

GUIDANCE FOR SCIENTIFIC WRITING

I'll call for pen and ink, and write my mind.

– King Henry VI, part I, V, iii

I have not yet written a book on English usage or scientific writing. But on the following pages I have laid out a few principles of good writing in the sciences, which I hope may help you organize your own writing. I have also compiled some tips to help you avoid the common and easily cured grammatical and syntactical errors that I see routinely on written work in my four ecology courses. Learn the principles of clear writing and how to avoid the simple mistakes. By following a few simple guidelines, you can ensure that your writing is clear, precise and readable. You will benefit in every science course you take, and in everyday life as well.

The guidance is organized into three sections:

- A. General rules to follow
- B. Some traps to avoid
- C. Commonly misused words and phrases

A. General rules

1. Write in discrete **paragraphs** organized around a **topic sentence**. When the flow of ideas moves to another topic, begin a new paragraph. Paragraphs are normally 3-8 sentences long.
2. Use **specific subjects** and **active verbs** wherever possible. Avoid using abstract terms as the subject of a sentence.

Lipid extraction and saponification were carried out in 5 ml of KOH/methanol . . .

Better: Lipids were extracted and saponified in 5 ml of KOH/methanol . . .

Better: Leaf disks were immersed in 5 mL KOH/methanol to extract and saponify lipids.

The amended sentences have specific subjects (lipids, leaf disks) rather than an abstract concept (extraction and saponification).

Avoid “roundabout” sentences beginning with *There is* or *There are*:

There are a number of factors that can affect the zooplankton communities in ponds.

Better: A number of factors can affect zooplankton communities in ponds

There are many factors that contribute to the differences in species composition and abundance between the two ponds.

Better: Many factors contribute to the differences in species composition and abundance between the two ponds.

The amended sentences have active verbs (affect, contribute) rather than the passive *are*

3. Write in the **first person** and **active voice** wherever appropriate. The use of the passive voice (Plants were collected) in place of the first person, active voice (We collected plants) is an old convention that has fallen out of favour among most scientific journals. The active voice supports clear, simple exposition that is easier to read.

4. Write with **economy**. Delete unnecessary words and phrases:

In a study performed by Dallard in 1993 it was shown that . . .

Better: Dallard (1993) showed that . . .

Several of the *observed* species *present* at this site . . .

Feeding *activity* of these insects modifies the local habitat *conditions*.

See *Filler Words*, below.

Omit empty sentences that add length without contributing information. Vague introductory sentences like “This is an important issue which every species must face.” force the reader to wade through verbiage in search of real information. Every sentence should say something useful. Introductory phrases such as “It is important to note that . . .” should be deleted for the same reason.

5. Write **directly**. Scientific writing is best when it is simple and uncluttered. Awkward sentences often arise from writers trying too hard to sound formally scientific, or from emulation of published papers, which are themselves replete with pompous vagueness. If sentences give you trouble, stick to simple declaratives: **Concrete Subject - Active Verb - Object**.

Whereas structure refers to spatiotemporal patterns, function refers to interspecies connections, metabolic rates, and the importance of ecosystem niches. [what does this sentence mean?]

Better: Structure refers to the species composing the invertebrate and microbial communities, while function refers to the activities, such as production and decomposition, carried out by those organisms.

6. Write with **precision**. Good scientific writing consists in saying *exactly* what you mean. Avoid colloquialisms and casual English.

Over time the population goes up.

Better: Over time the population grows.

Better: Over time the population size increases.

7. Remember these basic rules of the **metric system**:

Use words with words and symbols with numbers: Nine metres; 9 m

Spell out units when they are used alone: Length was measured in centimetres. (not cm)

Distinguish *metre* (unit of length) from *meter* (measuring device)

Leave a **space** between a number and its unit: 20 m, 2 kg, 5 yr, 40 W

except temperature: 35°C, 293K

But use a **hyphen** if the next word is a noun: 20-m rope, 2-kg bag, 40-W bulb

8. Be careful about expressing **numbers** and **dates**.

Write out whole numbers one through ten. Express larger numbers, or any number with a decimal fraction, as figures: One heron; three frogs; 13 dragonflies; 3.6 eggs.

But write out numbers at the beginning of a sentence (Thirteen frogs . . .) or recast the sentence (A total of 13 frogs . . .)

Always include a zero before decimal fractions less than one: 0.35 g (not .35 g)

The international standard format for dates is **year month day** (2019 March 11). An alternative that puts more relevant information first is **day month year** (11 March 2019). Both of these formats are unambiguous and avoid internal punctuation and superscripts (March 11th). Avoid ambiguous numerical dates (03/11/19, 11/03/2019) that can lead to confusion.

B. Some Traps to Avoid

1. Beware of incorrect or unclear attribution of **relative pronouns** (**it, this, that, these, those**), especially at the beginning of a sentence. If the pronoun is followed by a noun, there can be no ambiguity as to what it refers to.

Some species survive disturbances while other recolonize. This leads to a more diverse community. [What, exactly, leads to a more diverse community?]

Better: This *mixing of species* leads to a more diverse community.

2. Sentences must start with a capital letter. Therefore **numbers** and **symbols** (e.g., pH) cannot appear at the beginning of a sentence. Spell out the number or rephrase.

Three samples were collected. The pH of the soil was also measured.

Write out species names in full when they begin a sentence, even if they have been mentioned before.

We found several species of duckweed, including *Lemna trisulca* and *L. minor*, in the pond. *Lemna minor* was particularly abundant.

3. Avoid falsely attributing action to the reader through misuse of the personal pronoun **you**.

Short-lived species like insects are semelparous. *You* need to reproduce early to avoid mortality.

Predators are often hungry because *you* can't always find prey.

Correct this mistake by replacing **you** with an appropriate pronoun (**They** need to reproduce, **they** can't find prey.) or **recast the sentence** to place the correct agent as the subject.

Iteroparity is when *you* reproduce more than once throughout *your* adult life.

Better: Iteroparity describes species that reproduce more than once throughout their adult lives.

If *you* reproduce now . . . the time between generations is shortened and *you* are certain that *you* can indeed reproduce. However, if *you* wait until later, *you* are larger and stronger . . .

Better: Reproducing now shortens the time between generations and ensures that the organism can indeed reproduce. However, organisms that wait until later are larger and stronger . . .

4. Avoid **sentence fragments**. Like this one. A sentence fragment is a phrase lacking a subject or a verb.

Most insect are semelparous. Meaning they reproduce only once.

Better: Most insects are semelparous, which means they reproduce only once.

Better: Most insects are semelparous; they reproduce only once.

5. Avoid **anthropomorphism**: attribution of human characteristics to animals or inanimate objects

The organism *wants* to reproduce as quickly as possible.”

Better: The organism benefits from reproducing as quickly as possible.

Better: Natural selection favours organisms which reproduce as quickly as possible.

Species *who* [that] live in unstable environments tend to reproduce early.

6. Use the **simple present** tense, not the future tense, to describe actions which occur commonly and repeatedly.

An organism *will mark* [marks] its territory.

The organism *will defend* [defends] its territory to protect its food supply.

Clutch size refers to the number of offspring an organism *will produce* [produces] at one time.

7. Be sure that the **subject** of the sentence is capable of the **action** attributed to it by the verb.

High concentrations of salt ions in saline soils form bonds with carbonates and colloid particles. [Can a *concentration* form a *bond*?]

Better: Salt ions in saline soils form bonds with carbonates and colloid particles.

8. Watch out for **plural** pronouns with **singular** subjects.

One of the first decisions an organism must make is how large *their* [its] clutch size should be.

By reproducing now the organism ensures *they* [it] will survive to produce offspring.

The longer an organism waits to reproduce, the higher the chance the organism may die before *they are* [it is] able to produce offspring.

9. Distinguish **number** from **amount**

Amount refers to **quantities**: amount of rainfall, food, vegetation, reproduction

Number refers to **counts**: number of rainy days, meals, plants, offspring

This species produces a great *amount* [number] of offspring.

10. Distinguish **less** from **fewer**

Less refers to **quantities**: less rainfall, less applesauce, less vegetation, less patience

Fewer refers to **counts**: fewer raindrops, fewer apples, fewer plants, fewer tantrums

C. Commonly misused words and phrases

Able: in place of *is able to, are able to, has the ability to*, use **may** or **can**

The benefit of reproducing early is that the organism *is going to be able to* reproduce before it dies.

Better: The benefit of reproducing early is that the organism **can** reproduce before it dies.

Account: “on account of the fact that” Use **because**

Affect and **Effect**: The confusion generally arises between **Affect** (verb) which means to influence or modify (Temperature *affects* the respiration rate) and **Effect** (noun) which means the consequence of some action or force (The *effect* of a change in temperature is a change in respiration rate). Both words have other senses that are rarely used in scientific writing.

All right: two words [not *alright*]

Amazing, Amazingly: Use **very**, or a more exact descriptor. See *Slang Intensifiers*.

And/or: not English. Choose **and** or **or**. See *Slashes Between Words*

Approximately: be sure that the succeeding figure is indeed approximate.

The site lies on a hillside *approximately* 13.6 km from Ashdale.

Mean wing length in the juvenile sparrows was *approximately* 12.83 cm.

[Delete approximately. In the first example, the distance given is exact. In the second example, the figure 12.83 cm is the result of a calculation, not an approximation.]

Approximately may be replaced in many sentences with **about** or **roughly**. The word may be omitted if the context already suggests an approximation:

The village lies about 10 km south of Canning Harbour.

The village lies 10 km south of Canning Harbour.

As: in the sense of “the reason for” use **because**

Birds and squirrels may compete, *as* they both feed on a limited supply of seeds.

Better: Birds and squirrels may compete because they both feed . . .

Both: means two things may be considered together. Example: Both lakes were deep.

The communities in *both* lakes were different.

Better: The community in each lake was different.

Cannot: one word

Organisms cannot survive without resources.

Compare: Normally compare **with** [not compare *to*]. There are many variants on this mistake: *as compared to*, *when compared to*, *in comparison to*. In every case, **compared with** is the better choice.

Comprise: The whole **comprises** the parts; the parts **compose** the whole.

A plant is composed of [not *comprised of*] roots, stems and leaves.

A plant comprises roots, stems and leaves.

Consistent: means compatible or in harmony with something else. Do not use to mean *similar* or *invariant*.

Data from the first experiment were *consistent* until the fourth day.

Better: Data from the first experiment showed little variation until the fourth day.

Correlate: Correlate **with** [not *correlate to*] Same for **correspond**

Data: A simple plural. Singular **datum**.

The data are [not *is*] ready for analysis.

Data point: Redundant. Say **value**, **record** or **observation**

Degrees: By convention, numerical temperatures are followed by °C, not “degrees Celsius”.

Hence, 15°C [not 15 *degrees Celsius*]. Absolute temperatures (Kelvin scale) are written without the degree symbol. Hence, 100°C = 373K.

Dependent: Instead of “is dependent on”, write “depends on”. Fewer words and now the sentence has an active verb.

Different: often a **filler word**.

Comparison of Zooplankton Communities from Two *Different* Ponds in Antigonish County [delete *different*]

Downstream: Downstream **from** [not downstream *of*] Same for Upstream

Due: “due to the fact that” Say **because**

Effect: see **Affect**

Etc.: Latin for **et cetera**, meaning “and so on”. In scientific writing, **etc.** is almost always a sign of lazy or hurried writing. Decide what **etc.** is replacing; write it out if it's important, or leave it out if it isn't.

Floodplain plants are vulnerable to floods, disease, herbivory, *etc.*

Better: Floodplain plants are vulnerable to floods, disease and herbivory.

Better: Floodplain plants are vulnerable to floods, disease, herbivory and other mortal threats.

Lists intended as examples do not need **etc.** at the end:

Large African mammals (e.g., elephants, giraffes, wildebeest, *etc.*) [Delete *etc.*]

Event: Usually a *Filler Word* which should be omitted:

disturbance *event*, flood *event*, weather *event*

Better: disturbance, flood, rainstorm.

Example: in the sense of “for example” use **e.g.** (Latin *exempli gratis*, free example), not *ex*.

Note placement of periods.

Colour morphs are common in mammals (e.g., grey and black squirrels).

Exist: Be suspicious of sentences containing **exist**. While there are instances where the word is appropriate, more often it is a sign of a weakly constructed sentence. Delete, or recast the sentence.

Evidence *exists* to support this hypothesis, but it is sparse.

Better: Evidence to support this hypothesis is sparse.

Table 3 shows correlations *existing* between rainfall and production. [delete]

Extremely: Means “at the extreme.” Otherwise use **very**, or omit. See *Slang Intensifiers*.

These animals are *extremely* well adapted to the desert. [better than any other species]

These animals are very well adapted to the desert.

These animals are well adapted to the desert.

Fantastic: Means in the realm of fantasy, not real. In the sense of *very*, use a more exact descriptor, or omit. See *Slang Intensifiers*.

His claims about the size of the moose were fantastic [his claim is suspect]

Moose are fantastically large animals [They are too big to be real]

Better: Moose are very large animals. Moose are large animals.

Filler Words: Words that take up space in a sentence without contributing to its meaning.

Delete them relentlessly. The worst offenders are: *activity, actually, basically, condition, event, exist(ing), found, generally* and *overall*.

Focus: In any sense other than the literal (i.e., microscopy), trendy slang to be absolutely avoided.

The *focus* of this study is the interaction between white-footed mice and raspberries.

This study *focuses* on the interaction between white-footed mice and raspberries.

Better: This study concerns the interaction between white-footed mice and raspberries.

Found: another *Filler Word*.

Number of species *found* in samples from a hardwater pond [Delete *found*]

Impact: Reserve this word for metaphorical allusions to objects in collision. As a noun, use **effect**:

Diversity loss has far-ranging *impacts* on communities.

Better: Diversity loss has far-ranging effects on communities.

As a verb, replace *impact* with more exact words. Avoid meaningless phrases like *negatively impacts* in favour of exact words such as **impairs, harms** or **disturbs**.

The upstream lake that feeds the stream can *impact* [influence, modify, raise, lower] water temperature in the channel

In order to: Wordy. Say **to**

In order to avoid predators, ground-dwelling birds may use camouflage

Better: To avoid predators, ground-dwelling birds may use camouflage

In terms of: Rephrase to omit

The dominant species may benefit *in terms of* space and other resources.

Better: The dominant species may gain space and other resources.

Include: A list of items introduced by *include* is a common means for writers to avoid having to decide whether they have listed all of them, or all the important ones. This formula creates dull sentences that sound evasive and merely present a list. Recast the sentence to be definite and describe the items with active verbs.

Effects of salinity on plants include damage to cell membranes, decreases in photosynthetic and respiration rates and a lower rate of protein synthesis.

Better: The main effects of salinity on plants are damage to cell membranes, decreases in photosynthetic and respiration rates and a lower rate of protein synthesis.

[A more definite sentence]

Better yet: High soil salinity can damage plant cell membranes, interfere with photosynthesis and respiration and impede protein synthesis.

[active, descriptive verbs replace the passive *are*.]

Increased (Decreased): Implies a **change through time**. Usually an ordinary adjective (high, great, rich) is a better choice.

Algae respond to the increased N concentration by growing and dividing quickly.

[Implies the N concentration used to be lower]

Better: Algae respond to the high N concentration by growing and dividing quickly.

Incredible, Incredibly: Means that an assertion should not be believed. In the colloquial sense of **very**, use a more exact descriptor, or omit. See *Slang Intensifiers*.

His claims about the size of the moose were incredible [his claim is suspect]

Moose are *incredibly* large animals [They are too big to be real]

Better: Moose are impressively large animals.

“Is When”: A clumsy construction used in definitions, best avoided.

Directional selection is when . . .

Better: Directional selection **occurs** when . . .

Better yet: Directional selection creates a selective advantage for . . . [active verb]

Directional selection is a mode of evolution in which . . .

Lab: Slang contraction for **laboratory**

Lot: A *lot* (two words) is a group of objects for sale at once: three lots of shares; 15 lots of lumber. In everyday speech, *a lot* or *lots of* are slang substitutes for **much** or **many**, which terms should be used instead.

Semelparous species have *lots of* [many, numerous] offspring.

Meter, metre: **Meter** is a measuring device. **Metre** is a unit of length.

Dissolved oxygen tension was measured every metre with an electronic meter.

Methodology: Use **Methods**.

Month: Summer months, winter months, etc., is redundant. Say summer, winter. But *ice-free months*, *warmer months*, etc., where the adjective does not already specify a season.

Obvious: Better to say **conspicuous** or **apparent**.

“One man’s ‘It’s obvious!’ is another man’s ‘Huh?’ ” – Isaac Asimov

Ongoing: Use **Continuing**.

The fight against the patriarchy *remains ongoing* [from a 2020 movie]

Better: The fight against the patriarchy **continues**

Only: normally **after** the verb:

Sharks eat only when hungry [They do not eat when satiated.]

Sharks only eat when hungry [They do nothing but eat.]

Period of Time: Redundant. Say **period**.

Post (Pre): Physicians may be forgiven their “pre-surgical checklists” and “post-operation conditions”, but usually, *pre* and *post* are trendy substitutes for **before** and **after**, which will be preferred by those who would avoid pretentious writing.

Process: As a noun, usually a *filler word* that should be deleted for brevity.

High salinity can interfere with ion transport processes in the cell. [delete *processes*.]

As a verb, *process* is generally a vague substitute for more precise descriptors which should be used instead.

Samples were processed within two hours of returning to the laboratory.

Better: Samples were cleaned and sorted, and living organisms were removed, within two hours of returning to the laboratory.

Respectively: The construction illustrated by “The values of A and B are 6 and 4, respectively”, is a commonplace, but it makes work for readers, who must pause to associate 6 with A and 4

with B. It is better to save them that annoyance by doing it yourself: “A has a value of 6 and B has a value of 4.” More complex constructions, of the sort, “The values of A, B, and C are 6, 4 and 11, respectively”, should never be used.

Significant: Speaking of importance, opposite is **insignificant**. Speaking of statistics, opposite is **nonsignificant**.

Slang Intensifiers: words such as **amazing, extremely, incredible, fabulous, fantastic**, are used in casual speech to indicate surprise. In text they should be replaced by **very** or a more exact intensifier such as **highly, unexpected, exceptional, unusual, or surprising**. Often a sentence containing a salient fact is more effective without an intensifier.

Moose are *incredibly* large animals. Crows are *amazingly* intelligent.

Better: Moose are very large animals. Crows are surprisingly intelligent.

Better: Moose are big animals. Crows are intelligent.

Slashes Between Words: Separating words/phrases with slashes is the latest fashion/trend/fad in English composition. The use of slashes to separate/conjoin two words has spread from the appalling “and/or” to all sorts/kinds of constructions. Words/phrases separated by slashes are a sign/indicator of laziness/indecision on the part of the writer and are annoying/irritating to the reader. **Decide** which single word or phrase best expresses what you want to say and write that.

Species: Do not use as a general-purpose substitute for **organism, offspring, or population**.

Substrate, Substratum: Use **substratum** (plural substrata) to describe the bottom of a lake or stream. Reserve **substrate** for a substance modified by an enzyme.

Taxon: The standard term for any level of organism identification. Plural **taxa**

Phylum, genus and species are taxa.

A list of taxa of benthic invertebrates from South River

Via: Means “by way of” and should be restricted to navigation (to France via Belgium). In figurative sense use **by** or **through**.

The toxins may be produced *via* [by] secondary metabolic pathways.

Whether: *Whether or not* is redundant, except in one construction.

The experiment determined whether *or not* production increases with diversity.

[Delete *or not*. **Whether** already includes the negative possibility]

Whether or not production varies with diversity, a deeper mystery remains.