

Ecology 101

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Let's face it; reviewing, evaluating, or even sitting through faculty and student talks, poster presentations, papers, theses, and dissertations can be an excruciating experience. Whether you are an undergraduate or graduate student or teaching ecology, or you are a full-time researcher or practitioner, the following article provides solid advice and tips for all of us. Thanks to Jamie Smith (deceased), Judith Myers (University of British Columbia, Department of Zoology, Vancouver, BC, Canada) and Isla Myers-Smith, University of Alberta, Department of Biological Sciences, Edmonton, Alberta, Canada), we can all benefit from the following article on effective communication.

If you have created handbooks or guidelines for written and/or oral communications, please feel free to submit them to me for publication in this column.

Tips for Effective Communication in Ecology

Jamie Smith, who passed away in 2005, was a population ecologist and a dedicated teacher and communicator. He put together advice for writing a graduate thesis and giving a talk. We have recently added guidelines for presenting a poster. In his honor we have compiled these notes to spread his sage words of advice to the next generation of ecologists.

Part I. Giving a Research Talk

Giving a good research talk is a useful skill for both undergraduate and graduate students and a necessary skill for those with graduate school or professional aspirations. The following advice applies to the presentation of your ideas at committee meetings, seminars, or at scientific meetings.

Organization

Plan your talk as a series of sections, each with a distinct purpose and with clear links between sections. You can start your talk with a "menu," and notify the audience when you move from section to section. If you get into time trouble, consider dropping an entire section. Most talks contain the following sections:

Introduction

This is a statement of the research “problem,” your talk objectives, and a background of the work of others. Many speakers err by making this too short, or even by omitting it. For a general audience, this section may approach half of the talk; a good rule of thumb is to make it 25%.

Materials and Methods

In this section, you have to walk a fine line between boring the audience with details, and skipping over essential information. It’s better to be too brief than too detailed (people can ask you for more details in the discussion period).

Results

Talk only about the results that contribute to your story. Talk about preliminary findings, if you think they are of interest. This can stimulate discussion.

Take-home message

This should follow naturally from the statement of the problem in the introduction. If it doesn’t, the problem wasn’t stated clearly. Include speculations and suggestions for future work here. Don’t be afraid to leave loose ends; these can promote a dialogue with your audience.

Some talks fall naturally into two or more major parts, each of which has most of the above sections. If a talk gets too complex, however, it becomes hard to maintain a strong story line.

Visual aids

No matter how inexperienced or nervous you are as a speaker, good visual aids will anchor your presentation. Computer-generated graphics created with programs like Microsoft PowerPoint are also standard. The following basic rules apply:

1) Choose your template carefully. A plain white or other pale slide has several advantages (e.g., more space is available, lettering is easier to read). Patterns or photographs as backgrounds should be avoided (see Fig. 1).

2) Choose an easy-to-read, block font such as Arial, rather than a serif font such as Times New Roman. Use LARGE lettering (>28 point). Check to see that your smallest text can be read easily from the back of the room in which you will give your presentation.

3) Choose the color of your text and background carefully. Black/dark blue text on a white or light background optimizes contrast and is easier to read than the old PowerPoint default of yellow text on a blue background. Dark backgrounds in dark rooms can put your audience to sleep. Combinations of either pastel (e.g., yellow on pale blue) or dark colors (e.g., red on blue) may look good on your computer screen, but are disastrous when projected. Don’t forget that some people are red/green color blind.

4) Keep each visual aid simple. A good rule of thumb is to make ONE point per aid. Only write as much as you need to make that point; complete sentences are not required. In the final check of your talk eliminate all unnecessary words.

5) Use colors, arrows, cartoons, and bullets to highlight points.

6) Use graphs rather than tables. Label axes clearly in large letters. Convert your figures to image files or change your presentation to a pdf to prevent formatting problems and compatibility issues. Small tables are OK, but avoid tables with more than 3 rows and 3 columns. Do not cut and paste complicated tables from papers. Instead rewrite and simplify tables, highlighting the most important pieces of data.

7) Avoid bells and whistles like moving objects or bulleted statements that appear only when you click them. Use informative video/audio clips only when they will run on the technology that you will have available for your presentation. It can be effective to use multipanel graphics, adding one panel at a time, but make sure figure labels are legible.

8) When “borrowing” photographs from the internet, credit the photographer/source.

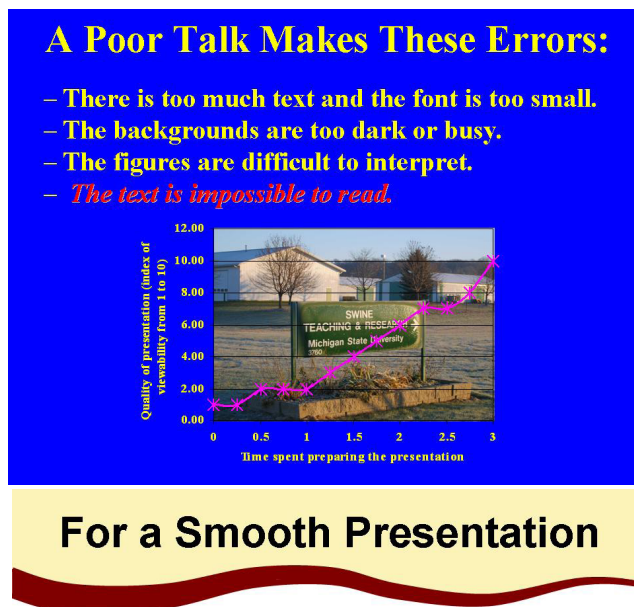
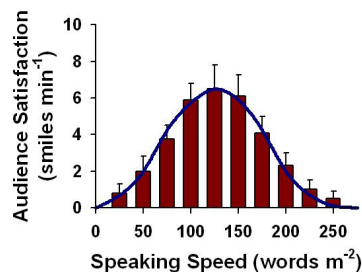


Fig. 1. The difference between a difficult and easy-to-read slide is really striking. It is worth the time to fine-tune the visuals, to allow you to focus on the rest of your talk (photo credit: Evan Kane).

- Plan talk carefully
- Check visual aids
- Practice timing
- Don't read from notes



Speaking skills

Listeners will expect novice speakers to be nervous, and will make allowance for this. Speak slowly, clearly, and simply, in the main, but more flowery language can provide occasional drama. Make your vocal delivery

interesting by varying your tone of voice. Express ENTHUSIASM for your topic. Address your remarks towards the back of the room and make eye contact with members of the audience. Speak louder than in normal conversation, and check that you can be heard. In your first talks, it may help you to write out complete notes, or a list of prompts, but don't refer to such notes more than necessary. If you read your talk, your voice will be a monotone and the pace too fast. People will lose interest in what you are saying. Instead, use your visual aids to prompt you on what to say next. Don't read word-for-word from the screen. Remember that your audience can read faster than you can speak.

Don't pace about the lecture room or play with objects such as pens or loose change in your pocket. If you choose to use a laser pointer, use it sparingly and hold your hand steady. A wooden stick, your hand, or a description of the slide is just as effective. Ask your colleagues to listen to a practice of your talk and offer suggestions for improvements. Time a practice talk, especially if it is for a meeting or exam. It is fine to talk for less than your allotted time (releases more time for questions), but it always offends if you talk for too long. Keep the pace even; a common fault is to start slowly and rush towards the end. Humor can improve a talk, but beware of offensive comments and jokes.

Technology issues

Projectors vary in image brightness and color quality. Visuals that look fine on a good-quality projector may not project well on a poor-quality one. Beware of Mac/PC and software incompatibility problems, although these are getting to be a thing of the past. The best way to be sure your presentation is going to work as you plan is to do a test run in the same room and using the same equipment as you will have on the day of your presentation.

Part 2. Presenting a Poster

Posters are for communicating visually, and are not short papers. They should be designed for rapid communication to tired meeting attendees. Make your poster a standout and people will remember it (Fig. 2). If you wish to include more details, you can make an accompanying handout for viewers to take away.

Criteria for good posters:

- 1) Keep it simple. Don't use too much text. Use a large block font and bold headings, your poster should be easy to read from 2 m away.
- 2) Plan carefully and decide what message you want to get across and which pieces of data will best support this message.
- 3) Use simple, clear graphs, pretty pictures, and remember that "a picture or figure is worth a thousand words."
- 4) Make clear the flow among sections of the poster. Use headings, numbered sections, boxes, and arrows to draw your reader through your story.

Organization

You can organize your poster as you would a paper with an Introduction, Methods, Results, and Conclusion sections; however, you don't need to stick to this format to get all the necessary information across.

Title

Use large print and summarize the main result to draw viewers to your poster.

Introduction

Introduce your research question or hypothesis and outline your objectives here. Use point format, with a maximum of several lines.

Materials and Methods

This section should be very brief. You can put the materials and methods at the bottom of the poster or in figure captions so that the viewer can look at them if they are sufficiently enticed by the research.

Results

Present your results as a few large and uncluttered pictures and graphs. Use brief captions, but clearly indicate statistical significance.

Discussion

In one or two points interpret the results in light of the research question. Why is your work novel and important?

Conclusion

This is what the reader is looking for, keep it clear and concise, and summarize the main take-home message. Many poster readers will skip right to the conclusions if they want to know what your poster is all about.

Authors and affiliation

Include a picture so viewers can identify you if you are not standing beside your poster.

Work in progress

You don't need final results to present a poster! The whole emphasis might be your struggles to define a research question. You can present your proposed research, methods, or experimental design and anticipated or preliminary results.

Printing your poster

Prepare your poster sufficiently in advance so that you have time to have an electronic copy proofread by coauthors and colleagues before printing. Printing your poster can be expensive; using heavyweight paper and laminating are probably not necessary. Cutting and pasting sections on poster board, when done well, can be just as effective, and cheaper.



The Jamie Smith Poster Award: Ecology and Evolution Retreat 2006



Judith Myers¹ and Isla Myers-Smith²

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2. Biological Sciences, Univ. Alberta, Edmonton, Canada



Results

Introduction

Research question:

How to make the most effective poster?

Objective

To improve communication through poster presentations.

Methods

To make a good poster...

- Plan carefully
- Few words
- Clear graphs
- Pretty pictures

Poster viewers like...

1. Simplicity and flow
2. Large block font and headings
3. Text easy to read (from 2m)
4. Clear message

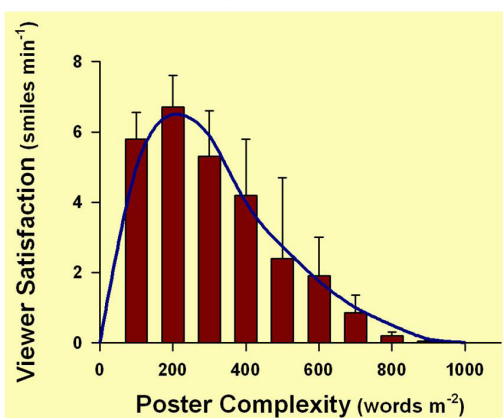


Figure 1. **Hypothetical** relationship between poster complexity and viewer satisfaction. Random sample of 50 posters and 500 viewers at the CSEE conference 2005 (error bars denote SD).

Discussion

- Posters are rapid communication
- Not short papers

Conclusion

The best poster is simple yet makes your work stand out!



References

Karban, R and Huntzinger, M. 2006. How to Do Ecology. Princeton University Press

Acknowledgements



Fig. 2. Sample poster of criteria for the Jamie Smith Poster Award, prepared for the UBC, SFU, and UVic Ecology and Evolution Retreat, 2006.

Part 3. Writing Your Thesis (or Dissertation)

Writing and defending a thesis is a requirement of most graduate programs in ecology. The problem is, you may not be offered any formal training in this task; you may find the following advice useful.

What should a graduate thesis look like?

Although some graduate offices may require a monograph of all questions investigated, data interpretation, and conclusions, many graduate programs now recognize that a thesis can be a set of manuscripts suitable for publication. There are three main reasons for this.

1) Researchers have obligations to granting councils, professional organizations, and to society in general to publish their findings. The more your thesis resembles manuscripts that can be submitted to a journal in your subject area, the less work it will be for you to transform it to published papers.

2) The “scientific paper” is a well-developed format that is designed to tell an internally coherent scientific “story.” Your graduate committee will give you advice on style issues and appropriate academic journals relevant to your discipline.

3) If you are pursuing a career in science, it is vital that you publish some of your work in peer-reviewed academic journals. Typically, graduating Ph.D. students need to have at least three papers (preferably more) accepted by (or submitted to) refereed international journals to have a good chance of obtaining a post-doctoral fellowship.

It is common for a Master’s thesis to consist of a single paper, but some M.Sc. and most Ph.D. theses have two or more research chapters with a general introduction and conclusion of ~3–7 pages each. The thesis should be organized around a coherent theme. The “General Introduction” should describe the overall research problem, outline your approach, and state your objectives for each chapter. The “General Discussion” should pull together the findings of your separate chapters and discuss their joint significance in light of current knowledge. You also may have parts of your research that are independent papers and not included in the thesis.

How long should the thesis be?

Only as long as needed to tell your scientific story! As a rough guide, 30–60 pages of text is a good target for an M.Sc. thesis and 100–130 pages for a Ph.D. thesis. If you did a lot of work, naturally the report will be longer. The shorter the draft, the easier it will be to get critical feedback from your committee and peers, and to publish it as papers.

When should I begin to write?

Don’t wait until all your research is done to begin writing. Anticipate the general form that your thesis may take, and as soon as you have a firm plan that has been approved by your advisory committee, prepare an outline (number of chapters, chapter titles, etc.). It is good to write up the Materials and Methods section as you go along so you will remember the details of what you did (Fig. 3). This makes life much simpler later on. As soon as you have completed your first project, you should write it up. It will be easier to do it while it is fresh in your mind than after you complete your other studies. By writing a manuscript, you can get critical feedback, and learn something about your skills as a writer. If your critics like what you have written (or even if they don’t, and you have the courage of your convictions), you may then submit it for publication. Don’t get too discouraged by rejections. Even famous Ecologists have papers rejected at all points in their careers!

What section should I start with?

After writing an outline, begin with the Materials and Methods, then results, then Discussion, and finally, the Introduction. This may seem backwards, but experience shows that it is easier for most people to introduce a story when they have already written the main elements of it.

Should I write about everything I do?

Write only about work that produced meaningful results (but these need not only be positive results). Rejecting hypotheses is how science progresses, so negative results are valuable. Most research projects encounter one or



Fig. 3. By planning ahead with thesis writing you can avoid become a Peter or Petra Procrastinator.

two blind alleys, and a brief account of these failures may be useful to others. Appendices can be used to archive information that may still be insufficient for a manuscript or thesis chapter, but potentially of use later or to others.

In how much detail should I present my results?

In your main text, present only the information needed to display your key findings clearly. Avoid including many meaningless digits in tables or text (e.g. “ $P < 0.001$, mean difference 3.28” rather than “ $P < 0.00001$, mean difference 3.2769”). Present data in either tables or figures, not both. If you include raw data for archival purposes, place it in Appendices, not in the main text. When presenting statistical results, use the minimum amount of information needed to explain what you did. If you are not sure what this is, look at recent published papers to see. When presenting statistical tests, remember that there are three aspects to these: (1) How big an effect was detected? (2) Was the effect statistically reliable? (3) The precise test you used, the necessary statistics, and degrees of freedom. Most writers play too little attention to effect sizes and too much to noting the statistical significance of the effect. Use confidence intervals, standard errors or interquartile ranges when displaying data as means or medians. Do a power analysis to evaluate the robustness of the result.

In how much detail should I review the literature?

The answer here is: “It depends.” If your subject area has been reviewed well by others, there is no need to reinvent the wheel. Your accounts of the literature/methods should be concise and sufficient only to show that you know what you are talking about. If, however, your area of study has not been reviewed for some time (>5 years?),

or is moving very fast, an extended review might constitute a separate chapter, and may be worth publishing in a journal. Place all your citations in a common reference list. It saves paper and makes the thesis look smaller, thus putting readers in a better mood. Using software such as Endnote to manage your references has an initial learning curve, but saves a lot of time in the long run.

In how much detail should I describe my materials and methods?

If the materials and/or methods you used are standard, you can refer to the published descriptions of others. If you are presenting new or unusual techniques, they will need to be described in more detail. If the Method sections for separate chapters have elements in common, only describe them once and cross-refer to that chapter in subsequent ones.

How can I learn good scientific writing skills?

There are several useful and widely available books on this topic (e.g., the Council of Science Editors style manuals), and advice can be found in the “Instructions to Authors” sections of most scientific journals. A few rules are:

- 1) Write mainly in the first person.
- 2) Avoid starting sentences with “There are” e.g., “There are many reasons for this result such as....” should be “Many reasons for this result are”
- 3) Keep sentences short (mean sentence length <20 words). Avoid complex sentences.
- 4) Use short, direct words, rather than long flowery ones (except for occasional emphasis).
- 5) Keep jargon to a minimum.
- 6) Avoid empty phrases (e.g. “but for the fact that”), ambiguous words (“strategy,” “situation,” etc.), and never use more than one hedging word (“we suggest that”... rather than “we consider it possible that this tentative result might suggest that...”).
- 7) Don’t string lists of nouns together as adjectives.
- 8) Find a writer whose work you enjoy reading and emulate them. Rachel Carson, Steven J. Gould, E. C. (Chris) Pielou, and Richard Dawkins are good role models.
- 9) Write two or three drafts of a chapter/paper and submit it to others for criticism. Few writers can write publishable first drafts; 2–4 drafts are normal. Your advisor and supervisory committee are obvious critics. However, colleagues at another institution may be more objective than your advisor(s). If you choose a critic from elsewhere, ask around to make sure that the person has a reputation for honesty. Plagiarism is rare, but it does happen. When you get contradictory opinions from critics, don’t worry; this forces you to choose one course over another. When you are examined, you will also benefit by knowing that others do not agree about all the issues you have studied. It is better to get your paper criticized early on by “friendly” critics, than later by a harsh external examiner or journal reviewer.

Getting started

It can be painful getting things on paper and exposing your ideas to criticism, and some people find it difficult to begin writing. If you feel this way, begin by writing a small portion describing your Materials and Methods, and get some feedback from your advisor or your peers. Then, expand your horizons step-by-step to a section, a chapter, and finally the thesis, at each point exposing your work first to friendly critics, then to those with high critical standards.

The final steps

When you have written the main parts of the thesis, and had them criticized by others, you can write the introductory and concluding chapters. Then, screen the whole document to eliminate redundancy and check your citations of the literature to make sure that references listed in the text appear in your reference list and vice versa. By this time you will be getting heartily sick of the whole venture! Proofread the finished product carefully, paying special attention to spelling and nomenclature (last thing before you print, run everything through your spell/grammar checker). Readers will still find a sloppy text irritating. The last major piece of the thesis that you need to write is the Abstract. People often don't give the Abstract sufficient attention. Make sure the Abstract is a concise and factual account of your goal(s) and main findings, and polish it carefully. When searching the literature, many people will decide whether to read/cite your paper based only on its title and/or abstract. Get your research committee members to approve your thesis before you submit it for examination. Finally, make sure the format meets your university regulations.

Take-home message

Communication is the most important part of science. To be a successful ecologist you need not only collect good data, you need to share your scientific story through papers and presentations to the rest of the ecological community and to the public. Communication is also a fun part of science. At professional meetings and in papers you can present your own science and be stimulated by the ideas of others. Through effective communication you both advance your own career and that of our discipline as a whole!

For a successful career in ecology, keep communicating!

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