



Promoting the Science of Ecology

Writing with Precision, Clarity, and Economy

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Voices of Experience

Here is a recipe for learning an immense amount about ecology and the work of ecologists. First you meticulously read and evaluate 100 manuscripts: are the questions important? Interesting? Are the methods sound and the results correct? Are the conclusions convincing and supported by the data? How can the presentation be clarified, shortened, sharpened? Now incorporate the results of your questioning along with the independent assessments of several reviewers into a tactful letter that will help the author achieve his own objectives. Help 30–50 of these authors polish their papers until they are ready for publication in *Ecology* or *Ecological Monographs*.

Members of our Board of Editors follow that recipe. When they retire from the Board, each is skilled at helping make good papers better. They also know exactly what's happening at the cutting edge of their discipline.

In the following article, Dick Mack shares his observations on writing, based on three years of editorial experience for our journals. We hope you will enjoy and *use* his recipe for clear, concise writing. We also hope this article is the first in a series to be written by editors. Each will offer new insights on writing, on the review system, or on whatever else comes to mind while reflecting on those 100 manuscripts, 200 peer reviews, countless letters and telephone conversations, and the 380 pages of articles they selected and helped prepare for publication.

—Lee Miller

writing with precision, clarity, and economy

*To be good is noble; but to show others
how to be good is nobler and no trouble.*

Mark Twain (1899)

The Instructions to Authors for *Ecology* and *Ecological Monographs* include the statement: "Write with precision, clarity, and economy." This wonderfully self-illustrative sentence contains some of the most important instructions given to prospective authors, yet it is probably the most overlooked. Based on my experience as a subject editor for the past three years, I contend that verbiage, obscurity, and imprecision in manuscripts slow the editorial process and ultimately hamper communication. Many of my comments and solutions will sound familiar. They should. Our familiarity with them does not, however, make them less important.

Writing with economy.—Inclusion of extraneous material and redundancy between

sections of a manuscript are two big enemies of economical writing. Whole paragraphs often appear in Introductions and Discussions that are only tangentially related to Results. An Introduction should clearly state the manuscript's subject and place it in broad context (the "Big Picture"), then swiftly focus on the specific question(s) that the manuscript addresses. Because of the current emphasis on testing hypotheses in ecology, editors now commonly see each alternative hypothesis erected and discussed at length in a manuscript's Introduction, Discussion, or both. Taken to an extreme, such treatment wastes a lot of print.

Redundancy between Results and Discussion is also common. One way to avoid this duplication is to compare drafts of the Results and Discussion line by line, eliminating sentences in the Discussion that merely paraphrase results. Although the reasons

vary, the Discussion is certainly the section most likely to contain rambling prose. A Discussion longer than one-third of the manuscript should alert the author to check for over-interpretations of the data and irrelevant musings.

Consecutive paragraphs in a poorly written manuscript can often be collapsed into one by eliminating unnecessary sentences. Some authors seem to need a "running start" in each paragraph: they repeat statements made elsewhere, even statements in the preceding sentence. Others seem reluctant to eliminate any sentence once inserted into the text; for whatever reason, the result is a series of loose sentences, each of which says little. And still others try to salvage an awkward sentence instead of scrapping it and starting over (e.g., "Survivorship among later other cohorts that were studied followed similar patterns"). Sentences beginning with the hackneyed construction: "There is (are) . . ." are common in *Ecology*.

Bad syntax makes sentences long, convoluted, and incomprehensible. Compound sentences, used correctly, can link closely related ideas clearly and concisely. Take this run-on sentence, for example: "Evaluation of dating methods, including identification of historically documented cultural horizons in profiles of regional pollen, a 20th-century increase in sediment concentrations of grassland-produced opal phytoliths, ^{210}Pb , and ^{14}C prompted recommendations that ^{14}C dating be restricted to deposits older than 500 yr because confidence intervals approach the radiocarbon age in younger samples and because pollen and ^{210}Pb can provide precise chronologies for sediments deposited since human settlement." A semicolon (plus elimination of verbiage) clears the fog: "Deposits older than 500 yr were dated with ^{14}C ; younger deposits were dated with ^{210}Pb or by identifying cultural horizons with diagnostic pollen or opal phytoliths." A paragraph in which each sentence is followed by an excessively long string of citations frustrates comprehension, particularly when the sentences are the interconnecting pieces of an argument. (I once encountered a simple declarative sentence followed by 26 citations.) So-called freight train strings of adjectives (e.g., "the now actively growing, adult caespitose alien grasses") are a similar though more commonly recognized problem.

Superfluous words also slow down comprehension. We often write with the same verbosity permissible in conversational English. Consequently, I suspect that some manuscripts are transcripts from dictation. A conscientious author can easily eliminate these crutches from his manuscripts; Hart (1976), Day (1983), and Strunk and White (1979) in their excellent *The Elements of Style* all illustrate superfluous expressions. I have assembled expressions that are among those most annoying to me, along with more succinct alternatives, in Table 1. My list was compiled from just six manuscripts submitted to *Ecology*; the potential list of phrases and words to be avoided is, of course, much longer.

Although my intent is not to poke fun at any class of authors, manuscripts prepared from dissertations are the high-grade ore of the problems I discuss here. Theses are rarely in a form suitable for publication. Often the syntax is ponderous and stilted (i.e., passive voice, nondescriptive verbs, and excessive use of negative clauses). Furthermore, the conversion from dissertation to manuscript often seems to have been made in great haste. For example, the statement "(see Chapter III)" was inadvertently left in the text of one manuscript I edited. The marching orders for those preparing manuscripts from theses should be to prune words ruthlessly. All who supervise graduate students should ensure that their students gain a lot of experience in writing concisely and clearly. A primer such as *The Elements of Style* should be issued to each beginning graduate student, and the student should master its contents.

I am not advocating that our journals be reduced to collections of papers with staccato phrases, like the documentation for computer programs. I also do not favor changing our journals to the style of reports in *Science* or letters in *Nature*. But a recent comment by Leslie Real, another editor for *Ecology*, deserves careful assessment. He reports that some ecologists consider *Ecology* and *Ecological Monographs* to be "archival" compared to more "communicative" ecological journals. Perhaps they have gained this impression because some papers are unnecessarily long. If progress is directly related to communication, Real's observation bodes ill for the future of our journals.

Table 1. Common expressions with superfluous words (left column) and suggested substitutes (right column).

The purpose of this study was to test the hypothesis	I (or We) hypothesized
In this study we assessed	We assessed
We demonstrated that there was a direct	We demonstrated a direct
we were responsible for	caused
played the role of	were
On the basis of evidence available to date	Consequently
in order to provide a basis for comparing	to compare
as a result of	through; by
for the following reasons	because
during the course of this experiment	during the experiment
during the process of	during
during periods when	when
for the duration of the study	during the study
the nature of	(eliminate by rearrangement)
a large (or small or limited) number of	many (or few)
conspicuous numbers of	many
substantial quantities	much
a majority	most
a single	one
an individual taxon	a taxon
seedlings, irrespective of species	all seedlings
all of the species	all species
various lines of evidence	evidence
they do not themselves possess	they lack
were still present	persisted; survived
the analysis presented in this paper	our analysis
indicating the presence of	indicating
despite the presence of	despite
checked for the presence of	checked for
in the absence of	without
a series of observations	observations
may be the mechanism responsible for	may have caused
It is reasonable to assume that where light is not limiting	With light not limiting
in a single period of a few hours	in a few hours
occur in areas of North America	are in North America
adjacent transects were separated by at least 20 m	adjacent transects were at least 20 m apart

Table 1. Continued.

in the vicinity	nearby
separated by a maximum distance of 10 m and a minimum distance of 3 m	3–10 m apart
the present day population	the current population; the population
their subsequent fate	their fate
whether or not	whether
summer months	summer
are not uncommon	may be
due to the fact that	(eliminate by rearrangement)
showed a tendency toward higher survival	had higher survival
devastated with drought-induced desiccation	killed by drought

Journals avoid becoming merely archives in part by stressing that all *accepted* manuscripts convey justification, results, and tightly reasoned arguments in crisp, clear sentences and a logical sequence of coherent paragraphs. As William Strunk said, "Vigorous writing is concise." Through careful editing, the purpose of each paragraph, each sentence, and each word in a manuscript should be apparent and defensible. That position may strike many authors as extreme, but I think it is nevertheless a useful goal. The excuses for not taking such care have largely evaporated with the widespread availability of word processors, which make successive revisions convenient and quick.

Editing sometimes yields unexpected results. Most societal journals are budgeted for a maximum number of pages that may be printed each year; the current budget for *Ecology* and *Ecological Monographs* allows 2725 pages. The advice from reviewers and editors may help an author trim so many unnecessary pages that in effect another author's *whole manuscript* can be published. The obvious benefits of that effort are shared by all prospective authors.

A deluge of publications is a permanent part of our professional lives. To an increasing degree, manuscripts not written with economy of expression will receive the Churchillian judgment: "*This paper, by its very length, defends itself against the risk of being read.*" (as cited in Manchester 1983).

Writing with clarity and precision.—Dictionary definitions of *clarity* are: “clearness or lucidity as to perception or understanding; freedom from indistinctness or ambiguity” (*Random House Dictionary of the English Language* 1971). In practice, clarity may simply mean comprehensibility upon first reading (J. R. King, *personal communication*). Despite the obligation to be clear in reporting our methods and results and the results and interpretations of others, problems commonly arise in manuscripts. Yet solutions sometimes appear from unexpected sources. For example, conversational English is often verbose, but it is usually clear. And some of its clarity can be effectively incorporated into manuscripts. Use of the first person avoids ambiguity in the description of experiments (“I divided the population into three equal groups.”) and the presentation of opposing positions (“We believe Smith’s (1983) contention is supported by his results, although Jones (1985) disagrees.”).

Hurlbert (1984) urges editors to insist that the experimental design be described in sufficient detail to permit repetition by the reader. This straightforward practice can reveal ambiguities or missing pieces in the description of a design, and should always be employed by the author before submitting the manuscript. The practice might also reduce cases in which an editor inadvertently changes the meaning of a sentence (a common complaint of authors) because he or she guessed incorrectly about the sentence’s murky meaning. Much misinterpretation also arises through reference to an indefinite antecedent, as in: “The radiocarbon dates define isochrones along the transect that establish a series of stratigraphic profiles. These provided the geomorphic basis for all subsequent analyses.” Does “These” refer to the radiocarbon dates, the isochrones, or the profiles?

Improper word choice also creates ambiguities. The incorrect use of “which” and “that” continues to plague manuscripts. As the *CBE Style Manual* (1983) points out, “which” should only be used for nondefining, nonrestrictive clauses or phrases; i.e., those beginning with “which” add some nonessential information about the subject of the sentence. “That” introduces restrictive clauses or phrases in which the information answers the question “which one?—that one.” Use

“while” to mean “during the time of” and not as a substitute for “although,” “whereas,” “as,” “but,” or “and” (Hart 1976). Neologisms will always be necessary in science, but jargon obscures clarity (e.g., “die-off,” “root-wad,” “feedforward”). An author using a phrase with no single, fixed meaning, such as “spatial and temporal pattern” should define it clearly.

By definition *precision* is intertwined with *clarity*. *Precise* means “definitely or strictly stated; being exactly that and neither more nor less; being just that and no other; carefully distinct” (*Random House Dictionary of the English Language* 1971). Nonetheless many common pitfalls occur through imprecise language alone. Instead of stating that “many” (or “few”) organisms live in the area, state the number (even if in parentheses). Do the same for distances. Were the plants “in the vicinity of” each other (a phrase I consider verbose), “near” each other, or were they “adjacent to” each other, i.e., “juxtaposed”? The prepositions “to” and “with” are often used imprecisely. One compares something “to” something that is dissimilar (“of a different order,” Strunk and White 1979), but compares something “with” something that is related (or at least not of a different order). As the editors for the British Ecological Society point out: “Your reputation will not be enhanced by a permanent record of woolly thinking.” (British Ecological Society 1978).

Precision can also be foiled by a word with multiple definitions. For example, a factor may “decimate” or “devastate” a population. “Decimate” can mean to reduce by one-tenth (as well as to reduce by a great number or proportion), although “devastate” always means lay waste, i.e., cause great destruction (*Webster’s Third New International Dictionary* 1963). Frequent use of an unabridged dictionary is the obvious and probably the unavoidable solution.

Conclusion.—Good writing will not make bad science good (the proverbial sow’s ear into silk purse), but poor writing can prevent good science from receiving the recognition it deserves. We all can list examples of similar points made in contemporaneous papers: one paper is often cited, the other languishes in obscurity. Not only do manuscripts vie for journal space; they ultimately vie for recollection by readers. Memorable papers are clear, brief, and forceful. No one would willingly

consign his work to obscurity, but we do so with imprecise, ambiguous, and verbose manuscripts.

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