

## Scientific writing guide

The following is a summary of advice from Tim Clutton-Brock on scientific writing, coupled with my own manuscript 'formula'.

### Writing

#### General

- **Be clear** and avoid jargon whenever possible.
- **Be consistent.** Use exactly the same words for the same variables or terms in different places.
- **Be concise;** go over your draft and see how many words you can lose.

#### Sentences

- Must have a subject, verb and object.
- **Should be technically correct if taken out of context.**
- Should be correctly punctuated.

#### Avoid

- Starting a sentence with an adverb or a dependent clause. Put the main point first.
- Misuse of conjunctions e.g. only use but or however where there is a real contrast; avoid using however twice in the same paragraph.

#### Paragraphs

- **Usually one main point per paragraph. Be sure you know what it is.**
- **The first sentence should encapsulate the paragraph and subsequent sentences should support, justify, modify or extend it.**
- Paragraphs should never consist of single sentences. Conversely, they should rarely be more than half a page long.
- There should be obvious logical connection between paragraphs.

### Headings

- Two categories (heads and subheads) are usually enough. Multi-level headings are tedious to read. In addition, too many headings encourage lazy writing and lack of logical connection between paragraphs.

#### Captions to figures, tables

- Should be self-supporting wherever possible. Make sure that your terms for particular measures describe them precisely and without ambiguity. Where a measure is a percentage, ensure the reader can tell what it is a percentage of. The precise nature and size of the sample must also be clear.

Before you start:

What is your question? This should guide everything you do

Abstract:

Introduction:

- First Paragraph – Lay out the broader interest area, question and why this is important. Start broad, then identify the specific goal of the manuscript.
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  - Start with a sentence or two identifying an area of interest or outstanding question.
  - Use a single sentence to state what outstanding knowledge/question needs to be addressed.
  - Several sentences outlining why this is important
  - Final sentence summarizing what we need to find out
- Subsequent paragraphs – note that the structure and content here is highly variable between manuscripts.
  - Provide more detail relevant to the main question, developing the hypotheses. You might
    - Discuss concerns that need to be accounted for
    - Identify theory that needs to be developed or informed
  - Discuss previous literature and specifically identify what is novel about your study (some of this will come in previous paragraphs on broader hypothesis).
    - Identify the relevant findings from previous literature.
    - Identify what has not been done and therefore what the specific outstanding question is. For example
      - Question not considered
      - Previous work had methodological flaws
      - Different study system or taxa which might be very different?
      - Whatever you think needs to be addressed.
    - Perhaps finish by summarizing the advances on the issues with previous research identified.
- Introduce your system in one or two paragraphs
  - Describe the system, perhaps with brief details on the species.
  - State why it is relevant to the question
  - Identify why it is particularly useful for the question
  - What we know and don't know about the specific system
  - Provide general information to set the stage.
- Final paragraph
  - Summarise what you will investigate generally and how you will do it.
  - Start with a statement of the main question, then state the subquestions you address to answer this.
  - You'll use the same order of sub-questions in your methods and results. This paragraph is like a road map to the manuscript.

Methods:

- General advice

- o Use subheadings for the main types of data collected with appropriate names for each
- o Always provide brand and headquarters location for equipment used
- o Provide sample sizes
- o Detail any problems during data collection and how these were addressed
- o Use consistent names for factors
- Open with a paragraph (subheaded) about the study site and species including
  - o Study location and dates of research
  - o Study species population
- Sections on observational data collected
  - o Open with a clear statement of the question for which you will collect the data
  - o Make sure to clearly state all details of how this was undertaken
  - o Provide extremely clear predefined definitions for behaviour categories observed
- Sections on experiments undertaken
  - o Open with a clear statement of the question for which you will undertake the experiment, then briefly outline the whole experiment in a sentence
  - o Provide further details on the experimental set-up
  - o Detail steps taken to randomise treatment orders
- Prepared materials – artificial nests, playback exemplars, models for presentation etc. etc.
  - o These are often detailed in separate paragraphs with details of preparation techniques
    - The key point is that these are matched to induce appropriate responses from receivers.
- Ethical permission
  - o This should be mentioned, including permit numbers and a statement on animal handling
- Statistical analysis section
  - o Start with a paragraph on the program used and general statistical tests, checks on data distributions etc.
  - o Include details of model selection methodologies where appropriate.
  - o Detail each major analysis,
    - Once more include a brief description of the question addressed when stating which analysis. For example:
      - To determine whether predation of bird's nests is greater in disturbed habitats, we used a generalised linear mixed model (GLMM) to investigate the likelihood that artificial nests containing quails eggs were predated in clear-cuts, forest edges or forests.

- Then detail the response variable, its distribution and sample size. Then detail the explanatory terms and if using a random model, any random terms.
- If you use the same terms/analysis techniques as in previous analyses, then just say that these were the same as above.
- Group analyses that address the same question together.

#### Results:

- General advice
  - You have to make this into a narrative that follows the structure of the final paragraph of your introduction. Analyses should be in the order defined there and also used in the order within the methods statistical analysis section.
  - Results sections should be brief, often incredibly brief.
- Perhaps open with some brief descriptive overall statistics to set the scene
- Detail the main analysis results with a paragraph for each typically
  - Briefly state the direction of differences and in brackets quote the test statistic (with degrees freedom in subscript), the significance level and the sample size. You might alternatively quote effect size and standard error.
  - Provide Tables for model output. Combine tables wherever possible.
  - Provide figures for all main significant results. Sometimes also include figures for non-significant results where this is relevant for the main hypothesis.
  - Provide mean values and SE's for factor levels where appropriate in quotes on results.
- Where analyses address the same question by different means, then results can be reported in the same paragraph. For example I did both point counts and ad libitum observations of predators in different areas, so in my paragraph on predator abundances, results from both analyses are presented and whether results patterns were similar or different was briefly considered.

#### Discussion:

- General advise:
  - Never make value judgments about your own results (don't say its novel, don't say its impressive etc)
  - Never state that you have 'shown' conclusively that something has happened. In science there is always doubt, so use words like 'Our results indicate that' or 'this strongly suggests' (ok, strongly is a value judgement, but minimize this!).
  - Don't quote results, interesting observations relevant to the findings

can be mentioned when appropriate.

- The first paragraph often leads with your key finding and then runs down the findings from your results which justify this. There is no longer any need to follow the specific order structure for your analyses and results, instead combine streams of evidence from different analyses to support your statements. You can finish with a sentence on the implications.
- Subsequent paragraphs should explore the findings in more detail, each will have a single point and will place the relevance of your findings within the broader literature.
  - Start by stating what the major advance on previous knowledge is.
  - Assess your own findings for concerns about the methodology and indicate your confidence in your conclusions based on this.
- Often results from analyses will speak to other issues beyond your main question, for example you might find an unexpected sex difference in behaviour or something similar. You can address these in separate paragraphs highlighting these additional results. Make sure to do this after first discussing the main question.
- You will also have paragraphs to discuss additional points of interest, constraints or methodological issues of your study, management implications etc.
- You normally end with a summary

Acknowledgements:

- Thank people and organizations who gave you land access, permits, helped collect data, read drafts etc.

References:

- Ideally use a reference software program like endnote or mendeley which will speed things along. Make sure statements are backed up with references where appropriate
- Meticulously check reference lists for errors.

