Wildlife Research Design

Summary, in 12 Steps:

1 Questions
2 Hypotheses and predictions
3 Develop study design
4 Select variables
5 Select recording method(s)
6 Establish acceptable precision
7 Pilot study (preliminary data collection)
8 Quality/quantity assurance
↓↑
9 Final data collection
10 Data analysis
11 Interpret results
12 Publish

1 Develop Questions

List all relevant questions that should be asked during study
Prioritize questions based on importance to the study
Design study to answer fully (in statistically rigorous way) one question at a time
– resist temptation to try addressing multiple questions with limited resources
– better to answer thoroughly one question than partially/weakly answer several
Develop questions from:
Literature review (= key to all research)
Expert opinion
Your own experiences
Intuition

2 Develop Hypotheses and Predictions

Apply hypothetical-deductive approach
Not adequate simply to state hypotheses; also must evaluate predictive value of hypotheses
Should consider how to interpret different/alternative outcomes
– helps ensure informative outcome

3 Design Research

3.1 Clearly define and delineate study population(s)
3.2 Determine the distribution of sampling locations
– see "Sampling considerations and strategies"

4 Choose Variables

Variables must be closely linked to relationship(s) being studied or treatment being tested
Variable selection should be informed by thorough literature review
Keep variable list short
Number of variables determines sample size needed:
General guideline: $n \geq 20 + (3 \text{ to } 5)$*(number of variables); e.g., for 3 variables: $n \geq 30$ to 35

5 Determine Recording Methods

Review all proposed methods for potential biases and degree of precision attainable

Designing field data forms; 4 steps:

5.1 Specify information to be collected

5.2 Select data collection strategy

5.3 Decide recording sequence;

give priority to efficiency and variables affected by sampling

5.4 Design recording structure

– sampling protocol

– data form layout, according to recording sequence

– variable key

6 Establish Acceptable Level of Precision

6.1 Power analysis: effect size detectable at acceptable power (e.g., power = 80%)

6.2 Independent peer review of study plan

7 Preliminary Data Collection

7.1 Observer training: must become competent in all sampling procedures

Requires establishing strict sampling procedures

Training should include:

– visual/aural testing

– standardized recording methods (reduces variance among observers)

7.2 Evaluate data collection procedures

Results may lead to redesign of sampling protocols and data forms

Should include as much of range of conditions as possible

Pre-test sampling vs. Pilot study:

Pretest sampling provides reality check of protocol effectiveness

Pilot study supports evaluation of entire study design, including power analysis

Pilot study generally larger than pretest sampling

Pilot study particularly useful at start of long-term study

8 Quality Assurance / Quality Control

Purpose: to ensure work implemented actually follows study design

QA/QC applies to both data collection and data processing

QA/QC Methods:

8.1 Resample subset of each data set;

e.g., resample veg. plots by different observer team

8.2 Rigorous and repeatable measurement techniques

– minimize sampling errors and observer bias

8.3 In pairs, observers repeat values back to each other

8.4 At end of each recording session, another observer proofs all data forms

– identifies obvious recording errors and illegible entries

– do ASAP because errors are corrected using observer memory

8.5 Each field assistant given responsibility for some aspect of study

– sense of ownership; mistakes not anonymous

8.6 Regular testing of observer abilities

9 Final Data Collection

Frequent feedback between data collection and QA/QC

Data entry, proofing, and analysis done on continuing basis

- do not wait several weeks/months/years before entering data
- requires including data entry, etc. in time budget
- allocating time for data entry, etc. may require reduction in sampling effort

10 Analysis, Hypothesis Testing

10.1 Look at data before conducting "black box" hypothesis testing
- evaluate distributions, outliers

10.2 Evaluate sample sizes relative to variables that can be included, etc.

10.3 Evaluate assumptions (equal variances, normality, etc.) relative to stat. assumptions

10.4 If transform data, evaluate post-transformation distributions relative to assumptions

10.5 For hypothesis testing, establish α a priori, based on relative cost of type I error
- if $P > \alpha$, do not interpret as "almost significant" or make recommendations as if H_0 rejected.
- i.e., do not interpret results as if α is a "floating" value

11 Interpretation

11.1 Restrict interpretations to population of inference (which should be defined in 3.2)

11.2 Consider distributions, not just means: use ecological relevance to determine quantities of interest

11.3 Before comparing with other published results, consider whether those results were correctly interpreted, made relevant comparisons, etc.

12 Publication

Should be published in peer-reviewed media (vs. "gray literature")

Peer review: both editor and referees must be completely independent from the project

Reference: Morrison ML, et al. 2001. *Wildlife Study Design*. Springer-Verlag, NY.
Ch. 7: A Practical Guide to Study Design