Chapter 4

Style, Usage, Grammar, and Punctuation

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And "write it up" they do.
　　—Paul H. Eschmeyer

Introduction

Authors can best ensure that their ideas and results are conveyed effectively by maintaining a constant focus on making their writing easy to read and understand. The primary task of the technical writer is to inform the reader. When a reader is confused or misinformed, the fault lies with the author. Authors therefore must give high priority not only to what they are writing about but also to the way in which they write it. The sheer volume, specialization, and complexities of science make keeping up with the literature increasingly difficult (Peters 1996; Graham and Dayton 2002). Clear scientific writing eases that difficulty. Accordingly, the objective of this chapter is to provide natural resources professionals with guidance on making their writing easy to read and understand.

　　We originally developed the advice in this chapter independently as checklists to remind ourselves of common mistakes that we committed in our technical writing. The lists were designed to facilitate pruning of errors from our reports, theses, dissertations, and manuscripts. In particular, we sought to eliminate the simple mistakes that were notorious for irritating our reviewers and editors, and that were equally notorious for slipping our minds. The checklists helped. We subsequently provided them and related guidance to our students and colleagues, who passed them along to others. Our hope is that this guidance will make writing, editing, and publishing more pleasant and efficient for others as well. Little of it is of our own making. Most was gleaned from those irritated reviewers and editors, and from books and articles authored by experienced technical writers and editors (Gopen and Swan 1990; Day 1992, 1994; Toft and Jaeger 1998; Strunk and White 2000; Williams 2006; AFS 2010),

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especially Eschmeyer (1990). The guidance in this chapter is not intended to be comprehensive but rather to address the most common mistakes and problems that we see in scientific writing about natural resources.

Poor writing can sabotage the reporting of an important scientific discovery. Poorly written manuscripts that describe excellent research are commonly rejected, and well-written manuscripts that describe banal research are accepted. An article that might otherwise have substantial influence on a scientific field may go unnoticed if written poorly, to the detriment of both the author and the field. Whereas articles sometimes go unnoticed because they are "ahead of their time," more often their relevance is underappreciated because the writing is not fully comprehensible (Harley et al. 2004; Sand-Jensen 2007). Structure, organization, and formatting are also significant challenges (Chapter 3), but the language of writing is vital to the success of the final product.

Authors often struggle at length with the details of style, usage, grammar, and punctuation. This struggle prolongs the writing process perhaps more than anything other than procrastination. Authors who are familiar with this struggle often chuckle to themselves at how absurdly optimistic students and colleagues sound when they casually say things such as, "I've finished the research. All I have to do is write it up" (Eschmeyer 1990:1).

The art and skill of writing in a formal, scientific format takes time and dedication to master. The difficulty is innate, and both experienced and inexperienced authors often find that an entire day of "writing" involves little more than editing a few paragraphs. Ultimately, writing, editing, and revising are all parts of the same process (Sindermann 1990). Fortunately, the process becomes less difficult and more efficient as an author develops a sense of proper technical writing style and a working appreciation of grammar and usage. Authors should approach writing in the same way that they approach their science—as a lifelong learning experience that requires focused attention and dedication. They can benefit from studying and emulating excellent writing in much the same way that they pay attention to the technical content of the literature they read. Inexperienced writers can use the work of successful authors as a template when writing about similar studies or experiments, noting especially how sentences, paragraphs, and sections are structured, and how complex points are conveyed simply and succinctly. Emulate the style and format of authors whose writing you find powerful and easy to understand. Those same tactics can improve your writing. Emulating writing style is not plagiarism.

Style

Whereas all writing should aim for "cleanliness, accuracy, and brevity" (Strunk and White 2000:xiii), scientific writing demands increased attention—it needs to be concise, declarative, and absolutely accurate and unambiguous. The requirements of scientific writing often lead to prose that consists of short, declarative sentences written in the active voice that may at first appear devoid of what most people think of as "style." However, style is a broad term that captures all of the choices that an author makes and consistently applies in communicating ideas to the reader (Gopen and Swan 1990); style need not be personal, creative, or stylish. Some elements of style, particularly those relating to structure, are critical to meeting the requirements of high-quality scientific writing.

Authors naturally develop their own writing styles, but personal style is no excuse for poor writing, a case that some inexperienced scientific authors try to make. Inexperienced authors should focus on writing well rather than on developing a personal style. Personal style usually involves clever violations of the principles of good writing and can only develop with experience. Regardless of experience, scientific authors should always be wary of unconventional stylistic devices that can invite criticism from reviewers and editors. In

the words of William Strunk, Jr. (Strunk and White 2000:xviii), "Unless [you] are certain of doing as well, [you] will probably do best to follow the rules." In fact, an argument can be made that a unique personal writing style impedes written communication. Comprehension is greatest of one's own writing. Therefore, communication is most effective if an author's style matches that of the reader. Such homogeneity of style is desirable because it allows the reader to effortlessly understand what the writer is trying to communicate without distractions or confusion. Moreover, English is not the first language of most scientists and natural resources professionals worldwide. Unfortunately for them, English is the *lingua franca* of scientific literature, and technical writing that deviates from the standard style unnecessarily imposes challenges to understanding (Weiss 2005). English is an incredibly difficult language to begin with; adding stylistic flair exacerbates that difficulty. For this reason, as well as the virtual impossibility for an inexperienced author to write well with personal style, we recommend a conservative approach to style.

Conformity of style does not mean that technical writing must be boring and dull. The successful technical writer focuses on writing documents that engage the reader, ease understanding, and flow logically, and that place the needs of the reader above all else. For example, readers have certain expectations about the structure and organization of writing (Gopen and Swan 1990). These expectations apply not only to documents as a whole (e.g., the typical arrangement of sections of a journal article; Chapter 3) but also to paragraphs within a document and sentences within a paragraph. Readers expect specific types of information to be placed in certain locations and often subconsciously use location as a guide to the importance of the material (Gopen and Swan 1990). Thus, structure should be a tool that helps the author pass along information and meaning by guiding the reader to the understanding that the author intends. Four structural principles (Gopen and Swan 1990) help readers get to the point:

1. Subjects and verbs should be placed as close to each other as possible. Readers expect to quickly connect subject with action, and words that come between the subject and the verb are interpreted as being of little importance.
2. Every document, section, paragraph, or sentence should make a single point. Trying to do too much at once almost always results in confusion and causes different readers to come away with disparate interpretations. Careful crafting of topic sentences addresses this principle. All sentences in a paragraph are about a single topic. The topic sentence summarizes that one main idea. All other sentences in the paragraph support that sentence.
3. Place items that provide context at the beginning, in the "topic" position. Authors should provide context that connects the sentence to material discussed previously and sets the stage for the important material in the current sentence. Readers expect to be led to the new and important material gently, and they expect to know right away who or what the sentence is about and why it is relevant (Sindermann 1990). This expectation is also the reason for topic sentences in paragraphs. A sentence in a paragraph about foods of fence lizards therefore might begin with "Fence lizards eat . . . ."
4. Place items that deserve emphasis at the ends of sentences in the "stress" position. Readers expect to "ramp up" to the new and important material; that is, "Fence lizards eat insects." The same principle applies to paragraphs and documents and is the reason that we use a concluding sentence in each paragraph and a concluding paragraph in every document.

Style is more than just structure. It "takes its final shape more from attitudes of mind than from principles of composition" (Strunk and White 2000:84). However, following at least a few concrete stylistic principles is prudent. To that end, we offer the following guidance.

1. ==A logical flow of ideas among paragraphs is essential.== Fortunately, it can evolve easily from a concise outline, which is essentially an ordered set of pithy topic sentences. Always outline a manuscript before you begin writing. A proper outline makes it easier to construct sentences, paragraphs, and sections in a logical manner, and makes the writing process more efficient. The outline need not be overly detailed. In fact, an outline may be a hindrance if it is too detailed; it need only lay out the flow of ideas. Moreover, an outline eases an author past the hardest part of the writing process: getting started. An outline is easily supplemented with lists of supporting points, concepts, and phrases, which later begin to form incipient (and typically ungrammatical and unconnected) sentences. After some text is generated, the dam holding back all of the wonderful material trapped in your mind starts to give way. Just start typing without concerning yourself with grammar and organization, which will come later after the main points and supporting items have been formulated.

2. ==Use topic sentences and logical paragraph structure.== Topic sentences should form easily from entries in a good outline. Every paragraph should proceed as would a good oral presentation: tell the reader what you are about to tell them, tell them, and then tell them what you told them. Authors can check themselves by applying the "highlighter" test: the reader should want to highlight at least the first and last sentences of each paragraph, especially in book chapters, review articles, and Introduction sections of research articles. As an alternative, paragraphs and other sections of research articles can as follow a journalism style wherein the essential elements are put at the beginning, with supporting information following in order of diminishing importance. This structure enables the reader to stop reading a paragraph or section at any point and still come away with its essence. A reader can explore a topic to the depth of their interest without the imposition of potentially irrelevant details or nuances; readers who consider them to be of interest can keep reading. The last sentence of a paragraph written in journalism style would therefore rarely be highlighted.

3. ==Strive for succinctness and brevity.== Every extra sentence, word, or letter is wasteful—to write, print, and read. Cut words and simplify sentences whenever possible. Focus on nouns and verbs rather than adjectives and adverbs. Simple, direct sentences (subject verb object period) convey thoughts efficiently and reduce the chances of making a grammatical error. For example, "Trees grow in forests" is preferable to "Our research activities showed that trees generally grow in forest habitats" or "The data suggest that trees grow in forests." Consider rewriting a long sentence into several short sentences and make sure that each makes a single point in the simplest manner possible. As you compose each sentence, see if it can be made shorter or more direct without a loss of meaning. Try different variations and pick the best. Ask yourself if your meaning could possibly be misconstrued by a naive reader because of ambiguity or lack of clarity or specificity. Find the perfect balance between brevity and completeness in each sentence you write.

4. ==In general, use the active voice instead of the passive voice in sentence construction because the passive voice tends to impart ambiguity.== For example, "The sex of the fish was determined" should be replaced with "We determined the sex of the fish." However, passive voice may be appropriate in certain contexts. For example, the passive "Pollen is dispersed by bees" may be more appropriate than "Bees disperse pollen" in a paragraph about pollen (Gopen and Swan 1990).

5. ==Avoid conversational prose.== In conversation, or when speaking before a group, we tend to speak in rather convoluted and complex sentences, much like this one, that are sequenced and qualified, with various adorning phrases, to conform with the way the mind listens—much of the time anyway—and they are often grammatically incorrect.

Moreover, tone, voice quality, emphases, and facial expressions help impart the true intent of the speaker. However, the mind reads differently. It expects and better understands simple, declarative, and straightforward writing. Therefore, do not simply write your thoughts as you might express them verbally. Furthermore, writing affords efficiencies that speech lacks. For example, we might tell a colleague that "The evidence from the literature suggests that high concentrations of bourbon limit reproduction by brook trout," but when writing that concept we can simply state "High concentrations of bourbon limit reproduction by brook trout (Beam 1954[2])." Including "The evidence from the literature suggests that" in writing would just take up space; the citation imparts that evidence exists to back up the statement.

6. Quotation marks are used to denote the exact words of other authors, but such use is rarely appropriate in scientific writing. Inexperienced writers tend to insert long quotes, perhaps because of insecurity about their own writing; their inability to review, distill, and communicate complex material; or as filler. Authors should learn to summarize the work of others in original integrative statements that provide syntheses germane to the topic under consideration and cite the authors appropriately. Consider the following sentence from Gahagan et al. (2010:1079): "Juveniles that delay migration can be subject to the risk of entrapment in nursery habitat when surface flow ceases." Use of that sentence verbatim without quotation marks and attribution would be plagiarism and could be easily detected online. In fact, "Juveniles that delay migration risk entrapment in nursery habitat" would raise plagiarism concerns as well, because it is only a slightly reworded version of the original. Searches for both sentences lead directly to the source. However, the phrase "risk of entrapment" can be used freely; it is widely used in a variety of contexts and did not originate with Gahagan et al. (2010). Avoid plagiarism by using quotation marks or preferably by restating the information in your own words (paraphrasing) and by citing the source.

7. Use introductory words and phrases sparingly and keep them short; set them off by a comma unless they do not pose the risk of misinterpretation. Common introductory words and phrases are "To," "In," "On," "At," "During," and "Given that." Deleting them or inverting such sentences to place the subject at the beginning can increase directness and readability. For example, "In 1998, we sampled fish at eight sites" reads more clearly as "We sampled fish at eight sites in 1998." Consider "In the Missouri River mainstem, below Hauser Dam, where the spawning habitat is limited, relative to the large population of rainbow trout, the presence of multiple redds and superimposition was common." Those four introductory clauses would sound dramatic and persuasive in making a point orally, but "Multiple redds and superimposition were common in the Missouri River below Hauser Dam where spawning habitat was limited for abundant rainbow trout" is preferable in technical writing.

8. Limit the use of nonrestrictive clauses, phrases, and appositives. Nonrestrictive elements are not essential to the meaning of the sentence. A good test is to consider whether the clause, phrase, or appositive could be placed in parentheses or deleted without changing the meaning of the sentence; if so, it is nonrestrictive. Nonrestrictive elements often impair readability by creating a break in the flow of the sentence; long nonrestrictive elements are especially cumbersome. Consider moving a nonrestrictive element to its own sentence or removing it entirely. Parenthetical phrases or statements placed anywhere (such as here) except at the end of a sentence will impair readability. The reader will need to reread the sentence, skipping the parenthetical statement the second time through. Parenthetical constructs in general are usually afterthoughts or digressions that can often

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[2] A fictitious reference.

     simply be removed. Excessive parenthetical statistical results can make a Results section virtually unreadable (Sand-Jensen 2007). Such statistical results can often be collected in tables (Chapter 6).

9. Red flags that identify indirect and inefficient sentences for citing supporting work are the words "found," "demonstrated," "determined," "documented," "observed," "reported," "revealed," and "showed." For example, "Jones and Smith (1692[3]) found that trout live in water" can be shortened and made more direct as "Trout live in water (Jones and Smith 1692[3])" by excising "found that" and inverting the sentence. The subject of the sentence is now the trout, which are probably what the author and readers are really interested in, not the long-dead and irrelevant authors. An exception is the description of the historical development of a topic when "what" is less important than "who" and "when."

10. Avoid redundancies. If you repeat the same phrase or concept in consecutive sentences, either (1) combine the sentences, or (2) delete the redundancy from one sentence and improve the transition between the two to make the redundancy unnecessary. If you repeat the same phrase or concept at different places in a paragraph or section, unite those two parts such that the phrase only has to be used once (or the concept only has to be covered once). If you introduce a topic once and then have to remind the reader of it again later, that typically means that you drifted away from the topic. Whenever this happens, excise and move the intervening material and coalesce the separated topic.

11. Use abbreviations only when they contribute to readability, and be sure to define them. Usually this is done when the abbreviated term is first introduced, as in "data from the U.S. Environmental Protection Agency (EPA) . . . ." If you use an abbreviation only a few times, consider using the long version in each case; this keeps the reader from having to go back to the original definition. Never introduce and define an abbreviation that is used only once or twice. Do not use abbreviations in the Abstract section of a journal article.

12. Never start a sentence with a digit or an abbreviation, including abbreviations of genus names (e.g., "*M. salmoides* prefers . . ."). Rewrite the sentence to place the number or abbreviation elsewhere in the sentence. If the sentence is best with a number at the start, spell it out (e.g., "12 mice survived . . ." becomes "Twelve mice survived . . ."). If an abbreviated term needs to stay at the start of the sentence, it too should be spelled out (e.g., "NOAA . . ." becomes "National Oceanic and Atmospheric Administration . . .").

13. References to tables and figures should usually be parenthetical and follow a summary of something contained in the table or figure. For example, "Growth rates were significantly higher in the first trial than in the second and third trials (Table 1)." Simply sending the reader to a table or a figure without mention of what they will find there is not helpful; "Table 1 contains data from the first three trials" wastes time and space. If you cannot say something about the content of a table or figure, it is probably superfluous and can be deleted.

14. Check table and figure captions to be sure that they include all of the information needed to understand them. Tables and figures should be able to stand alone without reference to the text; Chapter 7 provides guidance on when to use each.

15. Avoid "I wish to thank . . ." and similar constructs in the Acknowledgments section. The wish is fulfilled if "wish to" is simply omitted. Consider using only initials for the first and middle names of individuals listed in the Acknowledgments. This format saves space, and initials are usually adequate to identify the target individuals. Consider organizing the names in alphabetical order. Journal policy may dictate how names are to be listed.

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[3] A fictitious reference.

Usage

Usage is the manner in which language is used, in particular, the way in which a word or phrase is normally and correctly used. Scientific writing adheres to standard English usage for the most part but has its own peculiarities and conventions.

1. Avoid superlatives (e.g., "very," "extremely"), humor, and undue enthusiasm ("dramatic differences," "striking results"); be professional. Be declarative and avoid qualifiers (e.g., "fairly," "rather," "somewhat"). Scientists should be especially wary of qualifiers because of our tendency to shy away from definitive conclusions even when doing so is reasonable.

2. Avoid the use of "former" and "latter." These words invariably make the reader go backwards to assess meaning. Rewrite the sentence, repeating original words or phrases if necessary.

3. Avoid the word "respectively." The word is often used at the end of the list and is preceded by a comma, as in "Correlations were 0.56, 0.45, and 0.85 for coho, sockeye, and Chinook salmon, respectively." Such constructs make unnecessary work for the reader. The word can sometimes be removed without loss of meaning. When "respectively" seems to be necessary, the sentence can be rewritten to connect the items directly, as in "Correlations were 0.56 for coho salmon, 0.45 for sockeye salmon, and 0.85 for Chinook salmon."

4. When reporting comparative results (e.g., higher, greater, slower), always include what the finding is being compared, as in "Mouse density was greater near the potato chip factory than next to the chemical plant." Do not leave a reader asking "greater than what?" The comparison may not be obvious.

5. Be consistent. If you refer to an area as "Study Reach 1," do not shift to "study reach one" elsewhere.

6. The word "that" is used with restrictive (defining) clauses and "which" is used with nonrestrictive (supplemental) clauses. For example, in "the one that got away," the "that got away" is necessary to define the fish that is being discussed. The nonrestrictive use in "the fish, which got away, . . ." may be suitable but only if the fact that the fish got away is not important to the rest of the sentence. In scientific writing, "which" is often used inappropriately where "that" is the correct word, perhaps because "which" sounds more formal. If a phrase aches to be set off by commas, "which" is the word you want. Set the phrase off with commas to add clarity and be sure that the phrase beginning with "which" refers to whatever came immediately before the leading comma.

7. The word "like" is a preposition and is appropriately used to introduce a modifying phrase (e.g., "the blue crab, like most swimming crabs, has . . .). In such uses, "like" serves as a substitute for "similar to." "Like" can be ambiguous when used as a conjunction to join clauses, words, or phrases ("Fish like dolphin") and such use should be avoided; use "such as" instead and avoid confusion.

8. The word "with" is best restricted to use as a preposition. It is often carelessly used as a conjunction to append afterthoughts to completed sentences. For example, "A variety of sizes was caught, with the largest fish being 112 cm." Rewrite the sentence and substitute "and" for "with" or use a semicolon, as in "A variety of sizes was caught and the largest fish was 112 cm" or "A variety of sizes was caught; the largest fish was 112 cm."

9. Replace the adverbial form of "likely" with "probably" unless it is preceded by an intensive (e.g., "very," "more," "most"). "Likely" can be used as an adjective, as in when describing probability ("a likely outcome").

10. Replace long, polysyllabic words with their simpler counterparts; simpler words are more effective and efficient than longer ones. Attempts to sound scholarly through the

use of polysyllabic words where simpler ones suffice are transparent to reviewers and editors. Common examples, with simpler counterparts, are shown below. Use a thesaurus to find others. Unless dictionary definitions clearly favor the polysyllabic word, use the simpler word.

Pompous polysyllabism	Simple word
additionally	also
approximately	about
consumed	ate
currently, presently	now
exacerbate	worsen
enumerate	count, list
excepting	except
exhibit	show
following, subsequent to	after
individual	one, person
initially	first
majority	most
methodology	method
numerous	many
partially	partly
prior to	before
relationship	relation
remainder	rest
reside, inhabit	live
retained	kept
subsequent	later
succumbed	died
sufficient	enough
summation	total
termination	end
utilization, utilize	use

11. The word "parameter" has a specific meaning in mathematics and statistics. A parameter is a quantity that cannot be measured directly and has to be estimated. "Parameter" should therefore not be substituted for "variable," "quantity," "quality," "determinant," "feature," or other similar words in an effort to sound scholarly.
12. "Autumn" is preferable to "fall" because "fall" has multiple meanings. In fact, use of "fall" in place of "autumn" is largely restricted to North American English today.
13. Beware of homophones; spell-checkers will not alert you to errors. Common misapplications abound: auger, augur; capital, capitol; censor, sensor; course, coarse; complement, compliment; defuse, diffuse; discrete, discreet; grisly, grizzly; lead, led; naval, navel; pique, peek, peak; principle, principal; role, roll; stationary, stationery; sight, site, cite; taught, taut; their, there; too, to, two; vial, vile. Similar-sounding word pairs are also often misused as well: affect, effect; climatic, climactic; historic, historical; elicit, illicit; eminent, imminent; flaunt, flout; lightning, lightening; mute, moot; predominant, predominate; tact, tack; varying, various.
14. Avoid the word "quite." It means absolutely, completely, or to the fullest extent as in "quite right." It is ambiguous and slangy when used to mean somewhat or to some degree.

15. Resist the temptation to use the word "impact" in place of "effect" (typically a noun) or "affect" (usually a verb). Despite its common use, "impact" is inappropriate in scientific writing unless you study collisions or concussions. "Effect" can be a verb that means "to bring about" ("Darwin's theory effected a change in how we view life"), but it is used rarely in that manner and causes confusion. "Affect" can be a noun, but only in reference to facial signs of emotions or feelings, and is pronounced differently, as in "Eric exhibited no affect as the boat rolled off of the trailer and crashed down onto the boat ramp."

16. The whole "comprises" the parts (e.g., "The family comprises 20 species") and the parts "compose," "constitute," or "make up" the whole (e.g., "The family is composed of 20 species"). The construct "is comprised of" is incorrect (e.g., "The family is comprised of 20 species").

17. "Between" refers to two things, whereas "among" refers to three or more.

18. "While" refers to time (at the same time as) and has traditionally been considered inappropriate as a substitute for "whereas," "although," "and," or "but." The same goes for "since" (in the time after) when used in place of "because." These words are especially problematic when used at the start of a sentence.

19. The phrase "due to" can substitute for "caused by" or "attributable to" but not "because of." "The elevated water temperatures were due to higher air temperatures" is correct but "The water temperatures were elevated due to higher air temperatures" is not. Avoid use of "due to" altogether and you will avoid using it incorrectly.

20. Never use "and/or" ("electrofishing and/or seining"). Often the simple "or" suffices. However, if samples are taken only by electrofishing at some sites, only by seining at others, and by both methods at yet others, the correct usage is "electrofishing or seining or both."

21. The abbreviation "e.g." means "for example" (*exempli gratia*) and "i.e." means "that is" (*id est*). Thus, "e.g." should be followed by specific examples of something already mentioned, whereas "i.e." introduces an explanation and can substitute for "in other words." Both are always followed by a comma (when used in their normal context, not as in this paragraph). The periods are necessary because they are abbreviations. Phrases or lists that begin with "e.g." should never end with "etc.," which would be redundant. The construction "and etc." is also redundant. The abbreviation "et al." means "and others" (*et alii*); a period follows "al." but not "et" because "et" is not abbreviated.

22. The word "via" is an appropriate substitute for "by way of," but not "by means of." "We traveled to Newark via the interstate" is correct, but "we traveled to Newark via limousine" is not.

23. Do not use "feel" in place of "think" in scientific writing. "We think additional research is needed" is appropriate, but "We feel additional research is needed" is not. Many writers also avoid "believe" in this context.

24. When used to mean "nevertheless," the word "however" is typically found at the beginning of a sentence or more rarely after a semicolon. It is followed by a comma unless it is being used to mean "in whatever way" or "to whatever extent." If you use the word as a conjunctive adverb to mean "nevertheless" in the middle of a sentence without a preceding semicolon, you have probably used it improperly or have created a sentence that is more complicated than it should be for technical writing. For example, "All 105 samples have been preliminarily aged, however final ages will not be estimated until all samples have been prepared" is incorrect. The simplest fix is to insert a semicolon and comma: "All 105 samples have been preliminarily aged; however, final ages will not be estimated until all samples have been prepared." Other conjunctive adverbs that should follow semicolons include "consequently," "furthermore," "likewise," "moreover," "nevertheless," and "therefore."

25. Ruthlessly prune "weasel words" such as "appears," "could," "may," "perhaps," "possibly," and "seems" from Discussion sections. Except in rare cases, findings are insufficient to permit unqualified conclusions such that the equivocations are implicit. Overuse of equivocations weakens a section that needs to be confident and conclusive. A paragraph loaded with weasel words is probably too speculative and should be removed.

26. Both "fishery" and "fisheries" are now used as adjectives with the same meaning ("fishery management," "fisheries management") but should be used consistently in a document to avoid confusion. Traditional usage distinguished between references to a single fishery versus multiple fisheries. When used as nouns, "fisheries" is the plural of "fishery."

27. Specific names can be used in two ways: as the species (singular) or as a number of individuals of that species (plural); that is, "the westslope cutthroat trout has a limited distribution" versus "westslope cutthroat trout are limited in distribution." Avoid alternating between the two, especially in the same sentence, as in "the westslope cutthroat trout is sparsely distributed throughout their historic range."

28. Write out the full common name of a species or subspecies the first time you use it in each paragraph ("westslope cutthroat trout"). Thereafter, within that paragraph only, you can simply use "trout" to improve readability but only if the reader cannot possibly confuse these fish with other trout. Similarly, if you state that total lengths (TL) of fish were measured and never mention other types of length measurements (e.g., standard length, SL; fork length, FL), you need not repeat "TL" after each length reported.

29. "Fish" is the plural of "fish" as in "The sample was made up of 10 fish: three carp and seven bluegills.") "Fishes" is the plural of "species of fish" as in "The sample included only two fishes."

30. The plural form of most fish names is formed by adding "s" (or occasionally "es" or "ies") to the singular form when referring to a number of individuals of the same species (one bluegill, seven bluegills). The plural is the same as the singular for several dozen names (e.g., carp, grayling, snapper); AFS (2010) includes the complete list. Only seven fish names have two acceptable plurals (Dolly Varden, Dolly Vardens; drum, drums; kokanee, kokanees; ruffe, ruffes; sculpin, sculpins; sturgeon, sturgeons; tilapia, tilapias). Reference to a number of species within a taxonomic group (as opposed to individuals) requires a plural ending (e.g., carps, graylings, sculpins, sturgeons).

31. For scientific names, genus and species names are italicized and the species name is not capitalized (e.g., *Etheostoma vulneratum*). Family and higher-level names as well as authority names are capitalized but not italicized (e.g., Percidae, *Etheostoma vulneratum* Cope). Vernacular forms of family or higher-level names are not capitalized (e.g., percid), and the abbreviations for species are not italicized (e.g., *Etheostoma* sp. and *Etheostoma* spp.).

32. Check the spelling of all scientific and geographic names and any unusual terms. Authoritative references for most taxa are available from professional and scientific organizations.

33. The words "community" and "population" are commonly misused, as in "rodent community" and "juvenile fish population." An ecological community refers to all interacting organisms (plants, bacteria, animals) living in sympatry. Because all ecosystems except those solely occupied by bacteria include other taxa, no such thing as a "rodent community" exists. "Rodent assemblage" is the proper term. Similarly, "population" has a specific meaning and should not be used carelessly to refer to any group of animals.

34. All numbers between 0 and 1 (and –1) need a 0 before the decimal point (i.e., "0.35" not ".35"). Many journals require that you spell out any numbers less than 10; check the instructions to authors.

Grammar

Grammar is the set of structural rules that governs use of a language. Grammar is not as flashy as style but is just as important. An author's grammar is often considered indicative of his or her approach to science; poor grammar suggests equally poor science. Proper grammar conveys a dedication to making sure that details are in order and instills confidence. Improper grammar indicates ignorance or sloppiness, neither of which inspires confidence. The duty of the author is simply to be correct. Mistakes tend to stand out and draw attention, and readers have enough work to do without having to stumble over grammatical errors. Fortunately, grammar is typically more straightforward than style and therefore requires less contemplation. Many excellent guides exist to serve the author in this task, some of which are freely available on the Web (Lynch 2011; Purdue University 2012). The Grammar Girl Web site (http://grammar.quickanddirtytips.com/) is searchable and offers easily understood guidance.

1. Parallel structure is the repetition of a chosen grammatical form within a sentence. For example, in "We sampled leaves, insects, and characterized the atmosphere," "characterized" (a verb) is not parallel to "leaves" and "insects" (nouns). "We sampled leaves, insects, and atmospheric characteristics" enhances readability by continuing the initial pattern.

2. Check for subject-verb agreement. In particular, singular subjects need singular verbs and plural subjects need plural verbs. Errors typically occur when the subject and verb are far apart, as in "The use of piscicides, electrofishing, and gill nets in streams are prohibited." A common error is to use a singular verb with certain plural subjects (singular form in parentheses): "data" (datum), "annuli" (annulus), "media" (medium), "bacteria" (bacterium), and "strata" (stratum). "The data on this bacteria is limited" should read "The data on this bacterium are limited."

3. Singular verbs require singular modifiers, and plural verbs require plural modifiers. Singular modifiers include "little," "much," and "this." Plural modifiers include "few," "many," and "these." For example, "few of these data are relevant" is correct, but "much of these data are relevant" is not.

4. Avoid confusing dangling participles, especially "using." A participle is a verb (e.g., "use") that acts like an adjective ("using"). It dangles when it modifies the wrong noun. For example, in "We caught the crabs using a trotline," it is unclear if we used a trotline to catch the crabs or if we caught the crabs using a trotline for some nefarious purpose. Often the sentence is clearer when "using" is replaced by "with," as in "We caught the crabs with a trotline," but even that could be misconstrued; they might have been absconding with it. "We used a trotline to catch the crabs" avoids the participial phrase and the confusion. Granted, the example is a bit far-fetched. Perhaps "We criticized our colleagues using bad grammar" might be more likely.

5. The pronoun "it" should not be used to begin a sentence without a proper antecedent, as in "It was a good idea to write this chapter." It can be used in a sentence such as this one, in which the word it refers to is clear. Similarly, never start a sentence with "There were . . ." (or there are, was, is), as in "There were significant differences among the treatments." "There" is confusing because it normally refers to a place and makes the sentence longer than it needs to be. The sentence can be rewritten to read "Significant differences existed among the treatments" or maybe even better "The treatments were significantly different," depending upon which is more important—the differences or the treatments.

6. Avoid using strings of nouns and adjectives to modify a terminal subject noun (stacked modifiers). For example, in "forest-litter frog diet resource-partitioning patterns," determining the subject noun is difficult. For clarity, put the terminal subject noun "patterns"

closer to the beginning of the sentence and break up modifiers with prepositions. For example, we could replace the string with "patterns in resource partitioning of diets of forest-litter frogs." Scientific jargon often appears in stacked modifiers and impedes readability.

Punctuation

Complicated punctuation often leads to poor grammar. Stick to periods and commas as much as possible. Use other punctuation only when absolutely necessary, and be certain of proper usage.

1. A colon (:) that precedes a list should follow an introductory phrase that could stand alone as a sentence and should never be placed between a verb and its direct objects. For example, "The sample included three species. They were: oxeye daisy, Russian knapweed, and musk thistle" is doubly incorrect. The correct construction is "The sample included three species: oxeye daisy, Russian knapweed, and musk thistle." A colon is used correctly when it can be replaced by "namely" ("The sample included two species, namely, oxeye daisy and Russian knapweed.")
2. Commas and almost all other punctuation marks should not precede a parenthesis.
3. A comma should precede "and" or "or" in a series of three or more items. For example, the second comma in the phrase "bluegills, anchovies, and mud crabs" is necessary; it improves readability and precludes ambiguity.
4. Semicolons (;) can enhance writing when used correctly; however, they are often misused. Semicolons are used to join two grammatically complete and independent but closely related statements into a single, compound sentence. For example, "Three estimates were made for each rotifer; the mean of the three was used in analyses."
5. Avoid side-by-side parenthetical expressions within sentences. For example, "(*Callinectes sapidus*) (Figure 2)" is better written as "(*Callinectes sapidus*; Figure 2)." If parentheses are needed within another set of parentheses, replace the interior set with brackets or (preferably) rewrite the sentence.
6. Never use an exclamation point (!), and be sure that a question mark (?) is appropriate—chances are good that it is not.
7. Avoid apostrophes ('). They are not needed in dates (e.g., 1990s is correct; 1990's is not), and you should never use contractions (e.g., "shouldn't") in technical writing. Also, limit possessives if possible ("the angler's opinion" can be replaced by "opinion of the angler").
8. Hyphens (-) are used in compound adjectives (e.g., "light-absorbing layers") and between a measurement and its unit when the two are used as an adjectival modifier for a following noun. For example, "Sample sites were located at intervals of 50 m; the 50-m spacing precluded disturbance of adjacent sites." Hyphens are usually omitted after the prefix "non." Hyphens are not used in two-word modifiers that include adverbs ending in "ly." For example, "terminally-molted crabs" should be "terminally molted crabs."
9. Dashes (–) can be used to indicate numerical intervals (6–10 mm), but replacing them with the word "to" (if preceded by "from") or "and" (if preceded by "between") enhances readability: "from 6 to 10 samples" and "between 6 and 10 samples." Note, however, that "between 5 and 10 samples" literally means from 6 to 9 samples, because these are *between* 5 and 10. "Between July and September" therefore refers only to August. "From July through September" may more accurately describe the intent of the writer.
10. Nonrestrictive elements needed for emphasis can be set off by commas or dashes if they do not impair readability. Dashes are used to announce a long appositive—a noun or

noun phrase that adds identifying information to a noun it follows—or to set off apposi-tives that contain commas to avoid confusion. Dashes are also used to give more em-phasis to a nonrestrictive element than would be provided by commas. In contrast to pa-rentheses, dashes are underused in scientific writing and can enhance readability when used judiciously.

11. A forward slash or solidus (/) is appropriately used only as a mathematical sign for divi-sion, a substitute for "per," or in URLs (Internet universal resource locators).

12. Closing quotation marks should be placed outside of punctuation such as commas and periods.

Final Steps

After completing a draft and checking it against the guidance provided in this chapter, put the draft away for at least 3 days. Do not show it to anyone, and do not work on it again until it has started to drift from your thoughts. Doing so gives you a fresh perspective and enables you to see typos, errors, and areas for improvement that you missed earlier. Double-check everything, taking special care to ensure that you adhere to the prescribed format. The end product will suffer if you are writing under a tight deadline and have not scheduled this extra time. Both friendly and formal reviewers, and especially editors, will respond more favorably to an error-free manuscript than one prepared hastily with many simple mistakes. Manu-scripts are routinely rejected for reasons totally unrelated to scientific content; be meticulous and avoid the embarrassment.

Acknowledgments

References

AFS (American Fisheries Society) 2010. A guide to AFS publications style. American Fisheries So-ciety, Bethesda, Maryland. Available: http://fisheries.org/docs/pub_stylefl.pdf. (April 2012).

Day, R. A. 1992. Scientific English: a guide for scientists and other professionals. Oryx Press, Phoe-nix, Arizona.

Day, R. A. 1994. How to write and publish a scientific paper. Oryx Press, Phoenix, Arizona.

Eschmeyer, P. H. 1990. Usage and style in fishery manuscripts. Pages 1–25 *in* J. Hunter, editor. Writing for fishery journals. American Fisheries Society, Bethesda, Maryland.

Gahagan, B. I., K. E. Gherard, and E. T. Schultz. 2010. Environmental and endogenous factors in-fluencing emigration in juvenile anadromous alewives. Transactions of the American Fisher-ies Society 139:1069–1082.

Gopen, G. D., and J. A. Swan. 1990. The science of scientific writing. American Scientist 78:550–558.

Graham, M. H., and P. K. Dayton. 2002. On the evolution of ecological ideas: paradigms and sci-entific progress. Ecology 83:1481–1489.

Harley, C. D. G., M. A. Hixon, and L. A. Levin. 2004. Scientific writing and publishing—a guide for students. Bulletin of the Ecological Society of America 85:74–78.

Lynch, J. 2011. Guide to grammar and style. Available: http://andromeda.rutgers.edu/∼jlynch/ Writing/. (April 2012).

Peters, R. H. 1996. The ecology of science policy. Journal of Lake and Reservoir Management 12:407–419.

Purdue University. 2012. Online writing lab (OWL). Available: http://owl.english.purdue.edu/owl/. (April 2012).

Sand-Jensen, K. 2007. How to write consistently boring scientific literature. Oikos 116:723–727.

Sindermann, C. J. 1990. Scientific writing as English prose. Pages 75–78 *in* J. Hunter, editor. Writing for fishery journals. American Fisheries Society, Bethesda, Maryland.

Strunk, W., Jr., and E. B. White. 2000. The elements of style, 4th edition. Longman, New York.

Toft, C. A., and R. G. Jaeger. 1998. Writing for scientific journals I: the manuscript. Herpetologica 54 (Supplement):S42–S54.

Weiss, E. H. 2005. The elements of international English style: a guide to writing English correspondence, reports, technical documents, and Internet pages for a global audience. M. E. Sharpe, Armonk, New York.

Williams, J. M. 2006. Style: the basics of clarity and grace, 2nd edition. Pearson Longman, New York.