examples of redundant words to avoid

Avoid	Better write
due to the fact that	because or since
immediately apparent	apparent
in the case that	in case
And also	and
in order to determine	To determine
to try and determine	To determine
High resolution	resolution
New result or latest findings	Result or findings

- **Sentences**

- * **Write direct and short sentences.** The average length of sentences in scientific writing is only about 12-17 words.
- * **Include only one piece of information per sentence.** Sentences should be constructed in short, factual bursts. Long and complicated sentences tend to confuse readers.
- * **Avoid making multiple statements in one sentence.** Convey only a single idea per sentence. Link sentences together within a paragraph to provide a clear story-line.
- * **Keep related words together.** Closely place the subject and verb to allow the reader to understand

what the subject is doing.

- * **Avoid the overuse of etc. or and so on.**
- * **Avoid exaggeration but write only what is significant.**
- * **Pay attention to the order in which you write a sentence.** Old information should come before new information.
- * **Put statements in a positive form.**
 - **Positive:** "He usually came late."
 - **Negative:** "He is not very often on time."
- **Paragraphs**
 - * Have one paragraph for each distinct topic.
 - * Begin a paragraph with a topic sentence, and end in conformity with the beginning.
 - * Avoid a succession of loose sentences.
 - * Parallel structures are simpler to parse as a reader. Retain consistent tenses within each paragraph.
 - * Provide a logical transition from one paragraph to another to render a clear flow, thus guiding the reader from one topic to another.
 - * Paragraphs are similarly constructed to sentences, bringing the reader from the "familiar" at the start to new ideas towards the end.
 - * Fill logical holes empathizing with a smart reader who genuinely wants to understand the flow of ideas.



Appendix 4. An example of well-written research proposal extracted from the successful IFS proposal of Dr Fandohan Belarmain (Fandohan 2013).

Title: Climate change and *Thunbergia atcorensis* (Acanthaceae), a rare and endemic species in Benin: Implications for a better conservation strategy

Abstract

Apart from anthropogenic threats, climate change is one of the largest threats to biodiversity. The risks and uncertainties associated with these threats call taking into account climate change for conservation. The purpose of this project is to assess the potential impact of climate change on spatial and temporal distribution areas favorable to the conservation of *Thunbergia atcorensis* (Acanthaceae), a rare and endemic species in Benin. Specifically, the study will be articulated around the following questions: From a bioclimatic point of view, what is the extent of the areas favorable to the conservation of *T. atcorensis* in Benin? In view of climate projections at different horizons, what is the potential effect of climate change over the extent of these areas and their geographical distribution? What proportion of habitats is currently covered by the national network of protected areas and could be the future situation? What are the implications of the results for the development of future conservation policies for the species? The entropy principle maximum in combination with the Geographic Information System will be used to model the geographical distribution

of habitats favorable to the conservation of the species, under current and future climatic conditions. To do this, the data from presence of the species will be collected and combined with bioclimatic data derived from the Worldclim database and soil data. The bioclimatic models CSIRO mk3 and MIROC-H will be used for projections of the future. The results of this project will be used as part of plans to create new protected areas in the inselbergs, to improve living standards of rural communities and the ecological database on rare species in Africa.

1. Introduction

1.1. Background and statement of the problem

Climate change is now recognized as one of the major threats to species survival and ecosystem integrity around the world. Indeed, it is likely that fluctuations in climatic variables such as precipitation and temperature will affect biodiversity and the geographic distribution of species-friendly habitats (IPCC, 2007). In Africa, 25-42% of plant species may be threatened with extinction due to a loss of 81-97% of favorable habitats by 2085 (IPCC, 2007). According to projections, 20 to 30% of plant and animal species will face a greater risk of extinction if global warming exceeds 1.5 ° to 2.5 ° C in this region (Busby *et al.*, 2010). Much of Africa's impressive biodiversity is conserved to date in protected areas through a very large system of different types of bio-reserves. In sub-Saharan Africa, investigations of the potential impact of climate change on the effectiveness of protected areas in conserving rare, endemic or IUCN red-

listed species are still rare. However, climate change poses a fundamentally different threat from other threats because in the past, no ecological stressor has challenged the effectiveness of protected area networks in conserving representative samples of species (Scott, 2005) or to cover habitats that are favorable to them. In a nutshell, there are great uncertainties (at the country and regional level) about how these static areas will continue to conserve the species concerned or provide them with favorable habitats, along with climate change. Information on the potential impact of climate change on the geographical distribution of habitats favorable to these species is therefore important to better reason the choice of areas where they will be conserved today and in the future. Indeed, these changes could result in spatial dynamics of the geographic distribution of favorable habitats for these species (Hannah *et al.*, 2002).

Various statistical methods are used to model the distribution of species, the distribution of habitats that are favorable to them or to estimate the probability of presence / absence of a given species at a given geographic position (Guisan *et al.*, 2000). MaxEnt (maximum entropy modeling) is one of the most powerful modeling methods that can generate very good biogeographic information while offering good discrimination of favorable and bioclimatic habitats (Phillips *et al.*, 2006). However, bioclimatic models have also been widely criticized given some weaknesses in predicting the impact of climate change on the spatio-temporal dynamics of species distribution. These weaknesses include uncertainties in the models used, difficulties to parameter ecological interactions, individual idiosyncratic responses of species to climate change, species-specific dispersal

limitations, plasticity of physiological limits, and adaptive responses of dispersal agents (Elith *et al.*, 2006; Schwartz, 2012). Despite these weaknesses, these models provide very important bioclimatic information in decision-making, particularly to identify new areas potentially favorable to the conservation of a given species (Schwartz, 2012). Research has recently assessed the effectiveness of protected areas in conserving certain taxa, eg. *Tamarindus indica* L. (Fandohan *et al.*, 2011), the genus *Acacia* (Marshall *et al.*, 2012), or the impact of climate change on habitat distribution of species (*Adansonia digitata* L., Cuni-Sanchez *et al.*., 2011). However, studies combining the two approaches to better guide conservation decision-making are rare on the African continent.

1.2. Research objectives

The present study proposes to evaluate the potential impact of climate change on the spatio-temporal distribution of areas favorable to the conservation of *Thunbergia atcorensis* (Acanthaceae), a rare and endemic species in Benin. Specifically, it will

- Model the current ecological niche of *T. atcorensis* in Benin.
- Project the potential spatio-temporal dynamics of the niche of the species in Benin (in the 2030, 2050, 2070 and 2100 horizons), attributable to climate change.
- Make a comparative analysis of the CSIRO mk3 and MIROC-H Global Circulation Models (GCMs) projections under the A2 and B2 scenarios.
- Make an analysis of current and future gap analysis gap of

suitable habitats for the species in the national network of protected areas for both models and the two scenarios.

1.3. Research questions

From a bioclimatic point of view, what is the extent of areas favorable to the conservation of *T. atacorensis* in Benin? In view of climate projections, what is the potential effect of climate change on the extent of these areas and their geographical distribution in the 2030, 2050, 2070 and 2100 horizons? How much of the species-friendly habitat is currently covered by the national network of protected areas and could it be the situation at different horizons? What are the implications of the results for the development of future conservation policies for the species?

2. Methodology

2.1. Rationale for the species studied and the MaxEnt model

The genus *Thunbergia* Retz. includes flowering plants of the Acanthaceae family, native to tropical Africa, Madagascar and South Asia. *Thunbergia atacorensis* Akoègninou Lisowski & Sinsin is a perennial suffrutescent, upright grass, 40-80 cm tall, with a small woody subterranean stem and Hispid stem. It is typical of gallery forests and is so far endemic and officially listed as Endangered on the Benin Red List (Neuenschwander *et al.*, 2011). It is said to be confined to the Atacora Mountain Range which has recently been classified as one of the priority sites for the creation of new protected areas in Benin (Adomou *et al.*, 2010). However, since its discovery, and although a summary

study has recently noted its presence in one of the protected areas in Benin (Assédé *et al.*, 2012), no study has been undertaken on its ecology. In addition, it is necessary to extend detailed excavations at least to all Inselbergs of Benin.

Despite the merits of the MaxEnt model, recent studies have shown that it has a lower performance compared to the CLIMEX model for distribution projections on a new continent or under future climate scenarios (Webber *et al.*, 2011). Indeed, on a global scale, while MaxEnt made biologically unrealistic projections, CLIMEX was more conservative in respecting species tolerance limits. However, these problems noted for the MaxEnt model do not constitute one in the present study because it covers a small (national) scale and the reference area for testing and calibrating the model has been limited to West African climatic conditions where species is under the influence of the same climatic factors. Also, the use of the CLIMEX model would have required the availability of good quality data on the eco-physiological tolerances of the studied species; which is not the case for *T. atacorensis*.

2.2. Field of study

This study will be conducted in the Republic of Benin (6° - 12.25° N, 0.40° - 3° E). Benin is located in the Dahomey Gap, a corridor of savannah ecosystems interrupting the West African block of evergreen forest (0° - 3° E) created by Holocene climate change (Salzmann *et al.* 2005). The study will cover the Sudanese climatic zone of Benin (between latitude $11^{\circ} 5'$ N and $12^{\circ} 25'$ N), notably the Atacora mountain range where the species is

confined (Adomou *et al.*, 2010) and the Sudano-Guinean zone characterized by several inselbergs (between latitudes 7 ° N and 9 ° N).

2.3. Data collection

Coordinates of presence of the species

The geographic coordinates (longitude and latitude) of *T. atacorensis* will be recorded from an expedition within protected areas and agroforestry systems through the Atacora mountain range and inselbergs. To these data will be added the contact point coordinates preceding the species, available at the National Herbarium of Benin. The expedition will be made with two hunters from the brotherhoods of hunters of the main villages and / or sites within the mountain range (in particular, Bondjagou, Kobli, Konkombri, Kouandé, Koussoukouangou, Perma, Tanguieta, Tanougou, Tora and Yarpao). These brotherhoods have a great reputation in terms of knowledge of the distribution of rare plants and a long tradition of collaboration with the research units of the Laboratory of Applied Ecology of the University of Abomey Calavi and the National Herbarium, with which we will collaborate in this study.

Bioclimatic and soil data

Current and future climate data for the global area under consideration will be uploaded from the Worldclim website 'www.worldclim.org' (Regional Circulation Model for West Africa). Nineteen (19) bioclimatic variables (Busby, 1991) will be derived from these raw climate data (precipitation and

temperature), prepared and put into formats compatible with the MaxEnt program using the DIVA-GIS version 7.5 software. Current weather data will be derived from 1950-2000 climate data downloaded from the Worldclim version 1.4 databases. For future climate projections, two of the most recommended Global Circulation Models (GCMs) (IPCC 2007, Kriticos *et al.*, 2012) will be used: the Commonwealth Scientific and Industrial Research Organization (CSIRO) model MK3_0, and the MIROC-H model (Center for Climate Research). For these models, we will use projections made for 2030, 2050, 2070 and 2100 under the A2 emission scenario. This scenario will be used preferably because it predicts a situation considered more likely for Africa (Williams *et al.*, 2007). It describes a very heterogeneous world, a population with a high growth rate (15 billion in 2100) with a low level of technology and development. Since the odds for a less dramatic scenario are not zero, modeling of the future distribution of suitable habitats will also be done for scenario B2. This emission scenario assumes: (i) a population with a lower growth rate than in the previous case (10.4 billion in 2100); and (ii) the implementation of the precautionary principle in environmental management, resulting in more conservative predictions of the level of anthropogenic emissions (IPCC, 2007). Given the specificity of the microclimate of the mountains, the 30-second resolution climate layers (a resolution grid of approximately 1 km x 1 km) will be used. Soil type data will be extracted from the Harmonized World Soil Data Base, put in appropriate format and combined with bioclimatic data to model the geographic extent of suitable habitats for the species under present and future conditions and for the scenario A2

and B2. The integration of soil data will also make it possible to refine the results and to limit the possible biologically unrealistic extrapolations.

2.4. Modeling and validation

The bioclimatic variables will be subjected to a correlation test to select those least correlated given the biases that correlations have on future predictions (Elith *et al.*, 2010). A Jackknife test will then be performed on the bioclimatic variables considered to determine which ones contribute the most to the modeling. To evaluate the model, 25% of the points of contact of the species will be used to test the model and the rest of the points will be used to calibrate it. The performance of the model will be evaluated using AUC (area under the curve) (Phillips *et al.*, 2006). A model will be said to be of good quality if the value of the AUC is greater than 0.90 (Swets, 1988). A one-sided binomial test will also be performed to verify whether the prediction of habitat favorable to the species is significantly different from a random prediction.

2.5. Mapping and analysis

Modeling results will be imported into ArcGIS 9.3 software to map the current and future geographic distribution of favorable habitat for the species according to each of the two models used. To assess the present and future capacity of the national network of protected areas to conserve the species, a gap analysis of suitable habitat for protected areas will be carried out by superimposing each result from the modeling of the network of

protected areas. To do this, the map of Benin's national network of protected areas will be extracted from the global map of the global network of protected areas (IUCN and UNEP, 2009). The logistic probability distribution generated by the model will be considered as a measure of habitat quality for the species.

The value of the "maximum training sensitivity plus specificity threshold" will be considered as the zero of the model and the zones with a lower probability will be considered as non-favorable zones for the species. Areas with a probability of occurrence between the "maximum training sensitivity plus specificity threshold" and the "equal training sensitivity and specificity threshold" will be considered as unfavorable and those with a probability above the latter will be said to be very favorable to the species (Liu *et al.*, 2005). The extent of each habitat type (area and percentage) will be estimated using the ArcGIS 9.3 software "spatial analyst" tool. The proportions of habitats currently very favorable and likely to become unfavorable in the future and vice versa will also be estimated according to each climate model.

3. Work plan

Activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Literature review												
Data collection												
Bioclimatic and soil data downloading												
Data treatment												
Data analysis (modeling)												
Download of MaxEnt update version												
Download of maps on diva-gis and UNEP websites												
Writing of manuscript												

4. Budget

Item	Cost (USD)
Laboratory-field-laboratory trip for an estimate of four return trips	400
Local transportation (rental of two motorcycles (\$ 12 / day) + fuel (\$ 12 / day) = \$ 12 * 2 / day * 120 days	2880
Internet, Books, Photocopies	1200
Total	4480

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ISBN 978-99982-51-04-5

