A review of the *International Code of Botanical Nomenclature* with respect to its compatibility with phylogenetic classification

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This article presents a summary of a discussion on the current *Code* of botanical nomenclature (Greuter & al., 2000) that took place at the Linnaean Nomenclature Workshop held on 26–28 June 2002 at the Hunt Institute for Botanical Documentation in Pittsburgh, Pennsylvania (see also Barkley & al., 2004). An article by article vetting of the *Code* was conducted with the goal of identifying parts of it that may be in conflict with phylogenetic approaches to classification. It was concluded that the *Code* **does not** contain any rules that actually prevent phylogenetic classification. However, it was noted that some articles could benefit from clarification. Each article that was identified during the workshop as being potentially problematic is discussed below. In some cases it was determined that the language of the current *Code* should be modified and formal proposals for such changes are being published separately (Moore & al., 2004). For each case, if a similar concern could be raised with the language in the *International Code of Zoological Nomenclature* (Ride & al., 1999) this was also identified.

Article 2.1: "Every individual plant is treated as belonging to an indefinite number of taxa of consecutively subordinate rank, among which the rank of species (species) is basic".

Concern: The main concern with this article is the designation of the species rank as being "basic". It was suggested that this may lead some practitioners to conclude that the *Code* states that those taxa assigned the rank of species are somehow more "real" than taxa assigned to other ranks. Indeed some taxonomists do believe that this assertion is the case, but many others do not.

Discussion: From a nomenclatural perspective, the rank of species is indeed basic. The species is the only primary rank whose names must be typified by particular specimens (or illustrations) (Art. 8.1). Thus, the names of species are typified (anchored) by concrete entities. Types of names of families are the same as those of the generic names on which they are based (Art. 10.6) and types of generic names are the types of names of species (but see Art. 10.4 for rare exceptions where a specimen may typify a generic name). Thus, the typification "cascade" ends with the type of the species. Another way to look at the species rank being basic from a nomenclatural perspective is that one cannot describe a family name without identifying at least one generic name (the type) that is included within it, nor can one describe a new genus without citing at least one species (the type) that is included within it (again see Art. 10.4 for exception); however, one can describe a species without citing the names of any infraspecific taxa.

Proposed changes: None.

Is there a similar issue with the ICZN? No. The ICZN does not identify the species as "basic".

Article 3.1: "The principal ranks of taxa in descending sequence are: kingdom (regnum), division or phylum (divisio, phylum), class (classis), order (ordo), family (familia), genus (genus), and species (species). Thus, each species is assignable to a genus, each genus to a family, etc".

Concern: The second sentence of this article (also

Article 2.1: "every individual plant is treated as belonging to an indefinite number of taxa…") may lead some to conclude that each genus **must** be assignable to a family (and thus each family **must** be assignable to an order etc.). Therefore, it might be concluded that the *Code* forces one to provide a complete classification for an organism. This is problematic because information for a taxon may be insufficient to provide a complete classification of it.

Discussion: Article 3.1 (and 2.1) is referring to hypothetical scenarios and is not placing any requirements on how extensively a worker must classify a given taxon. How many ranks a taxonomist uses is up to her/him. However, names of species and infrageneric taxa (binomials) must include a genus name (Art. 21.1, 23.1), although the generic placement of such taxa can change. The same applies for infraspecific names (Art. 24.1).

Proposed changes: Add a note to the *Code* with examples that show this (see Moore & al., 2004).

Is there a similar issue with the ICZN? No. The ICZN does not have an article that specifies ranks and their proper relative order.

Articles 3–5: These articles introduce rank-denoting terms and their relative order.

Concern: The articles that introduce rank-denoting terms and their proper relative order do not clearly state that two taxa assigned the same taxonomic rank are not necessarily comparable in any way. For example, two genera in the Compositae (Asteraceae) are not necessarily similar with regard to their times of origin.

Discussion: These articles simply specify the set of rank-denoting terms that may be used and their proper relative order. The *Code* in no way states or implies that taxa at a given rank are or should be comparable in any way.

Proposed changes: None.

Is there a similar issue with the ICZN? No and yes. No, the ICZN does not have an article that specifies rank-denoting terms and their proper relative order. Yes, the ICZN also does not clearly state that taxa of a given rank are not necessarily comparable in any way.

Article 7–10: Articles governing typification.

Concern: These articles do not clearly state that typification is merely the mechanism by which nomenclature is kept distinct from classification.

Discussion: Names are assigned types, whereas taxa are assigned circumscriptions and descriptions. A taxon's circumscription (or description) is subject to change, whereas a name's type cannot change without formal conservation. These articles simply lay out the rules for how names are to be typified. These articles do make it

clear that names of taxa are typified and not the taxa themselves.

Proposed changes: None.

Is there a similar issue with the ICZN? Yes. The ICZN also does not explain how typification keeps nomenclature distinct from taxonomy.

Articles 16, 17: Names of taxa above the rank of family.

Concern: The *Code* treats names above the rank of family very differently from the way it treats those names at the rank of family and below. Some may regard the *Code* as inconsistent since it requires typification and priority at the rank of family and below, but does not require these above the rank of family.

Discussion: The current wording arises from taxonomists having come to grips with the fact that a one-size-fits-all approach does not work with regard to nomenclature at different ranks. Above the rank of family, the *Code* leaves things largely unregulated (no typification requirements, priority does not apply). The reasoning here is that the number of names being used at these ranks is small and that common usage may indeed work very well. However, at the rank of family and below the number of names available is significantly higher. Therefore, more stringent rules are needed for these ranks including a separate article (Art. 11.1) requiring that each taxon with a particular circumscription, position, and rank can bear only one correct name. Above the rank of family, less appears to be better because the goal of Art. 11.1 seems to be largely achieved to a great extent without regulation; at the rank of family and below more regulation (rules, committees) is needed.

Proposed changes: None.

Is there a similar issue with the ICZN? Yes. The ICZN does not regulate names in any way above the rank of superfamily.

Art 16.1 (b): "descriptive names, not so formed, which apply to taxa with a recognized circumscription and which may be unchanged at different ranks".

Concern: This article allows untypified suprafamilial names (e.g., Angiospermae) to be used unchanged at different ranks. The *Code* could be viewed as inconsistent since it provides either recommended or mandatory endings for typified suprafamilial names. Also the valuable set inclusivity/exclusivity information is lost when names at a given rank are not of the same form (or names of different ranks are of the same form).

Discussion: There is a long history in botanical nomenclature (perhaps now waning) of using character-based names for suprafamilial taxa in which all representatives possess the character (e.g., Sympetalae). If the

use of such names is declining, is it necessary to do anything? Perhaps they might die a natural death like initial capitalization of some specific epithets (it is permitted but almost no one does so). Previously, it has been proposed that untypified descriptive names be banned. Priority does not apply above the rank of family, so no one is forced to use a descriptive name.

Is there a similar issue with the ICZN? Yes. Names above superfamily are not regulated and can be formed in any manner.

Articles 21–23: Names of subdivisions of genera, species.

Concern: The binominal construction of these names forces one to assign a taxon in these ranks to a genus even if such placement may be uncertain. Thus, if the generic placement of a subgenus or a species changes, its name must be changed. This is different from the situation in those ranks where taxa are assigned uninomials. For example if a tribe is shifted from one family to another the name of the tribe is not changed.

Discussion: Using binominal nomenclature is a common practice when communicating about a group in which there are multiple kinds. It greatly assists in preventing homonymy in a nomenclatural system. Binominal nomenclature is not limited to scientific nomenclature; for example, common names of species are often binominal (e.g., snowy owl, Fraser fir). The binomial does force one to assign a species to a genus and thus a change in generic placement will require a change in name. However, this can also be quite useful in communication. For example, if the taxon *Malus hypotheticus* were later found actually not to be an apple but an orange and hence a member of the taxon *Citrus*, the name would change to *Citrus hypotheticus* (assuming this epithet were available). This change is actually useful in that it updates the taxonomic address of the plant, and it is a perfectly logical manoeuvre when communicating with binomials. Indeed it would be inconvenient and illogical to continue to refer the taxon as *Malus hypotheticus* once it were shown that it did not belong to the taxon *Malus* (but rather *Citrus*).

Proposed changes: None.

Is there a similar issue with ICZN? In the ICZN only the names of species are binomials (and not those of taxa at infrageneric ranks such as subgenus).

Articles 22, 26: Autonym articles

Concern: The autonym rules state that the first instance of valid publication of a name of a subdivision of a genus or of an infraspecific taxon under a legitimate name of a genus or a species, respectively, automatically establishes the corresponding autonym (Arts. 22.3, 26.3). Some practitioners are concerned that this rule may force

the recognition of non-monophyletic groups. For example, Taxonomist 1 works in the genus *Alpha* (comprising species a–z) and revises a subgenus (that does not include the type of the genus name). Taxonomist 1 gives the subgenus the name *Alpha* subg. *Beta*. This act automatically establishes the autonym *Alpha* subg. *Alpha*. Taxonomist 1 circumscribes *A.* subg. *Beta* to include species a–f. Hasn't Taxonomist 1's action thereby resulted in a circumscription of *Alpha* subg. *Alpha* that includes all species not included in *A.* subg. *Beta* (i.e., species g–z), regardless of the monophyly of that group?

Discussion: While the autonym *Alpha* subg. *Alpha* was automatically established with the publication of *Alpha* subg. *Beta*, its circumscription was never established (so "no" to the question posed above). Taxonomist 1 may have circumscribed *Alpha* subg. *Beta* to include species a–f, but this act (which established the name *Alpha* subg. *Alpha*) does not mean that Taxonomist 1 has indirectly circumscribed the taxon represented by the autonym to include species g–z. The autonym rules automatically establish names (autonyms only); they do not automatically establish taxa or their circumscriptions.

Proposed changes: Add notes under Articles 22 and 26 to make it clearer that names and not taxa are established (Moore & al., 2004).

Is there a similar issue with the ICZN? Yes. The ICZN does not have articles discussing the automatic establishment of autonyms, but the provisions for "nominotypical taxa" (see Art. 44) appear to have the same effect.

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