Research Paper E-ISSN NO : 2455-295X | VOLUME : 9 | ISSUE : 2 | SPECIAL ISSUE FEBRUARY-2023

PHYLOCODE RULES OF PHYLOGENETIC NOMENCLATURE

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ABSTRACT:

Phylogenetic nomenclature employs specifies (such as species, specimens, and apomorphies) to identify actual creatures and a definition based on phylogeny (i.e., ancestry and descent) to delimit the content of taxa. The definition's formula suggests an ancestor. Therefore, that progenitor and all of its offspring constitute the defined taxon. As a result, a phylogenetic hypothesis determines the content of a phylogenetically defined taxon.

KEYWORDS:

1. INTRODUCTION:

In biological categorization, nomenclature is the system used to name species. The genus and species names, which are Latinized terms drawn from different sources, identify the species to which the creature belongs.A rank-free method of biological naming called phylogenetic nomenclature (PN) is used to name clades and species (de Queiroz and Gauthier, 1990, 1992, 1994; Cantino and de Queiroz, 2006). In this system, the classifications of species and clade refer to distinct biological things rather than taxonomic levels. An individualized portion of a lineage at the metapopulation level is called a species. A clade is an entire lineage and descent system made up of all the descendants of an ancestor (a population, species, or other entity) (de Queiroz, 1998, 1999, 2005a, 2005b, 2005c; Cantino& de Queiroz, 2006). Viewed as concrete persons rather than abstract classes in the ontological sense, both are historical beings that make up the Tree of Life (but for an idea of the ontological distinction between synchronic individuals and diachronic historical entities, see, e.g., Lee and Wolsan [2002]).Several authors have proposed the possibility of basing the definitions of taxon names on phylogenetic relationships in the context of attempts to develop an explicitly phylogenetic system of biological taxonomy (e.g., Hennig 1965, 1966; Eldredge and Cracraft 1980; Wiley 1981a; Ax 1987).Some practitioners of PN have questioned the existence of species or denied any role for species in this system, which has given birth to the dispute surrounding species names (Pleijel, 1998, 1999, 2001, Mishler, 1999, 2003).On the other hand, taxa are often thought of as concrete entities, and concrete entities are sometimes described as defined, or as self-defining, in the sense of drawing a boundary. Taxonomists have rarely specifically addressed the question of how taxon names (as opposed to taxa) should be defined, as they typically do not discriminate between taxa and taxon names. Additionally, "definition" and "diagnosis" are frequently used interchangeably (Simpson 1961).Under codes of traditional rank-based nomenclature (TN), the zoological code (ICZN; International Commission on Zoological Nomenclature, 1999), the botanical code (ICBN; Greuter et al., 2000), and the bacteriological code (ICNB; Lapage et al., 1992), but not the viral code (Mayo and Horzinek, 1998).Prior to the introduction of PN, other systems for identifying species had been suggested, but none of them were widely accepted. While history and familiarity play a significant and possibly critical role, they are not the only factors maintaining Linnaean binominal (binary) nomenclature in use. Undoubtedly, LBN has some benefits. The binominal form of LBN also serves a practical purpose by separating species names from other taxa, whose names often consist of three words (infraspecific taxa) or one word (supraspecific taxa).

The focus has been on well-supported clades with deep origins in Angiospermae or Tracheophyta, which are also commonly known to non-specialists. These treatments adhere to the proposed PhyloCode and show how phylogenetic nomenclature can be applied in a range of nomenclatural and phylogenetic situations.

2. PhyloCode Rulees of Phylogenetic Nomenclature

2.1 Method for phylogenetic nomenclature of *Cooksonia and Bennettitales:*

- **Chapter I. Taxa (Arts. 1-3)**

Article 1. **Categories of Taxa 1.1-** The groups of organisms or species considered potential recipients of scientific names are called taxa (singular: taxon). The only taxa whose names are governed by this code are clades. However, species, whose names are governed by the rank-based codes, are frequently used to define clade names in this code.

Article 2. Clades 2.1-*In this code, a clade is an ancestor (an organism, population, or species) and all of its descendants.*

Note 2.1.1-Every individual organism (on Earth) belongs to at least one clade (i.e., the clade comprising all extant and extinct organisms, assuming that they share a single origin). Each organism also belongs to a number of nested clades (though the ancestor of the clade comprising all life—again assuming a single origin—does not belong to any other clade).

Note 2.1.2- It is not necessary that all clades be named. **Note 2.1.3-** Clades are often either nested or mutually exclusive; however, phenomena such as speciation via hybridization, species fusion, and symbiogenesis can result in clades that are partially overlapping.

- **Chapter II. Publication (Arts. 4-5)**

Article 4. Publication Requirements 4.1-The provisions of this article apply not only to the publication of names, but also to the publication of any nomenclatural act (e.g., a proposal to conserve a name).

4.2- Publication, under this code, is defined as the distribution of peer-reviewed works consisting of: (1) printed text with or without images, which, unless also published electronically, must be distributed to libraries or scientific institutions associated with libraries in at least five countries on three continents, so that the work is accessible as a permanent public record to the scientific community; and/or (2) electronic text with or without images or sound in Portable Document Format (PDF) in an online publication (however, not just in supplementary material; see Note 7.2.2); in both cases with an International Standard Serial Number (ISSN) or an International Standard Book Number (ISBN).

Note 4.2.1- If a manuscript is released electronically in stages (e.g., accepted manuscript, uncorrected proofs, corrected proofs without pagination, and final version with pagination), the final version with pagination is to be considered the "publication" for the purposes of this code.

Note 4.2.2- If an entire book is not peer-reviewed or a periodical is not consistently peer-reviewed, the article or chapter in which a name or nomenclatural act appears must be peer-reviewed in order to qualify as published.

Note 4.2.3- Approval of a work by a thesis or dissertation committee does not constitute peer review.

Note 4.2.4- The distribution before the publication date of *Phylonyms: A Companion to the PhyloCode* of any material (printed or electronic) does not constitute publication (see Art. 7.1).

4.3- For the purpose of Article 4.2, "online" is defined as accessible electronically via the World Wide Web.

4.4- Should Portable Document Format (PDF) be succeeded, a successor international standard format approved and communicated by the Committee on Phylogenetic Nomenclature would be acceptable.

Recommendation 4.4A- Publication electronically in Portable Document Format (PDF) should comply with the PDF/A archival standard (ISO 19005).

Recommendation 4.4B- Authors of electronic material should give preference to publications that are archived and curated in trusted online digital repositories, e.g., an ISO-certified repository. Digital repositories ideally should be in more than one country, preferably on different continents.

4.5- An electronic publication (see Note 4.2.1) must not be altered after it is published. Any such alterations are not themselves considered published. Corrections or revisions must be issued separately to be considered published.

4.6- The following do not qualify as publication: (a) dissemination of text or images solely through storage media (such as CDs, diskettes, film, microfilm, and microfiche) that require a special device to read; (b) theses and dissertations; (c) abstracts of articles, papers, posters, texts of lectures, and similar material presented at meetings, symposia, colloquia, or congresses, even if the abstract is printed in a peer-reviewed journal; (d) the placing of texts or images in collections or exhibits, for example, on labels (including specimen labels, even if printed) or information sheets; (e) the reproduction of hand-written material in facsimile, for example, by photocopy; (f) patents and patent applications; (g) newspapers and periodicals intended mainly for people who are not professional scientists, abstracting journals, trade catalogues, and seed exchange lists; (h) anonymous works. See also Article 7.3.

- **Chapter III. Names (Arts. 6-8)**

Article 6. Categories of Names 6.1- Established clade names are those that are published in accordance with Article 7 of this code. Unless a clade name is established, it has no status under this code.

Recommendation 6.1A- *In order to distinguish scientific names from other (e.g., vernacular) names, all scientific names should be italicized when they appear in print.*

Note 6.1A.1- *Italicizing all scientific names is consistent with the 2018 edition of the* ICNAFP *but not with the 1999 edition of the* ICZN*.*

Recommendation 6.1B- In order to indicate which clade names are established under this code and therefore have explicit phylogenetic definitions (and whose endings are not reflective of rank), it may be desirable to distinguish these names from supraspecific names governed by the rank-based codes, particularly when both are used in the same publication.

- **Chapter IV. Clade Names (Arts. 9-11)**

Article 9. General Requirements and Phylogenetic Definitions 9.1- The names of clades may be established through conversion of preexisting names or introduction of new names.

9.2- In order to be established, converted clade names must be clearly identified as such in the protologue by the designation "converted clade name" or "*nomencladiconversum*." New clade names must be identified as such by the designation "new clade name" or "*nomencladinovum*."

9.3- In order to be established, a clade name must be provided with a phylogenetic definition, written in English or Latin, linking it explicitly with a particular clade. The name applies to whatever clade fits the definition.

- **Chapter V. Selection of Established Names (Arts. 12-15)**

Article 12. Precedence 12.1-Nomenclatural uniqueness is achieved through precedence, the order of preference among established names. When homonyms or synonyms exist, precedence determines the selection of accepted names.

Note 12.1.1- Although the entity to which precedence applies in this code is referred to as a name, it is really the combination of a name and its definition. In different cases, one or the other of these components is more important. Specifically, in the case of synonyms, precedence refers primarily to the name, whereas in the case of homonyms, precedence refers primarily to the definition.

12.2- Precedence is based on the date of establishment, with earlier-established names having precedence over later ones, except that later-established names may be conserved over earlier ones under the conditions specified in Article 15, and panclade names (Art. 10.3) have precedence under the conditions specified in Article 14.4**.**

Note 12.2.1- *In the case of homonymy involving names governed by two or more rank-based codes (e.g., the application of the same name to a group of animals and a group of plants), precedence is based on the date of establishment under this code. However, the Committee on Phylogenetic Nomenclature (see Art. 22) has the power to conserve a later-established homonym over an earlier-established homonym. This might be done if the later homonym is much more widely known than the earlier one.*

12.3- *For the determination of precedence, the date of establishment is considered to be the date of publication (see Art. 5), not the date of registration (but see Arts. 13.4 and 14.3).*

- **Chapter VI. Provisions for Hybrids (Art. 16)**

Article 16. Provisions for Hybrids 16.1- Hybrid origin of a clade may be indicated by placing the multiplication sign (×) in front of the name. The names of clades of hybrid origin otherwise follow the same rules as for other clades.

16.2- An organism that is a hybrid between named clades may be indicated by placing the multiplication sign between the names of the clades; the whole expression is then called a hybrid formula.

Recommendation 16.2A- In cases in which it is not clear whether a set of hybrid organisms represents a clade (as opposed to independently produced hybrid individuals that do not form a clade), authors should consider whether a name is really needed, bearing in mind that formulae, though more cumbersome, are more informative.

- **Chapter VII. Orthography (Arts. 17-18)**

Article 17. Orthographic Requirements for Establishment 17.1- In order to be established, a clade name must be a single word and begin with a capital letter. The name must be composed of more than one letter and consist exclusively of letters of the Latin alphabet as used in contemporary English, which is taken to include the 26 letters a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, and z, even though some of these letters are rare or absent in classical Latin. If other letters, ligatures, numerals, apostrophes, or diacritical signs that are foreign to classical Latin appear in a name, it cannot be established. A hyphen may be included in a clade name only when it is a panclade name (see Art. 10.3), or the name has an apomorphy-based definition and is formed in accordance with Article 10.8, or the name is based on the preexisting name of a subdivision of a genus (see Rec. 10F), or the name is based on a preexisting name preceded by a taxon-related prefix such as *Phyto-*, *Phyco-*, *Myco-*, *Prokaryo-*, or *Zoo-* in the situation covered by Recommendation 10D. When other letters, ligatures, or diacritical signs appear in the protologue of a preexisting name, they must be transliterated at the time of conversion in conformity with the rank-based code that is applicable to the clade concerned. Hyphens or apostrophes present in a preexisting name must be deleted at the time of conversion. See Note 18.1.2 for the inclusion of diaereses and apostrophes as optional pronunciation guides in the subsequent use of established names.

17.2- When a preexisting name has been published in a work where the letters u and v or i and j are used interchangeably, or are used in any other way incompatible with modern practices (e.g., one of those letters is not used or is used only when capitalized), those letters must be transliterated at the time of conversion in conformity with modern usage.

17.3-A clade name may be a word in or derived from Latin, Greek, or any other language provided that the name uses the Latin alphabet (Art. 17.1).

Recommendation 17.3A- If a clade name is derived from a language other than Latin, it should be Latinized, in the tradition of scientific names governed by the *ICNAFP*, *ICZN*, etc.

Recommendation 17.3B- In order to avoid confusion with vernacular and informal names, a new clade name should not be spelled identically to a vernacular or informal name in any modern language. However, the scientific name may be derived from the vernacular or informal name by Latinization.

17.4- If a clade is named after a person, the clade name, in order to be established, must differ in spelling from the person's name, for example through the addition of a Latinized ending.

17.5- In order to be established, the spelling of a converted name must be identical to that of the preexisting name on which it is based, except as noted in Articles 17.1 and 17.2.

Recommendation 17.5A- When a preexisting name is converted, the spelling in prevailing use should be retained. As a general guideline, adoption of a spelling by

two-thirds of the authors who have used the name in the past 25 years would qualify as prevailing use. If it is not clear which spelling is the prevailing one, the original spelling should be adopted for the converted name, except for the correction of orthographical (including typographical) errors and the mandatory corrections imposed under Articles 17.1 and 17.2. In this code, the original spelling is the one used in the protologue.

Recommendation 17A- Names established under this code should be pronounceable. Thus, every syllable should contain a vowel (or diphthong), and combinations of consonants that do not generally occur in either Latin or English should be avoided unless they are contained within the name of a person, place, or other entity after which a clade is named.

Recommendation 17B- New clade names should follow the rules and recommendations of the appropriate rank-based code with regard to Latin grammar. However, failure to follow those rules and recommendations does not invalidate the establishment of names under this code.

- **Chapter VIII. Authorship of Names (Art. 19)**

Article 19. Authorship of Names and Definitions 19.1- The nominal author(s) of a clade name is (are) the person(s) who first published the name (but see Notes 9.15A.1, 19.1.1), regardless of whether it was phylogenetically defined and regardless of whether it was initially applied to a taxon that differed somewhat in composition from the clade for which the name is being converted (provided that it is not a homonym; see Note 9.15A.2). The definitional author(s) of a clade name is (are) the person(s) who established that name, including publication of a phylogenetic definition for it (either the original definition or an emended one), under this code.

Note 19.1.1- When determining nominal authorship, publications before the nomenclatural starting point for the particular group of organisms under the appropriate rank-based code are not considered.

Note 19.1.2- For a new clade name (except a new replacement name), the nominal and definitional authors are the same. For a converted clade name or a replacement name, the nominal and definitional authors are frequently different.

Note 19.1.3- The *ICNAFP* (Art. 39) requires that new taxon names (other than for fossils) published from 1935 through 2011 be accompanied by a Latin description or diagnosis or a reference to the same. By contrast, this code does not require a Latin description or diagnosis for the establishment of a name. Therefore, a person who published a preexisting botanical name with a description or diagnosis and otherwise satisfying the *ICNAFP* rules for a legitimate name (see Art. 6.2) may be considered the nominal author, regardless of whether the description or diagnosis was in Latin (although there are situations in which such a person might not be considered the nominal author; see Note 9.15A.1, Ex. 1).

19.2- A clade name or definition is to be attributed to the author(s) of the protologue, even though authorship of the publication as a whole may be different.

- **Chapter IX. Citation of Authors and Registration Numbers (Art. 20)**

Article 20. Citation of Authors and Registration Numbers **20.1**- Citation of nominal and definitional authors (Art. 19.1) is optional, but if authors are cited, Articles 20.2–20.8 are to be followed.

20.2- Authors' names are to be cited after the clade name. Nominal authors of any name, whether preexisting or new, are to be cited without enclosing symbols. Definitional authors, if different from the nominal author(s) of the name in question (Note 19.1.2 and Note 20.2.1), are to be cited within enclosing symbols: the authors of the original definition (i.e., the definitional authors of a converted name) are to be cited in square brackets ([ ]; Art. 20.4, Ex. 1); the authors of an emended definition are to be cited in braces ({ }; Art. 20.6, Ex. 1).

Note 20.2.1-If the nominal and definitional authors are the same (as for most new clade names; see Note 19.1.2), they are to be cited as nominal authors, and thus no enclosing symbols are to be used.

20.3- If more than one set of authors is cited, they are to be cited in the following order: nominal author(s) of the preexisting or new name (including a replacement name); author(s) of the original definition; author(s) of an emended definition.

20.4- If the definitional authors of a converted name are cited, the nominal authors of the preexisting name on which it is based, if known, must also be cited.

- **Chapter X. Species Names (Art. 21)**

Article 21. Provisions for Species Names 21.1- This code does not govern the establishment or precedence of species names or names associated with ranks below species under the rank-based codes (e.g., *ICNP*, *ICNAFP*, *ICZN*). To be considered available (*ICZN*) or validly published (*ICNAFP*, *ICNP*), the name of a species or infraspecific taxon must satisfy the provisions of the appropriate rank-based code. This article contains recommendations about how to publish or use previously published names of species and infraspecific taxa governed by rank-based codes in conjunction with clade names governed by this code.

Note 21.1.1- In Article 21.1, the term "names of species and infraspecific taxa" does not refer to names established under this code that apply to clades that correspond in composition to or are nested within taxa that are ranked as species under a rank-based code.

21.2- The name of a species under the rank-based codes (except the *ICVCN*) is a binomen (two-part name), the first part of which is a generic name (i.e., a name that is tied to the rank of genus) and the second part of which is a specific name (*ICZN*) or epithet (*ICNP*, *ICNAFP*) (i.e., a name that is tied to the rank of species). Because this code is independent of categorical ranks (Art. 3.1), the first part

of a species binomen is not interpreted as a genus name but simply as the name of a taxon that includes that species.

21.3- To satisfy the requirements of the rank-based codes (see Art. 21.2), a specific or infraspecific name (*ICZN*) or epithet (*ICNAFP*) must be published in unambiguous combination with a name that is implicitly or explicitly associated with the rank of genus (even though it may not have been established as a clade name under this code). For names governed by the *ICZN*, this practice must be followed throughout the publication that establishes the name (*ICZN* Art. 11.4).

Recommendation 21.3A- When establishing a new species name (binomen) under the appropriate rank-based code, some mechanism should be used to indicate whether the genus name is an established clade name under this code. If symbols are used, their meaning should be made clear.

Note 21.3A.1- Although Example 1 uses one symbol to indicate establishment under this code and another symbol to indicate the absence of such establishment, an alternative would be to use the presence or absence of a single symbol. However, using absence of a symbol to designate nomenclatural status is potentially confusing because its absence may result from accidental omission. Furthermore, some readers may misinterpret absence of a symbol because they are unaware of the author's convention.

Note 21.3A.2- If a symbol (e.g., quotation marks) is used to indicate non-monophyly of the taxon designated by the genus name, it would be redundant to indicate that the genus name is not an established clade name under this code.

Note 21.3A.3- If a symbol is used to indicate non-monophyly or questionable monophyly of the taxon designated by the genus name, this does not imply that the author does not accept the species. Therefore, the species name should not be interpreted as not validly published under *ICNAFP* Article 36.1.

Recommendation 21.3B- When publishing the name of a new species, selection of a genus name will require consideration of the nomenclatural consequences under both the appropriate rank-based code and this code. In general, a genus name that is also an established clade name (or is simultaneously being established as a clade name) under this code should be selected if possible. (If the names of more than one clade in a nested series of clades satisfy these conditions, any one of the names may be selected.) If this is not possible, an existing genus name may be used, even if the monophyly of the associated taxon under the rank-based code is unknown or doubtful, or a new genus name may be used. If the species to be named cannot be assigned to any taxon with which a genus name has been associated under the appropriate rank-based code, then the only option is to publish a new name to serve as a generic name under the appropriate rank-based code. This name may be simultaneously established as a clade name under this code.

- **Chapter XI. Governance (Art. 22)**

Article 22. Governance of Phylogenetically Defined Names 22.1- The International Society for Phylogenetic Nomenclature (ISPN) is an international, non-profit organization with no membership restrictions. Two committees of the ISPN have responsibilities that pertain to this code: the Committee on Phylogenetic Nomenclature (CPN) and the Registration Committee.

22.2- The Registration Committee is responsible for managing the registration database for phylogenetically defined names. It has the authority to set policy concerning the routine operation of the database, so long as such decisions do not conflict with the provisions of this code. The members of the Registration Committee will be appointed by the ISPN through a vote of the Council.

22.3- The CPN has the responsibility and power to: (a) ratify the first edition of this code prior to its implementation; (b) rule on applications for suppression or conservation of names; (c) resolve ambiguities in the provisions of this code; (d) amend the provisions of this code; and (e) produce future editions of this code.

22.4- The members of the CPN will be elected by the membership of the ISPN. The number of members in the CPN will be determined by the ISPN. The CPN officers (Chair and Secretary) will be elected by the membership of the CPN.

22.5- Members of the CPN will be elected for three-year terms. Members may be elected for up to three consecutive terms. Each officer will be elected for a one-year term in that office (as part of the three-year term as a member). Officers may serve for up to three consecutive one-year terms and shall not be eligible to serve again in the same office until one year has elapsed since completing the third consecutive term.

22.6- Applications for suppression or conservation of names, restricted emendations of definitions, and rulings on whether a proposed emendation is restricted or unrestricted must be submitted to the CPN. Once received, they will be published (Art. 4) and made available on a web site administered by the ISPN.

22.7- Decisions by the CPN on applications to suppress or conserve names or to emend definitions must be approved by a two-thirds vote of the CPN. Decisions will be published and announced on a web site administered by the ISPN, and the affected names will be annotated in the registration database.

22.8- Decisions by the CPN regarding interpretation of rules (in case of ambiguity) and the status of proposed emendations as restricted or unrestricted require approval by a simple majority of the CPN. Decisions will be published and announced on a web site administered by the ISPN.

22.9- Proposed modifications of this code after its ratification and implementation must be submitted to the CPN. Once received, they will be published (Art. 4) and

made available on a web site administered by the ISPN.

22.10- Proposed modifications of this code after its ratification and implementation may not be voted upon until at least three months have elapsed from the date of their publication, to allow for discussion by the systematics community and communication of opinions to the members of the CPN.

22.11- Decisions to modify the code after its ratification and implementation must be approved by a two-thirds vote of the CPN. Any decision adopted by the CPN will be published and announced on a website administered by the ISPN. Decisions take effect immediately upon publication.

3. CONCLUSION:

Designed to name species and clades, phylogenetic nomenclature (PN) is a rank-free system of biological nomenclature (de Queiroz and Gauthier, 1990, 1992, 1994; Cantino and de Queiroz, 2006). The designations "species" and "clade" in this scheme refer to distinct biological entities rather than taxonomic grades.

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2. Although note that the PhyloCode does not permit a taxon's name to change when its rank changes, while the rank-based codes require this for at least some names.

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