Writing Good Questions, Hypotheses and Methods for Conservation Projects: A Quick Reference Guide

This guide provides a set of basic tips for students and researchers to propose and plan a conservation initiative that is clear and concise. We hope that these suggestions will help applicants to effectively formulate good conservation questions, as well as clear hypotheses and predictions. The document also describes the information that must be included in the methods section of a conservation project. These recommendations will increase the probability of a project being evaluated positively by the reviewers, which will ultimately increase the likelihood of the project being funded.

Correctly Identify the Problem and Research Question

Every project starts with an observed problem(s), which guides the formulation of a question(s) to be answered. Typically, a question must start with **How, What, When, Who, Which, Why or Where**. Identifying the problem and the question to be addressed correctly is fundamental to the success of a project. This ensures that reviewers will know the applicant's thinking process. The more specific the question, the easier it will be to determine the objectives, hypotheses and predictions of the project[1].

Tip: Ask yourself "What is my Question?" If you start answering this by saying "I want to know if….", this will tell you that you have not identified your question correctly.

Examples of well-framed questions:
- "**How** do ecological corridors affect the population size of species X living in fragmented habitat Y?"
- "**How** does environmental education influence the behavior of local community Z toward species X?"
- "**What** benefits can an ecotourism program bring to local community Z?"
- "**How** are ecotourism visitors in area Y affecting the population density of species X?"

Examples of questions that are not correctly framed:
- "We want to know if population size of species X increases with the number of corridors between fragments". This is a prediction, not a question.
- "We want to know if species X is present in area Z". Lack of information is not itself a conservation question.

The question must address something that can ultimately be measured. This means that the question <u>has</u> to be answerable – one that can be used to propose a set of hypotheses that can

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[1] Hailman and Strier. 2006. Planning, Proposing, and Presenting Science Effectively.

be tested and a set of predictions against which one can compare the results from the study[2].

Tip: The questions that you propose to address in your project will be clear if they are framed in terms of specific hypotheses and predictions. We will discuss later in the document how to write good hypotheses and predictions.

Turning the Question(s) into an Overall Goal and Project Purpose

Once the question is clearly written, the overall goal and the main purpose of the study can be proposed. The overall goal refers to the reasonable and expected contribution of the study to broad conservation or social concerns. It represents the vision of the proposal and shows that the applicant thinks about the issues from a global perspective. The overall goal is based on the formal scientific or conservation context from which the study is derived and to which the project will ultimately contribute[3].

The project purpose refers to the specific contribution that the project is hoping to provide, i.e. how the applicant envisions things will be "different" once the project is complete. Contrary to the overall goal, the project purpose is specific to the species, habitat and/or conservation issue which the project will address (Refer to Appendix 1, Case Study, for specific examples).

Defining Project Objectives

The project objectives are the main results of the study; a set of concise statements that provide enough detail to communicate the focus of the conservation initiative or question.

*Tip: Objectives usually start with verbs like **determine, examine, investigate, explore, improve, develop** or **evaluate.***

Examples of objectives:
- **Investigate** the effect of ecological corridors in the population size of species X
- **Develop** an environmental education program to implement with the human community in the area where species X survives
- **Improve** the livelihood of the community in area Y through the creation of an ecotourism program

REMEMBER: Objectives must be SMART: Specific, Measurable, Achievable, Realistic and Time bound.[4]

Writing a Clear Hypothesis and Predictions

Carefully conceived hypotheses demonstrate that the applicant is aware of how the project fits into prior conservation initiatives and research. It also shows to the reviewer that the applicant knows what needs to be tested. A hypothesis is a tentative statement that proposes a possible explanation to the question. Thus, a useful hypothesis must be a **testable statement**[5].

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[2] For more information, refer to section 3.3, problem analysis, in the CLP project Manual. http://www.conservationleadershipprogramme.org/UserDataWEB/ProjectManuals/ConservationProjectManual.pdf

[3] Friedland and Folt. 2009. Writing Successful Science Proposals.

[4] For more details about how to create objective trees, refer to the Conservation Leadership Programme Project Manual, Section 3.4, http://www.conservationleadershipprogramme.org/ProjectManuals.asp

[5] Hailman and Strier. 2006. Planning, Proposing, and Presenting Science Effectively.

Each of the objectives must have one or a set of hypotheses to test, and each hypothesis should have a prediction, typically derived from existing knowledge reviewed in the background section. A prediction is the way the hypothesis will be accepted or rejected when compared with the collected data.

Tip: Predictions should tell you the variables that you are going to measure. Think about them in terms of the ultimate graph of the relationship that you hope to observe. If you write your predictions but you do not know what data you need to collect when you get to your methods section, it means that your predictions are not well proposed.

Examples of hypotheses and predictions:
H1: Connectivity between fragments increases the population size of species A.
Prediction: <u>If</u> connectivity affects the population size of species A, <u>then</u> the number of individuals in an area will be smaller in fragments where no corridors are developed than in fragments connected through ecological corridors.

H2: Environmental education will positively influence the behavior of local communities toward habitat destruction.
Prediction: <u>If</u> education influences the behavior of human communities, <u>then</u> areas in which education activities are implemented will have lower rates of deforestation in the near future than areas where communities do not receive education.

Examples of incorrect hypotheses:
- H1. Species X is found in habitat Y.
  Although presence/absence data can be used, to find a species in certain area is not itself testable and will not provide a solution to the main conservation problem.
- H2. Surveys about the use/consumption of species X will be answered by the local community.
  This is too general to be a hypothesis and it is also not testable. Specificity is important when writing a hypothesis. In this case, a prediction cannot be proposed because the hypothesis does not clearly state the potential variables to measure.

*Tip: A prediction is what is expected if the hypothesis is true. It is useful to state the predictions using **if/then** statements. If the hypothesis is true, then the data will show certain relationships.*

Explain the Methods That Will be Used to Test the Hypothesis
How one plans to obtain the necessary data to test the hypothesis is just as important to a reviewer as the clarity of the questions. Sound methods will strengthen the case for a successful project. The methods section should include information about the study site, the duration of the study, the unit of sampling (e.g. plot, transect, region, point count) and the number of study subjects and sampling units. It is important to be as detailed as possible about the data collection methods; it should include the number of sites, groups and communities with which the applicant is planning to work. One must also detail how differences will be identified between subjects or areas where the data will be collected.[6]

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[6] Creswell. 2009. Research design: qualitative, quantitative, and mixed methods approach

The predictions must be used to determine which data are absolutely necessary to collect in order to test the hypothesis. Established methods and protocols should also be used wherever possible. This will improve the likelihood of collecting good data sets and will facilitate the comparison between the project and other related conservation initiatives, while avoiding the necessity of detailed explanations.

Depending on the data that will be collected, a description of the type of statistical analyses that will be used to test the hypothesis in the methods section should be included. These do not need to be completely specified, but it is not sufficient to say that standardized statistical methods will be used. Find out how other studies have analyzed the type of data that will be collected and which statistical test(s) were used and reference them in the methods. This will demonstrate to the reviewers that the applicant understands the topic, has thoughtfully planned it and is aware of the type of data that needs to be obtained to ensure solid results, conclusions and recommendations.

We hope applicants find these tips and recommendations useful and that following them will help to write successful conservation or research projects. The literature below offers more detailed explanations about project writing. Please read the **case study** below for a specific example of a conservation project.

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Case Study

Background information
Habitat fragmentation poses a severe threat to primate populations around the world, with some of the most unusual primate communities now surviving in highly fragmented habitats. The Atlantic Forest of Brazil,which has suffered greatly from the combined effects of agriculture, forestry and urbanization, now exists only as a complex of remnant fragments constituting a mere 12% of the original 1 million hectares of forest. The Atlantic Forest is the home of the critically endangered Northern Muriqui (*Brachyteles hypoxanthus*). Once vast populations of *B. hypoxanthus* existed in the Atlantic Forest but today only about a thousand individuals survive in small populations in isolated remaining fragments.

Competition and relative scarcity of resources in the fragments led to a rapid decline of *B. hypoxanthus*, even in relatively larger fragments, due to direct mortality. Although the pattern is not typical in other fragmented ecosystems, studies have suggested that fragments in the Atlantic Forest tend to be close to one another, with about 98% of the fragmented forest area within 350 m of another fragment. This provides a unique opportunity to interconnect isolated populations of *B. hypoxanthus*, facilitate female migration to increase gene diversity, and increase the survival probability of these populations.

Overall Goal
Create an interconnected matrix of remaining fragments of Atlantic Forest with the collaboration of landowners and local communities to facilitate the migration of young females of *B. hypoxanthus*, increase genetic variability, and allow small populations with few individuals to emigrate to areas with more resources.

Question
How do ecological corridors affect the population size of *B. hypoxanthus* living in fragmented Atlantic Forest in the area of Governador Valadares, Minas Gerais-Brazil?"

Project Purpose
Evaluate the likelihood and effects of interconnecting four populations of *B. hypoxanthus* isolated in fragments of forests through ecological corridors, in the area of Governador Valadares, Minas Gerais, Brazil.

Project Objectives
O1. Evaluate the likelihood and efficiency of using native seedlings to build ecological corridors in the Atlantic Forest vs foreign/commercial species of seedlings.

O2. Determine the effect of interconnectivity on the populations of *B. hypoxanthus* surviving in the fragments.

O3. Develop an education program with local communities about the importance of connectivity between forest fragments through ecological corridors on the survival of the *B. hypoxanthus*.

Hypotheses

H1. Native species are more efficient to build ecological corridors in the Atlantic forest than foreign/commercial species.
Prediction 1. If native species are more efficient to build ecological corridors than foreign species, then corridors built with native species will show lower rates of mortality of the seedlings than corridors built using foreign/commercial seedlings.

H2.1: Connectivity between fragments increases the population size of *B. hypoxanthus*.
Prediction2.1: If connectivity affects the population size of *B. hypoxanthus*, then the number of individuals per area will be smaller in fragments where no corridors are developed than in fragments connected through ecological corridors.

H2.2. Connectivity between fragments increases the migration opportunities for females of *B. hypoxanthus*.
Prediction 2.2: If connectivity affects the migration opportunities for *B. hypoxanthus*, then the number of young females remaining in their natal groups will be higher in fragments were no corridors are developed than in fragments connected through ecological corridors.

H3.1. Environmental education will positively influence the behavior of local communities toward habitat destruction and fragmentation.
Prediction 3.1. If education influences the behavior of the human community in the fragmented Atlantic Forest, then areas where education is implemented will have lower rates of deforestation in the near future than areas where communities do not receive education.

H3.2. Environmental education will provide an incentive to local communities to protect the ecological corridors.
Prediction 3.2. If environmental education provides an incentive to local communities to protect the ecological corridors, the number of seedlings damaged by human activity and the rates of clearing of ecological corridors will be lower in areas in which education is implemented than in communities where environmental education is not provided.